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Astronomy in the FY 2009 Budget

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HIGHLIGHTS

- The Science Mission Directorate (SMD) of the National Aeronautics and Space Administration[1] (NASA) would see a significant 5.6 percent decrease for FY 2009 to $4.4 billion, compared with the enacted FY 2008 level through Public Law 110-161 (2008 Omnibus Appropriations Act). The budget initiates the Joint Dark Energy Mission (funded together with DOE) in 2009.

- The National Science Foundation[2] (NSF) top line budget authority grows by 13.6 percent to $6.9 billion for FY 2009, compared to the enacted FY 2008 level, returning to a doubling path provided in America COMPETES Act and the American Competitiveness Initiative, after NSF failed to achieve any real increases in the FY 2008 Omnibus bill. The proposed FY 2009 budget contains $250 million for the Astronomical Sciences Division[3] (AST), an increase of 14.8 percent over the FY 2008 omnibus level.

- The Department of Energy's (DOE) Office of Science[4] receives an R&D budget of $4.3 billion for FY 2009, an increase of 20.7 percent over the final FY 2008 level. DOE Science, along with NSF and the National Institute of Standards and Technology (NIST), benefits from the President's American Competitiveness Initiative (ACI), which seeks to double the total funding for these three agencies by 2016. While those increases did not survive in the FY 2008 Omnibus budget, sharp increases are proposed for FY 2009.

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[1] http://www.nasa.gov
[2] http://www.nsf.gov
[3] http://www.nsf.gov/mps/ast
[4] http://www.er.doe.gov/

INTRODUCTION

Astronomy is one of the most exciting and dynamic fields of science, and astronomical research in the past few decades has literally changed our understanding of the Universe. The most ancient of the sciences, astronomy began with the earliest recorded history, when the sky was first observed and debated. Only in modern times have we truly discovered our place in the Universe—we live 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 life on it) were formed in supernova explosions and aging giant stars. 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.

Some of the most cutting-edge scientific discoveries in recent years have come from astronomy. In the past decade, astronomers have discovered that the Universe is expanding faster and faster in a kind of "runaway" situation, identified and characterized planets around other stars (raising interest in detecting Earth-like planets around other stars), and found that roughly 96 percent of the matter and energy content of the Universe is completely unknown to us.

Each new discovery raises more questions and creates new technological needs, thus spawning creativity and innovation. Astronomy is truly an exciting, vibrant science that adds meaning to our human existence, captures the public's imagination, and inspires young people to pursue careers in science and technology.

NASA provides roughly 75 percent of the federal funding[5] for astronomical research in the United States. When the budget for the Science Mission Directorate of NASA is changed, many American astronomers can be affected, not to mention the workers in the aerospace industry who build the spacecraft that make these missions possible. NASA continues to provide observing opportunities for astronomers beyond the hindering absorption of the Earth's atmosphere.

[5] http://www.nap.edu/books/0309071399/html/

NSF provides approximately two-thirds of all federal support for ground-based astronomy, including nearly all support for radio astronomy.[6] NSF funds the construction and operation of the U.S. National Observatories.[7] These observatories play a critical role for researchers from smaller institutions for which large observing facilities are too expensive to construct and operate. They also provide access for American astronomers to the Southern hemisphere sky, where many important astronomical objects are located and cannot be observed from Northern hemisphere locations (*e.g.* the Magellanic Clouds, our nearest galactic neighbors).

Lately, the Department of Energy (DOE) has undertaken new astronomical research projects, and the Smithsonian Institution and the Department of Defense also fund astronomical research, though on a much smaller scale than both NASA and NSF.

A traditional, but arbitrary, split in funding exists between NASA and NSF with NASA funding *mostly* space-based observing and NSF funding *mostly* ground-based. This line is often blurred, since both agencies support balloon-based observing and other cross-cutting research. NASA does support ground-based observing when these activities have a direct supporting role for their space missions. A recent example is the Keck Interferometer.[8] Additionally, DOE has begun collaborations with both the NSF and NASA on astronomy-related projects, such as the Joint Dark Energy Mission, one early mission idea being represented by the Supernova Acceleration Probe (SNAP).[9] The Astronomy and Astrophysics Advisory Committee[10] (AAAC) meets regularly to discuss and advise on the best and most efficient ways for agencies to collaborate on astronomy research.

ASTRONOMY IN THE NASA BUDGET

The overall NASA budget would increase from $17.1 billion in the FY 2008 final estimate to $17.6 billion for FY 2009, a 2.9 percent increase. (All figures for the NASA budget can be found in Table II-12.)

[6] http://www.nsf.gov/bfa/bud/fy2004/pdf/fy2004_11.pdf
[7] http://www.nsf.gov/mps/divisions/ast/about/c_facilities.htm
[8] http://huey.jpl.nasa.gov/keck/index.html
[9] http://snap.lbl.gov/
[10] http://www.nsf.gov/mps/ast/aaac.jsp

The agency is focused on implementing the priorities set out by the NASA Authorization Act of 2005 and the Vision for Space Exploration.[11] Major priorities include the completing the International Space Station, retiring the Space Shuttle by 2010, and transitioning to the Orion Crew Exploration Vehicle and Ares launch vehicle.

The agency's task to implement the President's Vision for Space Exploration without incurring a large gap in U.S. capability to place humans in orbit has placed significant pressure on other parts of the agency, given the assumption of a nearly flat budgetary growth. In addition to an ambitious program of exploration, NASA is also charged with continuing its mission of scientific discovery. Currently, NASA manages 55 spacecraft conducting scientific research, with 15 additional science launches by the end of FY 2009.

The top line NASA/SMD budget would decrease from $4.7 billion in FY 2008 to $4.4 billion in FY 2009, a decrease of 5.6 percent. A portion of this decrease is due to the transfer of the Deep and Near Earth Networks to Space and Flight Support. Excluding that $256 million, the SMD budget decreases 0.3 percent in FY 2009.

As the overall SMD budget faces cuts, Earth Science and Planetary science see very small increases, while Astrophysics and especially Heliophysics face decreasing budgets.

Astrophysics decreases by 13.1 percent over the FY 2008 level, to $1.2 billion. The astrophysics portfolio is dominated by development of the James Webb Space Telescope (JWST) and Cosmic Origins programs. Programs seeing increases within Astrophysics include the Astrophysics Explorer program, primarily for the NuSTAR black hole detection mission, and SOFIA, an aircraft-carried infrared telescope that will begin science operations in 2009. Astrophysics Research sees a 49 percent increase, including a 22 percent increase for Research and Analysis.

Earth Science sees an increase of 6.8 percent over the FY 2008 level to $1.4 billion, including funds for implementing three new missions by 2013 in response to the Earth Decadal Study.

Heliophysics decreases to $577 million in FY 2009 from $840.9 million in FY 2008. However, the bulk of this is due to a transfer of the Deep

[11] http://www.nasa.gov/mission_pages/exploration/main/index.html

Space and Near Earth Networks to Space and Flight Support, outside of SMD. Excluding that portion of the budget, Heliophysics sees a 2.3 percent decrease in FY 2009 from the enacted FY 2008 budget. The New Millennium project is designed to test new flight technologies within SMD. The entire budget line is being reallocated into other areas within SMD.

Planetary Science increases by 6.9 percent to $1.3 billion. The Mars Scout 2011 mission is delayed to 2013 and an Outer Planet Flagship mission is added. This represents a sharp decrease in funding on Mars missions, bringing the total budget for Mars Exploration from $553.5 million in FY 2008 to $386.5 million in FY 2009. Within Planetary science, there are increases to the Outer Planets, Discovery, and New Frontiers programs.

The overall NASA budget increases 2.9 percent, with NASA maintaining a wide range of responsibilities in both space exploration and science. The budgetary pressure leads to reductions in Science, Aeronautics, and Education, as Exploration and Space Operations require budget increases. Testimony on the Hill from a variety of experts[12] indicates that NASA's budget is insufficient for its many missions, both in human space flight and science. (For more on the NASA budget, see Chapter 9.)

ASTRONOMY IN THE NSF BUDGET

The total NSF budget is slated to increase to $6.9 billion for FY 2009, an increase of 13.6 percent. NSF is one of three agencies singled out for increased funding as part of the President's American Competitiveness Initiative (ACI), and through the American COMPETES Act, although higher congressional appropriations did not materialize in the FY 2008 Omnibus Appropriations Bill. (See Table II-7 for NSF funding details.)

The impact of the FY 2008 Omnibus bill, which raised NSF funding agency-wide only 1.4 percent, had significant consequences for the entire agency, including 1000 fewer new research grants, 230 fewer Graduate Research Fellowships and, specifically to astronomy, flat funding of grants for astrophysics. In addition, a planned infusion of money to the National Optical Astronomical Observatory for refurbishing of facilities was deferred.

[12] http://www.science.house.gov/publications/hearings_markups_details.aspx?NewsID=2119

NSF funds astronomy through the Astronomical Sciences Division (AST).[13] AST funds astronomy in two major ways—research and education grants to individuals and large collaborations, and through major facilities, such as the International Gemini Observatory[14] and the four national astronomy R&D centers, the National Radio Astronomy Observatory[15] (NRAO), the National Optical Astronomy Observatories[16] (NOAO), the National Solar Observatory[17] (NSO), and the National Astronomy and Ionosphere Center[18] (NAIC).

AST would grow in the President's FY 2009 budget by 14.8 percent to $250 million over the estimated FY 2008 amount of $218 million. From FY 2007 to FY 2008, AST increased by only 1.1 percent. This trend reflects the desire of the Administration to return NSF to a doubling path provided in the America COMPETES Act and the ACI. 20 percent of the AST portfolio will be available for new grants in FY 2008, with 54 percent allocated to facilities, and the remainder commitments to previous grants awarded, instrumentation, education and outreach, and centers.

The Research and Education Grants portion of AST's budget would increase from $92.8 million in FY 2008 to $112.4 million in FY 2009 (21.1 percent increase), representing the bulk of the increase in the division. AST continues to support a wide range of investigations, ranging from the detection of extrasolar planets to the origin of the Universe, as well as numerous education and outreach activities. The FY 2009 budget also includes support for technology development for the Large-Aperture Synoptic Survey Telescope (LSST).

Astronomy Facilities would see an increase of $13.3 million over FY 2008 to $135 million. NSF continues to implement the recommendations of the Senior Review[19] of AST facilities. AST is employing this process to evaluate the cost effectiveness of its facilities and to determine how to manage its current portfolio of facilities in order to achieve the priorities outlined in the National Research Council (NRC) Decadal Survey

[13] http://www.nsf.gov/mps/ast
[14] http://www.gemini.edu/
[15] http://www.nrao.edu/
[16] http://www.noao.edu/
[17] http://www.nso.edu/
[18] http://www.naic.edu/
[19] http://www.nsf.gov/mps/ast/ast_senior_review.jsp

(*Astronomy and Astrophysics in the New Millennium*[20]) while maintaining core programs.

Changes to the budget for astrophysics include an increase of $2 million for the Gemini Observatory to fund new advanced instrumentation an increase of $2 million. NOAO receives an increase of $3.3 million (8.5 percent) to continue to implement the Senior Review recommendations, which include improving infrastructure and reducing other lower priority programs. The Atacama Large Millimeter Array (ALMA) receives a 43.2 percent increase over FY 2008, and the National Radio Astronomy Observatory sees a $5.3 million increase (8.5 percent).

Research Grants Programs are the highest priority for maintaining the AST portfolio, emphasizing the scientific priorities outlined in the Decadal Survey, and supporting the goals of "Physics of the Universe," written by the National Science and Technology Council. [21] Gemini and ALMA are AST's most important priorities in the realm of current facilities.

AST contributes to the American Competitiveness Initiative and the America COMPETES Act by increasing the emphasis on intermediate-scale instrumentation, and developing programs in universities on astronomical instrumentation to allow students and faculty to collaborate with industry and other national facilities.

Astronomy is also supported within the NSF budget through the Office of Polar Programs[22] (OPP), Major Research Equipment and Facilities Construction (MREFC) and Multidisciplinary Activities budget lines. The Antarctic Science division of OPP partially funds the IceCube Neutrino Observatory,[23] which receives a $3.4 million increase in funding from OPP in FY 2009. (For more on the NSF budget, see Chapter 6.)

ASTRONOMY ELSEWHERE IN THE BUDGET

Both the Navy and Air Force fund fundamental astronomical research for a variety of reasons related to national security. The Navy operates the

[20] http://www.nap.edu/books/0309070317/html/
[21] http://www.ostp.gov/galleries/press_release_files/physicsoftheuniverse2.pdf
[22] http://www.nsf.gov/od/opp
[23] http://icecube.wisc.edu/

United States Naval Observatory,[24] which provides important astrometric observations as well as maintaining the Time Services Department for the United States. While the money spent at the Navy and Air Force is small compared to NSF or NASA, it is important as it often represents multidisciplinary involvement in astrophysical research.

The Department of Energy also funds astrophysical research under its Office of Science. One example is the Joint Dark Energy Mission, funded together with NASA. Support for R&D within High Energy Physics increases from $689 million to $805 million (16.8 percent). (All figures for the DOE budget can be found in Table II-11.)

[24] http://www.usno.navy.mil/