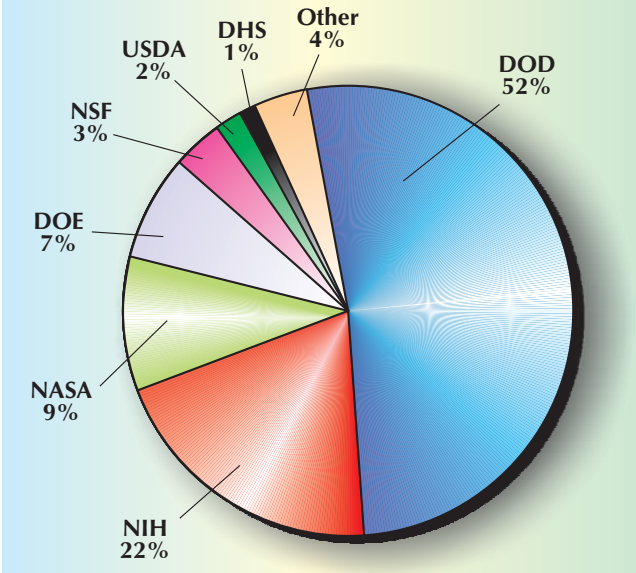
Bush R&D Budget Remains Focused on War, Terrorism, and Security in FY 2005; Civilian R&D Funding Flat

The administration is proposing another record-setting R&D budget that is $5.5 billion more than last year. But the entire increase would go to Pentagon weapons systems and homeland security programs.

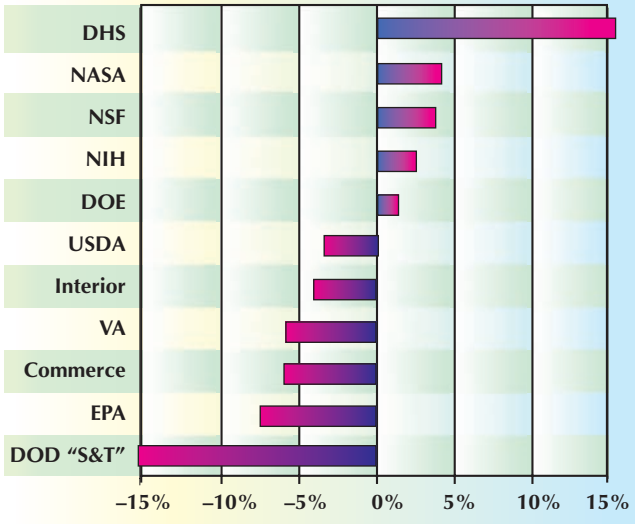
Whether it was a moment of sympathy or condescension wasn't clear, but the tone of the budget hearing before the House Committee on Science was set when Representative Bart Gordon leaned into his microphone and told the Bush administration's chief scientist, "I recognize you are just a messenger doing the best you can with what you have."

The "messenger" was Office of Science and Technology Policy Director John Marburger, and Gordon was making clear before Marburger uttered a word that the science committee wasn't happy with the administration's proposed fiscal year 2005 science and technology budget. "Dr Marburger will tell us today that this

Total R&D by Agency: FY 2005 Proposed



FY 2005 R&D Request: Percent Change from FY 2004



DHS, Department of Homeland Security. DOD, Department of Defense. DOE, Department of Energy. EPA, Environmental Protection Agency. NIH, National Institutes of Health. USDA, Department of Agriculture. VA, Veterans Administration.

Where Bush's R&D money would go. For yet another year, the Department of Defense remains the largest recipient of federal R&D money in the administration's FY 2005 budget; DOD funding increases $4 billion to $69.9 billion. Following the pattern of the multibillion dollar increases of the previous Bush budgets, this one would put virtually all new money into weapons systems, with the Missile Defense Agency getting a 20% increase to $9.1 billion. But basic (6.1) and applied (6.2) research would decline, with basic research falling 5.3% to $1.3 billion and applied research dropping 12.3% to $3.9 billion. While the National Institutes of Health still has the second largest piece of the pie, that share is the result of the five-year doubling of the NIH budget that ended in FY 2004. In the FY 2005 budget proposal, NIH R&D would receive a 2.6% increase to $27.9 billion. Although it represents the smallest slice of the pie, the Department of Homeland Security's R&D budget would receive the largest percentage increase, jumping 15.5% to $1.2 billion—an increase of $163 million. DHS plans to more than double its basic and applied research funding to $431 million, a 152% increase. NSF would receive a 3% increase overall, and a 3.6% gain to $4.2 billion in its R&D funding. That keeps NSF well short of the five-year doubling plan authorized by Congress in 2002. The Department of Energy R&D would increase 1.3% to $8.9 billion, with the entire increase going to the radioactive waste management program related to Yucca Mountain. DOE Office of Science R&D money would drop 0.4% to $3.2 billion.

Winners and losers in Bush's science funding. President Bush recently declared himself a "war" president, and his proposed FY 2005 budget supports that declaration. The administration is fighting a war in Iraq, a war in Afghanistan, and an antiterrorism war both at home and abroad. All of the fighting and the concurrent nation building, as well as the dramatically increased homeland security efforts, are being played out against a ballooning federal deficit that is expected to reach $521 billion this year. The proposed R&D budget reflects that reality. While the total federal R&D budget proposal for FY 2005 is a record, all of the new money would go to Department of Defense weapons development and new Department of Homeland Security programs. The DOD bar (above) is negative because it reflects the department's "Science and Technology" budget, which includes research, medical research, and technology development. NASA would see its R&D budget increase by 3.9% to $11.3 billion, the space agency's basic and applied research funding would drop 3.3%. NSF has positive numbers, but not nearly as large as foundation officials had hoped for when the NSF doubling plan was signed by President Bush in 2002. The Department of Energy's Office of Science funding would be down slightly, leaving a key source of funding for the physical sciences in its fifth straight year with a flat or declining budget. So while the overall federal R&D budget would be at a record high, the basic and applied research money would stay virtually flat at $55.7 billion, a $22 million increase.

National Science Foundation R&D Programs

	FY 2003 actual	FY 2004 estimate	FY 2005 request	FY 2004–05 percent change
	(millions of dollars)*			
NSF total	5332	5578	5745	3.0
NSF R&D	3926	4077	4226	3.6
Research and related activities (R&RA)				
Mathematical and physical sciences (MPS)				
Mathematical sciences	179	200	202	0.9
Astronomical sciences	187	197	204	4.0
Physics	225	228	236	3.6
Chemistry	182	185	189	2.0
Materials research	241	251	253	0.9
Multidisciplinary activities	27	31	31	0.9
Total MPS	1041	1092	1116	2.2
Geosciences (GEO)				
Atmospheric sciences				
Atmospheric sciences research support	148	157	160	2.1
National Center for Atmospheric Research	83	82	84	1.8
Total atmospheric sciences	231	239	244	2.0
Earth sciences	147	152	156	2.7
Ocean sciences	313	323	329	2.0
Total GEO	692	713	729	2.2
Engineering	542	565	576	1.9
Biological sciences	570	587	600	2.2
Computer and information science and engineering (CISE)				
Computer and network systems	117	115	132	15.2
Computer-communications research	81	79	91	15.8
Information and intelligent systems	82	80	93	15.6
Information technology research	214	218	178	–18.3
Shared cyberinfrastructure	95	113	124	9.7
Total CISE	589	605	618	2.2
US polar programs				
Polar research programs	255	274	282	2.8
Antarctic logistical support	69	68	68	0.0
Total polar programs	324	342	350	2.2
Social, behavioral, and economic sciences	185	204	225	10.3
Integrative activities	98	144	240	66.5
Budget authority adjustment	29	0	0	—
Total R&RA	4070	4251	4452	4.7
Major research equipment and facilities†	150	155	213	37.6
Education and human resources‡	909	939	771	–17.9
Salaries and expenses	190	219	294	34.4
National Science Board	4	4	4	1.8
Inspector General	9	10	10	1.7

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

†Funding would continue for Atacama Large Millimeter Array ($50 million); EarthScope ($47 million); IceCube Neutrino Observatory Network ($33 million). Funding requests for new projects are the National Ecological Observatory Network ($12 million); the Scientific Ocean Drilling Vessel ($41 million); and the Rare Symmetry Violating Processes ($30 million).

‡Reflects a proposal to transfer the Math and Science Partnership from NSF to the Department of Education. Of the $139 million in fiscal year 2004 funding for the partnership, $80 million would move to the Integrated Activities budget for FY 2005. Graduate education would increase 2.2% to $159 million; elementary, secondary and informal education would decrease 18.6% to $173 million.

budget proposes to spend more on R&D than any budget in history. That is technically true, but the biggest part of this R&D increase is for weapons development, which does very little for the broader economy."

Tennessee Democrat Gordon's views were shared by Republican Committee Chairman Sherwood Boehlert (R-NY), who said it would be "impossible to view this as a good budget for science." Before the 11 February hearing, Boehlert, playing off a quote from a Bush budget document that described science as a horse that must be fed, said, "After a few years of spending at the levels proposed . . . science would be an emaciated, old, grey mare, unable to produce any new ideas or young scientists."

As has been the case with the previous two administration budget proposals, the FY 2005 proposal focuses heavily on war, terrorism, and homeland security. The federal deficit, projected to hit $521 billion this year, provides additional context for the numbers and caused Bush to promise to hold nondefense domestic discretionary spending to just a 0.5% increase. Like the previous budgets, FY 2005 would see record spending for defense and homeland security R&D, but most other R&D spending would remain flat or decline.

Budget negotiations, marked by the tight constraints on discretionary spending, are also being conducted under the shadow of the cost of the war in Iraq. The budget's high deficits and tight spending goals do not include what is expected to be a request from the administration late in 2004 for tens of billions of dollars to continue financing the war.

A bipartisan background document written by staff of the House Committee on Science before the 11 February hearing identifies several areas of congressional concern in the budget proposal:

▶ Overall funding levels and balance. The research community has called for substantial increases in R&D funding for several years, usually with the support of Congress and the relevant federal agencies, the document says. As a result, in 2002, Congress passed the NSF Authorization Act, which calls for a doubling of the NSF budget over five years. Bush signed the act, but has not authorized the money to meet the doubling goal. The document also notes that "the increase for non-defense, non-homeland security R&D . . . is 2.3%. Further, research (basic and applied) is essentially flat-funded while support for development is increased 8 percent." Another science committee report notes that "at $69 and $29 billion, respectively, the R&D budgets of DOD [Department of Defense] and the National Institutes of Health comprise 75 percent of the total R&D budget, including 93% of the FY05 increase." The committee urged that "similar attention be given to other important R&D agencies."

▶ Physical science research. The staff document says "the FY05 budget request would continue the decade-long trend of flat funding [for] physical science research. In constant dollars, physical science research is funded at about the same level as in 1993, while biological research has more than doubled."

▶ NSF's Math and Science Partnership program. The administration proposes moving the $139 million program from NSF to the Department of Education and applying those funds exclusively to mathematics for secondary school students. Boehlert called that proposal one of several "glaringly bad decisions" in the budget document. Marburger and NSF Director Rita Colwell were told by several science committee members during the hearing that the transfer simply wasn't going to happen.

Marburger was undeterred by the skeptical reception he received from members of the House Committee on Science. "The president's FY 2005 budget request commits 13.5% of total discretionary outlays to R&D, the highest level in 37 years," he said. "Not since 1968 during the Apollo program have we seen an investment of this magnitude in research and development. Of this amount, the

budget commits 5.7% of total discretionary outlays to nondefense R&D, the third highest level in 25 years."

In his written statement to the committee, Marburger made his case for the physical sciences, noting that the budget proposal "provides $1.1 billion for the mathematical and physical sciences" at NSF and "proposes significant increases for the priority areas of nanotechnology (up 20% to $305 million) and cyberinfrastructure (up 12% to $399 million)."

While noting that the Department of Energy's Office of Science would see a $52 million decrease in funding from the amount Congress enacted for FY 2004, Marburger said the science office would actually receive an $88 million increase if congressional mandates passed last year were subtracted. He also cited $53 million in proposed funding for nanometrology research at NIST.

"I believe this is a good budget for science and technology," Marburger concluded. "This administration is committed to strong science and technology as a foundation for national security and economic strength."

Democratic proposals

About a month after the science committee testimony from Marburger, NSF Director Colwell, DOE's Office of Science Director Ray Orbach, and others, the Democratic members of the science committee issued their recommendations for the FY 2005 R&D budget. The first recommendation calls for a 5% increase in R&D spending for all federal science- and energy-related R&D programs. The second calls for reallocating the proposed NASA budget away from the administration's Moon/Mars initiative and toward NASA's existing programs. The third calls for maintaining and strengthening the NIST Manufacturing Extension Program (MEP) and Advanced Technology Program (ATP).

Both the MEP and ATP programs, designed to help small high-tech manufacturers, have been targets of many Republicans who believe the federal government should not pick winners and losers in the private marketplace. The administration once again proposes to eliminate ATP and fund MEP at $39 million, well below last year's budget of $106 million. The science committee, including its Republican members, has been successful in keeping the programs alive and said it will once again push to keep them funded.

On the Senate side of the Capitol, Jeff Bingaman (D-NM), in a speech on the Senate floor, said the proposed elimination of ATP is "a particularly egregious step in the wrong direction." He noted that the administration's budget documents praise ATP as a "merit-based, rigorously competitive, cost-shared partnership program" that has been successful. Bingaman concluded by saying, "The president's rationale is, 'ATP is a great program. It helps our competitiveness. It is well run and effective. Therefore, we are going to kill it.' "

During the first two weeks of March, budget committees on Capitol Hill were already reflecting congressional concern about the administration's lackluster funding for basic science. In one budget committee, the administration's proposal to cut DOE's Office of Science by 2% was being replaced with a 1.1% increase of $38 million over FY 2004. The numbers will shift and the arguments will continue throughout the year as science proponents fight to increase nondefense R&D spending despite a huge deficit and a war-oriented budget. The following agency highlights indicate some areas of contention:

National Science Foundation. For several decades, NSF has received fairly steady budget increases and has

NASA R&D Programs

	FY 2003 actual	FY 2004 estimate	FY 2005 request	FY 2004–05 percent change
	(millions of dollars)*			
NASA total	15 388	15 378	16 244	5.6
NASA R&D	10 681	10 909	11 334	3.9
R&D programs				
Exploration, science, and aeronautics (ESA)†				
Space science	3531	3971	4138	4.2
Solar System exploration	1039	316	1187	–9.8
Development				
Mercury Surface Space Environment, Geochemistry and Ranging (MESSENGER)	87	38	0	–100.0
Deep Impact comet mission	58	13	10	–26.3
Dawn asteroid mission	36	125	84	–32.4
Small projects	4	—	—	—
New Horizons (Pluto–Kuiper Belt mission)	124	117	116	–0.8
Total development	308	292	210	–28.2
Operations	299	308	277	–10.1
Research	259	324	367	13.2
Technology and advanced concepts	174	392	334	–14.7
Mars exploration	500	595	691	16.1
Lunar exploration	0	0	70	—
Astronomical search for origins	685	899	1067	18.7
Development				
Hubble Space Telescope	141	140	30	–78.7
Stratospheric Observatory for Infrared Astronomy (SOFIA)	47	54	0	–100.0
Spitzer Space Telescope	148	0	0	—
Kepler mission	23	51	127	150.3
Total development	359	245	157	–35.9
Operations	7	24	57	131.9
Research	119	198	232	17.3
Technology and advanced concepts‡	200	431	621	43.8
Structure and evolution of the universe	402	406	378	–6.9
Development				
Gravity Probe B	65	0	0	—
Gamma Ray Large Area Space Telescope (GLAST)	57	115	103	–10.2
Swift Gamma-ray Burst Explorer	48	0	0	—
Small development projects	62	34	20	–42.1
Total development	232	149	123	–17.5
Operations	8	10	4	–58.2
Research	141	188	210	12.0
Technology and advanced concepts	21	59	40	–31.5
Sun–Earth connection	480	755	746	–1.2
Development				
Solar Terrestrial Relations Observatory (STEREO)	68	99	74	–25.2
Solar Dynamics Observatory (SDO)	58	66	158	140.7
Small development projects	41	54	45	–17.1
Total development	167	219	277	26.7
Operations	35	57	34	–40.5
Research	134	177	195	9.8
Technology and advanced concepts	144	303	240	–20.5
Institutional support	424	0	0	—
Biological and physical sciences	680	985	1049	6.4
Earth science	1719	1613	1485	–7.9
Earth systems science	1304	1522	1409	–7.4
Earth science applications	78	91	77	–15.3
Institutional support	335	0	0	—
Aeronautics	1044	1034	919	–11.1
Education programs	199	226	169	–25.5
Exploration systems§	—	1646	1782	8.2
Space flight	6149	5875	6674	13.6
International Space Station	1462	1498	1863	24.3
Space shuttle	3301	3945	4319	9.4
Space and flight support	352	432	492	13.9
Institutional support	1033	0	0	—
Aerospace technology (crosscutting technologies)	1882	0	0	—

*Figures are rounded to the nearest million. Changes calculated from unrounded figures.
†Formerly Science, Aeronautics, and Exploration (SAE).
‡The fiscal year 2005 request includes $318 million for the *James Webb Space Telescope*.
§Includes human and robotic technology and transportations systems for spaceflight.

Department of Energy R&D Programs

	FY 2003 actual	FY 2004 estimate	FY 2005 request	FY 2004–05 percent change
	(millions of dollars)*			
DOE total	21 959	23 209	24 320	4.8
DOE R&D	8 292	8 762	8 872	1.3
Science R&D programs				
High-energy physics (HEP) total	702	734	737	0.5
Proton accelerator-based physics	384	391	412	5.5
Research	76	73	74	1.0
University research	46	46	47	1.3
National laboratory research	29	26	26	28.7
University service accounts	1	1	1	0.0
Facilities	308	317	338	6.5
Tevatron operations	185	197	194	–1.6
Tevatron improvements	45	42	70	65.5
Large Hadron Collider	59	49	33	–33.4
Large Hadron Collider support	7	15	29	90.9
AGS operations/support	1	0	0	—
Other facilities	11	14	13	–9.3
Electron accelerator-based physics	138	146	151	3.6
Research	27	28	29	2.5
University research	17	17	17	1.0
National laboratory research	10	11	12	4.3
Facilities (B-factory operations and improvements)	111	118	122	3.8
Nonaccelerator physics	44	49	43	–13.1
University research	12	12	12	0.6
National laboratory research	16	14	10	–27.5
Projects†	16	21	18	–12.5
Other	1	3	3	0.1
Theoretical physics	45	48	50	4.2
Advanced technology R&D (accelerators and detectors)	71	88	81	–7.8
Construction‡	20	12	1	–94.0
Nuclear physics total	371	390	401	2.9
Medium-energy nuclear physics	116	123	126	1.9
Research	30	36	37	2.2
University research	15	15	16	1.4
National laboratory research	15	15	16	5.3
Other research	0	6	5	–4.2
Operations§	86	87	89	1.7
Heavy-ion nuclear physics	160	167	174	4.1
Research	30	35	34	–3.7
University research	12	12	13	4.2
National laboratory research	18	18	17	–8.4
Other research	0	4	4	–6.7
Operations (primarily RHIC)	129	132	140	6.1
Low-energy nuclear physics	68	71	73	2.0
Research	41	48	49	1.7
University research	17	18	19	2.4
National laboratory research	20	22	25	11.7
Other research	4	8	6	–27.9
Operations (ATLAS and HRIBF facilities)	26	23	24	2.7
Nuclear theory	27	28	29	3.2
Fusion energy sciences total	241	263	264	0.6
Science	136	151	151	0.1
Tokamak experimental research	47	50	48	–2.2
Alternative concept experimental research	52	54	55	2.1
Theory	24	25	25	0.4
SciDAC (advanced computing)	3	3	3	–0.6
General plasma science	9	12	12	–0.2
Small business research	0	7	7	0.7
Facility operations	66	85	85	1.1
Technology	38	27	28	1.6
Basic energy sciences (BES) total	1002	1008	1064	5.5
Materials sciences	534	572	603	5.4
Chemical sciences, geosciences, and energy biosciences (CGEB)	212	220	228	4.0
National user facilities operations (funding is contained in the materials sciences and CGEB budgets)				
Advanced Light Source, LBNL	43	43	42	–2.3
Advanced Photon Source, ANL	91	93	97	4.3
National Synchrotron Light Source, BNL	37	38	38	0.2
Stanford Synchrotron Radiation Laboratory	26	30	28	–7.3
High Flux Isotope Reactor, ORNL	37	38	40	5.4
Radiochemical Engineering Development Facility, ORNL	7	6	6	–0.1
Intense Pulse Neutron Source, ANL	17	17	17	3.4
Manuel Lujan Jr Neutron Scattering Center, LANL	10	10	10	1.9
Spallation Neutron Source, ORNL	14	18	33	79.9
Combustion Research Facility, MSFC	6	6	6	3.4
Construction‖	256	219	232	6.0
Adjustment	0	–2	0	–100.0
Advanced scientific computing research	163	202	204	1.0
Biological and environmental research total	494	590	502	–14.9
Fossil energy R&D	416	565	526	–6.9
Energy conservation	421	419	345	–17.7

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been regarded as one of the best-supported science agencies. When the science community became concerned that NSF funding was being left in the wake of a five-year plan that doubled the National Institutes of Health budget, Congress responded with the National Science Foundation Authorization Act of 2002. The bill, intended to double the NSF budget by 2007, was passed and signed by President Bush. But with the mounting deficits and war-focused budget, it is clear that the doubling won't happen.

The FY 2005 budget proposal for NSF is $5.7 billion, a 3% increase from FY 2004. That leaves NSF $1.7 billion short of where it needs to be to reach the $9.8 billion doubling target by 2007. According to an American Association for the Advancement of Science (AAAS) analysis of future funding projections, NSF won't come close to reaching the doubling goal and may actually see its funding decline in the next few years.

Preliminary projections for the NSF budget contained in the FY 2005 budget documents indicate that in FY 2006, the NSF budget will fall to $5.6 billion. "After adjusting for expected inflation," the AAAS analysis says, "the five-year Bush budget would leave NSF's R&D investments 5% below this year's funding level in 2009."

NSF Director Colwell, who, just before appearing at the 11 February science committee hearing, announced that she was resigning from the foundation on 21 February, was pragmatic in describing the FY 2005 budget. "In light of the significant challenges that face the nation in security, defense, and the economy, NSF has, relatively speaking, fared well," she said. "We are pleased to be able to anticipate an increase of three percent when many agencies are looking at budget cuts."

NSF's research and related activities (R&RA) account, which funds most of the foundation's research, would receive a 4.7% increase to $4.5 billion. Several of the research directorates—mathematical and physical sciences, biological sciences, computer and information science and engineering, and geosciences—would increase by 2.2%. The social, behavioral, and economic sciences directorate would receive a 10.3% increase. A portion of the R&RA increase is due to a transfer of $80 million in Math and Science Partnerships money into the account from NSF's education and human resources programs.

Funding for the foundation's participation in the multiagency nanoscale science and engineering initiative would jump 20% to $305

million. Most of the funding would be split between two NSF directorates—engineering and mathematical and physical sciences.

The education and human resources programs at NSF would drop $168 million to $771 million, reflecting in part the shift of the Math and Science Partnerships program money to R&RA. There is also $10 million less proposed for the Experimental Program to Stimulate Competitive Research (EPSCoR).

The major research equipment and facilities construction account would increase from $155 million to $213 million. That money would cover three proposed new starts: the National Ecological Observatory Network (NEON); the Scientific Ocean Drilling Vessel, a state-of-the-art drilling ship that would take core samples from the ocean floor; and the Rare Symmetry Violating Processes (RSVP), which will look for the particles and processes that explain the predominance of matter in the observable universe.

Department of Energy. When budgets are tight and funding is flat, as is the case with DOE's Office of Science, how the numbers are interpreted becomes important. In presenting his budget numbers to Congress, Office of Science Director Orbach tried hard to cast the fifth straight year of near flat funding in the best possible light. "The Office of Science FY 2005 budget request is $3.432 billion, a $68,451,000 decrease over the FY 2004 appropriations levels," Orbach said in his written testimony to the science committee. "When $140,762,000 for FY 2004 Congressionally directed projects is set aside, there is an increase of $72,311,000 in FY 2005. When compared to the FY 2004 comparable President's Request, the FY 2005 request increases $104,855,000, or 3.2 percent."

Overall, the administration proposes increasing DOE funding by 1.2% to $24.3 billion. R&D funding would increase 1.3% to $8.9 billion. That entire increase, according to a AAAS analysis, would go to the Radioactive waste management program for a tripling of R&D activities related to the Yucca Mountain nuclear waste disposal site.

Orbach detailed the funding and priorities for several major areas within his office. Advanced scientific computing research would receive a 1% increase to $204 million. The request includes $38 million for the next-generation computer architecture program and money for enhancing the Energy Sciences Network (ESnet), and the National Energy Research Scientific Computing Center (NERSC). DOE also would receive $8.5 million for a new "atomic to macroscopic mathematics" research effort to "break through the current barriers in our understanding of complex physical processes."

Basic energy sciences would get a 5.5% increase to $1064 million. That includes $209 million dedicated to nanoscale science. Orbach said the money would be used in part to support the design and construction of four DOE nanoscale science research centers. The request also includes $80.5 million for construction, and $33.1 million for operation of the Spallation Neutron Source being built at Oak Ridge National Laboratory. Another $50 million is for the design and "long lead procurement" of the Linac Coherent Light Source, an x-ray laser light source being developed at SLAC. The hydrogen fuel initiative would receive $29 million.

High-energy physics would receive a 0.5% increase to $737 million. "The highest priority in HEP is the operations, upgrades, and infrastructure for the two major . . . user facilities at the Fermi National Accelerator Laboratory, and [SLAC] to maximize the scientific data generated," Orbach said.

Fusion energy sciences is dominated by the US's rejoining ITER (the international thermonuclear reactor). Overall, fusion energy support would increase to $264 million, up 0.6%. Funding for ITER-related work would increase from $8 million to $38 million. "About $31 million of that amount would be for experiments on our tokamak facilities and for component R&D in our laboratories and universities . . . which is focused on ITER's specific needs," Orbach said.

Nuclear physics would increase 2.9% to $401 million. The highest priority, Orbach said, is "exploiting the unique discovery potentials of the facilities at the RHIC [Relativistic Heavy Ion Collider] at Brookhaven National Laboratory, and the Continuous Electron Beam Accelerator Facility (CEBAF) . . . at the Thomas Jefferson National Accelerator Facility."

Biological and environmental research would drop from $590 million to $502 million, nearly a 15% decline. Much of that decline reflects the elimination of $141 million in congressional earmarks in FY 2004. The budget also cuts the science laboratories infrastructure account by 46% to $29 million. Science committee members have expressed concern about DOE plans to cut infrastructure funding and, instead, allow private contractors to build new facilities that would then be leased by the agency.

NASA. After years of stagnant or declining budgets, NASA would receive a 5.6% budget increase to $16.2 billion. This comes as the agency starts an ambitious schedule to phase out the space shuttle and International Space Station (ISS), return to the Moon by 2020, and send humans to Mars by 2032. This new vision, announced by Bush shortly before NASA released its 2005 budget, followed months of discussion between NASA and White House officials. A nine-

Department of Energy R&D Programs (continued)

	FY 2003 actual	FY 2004 estimate	FY 2005 request	FY 2004–05 percent change
	(millions of dollars)*			
Atomic energy defense activities R&D total	4049	4244	4333	2.1
National Nuclear Security Administration (NNSA) R&D total	3951	4156	4248	2.2
Weapons activities R&D total	3019	3184	3261	2.4
Stockpile R&D	313	467	433	–7.3
Science campaigns	257	255	270	5.5
Advanced simulation and computing	704	704	751	6.6
Inertial confinement fusion#	507	504	467	–7.4
All other weapons R&D	1239	1253	1341	7.0
Nonproliferation and verification	254	234	218	–6.8
Naval reactors	678	738	769	4.2
Other atomic energy defense activities R&D	27	28	29	3.6
Environmental management	71	60	56	–6.7
Radioactive waste management**	62	69	275	298.6

AGS, Alternating Gradient Synchrotron. ANL, Argonne National Laboratory. ATLAS, a Torroidal LHC apparatus. BNL, Brookhaven National Laboratory. HRIBF, Hollifield Radioactive Ion Beam Facility. LANL, Los Alamos National Laboratory. LBNL, Lawrence Berkeley National Laboratory. MSFC, NASA's Marshall Space Flight Center. ORNL, Oak Ridge National Laboratory. RHIC, Relativistic Heavy Ion Collider.

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

†Projects will focus primarily on completing fabrication of the *GLAST*/LAT telescope, initial fabrication of the VERITAS telescope array, and R&D money for the *SNAP* dark energy program.

‡Decrease reflects the completion of the Neutrinos at the Main Injector (NuMI) at Fermilab.

§Primarily for operation of CEBAF at the Thomas Jefferson National Accelerator Facility, and the MIT/Bates Linear Accelerator Center.

||Includes $80.5 million for the Spallation Neutron Source.

#Includes $150 million for the National Ignition Facility.

**The radioactive waste management program would triple R&D activities to support the Yucca Mountain nuclear waste disposal site; the $275 million R&D investment (up from $69 million) depends on congressional approval of a new source of dedicated revenues.

Department of Defense R&D Programs

	FY 2003 actual	FY 2004 estimate	FY 2005 request	FY 2004–05 percent change
		(millions of dollars)*		
DOD total R&D	**59 296**	**65 970**	**69 928**	**6.0**
Research, development, test, and evaluation (RDT&E)				
Total basic research (6.1)	1369	1404	1330	–5.3
US Army				
In-house independent research	20	24	24	0.2
Defense research sciences	138	156	131	–16.0
University research initiatives†	0	85	75	–11.9
University and industry research centers†	84	100	78	–22.2
Force health protection†	0	17	10	–42.2
Total US Army	243	382	318	–16.8
US Navy				
University research initiatives†	0	91	84	–8.7
In-house independent research	13	17	18	2.7
Defense research sciences	393	375	376	0.1
Total US Navy	406	484	477	–1.5
US Air Force				
Defense research sciences	212	213	217	2.1
University research initiatives†	0	106	116	9.0
High-energy laser research†	0	12	12	3.1
Total US Air Force	212	331	346	4.3
Defense agencies				
In-house independent research	2	0	0	—
Defense research sciences	171	139	144	3.1
University research initiatives†	233	0	0	—
Force health protection†	14	0	0	—
High-energy laser research†	11	0	0	—
Government–industry cosponsorship of university research	8	7	0	–100.0
DEPSCoR‡	15	10	10	0.1
Chemical and biological defense research	53	51	37	–28.4
Total defense agencies	508	207	190	–8.2
Applied research (6.2)§	4269	4423	3878	–12.3
Advanced technology development (6.3)	5091	6254	5343	–14.6
Total science and technology	10 729	12 081	10 550	–12.7
Other RDT&E	47 375	52 584	58 392	11.0
Total RDT&E	58 103	64 665	68 942	6.6
Medical research	458	486	72	–85.1
Other appropriations	735	819	914	11.6

*Figures are rounded to the nearest million. Changes calculated from unrounded figures.
†Funds for university research initiatives, force health protection, and high energy laser research were transferred from the defense agencies account to the military services account in fiscal year 2004.
‡DEPSCoR = Defense Experimental Program to Stimulate Competitive Research.
§The army would see its applied research funds decline 37%, the navy would decline 22%, the air force would decline 12%.

member presidential commission, headed by Edward C. Aldridge, the former US Air Force secretary, will report in June on the long-term implications of the administration's vision for NASA.

The fundamental goal of the space agency's budget proposal, NASA Administrator Sean O'Keefe said at a press conference, is to advance US scientific, security, and economic interests through a robust space exploration program. Without a defining mission, NASA's budget would have drastically declined over the coming decade, he added.

As part of this new vision, the agency is undergoing a major financial and operational reorganization as more than $11 billion of NASA's projected $86 billion budget over the next five years will be reallocated to the administration's new goals. A new enterprise, the Office of Exploration Systems (OES), has been created from elements of the offices of aerospace technology, space flight enterprises, and space science to develop research and technology for human exploration. Over the next six years, OES will work closely with space science to launch two robot missions to the Moon and five missions to Mars.

To keep costs under control, many current programs are being reevaluated to see if they should be terminated early. The first major scientific casualty may be the *Hubble Space Telescope* (see PHYSICS TODAY, March 2004, page 29). In the human spaceflight division, the space shuttle is scheduled to retire in 2010 after completing the ISS. Russian *Soyuz* spacecraft will be used to carry crews to and from the ISS until the US sharply curtails its involvement with the ISS around 2015, five years earlier than planned. Science experiments planned for the ISS will be cut back.

The billion-dollar space launch initiative program for building a replacement shuttle would be canceled and the funds transferred to develop a crew exploration vehicle as the new workhorse of the manned space fleet. NASA hopes the craft will be operational by 2014. The CEV program will be based in OES.

The Moon/Mars program could result in "collateral damage to certain NASA science programs that are not judged as being essential for the exploration initiative," said Lennard A. Fisk, chairman of the space studies board of the National Academy of Sciences. For example, the funding schedule for projects such as *LISA* (the *Laser Interferometer Space Antenna*) and the *Constellation-X* mission is being stretched out to accommodate the Moon/Mars program. Fisk said that he worries that the demarcation between the science disciplines, with some in space science and others in exploration systems, is not a good concept, but applauds OES for having an integrated program in which human and robotic exploration can each play an appropriate role.

Earth science enterprise is one of the NASA divisions that would see its budget drop. The ESE budget would decline 8%, partly because of the completion of the first phase of the Earth Observing System. Earth science also receives a higher proportion of congressional earmarks than any other NASA division, and more than $300 million earmarked from last year's budget has been eliminated from the administration's request.

All the new resources are redirected toward space exploration. "Overall, the space science budget over the next four years rises 41% [2005–09]. That's incredibly good news when the average federal budget increase was less than 1%," said Ed Weiler, NASA's associate administrator for space science.

However, it is uncertain that these time scales and funds will remain constant, as the budget estimate for returning the shuttle to flight has jumped from $400 million to more than $1 billion in the past few months, and the shuttle's next flight has been moved back a year to March 2005, at the earliest. On 4 March, the Senate Budget Committee voted to trim about $600 million from the NASA budget. The committee, said Representative Don Nickles (R-OK), the chairman, "supports the president's vision for exploration and discovery [but] the current budget situation necessitates slower implementation."

Department of Defense. President Bush recently described himself

as a "war president," and the administration's DOD budget proposal clearly reflects that. The DOD would see its overall FY 2005 R&D budget increase 6% to a record high of $69.9 billion. That $4 billion increase would go entirely into weapons systems, as have the multibillion-dollar increases in each of the past four years.

Most of the money would go to the missile defense system. The Missile Defense Agency would see a 20% increase in funding to $9.1 billion. When other DOD missile defense monies are included, the entire program would be funded at $10.2 billion and would increase from current funding of $9 billion.

The Defense Advanced Research Projects Agency would see its R&D funding increase 9.1% to $3.1 billion. DARPA focuses primarily on technology development and has a broad research portfolio that covers everything from new materials and battlefield tactical technology to sensors and guidance systems.

Although the weapons and battle technology funding would increase, basic and applied research, known respectively as 6.1 and 6.2 funding in Pentagon parlance, would fall dramatically. Basic research would decrease 5.3% to $1.3 billion, while applied research would decline 12.3% to $3.9 billion. The DOD's science and technology category, which includes general research, medical research, and early technology development, would fall 15.5% to $10.6 billion.

Department of Homeland Security. Founded by the Homeland Security Act of 2002, DHS has quickly grown into the seventh largest federal source of R&D funds, with an R&D budget of slightly less than $1.1 billion in FY 2004. That budget would increase 15.5% in FY 2005 to slightly more than $1.2 billion. Reflecting the administration's concern over the war on terrorism, the overall DHS budget would increase 9.9% to $40.2 billion.

The Directorate of Science and Technology would fund 81% of the R&D in DHS, or $987 million out of the $1.2 billion R&D budget. The early emphasis at the DS&T has been on developing antiterrorism technology that can be used quickly. Indeed, 79% of the FY 2004 budget has gone to that development, with another 10% going to construction of laboratories. Just 11% has gone to basic and applied research. That is expected to change in FY 2005, when basic and applied research funds may double to $431 million.

Biological countermeasures would receive a big boost in FY 2005, up from $285 million to $407 million. Much of the new money would go to a biosurveillance program intended to provide biological detection systems in major US cities. The program, carried out in conjunction with the Centers for Disease Control, the Food and Drug Administration, and the Department of Agriculture, is focusing on faster, more accurate biological sensors.

NIST and NOAA. Both NIST and the National Oceanic and Atmospheric Administration, which account for most of the R&D within the Department of Commerce, face budget cuts in the FY 2005 budget proposal. Exactly how the budget plays out at NIST depends on how Congress counters the administration's effort to kill the ATP. Under the FY 2005 proposal, if the $171 million ATP is eliminated, there would be a 30% boost in NIST's intramural research funding.

But if FY 2004 is a guide, congressional efforts to save the ATP could hurt NIST R&D. Last year, Congress rescued the ATP by taking money from the intramural account. The resulting 10% loss of funds has caused NIST to consider layoffs and early retirement options for some of its scientists. If the ATP is zeroed out and the MEP is cut dramatically, the resulting 30% increase in intramural research funding would be spent as follows: $26 million for instrumentation for the new Advanced Measurement Laboratory, $8 million for improvements at the NIST Center for Neutron Research, $16 million for advanced measurement science, $19 million for homeland security work, and $16 million in advanced manufacturing R&D.

NOAA's R&D budget would decline 3.3% to $611 million. The oceanic and atmospheric research division would fall by nearly 11%. Most of the decline comes from elimination of congressional earmarks. NOAA's climate research program would increase from $170 million to $183 million. Weather and air quality research, as well as the National Sea Grant College program, would take serious hits.

Jim Dawson
Paul Guinnessy ■

National Institute of Standards and Technology R&D Programs

	FY 2003 actual	FY 2004 estimate	FY 2005 request	FY 2004–05 percent change
	(millions of dollars)*			
National Oceanic and Atmospheric Administration R&D				
Total NOAA R&D	666	632	611	–3.3
NIST total R&D	492	471	426	–9.5
Scientific and Technical Research and Services (STRS)				
Physics	34	35	38	8.1
Electronics and electronics engineering	45	42	52	24.4
Chemical science and technology	40	41	48	15.6
Computer science and applied mathematics	47	43	51	18.8
Manufacturing and engineering	21	20	29	42.2
Materials science and engineering	56	52	61	18.5
Building and fire research	21	21	23	11.0
Technology assistance	4	3	3	2.2
Research support and equipment	33	25	61	143.7
Total STRS R&D	301	283	367	29.8
Industrial Technology Services				
Advanced technology program	148	145	0	–100.0
Manufacturing extension program (non-R&D)	106	39	39	1.2
Construction†	43	43	59	36.6

*Figures are rounded to the nearest million. Changes calculated from unrounded figures.
†Includes $31 million to equip and operate the Advanced Measurement Laboratory and $25 million for continued renovations of NIST's Boulder, Colorado, facilities.

Department of Homeland Security R&D Programs

	FY 2003 actual	FY 2004 estimate	FY 2005 request	FY 2004–05 percent change
	(millions of dollars)*			
DHS total	31 182	36 541	40 167	9.9
Total DHS R&D	737	1053	1216	15.5
Border and transportation security	163	170	229	34.7
Science and technology	553	869	987	13.6
Biological countermeasures	363	285	407	42.6
Chemical and high explosives	7	62	63	2.0
Radiological and nuclear	75	126	129	2.4
Threat and vulnerability assessment	36	100	102	1.8
Standards	20	39	40	1.8
Components	0	34	34	0.0
University programs	3	69	30	–56.4
Emerging threats	17	21	21	0.0
Rapid prototyping	33	73	76	4.1
Anti-aircraft missiles	0	60	61	1.7
US Coast Guard and other transfers	0	0	24	—
US Coast Guard	21	14	0	–100.0

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