

Planetary Science Division Status Report



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NASA, Planetary Science Division

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Presentation at VEXAG

Outline

- Mission Overview
- Discovery Program
- New Frontiers Programs - Curt
- 2016 Senior Review Results
- NAS studies and schedule
- International Venus Studies
- VEXAG 2015 Findings

Planetary Science Missions Events

2016

March – Launch of ESA's *ExoMars Trace Gas Orbiter*

July 4 – *Juno* inserted in Jupiter orbit

* **Completed**

July 20 – 40th Anniversary of the Viking missions

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

September 30 – Landing Rosetta on comet CG

October 19 – ExoMars EDM landing and TGO Orbit insertion

December/January – Discovery 2014 Step 2 selection announced

2017

January – New Frontiers AO release (NLT)

April 22 – *Cassini* begins plane change maneuver for the “Grand Finale”

September 22 – *OSIRIS-REx* Earth flyby

September 15 – *Cassini* enters Saturn and completes mission

November - New Frontiers Step 1 selection announced

2018

April – Launch of ESA's *BepiColombo*

May 5 - Launch *InSight* mission to Mars

August – *OSIRIS-REx* arrival at Bennu

November 26 – *InSight* landing on Mars

2019

January 1 – *New Horizons* flyby of Kuiper Belt object 2014MU69

Discovery Program

Discovery Program

Completed

Mars evolution:
Mars Pathfinder (1996-1997)



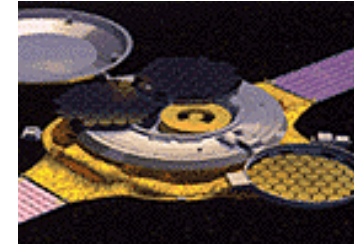
Lunar formation:
Lunar Prospector (1998-1999)



NEO characteristics:
NEAR (1996-1999)



Solar wind sampling:
Genesis (2001-2004)



Completed

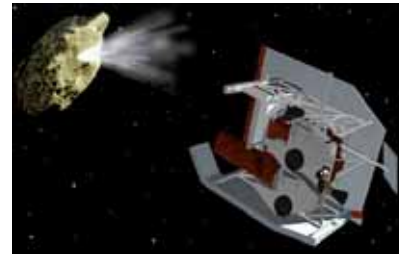
Comet diversity:
CONTOUR (2002)



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



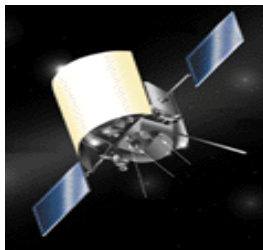
Comet internal structure:
Deep Impact (2005-2012)



Lunar Internal Structure
GRAIL (2011-2012)



Mercury environment:
MESSENGER (2004-2015)



Main-belt asteroids:
Dawn (2007-TBD)



Lunar surface:
LRO (2009-TBD)



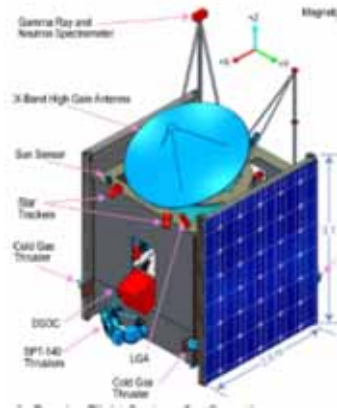
ESA/Mercury Surface:
Strofió (2017-TBD)



Mars Interior:
InSight (2018)



Discovery Selections 2014



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



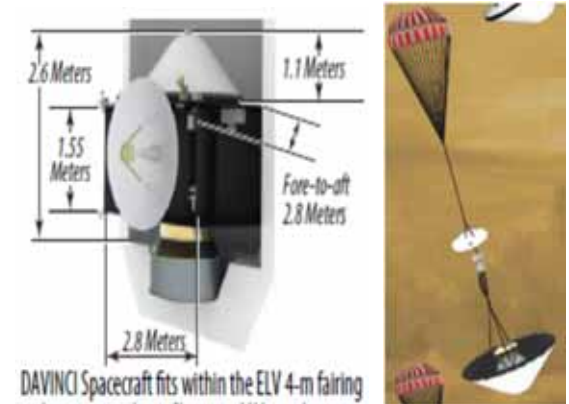
VERITAS: Venus Emissivity, Radio Science, InSAR, Topography, And Spectroscopy
 PI: Suzanne Smrekar, JPL
 Deep-Space Optical Comm (DSOC)



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)



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

Results of the 2016 Planetary Mission Senior Review (PMSR)

Senior Review Summary

- Top Recommendation: “The Panel unanimously believes that all (missions) should be approved for extension.”

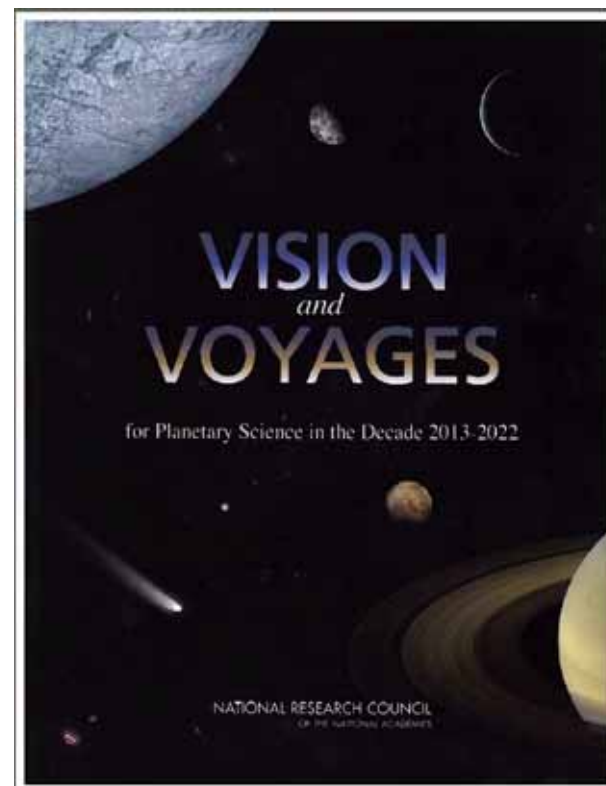
MISSION	Panel Rating
Mars Reconnaissance Orbiter (MRO)	EXCELLENT
New Horizons	EXCELLENT
Lunar Reconnaissance Orbiter (LRO)	EXCELLENT/Very Good
Mars Atmosphere & Volatile Evolution (MAVEN)	EXCELLENT/Very Good
Opportunity/Mars Exploration Rover	EXCELLENT/Very Good
Curiosity/Mars Science Laboratory	Very Good
DAWN - Ceres	Very Good/Good
Odyssey	Very Good/Good
Mars Express (MEx)	Good

All 9 missions have been directed to plan for continued operations through FY18 (NH through 2021), subject to availability of appropriated funds and the outcome of the annual budget process

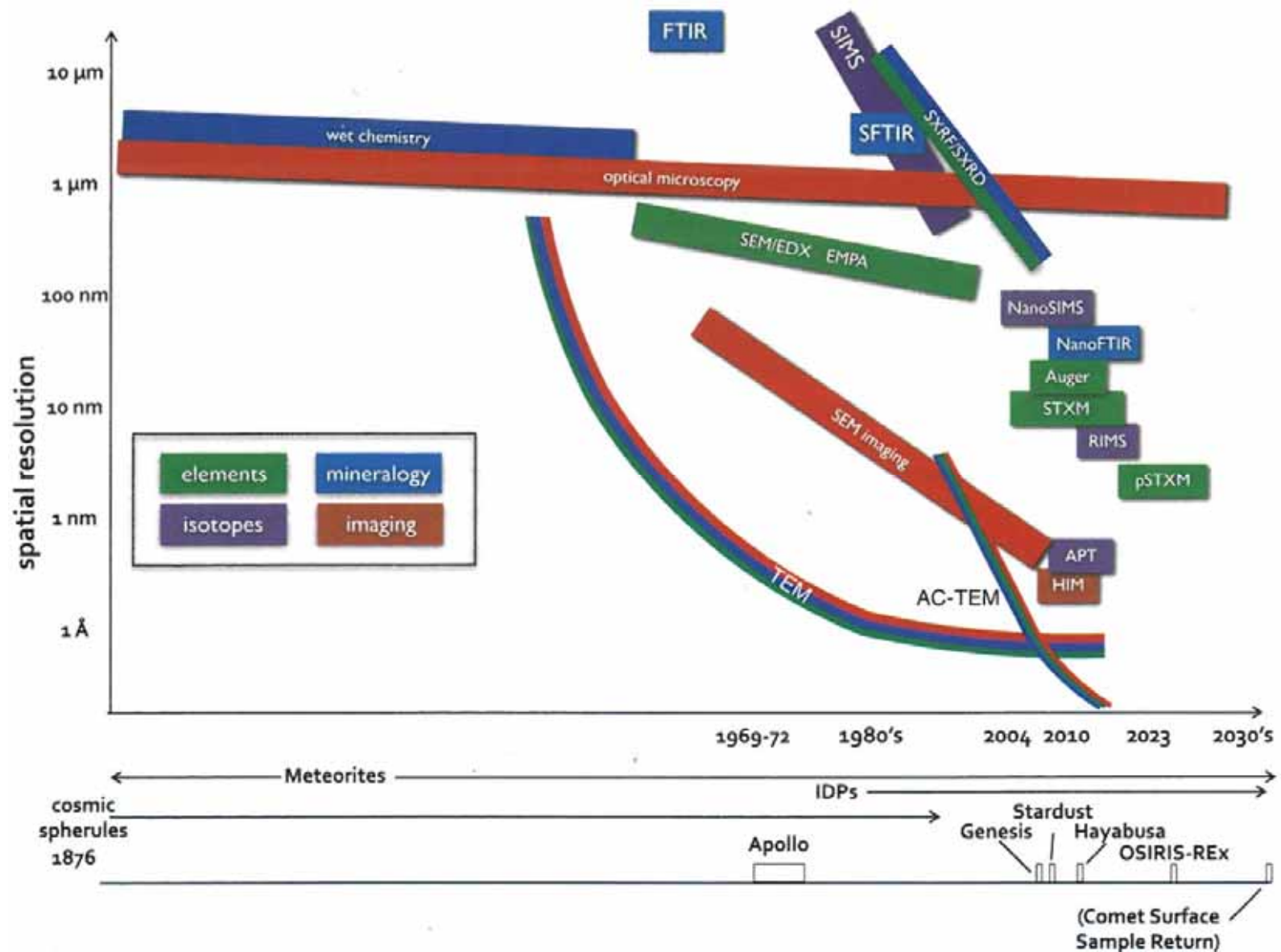
NAS Studies for Planetary Science

Timeline of NAS Studies

- 1st Planetary decadal: 2002-2012
- 2nd Planetary decadal: 2013-2022
- Cubesat Review: Completed June 2016
- Extended Missions Review: Completed Sept 2016
- R&A Restructuring Review:
 - Tasked August 13, 2015
 - Report due to NASA December 2016
- Large Strategic NASA Science Missions
 - Tasked December 23, 2015
 - Report due to NASA August 2017
- Midterm evaluation:
 - Tasked August 26, 2016
 - Cubesats, EX Missions, R&A Restructuring & Large Strategic Missions will be input
 - Expect report due December 2017
- **New Study: Sample Analysis Future Investment Strategy (Tasked Sept 23, 2016)**
- 3rd Planetary Decadal: 2023-2032
 - To be tasked *before* October 2019
 - Expect report to NASA due 1st quarter 2022



Sample Analysis Instrumentation Evolution



Statement of Task

The Committee will assess:

- What laboratory analytical capabilities are required to support PSD (and partner) analysis and curation of existing and future extraterrestrial samples?
 - Which of these capabilities currently exist, and where are they located (including international partner facilities)?
 - What existing capabilities are not currently accessible that are/will be needed?
- Whether the current sample laboratory support infrastructure and NASA's investment strategy meets the analytical requirements in support of current and future decadal planetary missions.
- How can NASA ensure that the science community can stay abreast of evolving techniques and to be at the forefront of extraterrestrial sample analysis.

International Activities

International Venus Efforts

- JAXA/Akatsuki Participating Science Program
- NASA – RSA bilateral (October 12, 2016)
 - Joint SDT on Venera-D Status Presentation
 - Comprehensive overview of possible missions
 - Developing report by end of January 2017
 - JSDT will be extended for the next two years
 - New charge will involve a more focused approach
- Upcoming Venus Modeling Conference at GRC in 2nd quarter 2017
 - Encourages international participation
 - Results to be discussed with RSA at a later date & venue as it relates to Venera-D

Status of VeGASO

- Venus Gravity Assist Science Opportunities (VeGASO) – Flyby Venus Science
 - Working Group established with report Apr 2015
 - Jointly set up by NASA/SMD Heliophysics & Planetary Divisions
 - Missions: Solar Probe Plus, Solar Orbiter and BepiColombo
- These missions do present an opportunity to make important observations:
 - Ionosphere/Induced magnetosphere
 - Atmosphere, surface, and interior science
- Briefing to new Heliophysics Division director scheduled
 - Will then initiate discussion on next possible steps

VEXAG 2015 Meeting Findings

VEXAG Findings (1/3)

- VEXAG encourages the PSD to identify a HQ POC who is available to engage in our activities and represent our needs as a backup until Dr. Ocampo resumes her role.
- Response: Adriana is back!
- VEXAG appreciates recent support from the Planetary Science Division, and strongly encourages continued support of international opportunities for science participation and investigation.
- Response: See previous section
- VEXAG encourages the Planetary Science Division to provide adequate, additional time for New Frontiers proposers to complete their proposals after the 2016 Discovery selection(s) are announced.
- Response: We are on-schedule to announce the 2016 Discovery selection before the end of December 2016. We are on-schedule for the release of New Frontiers-4 no later than the end of January 2017.

VEXAG Findings (2/3)

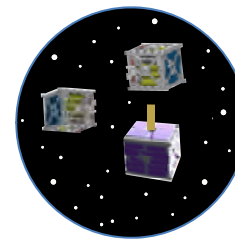
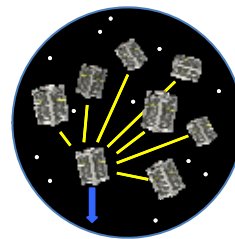
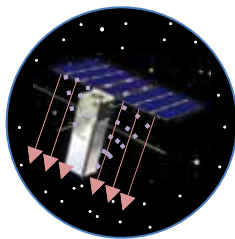
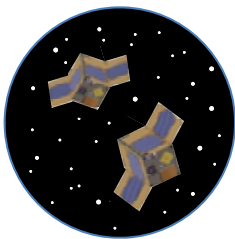
- PSD studies in FY16 and FY17 of the Ice Giants and Enceladus Flagship missions that were identified and prioritized by the 2011 Planetary Science Decadal Survey (PSDS). VEXAG finds that reassessment of the Venus Climate Mission (VCM), which was also identified by the PSDS as a Flagship priority, is also needed. Conducting further studies of the Venus Flagship mission immediately following the completion of the Enceladus study should allow sufficient time for an in depth study in time to be evaluated by the next PSDS.
- Response: Due to the addition of Ocean Worlds in the NF-4 no additional studies of Enceladus or Titan are being planned. The next mission study(s) beyond the Ice Giants is TBD.
- PSD is conducting further studies in FY16 and FY17 of the Ice Giants and Enceladus Flagship missions that were identified and prioritized by the 2011 Planetary Science Decadal Survey (PSDS). VEXAG finds that reassessment of the Venus Climate Mission (VCM), which was also identified by the PSDS as a Flagship priority, is also needed.
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VEXAG Findings (3/3)

- VEXAG encourages PSD support for upcoming opportunities and initiatives:
 - Continued efforts to initiate the Extreme Environments Challenge;
 - A workshop focused on science results based on laboratory, theoretical modeling, and simulation studies of a broad range of Venus topics;
 - Comparative Climatology of Terrestrial Planets-3 (CCTP-3), in FY2017;
- Response: Agreed. Also note other upcoming opportunities for future Venus concept missions

Planetary Science Deep Space SmallSat Studies

- ROSES Appendix C.23 was released on August 19, 2016
 - NOI/STEP 1 : September 30, 2016 → 107 Submissions
 - STEP 2 : November 18, 2016 → 102 Submissions
- Solicited concept studies for potential CubeSat and SmallSat
 - Concepts sought for 1U to ESPA-class missions
 - Up to \$100M mission concepts considered
 - Not constrained to fly with an existing mission
 - Will generate ideas to inform future mission planning
 - Will quantify technology gaps
 - 6 to 15 awards expected





- Present a compelling, 35-year science vision within the frame work of the future decades (2020s, 2030s, and 2040s)
- Planetary Science decadal survey is the starting point with notional technologies and missions
- Deliver to the Planetary Science Division Director a report that will:
 - have a compelling, over-arching planetary science theme for each decade as the next phase in Solar System Exploration;
 - contain one or multiple paths forward (science areas and technologies needed) towards a long-range vision;
 - consider cross-cutting opportunities with other disciplines as well as the larger context of international planetary science and human exploration;
 - be built on science investigations goals, leading to notional missions that achieve the science as appropriate;
 - consider the technology needed to achieve specific goals;
 - identify challenges (e.g. measurement challenges, technology challenges....) that will need early investment to become viable.

<http://www.hou.usra.edu/meetings/V2050/>

Workshop Themes

There are 5 basic themes. Take the current planetary science goals articulated below and develop a vision of where they might go in the coming three decades:

- **ORIGINS** — understanding formation and evolution of solar systems (including exoplanetary systems)
- **WORKINGS** — understanding how the processes in our solar system operate, interact, and evolve
- **LIFE** — improve our understanding of the origin & evolution of life, including Earth analogs, to guide our search for life elsewhere
- **THREATS AND RESOURCES** — identify and characterize objects that pose threats to Earth or offer resources for human exploration
- **OTHER** — other thoughts about where we might be in three decades that are not captured above (e.g., terraforming)

<http://www.hou.usra.edu/meetings/V2050/>

Workshop Format

- Participation in this workshop will be space-limited and requires submission of an abstract
- All abstracts will be posted to the workshop website and used in the development of the workshop report
- Oral sessions will be **live-streamed** so that community members unable to attend the workshop can participate
- PDFs of poster presentations will be posted on the workshop website.
- The workshop program will include **five half-day sessions with no parallel sessions**
- **Two poster sessions**, one each on Monday and Tuesday evening
- The half-day sessions will each include an **invited plenary talk**, followed by a series of invited and contributed oral presentations, and a panel discussion
- The afternoon sessions will provide time for brief one-slide **introductions to the evening posters**

Questions?

