Exploring the Outer Planets

Fran Bagenal
University of Colorado, Boulder

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

How do we do this?
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
• **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 Horizons

- Pluto / Charon & Kuiper Belt
- Launch ~Jan 06
- Jupiter flyby mid-2007
- Pluto / Charon ~2015
- Additional Kuiper Belt Object(s) as feasible
Juno

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