

NASA R&D in the FY 2004 Budget

*Michael Beavin,
American Institute of Aeronautics and Astronautics*

HIGHLIGHTS

- The FY 2004 budget request provides \$15.5 billion to NASA, less than a 1 percent increase from the FY 2003 appropriation (see Table II-12).
- Total NASA support of R&D in FY 2004 increases to \$11.0 billion, a marginal 0.2 percent increase from FY 2003.
- NASA released its new Strategic Plan with the President's FY 2004 request. The NASA 2003 Strategic Plan seeks the answers to the fundamental questions, "How did we get here?", "Where are we going?", and "Are we alone?"
- Administrator O'Keefe has stated that NASA will utilize a "stepping stone" approach to determine the agency's explorations goals. These goals will not be established on a fixed timescale or location but rather be driven by science, exploration, and discovery.
- To reflect the new Strategic Plan, the FY 2004 budget has been restructured and replaces the previous structure with two new appropriation accounts: Science, Aeronautics and Exploration (SAE); and Space Flight Capabilities (SFC).
- For the first time, NASA's programs are in a full-cost accounting budget format, which includes the cost of institutional activities (personnel, facilities, and support) within each program.
- In order to develop the building blocks that will enable new exploration and discovery as well address other challenges, the FY 2004 request includes nine new initiatives, described below.

Michael Beavin

- The NASA/Federal Aviation Administration (FAA) joint programs will be strengthened to ensure that NASA technology investments are incorporated into the National Airspace System.
- In 2002, NASA submitted to Congress legislative proposals to address the agency's critical workforce concerns. This year, NASA will continue to work with Congress to ensure enactment of legislation to help reconstitute and reconfigure its workforce.

THE COLUMBIA ACCIDENT

The tragic loss of the Space Shuttle *Columbia* and her crew on February 1st, 2003 has dramatically changed NASA's plans for FY 2004 and beyond. NASA has established an independent Columbia Accident Investigation Board, under Admiral Gehman, to determine the cause of the accident. As of this writing, the investigation board continues to organize its work and the *Columbia* debris recovery operation continues to search for clues to the accident on the ground, an effort that includes over 2,000 men and women from federal, state, and local agencies.

It remains to be seen how the accident and the subsequent Space Shuttle fleet grounding will affect the agency as a whole and, specifically, the International Space Station (ISS), the Hubble Space Telescope (HST), and plans for the Orbital Space Plane Program (OSPP). NASA Administrator Sean O'Keefe testified before the House Science Committee on February 27, 2003 and reported that groundwork on the remaining ISS Core Complete elements is continuing. O'Keefe further testified that Russian Soyuz capsules will perform ISS crew change-outs and if necessary, additional supply missions to the station will be performed by Russian unmanned Progress vehicles. The crew size will be reduced from three to two and a revised US Core Complete assembly schedule will be confirmed once the Shuttle fleet is returned to flight status. With the HST, if there is a delay in the servicing mission scheduled for November 2004 and the HST is unable to perform its science mission, it can be placed in a safe mode until a service mission can be conducted. The OSPP requirements mandate an ISS crew rescue capability as soon as practical but no later than 2010. Although the requirements were drafted before the Columbia tragedy, NASA is currently considering options to accelerate the program.

NASA R&D IN THE FY 2004 BUDGET

AGENCY OVERVIEW

The Honorable Sean O’Keefe was confirmed as NASA Administrator in late December of 2001 and took the NASA helm at the beginning of 2002. In 2002, NASA worked to improve the agency’s management capability. Administrator O’Keefe promised a “return to basics” at NASA, a reference to reforming the agency’s financial and management issues, and specifically referenced the Presidential Management Agenda as his guideline to improve the agency’s management. The areas targeted for enhancement included: Improving Human Capital, Competitive Sourcing, Improved Financial Management, Expanded Electronic Government, and Budget and Performance Integration.

The ISS Management and Cost Evaluation (IMCE) Task Force, led by Thomas Young, was organized in 2001 to perform an independent review of the ISS budget and to provide recommendations to control costs while still providing the maximum scientific return. The Task Force concluded that an equal level of fiscal management must meet the program’s technical excellence. NASA worked to adopt key recommendations of the IMCE report as the roadmap to improve the ISS program management in 2002. NASA has also revamped the ISS science program to the highest priority research as identified by the Research Maximization and Prioritization task force.

As stated, it remains to be seen how the Shuttle fleet grounding will affect the continued construction of the Space Station. Ground processing of the final US station elements is continuing with the last US element scheduled for delivery to NASA by spring 2003. As the program moves from construction into scientific research and operations, the FY 2004 budget continues progress toward solving the cost control and management issues of the station.

The 2002 annual report of the Aerospace Safety Advisory panel stated that current budget projections for the Space Shuttle were insufficient to fund planned safety upgrades. As a result, the Integrated Space Transportation Plan (ISTP) was included in the FY 2003 budget amendment in November 2002. The goal of the ISTP is to address the near and mid-term requirements in human space flight. Investments in extended Shuttle orbital life, development of a new Orbital Space Plane, and funding next-generation launch vehicle technology are provided under the ISTP. NASA has directed that the Space Shuttle upgrade

Michael Beavin

strategy should be developed to safely fly the Shuttle fleet beyond the planned phase-out in 2012 and through 2020. NASA has pledged to find the cause of the Columbia accident, correct the problem(s), and return the Shuttle fleet to safe flight operations as soon as possible.

In 2002, the Office of Space Science produced many exceptional results. The successful HST service mission in March 2002 increased the Hubble's "vision" tenfold. The new capabilities of the orbiting telescope have revealed such marvels as colliding spiral galaxies, planetary system formation, and an examination of the core of the Milky Way. The Mars Odyssey spacecraft went into orbit around Mars and began its science mission to examine the Martian surface; initial measurements have indicated large amounts of frozen water buried beneath the Martian surface. Space Science programs have also discovered, for the first time, a planetary system outside of our own Solar System.

In Earth Science, the global view afforded by the unique vantage point of space is providing new perspectives on how our planet's environment is influenced by natural and human forces. These views are finding increasingly broader applications in business, agriculture, and local governments in the United States. Last year, NASA's Earth Science missions examined the disintegration of the Antarctic Larsen Ice Shelf, completed processing of the Shuttle Radar Topography Mission (which has produced the most detailed globally consistent topographic data set ever), and helped the US Forest Service fight forest fires.

NASA's Aerospace Technology Enterprise conducts high-risk, high-payoff research and development but also both nearer term and longer-term research focused on public good issues such as environmental compatibility, security, safety, and air traffic management. The goal of the Enterprise is to provide revolutionary advancements in science and technology that sustain U.S. leadership in civil aeronautics and space.

The mission of NASA's Aeronautics Technology Research and Development program is to perform the R&D that supplies the critical aeronautics technology base of the Nation. NASA has developed technology applications that have improved aviation weather information systems, aircraft safety and jet engine emissions reductions, autonomous flight control, and advanced air traffic management systems.

NASA R&D IN THE FY 2004 BUDGET

On the legislative front, the key authorizing committees of the 108th Congress will work this session to pass a multi-year NASA Authorization bill for FY 2004 and beyond. Former President Clinton signed the last NASA Authorization bill in 2000, authorizing funding for FY 2001 and FY 2002. No authorization legislation was introduced in the last session of the 107th Congress.

FISCAL YEAR 2004 PRESIDENTIAL BUDGET REQUEST

NASA's FY 2004 budget request of \$15.5 billion, less than a 1 percent increase over the FY 2003 appropriation, provides relatively flat funding for the agency (see Table II-12). As noted before, NASA has restructured its appropriation accounts into two accounts in order to mirror its new Strategic Plan. The two new accounts are Science, Aeronautics, and Exploration (SAE) and Space Flight Capabilities (SFC). All NASA Enterprises fall within these two accounts and are further broken down into themes. The budget request for SAE in FY 2004 is \$7.66 billion and represents a 2.8 percent increase from the FY 2003 appropriated level. The budget request for SFC in FY 2004 is \$7.78 billion and represents a 0.9 percent decrease from the FY 2003 appropriated level. It should be noted that due to the new full-cost accounting format for FY 2004, a true comparison to FY 2003 is not possible.

SPACE FLIGHT CAPABILITIES (SFC)

Space Flight Enterprise: The Space Flight Enterprise programs include the following three themes: International Space Station, Space Shuttle, and Space and Flight Support.

In FY 2004 the International Space Station will receive \$1.71 billion, a reduction of 7.3 percent from the FY 2003 appropriated funding. The primary reason for the funding reduction is that 98 percent of the hardware for the U.S. Core has been developed and on-orbit operations are the focus of planned activities. Unfortunately, in light of the grounding of the Shuttle fleet it is difficult to say what delays or budget increases will impact the ISS program.

Because of the problems plaguing the Space Station program over the years, Congress initiated an investigation into the ISS program to answer basic questions regarding the program's budgetary and management concerns. The ISS Management and Cost Evaluation Task Force report

Michael Beavin

concluded that the concept of “U.S. Core Complete” was ill defined and recommended a course of action to improve the program. In 2002, NASA instituted a number of reforms and management changes. These changes have been made to ensure that ISS capabilities are driven by science requirements and have increased NASA’s confidence in achieving success with the U.S. Core Complete station.

The Space Shuttle program budget request is for \$4.0 billion in FY 2004, representing a 3.5 percent increase above FY 2003 (full cost). Congress included an additional \$50 million to the President’s FY 2003 request to pay for the cost of the Columbia investigation in the FY 2003 omnibus appropriation bill, for a total of \$3.8 billion. The FY 2004 request supports the planned steady rate of five Shuttle launches per year starting in FY 2006. The FY 2004 request also includes \$1.7 billion to be provided for the Space Shuttle Service Life Extension Program over the next 5 years. The Space Shuttle Life Extension Program is intended to improve the safety and infrastructure needs to allow the Space Shuttle fleet to fly well beyond 2010 and includes the Cockpit Avionics Upgrade and the Advanced Health Monitoring System.

Crosscutting Technologies: The Aerospace Technology Enterprise has been restructured into two themes, Aeronautics Technology and Crosscutting Technologies, now budgeted out of separate appropriations accounts. The Crosscutting Technologies theme is funded through the SFC appropriation account while the Aeronautics Technology theme is funded through SAE.

The Crosscutting Technologies theme includes the Space Launch Initiative (SLI), Mission and Science Measurement Technology (MSM), and Innovative Technology Transfer Partnerships (ITTP). SLI has been restructured with the development of the ISTP. Funding has been shifted out of the SLI account and used to create a new program called the Orbital Space Plane Program (OSPP). The OSPP is intended to meet the crew rescue and transportation requirements of the ISS by 2010 and 2012, respectively. The FY 2004 request for SLI includes \$550 million for OSPP, which includes funding for the X-37 flight demonstrator, and \$515 million for Next Generation Launch Technology. The NGLT, in partnership with the Department of Defense’s (DOD) National Aerospace Initiative, will focus on the most critical technologies from 2nd and 3rd generation Reusable Launch Vehicle research and development.

NASA R&D IN THE FY 2004 BUDGET

The Mission and Scientific Measurement Technologies theme develops crosscutting space and aviation technology focused on communications, information technology, microtechnology, nanotechnology, power and propulsion and biotechnology. Three Program areas are responsible for conducting this research: Computing, Information, and Communications Technologies (CICT) program, Engineering for Complex Systems (ECS) program, and the Enabling Concepts and Technologies (ECT) program. The FY 2004 budget request includes \$233 million for CICT, \$44 million for ECS, and \$161 million for ECT.

NASA develops partnerships with industry and academia in order to transfer NASA technology to industry and to develop new technology that supports NASA programs. The ITTP FY 2004 request of \$169 million funds the Technology Transfer Activities, the Small Business Innovative Research program and the Small Business Technology Transfer program. The FY 2004 request also introduces \$5 million for Enterprise Engine, a new partnership program for dual-use technologies.

SCIENCE, AERONAUTICS, AND EXPLORATION (SAE)

The SAE appropriation contains the majority of NASA R&D programs. It funds R&D activities that extend our knowledge of the Earth, our Solar System and space environment, and the Universe. SAE 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. Funding for R&D is included in the five accounts below (see also Table II-12). The FY 2004 request for SAE funding is \$7.66 billion, up 2.8 percent from FY 2003 appropriation.

Space Science Enterprise: The FY 2004 Space Science budget of \$4.0 billion represents an increase of 12.7 percent over the FY 2003 enacted level of \$3.6 billion. Funding has been increased as certain missions enter their peak development activity and new initiatives are started. Space Science has been organized into the following themes: Solar System Exploration, Mars Exploration, Astronomical Search for Origins, Structure and Evolution of the Universe, and Sun-Earth Connection. Space Science is the office of NASA that conducts planetary exploration, studies the Universe beyond our own Solar System, and other phenomena that populate our Universe. The enterprise develops and operates a fleet of space probes and both space-based and ground-based

Michael Beavin

telescopes to pursue the answers to fundamental questions about the origins of life and planets, how the Universe began and evolved, and the existence of life beyond Earth.

The Space Science program includes three new initiatives: Project Prometheus, Optical Communications, and Beyond Einstein. The Project Prometheus program intends to develop and demonstrate safe nuclear power and propulsion systems for deep space exploration of the icy moons of Jupiter. NASA has requested \$279 million (\$3 billion over 5 years) for the program. NASA has requested \$31 million (\$233 million over 5 years) to develop Optical Communications. This project is aimed at demonstrating laser communications technology on a telecommunications satellite that would send data to the Earth while orbiting Mars in 2009. The Beyond Einstein program seeks to answer questions that have arisen from Albert Einstein's theories. The program will launch observatories to probe into such mysterious theories as The Big Bang, Black Holes, and Dark Energy. NASA is requesting \$59 million (\$765 million over 5 years) for the program in FY 2004.

The President's request for Solar System Exploration in FY 2004 is \$1.4 billion and represents a 26.6 percent increase over FY 2003 funding. This funding will support planned missions to probe comets, return comet dust samples, explore Mercury and Saturn, examine the solar wind, the New Frontiers program to explore the outer planets of the Solar System, as well as Astrobiology research to find and identify potential life harboring planets.

The proposed Mars Exploration budget for FY 2004 is \$570 million. Funding will support two Mars Exploration Rovers in 2004 and the continued development of the Mars Reconnaissance Orbiter in 2005, the Mars Science Laboratory rover in 2009, and the laser communications technology demonstration satellite in 2009.

The FY 2004 request for Astronomical Search for Origins is \$877 million, a 7.1 percent increase from FY 2003. This funding will provide for the operation of the Hubble Space Telescope, development of the Next-Generation Telescope, the Space Interferometry Mission, and operations of the Space Infrared Telescope Facility. The budget also reflects the final HST servicing mission. As stated, this mission is temporarily on hold until the Shuttle fleet is returned to flight status.

NASA R&D IN THE FY 2004 BUDGET

The Structure and Evolution of the Universe theme's FY 2004 request is \$432 million, a 5.7 percent increase from FY 2003. This theme seeks to answer questions about the Big Bang and probe such phenomena as Black Holes and Dark Matter. Funding will support development of the Gamma-ray Large Area Space Telescope and Beyond Einstein.

NASA's Sun-Earth Connections theme investigates the Sun and how it affects the Earth. The request for this theme in FY 2004 is \$770 million, an 11.3 percent increase over FY 2003. The request would support the development and mission flights of the Solar Dynamics Observatory, a program to study the Sun's magnetic field and its influence on space weather, and the STEREO, which will study the Sun's coronal mass ejections. (For more on astronomy in Space Science, see Chapter 15.)

Earth Science Enterprise: The request for Earth Science in FY 2004 is \$1.55 billion, an 8.1 percent decrease from FY 2003. The decrease is the result of major programs, such as AURA, Cloudsat, and Calipso that are preparing for launch and are past their more intensive development stage. The unique vantage point of space allows scientists to observe the linkages of natural and man-made interactions on the Earth system.

The Earth System Science request will support the launch of three satellites: the AURA, Cloudsat, and Calipso will fly in a polar orbit formation and complement each other in FY 2004. Data from the satellites will support the President's Climate Change Research Initiative (see Chapter 16). Additionally, the budget request includes \$27 million (\$72 million over five years) to fly an advanced instrument called a polarimeter. The polarimeter will measure aerosols in the atmosphere and study the impact they have on Earth's climate. The initiative accelerates the launch of the polarimeter by about four years, to 2007. The request also provides \$524 million for research and modeling to study climate change, \$96 million for the NPOESS Preparatory Project (NPP), and \$60 million for the Landsat Data Continuity Mission. The NPP transfers critical research data to operational agencies and is being developed in partnership with the National Oceanic and Atmospheric Administration (NOAA) and DOD. The Landsat Data Continuity Mission is an innovative program that partners NASA with industry to continue remote sensing data through a commercial data buy.

The FY 2004 request for Earth Science Applications is \$75 million, a 12.3 percent cut from FY 2003. Funding will support partnerships

Michael Beavin

between NASA and other federal agencies to conduct joint research and demonstration projects that develop and advance the use of NASA-unique information and technology across new applications, including topics such as weather prediction models, near-airport terrain databases, air quality, and agricultural productivity. The goal is to support and improve the decision support systems of the partnering agencies.

Biological and Physical Research Enterprise (BPR): BPR was created in 2001 to conduct research in the unique space environment and develop commercial opportunities. This research will be used to increase the fundamental knowledge of biological, physical, and chemical processes; enable the development of space for human enterprise; and create new products and services. BPR is structured into three themes: Biological Sciences Research, Physical Sciences Research, and Research Partnerships and Flight Support. The FY 2004 request for BPR is \$973 million, an increase of 4.0 percent over the FY 2003 appropriated level.

A new start for FY 2004 is the Human Research Initiative (HRI). This initiative will research the radiation environment beyond low-Earth orbit and develop ways to protect humans from long duration exposure to radiation. The program would receive \$39 million in FY 2004.

Within the Biological Sciences Research theme, NASA seeks ways to support a safe human presence in space. From research at a cellular level to entire organisms, research is conducted to determine the risks posed to human health by exposure to radiation, microgravity, and isolation. The FY 2004 request of \$359 million will fund expanded ground research and flight experiments. Funding for HRI is provided here.

The request for the Physical Sciences Research theme in FY 2004 is \$353 million. This theme supports research in space to expand the understanding of the fundamental laws of nature and is structured to respond to the Research Maximization and Prioritization Task Force process. The Task Force was organized in 2002 to prioritize BPR research. Funding in FY 2004 will support the preparation of the first major Physical Sciences Research rack to the ISS and the beginning of prime research facility operations on the Space Station.

NASA requests \$261 million for the Research Partnerships and Flight Support theme in FY 2004. The Research Partnership element seeks to establish policies to encourage industry partnerships to accelerate

NASA R&D IN THE FY 2004 BUDGET

progress in research areas. However, the majority of funds would go to Flight Support, which includes multi-user hardware development, payload integration and training, and payload operations support.

Aerospace Technology Enterprise: This year marks the 100th Anniversary of Orville and Wilbur Wright's first successful powered flight. In the 20th century, the U.S. became the world leader in aeronautics technology and the aerospace industry played a critical role in our Nation's economy and standard of living. That leadership has been challenged recently with new foreign competition from the European Union, India, and China as well as the economic conditions after 9-11 and the current recession. NASA's FY 2004 request for the Aeronautics Technology theme in FY 2004 is \$959 million, a decrease of 8.5 percent from FY 2003. The aeronautics program is intended to conduct research in technologies that will make the Nation's air transportation system safer, cleaner, more efficient, and secure. The aeronautics R&D activities in the budget request include \$168.5 million for Aviation Safety and Security projects (AvSSP), \$217.1 million for Airspace Systems (AS), and \$573.5 million for Vehicle Systems (VS). Three new initiatives are also included in the budget request: Aviation Security, National Airspace System Transition Augmentation, and Quiet Aircraft Technology.

In cooperation with the aviation industry and the Federal Aviation Administration (FAA), NASA seeks to develop and transfer advanced aviation safety and security technologies and procedures through the Aviation Safety and Security project. The goal of the AvSSP is to greatly reduce the aircraft fatal accident rate and to decrease the vulnerability of the air transportation system. Research in hazardous weather, human-error, aircraft system malfunctions and security concerns (including criminal acts) will be leveraged through cooperative agreements and cost-shared contracts to maximize the investments in key technologies. The new Aviation Security initiative will begin development of technologies to protect commercial aircraft and the National Airspace System (NAS) from terrorist threats such as sabotage and hijackings. The FY 2004 request includes \$21 million, \$225 million over five years.

The request provides for collaboration in aeronautics R&D between NASA and the FAA to meet future demands in air travel. The primary goal of the Airspace Systems Program is to increase the capacity and mobility of the NAS through revolutionary improvements and modernization. The AS program will develop the technologies to

Michael Beavin

maximize the airspace system while maintaining safety and environmental protection. The FY 2004 budget also includes \$27 million, \$100 million over five years, for the new National Airspace System Transition initiative. As unmanned aerial vehicles become more common in civil and military applications, their operation in the NAS will require additional technologies and procedures.

The Vehicle Systems (VS) Program research goal is to provide enabling technologies to reduce the environmental impact of aviation. The Ultra-Efficient Engine Technology program and the 21st Century Aircraft Technology project will conduct research to reduce aircraft engine CO₂ and NO_x emissions by 25 and 70 percent respectively. The new Quiet Aircraft Technology initiative will develop technologies to reduce 50 percent of the noise generated by aircraft. The FY 2004 request provides \$15 million, \$100 million over five years, for this new initiative. The VS, in collaboration with DOD, will also develop national security technologies through air vehicle applications.

Education Enterprise: The FY 2004 request for the Education Enterprise is \$170 million, a 24.7 percent decrease compared to FY 2003 because NASA would not renew \$56 million in congressional earmarks in FY 2003 appropriations. NASA promotes excellence in the U.S. education system through its new Education Enterprise, established in 2002. The new Enterprise will unify the educational programs in NASA's other five enterprises and 10 field centers. Education programs include Space Grant, the Experimental Program to Stimulate Competitive Research (EPSCoR), and Minority University Research and Education Grants. These programs seek to involve America's students, of all ages, in NASA's endeavors to create unique learning opportunities and to enlighten and inspire minds. Funding is also provided for the new Education Initiative. This new initiative establishes the Educator Astronaut Program, a Scholarship for Service Program, the Explorer Institutes, and the NASA Explorer Schools Program.

INSPECTOR GENERAL

The FY 2004 request for the Office of the Inspector General is \$26 million, an increase of 3.4 percent over the FY 2003 appropriations.