



National Aeronautics and  
Space Administration

# NASA SCIENCE

Planetary Science Advisory  
Committee (PAC)

**Gina DiBraccio, Ph.D.**

NASA Planetary Science Division Director (Acting)

**Shannon Fitzpatrick**

NASA Planetary Science Division Associate Director  
for Flight Programs

July 9, 2024



## PSD LEADERSHIP



*Gina DiBraccio, PSD  
Director (Acting)*



*Shannon Fitzpatrick,  
Associate Director for  
Flight Programs*



*Kathleen Vander Kaaden,  
PSD Director of Research  
Programs (Acting)*



*David Grinspoon, Senior  
Scientist for Astrobiology  
Strategy*



*Eric Ianson, PSD  
Deputy Director/MEP  
Director/RPS Director*



*Tiffany Morgan, MEP  
Deputy Director*



*Christy Layton, Deputy  
Associate Director for  
Flight Programs*



*Delia Santiago-  
Materese, PSD Deputy  
Director of Research  
Programs (Acting)*



*Lindsay Hays, Program  
Scientist for  
Astrobiology*

# Welcome to PSD!



*J. Michael  
Newman  
Program  
Executive*



*Cerese Albers  
Program  
Scientist/  
Executive*



*Nalin Ratnayake  
Program Scientist*



*Hannah Jang-  
Condell  
Program  
Scientist*



*Bradley Burcar  
Program Officer*



*Rachel Harris  
Postdoctoral  
Management  
Program Fellow*



Budget

# FY 2024 Budget: NASA & SMD

NASA's budget for FY2024 was included in the minibus bill passed by Congress and signed into law by the President on March 9, 2024

(\$M)	FY23 Enacted	FY24 PBR	FY24 Minibus Bill	Delta from PBR	Delta from FY23
Science	7,795.0	8,260.8	7,334.2	-926.6	-460.8
Earth	2,195.0	2,472.8	2,195.0	-277.8	0.0
Planetary	3,200.0	3,383.2	2,716.7	-666.5	-483.3
Astrophysics	1,510.0	1,557.4	1,530.0	-27.4	20.0
Heliophysics	805.0	750.9	805.0	54.1	0.0
Biological & Physical Sciences	85.0	96.5	87.5	-9.0	2.5

# FY 2024 Budget: PSD

- NASA's FY 2024 Appropriations for PSD: \$2.7B
  - \$483M lower than FY 2023 (15% reduction of FY 2023 budget)
  - \$666.6M (~20%) lower than FY 2024 President's Budget Request (PBR)
- Reduction is mostly accounted for by reduced support for Mars Sample Return
  - MSR to be funded at \$300M (or more)
  - Although appropriation allows **up to** the President's FY 2024 request (\$949.3M) for MSR, portfolio balance and Decadal Survey guidelines within the fixed top line are a high priority
- Specific language:
  - ~\$210M for NEO Surveyor
  - Up to FY 2023 level (~\$488M) for New Frontiers, including not less than \$360M for Dragonfly
- Operating plan still being worked

(\$M)	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24
PSD	1,342.3	1,446.7	1,628.0	1,827.5	2,217.9	2,746.7	2,712.6	2,693.2	3,120.4	3,200.0	2,716.7

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\*From FY25 PBR

# Planetary Science Budget Priorities

## Explore/Innovate/Partner/Inspire

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Successfully complete confirmed high-priority missions including **Europa Clipper, NEO Surveyor, Dragonfly**

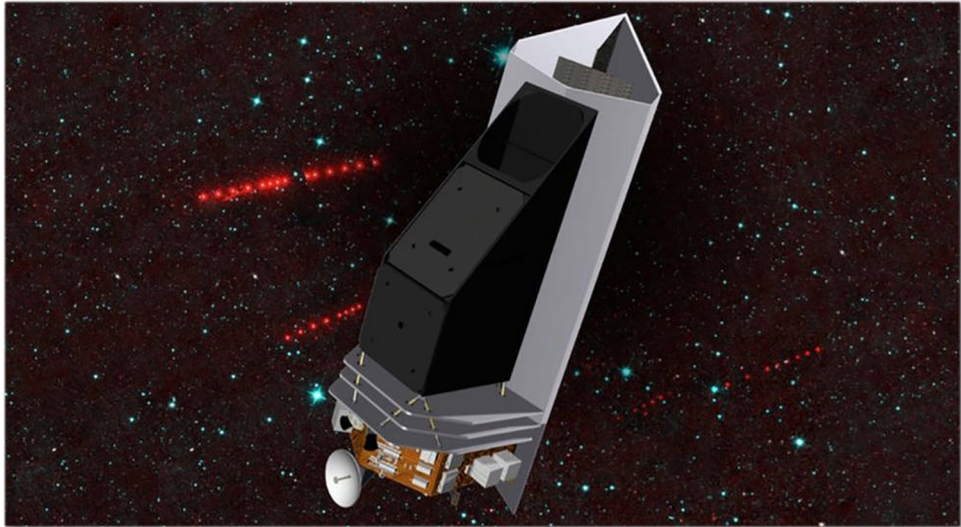
Support **international partnerships**: Juice, MMX, Rosalind Franklin Mission, Envision

Ensure Decadal-recommended science investigations are included in **Artemis** campaign; support stable cadence of future CLPS deliveries to the lunar surface

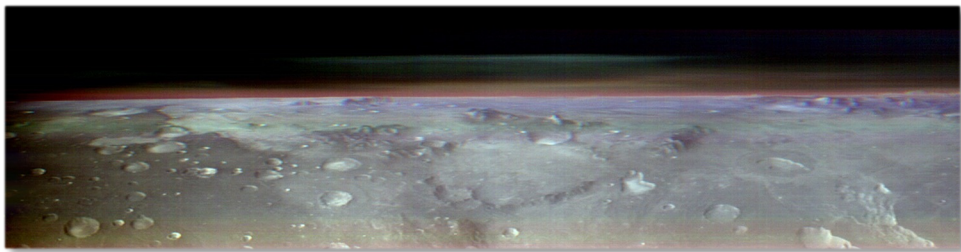
Support Planetary Science **research** community to ensure continued scientific discovery from NASA mission data



# Planetary Science Highlights



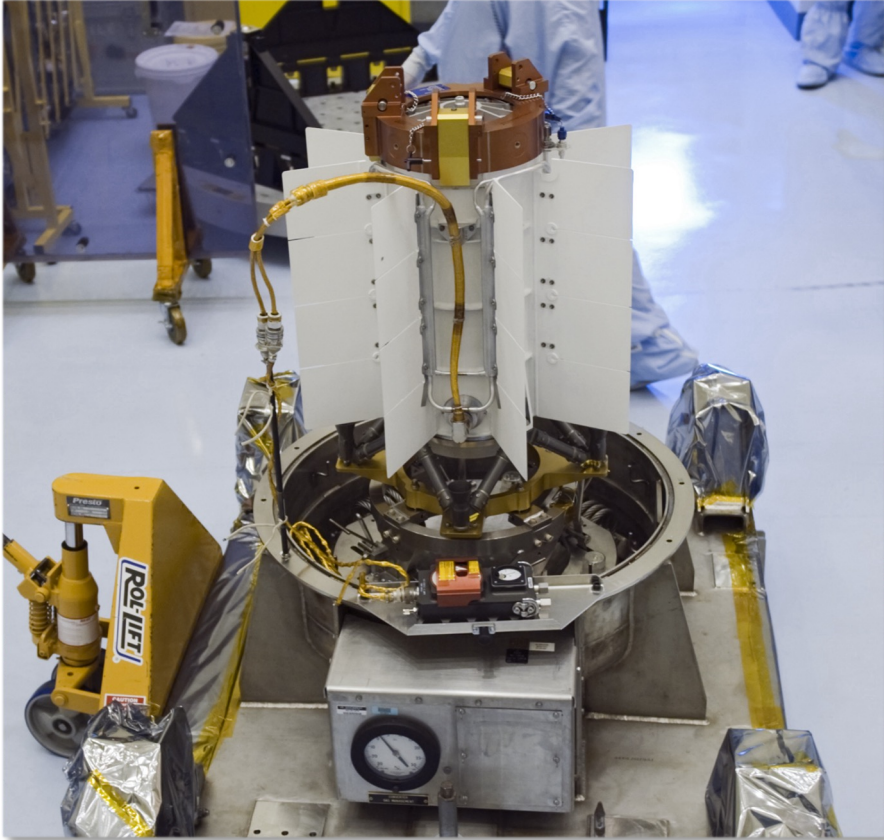
Artist conception of the NEO Surveyor spacecraft. Image credit: NASA/JPL-Caltech



This view of Mars was captured by NASA's Odyssey orbiter using its THEMIS camera. It combines three channels of infrared data that highlight water-ice clouds and dust in the atmosphere. Image credit: NASA/JPL-Caltech/ASU

- **Mars Sample Return** paused in FY24 while architecture studies are completed; FY25 budget request is \$200M
- Supports launches of **Europa Clipper** (Oct 2024) and **NEO Surveyor** (2027)
- Supports **Dragonfly** mission for 2028 LRD, confirmed on April 16
- Three missions to study Venus: **DAVINCI**, **VERITAS** (both to launch in 2031–32 timeframe) and contributions to ESA **EnVision**
- **Mars Exploration Program** supports ongoing operation of 5 missions at Mars, including Perseverance and MSL, and new investments in technology to enable future Mars missions
- **Robust Lunar Discovery and Exploration Program** which includes:
  - Two **CLPS** awards per year in most years
  - Annual **PRISM** calls for instruments
  - Artemis Science instruments, including handheld instruments for astronauts and the lunar terrain rover
  - Lunar Reconnaissance Orbiter operations
  - Support **Lunar Trailblazer** for planned launch in FY 2025
  - VIPER Continuation/Termination review took place and NASA is formulating the decision

# Planetary Science Highlights



*An RPS MMRTG. This unit is currently installed and operating on the Curiosity Rover. Image Credit: NASA/DOE*

- The next **New Frontiers, Discovery, and SIMPLEx** AOs expected to be released no earlier than 2026
- New **Planetary Technology** strategy and project, to provide integrated technology development for future planetary science missions
- Pre-formulation studies of the Decadal-Survey-recommended Uranus Orbiter and Probe mission will begin in the current budget horizon
- Investments in **Open Source Science** to enhance transparency, inclusivity, accessibility, and reproducibility in publicly funded scientific research.
  - This project also supports SMD's transition to cloud computing services
- **Radioisotope Power Systems** program investments in technology, to enable successful trips to distant solar system destinations with harsh environments; includes development of the Dragonfly MMRTG
- **Planetary Data System** data archives, which now span more than 50 years of NASA-funded research, and will expand to include ground-based observations of Near-Earth objects

*The National Academies of*  
SCIENCES • ENGINEERING • MEDICINE

# ORIGINS, WORLDS, AND LIFE

A Decadal Strategy for Planetary Science & Astrobiology  
2023–2032



# Decadal Survey Progress

## Integrated Lunar Science Strategy

- Final release coming very soon

## Future Mars Science Plan

- Document is being finalized and release is targeted for this summer

## Technology Development plan

- PESTO team working to create an updated Comprehensive Planetary Science Technology Development Plan
  - Feedback from science community is now being reviewed for inclusion of updates
- Draft was presented at LPSC:  
<https://www1.grc.nasa.gov/space/pesto/tech-dev-plan/>



# PLANETARY FLEET



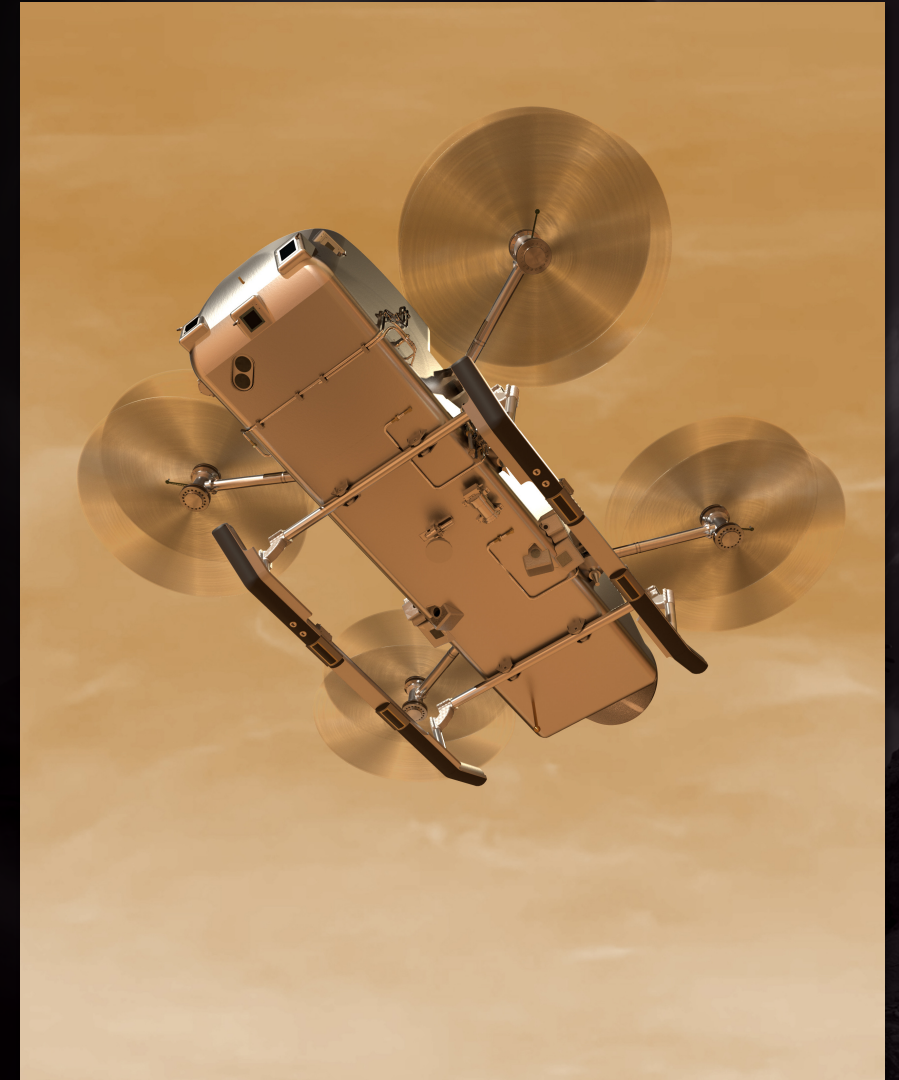


# Mission Updates

# Dragonfly



- In November 2023, the Agency postponed formal confirmation of mission until release of FY25 President's Budget Request (PBR)
- With the release of FY24 PBR Dragonfly was confirmed on April 16, 2024
  - Mission has proceeded into Phase C
  - Launch Readiness Date: July 2028
- Project is now working towards Mission Critical Design Review (CDR) in April 2025
  - Subsystem CDRs are ongoing
- Launch Vehicle Procurement is underway, and selection is on schedule for Fall 2024





# Europa Clipper

## Assembly, Test, and Launch Operations (ATLO) Progress

- All environmental testing completed successfully
- System Test 3 completed successfully in April
- Operational Readiness Test-2 completed successfully in May
- Spacecraft successfully shipped from JPL to KSC and commenced final I&T activities
- Final launch load of Flight Software delivered, will be installed ahead of System Test 4 in July
- Solar arrays completed all preparatory work, and ready for final installation in July

Spacecraft shipped to KSC: May 2024

Launch period opens: October 2024

Jupiter Orbit Insertion: April 2030



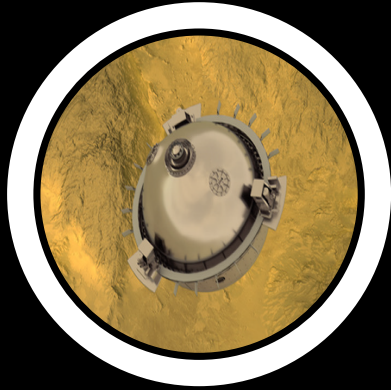
*Shipping container opening in the Payload Hazardous Servicing Facility (PHSF) at KSC, following C-17 flight from March Air Reserve Base*



*Europa Clipper vault plate installation at JPL*



# Back to Venus



## DAVINCI (2031/2032)

*Deep Atmosphere Venus Investigation of  
Noble Gases, Chemistry, and Imaging*



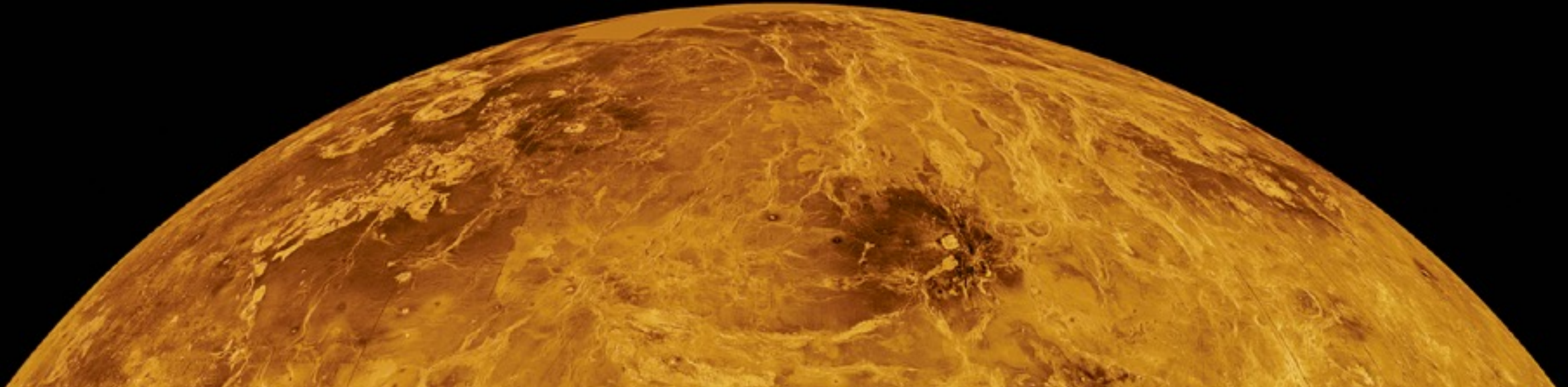
## Envision (2031)

*ESA Medium-Class Mission  
NASA contribution includes VenSAR  
(Synthetic Aperture Radar)*



## VERITAS (2031/2032)

*Venus Emissivity, Radio Science,  
InSAR, Topography, &  
Spectroscopy*

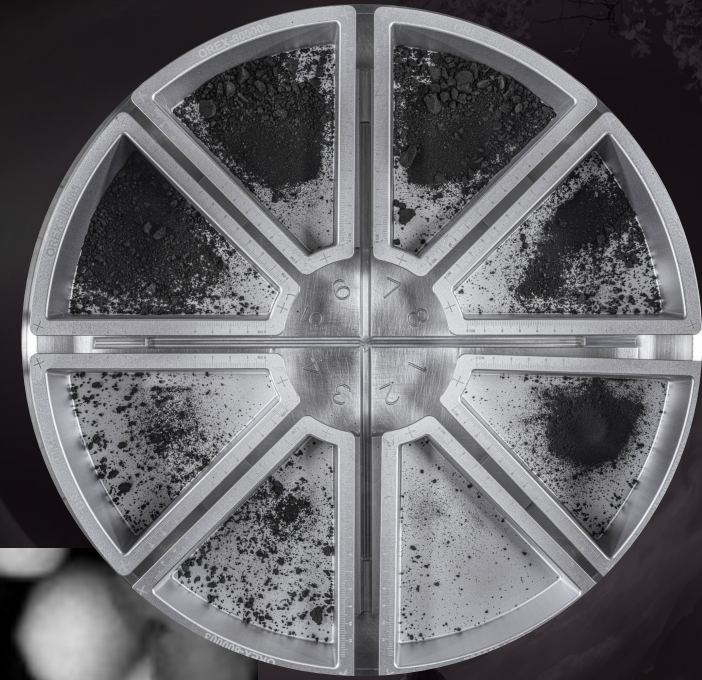




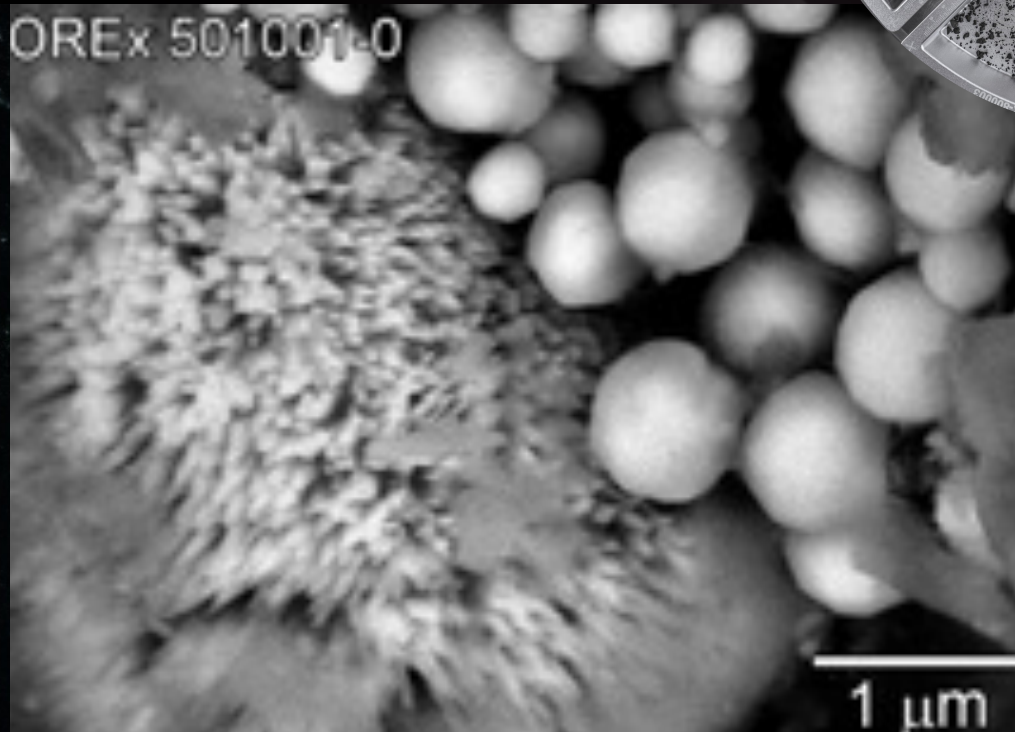
# OSIRIS-REx: Sample Surprises

Sample catalog: <https://curator.jsc.nasa.gov/osirisrex/index.cfm>

Lauretta et al., 2024, Asteroid (101955) Bennu in the laboratory: Properties of the sample collected by OSIRIS-REx, *Meteoritics & Planetary Science* ([doi:10.1111/maps.14227](https://doi.org/10.1111/maps.14227))



*Top: Benu sample contained in eight trays*



*Left: Benu particle (about 1 mm long) with crust of bright phosphate*

*Right: Magnetite spheres with radially projecting needles next to dodecahedral crystals*



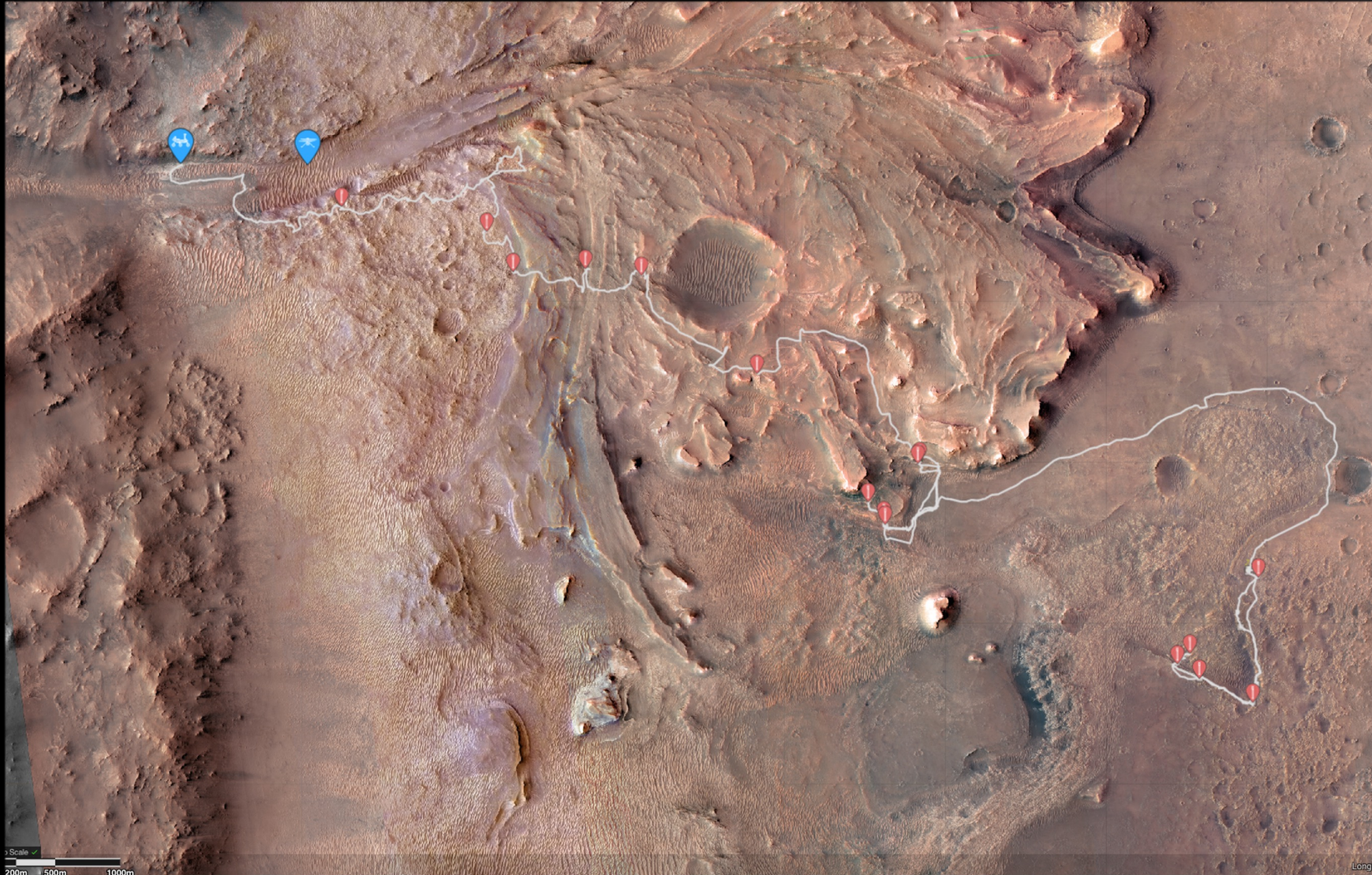
# Perseverance



Mount Wasburn outcrops in Neretva Vallis



Proximity science with WATSON/SHERLOC at Bright Angel





Community

# PSD Early Career Award Winners



Emily Costello, University of Hawaii at Manoa

Navigating by Moonlight:  
The art of planetary science



Christopher Fowler, West Virginia University

Bringing planetary science to West Virginia



Peter James, Baylor University

Origins of porosity on rocky planetary surfaces



Kelly Miller, Southwest Research Institute

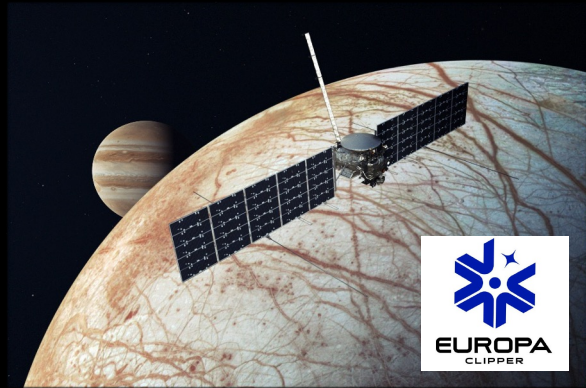
Carbon-based connections:  
From Earth to the Outer Solar System



Laura Rodriguez, Lunar and Planetary Science Institute

Supporting planetary science and mission work with the astrobiology spectral database

# Here to Observe (H2O) Program – New Teams Added



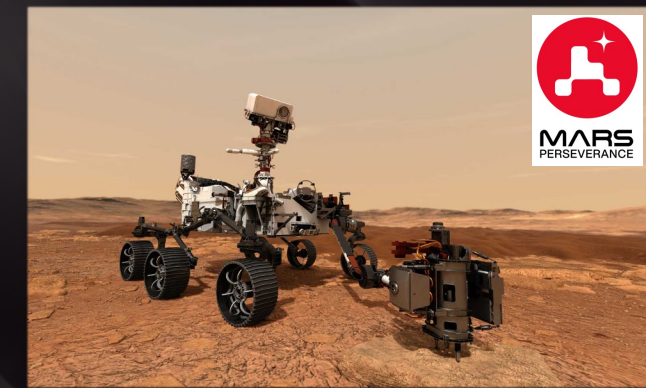
Ohio & Puerto Rico Space Grant  
 Consortia Robert Romero (Ohio  
 Aerospace Institute)  
 Prof. Gerardo Morell (U. of Puerto Rico)  
 Dr. Rachel Klima (Europa Clipper Liaison)



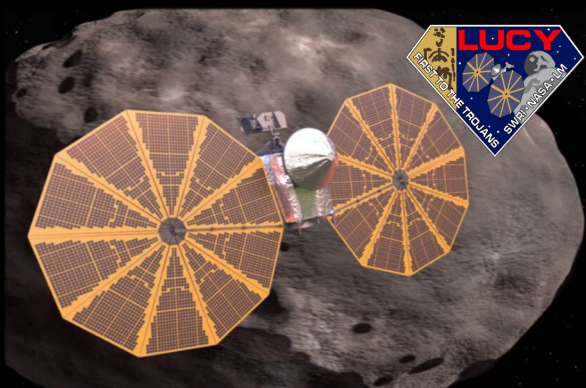
Kingsborough Community College  
 Prof. Steven Jaret (KBCC)  
 Dr. Alexandra Pontefract (Dragonfly  
 Liaison)



New Mexico State University  
 Prof. Nancy Chanover (NMSU)  
 Dr. Erika Kohler (DAVINCI Liaison)



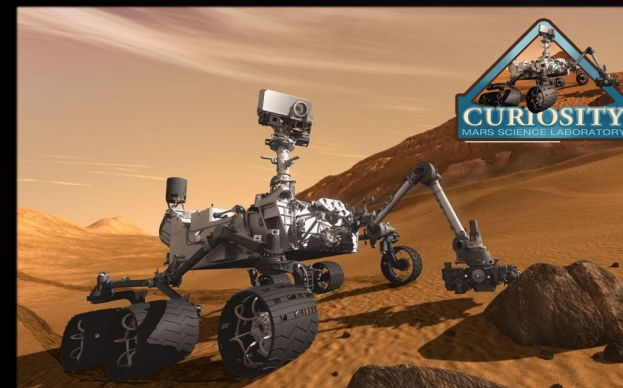
Kutztown University  
 Prof. Erin Kraal (KU)  
 Nicole Spanovich (M2020/Perseverance  
 Liaison)



Univ. of Arkansas at Pine Bluff  
 Prof. Richard Walker (UAPB)  
 Dr. Katherine Kretke (Lucy Liaison)



New Mexico Institute of Mining & Tech.  
 Prof. Raúl Morales-Juberías (NMT)  
 John Van Eepoel (LRO Liaison)



Virginia State University  
 Prof. Dawit Haile (VSU)  
 Dr. Ashwin Vasavada (Curiosity Liaison)

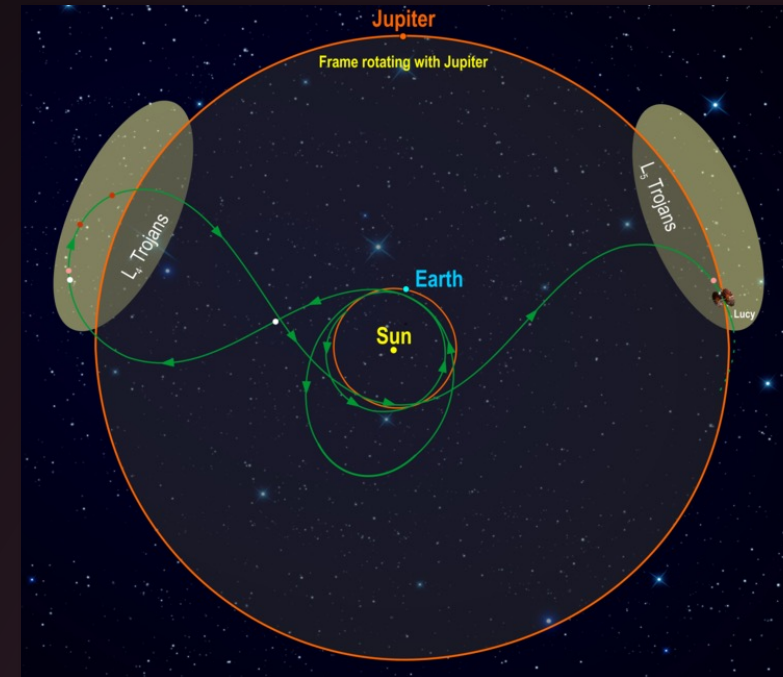


California State University, Channel Islands  
 Prof. Kevin Hayakawa (CSUCI)  
 Dr. Amy Mainzer (NEO Surveyor Liaison)



# Lucy Participating Scientist Program

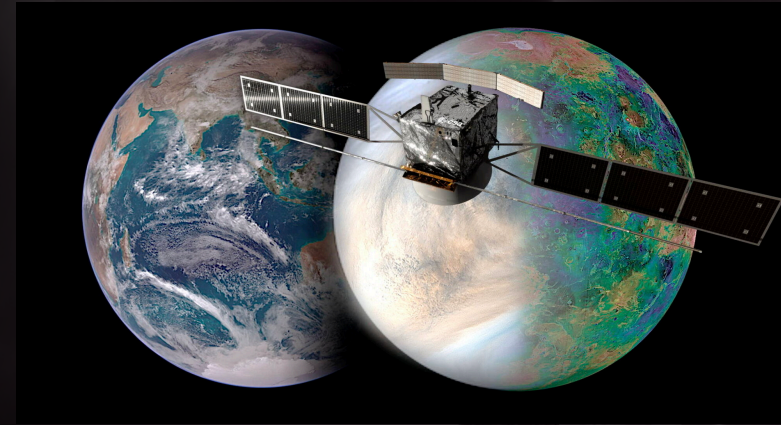
- New solicitation in ROSES-2024: [C.27 Lucy in the L4 Trojans Participating Scientist Program](#) (Lucy-L4-PSP)
- Proposals for science investigations or other scientific contributions to the Lucy mission that directly address outstanding questions in planetary science related to the Jupiter Trojan asteroids—specifically those Lucy will encounter in the L4 swarm in 2027 and 2028
  - Mandatory NOIs due August 19, 2024
  - Full proposals due October 2, 2024



# Envision Science Working Team Interdisciplinary Scientist Announcement of Opportunity

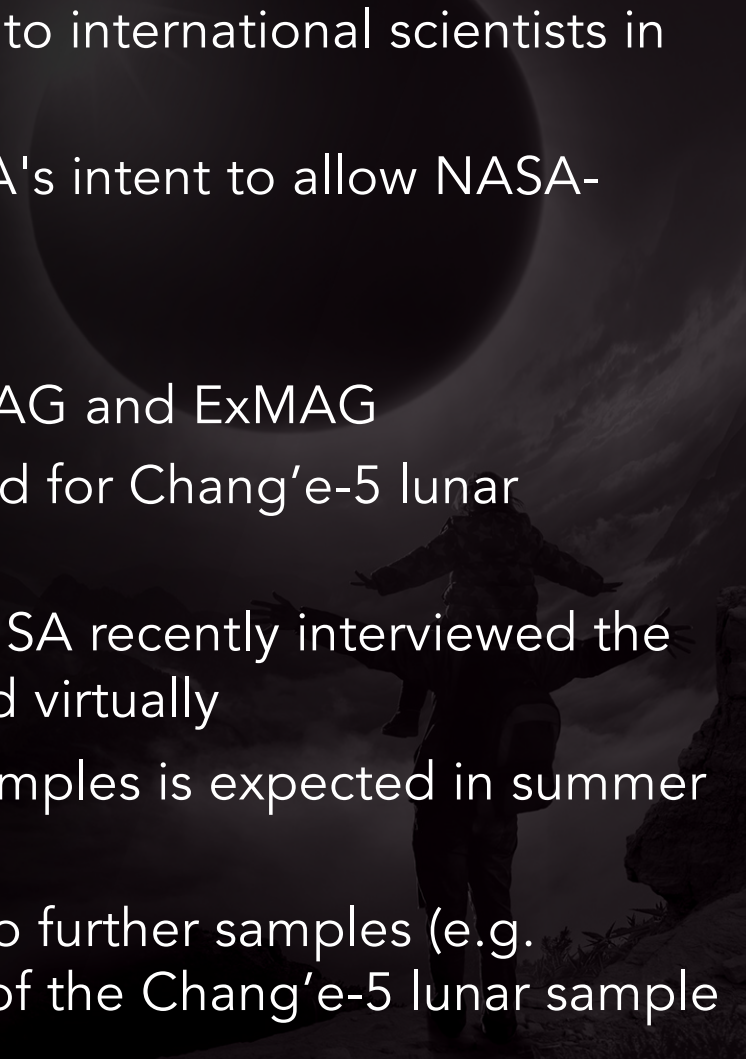


- Envision Science Working Team (SWT) will provide input to ESA and NASA on all aspects of the mission potentially affecting its scientific performance and be a mission focal point for the scientific community
- ESA Announcement of Opportunity (AO) invites proposals for Interdisciplinary Scientists (IDSs) to become members of the Envision SWT
  - Mandatory Letter of Intent due by July 30, 2024
  - Full proposals due September 24, 2024
- Up to two U.S. scientists can be selected as IDSs through this opportunity
  - U.S. investigators will require letters of endorsement
    - Letters of endorsement from NASA must be requested by emailing the NASA Point of Contact by September 9, 2024
- Full details: <https://cosmos.esa.int/web/envision-ids-2024>





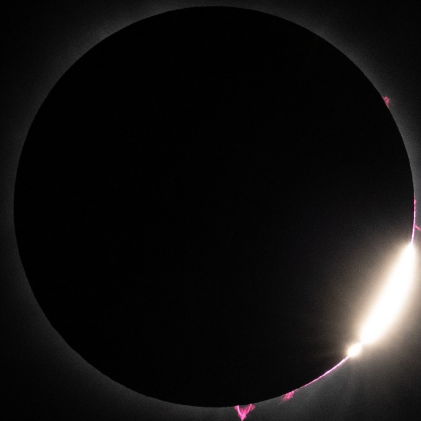
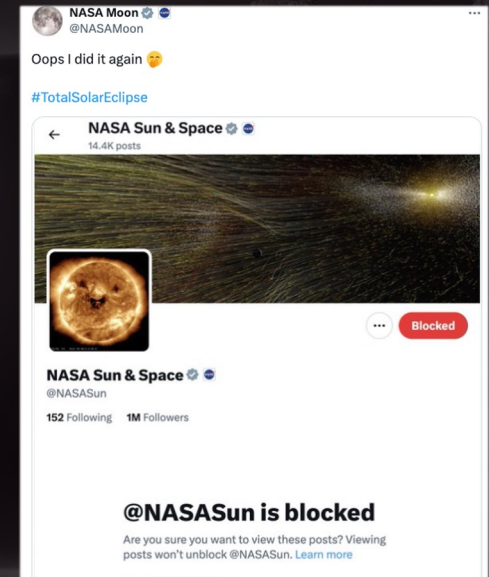
# CNSA Chang'e-5 Lunar Samples Update

- CNSA opened applications for access to Chang'e-5 lunar samples to international scientists in late 2023
  - November 2023, Administrator Nelson certified to Congress NASA's intent to allow NASA-funded researchers to apply to CNSA for access to these samples
    - A limited exemption under the Wolf Amendment
  - NSPIRES released a notification on November 29, amplified by LEAG and ExMAG
  - NASA is continuing to coordinate with U.S. researchers that applied for Chang'e-5 lunar samples
    - The agency is aware that as part of the application process CNSA recently interviewed the international loan applicants, U.S. researchers were interviewed virtually
  - A second opportunity for international proposers for Chang'e-5 samples is expected in summer of 2024
  - NASA is aware of the U.S. science community's interest in access to further samples (e.g. Chang'e-6) and may pursue this in the future based on outcomes of the Chang'e-5 lunar sample process
- 

Celebrating Success



# The Moon's Moment in the Sun





Findings

# Finding 1: Support for Decadal Survey priorities & budget guidelines

**Finding:** The PAC reaffirms our prior finding\* from November 2023 in strong support of the priorities and budget guidelines of the Origins, Worlds, and Life Decadal Survey (OWL). We also note that support was expressed unanimously by the community Assessment/Analysis Groups (AGs) for the OWL priorities.

*\*Prior finding (November 2023): Finding: The PAC recognizes the extreme challenge of decision making in the current uncertain budget environment and expresses our sincere appreciation for the level of transparency shown with respect to PSD budget priorities and the development of NASA's response to the MSR IRB. The PAC continues to support the Decadal recommendations/priorities and the PSD funding priorities laid out by Lori Glaze (initially endorsed in the PAC June 2023 Finding). Recommendation: The PAC reaffirms support for both the Decadal's prioritization of MSR and the need for balance across the planetary portfolio and community support. The PAC recommends continued focus on both those aims as the MSR budget and NASA's plan become better defined and looks forward to hearing the full NASA response to the MSR IRB in the spring.*

**Response:** PSD thanks the PAC for this finding.

## Finding 2: Thank you for Chang'e-5 sample access

**Finding:** The PAC expresses sincere gratitude to PSD and SMD leadership for advocacy ultimately resulting in the NASA Administrator's certification to Congress for a limited exemption under the Wolf Amendment that allows for access to Chang'e-5 samples by NASA-funded researchers. When the Chang'e-5 mission returned the first new lunar sample return in decades, the community recognized the uniqueness of these samples as a young mare basalt far from previous collection sites and holding the potential to dramatically change our understanding of solar system volcanic and impact history. As noted in a prior finding (November 2021), NASA-funded researchers have a strong interest in studying these samples but understand that their collaboration with the People's Republic of China (PRC) is constrained by the Wolf Amendment, a Congressional limitation prohibiting bilateral exchanges between NASA-funded scientists and scientists and institutions in the PRC. The PAC recognizes both the work by NASA to achieve the exemption along with the potential for scientific advancement enabled by access to the samples via NASA awards.

**Response:** PSD thanks the PAC for this finding.

# Finding 3: Science in Moon-to-Mars

**Finding:** The PAC recognizes and appreciates the ongoing efforts to implement compelling science in the Artemis architecture under the Moon-to-Mars program, and to proactively study science objectives in future Mars exploration architectures.

**Recommendation:** The PAC recommends a regular and ongoing pattern of collaboration among the science, engineering, and technology communities working on elements of the Moon-to-Mars program (e.g., individual Artemis missions, science advisory groups, science teams) to instantiate compelling science as a pillar of the program. The PAC requests a briefing from the Moon-to-Mars initiative leadership on the pattern of collaboration when established as soon as the next PAC meeting but not later than the fall 2024 PAC meeting.

**Response:** NASA currently engages across several mission directorates, through regular boards that are focused on science and utilization. These boards draft science needs that lead to the definition of system requirements. Each of these boards is co-chaired by, or have polling membership from, all four mission directorates (SMD, ESDMD, SOMD, STMD), to ensure science needs are met by the proposed implementation/execution paths and are factored into technology development investments. These boards apply at both the strategy and execution branches of the exploration programs. The ESDMD DAA for Strategy and Architecture and the Chief Exploration Scientist will attend this PAC meeting to talk through these processes. In addition, NASA continues to regularly solicit input from the science and technology communities through a variety of activities, including Lunar Surface Science Workshops, LEAG/MEPAG studies, Lunar Surface Innovation Consortium (LSIC) focus groups, community studies/reports, and input to the annual Architecture Definition Document.

# Finding 4: DSN Maintenance and Expanded Capabilities (1/2)

**Finding:** The PAC recognizes the critical role that the Deep Space Network plays in Planetary Science missions and planetary radar science. However, deferred maintenance and significantly increased demand due to upcoming planetary and crewed lunar missions through the Artemis Program will substantially stress an already strained, aging infrastructure. As shown in the DSN update to the PAC by Jeffrey Volosin at our Nov 2023 meeting, while the Lunar Exploration Ground Sites (LEGS) facilities will reduce the pressure on the DSN and select DSN Lunar Exploration Upgrades (DLEU) are underway, the network's current capacity is still likely to be insufficient to meet both the needs of Artemis and Planetary Science. Support for the Artemis missions will necessarily require DSN resources at a level that will challenge existing and upcoming missions in Planetary Science and other mission areas.

**Recommendation:** Recognizing budgetary constraints across the Agency, the PAC requests more detailed information on the strategy for allocation of DSN resources, as well as the Agency's strategy for mitigation efforts and policies for prioritization of missions (both US and international) directly competing for DSN resources at a given time. This request includes the opportunity to hear a review of the DSN Futures Final Report when it becomes available.



# Finding 4: DSN Maintenance and Expanded Capabilities (2/2)

**Response:** PSD recognizes and shares the PAC's concerns regarding DSN maintenance, capabilities, and bandwidth, and thanks the PAC for their recommendation. SMD has assigned a POC from the DAA/P office to collaboratively working with DSN to enhance communication and work through specific concerns related to SMD missions. As part of this enhanced collaboration with DSN, SMD has also created a SCaN Working Group and a Spectrum Working Group, which includes representatives from each SMD Division. These working groups meet regularly to work through the details of mission specific concerns that are then brought forth to SCaN via the SMD POC. Additionally, SMD is increasing the rigor and frequency of dialogue pertaining to DSN maintenance and capabilities concerns that could affect our missions at the monthly Flight Program Review (FPR), as well as instituting a new review section required at each KDP-C, specific to SCaN/DSN details for each mission. SCaN/DSN representatives are in attendance for those discussions at KDP-C.

Specifically for PSD, we have assigned the same Program Executive to both the SCaN Working Group and the Spectrum Working Group, and now require all mission Program Executives to engage in early and frequent discussions with SCaN/DSN.

At the Agency level, a DSN Tiger Team has been created, with the SMD SCaN POC as an active member. This team meets weekly to work through DSN maintenance and capabilities issues, along with bandwidth and prioritization issues that could impact future support from DSN for SMD missions, as well as potential impacts and conflict resolution for Artemis DSN usage. This team reports directly to the Space Operations Mission Directorate AA at the quarterly SCaN Board of Directors, which SMD's AA co-chairs with the SOMD AA.

As a result of the Agency and SMD enhanced collaboration with SCaN/DSN, we are seeing issues being resolved and future planning is more detailed and accurate. A unified voice (from SMD and SOMD) is also better communicating the need for additional funding for SCaN to senior Agency leadership. PSD is optimistic that the increased spotlight on DSN issues to senior Agency leadership will result in fruitful changes and risk mitigation for our SMD and Planetary missions.

# Finding 5: Thanks to ExoPAG

**Finding:** The PAC appreciates the efforts of ExoPAG in proactively taking steps to create productive and longstanding relationships between many disciplines, including the astrophysics and planetary science communities. The PAC is supportive of the ongoing ExoPAG efforts in seeking ways to strengthen these relationships across multiple avenues of engagement, including invited speakers, virtual direct messaging, and thoughtfully scheduled workshops. The PAC looks forward to the forthcoming community review paper that will identify overlaps and synergies among multiple disciplines and link the science initiatives of the Astro2020 and Origins, Worlds and Life 2023 decadal surveys.

**Response:** PSD thanks the PAC for this finding.

# Through the Eyes of NASA

