

OPAG Findings from September 5-6 meeting at Scripps, La Jolla CA

Current Missions

OPAG heard updates from the Cassini, New Horizons, and Juno missions. All three missions have achieved important fundamental science results. These missions have returned and are continuing to return (in the case of Juno) an immense wealth of data about outer planet systems. Cassini spacecraft activity ended on September 15 with spectacular and unique data return to the very end.

Finding 1:

OPAG applauds the spectacular successes of the Cassini mission at the Saturn System and New Horizons at the Pluto System, and looks forward to the continuing scientific return from the Juno mission. The archived data will support continued major science results for many years. OPAG asks NASA to adequately support the associated data analysis programs to ensure optimum science output from these missions. Cassini in particular, with its 13 years of Saturn system data, should have a continued dedicated data analysis program for many years to come.

Europa Lander

The OPAG community appreciates the work of the Europa Lander SDT and recognizes the challenges that will be faced by this potential mission. However, we note three major concerns about the implementation of this mission. The first concern is science risk. NASA has communicated that it is in the process of rescoping the Europa Lander mission to achieve the best balance between cost, risk, and science. However, the initial science package for the lander was already very focused and highly constrained. The OPAG science community expressed concerns that the science is at risk by further constraints on this mission, and may become too narrow. While searching for life and understanding Europa's chemistry are important goals, other science unique to a landed mission is equally important to the OPAG community. The mission must accomplish key science even if definitive biosignatures are not detected, and it must advance knowledge needed to search for life in the future, such as by missions that would access the deeper interior. It is not clear to OPAG how science decisions will be made as part of this trade, given that the Science Definition Team (SDT) has not been involved, or how information from sources outside of JPL will be integrated. The second concern to the OPAG community is the potential for cost overruns from the mission to impact other missions and priorities advanced in the Decadal survey. OPAG welcomes additional outer planet missions; however, this requires additional resources to be added to PSD to accommodate the decadal priorities and this new opportunity. Finally, OPAG members are concerned about the schedule and expected release of the Program Element Appendix (PEA).

Finding 2:

We support NASA's decision to proceed methodically, working to understand science, technology, and cost during the Pre-Phase A study of the Europa Lander concept, but we urge NASA to obtain the best possible advice from members of the science community on decisions impacting the stated SDT science objectives. NASA should clarify the schedule and specific plans for the Europa Lander instrument PEA as soon as possible.

Exploration of the Ice Giant Systems

The Ice Giants, Uranus and Neptune, remain high-priority targets for exploration as reflected in the Visions and Voyages Planetary Science Decadal Survey. We thank NASA for completing its

pre-decadal Ice Giant mission study, and agree with the study's conclusions that a Flagship mission exploring the interior, atmosphere, rings, satellites, and magnetosphere of an ice giant system would yield extremely valuable science. Such a mission would engage all disciplines within planetary science as well as several external communities. We note that the continued development of eMMRTG and HEEET technologies are crucial for an ice giant mission, and that there are several science areas whose development would enhance the return from such a mission (such as a better understanding of the distribution of ring particles near the planets and the field of "Atmospheric Seismology"). We also note that an ice giant mission could address important ocean world-related questions.

Finding 3:

NASA should pursue development of an Ice Giant Flagship mission as soon as its budget allows. We encourage completion of the eMMRTG and HEEET technology development programs, and the support of laboratory, instrument, and R&A work that enhances such a mission. We also encourage the involvement of other NASA Divisions and of international partners to maximize the mission's science return.

Discovery AO

The next Discovery mission announcement of Opportunity (AO) is expected in early 2019, and proposal teams are already forming. However, some key constraints are not yet known, such as whether radioisotope power systems (RPS) will be allowed.

Finding 4:

NASA should announce the expected date of the next Discovery AO and key mission constraints as soon as possible.

Technology

OPAG commends the PSD for increased attention to the broad technology requirements for future missions and, specifically, for initiating a Planetary Exploration Science Technology Office (PESTO) that will coordinate and oversee all the technologies (except RPS) required to ensure these challenging missions are successful. This office has great promise for furthering solar system technologies and infusing them into missions. The draft list of technology priorities is an excellent start and we look forward to completing the OPAG Technology Plan and working with PSD to define the technologies required for the outer planet missions. OPAG would like clarity on the plans for the office as they mature, specifically what funding will augment the existing programs and how the funds will be administered (competed vs designated) as well as further information on the technologies.

For RPS, OPAG advocates continuing the close working relationship with DOE because it is clear that the PSD-DOE relationship is improving as a result of having an RPS lead detailed to DOE. OPAG also agrees that the model of constant rate production *does* provide flexibility and allows for surge capabilities as well as alleviating process and production limitations. The rate of production at present seems to be sufficient for the outer planet community given that many of the missions proposed will not require RPS and there is sufficient production to satisfy the needs of those missions that do require RPS. However, as the Ice Giant mission(s) become a reality, the production needs to match the long lifetime requirements of such a mission. In addition, as we get closer to exploring the deep sub-surfaces of icy ocean worlds, the PSD needs to consider how to power the drills and sampling systems with a plan to develop them as an integrated

system. OPAG is in support of pursuing the advancement and maturation of segmented thermoelectric converter technology for development of a modular Next Generation RTG capability and recommends that additional studies be conducted to explore the potential for Next Gen RTG “block upgrades” enabling operation in planetary environments, such as those encountered on Titan. To be successful, technology investments, including energy sources and launch capabilities, must be driven by science and future mission needs. OPAG would appreciate ongoing involvement with and updates from both the PESTO and RPS office.

Finding 5:

OPAG suggests that both the PESTO and RPS offices work closely with OPAG to develop the rationale and guidance for the relevant portions of their programs since, in many cases, the needs of the outer planets community drive the technologies developed by those two program offices.

Mission studies in preparation for the upcoming decadal survey

The strategy that has been adopted to perform mission studies in advance (Ice Giants in 2016-2017 and upcoming Ceres in 2017-2018) has the potential to greatly streamline activities during the upcoming planetary science decadal survey. With potential durations of ~1 year or more, depending on the breadth and depth of the study, multiple simultaneous studies will likely be needed to be able to complete a sufficient number of studies in time to inform the next decadal survey process. We believe that the pre-decadal mission studies follow the “best practice” identified by “The Space Science Decadal Surveys: Lessons Learned and Best Practices” study conducted by the NRC in 2015, which noted:

“It is desirable that the survey committee determine, as early in the process as possible, how robust a mission concept needs to be to provide sufficient cost certainty. An example is an ambitious mission where the survey committee needs to know—with reasonable confidence—that a mission team will be able to propose a credible design that meets science requirements and fits within the cost cap for the mission class.”

However, the process for selecting which studies to conduct is unclear to the community. OPAG requests clarification about the process for selecting missions to be studied and the timeline for Assessment Groups to provide input. Additionally, regarding mission studies that were performed during the previous decadal survey, should these be repeated in light of new discoveries and technology advancements? Will new mission studies be required in order for that mission to be considered an option in the next decadal survey?

In particular, the Committee on Astrobiology and Planetary Science (CAPS) recently published a list of recommended mission studies. Potential missions discussed at the September 2017 OPAG meeting include Io – for which initiation of a study was requested after the August 2016 OPAG meeting – Triton (as principal target), large KBOs, and a dedicated space-based telescope for planetary observations, all of which are included in the CAPS recommendations. (Titan, Enceladus, and a Saturn probe are also of interest but are necessarily deferred while under competition for New Frontiers.) Roadmap to Ocean Worlds (ROW) recommendations include these targets as well as Callisto and Ceres. We are planning more presentations of outer planet mission concepts to be considered for studies at the OPAG meeting in February 2018.

Finding 6:

OPAG supports the early initiation of mission studies that has been adopted in preparation for the upcoming decadal survey. Given the time remaining before the next decadal survey, we

request clarification of the process NASA intends to use for identifying targets for mission studies, how the results of the mission studies for the previous decadal survey will be taken into account (or need to be redone), and the timeline for performing multiple ~year-long studies with empaneled science definition teams. We recommend identification of a NASA point of contact to communicate with the NAS on a frequent and regular basis to support coordination of mission studies in preparation for the decadal survey.

Building connections between the outer planets and Earth oceanography communities

Ocean worlds are obvious targets for future life detection missions, including the moons of the outer planets that host subsurface oceans. Collaboration between the planetary science and Earth oceanography communities can improve these missions through technology development and an improved understanding of the hypothesized ecology. OPAG recognizes that there is considerable potential to enhance collaboration between the outer planets and Earth oceanography research communities, including working on polar oceans under ice, the deep ocean, and low-nutrient environments as well as fundamental geophysical fluid dynamic problems. Greater collaboration is expected to lead to a greater pace of technology development and technology transfer between these communities, and to a greater intellectual exchange that will directly facilitate the search for life on ocean worlds. Moreover, targeted resource sharing could enhance the return for both communities. This potential is highlighted by the work of the ongoing, multidisciplinary Roadmap to Ocean Worlds (ROW) team, and the upcoming Ocean Worlds meeting (the third such meeting) to be hosted by the LPI in May of 2018.

Finding 7:

OPAG encourages NASA to emphasize the connections between the Earth and the outer solar system ocean worlds. We support the appointment of an ocean world scientist at NASA, to capitalize on and enhance interactions between NASA and other ocean agencies and research communities.

Status of CDAP and NFDAP

Cassini Data Analysis (CDAP) and New Frontiers Data Analysis (NFDAP) programs support a large proportion of the OPAG community. These programs are also necessary for enhancing the science return of the Cassini and New Frontiers missions by funding the work of scientists who may not be funded by the mission teams. In mid-August 2017, the PIs who submitted proposals to NFDAP-2016 and CDAP-2017 received a letter stating that, due to "unavoidable scheduling and workforce issues" the proposals submitted to these programs will be reviewed together. In addition, the OPAG steering committee was recently notified by Dr. Green that the program officer of CDAP and NFDAP, Dr. Jared Leisner, has transferred to another division of NASA SMD, and Dr. Leisner will continue to serve as the program officer of NFDAP and CDAP on a part-time basis. Thus, the community is concerned that, without a dedicated PSD lead, the NFDAP and CDAP programs may be at risk of significant delays and/or disorganization.

Finding 8:

OPAG is concerned about the sustainability of NFDAP and CDAP programs without a full-time PSD program officer. We request NASA to ensure that such workforce issues do not become a cause of delays in reviewing proposals submitted to these programs. Furthermore, we ask NASA to assign a dedicated PSD manager to the CDAP and NFDAP programs, and correct the aforementioned workforce issues perhaps through additional staffing, to ensure that these programs remain viable now and in the future and thereby optimize the science outputs from

these successful missions and maintain the vibrant research community needed to support future missions.

Diversity and Unconscious Bias

At the previous OPAG meeting (February 2017), Dr. Janet Vertesi provided information on workforce inclusivity and diversity (<http://www.lpi.usra.edu/opag/meetings/feb2017/presentations/Vertesi.pdf>). It is clear that unconscious bias exists in all populations, and that diversity in a team or program can improve overall outcomes. Many organizations, including NASA, the NSF, and the Space Telescope Science Institute, have begun exploring ways to overcome these biases. In particular, some barriers to diversity may be alleviated by modifying the proposal review process.

Finding 9:

We request NASA brief OPAG on PSD's work on mitigating biases in proposal review activities.