| Poster # | Presenter | Topic | Title | Author(s) | Abstract |
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| 1 | Hera Mukhtar | Basic Life Science | Effects of Aging on Cardiac Extracellular Matrix, Component Content, and Macrophage Phenotype | Hera Mukhtar; Martin Haschak; Bryan N. Brown, PhD | Aging is a primary risk factor for cardiac death due to heart walls thickening, slowing heart rate, and loss in strength. Macrophages are crucial role in both homeostatic maintenance of the heart and restoration following injury pro-inflammatory/phagocytic (M1) and pro-repair (M2) responses. The immune system dysregulates with age; therefore, the amount of macrophages increases. Aged macrophages have impaired phagocytic functionality and reduced production of nitric oxide. This study will observe the phenotype of macrophages, along with the extracellular matrix content, glycosaminoglycans and collagen, in aging hearts. Samples were taken from hearts of 6 week old and 48 week old mice. Immunolabeling was conducted with macrophage markers to determine the phenotype of macrophages: iNOS (M1), arginase (M2), F480, and GFP. Slides were also stained with Masson's trichrome, and Alcian blue, in order to observe glycoproteins and amount of collagen, respectively. The samples were analyzed using ImageJ. Aged cardiac tissue increased in M1 (pro-inflammatory macrophages), as opposed to the M2 type. The F480 and GFP confirmed a greater quantity of macrophages in the aged sample as opposed to the young. Additionally, the histology found the young samples to be more collagenous, and the aged sample to contain a greater number of glycosaminoglycans. |
| 2 | Juhoon So, PhD | Basic Life Science | Suppressing the EGFR-Sox9 Axis Promotes Liver Regeneration in Zebrafish Chronic Liver Injury Models | Juhoon So, PhD; Minwook Kim, MS; Daniel Lee, PhD; Sungjin Ko, PhD; Michael Parsons, , PhD; Kimberly Evason, MD, PhD; David Prober, PhD; Mizuki Azuma, PhD; Donghun Shin, PhD | When hepatocyte proliferation is compromised as in severe liver injury settings, liver progenitor cells (LPCs) are activated and eventually differentiate into hepatocytes. A correlation between LPC number and disease severity in human chronic liver diseases suggests that LPCs fail to efficiently differentiate into hepatocytes in the patients. Promoting LPC differentiation into hepatocytes should be beneficial to the liver patients; thus, it is considered an alternative therapy for severe liver diseases. We have established a zebrafish liver injury models, in which hepatocyte-specific over-expression of oncogenes leads to LPC-mediated liver repair. In the oncogene-overexpressing transgenic zebrafish, hepatocyte damage, LPC activation, fibrosis, and LPC differentiation into hepatocytes sequentially occur, which are similarly observed in mammalian chronic liver injury models. The zebrafish model allowed us to identify compounds that can promote LPC-to-hepatocyte differentiation. We found that the treatment with EGFR inhibitors promotes LPC-to-hepatocyte differentiation. Sox9b was highly up-regulated in LPCs and the treatment with the EGFR inhibitor greatly reduced Sox9b expression, suggesting its regulation by EGFR signaling. Sox9b heterozygous mutants also exhibited enhanced LPC-to-hepatocyte differentiation and importantly efficient liver recovery. These data suggest that suppressing EGFR-Sox9 signaling can promote liver regeneration, particularly LPC-to-hepatocyte differentiation, in patients with advanced liver diseases. |
| 3 | David Baranger, PhD | Basic Life Science | Convergent Evidence for Predispositonal Effects of Brain Volume on Alcohol Consumption | David AA Baranger, PhD; Catherine H. Demers, PhD; Nourhan M. Elsayed, BA; Annchen R. Knodt, BS; Spenser R. Radtke, BA; Aline Desmarais, BA; Lauren R. Few, PhD; Arpana Agrawal, PhD; Andrew C. Heath, PhD; Deanna M. Barch, PhD; Lindsay M. Squeglia, PhD; Doug | |
| 4 | Manush Saydmohammed, PhD | Basic Life Science | Vertebrate Myosin1d Regulates Left-Right Organizer Morphogenesis and Laterality | Manush Saydmohammed, Hisato Yagi, Michael Calderon, Madeline J. Clark, Timothy Feinstein, Ming Sun, Donna B. Stolz, Simon C. Watkins, Jeffrey D. Amack, Cecilia W. Lo, Michael Tsang | Establishing left-right asymmetry is a fundamental process essential for arrangement of visceral organs during development. In vertebrates, motile cilia driven fluid flow in the left-right organizer (LRO) is essential for initiating symmetry breaking event. Here, we report that myosin 1d (myo1d) is essential for establishing left-right asymmetry in zebrafish. Using super-resolution microscopy, we show that the zebrafish LRO, Kupffer's vesicle (KV), fails to form a spherical lumen and establish proper unidirectional flow in the absence of myo1d. This process requires directed vacuolar trafficking in KV epithelial cells. Interestingly, the vacuole transporting function of zebrafish Myo1d can be substituted by myosin1C derived from an ancient eukaryote, Acanthamoeba castellanii, where it regulates the transport of contractile vacuoles. Our findings reveal an evolutionary conserved role for an unconventional myosin in vacuole trafficking, lumen formation and determining laterality. |

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| 5 | Alan Li, PhD | Basic Life Science | Organ-on-a-Chip System for the Modeling of Synovial Joint Pathologies | Zhong Li, Zixuan Lin, Monica R. Lopez, Benjamen O'Donnell, Xinyu Li1, Ian J. Moran, Peter G. Alexander, Stuart B. Goodman, Bruce A. Bunnell, Hang Lin, Rocky S. Tuan | Osteoarthritis (OA) is a painful joint disease resulting in physical disabilities that compromise quality of life. However, currently there exists no effective disease-modifying medications (DMMs) for OA treatment. Herein we propose the engineering of a stem cell-based 3D human micro-joint chip (mJoint), which is physiologically analogous to the native joint, and capable of modeling pathogenesis of joint diseases for DMM screening/development. Different joint tissues, including osteochondral complex (bone and cartilage), synovium, and fat pad were engineered from human mesenchymal stem cell (hMSC)-laden gelatin hydrogel scaffolds and prepared as modules for convenient integration in the mJoint. The 3D tissues were matured by differentiating them in their respective induction media for 28 days before their integration in the mJoint bioreactor. The interconnection among tissue components was guided via directional fluidic flow of the culture medium to simulate in vivo physiology. RT-PCR and histological staining both confirmed that individual joint components within the mJoint chip were able to maintain respective tissue-specific phenotypes up to 4 weeks. We also modeled OA in the mJoint by perfusing inflamed synovium-conditioned medium through cartilage tissues. This study is the first to report the generation of human cell-derived multi-tissue joint chip that allows the study of joint pathologies. |
| 6 | Katherine Wozniak | Basic Life Science | Extracellular Zinc Contributes to the Slow Block to Polyspermy | Katherine L Wozniak, Wesley A Phelps, Miler T Lee, and Anne E Carlson | Ensuring that an egg is fertilized by a single sperm is essential for progression through embryogenesis. Eggs therefore have multiple mechanisms to prevent sperm entry into an already fertilized egg. In the slow block to polyspermy, fertilization induces exocytosis of cortical granules, which are enriched with compounds that transform the extracellular matrix surrounding eggs into a barrier impenetrable by sperm. The underlying mechanisms that enable the creation of this protective barrier are largely-unknown. We hypothesize that extracellular zinc may contribute to the slow block. It has recently been shown in mice, primates, and humans that cortical granules are enriched with zinc; furthermore, extracellular zinc impairs sperm motility and binding to the extracellular matrix of eggs. Using confocal microscopy with the zinc indicator FluoZin-3, we demonstrate that fertilization and egg activation evoke zinc release from eggs of the African clawed frog, Xenopus laevis, and zebrafish, Danio rerio. Additionally, we show that insemination of X. laevis eggs in extracellular zinc blocks embryonic development in a concentration-dependent manner, with an IC50 of 20 ± 3 µM. Overall, our data demonstrates that fertilization-induced zinc release is conserved in vertebrates, and that this zinc may contribute to the slow polyspermy block. |
| 7 | Maiwase Tembo | Basic Life Science | PIP2 Potentiates the Ca2+-Activated Cl- Channel TMEM16a in *Xenopus laevis* oocytes | Maiwase Tembo, Rachel E. Bainbridge and Anne E. Carlson | The Ca2+-activated Cl- channel, Transmembrane member 16A (TMEM16a), plays various physiological roles including smooth muscle regulation, mucosal secretions, and signal transduction. Despite its importance, TMEM16a's biochemical and biophysical properties are less understood. Here we recorded endogenous TMEM16a Ca2+-evoked Cl- currents from Xenopus laevis oocytes. Using the inside-out configuration of the patch clamp technique, we found that TMEM16a -conducting currents rundown within seconds of patch excision despite the continued presence of Ca2+. Current rundown is common amongst channels regulated by phosphatidylinositol 4,5-bisphosphate (PIP2). Thus, we tested the hypothesis that TMEM16a is potentiated by PIP2 by exposing excised inside-out patches to either PIP2 sequestering agents or PIP2 recovering agents. We observed that PIP2 sequestration rapidly depleted TMEM16a currents while PIP2 application recovered TMEM16a currents. In another series of experiments, we also tested our hypothesis that PIP2 potentiates TMEM16a but within a whole cell context and using the two-electrode voltage clamp technique to measure the effects of modulating the levels of PIP2 via exogenously expressed enzymes. Similarly, we observed that reducing PIP2 levels also reduced TMEM16a Ca2+-evoked Cl- currents in Xenopus laevis oocytes. Taken together, our data demonstrate that TMEM16a and Ca2+ are necessary for TMEM16a to pass currents. |
| 8 | Yuemin Bian | Basic Life Science | Computational Systems Pharmacology Analysis on α-mangostin Derivative, a Promising Ligand for the Treatment of Alzheimer's Disease | Yuemin Bian, MS | α-mangostin, a natural xathone from the pericarps of fruit Garcinia mangostana, has therapeutic potential to treat Alzheimer's disease. 21 derivatives were designed and synthesized to reduce the cytotoxicity and improve its neuroprotective functions. Animal behavior studies and brain staining confirmed that A-MG-1 treatment can (1) have neuron cells in better morphology and density compared with the disease model; (2) significantly prevent the neuronal loss in Aβ induced AD rats; and (3) reduce the senile plaque and repair the neurons' injury on the AD model. A computational systems pharmacology analysis using Chemogenomics-knowledgebases was applied for network studies. Compound-target, target-pathway, and target-disease networks were constructed integrating both in silico analysis and reported experimental data. The systematic network analysis (1) confirmed the broad therapeutic spectrum of α-mangostin; (2) bridged the corresponding targets with specific pathways and diseases; and (3) speculated that A-MG-1 can demonstrate its therapeutic effects in a one molecule, multiple targets manner. |

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| 9 | William Bartel III | Basic Life Science | Functional Evaluation of GWAS Hits in Progressive Supranuclear Palsy: Exploiting High-Throughput Reverse Genetics in a Novel Zebrafish Tau Model | W. Philip Bartel, ScB; Qing Bai, PhD; Edward Alan Burton, MD, DPhil, FRCP | Progressive supranuclear palsy (PSP) is a neurodegenerative disease causing hypokinesia, falls, and bulbar, cognitive and oculomotor deficits. Pathologically, PSP is characterized by neuronal loss and insoluble deposits of the microtubule-associated protein tau within surviving neurons. Genetic evidence implicates tau as central to pathogenesis, although the mechanisms underlying its accumulation, or the resulting neuronal dysfunction, are poorly understood. Genome-wide association studies (GWAS) have identified single nucleotide polymorphisms associated with increased risk of developing PSP, but their role in the disease is currently unclear. We will test the hypothesis that these risk-associated SNPs alter expression of nearby genes, thereby enhancing cellular susceptibility to tau accumulation and dysfunction. Transgenic zebrafish expressing human tau replicate many features of PSP, and provide an ideal model for these studies. We have identified the zebrafish homologues of genes adjacent to PSP risk SNPs, and will determine how heterozygous null alleles modulate pathogenesis of the zebrafish tau model, by measuring PSP-relevant phenotypes including motor function, ocular movement, lifespan, neuronal death, and tau accumulation. In addition to resolving the role these genes play in PSP pathogenesis, our study will provide a powerful new approach to elucidating pathogenic mechanisms from GWAS findings, which will be broadly applicable in other diseases. |
| 10 | Mariah Denhart | Basic Life Science | Ectopic Expression of T-box Factors Causes Limb Defects in Mice | Mariah Denhart; Deborah Chapman, PhD | The T-box proteins are an evolutionarily conserved family of transcription factors, found in organisms ranging from C. elegans to humans. All members of the T-box family share a conserved DNA binding domain (T-domain) and thus can potentially bind to the same core DNA sequence. Outside of the T- domain, however, the proteins are quite diverse, suggesting that they function differently to regulate transcription. Interestingly, human disorders, such as Holt-Oram syndrome and ulnar-mammary syndrome, result from haploinsufficient levels of Tbx5 and Tbx3, respectively. This dosage sensitivity combined with the shared T-domain leads to the hypothesis that when co-expressed a competition at target genes can occur. For example, vertebrates may rely on T-box competition for normal limb development since as many 6 T-box factors are known to be expressed during limb formation. Using an inducible expression system, I ectopically expressed the T-box factor Brachyury (T) or Tbx6 in the developing mouse limb. Depending on the T-box factor expressed, I observed different skeletal phenotypes. To elucidate the underlying mechanism resulting in skeletal differences I have performed whole mount in situ hybridization and cell death assays. |
| 11 | Mitchell Ellison II | Basic Life Science | Investigating the Recruitment of a Key Epigenetic Factor in *Saccharomyces cerevisiae* | Mitchell A. Ellison II, Matthew S. Blacksmith, Fei Fang, Eleanor Kerr, Rachel Schusteff, Andrew P. VanDemark, Yi Shi, Karen M. Arndt | The eukaryotic genome is packaged into chromatin by interactions between the DNA and histone proteins. Approximately 147bp of DNA is wrapped around a globular core of 8 histone proteins consisting of two copies each of histone 2A (H2A), H2B, H3 and H4 forming a structure termed the nucleosome. Nucleosomes are modified post-translationally in many ways and some of these modifications are placed co-transcriptionally and involved in the regulation of transcription. Aberrant histone modification patterns have been observed in many cancers and developmental disorders. A protein complex termed Paf1C (Polymerase Associated Factor 1 complex) is critical for the placement of several co-transcriptional histone modifications. Therefore, proper recruitment of Paf1C to the transcription machinery is a critical process in eukaryotes. The work presented here reveals a previously unrecognized interaction that we hypothesize to be involved in Paf1C recruitment during transcription elongation. Both *in vivo* and *in vitro* crosslinking assays reveal an interaction between the histone chaperone Spt6 and Cdc73, a member of the Paf1C. Native gel-shift assays confirm the interaction and reveal a dissociation constant (Kd) of ~1 µM. Together these data demonstrate an interaction between an essential histone chaperone and a highly conserved transcription elongation factor. |
| 12 | Manisha Chandwani | Basic Life Science | Anti-Viral Immunity Induces Proliferation and Neuronal Differentiation of Adult Neural Stem Cells | Manisha N. Chandwani, Kristen N. Fantetti, Lauren A. O'Donnell | Viral infections in the central nervous system (CNS) alter neural stem/progenitor cell (NSPC) activity and survival via direct infection and/or through immune-mediated mechanisms. In order to dissect the effect of anti-viral immunity on NSPCs, we utilized transgenic NSE-CD46+ mice, which expresses human CD46, a measles virus (MV) receptor, under the control of the neuron specific enolase promoter. Thus, only CNS neurons are infected, sparing the NSPCs from infection. We hypothesized that adult CD46+ mice, which control MV infection with limited neuropathology, would not demonstrate NSPC loss. To test this hypothesis, the hippocampi of MV-infected adult CD46+ mice were analyzed by flow cytometry at 7, 21, and 60 days post-infection (dpi). The NSPC pool remained unchanged at 7 and 21 dpi, but increased at 60 dpi. Newly-differentiated neurons showed a similar pattern, suggesting increased neurogenesis post-viral clearance. In mice lacking interferon-gamma (IFNγ), a key anti-viral cytokine, NSPCs increased at 21 and 60 dpi and immature neurons increased at 21 dpi only, which may reflect an early attempt at repair due to increased neuronal dropout. These studies suggest that effective viral clearance can be associated with enhanced NSPC proliferation and neurogenesis independently of direct infection by the virus. |

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| 13 | Anna Bailes | New Research Tools and Techniques | Anxiety and Depression are Associated with Increased Healthcare Utilization in Low Back Pain | Anna H. Bailes, Rohit Navlani, Stephen Koscumb, Amanda Malecky, Oscar C. Marroquin, Ajay D. Wasan, Howard Gutstein, Gwendolyn A. Sowa | Psychological characteristics are important prognostic factors in the treatment and trajectory of low back pain (LBP). The purpose of this study was to identify how the presence of depression/anxiety is related to healthcare utilization. Data was collected from electronic health records from January 2010-April 2018. Healthcare utilization was based on opioid prescription, use of advanced imaging, epidural steroid injection (ESI), surgery, emergency room visits, and hospitalizations. Odds ratios and 99% confidence intervals were calculated to compare utilization. Data from 428,401 patients with LBP was extracted. Compared to those without depression, those with depression were more likely to receive an opioid prescription (OR= 1.72), go to the emergency room (OR= 1.72), be hospitalized (OR= 1.31), receive advanced imaging (OR= 1.20), and receive an ESI (OR= 1.33). They were less likely to have surgery (OR= 0.74). Compared to those without anxiety, those with anxiety were more likely to receive an opioid prescription (OR= 1.46), go to the emergency room (OR= 1.47), and receive an ESI (OR= 1.13). They were less likely to have surgery (OR= 0.59). The co-occurrence of depression/anxiety is associated with increased utilization, including elevated opioid prescriptions and emergency room visits. More effective interventions should be investigated for this population. |
| 14 | Leming Zhou, PhD | New Research Tools and Techniques | Development and validation of a comprehensive well-being scale in a university environment | Leming Zhou | Well-being has multiple domains and these domains are unique in different populations. Therefore, to precisely assess the well-being of a population, a scale specifically designed for this population is needed. The goal of this project was to design and validate a comprehensive well-being scale in a university environment. A crowdsourcing approach was used to determine domains of the comprehensive well-being scale, and the specific questions in each domain. In the first stage, 518 students, staff and faculty indicated the domains they desired to have in a comprehensive well-being scale. In the second stage, 137 students, staff, and faculty evaluated the relevance and clarity of the proposed questions in each domain. The questionnaire was then released to the students, staff and faculty. In total, 582 students, staff, and faculty answered the questionnaire. A psychometric analysis was performed to determine the validity and reliability of the questionnaire. The evaluation results indicated that this new scale is highly reliable and can be used to measure well-being in the university environment. |
| 15 | Dilhari DeAlmeida | New Research Tools and Techniques | Applying User-Centered Approach to the Development of A Mobile Personal Health Record Application for Use in A University Environment | Leming Zhou, Dilhari DeAlmeida | Previous studies indicated that patients who were actively involved in their own healthcare tend to be healthier and the treatment outcomes were better. Personal Health Record (PHR) is one way to encourage patients to engage with their own healthcare by managing and keeping track of their own health data. There are a number of PHR systems available in the market, most are web portals and a few are mobile apps. However, the adoption of these PHR systems are low. One of the reasons is the lack of user involvement during the development of these PHR systems, which is one critical lesson learned in the health IT adoption for personal health management. In this project, we used a user-centered design method to develop a new mobile PHR app. We first conducted a large-scale survey study with target users to understand their needs and expectations on a mobile PHR app. Based on the obtained results, we created a mobile app for personal medical data tracking and management by actively involving users in all app development stages. The study results indicated that this new mobile PHR app meets the need of users and the users welcome this app. |
| 16 | Victor Venturi | Physical Science and Engineering | Microstructured Polymer Composites as Electrolytes for Lithium Ion Batteries | Victor Venturi; Venkat Viswanathan | Lithium metal anodes could enable next generation lithium-ion batteries. However, formation of dendrites on charge/discharge cycles is a safety hazard that hinders commercialization. The use of solid electrolytes can allow for stable lithium electrodeposition, provided the properties of the electrode-electrolyte interface obey criteria established in previous work and, thus, mechanically prevent dendrite formation and growth, which would make lithium metal batteries viable. In this report, a new organic-inorganic composite is tested to determine whether it meets the stable electrodeposition criteria. Both the Mori-Tanaka analytical micromechanical continuum model and molecular dynamics (MD) simulations are used to determine the viability of this composite for use with lithium metal anodes. Very little has been reported about the properties of the polymer used for the organic part of the composite, making the Mori-Tanaka analysis inaccurate, and hampering validation of computational simulations. Nevertheless, we were able to simulate systems composed of only polymer chains. A force field that accurately describes the crystalline structure of the inorganic parts of the composite was also identified and tested. Current and future work involves performing MD simulations on the actual composite system, with both organic and inorganic parts together, and determining if its properties meet the stable electrodeposition criteria. |

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| 17 | Tejal Sawant | Physical Science and Engineering | Rotating-Disk Electrode Voltammetry for Fe-Based Flow Battery Characterization | Tejal Sawant, Prof. James McKone | There is a need to improve the performance and economics of renewable energy technologies for global energy sustainability. Spatial and temporal intermittency of many renewables, large-scale electrochemical energy storage plays an important role. The redox-flow-battery (RFB) is a promising approach to store renewable energy for continuous use. Conflicting reports on RFB kinetics for well-established electrolyte chemistries pose a challenge to its technological improvement. To address this challenge, we are assessing the effectiveness of classical electroanalytical techniques for accurately measuring the electron-transfer kinetics of RFB electrode-electrolyte combinations. Using rotating-disk-electrode (RDE) voltammetry, we compared kinetics data for platinum, gold and glassy carbon electrodes toward aqueous Fe(3+/2+) redox chemistry in several supporting electrolytes. Both the reproducibility of these measurements and the resulting electron-transfer rates depended heavily on the type of surface pretreatment, which we attribute to the presence of specific surface functional groups that catalyze the inner-sphere redox chemistry of Fe aquo-complexes. We also found significant differences in the apparent kinetics for electrolytes containing 10mM versus 1M total Fe concentration. Based on these results, we conclude that RDE methods can be used to good effect for RFB kinetics measurements. Additional work is needed to better understand these systems under battery operation. |
| 18 | Rituja Patil | Physical Science and Engineering | Mitigating Resistivity Limitations in Ni-Based Alkaline Hydrogen Evolution Electrocatalysts | Rituja B. Patil, Aayush Mantri, Stephen D. House, Prof. Judith C. Yang, Prof. James R. McKone | Earth-abundant electrocatalysts are essential for cost-effective hydrogen production by water electrolysis. Ni-Mo alloys are among the most efficient non-noble hydrogen evolution electrocatalysts known, as their activity under alkaline reaction conditions approaches that of Pt when they are deposited in a high-surface area form. Although the mechanistic details of Ni-Mo alloys remain unclear, we have recently advanced our understanding of the precise chemical composition and morphology of the active catalyst. We found that as-synthesized Ni-Mo alloy “nanopowders” actually consist of agglomerates containing Ni-rich nanoparticles surrounded by Mo-rich oxide layer. We postulate that the oxide layer forms from incomplete reduction of Mo into the alloy and/or by spontaneous surface oxidation when the nanopowders are handled in air. Importantly, we found that the oxide coating obstructs the flow of electrons through the catalyst film, leading to increased overpotentials for hydrogen evolution. We identified a simple, effective strategy to mitigate these resistivity limitations by incorporating Vulcan carbon black as a conductive additive. Carbon black provides pathways for electron percolation throughout the catalyst film, resulting in greatly increased mass-specific activity (on Ni-Mo mass basis). Carbon incorporation also offers several benefits in the processing of Ni-Mo alloys, particularly in enabling direct membrane deposition for membrane-based electrolyzers. |
| 19 | Lu Chen | Physical Science and Engineering | Over 100-THz Bandwidth Selective Difference Frequency Generation at Laaio3/Srtio3 Nanojunctions | Lu Chen; Erin Sutton; Hyungwoo Lee, PhD; Jung-Woo Lee, PhD; Jianan Li; Chang-Beom Eom, PhD; Patrick Irvin, PhD; Jeremy Levy, PhD | The ability to combine continuously tunable narrow-band terahertz (THz) generation that can access both far-infrared and mid-infrared regime with nanometer scale spatial resolution holds great potential for uncovering underlying light-matter interactions as well as realizing selective control of rotational or vibrational resonances in nanoparticles or molecules. Here, we report selective difference frequency generation with over 100 THz bandwidth through femtosecond optical pulse shaping. The THz emission is generated at nanoscale junctions at the interface of $LaAlO_3/SrTiO_3$ (LAO/STO) defined by conductive atomic force microscope lithography, with the potential to perform THz spectroscopy on individual nanoparticles or molecules. Numerical simulation of the time-domain signal helps to identify different contributing components for the THz generation. This ultra-wide bandwidth tunable nanoscale coherent THz source transforms the LAO/STO interface into a promising platform for integrated lab-on-chip optoelectronic devices with various functionalities. |
| 20 | Shreya Ghosh | Physical Science and Engineering | Development of Copper Based Strategies to Probe Protein-DNA Interation | Shreya Ghosh, M.Sc.; Sunil Saxena, PhD | Interactions between proteins and specific sequences of DNA lie at the heart of many cellular processes. My broad aim is to develop methods that allow us to build an atomic level picture of such interactions and to apply this technology to understand these key cellular processes. One such process I am interested in is the mechanism by which bacterial cells regulate the amount of copper as free copper ion is toxic to the cell. There is limited understanding as to how protein and DNA structure mediate these interactions. To this end, I have developed electron paramagnetic resonance (EPR) methodology: 1) To measure precise point to point distances in DNA that can easily be related to the three-dimensional structure of DNA 2) To enhance the affinity of a copper complex to modified α-helical sites in proteins in order to measure protein structure by EPR By obtaining several distance constraints in protein as well as DNA, I will be able to generate a full 3-D structure of the copper regulation mechanism. Thus, my research will shed light on how to create new inhibitor in order to stop this regular mechanism in drug-resistant bacteria and consequently lead to the development of new antibiotics. |

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| 21 | Jianan Li | Physical Science and Engineering | Reversible Nanoscale Control of the Charge Neutrality Point in Graphene Using Laaio3/Srtio3 Heterostructures | Jianan Li MD; Qing Guo, MD; Jen-Feng Hsu, PhD; Hyungwoo Lee, PhD; Chang-Beom Eom, PhD; Patrick Irvin, PhD; Brian D'Urso, PhD; and Jeremy Levy, PhD | The properties of graphene depend sensitively on doping with respect to the charge-neutrality point (CNP). Tuning the CNP usually involves electrical gating or chemical doping. Here, we describe a technique to reversibly control the CNP in graphene with extreme nanoscale precision, utilizing $LaAlO_3/SrTiO_3$ (LAO/STO) heterostructures and conductive atomic force microscope (c-AFM) lithography. The conductivity of LAO/STO interface can be switched on or off with a conductive AFM tip, even with graphene transferred on surface. In ambient conditions, a trace of protons can be left with a positively biased AFM tip on graphene, rendering the LAO/STO interface conductive while shifting the position of graphene CNP. When a negative voltage is applied to the AFM tip, protons are removed from the graphene-LAO interface, restoring the insulating LAO/STO interface and shifting the CNP back in the graphene. Here we demonstrate that edge state engineering can be achieved from this method using the quantum Hall effect. Clear quantized resistance at plateaus $h/e^2$ and $h/3e^2$ are observed in a split Hall device, demonstrating edge transport along the c-AFM written edge, depending on the polarity of magnetic field and position of mixing point of edge channels. This technique can be extended to many other device geometries. |
| 22 | Matthew Grasinger | Physical Science and Engineering | Electroelasticity of Polymer Chains and Networks | Matthew Grasinger, MS; Kaushik Dayal, PhD | Electroactive polymers are a class of soft materials that deform and provide actuation when subject to electrical loads. The type of actuation EAPs provide are related to that of muscles and other biological tissues; that is, EAP films stretch when a voltage is applied and contract when it is removed. For this reason, EAPs could be an ideal material for biologically inspired robots and newer, more advanced prosthetics. However, currently available EAPs are limited by weak electromechanical coupling and the general understanding of EAPs could improve. In this work, an electrostatic response of a single EAP monomer is assumed and, using statistical mechanics, the thermodynamics of an EAP chain is investigated; in particular, when the chain is subjected to electrical loading and kinematic constraints. The equations of the most likely monomer orientation density and an approximate chain free energy are derived. These equations are investigated numerically and closed-form approximations are also developed in the limit of small electrical energy (with respect to thermal energy), in the limit of small chain tension, and for general chain conditions. Lastly, the chain-scale response is built up to an EAP network response. Some preliminary results from the newly developed constitutive model are also presented. |
| 23 | Nathaniel Miller | Physical Science and Engineering | Exploration of Single Molecule Piezoelectric Materials | Nathaniel C. Miller; Haley Grimme; Seth Horne, PhD; Geoffery Hutchison, PhD | Piezoelectric materials see applications from sensing to drive motors. Intertwined into everyday life the need for more responsive flexible materials is ever present. Here we explore the design and quantification of molecular springs for novel energy harvesting applications. By controlling the helicity of fixed polarity peptides and peptoids we can tailor the resulting piezoelectric coefficient ($d_{33}$) of the resulting film. These designed molecules give experimentally determined $d_{33}$ values on the order of other biocompatible materials such as collagen. These "soft monolayers" facilitated the need to develop new routes to determine the $d_{33}$ of materials in the absence of electrostatic forces. Electrostatic free quantitation of the piezoelectric coefficient is achieved by replacing the traditional sweep of the AC field in dual AC resonance tracking piezoelectric force microscopy (DART PFM) with a fixed AC field under a varied DC field. By quantifying the point where the applied DC field is equal to the contact potential difference ($V_{cpd}$) the electrostatic contribution to the measured piezoelectric response by DART will be zero leaving only the mechanical response of the material. |
| 24 | Erin Sutton | Physical Science and Engineering | THz Spectroscopy of Graphene Coupled to Laaio3/Srtio3 Nanoscale Junctions | Erin Sutton; Lu Chen; Jianan Li, MD; Hyungwoo Lee, PhD; Jung-Woo Lee, PhD; Chang-Beom Eom, PhD; Patrick Irvin, PhD; Jeremy Levy, PhD | We investigate the gate-dependent optical response of graphene using the broadband nonlinear generation and detection capabilities of nanoscale junctions created at the $LaAlO_3/SrTiO_3$ interface. Using the large non-resonant third-order nonlinear susceptibility in $SrTiO_3$, strong difference frequency mixing occurs when the junction is biased, leading to induced polarization that can also be detected at the junction (Ma et al, Nano Lett 13, 2884 (2013)). Here we discuss results of gate-dependent experiments which interrogate the relationship between the THz signal and the gate location with respect to the Dirac point in devices where graphene is coupled to the $LaAlO_3/SrTiO_3$ interface. Preliminary results suggest we may be detecting a surface plasmon resonance or phonon mode, in addition to detecting changes in graphene absorption and transmission. |
| 25 | Yuchi He | Physical Science and Engineering | Tomonaga-Luttinger Liquid Enriched by Emergent Mode | Yuchi He; Binbin Tian, PhD; David Pekker, Roger Mong | This poster introduces the emergent mode theory construction for a "beyond standard" Tomonaga-Luttinger liquid and the corresponding numeric evidence. |
| 26 | Qing Guo | Physical Science and Engineering | Coulomb Drag Between Graphene and Laaio3/Srtio3 Heterostructures | Qing Guo MD, Jianan Li MD, Mengchen Huang PhD, Jen-Feng Hsu PhD, Shonali Dhingra PhD, Hyungwoo Lee PhD, Sangwoo Ryu PhD, Chang-Beom Eom PHD, Brian D'Urso PHD, Patrick Irvin PHD, and Jeremy Levy PHD | Vertical heterostructures combining different layered materials offer novel platform for investigating many-body effects. Here we report anomalous coulomb drag effect of a heterostructures comprising a single-layer graphene in close proximity (about 2nm) to a two-dimensional electron gas formed at $LaAlO_3/SrTiO_3$ interface. In our devices, graphene is naturally hole-doped. $LaAlO_3$ layer can work as an insulating barrier. With conductive Atomic Force Microscopy lithography technique, $LaAlO_3/SrTiO_3$ interface enable nanoscale reconfigurable control of two-dimensional electron gas underneath graphene. Thereby allowing for the investigation of electron–hole interactions . The observed Coulomb drag resistance significantly increases for temperatures below 20 K. The low-temperature data appear to contradict Onsager's reciprocity theorem, showing a notable departure from the ordinary quadratic temperature dependence expected in a weakly correlated Fermi-liquid. This anomalous behaviour can be associated with the onset of strong interlayer correlations. |

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| 27 | Matei Jordache | Physical Science and Engineering | FEWW-Layer Transition Metal Dichalcogenide Exfoliation and Characterization for Future Electronics | Matei Jordache, Undergraduate; Jierui Liang, PhD Student; Susan Fullerton, PhD; | Transition metal dichalcogenides (TMDs) possess unique electrical and mechanical properties when isolated to thin flakes, making them desired for advanced electronic devices. These devices offer potential advantages over traditional devices, including lower power consumption, smaller size, and larger ON/OFF current ratio. Specifically, molybdenum disulfide ($MoS_2$) and molybdenum ditelluride ($MoTe_2$) are of interest- however, the process for isolating flakes for devices is unpredictable. We found that both reactive ion etching (RIE) before deposition and annealing before exfoliation will increase flake yield (from ~1 flake/substrate to ~5 flakes/substrate) and decrease thickness (from >50nm to <15nm). The increased yield and quality of flakes obtained with RIE and annealing can be attributed to increasing the flake's contact area with the substrate. After exfoliation, we characterize the geometry and surface roughness of the flakes using atomic force microscopy (AFM). The ideal flake shape is rectangular, with length of 10-30 µm and width of 2-3 µm. The average surface roughness measured is ~0.4 nm for $MoS_2$ exfoliated using the standard method, and the average surface roughness is measured at ~0.4nm for $MoS_2$ exfoliated using the modified method, which suggests this method does not affect flake quality. |
| 28 | Zhikang Zhou | Physical Science and Engineering | Vortices Generating by Linear Polarized Light on Ag Film | Zhikang Zhou; Yannan Dai ; Robin Huang, PhD ; Hrvoje Petek, PhD | In the previous research, people get the surface plasmon ploriaton vortex using circular polarized light with the spiral on Au film. In our recent PEEM measurement, we observe the similar vortices using 550 nm linear polarized light with the high order spiral(m>5) on Ag film. This results indicate that for high order spiral on metal surface, linear polarized light can generate not only the SPPs focus but also vortex. |
| 29 | Andi Li | Physical Science and Engineering | The Dynamical Responses of Noble Metal Surfaces to Optical Excitation | Andi Li; Marcel Reutzel, PhD; Hrvoje Petek, PhD | Metal surfaces serve as nearly-perfect systems to study coherent light-matter interactions. Here, we apply the energy-resolved and time-resolved multi-photon photoemission technique to study the coherent nonlinear dynamics of noble metal surfaces excited by optical field in the perturbative regime. We focus on the Shockley surface (SS) state of Ag(111) as a benchmark for spectroscopy. By measuring the non-resonant 3- and 4-photon photoemission of the SS state, as well as its replica structures in the above-threshold photoemission (ATP), we correlate coherent polarizations and populations excited in the sample with final photoelectron distributions where the interaction terminates. We also interpret the experiment results using an optical Bloch equation (OBE) model, which shows that the spectroscopic feature of the 2D photoelectron spectra obeys a relation between the nonlinear orders of the coherent photoemission process m and the induced coherence n. By measuring the resonant 4-photon photoemission between SS and image potential (IP) states, we observe some interference patterns between different photoemission pathways in different metal surfaces and in different appearance, and this is still an on-going work. |
| 30 | Stephen House | Physical Science and Engineering | Uncorking and Oxidative Decomposition Dynamics of Gold Nanoparticle Corked Carbon Nanotube Cups for Drug Delivery Studied with In Situ Transmission Electron Microscopy | Stephen D. House, PhD; Christopher M. Andolina, PhD; Seth C. Burkert; Alexander Star, PhD; Judith C. Yang, PhD | Nitrogen-doped carbon nanotube cups (NCNCs) are an intriguing material for drug-delivery applications due to their cup-shaped morphology and propensity for chemical modification. A gold nanoparticle (NP) can be formed on the open end of the cup to seal a therapeutic molecule inside, which is released when the nanocapsule undergoes oxidative biodegradation. In this study, we employed environmental transmission electron microscopy (ETEM) to directly investigate the structural evolution, uncorking, and degradation of the nanocapsules under thermal (up to 800 °C) and/or oxidative (oxygen gas) conditions. Upon heating, thermally induced reshaping of the internal NCNC cavities was observed, though the rest of the tube exhibited remarkable temperature tolerance. This reshaping increased the internal cavity pressure, suggesting an additional potential use as nanoscale pressure-reactors. Appreciable uncorking and tube decomposition only occurred upon exposure to oxygen at elevated temperatures. Uncorking proceeded in a stepwise, punctuated manner, the rate of which depended strongly on temperature, with an onset prior to oxidative degradation of the NCNCs. The nucleation sites of tube degradation and the rates of its progression were measured from in situ video. These findings provide a better understanding of the mechanisms of cargo release and will inform synthesis developments for optimizing therapeutic delivery. |
| 31 | Dengyu Yang | Physical Science and Engineering | Surface Acoustic Wave Generation and Detection on LAO/STO | Yun-Yi Pai, Yuhe Tang, Yang Hu, Hyungwoo Lee, PhD; Jung-Woo Lee, PhD; Chang-Beom Eom, PhD; Patrick Irvin, PhD; Jeremy Levy, PhD | We aim to observe Surface Acoustic Wave (SAW) in LAO/STO heterostructures. Using well-developed conductive-AFM lithography, one can switch between the conducting and insulating phases of the material, thus interdigited transducers (IDT) can be created in the structure, which can convert electronic signals into acoustic signals and vice versa. Two IDTs are thus written on the structure as a generator and a detector. Due to material and dimensional constraint, a radio frequency electronic signal is used to maximize the effect. SAW can generate potential minima relying on the piezoelectric property of LAO/STO, and by changing position of these potential minima electrons can be transported along the nanowire, which is an emerging option for quantum information transfer. |
| 32 | Huiling Shao | Physical Science and Engineering | Control of Reaction Mechanism and Reactivity and by Photoswitchable N-Heterocyclic Carbene Ligands in Rh-Catalyzed Hydrocarbons of Styrene - A Computational Investigation | Huiling Shao; Yuening Wang, PhD; Christopher W. Bielawski, PhD; Peng Liu, PhD | DFT calculations revealed the effects of N-heterocyclic carbene (NHC) ligands on reaction mechanism and bridged between ground state ligand properties and reaction outcomes. The rate determining step (RDS) for Rh-NHC catalyzed hydroboration of styrene is boryl migration for linear regio-isomer and hydride migration for branched regio-isomer. Due to different geometries of these RDS, following designing principles were concluded for rational catalyst design: 1). Better doner ancillary ligands, evidenced by smaller tolman electronic parameter (TEP) promote activity of both linear and branched products; 2). Bulky NHC ligands with larger cone angle suppresses sterically sensitive hydride migration making linear selective boryl migration more accessible; 3). Smaller NHC and $PPh_3$ ligands with smaller cone angle lead to branched product. These summarized designing principles of Rh-NHC catalysts aim to achieve enhanced reactivity, and the ability to perform switchable catalysis in hydroboration even other hydrofunctionalization reactions. |

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| 33 | Aditi Nethwewala | Physical Science and Engineering | Quantum Transport of Quasi-1D Crossed Electron Waveguides | Aditi Nethwewala; Megan Briggeman; Jianan Li, MD; Yuhe Tang; Hyungwoo Lee, PhD; Jungwoo Lee, PhD; Chang-Beom Eom, PhD; Patrick Irvin, PhD; Jeremy Levy, PhD | We report low temperature magnetotransport measurements in quasi-1D crossed electron waveguides created using conductive atomic force microscope (c-AFM) lithography. Conductance quantization is observed along with aperiodic universal conductance fluctuation (UCF), thereby exhibiting coherent ballistic transport over micrometer length scales. Magnetic asymmetries are observed in the magnetoconductance which are correlated with UCF. Inhomogeneity found across the nanocross is shown to significantly affects the transport properties. Hall measurements are taken and the resistance is a non-linear function of magnetic field strength which is attributed to as an example of anomalous Hall effect (AHE). |
| 34 | Aaron Woeppel | Physical Science and Engineering | Locally Induced Semiconductor-to-Metal Transition in Two-Dimensional Crystals Using an Ionomer | Aaron Woeppel; Susan Fullerton, PhD; Ke Xu | Two dimensional MoTe2 has two unique phases; its 2H phase is semiconducting, while its 1T phase is metallic. MoTe2 can be shifted between these two phases by applying appropriate strain (~3%). We have developed a new approach of applying this strain locally to a device using a suspended MoTe2 field effect transistor with an ionomer gate. Ionomer's have previously been studied as IPMC's used in artificial muscles. When a bias is applied, selective cation drift and buildup at the ionomer electrode interface results in the devise bending. We have been modeling this selective ion drift in a parallel plate capacitor geometry using COMSOL Multiphysics. Since ions build within nanometers of the electrode surface, the finite volume of ions must be considered. A Stern Layer was added to prevent unrealistically close ion buildup and sheet densities of successive layers of ions were calculated once every ion diameter. A simple model for deformation was later added to begin estimating the expected strain on the MoTe2 crystal. Meanwhile, a custom ionomer was synthesized and drop-cast and annealed on a Si/SiO2 surface with Au/Ti electrodes in a similar capacitor geometry, and real MoTe2 electric devices. |
| 35 | Xinyi Wu | Physical Science and Engineering | Uniaxial Strain Effect on Superconductivity in Nanostructures at LAALO3/SRTIO3 Interface | Xinyi Wu; Megan Briggeman; Joe Albro; Jianan Li, MD; Jungwoo Lee, PhD; Hyungwoo Lee, PhD; Chang-Beom Eom, PhD; Patrick Irvin, PhD; Jeremy Levy, PhD | We investigate the effects of uniaxial strain on superconductivity with particular reference to nanowires created at the LaAlO3/SrTiO3 interface using conductive AFM lithography. Applying continuously tunable tensile and compressive strains within a cryogenic environment, we observed the emergence and disappearance of superconducting state. The strain directions parallel and perpendicular to superconducting nanowire section have different effects on its conductivity. The ability to change ferroelastic domains or ferroelectric soft modes through uniaxial strain in interface materials adds a novice and powerful experimental tool. These results offer insights into electron pairing mechanism in SrTiO3. |
| 36 | Yun-Yi Pai | Physical Science and Engineering | One-Dimensional Nature of Superconductivity at the LAALO3/SRTIO3 Interface | Yun-Yi Pai; Hyungwoo Lee, PhD; Jung-Woo Lee, PhD; Anil Annadi; Guanglei Cheng; Shicheng Lu; Michelle Tomczyk; Mengchen Huang, PhD; Chang-Beom Eom, PhD; Patrick Irvin, PhD; Jeremy Levy, PhD | We examine superconductivity in LaAlO3/SrTiO3 channels with widths that transition from the 1D to 2D regime. The superconducting critical current is independent of the channel width and increases approximately linearly with the number of parallel channels. Signatures of electron pairing outside of the superconducting regime are also found to be independent of channel width. Collectively, these results indicate that superconductivity exists at the boundary of these channels and is absent within the interior region of the channels. The intrinsic 1D nature of superconductivity at the LaAlO3/SrTiO3 interface imposes strong physical constraints on possible electron pairing mechanisms. |
| 37 | Dakota Folmsbee | Physical Science and Engineering | Rapid Predictive Methods to Screen for Organic Dielectric Materials | Dakota Folmsbee; Geoff Hutchison, PhD | To be able to efficiently scan chemical space in search for optimal organic dielectric materials, a rapid search technique along with rapid property evaluation must be employed. Genetic algorithms offer the ability to rapidly screen by modifying optimal candidates and introducing mutations in order to possibly generate more ideal organic molecules. To aid in the rapid screening process, the use of machine learning algorithms are explored for use as a rapid evaluation method in predicting properties at each generation. To take best advantage of machine learning a proper representation must be constructed to best depict the molecule to the machine learning model. The proposed representation consisting of bonds, angles, and torsions using atom typing performs on par or better than the non-typed representations with bonds, angles, torsions, and nonbonding interactions when using conventional machine learning methods. The pairing of these rapid evaluation and screening methods should allow for the discovery of optimal organic dielectric candidates for use in energy storing applications. |
| 38 | Olga Vinogradova | Physical Science and Engineering | Quantifying Confidence in DFT Predicted Surface Pourbaix Diagrams of Transition Metal Electrode-Electrolyte Interfaces | Olga Vinogradova; Dilip Krishnamurthy; Vikram Pande; Venkatasubramanian Viswanathan, Ph.D. | Low temperature Proton-Exchange Membrane (PEM) fuel-cells are attracting considerable attention for chemical energy conversion. It is widely recognized that a major bottleneck for PEM fuel-cells relates to sluggish kinetics of the Oxygen Reduction Reaction (ORR) at the cathode. Understanding how to improve ORR and the activity of catalyst materials requires a detailed understanding of atomistic surface dynamics. Density Functional Theory (DFT) calculations are widely used to identify active catalysts by constructing free energy diagrams incorporating the electrochemically stable surface structure [1]. We construct surface Pourbaix diagrams for ORR to capture the most stable state of the surface under reaction conditions of electrode potential and pH. A unique aspect of this work is incorporation of error estimation techniques from within the Bayesian Error Estimation Functional with Van der Waals corrections (BEEF-vdW) exchange correlation function [2]. We developed a systematic approach to propagate the uncertainty associated with the energetics for the construction of surface Pourbaix diagrams [3]. In particular, we discuss the phase transition boundary from OH* to O* on commonly studied transition metals Pt, Pd, Ir, Rh, and Ru in terms of prediction confidence and report comparison of surfaces in terms of their binding strength of OH*. |

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| 39 | Chenxu Liu | Physical Science and Engineering | Single-Photon Heralded 2-Qubit Gates for Pairs of NV Centers in Diamond | Chenxu Liu; M.V. Gurudev Dutt; David Pekker, PhD | The implementation of a high-fidelity 2-qubit quantum gate is an essential, and perhaps the most challenging, ingredient in building a measurement-based quantum computer using NV centers. We propose a single-photon heralded scheme to generate 2-qubit quantum gates for two Nitrogen-vacancy (NV) centers in diamond. We drive a scattering transition in both NV centers simultaneously. We demonstrate that our scheme results in a 2-qubit quantum gate heralded by a scattered photon when the distance between the NV centers is chosen to be a quarter-wavelength of the scattered photon. The generation of the scattered photon goes through multiple excited electronic states of an NV center, and the interference between these paths controls the fidelity of the 2-qubit gate. We proposed four possible schemes with different configurations of the polarization of the driving light and collection path, combining with two spectial drive frequencies, to achieve high fidelity of the 2-qubit gate. |
| 40 | Azarin Zarassi | Physical Science and Engineering | Mirage Andreev Spectra Generated by Mesoscopic Leads in Nanowire Quantum Dots | A. Zarassi, J.-F. Hsu, Z. Su, P. San-Jose, E. Prada, R. Aguado, E.J.H. Lee, S. Gazibegovic, R. Op het Veld, D. Car, S.R. Plissard, M. Hocevar, M. Pendharkar, J.S. Lee, J.A. Logan, C. J. Palmstrom, E.P.A.M. Bakkers, S. M. Frolov | We study transport mediated by Andreev bound states formed in InSb nanowire quantum dots. Two kinds of superconducting source and drain contacts are used: epitaxial Al/InSb devices exhibit a doubling of tunneling resonances, while in NbTiN/InSb devices Andreev spectra of the dot appear to be replicated multiple times at increasing source-drain bias voltages. To describe the observations a model is developed that combines the effects of a soft induced gap and of additional Andreev bound states both in the quantum dot and in the finite regions of the nanowire adjacent to the quantum dot. Understanding of Andreev spectroscopy is important for the correct interpretation of Majorana experiments done on the same structures. |
| 41 | Jimeng Wei | Physical Science and Engineering | Chiral Induced Spin Selectivity in CuO Films | Paul Möllers; Jimeng Wei; David Waldeck, PhD; Helmut Zacharias, PhD | CuO thin films electrodeposited in the presence of a chiral precursor( i.e. L-tartaric acid) retain the same chirality as the precursor. According to the chiral induced spin selectivity (CISS) effect, it should be possible to use chiral CuO films as electron spin filters. Cyclic voltammetry and CD spectroscopy are used to verify that the CuO films are chiral, and photoemission spectroscopy is used to examine the spin polarization of electrons that pass through the chiral CuO films. |
| 42 | Henry Ayoola | Physical Science and Engineering | Describing the Bonding at the PT/Γ-AL2O3 Interface Using a Model System Combined with Electron Microscopy and Spectroscopy Simulations | Henry Ayoola; Cecile S. Bonifacio, PhD; Qing Zhu, PhD; Joshua J. Kas, PhD; John J. Rehr, PhD; Eric A. Stach, PhD; Wissam A. Saidi, PhD; Judith C. Yang, PhD | Pt/γ-Al2O3 is an important catalyst system due to its widespread use in fuel cells, catalytic converters, and petroleum reforming. The metal-support interaction is particularly interesting because it significantly influences many catalytically relevant properties, including catalyst dispersion, particle shape, and electronic structure. Studying these catalyst properties in situ is crucial, as post mortem analysis will miss any changes in these properties—which could modify the number and types of active sites present—that emerge only under reaction conditions. We have synthesized a model Pt/γ-Al2O3 catalyst consisting of 2-3 nm Pt nanoparticles on single-crystal γ-Al2O3 (111) thin films, enabling us to study specific structural and electronic properties at the nanoscale and directly correlate these with computational results. Using electron energy-loss spectroscopy (EELS), we revealed how the electronic structure at the Pt/γ-Al2O3 interface differs from that of bulk γ-Al2O3. Through correlation with EELS simulations, we determined the most probable Pt atomic bonding configuration on γ-Al2O3 (111). We are now studying the structural dynamics of the Pt/γ-Al2O3 catalyst during reactant adsorption/desorption in situ using environmental TEM, with a focus on the role of the metal-support interaction. |
| 43 | Caleb Clever | Physical Science and Engineering | Study of CISS Effect in Peptides and Amino Acids via the Hall Effect | Caleb Clever; David Waldeck, PhD | We are examining the spin polarization of electrons that is generated within self-assembled monolayer films of peptides and amino acids that are charge polarized. According to the chiral induced spin selectivity (CISS) effect, when electrons flow through or within a chiral molecule, they are selected preferentially for one spin. This spin polarization produces a magnetic field which we can measure by means of the Hall effect. When a voltage is applied from an electrode insulated from the electrolyte solution, the electrons of the molecules polarize, which also results in a spin polarization, according to the CISS effect. By studying the individual magnetization as a function of the applied voltage and the surface coverage of molecules we can determine the average magnetic moment per molecule. We are using this method to examine how the magnetization depends on molecular properties. |
| 44 | Xing Yee Gan | Physical Science and Engineering | Understanding the Emergent Plasmonic Properties of Degenerately Doped Copper Selenide Nanoparticles Towards Light Driven Applications | Xing Yee Gan, Lauren Marbella, PhD; Emily Keller, PhD; Derrick Kaseman, PhD; Austin Gamble Jarvi; Scott Crawford; Renee Frontiera, PhD; Sunil Saxena, PhD; Jill Millstone, PhD | The phenomena of localized surface plasmon resonances (LSPRs) has been broadly studied and is a property of nanomaterials that can be used to enhance or enable a wide variety of technologies including cancer treatment, light-driven catalysis, and ultrasensitive detection. While most widely observed and studied in noble-metal nanomaterials, a much broader selection of nanoscale materials may exhibit LSPRs. Recently, degenerately doped colloidal semiconductor nanoparticles have been identified as one such class of alternative plasmonic nanomaterials. Unlike their noble-metal counterparts, a powerful way to tune plasmonic properties of doped semiconductor nanoparticles is by controlling their charge carrier density. Therefore, methods to control and measure carrier density in these materials is crucial to their development and design. Herein, we first track and quantify carrier density in a well-studied non-noble metal plasmonic system, copper selenide (Cu2-xSe), using 77Se solid state NMR. Further, we use EPR measurements to establish detailed chemical picture of the nanoparticle surface as a function of progressive oxidation. We then study the performance of the nanoparticle plasmonic properties in light-driven sensing applications and chemical reactions. Taken together, these observations are a key step towards the translation of non-noble metal, and specifically semiconductor, alternatives in study and use of plasmon-based technologies. |

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| 45 | Yuhe Tang | Physical Science and Engineering | Long-Range Non-Coulombic Electron-Electron Interactions in Coupled Lao/Sto Nanowires | Yuhe Tang, MS; Anthony Tylan-Tyler, PhD; Hyungwoo Lee, PhD; Jung-Woo Lee, PhD; Michelle Tomczyk, PhD; Mengchen Huang, PhD; Chang-Beom Eom, PhD; Patrick Irvin, PhD; Jeremy Levy, PhD | Frictional drag phenomena are investigated in coupled nanowires formed at $LaAlO_3/SrTiO_3$ heterointerfaces. The weak decay of drag resistance with increasing wire separation rules out Coulomb interactions as the dominant coupling mechanism. The observed unidirectional current drag is explained using a simple model that invokes slight asymmetries within nanowires. These results provide new insights into non-Coulombic electron-electron interaction effects that must be accounted for in any full description of electron transport at oxide interfaces. |
| 46 | Jonathan Ruffley | Physical Science and Engineering | Differential Uptake of a Chemical Warfare Agent Simulant Using Functionalized MOFs | Jonathan Ruffley, J. Karl Johnson | The continued use of chemical warfare agents demands novel materials capable of enhanced destruction of such agents. We seek to understand the properties of interactions between metal-organic frameworks (MOF) and chemical warfare agent simulant molecules in order to guide the synthesis of MOFs capable of selectively concentrating them. Through the use of density functional theory (DFT), a classical force-field, and grand canonical Monte Carlo simulations, we evaluate three functionalized UiO-67 MOFs for this purpose. We find that cluster and crystal DFT calculations predict the trends of low pressure adsorption of dimethyl methylphosphonate, a simulant of sarin, onto the MOFs. Thus, these materials show promise in promoting diffusion in a stratified MOF architecture. |
| 47 | Spencer Graves | Physical Science and Engineering | Development of a Homemade Device to Measure Color Concentration in Water Samples | Spencer Graves, Ross Aguilar, Theodore A. Corcovilos, PhD | A common method for finding impurities in water involves measuring the color of a sample after a chemical sensor has been added. We developed an all-purpose color sensing device that is small, portable and economical allowing water samples to be tested on site instead of in a lab. The device utilizes a color sensor measuring light intensity at six wavelengths: Violet (450 nm), Blue (500 nm), Green (550 nm), Yellow (570 nm), Orange (600 nm), and Red (650 nm). The device flashes a known amount of white light from an LED onto a sample and measures the transmittance of each color through the sample. Concentrations are found using a calibration curve generated from measuring known samples. The results are displayed on the device's LCD screen. This device has the flexibility to conduct a wide range of color tests for contaminants such as fluoride, chloride, and metals. |
| 48 | Scott Crawford | Physical Science and Engineering | Surface-Functionalization Strategies for Tuning the Optoelectronic Properties of Phosphine-Capped Gold Nanoparticles | Scott Crawford; Chrisotpher Andolina, PhD; Ashley Smith, PhD; Derrick Kaseman, PhD; Kathryn Johnston; Bo Ryoo; Jill Millstone, PhD | Surface functionalization of nanomaterials profoundly influences material properties ranging from catalytic activity to biocompatibility. Yet, strategies to functionalize nanomaterials and to directly correlate surface structure with nanoparticle properties remains a challenge. Here, we use a ligand-exchange strategy to demonstrate the impact of surface chemistry on gold nanoparticle (AuNP) photoluminescence. Phosphine-capped (diameter = 1.7 ± 0.4 nm) AuNPs that are non-luminescent are first synthesized, and emission is then induced by exchanging the surface phosphine ligands with the more commonly-used thiolated ligands of different sizes. Remarkably, the quantum yield is altered dramatically depending on ligand size. We then demonstrate that, unexpectedly, even electropositive sulfur ligands such as dimethylsulfoxide can “turn on” AuNP emission, and exploit this to conduct isotopic studies, where deuterated dimethylsulfoxide enhances the quantum yield by 800%. Finally, we conduct analogous experiments using alkyne ligands to induce AuNP PL, which are emerging as a widely-used class of ligands on atomically precise clusters. The ligand-exchange techniques demonstrated here allow AuNP surface functionalization (i.e. small or weakly bound ligands) that might not be accessible via direct synthetic techniques. Taken together, this work illustrates the importance of surface functionalization techniques in driving nanomaterial properties, with implications for applications including energy transfer and sensing. |
| 49 | Yang Hu | Physical Science and Engineering | Single-Electron Source from LAALO3/SRTIO3 System | Yang Hu, Yuhe Tang, Dengyu Yang, Yun-Yi Pai, Jianan Arthur Li, Patrick Irvin, and Jeremy Levy | We investigate the single-electron source creation from LaAlO3/SrTiO3 interface using conductive AFM lithography. Due to the "Water Cycle" mechanism (Applied Physics Letters 97, 173110 (2010).), 2D Electron Gas will emerge in the LAO/STO interface when put a biased c-AFM tip in contact with the surface of top LAO layer. This technique enable us to design multiple interesting devices. Here we want to create a double-quantum-dot system with current source, current drain as well as two sidegates tuning each quantum dot. By tuning the quantum dots periodically in a tricky way we can make the system complete a cycle phase transition so that only one electron tunnel through, making this system serve as a single-electron source, which shall have applications in quantum computing or other research fields. |
| 50 | Zheni Georgieva | Physical Science and Engineering | Inducing Chiro-Optical Properties in Methylammonium Lead Halide Perovskite Nanoplatelets | Zheni N. Georgieva, Brian P. Bloom, PhD, David H. Waldeck, PhD | Chiral semiconductor nanoparticles represent a new class of materials with promising properties for application in the fields of optoelectronics, spintronics, amongst others. In this work we describe a synthetic protocol for the development of chiral quantum-confined perovskite nanoplatelets (NPLs). Chiral properties are induced in the NPLs by incorporating a chiral ligand (R- or S-phenylethylammonium, R/S-PEA) into the ligand shell. The nanoplatelets exhibit absorbance and emission properties comparable with previous literature reports, along with chiro-optical activity as demonstrated by circular dichroism (CD) spectroscopy. To study the versatility of the approach, this synthetic protocol was applied to NPLs of varied halide compositions, specifically perovskites of compositions CH3NH3PbBr3-xClx and CH3NH3PbBr3-xIx. The chiro-optical activity persisted in varied halide structures and shifts in the CD spectra are consistent with the halide-driven changes in bandgap. Current efforts are focused on elucidating the origin of the different optical transitions present in the absorbance and CD spectra of the chiral NPLs. It is hoped that a better understanding of the electronic transitions responsible for the CD line shape would allow for greater insight into the mechanism of chiral imprinting in perovskite nanoplatelets. |

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| 51 | Jen-Feng Hsu | Physical Science and Engineering | Superconducting Microwave Circuits with Semiconducting Nanowires in High Magnetic Fields | Jen-Feng Hsu, PhD; Azarin Zarassi, Sergey Frolov, PhD; E. P. A. M. Bakkers Group; S. R. Plissard, PhD; C. Palmstrom Group; David Pekker; M. Hatridge Group | Topological quantum devices that require high magnetic fields and quantum-limited microwave measurements are two powerful, but not completely compatible techniques. E.g., Josephson Parametric Converters are very sensitive to external magnetic fields. We attempt to integrate them through material and hardware designs. This hybrid system has a potential to explore fault-tolerant qubits from Majorana zero modes in superconductor-semiconductor nanowire devices; at the same time, use superconducting qubits to manipulate and read out. |
| 52 | Austin Gamble Jarvi | Physical Science and Engineering | Advancing the Applications of Cu(II) Based Distance Measurements by EPR | Austin Gamble Jarvi; Shreya Ghosh; Ralph Weber, PhD; Kalina Ranguelova, PhD; Timothy Cunningham, PhD; Sunil Saxena, PhD; | Herein we demonstrate the use of the Double Histidine (dHis) Cu(II) binding motif for structural and conformational determination of proteins via Electron Paramagnetic Resonance (EPR) distance constraints. Specifically, we demonstrate a trilateration approach to determine native Cu(II)binding in a simple model protein, and the use of Q-band EPR to report on the relative orientations of the spin labels. For trilateration, the dHis motif provides precise distance constraints such that the location of a native Cu(II) binding site within a protein may be determined using the minimum number of constraints. Such methodology may easily be applied to other biological issues such as protein-protein and protein-DNA interactions, and substrate binding. Additionally, Q-band EPR in conjunction with the rigid dHis Cu(II) binding motif allows for the determination of the relative orientations of the Cu(II) labels within a protein. This technique enables additional structural constraints to be used in conjunction with other structural methodologies to provide unprecedented insight into protein structure and conformations. This work furthers the applicability the dHis Cu(II) motif, and demonstrates its efficacy in elucidating precise structural information. |
| 53 | Michael Sinko | Physical Science and Engineering | Superconducting Quantum Interference in 1D AL Contacts to a 2D Superconductor | Michael Sinko, MS; Sergio de la Barrera, PhD; Olivia Lanes, MS; Michael Hatridge, PhD; Ben Hunt, PhD; | Robust superconducting edge contact is made to NbSe2 fully encapsulated by insulating hexagonal boron nitride. We present evidence that this contact is fully superconducting with a critical current density Jc = 7*10^8 A/m^2. A three component system of low pass electrical filters is necessary to measure these samples, as high frequency noise in the system will cause a finite remnant contact resistance to be measured. Also presented is a second sample in which two of these contacts are patterned to form a Superconducting QUantum Interference Device (SQUID), and an associated Fraunhofer pattern is observed. |
| 54 | Shoham Sen | Physical Science and Engineering | Greens Function Approach to Electronic Structure Calculation of Graphene | Shoham Sen, Prof. Yang Wang, Prof. Kaushik Dayal | We perform electronic structure calculations for Graphene using density functional theory based ab initio method with linear scaling Greens function approach, known as Locally Self Consistent Multiple Scattering Method (LSMS). The Greens function for the Kohn-Sham equation is solved in the framework of multiple scattering theory, in which the scattering operator represents the electron scattering off the atoms in a crystal. By making an assumption of "near-sightedness" or "local Interaction zone" around each atom, the computational cost for calculating the Green function is reduced from O(N^3) to O(N), where N is the number of atoms in unit cell. We apply the LSMS method to the study of density of states of Graphene doped with transition metal elements. |
| 55 | Micah Bostian | Physical Science and Engineering | Fabrication and Characterization of Ionomer-Gated Mote2 and Graphene Field Effect Transistors | M.Eli Bostian; Ke Xu; Susan Fullerton-Shirey | MoTe2 and graphene field-effect transistors (FETs) were ion gated utilizing a polymer electrolyte composed of a custom single-ion conductor. The anions in this ionomer are covalently bound to the polymer backbone, while the cations are free to respond to the applied field. In our device design, when a positive gate bias is applied, cations drift away from the gate to the surface of the device channel (MoTe2 or graphene crystal) and establish an electrostatic double layer (EDL) at the electrolyte/channel material interface and a depletion layer at the gate/electrolyte interface. MoTe2 and graphene crystal FETs are fabricated by electron beam lithography (EBL) on corresponding material flakes exfoliated onto p-doped SiO2/Si; 10 nm Ti/100 nm Au contacts are deposited by e-beam evaporation. MoTe2 and graphene FET transfer and output characteristics will be reported with the channel current modulated by an ionomer gate. EDL formation and dissolution is measured by changes in the channel current (IDS) as a function of the ionic gate bias (VG). |
| 56 | Shan Hao | Physical Science and Engineering | Transport Characteristics of Superlattice Modulated LAO/STO Nanostructures | Shan Hao, Jianan Arthur Li, Hyungwoo Lee, Jung-Woo Lee and Chang-Beom Eom, Patrick Irvin, Jeremy Levy | The interface of LAO/STO supports a 2D electron gas that can be further reconfigured into nanostructures, using conductive atomic force microscope lithography or, probably, by capping nano-scale Al onto the surface. The specific nanostructure of interest is the dot lattice, which has the potential of simulating Hubbard Hamiltonian. Our aim is to create and tune such nanostructure, simulate Hubbard model and do quantum simulation. We will also have a chance to investigate the role played by electron-electron interaction in the superconductivity. |
| 57 | Shiv Upadhyay | Physical Science and Engineering | Accurate Predictions of Electron Binding Energies of Dipole-Bound Anions via Quantum Monte Carlo Methods | Hongxia Hao, BS; James Shee, BA; Shiv Upadhyay, MS; Can Ataca, PhD; Kenneth D. Jordan, PhD; Brenda M. Rubenstein, PhD | Dipole-bound anions are formed when neutral molecules with sufficiently large molecular dipole moments (1.625 D within the Born-Oppenheimer approximation) capture an excess electron in a diffuse non-valence orbital. The description of dipole-bound anions is a strong test of the accuracy of theoretical models owing to the difficulty of resolving the small energy differences giving rise to the weak binding energies and the importance of long-range electron correlation effects to these energies. Here, we demonstrate that quantum Monte Carlo methods can accurately characterize molecular dipole-bound anions with near threshold dipole moments. We also demonstrate that by introducing correlated sampling to the Auxiliary Field Quantum Monte Carlo method, the small energy differences between the neutral and anionic species can be resolved to an order of magnitude lower uncertainty using two orders of magnitude less sampling. These results show the utility of quantum Monte Carlo methods for characterizing weakly-bound species. |

| Poster # | Presenter | Topic | Title | Author(s) | Abstract |
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| 58 | Muqing Yu | Physical Science and Engineering | Shot Noise Measurement of LAO/STO Electron Waveguide | Muqing Yu, Leena Aggarwal, Yunyi Pai, Yang Hu, Jungwoo Lee, Hyungwoo Lee, Chang-Beom Eom, Patrick Irvin, Jeremy Levy | Current fluctuations due to the discreteness of the electrical charge are known as shot noise, which allow us to determine the type of charge carriers in the 2D electron gas found at the LAO/STO interface. Using conductive atomic force microscope (c-AFM) lithography we are able to create nanoscale devices at the LAO/STO interface. One such device is an electron waveguide in which electrons can exist as single particles and, because of electron-electron interactions, they can also form pairs, three-electron bound states, or even quasi-particles with fractional charge. Different species of “electron molecules” can be accessed using different gate and field conditions. Here we will discuss our efforts to construct a measurement setup to detect shot noise in electron waveguides. These measurement should not only confirm the identity of those exotic carrier states but may also illuminate possible interaction mechanisms. |
| 59 | Mohammad Taghi Sharbati | Physical Science and Engineering | Energy-Efficient, Two-Dimensional Analog Memory for Neuromorphic Computing | Mohammad Taghi Sharbati; Yanhao Du; Feng Xiong, PhD | Brain-inspired neuromorphic computing has the potential to revolutionize the current computing paradigm with its massive parallelism and potentially low power consumption. However, the existing approaches of using digital complementary metal-oxide-semiconductor (CMOS) devices (with ‘0’ and ‘1’ states) to emulate gradual/analog behaviors in the neural network are energy intensive and unsustainable; furthermore, emerging memristor devices still face challenges such as non-linearities and large write noise. In this study, we present an electrochemical graphene synapse, where the electrical conductance of graphene is reversibly modulated by the concentration of Li ions between the layers of graphene. This fundamentally different mechanism allows us to achieve a good energy efficiency (<500 fJ per switching event), analog tunability (>400 non-volatile states), good endurance and retention performances, and a linear and symmetric resistance response. We demonstrate essential neuronal functions such as excitatory and inhibitory synapses, long-term potentiation and depression, and spike timing dependent plasticity with good repeatability. Our scaling study suggests that this simple, two-dimensional (2D) synapse is scalable in terms of switching energy and speed. This work can lead to the low-power hardware implementation of neural networks for neuromorphic computing as well as tunable 2D electronics where the material properties can be precisely engineered. |
| 60 | Joseph Albro | Physical Science and Engineering | Nanomechanical Probes of Sketched LAALO_3/SRTIO_3 Single-Electron Transistors | Joseph Albro, Jessica Montone, Feng Bi, Mengchen Huang, Jung-Woo Lee, Hyungwoo Lee, Chang-Beom Eom, Patrick Irvin, Jeremy Levy | Nanoscale devices that manipulate single electrons present an exciting platform for the observation of electronic and mechanical effects. By utilizing the locally tunable metal-insulator transition at the interface of LaAlO3/SrTiO3, we create single-electron transistors using conducting atomic force microscope (c-AFM) lithography. The piezoelectric nature of LaAlO3/SrTiO3 gives way to an expected coupling between mechanical motion and electric charge within the device. We test this effect by applying pressure to the device using an insulating AFM tip while measuring changes in electron density. I describe our efforts to perform nanomechanical imaging of conductive structures on LaAlO3/SrTiO3. I describe our method of performing imaging in a cryogenic AFM system, as many interesting properties of single-electron devices are observed at low temperatures. |
| 61 | Erin Fierro | Physical Science and Engineering | Coupling Single NVS to External Target Spins Using Double Electron-Electron Resonance | Erin Fierro; Kai Zhang; Gurudev Dutt | Nitrogen vacancy (NV) centers are defects found in a diamond crystal structure. They have desirable properties at room temperature such as long coherence times, spin-dependent optical read out and the ability to be initialized optically, making them ideal candidates for developing potential qubits and for nanoscale sensing purposes. Because of their sensitivity to an externally applied magnetic field and their narrow linewidth, NVs can act as high-resolution detectors. Sensitivity to external changes can be improved further by using vacancies near the surface, reducing sensor to sample distance. At these distances, the NV can be coupled to an external target spin and driven with on resonance microwave pulses. We attempt to reproduce previous work showing a single NV can be coupled to a Cu2+ target and driven using double electron-electron resonance (DEER). We further attempt to improve upon the previous method by removing set up related time restrictions on measurements. Ultimately, we hope to apply this technique to organic materials such as proteins that use Cu2+ in their structures for biological processes and to other suitable spin targets. |
| 62 | Zhongmou Chao | Physical Science and Engineering | Direct-Write Formation and Dissolution of Silver Nanofilaments in Ionic Liquid-Polymer Electrolyte Composites | Zhongmou Chao, Susan K. Fullerton-Shirey | Materials with reconfigurable optical properties are candidates for applications such as optical cloaking and wearable sensors. One approach to fabricate these materials is to use external fields to form and dissolve nanoscale conductive channels in well-defined locations within a polymer. In this study, conductive atomic force microscopy is used to electrochemically form and dissolve nanoscale conductive filaments at spatially distinct points in a polyethylene glycol diacrylate (PEGDA)-based electrolyte blended with varying amounts of ionic liquid (IL) and silver salt. The fastest filament formation and dissolution times are detected in a EGDA/IL composite that has the largest modulus (several GPa) and the highest polymer crystal fraction. This is unexpected because filament formation and dissolution events are controlled by ion transport, which is typically faster within amorphous regions where polymer mobility is high. Filament kinetics in primarily amorphous and crystalline regions are measured, and two different mechanisms are observed. The formation time distributions show a power-law dependence in the crystalline regions, attributable to hopping-based ion transport, while amorphous regions show a normal distribution. The results indicate that the timescale of filament formation/dissolution is determined by local structure, and suggest that structure could be used to tune the optical properties of the film. |

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| 63 | Yike Zhang | Physical Science and Engineering | Magneto-Optical Kerr Probing On Graphene/LAO/STO | Yike Zhang, Jianan Li, Muqing Yu, Qing Guo, Hyungwoo Lee, Chang-Beom Eom, Patrick Irvin, Jeremy Levy | LAO/STO heterostructure is popular with its versatile properties such as high mobility 2D electron gas, superconductivity and magnetism. In the past few years, several papers have reported ferromagnetism at LAO/STO interface through different approach such as scanning SQUID and torque magnetometry. We aim to use magneto-optical Kerr effect with femtosecond laser to measure the ferromagnetism on Graphene/LAO/STO. Linear polarized laser can be decomposed into left and right handed circular light. And magnetized media would cause phase shift and amplitude change for the circular components. When a linear polarized light is incident on the magnetized media which has different respond to left and right handed circular light, the reflected light will be elliptical polarized. By using photo elastic modulator and analyzer, this change of polarization can be convert to change of intensity and be detected by a detector. Our sample has a thickness of 10 u.c. of LAO. Graphene was transferred on LAO/STO as top gate to tune the interface conductivity and also allows 425nm laser which is a sub-bandgap absorption peak of STO to pass through and interact with LAO/STO. |
| 64 | Kshiteej Deshmukh | Physical Science and Engineering | Bond Energies of Molecules Using Strictly-Correlated-Electron (SCE) Limit of Density-Functional-Theory | Kshiteej Deshmukh, PhD student; Kaushik Dayal, PhD | Standard Kohn-Sham DFT starts from a mean-field approximation: the kinetic energy is modeled exactly, while the electron-electron interactions are modeled through a split into a mean-field term, and corrections from the exchange-correlation term. The SCE limit starts from the opposite limit: the electron-electron interactions are assumed to dominate over the kinetic energy, and hence it is a semi-classical limit. It is hence well suited to study strongly-correlated situations, e.g. bond breaking. While the SCE limit includes many-body interactions, it can be identified as a problem from Optimal Transport theory with Coulomb cost function. Hence it can be solved by a nested optimization in its dual (Kantorovich) formulation. We incorporate the Kantorovich solution within the KS-DFT framework. |
| 65 | Shouvik Mukherjee | Physical Science and Engineering | Measurement of Exciton-Exciton Interaction Strength in a Polariton Condensate | Shouvik Mukherjee, David M. Myers, Burcu Ozden, Rosaria Lena, Andrew Daley, Lorren Pfeiffer, Ken West, David W. Snoke | We find bounds on the value of the exciton-exciton interaction strength in a polariton condensate. The bounds agrees well with the theoretical prediction. The measurement is important for a polariton system as there have been controversial values reported in the literature. |
| 66 | Bryan Henderson | Physical Science and Engineering | Vibrational Coupling in Water-Anion Clusters: a Study of HCO2-·(H2O) | Bryan V. Henderson; Kenneth D. Jordan, PhD | Gas phase water-anion clusters exhibit many interesting vibrational properties. In particular, several clusters, such as HCO2-·(H2O), NO3-·(H2O), and CH3CO2-·(H2O), display a progression of nearly evenly spaced peaks in the OH stretch region of the vibrational spectra. Previous studies have shown that this progression can be qualitatively reproduced theoretically by a treatment allowing for the cubic coupling between the water OH stretch vibrations and the low frequency intermolecular rock mode. In this study, we use the HCO2-·(H2O) system to investigate the assumptions in this model. We examine the extent that the intermolecular rock motion couples with other degrees of freedom in the cluster, and show that the normal mode approximation does not accurately describe the rock vibrational mode. Finally, we show that a one-dimensional adiabatic model can be used to quantitatively reproduce the experimental spectrum, provided one accounts for the anharmonicity in OH stretch vibrations and uses a variable reduced mass. |
| 67 | Kevin Singewald | Physical Science and Engineering | Increasing Nitroxide Lifetime in Cells to Enable in-Cell Protein Structure and Dynamics Measurements by Electron Spin Resonance Spectroscopy | Kevin Singewald, BS; Matthew Lawless, PhD; Sunil Saxena, PhD | There is increasing evidence that the stability, structure, dynamics, and function of many proteins differ in cells versus *in vitro* . The determination of protein structure and dynamics within the native cellular environment may lead to better understanding of protein behavior. Electron spin resonance (ESR) has emerged as a technique to report on protein structure and dynamics within cells. Nitroxide based spin labels are capable of reporting on protein dynamics, structure, and backbone flexibility but are limited due to nitroxide reduction occurring in cells. In order to overcome this limitation, we used the oxidizing agent potassium ferricyanide as well as the cleavage resistant spin label 3-malemido-PROXYL (5-MSL). Furthermore, we hypothesized that injection concentration is an important parameter regarding nitroxide reduction kinetics. By increasing the injection concentration of doubly 5-MSL labeled protein into Xenopus laevis oocytes, we found an increased nitroxide lifetime. Our work demonstrates unprecedented incubation times of 3-hour in-cell and 5-hour in-cytosol for double electron-electron resonance (DEER) experiments using nitroxide spin labels. This allows for more meaningful measurements of larger protein systems which may require longer incubation times for equilibration in the cellular milieu. Even longer incubation times are possible by combining our approach with more shielded nitroxides and Q-band. |
| 68 | Supriya Ghosh | Physical Science and Engineering | Chiral Molecule Induced Magnetization of Superparamagnetic Nanoparticles and Their Use in Water Splitting | Supriya Ghosh; Brian P. Bloom, PhD; David H. Waldeck, PhD | Current generations sprintronics based memory devices use ferromagnetic materials and this limits the device size reduction because of size limitations of ferromagnetic particles, which become superparamagnetic (coercivity is zero) below 10 nm to 50 nm. We show that the absorption of chiral molecules on one side of 12 nm superparamagnetic Iron Oxide nanoparticles (SPIONs) changes their magnetic properties from paramagnetic to ferromagnetic. This effect is called magnetism induced by proximity of adsorbed chiral molecules (MIPAC), which arises due to chiral induced spin selectivity effect (CISS effect). In our case the chiral molecules break the symmetry in superparamagnetic particle and imprint a magnetisation on the SPIONs. We also show that the preferred magnetization direction can be realized by changing the chirality of the SAM. Further studies show that when chiral molecules attach from all side of the SPIONs, a random magnetization occur due to frustrated magnetic dipoles. Another important application of chiral molecule coated metal oxide is that they act as an efficient water splitting catalyst and we are exploring the use of chiral SPION as electrocatalysts for the oxygen evaluation reaction. |

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| 69 | Amanda Dumi | Physical Science and Engineering | Development of an Automatic Fragmentation Approach to Effectively Describe Molecular Interactions | Amanda E. Dumi; Daniel S. Lambrecht, PhD | Many large molecular systems, such as polymers and biological macromolecules, are computationally intractable with common quantum mechanical methods. This limitation can be addressed through fragmentation approaches. These partition the molecule into fragments, which can be tackled more readily with existing quantum approaches. Subsequently these results are combined to make predictions for the entire molecule. Besides enabling expedited predictions, fragmentation approaches can help develop an understanding of the 'inner workings' of a molecule by revealing important interactions between the fragments. The choice of fragments is often based on functional groups established in chemistry, or by manual inspection, which may fail to capture important properties of the molecules and can be very time consuming for the user. This work presents our automated approaches for fragment selection based on clustering techniques, such as hierarchal or k-means clustering. This automated selection significantly reduces the time burden placed on the user and provides a more reproducible selection process based on quantitative criteria. We present our progress on developing this automatic fragmentation approach and investigate the benefits for various molecular properties as well as their dependence on molecular representation. |
| 70 | Emily Eikey | Physical Science and Engineering | Controlling Plasmonics Through Structure: AG Incorporation in Plasmonically Active CU2-XSE Nanoparticles | Emily A. Eikey; Xing Yee Gan; Derrick C. Kaseman, PhD; Corban G. E. Murphey; Jill E. Millstone, PhD | Copper selenide nanoparticles (Cu2-xSe NPs) can be used in a variety of applications ranging from catalysis to cancer therapies. To manipulate and fully control Cu2-xSe NP properties for technological use, chemists must exercise control over atom location. However, before atomic precision can be realized, pathways to access various composition architectures must be developed. Traditional techniques such as hot injection and cation exchange have been well-studied, yet controlling atom position is still nascent. Using aqueous-based techniques, the composition and composition architecture of Cu2-xSe NPs is explored through the incorporation of Ag using a one-pot synthesis and cation exchange. We find that both methods cause domain formation at the single-NP level. Over 40% Ag, there is no optically discernible plasmon for the as-synthesized NPs, yet through nuclear magnetic resonance techniques, charge carriers are still present. These results suggest that carriers may be residing in the Cu2-xSe domains, while the presence of other domains prevents their collective oscillation. By comparing these methods and final NP structures, we can gain key insight into how the synthetic routes of incorporation impact composition and atom arrangement. These findings could give synthetic chemists leverage in developing techniques to eventually exert precise control of atom positions within NPs. |
| 71 | XuHai Huang | Physical Science and Engineering | Gate Tunable Silicon Germanium Heterostructure Junction | XuHai Huang; Florian Vigneau, PhD; Silvano De Franceschi, PhD; Sergey Frolov, PhD; François Lefloch, PhD; | Utilizing the "Proximity Effect" we can induce superconductivity into a semiconductor to make a Josephson Field-effect transistor (JoFET). Studying and characterizing SiGe JoFETs helps in the development of superconducting electronics and superconducting qubits. The uniqueness of the material also contributes to the investigation of topological superconductivity and Majorana Fermions. |
| 72 | Sarah Motz | Physical Science and Engineering | Induced Superconductivity in Al-Ge Hybrid Junctions | Sarah Motz; Florian Vigneau, PhD; Francois Lefloch, PhD | Superconductors have the ability to induce superconductivity in neighboring normal metal via the proximity effect. Superconducting-semiconducting hybrid junctions with quality interfaces play a key role in the operation of Superconducting Quantum Interference Devices (SQUIDs) and Josephson Field Effect Transistors (JoFET). However, unexpected effects of nonideal junctions are still being discovered and the fabrication process of idea junctions is yet to be perfected. This project explores the promise of induced superconductivity in Germanium. |
| 73 | Arailym Kairalapova | Physical Science and Engineering | Theoretical Studies of Non-Valence Correlation-Bound Anion States of C6F6 Dimers | Arailym Kairalapova; Kenneth D. Jordan | When molecules bind excess electrons via short-range interactions they form valence anions. There also exist anions that are bound by non-valence interactions such as electrostatics, correlation, or their combination. In our group we study non-valence correlation-bound (NVCB) anions. NVCB anions are not bound by the Hartree-Fock (HF) method because it does not account for electron correlation. As a result, commonly used methods that rely on the HF as an initial guess also fail to bind such anions. We study various methods that can bind NVCB anions, for example, equation-of-motion coupled cluster theory. It has been shown previously in our lab that C6F¬¬6 molecule possesses a non-valence correlation-bound anion state, which transitions into a valence anion. In the present work we study C6F6 dimers to observe the same transitioning of a non-valence anion to a valence anion when one of the monomers serves as the electron donor. We use common Pi stacking conformations to determine the optimal geometry of the neutral dimer. We then replace one of the monomers with the anion and monitor changes in energy to determine the most plausible anion dimer structure. |
| 74 | Paul Justice | Physical Science and Engineering | Development of a Clicker Question Sequence on the Addition of Angular Momentum In QM | Paul Justice; Emily Marshman, PhD; Chandralekha Singh, PhD | Engaging students with well-designed clicker questions is one of the commonly used research-based instructional strategy in physics courses partly because it has a relatively low barrier to implementation [1]. Moreover, validated robust sequences of clicker questions are likely to provide better scaffolding support and guidance to help students build a good knowledge structure of physics than an individual clicker question on a particular topic. Here we discuss the development, validation and in-class implementation of a clicker question sequence (CQS) for helping advanced undergraduate students learn about addition of angular momentum, which takes advantage of the learning goals and inquiry-based guided learning sequences in a previously validated Quantum Interactive Learning Tutorial (QuILT). The in-class evaluation of the CQS using peer instruction is discussed by comparing upper-level undergraduate students' performance after engaging with the CQS with previous published data from the QuILT pertaining to these concepts. |

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| 75 | Philip Shenk | Physical Science and Engineering | Single-Electron Charging Effects in Sketched Quantum Dot Transistors | Phil Shenk; John Maier; Juliana Sebolt; Jung-Woo Lee, PhD; Hyungwoo Lee, PhD; Chang-Beom Eom, PhD; Patrick Irvin, PhD; Jeremy Levy, PhD | Devices at the smallest limit of electronics can behave in a fundamentally different way when the effects of charge quantization become prevalent. Single-electron transistors (SETs) have gained widespread use as charge sensors in various nanoscale systems, where they can provide insight into the nature of electron transport. One particular system of interest is the interface of the LaAlO3 / SrTiO3 heterostructure, where a 2-dimensional electron liquid (2DEL) with strong electron-electron interactions can be formed and manipulated. Here, we begin to observe the nature of single-electron transport through this 2DEL by creating nanoscale quantum dot devices. We use a reversible conductive atomic force microscope lithography technique to 'sketch' conductive wires and tunnel barriers within the 2DEL. These devices exhibit gate-tunable single-electron charging effects in the Coulomb blockade regime. In the future, we hope to exploit the sensitivity of such devices to shed light on the electron-electron interactions that have been observed in the LaAlO3 / SrTiO3 interface. More broadly, these devices may have applications in high-density memory, logic gates, and single-electron sources. |
| 76 | Gregory Houchins | Physical Science and Engineering | Mechanism of Electrochemical Production of Singlet Oxygen in Batteries | Gregory Houchins; Vikram Pande; Abhiskek Khetan, PhD; Venkat Viswanathan, PhD | At high voltages, Li-ion and Li-air batteries undergo unwanted electrochemical reactions that can permanently decrease the performance of the battery. Very recently, it was suggested that not only is Li2CO3 on NMC cathodes responsible for the majority of CO2 production but that singlet oxygen is produced when Li2CO3 is bias above 3.82 V. This and other studies suggest singlet oxygen production as a common degradation pathway in Li-ion, Li-air, and Na-air. With the use of first principles methods, we attempt to reconcile these experimental works and propose a universal mechanism of singlet oxygen production. We will also discuss a way to experimentally verify our mechanism by varying the electrolyte, which we claim will change the onset potential of singlet oxygen production in a predictable way. |
| 77 | Jierui Liang | Physical Science and Engineering | Bistability in Electric Double Layer-Gated WSE2 Field-Effect Transistors Using a Monolayer Electrolyte Capped with H-BN | Jierui Liang; Ke Xu, PhD; Susan Fullerton, PhD | Electric double layer (EDL) gating using polymer electrolytes or ionic liquids is a commonly used technique for two-dimensional (2D) crystal field-effect transistors (FETs) that can induce high gate capacitance corresponding to sheet carrier densities exceeding 1013 cm-2. Here, we demonstrate the EDL gating on WSe2 FETs using a monolayer electrolyte that is single molecule thick and consisting of cobalt crown ether phthalocyanine and lithium ions. Backgated WSe2 FETs were fabricated and the monolayer electrolyte was deposited by drop-casting and annealing. Transfer characteristics after programming show a bistability of monolayer electrolyte with the extent of doping depending on the magnitude and polarity of the applied bias. By capping with h-BN, the bistability is further improved with an increased threshold voltage shift between two states corresponding to a sheet carrier density change of ~ 6.5 × 1012 cm-2. The monolayer electrolyte after programming provides two states at the gate voltage of 0 V with an on/off ratio ~105 and a retention time exceeding 6 hrs. The on-off ratio remains > 102 with the programming time of 1 ms to switch two states, suggesting that monolayer electrolyte gated 2D FETs have potentials for memory applications. |
| 78 | Yasemin Basdogan | Physical Science and Engineering | Unravelling Hydrogenation Barriers for CO2 Reduction on Nitrogen Doped Zigzag Edges of Graphene | Yasemin Basdogan, PhD; John A Keith, PhD | We have used first principles quantum chemistry methods including cluster-continuum solvation modeling and the growing string method to study reaction pathways for CO2 reduction on cluster models for nitrogen doped zigzag edges of graphene. Our motivation was to better understand the viability of fundamental pathways classified as sequential proton and electron transfers, hydrogen atom transfers, and proton-coupled hydride transfers that would convert CO2 into CO, formate, and other more reduced products. We analyzed the degree that local solvation environments (i.e. explicit solvent molecules and the proximity of electrolyte ions) would impact the relative energetics of these pathways. This work provides an atomic scale elucidation of energetically viable hydrogenation pathways for the design of renewable energy catalysts. |
| 79 | Sai Bharadwaj Vishnubhotla | Physical Science and Engineering | Direct Determination of Contact Size for Platinum Nanocontact Using In Situ and In Silico Techniques | Sai Bharadwaj Vishnubhotla, Rimei Chen, Subarna R. Khanal, Ashlie Martini, Tevis D. B. Jacobs. | The mechanical and electrical properties of metallic contacts between nanoscale bodies are relevant in probe-based microscopy, probe-based lithography, and electromechanical switches. In all cases, the functional properties such as adhesion, friction, and electrical and thermal transport depend on the contact size. Contact mechanics models are commonly used in predicting contact area; however, there is a lot of conflicting evidence about their applicability at the nanoscale. The present investigation investigated the contact area for platinum nanocontacts at low applied loads using in situ transmission electron microscope, with real-time direct measurement of the contact size. In silico contact tests, with molecular dynamics simulations, were performed for contacts with precisely-matched conditions including: materials, crystal orientations, geometry, and loading. The combined experimental and simulation investigations yielded three important findings. First, the measured contact area deviated significantly from the standard predictions of contact mechanics. Second, the contact-area-vs-load curve could be accurately fit using a continuum model but only by using a modified value of modulus that was less than half the true value for platinum. Third, the physical mechanism that explains the deviations from elastic contact mechanics is the nucleation and propagation of near-surface dislocations; a process that was completely reversible upon unloading. |
| 80 | Xi Cao | Physical Science and Engineering | Two Mode Squeezed Qubit Readout and Remote Entanglement | X. Cao, MS; G. Liu, PhD; T-C. Chiao, MS and M. Hatridge, PhD | Implementing quantum information processing on a large scale with flawed components requires highly efficient, quantum non-demolition qubit readout. The ability to remotely entangle distant quantum systems is also very desirable. Currently, a typical dispersive superconducting qubit measurement [1] and remote entanglement are achieved using coherent light [2, 3] or Fock states [4]. Here, we demonstrate a dispersive qubit readout which exploits the two-mode squeezed light generated from a Josephson Parametric Converter (JPC) and processed by a second JPC to form an amplified interferometer [5] and compare its readout fidelity to coherent light. In future work, we also propose a remote entanglement protocol by adding a second qubit-cavity system to the other arm of the interferometer. This work is partially supported by Army research funding. |

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| 81 | Chao Zhou | Physical Science and Engineering | A FPGA Design for Fast Qubit Measurement and Real-Time Feedback | Chao Zhou; Pinlei Lu; Xi Cao; Tzu-Chiao Chien; Michael Hatridge | A field-programmable gate array (FPGA) is an integrated circuit which can be repeatedly reconfigured to achieve a desired information processing functionality. Compared with software data processing in PC, the data processing in FPGA is much faster and can give us precise waveform control at the nanosecond scale. I will show results using commercial waveform generation electronics with laboratory-built FPGA programming to implement quantum-limited readout of superconducting qubits with fast post-processing and qubit and measurement feedback. We have realized all qubit data processing with a delay of 22 clock cycles(220 ns) after receiving the last input, far faster than our coherence times of 10s of microseconds. We can currently use the feedback loop to efficiently prepare desired qubit states without waiting for the natural qubit relaxation process, as well as perform weak measurement protocols to study the measurement process. We are currently expanding the FPGA and control software to enable multi-qubit control and readout for remote entanglement protocols, which are not possible with our current generation of non-FPGA based readout and control electronics. |
| 82 | Cristine Oh | Translational Life Science | Effects of Sex and Childhood Trauma on Subjective and Objective Sleep Measures in Healthy Young Adults | Cristine Oh, BA; Anne Germain, PhD; Meredith L. Wallace, PhD | We examined whether sex moderates effects of childhood trauma on subjective sleep in a large sample of young adults and on objective sleep measures in an extremely healthy sub-sample. 213 men and 278 women aged 18-30 completed the Childhood Trauma Questionnaire (CTQ) and self-report sleep measures: the Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), and Epworth Sleepiness Scale (ESS). Objective polysomnographic (PSG) measures were obtained in a subsample of 172 participants with no comorbid psychiatric, medical, or sleep disorders. Multiple regressions determined sex and childhood trauma interactions. If sex was not a moderator, we examined independent effects of sex and CTQ. Models were adjusted for race and age. Interactions were non-significant for both subjective and objective sleep. Men had lower subjective sleep quality. Greater CTQ was associated with increased sleepiness and insomnia severity. For objective sleep measures, women had significantly more delta sleep than men. Childhood trauma was significantly associated with lower REM Density. No Sex by Childhood trauma interactions were detected. Childhood trauma has specific effects—independent of sex—on objective and subjective sleep measures. Clear effects of childhood trauma was seen even in a selected sample of healthy sleepers. |
| 83 | Christy Taylor | Translational Life Science | Objectively Measured Snoring is Associated with Carotid Vascular Remodeling in Overweight and Obese Adults | Christy Taylor, Christopher Kline, Chunzhe Duan, Emma Barinas-Mitchell | Although the literature supports a link between snoring and CVD, it is unclear if this is independent of OSA. The objective of our study was to explore the association between snoring and subclinical CVD in adults with and without OSA. Methods: Cross-sectional analyses were conducted using 24-month follow up data from the SAVE study, an RCT evaluating the effects of weight loss, increased physical activity, and reduced dietary sodium intake on vascular health. Participants (n=122) with objective measures of sleep-disordered breathing from a home-based sleep assessment (ResMed ApneaLink) were grouped into three snoring categories. Vascular measures were compared across snoring groups using multiple linear regression. Results: Across snoring severity categories, most CVD risk factors worsened including age, blood pressure, BMI, lipids, and fasting glucose (ANOVA; all $p < .05$). Similarly, vascular measures including faPWV, baPWV, CIMT, inter-adventitial diameter and bulb IMT differed mainly between the normal snoring and OSA groups. Differences in carotid inter-adventitial diameter and CIMT were noted between normal and heavy snoring groups, which persisted following covariate adjustment ($p < .05$). Conclusion: Our findings suggest that, in overweight and obese adults, objectively measured snoring is related to indices of local vascular remodeling and aging, even in those without OSA. |
| 84 | Diana Delgadillo | Translational Life Science | Feline Infectious Keratitis Leading to Eye Rupture – Molecular Determination of Possible Pathogens | Delgadillo, Diana; Morrow, Becky | Upper respiratory infections (URIs) are common in felines. Typical signs of URI include sneezing, nasal discharge, ocular discharge, and conjunctivitis, inflammation of the sclera and lining of the eyelids. Keratitis, inflammation of cornea, is a less common sign of URI, and can cause scarring and rupture of the eye. Feline herpesvirus 1 (FHV-1) is currently considered to be the most common primary pathogen associated with the ocular manifestations of URI, however, Clamydolphia felis (C. felis) and Mycoplasma felis (M. felis) are also prevalent in cats with conjunctivitis. Feline calicivirus (FCV) and other opportunistic bacteria may also be present. Twenty ruptured, enucleated eyes were evaluated for the presence of bacteria, FHV-1, and FCV using PCR with universal bacterial primers and FHV-1 primers, qPCR with FCV primers, and Next-generation sequencing (using universal bacterial primers). These techniques allow detection of typically culture-resistant bacteria and insight into co-infections associated with severe ocular disease. |
| 85 | Kristen Breslin | Translational Life Science | Development of an Individualized Risk Assessment for Post-Traumatic Seizure: Applications of LASSO Regression | Kristen Breslin, BS; Seo Young Park, PhD; Raj Kumar, MPH; Amy Wager, MD | Individuals suffering from posttraumatic epilepsy (PTE) following severe traumatic brain injury (sTBI) have increased risk of physical and cognitive impairment and mortality. We aim to validate our original PTE predictive model using the TBI-Model Systems National Database, and produce a simplified predictive model using the "lasso" statistical method that will provide individual risk assessment for developing PTE over the first two years of follow-up. Our predictors include the demographic and clinical characteristics that were included in our original published models. We used the grouped lasso logistic regression to build a predictive risk model that avoids the problem of "overfitting" and increases external generalizability by shrinking the beta coefficients. The tuning parameter that determines the tradeoff between the goodness of fit and generalizability was selected using 10-fold cross-validation. This model achieved AUC=0.762. By selecting the risk cutoff of 0.548, one fourth of patients were classified as high PTE risk. Sensitivity and specificity were 0.580 and 0.803, respectively. Our goal was to identify a simplified PTE risk model that maximizes AUC and can be used to estimate individual patient risk for PTE at year 2. Improving PTE risk assessment could have broad clinical implications to better treat TBI patients and improve recovery. |

| Poster # | Presenter | Topic | Title | Author(s) | Abstract |
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| 86 | Thomas Hagerman | Translational Life Science | Characterization of the Emotional and Physical Health of Mothers of Children with Special Health Care Needs in the United States | Thomas K Hagerman; Amy J Houtrow, MD MPH PhD | Almost 1 in 5 children in the United States has a special health care need. These children and their families face significant challenges in many aspects of their lives, such as increased work loss and difficulty accessing nonmedical services. Methods: We conducted a secondary data analysis of the 2016 National Survey of Children's Health of a total sample of 50,212 children ages 0-17 representing 73.35 million children nationally. Primary outcomes included respondent reported emotional and physical health of mothers of children with special health care needs (CSHCN). Findings: Over twice as many mothers of CSHCN had fair/poor emotional (10.3%) and physical (12.9%) health than mothers of non-CSHCN (4.1% and 5.5%, respectively). After adjustment for sociodemographic factors in multivariable models, mothers of CSHCN meeting 4 or 5 special health care needs criteria were 3.28(95% CI 2.22-4.83) times more likely to have poor emotional health and 2.32(95% CI 1.56-3.45) times more likely to have poor physical health compared to mothers of non-CSHCN. Conclusions: Suboptimal emotional and physical health is common among mothers of CSHCN, especially those who experience social disadvantage, and appears to be associated with the degree of the child's care needs. |
| 87 | Daniel Evans | Translational Life Science | Back to the Future: Screening Hospital Wastewater for Phages that Target Multidrug-Resistant Bacteria | Daniel Evans, Roberta Mettus, Sarah Bowler, Alina Iovleva, Erin Fowler, Christi McElheny, Yohei Doi, and Daria Van Tyne | Multidrug-resistant (MDR) bacterial infections impose a substantial burden on healthcare infrastructure in the United States and worldwide. As modern medicine approaches a post-antibiotic era, it is time to explore alternative therapies. Bacteriophages were historically used to treat bacterial infections—and were successful at doing so—until antibiotics largely replaced them in the 1940s. The aim of our study was to identify and isolate bacteriophages from hospital wastewater that could infect MDR bacteria. Wastewater effluent was collected from a Pittsburgh area hospital, cultured for the presence of drug-resistant bacteria, filter-sterilized, and screened for lytic activity against clinical isolates of 17 different bacterial species. Culturing of the wastewater confirmed the presence of enteric bacteria resistant to meropenem (>16 µg/mL). Screening of filtered wastewater has so far identified 20 phages with lytic activity against multiple pathogenic, MDR bacterial species. The preparation of high-titer stocks of these phages is ongoing, as is expanded screening against additional bacterial isolates. Future work will include sequencing and characterizing the genomes of the phages identified, and arraying them into libraries for additional screening. Overall, this study is accelerating progress toward the development of novel therapeutics to treat MDR bacterial infections, which are a pressing public health concern. |
| 88 | Areej Ali | Translational Life Science | Investigating Social and Psychological Predictors of Outcomes Following Pancreas Surgery | Areej Ali, BS; Vernissia Tam, MD; Herbert J. Zeh, III, MD; Mazen Zenati, MD, PhD | Pancreatic cancer is a morbid disease that can be treated with surgery, but the median survival following resection of locally advanced pancreatic cancer is 26 months, with only 25% surviving 5 years. This study aims to ameliorate the paucity of data when it comes to examining factors that affect functional recovery after pancreas surgery. This study aims to determine if marital status, socioeconomic status, and psychosocial wellbeing can predict the functional status of patients undergoing pancreas surgery, as measured by wearable activity trackers, wellness and demographic surveys.This is part of a larger pragmatic, non-blinded, non-randomized, observational trial. Patients (age >18 years) being evaluated for surgery for both benign and malignant conditions are recruited into the study. Eligible subjects are equipped with a Fitbit pre-operatively and followed post-operatively for 3 months. Endpoints are measures of activity, including total daily steps taken, 90-day complication rates and 90-day survival rates. Secondary endpoints are quality of life and satisfaction as measured by The Functional Assessment of Cancer Therapy for Hepatobiliary Cancer, Center for Epidemiologic Studies Depression Scale, and Patient Satisfaction Questionnaire (PSQ-18). Each patient serves as their own control by comparing post-operative values to their pre-operative value, expressed as a percent baseline. |