Mission Directorate: Science

Overview

NASA leads the nation on a great journey of discovery, asking profound questions that touch us all:

- What are the origin and destiny of the universe?
- How did the galaxies, stars, and planetary bodies form and evolve?
- How is our planet changing, and what are the consequences?
- How did life originate and evolve?
- Are we alone?

NASA performs scientific exploration enabled by space observatories and space probes, viewing the Earth from space, visiting the Moon and other bodies in the solar system, returning samples from them, and looking out into our Galaxy and beyond.

From space, we can view the Earth as a planet and study it as a complex, interacting dynamic system with diverse components: the oceans, atmosphere, continents, ice sheets, and life itself. We observe and track global-scale changes, and we study regional changes in their global context. We observe the role that human civilization increasingly plays as a force of change. Through partnerships with other agencies that maintain forecast and decision support systems, we improve national capabilities to predict climate, weather, and natural hazards, to manage resources, and to support the development of environmental policy. These activities and other NASA research on our home planet are an essential part of national and international efforts to employ Earth observations and scientific understanding in service to society.

We extend humankind's virtual presence throughout the Solar System via robotic space probes to other planets and their moons, to asteroids and comets, and to icy bodies of the outer solar system. We are completing humankind's first basic reconnaissance of the Solar System by sending one mission to fly by Pluto and another that will visit two world-sized asteroids, Ceres and Vesta. We are in the midst of a large-scale investigation of Mars, launching a series of ever more capable orbiters, landers, and rovers. And we are directing our attention to certain moons of the giant planets where we see intriguing signs of surface activity and of liquid water within, knowing that on Earth, where there is water and an energy source there is also life.

Our solar system is very much governed by the Sun, a main-sequence star midway through its stellar life. Through the eyes of multiple spacecraft, we see the solar system as a "heliosphere," an interconnected system with diverse components. At the center of the heliosphere, solar radiation controls the climate and sustains the biosphere of Earth, causes modifications to the ozone layer, and has effects on radio and radar transmissions, electrical power grids, and spacecraft electronics. We seek to understand how and why the Sun varies, how planetary systems respond, and how human activities are affected. As human presence expands beyond the confines of Earth, this science will enable the space weather predictions necessary to safeguard the outward journeys of human and robotic explorers.

Some of the greatest minds of the last century discovered wondrous things about our astrophysical universe -- the Big Bang and black holes, dark matter and dark energy, and the interrelated nature of space and time. Their theories challenge NASA to use observations from space to test the limits of our understanding. Having measured the age of the universe, we now seek to explore its ultimate extremes -- its birth, the edges of space and time near black holes, and the dark energy filling the entire universe. We seek to understand the relationship between the smallest of subatomic particles and the vast expanse of the cosmos. And having discovered hundreds of planets around other stars, humankind now seeks to find Earth-like planets and understand the diversity of planetary systems.

This is NASA's science vision: to achieve a deep scientific understanding of our planet, other planets and solar system bodies, our star system in its entirety, and the universe beyond.

FY 2010 Budget Request

Budget Authority ($ millions)	FY 2008 Actual	FY 2009 Enacted	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
FY 2010 President's Budget Request	**4,733.2**	**4,903.0**	**4,477.2**	**4,747.4**	**4,890.9**	**5,069.0**	**5,185.4**
Earth Science	1,237.4	1,704.6	1,405.0	1,500.0	1,550.0	1,600.0	1,650.0
Planetary Science	1,312.6	1,325.6	1,346.2	1,500.6	1,577.7	1,600.0	1,633.2
Astrophysics	1,395.6	1,281.2	1,120.9	1,074.1	1,042.7	1,126.3	1,139.6
Heliophysics	787.6	591.6	605.0	672.6	720.5	742.7	762.6
FY 2009 President's Budget Request	**4,706.2**	**4,441.5**	**4,482.0**	**4,534.9**	**4,643.4**	**4,761.6**	**--**
Earth Science	1,280.3	1,367.5	1,350.7	1,250.9	1,264.4	1,290.3	--
Planetary Science	1,247.5	1,334.2	1,410.1	1,537.5	1,570.0	1,608.7	--
Astrophysics	1,337.5	1,162.5	1,122.4	1,057.1	1,067.7	1,116.0	--
Heliophysics	840.9	577.3	598.9	689.4	741.2	746.6	--
Total Change from FY 2009 President's Budget Request	**27.0**	**461.5**	**-4.8**	**212.5**	**247.5**	**307.4**	**--**

Note: In all budget tables, the FY 2010 President's Budget Request depicts the September 2008 Operating Plan for the 2008 Actuals and the 2009 Omnibus Appropriations Act (P.L. 111-8) and the American Recovery and Reinvestment Act (P.L. 111-5) for the 2009 enacted. Starting in FY 10, the NEOO project moves from Earth Science to the Planetary Science theme and Astro-H moves from Heliophysics to the Astrophysic theme.

Plans for FY 2010

Science

Earth Science

New Initiatives:

Consistent with the American Recovery and Act of 2009, the FY 2010 Budget request for Earth Science (and its FY 2011-14 runout) reflects a significant commitment to Earth Science on the part of the new Administration. In total, projected Earth Science funding from FY 2009-2013 is increased by approximately $1.2 billion, allowing significant progress towards the goals of identified in the National Research Council's 2007 Decadal Survey report, "Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond", as detailed below.

Major Changes:

The Decadal Survey Tier-1 Soil Moisture Active-Passive (SMAP) and Ice, Cloud and Land Elevation Satellite 2 (ICESat-2) missions have been accelerated to the maximum extent possible, and are planned for launch in late 2013/early 2014 and late 2014/early 2015, respectively.

NASA is initiating a new series of competed "Venture-class" missions. These missions, which may include suborbital payloads, instruments to be flown on non-NASA spacecraft, or small dedicated spacecraft, will be selected via an Announcement of Opportunity. Selection of the first Venture-class mission(s) is planned for FY 2010.

The budget for LDCM, planned for launch in December 2012, now includes the cost of a thermal infrared instrument, consistent with Congressional direction in the FY09 appropriation.

NASA has already begun a new Airborne Science campaign, called IceBridge, to "bridge the gap" between ICESat I and ICESat II data. This activity, focusing on changes in Greenland and arctic ice, will continue in FY 2010 and beyond.

For the first time, all Science missions in development are conservatively budgeted at the "70%" confidence level. Hopefully, this will minimize future overruns and disruptions of the portfolio.

Major Highlights for FY 2010

Besides the acceleration of SMAP and ICESat-2, the other Tier-1 missions -- Deformation, Ecosystem Structure, and Dynamics of Ice (DESDynI) and Climate Absolute Radiance and Refractivity Observatory (CLARREO) -- are preparing to enter formulation phase, towards planned launches in the middle of the next decade. Detailed mission studies and science community workshops for all five Tier-2 missions will prepare them to follow the Tier-1 missions.

NASA will continue to implement five precursor Earth Science missions, Glory, Aquarius, NPOESS Preparatory Project (NPP), Landsat Data Continuity Mapper (LDCM), and Global Precipitation Measurement (GPM) for launch between 2009 and 2014.

The budget will fund operations of approximately 15 on-orbit Earth Science missions in FY2010, while maintaining robust Research and Analysis, Applied Sciences, and Technology Development programs.

NASA is determining how best to meet the lost science contribution after the Orbiting Carbon Observatory (OCO) launch vehicle failure. We have initiated studies to examine both science and hardware considerations. The science study is assessing the current state of carbon cycle science and existing measurements to see what course of action would best address the key science issues. On the hardware side, NASA is examining reflight opportunities, including, but not limited to, flying an OCO-like instrument on a shared platform or as a dedicated mission.

Planetary Science

New Initiatives:

None

Major Changes:

The FY 2010 Budget proposal for Planetary Science includes more conservative estimates for many projects, reflecting a balanced portfolio that fits more realistically within budget constraints. For instance, the Juno mission to Jupiter, and the Gravity Recovery and Interior Laboratory (GRAIL) mission to the Moon, have entered development phase, and consistent with NASA policy, their budgets now reflect independent cost estimates at the 70% confidence level.

Previous cost estimates for the major Outer Planet Flagship (OPF) and Mars Sample Return (MSR) missions have been determined to be unrealistic. Studies of potential future OPF missions will continue, but the start of OPF development will be delayed by several years. We have re-established a balanced Mars exploration program, with a launch at every opportunity (about every 26 months) after 2011; launch of MSR is no longer expected until well after 2020.

Since the release of the FY2009 Budget request, NASA selected the Mars Atmosphere and Volatile EvolutioN (MAVEN) Mars Scout mission, for launch in 2013. The launch of Mars Science Laboratory (MSL) was delayed until late 2011.

A new Lunar Quest program has been established, incorporating activities previously funded under the Planetary Science Research program. Funding for Near Earth Object Observations (NEOO) has been transferred from Earth Science, and is now part of Planetary Science Research.

Major Highlights for FY 2010

Announcements of Opportunity for new missions in the Discovery and New Frontiers programs are planned during FY2009 and early FY2010 respectively, with concept study selections in FY2010. The selected Discovery mission may launch as early as 2014, and the selected New Frontiers mission may launch as early as 2018. Planning will begin for a Mars 2016 mission, with the potential for a cooperative mission with the European Space Agency's (ESA) ExoMars mission.

NASA will continue to implement six Planetary Science missions in development or formulation: MSL, Juno, the Gravity Recovery and Interior Laboratory (GRAIL), the Lunar Atmosphere and Dust Environment Explorer (LADEE), MAVEN, and the first two U.S. landers in the International Lunar Network (ILN).

The budget will fund operations of approximately 13 ongoing Planetary Science missions in FY2010, while maintaining robust Research and Analysis and Technology programs.

Astrophysics

New Initiatives:

None

Major Changes:

In June 2008, NASA selected the High Resolution Soft X-ray Spectrometer (SXS) instrument as an Explorer Mission of Opportunity, and is scheduled to fly on the Japanese Astro-H mission in 2013.

The James Webb Space Telescope (JWST) has entered development phase, and consistent with the new NASA policy, the JWST budget now reflects independent cost estimates at the 70% confidence level.

For the first time, all Science missions in development are conservatively budgeted at the "70%" confidence level. Hopefully, this will minimize future overruns and disruptions of the portfolio.

Major Highlights for FY 2010

The Herschel, Planck, and Kepler missions are expected to be in their first full year of operations, following launch in FY09. The Wide-field Infrared Spectroscopic Explorer (WISE) mission is scheduled for launch in early FY2010. NASA will continue to support seven other Astrophysics missions in development or formulation: JWST, Nuclear Spectroscopic Telescope Array (NuSTAR), SXS, Stratospheric Observatory for Infrared Astronomy (SOFIA), JDEM, the International X-ray Observatory (IXO/Constellation-X), and the Laser Interferometer Space Antenna (LISA).

The budget will fund operations of approximately eight ongoing Astrophysics missions in FY2010, including Fermi, HST, Spitzer Space Telescope, Chandra X-ray Observatory, Swift, Suzaku, Galaxy Evolution Explorer, and Wilkinson Microwave Anisotropy Probe. Early science flights of SOFIA will begin. The budget also maintains robust Research and Analysis and Scientific Balloon programs.

Heliophysics

New Initiatives:

None

Major Changes:

In May 2008, NASA selected six candidate Small Explorer (SMEX) mission proposals for further evaluation. Final selection of up to two missions for development and launch is expected in 2009.

In June 2008, NASA selected the Global-scale Observations of the Limb and Disk (GOLD) instrument, for additional study as a potential Explorer Mission of Opportunity, to be flown on a future commercial satellite. If approved for development and launch, GOLD would help determine how the Earth's outer atmosphere responds to external forces.

NASA selected the Balloon Array for Radiation-belt Relativistic Electron Losses (BARREL) as a new Living With a Star Mission of Opportunity. BARREL seeks to measure the precipitation of relativistic electrons from the radiation belts using multi-balloon campaigns, starting in FY 2012.

For the first time, all Science missions in development are conservatively budgeted at the "70%" confidence level. Hopefully, this will minimize future overruns and disruptions of the portfolio.

The Radiation Belt Storm Probes (RBSP) mission completed preliminary design, and has entered development. Consistent with NASA policy, the RBSP budget reflects independent cost estimates at the 70% confidence level.

Incorporating more conservative budget estimates for RBSP and other missions does not leave sufficient funding to support a Solar Probe mission in 2015; the mission is now scheduled for 2018, which is the next desirable launch window.

Major Highlights for FY 2010

The Solar Dynamics Observatory is expected to launch in October/November of 2009.

NASA will continue to support the RBSP and Magnetospheric Multiscale (MMS) missions, for launch in 2012 and 2014 respectively.

The budget will fund operation and data analysis of approximately 16 ongoing Heliophysics missions in FY2010, while maintaining robust Research and Analysis and Sounding Rocket operations programs.

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