

## NASA R&D in the FY 2002 Budget

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### HIGHLIGHTS

- Beginning in FY 2002, the National Aeronautics and Space Administration (NASA) is implementing a two-appropriation budget (excluding the Inspector General). The appropriation includes Human Space Flight (HSF) and Science, Aeronautics and Technology (SAT); Mission Support budgets will now be rolled into the two accounts. The new accounts reflect NASA's first attempt to transition to a full-cost budget.
- The FY 2002 budget provides \$14.5 billion, a 1.8 percent increase over FY 2001 (see Table II-12). The budget is projected to increase yearly in small increments to \$16.1 billion in FY 2006.
- Total NASA support of R&D would remain flat at \$10.0 billion. HSF R&D would decrease from \$2.9 billion to \$2.8 billion and SAT R&D would increase from \$7.1 billion to \$7.2 billion.
- NASA will invest \$4.5 billion over the next 5 years in the Space Launch Initiative (SLI). SLI will focus on developing the technologies for a 2<sup>nd</sup> Generation reusable launch vehicle (RLV). SLI will allow for at least two competitive options for industry to pursue in the middle of this decade.
- Both NASA's X-33 and X-34 programs were terminated in March 2001. Savings will be passed on to the SLI program.

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SAT's Rotorcraft and two Space Science missions (Pluto-Kuiper Express and Solar Probe) were also cancelled.

## **INTRODUCTION AND POLITICAL ENVIRONMENT**

The National Aeronautics and Space Act of 1958 established the National Aeronautics and Space Administration (NASA) to conduct aeronautic and space activities for the benefit of all humankind. As part of its mission, one of NASA's key functions as the lead agency for civil space R&D has been to preserve U.S. leadership in aeronautics and space science and technology. Specifically, NASA's central focus is to: advance human exploration, use and development of space; advance and communicate scientific knowledge and understanding of the Earth, the Solar System and the Universe; and research, develop, verify and transfer advanced aerospace technologies.

Keeping in line with its core mission areas, this past year saw a flurry of activity for the space agency. The International Space Station (ISS) made tremendous progress as the program grew from the Unity and Zarya modules to become a permanently crewed research laboratory in space. Since May 2000, NASA and its partners at the Russian Aviation and Space Agency have executed 11 successful launches and dockings to the ISS, with a net schedule slip of only three weeks. The elements now in space include the Zvezda Service Module, Russia's major contribution, and the U.S. laboratory, Destiny.

The Expedition One crew arrived at the ISS via a Soyuz spacecraft in November 2000. Ramp-up of Station's components continued and early research experiments were carried out. The flight of Expedition Two commenced soon after as the first Multi-Purpose Logistics Module, built by the Italian Space Agency, was delivered.

Another highly publicized activity occurred in the area of human space flight. However, the achievement came from across the Atlantic through the Russian Space Agency. U.S. civilian Dennis Tito became the first tourist in space over NASA's objections. NASA was concerned that Tito could pose a risk to crew aboard the ISS and hinder the continued development of Station.

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In Earth Science, NASA deployed the first series of Earth Observing System (EOS) satellites that will observe the major interactions of the land, oceans, atmosphere, ice and life that comprise the Earth system. A major milestone for the program was achieved with the first launch of the EO-1 spacecraft, a technology development test bed. The spacecraft, which is testing new technologies to be used in future Landsat continuity missions, carries Earth-observing instruments.

The Office of Space Science also achieved some major milestones. After several highly publicized failures in the Mars Exploration Program (MEP) in 1999 with the loss of both the Mars Climate Orbiter and the Mars Polar Lander, the MEP program was restructured. The 2001 Mars Odyssey orbiter was launched in April of 2001 and the Genesis probe is scheduled for launch in July 2001. Genesis will bring back to Earth samples of solar wind particles, helping scientists dramatically increase knowledge concerning the birth of the solar system. Throughout the summer of 2001, additional small probes are scheduled for launch.

Along with some major achievements also came some disappointments. As the contract between NASA and Lockheed Martin expired in March 2001 for development of the X-33 reusable launch vehicle, NASA decided to cancel the cooperative agreement. NASA determined that the benefits derived from the program did not warrant additional government investment. Similarly, NASA's X-34 program, which focused on reducing the cost of access to space through the development of revolutionary technologies, was also canceled. Savings from both programs will be passed on to NASA's new Space Launch Initiative program.

FY 2001 also brought about debate on Capitol Hill and in the press concerning NASA's research investments in aeronautics. NASA was criticized for not investing enough in "traditional" aeronautics R&D, as research budgets for aeronautical accounts have decreased dramatically over the last decade. This debate will continue to be a focus in the policy-making arena in FY 2002.

### **BUDGET OVERVIEW**

Heading into FY 2002, NASA officials are "looking for efficiencies" with a relatively flat budget of \$14.5 billion with the goals of continuing work

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on the International Space Station Alpha, revamping advanced aeronautics research and continuing a program to develop new launch technologies in the newly created SLI program.

Unfortunately, achieving more efficiencies will come at a price as some programs will be canceled. NASA Administrator Daniel Goldin said some difficult decisions must be made and the Bush Administration fully expects NASA to live within its means.

Among the programs to fall by the wayside are the Pluto-Kuiper Express, the \$31.6 million Rotorcraft program, an advanced computing initiative, and the Solar Probe program. NASA has also shelved Triana, the Earth-observing satellite, until it can find a suitable Space Shuttle launch for it.

NASA is also struggling with a \$4 billion space station overrun, which has forced NASA to drop plans for building a Crew Return Vehicle (CRV), a station propulsion habitation module that would have allowed the crew size to grow from three to seven. The agency plans to spend about \$1 billion more on the station from FY 2002 to FY 2006 than was previously planned, money redirected from the CRV and other programs.

However, Goldin stated that the CRV might be revived if money can be found during that search for efficiencies, but NASA is also talking to its European partners to see if they might build more hardware for the station.

Goldin said the SLI program, which will spend \$4.5 billion over the next five years, will drive new technology in the development of a RLV. It is hoped that the program will substantially reduce technical, programmatic and business risks associated with developing an RLV.

NASA is also changing its aeronautics program in FY 2002. It will not be a separate line item, but will be folded into other NASA research in a merger of "hypersonics, space and aeronautics."

#### **INTERNATIONAL SPACE STATION**

The International Space Station (ISS) continued development as the Unity and Zarya modules became operational. The goal of the ISS is to support

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activities that require humans in space and to establish a permanent human presence in Earth orbit. Capabilities include the ability to perform long-duration, space-based research in cell and development biology, plant biology, human physiology, fluid physics, combustion science, materials science and fundamental physics. ISS will also provide a platform to study Earth and the Solar System. Utilization of Alpha is critical, as any future findings from research experiments aboard it will guide the direction of further U.S. exploration and development of space.

The ISS is funded at \$2.1 billion, which is a slight decrease of 1.2 percent from FY 2001 budget figures (see Table II-12). In addition, due to NASA's projection of ISS cost growth of potentially as much as \$4 billion for the FY 2002-2006 period, NASA is undertaking reforms to curtail cost growth and find savings. Because of the urgent need to begin operating the ISS and to continue integrating many of its components, NASA will redirect funding from Station projects with significant development activity remaining.

Savings will be achieved in FY 2002 by cutting CRV's budget by nearly 16.5 percent, down from \$90 million in FY 2001 to \$75 million, reducing ISS's research program by 38 percent, down from \$457 million in FY 2001 to \$284 million, and by cutting Station's operations capability program by 4.7 percent from \$825 million to \$786 million. In addition, total Space Operations R&D in the Human Space Flight account would be cut drastically by 24.2 percent down to \$178 million.

The restoration of these projects and line items will be contingent on the quality of NASA's future cost estimates, the resolution of major technical issues, and the success of management reforms and other cost-control actions that are underway or will be implemented.

One ISS line item that would receive a funding boost, but has also received great scrutiny from Congress, is Russian Program Assurance (RPA). The program serves as a contingency plan for further development of ISS to protect its schedule if the Russian partners cannot meet its funding support obligations. Due to the Russian Aviation and Space Agency receiving only a fraction of its approved budget, funding shortfalls have occurred. Consequently, the RPA program would receive

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an increase of nearly 740 percent, up from \$24 million to \$200 million in FY 2002.

It should also be noted that one area, however, of the RPA program was canceled. The Interim Control Module (ICM), which was to be developed by the U.S. Naval Research Lab and would provide reboost capabilities, was scrapped after control module needs were deemed no longer a priority relative to other program needs.

Savings from the ICM were passed on to the ISS's Habitation Module. The Habitation Module will provide residence for the crew and laboratory space for the conducting of science and research experiments. Funding for this module would increase by 3.6 percent, from \$717 million in FY 2001 to \$743 million in FY 2002.

#### **SCIENCE, AERONAUTICS AND TECHNOLOGY (SAT)**

The SAT appropriation has the majority of NASA's funding for R&D programs. It funds R&D activities that extend our knowledge of the Earth, its space environment, and the universe. SAT also provides funds to invest in new aeronautics and advanced space transportation technologies that support the development and application of technologies critical to national economic, scientific and technical competitiveness. The FY 2002 request for SAT is \$7.1 billion, an increase of 1.8 percent (see Table II-12).

***Space Science:*** The FY 2002 Space Science budget of \$2.8 billion represents an increase of 6.2 percent over the FY 2001 enacted level of \$2.6 billion. In addition, NASA has planned for a large increase for future space science missions through FY 2006, reaching \$3.6 billion that year. The Space Science Enterprise is the arm of NASA that looks up, out, and back in time at planets, stars, galaxies and other phenomena that populate our Universe.

The FY 2002 budget offers several new programs and other major features. The newly restructured Mars Exploration Program (MEP) includes a strategy for the agency to be more responsive to scientific discoveries as they are made. The strategy is linked to NASA's experience exploring Earth, and uses Mars as a natural laboratory for

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understanding life and climate on Earth-like planets. The 2001 Mars Odyssey orbiter was launched in April 2001 and twin Mars Exploration Rovers are being prepared for launch in 2003. A Mars Reconnaissance Orbiter is also being planned for 2005.

In all, there are currently 29 ongoing Space Science spacecraft programs, including several that involve international cooperation. Between now and the end of FY 2002, several missions are scheduled for launch, which include the High Energy Solar Spectroscopic Imager (HESSI) that will study solar flares, the Microwave Anisotropy Probe (MAP) which will observe temperature variations in the cosmic microwave background in space, the Genesis spacecraft which will bring back Earth samples of solar wind particles and the Space Infrared Telescope Facility (SIRTF) which is a space-borne, infrared observatory capable of studying objects ranging from our Solar System to the distant reaches of the Universe.

However, two Science missions that have been canceled include Living with a Star's Solar Probe and the Pluto-Kuiper Express. Both projects were not near-term budget priorities for the agency. (Please see Chapter 14 for more information on astronomy in the NASA budget.)

***Biological and Physical Research (OBPR):*** Replacing NASA's Office of Life and Microgravity Sciences and Applications is the Biological and Physical Research Office. OBPR was created at the beginning of FY 2001 to affirm NASA's commitment to the role biology will play in the 21<sup>st</sup> Century and to establish the core of biological and physical sciences research needed to fulfill agency objectives.

OBPR will pursue its goals by using the space environment as a laboratory to test the fundamental principles of physics, chemistry and biology; by conducting research to enable the human habitation of space; and by enabling and promoting commercial research in space for the benefit of life on Earth. Many of OBPR's goals will ultimately be carried out through the utilization of the ISS.

The funding request for OBPR in FY 2002 is set at \$361 million. Compared to funding levels in the previous office of Life and Microgravity Sciences, FY 2002 appropriations would be cut by 4.7 percent. Six out of nine program areas in OBPR would receive budget

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cuts. The Health Research program would receive a 19.8 percent cut to \$9 million and the Mission Integration Program would be eliminated.

***Earth Science:*** The budget request for Earth Science in FY 2002 is \$1.5 billion, down \$201 million. The decreased funding levels reflect the “shelving” of the Triana program and the maturity of several Earth Explorer spacecraft that are set to be launched in FY 2002 and FY 2003.

The goal of the Earth Science program is to work to improve the scientific understanding of the Earth system and its response to natural and human-induced changes. This knowledge will enhance ability to predict climate change, better understand weather patterns, and help mitigate future natural hazards.

As mentioned, NASA is currently deploying the first series of Earth Observing System (EOS) satellites that will concurrently observe the major interactions of the land, oceans, atmosphere and life that comprise the Earth system.

***Aero-Space Technology Program (AST):*** In FY 2002, AST is requesting a 7.3 percent increase in its budget to \$2.4 billion, almost \$161 million over FY 2001 figures. The AST Enterprise’s responsibility is to provide revolutionary advancements in science and technology that sustain global U.S. leadership in civil aviation and space. One of the goals of the program is to provide the public with safe, reliable and efficient air and space transportation systems and to reduce the costs associated with space travel. AST is focused into three subcategories: Research & Technology (R&T) Base, Focused Programs and Commercial Technology.

The R&T Base focuses on developing high-payoff revolutionary technologies that will be required to support 21<sup>st</sup> Century Aerospace Vehicles and the National Aerospace System. The Base seeks to pioneer the development of new breakthrough technologies such as nanotechnology and other technologies that will help the agency carry out its core competencies. In FY 2002, the R&T Base would be cut by 10.8 percent to \$637 million. Most of the cuts reflect the cancellation of two base programs, Rotorcraft and Information Technology, with a reduction of \$31.6 million and \$118.4 million, respectively.

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The Vehicle Systems and Technology Program, whose goal is to maximize the synergies between aeronautics and space transportation, would receive a funding increase of almost \$6 million, up to \$157.5 million. The Propulsion & Power Base Program would also increase by almost \$10 million, from \$85.8 million in FY 2001 to \$94.8 million in FY 2002. The Propulsion & Power Base Program focuses on technologies that include improving general aviation turbine engines, aircraft anti-icing devices/systems and developing rocket-based combined cycle propulsion technology.

It is worth noting that the Base program has been criticized by some observers for blending space technology with aviation technology to the point that it is difficult to gain an understanding of the precise research that is being performed in these core research areas. However, other observers believe that the two technology areas are synergistic in nature and will help revolutionize the future of both space and aviation.

The Focused Programs area would receive a 36.6 percent increase in funding in FY 2002, up to \$721 million. This program area addresses national needs in both space and aeronautics and helps define customer requirements. The Focused Program largely strives to assist the aerospace industry in meeting critical needs such as aviation safety, capacity, noise and congestion problems and provides the technological seeds for developing more efficient aircraft and more revolutionary spacecraft.

Due to increased congestion and airline delays over the last several years, the Aviation System Capacity program is receiving focused attention. It would receive a funding increase of 47 percent, up to \$100.6 million in FY 2002. The Aviation Safety Technology Program and the Quiet Aircraft Technology Program would both remain stagnant at \$70 million and \$20 million in FY 2002.

The Small Aircraft Transportation System (SATS), which focuses on revitalizing the general aviation industry through the development of new technologies, would receive a funding increase of \$6 million, up to \$15 million in FY 2002.

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The biggest change, however, to the Focused Program area is in the Space Launch Initiative (SLI) program and the cancellations of the X-33, X-34 and High Performance Computing and Communications (HPCC) programs. Most of the savings have been passed onto the development of a 2<sup>nd</sup> Generation RLV in the SLI program. The focus of the SLI is to develop low cost, reliable space transportation. By 2005, NASA plans to enable a competition for NASA launch services, including human space flight, using commercially competitive, privately owned and operated, Earth-to-Orbit RLVs. NASA would fund the 2<sup>nd</sup> Generation RLV at \$475 million in FY 2002, up from \$272 million in FY 2001.

The last major program area of this Enterprise, Commercial Technology Programs, would decrease to \$147 million in FY 2002. The focus of this program area is to ensure that NASA-developed technology is transferred to U.S. industry to improve U.S. economic competitiveness. This account also includes funding for the Small Business Innovation Research (SBIR) programs.

***Academic Programs:*** NASA promotes excellence in the U.S. educational system through enhancing and expanding scientific and technological competence. The FY 2002 request is \$153.7 million, an increase of almost 16 percent over last year's totals.