



Planetary Science Division

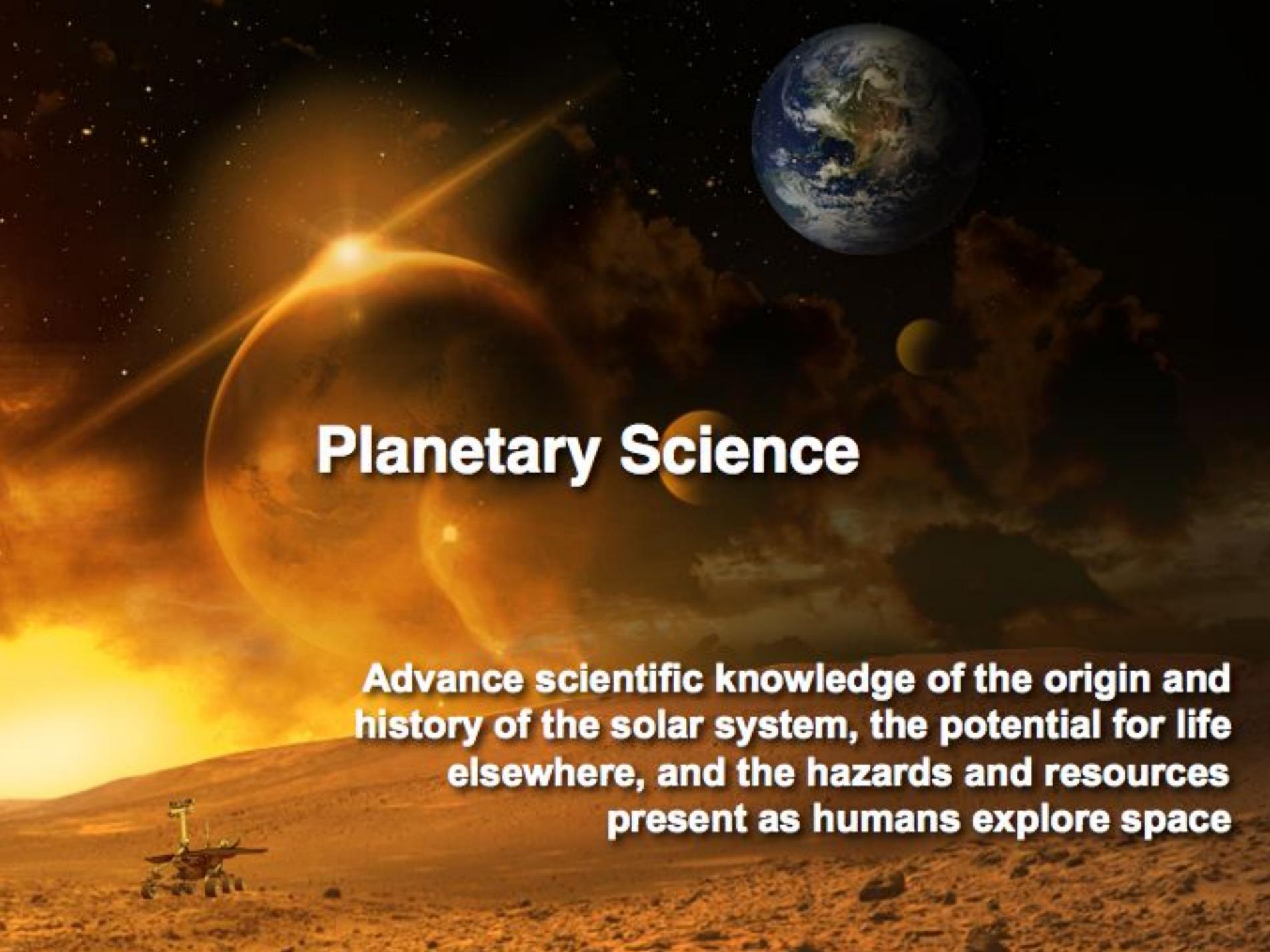
James L. Green
Acting, Director PSD
(on detail from GSFC)

December 1, 2006



Outline

- Non-Mars Mission Overview
 - Discovery
 - New Discover Mission Selections
 - New Frontiers missions
 - Flagship missions
- PSD mission calendar
- Summary

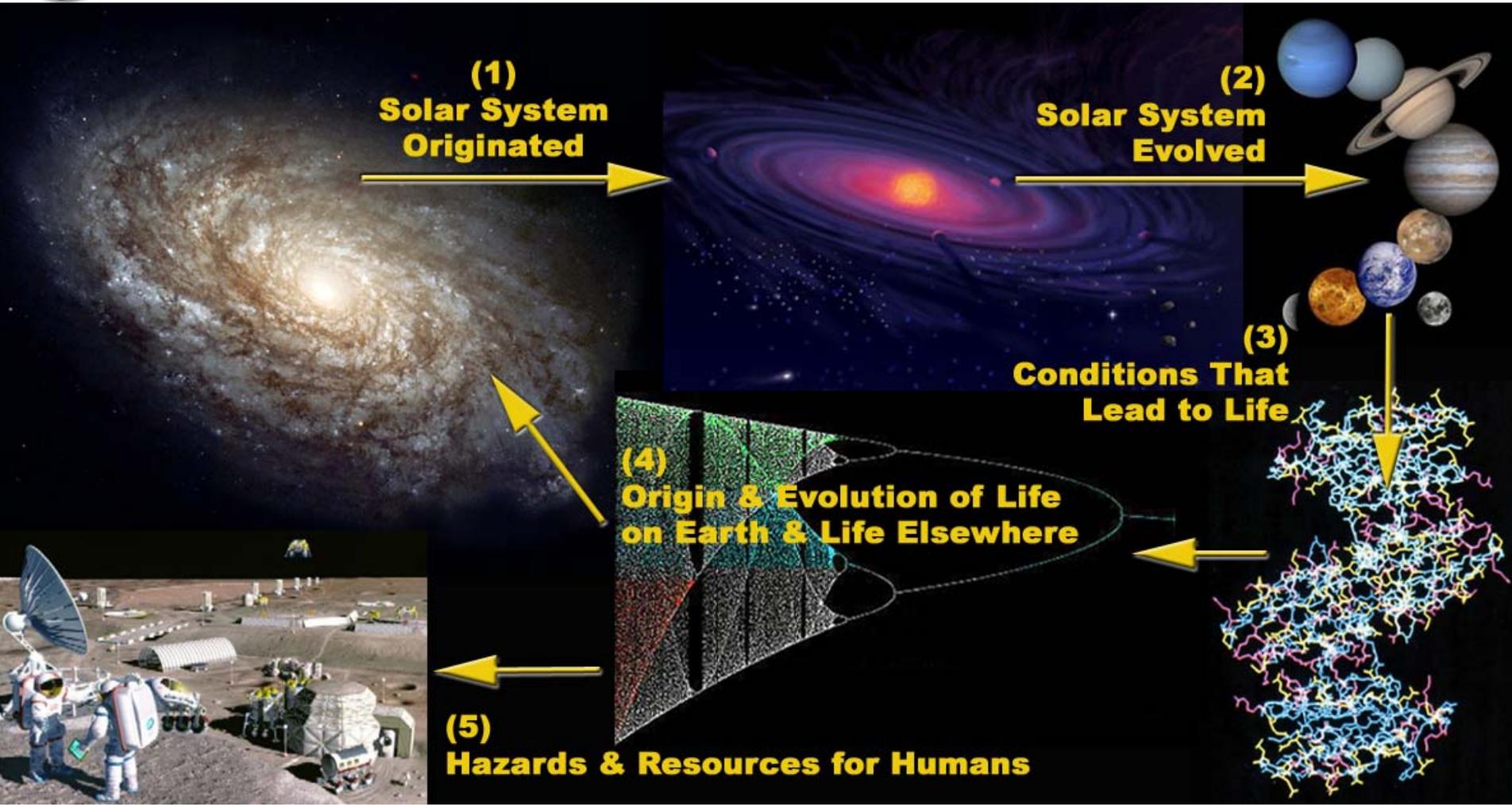


Planetary Science

Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space



Scope of the Planetary Science Division Activities



Underlying Theme: **Habitability**

- Habitability of worlds
- Architecture of systems
- Hazards to Earth

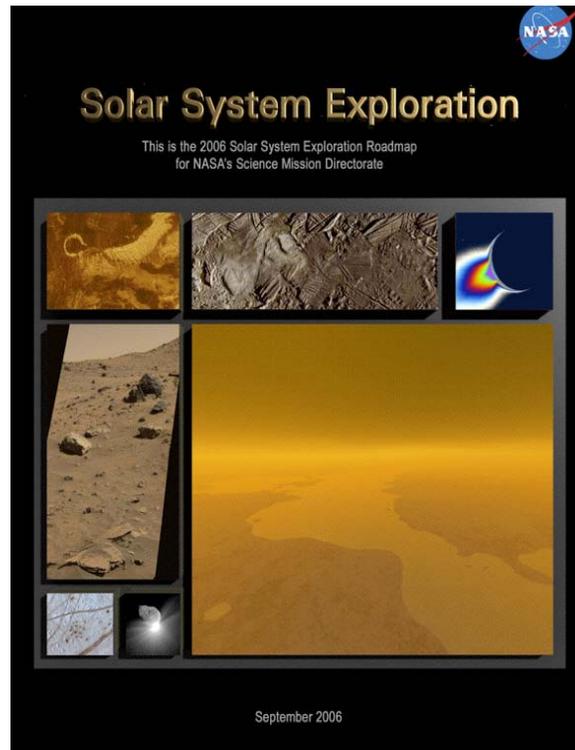
Scientific Questions

- How did the Sun's family and minor bodies originate?
- How did the Solar System evolve to its current diverse state?
- What are the characteristics of the Solar System that lead to the origin of life?
- How did life begin and evolve on Earth and has it evolve elsewhere in the SS?
- What are the hazards and resources in the Solar System environment that will affect the extension of human presence in space?



Planetary Science Division Roadmap

- Roadmap has been issued & posted at a number of locations



<http://solarsystem.nasa.gov/multimedia/downloads.cfm>



Current Mission Status

- Mars: MRO, MER-1, MER-2, Mars Odyssey
 - *New Launches*: MSL and Phoenix
 - *Recently lost*: MGS
- Discovery: Messenger, Deep Impact, Stardust
 - *New Launches*: Dawn
- New Frontiers: New Horizons
 - *New Launches*: Juno
- Flagships: Cassini/Huygens at Saturn, Mars Science Laboratory (MSL)
- International: Mars Express, Venus Express, Rosetta, Hayabusa
 - *New Launches*: Moon Mineralogy Mapper-Chandrayan



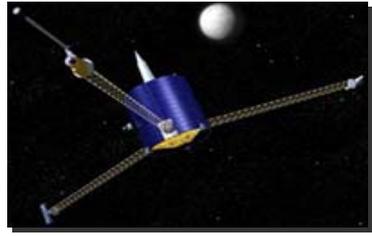
Discovery Program

Completed

Mars evolution:
Mars Pathfinder (1996-1997)



Lunar formation:
Lunar Prospector (1998-1999)

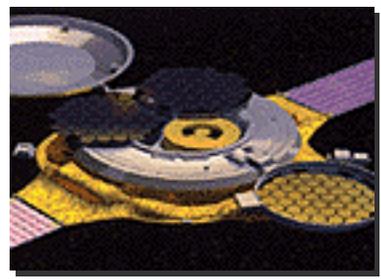


NEO characteristics:
NEAR (1996-1999)

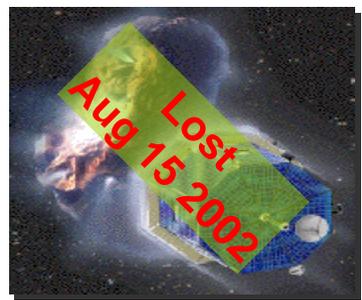


Completed / In Flight

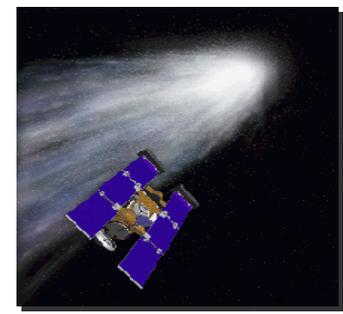
Solar wind sampling:
Genesis (2001-2004)



Comet diversity:
CONTOUR

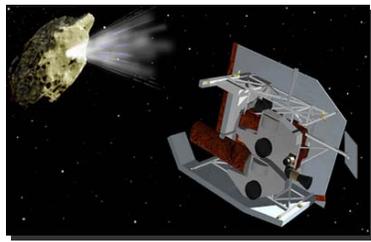


Nature of dust/coma:
Stardust(1999-2006)

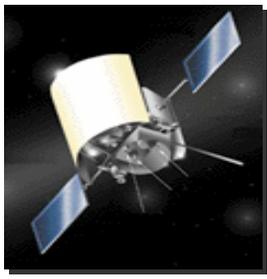


In Flight / In Development

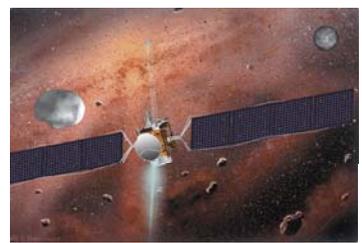
Comet internal structure:
Deep Impact (2005-2006)



Mercury environment:
MESSENGER (2004-2012)



Main-belt asteroids:
Dawn (2007-2015)

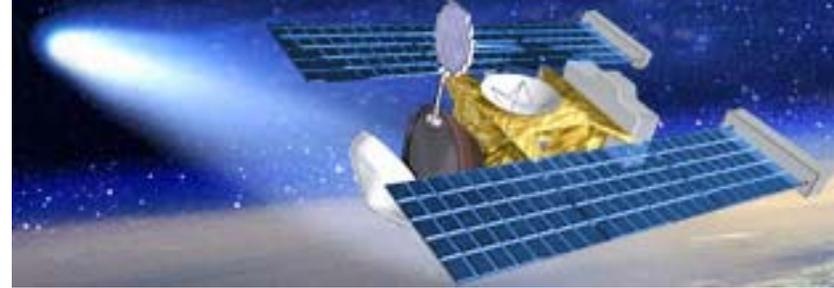


Extra-solar planets:
Kepler (2007-)





Stardust Science Workshop



- Stardust (4th Discovery mission)
 - PI: Don Brownlee; Co-PI: Peter Tsou
 - Launched on Feb. 7, 1999
 - Encountered Comet Wild 2 on Jan. 2, 2004
 - Earth return of aerogel with comet material on Jan. 15, 2006
 - Flown as proposed! (on budget and on schedule)
- About 200 attended with ~40% foreign (Europe & Japan)
 - Teams working on the bulk composition, organics, mineralogy, isotopes, spectroscopy and craters in the aluminum holding frame.
- Major advances in material analysis partially funded by Sample Return Lab Instruments R&A
- If you thought we knew everything about comets, your wrong!
 - See their papers in *Science*, Dec. 15th



Messenger

Function of Mission:

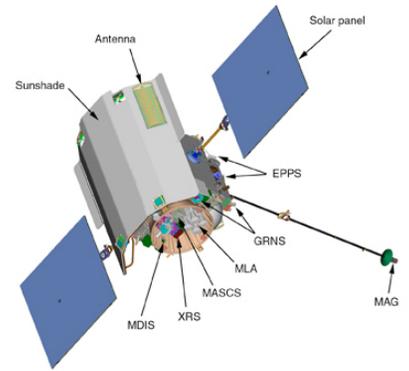
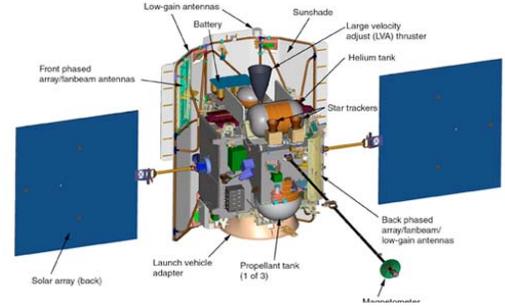
- To better understand terrestrial planet evolution by determining the composition and structure of Mercury

Exploration Metrics:

- Earth / Venus / Mercury Gravity Assist
- *Venus flybys (2)*: October 2006, June 2007
- *Mercury flybys (3)*: January 2008, October 2008 September 2009
- *Mercury orbit insertion*: March 2011

Mission & LV Class:

- Discovery Class
- Delta II



Science Payload:

- Mercury Dual Imaging System (MDIS), Gamma-Ray and Neutron Spectrometer (GRNS), X-Ray Spectrometer (XRS), Magnetometer (MAG), Mercury Laser Altimeter (MLA), Mercury Atmospheric and Surface Composition Spectrometer (MASCS), Energetic Particle and Plasma Spectrometer (EPPS), Radio Science

Technology & Heritage:

- Phased Array Antenna
- High Temperature Solar Arrays
- Ceramic Cloth Sunshade

Launched: August 3, 2004

Ref: <http://messenger.jhuapl.edu/>

For discussions purposes only



Dawn

Scientific Objectives:

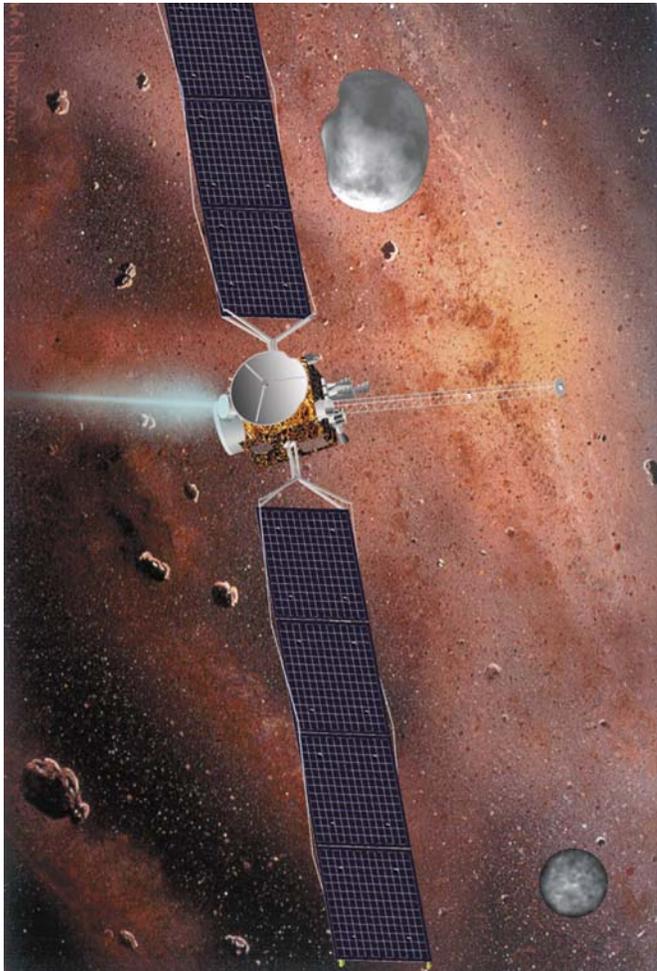
- Orbit about the two most massive asteroids / dwarf planets: Vesta and Ceres, to understand conditions and processes present at the solar system's earliest epoch, and the role of water content and size in planetary evolution.

Exploration Metrics:

- Vesta arrival September 11, 2011; departure April 2012;
- Ceres arrival February 2015; end of primary mission July 2015

Mission & LV Class:

- Discovery Class
- Delta II 7925H



Science Payload:

- Framing camera
- Mapping spectrometer
- Gamma-ray/neutron spectrometer
- Gravity investigation.

Technology & Heritage:

- Orbital Sciences Corp S/C Bus
- Instruments from Messenger and Lunar Prospector
- Ion Propulsion (400 kg throughput) (DS-1)

Mission/Technology Studies:

- Currently in Phase C/D

Planned Launch Date: June 21, 2007

Ref: <http://dawn.jpl.nasa.gov/>



Discovery Selections

- 3 full missions and 3 Missions of Opportunity announced October 31st
- New missions will receive \$1.2M to conduct concept studies (Phase-A) over the next 7 months
- NASA may choose one or more missions to continue
 - If selected for continuation each is cost capped at \$425M.
- MOO will receive \$250K to conduct concept studies.
 - If selected for continuation, each MOO is capped at \$35M.



Selected Full Missions

- **GRAIL: Gravity Recovery and Interior Laboratory - Maria Zuber (PI), MIT** — Produce a uniform, global, high-quality gravity field mapping of the Moon that will allow for unprecedented modeling of its internal structure and thermal history.
- **OSIRIS: Origins Spectral Interpretation, Resource Identification, and Security - Michael Drake (PI), University of Arizona** — Survey asteroid 1999 RQ36 and provide return of uncontaminated surface sample to Earth.
- **Vesper: Venus Chemistry and Dynamics Orbiter - Gordon Chin (PI), NASA GFSC** — Advance our understanding of the atmospheric composition and dynamics of Venus, especially its photochemistry.



Mission of Opportunity

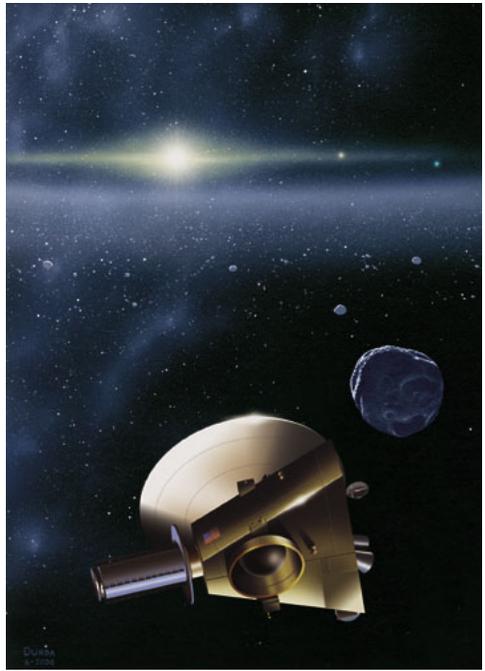
- **DIXI: Deep Impact eXtended Investigation of Comets - Michael A'Hearn (PI), University of Maryland** — Uses the existing *Deep Impact* spacecraft for an extended flyby mission to a second comet, Boethin, that will return data advancing our understanding of the nature of comet nuclei.
- **EPOCH: Extrasolar Planet Observations and Characterization - L. Drake Deming (PI), NASA GSFC** — Observations using *Deep Impact's* High Resolution Imager will either lead to the discovery of additional low mass (down to one Earth-mass) planets or will set limits on the existence of such planets that will be useful for constraining theories of planet formation.
- **Stardust NExT: A Mission of Opportunity to complete the exploration of Tempel 1 - Joseph Veverka (PI), Cornell University** — Uses the *Stardust* spacecraft to perform an extended flyby mission to comet Tempel 1 which will provide the first look at the changes to a comet nucleus after a perihelion passage.



New Frontiers Program

1st NF mission
New Horizons:

Pluto-Kuiper Belt Mission
(scheduled launch: Jan. 2006)

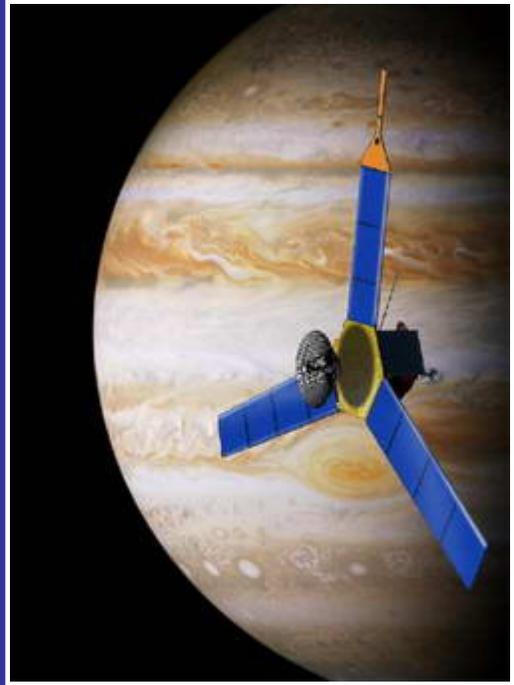


Pluto-KBO

NASA named New Horizons as the first mission in the series of New Frontiers missions for Solar System Exploration (2006 launch)

2nd NF mission
JUNO:

Jupiter Polar Orbiter Mission



Possible 2011 launch

3rd NF mission opportunity

Lunar South Pole – Aitken Basin Sample Return



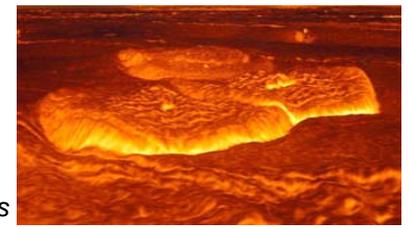
Moon

Comet Surface Sample Return (CSSR)



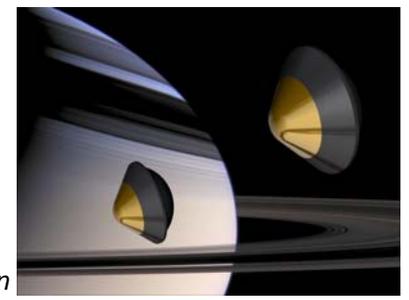
Comets

Venus In Situ Explorer (VISE)



Venus

Saturn Flyby with Probes



Saturn

One will be selected;
Possible 2015 launch



Outer Planets Flagship Missions: Concept Studies

- PSD conducting detailed studies for several flagship-class missions to the following moons:
 - Europa
 - Titan
 - Enceladus
 - Ganymede (with additional focus on other Jovian system science)
- An open call for science community interest will be issued in December
- Science community participation via Science Definition Teams
- Study results will undergo independent external review
- Study results will be used as input to near term NASA strategic planning for a Flagship mission



+ Planetary Mission Event Schedule

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
<p>NH/Pluto</p> <p>Oct. 24 Messenger @ Venus</p>	<p>Feb 28, NH @ Jupiter</p> <p>June 5, Messenger @ Venus</p> <p>Phoenix</p> <p>Dawn</p>	<p>Jan. 14 Messenger @ Mercury</p> <p>Chandrayan</p> <p>Oct. 6 Messenger @ Mercury</p> <p>(LRO- LCROSS)</p>	<p>MSL</p> <p>Sept. 29 Messenger @ Mercury</p>		<p>March 3 Messenger @ Mercury</p> <p>Juno</p> <p>Mar Scout2</p> <p>Fall Dawn @ Vesta</p>	<p>Disc-12</p>	<p>Disc-13</p> <p>MSO</p>	<p>NewFront3</p>	<p>Disc-14</p> <p>July NH @ Pluto/Charon</p> <p>Summer Dawn @ Ceres</p>

- Planetary Division launches (green)
- Planetary mission events (red)



PSD Opportunities

- Current civil servant positions to be posted and open to all:
 - Discovery Program Executive
 - A Discovery Program Scientist



Summary

- Planetary Science Division supports small, medium, and flagship missions
- Discovery selections completed and Mars Scout selections will soon follow
- We are developing plans for our next outer planets flagship