

National Aeronautics and  
Space Administration



# EXPLORE SCIENCE

**Lori S. Glaze, Ph.D.**, NASA Planetary  
Science Division Director

**Planetary Science Advisory  
Committee (PAC) Meeting**

December 5, 2022

# SMD Leadership



**Thomas Zurbuchen**  
*Science Mission Directorate Associate  
Administrator (2016–2022)*



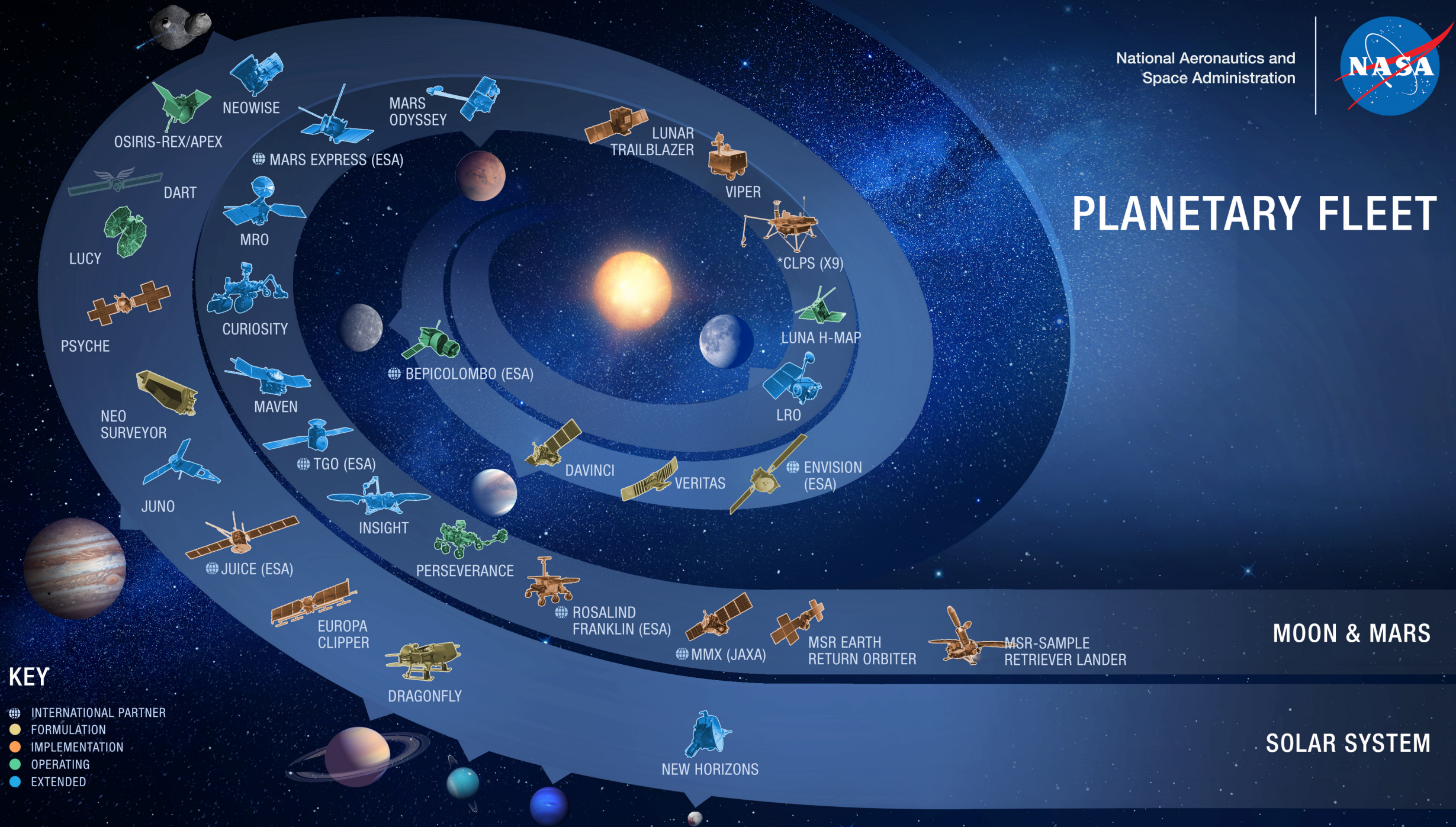
**Sandra Connelly**  
*Science Mission Directorate Acting  
Associate Administrator (2023–)*



**Eric Ianson**  
*Science Mission Directorate Acting  
Deputy Associate Administrator  
(2023–)*



# PLANETARY FLEET



- KEY**
- INTERNATIONAL PARTNER
  - FORMULATION
  - IMPLEMENTATION
  - OPERATING
  - EXTENDED

MOON & MARS

SOLAR SYSTEM

# Recent Highlights





September 26, 2022  
7.10–7.15 pm EST

DRACO images  
streamed to Earth  
from 7 million miles  
away

(10 x speed)





*Impact witnessed by ATLAS telescope*

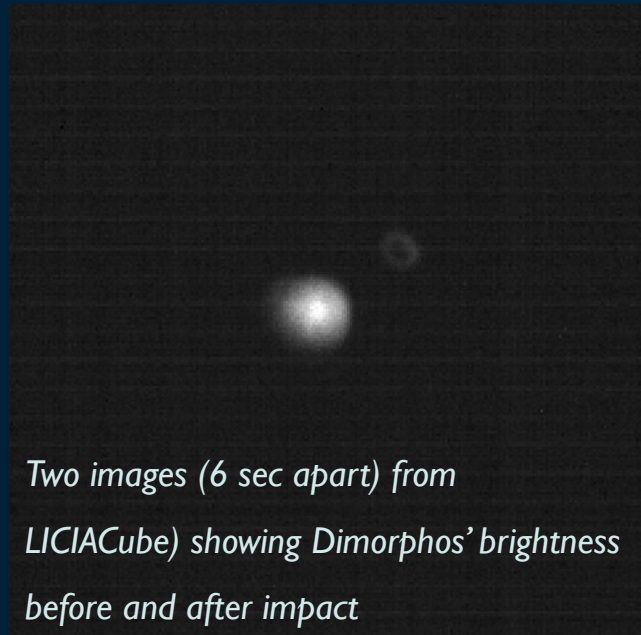


*>10,000 km trail of debris from Dimorphos*

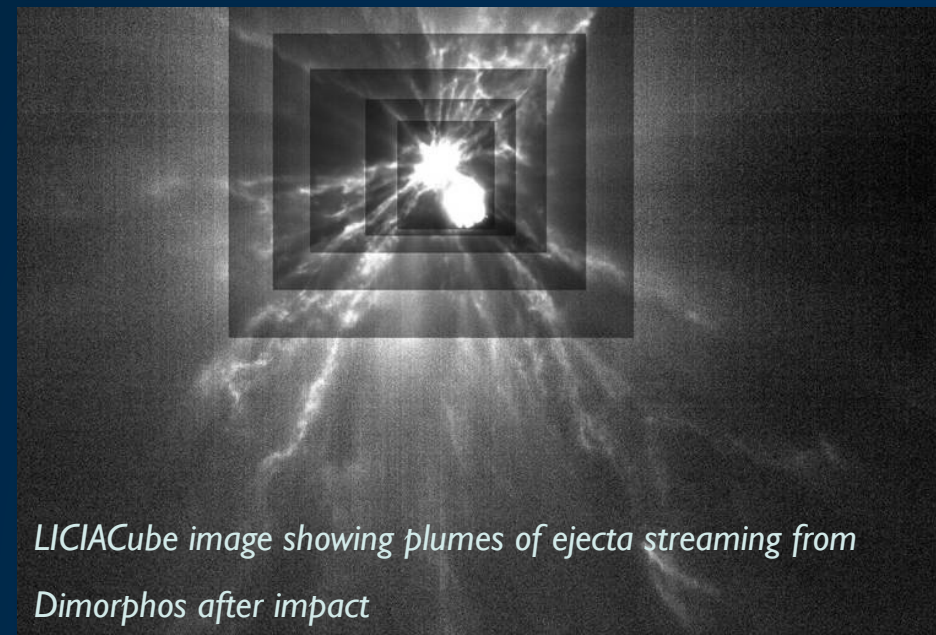
Before: 11 hr 55 min

After: 11 hr 23 min

Change: 32 mins!



*Two images (6 sec apart) from LICIACube) showing Dimorphos' brightness before and after impact*



*LICIACube image showing plumes of ejecta streaming from Dimorphos after impact*

# Sample Collection Map: Cores 1-14

The Perseverance rover has collected two witness (blank), one atmosphere, and 14 core samples out of a total of 38: 8 cores during the Crater Floor campaign and 6 during the Delta Front campaign. Abrasions spots are 5 cm across and cores are 1.3 cm wide. Map Production & Image Credits: NASA/JPL-Caltech, Univ. of Az, MSSS.





MARS 2020

# Sample Collection Map: Cores 1-14

The Perseverance rover has collected two witness (blank), one atmosphere, and 14 core samples out of a total of 38: 8 cores during the campaign-wide. Map M555.

Sample Tube Drop-off Location

First sample depot/cache:  
'Three Forks' near base of ancient river delta





# Challenges





# PSD Budget Considerations

- Absorbed significant COVID-related costs
- Accommodated Phase-E increases to several missions
- Need to accommodate increased costs on projects in formulation
  - Inflation
  - Long-lead-time (rephasing) issues
- Must accommodate lower budget than anticipated when last two Discovery selections were made
  - FY22 appropriation \$80M less than President's request
  - FY23 President's request also lower

# Psyche Independent Review Board (IRB)

- Co-chartered by NASA HQ and JPL
- Two main sections focused on (1) Psyche and (2) JPL Institution
- Final report and responses [published online](#)

## Psyche Recommendations – Considered as part of the Continuation/Termination Review

- **General:** Develop a plan to meet new Launch Readiness Date (**October 2023 LRD** approved at Continuation/Termination Review)
- **Management and communications:** establish and implement processes to improve communications at all levels within the Psyche project and at JPL
- **Staffing:** Provide additional, experienced leaders at all levels of the project, as well as sufficient project staffing
- **COVID-19-related:** Re-establish informal communications at JPL, and minimize hybrid/remote work on Psyche
- **Project metrics:** Develop an adequate and verified schedule for remaining work
- **SRB Review:** Strengthen SRB process, e.g., by discriminating between ‘normal’ activities and serious/critical issues
- **JPL/MAXAR Relationship:** Psyche experience provides an excellent opportunity to document best practices for future NASA/commercial spacecraft provider collaborations

# Psyche IRB: JPL Institution Findings

Many Psyche issues identified are not unique to Psyche and are indicative of broader institutional issues—many of these are likely not unique to JPL

## Institutional issues

- Inadequate flight project staffing—number of personnel and experience
- Erosion of line organization technical acumen
- Insufficient JPL senior management engagement with flight projects
- The post-pandemic work environment

## Urgent corrective action recommendations

- No new flight projects until workforce balance is achieved
- **Cancel, redirect, or delay a flight project**
- Transfer required talent from non-flight projects within JPL to flight projects
- Focused personnel training and development in key areas
- Significantly increase use of industry prime and support services contractors
- Increase use of and collaboration with other NASA Centers
- Aggressive recruitment and hiring
- Accept the risk of layoffs

# VERITAS Status



- NASA anticipates delaying the VERITAS launch to no earlier than 2031
  - Providing FY23 funding for orderly stand down
  - Providing funding for continued science team support
- Restart will be contingent on funding and progress on IRB issues
- PSD/SMD will pursue funding to support both VERITAS and the next Discovery AO through the FY2025 budget process

# Psyche & Janus

## Psyche

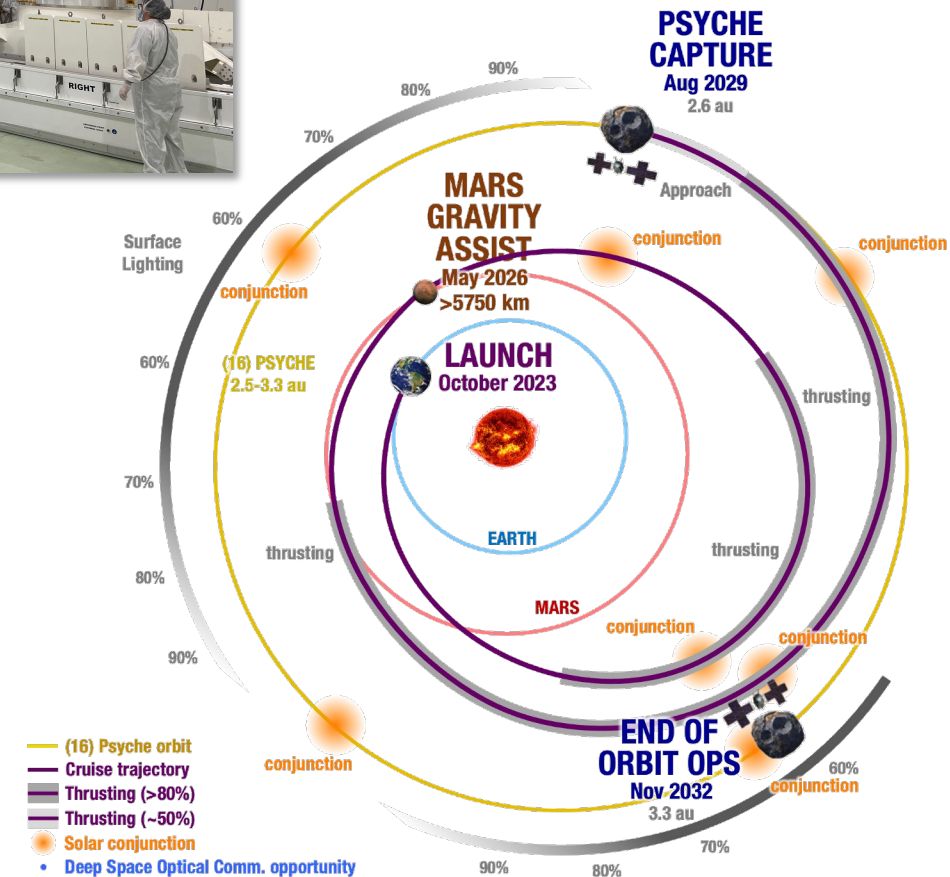
- Launch period: **October 10–30, 2023**
  - Arrives at Psyche August 2029
  - No new Ops activities/processes required
  - Does not stress spacecraft design
- ATLO 1.0 completed; spacecraft is in maintenance mode until ATLO 2.0 begins June 2023
- JPL working closely with project to maintain level of experienced staff to complete remaining work prior to launch
- Status DPMC planned for February/March 2023

## Janus (SIMPLEX-2)

- Removed from Psyche's 2023 launch manifest
  - Would not be on a trajectory to meet science requirements
- Spacecraft reside at Lockheed Martin



*Psyche after removal from storage facility at Astrotech, November 2022*

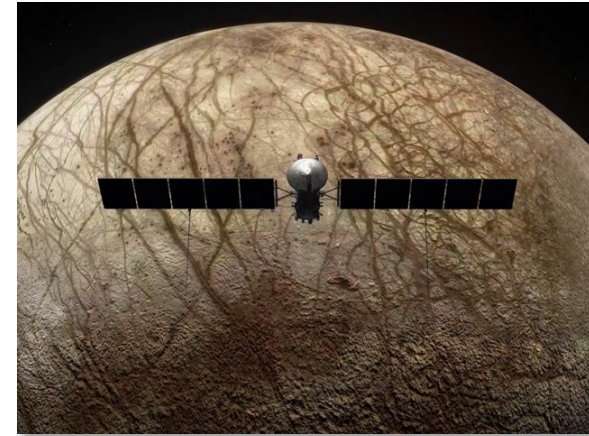
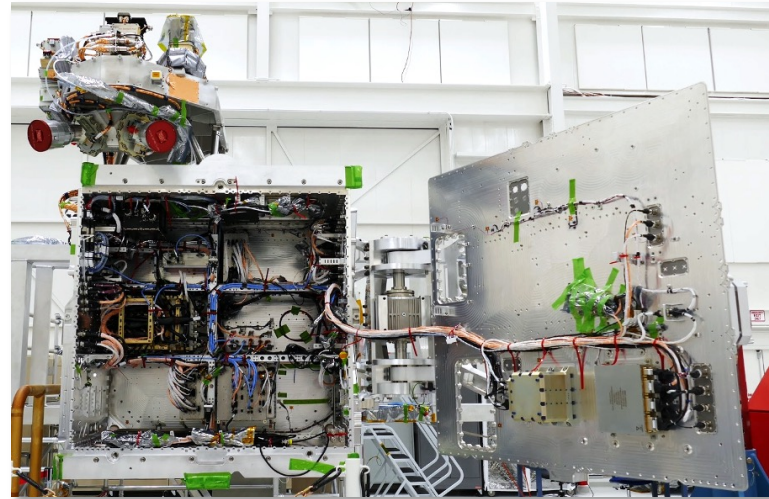


# Other Mission Updates

# Europa Clipper



- ATLO pace is accelerating: [live feed from High Bay](#)
- Five (of nine) science instruments have been delivered:
  - Plasma Instrument for Magnetic Sounding (PIMS)
  - Europa Imaging System Wide-Angle Camera (EIS WAC)
  - Europa Thermal Emission Imaging System (E-THEMIS)
  - Europa Ultraviolet Spectrograph (E-UVS)
  - Surface Dust Analyzer (SUDA)
- More hardware and science instruments expected by end of February 2023
- Target launch: October 2024
- Jupiter Orbit Insertion: April 2030



*Top left: Avionics module; nadir deck and vault. Bottom left: Solar array integration. Bottom right: Module current configuration.*



# SIMPLEx

## LunaH-Map (SIMPLEx-1)

- Launched Nov 16, 2022 on Artemis I
- Nov 17: propulsion system powered on, but thrust not achieved
- Team assessed that propulsion system may be partially stuck
  - Spacecraft is now heating the propulsion valve, which may free it
  - If thrust is achieved within the next few months, mission may still recover some/all of original science mission
- Compact neutron spectrometer collected data during Nov 21 lunar flyby (from as close as 810 miles)
  - Instrument is operating as expected



## Lunar Trailblazer (SIMPLEx-2)

- Set to launch on Intuitive Machines-2 (IM-2) PRIME-1 CLPS delivery
- Decision to continue was made following the cost review in November 2022
- Mission goal: understand the form, abundance, and distribution of water on the Moon and the lunar water cycle



# InSight

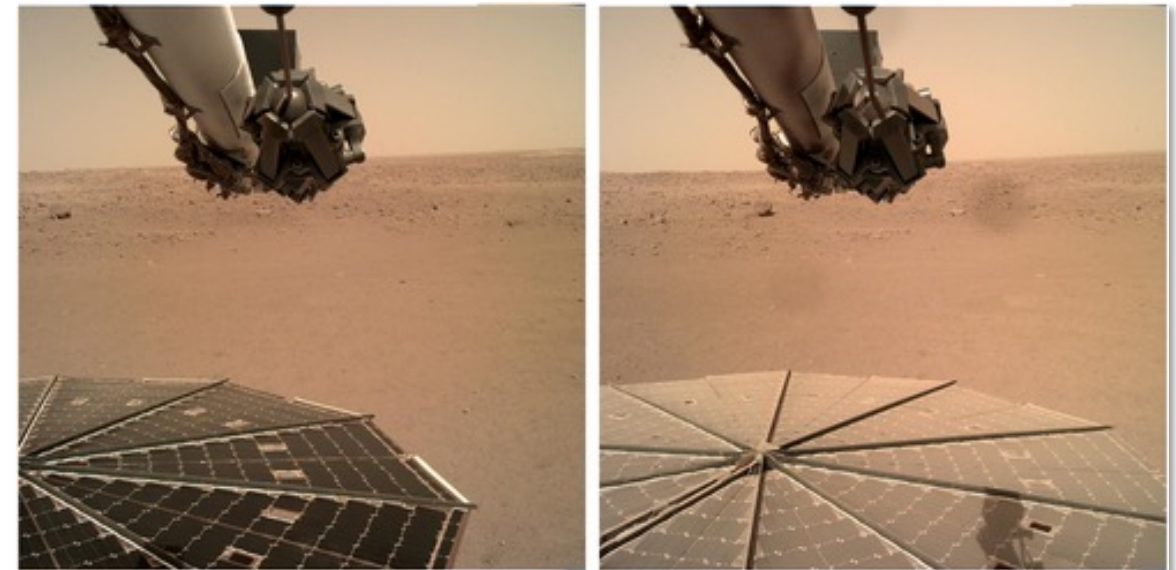


- Continuing to map Mars seismic activity: more than 1,300 ‘marsquakes’ detected to date
- Available power partially restored after sharp decrease caused by late-Sep/Oct dust storm
  - Generating 290–310 watt-hr/sol
- Science operations expected to cease late fall/early winter
  - Available energy stressing SEIS on-time
  - Current SEIS strategy: ~8 hours on, followed by 3 sols of recharge
- Detection of seismic waves from various meteoroid impacts:
  - **Garcia et al., 2022** (*Nat. Geosci*): Mag. <2 from four meteoroid impacts in 2020 and 2021
  - **Posiolova et al., 2022** (*Science*): Mag ~4 from a large impact on Dec 24, 2021
- For latest updates:

<https://blogs.nasa.gov/insight/>



*HiRISE view of impact crater (~150 m diameter) surrounded by blocks of excavated water ice. Crater formed Dec 24, 2021; impact detected by InSight SEIS*



*Accumulation of dust on InSight's solar arrays: stressing energy levels*

# Research & Community



# New Frontiers 5

- Fifth Community Announcement released September 1, 2022
  - Shares some policies under consideration for the AO and invites public comment to NASA
- Current planned schedule:
  - Estimated release of draft AO: December 2022
  - Estimated release of final AO: November 2023
  - Estimated proposal due date: March 2024
- Draft mission themes:
  - Comet Surface Sample Return
  - Lunar South Pole-Aitken Basin Sample Return
  - Ocean Worlds (only Enceladus)
  - Saturn Probe
  - Io Observer
  - Lunar Geophysical Network
- Comments and questions should be addressed to Curt Niebur, New Frontiers Program Scientist ([curt.niebur@nasa.gov](mailto:curt.niebur@nasa.gov))

# Technology

## Planetary Exploration Science Technology Office (PESTO)

New Manager: Erica Montbach  
(NASA Glenn)

## Technology Showcase for Future NASA Planetary Science Missions

January 9–11, 2023 Galveston, TX

More information: <https://nasa-techshowcase.seti.org/>



# Responses to June 2022 PAC Findings

# Finding 1: Decadal Survey

**Finding:** The PAC thanks the committee members of the Planetary Decadal Survey for their significant contribution in researching and generating the consensus report, “Origins, Worlds, and Life: A Decadal Strategy for Planetary Science and Astrobiology 2023-2032” (OWL). While the PAC is still digesting the full content of the OWL, we express our support for the excellent roadmap it provides for NASA in the coming decade. In particular, we express strong support for the OWL recommendations regarding: a. minimum R&A funding as a percentage of PSD total budget, b. the Recommended Program, c. actions to benefit the state of the profession, d. development and timely launch of NEO Surveyor, e. Uranus probe development start by FY24, f. development of sufficient RPS supply for the Recommended Program, and g. expanding commercial providers for CLPS and taking CLPS beyond the Moon. We look forward to NASA’s upcoming response to the OWL.

**Response:** NASA’s official initial (90-day) response to the 2023–2032 Planetary Science and Astrobiology Decadal Survey is available online at: <https://science.nasa.gov/solar-system/documents>. The full written response to NASEM is posted, along with presentation materials from the public community townhall held on August 18, 2022. There will be a dedicated period during this PAC meeting for discussion of the Decadal Survey.

# Finding 2: Workforce Information

**Finding:** The PAC endorses the recommendation from the Decadal Survey State of Profession chapter for the collection of information about the planetary science community workforce.

**Recommendation:** The PAC encourages PSD to explore creative ways to obtain and analyze these data, within NASA's legal confines; for example, working with professional societies and cross-AG forums. Such efforts should also be done in collaboration with social scientists with expertise on writing and administering such information collection. In future PAC meetings, the PAC requests to hear presentations from those who have successfully run past planetary science workforce surveys and other relevant information collections, to explore potential solutions and collaborations to fulfill this need.

**Response:** SMD will be issuing its first annual "Research Program Yearbook" early in 2023. It will contain demographic and other information about SMD proposal PIs, Co-Is, awards, and reviewers. It will also have division-specific sections on these data. Currently, OMB will not allow changes to the NASA-posed demographic questions, therefore, working with professional societies, cross-AG fora, social scientists, etc will not provide changes to the data obtained. We note that although professional societies are not bound by the same constraints of the Paperwork Reduction Act and Privacy Act as NASA, but those constraints extend to any study NASA asks a third-party to perform.



# Finding 3: Code of Conduct

**Finding:** The PAC recognizes the need for inclusion of a code of conduct (CoC) in all NASA-supported activities and encourages CoC standardization to ensure that best practices are being followed, which include a reporting and accountability structure—as also recommended by the Decadal Survey. The PAC commends the Astrobiology program for now requiring a CoC-type policy for field site use and the AGs for implementing CoCs for their steering committees and events.

**Recommendation:** The PAC recommends that NASA provide a code of conduct (CoC) template for all NASA-supported activities, which includes a reporting and accountability structure. For each activity, the CoC should be introduced at the beginning of the event and posted where appropriate, in order to encourage all participants to be both mindful and accountable.

**Response:** SMD is developing several approaches to improving the climate of science teams. SMD has been developing a template for a mission team Code of Conduct but, by its prescriptive nature, it could be viewed as interfering with the employer–employee relationship. A new approach is therefore being developed in which a team would develop an “Agreement on Acceptable Behavior” that would cover broad topics stated by SMD (and that SMD would review). With this approach, i.e., an agreement amongst team members, NASA would not be interposing itself between faculty and their universities, for example. Moreover, it would be expected that an “Agreement on Acceptable Behavior” would incorporate the resources and processes of the participating institutions.

# Finding 4: NSF Collaboration & ANSMET

**Finding:** The PAC recognizes the critical role of NASA's interagency collaboration and coordination with NSF. For example, over four decades, the U.S. has annually performed meteorite recovery through ANSMET (the Antarctic Search for Meteorites Program). The meteorites recovered by ANSMET are vitally important for planetary research, providing scientists from around the world with samples of planetary bodies not easily obtainable by other means and at relatively low cost compared to sample return missions. Meteorites motivate and provide key information to preparations for, analyses during, and context following current and planned missions to small bodies, moons and planets. ANSMET is funded by NASA but relies on logistical support of Antarctic field activities by NSF. Due to the ongoing COVID-19 pandemic, the 2020-21, 2021-22, and 2022-23 ANSMET field seasons have been canceled, halting meteorite collection and field work on analogs in Antarctica.

**Recommendation:** The PAC encourages NASA to pursue conversations with NSF to prioritize support for critical work funded by NASA but requiring NSF coordination and support. In particular, the PAC encourages resumption of ANSMET field seasons as soon as practical.

**Response:** NASA thanks the PAC for this finding and recommendation. NASA is planning to hold a meeting of the Meteorite Steering Committee (with members from NASA, NSF, and the Smithsonian Institution) in 2023, during which the ANSMET program will be discussed.

# Finding 5: Ground-based Radar

**Finding:** The PAC recognizes the importance of ground-based radar observations for both planetary science and planetary defense and continues to recognize the impact of the loss of Arecibo Observatory planetary radar system. The PAC supports ongoing cross-divisional discussion to replace the capabilities lost at Arecibo Observatory and supports the Decadal Survey recommendation, highlighted by many AG findings, to “develop a plan for ground-based planetary radar capabilities comparable to or exceeding those of the Arecibo Observatory necessary for achieving planetary defense objectives”.

**Response:** NSF, NASA, and US Space Force are participating in an NSF-led study, possibly also supported by other entities, to establish the context of the broad national needs for a next-generation planetary radar capability and possible technology concepts for addressing those needs. This study has taken longer than expected to initiate, but is now on track to kickoff in January 2023 and expected to provide preliminary input for the FY25 budget planning cycle in late spring 2023.

# Finding 6: R&A

**Finding:** The PAC commends PSD for their general successes in R&A trials (NoDD and DAPR), and related community presentations, intended to improve equity, efficiency, and transparency. Such transparency continues to build support and trust in the community for the R&A program.

**Recommendation:** The PAC recommends continuation of the NoDD and DAPR programs in the future. The PAC also recommends including a line in the selection letter to “selectable” proposals in NoDD programs with targeted response time. The PAC encourages PSD to continue to provide detailed communication about the R&A program to the planetary science community, specifically the high-fidelity data on proposal pressures, selection rates, community statistics, and assessments of the NoDD and DAPR programs presented to the PAC.

**Response:** NASA concurs with this recommendation. An anticipated timeline for a final decision on “selectable” proposals is now standard practice in notification letters. We will continue to keep the PAC and the planetary science community apprised of developments within the R&A program.

# Finding 7: H2O

**Finding:** The PAC commends the accomplishment of the organizers and student participants for the first year of the Here to Observe (H2O) program. We were very impressed at the activities and level of inspiration and passion displayed, as well as the great ideas from the student participants for improving the program.

**Recommendation:** The PAC recommends continuing to develop this program, especially in directions that will lead to lasting and authentic connections with the partner universities and following the advice of the student participants. This development should also include definition of ways to assess impact of the program. Additionally, the “co-creation” premise of this program was key for its success and should be continued, and perhaps should serve as a model for other NASA IDEA and outreach efforts; the importance of relationship building was also discussed in Planetary Science & Astrobiology Decadal Survey white papers, such as that by Gardner-Vandy, Scalice, et al. (#471).

**Response:** NASA thanks the PAC for the positive feedback. The H2O program has been extended for an additional pilot year, with two participating institutional partners (University of Puerto Rico and Virginia State University). This second pilot year will allow the incorporation of more student-suggested events, activities, and engagement opportunities with PSD missions and mentors. Student participant surveys are conducted quarterly to assess, longitudinally, the impacts of the program. These recurring surveys will remain a core aspect of H2O as we prepare for broader participation and will continue to include H2O ‘alumni,’ to allow tracing of STEM education/career outcomes.

# Finding 8: IDEA

**Finding:** The PAC commends NASA's support for the recent Advancing IDEA in Planetary Science conference (IDEACon), and the usefulness of the detailed report of recommendations from IDEACon. The PAC emphasizes that there remains a need for improved and intentional coordination for IDEA efforts within and outside of NASA SMD. While the Cross-AG IDEA working group helps with some of this coordination outside of NASA, the coordination is not yet sufficiently happening with the inside NASA efforts and between internal and external efforts.

**Recommendation:** The PAC endorses the recommendations from the IDEACon report and requests from NASA a response to the report's top recommendations for funding agencies at the next PAC meeting. The PAC urges further coordination between NASA and community efforts, with one option being the outward-facing IDEA-coordination position as well development of a centralized repository of relevant resources, as recommended in the IDEACon report. An existing model that may inform efforts to address this is the Planetary Data Ecosystem (PDE), where a paid, non-civil servant Chief Scientist has a mission to engage the community, is supported by an internal NASA group, and provides institutional support for a central information repository.

**Response:** NASA thanks the PAC for this finding and recommendation. A detailed response to the findings from IDEACon will require additional time and effort, but some initial commentary will be provided during the R&A Update during this PAC meeting.

# EXPLORE

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