Planetary Science Division
Program Overview

James L. Green, Director
Planetary Science Division
July 19, 2013
Outline

- Upcoming Planetary Events
- Planetary Missions Status
- Campaign Science
- NASA’s Asteroid Initiative
- Astrobiology CAN Cycle 7
- Radioisotope Power Systems & DoE
Planetary Science Missions and Events as of 07/05/13

2013
July 19 – Wave at Saturn (Cassini’s Imaging of Earth from Beyond Saturn)
July 25-28 – Intrepid Spacefest, NYC
July 26 – NASM Mars Day
July 31 – Curiosity Day on the Hill
August 5 – One Year Anniversary of Curiosity Landing on Mars
September 6 – LADEE launch from Wallops Flight Facility, VA
October 1 – Close approach of Comet ISON to Mars – Campaign Science
October 9 – Juno flyby of Earth
October 12 – International Observe the Moon Night
November 4 – VESPER rocket launch observing Venus
November 19 - Launch of MAVEN from Cape Canaveral, FL
November 28 – Comet ISON Perihelion. Brightest view from Earth of Comet ISON

2014
January – EXCEED-HST observations of Io – Campaign Science
Two Views of Our Home Planet

On July 19th, NASA spacecraft will take pictures of Earth from two separate planets, on the same day! This photo op is brought to us by the MESSENGER spacecraft at Mercury and Cassini spacecraft at Saturn.

Saturn
Cassini will be imaging our Home Planet on July 19, 2013.

Bonus!
44 Years after Neil Armstrong’s first footprints, MESSENGER will be imaging our Moon on July 20, 2013.

For more information, see:
http://messenger.jhuapl.edu/
http://saturn.jpl.nasa.gov

Follow along at
http://eyes.jpl.nasa.gov
Planetary Mission Status
Lunar Atmosphere and Dust Environment Explorer

Objective:
• Measure the lofted Lunar dust
• Composition of the thin Lunar atmosphere

Instruments:
• Science: NMS, UVS, and LDEX
• Technology: Laser Communications

Launch: Sept. 6, 2013 Wallops Flight Facility
LADEE - A Mission of Firsts

- First Moon launch from WFF
- First launch of Minotaur V rocket from WFF
- First demo of Laser Communications

LLCD (Lunar Laser Communications Demonstration) will demonstrate transferring data at a rate of 622 megabits per second, which is about five times the current state-of-the-art from lunar distances.
Launch November, 2013 Cape Canaveral
- Mars orbit insertion in Sept. 2014

Science:
- Determine the structure and composition of the Martian upper atmosphere today
- Determine rates of loss of gas to space today
- Measure properties and processes that will allow us to determine the integrated loss to space through time
Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer (OSIRIS-REx)

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
• Characterize the integrated global properties to allow comparison with ground-based telescopic data of entire asteroid population
• Measure the Yarkovsky effect

Mission Overview:
– Launch in September 2016
– Encounter asteroid (101955) 1999 RQ36 AKA Bennu in October 2019
– Study Bennu 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
InSight: Interior Structure from Seismic Investigations, Geodesy and Heat Transport

Mission & Science Team:
PI: Bruce Banerdt, JPL
PM: Tom Hoffman, JPL
Deputy PI: Sue Smrekar, JPL
Management: JPL
Spacecraft: Lockheed-Martin
Operations: JPL/LM
Payload: CNES (France), DLR (Ger.), JPL

Mission:
- Geophysical 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 System

Mission Details:
- Flight: 3/2016 launch w/ELV, 4m fairing; 9/2016 landing; ~6.5 mo cruise, 1 Mars yr surface ops
- System Features (Phoenix-based design): Phoenix EDL architecture, solar power, UHF relay comm with X-band backup, updated RAD 750-based avionics
- Mass: 597.6kg dry launch, margin ≥31% (depending on ELV)
- Schedule: 43.5 mo B/C/D, 105 days sched. reserve
- Threshold Mission: Descope: HP^3, SEIS SP sensors
CONDUCT RIGOROUS IN-SITU SCIENCE

GEOLOGICALLY DIVERSE SITE

COORDINATED, NESTED CONTEXT AND FINE-SCALE MEASUREMENTS

ASTROBIOLOGY

MARS SCIENCE LABORATORY HERITAGE ROVER AND MODERATE INSTRUMENT SUITE STAYS WITHIN THE RESOURCE CONSTRAINT

ENABLE THE FUTURE

RETURNABLE CACHE OF SAMPLES

CRITICAL IN-SITU RESOURCE UTILIZATION AND TECHNOLOGY DEMONSTRATIONS REQUIRED FOR FUTURE MARS EXPLORATION

2020 Mars Rover Science Definition Team
http://mars.jpl.nasa.gov/m2020/
Campaign Science:

Maximize the Science using multiple coordinated observations
Comet ISON Observing Campaign

In: Mars-Comet closest approach ~0.08 AU (Oct 4)
Out: Earth-Comet closest approach ~0.44AU (Jan 2)
How NASA Space Assets Will Observe Comet ISON

For more information, visit: http://solarsystem.nasa.gov/ison
Space-Based Observations of the Jovian System

- **SPRINT-A/EXCEED – LRD Aug. 22nd**
  - 50 min. of every 100-min. orbit from November 2013-April 2014
  - FUV spectra of the Io torus and Jovian aurora
  - composition/electron temperature of torus; energy of auroral electrons

- **HST/STIS**
  - 14 orbits in early Jan. 2014
  - Imaging & spectroscopy of Jupiter’s FUV aurora
  - Global morphology & incident auroral electron energy

- **Chandra X-Ray Observatory/ XMM-Newton**
  - 160 ksec in April 2014
  - Imaging & spectra of X-ray emissions from Jupiter and the Io torus
  - Global morphology and energy of auroral x-rays
Ground-Based Observations of the Jovian System

- **KPNO 4m**
  - 7 half-nights in early Jan. 2014
  - Spectra of optical S⁺ & Na emissions from the Io plasma torus (IPT)
  - Electron density in the IPT

- **Gemini North**
  - 14 hours in early Jan. 2014
  - H₃⁺ and H₂ Near-IR emissions from the Jovian aurora
  - Spatially-resolved atmospheric temperature, column density, and auroral electron energy

- **NASA IRTF**
  - 3 separate accepted proposals:
    - 1-5 µm imaging of thermal emission from Io’s volcanoes
    - Observe Jupiter’s aurora H₃⁺ @ 4µm
    - Io 3-5 µm spectral monitoring.

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**Optical spectroscopy**

**IR spectroscopy**

**Io @ 3.5µm**

**Volcanic hotspot**
Jupiter Observing Strategy: Jan 2014

(a) HST
- FUV H₂ aurora
- spatial position of energy release
- energy of precipitating auroral electrons
- imaging

(b) EXCEED
- 400"
- EUV IPT and aurora
- hot electron temperature of IPT
- precipitation of auroral electrons
- spectroscopy

(d) GEMINI
- spectroscopy
- IR H₃⁺ and H₂ aurora
  - atmospheric temperature
  - ion density

(c) WIYN
- energy transport scenario 1
- energy transport scenario 2
- auroral emission
- plasma torus heating
- energy release
- Solar wind compression?

(e) Solar wind
- Sunspot number
  [Hathaway, NASA, MSFC]
- Solar Wind at Jupiter 2010
- Pressure [nPa]
- MHD solar wind model [5]
- dynamic pressure at Jupiter
- Visible IPT
  - imaging of visible ion IPT
  - cold electron temperature of IPT
  - spectroscopy

IPT [3]
IPT (top) and aurora (bottom) [4]
IPT at 673.1 nm [11]
IPT [17]

spectroscopy

Sunspot Number
This campaign

Previous campaign [8]

Magnetic field of Jupiter

Satellite image of Jupiter and its moons

Diagram showing energy transport scenarios and their effects on Jupiter's aurora and solar wind.
NASA’s Asteroid Initiative
Capture and Redirect an Asteroid

- Capture and redirect a 7-meter diameter, 500-1000 ton near-Earth asteroid to cis-lunar space
- Enable astronaut missions to the asteroid by as early as 2021
- Obtain valuable information for exploration, planetary defense, science, and *in situ* resource utilization (ISRU)
- Parallel and forward-leaning development approach
- Under Review by SBAG
Asteroid Mission Would Consist of Three Main Segments

Asteroid Identification Segment:
Ground and space based NEA target detection, characterization and selection

Asteroid Redirection Segment:
Solar electric propulsion (SEP) based asteroid capture and maneuver to trans-lunar space

Asteroid Crewed Exploration Segment:
Orion and SLS based crewed rendezvous and sampling mission to the relocated asteroid
Quick Status of the NEO Survey Program

- Congressional Bill 1998 – Find 90% of the >1km NEO within 10 yrs
- Congressional Bill 2005 – Find 90% of the >140m NEO within 15 yrs
Astrobiology CAN Cycle 7
NASA Astrobiology Institute - Cycle 7

- CAN Cycle 7 will maintain a multidisciplinary institute by selecting focused, interdisciplinary teams that complement without replicating the strengths of the continuing teams.
- The teams selected in Cycle 7 (no more than 6-7) will replace the teams selected in Cycle 5, whose five-year Cooperative Agreements are expiring.

**Important Dates:**
- Draft Cooperative Agreement Notice: July 3, 2013
- Comment Due Date: July 31, 2013
- CAN Release Date: September TBD, 2013
- Preproposal Conference: October TBD, 2013
- Step 1 Proposal Due: November TBD, 2013
- Step 2 Proposals Due: January TBD, 2014
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<td><strong>Rensselaer Polytechnic Institute</strong></td>
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<td><strong>University of Hawaii, Manoa</strong></td>
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<td><strong>Ames Research Center</strong></td>
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<td><strong>Arizona State University</strong></td>
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<td><strong>Goddard Space Flight Center</strong></td>
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<td><strong>Pennsylvania State University</strong></td>
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<td><strong>Carnegie Institution of Washington</strong></td>
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<tr>
<th>Institution</th>
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<tr>
<td>Massachusetts Institute of Technology</td>
<td>Foundations of Complex Life: Evolution, Preservation and Detection on Earth and Beyond</td>
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<tr>
<td>University of Illinois at Urbana-Champaign</td>
<td>Towards Universal Biology: Constraints From Early and Continuing Evolutionary Dynamics of Life on Earth</td>
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<td>University of Southern California</td>
<td>Life Underground</td>
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<td>University of Wisconsin</td>
<td>Habitability, Life Detection, and the Signatures of Life on the Terrestrial Planets</td>
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<td>The Virtual Planetary Laboratory</td>
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Radioisotope Power Systems/DoE
Over 50 years of RPS Missions

- Voyager 1
- Voyager 2
- Pioneer 10
- Pioneer 11
- New Horizons
- Ulysses
- Viking 1
- Viking 2
- Apollo Lander Surface Experiments
- Curiosity
- Cassini
- Galileo
- Nimbus III

Orbit
Flyby
Rove
Land
FY14 Funding Realignment for RPS

• In FY14, DOE is to transition to a full cost recovery strategy for RPS
• NASA to provide full funding so RPS program requirements and funding are aligned under one Agency
  – NASA is the prime customer for Pu-238
• Funding and justification for sustainment of all necessary supporting infrastructure and capabilities at DOE is in the FY14 NASA budget request
• DOE will be funded by NASA for execution of RPS flight development and to provide production, safety, and management of necessary infrastructure
• To support and advise NASA, a facilities and capability review committee was put together and has started to perform a zero-base review
  – NASA membership: Jim Adams, David Schurr, Hal Bell, Frank Bellinger, Kevin Gilligan
  – Non-NASA consultants: Ralph McNutt (APL), Tim Frazier (former DOE), Aerospace Corporation (Mark Rokey and others)
  – Ex-officio observers: Len Dudzinski (NASA PSD Liaison) and Alice Caponiti (DOE Liaison)
• Review Committee to report findings/recommendations by October 1st
Planetary Science 2013 Events
Join Us?
Contact: Steven Williams at WilliamsSH@si.edu

MAVEN Launch to Mars
No earlier than November 18, 2013
From Cape Canaveral, Florida

Comet ISON
Best Visible November 28, 2013
From Northern Hemisphere

LADEE Launch to the Moon
No earlier than September 5, 2013
From Wallops Island, Virginia
Backup Charts

“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