Minnesota Space Grant Consortium (MnSGC)
Spring 2024 Student Symposium

Book of Abstracts

February 24, 2024
Augsburg University

https://umn.zoom.us/j/7261550823

https://www.mnspacegrant.org

Table of Contents and Session Time Slots

Technical Issues:

Please, call James Flaten – 651-399-2423

Location & Parking

- **Hagfors Center, Augsburg University, 700 21st Ave S, Minneapolis, MN 55454**
- **Building entrance is on the east side, next to the roundabout**
- **You may park for free in Lot D, 1 block due south of Hagfors Center**

Lunch

- **Bring a sack lunch or work with Prof. Ben Stottrup to order lunch to be delivered. Lots to see and do during the mid-day break, so don't plan to leave to go out to lunch.**

Zoom link for oral presentations (with breakout rooms during poster sessions)

- **https://umn.zoom.us/j/7261550823**

Welcome to NASA's MN Space Grant Consortium's 2024 Student Symposium!

The Minnesota Space Grant Consortium (MnSGC) is part of the NASA-funded National Space Grant College and Fellowship Program (usually just called Space Grant) established by Congress in 1988. Nationally, Space Grant is a network of 52 university-based statewide consortia, including all 50 states plus the District of Columbia and Puerto Rico, with nearly 1000 mostly-higher-education affiliate institutions delivering programming nationwide. Space Grant provides support for higher education students majoring in STEM fields, NASA-themed higher education offerings plus research opportunities for faculty and students, NASA-themed professional development for pre-college and in-service and pre-service teachers, and informal education aerospace science and engineering activities for pre-college students and the general public.

The mission of the MnSGC is to provide a driving force for aerospace education in Minnesota. Program goals and objectives include diversity, competitiveness coupled with accessibility, ties with NASA Centers and enterprises, and relationships with local industries and state government. The MnSGC supports a variety of projects including higher education course development, hands-on flight hardware projects and research for higher education students and faculty, scholarship/ fellowship support for full-time students attending its 12 academic affiliate institutions of higher learning, NASA Center summer internships for college students attending any accredited MN college or university (when selected by NASA Center mentors), teacher and informal educator workshops, and NASA-themed activities in STEM (Science, Technology, Engineering, and Mathematics) for pre-college and general public audiences including public exhibits and occasional school visits. Learn more about the MnSGC by visiting https://www.mnspacegrant.org.

This student symposium features 11 contributed student talks, 14 student posters, plus the finals of an intercollegiate challenge and several exhibits by student groups who have worked on MnSGC projects in the past year. Presentations for in-person attendees will be in Hagfors Center at Augsburg University. Remote attendees can watch oral presentations on Zoom, with posters being shown in breakout rooms.

The contributed talks are spread over three sessions – one starting at 9:10 a.m., one starting at 11:10 a.m., and one starting at 1:30 p.m. Posters will be spread over two sessions: an intern poster session starting at 10:20 a.m. and a general poster session starting at 2:40 p.m. Each poster session will be preceded by a viewing of 1-minute promo videos by the poster presenters. The (in-person-only) intercollegiate challenge and exhibits will run from 12:00 p.m. to 1:20 p.m. We are also pleased to offer a keynote talk at 3:30 p.m. about NASA's Juno mission to Jupiter. Students who received NASA Center Internships in the summer of 2023, and students who did MnSGC centrally funded in-state internships, will exhibit at the intern poster session in the morning.

Use the Table of Contents and Timing for the Student Symposium (above) and the abstracts (below) to help guide you through the day. Again, thanks for joining us!

Dr. Demoz Gebre-Egziabher, Director of the MN Space Grant Consortium, U of MN – Twin Cities
Dr. James Flaten, Associate Director of the MN Space Grant Consortium, U of MN – Twin Cities

List of participants:

Presenter	Title of the presentation
Augsburg University	
Eleanor Flynn (oral)	Quantifying Changes in Daphnia Locomotion Patterns
Abram Cressman (poster)	Equilibrium behavior of branching curvature and comparison of enantiomer morphology in lipid monolayers
Jimmy Hemera (poster)	Chemical Kinetics of the Reaction Between the Acetyl Radical and Oxygen
Luke Omodt (poster)	$Pb_2Ir_2O_7$ Thin Film Growth for Spin Transport
Martina Wolo, Hanna Le, Ganame Kassim, Rahmanimo Yusuf (poster)	Staying Aloft, A Second Year of Project Launch
Bethel University	
Xavier Blasingame (oral)	Finding Servo Error in an Atomic Clock Based on a Two-Photon Transition in Rubidium
Bemidji State University	
Collin Glass (oral)	Using Dragonfly Nymphs as Bioindicators of Mercury Input to Upper and Lower Red Lakes in Northern Minnesota
Carleton College	
Max Kingston, Carolyn Chinatti (oral)	High-resolution spectroscopic monitoring of a magnetically sensitive Solar line
Concordia College	
Favziya Rasulova (oral)	Exploring Different Recipes for New Chitosan and Alginate Bioplastics
Matthew Mondry, Zach Jackson (poster)	Quantum Tunneling Time Distributions in a Semi-infinite Square Well Potential
Fond du Lac Tribal and Community College	
Jessie Drift, Eric Waino (oral)	Build, First Flight and Iffy Landing After MnSGC Remote Rocketry Lessons
Inver Hills Community College	
Kelly Behlen (in-state intern poster)	Opportunities in Small Satellite Research
Ryan Kappes (in-state intern poster)	A New Look on Physics: Using Modern Media to Aid in Teaching Physics to Undergraduate Students

Leech Lake Tribal College

Samantha Fairbanks (oral)	First Nations Rocket Launch Wisconsin Space Grant

St. Catherine University

Bronwyn Hicks (oral)	Earth superpowers in space - How can we employ energy-harnessing enzymatic pathways from Earth to help sustain us in space?
Abby Conrad (poster)	Reflections From Socorro, NM Surrounding the 2023 Annular Eclipse

University of Minnesota - Duluth

Matt Laine (oral)	The M-dwarf Discrepancy

University of Minnesota – Twin Cities

Ashton Posey (oral)	Development of the PADL flight computer for stratospheric ballooning and high-power rocketry

University of St. Thomas

Luke Freimuth (oral)	Oscillatory Characteristics of Twin Impinging Jets
Madelyn Wick (in-state intern poster)	Flow Rate Impact on Fluidic Oscillator Performance
Sofia Caballero (in-state intern poster)	Developing an Attitude Determination Algorithm Utilizing Smartphone and Drone Sensors
Conrad Provost (poster)	Applying Simulations to Space Radiation Testing Applications

NASA – Center Internships

Skye Gagnon, Jeffrey Neumann (Ames)	Platform for Low-Cost, Low-Risk Testing of Entry Descent and Landing System Technologies
Sarah Boelter (Ames)	Understanding Drill Data for Autonomous Application
Eloisa Carrasco (Langley)	Compact Lightweight Aerial Sensor System (CLASSy)

Keynote Speaker

Ali Sulaiman	NASA’s Juno Mission to Jupiter

Exhibits

Ashton Posey, Jessica Glamm, Yoel Mekbeb	Nationwide Eclipse Ballooning Project, U of MN - Twin Cities

Bronwyn Hicks and Abby Conrad

Gweneth Lau, Rachel Cirillo, Dagan Larson, Anna O'Brien, Andrew Carland, Samuel Draeger

St. Catherine University Ballooning Team

Bulldog Rocketry: Superior I, U of MN - Duluth

Intercollegiate Challenge Teams

Concordia College (2 teams)

Anoka-Ramsey Community College

St. Olaf College

Oral Presentation - Session 1 (9:10 am – 10:10 am)

(Zoom Link: https://umn.zoom.us/j/7261550823)

Talk 1: 9:10 am – 9:25 am

Institution: **Fond du Lac Tribal and Community College**

Student Presenter(s): **Jessie Drift, Eric Waino**

E-mail address for each presenter: jessieanne.drift@s.fdltcc.edu, waino.t.eric@gmail.com

Mentor: **Steve Highland**

Title: **Build, First Flight and Iffy Landing After MnSGC Remote Rocketry Lessons**

Four students from Fond du Lac Tribal and Community College participated in James Flaten's MnSGC Remote Rocketry Lessons during September and October 2023. Eric Waino, Jessie Drift, Thomas Carlson and Rax Greyhair all worked together on the build of the Basic Blues high power rocket kit and launched the rocket in North Branch on November 18. In this presentation Jessie and Eric will take us through the build process and test flight results.

Our team "Molasses" never really organized a detailed plan of the build but we did manage to spread the work of the various jobs among all four students equally. It pretty much depended on who was free at the moment to pick up the job at whatever stage it was at and continue from there.

We test flew the rocket on November 18 at the TripoliMN launch site in North Branch on an H225 motor. The rocket ascended nice and straight but for reasons we don't fully understand the altimeter did not fire the ejection charges to get the parachutes out. The backup charge did separate the airframe sections, though, and the rocket landed without damage. We have some thoughts on what may have occurred.

Talk 2: 9:25 am – 9:40 am

Institution: **University of St. Thomas**

Student Presenter(s): **Luke Freimuth**

E-mail address for each presenter: frei1578@stthomas.edu

Other Student Author: **Xijun Tan**

Mentor: **Dr. David Forliti**

Title: **Oscillatory characteristics of Twin Impinging Jets**

Within rocket engines, twin impinging jets are often used as a method to break up fluid flow and encourage fuel mixing, a critical factor to an engine's fuel efficiency and overall performance. This fan-shaped fluid pattern exhibits oscillatory characteristics that can be potentially dangerous when aligned with the resonance of an engine's structure. In this study, a similar fluid flow was created with room-temperature air, and an observation method called Particle Image Velocimetry (PIV) was used to track the flow movement. This technique utilizes a rapidly pulsing laser to illuminate mist particles embedded within the fluid flow and a high-speed camera synced to the laser's pulsing to capture images of the particles, which can then be tracked frame-by-frame to obtain substantial and non-invasive data about the flow's characteristics. Analysis of the data was performed in MATLAB. Stereoscopic PIV, a different technique utilizing two cameras to obtain three-dimensional data, was briefly tested, and future data collection will potentially use this more complex and informative setup.

Talk 3: 9:40 am – 9:55 am

Institution: **Carleton College**

Student Presenters: **Max Kingston, Carolyn Chinatti**

E-mail address for each presenter: kingstonm@carleton.edu, chinattic@carleton.edu

Max

Carolyn

Mentor: **Ryan Terrien**

Title: **High-resolution spectroscopic monitoring of a magnetically sensitive Solar line**

We frequently analyze variations of the spectra of stars to identify and characterize their exoplanets. However, the rotational cycles and magnetic activity of these stars significantly affect our investigations of stars harboring potential exoplanets. Therefore, understanding precisely how these extraneous variables impact observations is crucial for future discrimination between stellar activity and exoplanet-related signals in stellar spectra data. A Laser Heterodyne Radiometer is making daily spectroscopic measurements of our own sun of high resolution that enable cutting edge precision measurements of a single spectral line (Fe I). This data can be used to calculate radial velocity shifts of the sun. Throughout our development of a pipeline to process and analyze this data, we have worked on performing telluric corrections, Fe I shape analysis, and characterization of apparent solar behavior such that those characterizations might be applied to the solar spectra measurements of other stars.

Talk 4: 9:55 am – 10:10 am

Institution: **Concordia College**

Student Presenter(s): **Favziya Rasulova**

E-mail address for each presenter: frasulov@cord.edu

Mentor: **Dr. Graeme Wyllie**

Title: **Exploring Different Recipes for New Chitosan and Alginate Bioplastics**

Plastics pose a huge threat to the environment with particular concern focusing on microplastics, which are tiny plastic particles found in drinkable water and human breast milk. In the Wyllie lab, we study bioplastics, which are made of renewable plants or animal-derived biopolymers. These naturally break down in various environments by being enzymatically digested by naturally occurring microorganisms that live in soil or water. Our bioplastics are typically made from two polysaccharides: chitosan and alginate. Chitosan is a fibrous compound derived from chitin, which is found in crustacean and insect shells. Alginate is a naturally occurring anionic polymer obtained from seaweed. These polysaccharides are long chain molecules that can form cross-links connecting the separate strands. In my research, I have investigated new ways to make new bioplastics by testing different recipes, which expand upon the original protocol (Ward, 2019). The cross-linking lactic acid was substituted by different acids while other experiments examined the creation of new bioplastics by adding additional polysaccharides or non-polysaccharides such as glycerol or collagen. Finally, we explored whether bioplastics could still be made if chitosan or alginate were substituted with other polysaccharides.

Website(s)/On-line Reference(s) (max 3):

Alexandra M. Ward and Graeme R. A. Wyllie Journal of Chemical Education 2019 96 (4), 668-676
DOI: 10.1021/acs.jchemed.8b0066

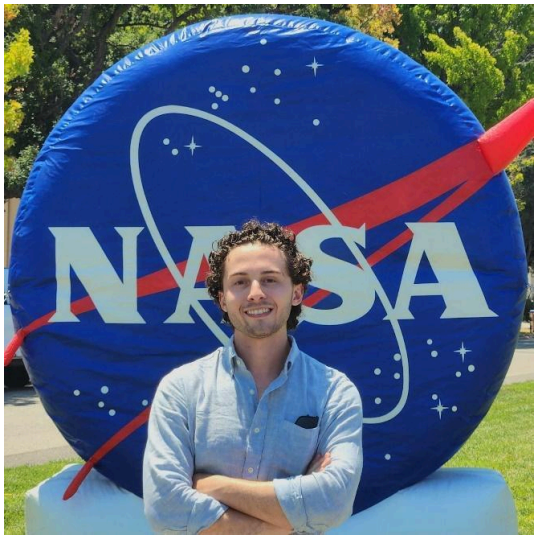
Poster Session 1 (10:20 am – 11:05 am)

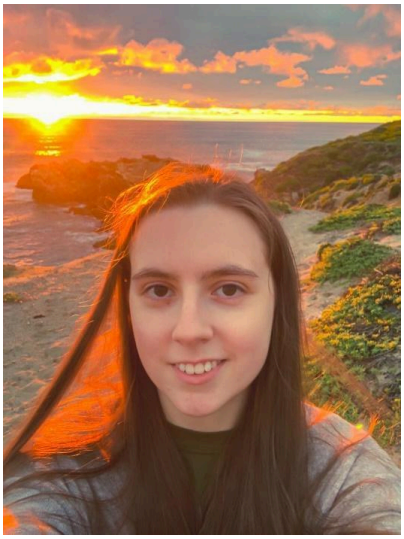
(Posters in breakout rooms on Zoom Link: https://umn.zoom.us/j/7261550823)

Student home institution: **University of Minnesota**

Student Presenter(s): **Skye Gagnon, Jeffrey Neumann**

E-mail address for each presenter: gagno080@umn.edu, neuma522@umn.edu





Other Student Authors: **Alessio Gardi, Vincent Twin**

Mentors: **Academic mentors: Demoz Gebre Egziabher, Ellen Longmire, Marien Junior Simeni Simeni, Industry mentors: Marcus Murbach, Alejandro Salas, Seth Schisler, Malachi Mooney-Rivkin**

NASA Center involved: **NASA Ames Research Center**

Title**: Platform for Low-Cost, Low-Risk Testing of Entry Descent and Landing System Technologies**

With a growing interest in atmospheric entry, descent, and landing research as well as the necessity to empirically test increasingly complicated entry systems, a growing need for a quick and cost-effective method of experimentation is needed. The Hypersonic Configurable Unit Ballistic Experiment is a test and evaluation platform allowing for in-situ research and rapid testing of novel technologies in a re-entry environment. HyCUBE takes the form of a small satellite-sized re-entry vehicle and, with the additional payload space on board the vehicle, can act as a platform for testing novel guidance and control methodologies. During re-entry, HyCUBE will be subject to extreme heat loads, mechanical stresses, and electromagnetic interference. For it to survive hypersonic re-entry, HyCUBE will utilize modern thermal protection systems and demonstrate novel drag technologies. Development work for the first iteration of HyCUBE was performed this past Summer at the NASA Ames Research Center.

Poster Session 1 (10:20 am – 11:05 am)

(Posters in breakout rooms on Zoom Link: https://umn.zoom.us/j/7261550823)

Student home institution: **University of Minnesota – Twin Cities**

Student Presenter: **Sarah Boelter**

E-mail address for each presenter: boelt072@umn.edu

Other Student Author: **Ebasa Temesgen (student at UMN in CS PhD Program)**

Mentors: **Brian Glass (NASA Ames), Maria Gini (UMN Faculty Member Computer Science)**

NASA Center(s) involved: **NASA Ames**

Title: **Understanding Drill Data for Autonomous Application**

In high-risk, high-cost environments like Mars it is necessary for robotic agents to either avoid or reason through potential indicators of trouble before they escalate to problems that effectively mean mission failure. Currently, no broadly applicable solution exists to give a complicated and specialized agent like The Regolith and Ice Drill for Exploring New Terrain (TRIDENT) the ability to understand the rate of its progress on a task or the situational awareness to know when a situation might escalate to a drilling fault. To better understand potential drilling faults TRIDENT will have to reason through, we examine logged data from previous field experiences and applied techniques like Time Series Analysis to determine what trends in the data exist during faults and used Change Point Analysis to explore the possibility of faults being detected in real-time in a planetary environment. These results will be used to inform a deterministic Artificial Intelligence (AI) model for TRIDENT.

Poster Session 1 (10:20 am – 11:05 am)

(Posters in breakout rooms on Zoom Link: https://umn.zoom.us/j/7261550823)

Student home institution: **University of Minnesota – Twin Cities**

Student Presenter(s): **Eloisa Carrasco**

E-mail address for each presenter: carra166@umn.edu

Other Student Authors: **Kyleigh Anderson, Chad Brander, Reagan Courville, Adriana de la Guardia, Jasmine Fensler, Lawrence Giron Jr., John Oberlies, William Pankiewicz, Grace Wachter**

Mentors: **Liz Ward, Paul Krasa, Stewart Nelson, David North, Kailey Pierce, Patrick Quach, Garry Qualls, Kyle Smalling, Matt Underwood**

NASA Center(s) involved: **NASA Aeronautics Academy at Langley**

Title: **Compact Lightweight Aerial Sensor System (CLASSy)**

The escalating frequency and intensity of wildfires necessitate innovative solutions like the Compact Lightweight Aerial Sensor System (CLASSy) to enhance wildfire management strategies. CLASSy is a low-tech, disposable system designed to provide real-time, high-resolution data to frontline firefighters, aiding in decision-making. It comprises of a launch mechanism powered by resistive bands and a flight body equipped with a sensor package and parachute. The system captures infrared imagery and temperature differentials, which can offer insights into fire behavior, hotspot detection, and fire spread trajectories. CLASSy's variable launch height and disposability make it versatile for various natural disaster mitigation needs. It is designed to be lightweight, easily expendable, cost-effective, and operable by a single individual. By integrating sensor networks with data analytics, CLASSy provides a comprehensive decision support system, empowering firefighting teams to proactively address wildfire challenges. As wildfires become more frequent, technological innovations like CLASSy are crucial for effective wildfire management.

Website(s)/On-line Reference(s):
https://ntrs.nasa.gov/citations/20230011971
https://www.epa.gov/climate-indicators/climate-change-indicators-wildfires

Poster Session 1 (10:20 am – 11:05 am)

(Posters in breakout rooms on Zoom Link: https://umn.zoom.us/j/7261550823)

Student home institution: **Inver Hills Community College**

Student Presenter: **Kelly Behlen**

E-mail address for each presenter: KellyBehlen@gmail.com

Mentor: **Demoz Gebre-Egziabher**

Institution where the internship took place: **University of Minnesota – Twin Cities**

Title: **Opportunities in Small Satellite Research**

Continuing my ongoing work with the Small Satellite Research Lab at the University of Minnesota, I have assisted with the design and progress of the EXACT and IMPRESS satellites, along with the proposal designs of the (pending) DESPINA satellite, the (approved) IMPRESS-II instrument for use on the NASA GRIPS-II Balloon Telescope, and the (approved) ALXS instrument for use on the ESA/NASA Vigil mission. Through this opportunity I have learned the intricacies of working in a multidisciplinary team on incredibly complex, real-world engineering projects.

As part of the MnSGC Symposium, I will be available to explain the various missions (EXACT, IMPRESS, IMPRESS-II, DESPINA, and ALXS) that I have had the honor to work on, as well as the design decisions and hurdles experienced over the course of these projects. I will also speak to the use of iterative design on our Structures/Mechanical Team as we have built upon every success and failure over the last two years in conjunction with multiple sub-teams through many design reviews to reach our current build state in anticipation of a launch to the International Space Station within a year.

Poster Session 1 (10:20 am – 11:05 am)

(Posters in breakout rooms on Zoom Link: https://umn.zoom.us/j/7261550823)

Institution: **University of St. Thomas**

Student Presenter: **Madelyn Wick**

E-mail address for each presenter: wick2838@stthomas.edu

Mentor: **David Forliti**

Title: **Flow Rate Impact on Fluidic Oscillator Performance**

A fluidic oscillator is a device that can be applied to airplane aerodynamics as fluid flow disrupters. Fluidic oscillators have a steady flow input of fluid and a sinusoidal output. Utilizing additive manufacturing, prototypes were fabricated and analyzed in Ansys to determine the effectiveness of the output geometry. Testing was achieved with PIV laser equipment by measuring the velocities of the fluid flow. Tracer particles were illuminated by a laser field and their displacement vectors were captured using a high-speed camera. The fluidic oscillator was tested at five different flow rates to determine the effect on oscillation. The results of the PIV testing correlated with the hypothesis made from Ansys simulation that the oscillation angle increased with increased flow rate.

Poster Session 1 (10:20 am – 11:05 am)

(Posters in breakout rooms on Zoom Link: https://umn.zoom.us/j/7261550823)

Student current institution: **University of St. Thomas**

Student Presenter(s): **Ryan Kappes**

E-mail address for each presenter: kapp4779@stthomas.edu

Mentor: **Dr. Benjamin Stottrup, Ph.D**

Institution where the internship took place: **Augsburg University**

Title: **A New Look on Physics: Using Modern Media to Aid in Teaching Physics to Undergraduate Students**

Many students might not have their first taste of a physics class till their first year of college, and the concepts can seem foreign. The goal of this project was to develop a new look into physics for new students so they could see physics in the world around them, especially in the realm of biophysics and kinematics. Media can be a window into seeing physics in a new light. Using sources such *as An Immense World* (Yong, 2022) and *The Martian* (Scott, 2015) for developing homework exercises, classical physics examples can be seen in new ways to make these examples more tangible to the learner. Topics such as light, color, sound, and movement are all explored using real-world examples of the incredible creatures we share this planet with. How does a dog sense the world compared to humans? What would it take to live on Mars? Many of these topics can be explored in an introductory capacity to the world of physics.

Poster Session 1 (10:20 am – 11:05 am)

(Posters in breakout rooms on Zoom Link: https://umn.zoom.us/j/7261550823)

Student home institution: **University of St. Thomas**

Student Presenter(s): **Sofia Caballero**

E-mail address for each presenter: caba7307@stthomas.edu

Mentor(s): **Demoz Gebre-Egziabher**

Institution where the internship took place: **University of Minnesota**

Title: **Developing an Attitude Determination Algorithm Utilizing Smartphone and Drone Sensors**

Attitude Determination allows for the control of an aircraft's orientation in space. The rotational behavior of an aircraft is determined relative to a frame of reference. The study of attitude determination has become increasingly more important as the development of self-flying drones and aircraft continues. Our results demonstrate how an object's motion overtime can be represented in a series of MATLAB plots. Through experimentation and analysis, we identified the different sensors that are used for attitude determination. Starting with Android sensors, we used the data to develop code that displayed motion over time of the smartphone. From there, we tested the sensors from a drone in a high bay. This data was used to check and revise the code. The code that was developed could now be used in a tracking system for self-flying drones or other aircraft. The data gathered would allow researchers to better understand and address the challenges that self-flying objects present.

Oral Presentation - Session 2 (11:10 am – 11:55 am)

(Zoom Link: https://umn.zoom.us/j/7261550823)

Talk 1: 11:10 am – 11:25 am

Institution: **Bemidji State University**

Student Presenter: **Collin Glass**

E-mail address for each presenter: collin.glass@live.bemidjistate.edu

Mentor: **Carl Issacson**

Title: **Using Dragonfly Nymphs as Bioindicators of Mercury Input to Upper and Lower Red Lakes in Northern Minnesota**

Wetlands can be major contributors of mercury to surface waters. Upper and Lower Red Lake are connected to the largest peat bog system in the contiguous United States. A previous study conducted on Upper and Lower Red Lake indicated that mercury concentrations in walleye were significantly higher in Upper Red Lake compared to Lower Red Lake. This study sets out to determine the source of this mercury. To do this we measured mercury concentrations in water and dragonfly tissue to assess mercury loads from seven tributaries, four of which are directly influenced by peatlands and three of which are not influenced by peatlands. Two of the peatland-influenced tributaries have water mercury concentrations between two and four times the concentration of other tributaries. The dragonfly larvae collected from the high mercury bearing tributaries have almost double the mercury concentration compared to dragonfly larvae from non-peatland influenced tributaries, indicating that some peatland influenced tributaries are a greater source of mercury than other peatland or non-peatland influenced tributaries.

Talk 2: 11:25 am – 11:40 am

Institution: **St. Catherine University**

Student Presenter: **Bronwyn Hicks**

E-mail address for each presenter**:** blhicks288@stkate.edu

Mentors: **Dr. Erick Agrimson, Dr. Tami McDonald, and Dr. Rahul Roy**

Title: **Earth superpowers in space - How can we employ energy-harnessing enzymatic pathways from Earth to help sustain us in space?**

Astrobiology, the study of biological mechanisms in space, is crucial for our sustained presence in space and on the Moon and Mars. Photosynthesis, utilizing sunlight for food production, is vital for our ecosystem. Plants, essential for survival beyond Earth, offer medicine and fuel. However, soil, a scarce resource in space, poses challenges for inclusion in payloads. Therefore, our research focuses on plant growth in synthetic Lunar and Martian "regolith," the loose rocky material covering bedrock. Our experiments aimed to understand the physiology and gene expression of the model crop *Brassica rapa*, grown on lunar regolith alone or enriched with lightweight fertilizer for supplemental minerals. Despite visible plant stress, we observed germination and survival over four weeks.

In parallel to photosynthesis, another metabolic pathway for organisms is chemolithotrophy. Chemolithotrophic bacteria have the ability to derive energy from inorganic compounds without the need for sunlight and produce electrons as a by-product of their metabolism. Integrqting of chemolithotrophic bacteria into space habitats could offer a self-sustaining ecosystem for energy production and nutrient cycling. We grew chemolithotrophic organism, *Shewanella oneidensis*, in a MudWatt kit containing an anode and cathode for the bacteria to deposit electrons onto. After the culture was established, we enriched the habitat with different carbon sources. While initially displaying slow growth, the cultures grew to be well-established colonies, steadily powering an LED light on top of the MudWatt kit.

Website(s)/On-line Reference(s) :
Regolith Simulants Supplier: https://spaceresourcetech.com/collections/regolith-simulants
MudWatt Assembly Protocol**:**
https://www.magicalmicrobes.com/products/mudwatt-clean-energy-from-mud

Talk 3: 11:40 am – 11:55 am

Institution: **University of Minnesota - Duluth**

Student Presenter(s): **Matt Laine**

E-mail address for each presenter: laine053@d.umn.edu

Other Student Author: **Jacson Reichel**

Mentor: **Dan Stevens**

Title: **The M-dwarf Discrepancy**

M-dwarf stars are highly sought after by astronomers when searching for Earth-like exoplanets due to their unique characteristics. Models of low-mass stellar evolution are usually required to determine a star's physical properties, which in turn can be used to calculate the parameters of an orbiting exoplanet. Some observed parameters derived from "benchmark" binary systems with two M-dwarf stars vary from the stellar model by 5-10%. Recent satellite observations enable a different type of binary – one in which an M-dwarf orbits a larger primary star – to be used as stellar model calibrators. The analysis of a sample of such binary stars will be presented, using the EXOFASTv2 exoplanet-fitting software to determine the stars' physical properties to high precision and accuracy. The results will be shown compared to model-predicted values to determine whether the M-dwarf models and/or the double M-dwarf binaries are the cause of the M-dwarf discrepancies.

Exhibits (12:00 pm – 1:20 pm) in the Hagfors Center Lobby

Institution: **St. Catherine University**

Student Exhibitors: **Bronwyn Hicks and Abby Conrad**

Other Students: **Kadiatu Kaya, Susan Adewale**

Mentors: **Prof. Erick Agrimson**

Name of Team/Project on Exhibit: **St. Catherine University Ballooning Team**

We will be showing two items:

The first is what is known as the Geiger payload. This payload will be flown by a group of St. Catherine University alumna during the April 8th, 2024 total solar eclipse. This payload is composed of a Geiger-Mueller (GM) tube to measure charged particles in the atmosphere. It also has a personal neutron dosimeter (PND) which measures the neutral particles which are filmed using a Go-Pro camera and internal payload lighting provided by a battery-powered LED.

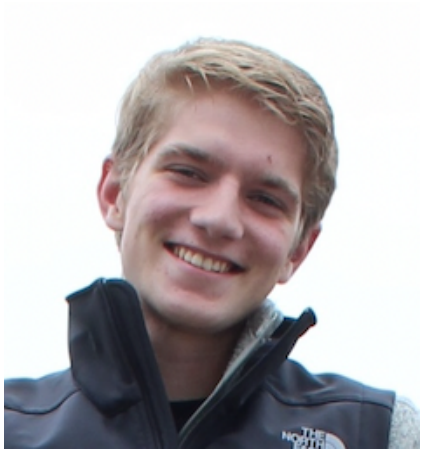
We will also show off a sun spotter which is a solar telescope that allows the viewer to see a projected image of the sun on a sheet of paper that can allow the viewer to see the sun's motion as well view as any present sunspots. We plan to bring the sun spotter for outreach activities at Taylor University during the eclipse.

Website(s)/On-line Reference(s):
https://www.iastatedigitalpress.com/jhab/article/id/13031/
https://www.cloudynights.com/articles/cat/user-reviews/telescopes/solar-telescopes/the-sunspotter-the-safer-solar-telescope-r101

Exhibits (12:00 pm – 1:20 pm) in the Hagfors Center Lobby

Institution: **University of Minnesota - Twin Cities**

Student Exhibitor(s): **Ashton Posey, Jessica Glamm, Yoel Mekbeb**



Other Students (involved, but not exhibiting): **Jasmine Thayer, Jesse Cook, Ethan Thompson-Jewell, Seyon Wallo, Alex Halatsis**

Mentor(s): **James Flaten**

Name of Team/Project on Exhibit: **Nationwide Eclipse Ballooning Project**

The Nationwide Eclipse Ballooning Project consists of teams across the country designing, building, and testing diverse experimental payloads for scientific observations during the October 2023 and April 2024 solar eclipses. The University of Minnesota Team has been actively involved in the project with a focus on developing and testing payloads including:

- Remote Flight Data (RFD) System
- Video Streaming System
- Vent System
- Camera Systems
- Iridium Tracking System
- PTERODACTYL Data Collection Unit

Find out more about the functionality and technical design of some of the payload systems at the MN Space Grant Consortium Student Symposium!

Website(s)/On-line Reference(s) (max 3): https://eclipse.montana.edu/ebp-engineering.html
https://www.mnspacegrant.org/umn-twin-cities-to-be-pod-lead-for-nebp-project/

Exhibits (12:00 pm – 1:20 pm) in the Hagfors Center Lobby

Institution: **University of Minnesota - Duluth**

Student Presenters: **Gweneth Lau, Rachel Cirillo, Dagan Larson, Anna O'Brien, Andrew Carland, Samuel Draeger, Andrew Ludwig**

Headshot of Student Exhibitor(s):

Mentors: **Jose Carrillo - University of Minnesota, Duluth, David Fliger- Tripoli Rocketry Association, Gary Stroick- University of Minnesota, Twin Cities**

Title: **Bulldog Rocketry: Superior I**

Bulldog Rocketry, a student-led organization at the University of Minnesota Duluth, will be displaying their rocket designed for the 2023 Spaceport America Cup. They have manufactured and tested a solid-fueled high-powered rocket, named *Superior One,* spanning 15' 1' in length and measuring 6" in diameter to carry a 9.1lb 3U payload to a projected apogee of 31,303ft. Their Payload, dubbed the Igloo, has the mission to determine the feasibility of collecting waste heat energy around the rocket from the motor and flight friction, to then store it as usable electricity within the payload. The team competed in the Student Researched And Developed (SRAD) solid motor - 30,000 ft category of the Intercollegiate Rocket Engineering Competition (IREC), which they have competed in for the past 6 years. The team will be happy to show off what they have made and answer any questions that you may have.

Website(s)/On-line References:
https://www.bulldogrocketry.org/
https://www.soundingrocket.org/
https://www.herox.com/SpaceportAmericaCup2024

Oral Presentation - Session 3 (1:30 pm – 2:30 pm)

(Zoom Link: https://umn.zoom.us/j/7261550823)

Talk 1: 1:30 pm – 1:45 pm

Institution: **University of Minnesota – Twin Cities**

Student Presenter: **Ashton Posey**

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Mentor: **James Flaten**

Title: **Development of the PADL flight computer for stratospheric ballooning and high-power rocketry**

The “Phully-Adaptive Data Logger” (PADL-33) flight computer is an avionics package for use in stratospheric ballooning and high-powered rocketry (it is longer and narrower than our other flight computers, to fit into high-power rockets better) that can log a 9 degree of freedom (DOF) inertial measurement unit (IMU), barometric pressure, 2 temperatures, and GPS and costs about $180. The microcontroller used on the PADL-33 is the Arduino Nano BLE33 Sense Rev2 with a built-in 9-DOF IMU, pressure sensor, humidity sensor, gesture/light/proximity/color sensor, and microphone. This microcontroller can be mounted on a solderless breadboard or soldered onto a custom PCB. The PCB variant includes a 3.7V to 5V booster breakout that can also charge a 3.7V battery, a micro-SD card breakout, a u-blox NEO-M9N/M8N or ZED-F9P GPS breakout, four indicator LEDs, 2 switches, terminal block breakouts for most pins on the microcontroller, and a piezo buzzer. The PADL-33 has flown on 5 high-powered rocketry flights and 6 stratospheric ballooning flights to date. More success has been found on rocketry flights, with all known errors already patched. The low temperatures encountered on stratospheric balloon flights have caused some issues for the PADL-33 design which can be alleviated with active heating and insulation.

Talk 2: 1:45 pm -2:00 pm

Institution: **Bethel University**

Student Presenter: **Xavier Blasingame**

E-mail address for each presenter: xsb24243@bethel.edu

Mentor: **Dr. Nathan Lemke**

Title: **Finding Servo Error in an Atomic Clock Based on a Two-Photon Transition in Rubidium**

Atomic clocks have become a heavily researched part of our world today with their importance in deep-space navigation and communication. There are always errors that occur in an atomic clock that keep it from being able to perfectly keep time (stability). One of those errors is servo error, which is an error caused by limitations in instruments used to lock the clock thereby causing the frequency that is locked at to be different from the true center frequency of the atomic transition. In order to see that there is servo error and not confuse it with other errors, other errors in the clock have to be corrected. This can be done by applying data corrections with the light shift coefficients which are the results of this research, having numerical values of 1.83×10^{-10} and -7.43×10^{-10}.

Talk 3: 2:00 pm – 2:15 pm

Institution: **Leech Lake Tribal College**

Student Presenter: **Samantha Fairbanks**

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Mentor: **Kelly Nipp**

Title: **First Nations Rocket Launch Wisconsin Space Grant**

First Nations Rocket Launch is an annual rocket competition that has been put on by the Wisconsin Space Grant for students attending a Tribal College or University (TCU), a Native-American-Serving Nontribal(NASNTI), or members of an active American Indian Science and Engineering Society (AISES) collegiate chapter to design, build, and fly a high powered rocket to be launched at the Richard Bong State Recreational Area in Kansasville, WI in late April 2024. Leech Lake Tribal College has participated in the rocket competition since 2010 and has successfully placed in the top three multiple times. This year Leech Lake will be participating in the Gateway Challenge as our team consists of all new members and we lack experience. This year's Gateway Challenge competition parameters will be discussed along with modifications our team is making to the rocket to increase our experience and gain extra points for award consideration. Team challenges will be discussed along with what our team hopes to get out of competing in high-powered rockets.

Talk 4: 2:15 pm – 2:30 pm

Institution: **Augsburg University**

Student Presenter: **Eleanor Flynn**

E-mail address for each presenter: flynne@augsburg.edu

Other Student Authors: **Edwin Panora, Francesca Savio**

Mentor: **Dr. Moumita Dasgupta**

Title: **Quantifying Changes in Daphnia Locomotion Patterns**

Daphnia magna, a small crustacean inhabiting freshwater environments, holds pivotal significance in ecological, toxicological, and pharmacological research. Its locomotion, primarily driven by antennae movements, remains inadequately quantified despite its importance. Our study aims to provide a comprehensive, detailed analysis of Daphnia's motion. We conducted observations of their free-swimming behavior in a quasi-2D chamber and examined their antennal movements while tethered. Leveraging deep learning software (SLEAP), we gathered precise positional, temporal, and orientation data, enabling the categorization of distinct Daphnia magna gaits. We administered a dopamine receptor agonist—a known agent that reduces the average swimming speed of these organisms and observed the changes to their position, velocity, and orientation. However, the precise mechanisms underlying the changes remain elusive. Our study aims to identify the specific features of swimming gaits that give rise to discernible mobility patterns, consequently contributing to the reduction in overall swimming speed.

Poster Session 2 (2:40 pm – 3:25 pm)

(Posters in breakout rooms on Zoom Link: https://umn.zoom.us/j/7261550823)

Institution: **Concordia College**

Student Presenters: **Matthew Mondry, Zach Jackson**

E-mail address for each presenter: mmondry@cord.edu, zjackso1@cord.edu

Mentor: **Dr. Luiz A. Manzoni**

Title: **Quantum Tunneling Time Distributions in a Semi-infinite Square Well Potential**

We examined the concept of tunneling times by observing the following situation: We considered a particle in an initially confining semi-infinite square well potential that suddenly changes to a square barrier potential, allowing the particle to escape by tunneling and, thus, simulating the phenomenon of strong-field ionization. We observed the initial boundary conditions for the well's system, then calculated the wave function for the system and the spectral distribution for a particle that has escaped the potential well. Then, using a Salecker-Wigner-Peres quantum clock, we were able to define the cumulative probability that the particle has escaped and obtain a distribution of exit times resulting from the previous equations we developed. We calculated the time spent in the well, the barrier, and outside the system by using the phase constant given by the initial boundary conditions and graphed the functions – a numerical analysis of the final results is still in progress.

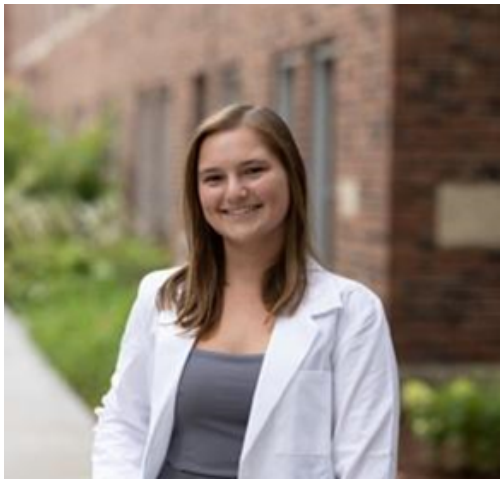
Poster Session 2 (2:40 pm – 3:25 pm)

(Posters in breakout rooms on Zoom Link: https://umn.zoom.us/j/7261550823)

Institution: **St. Catherine University**

Student Presenter: **Abby Conrad**

E-mail address for each presenter: akconrad425@stkate.edu



Other Student Authors: **Bronwyn Hicks, Kadiatu H. Kaya, Odunola Adewale**

Mentor: **Erick Agrimson**

Title: **Reflections From Socorro, NM Surrounding the 2023 Annular Eclipse**

In this talk, we present a brief look back on St. Catherine University's (St.CU) trip for the Annular Eclipse on October 14th, 2023 as well as our hosting institution the New Mexico School of Mines and Technology (NMMT), and the National Radio Astronomy Observatory (NRAO) guesthouse in Socorro NM. We will present a short overview of our involvement in the Nationwide Eclipse Ballooning Project (NEBP) atmospheric science team collecting ground as well as tropospheric and stratospheric data for 30 hours surrounding the eclipse. The purpose of the project included outreach to community members, especially our host Ken Minschwaner, as well as collecting data of the atmosphere to look for gravitational waves. We conducted this research with partners St. Cloud State University (SCSU) and Fond du Lac Community and Tribal College (FDLTCC). We will discuss our protocols and a summary of overview results collected from the Minnesota Atmospheric Science team. We will also include some fun photos we took in the desert southwest during this incredible celestial event. In addition, we will outline the setup for our trip to Upland, IN, and our host institution for totality Taylor University on April 8th, 2024!

Website(s)/On-line References:
[1] Nationwide Eclipse Ballooning Project (NEBP) | Science Mission Directorate.(n.d.). https://eclipse.montana.edu/

[2] Espenak, F., “Glossary of Solar Eclipse Terms,” NASA Available: https://eclipse.gsfc.nasa.gov/SEhelp/SEglossary.html. [retrieved 7 July 2023]
[3] Dr Sean Bailey., University of Kentucky, Department of Mechanical and Aerospace Engineering. Figures 3, 5 and 6

Poster Session 2 (2:40 pm – 3:25 pm)

(Posters in breakout rooms on Zoom Link: https://umn.zoom.us/j/7261550823)

Institution: **Augsburg University**

Student Presenter: **Abram Cressman**

E-mail address: cressmaa@augsburg.edu

Other Students: **Bjorn Solberg**

Mentor: **Benjamin Stottrup**

Title: **Equilibrium behavior of branching curvature and comparison of enantiomer morphology in lipid monolayers**

Dipalmitoylphosphatidylcholine (DPPC) is a common model system for exploring the phase behavior of Lung Surfactant -the lipid-protein layer coating of the alveolar interface that facilitates breathing by reducing the line tension. The availability of enantiomers of DPPC in purified form allows us to investigate the chiral nature of model lipid monolayers through fluorescence microscopy and traditional Langmuir thermodynamic techniques. We focus on mixtures of DPPC with cholesterol, hexadecanol (HD), and palmitic acid (PA), which have been previously studied and shown to form equilibrium morphologies over experimental time scales REF: Valtierrez et al., Sci. Adv. v:8:14, 2022). In this poster, we will assess the use of complementary image processing and analysis routines to measure the curvature of morphologies within these monolayers. The introduction of cholesterol within the monolayers stabilizes domain branches which curl and elongated over time. Previously it was shown that domain morphologies evolve to stripes of equilibrium widths. We are currently investigating the distributions of curvatures within the monolayer morphologies and their use as a signature of equilibrium behavior.

Poster Session 2 (2:40 pm – 3:25 pm)

(Posters in breakout rooms on Zoom Link: https://umn.zoom.us/j/7261550823)

Institution: **Augsburg University**

Student Presente: **Jimmy Hemera**

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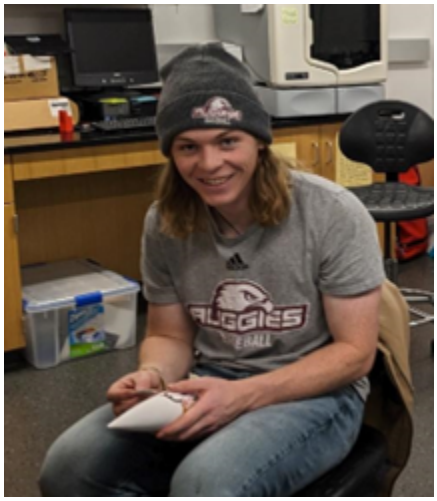

Other Student: **McKenna Minder**

Mentor: **Dr. Amanda Case**

Title: **Chemical Kinetics of the Reaction Between the Acetyl Radical and Oxygen**

Through the use of a pump-probe laser set up, an investigation into aromatic radicals can be achieved. The acetyl radical is prevalent in the atmosphere where it can react with oxygen to form large hydrocarbons that pollute the environment. By researching the formation rate of the hydroxyl radical byproduct, we aim to understand the factors that affect how these radicals are formed. Two Nd:YAG lasers were employed to create the acetyl radical from acetone being supplied through a flow tube with a stable mixture of O2, nitrogen in the form of dry air and the vapour of the acetone sample. The tube is maintained at a near vacuum with a total pressure of 20 torr when at full flow. First the concentration of the mixture in the flow was varied while maintaining pressure, then the pressure was varied whilst maintaining the oxygen concentration. From this research we found an apparent correlation between the formation rate and concentration of the oxygen, and an inverse correlation with the pressure. Further research into this reaction is needed to gain a fuller understanding.

Poster Session 2 (2:40 pm – 3:25 pm)

(Posters in breakout rooms on Zoom Link: https://umn.zoom.us/j/7261550823)

Institution: **Augsburg University**

Student Presenters: **Martina Wolo, Hanna Le, Ganame Kassim, Rahmanimo Yusuf**

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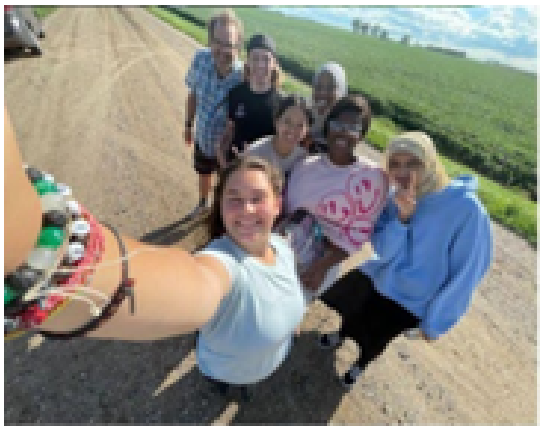

Mentor: **Benjamin L. Stottrup**

Title: **Staying Aloft, A Second Year of Project Launch**

We will discuss the second year of using our simple Project Launch platform. This platform quickly assembles for high-altitude balloon data collection using Teensy Board, Sparkfun sensors, a breadboard, and a power supply module. Additional sensors and experiments can be seamlessly integrated. We'll detail our flight and progress. The Project Launch platform provides a stable foundation for student projects, facilitating classroom knowledge sharing. Students receive basic Arduino/Teensy software for customization, fostering inquiry-based experiment development.

Poster Session 2 (2:40 pm – 3:25 pm)

(Posters in breakout rooms on Zoom Link: https://umn.zoom.us/j/7261550823)

Institution: **Augsburg University**

Student Presenter(s): **Luke Omodt**

E-mail address for each presenter: **omodtl@augsburg.edu**

Mentors: **Maya Ramesh, Anna Park, Darrell G. Schlom**

Title: **$Pb_2Ir_2O_7$ Thin Film Growth for Spin Transport**

$Pb_2Ir_2O_7$ is a promising material for spin transport. $Pb_2Ir_2O_7$, having a cubic structure, is interesting because it contrasts the many low symmetry spin transport studies. This work shows the successful growth of $Pb_2Ir_2O_7$ {111}, {110}, and {100} in order to explore the possibility of different crystal orientations yielding distinctive spin transport results. In addition, we did extensive xray diffraction (XRD) and x-ray photoelectric spectroscopy (XPS) studies proving the successful growth. Lastly, we include preliminary spin transport data on $Pb_2Ir_2O_7$ {111}.

Poster Session 2 (2:40 pm – 3:25 pm)

(Posters in breakout rooms on Zoom Link: https://umn.zoom.us/j/7261550823)

Institution: **University of St. Thomas**

Student Presenter: **Conrad Provost**

E-mail address for each presenter: **conradprovost@gmail.com**

Mentor: **Dr. Rob Davies**

Title: **Applying Simulations to Space Radiation Testing Applications**

Radiation, such as the high-energy particles in space, are damaging to microelectronics on board spacecraft. Thus, microelectronics that are considered for space flight are commonly tested in terrestrial labs to understand their tolerance to radiation. A common standard for performing such testing, MIL-STD- 883-1019, requires that radiation test articles be enclosed in a lead aluminum box.

We are interested in understanding the efficacy of such Pb-Al boxes for different test configurations. During the summer of 2023, we used data available in the literature to validate a radiation transport simulation package known as Geant4 for studying surface dose profiles caused by a Co-60 radiation field that has passed through various material combinations. Having validated Geant4 for this work, we are now studying the effects of factors such as geometry of the lead-aluminum box, the situation of the test material within the box, material transitions in microelectronic packages, and radiation source geometry to predict test variability within MIL-STD-883 compliant tests.

Keynote Speaker (3:30 pm – 4:15)

(Zoom Link: https://umn.zoom.us/j/7261550823)

Institution: **University of Minnesota - Twin Cities**

Presenter: **Professor Ali Sulaiman**

E-mail address: asulai@umn.edu

Title: **The Juno Mission at Jupiter**

Jupiter's internal magnetic field carves out a cavity in the interplanetary medium to form the largest magnetosphere in our solar system.

Immersed within its magnetic environments are geologically active moons. A notable example is Io which is populated with active volcanoes. The volcanic activity drives the ebbs and flows of the magnetosphere. One obvious manifestation is Jupiter auroras – the most powerful in the solar system. Other notable moons are Europa and Ganymede, both believed to harbor oceans beneath their icy crusts.

In the past decade, NASA's Juno spacecraft undertook the first polar orbits of Jupiter providing unprecedented coverage and proximity to the giant planet, its auroras, and its dynamic moons.

I will highlight some discoveries enabled by Juno and planetary explorers that have revolutionized our view of the solar system, ushering in a new and exciting era for space plasma processes and the question of habitability beyond our planet.

Website/On-line Reference:
https://cse.umn.edu/physics/ali-sulaiman