

# Outer Planets Flagship

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Outer Planets Assessment Group Meeting  
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# Outer Planets Mission Studies

- 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



# 2007 Study Review Results

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



# Science Panel Significant Findings

## 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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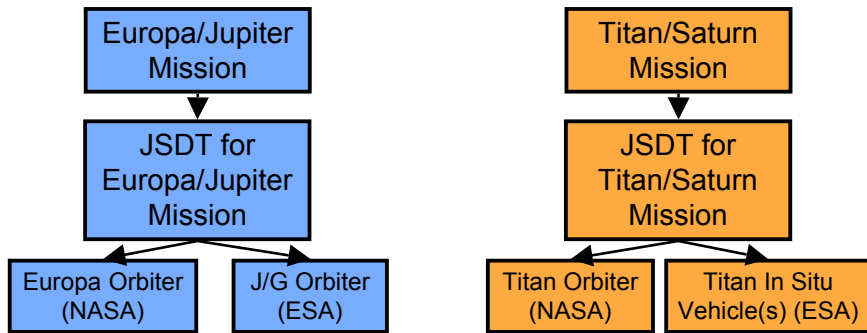
## Outer Planets Flagship Mission

- 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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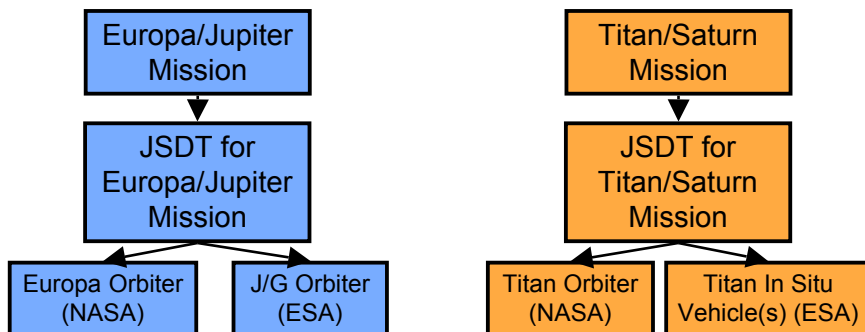
## Career Development

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

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