

Astronomy and Astrophysics in the FY 2015 Budget

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HIGHLIGHTS

- The National Aeronautics and Space Administration’s (NASA) Science Mission Directorate is slated for a \$180 million (3.5 percent) cut relative to FY 2014, with the largest impacts felt in the astrophysics and planetary science divisions.
- Fabrication of the Large Synoptic Survey Telescope and its camera are underway at the National Science Foundation (NSF) and Department of Energy (DOE), respectively.
- Ongoing facility/mission operations, research and data analysis grants, and smaller-sized competitive facility/mission development programs continue to see downward budget pressures.

INTRODUCTION

Through the astronomical sciences, humanity seeks answers to some of the most fundamental questions. How did we get here? What’s out there? Are we alone? Each new discovery drives our understanding further, but also raises new exciting questions.

As we strive to understand more about our origins and our place in the cosmos, we drive innovations that may find use in meeting our nation’s technological needs — innovations that spur economic growth both in ways we can predict and in many we cannot. Our growing knowledge of the universe excites and inspires young people, driving them to seek deeper understanding of the universe around them and potentially into scientific or technological careers. Astronomy is a vibrant field that makes unique contributions to our nation’s prosperity.

Table 1. Astronomy in the Federal R&D Budget
(budget authority in millions of dollars)

	FY 2013	FY 2014	FY 2015	Change FY 15-14	
	Actual	Estimate	Budget*	Amount	Percent
Nat'l Aero and Space Admin	16,865	17,647	17,461	-185.9	-1.1%
<i>Science</i>	4,782	5,151	4,972	-179.2	-3.5%
<i>Heliophysics</i>	603	654	669	14.9	2.3%
<i>Planetary Science</i>	1,275	1,345	1,280	-64.7	-4.8%
<i>Astrophysics</i>	617	668	607	-60.7	-9.1%
<i>James Webb ST</i>	628	658	645	-12.8	-1.9%
National Science Foundation	6,902	7,172	7,255	83.1	1.2%
<i>Math & Physical Sciences</i>	1,249	1,300	1,296	-4.2	-0.3%
<i>Astronomical Sciences</i>	232	239	236	-2.9	-1.2%
<i>Geosciences Directorate</i>	1,274	1,303	1,304	1.4	0.1%
<i>Atm & Geospace Sci.</i>	245	251	251	0.1	0.0%
<i>Major Res. Equip & Faci</i>	196	200	201	0.8	0.4%
<i>Astronomy projects</i>	26	64	105	40.4	62.7%
Department of Energy	25,137	27,225	27,940	715.6	2.6%
<i>Office of Science</i>	4,681	5,066	5,111	44.8	0.9%
<i>High Energy Physics</i>	728	797	744	-52.5	-6.6%
<i>Cosmic Frontiers</i>	80	99	101	2.1	2.1%

Source: Agency budget justifications. Figures rounded to the nearest million.

*Does not include extra Opportunity, Growth, and Security Initiative funding.

All three major areas of the astronomical sciences are working to realize the vision of their National Research Council decadal survey reports: *New Worlds, New Horizons in Astronomy and Astrophysics*; *Visions & Voyages in Planetary Sciences*; and *Solar and Space Physics: A Science for a Technological Society*. These decadal surveys represent a consensus view of the current state of scientific understanding and present prioritized lists of projects, programs, and missions important in the next decade. The funding agencies look to these reports for guidance on scientific priorities.

NASA, NSF, and DOE provide most of the federal funding for astronomical research, with NASA contributing over 80 percent of federal support for the discipline. The Department of Defense and the Smithsonian Institution also provide federal support, but neither is a significant source of extramural grant funding for the community.

Astronomy funding at all three major supporting agencies continues to struggle with finding the right balance between large, medium, and small missions, facilities, and projects. Downward pressure on the agency top

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lines, combined with the communities' desires to develop revolutionary new facilities and flagship missions, continues to squeeze the more budget-flexible grants programs and competitive mid-scale projects. In the tightly constrained budget scenarios now realized — flat or falling budgets in real dollars — there is no clear consensus on the proper mix of mission scales, as “balance” is largely in the eye of the beholder.

ASTRONOMY IN THE NASA BUDGET

Within the \$17.46 billion request for NASA in FY 2015, the Science Mission Directorate (SMD) — which houses the James Webb Space Telescope (JWST) project and the Earth Science, Astrophysics, Planetary Science, and Heliophysics Divisions — requests funding of \$4.97 billion, a \$179 million (3.5 percent) cut relative to the FY 2014 enacted level.

The budget request of \$1.28 billion for the Planetary Science Division (PSD) is higher than the Administration's two previous requests, but remains below the level supported by Congress in both FY 2013 and 2014. In each of these years, congressional action brought the enacted levels for PSD up \$0.1 billion above the request. The FY 2015 request is the first to include funding (\$15 million) for pre-formulation of a mission to Europa, though the Congress provided \$80 million for this in FY 2014. Funding for production of new plutonium-238 and rehabilitation of infrastructure for the radioisotope power systems crucial for deep space missions would continue for a second year under a full cost recovery scheme with DOE. Funding for small-scale planetary science research grants would remain roughly flat under this request.

The request proposes a \$61 million (9.1 percent) cut to the Astrophysics Division (APD) budget compared to FY 2014 enacted, bringing it down to \$607 million in FY 2015. This reduction is largely due to the proposal to mothball the Stratospheric Observatory For Infrared Astronomy (SOFIA) and a one-time reduction to the operating budget for the Hubble Space Telescope of \$23 million (or 23 percent). The addition of a fund for Education and Public Outreach (EPO) activities across SMD (\$15 million), booked in the APD budget, represents a potential further cut. The FY 2015 request is the first to include funding for pre-formulation of the Wide-Field Infrared Space Telescope (WFIRST) mission (\$14 million), though this is significantly less than the \$56 million Congress appropriated in FY 2014. The request would increase the Astrophysics Explorer competitive mission line by \$39 million (39 percent) over the previous request to support development of the Explorer and Mission of

Opportunity selected in 2013; the notional out-year budgets would also support increased mission cadence in the latter half of this decade. Funding for small-scale research and analysis grants would remain flat under this request.

The budget request includes \$645 million for the James Webb Space Telescope (JWST) to keep this top NASA priority on schedule to launch in 2018. FY 2014 was the peak funding year for JWST development, and FY 2015 is viewed as a crucial year for components on the critical path to launch. Notional out-year budget projections in the FY 2015 request propose a constant total budget for APD and JWST combined.

The Heliophysics Division (HPD) — the smallest of SMD's four disciplinary divisions — would see an increase of \$15 million over FY 2014 to \$669 million in the President's FY 2015 request, though \$11 million is due to increased support for SMD-wide activities. The division is, however, facing an estimated \$39 million cost increase for the Magnetospheric Multi-Scale Mission (MMS), which missed its launch window due to the 2013 government shutdown.¹ The FY 2015 request would provide additional support for the Solar Probe Plus mission (\$11.5 million over the FY 2014 projection for 2015) using re-phased funding for the delayed Solar Orbiter Collaboration with the European Space Agency (down \$21 million compared to the FY 2014 projection). The division's request still falls short of the *Solar and Space Physics* decadal survey's recommendation to increase support for small, competed grants.

The Administration's modified STEM education proposal for FY 2015 would see all EPO activities *within SMD* consolidated into one \$15 million funding line, bookkept in the APD budget. Prior to FY 2014, each mission contributed 1 percent of its total budget to EPO, for a total of \$48 million in FY 2012 and prior. Thus, this FY 2015 proposal would represent a cut of \$33 million compared to past levels.

The President's Opportunity, Growth, and Security Initiative would provide an additional \$187 million for SMD, including \$35 million for extended missions in PSD, \$15 million for Advanced Stirling Radioisotope Generator technology development, \$20 million for SMD-wide Research and Analysis funding and \$20 million for WFIRST risk reduction activities.

¹ GAO report from April 2014: <http://www.gao.gov/assets/670/662571.pdf>

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ASTRONOMY IN THE NSF BUDGET

The budget request includes \$7.3 billion for NSF in FY 2015, a proposed increase of \$83 million, or 1.2 percent, over FY 2014 enacted. Most of this increase would go to the Education and Human Resources (EHR) Directorate, while the Research and Related Activities (R&RA) account would see no increase. The budget includes \$1.3 billion for each of the Mathematics and Physical Sciences (MPS) and Geosciences (GEO) Directorates, which house the Division of Astronomical Sciences (AST) and the Division for Atmospheric and Geospace Sciences (AGS), respectively; both directorates' budgets are flat compared to FY 2014.

The AST budget is proposed to decrease \$2.9 million (1.2 percent) to \$236 million in FY 2015. Within this topline, the division faces growing facilities operations costs, especially for the Atacama Large Millimeter/sub-millimeter Array (ALMA) and the Daniel K. Inouye Solar Telescope (DKIST, formerly the Advanced Technology Solar Telescope). ALMA reaches its full operations budget in FY 2015 (\$5.9 million over FY 2014), but is expected to continue growing slightly with inflation. DKIST, on the other hand, is just entering the ramp-up toward full operations over the next several years. With this prevailing trend, small, competed grants and mid-scale instrumentation programs face severe downward pressure in a scenario where budgets remain flat. The FY 2015 request would support a flat budget, compared to FY 2014, for the small-scale grants programs. The Mid-Scale Innovations Program (MSIP) recommended in the most recent astrophysics decadal survey would also stay roughly flat compared to FY 2014 at \$13.0 million. However, other programs supporting projects of this scale would be consolidated under MSIP.

Astronomy continues to benefit from telescope construction funding through the NSF Major Research Equipment and Facilities Construction (MREFC) account, which is proposed to stay roughly flat at \$201 million in FY 2015. There are two astronomy projects proposed for continued funding within the MREFC account in FY 2015. The Large Synoptic Survey Telescope's (LSST) construction ramps up to \$80 million in FY 2015 (an increase of \$52 million compared to FY 2014) as the project clears the MREFC approval process this year. Consistent with the new baseline approved in FY 2013, the request would provide \$25 million for DKIST construction (down \$12 million compared to FY 2014).

MPS chartered an ad hoc advisory panel to carry out a review of the entire AST portfolio, given projected growth in facilities operations costs and a constrained budget environment.² The review panel, which finished its work in August 2012, recommended that NSF divest itself of a number of currently operating telescopes (located primarily in the continental US) in order to achieve a more balanced portfolio. The division is currently working on environmental reviews of the facilities recommended for divestment and actively seeking funding partners for these facilities.

Funding for AGS would remain flat from FY 2014 levels. The grants programs within the Geospace section of AGS support heliophysics research. The section faces similar downward pressures on small and mid-scale programs due to growing facilities costs and is planning a portfolio review similar to the AST review described above.

ASTRONOMY IN THE DOE BUDGET

The Cosmic Frontier Experimental Physics program within the DOE Office of Science's High Energy Physics (HEP) division funds activities designed to advance our understanding of the fundamental laws of physics and includes explorations into the nature of dark matter and dark energy. The FY 2015 request includes \$101 million for the Cosmic Frontier program, an increase of \$2.2 million (2.2 percent) above FY 2014, despite a \$53 million cut to HEP overall (6.6 percent).

HEP is collaborating with NSF on LSST for studies of dark energy; HEP would supply the primary camera for the telescope at an estimated cost of \$160 million. Fabrication costs for this project (\$35 million in FY 2015) largely account for the increase in the Cosmic Frontier program. HEP also funds other dark energy projects, including the Baryon Oscillation Spectroscopic Survey slated to finish in FY 2014, and the Dark Energy Survey that began observations at the end of FY 2013.

² http://www.nsf.gov/mps/ast/ast_portfolio_review.jsp