Mission Directorate:	Science
Theme:	Heliophysics

Theme Overview

Our planet is immersed in a seemingly invisible yet exotic and inherently hostile environment. Above the protective cocoon of Earth's lower atmosphere is a plasma soup composed of electrified and magnetized matter entwined with penetrating radiation and energetic particles. Our Sun's explosive energy output forms an immense structure of complex magnetic fields. This colossal bubble of magnetism, known as the heliosphere, stretches far beyond the orbit of Pluto. On its way through the Milky Way, this extended atmosphere of the Sun affects all planetary bodies in the solar system. It is itself influenced by slowly changing interstellar conditions that in turn can affect Earth's habitability. In fact, the Sun's extended atmosphere drives some of the greatest changes in our local magnetic environment affecting our own atmosphere, ionosphere, and potentially our climate. This immense volume is our cosmic neighborhood; it is the domain of the science called heliophysics.

Heliophysics seeks understanding of the interaction of the large complex, coupled system comprising the Sun, Earth, and Moon, other planetary systems, the vast space within the solar system, and the interface to interstellar space. Heliophysics flight missions form a fleet of solar, heliospheric, and geospace spacecraft that operate simultaneously to understand this coupled Sun-Earth system.

A robust heliophysics research program is critical to human and robotic explorers venturing into space. Solar radiation drives the climate system and sustains the biosphere of Earth. Solar particles and fields drive radiation belts, high-altitude winds, heat the ionosphere, and alter the ozone layer. The resulting space weather affects radio and radar transmissions, gas and oil pipelines, electrical power grids, and spacecraft electronics. As a result, scientific research in this area has the potential to return economic and political value to modern society. An effective plan incorporates studying the Sun, heliosphere, and planetary environments as elements of a single interconnected system: one that contains dynamic space weather, and one that evolves in response to solar, planetary, and interstellar conditions. NASA is working to advance this science that enables space weather prediction by answering fundamental questions about this system's behavior:

- What causes the Sun to vary?
- How do the Earth and the Heliosphere respond?
- What are the impacts on humanity?

Heliophysics strategic goals are achieved through four program/mission lines: two strategic programs/missions, one competed program, and a Research and Analysis program. Solar Terrestrial Probes, a strategic program, provide understanding of the fundamental processes inherent in all astrophysical systems and how they affect the nature of our home in space. Living With a Star, the other strategic program, emphasizes the science necessary to understand those aspects of the Sun and space environment that most directly affect life and society and that enable robotic and human exploration of the solar system. The Explorer Program consists of competitively selected small PI-led missions that can be developed relatively quickly, providing frequent flight opportunities for world-class scientific investigations from space. The Heliophysics Research Program supports physics-based modeling that has played an increasingly important role both in defining the missions and interpreting their observations.

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	**607.8**	**627.4**	**641.9**	**647.6**	**679.8**	**704.4**	**750.8**
Heliophysics Research	204.7	173.0	166.9	165.4	168.7	172.9	172.9
Living with a Star	222.6	240.2	214.3	207.9	216.5	243.0	288.8
Solar Terrestrial Probes	143.0	143.0	162.9	175.1	178.5	161.7	121.4
Heliophysics Explorer Program	34.8	69.4	97.7	99.2	116.1	126.8	167.8
New Millennium	2.7	1.8	0.1	0.0	0.0	0.0	0.0
FY 2010 President's Budget Request	**591.6**	**605.0**	**672.6**	**720.5**	**742.7**	**762.6**	**--**
Heliophysics Research	195.9	178.6	178.1	183.1	190.6	194.3	--
Living with a Star	238.6	212.2	204.6	208.7	230.0	236.6	--
Solar Terrestrial Probes	123.1	143.0	169.1	170.6	160.8	164.3	--
Heliophysics Explorer Program	31.4	69.4	119.7	158.1	161.3	167.4	--
New Millennium	2.7	1.8	1.1	0.0	0.0	0.0	--
Total Change from FY 2010 Request	**16.2**	**22.3**	**-30.7**	**-72.9**	**-62.9**	**-58.2**	**--**

Note: Budget of $169 million for GEMS has been transferred from Heliophysics to Astrophysics Theme.

Plans for FY 2011

Heliophysics Research

The Research program will continue to operate 16 missions comprising 27 spacecraft through FY 2010 and conduct another senior review in April 2010 to determine whether to continue those missions into FY 2011. Heliophysics data centers will continue to archive and distribute collected science data.

Living with a Star

The Radiation Belt Probes (RBSP) mission will complete manufacturing of its hardware and begin integration and testing. The Solar Orbiter Collaboration will transition into Phase B for formulation. Solar Probe Plus will develop draft program-level requirements and memoranda of agreement during Phase A and end in an Initial confirmation Assessment. SDO will continue mission operations.

Solar Terrestrial Probes

The Magnetospheric Multiscale Mission (MMS) will continue the implementation phase. STEREO and Hinode will continue mission operations. The program will begin preliminary studies to define the next STP mission.

Heliophysics Explorer Program

IRIS, a Small Explorers (SMEX) selected in FY 2009, plans on conducting its Critical Design Review in FY 2011. The IBEX, CINDI, TWINS, AIM, and THEMIS missions will continue mission operations. An Announcement of Opportunity for the next Explorer missions will be developed and prepared for release.

Relevance

Relevance to national priorities, relevant fields, and customer needs:

The Heliophysics Program is guided by U.S. National Space Policy and follows NASA's tradition of establishing its priorities through consultation with world-class experts. Heliophysics relies on two advisory bodies for scientific assessments and decadal surveys: the National Research Council's Space Studies Board and the NASA Advisory Council. Heliophysics missions such as the Advanced Composition Explorer provide critical data to the Department of Defense, the Federal Aviation Administration, and the National Oceanographic and Atmospheric Administration to guard against space weather impacts. The Living With a Star (LWS) program targets research and technologies that are relevant to the operational needs of these agencies. The nation's safety, security, and economy have become increasingly dependent on technologies that are susceptible to the extremes of space weather i.e. severe disturbances of the upper atmosphere and of the near-Earth space environment that are driven by the magnetic activity of the Sun. Space weather events can damage satellites and power grids, and disrupt air traffic communications. Inter-agency activities are coordinated through the National Space Weather Program Council (NSWPC) within the Office of the Federal Coordinator for Meteorology. Organizations around the world also access Heliophysics data via the International Space Environment Service.

Heliophysics is also working to improve our understanding of magnetic reconnection, a process that occurs throughout the universe when stressed magnetic field lines suddenly transition to a new shape. This understanding is expected to greatly benefit the Department of Energy's efforts in the area of fusion energy, as magnetic reconnection phenomena play a critical role in virtually every configuration that is being explored to confine high-temperature plasmas. Internationally, NASA's Heliophysics Program plays a leadership role with both the International Heliophysical Year and International Living With a Star activities, leveraging space assets and resources to achieve greater scientific advancement now and in the future.

Relevance to education and public benefits:

Society is increasingly dependent on modern technology, including power grids, global positioning, weather forecasting and satellite communications. The valuable assets that support these technologies are vulnerable to solar activity and space weather events, so the need to predict solar events and mitigate their effect is critical to the public's safety, security, and the Nation's economy. A newly released report by the National Academy of Sciences titled "Severe Space Weather Events -- Understanding Societal and Economic Impacts" for the first time attempts to quantify the effects of extreme space weather on the nation (www.nap.edu/catalog/12507.html). The report concludes that improving forecasting capabilities and raising public awareness are instrumental in mitigating severe consequences. The Heliophysics Program supports the rapid transition of research results, models and data into operational products that benefit the public and other segments of the United States Government.

Heliophysics education programs include the award-winning Family Science Night, which introduces local communities to a wide range of Heliophysics-related topics. The Program partners with Astrophysics and Earth Science for a multi-disciplinary approach to such topics as light and spectrum, the seasons, and solar power. The IBEX mission has partnered with Adler Planetarium in Chicago to develop a planetarium show that communicates the scientific goals and results of the IBEX mission. The STEREO mission regularly provides selected images and movies to over 250 science centers through outreach program and through the American Museum of National History in New York.

The combined community Modeling center, a collaborative partnership with NSF, NOAA, and the USAF, provides the nation with verification and validation of innovative space weather numerical models. This data is widely used by academia, other U.S. government agencies and the space weather forecast industry.

Performance Achievement Highlights:

Even though Earth is 93 million miles away from the Sun, our planet is affected by what happens on the Sun's surface. We are currently in an extended solar minimum and 2009 has been the quietest year on the Sun since 1913. The Heliophysics fleet of 16 operating missions and the R&A programs were coordinated to study this unusual pattern enabling scientists worldwide to uncover effects never before seen. In 2008, there were 266 spotless days, and up through September 30, there were 215 days without sunspots for 2009. No 11-year solar cycle is exactly the same as another, but this research showed that sunspot activity during this 2007 - 2010 minimum is surprisingly low as compared to cycles of the last century.

These observations have brought many new discoveries about the underlying physics of the sunspot cycle. For example, the NASA measurements showed that solar wind pressure dropped 20 percent since the mid-1990s. Since the solar wind helps keep galactic cosmic rays out of the inner solar system, with the solar wind flagging more cosmic rays reach Earth, resulting in increased health hazards for astronauts. Weaker solar wind also meant fewer geomagnetic storms and auroras, the northern and southern (polar) lights we see on Earth. Other NASA measurements showed that the Sun's brightness dimmed 0.02 percent at visible wavelengths and six percent at extreme ultraviolet wavelengths since the previous solar minimum. One effect of this change is that the upper atmosphere is less heated and not as "puffed up," which means that satellites in low Earth orbit experience less atmospheric drag, extending their operational lifetimes.

The NASA observations were incorporated into state-of-the-art prediction models. It is now believed that the upcoming solar cycle will be significantly different than previous cycles sampled since the start of the space age. This new understanding of our Sun's connection to Earth has provided essential information on space weather effects and will be used to improve the reliability of space weather warnings that affect technologies on Earth and the productivity and safety of explorers in space.

Preparing for the next solar maximum, the Solar Dynamics Observatory completed its development phase smoothly and is awaiting launch in early 2010. The Radiation Belt Storm Probes (RBSP) and Magnetospheric Multiscale (MMS) missions were confirmed and approved to proceed into Implementation (Phase C). Four investigations were selected for Phase A studies for Solar Orbiter collaboration mission. Solar Probe Plus, completed the Mission Concept Review in September 2009 and was approved to proceed into Phase A in December 2009. Three Heliophysics missions, AIM, THEMIS and STEREO, successfully completed their prime missions in FY 2009, meeting all mission science requirements.

The selection of two new Small Explorer (SMEX) missions was announced: Interface Region Imaging Spectrograph (IRIS) and Gravity and Extreme Magnetism (GEMS). The Balloon Array for Radiationbelt Relativistic Electron Losses (BARREL) completed the Mission Readiness Review in August 2009, and an Antarctic test campaign in December 2009. In the New Millennium Program (NMP), the Space Technology ST7 Disturbance Reduction System, shipped to the United Kingdom for integration with the Astrium testbed. The Sounding Rockets program completed 14 suborbital launches. Wallops Range provided services for 5 Shuttle missions, the 14 NASA suborbital launches, and launch services for the USAF TacSat-3 mission.

Mission Directorate:	Science
Theme:	Heliophysics

Independent Reviews:

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Other	National Research Council	12/2003	The Decadal Research Strategy assessed the current status and future directions of NASA's programs in solar and space physics research. The report identifies broad scientific challenges that define the focus and thrust of solar and space physics research for the decade 2003 through 2013 and presents a prioritized set of missions, facilities, and programs designed to address those challenges.	12/2012
Relevance	NAC/Helio-physics Subcommittee	07/2009	Release of new Heliophysics Roadmap including science and program implementation strategies and relevance to the NASA Strategies and goals. Roadmap lays out a new paradigm for mission planning and implementation that is expected to help control mission lifetime cost. Subcommittee concerns remain with regard to R&A and Explorer program funding.	06/2010
Quality	Senior Review Panel	04/2008	All Heliophysics Operating Missions were reviewed for their continued relevance to the strategic goals of the Heliophysics division. All missions except FAST received satisfactory or excellent ratings.	04/2010
Performance	NAC/Helio-physics Subcommittee	07/2009	Reviews of selected annual performance goals as documented in Performance and Accountability Report (PAR). Review found that Heliophysics has achieved its annual goals, and made significant progress toward understanding our local space environment and the fundamental science that is beginning to enable a reliable space weather predictive capability.	07/2010
Other	National research Council	03/2009	An ad hoc panel of the NRC conducted a mid-term performance assessment of the NASA Heliophysics program, ISBN:0-309-13657-1. The report assessed NASA's progress against 2003 Decadal survey.	03/2013

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Research

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	**204.7**	**173.0**	**166.9**	**165.4**	**168.7**	**172.9**	**172.9**
Heliophysics Research and Analysis	**31.5**	**31.0**	**31.7**	**32.2**	**33.0**	**33.8**	**34.2**
Sounding Rockets	**45.1**	**65.3**	**48.9**	**49.7**	**51.8**	**53.0**	**53.8**
Research Range	**32.3**	**19.2**	**19.6**	**20.1**	**20.6**	**21.1**	**21.4**
Other Missions and Data Analysis	**95.8**	**57.5**	**66.7**	**63.4**	**63.4**	**65.0**	**63.5**
FY 2010 President's Budget Request	**195.9**	**178.6**	**178.1**	**183.1**	**190.6**	**194.3**	**--**
Heliophysics Research and Analysis	**31.0**	**35.4**	**38.4**	**39.1**	**40.1**	**41.1**	**--**
Sounding Rocket Operations	**77.4**	**66.5**	**67.5**	**68.9**	**71.4**	**73.1**	**--**
Other Missions and Data Analysis	**87.5**	**76.7**	**72.3**	**75.1**	**79.1**	**80.1**	**--**
Changes from FY 2010 Request	**8.8**	**-5.6**	**-11.2**	**-17.7**	**-21.9**	**-21.5**	**--**

Program Overview

NASA's Heliophysics Research Program supports activities that address understanding of the Sun and planetary space environments, including the origin, evolution, and interactions of space plasmas and electromagnetic fields throughout the heliosphere and in connection with the galaxy. Understanding the origin and nature of solar activity and its interaction with the space environment of the Earth is a particular focus. The program seeks to characterize these phenomena on a broad range of spatial and temporal scales, to understand the fundamental processes that drive them, to understand how these processes combine to create space weather events, and to enable a capability for predicting future space weather events.

The Heliophysics Research Program supports investigations of the Sun and planetary space environments from the 16 operating missions involving 27 spacecrafts. This fleet of spacecraft is informally termed the "Heliophysics System Observatory" since the aggregation of data from all the spacecraft results in research synergies not possible with single observatories.

Heliophysics Research & Analysis routinely solicits proposals in several broad areas in order to advance our knowledge in support of NASA strategic goals. In addition, NASA occasionally offers special solicitations to take advantage of research opportunities that arise from the current solar environment. The Research Program also funds scientific investigations based on suborbital platforms, such as balloons or sounding rockets, and maintains some of the vital communications infrastructure at Wallops Flight Facility. The Research and Analysis and Guest Investigator Projects fund more in-depth scientific investigations using all of this collected data via a competitive process that is held each year.

Plans For FY 2011

NASA's Heliophysics research program supports NASA flight program by formulating the theories of the phenomena to be studied; the design of the experiments to test these theories; the development of the instrument technology; experiments in the laboratory and from an appropriate set of balloon or sounding rocket platforms; provides the results to increase basic knowledge; incorporates results into computational models that can be used to more fully characterize the present state and future evolution of the Heliophysics system.

The Supporting Research and Technology Program will hold its annual competition for new research awards. Participation will be open to all categories of U.S. organizations, including educational institutions, industry, not-for-profit organizations, Federally Funded Research and Development Centers, NASA Centers and other Government agencies.

The Geospace Science, and Solar and Heliospheric Science subelements will hold their annual competition for new research awards: approximately $9 million will be available for competition, resulting in approximately 65 new awards. These subelements support detailed research tasks that employ a variety of research techniques (e.g., theory, numerical simulation, and modeling), analysis and interpretation of space data, development of new instrument concepts, and laboratory measurements of relevant atomic and plasma parameters, all to the extent they have a clear application to heliophysics program goals.

The Theory subelement will fund 10 new teams in FY 2011 based on a competition to be held in mid-2010. The Theory Program supports large PI-proposed team efforts that require a critical mass of expertise to make significant progress in understanding complex physical processes with broad importance.

Heliophysics data centers will be supported to continue the archival and distribution of collected science data.

The Guest Investigator competition, canceled in FY 2010 due to budget reductions, will resume to support and extend the scientific impact of the currently operating missions: approximately $13 million will be available for competition.

The Low Cost Access to Space subelement supports the science investigation and new instrument concepts to be flown on sounding rockets or balloons. This subelement will support approximately 22 teams to prepare payloads for future sounding rockets and 2-3 teams for future balloon launches.

Science Data and Computing Technology will hold its annual competition for the Applied Information Systems Research Program where approximately $2 million will be available for new research awards.

All missions operating beyond their prime phase will be evaluated by a NASA-sponsored Senior Review in April 2010 to determine their status and optimize the allocation of funding for FY 2011 and beyond in order to address NASA's strategic science goals The Research Range will provide launch instrumentation for NASA suborbital programs and projects at both local and remote locations. Science Data and Computing Technology will continue to sustain the National Space Science Data Center.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Research

Project Descriptions and Explanation of Changes

Heliophysics Research and Analysis

Supporting Research and Technology comprises an ever-evolving suite of individual Principal Investigator-proposed investigations that cover the complete range of science disciplines and techniques essential to achieve the Heliophysics Theme objectives and to take full advantage of the scientific data collected by NASA missions. Supporting Research and Technology covers five subelements: Heliophysics Theory, Geospace Science, Solar and Heliospheric Science, Low-Cost Access to Space (LCAS), and Instrument Development.

The Theory subelement is the intellectual compass of the Heliophysics Division. Teams work to consolidate the scientific understanding of previous missions and determine the scientific hypotheses to be tested by future strategic missions. The Theory Program supports large PI-proposed team efforts that require a critical mass of expertise to make significant progress in understanding complex physical processes with broad importance.

Geospace Science subelement funds studies of the physics of magnetospheres, including their formation and fundamental interactions with plasmas, fields, and particles (Earth's magnetosphere is emphasized, but studies of the magnetospheres of planets, comets, and other primordial bodies are also supported). Geospace Science deals with the physics of the mesosphere, thermosphere, ionosphere, and aurorae of Earth, including the coupling of these phenomena to the lower atmosphere and magnetosphere.

Solar and Heliospheric Science subelement funds studies that treat the Sun as a typical star, as the dominant, time-varying source of energy, plasma, and energetic particles in the solar system (especially concerning its influence on Earth). This project investigates processes taking place throughout the solar interior and atmosphere: the evolution and cyclic activity of the Sun; the origin and propagation of the solar wind and magnetic field from the Sun to the Heliopause (the boundary between the solar wind and the interstellar medium); the acceleration and transport of energetic particles in the heliosphere; and the interface of solar influence with the interstellar medium.

Low-Cost Access to Space funds the science investigations that utilize suborbital sounding rockets, commercial reusable suborbital vehicles, or high altitude balloons, as well as proof-tests of new concepts in experimental techniques that may ultimately find application in free-flying Heliophysics space missions. These investigations are developed and flown in a rapid turnaround environment. LCAS investigations address open science questions, but serve additional purposes not addressed in other flight programs: the training of experimental space physicists and engineers, and the development and flight verification of new technology.

Instrument development investigations have as their objective the development of instrument technologies that show promise for use on future Heliophysics science missions, including the development of prototypes. The goal is to define scientific instruments to the point where complete instruments may be proposed in response to future Announcements of Opportunity without significant additional development.

Sounding Rockets

This project funds all suborbital mission activities (payload integration, launch, and mission operation) that support the science investigations funded in other parts of the research program. Sounding Rockets present unique low-cost platforms that provide direct access to Earth's mesosphere (50-90 kilometers), lower thermosphere (90-120 kilometers), and the Earth's magnetosphere (up to 1,500 kilometers). Because of their short duration and access to Earth's upper atmosphere and the space environment, sounding rocket suborbital missions also enable calibration under-flights of orbital missions, repeated proof-of-concept technology demonstration missions, and valuable end-to-end space mission experience for scientists and engineers learning to develop and execute discovery-oriented orbital missions.

Research Range

The Research Range effort funds NASA's only test range, located at Wallops Flight Facility, for launch of suborbital and orbital vehicles, supporting launch operations, tracking, telemetry and command (TT&C) capabilities. The Wallops Research Range also supports a mobile TT&C capability to support launches safely from a number of woldwide launch sites. The NASA Research Range is one of the few ranges in the Nation to offer a mobile capability. The Range maintains it own airspace and supports a wide variety of small launch vehicles, suborbital missions, and airborne missions utilizing non-FAA-certified vehicles such as unmanned aircraft systems.

Other Missions and Data Analysis

Following the commissioning and checkout phase of any spacecraft, Headquarters management responsibility for operations and data analysis transitions to the Heliophysics Research Program. However, a number of operating spacecraft still receive funding from their respective development programs. The Research Program is responsible for collecting, archiving, and distributing the data collected by all operating spacecraft. Current operating spacecraft include: Cluster II, AIM, ACE, THEMIS, Voyager, Wind, Geotail, TWINS, RHESSI, CINDI,SOHO, TIMED. It is this collective asset that provides the data, expertise, and research results that contribute directly to the national goal of real-time space weather prediction and to fundamental research on solar and space plasma physics. In April 2010, these missions will undergo their biannual Senior Review. New budgets for FY 2011 will be determined, consistent with their evolving scientific goals.

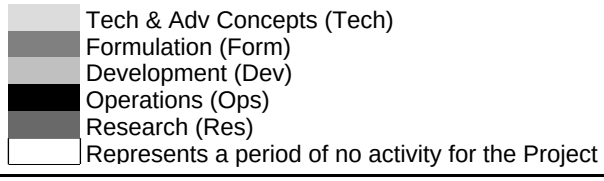
Program Commitments

Commitment/Output FY 2011	Program/Project	Changes from FY 2010 PB Request
Annual peer-reviewed research solicitation for grant opportunities	Research & Analysis	None

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Research

Implementation Schedule

Project	Schedule by Fiscal Year																Phase Dates		
	Prior	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23		Beg	End
Voyager																	Tech Form Dev Ops Res	Aug-77	Aug-13 Aug-14
Geotail																	Tech Form Dev Ops Res	Jul-92	Jul-08 Jul-10
Wind																	Tech Form Dev Ops Res	Nov-94	Nov-13 Nov-14
Solar and Heliospheric Observatory (SOHO)																	Tech Form Dev Ops Res	Dec-95	Dec-13 Dec-14
Advanced Composition Explorer (ACE)																	Tech Form Dev Ops Res	Aug-97	Aug-13 Aug-14
Cluster-II																	Tech Form Dev Ops Res	Jul-00	Jul-10 Jul-11
Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics (TIMED)																	Tech Form Dev Ops Res	Dec-01	Dec-13 Dec-14
RHESSI																	Tech Form Dev Ops Res	Feb-02	Feb-13 Feb-14



Program Management

NASA Headquarters has program management responsiblity for the Heliophysics Research Program.

Project	Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Research and Analysis	SMD	All NASA Centers	None
Heliophysics Operating Missions	SMD	GSFC and JPL	ESA and JAXA
Sounding Rockets and Research Range	SMD	GSFC	None
Science Data and Computing	SMD	GSFC and other NASA Centers	None

Acquisition Strategy

All acquisitions in the Heliophysics Research and Analysis (R&A) component are based on full and open competition. Proposals are peer reviewed and selected based on the NASA research announcement, Research Opportunities in Space and Earth Sciences (ROSES). Universities, government research labs, and industry throughout the U.S. participate in R&A research projects. The Heliophysics Operating Missions and instrument teams were previously selected from NASA Announcements of Opportunity. NASA evaluates the allocation of funding among the operating missions bi-annually through the Heliophysics Senior Review.

Both the prime contracts for the Sounding Rocket Operations and for Research Range Operations are currently being re-competed. The new contracts are expected to be in place in CY 2010.

The Science Data and Computing component holds a competition where proposals have been peer reviewed and selected based on ROSES research announcement. Universities, government research labs, and industry throughout the United States participate in Science Data and Computing Technology research projects.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Quality	Senior Review Panel	05/2008	The Heliophysics operating missions will undergo a Senior Review panel in April 2010 to assess their operational effectiveness.	04/2010

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star

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	222.6	240.2	214.3	207.9	216.5	243.0	288.8
Radiation Belt Storm Probes (RBSP)	154.4	129.1	140.0	92.2	30.2	22.0	9.1
Solar Probe Plus	18.0	40.0	14.1	49.7	104.3	104.4	148.2
Other Missions and Data Analysis	50.2	71.1	60.2	66.0	82.0	116.6	131.5
FY 2010 President's Budget Request	238.6	212.2	204.6	208.7	230.0	236.6	--
Solar Dynamics Observatory (SDO)	20.8	34.1	20.2	18.6	16.3	15.6	--
Radiation Belt Storm Probes (RBSP)	154.4	137.1	127.9	105.1	22.0	17.3	--
Solar Probe Plus	18.0	4.0	16.6	36.7	57.8	81.3	--
Other Missions and Data Analysis	45.3	37.0	39.8	48.3	134.0	122.4	--
Changes from FY 2010 Request	-16.0	28.0	9.6	-0.8	-13.5	6.4	--

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star

Program Overview

The Living with a Star (LWS) Program seeks to improve our understanding of how and why the Sun varies, how the Earth and solar system respond, and most importantly, how this variability and response affect life on Earth. This improved understanding of solar variability (i.e., space weather) and its effects will lead to a reliable predictive capability for space weather. This capability is essential to safe and successful future space exploration and increased use of complex technological systems to improve the safety and quality of life on the ground. LWS accomplishes its goals with a combination of new science missions and yearly science research grant opportunities.

The first mission of LWS, the Solar Dynamics Observatory (SDO) launched in FY 2010, will complement and improve upon major capabilities of the Solar and Helispheric Observatory (SOHO), launched in December 1995. SDO is designed to help us understand the Sun's influence on Earth and near-Earth space by studying the solar atmosphere on small scales of space and time and many wavelengths simultaneously.

The Sun's variable activity produces variability in the Earth's radiation belts. The second LWS mission, the Radiation Belt Storm Probes (RBSP), will analyze these belts in unprecedented detail. Two identical spacecraft in elliptical orbits will make simultaneous measurements of processes that accelerate and transport radiation particles as they transit through Earth's radiation belts. The RBSP results will enable the development of models for Earth's radiation belts and for other related but under-sampled planetary environments, such as Mars. Spacecraft and aeronautics engineers will apply the models to improve spacecraft design and to alert operators or pilots of predicted storms and ionizing radiation that could impact crew health or vehicle operations.

Two additional missions are currently developing mission concepts: the Solar Probe Plus (SPP) and the Solar Orbiter Collaboration (SOC) mission. Solar Probe Plus will explore the Sun from very close range (inside 10 solar radii) to improve our understanding of the generation and flow of the solar wind that links the Sun to the Earth and the solar system. The SOC, led by the European Space Agency, will investigate the links between the solar surface, corona, and inner heliosphere from as close as 45 solar radii, and image the side of the Sun not visible from Earth.

For more information, please see http://lws.gsfc.nasa.gov/.

Plans For FY 2011

The SDO mission will continue prime operations in space. The RBSP mission will complete manufacturing of flight hardware during the first quarter of this year and transition to integration and testing. The Solar Orbiter Collaboration and Solar Probe Plus missions will develop detailed requirements and further define their mission concepts during formulation. Solar Probe Plus will also continue to retire technology risk. The Space Environment Testbed awaits its upcoming launch in FY 2012. The BARREL project will use the results of the FY 2010 test campaign to fabricate 20 flight payloads for the first science campaign in FY 2013.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star

Project Descriptions and Explanation of Changes

Radiation Belt Storm Probes (RBSP)

The RBSP mission will improve the understanding of how solar storms interact with and change particles, fields, and radiation in Earth's Van Allen radiation belts and atmosphere. This knowledge could be applied to any planet in our solar system that has a magnetic core. This mission was recently approved to begin hardware fabrication and is scheduled to launch in May 2012. Additional detail can be found in the RBSP development section of this document.

Solar Probe Plus

The Solar Probe Plus mission is currently in formulation. It will perform the first in-situ measurements very close to the Sun (as close as 10 solar radii) to improve our understanding of the generation and flow of the solar wind that links the Sun to the Earth and the solar system. Instruments will be selected in FY 2010 in support of a FY 2018 launch. Additional detail can be found in the Solar Probe Plus formulation section of this document.

Other Missions and Data Analysis

Solar Dynamics Observatory (SDO): The SDO mission will launch February 2010 after a delay of 14 months due to problems securing a spot on the Atlas V launch vehicle manifest. SDO will investigate how the Sun's magnetic field is structured, as well as how its energy is converted and released into the heliosphere in the forms of solar wind, energetic particles, and variations in solar irradiance.

Space Environment Testbeds (SET): The Space Environment Testbeds (SET) will improve the engineering approach to accommodate and/or mitigate the effects of solar variability on spacecraft design and operations. It has two components: a data mining element that has been completed and a space flight mission. The flight mission is a testbed that has been integrated onto the Air Force Research Lab's Demonstration and Science Experiments (DSX) mission. The DSX launch is scheduled for FY 2012 as a secondary payload.

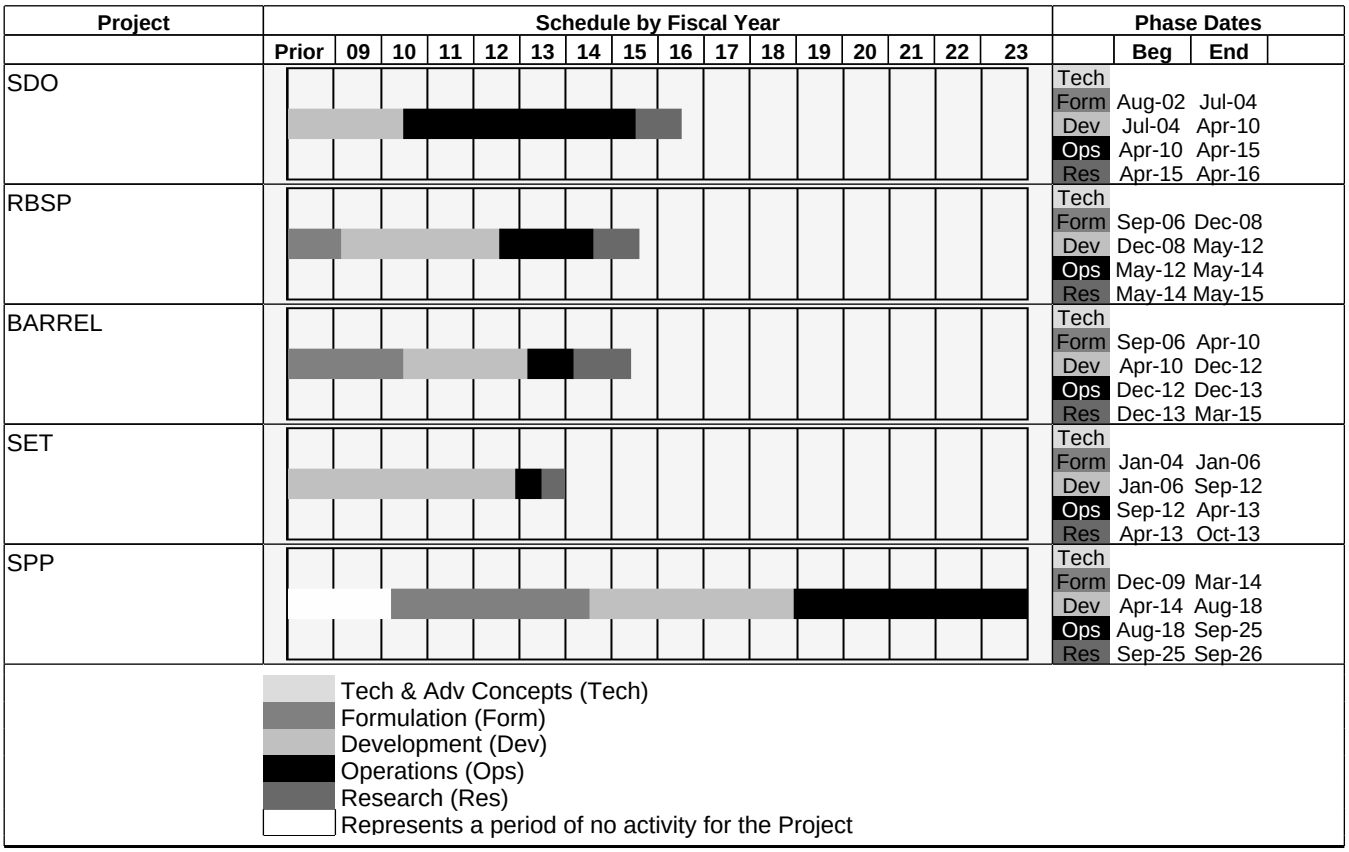
Balloon Array for Radiation-belt Relativistic Electron Losses (BARREL): BARREL is a balloon-based mission that will launch a series of science instruments to complement the measurements made on the Radiation Belt Storm Probes (RBSP) mission. BARREL will measure the precipitation of relativistic electrons from the radiation belts. Implementation responsibility has been assigned to the Wallops Balloon Program Office.

Solar Orbiter Collaboration (SOC): The Solar Orbiter Collaboration (SOC) is a joint mission with the European Space Agency (ESA) wherein ESA provides the spacecraft operations and majority of the instruments. The LWS Program provides the launch vehicle up to four science investigations. These instruments were selected in FY 2009 and will continue formulation work in FY 2011. The SOC will provide close-up views of the Sun's polar regions and its back-side, and tune its orbit to match the Sun's rotation. This will permit the spacecraft's instruments to observe emissions and solar wind from one specific area for much longer than currently possible and will provide more insight into the evolution of sunspots, active regions, coronal holes and other solar features and phenomenona than past missions.

Living with a Star Science: LWS science funds competitively-selected proposals that improve the understanding of the physics of the integrated system that links the Sun to the heliosphere and planetary atmospheres. This improved understanding will be achieved through data analysis supporting the development of new or revised theories and numerical models. This step is necessary for development of a predictive capability for space weather.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star

Implementation Schedule



Program Management

Program management responsibility for the LWS Program is assigned to the Goddard Space Flight Center(GSFC). Projects are managed by GSFC or Johns Hopkins University-Applied Physics Labortory (JHU-APL).

Project	Management Responsibility	NASA Center Performers	Cost-Sharing Partners
SDO	GSFC	GSFC	None
RBSP	JHU/APL	None	National Reconnaissance Office (NRO)
BARREL	GSFC	GSFC	None
Solar Probe Plus	JHU/APL	None	None
SOC	GSFC	GSFC	European Space Agency, ESA member states
SET	GSFC	GSFC	CNES (French Space Agency, Centre National d'Etudes Spatiales), DERA (Defence Evaluation and Research Agency)

Acquisition Strategy

LWS missions will be managed either by Goddard Space Flight Center (GSFC) or by Johns Hopkins University - Applied Physics Laboratory (JHU-APL). All missions will report to GSFC as the managing center for the program. The Science Mission Directorate Associate Administrator will determine which organization will manage each mission, and whether the spacecraft will be procured or built in-house at the managing organization for the mission.

Four instrument suites for the Radiation Belt Storm Probes (RBSP) were selected through full and open competition, and one instrument is being provided by the National Reconnaissance Office. The launch vehicle was selected through full and open competition, and the spacecraft is an in-house build at JHU/APL.

BARREL was selected through full and open competition through the same solicitation as the RBSP instruments. Two SET experiments were selected through full and open competition, and two were contributed by CNES and DERA.

NASA-led Solar Orbiter Collaboration (SOC) instruments were selected for Phase A using full and open competition as will the Solar Probe Plus (SPP) and SOC launch vehicles. The SPP spacecraft will be built in-house at JHU/APL.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO	02/2009	Overall assessment of the life cycle cost, schedule and deliverables of the LWS Program. Review board concluded that these programs have met their success criteria and should continue in accordance with their existing plans.	02/2011

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Development:	Radiation Belt Storm Probes (RBSP)

FY 2011 Budget Request

Budget Authority ($ millions)	Prior	FY 2009 Actual	FY 2010 Enacted	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	BTC	LCC TOTAL
FY 2011 President's Budget Request	**116.8**	**154.4**	**129.1**	**140.0**	**92.2**	**30.2**	**22.0**	**9.1**	**0.0**	**693.8**
Formulation	88.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.2
Development / Implementation	28.8	154.2	129.1	140.0	81.5	8.3	0.0	0.0	0.0	541.9
Operations / Close-out	0.0	0.0	0.0	0.0	10.7	21.9	22.0	9.1	0.0	63.7
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FY 2010 President's Budget Request	**116.8**	**154.4**	**137.1**	**127.9**	**105.1**	**22.0**	**17.3**	**--**	**5.2**	**685.8**
Formulation	88.0	0.2	0.0	0.0	0.0	0.0	0.0	--	0.0	88.2
Development / Implementation	28.8	154.2	137.1	127.9	85.9	0.0	0.0	--	0.0	533.9
Operations / Close-out	0.0	0.0	0.0	0.0	19.2	22.0	17.3	--	5.2	63.7
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	0.0	0.0
Changes from FY 2010 Request	**0.0**	**0.0**	**-8.0**	**12.1**	**-12.9**	**8.2**	**4.7**	**--**	**-5.2**	**8.0**
Formulation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	0.0	--
Development / Implementation	0.0	0.0	-8.0	12.1	-4.4	8.3	0.0	--	0.0	8.0
Operations / Close-out	0.0	0.0	0.0	0.0	-8.5	-0.1	4.7	--	-5.2	--
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	0.0	0.0

Note: The FY 2011 LCC number in the table above is overstated by $7.9M due to the difference between the FY 2010 enacted bill and the pending FY 2010 initial operating plan. Assuming approval of the initial operating plan, the estimated lifecycle cost will be $685.8M and the estimated development cost will be $533.9M

Explanation of Project Changes

RBSP was confirmed in CY 2008 to proceed into the development phase, and will still launch in May 2012. The total funding for RBSP did not change.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Development:	Radiation Belt Storm Probes (RBSP)

Project Purpose

The Radiation Belt Storm Probes (RBSP) mission will observe the fundamental processes that energize and transport radiation particles in Earth's inner magnetosphere (the area in and around the Earth's radiation belts). These dynamic processes operate throughout the universe at other planets and stars, and they continuously operate within Earth's immediate space environment.

The primary science objective of the RBSP mission is to provide understanding, ideally to the point of predictability, of how populations of relativistic electrons and penetrating ions in space form or change in response to variable inputs of energy from the Sun. The RBSP mission lifetime will provide sufficient local time, altitude, and event coverage to improve our understanding, and determine the relative significance of the various mechanisms that operate within the radiation belts.

RBSP observations will provide new knowledge on the dynamics and extremes of the radiation belts that are important to all technological systems that fly in and through geospace.

Project Parameters

The RBSP mission is comprised of two identical spacecraft in elliptical, low-inclination orbits that travel independently through Earth's radiation belts to distinguish time and space variations in the measured ions, electrons, and fields.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Development:	Radiation Belt Storm Probes (RBSP)

Project Commitments

The Radiation Belt Storm Probes (RBSP) project will launch two identical spacecraft in FY 2012 to begin a two-year prime mission.

Project Element	Provider	Description	FY 2010 PB Request	FY 2011 PB Request
EELV	KSC	Deliver a spacecraft to operational orbit	Same	Same
Energetic Particle, Composition and Thermal Plasma Suite (ECT)	Boston University	Measure the electron & ion spectra & composition to understand the electron & ion changes	Same	Same
Radiation Belt Storm Probes Ion Composition Experiment (RBSPICE)	New Jersey Institute of Technology	Measure the ring current in the magnetosphere during geomagnetic storms	Same	Same
Electric and Magnetic Field Instrument Suite and Integrated Science (EMFISIS)	University of Iowa	Measure the magnetic fields & plasma waves	Same	Same
Electric Field and Waves Instrument for the NASA RBSP Mission (EFW)	University of Minnesota	Measure the electric fields in the radiation belts	Same	Same
Proton Spectrometer Belt Research (PSBR)	National Reconnaissance Office	Measure the inner Van Allen belt protons	Same	Same
Spacecraft	JHU-APL	Operate science instruments in high radiation; transmit science data to ground	Same	Same
Ground System	Primary ground station at JHU/APL; instrument operation is distributed among investigators	Receive science data from two spacecraft; distribute to archive	Same	Same

Schedule Commitments

The RBSP project was authorized to begin formulation in September 2006 when the selections for science investigations were announced. It was confirmed to proceed into development on December 19, 2009. Schedule details are still under development and are subject to change.

Milestone Name	Confirmation Baseline	FY 2010 PB Request	FY 2011 PB Request
Development			
Begin Implementation	January 2009	January 2009	January 2009
Critical Design Review	December 2009	December 2009	December 2009
System Integration Review	November 2010	November 2010	November 2010
Launch Readiness Review	May 2012	May 2012	May 2012

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Development:	Radiation Belt Storm Probes (RBSP)

Development Cost and Schedule Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Radiation Belt Storm Probes (RBSP)	2009	533.9	2010	533.9	0	Launch Readiness	05/2012	05/2012	0

Development Cost Details

Development cost details are still under work by the project and are subject to change.

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**533.9**	**533.9**	**0.0**
Spacecraft	85.6	85.6	0.0
Payload	95.4	95.4	0.0
System I&T	36.9	36.9	0.0
Launch Vehicle	133.6	133.6	0.0
Ground System	16.3	16.3	0.0
Science/Technology	3.1	3.1	0.0
Other	163.0	163.0	0.0

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Development:	Radiation Belt Storm Probes (RBSP)

Project Management

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Ground Systems	APL	None	None
Data Analysis	APL	None	National Reconnaissance Office
Instrument Development	APL	None	National Reconnaissance Office
Spacecraft design, integration with instrument, and test	APL	None	None
Mission Operations	APL	None	None
Expendable Launch Vehicle	KSC	None	None

Acquisition Strategy

The RBSP spacecraft and ground system are being designed, developed, and tested at the JHU-APL. The acquisition of sub-contracted spacecraft sub-assemblies, components, and parts is through procurement contracts issued by the JHU-APL Procurement Office. Instrument development participants include the University of Iowa, University of Minnesota, New Jersey Institute of Technology, and Boston University, as well as contributions from the National Reconnaissance Office and the Czech Republic.

The ground system components were defined during the formulation phases (Phases A and B) and include a mission operations center at the JHU-APL.

The Energetic Particle, Composition and Thermal Plasma Suite (ECT), Electric and Magnetic Field Instrument Suite and Integrated Science (EMFISIS), Electric Field and Waves Instrument for the NASA RBSP Mission (EFW), and Radiation Belt Storm Probes Ions Composition Experiment (RBSPICE) science investigations were procured through the Announcement of Opportunity process. The Proton Spectrometer Belt Research (PSBR) instrument is being contributed through an agreement with the National Reconnaissance Office.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	Senior Review Board	10/2008	Preliminary Design Review. Review concluded that the RBSP design was sufficiently mature to proceed to KDP-C.	12/2009
Performance	SRB	12/2009	Critical Design Review: Review concluded that there were no significant issues in the project should continue as planned.	11/2010

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Development:	Radiation Belt Storm Probes (RBSP)

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Complete Electric and Magnetic Field Instrument Suite and Integrated Science End-to-End Testing	Electric and Magnetic Field Instrument Suite and Integrated Science (EMFISIS) main Electronics Box Engineering Model 2(EM2) needs to be successfully integrated and tested per the EM2 test plan and schedule. If not the flight build and delivery will be delayed.	Hold Flight Manufacturing Readiness Reviews. Complete Electronics Box Engineering Model 2 environmental testing and characterization. Complete EM2 Integration and Test Peer Review.
XCVR Qualification Program	If the Transceiver qual program does not perform to their re-plan schedule, then the Project's Integration and Test schedule will be delayed.	Provide bi-weekly schedule updates to the Integrated Master Schedule. Burn Qualification Model on the RTAX, the field programmable gate array. Conduct Engineering Design Review of Qual Model.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Formulation:	Solar Probe Plus

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	18.0	40.0	14.1	49.7	104.3	104.4	148.2
FY 2010 President's Budget Request	18.0	4.0	16.6	36.7	57.8	81.3	--
Total Change from 2010 President's Budget Request	0.0	36.0	-2.6	13.0	46.5	23.0	--

Project Purpose

Solar Probe Plus will be an extraordinary and historic mission, exploring the Sun's outer atmosphere, or corona, as it extends out into space. Approaching as close as 9.5 solar radii, Solar Probe Plus will repeatedly sample the near-Sun environment, revolutionizing our knowledge and understanding of coronal heating and of the origin and evolution of the solar wind, answering critical questions in heliophysics that have been ranked as top priorities for decades. Moreover, by making direct, in-situ measurements of the region where some of the most hazardous solar energetic particles are energized, Solar Probe Plus will make a fundamental contribution to our ability to characterize and forecast the radiation environment in which future space explorers will work and live.

For more information please see Solar Probe project at
http://nasascience.nasa.gov/missions/solar_probe.

Project Preliminary Parameters

The first near-Sun pass occurs three months after launch, at a heliocentric distance of 35 Rs (Solar Radius). Over the next several years successive Venus gravity assist maneuvers will gradually lower the spacecraft's near-Sun pass to approximately 9.5 Rs, by far the closest any spacecraft has ever come to the Sun. With an August 2018 launch, Solar Probe Plus will spend, during its seven year mission, a total of 30 hours inside 10 Rs, 961 hours inside 20 Rs, and 2149 hours inside 30 Rs, sampling the solar wind as it evolves with rising solar activity toward an increasingly complex structure.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Formulation:	Solar Probe Plus

Estimated Project Deliverables

Solar Probe will launch from KSC on an EELV in FY 2018, with an expected mission duration of 7 years.

Project Element	Provider	Description	FY 2010 PB Request	FY 2011 PB Request
EELV	KSC	Deliver the spacecraft to operational orbit	Same	Same
Ground Systems	APL	Receive science data and telemetry from spacecraft, command spacecraft, distribute science data to investigator teams	Same	Same
Spacecraft	APL	Transport instruments to science destination, operate instruments, modify orbit including several Venus gravity	Same	Same
Instruments	NASA-funded investigators	Perform in situ measurements and remote observations of the Sun	Same	Same

Estimated Project Schedule

Solar Probe Plus received approval to proceed to Phase A in November 2009 and Announcement of Opportunity to solicit science investigations in December 2009. NASA anticipates announcing these selections in the fall of 2010. Phase B will begin in July 2011 following a successful preliminary Non-Advocate Review (PNAR).

Milestone Name	Formulation Agreement Estimate	FY 2010 PB Request	FY 2011 PB Request
Formulation			
Mission Definition Review /PNAR	01/2012	04/2012	05/2011
Preliminary Design Review/NAR	01/2014	N/A	01/2014
Critical Design Review	01/2016	N/A	11/2015
Launch	08/2018	08/2018	Same

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Living with a Star
Project In Formulation:	Solar Probe Plus

Project Management

Johns Hopkins University/Applied Physics Laboratory (JHU/APL) will manage the project. GSFC is responsible for program management and science management

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Instrument	APL	TBD	None
EELV	APL	KSC	None
Spacecraft	APL	None	None
Mission Operations	APL	None	None

Acquisition Strategy

A Solar Probe Plus Announcement of Opportunity will be used to acquire the science investigations. The spacecraft will be built by JHU-APL with the spacecraft subassemblies, components, and parts procured by JHU-APL. The ground system components will be defined during formulation and will be determined by the implementing organization for the project. The Phase E contracts will be managed by GSFC.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	SRB	09/2009	SRB approved the project to proceed into Phase A.	05/2011

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
1. Thermal Protection System (TPS) thermal Performance	If TPS thermal conductivity is greater than required and/or the coating performance is less than required, the cooling system and s/c radiators may not be able to remove sufficient heat, leading to elevated solar array and s/c temperature.	- Coating development work - Early materials characterization - Early manufacture and test of prototype articles - Increased TPS thickness
2. Solar Cell and Array Performance	If solar cell and array performance in the near-Sun environment is less than expected, power system performance may not meet requirement and/or cooling system requirements may increase	- Cell technology development work - Extensive power system and solar cell modeling and test - Parallel approaches to development and design - Margins in power and cooling system design - Prototype development

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes

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	**143.0**	**143.0**	**162.9**	**175.1**	**178.5**	**161.7**	**121.4**
Magnetospheric Multiscale (MMS)	**115.9**	**118.6**	**143.8**	**155.8**	**158.9**	**141.4**	**96.1**
Other Missions and Data Analysis	**27.1**	**24.4**	**19.1**	**19.3**	**19.6**	**20.3**	**25.3**
FY 2010 President's Budget Request	**123.1**	**143.0**	**169.1**	**170.6**	**160.8**	**164.3**	**--**
Magnetospheric Multiscale (MMS)	**94.6**	**118.6**	**149.3**	**148.8**	**137.5**	**143.8**	**--**
Other Missions and Data Analysis	**28.5**	**24.4**	**19.8**	**21.8**	**23.3**	**20.5**	**--**
Changes from FY 2010 Request	**19.9**	**0.0**	**-6.3**	**4.5**	**17.7**	**-2.6**	**--**

Program Overview

Solar Terrestrial Probes (STP) provide understanding of the fundamental plasma processes inherent in all astrophysical systems. To accomplish this goal, STP investigations focus on specific scientific areas that will help us understand how plasma behaves in the space between the Sun and Earth. STP missions address processes such as the variability of the Sun, the responses of the planets to these variations, and the interaction of the Sun and solar system. STP missions are strategically defined and investigations are competitively selected. Strategic mission lines afford the space physics community the opportunity to plan specific missions to address important research focus areas and thus make significant progress in elucidating the fundamental processes of Heliophysics.

For more information please see Solar Terrestrial Probes Program at http://stp.gsfc.nasa.gov/.

Plans For FY 2011

The Magnetospheric Multiscale Mission will continue the implementation phase. The STEREO mission will commence joint observations with SDO.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes

Project Descriptions and Explanation of Changes

Magnetospheric Multiscale (MMS)

MMS is a four-spacecraft mission planned for launch in March 2015 with a two-year mission life. MMS is designed to study magnetic reconnection in key boundary regions of the Earth's magnetosphere. Reconnection is a fundamental process that occurs throughout the universe, by which magnetic energy is converted into heat, radiation, and particle acceleration. The best laboratory for understanding this process is the Earth's magnetosphere, where reconnection between the Earth's and Sun's magnetic fields power magnetic storms, and substorms on our planet. The spacecraft will probe the regions of geospace most critical to measuring reconnection. Additional detail can be found in the Magnetospheric Multiscale Project development section of this document.

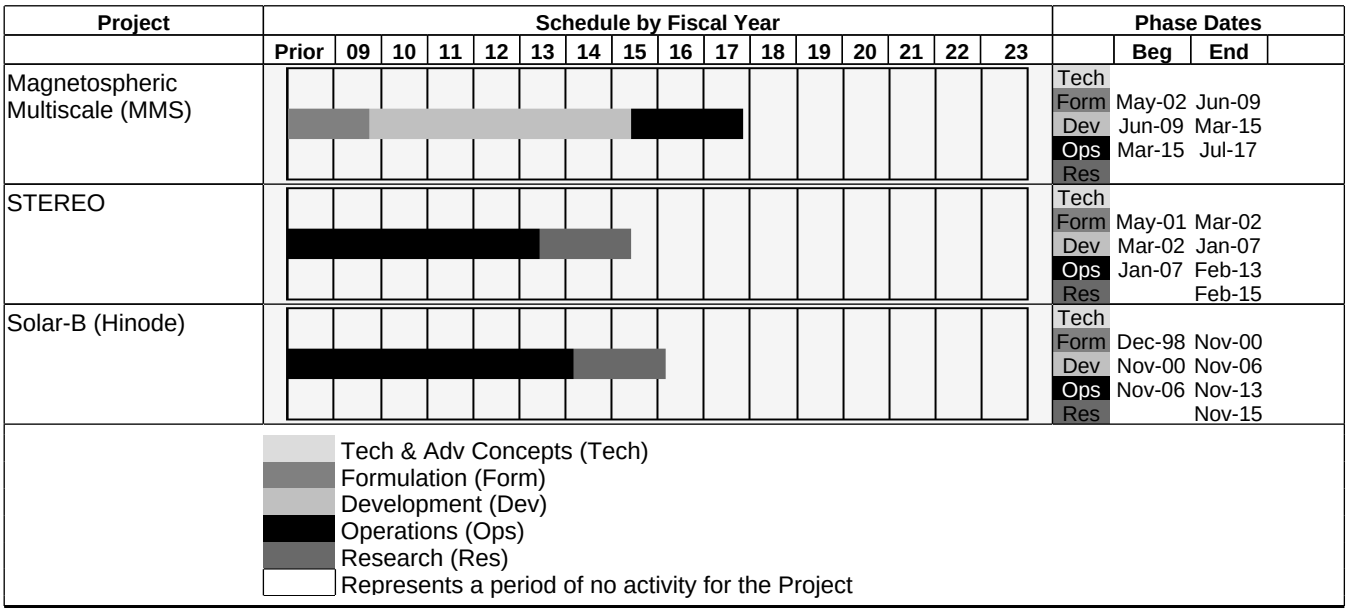
Other Missions and Data Analysis

Solar TErrestrial RElations Observatory (STEREO): Launched on October 25, 2006, STEREO is now an operating mission employing two nearly identical observatories to provide three-dimensional measurements of the Sun to study the nature of coronal mass ejections. These powerful eruptions are a major source of the magnetic disruptions on Earth and a key component of space weather, which can greatly affect satellite operations, communications, power systems, the lives of humans in space, and global climate.

Solar B (Hinode): Hinode launched on September 22, 2006, from Japan's Uchinoura Space Center to begin its mission to explore the magnetic fields of the Sun. NASA developed three science instrument components: the Focal Plane Package (FPP), the X-Ray Telescope (XRT), and the Extreme Ultraviolet Imaging Spectrometer (EIS) and provides operations support for science planning and instrument command generation activities. A follow-on to the highly successful Japan/US/UK Yohkoh (Solar-A) satellite that operated between 1991 and 2001, Hinode consists of a coordinated set of optical, Extreme-Ultraviolet (EUV), and X-ray instruments that will investigate the interaction between the Sun's magnetic field and its corona.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes

Implementation Schedule



Program Management

Program management responsibility for the STP Program is assigned to the Goddard Space Flight Center (GSFC).

Project	Management Responsibility	NASA Center Performers	Cost-Sharing Partners
MMS	GSFC	GSFC	Austria, Sweden, France,Japan
STEREO	GSFC	None	United Kingdom

Acquisition Strategy

STP missions are strategically defined and investigations are competitively selected. The STP uses full and open competitions to the greatest extent possible for the acquisition of scientific instruments, spacecraft, and science investigations, including research and analysis.

The MMS spacecraft will be built in-house at GSFC and GSFC will also provide mission Operations Center. The Southwest Research Institute (SwRI) is the single MMS instrument suite contractor, selected through a full and open competition. All instruments are developed by the SwRI team which includes SwRI, their subcontractors, their international partners, and GSFC.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO	02/2009	Overall assessment of life cycle cost, schedule and deliverables of the STP Program. Review board concluded that this program has met the success criteria and should continue in accordance with their existing plans.	02/2011

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes
Project In Development:	Magnetospheric Multiscale (MMS)

FY 2011 Budget Request

Budget Authority ($ millions)	Prior	FY 2009 Actual	FY 2010 Enacted	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	BTC	LCC TOTAL
FY 2011 President's Budget Request	**110.2**	**115.9**	**118.6**	**143.8**	**155.8**	**158.9**	**141.4**	**96.1**	**36.0**	**1,076.7**
Formulation	108.5	64.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	173.0
Development / Implementation	1.7	51.4	118.6	143.8	155.8	158.9	141.4	79.8	0.0	851.4
Operations / Close-out	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.3	36.0	52.3
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FY 2010 President's Budget Request	**110.1**	**94.6**	**118.6**	**149.3**	**148.8**	**137.5**	**143.8**	**--**	**90.5**	**993.0**
Formulation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	0.0	--
Development / Implementation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	0.0	--
Operations / Close-out	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	0.0	--
Other	110.1	94.6	118.6	149.3	148.8	137.5	143.8	--	90.5	993.0
Changes from FY 2010 Request	**0.1**	**21.3**	**0.0**	**-5.6**	**7.0**	**21.4**	**-2.4**	**--**	**-54.5**	**83.6**
Formulation	108.5	64.5	0.0	0.0	0.0	0.0	0.0	--	0.0	173.0
Development / Implementation	1.7	51.4	118.6	143.8	155.8	158.9	141.4	--	0.0	851.4
Operations / Close-out	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	36.0	52.3
Other	-110.1	-94.6	-118.6	-149.4	-148.8	-137.5	-143.8	--	-90.5	-993.1

Note: The FY 2011 LCC number in the table above is understated by $6M due to the difference between the FY 2010 enacted bill and the pending FY 2010 initial operating plan. Assuming approval of the initial operating plan, the estimated lifecycle cost will be $1082.7M, and the estimated development cost will be $857.4M.

Explanation of Project Changes

MMS KDP-C decision resulted in a more conservative estimate and funding profile.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes
Project In Development:	Magnetospheric Multiscale (MMS)

Project Purpose

The Magnetospheric Multiscale (MMS) Project will use four identically instrumented spacecraft to perform the first definitive study of magnetic reconnection in space. Reconnection occurs in all astrophysical plasma systems but can be studied efficiently only in the Earth's magnetosphere. It is thought to be of great importance for energy transfer throughout the universe and is an efficient and fast acceleration mechanism. Reconnection is the primary process by which energy is transferred from the solar wind to Earth's magnetosphere and is the critical physical process determining the size of a space weather geomagnetic storm. MMS will determine why magnetic reconnection occurs, where it occurs, how it varies, how magnetic energy is coupled into heat and particle kinetic energy, and how this energy is coupled into the surrounding plasma.

For more information see http://stp.gsfc.nasa.gov/missions/mms/mms.htm.

Project Parameters

The MMS instrument payload will measure electric and magnetic fields and plasmas within the small-scale diffusion regions where magnetic reconnection occurs. High temporal and spatial resolution measurements will permit direct observation of these physical processes. The four spacecraft and instrument suites have identical design requirements. A two-phase, low-inclination orbit will probe both the dayside magnetopause and the nightside magnetotail neutral sheet where reconnection is known to frequently occur. The primary target of Phase 1 is the dayside magnetopause reconnection region. Phase 2 will focus on the near-Earth neutral line in the magnetotail. The four spacecraft will fly in a tetrahedron formation and the separation between the observatories will be adjustable over a range of 10 to 400 kilometers during science operations in the area of interest. The mission design life is two years.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes
Project In Development:	Magnetospheric Multiscale (MMS)

Project Commitments

NASA plans to launch four identically-instrumented spacecraft on an Evolved Expendable Launch Vehicle (EELV) into a highly elliptical Earth orbit in March 2015 and begin two years of scientific measurements that will enable an understanding of fundamental plasma physics processes associated with magnetic reconnection.

Project Element	Provider	Description	FY 2010 PB Request	FY 2011 PB Request
Launch Vehicle	KSC	Deliver ~4,000-kg payload consisting of 4 observatories to a highly elliptical Earth orbit	Same	Same
Ground Systems	GSFC	Provide during operations minimum science data payback of ~4 Gbits of data per observatory each day.	Same	Same
Spacecraft	GSFC	Deliver high-rate data from instruments to ground station with a high accuracy for 2 years	Same	Same
Electric Field Instruments	UNH	Provide measurements of electric fields (time resolution 1 ms) and magnetic fields (time resolution 10 ms)	Same	Same
Fast Plasma Investigation	GSFC	Provide plasma wave measurements (electric vector to 100 KHz).	Same	Same
Energetic Particle Detectors	JHU/APL	Provide high-resolution measurement of energetic particles	Same	Same
Hot Plasma Composition Analyzers	Southwest Research Institute	Three-dimensional measurements of hot plasma composition (time resolution 10s).	Same	Same
Science Operations Center	LASP	Science data to the community and archive	Same	Same

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes
Project In Development:	Magnetospheric Multiscale (MMS)

Schedule Commitments

Magnetospheric Multiscale (MMS) began formulation in FY 2002 and the project's Confirmation Review was held in June 2009 when the project was approved to enter implementation. As a result of the confirmation review, the launch date was moved to March 2015. The Mission Critical Design Review is planned for August 2010.

Milestone Name	Confirmation Baseline	FY 2010 PB Request	FY 2011 PB Request
Formulation			
Mission Definition Review	September 2007	Same	Same
Initial Confirmation Review	November 2007	Same	Same
Development			
Confirmation Review	June 2009	Same	Same
Critical Design Review	August 2010	N/A	Same
System Integration review	January 2012	N/A	Same
Launch	March 2015	October 2014	March 2015

Development Cost and Schedule Summary

Magnetospheric Multiscale(MMS)

Project	Base Year	Base Year Development Cost Estimate ($M)	Current Year	Current Year Development Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Magnetospheric Multiscale (MMS)	2010	857.4	2010	857.4	0	Launch Readiness	03/2015	03/2015	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**857.4**	**857.4**	**0.0**
Payload	131.9	131.9	0.0
Spacecraft	169.0	172.3	3.3
Systems I&T	55.3	55.3	0.0
Ground Systems	19.1	19.1	0.0
Science/Technology	19.9	19.9	0.0
Other (Project Management)	268.0	264.7	-3.3
Launch Services	194.2	194.2	0.0

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Solar Terrestrial Probes
Project In Development:	Magnetospheric Multiscale (MMS)

Project Management

The Goddard Space Flight Center (GSFC) has program management responsibility for the Solar Terrestrial Probes Program and Project Management responsibility for the MMS project.

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Four Instrument Suites	GSFC, Southwest Research Institute	GSFC	Austrian Space Agency, Sweden (SNSB), France (CNES), and Japan (JAXA)
Launch Vehicle	KSC	KSC	None
Four Spacecraft	GSFC	GSFC	None
Mission Operations	GSFC	GSFC	None
Science Operations	GSFC, LASP	None	None

Acquisition Strategy

The MMS spacecraft is being designed, developed, and tested in-house at GSFC using a combination of GSFC civil servants and local support service contractors. The acquisition of subcontracted spacecraft sub-assemblies, components, and parts is through procurement contracts issued by the MMS Procurement office. Instrument development activities are under contract with the Southwest Research Institute (SwRI). Instrument development subcontracts include Lockheed Martin, JAXA/MEISEI, University of New Hampshire, Johns Hopkins University/Applied Physics Laboratory, Aerospace Corporation, and a team at GSFC. The Mission Operations Center and the Flight Dynamics Operations Area will be developed and operated at GSFC using a combination of GSFC civil servants and local support service contractors. The Science Operations Center for the Instruments will be developed and operated at the Laboratory for Atmospheric and Space Physics at the University of Colorado and is under contract to SwRI.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO	05/2009	The Critical Design Review (CDR), a NPR 7120.5D review will assess the technical, cost, and schedule status of MMS.	08/2010

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
MMS Instrument International Partership Risk	A component of the Sweden team with the Fields Investigation on the MMS instrument suite is at risk. Inadequate technical and programmatic progress. Design is not mature. No detailed schedule. Insufficient mission assurance.	GSFC/SwRI/UNH provide management and technical support. Assess progress. Decide on need for alternate vendor. Select new SDP supplier.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Explorer Program

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	**34.8**	**69.4**	**97.7**	**99.2**	**116.1**	**126.8**	**167.8**
IRIS	**15.0**	**0.0**	**69.0**	**37.6**	**9.2**	**7.3**	**1.2**
Other Missions and Data Analysis	**19.8**	**69.4**	**28.7**	**61.6**	**106.9**	**119.5**	**166.5**
FY 2010 President's Budget Request	**31.4**	**69.4**	**119.7**	**158.1**	**161.3**	**167.4**	**--**
Other Missions and Data Analysis	**31.4**	**69.4**	**119.7**	**158.1**	**161.3**	**167.4**	**--**
Changes from FY 2010 Request	**3.4**	**0.0**	**-21.9**	**-58.9**	**-45.2**	**-40.5**	**--**

Note: Budget of $169 million for GEMS has been transferred from Heliophysics to Astrophysics Division.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Explorer Program

Program Overview

The Heliophysics Explorer Program provides frequent flight opportunities for world-class astrophysics and space physics investigations using innovative and streamlined management approaches for spacecraft development and operations. Explorer missions are highly responsive to new knowledge, new technology, and updated scientific priorities by launching smaller missions that can be conceived and executed in a relatively short development cycle. Priorities are based on an open competition of concepts solicited from the scientific community.

The program also enables participation in missions of opportunity provided by other U.S. or international agencies. The program emphasizes missions that can be accomplished under the control of the scientific research community within constrained mission life-cycle costs. The program also seeks to enhance public awareness of space science by incorporating educational and public outreach activities into each mission. All investigations are competitively selected. Full missions can either be Medium-Class Explorers (MIDEX) or Small Explorers (SMEX). Mission of Opportunity (MO) space science investigations are typically instruments flown as part of a non-NASA space mission. MOs are conducted on a no-exchange-of-funds basis with the organization sponsoring the mission.

Following the commissioning and checkout phase of the spacecraft, HQ management responsibility for the operational phase transitions to the Heliophysics Research Program. While the Research Program assumes management responsibilities, funds for operating missions are provided by the Explorer Program.

The Heliophysics Explorer Program made two full mission selections from its SMEX Announcement of Opportunity (AO) competition during FY 2009. The Interface Region Imaging Spectrograph (IRIS) is a Heliophysics small explorer mission scheduled for launch in CY 2012. The Gravity and Extreme Magnetism SMEX (GEMS) is an Astrophysics small explorer mission selected for launch in FY 2014.

The Interstellar Boundary Explorer (IBEX) launched in October 2008 is now operating. The Coupled Ion Neutral Dynamics Investigation (CINDI), and Two Wide-angle Imaging Neutral-atom Spectrometers B (TWINS) were also launched in FY 2008 and conducting prime science operations.

The Explorer Program also has four Explorer missions currently in the Astrophysics Division. Details and the associated budget can be found in the Astrophysics Division section. For more information on any of the Explorer mission and new science discoveries, please see http://explorers.gsfc.nasa.gov/missions.html

Plans For FY 2011

The newly selected SMEX mission, IRIS will progress towards its development phase. The IBEX mission will complete its mission criteria, and will continue its primary science mission of mapping the heliosphere and uncovering the global interaction between the solar wind and the interstellar medium. TWINS and CINDI will both enter their third year on orbit. THEMIS and AIM will continue their extended Phase E operations (subject to the outcome of the FY 2010 Heliophysics Senior Review for operating missions).

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Explorer Program

Project Descriptions and Explanation of Changes

IRIS

The Interface Region Imaging Spectrograph (IRIS) is a Small-Class Explorer (SMEX) selected in June 2009 and expected to launch December 2012. This mission opens a window of discovery by tracing the flow of energy and plasma through the chromosphere and transition region into the corona. IRIS will revolutionize our understanding of energy transport into the corona and solar wind and provide an archetype for all stellar atmospheres. The unique instrument capabilities, coupled with state of the art 3-D modeling, will fill a large gap in our knowledge of this dynamic region of the solar atmosphere. The mission will greatly extend the scientific output of existing heliophysics spacecraft that follow the effects of energy release processes from the sun to Earth.

Other Missions and Data Analysis

Aeronomy of Ice in Mesophere (AIM): The primary objective of the AIM mission is to understand why polar mesospheric clouds (PMCs) form and why they vary. AIM will also determine the causes of Earth's highest-altitude clouds, which form in the coldest part of the atmosphere about 50 miles above the polar regions every summer. AIM launched on April 25, 2007, on board a Pegasus XL from Vanderberg Air Force Base and completed it's prime mission in FY 2009. This mission supplies spectacular data, which has led to new science discoveries.

Coupled Ion-Neutral Dynamics Investigation (CINDI): CINDI is a NASA-sponsored Mission of Opportunity (MO) managed by the University of Texas at Dallas (UTD). CINDI will discover the role of ion-neutral interactions in the generation of small- and large-scale electric fields in Earth's upper atmosphere. In addition, the CINDI instruments will provide measurements of the three-dimensional neutral winds and ion drifts. This mission launched April 16, 2008, aboard the Air Force Research Laboratory's Communication/Navigation Outage Forecast System (C/NOFS) spacecraft.

Interstellar Boundary Explorer (IBEX): IBEX allows the first glimpse into the edge of the solar system, where the solar wind interacts with winds from other stars. This region is a breeding ground for anomalous cosmic rays that form a component of energetic particles from beyond the solar system that may pose health and safety hazards for humans exploring beyond Earth's orbit. IBEX will make observations from an elliptical Earth orbit that takes it beyond the interference of Earth's magnetosphere. IBEX launched on October 5, 2008, on a Pegasus XL from Kwajalein. The IBEX spacecraft has made it possible for scientists to construct the first comprehensive sky map of our solar system and its location in the Milky Way galaxy. The new view will change the way researchers view and study the interaction between our galaxy and sun.

Time History of Events and Macroscale Interactions during Substorms (THEMIS): THEMIS has provided breakthroughs in our understanding of the onset and evolution of magnetospheric substorms. NASA's THEMIS mission uses five identical micro-spacecraft (probes) to answer the fundamental questions regarding magnetospheric substorm instability, a dominant mechanism of transport and explosive release of solar wind energy within geospace. In addition to addressing its primary objective, THEMIS answers critical questions in radiation belt physics and solar wind-magnetosphere energy coupling. THEMIS is a Medium-Class Explorers(MIDEX) mission that launched on February 17, 2007.

Two Wide-angle Imaging Neutral-atom Spectrometers (TWINS): TWINS will provide the second half of the stereo imaging capability of Earth's magnetosphere in conjunction with the TWINS-A mission. The region surrounding the planet is controlled by its magnetic field and contains the Van Allen radiation belts and other energetic charged particles. TWINS-B will enable three-dimensional global visualization of this region, which will lead to a greatly enhanced understanding of the connections between different regions of the magnetosphere and their relation to the solar wind. TWINS-B was launched as a NASA-sponsored Mission of Opportunity in February 2008.

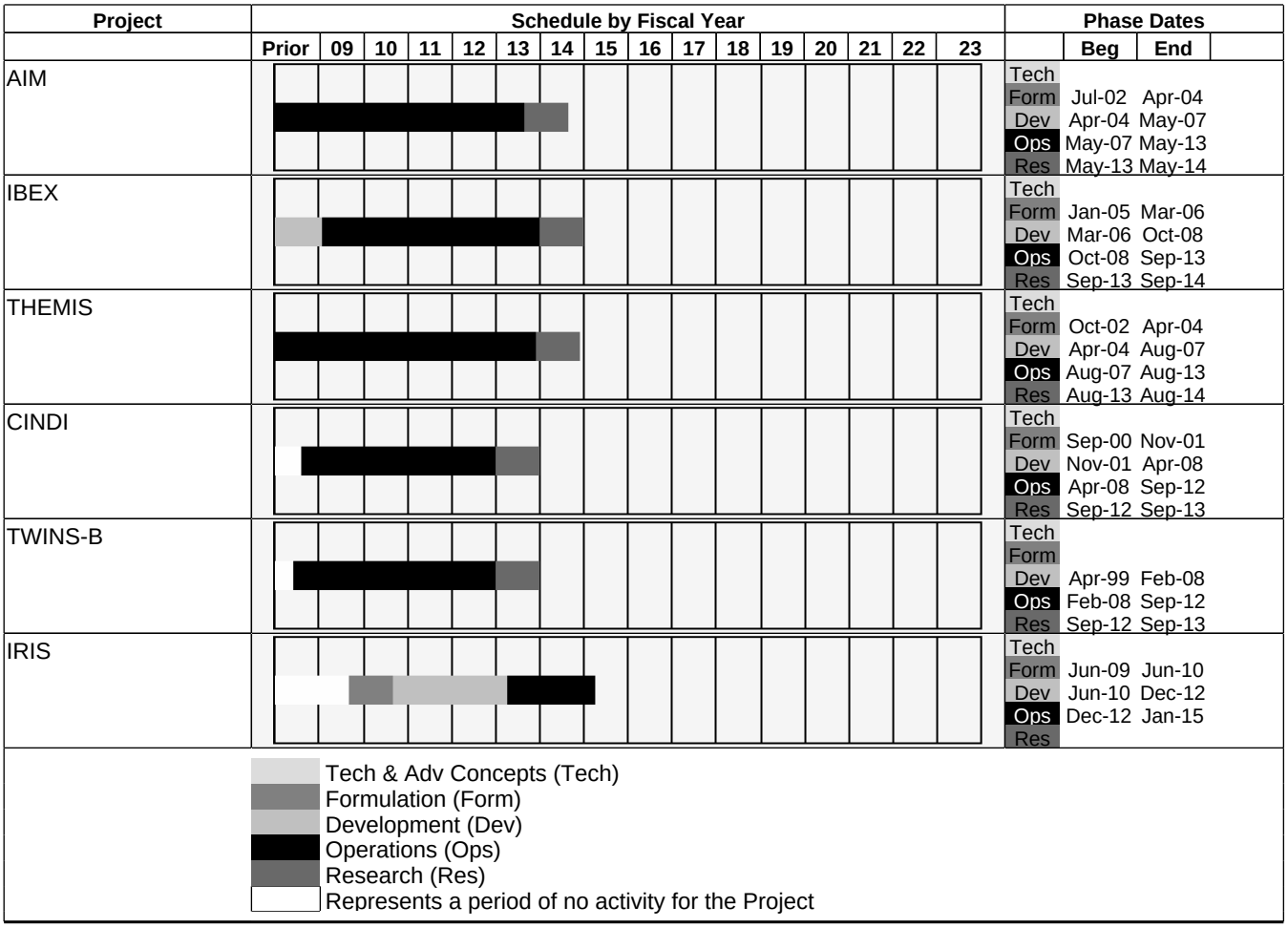
Explorer Future Missions: The Program funds future Explorer mission selections for the Medium-Class Explorers (MIDEX), the Small Explorer (SMEX), and Mission of Opportunity (MO).

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Explorer Program

Program Commitments

Commitment/Output FY 2011	Program/Project	Changes from FY 2010 PB Request
Release Explorer Announcement of Opportunity	Explorer Future Mission	New

Implementation Schedule



Program Management

Goddard Space Flight Center (GSFC) has Program Management responsibility for all Heliophysics Explorer Programs.

Project	Management Responsibility	NASA Center Performers	Cost-Sharing Partners
AIM	GSFC	None	N/A
IBEX	GSFC	GSFC	N/A
THEMIS	GSFC	None	N/A
CINDI	GSFC	None	DoD
TWINS-B	GSFC	None	DoD
IRIS	GSFC	AMES	N/A

Acquisition Strategy

The Heliophysics Explorer Program has established an acquisition strategy that contracts for the whole mission (concept through delivery of science data and analysis), with emphasis on performance incentives and a cost cap for each mission.

Investigations are selected through the Announcement of Opportunity (AO) process, where multiple investigations are selected competitively for initial concept studies with a competitive down-select to proceed to the next stage of formulation. The investigations are selected to proceed from one phase to the next through execution of contract options, based on successful technical, cost, and schedule performance in the previous phases.

The following selection has been made for development:
IRIS: Lockheed Martin Space Systems Company and NASA AMES Research Center

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	Space Science Support Office	06/2009	Reviewed and evaluated Small Explorers (SMEX) Announcements of Opportunity proposals for selection. Written evaluations were provided and IRIS mission was selected for development as the next SMEX mission.	01/2011
Performance	IPAO	02/2009	Overall assessment of life cycle cost, schedule and deliverables of the Explorer Program. Review board concluded that these programs have met their success criteria and should continue in accordance with their existing plans.	02/2011

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Explorer Program
Project In Formulation:	Interface Region Imaging Spectograph (IRIS)

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	**15.0**	**0.0**	**69.0**	**37.6**	**9.2**	**7.3**	**1.2**
Total Change from 2010 President's Budget Request	**15.0**	**0.0**	**69.0**	**37.6**	**9.2**	**7.3**	**--**

Project Purpose

Understanding the interface between the photosphere and corona remains a fundamental challenge in solar and heliospheric science. The Interface Region Imaging Spectrograph mission will use a solar telescope and spectrograph to explore the solar chromospheres. This mission opens window of discovery into this crucial region by tracing the flow of energy and plasma through the chromosphere and transition region into the corona using spectrometry and imaging. Recent discoveries have shown the chromosphere is significantly more dynamic and structured than previously thought. IRIS will revolutionize our understanding of energy transport into the corona and solar wind and provide an archetype for all stellar atmospheres. The unique instrument capabilities, coupled with state of the art 3-D modeling, will fill a large gap in our knowledge of this dynamic region of the solar atmosphere. The mission will greatly extend the scientific output of existing heliophysics spacecraft that follow the effects of energy release processes from the sun to Earth.

Project Preliminary Parameters

IRIS is a sun-pointed mission that studies the chromospheres in the FUV & NUV with 0.33 arcsec spatial resolution, 0.4 km/v velocity resolution and a FOV of 171 arcsec. This 2-year mission fills in critical gap by providing simultaneous, co-spatial and comprehensive coverage from photosphere (~4,500K) up to corona (<= 10 MK). IRIS has a 20-cm UV telescope which has 1/6 arcsec pixels, a multi-channel spectrograph and a slit-jaw imaging.

Estimated Project Deliverables

Project Element	Provider	Description	FY 2010 PB Request	FY 2011 PB Request
Ground Systems	Lockheed Martin Space Systems Company	Receive science data and telemetry from spacecraft, command spacecraft, distribute science data to investigator teams	N/A	NEW
Spacecraft	Lockheed Martin Space Systems Company	Transport instruments to science destination, operate instruments	N/A	NEW
Instruments	Lockheed Martin Space Systems Company	Perform in situ measurements and remote observations of the Sun	N/A	NEW
Launch vehicle TBD	TBD	Deliver the spacecraft to operational orbit	N/A	NEW

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Explorer Program
Project In Formulation:	Interface Region Imaging Spectograph (IRIS)

Estimated Project Schedule

The IRIS Confirmation review is planned for June 2010. IRIS launch is planned for December 2012.

Milestone Name	Formulation Agreement Estimate	FY 2010 PB Request	FY 2011 PB Request
Formulation			
System Readiness Review	01/2010	N/A	01/2010
Preliminary Design Review	04/2010	N/A	04/2010
Confirmation Review	06/2010	N/A	06/2010
Critical Design Review	02/2011	N/A	02/2011
Pre-Environmental Review	10/2011	N/A	10/2011
Pre-Ship Review	07/2012	N/A	07/2012
Launch Readiness Date	12/2012	N/A	12/2012

Project Management

Lockheed Martin Space Systems is leading the formulation and implementation of the project. GSFC is responsible for oversight and science management including data analysis during operations.

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Instrument	GSFC	GSFC	None.
Launch Vehicle	GSFC	KSC	None.
Spacecraft	GSFC	GSFC	None.
Mission Operations	GSFC	GSFC	None.

Acquisition Strategy

The Interface Region Imaging Spectrograph (IRIS)awarded in June 2009, is a PI led project that was competitively selected under the Small Explorer (SMEX) program. The contractor's final proposal for Phase B has been submitted and is in the process of review and negotiation. Contractor proposals for Phases C-E are expected in December 2009. The Phase E contracts will be managed by GSFC.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
All	SRB	N/A	System Readiness Review	1/2010
All	PDR	N/A	Preliminary Design Review	04/2010
All	CR	N/A	Confirmation Review	06/2010
All	CDR	N/A	Critical Design Review	02/2011

Mission Directorate:	Science
Theme:	Heliophysics
Program:	Heliophysics Explorer Program
Project In Formulation:	Interface Region Imaging Spectograph (IRIS)

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
TBD	TBD	TBD

Mission Directorate:	Science
Theme:	Heliophysics
Program:	New Millennium

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	**2.7**	**1.8**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**
New Millennium	**2.7**	**1.8**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**
FY 2010 President's Budget Request	**2.7**	**1.8**	**1.1**	**0.0**	**0.0**	**0.0**	**--**
New Millennium	**2.7**	**1.8**	**1.1**	**0.0**	**0.0**	**0.0**	**--**
Changes from FY 2010 Request	**0.0**	**0.0**	**-1.0**	**0.0**	**0.0**	**0.0**	**--**

Program Overview

The New Millennium Program (NMP) is a technology flight validation program designed to mature key emerging and breakthrough technologies that will enable future NASA science missions. The objective of the program is to accelerate the incorporation of new technologies into future NASA science missions by conducting in-space validation and testing. The NMP allows NASA to conduct technology maturation and validation activities in low cost projects, rather than during science mission development of larger, more expensive missions.

The NMP is being phased out and all current activities will be finished by FY 2012. A small amount of funding remains to cover closeout costs.

For more information, please see: http://nmp.jpl.nasa.gov.

Plans For FY 2011

Program closeout activities will continue for Space Technology 8 disturbance reduction system.

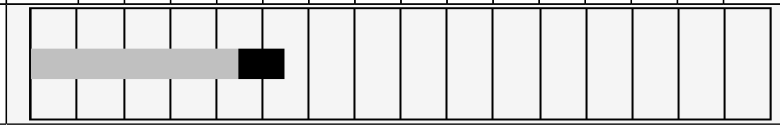
Project Descriptions and Explanation of Changes

New Millennium

Space Technology 7's Disturbance Reduction System (DRS) incorporates enhanced micro-Newton thruster technology, which works with enhanced sensor technology provided by the European Space Agency. Together, these technologies will demonstrate precision spacecraft control, validating position-measurement of objects in weightlessness with 100-times greater accuracy than ever before.

Mission Directorate:	Science
Theme:	Heliophysics
Program:	New Millennium

Implementation Schedule

Project	Schedule by Fiscal Year															Phase Dates		
	Prior	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23		Beg	End
Space Technology 7																	Tech	Apr-01	Apr-03
																	Form	Apr-03	Jul-03
																	Dev	Jul-03	Apr-12
																	Ops	Apr-12	Apr-13
																	Res		

Tech & Adv Concepts (Tech)
Formulation (Form)
Development (Dev)
Operations (Ops)
Research (Res)
Represents a period of no activity for the Project

Program Management

The New Millennium Program is managed by Jet Propulsion Laboratory.

Project	Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Space Technology 7	JPL	JPL	European Space Agency and Busek Corporation

Acquisition Strategy

No further acquisitions are planned.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	IPAO	01/2007	Program Implementation Review. Results were reported to the Agency PMC on 9/12/2007. Review concluded that there should be more emphasis on technology infusion.	N/A