2021 Student Symposium Project Descriptions

Los Alamos
NATIONAL LABORATORY

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Nicole Aldaz

Program: Undergraduate
School: New Mexico State University
Group: B-10
Mentor: Nileena Velappan
Category: Biological Science
Sub Category: Data Analytics
Type: Individual
LA-UR-21-26625

Developing for Investigation of Disease Outbreaks for Crops (AIDO4Crops)

Agriculture is a one trillion dollar industry in the United States and diseases caused by various plant pathogens and pests result in a 20-40% crop loss per year. AIDO4Crops is a web-based analytical tool that is currently being developed for disease analysis and forecasting of wheat, corn, and cotton diseases. It uses a library of historical disease occurrences to help predict the trajectory of an unfolding disease situation in the current crop year. The presentation will detail techniques used in data collection, identification of important features in disease occurrence, and the development of the web analytics for wheat rust caused by Puccinia species and wheat blotch/spot diseases caused by three different fungi (Pyrenophora tritici-repentis, Septoria tritici, Stagonospora nodorum).

Lyan Basora Dorville

Program: Undergraduate
School: Florida International University
Group: B-10
Mentor: Antonietta Lillo

Bryan Garcia

Program: Graduate
School: California State University, Los Angeles
Group: B-10
Mentor: Antonietta Lillo

Victoria Nisoli

Program: Undergraduate
School: University of New Mexico
Group: MPA-CINT
Mentor: Mary Phipps

Category: Biological Science
Sub Category: Biosecurity and Public Health
Type: Group
LA-UR-21-27104

Lateral flow assay for SARS-CoV-2 detection using Antibody Discovered at LANL

The pandemic of the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), responsible for 4+ million deaths since December 2019, remains an evolving public health crisis. Rapid and accurate detection of SARS-CoV-2 is critical in management of COVID-19. We aim to design an accurate and sensitive point of care assay using antibody pairs capable of binding non-competitively to the Receptor Binding Domain region of viral spike protein (RBD2). We present our work on development of a lateral flow assay (LFA) using two signal reporters: colloidal gold (CG) and giant quantum dots (gQD). When using CG, we derivatize the "detecting" antibody using a set of optimal conditions. When using gQD, we use biotinylated detecting antibodies and streptavidin-conjugated gQD in a two-step LFA.

Sarah Crotzer

Program: Undergraduate
School: New Mexico Institute of Mining and Technology
Group: B-11
Mentor: Hau Nguyen
Category: Biological Science
Sub Category: Protein Engineering
Type: Individual
LA-UR-21-26430

Engineering Enzymes for the Fast and Efficient Degradation of Plastics

Since the mass production of plastic began a little more than six decades ago, researchers estimate that more than 8.3 billion metric tons have been created, with a vast majority ending up in landfills or the natural environment. Plastic takes a very long time to decompose and usually breaks up into microplastics rather than biodegrading. My work this summer focuses on developing new enzymes for the fast and efficient degradation of plastics. I am using directed evolution to improve the characteristics of plastic-degrading enzymes expressed in E. coli. I used Split-GFP technology to screen for solubility and expression levels and BHET agar plates and PET powder assays to screen for activity. Several mutations were identified in two enzymes that improved their activity.

Wyatt Eng

Program: Post Masters
Group: B-10
Mentor: Christina Steadman
Category: Biological Science
Sub Category: Epigenetics
Type: Individual
LA-UR-21-27225

Correlation and Prediction of Epigenetic Data types; Machine learning lessons

DNA is entangled around specialized histone proteins to form chromatin which allows for better spatial conservation. Chromatin can be found in an open or closed state to regulate protein accessibility to specific genomic regions. ATAC-Seq and ChIP-seq are two next-generation sequencing assays that are used to study the open/closed chromatin region across the genome. In order to mitigate the cost of using multiple sequencing assays, we are studying the correlation between the two assays in order to develop a machine learning neural network that can predict epigenetic assay data from structural assay data. In our findings, the binarized and binned data shares mutual information between the sequencing replicates and similarly pre-processed ATAC-seq data and ChIP-seq data.

Sarah Kane Moser

Program: Post Bachelors
School: Bard College
Group: B-10
Mentor: Andrew Bartlow
Category: Biological Science
Sub Category: Biosurveillance and Public Health
Type: Individual
LA-UR-21-26564

Comparing screech owl microbiomes using a novel 16s rRNA sequencing method

Microbiota play a key role in host species function, yet much remains unknown about their ecology and evolution in wildlife. This raises the need for long-term, in-depth analysis, which in turn requires fast and affordable methods. This study examined the microbiomes of two relatively understudied avian species with overlapping niches, the western screech owl (Megascops kennicottii) and the whiskered screech owl (M. trichopsis). Our goals were to establish a baseline understanding of the species' microbiomes, and to assess the utility of a new 16s metagenomic sequencing method that provides high taxonomic resolution. Our work represents the first application of this method to wildlife microbiomes, which will improve efforts in conservation, biosurveillance, and environmental monitoring.

Analyssa Gomez

Program: Undergraduate
School: University of New Mexico
Group: B-10
Mentor: Nileena Velappan
Category: Biological Science
Sub Category: Microbiology
Type: Individual
LA-UR-21-26594

Efficacy of NoWClean Disinfectant Against Bacteria, Viruses, and Fungi

In 2019 the CDC reported that antibiotic resistant bacteria and fungi cause 2.8 million illnesses and 35,000 deaths in the U.S. annually. Respiratory illnesses, neurological damage, and many more familiar yet fatal diseases are caused by fungi, bacteria, and viruses. NowClean, a disinfectant generator, may be capable of reducing the number of deaths caused by infectious agents using salt, water, and electricity, while remaining human safe and environmentally friendly. Previous research revealed that the water produced by the generator effectively killed various corona viruses. At the request of a small LLC in Alamogordo we tested the ability of NowClean water to kill various bacterial, viral and fungal species with hope for future utilization in restaurants, schools, and salons.

Hannah Kim

Program: Undergraduate
School: University of Michigan- Ann Arbor
Group: ESH-RSO
Mentor: Juliet S. Swanson
Category: Biological Science
Sub Category: Microbiology
Type: Individual
LA-UR-21-27111

Ionic Strength, Water Activity, and Chaotropes Affect Halobacterium sp. Growth

The Waste Isolation Pilot Plant (WIPP) is a salt-based repository for the disposal of nuclear waste. WIPP conditions (high NaCl, low water activity, high $MgCl_2$) rule out the survival of most non-halophilic microorganisms, but indigenous extreme halophiles can possibly survive and affect repository performance. This project tested a halophilic archaeon with respect to high ionic strength, low water activity, and high magnesium content. The test organism was able to grow in brines with ionic strengths of 14 m, in 1.7 M $MgCl_2$, and with water activity of 0.687. Optimum growth occurred when Na made up at least 40% of the ionic strength and was at least 2 M. Poor growth occurred at Na concentrations below 0.5 M. Under the most extreme conditions, growth was slow and resulted in low biomass.

Sara Pacheco

Program: Undergraduate
School: Northern New Mexico College
Group: B-11
Mentor: Claire Sanders
Category: Biological Science
Sub Category: Algae
Type: Individual
LA-UR-21-27097

Investigation of Nannochloris desiccata for potential biofuel source

Biofuel from algae can be carbon neutral, and when grown in non-freshwater does not compete with agricultural resources. Exploration of new species with high production potential increases the breadth of environmental conditions in which algae can be grown. In this study we evaluated Nannochloris desiccata against two highly productive algae strains. We ran small scale experiments to compare to multiple strains and at increasing scale to collect enough volume to complete biochemical analyses. We showed that N. desiccata has a high growth rate, is very tolerant to varying salt concentrations up to 52.5ppt, and produces a substantial amount of carbon storage molecules at higher salinities. Our investigation has shown N. desiccata as a promising species for algal biofuel production.

Alicia Romero

Program: Post Bachelors
School: New Mexico State University
Group: B-10
Mentor: Jeanne Fair
Category: Biological Science
Sub Category: Avian Ecology
Type: Individual
LA-UR-21-27224

Effects of environmental conditions on eggshell thickness of WEBLs and ATFLs

Avian reproductive success is directly impacted by eggshell thickness. However, environmental effects on its natural variation remain unclear. We quantified eggshell thickness of unhatched eggs collected from Western Bluebird and Ash-throated flycatcher nests over 18 years on the Pajarito Plateau and tested the influence of nesting elevation, drought, temperature, and precipitation. We found thickness significantly increased over the study period for both species, but thickness was not correlated with any environmental factors with the exception of flycatchers producing thicker eggshells in drier conditions. Future work will help to uncover why thicker eggshells were found in drier conditions in flycatchers.

Anthony Sabella

Program: Post Masters
School: Oklahoma State University
Group: B-11
Mentor: Christina Steadman
Category: Biological Science
Sub Category: Plant biology, Genomics
Type: Individual
LA-UR-21-27067

Soil Microbe Effects on Maize in Response to Different Watering Regimes

Our research project aims to use artificial selection of soil microbiomes to produce a microbial population that confers drought tolerance in maize. Using chlorophyll fluorescence, gas exchange, and epigenetic profiling, I test the effects of drought and different soil microbiomes on the B73 maize lineage. Photosynthesis assays did not reveal significant differences between full-water, half-water, or different microbiome treatments. Epigenetic profiling revealed reduced DNA methylation in plants exposed to drought conditions regardless of the type of microbiome they had. To date, epigenetic studies in this B73 lineage of maize have been performed on seedlings and not on mature, drought-stressed plants. Thus, hypomethylation in response to drought may be an important and novel finding.

Eric Tran

Program: Graduate
School: University of Oregon
Group: B-10
Mentor: Migun Shakya
Category: Biological Science
Sub Category: Bioinformatics
Type: Individual
LA-UR-21-27189

Understanding how the environment affects prophage distribution

Bacterial viruses that integrate their genomes into the host chromosome are called prophages. Prophages remain in the host chromosomes until conditions become unfavorable, upon which they replicate and escape by lysing the host cells. This process results in the release of nutrients from the bacterial cell into the environment, which contributes to the global biogeochemical cycle. However, not much is known about how the environment influences prophage distribution in bacterial genomes. Here, we characterize the distribution, abundance, and diversity of prophages in bacterial genomes from different environments. Our initial results indicate that the prophage content of bacteria is influenced by their environment, and identify genomic features that are affected and not affected.

Seychelles Voit

Program: Post Bachelors
School: Tennessee State University
Group: B-10
Mentor: Kumkum Ganguly
Category: Biological Science
Sub Category: Microbiology
Type: Individual
LA-UR-21-27168

Rapid Sterilizing Strategies for N95 Respirators PPE for the First Responders

COVID-19 pandemic exposed unprecedented concerns about the shortage of personal protective equipment (PPE), especially N95 masks. We evaluated the use of ionizing radiation as a potential sterilizing technique for N95 masks. We studied the impact on mask integrity and functionality such as material durability, structural integrity, particulate filtration efficiency and pathogen inactivation. The data obtained will help in designing reusable PPE to be mission ready.

Cameron Watson

Program: Graduate
School: University of Oregon
Group: B-10
Mentor: Helen Cui

Samuel Koehler

Program: Graduate
School: University of Oregon
Group: B-10
Mentor: Helen Cui

Category: Biological Science
Sub Category: Bioinformatics
Type: Group
LA-UR-21-27019

Environmental microbiome analytics: pipeline development and observations

The composition of indigenous microbiomes is critical for ecosystem functionality. Exploring environmental drivers of microbiome changes may inform how they are impacted by natural and anthropogenic disturbances, and could facilitate their use as indicators of stressors in the surrounding environment. The complexity of microbiomes continues to motivate the development of analytical tools for processing large datasets and elucidating microbe-ecosystem relationships in a robust and reproducible way. Here we report the development of an automated pipeline for processing microbial rRNA marker gene data and its implementation on multiple microbial community datasets with environmental metadata. Our results shed light on spatial and temporal patterns of microbiome change.

Austin Watts

Program: Post Bachelors
School: Weber State University
Group: B-11
Mentor: Claire Sanders
Category: Biological Science
Sub Category: Algae Biofuel
Type: Individual
LA-UR-21-27137

Comparing growth and analysis between scales for Monoraphidium minutum

Algae are a next-gen biofuel producing resource, however algae cultures are susceptible to crashing and cell death, due to pests and weather events. In this project, our partners at AzCATI (an algae testbed facility at ASU) grew Monoraphidium minutum (26BAM) in outdoor open raceway ponds and observed a culture crash due to a microbial pest. We simulated the weather of this experiment in laboratory environmental photobioreactors (ePBRs) and, as expected, observed healthy culture (no pest present). We then utilized flow cytometry to compare the unhealthy (AzCATI) and healthy (LANL) cultures over time, to identify signatures that may indicate an imminent crash. Of the tracked cell properties, a new way of measuring cell autofluorescence appears to be the most promising for signaling a crash.

Kayley You Mak

Program: Post Bachelors
School: Barnard College
Group: B-10
Mentor: Shawn Starkenburg

Category: Biological Science
Sub Category: Bioscience
Type: Individual
LA-UR-21-27169

Evaluation of carbon utilization by the algae Scenedesmus obliquus

Algae production for biofuels, bioplastics, and nutraceuticals require production strain performance improvements to be economically competitive. By sequencing complete genomes and curating gene annotations, we can learn more about the physiological potential of production algal strains, and ultimately engineer modified strains for increased productivity. Here, we curated and analyzed the genome annotation of *Scenedesmus, a* freshwater microalgae, to learn about its ability to assimilate inorganic and organic carbon. By determining carbon utilization through comparative genomic analysis and validating through phenotyping experiments, we demonstrate mixotrophic and heterotrophic carbon utilization in *Scenedesmus* beyond what was previously known. These data will be used to inform waste-stream carbon utilization and tailoring of growth medium to maximize productivity.

Brett Youtsey

Program: Post Masters
Group: B-10
Mentor: Migun Shakya
Category: Biological Science
Sub Category: Bioinformatics
Type: Individual
LA-UR-21-27173

KmerProf: A scalable and accurate k-mer based tool for comparing metagenomes

Publicly available shotgun metagenomic samples have increased in both size and volume in recent years. However, due to the complexity of the microbial communities, large fractions of metagenome sequences remain uncharacterized and unaccounted for in the downstream biological analyses and inferences. To address this and augment traditional analyses, methods that do not depend on reference datasets and assemblies have been developed. Here, we address that by developing KmerProf, one of the first comparative k-mer tools tailored for distributed-memory parallel computers, and demonstrate that it is able to recapitulate inferences made by established k-mer based tools and further extend performance to tera-byte scale metagenomic datasets.

CHEMISTRY

Jalen Borne

Program: Undergraduate
School: Georgia Institute of Technology
Group: MPA-11
Mentor: Benjamin L. Davis
Category: Chemistry
Sub Category: Energy Storage/ Materials Chemistry
Type: Individual
LA-UR-21-26980

Hydrazine Based Grid Energy Storage Using Lanthanide Electrocatalysis

This project explores the chemistry behind synthesizing hydrazine (N2H4), an energy dense liquid fuel that could make electrical infrastructure more robust, through inorganic and electrochemical means. Initial project goals are to create literature lanthanide complexes, test them for the dissociation of N2H4 then perform electrochemical studies on dinitrogen reduction. Techniques like 1H NMR and GC-MS were used to identify complexes and CV and bulk electrolysis were used to test the necessary potentials for reduction and if the reduced species are reversible.

Jonathan Reynolds

Program: Graduate
School: Tennessee State University
Group: MPA-11
Mentor: Jerzy Chlistunoff
Category: Chemistry
Sub Category: Electrochemistry
Type: Individual
LA-UR-21-27141

Electrochemical Behavior of a reaction in 1-Hexyl-3-Methyl-Imidazolium Chloride

Room-temperature ionic liquids (RTILs) have been suggested as substitute solvents for electrochemical processes. However, due to the ionic character and unique microscopic ordering of RTILs, the effects they exert on chemical reactions is significantly different from conventional solvents. Here, we report studies that probe the relationship between the electron transfer kinetics of the Cu(II)/Cu(I) redox system and structural properties of an ionic liquid solvent containing variable quantities of water. We found that water accelerates both the diffusion and the intrinsic reduction rate of Cu(II), while Cu(II) concentration plays no significant role. Small angle X-ray scattering experiments revealed that Cu(II) does not affect the liquid ordering while water destroys it.

Taylor Suazo

Program: Undergraduate
School: University of New Mexico
Group: C-AAC
Mentor: Jung Ho Rim
Category: Chemistry
Sub Category: Actinide Analytical Chemistry
Type: Individual
LA-UR-21-26982

Measurement of Am-241 in Plutonium Material Using HPGe Gamma Spectrometry

Radioactive isotopes emit energy when they decay into their progeny. Understanding the abundance of actinide isotopes gives vital information about the behavior of the material. The current method for evaluating the Am-241 concentration in a Pu sample is to measure the gross gamma and alpha activity using a thallium doped sodium iodide detector and gas flow proportional counter, respectively. The proposed new method for evaluating the Am-241 concentration involves using a High Purity Germanium detector. The goal is to use an established working standard sample to determine which method results in values with the best accuracy and precision. This project will allow an objective comparison of the two methods and ultimately decide how such samples should be analyzed in the future.

Anna Zeleny

Program: Energy Storage Summer Intern
School: College of Saint Benedict
Group: MPA-11
Mentor: Eun Joo Park
Category: Chemistry
Sub Category: Materials Chemistry and Energy Storage
Type: Individual
LA-UR-21-2698

Enhancing perfluorinated polymer membrane stability through radical scavengers

Polymer electrolyte storage devices offer high efficiency energy transfer that is scalable for industrial and commercial purposes. Although these devices are an attractive option for storage and production of green energy, polymer membrane degradation from radicals during system operation limits durability. Here, we propose a synthetic method to increase the durability of the polymer membranes through a radical scavenger, cerium ions, trapped within cavities of polymer-supported crown ethers. When blended with Nafion™ to form a polymer electrolyte membrane, the crown ether containing polymer provides stable ion complexes that keep cerium active as an antioxidant and decrease the vulnerability of the membrane and overall device.

Computing & Information Technology

Angelic Marie Arzola Roig

Program: Undergraduate
School: Inter American University of Puerto Rico at San German
Group: T-5
Mentor: John Moulton
Category: Computing and Information Technology
Sub Category: Computer Science
Type: Individual
LA-UR-21-27144

Sustainable Software Development Practices for the IDEAS-Watersheds Software

This project focuses on developing the software portal of IDEAS-Watersheds, including identifying and implementing methods to display relevant statistics and metadata, incorporating existing information resources such as DOECODE, and creating performance data for Amanzi, one of the IDEAS-Watersheds' software ecosystem codes. We explore code performance on the Intel Haswell, Skylake and Icelake processors utilizing the Darwin HPC cluster. For Amanzi, this information was featured in its page within the software ecosystem. This created a more concise presentation for the IDEAS-Watersheds codes, which is expected to promote higher collaboration and growth as more developers become aware of this software ecosystem.

Dani Barrack

Program: Graduate
School: Portland State University
Group: A-4
Mentor: Michael Dixon
Category: Computing and Information Technology
Sub Category: Computer Science
Type: Individual
LA-UR-21-26737

Secure System Composition and Type Checking using Cryptographic Proofs

Formally verifying the correctness of systems of systems involves verification of their compatibility. Conventional approaches require the exhaustive checking of an entire system's state space and the undesirable exposure of data. We overcome this limitation by including zero-knowledge proofs (ZKPs) with system outputs that assert desired system properties without revealing sensitive information. This approach allows us to ensure system integrity without checking every computational path, extends our trusted computing base well beyond our own system, and grants us fine-grained control over which bits of information to keep secret. To demonstrate our capability, we created a prototype compiler to read type annotations from source files and generate ZKPs to automate system verification.

Charles Corley

School: University of Texas at Austin
Group: ISR-3
Mentor: Heather Quinn
Category: Computing and Information Technology
Sub Category: Electrical Engineering
Type: Individual
LA-UR-21-27031

Raspberry Pi Accelerated Neutron Radiation Testing

Several inexpensive Raspberry Pi computer systems were provided by JPL for testing at LANSCE as they are appearing on the space station. The test plan was novel in that testing was performed while running the Linux-derived Raspberry Pi Operating System. A suite of common benchmarks that has been employed in micro-controllers was ported and executed during testing.

The systems proved to be very vulnerable to Single-Event Effects and required very frequent reboot to recover from crashes. The benchmarks did record Single-Event Upsets during testing as their memory locations were upset. Other errors in kernel memory, registers, or control logic caused system hangs and crashes. Network transmissions were monitored for system failures and the system power was cycled to restart failed tests.

Althea Rebekah Denlinger

Program: Undergraduate
School: University of New Mexico
Group: T-3
Mentor: Xylar Asay-Davis
Category: Computing and Information Technology
Sub Category: Computer Science
Type: Individual
LA-UR-21-26979

Implementation of Task Parallelism in Support of Climate Modeling

Climate modeling is an integral part of environmental science and has become a necessary step in many research projects, but global data are virtually limitless and expensive to put into digital form, resulting in simulation programs that require a significant amount of time and processing power to run. Task parallelism offers an efficient solution to this problem, allowing tests to run in parallel with one another to increase energy efficiency and reduce runtime. This presentation will discuss our ongoing work to implement task parallelism to test cases in COMPASS (Configurations for Model for Prediction Across Scales Setups), which performs regression testing and creates initial conditions for the ocean and land-ice components of the DOE Energy Exascale Earth System Model (E3SM).

Zachary DeStefano

Program: Graduate
School: NYU
Group: A-4
Mentor: Michael Dixon
Category: Computing and Information Technology
Sub Category: Cybersecurity
Type: Individual
LA-UR-21-26644

Distributed and Verifiable Uncertainty Quantification Via Zero-Knowledge Proofs

We developed tools and techniques for capturing statistical knowledge using zkSNARKs for national security applications, even in the case of a powerful malicious prover. zkSNARKs are tiny zero-knowledge proofs (ZKP) that proves a claim without leaking any information about the proof. These can remotely verify the integrity of distributed and untrusted computations; however, there is a need to capture computations with uncertainties, estimates, and probabilities. By applying Quasi-Monte Carlo and uncertainty quantification techniques, we created tooling that extends the capabilities of ZKPs to capture these statistical and empirical properties. This allows for privacy-preserving and rigorous end-to-end verification of data science pipelines, physics simulations, and stochastic processes.

Emily Holmes

Program: Undergraduate
School: University of California, Berkeley
Group: XCP-2
Mentor: David Culp
Category: Computing and Information Technology
Sub Category: Computational Physics
Type: Individual
LA-UR-21-27152

Improvements in PDV Diagnostics in Pagosa

Photon Doppler Velocimetry (PDV) is a laser interferometry technique that measures the velocity of a material's surface along the line of sight of a probe and is used experimentally at Los Alamos National Laboratory and other scientific institutions around the world. The Eulerian hydrocode Pagosa can calculate a PDV diagnostic in two and three dimensional simulations. Issues with the implementation of PDV simulations have been addressed, improving reliability and accuracy. Additions to the source code include error-checking in 2D problems, verifying probes are in the plane of the problem, as well as adding the capability to project probe coordinates from 3D to 2D. A long standing bug where the code intermittently fails to produce a PDV calculation has also been diagnosed and fixed.

Megan Phinney

Program: Undergraduate
School: Iowa State University
Group: HPC-ENV
Mentor: Reid Priedhorsky
Category: Computing and Information Technology
Sub Category: High Performance Computing
Type: Individual
LA-UR-21-25911

SquashFS & FUSE for Better HPC Containers

Containers improve supercomputer flexibility but are hard to deploy efficiently across thousands of nodes. We present an optimized workflow in Charliecloud with SquashFUSE. This lowers user complexity, fits with job schedulers and remains performant.

Sai Prabhakar Rao Chenna

Program: Graduate
School: University of Florida
Group: CCS-7
Mentor: Robert Pavel

Katherine Cosburn

Program: Graduate
School: University of New Mexico
Group: CCS-7
Mentor: Robert Pavel

Uchenna Ezeobi

Program: Graduate
School: University of Colorado Springs
Group: CCS-7
Mentor: Robert Pavel

Maxim Moraru

Program: Graduate
School: University of Reims Champagne-Ardenne
Group: CCS-7
Mentor: Robert Pavel

Category: Computing and Information Technology
Sub Category: HPC and Machine-learning Co-design
Type: Group
LA-UR-21-26456

Optimizing and extending the functionality of EXARL for reinforcement learning

Easily eXtendable Architecture for Reinforcement Learning (EXARL) is a scalable reinforcement learning (RL) framework designed to facilitate RL research for complex scientific environments. In RL, agents are algorithms that interact and learn from an environment, such as a game or physical problem. As part of the Co-Design Summer School 2021, we explore the implementation of additional agents, such as Advantage Actor Critic and Twin Delayed Deep Deterministic Policy Gradient and improve communication across multiple learners and between actors and learners using NVSHMEM and GPU direct RDMA. We optimize the current workflow, improve the data generation pipeline by offloading to environment processes, and add new architectures like SEED, a scalable RL agent with a central inference approach.

Sina Sontowski

Program: Graduate
School: Tennessee Technological University
Group: A-4
Mentor: Nigel Lawrence
Category: Computing and Information Technology
Sub Category: Cybersecurity
Type: Individual
LA-UR-21-26251

Detecting Electrical Anomalies via Overlapping Measurements

As cyber-attacks against critical infrastructure become more frequent, it is increasingly important to be able to rapidly identify and respond to these threats. Therefore, we are investigating using multiple independent systems with overlapping electrical measurements to more rapidly identify anomalies. While prior research has explored the benefits of fusing measurements, the possibility of overlapping measurements from an existing electrical system has not been investigated. To that end, we explore the potential benefits of combining overlapping measurements both to improve the speed/accuracy of anomaly detection and to provide additional validation of collected measurements.

Jacob Springer

Program: Undergraduate
School: Swarthmore College
Group: CCS-3
Mentor: Garrett Kenyon
Category: Computing and Information Technology
Sub Category: Computer Science
Type: Individual
LA-UR-21-26673

Exploring the Relationship Between Neural Networks With Diverse Architectures

Standard neural network image classifiers can be tricked by non-semantic perturbations to input and are thus thought to rely on non-semantic (non-robust) features. These features overlap across different neural networks with diverse architectures. In order to understand how non-semantic perturbations can be so effective for classification tasks, we establish a relationship between robust (semantic-looking) and non-robust features. This relationship exhibits two properties: robust and non-robust features are entangled—they rely on the same information in the input; certain robust networks exhibit universal features—features that are entangled with all tested non-robust networks. We expect that universal features can be used to derive insight into the behavior of every neural network.

Earth & Space Sciences

Angelica Berner

Program: Graduate
School: Arizona State University
Group: ISR-1
Mentor: Katherine Mesick
Category: Earth and Space Science
Sub Category: Systems Engineering & Instrumentation
Type: Individual
LA-UR-21-27115

Exploring Gamma-Ray and Neutron Spectroscopy Missions to Mars Caves

Mars collapse chains may indicate subsurface caves. Cave's ability to host water resources and potentially life is of interest to future NASA missions. We investigate neutron instruments to explore caves because of their sensitivity to hydrogen and baseline potential future mission instruments. Using MCNP6 to model neutron transport, we create a cave model with a hemisphere geometry, a Mars-like composition in the surrounding material, and simple neutron models. We vary instrument location, cave wall and ceiling hydrogen content separately. Initial results show that we can discriminate between the ceiling and the wall of the cave with particular sensitivity to composition and distance. We explore ways to quantify the relationship between the signals from the wall, floor, and ceiling.

Emma Bouie

Program: Graduate
School: The Ohio State University
Group: EEGS-14
Mentor: Elizabeth D. Miller
Category: Earth and Space Science
Sub Category: Landslide Susceptibility and Seismic Hazard
Type: Individual
LA-UR-21-27226

Geospatial Analysis of Slope Instability in the Guaje Mountain Quadrangle

Susceptibility maps provide useful information about the spatial distribution of existing landslides (Smith, 1970), but these products generally lack information regarding the triggering mechanisms. Understanding these triggering mechanisms is important because both natural and human-induced factors influence slope instability and therefore effect the extent and probability of landslides. This study used two geospatial analytical methods to interpret landslide susceptibility and generate geologic cross sections for the northern Guaje Mountain quadrangle: analytical hierarchy method and weighted linear combination. Landslide susceptibility data, paired with other geospatial information, may begin to reveal critical information on landslide mechanics and potentially hazardous locations.

Mohit Dubey

Program: Post Bachelors
Group: CCS-3
Mentor: Diane Oyen
Category: Earth and Space Science
Sub Category: Geoscience
Type: Individual
LA-UR-21-26949

Improving Oxide Estimation in ChemCam Data with Regularized Linear Regression

The problem of improving the accuracy of models to predict the elemental composition of rock samples observed on Mars from laser induced breakdown spectroscopy remains an open research question. In this work, we investigated the effectiveness of using regularized linear regression methods to improve current models for predicting compositions of eight major rock-forming oxides. We show that both LASSO and Ridge regression models provide improvement over the currently used PLS regression. Finally, we investigate the physical implications of our models by comparing the model coefficients to known spectral lines. Over the next year, we will explore nonlinear regression models and preprocessing techniques to improve these results.

Ari Essunfeld

Program: Undergraduate
School: Yale University
Group: ISR-3
Mentor: Patrick J. Gasda
Category: Earth and Space Science
Sub Category: Aerology
Type: Individual
LA-UR-21-27058

Attribute Recognition for Grouping ChemCam Targets by Visual Characteristics

The ChemCam instrument onboard NASA's Curiosity rover is exploring Gale crater, Mars. Thousands of images have been collected by ChemCam's remote micro-imager that contain various rock types, and several classification methods have been developed to sort these images. Since process-oriented classification can introduce bias, we have developed a new classification method using only visual features of rocks. We classified 201 ChemCam targets by tracking 17 common visual attributes. We used a graph to represent target similarities. The graph produced 10 disjoint groups of visually similar rocks, supporting this method for grouping visually similar ChemCam targets. Should future efforts aim to automate attribute recognition with machine learning, this method could provide an annotated dataset.

Estrella Gomez

Program: High School
School: Dulce High School
Group: EES-14
Mentor: Sanna Sevanto
Category: Earth and Space Science
Sub Category: Plant Biology
Type: Individual
LA-UR-21-26938

How do plant traits respond to microbiomes and drought?

Droughts are one of the most harmful impacts on field crops, they mostly lead to crop yield loss. We’re doing experiments on the different drought conditions of corn crops in the greenhouse since farmers may experience the same outcome. During this experiment we are testing how microbiomes and drought affects plant growth on the above ground and below ground plant parts. Microbiomes impact drought tolerance on plants by enhancing the plant growth, photosynthesis, and that the drought stress can be dampened by the enhanced root growth. In this presentations I will be discussing the effects of microbiomes and drought on root/plant growth.

Ryan Hodge

Program: Graduate
School: University of California, Riverside
Group: A-1
Mentor: Morgan Gorris
Category: Earth and Space Science
Sub Category: GeoHealth
Type: Individual
LA-UR-21-27202

Changing Geographic Factors and the Distribution of Aedes Mosquitoes

Aedes aegypti and Aedes albopictus are the most prevalent and important vectors for the transmission of arboviruses in the Americas. Using high-resolution mosquito presence, environmental, climatic, and economic data for 1990-2019, we study the actual distribution of these Aedes mosquitoes and the geographic factors that may explain their distribution across time. We use maximum entropy modelling, a machine learning ecological niche modelling technique, to construct models of the Aedes distribution and to measure the relative importance of each geographic factor in that distribution. The final product of this paper is a habitat suitability map that reveals the regions of the Americas currently suitable for Aedes to live.

Aitor Jimenez

Program: Graduate
School: University of Houston
Group: EES-14
Mentor: Rutuja Chitra-Tarak
Category: Earth and Space Science
Sub Category: Atmospheric, Climate and Ecosystems
Type: Individual
LA-UR-21-27207

Belowground droughts and deluge in an Amazonian tropical forest

Global climate change will affect the composition and function of tropical forests due to changes in water availability. More extreme weather events are projected that may lead to drought or deluge in tropical regions. Trees can access belowground water not quantified by shallow soil moisture observations. This belowground water must be modeled to improve our predictive capacity of how tropical forest trees respond to droughts and deluge. We plan to estimate plant available water for five climatically distinct, well-instrumented tropical forest sites using a land model (ELM) linked to a next generation vegetation model designed to represent the complexity of tropical forests (FATES). As a first-step, we employed our workflow in an Amazonian tropical forest in French Guiana.

Genevieve Kidman

Program: Graduate
School: University of Nevada Las Vegas
Group: Sigma 2
Mentor: Daniel Hooks
Category: Earth and Space Science
Sub Category: Mineral Physics
Type: Individual
LA-UR-21-26493

Measuring Stress Percolation through the Elastic Strain of Polycrystals

The stress distribution (SD) in an elastically anisotropic polycrystal dictates the distribution for plastic deformation, however the form that SD would take in a polycrystal is not well known. A model for SD in a polycrystal employs stress percolation or force chains. Measuring elastic strain to identify percolation patterns may be possible using Atomic Force Microscopy (AFM) and Digital Image Correlation (DIC) while the sample is under uniaxial compression. AFM allows us to map changes in surface topography and Young's Modulus while DIC allows us to map elastic strain through high resolution sample images. Polycrystalline quartz, calcite, and acetaminophen are tested. Thus our work may have important implications for explosive mechanics, pharmaceuticals, and geology.

Madelyn Kingston

Program: High School
School: New Mexico School for the Arts
Group: ISR-1
Mentor: Peter Bloser
Category: Earth and Space Science
Sub Category: Astrophysics
Type: Individual
LA-UR-21-26877

Mapping the Galactic Plane at Gamma Ray Energies with LOX

The Lunar Occultation Explorer (LOX) is an Astrophysics Explorer satellite for proposal to NASA in collaboration with JHUAPL. This project demonstrates the potential for LOX to map the galactic plane at MeV energies with unprecedented angular resolution. Orbiting the moon, LOX would generate high resolution images by using the moon as an occulting disk and gathering precise times for when sources rise and set. The lunar coordinate location and altitude at each time step of the proposed orbit of LOX are used to determine the location and angular size of the moon at each time step from its perspective. The moon is then projected onto a simulated MeV gamma ray sky that includes calculated diffuse emission and fake point sources and modeled to show the mapping capabilities of LOX.

Akshatha Konakondula Vydula

Program: Graduate
School: Arizona State University
Group: ISR-1
Mentor: Daniel Coupland
Category: Earth and Space Science
Sub Category: Astrophysics, Nuclear Physics
Type: Individual
LA-UR-21-27157

Measurement of Neutron Lifetime Using a Space-based Neutron Spectrometer

The precise measurement of mean lifetime of the neutron is significant in understanding the rate of nuclear energy generation in stellar cores. Although we have measurements upto an accuracy of 1% they differ by over 5 sigma, thus the problem remains unsolved. Here we use a space-based neutron spectroscopic detector by measuring the disappearance of neutrons with distance. We do feasibility tests and numerical modelling of the data from the Lunar prospector mis- sion. We produce MCNP simulation results for different lunar compositions and use these to arrive at a statistical estimation of neutron lifetime using Bayesian calibration & Gaussian processes.

Sophia Li

Program: Undergraduate
School: Massachusetts Institute of Technology
Group: EES-14
Mentor: Chelsea Neil
Category: Earth and Space Science
Sub Category: Mechanical Engineering
Type: Individual
LA-UR-21-26160

Designing a Pressure Cell for Geological Carbon Sequestration Studies

Geological carbon sequestration (GCS) combats climate change by injecting CO2 emissions into deep geological formations, and field studies indicate improved carbon capture when CO2 is injected into mafic rock formations. The goal of this project is to design and prototype a pressure cell and implement a pressure system to perform Raman spectroscopy under GCS conditions. Measuring the rate of carbon mineralization and exploring the effects of precipitation on the rate itself will give further insight to the effectiveness of this method, as well as the risk associated with it.

Bhushan Lohani

Program: Student Fellowship Guest
School: University of Texas at El Paso
Group: ISR-3
Mentor: Sean P. Blanchard
Category: Earth and Space Science
Sub Category: Radiation Effects
Type: Individual
LA-UR-21-26966

DDR4 DRAM fault due to neutron radiation form cosmic ray showers

Our aim is to study the effect of terrestrial neutron radiation on DRAM of computers. We are trying to extract failure on DDR4 DRAMs after having it irradiated at the neutron test facility at LANSCE. The neutron spectrum of the beam from LANSCE has a very similar spectrum to that of the neutrons produced by cosmic rays in the atmosphere. We plan on extracting useful results from the experiment for further study of neutron radiation effects on DDR4 DRAMs. This will open up doors in future to study possible mitigations of the problems faced due to neutrons from cosmic rays on supercomputing devices.

Eliana Rodriguez

Program: Undergraduate
School: Los Alamos High School
Group: EES-14
Mentor: Sanna Sevanto
Category: Earth and Space Science
Sub Category: Plant Science
Type: Individual
LA-UR-21-26695

Directed Evolution of Soil Microbes to Develop Drought Resistant Maize

The increasing prevalence of drought spells around the world threatens global crop yield and food security. Microbial communities found within the rhizosphere of plants have been shown to affect plant physiology under drought conditions. Understanding the symbiotic relationship between root-associated microbes and plants will aid in the approach to optimizing crop yield in our changing climate. Our goal is to direct the evolution of rhizosphere microbiomes to promote drought resiliency, and eventually, drought resistance in maize. Here, I will be analyzing the physiological and morphological effects that occurred due to plant-microbe interactions.

Juliana Simon

Program: Graduate
School: Arizona State University
Group: ISR-1
Mentor: Katherine Mesick
Category: Earth and Space Science
Sub Category: Planetary Science
Type: Individual
LA-UR-21-27210

MCNP Modeling of Martian Caves

Martian caves, such as lava tubes that have been identified from orbit, are a likely target for future missions because of their potential for astrobiological discovery. Cave environments on Mars may both shield from the harsh surface radiation from Galactic Cosmic Radiation and Solar Particle Events and could contain elements necessary for life. Gamma-ray and neutron spectroscopy (GRNS) could be a future method to analyze the chemistry and hydration of Mars caves. We are developing Monte-Carlo N-Particle models to constrain the GRNS at 5 meters depth and in cave interiors and how they are impacted by geochemical composition, hydration, and geometry. Future work will look at active detection methods to compare with measurements captured by MSL's Dynamic Albedo of Neutrons instrument.

Emily Snyder

Program: Post Masters
Group: EES-16
Mentor: Kurt Solander
Category: Earth and Space Science
Sub Category: Geophysics
Type: Individual
LA-UR-21-26987

Understanding Seismic Hazards in Northern NM with InSAR and Machine Learning

Low magnitude seismic events like a M3.7 in Gallina, NM that occurred on July 30, 2020 are considered low hazard and thus poorly studied. As a result, there is little understanding about the extent and magnitude of deformation from these earthquakes. However, the study of crustal deformation from these events is important due to the potential for serving as proxies for larger magnitude events if they occur along the same fault system. We applied standard InSAR processing techniques combined with a Machine Learning method to the NM earthquake, which revealed sub-millimeter level crustal displacement near the Nacimiento-Gallina arch. This new technique can open the door to study other faults that experience similar low-level seismicity to better prepare for larger events should they occur.

Jessica Soucie

Program: Undergraduate
School: University of Utah
Group: EES-14
Mentor: Chelsea Neil
Category: Earth and Space Science
Sub Category: Geosciences
Type: Individual
LA-UR-21-26188

Treaty monitoring and geologic transport of gaseous fission products

Gaseous fission products and their daughters are a critical signal of underground nuclear explosions (UNEs), yet their subsurface transport is not well characterized. To better understand the geologic transport of gases relevant to treaty monitoring, we used statistical design of experiments to plan and execute a series of diffusion studies through various media. This presentation provides an overview of treaty monitoring and detecting UNEs, discusses some of the complicating factors that impact subsurface transport of radionuclides, and presents early results from our diffusion studies.

Engineering

Stanley Afonta

Program: Graduate
School: University of Southern California
Group: ALDCP-IA
Mentor: Genna Waldvogel

Tannis Breure

Program: Graduate
School: Arizona State University
Group: ALDCP-IA
Mentor: Genna Waldvogel

Brian Roman

Program: Graduate
School: Arizona State University
Group: ALDCP-IA
Mentor: Genna Waldvogel

Amabilis Baca

Program: Undergraduate
School: University of New Mexico
Group: ALDCP-IA
Mentor: Sheila Garcia

Justin Kim

Program: Graduate
School: Texas A&M University
Group: ALDCP-IA

Lauren Heller

Program: Undergraduate
School: Carnegie Mellon University
Group: UI-OSI
Mentor: Genna Waldvogel

Tyler Shaver

Program: Undergraduate
School: University of California, San Diego
Group: WIPO
Mentor: Karen Borovina

Category: Engineering
Sub Category: Environmental Engineering
Type: Group
LA-UR-21-27010

2021 Smart Labs Project

The 2021 Smart Labs project aims to determine the energy savings within building 03-1698 (Material Science Laboratory - MSL). Over the past couple of years, the Sustainability Group has been adding Smart Lab upgrades into the MSL building and we would like to understand the impact made for the overall energy consumption/demand and safety for the building, determine the overall return on investment (ROI), and recommend more Smart Lab upgrades that can be added to the MSL building.

Isaiah Archuleta

Program: Undergraduate
School: New Mexico State University
Group: IQPA-MPCL
Mentor: Mario Valdez
Category: Engineering
Sub Category: Mechanical Engineering
Type: Individual
LA-UR-21-27113

Investigation of Radius of Curvature Measurements using Laser Interferometry

This project included the following: developing an application using a ZYGO Verifire for calibration of artifacts where the measurand is defined as a Radius of Curvature (ROC), validating the measurements through an uncertainty analysis, and determining if the calibration method is a viable alternative/option for calibration outside of current standard methodologies used in the Dimensional lab.

Caitlin Benway

Program: Graduate
School: University of Texas at Austin
Group: MPA-11
Mentor: Ulises Martinez
Category: Engineering
Sub Category: Chemical Engineering
Type: Individual
LA-UR-21-27142

Study of the Effect of Electromagnetic Waves on Electrochemical Systems

This project aims to better understand the effect of externally applied electromagnetic (EM) disturbances on electrocatalyst surfaces. Our goal is to explore the ability to promote and/or control particular electrochemical processes using EM excitations. Initially, we will design an electrochemical system to study the behavior of various electrocatalyst surfaces undergoing a range of EM disturbances. With the use of frequency sweeps, crucial EM conditions will be identified to propose potential pathways to promote and control different electrochemical reactions using externally applied EM stimulus.

Andre Bos

Program: Post Bachelors
School: Fort Lewis College
Group: E-1
Mentor: Ryan Holguin

Douglas Meredith

Program: Post Master's
School: Colorado School of Mines
Group: E-1
Mentor: Ryan Holguin

Category: Engineering
Sub Category: Additive Manufacturing
Type: Group
LA-UR-21-26836

Additive Manufacturing of Glass Structures

Utilizing a carbon dioxide laser system and a rod feeding mechanism it is possible to print complicated structures out of commercially available glasses such as borosilicate, quartz, and soda lime. Glass Laser Additive Manufacturing (GLAMS) represents a large expansion in the possibilities of manufacturing glass structures with more complicated geometries, increased reliability, and lessened dependence on skilled artisans. GLAMS was initially developed by Dr. Ed Kinzel at the University of Missouri Science and Technology (MST). The system at Los Alamos began as a replica of the initial design at MST and has since been upgraded to incorporate the feedback and lessons learned from the prototype system.

Juan Branch

Program: Undergraduate
School: New Mexico State University
Group: ES-EPD
Mentor: Forrest Blackburn
Category: Engineering
Sub Category: Engineering Project Delivery
Type: Individual
LA-UR-21-27216

Anatomy of Engineering Project Delivery

Breaking down the EPD process.

Steven Bullock

Program: High School
School: Los Alamos High School
Group: Q-DO
Mentor: Curtt N. Ammerman
Category: Engineering
Type: Individual
LA-UR-21-27160

Best configuration for heat transfer using code

My symposium will be about heat transfer configurations using Robert Zimmerman's code that has been refined by Malcolm Porterfield. I am presenting a problem that tries to solve heat transfer through a composite wall. This problem requires me to not only find the heat transfer through the wall but also the best insulation configuration for the composite wall to block heat going into the wall and also heat coming out from internal generation. I will be showing how the code analyzes multiple combinations and displays those solutions. I will also be demonstrating the possible applications for this code and optimizations we have planned.

Cameron Calder

Program: Undergraduate
School: Stevens Institute of Technology
Group: MPA-Q
Mentor: Raymond Thorson Newell
Category: Engineering
Sub Category: Robotics
Type: Individual
LA-UR-21-27075

Automation and Machine Learning for Robust and Self-Tuning Magneto-Optical Traps

In recent years the Magneto-Optical Trap (MOT) has become a standard technology used in almost every AMO laboratory (Atomic, Molecular, and Optical Physics). While technology of individual components has improved over time, the alignment of the trap still requires tedious maintenance performed hands-on by skilled experimentalists. The project focuses on developing a custom control system for piezoelectric mirror mounts responsible for the position adjustment of the lasers beams in the experimental setup. The implementation consists of LabVIEW interface and python algorithms, supported by rotary encoders to correct for hysteresis of the devices. The control system's efficiency is tested through fiber coupling, typically performed manually, with the overall goal to fully automate it.

Cesar Camejo Vengoechea

Program: Post Bachelors
School: Florida International University
Group: MPA-11
Mentor: Tommy Rockward
Category: Engineering
Sub Category: Nuclear Engineering
Type: Individual
LA-UR-21-27026

Hydrogen Processing R&D for the Fusion Fuel Cycle

Fusion occurs when two atoms collide together to produce a heavier atom. Creating sustained fusion on earth would provide a virtually limitless source of energy. While a sustained reaction has yet to be demonstrated, it is possible to produce reaction conditions using hydrogen isotopes as fuel. Unburned tritium will need to be recycled, purified and sent back into the fuel cycle. The Hydrogen Processing Laboratory (HPL) was assembled to perform non-tritium testing for the fusion fuel cycle. The HPL is a system that can respond to experimental needs for the fusion community. Here we describe the recent restart of the HPL, its relevance, future testing directions for the apparatus, such as hydrogen permeation, hydrogen removal catalyst characterization, and fusion-relevant pumping.

Aniceto Chavez

Program: Graduate
School: Eastern New Mexico University
Group: IQPA-MPCL
Mentor: Christina Martinez
Category: Engineering
Sub Category: Calibration
Type: Individual
LA-UR-21-27112

Automated Calibration of Stopwatches and Timers

Describes methods used to automate the calibration process of stopwatches and timers.

Elena Gonzales

Program: Undergraduate
School: New Mexico State University
Group: ISR-2
Mentor: Ernst Esch
Category: Engineering
Sub Category: Mechanical Engineering
Type: Individual
LA-UR-21-26799

Automated Drum Retrieval and Storage System (ADReSS)

This project focuses on creating an automated shelving and robotic system to better utilize the facilities in TWF and improve the waste handling and shipping process at LANL. Currently waste drums are handled manually, which creates both, high workloads and high ALARA risks. We are working on the design of a three tier automated shelving system for TWF. This system will optimize storage capacity and work output, while minimizing worker injuries and dose rates. Minimizing this issue is the central priority of the ADReSS system. Concentrating on the development of a more suitable shelving structure brought forth four key conceptual designs. Performing stress and motion analysis allows for a better comprehension of the strength and effectiveness of these four concepts.

Colton Graham

Program: Graduate
School: University of Michigan
Group: NEN-1
Mentor: Tom Stockman, Sarah Sarnoski, Andrea Favalli
Category: Engineering
Sub Category: Nuclear Engineering
Type: Individual
LA-UR-21-25994

In Situ Assay for Dynamic Control of Special Nuclear Material

Supporting LANL's Nuclear Security strategic objective, a dynamic neutron source assay and localization system is developed which enhances safety and security by providing in situ inventory verification leveraging a novel deconvolution algorithm.

Andre Green

Program: Post Bachelors
School: University of New Mexico
Group: NSEC
Mentor: David Mascarenas

Peter Meyerhofer

Program: Post Masters
School: Case Western Reserve University
Group: NSEC
Mentor: David Mascarenas

Alessandro Cattaneo

Program: Staff Member
Group: E-1

Category: Engineering
Sub Category: Mechanical Engineering
Type: Group
LA-UR-21-25953

Digital image correlation with a neuromorphic event-based imager

Performing digital image correlation on silicon retina data can achieve similar results as a conventional camera, with much less memory required. A silicon retina only records change events, omitting periods when little happened.

Sophia Hitson

Program: Undergraduate
School: University of Tennessee, Knoxville
Group: NEN-1
Mentor: Vlad Henzi
Category: Engineering
Sub Category: Nuclear Engineering
Type: Individual
LA-UR-21-26917

Key Measurement Points Optimization Project

Nuclear material control and accountancy (NMCA) ensures that special nuclear material (SNM) is properly characterized and recorded. Optimization of Key Measurement Points (KMP) in a facility increases the reliability of SNM measurements. Many facilities traditionally rely on expert opinion or perceived convenience to identify KMPs, which might not be optimal for material processing and meeting regulatory requirements. In this study, the KMP optimization issue was addressed by using LANL-developed codes to inject physical detector imperfections such as dead-time into high-fidelity MCNP outputs to identify optimal KMPs for different types of neutron mass measurements. These calculations will show if faster neutron measurements can replace calorimetry for low-impurity, high-mass Pu items.

Shelby Hobohm

Program: Student Fellowship Guest
School: The University of Texas at Austin
Group: ISR-3
Mentor: Elizabeth Auden
Category: Engineering
Sub Category: Radiation Effects
Type: Individual
LA-UR-21-27006

Displacement Damage Dependence on Electrical Field during Irradiation for Diodes

This project aims to irradiate diodes at multiple different bias levels to find if a diode's leakage current measurements show differences in electrical degradation based on the bias level during irradiation. A total of twelve PAD1 diodes were irradiated at four different bias levels - 0V, -5V, -15V, and -25V - at the LANSCE Ice House with leakage currents measured before and after irradiation. The data collected will be analyzed to determine if any significant differences in leakage current exist between the four groups of diodes. If significant differences are shown, the next step would be narrowing down the physical mechanism responsible for the degradation difference, currently hypothesized to be molecular polarizability.

Md Reshad Ul Hoque

Program: Graduate
School: Old Dominion University
Group: CCS-3
Mentor: Diane Oyen
Category: Engineering
Sub Category: Computer Science
Type: Group
LA-UR-21-27124

Segmenting Technical Drawing Figures in US Patents

Image segmentation is the core computer vision problem for identifying objects within a scene. Segmentation is a challenging task because the prediction for each pixel label requires contextual information. Most recent research deals with segmentation of natural images rather than drawings. However, there is a very little research on sketched image segmentation. In this study, we introduced heuristic (point-shooting) and deep learning methods (Unet, HR-Net) to segment the technical drawing. Our proposed methods achieved over 90% accuracy where HRnet performs well with 96% segmentation accuracy which is not only promising but also computationally efficient for the technical drawing segmentation.

Wyatt Horan

Program: Undergraduate
School: University of Colorado- Denver
Group: ES-EPD
Mentor: Scott Beeson
Category: Engineering
Sub Category: Mechanical Engineering
Type: Individual
LA-UR-21-26528

Validating HVAC System of Radiochemistry Complex RC-1 (TA-48-0001)

Having reliable and efficient exhaust in a laboratory is an essential part in having a clean, safe and productive work space. This is why this project's objective is set on aiming to validate new supply and exhaust Heating Ventilation and Air Conditioning (HVAC) in Radiochemistry Complex (RC-1) Technical Area (TA) 48-0001. This building was originally constructed in 1957 with the original wings being the 100, 200, 300 and 400. The main focus is on the 300 and 400 wings because of the lack of updates since the original construction. Not only will this revitalization make these labs safer, but, also increase the efficiency because of the intended replacement of corroded heating and cooling piping and coil systems. New technology will also be replacing equipment that is over 60 years old.

Corinne Jackson

Program: Undergraduate
School: Brigham Young University
Group: W-11
Mentor: Nathaniel Mesick
Category: Engineering
Sub Category: Mechanical Engineering
Type: Individual
LA-UR-21-26655

High Temperature Aerosol Jet Sensors

The increased prevalence and diversity of electrical systems in the modern era has pushed the development of several new additive-manufacturing technologies that are safer than traditional subtractive methods, allow for direct embedding of components, and can form circuits on complex surfaces. Aerosol Jet technology has emerged as a new and promising manufacturing method for electronic systems. This direct-write method can lay down conductive traces on almost any substrate, and allows for the capability to overlap traces or print circuits on 3D geometries. In this project, we explore the design and functionality of Aerosol Jet printed thermocouples and strain sensors, with a novel focus on high temperature applications.

Henry Klee

Program: Post Bachelors
School: Clarkson University
Group: ES-EPD
Mentor: Thaddeus Kostrubala
Category: Engineering
Sub Category: Civil Engineering
Type: Individual
LA-UR-21-27213

Welding Inspection: The Role of 3rd Party Testing Agencies

The purpose of this project is to investigate the role of 3rd party inspectors during the construction process. The recently constructed parking garage at 03-2643 will be used to discuss the role of building codes and standards. The International Code Council and International Building Code will be reviewed. Primary focus will be on the welding inspections for the construction at 03-2643.

Gauri Koli

Program: Fellowship Student
School: Arizona State University
Group: ISR-3
Mentor: Elizabeth Auden
Category: Engineering
Sub Category: Electrical Engineering
Type: Individual
LA-UR-21-27005

Study of Neutron Induced Displacement Damage on Commercial Power Management ICs

The cosmic particles entering the earth's magnetic field create an overabundance of highly energetic free neutrons in the atmosphere that can produce damaging effects in the power management integrated circuits (PMICs) and larger electrical systems, which makes it imperative to study their performance in a similar environment. Neutron tests were performed at the LANSCE neutron beam facility on two sets of 3 PMIC boards, each from Texas Instruments, NXP and Analog Devices, respectively. The start-up operation and output voltages of the low drop-out (LDO) regulators and step-down voltage regulators (Buck) in all PMICs were studied before and at intervals as the beam was stopped mid-irradiation to observe the displacement damage effects.

Paul Lathrop

Program: Graduate
School: University of California, San Diego
Group: E-3
Mentor: Beth Boardman
Category: Engineering
Sub Category: Mechanical/Aerospace Engineering/Robotics
Type: Individual
LA-UR-21-27179

Safety Assignment of Obstacle Features with Expectation Maximization

We propose an online algorithm to adapt safety values of possibly adversarial actors within a path planning environment. First, a sample of obstacle trajectories are observed offline and features identified. We perform obstacle classification via expectation maximization using a dynamically calculated k-Gaussian mixture model. A supervisor then assigns safety values to each obstacle class. During online planning, obstacles are observed, features are identified, classes assigned, and safety values modified real time. We show in simulation that the proposed algorithm minimizes run-time around passive and avoidant obstacles while increasing safety around adversarial obstacles when compared to a similar algorithm with static safety values.

Leah Lujan

Program: Undergraduate
School: New Mexico State University
Group: Q-18
Mentor: Michael Steinzig
Category: Engineering
Sub Category: Mechanical Engineering
Type: Individual
LA-UR-21-2690

Effect of Surface Energy on Adhesive Properties of Sylgard

The objective of this experiment is to determine the cause of significant variation in measured Sylgard adhesive strength. Previous testing of eight double cantilever beam specimens, bonded using Sylgard, showed a variation in the measured separation load that was much higher than desired. Some of this variation may be attributed to the effects of surface preparation on the adherends.In this experiment,the following variables will be more closely controlled:component tolerances, assembly procedures, diagnostics, and surface preparation. In particular, surface preparation will be characterized by measuring the free surface energy of the adherends prior to assembly. The experimental data collected will also be used to calibrate a traction separation finite element model.

Therese Lujan

Program: Undergraduate
School: New Mexico State University
Group: Q-18
Mentor: Michael Steinzig
Category: Engineering
Sub Category: Chemical Engineering
Type: Individual
LA-UR-21-26881

Sealed Vessel Leak Test

The intent of this experiment is to develop a test procedure to validate leak-proof integrity of previously sealed Swagelok assembled fittings with welded tubes at one end. These vessels were previously used in support of the JT5-Alt370-IN-1 compatibility testing. Components remaining from the prior test will be assembled into vessels then submerged into a Parr Instrument Company pressure vessel. The instrument temperature and pressure conditions will be set to predetermined levels that simulate the prior test conditions. Vessel weights will be measured before and after immersion to determine if leakage occurred. Vessels will be opened and visually inspected for fluid to verify results. Once this technique has been validated the test will be conducted with the remaining IN1 vessels.

Mitchell Mika

Program: Undergraduate
School: University of Florida
Group: W-13
Mentor: Lucas Rolison
Category: Engineering
Sub Category: Nuclear Engineering
Type: Individual
LA-UR-21-27145

Detector Response Considerations for 1D Neutron Transport Assumptions in Air

This project focuses on exploring conditions in which 1D approximations are valid when considering detector response (absorbed dose), and investigating sources of error when these approximations are applied. Such approximations are useful for improving computational efficiency, but care must be taken in applying them to ensure that the results adequately predict the full 3D results. Furthermore, this project seeks to investigate variance reduction methods for simulating small solid angle neutron transport in air.

Fiona Powers

Program: EERE Robotics Intern
School: Montana State University
Group: MPA-11
Mentor: Troy Semelsberger
Category: Engineering
Sub Category: Mechanical/Chemical Engineering
Type: Individual
LA-UR-21-26759

Flowability of Biomass Feedstock

The rheological properties of corn stover were tested and analyzed using a Freeman Technology Powder Rheometer. Understanding and mitigating the impacts of moisture content on Integrated Biorefineries offers an improved economic pathway in biomass handling, transport and conversion. With the introduction of moisture in biomass feedstock, the aim of understanding the change in material properties with moisture was essential when researching the flow rates and economically viable solutions of bulk solids handling and transport.

Taylor Roybal

Program: Undergraduate
School: New Mexico State University
Group: C-IIAC
Mentor: Ellen O'Brien
Category: Engineering
Sub Category: Mechanical Engineering
Type: Individual
LA-UR-21-26295

Measurement of the IPF Beam Window Position Using a Displacement Probe

My project for this summer is to analyze the data that was collected on the location of the Isotope Production Facility (IPF) beam window relative to the isotope production target station and carrier using a displacement probe. The purpose of this measurement is to observe any deformation of our beam window over time and how the beam window does with all the radiation it is being exposed to. We also want to check to see how much the target carrier moves after we have flowed our cooling water through. With the data collected using this probe, I have been able to determine where the beam window sits relative to the target carrier and will compare it to historical measurements to see if there has been any further movement or deformation of the beam window.

Gonzalo Seisdedos Rodriguez

Program: PhD Student
School: Florida International University
Group: MPA-11
Mentor: Ulises Martinez
Category: Engineering
Sub Category: Materials Science and Engineering
Type: Individual
LA-UR-21-27047

Nondestructive Evaluation of Adhesive Quality Using Acoustic Emission

The objective of this research is to use nondestructive evaluation (NDE) methods to determine the quality of epoxy adhesive for aerospace applications. Unlike traditional mechanical fasteners, adhesive bonds are harder to inspect after being assembled so high quality control is needed. The chain's cross-linking density of polymers varying levels of hardener is evaluated via dynamic mechanical analysis (DMA) and is correlated via acoustic emission (AE). AE allows to non-invasively characterize the quality of an adhesive, ensuring its quality prior to being used in aircrafts. The varying hardener level in the adhesive is successfully observed using AE and confirmed via DMA, therefore making acoustic emission a potential method to non-destructively characterize the quality of adhesives.

Matthew Steiger

Program: Undergraduate
School: Georgia Institute of Technology
Group: ES-DO COE
Mentor: Sarah Murdock
Category: Engineering
Sub Category: Engineering Procedures
Type: Individual
LA-UR-21-27106

COE Requirement Matrix -- It's Not about What We Do, but How We Do It

Conduct of Engineering had no way to track the flow down of requirements to implementing documents and ensure that all of the applicable requirements are being implemented. So, it was decide that the best way to solve this problem would be to create a procedures matrix. This would list every individual requirement that needs to be implemented, where that requirement came from, and how it was being implemented. This is an ideal solution because it allows the user to efficiently filter for a section of a requirement document, a specific requirement, or an individual procedure.

Do Vo

Program: Undergraduate
School: University of New Mexico
Group: MPA-MAG
Mentor: Doan Nguyen
Category: Engineering
Sub Category: Engineering Physics
Type: Individual
LA-UR-21-23479

Redesign of the Coils for the 60 T Controlled Waveform Magnet at the NHMFL

The 60TCW magnet was the most powerful controlled waveform system in the world and had always been one of most important magnets to the high-field research community. The magnet is composed of nine concentric coils, each has several conductor winding layers reinforced by a high-strength metallic shell. In late 2014 the magnet failed in coil 7 where the stress level was the highest. The simulations indicated that the overall strength of the coil would increase by replacing a section of the reinforcing shell with Zylon fiber-epoxy composite. This reduces the stress and lowers the level of plastic deformation in the windings. The role of the metal and Zylon fiber reinforcing layers in bearing the axial and radial Lorentz forces has been studied to optimize the magnet design.

Destiny White

Program: Undergraduate
Group: NEN-1
Mentor: Sarah Sarnoski, Margaret Root
Category: Engineering
Sub Category: Nuclear Engineering
Type: Individual
LA-UR-21-26921

Nuclear Safeguards Considerations for Microreactors

Microreactors are an emerging type of small modular reactor that will be transportable and factory-fabricated. Although these reactors will bring revolutionary opportunities for areas that struggle to source power and heat, they introduce new safeguards challenges throughout their fuel cycle. The present paper identifies gaps in safeguards regulation that must be mended before microreactors can be adequately protected, licensed and operated. An overview of microreactor designs in development in the United States is also provided based on a review performed on currently published literature. All microreactors are early in the developmental process and host to complex diversity in design; thus, observations and recommendations made are based on the best publicly available information.

Carissa Yim

Program: PhD Student
School: University of Michigan
Group: MPA-11
Mentor: Sandipkumar Maurya
Category: Engineering
Sub Category: Chemical Engineering
Type: Individual
LA-UR-21-27064

Study of Membranes and Redox Couples for Nonaqueous Organic Redox Flow Batteries

This study characterizes ion exchange membranes (IEMs) and organic redox couples for NAORFBs. Transport numbers are found using the Meyer-Sievers-Teorell equation. From cyclic voltammograms (CVs) in a traditional three-electrode setup, the Butler-Volmer and Randles-Sevcik equations are used to find exchange current densities and diffusion coefficients of the organic species. The study of transport numbers will help identify dominant charge carriers in NAORFBs, and CVs of candidate redox couples provide insights on electron transfer kinetics and redox events. Both are critical to achieve high energy density NAORFBs.

HEALTH & SAFETY

Britney Hsu

Program: Undergraduate
School: Rice University
Group: B-10
Mentor: Alina Deshpande
Category: Health & Safety
Sub Category: Biosecurity and Public Health
Type: Individual
LA-UR-21-26769

Application of Web-Based Tool AIDO to COVID-19

Analytics for the Investigation of Disease Outbreaks (AIDO) is a web-based tool that analyzes historical outbreaks and their characteristics to enhance awareness about developing outbreaks and aid mitigation decisions. AIDO currently holds a library of over 650 historical outbreaks for approximately 40 infectious diseases. We expanded the library to include outbreaks from the ongoing COVID-19 pandemic and developed a unique algorithm that determines the defining characteristics of COVID-19 and provides situational awareness for an unfolding outbreak. Additionally, the visual analytics provide a trajectory for the developing outbreak. This presentation will cover the development of AIDO for COVID-19.

Materials Science

Ashley Atencio

Program: Undergraduate
School: University of New Mexico
Group: C-CDE
Mentor: Andrea Labouriau
Category: Materials Science
Sub Category: Materials Engineering
Type: Individual
LA-UR- 21-26281

Experiment, Fail, Learn, Repeat: The Engineering of Geometric Complex PDMS Foams

Room temperature vulcanizing (RTV) silicone materials are created through a condensation reaction between a hydroxyl-terminated poly(dimethyl siloxane) (PDMS) and a silane-terminated PDMS in presence of organotin catalyst (tin octoate). The crosslinking reaction generates hydrogen as the material cures and results in the generation of a foam. Thanks to their low density, high surface area and mechanical properties, these PDMS foams are often used as insulation material and for impact protection, among others. Here, we evaluate the importance of catalyst concentration, filler type and geometrical shape on the materials properties. The foams were characterized using a wide range of chemical, thermal, spectroscopic and mechanical techniques.

Diego Aubert-Vasquez

Program: Graduate
School: University of Oregon
Group: MST-7
Mentor: Matthew Crall
Category: Materials Science
Sub Category: Materials Development
Type: Individual
LA-UR-21-26179

DLP printing of Silicone

Using a novel resin recipe developed by the materials development team, we are for the first time able to print porous, pure silicone parts using light based 3d printing techniques.

Peter Beck

Program: Graduate
School: Oregon State University
Group: MST-8
Mentor: Tarik Saleh
Category: Materials Science
Sub Category: Materials Science
Type: Individual
LA-UR-21-26687

Ring Pull Technique Development for Testing Hoop Strength of Cladding Material

The recent push for accident tolerant nuclear reactor fuels (ATF) has resulted in multiple proposals for new cladding alloys to enter the current and future reactor fleet. These materials must be mechanically evaluated in irradiated and unirradiated states before being safely deployed in a reactor. Manufacturing processes can lead to anisotropic mechanical properties, therefore it is critical to test in the radial direction as well as axial. Current tests for the hoop (radial) strength of tubing include a ring pull test with a gauge section to ensure the proper failure location, but this gauge section is difficult to machine for activated, irradiated, samples. This work presents a no-gauge ring pull test with simplified sample geometry and the effects of different parameters on this test.

Talia Ben-Naim

Program: Undergraduate
School: Northwestern University
Group: MST-8
Mentor: Saryu Jindal Fensin
Category: Materials Science
Sub Category: Data Management
Type: Individual
LA-UR-21-25934

Data Management for Mechanical Properties Test Data of Metals and Alloys

Mechanical property data is a critical input into LANL codes used to predict performance of components. We have developed workflows to manage stress-strain data for metals within the GRANTA database.

Manav Bhati

Program: Graduate
School: Rice University
Group: T-1
Mentor: Sergei Tretiak
Category: Materials Science
Sub Category: Nanomaterials
Type: Individual
LA-UR-21-26650

Investigating electronic excitations in non-stoichiometric quantum dots

Quantum dots (QDs) that exhibit tunable optoelectronic properties find applications in numerous fields (solar cells, LEDs, photocatalysis). While most experimentally synthesized QDs are non-stoichiometric, the theoretical exploration has mostly focused on stoichiometric QDs. Here, we aim to understand the optoelectronic properties of non-stoichiometric QDs using atomistic simulations. We find a distinct nature of low-energy electronic excitations in non-stoichiometric QDs, that corresponds to a charge transfer (CT) phenomenon between QD core and surface. Such CT arises due to inequivalent number of anionic and cationic atoms on the QD surface. Understanding CT phenomenon is crucial for emission characteristics and the insights can be utilized to manipulate QDs for various applications.

Zachary Brounstein

Program: Graduate
School: University of New Mexico
Group: C-CDE
Mentor: Andrea Labouriau
Category: Materials Science
Sub Category: Materials Science and Engineering
Type: Individual
LA-UR-21-26534

3D Printing Advanced Siloxane Composite Materials

Siloxanes and silicones in general are used as high performance polymer materials due to their range of desirable properties spanning chemical inertness, mechanical flexibility and strength, optical transparency, resistance to thermal and hydrolytic degradation, and material compatibility. Because of the breadth of these characteristics, siloxanes find applications in many industries, from biomedical to microelectromechanical systems. In this work, siloxanes were used as thermosets to develop novel 3D printing formulations for Direct Ink Writing (DIW). In order to create DIW formulations, different siloxanes were combined with fumed silicas along with indicators and metal and ceramic fillers to create chromophoric sensors and high weight-percent loaded printable radiation shields.

Ashleigh Chov

Program: Graduate
School: University of Oregon
Group: MST-7
Mentor: Robert Gilbertson
Category: Materials Science
Sub Category: Polymers
Type: Individual
LA-UR-21-26064

Effects of Gamma Irradiation on Polyethylene

Determination of the effect of gamma irradiation at various doses (25, 75, 150, and 300 kGy) on polyethylene through thermal and mechanical testing; overall goal is to improve creep properties of polyethylene.

Paul Geimer

Program: Graduate
School: University of Utah
Group: EES-17
Mentor: Marcel Remillieux
Category: Materials Science
Sub Category: Geophysics
Type: Individual
LA-UR-21-27139

Enhanced Resonant Ultrasound Spectroscopy for Multi-Material Characterization

Resonant ultrasound spectroscopy (RUS) is a non-destructive technique to describe the elastic tensor of a material through inversion of a sample's measured resonance frequencies. The original RUS approach is limited to simple geometries as it uses a semi-analytical method to simulate the vibrational response. We modified this approach by combining the finite-element method with genetic algorithm. The new approach is applicable to systems with composite materials, complex geometries, and misaligned material and geometry axes. We present recent work focused on the response of a graphite-TZM system. We find composite material properties only vary a few percent from results from single-material RUS. Results from varied geometries and materials suggest further optimizations to enhanced RUS.

Marcos Hernandez

Program: Post Bachelors
School: University of Texas El Paso
Group: MPA-11
Mentor: Tommy Rockward
Category: Materials Science
Sub Category: Materials Engineering
Type: Individual
LA-UR-21-26507

Engineering a Greener Future: Biodegradable Polyhydroxybutyrate Composites

Researchers have predicted that by 2050, only 9% of the 33 billion tons of plastics produced will have been recycled. By introducing biodegradable polymers as substitutes for common plastics, we can aim to decrease annual plastic pollution. In this study, we investigated the material behavior of Polyhydrobutyrates (PHBs), a family of bio-polyesters that can be synthesized by microorganisms such as cyanobacteria. To measure the viability of PHBs as a replacement for non-bioplastics, various additives such as carbon fibers, plasticizers, and hollow microspheres were introduced via extrusion molding to modify properties without altering biodegradability. The samples were then characterized through a variety of chemical, thermal, and mechanical tests to measure thermal and mechanical response.

Minh Tam Hoang

Program: Post Bachelors
Group: MST-8
Mentor: Saryu Fensin, Nithin Mathew, Daniel Blaschke
Category: Materials Science
Sub Category: Materials Science
Type: Individual
LA-UR-21-26821

Interaction between edge dislocation and Helium bubbles in FCC Cu

Implantation of helium atoms via (n,) transmutation reactions can significantly affect properties of materials. In the interest of improving the lifetime of materials and enhancing the cost-effectiveness for the reactor industry, it is pivotal to understand deformation mechanisms in helium-containing materials. In this work, we investigate the interactions between edge dislocations and helium bubbles using Molecular Dynamics (MD) simulations. We focus on the effect of helium bubble pressure on the obstacle strength of helium bubbles and the relationship between dislocation mobility and applied stress in the system. Also, activation energy barriers are obtained as a function of stress from MD simulations to inform continuum-scale models.

Caleb Horan

Program: Undergraduate
School: Colorado State University
Group: MST-8
Mentor: Dale Carver
Category: Materials Science
Sub Category: Neutron Imaging
Type: Individual
LA-UR-21-26098

Novel Molten Salt Neutron Imaging Furnace Design

Development of Gen IV molten salt nuclear reactors require greater precision of currently published macroscopic molten salt fluid property values. The targeted high temperature properties include density, viscosity, and surface tension. Neutron imaging measurements coupled with dilatometry, rheometry, and tensiometry techniques, will be evaluated while the sample is held in its molten state by a purpose-built furnace. The project focus was the mechanical design and deployment of a 1200°C capable furnace able to support neutron imaging while rotating an interchangeable sample containment. The presentation will follow the molten salt furnace through the design process as different obstacles and constraints are met with appropriate solutions.

Jessica Lalonde

Program: Graduate
School: Duke University
Group: B-11
Mentor: Babetta Marrone
Category: Materials Science
Sub Category: Biomaterials Engineering, Machine Learning
Type: Individual
LA-UR-21-25984

A Machine Learning Approach for Polymeric Degradation Prediction

A machine-learning model is developed and expanded to predict and better understand how bio-based plastic alternative materials break down in various environments by learning from trends in previously published, open-access degradation data.

Olivia Lutterman

Program: Undergraduate
School: Carthage College
Group: MPA-11
Mentor: Taeho Ju
Category: Materials Science
Sub Category: Mechanical Engineering
Type: Individual
LA-UR-21-26927

Creating Magnetic Lattice Structures to Manipulate Acoustic Propagation

There have been several previous studies on acoustic wave propagation in plates because such guided acoustic waves can be used in non-destructive evaluation of various plate-like structures. This study investigates how arrays of magnets attached on the surface of plates could be used to alter the propagation characteristics of guided acoustic waves in plates through frequency filtering. Although each individual attached magnet causes a small perturbation on the acoustic wave propagation, cumulative scattering effects are significant through magnetic lattice engineering. Results show that within a chirp range of 80-140kHz that lower frequency wave modes are significantly suppressed while wave modes in the range of 115-125kHz are relatively unaffected by the lattice formations.

Luke McClintock

Program: PhD Candidate
School: UC Davis
Group: MPA-CINT
Mentor: Dimitry Yarotski
Category: Materials Science
Sub Category: Renewable Energy; Halide Perovskites
Type: Individual
LA-UR-21-26096

Super-Mobile Excitons In Methylammonium Lead Tribromide Microstructures

We investigate temperature dependent transport behavior of free carriers and excitons in single-crystal MAPbBr3 microstuctures via scanning photocurrent microscopy (SPCM), photocurrent spectroscopy, and time resolved photoluminescence (TRPL). We observe temperature dependent resonance peaks in the photocurrent (PC) spectra which are attributed to exciton formation. SPCM profiles show PC quickly decaying at room temperature, but a much longer PC decay is observed at lower temperatures, in addition to the fast decay. The slow decay shows an almost flat distribution, indicating a large carrier diffusion length. With TRPL lifetimes on the nanosecond-scale, this suggests an incredibly large carrier mobility at lower temperatures, which we attempt to understand with highly mobile excitons.

Tanya Tafolla

Program: Graduate
School: University of California, Merced
Group: XCP-4
Mentor: Nathaniel Morgan
Category: Materials Science
Sub Category: Numerical Methods
Type: Individual
LA-UR-21-27158

3D Lagrangian Hydrodynamic Methods to Simulate Shock Driven Flows

We present a Lagrangian discontinuous Galerkin (DG) hydrodynamic method with slope limiters for 3D shock driven flows on structured meshes. These problems are numerically challenging because of the solution discontinuities which are due to the shock, and can lead to oscillations and unphysical model predictions such as negative internal energy. We utilize sequential slope limiters to enforce bounds on density, specific total energy, and velocity to ensure positivity and physical accuracy of the evolution polynomials. Two techniques are presented to compute bounds for each of the limited fields. Results are presented for a suit of test problems which demonstrate the accuracy and robustness of the limiting technique for DG.

Avery Torrez

Program: Undergraduate
School: New Mexico State University
Group: MPA-CINT
Mentor: Jonathan Gregory Gigax
Category: Materials Science
Sub Category: Mechanical Testing
Type: Individual
LA-UR-21-27061

High throughput tensile testing using femtosecond laser fabrication technique

This study provides a justification for using laser fabrication and an in-house built system to decrease tensile testing times at sub-microscale areas. Sub-microscale mechanical testing is time consuming, but with the help of this method, sample production times can be cut down tremendously while producing excellent data for homogenous and heterogeneous microstructure materials. Using a homogeneous microstructure material as a benchmark for the system, we then tested a heterogeneous material to understand boundary limits for strength and ductility for complicated microstructures.

Logan White

Program: Post Bachelors
School: Northwestern University
Group: MST-8
Mentor: Donald Brown
Category: Materials Science
Sub Category: Additive Manufacturing
Type: Individual
LA-UR-21-27211

Synchrotron diffraction analysis of laser powder bed fusion processed Ti-5553

Rapid cooling rates and large thermal gradients present during the laser powder bed fusion process leads to non-equilibrium microstructures, preferred orientation, and prominent residual stresses within build components. To develop an understanding of the process-structure relationship for the L-PBF processing of complex geometries, a lattice structure made of beta Ti-5Al-5V-5Mo-3Cr alloy was manufactured using the L-PBF process. X-ray diffraction was conducted at beamline 1-ID at the Advanced Photon Source at Argonne National Laboratory. Measurements were taken perpendicular to the build direction at lattice nodes and struts across the sample. Details on microstructure and residual stress will be presented as a function of location in the lattice relative to the base plate.

Steven Young

Program: Graduate
School: University of Oregon
Group: MST-7
Mentor: Brian Patterson
Category: Materials Science
Sub Category: Materials Science
Type: Individual
LA-UR-21-25892

A Look Inside Materials Imaged by X-ray Computed Tomography (CT)

X-ray computed tomography enables rendering of 3D images of a material's internal structure, providing further understanding of morphology and behavior under applied forces. This PowerPoint examines composites, explosives, metal, and eng. materials.

Mathematics

Sujay Kazi

Program: Graduate
School: New York University
Group: T-4
Mentor: Andrew Sornborger
Category: Mathematics
Sub Category: Quantum Computing
Type: Individual
LA-UR-21-27228

Studying Dynamical Lie Algebras Generated by Maxcut VQA and Mixer Hamiltonians

It is conjectured that the existence of barren plateaus in the cost function for a variational quantum algorithm (VQA) is closely tied to the dimension of the dynamical Lie algebra (DLA) obtained from the set of generators of the ansatz. To this end, given a simple graph $G = (V, E)$, we attempt to determine the dimension of the DLA generated by the generators $\{iH_p, iH_m\}$, where $H_p = \sum_{(i,j)\in E}Z_iZ_j$ is the Hamiltonian whose ground state is the solution to the Maxcut problem on G, and $H_m = \sum_{i\in V}X_i$ is a mixer Hamiltonian. We present an analytically derived upper bound that is usually close to the true DLA dimension. We further present numerical methods to compute the DLA dimension for this type of problem that outperform purely brute-force methods.

Chloe Paris

Program: Undergraduate
School: Johns Hopkins University
Group: A-1
Mentor: Sara Y. Del Valle
Category: Mathematics
Sub Category: Mathematical Epidemiology
Type: Individual
LA-UR-21-25881

Exploring the Impact of COVID-19 Variants and Vaccine Efficacy on Herd Immunity

We developed an age-structured SIR model to investigate the impacts of unvaccinated subpopulations on herd immunity. Our goal is to analyze different scenarios to support decisions regarding optimal reopening strategies.

Yu Wang

Program: Graduate
School: University of Michigan
Group: CCS-6
Mentor: Natalie Klein
Category: Mathematics
Sub Category: Statistics
Type: Individual
LA-UR-21-26824

Streaming Distributed PCA for Climate Modeling

Computer simulations continue to grow in size and complexity and are moving towards exascale, which can generate outputs that exceed storage capacity and the bandwidth for transfer to storage, making offline statistical inference challenging. One approach is to embed statistical analyses in the simulation while it is running -- a strategy called in situ inference. We focus on adapting Principal Component Analysis (PCA) -- a statistical method for reducing dimensionality of big data -- to the in situ setting. We develop a distributed streaming PCA algorithm that uses Message Passing Interface (MPI). Our approach significantly reduces the storage requirement and avoids excessive inter-node communication. We illustrate the method using data from DOE's E3SM project for Earth system modeling.

Other (Non-Technical)

Thomas Chadwick

Program: Undergraduate
School: University of California, Berkeley
Group: WRS-SIS
Mentor: Alan Carr

Sydney Manginell

Program: Undergraduate
School: New College of the Humanities
Group: WRS-SIS
Mentor: Alan Carr

William Mason

Program: Undergraduate
School: St. John's College
Group: WRS-SIS
Mentor: Alan Carr

Camille Valdez

Program: High School
School: Pojoaque High School
Group: WRS-SIS
Mentor: Alan Carr

Category: Other (Non-Technical)
Sub Category: History and Archiving
Type: Group
LA-UR-21-27068

The Importance of Ontologies to LANL's Future Search Capabilities

Ontologies are an essential component of the NSRC's efforts to implement AI technologies to improve search capabilities. Ontologies connect disparate information in search engines and clarify the complex relationships between individual concepts. Our project utilizes Protege, an ontology-building tool, to construct a simple ontology on the relationship between Norris Bradbury and Edward Teller. By researching the relationship between these important historical figures, we hope to not only demonstrate the important role of ontologies in the future search capability, Titan on the Red, but also to provide valuable historical information for the ongoing work of the WRS authors on their forthcoming H-Bomb book.

Karin Ebey

Program: Undergraduate
School: Eckerd College
Group: A-1
Mentor: Lori Daulesberg
Category: Other (Non-Technical)
Sub Category: Remote Scientific Collaboration
Type: Individual
LA-UR-21-26832

COVID-19's Impact on Work Practices and Scientific Collaboration

The COVID-19 pandemic was a sudden, unexpected event that instantly changed working behaviors and scientific research. While remote work and digitalization were explored before the pandemic, many organizations had to drastically change their practices. The shift to remote work forced organizations to adapt and learn new technologies, communication methods, and leadership practices. Literature suggests that scientists initially focused on tasks that could be done at home like paper writing, but found ways to collaborate remotely to complete lab experiments. Currently the world is in a transition period because the pandemic accelerated the prior trends of remote work and digitalization. Many lessons from the pandemic experience in remote work practices will carry forward to future work.

Jaimie Ritchie

Program: Undergraduate
School: University of New Mexico
Group: SAFE-OA
Mentor: James Faulkner II
Category: Other (Non-Technical)
Sub Category: Security
Type: Individual
LA-UR-21-27154

Analysis of Controlled Personal Electronic Devices

Analysis of introduction of controlled personal electronic devices (PEDs) as captured by Protective Force Incident Reports (IRs), with the intent to aid in identifying trends and causes to assist in eliminating associated security incidents and reduce introduction of PEDs into restricted areas.

Jacob Rutten

Program: Undergraduate
School: Texas A&M Texarkana
Group: SSO-2
Mentor: Matt Nguyen
Category: Other (Non-Technical)
Sub Category: Criminal Justice
Type: Individual
LA-UR-21-27194

Apollo Intelligent Security Solutions

Apollo security solutions, about their company and their products.

Will Sutherland

Program: Graduate
School: University of Washington
Group: CCS-6
Mentor: Benjamin Sims
Category: Other (Non-Technical)
Sub Category: Remote Scientific Collaboration
Type: Individual
LA-UR-21-26721

Tools and Concepts for Hybrid Science

Evaluating and Improving Los Alamos's Collaborative and Remote Scientific Work Environment.

PHYSICS

Iyan Ayres

Program: Undergraduate
School: Lamar University
Group: AOT-AE
Mentor: Ilija Draganic
Category: Physics
Sub Category: Ion source and accelerator physics
Type: Individual
LA-UR-21-27200

High Vacuum System at New H+ RFQ Ion Beam Injector

A Radio Frequency Quadrupole - RFQ accelerator is being developed to replace the H+ Cockcroft-Walton injector. The goal of this study is to evaluate the vacuum system of the new RFQ injector system and better understand the injector working parameters. The vacuum system will be tested in different operational regimes and observed vacuum measurements will be analyzed. Using the experimental data, the operational ion source pressures and the hydrogen flows will be optimized. A simple vacuum model will be constructed and compared to recorded vacuum pressures. The model will determine the maximal voltage limits in the HV extraction column and beam attenuation in low energy transport beam.

Kevin Clarke

Program: Undergraduate
School: Brigham Young University-Idaho
Group: P-1
Mentor: Dale Tupa
Category: Physics
Sub Category: Image Radiography
Type: Individual
LA-UR-21-27009

Preparing Fiber Scintillators for use at Proton Radiography Facility (pRad)

We are building scintillator fibers for use at the Los Alamos Proton Radiography facility (pRad). We built them out of two sizes and two types of scintillating fiber. We used connectors, epoxy, and polishing film to construct these scintillators. We will test these scintillators at pRad when proton beam becomes available.

Abigail Coker

Program: Graduate
School: University of Utah
Group: T-4/CNLS
Mentor: Jianxin Zhu
Category: Physics
Sub Category: Condensed Matter
Type: Individual
LA-UR-21-27209

Spin Dynamics in the Kagome Lattice

The Kagome lattice is attracting a multitude of research interest as a result of its ability to host the elusive quantum spin liquid state and topologically protected bands. Harnessing control of these intriguing states of matter in these materials requires an understanding of their spin dynamics and underlying microscopic processes. We seek to elucidate these by considering the effects of the exchange interaction, an applied magnetic field, on-site anisotropy, and Dzyaloshinskii-Moriya exchange interaction. Competition between these interactions leads to rich phase diagrams marked by unique spin configurations. We numerically explore the spin waves for these configurations, allowing us to provide key insights to the promising nature of Kagome materials in development of spintronics.

Filippo Delzano

Program: High School
School: Los Alamos High School
Group: T-2
Mentor: Vincenzo Cirigliano
Category: Physics
Sub Category: Nuclear and Particle Physics
Type: Individual
LA-UR-21-27174

Electroweak Baryogenesis and Baryon Asymmetry

Early in its history, the universe was not only filled with matter, but also with its antimatter counterpart. Yet today, when we look around, there seems to be no trace of antimatter. The question of what happened to the antimatter of the early universe has fascinated researchers for decades, with many theories attempting to answer this question.

The production of Baryon Asymmetry at the Weak Scale, or Electroweak Baryogenesis, is an attractive mechanism to describe the source of this asymmetry. In this talk, we derive numerical results for the presence of Charge-Conjugation Parity (CP) violating interactions in a "bubble" model of the early universe and highlight the generation of an asymmetry between matter and antimatter as particles move through our bubble's wall.

Ethan Fisk

Program: High School
School: Robinson Secondary School
Group: XTD-IDA
Mentor: Joseph Smidt
Category: Physics
Sub Category: Cosmology
Type: Individual
LA-UR-21-27217

Formation of Stars in the Early Universe

As the universe expanded, it cooled, which allowing high density regions of hydrogen and helium to form, and eventually led to the creation of stars. Because of nuclear fusion, stars emit light, but also create heavier elements than hydrogen and helium. All stars observed today have at least some of these higher density elements in them. We ran computational simulations of the first stars that formed in the universe (Population III stars), which are theorized to have been made up of only hydrogen and helium. We tracked the creation of heavier elements both during these stars' lifetimes and during supernovae at the end of their lives, with the goal of finding where water formed in the early universe.

Zev Goldhaber-Gordon

Program: Undergraduate
School: Carleton College
Group: CINT
Mentor: Andrew Cardin
Category: Physics
Sub Category: Metamaterials
Type: Individual
LA-UR-21-27025

Broadband Active Metamaterial Microwave Cloaking

In most situations, physical objects scatter radiation in the microwave frequencies, an often undesirable effect. Masking or 'cloaking' this radiation is a complex problem, to which metamaterials are well suited. With few exceptions, such cloaks are narrowband, passive, or both. We propose, and demonstrate in simulation, an efficient metasurface cloak in a reflection geometry, exhibiting broadband operation, and an electronically tunable ground plane. Our unique approach offers a dual broadband functionality, with the metasurface acting as either a cloak by tailoring the reflected phase along the surface, or as an absorber along the same band. Our work enables an exciting new class of thin, agile cloaks, setting the foundation for actively reconfigurable cloaking surfaces.

Emily Jevarjian

Program: Undergraduate
School: Michigan State University
Group: AOT-AE
Mentor: Evgenya Simakov
Category: Physics
Sub Category: Accelerators
Type: Individual
LA-UR-21-26907

Investigating persistent slip markings as breakdown sources by thermal processes

Breakdowns cause damage to accelerator structures in high-gradient systems and are thought to result from field-induced forces and emission-generated heat, the latter of which can lead to a thermal runaway process. The characteristics of emitter structures from which breakdowns occur remain unknown. We investigated persistent slip markings (PSM) as breakdown sources in copper structures. PSM aspect ratio and curvature dictate emission behavior and were varied to determine the geometrical conditions under which the thermal runaway process commenced. From the heat equation, temperature distributions were used to determine the bounds for PSM geometry where temperature showed a significant increase, indicating a geometry would likely undergo the thermal runaway process and lead to breakdowns.

Hanna Kim

Program: Graduate
School: University of Illinois, at Urbana-Champaign
Group: P-4
Mentor: Zhehui Wang
Category: Physics
Sub Category: Applied Physics
Type: Individual
LA-UR-21-27088

Physics-informed neural network for the Schrödinger equation

Recently, there have been many progress towards developing Deep neural networks (DNNs) so that DNN also obeys the rules of physics. PINN incorporates penalizing layer to satisfy the target partial differential equation. The training aims to minimize the sum of the loss function corresponding to the original data and the output not satisfying the equation. The time-dependent Schrödinger equation (TDSE) with electronic and neutron potential have been investigated in this work that correlates the potential function to the wave function. Here, we rely on the internal relation of the PDE and plug in a 1D, 2D potential to the neural network in order to attain the wave function.

Julian Kinney

Program: Undergraduate
School: University of Michigan
Group: P-4
Mentor: Eric Loomis
Category: Physics
Sub Category: Shock Physics, X-ray Diffraction, Material Structure
Type: Individual
LA-UR-21-26313

Simulations of a Laser Driven Experiment Exploring Metallic Phase Transitions

This research focuses on understanding the relationship between metal compounds and their constituent pure elements. Specifically, this can be done using the Matter in Extreme Conditions (MEC) hutch at the Linac Coherent Light Source (LCLS) by producing laser-driven shocks in targets containing various metal samples and tracking the phase transitions and high-pressure melting of the elemental metals and intermetallic compounds. First, we used a radiation hydrodynamics code to check individual target materials against SESAME equation of state tables and LASL experimental data. Then we performed a mesh convergence study followed by full laser-target simulations as compared to analytical results. Finally, experimental data obtained from x-ray diffraction patterns is presented and discussed.

Anthony Lestone

Program: Undergraduate
School: Texas A&M University
Group: P-3
Mentor: J. Matthew Durham
Category: Physics
Sub Category: Particle Physics
Type: Individual
LA-UR-21-27161

Analysis of D meson decays at LHCb

This project focuses on the study of D mesons produced in 13 Tev proton-proton collisions at the Large Hadron Collider measured with the LHCb experiment. The analysis of the decay products of the D mesons reveals the intermediate states that mediate these decays and probes at the quark-level transitions that occur. Comparison of the decays of the D+ (composed of a charm quark and a down antiquark) and the Ds+ (composed of a charm quark and a strange antiquark) shows the effects that different quark flavors have on D meson decays.

Emily Mendoza

Program: Undergraduate
School: New Mexico Highlands University
Group: P-1
Mentor: Verena Geppert-Kleinrath
Category: Physics
Sub Category: Neutron Imaging
Type: Individual
LA-UR-21-27214

MCNP Simulations for Aperture Alignment in ICF Imaging

Inertial confinement fusion experiments compress a Deuterium-Tritium (DT) capsule by ablating the capsule material creating a nuclear fusion reaction in a central burn volume. Burn propagation through the remaining cold fuel is disrupted by asymmetries in compression, creating a non-uniform temperature distribution within the implosion. MixIT diagnostic will spatially resolve ion temperature of ICF implosions at stagnation. The accuracy of aperture pointing used to image the plasma must be precise enough to produce a useful image. Simulations conducted using the Monte Carlo N-Particle code (MCNP6) will be integrated into MATLAB to streamline alignment procedures for upcoming experiments at the Laboratory for Laser Energetics.

Ryan Park

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LA-UR-21-26978

Plasma transport properties using quantum mechanical collision probabilities

State-of-the-art Monte Carlo plasma simulations use statistical methods to account for collisions of particles and require accurate angular distribution functions to describe scattering events. Due to new angular distribution models developed for H, H2, and He here at LANL, we sought to investigate the impact of the present work in the calculation of plasma transport parameters. We tested these models using a popular Boltzmann equation solver, BOLSIG, to obtain transport coefficients. We show that our present model is more consistent with benchmark convergent close-coupling collision models and swarm experiment measurements than other commonly used angular distribution models, resulting in error reduction of the calculated mobility and diffusion coefficients by as much as 50-100%.

Henry Prager

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LA-UR-21-27056

Understanding the Mass Loss of AGB Stars in the LMC

Asymptotic Giant Branch (AGB) stars are the final actively fusing stage of stellar evolution for stars like our sun. These stars are unstable, and are undergoing pulsations. These stars are losing their stellar envelope through mass loss, returning materials from their envelopes to the interstellar medium. The mass-loss rate can be expressed in terms of stellar parameters, most importantly in this work pulsation period, luminosity, and mass. Using these parameters, we can determine power-law fits of the mass-loss rate as a function of period and luminosity and a lower bound on the exponents of this fit as a function of luminosity and mass. This study focuses on the AGB stars of the Large Magellanic Cloud.

Michael Probst

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LA-UR-21-26308

A New Approach to Stabilizing Lasers

A gas can be cooled to extremely low temperatures by pairs of counter-propagating laser beams if the laser frequency is fixed just below resonance with the atom. The usual approach to stabilizing the laser frequency is to use an analog feedback circuit. However, if vibration or temperature changes cause the laser to move too far from resonance the feedback loop will be unable to return it to the right frequency when the perturbation is removed. When that happens a human operator needs to go into the lab to relock the laser. The goal of this project is to develop software on an FPGA to make a system that can recover automatically from such events by relocking to the desired transition. The system will also allow a computer to jump the laser in frequency for a few milliseconds and relock.

Megan Redding

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LA-UR-21-26988

Understanding Capacitively Coupled Contactless Conductivity Detection Systems

This study is an in-depth investigation of various techniques utilizing capacitively coupled electrodes wrapped around a cylindrical fluid carrier in order to determine conductivity. This investigation serves to maximize the efficiency of a C4D system while also providing mathematical modelling to further explain C4D behavior. The level of conductivity can be accurately determined and assigned a concentration in the 0.001 to 0.1 M NaCl (aq) range. Modeled behavior was consistent with experimental behavior and could therefore be used to predict NaCl (aq) concentration. These results lend support to the idea that contactless detection can be effectively utilized in the determination of unknown concentrations of salts.

Landon Tafoya

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LA-UR-21-27208

Investigation of proton-induced damage in Ce-doped mixed garnet scintillators

Scintillating materials emit visible light in response to radiation, and thus are critical to radiographic imaging and its applications. However, high radiation exposure can damage the materials and subsequently alter the optical properties. The effects of radiation damage in Ce-doped mixed garnet-based systems of varying compositionare investigated using optical techniques. Diffuse reflectance spectroscopy withvisible light canassess radiation tolerance in poly-crystalline samples. The samples were exposed to 200 keV protons to an accumulated fluenceof10^16protons per square centimeterand subsequently probed with diffuse reflectance spectroscopy to explore radiation-induced absorption.

Vashisth Tiwari

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LA-UR-21-26307

Optimizing beam splitters for matter waves

Atoms which have been cooled to ultra-low temperatures act as matter waves which can be used to create atom interferometers that can sense acceleration and rotation. In our atom interferometers, we split a Bose-Einstein Condensate into two wave-packets with pulses of a standing wave of light that acts as a diffraction grating for the matter wave. While how to choose the pulse parameters to use the first order of this grating is well known, producing higher orders, which correspond to higher momentum wave packets, is a much harder numerical problem. The main goal of this work is to use a range of optimization techniques and machine learning to discover optimal pulse parameters for higher order splitting processes. These new solutions will be tested with atom interferometers in MPA-Q lab.

Will Thompson

Program: Post Bachelors
Group: P-2
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Category: Physics
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LA-UR-21-26435

Searching For Dark Matter: The Coherent CAPTAIN Mills Detector

The Coherent Captain Mills Detector located at the Los Alamos Neutron Science Center is a 10-ton liquid argon scintillation detector intended to search for several dark matter candidates including vector portal dark matter and axions.