

Planetary Science Division Status Report



Jim Green

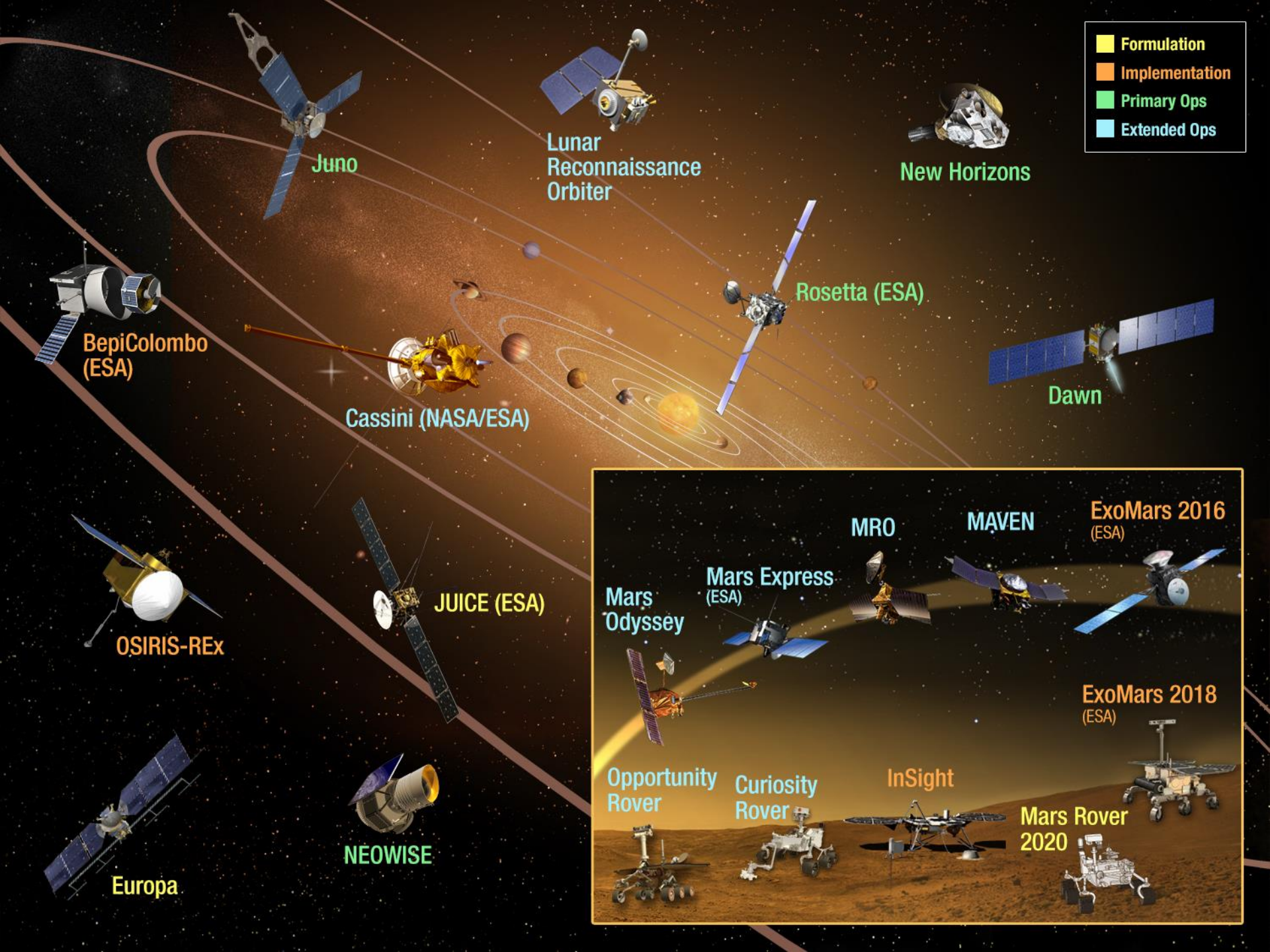
NASA, Planetary Science Division

March 11, 2016

Presentation at Science NAC

Outline

- Mission Overview and upcoming Events
- FY 2016 Appropriation
- FY 2017 President's Budget
- Discovery, New Frontiers, and Mars Exploration Program
- Europa mission
- Cubesats Selections
- Planetary Defense Coordination Office



Planetary Science Missions Events

2014

- July – *Mars 2020* Rover instrument selection announcement * **Completed**
- 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

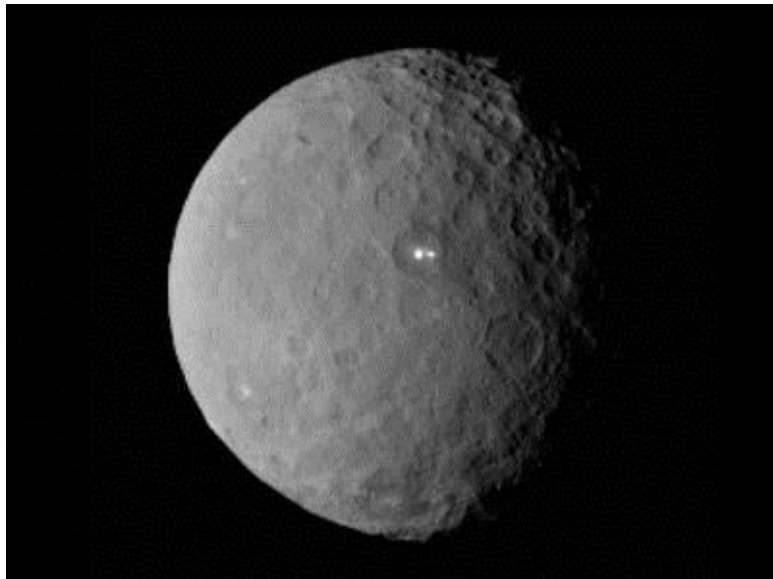
- \$277M for Planetary Science Research
- \$189M for Discovery (+\$33M), including full funding for LRO
- \$259M for New Frontiers
- \$448M for Mars (+\$36M), including full funding for Opportunity
- \$197M for Technology (+\$55M)
 - Includes \$25M for icy satellites surface technology
- \$261M for Outer 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

Planetary Science: President's FY17 Budget

Outyears are notional

(\$M)	2016	2017	2018	2019	2020	2021
Planetary Science	\$1,631	\$1,519	\$1,440	\$1,520	\$1,576	\$1,626

- 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.



Discovery Program

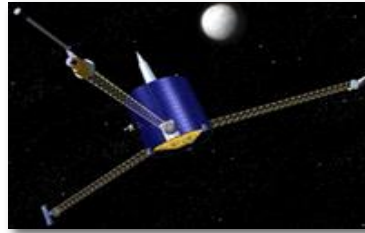
Discovery Program

Completed

Mars evolution:
Mars Pathfinder (1996-1997)



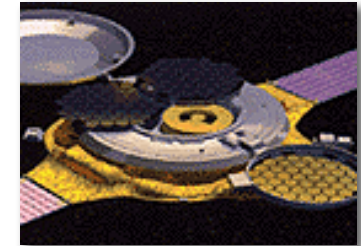
Lunar formation:
Lunar Prospector (1998-1999)



NEO characteristics:
NEAR (1996-1999)

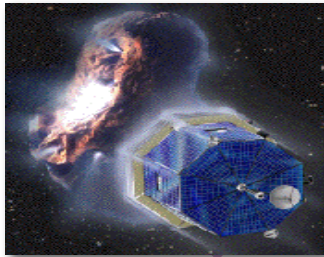


Solar wind sampling:
Genesis (2001-2004)



Completed

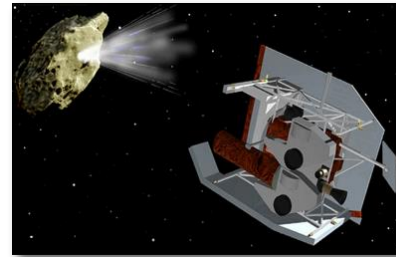
Comet diversity:
CONTOUR (2002)



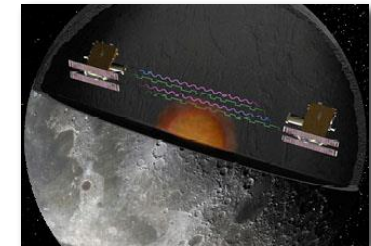
Nature of dust/coma:
Stardust (1999-2011)



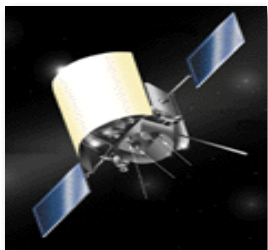
Comet internal structure:
Deep Impact (2005-2012)



Lunar Internal Structure
GRAIL (2011-2012)



Mercury environment:
MESSENGER (2004-2015)



Main-belt asteroids:
Dawn (2007-2016)



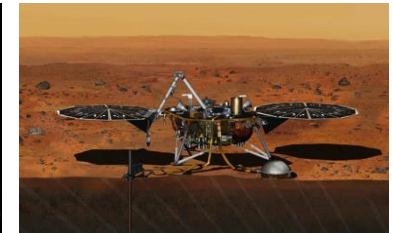
Lunar surface:
LRO (2009-TBD)



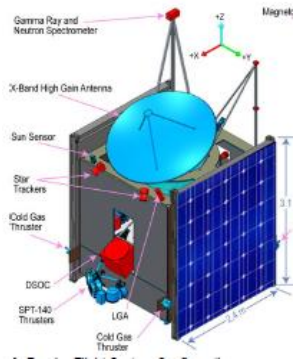
ESA/Mercury Surface:
Strofiio (2017-TBD)



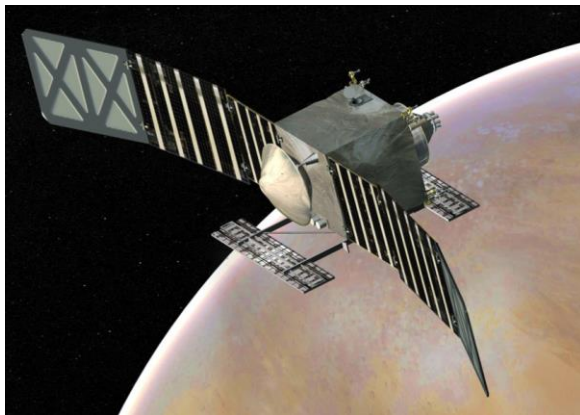
Mars Interior:
InSight (TBD)



Discovery Selections 2014



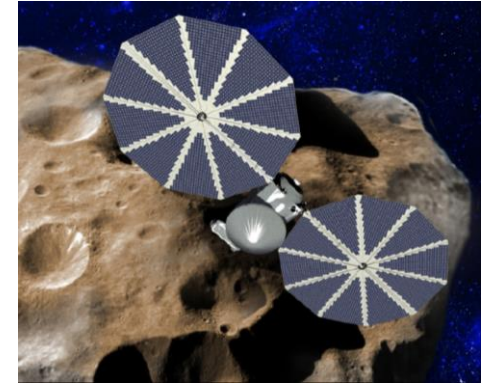
Psyche: Journey to a Metal World
 PI: Linda Elkins-Tanton, ASU
 Deep-Space Optical Comm (DSOC)



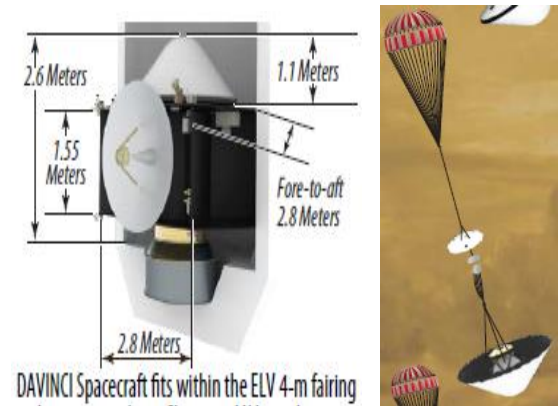
VERITAS: Venus Emissivity, Radio Science, InSAR, Topography, And Spectroscopy
 PI: Suzanne Smrekar, JPL
 Deep-Space Optical Comm (DSOC)



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



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



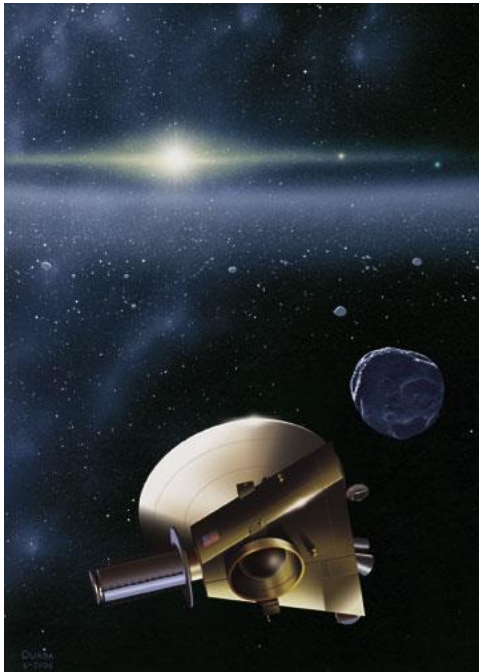
DAVINCI: Deep Atmosphere Venus Investigations of Noble gases, Chemistry, and Imaging
 PI: Lori Glaze, GSFC

New Frontiers Program

New Frontiers Program

1st NF mission
New Horizons:

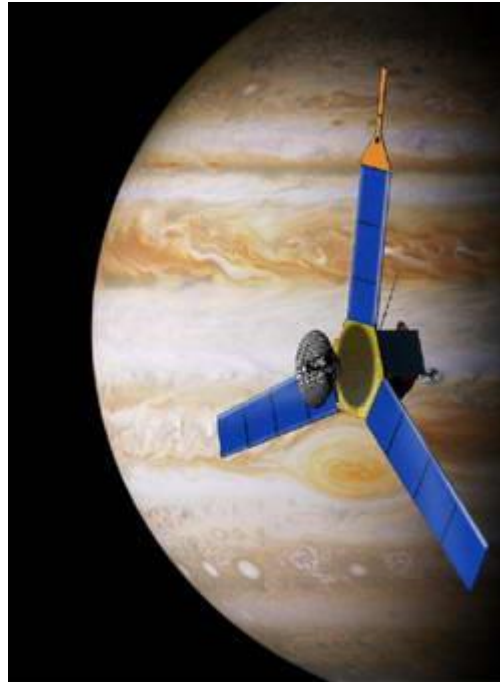
Pluto-Kuiper Belt



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

2nd NF mission
Juno:

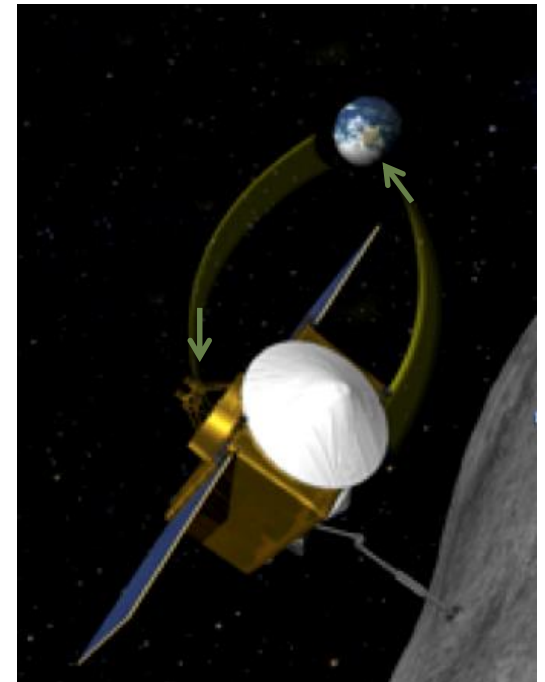
Jupiter Polar Orbiter



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 issued in 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

Next New Frontiers AO Time Frame

Notional Schedule:

- Release of final AO..... January 2017 (target)
- Preproposal conference..... ~3 weeks after final AO release
- Proposals due ~90 days after AO release
- Selection for competitive Phase A November 2017 (target)
- Concept study reports due..... October 2018 (target)
- Down-selection May 2019 (target)
- KDP B August 2019 (target)
- Launch readiness date 2024

New Frontiers 4 OW Targets

- 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 V&V Planetary Decadal: “A decadal survey should not be blindly followed if external circumstances dictate that a change in strategy is needed.”
 3. Very strong science case for Enceladus and Titan
 4. Congressional FY16 Approps: Response is required
- Next Steps:
 - Presented decision and rationale to PSS for feedback (considering AG input)
 - Will present 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

Mars Exploration Program

Program Overview

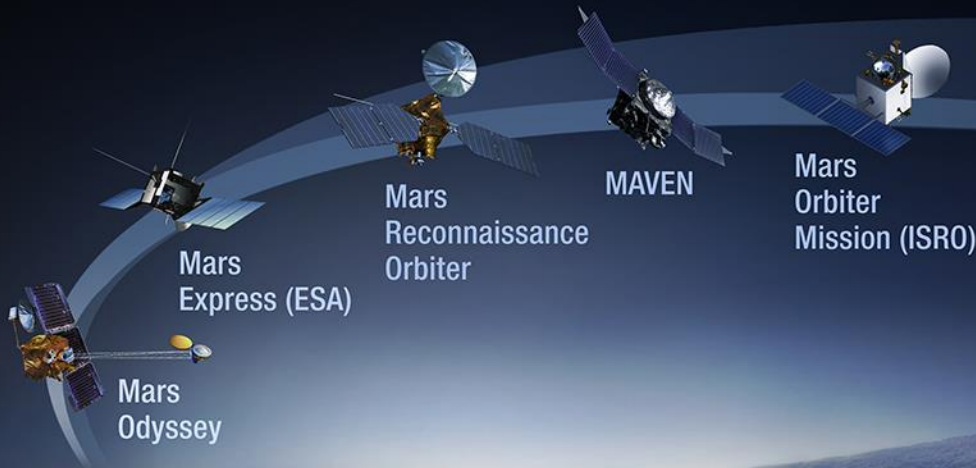
- Our operational assets remain healthy and productive:
 - MAVEN has successfully completed its prime science mission and is now continuing investigations in an extended mission
 - Odyssey continues to be healthy and contribute thermal imagery and data relay services
 - MRO continues to provide invaluable reconnaissance imaging and mineralogical mapping, supporting science investigations, rover operations, and exploring potential human landing sites
 - Opportunity continues to provide important ground truth data, recently scaling 30° slopes of Knudsen Ridge atop the southern flank of Marathon Valley
 - Curiosity at Gale Crater, generating important insights into Martian chemistry
 - Mars Express continues operating our deep radar sounder (MARSIS)
- M2020 development on-track and proceeding well:
 - PDR successfully completed Feb 2016
 - Heritage H/W fabrication underway; some delivered
 - Sampling system development labs up and running
- Our foreign commitments are on track
 - Our two Electra payloads on the TGO are ready for flight
 - MOMA is proceeding in development for the ExoMars Lander

Operational 2001–2015

2016

2018

2020



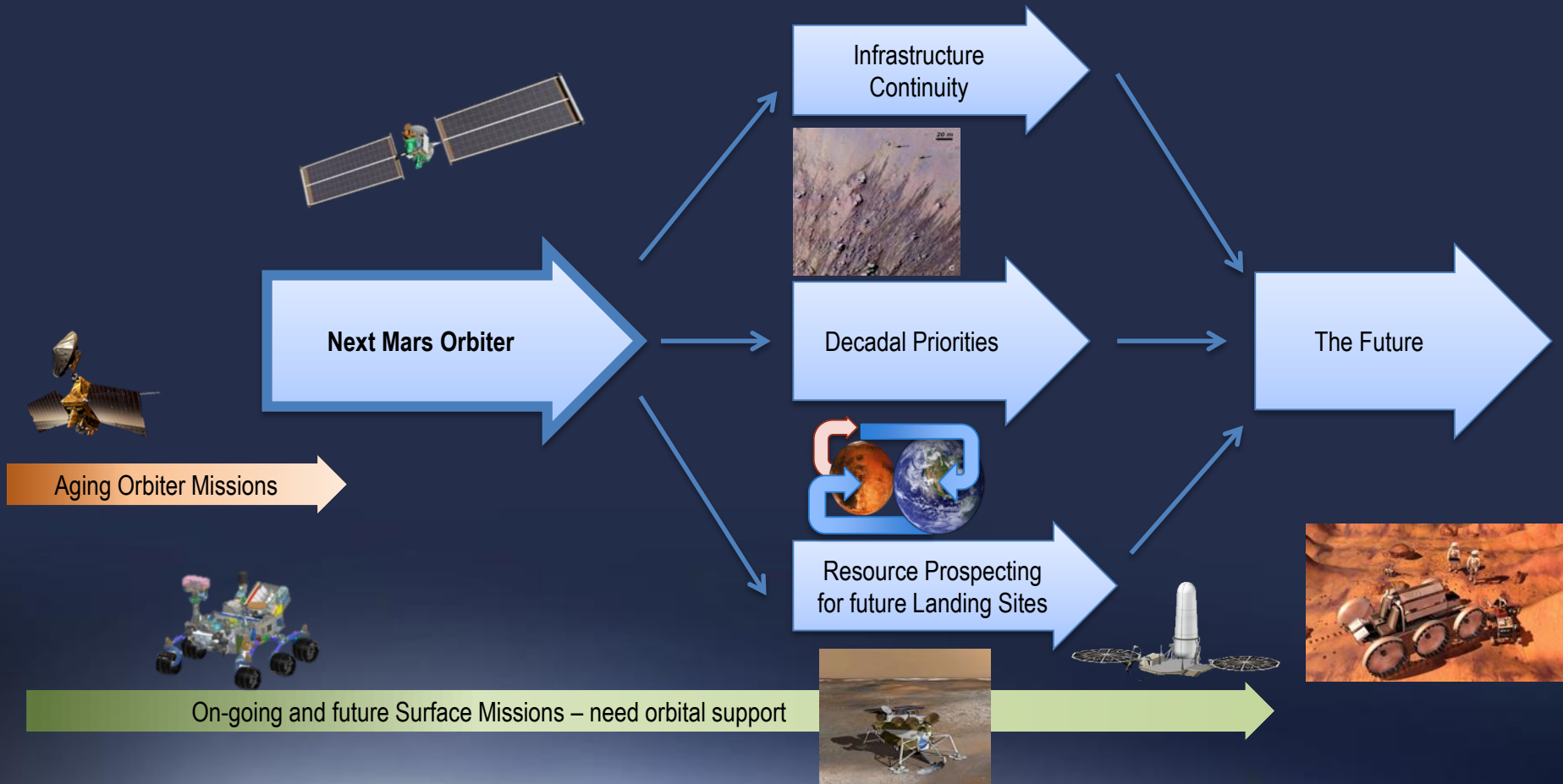
Follow the Water

Explore Habitability

Seek Signs of Life

Prepare for Future Human Explorers

Next Orbiter (Under Study): Provide Capabilities that enable many Future Pathways



Desired Orbiter Capabilities

Renew and Update Aging Communications Infrastructure

- Essential to the future of Mars exploration; Laying the foundation for missions to come, while supporting ongoing missions in the early 2020's

Provide Continuity of High Resolution Imaging

- Scientific Investigations for Landing Site Certification

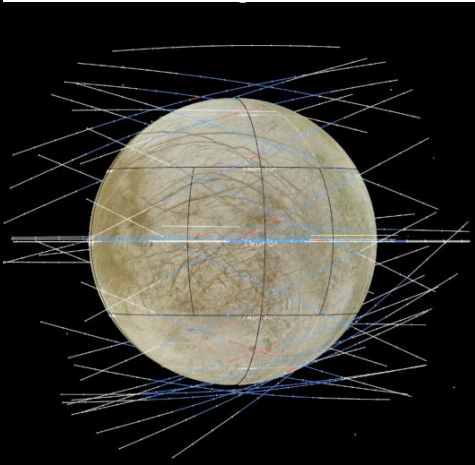
Emplace Essential Orbital Support for Sample Return

Opportunity for Resource Prospecting for future Landing Sites and Exploration planning

Other Relevant Remote Sensing Opportunities

Europa Mission

Europa Multi-Flyby Mission Concept Overview



Science

Objective

Description

Ice Shell & Ocean

Characterize the ice shell and any subsurface water, including their heterogeneity, and the nature of surface-ice-ocean exchange

Composition

Understand the habitability of Europa's ocean through composition and chemistry.

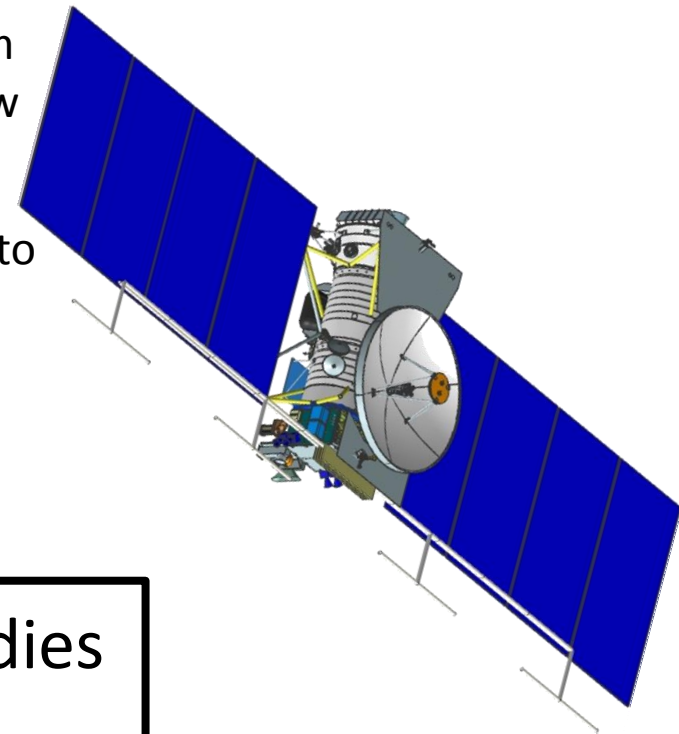
Geology

Understand the formation of surface features, including sites of recent or current activity, and characterize high science interest localities.

Recon

Characterize scientifically compelling sites, and hazards for a potential future landed mission to Europa

- 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

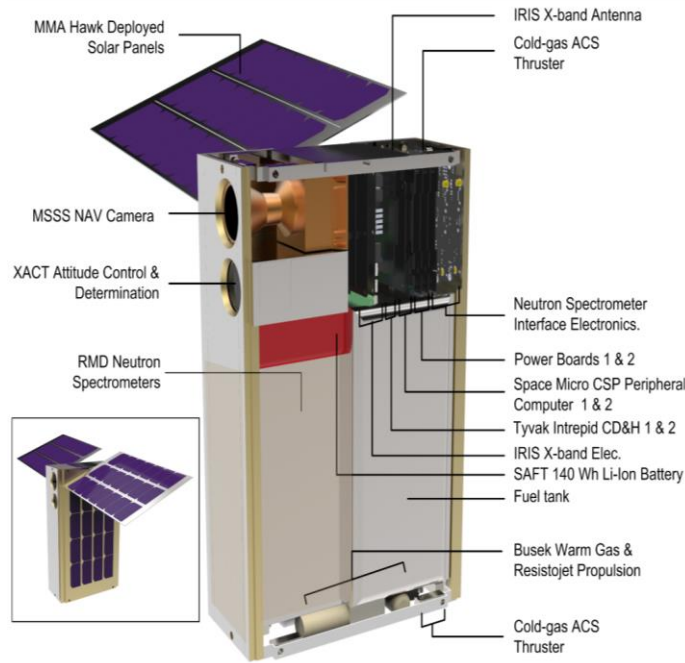
SIMPLEx Cubesats Selections

Full missions (2)

and

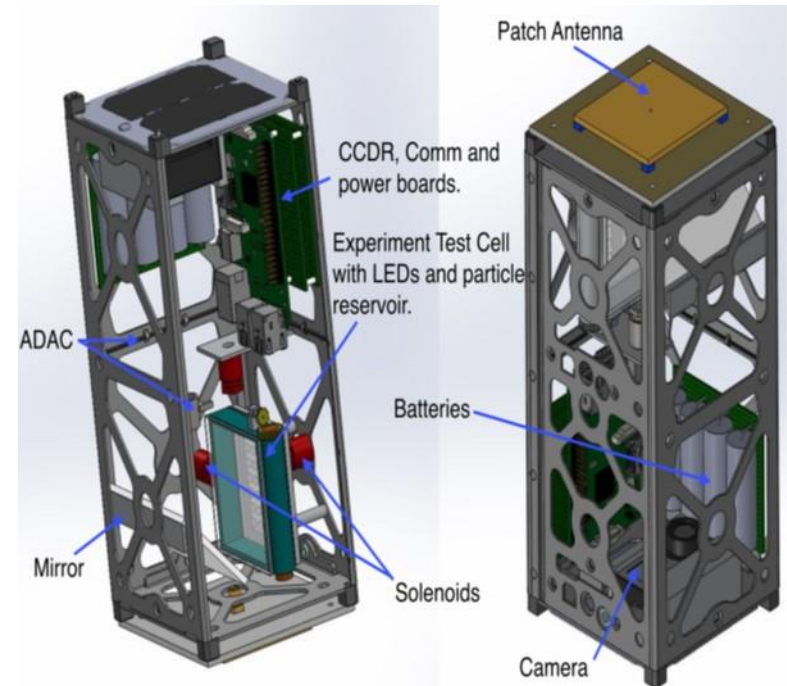
Approved for 1 year Tech Development (3)

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

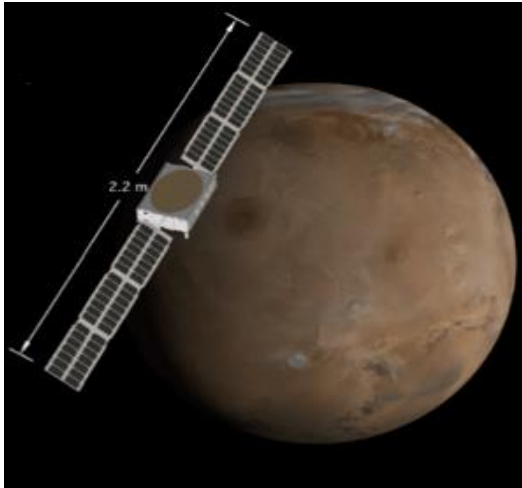


CubeSat Particle Aggregation and Collision Experiment (Q-PACE)

PI: Josh Colwel
University of Central Florida

Simplex Cubesats

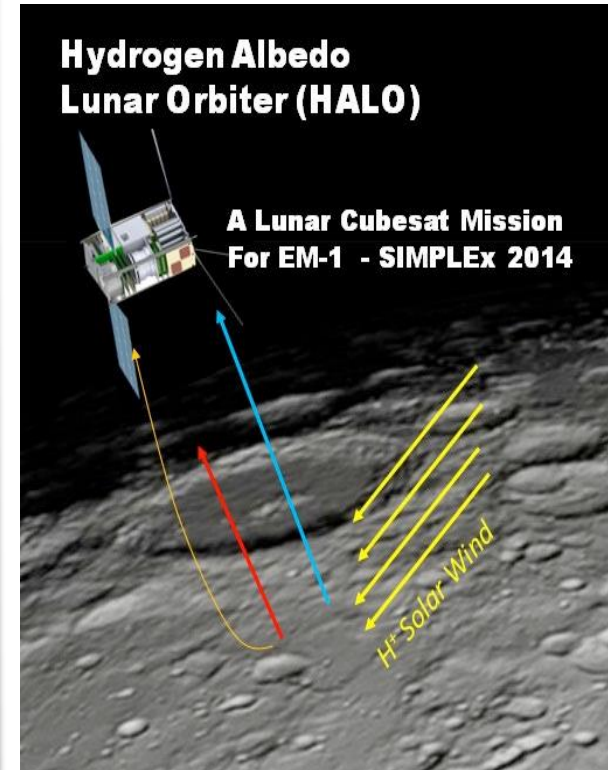
Approved for Tech Development (1 year) Study ONLY



Mars Micro Orbiter

PI: Michael Malin

Malin Space Science Systems



Hydrogen Albedo Lunar Orbiter (HALO)

PI: Michael Collier,
NASA GSFC

Diminutive Asteroid Visitor using Ion Drive (DAVID)

PI: Geoffrey Landis
NASA Glenn Research Center



Planetary Defense Program

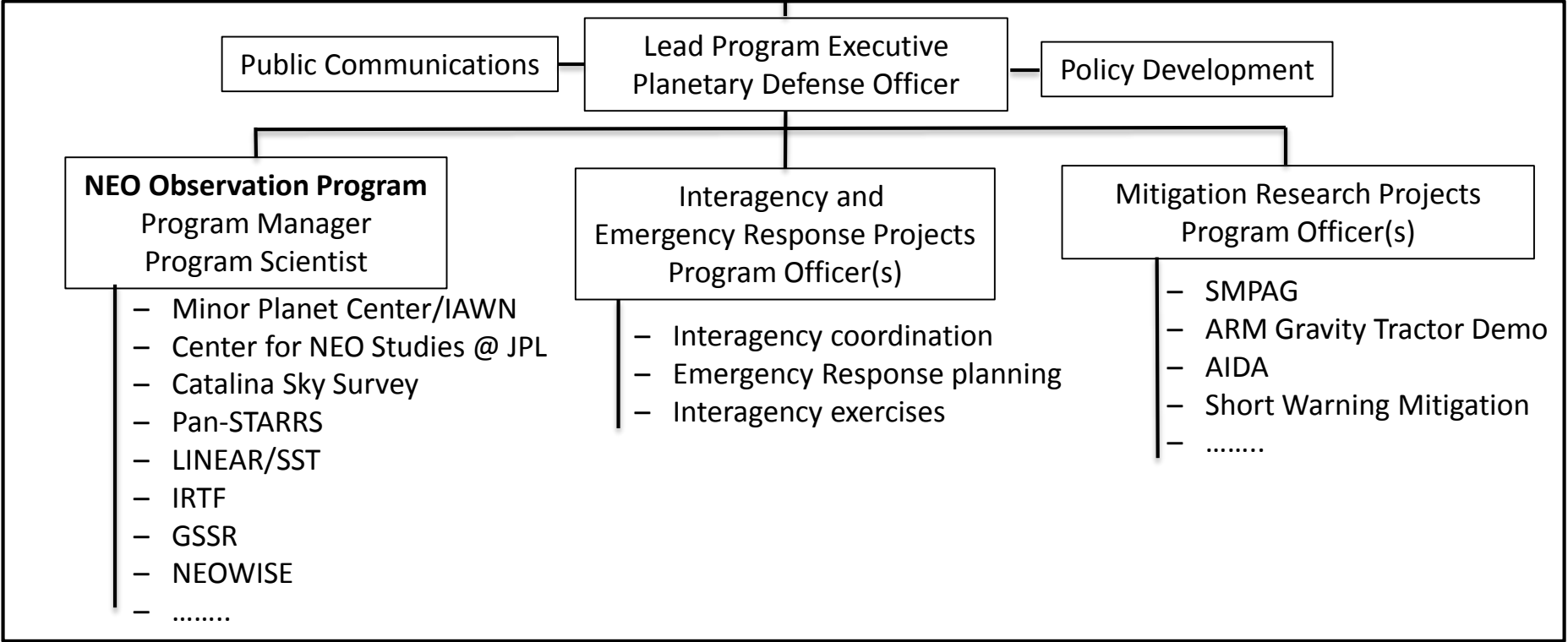
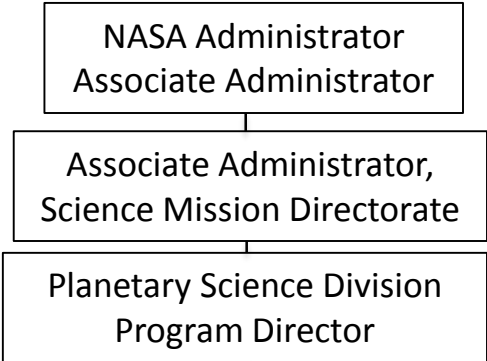
Planetary Defense Coordination Office (PDCO)

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)



Planetary Defense Coordination Office



Questions?

