Arizona NASA Space Grant Consortium

Thirty-Second Annual Statewide Student Research Symposium

ARIZONA
SPACE GRANT CONSORTIUM

Presentations by Space Grant Students from:

Arizona State University
Embry-Riddle Aeronautical University
Northern Arizona University
University of Arizona
Casa Grande Union High School
Central Arizona College
Diné College
Glendale Community College
Phoenix College
Pima Community College

April 22, 2023
DoubleTree by Hilton, Tempe, AZ

2022-2023 Arizona NASA Space Grant Consortium
Statewide Student Research Symposium
April 21-22, 2023

Welcome to the 32nd annual Arizona NASA Space Grant Statewide Student Research Symposium!

The Symposium consists of four parallel topical sessions, with a morning break for coffee, afternoon lunch, and refreshments at the end of the day. We encourage you to use these breaks to network with one another, talk to peers and colleagues from other schools, and take time to make connections.

The Symposium will feature talks from 166 students, with 4 students represented "In Title Only". In-person talks will typically last ten minutes each, roughly divided as ~8 minutes for presentations and ~2 minutes for questions from the audience.

This symposium is made possible through a NASA grant awarded to the Arizona Space Grant Consortium. The efforts of managers, mentors, steering committee members and Space Grant representatives at Arizona State University, Embry-Riddle Aeronautical University, Northern Arizona University, the University of Arizona, Casa Grande Union High School, Central Arizona College, Diné College, Glendale Community College, Phoenix College, Pima Community College, and Arizona Western College (honorable mention) are acknowledged. Students with a variety of academic backgrounds have come together with their mentors to make the program a success, and this Symposium is a tribute to their dedication and spirit of inquiry.

The Arizona NASA Space Grant Student Research Symposium also recognizes the efforts of many university faculty, private sector, and federal researchers/mentors, who give selflessly of their time and energy to provide leading-edge research experiences to enrich the education of Arizona's Space Grant students. We thank them all for their past, present and future support.

Timothy Swindle, Director
Arizona Space Grant Consortium, UA

Thomas G. Sharp, Associate Director
ASU NASA Space Grant

Michelle Coe, Manager
Arizona Space Grant Consortium, UA

Desiree D. Crawl, Sr. Coordinator
ASU NASA Space Grant

Deborah Bair, Business Operations
ASU NASA Space Grant

Saturday, April 22, 2023, DoubleTree by Hilton Phoenix Tempe

8:30-8:50 a.m. WELCOME & INTRODUCTION

FIESTA BALLROOM II & III
Thomas G. Sharp, Associate Director, Arizona State University NASA Space Grant

Room	Tempe	Fiesta I	Coronado	Redrock
TIME (MST)	**Moderators:** Dorothea Ivanova, Michele Zanolin **Session A** **TOPICS IN MATH, PHYSICS & CHEMISTRY** (9:00 AM – 10:10 AM) — **Moderators:** Anne Boettcher, Ashley Rea **Session B** **EDUCATION & PUBLIC OUTREACH** (10:30 AM – 11:20 AM) --- **Moderators:** Elliott Bryner, Paloma Rose Davidson **Session C** **AEROSPACE TECHNOLOGY: SPACEFLIGHT & ENGINEERING PROGRAMS** (11:20 AM – 3:30 PM)	**Moderators:** Clayton Jacobs, Tom Sharp **Session D** **ASCEND** (9:00 AM – 11:30 AM) — **Moderators:** Joseph Foy, Michele Zanolin **Session E** **ASTRONOMY & SPACE PHYSICS** (11:30 AM-3:30 PM)	**Moderators:** Theodore Kareta, Dante Lauretta, Tim Swindle **Session F** **PLANETARY SCIENCE** (9:00 AM - 2:00 PM) — **Moderators:** Anne Boettcher, Tom Sharp **Session G** **EXPLORATION SYSTEMS ENGINEERING** (2:00 PM-3:10 PM)	**Moderators:** Michelle Coe, Chandra Holifield Collins **Session H** **Earth & Environmental Science & Engineering** (9:00 AM – 2:00 PM) --- **Moderators:** Jisoo Kim, Yabin Liao **Session I** **AERONAUTICS** (2:00 PM-3:20 PM)

9:00-9:10	[A-1] *John Hardy* Helical-Shaped Tungsten Oxide as Active Layer for Resistive Random-Access Memory Applications	[D-1] *Arizona State University ASCEND* Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV-Exposed Plant Seeds	[F-1] *Laurinne Blanche* Structured Light Scanner Use in OSIRIS-REx Sample Analysis	[H-1] *Tracey Begaye* Protecting Forests and Infrastructure from Fire with Drones
9:10-9:20	[A-2] *Kaylee Freudenthal* Very Strongly Connected Graphs	[D-1] *Arizona State University ASCEND* Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV-Exposed Plant Seeds	[F-2] *Claire Blaske* Impactor-Atmosphere Interactions Above the Surface of Venus	[H-2] *Mikayla Bia* Applying Conventional Navajo Knowledge When Investigating DRUM Sites Within the Navajo Nation
9:20-9:30	[A-3] *Eric Gutierrez* Growing Boron Nitride Films for Alpha and Neutron Detectors in Radiation Settings	[D-2] *CGUHS ASCEND* ASCEND High Altitude Balloon - Casa Grande Union High School	[F-3] *Emily Clark* The Effects of Space Weathering on Airless Bodies	[H-3] *Lynn Carroll* Intermittent Performance of Pilot Scale Off-Grid Nanofiltration System
9:30-9:40	[A-4] *Marshall Hammond* Deep Machine Learning in Holography	[D-3] *Central Arizona College ASCEND* CAC ASCEND	[F-4] *Jacqueline Do* Arizona NASA Eclipse Ballooning Project	[H-4] *Sofia Delgado* US Fish and Wildlife Service Info Sheets
9:40-9:50	[A-5] *Jaxson Mitchell* A Time-Frequency Analysis of Chirps in Gravitational Wave Data	[D-4] *Embry-Riddle Aeronautical University ASCEND* Long-Distance Video and Telemetry Streaming	[F-5] *Jacob Eaton* Organosulfurs in Meteorites	[H-5] *Simon Fronmueller* Where Are All of the Ammonia Oxidizers?: A Yellowstone Mystery
9:50-10:00	[A-6] *Jack Nichols* Molecular Structure of Deuterated 2-aminopyridine	[D-5] *Glendale Community College ASCEND* GCC's Team Icarus	[F-6] *Greta Freeman* Exploring the Limits of Mineral Abundance Retrievals in the Thermal Infrared from Laboratory Particulate Spectral Analysis	[H-6] *Charlie Kruger* Radiocarbon Dating in Arctic Lakes
10:00-10:10	[A-7] *Olivia Pitcl* Machine Learning Approach in ATLAS Particle Energy Calibrations	[D-5] *Glendale Community College ASCEND* GCC's Team Icarus	[F-7] *Rachel Fry* An Apparatus for the Experimental Simulation of the Effects of Wind Transport on Martian Sands	[H-7] *Ellie Laton* Reductive Degradation of Insensitive Munitions Compound (IMC) Mixtures using Iron-Based Reactive Minerals
10:10-10:30	**MORNING BREAK IN FOYER**			

10:30-10:40	[B-1] *Kylianne Chadwick* Bridging the Gap Between STEM Professionals and "Everyone Else"	[D-6] *Glendale Community College ASCEND* GCC's Team AstroPeeps	[F-8] *Moises Gomez* Laboratory Measurements of the Thickness, Index of Refraction, and Density of Ices Important to Planetary Science	[H-8] *Trisha Jean Lane* Influence of Woodland Encroachment on Vegetation, Soils, Hydrology, and Erosion on Sagebrush Rangelands
10:40-10:50	[B-2] *Hayden Estrella* Combatting Fake Science Online	[D-6] *Glendale Community College ASCEND* GCC's Team AstroPeeps	[F-9] *Aidan Madden-Watson* Optical Constants of CH_4 + N2 Ice Mixtures and Outer Solar System Objects	[H-9] *Sophia Dixon* Effects of Biological Soil Crust Cover on Rainfall Runoff
10:50-11:00	[B-3] *Khushi Patel & Namita Shah* AI-Enhanced Education: Generalized Planning and Reinforcement Learning in Space Exploration	[D-7] *Phoenix College ASCEND* Phoenix College NASA ASCEND	[F-10] *Daniel Gonzalez* Contour Mapping of the Crustal Magnetism on Mars	[H-10] *Emma Lintz* Assessment of Extinction Risks of Sonoran Desert Plants
11:00-11:10	[B-3] *Khushi Patel & Namita Shah* AI-Enhanced Education: Generalized Planning and Reinforcement Learning in Space Exploration	[D-7] *Phoenix College ASCEND* Phoenix College NASA ASCEND	[F-11] *Jonas Hallstrom* The Formation and Thermal Evolution of Itokawa's Parent Body	[H-11] *David Lopez* A Microclimate Case-Study Comparison of Arizona Soundings
11:10-11:20	[B-4] *Katrina Robertson* Fostering Educational Equity in Engineering	[D-8] *Pima Community College ASCEND* High Altitude Crustaceans	[F-12] *Madeline Hart* Reconstructing the Real Chirp of the MARSIS Radar	[H-12] *Bo Manuszak* Space Exploration for Sustainable Development
11:20-11:30	[C-1] *Anna Alfermann* Remote Sensing of Vegetation and Geomorphic Change Along 11.75 km of the Paria River	[D-9] *University of Arizona ASCEND* UArizona ASCEND: High-Altitude Data Collection With a Custom CubeSat Payload	[F-13] *Jessica Maldonado Olivas* SNAPS: Real Time Outlier Detection	[H-13] *Cameron Morgan* Carbon Dioxide Capture in Spacecraft Using Novel Microsphere-Loaded Polymers
11:30-11:40	[C-2] *Nicolas Blanchard* Subterranean Exploration Using a Train of Autonomous Vehicles	[E-1] *Justin Klingele* Predicting Limits for Diffuser-Assisted Photometry of Transiting Exoplanets	[F-14] *Sarah Nielsen* Hydrothermal Alteration on Earth and Asteroids	[H-14] *Yamini Patel* Textural Analysis of Airfall Deposits From the Most Recent Explosive Eruption at the Valles Caldera, NM
11:40-11:50	[C-3] *Zoe Brand* Investigation of Total Momentum Ratio	[E-2] *Hanga Andras-Letanovszky* A Deuteration Survey of Dense Prestellar Cores in Taurus	[F-15] *Melissa Kontogiannis* Carbonate Clues for Hydrothermal Alteration History of Carbonaceous Chondrites	[H-15] *Annika Revis* Potential Effects of Endophytes in Tillandsia Usneoides
11:50-12:00	[C-4] *Jessica Dudek* General Dynamics Mission Systems	[E-3] *Naomi Carl* In with the Old, Out with the Young:	[F-16] *Adriana Olvera* Remote Sensing Compositional	[H-16] *Benjamin Ryan*

	Explorer GPS Receiver Production Testing & Improvements	Stellar Clusters in NGC 3344	Analysis of Unvegetated Meandering Stream Basins	Drought Impact on Cold Tolerance in Pinyon Pine
12:00-1:20	**LUNCH IN FIESTA BALLROOM I & II**			
1:20-1:30	[C-5] *Calvin Henggeler & Tyler Thurman* EagleSat-2: Memory Degradation Experiment	[E-4] *Logan Caudle & Brandon Pillon* Testing and Construction of a Short-Arm Interferometer and Low Frequency Prototype of Laser Interferometer Suspensions for Gravitational Wave Detection	[F-17] *Shradhanjli Ravikumar* A Potential Mechanism for Nitrogen Storage in the Earth's Mantle Transition Zone	[H-17] *Siena Smania* Meals for Microbes: How Do Energy Supplies of Hot Springs Vary with Geothermal Mixing?
1:30-1:40	[C-6] *Shae Henley* CatSat: Satellite Flight Hardware and Ground Station Assembly	[E-5] *Sadie Cullings* Signatures of Traversable Wormholes	[F-18] *Lucas Reynoso* Laboratory Analysis of Ceres Analogue Minerals	[H-18] *Brooke Sullivan* Sensitivity of North American Monsoon Convective Precipitation Flooding in Arizona to the Atmospheric Boundary Layer and Circulation
1:40-1:50	[C-7] *Alex Higuera Pierre Noel* The Effects of the Martian Atmospheric Conditions on a NACA 4412 Airfoil	[E-6] *Peter Hartman* A Kinematic Analysis of Proplyds in NGC 1977 and the ONC	[F-19] *Tessa Richardson* Echeclus Data Analysis of Phase Curve and Composition	[H-19] *Camille Tinerella* Measuring Dioxin and Dioxin-Like Compounds in Soil and Sediments Impacted by Wildfires and Flash Flooding
1:50-2:00	[C-8] *Shannon Moore & Hayden West* Centrifugal Nuclear Thermal Propulsion Ammonia Propellant Thermal Analysis	[E-7] *Amanda Holdsworth* The Spectroscopic and Visual Orbit of the Nitrogen-rich Massive Binary WR 138	[F-20] *Alejandro Romero-Lozano* Mechanical Assembly for NUV CCD Camera Telescope	[H-20] *Lauren Vasquez* Navajo Nation Municipal Water Reuse Feasibility Analysis
2:00-2:10	[C-9] *Tristan Muzzy* Analysis of Thermodynamic Cycles for Nuclear Thermal Rockets	[E-8] *Randy Loberger & Tri Phan* The Energetics of the Colliding Wind Binary γ2 Velorum: Multi-wavelength Studies in Optical X-rays	[G-1] *Hope Elmer* Investigation of Stress Concentrations in Parts Manufactured with Fused Deposition Modeling	[I-1] *Jackson Barger* Design and Implementation of a Focused Laser Differential Interferometer for Hypersonic Boundary Layer Transition Measurements
2:10-2:20	[C-10] *Andrew Purkeypile* Proximity Operation Maneuvers at Asteroidal Deep Space In-Situ Resource Utilization Stations	[E-9] *Nicolas Mazziotti* Identifying Diffuse Galaxies through Citizen Science	[G-2] *Adeeb Hossain* Quantitative Analysis of Bone Regenerated Using Patient Specific 3D Printed Scaffolds	[I-2] *Andrew Frisch* Effects of Structural Motion on Swept Wing Aerodynamics
2:20-2:30	[C-11] *Walter Rahmer* CatSat: Problem Solving for CubeSat Engineering, Integration, and Communication	[E-10] *Breck Meagher* Characterization of Oval Defects in Crystalline Optical Coatings	[G-3] *Loren Larrieu* Multi-Spectral Thermal Infrared Imager for UAV Based Remote Sensing	[I-3] *Morgan Goz* Transitional Shock-Boundary Layer Interactions at Mach 5

2:30-2:40	[C-12] *Hayden Roszell* Design and Implementation of the Onboard Computer for EagleSat-2	[E-11] *Jamesen Reese* Energy Partitioning and Particle Acceleration at the Bow Shock of Saturn	[G-4] *Stephany Maldonado* Choice of Best HA Coated Sensors to Measure Bone Maintaining Activity in Space	[I-4] *Lucas Guaglardi* Analysis and Optimization of Electric Ducted Fan Nacelle Geometry
2:40-2:50	[C-13] *Logan Ruddick* EagleSat-2: Attitude Determination and Control System Monitoring and Management	[E-12] *Maxwell Rizzo* Revisiting the FUSE Data Archive - Finding O VI Emission	[G-5] *Katie Twitchell* Zernike Wavefront Sensing for Adaptive Optics	[I-5] *Alec Maloney* Fin-induced Shock/Boundary Layer Interactions at Mach 5
2:50-3:00	[C-14] *Avery Stockdale-Stephens* Investigation of Wakes Behind Blunt-Bodies During Re-Entry	[E-13] *Calvin Sam & Tristen Sextro* X-ray Binaries as Flashlights to Map the Universe through Stellar Wind Studies	[G-6] *Mairely Urias* Space Environment Radiation Testing on Electrical Components	[I-6] *Nicholas Mammana* Force and Moment Measurements in the Arizona Polysonic Wind Tunnel
3:00-3:10	[C-15] *Lillian Sudkamp* The EagleSat 2 Structure	[E-14] *Meghan Speckert* The Stellar Content of IC1310	[G-7] *Edrik Vachier* Satellites and the World of RF	[I-7] *David Ordaz Perez* Aero-Thermodynamic Loads on Space Shuttle Orbiter Ascent
3:10-3:20	[C-16] *Jacob Chambers* Simulator and Flight Software Testing for Aspera SmallSat Telescope	[E-15] *Reynier Squillace* Nitrogen Isotopic Fractionation in Prestellar Core L43E		[I-8] *Samantha Stevens* Numerical Investigation of Hypersonic Boundary-Layer Transition for an Ogive Geometry
3:20-3:30	[C-17] *Pablo Luna* Data-driven Laser Powder Bed Fusion Distortion Prediction Using Geometric Parameters	[E-16] *Jake Summers* Observing Magellanic System Stars in the SMACS J0723-73 JWST ERO		
3:30 -	**AFTERNOON REFRESHMENTS, EVALUATIONS & NETWORKING IN FOYER**			

Program Schedule

Session A:
Topics in Math, Physics, & Chemistry

Moderators:
Dorothea Ivanova, Embry-Riddle Aeronautical University
Michele Zanolin, Embry-Riddle Aeronautical University

[A-1] **Helical-Shaped Tungsten Oxide as Active Layer for Resistive Random-Access Memory Applications**, John Hardy, (Senior, Electrical Engineering, Northern Arizona University). Mentor: Ying-Chen Chen, Engineering, Northern Arizona University.

[A-2] **Very Strongly Connected Graphs**, Kaylee Freudenthal, (Junior, Mathematics, Northern Arizona University). Mentor: Jeff Rushall, Mathematics & Statistics, Northern Arizona University.

[A-3] **Growing Boron Nitride Films for Alpha and Neutron Detectors in Radiation Settings**, Eric Gutierrez, (Senior, Physics, Arizona State University). Mentor: Robert Nemanich, Physics, Arizona State University.

[A-4] **Deep Machine Learning in Holography**, Marshall Hammond, (Sophomore, Computer Engineering, Northern Arizona University). Mentor: Christopher Mann, Applied Physics & Material Sciences, Northern Arizona University.

[A-5] **A Time-Frequency Analysis of Chirps in Gravitational Wave Data**, Jaxson Mitchell, (Sophomore, Space Physics, Embry-Riddle Aeronautical University). Mentor: Cameron Williams, Mathematics, Embry-Riddle Aeronautical University.

[A-6] **Molecular Structure of Deuterated 2-aminopyridine**, Jack Nichols, (Senior, Chemistry, University of Arizona). Mentor: Stephen Kukolich, Chemistry & Biochemistry, University of Arizona.

[A-7] **Machine Learning Approach in ATLAS Particle Energy Calibrations**, Olivia Pitcl, (Senior, Physics, University of Arizona). Mentor: Kenneth Johns, Physics, University of Arizona.

Program Schedule

Session B:
Education & Public Outreach

Moderators:
Anne Boettcher, Embry-Riddle Aeronautical University
Ashley Rea, Embry-Riddle Aeronautical University

[B-1] **Bridging the Gap Between STEM Professionals and "Everyone Else"**, Kylianne Chadwick, (Sophomore, Molecular & Cellular Biology, University of Arizona). Mentor: Daniel Stolte, University Communications, University of Arizona.

[B-2] **Combatting Fake Science Online**, Hayden Estrella, (Senior, Statistics, Data Science, University of Arizona). Mentor: Christopher Impey, Astronomy, University of Arizona.

[B-3] **AI-Enhanced Education: Generalized Planning and Reinforcement Learning in Space Exploration**, Khushi Patel, (Sophomore, Computer Science, Arizona State University). Mentor: Siddharth Srivastava, School of Computing & Augmented Intelligence, Arizona State University.

[B-3] **AI-Enhanced Education: Generalized Planning and Reinforcement Learning in Space Exploration**, Namita Shah, (Sophomore, Computer Science, Arizona State University). Mentor: Siddharth Srivastava, School of Computing & Augmented Intelligence, Arizona State University.

[B-4] **Fostering Educational Equity in Engineering**, Katrina Robertson, (Junior, Mechanical Engineering, Embry-Riddle Aeronautical University). Mentor: Ashley Rea, Rhetoric & Communications, Embry-Riddle Aeronautical University.

Program Schedule

Session C:
Aerospace Technology: Spaceflight & Engineering Programs

Moderators:
Elliott Bryner, Embry-Riddle Aeronautical University
Paloma Rose Davidson, Northern Arizona University

[C-1] **Remote Sensing of Vegetation and Geomorphic Change Along 11.75 km of the Paria River**, Anna Alfermann, (Senior, Environmental Science, Northern Arizona University). Mentor: Temuulen Sankey, School of Informatics, Computing & Cyber Systems, Northern Arizona University.

[C-2] **Subterranean Exploration Using a Train of Autonomous Vehicles**, Nicolas Blanchard, (Senior, Electrical & Computer Engineering, University of Arizona). Mentor: Sergey Shkarayev, Aerospace & Mechanical Engineering, University of Arizona.

[C-3] **Investigation of Total Momentum Ratio**, Zoe Brand, (Senior, Mechanical Engineering, Propulsion, Embry-Riddle Aeronautical University). Mentor: Elliott Bryner, Mechanical Engineering, Embry-Riddle Aeronautical University.

[C-4] **General Dynamics Mission Systems Explorer GPS Receiver Production Testing & Improvements**, Jessica Dudek, (Senior, Mechanical Engineering, Arizona State University). Mentor: Nathan Bales, General Dynamics Mission Systems, General Dynamics Mission Systems.

[C-5] **EagleSat-2: Memory Degradation Experiment**, Calvin Henggeler, (Junior, Computer Engineering, Embry-Riddle Aeronautical University). Mentor: Ahmed Sulyman, Computer, Electrical, & Software Engineering, Embry-Riddle Aeronautical University.

[C-5] **Eaglesat-2: Memory Degradation Experiment**, Tyler Thurman, (Junior, Computer Engineering, Embry-Riddle Aeronautical University). Mentor: Ahmed Sulyman, Electrical, Computer & Software Engineering, Embry-Riddle Aeronautical University.

[C-6] **CatSat: Satellite Flight Hardware and Ground Station Assembly**, Shae Henley, (Junior, Aerospace Engineering, University of Arizona). Mentor: Christopher Walker, Astronomy & Steward Observatory, University of Arizona.

[C-7] **The Effects of the Martian Atmospheric Conditions on a NACA 4412 Airfoil**, Alex Higuera Pierre Noel, (Sophomore, Aerospace Engineering, University of Arizona). Mentor: Sergey Shkarayev, Aerospace & Mechanical Engineering, University of Arizona.

[C-8] **Centrifugal Nuclear Thermal Propulsion Ammonia Propellant Thermal Analysis**, Shannon Moore, (Sophomore, Space Physics, Embry-Riddle Aeronautical University). Mentor: Darrel Smith, Physics, Embry-Riddle Aeronautical University.

[C-8] **Centrifugal Nuclear Thermal Propulsion Ammonia Propellant Thermal Analysis**, Hayden West, (Senior, Space Physics, Embry-Riddle Aeronautical University). Mentor: Darrel Smith, Physics & Astronomy, Embry-Riddle Aeronautical University.

[C-9] **Analysis of Thermodynamic Cycles for Nuclear Thermal Rockets**, Tristan Muzzy, (Senior, Aerospace Engineering, Embry-Riddle Aeronautical University). Mentor: Neil Sullivan, Engineering, Embry-Riddle Aeronautical University.

[C-10] **Proximity Operation Maneuvers at Asteroidal Deep Space In-Situ Resource Utilization Stations**, Andrew Purkeypile, (Senior, Aerospace Engineering, Embry-Riddle Aeronautical University). Mentor: Davide Conte, Aerospace Engineering, Embry-Riddle Aeronautical University.

[C-11] **CatSat: Problem Solving for CubeSat Engineering, Integration, and Communication**, Walter Rahmer, (Junior, Optical Sciences & Engineering, University of Arizona). Mentor: Christopher Walker, Steward Observatory, University of Arizona.

[C-12] **Design and Implementation of the Onboard Computer for EagleSat-2**, Hayden Roszell, (Senior, Software Engineering, Embry-Riddle Aeronautical University). Mentor: Ahmed Sulyman, Computer, Electrical, & Software Engineering, Embry-Riddle Aeronautical University.

[C-13] **EagleSat-2: Attitude Determination and Control System Monitoring and Management**, Logan Ruddick, (Senior, Aerospace Engineering, Embry-Riddle Aeronautical University). Mentor: Ahmed Sulyman, Electrical & Software Engineering, Embry-Riddle Aeronautical University.

[C-14] **Investigation of Wakes Behind Blunt-Bodies During Re-Entry**, Avery Stockdale-Stephens, (Senior, Aerospace Engineering, University of Arizona). Mentor: Kyle Hanquist, Aerospace & Mechanical Engineering, University of Arizona.

[C-15] **The EagleSat 2 Structure**, Lillian Sudkamp, (Junior, Aerospace Engineering, Embry-Riddle Aeronautical University). Mentor: Ahmed Sulyman, Electrical Engineering, Embry-Riddle Aeronautical University.

[C-16] **Simulator and Flight Software Testing for Aspera SmallSat Telescope**, Jacob Chambers, (Senior, Computer Science, University of Arizona). Mentor: Carlos Vargas, Steward Observatory, University of Arizona.

[C-17] **Data-driven Laser Powder Bed Fusion Distortion Prediction Using Geometric Parameters**, Pablo Luna, (Junior, Mechanical Engineering, University of Arizona). Mentor: Hannah Budinoff, Systems & Industrial Engineering, University of Arizona.

Program Schedule

Session D:
ASCEND

Moderators:
Clayton Jacobs, Lunasonde
Tom Sharp, Arizona State University

[D-1] **Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV-Exposed Plant Seeds**, Berkeley Adair, (Sophomore, Aerospace Engineering, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University.

[D-1] **Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV-Exposed Plant Seeds**, Tamim Alsharif, (Senior, Aeronautical Management Technology, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University.

[D-1] **Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV-Exposed Plant Seeds**, Brandon Bello, (Junior, Computer Science, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University.

[D-1] **Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV-Exposed Plant Seeds**, Robert Burton, (First-Year, Electrical Engineering, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University.

[D-1] **Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV-Exposed Plant Seeds**, Genevieve Cooper, (Junior, Computer Science, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University.

[D-1] **Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV-Exposed Plant Seeds**, Huy Dinh, (First-Year, Aerospace Engineering, Aeronautics, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University.

[D-1] **Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV-Exposed Plant Seeds**, Elizabeth Garayzar, (Sophomore, Exploration Systems Design, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University.

[D-1] **Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV-Exposed Plant Seeds**, Wilson Luu, (Senior, Applied Computing, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University.

[D-1] **Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV-Exposed Plant Seeds**, Anyell Mata, (Junior, Electrical Engineering, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University.

[D-1] **Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV-Exposed Plant Seeds**, Derek Talbot, (Senior, Biotechnology, Bioenterprise, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University.

[D-1] **Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV- Exposed Plant Seeds**, Muhammed Hunaid Topiwala, (First-Year, Computer Science, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University.

[D-1] **Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV-Exposed Plant Seeds**, Ricardo Ontiveros, (Junior, Electrical Engineering, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University.

[D-2] **ASCEND High Altitude Balloon - Casa Grande Union High School**, Neal Allado, (Senior, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[D-2] **ASCEND High Altitude Balloon - Casa Grande Union High School**, Ella Barth, (High School Student, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[D-2] **ASCEND High Altitude Balloon - Casa Grande Union High School**, Angel Gonzalez, (Junior, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[D-2] **ASCEND High Altitude Balloon - Casa Grande Union High School**, Valia Kaliotzakis, (High School Student, Biotechnology, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[D-2] **ASCEND High Altitude Balloon - Casa Grande Union High School**, Jonathan Lawson, (High School Student, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[D-2] **ASCEND High Altitude Balloon - Casa Grande Union High School**, Melody Limon, (High School Student, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[D-2] **ASCEND High Altitude Balloon - Casa Grande Union High School**, Elias Razo, (High School Student, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[D-2] **ASCEND High Altitude Balloon - Casa Grande Union High School**, Jacob Ross, (Senior, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[D-2] **ASCEND High Altitude Balloon - Casa Grande Union High School**, Amaya Fisher, (High School Student, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[D-2] **ASCEND High Altitude Balloon - Casa Grande Union High School**, Elijah Ramirez, (High School Student, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School.

[D-3] **CAC ASCEND**, Alex Aguilar, (Sophomore, Chemistry, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[D-3] **CAC ASCEND**, Ella Carreno, (Sophomore, Applied Science, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[D-3] **CAC ASCEND**, Mickyas Dinke, (First-Year, Mechanical Engineering, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[D-3] **CAC ASCEND**, Sonja Elstad, (Sophomore, Engineering, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[D-3] **CAC ASCEND**, James McGalliard, (Sophomore, Engineering, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[D-3] **CAC ASCEND**, Elijah Mountz, (High School Student, Software Engineering, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[D-3] **CAC ASCEND**, Ruth Mountz, (High School Student, Adminstration of Justice, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[D-3] **CAC ASCEND**, Norma Owens, (Sophomore, Applied Science, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[D-3] **CAC ASCEND**, Jordan Ragsdale, (Sophomore, Computer Engineering, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[D-3] **CAC ASCEND**, Ralph Rosales, (Sophomore, Mechanical Engineering, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[D-3] **Central Arizona College – NASA ASCEND!**, Robert Serrano, (Sophomore, Civil Engineering, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College.

[D-4] **Long-Distance Video and Telemetry Streaming**, Somaralyz Grullon, (Junior, Mechanical Engineering, Robotics, Embry-Riddle Aeronautical University). Mentor: Yabin Liao, Engineering, Embry-Riddle Aeronautical University.

[D-4] **Long-Distance Video and Telemetry Streaming**, Zachary Howe, (Senior, Aeronautical Sciences, Embry-Riddle Aeronautical University). Mentor: Yabin Liao, Aerospace Engineering, Embry-Riddle Aeronautical University.

[D-5] **GCC’s Team Icarus: Analysis of Gases and Ionizing Radiation within the Upper Atmosphere via Iridium Satellite Communication**, Alec Arcara, (Sophomore, Electrical Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College.

[D-5] **Payload Orientation: Team Icarus**, Kevin Ramirez, (Sophomore, Mechanical Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College.

[D-5] **GCC's Team Icarus: 3-D Printed Payload Housing Support Structure**, Alexander Robles, (Sophomore, Aerospace, Aeronautical Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College.

[D-5] **GCC’s Team Icarus: Measuring the Effectiveness of the Ozone Layer at Filtering UV Light**, Tyler Swingler, (Sophomore, Aerospace Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College.

[D-6] **GCC’s Team AstroPeeps: Propagation of RF Waves within the Upper Atmosphere**, Rik Bloemers, (Senior, Electrical Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College.

[D-6] **Radiation in the Upper Atmosphere and its Effect on Seeds**, Shelby Bump, (Sophomore, Astronautical Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College.

[D-6] **AstroPeeps**, Jose Ocampo, (Sophomore, Mechanical Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College.

[D-6] **Analysis of CO2 within the Upper Atmosphere**, Genaro Rivera, (First-Year, Mechanical Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College.

[D-7] **Phoenix College NASA ASCEND**, Rayan Alasow, (Sophomore, Computer Science, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College.

[D-7] **Phoenix College NASA ASCEND**, Michael Bittner, (Sophomore, Robotics Engineering, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College.

[D-7] **Phoenix College NASA ASCEND**, Jacob Brannon, (Sophomore, Mechanical Engineering, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College.

[D-7] **Phoenix College NASA ASCEND**, Lorynn Garcia, (Sophomore, Aerospace Engineering, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College.

[D-7] **Phoenix College NASA ASCEND**, Ivan Gonzalez Lopez, (Senior, Science, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College.

[D-7] **Phoenix College NASA ASCEND**, Jose Javier Herrera, (Sophomore, Mechanical Engineering, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College.

[D-7] **Phoenix College NASA ASCEND**, Jazmyn Jones, (Sophomore, Science, Astronomy, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College.

[D-7] **Phoenix College NASA ASCEND**, Orion Martin, (Junior, Electrical Engineering, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College.

[D-7] **Phoenix College NASA ASCEND**, Collin Montgomery, (Sophomore, Computer Science, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College.

[D-7] **Phoenix College NASA ASCEND**, Andrew Sherant, (Sophomore, Mechanical Engineering, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College.

[D-8] **High Altitude Crustaceans**, Jordan Boe, (Sophomore, Engineering, Pima Community College). Mentor: AnnMarie Condes, Chemistry, Pima Community College.

[D-8] **High Altitude Crustaceans**, Roberto Navarro, (Sophomore, Aerospace Engineering, Pima Community College). Mentor: AnnMarie Condes, Chemistry, Pima Community College.

[D-9] **UArizona ASCEND: High-Altitude Data Collection With a Custom CubeSat Payload**, Razak Adamu, (First-Year, Aerospace Engineering, University of Arizona). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona.

[D-9] **UArizona ASCEND: High-Altitude Data Collection With a Custom CubeSat Payload**, Nicolas Blanchard, (Senior, Electrical & Computer Engineering, University of Arizona). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona.

[D-9] **UArizona ASCEND: High-Altitude Data Collection With a Custom CubeSat Payload**, Sarina Blanchard, (Sophomore, Mechanical Engineering, University of Arizona). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona.

[D-9] **UArizona ASCEND: High-Altitude Data Collection With a Custom CubeSat Payload**, Colin Brown, (First-Year, Optical Sciences & Engineering, University of Arizona). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona.

[D-9] **UArizona ASCEND: High-Altitude Data Collection With a Custom CubeSat Payload**, Michelle Burr, (Senior, Molecular & Cellular Biology, Astrobiology, University of Arizona). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona.

[D-9] **UArizona ASCEND: High-Altitude Data Collection With a Custom CubeSat Payload**, Nicholas Gullo, (Senior, Electrical & Computer Engineering, University of Arizona). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona.

[D-In Title Only] **Diné College ASCEND**, Jessica Begay, (Senior, Biology, Diné College). Mentor: Demetra Skaltsas, Science, Technology, Engineering, & Mathematics, Diné College.

[D-In Title Only] **Diné College ASCEND**, Nicole Vann, (Junior, Engineering, Diné College). Mentor: Demetra Skaltsas, Science, Technology, Engineering, & Mathematics, Diné College.

Program Schedule

Session E:
Astronomy & Space Physics

Moderators:
Joseph Foy, Arizona State University
Michele Zanolin, Embry-Riddle Aeronautical University

[E-1] **Predicting Limits for Diffuser-Assisted Photometry of Transiting Exoplanets**, Justin Klingele, (Junior, Astronomy, Physics, University of Arizona). Mentor: Kevin Hardegree-Ullman, Astronomy, Steward Observatory, University of Arizona.

[E-2] **A Deuteration Survey of Dense Prestellar Cores in Taurus**, Hanga Andras-Letanovszky, (Sophomore, Astronomy, Physics, Mathematics, University of Arizona). Mentor: Yancy Shirley, Astronomy & Steward Observatory, University of Arizona.

[E-3] **In with the Old, Out with the Young: Stellar Clusters in NGC 3344**, Naomi Carl, (Sophomore, Astrophysics, Arizona State University). Mentor: Sanchayeeta Borthakur, School of Earth & Space Exploration, Arizona State University.

[E-4] **Testing and Construction of a Short-Arm Interferometer and Low Frequency Prototype of Laser Interferometer Suspensions for Gravitational Wave Detection**, Logan Caudle, (Sophomore, Space Physics, Embry-Riddle Aeronautical University). Mentor: Michele Zanolin, Physics, Embry-Riddle Aeronautical University.

[E-4] **Testing and Construction of a Short-arm Interferometer and Low Frequency Prototype of Laser Interferometer Suspensions for Gravitational Wave Detection**, Brandon Pillon, (Sophomore, Space Physics, Embry-Riddle Aeronautical University). Mentor: Michele Zanolin, Physics & Astronomy, Embry-Riddle Aeronautical University.

[E-5] **Signatures of Traversable Wormholes**, Sadie Cullings, (Sophomore, Aerospace Engineering, Arizona State University). Mentor: Paul Davies, Department of Physics: The Beyond Center, Arizona State University.

[E-6] **A Kinematic Analysis of Proplyds in NGC 1977 and the ONC**, Peter Hartman, (Senior, Astronomy, University of Arizona). Mentor: Serena Kim, Astronomy, University of Arizona.

[E-7] **The Spectroscopic and Visual Orbit of the Nitrogen-rich Massive Binary WR 138**, Amanda Holdsworth, (Junior, Space Physics, Embry-Riddle Aeronautical University). Mentor: Noel Richardson, Physics & Astronomy, Embry-Riddle Aeronautical University.

[E-8] **The Energetics of the Colliding Wind Binary γ2 Velorum: Multi-wavelength Studies in Optical X-rays**, Randy Loberger, (Junior, Astronomy, Embry-Riddle Aeronautical University). Mentor: Noel Richardson, Physics & Astronomy, Embry-Riddle Aeronautical University.

[E-8] **The Energetics of the Colliding Wind Binary γ2 Velorum: Multi-wavelength Studies in Optical X-rays**, Tri Phan, (Junior, Astronomy, Embry-Riddle Aeronautical University). Mentor: Noel Richardson, Physics & Astronomy, Embry-Riddle Aeronautical University.

[E-9] **Identifying Diffuse Galaxies through Citizen Science**, Nicolas Mazziotti, (Sophomore, Astronomy, Physics, University of Arizona). Mentor: David Sand, Astronomy, University of Arizona.

[E-10] **Characterization of Oval Defects in Crystalline Optical Coatings**, Breck Meagher, (Junior, Space Physics, Embry-Riddle Aeronautical University). Mentor: Ellie Gretarsson, Aerospace Engineering, Embry-Riddle Aeronautical University.

[E-11] **Energy Partitioning and Particle Acceleration at the Bow Shock of Saturn**, Jamesen Reese, (Junior, Physics, University of Arizona). Mentor: Federico Fraschetti, Lunar & Planetary Laboratory, University of Arizona.

[E-12] **Revisiting the FUSE Data Archive - Finding O VI Emission**, Maxwell Rizzo, (Senior, Physics, Astronomy, University of Arizona). Mentor: Haeun Chung, Steward Observatory, Astronomy, University of Arizona.

[E-13] **X-ray Binaries as Flashlights to Map the Universe through Stellar Wind Studies**, Calvin Sam, (Junior, Astronomy, Embry-Riddle Aeronautical University). Mentor: Pragati Pradhan, College of Arts & Sciences, Embry-Riddle Aeronautical University.

[E-13] **X-ray Binaries as Flashlights to Map the Universe through Stellar Wind Studies**, Tristen Sextro, (Junior, Astronomy, Software Engineering, Embry-Riddle Aeronautical University). Mentor: Pragati Pradhan, College of Arts & Sciences, Embry-Riddle Aeronautical University.

[E-14] **The Stellar Content of IC1310**, Meghan Speckert, (Junior, Physics, Astrophysics, Northern Arizona University). Mentor: Philip Massey, Lowell Observatory.

[E-15] **Nitrogen Isotopic Fractionation in Prestellar Core L43E**, Reynier Squillace, (Senior, Astronomy, University of Arizona). Mentor: Yancy Shirley, Astronomy & Steward Observatory, University of Arizona.

[E-16] **Observing Magellanic System Stars in the SMACS J0723-73 JWST ERO**, Jake Summers, (Sophomore, Astrophysics, Physics, Mathematics, Arizona State University). Mentor: Rogier Windhorst, School of Earth & Space Exploration, Arizona State University.

Program Schedule

Session F:
Planetary Science

Moderators:
Theodore Kareta, Northern Arizona University
Dante Lauretta, University of Arizona
Tim Swindle, University of Arizona

[F-1] **Structured Light Scanner Use in OSIRIS-REx Sample Analysis**, Laurinne Blanche, (Junior, Materials Science & Engineering, University of Arizona). Mentor: Andrew Ryan, Planetary Sciences, University of Arizona.

[F-2] **Impactor-Atmosphere Interactions Above the Surface of Venus**, Claire Blaske, (Senior, Earth & Space Exploration, Astrophysics, Arizona State University). Mentor: Joseph O'Rourke, School of Earth & Space Exploration, Arizona State University.

[F-3] **The Effects of Space Weathering on Airless Bodies**, Emily Clark, (Sophomore, Physics, Astrophysics, Northern Arizona University). Mentor: Mark Loeffler, Astronomy & Planetary Science, Northern Arizona University.

[F-4] **Arizona NASA Eclipse Ballooning Project**, Jacqueline Do, (Sophomore, Electrical Engineering, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University.

[F-5] **Organosulfurs in Meteorites**, Jacob Eaton, (Junior, Aerospace Engineering, Arizona State University). Mentor: Maitrayee Bose, School of Earth & Space Exploration, Arizona State University.

[F-6] **Exploring the Limits of Mineral Abundance Retrievals in the Thermal Infrared from Laboratory Particulate Spectral Analysis**, Greta Freeman, (Sophomore, Geology, Northern Arizona University). Mentor: Cheng Ye, Astronomy & Planetary Science, Northern Arizona University.

[F-7] **An Apparatus for the Experimental Simulation of the Effects of Wind Transport on Martian Sands**, Rachel Fry, (Junior, Astrophysics, Northern Arizona University). Mentor: Devon Burr, Astronomy & Planetary Sciences, Northern Arizona University.

[F-8] **Laboratory Measurements of the Thickness, Index of Refraction, and Density of Ices Important to Planetary Science**, Moises Gomez, (Senior, Physics, Astrophysics, Northern Arizona University). Mentor: Stephen Tegler, Astronomy & Planetary Sciences, Northern Arizona University.

[F-9] **Optical Constants of CH_4 + N2 Ice Mixtures and Outer Solar System Objects**, Aidan Madden-Watson, (Senior, Astronomy, Physics, Northern Arizona University). Mentor: Stephen Tegler, Astronomy & Planetary Sciences, Northern Arizona University.

[F-10] **Contour Mapping of the Crustal Magnetism on Mars**, Daniel Gonzalez, (Junior, Mathematics, Statistics, University of Arizona). Mentor: Lon Hood, Lunar & Planetary Laboratory, University of Arizona.

[F-11] **The Formation and Thermal Evolution of Itokawa's Parent Body**, Jonas Hallstrom, (Senior, Physics, Arizona State University). Mentor: Maitrayee Bose, School of Earth & Space Exploration, Arizona State University.

[F-12] **Reconstructing the Real Chirp of the MARSIS Radar**, Madeline Hart, (Senior, Electrical & Computer Engineering, University of Arizona). Mentor: Stefano Nerozzi, Lunar & Planetary Laboratory, University of Arizona.

[F-13] **SNAPS: Real Time Outlier Detection**, Jessica Maldonado Olivas, (Sophomore, Computer Science, Mathematics, Northern Arizona University). Mentor: David Trilling, Astronomy & Planetary Sciences, Northern Arizona University.

[F-14] **Hydrothermal Alteration on Earth and Asteroids**, Sarah Nielsen, (Sophomore, Biology, University of Arizona). Mentor: Dante Lauretta, Lunar & Planetary Laboratory, University of Arizona.

[F-15] **Carbonate Clues for Hydrothermal Alteration History of Carbonaceous Chondrites**, Melissa Kontogiannis, (Senior, Chemistry, University of Arizona). Mentor: Dante Lauretta, Lunar & Planetary Laboratory, University of Arizona.

[F-16] **Remote Sensing Compositional Analysis of Unvegetated Meandering Stream Basins**, Adriana Olvera, (Senior, Geology, Northern Arizona University). Mentor: Mark Salvatore, Astronomy & Planetary Science, Northern Arizona University.

[F-17] **A Potential Mechanism for Nitrogen Storage in the Earth's Mantle Transition Zone**, Shradhanjli Ravikumar, (Senior, Astrobiology, Biogeosciences, Astrophysics, Arizona State University). Mentor: Dan Shim, School of Earth & Space Exploration, Arizona State University.

[F-18] **Laboratory Analysis of Ceres Analogue Minerals**, Lucas Reynoso, (Senior, Mechanical Engineering, Arizona State University). Mentor: Maitrayee Bose, School of Earth & Space Exploration, Arizona State University.

[F-19] **Echeclus Data Analysis of Phase Curve and Composition**, Tessa Richardson, (Junior, Physics, Mathematics, Northern Arizona University). Mentor: Teddy Kareta, Lowell Observatory.

[F-20] **Mechanical Assembly for NUV CCD Camera Telescope**, Alejandro Romero-Lozano, (Sophomore, Electrical & Computer Engineering, University of Arizona). Mentor: Erika Hamden, Steward Observatory, University of Arizona.

Program Schedule

Session G:
Exploration Systems Engineering: Biological, Materials, Optical & Electrical

Moderators:
Anne Boettcher, Embry-Riddle Aeronautical University
Tom Sharp, Arizona State University

[G-1] **Investigation of Stress Concentrations in Parts Manufactured with Fused Deposition Modeling**, Hope Elmer, (Junior, Aerospace Engineering, Embry-Riddle Aeronautical University). Mentor: David Lanning, Engineering, Embry-Riddle Aeronautical University.

[G-2] **Quantitative Analysis of Bone Regenerated Using Patient Specific 3D Printed Scaffolds**, Adeeb Hossain, (Junior, Biomedical Sciences, University of Arizona). Mentor: David Margolis, Orthopedic Surgery, University of Arizona.

[G-3] **Multi-Spectral Thermal Infrared Imager for UAV Based Remote Sensing**, Loren Larrieu, (Senior, Electrical Engineering, Northern Arizona University). Mentor: Christopher Edwards, Astronomy & Planetary Science, Northern Arizona University.

[G-4] **Choice of Best HA Coated Sensors to Measure Bone Maintaining Activity in Space**, Stephany Maldonado, (Senior, Biomedical Sciences, University of Arizona). Mentor: John Szivek, Orthopaedic Surgery, University of Arizona.

[G-5] **Zernike Wavefront Sensing for Adaptive Optics**, Katie Twitchell, (Junior, Optical Sciences & Engineering, University of Arizona). Mentor: Sebastiaan Haffert, Astronomy, University of Arizona.

[G-6] **Space Environment Radiation Testing on Electrical Components**, Mairely Urias, (Senior, Electrical Engineering, Arizona State University). Mentor: Hugh Barnaby, School of Electrical, Computer & Energy Engineering, Arizona State University.

[G-7] **Satellites and the World of RF**, Edrik Vachier, (Junior, Aerospace Engineering, Arizona State University). Mentor: Sean Bryan, School of Earth & Space Exploration, Arizona State University.

[G-In Title Only] **Novel Poly(vinyl) Alcohol Composites for Carbon Regulation in Space**, Salma Ly, (Senior, Chemical Engineering, Arizona State University). Mentor: Matthew Green, School for Engineering of Matter, Transport & Energy, Arizona State University.

Program Schedule

Session H:
Earth & Environmental Science & Engineering

Moderators:
Michelle Coe, University of Arizona
Chandra Holifield Collins, USDA Southwest Watershed Research Center

[H-1] **Protecting Forests and Infrastructure from Fire with Drones**, Tracey Begaye, (Senior, Computer Engineering, Northern Arizona University). Mentor: Peter Fulé, School of Forestry, Northern Arizona University.

[H-2] **Applying Conventional Navajo Knowledge When Investigating DRUM Sites Within the Navajo Nation**, Mikayla Bia, (Sophomore, Environmental Engineering, Diné College). Mentor: Angelita Denny, Department of Energy (Legacy Management).

[H-3] **Intermittent Performance of Pilot Scale Off-Grid Nanofiltration System**, Lynn Carroll, (Senior, Biosystems Engineering, University of Arizona). Mentor: Vicky Karanikola, Chemical & Environmental Engineering, University of Arizona.

[H-4] **US Fish and Wildlife Service Info Sheets**, Sofia Delgado, (Junior, Ecology & Evolutionary Biology, University of Arizona). Mentor: Erin Posthumus, National Phenology Network, University of Arizona.

[H-5] **Where Are All of the Ammonia Oxidizers?: A Yellowstone Mystery**, Simon Fronmueller, (Sophomore, Astrobiology, Arizona State University). Mentor: Everett Shock, School of Earth & Space Exploration, Arizona State University.

[H-6] **Radiocarbon Dating in Arctic Lakes**, Charlie Kruger, (Sophomore, Geology, Northern Arizona University). Mentor: Darrell Kaufman, College of the Environment, Forestry, & Natural Sciences, Northern Arizona University.

[H-7] **Reductive Degradation of Insensitive Munitions Compound (IMC) Mixtures using Iron-Based Reactive Minerals**, Ellie Laton, (Sophomore, Environmental Engineering, Computer Science, University of Arizona). Mentor: Osmar Menezes, Chemical & Environmental Engineering, University of Arizona.

[H-8] **Influence of Woodland Encroachment on Vegetation, Soils, Hydrology, and Erosion on Sagebrush Rangelands**, Trisha Jean Lane, (Junior, Environmental Engineering, University of Arizona). Mentor: Jason Williams, USDA Agricultural Research Service, Southwest Watershed Research Center.

[H-9] **Effects of Biological Soil Crust Cover on Rainfall Runoff**, Sophia Dixon, (Junior, Environmental Science, University of Arizona). Mentor: Jason Williams, USDA Agricultural Research Service, Southwest Watershed Research Center.

[H-10] **Assessment of Extinction Risks of Sonoran Desert Plants**, Emma Lintz, (Senior, Ecology & Evolutionary Biology, Northern Arizona University). Mentor: Helen Rowe, School of Earth & Sustainability, Northern Arizona University.

[H-11] **A Microclimate Case-Study Comparison of Arizona Soundings**, David Lopez, (Senior, Geography, Meteorology, Climatology, Arizona State University). Mentor: Randall Cerveny, School of Geographical Sciences & Urban Planning, Arizona State University.

[H-12] **Space Exploration for Sustainable Development**, Bo Manuszak, (Senior, Aerospace Engineering, Arizona State University). Mentor: Eric Stribling, Interplanetary Initiative, Arizona State University.

[H-13] **Carbon Dioxide Capture in Spacecraft Using Novel Microsphere-Loaded Polymers**, Cameron Morgan, (Junior, Environmental Engineering, Arizona State University). Mentor: Matthew Green, School for Engineering of Matter, Transport & Energy, Arizona State University.

[H-14] **Textural Analysis of Airfall Deposits From the Most Recent Explosive Eruption at the Valles Caldera, NM**, Yamini Patel, (Senior, Earth & Space Exploration, Geology, Arizona State University). Mentor: Amanda Clarke, School of Earth & Space Exploration, Arizona State University.

[H-15] **Potential Effects of Endophytes in Tillandsia Usneoides**, Annika Revis, (Sophomore, Biology, Northern Arizona University). Mentor: Catherine Gehring, Biological Sciences, Northern Arizona University.

[H-16] **Drought Impact on Cold Tolerance in Pinyon Pine**, Benjamin Ryan, (Junior, Environment Science, Northern Arizona University). Mentor: Amy Whipple, Biology, Northern Arizona University.

[H-17] **Meals for Microbes: How Do Energy Supplies of Hot Springs Vary with Geothermal Mixing?**, Siena Smania, (Senior, Astrobiology, Biogeosciences, Arizona State University). Mentor: Everett Shock, School of Earth & Space Exploration, Arizona State University.

[H-18] **Sensitivity of North American Monsoon Convective Precipitation Flooding in Arizona to the Atmospheric Boundary Layer and Circulation**, Brooke Sullivan, (Senior, Applied Meteorology, Embry-Riddle Aeronautical University). Mentor: Dorothea Ivanova, Applied Meteorology, Embry-Riddle Aeronautical University.

[H-19] **Measuring Dioxin and Dioxin-Like Compounds in Soil and Sediments Impacted by Wildfires and Flash Flooding**, Camille Tinerella, (Junior, Environmental Science, University of Arizona). Mentor: Mónica Ramírez-Andreotta, Environmental Science & Public Health, University of Arizona.

[H-20] **Navajo Nation Municipal Water Reuse Feasibility Analysis**, Lauren Vasquez, (Junior, Biosystems Engineering, University of Arizona). Mentor: Vicky Karanikola, Chemical & Environmental Engineering, University of Arizona.

[H-In Title Only] **Seasonality of Dominant Abiotic Controls of Soil Respiration in Sonoran Desert Grasslands**, Jacob Blais, (Senior, Natural Resources, University of Arizona). Mentor: Nathan Pierce, School of Natural Resources & the Environment, University of Arizona.

Program Schedule

Session I:
Aeronautics

Moderators:
Jisoo Kim, Arizona State University
Yabin Liao, Embry-Riddle Aeronautical University

[I-1] **Design and Implementation of a Focused Laser Differential Interferometer for Hypersonic Boundary Layer Transition Measurements**, Jackson Barger, (Junior, Aerospace Engineering, University of Arizona). Mentor: Stuart Craig, Aerospace & Mechanical Engineering, University of Arizona.

[I-2] **Effects of Structural Motion on Swept Wing Aerodynamics**, Andrew Frisch, (Senior, Aerospace Engineering, University of Arizona). Mentor: Jesse Little, Aerospace & Mechanical Engineering, University of Arizona.

[I-3] **Transitional Shock-Boundary Layer Interactions at Mach 5**, Morgan Goz, (Junior, Aerospace Engineering, University of Arizona). Mentor: Jesse Little, Aerospace & Mechanical Engineering, University of Arizona.

[I-4] **Analysis and Optimization of Electric Ducted Fan Nacelle Geometry**, Lucas Guaglardi, (Sophomore, Aerospace Engineering, Arizona State University). Mentor: Timothy Takahashi, School for Engineering of Matter, Transport & Energy, Arizona State University.

[I-5] **Fin-induced Shock/Boundary Layer Interactions at Mach 5**, Alec Maloney, (Junior, Aerospace Engineering, University of Arizona). Mentor: Jesse Little, Aerospace & Mechanical Engineering, University of Arizona.

[I-6] **Force and Moment Measurements in the Arizona Polysonic Wind Tunnel**, Nicholas Mammana, (Senior, Aerospace Engineering, University of Arizona). Mentor: Jesse Little, Aerospace & Mechanical Engineering, University of Arizona.

[I-7] **Aero-Thermodynamic Loads on Space Shuttle Orbiter Ascent**, David Ordaz Perez, (Senior, Aerospace Engineering, Arizona State University). Mentor: Timothy Takahashi, School for Engineering of Matter, Transport & Energy, Arizona State University.

[I-8] **Numerical Investigation of Hypersonic Boundary-Layer Transition for an Ogive Geometry**, Samantha Stevens, (Sophomore, Aerospace Engineering, Mathematics, University of Arizona). Mentor: Hermann Fasel, Aerospace & Mechanical Engineering, University of Arizona.

2022-2023 Arizona NASA Space Grant Student Abstracts

Organized by presenter's last name.

Adair, Berkeley (Sophomore, Aerospace Engineering, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University. [D-1]

ANALYSIS OF ATTITUDE DETERMINATION AND CONTROLS ON A HIGH ALTITUDE BALLOONING PAYLOAD WITH LONG RANGE HAM RADIO COMMUNICATION AND UV-EXPOSED PLANT SEEDS

In Fall 2022, the purpose was to complete the two science missions of an Attitude Determination and Control System (ADCS) and Meteorology. The meteorological mission used pressure, internal and external temperature, GPS, and an accelerometer to monitor cloud condensation nuclei (CCNs). Further in Spring 2023, ASCEND tested long range HAM radio communication, ADCS and a plant module. The HAM radio mission allows ASCEND members to activate and communicate with the payload during flight. The plant module mission was designed to test the effects of UV radiation on the growth of lettuce seeds that would be sent up on the payload during launch, compared to a control group that would remain on the ground. Overall, ASCEND created a reusable design for the printed circuit board (PCB) and designed a CubeSat inspired payload. ASCEND is also able to profile the atmosphere, collect data, and test the payload design.

Adamu, Razak (First-Year, Aerospace Engineering, University of Arizona). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona. [D-9]

UARIZONA ASCEND: HIGH-ALTITUDE DATA COLLECTION WITH A CUSTOM CUBESAT PAYLOAD

CubeSats have been a rapidly growing technology over the last decade due to their diminutive total mass to orbit while maintaining spacecraft performance. However, due to their small form factor, CubeSats are extremely limited in the amount of electronics and power storage that they can carry. Within the bounds of a standard 1.5U CubeSat, the UArizona ASCEND payload houses a Geiger counter and atmospheric profiling system to collect data up to 100,000 feet. The project incorporates low power considerations, volume optimization, and high durability 3D printing to improve on the University's previous ASCEND launches. In addition, two traditional small form factor cameras and one 360 camera collect unique views of Earth's atmosphere throughout the ascent and descent of the payload.

Aguilar, Alex (Sophomore, Chemistry, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [D-3]

CAC ASCEND

Three teams at Central Arizona College constructed payloads to explore three research areas. These teams were the HONEY BADGERS, RAPTORS and OWLS. The HONEY BADGERS traced the payload's location using a GPS, measured the UV levels over certain altitudes, and calculated the gravitational acceleration as the payload ascended and descended. By dampening camera vibrations and creating systems to reduce rotation, the RAPTORS sought to capture quality flight footage. The OWLS measured the fluctuations in humidity, temperature, and altitude across the various atmospheric levels. In addition, their payload also carried a biological experiment designed by the Diné College team.

Alasow, Rayan (Sophomore, Computer Science, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College. [D-7]

PHOENIX COLLEGE NASA ASCEND

The Phoenix College NASA ASCEND team has participated in launches for many years. Its four sub-teams are diligently working toward our objectives. The mechanical/vehicle group has been working on improving our techniques for fabricating and standardizing the parts for our carbon fiber reinforced vehicle. The atmospheric profiling group is integrating a number of sensors for our light and gas experiments to make measurements as a function of altitude. We are also acquiring data on how our vehicle is behaving during the launch. For the Spring 2023 launch, we are also launching two Geiger counters to measure beta and gamma radiation at various altitudes and locate the Pfotzer –Regener maximum. The video stabilization group succeeded in recording stable video images during the Fall 2022 launch. We are trying to improve on our effort and repeat our success during the Spring 2023 launch.

Alfermann, Anna (Senior, Environmental Science, Northern Arizona University). Mentor: Temuulen Sankey, School of Informatics, Computing & Cyber Systems, Northern Arizona University. [C-1]

REMOTE SENSING OF VEGETATION AND GEOMORPHIC CHANGE ALONG 11.75 KM OF THE PARIA RIVER

Tamarisk and other vegetation along a 11.75 km reach of the Paria River above the confluence of the Colorado River at Lee's Ferry can be estimated using remote sensing data. Airborne multispectral images in 20 cm spatial resolution from 2009, 2013, and 2021 are used to detect vegetation and geomorphic changes along the Paria River. Image classification is completed using machine learning, normalized difference vegetation index, and other tools in ENVI software. Our results indicate that vegetation cover has declined up to 30% over the 12-year period along the Paria River. The river's floodplain, sandbars, and meandering have substantially changed, likely due to flood events. Our change detection map will be useful for land managers and serve as ecological indicators.

Allado, Neal (Senior, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [D-2]

ASCEND HIGH ALTITUDE BALLOON - CASA GRANDE UNION HIGH SCHOOL

A team of students from Casa Grande Union High School designed and implemented an instrumentation and biological payload to gather data about the lower stratosphere. The instrumentation mission gathered data on atmospheric phenomena, specifically the altitude and composition of the ozone layer. The biological mission gathered data on how the atmosphere at high altitude affects simple biological organisms with the goal of determining how alien atmospheres may affect life from Earth.

Alsharif, Tamim (Senior, Aeronautical Management Technology, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University. [D-1]

ANALYSIS OF ATTITUDE DETERMINATION AND CONTROLS ON A HIGH ALTITUDE BALLOONING PAYLOAD WITH LONG RANGE HAM RADIO COMMUNICATION AND UV-EXPOSED PLANT SEEDS

In Fall 2022, the purpose was to complete the two science missions of an Attitude Determination and Control System (ADCS) and Meteorology. The meteorological mission used pressure, internal and external temperature, GPS, and an accelerometer to monitor cloud condensation nuclei (CCNs). Further in Spring 2023, ASCEND tested long range HAM radio communication, ADCS and a plant module. The HAM radio mission allows ASCEND members to activate and communicate with the payload during flight. The plant module mission was designed to test the effects of UV radiation on the growth of lettuce seeds that would be sent up on the payload during launch, compared to a control group that would remain on the ground. Overall, ASCEND created a reusable design for the printed circuit board (PCB) and designed a CubeSat inspired payload. ASCEND is also able to profile the atmosphere, collect data, and test the payload design.

Andras-Letanovszky, Hanga (Sophomore, Astronomy, Physics, Mathematics, University of Arizona). Mentor: Yancy Shirley, Astronomy & Steward Observatory, University of Arizona. [E-2]

A DEUTERATION SURVEY OF DENSE PRESTELLAR CORES IN TAURUS

Prestellar cores are dense, cold clumps of gas and dust in molecular clouds that can gravitationally collapse into a protostar. The initial conditions of the future planet-forming disk are set during the prestellar phase, so understanding prestellar core evolution is crucial for understanding star and planet formation. One probe of these conditions is deuteration, where deuterium replaces one or more of a molecule's hydrogen atoms. Molecular deuteration increases in cold, dense regions, so older cores typically have more deuterated molecules. Thus, comparing a core's deuteration ratio to its density gives a relative estimate of its age. This project surveys HDCO/H2CO ratios in 12 prestellar cores in the Barnard 10 region of Taurus. HDCO was thought to deuterate on icy dust grain surfaces, but our observations indicate there may be gas-phase contributions as well. Our next steps are to obtain these cores' H2CO abundances and then determine their deuteration ratios.

Arcara, Alec (Sophomore, Electrical Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College. [D-5]

GCC'S TEAM ICARUS: ANALYSIS OF GASES AND IONIZING RADIATION WITHIN THE UPPER ATMOSPHERE VIA IRIDIUM SATELLITE COMMUNICATION

Project Icarus, the GCC NASA ASCEND team, conducted a research project to examine the relationship between ionizing radiation, altitude, and the composition of Earth's atmospheric gases. The team's research goal was to investigate the intensity of ionizing radiation as a function of altitude and atmospheric gas composition in order to better understand the ozone layer's effect on obstructing cosmic radiation. To achieve this, the team built a high-altitude weather balloon payload equipped with a micro-spectrometer, Geiger-Muller tube sensor, and iridium satellite communications modem. The micro-spectrometer surveyed the composition of atmospheric gases, providing detailed information about the concentration of different gases present at various altitudes. The Geiger-Muller tube sensor measured ionizing radiation intensity. The iridium satellite communications modem allowed for real-time data transmission from the payload while in flight, enabling the team to analyze the collected data as well as monitor the functionality of the flight data recorder's onboard sensors.

Barger, Jackson (Junior, Aerospace Engineering, University of Arizona). Mentor: Stuart Craig, Aerospace & Mechanical Engineering, University of Arizona. [I-1]

DESIGN AND IMPLEMENTATION OF A FOCUSED LASER DIFFERENTIAL INTERFEROMETER FOR HYPERSONIC BOUNDARY LAYER TRANSITION MEASUREMENTS

A Focused Laser Differential Interferometer (FLDI) is a non-intrusive, laser-based optical diagnostic that can measure density fluctuations at a point in fluid flows. An FLDI system was designed, built, and implemented as a diagnostic in wind-tunnel tests studying boundary-layer transition at hypersonic speeds. The FLDI system uses lenses, polarizers, and Wollaston prisms to create a focused beam pair and measures the phase difference between the two beams with a photodetector. The focusing nature of the system eliminates the influence of unwanted tunnel wall effects. Time-series data acquired by this diagnostic can be transformed into frequency space, where dominant flow instabilities and boundary-layer state can be determined. Benchtop tests of the system successfully detected laminar-turbulent transition in a nitrogen jet. In subsequent wind tunnel tests on a 7° cone, the FLDI system measured the expected turbulent boundary layer. Future work includes additional wind tunnel testing and implementing a multi-point FLDI system.

Barth, Ella (High School Student, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [D-2]

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A team of students from Casa Grande Union High School designed and implemented an instrumentation and biological payload to gather data about the lower stratosphere. The instrumentation mission gathered data on atmospheric phenomena, specifically the altitude and composition of the ozone layer. The biological mission gathered data on how the atmosphere at high altitude affects simple biological organisms with the goal of determining how alien atmospheres may affect life from Earth.

Begay, Jessica (Senior, Biology, Diné College). Mentor: Demetra Skaltsas, Science, Technology, Engineering, & Mathematics, Diné College. [D-0]

DINÉ COLLEGE ASCEND

Three teams at Central Arizona College and Diné College constructed payloads to explore three research areas. These teams were the HONEY BADGERS, RAPTORS and OWLS. The HONEY BADGERS traced the payload's location using a GPS, measured the UV levels over certain altitudes, and calculated the gravitational acceleration as the payload ascended and descended. By dampening camera vibrations and creating systems to reduce rotation, the RAPTORS sought to capture quality flight footage. The OWLS measured the fluctuations in humidity, temperature, and altitude across the various atmospheric levels. In addition, their payload also carried a biological experiment designed by the Diné College team.

Begaye, Tracey (Senior, Computer Engineering, Northern Arizona University). Mentor: Peter Fulé, School of Forestry, Northern Arizona University. [H-1]

PROTECTING FORESTS AND INFRASTRUCTURE FROM FIRE WITH DRONES

Structure from Motion (SfM) is a technique for three-dimensional visualization using images taken from different locations. Computer software, such as Metashape, can stitch the photos into a 3-D scene, called a point cloud, which is beneficial for applications such as predicting forest fire behavior, wildlife habitat, or climate vulnerability. In the forests of Northern Arizona, I fly drones at different heights over utility line corridors to collect data to measure fuel hazards. The forestry lab is doing similar work on the Navajo Nation in collaboration with Diné College. I use point cloud data to compute metrics such as tree segmentation, individual tree location, and tree height. These parameters help forecast the behavior of forest fires. Foresters, utility providers, and fire managers will all receive access to our research.

Bello, Brandon (Junior, Computer Science, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University. [D-1]

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Bia, Mikayla (Sophomore, Environmental Engineering, Diné College). Mentor: Angelita Denny, Department of Energy (Legacy Management). [H-2]

APPLYING CONVENTIONAL NAVAJO KNOWLEDGE WHEN INVESTIGATING DRUM SITES WITHIN THE NAVAJO NATION

The Department of Energy Office of Legacy Management's Defense-Related Uranium Mines Program (DRUM) mission is to protect human health and the environment. The DRUM teams conduct Verification and Validation (V&V) at abandoned uranium mines which consists of inventorying mining related features, collecting environmental data, and assessing surrounding vegetation and wildlife presence. As a member of the Navajo tribe and resident within the Navajo reservation, I applied my traditional knowledge of the organisms that are known to be within DRUM sites located on the Navajo reservation. Navajo Traditional Ecological Knowledge provided the V&V team information on the historical continuity and living organisms that remain within the area. Information that is presented includes the comparison and use of LM's framework and the Dine Educational Philosophy. For example, providing the traditional name and cultural purpose of the animals and vegetation. This guide helps benefit both nature and those that encounter it.

Bittner, Michael (Sophomore, Robotics Engineering, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College. [D-7]

PHOENIX COLLEGE NASA ASCEND

The Phoenix College NASA ASCEND team has participated in launches for many years. Its been working on improving our techniques for fabricating and standardizing the parts for our carbon fiber reinforced vehicle. It has also constructed a second vehicle for redundancy. The atmospheric profiling group is integrating a number of sensors for our light experiment and gas to make measurements as a function of altitude. We are also acquiring data on how our vehicle is behaving during the launch. For the Spring 2023 launch, we are also launching two Geiger counters to measure beta and gamma radiation at various altitudes and locate the Pfotzer–Regener maximum. The video stabilization group succeeded in recording stable video images during the Fall 2022 launch. We are trying to improve on our effort and repeat our success during the Spring 2023 launch.

Blais, Jacob (Senior, Natural Resources, University of Arizona). Mentor: Nathan Pierce, School of Natural Resources & the Environment, University of Arizona. [H-0]

SEASONALITY OF DOMINANT ABIOTIC CONTROLS OF SOIL RESPIRATION IN SONORAN DESERT GRASSLANDS

Representing microbial and root respiration, soil CO2 efflux (Fs) is abiotically controlled by soil moisture and temperature. Our objective was to examine how these abiotic controls interact across seasons to influence both baseline and pulses of Fs associated with episodic rainfall. We hypothesized that (1) moisture is the dominant control in the summer whereas temperature controls spring Fs, and (2) baseline respiration contributes more to cumulative Fs during the summer compared to the spring. Using automated soil respiration chambers at a rainfall manipulation experiment in southern Arizona, we found that moisture is the dominant Fs control during summer. However, temperature and Fs are positively related during the summer, suggesting that temperature more tightly regulates Fs than previously thought. Overall, Fs is positively related to moisture and temperature across seasons, thus, they co-control Fs year-round. Using a method analogous to baseflow partitioning of stream discharge, forthcoming analyses will assess hypothesis two.

Blanchard, Nicolas (Senior, Electrical & Computer Engineering, University of Arizona). Mentor: Sergey Shkarayev, Aerospace & Mechanical Engineering, University of Arizona. [C-2]

SUBTERRANEAN EXPLORATION USING A TRAIN OF AUTONOMOUS VEHICLES

Caves and lava tubes provide a unique environment for preserving microbial life. Orbiters have discovered pits on the surface of Mars that resemble caves or lava tubes. By analogy with Earth, caves on Mars may contain signatures of past microbial life and become valuable resources for study. However, these environments are challenging to navigate autonomously due to low light conditions, sharp corners, and lack of GPS. This work presents a conceptual design for an autonomous vehicles system for the exploration of subterranean environments as well as accompanying experimental data from a prototype drone system. Flight experiments employing LiDAR, tracking image sensors, and a Simultaneous Localization And Mapping (SLAM) algorithm show that Visual-Inertial Odometry (VIO) localization is an effective method for GPS-denied navigation. A custom ground station algorithm utilizes MAVLink communication to empower fully autonomous exploration. The results demonstrate the feasibility of the proposed system in a confined and GPS-denied environment.

Blanchard, Nicolas (Senior, Electrical & Computer Engineering, University of Arizona). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona. [D-9]

UARIZONA ASCEND: HIGH-ALTITUDE DATA COLLECTION WITH A CUSTOM CUBESAT PAYLOAD

CubeSats have been a rapidly growing technology over the last decade due to their diminutive total mass to orbit while maintaining spacecraft performance. However, due to their small form factor, CubeSats are extremely limited in the amount of electronics and power storage that they can carry. Within the bounds of a standard 1.5U CubeSat, the UArizona ASCEND payload houses a Geiger counter and atmospheric profiling system to collect data up to 100,000 feet. The project incorporates low power considerations, volume optimization, and high durability 3D printing to improve on the University's previous ASCEND launches. In addition, two traditional small form factor cameras and one 360 camera collect unique views of Earth's atmosphere throughout the ascent and descent of the payload.

Blanchard, Sarina (Sophomore, Mechanical Engineering, University of Arizona). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona. [D-9]

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Blanche, Laurinne (Junior, Materials Science & Engineering, University of Arizona). Mentor: Andrew Ryan, Planetary Sciences, University of Arizona. [F-1]

STRUCTURED LIGHT SCANNER USE IN OSIRIS-REX SAMPLE ANALYSIS

OSIRIS-REx is the first U.S. mission to return samples from an asteroid to Earth. These retrieved samples will be placed in a nitrogen glove box to avoid contamination and analyzed via 3D structured light scanner. These scans will be used to calculate sample volume, density, roughness, and select candidates for further research. To do this, the scanner's error and uncertainty must first be determined. This is accomplished by scanning samples of various shapes and sizes with known volumes. Accuracy is negatively impacted by some sample properties, including high reflectivity, lack of surface features, and knife-edges. Scanner alignment is one of the most important factors in improving scan quality. The overall maximum scanner error was found to be less than 2.0 ± 0.1 %. By determining Bennu's physical and chemical properties with such high accuracy, we can better understand solar system formation and develop mitigation measures against asteroid impacts.

Blaske, Claire (Senior, Earth & Space Exploration, Astrophysics, Arizona State University). Mentor: Joseph O'Rourke, School of Earth & Space Exploration, Arizona State University. [F-2]

IMPACTOR-ATMOSPHERE INTERACTIONS ABOVE THE SURFACE OF VENUS

Above the surface of Venus, the existence of lightning is hotly contested. While some evidence has been found (whistler-mode waves, optical flashes), alternative explanations or rebuttals to these pieces of evidence has been strong for the last few decades. Specifically, optical flashes observed by ground-based telescopes and the Akatsuki mission may actually be small, 1-2 kg meteors ablating high in the atmosphere. The CO_2-dominated atmosphere at the surface of Mars provides an analog for the atmosphere of Venus at ~100 km, where we expect these small meteors to burn up. To revisit the claim made by the Akatsuki team that all meteors emit as blackbodies, and therefore could not produce the observed optical flashes, we examined ChemCam's Laser-Induced Breakdown Spectroscopy (LIBS) data for emission of different materials at 777.4 nm, the unresolved excited atomic oxygen triplet.

Bloemers, Rik (Senior, Electrical Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College. [D-6]

GCC'S TEAM ASTROPEEPS: PROPAGATION OF RF WAVES WITHIN THE UPPER ATMOSPHERE

Our team built a balloon payload to examine the properties of the earth's atmosphere. Like previous payloads, the new payload contained 2 temperature sensors (internal and external), an accelerometer, a pressure sensor, and a video camera; however, it also contained a CO_2 sensor, an RF Receiver, a Geiger counter, seeds, and a marshmallow peep to observe how it expands within the low-pressure environment of the upper atmosphere. In particular, the RF receiver used an antenna to collect RF signals during the flight to determine how these signals bounce off the different layers within the atmosphere. Unfortunately, the signals received by the antenna are very small, which requires a great deal of amplification without introducing noise. A variety of techniques were used to amplify these signals and convert the o utput into a measurable analog signal while minimizing the noise.

Boe, Jordan (Sophomore, Engineering, Pima Community College). Mentor: AnnMarie Condes, Chemistry, Pima Community College. [D-8]

HIGH ALTITUDE CRUSTACEANS

The upper atmosphere is an inhospitable environment. The altitude in the upper atmosphere can reach up to 100 km, the pressure can be as low as 10^-11 atm, and temperature as low as -100°C, making it extremely difficult for any living organism to survive. This study looks at a very tiny crustacean of the order Anostraca indicating their ability to adapt to these harsh conditions. The question that arises is how do crustaceans survive in such conditions? This multiple semester experiment has studied the viability of both young, adult, and cyst forms of this crustacean in the extreme conditions of the upper atmosphere. Their survival in the upper atmosphere also provides valuable insight into the possibility of life on other planets, which was once considered impossible. Research on crustaceans is ongoing, and it is hoped that further results will shed more light on the possibility of life in hostile environments.

Brand, Zoe (Senior, Mechanical Engineering, Propulsion, Embry-Riddle Aeronautical University). Mentor: Elliott Bryner, Mechanical Engineering, Embry-Riddle Aeronautical University. [C-3]

INVESTIGATION OF TOTAL MOMENTUM RATIO

The goal of this project is to analyze the effect of total momentum ratio (TMR) on combustion performance for a pintle-type injector. TMR is a parameter that can be used to characterize combustion stability and the kinematics of propellant combinations. Analyzing the TMR, will help in the comprehension of how the engine is combusting propellant and if it is combusting as designed. Being able to study the effect of changing TMR will help understand if industry "rules of thumb" apply to Embry-Riddle's engine. Currently, a concern is that the engine is not mixing and combusting propellant efficiently enough to meet flight profile parameters. The goal set by the Mountain Spirit program dictates the engine will produce 1759lbf for 20 seconds of burn duration to get the rocket to 150,000ft. To meet these requirements, there needs to be a more comprehensive study into propellant mixing and combustion performance.

Brannon, Jacob (Sophomore, Mechanical Engineering, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College. [D-7]

PHOENIX COLLEGE NASA ASCEND

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Brown, Colin (First-Year, Optical Sciences & Engineering, University of Arizona). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona. [D-9]

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Bump, Shelby (Sophomore, Astronautical Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College. [D-6]

RADIATION IN THE UPPER ATMOSPHERE AND ITS EFFECT ON SEEDS

Our team built a balloon payload to examine the properties of the Earth's atmosphere. Like previous payloads, the new payload contained 2 temperature sensors, an accelerometer, a pressure sensor, and a video camera; however, it also contained a CO2 sensor, an RF Receiver, a Geiger counter, seeds, and a marshmallow peep to observe how it deforms in the upper atmosphere. The Geiger sensor could detect Gamma and Beta radiation while producing a pulsed output that was interfaced with an Arduino Mega microprocessor, and the results were stored on an SD card. The seeds that were sent up with the payload were Garden Cress seeds, also known as Lepidium Sativum or pepper grass. It is a quick growing garnish that sprouts typically within a two-week period or less. The purpose of including the seeds was to determine what the effects of radiation will be on the seeds.

Burr, Michelle (Senior, Molecular & Cellular Biology, Astrobiology, University of Arizona). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona. [D-9]

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Burton, Robert (First-Year, Electrical Engineering, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University. [D-1]

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Carl, Naomi (Sophomore, Astrophysics, Arizona State University). Mentor: Sanchayeeta Borthakur, School of Earth & Space Exploration, Arizona State University. [E-3]

IN WITH THE OLD, OUT WITH THE YOUNG: STELLAR CLUSTERS IN NGC 3344

Photometry analyzes light collected from observations to determine properties about stellar clusters. In this work, the Large Binocular Telescope was used to observe several galaxies with deep broadband filters Bessel-U, Sloan-g, and Sloan-r. This presentation will focus on our progress thus far on studying NGC 3344. This data will help us study how properties of stellar clusters differ in the outer disk versus inner disk. Stellar-detected objects were identified using Source Extractor and elliptical apertures. From there, we formed a color graph to compare the ages of the clusters versus their galactocentric difference. Our results showed that NGC 3344 has an inside-out formation pattern, due to the graph showing a lack of older stars in the outer disk. Moving forward, we will analyze the metallicities of the clusters and repeat this process for all of the galaxies in our study. This will provide us with valuable information about galaxy formation.

Carreno, Ella (Sophomore, Applied Science, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [D-3]

CAC ASCEND

Three teams at Central Arizona College constructed payloads to explore three research areas. These teams were the HONEY BADGERS, RAPTORS and OWLS. The HONEY BADGERS traced the payload's location using a GPS, measured the UV levels over certain altitudes, and calculated the gravitational acceleration as the payload ascended and descended. By dampening camera vibrations and creating systems to reduce rotation, the RAPTORS sought to capture quality flight footage. The OWLS measured the fluctuations in humidity, temperature, and altitude across the various atmospheric levels. In addition, their payload also carried a biological experiment designed by the Diné College team.

Carroll, Lynn (Senior, Biosystems Engineering, University of Arizona). Mentor: Vicky Karanikola, Chemical & Environmental Engineering, University of Arizona. [H-3]

INTERMITTENT PERFORMANCE OF PILOT SCALE OFF-GRID NANOFILTRATION SYSTEM

Navajo communities face a plethora of hardships in accessing drinking water. Challenges include low population density and reliance on unregulated wells that have exceedances of pollutants, such as arsenic, uranium, and salts. Thus, there is a need for energetically sustainable point-source water treatment technologies, such as solar-powered nanofiltration (SNF) systems. This study investigates the performance and scaling of one such intermittently operated system. The SNF system operated under intermittent and continuous operation with synthetic waters composed of inorganic salts and surrogate organics, representative of those found in remote wells on the Navajo Nation. Results show that during the relatively short trials, there was not significantly higher scaling associated with daily intermittent operation; however, extended periods of downtime did negatively affect performance. Moving forward, a number of questions remain such as determining if calcium-humic acid complexes are forming and if biological fouling is taking place on the membrane surface.

Caudle, Logan (Sophomore, Space Physics, Embry-Riddle Aeronautical University). Mentor: Michele Zanolin, Physics, Embry-Riddle Aeronautical University. [E-4]

TESTING AND CONSTRUCTION OF A SHORT-ARM INTERFEROMETER AND LOW FREQUENCY PROTOTYPE OF LASER INTERFEROMETER SUSPENSIONS FOR GRAVITATIONAL WAVE DETECTION

Our project is designed to understand the concepts needed for space based low frequency (1-10 Hz) gravitational wave astronomy. The first objective is a feasibility analysis for a small arm-length interferometer for the proposed use in a 3U class CubeSat. As such, determining the configuration and the components used will be the primary deliverable. The second objective is centered on looking into how to improve the detection capabilities of low-frequency gravitational waves. The current generation of gravitational wave detectors is not focused on the low-frequency end of the spectrum, and this project aims to design and potently build a detector that is solely focused on the low-frequency range. Another aspect of this project will be to build a functional representation of the LIGO (Laser Interferometer Gravitational Wave Observatory) mirrors to learn about their natural frequencies and how to mitigate the noise due to these natural frequencies.

Chadwick, Kylianne (Sophomore, Molecular & Cellular Biology, University of Arizona). Mentor: Daniel Stolte, University Communications, University of Arizona. [B-1]

BRIDGING THE GAP BETWEEN STEM PROFESSIONALS AND "EVERYONE ELSE"

While the University of Arizona ranks among top public research institutions, public awareness of scientific discoveries and innovations often lags behind. Science writers bridge the gap between STEM professionals and "everyone else" by interviewing researchers and communicating their complex work to those with limited or no science background. This project included the composition and publication of a wide variety of news and feature articles about UArizona research by applying proven journalistic techniques and processes. Each story underwent extensive editing to ensure factual accuracy in an effort to make science accessible without spreading misinformation. To further promote engagement, we used visually compelling imagery, videos, creative headlines and quotes that authentically featured the "person behind the science." Several of our press releases piqued the interest of media outlets, ranging from local to international news organizations. As a result, there was increased media coverage showcasing UArizona's leading role in scientific discovery and innovation.

Chambers, Jacob (Senior, Computer Science, University of Arizona). Mentor: Carlos Vargas, Steward Observatory, University of Arizona. [C-16]

SIMULATOR AND FLIGHT SOFTWARE TESTING FOR ASPERA SMALLSAT TELESCOPE

Aspera is a UV SmallSat designed to map OVI emission from nearby galaxy halos for the first time. As with any space mission, a key factor is ensuring that all software components work properly before launch. This project explores creating software to simulate events recorded on Aspera's microchannel plate detector (MCP), and a framework to automatically test all flight software for the mission. Prior to launch, the simulator produces a list of events received on the MCP derived from a galactic emission cube. In the future, these lists will be used to create, configure, and test the mission's data reduction pipeline. All flight software is run through a configuration-managed continuous integration framework where changes to the repository automatically trigger tests and compile their results into a user-friendly presentation. Together, these simulation and testing components help to ensure the mission will be ready for launch.

Clark, Emily (Sophomore, Physics, Astrophysics, Northern Arizona University). Mentor: Mark Loeffler, Astronomy & Planetary Science, Northern Arizona University. [F-3]

THE EFFECTS OF SPACE WEATHERING ON AIRLESS BODIES

Our research project investigated space weathering on airless bodies using experimental methods and computational modeling. We exposed mineral samples to a laser in a vacuum and collected spectroscopic data on the resulting changes in their properties, specifically their spectral slopes. We then used Python to model these changes using the Hapke radiative transfer model, which allowed us to analyze the effects of space weathering on mineral surfaces. Our results demonstrate the effectiveness of this approach for studying space weathering and provide valuable insights into the physical and chemical processes that occur on the surfaces of airless bodies in our solar system. This research has important implications for understanding the history and evolution of planetary bodies and the potential impact of space weathering on future space exploration missions.

Cooper, Genevieve (Junior, Computer Science, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University. [D-1]

ANALYSIS OF ATTITUDE DETERMINATION AND CONTROLS ON A HIGH ALTITUDE BALLOONING PAYLOAD WITH LONG RANGE HAM RADIO COMMUNICATION AND UV-EXPOSED PLANT SEEDS

In Fall 2022, the purpose was to complete the two science missions of an Attitude Determination and Control System (ADCS) and Meteorology. The meteorological mission used pressure, internal and external temperature, GPS, and an accelerometer to monitor cloud condensation nuclei (CCNs). Further in Spring 2023, ASCEND tested long range HAM radio communication, ADCS and a plant module. The HAM radio mission allows ASCEND members to activate and communicate with the payload during flight. The plant module mission was designed to test the effects of UV radiation on the growth of lettuce seeds that would be sent up on the payload during launch, compared to a control group that would remain on the ground. Overall, ASCEND created a reusable design for the printed circuit board (PCB) and designed a CubeSat inspired payload. ASCEND is also able to profile the atmosphere, collect data, and test the payload design.

Cullings, Sadie (Sophomore, Aerospace Engineering, Arizona State University). Mentor: Paul Davies, Department of Physics: The Beyond Center, Arizona State University. [E-5]

Signatures of Traversable Wormholes

The detection of gravitational waves has opened a new window on the very nature of the space-time continuum, promising novel discoveries and providing new insights into our place in the universe. As detector technology advances, there is a growing need to fill in the gaps in our current understanding of gravitational wave signatures associated with various astrophysical phenomena. My research centers on the possibility of detecting traversable wormholes by identifying a specific gravitational wave signature that can be differentiated from other astrophysical events. To accomplish this, I created a Newtonian analogue to better understand how nearby objects that encounter a wormhole may behave and the characteristics of the gravitational waves thereby produced. This preliminary research suggests that encounters between wormholes and other massive bodies such as neutron stars and black holes could readily be distinguished from binary black hole mergers, which so far have dominated the gravitational wave observations.

Delgado, Sofia (Junior, Ecology & Evolutionary Biology, University of Arizona). Mentor: Erin Posthumus, National Phenology Network, University of Arizona. [H-4]

US Fish and Wildlife Service Info Sheets

Anthropogenic climate change caused by an unprecedented level of greenhouse gases in the atmosphere has been disrupting natural cycles and other seasonal phenomena, called phenology. The US Fish and Wildlife Service (USFWS) is tasked with conserving the nation's wildlife and their habitat, however, this becomes difficult due to the unpredictable nature of climate change's effects. To assist in this mission, the USA National Phenology Network (USA-NPN) has partnered with USFWS to create regional information sheets that summarize changes occurring in USFWS priority species and ecosystems. The goal of this project is to translate the information to make it as accessible as possible for USFWS staff. The sheets will summarize existing research on how climate change is affecting phenology, synthesize climate projections for each region, as well as showcase relevant USA-NPN data and ongoing phenology research projects.

Dinh, Huy (First-Year, Aerospace Engineering, Aeronautics, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University. [D-1]

Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV-Exposed Plant Seeds

In Fall 2022, the purpose was to complete the two science missions of an Attitude Determination and Control System (ADCS) and Meteorology. The meteorological mission used pressure, internal and external temperature, GPS, and an accelerometer to monitor cloud condensation nuclei (CCNs). Further in Spring 2023, ASCEND tested long range HAM radio communication, ADCS and a plant module. The HAM radio mission allows ASCEND members to activate and communicate with the payload during flight. The plant module mission was designed to test the effects of UV radiation on the growth of lettuce seeds that would be sent up on the payload during launch, compared to a control group that would remain on the ground. Overall, ASCEND created a reusable design for the printed circuit board (PCB) and designed a CubeSat inspired payload. ASCEND is also able to profile the atmosphere, collect data, and test the payload design.

Dinke, Mickyas (First-Year, Mechanical Engineering, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [D-3]

CAC ASCEND

Three teams at Central Arizona College constructed payloads to explore three research areas. These teams were the HONEY BADGERS, RAPTORS and OWLS. The HONEY BADGERS traced the payload's location using a GPS, measured the UV levels over certain altitudes, and calculated the gravitational acceleration as the payload ascended and descended. By dampening camera vibrations and creating systems to reduce rotation, the RAPTORS sought to capture quality flight footage. The OWLS measured the fluctuations in humidity, temperature, and altitude across the various atmospheric levels. In addition, their payload also carried a biological experiment designed by the Diné College team.

Dixon, Sophia (Junior, Environmental Science, University of Arizona). Mentor: Jason Williams, USDA Agricultural Research Service, Southwest Watershed Research Center. [H-9]

EFFECTS OF BIOLOGICAL SOIL CRUST COVER ON RAINFALL RUNOFF

Biological soil crust (BSC) is a common ground cover in Grand Staircase Escalante National Monument (GSENM), Utah. As land managers assess vegetation removal due to pinyon-juniper expansion, it is necessary to study the effects of BSC on runoff and erosion processes. This study assessed twelve 0.5-m2 plots in the intercanopy of a pinyon-juniper woodland to determine the effects of BSC cover on soil surface conditions and runoff and erosion. Ground cover of BSC and surface roughness were quantified using point frame methods. Runoff and erosion rates for each plot were measured using rainfall simulators. Higher BSC cover and associated surface roughness were found to delay runoff generation, and limit runoff and erosion. In the future, the effects of BSC will be studied at additional sites and over larger spatial scales within GSENM to inform land managers and guide conservation decisions on western woodlands.

Do, Jacqueline (Sophomore, Electrical Engineering, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University. [F-4]

ARIZONA NASA ECLIPSE BALLOONING PROJECT

The Arizona NASA Eclipse Ballooning Team comprises ASU student organizations and participating institutions that will develop, test, integrate, and deploy two 12-pound payloads to study the Earth's atmospheric phenomena and meteorology, provide consistent live video streaming, and demonstrate flight and weather trajectory predictions during the 10/14/2023 annular and 4/8/2024 total eclipses. The RFD900 Atmospheric Profiling Telemetry Suite will record the following data for acquisition and analysis: GPS, pressure, temperature, accelerometer, and magnetometer. The Attitude Determination Control System (ADCS) will integrate two Raspberry Pi cameras to record consistent live video streaming by stabilizing the payload's rotation during the balloon's ascent and descent stages to and from Earth's surface and the Stratosphere. The radio communications will track the payloads' flight trajectory. Our student-led team will enact the Formulation and Implementation Life-Cycle Phases to accomplish this NASA mission and present and publish peer-reviewed journals on data analysis and payload design at scientific conferences.

Dudek, Jessica (Senior, Mechanical Engineering, Arizona State University). Mentor: Nathan Bales, General Dynamics Mission Systems. [C-4]

GENERAL DYNAMICS MISSION SYSTEMS EXPLORER GPS RECEIVER PRODUCTION TESTING & IMPROVEMENTS

The technology encapsulated within General Dynamics Mission Systems' Explorer GPS provides communication between spacecraft and Earth, making it possible to track satellites and vehicles in orbit. More specifically, the Explorer Global Positioning System (GPS) Spaceborne Receiver provides position, velocity, and time information for Low Earth Orbit (LEO) and Geostationary Earth Orbit (GEO) applications. To maintain the integrity of these receivers, this project explores the process of improving the production model that is currently sold to external customers. This process includes a re-evaluation of test methods for increased production, re-configuration of test equipment, and new procedures. Supporting these improvements required shock testing on an Engineering Development Unit (EDU) of the receiver and design modifications to the pyro-shock and vibration testing equipment. The results of testing have been analyzed, and a full qualification report of the product containing shock, thermal, environmental, and vibration results has been saved for future production reference.

Eaton, Jacob (Junior, Aerospace Engineering, Arizona State University). Mentor: Maitrayee Bose, School of Earth & Space Exploration, Arizona State University. [F-5]

ORGANOSULFURS IN METEORITES

Carbonaceous chondrites consistently possess some of the most extraterrestrial organic molecules. Studying and understanding how these molecules originate is potentially important for answering questions about the origin of life, as meteorite impacts may have been a crucial way of introducing organic molecules to Earth. This project aims to identify thiols in the meteorites GRA 95229 and Murchison using X-Ray Near Edge Structure spectroscopy and Micro X-Ray Fluorescence at the Stanford X-ray Beamline. The primary method of data analysis done was linear combination fitting, and at least nine distinct spectra were found to have very significant amounts of elemental sulfur and thiol. The locations on the meteorite where each spectrum was measured were found and plotted to show the distribution of different sulfur groups across the studied areas.

Elmer, Hope (Junior, Aerospace Engineering, Embry-Riddle Aeronautical University). Mentor: David Lanning, Engineering, Embry-Riddle Aeronautical University. [G-1]

INVESTIGATION OF STRESS CONCENTRATIONS IN PARTS MANUFACTURED WITH FUSED DEPOSITION MODELING

Fused Deposition Modeling (FDM), a type of additive manufacturing which deposits a thermoplastic filament layer-by-layer until completion, has experienced significant growth in recent years. However, there exists a gap of knowledge in how process parameters effect mechanical properties and if traditional solid mechanic theories are accurate to predict failure, hindering the full-scale implementation into product development. The aim of this study is to demonstrate the effects of certain process parameters combined with stress concentrations on the mechanical properties and failure of specimens manufactured using FDM. Two specimen series with stress inducing geometries were observed, one with a centered hole and the other with opposite semicircular edge notches. Solid mechanic theory predicts that the material's ultimate tensile strength will be reduced by the stress concentration factor for the specimen effective strength. However, initial results contradict this theory indicating potential reinforcement from the additional layers of material around the stress concentration location.

Elstad, Sonja (Sophomore, Engineering, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [D-3]

CAC ASCEND

Three teams at Central Arizona College constructed payloads to explore three research areas. These teams were the HONEY BADGERS, RAPTORS and OWLS. The HONEY BADGERS traced the payload's location using a GPS, measured the UV levels over certain altitudes, and calculated the gravitational acceleration as the payload ascended and descended. By dampening camera vibrations and creating systems to reduce rotation, the RAPTORS sought to capture quality flight footage. The OWLS measured the fluctuations in humidity, temperature, and altitude across the various atmospheric levels. In addition, their payload also carried a biological experiment designed by the Diné College team.

Estrella, Hayden (Senior, Statistics, Data Science, University of Arizona). Mentor: Christopher Impey, Astronomy, University of Arizona. [B-2]

COMBATTING FAKE SCIENCE ONLINE

The internet is wonderful in many ways, allowing everyone to have a voice. However, there are many negative consequences to this, such as the ease with which misinformation can spread. This project seeks to develop a deep learning algorithm that can accurately classify articles as real or misinformed science. There were 1,304 articles collected from the internet regarding a wide range of topics in science. They were then read and manually classified as legitimate science or misinformation. The article URLs and classifications were uploaded to an application and stored in a database so that the information from articles can be scraped and used to train and test the deep learning algorithm. If this deep learning algorithm becomes widely available, it could be used to help people surfing the web to be cautious of misinformation and help minimize its spread.

Fisher, Amaya (High School Student, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [D-2]

ASCEND HIGH ALTITUDE BALLOON - CASA GRANDE UNION HIGH SCHOOL

A team of students from Casa Grande Union High School designed and implemented an instrumentation and biological payload to gather data about the lower stratosphere. The instrumentation mission gathered data on atmospheric phenomena, specifically the altitude and composition of the ozone layer. The biological mission gathered data on how the atmosphere at high altitude affects simple biological organisms with the goal of determining how alien atmospheres may affect life from Earth.

Freeman, Greta (Sophomore, Geology, Northern Arizona University). Mentor: Cheng Ye, Astronomy & Planetary Science, Northern Arizona University. [F-6]

EXPLORING THE LIMITS OF MINERAL ABUNDANCE RETRIEVALS IN THE THERMAL INFRARED FROM LABORATORY PARTICULATE SPECTRAL ANALYSIS

Linear unmixing is a widely used method in thermal infrared emission spectroscopy for estimating mineral abundance on planetary surfaces, especially on Mars. This method is thought to only be valid for grains larger than 60 µm based on a limited number of laboratory analyses generated over the past 20 years. However, the full parameters, accuracies, and uncertainties of the linear mixing method have not been well explored. To test the limitations of this model, we conducted a large number of laboratory experiments through Fourier transform infrared spectroscopy to gather a suite of spectra from mineral mixtures of varying particle sizes. After some analyses, it was found that in certain cases the linear unmixing model generated large errors for coarser grains, but reasonable values for finer grains. Once fully developed, the linear unmixing method can be applied to future planetary remote sensing studies to better understand surficial features.

Freudenthal, Kaylee (Junior, Mathematics, Northern Arizona University). Mentor: Jeff Rushall, Mathematics & Statistics, Northern Arizona University. [A-2]

VERY STRONGLY CONNECTED GRAPHS

A simple connected digraph is strongly connected if there exists a directed path between every pair of vertices in both directions. But a random assignment of edge directions can result in a digraph not being strongly connected. We say that a digraph is very strongly connected if any choice of edge orientations that does not result in a vertex having maximal or minimal indegree yields a strongly connected digraph. We present new results on families of digraphs that are always very strongly connected or not very strongly connected.

Frisch, Andrew (Senior, Aerospace Engineering, University of Arizona). Mentor: Jesse Little, Aerospace & Mechanical Engineering, University of Arizona. [I-2]

EFFECTS OF STRUCTURAL MOTION ON SWEPT WING AERODYNAMICS

Laminar separation bubbles (LSBs) form in wall bounded flows when subject to a strong adverse pressure gradient. LSBs are found in many aerodynamic systems (e.g., UAVs, rotorcraft) and influence the overall performance and efficiency of aircraft. LSB characteristics are influenced by a wide array of factors, but little is known about the effects of wing sweep and structural motion. The latter is particularly relevant due to advances in composite manufacturing that allow for construction of high aspect ratio wings that are inherently more flexible. Previously, a NACA 64_3-618 airfoil was used to examine unswept, unsteady aerodynamics as well as static swept cases at UArizona. This research uses the same model to examine the effects of structural motion in a swept wing configuration. This presentation will review previous NACA 64_3-618 results and summarize the design and fabrication of a new mechanical assembly that employs electrodynamic shakers for generating structural motion.

Fronmueller, Simon (Sophomore, Astrobiology, Arizona State University). Mentor: Everett Shock, School of Earth & Space Exploration, Arizona State University. [H-5]

WHERE ARE ALL OF THE AMMONIA OXIDIZERS?: A YELLOWSTONE MYSTERY

Ammonia-oxidizing archaea and bacteria are some of the most abundant organisms on Earth. Despite this, ammonia-oxidizers are seemingly absent from many Yellowstone hot springs where conditions appear suitable. Why is this? One possible explanation is that ammonia-oxidizers require copper and iron ions as enzymatic cofactors and that low concentrations of these ions in hot springs may limit or prevent their growth. In an effort to solve this, we have conducted geochemical analysis of several years of Yellowstone hot spring field data. Specifically, plotting the molality of copper and iron in these springs as well as the mole percent of different species of copper and iron against pH. Currently, we are working on verifying the results of our geochemical analysis by creating cell cultures of known ammonia-oxidizing archaea collected from yellowstone grown in media with varying concentrations of copper and iron.

Fry, Rachel (Junior, Astrophysics, Northern Arizona University). Mentor: Devon Burr, Astronomy & Planetary Sciences, Northern Arizona University. [F-7]

AN APPARATUS FOR THE EXPERIMENTAL SIMULATION OF THE EFFECTS OF WIND TRANSPORT ON MARTIAN SANDS

Wind has been the dominant process of sediment transport on Mars for 3.6 billion years, yet there remain persistent uncertainties regarding the sources and duration of survivability of sand-sized grains on the planet. Based on previous studies, collisions between grains during wind-driven (aeolian) transport will lead to a reduction in grain size (comminution) over time until the sand is reduced to dust. We seek to experimentally reproduce the processes which lead to sand comminution using an air-driven mill which circulates sediment around a cylindrical chamber composed of silicon carbide. Through the construction, testing, and modification of this mill, we have developed a procedure to reliably produce an apparatus that will simulate comminution. Experimentation with this device will allow us to estimate an upper limit on the survivability of sand, as well as enable us to periodically extract and analyze the grains to characterize their geometric and compositional evolution over time.

Garayzar, Elizabeth (Sophomore, Exploration Systems Design, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University. [D-1]

ANALYSIS OF ATTITUDE DETERMINATION AND CONTROLS ON A HIGH ALTITUDE BALLOONING PAYLOAD WITH LONG RANGE HAM RADIO COMMUNICATION AND UV-EXPOSED PLANT SEEDS

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Garcia, Lorynn (Sophomore, Aerospace Engineering, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College. [D-7]

PHOENIX COLLEGE NASA ASCEND

The Phoenix College NASA ASCEND team has participated in launches for many years. Its four sub-teams are diligently working toward our objectives. The mechanical/vehicle group has been working on improving our techniques for fabricating and standardizing the parts for our carbon fiber reinforced vehicle. It has also constructed a second vehicle for redundancy. The atmospheric profiling group is integrating a number of sensors for our light experiment and gas to make measurements as a function of altitude. We are also acquiring data on how our vehicle is behaving during the launch. For the Spring 2023 launch, we are also launching two Geiger counters to measure beta and gamma radiation at various altitudes and locate the Pfotzer –Regener maximum. The video stabilization group succeeded in recording stable video images during the Fall 2022 launch. We are trying to improve on our effort and repeat our success during the Spring 2023 launch.

Gomez, Moises (Senior, Physics, Astrophysics, Northern Arizona University). Mentor: Stephen Tegler, Astronomy & Planetary Sciences, Northern Arizona University. [F-8]

LABORATORY MEASUREMENTS OF THE THICKNESS, INDEX OF REFRACTION, AND DENSITY OF ICES IMPORTANT TO PLANETARY SCIENCE

To determine the abundances of volatile ices on the surfaces of outer Solar System objects from telescope observations, we must first measure the intrinsic properties of the ices in laboratory experiments. Here, we describe our deposition of sub-micron thick ice films onto a quartz-crystal microbalance (QCM) inside of an ultra-high vacuum chamber with a pressure of ~ 5 x 10^-9 Torr and a temperature of 10 K. Using laser interferometry and the QCM; we accurately measured the thickness, indices of refraction, and density of pure CH4 ice, pure N2 ice, and mixtures of CH4 and N2 ices. Our results for pure CH4 and pure N2 agreed with published experiments. Our results are the first measurements of these quantities for CH4 and N2 mixtures. These properties are essential for deriving optical constants of the ices, the next step in deriving ice abundances of CH4 and N2 on outer Solar System objects.

Gonzalez, Angel (Junior, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [D-2]

ASCEND HIGH ALTITUDE BALLOON - CASA GRANDE UNION HIGH SCHOOL

A team of students from Casa Grande Union High School designed and implemented an instrumentation and biological payload to gather data about the lower stratosphere. The instrumentation mission gathered data on atmospheric phenomena, specifically the altitude and composition of the ozone layer. The biological mission gathered data on how the atmosphere at high altitude affects simple biological organisms with the goal of determining how alien atmospheres may affect life from Earth.

Gonzalez, Daniel (Junior, Mathematics, Statistics, University of Arizona). Mentor: Lon Hood, Lunar & Planetary Laboratory, University of Arizona. [F-10]

CONTOUR MAPPING OF THE CRUSTAL MAGNETISM ON MARS

Mars, unlike Earth, does not have a global magnetic field to protect it from cosmic radiation like galactic cosmic rays. However, Mars had an early global magnetic field generated in its iron core that produced very strong magnetization in its crust. The goal of this project is to develop an improved map of the crustal magnetism of Mars using magnetometer measurements from a recent NASA mission called MAVEN. This was done using Fortran and IDL programs that take the data of thousands of orbits across different longitudinal bands on Mars. Then, the programs average all of the different satellite observations into a single contour map of the magnetism at an altitude of 150 km above the surface of Mars. This is then compared to previously developed maps of the Moon in order to compare the difference between the two celestial bodies and find the areas of strongest magnetism.

Gonzalez Lopez, Ivan (Senior, Science, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College. [D-7]

PHOENIX COLLEGE NASA ASCEND

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Goz, Morgan (Junior, Aerospace Engineering, University of Arizona). Mentor: Jesse Little, Aerospace & Mechanical Engineering, University of Arizona. [I-3]

TRANSITIONAL SHOCK-BOUNDARY LAYER INTERACTIONS AT MACH 5

Transitional Shock/Boundary Layer Interactions (SBLIs) have a significant impact on the design of hypersonic systems. SBLIs can result in flow separation, low frequency unsteadiness, and high surface heat flux leading to system failure. Understanding the relationship between boundary layer transition and SBLI (transitional SBLI) can pave the way for mitigating these adverse effects. Transitional SBLI experiments have been performed in the UArizona Mach 5 Ludwieg Tube (LT5). This presentation will review results for a hollow cylinder flare test article which represents a common geometry in flight systems. Both flow field and surface measurements have been employed to study transitional SBLIs formed by the flare. The implications of these results and plans for future wind tunnel experiments will be discussed.

Grullon, Somaralyz (Junior, Mechanical Engineering, Robotics, Embry-Riddle Aeronautical University). Mentor: Yabin Liao, Engineering, Embry-Riddle Aeronautical University. [D-4]

LONG-DISTANCE VIDEO AND TELEMETRY STREAMING

This project involves testing and comparing the performance of two different radio frequencies, 900MHz and 2.4GHz, for satellite and UAV applications. The payload, attached to a high-altitude balloon, will transmit live video and telemetry over the 2.4GHz frequency while telemetry data will also be sent over a 900MHz link using an RFD900+ Modem. The signals will be received with high-gain antennas on a tracking ground station, and the on-board SD card will collect the same telemetry data for comparison purposes. Additionally, a Nivida Jetson Nano with sensors will be used to determine the location of the payload in 3D space and orientation. The goal of the project is to characterize the quality and range of these radio links to guide future university aerospace projects. The project will provide valuable information on the performance of different frequencies and equipment, helping to improve satellite and UAV technology in the future.

Guaglardi, Lucas (Sophomore, Aerospace Engineering, Arizona State University). Mentor: Timothy Takahashi, School for Engineering of Matter, Transport & Energy, Arizona State University. [I-4]

ANALYSIS AND OPTIMIZATION OF ELECTRIC DUCTED FAN NACELLE GEOMETRY

Electric ducted fans, or EDFs, are a form of electric propulsion typically used in small-scale unmanned aerial vehicles (UAVs). Given the different operating speed regimes, applying the traditional nacelle geometry for jet engines, for instance, a diverging inlet to slow down incoming air, is not necessarily the optimal design principle for small-scale UAVs. This study focuses on designing and testing various nacelles for EDFs with different converging and diverging geometries to understand the effects on performance quantities, including but not limited to static thrust, thrust lapse, and efficiency. Both static and dynamic tests in a wind tunnel were performed to understand the effects on performance. Thus far, it has been found that a converging inlet is ideal compared to the traditional diverging inlet as it has greater static thrust, and less nacelle drag, although it is slightly less efficient.

Gullo, Nicholas (Senior, Electrical & Computer Engineering, University of Arizona). Mentor: Michelle Coe, Lunar & Planetary Laboratory, University of Arizona. [D-9]

UARIZONA ASCEND: HIGH-ALTITUDE DATA COLLECTION WITH A CUSTOM CUBESAT PAYLOAD

CubeSats have been a rapidly growing technology over the last decade due to their diminutive total mass to orbit while maintaining spacecraft performance. However, due to their small form factor, CubeSats are extremely limited in the amount of electronics and power storage that they can carry. Within the bounds of a standard 1.5U CubeSat, the UArizona ASCEND payload houses a Geiger counter and atmospheric profiling system to collect data up to

100,000 feet. The project incorporates low power considerations, volume optimization, and high durability 3D printing to improve on the University's previous ASCEND launches. In addition, two traditional small form factor cameras and one 360 camera collect unique views of Earth's atmosphere throughout the ascent and descent of the payload.

Gutierrez, Eric (Senior, Physics, Arizona State University). Mentor: Robert Nemanich, Physics, Arizona State University. [A-3]

GROWING BORON NITRIDE FILMS FOR ALPHA AND NEUTRON DETECTORS IN RADIATION SETTINGS

In this project, we aim to fabricate PIN structure diodes for radiation detectors using Boron Nitride (BN). This fabrication is done by performing lithography, etching and metal deposition processes on a Cubic Boron Nitride (cBN) of around 800 nm in thickness layer on top of a diamond substrate. The main goal is to create the most efficient and affordable alpha particle—and ideally neutron—detector in a radiation setting. Thus, making more accessible radiation detectors that can be more easily produced and disposed of, as well as minimizing the size of conventional detectors.

Hallstrom, Jonas (Senior, Physics, Arizona State University). Mentor: Maitrayee Bose, School of Earth & Space Exploration, Arizona State University. [F-11]

THE FORMATION AND THERMAL EVOLUTION OF ITOKAWA'S PARENT BODY

Most asteroids originated in larger parent bodies that underwent accretion and heating during the first few million years of the solar system. We investigate the parent body of asteroid 25143 Itokawa by developing a computational model which can approximate the thermal evolution of an early solar system body. Comparing known constraints on Itokawa's thermal history to simulations of its parent body, which use material property measurements of Itokawa and related meteorites, constrains the size and time of formation of Itokawa's parent body. Taking into account uncertainties in the material properties of the parent body, we constrain its formation time to be between 1.4 and 2.5 million years after the beginning of the solar system. This work emphasizes the need for more accurate values of the composition and thermal properties of small bodies, especially as samples from missions to Ryugu, Bennu, and other bodies are returned.

Hammond, Marshall (Sophomore, Computer Engineering, Northern Arizona University). Mentor: Christopher Mann, Applied Physics & Material Sciences, Northern Arizona University. [A-4]

DEEP MACHINE LEARNING IN HOLOGRAPHY

Holography is a useful imaging tool typically for micro scale sample capturing, especially for biological material which is impractical to stain, or otherwise difficult to capture through normal visible light capture. Universally, phase retrieval is required such as through a Gerchberg Saxton process. Typically, eight to twelve images are captured at different z distances and through wave propagation equations, the phase is iteratively guessed and converges on the correct phase. This project aimed to use machine learning to bypass these intermediary steps to take a single out of focus hologram and output the corresponding in focus hologram at $z = 0$. A generative adversarial network was trained to produce that using MATLAB deep learning tools. The streamlining of the focusing process and the ability to produce practically infinite new, custom holograms to use in other deep learning projects could prove invaluable to reverse engineer critical patterns about holography.

Hardy, John (Senior, Electrical Engineering, Northern Arizona University). Mentor: Ying-Chen Chen, Engineering, Northern Arizona University. [A-1]

HELICAL-SHAPED TUNGSTEN OXIDE AS ACTIVE LAYER FOR RESISTIVE RANDOM-ACCESS MEMORY APPLICATIONS

Currently, Von Neumann architecture is the most popular form of computer design. In this design, the memory and central processing unit (CPU) are separated, and this distance creates a system that uses a large amount of power to retrieve, process, and store data. This distance also increases the latency of the system. This effect of high latency and power consumption described is known as the Von Neumann bottleneck. Resistive random-access memory

(RRAM) is a technology that is currently being researched to possibly eliminate this bottleneck effect because of the memory's high speed, high scalability, and low power applications. This research proposes utilizing nanohelical structures in the oxide layer to improve the density, scalability, and device characteristics. These helical devices would benefit space exploration by allowing reduced processing power of computing systems with quicker computing time.

Hart, Madeline (Senior, Electrical & Computer Engineering, University of Arizona). Mentor: Stefano Nerozzi, Lunar & Planetary Laboratory, University of Arizona. [F-12]

RECONSTRUCTING THE REAL CHIRP OF THE MARSIS RADAR

MARSIS is an orbital radar sounder currently orbiting Mars and acquiring 2D subsurface profiles for the creation of radargrams. The satellite currently uses idealized parameters for its pulse compression process. This idealization leads to less accurate measurements and reduced clarity in radargrams. This project works to improve accuracy across all four frequency bands of MARSIS by finding specific chirp functions associated with each band. Because little is known about the real parameters of MARSIS chirps, this project used several iterations of an evolutionary algorithm to find improved chirp functions. The process is used against several pieces of MARSIS data selected to minimize ionospheric interference in the four frequency bands, and will be manually validated against data with less ideal conditions. This project will improve the overall accuracy of MARSIS subsurface soundings, and will be a foundation for further work in improving subsurface sounding processes in satellites.

Hartman, Peter (Senior, Astronomy, University of Arizona). Mentor: Serena Kim, Astronomy, University of Arizona. [E-6]

A KINEMATIC ANALYSIS OF PROPLYDS IN NGC 1977 AND THE ONC

We present a kinematic study of Young Stellar Objects (YSOs) in NGC1977 using astrometric data from GaiaDR3 and radial velocity measurements from APOGEE-2/SDSS. We use these data to probe the 3D structure of these regions. Stellar properties of YSOs are determined from spectroscopic observations from MMT/Hectospec. Proplyds are photoevaporating protoplanetary disks near massive star(s). We find that the proper motions and parallaxes of proplyds are consistent with other YSOs in NGC1977, while in ONC proper motions of proplyds and YSOs are different. Proplyd lifetimes have been a persistent problem in the study of disk evolution, and our results provide valuable insight into the theory of proplyd evolution. NGC1977 provides the lowest-UV environment in which proplyds have been discovered. ONC represents a stronger far-UV environment than NGC1977 and has a different age range, so these results will provide a broader idea of how proplyds form and evolve in different UV-environments.

Henggeler, Calvin (Junior, Computer Engineering, Embry-Riddle Aeronautical University). Mentor: Ahmed Sulyman, Computer, Electrical, & Software Engineering, Embry-Riddle Aeronautical University. [C-5]

EAGLESAT-2: MEMORY DEGRADATION EXPERIMENT

Memory Degradation Experiment (MDE) is a NASA commissioned payload onboard EagleSat-2, an undergraduate-developed cube satellite. The objective of MDE is to measure the degradation and longevity of multiple types of commercially available computer memory in low earth orbit. The importance of MDE rests with the fact that the entire experiment is focused on directly comparing the performance of the memory types against each other with all other variables kept constant, and no other systems depending on the memory modules. The experiment is designed to detect bit-flips in the sequences written to the memory and read after a determined time being left vulnerable to change. MDE tracks the memory type and address location of when bit-flips occurred. The memory types tested are FLASH, FRAM, MRAM, and SRAM. Results of this experiment can be applied to any future space missions and other environments where radiation is a concern on the electronics.

Henley, Shae (Junior, Aerospace Engineering, University of Arizona). Mentor: Christopher Walker, Astronomy & Steward Observatory, University of Arizona. [C-6]

CATSAT: SATELLITE FLIGHT HARDWARE AND GROUND STATION ASSEMBLY

As more spacecraft enter low-Earth orbit each year, there is an increasing need to improve the downlink speed of small satellites. CatSat is a 6U CubeSat from the University of Arizona designed to test a new inflatable antenna technology and conduct ionospheric research with a WSPR (weak signal propagation reporter) antenna. My work mainly focused on system integration, functional and environmental testing, and construction of CatSat flight hardware; specifically the inflatable antenna and WSPR deployment systems. With the successful completion of spacecraft vibration testing last November, CatSat is now fully qualified for launch. My current work centers on developing the X-band optics for the 6.1 meter telescope ground station at Biosphere 2. Once the satellite is in orbit, I will be in charge of CatSat operations. The team is also developing an on-campus UHF (ultra high frequency) ground station for command and control of CatSat.

Herrera, Jose Javier (Sophomore, Mechanical Engineering, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College. [D-7]

PHOENIX COLLEGE NASA ASCEND

The Phoenix College NASA ASCEND team has participated in launches for many years. Its four sub-teams are diligently working toward our objectives. The mechanical/vehicle group has been working on improving our techniques for fabricating and standardizing the parts for our carbon fiber reinforced vehicle. It has also constructed a second vehicle for redundancy. The atmospheric profiling group is integrating a number of sensors for our light experiment and gas to make measurements as a function of altitude. We are also acquiring data on how our vehicle is behaving during the launch. For the Spring 2023 launch, we are also launching two Geiger counters to measure beta and gamma radiation at various altitudes and locate the Pfotzer–Regener maximum. The video stabilization group succeeded in recording stable video images during the Fall 2022 launch. We are trying to improve on our effort and repeat our success during the Spring 2023 launch.

Higuera Pierre Noel, Alex (Sophomore, Aerospace Engineering, University of Arizona). Mentor: Sergey Shkarayev, Aerospace & Mechanical Engineering, University of Arizona. [C-7]

THE EFFECTS OF THE MARTIAN ATMOSPHERIC CONDITIONS ON A NACA 4412 AIRFOIL

Prediction is a fundamental part of science and engineering. For aerospace engineering, forecasting the outcomes of aircraft and spaceships in all sorts of conditions has helped humanity better understand the adjustments needed to perform various tasks more efficiently. Programs like those offered by the ANSYS software applications permit take a robust approach of finite element analysis (FEA) to complete these projections. To demonstrate these statements, we can take Mars and apply its conditions to a known airfoil such as the NACA 4412, which is the object of study for this work. Computational Fluid Dynamics (CFD) could give an insight into how the airfoil will behave. By utilizing ANSYS Fluent, it was possible to observe the approximate lift and drag coefficient trend as a function of the angle of attack, and compare it to the airfoil under Earth's conditions, demonstrating that CFD is the present and future of space exploration.

Holdsworth, Amanda (Junior, Space Physics, Embry-Riddle Aeronautical University). Mentor: Noel Richardson, Physics & Astronomy, Embry-Riddle Aeronautical University. [E-7]

THE SPECTROSCOPIC AND VISUAL ORBIT OF THE NITROGEN-RICH MASSIVE BINARY WR 138

Wolf-Rayet (WR) stars are massive stars that have lost their exterior envelopes due to stellar winds, and possibly binary interactions, however, they have yet to be understood well enough to be placed on the Hertzsprung-Russell (H-R) diagram in the context of stellar evolution. In order to fully understand them, there must be direct constraints, namely measurements of their masses and luminosity. WR 138 is a nitrogen-rich WR star, whose empirical values have not been precisely determined. Its companion O star, has not been well constrained either, due to the brightness of the WR star and its inclination. By using spectroscopic observations, a more accurate period and radial velocity of WR 138 will be determined, along with a developed 3-dimensional orbital model. These key parts will allow us to determine the empirical relations of WR 138, to determine how the star evolved, and where it fits on the H-R diagram.

Hossain, Adeeb (Junior, Biomedical Sciences, University of Arizona). Mentor: David Margolis, Orthopedic Surgery, University of Arizona. [G-2]

QUANTITATIVE ANALYSIS OF BONE REGENERATED USING PATIENT SPECIFIC 3D PRINTED SCAFFOLDS

Space exploration limits the resources available to treat bone fractures. Optimizing healthcare resources is necessary to ensure that astronauts have the implants they need to treat bone trauma. There is interest in creating patient specific 3D printed implants to treat fractures. This research aims to analyze cortical bone regeneration using 3D printed bone scaffolds in sheep. Specifically, fluorescent and brightfield microscopic imaging using the Leica DMI6000 microscope captured the cortical bone of cross-sectional slides from sheep femurs treated with scaffolds. Quantitative analysis of the images were performed using ImageJ software. This enabled calculation of the surface area of cortical bone and the pores of the scaffold. The quantitative measurements of cortical bone are then used to examine the viability of patient specific 3D printed scaffolds, which can be useful to regenerate bone in an environment with limited resources.

Howe, Zachary (Senior, Aeronautical Sciences, Embry-Riddle Aeronautical University). Mentor: Yabin Liao, Aerospace Engineering, Embry-Riddle Aeronautical University. [D-4]

LONG-DISTANCE VIDEO AND TELEMETRY STREAMING

This project involves testing and comparing the performance of two different radio frequencies, 900MHz and 2.4GHz, for satellite and UAV applications. The payload, attached to a high-altitude balloon, will transmit live video and telemetry over the 2.4GHz frequency while telemetry data will also be sent over a 900MHz link using an RFD900+ Modem. The signals will be received with high-gain antennas on a tracking ground station, and the on-board SD card will collect the same telemetry data for comparison purposes. Additionally, a Nivida Jetson Nano with sensors will be used to determine the location of the payload in 3D space and orientation. The goal of the project is to characterize the quality and range of these radio links to guide future university aerospace projects. The project will provide valuable information on the performance of different frequencies and equipment, helping to improve satellite and UAV technology in the future.

Jones, Jazmyn (Sophomore, Science, Astronomy, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College. [D-7]

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Kaliotzakis, Valia (High School Student, Biotechnology, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [D-2]

ASCEND HIGH ALTITUDE BALLOON - CASA GRANDE UNION HIGH SCHOOL

A team of students from Casa Grande Union High School designed and implemented an instrumentation and biological payload to gather data about the lower stratosphere. The instrumentation mission gathered data on atmospheric phenomena, specifically the altitude and composition of the ozone layer. The biological mission gathered data on how the atmosphere at high altitudes affects simple biological organisms with the goal of determining how alien atmospheres may affect life from Earth.

Klingele, Justin (Junior, Astronomy, Physics, University of Arizona). Mentor: Kevin Hardegree-Ullman, Astronomy, Steward Observatory, University of Arizona. [E-1]

PREDICTING LIMITS FOR DIFFUSER-ASSISTED PHOTOMETRY OF TRANSITING EXOPLANETS

The Kepler and TESS spacecraft have identified thousands of transiting exoplanets, however ground-based telescope follow up observations are affected by atmospheric noise. Engineered diffusers have recently emerged as a cost-effective method of mitigating atmospheric noise by spreading starlight over the camera detector. The purpose of this project is to determine the utility of diffuser-assisted photometry for the Exoplanet Detection and Exploration Network (EDEN) Project. EDEN typically searches for exoplanets around M-dwarf targets. This project focused on writing a program to compare various system configurations to establish limits on the application of diffusers. This was built upon previous work with diffuser systems on large telescopes viewing bright targets, but instead applied to small telescopes viewing faint targets. A diffuser system was installed on Mt. Lemmon's 0.8-meter Schulman Telescope, allowing test observations of transiting exoplanets. Preliminary results have validated the program predications and shown success in improving observational precision.

Kontogiannis, Melissa (Senior, Chemistry, University of Arizona). Mentor: Dante Lauretta, Lunar & Planetary Laboratory, University of Arizona. [F-15]

CARBONATE CLUES FOR HYDROTHERMAL ALTERATION HISTORY OF CARBONACEOUS CHONDRITES

Remote observations of asteroid Bennu, the target of the ongoing OSIRIS-REx mission, reveal meter-scale carbonate veins in boulders on the asteroid's surface. These features are of particular interest in understanding Bennu's alteration history because they have informed the hypothesis that hydrothermal alteration on the asteroid's parent body may have occurred in an open, kilometer-scale system. In an effort to investigate the plausibility of such a system, we studied carbonate assemblages in a meteorite considered to be a reasonable analog for Bennu, specifically evaluating the replacement of olivine by carbonate as a potential pathway for the formation of these assemblages. Electron microprobe analysis, focused ion beam serial slicing, and transmission electron microscope imaging were key analysis techniques utilized in this investigation. However, data from the analyzed meteorite sample subverted our expectations, showing no evidence that olivine had been replaced by carbonate and prompting us to examine alternative pathways of carbonate formation.

Kruger, Charlie (Sophomore, Geology, Northern Arizona University). Mentor: Darrell Kaufman, College of the Environment, Forestry, & Natural Sciences, Northern Arizona University. [H-6]

RADIOCARBON DATING IN ARCTIC LAKES

For this research project, three Arctic lakes were cored, sampled, and dated. Using Arctic lakes is beneficial for this particular project because the permafrost most likely has not melted, slowing carbon decomposition and making the soil more resistant to current changes in climate. However, each lake had a different sedimentation rate, which varied their ages. The slower the sedimentation rate, the more likely there is to be an error in the dating of the soil, since there would be a wide range of dates in a small sample. The goal of this research is to create more definitive age ranges and search for patterns in sedimentation rates from the lake cores collected. By comparing the radiocarbon dates and sedimentation rates of different Arctic lakes in different locations, scientists can get a better understanding of Earth's past conditions.

Lane, Trisha Jean (Junior, Environmental Engineering, University of Arizona). Mentor: Jason Williams, USDA Agricultural Research Service, Southwest Watershed Research Center. [H-8]

INFLUENCE OF WOODLAND ENCROACHMENT ON VEGETATION, SOILS, HYDROLOGY, AND EROSION ON SAGEBRUSH RANGELANDS

Understanding the impacts of pinyon and juniper woodland encroachment on vegetation, hydrology, and erosion is needed to aid in land management and conservation planning. This research uses commonly-applied field methods and the Rangeland Hydrology and Erosion Model (RHEM) web tool to assess the hillslope-scale (100 square meters) ecohydrological and erosion impacts of woodland encroachment on sagebrush rangeland at Grand Staircase Escalante National Monument. We found that woodland encroachment on sagebrush rangeland can negatively impact vegetation structure by reducing cover, and that those changes enhance the connectivity of hydrology and erosion processes, increasing runoff and soil loss. In comparison, due to limited bare ground, the sagebrush vegetation type provides a better benefit for erosion prevention and hydrologic function. The study demonstrates the utility of the RHEM web tool in predicting woodland encroachment effects on hydrology and erosion and guiding future land-use management.

Larrieu, Loren (Senior, Electrical Engineering, Northern Arizona University). Mentor: Christopher Edwards, Astronomy & Planetary Science, Northern Arizona University. [G-3]

MULTI-SPECTRAL THERMAL INFRARED IMAGER FOR UAV BASED REMOTE SENSING

Thermal infrared (TIR) spectroscopy can provide important geological data for planetary science and has been used to characterize terrestrial and extra-terrestrial surfaces for decades. Planetary analog sites on Earth are particularly useful in planning for future planetary exploration. Here we present a proof of concept of a novel design for a multi-camera, TIR imaging system to be mounted on an Unmanned Aerial Vehicle (UAV) which can be utilized for surface characterization of planetary analog sites for geological exploration. We utilize commercially available or otherwise easily accessible materials to construct the assembly and mounting system. The system uses a pseudo-synchronous imaging technique and is powered by a Raspberry Pi 4 capable of supporting 5 FLIR Lepton 3.5 cameras. This system is also calibrated and tested for functionality utilizing the calibration method described in Edwards et al. 2021.

Laton, Ellie (Sophomore, Environmental Engineering, Computer Science, University of Arizona). Mentor: Osmar Menezes, Chemical & Environmental Engineering, University of Arizona. [H-7]

REDUCTIVE DEGRADATION OF INSENSITIVE MUNITIONS COMPOUND (IMC) MIXTURES USING IRON-BASED REACTIVE MINERALS

Following the establishment of the Insensitive Munitions program, the use of Insensitive Munitions Compounds (IMCs) in manufacturing explosives has become increasingly favored due to their reduced sensitivity to heat and mechanical impact. While this does result in safer and less reactive military technology, it also causes any ensuing chemical residuals to be particularly persistent through a range of ecological conditions, hence necessitating some form of environmental remediation. The goal of this project is to be able to characterize the rate of reduction-based reactions upon IMC mixtures using the iron-based reactive minerals, zero-valent iron and iron monosulfide. We focused on 2,4-dinitroanisole, nitroguanidine, and 3-nitro-1,2,4-triazol-5-one due to their frequently concurrent presence in the groundwater, soil, and waste streams of insensitive munitions manufacturing plants. From our experiments, we were able to analyze the efficacy of a mineral-based treatment in real-world conditions and predict how this technique could be utilized for future clean-up endeavors.

Lawson, Jonathan (High School Student, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [D-2]

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Limon, Melody (High School Student, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [D-2]

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Lintz, Emma (Senior, Ecology & Evolutionary Biology, Northern Arizona University). Mentor: Helen Rowe, School of Earth & Sustainability, Northern Arizona University. [H-10]

ASSESSMENT OF EXTINCTION RISKS OF SONORAN DESERT PLANTS

As anthropogenic climate change continues to worsen and damage sensitive environments, we are losing global biodiversity at a critical rate. Working under Dr. Helen Rowe, International Union for Conservation of Nature (IUCN) Chair of Sonoran Desert Plant Species Specialist Group, I conducted research on extinction risks of Sonoran Desert Plant species based on IUCN Red List guidelines. I completed assessment forms on these plant species analyzing various factors that increase extinction risk. In addition to this, I analyzed select Fabaceae species with restricted ranges for threats within their range.

Loberger, Randy (Junior, Astronomy, Embry-Riddle Aeronautical University). Mentor: Noel Richardson, Physics & Astronomy, Embry-Riddle Aeronautical University. [E-8]

THE ENERGETICS OF THE COLLIDING WIND BINARY Γ2 VELORUM: MULTI-WAVELENGTH STUDIES IN OPTICAL X-RAYS

γ2 Velorum is a binary system that contains the nearest Wolf-Rayet (WR) and an O star companion. We are working to re-evaluate the archival and new optical spectroscopy of the system to establish the spectroscopic orbital elements to greater precision. In addition, we will analyze archival X-ray measurements of the system along with new measurements from the NICER satellite on the ISS. Recent multi-wavelength results on a similar colliding wind binary WR 140 show that the cooling of the gas can switch between X-ray production to optical emission. Similar scenarios will be tested with this system. The binary orbit of γ2 Velorum is well constrained, being one of the three known WR binaries with a visual orbit. This coupled with the fact that the star is close (and bright), is an optimal binary to study the shocked gasses from the stellar winds as they collide.

Lopez, David (Senior, Geography, Meteorology, Climatology, Arizona State University). Mentor: Randall Cerveny, School of Geographical Sciences & Urban Planning, Arizona State University. [H-11]

A MICROCLIMATE CASE-STUDY COMPARISON OF ARIZONA SOUNDINGS

Radiosonde observations are used to create upper-air maps, and are used as initial conditions in weather models. In Arizona, the Flagstaff and Tucson National Weather Service (NWS) offices are upper-air stations. This project seeks to understand the applicability of launching radiosondes from the Phoenix NWS office during the late autumn season to aid in weather forecasting. Through a case study, we have launched a 0000 UTC radiosonde from the Phoenix NWS office to compare with the Tucson NWS's sounding. Significant differences in sounding analysis that affected weather forecasting occurred primarily within the planetary boundary layer. This project was simultaneously used as a teaching experience for the ASU Meteorological Instruments and Measurements course. Students had the opportunity to visit the Phoenix NWS office, learning about radiosondes and weather balloons from Phoenix NWS and Salt River Project meteorologists.

Luna, Pablo (Junior, Mechanical Engineering, University of Arizona). Mentor: Hannah Budinoff, Systems & Industrial Engineering, University of Arizona. [C-17]

DATA-DRIVEN LASER POWDER BED FUSION DISTORTION PREDICTION USING GEOMETRIC PARAMETERS

The aerospace industry benefits from the laser powder bed fusion process due to improved performance of complex lightweight structures and components. This process, however, presents complications when finding optimal parameters for minimal process-induced distortion. To increase dimensional accuracy and enable rapid certification of additive manufactured parts, we proposed using a model capable of predicting distortion based on geometry alone with statistical and machine learning approaches. For our model to deliver specific insights on distortion prediction, we seek to identify correlations between geometric metrics and maximum distortion. We generated 324 3-D axisymmetric models with varying features. The maximum distortion was extracted from laser powder bed fusion simulations using ANSYS Additive. After analyzing five geometric metrics we identified a strong statistical correlation between centroid position and maximum distortion. Our findings can guide data-driven models for distortion prediction, accelerating optimal parameter searching for aerospace lightweight structures and components.

Luu, Wilson (Senior, Applied Computing, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University. [D-1]

ANALYSIS OF ATTITUDE DETERMINATION AND CONTROLS ON A HIGH ALTITUDE BALLOONING PAYLOAD WITH LONG RANGE HAM RADIO COMMUNICATION AND UV-EXPOSED PLANT SEEDS

In Fall 2022, the purpose was to complete the two science missions of an Attitude Determination and Control System (ADCS) and Meteorology. The meteorological mission used pressure, internal and external temperature, GPS, and an accelerometer to monitor cloud condensation nuclei (CCNs). Further in Spring 2023, ASCEND tested long range HAM radio communication, ADCS and a plant module. The HAM radio mission allows ASCEND members to activate and communicate with the payload during flight. The plant module mission was designed to test the effects of UV radiation on the growth of lettuce seeds that would be sent up on the payload during launch, compared to a control group that would remain on the ground. Overall, ASCEND created a reusable design for the printed circuit board (PCB) and designed a CubeSat inspired payload. ASCEND is also able to profile the atmosphere, collect data, and test the payload design.

Ly, Salma (Senior, Chemical Engineering, Arizona State University). Mentor: Matthew Green, School for Engineering of Matter, Transport & Energy, Arizona State University. [G-In Title Only]

NOVEL POLY(VINYL) ALCOHOL COMPOSITES FOR CARBON REGULATION IN SPACE

Development of tunable high surface area poly(vinyl alcohol) amino acid composite polymer sorbents were investigated for carbon capture. To produce the composite electrospinning was used, which creates nonwoven fibrous mats of polymeric materials with a high surface area to volume ratio. This mat was functionalized with L-arginine to increase the charged amine groups in the membrane. The successful results in carbon capture over 24 hour cycles led to crosslinking using a variety of amino acids (lysine, etc.) which show minimal effect on the mechanical properties. This data was used in a simulation of the Carbon Dioxide Removal Assembly, testing the performance of the membrane in space conditions. Improvements in the weight, power usage, and efficiency of the system were calculated. With learning the space air regulating processes and finding a way to simulate the researched membranes this can lead to more in depth and targeted research to polymer improvement.

Madden-Watson, Aidan (Senior, Astronomy, Physics, Northern Arizona University). Mentor: Stephen Tegler, Astronomy & Planetary Sciences, Northern Arizona University. [F-9]

OPTICAL CONSTANTS OF CH_4 + N2 ICE MIXTURES AND OUTER SOLAR SYSTEM OBJECTS

Here we describe our experiments to derive optical constants of CH_4 and mixtures of CH_4 and N2 ices, which are essential to determine the abundances of CH_4 and N2 on outer Solar System objects. We used a ThermoFisher iS50 Fourier transform infrared spectrometer to obtain spectra of the ices from 8000 cm -1 (1.25µm) to 1000 cm^{-1} (10µm) at a resolution of 0.5 cm^{-1}. We combined the spectra, measurements of the thickness and index of refraction, and Fresnel equations to derive the optical constants. Here we focus on optical constants associated with the C - H stretch. Our optical constants for pure CH_4 agree well with published results. Our optical constants for CH_4 and N2 mixtures are new. They show that adding N2 to CH_4 affects the CH_4 band's position and shape and perhaps provides a new way to measure the abundance of elusive N2 on outer Solar System objects.

Maldonado, Stephany (Senior, Biomedical Sciences, University of Arizona). Mentor: John Szivek, Orthopaedic Surgery, University of Arizona. [G-4]

CHOICE OF BEST HA COATED SENSORS TO MEASURE BONE MAINTAINING ACTIVITY IN SPACE

The current standard to measure bone deformation directly is through strain gauges, which are attached to bone with cyanoacrylate-based adhesives that degrade rapidly. To facilitate strain gauge attachment in vivo and collect long-term measurements, our lab has used Calcium Phosphate Ceramic (CPC) particles. These CPCs are no longer commercially available. The purpose of this experiment is to characterize Hydroxyapatite (HA) particles as a replacement using tissue culture to compare cell proliferation and osteoblast differentiation. Seven types of HA and one CPC were tested. Well plates were coated with each type of particle and were seeded with 5000 human mesenchymal stem cells. Alkaline Phosphatase (ALP) assays and Direct Red 80 staining were performed every two weeks to measure ALP activity and collagen production. Preliminary results show that HA 7 supports collagen production and increase in ALP activity, indicating that there may be bone-like cell activity.

Maldonado Olivas, Jessica (Sophomore, Computer Science, Mathematics, Northern Arizona University). Mentor: David Trilling, Astronomy & Planetary Sciences, Northern Arizona University. [F-13]

SNAPS: REAL TIME OUTLIER DETECTION

This research presents an analysis of asteroid properties using data from the Solar System Notification Alert Processing System (SNAPS), which is a database that ingests alerts from all-sky surveys to produce a comprehensive archive of tens of thousands of asteroids. The primary objective of SNAPS is to enable a broad range of Solar System science cases by providing measurements and derived properties for asteroids. In this study, we use Python and Jupyter Notebook to analyze various asteroid properties, including their orbital parameters, physical characteristics, and brightness levels. By creating plots that highlight outliers, we can identify interesting or anomalous asteroids and gain insights into the formation and evolution of the Solar System. Our results demonstrate the value of SNAPS as a resource for advancing our understanding of the Solar System and highlight the potential for further discoveries through continued analysis and interpretation of the data.

Maloney, Alec (Junior, Aerospace Engineering, University of Arizona). Mentor: Jesse Little, Aerospace & Mechanical Engineering, University of Arizona. [I-5]

FIN-INDUCED SHOCK/BOUNDARY LAYER INTERACTIONS AT MACH 5

Numerous scientific and technical challenges must be overcome to achieve sustained hypersonic flight. One of the most significant is shock/boundary layer interaction (SBLI). SBLIs produce high levels of surface heat flux and unsteadiness. This can degrade materials, produce structural fatigue, and reduce control authority. Fin-induced SBLI experiments have been performed in two Mach 5 hypersonic wind tunnels at UArizona in support of the DLR (German Aerospace Center) STORT (Key Technologies in High-Speed Return Flights of Launcher Stages) Flight Program. This presentation will review the overall program and present fast-response pressure and infrared thermography results taken beneath the SBLI in both wind tunnel facilities. The implications of these results and plans for both wind tunnel experiments and flight test data analysis will be discussed.

Mammana, Nicholas (Senior, Aerospace Engineering, University of Arizona). Mentor: Jesse Little, Aerospace & Mechanical Engineering, University of Arizona. [I-6]

FORCE AND MOMENT MEASUREMENTS IN THE ARIZONA POLYSONIC WIND TUNNEL

The Arizona Polysonic Wind Tunnel became operational in January 2023 and this project concerns preparation for force and moment measurements on a generic projectile using a so-called “balance.” The projectile and model mounting system must be designed to ensure their survival during tunnel start-up/shut-down (where loads are most severe) while also maintaining a sufficient signal-to-noise ratio on condition. Normal shock theory (NST) with empirical corrections is used to predict the starting loads experienced by the projectile. Finite element analysis is then performed to ensure hardware survival. Estimates show that the balance must be placed close to the aerodynamic center of the model to maximize its capacity. The model must then be designed to meet criteria for maximum angle of attack, minimal start-up/shut-down loads, and material selection for survivability. This presentation will review these criteria and the overall decision process.

Manuszak, Bo (Senior, Aerospace Engineering, Arizona State University). Mentor: Eric Stribling, Interplanetary Initiative, Arizona State University. [H-12]

SPACE EXPLORATION FOR SUSTAINABLE DEVELOPMENT

This study aims to investigate the relationship between the space industry and the UN's Sustainable Development Goals (SDGs). By conducting a rapid review of each SDG and relevant space industries, the study examines the impacts of space exploration on global goals. The research question guiding this study is "How does space exploration intersect with the UN's SDGs?" Preliminary findings indicate that space technologies have four significant spheres of impact on the SDGs. Firstly, earth observation satellite data play a critical role in monitoring, modeling, and policymaking around the SDGs. Secondly, extraterrestrial conditions offer energy-reducing industrial capabilities. Thirdly, spinoff technologies from space exploration often find terrestrial applications. Finally, many articles discuss the possible societal implications of space technologies. Earth observation satellites are currently identified as one of the most powerful space-borne technologies for achieving the SDGs, so our team organized a satellite hackathon to engage ASU students with these impactful tools.

Martin, Orion (Junior, Electrical Engineering, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College. [D-7]

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Mata, Anyell (Junior, Electrical Engineering, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University. [D-1]

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Mazziotti, Nicolas (Sophomore, Astronomy, Physics, University of Arizona). Mentor: David Sand, Astronomy, University of Arizona. [E-9]

IDENTIFYING DIFFUSE GALAXIES THROUGH CITIZEN SCIENCE

Diffuse galaxies are difficult objects to find with automated detection algorithms because of their extended shape and low-surface brightness, appearing as faint "smudges" in optical image data. While diffuse galaxy catalogs can be reliably constructed through visual inspection, this method quickly becomes time-consuming for large scale surveys. To explore ways to make by-eye classification more practical, we developed a volunteer-based project on the Zooniverse web portal to search for diffuse galaxies in the Fornax Cluster. We tested our approach by inspecting a 2 square degree area in Fornax ourselves and compared our results to an established automated detection algorithm. We detected nearly all of the same diffuse galaxies plus a handful this algorithm missed that were too faint or obscured, which can be added to existing catalogs to increase their completeness of Fornax. This process will largely be expedited by the help of citizen scientists in the future.

McGalliard, James (Sophomore, Engineering, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [D-3]

CAC ASCEND

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Meagher, Breck (Junior, Space Physics, Embry-Riddle Aeronautical University). Mentor: Ellie Gretarsson, Aerospace Engineering, Embry-Riddle Aeronautical University. [E-10]

CHARACTERIZATION OF OVAL DEFECTS IN CRYSTALLINE OPTICAL COATINGS

Crystalline AlGaAs optical coatings are candidates for future upgrades to gravitational wave (GW) detectors. However, large area AlGaAs coatings develop oval defects during the manufacturing process. With the use of a Scanning Electron Microscope (SEM), three types of defects were found over a large area of the coating. Their positions and classes were then correlated with previous absorption measurements to gain insight on the nature of these defects.

Mitchell, Jaxson (Sophomore, Space Physics, Embry-Riddle Aeronautical University). Mentor: Cameron Williams, Mathematics, Embry-Riddle Aeronautical University. [A-5]

A TIME-FREQUENCY ANALYSIS OF CHIRPS IN GRAVITATIONAL WAVE DATA

The current techniques used to analyze gravitational wave data and chirp signals have theoretical shortcomings. A new method for analyzing these chirp signals is explored which relies on generalizations of the Fourier transform called the Φn transforms. A computational software library of these transforms has been developed to extract the highly oscillatory data (chirps) from a given signal which is an important problem in understanding gravitational wave data. In addition, these transforms are robust against noise and can be used to filter noise effectively. A voxel (three-dimensional) representation that generalizes the usual time-frequency representation has been constructed which contains time, frequency, and chirp order information that can be used to identify features of gravitational wave data.

Montgomery, Collin (Sophomore, Computer Science, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College. [D-7]

PHOENIX COLLEGE NASA ASCEND

The Phoenix College NASA ASCEND team has participated in launches for many years. Its four sub-teams are diligently working toward our objectives. The mechanical/vehicle group has been working on improving our techniques for fabricating and standardizing the parts for our carbon fiber reinforced vehicle. It has also constructed a second vehicle for redundancy. The atmospheric profiling group is integrating a number of sensors for our light experiment and gas to make measurements as a function of altitude. We are also acquiring data on how our vehicle is behaving during the launch. For the Spring 2023 launch, we are also launching two Geiger counters to measure beta and gamma radiation at various altitudes and locate the Pfotzer–Regener maximum. The video stabilization group succeeded in recording stable video images during the Fall 2022 launch. We are trying to improve on our effort and repeat our success during the Spring 2023 launch.

Moore, Shannon (Sophomore, Space Physics, Embry-Riddle Aeronautical University). Mentor: Darrel Smith, Physics, Embry-Riddle Aeronautical University. [C-8]

CENTRIFUGAL NUCLEAR THERMAL PROPULSION AMMONIA PROPELLANT THERMAL ANALYSIS

Working in conjunction with Marshall Space Flight Center we are assisting in the research for the next generation of Nuclear Thermal Propulsion called Centrifugal Nuclear Thermal Propulsion. The vast majority of the research conducted so far has used hydrogen as the sole propellant for this new propulsion system; however, hydrogen is incredibly hard to store as a form of propellant. In order to contribute this research effort, we decided that we would investigate the effects of utilizing different propellants. The propellant we decided to investigate was ammonia. There are two main parts of the propulsion we need to understand the first being how the nucleonics is affected in steady state when introducing nitrogen, and the second is how this different propellant affects the distribution of heat and the end result ISP.

Morgan, Cameron (Junior, Environmental Engineering, Arizona State University). Mentor: Matthew Green, School for Engineering of Matter, Transport & Energy, Arizona State University. [H-13]

CARBON DIOXIDE CAPTURE IN SPACECRAFT USING NOVEL MICROSPHERE-LOADED POLYMERS

This project explores how a novel additive filler and blowing agent, Expancel microspheres manufactured by Nouryon, impacts a polymer network designed for increased direct carbon dioxide capture from air while maximizing surface area and module strength. Novel polymer composites are created and characterized by CO2 capture performance, synthesis feasibility, and an energy analysis for their use aboard NASA spacecraft. The addition of microspheres to the polymer has led to an increase in CO2 capture capacity and sorption kinetics with lower energy consumption using a humidity-swing capture system.

Mountz, Elijah (High School Student, Software Engineering, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [D-3]

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Mountz, Ruth (High School Student, Adminstration of Justice, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [D-3]

CAC ASCEND

Three teams at Central Arizona College constructed payloads to explore three research areas. These teams were the HONEY BADGERS, RAPTORS and OWLS. The HONEY BADGERS traced the payload's location using a GPS, measured the UV levels over certain altitudes, and calculated the gravitational acceleration as the payload ascended and descended. By dampening camera vibrations and creating systems to reduce rotation, the RAPTORS sought to capture quality flight footage. The OWLS measured the fluctuations in humidity, temperature, and altitude across the various atmospheric levels. In addition, their payload also carried a biological experiment designed by the Diné College team.

Muzzy, Tristan (Senior, Aerospace Engineering, Embry-Riddle Aeronautical University). Mentor: Neil Sullivan, Engineering, Embry-Riddle Aeronautical University. [C-9]

ANALYSIS OF THERMODYNAMIC CYCLES FOR NUCLEAR THERMAL ROCKETS

Nuclear-thermal rockets represent a realistic near-future propulsion alternative for deep space missions within our solar system. Nuclear-thermal propulsion (NTP) operates by passing a liquid propellant, usually hydrogen, through a reactor core. The liquid propellant is energized in a heat exchanger and undergoes a phase change. The hot gas is then expanded through a converging-diverging nozzle, as with conventional chemical rocket engines, generating thrust. The goal of the project was to make a highly customizable propulsion simulation available in SIMULINK, and then use it to model different configurations of flow path for NTP systems. The original plan was to model Brayton cycle, Tapoff, and expander cycles to compare performance quantitatively and study transient responses. Other goals included implementing electrical generation bimodality, ammonia propellant, and re-adapting to simulating a bipropellant rocket.

Navarro, Roberto (Sophomore, Aerospace Engineering, Pima Community College). Mentor: AnnMarie Condes, Chemistry, Pima Community College. [D-8]

HIGH ALTITUDE CRUSTACEANS

The upper atmosphere is an inhospitable environment. The altitude in the upper atmosphere can reach up to 100 km, the pressure can be as low as 10^-11 atm, and temperature as low as -100°C, making it extremely difficult for any living organism to survive. This study looks at a very tiny crustacean of the order Anostraca indicating their ability to adapt to these harsh conditions. The question that arises is how do crustaceans survive in such conditions? This multiple semester experiment has studied the viability of both young, adult, and cyst forms of this crustacean in the extreme conditions of the upper atmosphere. Their survival in the upper atmosphere also provides valuable insight into the possibility of life on other planets, which was once considered impossible. Research on crustaceans is ongoing, and it is hoped that further results will shed more light on the possibility of life in hostile environments.

Nichols, Jack (Senior, Chemistry, University of Arizona). Mentor: Stephen Kukolich, Chemistry & Biochemistry, University of Arizona. [A-6]

MOLECULAR STRUCTURE OF DEUTERATED 2-AMINOPYRIDINE

Our lab uses high-resolution microwave spectroscopy to measure rotational spectra and structures of small molecules. Analogs of DNA bases, like 2-aminopyridine, can be analyzed with ease in isolated systems. The analysis of 2-aminopyridine can provide insight into the structure of DNA bases, which are difficult to analyze in biological environments. The purpose of this project was to use microwave spectroscopy to determine the structures of three isotopologues of 2-aminopyridine with varying degrees of deuteration of its amino group. Calculations were performed to predict the rotational transitions for each isotopologue, and a microwave spectrometer was used to detect transitions for these molecules. These transitions were used to determine the rotational constants and quadrupole coupling constants for the 14N and deuterium atoms in the isotopologues. These findings can be used in the future analysis of complexes containing 2-aminopyridine, such as the dimer of 2-aminopyridine and formic acid.

Nielsen, Sarah (Sophomore, Biology, University of Arizona). Mentor: Dante Lauretta, Lunar & Planetary Laboratory, University of Arizona. [F-14]

HYDROTHERMAL ALTERATION ON EARTH AND ASTEROIDS

Serpentinization is a major hydrothermal alteration process capable of generating carbonate assemblages deep in Earth's oceans. It is believed that the target asteroid of NASA's OSIRIS-REx mission, Bennu, underwent a similar alteration process due to the observation of meter-scale carbonate veins detected on its surface. Carbonate assemblages and veins have been observed in serpentinized International Ocean Drilling Project (IODP) samples from the deep ocean, specifically in an IODP sample originating from the Atlantis Massif. Olivine-carbonate assemblages were found in this sample, indicating a possible mechanism of carbonate formation via the replacement of olivine. Electron microscopy analysis was conducted to gain an understanding of the chemical behaviors of the mineralogical phases observed. The proposed mechanism of olivine replacement by carbonate can give insight into Bennu's formation history using the studied IODP sample analogically as well as its potential for CO_2 sequestration and implications for the origins of life.

Ocampo, Jose (Sophomore, Mechanical Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College. [D-6]

ASTROPEEPS

Our team built a balloon payload to examine the properties of the earth's atmosphere. Like previous payloads, the new payload contained 2 temperature sensors (internal and external), an accelerometer, a pressure sensor, and a video camera; however, it also contained a CO_2 sensor, an RF Receiver, a Geiger counter, seeds, and a marshmallow peep to observe how it deforms in the upper atmosphere. Designing and building a payload to study the properties of the upper atmosphere required a great deal of planning. In particular, it was necessary to consider the maximum weight, budget constraints, and limited time. The process started with the team brainstorming possible experiments and then a timeline was created. To minimize the payload's weight, the housing was made of foamboard, which also has good thermal insulation properties. As problems occurred, some experiments needed to be cut, including a yeast experiment, an ozone sensor, and a 360-video camera.

Olvera, Adriana (Senior, Geology, Northern Arizona University). Mentor: Mark Salvatore, Astronomy & Planetary Science, Northern Arizona University. [F-16]

REMOTE SENSING COMPOSITIONAL ANALYSIS OF UNVEGETATED MEANDERING STREAM BASINS

Meandering stream basins are held together by vegetation surrounding bank channels, but what holds the banks together when a stream is unvegetated? The focus of this project is unvegetated meandering streams on Earth to better understand the dynamics of meandering streams seen on Mars. Several experiments were conducted based on surface hardness and thermal gradient of set samples with various salinity levels ranging from 0% to 15%. Following the experiments, the trend appeared to be that the higher the salinity concentration, the more weight it took for the surface to break. Predicted results for thermal images would follow a similar pattern being; higher salinity maintaining a longer capacity for heat. With a higher percentage of salinity, the sample would be more cemented. This would mean with a higher salinity content, more thermal conductivity the sample will retain. These results would help understand meandering streams on the surface of planetary bodies.

Ontiveros, Ricardo (Junior, Electrical Engineering, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University. [D-1]

ANALYSIS OF ATTITUDE DETERMINATION AND CONTROLS ON A HIGH ALTITUDE BALLOONING PAYLOAD WITH LONG RANGE HAM RADIO COMMUNICATION AND UV-EXPOSED PLANT SEEDS

In Fall 2022, the purpose was to complete the two science missions of an Attitude Determination and Control System (ADCS) and Meteorology. The meteorological mission used pressure, internal and external temperature, GPS, and an accelerometer to monitor cloud condensation nuclei (CCNs). Further in Spring 2023, ASCEND tested long range HAM radio communication, ADCS and a plant module. The HAM radio mission allows ASCEND members to activate and communicate with the payload during flight. The plant module mission was designed to test the effects of UV radiation on the growth of lettuce seeds that would be sent up on the payload during launch, compared to a control group that would remain on the ground. Overall, ASCEND created a reusable design for the printed circuit board (PCB) and designed a CubeSat inspired payload. ASCEND is also able to profile the atmosphere, collect data, and test the payload design.

Ordaz Perez, David (Senior, Aerospace Engineering, Arizona State University). Mentor: Timothy Takahashi, School for Engineering of Matter, Transport & Energy, Arizona State University. [I-7]

AERO-THERMODYNAMIC LOADS ON SPACE SHUTTLE ORBITER ASCENT

The research conducted through NASA Space Grant focused on building upon a trajectory model to analyze the aero-thermodynamic effects on spacecrafts. As a result, the main objective was to investigate how the heating rates on critical locations of the Space Shuttle Orbiter were affected during the ascent stage. Specifically, the Orbiter's nose cone and leading-edge were identified as the critical locations for analyzing the aerothermal effects. The analysis was done by initially utilizing the trajectory model to calculate the Orbiter's Mach number as a function of time. Subsequently, the static and stagnation temperatures were calculated using the 1976 Standard Atmosphere Subroutine and stagnation-to-static temperature relationships, respectively. This provided the necessary quantities for calculating the heat rate of a sphere (nose cone) and swept cylinder (leading-edge). Ultimately, it was concluded that at higher altitudes and velocities, the heating rates were greater than those experienced at lower altitudes.

Owens, Norma (Sophomore, Applied Science, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [D-3]

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Patel, Khushi (Sophomore, Computer Science, Arizona State University). Mentor: Siddharth Srivastava, School of Computing & Augmented Intelligence, Arizona State University. [B-3]

AI-ENHANCED EDUCATION: GENERALIZED PLANNING AND REINFORCEMENT LEARNING IN SPACE EXPLORATION

Artificial Intelligence's contribution to technological development including space exploration is rapidly increasing. This research aims to expand on JEDAI, an educational platform that teaches AI planning and decision-making to non-AI experts. The software provides a user-friendly interface with multiple challenges to create high-level, intuitive plans that are then simulated and executed by the robot. In this research, we focus on space robotic planning and execution. Users direct the robot to accomplish desired tasks by dynamically populating puzzle-shaped blocks encoding the robot's possible actions. Our environment includes an intelligent agent that leverages task and motion planning, generalized planning, and explainable AI to learn and improve decision-making, generating flexible plans to achieve goals. Beyond the educational scope, these techniques are valuable for autonomous space robots operating in complex and unpredictable environments. This project provides a promising foundation for effectively simulating planning in environments and future practical applications in space exploration.

Patel, Yamini (Senior, Earth & Space Exploration, Geology, Arizona State University). Mentor: Amanda Clarke, School of Earth & Space Exploration, Arizona State University. [H-14]

TEXTURAL ANALYSIS OF AIRFALL DEPOSITS FROM THE MOST RECENT EXPLOSIVE ERUPTION AT THE VALLES CALDERA, NM

Calderas can be 'restless' for long periods after their climactic eruptive episodes and may eventually produce smaller scale inter-caldera eruptions. The Valles Caldera, NM, experienced caldera-forming eruptions ~1.6 and ~1.2 Ma, while its most recent eruption was ~ 50 ka, resulting in the El Cajete (EC) pyroclastic deposits. EC deposits are compositionally and petrographically different from previously erupted products indicating a new batch of magma beneath the caldera. Magma mixing is hypothesized to have rejuvenated the magma system, leaving the caldera in an eruptible state. We present thin-section analysis of EC pumice clasts under a petrographic microscope and SEM to reveal crystal phases present and quantify bubble and microlite textures. The imaging thus far supports the hypothesis that magma mixing triggered the eruptions, reveals highly sheared zones within the magma (indicative of high ascent rates), and suggests that the second of the two eruptions examined here was more volatile rich.

Phan, Tri (Junior, Astronomy, Embry-Riddle Aeronautical University). Mentor: Noel Richardson, Physics & Astronomy, Embry-Riddle Aeronautical University. [E-8]

THE ENERGETICS OF THE COLLIDING WIND BINARY Γ2 VELORUM: MULTI-WAVELENGTH STUDIES IN OPTICAL X-RAYS

γ2 Velorum is a binary system that contains the nearest Wolf-Rayet (WR) and an O star companion. We are working to re-evaluate the archival and new optical spectroscopy of the system to establish the spectroscopic orbital elements to greater precision. In addition, we will analyze archival X-ray measurements of the system along with new measurements from the NICER satellite on the ISS. Recent multi-wavelength results on a similar colliding wind binary WR 140 show that the cooling of the gas can switch between X-ray production to optical emission. Similar scenarios will be tested with this system. The binary orbit of γ2 Velorum is well constrained, being one of the three known WR binaries with a visual orbit. This coupled with the fact that the star is close (and bright), is an optimal binary to study the shocked gasses from the stellar winds as they collide.

Pillon, Brandon (Sophomore, Space Physics, Embry-Riddle Aeronautical University). Mentor: Michele Zanolin, Physics & Astronomy, Embry-Riddle Aeronautical University. [E-4]

TESTING AND CONSTRUCTION OF A SHORT-ARM INTERFEROMETER AND LOW FREQUENCY PROTOTYPE OF LASER INTERFEROMETER SUSPENSIONS FOR GRAVITATIONAL WAVE DETECTION

Our project is designed to understand the concepts needed for space based low frequency (1-10 Hz) gravitational wave astronomy. The first objective is a feasibility analysis for a small arm-length interferometer for the proposed use in a 3U class CubeSat. As such, determining the configuration and the components used will be the primary deliverable. The second objective is centered on looking into how to improve the detection capabilities of low-frequency gravitational waves. The current generation of gravitational wave detectors is not focused on the low-frequency end of the spectrum, and this project aims to design and potently build a detector that is solely focused on the low-frequency range. Another aspect of this project will be to build a functional representation of the LIGO (Laser Interferometer Gravitational Wave Observatory) mirrors to learn about their natural frequencies and how to mitigate the noise due to these natural frequencies.

Pitcl, Olivia (Senior, Physics, University of Arizona). Mentor: Kenneth Johns, Physics, University of Arizona. [A-7]

MACHINE LEARNING APPROACH IN ATLAS PARTICLE ENERGY CALIBRATIONS

This project investigates a new, machine learning (ML) based approach to improving energy measurements at ATLAS, a particle detection experiment at the CERN Large Hadron Collider (LHC). Accurate energy calibrations are integral to making precision measurements of objects such as jets and to search for new, beyond-the-Standard Model particles. ATLAS currently calibrates the energy of Liquid Argon calorimeter signals by a lengthy series of applied corrections. For this research, several iterations of a deep neural net (DNN) were trained, using features from the calorimeter signals to predict their true energies. Final models successfully outperformed the existing method employed by ATLAS. This project provides concrete evidence for the improvements machine learning can bring to calorimeter energy calibration.

Purkeypile, Andrew (Senior, Aerospace Engineering, Embry-Riddle Aeronautical University). Mentor: Davide Conte, Aerospace Engineering, Embry-Riddle Aeronautical University. [C-10]

PROXIMITY OPERATION MANEUVERS AT ASTEROIDAL DEEP SPACE IN-SITU RESOURCE UTILIZATION STATIONS

In-situ Resource Utilization (ISRU) of asteroids for interplanetary refueling necessitates understanding how to maneuver in the vicinity of these relatively small bodies. Given a transfer from Earth to an asteroid, the goal is to determine a probability distribution of rendezvous trajectories and the associated velocity changes required to correct them to a desired trajectory. A transfer orbit to a given asteroid is determined by solving the Lambert Problem. Position vectors for Earth and an asteroid can be acquired using ephemeris data from NASA JPL's Horizons System. The resulting velocities at the asteroid sphere of influence (SOI) are used to calculate the relative motion and rendezvous using the Hill-Clohessy-Wiltshire (HCW) equations of motion that result from linearizing the Newtonian equations of motion for the relative motion between two bodies. Determination of a trajectory probability distribution will be achieved using Body Plane (B-Plane) targeting methods and an associated error ellipse.

Ragsdale, Jordan (Sophomore, Computer Engineering, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [D-3]

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Rahmer, Walter (Junior, Optical Sciences & Engineering, University of Arizona). Mentor: Christopher Walker, Steward Observatory, University of Arizona. [C-11]

CATSAT: PROBLEM SOLVING FOR CUBESAT ENGINEERING, INTEGRATION, AND COMMUNICATION

CatSat is a technology demonstration and scientific research satellite designed and built primarily by students at the University of Arizona in partnership with Tucson companies. The satellite will demonstrate the use of a novel inflatable antenna design to allow future high speed communication with small satellites. Currently, small satellites are limited in data transmission capabilities by stringent size constraints. The research payload onboard is a high-frequency (HF) radio/antenna system designed to probe the Earth's ionosphere during twilight as well as a high definition camera for imaging the Earth. After overcoming numerous challenges in construction, the satellite was completed with successful vibrational testing in November 2022. Work continues to develop a secondary ultra high frequency (UHF) ground station on campus, an X-band ground station at the Biosphere, and train students for operations in flight.

Ramirez, Elijah (High School Student, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [D-2]

ASCEND HIGH ALTITUDE BALLOON - CASA GRANDE UNION HIGH SCHOOL

A team of students from Casa Grande Union High School designed and implemented an instrumentation and biological payload to gather data about the lower stratosphere. The instrumentation mission gathered data on atmospheric phenomena, specifically the altitude and composition of the ozone layer. The biological mission gathered data on how the atmosphere at high altitude affects simple biological organisms with the goal of determining how alien atmospheres may affect life from Earth.

Ramirez, Kevin (Sophomore, Mechanical Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College. [D-5]

PAYLOAD ORIENTATION: TEAM ICARUS

Our team built a balloon payload to examine the properties of the Earth's atmosphere. Like previous payloads, the new payload contained 2 temperature sensors (internal and external), an accelerometer, a pressure sensor, and a video camera; however, it also contained UV sensors, a magnetometer, a micro-spectrometer, a Geiger-Muller tube sensor, and an Iridium Satellite modem. The purpose of the magnetometer was to measure the Earth's magnetic field. This along with the combination of the accelerometer and gyroscope helped determine the orientation of the payload during flight, which was important to interpret the measurements taken with the UV sensors during flight.

Ravikumar, Shradhanjli (Senior, Astrobiology, Biogeosciences, Astrophysics, Arizona State University). Mentor: Dan Shim, School of Earth & Space Exploration, Arizona State University. [F-17]

A Potential Mechanism for Nitrogen Storage in the Earth's Mantle Transition Zone

Large reservoirs of nitrogen may exist in the deep interiors of rocky planets, including Earth. One possible mechanism of nitrogen storage is a solid solution between ringwoodite (Mg2SiO4) and silicon nitride (Si3N4) at depths between 500 and 660 km below the Earth's surface, within the mantle transition zone. Both minerals take on a cubic spinel structure at high-pressure and high-temperature conditions; therefore, incorporation of silicon nitride into ringwoodite at depth may serve as a potential nitrogen storage mechanism. Using density-functional theory (DFT) calculations, hypothetical models of mineral structures within this solid solution have been tested for their stability at high pressure. Since nitrogen is a major part of Earth's atmosphere, understanding its abundance in minerals within the lower mantle transition zone may provide insight into the atmospheric conditions of the early Earth, as well as past conditions on terrestrial planets and rocky exoplanets.

Razo, Elias (High School Student, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [D-2]

ASCEND High Altitude Balloon - Casa Grande Union High School

A team of students from Casa Grande Union High School designed and implemented an instrumentation and biological payload to gather data about the lower stratosphere. The instrumentation mission gathered data on atmospheric phenomena, specifically the altitude and composition of the ozone layer. The biological mission gathered data on how the atmosphere at high altitude affects simple biological organisms with the goal of determining how alien atmospheres may affect life from Earth.

Reese, Jamesen (Junior, Physics, University of Arizona). Mentor: Federico Fraschetti, Lunar & Planetary Laboratory, University of Arizona. [E-11]

Energy Partitioning and Particle Acceleration at the Bow Shock of Saturn

Saturn's bow shock proves to be an excellent laboratory for studying accelerated charged particles within interplanetary plasmas to better understand the origin of cosmic-rays. This is due to the shock's high Alfvén Mach number and the planet's proximity to Earth. We examine the energy partition across the bow shock surface to deduce the origin of energetic oxygen ions and protons. By applying the magnetohydrodynamic jump conditions (conservation of mass, momentum, and energy) to a number of shock crossings by the Cassini spacecraft, we found that charged particles made up over 30% of the total downstream energy. This result shows that the energy of such energized ions increases with Mach number, directly disproving some hybrid numerical simulations that claim quasi-perpendicular shocks are inefficient particle accelerators. We are still investigating possible contamination of energetic ions coming from Saturn's hot magnetosphere. Our conclusions utilize in-situ measurements and have far-reaching consequences for astrophysical shocks.

Revis, Annika (Sophomore, Biology, Northern Arizona University). Mentor: Catherine Gehring, Biological Sciences, Northern Arizona University. [H-15]

Potential Effects of Endophytes in Tillandsia Usneoides

Climate change is getting worse and abiotic factors such as water, wind, and sunlight are becoming more variable. The different water and nutrient dynamics that occur between plants the organisms surrounding them are part of the key to keeping these species alive through the changes our planet is experiencing. Endophytes are organisms, especially fungi, that live asymptomatically inside of plants. These organisms are known to sometimes improve the plants' ability to tolerate various abiotic and biotic stresses. Tillandsia usneoides is an epiphytic flowering plant that typically grows on large trees. Samples of this plant were taken on a gradient from Skidaway Island moving inland within Georgia. We isolated and sequenced the endophytes within this species from each sample to look at how these endophytes could potentially be helping the plant in various conditions. To do this we compared the endophyte's tolerance to different salinity concentrations in addition to drought conditions.

Reynoso, Lucas (Senior, Mechanical Engineering, Arizona State University). Mentor: Maitrayee Bose, School of Earth & Space Exploration, Arizona State University. [F-18]

LABORATORY ANALYSIS OF CERES ANALOGUE MINERALS

During the Dawn mission, bright spots were discovered on the surface of the dwarf planet Ceres, which are evaporite deposits of sodium carbonate, ammonium chloride, and hydrohalite. These deposits are significant because they indicate the presence of subsurface water. These evaporites form from the brine-water mixture in the deep Ceres reservoir, which likely possesses the conditions ideal for forming complex organics. Here, we report the results of several laboratory techniques (CHN Elemental Analyzer, SIMS, FTIR, Gas Chromatography, and BET Analysis) for quantifying the likelihood of carbon survival and distribution in analog evaporitic materials found on the Ceres, specifically looking at if the amino acid glycine can be preserved in sodium chloride crystals. Our results conclude that if the Ceres brine reservoirs are saturated with organics and with the lower limits for our instrumentation, these techniques should be sufficient to measure glycine content should we ever receive samples from Ceres.

Richardson, Tessa (Junior, Physics, Mathematics, Northern Arizona University). Mentor: Teddy Kareta, Lowell Observatory. [F-19]

ECHECLUS DATA ANALYSIS OF PHASE CURVE AND COMPOSITION

Echeclus is a centaur (trans-neptunian comet) with recorded outbursts which are not coincidental with an increased orbital approach to the sun. We examined data from JPL Horizons, ATLAS and other sources to produce models of magnitude and phase angle, first with respect to time and then controlling for time. Different programming languages and unique codes produced similar estimates for the phase curve of Echeclus. The phase curve produced by modeling from data was not consistent with phase curves of other outer solar system comets. The phase curve was higher than expected even when controlling for significant activity, outbursts, and taking filters into consideration. These results may provide insight into the apparent unusual activity of Echeclus and the possible composition of the nucleus. Our results are consistent with a recently published papers and provide motivation for further research into Echeclus over the summer.

Rivera, Genaro (First-Year, Mechanical Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College. [D-6]

ANALYSIS OF CO2 WITHIN THE UPPER ATMOSPHERE

Our team built a balloon payload to examine the properties of the earth's atmosphere. Like previous payloads, the new payload contained 2 temperature sensors (internal and external), an accelerometer, a pressure sensor, and a video camera; however, it also contained a CO2 sensor, an RF Receiver, a Geiger counter, seeds, and a marshmallow peep to observe how it expands within the low-pressure environment of the upper atmosphere. In particular, the CO2 sensor (SCD4x), which is built to successfully operate at the cold temperatures experienced during the balloon flight, has a built-in temperature and humidity sensor, and communicates with our Pro Micro Arduino on our flight data recorder board via I 2 C serial communication protocol. This sensor provided data showing the concentration of CO2 as a function of altitude.

Rizzo, Maxwell (Senior, Physics, Astronomy, University of Arizona). Mentor: Haeun Chung, Steward Observatory, Astronomy, University of Arizona. [E-12]

REVISITING THE FUSE DATA ARCHIVE - FINDING O VI EMISSION

A significant majority of the galactic baryonic matter exists in the form of diffuse gas, known as the Circumgalactic medium (CGM). The Far-UV O VI emission lines (1031.93, 1037.62 Å), corresponding to 6-times ionized Oxygen provide a crucial, but observationally challenging signal of warm-hot gas around a temperature of 10^5 - 10^6 K. Simulations of star forming galaxies indicate warm-hot gas contributes more mass than stars. This project revisited the entirety of the NASA FUSE (Far Ultraviolet Spectroscopic Explorer, 1999-2007) data archive, searching for more detections of extragalactic O VI signal to 3σ. A high-performance data pipeline was created to look for this signal using a combination of computational methods, and manual observation. We expect to increase the number of O VI detections, which will inform the target selection for the NASA Aspera mission, a SmallSat spectroscopic telescope to be launched in 2025.

Robertson, Katrina (Junior, Mechanical Engineering, Embry-Riddle Aeronautical University). Mentor: Ashley Rea, Rhetoric & Communications, Embry-Riddle Aeronautical University. [B-4]

FOSTERING EDUCATIONAL EQUITY IN ENGINEERING

Many have identified the marginalization of women that occurs within STEM education, and this research seeks to identify concrete ways in which educators might intervene to create more inclusive learning environments. Researchers in engineering education have evaluated the ways in which the curriculum can be altered to be more inclusive (Dewsbury, 2019), and assessed the outcomes of having diverse teams in the classroom (Oti et al., 2022). In technical and professional communication, researchers have developed taxonomies for understanding communication infrastructure (Adams, 2022) which focuses on how factors outside of the traditional communication impact its effectiveness. Our study seeks to gain firsthand insight from marginalized groups and faculty members regarding their experiences in academia. Participants were interviewed, where they shared their perspectives and provided their personal advice on how we can adjust course curriculum and methodology to establish a more inclusive setting within the introductory engineering courses at the university.

Robles, Alexander (Sophomore, Aerospace, Aeronautical Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College. [D-5]

GCC'S TEAM ICARUS: 3-D PRINTED PAYLOAD HOUSING SUPPORT STRUCTURE

Our team built a balloon payload to examine the properties of the earth's atmosphere. Like previous payloads, the new payload contained 2 temperature sensors (internal and external), an accelerometer, a pressure sensor, and a video camera; however, it also contained UV sensors, a magnetometer, a micro-spectrometer, a Geiger-Muller tube sensor, and an Iridium Satellite modem. To provide support for the foamboard payload, a 3-D printed skeleton structure was designed and analyzed using computer-aided design software before it was created using a 3D printer. In addition to providing structural integrity for the foamboard housing, the interior structure allowed for the proper mounting of the sensors, satellite modem, camera, and flight data recorder (microprocessor board).

Romero-Lozano, Alejandro (Sophomore, Electrical & Computer Engineering, University of Arizona). Mentor: Erika Hamden, Steward Observatory, University of Arizona. [F-20]

MECHANICAL ASSEMBLY FOR NUV CCD CAMERA TELESCOPE

Telescopes with high precision custom assemblies and multiple degrees of freedom are often needed for astronomical study. The study aims to provide an inexpensive, five axis, ultra-high vacuum (UHV), mechanical assembly that is designed for an ultraviolet optimized CCD camera. The parts in the assembly that were reused were digitized into computer aided design software. A fully articulating virtual model automated verification of non-interference between components. The three-dimensional model was prototyped in a cost-effective manner using additive manufacturing. The system involves an extremely low profile UHV viewport that is necessary to adapt to existing external geometry. The joints in the system are frictionless flexure bearings that allow for precise movements while allowing effortless manual operation. The inexpensive UHV mechanical assembly facilitates future astronomical studies by providing an efficient and effective design for many five axis assemblies.

Rosales, Ralph (Sophomore, Mechanical Engineering, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [D-3]

CAC ASCEND

Three teams at Central Arizona College constructed payloads to explore three research areas. These teams were the HONEY BADGERS, RAPTORS and OWLS. The HONEY BADGERS traced the payload's location using a GPS, measured the UV levels over certain altitudes, and calculated the gravitational acceleration as the payload ascended and descended. By dampening camera vibrations and creating systems to reduce rotation, the RAPTORS sought to capture quality flight footage. The OWLS measured the fluctuations in humidity, temperature, and altitude across the various atmospheric levels. In addition, their payload also carried a biological experiment designed by the Diné College team.

Ross, Jacob (Senior, Engineering, Casa Grande Union High School). Mentor: John Morris, Career & Technical Education, Casa Grande Union High School. [D-2]

ASCEND HIGH ALTITUDE BALLOON - CASA GRANDE UNION HIGH SCHOOL

A team of students from Casa Grande Union High School designed and implemented an instrumentation and biological payload to gather data about the lower stratosphere. The instrumentation mission gathered data on atmospheric phenomena, specifically the altitude and composition of the ozone layer. The biological mission gathered data on how the atmosphere at high altitude affects simple biological organisms with the goal of determining how alien atmospheres may affect life from Earth.

Roszell, Hayden (Senior, Software Engineering, Embry-Riddle Aeronautical University). Mentor: Ahmed Sulyman, Computer, Electrical, & Software Engineering, Embry-Riddle Aeronautical University. [C-12]

DESIGN AND IMPLEMENTATION OF THE ONBOARD COMPUTER FOR EAGLESAT-2

The On-Board Computer (OBC) integrated into EagleSat-2, a 3U CubeSat that will operate in low-Earth orbit, is designed to autonomously conduct scientific research, and carry out satellite operations when not in range of a commanding ground station. The OBC implements a 32-bit microcontroller that runs a real-time operating system with several concurrent threads to manage ground communication, research collection, attitude control, power management, and failure recovery. Subsystems onboard EagleSat-2 communicate with the OBC via low-level serial protocols, including UART and I2C. The OBC software stack implements abstraction layers for each subsystem, including serial communication, drivers to implement their proprietary communication protocol, application-controlled state managers, and applications to set desired state based on operational modes.

Ruddick, Logan (Senior, Aerospace Engineering, Embry-Riddle Aeronautical University). Mentor: Ahmed Sulyman, Electrical & Software Engineering, Embry-Riddle Aeronautical University. [C-13]

EAGLESAT-2: ATTITUDE DETERMINATION AND CONTROL SYSTEM MONITORING AND MANAGEMENT

The Attitude Determination and Control System (hereafter ADCS) onboard EagleSat-2 manages telemetry and inter-orbital maneuvering of the satellite in low earth orbit. It is responsible for managing rotation, speed, and orientation of the satellite to ensure confident satellite communication and control. It does this using magnetometers, magnetorquers, and reaction wheels to maintain desired flight conditions. Being a pivotal piece of hardware, it is imperative that the Onboard Computer (hereafter OBC) monitors, and, at times overrides the decisions of the ADCS to ensure steady flight in case of logical failure or non-standard desired flight parameters. This requires a driver implementation of analysis and communication protocols on the OBC to request telemetry and respond as needed. This allows the OBC to be a logical failsafe for the ADCS, as well as a health monitor and a middleman between the ADCS and other critical systems and payloads when necessary.

Ryan, Benjamin (Junior, Environment Science, Northern Arizona University). Mentor: Amy Whipple, Biology, Northern Arizona University. [H-16]

DROUGHT IMPACT ON COLD TOLERANCE IN PINYON PINE

Pinyon pine is predominant in many ecosystems across the western United States. They are a primary component of woodland ecosystems and support diverse plant and animal species that occur on over 24.7 million hectares. Because drought and freezing events are major determinants of plant distribution, it is important to understand how pinyon pine ecosystems will respond to prolonged drought as it becomes more commonplace, as well as how this will affect the survival of pinyon when exposed to additional stresses, such as sudden drops in temperature. While the effects of drought and freezing events have been studied in depth separately, there is a lack of research about how these factors interact with each other. Specifically, the extent to which drought affects the range of cold tolerance is unknown. My project will attempt to quantify the effects of drought on cold tolerance in pinyon pine populations.

Sam, Calvin (Junior, Astronomy, Embry-Riddle Aeronautical University). Mentor: Pragati Pradhan, College of Arts & Sciences, Embry-Riddle Aeronautical University. [E-13]

X-RAY BINARIES AS FLASHLIGHTS TO MAP THE UNIVERSE THROUGH STELLAR WIND STUDIES

Low Mass X-ray Binaries (LMXBs) comprise a low mass star and a compact object (neutron star/black hole) orbiting around a common center of mass. X-rays are generated through intense collision of star material on the surface of the compact object. Using X-ray data of GX 1+4 from NICER, we confirmed a strong presence of iron throughout the stellar wind with large absorption of X-rays. We plan to measure the size of clumps by measuring the X-ray extinction through spectro-timing analysis. We also analyzed the hard X-ray data from NuSTAR of the LMXB 4U 1822-37. We have confirmed the existence of cyclotron resonance scattering near 29 keV conveying magnetic field strength of 2-3 x 10^12 Gauss. The orbital period ~21 kiloseconds is also seen in the X-ray light curves. In the future, we will use time-resolved spectroscopy to look at the cyclotron line variation with spin phase of the neutron star.

Serrano, Robert (Sophomore, Civil Engineering, Central Arizona College). Mentor: Armineh Noravian, Science & Engineering, Central Arizona College. [D-3]

CENTRAL ARIZONA COLLEGE – NASA ASCEND!

Three teams at Central Arizona College constructed payloads to explore three research areas. These teams were the HONEY BADGERS, RAPTORS and OWLS. The HONEY BADGERS traced the payload's location using a GPS, measured the UV levels over certain altitudes, and calculated the gravitational acceleration as the payload ascended and descended. By dampening camera vibrations and creating systems to reduce rotation, the RAPTORS sought to capture quality flight footage. The OWLS measured the fluctuations in humidity, temperature, and altitude across the various atmospheric levels. In addition, their payload also carried a biological experiment designed by the Diné College team.

Sextro, Tristen (Junior, Astronomy, Software Engineering, Embry-Riddle Aeronautical University). Mentor: Pragati Pradhan, College of Arts & Sciences, Embry-Riddle Aeronautical University. [E-13]

X-RAY BINARIES AS FLASHLIGHTS TO MAP THE UNIVERSE THROUGH STELLAR WIND STUDIES

Low Mass X-ray Binaries (LMXBs) comprise a low mass star and a compact object (neutron star/black hole) orbiting around a common center of mass. X-rays are generated through intense collision of star material on the surface of the compact object. Using X-ray data of GX 1+4 from NICER, we confirmed a strong presence of iron throughout the stellar wind with large absorption of X-rays. We plan to measure the size of clumps by measuring the X-ray extinction through spectro-timing analysis. We also analyzed the hard X-ray data from NuSTAR of the LMXB 4U 1822-37. We have confirmed the existence of cyclotron resonance scattering near 29 keV conveying magnetic field strength of 2-3 x 10^12 Gauss. The orbital period ~21 kiloseconds is also seen in the X-ray light curves. In the future, we will use time-resolved spectroscopy to look at the cyclotron line variation with spin phase of the neutron star.

Shah, Namita (Sophomore, Computer Science, Arizona State University). Mentor: Siddharth Srivastava, School of Computing & Augmented Intelligence, Arizona State University. [B-3]

AI-ENHANCED EDUCATION: GENERALIZED PLANNING AND REINFORCEMENT LEARNING IN SPACE EXPLORATION

Artificial Intelligence's contribution to technological development including space exploration is rapidly increasing. This research aims to expand on JEDAI, an educational platform that teaches AI planning and decision-making to non-AI experts. The software provides a user-friendly interface with multiple challenges to create high-level, intuitive plans that are then simulated and executed by the robot. In this research, we focus on space robotic planning and execution. Users direct the robot to accomplish desired tasks by dynamically populating puzzle-shaped blocks encoding the robot's possible actions. Our environment includes an intelligent agent that leverages task and motion planning, generalized planning, and explainable AI to learn and improve decision-making, generating flexible plans to achieve goals. Beyond the educational scope, these techniques are valuable for autonomous space robots operating in complex and unpredictable environments. This project provides a promising foundation for effectively simulating planning in environments and future practical applications in space exploration.

Sherant, Andrew (Sophomore, Mechanical Engineering, Phoenix College). Mentor: Eddie Ong, Chemistry, Phoenix College. [D-7]

PHOENIX COLLEGE NASA ASCEND

The Phoenix College NASA ASCEND team has participated in launches for many years. Its four sub-teams are diligently working toward our objectives. The mechanical/vehicle group has been working on improving our techniques for fabricating and standardizing the parts for our carbon fiber reinforced vehicle. The atmospheric profiling group is integrating a number of sensors for our light and gas experiments to make measurements as a function of altitude. We are also acquiring data on how our vehicle is behaving during the launch. For the Spring 2023 launch, we are also launching two Geiger counters to measure beta and gamma radiation at various altitudes and locate the Pfotzer –Regener maximum. The video stabilization group succeeded in recording stable video images during the Fall 2022 launch. We are trying to improve on our effort and repeat our success during the Spring 2023 launch.

Smania, Siena (Senior, Astrobiology, Biogeosciences, Arizona State University). Mentor: Everett Shock, School of Earth & Space Exploration, Arizona State University. [H-17]

MEALS FOR MICROBES: HOW DO ENERGY SUPPLIES OF HOT SPRINGS VARY WITH GEOTHERMAL MIXING?

One of the many ways that a microbial community is influenced, is by the availability of nutrients in the environment. In thermophilic communities, such as those found in hot springs, chemosynthesis is the primary way that microbes produce energy. Many studies have investigated the influence of factors such as pH, temperature, and salinity on energy availability. However, one factor that hasn't been considered is the history of the water. In this study, we show that different water histories yield different frequencies at which reduction-oxidation reactions provide the most energy. We will continue to investigate the reasoning for this by considering other factors within the history of the water that could relate to this observation. Nonetheless, our current results indicate that where the water has been in its journey to get to the hot spring has an effect on the energy supplies available there and therefore the microorganisms present.

Speckert, Meghan (Junior, Physics, Astrophysics, Northern Arizona University). Mentor: Philip Massey, Lowell Observatory. [E-14]

THE STELLAR CONTENT OF IC1310

The IC 1310 star cluster is an understudied star cluster that this space grant project sought to learn more about through observing on the Lowell Discovery Telescope to gather spectra data. From the spectra, we were able to determine which stars are members, the distance to the star cluster, the magnitudes of these stars, and to categorize the types of stars based on their derived spectra. What brought attention to this star cluster is that there is a red supergiant located at the center of the star cluster. From the derived spectra, the stars in the star cluster are all B-type dwarfs, with the exception of the M-type supergiant at the center. While odd in the formation of the star cluster, we determined that the red supergiant is a part of the star cluster based on the relative parallax and interstellar reddening of all the surrounding members.

Squillace, Reynier (Senior, Astronomy, University of Arizona). Mentor: Yancy Shirley, Astronomy & Steward Observatory, University of Arizona. [E-15]

NITROGEN ISOTOPIC FRACTIONATION IN PRESTELLAR CORE L43E

Prestellar cores are nitrogen-rich, gravitationally bound dense regions within molecular clouds which will eventually lead to star formation. Throughout the Interstellar Medium, the two stable isotopes of nitrogen, 14N and 15N, are found in an average ratio of 330. The nitrogen isotopic fractionation ratio has been observed in fewer than 10 prestellar cores, and chemodynamical core models have difficulty predicting the observed ratios in these cores, which differ from the values found in both the Interstellar Medium and most planets. Because of this discrepancy, the mechanisms resulting in fractionation are unclear. We observed the 14N and 15N isotopes of ortho-NH2D in prestellar core L43E using the Arizona Radio Observatory Kitt Peak 12m telescope, and constrained the fractionation ratio to between 220 and 662, with a median of 405. This range suggests that fractionation processes begin to occur during the prestellar core phase of stellar evolution.

Stevens, Samantha (Sophomore, Aerospace Engineering, Mathematics, University of Arizona). Mentor: Hermann Fasel, Aerospace & Mechanical Engineering, University of Arizona. [I-8]

NUMERICAL INVESTIGATION OF HYPERSONIC BOUNDARY-LAYER TRANSITION FOR AN OGIVE GEOMETRY

Transition to turbulence in hypersonic boundary layers is associated with considerable increases in heat transfer. This may jeopardize the structural integrity of high-speed vehicles unless appropriate measures to guard against these increased heat loads are taken. Toward this end, it is necessary to understand the fundamental flow physics of the relevant linear and nonlinear transition stages. Therefore, numerical investigations of the various transition stages were carried out for the flow conditions and the ogive geometry from the experiments in the hypersonic wind tunnel (H2K) of the German Aerospace Center (DLR). The linear stages were investigated using Linear Stability Theory (LST) and revealed that for the geometry and flow conditions considered here the so-called first Mack mode was the dominant primary instability. Subsequent nonlinear calculations using a compressible Navier-Stokes code confirmed that these amplified first mode waves can lead to laminar-turbulent transition through a so-called first mode oblique breakdown.

Stockdale-Stephens, Avery (Senior, Aerospace Engineering, University of Arizona). Mentor: Kyle Hanquist, Aerospace & Mechanical Engineering, University of Arizona. [C-14]

INVESTIGATION OF WAKES BEHIND BLUNT-BODIES DURING RE-ENTRY

The Stardust mission, launched in 1999 was the first sample return mission from outside the Earth-moon system. The spacecraft performed a flyby of the Wild-2 comet, collected samples from the comet tail, and stored them in a sample return capsule (SRC). Due to the interplanetary trajectory, the SRC entered Earth's atmosphere with the highest ever recorded velocity, 12.9 km/s. The ability to accurately model and simulate such conditions can be invaluable to future missions and vehicle design. A hybrid structured-unstructured mesh of the Stardust SRC was constructed and the SRC was simulated using the computational fluid dynamics (CFD) solver, called SU2-NEMO (NonEquilibriumMOdels). Based on preliminary CFD results, the mesh was manually optimized to reduce computational cost. The mesh was further optimized using mesh adaptation software. The SRC was modeled and simulated at different freestream conditions to examine how the flow characteristics change with an increasing Mach number.

Sudkamp, Lillian (Junior, Aerospace Engineering, Embry-Riddle Aeronautical University). Mentor: Ahmed Sulyman, Electrical Engineering, Embry-Riddle Aeronautical University. [C-15]

THE EAGLESAT 2 STRUCTURE

The EagleSat 2 is a 3U CubeSat being developed at Embry-Riddle Aeronautical University Prescott with a dual scientific payload: to detect Cosmic Ray Particles and to study memory degradation caused by solar radiation. This presentation will provide an overview of the layout, structural design, the assembly process, and the challenges that arose during the fabrication of the satellite.

Sullivan, Brooke (Senior, Applied Meteorology, Embry-Riddle Aeronautical University). Mentor: Dorothea Ivanova, Applied Meteorology, Embry-Riddle Aeronautical University. [H-18]

Sensitivity of North American Monsoon Convective Precipitation Flooding in Arizona to the Atmospheric Boundary Layer and Circulation

In early September 2014, remnants of Hurricane Norbert brought record-setting rainfall that swept across the Southwest U.S. Flash flooding in Phoenix caused major damage to infrastructure, roadways, and many human casualties including two fatalities. The Phoenix flash flood of September 7-8th, 2014 resulting from the hurricane Norbert is investigated in this Weather Research and Forecasting (WRF) modeling study. Our goal is to simulate the general features of the boundary layer in Arizona prior and during the flash flood events and to study the related hazardous aviation weather patterns. To test this hypothesis, we investigate boundary layer and the atmospheric circulation in Arizona before and during the heavy rain events. WRF ARW (Advanced Research WRF model) successfully simulated the boundary layer properties and CAPE during the flood. The simulated Norbert moisture movement triggers strong winds, damaging rain, and thunderstorms for several days across Arizona. These are serious life and aviation hazards.

Summers, Jake (Sophomore, Astrophysics, Physics, Mathematics, Arizona State University). Mentor: Rogier Windhorst, School of Earth & Space Exploration, Arizona State University. [E-16]

Observing Magellanic System Stars in the SMACS J0723-73 JWST ERO

We present a catalog of star candidates observed by JWST NIRCam that could be part of either the outskirts of the Large Magellanic Cloud or a stellar component of the Magellanic Leading Arm. We find that the SMACS J0723-73 field contains thirty times the number of stars as the North Ecliptic Pole Time Domain Field at around the distance of the Leading Arm, compared to an average of three times for any other distance. This can be explained by the close proximity of the SMACS J0723-73 field to the Large Magellanic Cloud. The star excess found corresponds to a distance between 25.1 kpc and 39.8 kpc, with a slight excess up to 63 kpc. Plotting the stars on color-magnitude diagrams, we find that they form a stellar population that agrees with isochrones (with [Fe/H] = -0.7) of the same distance modulus.

Swingler, Tyler (Sophomore, Aerospace Engineering, Glendale Community College). Mentor: Timothy Frank, Engineering, Glendale Community College. [D-5]

GCC's Team Icarus: Measuring the Effectiveness of the Ozone Layer at Filtering UV Light

Our team built a balloon payload to examine the properties of the earth's atmosphere. Like previous payloads, the new payload contained 2 temperature sensors (internal and external), an accelerometer, a pressure sensor, and a video camera; however, it also contained UV sensors, a magnetometer, a micro-spectrometer, a Geiger-Muller tube sensor, and an Iridium Satellite modem. The payload actually included 2 analog UV sensors, one on the top, and one on the bottom, so it was able to measure the difference between 'Sky UV' and 'Ground UV'. The 'Sky UV' sensor measured the incoming radiation from direct sunlight, while the 'Ground UV' sensor measured the reflective radiation from the ground and clouds below the payload. Then as the payload rose above the ozone layer, the change in the UV light measurements was used to quantify the effectiveness of the ozone layer at filtering Ultraviolet (UV) light in the atmosphere.

Talbot, Derek (Senior, Biotechnology, Bioenterprise, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University. [D-1]

Analysis of Attitude Determination and Controls on a High Altitude Ballooning Payload with Long Range HAM Radio Communication and UV-Exposed Plant Seeds

In Fall 2022, the purpose was to complete the two science missions of an Attitude Determination and Control System (ADCS) and Meteorology. The meteorological mission used pressure, internal and external temperature, GPS, and an accelerometer to monitor cloud condensation nuclei (CCNs). Further in Spring 2023, ASCEND tested long range HAM radio communication, ADCS and a plant module. The HAM radio mission allows ASCEND members to activate and communicate with the payload during flight. The plant module mission was designed to test the effects of UV radiation on the growth of lettuce seeds that would be sent up on the payload during launch, compared to a control group that would remain on the ground. Overall, ASCEND created a reusable design for the printed circuit board (PCB) and designed a CubeSat inspired payload. ASCEND is also able to profile the atmosphere, collect data, and test the payload design.

Thurman, Tyler (Junior, Computer Engineering, Embry-Riddle Aeronautical University). Mentor: Ahmed Sulyman, Electrical, Computer & Software Engineering, Embry-Riddle Aeronautical University. [C-5]

EAGLESAT-2: MEMORY DEGRADATION EXPERIMENT

Memory Degradation Experiment (MDE) is a NASA commissioned payload onboard EagleSat-2, an undergraduate-developed cube satellite. The objective of MDE is to measure the degradation and longevity of multiple types of commercially available computer memory in low earth orbit. The importance of MDE rests with the fact that the entire experiment is focused on directly comparing the performance of the memory types against each other with all other variables kept constant, and no other systems depending on the memory modules. The experiment is designed to detect bitflips in the sequences written to the memory and read after a determined time being left vulnerable to change. MDE tracks the memory type and address location of when bitflips occurred. The memory types tested are FLASH, FRAM, MRAM, and SRAM. Results of this experiment can be applied to any future space missions and other environments where radiation is a concern on the electronics.

Tinerella, Camille (Junior, Environmental Science, University of Arizona). Mentor: Mónica Ramírez-Andreotta, Environmental Science & Public Health, University of Arizona. [H-19]

MEASURING DIOXIN AND DIOXIN-LIKE COMPOUNDS IN SOIL AND SEDIMENTS IMPACTED BY WILDFIRES AND FLASH FLOODING

In 2021, the Miami and Globe, Arizona area was impacted by the Mescal-Telegraph wildfire and subsequent flash floods. Due to concerns raised regarding environmental health, the "Rethinking Wildfires, Flash Floods, and Health" project was launched. 402 soil samples were collected at three different depths from nonresidential areas impacted. The soil samples were analyzed predominantly for pH, electrical conductivity, and contaminant concentrations. Due to fire and historic applications of herbicides, primarily 2,3,7,8-tetrachlorodibenzo-p-dioxin, this focuses on determining if dioxin is still present. Using U.S. Environmental Protection Agency's Method SW8290A, ten percent of the soil samples were analyzed for dioxins (family of polychlorinated dibenzo para dioxins and polychlorinated dibenzofurans). Toxic equivalency factors are used and toxic equivalency values are reported. We hypothesize that dioxin compounds will be present in the soil samples with varying concentrations. Due to toxicity and potential exposure pathways, this research will inform environmental public health.

Topiwala, Muhammed Hunaid (First-Year, Computer Science, Arizona State University). Mentor: Tom Sharp, School of Earth & Space Exploration, Arizona State University. [D-1]

ANALYSIS OF ATTITUDE DETERMINATION AND CONTROLS ON A HIGH ALTITUDE BALLOONING PAYLOAD WITH LONG RANGE HAM RADIO COMMUNICATION AND UV- EXPOSED PLANT SEEDS

In Fall 2022, the purpose was to complete the two science missions of an Attitude Determination and Control System (ADCS) and Meteorology. The meteorological mission used pressure, internal and external temperature, GPS, and an accelerometer to monitor cloud condensation nuclei (CCNs). Further in Spring 2023, ASCEND tested long range HAM radio communication, ADCS and a plant module. The HAM radio mission allows ASCEND members to activate and communicate with the payload during flight. The plant module mission was designed to test the effects of UV radiation on the growth of lettuce seeds that would be sent up on the payload during launch, compared to a control group that would remain on the ground. Overall, ASCEND created a reusable design for the printed circuit board (PCB) and designed a CubeSat inspired payload. ASCEND is also able to profile the atmosphere, collect data, and test the payload design.

Twitchell, Katie (Junior, Optical Sciences & Engineering, University of Arizona). Mentor: Sebastiaan Haffert, Astronomy, University of Arizona. [G-5]

ZERNIKE WAVEFRONT SENSING FOR ADAPTIVE OPTICS

Adaptive Optics (AO) systems work with existing ground-based astronomical telescopes to sense atmospheric disturbances and apply corrections via a deformable mirror to reverse their effects. The result is a substantial increase in image quality, allowing for the detection of faint exoplanets next to bright host stars. A Zernike Wavefront Sensor (ZWFS) is an optical sensor designed to detect very small disturbances in an incoming light field, allowing for precise atmospheric corrections. For this project, extensive analysis was performed in simulations to determine ideal ZWFS parameters and implement a novel nonlinear wavefront reconstruction algorithm. The sensor was built and tested with a monochromatic light source on the Comprehensive Adaptive Optics and Coronagraph Test Instrument (CACTI) testbed. Data collected were put through the nonlinear algorithm to reconstruct phase disturbances and test the sensor's phase detection abilities. I will present the results of these experiments and the potential for astronomical AO.

Urias, Mairely (Senior, Electrical Engineering, Arizona State University). Mentor: Hugh Barnaby, School of Electrical, Computer & Energy Engineering, Arizona State University. [G-6]

SPACE ENVIRONMENT RADIATION TESTING ON ELECTRICAL COMPONENTS

Electrical components can be damaged by radiation, as ionized particles passing through them generate charges that interfere with their normal operation by allowing unpredictable deviations in design behavior. In severe cases, this damage can destroy electrical components. In this study, LM741 operational amplifiers were irradiated with a Hitachi ProBeat IV synchrotron-based pencil beam scanning system to simulate radiation from a space environment. These tests are conducted to gather information on electrical component damage due to radiation exposure. To ensure the reliability and safety of satellites and other spacecraft, it is important to understand how the components are affected and design electronics that can withstand this type of radiation damage, especially with emerging interest in space tourism and space exploration.

Vachier, Edrik (Junior, Aerospace Engineering, Arizona State University). Mentor: Sean Bryan, School of Earth & Space Exploration, Arizona State University. [G-7]

SATELLITES AND THE WORLD OF RF

Throughout this project, the main goals were to learn how to use the GNU Radio Software, configure radios to computers for radio transmission, collect noise data, and implement all that I learned for the hardware and software to have the capabilities to communicate with satellites to send and receive information. The initial steps for the project were learning about the different types of radio frequency modulation and simulating how the transmission of those signals would look in real life (mostly FM and OAM signals). Next, knowledge gained from the simulation was used in a real-life context to send radio waves and discrete data from one radio-configured computer to another. In using this technology, the radio noise levels can be measured and evaluated in any area and signals can be transferred, which is important for the implementation of a ground station to communicate with satellites.

Vann, Nicole (Junior, Engineering, Diné College). Mentor: Demetra Skaltsas, Science, Technology, Engineering, & Mathematics, Diné College. [D-0]

DINÉ COLLEGE ASCEND

Three teams at Central Arizona College and Diné College constructed payloads to explore three research areas. These teams were the HONEY BADGERS, RAPTORS and OWLS. The HONEY BADGERS traced the payload's location using a GPS, measured the UV levels over certain altitudes, and calculated the gravitational acceleration as the payload ascended and descended. By dampening camera vibrations and creating systems to reduce rotation, the RAPTORS sought to capture quality flight footage. The OWLS measured the fluctuations in humidity, temperature, and altitude across the various atmospheric levels. In addition, their payload also carried a biological experiment designed by the Diné College team.

Vasquez, Lauren (Junior, Biosystems Engineering, University of Arizona). Mentor: Vicky Karanikola, Chemical & Environmental Engineering, University of Arizona. [H-20]

NAVAJO NATION MUNICIPAL WATER REUSE FEASIBILITY ANALYSIS

Water scarcity is a growing issue worldwide, especially in arid regions. Agricultural use of treated secondary effluent can provide irrigation water, fertilizing nutrients, and a method for wastewater disposal. However, improper evaluation of water quality has negative consequences. This study analyzes Navajo Nation municipal secondary effluent treated with a microfiltration and nanofiltration membrane technology system. We then evaluate the quality of treated permeate compared to various water reuse and irrigation guidelines. We also assessed the water quality parameters compared to specific crop characteristics and thresholds in order to maximize yield and efficiency through educated crop selection. Ion chromatography and other technologies are used to evaluate the water quality in the laboratory and results are then compared to established guidelines, regulations, and specific crop information collected through literature review. Finally, we determine optimal crops using a framework solution derived from water reuse regulations ensuring water quality safety standards for food production.

West, Hayden (Senior, Space Physics, Embry-Riddle Aeronautical University). Mentor: Darrel Smith, Physics & Astronomy, Embry-Riddle Aeronautical University. [C-8]

CENTRIFUGAL NUCLEAR THERMAL PROPULSION AMMONIA PROPELLANT THERMAL ANALYSIS

Working in conjunction with Marshall Space Flight Center we are assisting in the research for the next generation of Nuclear Thermal Propulsion called Centrifugal Nuclear Thermal Propulsion. The vast majority of the research conducted so far has used hydrogen as the sole propellant for this new propulsion system; however, hydrogen is incredibly hard to store as a form of propellant. In order to contribute this research effort, we decided that we would investigate the effects of utilizing different propellants. The propellant we decided to investigate was ammonia. There are two main parts of the propulsion we need to understand the first being how the nucleonics is affected in steady state when introducing nitrogen, and the second is how this different propellant affects the distribution of heat and the end result ISP.

2022-2023 Arizona NASA Space Grant Program Mentors

Organized by mentor's last name.

Bales, Nathan (General Dynamics Mission Systems) See: Dudek, Jessica [C-4].

Barnaby, Hugh (School of Electrical, Computer & Energy Engineering, Arizona State University) See: Urias, Mairely [G-6].

Borthakur, Sanchayeeta (School of Earth & Space Exploration, Arizona State University) See: Carl, Naomi [E-3].

Bose, Maitrayee (Earth & Space Exploration, Arizona State University)
See: Eaton, Jacob [F-5]
Hallstrom, Jonas [F-11]
Reynoso, Lucas [F-18].

Bryan, Sean (School of Earth & Space Exploration, Arizona State University) See: Vachier, Edrik [G-7].

Bryner, Elliott (Mechanical Engineering, Embry-Riddle Aeronautical University) See: Brand, Zoe [C-3].

Budinoff, Hannah (Systems & Industrial Engineering, University of Arizona) See: Luna, Pablo [C-17].

Burr, Devon (Astronomy & Planetary Sciences, Northern Arizona University) See: Fry, Rachel [F-7].

Cerveny, Randall (School of Geographical Sciences & Urban Planning, Arizona State University) See: Lopez, David [H-11].

Chen, Ying-Chen (Engineering, Northern Arizona University) See: Hardy, John [A-1].

Chung, Haeun (Steward Observatory, Astronomy, University of Arizona) See: Rizzo, Maxwell [E-12].

Clarke, Amanda (School of Earth & Space Exploration, Arizona State University) See: Patel, Yamini [H-14].

Coe, Michelle (Lunar & Planetary Laboratory, University of Arizona)
See: Adamu, Razak [D-9]
Blanchard, Nicolas [D-9]
Blanchard, Sarina [D-9]
Brown, Colin [D-9]
Burr, Michelle [D-9]

Gullo, Nicholas [D-9].

Condes, AnnMarie (Chemistry, Pima Community College)
See: Boe, Jordan [D-8]
Navarro, Roberto [D-8].

Conte, Davide (Aerospace Engineering, Embry-Riddle Aeronautical University) See: Purkeypile, Andrew [C-10].

Craig, Stuart (Aerospace & Mechanical Engineering, University of Arizona) See: Barger, Jackson [I-1].

Davies, Paul (Department of Physics: The Beyond Center, Arizona State University) See: Cullings, Sadie [E-5].

Denny, Angelita (Department of Energy, Legacy Management) See: Bia, Mikayla [H-2].

Edwards, Christopher (Astronomy & Planetary Science, Northern Arizona University) See: Larrieu, Loren [G-3].

Fasel, Hermann (Aerospace & Mechanical Engineering, University of Arizona) See: Stevens, Samantha [I-8].

Frank, Timothy (Engineering, Glendale Community College)
See: Arcara, Alec [D-5]
Bloemers, Rik [D-6]
Bump, Shelby [D-6]
Ocampo, Jose [D-6]
Ramirez, Kevin [D-5]
Rivera, Genaro [D-6]
Robles, Alexander [D-5]
Swingler, Tyler [D-5].

Fraschetti, Federico (Lunar & Planetary Laboratory, University of Arizona) See: Reese, Jamesen [E-11].

Fulé, Peter (School of Forestry, Northern Arizona University) See: Begaye, Tracey [H-1].

Gehring, Catherine (Biological Sciences, Northern Arizona University) See: Revis, Annika [H-15].

Green, Matthew (Chemical Engineering, ASU School for Engineering of Matter, Transport & Energy, Arizona State University)
See: Ly, Salma [G-In Title Only]
Morgan, Cameron [H-13].

Gretarsson, Ellie (Aerospace Engineering, Embry-Riddle Aeronautical University) See: Meagher, Breck [E-10].

Haffert, Sebastiaan (Astronomy, University of Arizona) See: Twitchell, Katie [G-5].

Hamden, Erika (Steward Observatory, University of Arizona) See: Romero-Lozano, Alejandro [F-20].

Hanquist, Kyle (Aerospace & Mechanical Engineering, University of Arizona) See: Stockdale-Stephens, Avery [C-14].

Hardegree-Ullman, Kevin (Astronomy, Steward Observatory, University of Arizona) See: Klingele, Justin [E-1].

Hood, Lon (Lunar & Planetary Laboratory, University of Arizona) See: Gonzalez, Daniel [F-10].

Impey, Christopher (Astronomy, University of Arizona) See: Estrella, Hayden [B-2].

Ivanova, Dorothea (Applied Meteorology, Embry-Riddle Aeronautical University) See: Sullivan, Brooke [H-18].

Johns, Kenneth (Physics, University of Arizona) See: Pitcl, Olivia [A-7].

Karanikola, Vicky (Chemical & Environmental Engineering, University of Arizona)
See: Carroll, Lynn [H-3]
Vasquez, Lauren [H-20].

Kareta, Teddy (Lowell Observatory) See: Richardson, Tessa [F-19].

Kaufman, Darrell (College of the Environment, Forestry, & Natural Sciences, Northern Arizona University) See: Kruger, Charlie [H-6].

Kim, Serena (Astronomy, University of Arizona) See: Hartman, Peter [E-6].

Kukolich, Stephen (Chemistry & Biochemistry, University of Arizona) See: Nichols, Jack [A-6].

Lanning, David (Engineering, Embry-Riddle Aeronautical University) See: Elmer, Hope [G-1].

Lauretta, Dante (Lunar & Planetary Laboratory, University of Arizona)
See: Kontogiannis, Melissa [F-15]
Nielsen, Sarah [F-14].

Liao, Yabin (Engineering, Embry-Riddle Aeronautical University)
See: Grullon, Somaralyz [D-4]

Howe, Zachary [D-4].

Little, Jesse (Aerospace & Mechanical Engineering, University of Arizona)
See: Frisch, Andrew [I-2]
Goz, Morgan [I-3]
Maloney, Alec [I-5]
Mammana, Nicholas [I-6].

Loeffler, Mark (Astronomy & Planetary Science, Northern Arizona University) See: Clark, Emily [F-3].

Mann, Christopher (Applied Physics & Material Sciences, Northern Arizona University) See: Hammond, Marshall [A-4].

Margolis, David (Orthopedic Surgery, University of Arizona) See: Hossain, Adeeb [G-2].

Massey, Philip (Lowell Observatory) See: Speckert, Meghan [E-14].

Menezes, Osmar (Chemical & Environmental Engineering, University of Arizona) See: Laton, Ellie [H-7].

Morris, John (Career & Technical Education, Casa Grande Union High School)
See: Allado, Neal [D-2]
Barth, Ella [D-2]
Gonzalez, Angel [D-2]
Kaliotzakis, Valia [D-2]
Lawson, Jonathan [D-2]
Limon, Melody [D-2]
Razo, Elias [D-2]
Ross, Jacob [D-2]
Fisher, Amaya [D-2]
Ramirez, Elijah [D-2].

Nemanich, Robert (Physics, Arizona State University) See: Gutierrez, Eric [A-3].

Nerozzi, Stefano (Lunar & Planetary Laboratory, University of Arizona) See: Hart, Madeline [F-12].

Noravian, Armineh (Science & Engineering, Central Arizona College)
See: Aguilar, Alex [D-3]
Carreno, Ella [D-3]
Dinke, Mickyas [D-3]
Elstad, Sonja [D-3]
McGalliard, James [D-3]
Mountz, Elijah [D-3]
Mountz, Ruth [D-3]

Owens, Norma [D-3]
Ragsdale, Jordan [D-3]
Rosales, Ralph [D-3]
Serrano, Robert [D-3].

Ong, Eddie (Chemistry, Phoenix College)
See: Alasow, Rayan [D-7]
Bittner, Michael [D-7]
Brannon, Jacob [D-7]
Garcia, Lorynn [D-7]
Gonzalez Lopez, Ivan [D-7]
Herrera, Jose Javier [D-7]
Jones, Jazmyn [D-7]
Martin, Orion [D-7]
Montgomery, Collin [D-7]
Sherant, Andrew [D-7].

O'Rourke, Joseph (School of Earth & Space Exploration, Arizona State University) See: Blaske, Claire [F-2].

Pierce, Nathan (School of Natural Resources & the Environment, University of Arizona) See: Blais, Jacob [H-In Title Only].

Posthumus, Erin (National Phenology Network, University of Arizona) See: Delgado, Sofia [H-4].

Pradhan, Pragati (College of Arts & Sciences, Embry-Riddle Aeronautical University)
See: Sam, Calvin [E-13]
Sextro, Tristen [E-13].

Ramírez-Andreotta, Mónica (Environmental Science & Public Health, University of Arizona) See: Tinerella, Camille [H-19].

Rea, Ashley (Rhetoric & Communications, Embry-Riddle Aeronautical University) See: Robertson, Katrina [B-4].

Richardson, Noel (Physics & Astronomy, Embry-Riddle Aeronautical University)
See: Holdsworth, Amanda [E-7]
Loberger, Randy [E-8]
Phan, Tri [E-8].

Rowe, Helen (School of Earth & Sustainability, Northern Arizona University) See: Lintz, Emma [H-10].

Rushall, Jeff (Mathematics & Statistics, Northern Arizona University) See: Freudenthal, Kaylee [A-2].

Ryan, Andrew (Planetary Sciences, University of Arizona) See: Blanche, Laurinne [F-1].

Salvatore, Mark (Astronomy & Planetary Science, Northern Arizona University) See: Olvera, Adriana [F-16].

Sand, David (Astronomy, University of Arizona) See: Mazziotti, Nicolas [E-9].

Sankey, Temuulen (School of Informatics, Computing & Cyber Systems, Northern Arizona University) See: Alfermann, Anna [C-1].

Sharp, Tom (School of Earth & Space Exploration, Arizona State University)
See: Adair, Berkeley [D-1]
Alsharif, Tamim [D-1]
Bello, Brandon [D-1]
Burton, Robert [D-1]
Cooper, Genevieve [D-1]
Dinh, Huy [D-1]
Do, Jacqueline [F-4]
Garayzar, Elizabeth [D-1]
Luu, Wilson [D-1]
Mata, Anyell [D-1]
Talbot, Derek [D-1]
Topiwala, Muhammed Hunaid [D-1]
Ontiveros, Ricardo [D-1].

Shim, Dan (School of Earth & Space Exploration, Arizona State University) See: Ravikumar, Shradhanjli [F-17].

Shirley, Yancy (Astronomy & Steward Observatory, University of Arizona)
See: Andras-Letanovszky, Hanga [E-2]
Squillace, Reynier [E-15].

Shkarayev, Sergey (Aerospace & Mechanical Engineering, University of Arizona)
See: Blanchard, Nicolas [C-2]
Higuera Pierre Noel, Alex [C-7].

Shock, Everett (School of Earth & Space Exploration, Arizona State University)
See: Fronmueller, Simon [H-5]
Smania, Siena [H-17].

Skaltsas, Demetra (Science, Technology, Engineering, & Mathematics, Diné College)
See: Begay, Jessica [D-In Title Only]
Vann, Nicole [D-In Title Only].

Smith, Darrel (Physics, Embry-Riddle Aeronautical University)

See: Moore, Shannon [C-8]
West, Hayden [C-8].

Srivastava, Siddharth (School of Computing & Augmented Intelligence, Arizona State University)
See: Patel, Khushi [B-3]
Shah, Namita [B-3].

Stolte, Daniel (University Communications, University of Arizona) See: Chadwick, Kylianne [B-1].

Stribling, Eric (Interplanetary Initiative, Arizona State University) See: Manuszak, Bo [H-12].

Sullivan, Neil (Engineering, Embry-Riddle Aeronautical University) See: Muzzy, Tristan [C-9].

Sulyman, Ahmed (Computer, Electrical, & Software Engineering, Embry-Riddle Aeronautical University)
See: Henggeler, Calvin [C-5]
Roszell, Hayden [C-12]
Ruddick, Logan [C-13]
Sudkamp, Lillian [C-15]
Thurman, Tyler [C-5].

Szivek, John (Orthopaedic Surgery, University of Arizona) See: Maldonado, Stephany [G-4].

Takahashi, Timothy (School for Engineering of Matter, Transport & Energy, Arizona State University)
See: Guaglardi, Lucas [I-4]
Ordaz Perez, David [I-7].

Tegler, Stephen (Astronomy & Planetary Sciences, Northern Arizona University)
See: Gomez, Moises [F-8]
Madden-Watson, Aidan [F-9].

Trilling, David (Astronomy & Planetary Sciences, Northern Arizona University) See: Maldonado Olivas, Jessica [F-13].

Vargas, Carlos (Steward Observatory, University of Arizona) See: Chambers, Jacob [C-16].

Walker, Christopher (Astronomy & Steward Observatory, University of Arizona)
See: Henley, Shae [C-6]
Rahmer, Walter [C-11].

Whipple, Amy (Biology, Northern Arizona University) See: Ryan, Benjamin [H-16].

Williams, Jason (USDA Agricultural Research Service, Southwest Watershed Research Center.
See: Dixon, Sophia [H-9]
Lane, Trisha Jean [H-8].

Williams, Cameron (Mathematics, Embry-Riddle Aeronautical University) See: Mitchell, Jaxson [A-5].

Windhorst, Rogier (School of Earth & Space Exploration, Arizona State University) See: Summers, Jake [E-16].

Ye, Cheng (Astronomy & Planetary Science, Northern Arizona University) See: Freeman, Greta [F-6].

Zanolin, Michele (Physics & Astronomy, Embry-Riddle Aeronautical University)
See: Caudle, Logan [E-4]
Pillon, Brandon [E-4].