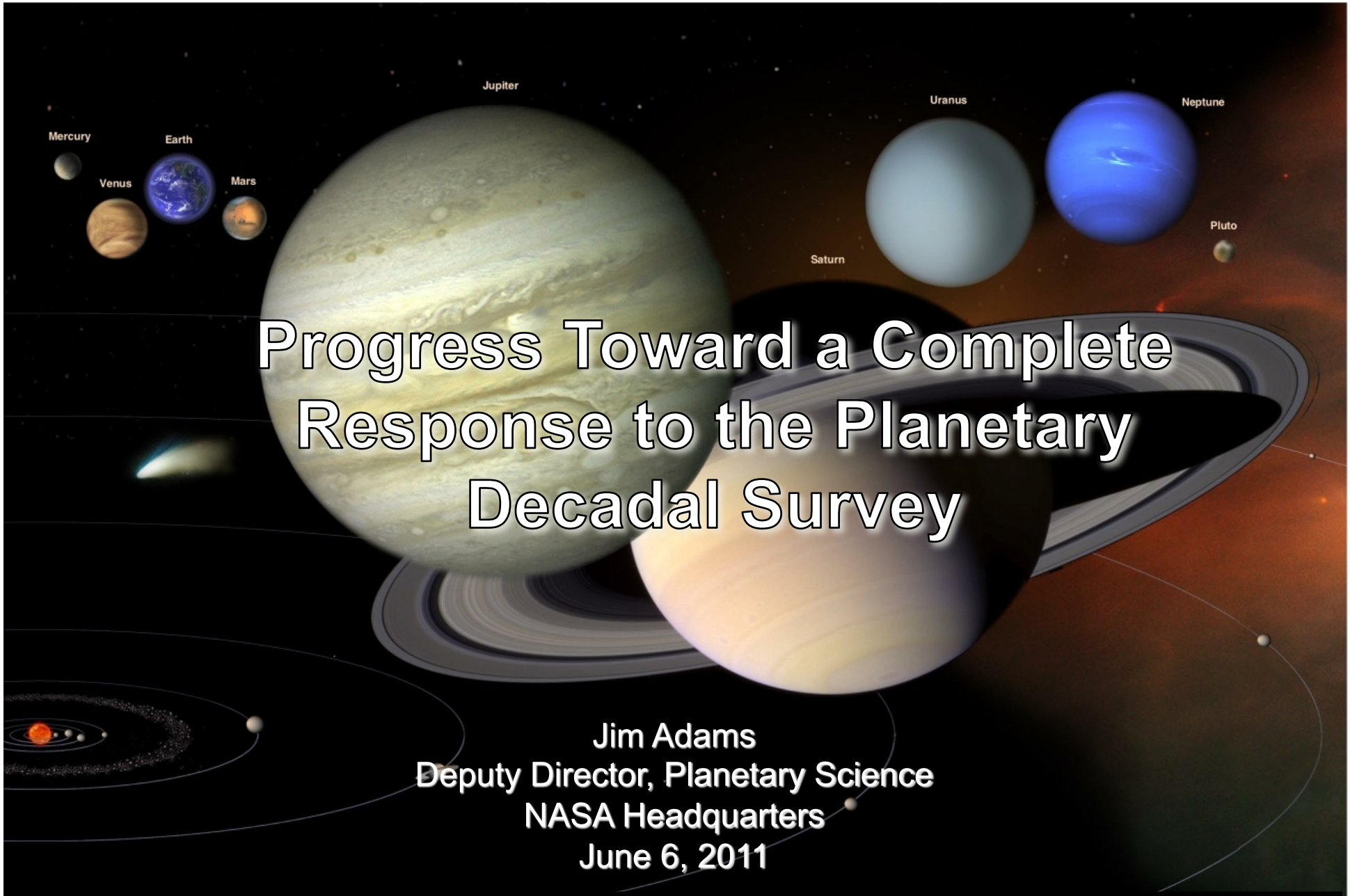


Progress Toward a Complete Response to the Planetary Decadal Survey

Jim Adams
Deputy Director, Planetary Science
NASA Headquarters
June 6, 2011

Presentation to the International Planetary Probe Workshop

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

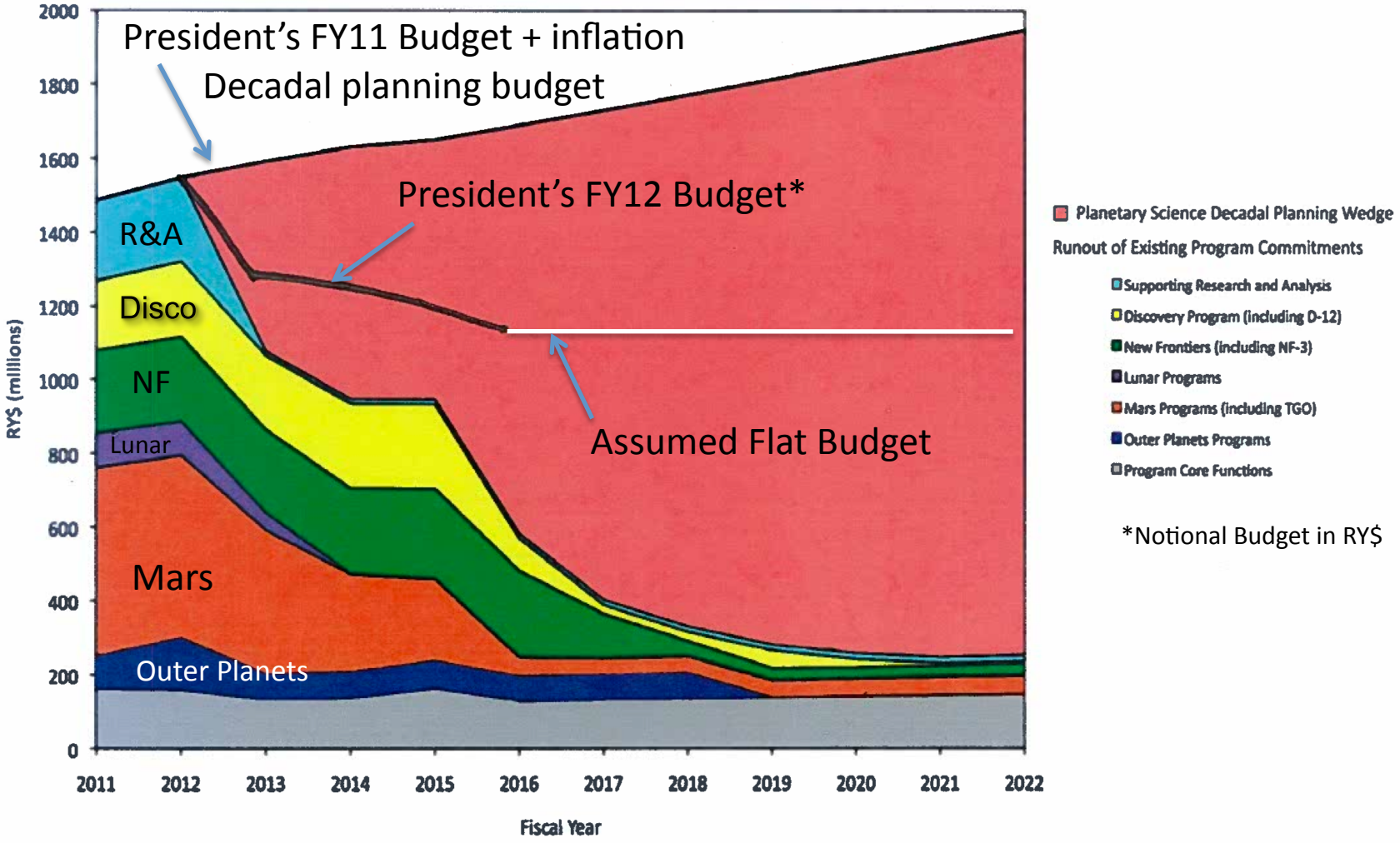
Research & Analysis (5% above final FY11 amount then ~1.5%/yr)

Technology Development (6-8%)

Current Commitments (ie: Operating Missions)

Planetary Funding Profiles

FY11 and FY12 Requests



*Notional Budget in RY$

Decadal Decision Rules

- Page 9-6: NASA's suite of planetary missions … should consist of a *balanced mix of Discovery, New Frontiers, and Flagship* missions, enabling both a steady stream of new discoveries and challenges …

- Page 9-21: It is also possible that the budget picture could turn out to be less favorable … If cuts to the program are necessary, the committee recommends that the first approach should be *descoping or delaying Flagship missions*. *Changes to the New Frontiers or Discovery programs should be considered only if adjustments to Flagship missions cannot solve the problem*.

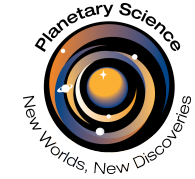
- Actions based on Decadal Guidance:
  - Maintain a balanced program – small, medium, large missions
  - Maintain a partnership with ESA
  - Descope flagship missions as a first resort due to tight budgets
  - If flagship descopes are *not sufficient* then stretch out New Frontiers and Discovery A/Os

PSD Decadal Budget Planning

- Lay In Current Commitments
  - All Operating Missions Through Expected End of Life
  - Current R&A Awards
  - All missions in development or competition
    - Juno, GRAIL, MSL, LADEE, MAVEN, EMTGO
    - New Frontiers-3, and Discovery 12
  - In-Space Propulsion Technology
  - Radioisotope Power System Program
  - Pu-238 Production
- Accommodate Decadal Recommendations
  - Maintain a healthy R&A program
  - Discovery AO's on 2 year Cadence
  - Make 2 New Frontiers Selections in the Decade
  - Mars 2018 Cache Rover Directly Tied to MSR
    - Includes initiation of MSR high-priority technologies wedge
- Per OMB $10M/year set aside for cooperative activities with Human Exploration

- Full decadal recommendations greatly exceed President's FY12 Budget
  - Must use decision rules from decadal to develop a balanced budget

Approach to Develop new "Notional" Budget



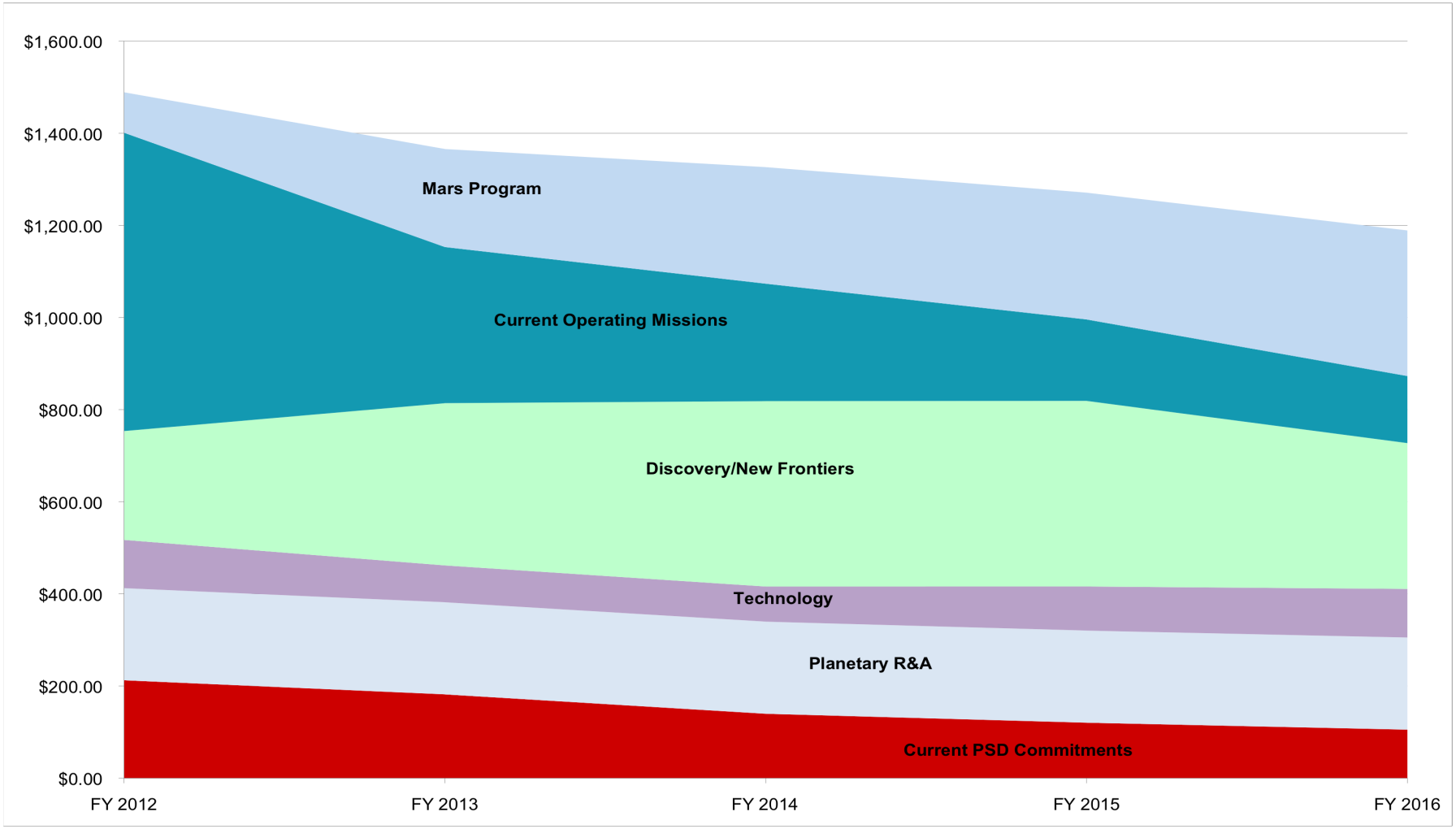
- R&A level at ~$200M/year
- Next Discovery AO on current <36 month cadence
  - All subsequent AO's accelerated to 24 Month Cycle
- Select NF-3 planned for NF-4 and NF-5 within decade
  - Will maintain New Frontiers schedule
- Extended Mission budget for operating missions
  - Senior Review used for determining which missions to be extended
- Dedicated Lunar R&A wedge transferred to PSD R&A
- Residual Lunar Quest Program moved to Discovery
- JEO Descoped to Studies Funded FY11/12
  - No JEO Instrument AO
  - Budget for some radiation technology efforts

Overall Program Content

- Mars Exploration Program (Negotiated with ESA)
  - EMTGO, MOMA, Mars 2018 (JR-1), Management, Future missions
- Discovery Program
  - Strofio, LaRa, Disc-12, Management, Future missions
- New Frontiers Program
  - OSIRIS-REx, Management, Future missions
- Technology Program
  - PIDDP, ASTID, ISP, RPS, MSR Tech, OP Tech
- Planetary R&A
  - Move PIDDP and ASTID to Technology Program
- Mission Commitments (operating etc.)
  - GRAIL, Juno, MSL, MAVEN, LADEE, MER, MRO, Odyssey, Mars Express, Dawn, New Horizons, LRO, MESSENGER, Deep Impact, Stardust, ASPERA-3, Rosetta, Cassini
- Other Commitments
  - Pu-238, AMMOS, OPF studies, JGO/ESA MOO, Joint coordination w/HSF

Operating
Development
In Competition

A PSD "Notional" Decadal Budget

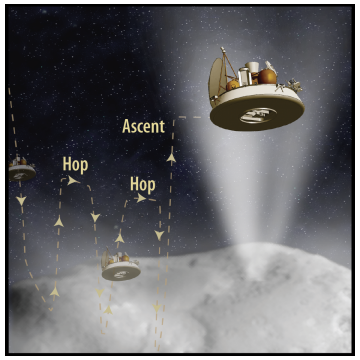


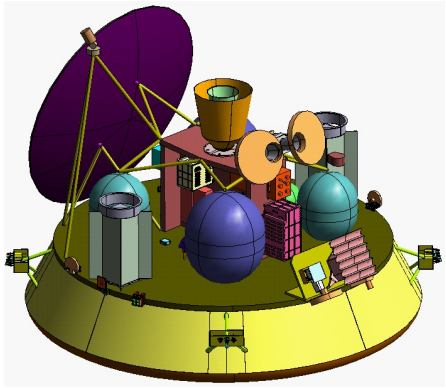
Road to Response

- March 7, 2011 Decadal Survey Released at LPSC
- April 5, 2011 Response Strategy Briefing to OMB
- Budget Guidelines and DS Objectives Reconciled
- Cataloging of Recommendations (200+) Completed
  - Consolidated into 37 Actionable Recommendations
  - Writing Assignments
- May 6, 2011 Rough Draft Assembled
- mid-June, 2011 Draft Supplied to PSS
- June 26, 2011 PSS Comments on PSD Response
- July, 2011 Final Response Delivered to NRC

Recent Selections

031- 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

Mission:

Comet Wirtanen rendezvous and landing mission using LM S/C. 4 sorties between 4.5 and 1.5 AU from Sun.

Goals:

- Map spatial heterogeneity of gas & dust emissions and surface solids
- Determine nucleus structure, geologic processes, coma mechanisms
- Document changes w/ increasing isolation

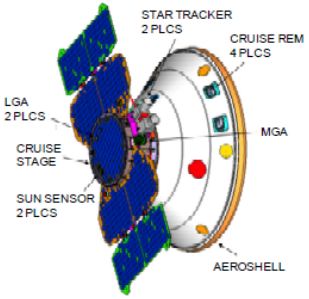
Instruments:

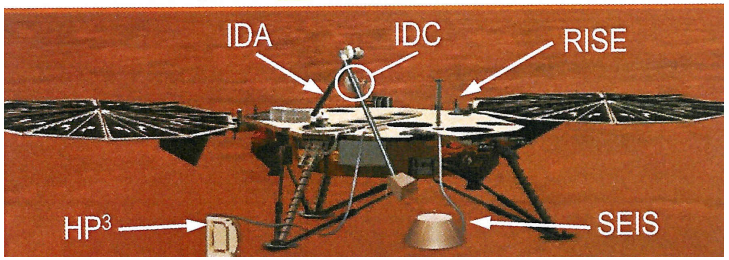
- CHIRS- CHopper Infrared Spectrometer
- CHIMS- CHopper Ion/Neutral Mass Spectrometer
- CHI- CHopper Imager
- CHEX- CHopper Heating Experiment
- PanCams- Panoramic Cameras

Mission Details:

- Flight: 2016 launch with Standard 4m LV, 34-day launch period
- Mission: 7.3-yr mission, 2022 rendezvous / science ops
- 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 cometary environment , two ASRGs supply continuous power during all mission phases

008- GEMS: GEophysical Monitoring Station
PI: Bruce Banerdt





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)

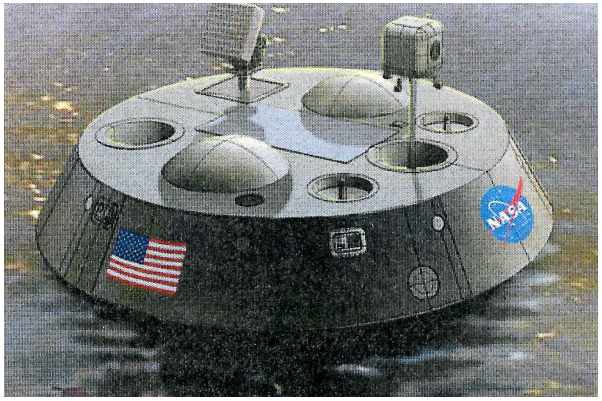
Mission:
- Geophysical (seismology, heat flow, planetary rotation) lander mission on Mars using Phoenix heritage spacecraft

Goals:
- Understand formation/evolution of terrestrial planets via interior structure/processes of Mars
- Determine present tectonic activity and meteorite impact rate

Payload:
- Seismic Experiment for Interior Structure (SEIS)
- Rotation & Interior Structure Experiment (RISE)
- Heat Flow & Physical Properties Probe (HP^3)
- Instrument Deployment Arm (IDA)
- Instrument Deployment Camera (IDC)

Mission Details:
- Flight: 3/2016 launch w/ELV, 4m fairing; 9/2016 landing; ~6.5 mo cruise, 1 Mars yr surface ops
- Selected Systems Features (Phoenix-based design): Cruise: 3-axis stabilized, 3.2 m^2 UTJ solar array, X-band telecom; EDL: Landing radar, UHF telecom; Surface: 4.3 m^2 UTJ solar array, 2 Li-ion batteries, UHF telecom, Rad 750-based avionics
- Mass: 597.6kg dry launch, margin ≥31% (depending 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 sensors

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

Mission:

Lander msn to Titan's *Ligeia Mare* methane-ethane polar sea, 96 days on surface

Goals:

- Understand Titan's methane cycle through study of a Titan sea.
- Investigate Titan's history & explore the limits of life

Instruments:

- Meteorology & physical properties (MP3)
- Mass Spec for Lake Chemistry (NMS),
- Descent 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

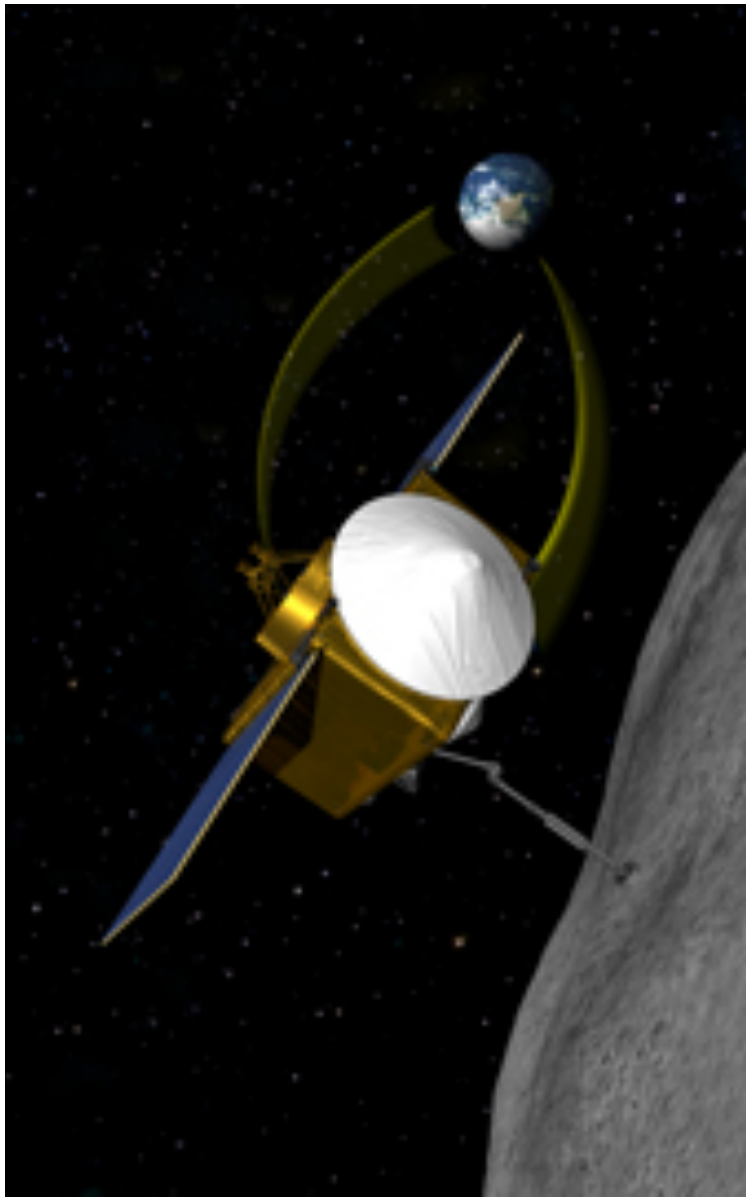
-- Primitive Material Explorer (PriME):
Cometary Mass Spectrometer

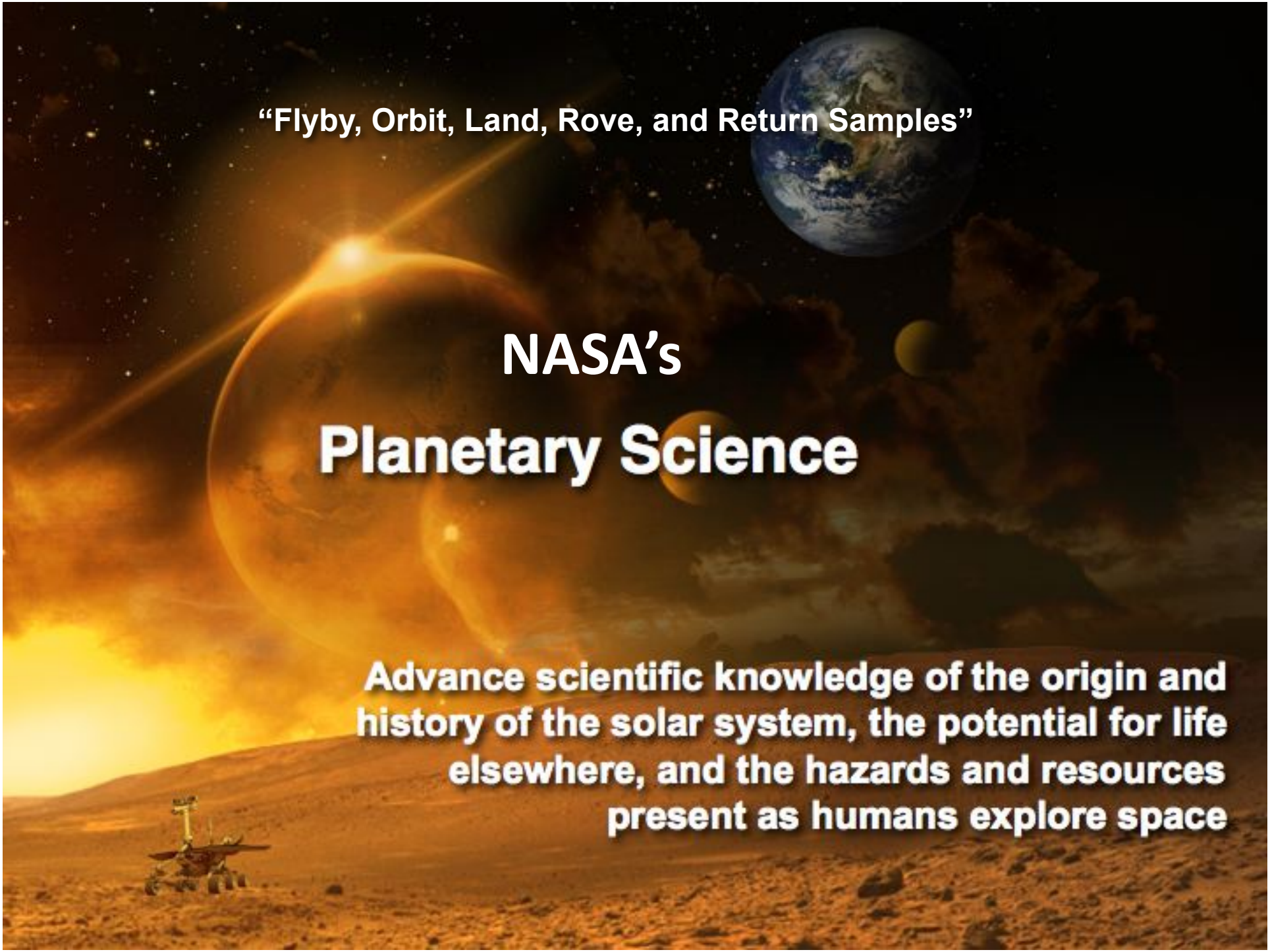
-- Whipple:
Outer Solar System Object Blind Occultation Technique

-- NEOCam:
Near Earth Object Telescope Technology

OSIRIS-Rex Asteroid Sample Return Mission

- NF-3 Selection Announced 5/25/2011
  - PI: 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 g 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)
  - Sample Curation - JSC




"Flyby, Orbit, Land, Rove, and Return Samples"
NASA's
Planetary Science
Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space