

**OPAG**

Outer Planets Assessment Group



## *Exploring the Outer Planets*

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**Chair of NASA's**

**Outer Planets Assessment Group**



# What is OPAG?

## ***Outer Planets Assessment Group***

- Open to all interested scientists
- Community-based forum to provide science input for outer planet exploration
- Chartered by NASA's Solar System Exploration Division



# What Does OPAG Do?

- ~1 year old
- Jan and Jun meetings of ~100 people
- Working groups studying missions to Europa & to Titan
- Studies of other targets lining up
- Strategy document in preparation

<http://www.lpi.usra.edu/opag>



## NASA Agency Goal:

*Conduct robotic exploration across the*

*Solar System for scientific*

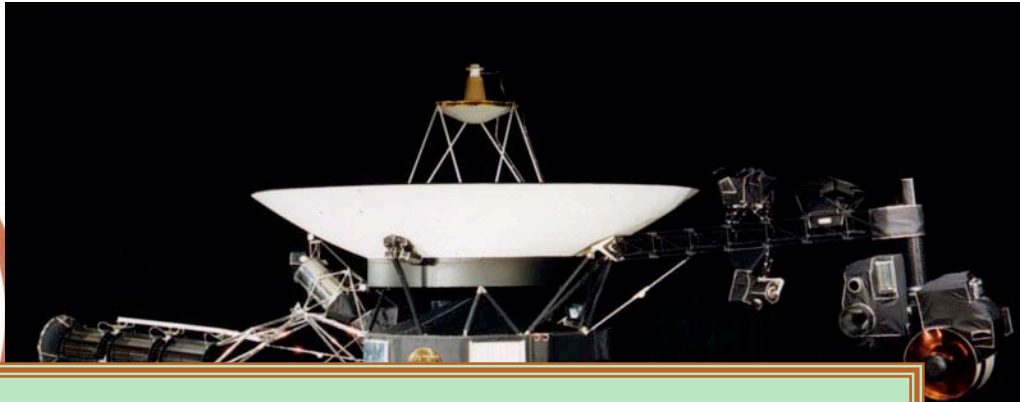
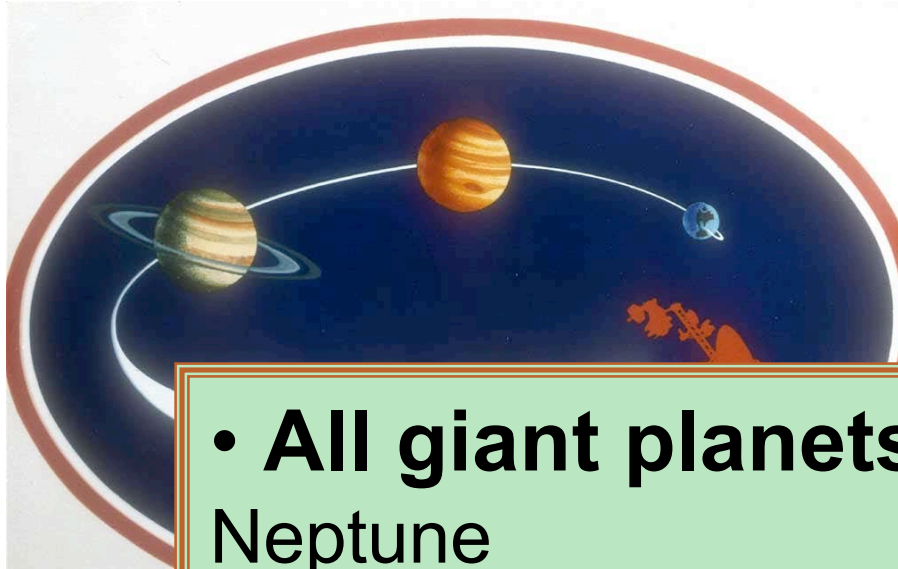
*How do we do this?*

*understand the history of the solar system, and to search for resources.*



# Current Status of Scientific Exploration of the Outer Planets

- What is our understanding and how did we get here?
- What do we have lined up?
- What are the next steps?



- **All giant planets:** Jupiter, Saturn, Uranus, Neptune
- **Exploratory:** Many instruments, broad approach
- **Flybys:** Quick glimpses of priority targets, many serendipitous discoveries
- **Told us:** Atmospheric structure & dynamics, basic properties of moons & rings



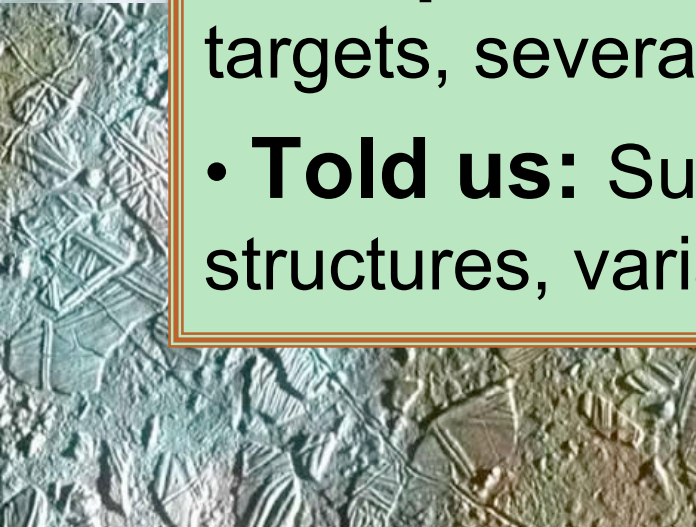
# *Galileo*



# *Cassini*



- **Orbiters:** Several years orbiting Jupiter, Saturn
- **Probes:** Atmosphere of Jupiter, atmosphere/surface of Titan
- **Deep Studies:** Many instruments, multiple targets, several return visits
- **Told us:** Substantial details about structures, variability, processes



**#1 *New Horizons*** - Pluto & Kuiper Belt

**#2 *Juno*** - Jupiter Polar Orbiter

- Competitive selection
- *Focused:* Limited instrumentation, limited duration

**NEW FRONTIERS**  
Program





# Juno

## *Juno*

- ❖ **Jupiter Polar Orbiter**
- ❖ **Launch ~mid-08 ?**
- ❖ **Probe interior with radiometry, gravity & magnetometry**
- ❖ **Explore polar regions**

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PRESSURE (BAR)





## OPAG View on New Frontiers - 1

- A flight rate of 3 NF missions per decade addresses outstanding solar system science in a timely fashion
- 3 targets remain on original list: **Venus** in situ explorer, **Comet** surface sample return and **Lunar** Aitken Basin sample return.



## OPAG View on New Frontiers - 2

*Possible targets for New Frontiers #3?*

- ¿ Trojan asteroids?*
- ¿ Captured moons of Jupiter?*
- ¿ Centaurs?*
- ¿ Other Kuiper Belt Objects? Binaries?*
- ¿ Jupiter flyby + probe?*

- Outer solar system science is best served by an expanded scope for NF#3
- **OPAG recommends that the scope of the NF#3 AO be addressed ASAP**



## Next Flagship Mission?

>Decade to plan, build, fly

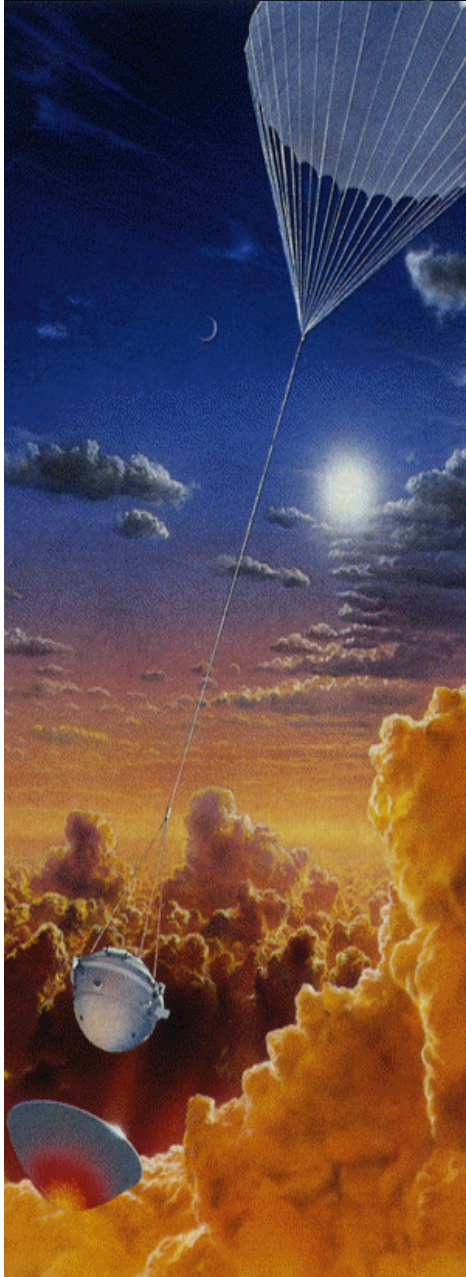
Many targets -

Which are top scientific priority?

Which are feasible?

Which are appealing?

***Need to start planning now.....***



## Four Key Mission Elements

**Science**

the case for going

**Technology**

the means to go

**Strategy**

all agree to go

**Programmatics**

money in place



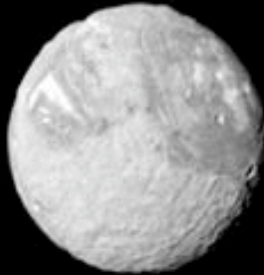
## EXPLORING THE OUTER SOLAR SYSTEM

### Destinations

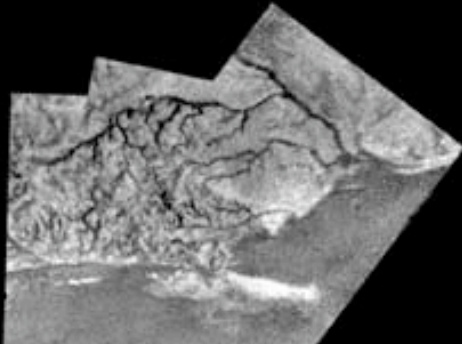
Giant Gas Planets



Small Icy Worlds



Intriguing Moons

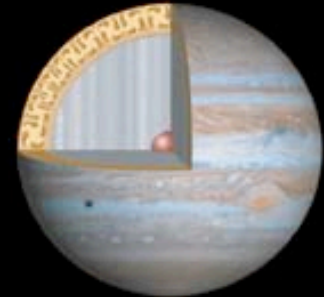


### Making Solar Systems

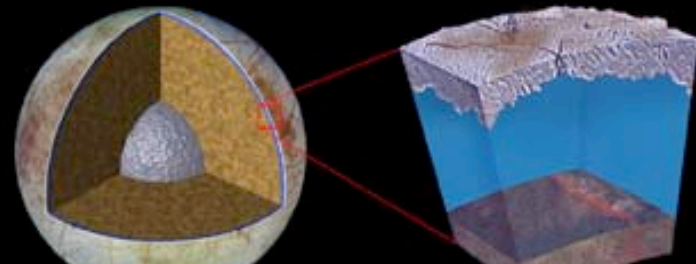
Building Blocks



Interior Secrets



Extreme Habitats





# 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



# What's Under Europa's Icy Surface?

- Characterize tidal deformation
- Characterize surface geology
- Measure 3-d distribution of water
- Determine surface composition
- Search for pre-biotic chemistry



# Back to Titan?

- An Exotic Earth-like World
- Dynamic and evolving atmosphere
- Active geology
- Provides clues to the origin of life on Earth



# First Building Blocks?

## Comet Cryogenic Sample Return

- Measure material from nucleus
- Determine origin of organics and water in the solar system
- Clues to formation and evolution of planetary atmospheres



# OPAG Working Groups

1. Europa concept relatively mature
  - other flagship missions need science & technology definition
2. Outer solar system missions take many years to get off ground, often stalled/cancelled
  - have queue of missions well defined and ready to step forward



# Outer Planets Program

- Flagship mission per decade
- New Frontier missions to the outer solar system 3/decade
- Discovery mission opportunities
- Telescopic observations
- Research and Analysis
- Technology development



## Next OPAG Meeting

October 6-7, 2005 in DC area

<http://www.lpi.usra.edu/opag>

*Let's Keep Exploring!*