

Preparing the OPAG Community for the Next Planetary Decadal Survey

2019-08-20

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For the OPAG Steering Committee

Starting Point: “Cross-Cutting Themes” of the **2011 DS**

Cross-Cutting Themes	2011 Priority Questions
Building new worlds	1. What were the initial stages, conditions and processes of solar system formation and the nature of the interstellar matter that was incorporated?
	2. How did the giant planets and their satellite systems accrete, and is there evidence that they migrated to new orbital positions?
	3. What governed the accretion, supply of water, chemistry, and internal differentiation of the inner planets and the evolution of their atmospheres, and what roles did bombardment by large projectiles play?
Planetary habitats	4. What were the primordial sources of organic matter, and where does organic synthesis continue today?
	5. Did Mars or Venus host ancient aqueous environments conducive to early life, and is there evidence that life emerged?
	6. Beyond Earth, are there modern habitats elsewhere in the solar system with necessary conditions, organic matter, water, energy, and nutrients to sustain life, and do organisms live there now?
Workings of solar systems	7. How do the giant planets serve as laboratories to understand Earth, the solar system, and extrasolar planetary systems?
	8. What solar system bodies endanger Earth’s biosphere, and what mechanisms shield it?
	9. Can understanding the roles of physics, chemistry, geology, and dynamics in driving planetary atmospheres and climates lead to a better understanding of climate change on Earth?
	10. How have the myriad chemical and physical processes that shaped the solar system operated, interacted, and evolved over time?

- **This table serves as a basis of every proposal we write.**
- **For Next DS: Ensure OPAG Topics are Well-Represented.**

What is the OPAG Community's Expectation on what the next Decadal Survey will achieve?

The Next Planetary Science Decadal Survey will...

- Identify Important Science Questions
- Prioritize (Based on the Important Science Questions):
 - Science Investigations:
 - *Missions, R&A*
 - Hard Infrastructure Investment:
 - *Technologies, Software and Facilities*
 - Soft Infrastructure / Human Capital Investment
 - *Maintaining and Training Scientific Leadership and Expertise*
 - *With emphasis on Diversity, Equity, and Inclusiveness*

White papers should advocate for high-priority Investigations and Infrastructure Needs based on Important Science Questions

Request from Lori Glaze at NASA HQ:

- Identify Three Top-Priority Science Questions of the OPAG community (and examples of how different destinations can address them)
- Goal of the current OPAG meeting

Proposed OPAG Approach to Next Decadal Survey

- OPAG will first identify:

Key Cross-Cutting Science Themes & Priority Science Questions

- Key Cross-Cutting Science Themes and Science Questions can serve as the basis of the whitepapers
- Goals of the whitepapers are to identify and advocate for:
 - Priority Investigations (Missions, R&A)
 - Priority Hard Infrastructure (Technology, Facilities)
 - Priority Soft Infrastructure (Scientific Leadership, Expertise)that are needed to address the Priority Science Questions
- Current OPAG Goals Document does not offer Key Cross-cutting Science Themes

Goal of Discussion Starting Today

Identify:

- Key Cross-cutting Science Themes
- Priority Science Questions and Missions
- Provide Lori Glaze with
Three Priority Science Questions of OPAG Community

Need Survey of OPAG Sub-Discipline Needs & Priorities

- OPAG represents many sub-disciplines (e.g, magnetospheres, geology, etc.) with diverse interests in multiple mission destinations
- We invited Destination leaders to present their needs & priorities

Assignments to the Destination Panels

- Identify Key Cross-cutting Science Themes of your Destination
 - Identify themes that addresses various sub-discipline needs, while appealing to the needs of other communities
 - Themes that appeal to non-OPAG communities will be a huge plus!
- Identify Priority Questions and Mission concepts for your Destination
 - That best address the Key cross-cutting Science Themes
 - Also consider missions that best address the Priority questions

OPAG Suggestions on Whitepapers

- Build on Key Cross-cutting Science Themes
- Identify Priority Investigations (e.g. Missions, R&A) that best address the Key Cross-cutting Science Themes
- Identify Hard Infrastructure (e.g. Technology, Facilities) needed to execute Priority Investigations
- Identify Soft Infrastructure (e.g. Leadership, Expertise) needed to execute Priority Investigations

Take-home Message

**Formulation of
Cross-Cutting Themes and Priority Questions
is about
Finding a Common Ground
that will serve all of us in 2022-2032**

Destination Panel Summaries

Unifying Science Themes Proposed by *Destination Dwarf Planets* Panel

Chair: Orkan Umurhan, (NASA ARC)

Building New Worlds (Origins)

Initial conditions of outer solar system, types of materials incorporated into bodies and where, chemical budget of outer solar system at birth dictates what drifts into inner planet zone (disk transport)

Planetary Habitats

Ocean world systems, synthesis of organics, evolution of climatic systems

Solar System Workings

Comparative planetology. Processes driving planetary climates and atmospheres potentially leading to terrestrial/martian insights, complex interplay of chemical/physical surface and surface-atmosphere processes, past and present.

Enceladus panel: Summary of Themes & Questions

Chair: Amanda Hendrix (PSI)

- **Theme #1: The search for life in the solar system**
 - 1.1. Does [Enceladus] host extraterrestrial life? (extant)
 - 1.2. Did [Enceladus] host extraterrestrial life? (extinct)
 - 1.3. How far toward life has chemistry progressed in [Enceladus'] liquid reservoirs?
 - 1.4. How habitable has [Enceladus] been over time?
- **Theme #2: Understanding the distribution and evolution of habitable environments in the solar system**
 - 2.1. How has the nature of the Enceladus ocean evolved over time? What metrics are needed to model the possibilities?
- **Theme #3: Understanding the physical nature and dynamics of solar system bodies**
 - 3.1 What are the mechanisms, drivers, and rates for circulating materials within and ejected from Enceladus? Have they changed over time?
 - 3.2 What is the fate of ejected materials? How has this loss influenced ocean chemistry and physics, as well as Saturn's E-ring composition?
 - 3.3 How does the geophysical evolution of Enceladus compare to other Ocean Worlds in the solar system?

Key Unifying Science Themes Proposed by *Europa* Panel

Chair: Cynthia Phillips (JPL)

The **Formation**, **Evolution**, and **Habitability** of Ocean Worlds in our Solar System and Beyond

Three unifying science themes:

1. How do ocean worlds **form**?
2. How do ocean worlds **evolve**?
3. What controls the **habitability** of ocean worlds? Are they **inhabited**?

A Europa exploration strategy would address all these questions!

Key Outer Planet Unifying Science Themes.

All are addressed
by an Ice Giant
mission.

Proposed Key Unifying Science Theme #1: How do planetary systems form?

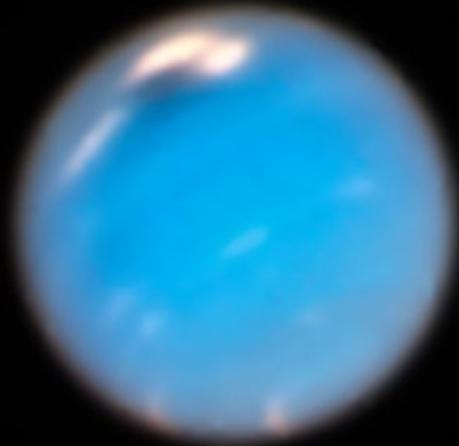
- OPAG disciplines: All
- Non-OPAG disciplines: exoplanets (Astrophysics), Earth Science, small bodies (SBAG), terrestrial planets (VEXAG, MEPAG), the Moon (LEAG)

Proposed Key Unifying Science Theme #2: Do Life or Habitable Conditions Exist Beyond the Earth?

- OPAG disciplines: Satellites, Ocean Worlds
- Non-OPAG disciplines: small bodies (SBAG), exoplanets (Astrophysics)

Proposed Key Unifying Science Theme #3: What Processes Control the Evolution and Current Conditions of Planets?

- OPAG disciplines: All
- Non-OPAG disciplines: all planetary disciplines plus exoplanets (Astrophysics), solar-magnetosphere interactions (Heliophysics), and Earth Science



Engages every planetary science discipline

Why the Ice Giants?

- Identified as high priority in the last Decadal and remain just as important
- Investigates the last unexplored class of large bodies in the solar system
 - Different class of planet than Jupiter and Saturn
 - Pivotal to understanding solar system formation and evolution
- Each has a unique ring and satellite system
 - Potential for new Ocean Worlds
 - Captured KBOs vs *in situ* formation
- Both have magnetospheric geometries not seen elsewhere
- Most known exoplanets fall in the ice giant size range

KEY QUESTIONS ABOUT TIDAL HEATING:

Io Chair: James Keane

1. What do volcanic eruptions tell us about the interior?
2. Does Io have a magma ocean?
Is [insert object] an ocean world?
3. How is tidal dissipation partitioned?
4. Is the resonance in equilibrium?
5. Can stable isotopes inform long-term evolution of tidally heated worlds?

BACKUP SLIDE STARTS HERE

OPAG Whitepaper to the Last Decadal Survey

Recommendations by the OPAG Steering Committee Whitepaper (McKinnon et al.):

- NA 1. OPAG recommends that the Decadal Survey explore the possibilities for a program structure/categorization that could allow ‘small flagship’ class missions to be considered, providing a greater range of choice and capabilities in the mix to balance the size of program elements and science return.**
- PA 2. OPAG strongly endorses the prioritization by NASA of the Jupiter Europa Orbiter (JEO) as the next Outer Planets Flagship and as part of the Europa Jupiter System Mission (EJSM) with ESA. This collaboration includes a Ganymede orbiter and an increased focus on Jupiter system science; OPAG strongly recommends support of JEO and EJSM in the Decadal Survey.**
- FA 3. In addition, OPAG strongly endorses approval by NASA of the Cassini Solstice Mission, including the Juno-like end-of-mission scenario, given the likely phenomenal return on investment.**
- FA 4. OPAG also advocates the need for a focused technology program for the next Outer Planet Flagship Mission, which should be to Titan and Enceladus, in order to be ready for a launch in the mid-2020s. Technologies that require long-term investment for missions beyond the next decade should also be considered.**
- FA 5. New Frontiers class missions that should be considered in the interim include (but *not* in priority order) a shallow Saturn probe, an Io observer, a Titan *in-situ* explorer or probe, a Neptune/Triton/KBO flyby, and a Uranus orbiter. OPAG recommends that these be studied, costed, and if deemed feasible, added to the approved New Frontiers mission set.**

NA: 2011 DS did not agree

Legend: PA: 2011 DS partially agreed

FA: 2011 DS fully agreed