Planetary Science Division Update to VEXAG

Jim Green

August 29, 2011

The Environment We Are In

Congress has started debating NASA's budget for FY12

- The House has a proposed NASA budget from its Subcommittee
- We expect to be under a "Continuing Resolution" for the 1st Q of FY12

In the meantime PSD is developing its FY13 budget supported by activities delineated in the Planetary decadal

- This is a critical time in securing our international partnerships

We are also aggressively pursuing a tighter connection with HEOMD (formally ESMD) over areas of overlap and interest

We are also engaging the Office of Chief Technologist for help in developing key technologies (Optical Comm, Aero-capture…)

Historic time in planetary science is *now*

Discoveries are happening almost daily - this is not by accident

NASA's Year of the Solar System Events

2010

- September 16 – Lunar Reconnaissance Orbiter in PSD
- November 4 - EPOXI encounters Comet Hartley 2
- November 19 - Launch of O/OREOS

- Completed

•***2011***

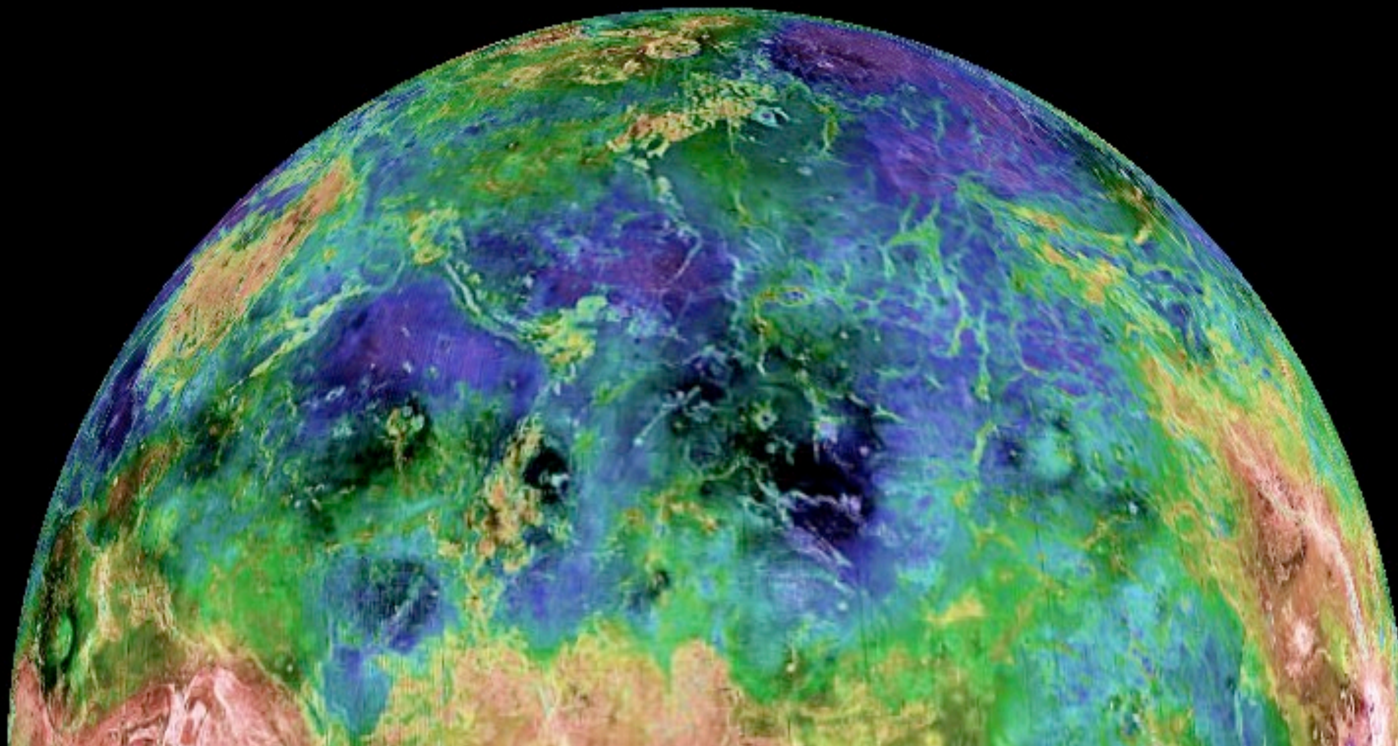
http://solarsystem.nasa.gov

- February 14 - Stardust NExT encounters comet Tempel 1
- March 7 – Planetary Science Decadal Survey released
- March 17 - MESSENGER orbit insertion at Mercury
- May 5 - Selection of 3 Discovery-class missions for study
- May - Selection of the next New Frontier mission for flight, OSIRIS-Rex
- July 16 - Dawn orbit insertion at asteroid Vesta
- August 5 - Juno launched to Jupiter
- August 9 - Mars Opportunity Rover gets to Endeavour Crater
- September 8 - GRAIL launch to the Moon
- November 25 - Mars Science Laboratory launch to Mars
- December 31 - GRAIL-A orbit insertion at Moon

2012

- January 1 - GRAIL-B orbit insertion at Moon
- June 6 – Venus transits the Sun – focus the world's attention on Venus!
- Mid-year - Dawn leaves Vesta starts on its journey to Ceres
- August - MSL lands on Mars
- August 27 – 50th Anniversary of Planetary Exploration – Mariner 2!

enus



1	2	3	4	5
lyby	Orbit	Lander	Rover	Return Sample
ariner 2, 5, 10 enera 11-14 alileo ssini ESSENGER katsuki	Venera 9, 10, 15, 16 Pioneer 12 (PV 1) Magellan Venus Express Akatsuki (2016)*	Venera 3 (crash landing) Venera 7-10, (11, 12), 13, 14 Pioneer 13 (PV 2; 1 entry survivor) VeGa 1, 2		

Planetary Program Architecture
Recommended by the Planetary Decadal Survey

Large Missions ("Flagship"-scale)

"Recommended Program"
(budget increase for JEO new start)

1) **Mars Astrobiology Explorer-Cacher – descoped**
2) **Jupiter Europa Orbiter (JEO) – descoped**
3) **Uranus Orbiter & Probe (UOP)**

4/5) **Enceladus Orbiter & Venus Climate Mission**

"Cost Constrained Program"
(based on FY11 Request)

1) **Mars Astrobiology Explorer-Cacher – descoped**
2) **Uranus Orbiter & Probe (UOP)**

"Less favorable" budget picture than assumed
(e.g., outyears in FY12 request)

Descope or delay Flagship mission

Discovery

$500M (FY15) cap per mission (exclusive of launch vehicle) and 24 month cadence for selection

New Frontiers

$1B (FY15) cap per mission (exclusive of launch vehicle) with two selections during 2013-22

Research & Analysis (5% above final FY11 amount then ~1.5%/yr)

Technology Development (6-8%)

Current Commitments (ie: Operating Missions)

Flagship Missions

(in priority order)

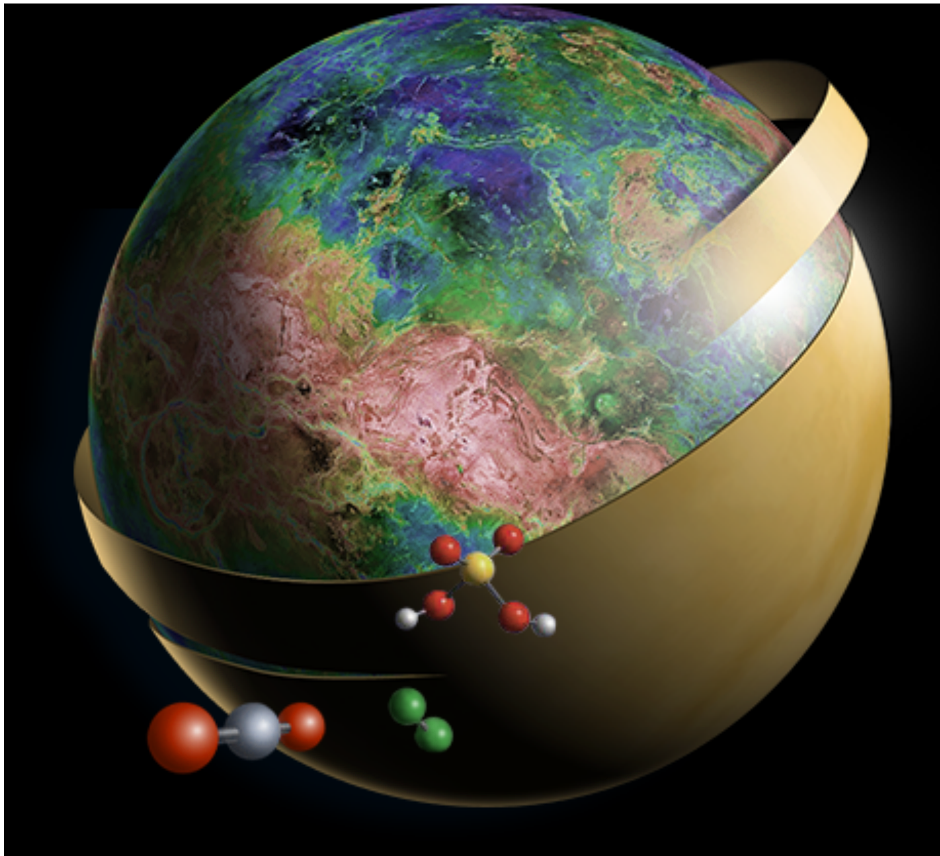
1. Begin NASA/ESA Mars Sample Return campaign: *Descoped Mars Astrobiology Explorer-Cacher/ExoMars*
2. Detailed investigation of a probable ocean in the outer solar system: *Descoped Jupiter Europa Orbiter (JEO)*
3. First in-depth exploration of an Ice Giant planet: *Uranus Orbiter and Probe*
4. Either *Enceladus Orbiter* or *Venus Climate Mission* (no relative priorities assigned)

- Intensive studies are now underway with #1 & #2 priorities the others will follow as budget permits
    - We should know within the next month if #1 is viable as a partnership with ESA

New Frontiers-4 Selection

- Select NF-4 from among:
  - *Comet Surface Sample Return*
  - *Lunar South Pole-Aitken Basin Sample Return*
  - *Saturn Probe*
  - *Trojan Tour and Rendezvous*
  - *Venus In Situ Explorer*
- No relative priorities among these are assigned
- For NF-5:
  - The remaining candidates from NF-4
  - Io Observer
  - Lunar Geophysical Network
- No relative priorities among these are assigned

Venus *In Situ* Explorer



Scientific Objectives:

•To compare Venus to other terrestrial planets, including Earth, Mars and Mercury, as well as planets recently discovered orbiting stars in other solar systems.

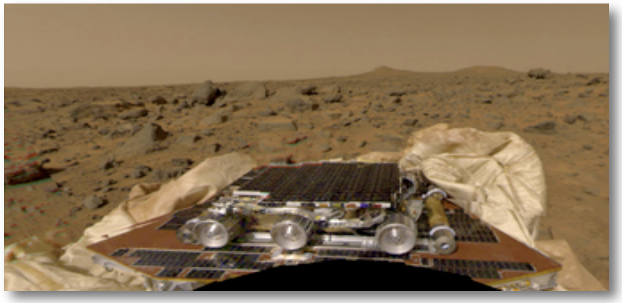
•To understand the physical and chemical reasons for Venus's runaway greenhouse gases and global warming. This may help scientists better understand the eventual fate of Earth

•Measurements:

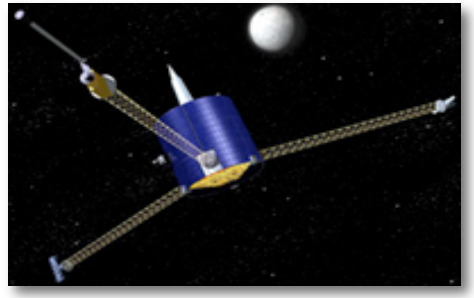
- *Measure lower atmosphere chemistry, including the isotopes and noble gases*
- *Measure the composition of the surface with unprecedented accuracy*

Discovery Program

Mars evolution:
Mars Pathfinder (1996-1997)



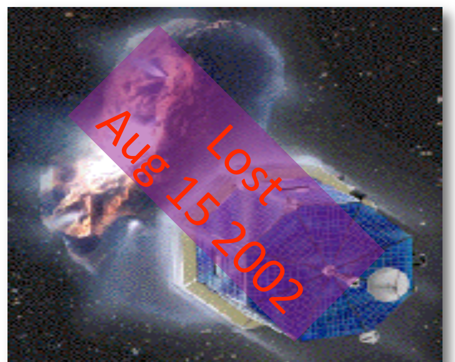
Lunar formation:
Lunar Prospector (1998-1999)



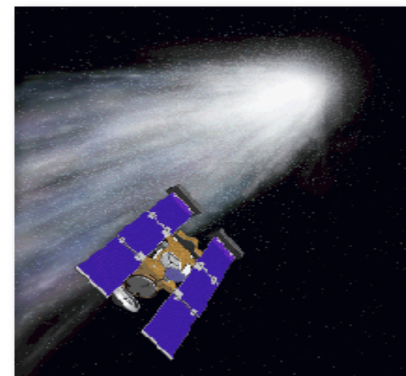
NEO characteristics:
NEAR (1996-1999)

Solar wind sampling:
Genesis (2001-2004)

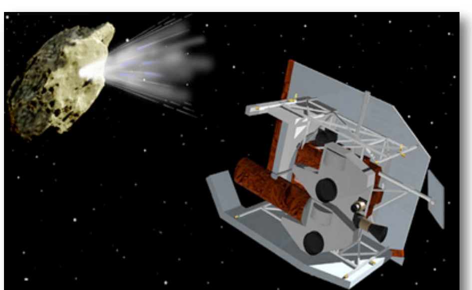
Comet diversity:
CONTOUR



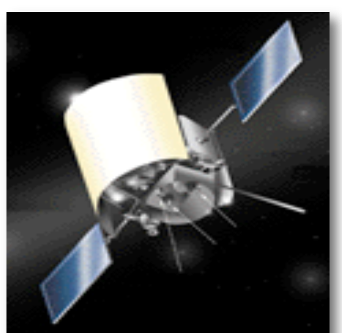
Nature of dust/coma:
Stardust(1999-2006)



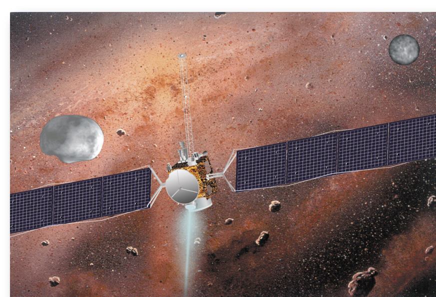
Comet internal structure:
Deep Impact (2005-2006)



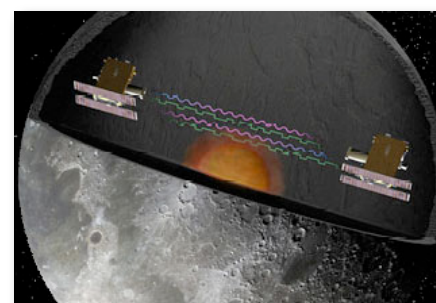
Mercury environment:
MESSENGER (2004-*2012*)



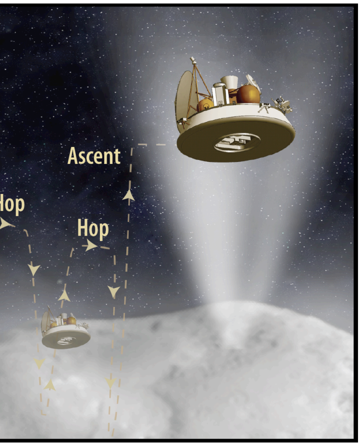
Main-belt asteroids: Dawn
(*2007-2015*)

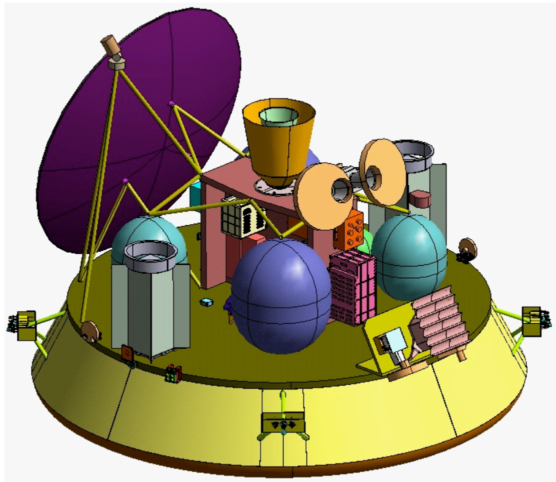


Lunar Internal Structure
GRAIL (*2011-2012*)



CHopper: Comet Hopper
PI: Jessica M. Sunshine





Mission & Science Team:

PI: Jessica Sunshine, UMD
Deputy PI: M. A'Hearn, UMD
Project Management: GSFC
S/C: LM
Mission Ops: LM
Science Ops: UMD

sion:
net Wirtanen rendezvous and landing mission using
S/C. 4 sorties between 4.5 and 1.5 AU from Sun.

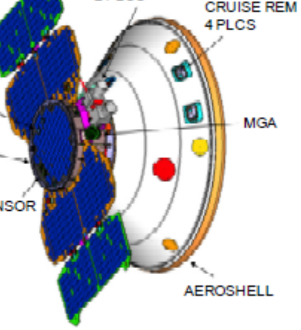
ls:
ap spatial heterogeneity of gas & dust emissions
surface solids
etermine nucleus structure, geologic processes,
na mechanisms
ocument changes w/ increasing isolation

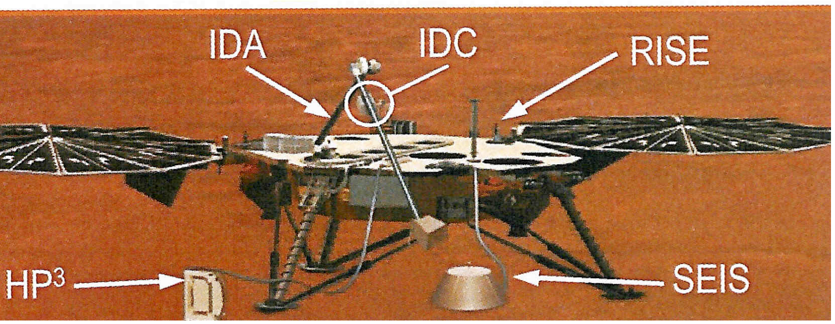
ruments:
HIRS- CHopper Infrared Spectrometer
HIMS- CHopper Ion/Neutral Mass Spectrometer
HI- CHopper Imager
HEX- CHopper Heating Experiment
nCams- Panoramic Cameras

Mission Details:

- Flight: 2016 launch with Standard 4m LV, 34-day lau period
- Mission: 7.3-yr mission, 2022 rendezvous / science
- Science Phase: Remote survey and multiple *in situ* surface measurements
- Cruise/Parked Ops: Quiescent ops during cruise and between sorties, science data downlink
- Spacecraft: high-heritage spacecraft design, flight-proven components for reliability and long life, large systems margins, dust covers for robustness in come environment , two ASRGs supply continuous power during all mission phases

GEMS: GEophysical Monitoring Station
PI: Bruce Banerdt





on:
physical (seismology, heat flow, planetary
tion) lander mission on Mars using Phoenix
tage spacecraft

:
erstand formation/evolution of terrestrial
ets via interior structure/processes of Mars
ermine present tectonic activity and meteorite
act rate

ad:
mic Experiment for Interior Structure (SEIS)
ation & Interior Structure Experiment (RISE)
t Flow & Physical Properties Probe (HP^3)
rument Deployment Arm (IDA)
rument Deployment Camera (IDC)

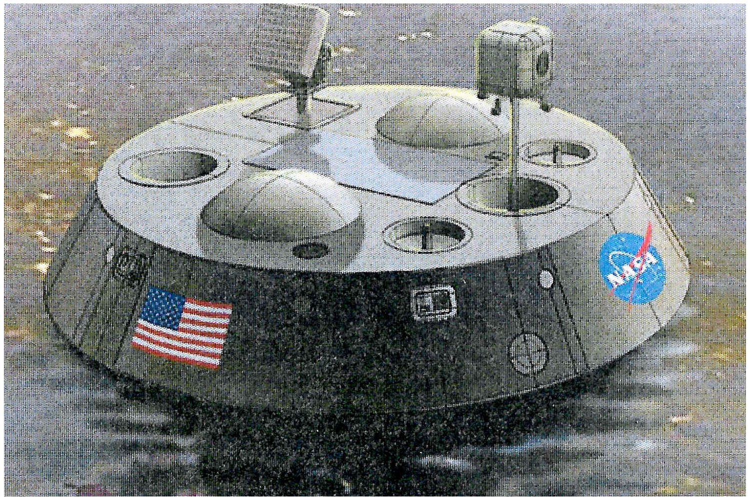
Mission & Science Team:

PI: Bruce Banerdt, JPL
PM: Tom Hoffman, JPL
Deputy PI: Sue Smrekar, JPL
Spacecraft: Lockheed-Martin (LM)
Operations: JPL/LM
Payload: JPL, IPGP (France), DLR (Germany)

Mission Details:

- Flight: 3/2016 launch w/ELV, 4m fairing; 9/201 landing; ~6.5 mo cruise, 1 Mars yr surface ops
- Selected Systems Features (Phoenix-based desi
  Cruise: 3-axis stabilized, 3.2 m^2 UTJ solar array, band telecom; EDL: Landing radar, UHF telecom Surface: 4.3 m^2 UTJ solar array, 2 Li-ion batterie UHF telecom, Rad 750-based avionics
- Mass: 597.6kg dry launch, margin ≥31% (deper on ELV)
- Surface Ops Energy: 881Wh/sol, margin 180%
- Schedule: 39 mo B/C/D, 98 days sched reserve
- Threshold Mission: Descope: HP^3, SEIS SP senso

TiME: Titan Mare Explorer
PI: Ellen Stofan



Mission & Science Team:

PI: Ellen Stofan, Proxemy
Project Mgmt: APL
S/C: LM
Ops: LM, JPL (nav)
Payload: APL, GSFC, MSSS
Deputy PI: J. Lunine, UA
Project Scientist: R. Lorenz, APL

ion:
er msn to Titan's *Ligeia Mare* methane-
ne polar sea, 96 days on surface

s:
derstand Titan's methane cycle through
/ of a Titan sea.
estigate Titan's history & explore the
s of life

uments:
eteorology & physical properties (MP3)
ss Spec for Lake Chemistry (NMS),
scent and Surface Imaging Cameras

Efficient Trajectory:

- Launch 2016
- Cruise 7.5 years (EGA, JGA)
- Entry 2023

Mission Features:

- Focused science objectives
- High-heritage instruments
- Simple cruise, no flyby science
- Simple surface operations
- ASRGs, launch vehicle are GFE

Discovery-12 Tech Development

- *Primitive Material Explorer (PriME):*
  Cometary Mass Spectrometer

- *Whipple:*
  Outer Solar System Object Blind Occultation Technique

- *NEOCam:*
  Near Earth Object Telescope Technology

New Frontiers Program

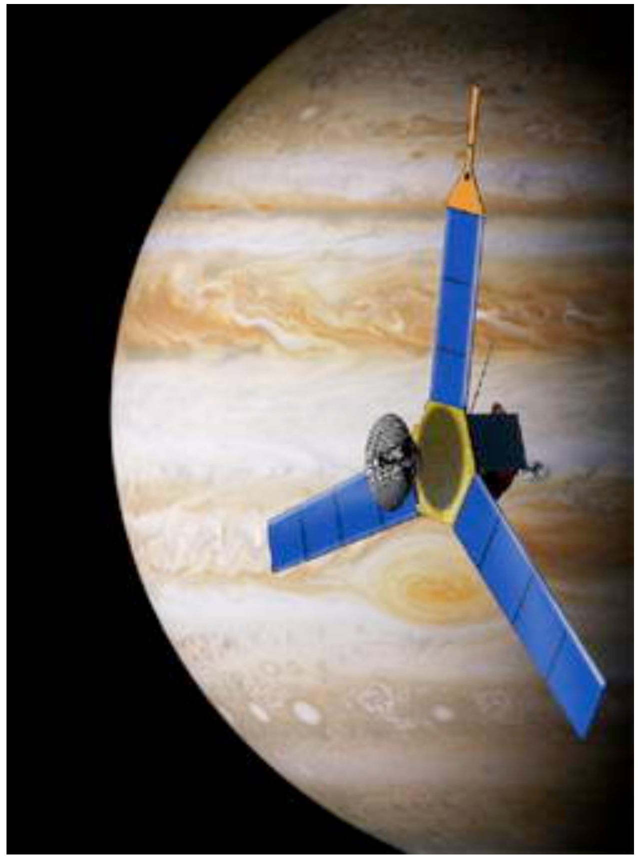
1st NF mission
New Horizons:

Pluto-Kuiper Belt

Launched January 2006
Arrives July 2015

2nd NF mission
JUNO:

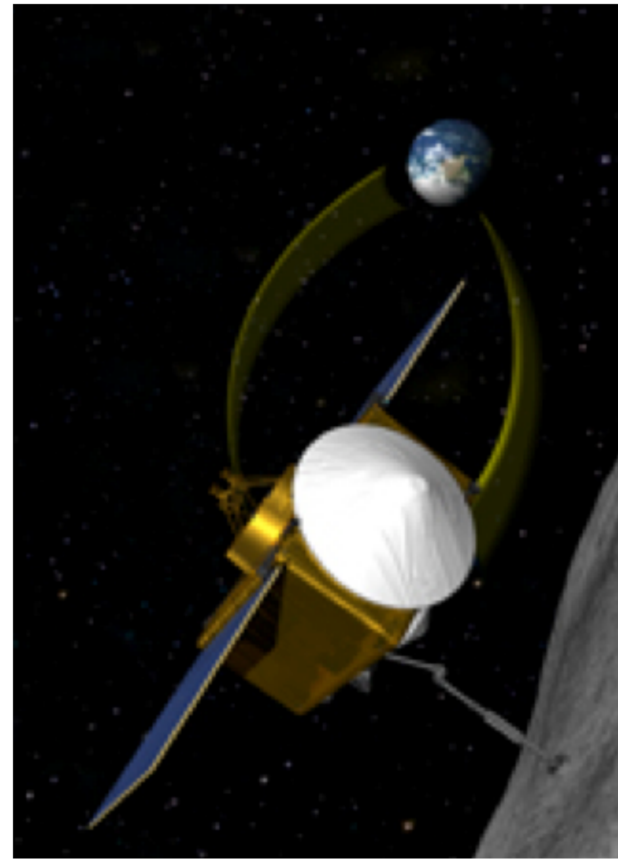
Jupiter Polar Orbiter



Launched August 2011
Arrives July 2016

3rd NF mission
OSIRIS-REx

Asteroid Sample Return



Sept. 2016 Launch

OSIRIS-REx Asteroid Sample Return Mission

: Michael Drake (UA), PM: Robert Jenkens (GSFC)

Science Objectives:

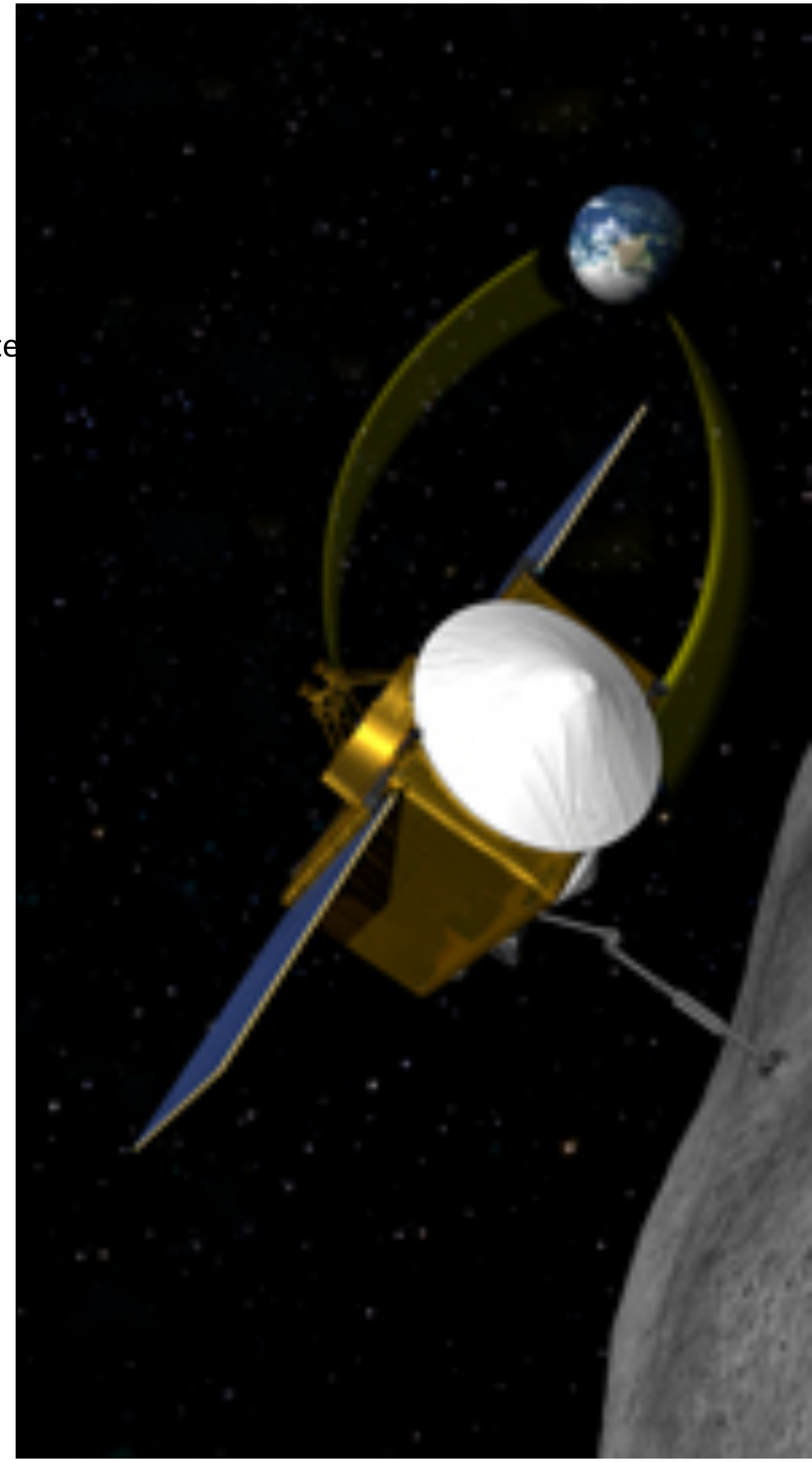
- Return and analyze a sample of pristine carbonaceous asteroid
- Map the global properties, chemistry, and mineralogy
- Document in situ the properties of the regolith at the sampling site
- Measure the Yarkovsky effect and constrain the asteroid properties that contribute to this effect.
- Characterize the integrated global properties to allow comparison with ground-based telescopic data of entire asteroid population

Mission Overview:

- Launch in September 2016
- Encounter asteroid (101955) 1999 RQ36 in October 2019
- Study RQ36 for up to 505 days, globally mapping the surface
- Obtain at least 60 grams of pristine regolith/surface material
- Return sample to Earth in September 2023 in a Stardust-heritage capsule
- Deliver samples to JSC curation facility for world-wide distribution

Instruments:

- OSIRIS-REx Camera Suite (OCAMS) - UA
- OSIRIS-REx Laser Altimeter (OLA) - CSA
- OSIRIS-REx Visible and IR Spectrometer (OVIRS) - GSFC
- OSIRIS-REx Thermal Emission Spectrometer (OTES) - USA
- Spacecraft Telecom/Radio Science
- Touch-And-Go Sample Acquisition Mechanism (TAGSAM) – LM
- Regolith X-ray Imaging Spectrometer (REXIS) MIT (Student Collaboration Experiment)



International Activities

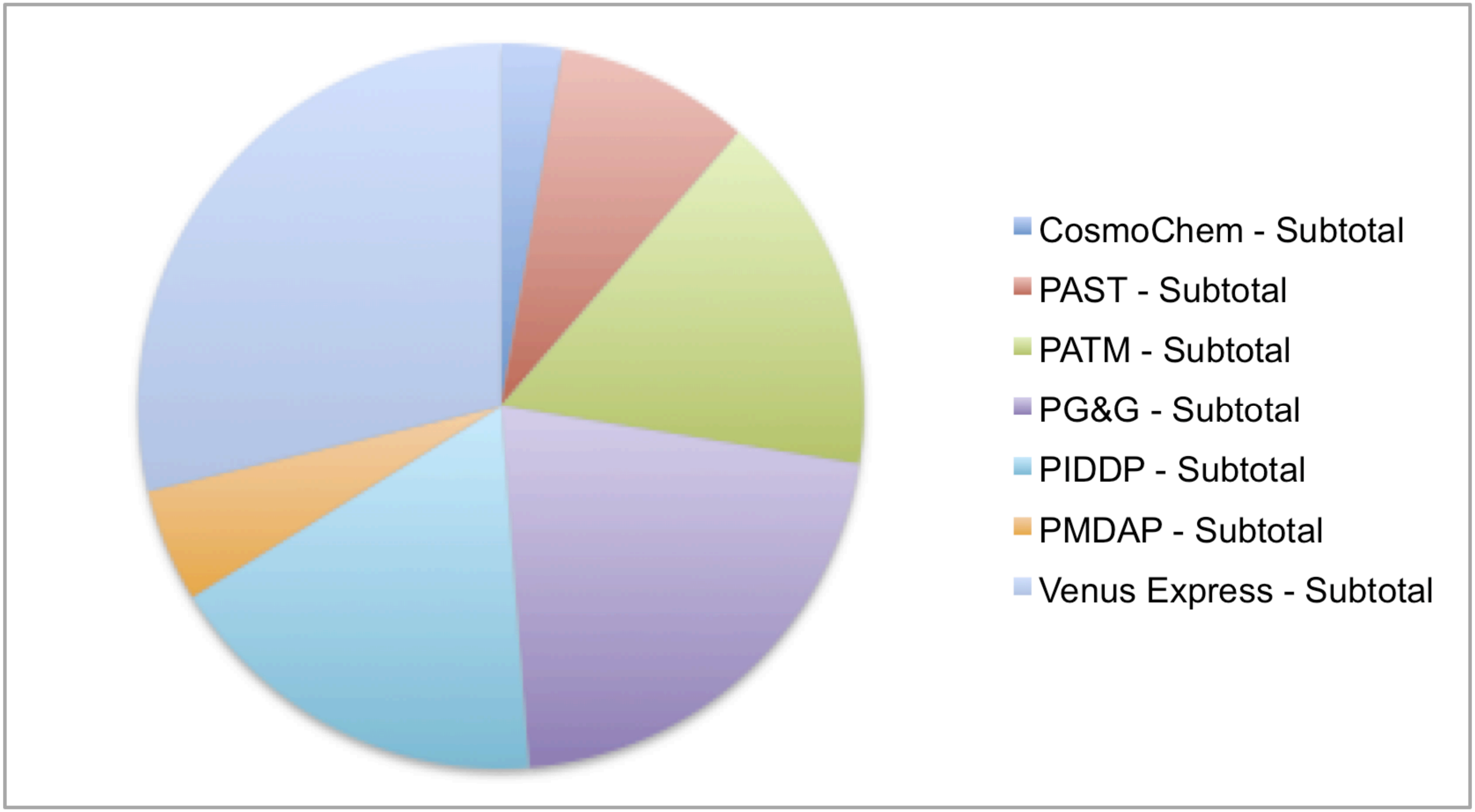
- PSD supporting Venus Express (ESA)

- JAXA's Akatsuki (Venus Climate Orbiter) support from NASA will include navigation and DSN (on a non-interference basis)

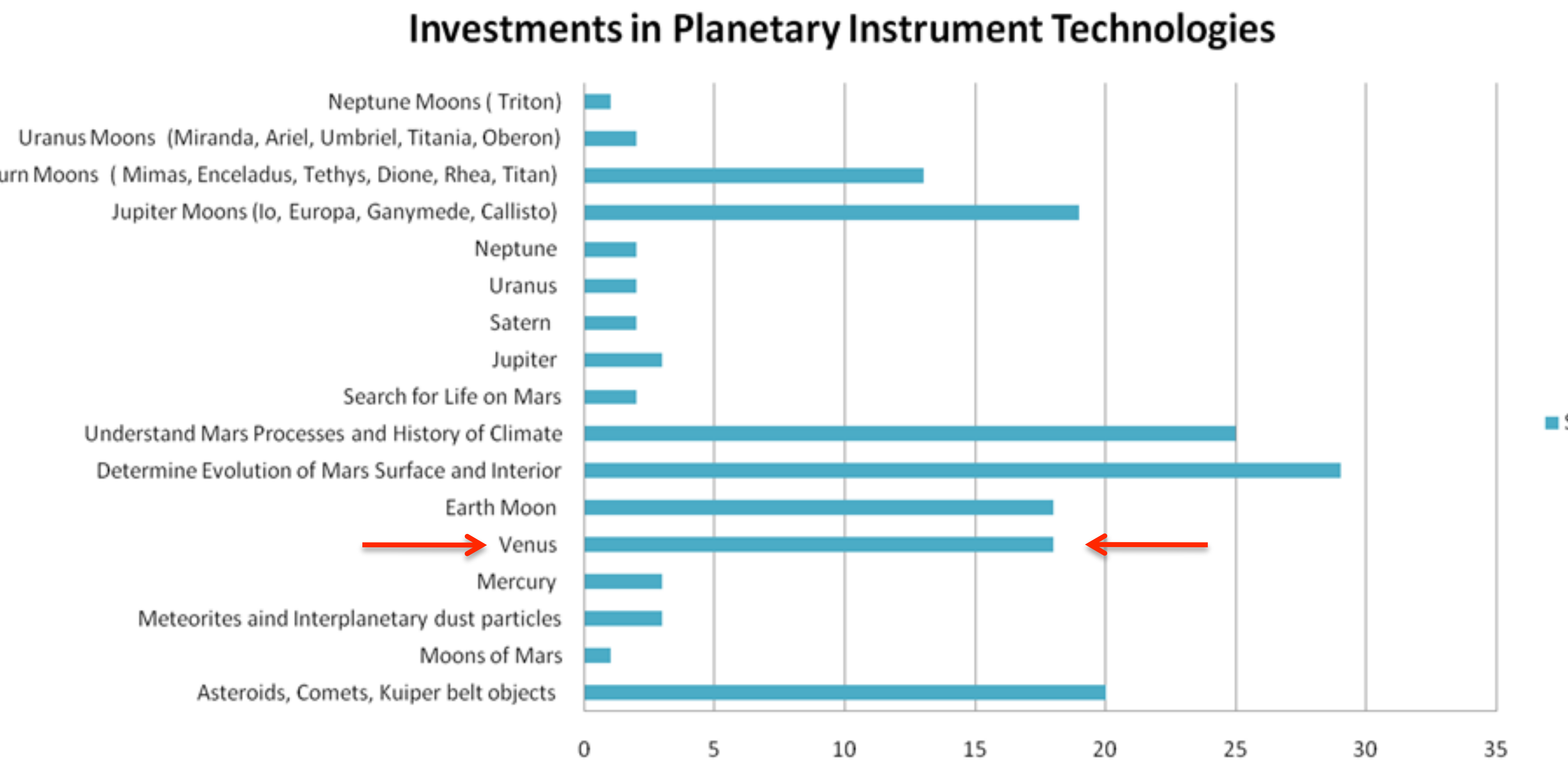
Venus Research

Venus R&A Investments

- Keyword search in RAPTOR for all fields containing "Venus"
  - All awarded activities from FY05 – FY11
  - Invested >$25M in 70 funded activities over 5+ fiscal years



Instrument Development Overview



Venus In-Situ Chamber Investigations (VICI)

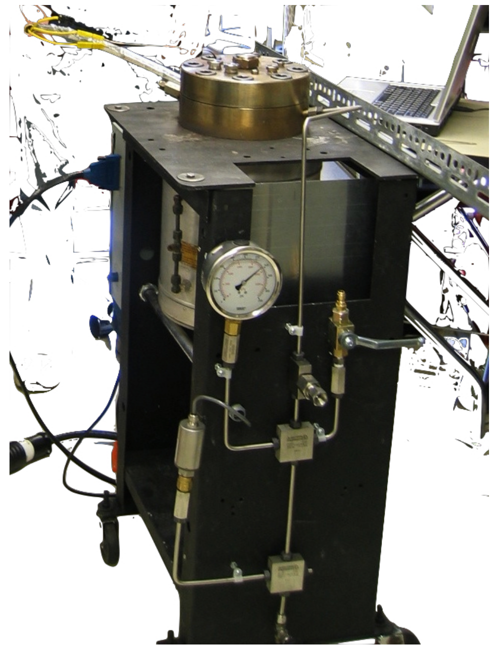
aka Venus Pressure Test Chamber

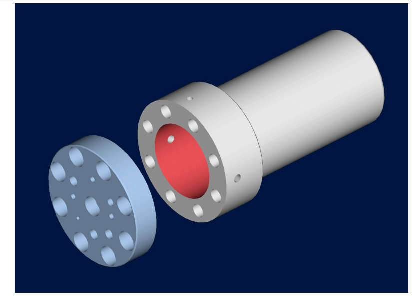
escription – What is it?:

small, high temperature, high pressure chamber to simulate environmental conditions on Venus' surface. (*e.g., 740 K and 95.6 bar*)

ill be included in ROSES-2012 as NASA operated equipment at GSFC

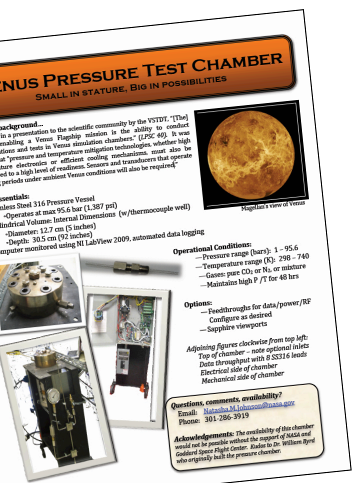
OC Natasha Johnson, *natasha.m.johnson@nasa.gov*)





he Basics:

- Stainless Steel 316 Pressure Vessel
- Internal dimensions: diameter 12.7 cm (5 in)
  depth 30.5 cm (12 in)



- ➢ Monitored via NI LabView
- ➢ Operating parameters:
  Max pressure 96 bar
  Temp range 298K – 740K
  Gases: CO_2, N_2, SO_2 *(ppm)* or mixture

Objectives

:

- ➢ Test instruments and/or components to b proposed for Venus missions (*i.e.,* Discovery/New Frontiers)
- ➢ Conduct Venus appropriate experiments (*e.g.,* surface-atmosphere reactions)
- ➢ Explore different chamber configurations a range of experimental options

“Flyby, Orbit, Land, Rove, and Return Samples”

NASA’s