

Outer Solar System: Many Worlds to Explore

Outer Planets
Assessment Group
(OPAG) Report to
PSS
September 2016
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Major OPAG Challenge

- How to keep outer Solar System science vibrant through the Decade of Darkness
 - No spacecraft data from Outer Planets between end of Cassini and Juno (2018) and arrival of Europa mission
 - ~10 year gap depending on when the Europa mission arrives



OPAG Charter and Meetings

Explore Outer Planets and Ocean Worlds

Charter:

- OPAG regularly evaluates outer Solar System exploration goals, objectives, investigations and required measurements on the basis of the widest possible community outreach. The group assembles twice per year to assess the current state of outer solar system exploration, goals for future exploration, and technology development needed to achieve those goals.

Meetings:

- The most recent OPAG meeting was August 11-12 in Flagstaff, AZ
- In 2017 we will have a winter meeting in Atlanta in late Feb, then tentatively meet at Scripps Institute of Oceanography, San Diego, in late August.
- **Next slides:** OPAG findings from Aug 2016 meeting
 - In order of importance to PSS

Europa Lander

- The Europa Lander SDT chairs presented a progress report on their activities
 - Curt Niebur invited OPAG to comment on this presentation.
- Ambitious science objectives combined with very constrained resources
- Draft science goals include:
 - (1) Search for evidence of life on Europa (with 5 investigations)
 - (2) Assess the habitability of Europa via in situ techniques uniquely available to a lander mission (3 investigations)
 - (3) Characterize surface properties at the scale of the lander to support future exploration (3 investigations).
- Expected resources, comparable to Philae, include:
 - Lander payload of 35 kg
 - Total mission energy of 2500 W-hr
 - 20-day surface lifetime
- OPAG is concerned that some of the current draft mission objectives are high-risk, and the mission would be perceived as a failure in an event of non-detection of life.
- OPAG fully supports the COLDTech program to address these concerns
 - To be effective, this effort needs to be completed prior to release of an AO for flight instruments.
- **OPAG Finding:** *We are concerned that resources available for the Europa Lander mission may not be sufficient to achieve the ambitious objectives to search for life on Europa. We recommend that mission objectives be structured so that the mission would not be characterized as failure in an event of a non-detection of life. OPAG also recommends that, prior to the release of a lander instrument AO, potential proposers are given sufficient time and resources to develop appropriate technologies to address the investigations to be defined in the SDT report.*

Io Mission Study for next Decadal Survey

- New mission studies across the Solar System are needed to inform the next Decadal Survey.
- Missions to Jupiter and icy Galilean satellites are underway, missions to Saturn are part of NF-4 competition, and Ice Giant Mission SDT study is near completion.
 - Io is the most neglected of the high-priority exploration targets in outer Solar System
- An Io Observer was listed by the 2003 Decadal Survey as a Deferred High-priority mission, and by the 2013 Decadal Survey as one of seven high-priority medium-class mission candidates.
- Vision and Voyages recommended an Io Observer for inclusion among the candidates for the New Frontiers 5.
 - Since the NF-4 AO is only being released in 2017, it is unlikely that NF-5 will be solicited before 2023.
- Io Observer, is, therefore, a top OPAG priority for the next Decadal Survey and a mission study is an important preliminary step.
- There have been significant recent advances in technology and scientific understanding relevant to Io driven by the Europa Clipper and Juno missions.
- **OPAG Finding:** *OPAG urges NASA PSD to convene an Io Observer Science Definition Team (SDT) to steer a comprehensive mission concept study.*

Responses to New Frontiers 4 Draft AO

- OPAG applauds progress on NF-4, and was generally positive about the draft AO.
- **MMRTGs** are available for NF-4, but the loss of power over time makes them of limited value for the three NF-4 mission candidates to Saturn.
- Development of the eMMRTG is coming along, but slowly. In order to be ready for the upcoming missions there needs to be more of a sense of urgency in pursuing this target.
- **OPAG Finding:** *eMMRTG are an enabling technology for the outer Solar System and we encourage them being ready and available as soon as possible. We are disappointed that they are not expected to be ready for the NF-4 AO.*
- **Launch expenses with RPS:** All spacecraft must have a power system with costs included in the price of the mission.
- There are extra costs associated with flying radioisotope power – the additional launch service costs.
 - In the draft version of the New Frontiers AO these are counted against the total mission cost.
- **OPAG Finding:** *OPAG suggests that, in order to level the playing field for missions to challenging locations, costs associated with NEPA and launch service/approval not be counted against the PI mission cost cap.*

Roadmap(s) to Ocean Worlds

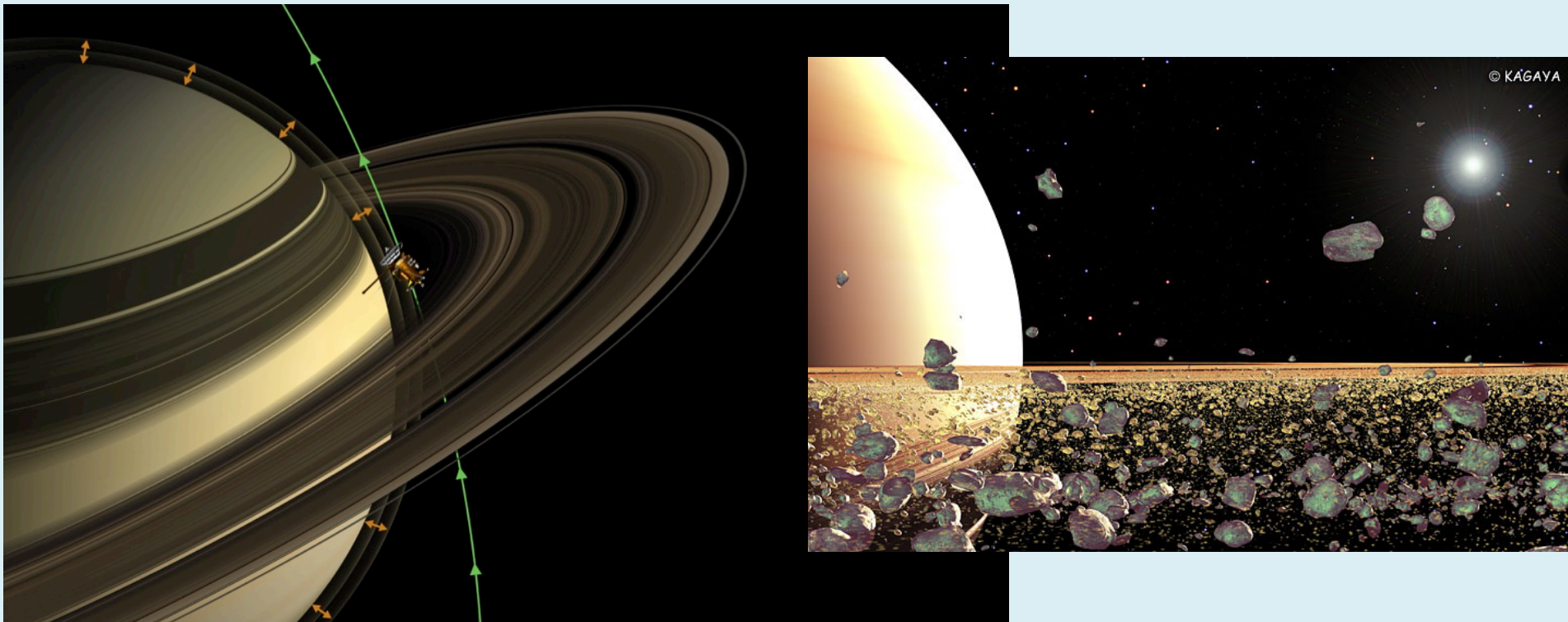
- OPAG thanks the ROW committee, led by Terry Hurford and Amanda Hendrix, for their ongoing work, and looks forward to their report at the end of the year.
- The goal of this study is to define a long-term program to understand ocean worlds and search for life beyond Earth.
- Preliminary findings:
 - Existing (or new) R&A investments should support fundamental research vital to Ocean World exploration ...
 - R&A investments to support maturation of instruments and technologies vital to Ocean World exploration should build on the augmentation of funding to PICASSO, MATISSE and the COLDTech programs.
 - Efficient, capable, robust energy sources and frequent launch capability are critical for supporting a healthy Ocean Worlds exploration program.
- **OPAG Finding:** *The Ocean Worlds initiative has great promise for Solar System science. For its success, investment must be continued or augmented in related fundamental research, instruments and technologies, power sources, and launch capabilities.*

Research & Analysis

- OPAG thanks Jared Leisner (NASA HQ consultant) for presenting data about the effects of R&A restructuring on OPAG-relevant funding.
- Overall, there is no clear evidence for decline in absolute funding levels.
- OPAG has several residual concerns:
 - Big, omnibus programs such as SSW are less transparent
 - OPAG is concerned that fundamental research is diminished
 - The new R&A structure may exclude good proposals with its specificity. For example, Cassini data analysis has a home in CDAPS, Juno data will be in the New Frontiers DAP, but it is not clear where comparative data analysis across the two projects has a home. SSW does not fund data analysis covered by other programs, and so some projects may fall through the cracks, or researchers may not apply.
- **OPAG Finding:** *We hope that the new keyword analysis will address concerns about the lack of transparency in the new, large R&A programs. We encourage the PSS to discuss what keywords would be most useful to the entire planetary science community, including target and type of research. OPAG requests that NASA release the total budget in each of the different R&A programs in order to enable transparency in the funding of different types of research, including fundamental research. Further, we request that PSD continue to actively consider whether there are gaps within the new R&A structure that preclude the submission and acceptance of good proposals.*

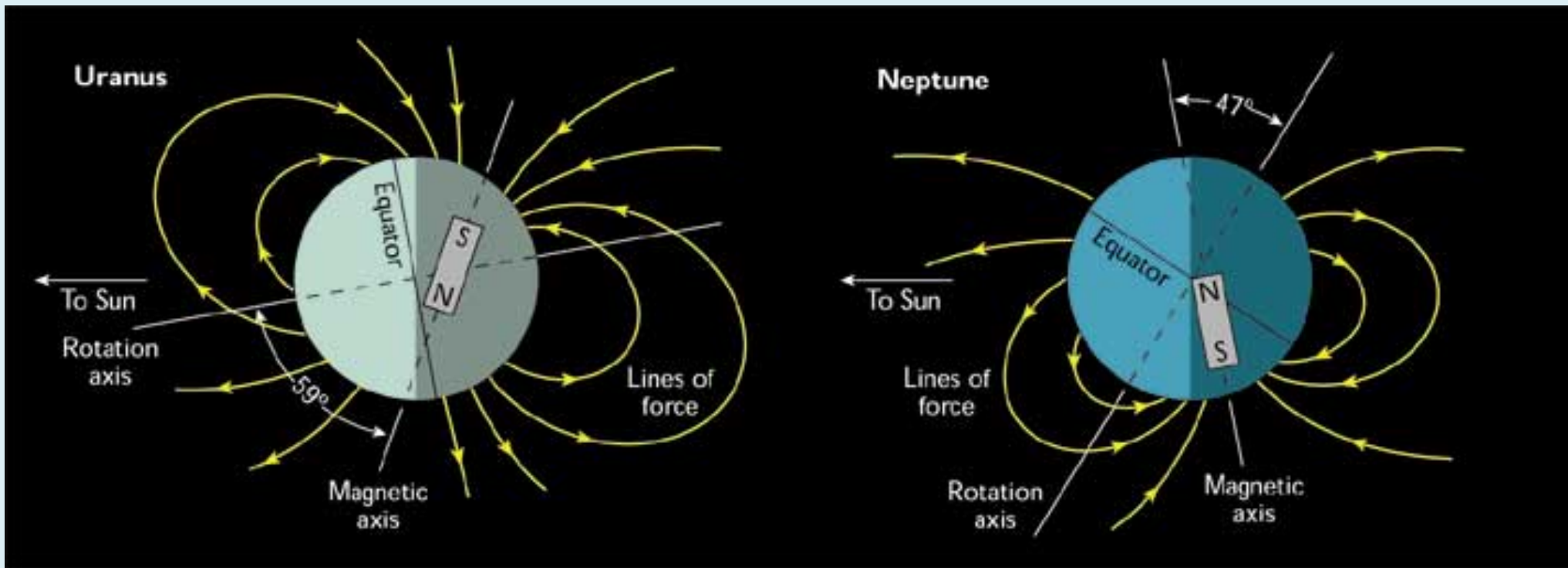
The Legacy of Cassini and Cassini Data Analysis Program (CDAP)

Finding: *The CDAP program has been incredibly successful in funding analysis and modeling of the wealth of data collected by Cassini. Continuation, and possibly augmentation, of CDAP will help to bridge the large gap before the next outer Solar System mission and ensure that a knowledgeable cadre of outer planet scientists will be ready to analyze data from the Europa mission, as well as other future outer planet missions. We expect that there may be an increase in the number of CDAP proposals once the Cassini mission ends. We request that NASA follow the submission rate and augment the budget if the proposal rate increases after Cassini.*



Ice Giant mission study for the next Decadal Survey

Finding: *OPAG is pleased with the progress being made by Ice Giant pre-decadal mission study, notes that high-science-return ideas are emerging, and looks forward to having the complete report at our next meeting.*



Participating Scientists

- **Finding:** *Participating Scientist programs provide particularly high value to NASA and to the scientific community, and should be a standard feature of future missions. OPAG requests that NASA be guided by recommendations in the white paper that results from this task force.*

Juno Mission

- **Finding:** *OPAG congratulates the Juno mission for its successful Jupiter Orbit Insertion, and we look forward to the results from the science orbits. We are disappointed that the Participating Scientist Program did not materialize for Juno, and we encourage PSD to offer such opportunities for future missions.*