Mission Directorate: Science

Overview

NASA's Science Mission Directorate (SMD) conducts scientific exploration enabled by the use of space observatories and space probes that view the Earth from space, observe and visit other bodies in the solar system, and peer out into our Galaxy and beyond. NASA's science program seeks answers to profound questions that touch us all:

- What are the origin and destiny of the universe?
- How did the planets and life originate?
- Are we alone?
- What is waiting to be discovered in the solar system?
- How is our planet changing, and what are the consequences for life and human civilization?

From space, NASA satellites can view the Earth as a planet and enable its study as a complex, dynamic system with diverse components: the oceans, atmosphere, continents, ice sheets, and life itself. The nation's scientific community can thereby observe and track global-scale changes, connecting cause to effects, and study regional changes in their global context, as well as observe the role that human civilization plays as a force of change. Through partnerships with agencies that maintain forecast and decision support systems, NASA improves national capabilities to predict climate, weather, and natural hazards, manage resources, and craft environmental policy.

NASA extends 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. SMD is 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. SMD is also in the midst of a large-scale investigation of Mars, launching a series of ever more capable orbiters, landers, and rovers, with the long-term goal of a sample return mission. In addition, SMD is focusing on certain moons of the giant planets where current NASA missions 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 governed by the Sun, a main-sequence star midway through its life. The Sun's influence is wielded through its gravity, radiation, solar wind, and magnetic fields as they interact with the masses, fields, and atmospheres of planetary and small bodies. Through the eyes of multiple spacecraft, the scientific community sees the solar system as a "heliosphere," another kind of interconnected system with diverse components. Using a fleet of sensors on various spacecraft in Earth orbit and throughout the solar system, SMD seeks to understand how and why the Sun varies, how planetary systems respond, and how human activities are affected. The science of Heliophysics enables 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 physical universe: the Big Bang and black holes, dark matter and dark energy, and the interrelated nature of space and time. Their theories challenge scientists and NASA to use observations from space to test the limits of our understanding of fundamental physics. Having measured the age of the universe, the scientific community now seeks to explore its ultimate extremes: its birth, the edges of space and time near black holes, and the mysterious dark energy filling the entire universe. Scientists also seek to understand the relationship between the smallest of subatomic particles and the vast expanse of the cosmos. With hundreds of planets around other stars now known, scientists are using current NASA missions in conjunction with ground-based telescopes to seek Earth-like planets in other solar 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. SMD lays the intellectual foundation for the robotic and human expeditions of the future while meeting today's needs for scientific information to address national concerns on global change, space weather, and education.

FY 2011 Budget Request

Budget Authority ($ millions)	FY 2009 Actual	FY 2010 Enacted	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
FY 2011 President's Budget Request	**4,903.0**	**4,493.3**	**5,005.6**	**5,248.6**	**5,509.6**	**5,709.8**	**5,814.0**
Earth Science	1,702.3	1,420.7	1,801.8	1,944.5	2,089.5	2,216.6	2,282.2
Planetary Science	1,288.1	1,341.3	1,485.7	1,547.2	1,591.2	1,630.1	1,649.4
Astrophysics	1,304.9	1,103.9	1,076.3	1,109.3	1,149.1	1,158.7	1,131.6
Heliophysics	607.8	627.4	641.9	647.6	679.8	704.4	750.8
FY 2010 President's Budget Request	**4,903.0**	**4,477.2**	**4,747.4**	**4,890.9**	**5,069.0**	**5,185.4**	**--**
Earth Science	1,704.6	1,405.0	1,500.0	1,550.0	1,600.0	1,650.0	--
Planetary Science	1,325.6	1,346.2	1,500.6	1,577.7	1,600.0	1,633.2	--
Astrophysics	1,281.2	1,120.9	1,074.1	1,042.7	1,126.3	1,139.6	--
Heliophysics	591.6	605.0	672.6	720.5	742.7	762.6	--
Total Change from FY 2010 President's Budget Request	**0.0**	**16.1**	**258.2**	**357.7**	**440.6**	**524.4**	**--**

Note: In all budget tables, the FY 2011 President's Budget Request depicts the July 2009 Operating Plan including American Recovery and Reinvestment Act for the FY 2009 Actual column and the Consolidated Appropriations Act, 2010 (P.L. 111-117) without the Administrative transfers for the FY 2010 enacted column.

Plans for FY 2011

Science

Earth Science

New Initiatives:

Funding is included for an Orbiting Carbon Observatory replacement, with a planned launch readiness date of February 2013.

The budget includes an increase of $2.1 billion in FY 2011-2015 for a global climate initiative, enabling significant mission accelerations and program expansions. This initiative will accelerate selected Decadal Survey missions; expand and accelerate the new Venture-class competitive program; enable development of "gap-filler" climate sensors and missions, including a GRACE follow-on mission and early instrument flights on ISS; and support enhanced investments in new technologies, modeling, data systems, and decision support systems.

The Decadal Survey Tier-1 Soil Moisture Active-Passive (SMAP) and Ice, Cloud and Land Elevation Satellite 2 (ICESat-2) missions are now planned for launched as early as November 2014 and October 2015, respectively. With the infusion of funds for the global climate initiative, these launch dates are not limited by budget availability; the missions will be completed and launched as rapidly as possible, based on technical considerations alone. CLARREO, DESDynI and selected Decadal Tier 2 and 3 missions will be accelerated; CLARREO and DESDynI may launch as soon as 2017, approximately two years earlier than previously planned.

NASA initiated a new series of small, rapid-development, competed "Venture-class" missions in FY 2010. These missions, which may include suborbital payloads (to be flown on sounding rockets, balloons, aircraft, or unmanned aerial vehicles), instruments to be flown on non-NASA spacecraft, or small dedicated spacecraft, will be selected via an Announcement of Opportunity (AO) in FY 2010, and the first science results will be returned in FY 2011. As a result of the global climate initiative, future AOs will be released annually, instead of every other year, doubling the output of this exciting new program.

Major Changes:

None, other than the new initiatives discussed above.

Major Highlights for FY 2011

OCO-2 will complete KDP-C and enter into development

Glory will have its Launch Readiness Review, followed by the launch of the spacecraft.

The NPOESS Preparatory Project (NPP) will complete its satellite pre-ship review and is scheduled to launch in FY 2011.

LDCM will complete its spacecraft integration and test, and the Operational Land Imager (OLI) instrument will be delivered to the spacecraft in FY 2012, in preparation for launch in FY 2013.

The Decadal Tier-1 mission of Soil Moisture Active-Passive (SMAP) will complete KDP-C and enter into development, while the Ice Satellite 2 (ICESat-2) project will complete KDP-B and initiate the spacecraft contract.

All operating spacecraft which are beyond their prime mission will be reviewed for potential missions extensions, as part of the FY 2011 Senior Review.

The budget supports robust Research and Analysis and Technology programs.

Planetary Science

New Initiatives:

Within the Lunar Quest Program, $15M is included for the restart of U.S. plutonium production capability, in support of future deep space missions. A similar amount is also included within the Department of Energy budget.

The Near Earth Object Observations (NEOO) project has been augmented by $16M/year, to accelerate progress on the detection and characterization of NEOs less than 1km in diameter. In FY 2011, this will support the analysis of archived data from the Wide-Field Infrared Spectroscopic Explorer (WISE) mission.

Major Changes:

NASA has engaged the European Space Agency in discussions regarding collaboration on future robotic Mars missions. Concept studies for partnership missions launching in the 2016 and 2018 windows will be completed, and the 2016 mission will enter into formulation phase, by the end of FY 2011.

Major Highlights for FY 2011

Stardust NExT will arrive at comet Tempel 1 in February 2011 to see how it has evolved since the Deep Impact encounter in 2005.

Having completed its third fly-by of Mercury, MESSENGER will prepare for Mercury orbit insertion in March 2011 while it continues its analyses of valuable data from the three flybys.

The Dawn spacecraft will encounter the asteroid Vesta in May 2011.

Juno will deliver all hardware to Florida, in preparation for a launch in August 2011.

GRAIL will be in Assembly, Test, and Launch Operations (ATLO) by the end of CY 2010 and prepare for its launch in September 2011.

MSL will complete ATLO, and deliver all hardware in preparation for a launch in October to December 2011.

In addition to further definition study and technology development efforts for the Europa Jupiter System Mission (EJSM) throughout FY 2011, NASA will also continue to negotiate the details of a potential partnership with the European Space Agency (ESA) should they select the Ganymede Jupiter System Mission from among the major mission candidates under consideration in Europe.

Following a Discovery Announcement of Opportunity released in early CY 2010, and a step 1 or concept study selection in late CY 2010, NASA will make final selection(s) by the end of FY 2011.

Following the completion of New Frontiers 3 concept studies, NASA will make a New Frontiers 3 mission selection by the end of FY 2011.

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:

The James Webb Space Telescope (JWST) has entered development phase, in preparation for launch in June 2014.

In June 2009, NASA selected the Gravity and Extreme Magnetism SMEX (GEMS), as a Small Explorer, planned for launch no later than 2015. GEMS is an X-ray telescope to explore the shape of space that has been distorted by a spinning black hole's gravity, and probe the structure and effects of the formidable magnetic field around magnetars, dead stars with magnetic fields trillions of times stronger than Earth's.

The Herschel, Planck, Kepler and Wide-field Infrared Spectroscopic Explorer (WISE) missions were all launched in CY 2009, and are now in prime operations.

Major Highlights for FY 2011

Four Astrophysics missions will be in development or formulation: JWST, the Nuclear Spectroscopic Telescope Array (NuSTAR), the SXS instrument on the Japanese Astro-H mission, and GEMS. The Stratospheric Observatory for Infrared Astronomy (SOFIA) will be conducting science operations as progress toward full capability continues. Planning will be underway on the top-priority missions identified by the Astro2010 decadal survey report from the National Reseach Council.

The budget will support approximately eleven operating Astrophysics missions in FY 2011, including Fermi, HST, Spitzer Space Telescope, Chandra X-ray Observatory, Swift, Suzaku, Galaxy Evolution Explorer (GALEX), Wilkinson Microwave Anisotropy Probe (WMAP), Herschel, Planck, and Kepler. The budget also maintains robust Research and Analysis and Scientific Balloon programs.

Heliophysics

New Initiatives:

None

Major Changes:

The budget for the Solar Probe Plus mission has been increased, to accommodate higher-than-expected launch vehicle and instrument costs. Solar Probe Plus is now scheduled for launch no later than FY 2018, which is the most desirable launch window attainable.

The European Space Agency announced a delay in the launch of the Solar Orbiter Collaboration mission to 2017.

In June 2009, NASA selected the Interface Region Imaging Spectrograph (IRIS) as a Small Explorer, planned for launch in December 2012. IRIS will use a solar telescope and spectrograph to explore the solar chromosphere, a 2000 kilometer thick layer of gas just above the visible surface of the Sun. IRIS' unique instrument capabilities, coupled with state of the art 3-D modeling, will explore this dynamic region in detail.

Major Highlights for FY 2011

NASA will award instrument contracts for the Solar Probe Plus mission.

An Announcement of Opportunity for the next Explorer missions will be developed and prepared for release.

The budget will fund operation and data analysis of approximately 16 ongoing Heliophysics missions (comprising 27 spacecraft) in FY 2011, while maintaining robust Research and Analysis and Sounding Rocket operations programs.

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