# Flash Talk Abstracts

**Jacquelyne Vega**
Project Manager, City of Tucson Office of Economic Initiatives
*City of Tucson Office of Economic Development*
The City of Tucson Office of Economic Initiatives is interested in sharing with the community about the work the City is doing in the area of Economic Development. This presentation outlines the City's Comprehensive Economic Development Strategy and highlights recent success stories. Listeners will also learn about the resources the Office of Economic Initiatives offers for business owners interested in relocating to Tucson, businesses in Tucson that are ready to expand, workforce development efforts, and other resources available through the robust economic development ecosystem in Tucson. The City is actively seeking ways to connect with local companies and work together to make our community a great place to live and grown their businesses.

**Victor Tenorio**
Professor of Practice, Mining & Geological Engineering- Wildcat Moon Miners
*Surface Mine Startup at the Lunar South Pole*
Returning to the Moon represents many challenges. In addition to the harsh conditions given by the lack of atmosphere, dealing with 1/6th of the Earth's gravity, extreme temperatures, unconventional length of daylight and darkness and direct exposure to radiation, we need to look after water and materials that would help us build the first permanent settlement for humans on the Lunar surface. The South Pole appears to be an attractive starting point for finding resources given the abundance of evidence of the presence of water in the form of icy regolith, and metals such as nickel and iron from the asteroids hitting the unprotected surface. Like the mining pioneers of our Earth's history, we are becoming prospectors of undiscovered deposits of different materials, useful for foundations, spare parts and other infrastructure required for establishing our first Moon base. Mining plans should consider choosing the proper location of our startup site, define the work cycle, and design systems to efficiently process our run-off-mine material using our limited sources of energy through Solar Panels and Kilo Power devices. Even though much of the mine excavation can be controlled remotely and with specially designed autonomous equipment, human supervision is key to accomplish the production requirements for a successful mining operation.

**Jarron Leisenring**
Assistant Research Professor, Steward Observatory
*IR Detectors and Instrumentation at AIRD Lab*
The Arizona Infrared Detector Laboratory (AIRD Lab) endeavors to further the development and maturation of infrared (IR) imaging technologies and instrumentation for astrophysical, planetary science, and Earth-observing applications. Building on existing capabilities at Steward Observatory, AIRD Lab's mission encompasses three primary tenets: 1) development of IR detection technologies and characterization of sensor chip arrays (SCAs); 2) deploying IR focal plane modules (FPMs) in instruments; and 3) training the next generation of IR detector scientists and engineers. We seek to partner with faculty and scientists throughout UAZ to execute IR instrumentation and detector projects, contribute IR expertise to future mission and instrument proposals, isolate and characterize knowledge gaps in modern IR detectors, and identify new technology concepts to pursue. At AIRD Lab, we strive to develop a deep understanding of all aspects of IR detector performance, advance technology development, and enable novel capabilities. Such a knowledge base

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furthers our capacity to design, build, and deliver IR instruments to meet a broad range of scientific objectives and missions. With a variety of project sizes and scopes, AIRD is an ideal environment to train and mentor early-career engineers and scientists, guiding their development into technical experts in their field. Steward Observatory has a decades-long history of maturing infrared detector technology crucial to existing state-of-the-art ground and space observatories, including the LBT and JWST. AIRD Lab possesses the expertise to continue this legacy and maintain University of Arizona's global leadership in maturing and deploying IR detectors on world-class instruments and missions.

**Nicole Melso**
Postdoctoral Research Associzate, Steward Observatory & Department of Astronomy
*Aspera Astrophysics Pioneers Mission Update*
For over half a century, observational astrophysics has been eager to successfully detect and map the most massive baryonic component of galaxies: warm-hot phase coronal gas extending into the circumgalactic medium (CGM). Despite its importance to galaxy evolution, this phase of gas is entirely unmapped in the nearby universe. In this talk, I present recent progress on Aspera (PI C. Vargas): a FUV SmallSat funded in the inaugural NASA Astrophysics Pioneers Program. The goal of Aspera is to detect and map warm-hot phase gas emission in nearby galaxies for the first time. The Aspera mission is designed to target the O VI emission line doublet from highly ionized oxygen, located at 1032, 1038 Å rest frame. Aspera combines a simple spectroscopic optical design using advances in highly-reflective FUV-coated optics with advanced UV MCP detectors to optimize throughput and sensitivity. The Aspera instrument is currently being assembled at UArizona, with an expected launch date near the end of 2025.

**Chris Impey**
University Distinguished Professor, University of Arizona
*Unbound: Ethics, Law, Sustainability, and the New Space Race*
We are witnessing a new space race. A half-century after the last Moon landing, and after a decade during which the United States could not launch its own astronauts to Earth orbit, there is new energy in the space activity. China has huge ambitions to rival or eclipse America as the major space power, and other countries are developing space programs. However, perhaps the greatest excitement attaches to the entrepreneurs who are trying to create a new business model for space travel based initially on tourism, and eventually, on colonizing the Moon and Mars and harvesting resources from asteroids. This presentation is a snapshot of the new space race and the rich men behind it, and it looks at some of the ethical and legal issues raised by this activity. The methodology is to consider the stated ambitions of the men leading private space companies, compare and contrast the space endeavor with earlier episodes of exploration and transportation innovation, review the regulatory environment for outer space, and consider two divergent scenarios for the future. Opinions are divided on whether commercial space flight is an expensive indulgence or potentially a way to find sustainable solutions for our life on Earth. It is concluded that the new space race can be characterized as unbounded: in ambition, in terms of laws and regulations, and in terms of ethical constraints on the activity.

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**Angela Marusiak**
Assistant Research Professor, Lunar and Planetary Laboratory

*Flight-Ready Seismometers for the Moon and Beyond*

Seismology is the preeminent approach for studying the interiors of planetary bodies and measuring current rates of geologic activity. In the coming years, NASA will send science payloads to the Moon as part of its Artemis program and its Commercial Payloads Services program. Here, we present our seismometers that have been under development at the UA. Our sensors are small, low mass, low power, yet will enable us to answer several key science questions. In addition to the Moon, our sensors are also being developed as payloads to icy ocean worlds and binary asteroids.

**Sergey Shkarayev**
Professor, Aerospace and Mechanical Engineering

*Mars Exploration Using Sailplanes and Balloons*

The Mars 2020 Perseverance Rover mission, which included the historic flights of Ingenuity helicopter in 2021, demonstrated the viability of using flying vehicles, albeit in relatively short flights. Moving forward, further advancements necessitate a paradigm shift in Mars exploration, with a focus on exploring extreme environments such as canyons and cliffs. Further, there are unanswered questions about small amounts of methane evident in low-lying basin, valleys and canyons. Consequently, there is a need for new types of aerial vehicles capable of long endurance and high altitudes that can transport state-of-the-art instruments to remote Martian surface features of interest. We propose a Mars mission consisting of sailplanes and balloons to meet the project requirements, particularly to reach Valles Marineris and Melas Chasma, destinations currently beyond the reach of existing missions. The system of balloons and sailplanes, acting as secondary payloads, offers additional advantages due to their compact size, allowing them to fit within the limited space allocated for ballast. These sailplanes and balloons will be deployed during Entry, Descent, and Landing and will commence their flights autonomously towards the destinations such as Valles Marineris and Melas Chasma. Balloons characterized by their relatively low speed and loitering capabilities, will be tasked with conducting detailed mapping of cliff and canyon walls. Additionally, they will serve as landing platforms for sailplanes. One or more sailplanes mounted to a balloon would have the advantage of increased direction and altitude potential providing the ability to conduct coupled missions. Such a system has redundancies that could make long duration voyages, lasting weeks to months credible. Analysis of sailplane flight dynamics enable the flight experiments in Earth's atmosphere that simulate conditions on Mars. The ongoing experimental program includes flights over the Double Crater Ridge in Arizona and proposed tests in jet streams at 70,000 feet in Space Port America.

**Tinotenda Chimbwanda**
Student, Mining and Geological Engineering

*Solar-Powered Steam Injection for Lunar Ice Mining*

The exploration and long-term habitation of the Moon require sustainable methods for extracting vital resources, notably water ice, from its surface. This project introduces a novel approach for lunar ice mining: Solar-Powered Steam Injection (SPSI). Utilizing the abundant solar energy available at the Moon's poles, this method involves generating steam on-site and injecting it into the lunar regolith to melt buried ice deposits. The primary innovation lies in leveraging the temperature differential and vacuum conditions of the lunar environment to facilitate the direct sublimation of ice to vapor, which is then collected and condensed back into liquid water. This study seeks to design the operational

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framework of the SPSI system, including solar energy capture, steam generation and injection mechanisms, and the vapor collection and condensation process. Theoretical analyses and preliminary simulations to demonstrate the potential efficiency gains and reduced environmental impact of SPSI will be conducted and compared to traditional mechanical excavation methods. Moreover, this study will investigate how to overcome the anticipated challenges of thermal management, regolith penetration, and the adaptation of solar power systems for the lunar night to enable continuous operation. This research contributes to the body of knowledge on in-situ resource utilization strategies, offering a feasible and eco-friendly solution for water extraction on the Moon. The successful implementation of SPSI could significantly enhance the sustainability of future lunar missions, providing a critical step towards the realization of lunar bases and the expansion of human presence in space.

**Haeun Chung**
Assistant Research Professor, Steward Observatory
*NOX: All-Sky Far-Ultraviolet background mapping with a SmallSat/CubeSat mission*
Nox is a SmallSat/CubeSat mission concept designed to map the Lyman-Ultraviolet (LUV) and Far-UV (FUV) background distribution across the entire sky. Despite the growing interest in LUV/FUV observations in orbit, the spectral and spatial distribution of the LUV/FUV background remains critically understudied. Without knowledge of background radiation, planning future missions to detect faint diffuse emissions becomes challenging. The Nox mission concept has been developed to bridge this gap by characterizing the background radiation in the LUV/FUV wavelengths. Utilizing state-of-the-art UV coating, grating, and detector technologies, Nox aims to deliver unprecedented foundational data in the LUV/FUV landscape. This will be achieved through spectroscopic all-sky observations in the 90-140 nm wavelength range, using a wide-field, low spectral resolution spectrograph with a field of view of 2.5 degrees by 90 arcseconds and a spectral resolution of approximately R~80. This mission will be proposed for future NASA Astrophysics SmallSat/Cubesat mission opportunities. In this flash talk, we will present the objective of Nox and the path forward to proposing future mission opportunities.

**Sarah Sutton**
Photogrammetry Program Lead, R&D Engineer/Scientist, Lunar and Planteary Laboratory
*The Lunar and Planetary Laboratory Photogrammetry Program*
Planetary missions are returning volumes of stereo images that can be used to generate topographic models using photogrammetric techniques. Topographic analysis is key to understanding and exploring planets, satellites, comets and asteroids. At LPL, several mission operations teams have established considerable expertise in digital terrain model (DTM) production. For example, the HiRISE operations team runs a photogrammetry lab with four dedicated workstations, employing highly trained staff and students. HiRISE has released more than 1,000 high resolution DTMs to the public to date. The same capabilities are used to create high resolution DTMs of the lunar surface with LROC Narrow Angle Camera (NAC) stereo images. The OSIRIS-Rex team leveraged this expertise to develop a photogrammetric workflow for their stereo imaging campaigns, yielding centimeter-scale DTMs of the surface of Bennu. Their work continues with the development of improved photogrammetric software for applications to irregularly shaped small bodies such as asteroids and comets. LPL's Space Imagery Center hosts an educational photogrammetry lab with five dedicated workstations that are available to students for class and research projects, as well as the greater LPL and Uarizona community. We have hosted several NASA-funded Planetary Photogrammetry Workshops at the Space Imagery Center, providing tutorials in

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SOCET SET/GXP (BAE, Inc.) commercial software, Structure from Motion (SfM) with Agisoft Metashape, and Ames Stereo Pipeline. The demand for these workshops reflects the increasing need in the planetary community for a photogrammetry program that is dedicated to research, development, training, and mission support.

**Roger Angel**
Regents Professor of Astronomy and Optical Sciences, Department of Astronomy
*6.5 m space telescope successors to Euclid, Roman and Webb*
Once SpaceX Starship becomes available, it will be possible to launch fully-assembled 6.5 m telescopes using Mirror Lab monolithic mirrors, at relatively low cost. Cryogenic options are attractive, and technically practical because the borosilicate glass used to make these mirrors has zero expansion coefficient at 40K, the Webb operating temperature. Another, simpler design to be presented is a room-temperature 6.5 m telescope with 0.4 square degree field of view. This would be configured to study large areas of the sky by the method of slit-less spectroscopy, as used by the smaller 1.2 m Euclid and 2.4 m Roman telescopes.

**Jekan Thangavelautham**
Associate Professor, Head of SpaceTREx, Head of ASTEROIDS, University of Arizona - SpaceTREx
*Advancing Lunar Pioneer Development to Enable the Future of Planetary Science and Astronomy*
A permanent human presence beyond Low Earth Orbit (LEO) will not just mark a significant milestone for human civilization but also serve as a springboard for unprecedented opportunities in planetary science and astronomy. NASA's Artemis mission, aiming to return humans to the Moon and establish a semi-permanent base by the end of this decade, is a testament to this grand vision. The construction of infrastructure, including landing pads, shelters, blast walls, control towers, and other critical base elements, is a crucial step toward realizing this semi-permanent lunar base. Shelters in particular are need to protect critical occupants of a semi-permanent base, both human astronauts and teams of robots. The Moon, with its strategic location, could house next-generation astronomical facilities that can match all major in-space observatory concepts. Further, there is significant knowledge to be gained exploring the geology and geohistory of the Moon, which will require well-established surface science laboratories. To kickstart a lunar future, the need is for a rapid start in the assembly and use of agile, critical lunar infrastructure such as shelters, warehouses, landing pads, power plants, and control towers at first. This will be followed by semi-permanent science laboratories and astronomical observatories. We see the need for a build-block strategy in which each block is added to construct progressively sophisticated structures. These critical structures will require mobile construction technologies, inherently robust to varied lunar surface conditions, do not require large quantities of power, and utilize multifunctional materials that can work without liquid water. The LUNAR-BRIC (Lunar Robotically-Based Regolith Incorporated Construction) team consisting of MDA, NASA JPL and UA have evaluated various technologies, including solar sintering, additive manufacturing, and traditional brick and motor-type construction. Regolith Containment Units (RCUs) are a practical and robust starting point for building lunar infrastructure. Our team has evaluated the utility of RCUs in building robot shelters, warehouses, blast walls, and utility trenches. Our research into RCUs shows they are capable of entirely replacing traditional brick or tile-type building blocks. The embedded regolith would shield against harsh lunar environmental conditions such as radiation and provide physical shielding from MMOD impact. The RCUs would coexist as part of an ecosystem of smart devices, including internal and external mobile robots attached to a lunar base, environmental sensor networks, and control

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towers. Through the execution of RCU-based construction, we can practically get started with ever more complex lunar construction techniques, including solar sintering and additive manufacturing, that can then be used to build precise structures, components, instruments, parts, and optics. RCUs offer the potential to build a smart decentralized ecosystem from the ground up that offloads challenges in sensing, mobility, autonomy, and manipulation. We hope to chart a framework for advanced structures to host next-generation science facilities on the Moon through this framework.

**Walter Rahmer**
Command System Lead, Steward Observatory
*CatSat: A 6U Student-built CubeSat for Ionospheric Research and Technology Demonstration*
CatSat is a 6U CubeSat designed to test a novel inflatable antenna design and conduct ionospheric research with an onboard HF antenna. The inflatable antenna provides a solution for future small satellite communication by offering significant data transmission capabilities within stringent size and mass constraints. The HF antenna experiment will probe the Earth's ionosphere during twilight by analyzing WSPR and other HF radio transmissions from the ground. CatSat was designed and built primarily by students at the University of Arizona in partnership with Tucson companies. CatSat is fully qualified for launch in 2024. Current work involves the development of X-band and UHF ground stations and preparations for flight operations.

**Daniel Apai**
Interim Associate Dean for Research; Professor of Astronomy and Planetary Science, College of Science / Astronomy and Planetary Science
*From Alien Earths to Pandora: Integrating Studies of Habitable Worlds into Mission Definition and Science Drivers*
Astrobiology and, in it, the search for and characterization of habitable extrasolar environments has emerged as one of the most important science drivers behind current and future NASA missions and space observatories. In this talk, I will provide an overview of our large ($12M+), NASA ICAR astrobiology project EOS / Alien Earths that aims to advance our understanding of two key questions: (1) How do habitable worlds form and evolve? and (2) Which nearby planetary systems are likely to harbor habitable planets and life? Among the largest NASA-funded astrobiology teams, Alien Earths is now its eighth year. It has published over 200 refereed papers, including multiple very high-impact seminal studies. But Alien Earths is more than just a powerful research collaboration: Our team has developed the arguably most comprehensive modeling framework to integrate a broad variety of relevant knowledge to inform future exoplanet missions science definition and mission design. Our work has already informed science cases for ELTs, HWO, Nautilus, PLATO, LIFE, and LFAST. Furthermore, our science results directly led to the proposal for the Pandora SmallSat, scheduled for launch in 2025. I will highlight the unique Alien Earths ecosystem that successfully integrated fundamental research on exoplanets with the assessment of potential science cases and mission architectures to provide a strategic advantage for mission proposals and to shape the future of exoplanet exploration.

**Murat Kacira**
Interim Head and Professor, Biosystems Engineering Department; Director, Controlled Environment Agriculture Center
*CEA for Space Farming and BLSS*
Sustainable food systems are needed for low earth orbit missions as well as on the Moon that meet lunar crews' needs which will be a fundamental step for both lunar sustainability and Mars exploration. Lunar analogs on Earth offer the best means to develop successful/reliable long duration food systems and allow long term testing and crew preference

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development. Future habitation of space, including lunar outposts will require special systems capable of performing important tasks such as revitalizing atmosphere (generate oxygen and fix carbon dioxide), purifying water (e.g., via plant transpiration), and growing human food. Bioregenerative Life Support Systems (BLSS) represent a solution to the problem of sustaining human existence in space. Innovative food production hardware and surface habitat systems will be needed for lunar surface explorations. This presentation will provide information about recent past and current efforts on University of Arizona's space farming, Lunar Mars Greenhouse, and Food Production System Prototypes, and BLSS.

**Joseph Shields**
Director, Large Binocular Telescope Observatory
*The Large Binocular Telescope as a Discovery Machine*
The Large Binocular Telescope, with two 8.4m mirrors on a single mount, is among the most powerful optical/infrared telescopes in the world, and Arizona scientists have access to a quarter of its observing time. The LBT Observatory features a sophisticated suite of instruments for optical and infrared imaging and spectroscopy, supported by innovative adaptive optics technologies and interferometry leveraging the 22.65-meter baseline. Second generation instruments are now being commissioned at the telescope, with capabilities optimized for study of exoplanets via high-contrast, high-angular-resolution imaging, and extremely high precision radial velocity measurements. This presentation will highlight current and emerging opportunities for forefront science using the LBT.

**Brittany Miles**
51 Pegasi b Fellow and Presidential Postdoctoral Fellow, Steward Observatory
*Spatial Variations in Atmospheric Chemistry of the Coldest Brown Dwarf*
For two decades astronomers have been measuring weather on other worlds with the goal of understanding what atmospheric phenomena drive time-dependent brightness variations in brown dwarfs and gas giant exoplanets. Previous weather studies have been limited to broadband photometry or low resolution spectroscopy. In the era of JWST, precise time-resolved medium-resolution spectroscopy of the coldest brown dwarfs is finally possible, allowing the effects of atmospheric chemistry, temperature, and clouds to be disentangled. While powerful, JWST is a shared observatory. Dedicated mid-infrared, space-based facilities are necessary to push exoplanetary science into understanding long term climate trends within planet atmospheres. WISE 0855 (280K) is the coldest known brown dwarf and the best analog for studying processes that also occur on gas giant planets within our Solar System. We present high SNR (80 â€“ 100), medium resolution (R âˆ¼1000), time-series JWST/NIRSpec spectra of WISE 0855. Our observations span 11 hours with 15 minute pointings covering 2.87â€“5.27 microns. The dominant time-variable feature is carbon monoxide gas absorption, producing modulations in its band strength with peak-to-peak amplitudes of 8%. We discuss the changes in CO in the context of other expected species such as water, phosphine, and carbon dioxide. Lastly, I will place this work in context to other JWST results and motivate why moving from hours-long observations into months and years is important for understanding atmospheric chemistry and structure.

**Clarissa DeLeon**
PhD Candidate, University of Arizona James C. Wyant College of Optical Sciences
*Complementary Software to Utilize a Generalized Open-Source Radiative Transfer Algorithm*
Missions conducted by NASA are increasingly incorporating polarimetric observations, particularly for aerosol studies. The

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Airborne Multiangle Spectropolarimetric Imager (AirMSPI) from the Jet Propulsion Laboratory has been utilized in multiple missions and has served as a prototype for the forthcoming Multiangle Imager for Aerosols (MAIA). These instruments are used to analyze the optical properties of atmospheric aerosols, which can directly impact Earth's radiation balance, as well as have indirect effects on cloud formation and human health. MAIA aims to provide deeper insight into the influence of atmospheric aerosols on human health. This goal will be of particular significance to the epidemiological community. Consequently, higher-level data products play a crucial role in this endeavor. The utilization of an open-source radiative transfer code empowers data users to interpret information from raw data to data products (e.g. aerosol optical depth, index of refraction). DeLeon et al. (2024, JQSRT) offers a complementary software program (CSP) with the open-source Generalized Retrieval of Atmosphere and Surface Properties (GRASP) retrieval algorithm. The CSP is capable of processing observations from various instruments but specifically designed for use with AirMSPI and MAIA data products. Integration of these instruments with an open-source algorithm presents unique challenges in conducting aerosol retrievals on polarimetric and multiangle data products. The CSP addresses the essential procedures for preparing polarimetric data and provides a technique to ensure the correct alignment of the instrument and algorithm coordinate systems, thus serving as a benchmark for optimizing the retrieval algorithm. The CSP offers solutions for data curation, polarimetric coordinate system reconciliations, and structuring data for GRASP input. The efficacy of the CSP has been demonstrated using datasets from the AirMSPI Fire Influence on Regional to Global Environments and Air Quality (FIREX-AQ) missions. Additionally, this presentation includes the CSP demonstration on simulation MAIA observations.

**Fazab Abbas Awan**
Visiting Research Fellow, McGill University
*Ecosystem of Low Earth Orbit: Opportunities and Challenges*
The space service sector is economically booming. Currently, it offers economic opportunities for developed and developing countries in abundance. However, certain challenges may restrict countries to cooperate. As far as the LEO economy is concerned, a surge has been witnessed in economic investments by the private sector in geostationary to low earth orbit. The private funding is largely focused on developing satellite communications such as GPS. LEO satellites offer high- accuracy, low-latency, and fast-speed communication services as compared to GEO counterparts. That is the reason why behind private sector is aiming for the big mega constellation in LEO. Private space sectors plan to develop mega-constellations in LEO to capitalize and invest in infrastructure, services, on-orbit R&D, on-orbit manufacturing, space tourism, media, entertainment, and advertisement. Economic investments in these fields by the private sector in LEO may offer significant returns. The economic potential of these above fields is around USD 400 bn in the next decade. This is a magic figure as far as economic opportunities are concerned. Investments may trigger development in manufacturing, production and designing of satellites, launch, education, and academic and government sector development. Nevertheless, there are multifaceted challenges posed by the rising commercialization of LEO in the form of astronomical observations, in-orbit spacecraft safety and degradation of the space environment. These challenges of dire nature need urgent solutions before the era the world witnesses LEO eats GEO. Likewise, the LEO ecosystem demands equitable sharing of economic investments and subsequent returns between developing and developed countries. That also warrant attention in the space world to provide these opportunities to the developing countries while protecting their economic interests. The study aims to highlight the opportunities and challenges to space sector in LEO with the help of social advocacy.

**Nina Bonaventura**

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Research Scientist, Steward Observatory

*The Relation between AGN and Host Galaxy Properties in the JWST era: a new Seyfert evolutionary sequence emerges at 0<z<4*

We exploit the unsurpassed image resolution and sensitivity of the Near-Infrared Camera (NIRCam) onboard the James Webb Space Telescope (JWST) to reveal a previously hidden evolutionary sequence amongst the sub-quasar (Seyfert) AGN population at 0<z<4. Utilizing both visual classification and computer vision, we were able to verify the suspected connection between galaxy merging activity — as evidenced by a close/merging galaxy pair, or tidal features surrounding an apparently singular system — and AGN activity (Bonaventura et al. 2024, Bonaventura et al., in prep). The AGN sample we consider is unprecedentedly complete, as it was built using both pre-JWST X-ray detections (Lyu et al. 2022) and new JWST Mid-Infrared Instrument (MIRI) photometry in the same field (Lyu et al. 2023). This 0.9-25 micron dataset enables constraints on the host galaxy morphologies of the broadest possible range of AGN beyond z~1, including heavily obscured examples missing from previous studies. We consider two AGN samples, one consisting of lightly to highly obscured X-ray-selected AGN (Lyu et. al 2022), and the other, presumed Compton-thick mid-infrared-bright/X-ray-faint AGN recently revealed by MIRI (Lyu et al. 2023). Both samples contain a significant fraction of host galaxies with disturbed morphologies at all redshifts sampled, and increasingly so towards higher redshift and AGN bolometric luminosity. The most obscured systems show the highest fraction of strongly disturbed host galaxies at 95+/-4%, followed by the moderately and unobscured/lightly obscured subsets at 78+/-6% and 63+/-6.5%, respectively. From a careful comparison of this pattern of disturbances to cosmological merger simulations (Bonaventura et al., in prep), we conclude that mergers are common amongst obscured AGN, and that the obscured Seyfert AGN phase may mark a period of significant SMBH growth -- in tension with the leading model on AGN fueling mechanisms in the Seyfert luminosity and black-hole-mass regime (Hopkins & Hernquist 2006, Hopkins et. al 2014).

**Andrew Gardner**

Systems Programmer, Principal, Lunar & Planetory Labratory

*Multi-Mission Operations Center*

ASI’s Multi-Mission Operations Center builds on the University of Arizona’s decades of space mission operations experience. We partner with instrument and spacecraft teams to provide world-class mission operations and data management services to Pioneer-class missions. Our first mission partner, the Pandora SmallSat telescope, will launch in early 2025.Our team’s experience includes mission planning, data stewardship, and operations from OSIRIS-REx, the Phoenix Mars lander, the 2001 Mars Odyssey spectrometer instrument suite, Mars Science Laboratory (Curiosity) DAN neutron spectrometer, Lunar Reconnaissance Orbiter LEND neutron spectrometer, MESSENGER gamma and x-ray spectrometers, and Cassini VIMS. Our software stack, Arizona Astrolabe, builds on twenty years of lessons-learned and best-in-class components combined with industry-standard tools like COSMOS and GMAT. Our facilities on-premises at the Applied Research Building and in the AWS GovCloud give us the flexibility to be partners rather than just service providers and to provide low-cost, high-impact capabilities. In this presentation, we’ll describe the services we offer, the facilities we use, and the software and hardware architecture that makes it all possible.

**Alejandro Salado**

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Associate Professor, Director Systems Engineering Program, *Department of Industrial and Systems Engineering*
*A Digital Environment to Support Multidisciplinary Work in Space Systems Engineering*
In the realm of space systems engineering, the complexity of designing and managing space missions necessitates collaboration across multiple disciplines. To address this challenge, the integration of various tools and resources within a digital environment offers a promising solution. This presentation will showcase how the University of Arizona's Digital Engineering Factory (DEF) can support multidisciplinary work for a space system. Key components of this environment include collaborative platforms, modeling and simulation tools, data analytics capabilities, and visualization techniques. By leveraging these technologies, engineers and scientists can seamlessly collaborate, share data, simulate mission scenarios, analyze performance, and visualize outcomes in real-time. Expected benefits of employing a digital environment in space systems engineering include improved efficiency, enhanced communication, reduced costs, and accelerated innovation.

**Samantha Moruzzi**
PhD Candidate, Lunar and Planetary Laboratory
*Beneath the Ice: Constraining the Interior of Dwarf Planet Pluto with Implications for Future Exploration of Icy Objects*
The New Horizons spacecraft flyby of Pluto in 2015 revealed a geologically complex and active surface with circumstantial evidence of a heterogenous and multifaceted interior. With no spatially resolved gravitational data from the New Horizons mission, the interior and evolution of Pluto remain a mystery, requiring innovative approaches to see beneath the ice. One of the most prominent surface features, an ~2000 x ~1000 km quasi-elliptical basin in Plutoâ€™s equatorial region named Sputnik basin, may provide a window into Pluto and its history. Sputnik basin has become the key to understanding the lithospheric structure, interior, and evolution of Pluto, and provides an example of how large surface features on planetary objects can illuminate the structure beneath. Here, we model a local gravity field over Sputnik basin using the low-viscosity material inside the basin and analyses that were originally used in studies of the terrestrial gravity field. This gravity field not only provides insight into the structure of Sputnik basin, but also the proposed subsurface ocean beneath the ice shell, the thermal evolution of Pluto, and the stress fields that may have induced the tectonic features observed on the surface. Our new approach introduces a tool for understanding the interior and evolution of icy, outer Solar System objects that are imaged by missions without instruments to probe the subsurface or in a data-limited environments.

**Maria Mutz**
Graduate Fellow, Department of Physics
*Stable Magnetic Field Geometry: The Missing Key to Neutron Stars*
It has been suspected for over half a century that purely dipolar magnetic fields are unstable in neutron stars, and simulations over the last 20 years have repeatedly confirmed those suspicions. Follow-up studies have only expanded the range of geometries believed to be unstable, and NICER data has suggested that dipolar fields do not match pulsar observation. Yet due to a lack of viable alternative configurations, researchers across several fields of astrophysics continue to employ simple dipole field models for neutron stars. Those who do not assume a dipole attempt to solve for field geometry alongside other variables. Either approach seriously limits the precision and accuracy of pulsar data analysis because magnetic field configuration is a major factor in neutron star dynamics and emission. But this dilemma reflects the current state of neutron star research, not what is possible! The parameter space affecting magnetic field geometry is still vastly under-explored, as are improvements to the computational models of pulsar evolution. Stable

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magnetic field configurations for neutron stars must exist, and identifying them is key to unlocking the full potential of pulsar research, from nuclear and gravitational physics to pulsar-based space navigation. I will give a brief overview of the search for neutron star magnetic field stability, what I'm doing now to find it, and what we could use that knowledge to achieve in the future.

**Naomi Yescas**
R&D Engineer II, Lunar & Planetary Labratory
*Waves, Instabilities & Noise Spectrometer (WINS) for Earth's Ionosphere*
The necessity to understand complicated interactions between the ionosphere and it's adjacent layers via description of waves is widely recognized as a one of the central problems in space exploration. For this daily cycling three-dimensional system, it is required to perform comprehensive mapping of plasma conditions over longitude, latitude, altitude, and local time, which is achievable only if the diagnostic equipment is affordable, energy efficient, and small in size. Waves, Instabilities & Noise Spectrometer (WINS) is an instrument that satisfies these requirements and is planned to fit a single CubeSat unit. It performs accurate measurements of plasma density and temperature from MHz range electric field fluctuations via Quasi-Thermal Noise (QTN) spectroscopy. QTN spectroscopy has a half a century long record in solar wind observations, but was not applied in the ionosphere before. WINS uses heritage of several solar wind missions and takes advantage of recent technology developments to accommodate the traditional solar wind setups to cold and dense ionospheric plasma. The maturation of the instrument TRL from 2 to 5 will make this instrument feasible for flight opportunities in the future. WINS is developed au pair with Geospace Dynamics Constellation (GDC) Atmospheric Electrodynamics probe for THERmal plasma (AETHER) suite, aiming to aid in resolving potential observational issues early in the mission.

**Joseph Sepp Sprietsma**
Program Manager, College & Career Pathways, Center for the Future of Arizona
*Arizona Pathways to Prosperity*
Strengthening the connections between industry and education is essential for meeting the state's labor market needs, spurring economic expansion, and ensuring ample opportunity for our young people in Arizona. Pathways to Prosperity enables more young people to earn degrees and credentials for high-demand jobs, making it easier for them to enter the workforce and propel innovation and economic growth in the state. Arizona Pathways to Prosperity reimagines how education and workforce systems meet state and regional talent needs and prepare young people for careers. The Center for the Future of Arizona mobilizes employers, leaders in K-12 and postsecondary education, and policymakers to build a future that works for Arizona.