

Astronomy in the FY 2001 Budget

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HIGHLIGHTS

- The National Aeronautics and Space Administration's (NASA) exploration of Mars would continue in high gear under the President's FY 2001 budget, with a planned increase of 31.5 percent to \$327 million. The Mars Surveyor program takes advantage of launch opportunities that occur about every 26 months to send small missions to explore the Martian environment. Because of the failure of the Mars Climate Orbiter¹ and Mars Polar Lander² missions, the entire program is undergoing both internal re-planning and external review.
- The National Science Foundation's (NSF)³ division of Astronomical Sciences⁴ (AST) would receive a 37.3 percent increase in its Astronomy Research and Instrumentation budget in FY 2001. This line item provides grants to individual investigators to carry out astronomical research and funds cutting-edge instrumentation development.
- NASA plans to expand its Discovery⁵ program (which provides frequent access to space for small planetary science missions) to include new 'micromissions' (\$8 million in FY 2001). Micromissions will take advantage of new mission strategies such as: secondary launch capabilities; flying piggyback on other spacecraft; and the use of micro-rovers, penetrators, and other

¹ <http://mars.jpl.nasa.gov/msp98/orbiter/>

² <http://mars.jpl.nasa.gov/msp98/index.html>

³ <http://www.nsf.gov>

⁴ <http://www.nsf.gov/mps/ast>

⁵ <http://discovery.nasa.gov>

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micromission capabilities developed for previous NASA missions. Overall, the Discovery program would receive \$196.8 million in FY 2001, an increase of 27 percent over FY 2000.

- NASA proposes \$20 million in FY 2001 for a new “Living with a Star” initiative.⁶ The program is a set of missions and enhancements to current programs designed to study solar variability and its effects on humanity. This initiative expands the emphasis of the Sun-Earth Connections theme by adding the additional goal of studying how solar variability affects humans and our technology.

INTRODUCTION

The sky belongs to all of humanity, and astronomy has a special role to play in bringing knowledge of the cosmos to us all. Beginning with the earliest recorded history, objects in the sky have been described, studied, and analyzed. Only in modern times have we truly found our place in the Universe. We live our lives on a relatively small planet orbiting a rather normal star in an average galaxy. Just in this century, astronomers have determined how the chemical elements that make up our Earth (and us!) were formed in supernova explosions. Astronomers have managed to trace the history of the Universe back to its very first moments when all matter and light were compressed into a dense energetic state that rapidly expanded (for as yet unknown reasons), forming our Universe. This cosmic explosion is now known as the Big Bang. In the past decade, astronomers have finally discovered planets around other stars, confirming that our solar system is not unique.

The National Aeronautics and Space Administration (NASA) provides roughly 75 percent of the funding for space science and astronomical research for individuals in the United States. When the budget for the NASA’s Office of Space Science⁷ changes, many American astronomers can be affected. The National Science Foundation (NSF) also funds a significant amount of the astronomical research that takes place in the United States, including the construction and operation of the

⁶ <http://sec.gsfc.nasa.gov/lws.htm>

⁷ <http://spacescience.nasa.gov>

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U.S. National Observatories.⁸ These observatories play a critical role for researchers from smaller institutions which cannot afford to construct and operate large observing facilities. They also provide access for American astronomers to the sky in the southern hemisphere, where many important astronomical objects are located.

A traditional split in funding exists between NASA and NSF, with NASA funding space-based observations and NSF funding ground-based ones. However, this line is often blurred. For example, both agencies support balloon-based observations. NASA also supports limited ground-based observations when they have a direct supporting role for space missions, and both agencies are pursuing collaborative efforts such as the new NSTARS⁹ program, which will support theoretical and observational studies of the stars closest to Earth. The scientific results will support NASA's Space Interferometer Mission¹⁰ and fulfill a long-term goal of the NSF-AST division to study stars in the local solar neighborhood.

ASTRONOMY IN THE NASA BUDGET

February 7th was an unusually sunny day in Washington. Not only was the sun out but also Dan Goldin, the NASA administrator, announced the first proposed increase in the NASA budget for several years. From \$13.6 billion in FY 2000, NASA would receive an increase of 3.2 percent to \$14.0 billion for FY 2001 (see Table II-12). Goldin also announced that NASA would stop downsizing and begin hiring again.

The Office of Space Science (OSS) would experience a large budgetary growth of just over 9 percent from \$2.2 billion to a FY 2001 total of just under \$2.4 billion. The office has four long-term goals, which may be posed as simple, penetrating questions: How did the Universe, galaxies, stars, the Sun, and planets form and evolve? How can exploration of the Universe and our solar system revolutionize our understanding of physics, chemistry and biology? Are there Earth-like planets beyond our solar system? Does life in any form, however simple or complex, carbon-based or other, exist elsewhere than on planet Earth?

⁸ <http://www.nsf.gov/mps/ast/facility.htm>

⁹ <http://www.nsf.gov/mps/ast/nstars.htm>

¹⁰ <http://sim.jpl.nasa.gov/index.html>

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To attempt to answer these questions, OSS has undertaken a series of missions¹¹ that attempt to answer fundamental scientific questions. Although too numerous to mention here, a few of the missions stand out as particularly exciting (in addition to the ones in the Highlights section).

Chandra X-ray Observatory¹²: Deployed in July, 1999, the Chandra telescope (formerly the AXAF; one of the four great observatories, which includes the Hubble Space Telescope, the Compton Gamma-ray Observatory, and the Space Infrared Telescope Facility) has produced dramatic images of supernova remnants, active galactic nuclei, and diffuse X-ray emissions found in clusters of galaxies. With a proposed FY 2001 mission operations and data analysis budget of \$59 million, this observatory will continue to produce exciting science results for the next several years through 2005.

Space Infrared Telescope Facility (SIRTF¹³): The fourth and final great observatory, this telescope is slated for launch in December 2001. The President's budget proposes \$118 million in FY 2001 for continued development. This amount is slightly lower (about 5 percent) than FY 2000, as planned. This instrument is sensitive to the infrared portion of the electromagnetic radiation and in its high orbit above Earth will observe the earliest era of galaxy formation as well as sub-stellar mass objects in our own galaxy. The project was completely restructured to fit within a self-imposed fixed \$400 million (in FY 1994 dollars) cost ceiling. Because of cost-cutting measures as well as technological advances, SIRTF will still be able to meet most of the science goals of the instrument's original design.

Stratospheric Observatory for Infrared Astronomy¹⁴: This airborne observatory replaces the Kuiper Airborne Observatory, which was retired in October, 1995. This collaborative project with the German space agency, DARA, has met delays in the development of the German telescope assembly. These delays have pushed the beginning of science operations into FY 2002.

¹¹ <http://spacescience.nasa.gov/missions/index.htm>

¹² <http://chandra.harvard.edu/index.html>

¹³ <http://sirtf.jpl.nasa.gov/>

¹⁴ <http://sofia.arc.nasa.gov/>

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Explorer program: This program utilizes small to mid-sized spacecraft to investigate all space physics and astrophysics areas. A large number of missions such as the Far Ultraviolet Spectroscopy Explorer¹⁵, Microwave Anisotropy Probe¹⁶ and High Energy Transient Explorer-II¹⁷ (among many others) all utilize low-cost, rapid development and launch methods to explore our solar system, galaxy, and Universe.

Research Program: This program, part of the wider Supporting Research and Technology line item, supports researchers through peer-reviewed proposal selection. This program would receive an overall reduction of about 1 percent in FY 2001. The line item consists of both Research and Analysis (mainly direct funding to researchers) and Data Analysis (funding for distribution and analysis of mission data). The Data Analysis portion receives \$312 million (up 7 percent) while the R&A line receives an overall cut of 11 percent to \$212 million. This reduction could adversely impact astronomy researchers.

ASTRONOMY IN THE NSF BUDGET

NSF funds astronomy through its Division of Astronomical Sciences.¹⁸ This funding is split into two basic units, Astronomy Research and Instrumentation (ARI, which funds individual researchers and instrument development projects) and Astronomy Facilities (which supports the National Astronomy facilities). ARI would receive \$60 million for FY 2001, compared to \$44 million for FY 2000 for an increase of about 37 percent. The Astronomy Facilities would receive only a modest increase of 0.8 percent, or \$600,000, to a FY 2001 proposed funding level of \$80 million. This small increase would go entirely to the Gemini¹⁹ optical telescopes program, while the other National Facilities such as the National Radio Astronomy Observatory²⁰, National Optical Astronomy Observatories²¹, National Astronomy and Ionosphere Center²², and the

¹⁵ <http://fuse.pha.jhu.edu/>

¹⁶ <http://map.gsfc.nasa.gov/>

¹⁷ <http://space.mit.edu/HETE/>

¹⁸ <http://www.nsf.gov/mps/ast>

¹⁹ <http://www.gemini.edu/>

²⁰ <http://www.nrao.edu>

²¹ <http://www.noao.edu>

²² <http://www.naic.edu>

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University Radio Facilities²³ are proposed to receive FY 2001 budget levels identical to FY 2000. This adjustment likely represents a response to a long-standing community concern with the relatively low amount of funds available to individual researchers and, unfortunately, will have some detrimental impact on the National Facilities.

Astronomy is also supported within the NSF budget both through the Office of Polar Programs²⁴ (OPP) and Major Research Equipment (MRE). The exact amounts expended by OPP for astronomy research were not available. The Atacama Large Millimeter Array (ALMA) would continue into a fourth year of design and development with a proposed funding level of \$6 million in FY 2001, down from \$8 million.

ASTRONOMY ELSEWHERE IN THE BUDGET

Both the Navy and Air Force fund fundamental astronomical research for a variety of reasons related to national security. Although exact numbers were not available, the total amount expended is not as large as either NSF or NASA. One example of the basic research performed is the Air Force's Advanced Electro-Optical System²⁵ (AEOS) telescope on Maui (also available to civilian astronomers). The AEOS is used as a testbed for new technologies to be used for space surveillance. The U.S. Naval Observatory²⁶ uses various techniques to determine the accurate position of stars for navigational and earth-alignment purposes and, with the Naval Research Laboratory and Lowell Observatory, has developed the Navy Prototype Optical Interferometer.²⁷

²³ Five College Radio Astronomy Observatory (FCRAO; <http://www-astro.phast.umass.edu/fcad.html>), Berkeley-Illinois-Maryland Array (BIMA; <http://bima.astro.umd.edu/bima/>), Caltech Submillimeter Observatory (CSO; <http://www.submm.caltech.edu/cso/>), Owens Valley Millimeter Array (OVRO; <http://www.ovro.caltech.edu/>), and the Coordinated Millimeter VLBI Array (CMVA; <http://web.haystack.mit.edu/cmva/CMVA.html>)

²⁴ <http://www.nsf.gov/opp>

²⁵ <http://ulua.mhpcc.af.mil/>

²⁶ <http://www.usno.navy.mil/>

²⁷ <http://aries.usno.navy.mil/>