

OPAG Meeting Report
May 4-5th 2006

The Outer Planets Assessment Group is a NASA-supported forum for scientists and engineers to discuss exploration of the outer solar system and to enhance communication between community and NASA. The meeting of the Outer Planets Assessment Group held at the Westin Hotel, Pasadena, CA 4-5th, 2005 was attended by ~80 people. The agenda with links to presentations is available on the OPAG website (<http://www.lpi.usra.edu/opag/>) We heard presentations as follows:

Thursday May 4th – Chaired by Bill McKinnon (Washington Univ.)

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| • Cassini Status | Dennis Matson (JPL) |
| • Juno Status | Scott Bolton (SWRI) |
| • Europa Overview | Ron Greeley (Arizona State Univ.) |
| • Europa Science Objectives | Bob Pappalardo (Univ. of Colorado) |
| • Europa Explorer Mission Study | Karla Clark (JPL) |
| • ESA Europa Study | Gerhard Schwehm (ESA) |
| • Titan Montgolfiere Mission Study | Kim Reh (JPL) |
| • Uranus Equinox Workshop Briefing | Heidi Hammel (SSI) |
| • RPS Program | Ajay Misra (NASA HQ) |
| • DSN | Bob Preston/Les Deutsch (JPL) |
| • In Space Propulsion Program | Rae Ann Meyer (MSFC) |

Friday, May 5th – Chaired by Fran Bagenal (U. of Colorado)

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| • SMD/PSS Meeting Report | Fran Bagenal (OPAG Chair) |
| • Solar System Roadmap Update | Jim Cutts (JPL) |
| • Primitive Bodies: Missions | Mike A'hearn |
| • Primitive Bodies: Ground Based Astronomy | Mike Brown |
| • Enceladus: Case for a mission | Andy Ingersoll (Caltech) |

There were also open-mike sessions for the public to contribute on topics of science and technology.

Outer Solar System Program – as per our reports of previous OPAG meetings, OPAG advocates a balanced program of outer planet research that involves:

1. Flagship missions (~1 per decade)
2. New Frontiers missions (~3 per decade)
3. Discovery opportunities as they arise
4. Funding research and analysis programs to maximize the scientific return of outer planet exploration
5. Appropriate technology development to enable outer planet missions

A full discussion of OPAG science priorities is provided in the OPAG Pathways document that will be posted on the website in early June 2006.

Research & Analysis Programs Given the recent cuts to research and analysis programs, items 4 and 5 warrant particular attention.

- OPAG notes the findings and recommendations of the NRC's Space Studies Report on Research and Analysis supporting a balanced program for NASA's scientific research (<http://www7.nationalacademies.org/ssb/>)
- OPAG endorses the recommendations of the Planetary Science Subcommittee of the NAC (<http://science.hq.nasa.gov/strategy/subcomm.html>)
- OPAG is enthusiastic to see Cassini Data Analysis Program (CDAP) started. However, the funding profile for the program is inadequate considering the expected science return of the Cassini mission. The initial budget of \$2.5M is expected to double in subsequent years.
- A Cassini Extended Mission is a fantastic opportunity to further science return. Cassini science teams as well as CDAP will both need to be funded accordingly.

Flagship Mission Studies

- Recognizing the long time scales of exploration of the outer solar system, as well as the huge challenges of flagship missions, OPAG advocates an approach that develops options for exploring multiple targets which gives NASA flexibility in selecting a sequence of missions that optimizes science return. This is the same approach advocated in the Decadal Survey. To this end, OPAG has working groups looking at Europa, Titan, giant planet (particularly their deep atmospheres) and primitive bodies as important scientific targets as well as defining feasible missions.
- OPAG urges that all studies of missions involve scientists working shoulder-to-shoulder with mission engineers and be subject to a review of technical, management and cost by an independent body.
- **To inform decisions about future flagship missions we need mission concept studies of outer planet flagship missions with sufficient fidelity to ascertain whether missions realistically fit into a "flagship box" – e.g. 15 year timeframe, \$2.5 B total mission cost.**

Europa

- Europa remains the consensus priority target of the OPAG community, as it is in the NRC Decadal Survey, in reports to NASA from both COMPLEX and SSES.
- SSES has consistently expressed concerns about delays in starting a Europa mission in July 2003, March 2004, June 2004, October 2004, and February 2005, (see <http://science.hq.nasa.gov/strategy/sscac/sscacpast.html>). OPAG strongly reiterates these concerns and urges NASA to make the primary goal of a comprehensive Phase A mission study to be a reliable evaluation of the feasibility of a Europa mission that can achieve the priority science (e.g. as stated in the Decadal Survey and by the OPAG Europa Working Group) within an accurate and realistic cost-cap and, most importantly, complete the primary mission by a timeframe of 2020-2022. OPAG encourages NASA to complete the detailed study as soon as possible so that a decision can be made about the implementation of a Europa mission.

- OPAG is very concerned that any delays and/or cost over-runs of a Europa mission would jeopardize broader goals for scientific exploration of the outer solar system.
- The OPAG Europa Working Group will continue to work with the ESA-NASA Jupiter mission task force to assess international collaborations that will enhance scientific return.

Titan

- Titan is an OPAG priority. The Vision Studies presented in October to OPAG spanned a wide range of missions. Currently, the OPAG Working Group concludes: 1) exploration of Titan requires a flagship mission and 2) a flagship Titan mission should include an orbiter as well as a balloon/aerobot/probe.

Giant Planets

- OPAG is heartened by the report from the probes workshop that the major scientific goals of understanding the volatile inventory of giant planets could be achieved with a combination of shallow probes (about 10 bars, rather than very deep probes, as initially thought) and radiometry at Jupiter or Saturn. Uranus and Neptune will probably need deeper probes, but the depth of penetration needs further study.
- OPAG encourages NASA to support development of necessary probe technologies as well as mission architectures, involving OPAG scientists in probe studies to ensure that such technologies are keyed to needs of specific missions.

Enceladus

- OPAG has begun discussions of Enceladus as a potential mission target and will expand these discussions as it continues to be studied by Cassini.
- The Cassini spacecraft shows that Saturn's small moon Enceladus has plumes of ice and gas rising from warm active fractures in its south polar region, probably the action of localized tidal heating. Water is the dominant plume constituent, and trace amounts of the simple organic molecules acetylene and propane are also detected. It is uncertain whether plume material is erupting like geysers, or sublimating from warm fractures. If water exists in the shallow subsurface of Enceladus, then this moon joins the short list of icy bodies that may be habitable environments. These new discoveries at Enceladus are pertinent to all four major science themes pertinent to large satellites, as recommended by the Decadal Survey: origin and evolution of satellite systems, origin and evolution of water-rich environments in icy satellites, exploring organic-rich environments, and understanding dynamic planetary processes. Thus, Enceladus is elevated to a high priority for continued examination by the Cassini spacecraft, to establish whether liquid water exists or is likely to exist near the surface, thereby making this a prime target for future solar system exploration.

Small Bodies

- Key to understanding the rapidly-increasing inventory of small bodies in the solar system is a survey of their diversity. To this end, the OPAG small body working group is tasked to evaluate what (a) current/planned missions and (b) ground-based studies, are likely to have told us 5-10-years hence.
- OPAG urges continued support for telescopic observations of small objects of the outer solar system

New Frontiers

- OPAG congratulates the New Horizons PI Alan Stern and his team on the successful launch in January.
- OPAG supports an AO for the 3rd New Frontiers mission in the 2008 timeframe and encourages NASA to make the scope the AO broad. For example, some of the closer primitive bodies (e.g. Trojan asteroids, captured satellites, Centaurs) are possible targets for New Frontiers missions. OPAG encourages NASA to allow such missions within the next AO for New Frontiers missions.

Priorities for Technology development – this is a prioritized list of the top technology issues to enable outer solar system exploration. We encourage NASA to include OPAG scientists on technology studies to ensure that they relate to specific mission needs. At the top of the list is Pu-238. This isotope of plutonium is currently in short supply and not being produced in the United States or Russia, but is essential for most planned or envisioned outer planet missions. OPAG encourages NASA to carefully examine its near- and long-term needs for Pu-238 and to make sure that the right people at DOE are aware of these needs.

- Radioactive Power Systems – efficient and minimizing ²³⁸Pu required.
- Capable and affordable launch vehicles with better upper stages
- Up-scaled Deep Space Network at Ka-band
- Space-qualified parts - reasonable qualification and test requirements
- Instruments and components able to operate at low temperatures
- Communications downlink capabilities
- Spacecraft stability for hi-resolution remote sensing
- Probe, balloon & aerocapture technologies
- Cryogenic instrumentation for primitive body studies

Uranus at Equinox Workshop

To facilitate planning for this event, the "Uranus at Equinox" workshop was held at the Pasadena Westin on 2-3 May 2006, with sponsorship from NASA. Several dozen scientists attended, including observers, theorists, and modelers with interests in all aspects of the uranian system. The primary focus was on observational planning and coordination, along with discussion of strategies for educating the community about equinoctial opportunities. Co-conveners Heidi Hammel and Mark Hofstadter led the workshop, and are preparing to distribute a summary document.

Once every 42 years, we have an opportunity to see the planet Uranus and its moons from pole to pole, and to view its ring system edge on. That opportunity comes in 2007. By

observing the Uranus system at its equinox in 2007, we will explore an atmosphere that is changing rapidly. We will probe newly discovered faint rings. We will use the rare opportunity of mutual satellite eclipses to map the brightness variations on large moons. Observations at the equinoxes of Jupiter, Saturn, and Pluto provided fundamental insights. The year 2007 is our chance to do the same for the Uranus system.

Next Meeting

- November 6-7th, 2006 in Tuscon, Arizona.