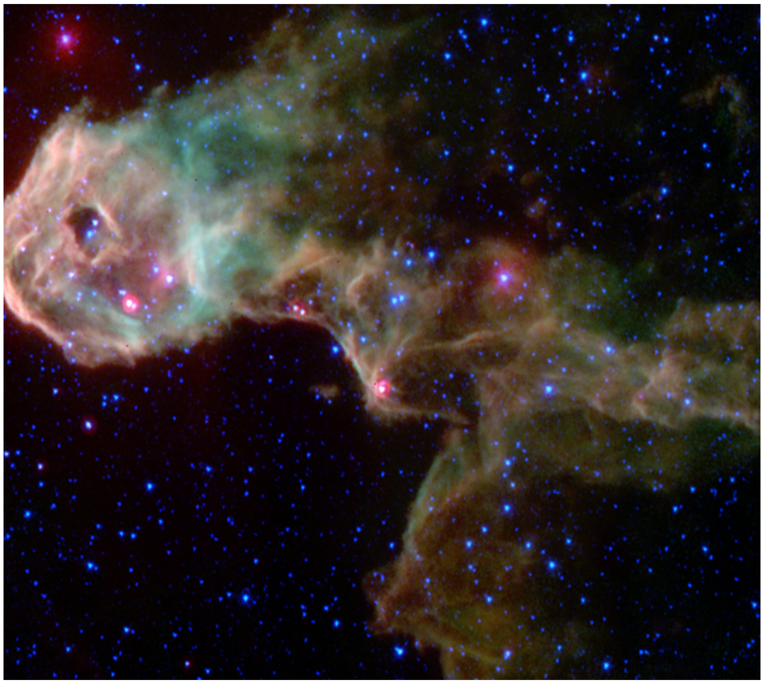
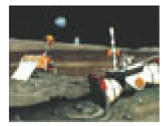


NASA's Spitzer Space Telescope (SST), launched in August 2003, has captured a glowing stellar nursery within a dark globule that is opaque to visible light. Located at a distance of 2,450 light years from Earth, the globule is a condensation of dense gas that is being compressed by the wind and radiation from a nearby massive star. Within the globule, newly discovered protostars are easily discernable as the bright red-tinted objects. This composite image is a product of SST's highly sensitive infrared camera multiband imaging photometer. More information can be found at: http://spacescience.nasa.gov/.

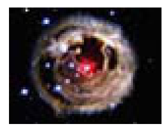
THEMES

Solar System Exploration

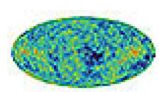
Mars Exploration



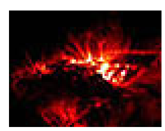
Lunar Exploration



Astronomical Search for Origins



Structure and Evolution of the Universe



Sun-Earth Connection

SPACE SCIENCE

PURPOSE

Thousands of years ago, on a small rocky planet orbiting a modest star in an ordinary spiral galaxy, our remote ancestors looked up and wondered about their place between Earth and sky. Like them, we ask the same profound questions, such as how did the universe begin? Today, we are beginning to answer these questions. Using tools of science that range from abstract mathematics and computer modeling to laboratories and observatories, humans are filling in the details of the amazing story of the universe. In the last 40 years, space probes and space observatories have played a central role in this fascinating process, and NASA's Space Science Enterprise will continue to address these four profound questions:

How did the universe begin and evolve? We seek to explain the earliest moments of the universe, how stars and galaxies formed, and how matter and energy are entwined on the grandest scales.

How did we get here? We investigate how the chemical elements necessary for life have been built up and dispersed throughout the cosmos, evidence about how the Sun affects Earth, similarities between Earth and other planets, and how comets and asteroids in our solar system affect Earth.

Where are we going? Our ultimate place in the cosmos is wrapped up in the fate of the universe. Humanity has taken its first steps off our home world, and we will contribute to making it safe to travel throughout the solar system.

Are we alone? Beyond astrophysics and cosmology, there lies the central human question: Are we on Earth because of an improbable accident of nature? Or is life, perhaps even intelligent life, scattered throughout the cosmos?

Now, in support of the President's new vision of space exploration, orbiting observatories and planetary probes will be joined by human explorers in seeking answers to these questions. Robotic scouts will blaze the trail, reconnoitering the planets, moons, asteroids, and comets of the solar system in advance of human expeditions, as observatories monitor the sun and its effects on its planetary retinue. The Space Science Enterprise will work with the new Exploration Systems Enterprise to develop and deploy new technologies, first on automated spacecraft and then on human missions.

FY 2003 Accomplishments

The Spitzer Space Telescope (SST, formerly the Space Infrared Telescope Facility), the fourth and final Great Observatory, was launched and began science operations. Spitzer is the largest infrared telescope ever launched into space. Its highly sensitive instruments allow us to peer into regions of space that are hidden from optical telescopes. Many areas of space are filled with vast, dense clouds of gas and dust that block our view. Infrared light, however, can penetrate these clouds, allowing us to see into regions of star formation, the centers of galaxies, and newly forming planetary systems.

The Wilkinson Microwave Anisotropy Probe (WMAP) provided some of the most important scientific results in modern astronomy. The WMAP science team constructed the first detailed full-sky map of the oldest light in the universe. WMAP data have determined the age of the universe to an unprecedented level of accuracy: 13.7 billion years. These data have also shown that the first stars ignited 200 million years after the Big Bang, provided new evidence that the universe is expanding at an increasing rate, and determined that the universe is composed of 4% conventional matter, 23% cold dark matter, and 73% dark energy.

"Spirit" and "Opportunity," the twin Mars Exploration Rovers, were successfully launched in the summer of 2003. On January 3, 2004, Spirit landed safely on Mars and has since begun to explore the planet; Opportunity followed on January 25. The rovers, working as robotic field geologists, will examine two sites offering a balance of favorable conditions for safe landings and interesting science: Gusev Crater and Meridiani Planum. At both sites the rovers will examine rocks and soils that could hold clues to the wet environments of Mars' past. Scientists will assess the data to determine whether those environments may have been conducive to life.

Additional FY 2003 accomplishments include the successful launch of the Galaxy Evolution Explorer (GALEX), an orbiting space telescope that will observe galaxies in ultraviolet light across 10 billion years of cosmic history; the confirmation of the oldest known planet by the Hubble Space Telescope; and the detection of regions of magnetic field concentration (which lead to sunspots) on the far side of the Sun by the Solar and Heliospheric Observatory through a new technique called helioseismology. Since sunspots are sites of catastrophic solar activity that sometimes affect the Earth, this new technique allows for early detection of events that may interfere with power and communications systems.

On September 21, 2003, the Galileo spacecraft plunged into Jupiter's atmosphere, ending an historic mission that circled the solar system's largest planet 34 times. Galileo was the first mission to measure Jupiter's atmosphere with a descent probe and the first to conduct long-term observations of the Jovian system from orbit. The spacecraft was purposely put on a collision course with Jupiter to eliminate any chance of an unwanted impact between the spacecraft and Jupiter's moon Europa, which Galileo discovered is likely to have a liquid subsurface ocean.

Theme Distribution

Budget Authority ($ in millions)	FY 2003	FY 2004	FY 2005
Solar System Exploration	1,039.1	1,315.9	1,187.0
Mars Exploration	500.4	595.1	690.9
Lunar Exploration	0.0	0.0	70.0
Astronomical Search for Origins	685.3	898.8	1,066.8
Structure and Evolution of the Universe	402.0	406.0	377.7
Sun-Earth Connection	479.7	755.4	745.9
Institutional Support	424.1	--	--
Total	3,530.6	3,971.2	4,138.3

Note: For all formats, the FY 2003 column reflects the FY 2003 Congressional Operating Plan, dated 9/04/03. The FY 2004 column reflects the FY 2004 Conference committee report. The FY 2005 column represents the FY 2005 President's Budget Submit.

(Yellow) Indicates budget numbers in full cost

Solar System Exploration

This theme seeks to understand how our own solar system formed and evolved, and whether there might be life in the solar system beyond Earth. In support of the President's new vision of space exploration, the robotic spacecraft dedicated to answering these questions will serve as trailblazers for the future human exploration of the solar system. The planets of our solar system and the ancient icy bodies far from the Sun are Rosetta stones that can tell unique stories about the evolution of our solar system. As we learn more about the origins of living systems on Earth and our solar system's planets and moons, we may learn that life has also arisen on some of them. Highlights for FY 2005 include:

Overall Budget

FY 2005 request is $1,187 million, a $129 million or 10 percent decrease from the likely enacted FY 2004 budget:

- $210 million for three missions in development: the Dawn mission to orbit two asteroids, the Deep Impact mission to probe below the surface of a comet, and the New Horizons mission to Pluto and the Kuiper Belt.
- $164 million for an In-Space Power and Propulsion program, which includes an effort to develop a new radioisotope power system to enable greatly extended mission lifetimes.
- $75 million for Astrobiology research to improve the ability to find and identify life on other planets.
- $261 million for operation of the Deep Space Management System.
- A decrease of $438 million from the transfer of most elements of Project Prometheus to the new Exploration Systems Enterprise.

Mars Exploration

This theme explores the mysteries of the history and present conditions on Mars. Dry and cold today, the Martian surface shows the traces of a wet and warmer past. Frozen water at its poles and hints of relatively recent liquid water flows make Mars the most likely place to seek evidence of ancient or present extraterrestrial life. Contrasts between the current and past geology, atmospheres, and magnetic fields of Mars and Earth promise insights into why these neighboring planets differ so much today. Advances in our understanding of Mars will be critical for future human exploration. The FY 2005 program includes multiple efforts to build upon the recent success of the Mars Exploration Rover program.

Overall Budget

FY 2005 request is $691 million, a $96 million or 16 percent increase over the likely enacted FY 2004 budget:

- $104 million for development of 2005 Mars Reconnaissance Orbiter, an orbiter that will map Martian surface features as small as a basketball (20-30 cm).
- $103 million for the 2007 Scout Mission, called Phoenix, a competitively selected mission to land on the Martian plains and analyze surface and subsurface samples of water and ice.
- $175 million for 2009 Mars Science Laboratory, a rover that will traverse tens of kilometers over Mars and last over a year, digging and drilling for unique samples to study in its onboard laboratory.
- $25 million for the 2009 Mars Telesat Orbiter (MTO), a multi-band (X-, Ka-, and UHF band) spacecraft that will provide communications relay support for assets at Mars. MTO will also provide entry, descent, and landing (EDL), and Mars orbit insertion (MOI) support for the 2009 Mars Science Laboratory.
- $56 million for an optical communication technology demonstration, which will help develop technology to increase communication data rate and improve the cost-per-bit of data returned. This technology will be demonstrated on the 2009 MTO.
- An increase of $63 million in FY 2005 ($1,311 million over five years, a 192% increase) to prepare for the next decade of Mars research missions by investing in key capabilities to enable advanced robotic missions, such as returning geological samples form Mars or drilling under the surface of the planet. In the next decade, NASA will launch precursor missions to Mars to test new technologies that will be key to enabling future human missions. These robotic flights will obtain critical data for human missions on chemical hazards, resource locations, and research sites, and they may prepare resources and sites in anticipation of human landings.

Lunar Exploration

The Lunar Exploration (LE) Theme will undertake lunar exploration activities that enable sustained human and robotic exploration of Mars and other bodies in the solar system, through the development of new approaches, technologies, and systems. The major focus of the LE Theme will be demonstrating capabilities to conduct sustained research on Mars as well as deeper and more advanced explorations of our solar system. The specifics of lunar missions and systems will be driven by the requirements of future human and robotic explorations of Mars and other solar system destinations, as well as by research results from ongoing robotic missions to Mars and other bodies in the solar system. Lunar missions will also pursue scientific investigations on the Moon, such as uncovering geological records of our early solar system. Robotic lunar missions will begin in 2008, with human lunar missions following as early as 2015.

OVERALL BUDGET

FY 2005 request is $70.0 million (full cost).

Astronomical Search for Origins

This theme strives to answer two questions: Where did we come from? Are we alone? The theme seeks to observe the birth of the earliest galaxies and the formation of stars, find planetary systems in our region of the galaxy, including those capable of harboring life, and learn whether life exists beyond our solar system. We need to understand the building blocks of life, the conditions necessary for life to persist, and the signatures of life that might be detectable from Earth. By exploring the diversity of other worlds and searching for those that may harbor life, we hope to understand the origins of our own world. Highlights for FY 2005 include:

OVERALL BUDGET

- FY 2005 request is $1,067 million, a $168 million or 19 percent increase over the likely enacted FY 2004 budget:
- $37 million for Hubble Space Telescope operations, as well as funding for a robotic mission to safely deorbit the telescope when it ends operations.
- $318 million for development of James Webb Space Telescope planned for launch about 2010 and promising to build on the legacy of Hubble Space Telescope.
- $155 million for development of Space Interferometry Mission planned for launch in late 2009 to detect planets around other stars.

Structure and Evolution of the Universe

This theme seeks to understand the nature and phenomena of the universe. It seeks to understand the fundamental laws of space, time, and energy and to trace the cycles that have created the conditions for our own existence. This is accomplished in part by observing signals from the Big Bang, mapping the extreme distortions of space-time about black holes, investigating galaxies, and understanding the most energetic events in the universe. Highlights for FY 2005 include:

OVERALL BUDGET

- FY 2005 request is $378 million, a $28 million or 7 percent decrease from the likely enacted FY 2004 budget:
- $103 million for development of Gamma-ray Large Area Space Telescope (GLAST), a mission to study high-energy objects like black holes.
- $31 million for continued technology development for two missions: Laser Interferometer Space Antenna (LISA) and Constellation-X. LISA will use three spacecraft “formation flying” 5 million kilometers apart in a triangle to observe the distortion of space due to gravity waves. Constellation-X will use a team of powerful X-ray telescopes working in unison to observe black holes, investigate “recycled” stellar material, and search for the “missing matter” in the universe; it will be 100 times more powerful than any single X-ray telescope that has come before it. As a result of the reprioritized agency activities, the budgets for Con-X and LISA have been reduced; impacts to these programs and their launch dates will be fully assessed as part of the development of the FY 2006 budget.

Sun-Earth Connection

This theme investigates our Sun and how its structure and behavior affect Earth. The Sun’s energy is responsible for the Earth’s present ecosystem, but the Sun is a variable star. Its small variability profoundly affects the Earth. Changes in its long-term brightness cause ice ages, and its 11-year cycle of activity causes aurora and other disturbances on the Earth. Solar flares affect the upper atmosphere and can damage satellites and disable the power distribution grid on the ground. The Sun is also our nearest star and is an ideal laboratory for basic physics and learning about other stars. Highlights for FY 2005 include:

OVERALL BUDGET

- FY 2005 request is $746 million, a $10 million or 1 percent decrease from the likely enacted FY 2004 budget:
- $232 million for development of STEREO and Solar Dynamics Observatory.
- $47 million for future flight missions in the Living With a Star program.

A Note on Mission Operations and Data Analysis

In a flight project, the work covered under Mission Operations (MO) and Data Analysis (DA) includes: communicating with the spacecraft; control center and flight operations team activities; controlling spacecraft orbit and attitude; level-0 data processing; project management and administration; science planning (including commanding individual instruments mounted on the spacecraft); spacecraft and instrument engineering; science data processing, validation, distribution, and archiving; science data analysis; the publication and presentation of science results; and the conduct of education and public outreach activities.

Beginning in FY 2005, the Space Science Enterprise will combine the MO budget lines of many of its flight projects with their counterpart DA lines. This will be done, in part, because many of the activities noted above could be considered either MO or DA (e.g. project management and administration, science planning/instrument commanding, instrument engineering, level-0 processing). In addition, since the project science team usually manages both MO and DA activities, tracking them as though they were separate lines of work is inefficient, and affords managers less flexibility in allocating resources where they are most needed during the operational phase of a mission.

Certain missions with extended cruise phases (where operations can be readily distinguished from data analysis) and/or significant operations funding will retain their current MO lines. Examples of space science missions that will continue to use their MO lines include: all Mars Exploration missions; all Great Observatories (i.e. Hubble Space Telescope, Chandra X-Ray Observatory, and Spitzer Space Telescope); the airborne Stratospheric Observatory For Infrared Astronomy (SOFIA); and “strategic” planetary missions (e.g. Cassini and New Horizons). In addition, funding for Multimission Operations, including the Deep Space Network, will be retained in MO. Please note that in the case of all other missions, the combination of MO and DA funding constitutes a zero-sum action that will not affect the missions’ lifecycle costs.