Planetary Science Division Status Report

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Presentation at MEPAG

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Outline

• Mission Overview
• FY 2016 Appropriation
• FY 2017 President’s Budget
• Discovery & New Frontiers Programs
• New Cubesat Selections
Planetary Science Missions Events

2014
July – Mars 2020 Rover instrument selection announcement
August 6 – 2nd Year Anniversary of Curiosity Landing on Mars
September 21 – MAVEN inserted in Mars orbit
October 19 – Comet Siding Spring encountered Mars
September – Curiosity arrives at Mt. Sharp
November 12 – ESA’s Rosetta mission lands on Comet Churyumov–Gerasimenko
December 2/3 – Launch of Hayabusa-2 to asteroid 1999 JU3

2015
March 6 – Dawn inserted into orbit around dwarf planet Ceres
April 30 – MESSENGER spacecraft impacted Mercury
May 26 – Europa instrument Step 1 selection
July 14 – New Horizons flies through the Pluto system
September – Discovery 2014 Step 1 selection
December 6 – Akatsuki inserted into orbit around Venus

2016
March – Launch of ESA’s ExoMars Trace Gas Orbiter (Launch of NASA’s InSight postponed)
July 4 – Juno inserted in Jupiter orbit
September – Launch of Asteroid mission OSIRIS – REx to asteroid Bennu
September – Cassini begins plane change maneuver for the “Grand Finale”
Late 2016 – Discovery 2014 Step 2 selection
FY16 Appropriation supports a robust Planetary Science program

Planetary Science $270M above the request, at $1.63B

- $277M for Planetary Science Research
- $189M for Discovery (+$33M), including full funding for LRO
- $259M for New Frontiers
- $448M for Mars (+$36M), including full funding for Opportunity
- $197M for Technology (+$55M)
  - Includes $25M for icy satellites surface technology
- $261M for Outer Planets (+$145M) with direction
  - Directs that the Europa mission be launched on an SLS in 2022 and that a lander be included ($175M)
- Direction to continue to fund AIDA/DART joint study with ESA
- Direction to establish a new Ocean Worlds program with a primary goal to discover extant life on another world using a mix of Discovery, New Frontiers, and flagship class missions
President’s FY17 Budget
Planetary Science

- Continues development of the Mars 2020 mission.
- Funds continued formulation of a mission to Jupiter’s moon, Europa.
- Continues work on the JUICE instrument in collaboration with the European Space Agency mission to Jupiter.

- Initiates studies for the next New Frontiers Mission and continues operations of Juno and New Horizons.
- Operates 13 Planetary missions including MAVEN, Mars Curiosity, Opportunity, Odyssey, Mars Express, and Cassini (Saturn).
- Increases support for technology development to accelerate future power systems.
- Increases support for Research and Analysis.

<table>
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<tr>
<th>($M)</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
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<tbody>
<tr>
<td>Planetary</td>
<td>1,631</td>
<td>1,519</td>
<td>1,440</td>
<td>1,520</td>
<td>1,576</td>
<td>1,626</td>
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Outyears are notional.
Discovery & New Frontiers
Discovery Program

**Completed**

- **Mars evolution:**
  - Mars Pathfinder (1996-1997)

- **Lunar formation:**

- **NEO characteristics:**
  - NEAR (1996-1999)

- **Solar wind sampling:**
  - Genesis (2001-2004)

- **Comet diversity:**
  - CONTOUR (2002)

- **Nature of dust/coma:**
  - Stardust (1999-2011)

- **Comet internal structure:**

- **Lunar Internal Structure:**
  - GRAIL (2011-2012)

**Completed**

- **Mercury environment:**

- **Main-belt asteroids:**
  - Dawn (2007-2016)

- **Lunar surface:**
  - LRO (2009-TBD)

- **ESA/Mercury Surface:**
  - Strofio (2017-TBD)

- **Mars Interior:**
  - InSight (TBD)
Status of Discovery Program

Discovery 2014 – Selections announced September 30
- About 3-year mission cadence for future opportunities

Missions in Development
- *InSight*: Missed March 2016 launch window
- *Strofio*: Delivered to SERENA Suite (ASI) for BepiColombo

Missions in Operation
- *Dawn*: Science observation now in Low Altitude Mapping Orbit

Missions in Extended Operations
- *LRO*: In stable elliptical orbit, passing low over the lunar south pole
Psyche: Journey to a Metal World  
PI: Linda Elkins-Tanton, ASU  
Deep-Space Optical Comm (DSOC)

NEOCam:  
Near-Earth Object Camera  
PI: Amy Mainzer, JPL  
Deep-Space Optical Comm (DSOC)

VERITAS: Venus Emissivity, Radio Science, InSAR, Topography, And Spectroscopy  
PI: Suzanne Smrekar, JPL  
Deep-Space Optical Comm (DSOC)

Lucy: Surveying the Diversity of Trojan Asteroids  
PI: Harold Levison, Southwest Research Institute (SwRI)  
Advanced Solar Arrays

DAVINCI: Deep Atmosphere Venus Investigations of Noble gases, Chemistry, and Imaging  
PI: Lori Glaze, GSFC
New Frontiers Program

1st NF mission
New Horizons:
Pluto-Kuiper Belt

Launched January 2006
Flyby July 14, 2015
PI: Alan Stern (SwRI-CO)

2nd NF mission
Juno:
Jupiter Polar Orbiter

Launched August 2011
Arrives July 4, 2016
PI: Scott Bolton (SwRI-TX)

3rd NF mission
OSIRIS-REx:
Asteroid Sample Return

Launch window: Sept. 8, 2016
PI: Dante Lauretta (UA)
Next New Frontiers Program AO

- Community Announcement Regarding New Frontiers Program January 2016
- Draft to be released by end of Fiscal Year 2016 (September)
- Investigations are limited to the following mission themes (listed without priority):
  - Comet Surface Sample Return
  - Lunar South Pole-Aitken Basin Sample Return
  - Ocean Worlds (Titan, Enceladus)
  - Saturn Probe
  - Trojan Tour and Rendezvous
  - Venus In Situ Explorer
Europa Mission
**Science**

<table>
<thead>
<tr>
<th>Objective</th>
<th>Description</th>
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<tbody>
<tr>
<td>Ice Shell &amp; Ocean</td>
<td>Characterize the ice shell and any subsurface water, including their heterogeneity, and the nature of surface-ice-ocean exchange</td>
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<tr>
<td>Composition</td>
<td>Understand the habitability of Europa’s ocean through composition and chemistry.</td>
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<tr>
<td>Geology</td>
<td>Understand the formation of surface features, including sites of recent or current activity, and characterize high science interest localities.</td>
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<tr>
<td>Recon</td>
<td>Characterize scientifically compelling sites, and hazards for a potential future landed mission to Europa</td>
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- Conduct 45 low altitude flybys with lowest 25 km (less than the ice crust) and a vast majority below 100 km to obtain global regional coverage
- Traded enormous amounts of fuel used to get into Europa orbit for shielding (lower total dose)
- Simpler operations strategy
- No need for real time down link

**Lander Concept Studies Are Continuing**
SIMPLEEx Cubesats Selections
   Full missions (2)
   and
   Approved for 1 year Tech Development (3)
Small Innovative Missions for Planetary Exploration (SIMPLEX-2014) – New Awards in FY15

Lunar Polar Hydrogen Mapper (LunaH-Map)
PI: Craig Hardgrove
ASU School of Earth and Space Exploration

CubeSat Particle Aggregation and Collision Experiment (Q-PACE)
PI: Josh Colwel
University of Central Florida
Simplex Cubesats

Approved for Tech Development (1 year) Study ONLY

Mars Micro Orbiter
PI: Michael Malin
Malin Space Science Systems

Diminutive Asteroid Visitor using Ion Drive (DAVID)
PI: Geoffrey Landis
NASA Glenn Research Center

Hydrogen Albedo Lunar Orbiter (HALO)
PI: Michael Collier,
NASA GSFC

A Lunar Cubesat Mission For EM-1 - SIMPLEX 2014
Questions?
New Frontiers 4

• Why was the Ocean Worlds mission theme added to NF4?
  1. NOSSE Report: As a strategic program NF should be “adaptable to new discoveries”
  2. Consistent with the V&V Planetary Decadal
  3. Strong science case for Enceladus and Titan
  4. Congressional FY16 Approps: Response is required

• Next Steps:
  – Present that decision and rationale to PSS for feedback (considering AG input)
  – Present that decision and rationale to CAPS for feedback – midterm charge will also address how to accommodate recent discoveries
  – Community can also comment via the draft AO process
Planetary Defense Coordination Office (PDCO)

Hosted by the Planetary Science Division PDCO is responsible for:

• Oversight of potentially hazardous objects (PHOs):
  – Ensure early detection
  – Characterize PHOs of size large enough to affect Earth’s surface
  – Provide warning of potential impact effects if not deflected or mitigated
  – Provide timely and accurate communications about PHOs and any potential impact

• Lead research into potential asteroid deflection and impact mitigation technologies and techniques

• Provide lead coordination role in U.S. Gov’t planning for response to an actual impact threat (e.g., planetary science and deep space mission expertise for Federal Emergency Response Team)