

Poster Abstracts

Michigan Space Grant Consortium 2026 Fall Conference
Saturday, October 31, 2026
Biomedical Science Research Building (BSRB)
University of Michigan 109 Zina Pitcher Pl. | Ann Arbor, MI 48109

Session A

1. Module-Centric Design and Modeling of an Omnidirectional Blimp

Zaid Ababneh, *Undergraduate Degree, Electrical and Computer Engineering Department, Oakland University;* ***Dr. Diego D'Antonio,*** *PhD, Electrical and Computer Engineering Department, Oakland University*

This poster presents a module-centric formulation for a modular omnidirectional blimp (OmniBlimp). Each propulsion module is modeled independently by its mounting position, fixed thrust direction, and scalar thrust command. The force and moment generated by one module are then stacked to obtain the control-allocation matrix of an arbitrary multi-module vehicle. This common formulation is applied to two platforms: a four-module vehicle used to expose the limitations of an underactuated arrangement, and a symmetric eight-module vehicle that is the primary focus of this work. For the eight-module cube configuration, the allocation matrix has rank six and two redundant inputs, enabling independent body-wrench commands when actuator-direction and saturation constraints are satisfied. A consistent rigid-body model and allocation strategy are developed as a foundation for parameter identification, motion control, and future cooperative net-based experiments for space-debris capture emulation.

3. Evaluating the Multi-Year Impact of the EMU High School Summer Science Program on Student Skill Development and STEM Readiness

Brittany Albaugh, *Associate Professor, Chemistry, Eastern Michigan University*

The Eastern Michigan University High School Summer Science Program enhances STEM engagement and workforce readiness aligned with NASA strategic goals and Michigan Science standards. Over three weeks, local Southeastern Michigan high school students complete authentic research mentored by faculty and undergraduates—learning experimental design, laboratory techniques, and ethical conduct, culminating in a poster session. Program impact was evaluated using quantitative and qualitative SURE survey instruments. Multi-year datasets demonstrate significant student gains across key competencies including understanding the research process, data analysis and interpretation, integrating theory with

practice, tolerance for scientific obstacles, and self-confidence in discussing science. Participants reported increased readiness for demanding research, feeling part of the scientific community, and confidence in contributing to scientific progress. These findings show early research immersion significantly enhances skill development and STEM career readiness.

5. Space and Time: The 2026 "Roger That!" Symposium

Bradley Ambrose, *GVSU Professor of Physics;* ***Amy Coon****, GRPM Public Programs Coordinator;* ***Jack Daleske,*** *GRPM Planetarium Manager;* ***Karen Gipson,*** *GVSU Professor of Physics;* ***Samhita Rhodes,*** *GVSU Professor of Engineering;* ***Rob Schuitema,*** *GRPM Director of Public Programs;* ***Glen Swanson,*** *Chaffee Scholarship Fund;* ***Deana Weibel,*** *GVSU Professor of Anthropology*

"Roger That!" is a two-day celebration of space exploration honoring Roger B. Chaffee. This annual collaboration with GVSU and Grand Rapids Public Museum (GRPM) features both in-person, family-friendly activities and online expert presentations, enhancing accessibility for participants and speakers alike. GRPM provides planetarium talks and field trips for local schoolchildren. GVSU hosts hands-on workshops that support community-building as well as the associated Design That! challenge for 4th – 6th graders. Our theme for 2026 was "Space and Time," and special guest former astronaut Dr. Jeanette Epps delivered inspiring talks to public audiences at both GVSU and GRPM. Our 2026 MSGC grant will support the 2027 "Roger That!" symposium—marking our ten-year anniversary—on Feb. 12 – 13, 2027, and former astronaut Dr. Linda Godwin will serve as keynote speaker.

7. Wooded Dunes as Tick Habitats

Syann Benckhuysen*,* ***Benjamin Cooper, Jared Genther, Levi King, Cole Schmidt, Polly Zenk*** *- Undergraduate Students, Department of Geology, Geography, and Environment, Calvin University*

Recent research shows large tick populations in wooded dune slip faces on the coast of Lake Michigan, but there are questions about why some dune sites that are very close to each other have very different tick densities. This study investigates wooded dunes as tick habitats by collecting data on various dune characteristics at locations with known tick populations. Sampling points were selected behind the dune slip face in 3 coastal parks, two with high tick densities and one with a low tick density. At each site we examined leaf litter, vegetation type and density, soil texture, grain size, and temperature. Our results indicate that parks with denser tick populations generally also had high levels of leaf litter, mixed sandy soils, and oak forests. Our results could help increase awareness of what kinds of areas ticks are located in, and where tick populations might move with the changing climate.

9. Quantitative mapping of solid carbon formation under closed-loop life support and ISRU conditions

Aliah Wasti, *Undergraduate Researcher, Department of Mechanical Engineering, Oakland University;;* ***Izabella Roma,*** *Undergraduate Researcher, Department of Mechanical Engineering, Oakland University;;* ***Francisco Cepeda****, PhD, Assistant Professor, Department of Mechanical Engineering, Oakland University*

Methane pyrolysis enables hydrogen recovery in advanced life support systems; however, the solid carbon byproduct can foul reactors or become a functional material depending on its microstructure. We

systematically decomposed methane at 700–1100 °C under thermal and catalytic (Fe, Ni) conditions, then characterized the carbon products using Raman spectroscopy and scanning electron microscopy. Raman analysis shows that carbon ordering, indicated by the D-band and G-band intensity ratio, increases predictably with temperature and varies with catalyst selection. Morphology changes from amorphous powder at lower temperatures to filamentous or aggregated structures at higher temperatures, with implications for fouling risk and processability. This quantitative process–structure dataset addresses a critical gap: existing literature lacks systematic characterization across realistic closed-loop conditions. The resulting correlations provide NASA engineers with actionable design constraints for controlling carbon properties during methane recovery cycles and enable predictive modeling for future ECLSS and in-situ resource utilization systems.

11. Investigation of the Contribution of Sea Spray Aerosol to Arctic Cloud Formation during the NASA ARCSIX airborne mission

XingZhi Chen, Logan Forshee, Andrew L. Holen, Vanessa Selimovic, Kerri A. Pratt *- Department of Chemistry, University of Michigan*

The Arctic is warming at an accelerated rate compared to the global average, leading to the decline of sea and glacial ice and an increase in locally emitted aerosols from exposed marine and terrestrial sources. These aerosols can affect the climate by directly absorbing or scattering radiation, and indirectly by acting as cloud nuclei, leading to uncertainties in the Arctic radiative budget. To address these uncertainties, the NASA Arctic Radiation-Cloud-Aerosol-Surface Interaction Experiment (ARCSIX), based out of Pituffik, Greenland, was conducted from May-August 2024. An aircraft-aerosol time-of-flight mass spectrometer (A-ATOFMS) was deployed on the NASA Orion P-3 aircraft and measured the size and chemical composition of individual aerosol particles below, above, and within clouds in real-time. For a flight over open water and broken sea ice, results show high number fractions of locally emitted sea spray aerosols below and within clouds, supporting these particles as cloud droplet nuclei.

13. Autonomous Cable-Based Manipulation and Transportation for Space Debris Collection

Diego S. Dantonio, *Assistant Professor, Electrical and Computer Engineering, Oakland University*

This project investigates autonomous cable-based robotic systems for transportation and manipulation in space debris collection. The research focuses on developing modeling, planning, and control methods that enable multiple robots to coordinate flexible cables to capture, secure, and transport debris without relying on conventional rigid grippers. By exploiting cable tension, geometry, friction, and coordinated motion, these systems can adapt to debris with diverse shapes, sizes, and dynamic behaviors. The project will further extend cable-based transportation to multi-cable and net-based mechanisms, enabling the capture and collection of uncooperative objects and advancing lightweight, adaptable robotic technologies for future orbital debris collection and removal missions.

15. Out of Sync, Out of Orbit: Groundwork for Multi-System Female Physiology From Earth to Space

***Yosamin Esanullah**, Graduate Student, Mechanical and Aerospace Engineering, Michigan Technological University*

More women are becoming astronauts, with recent candidate classes approaching gender parity. Despite this social progress, technical research on female physiology lags due to persistent gaps in terrestrial women's health data, creating major blind spots and operational risk factors in extreme space environments. These blind spots persist because existing literature evaluates stress (HPA), reproductive (HPG), and metabolic (glucose) pathways in isolated silos, masking key cross-axis interactions like cortisol-driven insulin resistance and stress-induced GnRH suppression. By synthesizing these interconnected pathways, this review hypothesizes that the compound stressors of long-duration spaceflight, including chronic stress, circadian rhythm disruption, and metabolic shifts, can trigger PCOS-like symptoms in female crewmembers. To evaluate these dynamics, we propose a non-invasive monitoring framework to establish essential terrestrial baselines. Ultimately, this work serves as a call for integrated physiology research to safeguard female astronaut health, performance, and mission resilience.

17. Preliminary Evaluation of Non-Traditional Coal Ash in Cementitious Materials

***Ephraim Joy Garcia, Cayden Sudworth, Dr. Shinhyu Kang -** *Engineering, Hope College*

This study evaluated the effects of supplementary cementitious materials (SCM) on cement hydration and performance. Mixtures containing ordinary Portland cement or Type IL cement with a Class C fly ash or slag were tested at a water-to-binder ratio of 0.45. Isothermal calorimetry, setting-time measurements, and mortar compressive-strength tests were used to compare early hydration and strength development. Higher SCM replacement levels generally reduced early heat release, delayed setting, and lowered early-age strength, while strength continued to develop at later ages. In addition, selected high-SO_3 harvested fly ashes, DH ashes, were screened using isothermal calorimetry. The DH ashes showed different heat-evolution behaviors, indicating that variations in ash composition may influence early hydration. These preliminary results provide a basis for further investigation of the relationships among ash chemistry, hydration, and cement-based material performance.

19. Mapping Urban Heat Islands and Environmental Inequity in West Michigan

***Kamrul Hasan, Tommy Gill** - *Information Sciences and Technologies, Grand Valley State University*

Rapid urbanization has intensified the urban heat island (UHI) effect across West Michigan, particularly in Grand Rapids, Muskegon, and the Holland area. This pilot study will integrate NASA Earth Observation data, specifically Landsat 8–9 (Thermal Infrared Sensor), ECOSTRESS, and Sentinel-2, with socio-demographic datasets from the U.S. Census to map spatial inequities in heat exposure and vulnerability. The research will quantify surface temperature variability, examine relationships with vegetation cover and impervious surfaces, and identify climate-vulnerable neighborhoods. As the initial phase of a two-year research effort, the West Michigan pilot will serve as a testbed for developing a transferable framework that can be scaled to the broader North Central region and other areas. By combining thermal remote sensing, spatial and time-series data with deep learning and Bayesian network modeling, alongside demographic analysis, this project will produce actionable insights to inform equitable urban planning and

strengthen environmental resilience. The outcomes will support NASA's 2022 Strategic Plan Goal 1.1, which focuses on understanding and protecting our home planet through Earth system science, and will establish the foundation for future NASA-funded investigations.

21. OSMED and MSGC: Building a Midwest Community for Human Spaceflight

Antony Hsu, *MD, Climate and Space Sciences and Engineering, University of Michigan;* ***Taania Girgla,*** *MD, MPH, Clinical Assistant Professor of Anesthesiology, University of Michigan*

The Organization for Space Medicine, Engineering, and Design (OSMED) is a global, multidisciplinary 501(c)(3) nonprofit advancing safer, more productive, and inclusive human spaceflight through research, education, professional development, and public engagement.

As exploration expands beyond low Earth orbit, astronaut safety and mission success depend on integrating engineering, medicine, and design. OSMED connects experts across disciplines, sectors, career stages, and geographies to improve collaboration and establish new standards for human spaceflight. Organization members have authored five publications, including three identifying Moon-to-Mars capability gaps. We welcome contributions from interested members to NASA information requests, active research programs in spaceflight epidemiology and analogs, educational initiatives, mentorship, accessibility programs, and international collaborations.

These efforts align with MSGC's mission to strengthen space education, mentoring and research by connecting academia, industry, and communities. We believe OSMED could integrate into MSGC's existing strong space ecosystem to build a Midwest hub for interdisciplinary human spaceflight innovation.

23. SatNOGs and the Calvin CubeSat Project

Ryan Deaton, Neal Jacobsen, Juan Moon, Isaiah VanHorn *– Engineering, Calvin University*

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.

25. The impact of industry-engaged experiential learning on pre-college students' STEM interests

Sooin Kim; Mansoureh Sheikhi *– Engineering Technology, Wayne State University*

This study examines the impact of industry-engaged experiential learning on pre-college students' education and career interests in science, technology, engineering, and mathematics (STEM) through the STEM Pathways through Applied Research and Knowledge (SPARK) Summer Camp. The SPARK Summer Camp engaged high school students from Detroit in interdisciplinary engineering design activities, prototype development, collaborative problem-solving, and field-based learning experiences at

local engineering firms. A mixed-methods evaluation was used to examine the impact of the industry-engaged experiential learning during the SPARK Summer Camp on students' learning and STEM interests. The findings demonstrate that participation in the SPARK Summer Camp enhanced pre-college students' meaningful exposure to engineering and increased their interest in pursuing engineering education and career pathways. Findings from this study will contribute to understanding how short-term, industry-engaged experiential learning can strengthen STEM pathways for pre-college students and inform the continued refinement, replication, and scaling of the SPARK model.

27. Radioactive Molecules: A New Messenger of Stellar Nucleosynthesis

Conrad Lupa, Shane Wilkins *– Physics and Astronomy, Michigan State University*

Studies of radioactive isotopes produced by stars provide insights into the origin of chemical elements. Current methods for detecting radioactive isotopes produced in stellar events, which rely on detecting gamma rays emitted during their nuclear decay, are limited in resolution and sensitivity.

This poster highlights a potential alternative to gamma-ray detection, measuring rotational photons emitted by radioactive molecules. By using facilities such as the Atacama Large Millimeter/submillimeter Array (ALMA), this approach would provide significantly improved resolution and sensitivity compared to gamma-ray detection.

Observing radioactive molecules in space requires high-precision data that is now attainable for the first time at the Facility for Rare Isotope Beams at Michigan State University. With funding through an MSGC seed grant, this poster will present progress on a software tool that can accurately predict the structure of radioactive molecules to aid experimental campaigns aiming to measure them to enable future astronomical observations.

29. Effects of Proton Irradiation on the Properties of TBCCO Thin-film superconductors

Faith Mitchell, *Undergraduate Student at Hope college;* ***Lincoln Bosh****, Undergraduate Student at Hope College;* ***Jeonghyun Rhee****, Undergraduate Student at Hope College;* ***Kyuil Cho****, PhD, Assistant Professor at Hope College*

We studied the effect of 0.6 MeV and 1.7 MeV proton irradiation on two thin film TBCCO superconductors, A and B. Sample A (5.69E-7m thick) received a total fluence of 6.98E16 p/cm^2 while sample B(5.95E-7m) received a fluence of 3.17E17 p/cm^2. The critical temperature (Tc) was suppressed from 101.38 K(A) and 101.84 K(B) towards 0 Kelvin as normal state resistivity increased. The ratio between Tc suppression and resistivity increase will be used to get insight on the copper pairing mechanism in high-Tc superconductors.

31. Mapping U.S. Parking Lots at 10 m Resolution Using Geospatial Foundation Model Embeddings

Divya Nema, *Novi High School;* ***Tirthankar Chakraborty,*** *Research Scientist, Pacific Northwest National Laboratory;* ***Rohit Mukherjee,*** *Postdoctoral Researcher, Pacific Northwest National Laboratory*

Space allocated to parking is widespread across U.S. cities, exacerbating local heat and pollution while occupying valuable real estate that could support housing or green infrastructure. However, spatially explicit information on parking infrastructure remains lacking, hindering evidence-based urban zoning and

sustainable development. To address this gap, we leverage Google's AlphaEarth Foundations Embeddings, a geospatial foundation model, alongside satellite-derived features and auxiliary spatial data to develop a nationwide 10 m resolution parking lot map. We developed a Random Forest classifier using these input features and trained it on over 400,000 stratified samples sourced from open-source parking data, road networks, and building footprints to capture diverse urban morphologies. Our classification framework achieved an 85% accuracy and an F1 score of 84%. Our findings demonstrate that geospatial foundation model embeddings enable scalable, high-resolution mapping of urban land cover subclasses, providing a vital baseline to guide nationwide climate mitigation and zoning reform.

33. 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.

35. Engaging STEM Educators with Great Lakes Issues

Dr. Carrie Ann Sharitt, *Assistant Professor, Department of Biology at Grand Valley State University*

Preparing K-12 educators who are knowledgeable on scientific topics and prepared to share real-world science in their classrooms has been a priority across the country. Over the past two summers, STEM Teacher & Researcher fellows have participated in a summer program in my lab. The fellows have gained

knowledge about Great Lakes issues (i.e., parasites, climate change, nutrient cycling, etc.) along with technical field and lab skills. At the end of the summer, students develop lesson plans relevant to the Great Lakes along with research posters. This presentation will explore the impact of this experience on STEM educators through their reflections of successes and challenges.

37. Exploring Advanced Manufacturing: A Hands-On STEM Camp Experience for Middle School Students

Jess Sudy, *M.A.T. Secondary Education, CCEE K-12 STEM Program Manager, Regional Math and Science Center – GVSU;* ***Anna Stover,*** *M.A.Ed Curriculum Development, STEM Camps Co-Director, Regional Math and Science Center - GVSU*

Grand Valley State University's Advanced Manufacturing Camp provides middle school students with hands-on experiences exploring advanced manufacturing technologies and career pathways. With support from the Michigan Space Grant Consortium (MSGC), the 2026 camp engaged students in computer-aided design (CAD), 3D printing, coding, cybersecurity, automation, and lean manufacturing. Students applied the engineering design process to improve a product (fish tank), connecting technical concepts to real-world manufacturing applications. A field trip to Royal Technologies provided additional exposure to manufacturing technologies and workplace environments. Programming was facilitated through collaboration among GVSU faculty and staff, industry partners, and STEM professionals. Pre- and post-camp assessments measured changes in students' understanding of manufacturing concepts and practices, perceptions of manufacturing careers, and understanding of educational pathways. This presentation will highlight the camp's instructional approach, industry partnerships, student experiences, and program evaluation.

39. Integrating Active Perception, Pushing, and Grasping for Autonomous Object Retrieval in Clutter

Zhengqi Sun*, Industrial Engineering, Master's Student, Electrical and Computer Engineering, Oakland University;* ***Diego S. D'Antonio,*** *Ph.D on Computer Science, Assistant Professor, Electrical and Computer Engineering, Oakland University;* ***Jared Strader,*** *Ph.D on Aerospace Engineering , Assistant Professor, Electrical and Computer Engineering, Oakland University*

Retrieving an occluded object requires a robot to coordinate observation, obstacle interaction, and grasping under incomplete scene information. This project integrates established perception and manipulation techniques into a closed-loop system, coordinated by hand-crafted heuristic decision logic. A robotic arm equipped with a wrist-mounted RGB-D camera and a parallel-jaw gripper combines active viewpoint selection, occupancy mapping, targeted pushing, and grasp planning. These capabilities enable the robot to locate hidden targets, improve grasp access, and revise decisions after environmental changes while limiting unnecessary disturbance. The research emphasizes information sharing between components, transitions between observation and action, and recovery from unsuccessful attempts. Evaluation in MuJoCo examines task completion, execution time, and object displacement across different occlusion and placement conditions to assess the integrated system's capabilities and limitations.

41. Radiography as an In-Flight Medical Diagnostic Capability for Human Spaceflight

***Suhani Thakur**, Undergraduate Presenter, Department of Biomedical Engineering, University of Michigan, Ann Arbor, MI; **George Hitti,** School of Medicine, University of California Irvine, Irvine, CA; **Khushi Bhatt,** School of Medicine, University of California Irvine, Irvine, CA; **Albert Yeam,** School of Medicine, University of California Irvine, Irvine, CA; **Kimiya Ghassemzadeh,** School of Medicine, University of California Irvine, Irvine, CA; **Evan Lin,** School of Medicine, University of California Irvine, Irvine, CA; **Isabella DeLorenzo,** Vast Space, Long Beach, CA; **Isaiah Hernandez,** Department of Biomedical Engineering, California State University Northridge, Los Angeles, CA; **Corey Young,** MD, Department of Emergency Medicine, University of California Los Angeles, Los Angeles, CA; **Natalie Halpern,** Department of Neuroscience, University of California Riverside, Riverside, CA; **Allison Adamovic,** MS, LMFT, Private Practice Marriage and Family Therapy, Long Beach, CA; **Michael Boyle,** MD, Department of Emergency Medicine, University of California Los Angeles, Los Angeles, CA; **Ariana Nelson,** MD, Department of Anesthesiology and Pain Management, University of California Irvine, Orange, CA; **Jon Steller,** MD, Department of Obstetrics and Gynecology, University of California Irvine, Orange, CA; **Michael Pohlen,** MD, Department of Radiology, University of California San Diego, San Diego, CA.*

As human spaceflight moves toward longer-duration lunar and Mars missions, crews will require greater autonomy in managing medical conditions. A NASA review identified 63 of 119 prioritized conditions as potentially benefiting from X-ray imaging, while the Fram2 mission demonstrated successful radiograph acquisition in microgravity. This work synthesized findings from an interdisciplinary OSMED hackathon with peer-reviewed literature to identify gaps and potential solutions for in-flight radiography.

Key challenges involved equipment mass, volume and power constraints, microgravity positioning, crew training and skill decay, radiation safety, and delayed expert review. Proposed solutions include equipment stabilization, step-by-step image acquisition guidance, and AI-supported preliminary image assessment. Radiography may be particularly valuable in emergent cases where timely imaging can guide clinical management, while individual diagnostic radiographs contribute minimally to the overall mission radiation burden. Future work should address remaining equipment, training, radiation safety, and image interpretation gaps by developing and testing these solutions in spaceflight-relevant environments.

43. The Person Inside the Project: Who Owns the Next Question? Agency and Stewardship in Space-STEM Education in the Era of AI

***Lisa S. Tsay,** Mentor of Dow High Space Farmers (H. H. Dow High School); NASA Growing Beyond Earth, NASA HUNCH, Saginaw Valley State University; **Jasmine M. Allen,** Data and Operations Manager of Dow High Space Farmers (H. H. Dow High School); NASA Growing Beyond Earth, NASA HUNCH; **Katie Cai,** Space Engineering Mission Lead of Dow High Space Farmers (H. H. Dow High School); NASA Growing Beyond Earth, NASA HUNCH; **Eric Niu,** Outreach & ASAP Lead of Dow High Space Farmers (H. H. Dow High School); NASA Growing Beyond Earth, NASA HUNCH; **Sanvi Patel,** Executive Director of Dow High Space Farmers (H. H. Dow High School); NASA Growing Beyond Earth, NASA HUNCH; **Gabriel Nix,** Space Botany Mission Lead of Dow High Space Farmers (H. H. Dow High School); NASA Growing Beyond Earth, NASA HUNCH; **Viktor Pangburn,** Alumni Advisory Board Lead of Dow High Space Farmers (H. H. Dow High School); University of Toronto, Canada; **Margaret E. Hitt**, Founder of Dow High Space Farmers; Columbia Space Initiative Astrobiology Mission Lead, Columbia University*

Authentic space-STEM projects can give students something increasingly important in the era of AI: a sense that their judgment, choices, and contributions matter. Drawing on nearly nine years of Dow High Space Farmers' work in space botany with NASA Growing Beyond Earth (GBE), NASA HUNCH engineering, astronaut-health research, AI applications, and outreach, this presentation examines how students can move from participating in projects to exercising agency and stewardship within them. A peer-reviewed publication, a U.S. patent-pending engineering design, and the continued development of the Astrobiology STEM Activation Program (ASAP) illustrate different ways students move beyond project completion toward scientific contribution, engineering contribution, mentorship, and stewardship. These experiences point toward space-STEM environments where students examine prior work, decide what remains worth pursuing, and formulate the next meaningful question. In the era of AI, human judgment, agency, and stewardship become central educational outcomes—not simply the production of an end product.

45. Analysis of Contact Binary Stars in the ATLAS Catalog

Zach Van Wyngarden, *Undergraduate Student, Dept. of Physics and Astronomy, Calvin University;* ***Jonathan Barrantes Segovia,*** *Undergraduate Student, Dept. of Physics and Astronomy, Calvin University;* ***Dr. Larry Molnar,*** *PhD, Professor, Dept. of Physics and Astronomy, Calvin University;* ***Dr. Jess Vriesema,*** *PhD, Assistant Professor, Dept. of Physics and Astronomy, Calvin University*

Despite efforts by many researchers, the process of contact binary star formation and evolution has remained an open question for over 80 years. Over the past decade our group has used the MESA software package (Modules for Experiments in Stellar Astrophysics) to develop a self-consistent physical model. In order to test this model, we analyzed the ATLAS Catalog of variable stars, which contains 427,000 probable variable stars. We examined the properties of these stars as found in several different catalogs and identified a set of 176,000 that we believe are contact binary systems. We analyzed the statistical properties of this dataset to test ideas about the life cycle of contact binary stars and to search for any that are nearing the end of their lifetime.

47. Effects of Composition and Electronic Spin on Raman Spectroscopy of Bridgmanite

Lily Velez Lewis, *Undergraduate, Department of Environmental Earth and Sciences at Michigan State University,* ***Biao Wang,*** *PhD, Research Associate, Department of Environmental Earth and Sciences at Michigan State University,* ***Rong Huang****, PhD, Research Associate, Department of Environmental Earth and Sciences at University of Michigan,* ***Devika Padmakumar,*** *PhD Student, Department of Environmental Earth and Sciences at Michigan State University,* ***Jie Li****, PhD, Professor, Department of Environmental Earth and Sciences at University of Michigan,* ***Susannah Dorfman,*** *PhD, Associate Professor, Department of Environmental Earth and Sciences at Michigan State University*

$(Mg,Fe)(Fe,Al,Si)O_3$ bridgmanite is the most abundant mineral in the Earth's lower mantle, and its elastic behavior is essential for interpreting seismic wave speeds. At lower mantle conditions, iron in bridgmanite may undergo an electronic transition that affects physical properties. This study examines whether the spin transition in bridgmanite is observable via Raman spectroscopy. Bridgmanite crystals with different compositions were loaded into diamond anvil cells, and Raman spectra were collected to 85 GPa. Fe^{3+} rich, Al free bridgmanite shows lower wavenumber vibrational modes, with strong effects of iron on vibrations at 200–300 cm^{-1}. A slope change at 40–45 GPa in both Fe^{3+} compositions marks the spin

transition, strongest in the ~200–300 cm^{-1} and ~400–500 cm^{-1} modes. These results calibrate Raman detection of the spin transition and refine elastic properties relevant to global geophysics.

49. AERONAUT: Adaptive Expandable Robot Operations for Navigating Uncharted Terrains

Saima Jamal, Askari Husaini, Tao Sevigny – *College of Engineering, University of Michigan*

AERONAUT is an adaptive inflatable robotic platform for lunar and Martian exploration that overcomes a reliance on tethered air sources and slow actuation speeds common in soft robotic systems. The platform integrates high-pressure fabric links that function as both structural members and onboard pneumatic reservoirs, or pneumatic capacitors, enabling lightweight, untethered mobility. By coupling pneumatic storage and actuation, AERONAUT establishes an energy-on-demand framework delivering higher actuation bandwidth, 13 L/min at 45 psig versus 2.4 L/min from a pump alone, while maintaining autonomous operation. A deployable mobility platform is validated through three objectives: (1) refining modular fabrication of inflatable links and actuators, (2) characterizing gait performance in granular analog terrains, and (3) modeling thermal and pneumatic behavior under lunar and Martian conditions. Collectively, these efforts advance deployable pneumatic robotic systems for future NASA missions, establishing the foundation for closed-loop, fluid energy storage–based autonomous systems capable of long-duration planetary operation.

51. Advanced Modeling of X-Ray Spectroscpy for Massive Stars

Nolan Wurtsmith, *Undergraduate Student, Physics, Central Michigan University;* ***Alexandre David-Uraz****, PhD Astrophyics and Astronomy, Program administrator, Trottier Space Institute, McGill*

Stars that are several times more massive than our Sun possess strong winds driven by their radiation. These winds represent an important source of X-rays and have a great impact on the evolution of the stars. We can use X-ray spectroscopy to infer wind properties of massive stars. One useful diagnostic is Helium-like triplets associated with atoms that have lost all except two of their electrons. The ratio of the forbidden-to-intercombination (f/i) line strengths is useful to study how close to the star X-rays are produced. However, the ratio can be affected by the dielectronic recombination (DR) lines for atoms in different ionization stages. In this study I modeled He-like lines in the X-ray spectra of zeta Puppis and computed APEC models to determine positions of DR lines near He-like lines. I found that there is significant overlap, and therefore the f/i ratios need to be corrected.

53. How Small Environmental Differences Impact Tick Populations in 3 Michigan Dunes

Nick Zwiers, Peter W. H. Baima, Jacob Kissinger, Micah J. Mackenzie, Betsy M. Perez, Kaley Sheahan, Jonathan Solis *– Geology, Calvin University*

Tick population numbers along backdune ecosystems fluctuate in similar ecological settings, but why they prefer some locations over others is currently uncertain. This study investigates the environmental conditions and abiotic factors which influence tick populations on Lake Michigan dunes. We collected data along transects perpendicular to the shore on dune slipfaces in three parks with differing levels of tick populations but similar environmental contexts. Along the transects, we measured elevation, soil type, plant density, leaf litter depth, soil moisture, and grain size. The park with the least soil diversity,

consistent leaf litter, and steepest slope had the highest number of ticks. Moisture, plant density and grain size seemed to have little to no effect on population numbers. Our study informs park managers and the public how to reduce the number of tick-borne illnesses and further the understanding of tick populations as a whole.

Session B

2. A Neuro-Symbolic AI Framework for Trustworthy Vulnerability Detection in Autonomous Spacecraft Software

Mst Shapna Akter, *Ph.D., Assistant Professor, Department of Computer Science and Engineering, Oakland University;* ***Md. Fahim Sultan,*** *[B.Sc.], Graduate Research Assistant, Department of Computer Science and Engineering, Oakland University;* ***Tasmin Karim,*** *[B.Sc.], Graduate Research Assistant, Department of Computer Science and Engineering, Oakland University;* ***Md. Shazzad Hossain Shaon,*** *[B.Sc.], Graduate Research Assistant, Department of Computer Science and Engineering, Oakland University*

Software vulnerabilities in autonomous spacecraft can escalate into mission loss, yet detecting them under strict onboard computing constraints remains an open challenge. This talk presents a neuro-symbolic framework that pairs frozen pre-trained code language models with symbolic reasoning grounded in NASA coding standards, enabling precise, interpretable vulnerability detection in spacecraft C/C++ software using fewer than 0.3% trainable parameters. Trustworthiness is established through four complementary analyses. Every symbolic feature traces to a verifiable rule in the JPL Coding Standard, SEI CERT C, or the NASA cFE Developer's Guide, spanning 30,241 tagged instances. A contamination analysis against 240,000 public code samples shows only 0.57% identifier overlap, statistically ruling out memorization. Obfuscation experiments with systematically renamed identifiers confirm the model learns structural vulnerability patterns, not names. Finally, stage-wise evaluation shows the symbolic and neural stages correcting each other's errors, cutting false negatives from 795 to 97 across the entire held-out NASA test set.

4. Hydrogel-Amended Perlite-Vermiculite Root Zones for Resource-Efficient Space Crop Production

Lisa S. Tsay, *Mentor, Dow High Space Farmers, H.H. Dow High School; NASA Growing Beyond Earth, NASA HUNCH, Saginaw Valley State University;* ***Sanvi Patel,*** *Executive Director, Dow High Space Farmers, H.H. Dow High School; NASA Growing Beyond Earth, NASA HUNCH;* ***Jasmine M. Allen****, Data and Operations Manager, Dow High Space Farmers, H.H. Dow High School; NASA Growing Beyond Earth, NASA HUNCH;* ***Katie Cai,*** *Space Engineering Mission Lead, Dow High Space Farmers, H.H. Dow High School; NASA Growing Beyond Earth, NASA HUNCH;* ***Gabriel Nix,*** *Space Botany Mission Lead, Dow High Space Farmers, H.H. Dow High School; NASA Growing Beyond Earth, NASA HUNCH;* ***Viktor Pangburn,*** *Alumni Advisory Board Lead, Dow High Space Farmers; University of Toronto, Canada;* ***Margaret E. Hitt,*** *Founder, Dow High Space Farmers; Astrobiology Mission Lead, Columbia Space Initiative; Columbia University*

Future space crop systems must reduce water use and root-zone resource demands while maintaining productive plant growth. This study evaluated Hydroxyethyl Cellulose (HEC) hydrogel lattices as a resource-efficiency strategy within lightweight perlite-vermiculite substrates. ISS-tested Red Romaine

Lettuce and Mizuna were co-grown under modeled Vegetable Production System (Veggie) conditions across nine treatments combining 0%, 1%, and 2% HEC with 500, 1000, or 2000 ppm CO2. HEC supplementation increased water-use efficiency by 35% relative to unamended PV under equivalent CO_2 conditions. Biomass and crop volume generally increased with HEC and elevated CO_2, although the most resource-efficient balance occurred at moderate rather than maximum treatment levels. Considering water use, crop performance, and nutrient outcomes, 1% HEC with 1000 ppm CO_2 emerged as the strongest co-cultivation treatment. These findings suggest that HEC-amended perlite-vermiculite can improve root-zone resource efficiency without requiring maximum hydrogel or CO_2 input, supporting tunable substrate designs for future space crop production.

6. Introducing Remote Observing at Eastern Michigan University

Ernest R. Behringer*, Ph.D., Professor, Department of Physics and Astronomy, Eastern Michigan University;* ***Thomas A. Kasper,*** *M.A., Part-time Lecturer, Department of Physics and Astronomy, Eastern Michigan University*

We are setting up two ZWO Seestar telescopes at the Starfront Observatories in Rockwood, Texas to enable remote observing in Bortle 1 skies for Eastern Michigan University astronomy students to use in at least two different astronomy courses and for in-depth observing projects. During times when courses are not running, we will open observing to verified, local teachers, thereby increasing the reach of this project. We are developing a planetarium show for general audiences that describe how the methods of astronomical observation have changed through time up to the present, including the use of remote-controlled telescopes.

8. Michigan Tech Aerospace Enterprise

Nolan Besaw, *Undergraduate Student, Michigan Technological University*

General overview of MTU Aerospace Enterprise

10. Connexus, Keeping Enterprises Connected

Jonathan Charles, *Undergrad in Data Science, Mission Director, MTU Aerospace Enterprise*

Connexus delivers a unified service package for IT and ground support laboratory equipment from IPv4/IPv6 networking to high-power satellite uplink/downlink systems and computationally intensive orbital flight simulations for MTU's aerospace enterprise. Specialized Information Technology solutions have been done before. What sets Connexus apart is our pioneering work in specialized AI assistant tools for retaining classified knowledge bases and documentation. Mission specs and licensing files demand security clearance that open-source and commercial AI platforms simply cannot provide.

We are developing a locally hosted, low cost, multi billion parameter AI model that eliminates these security vulnerabilities. Connexus isn't just supporting aerospace innovation. We are securing it. And, we are doing it ethically with locally powered, locally hosted AI.

12. VEGF Signaling Promotes Cell Viability in Non-Small Cell Lung Cancer Cells

Chanidapa Chutipassakul, *Undergraduate Student, Department of Chemistry, Eastern Michigan University;* ***Nicholas Falkiewicz****, High School Student, Department of Chemistry, Eastern Michigan University;* ***Hedeel Guy-Evans,*** *PhD, Faculty, Department of Chemistry, Eastern Michigan University*

Vascular endothelial growth factor (VEGF) is an angiogenic signaling protein that contributes to cancer progression by promoting cell survival and growth. We examined the effect of VEGF signaling on cell viability in A549 non-small cell lung cancer (NSCLC) cells. Cells were treated with VEGF, a VEGF-neutralizing treatment, or control conditions and analyzed after 24 and 48 hours using MTT and protein concentration assays. VEGF treatment increased cell viability, whereas neutralizing VEGF reduced viability. These findings demonstrate that VEGF signaling supports NSCLC cell viability and suggest that targeting this pathway may help limit lung cancer cell growth.

14. A DFT Study of N-Heterocyclic Carbenes as σ-Hole Acceptors in Hydrogen- and Halogen-Bonded Complexes

Danielle Dragoi, *Undergraduate Researcher, Oakland University Department of Chemistry;* ***Matthew Romaya,*** *Undergraduate researcher, Oakland University Department of Chemistry;* ***Alexander A. Rusakov****, PhD. Assistant Professor, Oakland University Department of Chemistry****; Zacharias J. Kinney****, PhD. Associate Professor, Oakland University Department of Chemistry*

Non-covalent σ-hole interactions, such as hydrogen bonding, provide a versatile route to robust materials of complex secondary nature. These interactions arise between an electron-rich species (A) and the electron deficient σ-hole of another molecule (X-E), forming a secondary bonding species (A···X–E) of variable strength. N-heterocyclic carbenes (NHCs) – a central component in organic, inorganic, and materials chemistry – are neutral, carbon-based σ-hole acceptors that remain underrepresented in the literature. We propose that functionalized carbazoles, as hydrogen bond donors, can tune the strength of these interactions with NHCs for improved stability and future reactivity. Using dispersion-corrected DFT (ωB97X-D4/pcseg-2), we computationally investigate NHCs as non-traditional acceptors in hydrogen-bonded adducts, both in the gas phase and in solution (via implicit SMD solvation). For each donor-NHC pair, we compute interaction energies, Hammett parameter correlations, and molecular geometries to assess how donor electronic properties tune these interactions, with the aim of applying these findings toward catalysis.

16. Space Environments and the Changing Rules of Bacterial Movement

Yosamin Esanullah, Petra Gablowski, Connor MacRobbie PhD, Madelyn MacRobbie PhD *–*
Mechanical and Aerospace Engineering, Michigan Technological University; ***Qianying Mao, Oscar Carreno-Molina, John Z. Wen PhD, Carolyn L. Ren PhD –*** *Mechanical and Mechatronics Engineering, University of Waterloo*

Bacterial movement, or taxis, is a property which enables bacteria to move along a gradient.Taxis mechanisms are environmentally driven. On Earth, these environmental parameters and their effects on bacterial movement are relatively well understood. Space exploration, however, introduces shifts in these parameters and therefore challenges our current understanding of microbial spread, contamination, survival, and control. This review identifies key parameters that may define the motion of bacteria in an off-Earth planetary environment, with implications for planetary protection and astrobiology. The environmental features of the Moon and Mars are first reviewed, as near-term targets for planetary surface exploration. The interaction of each feature with the physical drivers of common bacterial taxis

mechanisms is then evaluated. Finally, the ability to simulate extraterrestrial surface conditions on Earth is discussed. The limitations of these experimental platforms highlight knowledge gaps and future research directions that are vital to understanding bacterial taxis beyond Earth.

18. From detection to reproductive phenology: environmental DNA reveals lake sturgeon spawning dynamics in the Lower Kalamazoo River

Jimena Golcher-Benavides[1] *(PhD, Principal Investigator, Assistant Professor)* ***Cecilia Shaffer[1]*** *(undergraduate student),* ***Emily Drape[1]*** *(undergraduate student),* ***Claire VanTol[1]*** *(undergraduate student),* ***Annalise Waldron[1], Anna Forney[1] , Maria Maria Scarborough[2], Alisha Denue[2], Michael Moore[3]****. 1. Biology Department, Hope College; 2. Environmental Gun Lake Tribe Environmental Department; 3. Department of Biological Sciences, Eastern Kentucky University*

Environmental nucleic acids provide non-invasive molecular tools for monitoring small and difficult-to-detect populations, with the potential to reveal biologically meaningful events beyond detection. Lake sturgeon, one of the largest-bodied and longest-lived freshwater fishes in NA, undertake seasonal movements, with southeastern spawning runs consisting of <100 returning adults. We evaluated whether eDNA can provide information about the reproductive phenology and early life history of lake sturgeon in the Kalamazoo River (KR) watershed. Specifically, we sought to (1) evaluate the interannual consistency of lake sturgeon eDNA detections across the free-flowing lower KR during the 2025 and 2026 spawning seasons, and (2) investigate how environmental nucleic-acid signals vary during early lake sturgeon development within a streamside rearing facility. Water samples were collected repeatedly across sites connecting Lake Michigan with upstream reaches of the KR and analyzed using species-specific molecular assays, including quantitative PCR (qPCR), digital PCR (dPCR), and an experimental CRISPR-CAS13a SHERLOCK assay.

20. Flight Crew: Building a K–12 Drone and Robotics Pipeline for Workforce-Ready Students

Cynthia Heraud, Educator, Ann Arbor Public Schools

As CTE Drone Program Instructors and robotics coaches within Ann Arbor Public Schools, we have built a continuous STEM pipeline spanning grades 6-12, giving students up to seven years of hands-on technical training in flight systems, coding, CAD, and competitive robotics. This session shares outcomes from our program's core initiatives: a district drone camp introducing coding, drone building, and flight to sixth graders; a middle-to-high-school FIRST Robotics pathway; and drone soccer as an engagement and skill-building tool. We discuss how sustained, sequenced exposure, rather than one-off STEM events, builds durable technical confidence and prepares students for aviation, engineering, and technology careers, including alignment with FAA Part 107 certification pathways. Attendees leave with a replicable framework for structuring a multi-year drone and robotics pipeline, lessons from running a free student camp, and strategies for translating classroom robotics into workforce-relevant skills.

22. Carbene–Copper–Carbazole Complexes ‘Two-fer’: Synthesis and Analysis of Monotopic and Ditopic Ligands

Sarah M. Ibrahim, Evan W. Sadler, Noah Schepke, Jonathan Meyer, Zacharias J. Kinney – *Chemistry, Oakland University*

A central goal of novel technological development is to decrease production costs and maximize performance. At the forefront of this research is the development of organic light-emitting diodes (OLEDs), which are a core display technology utilizing novel photoactive materials based on hybrid molecules. Our laboratory has taken interest in carbene–metal–amido (CMA) complexes featuring scalable π-accepting imidazolylidene carbenes (IPr), copper, and π-expanded carbazolide units. We have observed that in CMA complexes of this alignment, emission can be modulated via the carbazole moiety, where electron withdrawing groups turn-on emission. With the original CMA design being symmetrical at the center, we aimed to further extend the π-conjugation system within this complex by incorporating multiple CMA complexes into singular molecules. Current synthetic, spectroscopic, and crystallographic results will be discussed for the monotopic and ditopic versions of these complexes.

24. The QuIRK Project: High-Performance Software for Numerical Solutions to PDEs

Kohl James, *Ph.D., Assistant Professor of Mathematics, Department of Mathematical Sciences at Saginaw Valley State University;* ***Katharine Long,*** *Ph.D., Professor of Mathematics, Department of Mathematics & Statistics at Texas Tech University*

Partial differential equations (PDEs) are used to model many phenomena of scientific interest including fluid mechanics, chemical reactions, population dynamics, and more. Many of these equations are difficult or impossible to solve by hand, thus requiring a numerical approximation. Implicit Runge-Kutta (IRK) methods are commonly used for this process in practice, due to their robustness. These methods are highly computationally expensive. Their cost arises from the numerous large systems of linear equations they produce. An effective way to mitigate this expense is to precondition these systems of linear equations. Highly effective preconditioning methods for the systems produced by IRK methods been developed in C++ using Sundance, a package for the Trilinos project. This code is very powerful but not intuitive to learn. The QuIRK project is a Python library that binds to Sundance, designed to make implementing such preconditioning methods simpler without compromising on performance.

26. PyCG-DTN: A Framework for Delay Tolerant Network Testing

Ishaan Lagwankar*, Master of Science, PhD Student, CSE, Michigan State University;* ***Griffin Klevering,*** *Master of Science, PhD Student, CSE, Michigan State University;* ***Alan Hylton,*** *PhD, Network Architect, NASA Goddard;* ***Sandeep Kulkarni,*** *PhD, Graduate Director, CSE, Michigan State University*

With the rise of space-based networking and growing focus on Delay Tolerant Networking (DTN), understanding satellite topologies and bundle behavior across networks has become essential. Currently, testing these networks is a challenge due to the absence of readily-available network testing frameworks for deep space. We introduce PyCG-DTN, a tool that generates DTN contact plans from ephemeris data. Leveraging NAIF's SPICE kernels for orbital information, PyCG-DTN produces contact plans that account for occultation and solar conjunction effects, following DSN practices. These plans identify which bodies can communicate based on communication bands and export results to most DTN implementations. PyCG-DTN includes a user-friendly API for defining satellites via orbital parameters, along with a hosted web interface for visualizing the resulting contact graph in 3D, showing body movement and contact availability over time. A dedicated tab illustrates how bundles traverse the network generated via simulators implementing BPv7, alongside link budget and characteristic support.

28. System-Level Modeling and Optimization of a Closed-Loop Oxygen Recovery Cycle for Space Life Support

Aiden Martin, *B.S. Mechanical Engineering, Department of Mechanical Engineering, Oakland University;* ***Francisco Cepeda,*** *PhD, Assistant Professor, Department of Mechanical Engineering, Oakland University*

Oxygen recovery and carbon management in crewed spacecraft rely on integrated systems combining Sabatier reduction ($CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$), oxygen generation, and methane pyrolysis. Current configurations recover approximately 50% of available oxygen; methane is vented as waste. We present a system-level model coupling plug-flow representations of the Sabatier reactor and methane pyrolysis module to quantify the effect of integration on closure and carbon byproduct yield. Using NanoPFR, we investigate how pyrolysis temperature, Sabatier conversion, reactor pressure, and hydrogen recycle ratio affect oxygen recovery, hydrogen balance, and solid carbon formation. Parametric studies identify the operating envelope in which the system achieves 85–95% O_2 recovery with acceptable energy cost and carbon morphology suitable for in-situ resource use. Results provide quantitative guidance for NASA's Environmental Control and Life Support System design while establishing a modular framework applicable to other regenerative thermal systems.

30. A Lota Trouble: How This Cold-Water Fish is Finding Refuge in a Warming World

Megan Moilanen*, Biology Graduate Student, Grand Valley State University*

In July of 2026 we implanted 15 burbot (Lota lota) in the Clam River (a tributary of the Muskegon River) with ATS radio telemetry tags with the intention of tracking their movements over the next six months. The goal of the experiment is to establish if, where, and how burbot are using thermal refuge in lotic ecosystems, as well as establishing migration patterns, home range size, and habitat diversity preferences. Movement data will be paired with environmental and chemistry data and modeling will be conducted to establish thermal and environmental habitat preferences. This data can be extrapolated to predict future population resilience under a warming climate. Through our efforts, we hope to gain a deeper understanding of lotic burbot behavior and population dynamics. This research aims to fill in a knowledge gap that currently exist around lotic-dwelling burbot, as most research on this species occurs in lentic systems or laboratories.

32. Study of Abnormal Grain Growth in Cu, Cu-Cr and Cu-Cr-Zr Systems

Aiden Niemiec, *B.S. in Materials Science and Engineering, Graduate Student, Michigan State University, Chemical Engineering and Materials Science Department;* ***Carl Boehlert,*** *Ph.D. in Materials Science and Engineering, Professor, Graduate Program Advisor, Michigan State University, Chemical Engineering and Materials Science Department*

Anomalous grain growth (AGG), also known as Abnormal Grain Growth, is a phenomenon observed in crystalline materials during thermomechanical processing (TMP). It occurs when a small number of grains grow rapidly at the expense of surrounding finer grains, leading to a distinct disparity in grain sizes. Unlike normal grain growth where all grains coarsen uniformly and produce a unimodal grain size distribution, AGG results in a bimodal or multimodal distribution. The smaller grains in the matrix remain largely

unchanged while the abnormally large grains continue to grow, significantly altering the microstructure and properties of the material. Often, AGG is considered undesirable as this behavior leads to microstructural instability and degrades strength, ductility, toughness, creep and fatigue life of components, all of which must be avoided in manufacturing for aerospace applications. Thus, understanding the mechanisms and mitigation strategies for AGG is essential for optimizing copper processing in aerospace manufacturing.

34. Space-Tolerant Semiconductors: Exploring the Radiation Stability of Chalcogenide Perovskites

***Anika Rahman Riya**, Ph.D. Student, Presenting Author, Chemical Engineering and Materials Science, Michigan State University; **Jonathan Turnley,** Ph.D., Assistant Professor, Project Mentor, Chemical Engineering and Materials Science, Michigan State University.*

For electronic devices to support space missions, they must withstand intense radiation, extreme temperatures, vacuum, and other harsh conditions that typically degrade semiconductor materials. Rather than just design around the limitations of traditional materials, it is advantageous to develop new semiconductors that are intrinsically stable in extreme environments. This project investigates the chalcogenide perovskite $BaZrS_3$ as a promising candidate for space electronics. $BaZrS_3$ is a non-toxic and earth abundant material with excellent thermal and air stability. In this research, we have investigated methods for synthesizing high-quality $BaZrS_3$ samples with strong optoelectronic properties. These $BaZrS_3$ samples then serve as a model system for understanding chalcogenide perovskites degradation under the extreme radiation conditions that mimic the conditions in space. This study will identify the bulk, surface, and optoelectronic degradation mechanisms of $BaZrS_3$ and guide the development of radiation-tolerant semiconductors for space electronics.

36. Modeling Contact Binary Star Interactions

***Nathan Steenwyk**, Undergraduate; **Ethan Webber,** Undergraduate; **Larry Molnar,** Professor; **Jess Vriesma,** Professor – Department of Physics and Astronomy, Calvin University*

Contact binary stars are systems in which two stars orbit each other so closely that their atmospheres touch and interact. We used the stellar simulation package MESA (Modules for Experiments in Stellar Astrophysics) to explore how these interactions affect each of the two stars. Highlights of our results include 1) the effect of metallicity (fractional composition of elements heavier than helium) on the thermal stability of mass transfer to the primary star; 2) the effect of luminosity transfer to the secondary star on its radius. The ultimate goal of this research is to create a self-consistent model of a stably interacting binary.

38. Fate and transport of extracellular polysaccharides in icy moon plumes

***Megan Stull,** Graduate Student, Department of Chemistry, Oakland University; **Ziming Yang,** Professor, Department of Chemistry, Oakland University*

Icy ocean worlds are of special interest for the search for life beyond Earth, as biosignatures are expected within the subsurface liquid oceans. Plumes from these planetary bodies can allow for easier sampling, but this leads to questions on how the transition from liquid to vacuum influences the detection and interpretation of biosignature distributions. Previous studies on amino and fatty acids suggest relative

abundances are sufficiently conserved to determine whether the compounds are biological or abiotic in origin. However, the fate and transport of larger biological polymer substrates in icy moon plumes are unknown. Our work aims to expand the scope of research by exploring how extracellular polymeric substances (EPS) behave during the liquid-vacuum transition, which will help interpretations of biosignature distributions in future spacecraft missions.

40. Report on MSGC Student Fellowship Award

Emma Telepo, B.S. Mechanical Engineering, Ms., Michigan State University

This Fellowship has given me the opportunity to seek NASA-relevant experience outside of the classroom. As an undergraduate research assistant, I utilize MATLAB-based image processing to process high-speed flame front images of Sustainable Aviation Fuels (SAFs). From these images, I extract radius and area data to calculate the laminar flame speed of the flame fronts. Analyzing these speeds at different chamber conditions advances our understanding of optimal SAF combustion.

I also had the opportunity to participate as a Thermal Engineer in the NASA L'SPACE Mission Concept Academy, where I gained specific knowledge of NASA mission design concepts over 15 weeks. I attended weekly lectures by NASA scientists and engineers and weekly thermal design training meetings. Outside of these, I worked on an 18-person, interdisciplinary team to create a conceptual lunar rover capable of launch, landing, and traversing the Lunar South Pole.

This MSGC Fellowship allowed me to seek these opportunities rather than take on external job responsibility, and has been a truly meaningful development path. Thank you MSGC for the NASA Student Fellowship award opportunity, helping me move towards my dream and commitment of becoming a NASA Engineer.

42. Cooperative Aerial Transportation of a Payload with a Sliding Cable Attachment

Sebastian Tilaguy Lezama, *Electrical Engineer, Ph.D student, Electrical and Computer Engineering, Oakland University;* ***Diego S. D'Antonio,*** *Ph.D on Computer Science, Assistant Professor, Electrical and Computer Engineering, Oakland University*

A Dual-Quadrotor Hook Suspended Transport system is a novel platform to transport payload using cooperative aerial manipulation physically connected by a single inextensible cable, which interact with its payload through an ideal frictionless hook attached to the cable, which allows the cable to slide between its two segments. This configuration introduces a cable-distribution variable coupling quadrotor motion, cable geometry, and payload dynamics. A feasible reference-generation framework uses the desired payload pose, cable distribution, and system shape while satisfying the cable-length constraint and elliptical workspace. The proposed framework and system behavior are assessed through numerical simulations and physical demonstrations, showing the feasibility of coordinated transport with controlled sliding cable distribution.

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

Caroline *Valdes, 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.

46. From Earth to Mars: Terrestrial analogs as a framework for interpreting Martian clay minerals and ancient Mars

Michael Velbel, Professor Emeritus, Department of Earth and Environmental Sciences, Michigan State University

Orbiter and lander/rover studies of Mars' surface, and studies of Mars meteorites, indicate that abundant and widespread clay and other phyllosilicate minerals formed early in the geologic history of Mars. On Earth, these minerals commonly form by mineral-water interactions during weathering of rocks and minerals by natural aqueous solutions. Field studies in active natural terrestrial systems include aqueous geochemistry data (solute concentration and flux). On Mars, the aqueous solutions left the regolith and the near-surface weathered rock long ago, and it is from the surviving solids that the former chemical processes and paleoenvironmental conditions must be inferred. This presentation reviews how several widely used approaches to natural terrestrial weathering – of carefully selected and well-studied Mars-analog rocks and regolith – have been and are being used by Mars mission scientists to support inferences about ancient conditions on Mars, from mission studies of the clay-mineral products of mineral-water interactions and their host materials.

48. Partial Energy Harvesting Study Utilizing Adjustable Solar Cage

Allie R. Welch: *Undergraduate Student from the Department of Electrical and Computer Engineering at Saginaw Valley State University;* ***Morgan S. Walle:*** *Undergraduate Student from the Department of Electrical and Computer Engineering at Saginaw Valley State University;* ***Mohammed W. Alif:*** *Undergraduate Student from the Department of Electrical and Computer Engineering at Saginaw Valley State University*

Solar energy is an accessible renewable resource used across the world, increasingly in more areas as technology advances. However, solar farms take up land, even grounds that are potentially cultivable. To create a balance between power and food production, co-farming, where energy harvesting and plant farming coexist, is an emerging method of agriculture that attempts to maximize energy production in a given space. In this study, solar cages have been built to explore configurations that optimize this practice. The primary focus is to explore sustainable energy harvesting utilizing the cage and provide quantitative results of the energy remaining in the cage that could potentially support a biological system. In controlled and natural environments, up to 55% illumination reduction has been found inside the structure. The secondary focus is to design a combined buck and boost converter to regulate the amount of output voltage to produce a constant power source.

50. The Michigan Tech Auris Nanosatellite Project

Martin Wilkens, *Graduate Student, Auris Mission Director, Electrical and Computer Engineering Department, Michigan Technological University;* ***Conner Larson****, Undergraduate Student, Auris Mission Systems Engineer, Mechanical Engineering Department, Michigan Technological University*

Dozens of commercial and government spacecraft reside in Geostationary Earth Orbit (GEO), providing global telecommunications services for an international customer base. As more spacecraft are launched into the GEO region, the potential for interference between spacecraft grows. Antenna beam overlap and close transmit frequencies can degrade communication performance through relative proximity and electromagnetics, potentially resulting in unintended behavior. The Michigan Tech Auris spacecraft is a pathfinder mission designed to aid in the characterization of potential interference in the GEO belt. As a nanosatellite orbiting in LEO, the Auris spacecraft would continuously pass through radiation patterns emitted from GEO, allowing it to spatially map out the antenna spot beam patterns that it passes through. Spot beams are mapped according to the received signal strength detected by the Auris spacecraft over multiple orbits, localizing each power measurement and creating a spatial map.

52. Construction and Verification of Atg1-HA for Autophagy Research

Madison Buza, *High School Diploma (Expected 2027), Student, Department of Chemistry, Eastern Michigan University;* ***Evan Zhen,*** *High School Diploma (Expected 2028), Student, Department of Chemistry, Eastern Michigan University;* ***Iñigo Demerath****, Associate's Degree, Student, Department of Chemistry, Eastern Michigan University;* ***Dr. Steven K. Backues****, PhD, Professor, Department of Chemistry, Eastern Michigan University*

Autophagy is a highly conserved cellular process which recycles damaged proteins and organelles and helps cells survive starvation. Consequently, this process is very important for the health of many organisms, including humans. Atg1 is a key protein kinase that initiates the formation of autophagosomes, structures that engulf cellular cargo to be degraded and recycled in the vacuole. As the first step in a larger project aimed at determining how Atg1 affects autophagosome size and number, we successfully tagged Atg1 with an HA tag to allow detection by western blot and began the process of cloning the Atg1-HA gene into a plasmid for further genetic manipulation.