

Oral Presentations

Michigan Space Grant Consortium 2026 Fall Conference
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Biomedical Science Research Building (BSRB)
University of Michigan 109 Zina Pitcher PL. | Ann Arbor, MI 48109

Keynote Talk: Built, Not Born: From Community College to Space, and the Making of Tomorrow's Innovators

Aisha Bowe, *Former NASA Aerospace Engineer, Blue Origin Astronaut, Entrepreneur*

Aisha Bowe wasn't born an aerospace engineer. She became one.

Her journey began at community college in Michigan and led to degrees in aerospace engineering from the University of Michigan, a career at NASA, the founding of two technology companies, and ultimately, a journey to space.

But that path was anything but inevitable.

In this keynote, Bowe explores the experiences, mentors, opportunities, and defining decisions that transformed an unlikely beginning into a career spanning engineering, entrepreneurship, and space exploration. Drawing on her work at NASA, her experience building STEMBoard and LINGO, and her journey aboard Blue Origin's New Shepard, she examines how technical talent is developed through curiosity, hands-on learning, experimentation, failure, and persistence.

At a time when the future of space exploration depends on new ideas, emerging technologies, and an increasingly capable workforce, Bowe makes the case that the next generation of innovators will not emerge by accident. They will be developed through meaningful research opportunities, mentorship, technical education, and the freedom to build, test, question, and discover.

Her message challenges students to recognize their own potential and invites educators, researchers, and industry leaders to consider their role in developing it.

Because the future of space exploration won't just be shaped by the technology we build. It will be shaped by the people empowered to build it.

Session 1

1. Adaptive and Efficient Intrusion Detection Framework for Cyber-Resilient Edge AI Systems

Linxi Zhang, *Ph.D., Assistant Professor, Department of Computer Science, Central Michigan University*

Embedded communication networks in vehicles and autonomous systems are vulnerable to spoofing, replay, and flooding attacks, while intrusion detection must meet strict latency and power constraints. Building on a lightweight, multi-scale intrusion detection system for Controller Area Network (CAN) traffic, this project investigates adaptive feature reweighting to address changing traffic patterns, cross-domain alignment to improve transfer across platforms, and latency-aware optimization for edge deployment. We discuss the framework and ongoing evaluation of detection robustness across CAN datasets, along with plans to assess accuracy, inference latency, and power use on Raspberry Pi and NVIDIA Jetson devices. The work aims to inform the design of cyber-resilient autonomous and robotic systems relevant to NASA missions and to support education in embedded AI security.

2. Assembly and Characterization of a Modular Liver-on-a-Chip System using small-diameter and hepatocyte-laden electrosprayed microcapsules

Rafael Ramos, MS; MD-PhD Candidate in Biomedical Engineering, Wayne State University; ***Howard W.T Matthew****, PhD; Professor Chemical Engineering & Materials Science Wayne State University*

The engineering physiologically relevant, vascularized liver constructs for long-term culture remains challenging due to high metabolic demand, mass transport limitations as construct size is increase, hepatocyte dedifferentiation in vitro, and the difficulty of recreating the three-dimensional architecture of native hepatic tissue. To address these limitations, we have developed a modular, perfusable liver-on-chip platform that integrates microscale cell encapsulation, tunable extracellular matrix environments, vascular components, and a controlled flow system. Using a ring-electrode electrospray system, primary rat hepatocytes were encapsulated within glycosaminoglycan (GAG)-stabilized chitosan membranes to batch-generate uniform capsules below 400 μm. These modules provide small-diameter, matrix-supplemented, high-density cellular microenvironments designed to minimize diffusion limitations while supporting hepatic self-assembly. The capsule exterior additionally provides a surface for liver sinusoidal endothelial cell attachment, creating an approach for establishing extracapsular vascular networks following module assembly. To translate these modules into larger constructs, we designed and constructed an additively manufactured millifluidic bioreactor capable of maintaining >10^7 encapsulated cells under controlled perfusion. The platform enables direct visualization, longitudinal metabolite sampling, and characterization of intracapsular hepatic organization and extracapsular vascular remodeling. Ongoing studies are evaluating combinations of intracapsular matrix and cellular components with extracapsular endothelialization to allow long-term tissue organization and function for a minimum of 4 weeks. By integrating scalable capsule fabrication, tunable microenvironments, vascularization, and perfusion, this platform provides a versatile liver-on-chip system for disease modeling, drug toxicity testing, and bioartificial liver development, with future applications for investigating hepatic

responses to microgravity and supporting NASA-directed in-space tissue engineering and biomanufacturing.

3. Chemically Generated Liquid Sulfur for High-Performance Li-S Batteries

Ankun Yang, Associate Professor, Mechanical Engineering, Oakland University

The liquid phase of sulfur has been observed at room temperature, resulting from the electrochemical oxidation of polysulfides, a process that occurs at the electrodes and is influenced by the electrode materials. However, such electrode-dependent behavior of liquid sulfur has constrained its use in battery applications, driving research for alternative processes. This presentation introduces an approach to generating liquid sulfur at both room and subzero temperatures through chemical reactions independent of the substrate material. We show that, with a redox mediator, polysulfides can be chemically oxidized into liquid sulfur droplets in the electrolyte near but away from the electrode. This pathway can generate liquid sulfur at room and subzero temperatures, down to −15 °C, 130 °C below sulfur's melting temperature (115 °C). Our preliminary battery tests show that chemically generated liquid sulfur can significantly boost the Li-S cell capacities. Chemically generated liquid sulfur further enriches lithium–sulfur electrolyte systems, potentially creating opportunities for high-energy lithium–sulfur and other metal-sulfur batteries.

4. Exploring Stability of Expressed Personalities in LLMs using Personality Trait-Specific Prompt Nudging

***Wyatt Snyder**, Undergraduate Computer Science and Mathematics student, Hope College; **Dr. Omofolakunmi Olagbemi,** Assistant Professor of Computer Science, Hope College*

The expressed personality profile of a Large Language Model (LLM) plays an integral role in determining model behavior. Thus, understanding personality stability is relevant to grasping LLM behavioral consistency and reliability. In order to examine this stability, models were prompted to role-play several character personas, then prompted to change their expressed personalities in specific ways, and finally to respond to a series of task-oriented questions. Between each prompt, the LLM instances filled out a survey measuring their expressed personality trait changes over time. A variety of differential system models were then fit to the survey responses, revealing patterns in personality shift for various personas. These results quantify the stability and susceptibility to perturbation of various personas and personality traits, providing a mathematical framework for analyzing the dynamics of personality expression in LLMs.

5. Radiation-Tolerant Halide Perovskite Nanocrystals for Space Photonic Applications

***Caroline Valdes,** Undergraduate Student, Chemistry, Hope College; **Zachary VanOrman,** PhD, Professor, Chemistry, Hope College*

Unlike the commonplace silicon-based semiconductors, lead halide perovskite semiconductors are resistant to radiation present in space due to self-healing properties and can be adhered to flexible surfaces. Bulk halide perovskite semiconductors are well researched, but halide perovskite nanocrystals and their radiation tolerance is largely unexplored. Research would

consist of synthesizing cesium lead bromide nanocrystals of varying sizes. The optoelectrical properties of the crystals will be evaluated through spectroscopy and irradiated with either UV light or the in-house particle accelerator to mimic space-like radiation conditions. The optoelectrical properties will be reevaluated to see how they withstand radiation. This research serves the students goal of attending graduate school for materials science and a career in development of materials for space exploration.

6. **Demystifying AI for High School Girls: Lessons from the Terabytes AI Pilot**
   Krish Narayanan, *Professor of Computer Science, Eastern Michigan University*

   Building on Eastern Michigan University's MSGC-funded summer computing initiatives, Terabytes AI was introduced as a new 3-day pilot bootcamp for high school girls. Modeled after EMU's long-standing Bits & Bytes and Gigabytes camps, the program emphasizes collaborative learning, career exploration, and near-peer mentorship. Developed and delivered by EMU faculty with support from the Women in Computer Science (WiCS) student organization, the curriculum provides hands-on experience in machine learning, data science, Python coding, embedded AI, and generative AI. It also engages participants in critical discussions on the ethical and responsible use of AI. In this talk, we will present the curriculum and share feedback from participants and staff.

Session 2

1. **Investigation of Transported Boreal Wildfire Smoke during a NASA Airborne Campaign**

   Theo Severud, *B.S., Ph.D. Candidate, Department of Chemistry, University of Michigan;* ***Vanessa Selimovic,*** *Ph.D., Senior Research Lab Specialist, Department of Chemistry, University of Michigan;* ***Andrew L. Holen,*** *Ph.D., Department of Chemistry, University of Michigan, now an Application Scientist and Instrumentation Advisor at AMPTIUS | AMP Tech Instruments;* ***Logan Forshee,*** *Ph.D., Department of Chemistry, University of Michigan, now a Postdoctoral Researcher in the Department of Chemistry at the University of Montana;* ***Kerri A. Pratt,*** *Ph.D., Professor, Department of Chemistry, University of Michigan*

   Wildfires are increasing in intensity and frequency globally. Canadian boreal wildfires generate smoke that transports far from its origin, impacting the Arctic and mid-latitudes. As smoke transports, it undergoes atmospheric chemical reactions, altering the chemical and physical properties of gases and aerosols. Despite the prevalence of aged biomass burning aerosol globally, they remain understudied which causes atmospheric models to produce values with large ranges and uncertainty. To investigate chemical processing and evolution of biomass burning aerosols, we deployed the aircraft aerosol time-of-flight mass spectrometer aboard the NASA P-3 aircraft during the Summer 2024 NASA Arctic Radiation-Cloud-Surface Interaction Experiment (ARCSIX) to analyze the chemical composition and size of individual aerosol particles in real-time. Here, we focus on smoke intercepted during almost the entirety of a transit flight from Pituffik, Greenland to Wallops Island, Virginia, USA. This work aims to improve understanding of aged smoke chemical composition and properties.

2. **Modeling the Transport of Primary Oceanic Plankton Species in Polar Regions**

Lee Rosenberg, PhD Candidate, Department of Mechanical Engineering, Oakland University

A pressing threat to human survival is climate change. While weather shifts and sea level rise remain at the forefront of headlines, lesser-known but equally important threats exist, such as the collapse of polar ecosystems. Phytoplankton, microscopic marine algae, is foundational for critical global carbon recycling processes, producing ~50% of Earth's oxygen and oxygenating the oceans. Notably, large-scale impacts of climate change (e.g. glacial melting) have recently been observed to cause a localized shift in plankton speciation places. This disrupts the marine food chain and puts the carbon recycling processes at risk. While models exist to track surface-level population shifts, they cannot predict depth-wise transport of plankton. In this work, we propose to leverage high fidelity computational fluid dynamics and satellite-based data to develop a model for depth-wise transport of key phytoplankton species and promote a better understand the impact of speciation shifts on a global scale.

3. **Using Sedimentary Archives to Elucidate Land-lake Connectivity in the Lake Michigan Basin**

***Melinda C. Higley**, PhD, Assistant Professor of Geology, Geology, Geography and Environment, Calvin University*

Sedimentary archives provide an opportunity to extend observations of hydrologic variability beyond the instrumental record and examine how inland water systems responded to changing climate conditions over centuries to millennia. This is especially important in Michigan, where climate change is affecting water resources. Flat Iron Lake (Kent County, MI) is a kettle lake in the upper Grand River watershed with a postglacial sedimentary record that provides an archive of environmental change. Sediment cores were collected and analyzed using loss-on-ignition, mineralogy, charcoal, pollen, thin sections, and X-ray fluorescence (XRF). Radiocarbon ages indicate deposition beginning approximately 14,500 years ago, and sediment stratigraphy documents changes in lake and watershed conditions through 6,000 years before present. Thin sections reveal seasonal variability, while XRF data show centennial- to millennial-scale paleohydrological variability, including episodic sustained drought conditions, revealing substantial hydrologic variability extending beyond the modern instrumental record. XRF scanning has been completed on recently collected core material, and additional radiocarbon dating is underway to refine the age-depth model and extend the record to the present.

4. **Exploring water isotopes as a predictive lens for drought**

***Adriana Bailey,** Assistant Professor, Climate and Space Sciences and Engineering, University of Michigan; **Daniel He,** Undergraduate Student, Climate and Space Sciences and Engineering, University of Michigan; **Kyle Heyblom**, Schmidt AI Fellow, Michigan Institute for Data & AI in Society, University of Michigan*

Precipitation minus evapotranspiration (ET) defines regional water balance and influences drought risk. Yet ET remains frustratingly difficult to measure. Here, we test whether atmospheric isotopic "fingerprints" can detect water-balance shifts and predict impending dry spells at

subseasonal lead times. Using NASA Atmospheric Infrared Sounder observations and drought indicators from 2003–2019, we analyze water vapor δD (the heavy-to-light hydrogen isotope ratio) and water vapor concentration over the southeastern and southwestern US. We find that wetter years in the Southeast correlate with higher δD but that there is no subseasonal relationship between δD and conventional drought indices in either region. Instead, we find that the covariance between δD and water vapor strongly distinguishes regional hydroclimate behavior. Thermodynamic controls dominate in the Southeast, whereas moisture-source shifts dominate in the Southwest. These findings suggest that isotopic measurements may improve subseasonal detection of drought-related water-balance shifts in ways that conventional indices cannot.

5. Plaster Creek Watershed: Storytelling to Promote Public Engagement with Ecological Restoration

Andrew Slagter, *Undergraduate Student, Biology, Calvin University*

Contaminated urban waterways carry consequences that extend beyond aquatic habitats in stream channels, directly affecting the health and quality of surrounding communities and ecosystems. While ecological research and remediation remain crucial, science communication is essential for equipping residents with the knowledge and resources to support and become involved in the restoration efforts. Using Plaster Creek Stewards as a case study, this presentation offers a framework for how restoration groups can use narrative-driven video storytelling to expand outreach in the urban communities most impacted by degraded water quality. With a focus on Plaster Creek, the most contaminated waterway in West Michigan, I will detail the steps involved in developing a creative story, collaborating on best practices, capturing footage in the field, and filming interviews in communities, as well as the planning needed for eventual distribution.

6. Pairing Schmidt Hammer and 10Be Data: Validating a Terrestrial Analog for Inferring Geomorphology Processes on Mars

McKenzie Hatfield, *Undergraduate Student, Environmental Science & Society, Interdisciplinary Program, Eastern Michigan University;* ***Eric Portenga,*** *PhD, Associate Professor, Department of Geosciences, Eastern Michigan University*
Joel Harris, *BS, Environmental Geoscience 2021, Environmental Science & Society Program, Eastern Michigan University*

Glacial rocks (erratics) left behind following retreat of the Laurentide Ice Sheet are often moved by modern land use. This research explores a new approach of combining Schmidt hammer (SH) rock hardness measurements with measurements of the cosmogenic isotope, beryllium-10 (10Be), with the aim of identifying erratics' pre-displacement orientations. Distributions of SH rebound values (R-values) on two moved erratics in Michigan, on the Ft. Wayne and Sturgis Moraines, reveal distinct weathering hemispheres on each erratic. 10Be concentrations of rock collected from the center of each weathering hemisphere help us evaluate the validity of interpretations of rock exposure history based on R-values alone. The results from this study can be used to better understand movement histories of rocks on Earth and potentially other celestial bodies, especially in the absence of direct knowledge of rock movement.

Session 3

1. Exploring the Potential to use Bio-Mining to Sustainably Extract Metals from Martian Regolith

Charley Russell, *Department of Earth and Environmental Sciences, Michigan State University;* ***Sarah Gonzalez Henao,*** *PhD Candidate, Department of Earth and Environmental Sciences and Department of Microbiology, Genetics, and Immunology, Michigan State University;* ***Jack Marean****, Department of Microbiology, Genetics, and Immunology, Michigan State University, Matthew O. Schrenk, PhD, Department of Earth and Environmental Sciences and Department of Microbiology, Genetics, and Immunology, Michigan State University.*

Over the past few decades, humankind has carried out exploration of our solar system like never before. Critical metals are needed for technology and potential catalytic processes. When exposed to water, iron-rich ultramafic rocks undergo serpentinization, a hydrating and low-grade metamorphic process. This reaction creates minerals with high concentrations of Ni, Cr, and Co and holds potential for supporting microbial communities. Mars has evidence of serpentinization-associated minerals found in regions such as the Nili Fossae. The goal of the project is to understand microbe-metal interactions in serpentinites and the extraction of metals from serpentinites and Mars regolith simulant to examine the potential for in-situ resourcing. To address this goal, high throughput culturing and biochemical assays and Inductively Coupled Plasma Mass Spectrometry (ICP-MS) are being used to understand the mechanisms used by microbes to metabolize metals necessary for future space exploration.

2. SatNOGs and the Calvin CubeSat Project

Neal Jacobsen, *Undergraduate Student, Engineering, Calvin University*
Ryan Deaton; Juan Moon; Isaiah VanHorn

Calvin University is currently developing an imaging mission CubeSat to be deployed into Low Earth Orbit. The team decided to use the SatNOGS network, a free, open-source, worldwide volunteer, ground station network for the telemetry side of the project. To facilitate this, they have developed a portable antenna to integrate into the SatNOGs network to be distributed among Calvin, alumni, and other interested parties. The presentation will focus on the project telemetry and antenna development and the benefits of the SatNOGS deployment strategy for Calvin and other interested parties.

3. Modelling Multi-messenger White Dwarf Binaries Within The Milky Way

Ryan Beam *- Grand Valley State University - Undergraduate;* ***William Adkins*** *- Grand Valley State University - Undergraduate;* ***Dr. Brett Bolen*** *- Grand Valley State University - Associate Professor of Physics;* ***Dr. Shane Larson*** *- Clarkson University - Professor of Physics*

Multi-messenger astronomy is a new and promising area in astrophysics where the same phenomenon is seen using multiple methods. In this project, we examine binary systems of dense stellar core remnants known as white dwarfs, which may be seen both in the

electromagnetic spectrum as light and in gravitation as gravitational waves. Laser Interferometer Space Antenna (LISA) is a future gravitational wave detector set to launch in 2034 that will use laser interferometry to measure low frequency gravitational waves. In preparation for LISA observation, one can simulate these binary systems numerically to accurately predict observational expectations. This project will use a software suite known as COSMIC to generate initial white dwarf populations, which will then be reduced down to populations of only observable multi-messengers using custom-made Python scripts. Once properly reduced, the populations will be analyzed using plots, graphs, and statistical analysis techniques to inform on important and unforeseen characteristics.

4. Deep Groundwater Microbiology in Michigan as an Analog to Understand Extraterrestrial Environments

***Mio Hogan**, Master's Degree in Microbiology, Michigan State University*

The known physical-chemical limits to life have expanded over the past few decades through the study of extreme environments on Earth and improvements in detection methodology. One such environment is in the deep subsurface of Earth, where nutrients and energy sources are limited for microbial life. Michigan Basin provides a tremendous opportunity to study subsurface life, as numerous wells and boreholes exist throughout the state. This study examined microbial communities and their associated environment within the Saginaw Aquifer. Wells with recharge ages of up to 48,060 years were sampled and characterized using DNA sequence-based and geochemical approaches. Ecological modeling approaches showed environmental filtering, likely driven by sulfate and EC, played a greater role in differentiating microbial communities between sites as compared to dispersal limitation. These data provide important perspectives on how subterranean microbial communities survive and thrive in extreme subsurface environments that could guide the exploration of Mars.

5. AJAX (Additive Jet-printed Antenna eXperiment)

William Bowen (Electrical Engineer at Michigan State University); Kerian Russel (Mechanical Engineer at Michigan State University); Nirei Sundaramsomu (Electrical Engineer at Michigan State University); Ioannis Papapolymerou (Dean of Engineering at Michigan State University)

Developed with the Dean of Engineering at Michigan State University, KRONOS is a high-speed wireless transmission device operating at 15 GHz. Its core innovation is a flexible, band-aid-style conformal antenna that wraps seamlessly around curved surfaces without compromising signal integrity. By overcoming rigid hardware limits, KRONOS delivers high throughput across complex geometries while mitigating high-frequency attenuation and phase noise. This session covers the RF substrate design, mechanical flexibility, and practical deployment of next-generation microwave hardware.

6. The Impacts and Subsequent Debris that Dominate the Early Instability Scenario

***Emily Elizondo,** PhD Candidate, Department of Physics and Astronomy, Michigan State University; **Seth Jacobson,** PhD, Assistant Professor, Department of Earth and Environmental Sciences, Michigan State University*

The number of giant impacts occurring during terrestrial planet formation is unknown. A prerequisite for all formation scenarios is the Moon-forming impact, which likely resulted in the ejection of mass as impact debris. The amount of debris produced is dependent on the frequency and strength of the impacts, making it a potential tracer for these events. However, debris production is typically neglected in formation models. This work couples the N-body integrator, SyMBA, with a collisional algorithm to quantify collision occurrences and trace debris. Within the simulations, generating tens of impacts over 200 Myr, the most common debris-producing impact accounts for ~30% of collisions, primarily occurring within 100 Myr. In ~61% of 160 simulations, debris resides in the asteroid belt, often implanting an excess amount of mass, with the remaining simulations implanting no debris in the belt. These discrepancies may reflect insufficient particle resolution or unmodeled mass loss through debris vaporization.