

Modest but uneven R&D increases proposed for FY 2013

Uncertainty created by the Budget Control Act of 2011 clouds the outlook for federal science and technology funding. Some Department of Energy physics programs face significant cuts.

For the second straight year, President Obama has proposed increasing R&D expenditures despite an overall federal budget that remains frozen at its fiscal year 2011 level. But the \$2 billion, 1.4% increase for R&D he is requesting for FY 2013 is considerably less bold than the \$4.1 billion, 6.5% jump he had sought for FY 2012.

"The president thinks that it's absolutely critical to the nation's future to make these investments in research and development and STEM education in order to have the sort of future that I think all Americans want," presidential science adviser John Holdren said at the 13 February unveiling of the budget. "The president has consistently stuck to the message that whatever else we've got to do to live within our financial means, we're not going to skimp on investments in these crucial domains."

As is the case each year, some federal agencies that fund R&D fare better than others. On the down side for the second year is the Department of Defense, whose massive R&D programs are trimmed by 4.4%, to \$69.7 billion. As recently as FY 2010, the Pentagon had spent \$80.6 billion for R&D.

In percentage terms, the big winners

for FY 2013 are NSF, which is slated for a 4.8% increase, to \$7.4 billion, and the relatively tiny laboratory programs of NIST, which would move up 14.3%, to \$648 million. And although the Department of Energy, the largest federal funder of basic research in the physical sciences, grows 3.2%, its high-energy physics, nuclear physics, and fusion-energy programs are squeezed. NASA is in store for another small reduction in funding, to \$17.7 billion.

In the unlikely event that Congress enacts Obama's budget proposal largely intact during an election year, appropriations for R&D, as with all other discretionary federal spending, could still sink in January 2013 by as much as 8% from their proposed level. That's when mandatory reductions, or sequestrations, are due to take effect in accordance with last year's Budget Control Act. Unless Congress and the president agree to change the statute, discretionary outlays are to be cut by \$109.3 billion per year beginning in FY 2013. Half of that, \$54.7 billion, will come from the Defense Department and half from the remainder of the budget. The act does not further specify how the reductions will be applied, and

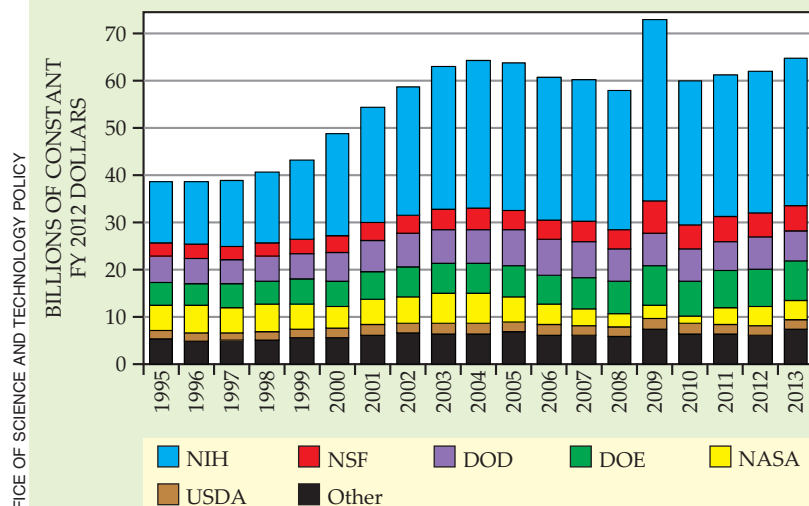
neither the White House nor lawmakers have begun to address that looming crunch.

Obama's FY 2013 budget purports to keep R&D funding at three agencies—NIST, NSF, and DOE's Office of Science—on a path to doubling in size, through "fiscally responsible increases." With austerity now the watchword, however, the doubling period is being stretched out well beyond its originally envisioned 10 years. Holdren, who calls those three agencies' portfolios "absolutely critical to contributing to fundamental research," allowed that their growth "is not at the rate of increase we would have preferred." At the 2.4% growth proposed for the Office of Science in FY 2013, doubling its current \$4.9 billion budget would take about 30 years.

The White House proposes a federal portfolio of basic and applied research totaling \$64 billion—a \$2 billion, 3.3% increase from the current year. The budget for the National Institutes of Health, by far the largest supporter of basic research, would stay exactly even with this year's level of \$30 billion. Holdren told reporters that he was "rather relieved that [NIH] didn't go down because of the pressures on the budget."

The budget would allocate \$3 billion in science, technology, engineering, and mathematics (STEM) education programs government-wide, an increase of

Federal research funding by agency, FY 1995–2013



Federal funding for basic and applied research under President Obama's budget request for fiscal year 2013 would rise 3.3%, to \$64 billion, matching levels last seen in the mid 2000s (excluding 2009, which included funding from the American Recovery and Reinvestment Act). Overall, the president proposed \$140 billion for federal R&D, a 1.4% increase compared with the amount appropriated in FY 2012. Whereas defense R&D, totaling \$75.9 billion, would decline 1.5%, non-defense-related R&D would increase 5%, to \$65 billion. Increases sought for NSF, DOE's basic research programs, and NIST's laboratory programs fall well short of the amounts needed to double their budgets over a 10-year period. The budget reemphasizes clean energy research and proposes new initiatives in manufacturing technology research.

2.6% from the current year. Carl Wieman, the associate director for science at the White House Office of Science and Technology Policy, said the request reflects Obama's call for the training of 100 000 new, effective STEM teachers and a 1 million, or 33.3%, increase in the number of well-prepared STEM college graduates over the next 10 years. A five-year strategic plan for STEM education, to be released by the White House in the spring, will propose ways to increase coordination and collaboration and to improve the efficiency and impact of the 235 STEM education programs currently operated by 13 different agencies, Wieman said. Through consolidation or elimination, the budget proposes to reduce that number by more than two dozen in FY 2013. NASA's STEM education funding would be cut 21.3%, to \$117 million, and NSF's STEM programs would grow 3.4%, to \$1.2 billion next year. The Department of Education would receive a 21.5% increase, to \$628 million, for STEM education.

NSF and the Department of Education are set to launch a joint \$60 million evidence-based initiative to improve K–16 mathematics education. The program will support collaborations between education researchers and practitioners to develop and test promising approaches and support widespread adoption of practices found to be effective. The multiagency model will be expanded in the future to include other STEM programs and agencies as part of the strategic plan.

The 2013 budget would provide \$2.6 billion for the multiagency US Global Change Research Program, an increase of 5.6%. The interagency Networking and Information Technology R&D program would increase 1.8%, to \$3.8 billion, and the National Nanotechnology Initiative would receive \$1.8 billion, \$70 million more than the current year.

The request calls out a total of \$2.2 billion for R&D related to advanced manufacturing at DOE, NSF, DOD, NIST, and nine other agencies. The focus on manufacturing follows Obama's announcement last summer of an industry–government Advanced Manufacturing Partnership (see PHYSICS TODAY, August 2011, page 27). The initiative calls for collaborations that will invent and scale up new manufacturing technologies and provide shared facilities to help small- and medium-sized manufacturers become internationally competitive.

Department of Energy. There is a wide disparity in the distribution of the

Department of Energy R&D programs

	FY 2012 actual	FY 2013 request	FY 2012–13 percent change
	(millions of dollars)*		
Total DOE	26 299	27 155	3.2
DOE R&D	11 429	12 468	9.0
Office of Science R&D programs	4 874	4 992	2.4
Total high-energy physics (HEP)	791	777	–1.7
Proton accelerator–based physics	422	412	–2.3
Research	123	125	2.0
Grants research	62	63	2.0
National laboratory research	61	62	2.0
Facilities	299	286	–4.2
Proton accelerator complex operations	103	107	4.7
Proton accelerator complex support	22	27	23.9
Proton accelerator facility projects	85	59	–29.9
Large Hadron Collider project and support	73	73	0.0
Other facilities†	17	19	15.0
Electron accelerator–based physics	23	29	26.5
Research	13	14	11.1
Grants research	5	6	29.3
National laboratory research	8	8	0.0
Facilities	10	15	45.1
Nonaccelerator physics	84	97	15.8
Theoretical physics	67	69	2.5
Advanced technology R&D (accelerators and detectors)	167	150	–10.4
Construction	28	20	–28.5
Total nuclear physics	547	527	–3.7
Medium-energy nuclear physics	133	135	2.0
Research	37	35	–5.1
University research	19	18	–5.7
National laboratory research	17	17	–4.4
Other research	1	1	–5.7
SBIR, other	17	19	7.4
Operations	77	81	4.2
Heavy-ion nuclear physics	201	197	–1.6
Research	40	39	–3.3
University research	14	13	–5.7
National laboratory research	24	24	–1.9
Other research	2	2	–3.9
Operations (primarily RHIC)	161	159	–1.2
Low-energy nuclear physics	106	98	–7.2
Research	52	49	–6.2
University research	20	19	–5.4
National laboratory research	32	30	–6.6
Operations (primarily ATLAS and HIRBF)	32	27	–14.1
Facility for Rare Isotope Beams	22	22	0.0
Nuclear theory	39	37	–5.6
Isotope development and production	19	19	–1.9
Construction	50	40	–18.8
Total fusion energy sciences	401	398	–0.6
Science	181	154	–14.5
Facility operations‡	194	221	13.8
Enabling R&D	26	23	–12.8
Total basic energy sciences	1 688	1 800	6.6
Materials sciences	361	421	16.3
Chemical sciences, geosciences, and energy biosciences	316	349	10.5
Energy frontier research centers (EFRCs)§	100	120	20.0
Energy innovation hubs	44	48	11.0
Total scientific user facilities	1 009	1 029	2.0
Operations	731	810	10.8
Advanced Light Source, LBNL	62	70	12.9
Advanced Photon Source, ANL	123	135	9.6
National Synchrotron Light Source, BNL	36	39	9.7
National Synchrotron Light Source II, BNL	0	22	—
Center for Nanophase Materials Sciences, ORNL	20	23	10.7
Center for Integrated Nanotechnologies, SNL/LANL	21	23	8.0
Molecular Foundry, LBNL	20	23	10.7
Center for Nanoscale Materials, ANL	20	23	10.7
Center for Functional Nanomaterials, BNL	20	23	13.5
Stanford Synchrotron Radiation Laboratory, SLAC	34	42	23.5
High Flux Isotope Reactor, ORNL	58	60	3.4
Manuel Lujan Jr Neutron Scattering Center, LANL	10	10	0.0
Spallation Neutron Source, ORNL	181	187	3.7
Linac Coherent Light Source (LCLS), SLAC	124	130	5.2

continued on next page

Department of Energy R&D programs (continued)

	FY 2012 actual	FY 2013 request	FY 2012–13 percent change
	(millions of dollars)*		
Research	25	27	10.0
Major equipment	73	32	–56.5
Other project costs	8	24	200.0
SBIR	23	25	8.7
Construction	151	111	–26.9
National Synchrotron Light Source II, BNL	151	47	–69.0
LCLS II, SLAC	0	63	—
Advanced scientific computing research (ASCR)	441	456	3.3
Biological and environmental research	610	625	2.6
Science laboratories and infrastructure	112	118	5.3
Program direction	185	203	9.7
Workforce development for teachers and scientists	18	14	–22.2
Safeguards and security	81	84	3.7
Advanced Research Projects Agency–Energy	275	350	27.3
Fossil energy R&D	347	421	21.3
Nuclear energy R&D	765	770	0.7
Energy efficiency and renewable energy	1 810	2 337	29.1
Electricity delivery and energy reliability	139	143	2.8
Total National Nuclear Security Administration R&D	3 208	3 435	7.0
Total weapons science, technology, and engineering	1 578	1 579	0.0
Science campaigns	333	350	5.1
Engineering campaigns	143	151	5.6
Advanced simulation and computing	618	600	–2.9
Inertial confinement fusion	475	460	–3.1
National security applications	10	18	82.4
Directed stockpile work R&D#	196	220	12.2
Nonproliferation and verification R&D	354	548	54.8
Naval reactors	1 080	1 089	0.7
Environmental management R&D	11	20	88.3

*Figures are rounded to the nearest million. Changes are calculated from unrounded figures.

†Includes \$10 million to support “minimal, sustaining efforts” at the proposed Deep Underground Science and Engineering Laboratory in South Dakota. Another \$4.5 million is being provided from the Nuclear Physics budget.

‡Includes \$150 million for the US contribution to ITER, an increase from the \$105 million appropriated for ITER in FY 2012.

§Sixteen of the 46 EFRCs were fully funded in 2009 for five years with monies from the American Recovery and Reinvestment Act. Funds for the other 30 must be provided from annual appropriations.

||Includes \$24 million for the batteries and energy storage hub and \$24 million for the fuels-from-sunlight hub. Department-wide, DOE is requesting a total of \$140 million for its five existing hubs and for a new hub to focus on the electrical grid, to be initiated in FY 2013.

#Includes the R&D support and R&D certification and safety items of the directed stockpile work program.

ANL, Argonne National Laboratory. ATLAS, a Toroidal LHC Apparatus. BNL, Brookhaven National Laboratory. HRIBF, Holifield Radioactive Ion Beam Facility. LANL, Los Alamos National Laboratory. LBNL, Lawrence Berkeley National Laboratory. ORNL, Oak Ridge National Laboratory. RHIC, Relativistic Heavy Ion Collider. SBIR, Small Business Innovation Research. SNL, Sandia National Laboratories.

2.4% increase proposed for the Office of Science, which funds DOE's non-weapons basic research. Declines are in store for the high-energy physics, nuclear physics, and fusion energy programs. The \$14 million cut for high-energy physics, to \$777 million, imperils the Fermilab-led Long-Baseline Neutrino Experiment. Energy Secretary Steven Chu told the House Science, Space, and Technology Committee on 1 March that DOE and Fermilab are trying to come up with a plan to keep the experiment alive despite the reduced funding.

With its 3.7% decline, the nuclear-physics program would provide enough funding to operate the Relativistic Heavy Ion Collider at Brookhaven National Laboratory for just 10 weeks next year—half this year's run time. But Steven Vigdor, Brookhaven's associate director for nuclear and particle physics, says the lab has found sufficient internal money to operate the

collider for 15 weeks. That's about the minimum required for physics experimentation, he says, given that five weeks are required just to cool down the superconducting magnets, tune the beams, and shut the machine down. The nuclear-physics budget provides just \$22 million for the \$650 million Facility for Rare Isotope Beams, an accelerator project just getting under way at Michigan State University. That's less than half the \$55 million the university had been expecting next year. Budget documents state that the funding will support engineering and design efforts that are needed before DOE formally decides whether to approve the start of construction.

A \$3 million trimming of the fusion energy research budget, to \$398 million, masks a big cut proposed for the US fusion laboratories. The request would raise the annual US contribution to the ITER fusion test reactor by \$45 million, to \$150 million next year, but would

simultaneously cut back the domestic research program by \$49 million. One of three US experimental fusion devices, MIT's Alcator C-Mod, would be shut down altogether in 2013, halting work for the 100 staff members and 30 graduate students there, says Miklos Porkolab, director of the MIT plasma fusion center. In a 27 February letter sent to Holdren and Chu, Porkolab, Princeton Plasma Physics Laboratory director Stewart Prager, General Atomics vice president Tony Taylor, and other US fusion scientists warned, “If implemented, the \$49 million cut contained in the budget request will result in the layoff of hundreds of fusion scientists, engineers, graduate students, and support personnel” and “will demote the US program to a second-tier player in the world fusion effort.” What's more, the US commitment to ITER is slated to ramp up to a peak of \$350 million in FY 2016—more than the total US fusion energy budget—according to the ITER agreement. “ITER is too expensive to be paid for out of the domestic program,” says Stephen Dean of Fusion Power Associates, an industry group.

Asked about fusion, Holdren said that “the cutting edge of fusion right now is determining whether we will create a burning plasma,” and that ITER is “the only machine in the world that has a prospect of doing that.” Chu, testifying before the House Science Committee, noted that 80% of the US ITER contribution will be spent on components to be manufactured in the US.

Funding for inertial confinement fusion would decline 3.1%, to \$460 million. According to budget documents, the campaign to achieve fusion ignition at the National Ignition Facility will conclude at the end of FY 2012, when the facility will transition “to routine operations” in support of stockpile stewardship. Should ignition not be achieved by 30 September, researchers will work to develop a detailed understanding of the remaining physics challenges and will also consider alternative ignition concepts. “This will allow a discovery- rather than schedule-driven program that will provide more opportunities for comparison with simulations and feedback from them to resolve the outstanding physics questions,” the documents state.

Coming out on the winning side at the Office of Science are the materials sciences, chemical sciences, geosciences, and energy biosciences research programs in the Office of Basic Energy Sciences, all of which would receive double-digit increases in FY 2013. All but 1 of the 14 scientific user facilities

supported by the office would receive more funding, and the 46 energy frontier research centers would split a 20% increase, to \$120 million. Funding for construction of the National Synchrotron Light Source II at Brookhaven would ramp down on schedule as it nears completion.

DOE's Energy Efficiency and Renewable Energy programs are proposed to jump 29.1%, to \$2.3 billion. A sixth interdisciplinary energy innovation hub, funded at \$20 million, will be launched next year to address the research challenges associated with modernizing the electricity grid. The budget would provide the Advanced Research Projects Agency-Energy, which funds high-risk, potentially high-payoff clean energy research, with \$350 million, compared with \$275 million currently.

A 7% increase is proposed for R&D activities of DOE's National Nuclear Security Administration. Its nonproliferation and verification R&D programs would swell more than 50%, to \$548 million. Those programs develop the technical capabilities to detect foreign nuclear weapons development, nuclear detonations, and the movement or diversion of weapons-usable materials; to monitor compliance with nuclear arms control and nonproliferation commitments; and to discourage the unnecessary spread of enrichment technology.

Construction of the \$6 billion Chemical and Metallurgy Research Replacement facility at Los Alamos National Laboratory has been deferred for five years. The plant was to have the capacity to manufacture dozens of replacement plutonium pits for nuclear warheads annually.

NSF. Agency director Subra Suresh said he hopes the bipartisan congressional support for the 2.5% increase NSF received in FY 2012 is a sign that lawmakers will approve the 4.8% raise in the FY 2013 request. But the \$7.4 billion request is a scaling back of the nearly \$7.8 billion that Obama had wanted for NSF in FY 2012. An estimated \$3.2 billion is provided for the individual-investigator-initiated research grant programs that make up NSF's Research and Related Activities and Education and Human Resources accounts. Every field of science and engineering supported by NSF will see an increase in support, said Suresh. In 2013, he estimated, the agency will support 285 000 researchers, postdocs, trainees, teachers, and students, or 10 000 more than this year. NSF expects to award 12 000 new grants in 2013, an increase from the 11 700 awards the agency projects to make in FY 2012. Due to antici-

NASA R&D programs

	FY 2012 actual	FY 2013 request	FY 2012–13 percent change
	(millions of dollars)*		
Total NASA	17 770	17 711	–0.3
NASA R&D			
R&D programs			
Total Science	5 074	4 911	–3.2
Planetary science			
Discovery	173	190	9.8
New Frontiers	161	175	8.9
Technology	145	133	–8.3
Planetary science research	174	188	8.3
Mars exploration	587	361	–38.5
Outer planets	122	84	–31.2
Lunar quest	140	61	–56.0
Total planetary science	1 501	1 192	–20.6
Astrophysics			
Astrophysics research	164	176	7.4
Cosmic Origins	237	240	1.3
Physics of the Cosmos	108	112	3.2
Exoplanet Exploration	51	56	10.2
Astrophysics Explorer	112	75	–33.1
Total astrophysics	673	659	–1.9
Earth science			
Earth systematic missions	881	886	0.5
Earth system science pathfinder	188	219	16.6
Multimission operations	163	162	–1.0
Earth science research	440	434	–1.5
Applied sciences	36	35	–4.9
Earth science technology	51	49	–3.3
Total Earth science	1 760	1 785	1.4
Heliophysics			
Heliophysics research	175	179	2.1
Living with a star	196	233	18.5
Solar terrestrial probes	189	189	0.4
Heliophysics explorer program	60	46	–23.4
New Millennium	0.1	0	–100.0
Total heliophysics	620	647	4.3
<i>James Webb Space Telescope</i>	519	628	21.0
Exploration			
Exploration systems development	3 007	2 769	–7.8
Exploration R&D	300	334	11.3
Commercial spaceflight	406	830	104.3
Total exploration	3 713	3 933	5.9
Aeronautics research	569	551	–3.1
Space technology	574	699	21.8
Space operations			
International Space Station	2 830	3 008	15.3
Space shuttle	556	71	–87.3
Space and flight support	801	935	16.7
Total space operations	4 187	4 013	–4.1
Cross-agency support	2 994	2 847	–4.9

*Figures are rounded to the nearest million. Changes are calculated from unrounded figures.

pated growth in the number of proposals received, from 53 400 this year to 55 000 in 2013, the success rate for applicants is expected to remain at 22%.

A new emphasis is placed in FY 2013 on the OneNSF Framework—a set of seven research focus areas that cut across the agency's organizational and disciplinary boundaries. Collectively,

funding for those seven areas would surge by 56.3% above this year's level, to \$807 million. The Science, Engineering, and Education for Sustainability program, which addresses clean energy and sustainability issues, would rise to \$203 million, from \$157 million. A second OneNSF component, Cyber-enabled Materials, Manufacturing,

Department of Commerce (NOAA and NIST) R&D programs

	FY 2012 actual	FY 2013 request	FY 2012–13 percent change
	(millions of dollars)*		
National Oceanic and Atmospheric Administration R&D			
Total	574	552	–3.8
NIST R&D			
Total	751	857	14.1
Scientific and Technical Research Services (STRS)†	567	648	14.3
Technology Innovation Program‡	—	—	—
Construction of research facilities	55	60	8.3

*Figures are rounded to the nearest million. Changes are calculated from unrounded figures.

†STRS includes NIST's laboratories.

‡Terminated in FY 2012.

Department of Defense R&D programs

	FY 2012 actual	FY 2013 request	FY 2012–13 percent change
	(millions of dollars)*		
Research, development, test, and evaluation (RDT&E)			
Total basic research (6.1)	2 112	2 117	0.2
US Army			
In-house independent research	21	21	–0.8
Defense research sciences	214	219	2.6
University research initiatives	81	81	0.1
University and industry research centers	141	123	–12.5
Total US Army	456	444	–2.6
US Navy			
University research initiatives	133	114	–14.6
In-house independent research	18	18	0.9
Defense research sciences	454	473	4.1
Total US Navy	605	605	0.0
US Air Force			
Defense research sciences	364	362	–0.7
University research initiatives	152	141	–7.3
High-energy laser research	14	13	–8.1
Total US Air Force	531	516	–2.7
Defense-wide basic research program†			
DTRA basic research initiative	48	45	–5.6
Basic research initiatives	7	19	159.4
Defense research sciences‡	291	309	6.3
National defense education program	84	88	5.3
Basic operational medical research science	38	40	4.8
Chemical and biological defense research	53	51	–3.9
Total defense-wide basic research programs	520	552	6.1
Applied research (6.2)	4 739	4 478	–5.5
Advanced technology development (6.3)	5 411	5 266	–2.7
Total science and technology (6.1–6.3)	12 263	11 861	–3.3
Other RDT&E§	60 574	57 792	–4.6
Total RDT&E 	72 837	69 653	–4.4

*Figures are rounded to the nearest million. Changes are calculated from unrounded figures.

†Includes the basic research budgets of DOD agencies such as DARPA, the Defense Advanced Research Projects Agency; DTRA, the Defense Threat Reduction Agency; the Missile Defense Agency; and the Office of the Secretary of Defense.

‡Includes DARPA's basic research budget. The bulk of DARPA's budget is provided from the applied research (6.2) and advanced technology development (6.3) categories. DARPA's overall FY 2013 request is \$2.8 billion, virtually even with its FY 2012 appropriations.

§Includes RDT&E categories 6.4 through 6.7.

|| Excludes medical research and R&D support in military personnel, construction, chemical agents and munitions destruction, and other programs.

and Smart Systems, would grow to \$257 million, from \$142 million; and a third, Cyberinfrastructure Framework for 21st Century Science and Engineering, would climb to \$106 million, from \$78 million. The expectation is that NSF

will devote \$355 million altogether for clean energy research, with particular emphasis on energy conversion, storage, and distribution. The \$148 million requested for advanced manufacturing research at NSF includes robotics re-

search, materials processing and manufacturing, and advanced semiconductor and optical device design. Support for major facilities and research equipment funding is just below 2012 levels, at \$196 million.

NSF's Education and Human Resources division will see an increase of 5.6%, to \$876 million.

NASA. The space agency's budget involved "some very difficult choices," Holdren acknowledged, though he asserted that investments needed to sustain US leadership in space science and exploration will continue. NASA's R&D programs, which include aeronautics research and the development of new space vehicles and technologies needed for human space travel, would increase \$203 million, or 2.2%, to \$9.6 billion. But the basic science programs would dip by 3.2%, to \$4.9 billion. Planetary science would plunge more than 20%, mostly due to the administration's decision to back out of participation in two European Space Agency-led missions to Mars, scheduled for launch in 2016 and 2018. Holdren insisted that the news didn't augur the end of US interest in the red planet. "Mars is clearly the centerpiece of our planetary exploration program," he said, citing the Mars Science Laboratory rover now on its way to the planet, two satellites presently orbiting Mars, and the *Mars Atmosphere and Volatile Evolution* probe due for launch in 2013. The NASA budget provides \$628 million to keep the *James Webb Space Telescope* on track for a 2018 launch.

Department of Defense. Although the Pentagon's overall R&D budget would decline 4.4% to \$69.7 billion, the basic research component, designated 6.1, is maintained essentially unchanged at the current year's \$2.1 billion level. The 6.1 account provides about one-third of all federal support for research in computer science and engineering and an even greater share of funding for specific fields of electrical and materials engineering. Applied research (6.2) would decline by 5.5%, advanced technology development (6.3) would decrease 2.7%, and weapons system development would see a 4.6% reduction compared with FY 2012 levels. The Defense Advanced Research Projects Agency would be funded at \$2.8 billion, essentially unchanged from the current year.

Department of Homeland Security. Homeland Security R&D rebounds 19.6%, to \$1.2 billion, which partially restores steep cuts enacted in FY 2012 appropriations. The budget does not fund construction of the \$150 million

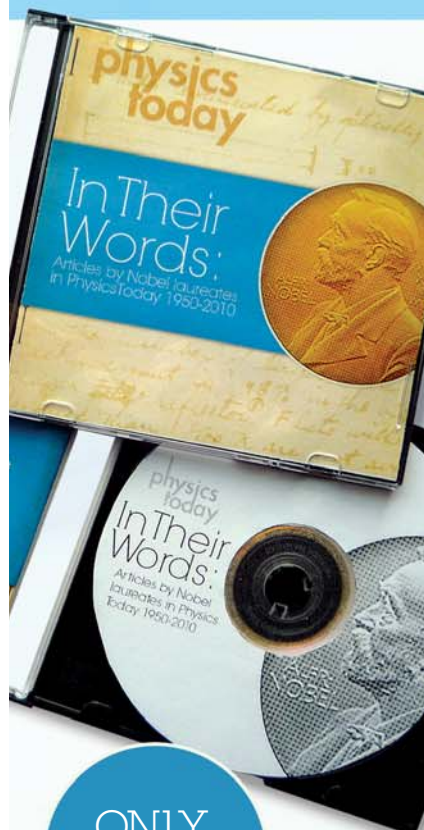
Department of Homeland Security R&D programs

	FY 2012 actual	FY 2013 request	FY 2012–13 percent change
	(millions of dollars)*		
Total DHS R&D	986	1 179	19.6
Domestic Nuclear Detection Office	290	328	13.1
Science and technology			
Acquisition and operations support	54	48	–11.4
Research, development and innovation	266	478	79.9
APEX R&D†	14	15	7.1
Border security R&D	16	32	101.0
CBRNE defense R&D	127	198	56.2
Counterterrorism R&D	2	25	1150.0
Cybersecurity R&D	46	64	40.7
Disaster resilience R&D	61	144	134.0
University programs	37	40	9.4
Laboratory facilities	176	127	–27.8
Management and administration	135	138	2.2
Total science and technology	668	832	24.5
Coast Guard	28	20	–29.0

*Figures are rounded to the nearest million. Changes are calculated from unrounded figures.

†APEX R&D projects are described as cross-cutting, multidisciplinary projects that have been requested by DHS's numerous operating units and are said to be "high-priority, high-value, and short turnaround in nature."

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NSF R&D programs

	FY 2012 actual	FY 2013 request	FY 2012-13 percent change
	(millions of dollars)*		
Total NSF	7 033	7 373	4.8
Research and related activities (R&RA)			
Mathematical and physical sciences (MPS)			
Mathematical sciences	238	245	3.0
Astronomical sciences	235	245	4.3
Physics	277	280	1.0
Chemistry	234	244	4.2
Materials research	295	303	2.7
Multidisciplinary activities	31	29	-5.1
Total MPS	1 309	1 345	2.8
Geosciences (GEO)			
Atmospheric and geospace sciences	259	264	2.1
Earth sciences	183	189	3.1
Ocean sciences	352	362	2.9
Integrative and collaborative education and research	91	91	0.0
Total GEO	885	906	2.4
Engineering	826	876	6.1
Biological sciences	712	734	3.0
Computer & Information Science & Engineering (CISE)			
Computer and network systems	212	233	9.9
Computing and communication foundations	179	195	8.9
Information and intelligent systems	176	193	9.3
Information technology research	85	88	3.2
Total CISE	654	710	8.6
Office of cyberinfrastructure	212	218	3.1
Polar programs			
Arctic sciences	103	109	5.6
Antarctic sciences	70	76	8.7
Antarctic infrastructure and logistics	257	258	0.6
US Antarctic logistical support†	68	68	0.0
Polar environment, health, and safety	7	7	7.3
Total polar programs	436	450	3.2
Arctic research commission	1	1	-4.1
Social, behavioral, and economic sciences	254	260	2.1
Office of international science and engineering	50	51	2.9
Integrative activities	350	432	23.4
Total R&RA	5 689	5 983	5.2
Major research equipment and facilities construction	197	196	-0.5
Education and human resources	829	876	5.6
Agency operations and award management	300	300	0.0
National Science Board	4	4	0.0
Inspector general	14	14	0.0

*Figures are rounded to the nearest million. Changes are calculated from unrounded figures.

†Payments are from other federal agencies that use NSF-owned Antarctic facilities.

National Bio and Agro-Defense Facility, a replacement for an aging facility used to develop measures to counter emerging agricultural diseases. Instead, DHS will conduct a comprehensive reassessment of the need for the new lab. The Domestic Nuclear Detection Office budget would increase by 13.1% to gain back some of the 29% reduction it had incurred in FY 2012.

NIST and NOAA. NIST director Patrick Gallagher said that more than half of the \$106 million increase proposed for his agency is to be focused on advanced manufacturing research. The request includes \$21 million for a new program to provide cost-shared funding to industry-led consortia. Those teams are to conduct precompetitive research addressing major technical problems that are preventing small-

and medium-sized US companies from more widely adopting advanced manufacturing capabilities. NOAA's R&D budget would decline 3.8%, to \$552 million, but the loss to basic and applied research components would be a steeper 6.3%, to \$384 million.

Other agencies. The Department of Transportation would receive \$1.1 billion for R&D, a 14% increase from the current year. Its request includes funds for several activities that are part of the Federal Aviation Administration's Next Generation Air Transportation System. The Environmental Protection Agency R&D program would increase \$12 million, to \$580 million. The US Geological Survey, the lead science agency in the Department of the Interior, would receive a \$35 million increase, to \$854 million.

David Kramer ■