Planetary Protection at NASA: Overview and Status

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2012 NASA Planetary Science Goals

Goal 2: Expand scientific understanding of the Earth and the universe in which we live.

2.3 Ascertain the content, origin, and evolution of the solar system and the potential for life elsewhere.

2.3.1 Inventory solar system objects and identify the processes active in and among them.

2.3.2 Improve understanding of how the Sun's family of planets, satellites, and minor bodies originated and evolved.

2.3.3 Improve understanding of the processes that determine the history and future of habitability of environments on Mars and other solar system bodies.

2.3.4 Improve understanding of the origin and evolution of Earth's life and biosphere to determine if there is or ever has been life elsewhere in the universe.

2.3.5 Identify and characterize small bodies and the properties of planetary environments that pose a threat to terrestrial life or exploration or provide potentially exploitable resources.

NASA Planetary Protection Policy

- The policy and its implementation requirements are embodied in NPD 8020.7G *(NASA Administrator)*
  - Planetary Protection Officer acts on behalf of the Aassociate Administrator for Science to maintain and enforce the policy
  - NASA obtains recommendations on planetary protection issues (requirements for specific bodies and mission types) from the National Research Council's Space Studies Board
  - Advice on policy implementation to be obtained from the NAC Planetary Protection Subcommittee
- Specific requirements for robotic missions are embodied in NPR 8020.12D *(AA, SMD)*
  - Encompasses all documentation and implementation requirements for forward and back-contamination control
- Future requirements for human missions are being studied with a broad science and exploration focus (Initial recommendations for Mars developed in 2001; Further refined in 2005; NPR planned responding to human exploration initiatives)

Role of the Planetary Protection Officer (NPD 8020.7G)

- Designee of the SMD Associate Administrator, responsible for managing planetary protection policy:
  - Prescribes standards, procedures, and guidelines applicable to all NASA organizations, programs, and activities to achieve policy objectives
  - Certifies to the SMD AA that missions are compliant
    - Before launch
    - If returning samples, before initiating return and again before Earth entry
  - Conducts reviews, inspections, and evaluations of plans, facilities, equipment, personnel, procedures, and practices of NASA organizational elements and NASA contractors
  - Keeps the SMD AA (and, as appropriate, the Administrator) informed of developments, and takes action to ensure compliance with applicable NASA policies and requirements

Role of PPS

- Provides expert advice to NASA on planetary protection, as part of the NASA Advisory Council
  - Reviews mission activities and makes recommendations on implementation options
  - Considers and advises on specific points of policy that are below the resolution of international policy set by the Panel on Planetary Protection of the Committee on Space Research
  - Provides guidance regarding programmatic direction and issues of importance/relevance to future missions and implementation of planetary protection requirements

Programmatic Concerns

- An increasing number of mission concepts target locations of concern for planetary protection, both Mars and Outer Planets
  - Technology development for planetary protection, beyond basic research, has historically been left to missions: better coordination in planetary protection technology development would facilitate efficient use of resources (PPR is not enough...)
  - Ongoing planning for human spaceflight beyond Earth orbit highlights the need to elaborate, at the level of NASA policy, the guidelines for human exploration that were accepted by COSPAR in 2008
  - Increasing interest in exploration activities by multiple national and private organizations raises a range of concerns: e.g., international cooperation, commercial exploration, and historical/environmental protection

Planetary Protection Research

- Element of SMD ROSES call; solicits research that isn't covered by Astrobiology in these areas (13 grants total)
  - Characterizing the limits of life in laboratory simulations of planetary environments or in appropriate Earth analogs, particularly studies of the potential, distribution and dynamics of organism[s] (4 grants)
  - Modeling of planetary environmental conditions and transport processes that could permit mobilization of spacecraft-associated contaminants (2 grants)
  - Development or adaptation of modern molecular analytical methods to rapidly detect, classify, and/or enumerate the widest possible spectrum of Earth microbes ... and (4 grants)
  - New or improved methods, technologies, and procedures for spacecraft sterilization (3 grants)

Current and Upcoming Missions

- Several missions in operation and in preparation have planetary protection considerations to watch
  - The Dawn asteroid orbiter mission must avoid possible contamination of Ceres
  - Two of the Discovery selection competitors have planetary protection implementation challenges
  - The OSIRIS-REx asteroid sample return mission faces organic contamination constraints driven by science, but relevant to future planetary protection implementation concerns
  - The MAVEN Mars orbiter mission plans to implement the bioburden control option to meet planetary protection requirements: analysis currently under review

New Frontiers Program

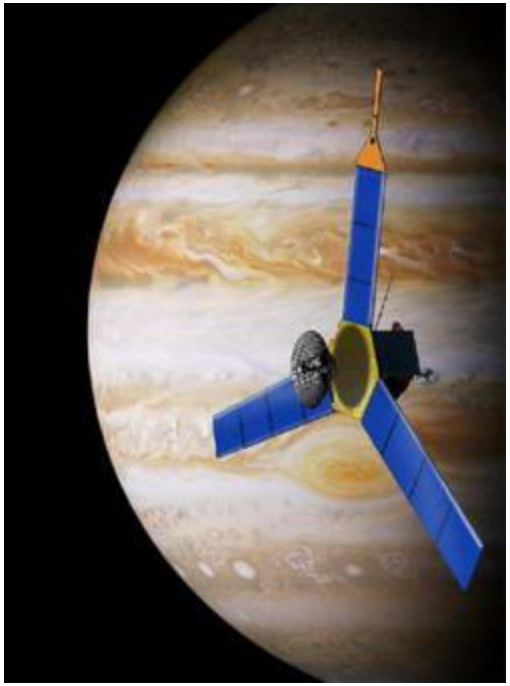
1st NF mission
New Horizons:

Pluto-Kuiper Belt Mission

Launched January 2006
Arrival July 2015

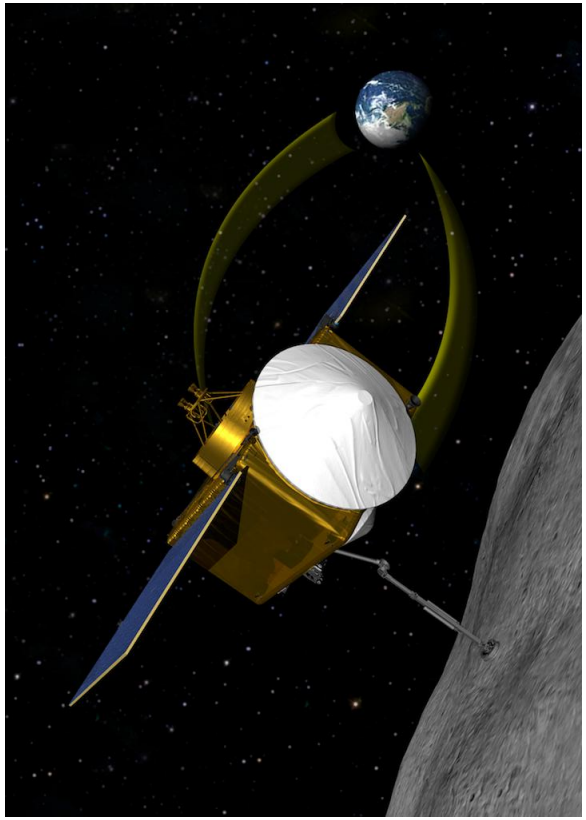
2nd NF mission
JUNO:

Jupiter Polar Orbiter Mission



August 2011 Launch
Arrival 2017

3rd NF mission
OSIRIS-REx
Asteroid Sample Return



September 2016 Launch
Arrival 2019

Discovery: Operating Planetary Missions

MESSEnGER:

GRAIL:

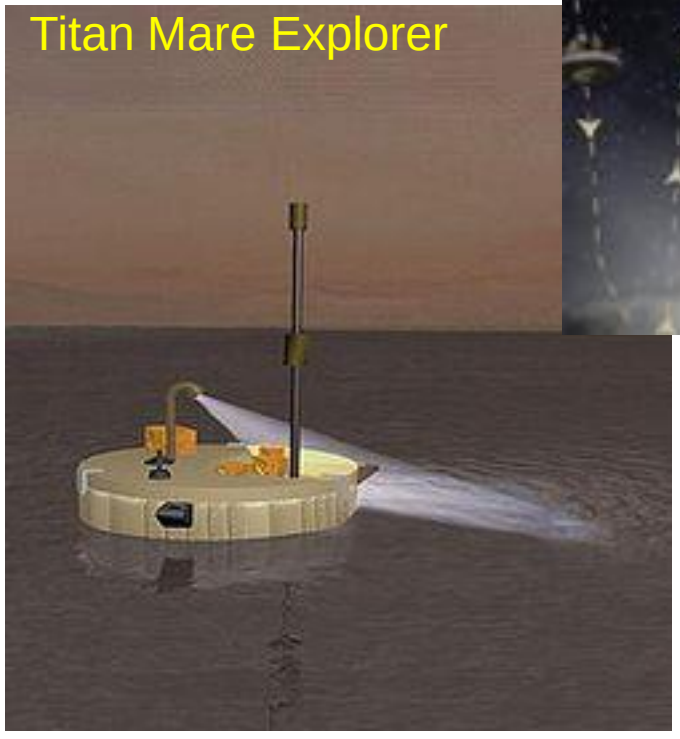
Dawn:

If Dawn finds water at Ceres, the project must take precautions

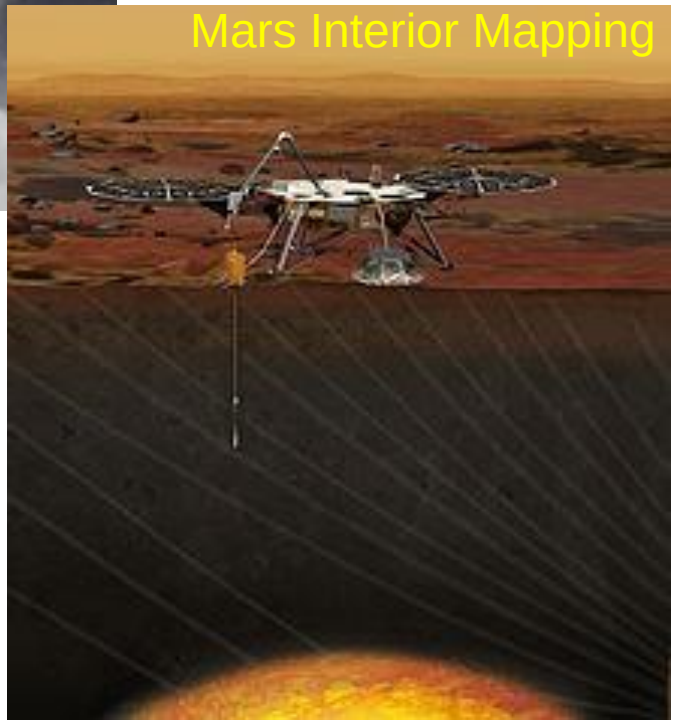
Current Discovery Competition:

CHopper:

TiME:



InSIGHT:



The Mars Exploration Program

The Current Decade

Launch Year

OPERATIONAL	2007	2011	2013

RIP

Mars Global Surveyor

Mars Odyssey

ESA
Mars Express

Mars
Reconnaissance
Orbiter

MAVEN

Science pathways
responsive to discovery

Mars
Exploration
Rovers

Competed Scout Mission

Phoenix

Mars Science
Laboratory

MSL Lands
1am Aug. 6

Updates to Policy and Requirements

- The reconsideration of NASA planetary mission priorities allows time for better refinement of planetary protection requirements and policy development needs
  - Support for future Mars lander missions includes documentation of planetary protection practices
  - Establishment of a Life Detection Protocol and sample handling capabilities for samples returned from Mars will require significant ground-based work to improve our capabilities and understanding
    - joint development with ESA is ongoing (LoA renewal starts Nov ‘12)
    - organic cleanliness and sample handling capabilities are relevant to multiple missions in development, including OSIRIS-REx
  - Implementation of planetary protection probabilistic requirements for proposed outer planet mission concepts could require consideration of multiple moderate-probability events

More than Fiction...

H.G. Wells
1898

Orson Welles
1938

And scattered about... were the Martians–dead! –slain by the putrefactive and disease bacteria against which their systems were unprepared; slain as the red weed was being slain; slain, after all man's devices had failed, by the humblest things that God, in his wisdom, has put upon this earth.

...By virtue of this natural selection of our kind we have developed resisting power; to no germs do we succumb without a struggle...