SUMMER UNDERGRADUATE RESEARCH POSTER SESSION

ABSTRACT BOOK

Wednesday, August 3, 2022

Interdisciplinary Life Sciences Building Lobby

Morning Session

10:00 AM – 12:00 PM

Afternoon Session

2:00 PM – 4:00 PM

LAUNCH
UNDERGRADUATE RESEARCH

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MORNING SESSION

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1. Level Set Modeling of the Double Diamond and Double Gyroid Phases of Block Copolymers

Quentin Franklin (Texas A&M University)
Undergraduate Summer Research Grant (USRG) - MSEN
Research Advisor: Edwin Thomas

Block copolymers are comprised of two or more different chemical species that phase separate into nanoscale self-assembled microdomain structures defined by the Intermaterial Dividing Surface (IMDS). Two of these structures, double diamond (DD) and double gyroid (DG), form tubular networks of the minority component block. These cubic, 3D bicontinuous structures exhibit superior charge/mass transport, outstanding mechanical properties, and interesting photonic properties. Understanding the nature of defects in these network phases is critical to taking advantage of and improving their properties. Level set models of DD and DG networks can be used to create perfectly periodic, defect free, simulations for comparison to experimental structures. Level sets are differentiable, real-valued functions that correspond to a constant value c. A level set generates simulated 2D “slices” of the IMDS which are used to interpret and compare to experimental slice and view scanning electron microscopy (SVSEM) images. In SVSEM, a low keV electron image is taken of the exposed surface allowing for an almost 2D viewing much like a level set slice. After the image is taken, an ion milling beam positioned normal to the viewing angle mills away a few nanometers of material. The process then repeats, and another image is taken nanometers deeper into the material without changing the viewing direction. Layering and averaging the intensity of sets of adjacent “slices” allows for creation of simulated SVSEM slices as well as simulated transmission electron microscopy (TEM) projections for comparison to actual SVSEM and TEM data.

2. Characterization of Phase Change Material Composites

Veronica Gonzalez Fernandez (Texas A&M University)
MSEN Multifunctional Materials REU
Research Advisor: Patrick Shamberger

A growing demand for higher-powered electronics has resulted in greater heat production by such devices, which can negatively affect their reliability and lifetime. Phase change materials (PCMs) are ideal candidates for managing thermal loads because they quasi-isothermally absorb and release thermal energy when melting and solidifying. The main goal of this research project is to use experimental data to identify the PCM composite’s key operational zone, identified as the antiresonance regime. This is where PCMs can meaningfully dampen temperature rises by heat absorption related to latent heating. An experimental setup that collects temperature data is used to characterize PCM composites’ thermal response to non-steady boundary conditions, such as pulse trains. This setup simulates an electronics package that cools as the PCM absorbs heat and as an external cooling fluid gains convective heat from the system. This study seeks to identify and predict the temperature-damping, localized regime for using PCMs as thermal management solutions for non-steady heat sources, such as electronic components. Another main objective is to measure the transient, or time-dependent, response of the PCM when heated because it corresponds to the material’s responsiveness. Understanding the dynamics of PCM’s thermal behavior and its various dependencies on geometry, material properties, and boundary conditions will help clarify PCM’s practical use.

3. Data Enabled Design of Plastic Crystals for Use in Tunable Thermal Energy Storage

Alexander Foncerrada (Texas A&M University)
MSEN Multifunctional Materials REU
Research Advisor: Patrick Shamberger

Energy use for cooling applications, including air conditioning and refrigeration, accounts for 25-30 percent of worldwide energy consumption. A solution to this is tunable thermal energy storage, which is able to store heating or cooling energy on demand over a range of temperatures, this application will lower energy consumption for cooling applications overall. Efficient tunable thermal energy storage has been demonstrated with a class of compounds known as plastic crystals by exploiting their solid-solid transition and the thermal response when applying pressure. We aim to further the understanding of the relationship between chemical structure and the resulting thermodynamics of the plastic crystal transition. We will utilize two techniques to achieve this goal. First, we use the group contribution method to correlate the presence of specific functional groups to the thermodynamic properties of the phase transition. Second, we will use a machine learning model to identify the effects of molecular geometry, inter-chemical interactions, crystal structure and molecule size on thermodynamic properties of the phase transition. Our study will identify and quantify the chemical degrees of control in plastic crystals specifically looking at entropy and enthalpy change of the plastic crystalline phase transformation. Once we know the chemical degrees of control, we can improve cooling and heating efficiency.

4. Multi-Scale Modeling, Optimized Design, and Characterization of Multi-Functional SMA-Based System

Hector Luna (The University of Texas Rio Grande Valley)
MSEN Multifunctional Materials REU
Research Advisors: Dimitri Lagoudas, Jobin Joy, Jim Mabe

Smart materials are materials that change their shape, color, or size in response to an externally applied stimulus. One of these, particular to our interest, is shape memory alloys or SMAs for short. They are metal alloys that exhibit shape memory properties where it is possible to have a transformation temperature below ambient temperature in which case the alloy will behave in that it can contract, expand, or rotate for our situation when trained properly and thermally stimulated. Over a range of temperatures, starting at the transformation temperature, the alloy undergoes a reversible diffusion-less solid-state transformation between its respective martensite and austenite phase. The transformation temperature is wholly influenced by composition and other factors. Hence, the objectives of this work are to optimize the design of a functioning finite element SMA-based model that incorporates super elastic materials as flexures that permit the deformations involved in the configuration change.

5. Fuel-Driven Polypyrrole Actuators

Roshdi Rashed (University of Houston)
MSEN Multifunctional Materials REU
Research Advisors: Mohammed Naraghi, Frank Gardea

Artificial muscle refers to a class of materials and devices that may contract, expand, or rotate reversibly within a single component in response to an external stimulus such as voltage, current, pressure, temperature, etc. However, these stimuli offer limited applicability for the use of soft actuators. Thermal actuators are impractical due to their high-temperature requirements and low heating and cooling rates. On the other hand, voltage-driven polymers are notorious for requiring high voltages and large power systems. The increasing interest in fabricating real muscles has led to the development of a soft actuator driven only by a redox reaction. Despite the advantages of current redox actuators, their actuation methods need liquid electrolytes, and external driving voltages, which are unsuitable for many applications. Soft redox actuators and stimuli-responsive materials are flourishing. These materials might change healthcare, wearable technology, manufacturing, and robotics. In contrast to their rigid counterparts, soft actuators may bend readily, adapt to changing surroundings and dynamic work settings, resist large loads, and are safe around humans. The goal of this research is to investigate the potential of an ionic polymer, polypyrrole (PPy), as a soft actuator driven solely by a redox reaction in a solid environment. PPy fibers are actuated by the supply of chemical gases, including oxygen and hydrogen. The objectives are to fabricate PPy fibers using a wet-spinning technique, characterize the actuation performance as a function of applied stress, and determine the influence of architecture (aligned vs. coiled fiber) on actuation performance.

6. An Investigation of the Anisotropic Deformation Response in HCP Metal through Nanoindentation of Single Crystal Magnesium

Joseph Leal (Texas A&M University)
Undergraduate Summer Research Grant (USRG) - MSEN
Research Advisors: George Pharr, Christopher Walker

The anisotropic deformation response of single crystal magnesium has been examined using diamond berkovich nanoindentation. EBSD was used to confirm the orientation of the crystal, and indentation was done on the (0001) basal plane. Using a rotary stage, a 5 degree rotation between sets of indents is present in order to observe changes in indentation deformation response due to load orientation. The indent alignment was varied by 30 degrees total, beginning with each edge loading along the [1120] basal slip direction, perpendicular to the c-axis of the crystal. Laser microscopic imaging of the indents is presented which shows any variation in material pile up present around each indent. While some variation is present, careful analysis of the imaging and nanoindentation results show that the loading direction within the basal plane has little meaningful effect on either the modulus and hardness, or deformation of the material.

7. Simulating the Reduction of Transient Thermal Load In Electronics with PCMs

Colton Brietzke (Texas A&M University)
Undergraduate Summer Research Grant (USRG) - MSEN
Research Advisor: Patrick Shamberger

As the electronic industry continues to take steps forward, the power density of these transistors and other components continues to increase. This creates a need for more effective thermal management methods within all electrical systems. However, active cooling is not feasible for all systems, nor very practical. One solution is Phase Change Materials (PCMs). Testing these PCMs in different positions within the electronic have shown to reduce the thermal load by isothermally going through a phase change at a critical temperature. This keeps the surrounding components at a constant temperature while heat is still being put into the system. During transient thermal load, this PCM will be able to reset and continually undergo this phase change, flattening out large temperature spikes in the system. Using a finite difference model, thermal transfer is modeled using a MOSFET as a guideline. The PCM is then added into the 1D stack model, and then simulations are done with the PCM in different locations in order to find an optimal thermal dampening.

8. Effect of Composition and Microstructure on Fatigue Crack Growth in High Temperature Shape Memory Alloys NiTiHf under Several Thermomechanical Paths

Alfonso Gonzalez (St. Mary's University)
MSEN Multifunctional Materials REU
Research Advisor: Ibrahim Karaman

The motivation of the research is to reduce the over conservative safety parameters set by fracture mechanics due to the lack of understanding of the effect of cyclic phase transformation on crack growth. The scope of this project has been altered to achieve two rudimentary stages of this research. The first stage of this project encompasses the characterization of the thermomechanical response of three different materials with Nominal composition $Ni_{50.3}Ti_{29.7}Hf_{20}$ (at%) with homogeneous and nano-precipitated microstructures. The second stage of the project involves the characterization of fracture toughness and fatigue crack growth rates for these materials. However, due to the lengthy testing time required for fatigue crack growth experiments, only short exposure to these experiments and procedures is estimated.

9. Laser Direct Energy Deposition for Plasma Facing Components in Fusion Reactors

Adam Bebak (Texas A&M University)
Undergraduate Summer Research Grant (USRG) - MSEN
Research Advisor: Ibrahim Karaman

Due to the hostile internal environment, a suitable plasma facing component (PFC) in fusion reactors is needed. Tungsten has been identified as a candidate for a PFC, however, cost, weight and other factors limit the use of complete tungsten parts. Due to differences in thermal expansion coefficients, steel cannot be directly joined with tungsten. To remedy this, a pathway gradient has been found from tungsten to GR91, a reduced-activation ferritic-martensitic steel, through vanadium and other alloys. However, due to tungsten's resistance to machining through its brittleness, an alternative manufacturing technique is required. In this study, laser directed energy deposition (L-DED), an additive manufacturing technique, is used to create porosity and crack-free multi-layer compositionally graded samples.

10. Characterization and Selection of Refractory Multi-Principle Element Alloys Using High-throughput Synthesis

Vladimir Coon (Texas A&M University)
MSEN Multifunctional Materials REU
Research Advisor: Ibrahim Karaman

Refractory alloys are known for their considerable strength at high temperature; this, along with their low thermal expansion coefficient and high thermal conductivity, makes them ideal for high-temperature applications. To find suitable refractory alloys for these applications, 88 alloys were created via vacuum arc melting (VAM) and then heat treated at high temperatures (1800°C and 1925°C) determined by the compositional difference between the dendritic and inter-dendritic regions and dendritic arm spacing to homogenize the microstructure. The samples were then characterized with electron microscopy (SEM/EDX) and down-selected using Vickers hardness. The selected alloys were, or will be, put through a battery of tests to determine their suitability including: nano-indentation, linear thermal expansion, thermal conductivity, and compression and tension at both room temperature and 1300°C. The results from these tests will be entered into a database to refine our computational team's predictions.

11. The Fabrication and Processing for Testing of Refractory High Entropy Alloys

Preston Hackney (Texas A&M University)
Undergraduate Summer Research Grant (USRG) - MSEN
Research Advisors: Ibrahim Karaman, Cafer Acemi

Refractory alloys are promising for high-temperature applications because of their high strength at elevated temperatures, high thermal conductivity, low thermal expansion coefficient, and operability under oxidizing conditions. Forty-five refractory multi-principal element alloys (MPEAs) have been designed to exhibit single BCC phase at elevated temperatures, target yield strength (>200 MPa) at 1300°C, and narrow solidification range for additive manufacturability. The designed compositions are synthesized with high-throughput vacuum arc melting and characterized with electron microscopy (SEM/EDX), XRD, Vickers microhardness, and nanoindentation experiments. These alloys will be subjected to different processing and synthesis techniques to eliminate porosity and reduce the oxygen content. These techniques include HIPing, outgas capture in the melting phase, hydrogen-argon mixture in heat treatments, and roll forming. This paper will address the advantages and disadvantages for using each individual technique and explore combinations of these methods in order to enhance the fabrication and processing of refractory high entropy alloys.

12. DFT Study for NiCuTi and NiTiHf Shape Memory Alloy

Carlos Cantu (Edinburg)
MSEN Multifunctional Materials REU
Research Advisor: Raymundo Arroyave

Shape Memory Alloys (SMA) have gained popularity for their unique properties like phase transformation. There are different transformation routes for the transformation between martensite and austenite that are mainly based on thermal treatment and composition, this research will base the transformation from B2 to B19 as a transition phase to end in B19’ where after cooling will go back to the original B2. This occurs because the stress that occurred during B2 to B19’ lattice transformation is released by the twinning of the developed martensite. This phase transformation creates a “memory” effect by making the alloy to recall its original structure after deformation, this change occurs when exposed to a change in temperature. This study will focus on the energy in between the B2, B19, and B19’ phases of the NiCuTiHf (exactly the alloys: $Ni_{40}Cu_{10}Ti_{50}$ and $Ni_{50}Ti_{40}Hf_{10}$) SMA. Density Functional Theory calculations (DFT) are used to study these phases.

13. Study of the effect of L-PBF Model Variables on Melt Pool Formation using Numerical Modeling

Michael DeLouker (Siena College)
MSEN Multifunctional Materials REU
Research Advisor: Raymundo Arroyave

Laser-Powder Bed Fusion (L-PBF) is an additive manufacturing technique typically used for efficient manufacturing of flexible parts. There are many publications describing the effect of process parameters on track formation, however, there is no study discussing how changing the material properties will affect the given printability region. Incorporating computational fluid dynamics through numerical modeling for single tracks using Flow-3D software, we will report the effect of varying the parameters and material properties on the melt pool dimensions.

14. Deformation behavior of Copper-Tantalum Composites

Kyle Johnson (Texas A&M University)
Undergraduate Summer Research Grant (USRG) - MSEN
Research Advisors: Brady Butler, James Paramore

Co-deformation plays a role in the deformation behavior of every multiphase material. These properties come from individual characteristics of the different phases and how they interact with one another. A better understanding of how multi-phase materials co-deform is important in creating stronger, more ductile and resistant materials. This study focuses on an FCC-BCC system, copper tantalum, and uses miniature tension tests and in-situ imaging to observe the behavior of deformation in this composite. With a goal of assessing the effects of interfacial bonding, the composites chosen for this experiment consist of both 75% copper and 25% tantalum by volume sample and a modified sample where a small amount of titanium (less than 1% by volume) is added. Pure copper and tantalum already exhibit excellent ductility, and larger tension tests have been performed providing evidence this addition increases ductility, strength and interfacial bonding of the immiscible FCC-BCC material. Using in-situ imaging on miniaturized tension tests, we observed ductility of individual phases, and we found that fracture was initiated at interphase boundaries.

15. Effects of Irradiation on Water Ice

Wendy Storms (Texas A&M University)
Undergraduate Summer Research Grant (USRG) - MSEN
Research Advisor: Michael Demkowicz

Europa is one of Jupiter's moons, and it is believed to have a liquid ocean beneath its icy crust. This icy surface is subject to high amounts of radiation. Currently there is little data, if any, that explores how exposure to high amounts of radiation changes the properties of water ice. Knowing how radiation affects ice will be important to future space exploration missions, such as sending a probe to Europa to collect data from the ice crust. The purpose of this research is to collect data about how water ice responds to high levels of radiation. Specifically, the research done this summer focuses on how to image water ice using polarized light microscopy to see grain boundaries, and how to transport that ice without significantly altering the structure of the ice. This process for transferring ice will be used in the future to take micrographs of ice, transport the ice to an ion beam chamber where the ice will be irradiated and characterized with ion beam analysis, then take the ice back to the microscope to be imaged again.

16. Effects of Calcination Temperature of Metakaolin on Geopolymer Properties

Lara Rios (New Jersey Institute of Technology)
MSEN Multifunctional Materials REU
Research Advisor: Miladin Radovic

Geopolymers (GPs) can serve as an eco-friendly alternative to Ordinary Portland Cement (OPC), which is a significant contributor to global CO_2 emissions. The potential for GPs to replace cement has motivated much of the research to be application-based, focused on their benefit to the cement industry rather than how geopolymers work. Currently, GPs under investigation or in use are mostly processed using waste materials such as fly ash, or metakaolin. This study focuses on GPs processed from local calcined clays, and evaluates the effect of calcination temperature of natural kaolinite clay on geopolymer strength and microstructure. Four types of kaolinite clay were calcined at 700, 800, and 900^o C, producing metakaolin-based precursors for GP synthesis. Samples were cured under ambient temperature for 28 days and then tested for compressive strength. Additional characterization tests such as X-ray Diffraction Analysis, Scanning Electron Microscopy, and Nuclear Magnetic Resonance were conducted to further understand the structures of produced GPs and their effect on the measured strength. This presentation will discuss the processing-structure-properties relationship of geopolymers produced from calcined kaolinite clay.

17. Photoluminescence Quantum Yield Optimization of Cesium Lead Tribromide Nanocrystals via Post-Synthetic Excess Ligand Addition

Joshua John (Texas A&M University)
Undergraduate Summer Research Grant (USRG) - MSEN
Research Advisor: Matthew Sheldon

Nano-scale semiconductors offer a promising platform for future optoelectronic devices thanks to unique light-matter interactions that result from quantum confinement effects that occur at small sizes. Perovskite CsPbBr3 nanocrystals (NCs) have recently drawn attention due to their high photoluminescence quantum yields (PLQYs) and defect tolerance. We seek to optimize PLQYs by regulating the purity of the surface stoichiometry through post-synthetic NC concentration manipulation and ligand addition. The effect of NC concentration on PLQY informs the addition of excess ligands to facilitate the passivation of surface traps. The results reported herein offer insight into post-synthetic methods of surface control for PLQY optimization.

18. Density Functional Theory Studies of Group 3 Elements in Compression

Trinity Wagner (Trinity University)
MSEN OREU
Research Advisor: Xiaofeng Qian

This project is sponsored by the Texas A&M REU Program and the Computational Physics Division at Los Alamos National Laboratory. The group 3 elements of the periodic table (scandium, yttrium, and lutetium) all exist under ambient conditions in the hexagonal close packed (hcp) crystal structure. When these structures are compressed (for example in diamond anvil cell experiments) at low temperatures (< 3 K), they become superconducting. The objectives of this research are to understand changes that occur in the crystal and/or electronic structure of these 3 elements near their transition to superconductivity. By conducting and analyzing density functional theory (DFT) calculations as well as energy versus volume curves (cold curves), similarities in these group 3 elements will be observed and interpreted. From these curves it will be possible to compare the ratio of the c to a lattice constants (c/a) to the ideal ratio, or more specifically compare the relaxed c/a ratio to the fixed c/a ratio of each element. There are also a variety of equations of state models, which will be plotted for each element and analyzed against the cold curves to find any interesting features. The majority of these calculations and plots will be completed using the VASP software, a program used to create DFT simulations and allow for research such as this.

19. FFT based Micromechanical Homogenization of IN718 Manufactured by Selective Laser Melting

Nathan LaVoie (Univerity of Idaho)
O-REU
Research Advisor: Aitor Cruzado

The mechanical properties of superalloys can vary greatly depending on their microstructure. While research has been conducted testing the effects of temperature, grain size, manufacturing technique, and strengthening precipitates on Inconel 718 manufactured by selective laser melting, still there is a lack of understanding of how secondary particles affect the mechanical behavior. Here we aim to use a microstructural-based modeling framework to predict the mechanical behavior of this material. To this end, synthetic microstructures of IN718 will be generated for different mean grain sizes, and random orientations. Through inverse optimization algorithms, the physical properties of grains will be obtained by means of crystal plasticity FFT-based homogenization framework, using known experimental data. Finally, a set of random microstructures will be generated and introduced secondary particles in different locations to predict their influence on the overall behavior. This will allow optimizing the material for the desired behavior. Once optimized, the model will show how secondary particles impact the mechanical properties of IN718 manufactured by selective laser melting. Researchers and engineers will be able to predict the characteristics of theoretical microstructures. This would allow to reduce considerably the time used in testing and to obtain a better understanding of the microstructure needed prior to its creation.

20. Temperature Dependence of the Recombination of Vacancies and Interstitials

John Mwungeli (Texas A&M University)
O-REU
Research Advisor: Michael Demkowicz

Radiation resistant materials are important for harnessing energy produced from nuclear fission and fusion reactors operating at extreme temperatures. This project examines the behavior of two key types of defects created by radiation in crystalline materials, namely vacancies and self-interstitials, and their recombination, or mutual annihilation, as a function of temperature. To this end, we perform molecular dynamics simulations of the defects in copper using the high-performance research computing (HPRC) center at Texas A&M University using the LAMMPS software package (Plimpton 1995). Modeled copper structures are created using MATLAB scripts and visualized with atomistic viewers AtomEye (Li 2003) and Ovito (Stukowski 2010). An embedded atom method (EAM) potential is used to model interatomic interactions (Mishin et al., 2001). We were able to observe vacancies and self-interstitials recombine within 3.3 picoseconds at a temperature of 300 K by computing the number of atoms with a coordination number of twelve.

21. Nuclear Forensics and Material Morphology

Kathleen Matthies (Alfred University)
O-REU
Research Advisors: Ian Schwerdt, Alexa Hanson

Illicitly diverted nuclear material poses a great threat to national security. Certain material forms, like UO2 and UF4, are common in the nuclear fuel cycle and can be difficult to ascribe to a specific production source. However, by quantitatively analyzing the physical morphology of UF4 - captured in microscopy images, the current forensic analysis toolkit can expand and assist authorities to conduct investigations quickly and obtain answers in order to prevent further material diversions. This project looks to study the characteristics and morphology (e.g. particle size, shape, and texture) of various uranium compounds with diverse synthetic pathways to better understand the ability of morphology to differentiate between similar material forms with distinctly different origins. The characterization and morphology of each stage were conducted using a variety of analytical techniques, beginning with the initial UO2 through the intermediate solid, ((NH4)4UF8), to the final product, UF4. Using the Morphological Analysis of Materials (MAMA) software, the particulate present in scanning electron microscope images of the starting, intermediate, and final materials were quantified in order to obtain data like the ellipse aspect ratio, circularity, and size (pixel area). Once quantified, these attributes are used to conduct statistical analyses to determine which attributes can be used to quantitatively distinguish between the synthetic material pathways and potentially the originating facility.

22. Analyzing Meta Structured Shape Memory Alloys

Nathaniel Youmans (Oral Roberts University)
O-REU
Research Advisors: Dimitris Lagoudas, Jobin Joy, Manish Vasoya

The objective of this project is on the analysis of various SMA (Shape Memory Alloys) - based meta structures. Elastic materials have been shown to exhibit unique behaviours when they are manufactured with certain meta structures and patterns in them. The specific aim of this project is to study how the constitutive behaviour of SMAs affect the behaviour of the meta structures. While SMAs already have unique properties when heated or stressed, their properties may change when manufacturing according to a repeating meta structure. My execution plan is to (1), study previous literature and research on the topics of SMAs, meta structures, and mechanics of materials to gain a base of knowledge of the subject. (2), learn how to use ABAQUS and the High Performance Research Center. (3), try to find a specific meta structure that yields unique behaviour when simulated. Once something is found, explore manufacturing the meta structure to perform experiments to confirm what the simulations suggest.

23. No Pain, No Grain: Standardizing Grain Size Measurement in AM Metals

Morgan Nix (LeTourneau University)
O-REU
Research Advisors: Cheryl Hawk, Nick Gandara

The structure (e.x. grain size) of a component governs the properties and performance. The standard methodology to measure grain size (ASTM E112) used today is great for equiaxed grains, but the standard only accounts for a select grain morphology. Additive manufactured (AM) components typically contain columnar grains, which the standard method can not account for. This research study is aimed to understand what governs grain growth/size, learn about grain structures, and propose a method to measure AM grains in metals. It will not only cover the measurement of average grain size by comparison, but also the different methods and procedures used to determine the average grain size of columnar grain structures in AM components. This project will be split up into three phases. During phase 1, a literature review will be conducted. The purpose of this phase is to learn how to perform a literature review, learn technical writing, and learn about material science. During phase 2, technical skills will be learned. Some of these skills will include metallography, image analysis, and grain sizing techniques. During phase 3, a microstructural analysis will be performed. The objective is to use the applied concepts from phase 1 and phase 2 to determine grain size in AM components. The method used to carry out this research will characterize the grains with ASTM E112. The three methods defined for this project are Comparison Procedure, Planimetric Procedure, and the Linear Intercept Procedure. With these methods, the equiaxed grain structures will be able to represent a variation of properties that are influenced by grain size. These methods are intended to determine the average grain size of specimens with single distribution of grain areas and diameters.

24. Fast Computation of Generalized Dedekind Sums

Preston Tranbarger (Texas A&M University)
Mathematics REU
Research Advisor: Matthew Young

The classical Dedekind sum is well-studied both inside and outside of number theory due to its connections with the Dedekind eta function and its applications in topology and combinatorial geometry. There exists an algorithm to compute classical Dedekind sums in polynomial time, which has a close relation to the Euclidean algorithm. In 2020, Stucker, Vennos, and Young developed a generalized Dedekind sum defined on the congruence subgroup $\Gamma_0(N)$, which requires exponential time to compute from the definition. We construct an algorithm that reduces the complexity for computing generalized Dedekind sums from exponential to polynomial time. We do so by examining the structure of the congruence subgroups $\Gamma_0(N)$ and $\Gamma_1(N)$ in $SL_2(\mathbb{Z})$, thereby treating it as a word-rewriting problem in group theory.

25. Optimizing Simulations of Plasma Particles in a Magnetic Nozzle for Different Types of Propellants

Matthew Bradberry (Texas A&M University)
AERO-U REU
Research Advisor: Jacques Richard

Electric propulsion systems provide the most efficient spacecraft thrusters for deep space missions to date. In order to better understand these thrusters' plasma flows, a model of the trajectory of individual plasma particles' motion is under development to simulate how they move through the electromagnetic field generated in a thruster's exhaust plume. A magnetic field generated by a current loop accelerates the plasma exhaust in what is effectively a magnetic nozzle. Newton's second law is numerically integrated for the particle motions under electromagnetic fields. Maxwell's equations are solved using spectral methods for the three dimensional electric and magnetic fields. We integrate the Biot-Savart equation to compute the magnetic field of a circular current loop through which passes a plasma jet. This study examines electric propulsion systems for spacecraft with simulations of different propellants for a magnetoplasma rocket. This study focuses primarily on the qualities of Carbon Dioxide, Nitrogen, and Argon being accelerated by this magnetic nozzle. Finally results are compared to real world magnetoplasma data as well as to other electric propulsion systems.

26. Optimizing the Multi-Processing of Simulations of Plasma Particles' Motions in a Magnetic Nozzle

Dante Belcher (Texas A&M University)
AERO-U REU
Research Advisor: Jacques Richard

Researchers are studying electric propulsion systems, such as the Variable Specific Impulse Magnetoplasma Rocket (VASIMR), as alternative spacecraft thrusters. In order to better understand these thrusters' plasma flows, a model of the trajectory of individual plasma particles' motion is under development to simulate how they move through the electromagnetic field generated in a thruster's exhaust plume. Parallel processing helps to reduce the runtime of the simulations. The relationship between the number of particles being simulated and the runtime was measured to optimize attempts to reduce the runtime of the algorithms. The optimization can guide future revisions of the algorithms to reduce the runtime per particle being simulated. In addition to revising the current algorithm, alternative parallel processing libraries are investigated for implementations that can improve the multiprocessing.

27. Student Performance Impacted from Modifying a First-Year/Semester Engineering Core Course during a Global Pandemic

Alice Rosenbaum (Texas A&M University)
AERO-U REU
Research Advisor: Jacques Richard

This Research Full Paper considers the effects of precipitously deciding to abruptly migrate a first-year and first- semester engineering core course to partially online as a response to a global pandemic. This quantitative and retrospective study seeks to identify any effects of the sudden changes on student performance in a course at a large research university in the southwestern continental United States. The study focuses on student performance as an important factor that directly impacts and concerns many students. The study compares pre-pandemic Fall 2019 students' coursework performance to that of Fall 2020 students who work on similar course materials during the pandemic. The Fall 2020 course implemented a transition to a hybrid format, combining online synchronous content delivery with in-room class meetings, as part of precautions over the pandemic. We utilize statistical analyses methods (paired t-tests, etc.) on existing student data. Preliminary results indicated that the Fall 2020 students performed worse on the first exam than those of their 2019 peers on the same exam. This prompted closer examinations of specific assignments that contribute to the exams and so we look at which topics in particular assignments con- tribute to low performance on each exam. Certain course topics emerged as worse for both groups of students but preliminary results suggest that this is not always the case.

28. Further Development of Out-of-Field High School Teacher Preparation

Carlee Garrett (Texas A&M University)
Independent Research Project
Research Advisor: Tatiana Erukhimova

Due to the low number of physics majors choosing to go into high school teaching positions, there has been an increasing number of physics classrooms led by teachers with little to no background knowledge. These limitations reduce the effectiveness of the class, and tend to go unaddressed by public school systems. The Mitchell Institute Physics Enhancement Program was created to address these issues through assisting out-of-field teachers in gaining necessary background knowledge. Over a two week period, participants work with physics faculty as well as two master high school physics teachers, training in both their subject knowledge and implementation. Participant pre- and post-program knowledge and confidence were measured using an assessment compiled of questions from mechanics, electricity and magnetism, optics, and modern physics. New results from the 2021 and 2022 cohorts will be presented. Analysis of our findings will also be discussed to encourage other institutions to create similar programs.

29. Carbon Fiber Based Electrodes for a Structural Lithium-Ion Battery

Nathan Santangelo (Texas A&M University)
Cybermanufacturing REU
Research Advisor: Amir Asadi

Despite recent advances and complicated processing in lithium-ion batteries, the current batteries use materials that do not optimize the weight or energy density of the electrode. In this research, we investigate carbon fiber (CF) electrodes as CF is a lightweight composite material with high stiffness, strength-to-weight ratios, and good electrical conductivity. Lithium iron phosphate (LFP) is ideal for the positive electrode because of its structural and chemical stability; however, integrating them with CFs is challenging due to the harsh toxic processing. To overcome this issue, we propose a water-based coating approach to transfer LFPs on CF for positive electrodes, which promotes its scalability and provides non-toxic processing. Herein, cellulose nanocrystals (CNCs) assist the dispersion of the LFPs and graphene nanoplatelets (GNPs) in water using probe-ultrasonic treatment. CNC-LFP-GNP suspension is used as a coating suspension to transfer hybrid solutions through the surface of CF. To manufacture the composite material for testing, coated CFs are combined with polymer-electrolyte via vacuum-assisted resin transfer molding. The finished composites are then tested to reveal their structural (e.g., bending test) and electrochemical (e.g., cyclic voltammetry) properties. The carbon fiber electrodes will be assembled with a split coin cell and tested under an argon atmosphere. This method of manufacturing structural lithium-ion batteries could be used by the aerospace, automotive, electronic, and industrial industries, the military, and the Department of Defense to create lighter batteries that store more energy.

30. Access Control Simulation in a Manufacturing Plant

Martina Viteri (Texas A&M University)
Cybermanufacturing REU
Research Advisor: Amarnath Banerjee

Not only do access control systems protect a building and its occupants, but these systems may also reduce wasted energy in unoccupied sections of a plant, and they can provide the owner of the premise reassurance regarding security. This project simulates a minimum-security access control system. The simulation entails programming an NFC reader to grant or deny access through a gate. By recording IDs and duration of visitation to designated areas, an audit trail will be accessible electronically to company owners. Audit trails indicate effective monitoring of manufacturing activities. Reviewers can use an audit trail to recognize unusual activities, and with proper analysis of audit trails, companies can focus on optimizing specific operating systems in the plant.

31. The Application of Machine Learning in Factory Error Detection

Maanya Gulati (Texas A&M University)
Cybermanufacturing REU
Research Advisors: Amarnath Banerjee, Bimal Nepal

The purpose of this study is to investigate the different sensory signals from a production system to help predict the onset of the system getting out of control or possible error conditions. The signals that will be collected in this experiment are vibrations, audio, and motion. The signals will be obtained from different types of sensors. These sensors are going to be mounted on an Industry 4.0 Factory Simulator. The operations of the factory simulator will provide the sensory inputs. Data will be collected from different runs of the simulator. A machine learning algorithm will be developed using Python libraries to analyze the data and learn the characteristics of the system under normal operating conditions. Several scenarios will be developed to simulate the system to operate under extreme conditions mimicking the behavior of the system getting out of control. The placement of the sensors in the factory simulator is a design problem that is currently under investigation. The placement of the sensors is being determined so as to not obstruct the functionality of the factory simulator. The machine learning code is currently under development in parallel. The third ongoing task is on the planning of the experiments to be run on the factory simulator to collect the data and analyze them. As of now, no conclusions have not been made since the system is currently under development.

32. Human Robot Interaction in Robotic Welding

Carolina Villarreal (Texas A&M International University (TAMIU))
Cybermanufacturing REU
Research Advisor: Prabhakar Pagilla

Robots have been widely used in welding. Robotic welding makes a welder's job simpler, quicker, and safer due to the aid of a robot instead of a human doing the heavy work when completing a welding task. Although there are many benefits to robotic welding, an ongoing issue is that path planning in fully automated welding requires the accurate locations of the workpieces, which often relies heavily on fixtures and extensive measurements. Workpiece locations are also prone to errors when the robot work space is changed. Human operators can select the key points for measurement in order to obtain the workpiece locations. There are also many cases where human operators can identify potential obstruction during welding and welds with poor quality. With this being said, the strengths of humans and robots can be combined to effectively plan motions for welding. In this project, I aim to do a thorough analysis on the current robotic welding methods and summarize the advantages and disadvantages. I will then use my knowledge of robot kinematics to plan paths for welding as well as use the points I planned to generate motions to automate the remaining welding tasks. In addition, I will develop methods to make robotic welding more efficient with human assistance. Finally, I will discuss the future of robotic welding and how to further develop human robot interaction strategies for welding in the years to come.

33. High-Speed Capture of Failure Patterns in Unit-Cell Lattice Architectured Materials

Gabrielle Nichols (Texas A&M University)
Cybermanufacturing REU
Research Advisors: Arun Srinivasa, Alekhya Banki

As additive manufacturing improves, architecture materials and complex lattice structures become a plausible options for manufacturing. Architected materials can provide unique material properties manipulated by their lattice structures and unit cell composition that are not obtainable in traditional materials. Typical architected structures have a repeatable cell lattice structure and are composed of unit-cell configurations. The microstructure of the cell, the size of the cell, the dimensions of the lattice, and other factors all have an impact on the behavior of the structure. While the stiffness characteristics of these materials are well known, failure properties are less understood. Therefore, engineers use high factors of safety when designing these structures, negating weight-saving advantages. It is therefore important to understand how the structures fail so they can be implemented in a viable way. We manufactured several lattice structures via resin stereolithography. Then, using impact tests the fracture patterns are captured via high-speed imagery. The dense unit cell is expected to break cleanly with little to no fraying in the fracture whereas the sparser structure is expected to have more fracture paths around the area of failure. These fracture patterns and behaviors can be translated to energy absorption. Though the denser unit cell is expected to show greater strength, its energy absorption is less than the sparser structures. This information can be applied to the utilization of the structure and how the lattice should best fail in application.

34. Augmentation and Pre-processing of Wireless Signal Datasets for Intelligent Communication Receivers

Jason Hardjadinata (Texas A&M University)
Independent Research Project
Research Advisors: Linda Katehi-Tseregounis, Arya Menon

In the world today, almost all devices we use require WiFi and network connections for best performance. These wireless connections use different frequencies in the electromagnetic spectrum. Increasing usage of an already crowded spectrum has resulted in research into spectrum sharing that can intelligently sense the current state of the spectrum and use it efficiently with other users in a cooperative manner. Creating artificial intelligence for spectrum sharing first requires the collection of accurate, well-curated data for training. However, there are no standard or benchmark datasets for wireless signals that capture multiple wireless standards and well as environmental scenarios. Collecting such data comes with its own challenges – the data may be available in different formats and may require augmentation to synthetically add scenarios that aren't present in the original dataset. This poster presents my contribution towards augmentation and pre-processing of wireless signal datasets for intelligent communication receivers including time resampling, adding gaussian noise, etc. This work is contributing to the larger project by the Intelligent EM Sensors group of creating a centralized database of wireless signals and providing MATLAB scripts that would perform data augmentation without much effort. This data will eventually be used to train intelligent hardware-software codesigned memristor-based receivers for spectrum sensing.

35. Acid-Doped Biopolymer Nanocoatings for Flame-Retardant Polyurethane Foam

Sashi Kulatilaka (College Station High School)
Independent Research Project
Research Advisors: Jaime Grunlan, Natalie Vest

Soft furnishing fires contribute to 29% of fire causalities and $8.7 billion in direct property damage annually in the United States. Polyurethane foam (PUF), a common component in soft furnishings known for its comfort and flexibility, can emit toxic gases and propagate fires due to melt dripping when ignited. Various acid salts were added to a layer-by-layer assembled nanocoating, consisting of chitosan and carboxymethyl cellulose, to improve PUF flame retardancy and to understand the influence of salt-doping on flammability. The 20-bilayer phosphoric acid-doped coating exhibits a self-extinguishing behavior, with a 67% reduction in peak heat release rate while maintaining the structural integrity of the foam. By depositing this completely environmentally sourced coating on PUF, the inherent danger of soft furnishing fires can be significantly reduced in a nontoxic manner.

36. Educational Videos for Diabetes Remote Monitoring Health Application

Alberto Gutierrez-Irizarry (Texas A&M University)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisors: Farzan Sasangohar, Samuel Bonet

Underserved populations are hindered by the number of resources they have at their disposal. Because of this, underserved populations have lowered amounts of care received and lower understanding of the care received. In order to address this, PATHS-UP is developing remote monitoring devices that allow underserved populations better healthcare access. One method to conduct this healthcare is remote monitoring devices for diabetes management. mHealth apps, U.S. Mobile health applications, attempt to address this facet of healthcare by providing cost-effective ways for patients to self-manage their conditions. GlucoseCoach, one iteration of these mHealth apps, allows patients to self-manage diabetes through remote monitoring. As part of this self-management, education of underserved individuals who partake in this remote monitoring would be beneficial. Thus educational videos on diabetes and how to live a healthy lifestyle helps provide underserved individuals with a better understanding of their condition. These videos would explain how to manage their diabetes with food and exercise.

37. Development of a Paper-Based Microfluidic Device for the Detection of Preeclampsia using Silver Nanoparticles

Sidney Fitzpatrick (The University of Texas at San Antonio)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisor: Samuel Mabbott

Preeclampsia is a dangerous and often fatal placenta disorder that affects 2-8% of all pregnancies globally. Markers of the disease commonly include proteinuria and hypertension. Preeclampsia is best treated early, and current methods of diagnosis are numerous, time-consuming, and costly. This project aims to create an accurate, rapid preliminary diagnostic test in the form of a paper-based microfluidic device. The detectable target will be microRNA-17a (miR-17a), which is upregulated 3-fold in preeclamptic patients during the first trimester of pregnancy. Our surface-enhanced Raman scattering (SERS)-based sandwich assay will contain thiolated DNA sequences designed to recognize miR-17a bound to silver-gold (AgAu) core-shell nanoparticles (NPs). The capturing sequence of the assay will be composed of the biotinylated DNA sequence bound to paper. NP optimization is performed to minimize the gap size and maximize the Raman signal peaks between the Ag core and Au shell using the Raman reporter 4-aminothiophenol (4-ATP). The thiolated DNA sequence is functionalized to the AgAu NPs and characterized by dynamic light scattering (DLS) to obtain the particle size and zeta potential. The SERS assay will be run in well plates and a Raman spectrometer will be used to evaluate miR-17a concentrations.

38. Measuring Fluid Viscosity using a Mobile Phone

Kate Wang (Texas A&M University)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisors: Hatice Koydemir, Weiming Xu

Cardiovascular diseases (CVDs) are the leading cause of death globally and are classified as a group of heart disorders. Monitoring the increase of blood viscosity, which contributes to the elevation of the blood pressure and associated risk factors, can play an important role in reducing cardiovascular diseases. Current fluid viscosity measurements are expensive, often costly, and time-consuming. There is a need for a more accessible, affordable, and portable device for measuring fluid viscosity in resource-limited settings. Here we present a mobile phone-based viscosity meter to measure blood viscosity in resource-limited settings. The lightweight device utilizes microcapillary glass tubes as a sample holder and uses the sample flow rate and other factors such as liquid density to quantify the liquid viscosity. After adding the fluid into the pressure reservoir on the device, the control valve was opened to allow for fluid flow. A mobile phone was then used to capture a video of the fluid flow to determine the viscosity. This was done by converting the data, such as its fluid rate and density. We demonstrate that this portable imaging flow viscometer coupled to a laptop computer can detect and quantify, in real-time, low levels of viscosity changes.

39. Non-invasive Glucose Monitoring via Colorimetry

Justin Nguyen (Texas A&M University)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisors: Hatice Ceylan Koydemir, Weiming Xu

There are numerous glucose monitoring systems on the market, but the most common option consists of an invasive method that involves finger prick sampling for blood. In addition, more non-invasive, affordable, and accessible methods are highly sought out for glucose monitoring. Here we present a portable noninvasive device for glucose measurement from saliva samples. The device utilizes a colorimetric enzyme based detection assay and quantify the glucose amount in the sample using custom developed image processing algorithms. We tested the performance of the device using a wide range of glucose concentrations in buffer solutions and the results were compared to our gold standard method, i.e. spectrophotometry. Separate measurements were carried out to quantify the concentration of salivary glucose for the samples tested to build the calibration curves. Our results demonstrated that a greater intensity in color indicated a higher glucose concentration in samples for both methods as expected. However, more testing is needed to validate the salivary glucose concentrations of the developed colorimeter against the spectrophotometric results from the plate reader. This noninvasive device has potential as an analytical tool for the detection of glucose in a low-cost and portable manner in resource limited settings.

40. Using Aptamer Based Biosensors for Troponin Detection for Cardiac Arrest Diagnosis

Andres Thrailkill (Texas A&M University)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisor: Gerard Cote

Underserved populations have a distinct disadvantage compared to well funded and especially urban areas when it comes to healthcare. In these underserved areas, chronic diseases such as diabetes and cancer have an even bigger impact on a person's life than they would on an individual in a properly served area. Innovative and affordable technologies are needed to help diagnose and handle these diseases to reduce their fiscal impact and improve patient's quality of life. A heart attack, or acute myocardial infarction (AMI), is a disease characterized by the death of cardiac myocytes, which is due to an imbalance between the demand for blood by the cardiac tissue and the supply of blood. The symptoms of this perfusion imbalance or ischemia can be misdiagnosed as gastrointestinal or pulmonary disorders because of their atypical clinical presentation. This leaves the patient vulnerable to cardiac arrest, which is life threatening. Patients with acute chest pains are diagnosed with AMI typically by using an electrocardiogram (ECG). This technique, however, has only a 50% accuracy in detecting AMI which causes many patients to often be misdiagnosed. The authors, therefore, would like to create an easy to use and produce wearable that can be used to screen individuals who potentially may have had a heart attack so that proper treatment may be given. Not only will this work provide a method to easily and affordably screen for heart attacks in underserved populations, but it will also decrease healthcare costs and secondary complications caused by the condition.

41. Implementing Optical Biosensors for Glucose Monitoring and Heart Rate Detection

Alberto Rios (Texas A&M University)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisor: Gerard Cote

Several studies have shown that optical biosensors outperform traditional analytical techniques by allowing for the direct, real-time, and label-free detection of a range of biological and chemical molecules. Our research focused on designing and creating optical biosensing systems for continuous glucose monitoring and heart rate detection. Currently, continuous glucose monitors with FDA approval are limited by lifespan (7 – 14 days). Our goal is to develop an implantable biosensor that will utilize fluorescence to detect changes in glucose concentration and to design a wearable device that would use NIR light to excite the fluorescent assay and photodiodes to detect the emission. An optical-based system was designed by using a combination of laser diodes, filters, a bifurcated fiber optic cable, and a spectrometer. Photoplethysmography (PPG) is used for wearable devices to gather optical measurements of heart rate with the use of LEDs and photodiodes to measure volumetric variations in blood. Currently, market PPG sensing devices are limited by their capability to produce accurate results due to several factors including movement. Our goal is to develop a wearable PPG sensing device to monitor an individual's heart rate and develop a motion compensation algorithm. An embedded system with an Arduino and a MAX30101 sensor was used to measure PPG signals. A heart rate algorithm was developed to analyze the accuracy of three wavelengths (537nm, 660nm, and 880nm) to identify changes in noise.

42. Sex Difference in Weight Gain after Low Chronic Infection with Staphylococcus in AD Mouse Model

Wajihah Chaudhary (Texas A&M University)
Independent Research Project
Research Advisors: Karienn Montgomery, Anatoliy Gashev, Morgan Jackson

Criteria for diagnosis of Alzheimer's disease (AD) include presence of abnormal Aβ amyloid markers, abnormal neuronal injury markers and cognitive changes. Long terminflammation has been linked to dementia and chronic bacterial infections are frequently associated with amyloid deposition, potentially initiating the cascade of events leading to inflammatory condition of the central nervous system. To better understand the influence of chronic inflammation and the mechanism of Alzheimer's Disease we treated young (6 mo old) APP/PS1 and NTg mice with Staphilocous Aerus 3x a week for 4 months. Our hypothesis is that weight gain is affected by the sex of the mice after having a low chronic infection with Staphilococus in the AD mouse model. In humans, weight changes in AD are associated with severity of disease and mortality. We found that both NTg and APP/Ps1 female mice treated with Staph had lower survival rates than their non-treated counterparts. Further, the weight of the females appeared to be more affected by the genetic mutation (APP/PS1) and infection. This data suggests a sex-dependent effect of amyloid deposition and infection on weight and survival, and further studies are needed to further understanding of the effect of female hormones on disease progression.

43. Gait and Motor Changes as Predictors of Alzheimer's Disease in Infected APP/PS1 Mice

Sneha Philip (Texas A&M University)
Independent Research Project
Research Advisor: Karienn Montgomery

Alzheimer's disease (AD) is characterized by Aβ plaques and neuronal loss in regions of the brain responsible for cognition, such as the hippocampus and prefrontal cortex. Studies have shown AD pathology can also develop in the motor cortices, striatum, and substantia nigra. Cognitive symptoms are used to diagnose clinical AD, though recent studies show that changes in motor abilities may occur early in the disease. Detection could thus be used to predict a further decline in AD patients who do not yet present cognitive impairment. The localization of AD pathology in motor regions and the noted motor decline substantiate motor deficits as predictors of cognitive changes in AD. Thus, our lab used a mouse model of AD to investigate motor and gait-related changes. We used bacterial infection as an added insult to assess the action of immune responses on pathological and behavioral phenotypes. We hypothesize that a low-grade nonpathological staph infection accelerates the aging process in a mouse AD model. We inoculated 6-month-old male APP/PS1 and NTg mice with *Staphylococcus aureus* (Staph) or PBS three times each week for four months. Performance tests were conducted to evaluate motor function and measures of gait utilizing Rotarod and DigiGait. Both genotypes exhibited decreased survivability upon exposure to Staph. Staph-treated APP/PS1 mice exhibited significant motor deficits in Rotarod, and longer brake and stance times in DigiGait. Preliminary results suggest that the added bacterial infection resulted in lower motor performance in the AD mouse model.

44. Analysis of c-Fos Expression in Rostromedial Tegmental Nucleus during Punishment of Cocaine Seeking

Sarah Mitchell (Texas A&M University)
Independent Research Project
Research Advisors: Rachel Smith, Adelis Cruz

Drug addiction is characterized by continued drug use despite negative consequences. This behavior may result from an impaired ability to learn from aversive or negative consequences (e.g., punishment). We hypothesized that a brain region called the rostromedial tegmental nucleus (RMTg) may be involved in this process, based on its known role in encoding aversive events and learning punishment. Here we quantified c-Fos expression, a marker of neural activity, in the RMTg of rats that experienced cocaine seeking in the face of footshock punishment. Male Sprague Dawley rats were trained to self-administer cocaine during daily 2-h sessions for ~3 wks. Rats were then sacrificed 30 min after one or two sessions of footshock punishment (0.7 mA, 0.3 s, randomly 1/3 trials) or after a cocaine self-administration session with no footshock. Brains were then analyzed for c-Fos expression using immunohistochemistry. We found a significant reduction in RMTg c-Fos activity in rats that received two punishment sessions as compared to one or no punishment sessions. Further, we found that RMTg c-Fos activity was positively correlated with the number of footshocks received during the punishment sessions. Although we also observed a correlation with the number of cocaine injections earned, there was no correlation in rats that experienced cocaine self-administration session without punishment, indicating that c-Fos activity in RMTg during punishment sessions cannot be attributed solely to cocaine effects. These data indicate that RMTg is recruited in response to footshock punishment. Authors: Mitchell SE, Cruz AM, Handel SN, Smith RJ

45. Noncontingent Footshock, Unlike Contingent Footshock, Does Not Reduce Cocaine Seeking in Rats

Payton Kahanek (Texas A&M University)
Independent Research Project
Research Advisor: Rachel Smith

A defining characteristic of addiction is compulsive drug use, or continued drug use despite negative consequences. In an animal model of compulsive drug seeking, a subset of animals continue to seek cocaine despite receiving footshock (punishment resistance), while another subset reduces cocaine seeking to avoid footshock (punishment sensitive). Here, we wanted to investigate the effects of noncontingent footshock on cocaine seeking to determine what role footshock-induced stress might play in punishment sensitivity. Male Sprague Dawley rats were trained to self-administer intravenous cocaine via a seeking-taking chained schedule of reinforcement during daily 2-hour sessions. After ~3 weeks of self-administration, rats were given 4 days of testing with either contingent footshock (0.4 mA, 0.3 sec, randomly ⅓ trials, delivered after completion of seeking) or noncontingent footshock (similar parameters and number of shocks, but independent of behavior). We found that noncontingent footshock did not affect cocaine seeking and that rats self-administered cocaine at a similar rate to baseline. In contrast, contingent footshock resulted in reduced cocaine seeking on average, with some rats more sensitive than others. A proportion of rats then received ramped levels of footshock across days (0.32, 0.56, 1.0 mA). Surprisingly, even at the highest amplitude, noncontingent footshock did not reduce cocaine seeking. These data indicate that sensitivity to footshock punishment cannot be explained by footshock-induced stress and that contingency plays a key role. Further work is necessary to determine whether punishment resistance, therefore, may be related to a lack of awareness of the footshock contingency.

46. Hint Blindness and Mental Set Strength

Lauren Jackson (Texas A&M University)
Independent Research Project
Research Advisor: Steven Smith

The benefits of taking breaks when problem solving becomes fixated have been attributed to serendipitous hints encountered during those breaks, and some have even reported effects of "subliminal" hints. Our experiments examined the effectiveness of pictorial hints (i.e., pictures of objects whose names were solutions) in triggering resolution of initially unsolved word problems. When a problem was initially unsolved, an extra ten seconds of work on the problem continued with a usually irrelevant photo in the background, and a letter maze that usually contained the solution. On critical trials, however, mazes did not contain solutions, but background photos depicted solutions; attention to mazes on such trials functioned as a mental set, preventing participants from using good photo hints in plain sight. Although photo hints helped participants resolve about two-thirds of the problems in a control condition where no mental set was present (i.e., no letter mazes were shown), there was nearly no benefit of hints in the mental set condition, a hint blindness effect. Our experiments examined the effect of mental set strength on hint blindness.

47. Teaching Wireless Circuit Design - Developing a New Undergraduate Microwave Laboratory at Texas A&M

Amarachukwu Nzedibe (Texas A&M University)
Independent Research Project
Research Advisors: Linda Katehi, Arya Menon

Through the proliferation of wireless devices, we are moving towards a more interconnected world where people have access to information at their fingertips, where individuals no longer have to meet face-to-face to conduct businesses. However, with new technology comes a demand for new skills. There is a demand for a new generation of engineers who would build wireless circuits to commandeer the future. To teach this new generation, there is a need for more practical work to be incorporated into the learning curriculum. This poster presents the educational research efforts made towards creating a state-of-the art undergraduate microwave laboratory for the course ECEN 453 at Texas A&M University. By involving undergraduate students in course development, we seek to better tailor the course material to the level of understanding of a senior electrical engineering major and maximize the learning outcomes during course deployment. My role in this effort consists of evaluating course material for clarity in the instructions, providing feedback on overall improvement in learning, providing estimates on time taken to complete the activity, and creating supplemental material for the lab assignments. In this poster, I will be presenting our process for course development through the material created for teaching transmission lines, filters and s-parameters. Through this research, we believe that we can equip students with sought after skills that would make them valuable to the industry.

48. Volumetric Printing Biomedical Applications

Nicholas Granados (Texas A&M University)
Independent Research Project
Research Advisors: Shiren Wang, Aolin Hou

Volumetric printing revolutionizes traditional additive manufacturing via unprecedented prototyping speed, layerless fabrication in the biomedical field. The biomedical field has several methods of bioprinting but not at a complex scale and reasonable speed that is personalized. Through optical tomography, it is possible to transform hydrophilic polymers into custom hydrogel models with complex three-dimensional objects with complex structural features in minutes that current additive manufacturing technologies achieve in hours. We have performed experiments with a self-constructed volumetric printer with visible light. The resin formulation is composed of poly(ethylene glycol) diacrylate (PEGDA) as crosslinking monomer and camphorquinone (CQ)/ethyl 4-(dimethylamino) benzoate (EDAB) as visible light photoinitiator system. The present work confirms the high-speed characteristic of volumetric printing even with long wavelength visible light. What this particular method means for the future is being able to manufacture custom-made tissue such as bio scaffolding for cells or more sophisticated devices like a customized heart valve via a wide range of light sources.

49. Development & Testing of Wearable Cardiovascular Health Monitors

Kamryn Scott (Texas A&M University)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisor: Gerard Cote

The leading cause of death worldwide is persistently cardiovascular disease (CVD). Access to adequate health care leads to earlier detection and diagnosis of CVD, reducing the risk of death. As a result, CVD has a disproportionately negative impact on marginalized groups, who typically lack access to physicians. Therefore, there is a critical need for cost-effective ways to continuously track the signs of CVD. Two common modalities that can be used to do this are photoplethysmography (PPG) and bioimpedance (BIO-Z). However, the quality of PPG signals can drastically vary depending on several factors such as skin tone and motion artifacts. Through the use of a benchtop testing system and optical skin phantoms the effectiveness of a PPG device may be tested under varying conditions. Through testing a variety of PPG devices with this system, we are able to determine the device and PPG sensor wavelength which performs best under various skin tones and motion artifacts. In addition to this, there is a need to make the output from the current BIO-Z circuit readable by a microcontroller. Thus, allowing for the device to eventually become more remote, and allowing for the BIO-Z circuit to be tested simultaneously with a PPG prototype. This can be accomplished by altering the current circuit to only produce positive voltage outputs. Overall, this study can further the development of PPG and BIO-Z

devices, allowing us to produce remote and wearable devices that can continuously monitor the signs of CVD.

50. The Role of Mobile Applications for Social Support and Diabetes Self-management.

Jacey Henrichs (Texas A&M University)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisor: Sherecce Fields

Diabetes is a chronic health condition which affects millions of people worldwide. Hallmarked by high blood glucose levels, diabetes may lead to a variety of health-related complications. This is especially true in individuals from historically underrepresented communities, such as racial and ethnic minorities, who face greater health care disparities. Previous research has identified self-management as an important component of diabetes care plans. Additionally, social support has been linked positively to better self-management and health outcomes. Mobile health applications can provide individuals with the tools and support necessary to self-manage their diabetes. However, little research has been dedicated to the role of social support in diabetes management applications. The purpose of this study is to explore the nature of social support currently provided in these applications, focusing on individuals from backgrounds typically underrepresented in diabetes research. The aims of this study are to determine (1) the level of support currently provided by diabetes management applications including individuals' interest in receiving support from them. (2) Whether support received is associated with external support levels, application usability, self-management behaviors, and health literacy. Finally, implications for future research and the development of diabetes management applications will be discussed.

51. Optimizing Source-Detector Spacing for Reflectance-based Multiwavelength Photoplethysmography

Kemani Harris (Florida A&M University)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisor: Gerard Cote

In recent years, with advances in remote sensing technology, wearable devices have become popular for tracking The purpose for the research is to be able to provide health assistance tracking concerning cardiovascular information of an individual disease like diabetes and high blood pressure. Improving widespread distribution targeting underserved communities who lack the necessary resources to prevent disproportionate levels of negative health outcomes like a higher risk of diabetes and higher morbidity rates not being able to afford frequent check ups from doctors to track their health. To help this lack of tentative treatment is developing wearable optical sensorsing devices to can constantly track an individual person's heart rate to observe any obscurities in blood flow to prevent the growth of these cardiovascular diseases like diabetes and high blood pressure. This will be accomplished by using optical sensing technology which emits light through LEDs at which the light goes through the skin and would reflect off the blood going back to the sensor to see the fluctuation in the blood flow seeing the change in the volume of the veins as the heart pump the blood through the body. Even though this is shown to be a reliable way to track the heart rate of a person there are still factors to consider upon improving the sensing capabilities of wearables. Testing the sensor the placement of searching for the most viable location to pick up strong signals as well as comparing the results of using different LEDs especially on different skin tones. The constant research of improving the capabilities of PPG wearable will make it beneficial for the widespread use of wearable devices that is beneficial for the users health over time.

52. Synthesis of Polyacrylonitrile-encapsulated Phosphors for Lifetime Referencing

Rebekah Lindblade (Louisiana Tech University)
Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) REU
Research Advisor: Mike McShane

Phosphorescence lifetime-based sensing instruments are being developed for minimally invasive, continuous analyte monitoring for chronic diseases. The development of these instruments necessitates a stable phosphorescence lifetime reference material to validate instrument designs. However, exposure to oxygen changes the phosphorescent lifetimes. The oxygen response of a phosphor can be changed by encapsulation of the phosphor in a carefully selected polymer. Polyacrylonitrile (PAN) was used to encapsulate red- and green-excited phosphors through precipitation. This process was repeated using different dye concentrations. Dynamic oxygen experiments showed decreased oxygen sensitivity of the encapsulated phosphors against an un-encapsulated phosphor control. Dynamic temperature experiments suggest that the particles may be useful as temperature sensors. Overall, the results suggest the repeatability of the fabrication of the nanoparticles and the utility of the nanoparticles as a lifetime-referencing and temperature-sensing material.

53. Hydrophobic Ternary Mixtures of Pharmaceutical and Food Grade Reagents: Characterization in Indium Extraction from Aqueous Hydrochloric Acid Media

Sofia Allison (Mount St. Mary's University)
Texas A&M Cyclotron Institute REU
Research Advisors: Charles Folden, Evgeny Tereshatov

Environmentally friendly and cost-efficient ways to extract rare metals from aqueous phase solutions are desirable for health and financial reasons. New hydrophobic ternary mixtures made of common pharmaceutical reagents were introduced to form low transition temperature mixtures (LTTMs). LTTMs are liquids in which no true melting point is observed, but the system instead has only a glass transition point, which is a second order phase transition. As the system cools, the mixture becomes glassy instead of crystalline. Understanding of indium behavior in the presence of LTTMs is important because it can provide an opportunity to develop a new selective chemical system for metal extraction not only for liquid-liquid but also for gas-solid interactions. The latter is the only path to study chemical properties of superheavy elements. These elements are produced in nuclear fusion reactions, and are studied in comparison with their light homologs. Indium is the light homolog of nihonium. Thus, the project is devoted to developing procedures to study chemical properties of superheavy elements. Using different ratios and combinations of five different organic reagents (ibuprofen, lidocaine, menthol, methyl anthranilate, and Proton SpongeTM), four of which are solid at room temperature, we have produced

LTTMs and tested the melting point and extraction coefficient of these now liquid systems. The medical radioisotope indium-111 in a hydrochloric acid solution was utilized to test the extraction efficacy. This carrier-free radionuclide was extracted from the aqueous to the organic phase and its partitioning was measured by means of distribution ratio values, which are the ratio of the analyte concentration in organic to aqueous phases.

54. Measuring Ions Per Bunch in the RFQ

Olivia Bruce (Spelman College)
Texas A&M Cyclotron Institute REU
Research Advisors: Dan Melconian, David McClain

The6He-CRES collaboration centered at the University of Washington seeks to find beyond-standard-model-physics contributions in weak interactions, “or new physics.” While the first measurement is being developed, we are looking forward to upgrades, particularly using a Penning trap to better confine beta decays from walls to reduce sources of systematic uncertainties. To efficiently load the Penning trap, we must design a radio frequency quadrupole (RFQ) trap to cool (ΔE~eV) and bunch (Δt~μs) the short-lived ions. Current understandings of ion traps suggest that our RFQ is limited to 10^4 ions per bunch, but simulations predict yields of 106 ions per bunch. The next stage of the collaboration is to implement an ion trap to remove systematics affecting their current setup. The idea of getting 10^6 comes from the lack of statistics expected from smaller bunch sizes. This will allow for several experiments to be done with different sources. To experimentally find the space-charge limit of TAMUTRAP’s RFQ, we will inject a variable intensity of potassium ions through the RFQ with low intensity and slowly increase the source gain until the RFQ becomes ion-saturated. If we achieve 106 ions per bunch, we will show that an ion trap addition to the6He-CRES experiment will not detriment the count rate. We seek to measure the potential bunch size by changing several parameters to change the bunch size without greatly increasing our beam spread. These results will contribute to the future direction of the collaboration.

55. The Study of the Spectral Functions of Baryons in Hot and Dense Nuclear Matter

Sarah Tucker (Ohio Northern University)
Texas A&M Cyclotron Institute REU
Research Advisor: Ralf Rapp

High-energy heavy-ion collision experiments produce strongly interacting matter under extreme conditions of temperature, where a phase change from hadronic matter to a quark-gluon plasma is expected. By studying the spectral functions of hadrons immersed into this medium, we can obtain valuable insights into how the properties of this medium arise from its microscopic interactions. In this project, we examine spectral functions by analyzing in-medium correlation functions of baryons that have been computed in first-principle lattice-QCD simulations at finite temperature. Toward this end we utilize empirical parameterizations of the spectral functions of the N and Δ baryons and investigate how variations of the energy dependencies of these spectral functions manifest themselves in the lattice-QCD correlators. In particular, we are interested in how the spectral functions change during the transition from hadronic matter into a QGP where one expects a change in the effective degrees of freedom of the system.

56. Oxygen-14 Beam Production at 5 and 15 MeV/u with the K150 Cyclotron

Henrique Raposo (University of Rhode Island)
Texas A&M Cyclotron Institute REU
Research Advisor: Brian Roeder

Oxygen-14 (O-14) is a rare isotope beam of interest for many groups studying the structure of proton-rich nuclei. At the Cyclotron Institute of Texas A&M University, there were two groups interested in studies with O-14. The Center for Exotic Nuclear Studies (CENS) at the Institute of Basic Science in South Korea requested an O-14 beam at 5 MeV/u and a group from Washington University in St. Louis has requested an O-14 beam at 15 MeV/u. The O-14 beams were produced and separated with the Momentum Achromat Recoil Separator (MARS). The LISE++ spectrometer simulator, designed to predict the intensity and purity of rare isotope beams (RIBs), provided useful projections of particle production through the MARS beam line with nitrogen-14 as the accelerated projectile (with 7.7 MeV/u and 17 MeV/u of incident energy) and hydrogen-1 gas as the target (to cause O-14 production). Using these predictions, production tests for O-14 beams at the two energies requested have been conducted. In this presentation, the experimental results of these production tests will be compared with the predictions of the LISE++ simulations of the MARS beam line.

57. Gain Mapping of Micromegas by Localized Beta and X-ray Emissions

Jason Flittie (Michigan Tech)
Texas A&M Cyclotron Institute REU
Research Advisors: Grigory Rogachev, Antti Saastamoinen

The Texas Active Target detector (TexAT detector) is an active target time projection chamber (TPC) for rare isotope beam (RIB) experiments that was built at the Cyclotron Institute at Texas A&M University [1]. A primary component of the TexAT standard setup is a micromegas detector, which detects electron cascades resulting from charged particle interactions. This allows for particle track reconstruction, which requires high precision in both energy measurement and position of impact. The micromegas manufacturing process and environmental degradation [2] results in mechanical deformities in gap distance and electric field strength, especially near extrema of the detector region. Therefore, the micromegas gap uniformity is characterized by measuring detector energy response to localized beta and x-ray sources, providing a gain map for more accurate experimental energy determination.

References

[1] E. Koshchiy, et. al., Texas Active Target (TexAT) detector for experiments with rare isotope beams (2020).

[2] M.R. Jäkel, et al., CERN: A New Irradiation Facility to Test Large-area Particle Detectors for the High-luminosity LHC Program (2014).

[3] B. Mauss, et. al., Micromegas calibration for ACTAR TPC (2018).

58. Designing a Detector for Superheavy Elements Produced from Multinucleon Transfer Using Monte Carlo Method

Catherine Beckman (University of Wisconsin)
Texas A&M Cyclotron Institute REU
Research Advisor: Sherry Yennello

It has been proposed that superheavy elements (SHE) in the island of stability may be created through a process called multi-nucleon transfer (MNT). When two elements collide, MNT theorizes that one element will pick up nucleons from the other, thus forming a SHE. This work centers around a simulation created to benchmark the viability of detector parameters to identify alpha decay chains from superheavy elements using Monte Carlo simulations and statistical likelihood analysis. In the simulation, an argon filled detector is modeled. The MNT reaction occurs when a gold beam hits a gold target. Inside the target a SHE is produced, which then travels out of the target and into the detector where it is embedded and subsequently undergoes its decay chain. The energy loss both in the target and in the detector medium is calculated to determine where the SHE is stopped. Alpha particles detected from the decays are then paired with their decay chain based on their energy of the alpha particle and the time between each decay event. Once the work is completed, the feasibility of detecting SHE produced from MNT using a gas filled detector will be discussed.

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59. First Results from Testing the Utility of Prototype Solid State Detectors With Particle Beams

Benedict Anderson (University of Dallas)
Texas A&M Cyclotron Institute REU
Research Advisor: Michael Youngs, Will Flanagan

Neutron and heavy-ion detection has traditionally been both expensive and bulky, making arrays of detectors both cost-prohibitive and difficult to transport. The prototype solid-state detectors tested in this experiment aim to solve both these issues. These detectors are both relatively cheap to produce and incredibly small (approximately 1 by 2 cm). The detectors take advantage of non-volatile charge storage SONOS (Silicon, Oxide, Nitride, Oxide, Silicon) arrays. When a heavy-ion passses through a chip, it depletes the charge stored in the SONOS region it passes through. These bits can then be read out later and this voltage drop can be measured. These detectors were examined to determine their applicability as heavy-ion detectors and to help understand the base idea which could be applied to neutron detectors based on the same SONOS memory chip. These chips were placed into either a 10 AMeV 4He beam or a 15 AMeV 14N beam to test the reliability and sensitivity of these chips for different particle energies. In addition, the devices were tested for various amounts of time to determine if the chips respond to charged particle beams in a predictable way. The results from the first ever heavy-ion beams incident on these detectors will be shown.

This work was completed as part of the Research Experience for Undergraduates (REU) program and was funded by the Department of Energy Nuclear Physics via grant number DE-FG02-93ER40773 as well as the National Science Foundation via grant number PHY-2051072.

60. Silicon Surface Barrier Detector Testing

Nathan Shaffett (Shorter University)
Texas A&M Cyclotron Institute REU
Research Advisor: Phil Adsley

Resonance scattering is a powerful tool because it allows us to access the widths of states, not just energies. Widths give us insight into the microscopic structure of a state. Resonance-scattering measurements can be performed with various experimental tools, including solid-state detectors made from materials such as silicon. Silicon surface barrier detectors are a form of reversed biased diodes used in resonance scattering experiments by generating current pulses proportional to the energy deposited by a charged particle passing through them. In this study, we tested several silicon detectors to test whether they are appropriate for resonance-scattering experiments and implemented a digitizer readout system. Each detector was placed in a vacuum chamber with an alpha-particle source. The leakage current response to a bias was measured. Signals from the detector were digitized and processed through a moving-window deconvolution and a trapezoidal filter in order to extract the energies of the particles measured. The width of the energy spectra peaks was used to determine the energy resolution of the detectors. This demonstrated which detectors were viable for usage in resonance scattering experiments.

61. Using a Generalized Bohr Model and the Hyper-Spherical Formalism to Study the Thomas and Efimov States for Three Nucleon Systems

Michael Gajdosik (Stevens Institute of Technology)
Texas A&M Cyclotron Institute REU
Research Advisor: Aldo Bonasera

The Thomas Theorem suggests that weakly bound two body states can combine to form a strongly bound three body system. Using the experimental deuterium binding energy as the two body proton-neutron spin-1 system, we attempt to replicate and predict the binding energies of three body systems. We find that the three body system is generally more bound than the two body state would suggest, thus the Thomas Theorem holds. Assuming a simple interaction depending on the range of the potential, and using the hyper-spherical formalism, we generate the universal energy function for three-body nuclear systems. With the two-body energy given for deuterium, we are able to fit the binding energy of a triton. This fitting allows us to predict the spin-0 energy for a two-body system. Modeling this spin-0 system (the case of a neutron-neutron system), we find a local minimum in energy, indicating a resonance of the system. Adding a Coulomb potential, however, as in the case of a proton-proton system, the local minimum is eliminated. Fixing the experimental binding energy of deuterium and the scattering lengths, we are able to find the most likely hyper-angle to describe the geometry of the system. To model three-particle systems, we instead fix the hyper-angle and vary the scattering lengths of the system. This model allows us to prove the Thomas Theorem, i.e. when the scattering length goes to zero, the three-body system becomes infinitely bound.

62. Producing Radioisotope 99Mo

Njeri Edwards (Prairie View A&M University)
Texas Research Expanding Nuclear Diversity (TREND)
Research Advisors: Aldo Bonasera, Marcia Rodrigues

By using inverse kinematics, the goal is to successfully produce the ion 99Mo from a 100Mo ion beam. 99Mo is used as a medical radioisotope and is very important in nuclear medicine. The experiment took place in the K500 Superconducting cyclotron facility at the Texas A&M Cyclotron Institute. The 100Mo beam enters the gas cell target of 4He at 12 MeV/u and as it goes through the gas is then cooled to 77K with the gas pressures at 102Torr, 213Torr, and 1009Torr. The first 2 sources react with a gas target of low gas density. The third source reacts with a gas target of a higher gas density, showing energy loss. The beam hits a thick Al target where the isotopes are collected. The beam intensity, the live, real and cool time of the beam are measured and the end of bombardment which is the the activity of the beam. The probability of a reaction is calculated by finding the cross-sections for each source. The reactions that took place in the 4He gas cell were, α(100Mo,5He)99Mo, α(100Mo, 5Li)99Nb□(→┴(β-(T 1/2=15s)))99Mo, 27Al(100Mo,28Al)99Mo, and 27Al(100Mo,28Si) 99Nb□(→┴(β-(T 1/2=15s)))99Mo Along with 99Mo, 24Na, 28Mg, and 103Ru were also produced with the same γ-line energy. With these findings, there is hope of being able to produce isotopes as beams with higher energy.

63. Search for States in 23Na above the Proton Threshold

Diana Carrasco-Rojas (The University of Texas at El Paso (UTEP))
Texas Research Expanding Nuclear Diversity (TREND)
Research Advisors: Philip Adsley, Jorge Lopez

Globular clusters are dense groups of stars that exist near the galactic plane. Understanding their history and evolution sheds light on the history and evolution of galaxies. The presently observed stars contain elements resulting from previously unknown polluting sites. Identifying those polluting sites requires improved knowledge of nuclear reaction rates. One important rate is the 22Ne(p, gamma) reaction. There are several unmeasured resonances lying just above the proton threshold for this reaction, and although many studies have been already conducted, resonances at Ecm = 68 and 100 keV (8894 and 8862 keV excited states) have not yet been confirmed. These potential resonances, which are based on two tentatively observed states in the compound nucleus 23Na, have never been observed. In fact, it is unclear if the underlying states giving rise to these resonances even exist. These resonances have a large influence on the reaction-rate uncertainty and predicted final abundances, depending on whether they are included in the final rate. For this experiment, we performed a new high-resolution study where a magnetic spectrograph was used to search for states above the proton threshold in 23Na via the

23Na(p,p')23Na reaction, using this reaction due to its low selectivity to the structure of the excited states. Investigation into the existence of these states in the existing data is being performed. Preliminary results will be shown, to be later followed up with direct or indirect measurements of the resonance parameters.

64. Normalizing Flows for Generative Modeling of the Nucleon-Nucleon Interaction

Maggie Li (Cornell University) and Irving Silva (University of Texas at El Paso)
Texas A&M Cyclotron Institute REU
Research Advisors: Jeremy Holt, Pengsheng Wen

Over the past decade, chiral effective field theory has been extensively used to derive models of nuclear two-body and many-body forces. The choice of resolution scale and the associated high-momentum regulating function in chiral nuclear interactions are in principle arbitrary and represent a source of uncertainty in the calculation of nuclear many-body observables. Systematically accounting for uncertainties due to the choice of regulating function is challenging, and in the present work we explore the use of generative modeling to propose new interactions based on a set of training samples. Using normalizing-flow models (NFs) from machine learning, we seek to create a model that can learn a distribution of matrix elements for any appropriate cutoff value, from which we can sample new effective potentials for different cutoffs. We attempt two different NF architectures, the Glow model [1] and a similar model without multi-scale architecture. As a test case, the models are trained on a set of low-momentum and similarity renormalization group evolved potentials. We show the effectiveness of the NF models by reconstructing the initial potentials and generating new matrix elements for validation samples. Future work will involve testing the models on a set of high-precision chiral nuclear forces.

[1] Kingma, D. P., & Dhariwal, P. (2018). Glow: Generative flow with invertible 1x1 convolutions. arXiv. Retrieved from https://arxiv.org/abs/1807.03039 DOI: 10.48550/ARXIV.1807.030

65. Coalescence Probabilities of Polarized and Unpolarized Mesons

Sophia Sauceda (Texas Lutheran University)
Texas Research Expanding Nuclear Diversity (TREND)
Research Advisors: Rainer Fries, Toni Sauncy

The recombination of two particles into angular momentum eigenstates in a 3D isotropic harmonic oscillator potential was explored. Recently, the probabilities for coalescence of two particles into a bound state with well-defined angular momentum quantum number l, and summed over the magnetic quantum number m, where the particles are represented by generic wave packets, was computed in "Angular momentum of the isotropic 3-D harmonic oscillator: Phase-Space-Distributions and coalescence probabilities" [Kordell II, Fries, and Ko, Ann. Phys. 443, 168960 (2022)]. We have added to this work by computing probabilities dependent on m, which allows us to consider the polarization of mesons coalescing from quarks. We have utilized Monte Carlo integration to compute the spectrum of mesons if the initial quarks are given by thermal distributions with various temperatures and collective motion. We have tested our Monte Carlo integration in limiting cases where analytic results are known.

In particular, we explore the relationship of collective vortical motion of quarks and the polarizations of mesons.

66. Constructing a Microwave Camera to Explore the Behavior of ECR Ion Sources

Alexander Pantoja (Texas Lutheran University)
Texas Research Expanding Nuclear Diversity (TREND)
Research Advisors: Carl Gagliardi, Ethan Henderson

This research focuses on developing computer control and data acquisition used for a microwave camera observing plasma inside Electron Cyclotron Resonance Ion Sources (ECRIS). A Python Graphic User Interface (GUI), microcontroller-based signals generator for hardware timing pulses, a scalable configuration system, designing a Printed Circuit Board (PCB), and interfacing for a set of SignalHound spectrum analyzers are necessary for the microwave camera to observe the plasma. The GUI allows the user to update the configuration files that will be accessed by the microcontrollers for the timing pulse scheme sent to Radio Frequency (RF) Bandpass Filters. The SignalHound spectrum analyzers will also be incorporated into the timing pulse scheme by synchronizing with the accompanying microcontrollers and gathering information from the Intermediate Frequency (IF) multiplexers. The configuration system creates the files that will be accessed and amended by the GUI and pass onto the microcontrollers for the timing pulse scheme. The PCB is custom made in KiCAD software to interface with the microcontrollers and to assist in constructing a data capture tower. Determining achievable frame rates by the receiver electronics will inform which dynamic plasma processes can be observed as part of Ethan Henderson’s doctoral research.

67. Mapping a Dual Axis Duo Lateral Position Sensitive Silicon Detector

Sebastian Regener (Texas A&M University)
Texas Research Expanding Nuclear Diversity (TREND)
Research Advisors: Alan McIntosh, Sherry Yennello

A Dual Axis Duo Lateral (DADL) position sensitive silicon detector, used in the Forward Array Using Silicon Technology (FAUST), was developed to record data on position and energy as high energy charged particles pass through. In the process the particle encounters multiple materials that contribute to energy loss, including the varying thickness of the silicon and aluminum dead layers within the DADL. Mapping these two materials across the face of the DADL results in improved energy and position resolution. This process involved comparing energy loss data at different dead layer thicknesses and resultant particle energy throughout the face of the detector. Identifying these variables required us to be able to maximize our resolution to the manufacturer’s specification for the silicon detector. Furthermore, we have constructed, tested, and analyzed different biasing configurations for the DADL to see if an improvement to energy and position resolution could be made to the current configuration used in the FAUST array. The primary motivation for the improved resolution in this work is to enhance the mapping of the dead layer thicknesses. Current findings demonstrate a requirement for a 1.5 keV or less energy resolution to map these materials to a dead layer thickness variation of 100 Angstrom across the face of the silicon.

68. Highly-segmented Electron-positron Telescope Array

Daniela Ramirez Chavez (University of Texas at El Paso)
Texas Research Expanding Nuclear Diversity (TREND)
Research Advisors: Grigory Rogachev, Aldo Bonasera

A new array to study electron-positron pair production in nuclear reactions is being constructed at the Cyclotron Institute, Texas A&M University. The array is suitable for a wide range of experiments. One of the first projects planned for the new setup is validation of the recent claim for observation of the hypothetical X17 "dark boson" particle in the decay of the highly excited state of 8Be [Ref1]. Investigation of the production of electron-positron pairs in light-ion collisions below the Coulomb barrier [Ref2] and studies of monopole transition probabilities is also envisioned. The design consists of four highly-segmented double-sided silicon strip detectors (DSSDs) having 128x128 channels, each backed by 9 CsI(Tl) scintillator crystals (36 in total). A Monte Carlo simulation of the setup, combined with the experimental data obtained with the prototype with an electron source, will be presented, and the performance of the detector will be discussed.

[Ref1] A. J. Krasznahorkay et al. Phys. Rev. Lett. 116, 042501 (2016).

[Ref2] T. Settlemyre, H. Zheng and A. Bonasera, Nucl. Phys. A 1015, 122282 (2021).

69. Characterization of a Mechanically Imposed High Entropy Alloy

Jillian Bennett (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisors: Amine Benzerga, Ahmed Ataya

Characterization of a high entropy alloy is used to observe void nucleation due to mechanical testing imposed on the sample. The problem in question is how voids and grain boundaries change in size in this alloy when put under tension. Five samples of CrMnFeCoNi of varying gauge lengths were tested. These consisted of two smooth bars, two RN-2 bars, and one RN-10 bar. One of the smooth bars and one of the RN-2 bars were interrupted at testing and the remaining were tested to failure. We found that the average grain sizes for the RN-2 sample were the most sizable and the RN-10 and smooth bars varied too closely to accurately compare. Additionally, the voids nucleated toward the fracture site and had incomparible densities throughout the fracture sites.

70. Electrified Tribology

Sean Skowron (University of Florida)
Undergraduate Summer Research Grant (USRG)
Research Advisors: Ali Erdemir, Leonardo Farfan

Efforts to reduce friction play a large role in increasing fuel efficiency in vehicles. One major source of friction in automobiles is in the drivetrain. The increased prevalence of electric motors used to power vehicles presents new challenges to mitigating this friction. There is a voltage at the shaft of an electric motor that can cause an electrical current to pass through the gears of a transmission. More needs to be understood on the role an electrical current plays in the friction coefficients and wear of components in a drivetrain. In this paper, we compare friction coefficient (CoF) and wear with and without electrification on 52100 steel. A pin-on-disk tribometer is used to measure the CoF and wear is measured with both a 3-D profiler and analytical methods. Tests were done both dry and with several kinds of lubricants. A synthetic ATF and two kinds of base lubricants - PAO2 and PAO10 were used. Wear was measured on both the spherical pin and the disk. Preliminary results suggest that electrification increases wear by twofold and increases CoF by about 50%. Further research is needed to find ways to mitigate these increases.

71. Detonation Tube Research, Design, and Construction

Travis Gallington (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Scott Jackson

This paper details the research, design, construction, and use of a combustion tube in order to study the transient nature of detonations in a controlled, contained environment. Detonations are normally difficult to research and require special engineering design analysis due their extreme nature. A methodology for the design of a detonation tube is presented that relies on a combination of prior theory and empirical measurements. Through literature search the approach is validated against prior successful designs and analyzed with finite element model analysis via Ansys code suite. A detonation tube was designed in this fashion to withstand a 33.8 bar dynamic loading with a 100 millimeter inner diameter. This will allow the tube to accommodate detonation experiments at an initial pressure of 338 bar. The underlying theory, design methodology, and FEM results are presented.

72. Absorption Spectroscopy Modeling of a Supersonic Expansion Flow Path with Transition to Free Molecular Flow for Beam Propulsion Experiments

Eric Comstock (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Christopher Limbach

Interstellar travel has long been a great dream of humanity and perhaps the greatest technological challenge in spaceflight. One potential method of achieving this dream is through beamed propulsion,

an approach which uniquely circumvents the rocket equation by producing thrust via an extended beam projected from facilities on or near Earth to propel a ship. While both laser and particle beams have been considered previously, a new approach to the problem using a combined laser and particle beam was recently introduced as a way to mitigate beam divergence. This mode of propulsion, based on self-channeling generated by refraction and optical forces, may provide advantages in propulsion efficiency and beam system requirements. At the ALLEMO laboratory, research into the refractive and mechanical interactions between laser and atomic beams utilizes an apparatus designed to produce a collimated low-density atomic flow. In this poster, methods for characterizing the atomic flow properties and its precursors are analyzed by modeling absorption spectroscopy carried out co-axially with the flow. This model will be used to understand the impact of different flow sections on the absorption spectra and determine the capacity to quantify flow properties in various sections of the apparatus, dependent on the total pressure, total temperature, and gas composition of the flow. These results will then be applied to optimize the experimental configuration being used to study the optical-flow interaction physics.

73. Day in the Life Hardware-In-The-Loop Satellite Simulator

Luke Bedrosian (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Daniel Selva

This paper presents the development of a satellite simulation tool that simulates a "day in the life" in the operations of a satellite to establish the feasibility of a mission concept during Pre-Phase A conceptual mission studies. The paper provides a thorough description of the simulation tool, which propagates a rich satellite state vector which, in addition to position and velocity (or orbital parameters), includes on/off state of significant components, power in/out, battery state of charge, eclipse, and accessible data storage. The simulator includes an interface that executes the flight software at discrete events in the simulation (e.g. attitude corrections) on realistic satellite hardware. In this case, the hardware used is the EyasSat GEN 5 Nanosatellite Simulator and is controlled using COSMOS by Ball Aerospace. The paper discusses simulation performance and its implications for facilitating feasibility checks in early mission concept studies.

74. Turbulent Wedge Infection in Vortex Generator Wakes

Richard Binzley (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Edward White

Vortex generators (VGs) are added to wings and other aerodynamic surfaces to delay boundary-layer separation, resulting in loss of lift and control. Upstream roughness on the surface can cause turbulent wedges to form. This work seeks to determine if there is a mechanism through which a turbulent wedge can destabilize and induce premature transition in the wake of a vortex generator. The premature transition would result in a wider turbulent region over the surface than would be created by the imperfection or VG on their own, and a larger turbulent region means increased drag. Naphthalene flow visualization is used to determine valid configurations of perceived premature transition. Hot-wire anemometry of the boundary layer is used to monitor disturbance evolution and wake interactions. Preliminary naphthalene studies show configurations where the premature transition is likely being observed.

75. Using Titanium Nitride Nanoparticles to Optimize Laser Nanowarming of Vitrified Droplets

Juan Arriaga (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Guillermo Aguilar

Vitrification is a novel approach to rapidly cryopreserve biomaterials without ice formation, which induces mechanical injury to the specimen. This approach requires specific critical cooling and rewarming rates. Vitrification of microvolume samples at the required critical cooling rates has been achieved, however, the rewarming stage remains a challenge. A slow rewarming rate induces thermal gradients leading to devitrification, ice formation during the rewarming stage, destroying the sample. To overcome this, this study proposes using an infrared (IR) laser to nanowarm microliter vitrified water droplets using titanium nitride nanoparticles (TiN NPs) in cryoprotective agent solutions (CPAs) in comparison to gold nanorods (GNRs). To further understand this a simulation of the process was developed in ANSYS Fluent. An internal Gaussian energy component simulated the energy delivered by the IR laser and its subsequent absorption by the mixture. This simulation was compared to previous experiments to calibrate it to match the behavior. The absorption coefficient used in the simulation was calculated using the respective absorption coefficients of water and the TiN NPs under the assumption of a uniform mixture of the two. Additionally, a digital holography setup captured the thermal gradient induced in droplets during IR laser nanowarming experiments. Side-by-side analysis of these recordings and simulations produced an understanding of the temperature gradient induced under various conditions. This cross analysis helped determine the optimal TiN NPs concentration and laser energy to rapidly and uniformly rewarm microliter droplets. These results enhance the nanowarming process of biological samples and enhance future banking of samples.

76. Scalable Selective Solar Absorbers

Zachary Shuler (Syracuse Univeristy)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Dion Antao

As climate change wrecks havoc worldwide, it has become necessary to use renewable resources of energy to replace fossil fuels. Solar energy is one such source of renewable energy. There is enough sunlight that strikes the Earth's surface to theoretically power the entire world. Yet only a small fraction of this sunlight is actually used. Scalable Selective Solar Absorbers are materials that can capture sunlight for conversion into thermal energy for use in different applications. Electromagnetic radiation from the sun typically comes in three forms: UV (ultraviolet), visible light, and infrared radiation. However, many objects that absorb sunlight also emit infrared radiation as their temperature increases. Pyromark is a silicone based black paint that can be applied to solar surfaces. Materials coated in

pyromark excel at absorbing solar energy, but much of the infrared radiation is later emitted, reducing the optical solar to thermal efficiency of the material. The Scalable Selective Solar Absorbers use Copper Oxide nanostructures to absorb UV, visible, and NIR (Near Infrared) radiation while reflecting other forms of infrared radiation. This report will discuss the fabrication of these nanostructures and compare different recipes for producing them. In addition, the samples will be tested using UV-Vis spectroscopy in order to determine which recipe is the best one for the Scalable Selective Solar Absorbers. Finally, the Scalable Selective Solar Absorbers will be tested in ambient conditions outside.

77. Application of Digital Image Correlation Method for Particle Systems Under Compression

Bryce Miller (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Marcia Cooper

Polymer particulate composites with high-solids loadings exhibit complex deformation and fracture behaviors under compression. High-resolution, non-contact measurements of the composite material deformation in 2D and 3D were collected with an integrated digital image correlation (DIC) diagnostic. Image sequences of the material deforming under an applied load were captured by 5.0-megapixel machine vision cameras and processed by the open-source applications of Digital Image Correlation Engine (DICe) and ParaView. A single-camera setup captured image sequences of rigid body translation and uniaxial compression to explore the coupled parameters of speckle size, camera resolution, and surface deformation uncertainty. A stereo-DIC setup using two cameras captured image sequences of non-planar samples of a polymer particulate composite deforming under uniaxial compression. The average DIC-calculated strain shows good agreement with the simultaneous measurement of bulk material strain. Full-field data of strain demonstrates the ability to resolve local variations in deformation behavior on the order of the particle size.

78. Two-Stage Light Gas Gun Compression Piston Velocimetry

Brynn Martin (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Thomas Lacy

The investigation of hypervelocity impacts (HVIs) is essential in understanding the ultra-high strain rate response of materials and structures. Two-stage light gas guns (2SLGGs) can be used to launch projectiles to hypervelocities (≥2.5 km/s) by utilizing a consumable piston to compress a light working gas to extremely high pressures in a pump tube. The release of this high-pressure gas accelerates the projectile to the desired muzzle velocity. 2SLGG muzzle velocity has been and remains difficult to accurately predict due to the intrinsic 2SLGG complexity. Reliable piston velocimetry is a useful tool that permits validation and tuning of 2SLGG performance prediction models. This work presents the development and implementation of an induction coil velocimetry gate (i.e., reverse solenoid), through which a magnet-embedded compression piston travels. As the piston passes through the gate, a change in the magnetic field induces a voltage in the coil that can be detected by an oscilloscope. A single, full-scale feasibility experiment was conducted with a single induction coil gate on the 2SLGG pump tube,

resulting in a clear voltage signal variation due to magnet passage. The final manuscript will include the implementation of multiple induction coil gates along the length of the pump tube, which will provide the ability to derive the temporal and spatial histories of the piston position, velocity, and acceleration.

79. Designing 3D Printed Kerf Structures

William Betts (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Anastasia Muliana

Kerf structures are typically planar structures constructed from stiff materials such as wood and metal. These structures are created with relief cuts to give it unique properties and make it more deformable. Kerf structures also have parameters such as cut shape and cut density that can be altered to change the structure's behavior. This experiment investigated the use of 3D printing to create kerf structures. Introducing a new manufacturing process of these structures enables the exploration of using polymeric materials in kerf structures and modifying their material composition very precisely and easily. The kerf structures were initially tested using Abaqus, a finite element analysis software, that allowed the kerf structures material and geometric properties to be easily manipulated. Kerf structures that were representative of the simulations were then 3D printed and mechanically tested. The mechanical testing results were then compared with the simulation results, and there was a clear correlation between the two sets of data. This process will be reiterated with different properties in finite element analysis to make them resemble the mechanical testing results more accurately. Once the mechanical testing results have very high correlation with the finite element analysis results, material composition of the kerf structures can be optimized along with cut shape and cut density to produce an ideal structure.

80. Operational State Evaluations of an Integral Reactor Unit Via Nominal Parametric Telemetry

Hannah Patz (University of Florida)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Pavel Tsvetkov

The advancement of nuclear reactors has been an effort for a safe source for the zero-carbon energy goal. These advancements have led to the development of several designs that all have a focus on increased safety measures, efficiency, and standardization. Many of these designs demonstrate an integral approach to the reactor design in which components like the steam generators, control rod system and pressurizer are combined into the reactor pressure vessel. One of the main needs of emerging reactor technologies is their ability to sense changes in their operations. Because most of emerging advanced reactors are integral in nature, this effort uses the integral simulator to assess reactor operation characteristics. The iPWR (integral Pressurized Water Reactor) simulator is used in this paper to analyze parametric sensitivities on production characteristics. The paper will focus on different perturbations that are seen throughout the performance characteristics domain due to fluctuations of different reactor operating conditions. The components that were chosen to be perturbed were based on how quickly the simulator responded to the changes as well as the real-life capabilities of changing this measurement. Further analysis of this data provides a model for which performance characteristics have the greatest potential for being an indicator of the security of the reactor.

81. Examining Potential Flaws in Error Detection and Correction within the IP/TCP System

Thomas Dawson (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Pierce Cantrell

Reliable error detection is a cornerstone of any robust computer network as it ensures the accurate transfer of data. Without an effective error detection mechanism in place, there is room for a whole host of potential problems. Today, the most common method of sending important data through a computer network utilizes the Transmission Control Protocol (TCP), which includes a 16-bit checksum based on one's complement addition. While this checksum is easy to compute, it suffers from multiple vulnerabilities pertaining to its ability to detect various types of errors. Fortunately, there are many alternatives to this checksum, including other more effective error detection schemes built around the Cyclic Redundancy Check (CRC). Methods utilizing CRC significantly increase the rate of error detection, however they have typically required more computational power than the default TCP checksum. Recently, major CPU designers such as Intel, ARM, and others have begun to include hardware instructions that greatly improve upon the computational times of the aforementioned alternatives, making them comparable to that of the TCP one's complement checksum. The goal of this research is to first perform a literature review of recent publications pertaining to the speed at which the aforementioned error-detection algorithms, such as the Adler checksum and various software and hardware-based CRC algorithms, can be executed, and to find if any studies had recently been conducted to measure error detection rates for these algorithms. The second major part of this research consists of measuring the speeds at which these various error-detection algorithms can be executed, in order to both examine their feasibility, and to confirm prior measurements of the speeds of these algorithms.

82. INL & DNL Quantification of 12-Bit DAC

Michel Bispo Dos Santos Junior (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Rainer Fink

This study investigated the Integral Nonlinearity (INL) and Differential Nonlinearity in a Digital-To-Analog Converter (DAC). The purpose of the study is to quantify the changes in INL and DNL when the device is put through different humidity and temperature levels, while also quantifying the change when a DAC is older and has been used for a longer time. In order to gather the data to quantify such values, the DAC was connected to the ETS-364 Eagle tester. While the DAC was in a humidity/heat chamber, the student wrote the code to acquire the analog output and then manipulate it to acquire INL and DNL. The code consisted of all the possible digital inputs, while acquiring all of the analog outputs. In order to determine the most effective parameters to test, a design of experiments, or DoE was conducted.

Multiple runs were performed to thoroughly determine the INL and DNL changes in different circumstances.

83. Machine Learning-Based Fast Verilog Code Assessment for FPGA Designs

Jack Walker (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Jiang Hu

Verilog is a common entry point for FPGA design, which is a complicated process of multiple steps. There are various design choices made for each circuit, and several styles of Verilog that can be used to create that design. Each choice is vital when it comes to the final performance of a circuit, but it is impossible to know the extent of these choices until you run the complete design flow - which takes a long time. By creating and training a Machine Learning model to predict clock frequencies of FPGA circuits, it is possible to determine the final circuit performance without needing to complete the lengthy design flow process.

84. Coastal Hazards Impact: Social Vulnerability and Hurricane Impact

Ayanna Rucker (University of Texas)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Maria Koliou

Hurricanes cause tremendous amounts of damage to many people around the United States. Many aspects have been investigated surrounding hurricanes such as social vulnerability, infrastructure impacts, and community impact. Though there is an extensive amount of research done on these topics, there is not a lot of research that focuses on indigenous people in Louisiana. The purpose of this critical literature review is to summarize and identify gaps in the research that has been done on social vulnerability and infrastructure and community impacts for indigenous people in Louisiana. The most common research topics in existing literature are measuring social vulnerability, hurricane or natural disaster impact on vulnerable communities, infrastructure damage, and hurricane impact on community health. Most research focuses on physical and economic impacts on communities. There is a lack of research from the perspective of impacted indigenous communities.

85. Comparison of Carbon Dioxide and Water Vapor Sensors for use in Monitoring Rainforests with UAS

Abdallah Alhalaseh (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Gretchen Miller

Rainforests are an essential part of the plant’s ecosystem, but collecting data about these systems is hampered by challenging field conditions. The access to rainforests is limited due to the dangerous wildlife, steep terrain, and heavy vegetation. The objective of this project is to find the best sensor that could provide the most accurate results for carbon dioxide concentration and relative humidity, and could be installed on an unmanned aerial system (UAS) without hindering the UAS's flying ability. In this study, we developed an experiment method to test the accuracy of the multiple sensors . The testing protocols were as such: first we would have to allow the sensors to settle in their environment for 15 minutes or less. Then, we ran the sensors for 15 minutes before logging any data. Moreover, we would run two sensors at a time; one of them would be the Licor LI-850 (LI-COR Environmental, Lincoln, Nebraska) which is considered the scientific standard, the other one is the sensor we wish to test. Furthermore, the experiment had three different testing environments: an empty lab, an outdoors environment, and an indoors environment with people around the sensors. In this experiment we tested two different sensors against the LI-850: the Aranet4 (Aranet, Aurora, Colorado) and GZAIR CO2 Data Logger (GZAIR, Guangzhou, China). The results indicated that the Aranet4 was accurate and very precise in its measurements. A statistical analysis showed that the variance in CO_2 concentration between the LI-850 and Aranet4 is zero ($p<0.01$) making the Aranet4 the best fit for our research purposes.

86. Electrical Engineering Micro-heaters Research

Daniel Suh (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Sam Palermo

Integrated circuits experience degradation from stress induced leakage (SILC), hot carrier injection (HCI), and total ionizing dose (TID). Moreover, a non-invasive method to restore a circuit to its nominal performance is desired. Heater based annealing is a known method to recover devices from common degradation. More specifically we will explore using MEMs heaters co-packaged with our system to act as an immune system for the chip. This paper outlines the characterization of a particular MEMs heater and presents a PID controlled system used to automatically set temperature outputs for annealing.

87. Spiking Neural Network Enabled Real-time Management of in-situ Curing during the 3D Printing

Schuyler Marshall (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Shiren Wang

This study is focused on Spiking Neural Networks' improving viability in low-trial industrial applications. The purpose of our research was to analyze a specific material's industrial viability before completing a 3D print. By first examining a spiking neural network with a large amount of bearing fault diagnostic data, we were able to use this pre-trained neural network and modify it to our needs. This was critical because the specific material is difficult to obtain and replicate on a mass scale, making the data difficult to produce. Results of this study will show the ideal Power (Watts) and Speed (mm/s) for a specific material can be 3D printed while maintaining an optimal Degree of Cure. A pre-trained neural network allowed data sorting of this material to be possible.

88. The Effects of Norepinephrine Treatment After Spinal Cord Injury

Rafael Elejalde (Texas A&M University)
Independent Research Project
Research Advisor: James Grau

Previously, our lab has examined how nociceptive input after spinal cord injury (SCI) is detrimental to functional recovery. We have gone on to show that pain induces hemorrhage, increased inflammatory markers, and causes tissue loss at the site of injury (Grau et al., 2017). Additionally, we have shown that this pain induces an acute rise in systolic blood pressure after SCI. We hypothesized that this hypertension was driving the increase in hemorrhage seen at the injury site, leading to a decrease in locomotor recovery. To examine this, we used norepinephrine (NE) to pharmacologically induce hypertension 24 hours after a moderate contusion was given at the T10 spinal level in male rats. In experiment 1, 0.5 mg/kg NE or vehicle was administered subcutaneously. In experiment 2, 10 micrograms of NE or vehicle were injected intravenously to assess the effects of different routes of administration. Before drug treatment in both experiments, baseline locomotor function (BBB score) and blood pressure (BP) data were assessed. BP and BBB were evaluated 0, 1, 2, and 3 hours post-treatment. At the end of the experiments, a 1-cm section of the spinal cord, centered at the lesion site, was collected. The tissue was processed for protein analysis, and the extent of the hemorrhage was then evaluated via spectrophotometry. Subjects that received NE post-SCI exhibited a significant impairment in locomotor recovery. Interestingly, this was not associated with a significant increase in hemorrhage. These findings were true regardless of the route of administration.

89. Establishing A Callus-induced Plant Regeneration System from Leaf Explants of Queen's Crapemyrtle (Lagerstroemia speciosa), A Species Resistant to Crapemyrtle Bark Scale (Acanthococcus lagerstroemiae)

Nicholas Zhang (Texas A&M University)
Aggie Research Program
Research Advisor: Hongmin Qin

Crapemyrtle (*Lagerstroemia speciosa*.) is a widely popular flowering tree, especially in warmer climates around the world. One of the largest threats to many different crapemyrtle species in the southern United States is the invasive insect crapemyrtle bark scale (CMBS; *Acanthococcus lagerstroemiae*), which feeds on host phloem. Because of the incredible popularity of these flowering plants, commercial planters and hobbyists alike are in high demand for a CMBS-resistant crapemyrtle cultivar. A previous study conducted by our lab showed that Queen's crapemyrtle (*L. speciosa*) was one of the crapemyrtle species resistant to CMBS. With the goal of transferring these highly advantageous resistances to other crapemyrtle species, we first designed this study to establish an efficient plant regeneration system. Our project outlined four major steps to the regeneration system: initiation of calluses from leaf explants, callus differentiation into adventitious buds, adventitious bud micropropagation, and rooting. The success of our callus-induced regeneration system allows for aseptic in-vitro propagation of Queen's crapemyrtle, paving the way for future genetic transformation experiments.

AFTERNOON SESSION

2:00 PM – 4:00 PM

1. Phytoplankton Assemblage Diversity and Patterns in the Northern Gulf of Mexico

Isabella Brunet (Wellesley College)
Observing the Ocean REU
Research Advisor: Lisa Campbell

Phytoplankton are a highly complex and diverse group of microscopic organisms that make up the base of the aquatic food chain, responsible for supporting marine ecosystems along with human populations. In this study, we examined how phytoplankton community assemblage and diversity change spatially and temporally within the Northern Gulf of Mexico using metabarcoding analysis and imaging flow cytometry. Aboard the R/V Pelican this summer, we collected phytoplankton samples from seawater across 12 stations in the Northern Gulf of Mexico. At each station, we sampled from 3 different depths: surface, chlorophyll maximum, and a deeper depth. We used metabarcoding analysis of the V4 region of the 18S and 16S rRNA for bulk taxonomic annotation of eukaryotic and prokaryotic phytoplankton, respectively, in these samples. In the summers of 2016 through 2019, imaging flow cytometry data were collected using the Imaging FlowCytobot (IFCB) aboard research cruises following the same transects as this year's cruise. This year's metabarcoding data and the past IFCB data were compared to analyze variation with distance from the coast and change across this span of time.

2. Colloidal Trace Metals in the Central Pacific

Catherine Kaylor (Texas A&M University)
Observing the Ocean REU
Research Advisor: Jessica Fitzsimmons

Trace metals (Fe, Zn, Cu, Co, Ni and Mn) act as essential micronutrients for phytoplankton, the foundation of the marine food web, in photosynthesis, nitrogen fixation, and respiration. Not all trace elements act as micronutrients, with some metals (Pb and Cd) having adverse effects on the marine environment through anthropogenic contamination. Studying the distribution of trace metals throughout the global ocean is critical to estimating ecosystem health and understanding biogeochemical processes. Metals can be partitioned into three size classes: soluble, colloidal, and particulate. Dissolved metals (<0.2 um) consist of both soluble ("truly dissolved;" <0.003 um ~10 kDa) and colloidal phases (0.003 – 0.2 um). Colloids are tiny particles that are still small enough to pass through the 0.2 um dissolved filter membrane; they are considered an intermediary between soluble and particulate. The size partitioning of trace metals is important because it impacts the fate and lifetime of different elements, particularly their availability to be taken up by phytoplankton. In this study, the concentration of colloidal trace metals in the central Pacific Ocean is compared to the colloidal composition of trace elements in other basins including the South Pacific, Atlantic, and Arctic Oceans. Seawater samples were collected on the GEOTRACES Pacific Meridional Transect cruise conducted along the 152°W meridian of the central Pacific Ocean from Alaska to Tahiti in Fall 2018. This cruise was the first basin-scale meridional trace element analysis in the Pacific Ocean covering a wide range of biogeochemical features allowing for the analysis of differences in inter-basin colloidal composition.

3. Analysis of Chromophoric Dissolved Organic Matter (CDOM) in the Northern Gulf of Mexico

Alexandra Larson (University of Tampa)
Observing the Ocean REU
Research Advisor: Gerardo Gold-Bouchot

Chromophoric dissolved organic matter (CDOM) is a subset of the larger pool of dissolved organic carbon within aquatic ecosystems that absorbs light at UV-visible wavelengths and has a subfraction that fluoresces (FDOM). CDOM enters the ocean through different sources, including rivers and microbial activity, and contributes to a variety of biogeochemical processes, including carbon cycling. This research aims to better understand the type of CDOM present at various locations and depths in the northern Gulf of Mexico, and investigate any correlations between CDOM type or concentration and factors such as salinity, dissolved oxygen, and AOU. Samples were collected throughout the northern Gulf of Mexico during cruises in 2018, 2019, and 2022. These samples were run in a Horiba Aqualog fluorometer to produce fluorescence and absorbance spectra. The fluorescence data was used to extract Coble's peaks to identify the composition of CDOM at each site and depth, and better understand its source. Additionally, the absorption results will provide insight into the aromaticity, concentration, and relative molecular weight of the molecules present. It was found that the CDOM properties changed at each depth and site with some types of CDOM such as Coble's peak B, a protein-like molecule, decreasing in intensity over the three years that samples were taken. With this research, the goal will be to determine the ways in which CDOM is affected by the aforementioned factors and analyze the current and past distribution of CDOM in the northern Gulf of Mexico.

4. No Oxygen, No Problem? The Assessment of Dinoflagellate Behavior in the Presence of Hypoxia

Robert Clegg (University of South Carolina)
Observing the Ocean REU
Research Advisor: Darren Henrichs

Hypoxic regions of the coastal ocean, often referred to as 'dead zones,' are expected to increase in size and duration in the future yet it is unclear how plankton populations, including toxic dinoflagellates, will respond to these changes. During a summer research cruise in the northern Gulf of Mexico, Prorocentrum texanum, a toxic dinoflagellate, was observed at high abundances within a hypoxic layer. While many dinoflagellate species are autotrophic, their correlation with levels of low dissolved oxygen is not well studied. The aim of this study was to further understand how P. texanum behaves in the presence of hypoxia. Laboratory mesocosms were used to test the vertical migration behavior of P. texanum in normal oxic conditions and hypoxic conditions. The cells were recorded throughout their diurnal cycle to quantify their concentrations in varying salinity and dissolved oxygen levels. Preliminary data has shown cell concentrations increase at depth after sunset, consistent with prior work that suggests some species of dinoflagellates migrate downwards in the water column at night to maximize nutrient absorption. In hypoxic mesocosms, cells migrate further from hypoxia compared to experiments with oxic conditions. If dinoflagellates are benefiting in the presence of hypoxia, future harmful algal blooms could be enhanced.

5. Comparing the Most Likely Path of Tracers in Laminar and Turbulent Flow

Sarah Bellefleur (St. Lawrence University)
Observing the Ocean REU
Research Advisor: Spencer Jones

Understanding the paths of ocean currents is crucial to understanding how tracers move. Transition matrices have proven effective at showing the general circulation patterns, however the objective of this research is to expand upon that method and understand the exact pathway that tracers take between specific points. Furthermore, this research will compare these pathways in both laminar and turbulent flow. Understanding the most likely paths of tracers can help in predicting the location of missing objects, pollution, and biogeochemical tracers (McAdam & van Sebille, 2018). The dataset used for this project came from the Barotropic Ocean Gyre Model from MITgcm (Massachusetts Institute of Technology General Circulation Model) through which particles were advected and their trajectories were recorded (Adcroft et al., 2018). To develop the algorithm for the most likely path, Dijksta's shortest path algorithm was modified and run in python.

6. Investigating Spatial Representation of Sea Ice Concentrations at Coastal Sites in the Western Antarctic Peninsula

Carly Casper (North Central College)
Observing the Ocean REU
Research Advisor: Andrew Klein

In 2019, an expedition to the Western Antarctic Peninsula investigated the macroalgal distribution on a latitudinal gradient (64°-69° S) by sampling fifteen coastal sites. The study found a strong negative correlation between total macroalgal cover and sea ice concentration. However, the remote sensing derived sea ice datasets of sea ice concentrations have coarse spatial resolution (25 kilometers on a side) compared to the size of the sampling sites themselves which are only a few hundred meters across. To investigate differences in measured sea ice concentrations across the difference in these two spatial scales, moderate spatial resolution Landsat satellite imagers (30 meters on a side) will be used to determine how representative the large footprint sea ice concentrations are of the small sampling sites. The initial hypothesis is that this large footprint will likely not be representative of these sites in terms of their sea ice concentration. An algorithm based on a Normalized Difference Snow Index (NDSI) approach enables images in GIS to be classified as either sea ice, clouds, or ocean and will aid in testing this hypothesis. In general, the initial findings indicate the larger the area considered, the lower the sea ice concentrations.

7. PFAS Everywhere: A Spatial Analysis of PFAS in Galveston Bay and the Northern Gulf of Mexico

Brittany Pan (Harvey Mudd College)
Observing the Ocean REU
Research Advisor: Yina Liu

Per- and polyfluoroalkyl substances (PFAS) are a group of over 5000 synthetic compounds characterized by their numerous stable carbon-fluorine bonds. Due to their chemical structure, PFAS have water and grease-resistant properties. These properties make PFAS useful in many applications including water-resistant clothing, cookware, food packaging, and fire-fighting foams. Unfortunately, due to the extensive use of PFAS in manufactured products, there are many opportunities for PFAS to contaminate the environment. This is concerning because PFAS are subject to bioaccumulation and biomagnification in the food chain. Exposure to PFAS has been linked to numerous health problems for humans and wildlife including cancers, thyroid disease, and reproductive issues. Recently the U.S. EPA released a health advisory which suggested that even at near-zero levels in drinking water, two well-known types of PFAS pose risks to human health. This advisory is especially concerning considering that the health effects of many other types of PFAS are not well understood. Given the known and unknown risks PFAS exposure poses to human and marine life, it is increasingly important to understand the diversity and concentrations of PFAS in marine environments. The goal of this project is to compare the diversity and concentrations of PFAS found in Galveston Bay with those found in the open ocean of the Northern Gulf of Mexico. In doing so, this project will add to the currently limited understanding of PFAS transport in the ocean. This will be important for estimating exposure and conducting remediation efforts for PFAS.

8. The World's Least Understood Carbon Sink; Analysis of Peat through Novel Compound Discovery

Iris Parke (Marymount Manhattan College)
Observing the Ocean REU
Research Advisor: Yina Liu

Peatlands, which are defined as an area of land with high peat accumulation, cover only 3 percent of the land on earth but store 24 percent of the global soil carbon. Organic carbon decomposition is slow in peat's ecosystem which allows peat to become a stable carbon reservoir for thousands of years and a statistically significant carbon sink. However, the mechanisms for carbon storage in peatlands is poorly understood. The objective for this project is to further understand how peat stores carbon for long timescales by studying its chemical composition on the molecular level. Prior research has suggested that peat retains organohalides, an organic compound that contains at least one halogen. A study done through X-ray absorption near edge structure spectroscopy on a southern Chilean peat core, which dates back to thousands of years before present, has shown that organobromine is enriched with depth. This research aims to test our hypothesis that this organohalide enrichment is due to the organic carbon being halogenated overtime within peat. For this project, two southern Chilean peat cores were analyzed to investigate the chemical characterization of halogenated organic compounds. The peat samples were freeze dried, homogenized, and sonicated with methanol and dichloromethane prior to analysis. Ultra high performance liquid-chromatography quadrupole time-of-flight mass spectrometry was used to analyze the peat samples.

9. Spatial and Temporal Trends of Aqueous Methane and Nitrous Oxide in the Northern Gulf of Mexico

William Love (University of Tampa)
Observing the Ocean REU
Research Advisor: Shari Yvon-Lewis

Nitrous oxide and methane are potent greenhouse gasses that account for a combined 18 percent of global warming worldwide. Nitrous oxide has a global warming potential that is 300 times higher than carbon dioxide, and methane is 23 times higher. Additionally, nitrous oxide has a lifetime of up to 120 years in the atmosphere, which is a longer lifespan than most other greenhouse gasses. In the northern Gulf of Mexico, nitrous oxide is produced through nitrification and denitrification, while methane is produced by methanogenesis or methylphosphonate decomposition. These processes are all regulated by bacteria. Production of nitrous oxide and methane occurs in the Gulf of Mexico which makes it a net source to the atmosphere. In June 2022, water samples were collected during a 3 day research cruise along the Texas-Louisiana shelf in the northern Gulf of Mexico. These water samples were preserved through mercury poisoning and then analyzed using headspace gas chromatography with electron capture detection and flame ionization detection to determine the gasses' concentrations. These concentrations were partnered with wind speed and atmospheric concentrations from the National Oceanic and Atmospheric Administration Global Monitoring Laboratory to calculate the sea-to-air flux. Furthermore, the concentrations were compared to parameters such as dissolved oxygen, salinity, depth, location, and nutrient concentrations. Finally, contrasts were run between data collected and identical transects conducted in the northern Gulf of Mexico in 2018 and 2019.

10. Expressing Insecticidal Toxins in Aedes aegypti Cells

Tere'zan lewis (Prairie View A&M University)
REEU Diversity in Entomology
Research Advisor: Zach Adelman

Aedes aegypti is a vector of viruses such as dengue and yellow fever. Historically, insecticides have been the primary method for suppressing disease spread, but mosquito populations have grown increasingly resistant. Insecticidal peptides from venomous animals have become attractive candidates for control, but many of these peptides have only been isolated from crude venom due to limited genomic information and challenges with protein synthesis and expression. The ability to express these peptides in insect cells would provide a cost-effective and feasible means for furthering their analysis and potential application. In this study, we sought to generate toxin mRNA via transfection of *Ae. aegypti adults* and cells. Using eight toxin-expressing plasmids, we transfected A20 cells, isolated the RNA, and generated cDNA. Presently, we are transfecting the bodies of adult *Ae. aegypti* females via thoracic injections for the isolation of RNA and generation of cDNA. Using RT-PCR, we will amplify the cDNA of each toxin with gene-specific primers. Our expectation is that if the toxins are being expressed correctly, we should be able to the detect the presence of their mRNA. This is important because previous attempts to detect and isolate the toxin peptides from A20 cells have been fruitless. If successful, this study will help elucidate where the expression failure is occurring. Also, whole body transfection of adult mosquitos is a method that has been minimally explored in vector biology. Standardization of this method could potentiate the study of genes and their elements in adult mosquito vectors without generating transgenics.

11. Can Drought Shield Hay Grasses from Fall Armyworm Pests?

Clayton Terry (Prairie View A&M University)
REEU Diversity in Entomology
Research Advisors: Anjel Helms, Julio Bernal

Forage and hay grasses for livestock feed are a major industry across the United States. In Texas alone, in 2008, 4.4 million acres of hay were harvested, with a value estimated at $1 billion. Fall armyworms (*Spodoptera frugiperda*) are a major pest of many crop species including hay grass pastures in Texas. Fall armyworm infestations can damage entire fields within in two or three days, causing major losses. Many regions across the U.S. are experiencing increasingly severe weather conditions, including less predictable rainfall events and droughts. Because water is an essential resource for plants, drought stress can negatively impact plants in a variety of ways. For example, waters tress can reduce plant growth, alter plant nutrients, and alter plant defense chemicals. The goal of this research is to investigate how water stress affects the interactions between hay grass and fall armyworms. More specifically, I am evaluating insect preference and performance on two different varieties of grass grown for hay in Texas (pearl millet—which is a drought tolerant variety—and brown top millet—which prefers wetter soils) under irrigated and drought stressed conditions. I predict that fall armyworm will perform better and prefer wellwatered plants over water-stressed plants. I expect water-stressed plants to have elevated defense levels and reduced nutrient contents that negatively affect fall armyworm. To test this hypothesis, I am conducting choice tests and performance bioassays with fall armyworm. I am also analyzing plant growth and defense traits. This research will provide better insights into plant resistance against fall armyworm across different environmental conditions

12. Differences in Africanized and European Honeybees (Apis mellifera): Visitation of Larval Cells by Nurses

Ashyaa Brown (Prairie View A&M University)
REEU Diversity in Entomology
Research Advisor: Juliana Rangel

The European honey bee (*Apis mellifera*) is an important global pollinator and is responsible for approximately 200 billion dollars' worth of pollinating services per year. The European honey bee is separated into several subspecies. The Africanized honey bee is characterized as a “killer bee” and is infamously known for its aggressive behaviors when compared to its’ European counterparts. They are known to swarm in large numbers and follow threats to the hive for longer distances. It is difficult to tell the difference between the two subspecies unless they undergo mitotyping within a laboratory setting.

In this study we observed that there are several behavioral differences within the feeding behaviors of nurse bees in the different subspecies. Using scan sampling, we were able to identify visitation rates of nurse bees tending to larvae in their several stages of development. Understanding the visitation rates between these species will allow us to further understand differences in their effectiveness in combating parasites, such as the Varroa mite (Varroa destructor). The study will allow us to expand insight to provide further insight into observable differences between the two mitotypes, increasing our understanding of the separate lineages.

13. Study Proliferation in the Development of New Blood Vessels

Solimar Alvarez Cruz (University of Puerto Rico Aguadilla)
Summer Undergraduate Research in Genetics and Genomics (SURGe)
Research Advisor: Kayla J. Bayless

A single layer of endothelial cells lines the vascular system and acts as a barrier to control the movement of fluids and macromolecules to all tissues. With injury or disease, new blood vessel growth (i.e., angiogenesis) occurs. Endothelial cells emerge from existing vessels during angiogenesis and differentiate into tip and stalk cells. Although high growth factors are present in Angiogenesis, it has been reported in mouse retinal angiogenesis models that tip cells do not divide. We would like to determine if proliferation is also halted during tip cell differentiation in human endothelial cells. The first step is to prove that primary human endothelial cells budding in three-dimensional (3D) model collagen behave similarly to tip cells in mouse retinal angiogenesis. The objective is to accurately count the percentage of dividing cells that are invasive or non-invasive. The hypothesis is that invading cells are tip cells and divide less than non-invading cells. Using a FUCCI reporter, Edu labeling, and tubulin stain, cells were collected at 5,10, and 15 hours. Cells were assigned to G0/G1, S, and G2/M phases of the cell cycle using confocal images. We found that cells S phase at a significantly lower rate than the non-invasive cells, and thus invading cells proliferate less than non-invading cells. These data show the 3d model is reliable for reproducing the tip cell phenotype and can be used to study the mechanism(s) that regulate this phenomenon and build a foundation for future therapies to control angiogenesis.

14. Role of Inorganic Biomaterials on Osteogenic Differentiation of Human Mesenchymal Stem Cells

Melissa Mackelprang (University of Georgia)
Summer Undergraduate Research in Genetics and Genomics (SURGe)
Research Advisor: Akhilesh Gaharwar

Minerals have long played a vital role in maintaining homeostasis by working synergistically with enzymes and other cofactors to regulate physiological functions. The inherent bioactivity of nanomaterials based on these minerals can be harnessed to promote successful tissue regeneration by serving as an attractant to endogenous stem cell populations thereby directing tissue-specific healing. Here, we investigate cellular responses of human mesenchymal stem cells (hMSCs) to traditional bioactive mineral-based nanomaterials, such as hydroxyapatite (nHA), whitlockite (nWH), silicon-dioxide (nSiO2), and the emerging synthetic 2D nanosilicates (nSi). We assess and compare the efficacy of each of these nanomaterials in maintaining the viability and promoting the osteogenic differentiation of bone marrow derived human mesenchymal stems (BM-hMSCs). Unique cellular pathways that are differentially regulated by each of these ceramic nanomaterials were identified previously by the lab and are being validated at gene and protein levels in the current research. We will be using a combination of quantitative real-time polymerase chain reaction (qRT-PCR), enzyme linked immunosorbent assays (ELISAs), immunocytochemistry (ICC) and functional assays against various markers of osteogenic commitment of hMSCs. This will allow us to compare and contrast the pro-osteogenic capabilities of these nanomaterials at the cellular and molecular levels during various time points of the differentiation process. An in-depth understanding of this will enable researchers to design better bioinstructive nanomaterials to direct in situ tissue repair.

15. Analysis of dfTAT-TMR Peptide for Enhancement of Cellular Delivery Through Endosomal Escape

Danielle LaVigne (Clemson University)
Summer Undergraduate Research in Genetics and Genomics (SURGe)
Research Advisor: Cédric Geoffroy

A common practice in biological studies includes delivering various substances to cells, where effective delivery can become a challenge. A cargo is any substance that is being delivered, such as proteins, viruses, and nucleic acids. When delivering cargos into cells, these cargos typically end up in the endosome where they become trapped and unable to reach their intended target, for example the cytosol. dfTAT-TMR is a dimeric cell-penetrating peptide that is able to permeabilize membranes, where TAT stands for transactivating transcription. TMR gives the dfTAT red coloring which can be tracked through fluorescence microscopy. By transfecting various cargos into different neural cell lines along with dfTAT, we hypothesize that dfTAT will help penetrate the endosomal membrane allowing the cargos to be released into the cytosol with a higher efficiency than those cells transfected without dfTAT. Two different dfTAT concentrations were tested with various cargos tagged with green fluorescence by following an incubation protocol. These cells were then imaged over time to track endosomal escape before being fixed and stained with DAPI in order to quantify the efficiencies of the transfections. By understanding the effects of dfTAT on cellular delivery, further implications could help with the development and delivery of different kinds of drugs. Future studies will be performed to test in vivo delivery with mice as a model organism.

16. Epistatic Screening in Drosophila to Identify Novel Regulators of the Human Wnt Signaling Pathway

Megan Rupp (Biola University)
Summer Undergraduate Research in Genetics and Genomics (SURGe)
Research Advisors: Jason Karpac, Mohamed Mlih

The Wnt signaling pathway is highly implicated in the progression of various cancers, especially colorectal cancer (CRC). Thus, exploring the diverse roles of Wnt signaling in both normal biology and disease pathology remains a critical component of cancer discovery. Compared to traditional disease models, humanized Drosophila can provide highly specific and unique (and sometimes translatable) insight into disease signaling mechanisms by introducing human genes into the Drosophila genome, coupled with functional genomic screening. The Karpac Lab, in collaboration with other labs using murine and human cancer models, has been utilizing humanized Drosophila to explore the role of human Wnt receptor function in CRC. To this end, the lab has also observed that the human LRP6 receptor (hLRP6), one of the co-receptors that initiate Wnt signaling, can uniquely induce activation of Wnt signaling when expressed specifically in Drosophila eye, characterized by a glass eye phenotype and allowing for rapid in vivo epistatic screening. To identify potential novel regulators required for hLRP6 function, we leveraged the hLRP6 eye phenotype in Drosophila to perform a biased genetic screen of the Wnt signaling pathway. Drosophila expressing the hLRP6 receptor specifically in the eye (retinal epithelium) were crossed with a series of RNA interference lines to silence individual components of the canonical Wnt pathway. Our data revealed that only the conserved Drosophila transcription factor TCF/LEF was able to rescue hLRP6 eye phenotype. These results suggest that hLRP6 may be able to activate Wnt signaling through a non-canonical pathway that remains unknown, which may have implications for Wnt/LRP6-driven cancers.

17. Recombination of Organoids using an Adenovirus Containing Cre Recombinase

Megan Patterson (Clemson University)
Summer Undergraduate Research in Genetics and Genomics (SURGe)
Research Advisor: David Threadgill

Colorectal cancer (CRC) is the third most commonly diagnosed cancer and the second highest cause of cancer-related death worldwide. Diagnosis typically comes in advanced clinical stages where treatments are less effective, so the study of mutations commonly associated with CRC is important to identify early markers. In vitro studies of colon cancer are done using organoids derived from multipotent stem cells within intestinal crypts. Mice harboring specific modifications were utilized for obtaining organoids, which contained loxP sites in genes whose mutations are commonly associated with colon cancer. This allows for recombination using Cre recombinase to induce cancerous mutations, which is delivered to the organoids through an adenovirus that expresses the Cre recombinase allele. After harvesting organoids from a mouse containing loxP sites in the APC, KRAS, and TP53 alleles, half of the crypts were exposed to the adenovirus and were left to grow for a week. A difference in the size of the organoids was observed after 10 days, where the ones exposed to the virus are much larger. Further tests will be performed to determine if recombination was successful in the exposed organoids and if potentially cancerous organoids can be maintained through multiple passages.

18. Humanization of Yeast Genes of the Mitochondrial Copper Delivery Pathway to Identify Pathogenic Mutations

Osvaldo Rios (University of Puerto Rico - Mayagüez)
Summer Undergraduate Research in Genetics and Genomics (SURGe)
Research Advisors: Vishal Gohil, Abhinav Swaminathan

Copper is an essential cofactor of cytochrome c oxidase (CcO), the terminal enzyme of the mitochondrial respiratory chain that powers cellular energy production. The delivery of copper to this enzyme is a complex process requiring multiple proteins and loss-of-function mutations in many of these proteins have been identified in patients with fatal infantile disorders. Motivated by the highly conserved nature of the copper delivery pathway proteins, here we aim to develop a “humanized yeast” system to rapidly test the pathogenicity of spontaneous mutations reported in these patients. Towards this goal, we have cloned ten evolutionarily conserved human genes of the mitochondrial copper delivery pathway in a yeast expression vector. Deletion of their corresponding yeast genes results in respiratory growth defect and decreased respiration. We hypothesize that expression of the conserved human protein in their corresponding yeast knockout would restore its respiratory growth and mitochondrial respiration. The successful completion of our work will not only validate the functional conservation of these genes but also offer a facile system to provide rapid molecular diagnosis of rare mitochondrial disorders caused by mutations in these genes.

19. Bond Trading: e-Deal with NO Currency

Xueyan Zheng (Texas A&M University)
Independent Research project
Research Advisor: Marcetta Darensbourg

The chemistry of transition-metal nitrosyl complexes has received much attention in recent decades especially as discoveries that nitric oxide (NO) plays important role in biological processes, such as inflammatory response, nerve signal transduction, angiogenesis etc. have come to the fore. It has been shown that NO-transfer between two metal complexes can occur, depending on the NO-to-metal big constant, ligand geometry, and metal oxidation state. Metal complex NO-transfer chemistry suggests several proposed pathways, but no unambiguous mechanistic conclusion has ever been reached. In this project, a new cobalt nitrosyl complex [Co(NO)(DADT)] (DADT is N,N’-dibenzyl-3,7-diazanonane-1,9-dithiolate) has been synthesized. This new cobalt nitrosyl complex was used to react with a known nickel nitrosyl [Ni(NO)(CH3NO2)3PF6] synthon, and a new bimetallic complex has been synthesized and characterized by using FTIR, UV-vis, mass spectrum, X-Ray diffraction, and cyclic voltammetry. Low temperature reactions and kinetic studies are in progress for the detailed mechanistic understanding of the NO transfer reaction.

20. Cobalt vs. Nickel in Polymetallic, Sulfur-bridged Complexes

David Rodriguez (Texas A&M University)
Independent Research Project
Research Advisors: Marcetta Darensbourg, Paulina Guerrero

Synthetic chemistry advances as the usefulness, scope and breadth, of new synthons are established. Earlier, multimetallic aggregates were shown to be accessible when nickel thiolates were considered as metal-bearing S-donor ligands and connected with acceptor metals. My research has explored the possibility of cobalt, in the form of a nitrosylated Co(III) complex of an N 2 S 2 ligand, derived from a diazacycle, N,N’-bis(mercaptoethyl)-1,5-diazacycloheptate, (bme-dach)Co(NO), to form similar compounds, with an added benefit: infrared spectroscopy might use the ν(NO) stretching vibrational mode as an indicator for binding of exogenous metals. When (bme-dach)Co(NO) is treated with Zn II and Pd II sources, a Co—Pd—Co stair-step structure is revealed for the latter and a direct bimetallic complex, Co-Zn is seen for Zn II. On treatment with Ag I , a C 3 paddlewheel, Ag 2 Co 3 results, similar to the Ag 2 Ni 3 complex, with a structural difference lying on the directionality of the S-lone pair on the metallodithiolate. These distinctive structural forms are compared to the stronger (bme-dach)Ni metallodithiolate donor, stressing the versatility, and predictability, of our synthetic designs for extending transition metal coordination chemistry with a new class of ligands.

21. Adequacy of Undergraduate and Graduate Nursing Education Addressing Firearm Safety: A Scoping Review of the Literature

Mary McDaniel (Texas A&M University)
Nursing Honors Program
Research Advisor: Stacy Drake

The objective of this presentation is to present the results of a scoping review that addressed the educational preparation of nursing students and professional nurses surrounding firearm safety. The research questions are “are nurses adequately prepared to conduct a firearm safety risk assessment?” and “what are the barriers and facilitators nurses identified for addressing firearm safety?”. The scoping review process is directed by the Arksey and O'Malley methodology and JBI Manual for Evidence synthesis search framework. Covidence was used to manage database searches and store articles. A search of four databases resulted in 645 articles to screen. After an initial title and abstract review, and then a full-text review, 15 articles met inclusion criteria. The studies included were; nine surveys, two quasi-experimental, two qualitative, one mixed method, and one systematic review. Seven articles, specifically, addressed nursing education regarding firearm safety. Identified barriers for addressing firearm safety were a lack of time and knowledge as well as a lack of firearm safety resources to equip patients/ families with. Additional barriers for nurses (and other healthcare professionals) to address firearm safety are discomfort or safety concerns resulting from discussing the topic with patients and their family members. Facilitators for addressing firearm safety concerns included the need for increased knowledge and training. It was identified that policies regarding firearm safety are needed from both professional associations and healthcare facilities. The lack of evidence regarding firearm training indicates that further research is needed to determine best practices.

22. To Review the Use of Virtual Reality in Nursing Education

Cristina Canal (Texas A&M University)
Nursing Honors Program
Research Advisor: Jodie Gary

Background: Nursing schools and hospitals have used the concept of role-play simulation to help teach students for over 100 years (Craig, 2019). Technological advances have allowed for simulation with actors and high-fidelity mannequins for a more life-like interaction (Marks, et al,). To resume teaching during the 2020 pandemic, virtual reality (VR) increased drastically in nursing education (Dolan). Schools

bought subscriptions to virtual simulation platforms that could be easily accessed from any computer. Immersive VR simulators have also begun to rise in popularity to allow students a fully safe environment to practice communication, and quick thinking skills without fear of harming a real patient (Rim, 2021). Purpose: The overall purpose of this review literature on the current use of VR in nursing education. Results: Literature was pulled from 2017-2022 including systematic reviews, meta-analysis, and qualitative studies. The presentation will review the details. Conclusion & Recommendations: Overall, VR is being incorporated into nursing education worldwide. It is important to assess the student's perspective on its effectiveness as well as quantitative data to support change in curriculum. Recent literature recommends that VR be implemented in addition to traditional simulation.

23. Evaluating Sexual Assault Nurse Examiner Learning in a Simulated Skills Course

Mary McQuade (Texas A&M University)
Nursing Honors Program
Research Advisors: Stacey Mitchell, Jodie Gary

Sexual Assault Nurse Examiners (SANEs) are Registered Nurses educated to provide comprehensive care to victims and perpetrators of crime. Special training is necessary to develop skills to appropriately document injuries. 40 hours of advanced education and training are necessary to develop skills in injury documentation and include courses such as Survivor symptomatology, Documentation, History taking skills, Evidence collection, Courtroom testimony, and Forensic photography. SANEs must develop competence in forensic photography to effectively capture and document injuries sustained during an assault. A Medical Forensic Photography Bootcamp course, which includes both didactic lecture and hands-on simulation, covers topics of photodocumentation, equipment used, legal forensic considerations, and potential current policy improvement areas. The purpose of this project is to determine the effectiveness of this forensic photography course and to identify areas of improvement following evaluation of its incorporation in the clinical setting.

24. Increasing Nursing Access Across Populations with Technology in Simulation (INPACTS)

Colleen LaRue (Texas A&M University)
Nursing Honors Program
Research Advisors: Elizabeth Wells-Beede, Angela Mulcahy

In 2016, the United States Census Bureau reported the national poverty level was 11.8% while the poverty level for the state of Texas was 14.9%. There are currently 15 Texas counties with poverty levels that exceed both state and national poverty levels with an average of only 0.06% of registered Texas nurses living and working in these medically underserved areas. Individuals living in these areas lack access to quality healthcare which makes managing chronic conditions such as diabetes, hypertension, childhood illness, and mental health difficult. This project aims to implement virtual reality simulation in eight core nursing courses to integrate public health competencies and strengthen value-based care and quality improvement education in the pre-licensure baccalaureate nursing curriculum. By implementing public health competencies and valued based care into virtual reality simulation we hope to improve patient outcomes for those with chronic conditions and prevent the need for recurrent hospitalization.

Due to the acute care nature of our current curriculum many students are unable to educate and provide appropriate care for patients with chronic conditions outside of the immediate hospitalization period. It is our goal that by implementing public health competencies we can provide better care for those in impoverished and medically underserved regions.

25. Live Imaging of Palatal Fusion

Cole Wickham (Cornell College)
College of Dentistry Summer Undergraduate Research Program
Research Advisor: Douglas Benson

The mammalian secondary palate forms from shelves of epithelia-covered mesenchyme that meet at midline and fuse. Failure of the midline epithelial seam (MES) to degrade blocks fusion and causes cleft palate. Recent work in our lab revealed that the MES cells migrate to the oral surface of the seam during fusion in a process that involves their transition to a mesenchymal state. We developed a technique to observe migration of these cells in real time using multi-photon laser scanning confocal microscopy of fusing mouse palates. MES cells were labeled by either addition of Celltracker Green fluorescent dye or by the expression of a green fluorescent protein under control of the ephrin-B2 locus in mutant mice. This system allowed us to visualize MES cell migration far deeper into the tissue and with much less damage than previous microscopic methods, allowing a more complete and accurate view of this essential developmental process. The data acquired with this method will be essential for study of the palatal fusion mechanism.

26. Collagen 9 rtCPR Comparisons of its Long and Short Forms, Between Tubular and Flat Membrane

Samantha Williams (Spelman College)
College of Dentistry Summer Undergraduate Research Program
Research Advisors: Reginald Taylor, Qian Li

Collagen is a common protein in body tissues that contains various forms with different roles to provide structure and strength between cells. Collagen II and IX are typically found together in cartilages for cohesive and compressive properties. However, a(1)IX and its short and long forms have recently been found in the periodontal ligament (PDL) of gums without collagen II being present. Following this discovery, it is crucial to determine type IX's role in the PDL, beginning with examining the expressions of its different forms. Two primer sets were compared after RNA was isolated from tubular and flat membranes for three and seven days. Real-time PCR with TB Green Premix Ex Taq II and the gene-specific primers COL9A1 short (C9), 9A1 EXON 1S long (E1), and GAPDH were completed several times for analysis. The results demonstrated the E1 expression increase in flat membrane from day 3 to day 7, while their tubular membrane decreased, making fewer gene expressions on day 7. The C9 flat membrane increased from day 3 to day 7, while the tubular membrane shows no significant decrease. The flat membrane has more gene expressions for both C9 and E1. Therefore, the flat is suitable for PDL cell culture. The tubular membrane decreased the C9 and E1 gene expression limiting cell growth.

Although some data shared no common tendencies, it is best to continue with more research for further analysis.

27. Identification of Quantitative Trait Loci Associated with Hematological Parameters and Cytokine Levels in Mice

Laurel Boatright (Texas A&M University)
College of Medicine Summer Undergraduate Research Program
Research Advisor: Helene Andrews-Polymenis

Hematological parameters and serum cytokine measurements have clinical utility in the detection and management of various conditions. The misinterpretation of reported ranges can have consequences for accurate diagnoses and treatments. Quantitative trait loci (QTL) are genomic regions containing genes that influence the variation of quantitative traits. We wanted to identify QTL implicated in the variation of complete blood count (CBC) measures and serum cytokine levels. Collaborative Cross (CC) mice are a panel of recombinant inbred mice created for the study of complex traits. Previously, CBC were collected from 511 mice of 32 CC strains (at least 6 males and 6 females per strain) and data for 36 cytokines was collected from the serum of 155 mice of 26 CC strains (3 males and 3 females per strain). Broad-sense heritability ranged from -9.19% to 80.71% and traits with positive scores were used for analysis. Rank-based inverse normal transformed median values for each strain were analyzed using R/qtl2. We discovered a novel QTL associated with circulating neutrophil count on Chromosome (Chr) 6 and a QTL for white blood cell/lymphocyte count on Chr 4. QTLs associated with the levels of 10 serum cytokines were identified on 9 different chromosomes. Candidate genes in these regions were shortlisted by coding region variants, their impact, and SIFT scores. Further investigation is needed to confirm the influence of these QTL. Our ultimate goal is to use this genetic data to better inform the diagnosis and management of different conditions in conjunction with CBC/cytokine information.

28. MicroRNA-27 Remediates Periodontal Disease

Nathan Lazo (The University of Texas Rio Grande Valley)
Summer Undergraduate Research Program (SURP)
Research Advisor: Xianghong Luan

Background: Periodontitis is one of the biggest threats to dental health. The infection is initiated by poor oral hygiene allowing bacteria to build up around the teeth resulting in inflammation. If left untreated, continuous supporting tissue loss can lead to tooth loss. MicroRNAs are known to play key roles in etiology and the progression of many inflammatory diseases, including periodontitis. In this study, we evaluated the ability of miR-27 to modulate periodontal ligament cell functions and bone homeostasis by combining scaffolds with miRNA delivery to promote periodontal tissue formation and bone regeneration. Methods: For in vitro studies, PDL cells were cultured in an osteogenic induction system. Osteogenic differentiation was determined by ALP and ARS. Gene expression was detected by qRT-PCR. For in vivo studies, miR-27 mimic-liposome particles were generated and used to coat collagen sponges which were subcutaneously implanted into the model. Newly regenerated tissues were identified by H&E and Mason trichrome staining. Mineralized tissue was visualized by micro-CT reconstruction. Results: MiR-27 treatment group increased 4 times of BMP7 expression and 3 times PDGF expression.

ALP activity as well as mineral nodule formation were also increased by MiR-27 treatment. In vivo implantation revealed that miR-27 accelerated extracellular matrix remodeling in subcutaneous implants, promoted formation of new blood vessels, and enhanced periodontal tissue formation and bone regeneration. Conclusions: In our studies, miR-27 mimics functioned as a potential bioactive molecule for the regeneration of periodontal tissues. The results indicate that miR-27 might serve as novel agents in the treatment of periodontal disease.

29. Chemogenetic Silencing of Nociceptors to Alleviate Sensory Hyperactivity and Improve Functional Recovery After Spinal Cord Injury

Joseph Hoppe (Texas A&M University), Yahya Kharbat (Texas A&M University)
Independent Research Project
Research Advisors: Jennifer Dulin, Prakruthi Kumar

Chronic neuropathic pain (CNP) affects as high as 80% of spinal cord injury (SCI) patients. CNP is caused by hyperactive peripheral pain-sensing neurons called nociceptors, located in the dorsal root ganglion (DRG), early after injury. Our study utilizes a chemogenetic approach that directly addresses the hyperactive nociceptors, silencing them in the acute phase, with the goal of alleviating neuropathic pain. We also examined if silencing the nociceptors would improve locomotor recovery as well. To test this, we targeted lumbar DRG (L4-L6) nociceptors by introducing inhibitory Designer Receptors Exclusively Activated by Designer Drugs, or Gi-DREADDs, and used adeno-associated 6 viral vector (AAV6) as the delivery mechanism. Bilateral intra-sciatic nerve injections to deliver AAV6-Gi-DREADDs were performed 4 weeks before the thoracic spinal cord contusion in rats. We administered the ligand CNO (clozapine-N-oxide) orally, after the contusion and up to 14 days to activate the Gi-DREADDs. We then performed weekly sensory and locomotor behavioral assessments for a period of 10 weeks following SCI. Behavioral test results showed that early chemogenetic silencing of nociceptors improved hindlimb locomotor recovery while significantly reducing thermal hyperalgesia throughout the subacute phases of injury compared to control subjects. Histological assessments of the thoracic spinal cord tissue showed an increase in CGRP+ axon sprouting and reduced lesion volume in experimental subjects as compared to control SCI subjects. This data suggests that silencing nociceptors early on after SCI may improve neural plasticity and promote better long-term functional outcomes.

30. Effects of Developmentally-Restricted Neural Progenitor Grafts on Recovery of Function Following Spinal Cord Injury

Joshua Moses (Texas A&M University)
Independent Research Project
Research Advisors: Jennifer Dulin, Miriam Aceves

Neural progenitor cells (NPC) have shown great therapeutic potential in experimental models of spinal cord injury (SCI). Our previous research has shown that developmental restriction alters NPC graft composition in a mouse model of SCI. In these studies, embryonic donor NPCs were isolated at distinct stages of development (E11.5, E12.5, and E13.5) and transplanted into lesioned host spinal cord, resulting in different mature graft phenotypes: earlier-stage grafts produced ventral/motor interneuron

subtypes, while later-stage grafts produced dorsal/sensory interneuron subtypes. Importantly, this suggests that different NPC developmental stages may be better suited for restoration of motor or sensory functions disrupted by SCI. To address this, in this experiment we are investigating the effects of NPC developmental restriction on graft-host connectivity and recovery of function. Wild type female mice were given moderate T12 contusions and two weeks later transplanted with developmentally-restricted (E11.5, E12.5, and E13.5) rabies helper grafts. Behavioral assessments of motor (Motion Sequencing, BMS, CatWalk) and sensory (Hargreaves) function were conducted pre-injury as well as post-SCI on a weekly basis and are still ongoing. At the end of a 10-week recovery period, a modified rabies virus expressing a GFP reporter will be injected into graft tissue to enable selective tracing of graft-host connectivity. Here, we show our results to date and preliminary evidence showing proof-of-concept of our rabies system. Overall, the aim of this work is to establish new guidelines for engineering effective cell sources for SCI clinical trials in order to improve recovery in individuals living with an SCI.

31. Using Machine Learning to Identify Novel Circadian Behaviors

Blanca Perez (Brown University)
Independent Research Project
Research Advisor: Jeff Jones

Organisms have evolved circadian rhythms in behavior to anticipate daily opportunities and challenges such as mating and predation. However, the ethological investigation of behavioral rhythms has been traditionally limited to studying easy-to-measure behaviors (such as locomotor activity) on a circadian timescale or difficult-to-measure behaviors with limited temporal resolution. Here we sought to examine eight overt behaviors never before studied as a function of time of day, sex, light cycle, and neuropeptide signaling. We hypothesized that sex and neuropeptide signaling-dependent differences in daily behaviors have been largely missed because of the focus on locomotion. To address this hypothesis, we used high-throughput machine learning to automatically score complex behaviors from millions of video frames of singly-housed mice. We recorded movies from male and female wild-type mice and vasoactive intestinal peptide (VIP)-deficient mice, which lack a neuropeptide critical for circadian synchrony and thus exhibit deficits in circadian wheel-running behavior. Using our model, we discovered that female mice dramatically differed from males in several daily behavioral rhythms. Similarly, Vip-/- mice were markedly different from wild-type mice in most, but not, all, behavioral rhythms. We observed these sex and neuropeptide signalling-dependent differences in the time and amplitude of daily peak activity, total amount of activity, and whether a behavior shows a daily rhythm that is driven by the circadian system. We conclude that several previously-unstudied behavioral rhythms depend on sex, neuropeptide signaling, and ambient light. The method we developed here will allow for the rapid circadian phenotyping of mice with different genotypes or disorders.

32. NH_2* and NH* Chemiluminescence during NH_3 Oxidation in a Shock Tube

Maryam Khan-Ghauri (University College London)
Independent Research Project
Research Advisors: Olivier Mathieu, Eric Petersen

A study was undertaken to measure and model the chemiluminescence of NH_2^* and NH^* to make advancements in the understanding of the combustion of NH_3. The understanding of ammonia combustion has become increasingly popular as the demand for alternative, carbon-free, fuel rises to mitigate global warming. Shock-tube experiments were carried out with a mixture of NH_3 and O_2 highly diluted in Argon. The light released from NH_2^* and NH^* was collected using filters centered at 633 nm and 337 nm, respectively. Experiments were performed at a range of temperatures between approximately 2400 K and 1900 K for both excited species. Within the species, chemiluminescence profiles were normalized to the one obtained at the highest temperatures. A new mechanism was then created to model the normalized experimental profiles. Reactions pertaining to the chemiluminescence sub-mechanisms were identified by determining which reactions were exothermic enough to produce either NH_2^* or NH^* from the ground state species. Thermodynamic data for the excited species were also developed by considering the enthalpy of NH_2^*/NH^* compared to the ground state molecule. This chemiluminescence sub-mechanism was added to a literature mechanism for ammonia known to work well in ammonia pyrolysis and oxidation. The final model significantly underestimates the evolution of chemiluminescence intensity with temperature for NH_2^*. However, the profile shape is similar to that found experimentally. Attempts to improve the intensity are ongoing by looking at the base mechanism and rate coefficients in the mechanism.

33. Effect of Relative Humidity on Enteric Bacteria and its Antibiotic Resistance from Feedyard Cattle Manure

Daniella Garza (Texas A&M University)
Independent Research Project
Research Advisor: Keri Norman

Antimicrobial resistant bacteria have been cultured from dust at cattle feedyards; however, it is unknown how long bacteria remain viable in the dust. Nutrient deficiency, desiccation, ultraviolet light, temperature and pH changes can affect bacterial viability. The objective of this study was to explore the effect of relative humidity (RH) on the desiccation of enteric bacteria. Feedyard manure was collected, half was placed in a NaCl chamber (73 % RH) and the other half in a MgCl chamber (31 % RH). Three samples were received daily for 4 days and processed in triplicate. Samples were diluted, spiral-plated using Eddy Jet® 2, and counted with Flash & Go. Aerobic bacteria were counted in Tryptic Soy Agar, Enterococcus in M-Enterococcus agar (plain, tetracycline (TET) and erythromycin (ERY)). and E. coli in MacConkey agar (plain, TET and ceftriaxone (AXO)) at CLSI/NARMS breakpoints. RESULTS: The highest counts (CFUs) were aerobic bacteria, then *E. coli* and lastly Enterococcus. Mean Aerobic CFUs were not significantly different by treatment, except for on Day 2. Treated *E. coli* mean CFUs were significantly higher than control on plain MacConkey. AXO resistant *E. coli* mean CFUs were lower than TET. *E. coli* mean CFUs were not significantly different by day or treatment. Enterococcus mean CFUs were significantly different by treatment on Days 3 and 4. Enterococcus mean CFUs were also significantly different between treatment on plain and ERY media. Mean log10 bacterial counts showed some significant differences in treatments on particular days or media.

34. Objective Measures of Near Viewing and Light Exposure in Schoolchildren during COVID-19

Divya Shukla (Texas A&M University)
Independent Research Project
Research Advisor: Lisa Ostrin

Purpose: Numerous behavioral factors, including near work, time outdoors, electronic device use, and sleep, have been linked to myopia. The purpose of this study was to assess behaviors using subjective and objective methods in myopic and nonmyopic schoolchildren in the United States. Methods: Forty children (aged 14.6 ± 0.4 years) simultaneously wore two sensors for 1 week, a Clouclip for objective measurement of near viewing and light exposure and an Actiwatch for objective measurement of activity and sleep. Parents completed an activity questionnaire for their child. Near-viewing distance, daily duration, short-duration (>1 minute) and long-duration (>30 minutes) near-viewing episodes, light exposure, time outdoors, electronic device use, and sleep duration were analyzed by refractive error group and day of the week. Results: Objectively measured daily near-viewing duration was 6.9 ± 0.3 hours. Myopes spent more time in near + intermediate viewing than nonmyopes ($P = .008$) and had higher diopter hours ($P = .03$). Short- and long-duration near-viewing episodes were similar between groups ($P < .05$ for both). Daily light exposure and time outdoors were significantly lower for myopes ($P < .05$ for both). Electronic device use (12.0 ± 0.7 hours per day) and sleep duration (8.2 ± 0.2 hours per night) were similar between groups ($P > .05$ for both). Conclusions: Objective and subjective measures confirm that myopic and nonmyopic schoolchildren exhibit different behaviors. Combining wearable sensors with questionnaires provides a comprehensive description of children's visual environment to better understand factors that contribute to myopia.

35. Melatonin Treatment in a Model of Chronic Gulf War Illness Positively Modulates Activated Microglia and Reactive Astrocytes in the Cerebral Cortex

Keerthana Prayaga (Texas A&M University)
Independent Research Project
Research Advisors: Ashok Shetty, Madhu Leelavathi

Gulf War Illness (GWI), a chronic multi-symptom illness affecting ~30% of veterans who served in the first GW, is characterized by enduring brain impairments, likely resulting from persistent neuroinflammation. A previous study reported that melatonin (MEL) treatment could improve brain function in a rat model of chronic GWI through antiinflammatory, neurogenic, and neurotrophic effects within the hippocampus (Madhu et al., Redox Biol, 2021). The current study investigated the effect of MEL treatment on activated microglia and reactive astrocytes, the mediators of chronic neuroinflammation, in the cerebral cortex of rats with chronic GWI. Male Sprague Dawley rats were exposed daily to GWI-related chemicals and restraint stress for 28 days. Six months later, animals were treated with 80 mg/Kg MEL for eight weeks, following which animals were euthanized for brain tissue analysis using immunohistochemistry for IBA-1 (a microglia marker) and GFAP (an astrocyte marker). Microglia and astrocytes in the somatosensory cortex of naïve and GWI rats receiving vehicle or MEL (GWI-Veh or GWI-MEL) were chosen for quantitative analysis. The area and perimeter of microglia were measured through tracing using Neurolucida, and the density of GFAP+ astrocytic structures was quantified using Image J. Microglia displayed processes with extensive ramifications in the GWI-MEL group compared to the hypertrophied soma and processes with reduced ramifications seen in the GWI-Veh group. Furthermore, GFAP+ astrocytic processes were reduced in the GWI-MEL group. The results suggest that MEL treatment in chronic GWI can positively modulate activated microglia and reactive astrocytes and reduce neuroinflammation in the cerebral cortex.

36. Quantifying Changes in Downstream Clocks as a Result of Optogenetic Stimulation of the SCN

Logan Perry (Texas A&M University), Ashley Starnes (Texas A&M University)
Independent Research Project
Research Advisor: Jeff Jones

Circadian rhythms in behavior and physiology occur when gene expression and neuronal firing vary over the course of a day. The suprachiasmatic nucleus (SCN) of the hypothalamus synchronizes “molecular clocks” in nearly every cell throughout the brain and body. However, it is unclear how these clocks encode daily input from the SCN. We hypothesized that the simultaneous manipulation of SCN firing rate and measurement of rhythms in downstream target neurons will clarify these encoding mechanisms. First, to confirm that we could manipulate the SCN while measuring clock gene rhythms, we recorded bioluminescence in SCN brain slices from a clock reporter mouse over multiple days. Consistent with previous studies, we found that optical stimulation of SCN neurons expressing the optogenetic construct ChrimsonR around subjective dusk delayed the molecular clock in the SCN. Next, to allow for the selective optogenetic manipulation of the SCN, we characterized two novel mouse lines that express Flp-recombinase in specific populations of vasoactive intestinal peptide (“input”) and arginine vasopressin (“output”) SCN neurons. Finally, we expressed an adeno-associated virus that expresses oxytocin promoter-driven Cre-recombinase in brain slices from a Cre reporter mouse line to confirm that we could selectively target neurons downstream to the SCN. Together, these results will allow us to simultaneously use Flp-recombinase dependent optogenetics to stimulate the input or output of the SCN and a Cre-recombinase dependent clock reporter to measure the state of the molecular clock in an SCN target population. This will ultimately reveal how downstream clocks encode daily input from the SCN.

37. 3D Bioprinted Breast Cancer Model for In-Vivo Mimicry of Tumor Pathophysiology

Tristan Nguyen (Texas A&M University)
Independent Research Project
Research Advisor: Sarkar Tapasree Sarkar

Breast cancer niche is heterogenous and surrounded by extracellular matrix (ECM), endothelial cells, immune cells, fibroblasts, and adipocytes, which enhance tumor progression.Although development of 3-dimensional (3D) organoids, tumor-on-a-chip, patient-derived xenografts (PDX), and genetic mouse models offer innovative avenues, there are several unresolved limitations. The available in vitro bioprinted models either suffer from the momentous hurdle of lack of functional vasculature or absence of different types of cells present in the tumor microenvironment (e.g. immune cells, fibroblasts etc.).

The only available approach to study the effects and role of the vasculature on tumor growth, effect of different drugs on tumor progression is by generating animal models with implanted tumors. However, these animal models offer minimal tractability to study the pathophysiology or perform drug screens. Overall, there is an unmet need to develop biologically-relevant preclinical models that will serve as valuable tools to study cancer progression and designing patient specific therapeutic strategies. Our hypothesis is: Combination of 3D-bioprinted vasculature and breast tumor organoids in a breast tumor-mimicking tumor microenvironment (TME) can be leveraged to provide an alternative in vitro approach to mimic breast tumors.

38. Metatranscriptomic Analysis of Biochar's Impact on Microbial Abundance and Activity in the Tomato Rhizosphere

William Troxel (University of California-Riverside)
Agriculture and Life Sciences (AGLS) REU
Research Advisors: Amit Dhingra, Seanna Hewitt

As climate change and the growing global population impose agricultural stresses, it is necessary to identify long-term strategies for sustainable crop production. One avenue is controlling microbial abundance and activity in the soil rhizosphere. A beneficial rhizosphere enhances crops' adaptability, increases resilience to environmental stresses, and ensures higher yields. Prior research demonstrates that biochar, biomass pyrolyzed with high temperatures and low oxygen to produce ash, used with organic fertilizer improves tomato growth and yields. It is not understood how biochar impacts microbial abundance and activity, but its bioremediation and carbon sequestration abilities may be contributing factors. The tomato rhizosphere metatranscriptome was sampled at four key developmental stages under no biochar, 1 ton/acre biochar, and 2 ton/acre biochar conditions. The top five relatively abundant microbial genera, accounting for approximately 50% of the rhizosphere, were studied. The sample results show the most relatively abundant microbes do not correspond with the most genetically active. Their relative abundance increases more slowly and they account for smaller shares in the rhizosphere as the biochar concentration increases. This indicates that the remaining microbes remain in higher abundance for a longer period of the tomato's growth period. A second category of microbes were less abundant and more active, displaying a slower decrease in abundance with increasing biochar. The latter may help diversify the rhizosphere and confer benefits. These preliminary findings may be applied generally to improve crop growth, enhance yield, and relieve agricultural pressures.

39. Potential Role of Leptin and Adiponectin as Biomarkers of Obesity-Associated Breast Cancer Risk

Nicole Marie Rodríguez Trujillo (Universidad de Puerto Rico)
Agriculture and Life Sciences (AGLS) REU
Research Advisors: Erin Giles, Danilo Landrock

During the peri/postmenopausal period, hormonal changes are known to promote weight gain, increased adiposity, mood swings, and the development of several related health conditions. In particular, weight gain and increased adiposity have been associated with an increased risk of developing several cancers including: breast, ovarian, and endometrial. Identifying means to decrease the development of obesity-associated breast cancer in postmenopausal women is important for our society. Obesity-associated hormones like leptin and adiponectin have been identified as factors that may be associated with tumor development and progression. However, the precise effect that leptin and/or adiponectin have in tumor development is not fully known. The goal of this project was to determine if the adiponectin:leptin ratio could serve as a reliable biomarker for tumor risk, particularly in peri/postmenopausal women with obesity. Plasma samples from rat models were measured using enzyme-linked immunosorbent assays (ELISA) to detect the presence of adiponectin and leptin. Preliminary measurements have shown that leptin concentrations decrease when treated with Duavee, a selective-estrogen receptor modulator (SERM) known to decrease breast cancer risk. On the other hand, both adiponectin concentrations and the adiponectin:leptin ratio increased in animals treated with Duavee. Further analysis will determine if these hormones are predictive of tumor growth in these same animals. If successful, this may identify a new biomarker of breast cancer risk that could be used clinically to identify patients at risk for developing obesity-associated breast cancers after menopause.

40. LPS Induced Autophagy in RAW 264.7 Macrophages and BMDM and its Effects by Ghrelin

Stella Bayiokos (Fordham University)
Agriculture and Life Sciences (AGLS) REU
Research Advisors: Yuxiang Sun, Mary Bryk, Hye Won Han

Inflammation serves as a defense mechanism against harmful pathogens upon entering the body. However, if not controlled, it can lead to chronic diseases such as obesity, Alzeheimers, and Type 2 DM. One way inflammation is triggered is by gram-negative bacteria (LPS). LPS induced autophagy promotes the production of inflammatory mediators relating to NF-kB signaling pathways. LPS is an important cause of systemic inflammation and can trigger autophagic induction and the blockage of autophagic flux. Recent studies have shown that, Ghrelin, an orexigenic hormone that regulates food intake, and its receptor, GHS-R, play a role in immunoregulation. To substantiate the role of Ghrelin signaling in LPS induced autophagy, we compare protein expression levels between various treated groups in RAW 264.7 cells and Bone marrow-derived macrophages (BMDM) via Western blot. Our experiment was designed in two parts. First, controlling the amount of ghrelin, and second seeing the autophagic effect with knockout GHS-R. Understanding how Ghrelin signaling affects inflammation under various pathological conditions has the potential to lead novel strategies for treatments of obesity, diabetes, and aging.

41. Assessment of Left Ventricular Remodeling in Structural Heart Diseases through Medical Imaging

Izaiah Ramirez (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisors: Reza Avaz, Tanmay Mukherjee

Myocardial Infarction manifests as structural changes in the cardiac muscle as a consequence of reduced oxygen supply. These adaptations often result in tissue death and subsequent scar formation. This condition ultimately weakens the heart's ability to contract, referred to as systolic dysfunction and affects roughly 3% of U.S. adults over the age of 20. Currently, the medical standard for a prognosis involves measurements of global imaging-based biomarkers such as the left ventricular ejection fraction (LVEF). These markers require additional medical diagnosis relying on myocardial mechanics to draw conclusive statements. A promising approach to solve this problem involves deploying ventricular mechanics to study myocardial strain and torsion. Our research focuses on the development of an LV structure-function relationship by conducting non-invasive studies and the characterization of systolic functioning through medical image processing. Left Ventricular (LV) torsion and strain maps obtained via cardiac magnetic resonance (CMR) images can provide additional insight into cardiac tissue function that complements clinical measurements. in structural heart diseases such as Myocardial Infarction (MI). MRI slices provide a continual map of strain while regional torsion analysis is a useful index for myocardial mechanics during LV contraction and can consequently highlight abnormal cardiac function. These parameters together provide crucial information on shearing and deformation of the myocardium. Through mathematical models, ventricular mechanics can ultimately aid in describing internal myocardial architecture that can characterize heart conditions as well as be extremely useful in creating biomechanical models for MI to aid in patient prognosis.

42. De novo in silico Design and Validation of RNA Aptamers as Binding Inhibitors of SARS-CoV-2 Spike Protein

Iyan Cirillo (University of California Santa Cruz)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Sandun Fernando

Viruses rely on infection of host cells to infect an organism and replicate themselves. To achieve this, the spike protein on severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) binds to the cell's angiotensin-converting enzyme 2 (ACE2) receptor. In this study, we will focus on a novel method for developing high-affinity aptamers targeting the receptor binding domain (RBD) on the SARS-CoV-2 spike protein. With appropriate binding, the aptamer should inhibit the RBD from accessing the ACE2 receptor. Conventional approaches to aptamer design typically carry either a high cost or are inefficient. To avoid these issues, we will be handling the initial design steps entirely in silico, by impinging nucleotide emulating probes to the spike RBD. Then the probes that tightly bind to specific locations at the active site will be isolated and fuse together to form novel aptamer sequences. These will be screened further by evaluating their binding affinities to the RBD in silico. Biolayer interferometry experiments will be performed to validate and measure the binding kinetics of the screened aptamers in vitro. Follow-up studies will be conducted to optimize the aptamer sequences for improved performance of the aptamers.

43. High-Speed Craft Free Running Model Test

Anna Freeman (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Mirjam Furth

For decades researchers have been working to improve the performance of High-Speed Craft, a recent method achieving this is spray deflectors. Spray deflectors run along the bottom of a planing boat parallel to the chine, and have been shown to improve the efficiency of planing boats by reducing the resistance caused by whisker spray. However, these deflectors have only been tested in wave tanks, which are very controlled environments compared to the open ocean. This paper will describe the steps taken toward planning, constructing and performing a free running model test 20 miles off the coast of Galveston.

44. Electrochemical Exfoliation of Graphene (EEG)

David Chi (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Micah Green

In the past, it has been demonstrated that electrochemical exfoliation of graphene (EEG) can be used as a bulk method of synthesizing graphene nanosheets from graphite. This process involves applying a voltage between two electrodes connected to compressed graphite, which drives ionic species to intercalate between the layers of graphite, releasing gaseous particles that exfoliate individual graphene sheets. In this study, the EEG process was used on a fine (3 to 5 µm D50) variety of graphite, and its resulting product was characterized through microscopy and spectroscopic analyses.

45. AVM Embolization

Jackson Jarboe (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisors: Balakrishna Haridas, Grace Fletcher

Arteriovenous malformation (AVM) is a conglomeration of abnormal veins and arteries which disrupts normal blood flow by eliminating the capillary bed and diverting the flow directly from arteries to veins. The treatment of AVMs remains a challenging, important issue as ruptures resulting in intracranial hemorrhage are difficult to prevent and can be fatal. Embolization is a clinical approach used in treating AVMs in which a liquid embolic agent is delivered through a catheter to block off abnormal vascular channels. This study examined the use of Onyx to treat pediatric AVMs with the goals of reducing reflux and improving embolization of the nidus. An in vitro test bed was designed to simulate blood flow through an AVM using a 40% glycerol-water solution inside of a 3D-printed silicone model with a feeding artery leading to an artificial nidus geometry connected to three draining veins. A peristaltic pump was used to administer a constant flow rate of 70 mL/min to simulate the high flow rate in an AVM. Two 30 psi pressure transducers were calibrated and then connected to three-way stopcocks and powered by a

NI-DAQmx to measure the pressure of the fluid both proximal and distal to the nidus. Benchtop testing will be performed to determine the percent embolization in the nidus of the AVM and to conceptualize new improvements to the model. By proposing an in vitro design to model abnormalities in the brain, this study provides an impactful method of blocking AVM pathways to mitigate health risks for children.

46. Identification of Naringenin Pathway in Gut Microbiota

Natalie New (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Arul Jayaraman

The gut microbiota play an important role in breaking down nutrients into usable metabolites for humans. The goal of this project is to begin characterizing how a particular flavonoid, naringenin, is catabolized. Using data from computer simulations, one step in the naringenin pathway was predicted to be the conversion of phloretin to 3-(4-hydroxyphenyl) propionic acid. It was hypothesized that acetyl coenzyme A transferase from *Clostridium sporogenes* is responsible for catalyzing this reaction. The computational predictions were then tested experimentally in the laboratory. First, the ACoA gene was isolated from *C. sporogenes* and inserted into a vector. Escherichia coli was transformed with the vector in order to upscale the expression of ACoA. The enzyme was then purified, followed by treatment with the substrate phloretin. Its products were analyzed over time using high-performance liquid chromatography. The presence of 3,4 HPPA was expected to confirm if ACoA catalyzed the proposed reaction and to support the hypothesized pathway. Understanding the mechanisms behind gut microbiota pathways has many potential benefits for improving health and aiding in drug development.

47. Response of Persisters to Environmental Signals

Isabella Schmitz (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Pushkar Lele

Persisters are bacterial cells speculated to be in a state of dormancy, where the metabolism is predicted to be so low that the uptake of antibiotics is significantly decreased. Once the antibiotics are no longer present, the persister cells can resurrect and repopulate, which causes chronic infections. However, little is known about the physiology of persisters. In this study, *Escherichia coli* cells were pretreated to an antibiotic, rifampicin, and subsequently exposed to ampicillin to induce and concentrate persisters in wild-type populations. We focused on their chemotaxis response to a known chemoeffector, serine. We employed single-cell assays to measure the response and observed weak but positive chemotaxis toward serine. In subsequent experiments, we plan on testing if the persisters can survive against TESET pentablock polymers, which are commercial and effective antibacterials that kill by decreasing the pH of the medium.

48. Real Time Analysis of Mass Transfer for PEDOT:PSS through EQCM-D

Alan Ferris (North Carolina State University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Jodie Lutkenhaus

Poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS) is an extensively studied conjugated polymer applied for energy storage and organic electronics applications. This is due to the redox active nature of the combination of the positive PEDOT component and the negatively charged PSS component. However, little in-situ study of the ion movement during any electrochemical characterization has been done. This study highlights the use of electrochemical quartz crystal microbalance with dissipation monitoring (EQCM-D) to perform cyclic voltammetry and electrical impedance spectroscopy on thin films of PEDOT:PSS were spin coated onto Au-Ti quartz sensors. These methods were able to show how the mass of thin film PEDOT:PSS changes during oxidation and reduction cycles. This mass transfer of ions during the electrochemical tests provides a clear picture of the electrochemical doping mechanism of PEDOT:PSS and how the material can be effectively used in energy storage and organic electronics applications.

50. MXene/Polyelectrolyte Layer-by-Layer Assembly for Optical Applications

Diego Ross (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Jodie Lutkenhaus

MXenes are a class of 2-dimensional nanomaterials that have several desirable and tunable properties. Making films with MXenes using layer-by-layer (LbL) assembly allows for controllable thickness and composition on a variety of substrates. In these LbL films, polyelectrolytes can be added to create heterostructures. These building-block-like heterostructures display different optical properties depending on the order of the distinct ion-pair based sections. Here we report the LbL assembly of alternating blocks of Ti3C2Tz MXene nanosheets/poly(diallyldimethylammonium chloride) (Block A), and poly(styrene sulfonate sodium)/poly(diallyldimethylammonium chloride) (Block B). Films composed of alternating two layer pair (LP) sections of block A and B were created; the film growth profiles for thickness and absorbance were characterized. Next, new films were made with the amount of LPs within block B doubled. This was done to compare the properties of films based on the distance between the MXene-containing sections of the heterostructure. Absorbance growth within the first set of films was found to be 0.008 a.u. per LP, while the second set with the larger block B was 0.0191 a.u. per LP, more than twice as much. In addition, structural coloration was observed within all sets of films, with variation in hues between the two sets. This shows the viability of this method for creating thickness-dependent optical sensors which could be used to passively detect changes in humidity and other stimuli due to the polyelectrolytes' swelling.

51. TFAM and TFAM-DNA Complex Ability to Phase Separate

Ivan Rodriguez-Oliveros (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisors: Jeetain Mittal, Tien Phan

Mitochondrial DNA undergoes liquid-liquid phase separation to form nucleoids which play a role in maintenance and transcription in the mitochondria. In these nucleoids, TFAM serves as one of the major packaging proteins for mitochondrial DNA. Previous research has shown TFAM to phase separate in-vitro and in-vivo individually and in the mitochondrial nucleoid system. However, the molecular mechanism of its phase behavior is not well understood. By conducting a sequence analysis of TFAM, we identify several notable characteristics. We also use Alpha Fold, an artificial intelligence program to predict protein structure from sequence, to obtain TFAM's structure and assess its structural stability using all-atom simulations. Next, we use coarse-grained molecular dynamics simulations to study the phase separation of TFAM in silico. These simulations reproduce the experimentally observed phase separation behavior and provide residue-level information on the favorable contacts formed between TFAM-TFAM and TFAM-DNA. This study serves as a basis for continuing research to analyze TFAM phase behavior underlying nucleoid formation, including the role of post-translational modifications.

52. A Review of Literature on Water Usage in the Food Supply Chain

Kaylen Sexton (North Carolina A&T State University)
Undergraduate Summer Research Grant (USRG)
Research Advisors: Rabi Mohtar, Janie Moore

Water is the most crucial resource that exists on the planet. Water is constantly becoming more scarce in the world, due to things like climate change, population growth, and the food industry. About 70% of water use in the world is for agriculture and food production. The amount of water used for food production and processing is unsustainably high and must be reduced. If water usage does not get reduced in the food industry, eventually, this planet will no longer be sustainable for life and nothing will be able to survive. There have been countless publications where the topic of water usage and conservation is reflected upon. Most of these works usually come with solutions that aim to help water conservation efforts, but these preventative measures usually are never implemented. This study investigates water usage at different stages in the food supply chain process and tries to answer the question of how to make the water usage at those stages more sustainable and efficient. The focus will be to track water usage for a singular commodity in a specific location. This research was completed by the conduction of an in depth review of literature for topics related to food supply chain and water usage. It is expected that this study can successfully summarize the current state of the water footprint in food production and processing but also identify a policy, technology, or behavioral intervention that could potentially be beneficial in decreasing water use globally.

53. Force Induced Reactivity of 2D Membranes

Camille Cardinal (University of Southern Mississippi)
Center for the Mechanical Control of Chemistry (CMCC) REU
Research Advisor: James Batteas

Mechanochemistry is the study of chemical reactions driven by the introduction of mechanical energy, as compared to more traditional methods of inducing a reaction such as through the application of light, heat, or electricity. This area has little in-depth research on a molecular level and expanding our fundamental understanding of mechanochemistry would ideally allow for more efficient and greener syntheses of process chemicals and inorganic nanomaterials. The current research on driving chemical reactivity as a response to applied force is a focus of the Center for Mechanical Control of Chemistry. One platform for studying the influence of mechanical force on chemical reactivity is monolayer graphene. This is an ideal system, as graphene is a well characterized material consisting of only in-plane C-C bonds. As a model reaction, the susceptibility of graphene to oxidation will be studied using Raman spectroscopy. The extent of oxidation as a result of exposure to aqueous solutions of varying pH will be studied at ambient pressure, and with varying levels of backing pressure. Ideally, results will show that as the backing pressure increase, the out-of-plane distortion of the graphene membrane will increase, electron delocalization will become inhibited, ultimately leading to an increase in reactivity. Understanding how reactivity can be controlled on a microscopic level would allow for in-depth analysis of reaction conditions influenced by directionality as a result of applied force.

54. Normal and Shear Force Controlled Reactor for Mechanochemistry

Leo Beck (Clemson University)
Center for the Mechanical Control of Chemistry (CMCC) REU
Research Advisor: Jonathan Felts

Mechanochemistry is the branch of chemistry regarding chemical reactions driven by mechanical energy. Mechanochemical powder reactions do not require solvents or heating apparatuses and tend to reach close to 100% yield. Using these reactions instead of standard solvent chemical reactions will reduce the waste of the $4 trillion chemical industry. Unlike controlling temperature, mechanochemistry requires the control of mechanical force, a magnitude and direction. The field of mechanochemistry does not currently have chemical reactors that can control the magnitude of applied force, or reactors that can change the relative amounts of normal and shear forces. The Controlled Force Reactor (CFR) aims to quantify the effect of mechanical force on chemical reaction through force control. The CFR can control both the frequency and magnitude of the normal force. Additionally, the ball within the reactor is attached to an electric motor, so the shear force can also be controlled by adjusting spin speed. With both normal and shear force control, tests can be run to determine the effect of each on a mechanochemical reaction. Since different reactions are driven by either normal or shear forces, the CFR can be tuned for each reaction to optimize reaction rates and yields. This instrument opens the door to quantified mechanochemical reactions and provides the necessary functions for research into the driving mechanisms of mechanochemistry.

55. Integrating Force Measurements into Existing Ball Mill Reactors

Heily Chavez Davila (University of California Merced)
Center for the Mechanical Control of Chemistry (CMCC) REU
Research Advisor: Jonathan Felts

A growing alternative chemical synthetic technique is mechanochemistry, which drives chemical reactions using mechanical force, often in powder form without the need for expensive and toxic chemicals. A primary limitation of conventional mechanochemical mills, which often use some form of particle grinding via vigorous shaking of ball bearings with the reactants, is the lack of measurement and control of the applied forces from the ball bearing onto the reactants. Here, we have designed a grinding vessel with integrated force sensors inside the jar, providing the ability to monitor impact forces during reactions. We integrate force sensing using two compact compression load cell (50-1000 N) into a milling jar compatible with the Retsch MM400, where the load sensors measure every impact during the reaction. We further propose a model to link the input parameters of the mill—motor power and shaking frequency—to the forces applies to the reactants, and plan to utilize the newly designed force measurements within the mill to confirm this model. The innovation proposed here could transform ball mill based mechanochemical synthesis from a chaotic, uncontrolled process, to one with the ability to closely tune reaction rates and reaction products based on the forces applied to the reactants.

56. Solar Heat Gain Modulation of Fenestration Elements Using Thermochromic Nanocomposite VO_2 Thin Films

James Perez (University of Puerto Rico at Cayey)
Sustainable Chemistry REU
Research Advisor: Sarbajit Banerjee

The built environment accounts for an approximate 30—40% of the world's energy consumption. Around 46% of a building's energy expenditure is attributed to lighting, heating, and cooling. This can be reduced by modulating interior solar heat gain using dynamically tunable fenestration elements. Thermochromic "smart" windows represent an attractive option. We have specifically utilized the metal—insulator transition (MIT) of a binary transition metal oxide, vanadium(IV) oxide (VO_2), to design spectrally selective thermochromic fenestration elements. At low temperatures, the material is in the monoclinic phase, in which it allows for near total transmission of near-infrared (NIR) radiation, whereas at high temperatures, the material transitions to a tetragonal phase in which NIR absorption is blocked. The NIR region accounts for a substantial portion of solar heat gain in buildings; modulating NIR transmittance is thus key to climate control and energy conservation. The films remain transparent in the visible region of the electromagnetic spectrum. My research addresses several technical roadblocks related to the design of nanocomposite fenestration elements. Optical haze within the thin-films arises from refractive index mismatch. Proper dispersion of the VO_2 nanocrystals in the polymeric medium through silica and germania encapsulation, as well as silane functionalization has been used to reduce optical haze and to protect the active elements from oxidation. GeO_2 shells have been deposited onto VO_2 nanocrystals based on the hydrolysis of tetraisopropoxygermane. The core—shell nanocrystals have been characterized by transmission electron microscopy and the composite films have been characterized by variable-temperature optical transmittance measurements.

57. Using Recyclable PIB-bound Amines to Separate Acids from Polar Organic Solvents

Ramy Yousef (Hendrix College)
Chemistry REU
Research Advisor: David Bergbreiter

Synthetic chemists must separate compounds from one another to purify them. Extraction is one technique used in the purification of organic compounds. Extraction works quite well with organic acids and bases; nevertheless, the reagents used in acid/base extractions are not recyclable and extraction does not work with some pairs of organic solvents. The purpose of this project was to synthesize a recyclable base that could be used to extract acids from organic solvents. To do so, we synthesized a polyisobutylene (PIB)-bound amine and used 1H NMR spectroscopy to determine how effective the alkane-soluble PIB-bound amine was at extracting three different acids from acetonitrile (MeCN, a polar solvent). We found that the PIB-bound amine (dissolved in heptane) could be used as a recyclable extracting agent and removed > 90 % of benzoic acid, camphorsulfonic acid, and ibuprofen from MeCN. We also briefly explored whether chiral PIB-bound amines can be used as resolving agents for enantiomers. However, preliminary results suggest that there is little diastereoselectivity in such an extractive resolution.

58. Methods of Reusing Disposable Lab Equipment to Reduce Waste Accumulation

Rachel Wynn (Southeastern Oklahoma State University)
Chemistry REU
Research Advisors: Quentin Michaudel, Katarzyna Doktor

The convenience of single-use plastics, which are produced in over 300 million tons annually, has come with the negative drawback of contributing significantly to global pollution due to insufficient recycling methods. In laboratory settings, approximately 5.5 million metric tons of plastic waste are produced yearly. This plastic waste includes common consumables, such as weighing boats made of polystyrene or syringes made of polypropylene, which can take up to 1000 years to degrade. While completely cutting back on single-use and disposable materials might not be feasible for every laboratory, developing recycling methods to limit overall laboratory waste is a critical stepping stone. The aim of this project is to discover how many disposable items, consisting of plastics and glass, can be reused in chemistry laboratories. 1H NMR will be used to analyze the remaining impurities in the materials, if any, after washing cycles of water and acetone. Finally, the cost of acetone used during the cleaning cycle will be calculated and compared against the original price of the used disposables.

59. The Synthesis of a New POBOP Ligand and it's Complexation to Various Late Transition Metals

Thomas Suarez (Florida State University)
Chemistry REU
Research Advisor: Oleg Ozerov

The investigation in this paper was conducted on a set of pincer complexes derived from 2-diisopropylphosphino 4-methyl phenol in continuation of previous work from the Ozerov group in an attempt to catalyze C-H functionalization in various aromatic systems such as pyridine. Previous work in the group indicates that a pincer ligand system with a lewis acidic boron can help to direct pyridine and other heterocycles to the metal center, so the use of oxygen bonded to boron will hopefully change the electronics of this system enough from previously investigated complexes to allow for a catalytic cycle. In this work, we synthesized and characterized a variety of metal complexes that include late transition metals such as Pd and Ir. Characterization and preparation of these complexes will be discussed.

60. Synthesis of Neopentyl Glycol Derivatives for Thermal Energy Storing Materials

Sophia Gospodinova (Rose-Hulman Institute of Technology)
Chemistry REU
Research Advisor: Emily Pentzer

Plastic crystals are compounds comprised of small spherical molecules with centers of mass arranged in a crystalline structure that are able to rotate and deform. Upon cooling or adding pressure, plastic crystals undergo a phase transition to an ordered crystal phase. Neopentyl glycol (NPG: C(CH3)2(CH2OH)2) is a plastic crystal that has been found to have a phase transition entropy change comparable to that of commercial refrigerants. As such, it may serve as a viable alternative to traditional refrigerant systems which rely on the gas-liquid phase change to transfer energy. However, more work is needed to determine what factors influence a plastic crystal’s ability to store energy. This research aims to synthesize derivatives of neopentyl glycol to investigate the effects of deuteration, hydrogen bonding, and molecular volume on its solid-solid phase transition. Deuteration will be investigated by systematically replacing hydrogen atoms on NPG with deuterium. The effect of hydrogen bonding will be investigated by replacing alcohol groups on NPG with amines, thiols, and combinations thereof. These molecules may also be deuterated at the heteroatom through hydrogen-deuterium exchange. Changes in deuteration and heteroatom bonding will impact molecular volume. Additionally, molecular volume will be targeted by synthesizing NPG derivatives with central silicon atoms, cyclopropane or cyclobutane groups in place of methyl groups, and combinations of the two. Thermodynamic properties, including heat of fusion and melting point, of the materials will be analyzed using differential scanning calorimetry.

61. A Novel Aluminum Diimine Complex as a Potential Catalyst for Atom Transfer Radical Polymerization

Julia LeBlanc (Swarthmore College)
Chemistry REU
Research Advisors: Emily Pentzer, Chris Graves

Atom transfer radical polymerization (ATRP) is a relatively new technique for the controlled polymerization of various olefins. These polymerizations are typically catalyzed using copper-based catalysts, which are known to have an adverse impact on the environment. This study focuses on utilizing a novel aluminum-based catalyst, which is both inexpensive and less toxic. The catalyst used here is a Tp-Al-α-diimine complex that is expected to exhibit 1-electron redox processes that can be exploited for ATRP of several different monomers. The efficacy and selectivity of this catalyst will be investigated by varying the identity of the olefinic monomer, temperature and reaction time used for the polymerization reaction. Achieving successful polymerization using this aluminum-based catalyst would yield a more sustainable and greener pathway for ATRP.

62. Immobilizing Peroxides on Silica and Intramolecular Di(hydroperoxy)alkane Adducts of Phosphine Oxides: New Solid, Safe and Reusable Materials for Catalytic Oxidations

Arturo Perez (Augustana College)
Sustainable Chemistry REU
Research Advisors: Janet Blumel, John Hoefler

Oxidations represent a vital class of reactions that are ubiquitous in academia and industry. Hydrogen peroxide (H2O2) is a common source of active oxygen for oxidations. Currently, H2O2 is commonly diluted in water as it is too unstable to be used in pure form. The presence of water, which can complicate reactions through biphasic mixtures and side products, make alternative forms of H2O2, such as peroxide adducts an active area of research. Di(hydroperoxy)alkane (Ahn) adducts1 of phosphine oxides are one attractive solution as they are soluble in organic solvents, crystallizable and stable.1–4 By immobilizing Ahn adducts onto a porous solid support they can be recovered and recycled, making these already advantageous oxidizers even more attractive for academia3 and industry.2,4 Additionally, incorporation of a ketone group into the starting phosphine can also improve the efficiency of the synthesis of Ahn adducts by eliminating the need to add acetone during their formation. In this work, the bifunctional ligand (EtO)3Si(CH2)2PPh2 is immobilized on a silica (SiO2) support and end-capped with EtOSi(CH3)3. The surface-bound Ahn adduct is then generated with the immobilized phosphine oxide as carrier. The adduct has been characterized with solid-state NMR and has been shown to be oxidatively active and reusable. Additionally, synthesis of an intramolecular Ahn adduct from the starting ligand (CH3COCH2P(O)Ph2) was attempted with preliminary results supporting the synthesis of an intramolecular di(hydroperoxy) adduct.

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63. A Fluorogenic Sensor for Detection of the Pre-Exposure Prophylaxis (PrEP)-HIV Drug Emtricitabine (FTC)

Rolando Albarracín Rivera (University of Puerto Rico at Cayey)
Sustainable Chemistry REU
Research Advisor: Jonathan Sczepanski

The development and approval of Pre-exposure prophylaxis (PrEP) drugs for the prevention of HIV has been one of the most important breakthroughs in the history of the disease. Although HIV infection percentages have gone down over the years, there is still a significant number of people diagnosed with the disease due to inefficient adherence to the PrEP drug treatment. Current strategies for monitoring adherence to PrEP drugs have several disadvantages. For example, the current gold standard for monitoring PrEP drug levels in the body – liquid-chromatography -tandem-MS (LC-MS/MS) - relies on expensive equipment and scientifically-trained personnel to operate, and thus, is not compatible with monitoring therapy adherence at the point-of-care, especially in low-resource settings. In this work, we report an aptamer-based sensor for the PrEP drug Emtricitabine (FTC) that enables rapid determination of FTC concentrations in solution via a simple optical readout. This analysis has been achieved by a succession of binding experiments to a modified fluorogenic aptamer com-plex that is based on a novel FTC-binding aptamer. Overall, we conclude that the aptamer-based FTC sensor provides a simple, biocompatible, and cost-effective strategy for monitoring FTC in solution. This work lays the foundation for a novel objective adherence method that could serve as a tool for decreasing the risk patients have for contracting HIV.

64. Enzymatic Degradation of A2E and Cycloretinal using MSP1

Destiny Harrison (LSU Alexandria)
Sustainable Chemistry REU
Research Advisor: Coran Watanabe

Age-related macular degeneration (AMD) is the leading cause of visual impairment in individuals 50 years or more in age. AMD is a progressive disease with two distinguishments: dry and wet. The focus of this study is on the earlier stage of the disease, dry AMD, where the vision of the affected individual starts to malfunction leading to deposits of drusen. Structurally, drusen are made of lipofuscin components or bisretinoids, such as N-retinyl-N-retinylidene ethanolamine (A2E) and the all-trans-retinal dimer cycloretinal, which are proposed to be cytotoxic to retinal the pigment epithelium (RPE) and photoreceptor cells. It is believed the bisretinoids play a key role in the advancement of AMD. Formation of bisretinoids is attributed to malfunctioned transportation of the vitamin A aldehyde 11-cis-retinal within the visual light cycle of the eye. Currently, there are no interventions or treatments available to mitigate dry AMD. Published literature has studied the clearance of A2E via enzymatic degradation. Thus, the study of catabolizing lipofuscin components A2E and cycloretinal will be conducted with MSP1, a fungal heme dye-decolorizing peroxidase found in *Marasmius scorodonius*. The effectiveness of MSP1 peroxidase degrading A2E and cycloretinal will be evaluated via reaction kinetic assays using Ultra-violet visible spectroscopy. If successful, this study will be used to assess the potential of using MSP1 as a therapeutic enzyme in retinal cells to reduce lipofuscin buildup.

65. An In Situ Lipid Extraction of Human Serum Using a Theta-tip Based Interfacial Microreactor

Nicholas White (Southeastern Oklahoma State University)
Sustainable Chemistry REU
Research Advisor: Xin Yan

Traditional lipid extraction techniques are time consuming and use large amounts of solvent. The use of microdroplets is known to accelerate many reactions via interfacial chemistry but the exact mechanism is unknown. The ability to accelerate reactions in small aliquots is useful in that reactions, which are time consuming and reagent intensive, can be done in a quick and conservative manner. The purpose of our project is to use microdroplets, a unique interfacial microreactor, and nano-electrospray ionization (nESI) mass spectrometry to extract lipids from plasma. In nESI, a pulled capillary is used as an emitter to form a Taylor cone from which a jet of liquid forms a plume of charged droplets for analysis. We propose a design that uses a theta tip emitter to hold the sample and reagents in two separate barrels. Then, the sample can undergo electrochemical migration upon the application of voltage into a meniscus formed with the reagent at the tip of the theta emitter. In the theta emitter, we were able to observe a micro-dripping spray mode, which, does not have enough columbic forces to overcome the surface tension at the tip and thus, does not form a Taylor cone like traditional nESI. In this study, we applied the developed theta-tip based interfacial microreactor to investigate the potential for an in situ lipid analysis of human plasma.

66. Progress Toward the Synthesis of Next Generation Diphenyl Piperidine Inhibitor of Sars-CoV-2 Main Protease

Cameren Field Field (Carroll College)
Biochemistry REU
Research Advisor: James Sacchettini

The main protease (Mpro) of Sars-CoV-2, formally known as C30 endopeptidase, is a drug target of interest due to its critical function in cleaving the polyprotein which is translated from the viral RNA. Paxlovid, the FDA-approved drug from Pfizer is a peptide based inhibitor that covalently inhibits Mpro. My laboratory has developed a very potent series of Mpro inhibitors (DPP) that have several desirable properties compared to Paxlovid. The objective of this research was to develop a successful synthetic scheme to modify the lead DPP molecules in order to improve the pharmacological properties. The primary usefulness of the target molecule lies within its improved solubility in comparison to the lead inhibitor. Molecular model building suggests that the target molecule will also increase the potency through an additional hydrogen bond to the Mpro enzyme. Herein is the reported progress toward the synthesis of a next generation DPP, CF1. Use of 1H NMR and LC-MS spectral data for synthetic intermediates reveals the success or failure of chemical reactions within several attempted schemes.

Once CF1 is synthesized, its efficacy will be tested and the crystal structure of CF1 bound to Mpro will be evaluated.

67. Tribological Performance of Laser-Ablated Microtextured Surfaces

Victoria Manterola (Texas A&M University)
Metrology and Inspection REU
Research Advisor: Mathew Kuttolamadom

The research objective of this project is to investigate the tribological performance of laser-ablated microtextured surfaces. It is known that certain micro-scale textures on metallic surfaces have a beneficial tribological performance – lesser friction and wear. To study this, micro-patterns were systematically created on a metallic (stainless steel) surface by laser surface texturing (LST), which is a process used to alter a material surface profile, and hence properties. Reciprocating tribological tests were performed on each texture type to determine the friction and wear mechanism responses. Optical microscopy was used to characterize the wear mechanisms on these surfaces and interferometry was used to quantify the wear grooves. Analysis of such tribological performance is expected to provide useful information for designing material surfaces for durability.

68. Developing a Cost-Effective Slider Mechanism for Atomic Force Microscopy

Thomas Lagarde (University of Dallas)
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Research Advisor: Cha Bum Lee

Atomic Force Microscopy (AFM) is a branch of scanning probe microscopy. It is used to image a variety of surfaces, including glass, polymers, ceramics, and biological samples. AFM instruments are very precise, typically having vertical resolutions of less than a tenth of a nanometer and X-Y resolutions of about one nanometer. A typical AFM apparatus consists of a laser sensor and foil tip raster-scanned over the material to be imaged. The aim of this research is to design and construct a precise, easily controlled, and cheap “slider mechanism” for AFM using a simple Voice Coil Motor (VCM) and hall effect sensors. For the slider mechanism to be suitable for AFM, its motion must be smooth, accurate, and continuous. The VCM will be mounted to a double compound notch type flexure stage with four compound springs. Two Hall Effect Sensors will be used to eliminate natural resonance frequencies. A Digital to Analog Converter (DAC) and Proportional-Integral-Derivative (PID) controller will help to account for errors and accurately supply a power signal.

69. Directed Energy Deposition Additive Manufacturing of WC-Co

Brianna Duran (Texas A&M University - Central Texas), Isaiha Ponce (Texas A&M University)
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Research Advisor: Matthew Kuttolamadom

The overarching goal of this project is to investigate the processing - structure - property - performance framework of WC-Co metal-matrix composites that is manufactured via a laser-based additive manufacturing approach. In particular, this effort will elucidate the relationships between the process parameters of a directed energy deposition (DED) process and the resulting macro/microstructures, and how these affect the ensuring mechanical properties and performance. For this, WC-17Co spherical powder (with 45-105 µm particle size) was subjected to varying laser powers and scan speeds as per a design of experiments. Macro features such as layer thickness and as-printed surface roughnesses were quantified via interferometry, while microstructural features were captured via optical and electron microscopy/spectroscopy.

70. Effects of Burnishing Process Parameters on the Fatigue Life of 6061 Aluminum

Lillian Olkkola (Texas A&M University)
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Research Advisors: Jywen Wang, Mathew Kuttolamadom

This research project aims to determine the effects of burnishing operation parameters of fatigue life on samples. Previous studies have shown that compressing a surface will compartment residual stress and have improved fatigue life. In this study, the experiment's plan is to assert the effect of selectively deforming the surface of aluminum samples and how that modifies the surface stress state and the fatigue life. A burnishing tool attached on a lathe was used to selectively modify the surface of aluminum samples using a design of experiments that varied the depth of deformation, strain rates, and angles of contact on the samples. The surface profile of the samples were found using microscopy. Then the samples were tested on a fatigue tester, and S-N curves were procured in order to compare how the various operational parameters had on the fatigue life of the samples. To determine the failure mechanisms of the samples, they were reevaluated using microscopy. The findings of this experiment could help future researchers and manufacturers explore the possibility of selectively burnishing various parts in machines to prolong their fatigue life.

71. The Impact of Counterweight on the Stability and Velocity of a Z-axis Linear Stage

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Research Advisor: Cha Bum Lee

Elevator systems often jerk or vibrate when rising or falling, and systems that solely rely on torque from a motor are far more susceptible to this issue. The escalated friction, due to heavy strain on the motor and immense torque, is what causes this vibration. This unwanted movement that takes place can be referred to as motion error, and the elevator system, in this case, is a z-axis linear stage. Adding counterweight alleviates stress from the motor and provides more stability, thus decreasing the motion error. The counterweight does this by decreasing the amount of energy the motor must generate to elevate and lower the stage. However, including counterweight often takes up more space and can lead to a decrease in speed. The objective is to find a balance between the counterweight and motor to create the most stable elevation process attainable, ideally, eliminating motion error. The aim is to accomplish this while also maximizing the velocity of the system. A number of sensors will be used, including a load cell, rotary encoder and stepper motor. These sensors will gather data, specifically mass(grams) and velocity(mm/s), in order to clearly establish a correlation between the variables. The two previously mentioned variables will be plotted to signify their relationship and get a gauge of the system's stability.

72. The Measurement of Temperature during a Bone Drilling Operation to Minimize the Chance of Osteonecrosis

Arlette Munoz (University of Texas at El Paso), Elijah Ponce (University of Texas)
Metrology and Inspection REU
Research Advisors: Mathew Kuttolamadom, Bruce Tai

With operations regarding the cortical section of the bovine femur, also known as the thighbone, such as screw replacement and bone fractures, we have the technology and resources to assist people by having plates and prosthetics for the patient's need. To do these operations, however, holes need to be drilled into the bone and the problem that has been occurring is osteonecrosis, the death of bone tissue, which occurs when tissue is exposed to temperatures above 45°C causing permanent thermal damage to the bone and surrounding area. The heat generated during drilling can raise the temperature to these levels depending on different variables such as the spindle speed and feed rate of the drill. We want to know the different temperatures of the bone when drilling into it at certain feed rates and RPMs. We have gone about this by setting up an experimental investigation and testing the different spindle speeds and feed rates on a 3D printed bone to record the drilling power and temperature using thermocouples. The design that we setup consists of a linear slider for the x and y movement of the platform that the force sensor and 3D printed plate are on. A motor slide will be prompted up in the z axis and this is where the spindle is attached to. Having a reliable setup is of extreme importance to make sure we are getting accurate readings and have precise drilling locations.

73. Real Time Measurement System for Improved MetPeel Performance

Cimyia Cameron (Auburn University), Nahum Pagarey (Northampton Community College)
Metrology and Inspection REU
Research Advisor: Dinakar Sagapuram

The measurable goals of this project are to create a real time measurement system for improving the performance of MetPeel, a single-step process for producing metal strip coil at enhanced energy efficiency compared to conventional rolling-based processes. The efficacy of this real time measurement system in improving the performance of the manufacturing process will be validated through a series of experiments. The overall goal is to instrument the process with velocimeter, thickness, and diameter sensors. Velocimeters measure velocity and length on moving surfaces. A thickness sensor is a system used to measure the thickness of strip material without contact. A diameter sensor is a laser sensor used to measure the diameter of the rolled steel. Combining all four sensors allows for accurate real time measurements of important strip parameters, namely, tension, speed, thickness, and diameter of the coiled strip. This sensor data will be in turn used to adjust process conditions to control the above parameters in real time. Once the functionality of all the sensors is determined, the goal is to reduce error in the measurements.

74. Corrosion of 316H Stainless Steel and Graphite in Static Molten FLiNaK Salt

Sarah McQuaid (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Stephen Raiman

The use of molten salt in molten salt reactors (MSR) introduces a new set of design requirements because of its interaction with the structural alloys. Graphite, the most common moderator material in thermal spectrum MSRs, is believed to interact with salt-facing structural stainless steel, but debate exists regarding the nature and extent of the interactions. For this work, the corrosion of 316H SS in molten FLiNaK salt with and without graphite was examined to study the effects of the molten salt and graphite moderator on the alloy's corrosion behavior and mechanical properties. Tests were run at 650 °C for 100 hours in sealed nickel crucibles. Samples exposed in the same crucible with graphite were characterized to look for formation of chromium carbides that may affect mechanical behavior. This poster will present new insights into the interaction of stainless steel and graphite in molten fluoride salt.

75. Evaluating the Biocompatibility and Immune Response of Macrophages to Aneurysm Occlusion Devices

Del Donehoo (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Shreya Raghavan

Vascular occlusion devices are used to treat aneurysms, but there have historically been complications such as device-associated clotting and rebleeding associated with this method of treatment. These complications have led to a desire for devices which promote a pro-regenerative biological response. There have been several attempts to achieve this through various means which lead to anti-inflammatory macrophage activation, such as using fibrous surface modifying additives and coating occlusion devices with proteins. This project observes the macrophage differentiation and adhesion to multiple occlusion devices in vitro, with a focus on how a shape memory foam plug device compares to the other devices tested. Macrophages were seeded onto device samples, incubated and extracted at 6 hrs, 24 hrs, 72 hrs, and 96 hrs. PCR was performed on the extracted macrophages using various M1 and M2 markers to identify the inflammatory and healing responses of each device over time.

76. Analysis of Macrophage Polarization Under the Influence of Biomimetic Peristaltic Forces

Anirudh Madyastha (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Shreya Raghavan

The human body is in constant dynamic motion, and with that comes mechanical forces which impact many cellular processes within the body. Macrophages are immune cells that represent an essential portion of the body's inflammatory and healing responses. Cancerous cells remain undetected by the body's immune system in part due to the ability to evade immune action by macrophages by promoting the healing properties. The goal of this study is to better understand the relation between the mechanical forces present in the body and its impact on macrophages. To accomplish this, a biomimetic peristalsis bioreactor will be utilized. The bioreactor is capable of concurrent shear and multiaxial strain forces, mimicking the forces observed in vivo. Analyzing the gene expression of these cells, and comparing them to the gene expression of manually polarized macrophages, will demonstrate the effect of mechanical shear and strain on the function of immune macrophages. Gene expression of macrophages will be analyzed through RNA extraction and subsequent qPCR analysis of macrophage polarization genetic markers. These genetic markers indicate whether a macrophage has polarized into a pro-inflammatory M1 macrophage or a pro-healing M2 macrophage, and can be utilized to understand how mechanical forces alter the macrophage's function. This will allow for a heightened understanding of the body's immune reaction, which can be applied to the field of cancer immunology. Further investigation should include interactions between cancer cells and immune macrophages under simulated mechanical forces in order to understand cancer immune evasion and factors that lead to cancer progression.

77. Turning Plant Waste Into Profit: Exploring the Effects of Atmospheric Cold Plasma on Coniferyl Alcohol

Laura Landis (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Janie Moore

Current farming practices produce large amounts of plant waste, such as corn husks and twigs. These "leftovers" may seem useless, but with a little modification, they can be bottled up and put on grocery store shelves. Within plant cell walls is a molecule called lignin, which is made up of three components. The component of focus for this study is coniferyl alcohol. Breaking down this alcohol produces many compounds, including vanillin and vanillic acid. These materials can be used to make imitation vanilla. A relatively new and inexpensive way to encourage this reaction is by using atmospheric cold plasma, or ACP. An ACP system concentrates electricity, so that samples can be treated with high voltages without generating excess heat. The objective of this experiment is to optimize the amount of useful compounds produced by changing the amount of time that the alcohol is exposed to the plasma system. It is expected that the longer the coniferyl alcohol is exposed to ACP, the more alcohol is converted to other potentially useful molecules.

78. Radiation Damage in Lithium Oxide, a Surrogate for Beryllium Carbide

David Magee (Lancaster University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Stephen Raiman

Materials selection for salt facing components in molten salt reactors is a challenging task because of the corrosive environment and high temperature. Be2C is a proposed moderator material due to its efficient neutron moderating properties, high melting point, and its corrosion resistance in FLiBe salt. Radiation damage in this material is of particular interest as the irradiation stability of Be2C at high temperature is unknown. The only known study of irradiation damage in Be2C was at 90°C to a fluence of less than 0.01 dpa (3.5 × 1022 n/m2). The toxicity of beryllium makes studying its properties under irradiation especially difficult. Li2O is a useful surrogate because it shares a common antifluorite crystal structure with Be2C. For this work, radiation damage in Li2O is to be investigated. Solid Li2O was fabricated from Li2O powder with spark plasma sintering, and is to be irradiated with proton and oxygen ions at 700^{o}C. Samples are to be examined with microhardness indenting and SEM, and data is to be presented showing how radiation affected the microstructure of the materials. This work presents new data on the behaviour of an antifluorite structured ceramic under irradiation, for use in understanding the potential behaviour of Be2C.

79. Mitochondrial Analysis of Drug-treated Triple Negative Breast Cancer (TNBC) Cells

Joseph Afreh (Binghamton University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Alex Walsh

Triple negative breast cancer (TNBC) cells survive neoadjuvant chemotherapy through altered mitochondria metabolism. TNBC cells treated with chemotherapies have altered levels of metabolic pathways, and the mitochondria have induced fission or fusion (elongation) depending on whether DNA-damaging drugs or taxanes are used. Using live cell optical imaging of the autofluorescence of FAD and NADH in the mitochondria of TNBC cells, we tested the hypothesis that chemotherapy-induced alterations in mitochondria morphology are correlated with changes in oxidative phosphorylation (OXPHOS). The different wavelengths at which NADH and FAD fluoresce can be measured using optical microscopy to determine levels of OXPHOS from the optical redox ratio which is the ratio of the intensity of NADH to that of FAD. TNBC cells were treated with four chemotherapeutic drugs for 48 hours. Carboplatin and doxorubicin (DNA-damaging drugs) induced mitochondria elongation and increased OXPHOS levels with an average NADH and FAD optical redox ratio greater than the redox ratio for the control, vehicle-treated TNBC cells. The taxanes, paclitaxel and docetaxel, on the other hand, caused a reduction in the levels of the OXPHOS and fission of the mitochondria. Subcellular analysis of individual mitochondria within the TNBC cells may indicate a direct correlation between mitochondria mechanisms and changes in the state of OXPHOS. Such a correlation may be used as a therapeutic targeting opportunity to improve treatment outcomes for TNBC patients.

80. Data Processing of Viscoelastic Properties of Cell Tissues Obtained from Brillouin Spectroscopy

Roger Grande (University of Texas at San Antonio)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Vladislav Yakovlev

Brillouin spectroscopy is an emerging technique in biomedical imaging capable of providing unique information on the viscoelastic properties of cells and tissues at a microscopic level. However, processing data acquired with a typical setup, which is prone to noise and signal distortions, is one of the most challenging parts of research on the way to the successful application of this technique to myriads of applications. To address this problem, as a part of a USRG project, I demonstrate the computational algorithm capable of obtaining crucial information from experimental data. Python was used as a programming language to analyze the data and convert it into physically meaningful information, such as Brillouin frequency shift, which is typically used for local elasticity measurements. I redesigned the least-square fit algorithm to include an extension that filters the data from external noise and signal distortions. As a result, I was able to generate critically important images of tissue's elastic properties, even when a signal is sufficiently distorted. We expect this project to provide a foundation to process different kinds of data more easily and quickly while providing the best results possible.

81. Understanding Microscale Remodeling of Myofibril and Collagen Architecture Post-Myocardial Infarction

Eric Wang (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisors: Feng Zhao, Reza Avazmohammadi

Myocardial infarction (MI), commonly known as a heart attack, results in cardiac myocyte death and fibrotic scars on the left ventricular free wall (LVFW). The myofibril damage and collagen-rich scars heavily influence tissue stricture, stiffness, and ventricular dysfunction. Our objective is to study the myofibril and collagen architecture at various timepoints post-MI, and this was accomplished through 3D remodeling in the microscopy imaging software Imaris. Our study consists of 4-timepoints from 1 to 4 weeks, then the samples were appropriately sliced and immunolabeled for the collagen, vasculature, and myofibrils. Confocal imaging provided the detailed 3D images of our sample which are then processed via Imaris. Understanding the native structure post-MI down to the individual fibril level can provide unprecedented insight into the remodeling process.

82. The Removal of Turbidity Using Electrocoagulation

Hailey Blayer (Texas A&M University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Shankar Chellam

The following report is going to discuss the process of removing turbidity using electrocoagulation along with the implications of it within wastewater treatment, however, it is important to state what electrocoagulation is. Electrocoagulation is the process of adding an electrical current within wastewater to flocculate contaminates and total dissolved solids. In our following process we are using aluminum plates and an electrical current to cause the necessary reaction that will coagulate and flocculate many contaminants include suspended solids, oils, grease, and other metals within our wastewater. Properties and knowledge of electrochemistry will be involved to complete this experiment. The process of coagulation and flocculation is vital within wastewater treatment because it removes unwanted contaminants from our water that is not easily removable through simple processes. Similarly, the solutions from this experiment will not only prove that electrocoagulation is a necessary process within wastewater treatment, but that it also trumps other processes that carry out the same jobs, for example chemical coagulation and filtration. The electrocoagulation process is much simpler and safer, and it also produces a smaller waste output. This will provide us with safer drinking water for all, without the need for chemicals within treatment.

83. Treating Coniferyl Alcohol Using the High Performance Liquid Chromatography (HPLC) and Fourier Transform Infrared (FTIR) Machines

Alexander Wynn (North Carolina A&T State University)
Undergraduate Summer Research Grant (USRG)
Research Advisor: Janie Moore

Coniferyl alcohol is one of the monomers that makes up Lignin, which is a key polymer that solidifies plant cell walls, being a main contributor to the sustainability of plant structure. As research with coniferyl alcohol continues, the more intricate and detailed we will have to be in conducting experiments and treatments. Machines such as the HPLC (High Powered Liquid Chromatography) and FTIR (Fourier-Transform Infrared Spectroscopy) are designed to take a sample and then analyze that sample down to its individual components and its quantities, allowing us to see how the sample is composed. This is the way that we will be treating coniferyl alcohol throughout this summer. The sample of coniferyl alcohol will be placed inside of the FTIR where a series of lasers analyze the sample and will then produce a graphical representation showing the composition and intensity of the sample. The HPLC does the same thing however the sample will instead be separated and tested by going into a column that will analyze the separate sample components, providing the same kind of data that the FTIR will produce. How coniferyl alcohol reacts to various treatments will determine the use of it in farming and could possibly increase farming's financial production. Understanding how coniferyl alcohol works and operates will ultimately help us better understand how lignin works, which could lead to all sorts of technological advancements and breakthroughs in the field of agricultural engineering, such as insecticide that doesn’t kill the crops along with the insects for example. By treating coniferyl alcohol, one of the building blocks of lignin, with the HPLC and FTIR, we hope to further comprehend the chemical and physical properties of coniferyl alcohol and the link between it and lignin. This will allow for future extensive research about lignin as well, providing better insight into how we can protect and promote the environment.

84. Simultaneous Multi-Color Observations of an Unknown Variable Star

Nhu Ngoc Ton (Texas A&M University)
AggieSTAAR
Research Advisor: Ryan Oelkers

The Transiting Exoplanet Survey Satellite (TESS) has observed more than 420 million stars across the entire celestial sphere. However, the observations of many stars are blended due to the large size of the TESS pixels (21"/pix) and the classification of any individual object can be difficult without additional follow up observations. In particular, many variable stars can be accurately classified by comparing follow up observations at multiple optical wavelengths (more commonly known as colors). We present simultaneous multi-color observations, during three separate nights of observation, of an unknown variable star using the Exoplanet Transmission Spectroscopy Imager (ETSI) on the 2.1m at McDonald Observatory. In this poster we describe our methodology for observing and classifying the variable star and present some of the most accurately measured colors of any star known to date.

85. 3D Printing Diffraction Gratings Using Maskless Photolithography

Brant Conway (Texas A&M University), Zachary Read (Texas A&M University)
AggieSTAAR
Research Advisor: Jennifer Marshall

The Nanoscribe Photonics GT2 high-resolution 3D printer uses Two-Photon-Polymerization (2PP) to produce high resolution 3D printed products on the scale of micro- and nanometers. Our goal is to determine whether this machine is capable of producing diffraction gratings viable for use in modern astronomical instruments. To this end, we have designed a basic spectrograph to be used with a Meade LX200 10" Telescope and Sbig ST 8300M detector.

86. FOCUSS

Enrique Gonzalez Vega (Texas A&M University), Shravan Menon (Texas A&M University)
AggieSTAAR
Research Advisors: Jennifer Marshall, Luke Schmidt

Fiber Optic Characterization for Unprecedented Sky Subtraction (FOCUSS) aims to obtain an accurate subtraction of the sky background using calibrated fiber-fed spectroscopic instruments for targets observed with the next generation of spectroscopic facilities. The goal of FOCUSS is to develop techniques to test a large number of fiber characteristics such as: focal ratio degradation (FRD), fiber transmission vs. wavelength, sensitivity to stress and strain, the relevance of fiber profile shape, and the injection efficiency as relates to fiber positioner architecture.

87. Proper Motion Analysis of Reticulum II

Mitchell Barry (Texas A&M University)
AggieSTAAR
Research Advisor: Jennifer Marshall

We use Gaia DR3 to analyze the proper motion of spectroscopically confirmed members of Reticulum II, an ultra-faint dwarf galaxy (UFD) that is gravitationally bound to the Milky Way. Due to the high prevalence of dark matter in UFDs, findings could ultimately aid our understanding of dark matter and galaxy formation.

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