Spring 2008 Meeting  
Boulder, Colorado March 31-April 1

- Planetary Science Division - Jim Green (NASA HQ)
- Radioactive Power Systems - Len Dudzinski (NASA HQ)
- NOSSE report - Reta Beebe (NMSU)
- Outer Planet Flagship mission status/plans - Curt Niebur (NASA HQ)
- International collaboration - Jean-Pierre Lebreton (ESA)
- Joint Titan SDT - Dennis Matson (JPL)
- Joint Jupiter SDT - Ron Greeley (ASU)
- Aerocapture - Len Dudzinski (NASA HQ)
- Cassini extended mission(s) - Linda Spilker (JPL)

http://www.lpi.usra.edu/opag/reports.html
Outer Planets Flagship Mission

- **Outer Planets Flagship (OPF)** mission in the Presidents FY 2009 budget
- 2 joint U.S.-European Joint Science Definition Teams (JSDTs)
- highest priorities for exploration of the outer solar system are either
  1) a mission to the Jupiter system with a focus on in-depth exploration of Europa, or
  2) a mission to the Saturn system with a focus on in-depth exploration of Titan.
- Such a mission will capitalize on the phenomenal discoveries made by *Galileo* at Jupiter and made and being made by *Cassini/Huygens* at Saturn, and greatly advance our knowledge of the Solar System.

*described in the 2006 OPAG report *Scientific Goals and Pathways for Exploration of the Outer Solar System*
Cassini

OPAG applauds the plans, already approved by NASA, for a Cassini Extended Mission. The committee noted with great interest the plans for potential follow-on "Extended Extended" mission, in which a Juno-like exploration of Saturn would be possible.
The Saturnian System
Numbers

- 1 Cassini-Huygens
- 5 Scientific disciplines
- 18 Instruments (12 Orbiter)
- 27 Investigations
- 30 Project Science Group (PSG) Executive
- \( \sim 80-100 \) Scientists at PSG Plenary session
- \( \sim 270 \) Scientists on Investigation Teams (more than half are in Europe)
  - Does not include science associates and postdocs
Extended Mission (XM) Tour

- 2-year duration (1 July 2008 - 1 July 2010)
  - Informally termed Cassini Equinox Mission
    - Saturn Equinox in August 2009
- Driven by scientific requirements
- XM tour produces the maximum scientific return possible with the Cassini-Huygens spacecraft
Plume Discovery through Interdisciplinary Science

50 km altitude!
7 Enceladus flybys

Cassini's Enceladus Encounters

E4: August 2008
XXM Science Objectives - SATURN

- **Seasonal-Temporal Change**
  - Observe seasonal variations in temperature, clouds, and composition
  - Observe seasonal changes in the winds at all accessible altitudes

- **New Questions**
  - Determine Saturn's rotation rate and internal structure
  - Study the life cycles of newly discovered atmospheric waves
  - Measure the spatial and temporal variability of trace gases and isotopes
Scientifically interesting end of life option

- Inner D-ring radius: 
  - ~ 65,000 km
- Upper Extent of Saturn atmosphere: 
  - ~ 61800 km (at equator)
- Gap: ~ 3200 km
Discovery and Scout Mission Capability Enhancement - DSMCE

- Five out of the 9 missions selected for study involve exploration of the outer solar system.
- Exciting potential for use of Discovery missions enabled by ASRGs to address selective, focused scientific objectives in the outer solar system.

Program solicited mission concept proposals for small planetary missions that require the ASRG power source
  - Two Stirling Engines with ~140 Watts each (as GFE)
Mission design assistance for these 6 month mission concept studies will be offered by NASA
Selected 9 proposals
  - 40 proposals submitted with average budget of $271K
  - NRA directed proposers to budget $200,000-$300,000
1. OPAG encourages sufficient funds be included in Phase A to allow technology development since NASA has indefinitely postponed most technology development programs other than ASRG and instrument development.

2. OPAG encourages NASA to include radioactive power systems in the NF4 AO since RPSs enables missions to several important scientific objectives, including multi-targeted missions in outer (e.g., flybys of both Uranus and Neptune).
Radioisotope Power Systems

OPAG is encouraged that a sufficient supply of radioisotope fuel will be available for MMRTG use on OPF, and if selected, for ASRG use on a Discovery mission.

Technology development with respect to ASRGs is especially encouraging.

NASA’s support of DOE plans for restarting Pu processing in the next decade, as radioisotope power is a critical enabling technology for outer planets missions.
Next Decadal Survey

• OPAG notes several lessons to be learned from the first NRC Decadal Survey and urges the community and NASA to consider how the process should be improve next time.
• Emphasis should be on prioritizing science objectives rather than specific implementations and/or missions.
• As per Astrophysics and Heliophysics, the next DS for solar system exploration would benefit from studies of potential missions, including budget & mission costing.
• Less clear is how to a Decadal Survey should be updated mid-term as new data come in
Uranus & Neptune Orbiters? Probes?

- Logical sequence after Galileo & Cassini
- Comparison of J&S vs. U&N
  - Hydrogen vs. Water, Ammonia, Methane
- Why/Is Uranus so different?
- Triton - captured KBO?
  Pluto comparison
Next Meeting

• Report on Flagship Studies
• Technology development for outer solar system - needs of flagship mission(s)
• Strategic planning post flagship
• Cassini extended-extended mission
• Update science plan

November 6-7, 2008 in Tempe, AZ
http://www.lpi.usra.edu/opag/
Example of Europa Hypothesis Testing: Thin vs. Thick Ice Shell

Data from multiple instruments combine to test fundamental hypotheses: Gravity, altimetry, radar sounding, thermal, imaging.
Example of Europa Hypothesis Testing:
Catastrophic vs. Steady-State Evolution

Steady-state model

Catastrophism model

90% of Europa remains unseen at resolution needed to recognize key units.
Titan: Complex surface, atmosphere and organics

detached haze

huge cloud systems

mid-latitude streaks

drainage channels

river channels

mountains

Heavy-ion chemistry

chemically complex atmosphere

Titan’s ionospheric Density altitude region 1100 - 1300 km

Very few craters

aeolian patterns

lakes

wind driven dunes
Titan Orbiter Evolution

Titan Orbiter - FY07 concept

Titan Orbiter - FY08 concept

Europa Explorer - FY07 concept

5-m Fairing
Orbiter Aeroshell
3-m antenna (HGA)
5 ASRGs
Orbiter with payload

Titan orbiter payload
Modified structures

3-m HGA
Pressurant Tanks
Ox & Fuel Tanks
6 MMRTGs
Monopropellant Thrusters

Aeroshell for Titan In-situ

Main Engine

EE payload