



SCIENCE

Outer Planets Program Status

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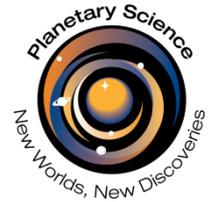
OPF Program Scientist, NASA Headquarters

OPAG Meeting

January 10, 2013



Science Nuggets



- Science nuggets are single slide, layman descriptions of fascinating science results
- These nuggets are shared with senior management inside and outside of the agency
- Missions regularly generate these, but we are always in need of nuggets from R&A efforts
- Nuggets should generate a “wow” factor and be relatable to non-experts

Ice Skating on Titan

Recent work by Cassini scientists suggests seasonal ice in Titan's hydrocarbon lakes probably floats*. Unlike water ice in Earth's oceans, the hydrocarbon ice in Titan's lakes and seas may float, sink and rise again to the surface as the temperature changes.

- Methane ice in Titan's methane-rich lakes will exist if the winter temperature is below the freezing point of pure methane (-297° F).
- In the case of Titan's larger ethane-rich seas, if the ice forms with at least 5 to 10 percent air, the ice will initially float but will sink if the temperature drops by just a few degrees. Seas could

Floating ice in Titan's reddish hydrocarbon lakes and seas is likely buoyant, as depicted in this artist's concept based on data from NASA's Cassini spacecraft orbiting Saturn.

Titan's Sky is Falling!

Saturn's moon Titan has a massive atmosphere laden with layers of photochemical haze/smog. Cassini cameras have measured a dramatic change in

3 May 2006 2 April

Haze layer near 500 km altitude

Altitude (km)

500
450
400
350
300
250

Cassini Documents Largest Storm Ever Observed on Saturn

Storm wraps around planet and covers approximately 1.5 billion square miles

Fischer, G. et al. A Giant Thunderstorm on Saturn. *Nature* vol. 475, pages 75–77 (July 07, 2011)

The largest and most intense storm ever observed on Saturn has been captured by the Cassini spacecraft. The storm, currently still active, encircles the planet. From north to south, it covers a distance of about 9,000 miles (15,000 km). It encompasses an area approximately eight times the surface area of Earth and is 500 times larger than any storm previously seen by Cassini at Saturn. The storm is also a significant source of radio noise, which comes from lightning deep in the planet's atmosphere. As on Earth, the lightning is produced in water clouds, where falling rain and hail generate electricity. At its most intense, the storm generated more than 10 lightning flashes per second. It is a mystery why Saturn stores energy for decades and releases it all at once. This behavior is unlike that of Jupiter and Earth, which have numerous storms occurring at any one time.

The false-color image mosaic from Cassini, released July 6, 2011, documents a day in the life of a huge storm that developed from a small spot that appeared 12 weeks earlier in Saturn's northern mid-latitudes. The false colors show clouds at different altitudes. Clouds that appear blue are the highest and are semitransparent. Those that are yellow and white are optically thick clouds at high altitudes. Those shown green are intermediate clouds. Red and brown colors are clouds at low altitude unobscured by high clouds, and the deep blue color is a thin haze with no clouds below. The storm clouds are likely made out of water ice covered by crystallized ammonia.

Feb. 25, 2011. Image taken about 12 weeks after the storm began.

07/11/2011

We are always in need of science nuggets. Want to brag a little?



Cassini Solstice Mission

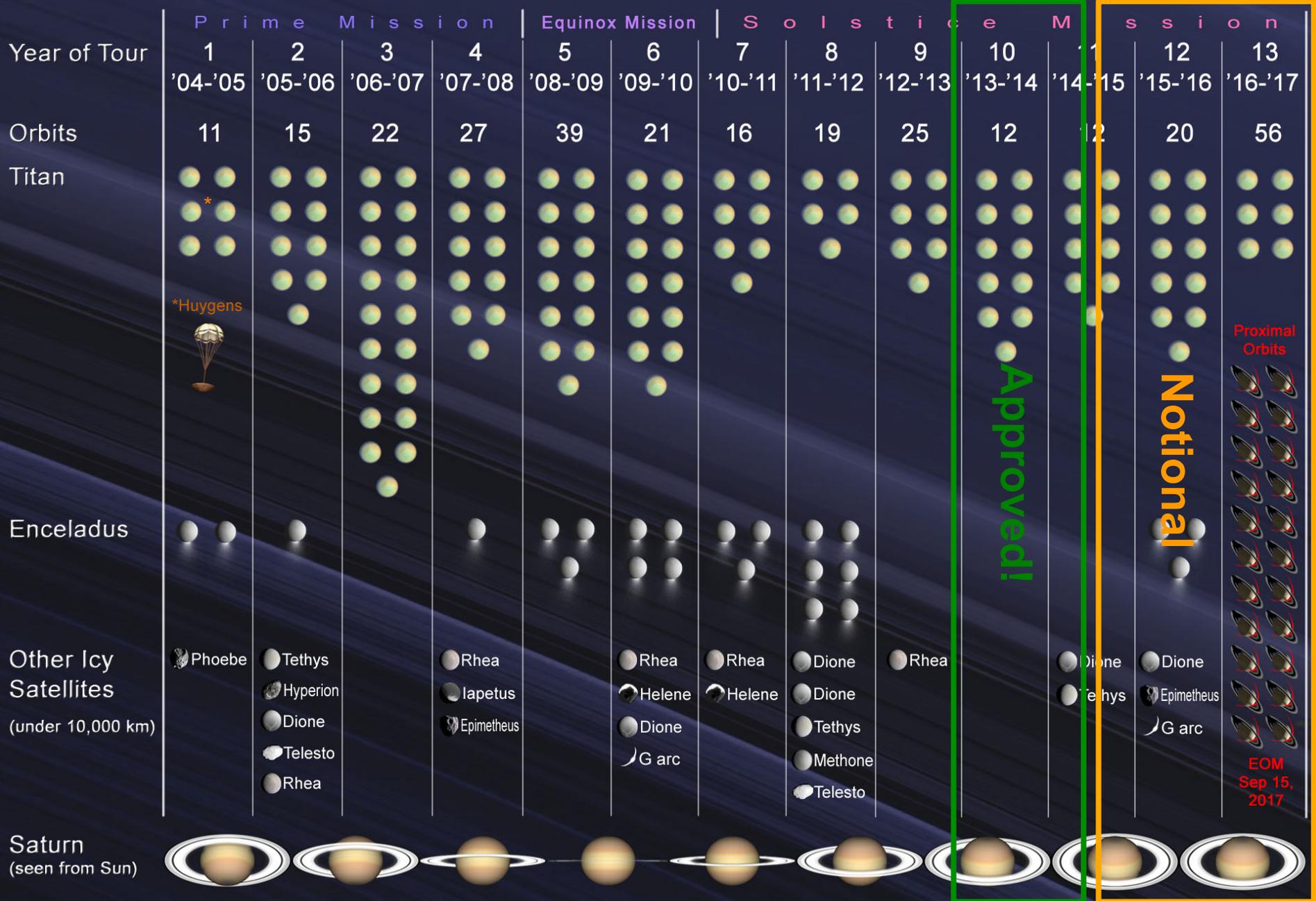


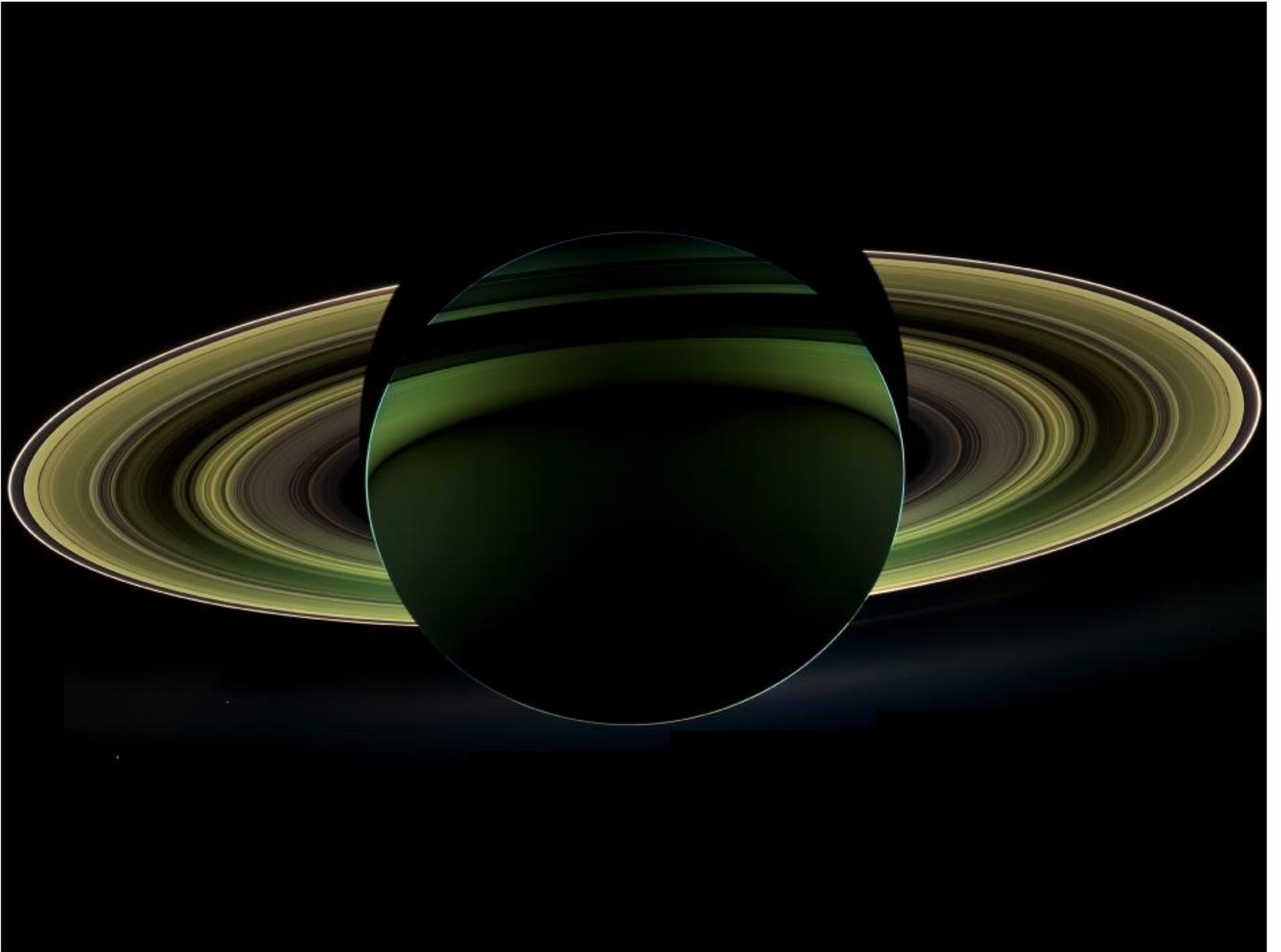
- Overall Cassini remains a very healthy and robust spacecraft
 - We just began to increase the orbital inclination
 - Unfortunately, since the last OPAG meeting the Cassini Plasma Spectrometer (CAPS) has malfunctioned and is currently off
- Cassini fared extremely well in the new PSD consolidated Senior Review



Cassini Mission Overview

Four-Year Prime Tour, Equinox Mission, and Solstice Mission (Proposed) July 2004 - July 2017



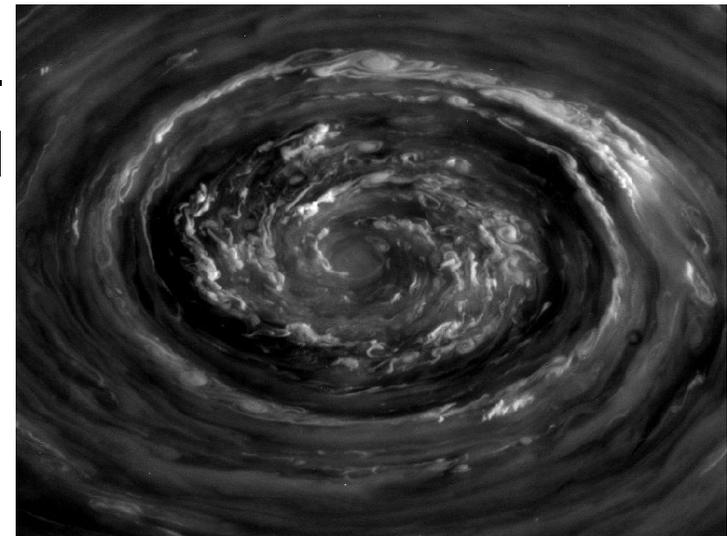




Cassini Solstice Mission



- Overall Cassini remains a very healthy and robust spacecraft
 - We just began to increase the orbital inclination
 - Unfortunately, since the last OPAG meeting the Cassini Plasma Spectrometer (CAPS) has malfunctioned and is currently off
- Cassini fared extremely well in the new PSD consolidated Senior Review
- The second group of eight new Participating Scientists were selected last fall
 - NASA is reevaluating the PS proposal process
 - Currently PS candidates include a 5 page addendum to CDAP proposal that could better balance preparation effort with usefulness

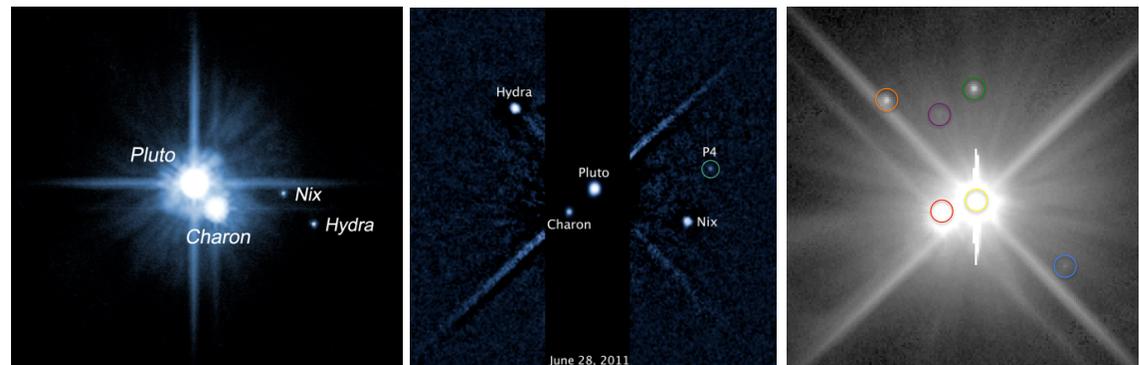
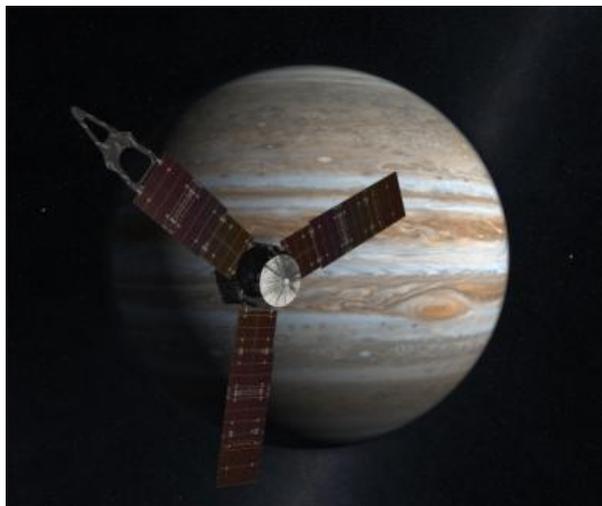




Mission Status – Juno and New Horizons



- Juno is in excellent health and operating nominally
- Spacecraft has covered ~33% of the 19-AU-long trajectory
- JOI in 3.5 years!
- New Horizons is in excellent health and operating nominally
- Spacecraft is 25.1 AU from the sun and 7.4 AU from Pluto system
 - “The year after next...”
- Pluto system has proven to be unexpectedly crowded...

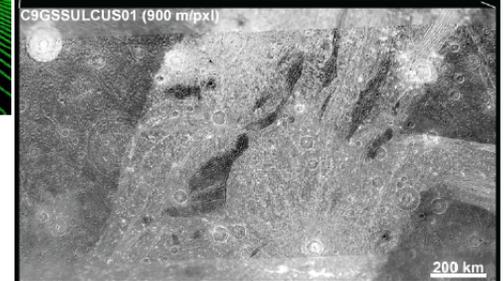
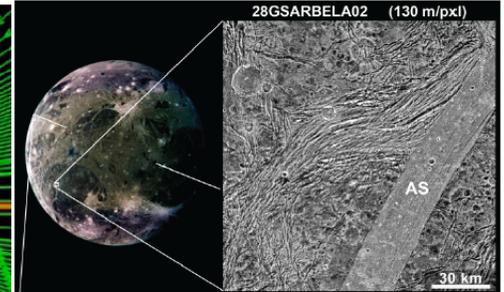
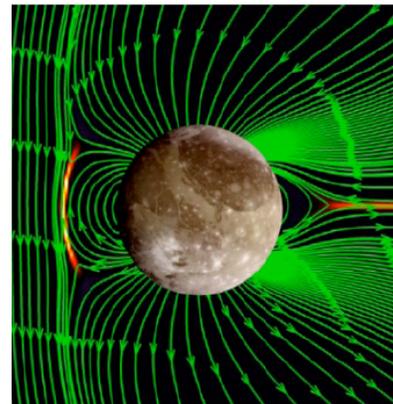
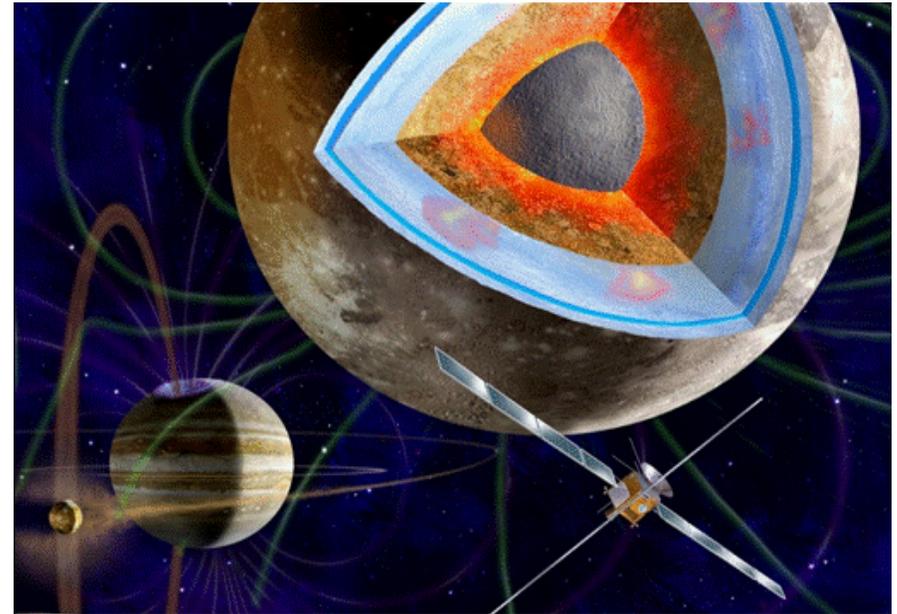




The JUperiter ICy moons Explorer Mission



- On May 2, 2012, the ESA SPC formally selected JUICE as the first Large-class mission in ESA's Cosmic Vision Program
- The JUICE mission will investigate the emergence of habitable worlds around gas giants, characterizing Ganymede, Europa and Callisto as planetary objects and potential habitats, and will also explore the Jupiter system as an archetype for gas giants.
- JUICE will first orbit Jupiter for ~2.5 years, providing 13 flybys of Callisto and 2 of Europa, and then will orbit Ganymede for 9 months
- Launch is scheduled for 2022 with Jupiter arrival in 2030, Ganymede orbit insertion in 2032, and Ganymede impact in 2033





ESA/NASA Partnership



- NASA offered to collaborate with ESA on its JUICE mission with up to a total of \$100M of contributions consisting of:
 - 1) NASA-funded instrument investigations led by a U.S. PI,
 - 2) NASA-funded instrument component(s) provided to non-U.S.-led instrument(s)
 - 3) NASA-funded U.S. Co-Is on non-U.S.-led instrument(s).
- Within this budget cap, NASA expects to select a mixture of the three types of contributions.
- NASA and ESA negotiated a coordinated AO process
 - NASA released PEA K to the SALMON-2 AO for U.S.-led proposals
 - ESA released its own AO for non-U.S.-led proposals
 - NASA and ESA evaluation process will be independent but share review results
- NASA AO was released on July 2, 2012, and proposals were due on Sept. 24, 2012

Review is complete and we are in the final stages of the coordinated selection process with ESA



Europa Flagship Mission



- We are wrapping up the Decadal-recommended effort to study ways to lower the cost and science content of the Europa flagship mission
 - OPAG has been regularly appraised of the effort to examine focused Orbiter, Lander, and Flyby missions
 - Final report has been delivered to HQ
 - Study effort will wrap up in April 2013 when funding is exhausted
- NASA has exhaustively studied missions to Europa and has independently validated (from a science, technical, and cost perspective) each of the concepts produced over the past 5 years
- NASA awaits the necessary budget for the next step, which is mission implementation



Presentations to pay heed to...



- This is not a slow period for Outer Planets!
 - We have three operating missions requiring care and attention
 - We are a partner on a new mission to Ganymede
 - We have a Europa Flagship mission that needs reinvigorated stakeholder support
 - We have AOs coming up for which we need to position the community
- PSD is currently funding a study to a) determine the potential value to planetary science of a balloon-based telescope and b) create a concept to achieve that science
 - Balloon Update by Tibor Kremic
- It is time to start thinking seriously about the next Discovery and New Frontiers AOs
 - Discovery AO Experience by Michael New
 - TPS Options by Steve Gaddis
 - Game Changing Technologies by Steve Gaddis
 - Etc.