2019 Science and Technology Open House
and
NSF EPSCoR CPU2AL Annual Meeting

Book of Abstracts

2019 Science and Technology Open House
and
NSF EPSCoR CPU2AL Annual Meeting

Mobile, AL - April 3 – 5, 2019

Meeting Agenda

Wednesday, April 3, 2019 **Gulf Coast Exploreum Science Center**	
Activities for K-12 Teachers and Students Begin	
First Group of K-12 Students and Teachers Arrive	9:00 AM
Students are Separated into Three Groups and Rotate Through the Following Activities: • Body Works • IMAX Theater: *Mysteries of the Unseen World* • Hands-On STEM Demonstrations by the Following Institutions o Auburn University o Bishop State Community College o Dauphin Island Sea Lab o The University of Alabama o The University of Alabama at Birmingham o The University of Alabama in Huntsville • Lunch	9:30 AM
K-12 Students and Teachers Leave	1:15 PM
Activities for K-12 Teachers and Students End **Activities for College Participants Begin**	
NSF EPSCoR CPU2AL Management Meeting	12:30 PM
Registration Opens	2:15 PM
STOH Poster Judges Orientation	3:45 PM
Welcome Reception and Registration	5:00 – 7:00 PM

Thursday, April 4, 2019 Renaissance Mobile Riverview Plaza Hotel, Ballroom Bon Secour Bay 3	
Registration and Breakfast	8:00 AM
Ed Thomas (AU CPU2AL co-PD) and Lynne Chronister (USA VPR) Welcome	9:00 AM
Uma Venkateswaran (NSF) Overview of the NSF EPSCoR Program	9:10 AM
Christopher Lawson (UAB) Overview of Alabama EPSCoR	9:25 AM
Coffee Break	10:00 AM
Sebastian Kirmse (USA) Z-Threaded Carbon Fiber Composite Technology	10:30 AM
Ryan Gott (UAH) Plasma-based System for Water Purification	10:45 AM
Lori Scott (AU) Measurements of the Thermal Properties of a Flowing Dusty Plasma Under Microgravity	11:00 AM
Bernabe Tucker (UAB) Innovations in Small Caliber Vascular Graft Devices	11:15 AM
Lunch and Student Organized Career Session - **Molly Wasko (UAB)** The Road to Commercialization and Entrepreneurship - **David Maurer (AU)** Expectations for Postdocs and Young Faculty	11:30 AM to 1:30 PM

Thursday, April 4, 2019 Renaissance Mobile Riverview Plaza Hotel, Mobile Bay Ballroom and Jubilee Suite	
Poster Session 1	1:30 PM
Poster Session 2 and Coffee Break	3:10 PM
Networking Among Participants and Selection of Poster Awardees	5:10 PM

Thursday, April 4, 2019 Renaissance Mobile Riverview Plaza Hotel, Ballroom Bon Secour Bay 3	
Conference Dinner - **Scott D. Baalrud, University of Iowa** Langmuir, Bohm and the Plasma Sheath - **Poster Awards**	6:10 PM

Friday, April 5, 2019 **Renaissance Mobile Riverview Plaza Hotel, Ballroom Bon Secour Bay 3**	
Breakfast and END of STOH	8:00 AM
Gary Zank (UAH) Welcome to NSF EPSCoR CPU2AL Annual Meeting	9:00 AM
Gary Zank (UAH) Overview of CPU2AL	9:05 AM
Vladimir Kolobov (CFDRC and UAH) Overview of Research Thrust 1	9:35 AM
Edward Thomas, Jr. (AU) Overview of Research Thrust 2	10:00 AM
Coffee Break	10:25 AM
Yogesh Vohra (UAB) Overview of Research Thrust 3	10:45 AM
Carlos Reinhold (UAH) Other CPU2AL Project Elements	11:10 AM
Dana Waller (UAH) Continuation of Other CPU2AL Project Elements	11:25 AM
Ivan Arnold (AU) Continuation of CPU2AL Project Elements	11:40 AM
Vijay Rangari (TU) Effect of Plasma Treatment on Powders	11:55 AM
Working Lunch and Parallel EAB Meeting **Alex Volkov (OU)** Cold Atmospheric-Pressure Plasma in Plant Biology **Robert Arslanbekov (CFDRC)** Implicit Fluid Solver for Non-Equilibrium Reactive Plasmas	12:10 PM
Srinivasa Rao Mentreddy (AAMU) Low-Temperature Plasma Applications in Agriculture Research at Alabama A&M University	1:10 PM
Rich Branam (UA) Non-intrusively Measuring Plasma Properties	1:25 PM
Edmund Spencer (USA) Space Weather and GPS Scintillation During Geomagnetic Activity	1:40 PM
Lingling Zhao (UAH) The Physics of a Partially Ionized Plasma in Space Plasma	1:55 PM
Gary Zank (UAH) Closing Remarks	2:10 PM
External Advisory Board (EAB) Meeting	2:25 PM
EAB Debriefing	2:55 PM
End of all activities	4:10 PM

Poster Session 1

Poster Session 1 Abstract Title	Presenter's Name	Poster Number
Targeting DNA-damage inducible homolog 2 (Ddi2) for the treatment of cancer	Ibtisam Ibtisam	BIO001
Development of Immunologic Assays to Support Clinical Trials of New Vaccines for Venezuelan Equine Encephalitis Virus	Erin Schmale	BIO003
Epigenomic and Epidemiological Factors of Schizophrenia through gene-environment interactions in socio-economically disadvantaged communities in Alabama	Jeremiah Pfitzer	BIO005
Robust Integral Projection Model	Gopal Nath	BIO007
Addressing Drought Emergencies in the Heat of the Moment: A Reduced Latency MODIS NDVI Product to Support Index-based Livestock Insurance in Kenya	Sara Miller	BIO009
Non-competitive inhibition of proteasome by kinase inhibitors	Olasubomi Akintola	BIO011
Evaluating A New Treatment Assessment Methodology on the Productivity of Agricultural Fields in Nepal using Machine Learning Techniques and Space-Borne Data	Ronan Lucey	BIO013
Field line resonance in the magnetosphere	Feng Shi	CPU001
Theoretical Model of Ion-Acoustic Shock Wave Structure in Dusty Plasma	Juan G Alonso Guzman	CPU003
Plasma assisted Chemical Looping System: A method to conduct dry reforming and water splitting at low temperature	Rajagopalan V. Ranganathan	CPU005
First-Principles Study of Mechanical Properties of B-C and B-N Systems with High Boron Content	Wei-Chih Chen	CPU007
Using Global 3-D Hybrid Simulation to Understand Kinetic Alfven Waves (KAWs) in the Magnetosphere	Lei Cheng	CPU009
Microwave Plasma Chemical Vapor Deposition to Synthesize Boron Nitride Thin Film	Kallol Chakrabarty, Shane A. Catledge	CPU011
Effects of Low Temperature Plasma on Turmeric Plant Height	Khadi Badiane	CPU013
Assembling Sounding Rockets to Study the Full-sun Ultraviolet Spectrum	Nicolas Donders	CPU015
A 3D simulation of filamentation in low pressure electric discharges	Mohamad Menati	CPU017
Determining Plasma Waves with a Plasma Wave Receiver	Riley Mayes	CPU019
Plasma Treatment of Calcium Carbonate Nanoparticles from Eggshell Waste	Vincent Hembrick-Holloman	CPU021
Low temperature plasma suppresses growth of the spinach seed-borne fungal pathogen Stemphylium botryosum	Shakina Hogan	CPU023

Poster Session 1 **Abstract Title**	**Presenter's Name**	**Poster Number**
Data-driven Magnetohydrodynamic Model of Solar Chromosphere and Laboratory Plasmas as Low Temperature Plasma	Mehmet Sarp Yalim	CPU025
Computational Simulations of Plasma Processes Relevant to Pulsed Laser Deposition of Thin Film Materials	Jacob Paiste	CPU027
Design of the Probe Antenna Deployment Mechanism on the JAGSAT 2U CubeSat	Darcey D'Amato	CPU029
The Effect of Zinc Titanate Nanoparticles on The Nano-Mechanical and Thermal Behavior of Polyetherimide	Mohamed Elafandi	PHY001
Interfacial properties of CNTs-modified carbon fiber epoxy composites through Nano indentation technique	Alexander Anderson	PHY003
Activation of Methyl-Coenzyme M Reductase	Bryan Cronin	PHY005
Two-Dimensional Transition Metal Carbides (MXenes) as Cathode Materials for Rechargeable Aluminum Batteries	Armin VahidMohammadi	PHY007
Morphology based Variability in Thermal Conductivity of Nanostructures: Molecular Dynamics Study	Sushan Nakarmi	PHY009
Semi-Automated Identification and Thermal Infrared Response of Dunes Materials at Hargraves Crater, Mars	Al Emran	PHY011
Development of a Rechargeable, Antimicrobial Fiber	Bradley Brimmer	PHY013
Towards Kink-free Vascular Grafts, Electrospun Vascular Grafts from Polymer Blends	Kiran R Adhikari	PHY015
Effects of Binary Nanoparticles on Mechanical & Thermomechanical Performance of Epoxy SC-780 Composites	Ryan Green	PHY017
Effect of laser-generated plasma properties on thin film growth of iron-based superconductors	Sumner Harris	PHY019
Improvement of Mobility and Stability of Motion of Skid-Steering UGV with New Individually Steering Inputs on Severe Terrain	Siyuan Zhang	PHY021
Exploring the Potential Energy Landscape of ∑5(310) Cu Grain Boundary.	Keshab Bashyal	PHY023
A Molecular Dynamics Study of Side-Chain Effects on Xylan Attachment to Cellulose	Morgan Lancaster	PHY025
A Pattern Reconfigurable Antenna with Full Hemispherical Null Steering	Zabed Iqbal	PHY027
Removal and Recovery of Phosphorus from Non-Point Source using Permeable Reactive Barriers	Rachel Chai	PHY029
Comparative Study on Flexural Properties of Nanoclay and Graphene Nanoplatelet Modified Carbon Fiber Reinforced Polymer Composites	Tareq Sarower	PHY031
Low-Level Convergence and the Formation of Convection along Sea Breeze Fronts	Zackary Webster	PHY033
Characterizing Side- Channel Resilience of Logic Redundancy for Secure Hardware	Venkat Dileep Bandlamudi	PHY035

Poster Session 1 **Abstract Title**	**Presenter's Name**	**Poster Number**
The Effect of Signal-to-Noise on Gamma-Ray Burst Prompt Emission Spectral Lag Measurements	Stephen Lesage	PHY037
Estimating Intracellular Signal Concentration Using 3-D Spectral Imaging	Taryn N. Dooms	PHY039
Engineering Design of an open-link locomotion module and a development of a Virtual Vehicle Demonstrator	Huashuai Fan	PHY041
Synthesis, characterization and applications of highly modular polyphosphonates	Ross Totsch	PHY043
Performance Analysis of a Hybrid Ground Source Heat Pump System Integrated with Liquid Dry Cooler	Gaoyang Hou	PHY045
Tensor Completion via the CP decomposition	Fatoumata Sanogo	PHY047
Accelerated Property Mapping and EDS Analysis of Zinc Titanate Reinforced Polyetherimide Nanocomposites	Isaiah Wilson	PHY049
Separating single wall carbon nanotubes ： length separation and single chirality isolation	Chunxu Chen	PHY051
Sequences Modulo Primes and Finite State Automata	Joel A. Henningsen	PHY053
Supercritical Fluid Enhanced Ionic Liquid Extraction	Kelsey Tootle	PHY055
Social Stress as an Indicator of Crime: Correlating a Spatial Distribution of Crime Using Proximate Locations and Social Stress at the Census Block Level	Jessica T. Ross-Romine	PHY057
Understanding the Dissolution Properties of Amorphous Cellulose and its Application to Sustainable Chemistry	B. Justin Harvell	PHY059
Subsequence Clustering with Local Gaussian Process Parameter Features	CScott Brown	PHY061
Incorporation of Traditional and Ionic-Based Plasticizers using Stereolithgraphy for Flame Retardants	Bryant Baldwin	PHY063

Poster Session 2

Poster Session 2 **Abstract Title**	**Presenter's Name**	**Poster Number**
Toxic Rice Water Experiment "Sticks and Stones May Break My Bones but Words will Make Rice Smell.”	Anthony Roberts	**BIO002**
Evidence of the Postmortem Clostridium Effect in the Prostate of European Cadavers	Marquis Nelson	**BIO004**
Synthesis of Polyvinyl Alcohol and CaCO3 from Eggshells for Nanocomposites via Ultrasonication	Aiesha L. Ethridge	**BIO006**
Thanatomicrobiome in Liver Samples of American and European Cadavers	Gabrielle Maloy	**BIO008**
Investigation of Cellulose Beads as an Efficient Biodegradable Nutrient Delivery System	Johnathan Mitchell	**BIO010**
Intrathymic Thymic Nurse Cell Transplants Increase Endothelium-Dependent Relaxation in the NZBWF1 Systemic Lupus Erythematosus Mouse Model	Terrance A. Platt	**BIO012**
Mapping Magnetic Field Lines for an Accelerating Solar Wind	Samira Tasnim	**CPU002**
Controlling dust charge with driven current fluctuations	Michael McKinlay	**CPU004**
Magnetic Field Influence on a Steady Dusty Plasma Flow	Dylan Funk	**CPU006**
Electric Field Structures in Magnetized Low-Temperature Plasmas	Taylor Hall	**CPU008**
Neutral temperature and density measurements inside the discharge channel of a Hall Effect thruster using LIF techniques	Mustafizur Rahman	**CPU010**
Measuring Energy Distributions Inside a Hollow Cathode Plasma	Kirk J. Boehm	**CPU012**
Characterization of a microwave generated plasma with varying fractional ionization on magnetic surfaces	Eleanor Williamson	**CPU014**
Diagnostics of Striations in RF Capacitively Coupled and DC Positive Column Discharge Plasma	Zachary White	**CPU016**
Tensile Properties of Extruded PBAT/PLA filaments incorporated with Carbon via Coconut Shell Powder	Chibu Umerah	**CPU018**
Wet Laid Polymer mesh Reinforced Hydrogels for Skin and Muscle Tissue Engineering	John Bradford	**CPU020**
Analysis of O2 Low Temperature Plasma Treatment on NanoCrystalline Carbon Derived from Spent Espresso Grounds	Shardai S. Johnson	**CPU022**
Substorm Prediction Using The WINDMI Model	Pavithra Srinivas	**CPU024**
Time Domain Impedance Probe for Jagsat 1	Christopher Burns	**CPU026**
Towards Modeling and Simulation of Low-Temperature Plasma for Ion Thrusters	Sajid Ahmed	**CPU028**
Characterization of low temperature Plasma treated biobased silica/carbon hybrid nanoparticles	Zaheeruddin Mohammed	**CPU030**

Poster Session 2 **Abstract Title**	**Presenter's Name**	**Poster Number**
JagSat I: EPS, C&DH, ADCS	Shawna M Mason	PHY002
A Distributed Energy Generation System Modeling and Simulation for Academic Buildings	Qing Mu	PHY004
Design and development of an affordable telemetry systems for navigation of autonomous vehicle	An Liu	PHY006
Assessing Changes in Mangrove Forests in Africa: Quantifying Loss and Identifying Drivers of Change using Landsat-8 OLI	Katie Strattman	PHY008
Evaluation of Effectiveness of Bio-based Graphene Reinforced Asphalt Pavement	Omar Tahri	PHY010
Characterization of Non-volatile, Self-neutralizing Acids formed from Ionic Liquids and CO2	Tanner Hickman	PHY012
Novel Anthracene-Based Materials for Non-Invasive Optogenetics	David French	PHY014
Effect of fabrication methods of amorphous silicon thin films on their charge carrier dynamics	Uddhab Tiwari	PHY016
Pointwise Estimates on the Green's Function of a Linearized Chemotaxis Model and a Pointwise Time Asymptotic Behavior of Solution to the Nonlinear Model.	Jean Rugamba	PHY018
Query Driven Association Action Rules	Lowell Crook	PHY020
Untangling YARN 2.0: Data Analytics in Apache Hadoop	Thomas Watts	PHY022
1/f Noise Characterization and Control in Length and Chirality-Separated Single-Walled Carbon Nanotube device	Xin Wang	PHY024
A Spatial Pattern Analysis of Forest Loss in the Madre de Dios region of Peru	Andrea Nicolau	PHY026
Oxidation Studies of Dinoflagellate Luciferin: A Combined Computational and Experimental Approach	Patrick Donnan	PHY028
Molecular Modeling of Singular and Binary Adsorption of CO2 and H2O onto Water Stable Metal Organic Frameworks	Arianjel Hernandez	PHY030
Binary Adsorption of CO2/H2O Mixtures on Amino Functionalized Metal Organic Frameworks	Rebekah Impastato	PHY032
Studies in the Crystallization Kinetics of Ultrathin Tungsten Oxide Layers	Chandler Cotton	PHY034
Interfacial properties of CNTs-added carbon fiber epoxy composites through Nanoindentation technique	Oluwaseyi Shofolawe-Bakare	PHY036
Imaging emission of a random lasing nanoscale media with sub-micron resolution	Bibek Dhami	PHY038
Analysis of Castor Oil Based Polyurethanes	Simone Brookes	PHY040
Fluorescent Nanodiamond infused in Molecularly Imprinted Polyacrylamide for Creatinine sensing application	Reim A. Almotiri	PHY042
Preparation and Characterization of Bionanocellulose- Polyvinyl Alcohol Films for Potential Use in Biosensors Applications	Christina Young	PHY044
Porous magnetic Fe3O4/NiLa-LDH for advanced wastewater treatment: phosphate removal and antibacterial activity	Thanh Vu	PHY046

Poster Session 2 **Abstract Title**	**Presenter's Name**	**Poster Number**
The Effect of Polymer Coating on Adsorption Capability of 13X-Zeolite	Carson Graves	**PHY048**
3D Printed MXene Micro-Supercapacitor with Ultra-High Energy Density	jafar orangi	**PHY050**
Prediction of the Best Injection Location for Catheter-Based Drug Delivery to Treat Brain Tumors	Lisa H. Antoine	**PHY052**
Mining Targeted Rare Association Rules Efficiently	Blake Johns	**PHY054**
Influence of Nano Fillers on The Flexural Strength, Flexural Fatigue, Thermal & Moisture Absorption Of Carbon Fiber Reinforced Sc-15 Epoxy	Onyekachi Ekwuazi	**PHY056**
Thermo-Mechanical and Mechanical Characterization of Carbon-E-glass Composites Exposed to Marine Conditioning	Delroy Watson	**PHY058**
Design and Analysis of a High-Altitude Multistage Launch Vehicle	Jane Gillette	**PHY060**
A Dynamic Programming based Outlier Rejection Algorithm for Image Mosaicing Problem	Christopher Smith	**PHY062**

Abstracts - Oral Presentations

ZT Composites – Towards stronger, tougher and more conductive carbon fiber composites

Sebastian Kirmse[1,2], *and Kuang-Ting Hsiao*[1]

[1]Department of Mechanical Engineering, University of South Alabama
[2]College of Engineering, Systems Engineering Program, University of South Alabama

Material scientists are constantly challenged to improve the design and performance of products and systems due to the continuously growing needs and expectation of our society. The need for lighter and stronger materials is larger than ever before. Carbon fiber reinforced polymer (CFRP) laminates are widely used in many applications due to their high strength-to-weight ratio. However, due to the multi-ply configuration, traditional CFRP laminates are vulnerable to matrix-sensitive damages, e.g., compressive failure, delamination, and shear failure.

A research group at the University of South Alabama is currently investigating a novel process that allows one to manipulate long carbon nanofibers (CNFs), pre-dispersed in a polymer matrix, to thread through the array of carbon fibers in order to enhance the CFRP in the laminate's through-thickness direction (z-direction). With this new process, it is possible to manufacture CFRP prepreg containing zig-zag transverse-oriented CNFs (z-threaded CNFs) by flow-transferring a resin film containing electrical-field-aligned CNFs into a dry carbon fiber fabric.

This presentation will discuss the current research status by presenting testing data (e.g., electrical and thermal conductivity measurements, as well as shear and compressive strength results). The group is currently exploring the commercialization capabilities of this promising technology. To do so, they participated in the National NSF Innovation Corps (I-Corps) Team program in order to investigate a potential business model and to perform a rigorous 8-week customer discovery process. Their journey and experience throughout the program and its effect on the research direction will also be discussed in this presentation.

Acknowledgement:
The authors would like to acknowledge the financial support of the Alabama Higher Education (Alabama GRSP program, Award number: 160310), Alabama Department of Commerce (Alabama Innovation Fund, Award number: 150436), the College of Engineering's Systems Engineering Program Graduate Assistantship at the University of South Alabama, and the National Science Foundation (National I-Corps Teams Program, Award number: 1748369). In addition, the authors are grateful for the carbon fiber materials provided by Hexcel Corporation, the carbon nanofiber materials provided by Applied Science, Inc., and the surfactants provided by BYK USA, Inc.

Characterization of an Atmospheric Pressure Plasma Jet for Water Purification

Ryan P. Gott, *Kunning G. Xu*

Mechanical and Aerospace Engineering Department, The University of Alabama in Huntsville

Atmospheric pressure plasma jets are currently being studied and developed for the water purification because of their ability to produce desirable reactive species at low temperatures and atmospheric pressures. Due to the high particle densities, small scales, and non-equilibrium nature of these plasmas, they can be difficult to predict. Dozens of atmospheric plasma sources, most commonly jets, have been reported in the literature with varying configurations and operating conditions. This work is an effort to characterize a single plasma jet over a range of conditions in order to build a more unified understanding and further the goal of water purification. The plasma was characterized using optical emission spectroscopy. The effect of how the operating conditions affected gas temperature, jet length, and reactive species production are reported. It was found that OH production, which drives the purification process, is dependent on gas flow and plasma density, while reactive nitrogen species depend on plasma interaction with the surrounding air. Generally, increasing voltage and frequency resulted in increases of reactive species. Higher flow rates increase OH production, while higher flow rates and voltages also increase jet length.

This work is funded by the NSF EPSCoR GRSP, Round 13.

Calibrating PIV Software using Synthetic Images of a Complex Plasma

Lori Scott[1], *Edward Thomas Jr.*[1], *Jeremiah Williams*[2]

[1]Department of Physics, Auburn University
[2]Department of Physics, Wittenberg University

Complex plasmas are composed of electrons, ions, neutrals, and micron-sized, charged particles (dust). Under microgravity conditions, the dust particles can fill the plasma volume, which enables the study of small-scale inter-dust forces. In the Plasma Kristall-4 (PK-4) microgravity laboratory on the International Space Station, particles are injected into a dc glow discharge plasma and flow along an axial electric field. We use particle image velocimetry analysis techniques on the PK-4 data to statistically describe the motion of the particles throughout the system. Previous works have created a calibration curve to account for the narrowing of the velocity distribution that arises due to the inherent averaging that occurs in the application of the PIV technique. This presentation will focus on extending the previous work to calibrate PIV measurements by creating synthetic images of complex plasmas which include a net drift so that we can more accurately represent the PK-4 experimental conditions due to the axial electric field. This calibration will be used in our analysis of PK-4 data to determine how the thermodynamic properties of a complex plasma evolves.

We acknowledge the use of the joint ESA-ROSCOSMOS Experiment «PK-4» on-board the ISS. This work is supported by funding from NSF EPSCoR (OIA-1655280), NSF (PHY-1615420), NASA/JPL (JPL-RSA 1571699), and DLR/BMWi (50WM1441).

Innovations in Small Caliber Vascular Graft Devices

*Bernabe S. Tucker**[1], *Yogesh K. Vohra*[2], *and Vinoy Thomas*[1,2]

[1]Department of Materials Science and Engineering, University of Alabama at Birmingham
[2]Center for Nanoscale Materials and Biointegration, Department of Physics, University of Alabama at Birmingham

*Presenter email: betucker@uab.edu

This presentation will communicate recent progress in small caliber (< 4 mm intimal diameter) vascular graft devices. The approach in our lab centered around manufacturing of a nano/microus porous structure accessed via electrospinning of optimized polymer solutions such as poly(ethylene terephthalate) (PET), poly(ε-caprolactone) (PCL), and poly(butylene terephthalate) (PBT) dissolved in 1,1,1,3,3,3-hexafluoro-2-propanol (HFIP). The surface properties are tailored to enhance the biocompatibility, bioactivity, and bio-interface via processing with low-temperature plasmas (non-equilibrium with respect to energy distributions of electrons and ions/neutrals). Air plasma, inert gas, nitrogen-rich, and other plasma systems are discussed. Furthermore, progress and results from preliminary biological work will be presented. Fibroblast cells displayed enhanced growth as a function of air plasma treatment time. Endothelial cells displayed remarkable 2-fold increase in metabolic activity in a novel nitrogen-rich surface which is being investigated for active-molecule release kinetics. Further, various methods of plasma processing including tuning of the feed gas composition, power, time, and magnetization will be covered briefly. The summary of recent progress highlights the revival of electrospinning for vascular graft devices, demonstrates the utility and potential of low-temperature plasma processing for enhanced bio-interfaces, and these methods are validated by the evidence provided by biological studies.

Acknowledgement: This material is based on work funded by NSF EPSCoR CPU2AL (OIA-1655280) any opinions, conclusions, or recommendations are solely those of the authors and do not necessarily reflect the official views of the NSF.

Implicit Fluid Solver For Non-Equilibrium Reactive Plasma

Robert Arslanbekov[1] *and Vladimir Kolobov*[1,2]

[1]CFD Research, Huntsville, AL
[2]Center for Space Plasma and Aeronomic Research, The University of Alabama in Huntsville

Low temperature plasma (LTP) finds an increasing number of applications in various fields from material processing to biology, medicine and agriculture. This work is devoted to the development of advanced computational tools for modeling of LTP. Physically accurate and numerically efficient modeling of LTP presents several major challenges: a) high spatial resolution is often required in certain parts of the system (sheaths, shock layers, steamer channels, etc.) – using a spatially uniform mesh results in a very large problem size; b) kinetic solvers (both particle- and grid-based) are expensive computationally and require huge computer memory or a large number of particles; c) disparate time scales for electron and ions require long simulation time if both the electron and ion time scales need to be resolved; d) coupling electromagnetics with charge transport results in highly non-linear problems (especially when ionization processes are important).

In this EPSCoR project, we are developing fully-coupled implicit schemes for fluid plasma simulations with dynamically adapted Cartesian mesh. The spatial discretization scheme is based on the Scharfetter-Gummel (SG) approach (in non-isothermal formulation), which is particularly suited for plasma simulations. The non-linear coupling between particle transport and electromagnetics is implemented through the Newton iteration scheme with appropriately derived Jacobian matrices. The implemented scheme shows excellent convergence properties (by several orders of magnitude) during non-linear Newton iterations and demonstrates significant efficiency improvements over the existing explicit schemes and even over the implicit schemes without non-linear coupling for baseline plasma tests with strong plasma-field coupling and highly time- and space-varying dynamic grid adaptation. The solver capabilities also include an arbitrary number of (positive or negative) ion and neutral species. The transport equations for all ion species are solved within the same full-Newton framework (i.e., in the same single Jacobian matrix framework) making possible large time step marching and improved convergence. We find that for the problems on interest, this approach is very efficient and can be particularly suitable for ion-ion plasma modeling or for modeling of plasmas when electron transport is severely retarded. We also enhanced the AMR plasma code with the finite-rate chemistry solvers with multi-temperature (e.g., electron, gas, or vibrational temperatures) reaction rates. In our presentation, we will report results of simulations of various multi-dimensional plasma systems, as well as discuss different grid adaptation strategies in the developed full-Newton framework. The overall goal is extending the applicability of the AMR plasma modeling tools to realistic plasma device conditions and thus to increase further the level of the model fidelity and predictability for EPSCoR team needs.

The Physics of a Partially Ionized Plasma in Space Plasma

Gary P. Zank[1,2], Laxman Adhikari[2], Lingling Zhao[2], Parisa Mostafavi[2,3], Eric J. Zirnstein[3], and David J. McComas[3]

[1]Center for Space Plasma and Aeronomic Research (CSPAR), University of Alabama in Huntsville, Huntsville, AL 35805, USA
[2]Department of Space Science, University of Alabama in Huntsville, Huntsville, AL 35899, USA
[3]Department of Astrophysical Sciences, Princeton University, Princeton, NJ 08544, USA

The New Horizons Solar Wind Around Pluto (NH SWAP) instrument has provided the first direct observations of interstellar H+ and He+ pickup ions (PUIs) at distances between ∼11.26 and 38 au in the solar wind. The observations demonstrate that the distant solar wind beyond the hydrogen ionization cavity is indeed mediated by PUIs. The creation of PUIs modifies the underlying low-frequency turbulence field responsible for their own scattering. The dissipation of these low-frequency fluctuations serves to heat the solar wind plasma, and accounts for the observed non-adiabatic solar wind temperature profile and a possible slow temperature increase beyond ∼30 au. We develop a very general theoretical model that incorporates PUIs, solar wind thermal plasma, the interplanetary magnetic field, and low-frequency turbulence to describe the evolution of the large-scale solar wind, PUIs, and turbulence from 1–84 au, the structure of the perpendicular heliospheric termination shock, and the transmission of turbulence into the inner heliosheath, extending the classical models of Holzer and Isenberg. A detailed comparison of the theoretical model solutions and observations derived from the Voyager 2 and NH SWAP data sets shows excellent agreement between the two for reasonable physical parameters.

Abstracts - Poster Presentations

BIO001

Targeting DNA-damage inducible homolog 2 (Ddi2) for the treatment of cancer

Ibtisam Ibtisam[1], *Jennifer Ann*[2], *Amit K. Mitra*[1], *Steven N. Fiering*[2], *and Alexei F. Kisselev*[1*]

[1]Department Department of Drug Discovery and Development, Harrison School of Pharmacy, Auburn University, Auburn – AL
[2]Norris Cotton Cancer Center, Dartmouth - Hitchcock Medical Center, Lebanon – NH

Proteasome is essential protein-quality control proteolytic complex in mammalian cells. It also controls the level of transcription factors and cell cycle regulatory proteins. Rapid growth and increased production of the damaged protein in cancer cells makes them highly proteasome-dependent. Unlike non-malignant cells, tumor cells undergo apoptosis upon partial proteasome inhibition. Proteasome inhibitors Bortezomib and Carfilzomib are approved for the treatment of multiple myeloma; novel proteasome inhibitors are in trials for the treatment of solid tumors. Clinical effectiveness of these drugs is limited by the rapid recovery of proteasome activity, and lack of therapeutic approaches to block this recovery. DNA-damage inducible 1 homolog 2 (Ddi2) is a novel aspartic protease, which activates the transcription factor Nrf1 responsible for the restoration of proteasome activity. We found that knockout of Ddi2 sensitizes cells to Bortezomib and Carfilzomib. Although Ddi2 knockout did not affect the growth in a 2D culture, it dramatically reduced the growth of xenograft tumors in mice. RNA sequencing of tumors revealed that knockout of Ddi2 leads to down-regulation of several pathways that have been associated with tumorigenesis such as STAT3. Additionally, Kaplan-Meier plot showed inverse correlation between Ddi2 expression levels and survival rate of pancreatic cancer adenocarcinoma. Together, our data suggest that Ddi2 is an oncoprotein and potential target for the treatment of cancer.

BIO002

Toxic Rice Experiment
"Sticks and Stones May Break My Bones but Words will Make Rice Smell."

Anthony Roberts, Boss Davis, Gabby Thomas. Wyatt Oliveras, Alexus Herron, and Elizabeth Schlosser

Department of Biology, Bishop State Community College

The purpose of the study was to determine whether we could effectively measure positive or negative verbal commands by observing the affect it had on the state of rice water. Three plastic weight trays were each filled with 50 mL of Mana brand rice and 100 mL of room temperature tap water. Over a two week period tray (A) was exposed to positive verbal commands, tray (B) was exposed to negative verbal commands, and tray (C) was not exposed to any verbalization. Trays were placed into a dark cabinet after each treatment. Recorded were the initial color, appearance, and smell of each tray. The dates and times of administered treatments were collected. It was determined at the end of the two-week trial that there was a significant difference among the treated trays. The results indicated that tray (A) had a slight color change and pleasant aroma. However, tray (B) had a significant change in color, mold began to grow on the specimen, and produced a foul smell, and tray (C) was recorded as having little to no change in appearance except that the water had completely dried up and the smelled produced was described as putrid.

BIO003

Development of Immunologic Assays to Support Clinical Trials of New Vaccines for Venezuelan Equine Encephalitis Virus

Erin O. Schmale[1] *and Jonathan O. Rayner*[1]

[1]Department of Microbiology and Immunology, College of Medicine, University of South Alabama

Venezuelan equine encephalitis virus (VEEV), a new world alphavirus endemic to Central and South America, has been the subject of several major outbreaks over the past century affecting tens to hundreds of thousands of people. The virus also has potential as a bioweapon due to its ease of production, its low infectious dose and its ability to spread via aerosols. Despite this risk, there is currently no FDA approved vaccine. An attenuated vaccine (strain TC-83) has previously been developed and tested primarily in military personnel but failed to confer long-term immunity. This vaccine strain has also been shown to be transmitted by mosquitoes, increasing the risk of reversion to wild type. Several new vaccine candidates have been proposed and are currently under investigation; however, current efforts to support vaccine licensure are hampered by the availability of high-throughput immunological assays that are appropriately validated to test for anti-VEEV antibody production in clinical trial participants. Using a TC-83 strain tagged with green fluorescent protein (GFP) and a commercial anti-VEEV monoclonal antibody, we established optimized conditions for a focus reduction neutralization assay (FRNT) in a 96-well format. We obtained optimal growth of VEEV by infecting Vero cells at a targeted plaque forming unit (PFU) concentration of 900 PFUs/well for 11 hours with an overlay of 0.3% Avicel to confine the virus' spread to neighboring cells and observed optimal antibody neutralization after incubation with the virus at 37^{o} C for 1.5 hours. Upon further validation of this assay, serum samples from pre-clinical efficacy studies, as well as from clinical trial participants, will be titrated in triplicate to determine the ability of candidate vaccines to elicit neutralizing antibodies against VEEV and support vaccine licensure. Once established, the platform can also be applied to other alphaviruses of concern in biodefense including Eastern and Western equine encephalitis virus.

BIO004

Evidence of the Postmortem Clostridium Effect in the Prostate of European Cadavers

Marquis Nelson[1], *Komal Vig*[2], *Gulnaz T. Javan*[3], *and Sheree J. Finley*[4]

[1]Forensic Science Program, Physical Sciences Department, Alabama State University
[2]Department of Biological Sciences, Alabama State University
[3]Forensic Science Program, Physical Sciences Department, Alabama State University
[1]Physical Sciences Department, Alabama State University

Human organs decay at various rates and in different ways. For example, human prostate glands and uteri are the last internal organs to deteriorate during putrefaction. However, the reason for this very important phenomenon has not been elucidated. To truly understand the mechanisms of the natural timeline of death and the thanatomicrobiome, a thorough examination of different strategies utilized by the trillions of microbes that colonize decaying tissues is needed from a multi-organ and multidisciplinary approach. In the current study, we hypothesize that the thanatomicrobiome is relevant to the determination of postmortem interval due to the abundance of certain microorganisms in prostate samples that are potentially indicative of the elapsed time since death. To test this hypothesis, 21 prostate samples were collected from Italian cadavers in Pavia, Italy. PCR, gel electrophoresis, and high-throughput DNA sequencing were performed on the Illumina MiSeq platform that focused on the V4 region of 16S rRNA genes using primer set 515F-806R. A standard bioinformatics pipeline was used to identify the most predominant bacteria in the tissues. The results of the relative abundances of bacterial families demonstrated that bacteria from the Clostridiaceae family was the predominant bacteria in the prostate samples. These results confirmed that putrefaction was influenced by the Postmortem Clostridium Effect in reproductive tissues at various times of death. Future research questions will determine the specific species of Clostridia are associated with reproductive (i.e. uterus) organ decay. A study of the thanatomicrobiome of female reproductive organs will be performed.

This research was supported by NSF HRD 1401075, NIJ 017-MU-MU-0042, and MSEIP P120A150008 grants.

BIO005

Epigenomic and Epidemiological Factors of Schizophrenia through gene-environment interactions in socio-economically disadvantaged communities in Alabama

Jeremiah Pfitzer[1], Suman Mazumder[1], Cherry Jackson[2,3], Li Chen[4], Sayak Charkravarti[1], Savan Patel[1], Jingjing Qian[4], Timothy Moore[1], Amit Kumar Mitra[1]

[1]Department of Drug Discovery and Development, Harrison School of Pharmacy, Auburn University
[2]Pharmacy Practice, Harrison School of Pharmacy, Auburn University
[3]Department of Psychiatry and Behavioral Neurobiology, University of Alabama Hospital, Birmingham, AL
[4]Health Outcomes and Research Policy, Harrison School of Pharmacy, Auburn University
of Materials Science and Engineering, University of Alabama at Birmingham

INTRODUCTION: Schizophrenia (SCZ) is a mental health disorder characterized by a combination of delusions, hallucinations, disorganized thinking, and/or movement dysfunction. Schizophrenia is relatively common, impacting around 1% of the United States population and yet is the most stigmatized Severe Mental Illness (SMI). SMIs have been correlated with homelessness and the associated financial costs of SCZ are disproportionately high in comparison to other disorders. Alabama is among the states with the lowest access to mental health services with less than half of the people living with SCZ receiving treatment.

OBJECTIVES: We hypothesize that the interaction between the environment (epidemiological parameters) and genes (genomics and epigenomics) contributes to the development of SCZ, and severity of disease is associated with a patient's demographics and family background. We therefore believe that a multi-dimensional predictive algorithm, using a screening of the most important gene-environment interactions, for the onset and severity of schizophrenia will enable early and timely treatment strategies for better outcomes.

METHODS: Data are taken from SOAP notes from patients with schizophrenia and other schizoaffective disorders at the Community Psychiatry Program at UAB Hospital and then epidemiologically studied. N = 500 patients. Patients will submit a saliva sample of their DNA for analyses. The purpose of our research is to reduce disparities in diseases disproportionately represented within Alabama. Success will enhance the understanding of the interaction between genes and environmental factors in disease and drug responses.

BIO006

Synthesis of Polyvinyl Alcohol and $CaCO_3$ from Eggshells for Nanocomposites via Ultrasonication

Aiesha L. Ethridge, *Vijay K. Rangari*

Department of Materials Science and Engineering, Tuskegee University, Tuskegee, AL

Eggshells are widely considered as waste but contain both inorganic and organic components that can be a potential source for bio-based calcium carbonate. Many solvents such as tetrahydrofuran (THF), acetic acid, and *N*,*N* – dimethylformamide (DMF) have been used to synthesize calcium carbonate nanoparticles; however, in this research we are focusing on using a greener solvent to synthesize the ultrasonic irradiated calcium carbonate nanoparticles. The synthesis of calcium carbonate was performed using a sonochemical technique to produce high surface area calcium carbonate nanoparticles from eggshells. The eggshell particles were irradiated with a high intensity ultrasonic horn in the presence of hydrogen peroxide. The solvent concentration varied from 10%, 15%, and 20%. The calcium carbonate nanoparticles were blended with a polyvinyl alcohol (PVA) to create a nanocomposite. The PVA/$CaCO_3$ nanocomposites will be characterized using field-emission scanning electron microscopy (FE-SEM), Fourier transform infrared spectroscopy (FTIR), Raman, and X-ray diffraction (XRD). For future work, we will synthesize the PVA/$CaCO_3$ particles for microfluidics and in biodegradable agricultural applications.

BIO007

Robust Integral Projection Models

Gopal Nath

Auburn University

The most commonly used data-driven models for population dynamics are matrix projec- tion models (MPM), which project discrete population structure (age or size classes) in dis- crete time. These models are well understood mathematically and there is a well-developed toolbox of techniques for their analysis. In many populations, a continuous trait such as body mass is a key determinant of performance: all else being equal, larger individuals tend to exhibit greater survival and fecundity, so using a continuous state variable will be more appropriate and often improve the performance of the model. Easterling, Ellner & Dixon (2000) originally proposed the integral projection model (IPM) as an alternative to matrix projection model for populations in which demographic rates are primarily influ- enced by a continuously varying measure of individual size or state. In our simulation study we will analyze how robustness in modeling the continuous size variable affects population growth rate.

BIO008

Thanatomicrobiome in Liver Samples of American and European Cadavers

Gabrielle Maloy[1], *Sheree J. Finley*[1], *Komal Vig*[2], *Gulnaz T. Javan*[1]

[1]Forensic Science Program, Physical Sciences Department, Alabama State University, Montgomery, AL
[2] Ph.D., Department of Biological Sciences, Alabama State University, Montgomery, AL

Is there any life after death? In many ways, there is. For this reason, there are continuing studies on the microbial lifeforms on and in corpses that may potentially help solve crimes. Human postmortem microbiome research has shown that microbes proliferate in a decaying body and are the primary mediators of decomposition. The source and diversity of microorganisms in regard to geographical factors in which corpses are found have yet to be elucidated after death. Next generation sequencing of 16S rRNA gene amplicons are used in forensic microbiology as molecular biomarkers for the classification of bacteria. Upon death, the immune system in the human body that occur during life stop, and bacteria start to decompose the body. Presumably, geographic location plays a role in postmortem microbial signatures in internal organs, namely the liver). We hypothesized that as a human body decays, microbiome communities within internal body sites will be analytical of the originating country after death. The objectives were to analyze the microbiome of the liver of European and American cadavers. To assess this hypothesis, liver samples were collected from 130 corpses from two countries with postmortem intervals ranging from 3 hours-11 days. PCR and high-throughput DNA sequencing that targeted the V4 region of the 16S rRNA gene using bacterial primers 515F-806R were performed. We used the standard bioinformatics pipelines (QIIME), to identify the most predominant bacteria that correspond to each location. The results revealed that there were statistically significant differences ($p < 0.001$) between locations (Europe versus the United States). Also, this study demonstrated that there was a lack of *Clostridium* spp. in the European corpses. In conclusion, these results established that the effect of distinct geographic variability in determining the different postmortem microbial signatures provide data that may potentially build forensic models that can predict the origin of bodies recovery for discrete locations.

Acknowledgments:
This research was supported by NSF HRD 1401075, NIJ 017-MU-MU-0042, and MSEIP P120A150008 grants

BIO009

Addressing Drought Emergencies in the Heat of the Moment: A Reduced Latency MODIS NDVI Product to Support Index-based Livestock Insurance in Kenya

Sara Miller[1], Emily C. Adams[1], Walter Lee Ellenburg[1], Vikalp Mishra[1], Ashutosh S. Limaye[2], Eric Anderson[1], Kel N. Markert[1], Francisco Delgado[3], William Ashmall[3], Lilian W. Ndungu[4], Stephen Sande[4], Steve Omondi[4], Maungu Oware[4], Anastasia Mumbi Wahome[4], and Robinson M. Mugo[4]

[1]University of Alabama in Huntsville, NASA-SERVIR, Huntsville, AL, United States
[2]NASA Marshall Space Flight Center, SERVIR Science Coordination Office, Huntsville, AL, United States
[3]USRA, NASA-SERVIR, Huntsville, AL, United States
[4]Regional Centre for Mapping of Resources for Development, Nairobi, Kenya

SERVIR, a joint venture between NASA and USAID, works to bolster the capacity of developing regions to leverage Earth observation data in solving pressing environmental challenges. SERVIR partners with organizations in five regions around the globe, including the Regional Centre for Mapping of Resources for Development (RCMRD) in Nairobi, Kenya. In arid and semi-arid regions of Eastern and Southern Africa, drought can be devastating to pastoralists who depend on healthy vegetation for their herds. Under the Kenya Livestock Insurance Program, a vegetation index-based insurance product utilizing eMODIS NDVI (enhanced Normalized Difference Vegetation Index) as a drought index has been implemented. Insurance payouts are triggered when index values fall below a certain threshold for a Unit Area of Insurance (UAI). The eMODIS NDVI product has a latency of about one month to allow for cloud filtering, which delays insurance payouts. SERVIR is working to produce a reduced-latency NDVI product, allowing for earlier payouts which may allow farmers to buy feed to sustain their herds during drought, rather than having to replace lost livestock. This product, provisionally named sMODIS, is being compared using statistical analyses to eMODIS to see if it could be a suitable replacement. Statistics including correlation, regression analysis, percent error, and RMSE, as well as potential payout comparisons were evaluated. Initially, the products show good comparability; monthly average NDVI per UAI have correlation values over 0.95 and RMSE under 0.04 for most UAIs. However, there were differences when looking at year to year payout amounts triggered. Because the payouts are currently calculated based on the 20th and 1st percentile of index values from 2001-2016, payouts are very sensitive to even small changes in NDVI. Though sMODIS is not a perfect copy of eMODIS it shows promise as a lower-latency vegetation index that addresses a pressing drought risk transfer challenge.

Support for this work was provided through the joint US Agency for International Development (USAID) and National Aeronautics and Space Administration (NASA) initiative SERVIR, particularly through the NASA Applied Sciences Capacity Building Program, NASA Cooperative Agreement NNM11AA01A

BIO010

Investigation of Cellulose Beads as an Efficent Biodegradeable Nutrient Delivery System

Johnathan Mitchell[1], *Demetrius Finley*[2], *Dr. Michael Curry*[1, 2], *Dr. Richard Whittington*[3]

[1]Department of Materials Science and Engineering, Tuskegee University, Tuskegee, AL 36088
[2]Department of Chemistry, Tuskegee University, Tuskegee, AL 36088
[3]Department of Biology, Tuskegee University, Tuskegee, AL 36088

Plant health and nourishment is a growing concern. This concern rises due to the world population steadily increasing at a rate of around 1.07% per year (2017-2018). With climate and geological changes occurring every day, the introduction of new ways of producing well-nourished plants becomes more difficult. Most micronutrients (i.e., Cu, Zn, or Mg) fail to find their way to the roots of the plants before ultimately being washed away or not properly being displaced within the system. This problem introduces the need for new sources of delivery that can eliminate these issues within many grow systems in soil or hydroponics-based mediums. Cellulose creates an ecofriendly supplemental delivery system that can protect the nutrients supplied to the plant while presenting no toxic waste to the environment. Cellulose is the most abundant renewable biopolymer on the earth. Cellulose is a complex carbohydrate made up of several thousand glucose molecules linked end to end, and due to its intra- and intermolecular hydrogen bonding various ordered crystalline arrangements are observed. Given the abundance of natural resources available for cellulose and the unique chemical and physical properties, it has great potential for use in the agricultural industry. We have developed cellulose-beads and tested its release of Cu nanoparticles via hydroponic systems. For this system to be fully functional, the Cellulose beads must be capable of being employed as stationary delivery systems that can effectively release nutrients to plants while undergoing the biodegradation process. Hence, my project will explore the employment of cellulose beads into the soil of crops and hydroponic systems to test its ability to effectively deliver its nutrients during the biodegradation process. (Supported by NSF-CREST 1137681, NSF HBCU-UP Implementation HRD# 1719433)

BIO011

Non-competitive inhibition of proteasome by kinase inhibitors

Olasubomi A. Akintola, *John Smith, Alexei Kisselev*

Department of Drug Discovery and Development, Harrison School of Pharmacy, Auburn University

Inhibitors of Bruton's Tyrosine Kinase (BTK) and inhibitors of the proteasome are currently in use for treatment of hematologic malignancies. While the proteasome is necessary for protein homeostasis in all mammalian cells, BTK is unique to some B cell malignancies. However, BTK inhibitors and LU-102, a specific inhibitor of the ß2 site of the proteasome have previously been shown to synergize in hematologic malignancies which do not express BTK, at a 100-fold higher concentration than is needed for complete inhibition of BTK, suggesting an off-target effect of these BTK inhibitors.

Triple Negative Breast Cancer (TNBC), a cancer with poor prognosis and no current targeted therapy, also does not express BTK. We found that LU-102 and a specific BTK inhibitor, CGI-1764, are de-facto synthetically lethal to TNBC cells, and that effect of other BTK inhibitors varied from similar synergy to no synergy. This data further supports the idea that synergy is due to off-target effects of BTK inhibitors.

We have now found through enzymatic analysis, measuring 7-amino-4-methylcoumarin (AMC) release from proteasome substrates of TNBC cell lysates and purified proteasomes isolated from rabbit muscle, that CGI-1764 is a non-competitive, allosteric inhibitor of all catalytic subunits of the proteasome 20S proteolytic core and exerts its effect in a unique, dose-dependent manner. Another kinase inhibitor, rapamycin and its closed ring analogs, were previously shown to inhibit proteasome allosterically, we further found that many other FDA-approved protein kinase inhibitors block proteasome allosterically. These findings may pave the development of more potent allosteric inhibitors of the proteasome, and that kinase inhibitors should be screened for inhibition of the proteasome as potential off-target effect.

BIO012

Intrathymic Thymic Nurse Cell Transplants Increase Endothelium-Dependent Relaxation in the NZBWF1 Systemic Lupus Erythematosus Mouse Model

T.A. Platt, [1,3]*, D. Weber Ph.D*[2,3]*, M. Martinez Ph.D*[2,3]*, C. Bradford Ph.D*[1,2,3]

Department of Biology and College of Veterinary Medicine, Tuskegee University, Tuskegee, AL

Rationale: Systemic Lupus Erythematosus (SLE), a chronic autoimmune disorder, primarily affects women of reproductive age. Surprisingly, during this time women with SLE are ~50 times more likely to develop cardiovascular disease and have an increased prevalence of hypertension. It is also known that SLE patients are predisposed to endothelial dysfunction. Although this is widely known, there are limited mechanistic studies on SLE-induced vascular remodeling, and the pathophysiological mechanisms which underlie the development of endothelial dysfunction in SLE remain poorly understood. Inflammation, the hallmark of the pathogenesis of SLE, has been hypothesized to be one of the most important triggers of endothelial damage. Because of the strong gender bias and complex genetic components of SLE, the NZBWF1 mouse model most closely resembles human SLE. This model exhibits impaired endothelial-dependent relaxation and hypertension. Thus, it is useful for understanding the pathophysiology of SLE hypertension-induced endothelial dysfunction. The inherent failure of the immune system to recognize self-antigens in lupus remains unknown; however, a specialized cell, thymic nurse cell (TNC) plays a significant role in T cell education. Our lab has previously demonstrated that TNC transplantation can increase anti-inflammatory cytokine profile. Most studies focus on the downstream targets of T cell dysregulation without exploring the contribution of TNCs to SLE-induced vascular dysfunction. We therefore decided to prove the concept that TNC transplantation alters endothelium-dependent relaxation in NZBWF1 mice. **Methods:** Immortalized TNC lines from female BALB/c mice were used as donor cells for intrathymic transplantation into NZBWF1 mice at 12 weeks, and at 16 (disease onset) and 30 (disease state) weeks, the animals were sacrificed. Forty-seven female NZBWF1 mice were divided into three groups: Untreated, Saline-treated, and TNC-treated. Upper thoracic aortas were isolated at each 30 weeks. The aortas from the 30-week animals were cut into rings and mounted onto myographs to perform a vasoreactivity protocol and measure isometric tension. After equilibration, upper thoracic aortas were pre-contracted with Phenylephrine and then treated with Acetylcholine (endothelium dependent relaxation) or Sodium Nitroprusside (endothelium-independent relaxation). The tension tracings were then analyzed for % Relaxation. The data was statistically analyzed via one-way analysis of variance and Bonferroni's post-hoc test. **Results**: As previously demonstrated, there was impaired relaxation to ACH in Untreated (13.2%, 0.25g mol/L) NZBWF1 mice. We are the first to demonstrate that TNC transplantation increased endothelium-dependent relaxation to 50.4% (2.4g mol/L) compared to the Saline-treated (20.8%, 0.25g mol/L) NZBWF1 mice. There was a decrease in maximum tension generated by P.E. in aortas from TNC-treated mice (0.63g mol/L) compared to NZBWF1 controls (1.06g mol/L – Untreated and 0.76g mol/L – Saline treated). **Conclusion:** Transplantation of thymic nurse cells into lupus-prone mice may alter impaired endothelial-dependent relaxation.

BIO013

Evaluating a New Treatment Assessment Methodology on the Productivity of Agricultural Fields in Nepal using Machine Learning Techniques and Space-Borne Data

Ronan Lucey[1], *W. Lee Ellenburg*[2], *Robert Griffin*[1,2,3], *and Udaysankar Nair*[1,3]

[1]Department of Atmospheric Science, University of Alabama in Huntsville, Huntsville, AL
[2]NASA SERVIR Science Coordination Office, Huntsville, AL
[3]Earth System Science Center, University of Alabama in Huntsville, Huntsville, AL

Food security is a major issue in Nepal in the face of environmental changes. NASA SERVIR connects space to village by partnering with stakeholders in developing countries like Nepal to build capacity in using space-borne datasets to address critical environmental challenges. Agricultural interventions are performed with the aim of increasing crop yields to combat food insecurity. In this study, we propose a new methodology for assessing the effectiveness of agricultural interventions on fields in western Nepal, which we will compare to a conventional multi-linear regression approach used for intervention assessment. The proposed methodology heavily utilizes space-borne datasets as well as a recursive neural network machine learning technique. The goal of the research is to determine whether this machine learning approach can accurately back-predict NDVI, serving as a proxy for yield, given historical space-borne datasets to train on. The back-predictions will then be compared to the observed NDVI values to see if the interventions caused unexpected deviations from the back-prediction expectation. To conduct this analysis, we use Python and Google Earth Engine, as well as numerous free and openly available space-borne datasets including the NASA Landsat constellation, the Climate Hazards Group Infrared Precipitation with Station (CHIRPS) dataset, and temperature data from the Global Land Data Assimilation System (GLDAS). The result of this research will be a machine learning methodology that can be used to assess the effectiveness of agricultural interventions accurately, while being more cost-efficient and less time-consuming than existing methods for intervention assessment.

CPU001

Field line resonance in the magnetosphere

Feng Shi

Auburn University

Dayside compressional waves and field line resonances (FLRs) are two typical ultra-low frequency (ULF) wave modes in the dayside magnetosphere, which play important roles in the precipitation of charged particles into the Earth's ionosphere through wave-particle interaction. Previous studies found that the FLRs, also known as standing Alfven wave resonances of the Earth's magnetic field lines, can be driven by foreshock disturbances, as a response to the magnetospheric compression. However, it is difficult to find spatial structure of dayside ULF waves by a limited number of satellites and ground-based instruments. This poster will present a global view of the azimuthal and north-south structure of the foreshock driven FLRs in the dynamic dayside magnetospheric system.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU002

Mapping Magnetic Field Lines for an Accelerating Solar Wind

Samira Tasnim[1], Iver H. Cairns[2], Bo Li[2], Michael S. Wheatland[2], and Gary P. Zank[1]

[1]The Center for Space Plasma and Aeronomic Research, University of Alabama in Huntsville
[2]School of Physics, The University of Sydney

Mapping of magnetic field lines is important for studies of the solar wind and the sources and propagation of energetic particles between the Sun and observers. A recently developed mapping approach is generalised to use a more advanced solar wind model that includes the effects of solar wind acceleration, non-radial intrinsic magnetic fields and flows at the source surface/inner boundary, and conservation of angular momentum. The field lines are mapped by stepping along **B** and via a Runge-Kutta algorithm, leading to essentially identical maps. The new model's maps for Carrington rotation CR 1895 near solar minimum (19 April to 15 May 1995) and a solar rotation between CR 2145 and CR 2146 near solar maximum (14 January to 9 February 2014) are compared with the published maps for a constant solar wind model. The two maps are very similar on a large scale near both solar minimum and solar maximum, meaning that the field line orientations, winding angles, and connectivity generally agree very well. However, close inspection shows that the field lines have notable small-scale structural differences. An interpretation is that inclusion of the acceleration and intrinsic azimuthal velocity has significant effects on the local structure of the magnetic field lines. Interestingly, the field lines are more azimuthal for the accelerating solar wind model for both intervals. In addition, predictions for the pitch angle distributions (PADs) for suprathermal electrons agree at the 90 – 95 % level with observations for both solar wind models for both intervals.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU003

Theoretical Model of Ion-Acoustic Shock Wave Structure in Dusty Plasma

Juan G Alonso Guzman[1], *Gary P Zank*[1,2]

[1]Department of Space Science, University of Alabama at Huntsville (UAH)
[2]Center for Space and Aeronomic Research, UAH

Dust is an important component of plasma in multiple environments throughout the solar system, including dust created as comets melt in the vicinity of the Sun or the dust rings that surround massive planets such as Saturn. The effects of dust particles in the structure and propagation of ion-acoustic waves through plasma have been empirically recorded and studied for nearly two decades (see Nakamura et al., 1999, Physical Review Letters). A Korteweg-de Vries-Burgers (KdVB) PDE involving the electrostatic potential governs the process, and numerical solutions agree well with the overall shock structure. However, the exact form and nature of the dissipation term within this equation is hitherto unknown. Inspired by comments in Nakamura et al. (1999), this research seeks to incorporate ion-dust collisions into the plasma framework in order to obtain an exact form for the dissipation coefficient in terms of experimental quantities. In order to achieve this goal, we assume a simplified shielded potential to derive appropriate scattering quantities for the Fokker-Plank equation, and then proceed with a Chapman-Enskog expansion, leading to an explicit form of the desired term, among others. With our contribution, we hope to provide a complete and rigorous theoretical foundation for the use of a KdVB equation to describe ion-acoustic shockwave structure, and obtain a formula for the dissipation coefficient based on measurable quantities. This will further our understanding of this phenomena, as well as pinpoint certain key parameters that could be adjusted to control the wave structure.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU004

Controlling dust charge with driven current fluctuations

Michael McKinlay, *Ed Thomas Jr.*

Department of Physics, University of Auburn

One of the limitations in studying dusty plasmas is that many of the important properties of the system are a consequence of the plasma conditions and potential structure rather than something which can be controlled independently of them. The application of controlled fluctuations in charging or discharging currents may provide an avenue for developing methods of controlling dust charge, without significantly altering the plasma. Recent experiments have observed equilibrium changes in clouds of dust suspended in an argon DC glow discharge when subjected to AC signals. The signals are high frequency relative to the dust response (5-50 kHz) and low power relative to the plasma source (a few mW). The dust clouds experience a vertical drop in equilibrium position in the plasma, and a decrease in inter-particle spacing – both of which are qualitatively consistent with a reduction in dust charge. A theoretical model of the modified charging process is presented, video analysis is used to quantify the changes in dust position and spacing, and a Langmuir probe array is used to examine the effect of the signals on the plasma.

Funding for research at the Magnetized Plasma Research Laboratory at Auburn is from the following sources:
NASA/Jet Propulsion Laboratory (JPL-RSA 1571699)
National Science Foundation (PHY-1613087)
National Science Foundation EPSCoR program (OIA-1655280)
US Department of Energy (SC-0016330)

CPU005

Plasma assisted Chemical Looping System: A method to conduct dry reforming and water splitting at low temperature

Rajagopalan V. Ranganathan[1], *Zhongqi Liu*[2], *Steven M. Fondriest*[1], *Ruigang Wang*[2], *and Mruthunjaya Uddi*[2]

[1]Mechanical Engineering, The University of Alabama, Tuscaloosa, AL 35487
[2]Metallurgical and Materials Engineering, The University of Alabama, Tuscaloosa, AL 35487

Chemical Looping reactions have the advantage of producing useful chemicals during redox cycling, with minimal energy penalty while achieving Carbon Capture Sequestration (CCS). We present the results of Plasma Catalytic (PC) CH_4 reforming reduction cycle coupled with PC water splitting oxidation cycle to produce hydrogen. The materials used for the experiments are $La_{0.9}Ce_{0.1}NiO_3$ + CeO_2 (LCN91Ce) and Ru/CeO_2 nanorods (NR). We use CH_4+CO_2 flow reduction cycle with nano-powder, and the material is oxidized with H_2O+Ar during the oxidation cycle leading to H_2 production by water splitting. The primary goal is to study the plasma-assisted reforming and water splitting, with the purpose of achieving significant reactions at low temperatures (150-400 ^oC). With the application of plasma to LCN91Ce, significant water splitting H_2 production of 24-30 µmole/g total and CH_4 reforming of 14-43 % conversion were observed in 150-400 ^oC temperature range. In the same temperature range, Plasma-assisted Ru/CeO_2-NR produced H_2 of 76-182 µmole/g total during the water splitting step and 43-66 % CH_4 conversion during the reforming step. No reactions were observed in the same temperature range without plasma.

Acknowledgements
This work is supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280 and the first author was awarded a Graduate Research Fellowship NSF EPSCoR.

CPU006

Magnetic field influence on a steady dusty plasma flow

Dylan Funk, Uwe Konopka and Edward Thomas, Jr.

Phys. Dept. Auburn University, Auburn, AL

Dusty plasmas consist of the standard plasma components (electrons, ions and neutrals) as well as micrometer sized particles. The dust particles become highly charged as a result of their interaction with the other plasma components. The charge of these dust particles is a difficult quantity to estimate precisely, especially when influenced by a magnetic field. We would like to develop a method for the experimental determination of the dust particle charge under the influence of a magnetic field. In our chosen approach we attempt to utilize the dynamics of a driven dust particle flow perpendicular to a static magnetic field. A dust particle density gradient will build up across the flow due to the Lorentz force. We will demonstrate, using an MD simulation, that studying the particle distribution in the flow, depending on magnetic field and flow velocity, can be used to estimate an average dust particle charge. We plan to apply our method on MDPX at Auburn University.

This work was supported by the NSF EPSCoR program through grant number OIA-1655280, US Dept. of Energy (DE-SC0016330), NSF (PHY-1613087) and JPL/NASA (JPL-RSA 1571699).

CPU007

First-Principles Study of Mechanical Properties of B-C and B-N Systems with High Boron Content

Wei-Chih Chen, Paul A. Baker, Yogesh K. Vohra, and Cheng-Chien Chen

Department of Physics, University of Alabama at Birmingham

Boron with unique icosahedral structure can form several different allotropes, and all have their Vickers hardness ~40 GPa. Their derivatives with C and N atoms also show high hardness phases in the experimental studies. Here we employ density functional theory to study the stability, electronic structure, mechanical properties, and phonon dispersion of high-boron-content B-C and B-N systems such as $B_{50}C_2$ and $B_{38}N_6$. Our results are discussed together with previous theoretical studies, and with more recent large-area synthesis based on microwave plasma chemical vapor deposition methods developed at the University of Alabama at Birmingham.

Funding Acknowledgement: This work is supported by the National Science Foundation EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU008

Electric Field Structures in Magnetized Low-Temperature Plasmas

Taylor Hall[1], Ed Thomas, Jr.[1], Lénaïc Couëdel[2], Robert Merlino[3], Marlene Rosenberg[4]

[1]Magnetized Plasma Research Laboratory, Department of Physics, Auburn University
[2]Department of Physics & Engineering Physics, University of Saskatchewan
[3]Department of Physics and Astronomy, University of Iowa
[4]Department of Electrical and Computer Engineering, University of California, San Diego

A complex, or dusty, plasmas is a four-component plasma system consisting of ions, electrons, neutral gas atoms, and large macroscopic grains hundreds of nanometers to tens of micrometers in diameter. These macroscopic dust particles collect charge from the background plasma and become coupled to the plasma system. Due to the low charge to mass ratio of the dust grains they require extremely large magnetic fields, on the order of several Tesla, to exhibit similar dynamics as the lighter ions or electrons in the plasma. The Magnetized Dusty Plasma Experiment at Auburn University is a superconducting magnet system capable of fields up to 4 Tesla in order to study the effects of high magnetic fields on dusty plasmas. One of the early discoveries in this experiment was the observation of imposed, ordered structures within a dusty plasma. At high magnetic fields ($B \geq 1$ T) dust particles became confined to a potential structure within the plasma which followed the pattern of a conducting wire mesh embedded in one of the plasma electrodes. In order to study the mechanism that causes these confining structures, a larger grid-like electrode was developed so that plasma probe measurements could be made beneath the electrode. Using a pair of electrically floating probes, measurements of the electric field beneath the electrode were made which suggest the presence of a confining field structure in the plasma. Particle-in-cell simulations that model the experimental conditions may also be presented.

Funding for the Plasma Sciences Laboratory is from the following sources:
- National Science Foundation (PHY-1613087)
- National Science Foundation EPSCoR program (OIA-1655280)
- US Department of Energy (SC-0016330)
- US Department of Energy - Plasma Science Facility (SC-0019176)
- NASA / Jet Propulsion Laboratory (JPL-RSA 1571699)

Taylor Hall is also supported by the NSF EPSCoR CPU2AL project through the Central Education, Recruitment, and Impact Fund (CERIF) Graduate Research Assistantship Program. The MDPX facility was developed and built through a grant from the NSF Major Research Instrumentation (NSF-MRI) program: PHY-1126067

CPU009

Using Global 3-D Hybrid Simulation to Understand Kinetic Alfven Waves (KAWs) in the Magnetosphere

Lei Cheng

Physics Department, Auburn University, AL 36849

We have used the Auburn Global Hybrid Code in 3-D (ANGIE3D) to study the generation, dynamics, and global structure of kinetic Alfven waves (KAWs) in the magnetotail. Our results show that KAWs are generated in magnetic reconnection in the plasma sheet, located around fast flows and carrying Poynting fluxes, parallel currents, and parallel electric field. It is found that in front of the flow braking region, the structure and strength of shear Alfven waves are significantly altered due to interaction with the dipole-like field, mainly by the flow shear associated with the azimuthal flows. Also in front of the dipole-like field region, ion kinetic effects lead to the generation of additional pairs of KAWs.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU010

Neutral temperature and density measurements inside the discharge channel of a Hall Effect thruster using LIF techniques

Mustafizur Rahman, *Richard Branam*

Department of Aerospace Engineering and Mechanics, University of Alabama, Tuscaloosa

The underlying physics inside the discharge channel of a Hall Effect thruster include coupled ionization/recombination and surface kinetic processes. To understand and design the most effective plasma thrusters, these processes need to be quantified and compared with theoretical expectations. The next step in understanding the internal plasma process is to measure neutral temperature and density without disturbing the plasma (non-intrusive diagnostics). Laser Induced Fluorescence (LIF) is being employed to measure temperature and number density, specifically of neutral xenon (Xe I) for the Hall effect thruster. The LIF profiles are being obtained at specific locations along the centerline of the discharge channel. The laser probe excites Xe I at 834.68 nm causing $6s^2[1/2]^0{}_1$ - $6\ p^2[3/2]^0{}_1$ transitions. The exited state neutrals relax back to $6s[3/2]_1^0$ state by emitting non-resonant fluorescence at 473.41 nm. The current experimental setup capture the fluorescence signal at 0.01 nm interval of the see through hollow cathode lamp. The plasma properties are determined by fitting the results to the theoretical line shape (Voigt profile), varying the density and temperature as input variables. Accurate determination of the density and temperature is heavily reliant on verifiable laser power measurements and wavelength precision.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU011

Microwave Plasma Chemical Vapor Deposition to Synthesize Boron Nitride Thin Film

Kallol Chakrabarty and Shane A. Catledge

Center for Nanoscale Materials and Biointegration, Department of Physics, University of Alabama at Birmingham

Boron nitride (BN) is a member of Group III nitrides, have aroused great interest among the scientific community during the past two decades for the outstanding properties such as, hardness, toughness and chemical inertness, thermally conductivity and electrically insulation. Preparation of boron nitride was reported using high pressure/high temperature approaches using diamond anvil cells/laser heating, however, this process is not very economically friendly due to the need for very high pressure and/or high temperature. Because of low-cost and scalable production technology, most viable technology routes for synthesizing BN material is plasma processing through chemical vapor deposition (CVD). In this study Microwave Plasma Chemical Vapor Deposition system (MPCVD) was used to synthesize BN on silicon substrate. Plasma activated H_2, NH_3, and B_2H_6 mixture was used as feed gas. The power, pressure and the flow rate of the feed gas was systematically varied using MPCVD system. According to optical emission spectroscopy, the ratio of atomic B/NH peak plays a key role for deposition of BN thin film. Intensity of the atomic boron lines varies with microwave pressure and is highest at 15 torr. The BN films were synthesized at 15 torr with different experimental conditions and B/N ratio were found to be 1 to 3. The films were analyzed using optical Microscopy, X-ray Photoelectron Spectroscopy (XPS), X-Ray Diffraction (XRD), Fourier-Transform Infrared Spectroscopy (FTIR) and Raman Spectroscopy. The hexagonal structure of BN film was confirmed using X-ray photoelectron spectroscopy, X-ray diffraction and Raman spectroscopy.

Funding Acknowledgement: CERIF Graduate Research Assistantship (GRA).

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU012

Measuring Energy Distribution Inside a Hollow Cathode Plasma

Kirk Boehm, Richard Branam

Department of Aerospace Engineering and Mechanics, The University of Alabama

In collaboration with and supported by "Connecting the Plasma Universe to Alabama", understanding the plasma physical phenomena inside of the hollow cathode will provide basic tools for optimizing and manipulating electron emitting systems; enabling researchers across the state of Alabama to advance plasma manufacturing processes, plasma research, and plasma understanding. Hollow cathodes are employed in many plasma processes (e.g. electron beam welding, lasers, plasma plating processes, etc.). Our focus is on optimizing plasma propulsion system performance; neutralizing ion beams, maximizing thrust, controlling spacecraft charging issues. This research will advance the state-of-the-understanding in plasma physics by studying the physical processes inside the cathode. A heaterless (lanthanum hexaboride or barium calcium aluminate) hollow cathode (HC) will be simulated with a focus on the plasma and low work function insert interaction. Hollow cathodes emit electrons often used to ionize a gas or to neutralize the ion beam of an electric propulsion system. To understand the electron emissions, empirical results will be compared to computational predictions on the surface of the cathode insert; temperature of the insert material, plasma sheath location, plasma surface interactions, and plasma kinetic and the energy distributions (rotational, vibrational, and translational). Initial investigations will be focused on validating diagnostics using argon in collaboration with Auburn researchers; Auburn has extensive research with argon plasma. Once diagnostic processes are developed and validated, the effort will focus on supported research at UAH (xenon). The long term vision of this research effort will then guide the efforts to focus on iodine, a continuing research thrust of NASA/MSFC (mission enabling technology). The mission enabling technology aspects of this research will be the ability of volume constrained spacecraft to reach the moon though increased lifetime and efficiency of plasma propulsion systems. Additionally, the research will directly impact many research and manufacturing areas in the state of Alabama (i.e. vacuum plasma plating, electron beam welding, and food sanitization). The success of this project is reliant upon the input and counsel from researchers at UAH and Auburn. The CPU2AL research initiative has provided access to previous results and plasma physics experts across the state of Alabama. The hope is to eventually provide portable diagnostics to support research efforts at UAB, Tuskegee, ASU and USA. The impact will not only be felt here in Alabama, but has the potential to change the worldwide use of electric propulsion systems, making this UA laboratory an asset in the plasma science community.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU013

Effects of Low Temperature Plasma on Turmeric Plant Height

Khadi Badiane[1], *Lam Duong, Suresh Kumar*[1]*, L. Nyochembeng*[1]*, E. Cebert*[1]*, S.R. Mentreddy*[1]*, and G. Xu*[2]

[1] Alabama A&M University
[2]University of Alabama in Huntsville
[3]University of Alabama in Birmingham

Turmeric (*Curcuma spp*.) is a rhizomatous herb known for its anti-inflammatory and antimicrobial properties, and anti-Alzheimer's diseases among many others. It is currently trending as 'Number One' herbal supplement in the US. Its medicinal properties are attributed to bioactive constituents in the rhizomes and faster growing plants with early maturity have been shown to have higher levels of bioactive compound(s) in this crop. Low temperature plasma (LTP) technologies are emerging as chemical-free biocides and plant growth enhancers among other agricultural applications. However, the effects of LTP on the rhizomes of turmeric and related physiological responses have not been fully established. Such knowledge could strengthen agricultural applications of LTP in addressing plant performance and rhizome yield of crops such as turmeric and ginger. An experiment was conducted using nine turmeric varieties (VN23, VN24, VN1, VN3, VN6, VN8, VN30, VN39 VN50) with the objective of assessing the effects of LTP on the growth and rhizome yield of pre-sprouted rhizomes. The pre-sprouted rhizomes of the nine varieties of turmeric were either treated (T) with LTP for 15 s at a power setting of 30W or not treated (U). The rhizomes were then planted in 4" pots filled with soil-less potting mix and allowed to grow in a controlled environment greenhouse. The height of the plants were recorded at weekly intervals. The plasma treated rhizomes of all of the varieties except one variety (VN1) grew faster than the untreated. The plant height of treated rhizomes were 9% (VN6) to 45% (VN3) taller than the plants from untreated rhizomes. The height of plants of all treated rhizomes increased with plasma treatment and showed inter-varietal differences. In variety VN1, the plant height of untreated rhizomes was greater by 9% than that of treated rhizomes. This cause for such a negative effect is unknown at this time and further research will be done to determine the cause(s) of such an effect. Our previous studies showed that plasma quickens sprouting of turmeric rhizomes and enhances plant growth relative to the untreated rhizomes. The research is in progress and the plants will be planted in field plots to assess their growth and rhizome yield with or without plasma treatment under field conditions. This study showed that plasma enhances plant growth of turmeric.

This research was supported by NSF EPSCoR RII Track 1 Grant OIA – 1655280.

CPU014

Characterization of a microwave generated plasma with varying fractional ionization on magnetic surfaces

Eleanor N Williamson, *David A. Maurer, David A Ennis, Greg J Hartwell*

Department of Physics, Auburn University

Understanding the transition region between fully ionized and neutral dominated plasma is important to the study of the magnetosphere/ionosphere as well as the solar corona/chromosphere transition regions of the earth and sun. We are exploring the use of the magnetic surfaces of a stellarator confinement device, the Compact Toroidal Hybrid, to contain plasmas with widely varying fractional ionization with the goal of studying those naturally occurring transitions. These plasmas are heated using Electron Cyclotron Resonance Heating at a fundamental cyclotron frequency of 17.65GHz with up to 2kW of power. A radially scannable triple probe and a four-chord interferometer are used to characterize electron density and electron temperature. Spectroscopy is being developed to determine neutral gas density within the plasma. Results from a systematic study of varying ECRH input power and neutral gas fill pressure to access a range of plasma fractional ionization levels and electron temperatures and densities will be presented.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU015

Assembling Sounding Rockets to Study the Full-sun Ultraviolet Spectrum

Nicolas G. Donders[1,2], *Amy R. Winebarger*[3], *Gary P. Zank*[1,2], *Charles C. Kankelborg*[4]

[1]Department of Space Science, University of Alabama, Huntsville, AL
[2]Center for Space Plasma and Aeronomic Research (CSPAR), University of Alabama, Huntsville, AL
[3]NASA Marshall Space Flight Center (MSFC), Huntsville, AL
[4]Solar Group, Department of Physics, Montana State University, Bozeman, MT

The Marshall Space Flight Center (MSFC) Solar Physics Group and Montana State University (MSU) collaborate in studying plasma throughout the solar atmosphere with their Sounding Rocket (SR) programs. One problem they address is Coronal Heating: the phenomenon where the solar surface is much cooler than the upper atmosphere. Small-scale explosive events (EEs) on the surface transfer heat to the corona. Traditional slit-based spectrometers have limited field-of-view, making viewing EEs difficult. The EUV Snapshot Imaging Spectrograph (ESIS), developed by MSU, is slit-less, giving it a large field-of-view. This complicates data analysis. Other SR experiments are being developed, including one that will provide unprecedented resolution UV data to compare our Sun to other stars. These constitute the two research areas of interest to be presented here: 1) analyzing complex solar data from SRs to understand the underlying processes of EEs and their potential impact on the solar atmosphere and 2) optical calibration of SRs for comparison between the Sun and stellar analogs. In upcoming research over the next few years, the Student will engage with MSFC and MSU team members in integrating, testing, and launching the SRs, as well as performing data analysis and reporting on the results. The Solar Physics Group has many international partnerships as well.

This material is based upon work supported by the NSF EPSCoR RII-Track-1.2a (Non-invasive plasma diagnostics for LTP) Cooperative Agreement OIA-1655280. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation

CPU016

Diagnostics of Striations in RF Capacitively Coupled and DC Positive Column Discharge Plasma

Zachary K. White, *Kunning G. Xu*

Mechanical and Aerospace Engineering Department, The University of Alabama in Huntsville

The phenomena of light and dark regions in a plasma discharge is referred to as striations. These separate regions occur when electrons with lower energy are unable to excite atoms for radiative emissions which causes the dark regions. The striations can appear as either stationary or moving, but if they are moving they cannot be seen by the naked eye, so high-speed imaging or probes are required to detect them. Understanding these non-uniform striations could be useful in developing and comprehending the instabilities within plasma. To do so, the lab constructed a discharge tube that would enable observation of plasmas to first confirm striations and next to perform diagnostics. To this point, the lab has confirmed standing and moving striations in argon using RF and DC power systems, and in moving striations in helium using only DC systems. Looking towards the future, performing single point diagnostics should be first task accomplished, followed by performing two-dimensional diagnostics at Sandia National Laboratory using the laser-collisional induced fluorescence (LCIF) method.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU017

A 3D simulation of filamentation in low pressure electric discharges

Mohamad Menati

Auburn University

Formation of stationary or mobile filaments along the magnetic field lines has been reported frequently in different experiments. When observed from the top, these filaments appear as discrete dots or continuous patterns and they are found to form at high magnetic field, low neutral pressure and low applied power. Current work reports on a 3D numerical simulations of low pressure plasmas in a rectangular chamber exposed to a high magnetic. It is shown that for this configuration, the patterns in the plasma shift from individual filaments to self-organized patterns by increasing the gas pressure. These patterns appear in the electron density and potential and are in good agreement with the experiments.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU018

Tensile Properties of Extruded PBAT/PLA filaments incorporated with Carbon via Coconut Shell Powder

Chibu O. Umerah[1], *Boniface J. Tiimob*[1], *Sydnei Head*[2], *Vijaya K. Rangari*[1], *Shaik Jeelani*[1]

[1]Department of Materials Science and Engineering, Tuskegee University, AL 36088
[2]Department of Chemical Engineering, Tuskegee University, AL 36088

Ubiquitous non-degradable plastics continue to be a threat to the environment. Such plastics poison the water, land, and air which we breathe. Specifically, plastics made from petroleum lead to pollution as it takes centuries for the materials to biodegrade. This in turn can cause climate change due to the emission of CO_2. Environmentally friendly plastics offer suitable alternatives. In this work, we explored biodegradable plastic created from PBAT/ PLA 75/25 blend with carbon nano-powder derived from coconut shell. The carbon material synthesized using high temperature reactor and characterized with SEM and Raman spectroscopy to investigate the micro and nanoparticle properties as well as the size of the powder. The neat polymers and carbon polymer composite filaments were created from solvent blended system which was precipitated and extruded into filaments. The specimens were then characterized using tensile testing for neat, blended, and composite materials. Composite materials consist of PBAT/PLA 75/25 blend and 0.2%, 0.4%, 0.6%, 0.8% and 1% carbon from coconut shell powder. Tensile strength showed an increase the higher the carbon content, however with the particles agglomerating at 0.8% and 1%, the strength began to decrease. The composite with the highest tensile strength is 0.6% composite ranging from 12 – 16 MPa in comparison to 0.2% being 6 – 12 MPa, 0.4% ranging from 7 – 12 MPa, 0.8% which ranged from 9 – 14 MPa and 1% being 8 – 12 MPa. Applications such as food packaging as well as packaging in general can benefit from this study.

Funding Acknowledgement: NSF Alabama EPSCoR-1655280, NSF-RISE #1459007, NSF-CREST#1137681 and NSF-MRI-1531934 grants

CPU019

Determining Plasma Waves with a Plasma Wave Receiver

Riley Mayes, *Dr. Edmund Spencer, Christopher Burns*

Electrical Engineering, College of Engineering, University of South Alabama

Plasma wave receivers (PWR) are used primarily to analyze plasma waves at certain frequencies. For our work, we are utilizing a low frequency (LF) amplifier in order to understand signals from a dipole antenna. The amplifier LTC2058 will be used in basis with intricate circuity to understand and analyze low frequency plasma waves.

Our work requires a built plasma wave receiver at the required frequency range which is between 100kHz and 2.5MHz The LTC2058 serves the range required and will be used to understand plasma waves more thoroughly in the ionosphere. Overall, the ionospheric F region is important to understand as this is where natural plasma occurs around the earth.
From calculations, only certain regions in the ionosphere can reflect or absorb signals from ground or from outside sources. The F1 layer reflects plasma waves from a low frequency band, 30kHz to 300kHz, the F2 layer reflects plasma waves from a high frequency band, 3MHz to 30MHz. For our plasma wave receiver, we are looking for waves between 100kHz to 2.5MHz. These waves seem to fit in between the F1 and F2 regions, so our instrument needs to be precise at making measurements. Other waves can be picked up by our instruments such as RCP, LCP, Ordinary, and Extraordinary waves.

PWRs are old instruments that are being designed in new ways with various components to more accurately collect measurements. Measurements for our instrumentation uses sophisticated circuitry that is composed of a amplifiers, filters, and antennas. These components are ultimately used in order to design a new circuit for a PWR that will be utilized for a specific frequency range. New circuitry for new frequency ranges. PWRs are extremely important in understanding and collecting data for future use.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU020

Wet Laid Polymer Mesh Reinforced Hydrogel Scaffolds for Skin and Muscle Tissue Engineering

John P. Bradford[1], *Andrew T. Wood*[1], *and Vinoy Thomas*[1,2]

[1]Department of Material Science and Engineering, School of Engineering, University of Alabama at Birmingham
[2]Center of Nanoscale Materials and Bio-integration (CNMB), Department of Physics, University of Alabama at Birmingham

Presenter's email: jpb@uab.edu

Wet Lay process is a synonymous technique done by the paper industry in paper making. Biodegradable or biological polymers such as Poly Lactide(PLA) or Soy protein fibers were converted into a fibrous mat using various solution concentrations and fiber concentrations in the making of a fibrous mat serving in the function of a wet laid scaffold substrate, subsequently the physical and cellular properties were measured for the variables. The Soy and PLA fibrous mats were use to infiltrate Gelatin or Poly (vinyl alcohol) (PVA) hydrogels (generally regarded as biocompatible materials) and chemically/physically cross-linked the hydrogels. As a result, the physical and mechanical properties of the hydrogels were increased without significantly decreasing cell viability on the newly made reinforced hydrogel scaffolds. The results of this research will be presented along with some of the potential applications and different directions of this project. The tailor-making of hydrogel reinforced scaffolds with required mechanical properties (strength and flexibility) could be possible using wet-lay process.

Acknowledgement: Funding provided by Alabama Space Grant Consortium Fellowship (to ATW) along with Funding provided by the GAANAN Fellowship (to JPB) (GANNAN: P200A180001). This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU021

Plasma Treatment of Calcium Carbonate Nanoparticles Derived from Eggshell Waste

Vincent Hembrick-Holloman, *Vijaya K. Rangari, Shaik Jeelani*

Department of Material Science and Engineering, Tuskegee University, Tuskegee, Alabama 36088

Calcium carbonate is a naturally occurring mineral that is found abundantly throughout nature and can be used as a natural filler for reinforced biocomposites. Calcium carbonate nanoparticles derived from egg shell waste was plasma modified with three different gas sources. To compare the morphological and chemical effects caused by the action of different gases in the creation of nanostructures on the cellulose surface, samples were exposed to oxygen (O_2), argon (Ar), and sulfur hexafluoride (SF_6) plasma treatments. Scanning electron microscopy (SEM) was utilized to determine the morphological changes after plasma treatment from each gas source. X-ray spectroscopy (XPS) and Raman spectroscopy was used for the analysis of elemental composition and identification of functional groups on the sample surface to determine if there were any chemical modifications caused by plasma treatment.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU022

Analysis of O_2 Low Temperature Plasma Treatment on NanoCrystalline Carbon Derived from Spent Espresso Grounds

Shardai S. Johnson, *Vijaya K. Rangari, Shaik Jeelani*

Department of Materials Science and Engineering, Tuskegee University

According to the International Coffee Organization, annual world consumption of coffee is up to 8.8 million metric tons (8.8E+9 kg). Due to anti-nutritional activity of the tannins in coffee, ecology near landfills can be greatly altered. Same-day spent coffee espresso pods were obtained from a franchise coffee shop in Montgomery, AL. The pods were collected over a three-hour period from the initial opening of the store. The pods were then dried at 90℃ for 70 hours to remove any remaining moisture. The coffee was then separated into 5.0g neat specimens and subjected to high pressure carbonization, starting at 4 MPa, in an inert atmosphere (NO_2). Three trials each of carbonization at 500℃, 750 ℃, and 1000 ℃ were conducted in an MTI GSL-1100X-RC Hydrothermal Reactor and a two-hour isotherm employed before system preset cooling. Additionally, 3 trials of carbonization at 1000℃ with three-hour isotherm were also conducted. Once the samples were removed from the pressure vessel of the reactor and weighed, they were characterized by Thermal Gravimetric Analysis (TA Q500), X-ray Diffraction (Rigaku MF600) and Scanning Electron Microscopy (JOEL JSM7200F). At the highest carbonization temperature and isotherm, the sample mass was reduced by 70.9%. TGA analysis was executed with a heating rate of 10℃/min, equilibrated at 30℃, and terminated at 800℃. From this, we were able to determine decomposition temperature of the carbonized coffee. Microstructures (agglomerations), 35um in diameter, were observed with pore sizes ranging from 400 to 900nm. The carbon is majorly amorphous but with extended residence time during carbonization, a 2-dimensional structure starts to form but with increased agglomeration. The explored technique delivers a secondary use for the SEG and reduces the ecological effects of the coffee waste.

Current research is exploring the feasibility of applying partially ionized plasmas to composites to tune hydrophilicity of polymers. Plasma cleaning is the removal of impurities and contaminants from surfaces. In this study we used oxygen to change the surface morphology of the neat carbon and neat polymers poly propylene (PP) and poly methyl methacrylate (PMMA). Oxygen increases the functionalization of the specimen surface. Increased oxygen concentration leads to the formation of a hydrophilic surface. Carbon nanoparticles, PP, and PMMA were treated with O_2 plasma for 30 secs, 1 min, 2 min, 5 min, 10 min, 20 min, 40 min, and 60 min. The treated samples were analyzed with SEM and TGA. Furthermore, we want to embed the nanocrystalline carbon in PMMA and PP to look for improved mechanical properties. This is the tunability in polymers that can lead to increased stability in biopolymers for extended shelf-life or increased degree of degradation for petroleum-based plastics for reduced environmental impact.

Work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU023

Low temperature plasma suppresses growth of the spinach seed-borne fungal pathogen *Stemphylium botryosum*

Shakina Hogan[1], Leopold Nyochembeng[1], Suresh Kumar[1], Srinivasa Mentreddy[1], Ernst Cebert[1], Gabriel Xu[2]

[1]Department of Biological and Environmental Sciences, Alabama A&M University
[2]University of Alabama in Huntsville

Stemphylium botryosum is a seed-borne fungal pathogen of spinach that is difficult to eradicate from spinach seed even by using chlorine treatment. Low temperature plasma (LTP) is emerging as a chemical-free biocide and seed surface disinfectant with proven agricultural applications. However, the effect of LTP on *S. botryosum* and related spinach plant responses have not been examined. The objective of this study was to determine the effect of LTP on spinach seeds with or without *S. botryosum*. Spinach seeds were artificially infested or not with *S. botryosum* and further exposed or not to low temperature plasma and evaluated for germination. Similarly, fungal propagules of S. *botryosum* strain 406 were exposed or not exposed to LTP and cultured on V8 juice agar. Both seeds and pathogen propagules were exposed to LTP for 15 s at a power setting of 30W. All LTP-treated and non-treated seeds were evenly spaced on Whatman #1 filter paper pre-wetted with distilled water in 100 x 15mm Petri dishes and incubated at 25 ±2°C for germination. Treatments were arranged in a completely randomized design with four replications each containing 25 seeds. Seed germination occurred between 4 - 12 days after incubation. Seeds infested with *S. botryosum* and exposed to LTP had 80% germination while LTP-treated non infested seeds had 62% germination. Non-plasma treated infested and non-infested spinach seeds had 78% and 57% germination respectively. Seeds exposed to LTP and seeds infested with the *S. botryosum* had increased germination compared to the non-LTP exposed and non-infested seeds. *S. botryosum* conidia exposed to plasma germinated but failed to produce any significant mycelial growth compared to the non-plasma treated conidia which grew mycelia normally. These results indicate that LTP technology can be used to suppress conidial germination in the seed-borne spinach fungal pathogen and enhance spinach seed germination without any deleterious effects.

This research is supported by NSF EPSCoR RII Track 1 Grant OIA – 1655280.

CPU024

Substorm Prediction Using The WINDMI Model

Pavithra Ganesh Srinivas[1], *Edmund A Spencer*[1], *Sai Krishna Vadepu*[1] *and Wendell Horton Jr*[2]

[1]Department of Electrical and Computer Engineering, University of South Alabama at Mobile
[2] Institute for Fusion Studies, University of Austin Texas in Austin

The WINDMI model is an 8-dimensional physics based state space model of the magnetosphere. The input to the model is the solar wind velocity Vx and the IMF Bz measured by the ACE satellite. The output of the model is the westward auroral electrojet that is proportional to the AL index. In this work we investigate if the model can be used effectively to predict the occurrence of substorms. The model parameters are optimized to give a statistical likelihood of substorm events.

The WINDMI model is constrained to trigger the substorms and establish the magnetospheric conditions that influence substorm dynamics. The timing of onset for each event, the model parameters and the model intermediate state space variables are examined and analyzed for substorms that occurred between 2005 and 2012, as determined from the SuperMAG substorm event list. We classify the events according to three particularly important and distinct parameters of the model, the critical geotail current Ic when a substorm is triggered, the plasma sheet capacitance, and the plasma sheet conductivity, both of which determine the strength, character and duration of geomagnetic activity. The statistical distribution of the model parameters over different types of substorms are presented.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU025

Data-driven Magnetohydrodynamic Model of Solar Chromosphere and Laboratory Plasmas as Low Temperature Plasma

Mehmet S. Yalim[1], *Nikolai V. Pogorelov*[1,2], *Gary P. Zank*[1,2], *and David Maurer*[3]

[1]Center for Space Plasma and Aeronomic Research, The University of Alabama in Huntsville
[2]Department of Space Science, The University of Alabama in Huntsville
[3]Department of Physics, Auburn University

Solar wind, which is the plasma emerging from the Sun, is the main driving mechanism of solar storms. The latter can lead to geomagnetic storms, which are the primary causes of space weather disturbances affecting the magnetic environment of Earth and can have hazardous effects on both space-borne and ground-based technological systems as well as human health. Therefore, accurate modeling of the solar wind is very important in order to be able to understand the underlying mechanisms of solar storms. A realistic solar wind propagation model should be data-driven. This model should ideally start in the photosphere that many space-borne and ground-based solar instruments observe and provide magnetogram data. These data will drive our low temperature plasma (LTP) chromosphere model, where plasma temperatures and ionization ratio are low, which will then drive our corona model through its upper boundary.

Our mathematical model for the LTP chromosphere model is based on the resistive MHD equations which include the Cowling resistivity as a parameter to model partially ionized plasma in the chromosphere and transition region. Our chromosphere model will be driven by observational data on the photosphere, in particular, the vector magnetogram data. These data are used to derive the transverse velocity vector. To apply the observational data in a physically and mathematically consistent way, a characteristic boundary condition formulation based on the characteristic wave propagation across the photospheric boundary is applied.

In order to model the laboratory plasmas, we use the same set of resistive MHD equations, including the Cowling resistivity, where additional physics related to the particular experiment involving the low temperature laboratory plasma is added as source terms to our mathematical model. We will simulate an experiment designed to measure the Cowling resistivity and its effect on plasma current flow in LTP plasmas on the CTH stellarator facility in the Department of Physics at Auburn University.

In this work, we present an overview of our LTP models for solar chromosphere and laboratory plasma, and preliminary results.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU026

Time Domain Impedance Probe for Jagsat 1

Edmund Spencer, Christopher Burns
Department of Electrical Engineering, University of South Alabama

A Time Domain Impedance Probe (TDIP) will be used on South Alabama's Jagsat 1 Cubesat to measure plasma characteristics in the ionosphere. This PIP (Plasma Impedance Probe) will measure in the time domain as opposed to the common frequency sweep. A dipole antenna will probe the plasma with various waveforms and receive the plasma response, generating time-varying, measurable impedance in the dipole. Plasma frequencies, cyclotron frequencies, RHP (Right Hand Polarization) modes, LHP (Left Hand Polarization) modes, and upper hybrid frequencies are expected to be found. An associated circuit board is in development to serve the probe, providing an earth-calibrated balance circuit to compare to the plasma response in the probe.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU027

Computational simulations of plasma processes relevant to pulsed laser deposition of thin film materials

Jacob Paiste[1], *Sumner Harris*[1], *Robert Arslanbekov*[2], *Vladimir Kolobov*[2,3], *and Renato Camata*[1]

[1]Department of Physics, University of Alabama at Birmingham
[2]CFD Research, Huntsville, AL
[3]Center for Space Plasma and Aeronomic Research, The University of Alabama in Huntsville

Pulsed Laser Deposition (PLD) is a well-established, versatile technique used to grow high quality thin film materials. In this process, a high-powered laser pulse ablates a solid target, causing the heating and evaporation of the target material. The laser-induced plasma plume that is produced in this process can be treated as a gas in Local Thermodynamic Equilibrium (LTE) and so the ionization ratio of the target material's atoms are described by the Saha equation. Our research group is involved in studying the fundamental aspects of the formation and expansion of the PLD plasma plume, with emphasis on understanding these processes to create higher quality thin film materials. In collaboration with Computational Fluid Dynamics Research Corporation, the laser-induced plasma is simulated with adaptive mesh computational techniques alongside experimental Langmuir probe measurements of electron and ion densities and temperatures. By comparing experiment to simulation, the similarities and differences can be identified and lead to a more robust simulation and better understanding of the laser ablation process.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU028

Towards Modeling and Simulation of Low-Temperature Plasma for Ion Thrusters

K.-L. Chen, Sajid Ahmed, Gary C. Cheng, and Richard Branam

Department of Aerospace Engineering & Mechanics, University of Alabama

The physical and chemical phenomena associated with low-temperature plasma around an ion thruster are very complex, and not well understood. To compliment the experimental investigation of the plasma field around an ion thruster in vacuum chamber conducted at the University of Alabama, we collaborated with other researchers to develop a software suite, which consists of different numerical programs pertinent to different flow physics of interest, and assess its validity with available test data. There are four main solvers in our compiled numerical model. First, we employed the DSMC method to compute the number density and trajectory of neutral gas in the flow channel and around the thruster because the continuum assumption is invalid under the extreme low-pressure environment. A plasma fluid modeling code with the continuum assumption was used to obtain the number density, temperature, and velocity vectors of electrons exhausting the cathode. To simulate ionization of the neutral gas and interactions of ions with electrons in the flow channel and around the thruster we employed a particle-in-cell (PIC) solver. Lastly, we applied a Maxwell equation solver to provide the static magnetic field to the PIC solver in order to include the interactions between the electrical and magnetic fields. The numerical study is in progress. In the poster, we will present the numerical results of DSMC and plasma fluid modeling.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU029

Design of the Probe Antenna Deployment Mechanism on the JAGSAT 2U CubeSat

Darcey L. D'Amato[1], *Edmund Spencer*[2], *Samuel Russ*[2], *Joseph Richardson*[1]

[1]Department of Mechanical Engineering, University of South Alabama
[2]Department of Electrical and Computer Engineering, University of South Alabama

The JAGSAT is an ongoing multidisciplinary project in the College of Engineering; this 2U (10×10×20cm) satellite will have the scientific goal of measuring plasma electron density in the atmosphere at higher resolution than has been measured before with the purpose of studying irregularities. Two pieces of hardware critical to the science mission are two 0.5 meter probe antennas which must be deployed from a stored state. Design of this these antennas include curved steel rods folded around the body of the satellite, secured by nylon tether attached to two loops of nichrome wire. The nichrome wire and the antennas are secured by hardware modeled through computer assisted design (CAD). The deployment sequence includes heating of the nichrome wire (via a power source) which then cuts the tether, releasing the tension in the antennas. The elasticity of the antenna rod allows them to return to their resting configuration, 180 degrees apart from each other. Further work on this project includes material selection for the mounting and covering hardware.

This work is supported by NASA USIP Grant CAN: NNX16AK75A and by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

CPU030

Characterization of low temperature Plasma treated biobased silica/carbon hybrid nanoparticles

Zaheeruddin Mohammed, Shaik Jeelani, and Vijaya Rangari

Department of Material Science and Engineering, Tuskegee University, Tuskegee AL 36088, USA

Biobased silica/carbon nanoparticles synthesized via pyrolysis of rice husk powder were treated with low temperature plasma. Three different gases argon (Ar), oxygen(O_2) and sulfur hexafluoride (SF_6) were used to treat the nanoparticles with plasma produced using 150 Watts of radio frequency (RF) generated power for a duration of 60 min. The chemical changes induced due to plasma treatment were characterized using FTIR, XPS and Raman spectroscopy. Topography of plasma treated samples was studied via SEM analysis. It was found that each different gas had a different effect on the morphology of the nanoparticles. These surface changes of the nanoparticles are expected to enhance the interphase interaction between the nanoparticles and the host matrix when employed for polymer reinforcement.

This material is based upon work supported by the NSF EPSCoR RII-Track-1 Cooperative Agreement OIA-1655280.

PHY001

The Effect of Zinc Titanate Nanoparticles on The Nano-Mechanical and Thermal Behavior of Polyetherimide

Mohamed Elafandi and Shaikh Zainuddin

Materials Science and Engineering Department, Tuskegee University

Polyetherimide (PEI) is a high performance polymer with considerably high glass transition temperature (Tg). It also exhibits excellent resistance to flame, as well as smoke generation. In addition, it has outstanding mechanical properties. Due to the desirable properties, PEI is widely used in automotive and aerospace applications, electrical and electronics applications, and medical applications. The aim of this work is to synergistically study the effect of Zinc Titanate (ZnTiO3) nanoparticles on the hardness (H) and elastic modulus (E) properties of (PEI) at nanoscale using TI 980 Triboindenter. Also, the thermal properties of these composites were studied using thermogravimetric analysis (TGA). Samples were prepared by adding 5-15 wt. % ZnTiO3 in PEI using magnetic stirring. Results showed significant enhancement in H and E with increasing ZnTiO3 weight percent with optimal values at 10 wt. %. The TGA results showed decrement in decomposition temperature, however a reduction in weight loss over a scan temperature of 1000oC in comparison to neat PEI samples. However, the H value in 15 wt. % samples was slightly lower than 10 wt. % counterpart which could be attributed to poor dispersion of ZnTiO3 and formation of voids (bubbles).

PHY002

JagSat I: EPS, C&DH, ADCS

Shawna M. Mason

Department of Electrical Engineering, University of South Alabama

CubeSats are a new, innovative way to collect data from space. NASA CubeSats are often comprised of several boards and are relatively inexpensive to make. Although they are small, the CubeSat allows for customization in its configuration to fit the project.

The University of South Alabama's CubeSat project, named JagSat I, is being made to test Dr. Edmund Spencer's invention, the Time Domain Impedance Probe (TDIP). To make JagSat I a success, the Electrical Power System (EPS), Attitude Determination and Control System (ADCS) and the Command and Data Handling (C&DH) boards must be fabricated and tested prior to launch.

The EPS module is the power management and delivery system for JagSat I. The module is connected to solar panels and batteries and supplies 3.3 V and 5 V to the rest of the circuit boards. The C&DH module commands and direct the other boards as well as stores and processes data. The ADCS module controls the positioning, altitude and orientation of JagSat I while in orbit, utilizing two reaction wheels.

PHY003

Interfacial properties of CNTs-modified carbon fiber epoxy composites through Nano indentation technique

Alexander Anderson, Oluwaseyi Shofolawe-Bakare, Shaik Zainuddin

Tuskegee University

Improving the interfacial properties between the fiber and matrix of a composite is an expedient step in attaining fiber reinforced composites with enhanced mechanical properties. However, the interaction between the fiber and matrix occurs at the micron-nanoscale and cannot be investigated using conventional macroscale mechanical testing. Therefore, in this work, the interfacial properties of these composites are investigated using a novel nanoindentation technique. In addition, the effect of carbon nanotubes reinforcement on the interfacial properties are also studied. The results show that there is no significant difference in the properties with the addition of the nanotubes.

PHY004

A Distributed Energy Generation System Modeling and Simulation for Academic Buildings

Qing Mu

University of Alabama at Birmingham

The ultimate goal of this research project is to plan feasibility of distributed energy generation for the campus of the University of Alabama at Birmingham (UAB). Distributed energy, also district or decentralized energy is generated or stored by a variety of small, grid-connected devices referred to as distributed energy resources or distributed energy resource systems. The distributed generation (DG) systems can increase energy system reliability, reduce peak power requirements, and improve energy infrastructure resilience. In this study, a DG system using renewable energy sources and energy storage is introduced for the whole UAB campus. The energy sources for DG systems comes from a variety of sources: photovoltaic arrays, natural gas, and micro wind turbines.

In order to study feasibility of a distributed generation systems for a group of building, energy use data is collected. Then a simulation of the building¡¯s energy usage is conducted for one building of each building use category. Openstudio and TRNSYS software tools are used in modeling a typical system, and the results will be extended to the entire campus buildings. The purpose of this study is to get the optimum size of the equipment to save the cost in campus operations and reduce greenhouse gas emissions.

PHY005

Activation of Methyl-Coenzyme M Reductase

Bryan Cronin, *Robel Ghebreab, Katherine Clohan, Evert Duin*

[1]Department of Chemistry & Biochemistry, Auburn University

Methyl-coenzyme M reductase (Mcr) is an enzyme of key interest for biofuel production. This is due to its ability to anaerobically form or oxidize methane. Methane has the highest heat of combustion amongst all hydrocarbons at 55.7 kJ/g making it an excellent fuel. The World Bank estimates that $50 billion worth of methane is flared yearly. Because methane is expensive to transport oil wells opt to flare the methane. If Mcr could be used to oxidize methane in an engineer organism and convert it to a liquid fuel, it could then be easily transported from oil wells and be used for our energy needs. This capability would not only lower greenhouse gases but effectively give us a mechanism to recycle methane. In order to accomplish this feat Mcr must remain active. In the active site of the enzyme lies the cofactor F_{430} which contains a nickel atom. Only in the Ni(I) can the enzyme perform catalysis. The Ni(I/II) has a low reduction potential of -650mV making the Ni(I) vulnerable to oxidation by its environment. In the native organism there is an activation complex called A3a which can reduce the Ni(II) or Ni(III) to the Ni(I) state to keep the enzyme active. To date the minimal components of this complex are still unknown. The research focuses on elucidating this complex and finding which of the proteins are essential for activation of Mcr. Once these proteins are found they can be further studied to better understand the individual roles these proteins have in the activation of Mcr.

PHY006

Design and Development of an Affordable Telemetry System for Navigation of Autonomous Vehicle

An Liu

Electrical and Computer Engineering, University of Alabama at Birmingham

Nearly 1.3 million people die in road crashes each year, which is on average 3,287 deaths a day. An addition to the death toll, another 20-50 million are injured or disabled [1]. These are the huge deal of damage to the human's body. Therefore, in this thesis, we implement autonomous navigation and find the safe path for travel, in which the vehicle can find the most feasible path and drive along this path independently.

In order to gain insight and have an opportunity to investigate further on autonomous vehicles field, we define the aim of this project to design, develop, build and test an affordable vehicle model for laboratory environment that it can autonomously navigate while avoiding the obstacles on its path. we are taking an affordable approach to accomplish a relatively new and difficult task that is involving new technologies. To meet the "low-cost" requirements, we have evaluated several off-the-shelve components, which was reliable, affordable and have easy system integration capabilities.

For the scanning of the field of view, we have used an affordable LIDAR (~ $130) as the main scanning device, Arduino Mega single board computer for serial data communication with the host computer (Laptop), and an H-Bridge DC-Motor controller to drive four DC Motors. For the software development, we have used MATLAB, and Sketch IDE for the software development for the Arduino Mega single board computer.

PHY007

Two-Dimensional Transition Metal Carbides (MXenes) as Cathode Materials for Rechargeable Aluminum Batteries

Armin VahidMohammadi[1] *and Majid Beidaghi*[1]

[1]Department of Materials Engineering, Auburn University, Auburn, AL 36849

Rapid growth in the development of portable electronic devices and electric vehicles (EVs) has significantly increased the demand for reliable and safe rechargeable batteries. Currently, Li-ion batteries are the dominant battery technology for portable electronics and EVs. However, limited lithium resources, their high cost, and safety issues have led to extensive research on the development of rechargeable batteries beyond Li-ion. Among various battery chemistries, multivalent-ion batteries based on divalent (Mg^{2+}, Ca^{2+}, Zn^{2+}) or trivalent (Al^{3+}) ions are promising candidates for future energy storage devices. Batteries based on multivalent ions (Mg^{2+}, Al^{3+}, etc.), are among the potential candidates for future cost-effective energy storage devices. However, development of these batteries is hindered by the lack of efficient electrolytes and cathode materials. Among various multivalent-ion batteries, rechargeable aluminum batteries are promising alternative energy storage devices due to the low-cost and abundance of aluminum. In addition, aluminum, can be handled in open air, providing easier cell fabrication processes and elimination of some of the safety issues associated with lithium and sodium ion batteries. A very few cathodes such as Vanadium Oxide, Chevrel phase (Mo_6S_8), and TiS_2 are known that can host the high charge density Al^{3+} ions. These materials usually suffer from low capacity, low voltage, and low cycle life with significant capacity decay over 100 cycles. Here we present two-dimensional (2D) transition metal carbides (called MXenes) as potential cathode materials for rechargeable aluminum batteries. For example, a battery fabricated with V_2C cathode and Al metal anode shows reversible charge and discharge behavior with a charge plateau at around 1.5 V and a distinct discharge plateau at around 1.2 V and a stable capacity of about 150 mAh g^{-1} for more than 100 cycles. We further show that MXene-based Al batteries can be charged at very high rates and still deliver high capacities and further investigate the kinetics of ion intercalation using variety of electroanalytical techniques. The results of our study represent an important step towards finding efficient cathode materials for Al batteries.

PHY008

Assessing Changes in Mangrove Forests in Africa: Quantifying Loss and Identifying Drivers of Change using Landsat-8 OLI

Katherine Strattman[1], *Robert Griffin*[1, 2], *Emily Adams*[2, 3], and *Emil Cherrington*[2, 3]

[1]Department of Atmospheric Science, The University of Alabama in Huntsville
[2]NASA-SERVIR Science Coordination Office
[3]Earth System Science Center, The University of Alabama in Huntsville

Mangrove forests are found in intertidal zones of tropical and sub-tropical regions around the world. Representing important ecological and economic assets, mangroves sequester significant amounts of carbon, provide natural barriers to hurricanes and tsunamis, and provide habitats to a diverse range of flora and fauna, therefore boosting biodiversity. Wood from mangrove forests are also important economic goods, and provide fuel and building materials to surrounding coastal communities. Despite the undisputed importance of these ecosystems, mangrove forests have been degraded due to natural processes such as storms and hurricanes, and anthropogenic factors like conversion to agriculture and aquaculture. Consequently, this study aims to assess changes of mangrove extents in Madagascar and Nigeria from 2015 to 2018, both of which contain a significant proportion of global mangroves. Change was estimated using multi-date Landsat 8 OLI data and cloud computational techniques, and validation was carried out using high-resolution Planet data. Findings show that mangroves in both countries have exhibited areal loss during the study period, but magnitude of loss varies spatially. Additionally, drivers of change were identified for areas where significant loss was observed. Understanding the rates and magnitude of mangrove change across space can aid in identifying priority areas for forest regeneration, and can help construct sustainable management practices for the future.

PHY009

Morphology based Variability in Thermal Conductivity of Nanostructures: Molecular Dynamics Study

Sushan Nakarmi[1], *Vinu U. Unnikrishnan*[2]

[1]Department of Aerospace Engineering and Mechanics, the University of Alabama, Tuscaloosa, AL
[2]School of Engineering, Computer Science, and Mathematics, West Texas A&M University, Canyon, TX

Carbon nanotubes and nanostructures have shown exceptional thermal transport capabilities and are excellent for thermal management in nano-electronic devices and composites. At the nano-level, the intrinsic properties such as thermal conductivity can no longer be considered as a "material property," but they are dependent on the size, deformation-state, defect and other ambient morphological conditions of the nanostructure. An understanding of the effect of these parameters are important in constructing a nanotube system with these desired thermal characteristics. In this work, we summarize the effect of size, strain-states and defects on the longitudinal thermal conductivity of nanotubes and nanotubes-based structures (junctions and nano models), using a heat bath method of non-equilibrium molecular dynamics simulation. This study is later followed by the comparative study of phonon density of states of nanotubes. Phonons are a major heat carrier in nanotubes and the study of vibrational mode and phonon frequency provides helpful insight in understanding the physics of thermal transport in nanostructures.

PHY010

Evaluation of Effectiveness of Bio-based Graphene Reinforced Asphalt Pavement

Omar Tahri

Department of Civil, Coastal, and Environmental Engineering, University of South Alabama

With an increased awareness of sustainability in transportation infrastructure, there has been an increasing use of green, smart and sustainable materials in asphalt pavement. More than 90% of U.S. roads and highways are paved with asphalt, and more than 95% of roads in Alabama are asphalt pavement. One of biggest challenges that asphalt community is facing is how to ensure the durability of asphalt pavement and maintain its cost-effectiveness at the same time. There is an emerging interest in applying nanotechnology to asphalt materials to improve the performance of asphalt pavement. Graphene is one of the "superstar" nanomaterial that can potentially improve asphalt pavement. It is a single layer of carbon atoms that are bonded together in a repeating pattern of hexagons. The thickness of graphene is a million times thinner than that of a paper. The major obstacle to limit the wide application of graphene is due to the high cost and few study in the use of graphene for civil infrastructure. Graphene family nanomaterials have been increasingly used in asphalt industry due to its superior mechanical properties. Various graphene synthesis methods (chemical vapor deposition, exfoliation, thermal decomposition, unzipping, and reduction of graphite oxide) and recent studies on typical graphene materials (nanotube, nanoplatelets, and graphene oxide) are used for the modification of asphalt. The effect of each graphene family nanomaterial on the rutting resistance (high temperature property), fatigue cracking resistance (intermediate temperature property), and thermal cracking resistance (low temperature property) are explored. This study also provides the first-time evaluation of the feasibility and effectiveness of bio-based graphene for asphalt mixture, which can be potentially used for asphalt pavement.

Acknowledgement: Faculty Development Council Grant Program, University of South Alabama

PHY011

Semi-Automated Identification and Thermal Infrared Response of Dunes Materials at Hargraves Crater, Mars

Al Emran, Luke J. Marzen, and David T. King Jr.

Department of Geosciences, Auburn University, 2050 Beard Eaves Coliseum, Auburn, AL 36849

This paper aims to identify individual dunes from a semi-automated object-based image analysis technique and thermal infrared response of dune materials at Hargraves crater, Mars. We were motivated in this work by the fact that the existing Mars digital dune database (MGD^3) needs to be updated, since it was done by manual visual photo interpretation from the Thermal Emission Imaging System (THEMIS; 100 m/pixel) images, for a better understanding of the martian surface and its atmospheric mechanisms at local scale. This study uses an object-based image-analysis technique applied to the Context Camera (CTX; 6m/pixel) dataset in order to extract dune data in a quick, reliable, and accurate fashion. Indeed, this study is a test case in having a validated and accurate result that has wide applicability to the entire martian surface for updating to a higher resolution dune database. We found an average thermal inertia value of 243±23 $Jm^{-2}K^{-1}s^{-0.5}$ for the dune materials, indicating a surface composed of an effective grain-size of ~230 µm, suggesting a fine sand size at the surface and moderately indurated areas with small granules or unconsolidated materials. Our compositional analysis indicates the dune materials is composed a mixture of feldspar, olivine, and pyroxene having a relatively lower bulk-silica content. The wind movement inside the crater, based on the dune slipface orientation, indicates that the prevailing wind direction inside the crater is west northwest. The dunes are labeled as active (stability index of 2) and do not appear to have been influenced by subsurface water ice or volatiles. We emphasize that with the accurate dune identification based on our auto/semi-automated method, coupled with the compositional and thermophysical characteristics for individual martian dune fields, would provide an excellent addition in the MGD^3 for better understanding of surface and atmospheric behavior of Mars at local scale.

Keywords: Dune, Hargraves crater, Mars, Thermal Infrared, and Object-Based Analysis

PHY012

Characterization of Non-volatile, Self-neutralizing Acids formed from Ionic Liquids and CO_2

Tanner J. Hickman, *Kevin N. West*

Department of Chemical and Biomolecular Engineering, University of South Alabama

The principles of green chemistry have provided a framework around which chemists and engineers have focused their efforts to design safer and more environmentally benign syntheses and processes. Among its important tenets are: the prevention of wasteful byproducts, creating safer solvents and catalysts, designing energy efficient processes and developing less hazardous chemical syntheses. The work described here includes the characterization of a novel class of carbonic acid catalysts which embody all of these principles: self-neutralizing Brønsted acids formed from the reaction of carbon dioxide with tethered hydroxyls (-OH groups). The hydroxyls are tethered in that they are attached to either nonvolatile ionic liquids or deep eutectic solvents. The carbonic acids form upon exposure of the alcohols to CO_2 and decompose when the CO_2 pressure is released, or upon gentle heating. Thus, they are self-neutralizing and can be stored as neutral substances. Furthermore, separation of product mixtures does not require a neutralizing base, eliminating byproduct salt waste, and separation from product mixtures can be accomplished via vaporization. The presence of the self-neutralizing acids from non-volatile species has already been established, however, the strength of theses acids and their abilities to catalyze reaction remains unproven. Thus, the two main objectives of this research are: 1) characterization of the strength of several representative acids using the Hammett acidity function and 2) demonstrating that the acids can catalyze a model reaction. An indicator probe, 4-nitroaniline or a similar derivative, will be used to demonstrate the acidity of several representative acids formed from ionic liquids containing hydroxyls and CO_2. This technique, which employs UV-Vis spectroscopy to determine the Hammett acidity function, is a well-known method for determining the relative acidity of non-aqueous or concentrated aqueous acids and has been used to measure the strength of dissolved acids (such as HCl) in ionic liquids. Once the acidity of the ionic liquids-based acids has been established and compared to traditional acids (such as acetic acid and HCl) a model reaction will be chosen based on the demonstrated acidity of the self-neutralizing acid (using liquid chromatography for analysis). The reaction will likely be a transesterification, linalool rearrangement or similar reaction often used to demonstrate acid catalysis.

PHY013

Development of a Rechargeable, Antimicrobial Fiber

Bradley Brimmer, Dr. Kevin West, Dr. Grant Glover

Department of Chemical and Biomolecular Engineering

Cotton textiles enhanced with anti-microbial properties create opportunity to provide sanitary environments for military troops, hospital patients, and the general public. 5,5-dimethylhydantion is a compound that, when charged with dilute bleach (sodium hypochlorite), can release low levels of molecular chlorine which provide antimicrobial properties. A derivative of this compound, allyl-5,5-dimethylhadantion (ADMH) maintains the ability for chlorine release with the potential to be bound to cotton. ADMH can be synthesized and purified using a modified techniques that reduce cost and time presented by the current literature synthesis. Using a proprietary process for covalently bonding the molecule to cotton, ADMH can be attached to the surface. Using generic household bleach, chlorine is attached and an attachment percentage is tested using a modified assay back titration method with a starch indicator. Using these chlorine percentages, it is possible to predict the time of chlorine release therefore showing the time interval before the need for chlorine regeneration in a bleach solution. In this work we detail the modified synthesis and purification and present results showing the amount of chlorine retained by the fabric, compared to an untreated control, and the longevity of the chlorination. Such a modified fabric could serve as a sterile fabric in the hospitals, an antiseptic bandage for the military in combat arenas and provide a fabric that would resist microbial growth for a variety of consumer applications.

PHY014

Novel Anthracene-Based Materials for Non-Invasive Optogenetics

David N. French[1], *Aundrea Bartley*[2], *Kavitha Abiraman*[2], *Lori McMahon*[2], *Gary M. Gray*[1]
[1]Department of Chemistry, University of Alabama at Birmingham
[2]Department of Neurobiology, University of Alabama at Birmingham

The field of Optogenetics currently relies on invasive means to deliver light to cells and tissue. A novel, non-invasive approach has been identified in the combination of a penetrative light source and a local light-converting material. A methacrylate-functionalized anthracene (AM) was synthesized to combine a known scintillator with polymer functionality. Methacrylate addition to anthracene does not affect optically active orbitals and does not change the excitation/emission profile of the anthracene moiety. Copolymers of AM with methyl methacrylate (MMA) were synthesized in ratios from 1:1 to 1:24 AM:MMA to observe effect of composition on scintillation. The monomer compositions of the purified products were calculated by ^{1}H NMR. The excitation/emission profile is also unchanged in the polymers. Anthracene-methacrylate and the copolymers glow bright under UV light, and have luminescence quantum yields between 2-6%. Visible x-ray fluorescence is observed in the monomer and copolymers. The scintillation of the materials peaks between 460-500 nm, which lies on top of the absorption range of the most common Optogenetic photoreceptor, channelrhodopsin-2 (ChR2). The copolymers were found to be non-toxic through immunohistochemistry. As proof-of-concept, Optogenetic capabilities of film-cast copolymers were examined using whole-cell patching techniques. Spontaneous photoreceptor events were observed when the polymers emitted blue light after UV irradiation. In future research, anthracene will be functionalized with phosphorus chemistry to increase emissive output and to further increase biocompatibility and overcome the hydrophobicity of the current system.

Acknowledgements:
EPSCoR Grant Number: 1632881
Alabama GRSP Round 13

PHY015

Towards Kink-free Vascular Grafts, Electrospun Vascular Grafts from Polymer Blends

Kiran R Adhikari[1], *and Vinoy Thomas*[2]

[1] Center for Nanoscale Materials and Biointegration, Department of Physics, University of Alabama at Birmingham
[2] Department of Materials Science and Engineering, University of Alabama at Birmingham

Mechanical mismatch between the native blood vessels and the implanted graft is the primary reason for the implant failure. In this study, we use the process of electrospinning for the fabrication of the synthetic vascular graft using blend polymers like PET, PU, PHH and PDO. Incorporation of elastomer PU into widely used vascular graft material PET (commercially known as Dacron) in 50/50 ratio enhanced the breaking strain of PET graft by 60%, which is helpful in the pulsating environment of the grafts inside the body. The Young's modulus of the graft is found to be 2.1 MPa at 10 percent elongation. SEM images shows the mesh structure in the nanoscale which is suitable for mimicking the ECM of the native blood vessels.

PHY016

Effect of fabrication methods of amorphous silicon thin films on their charge carrier dynamics

Uddhab Tiwari and Kannatassen Appavoo

Department of Physics, University of Alabama at Birmingham, AL 35294

Amorphous silicon (a-Si) has many industrial applications including in photovoltaics and transistors for display technologies. The main reasons for a-Si technological adoption are that it can be fabricated in thin film form and at lower temperatures (< 250oC), thus reducing the use of expensive crystalline Si (c-Si) while maintaining compatibility with micro-processing technologies. Since a-Si does not have a well-ordered crystal lattice, its electronic properties are highly dependent on the fabrication methods employed, with its bandgap varying from around 1.7 to 1.9 eV. Here, we study the ultrafast time-dependent optical properties of a-Si thin films that have been fabricated using three different techniques: electron-beam physical vapor deposition (ebeam), plasma-enhanced chemical vapor deposition (PECVD) and sputtering. We perform ultrafast broadband transient absorption on these films by exciting below (900 nm) and well above (350 nm) the a-Si band gap (Eg ~ 730 nm) to determine the carrier lifetimes and their overall dynamics. From the ultrafast spectroscopy data, we see that each fabricated method yields vastly different photoinduced absorption spectra caused by the various trap states. While ebeam and pecvd samples have overlapping spectral features in the visible range, samples that have been sputtered display broad absorption features in the visible-near infrared region. Our results demonstrate that ultrafast spectroscopy can help in understanding the nature of traps and how various fabrication methods are suited for various applications.

Funding Acknowledgement : UAB Physics Department’s startup funds

PHY017

Effects of Binary Nanoparticles on Mechanical & Thermomechanical Performance of Epoxy SC-780 Composites

Ryan Green, Delroy Watson, Jalon Levett, Alfred Tcherbi-Narteh

Department of Material Science Engineering, Tuskegee University

The purpose of this research is to find how various nanoparticles (NPs) interact with each other and epoxy molecules within a composite sample, leading to enhancement in mechanical and thermo-mechanical properties of the same. Nanoparticles used in this study were Montmorillonite nanoclay (MMT) and graphene nanoplatelet (GNP). These nanoparticles have high aspect ratio morphology and exhibit excellent mechanical and electrical properties, and ability to minimize moisture absorption in polymeric composites. Composite samples used in the study were unmodified (neat), samples with individual nanoparticle-fillers, and combination of MMT with GNP.

PHY018

Pointwise Estimates on the Green's Function of a Linearized Chemotaxis Model and a Pointwise Time Asymptotic Behavior of Solution to the Nonlinear Model.

Jean Rugamba

Mathematics Department, University of Alabama at Birmingham

We consider a Keller-Segel type chemotaxis model with a logistic growth term. For the corresponding linear system, linearized around a constant equilibrium state, we study the Green's function for the Cauchy problem. We are able to obtain detailed pointwise estimates on the Green's function using spectral analysis and other analytical tools. Besides its own significance in the linear theory, we also use the Green's function estimates to study a pointwise time asymptotic behavior of solution to the nonlinear system via Duhamel's principle.

PHY019

Effect of laser-generated plasma properties on thin film growth of iron-based superconductors

Sumner B. Harris, *Renato P. Camata*

Department of Physics, University of Alabama at Birmingham

Heteroepitaxial thin film growth on substrates with large lattice mismatch is an important area of crystal growth research to overcome applications-based restrictions on substrate choice. For some material systems, one crystalline phase may exhibit growth of domains with different epitaxial relationships to the substrate or two phases may grow simultaneously with different orientations. This process, known as double epitaxy, creates thin film materials with many grain interfaces at fixed angles with respect to the substrate. This work demonstrates double epitaxy in FeSe, an important superconducting compound with a complex phase diagram which is highly sensitive to stoichiometry. Conditions exist during pulsed laser deposition (PLD) that lead to the simultaneous epitaxial growth of the tetragonal (β-FeSe) and hexagonal Fe_7Se_8 (γ-FeSe) phases of FeSe in intermingled domains throughout the film, creating many phase boundary interfaces. We investigate the impact of PLD parameters on the double epitaxy of this interface-dominated material and identify the conditions under which double epitaxy is suppressed. FeSe films grown at temperatures between 350°C and 450°C with laser fluence fixed at 3.4 J/cm^2 showed the simultaneous epitaxial growth of both (001)-oriented β-FeSe and (101)-oriented γ-FeSe. The relative fraction of these two phases changes smoothly from majority β-FeSe at 350°C to majority γ-FeSe at 450°C. Substrate temperature of 550°C results in a change in epitaxial orientation of β-FeSe from (001) to (101)-oriented. The (101) oriented β-FeSe grows in three domains, one aligned with the substrate and two others rotated by ±30°. At 550°C, reducing the laser fluence to 1.4 J/cm^2 increased the relative fraction of the γ-FeSe phase. The parameters of the PLD plasma plume are expected to influence the simultaneous epitaxial growth of the two phases by delivering a locally non-stoichiometric flux. Measurements of space and time resolved ion densities of the PLD plume will be presented and correlated with the emergence of γ-FeSe to determine the impact of the relative density of arriving ions on phase crystallization.

PHY020

Query Driven Association Action Rules

Lowell H. Crook, *Ryan G. Benton, Tom Johnsten, David Bourrie*

School of Computing, University of South Alabama

Action rules represent an attempt to discover how changes in one attribute of an object might affect other attributes. Action rule mining contrasts with association mining, which looks for values that often appear together, and with classification, which discovers rules that can determine an object's class. For example, given a database of vehicle accident reports, association mining would discover that not wearing a seatbelt is correlated with fatal injuries. On the other hand, classification would find that a person not wearing a seatbelt gets put into a class of people that have fatal injuries. In contrast, the use of action rule mining would find that when a driver changes from not wearing their seatbelt to wearing their seatbelt, it is likely that the level of injury will change from fatal to non-fatal. Action rule mining provides more direct information than association mining and classification, as it searches for patterns that can directly help a decision maker learn what changes promote the desired outcome rather than just reporting correlations.

Research on the discovery of action rules has followed either a classification-based or association-based approach with both having their strengths and weaknesses. Classification-based approaches require a preprocessing stage where classification rules are created. Classification approaches are typically fast, but a poor choice of classification rule generators can lead to a poor set of action rules. The association-based approaches often create a rich set of action rules but are typically slower, and the number of rules generated can be in the thousands or more.

This research proposes a new method for finding action rules based on the Association Action Rules (AAR) algorithm proposed by Ras, Dardzinska, Tsay, & Wasyluk in 2008. The proposed algorithms improve on AAR's efficiency by using a query to reduce the search space, therefore, limiting the number of results. This provides a way to discover all the interesting rules that contain a given query result while simultaneously being more efficient than other association-based action rule methods. The three presented algorithms that can accomplish this goal are referred to as the AAR with Post Pruning (AARPP), Independent Association Mining with Post Merging (IAMPoM), and Query Driven Association Action Rules (QDAAR) methods. A diverse collection of experiments was executed on all three algorithms and found that QDAAR was better than or equivalent to IAMPoM, depending on the input parameters, while AARPP was always much slower.

PHY021

Improvement of Mobility and Stability of Motion of Skid-Steering UGV with New Individually Steering Inputs on Severe Terrain

Siyuan (Hunter) Zhang, *Vladimir V. Vantsevich*

Mechanical Engineering Department, University of Alabama at Birmingham

Conventional turning mechanisms of wheeled skid-steer vehicles provide different velocities of the wheels at the left and right side while the wheels of each side are rigidly coupled and, thus, rotate with the same angular velocity. This turning principle has been employed for decades and provided high turnability of small unmanned ground vehicles (UGV) in both indoor and outdoor conditions with a high grip between pneumatic tires and surface of motion. However, as an analysis revealed, small UGVs habitually demonstrate non-sufficient turnability on deformable, extremely moisturized and heterogeneous terrains.

This research deeply analyzes the turning principle of conventional skid-steering wheeled vehicles and tracked vehicles, and indicates the turning moment is the primary characteristic that dictates the actual curvilinear movement. Based on this, this research proposes and develops new skid-steering inputs that are associated with de-coupled wheels, which are individually driven by either mechanical drivelines or electric motors. The skid-steering inputs are introduced as four kinematic discrepancy factors (KDF), which individually and, the same time in coordination with each other characterize kinematic and force variances of the UGV four drive wheels. In the paper, the KDF are explicitly determined as skid-steer variables through tire characteristics and parameters of individual mechanical and electric drivelines. The KDF are suitable for a lower vehicle sub-system control to individually manage the wheel torques.

The effectiveness of the skid-steering inputs is illustrated by analyzing vehicle understeer and oversteer maneuvers that are caused by various combinations of terrain conditions. A smooth and continuous transition from one to another KDF combination converts vehicle maneuvers and improves UGV turnability and mobility.

Funding Acknowledge: The researchers gratefully acknowledge the financial support provided by the Southern Company.

PHY022

Untangling YARN 2.0: Data Analytics in Apache Hadoop

Thomas Watts[1], *Ryan Benton*[1], *Jordan Shropshire*[1], *David Bourrie*[1]

[1]School of Computing, University of South Alabama

Modern big data applications are a number of individual services that are stitched together, and can be reconfigured depending on the data flows that are being analyzed. The most commonly used big data application is Apache Hadoop. YARN, or Yet Another Resource Negotiator is tasked with managing processes and resources within a Hadoop stack. This service received a major update, the ability to natively use containers, as part of the Apache Hadoop version 3.0 release in December 2017. A container is a computing unit that is quick to build, perform a task, and then terminate. It was added to handle new data use cases, as well as improve elasticity and resource utilization for more efficient scalability. These new use cases require a fresh look at the analytics pipeline that empower both live health monitoring and forensic analysis of big data systems.

Previous research has indicated that introspection tools, independent programs configured to pull data out of a system, were able to gather specific data from a small containerized architecture for monitoring and forensic purposes. This project aims to expand that research to a full big data system. Introspection tools will be paired with new sources of data including YARN's internal monitoring toolset, YARN Timeline Service, as well as network transfer captures between Hadoop services. Tests will be conducted on a variety of big data tasks in order to generate metrics from a set of points throughout the Hadoop stack. The goal will be to determine if we can reliably detect performance bottlenecks and unexpected events.

This research will be supported on a local computing cluster running the cloud computing software Openstack. That cloud was acquired through NSF grant (CNS-1726069) and will administer a multi-node instance of Apache Hadoop. The various data streams will be pulled from both the Namenode (master) and Datanode (slave) within the configuration. These streams of data will allow for the detection of system instabilities within a running big data system such as the presence of malware. In order to support forensic analysis, the data collected will be stored on systems separate from the Apache Hadoop system and saved elsewhere.

PHY023

Exploring the Potential Energy Landscape of ∑5(310) Cu Grain Boundary

Keshab Bashyal[1], *Lin Li*[2]

[1]*Department of Metallurgical and Materials Engineering, The University of Alabama, Tuscaloosa*
[2]*Department of Metallurgical and Materials Engineering, The University of Alabama, Tuscaloosa*

Grain boundaries (GB) govern many materials properties such as plasticity, corrosion, intergranular and fatigue crack, creep and thermal coarsening. Grain boundaries can have multiple phases and exhibit structural transitions. The kinetic properties of the GBs that drive such macroscopic properties can be explained by understanding their potential energy landscape i.e. the energy basins and nearby saddle points separating adjacent structures. The activation-relaxation technique (ARTn) is used to identify the possible transition (saddle) states and spectrum of activation and relaxation energies in ∑5 (310) GB in Cu-bicrystal sample. The transitions are grouped based on the energy difference between the initial and final configurations. The atomic scale transition in terms of their local structure and environment is characterized. The detail analysis of the correlation between the GB configuration and the activation energy is studied.

Funding Acknowledgements:

- This work is funded by NSF CMMI 1727875.
- Keshab Bashyal acknowledges financial support from the Alabama Graduate Research Scholars Program (GRSP) funded through the Alabama Commission for Higher Education and administered by the Alabama EPSCoR.

PHY024

1/f Noise Characterization and Control in Length and Chirality-Separated Single-Walled Carbon Nanotube Device

Xin Wang[1], Chunxu Chen[1], Hanxiao Huang[2], Clayton E. Simien[3], Rekha Gautam[4], Upendra Adhikari[3], and Daneesh Simien[1]

[1]Department of Materials Science and Engineering, University of Alabama at Birmingham
[2]Department of Biomedical Engineering, Alabama State University
[3]Department of Physics, University of Alabama at Birmingham
[4]Department of Chemistry, University of Alabama at Birmingham

There is an urgent need to control the nonnegligible noise level of Single-Walled Carbon Nanotube (SWNT) based semiconducting devices. The 1/f noise of SWNT based devices can be moderated with novel controlling methods and techniques, such as developed in this work. In our work, we investigate and present the study of the effect of homogenous, single length and chirality SWNT random networks on 1/f noise. Using sorted SWNTs (3360nm, 587nm, (6,5)), we compared their Power Noise Spectral Density (Sv), and surface concentration with unsorted SWNTs' to reveal key insights into controlling 1/f noise. Furthermore, with Raman spectroscopy, SWNTs with homogeneous length(3600nm) and chirality ((6,5)) were also studied, by examining their G+/G' ratios and their respective RBM modes. It is shown, SWNTs of homogeneous length and chirality with networks configurations at their conductivity percolation threshold can have significant contributions to the reduction of 1/f noise. Collectively, our study presents a novel way to control and reduce 1/f noise in SWNTs networks with both unique and homogeneous length and chirality characteristics.

PHY025

A Molecular Dynamics Study of Side-Chain Effects on Xylan Attachment to Cellulose

Morgan Lancaster, *Brooks Rabideau*

Department of Chemical and Biomolecular Engineering, University of South Alabama

Cellulose is a highly coveted resource for industry but remains tremendously underutilized due to its insolubility, which may be exacerbated by its interactions with hemicellulose in the plant cell wall. Hemicellulose is another plant cell wall component similar in structure to cellulose, and examples include xyloglucan, xylan, and mannan. Xylan, the most abundant hemicellulose in nature, interacts with cellulose and often displays various side chain substituents that include acetate, glucuronic acid, and arabinose. According to recent studies, these substituents are not random but follow patterns dependent on the plant taxonomic family and cell wall type. In this study, molecular dynamic (MD) simulations are utilized to observe the behavior of seven unique xylan chains in their own aqueous environments. MD simulations are useful computational tools used for studying the physical movements and properties of atoms and molecules, and are highly useful for observing elusive molecules such as cellulose. The results of this study show that xylan chains with glucuronic acid substituents experienced more hydrogen bonding forces with water than the undecorated xylan chain and the arabinose substituents. Xylan chains with more substituents overall created more hydrogen bonds with water and themselves than chains with less substituents or none at all. Additionally, xylan chains with glucuronic acid substituents experienced more variation in their radii of gyration, indicating more twisting and curling behavior. These results suggest that glucuronic acid substituents will create more stabilized bonding with cellulose bundles than arabinose or the undecorated chain. The outcomes of this study will aide in future work, which will include cellulose bundles simulated alongside xylan. Once cellulose is added, it will help further elucidate the role xylan substituents play in xylan-cellulose interactions as well as show which substituents bind better or less favorably, which can have an impact on the complications with cellulose dissolution.

PHY026

A Spatial Pattern Analysis of Forest Loss in the Madre de Dios region of Peru

Andrea Puzzi Nicolau[1], *Kelsey Herndon*[2,3], *Africa Flores*[2,3], *Robert Griffin*[1,3]

[1]Department of Atmospheric Science, University of Alabama in Huntsville
[2]Earth System Science Center, University of Alabama in Huntsville
[3]NASA-SERVIR Science Coordination Office

The increased availability of satellite-based data has become central to land use land cover change research at regional and national scales, where traditional methods would be costly and time consuming. Over the past decades, the Peruvian Amazon has experienced a rapid change in forest cover due to the expansion of agriculture and extractive activities. This study uses Spectral Mixture Analysis (SMA) in a cloud-computing platform to map forest loss within and outside key land tenure areas in the Madre de Dios Region of Peru. Landsat surface reflectance data were used spanning 2013 to 2017 and spectral unmixing was performed to identify patterns of forest loss for each year. Data with 3 to 5 meters spatial resolution from Planet were used to validate the final maps and identify main drivers. Results show a total of 12,841 ha of forest loss, most of it located in the buffer zones of the protected areas (7,047 ha). Forest loss also appears in the Kotsimba Native Community within a 1-km buffer of the Malinowski River, and the Tambopata Reserve. Gold mining seems to be the main driver of forest loss and this activity may not be restricted to the legal mining concession areas, since 52% of forest loss occurs outside these areas. Overall accuracy obtained was 95%. These results illustrate the applicability of a cloud-based platform for accessing and processing multi-temporal datasets; the importance of monitoring deforestation progression in the Peruvian Amazon; and suggests the use of SMA as reliable classification approach.

PHY027

A Pattern Reconfigurable Antenna with Full Hemispherical Null Steering

Zabed Iqbal and Maria Pour

Department of Electrical and Computer Engineering, The University of Alabama in Huntsville

Recent advancements in the cognitive communication systems and the ubiquity of the wireless sensors have driven the necessity to develop reconfigurable antennas with adaptive null steering capabilities that enable the wireless receiver to avoid interference and jamming signals. In this study, a novel null steering method is proposed based on the excitation of higher order modes in an over-moded circular microstrip patch antenna. The circular patch antenna under study has a three-layer stacked configuration, where the top layer excites the fundamental TM_{11} mode with a broadside radiation pattern, and middle and bottom layers excite the higher order TM_{21} and TM_{31} modes, respectively, with a conical radiation pattern. By controlling the amplitude excitation ratios of these modes and applying proper phase shifts between them, a continuous null steering pattern with a maximum of three independent nulls can be realized while two or more modes are excited simultaneously. As a result, a full hemispherical null steering with a ±90° dynamic range is achieved. In addition, the null steering capability of the tri-mode antenna is studied in terms of different dielectric substrates to further showcase the adaptability of the proposed technique.

Funding Acknowledgement: This work was supported in part by the National Science Foundation (NSF) CAREER Award no. ECCS-1653915.

PHY028

Oxidation Studies of Dinoflagellate Luciferin: A Combined Computational and Experimental Approach

Patrick H. Donnan[1], *Thomas Brown*[1], *Xingchen Huang*[1], *Kirsta G. Channell*[1], *and Steven O. Mansoorabadi*[1]

[1]Department of Chemistry and Biochemistry, Auburn University

Dinoflagellates are marine microorganisms capable of both bioluminescence and photosynthesis. In the bioluminescent reaction, the enzyme luciferase catalyzes an oxidation of the luciferin substrate with molecular oxygen, producing oxyluciferin and light. Purified luciferin is extremely sensitive to air and will oxidize to a non-enzymatic product if exposed to atmospheric oxygen concentrations. The non-enzymatic, air-oxidation product is structurally different from oxyluciferin and does not emit light when formed. The reaction mechanism for the air-oxidation product is currently unknown. The biosynthetic precursor to luciferin is also an oxidized version of luciferin, called P630 for its characteristic absorbance at 630 nm. Prior work in our laboratory investigated the enzymatic oxidation mechanism [P. D. Ngo and S. O. Mansoorabadi, *ChemPhotoChem* **1**, 383 (2017)], and we have extended similar studies to the air oxidation mechanisms of luciferin. Combining density functional theory (DFT) calculations and UV-visible spectroscopic characterizations, we have identified different conditions which change the predominant mechanism and therefore the oxidation product. Acidic conditions favor the production of P630, while basic conditions favor the production of the air-oxidation product. Luciferase is a pH-regulated enzyme, and these results have implications for how dinoflagellates prevent unproductive oxidation of luciferin in the cell.

This worked was supported by NSF EPSCoR via NSF CAREER Award CHE-1555138 (S. O. M.). P. H. D. was supported by an award from the AL EPSCoR Graduate Research Scholars Program.

PHY029

Removal and Recovery of Phosphorus from Non-Point Source using Permeable Reactive Barriers

Rachel S. Chai[1], *Arka Pandit*[2]

[1]Department of Civil, Coastal, and Environmental, University of South Alabama
[2]Arka Pandit, Department of Civil, Coastal, and Environmental, University of South Alabama

Eutrophication is one of the more pressing challenges of this time. Coastal areas across the world, including the Gulf of Mexico, have been experiencing one of the worst eutrophication problems over the last few years. There has been marked improvement in reactive phosphorus (P) removal technologies from point sources like municipal wastewater treatment plants. However, not much focus has been on nutrient removal and its possible recovery from non-point sources (NPS). Managing the influx of nutrient to watersheds from NPS has a significant potential to address the eutrophication of coastal areas. While precipitation, filtration, membrane processes, Enhanced Biological Phosphorus Removal (EBPR) and Physico-chemical (adsorption based) methods have been successfully used to effect P removal, application of these technologies to non-point sources has remained limited till date.

This research proposes to develop a permeable reactive barrier for P adsorption from NPS pollution. Permeable reactive barriers (PRBs) are subsurface passive treatment systems that require low to no periodic maintenance and are ideal for decentralized in-situ applications. This research uses spent alum sludge (SAS) as the primary reactive substance within the permeable reactive barriers. SAS is a by-product of potable water treatment process and is typically landfilled. While SAS has shown some promise in removing P from municipal wastewater, its application has been limited in practice. This research will determine the efficacy of SAS in removing P from NPS at the bench scale. The research will conduct a set of experiments to determine the capacity of SAS for P adsorption, kinetics of P adsorption in an SAS PRB, and design criteria for SAS based PRBs. Based on the data obtained from these set of experiments, stakeholders will be able to design SAS based PRBs that have the potential to remove P from NPS pollution. Given the current eutrophication challenge in the Gulf of Mexico, this is a topical research problem that needs to be addressed.

Research findings indicate that SAS is highly effective in adsorbing phosphorus and the adsorption capacity is at its maximum in the near neutral pH range. Furthermore, the research reveals that there is no significant leaching of heavy metals or other pollutants from the SAS. The aforesaid qualities make SAS a good candidate for large-scale decentralized in-situ application. SAS PRBs offer a novel and sustainable (e.g. low-to-no energy requirement in operation, reuse of a conventional waste material) solution to control NPS nutrient pollution.

PHY030

Molecular Modeling of Singular and Binary Adsorption of CO2 and H2O onto Water Stable Metal Organic Frameworks

Arianjel Hernandez, Sabrina de Jong, Dr. Brooks D. Rabideau

Department of Chemical & Biomolecular Engineering, University of South Alabama
Materials and Biointegration, Department of Physics, University of Alabama at Birmingham

Metal organic frameworks are frequently studied analytically to develop solutions to gas phase separations. These frameworks are sought after as they are highly designable to adsorb specific compounds from a system. However, due to the complexity of analytical sampling of binary systems, there is a general absence of data of adsorption onto the modern metal organic frameworks (MOFs). Therefore, our research will focus on modeling of the singular and binary adsorption of CO_2 and H_2O onto UiO-66 variants. UiO-66 is a water stable MOF with promising literature values for nonfunctionalized ligands. This research seeks to model a potential replacement of the common CO2 adsorbent, zeolite 13X, by providing single and binary data for a plethora of UiO-66 structures. The modeling will be done through the use of Grand Canonical Monte Carlo and forcefields to emulate the intermolecular forces between the species and structure.

This work seeks to understand the effects of varying the MOF structure through changing functional groups, functional group locations, and through the addition of defects through digital representations of adsorption onto the frameworks. Thereafter.

PHY031

Comparative Study on Flexural Properties of Nanoclay and Graphene Nanoplatelet Modified Carbon Fiber Reinforced Polymer Composites

Tareq Sarower, *Shaik Zainuddin*

Department of Materials Science and Engineering, Tuskegee University, Al-36088, USA

In this study we thoroughly investigated and compared effect of nanoclay (MMT) and graphene naoplatelet (GnP) on flexural properties of carbon fiber reinforced polymer (CFRP) composite. MMT and GnP were added both in individual and in combined (binary) in SC-15 epoxy resin to fabricate the laminate by hand layup and compression molding techniques. 3-point flexure test result suggested that addition of nanoclay significantly increased flexural modulus (19%), where addition of GnP was found to increase flexural strength more significantly (14.3%). However, addition of binary nanoparticles though improved flexural strength by 5.7%, they were found to show reduced flexural modulus by 5.4%. Optical microscopy and SEM analysis on fractured specimens of flexure test suggested that addition of nanoparticles considerably changed the damage mode and failure criteria of CFRP composite. Upon addition of single nanoparticle, delamination and matrix crack during fracture were significantly reduced because of strong interfacial bonding; and in that place, fiber breakage was found to be domineering damage criteria. SEM images of binary fractured specimens showed particle agglomeration that act to degrade overall flexural performance.

PHY032

Binary Adsorption of CO_2/H_2O Mixtures on Amino Functionalized Metal Organic Frameworks

Rebekah Impastato, Dr. Mohammad Hossain, Dr. T. Grant Glover

Department of Chemical Engineering, University of South Alabama

In 1994, NASA announced the beginning of the Mars Explorer Program. This program has many scientific focuses, such as the future for manned space travel to Mars. NASA has described the need for advancements in air revitalization technology to promote long-term, deep space travel. It is desired to diminish the current space and power requirement of the current system used by the International Space Station (ISS). A fundamental part of the system is the zeolite adsorbent material, which is hindered by its greater affinity for water over CO_2. Identifying a novel adsorbent material would provide a means of meeting the objective set forth by NASA. One class of materials of interest are metal-organic frameworks (MOFs). They are versatile materials that are applicable in many chemical processes and have shown promise in CO_2 removal from air. However, these materials are relatively new and research into the field of MOFs is limited. The use of MOFs in air revitalization is less explored, and most of available data is for pure components. MOFs are complex materials and measurements of behavior for binary adsorption behavior is largely under researched. This is due to the complex nature of completing these measurements. This research will explore the non-ideal behavior of mixed gas streams on amine functionalized MOF UiO-66-NH_2 by measuring CO_2/H_2O binary adsorption isotherms. UiO-66-NH_2 is water-stable, readily synthesized, and provides a general representation of many MOFs researched for this application. Preliminary binary adsorption has been measured for UiO-66-NH_2 at a water loading of 1.8 mmol/g adsorbent. The water loading will be varied to see the effect it has on the binary adsorption of carbon dioxide. Binary isotherms will also be measured for amino-MIL- 53(Al) in future research.

PHY033

Low-Level Convergence and the Formation of Convection along Sea Breeze Fronts

Zackary A. Webster and Dr. Sytske Kimball

Department of Earth Sciences, University of South Alabama

Sea breezes are a frequent source of rain and thunderstorms across the Gulf Coast during the summer. Sea breezes form through differences in air pressure between the land and the sea, caused by the differential in the time it takes the sea to warm up compared to the land. Since the sea warms quicker than the land, lower pressure forms over land. As a result, air flows from the higher pressure over the sea to the lower pressure over the land. As these sea breezes move inland, low-level convergence generated at the front of the sea breeze can cause air to rise and condense, possibly forming a thunderstorm.

Using base velocity radar data, convergence can be calculated by using the inbound and outbound winds along the sea breeze front just before convection forms along the front. The inbound and outbound winds, as well as the distance between the two points on either side of the sea breeze front can be used to complete the convergence calculation.

Upper-air soundings can also be used to determine whether or not convection is favorable on any given day. Indices being studied for this project include Showalter Index, K Index, Lifted Index, Total Totals Index, and Convective Available Potential Energy (CAPE).

PHY034

Studies in the Crystallization Kinetics of Ultrathin Tungsten Oxide Layers

Chandler W. Cotton, Michael Martinez-Szewczyk, Sumner B. Harris, and Renato P. Camata

Department of Physics, University of Alabama at Birmingham

The growing interest in studying thin film materials comes from the fact that materials exhibit numerous physical properties at the nanoscale level that are not seen compared to their bulk counterparts. Tungsten oxides are a particularly interesting system to study at the nanoscale level because they exhibit several crystallization-dependent properties. Some of the properties of note are evidence of a superconducting phase when tungsten oxide is surface-doped with alkali metal ions and electrochromic behavior. Our group is interested in studying how these oxide films crystallize to optimize the growth of already observed phases and explore crystallization pathways that may allow for large-area crystal growth. The tungsten oxide films were created by oxidizing tungsten thin films of approximately 10 nm thickness, previously deposited on silicon wafers by atomic layer deposition. The tungsten films were oxidized in a tube furnace containing an oxidizing atmosphere at 400°C and 500°C. Platinum wires were connected to the films using a silver paste to pass a current through the tungsten oxide layer. Using electrochemical impedance spectroscopy (EIS), various electrical properties were tracked as the films were oxidizing. Time-dependent EIS data allows in-situ measurement of the progression of tungsten oxidation, the sharp transition to a continuous oxide thin film, and the capacitive characteristics of the fully crystallized (polycrystalline) ultrathin tungsten oxide layers.

PHY035

Characterizing Side- Channel Resilience of Logic Redundancy for Secure Hardware

Venkat Dileep Bandlamudi[1], *Dr. Waleed Al-Assadi*[1], *Dr. J. Todd McDonald*[2], *and Dr. Todd Andel*[2]

[1]Department of Electrical and Computer Engineering, University of South Alabama at Mobile
[2]Department of Computer Science, University of South Alabama at Mobile

The global proliferation of outsourcing IC foundries resulted in potential threat to tamper IC design and fabrication processes. The adversary may tamper the designs and/or may extract the important design functionality. The adversaries modify the functionality of the design by inserting unwanted circuits into the design and thereby making the designs less reliable and vulnerable to attacks. Thus, the security and reliability of ICs is of paramount interest. Many techniques have been proposed to improve the security and trustworthiness of circuits. Even though techniques to increase the reliability and security of circuits were proposed, many new attacks were being identified that exploits the design characteristics of the circuits. Side- channel attacks (SCA) have been demonstrated as powerful ways to recover functionality of a design and is one of many common ways an adversary can undermine and recover information from the IC. SCA exploits information by analyzing the running time, power consumption, faulty output, heat and electromagnetic emissions of the circuits. Among them running time, power consumption and faulty output are most exploited. The logic redundancy introduced into circuits, which does not alter its original functionality, has been used to achieve optimization (timing and/or area) in synchronous and asynchronous digital circuits. Even though, redundant circuits increase the circuit overhead, but by comparing the power and delay of the golden circuit with the tampered (redundant) circuit, one can identify whether the circuit is tampered or not. Our work focusses on the use of power-delay product (PDP), which is used to evaluate digital circuits, as a metric in identification and localizing the redundant circuit introduced into the circuit. This work also focused on developing an algorithm that helps in localizing the redundant circuit using the PDP metric.

PHY036

Interfacial properties of CNTs-added carbon fiber epoxy composites through Nanoindentation technique

Oluwaseyi Shofolawe-Bakare[1], *Alexander Anderson*[2], *Farooq Syed*[1], *and Shaik Zainuddin*[1]

[1]Department of Material Science and Engineering, Tuskegee University.
[2]Department of Mechanical Engineering, Tuskegee University.

Improving the interfacial properties between the fiber and matrix of a composite is an expedient step in attaining fiber reinforced composites with enhanced mechanical properties. However, the interaction between the fiber and matrix occurs at the micron-nanoscale and cannot be investigated using conventional macroscale mechanical testing. Therefore, in this work, the interfacial properties of these composites are investigated using a novel nanoindentation technique. In addition, the effect of carbon nanotubes reinforcement on the interfacial properties are also studied. The results showed that the interfacial properties are directly dependent on the bonding between fiber and matrix. It was also found that the interfacial properties enhanced significantly with the addition of CNTs reinforcement.

Funding Acknowledgement: NSF REU DMR-1659506, HBCU TIP HRD-1818696, MRI DMR-1725513, CREST- 1735971

PHY037

The Effect of Signal-to-Noise on Gamma-Ray Burst Prompt Emission Spectral Lag Measurements

Stephen Lesage[1,2] *and Jon Hakkila*[2]

[1]Department of Space Science, University of Alabama in Huntsville
[2]Department of Physics and Astronomy, College of Charleston

Pulses are the basic units of gamma-ray burst (GRB) emission. GRB pulses are structured rather than monotonic and spectrally-evolving rather than monochromatic. Spectral lags, as measured from the cross-correlation function, have been shown to provide valuable insights into GRB spectral characteristics. We demonstrate that the spectral lags of six bright GRB pulses observed by the Burst and Transient Source Experiment (BATSE) on NASA's Compton Gamma Ray Observatory (CGRO) are not systematically affected by signal-to-noise ratio reduction, supporting the efficacy of spectral lags as GRB data analysis tools.

PHY038

Imaging emission of a random lasing nanoscale media with sub-micron resolution

Bibek S. Dhami[1], Uddhab Tiwari[1], Karly Casey[2] and Kannatassen Appavoo[1]

[1]Department of Physics, University of Alabama at Birmingham, AL 35294
[2]School of Engineering, University of Alabama at Birmingham, AL 35294

Integrated photonic devices are a key part in the sensing, energy and medical technology sectors. For these technologies, solution-processed methods are desirable due to their simple, low-cost fabrication methods that can be readily scale. Here we build on our recent discovery that zinc oxide (ZnO) nanospheres with high crystal quality and when coupled together can create ultrathin film nanolasers to understand how the effects of near-field environment modifies the lasing performance. First, we conduct optical fluence-dependent measurements to find the lasing threshold of our samples and perform ultrafast transient absorption spectroscopy above and below the lasing threshold. Second, we scan our thin film samples using a high-resolution stage when excited by a 50 fs UV laser pulse to map their emission profile with high spatial and spectral accuracy. Our results highlight the importance of the near-field environment in modifying the requirements for efficient lasing at the nanoscale.

PHY039

Estimating Intracellular Signal Concentration Using 3-D Spectral Imaging

Taryn N. Dooms

University of South Alabama

Hyperspectral imaging is a useful technique highly applicable to live-cell and whole-tissue signaling. Cells respond to the rapid changes in their environment by receiving and processing intra and extra cellular signals. By measuring the concentration of second messenger proteins cAMP (cyclic adenosine monophosphate) in 3-Dimensions, one can accurately model intricate intra-cellular processes. Time as well as photosensitive limitations have restricted most imaging techniques[1]. In this work, a new technology is developed that incorporates high speed 3-D imaging to model the changes in concentration of multiple cAMP molecules within a cell. This is achieved by measuring and analyzing large portions of the excitation spectrum of the cAMP proteins. This method of excitation scanning has provided higher signal-to-noise characteristics, as well as shorter acquisition times (one tenth of the acquisition time reported with emission scanning)[1]. When applied to lung endothelial cells which express the Green Flourescent Protein, excitation scanning also provided higher delineation of nuclear and cell borders and increased identification of GFP regions in highly autofluorescent tissue[1]. Modeling the concentration gradients of these fluorescent proteins, contributes novel information about important interactions within cells and can ultimately lead to advancements in endoscopic medical techniques.

[1] Favreau, P. F., Hernandez, C., Heaster, T., Alvarez, D. F., Rich, T. C., Prabhat, P., & Leavesley, S. J. (2014). Excitation-scanning hyperspectral imaging microscope. *Journal of Biomedical Optics*, *19*(4), 046010. doi:10.1117/1.jbo.19.4.046010

PHY040

Analysis of Castor Oil Based Polyurethanes

Simone Brookes

Tuskegee University

The intent of this research is the synthesis of a novel, self-healing polymer from a plant oil. Polyurethanes were synthesized from castor oil, a diisocyanate, and an agent intended to incorporate reversible covalent bonds in the polyurethane structure. The three polyurethanes synthesized were 1) a control from essentially equimolar amounts of castor oil (35.4 mmoles) and hexamethylene diisocyanate (35.7 mmoles); 2) a modification using a slight excess of sulfur (41.7 mmoles) relative to 37.5 mmoles castor oil and 39.3 mmoles diisocyanate; and 3) a modification using 33.8 mmoles dimethyl polysiloxane, 36.4 mmoles castor oil, and 35.7 mmoles diisocyanate. All three reactions were for 1 hour under nitrogen; the reaction temperatures were 180 ℃, 145 ℃, and 150 ℃, respectively. Polymer 1) was colorless, transparent, and inelastic; polymer 2) was rubbery and amber brown; polymer 3) was yellowish, translucent, and the most elastic of the three polymers. The three polymers were characterized by Fourier transform infrared (FTIR) spectroscopy and nano-indentation measurements. The modulus and hardness of the polymers was obtained by nano-indentation testing using a Hysitron TI 980 TriboIndenter. Reversible covalent bonding can effectively bestow thermoplastic properties on crosslinked polymers, so that they exhibit the benefits of toughness and elasticity, while being repairable and reprocessable. Ultimately, the findings of this research may help to reduce the very serious impact of commercial plastic production and waste on the environment, particularly within the oceans.

PHY041

Engineering Design of an open-link locomotion module and a development of a Virtual Vehicle Demonstrator

Huashuai Fan, Siyuan (Hunter) Zhang, Dawei Liu, Vladimir Vantsevich

Mechanical Engineering Department, University of Alabama at Birmingham

This study presents a detailed engineering design of an open-architecture-based open-link locomotion module (OLLM). All subsystems of the OLLM, including an independent suspension sub-system, a steering sus-system, a propulsion and a wheel-tire sub-system, are designed and drawn using the engineering Software SolidWorks. This drawing allows for visualizing the actual layouts of each single part of the systems and for being imported to the software ADAMS to conduct an animation of the module.

Based on the complete design of the OLLM, a virtual four-wheel-drive fully electric vehicle was developed by assembling four OLLMs into a vehicle chassis. The assembly of the four modules is considered as a virtual driveline system as analogy of a conventional mechanical positively locked driveline system. This virtual fully electric vehicle is further imported into ADMAS and used to develop a Virtual Vehicle Demonstrator. This virtual demonstrator allows for animating a fully electric vehicle with a virtual driveline system moving stochastic terrain condition. This animation is conducted based on computing and analyzing the mathematical models of the virtual driveline system. This virtual vehicle demonstrator provides the benefit of visualizing the dynamics and operational properties (such as mobility, ride, stability, etc.) of a fully electric vehicle.

Funding Acknowledge: The researchers gratefully acknowledge the financial support provided by the Southern Company.

PHY042

Fluorescent Nanodiamond infused in Molecularly Imprinted Polyacrylamide for Creatinine sensing application

Reim A. Almotiri, *Shane A. Catledge*

Center for Nanoscale Materials and Biointegration, Department of Physics, University of Alabama at Birmingham

The measurement of the amount of creatinine (Cr) in urine is an important diagnostic test for assessing kidney health. In this study, nanodiamond (ND) fluorescence is measured before and after the addition of Cr, used as the template inside a Molecularly Imprinted Polymer (MIP) based on polyacrylamide (PAAm) hydrogel. Fluorescence quenching allowed determination of imprinting ratio associated with Cr detection in aqueous media. Fourier Transform Infra-Red (FTIR) spectroscopy and microscopic imaging was used to investigate the nature of chemical bonding on and distribution of NDs inside the PAAm network. We find that NDs bind strongly to the hydrogel network and aggregate to form clusters of varying diameters. The ND fluorescence intensity increases with the size of the ND cluster. We utilize the fluorescence from nitrogen-vacancy color centers (NV- and NV0) to determine the specificity and selectivity of the MIP hydrogel for Cr detection and to evaluate the nature of binding sites within the MIP-ND system. A Stern–Volmer analysis based on the fluorescence of the MIP-ND system is used to obtain the Cr concentration calibration curve. To the author's knowledge, this study represents the first investigation of the use of NDs fluorescence in MIPs for the detection of small molecules such as Cr.

PHY043

Synthesis, characterization and applications of highly modular polyphosphonates

*Totsch, T. R., Stanford, V.[1], Popov, I.[2], Klep, O.[3], Burdette, M. K.[2], Gray, G. M.[1]**

[1]Chemistry Department, University of Alabama at Birmingham (UAB)
[2]Oak Ridge National Lab (ORNL)
[3]Department of Materials Science and Engineering and Center for Optical Materials Science and Engineering Technologies, Clemson University

Phosphorus-based polymers have exhibited a widespread use in multiple applications such as drug design and delivery, biomedical infrastructure for implants, and as additives in flame-retardants. To further this, our group has expanded this widespread use to the areas of ionic conduction and radioluminescence. Work in this area has led to the successful synthesis of high molecular weight polyphosphonates through a 1:1 molar ratio polycondensation reaction of bis(diethylamino)phenylphosphine ($PhP(NEt_2)_2$) or its anthracenylphosphine derivative ($(C_{14}H_9)P(NEt_2)_2$) with dodecanediol, 1,4-benzenedimethanol and tetraethylene glycol.

Our objective is to exploit the modularity of this unique synthesis of polyphosphonates to apply them as materials in the previously mentioned research areas. The ionic conduction portion of this research was aimed at designing a polyethylene oxide (PEO) backbone to mimic conducting polymers that utilize the ionic interactions with Li^+ to transfer and/or store charge. Materials such as these are desirable for Li^+ ion battery systems but require stability in order to address safety concerns. Phosphorus polymers are widely used for their thermal stability or flame retardant properties and this could make for conducting materials that are much safer than many current available options. In the direction of biocompatible radioluminescent materials, polyphosphonates can be designed with a naphthalene backbone structure or an anthracene functional group, both of which exhibit X-ray fluorescent properties. Additionally, the similarity of these polymers to bioanalgous structures such as DNA/RNA make them excellent candidates for biocompatible materials. Thus, these materials possess potential for chemically activating Channelrhodopsin-2 (ChR2; a light-gated ion channel) *in vivo*.

PHY044

Preparation and Characterization of Bionanocellulose- Polyvinyl Alcohol Films for Potential Use in Biosensors Applications

Christina Young, Mohamed A. Abdalla, Adriane Ludwick, Heshmat Aglan

Department of Materials Science and Engineering, Tuskegee University.

Nanostructured biocomposites have attracted great interest due to their biodegradability, excellent mechanical properties, and high specific surface area. Bionanocellulose (BNC) can be challenging to dissolve successfully with other polymeric systems. In interest of minimizing organic solvents, polyvinyl alcohol (PVA) was used as a matrix for the preparation of BNC-PVA films. From tensile measurements it was found the addition of BNC fibers at 4, 12, and 37% reduced tensile strength; however, increased ductility was observed. The tensile strength and elastic modulus of the 25%BNC-75%PVA films are 48 MPa and 0.1 GPa, respectively.

PHY045

Performance Analysis of a Hybrid Ground Source Heat Pump System Integrated with Liquid Dry Cooler

Gaoyang Hou, *Hessam Taherian*

Department of Mechanical Engineering, University of Alabama at Birmingham, Birmingham, USA

Because of locating in different longitudes and latitudes, most of locations suffers from hot summer to freezing winter. Nevertheless, comparing to earth's surface, temperatures of several meters underneath our feet ranging from 7℃ to 21℃ keep relative stable. In order to take advantage of relatively steady thermal energy underground to be utilized in heating ventilation and air-conditioning (HVAC) system, a hybrid ground source heat pump (HGSHP) system is designed and assembled in Transient System Simulation (TRNSYS). Ground source heat pump (GSHP) system provides building with more efficient heating and cooling comfort at a high coefficient of performance (COP) comparing to conventional HVAC units such as furnace, electrical resistance or air source heat pump. For the sake of improving overall performance, various assisted components can be coupled to assemble a hybrid system. In this design, the system is presented as horizontal ground loop paralleled with alternative assisted components liquid dry cooler. Both heating and cooling features have been studied for a case study house located in Birmingham, Alabama. The simulations run for a full calendar year (simulation time) to generate important analytical data such annual energy consumption and thermal flow rate. The results are used to optimize this system from the perspectives of energy performance analysis.

PHY046

Porous magnetic Fe_3O_4/NiLa-LDH for advanced wastewater treatment: phosphate removal and antibacterial activity

Chi Thanh Vu, *Tingting Wu**

Civil and Environmental Engineering Department, the University of Alabama in Huntsville, Huntsville, AL 35899, USA

Though being treated, secondary effluent from conventional wastewater treatment plant may still contain nutrients (e.g. phosphate) and pathogens (e.g. *E. coli*), which need to be further treated before discharge. Layer double hydroxide (LDH) is a promising material for the adsorption of contaminants from water/wastewater. In this study, magnetic Fe_3O_4/NiLa-LDH was synthesized using co-precipitation method. The magnetic property helped the material to be easily separated from the treated water. Egg white, for the first time, was used as template in the synthesis to enhance the porosity of the magnetic Fe_3O_4/NiLa-LDH. The porous magnetic Fe_3O_4/NiLa-LDH was employed for the removal of phosphate from secondary effluent and showed high adsorption capacity (~ 180 mg/g). Further, the porous magnetic Fe_3O_4-NiLa LDH was tested for the antibacterial activity toward *E. coli* and 7-log reduction was achieved ffter 30 hour contact. The results obtained from this study indicate that porous magnetic Fe_3O_4/NiLa-LDH can be a promising multifunctional material used for advanced wastewater treatment.

Funding Acknowledgement: This research was supported in part by the Alabama State funded Graduate Research Scholars Program (GRSP).

PHY047

Tensor Completion via the CP Decomposition

Fatoumata Sanogo, *Carmeliza Navasca*

Department of Mathematics, University of Alabama at Birmingham

We propose a new algorithm for tensor completion. The tensor completion problem is about finding the unknown tensor from a given tensor with partially observed data. While most tensor completion methods use the Tucker model, our new approach uses the canonical polyadic decomposition model to reconstruct the unknown tensor. The unknown tensor is reconstructed by finding the optimal factors through linear least squares and the singular vectors through a proximal algorithm of soft thresholding.

PHY048

The Effect of Polymer Coating on Adsorption Capability of 13X-Zeolite

Carson Graves[1], *Dr. T. Grant Glover*[1], *Dr. Mohammad I Hossain*[1]

[1]Department of Chemical and Biomolecular Engineering, The University of South Alabama

One necessity for space travel is the ability to sustain a suitable environment to support human life via the removal of metabolic CO_2 and water from the cabin air. The current system on the International Space Station (ISS) that completes this work is the Carbon Dioxide Removal Assembly (CDRA). The CDRA is a 4-Bed molecular sieve system that operates using physical sorbents to adsorb CO_2 and water from the cabin air. The current 13X zeolite adsorbent produces dust that can interfere with normal continual operation of the CDRA, and modification of the adsorbent pellet to reduce dust is one approach to solving this problem. It has been shown that adsorbents coated with polymer membranes, like Matrimid, can increase the mechanical stability of the adsorbent pellet while maintaining comparable CO_2 loading. For this study, 13X zeolites will be coated with similar polymers, polysulfone and polyethersulfone, and the coated zeolites will be characterized by measuring CO_2 isotherms, surface area, and completing mechanical integrity tests.

PHY049

Accelerated Property Mapping and EDS Analysis of Zinc Titanate Reinforced Polyetherimide Nanocomposites

Isaiah Wilson[1], Farooq Syed[2], S. Zainuddin[2], Jamyla Burkes[3], Shaik Jeelani[2]

[1]Department of Materials Science and Engineering, Tuskegee University, Tuskegee, AL 36088
[2]Department of Mechanical Engineering, Tuskegee University, Tuskegee, AL 36088
[3]Department of Chemical Engineering, Tuskegee University, Tuskegee, AL 36088

In this study, we have used a novel high-resolution property mapping (HRPM) technique through nanoindentation test mechanism to investigate the effect of Zinc Titanate ($ZnTiO_3$) nanoparticles on the hardness and elastic modulus properties of Polyetherimide (PEI) composites. Samples were prepared by adding 5-15 wt. % of $ZnTiO_3$ in PEI using ultrasound dispersion and solvent casting methods. Results showed significant enhancement in 15 wt. % composites (20.83% in hardness and 15.96% in modulus) in comparison to control (without nanoparticles) counterpart. The properties obtained through this HRPM technique were comparable to the results obtained from conventional nanoindenation test, but at much faster rate (6 indents per second) with greater accuracy. Also, The EDS spectrum of PEI- ZnTiO3 nanocomposites showed the presence of ZnTiO3 nanoparticles in the PEI polymer.

PHY050

3D Printed MXene Micro-Supercapacitor with Ultra-High Energy Density

Jafar Orangi[1], *Fatima Hamadi*[2], *Virginia A. Davis*[2], *and Majid Beidagh*[1]

[1]Department of Materials Science and Engineering, Auburn University
[2] Department of Chemical Engineering, Auburn University

Energy storage devices will play a significant role in the future advances of portable electronics, wireless sensors, and multifunctional micro/nanosystems due to their high power density, long cycle life, and fast charge-discharge. The first requirement for the fabrication of energy storage devices with high energy and power densities is using electrode materials and electrolyte with superior electrochemical properties. In order to promote high electrical and ionic conductivities of electrode materials and electrolytes, develop manufacturing methods that optimize the assembly of this device component is crucial. Discovering new class of materials including MXenes with favorable intrinsic properties, high electronic conductivity, and hydrophilicity, gain much interest as high-performance electrode materials for electrochemical capacitors (high volumetric capacitance of ~1500 Fcm^{-3}). We will present our recent research on using 2D MXenes as building blocks for the fabrication of three-dimensional (3D) supercapacitors in combination with extrusion-based 3D printing. In this method, a water-based MXene ink with favorable viscoelastic properties was developed and directly used for extrusion-based 3D printing of microsupercapacitors. A programmable printing machine was used for the fabrication process follows a layer-by-layer deposition of the MXene ink. This development facilitates rapid fabrication of supercapacitors on a variety of substrates, while the electrodes thickness can be controlled by the number of deposited layers. The printed devices electrochemical performance showed their excellent electrochemical properties even under bending condition. Our study suggests that due to its high electrical conductivity and electrochemical properties, MXene is an excellent choice as the building block for the fabrication of 3D energy storage devices.

PHY051

Separating single wall carbon nanotubes：length separation and single chirality isolation

Chunxu Chen, *Daneesh Simien*

University of Alabama at Birmingham, Department of Materials Science and Engineering, Birmingham, AL, 35205

Separation of single wall carbon nanotubes (SWNTs) are required by assorted applications because of the various length and chirality of pristine material. We used two techniques to separate the single wall carbon nanotubes by length and chirality. The density gradient ultracentrifugation (DGU) was applied for length separation. With an optimized processing procedure, the length distribution was observed from ~600nm to ~60nm by layers, and the yield can be expected up to 1.2ml for each length in one day. A new approach, aqueous two-phase separation (ATPS), was used for isolating the single chirality of SWNTs. We studied the surfactants' influence in a two- phase system, polyethylene glycol (PEG) – dextran solution, for isolating single chirality. We found the concentration of surfactant could control the separation behavior, as the concentration of sodium dodecyl sulfate (SDS) increasing smaller diameter of SWNTs will be partition into PEG phase. The effective SDS concentration was ~0.9wt% to ~ 1.6wt% while kept the DOC concentration under 0.04wt%. The sodium cholate (SC) was added to further separate the metallic- semiconducting SWNTs from the diameter groups of SWNTs.

PHY052

Prediction of the Best Injection Location for Catheter-Based Drug Delivery to Treat Brain Tumors

Lisa H. Antoine[1]

[1]School of Engineering, University of Alabama at Birmingham

In 2019, the National Brain Tumor Society reported that physicians would diagnose approximately 86,000 new cases of brain tumors. These cases will add to the almost 700,000 individuals in the United States living with brain and central nervous system tumors. Almost 17,000 of these cases will prove fatal [1].

The blood-brain barrier, which consists primarily of brain cells, hinders the effective treatment of brain tumors. The task of this barrier is to protect the brain from composition instabilities in blood plasma. It also shields the brain from agents that may adversely affect brain functionality. However, by performing its tasks the barrier prevents potential effective drugs from penetrating the brain. Yet, carbohydrates and amino acids via glucose transporters can cross these barriers.

To deliver these permissible drugs, clinicians currently use mechanisms such as convection-enhanced delivery (CED) and Ommaya devices [2]. Both of these mechanisms use catheters to inject the drugs that cross the barriers to treat the tumors. However, the injections appear to deliver insufficient amounts of the drug, thereby failing to destroy the tumors.

This failure to destroy the tumors may result from an inadequate selection of the injection location. The injection location influences the travel path of the drug. Drug travel throughout the gray matter and especially the white matter of the brain is directionally dependent because of its anisotropic characteristics. This dependency make the travel path challenging to predict. Currently, researchers use diffusion-weighted imaging (DWI) to determine the travel path in the brain by measuring the motion of water molecules [3].

The proposed study is the development of a computational methodology to predict the best injection location for catheter-based drug delivery into the brain for maximum coverage of the tumor surface area. This study uses T1-weighted brain imaging (T1) to derive surface models for the white matter, gray matter, and tumor. It also uses DWI to derive diffusion tensors for the white matter and gray matter. Diffusion tensors quantitatively describe the likely drug travel direction at a given location. The surface models and the tensors will enable the simulation of the anisotropy in the brain. From a selection of injection locations, this study will support the prediction of the best injection location based on the maximum coverage of the tumor surface area.

[1] "Quick Brain Tumor Facts." National Brain Tumor Society, National Brain Tumor Society, 2018, braintumor.org/brain-tumor-information/brain-tumor-facts/.
[2] Frosina, G., "Advances in drug delivery to high grade gliomas", Brain Pathology, 2016. doi: 10.1111/bpa.12423.
[3] Kang, N., Zhang, J., Carlson, E., et al., "White matter fiber tractography via anisotropic diffusion simulation in the human brain", IEEE transactions on medical imaging 24.9 (2005): 1127-1137.

PHY053

Sequences Modulo Primes and Finite State Automata

Joel A. Henningsen and Dr. Armin Straub

Department of Mathematics and Statistics, University of South Alabama

A sequence is k-automatic if its values $a(n)$ are determined by a finite-memory function of the base-k digits of n. Rowland and Zeilberger describe two algorithms to obtain, given a sequence as a constant term of powers of Laurent polynomials, the finite state automaton describing its values modulo a power of p. We discuss and analyze these algorithms, and consider examples that include the Catalan numbers, the Motzkin numbers and other famous combinatorial sequences. In particular, we make a conjecture on the number of states of some of the resulting recurrence schemes. Furthermore, we provide a characterization for the sequence of Catalan numbers modulo p and the sequence of Motzkin numbers modulo p.

PHY054

Mining Targeted Rare Association Rules Efficiently

Blake Johns and Ryan Benton

[1]Department of Computer Science, School of Computing, University of South Alabama

Association mining is the detection of correlations, given a sample data set, between two subsets, in which each subset contains one or more items. Rare associations are those correlations (called itemsets) that occur infrequently. For example, suppose item X is purchased 2/10,000 transactions, this would be considered to have a low frequency (occurrences). However, if every time item X occurs then item Y also occurs, this relationship, which can be represented as X → Y, has a high confidence (certainty). These rare rules are often useful in domains such as medical diagnosis; knowing some symptoms, although rare, may be highly indicative of a deadly condition would be beneficial. One challenge is that there are different takes on what is considered a "rare" itemset. To our knowledge, there is no efficient method to generate all possible rare itemsets and rules. Additionally, two other challenges exist.
As a database grows larger, the number of transaction traversals grows along with it. Exhaustive searching and ensuring that we account for all rare item sets in a large database gets expensive quickly (e.g. the "needle in the haystack" saying).
Moreover, in many cases, the user isn't interested in all the rare itemsets and rules; just a subset containing items of interest.
In order to generate only rare itemsets and rare rules of interest, we are proposing to use a targeted association mining method called Itemset Tree. This data structure, which can be kept in main memory, is used to quickly find only itemsets that are of potential interest. Coupled with the FP-Growth algorithm (an efficient frequent itemset generation method), it is possible to quickly create frequent itemsets and rules containing those which are of interest to the user.
We propose two key modifications to the current Itemset Tree method. First, we propose implementing a modification of the "FP-Growth", named "RP-Growth", which mines a vast amount of rare itemsets efficiently. Second, we need to modify FP-Growth to generate the one class of rare rules that RP-Growth cannot. Once done, the Itemset Tree method will allow for efficient generation of all frequent and rare rules of interest to the use.
At present, we have implemented the RP-Growth method and have incorporated it into an open source package known as SPMF; to our knowledge, it is the only public version of the algorithm. We are in the process of modifying FP-Growth and updating the Itemset Tree algorithm.

PHY055

Supercritical Fluid Enhanced Ionic Liquid Extraction

Kelsey Tootle, *Dr. Christy W. West, Dr. Kevin West*

University of South Alabama

Supercritical fluids (SCFs) are substances in a state above their critical temperature and pressure ranges where they exhibit some properties of both liquids and gases. This peculiar state generally heightens a fluid's diffusivity and lowers its viscosity, aspects that become especially advantageous as they generate high transport rates when applied in various chemical processes, in particular, extraction processes. The main limiting factor in using SCFs for extraction is the fact that their moderate solubility leaves room for improvement as most extraction processes are heavily based on relative solubility.

The SCF's performance can be enhanced by employing ionic liquids (ILs) – non-volatile liquids composed almost entirely of cations and anions – allowing for the solubility limitation to be circumvented. Key features of ILs include low melting points, good solvating ability, high thermal stability, low viscosity, virtually no vapor pressure, and the ability to be modified to display certain selective properties based on the designer's desires. Considering separation systems are based on relative affinity for non-volatile substances, ILs can act as a sink for the SCF to deposit its continuously accumulating extract. A solid phase substance containing a component that needs to be extracted is placed in a SCF-filled environment that also contains a reservoir or multiple reservoirs of IL(s). The desired component will quickly diffuse into the SCF-rich environment where it will come into contact with the IL. Since the component will share an affinity for the IL, it will then transfer into the IL. While the component takes to the IL, it's concentration in the SCF will lower, in turn, driving the equilibrium of the component between the SCF and the solid to favor the SCF. This method utilizes the zeroth law of thermodynamics: if substance A (in this case the desired component) is in equilibrium with substance B (the SCF) while substance B is in equilibrium with substance C (the IL), then substance A is in equilibrium with substance C.

By taking advantage of SCFs' high transport rate along with ILs' stability, extraction processes will become more efficient and precise. This will lead to developments wherever extraction precision is in demand such as pharmaceutical applications, flavor and fragrance manipulation, or analytical methods. This work explores some of the modelling of solute solubility in the supercritical fluid and in the ionic liquids. Future work will include application of this method to the extraction of caffeine and theobromine for use in analytic chemistry.

PHY056

Influence of Nano Fillers On the Flexural Strength, Flexural Fatigue, Thermal & Moisture Absorption of Carbon/Glass Hybrid Reinforced Sc-15 Epoxy

Onyekachi Ekwuazi, Alfred Tcherbi, Delroy Watson

Physical Science Department, Materials Science and Engineering, Tuskegee University

The aim of the study is to investigate the effects of Nano fillers reinforced polymer composites (FRPC) exposed to seawater, and adverse impact on the mechanical and thermal properties. There has been growing interest in the study of barrier properties of polymer composite materials, due to increasing exposure to different environments. Moisture absorption and solvent attacks have been regarded as unintentionally destructive factors that weaken the structure of polymer materials under prolong exposure. Hence, in this study, Hexagonal boron nitride (HBN) and Graphene Nano platelets (GNP) were used as reinforcement in diglycidyl ether bis-phenol A (DGEBA) epoxy SC-15 to fabricate carbon and carbon/glass hybrid fiber composites. Fabricated samples were characterized using DMA, flexural and moisture absorption analysis. The preliminary results in comparison with unmodified laminate, shows that samples fabricated with 4.5wt% HBN shows an increase in the specific flexural strength and modulus by 10.23 and 19.67% respectively of reinforced carbon fiber laminate. Also, samples fabricated with 0.1wt% graphene shows an increase in the specific modulus by 13.23% and there was no statically difference for the specific strength. Furthermore, samples fabricated with 4.5wt% HBN + 0.1wt% GNP shows an increase in the specific flexural strength and modulus by 12.29 and 43.38% respectively. On moisture absorption characteristics of carbon and carbon/glass hybrid fiber composites, after 5weeks of sea water exposure at room temperature, samples fabricated with HBN and GNP showed relatively lower rate of absorption compared to unmodified laminates.

Funding Acknowledgement: Graduate Research Scholars Program (GRSP) & ARO

PHY057

Social Stress as an Indicator of Crime: Correlating a Spatial Distribution of Crime Using Proximate Locations and Social Stress at the Census Block Level

Jessica T. Ross Romine[1], *Abigail Jacobs*[2], *Holly Pak*[3], *Larry J. Morgan*[4],

[1]Department of Geology and Geography, Auburn University
[2]Department of Physical and Earth Sciences, Jacksonville State University
[3]Department of Geology and Geography, Auburn University
[4]Department of Physical and Earth Sciences, Jacksonville State University

It is hypothesized that areas of higher crime are directly related to the spatial arrangement of socially stressed neighborhoods at the micro or block level of aggregation. Of particular concern is that crime and stress, though mildly correlated when considering crime and stress within the same localized spatial area, indicate stronger relationships at varying distances from the associated block. It is also suggested that higher stress levels using the Localized Index of Social Stress (LISS) will manifest in stronger correlations with crime at greater distances and that these correlations will peak and then dissipate with the effect of distance decay. Five characteristics of stress have been identified as areas of lower income, non-white populations, higher numbers of children per household, and female heads of households with no husband present (Bronnimann 2008). Using the data that was collected at the individual household level, we were able to find that these five variables are directly associated with stress and levels of stress making up part of the social hierarchy.

PHY058

Thermo-Mechanical and Mechanical Characterization of Carbon- E-glass Composites Exposed to Marine Conditioning

Delroy Watson, Ryan Green, Jalon Levett, Malysha Willies, Alfred Tcherbi-Narteh

Department of Materials Science and Engineering, Tuskegee University

Recent advancements in modern engineering have given rise to increasing demand for high performance materials with enhanced durability and load bearing capabilities. In recent years, fiber reinforced polymer composites (FRPC) are been widely as replacements for metals due to promising properties. Applications of these materials have gained traction in aerospace, naval, civil, automobile and other industrial applications with one major drawback. They are susceptible to thermal aging and in marine conditions due to viscoelastic nature, increasingly affecting their performance during service. In this study, the primary objective is to fabricate hybrid FRPC using carbon and E-glass and compare the specific strength and modulus to that of FRPC from individual carbon and E-glass fibers conditioned to seawater. Durability and property retention of hybrid FRPC was compared to that of carbon and E-glass FRPC respectively and presented as function of exposure time. Fabrication of hybrid fiber reinforced composites was done using layers of carbon(C)/E-glass(G)/carbon (C) fibers in 4C-2G-4C configuration. E-glass and carbon FRPC were fabricated using 8 and 10 layers respectively. Fabricated composites were conditioned by submerging in seawater at room temperature for 3 and 6 months respectively. Absorption characteristics were monitored using plots of weight gained curves, while mechanical and viscoelastic properties were characterized using three-point bending flexure tests and dynamic mechanical analysis respectively.

Funding Acknowledgement: Alabama NSF EPSCoR

PHY059

Understanding the Dissolution Properties of Amorphous Cellulose and its Application to Sustainable Chemistry

B. Justin Harvell, *Brooks D. Rabideau*

Department of Chemical and Biomolecular Engineering, University of South Alabama

Sustainable chemistry has and will continue to be a rising topic in today's world. The need for greener resources is driven by the desire to create safer and cleaner products and reduce the production of toxic and pollutant wastes. Energy production uses unsustainable resources and a need for cleaner resources exists. Cleaner sources of energy production use biomasses such as cellulose, which can be broken down to produce cleaner chemicals that can replace the current resources used to produce energy. Cellulose is a polysaccharide polymer chain that is intertwined and stacked together to create bundles. Its stable, water-insoluble structure can be broken down to create other chemicals, however, current methods are costly and produce harmful byproducts. Other methods are being explored to break down cellulose. Ionic liquids (IL), salts that have a melting point below 100ºC, break down cellulose by peeling back the chains within the bundles. Many IL's exist and each anion and cation affect the solubility of cellulose. IL's are being explored through the use of molecular dynamics (MD). MD are computer simulations of atoms and MD allows cellulose to be seen on a molecular level. This enables a better understanding of how cellulose dissolves and interacts with different cations and anions. Cellulose creates a crystalline structure with smooth structured chains but has amorphous periodic, well-defined regions distributed throughout. Amorphous cellulose is unstructured and bulky compared to crystalline cellulose. In this work, amorphous cellulose will be studied in MD to understand how and if it dissolves in mediums such as IL's. To see how amorphous cellulose is formed, crystalline cellulose will be heated to high temperatures and cooled quickly such that amorphous regions will be created. The kinetics of dissolution of amorphous cellulose will be determined; if cellulose prefers to be dissolved in amorphous regions or crystalline regions will also be determined. Different methods will be explored to induce amorphicity and a degree of amorphicity will be quantified. Overall, this poster will present preliminary research on amorphous cellulose and how it will be studied. The application of this study will be directed toward creating sustainable chemistry.

PHY060

Design and Analysis of a High Altitude Multistage Launch Vehicle

Jane E. Gillette[1], Liam M. Nester[2], Sean T. Tibbetts[1], Savannah C. Olmstead[1], Jacob P. Montgomery[1], Gregory J. Liesen[1], Hailey B. McMillan[1], Julie M. Warchol[1], and Dr. Marcus D. Ashford[2]

[1]Department of Aerospace Engineering and Mechanics, University of Alabama
[2]Department of Mechanical Engineering, University of Alabama

In high altitude missions, from Low-Earth Orbit to deep space, the inclusion of stage separation has become paramount. Multistage launch vehicles most effectively reduce cost and usage of propellant as well as structural materials while achieving intended altitude with a payload. Using multiple stages, the same change in velocity can be attained while using less propellant, optimizing its allocation between the stages, and increasing the amount of payload the rocket may carry.

At the University of Alabama, The Alabama Rocket Engineering Systems (ARES) Initiative design team is currently pursuing its first successful implementation of stage separation. The dual-stage launch vehicle will use Student Researched and Developed (SRAD) solid fuel motors, contained in carbon overwrapped pressure vessel motor casings in order to minimize mass and reach an apogee of 100,000 feet. The focus of this year's project is the successful implementation of stage separation mechanisms and Composite Overwrapped Pressure Vessel (COPV) motor casings for further development in future iterations of the program. Over the previous semester, the ARES Team completed the design of the launch vehicle and testing plan. The multistage vehicle will have aluminum motor case liners in each stage, designed to seal the SRAD motors and allow the chamber pressure to maximize thrust values. However, the main structural integrity and strength properties of these motor cases will come from the carbon fiber overwrap, wrapped on an industry-level filament winder.

To promote system-level integrity and cohesion, the ARES Initiative applies testing and validation for all components, subsystems, and system integration. In the next six months, the ARES team will conduct in-depth developmental testing of the launch vehicle system, beginning with a hydrostatic pressure test of the COPV motor cases. Simultaneously, developmental testing of individual systems will take place confirming abilities of recovery ejection and stage separation mechanisms. Following confirmation of the success of these tests, system testing will take place with a full-scale static fire test and a boosted dart test launch. Additionally, redundancy for all systems, particularly those related to stage separation and recovery, will be tested extensively to ensure proper recovery of the system. The launch vehicle will implement dual-deployment in recovery systems on each stage, using a drogue parachute deployed at apogee and a main parachute deployed at 1,500 meters.

PHY061

Subsequence Clustering with Local Gaussian Process Parameter Features

CScott Brown, *Ryan Benton*

Department of Computer Science, University of South Alabama

We present a general means for extracting features from datasets using localized Gaussian Process Regression, by a mapping from the original space to parameter space using the parameters of the locally trained models.

The resulting features can then be used for subsequent machine learning applications. Specifically, we demonstrate that these features can be used for subsequence clustering and change-point detection in time series applications, on contrived and real-world datasets.

PHY062

A Dynamic Programming based Outlier Rejection Algorithm for Image Mosaicing Problem

Christopher S. Smith[1] *and Semih Dinc*[2]

[1]Math and Computer Science Department, Auburn University at Montgomery, csmit134@aum.edu
[2]Math and Computer Science Department, Auburn University at Montgomery, sdinc@aum.edu

Image mosaicing is a challenging problem when there is one (or more) corrupted image in the input sequence. Since the transformation of later images relies upon previous transformation calculations, one miscalculation error caused by the corrupted image propagates to other image transformations, which fails the process.

It is not a trivial task to detect and remove these corrupted images (outliers). We propose an outlier rejection algorithm based on dynamic programming which can identify and remove the corrupted image(s) from the sequence and generate a correct mosaic image. Inspired by the dynamic programming approach, our algorithm stores previously calculated transformations in a 2D array and selects the values of composite transformations by applying our decision criteria. These criteria identify the transformations derived from corrupted images by comparing the values of a new composite transformation with an equivalent transformation calculated by matrix multiplication of pre-existing transformations from the 2D array.

Our experiments on both synthetic and real datasets show that the proposed algorithm is an efficient tool for the mosaicing problem. Our algorithm successfully rejects solitary corrupted images in a set, multiple corrupted images (either adjacent or non-adjacent), and alternating corrupted (corrupted, non-corrupted, corrupted) images. The output mosaic image of our algorithm on synthetic dataset is compared with the ground truth image. Visually satisfactory results are achieved with a high PSNR (Peak Signal-to-Noise Ratio).

PHY063

Incorporation of Traditional and Ionic-Based Plasticizers using Stereolithgraphy for Flame Retardants

Bryant M. Baldwin, *Gregory M. Poole*

Department of Mechanical Engineering, University of South Alabama, Mobile, Alabama, USA

While significant advancements have been made into ensuring high shape fidelity and increasing print resolution, materials scientists have turned their attention towards manipulating the properties of additively manufactured components to tailor them to specific applications. Although the incorporation of additives to make polymers flame retardant is not a new concept, literature detailing their incorporation into components produced by additive manufacturing (AM) is sparse. Stereolithography (SLA) printing holds a particular advantage in the incorporation of additives due to its liquid precursor resin. We will discuss our work on incorporating phosphate-based flame retardants into SLA resins. Functional group effects on the mechanical, flame mitigation, and leaching properties will be discussed, where tests were performed in accordance with ASTM standards for elastic modulus and leaching behavior, and UL94HB standard for burn behavior. It was found that all specimens tested were flame resistant above 20 percent concentration flame retardant by weight, and that leaching was inversely proportional to side functional group size. This data suggests that it is possible to create AM resin blends whereby the thermal properties, in this case, can be tailored to yield printed components possessing resistance to flame exposure.