Planetary Science Division Status Report

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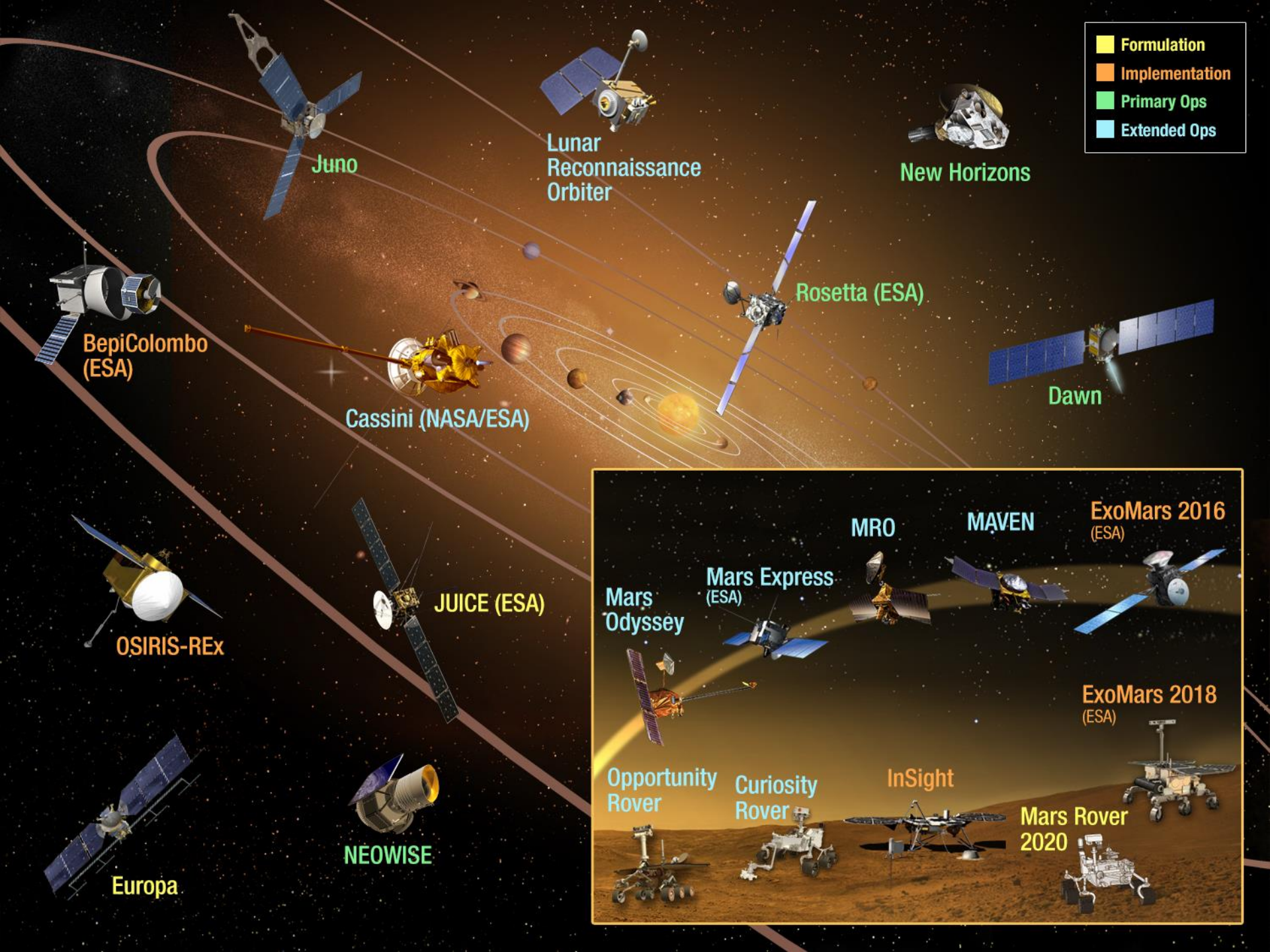
NASA, Planetary Science Division
March 29, 2016

Presentation at CAPS

Outline

- Mission Overview
- FY 2016 Appropriation
- FY 2017 President's Budget
- Discovery & New Frontiers Programs
- Mars Exploration Program – *Jim Watzin will cover*
- Europa mission
- Cubesates
- Research and Analysis
- Planetary Defense Coordination Office
- NRC studies and schedule for the mid-term


Formulation
Implementation
Primary Ops
Extended Ops
Juno
Lunar Reconnaissance Orbiter
New Horizons
BepiColombo (ESA)
Rosetta (ESA)
Cassini (NASA/ESA)
Dawn
OSIRIS-REx
JUICE (ESA)
Europa
NEOWISE
MRO
MAVEN
ExoMars 2016 (ESA)
Mars Express (ESA)
Mars Odyssey
ExoMars 2018 (ESA)
Opportunity Rover
Curiosity Rover
InSight
Mars Rover 2020

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 JU_3

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*

July 4 – *Juno* inserted in Jupiter orbit

July 20 – 40th Anniversary of the Viking missions

September 8 – Launch of Asteroid mission *OSIRIS – REx* to asteroid Bennu

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

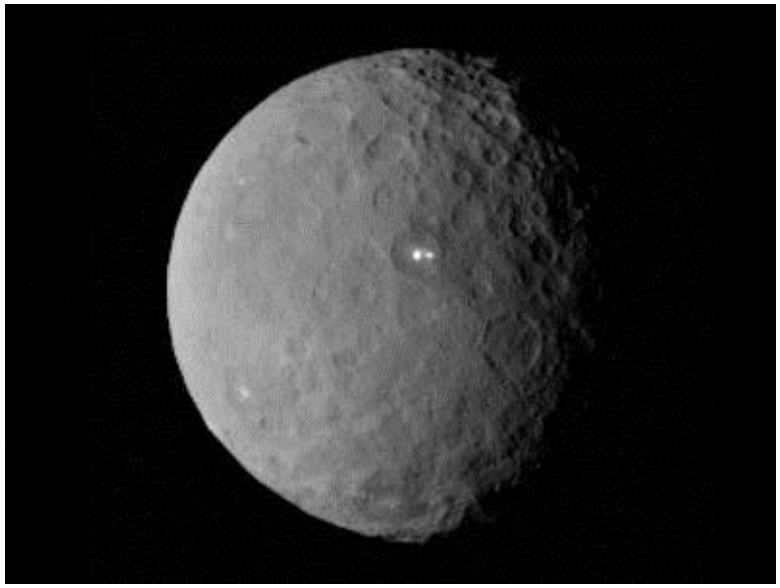
President’s FY17 Budget

Planetary Science

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.



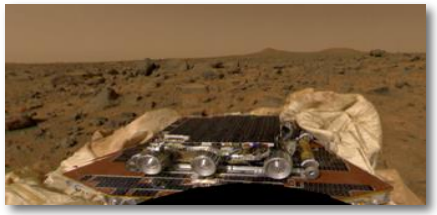
- Initiates studies for the next New Frontiers Mission and continues operations of Juno and New Horizons.
- Operates 13 Planetary missions including MAVEN, Mars Curiosity, Opportunity, Odyssey, Mars Express, and Cassini (Saturn).
- Increases support for technology development to accelerate future power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

Discovery Program

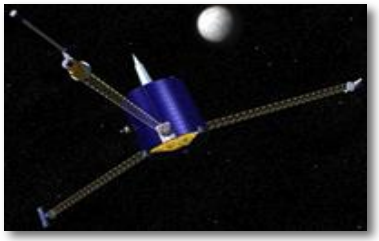
Discovery Program

Completed

Mars evolution:
Mars Pathfinder (1996-1997)

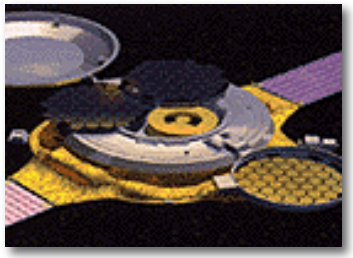


Lunar formation:
Lunar Prospector (1998-1999)



NEO characteristics:
NEAR (1996-1999)

Solar wind sampling:
Genesis (2001-2004)

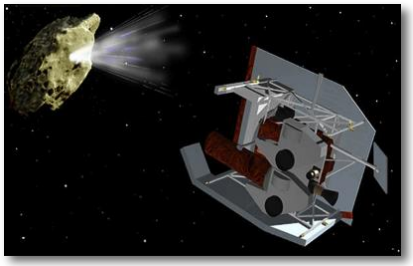


Completed

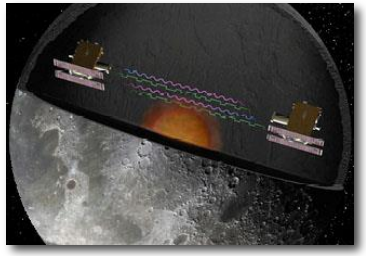
Comet diversity:
CONTOUR (2002)

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

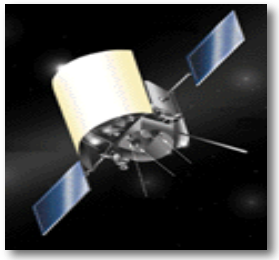
Comet internal structure:
Deep Impact (2005-2012)



Lunar Internal Structure
GRAIL (2011-2012)

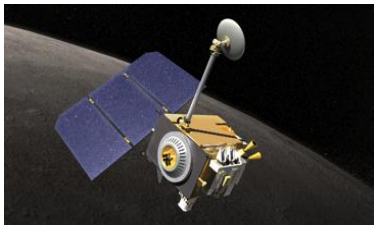


Mercury environment:
MESSENGER (2004-*2015*)



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

Lunar surface:
LRO (2009-*TBD*)

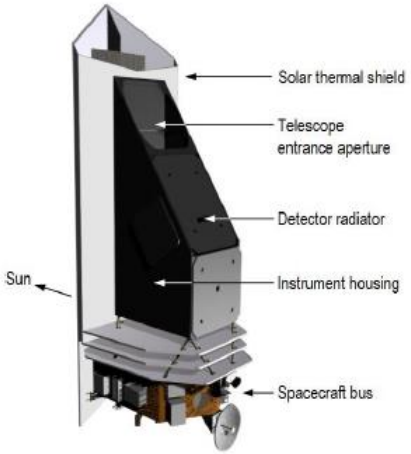


ESA/Mercury Surface:
Strofio (*2017-TBD*)

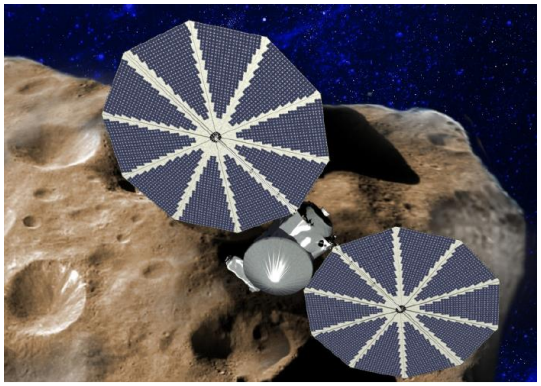
Mars Interior:
InSight (*2018*)

Discovery Selections 2014

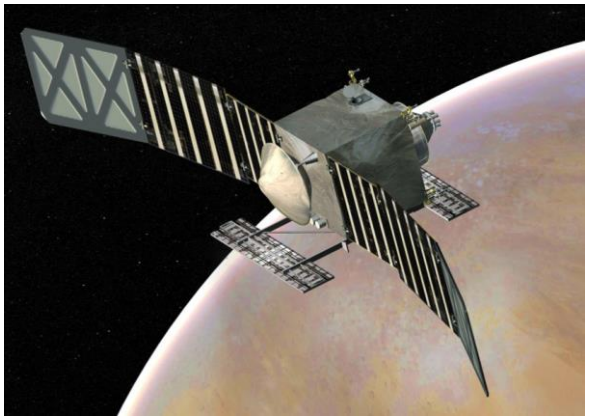
Psyche: Journey to a Metal World
PI: Linda Elkins-Tanton, ASU
Deep-Space Optical Comm (DSOC)



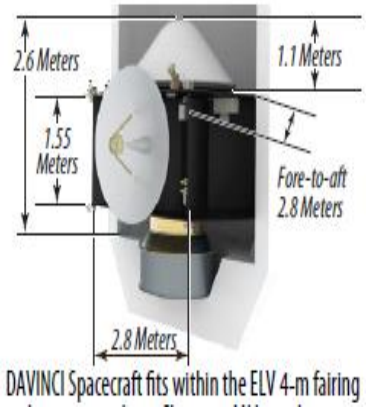
NEOCam:
Near-Earth Object Camera
PI: Amy Mainzer, JPL
Deep-Space Optical Comm (DSOC)



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



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



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

New Frontiers Program

- New Frontiers Missions for flight
- National Academy Reports
- Science Case for Ocean Worlds: Enceladus & Titan
- Congressional Interest
- NF-4 Announcement
- Summary

Announcement of Opportunity (AO): Inputs

Note that a Decadal Survey is a critical component but not the *only* input in the preparation of an AO

- Science Community input
  - Decadal Survey *Vision and Voyages*
- Administration priorities (OSTP, OMB, NASA)
- Congressional guidance/instruction and funding
- Major discoveries or technology advances that may affect implementation planning

New Frontiers Program

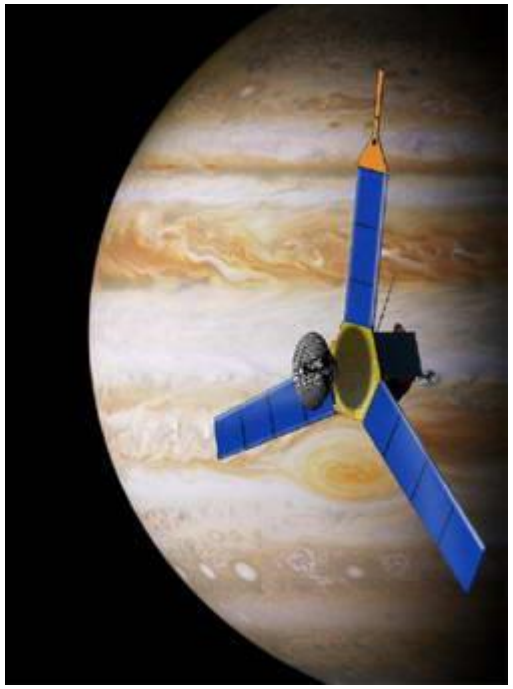
1st NF mission
New Horizons:

Pluto-Kuiper Belt

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

2nd NF mission
Juno:

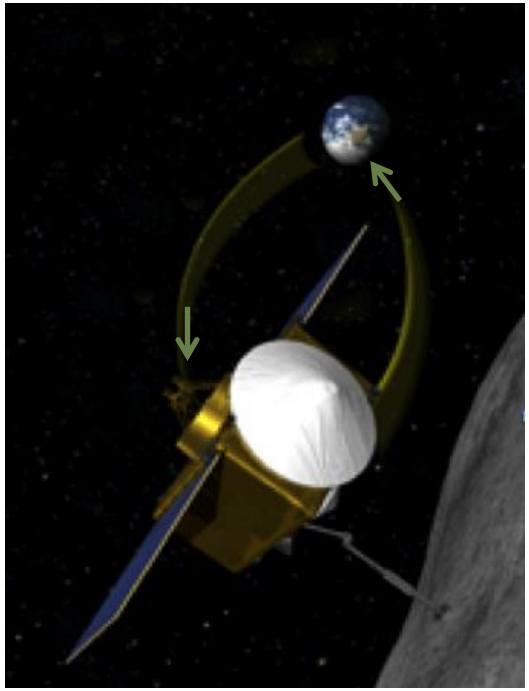
Jupiter Polar Orbiter



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

3rd NF mission
OSIRIS-REx:

Asteroid Sample Return

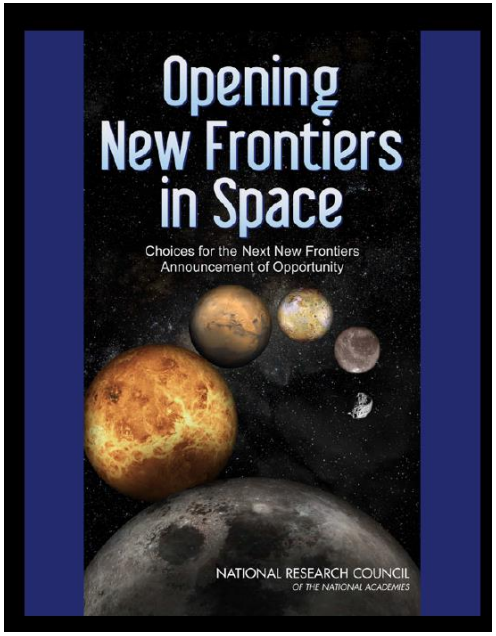


Launch window: Sept. 8, 2016
PI: Dante Lauretta (UA)

Relevant National Academy Reports
1. NOSSE Report
2. Vision & Voyages

NOSSE Report: Opening New Frontiers in Space

- NASA recognized that the New Frontiers program is both a *Principal Investigator* and a *Strategic* program
  - A study was requested in March 2007
  - This study was NOT a mid-term review
- During the last decadal: The study was requested to ensure that NF-3 AO would have selectable missions
- For this report, the NRC was asked to "provide criteria and guiding principles to NASA for determining the list of candidate missions."
- Results were issued in March 2008



NOSSE Report: Opening New Frontiers in Space

- The committee acknowledged that it could not do the job of a Decadal Survey in building community consensus beyond a new set of mission concepts
- Recommendation #2" NASA should take the full set of 8 remaining mission concepts from the 2003 -2012 Decadal Survey and include them all in the next NF AO(-3)
- Recommendation #3, the committee noted: ".. NASA should offer an additional option for other missions in the same size class that can acquire compelling information answering high-priority science questions from the decadal survey. The committee believes that this approach not only will provide an opening for innovation but also might enable the applicant pool for future missions to grow…."
- Would this recommendation be different if we commissioned the Committee today to consider Enceladus and Titan?

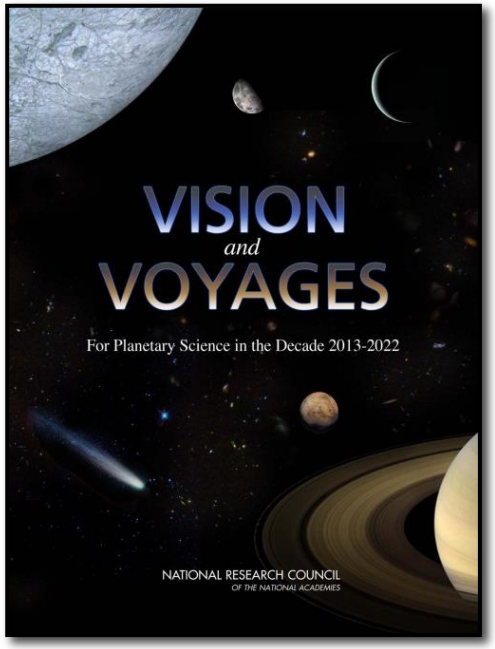
V&V Decadal Survey:

Community inputs led to identification of three Crosscutting Themes for planetary science:

- Building New Worlds: Understanding solar system beginnings
- *Planetary Habitats: Searching for the requirements for life*
- Workings of Solar Systems: Revealing planetary processes through time

The Satellites Panel identified 3 science goals:

- How did the satellites of the outer solar system form and evolve?
- What processes control the present-day behavior of these bodies?
- *What are the processes that result in habitable environments?*



V&V Decadal Survey

- Prior to the Decadal Survey, NASA chartered a number of flagship mission studies, including missions to study the icy satellites: Europa, Enceladus and Titan
- These studies were input into the Decadal Survey process and reviewed and prioritized by the Satellites Panel:
  1. Jupiter Europa Orbiter ($4.7b)
  2. Titan Saturn System Mission ($5.7b)
  3. Enceladus Orbiter ($1.9b)
- Within the timescale of the Decadal Survey, descoping of these mission concepts to see whether New Frontiers class mission concepts could be achieved, focusing on critical science goals, was not performed by the Satellites Panel
- The Enceladus Orbiter was identified as the *highest priority* small flagship based on input into the Decadal

PSS Findings Excerpts: March 9-10, 2016

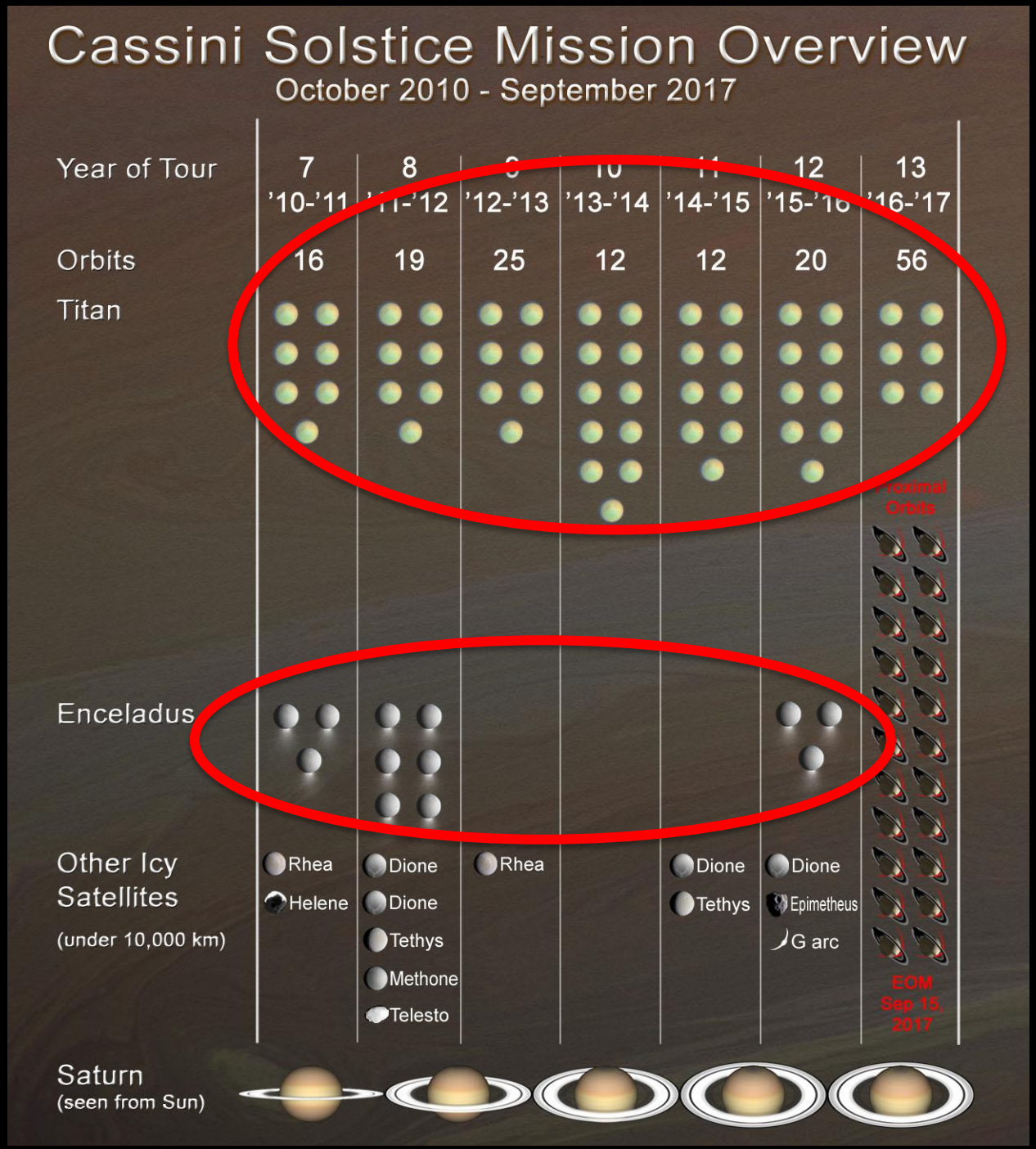
Ocean Worlds

We applaud the public and legislative interest in Ocean Worlds spurred by recent discoveries related to the possibility of extant life in the oceans of Europa, Enceladus, and Titan. . . . .

PSS encourages PSD to put in place as soon as possible a process to integrate community input into the incorporation of Ocean Worlds into the New Frontiers program. The Planetary Decadal Survey has much content on how to respond to new discoveries but Ocean Worlds were not fully vetted as a New Frontiers mission concept. A major part of that process is the establishment of the science objectives and subsequent confirmation that implementation concepts exist that can achieve those objectives within the New Frontiers cost cap.

The PSS encourages PSD to ask the Committee on Astrobiology and Planetary Science (CAPS) to consider whether inclusion of Ocean Worlds in NF-4 can be done via the processes and practices available to the agency and the community. CAPS should help to identify the path for taking advantage of similar exciting opportunities of this nature going forward.

Science Case for Ocean Worlds: Enceladus and Titan



56 Flybys

12 Flybys

Enceladus Discoveries (1/2)

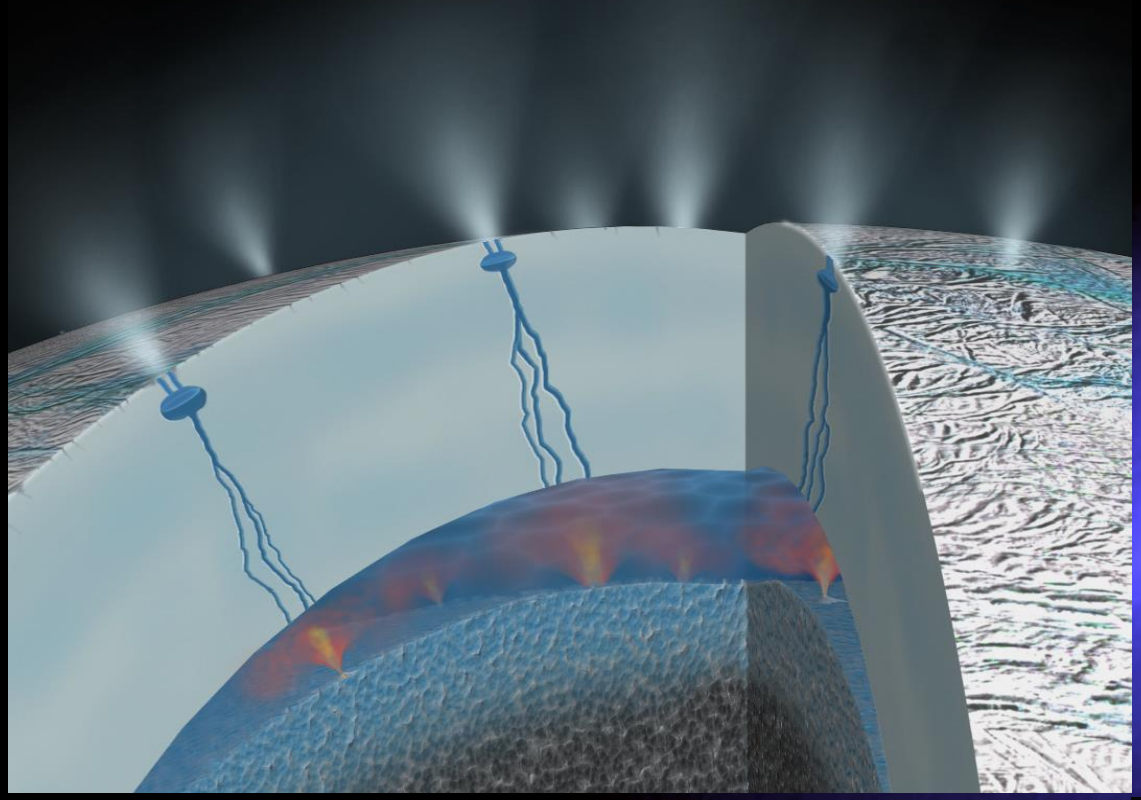
Year paper Accepted	**Summary of Discovery** (V&V priorities were finalized Sept 2010)
2009	The plume of Enceladus feeds the E ring of Saturn
2010	The plumes of Enceladus vary over time
2010	Enceladus maybe the ultimate source of oxygen for the upper atmospheres of Titan and Saturn
2010	Heat output of Enceladus is greater than thought possible
2011	Dusty plasma, previously theorized, discovered near Enceladus
2011	Grains from Enceladus plume are from a subsurface ocean or sea
2011	Saturn & Enceladus share electrical circuit: Auroral footprint of Enceladus on Saturn"
2011	Saturn and Enceladus share an electrical circuit: Observing auroral hiss, electron beams and standing Alfvén wave currents near Enceladus
2012	Enceladus Plume is a new Kind of Plasma Laboratory
2012	Enceladus is theorized to have hydrothermal activity
2012	Many craters on Enceladus are unusually shallow, suggesting high heat fluxes
2013	Enceladus' subsurface ocean may be long-lived; Ice rheology and tidal heating
2013	Enceladus' subsurface ocean may be long-lived: Shape of Enceladus due to an irregular core: Implications for gravity, libration, and survival of its subsurface ocean"
2013	Intensity of Enceladus jets depends on proximity to Saturn
2013	Plume activity and tidal stresses on Enceladus are correlated
2013	Enceladus fissures are ~9 m wide

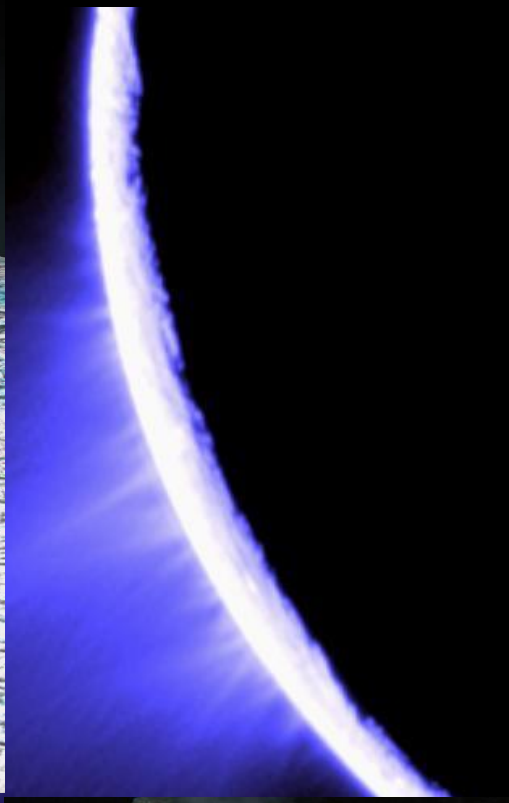
Enceladus Discoveries (2/2)

Year paper Accepted	Summary of Discovery
2014	Enceladus is differentiated and has a regional subsurface ocean (global ocean not ruled out)
2014	Jet activity & tidal stresses correlate spatially along the active tiger stripe fractures in the South Polar Terrain
2015	Enceladus has a fragmented, unconsolidated core that may produce sufficient heat to keep the global subsurface ocean from freezing over long timescales
2015	The pH of the ocean is basic (11-12)
2015	Plume structure may be curtain-like
2015	Detection of a global ocean
2015	Ongoing hydrothermal activity
2015	Hydrothermal vents: Evidence for a methane source in Enceladus' ocean
2015	Heating on Enceladus is not caused by obliquity tides, but probably eccentricity tides
2015	Enceladus' core is irregularly shaped, possibly due to low-velocity impacts by impactors in the 10 km size range (supports hydrothermal activity)
2015	Confirmation of a global ocean
2015	Liquid water on Enceladus could be only 2 km below the surface

19 NASA Press Releases

Seafloor Dust Captured by Cassini





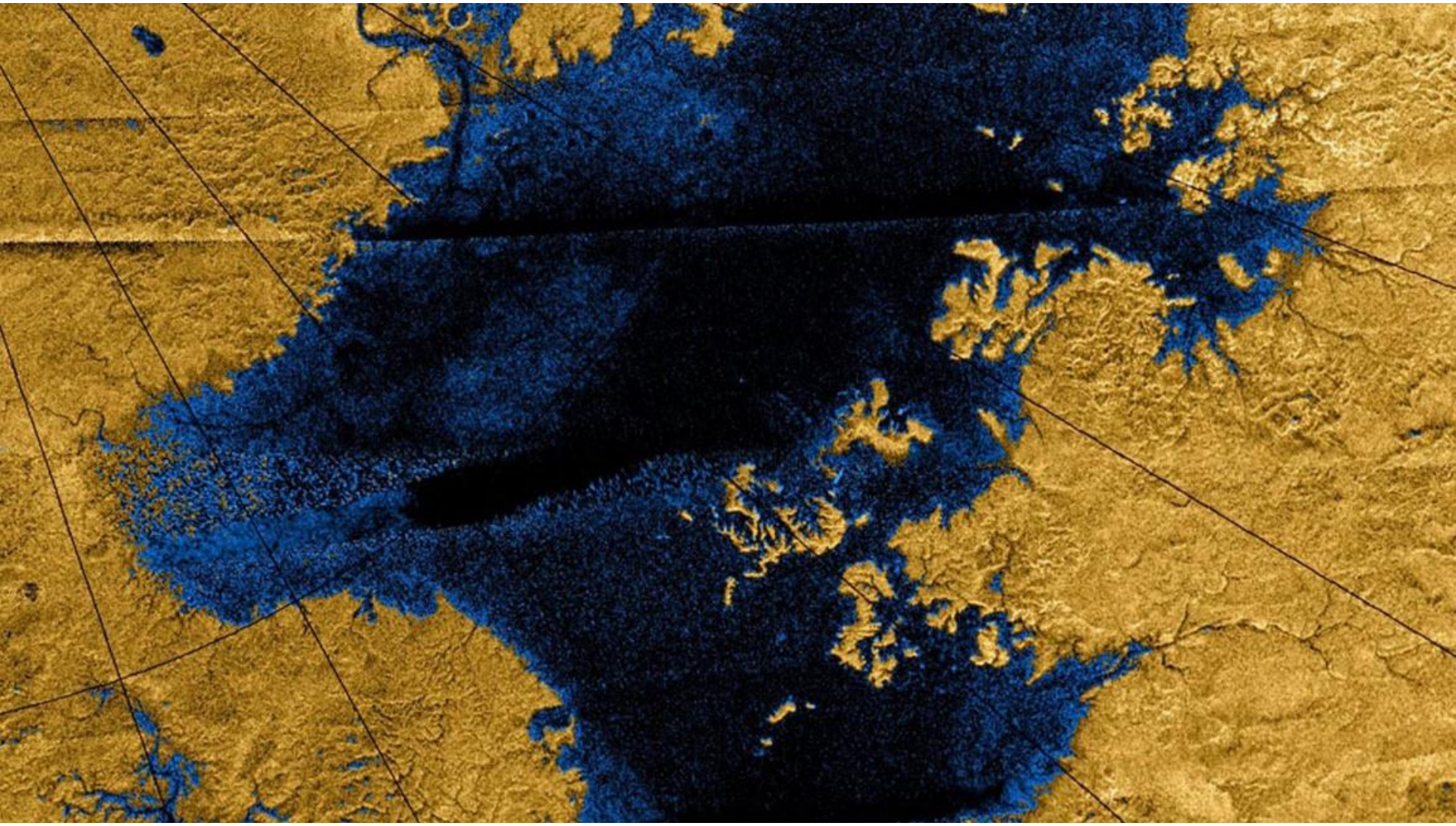
Silica nanoparticles captured by Cassini provides first evidence for ongoing seafloor hydrothermal activity.

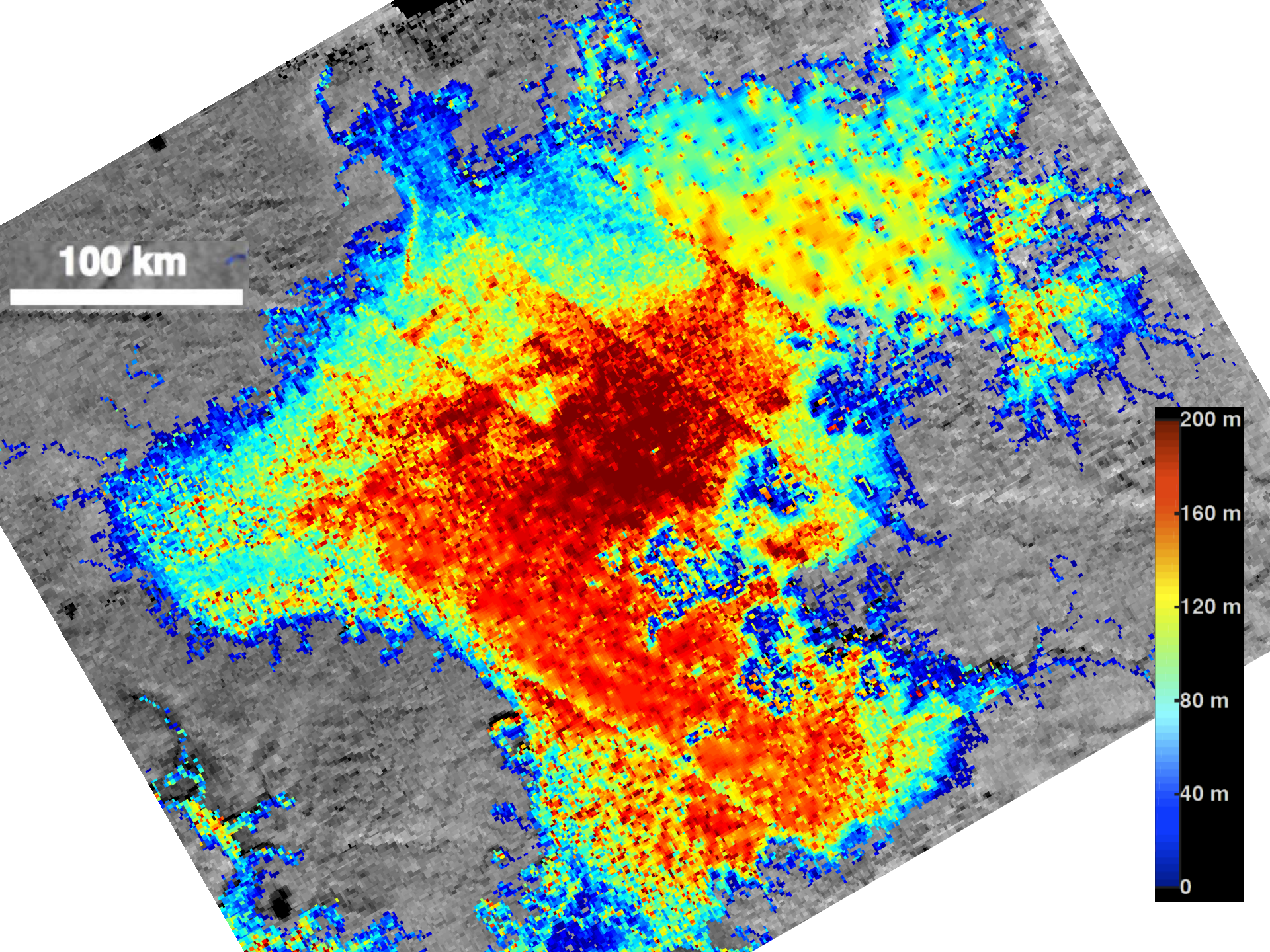
Hydrothermal activity occurs when seawater infiltrates and reacts with a rocky core, emerging as a heated, mineral-laden liquid.

Titan Discoveries

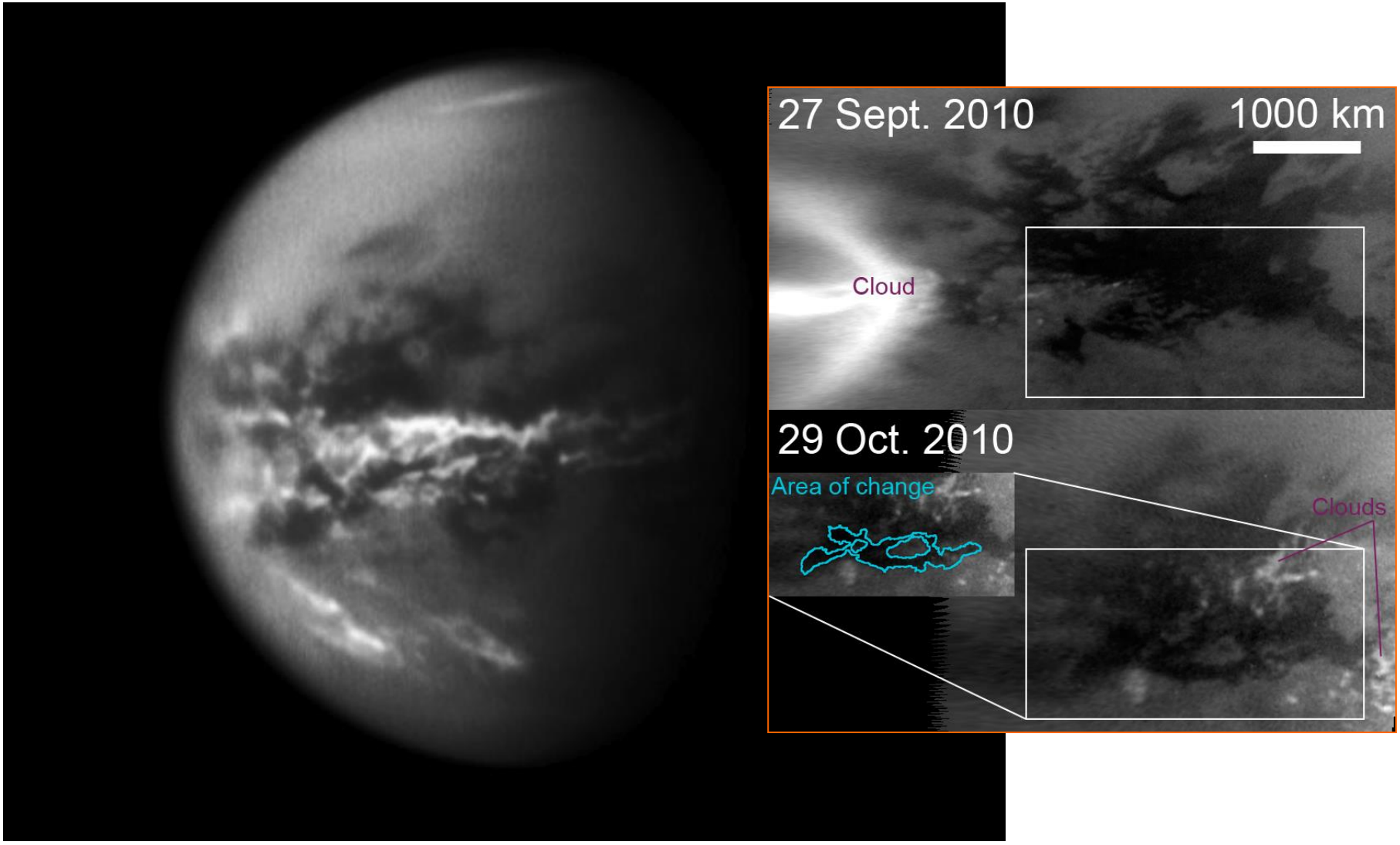
Year paper Accepted	**Summary of Discovery** (V&V priorities were finalized Sept 2010)
2010	Changing shoreline of northern seas
2011	Titan south polar vortex
2011	Methane rain storm
2012	Global subsurface ocean
2012	Seasonal change in atmosphere circulation
2012	Tropical lakes
2013	Definitive detection of a plastic ingredient
2013	Confirmation of complex hydrocarbons in Titan's upper atmosphere
2013	Large Abundances of Polycyclic Aromatic Hydrocarbons in Titan's Upper Atmosphere
2013	Titan’s ionospheric density linked to solar activity
2014	First determination of depth of a Titanian sea
2014	Titan's "Magic Islands": initial discovery
2014	Titan's ocean as salty as Dead Sea
2014	Methane Ice Cloud in Titan’s Stratosphere
2014	Titan Observed Outside of Saturnian Magnetosphere
2015	Titan dissolves to form small lake basins
2016	"Magic Islands" ongoing observations

22 NASA Press Releases




100 km
200 m
160 m
120 m
80 m
40 m
0

Seasonal Rains Transform Titan's Surface



Congressional Interest

House Report Language (Hrpt 114-130, p. 59):

Ocean Worlds Exploration Program.—The recommendation provides $226M for Outer Planets, of which not less than $140M is for the Jupiter Europa Clipper, or comparable mission, to support the process of finalizing the mission design concept that meets the scientific objectives described in the most recent Planetary Science decadal survey. To support sustained momentum in this program, NASA shall ensure that future funding requests are consistent with achieving a launch no later than 2022, with the goal of launching on a Space Launch System platform as discussed elsewhere in this report.

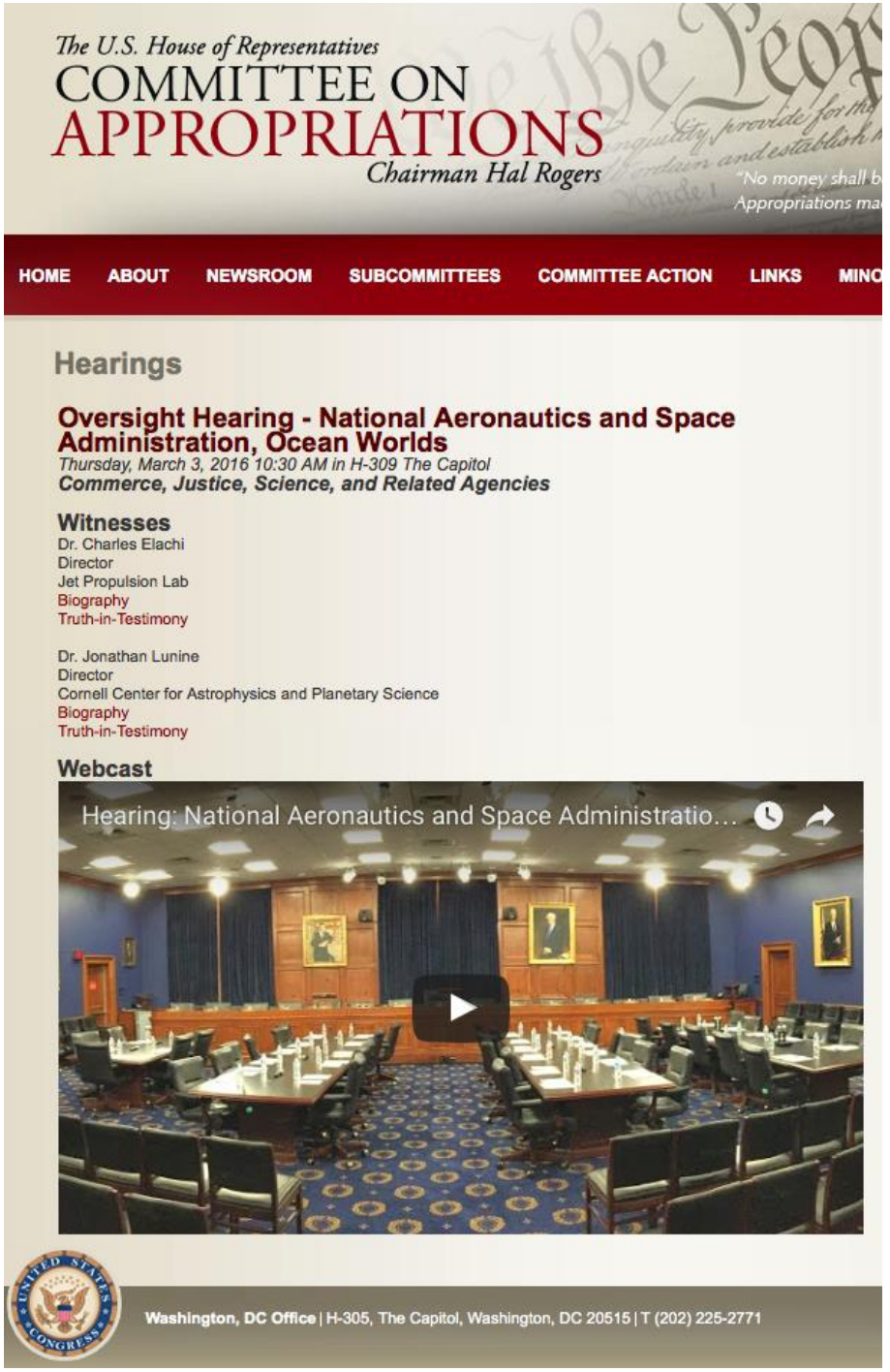
Many of NASA's most exciting discoveries in recent years have been made during the robotic exploration of the outer planets. The Cassini mission has discovered vast oceans of liquid hydrocarbons on Saturn's moon Titan and a submerged salt water sea on Saturn's moon Enceladus.

The Committee directs NASA to create an Ocean World Exploration Program whose primary goal is to discover extant life on another world using a mix of Discovery, New Frontiers and flagship class missions consistent with the recommendations of current and future Planetary Decadal surveys.

OW Hearing 3/3/2016

"Cassini and its antecedent at Jupiter, the Galileo orbiter, have provided nearly incontrovertible evidence for salt water oceans underneath the icy surfaces of three moons of the outer solar system—Europa at Jupiter, Enceladus and Titan at Saturn. And, on Titan, Cassini has discovered vast hydrocarbons seas."

Jonathan Lunine



New Frontiers - 4 Announcement

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

Overarching Science Objectives

Approach:

- Evaluate the current Decadal Survey *Vision and Voyages* (V&V) in the context of the "search for life" to identify Science Goals, Specific Objectives and Important Questions in the Satellites chapter that take on added relevance, and use those to formulate objectives for the NF-4 AO for Enceladus and Titan missions

Enceladus

- Assess the habitability of Enceladus' ocean
- Search for signs of biomarkers and evidence of extant life

Titan

- Understand the organic and methanogenic cycle on Titan, especially as it relates to prebiotic chemistry
- Investigate the subsurface ocean and/or liquid reservoirs, particularly their evolution and possible interaction with the surface

Example: Enceladus Mission

1. Identify the organics expelled from Enceladus' interior and understand whether those organics are produced by hydrothermal activity.
2. Identify any pattern that may be consistent with a biologic origin for the observed organic compounds.
3. Understand the exchange processes between the silicate interior and the ocean.
4. Understand the exchange processes (geysers) between the ocean and the outer space.
5. Determine whether the ocean has the right composition and chemical energy to host life.
6. Look for detectable biomarkers or signs of extant life in the plume.

Example: Titan Mission

1. Identify the vertical distribution & chemical reactions of the primordial heavy organic molecules produced in Titan's upper atmosphere;
2. Characterize the processes responsible for transforming the primordial organics in the atmosphere, on the surface and subsurface;
3. Characterize the exchange processes between the interior and the atmosphere by measuring the abundances of its trace gases, and noble gas isotopes;
4. Understand the organic cycle on Titan, in particular the role of the large seas;
5. Understand the physics and chemistry of Titan's crust on a regional sale;
6. How does this inventory of organics differ from known abiotic organic material in meteorites and contribute to our understanding of the origin of life in the Solar System?
7. Look for regional scale evidences of past resurfacing and interaction between the interior deep salty ocean and the organic surface; and
8. Understand the exchange processes between the silicate interior and the deep salty ocean – has the ocean been in contact with the silicate core and were the conditions similar to those existing on terrestrial sea-floor.

Summary

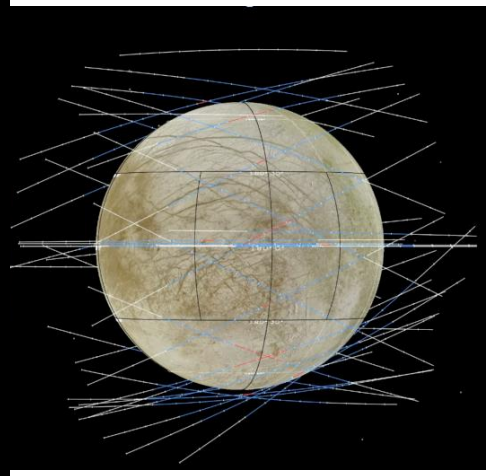
- Why was the Ocean Worlds mission theme added to NF4?
  1. The Decadal Surveys are one of several considerations NASA must use in crafting mission AOs
  2. Congressional FY16 Appropriations: Response is required
  3. NOSSE Report (previous decade): As a strategic program NF should be "adaptable to new discoveries"
  4. 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."
  5. Compelling science case for Enceladus and Titan

Next Steps:

- Present that decision and rationale to PSS for feedback (considering AG input) - *Completed*
- 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

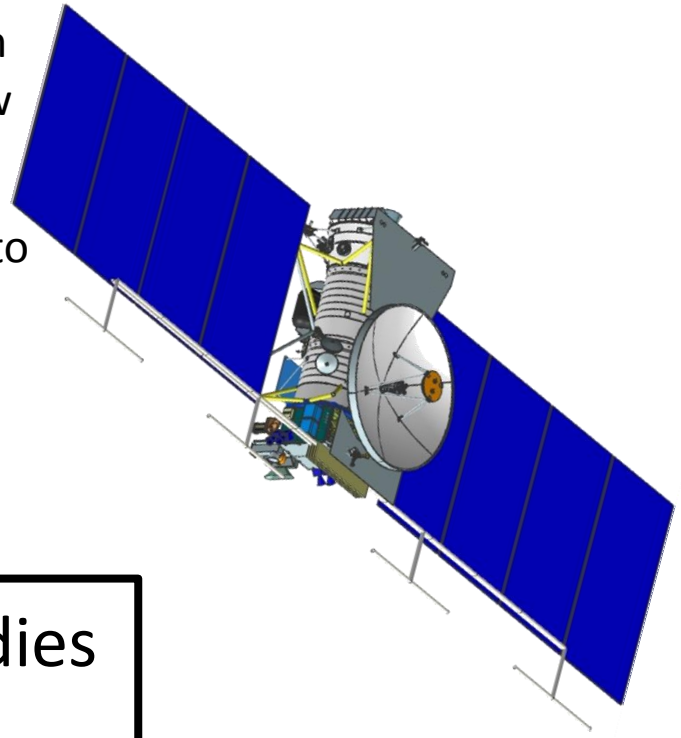
Europa Mission

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

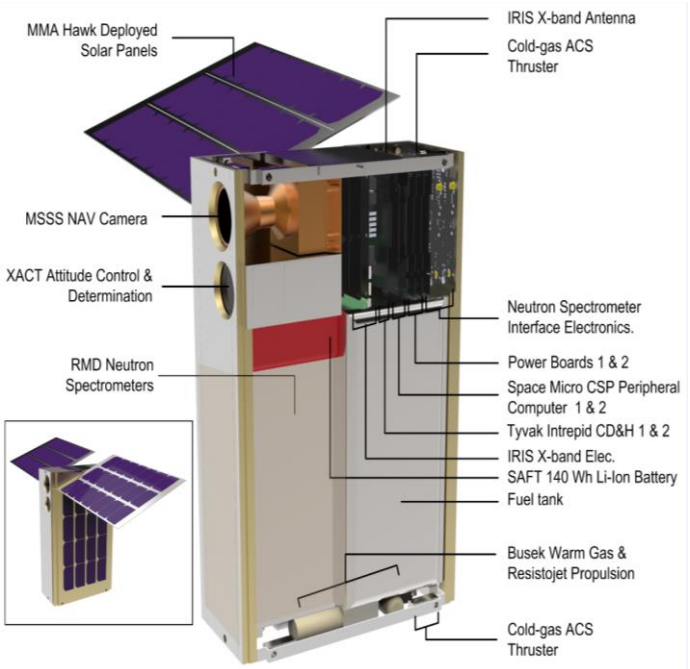
- Conduct 45 low altitude flybys with lowest 25 km (less than the ice crust) and a vast majority below 100 km to obtain global regional coverage
- Traded enormous amounts of fuel used to get into Europa orbit for shielding (lower total dose)
- Simpler operations strategy
- No need for real time down link



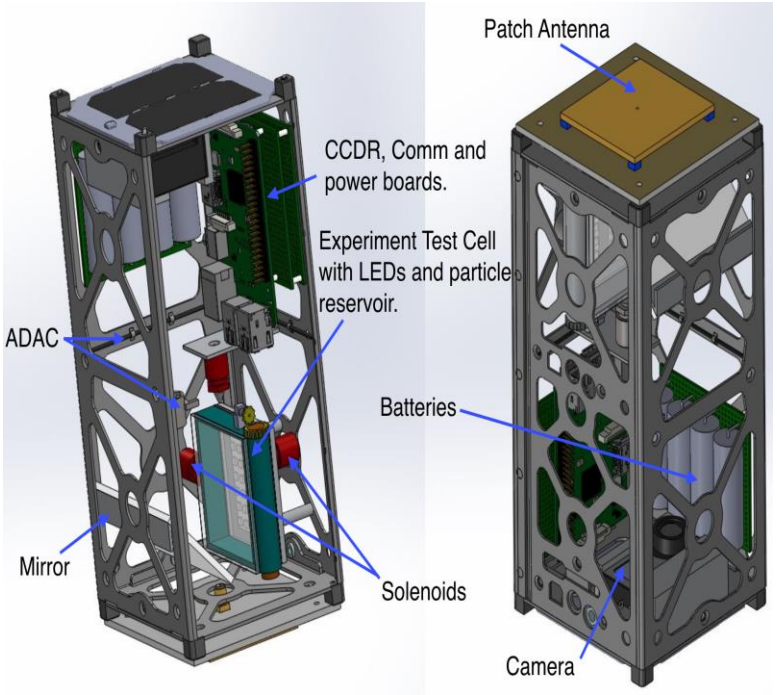
Lander Concept Studies Are Continuing

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



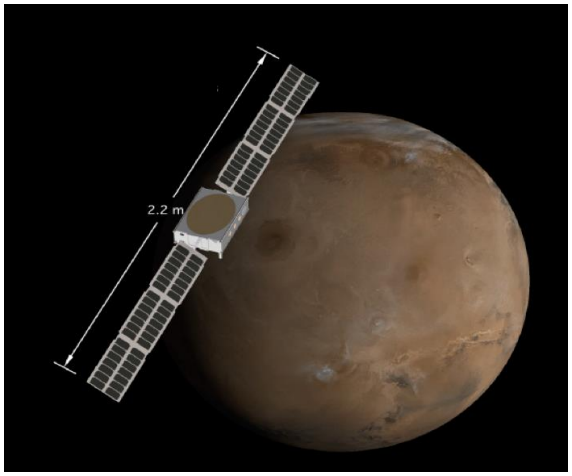
Lunar Polar Hydrogen Mapper (LunaH-Map)
PI: Craig Hardgrove
ASU School of Earth and Space Exploration



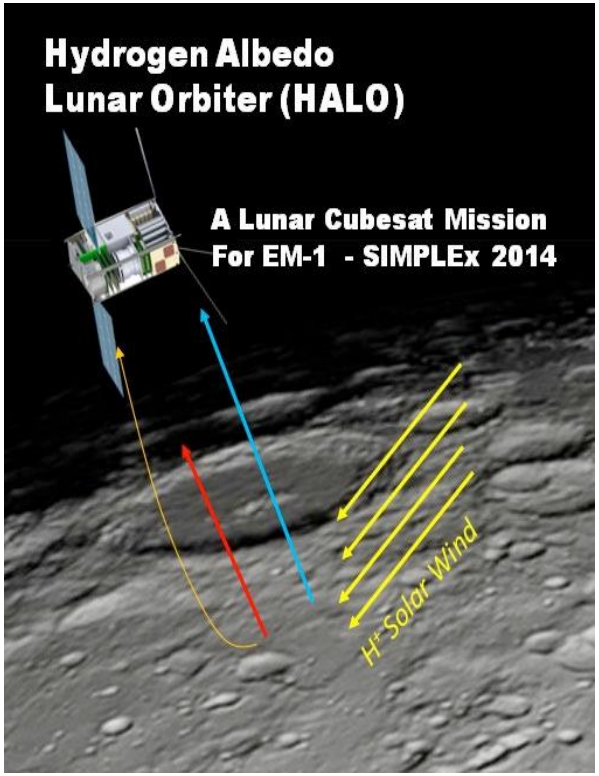
CubeSat Particle Aggregation and Collision Experiment (Q-PACE)
PI: Josh Colwel
University of Central Florida

Simplex Cubesats

Approved for Tech Development (1 year) Study ONLY



Mars Micro Orbiter
PI: Michael Malin
Malin Space Science Systems

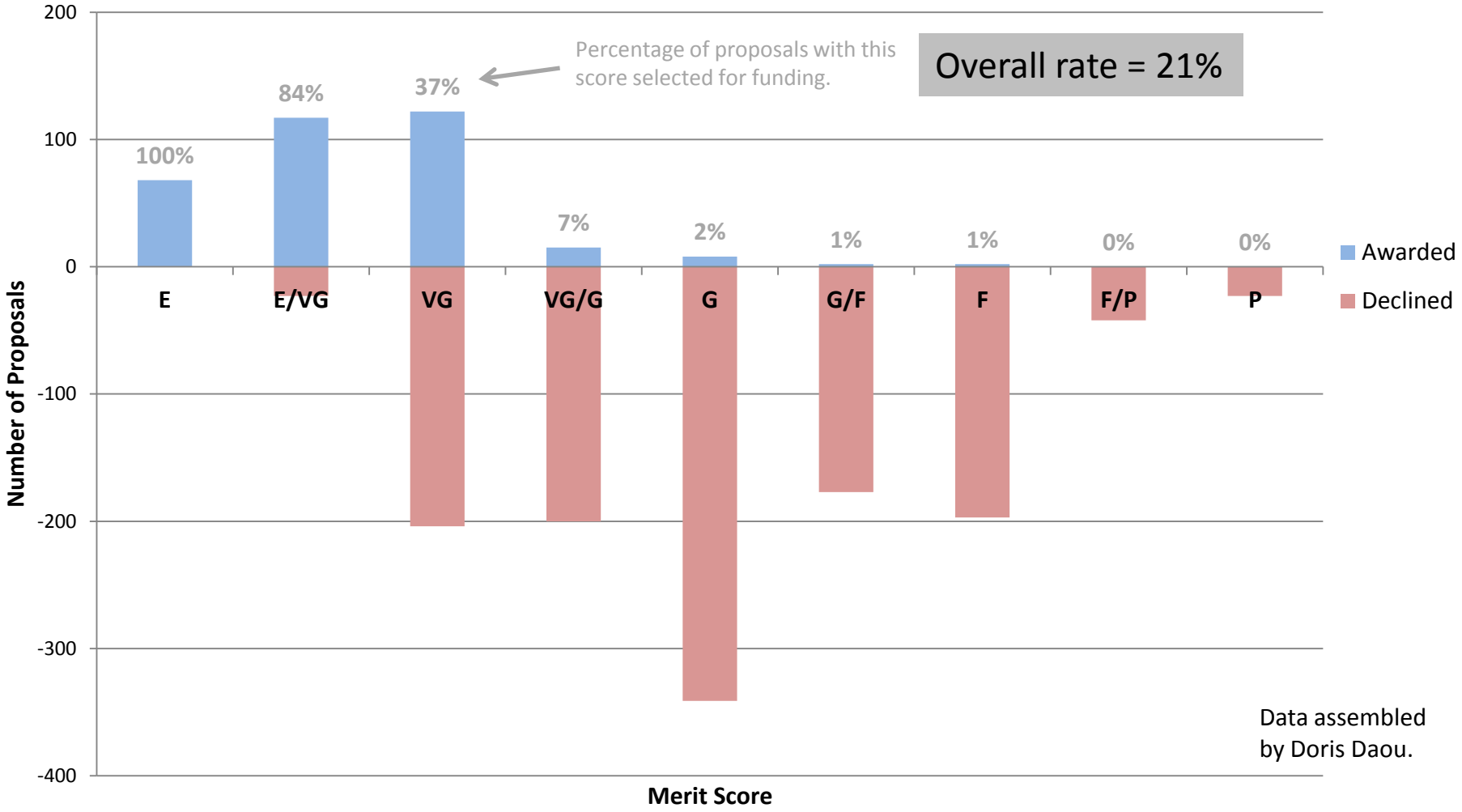


Hydrogen Albedo Lunar Orbiter (HALO)
PI: Michael Collier,
NASA GSFC

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

Research and Analysis Program

A Selection Metric



Shown are proposals submitted to ROSES-2014, including all core programs (EW, SSW, HW, SSO, EXO) and all DAPs (MDAP, DDAP, LDAP, CDAPS).

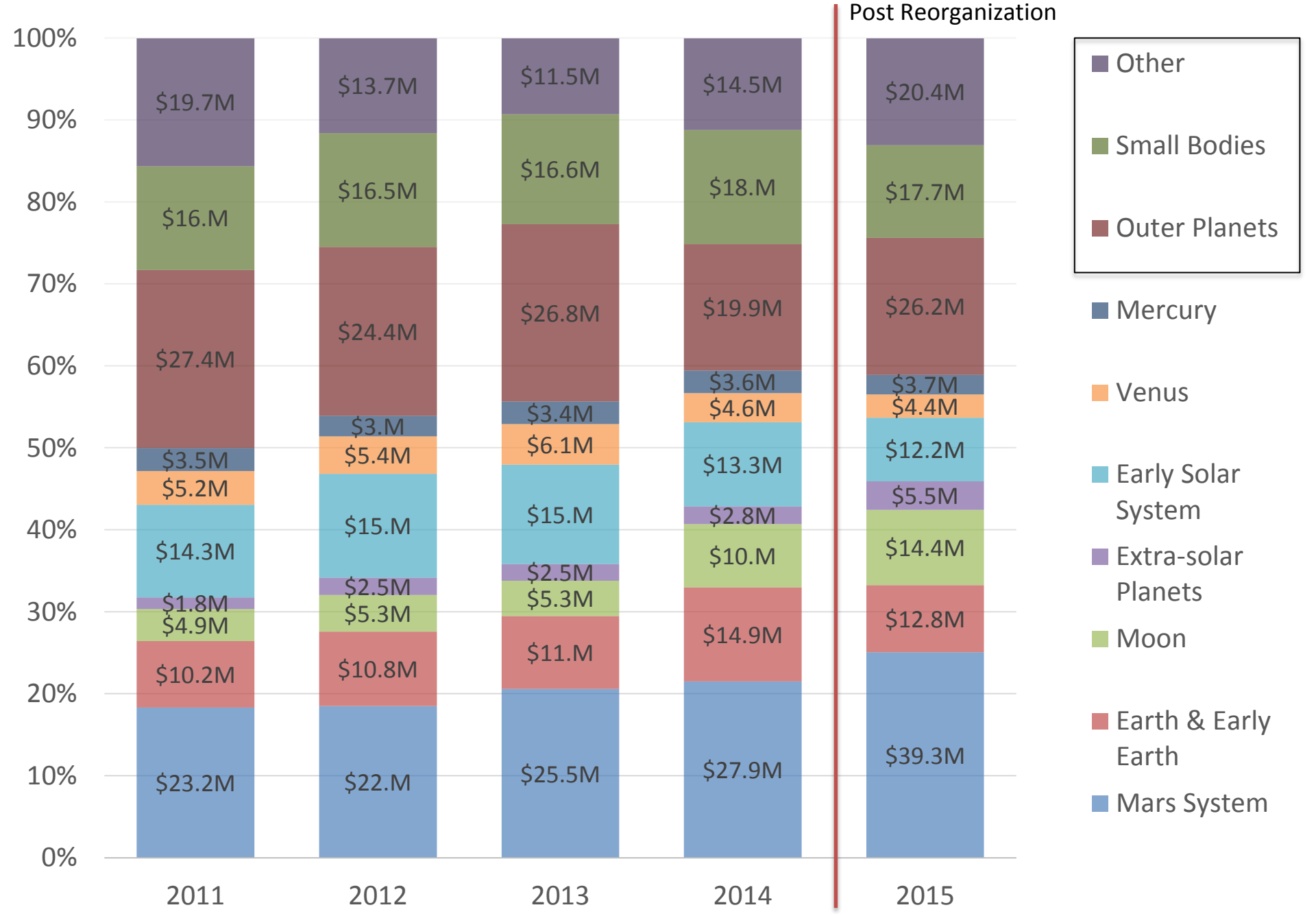
FY16 Research Budget by Funding Line

Program	Budget ($M)
Planetary R&A (Competed and supported activities)	154.0
Mars R&A (Mars Data Analysis Program) (excluding Critical Data Products (CDP)	9.4
Outer Planets Research (Cassini Data Analysis Program & PSP)	8.4
Discovery Research	11.4
Joint Robotics Program for Exploration (JRPE) (SSERVI Nodes)	10.0
NEOO (Competed activities)	20.9
Europa Technology	25.0*
Total	**214.1**

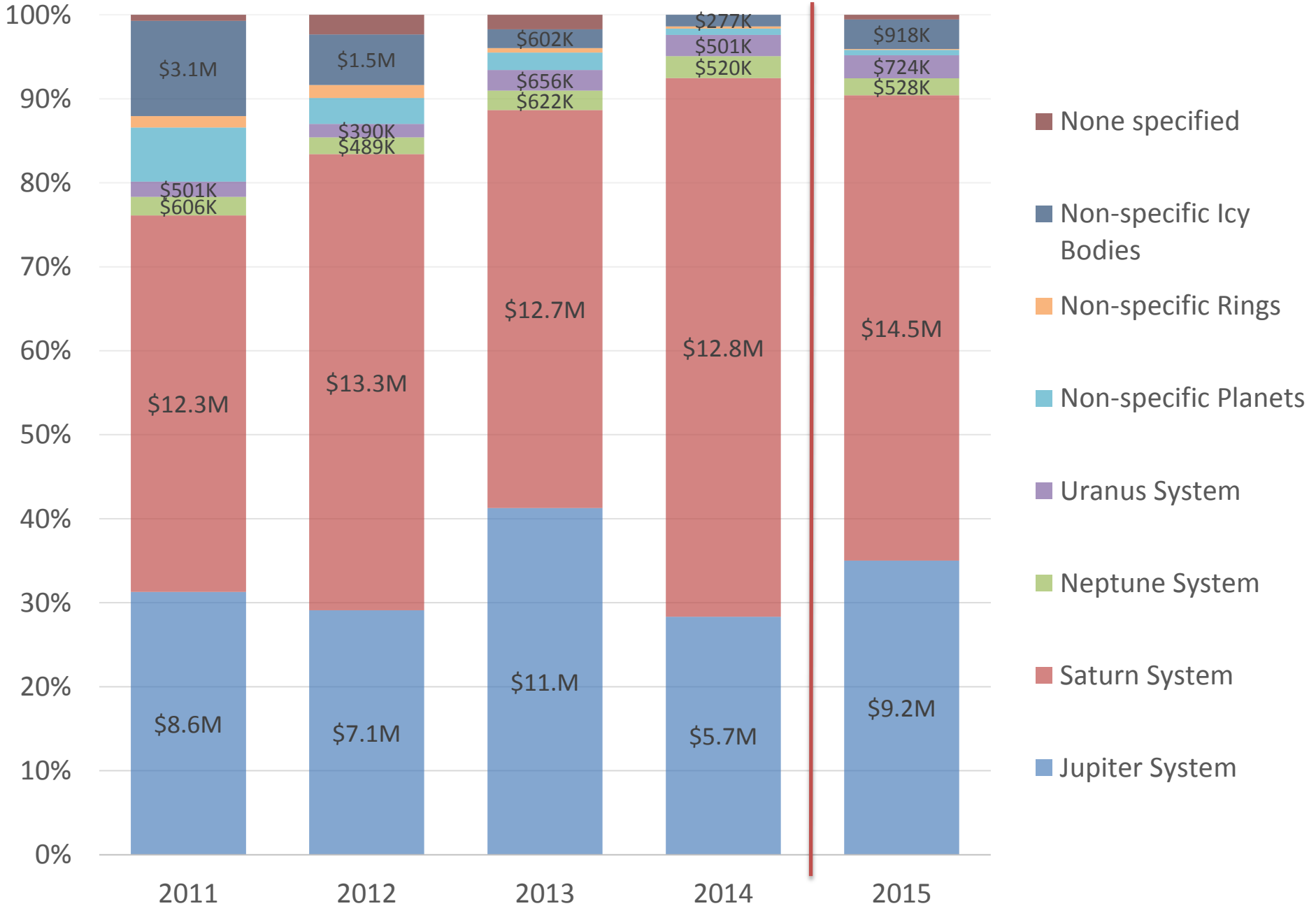
Keyword Analysis

- Keywords were developed that are independent of an individual ROSES Call
  - Words are basic “target object”
- Analysis of Keywords for ROSES 2011-15
  - Includes: DAPS & Participating Science Programs
  - Excludes: NAI & SSERVI nodes
- Caveats:
  - Keywords were not completed for all grants (missing ~8%)

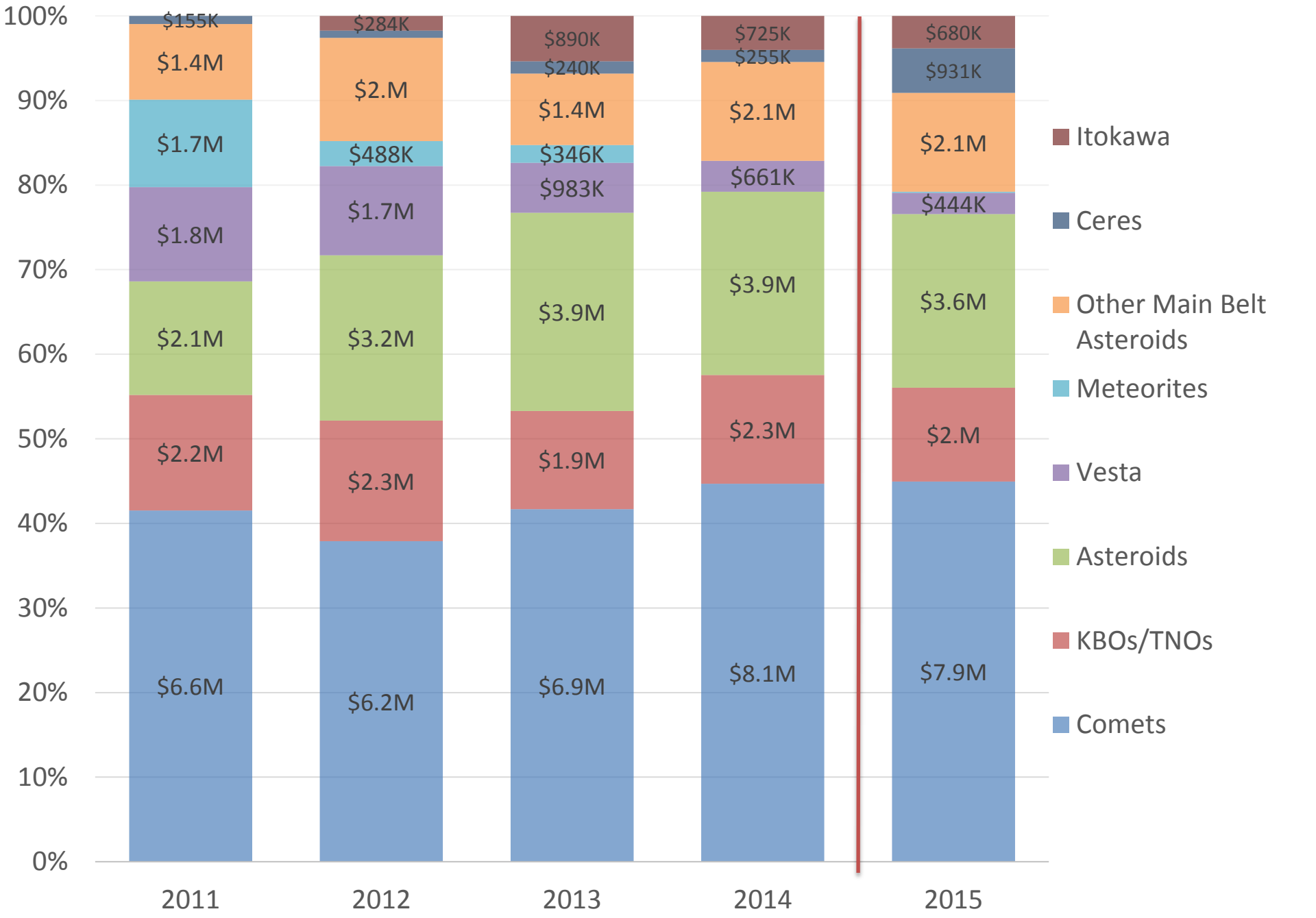
KEYWORD ANALYSIS

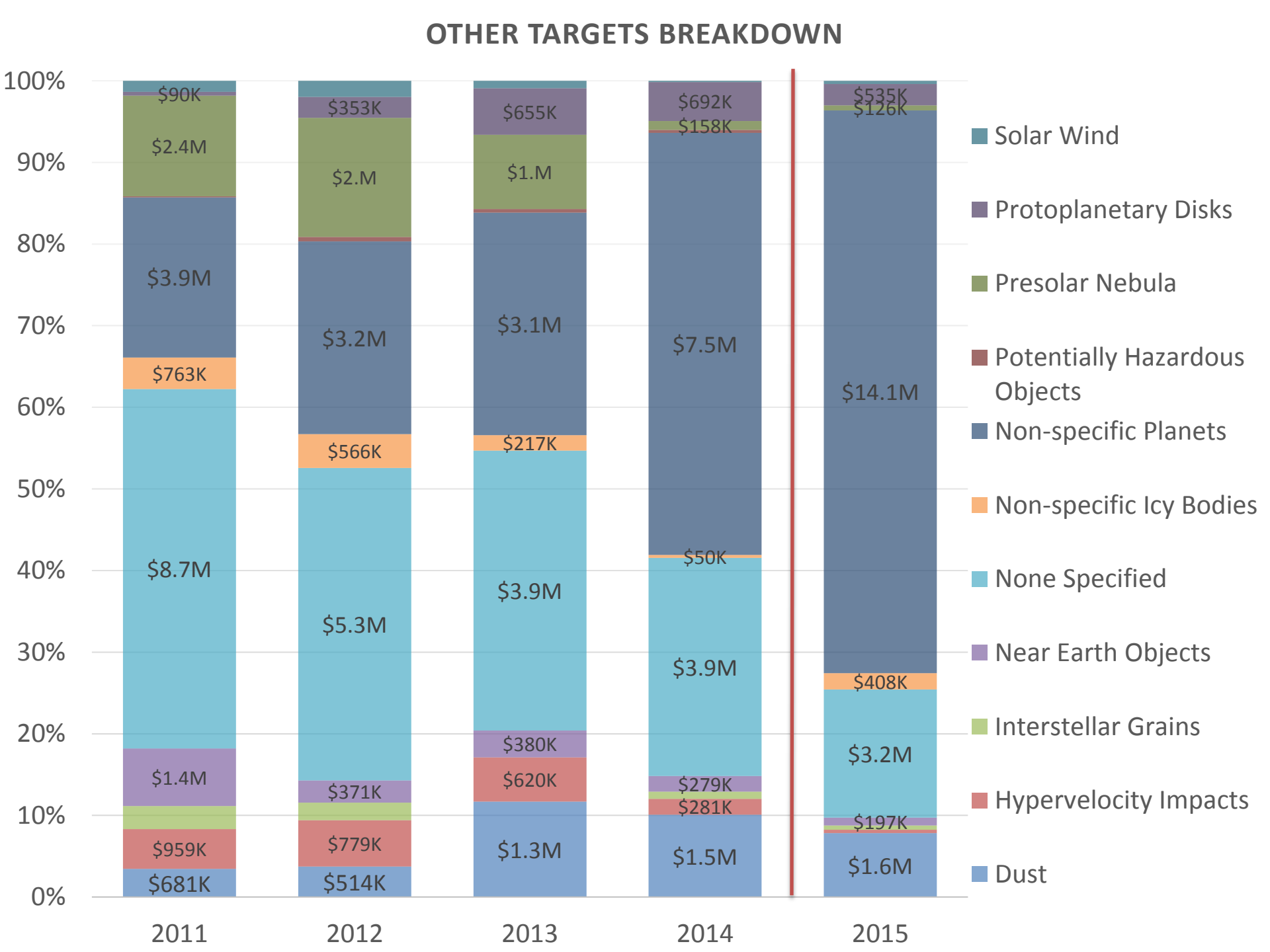


OUTER PLANETS BREAKDOWN



SMALL BODIES BREAKDOWN




OTHER TARGETS BREAKDOWN
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2011
2012
2013
2014
2015
$90K
$2.4M
$3.9M
$763K
$8.7M
$1.4M
$959K
$681K
$353K
$2.M
$3.2M
$566K
$5.3M
$371K
$779K
$514K
$655K
$1.M
$3.1M
$217K
$3.9M
$380K
$620K
$1.3M
$692K
$158K
$7.5M
$50K
$3.9M
$279K
$281K
$1.5M
$535K
$126K
$14.1M
$408K
$3.2M
$197K
$1.6M
Solar Wind
Protoplanetary Disks
Presolar Nebula
Potentially Hazardous Objects
Non-specific Planets
Non-specific Icy Bodies
None Specified
Near Earth Objects
Interstellar Grains
Hypervelocity Impacts
Dust

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

NASA Administrator
Associate Administrator

Associate Administrator,
Science Mission Directorate

Planetary Science Division
Program Director

Public Communications

Lead Program Executive
Planetary Defense Officer

Policy Development

NEO Observation Program
Program Manager
Program Scientist

- Minor Planet Center/IAWN
- Center for NEO Studies @ JPL
- Catalina Sky Survey
- Pan-STARRS
- LINEAR/SST
- IRTF
- GSSR
- NEOWISE
- ……..

Interagency and
Emergency Response Projects
Program Officer(s)

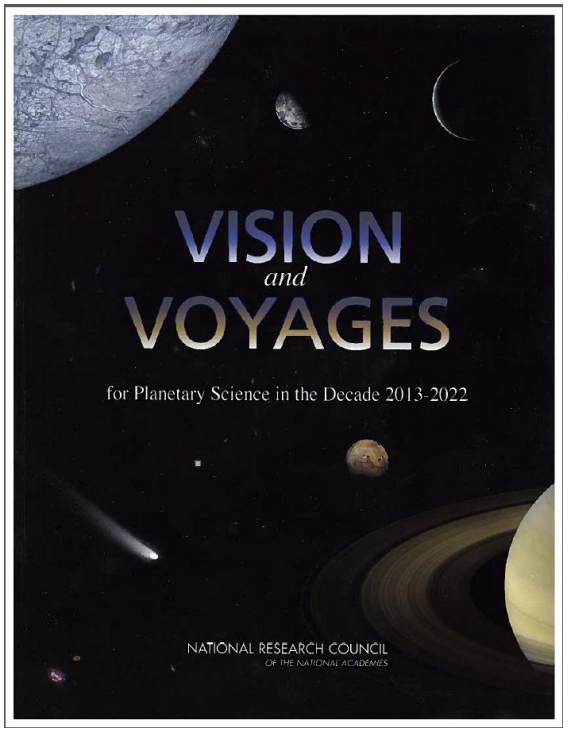
- Interagency coordination
- Emergency Response planning
- Interagency exercises

Mitigation Research Projects
Program Officer(s)

- SMPAG
- ARM Gravity Tractor Demo
- AIDA
- Short Warning Mitigation
- ……..

Timeline of NRC Studies

- 1st Planetary decadal: 2002-2012
- 2nd Planetary decadal: 2013-2022
- Extended Missions Review:
  - Tasked April 30, 2015
  - Report due to NASA September 2016
- R&A Restructuring Review:
  - Tasked August 13, 2015
  - Report due to NASA December 2016
- Large Strategic NASA Science Missions
  - Tasked March 2016
  - Report due to NASA March 2017
- Midterm evaluation:
  - To be tasked by September 2016
  - Extended Missions, R&A Restructuring & Large Strategic Missions will be input
  - Expect report due December 2017
- 3rd Planetary Decadal: 2023-2032
  - To be tasked *before* October 2019
  - Expect report to NASA due 1st quarter 2022



DRAFT

Planetary Sciences Mid-Term 2016

The Committee will:

1. Describe the most significant scientific discoveries, technical advances, and relevant programmatic changes in planetary sciences over the years since the publication of the planetary decadal survey;
2. Assess the degree to which NASA's current planetary science program addresses the strategies, goals, and priorities outlined in the 2011 decadal survey and other relevant NRC reports;
3. Assess NASA progress toward realizing these strategies, goals, and priorities, and effectiveness in maintaining programmatic balance;
4. Recommend any actions that could be taken to optimize the science value of the program including how to take into account emergent discoveries since the decadal in the context of current and forecasted resources available to it;
5. Provide guidance about implementation of the recommended mission portfolio and decision rules for the remaining years of the current decadal survey, but not revisit or redefine the scientific priorities or mission recommendations from the 2011 decadal survey; and
6. Recommend any actions that should be undertaken to prepare for the next decadal survey, such as community discussion of science goals, potential missions, and programmatic balance, and NASA support of potential mission concept studies.

Questions?

National Academies R&A Study

Objective: Examine the program elements of the PSD R&A programs, as they currently exist following restructuring, for their consistency with past NRC advice

The committee* will address the following questions:

1. Are the PSD and R&A program elements appropriately linked to, and do they encompass the range and scope of activities needed to support, the NASA Strategic Objective for Planetary Science and the PSD Science Goals, as articulated in the *2014 NASA Science Plan*?
2. Are the PSD R&A program elements appropriately structured to develop the broad base of knowledge and broad range of activities needed both to enable new spaceflight missions and to interpret and maximize the scientific return from existing missions?

* Report anticipated by December.