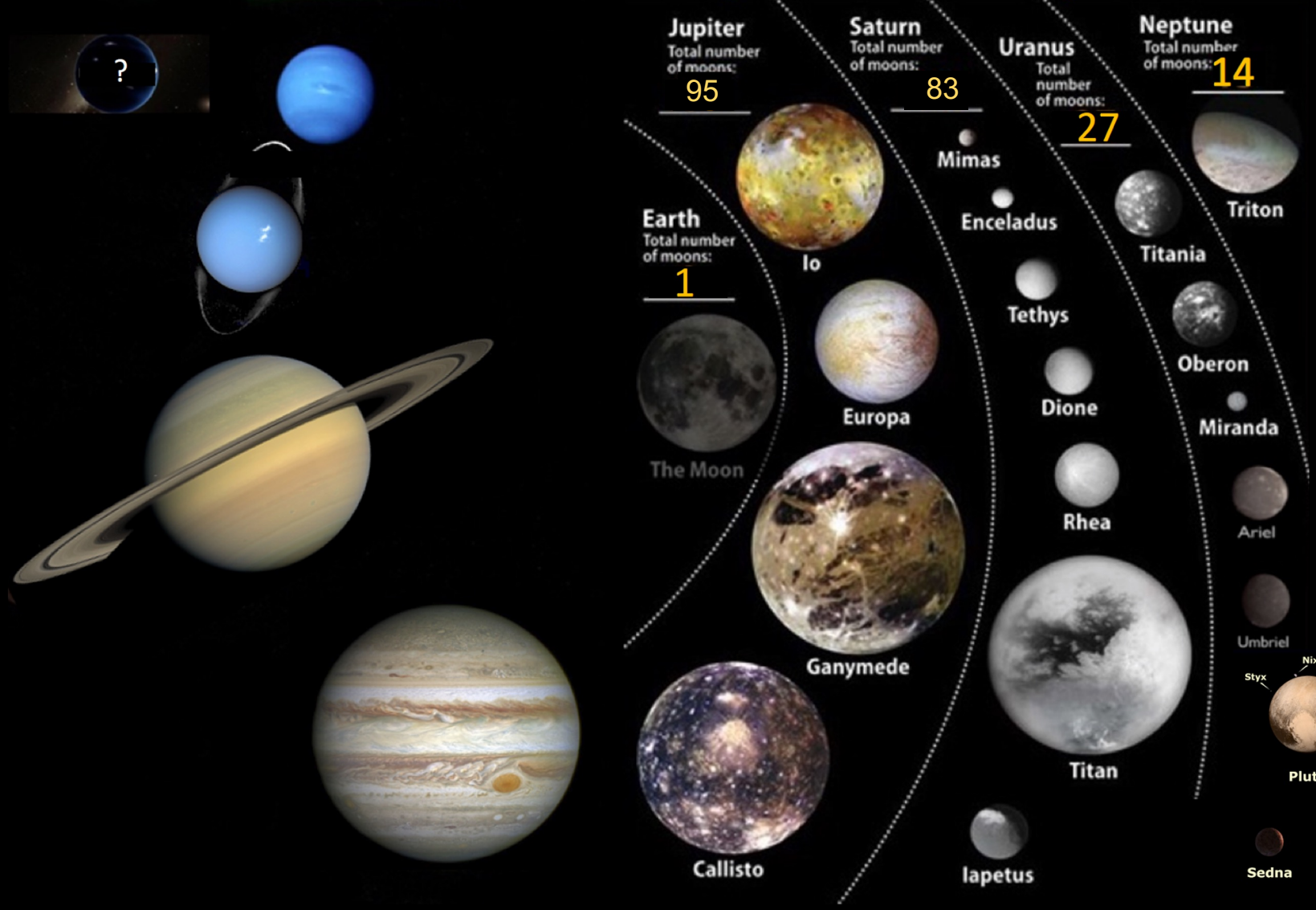
OPAG

OPAG Update to the Planetary Science Advisory Committee (PAC)

Amanda Hendrix, OPAG Chair, PAC Meeting, 1 March 2023

Outer Solar System: Many Worlds to Explore



OPAG *is* the Comparative Planetology AG

Large KBOs:

The 4th finding from the November 2022 OPAG community meeting (not included in OPAG report to PAC in Dec 2022)

- **OPAG encourages NASA to consider updating New Frontiers lists based on scientific, as opposed to schedule-based, considerations.**
- OPAG is concerned that, depending on the timing of future AOs, rigid assignment of mission themes to specific New Frontiers opportunities may not follow the scientific intent of the Origins, Worlds, and Life (OWL) decadal survey. Focusing on science would mean that targets that are linked to time-constrained mission opportunities would not be locked into a particular NF# list, thus allowing for more launch flexibility.
- The New Frontiers budget has historically enabled missions to the outer solar system with moderate-size payloads and long flight times. However, several scientifically compelling targets (e.g., Neptune/Triton, Uranus, and KBOs) require the use of gravity assists (e.g., Jupiter) to reduce flight time, and/or include launch vehicle requirements in order to fit into a New Frontiers envelope. Given that the required gravity assists are only periodically available, these requirements present a significant challenge when it comes to the exploration of particular outer planets targets. If schedules and/or budgets require shifting of pre-planned launch readiness dates (LRDs) even slightly, trajectories to certain targets can suddenly become unavailable. Similarly, shifting LRDs can also make trajectories to certain compelling targets suddenly available (e.g., Triton is unexpectedly accessible within the current NF5 LRD range).
- A specific example is the case of the Triton Ocean World Surveyor (OWS), which was recommended by OWL for inclusion in the NF7 list but not the NF6 list. As stated in OWL, this recommendation was based not on its scientific priority but on the fact that the assumed LRD range for NF6 did not include the required gravity assists to permit an appropriate trajectory. Given that the date range for NF6 assumed by OWL is almost certainly not going to be the actual LRD range, the justification for excluding OWS from NF6 is already likely obsolete.

OPAG concerns with draft NF5 AO

- A number of issues in the draft NF5 AO may put Outer Planet (OP) concepts at a disadvantage
- A 2-hr remote OPAG community town hall was held on Feb 16
- The community provided feedback on topics in draft AO
- OPAG S.C. is assembling the community feedback into a formal set of comments for NASA ahead of the March 3 due date for community comments
- Because costs are a concern for everyone
  - OPAG may suggest NASA to do more PMCS studies throughout the decade to prepare for future NF concepts & cost challenges
- The NF program is critical for OP science!
  - We do not have an Outer Planets Program, nor an Ocean Worlds Program
  - No Discovery mission to an OP target has been selected… we rely on NF

ESA Contributions

- Draft Language:
  - “A list of various hardware contributions in five cost bins is provided in the Program Library.”
  - “Proposers will not engage directly with ESA until Phase A after selection”
  - “After Step-1 selection ESA will select, in consultation with NASA and the PI(s), a minimum of two scientists from ESA member states to join each of the teams conducting a Concept Study.”

- OPAG Concerns:
  - There is currently no program library, and NASA has stated that it will not begin to populate it until April. How can proposers design missions without knowing specifics of potential hardware contributions?
  - Not being allowed to engage with ESA until Step-2 presents a planning challenge; How can proposers design missions without engaging with major component providers? (component spec sheets might not be sufficient)

- Possible Resolution:
  - OPAG encourages NASA to release the Program Library information as soon as possible, without introducing disadvantages to technically challenging OP mission proposals.
  - OPAG encourages NASA to clarify details about ESA contribution list specs and consider facilitating preliminary communication with European providers before Step-2 to refine and resolve questions on specs
  - OPAG suggests NASA to elaborate the (newly introduced) ESA-selected co-I process, perhaps modeling it after the Participating Scientist program

Launch Vehicles

- Draft Language:
  - The draft AO indicates that only the 4m fairing options are free. For 5m fairings the cost ranges from $13M to $72M. (Draft AO p.58 Section 5.9.2.1)
  - The Launch Vehicle performance curves are referred to, but not yet posted in the NF Library (deferred to April).

- OPAG Concerns:
  - Currently there are no launch vehicles with 4m fairing that are capable of supporting Outer Planets missions (I,e. with high C3 performance with reasonable mass delivered to target). Thus, this puts Outer Planets concepts at a cost disadvantage.
  - This potentially prevents proposing teams from selecting a launch vehicle, identifying available mass, and closing their point designs – until very late in the process.

- Possible Resolution:
  - OPAG requests that NASA post Launch Vehicle performance curves in the NF Library as soon as possible and to clarify the cost structure for available launch vehicles, with a consideration that does not disadvantage Outer Planets missions (fairing size, high C3 performance, delivered mass). For example, we urge NASA to consider providing free high C3 launch vehicle options to proposers that could deliver a usable mass to the Outer Planets, in line with the delivered mass capabilities for NF5 lunar concepts. (As there are only 5 m fairing options that exist for launch vehicles capable of supporting Outer Planets missions, this would remove the cost penalty and level the field with other NF5 concepts to near targets.)

Phase A-D Cost Cap

- Draft Language:
  - The PI-Managed Mission Cost (PIMMC) for Phases A-D will be capped at $900M in NASA Fiscal Year 2022 dollars (FY22$). These caps do not include the cost of a standard launch vehicle and launch services or any contributions. Application of AO-specified incentives and/or charges may result in a proposal-specific Adjusted AO Cost Cap.

- OPAG Concerns:
  - The $900M NF5 cost cap represents a 12.5% decrease as compared to NF4 ($1029M FY22 or $850M FY15). This is an issue for new teams as well as for those who plan to re-propose from NF4.
    - Proposal teams that are re-bidding have to shed $~130M off of their already mature designs. This puts them at a disadvantage.
  - It is not clear whether this ~$130 M reduction would be even partially offset by the ESA contribution (TBD) and free launch vehicle, which has challenges (or could be simply inapplicable) for Outer Solar System missions (separate discussion).
    - This creates a bias toward missions that can make use of the ESA list and/or free (i.e., 4-m fairing) launch vehicle; as already discussed, there are currently no launch vehicles with 4m fairing that are capable of supporting Outer Planets missions.

- Possible Resolution:
  - Closely tied to ESA Contributions, Launch Vehicles

Phase E Cost Cap

- Draft Language:
  - The PI-Managed Mission Cost (PIMMC) for Phase E will be capped at $300M in FY22$
  - Reserve posture: Traditionally, Phase E required no less than 15% reserves and required proposals to justify the reserve amount. NF5 AO requires 25% reserves, further reducing available funds.
- OPAG Concerns:
  - The Phase E cost cap penalizes missions with longer (especially active) cruise phases needed to reach outer planet targets and thus creates an unequal playing field – this biases against long-duration missions and is thus a **huge** problem for OP missions with their longer cruise times
  - The Phase E cap is especially problematic as the validation models (e.g., MOCET) are based on past flights. Validation models won't reflect novel efforts to meet the new cap.
  - *“I don't see at all how there can be an equitable reasonable proposal evaluation between an inner planet and outer planet when there is a Phase E cost cap”* (quote from a town hall participant)
  - Phase E cost cap could also limit the amount of people on the team itself, limiting the diversity of the proposal team
- Possible solutions:
  - Adding a credit for cruise duration could correct this imbalance.
  - Alternative to Phase E cap is to do more review of Phase E plans

Radioisotope Power Systems (RPS)

- Draft Language:
  - “Two technologies are under consideration for electrical power: the Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) and the Next Generation Radioisotope Thermoelectric Generator (RTG). Up to two MMRTG units or a single Next Generation RTG unit will be made available to proposers. Only one of these technologies will be offered, and NASA will communicate its decision **no later than the release of the final New Frontiers 5 AO**.” (Draft AO Section 5.9.3 & SOMA NF5 Draft AO Q&A 2/16/2023)

- Implications for OP missions:
  - Teams proposing an RPS-enabled concept will have to carry two separate designs until the final AO, then have just a few months to choose the allowed option and write the proposal … a logistical and proposal development cost challenge! This adversely affects OP missions, which tend to be more dependent on RPS.

- Possible Solution:
  - OPAG encourages NASA to finalize the RPS option by the end of May, 2023, at the latest.

Radioisotope Heater Units (RHU)

- Draft Language:
  - *Table 4* adds $5M to the mission cost for use of <43 RHU and $18M for >43 RHUs
  - *Table 2:* Use of RHUs will incur a cost of $25-39M
  - *Table 2 footer:* Use of RHUs will also incur a cost of $11M for nonstandard launch services.
  - *Page 28:* "Typical cost estimates to prepare an EIS involving RPSs or RHUs can be $1M+ and require more than one year to complete."
  - *Bottom Line:* Use of RHUs could add up to $56M (for no sample return, and for < 43 RHUs, and more if one needs more); this is a $51M cost upper (above the $5M unit cost); and an extra $13M if more than 43 RHUs are used.

- OPAG Concerns:
  - This primarily affects missions with no RTGs, only RHUs … more likely to negatively affect OP missions
  - With long cruise times and low power availability and with potential thermal design challenges, OP missions will be penalized for RHU usage with an additional $51M-64M cost upper in the edge case scenario. This RHU-only cost is on par with using RPSs + RHUs, without having the benefit of RPSs.
  - These RHU-only costs are in family with NF4 - but whereas such costs might have been accommodatable in NF4, with all the other costs and cap reduction in NF5, this could become a hardship in NF5.

- Possible solution:
  - OPAG encourages NASA to review the RHU cost information provided in the draft AO, and provide clarification and/or revision to the cost structure as soon as possible

Target List

- Draft AO language
  - (Sect. 2.4, p. 4). Proposals prepared in response to this AO must describe an investigation that addresses at least one out of any of the six mission themes described below. These themes, listed without priority, are:
    - Comet Surface Sample Return
    - Io Observer
    - Lunar Geophysical Network
    - Lunar South Pole-Aitken Basin Sample Return
    - Ocean Worlds (only Enceladus), and
    - Saturn Probe

- Community Discussion:
  - Given the timing concerns for many targets in the outer solar system (that led to OPAG's November 2022 4th Finding - see slide 2), the NF5 target list was a topic of discussion
  - The community has a desire to ensure that the NF5 stays on schedule
  - The community discussed opening the ocean worlds targets or at least broadening the focus on Enceladus science more generally instead of just focusing on search for life
  - It was noted that moving targets from future NF calls to NF5 (or NF6) is different than adding brand new targets


MEXAG

Mercury Exploration Assessment Group (MExAG)

March 1, 2023

Steven A. Hauck, II, MExAG Chair

Case Western Reserve University

MExAG Steering Committee

Steven A. Hauck, II
Case Western Reserve U.
Chair

Carolyn Ernst
JHU APL
Vice-Chair

Ronald J. Vervack, Jr.
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Exosphere Discipline Member

Stephen Parman
Brown University
Geochemistry Discipline Member

Christian Klimczak
U. of Georgia
Geology Discipline Member

Catherine L. Johnson
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Geophysics Discipline Member

Gina DiBraccio
NASA GSFC
Magnetosphere Discipline Member

Ariel Deutsch
NASA ARC
Early Career Member

Ryan Dewey
University of Michigan
Early Career Member

Suzanne Imber
U. of Leicester
International Liaison

Shoshana Weider
NASA HQ
NASA Liaison

Four Steering Committee positions will be open for nominations later this spring.

MExAG Activities

- Goals Document: On target to complete the first MExAG Science Goals Document in Q2 2023
- MExAG23: Feb 1–3, 2023 (virtual, 3 hr/day)
  - >130 total participants with 90–110 each day
    - ~1/3 international
  - 47 presentations
    - >50% of presenters were early career researchers
  - Breakout discussions to kick-off development of upcoming Community and Technology Goals Documents
  - Extended discussions of IDEA, support of early career researchers.
  - Produced three new Findings

Finding: Discovery Program

- MExAG is disappointed that problems with the Psyche mission have led to substantial negative consequences for other PI-led missions. The MExAG community supports the principle that each competitively selected, PI-led mission should have the opportunity to proceed through the development process, including reviews and key decision points, on its own merits to achieve the science for which it was selected.

- Further, MExAG notes that within the context of the recommended program for missions in the most recent Decadal Survey, *Origins, Worlds, and Life*, it is the only AG community for which Discovery is the sole potential avenue for exploration in the next decade. This fact, compounded by the long cruise times for missions to Mercury, means that any delays or reductions in the Discovery AO cadence will disproportionately impact opportunities for exploration of the innermost planet and the health of the Mercury community.

Finding: Decadal Survey Mission Assessment Process

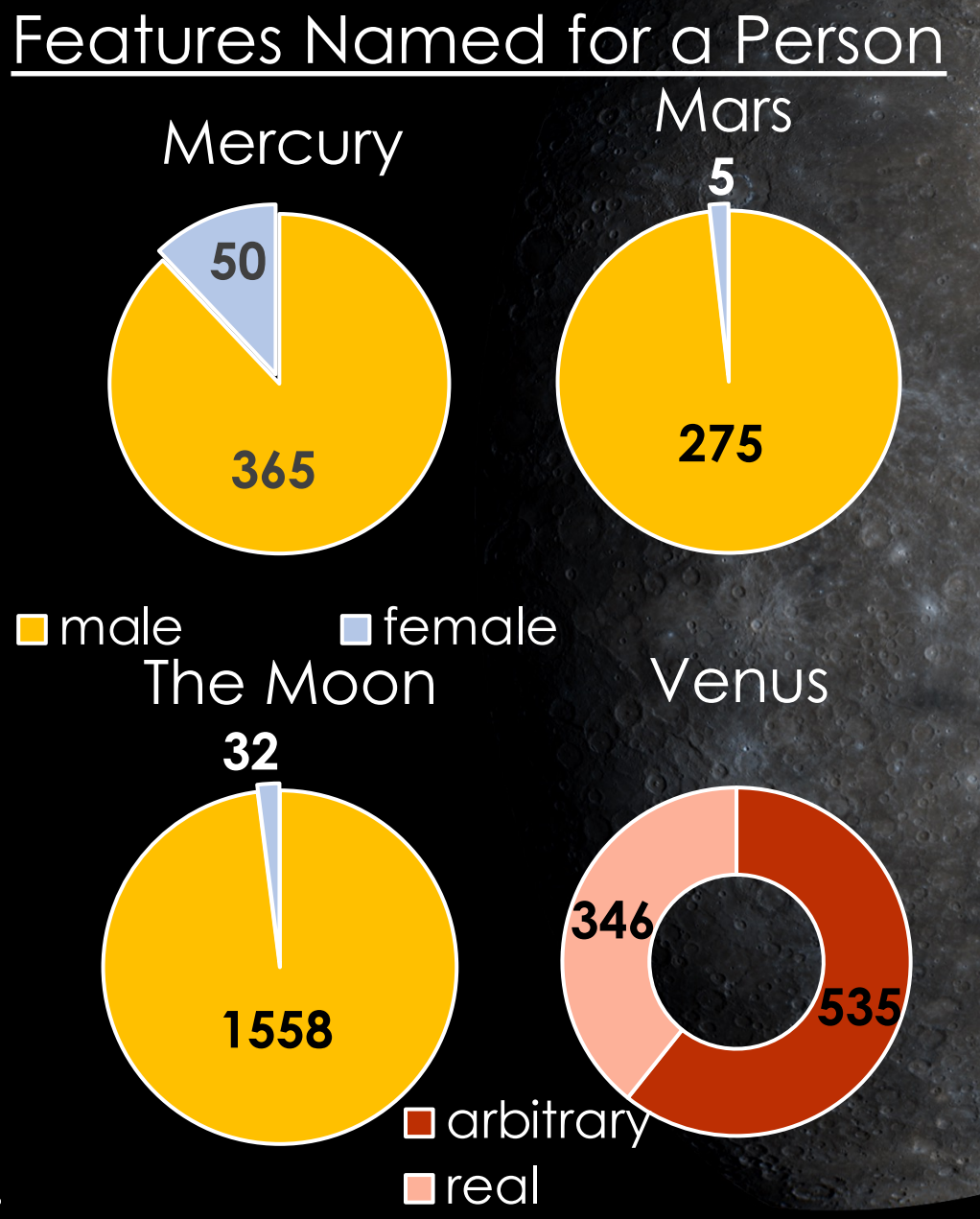
- The Decadal Survey applied independent cost and risk (TRACE) assessments of the mission concepts. However, the extraordinarily brief TRACE outcomes presented in Appendix C of *Origins, Worlds, and Life* lacks documentation of the specific drivers of cost and risk in their assessments. These drivers are vital for NASA and the planetary science community to identify technologies in need of investment.
- MExAG encourages NASA to ensure that all future assessments of cost and risk of mission concepts associated with the Decadal Survey be disclosed with at least the same level of detail as any pre-Decadal Survey mission study programs. Decadal Survey related mission studies and their results should be disclosed consistent with all Open Science expectations at NASA, without exception.

Finding: Gratitude for Decadal Survey

- The MExAG community is extraordinarily thankful for the incredible efforts of everyone who served on the Decadal Survey and produced such a detailed and comprehensive strategy for astrobiology and planetary science in the coming decade.

Highlight: Representation in naming conventions

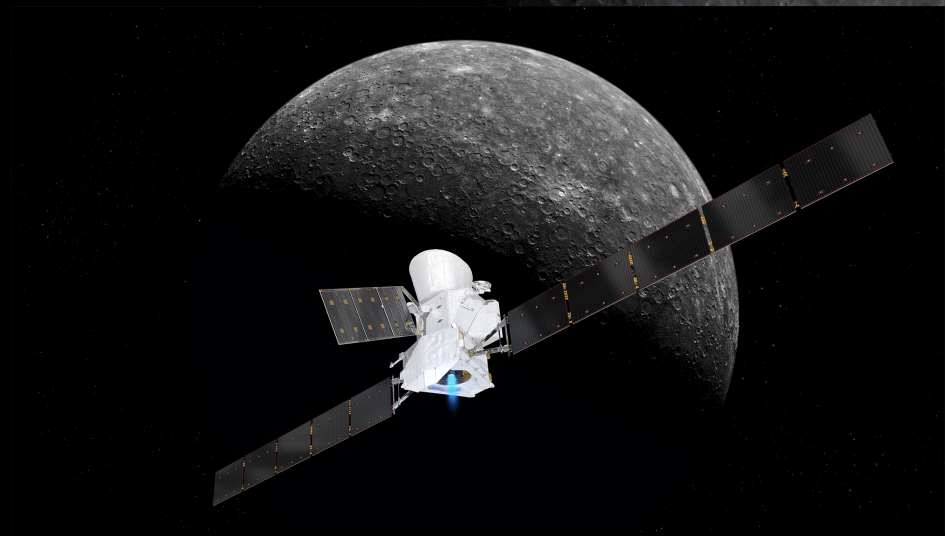
- Annie Lennox (Open University) compared features named for people.
- Representation is poor across all bodies.
- 12% named for women on Mercury, 2% on Moon and Mars.
- 39% of named features on Venus are for real persons.
- Study focuses on gender and acknowledges that imbalances along other axes exist as well.
- Current naming conventions:
  - put weight on **historical celebrity status**
  - were written during a time when diversity within the sector was extremely poor
  - exclude representing individuals of **political**, military or religious significance
  - do not allow for name repetition even on different bodies



Lennox & Rothery, *Naming conventions and underrepresentation: on Mercury and across the Solar System*, MExAG Ann. Mtg, #6032, 2023.

Summary and Upcoming Mercury Events

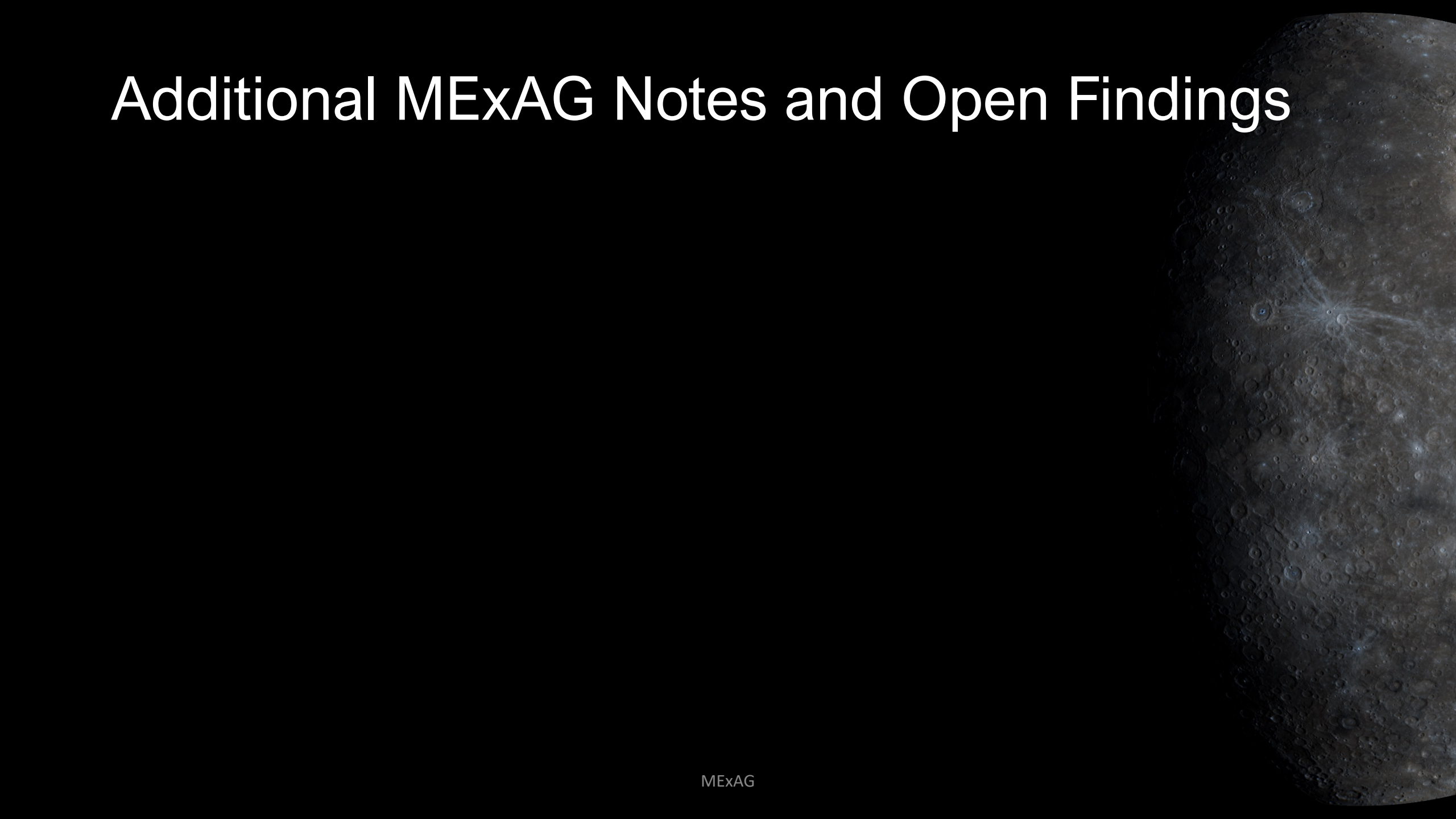
- New Discovery Program Finding: Support for competitively selected PI-led missions to proceed through development process and reviews to achieve science for which they were selected. Delay in Discovery AO disproportionately impacts opportunities to explore Mercury
- New Decadal Survey Process Finding: Results from cost and risk assessments should be released in detail in all future Surveys.
- LPSC 2023, 13–17 March 2023
- Mercury 2024, To be held in Japan
- BepiColombo:
  - Mercury Flyby 3, 20 June 2023



MExAG: https://www.lpi.usra.edu/mexag

Twitter: @ExploreMercury

Additional MExAG Notes and Open Findings



Ongoing Finding: Ground-based Observatories

- Ground-based optical, infrared, and radio/radar observations play a critical role in the study of Mercury. MExAG encourages NASA to work with key facilities to address procedural/logistical obstacles that create serious challenges for proposals to observe Mercury, particularly during the coming years when support for – and coordinated science with – the BepiColombo mission is vital to provide increased science context.
- MExAG encourages NASA to:
  - Work with optical telescope facilities on which NASA acquires time (e.g., Keck Observatory) and their Telescope Allocation Committees (TACs) to ease the scheduling of twilight-time observations for Mercury. Many telescopes require half-night or even full night proposals; however, Mercury is only available for 1-2 hours at the beginning or end of the night, substantially disadvantaging observers of the innermost planet.
  - Engage with Goldstone and Green Bank Telescope, to ensure that there are equitable opportunities for planetary science observations, particularly now that Arecibo is no longer an option.
  - Allow observers to obtain letters of endorsement from NASA for Mercury observations in support of the BepiColombo mission during the upcoming flybys and orbital mission.

Decadal Survey – Highlighted Recommendations

- R&A constitute 10% of PSD budget.
- Technology be 6–8 % of PSD budget.
- New NF concepts due to new discoveries be evaluated before NF-7.[a]
- Plutonium-238 needs be evaluated against mission portfolio and increased as needed.[a]
- Expanding support for ground-based telescope observations and planetary astronomers.[a]
- Reviewing current radar infrastructure to meet community needs, including replacing capabilities lost with Arecibo.[a]

[a] MExAG has presented findings to the PAC in 2021 & 2022 consistent with these recommendations.


MEPAG

- In short:

- VERITAS before a new AO.
- Keep talking science for Moon-and-Mars.
- Mars needs infrastructure.
- Watch this space for the MEP strategy.

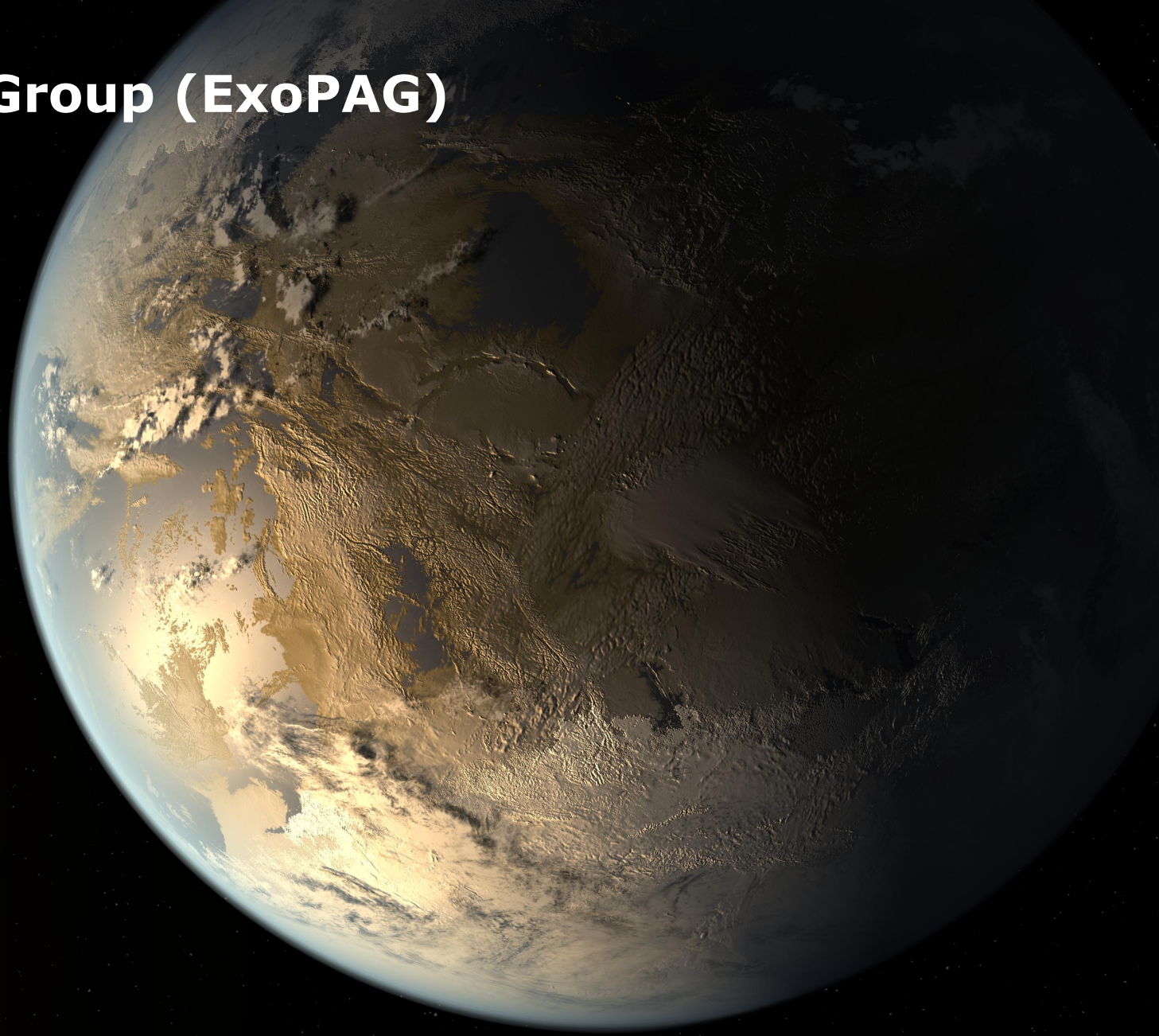
Mars Exploration Program Analysis Group (MEPAG)

- Since the last PAC meeting, MEPAG held a Virtual Meeting Feb. 27, 2023.

- VERITAS: With respect to a question raised by PSD at the last PAC meeting regarding prioritization of Discovery funding, MEPAG believes that the Discovery Program should prioritize in the following order: 1. Already selected missions; 2. New AOs.
- Moon-and-Mars: To ensure that the highest quality, highest priority science objectives will be met, science must be integrated into the implementation of the human program from the beginning. MEPAG proposes to engage with LEAG to define a clear message on the key science the community would like to focus on with respect to MaM.
- And by the way: Given that the next opportunity to launch an orbital Mars mission is no sooner than 2028 (and more likely 2031), there is an urgent need to establish a communications infrastructure plan for Mars, including the ground segment.
- MEP Strategy: This is still being circulated among stakeholders, so it was not presented at the meeting. We expect to hear more at our April 11-12, 2023 Face-to-Face (F2F) meeting.

ExoPAG

Exoplanet Program Analysis Group (ExoPAG)
Report to PAC



Ilaria Pascucci (U. Arizona)
Chair, ExoPAG Executive Committee
Laura Schaefer (Stanford)
ExoPAG EC member, PAC representative

December 6, 2022

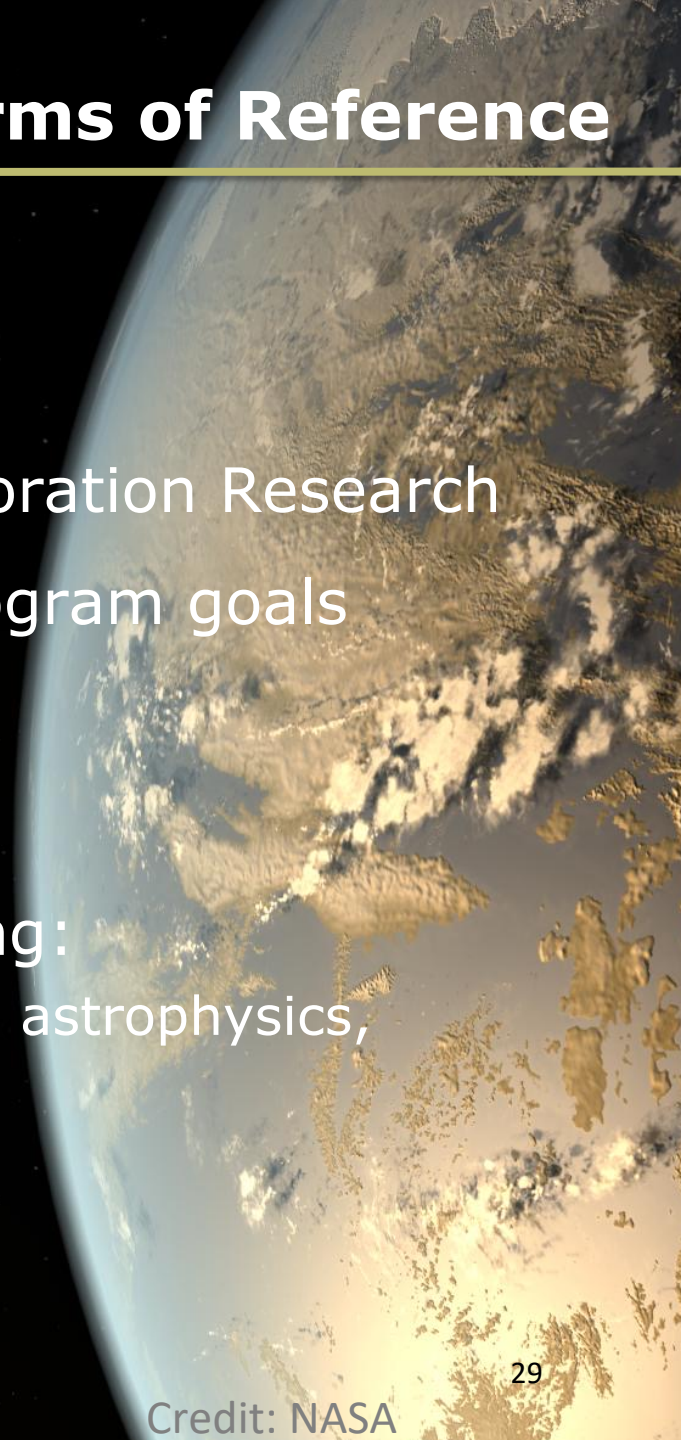
Credit: NASA

Exoplanet Program Analysis Group: Terms of Reference

(charted by the Astrophysics Division)

1. Articulate & prioritize science drivers for Exoplanet Exploration Research
2. Evaluate capabilities of potential missions to achieve program goals
3. Evaluate ExEP activities with broad community input
4. Articulate & prioritize new mission technologies
5. Provide findings on all related program activities including:

ground-based observing, theory and modeling programs, laboratory astrophysics, suborbital investigations, data archiving, community engagement



Credit: NASA

Ilaria Pascucci *Chair*	The University of Arizona
Natasha Batalha	NASA-Ames
Jacob Bean	The University of Chicago
Michael Bottom	The University of Hawaii
Ofer Cohen	University of Massachusetts Lowell
Knicole Colon	NASA GSFC
John Debes	STScI
Diana Dragomir	University of New Mexico
Erin May	Johns Hopkins Applied Physics Laboratory
Bertrand Mennesson	Jet Propulsion Laboratory/Caltech
Laura Schaefer	Stanford University
John Wisniewski	The University of Oklahoma
Michael Meyer *Past Chair, Emeritus*	University of Michigan
Hannah Jang-Condell, *Executive Secretary, Astrophysics Division*	NASA Headquarters
Douglas Hudgins, *Program Scientist, Exoplanet Exploration Program*	NASA Headquarters
Doris Daou, *NASA Planetary Science Division Liaison*	NASA Headquarters
Richard Eckman, *NASA Earth Science Division Liaison*	NASA Headquarters
Galen Fowler, *NASA Heliophysics Division Liaison*	NASA Headquarters

2022 ExoPAG Executive Committee members

Identified all of the ongoing (and some of the upcoming) activities as well as EC members who could lead them

New member applications are being reviewed right now as several EC members will be rotating off in April.

Thank you to those who volunteered!

ExoPAG ongoing & recent activities I (since the last PAC meeting)

- Organize monthly ExoPAG EC meetings (1/8,2/15), cross-PAG meetings, rep. to APAC (I. Pascucci)
- Reviewed ExEP Science Gap List (deadline 9/30, all EC members)
- Ongoing activities with the Planetary Science Division: Exoplanets in Our Backyard workshop (Nov. 2-4, 2022) & Planetary Science Advisory Committee meeting (rep.: L. Schaefer)
- Organization of the ExoPAG27 meeting (all EC members)

ExoPAG ongoing & recent activities II (since the last PAC meeting)

- Great Observatory Maturation Program (GoMaP) workshop II, 11-13 Oct. (rep.: B. Mennesson & M. Bottom)

- Cross-PAG SAG on barriers to participation (rep.: N. Batalha). Cross-AG IDEA working Group (rep.: E. May), the EC has signed the recent response to the New Frontiers AO draft requiring Inclusion Plans

- ExoExplorers Program (rep.: K. Colon & N. Batalha)

ExoPAG ongoing & recent activities III (since the last PAC meeting)

- NASA Open Science Initiative (Liaison: N. Batalha).

ExoPAG EC meeting 9/21: the EC discussed the Space Telescope User Committee Report (no endorsement of the Zero Exclusive Access Period and recommendation to solicit broader community feedback). The EC supports the STUC's decision/recommendation and discussed community concerns regarding no proprietary data for JWST

- Science Interest Groups (SIGs) and Study Analysis Groups (SAGs):

- SIG2 "Exoplanets Demographics", finalizing report (Christiansen & Meyer)
- SIG3 "Exoplanets Solar System Synergies", on-going (Meadows & Mandt)
- SAG23 "The Impact of Exo-Zodiacal Dust on Exoplanet Direct Imaging Surveys" (Debes, Rebollido, Hasegawa)

Cross-PAG SIG to support IROUV GOMaP-related activities

Meeting of the PAGs EC Chairs on Sep 9, 2022: agreement on the number/distribution of leads among PAGs. New discussion planned after this APAC meeting to better define the TOR

- The SIG would conduct analyses on scientific and related technical issues that would inform GOMaP
- The SIG would take full advantage of work done previously by STDTs, and other entities such as the NASA Exoplanet System Science (NExSS) research coordination network
- All PAGs will be included in this activity: coordination by a five-person team comprised of members of ExoPAG, COPAG, and PhysPAG
- The SIG would conduct analyses coordinated and prioritized by the leadership team
- Specific analyses would result in technical reports addressed to NASA's Astrophysics Division in time-limited activities
- We expect that such a cross-PAG SIG would be useful to APD for several years

ExoPAG SAG 23

The Impact of Exo-Zodiacal Dust on Exoplanet Direct Imaging Surveys

Co-leads: J. Debes, Y. Hasegawa, I. Rebollido

SAG23 includes 38 members working on eight major subject areas:

- A Catalog of Dusty Systems around Nearby Stars (lead: Steve Ertel)
- A review of host dust systems (leads: Steve Ertel and William C. Danchi)
- The theory of Exozodi Sources and Dust Evolution (lead: Mark Wyatt)
- Post-Processing and Detection of Extended Sources (leads: Ewan Douglas, Max Millar-Blanchaer)
- Pan-Chromatic Radiative Transfer of Exozodis (lead: Ramya M. Anche)
- Prioritization of Precursor Observational Studies of Debris Disks/Exozodis for future direct imaging missions (leads: Max Millar-Blanchaer, William C. Danchi)
- Prioritization of Precursor Theoretical Studies of Debris Disks/Exozodis for future direct imaging missions (lead: Jess Rigley)
- Update and prioritization of ExEP Gaps relevant to Exozodis (lead: Emily Rickman)
- A Review of the Solar System's Zodiacal Cloud (leads: Neal Turner, Geoff Bryden)

Several groups had their first organization meeting
Other interested members of the community are welcome to join and contribute!

https://sites.google.com/view/sag23-exozodiacaldust/home

ExoPAG 27 meeting

announcement on exopagannounce@jpl.nasa.gov

- Saturday Jan. 7 & half day Sunday Jan. 8 in Seattle had more than 100 attendees
- Two major changes (discussed and approved by the EC): 1. More accessible presentations (reduce acronyms, more background); 2. Group presentations by topic (D. Dragomir & O. Cohen)
- Mini-symposium focused on recent JWST results with contributions from early-career scientists (E. May)
- Two structured discussions during the business meeting on Zero Proprietary Periods and the Biosignature Assessment Standards. Anonymized minutes to be shared with community (M. Bottom).

https://exoplanets.nasa.gov/exep/events/388/exopag-27/

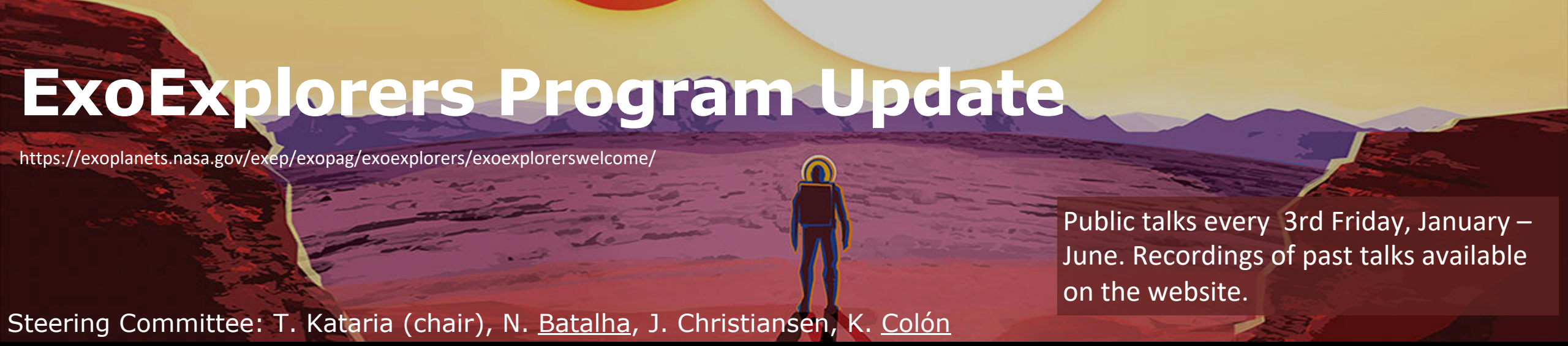
ExoPAG 28 meeting planning

- September 30 – October 1, 2023, in conjunction with the 55th Division of Planetary Sciences annual meeting in San Antonio, TX

- Last time an ExoPAG meeting was held at a DPS meeting was in 2013
- The EC invites suggestions on topics that would strengthen the connection between the astronomy and planetary science communities focused on exoplanets

ExoExplorers Program Update

https://exoplanets.nasa.gov/exep/exopag/exoexplorers/exoexplorerswelcome/



Public talks every 3rd Friday, January – June. Recordings of past talks available on the website.

Steering Committee: T. Kataria (chair), N. Batalha, J. Christiansen, K. Colón

- Third cohort of ExoExplorer Science Series (Jan-Jun 2023), 12 early-career scientists
- Scope of the program expanded to include international ExoGuides and ExoExplorers

- ExoExplorer Program Steering and Organizing Committees developed the call for the next round of ExoGuides and for the third cohort of ExoExplorers in Jul-Aug 2022. Applications due Sep 2022
- 48 ExoExplorer applications were submitted along with 4 new ExoGuide nominations

- The first cohort of ExoExplorers had a Special Session at AAS 241 (Jan 2023) "*The ExoExplorers: Early-Career Perspectives on the Intersection of Exoplanet Science and DEIA in Astronomy*"


ExMAG

Extraterrestrial Materials Analysis Group (ExMAG)

PAC meeting, March 1, 2023

Barbara Cohen, Chair

ExMAG.community@gmail.com

ExMAG membership

ExMAG STEERING COMMITTEE

ExMAG Chair
Barbara Cohen

Astromaterials Curator
Francis McCubbin

NASA HQ Liaison
Kathleen Vander Kaaden
Jeff Grossman

Facilities and Informatics Subcommittee
Sample curation facilities, databases, and catalogs
Pierre Haenecour
Rhiannon Mayne

Barbara Cohen (GSFC), Chair
Jemma Davidson (ASU), Vice-Chair
Michelle Thompson (Purdue), Secretary
Jessica Barnes (U of Arizona)
Kate Burgess (NRL)
Jon Friedrich (Fordham)
Juliane Gross (Rutgers)
Pierre Haenecour (UA)
Lydia Hallis (U Glasgow)
Philipp Heck (Field Museum)
Manavi Jadhav (UL)
Yang Liu (JPL)
Rhiannon Mayne (TCU)
Molly McCanta (UT)
Larry Nittler (CIW)
Laura Chaves (Purdue) – nonvoting EC member, social media coordinator

Lunar Sample Subcommittee
Apollo samples, Artemis sample planning
Jessica Barnes

Mars Sample Subcommittee
MMX and Mars Sample Return planning
Lydia Hallis and Yang Liu

Microparticle Subcommittee
Cosmic Dust, Stardust mission, microparticle impacts
Philipp Heck

Asteroid Subcommittee
Hayabusa, Hayabusa-2, OSIRIS-Rex
Larry Nittler

Meteorite Subcommittee
Antarctic meteorites
Jon Friedrich

Genesis Subcommittee
Genesis mission
Larry Nittler

ExMAG recent activities

- Continuing to advance how we engage with our community
  - Brought on a non-voting early career member (Laura Chaves) to run social media
  - Moving to a single annual meeting with contributed posters (collections and facilities, including recent PSEFs) and discussion sessions, possibly supplemented with Virtual Town Halls
  - Subcommittees will start producing (short) annual reports on the state of their communities and collections, use them to engage at public meetings/ town halls
- Revitalizing the Mars Subcommittee
  - Lydia Hallis (Europe side) and Yang Liu (US side)
  - Focusing on the broader analysis community for returned Mars samples – is the community ready, what do we / NASA need to get ready
  - Complementary to MSR project, standing ready to help if needed
  - Cross ties to MEPAG
- Subcommittee activities
  - Meteorites and Lunar subcommittees working together to finalize their recommendations for revision of the lunar nomenclature.
  - Asteroids subcommittee considering several curation-focused decisions for collections management
  - Lunar cryo sample science – in formulation
- Annual meeting April 25-27, 2023
  - First in person meeting of ExMAG ever!
  - Virtual delivery for community participants

Continuing the Sample Data Conversation

- ExMAG submitted comments and recommendations to SPD-41 pertaining to current, NASA-compliant data repositories available to archive planetary sample analysis data and spacecraft mission activities involving sample analysis, but these were not incorporated into the revision.
- ExMAG has engaged Moses Milazzo / Planetary Data Ecosystem activity to include issues and topics specific to sample analysis
- ExMAG Annual Meeting will include discussion and Q&A on SPD-41a and Astromat, as well as the example that OREx mission is setting.
- ExMAG F&I subcommittee will stand up a working group to promote community engagement initiatives and help define community standards for Astromaterials data archiving.

Findings and issues for the PAC

- ExMAG continues to encourage NASA to explore a path to permit sample exchange and reciprocal sample loans between NASA and CNSA. This will become even more urgent as China's Chang'E-6 mission will return material from the South Pole-Aitken (SPA) basin. SPA sample return has been the highest priority for the lunar science community in three consecutive Decadal Surveys but there is currently no NASA plan to implement such an activity. Facilitating US scientists working with SPA samples from such a mission would be a uniquely enabling opportunity.
- Thank you to the PAC for elevating the ANSMET criticality – we look forward to engaging with NASA and NSF on this conversation
- Nothing pressing that we need the PAC's help with ☺


MAPSIT

Mapping and Planetary Spatial Infrastructure Team (MAPSIT)

Findings for the Planetary Advisory Committee (PAC) Feb 28–Mar 1, 2023 Meeting

Updates to MAPSIT Steering Committee

Brad Thomson (Univ. Tenn.), *Chair*

Julie Stopar (LPI), *Vice Chair*

Brent Archinal (USGS)

Ross Beyer (SETI/NASA Ames)

Sander Gossens (NASA Goddard)

Justin Hagerty (USGS), *Ex Officio*

Trent Hare (USGS)

Jay Laura (USGS)

Sam Lawrence (JSC), ESDMD rep, *Ex Officio*

Myriam Lemelin (Université de Sherbrooke, Canada)

Jeannette Luna (Tennessee Tech Univ.)

Becky McCauley Rench (NASA HQ), *Ex Officio*

Moses Milazzo (Other Orb), *Ex Officio*

Pete Mouginis-Mark (Univ. Hawaii)

Andrea Naß (DLR, Germany)

Jani Radebaugh (Brigham Young Univ.), *past Chair*

David Williams (Arizona State Univ.)

MAPSIT Findings (1 of 1)

Finding: The requirement for proposers to include Data Management Plans (DMPs) into science and mission proposals has been a success. Perhaps other proposal components could benefit from a similar approach.

- DMPs were introduced gradually, initially scored separately from Merit, Relevance, and Cost (with non-binding scores).
- DMPs scores are now incorporated into findings of Merit.
- NASA has made a template available for DMPs to reduce burden on proposers; evaluation criteria are clearly defined.

MAPSIT Findings (1 of 1)

Finding: The requirement for proposers to include Data Management Plans (DMPs) into science and mission proposals has been a success. Perhaps other proposal components could benefit from a similar approach.

- It is a still a burden to produce a DMP, but reduction of uncertainty means they can be produced with economy of effort.
- *Inclusion plans* might not lend themselves to templatization (e.g., there may not be a one-size-fits-all approach), but clarity of evaluation metrics would benefit the community.

Upcoming activities

- 6th Planetary Data Workshop (PDW): June 27-30, 2023, Flagstaff, AZ, in hybrid format
  - Organizers: Trent Hare (USGS)

- Planetary Geology Mappers' Meeting: Oct 15–18, 2023 as part of GSA Annual Meeting in Pittsburg, PA. Hybrid format.
  - Organizers: Jeanette Luna (TN Tech) and Jim Skinner (USGS)


VEXAG

PAC meeting March 1, 2023

VEXAG

VERITAS
Findings in light of ROSES 2023
Venus Exploration Strategy
Upcoming Activities

Noam Izenberg	Applied Physics Laboratory, Chair
Debra Buczkowski	Applied Physics Laboratory, Deputy Chair
Natasha Johnson	Goddard Space Flight Center
Stephen Kane	University of California at Riverside
Molly McCanta	University of Tennessee
Jason Rabinovich	Stevens Institute of Technology
Siddarth Krishnamoorthy	Jet Propulsion Laboratory, EC Representative
Sara Port	Glenn Research Center, EC Representative
Chuanfei Dong	Princeton University, EC Representative
Eric Grosfils	Pomona College
Erika Kohler	Goddard Space Flight Center, EC Representative
Alexander Akins	Jet Propulsion Laboratory, EC Representative
Tracy Gregg	University of Buffalo
Michael Way	Goddard Institute of Space Studies
Anna Gülcher	Jet Propulsion Laboratory, EC Representative
Daniel Nunes	Jet Propulsion Laboratory
Natalie Punt	Scribe
Nick Lang	NASA HQ, ex officio

PAC meeting March 1, 2023

VEXAG

VERITAS

Findings in light of ROSES 2023

Venus Exploration Strategy

Upcoming Activities

VERITAS

Current Status

1. HQ has removed all VERITAS engineering funding from NASA's budget though FY28 (restart funds are required in FY25 for FY31 launch)
2. HQ asked to see launch dates 'beyond FY31'
3. November communication promised SciTeam funding for FY23-5
4. Restart Criteria need more specificity

Since the last PAC meeting, SMD has taken two actions relevant to budget and JPL workforce:

1. Confirmed NEO Surveyor, managed at JPL, for a 2027 launch. Their overall budget is similar to VERITAS.
2. Issued the draft NF call, for LRDs starting in 2031

Workforce Needs

1. VERITAS workforce footprint at JPL is very small, especially in areas deemed critical by the Psyche IRB
   - The spacecraft is being built by Lockheed
2. Workforce needed in the critical areas:
   i. In FY23 (before the stand-down order) VERITAS had ~5 people
   ii. In peak development year, VERITAS would need 15 people

PAC DISCUSSION / SUPPORT REQUESTED

- Endorsement of VERITAS Launch in 2031 with restart in 2025
- Endorsement of VERTAS priority over new Discovery call (as per OWL guidelines)

PAC meeting March 1, 2023

VEXAG

VERITAS
Findings in light of ROSES 2023
Venus Exploration Strategy
Upcoming Activities

FINDINGS

- A **"Precursor Science Investigations – Discovery" (PSI-D) R&A program**, focused on ensuring success of and maximum scientific return from upcoming Discovery missions and the EnVision partnership, is in the interests of the broad planetary community. Could be expanded to PSI-C to include pre-phase E of any competed science mission.
- A new **"CloudTech" R&A program** to focus on aerial/airborne technologies and implementations applicable to multiple planetary targets, in addition to a **HOTTech 3 program**, in an upcoming ROSES cycle would allow focus on maturing important technologies and integration into platforms and systems.

PAC DUSCUSSION / SUPPORT REQUESTED

- Endorsement PSI-D ROSES concept in upcoming years
- Endorsement of HT3, then CloudTech in upcoming years

VEXAG Venus Strategy Study Analysis Workgroup

Mandate

Develop a community-supported strategy for Venus exploration for the coming decade and beyond:

> "NASA should develop scientific exploration strategies, as it has for Mars, in areas of broad scientific importance, e.g., Venus and ocean worlds, that have an increasing number of U.S. missions and international collaboration opportunities"
>
> *Origins, Worlds, and Life*, p. 22-10

> "NASA… asserts that specific scientific exploration strategies should be community generated by bodies such as the Analysis Groups, advisory committees, and NASEM's standing boards and commissioned studies"
>
> *NASA's Initial Responses to the 2023–2032 Planetary Sciences Decadal Survey, 22 August 2022*

Approach

Solicit community feedback to update 2019 VEXAG strategic documents in light of the 2021 selections of VERITAS, DAVINCI, and EnVision, and the comparative planetology recommendations relevant to Venus in *Origins, Worlds, and Life*.

Schedule

Finish gathering community input by the summer; draft strategy by early autumn; final strategy document presented at VEXAG 2023

Next Opportunity for Community Input

Thursday of LPSC (March 16) at 2:00 pm, Indian Springs room

PAC Discussion and Support Requested

Feedback on draft(s), potential endorsement of document

PAC meeting March 1, 2023

VEXAG

VERITAS
Findings in light of ROSES 2023
Venus Exploration Strategy
Upcoming Activities

Upcoming Activity Highlights

LPSC

- 2 Oral, 1 Poster, 1 virtual poster session, Multi-AG workforce presentation on AG committee selection
- Early Career Mixer (Tuesday, between talks and posters)
- VEXAG Town Hall (Wednesday, 11:45-1pm)
- Venus Exploration Strategy Community meeting (Thurs 2pm)

EnVision Science Team Meeting (May 9-11, Berlin)

Venus Laboratory Capability Workshop (June 3-4, Wesleyan)

21st VEXAG Mid-Late Oct (Final TBD), Albuquerque, NM (To be confirmed)

Closing Reminder: Inter-AG Caucus Findings on VERITAS

- The AG Caucus is deeply disappointed that problems on the Psyche mission have resulted in the delay of VERITAS and strongly supports the launch of VERITAS on its new schedule. Should budget be the rate-determining step, **NASA should follow the OWL guidelines** for budgetary decisions.
- The issues revealed by the Psyche IRB illuminate what may be a systemic problem with how missions are selected, funded and monitored through every phase.

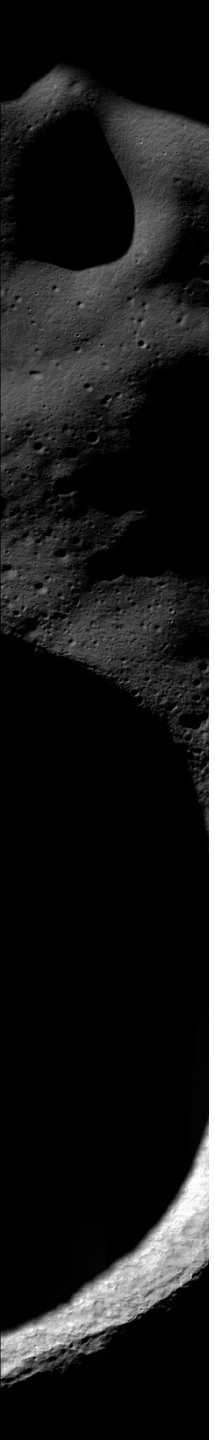
OWL, findings, recommendations:

Finding (p. 22-6): The committee strongly endorses the continued development of the Dragonfly, Psyche, DAVINCI, VERITAS, and small satellite missions. The committee finds the projected costs of these missions to be commensurate with their expected scientific return.

Budget Decision Rules (p. 22-40) to follow in case of budget pressure give eight major cost saving recommendations.

1. Delay the start of the next Flagship mission;
2. Reduce the number of new Discovery missions to four;
3. Reduce the funding level for Planetary Defense by removing the new-start mission after NEO Surveyor;
4. Reduce the cadence of New Frontiers in the coming decade;
5. Reduce the funding level for LDEP with a late-decade start of Endurance-A;
6. Reduce the funding level for MEP below the Level program;
7. Reduce the number of new Discovery missions to three; and
8. Reduce R&A funding.


LEAG



Lunar Exploration Analysis Group Updates and Action Requests-

March 2023 Edition

Dr. José M. Hurtado, Jr., LEAG Technology Chair

Presented to NASA Planetary Advisory Committee

1 March 2023

Continuous Lunar Orbital Capabilities Specific Action Team (CLOC-SAT) Report and Traceability Tensors now Available

- **Born from a Community-Defined Need**
- **Overarching Findings:**
  - Continuity of Capabilities
  - Implementation Approaches:
    - Critical Need for Long-Lived Integrated Orbiter Capabilities
    - Diversity of Implementation Capabilities
  - Measurement Approaches:
    - Landing-Site-Scale Capabilities
    - Global Context Capabilities
    - Long Temporal-Baseline Capabilities
    - Next Generation of Orbital Capabilities
    - Data Downlink and Access Capabilities
  - Next Steps:
    - Orbital Capabilities as Part of an Integrated Lunar Strategy

Dr. José M. Hurtado, on behalf of
Lunar Exploration Analysis Group

Given to NASA Planetary Science Advisory Committee

Wednesday, March 1, 2023
https://www.lpi.usra.edu/leag/

Continuous Lunar Orbital Capabilities Specific Action Team (CLOC-SAT) Report and Traceability Tensors now Available

Investigation Traceability Tensor Examples

WHY		WHAT	HOW					
			ALTITUDE		COVERAGE			
SCIENCE THEMES	TRANSFORMATIVE INVESTIGATIONS	EXAMPLE MEASUREMENT TYPES	Low Altitude	Distant Orbit	Global	Poles	Local/ Targeted	Long-term Monitoring
The state and evolution of the interior of the Moon (3.3.1)	Map global heat flow	Microwave radiometry (5.5.2)	■		■			
		IR radiometry (5.5.3)	■		■			
	Determine state of inner core	Time-dependent gravimetry (5.5.4)	■		■			■
Lunar Volcanism and Magmatism (3.3.2)	Determine the composition of silicic features	TIR imaging spectroscopy (5.3.2)	■				■	
		Gamma ray spectroscopy (5.3.6)	■				■	
	Determine the nature of irregular mare patches	VIS imaging (5.4.1)	■				■	
		Radar imaging (5.4.2)	■				■	
		Radar sounding (5.5.1)	■				■	
	Characterize the structure of mare pits and lava tubes	VIS imaging (5.4.1)	■				■	
		VIS imaging spectroscopy (5.3.1)	■				■	
		NIR imaging spectroscopy (5.3.1)	■				■	
		Radar sounding (5.5.1)	■				■	
		IR radiometry (5.5.3)	■				■	
		Microwave radiometry (5.5.2)	■				■	
		Gravimetry (5.5.4)	■				■	
	Characterize the nature of localized pyroclastic deposits	VIS imaging (5.4.1)	■				■	
		VIS imaging spectroscopy (5.3.1)	■				■	
		NIR imaging spectroscopy (5.3.1)	■				■	
The Lunar Volatile System (3.3.8)	Determine the four-dimensional behaviour of exospheric volatiles	Neutral and ion mass spectroscopy (5.2.3)	■		■			■
		FUV spectroscopy (5.3.4)	■		■			■
		NIR spectroscopy (5.3.1)	■		■			■
		IMIR spectroscopy* (5.3.3)	■		■			■
		TIR spectroscopy (5.3.2)	■		■			■
	Fully characterize lunar surface hydration	FUV spectroscopy (5.3.4)	■		■			■
		NIR spectroscopy (5.3.1)	■		■			■
		IMIR spectroscopy* (5.3.3)	■		■			■
		TIR spectroscopy (5.3.2)	■		■			■
		Active reflectance spectroscopy (5.3.7)	■		■			■
Heliosphere and the Lunar Plasma Environment (3.3.9)	Determine the three-dimensional structure of lunar magnetic anomalies	Plasma package (5.2.1)	■	■	■	■	■	■
		Electric and magnetic field (5.2.2)	■	■	■	■	■	■

Measurement Traceability Tensor Examples

WHAT	WHY		HOW					
			ALTITUDE		COVERAGE			
MEASUREMENT TYPES	TRANSFORMATIVE INVESTIGATIONS	SCIENCE THEMES	Low Altitude	Distant Orbit	Global	Poles	Local/ Targeted	Long-term Monitoring
Active fluorescence spectroscopy* (5.3.8)	Determine composition of surface and near surface PSR volatiles	Special Polar Region Environments (3.3.7)	■			■		
	Characterize chemical processing products of regolith		■			■		
Active IR reflectance spectroscopy (5.3.7)	Characterize chemical processing products of regolith	Special Polar Region Environments (3.3.7)	■			■		
Active reflectance spectroscopy (5.3.7)	Characterize ultramafic lithologies	The Composition of the Moon through the Lens of its Surface Deposits (3.3.6)	■		■		■	
	Determine composition of surface and near surface PSR volatiles	Special Polar Region Environments (3.3.7)	■			■		
	Characterize the abundance of volatiles over various timescales		■			■		■
	Fully characterize lunar surface hydration	The Lunar Volatile System (3.3.8)	■		■			■
Cosmic ray radio frequency sounding* (5.5.1)	Determine the distribution of volatiles at depth	Special Polar Region Environments (3.3.7)	■			■		
NIR imaging spectroscopy (5.3.1)	Characterize the structure of mare pits and lava tubes	Lunar Volcanism and Magmatism (3.3.2)	■				■	
	Characterize the nature of localized pyroclastic deposits		■				■	
	Determine the products of space weathering	The Lunar Regolith and Space Weathering (3.3.5)	■		■			
	Characterize ultramafic lithologies	The Composition of the Moon through the Lens of its Surface Deposits (3.3.6)	■		■		■	
	Determine composition of surface and near surface PSR volatiles	Special Polar Region Environments (3.3.7)	■			■		
	Characterize the abundance of volatiles over various timescales		■			■		■
	Characterize chemical processing products of regolith		■			■		
NIR spectroscopy (5.3.1)	Determine the four-dimensional behaviour of exospheric volatiles	The Lunar Volatile System (3.3.8)	■		■			■
	Fully characterize lunar surface hydration		■		■			■
Plasma package (5.2.1)	Determine the three-dimensional structure of lunar magnetic anomalies	The Lunar Volatile System (3.3.8)	■	■	■	■	■	■
Radar imaging (5.4.2)	Determine the nature of irregular mare patches	Lunar Volcanism and Magmatism (3.3.2)	■				■	
Radar sounding (5.5.1)	Determine the nature of irregular mare patches	Lunar Volcanism and Magmatism (3.3.2)	■				■	
	Characterize the structure of mare pits and lava tubes		■				■	
	Determine structure of regolith and megaregolith	The Lunar Regolith and Space Weathering (3.3.5)	■		■			
	Determine the distribution of volatiles at depth	Special Polar Region Environments (3.3.7)	■			■		
Repeat laser altimetry (5.4.5)	Measure surface strain	Lunar Tectonics (3.3.3)	■		■		■	■
	Constrain mass wasting events		■		■		■	■
	Determine present-day impact rate	Understanding the Impact Process (3.3.4)	■		■			■
	Determine secondary impact rate		■		■			■
Repeat VIS imaging (5.4.3)	Measure surface strain	Lunar Tectonics (3.3.3)	■		■		■	■
	Determine present-day impact rate	Understanding the Impact Process (3.3.4)	■		■			■
	Determine secondary impact rate		■		■			■
Time-dependent gravimetry (5.5.4)	Determine state of inner core	The state and evolution of the interior of the Moon (3.3.1)	■		■			■

Dr. José M. Hurtado, on behalf of
Lunar Exploration Analysis Group

Given to NASA Planetary Science Advisory Committee

Wednesday, March 1, 2023
https://www.lpi.usra.edu/leag/

Long-Term Capability Plans and Presence Benefit Science and Exploration

Request to the PAC: Encourage continued engagement between NASA and the Commercial Lunar Payload Service (CLPS) providers to:

1. **Develop long-term capability plans aligned with the needs of the lunar science and exploration community**
   - Findings from 2021 (e.g., Findings #2.4, 2.6) and 2022 LEAG meetings (Finding #3) endorsed
   - Capabilities Roadmap: allow for development time of the necessary technologies and to enable the community to address long-standing science objectives.
   - Technology Roadmap: evolve CLPS capabilities to advance science and exploration objectives prioritized by the lunar community.
   - Expected Capabilities: sample return, mobility, surviving the lunar night, long-term surface assets etc..
   - Concrete plans, adhered to by all partners, is essential for developing business plans and building actionable investment portfolios

Long-Term Capability Plans and Presence Benefit Science and Exploration

<u>Request to the PAC:</u> Encourage continued engagement between NASA and the Commercial Lunar Payload Service (CLPS) providers to:

1. **Develop long-term capability plans aligned with the needs of the lunar science and exploration community**
2. **Open pathways for long-lived presence on the lunar surface.**
    - Community Support Examples:
        - 2022 LEAG meeting Finding #3
        - Lunar Exploration Roadmap Sustainability Objective B-3: Development of surface power and energy storage systems [Initiative I: Develop reliable and safe nuclear power system]
    - Nuclear power on the lunar surface is enabling for lunar surface operations (sustained and sustainable)
    - Commercial use of nuclear power is currently hamstrung by a complex regulatory environment
    - Development of a pathway for commercial delivery of nuclear-powered payloads to the lunar surface
        - Requirement: NASA, CLPS providers, and other partners with appropriate regulatory authorities working together to produce creative solutions

Dr. José M. Hurtado, on behalf of
Lunar Exploration Analysis Group

Given to NASA Planetary Science Advisory Committee

Wednesday, March 1, 2023

High-Priority Lunar Science Benefits Solar System Science

Request to the PAC: Encourage NASA to implement high priority science missions to the Moon regardless of other lunar activities

- Recent Decadal Survey reaffirmed long-standing scientific priorities for the Moon and for solar system science that can be achieved at the Moon:
  - Lunar Geophysical Network
  - South Pole Aitken Basin Sample Return

  → These require New Frontiers-class missions to accomplish
- Current Community Perception of the Mission Proposal Environment:
  - Potentially no lunar missions will be submitted to the New Frontiers 5 opportunity
  - Uncertainty from mission centers in taking on labor for a mission that NASA is unlikely to select
    - Notion based in part on past NASA statements (e.g., Discovery 2019 selection statement)
      - Indicated no lunar missions selected due to other ongoing NASA activities at the Moon
- Reaffirms need for NASA to take action (recommended by the Decadal Survey) to accomplish the highest priority science at the Moon by working synergistically with other ongoing NASA lunar activities (CLPS, Artemis) to implement transformative missions (e.g., Endurance-A)
  - See also LEAG 2019 Open Letter in response to AAS/DPS letter RE NASA proposed budget amendment and Artemis rollout (https://www.lpi.usra.edu/leag/open-letter-061219.pdf)

Dr. José M. Hurtado, on behalf of
Lunar Exploration Analysis Group

Given to NASA Planetary Science Advisory Committee

Wednesday, March 1, 2023

March 2023 LEAG Summary

We request that the PAC:

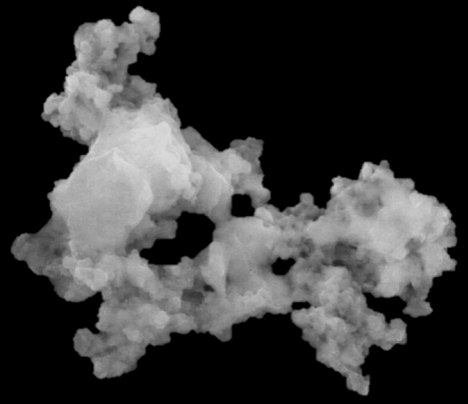
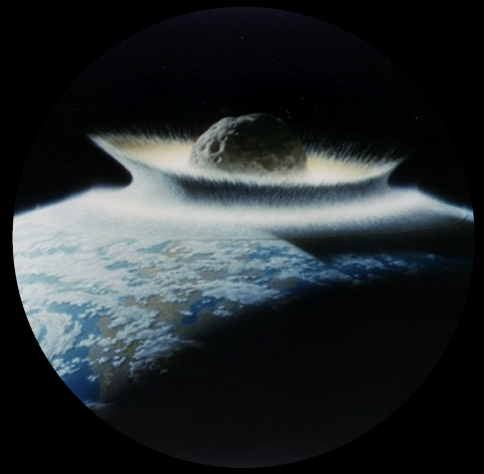
- Encourage continued engagement between NASA and the Commercial Lunar Payload Service (CLPS) providers to:
    1. Develop long-term capability plans aligned with the needs of the lunar science and exploration community
    2. Open pathways for long-lived presence on the lunar surface.
- Encourage NASA to implement high priority science missions to the Moon regardless of other lunar activities

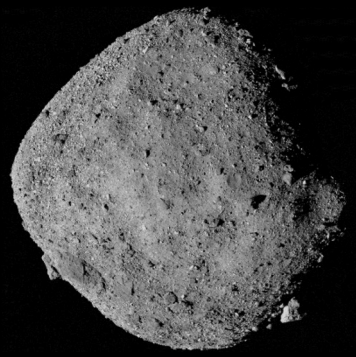
Dr. José M. Hurtado, on behalf of
Lunar Exploration Analysis Group

Given to NASA Planetary Science Advisory Committee

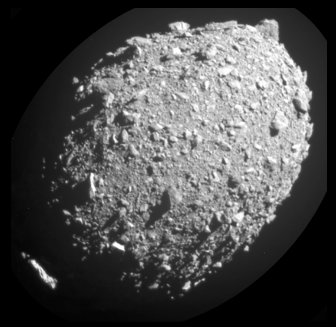
Wednesday, March 1, 2023


SBAG

SBAG
SMALL BODIES ASSESSMENT GROUP

Lori Feaga, SBAG Steering Committee Chair
Department of Astronomy, University of Maryland, College Park

March 1, 2023

NASA Planetary Science Advisory Committee (PAC)

www.lpi.usra.edu/sbag/

Government funding acknowledged

Summary of recent SBAG activities for the PAC

- Steering Committee Code of Conduct approved November 2022, signatures added November/December 2022, posted to SBAG website December 2022
- Ocean Worlds inter-AG collaborative working group leadership search in process (with SBAG representation on search committee)
- Held our community meeting (SBAG #28) January 24-25, 2023 at IPAC on the CalTech campus
  - Hybrid format
  - 2 Early Career invited talks, 5 Early Career lightning talks, 6 Early Career travel stipends
  - Cross-AG IDEA (Inclusion, Diversity, Equity, and Accessibility) Working Group gave a report
  - 9 findings (4 immediate concerns raised here, 3 others offered for public consumption, and 2 action items for the community/SBAG)

Finding #1 – Preservation of Arecibo Radar Data

To ensure continued usability of the Arecibo radar data, SBAG recommends that NASA work with NSF to promptly establish a mechanism by which to preserve the data as well as necessary processing software and systems, including identifying an appropriate organization for hosting them and more importantly the responsible agency for supporting the endeavor.

The Arecibo Observatory is currently scheduled to end science operations in April 2023 with discontinued access for the scientific staff after mid-August 2023. It is unclear to the community if the end-of-operations plan includes retaining Arecibo planetary radar data processing software and systems in addition to the radar data archive.

Finding #2 – Request for Information on PSD Mission Delays

SBAG recommends that NASA PSD compile the historical data for all competed missions to date and assess the full scope of mission delays, look for the root causes, and determine any common themes. Once NASA PSD has analyzed the data, SBAG encourages them to share their findings with the community.

Finding #2 – RFI on PSD Mission Delays (cont'd)

It is undeniable that NASA mission delays have a cascade effect on selected flight missions in the queue and funding for and cadence of new AOs. In the most recent example presented in a full mission specific report (Psyche IRB), a delay in the Psyche launch has caused the demanifestation of Janus, a SIMPLEx mission catching a rideshare with Psyche now with an uncertain future, a delay in the unrelated launch of the VERITAS mission to Venus to no earlier than 2031, and an unknown delay in future Discovery and SIMPLEx announcements. Delays like this are detrimental to the existing mission teams and potentially the baseline science of selected flight missions and affect the next generation of mission teams who may not be provided with reasonable opportunities to participate in a timely mission proposal. While individual mission delays are investigated in detail by NASA, what is unclear to the community is why delays happen in a more high-level sense, if delays are more common in a specific mission class, what is the final cost of missions especially compared to their original cost cap, and if there are commonalities that may factor into the probability of a delay. If NASA shares the resulting conclusions with the community, SBAG will be better informed to discuss and identify appropriate findings for future situations that warrant community response.

Finding #3 – Support for US Participation in ESA's Hera Mission

SBAG encourages NASA to continue supporting international collaborations with other ongoing and developing international small body and planetary defense missions. SBAG especially recommends NASA support for US participation on ESA's current Hera mission to the Didymos system.

The Hera mission will explore the consequences of the impact caused by NASA's DART spacecraft. SBAG is highly supportive of an equitable process and program to permit members of the small body community to participate in ESA's Hera mission.

Finding #4 – Apophis SAT Report Endorsement

SBAG endorses the findings outlined in the SBAG Apophis Specific Action Team (SBAG Apophis SAT) report and encourages the community to identify a path forward for a coordinated remote sensing campaign that would take advantage of the unique 2029 close encounter of Apophis with the Earth.

The SBAG Apophis SAT was formed and tasked by NASA to study the scientific opportunities surrounding Apophis's Earth close approach in 2029. The SBAG Apophis SAT report is available on the "Documents" section of the SBAG website (https://www.lpi.usra.edu/sbag/documents/Apophis_SAT.pdf) and provides detailed scientific and technical information that assesses the current predictions for the effects that may occur due to the Apophis close encounter, evaluates observing capabilities, and identifies possible investigations.

Other Meeting and Steering Committee Updates

- Our full list of SBAG #28 Findings can be found at: https://www.lpi.usra.edu/sbag/findings/

- The Human Exploration Lead, Early Career Secretary, and 3 at large members are rotating off the Steering Committee. Steering Committee Member applicants will be solicited over the coming months through various channels. Selections will be announced at SBAG #29 (Summer 2023).

Summary

- SBAG appreciates the support from the PAC and NASA on the various findings and initiatives we bring forth as a voice of the small bodies community.
- SBAG is behind the Decadal Report 100% and will continue echoing the needs of the community in accordance with OWL.
- SBAG supports the efforts of cross-AG IDEA and Ocean Worlds Working Groups.
- Finding #1 - To ensure continued usability of Arecibo radar data, SBAG recommends NASA work with NSF to promptly establish a mechanism to preserve the data and necessary processing software/systems and identify the responsible agency.
- Finding #2 - SBAG recommends that NASA PSD compile historical data for all competed missions to assess the full scope of mission delays and trends and encourages PSD to share their findings with the community.
- Finding #3 - SBAG encourages NASA to continue supporting international collaborations, especially US participation on ESA's Hera mission to the Didymos system.
- Finding #4 - SBAG endorses the findings outlined in the Apophis SAT report and encourages the community to identify a path forward for a coordinated 2029 remote sensing campaign.

Supporting slides

The Steering Committee

Present Steering Committee

Justin Atchison (JHU/APL), Technology Lead
Olivier Barnouin (JHU/APL)
Bonnie Buratti* (NASA JPL/Caltech), Past Chair
Michael Busch* (SETI Inst)
Lori Feaga (Univ of Maryland), Chair
Henry Hsieh (Planetary Science Institute)
Mihaly Horanyi* (Univ of Colorado, Boulder)
Stephanie Jarmak (SwRI), Early Career Secretary
Prajkta Mane (LPI/NASA JSC)
Joe Masiero (IPAC/Caltech), Planetary Defense Lead
Stefanie Milam* (NASA GSFC)
William O'Hara* (Blue Origin), Human Exploration Lead
Timothy Titus (USGS, Flagstaff)

Thomas Statler NASA Headquarters Liaison
Jake Bleacher NASA Human Exploration and Operations Mission Directorate (HEOMD) Liaison
Paul Abell (JSC) HEOMD Observer

Steering Committee selects Chair and Steering Committee members from among nominations and applications. Requests go out on the DPS Newsletter, Planetary Exploration Newsletter (PEN), and our listserv. General membership is open to the community.

*Terms end in 2023

SBAG 28: Findings 5 – 7

#5. SBAG recommends that the future planetary defense rapid response reconnaissance mission be selected by an open competitive process.

#6. SBAG urges NASA to stress to all participants in the Inter-agency Radar Panel the urgency of their work, especially with respect to the future capabilities of planetary radar and planetary defense, and asks that the details of its findings and actions to the community are publicly released at the Panel's conclusion.

#7. SBAG eagerly awaits the public release of a SIMPLEx program lessons learned draft and recommends that there be a period of community engagement and stakeholder input before the document is finalized.

SBAG 28: Findings 8 – 9

#8. SBAG recommends that early mission design and planning for the Uranian Flagship mission consider the science cases and implementation of a flyby of an outer irregular moon or targeted flybys of the inner moons and is encouraged by the recently announced cross-discipline science workshop for the Uranus Flagship (July 2023).

#9. SBAG will emphasize the connection between small body exploration and new innovative technologies in the coming year.

Apophis Specific Action Team (SAT) Report

Statement of Task:

The Specific Action Team (SAT) shall conduct a study to:

1. Identify and quantify the detectable effects on Apophis expected to result from the Earth encounter, and identify the measurements and instrumental sensitivities needed to detect them and determine their magnitudes;
2. Assess and prioritize the importance to planetary science and planetary defense of detecting and measuring each of these effects, as well as the value of non-detections (upper limits);
3. Categorize these effects according to (a) detectable using Earth-based assets, (b) detectable using a spacecraft arriving only after Earth close approach, (c) detectable using a spacecraft arriving before Earth close approach; and
4. Quantitatively assess the possibility that spacecraft sent to Apophis could increase the risk of a future Earth impact.

The study shall not:

Assess, prioritize, or recommend specific instruments, facilities, flight hardware, mission profiles or concepts;

Members: Jesse Dotson (Chair), Tim Titus, Stephanie Jarmak, Andy Rivkin, Marina Brozovic, Steve Chesley
Damya Souami, Paul Sanchez, Nick Moskovitz

Report released: **November 11, 2022 (https://www.lpi.usra.edu/sbag/documents/Apophis_SAT.pdf)**

Report presented to PAC and SBAG: **PAC on December 6, 2022 (Jesse Dotson); SBAG on January 24, 2023 (Jesse Dotson)**

Informational Slide on Ocean Worlds Inter-AG Working Group

Ocean worlds inter-AG collaboration: The SBAG community is in favor of establishing an inter-AG collaborative working group between OPAG and SBAG on ocean worlds. This plan is in keeping with the Decadal Survey recommendation that "NASA should develop scientific exploration strategies, as it has for Mars, in areas of broad scientific importance, e.g., Venus and ocean worlds, that have an increasing number of U.S. missions and international collaboration opportunities." SBAG suggests that leadership of such an inter-AG collaboration should be selected by liaison representatives from OPAG and SBAG from an applicant pool resulting from an open call to the community at large and general membership/participation in the working group include all interested parties from the ocean worlds community (e.g., SBAG members, OPAG members, astrobiologists, oceanographers, etc.). It is envisioned that the inter-AG working group may hold semi-regular coordinated meetings or other activities and report back to the AGs points of concern. These points of concern will be discussed during AG meetings and as warranted will be elevated to the PAC as findings from the meeting.