

## OPAG Meeting Report October 6-7th 2005

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 Keys Bridge Marriot, Virginia October 6-7<sup>th</sup>, 2005 was attended by over 70 people. We heard presentations as follows (not necessarily in order):

- Solar System Division Overview – Andy Dantzler (NASA HQ)
- New Horizons status - Hal Weaver (APL)
- Juno status - Scott Bolton (SWRI)
- Cassini Data Analysis Program - Melissa McGrath on behalf of Denis Bogan (NASA HQ)
- NASA/ESA study of Europa mission concepts - Melissa McGrath (NASA HQ)
- Titan OPAG working group report - Ralph Lorenz (Arizona)
- Titan Vision Study 1 - Jonathan Lunine (Arizona)
- Titan Vision Study 2 - Chris Edwards (Langley)
- How Atmospheric Probes fit into Outer Planets Exploration - Sushil Atreya (Michigan)
- Technologies for Outer Solar System Exploration - Ralph McNutt (APL)

Outer Planets Program – as per our report of June 2005, OPAG advocates a balanced program of outer planet research then involves:

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

### Flagship Mission Studies

- OPAG is enthusiastic to hear Andy Dantzler's announcement of funding (~\$10M) in the FY06 budget for comprehensive studies of missions for the next flagship mission (see his presentation on the OPAG website). As discussed below, OPAG continues to put Europa and Titan at the top of the list of priority targets.
- 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 pathways to 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.

## 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 Phase A study within FY06 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 will jeopardize broader goals for scientific exploration of the outer solar system.
- The OPAG Europa Working Group should 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 to OPAG spanned a wide range of missions. The OPAG Working Group needs to (a) evaluate what issues will be outstanding by the end of the Cassini mission (with or without Extended Mission), (b) prioritize science objectives, and (c) narrow down the range of mission architectures.
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## 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.

- COMPLEX is considering approaching NASA regarding an evaluation of current understanding and outstanding scientific issues of giant planets in both our solar system and other systems. OPAG notes that such a study would provide valuable depth in this critical component of solar system science, beyond the Decadal Survey (whose scope was limited by time and budget). Such an NRC-based study would be useful for guiding NASA on future missions to the giant planets.

#### Primitive Bodies

- Key to understanding the rapidly-increasing inventory of primitive bodies in the solar system is a survey of their diversity. To this end, the OPAG primitive 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 notes that COMPLEX is chartered to conduct rigorous studies of scientific issues. We urge COMPLEX to consider a study such as described above which will be valuable for assessing the next steps in exploration of primitive bodies of the outer solar system.

#### New Frontiers

- OPAG congratulates the New Horizons PI Alan Stern and his team in their delivering the spacecraft to KSC in preparation for a January 2006 launch. Following what we hope to be a successful launch, OPAG would welcome a report from the New Horizons team on their experiences of the NEPA and launch approval process, and any lessons learned for future outer planets missions.
- OPAG is concerned about a possible delay in the launch of Juno from 2010 to 2011, specifically the impact this would have on delaying scientific return, as well as the impact any likely cost growth might have on outer solar system exploration.
- OPAG supports an AO for the 3<sup>rd</sup> 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.

- Radioactive Power Systems - efficient, minimize <sup>238</sup>Pu needed
- 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
- Radiation-hard components
- Instruments and components able to operate at low temperatures
- Communications downlink capabilities
- Volatile memory
- Spacecraft stability for hi-resolution remote sensing
- Probe technologies
- Aerocapture technologies

- Cryogenic instrumentation for primitive body studies

#### Cassini Data Analysis Program (CDAP)

- OPAG is enthusiastic to see CDAP started. However, the funding profile for the program is inadequate considering the expected science return of the Cassini mission. The first year budget of \$2.5M will only fund approximately 25 investigations, and no information was provided on the budget profile beyond year 1. Other R&A programs that are relevant to Cassini data analysis (such as Planetary Geology and Geophysics or Planetary Atmospheres) are well established programs with limited opportunities for new research. The Outer Planets Research Program, while new, does not allow the use of Cassini data. Given these constraints, the CDAP is the only meaningful avenue for Cassini-related research, and a robust program is needed
- 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.
- OPAG welcomes Melissa McGrath (NASA HQ) co-ordinating R&A programs in the Solar System Division.

#### Education and Public Outreach

- OPAG welcomes collaboration with Planetary Society on enhancing communication with the public about outer planet science and missions. Bruce Betts is working with OPAG on a possible Europa workshop and a website providing the scientific context of outer solar system exploration.

#### Next Meeting

- Dates being considered are May 4-5th, 2006, probably adjoining a workshop on Uranus at equinox, or April 20-21. The meeting will be in southern California.
- Status report on primitive body science in light of Genesis, Star Dust, Deep Impact, Rossetta, New Horizons, Dawn missions, as well as ground-based studies.
- Review of ground-based capabilities for exploration of the outer solar system
- Status of technology development programs & comparison to OPAG mission needs

#### In the meantime ....

- OPAG Working Group Activities on Europa, Titan, GP probes and primitive bodies.
- Steering Group to complete OPAG Pathways Document
- Work with COMPLEX on potential studies of (a) Giant planets, (b) Kuiper Belt