2022 Minnesota Space Grant (MnSG) Student Symposium

Book of Abstracts

March 26, 2022

"Main Room" Akerman 209 https://umn.zoom.us/j/7261550823 **(open 9 a.m. to 4:45 p.m: Welcome, Session 1, Session 3, Keynote, Session 5, NASA Center Internships, Career Panel, and Announcements)**

"Alternate Room" Akerman 225 https://umn.zoom.us/j/9772902391 **(open for Session 2 (9:15 to 10:00 a.m., Session 4 (11:00 a.m. to 12 noon), and Session 6 (1:00 to 2:00 p.m.)**

https://www.mnspacegrant.org

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Technical Issues:

Please, call James Flaten – 651-399-2423

Room numbers (in Akerman Hall, U of MN East Bank campus, Minneapolis)

- **"Main Room" - Akerman 209**
- **"Alternate Room" - Akerman 225**
- **"Exhibit Space" - Balas Atrium - ground floor of Akerman Hall**

Zoom links

"Main (Zoom) Room" https://umn.zoom.us/j/7261550823

"Alternate (Zoom) Room" https://umn.zoom.us/j/9772902391

Welcome to NASA's MN Space Grant Consortium's 2022 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 24 contributed talks and 14 exhibits by students who have worked on a variety of MnSGC research, higher education, and outreach projects in the past year. In-person attendees will meet in the "Main Room" (Room 209) and the "Alternate Room" (Room 225) in Ackerman Hall on the U of MN's East Bank campus in Minneapolis. Exhibits will take place in the Balas Atrium, also in Akerman Hall. Remote attendees will view the proceedings in one of two Zoom rooms called the "Main (Zoom) Room" and the "Alternate (Zoom) Room"

The contributed talks are spread over six sessions – two in parallel starting at 9:15 a.m., two in parallel starting at 11:00 a.m., and two in parallel starting at 1:00 p.m. – one in the "Main (Zoom) Room" and one in the "Alternate (Zoom) Room" for each pair of sessions. The in-person exhibits will run from 10:15 to 11:00 a.m. and, with different exhibit topics, from 2:00 to 2:45 p.m.

Also in the "Main (Zoom) Room" we are pleased to offer a session (not in parallel, so that everyone can attend) a keynote student talk about a NASA project to use a UAV testbed to test control algorithms for "big" launch vehicles and landing systems and a session by 3 students who received NASA Center Internships in the summer of 2021.

The symposium will end in the "Main (Zoom) Room" with a Career Panel by several individuals with interesting career stories and advice to share with students. That panel discussion will be followed by announcements of awards from each of the 6 contributed student talk sessions.

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
Talks	
Augsburg University	
Bjorn Solberg; Aidan Dosch (Saint Olaf College)	Phase behavior in two dimensional Langmuir monolayers
Leon Armbruster	First Passage Properties of Active Self-propelled Systems through Obstacles
Jade Boysen	Weyl semimetal behavior in shandite $Co_3Sn_2S_2$ single crystals and thin films.
Bethel University	
Jordan Mugglin	Imaging Thermally Driven Periodic Flow in Air
Kristina Boecker	Frequency measurement of two optical rubidium clocks
Bemidji State University	
M. D. Kaes	Hyperspectral imaging for plant identification
Concordia College	
Noel Geiger	GLEAM Lunar Robotics Intercollegiate Challenge
Mikala Hammer, Colton Thomasson	Investigation of iron oxides transformations in different environmental conditions
Taylor DeVine, Melanie Borysewicz	*Spinacia oleracea* can germinate but is unable to grow in Mars regolith without soil amendments
Lucas Vanhoever	Design and projected performance of a permanent magnet-based vector magnet
Gabe Holum, Ashton Posey (UMTC)	GLEE – the Great Lunar Expedition for Everyone
Fond du Lac Tribal and Community College	
Joseph Bruce	How Rocketry Can Advance Native American Youth & Tribal Communities
Macalester College	
Jason Beal	Knocking Down NOx: Examining the Effects of Transportation Electrification on Urban Ozone Production in the South Coast Air Basin
St. Catherine University	
Anisa Tapper	Stratospheric Neutron Detection Using Personal Neutron Dosimeters

University of Minnesota - Duluth

Max Benson, Gwen Lau, Nick Klemman, Emma Nelson, Zach Coughlin, Logan Iverson	Bulldog Rocketry and the Spaceport America Cup

University of Minnesota – Twin Cities

Akshay Naik	NASA's Artemis Student Challenges and Other NASA-Related National Competitions
Noé Bazán, Isidore Simon, Jesse Cook	The "Everest" Project – Development of a Portable Weather Station for Mountain Climbers and Hikers
Nathan Pharis	High Altitude Student Platform (HASP)
Joe Poeppel	MnSGC Intercollegiate Challenges and Competitions
Paul Wehling, Shea Larson	The Nationwide Eclipse (Stratospheric) Ballooning Project (NEBP)
Dominic Adams	Universe in the Park (UitP): Our experiences with astronomical outreach
Megan Clarke, Robbie Pettys-Baker	Developing an Interdisciplinary Wearable Technology Lab Course
Ashton Posey, Gabe Holum (Concordia College)	GLEE – the Great Lunar Expedition for Everyone
Demoz Gebre-Egziabher	The IMPRESS and EXACT CubeSat Missions

NASA – Center Internships

Crystal Compton (UMTC)	Textile-Based On-Body Sensing for Sizing and Fit of Wearable Systems
Walker Nelson (St Cloud State University)	Research and Design of Additively Manufactured Battery Thermal Management Systems
Kailey Pierce (UMTC)	Aerial Data Acquisition Platform for Firefront Monitoring

Exhibits - Morning

Ben Stottrup (Augsburg University)	Making @ Augsburg
Greta Elliott, Erne Habegger Mc Cabe, Shawn Meyer (UMTC)	GLEE (the Great Lunar Expedition for Everyone) Hardware
Noel Geiger, (Concordia College) Jasmine Thayer, Tony Tran (UMTC)	GLEAM Lunar Robotics Challenge Hardware and Designs
Seyon Wallo, Abigail (Abbie) Friessen (UMTC)	Hardware from Introduction to Spaceflight with a Stratospheric Ballooning Project – a Hands-on Freshman Seminar

Sophia Vedvik (UMTC)	Remote High-Power Rocketry Lessons
Zoë Foster, Paul Wehling, Noé Bazan (UMTC)	Extracurricular Stratospheric Ballooning

Exhibits - Afternoon

Shea Larson, Alex Omweri (UMTC)	Eclipse Ballooning Hardware and Software
Ben Teigland, Alec Braun, Nathan Engman (Bethel University)	Space Grant Midwest High-Power Rocket Competition
Kaitlyn Blair, Zoe Sternberg (St. Catherine University)	Charged and neutral particle detection HAB payloads
Max Benson, Gwen Lau, Nick Klemman, Emma Nelson, Zach Coughlin, Logan Iverson (UMD)	Bulldog Rocketry and the Spaceport America Cup - Intercollegiate Rocketry Engineering Competition
Ross Ferguson (Macalester College)	RockOn Suborbital Rocketry Workshop payload plate
Ty Kozic, Annsley Greathouse (UMTC)	CubeSat development
Milan Patel (UMTC)	Quadcopter Based Launch Vehicle Control System Test Bed

Keynote Speaker

Liam Elke (UMTC)	UAV testbed

Career Panel

Mark Abotossaway - Blue Origin (formerly at Boeing)
Keegan Bunker - UMTC, NASA Pathways Internship
Lucy Dunne - Wearable Technology Lab, UMTC

Concurrent Session 1 in Main Room (9:15 am – 10:15 am) Akerman 209

Moderator: Rik Gran – University of Minnesota – Duluth

Session 1 Talk 1: 9:15 am -9:30 am

Institutions: University of Minnesota – Twin Cities and Concordia College

Student Presenters: Ashton Posey (University of Minnesota - Twin Cities) and Gabe Holum (Concordia College)

Mentor: James Flaten

Title: GLEE – the Great Lunar Expedition for Everyone

Recording link: https://youtu.be/05RwZXzAo9s

The Great Lunar Expedition for Everyone (GLEE) is a project led by the Colorado Space Grant to engage hundreds of student teams around the US, and indeed around the world, to work on very small radio-networked sensor suites onboard LunaSats. The University of Minnesota – Twin Cities and Concordia College sent representatives to an in-person workshop in October 2021 where they worked with the actual GLEE hardware and ten hands-on-modules. Both were developed to teach teams about various sensors, RF communication, and more. Their goal is now to engage students at the U of M by creating a team and promoting this opportunity. Many student teams around the world will design a science mission for their LunaSat based on their own interest and expertise. Together, the collection of LunaSats will perform larger-scale experiments on the Moon, beyond any individual team's local mission. Hopefully, by the end of 2023, five hundred LunaSats will be sent to the lunar surface to conduct distributed-science experiments. GLEE will provide an opportunity for STEM education to anyone who is interested. GLEE is looking for more teams to get involved and will be having an asynchronous remote workshop starting May 11. Sign-ups are open until April 4, 2022 – register a team now!

Website(s)/On-line Reference(s) (max 3):
https://www.glee2023.org/
https://www.youtube.com/watch?v=24ujpW5nN5Q&t=17s (1.5 min promotional video)
https://www.glee2023.org/workshop-apply-now

Session 1 Talk 2: 9:30 am – 9:45 am

Institution: Concordia College

Student Presenter: Noel Geiger

Other Student Authors: Taylor Streyle, Hannah Olsen, Nick Perkins, Lucas Vanhoever, Noah Halmar, Colton Thomasson, Logan Jackson, Micah Solberg

Mentors: Dr. James Lee

Title: GLEAM Lunar Robotics Intercollegiate Challenge

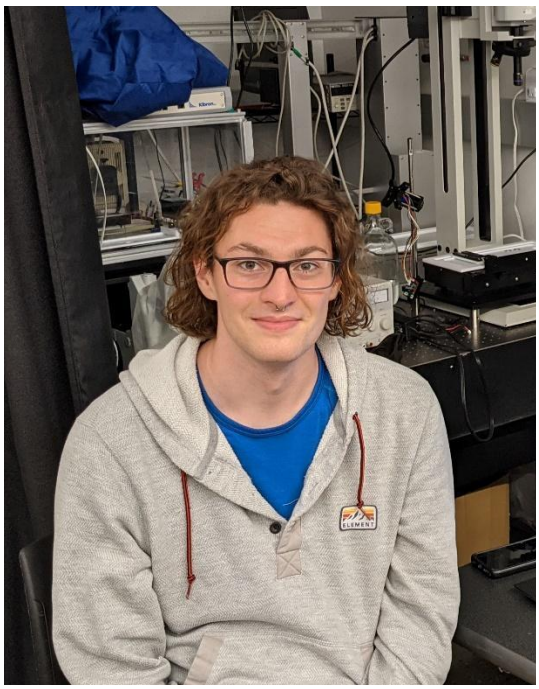
Recording link: https://youtu.be/SRtwnEc7G1k

The MnSGC's GLEAM Lunar Robotics Intercollegiate Challenge was educational, inspiring, and a perfect opportunity for college student teams to participate in an exciting, NASA-themed, hands-on activity. Teams participating in the challenge were asked to design a miniature rover system capable of exploring and mapping a fully-darkened, simulated lunar surface consisting of a plain, a ramp-up to an elevated surface (the "plateau"), and a "cave." The video-streaming rover(s) had to be controlled from "Earth" via radio. Sensor data had to be relayed to "Earth" through a Moon-based "central (radio) unit." It was up to each team to decide what sensors should be on the rover(s) and how the data would be relayed to "Earth." Using the data, the team needed to create a map and describe the mock-lunar environment in as much detail as possible. Aside from strict mass limitations, the challenge goals provided were somewhat vague, thus forcing the teams to think hard about how to best map the environment, what sensors would be most useful, and how to design a low-mass rover and radio system to achieve this. The GLEAM Lunar Robotics Challenge was an invigorating project that forced students to branch out, learn, and design creatively.

Session 1 Talk 3: 9:45 am – 10:00 am

Institution: Augsburg University

Student Presenters: Bjorn Solberg (Augsburg University); Aidan Dosch (Saint Olaf College)



Mentors: Benjamin L. Stottrup (Augsburg University); Cain Valtierrez (University of Minnesota) J. Zasadzinski (University of Minnesota)

Title: Phase behavior in two dimensional Langmuir monolayers

Recording link: https://youtu.be/Km4OiBmCiXk

This talk will focus on the unique opportunity presented to investigate two-dimensional phase separation in lipid monolayer systems. Using traditional Langmuir monolayer measurements of thin films and fluorescence microscopy to study both liquid-liquid and solid-liquid coexisting phases. We will present existing questions of dipole density differences between these phases as well compositional variation in these two-dimensional systems. Approaches to address these questions using image processing and atomic force microscopy will be discussed.

Session 1 Talk 4: 10:00 am – 10:15 am

Institution: University of Minnesota – Twin Cities; Minnesota Institute for Astrophysics (MIfA)

Student Presenter: Dominic Adams

Mentor: Evan Skillman

Title: Universe in the Park (UitP): Our experiences with astronomical outreach
Recording link: https://youtu.be/hn60iu9w974
For more than 20 years, the "Universe in the Park" (UitP) outreach program has been promoting the appreciation of space and astronomy across Minnesota. Each summer this program provides about 15 nights of free telescope observations in state or local parks across the state, guided by graduate students in the University of Minnesota's astrophysics program. As the coordinator of the UitP program over the last few years, I've gotten to see the power of hands-on, face-to-face interaction to generate passion about science. I've also had to learn how to adapt when those sorts of interactions are impossible – as happened during the COVID-19 pandemic in 2020. During this talk, I'll discuss our experiences with Universe in the Park, as well as with our virtual "Universe @ Home" program that we launched as a virtual replacement during the pandemic. In particular, I'll focus on how these programs work and why we find them valuable.

Website(s)/On-line Reference(s):
https://cse.umn.edu/mifa/public-events/universe-park

Concurrent Session 2 in Alternate Room (9:15 am – 10:15 am) Akerman 225

Moderator: Carl Isaacson – Bemidji State University

Session 2 Talk 1: 9:15 am – 9:30 am

Institution: University of Minnesota – Twin Cities

Student Presenter: Joe Poeppel

Mentor: James Flaten

Title: MnSGC Intercollegiate Challenges and Competitions

Recording link: https://www.youtube.com/watch?v=YeRxLjzfM7k

Every year the MN Space Grant Consortium (MnSGC) offers "challenges" and "competitions" for college/university student teams. These academic-year-long events, the topics of which often change from year to year, start in the fall and are completed by the following spring. Participants are welcome from MnSGC affiliates and also from schools that are not formally involved in Space Grant. The MnSGC often provides support – both materials and training – to teams from schools that are new to the topic. This presentation will describe recent iterations of (A) the "Space Grant (in-the-)Midwest High-Power Rocketry Competition" which is open to teams from around the country but mostly attracts participants from Minnesota and surrounding states, and (B) the "MnSGC Intercollegiate Challenge" which is only open to teams from colleges and universities in Minnesota. This year's "GLEAM Lunar Robotics" challenge is currently finishing up, and fly-offs for this year's "Return to Flight: Fleet (high-power rocketry) Challenge" are scheduled for May 22, 2022 – spectators are welcome! Next year's opportunities will be announced in early September 2022 and will be completed by May 2023.

Website(s)/On-line Reference(s):
https://dept.aem.umn.edu/mnsgc/Space_Grant_Midwest_Rocketry_Competition_2021_2022/
https://m.dept.aem.umn.edu//msgc/MN_Space_Grant_GLEAM_Lunar_Robotics_Challenge_2021_2022/

Session 2 Talk 2: 9:30 am – 9:45 am

Institution: Bemidji State University

Student Presenter: MD Kaes

Mentor: Carl Isaacson

Title: Hyperspectral imaging for plant identification

Recording link: https://www.youtube.com/watch?v=NmWsjrEIHeU

Identifying non-point sources of nutrients to surface waters is a problem that has confounded water quality managers for years. Conventional approaches to monitoring water quality require collecting individual grab samples which are then measured in a lab using wet chemistry techniques. While this approach gives precise point information, it doesn't provide significant spatial resolution. Recently remote sensing has been used to monitor spatial variation of agricultural production and water quality at a larger scale. We propose that remote sensing can be used to identify point sources of nutrient pollution to surface waters at a much higher resolution. Our first steps in this direction are to develop a remote sensing platform for terrestrial systems and these results will be presented here.

Session 2 Talk 3: 9:45 am – 10:00 am

Institution: University of Minnesota – Twin Cities

Student Presenters: Megan Clarke, Robbie Pettys-Baker

Mentors: Lucy Dunne, Brad Holschuh

Title: Developing an Interdisciplinary Wearable Technology Lab Course

Recording link: https://www.youtube.com/watch?v=gNg4N-fP7Vs

Wearable Technology is a topic area that sits at the intersection of many different fields. It is also an exciting opportunity area for enabling more efficient human spaceflight, both for extra-vehicular activities (for areas like control and feedback in advanced space suits and multi-sensory perception) and for intra-vehicular activities (such as long-term health monitoring and communications). This talk will discuss a summer experience co-developing an interdisciplinary Wearable Technology lab course in collaboration with two professors. Our efforts involved identifying key topic areas for hands-on learning experiences among students with very diverse background knowledge, developing methods to facilitate students' sharing of their prior disciplinary knowledge with others in the course, and designing a project experience in which prior knowledge and new skills can be applied to solve a wearable technology challenge. The course is currently being delivered for the first time, and we will also discuss experiences so far in course delivery.

Session 2 Talk 4: 10:00 am – 10:15 am

Institution: Macalester College

Student Presenter: Jason Beal

Mentors: Don Blake, Alex Jarnot

Title: Knocking Down NOx: Examining the Effects of Transportation Electrification on Urban Ozone Production in the South Coast Air Basin

Recording link: https://youtu.be/P2lX4y7JViA

With last year's commitment to all in-state sales of new passenger cars and trucks being zero-emission by 2035 (California Executive Order N-79-20), California is leading the charge for transportation electrification in the United States. The goal of this study is to quantify and qualify the impact of California's transportation electrification on urban ozone production in the South Coast Air Basin (SoCAB). From robust studies of the weekend ozone effect, we know that reductions in vehicle emissions on weekend days can actually increase urban ozone concentrations. By examining data from eight ground monitoring stations in the SoCAB over a period of 40 years, we show that this region is a volatile organic compound (VOC)-limited system in which the weekend ozone effect is a clear trend. With this in mind, the question looking forward becomes: how will local atmospheric chemistry and air quality evolve as transportation electrification accelerates? To investigate this question, VOC-NOx ratios are modeled for varying rates of light and heavy-duty vehicle electrification in order to gauge how urban ozone production will be affected. While it is clear that vehicle electrification will ultimately improve air quality and help mitigate climate change, this study provides a unique perspective into the less understood transient impacts of electrification.

Morning Exhibit in the Balas Atrium of Akerman Hall (10:15 am – 11:00 am)

Institution: University of Minnesota – Twin Cities

Student Exhibitor: Sophia Vedvik

Other Students (involved, but not exhibiting): student teams from Inver Hills Community College, Augsburg University, Normandale Community College, University of Minnesota – Duluth, Fond du Lac Tribal and Community College, Hamline University, Bethel University, Century (Community) College.

Mentor: James Flaten

Name of Team/Project on Exhibit: Remote High-Power Rocketry Lessons

Promo video link:
https://drive.google.com/file/d/1-G__D5y1NYx-EkhjKJ0Iv_10WYJGEONG/view?usp=sharing

Description of Project and Items on Exhibit:
To help college and university student teams from across Minnesota get involved in high-power rocketry and gain valuable technical experience, the MN Space Grant offered weekly "Remote High-Power Rocketry Lessons" for six weeks in Fall 2021. Teams from eight schools (listed above) were given the same basic kit rocket to assemble, plus a tote of materials. Each week the teams studied the theory behind high-power rocketry, such as design considerations and simulation methods, and were given an overview of techniques used for building high-power rockets. The instructors also provided a detailed presentation of the build steps for the kit rocket and did pre-launch checkout interviews when each team completed their rocket. Participants not only learned about rocketry, but also about time management, task delegation, and leadership.
About half of the participating teams were able to launch their rockets in December 2021, while the others plan to launch in the spring of 2022. This exhibit will include instructional materials, some kit rockets built in this program, and launch footage from the December launch event.

Website(s)/On-line Reference(s):
https://www.mnspacegrant.org/high-power-rockets-are-flying/
Folder containing materials used for the lessons, links to the remote lesson videos, as well as launch videos for some rockets:
https://dept.aem.umn.edu/people/faculty/flaten/Rocketry_Remote_Lessons_Fall_2021/

Institution: University of Minnesota – Twin Cities

Student Exhibitors: Seyon Wallo, Abigail (Abbie) Friessen

Mentor: James Flaten

Name of Team/Project on Exhibit: Hardware from Introduction to Spaceflight with a Stratospheric Ballooning Project – a Hands-on Freshman Seminar

Promo video link: https://photos.app.goo.gl/6BC3ZeZDGtqxZieo8

Description of Project and Items on Exhibit:
The MN Space Grant has offered hands-on freshman seminars on stratospheric ballooning quite regularly since 2008, most-recently in the fall of 2021. In these classes, which are open to students considering any major, students hone "amateur-spacecraft"-building skills including rugged-but-light-weight construction, microcontroller programming, soldering, wiring, and CAD. Students then design and build miniature spacecraft (AKA "payloads") which are carried by weather balloon into the stratosphere, which has many of the same physical properties (and view!) as outer space. Students go on a day-long field trip to participate in the ballooning mission (when COVID protocols allow), then analyze the data collected. This exhibit will include payloads built and flown by students in the Fall 2021 ballooning freshman seminar, as well as videos they took and results from the experiments they conducted. These payloads incorporated off-the-shelf Neulog sensor chains, Lightdow LD4000 video cameras, as well as custom "PTERODACTYL" flight computers (based on Teensy 3.5 microcontrollers), as well as a custom system to relay experiment data through a commercial StratoStar "SatCom" unit while in flight, plus additional unique experiments suggested by class members.
Website(s)/On-line Reference(s):
https://dept.aem.umn.edu/people/faculty/flaten/AEM1301BallooningFreshmanSeminarFall2021SampleDocs/

Institution: University of Minnesota – Twin Cities

Student Exhibitors: Zoë Foster, Paul Wehling, Noé Bazán



Mentor: James Flaten

Name of Team/Project on Exhibit: Extracurricular Stratospheric Ballooning

Promo video link:
https://drive.google.com/file/d/173-XXNjCdDSE6q6VTcq4rGps0lrt2eys/view?usp=sharing

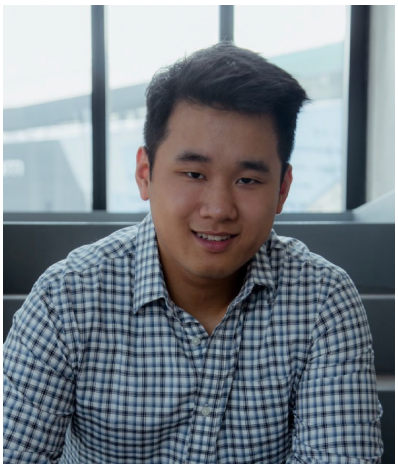
Description of Project and Items on Exhibit:
The University of Minnesota – Twin Cities has engaged college/university students and faculty, as well as pre-college teachers and their students, in extracurricular stratospheric ballooning since 2007. Unlike research-oriented ballooning and curricular (freshman seminar) ballooning, our extracurricular ballooning efforts focus on getting participants familiar with basic ballooning techniques and off-the-shelf payload options, then letting them develop payloads to do experiments of their own devising (as time and resources allow). We even have a standing BABBSS (Build A Balloon-Borne Stratospheric Spacecraft) program in which we offer to train participants to build payloads, then fly the things they construct (inquire with James Flaten for more details). This exhibit will show off a variety of already-flown ballooning payloads ranging from basic payloads assembled at a workshop for Go4St8 physics teachers last summer to CubeSat-shaped payloads and a solar-powered payload developed by students in the stratospheric ballooning team at the University of Minnesota – Twin Cities.

Website(s)/On-line Reference(s):
Overview of Stratospheric Ballooning video posted here: https://www.mnspacegrant.org/videos/
https://dept.aem.umn.edu/people/faculty/flaten/Ballooning_Workshop_2021/
https://dept.aem.umn.edu/people/faculty/flaten/Solar-Powered_Payload_poster_N_Bazan.pdf

Institution: Concordia College and University of Minnesota – Twin Cities

Student Exhibitors: Noel Geiger (Concordia College, Jasmine Thayer (UMTC), Tony Tran (UMTC)





Other Students: Taylor Streyle, Hannah Olsen, Nick Perkins, Lucas Vanhoever, Noah Halmar, Colton Thomasson, Logan Jackson, Micah Solberg (Concordia College), Rory Conway, Esther Ortega Kluger, Ashton Posey (University of Minnesota – Twin Cities)

Mentors: James Lee (Concordia College), James Flaten (UMTC)

Name of Team/Project on Exhibit: GLEAM Lunar Robotics Challenge Hardware and Designs

Promo video link:
https://drive.google.com/file/d/1xD5Blu6peYFPTCD5QfPKe8CJe5wX1RfE/view?usp=sharing

Description of Project and Items on Exhibit:
The GLEAM Lunar Robotics Challenge was an intercollegiate challenge in which teams designed a rover system that will be controlled remotely to explore a mock-lunar environment and transmit data via a radio network to the team at an "Earth" ground station. Each team used the data collected to characterize and map the exploration area. This exhibit will showcase the designs, hardware, and software solutions from two participating teams, one from Concordia College and one from the University of Minnesota – Twin Cities (UMTC). The UMTC team made use of the RC tank that was provided, but heavily modified the original GLEAM hardware and added a video camera from a drone, color-adjustable LEDs, and a thermopile for distance temperature sensing (instead of light detectors). The Concordia College team, on the other hand, basically built a system from scratch. They built a rover with a custom 3D printed chassis and plastic treads sprayed with a rubber coating, on which they mounted a breadboard with sensors (IMU, seismic, and magnetic field sensors), a motor controller, XBee radios, and a geared stepper motor to point a 3D printed turret carrying an IR thermal camera, an ESP-32 Camera, and a TeraBee Lidar Camera.
Website(s)/Reference(s):
https://dept.aem.umn.edu/msgc/MN_Space_Grant_GLEAM_Lunar_Robotics_Challenge_2021_2022/

Institution: University of Minnesota – Twin Cities

Student Exhibitors: Greta Elliott, Erne Habegger Mc Cabe, and Shawn Meyer



Other Students: Ashton Posey, Gabe Holum, Isabelle Vanhatten

Mentor: James Flaten

Name of Team/Project on Exhibit: GLEE (the Great Lunar Expedition for Everyone) Hardware

Promo video link:
https://drive.google.com/file/d/1ozjnE6uvlf9BZn_wfW_tnXsauEJBzc1R/view?usp=sharing

Description of Project and Items on Exhibit:
GLEE (the Great Lunar Expedition for Everyone) is a project led by the Colorado Space Grant to engage hundreds of student teams from all around the US, and indeed around the world, to work on very small radio-networked sensor suites and to send them to the lunar surface to conduct distributed-science experiments, hopefully by the end of 2023. The University of Minnesota – Twin Cities and Concordia College sent representatives to an in-person workshop in October 2021 where they worked with the actual GLEE hardware and brought it back to Minnesota. We will be exhibiting, and demonstrating the capabilities of, the actual GLEE hardware. The LunaSats will collect temperature, magnetic field, and inertial measurements, but other data can be taken depending on each individual team's interests. The mission life for each LunaSat on the Moon is expected to be two lunar days or approximately 56 Earth days. We will show the capabilities of these LunaSats within our atmosphere, and relate what changes they may have on the moon.
Website(s)/On-line Reference(s):
https://www.glee2023.org/
https://www.youtube.com/watch?v=24ujpW5nN5Q&t=17s (1.5 min promotional video)
https://www.glee2023.org/workshop-apply-now

Institution: Augsburg University

Exhibitor: Ben Stottrup

Name of Team/Project on Exhibit: Making @ Augsburg

Promo video link:
https://drive.google.com/file/d/1n8SxJMVluHORWlkNBXTAuwNlXujLh9V8/view?usp=sharing

Description of Project and Items on Exhibit:

At Augsburg University we have used Minnesota NASA Space Grant Consortium funds to support several extra and co-curricular activities focused on building a culture of "Making." This has included support for our machine shop, 3D printer workspace, Arduino kits, and material and kits for soft matter studies. Our activities have taken several forms from Arduino and 3D Printing workshops sponsored by our Society of Physics Students, support of activities like Remote Rocketry Lessons, Pre-College activities for student groups, and more formal activities through courses. These efforts are used to raise the visibility of STEM at Augsburg and engage individuals who might not normally be involved. We will discuss some projects as well as some of the challenges we have in maintaining student run activities.

Concurrent Session 3 in Main Room (11:00 am – 12:00 pm) Akerman 209

Moderator: Alec Habig – University of Minnesota – Duluth

Session 3 Talk 1: 11:00 am – 11:15 am

Institution: University of Minnesota – Twin Cities

Student Presenter: Akshay Naik

Mentor: James Flaten

Title: NASA's Artemis Student Challenges and Other NASA-Related National Competitions
Recording link: https://youtu.be/sZvA7KfxriM
Every year NASA offers multiple nationwide "challenges" (sometimes called "competitions") to engage college/university student teams on a wide range of tasks of interest to NASA. These challenges range from building and testing aerospace hardware (drones and other UAVs, high-power rockets, payloads to fly on "zero-g" flights or stratospheric balloons or suborbital rocket missions or orbital vehicles), developing devices (autonomous, radio-controlled, or people-powered) to do tasks in Lunar/Martian/Other extreme environments, developing tools and spacesuits for use by astronauts, coding (especially for autonomous robots), and more. NASA currently has a set of "Artemis" Student Challenges, on topics related to the Artemis Program to return astronauts to the Moon in the next few years. This presentation will talk about the six "standing" Artemis Student Challenges (Human-Powered Exploration Rover, Micro-g NExT, BIG Idea Challenge, First Nations Launch, SUITS, Student Launch) as well as about six additional Artemis Student Challenges currently being developed and run by Space Grants around the nation (AL: Artemis Trajectory Design and Mission Analysis, IL: Artemis Space Technologies; CO: GLEE (Great Lunar Expedition for Everyone); HI: Low-Cost CubeSat kits; CA: LeapFrog Lunar/Martian Lander; WA: Lunar/Martian Lava Tube Robotics Challenge). Other NASA-related nationwide student challenges will be described as well.

Website(s)/On-line Reference(s) (max 3):
https://www.youtube.com/watch?v=Xn4JTR1n96c (1:20 min promotional video)
https://stem.nasa.gov/artemis/
https://www.nasa.gov/press-release/nasa-funds-artemis-student-challenges-to-inspire-space-exploration

Session 3 Talk 2: 11:15 am – 11:30 am

Institution: University of Minnesota – Duluth

Student Presenters: Max Benson, Gwen Lau, Nick Klemman, Emma Nelson, Zach Coughlin, Logan Iverson






Mentors: Jose Carrillo - University of Minnesota – Duluth, Dave Leininger - Tripoli Rocketry Association, John Christopherson - University of Minnesota – Duluth

Title: Bulldog Rocketry and the Spaceport America Cup

Recording link: https://youtu.be/d711nSCesq0

The Bulldog Rocketry team has had the opportunity to compete in local competitions such as the Space Grant Midwest High Powered Rocketry Competition. The experience gained has allowed Bulldog Rocketry to move on to larger international competitions, specifically the Experimental Sounding Rocket Association's Spaceport America Cup. This is the largest international intercollegiate high-powered rocketry competition that is hosted in Spaceport, New Mexico in June of each year. In the past two years that the team has been able to launch, we have placed 2nd place in the 30,000ft Student Researched and Designed motor category.

Despite the adversity faced in the past few years, the team has been able to continue growing strong through the commitment and excitement our members bring. Students are able to gain hands-on experience designing and manufacturing all aspects of a high-powered rocket, where they are able apply this knowledge to building rockets of their own to get certified through the Tripoli Rocketry

Association. Students also gain valuable life skills such as teamwork, leadership, time management, and communication while following each step of the engineering process. Bulldog Rocketry will continue to grow and expand its capabilities as well as propel its members into their careers.

Website(s)/On-line Reference(s):
https://sites.google.com/view/bulldog-rocketry/home?authuser=1
https://www.soundingrocket.org/
https://www.herox.com/SpaceportAmericaCup2022

Session 3 Talk 3: 11:30 am – 11:45 am

Institution: University of Minnesota – Twin Cities

Student Presenters: Noé Bazán, Isidore Simon, Jesse Cook



Other Student Author: Paul Wehling

Mentor: James Flaten

Title: The "Everest" Project – Development of a Portable Weather Station for Mountain Climbers and Hikers

Recording link: https://youtu.be/lSg-p8jIL7c

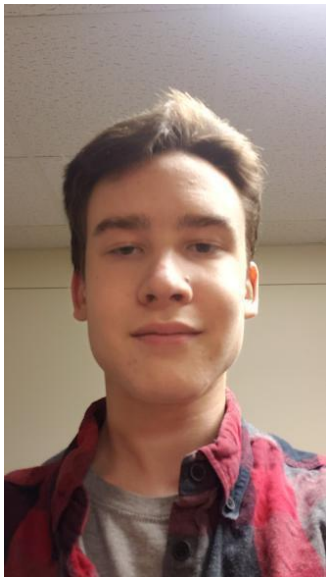
Students at the University of Minnesota – Twin Cities have designed, built, and tested a robust, rechargeable, portable weather station. This is nicknamed the "Everest" project, with the objective of being carried by expeditions to Mount Everest (and elsewhere) to provide long-term (~3 month) surface weather data at altitudes greater than 20000 feet (~6000 m) in subzero temperatures and challenging weather conditions. The exhibit will consist of our custom "Everest" microcomputer-logged sensor suite which includes GPS (for lat/long/alt), as well as a high-accuracy pressure sensor, a humidity sensor, plus thermistors to measure internal and external temperature; all being controlled and logged by a Teensy microcontroller. To monitor the health/longevity of the battery, the "Everest" system also includes a "fuel gauge" for its Lithium-Ion battery, plus an INA219 current/voltage sensor. These monitor the battery life and measure the current flow and discharge rate from the battery, respectively. The "Everest" battery pack will be recharged using a solar panel, with a hand-cranked dynamo for back-up. The "Everest" hardware will be carried in a weather-proof, partially-transparent Pelican "micro" case, to protect the electronics from the extreme weather conditions users will encounter.

Website(s)/On-line Reference(s):
https://storymaps.arcgis.com/stories/8d4353fa92a342349f98eb78e5fb7a9a
https://storymaps.arcgis.com/stories/40bbffd7d1bf4e718e387885f410db0b

Session 3 Talk 4: 11:45 am – 12:00 pm

Institution: Concordia College

Student Presenter: Lucas Vanhoever



Mentor: Dr. James Lee

Title: Design and projected performance of a permanent magnet-based vector magnet
Recording link: https://youtu.be/MnxuFXZSAqg
The design for a vector magnet apparatus capable of applying uniform magnetic fields, in an arbitrary direction, to samples of magnetic materials will be described. Magnetic fields are generated using arrays of cylindrical rare earth permanent magnets. Different segments of this array can be moved toward or away from the sample position to achieve desired field strengths. The array can be rotated around a vertical axis to achieve the correct field direction. Field calculations for the 3 mm x 3 mm x 3mm sample volume indicate that the maximum field will be 0.42 T. The field will be uniform to within 5% in magnitude and direction. The sides of this apparatus are mostly open, allowing laser beams to hit and reflect from the magnetic material samples. This design is suitable for experiments based on optical effects, such as the Kerr effect.

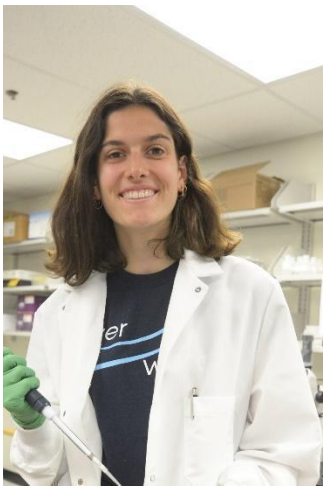
Concurrent Session 4 in Alternate Room (11:00 am – 12:00 pm)

Moderator: Carl Sack - Fond du Lac Tribal and Community College

Session 4 Talk 1: 11:00 am – 11:15 am

Institution: Concordia College

Student Presenters: Taylor DeVine, Melanie Borysewicz



Other Student Authors: Kay Franzese, Annika Pratt

Mentor: Dr. Mallorie Taylor-Teeples

Title: *Spinacia oleracea* can germinate but is unable to grow in Mars regolith without soil amendments

Recording link: https://youtu.be/CgazzVihZoA

Living on Mars may seem like a far-fetched idea, but could potentially become a reality in the future of human beings. In this research, we investigated the methods and resources needed to successfully grow plants in Mars regolith simulant. We chose to focus on *Spinacia oleracea* (spinach) due to its nutritional content and short germination time. During the fall semester of 2021, our team recorded data on multiple different samples using Mars regolith simulant or earth topsoil with or without arbuscular mycorrhizae fungi, while varying watering methods. Our goal was to determine if spinach growth within Mars regolith simulant is possible and whether arbuscular mycorrhizae fungi or different water delivery methods improved plant germination or growth. Overall, while some samples were able to successfully germinate, they were unable to grow within the Mars regolith soil, which provided us with evidence that additional soil amendments are necessary for successful growth of spinach seedlings.

Website(s)/On-line Reference(s):
https://www.competitionsciences.org

Session 4 Talk 2: 11:15 am – 11:30 am

Institution: Bethel University

Student Presenter: Kristina Boecker

Other Student Authors: River Beard and John McCauley

Mentor: Nathan Lemke

Title: Frequency measurement of two optical rubidium clocks

Recording link: https://youtu.be/ghxeE24FvT8

We developed a system featuring two two-photon rubidium clocks and a measurement of the frequency gap between Rb-87 and Rb-85 transitions. Atomic clocks have many applications. Often clocks are needed in environments outside of a lab, which requires small and effective portable clocks. For example, atomic clocks are an essential component of satellite navigation systems. This project's goal was to explore ways to make atomic clocks more portable and effective. We assessed the effectiveness of an alternating current resistive heater and magnetic field coils which were both used to avoid frequency shifts in the atomic transitions of Rb-87 and Rb-85.

Session 4 Talk 3: 11:30 am – 11:45 am

Institution: Fond du Lac Tribal and Community College

Student Presenter: Joseph Bruce

Mentor: Steve Highland

Title: How Rocketry Can Advance Native American Youth & Tribal Communities

Recording link: https://youtu.be/jsB3zgCtBWk

How rocketry can help prepare and introduce native American students and tribal communities to science, engineering, and mathematics. The opportunities, and effects rocketry can have on tribal communities and native American students who are searching for careers in science, engineering, and mathematics.

Session 4 Talk 4: 11:45 am – 12:00 pm

Institution: Augsburg University

Student Presenter: Jade Boysen

Mentors: Jeff Walter (Augsburg University); Chris Leighton (University of Minnesota)

Title: Weyl semimetal behavior in shandite $Co_3Sn_2S_2$ single crystals and thin films

Recording link: https://youtu.be/WJOm2h9svtw

$Co_3Sn_2S_2$ (shandite) has recently been found to be a magnetic Weyl semimetal, thus providing an interesting platform to study the interplay between magnetism and band topology. In this work we developed procedures for single crystal growth of shandite using chemical vapor transport (CVT) and optimized the growth of thin films using an ex situ sulfidation technique. In ex situ sulfidation, we sputter a Co_3Sn_2 film and then sulfidize by reacting it with SnS powder at an elevated reaction temperature to create shandite films. Here we report a systematic reaction temperature study, varying between 450 °C and 600 °C . Phase pure crystalline shandite is found at 550 °C, though Co : Sn : S ratio is 3.2 : 2 : 2.5, indicating further optimization is required to approach the desired $Co_3Sn_2S_2$ stoichiometry. We also report progress toward CVT growth of single crystals, by demonstrating the growth of nearly phase pure precursor $Co_3Sn_2S_2$ powder. Further, we report results from a CVT crystal growth using elemental powder precursors, in which small (< 1 mg) and fragile crystals were produced. A preliminary Hall measurement on these crystals, however, indicates the promising result of a giant Hall angle of 15%, consistent with previous reports on this magnetic Weyl semimetal.

Keynote Speaker in Main Room (12:05 pm – 12:55 pm)

Moderator: Demoz Gebre-Egziabher – University of Minnesota

Institution: University of Minnesota – Twin Cities

Presenter: William Elke III

Mentors: Dr. Demoz Gebre-Egziabher, Dr. Ryan Caverly, Jing Pei

Title: Launch Vehicle Control Design on a Quadcopter Testbed

Recording link: https://youtu.be/SnS-C1mbDUw

This presentation overviews the low-cost and low-risk testbed designed to help bridge the gap between the simulation/theory and the flight-testing phases of control algorithm design for launch vehicles (LVs) and landing systems (LSs). The testbed utilizes a quadcopter, flexible inverted pendulum, and a hanging pendulum. Also presented are simulation results of the testbed following an optimal trajectory generated by a booster soft-landing algorithm.

As mission objectives for frequent cislunar and interplanetary travel become more complex, the algorithms that control LVs and LSs need to become more advanced to ensure mission safety and success. These control systems are slow to mature because it is difficult to perform experiments in an environment relevant to the mission in a safe and cost-effective manner. A solution to this problem frequently leveraged in the aviation and satellite industries involves mimicking the dynamic response of the vehicle with a test platform that is low-cost and low-risk.

References:

https://ui.adsabs.harvard.edu/abs/2021A%26A...647A..54T/abstract
https://ui.adsabs.harvard.edu/abs/2021arXiv210100374M/abstract

Concurrent Session 5 in Main Room (1:00 pm – 2:00 pm)

Moderator: Tonnis ter Veldhuis – Macalester College

Session 5 Talk 1: 1:00 pm – 1:15 pm

Institution: University of Minnesota – Twin Cities

Student Presenters: Paul Wehling, Shea Larson

Other Student Authors: Alex Omweri, Seyon Wallo

Mentor: James Flaten

Title: The Nationwide Eclipse (Stratospheric) Ballooning Project (NEBP)
Recording link: https://youtu.be/3vO1atQ4Rbw
Starting in 2017, Space Grants around the country, led by the Montana Space Grant, have engaged college student stratospheric ballooning teams in flying payloads during solar eclipses. The next opportunity for eclipse ballooning in the United States will be an annular solar eclipse on 10/14/2023 and a total solar eclipse on 4/8/2024. The MT Space Grant has landed a grant to fund training and hardware for up to 70 teams across the country to participate in (A) an "Atmospheric Sciences" track, where teams launch commercial radiosondes once an hour for 24 hours to seek evidence of eclipse-induced meteorological gravity waves, or (B) an "Engineering" track, in which teams assemble their own payloads and ground stations to live-stream the view of the passing eclipse from the stratosphere. The University of Minnesota – Twin Cities has been selected as a "pod lead" and will train teams from around the Midwest to participate in the "Engineering" track of this nationwide program. This talk will briefly cover the 2017 campaign before a discussion of capabilities under development by the ballooning team at the University for use in the upcoming campaigns, including active venting for altitude control, a standardized sensor suite, and advanced flightpath prediction.

References:
https://eclipse.montana.edu/
https://umt.box.com/s/1g5whedxb6d1w3bnjytrk5u2ow780iwe (<4 min promotional video)

Session 5 Talk 2: 1:15 pm – 1:30 pm

Institution: St. Catherine University

Student Presenter: Anisa Tapper

Other Student Authors: Maddie Ross, Margaret Medini

Mentor(s): Erick Agrimson

Title: Stratospheric Neutron Detection Using Personal Neutron Dosimeters

Recording link: https://youtu.be/QnXpnUc9lKg

High Altitude Balloon flights provide a platform for measuring galactic cosmic ray interactions in the Regener-Pfotzer maximum (R-P max, 15-25 km) where ionizing particle count rate reaches an apex. Through interactions, these particles undergo energy loss and decay while traveling through the atmosphere; neutrons are a part of the secondary interaction. Flux and fluence measurements allow for the categorization of particles from GCR interactions to determine the number of neutrons relating to the R-P max. It is hypothesized that neutrons are generated in the upper atmosphere due to collisions between the GCR and nuclei of atmospheric oxygen and nitrogen, causing the nuclei to break into atomic and subatomic particles, causing higher numbers of neutrons to occur lower in altitude. An investigation was conducted using a personal neutron dosimeter paired with a Geiger-Müller omnidirectional counter to establish a correlation between neutron counts and altitude of charged particle maxima. A greater occurrence of neutrons appeared at or below the main interaction layer in the upper atmosphere. Charged and neutral detectors used in conjunction with each other better understand the dynamics of the charged and uncharged particles in the atmospheric environment.

Website(s)/On-line Reference(s):
https://www.iastatedigitalpress.com/jhab/article/id/13031/

Session 5 Talk 3/4: 1:30 pm – 2:00 pm

Institution: University of Minnesota – Twin Cities

Faculty Presenter: Demoz Gebre-Egziabher

Faculty Collaborators: Lindsey Glesener (University of Minnesota – Twin Cities, School of Physics and Astronomy)

Title: The IMPRESS and EXACT CubeSat Missions

Recording link: https://youtu.be/shXersXf4rw

IMPRESS (Impulsive Phase Rapid Energetic Solar Spectrometer) and EXACT (Experiment for X-ray Characterization and Timing) are a pair of 3U CubeSats being built by a team of student researchers at the University of Minnesota – Twin Cities. Both satellites will carry an X-Ray spectrometer as their main payload into low Earth orbit (LEO). In the case of IMPRESS, the spectrometer will be pointed at the sun to collect X-Ray associated with solar activity. The data collected will be used to better understand the physics behind solar activity. EXACT will point the X-Ray spectrometer at the pulsar (rapidly-spinning X-Ray emitting star) located in the Crab Nebula. The data collected will be used to characterize the ability of an X-Ray spectrometer to be used as a positioning, navigation, and timing (PNT) sensor in deep space. In this presentation, both missions will be described in more detail and how student researchers have organized to manage the day-to-day activities associated with design, fabrication, and testing of these satellites will be presented.

Website(s)/On-line Reference(s):
https://smallsat.umn.edu/

Concurrent Session 6 in Main Room (1:00 pm – 2:00 pm)

Moderator: Alyssa Hamre Kontak – Bethel University

Session 6 Talk 1: 1:00 pm – 1:15 pm

Institution: University of Minnesota – Twin Cities

Student Presenter: Nathan Pharis

Mentor: James Flaten

Title: High Altitude Student Platform (HASP)

Recording link (missing audio for first several minutes): https://youtu.be/AWnn1kswxu4

The High-Altitude Student Platform (HASP) is a NASA launched balloon platform that is designed for long duration (~10 hour) stratospheric flight. This program is led by Louisiana State University (LSU), in collaboration with the Columbia Scientific Balloon Facility (CSBF), and provides an exceptional threefold opportunity for student-led projects. Payload design, construction, and operation are coupled with the chance to develop project management skills and the chance to conduct high-quality research in an environment that is normally out of reach. This talk will outline how the complete HASP program works, from application to final report, based on the experiences of Nathan Pharis, who led the University of Minnesota Twin Cities (UMNTC) HASP project for the 2019 launch. The UMNTC HASP payload sought to directly compare high-cost fan-based optical particle counters to low-cost alternatives and also to particle data collected on much-shorter-duration stratospheric balloon flights conducted using weather balloons flown in Minnesota. It will also discuss how a collegiate team can participate in HASP, what they will gain, and the next steps of participation for a prospective team.

Website(s)/On-line Reference(s):
https://laspace.lsu.edu/hasp/
https://www.csbf.nasa.gov

Session 6 Talk 2: 1:15 pm – 1:30 pm

Institution: Augsburg University

Student Presenter: Leon Armbruster

Other Student Authors: Kong Yang (Augsburg University)

Mentors: Moumita Dasgupta (Augsburg University); Sougata Guha (Indian Institute of Technology Bombay); Mithun K Mitra (Indian Institute of Technology Bombay)

Title: First Passage Properties of Active Self-propelled Systems through Obstacles

Recording link: https://youtu.be/btnm2F_2JRI

Recent studies suggest that the motility phases of active matter systems depend sensitively on the structural features of their environment. In this study, we investigate the first passage properties of an active self-propelled system - a robotic bug - as it navigates through a heterogeneous environment characterized by spatially patterned densities of obstacles. We show, using extensive experiments and simulations, that different spatial patterning - as characterized by the nature of the obstacles, their number, and physical properties - can give rise to non-trivial first passage properties. We discuss how these results can theoretically be interpreted by simple physical arguments that highlight the interplay between energy and entropy in these systems.

Session 6 Talk 3: 1:30 pm – 1:45 pm

Institution: Concordia College

Student Presenters: Mikala Hammer and Colton Thomasson


Mentors: Thelma Berquó

Title: Investigation of iron oxides transformations in different environmental conditions
Recording link: https://youtu.be/yAvDcRbDCmw
Iron oxides, in which we also include hydroxides and oxide-hydroxides, are a class of materials that can be found on Earth's surface. They are present in rocks, soils, sediments, and living organisms. They are compounds of iron, oxygen (oxides), and hydrogen (hydroxides and oxide-hydroxide), which can also undergo iron replacement with cations such as aluminum, among others. In this research, we are investigating the conversion processes of five different iron oxides. During the summer of 2021, we began a long-term research project using Concordia College's outdoor garden and high tunnel (hybrid greenhouse). The environmental conditions of the two gardens are starkly different in terms of temperature and moisture content. Both locations contain variables to consider such as microorganisms, fertilizer, and roots. We used Mössbauer Spectroscopy to collect data from five iron oxide phases and the soil from our two different environments. After getting our baseline readings, we mixed the iron oxides with the soil in garden beds. Every year, samples will be collected from the beds of the two gardens to investigate their magnetic properties and track their conversion process. In the end, the goal is to compare how the two different environments affect the transformations of the iron oxides.

Session 6 Talk 4: 1:45 pm – 2:00 pm

Institution: Bethel University

Student Presenter: Jordan Mugglin

Mentors: Keith Stein, Alyssa Hamre Kontak

Title: Imaging Thermally Driven Periodic Flow in Air

Recording link: https://youtu.be/aNsPUv22ZD4

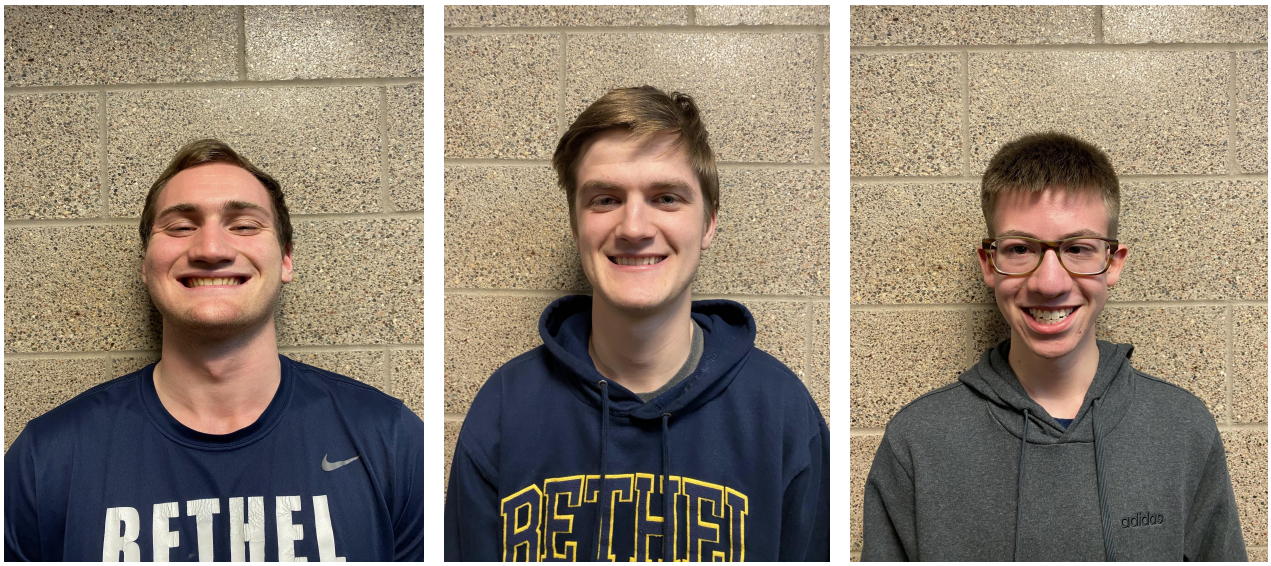
In the Summer of 2021 I designed and prototyped a device that allowed the user to view periodic flow using optical techniques such as Schlieren imaging and Mach-Zehnder interferometry. This device was specifically intended for use in an educational setting, as a demonstration of vortex shedding. Vortex shedding is a physical phenomenon that occurs as relatively laminar fluid flows over an object, creating a pattern of oscillating eddies in the fluid after it passes the object. In this presentation I will give an overview of the design process, the physical principles behind this phenomenon, and the computational fluid dynamics principles that were integrated into this design.

Afternoon Exhibit in the Balas Atrium of Akerman Hall (2:00 pm – 2:45 pm)

Brief walk-through of some of the afternoon exhibits: https://youtu.be/MHN1VLMJZiA

Institution: Bethel University

Student Exhibitors: Ben Teigland, Alec Braun, Nathan Engman



Mentors: Art Gibbens

Name of Team/Project on Exhibit: Competition High Powered Rocket

Promo video link:
https://drive.google.com/file/d/1fkJveDT8ahPvqbqluDQ45u_DCj9hzm04/view?usp=sharing

Description of Project and Items on Exhibit

Our exhibit will show a high-powered rocket opened up and separated. The vehicle stands a little over 4 feet tall with a 3 inch diameter airframe. It is divided up into 3 sections, each serving a different purpose. The lowest section houses the motor mount for our engine to achieve liftoff, followed by a payload section, and a section near the nose that houses the main parachute. Each of the 3 sections will give visibility to the components inside the vehicle that allows for a safe and effective flight. The payload section will show an inside look into the avionics bay which includes an altimeter, power source, and a 3-D printed camera mount. You will also get a look at the placements of explosive charges that ensure safe and proper timing separations of the vehicle in order to allow parachutes to deploy. The rocket will be flown in the Return to Flight competition this Spring alongside two other rockets built by our rocketry team.

Institution: University of Minnesota – Duluth

Student Exhibitors: Max Benson, Gwen Lau, Nick Klemman, Emma Nelson, Zach Coughlin, Logan Iverson






Mentors: Jose Carrillo - University of Minnesota – Duluth, Dave Leininger - Tripoli Rocketry Association, John Christopherson - University of Minnesota – Duluth

Name of Team/Project on Exhibit: Bulldog Rocketry and the Spaceport America Cup - Intercollegiate Rocket Engineering Competition

Promo video link: https://youtu.be/Wl6warWgRsY

Description of Project and Items on Exhibit

Bulldog Rocketry has participated in the Spaceport America Cup for the last 5 years, building different sizes of rockets depending on the design requirements created that year. For this year's competition, we are building a rocket that is close to 15 feet tall. We will be traveling down to Las Cruces New Mexico for the first time since 2019 to compete in person at this incredible event in order to bring home the Spaceport America Cup. We have produced rockets as tall as 19 feet, which required us to build our own launch rail. We plan to showcase some of our rockets for the 2022 competition as well as rockets from our past that started our success as an organization. These include 4-5 foot rockets that competed at the Midwest Rocketry Competition as well as some of our

scratch built Level 1 certification rockets that our club has built to become more comfortable and get certified by the Tripoli Rocketry Association.

Website(s)/On-line Reference(s):
https://sites.google.com/view/bulldog-rocketry/home?authuser=1
https://www.soundingrocket.org/
https://www.herox.com/SpaceportAmericaCup2022

Institution: St. Catherine University

Student Exhibitors: Kaitlyn Blair, Zoe Sternberg

Other Student (involved, but not exhibiting): Anisa Tapper

Mentor: Prof. Erick Agrimson

Promo video link: https://www.youtube.com/watch?v=BrQaSdBKx3I

Name of Team/Project on Exhibit: Charged and neutral particle detection HAB payloads.

Description of Project and Items on Exhibit:
Two payload boxes are exhibited:

A) The neutron box: This payload makes use of an Arduino Mega controller to measure charged particles in the atmosphere using a RM 60 Omnidirectional Geiger counter. This data is correlated with GPS altitude data. In addition, a Go-Pro camera is used to capture bubbles created when a neutron collides with gel material in a personal neutron dosimeter. The film has to be correlated to the altitude data in post processing to determine the altitude at which the neutron/ gel interaction occurred.

B) The Quad: This payload also makes use of the Arduino Mega controller which is connected to four RM 80 pancake Geiger detectors which are orientated along the azimuth or along the horizon. This orthogonal configuration allows for measurement directionality of the charged particles. In addition, this system can also look at coincidences between detectors allowing for directional particle studies between two, three or four detectors. The payload also can provide an indication of the relative pressure as well as providing GPS updates to the data logged.

Website(s)/On-line Reference(s):
https://www.iastatedigitalpress.com/jhab/article/id/13031/

Institution: University of Minnesota – Twin Cities

Student Exhibitors: Shea Larson, Alex Omweri

Other Students (involved, but not exhibiting): Paul Wehling, Seyon Wallo

Mentors: James Flaten

Promo video links:
https://drive.google.com/file/d/1bEpkX4lX3PB0plWBceX98ekLwCw9CYlE/view?usp=sharing
https://drive.google.com/file/d/1T9M4R3bliqSVmQSgeXPiaKWTqT0hOpE5/view?usp=sharing

Name of Team/Project on Exhibit: Eclipse Ballooning Hardware and Software

Description of Project and Items on Exhibit (150 to 200 words): The University of Minnesota – Twin Cities has been selected as a "pod lead" and will help train teams from the around Midwest to participate in the "Engineering" track of this nationwide program. (See abstract and talk about the Nationwide Eclipse Ballooning Project (NEBP)). Pod lead institutions are already in the process of testing hardware and software for potential use by participating ballooning teams during the annular solar eclipse on 10/14/2023 and the total solar eclipse on 4/8/2024. We will exhibit a light-weight "vent" payload which will allow latex balloons to halt their ascent while the eclipse passes by, thereby improving the stability of the platform for video streaming. We will also show our "PTERODACTYL" flight computer which will be carried on the eclipse payloads to log experiment data, possibly including high-speed gps to try to detect eclipse-induced meteorological gravity waves (in support of the "Atmospheric Sciences" side of the NEBP). We will also show enhanced balloon trajectory simulation software that can deal with "floating" balloons – required to help teams select appropriate launch sites and launch times so as to intercept the eclipse shadow.

Website(s)/On-line Reference(s):
https://eclipse.montana.edu/
https://umt.box.com/s/1g5whedxb6d1w3bnjytrk5u2ow780iwe (<4 min promotional video)

Institution: University of Minnesota – Twin Cities

Student Exhibitors: Ty Kozic, Annsley Greathouse

Other Students (involved, but not exhibiting): rest of the University of Minnesota – Twin Cities Small Satellite (SmallSat) Team

Mentors: Demoz Gebre-Egziabher and Lindsay Glesener

Promo video link:
https://drive.google.com/file/d/1-Q_-GO9NxMCp2dnIxD-SAIU5Okv2wSLm/view?usp=sharing

Name of Team/Project on Exhibit: IMPRESS/EXACT CubeSats

Description of Project and Items on Exhibit:
IMPRESS (Impulsive Phase Rapid Energetic Solar Spectrometer) and EXACT (Experiment for X-ray Characterization and Timing) are two CubeSats that are under development at the University of Minnesota – Twin Cities. Mission software and supporting hardware designed and built by the members of the SmallSat team will be exhibited.

Website(s)/On-line Reference(s):
https://smallsat.umn.edu/

Institution: University of Minnesota – Twin Cities

Student Exhibitor: Milan Patel

Other Student (involved, but not exhibiting): Grant Hietpas (Gustavus Adolphus College)

Mentors: Demoz Gebre-Egziabher, Ryan Caverly, and Chris Regan

Promo video link:
https://drive.google.com/file/d/17RvIaH53VDzv-iUFgqcVZn9OIBZdHO4V/view?usp=sharing

Name of Team/Project on Exhibit: Quadcopter Based Launch Vehicle Control System Test Bed

Description of Project and Items on Exhibit:

A quadcopter-based test bed for designing and testing control systems for launch vehicles is presented. This is an exhibit of the hardware discussed in the keynote presentation.

Institution: Macalester College

Student Exhibitor: Ross Ferguson

Mentor(s): Tonnis ter Veldhuis

Promo video link: *TBA*

Name of Team/Project on Exhibit: RockOn Workshop Plate

Description of Project and Items on Exhibit (150 to 200 words): In the RockOn workshop, I built a rocket payload designed to measure radiation as a function of distance from Earth's surface. The scientific instruments on the payload are a Geiger counter, a temperature/pressure sensor, three accelerometers, three gyroscopes, and a humidity sensor. Once assembled, the plate was sent to the edge of space on HASP, a huge helium-filled balloon used to carry student projects, last September. Similar payloads built by other workshop participants were carried into outer space (for a short time) on a suborbital rocket launched from NASA's Wallops Flight Facility in Virginia.

Website(s)/On-line Reference(s) (max 3):
https://spacegrant.colorado.edu/rockon-home/rockon-2021-2020-home

NASA Center Internships in Main Room (2:45 pm – 3:45 pm)

Moderator: James Flaten – University of Minnesota

Session 7 Talk 1: 2:45 pm – 3:05 pm

Institution: University of Minnesota – Twin Cities, Wearable Technology Lab

Student Presenter: Crystal Compton

Mentors: Dr. Lucy Dunne, Linh Vu, Yaritza Hernandez, Dr. Han Kim, Dr. Sudhakar Rajulu, Dr. Brad Holschuh, Dr. Elizabeth Bye, Dr. Peter Marchetto at NASA's Johnson Space Center

Title: "Textile-Based On-Body Sensing for Sizing and Fit of Wearable Systems"
Recording link: https://www.youtube.com/watch?v=9OFYipRUk2U
Spacesuits must provide sufficient fit and mobility for crew to successfully perform extravehicular activities (EVAs), particularly for future planetary EVAs. The quality of suit fit is influenced by complex interactions between the suit's geometry, mechanisms, and materials and the wearer's body geometry. Contact between the suit and the wearer's body is a key metric that can be used to understand body-spacesuit interactions. A wearable contact sensing technology can be used to measure how contact patterns vary across wearers of different body shapes and sizes performing functional EVA postures. The objective of this research is to develop and validate a conformable, textile-based, wearable contact sensing system that can be easily implemented into an existing inner-layer garment. The sensors use a binary approach to detect contact between two surfaces when the electrical circuit path is completed and provides quantitative measurements of fit in a spacesuit with minimal intrusiveness. The functional fit assessment method developed here is expected to provide useful information to improve suit design and define quantitative metrics for suit sizing and fit and enable a more detailed understanding of suit-to-body interactions during dynamic and functional EVA movements.

Session 7 Talk 2: 3:05 pm – 3:25 pm

Institution: St. Cloud State University

Student Presenter: Walker Nelson

Mentors: Amjad Almansour, Mrityunjay Singh, Michael Halbig at NASA's Glenn Research Center

Title: Research and Design of Additively Manufactured Battery Thermal Management Systems

Recording link: https://youtu.be/A82iH9RAzQ4

A common way to improve energy storage is to create cell array systems in various configurations where energy can be stored and used on demand. Thermal management of battery cell packs is a critically needed technology. The purpose of this work is to design new and improved Battery Thermal Management Systems (BTMS). The BTMS should be 3D printable and hold twelve-sixteen 18650 batteries. The BTMS will be assembled as a battery pack for use in electric airplanes. In order to meet the goal of an aircraft's weight reduction, it was decided to make an active air-cooled battery pack to avoid the excess weight of water-cooled and PCM cooled packs. To drop weight, significant changes were made in order to remove as much metal as possible and replace it with lower density PMC's. To create the final pack, battery sheaths were created. These sheaths are made of high conductivity materials and are designed to have the maximum surface area for the air flow and cooling. These sheaths and packs were first modeled in SolidWorks 2021 3D CAD3 , then imported into COMSOL MultiPhysics4 to be studied using the "Heat Transfer in Solids and Fluids" module.

Session 7 Talk 3: 3:25 pm – 3:45 pm

Institution: University of Minnesota – Twin Cities

Student Presenter: Kailey Pierce

Other Student Authors: Austin Adkins, Matteo Ceresoli, K.J. Lewis, Travis Bowman, Wilson Martinez, Cicely Sharafti, Jared Short, Chris Titus, Seth Young

Mentors: Liz Ward at NASA's Langley Research Center

Title: Aerial Data Acquisition Platform for Firefront Monitoring

Recording link: https://youtu.be/wML006-J754

Over the past century, wildfires have grown in their destructive tendencies, and have become a threat to civilian lives, infrastructure, and emergency officials. The 2021 NASAAcademy at Langley Research Center was tasked with utilizing NASA technology to increase situational awareness and communication amongst both incident officials and the public. With this mission in mind, the Data Acquisition sub-team chose to develop an outline for a small unmanned aircraft system (UAS) package including required specifications, a payload layout, and mission planning. The proposed system would be capable of mapping firelines at a speed of about 9.8 m/s for periods of up to 3.6 hours. The system would also be able to gather near real-time data at a lower cost than currently utilized systems.

Panel Discussion in Main Room (3:50 pm -4:35 pm)

Moderator: Demoz Gebre-Egziabher – University of Minnesota -Twin Cities

Session recording link: https://youtu.be/F9YIn_bGy-w

Current affiliation: University of Minnesota - Twin Cities

Panelist 1: Lucy Dunne

Biography:

Lucy E. Dunne is a Professor at the University of Minnesota, where she directs the Apparel Design program and is the founder and co-director of the Wearable Technology Lab. She is a co-author (with Susan Watkins) of "Functional Apparel Design: From Sportswear to Space Suits" (Bloomsbury, 2015), and her academic background includes degrees in Apparel Design (Cornell University, BS and MA), Electronic Engineering (Tompkins-Cortland Community College, AAS), and Computer Science (University College Dublin, PhD). Her research is focused on pursuing the vision of scalable, wearable garment-integrated technology, and explores new functionality in apparel, human-device interface, production and manufacture, and human factors of wearable products. Dr. Dunne has received the National Science Foundation's CAREER award and the NASA Silver Achievement Medal for her work with functional clothing and wearable technology.

Website: http://wtl.umn.edu

Current affiliation: University of Minnesota – Twin Cities (Master's Student) and NASA Goddard Space Flight Center – Pathways Intern

Panelist 2: Keegan Bunker

Biography:

Keegan is currently a masters student studying aerospace engineering at the University of Minnesota and is advised by Dr. Ryan Caverly and Dr. Demoz Gebre-Egziabher. His research interests include optimal control and state estimation for spacecraft on deep space missions and other challenging mission architectures. While being a graduate student, Keegan is also a NASA Pathways intern at Goddard Space Flight Center in the Navigation and Mission Design Branch. He primarily supports the Autonomous Navigation, Guidance, and Control (autoNGC) project; an onboard autonomous software aiming to consolidate separate guidance, navigation and control functions under a single autonomous structure to enable time critical dynamic spacecraft maneuvers and mission designs. Keegan has previously interned at Northrop Grumman supporting systems engineering efforts on the Department of Defense's Space Test Program 3 mission, and at Honeywell supporting novel navigation algorithm development for GNSS denied environments.

Website(s)/On-line Reference(s):
https://www.linkedin.com/in/keegan-bunker/
https://etd.gsfc.nasa.gov/590/code595.php
https://techport.nasa.gov/view/94817

Current affiliation: Blue Origin (formerly at Boeing)

Panelist 3: Mark Abotossaway

Biography:

Mark Abotossaway graduated with a Bachelor of Aerospace Engineering and Mechanics degree from the University of Minnesota in 2013 and holds a Bachelor of Physics degree from the University of Winnipeg.

Mark worked as a structural analyst for The Boeing Company in Washington for a number of years. He worked on the 787-10 airplane program in the wing group, which involved oversight of an international partner, Mitsubishi Heavy Industries. He then worked on the 777X airplane program in the wing group, in both design and production support. He spent almost a year working for Spirit Aerosystems, as a structural analyst, developing a new vehicle with a small startup. He recently accepted a position with Blue Origin, as a structural analyst on the New Shephard vehicle.

While at University of Minnesota, Mark was involved with various diversity student groups, as he is American Indian (First Nation – Ojibwe). Mark also brought high-powered rocketry to the school as he led the WSGC First Nations Launch team in 2011 and the NASA Student Launch Initiative team in 2012. He advised on numerous other rocketry teams until 2013. He is currently the Project Assistant for WSGC First Nations Launch since 2016.

Mark likes to volunteer his time to encourage minority students to pursue STEM degrees and careers. Mark also volunteers as a mountaineering instructor.

Website(s)/On-line Reference(s):
First Nations Launch | First Nations Launch | Carthage College