 Outer Planets Assessment Group Meeting
March 31, 2008



- NASA and ESA have been regularly studying these missions
- Significant NASA study investment in 2007 examining flagship missions to Europa, Jupiter system, Titan, and Enceladus
 - HQ selected Europa, Jupiter system, and Titan for continued study with revised groundrules
 - Study Reports and independent review results posted on the OPAG website
- ESA conducted Cosmic Vision call for proposals in 2007



Study	Form A: Science Merit	Form B: Science Implementation Risk	Form C: Mission Implementation Risk
Enceladus	G/F	Not Voted	Not Voted
Titan Explorer	E/VG	Medium	High
Europa Explorer (2015)	E/VG	Medium	High
Europa Explorer (2017)	E/VG	Medium	Medium
Jupiter System Observer	VG/G	High	High



Enceladus

Science Merit: Good/Fair

- Enceladus is an obvious and tempting target
- The desirability of a lander to do chemical analyses is demonstrated
- The polar orbits used by the Enceladus Orbiter contain the high priority science but are too short, too few, and too late
- For the Saturn Orbiter with Lander concept, too much of the anticipated science yield depends on Enceladus flybys
- The report does not adequately address the multiple competing hypothesis for plume origin, so the mission's potential biological significance is compromised

Titan Explorer

Science Merit: Excellent/Very Good

- Science return from the baseline mission (orbiter plus lander plus balloon) will be extremely rich
- The descope from baseline mission (orbiter plus lander plus balloon) to orbiter plus lander still provides a viable flagship mission with compelling science
- The orbiter-only mission addresses the first of two major objectives (to explore Titan as an evolving Earthlike system) of the mission very well.
- An orbiter only-mission severely compromises the second of two major objectives (to explore Titan's organic inventory) for the mission

Science Panel Significant Findings

Europa Explorer

Science Merit: Excellent/Very Good

- Science objectives are comprehensive, compelling, and mature
- The geological and geophysical objectives, investigations, and proposed measurements in particular are comprehensive
- Jovian tour offers important advance in comparative planetology
- The Europa Explorer mission provides a clear descscope pathway from a comprehensive baseline mission, through staged steps, to a floor mission that still meets all "priority 1" science objectives
- The chemistry objective, including portion related to habitability, was not comprehensively addressed

Jupiter System Observer (JSO)

Science Merit: Very Good/Good

- JSO offers a unique opportunity to study all four Jovian satellites
- The mission design provides comprehensive geophysical and geological interrogation of Ganymede
- Nearly continuous monitoring of Ionian volcanism for 3 years or more
- JSO will acquire extensive global visible and IR and stereo topographic mapping data of the other Galilean satellites
- Synoptic Jupiter atmosphere measurements will be obtained with greatly improved spatial resolution and potential spatial and temporal coverage
- The Jupiter atmospheric scientific investigations in particular were poorly justified
- The science theme of Habitability, which is called out in the Roadmap and is important to astrobiology, was not considered in formulating the science plan
- The SDT did not address how the mission and expected results can be used to study solar system formation and the chemical evolution of the proto-stellar disk

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Science Panel Significant Findings

Enceladus

Science Implementation: Not Voted; Mission Implementation: Not Voted

- Immature mission architecture
- None of the design concepts presented appear feasible
- Mission lifetimes too long to be considered an acceptable risk
- Mass margins are inadequate.
- Feasibility of landing on Enceladus could not be assessed
- Lack of definition in the requirements for the site selection, the landing event and the characterization of the landed operating environment and impacts on the Lander Design.

Titan Explorer

Science Implementation: Medium; Mission Implementation: High

- Extremely challenging design concept in terms of complexity, mass and cost
- Aerocapture for the baseline architecture drives substantial design risk for the Orbiter
- Lander and Aerial Vehicle entry systems and the Orbiter aeroshell are new designs
- Instrument concepts may not meet a number of the required science objectives
- Considerable uncertainty and immaturity associated with the design and implementation of the Chemical analysis Instrument operating in the Titan environment.

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Science Panel Significant Findings

Europa Explorer

2015: Science Implementation: Medium; Mission Implementation: High

2017: Science Implementation: Medium; Mission Implementation: Med

- 2015 launch of EE is not credible, considering the time required to resolve radiation issues prior to the release of instrument AO's and funding availability
- Detailed science traceability matrix that identifies goals and objectives, offers methods for the investigation and details measurement requirements
- Radiation-induced effects on the measurement quality is a significant issue
- The flight system instrument accommodation concept is detailed
- The 2017 launch provides considerable mitigation for the identified major issues, resulting in a reduced risk level.

Jupiter System Observer (JSO)

Science Implementation: High; Mission Implementation: High

- Traceability Matrix fails to clearly tie the particular instruments to the science goals
- Some of the highest in science value investigations may not lead to definitive answers
- Radiation-induced effects on the measurement quality is a significant issue
- Launch configuration with the JSO instrument platform located near the launch vehicle separation interface significantly increases instrument assembly, handling and access risk
- Unacceptable dry mass margin

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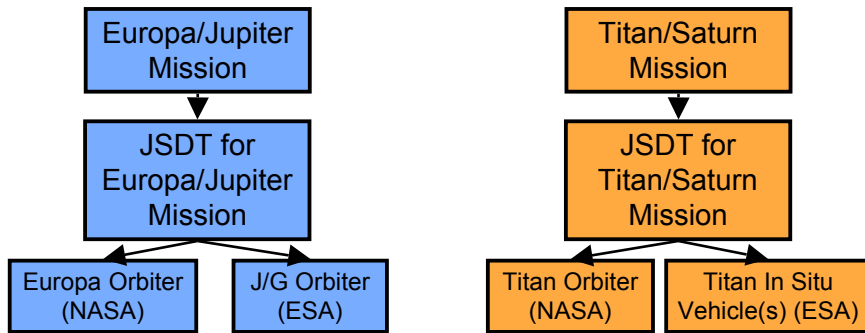
Outer Planets Flagship Mission

- NASA and ESA have firm plans leading to an OPF mission
 - The FY09 President's Budget includes an OPF mission launching in 2016-2017
 - ESA is currently conducting Cosmic Vision study and selection process, which includes OPF candidates
- In preparation, NASA and ESA are currently collaborating on mission studies for either Europa and the Jupiter system or Titan and the Saturn system
- As part of those study efforts, we have convened two Joint Science Definition Teams (JSDT)
 - The Jupiter JSDT will provide science input to the Europa Orbiter mission study (run by NASA) and to the Jupiter Orbiter mission study (run by ESA)
 - The Saturn JSDT will provide science input to the Titan Orbiter mission study (run by NASA) and to the Titan in situ mission study (run by ESA).

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Outer Planets Flagship Studies Study Structure

- NASA and ESA are considering two Outer Planets Missions
- NASA and ESA have created one JSDT for each mission
- Each mission is composed of multiple elements which are under study



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Outer Planets Flagship Mission: Key Constraints on NASA elements

- Cost Cap: \$2.1B (\$FY07) with 33% reserves
- Power System: only MMRTG's or solar allowed
- Launch Vehicle: Atlas 5, Delta IV-H, Ares 5
- Launch and Cruise: Launch nlt 2017 and cruise ngt 7 years
- DSN: utilize 34 m stations only
- Technology: "Rule of One" and missions own necessary technology development
- International Contributions: Partnerships are expected and are being pursued, but international contributions must provide capability above the mission science floor and cannot impinge on the ability of NASA to fly a complete mission for \$2.1B

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Outer Planets Flagship Mission: Tasks for NASA Mission Studies

Europa Orbiter

- Revise 2007 mission based on updated constraints, including:
 - Key constraints on previous slide
 - Limit mission floor to 60 days in Europa orbit
 - Add jovian system science
- Respond to review findings
- Refine and execute radiation plan
- Work with ESA on Jupiter/Ganymede Orbiter study

Titan Orbiter

- Revise 2007 mission based on updated constraints, including:
 - Aerocapture not allowed
 - Deliver and support in situ vehicle
 - Add Saturn/Enceladus system science
- Respond to review findings
- Work with ESA on Titan In Situ Vehicles under study

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Outer Planets Flagship Mission: The Road Ahead

- Summer 2008: Preliminary mission study reports
- Summer 2008: Independent TMC and Science review
- Fall 2008: Teams revise reports based on review results
- Late Fall 2008: HQ and ESA downselect to one OPF mission
- Early 2009: Begin Phase A, including release of instrument AO

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Outer Planets Flagship Mission: Other Activities

- Instrument workshops
 - Intended to prepare community to respond to the instrument AO by providing information on environmental and planetary protection constraints for both missions for interested potential instrument providers
 - June 3-5: Pasadena, CA
 - Fall 2008: Location and final date TBD
- Community Participation and Communication
 - OPF website being created
 - Conferences
 - Other Community Meetings: Opportunity for broad science community to offer input to mission planning
 - March 17-19: Titan/Saturn Community Science meeting in Meudon
 - March 31-April 1: OPAG mtg in Boulder, CO
 - April 21-22: Europa/Jupiter Science mtg in Rome
 - Outer Planets Colloquium Series

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List of Upcoming 2008 Outer Planet Mission Study Meetings

Dates/Location	Meeting Title	Purpose
March 17-19, Meudon, FR	Titan/Saturn Community Science meeting & JSDT meeting	Science and Instrument discussions and Furthering T/S science requirements. Identify model payload for in situ elements.
April 13-18, Vienna, Austria	EGU with Titan/Saturn splinter meetings	Follow-on from Meudon mtg
March 26-29, Pasadena, CA	Europa/Jupiter JSDT Mtg	Furthering E/J requirements
April 2-3, Tucson, AZ	Titan/Saturn JSDT Meeting	Furthering T/S science requirements
April 21-22, Rome, Italy	Europa/Jupiter Science Mtg	Open community science mtg.
April 23-24, Rome Italy	Europa/Jupiter JSDT Meeting	Furthering E/J requirements. Model payload definition for Jupiter Planetary Orbiter
May 8-9 Pasadena, CA	Titan/Saturn JSDT meeting	Furthering T/S requirements. Model payload definition for orbiter and in situ elements.
June 3-5, LA area (tentative)	OP Instrument workshops	Discuss environmental and planetary protection constraints for both E/J and T/S missions for interested potential instrument providers.
Additional workshops to be announced		

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Backup

Discovery and Scout ASRG Studies

- 9 selections for mission studies to inform decisions for Discovery AO
 - Outer Planets: Io Volcano Observer (McEwen) and Titan Mare Explorer (Stofan)
 - Primitive Bodies: Ilion: An ASRG-Enabled Trojan Asteroid Mission Concept (Rivken), Comet Hopper (Sunshine), and Concept Study for a Comet Coma Rendezvous Sample Return Mission (Sandford)
 - Terrestrial Planets: Kuklos (Hecht) and Polar Valor (Baines)
 - Moon: Exomoon (Elphic) and JEDI (Jolliff)

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Early Career Fellowships

- fsf
- Questions? Contact Curt Niebur

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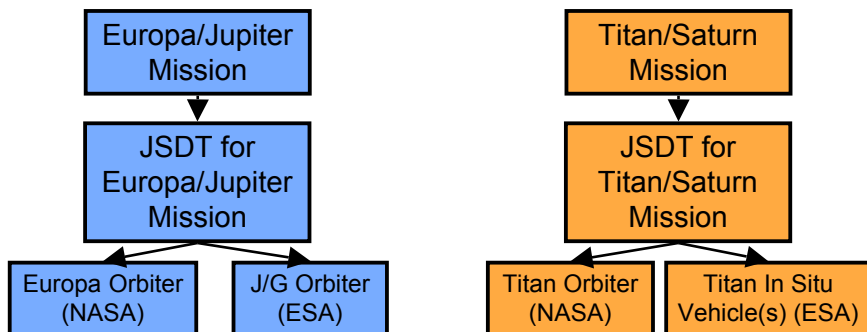
Career Development

- Women in Planetary Science
- NESSF
- NPP
- Proposal writing workshops

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