Most Federal Science Money Flat or Falling as Bush Favors Medical and Defense R&D in Fiscal 2002

Millie Dresselhaus spent her last day as the director of the Department of Energy's Office of Science waiting for *that* phone call from the transition team for President George W. Bush. She had only been on the job for a handful of months, yet she had spent many hours on Capitol Hill talking about her vision of the US leading the world with robust, well-funded science programs. She liked her government job.

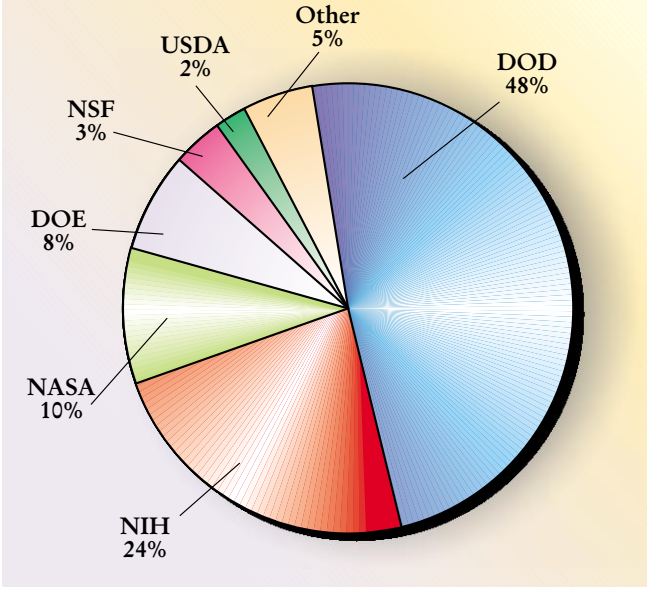
"I told them [Bush officials] that I would stay and help until my successor was chosen, and that I would help with the preparation of the budget,"

With the concept of a "balanced portfolio" for federal science funding gone from the Bush budget, Capitol Hill supporters of the physical sciences will spend the summer engaged in what looks to be a difficult search for more money.

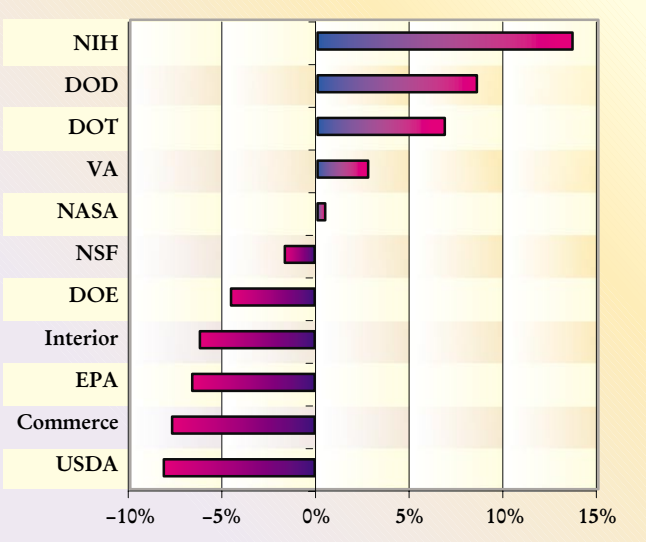
Dresselhaus said recently. "The phone call never came," she said, so she packed her bags and headed back to her physics lab at MIT, taking her vision of the future with her.

When Secretary of Energy Spencer Abraham stepped to the podium in a DOE auditorium on 9 April to provide an overview of his agency's funding under the Bush FY 2002 budget proposal, it was clear that a different view had indeed come to Washington. Last year the Office of Science received an impressive 14% increase, almost making the 15% figure that Dresselhaus had set as an annual target. This year, the budget calls for the office to receive only a 0.1% increase, up from $3.155 billion to $3.160 billion. And that is the general scenario for funding of most of the sciences, with the exception of the National Institutes of Health (NIH) programs, in Bush's FY 2002 budget.

Total R&D by Agency: FY 2002 Proposed



FY 2002 R&D Request: Percent Change from FY 2001



DOE, Department of Energy. DOT, Department of Transportation. EPA, Environmental Protection Agency. USDA, US Department of Agriculture. VA, Department of Veterans Affairs.

WHERE BUSH'S R&D MONEY WOULD GO. The FY 2002 budget request from President Bush calls for an overall increase in federal spending for R&D, but this year the Department of Defense and the National Institutes of Health get unusually large slices of the budget pie. Because of boosts to NIH and DOD funding, the total R&D request is a record $96.5 billion, some $5.6 billion, or 6.1%, above last year's. But Bush has limited the overall increase in discretionary spending to 4%, or $26 billion, in FY 2002 to a total of $661 billion. Because of the limits on growth of discretionary spending, the entire increase, according to analysts with the American Association for the Advancement of Science (AAAS), would go to the DOD (up $14 billion), NIH (up $2.8 billion), Department of Education (up $5 billion), and special emergency funding ($5 billion), leaving all other discretionary programs, including science, with flat or falling budgets.

WINNERS AND LOSERS IN BUSH'S SCIENCE FUNDING. With a new president and a closely divided Congress, no one is sure how the FY 2002 budget endgame will play out in the fall. Indications now are that even if more money flows toward science, it won't come close to matching the record R&D spending of the last budget. Under the Bush proposal, according to AAAS analysts, 6 of the 11 largest R&D funding agencies would see their research budgets fall. In the Department of Interior, the US Geological Survey would fall 10.7%. At the Department of Commerce, the Advanced Technology Program would be all but killed, and at the Environmental Protection Agency, the R&D budget would decline by 6.5% with the elimination of dozens of congressionally designated research projects. The Smithsonian Institution's R&D budget of $118 million would remain constant for FY 2002.

"It's pretty grim for just about every research agency," Dresselhaus said from her MIT office in early May. Science at DOE has suffered for a decade, she said, but last year's healthy increase marked "the first year of real recovery." Now, with new leaders in Washington, there is once again a "gap in knowledge and understanding" about the need for a broad, balanced science program, she said. Others say it is a matter of priorities. Most important to Bush is the $1.3 trillion to $1.6 trillion tax cut he and Congress have been fighting about.

So how bad is Bush's budget proposal for science? While the budget calls for a total increase in R&D of 6.1% over the FY 2001 budget, or a record $96.5 billion, the funding increases are so heavily weighted toward NIH and the Department of Defense (DOD) that 6 of the 11 largest agencies that fund R&D would actually see their R&D money decline. According to budget analysis by the American Association for the Advancement of Science (AAAS), if the whopping 13.6% increase in NIH funding (for a total budget of $22.4 billion) is excluded, then all other nondefense spending drops by 3%, to $24.7 billion. And while the proposed budget increases basic research by 6%, to a record $23.3 billion, most of that is due to the 12.4% increase proposed for basic research at NIH. Take away NIH, and basic research funding declines by 1%, or $10.4 billion. So much for the "balanced portfolio" theme that has been central to science funding discussions in Washington for the past few budget cycles.

For most R&D agencies other than NIH and the DOD, the budget word from the White House is, at best, "flat." Without taking inflation into account, funding for NSF is up only 1.3%, with research and related activities at NSF down 0.5%, and physics down 2.1%. Members of the House Science Committee were concerned enough by the science cuts indicated in Bush's March "budget blueprint" report (see PHYSICS TODAY, April 2001, page 29), that they issued their own *Views and Estimates* report commenting on the dearth of science money. The committee, chaired by Rep. Sherwood Boehlert (R-NY), described the proposed NSF increase as "minuscule." At recent budget hearings, Boehlert said that NSF stands for "Not Sufficient Funds."

NASA did better than NSF, but not by much. Funding for the space agency is up 1.8%, but with a significant shift of money away from Earth science (down 13.9%) to help fund space science (up 5.7%). NIST, part of the Commerce Department, is down 18.4%, most of that due to the minimal funding of the Advanced Technology Program (ATP), which is down 91.1%. The ATP program, which provides government funding to companies developing promising new technology, has long been a whipping boy for Republicans, who view it as corporate welfare. The program is "under review" by the Bush administration, and likely won't survive much longer. Funding for the other science and research arm of Commerce, the National Oceanic and Atmospheric Administration (NOAA), would drop 2%.

The Department of Interior's lead science agency, the US Geological Survey, also didn't fare well. R&D funding for USGS would fall 10.7%, to $491 million. The hardest hit of the USGS divisions would be Water Resources, down 25.5%, due mainly to reductions in the National Water-Quality Assessment Program. The USGS has powerful defenders such as Senators Robert Byrd (D-WV) and Conrad Burns (R-MT), who are challenging the cuts. Rep. James Moran (D-VA) accused Bush of taking a "slash-and-burn" approach to USGS funding.

A wild card that remained in the budget discussions in early May was the DOD, which underwent a top-to-bottom review of spending priorities that wasn't expected to be completed until this month. As a result, the DOD didn't submit a full 2002 budget. Instead, its request consisted mostly of numbers from FY 2001 plus inflation, with an additional "special request" of $2.6 billion. Budget watchers believe much of that money will go to a national missile defense program (see story on page 31). That alone pushes the DOD R&D request up by 8.5%

National Science Foundation Physics-Related Programs

	FY 2000 actual	FY 2001 request	FY 2001 current	FY 2002 request	Percent change
	(millions of dollars)				
NSF total	3954.5	4572.4	4416.3	4472.4	1.3
Research and related activities	2979.9	3540.7	3350.2	3327.0	–0.7
Mathematical and physical sciences	755.9	881.2	850.8	863.6	1.5
Physics research projects support	106.6	142.8	131.6	124.7	–5.3
Physics facilities	61.7	55.9	55.9	58.8	5.3
Total physics research	168.3	198.6	187.5	183.5	–2.1
Chemistry research and infrastructure	138.6	162.0	153.5	153.5	0.0
Materials research	163.3	185.3	179.5	170.7	–4.9
National facilities	27.2	35.3	30.2	34.7	14.9
Total materials research	190.5	220.6	209.7	205.4	–2.1
Astronomy research and instrumentation	43.0	59.8	53.9	54.7	1.4
Astronomy facilities	79.6	79.9	94.7	101.5	7.2
Total astronomical sciences	122.5	139.7	148.6	156.3	5.1
Mathematical sciences	106.0	130.2	121.5	141.5	16.5
Multidisciplinary activities	29.9	30.0	29.9	23.4	–21.8
Major research facilities and equipment	105.0	138.5	121.3	96.3	–20.6
Carryover*			71.0		
Large Hadron Collider	15.9	16.4	16.4	16.9	3.0
High Performance Instrumented Airborne Platform for Environmental Research (HIAPER)	8.5	0.0	12.5	0.0	
Atacama Large Millimeter Array (R&D)	8.0	6.0	6.0	0.0	
Network for Earthquake Engineering Simulation	7.7	28.2	28.1	24.4	–13.2
South Pole Station*	16.9	13.5	13.5	0.0	
Terascale computing systems	36.0	45.0	44.9	55.0	22.5
Geosciences	487.6	583.0	562.2	558.5	–0.6
Atmospheric sciences research support	95.6	118.3	117.1	115.9	–1.0
National Center for Atmospheric Research	68.6	75.7	71.4	70.6	–1.1
Earth sciences projects support	65.8	78.0	78.3	79.2	1.2
Instrumentation and facilities	27.2	31.0	28.5	28.5	0.2
Continental dynamics	9.2	9.5	9.06	9.08	0.2
Ocean section	81.5	102.0	97.6	96.1	–1.5
Integrative programs section	68.0	85.4	83.3	82.8	–0.5
Marine geosciences section	71.7	83.1	77.1	76.3	–1.0
Computer and information science and engineering	388.5	529.1	477.9	470.4	–1.6
Computer-communications research	60.2	69.2	65.5	64.4	–1.7
Information and intelligent systems	41.4	53.7	48.8	48.0	–1.7
Experimental and integrative activities	57.8	63.3	60.9	57.8	–5.2
Advanced computational infrastructure and research	78.0	84.1	81.6	80.2	–1.7
Advanced networking infrastructure and research	60.7	68.8	65.6	64.4	–1.7
Information technology research	90.4	190.0	155.5	155.5	0.0
Education and human resources	708.6	760.0	916.4	1016.4	10.9

*In FY 2000, $70.9 million was carried over into FY 2001 largely in support of the South Pole Station Modernization project. The ammount isn't counted as FY 2001 new funding.

Department of Energy Physics-Related Programs

	FY 2000 actual	FY 2001 request	FY 2001 current	FY 2002 request
	(millions of dollars)			
Office of Science				
High-energy physics (HEP)*				
Total research	161.7	156.2	156.4	155.1
University research at DOE and foreign labs†	105.3	105.6	101.3	96.6
Fermilab, includes particle theory and astrophysics	8.7	7.8	9.0	10.7
SLAC, includes data gathering and analysis from BaBar detector and Gamma Large Area Space Telescope fabrication	12.8	11.7	12.2	13.8
Brookhaven, includes D-Zero experiment work and ATLAS detector fabrication	11.2	9.8	10.8	10.2
Lawrence Berkeley, includes experiments at Fermilab and data taking at SLAC's BaBar detector	14.1	11.0	14.5	13.7
Argonne, includes Fermilab and DESY collaborations	6.6	5.6	6.5	6.1
Other physics research‡	2.8	4.6	2.0	3.8
Total HEP technology§	74.3	74.3	85.0	85.0
Facility operations, including personnel, equipment, and power	418.3	444.6	436.8	456.8
Fermilab, includes Tevatron operation for about 39 weeks	212.6	207.0	211.4	244.7
SLAC, includes B Factory for about 35 weeks	111.8	114.5	116.4	125.1
Brookhaven, includes AGS operation for 16 weeks	3.5	7.5	5.7	5.7
Other facilities support‖	10.4	27.3	20.2	14.6
Large Hadron Collider	70.0	70.0	58.9	49.0
Waste management	10.1	10.4	10.4	10.4
Small business programs	0.0	7.8	13.8	7.2
Nuclear physics				
Total low-energy nuclear physics	60.4	34.0	62.7	62.7
University research, supports scientists at 26 universities	16.8	10.5	17.4	17.0
National laboratory research for programs at ANL, BNL, LBNL, LANL, and ORNL	19.5	—	19.7	19.8
Other national laboratory research, mainly the underground Sudbury Neutrino Observatory	5.4	3.4	5.7	5.7
Other research, mainly for development of the Rare Isotope Accelerator	2.0	—	3.8	4.0
Small business research and Lawrence and Fermi awards	0.0	1.0	1.0	1.0
Total operations#	22.2	—	21.7	21.9
Total medium-energy nuclear physics	108.8	125.4	118.6	118.0
National laboratory research at Jefferson Lab, Argonne, Brookhaven, and Los Alamos	14.5	20.4	16.2	16.3
Jefferson Lab operations	66.3	68.4	66.7	67.5
Bates Linear Accelerator Center at MIT**	10.9	12.8	12.6	12.0
University research, includes 40 grants at 35 universities	16.6	16.9	16.5	15.3
Other research and operations	0.4	5.2	6.7	6.9
Total heavy-ion nuclear physics	150.7	192.4	155.8	156.3
University research††	11.5	18.0	12.0	11.5
National laboratory research‡‡	23.0	33.3	21.7	20.9
BNL Relativistic Heavy Ion Collider (RHIC) research	13.1	—	10.8	10.0
Other national laboratory research related to RHIC	9.8	—	10.8	10.7
RHIC operations	99.8	108.2	102.7	104.5
Other research	0.0	0.0	2.8	2.8
Other national labs operations and maintenance	10.1	10.8	10.6	10.6
Brookhaven waste management activities	6.4	6.0	5.9	5.9
Nuclear theory at universities and national labs	16.2	18.2	18.5	18.6
Major items of equipment	9.9	5.7	6.2	3.0
Fusion energy sciences				
Total fusion energy sciences program*	238.3	247.3	248.5	238.5
Tokamak experimental research, includes DIII-D at General Dynamics, Alcator C-MOD at MIT, electric tokamak at UCLA, and international collaborations	46.5	44.5	45.0	45.0
Alternative experimental concepts, includes Madison Symmetric Torus at University of Wisconsin, and the National Spherical Torus Experiment (NSTX) at Princeton Plasma Physics Laboratory	51.4	50.3	50.3	48.3
Fusion energy theory	24.3	27.5	27.3	26.0
General plasma science	8.1	8.5	8.4	8.0
Small business research	0.0	5.5	5.3	6.1
Facility operations, includes TFTR decontamination at Princeton, operation and improvements at DIII-D and Alcator C-MOD, and NSTX	73.7	77.4	77.9	72.0
Enabling R&D, mainly engineering and materials research	34.2	33.6	34.3	33.0
Basic energy sciences				
Total basic energy sciences	752.0	1015.8	991.7	1004.7
Materials sciences research, includes condensed matter physics, materials chemistry, neutron and x-ray scattering, and the Experimental Program to Stimulate Competitive Research (EPSCOR)	175.8	210.6	203.0	209.0
Waste management	8.2	—	8.0	8.0
Chemical sciences research, includes atomic, molecular, and optical and chemical physics	127.6	148.9	146.0	145.8
National user facilities operations				
Advanced Light Source, Lawrence Berkeley	30.6	35.4	35.6	37.6
Advanced Photon Source, Argonne	84.8	94.7	90.3	90.3
National Synchrotron Light Source, Brookhaven	30.9	36.5	34.7	34.7
Stanford Synchrotron Radiation Laboratory	22.7	22.5	20.7	21.7
High Flux Beam Reactor, Brookhaven‖‖	18.9	17.5	15.3	0.0
High Flux Isotope Reactor, Oak Ridge	37.7	34.2	37.0	38.5
Intense Pulsed Neutron Source, Argonne	12.7	13.6	13.5	16.1
Manuel Lujan Jr. Neutron Scattering Center, Los Alamos	7.0	10.0	9.2	9.2

continued on next page

Everyone from D. Allan Bromley, the White House science adviser for President George H. W. Bush, to former Speaker of the House Newt Gingrich assailed the budget proposal for the damage it could do to basic science. "The proposed cuts to scientific research are a self-defeating policy," Bromley wrote in the *New York Times* (Op-Ed, 9 March 2001). He concluded his piece with what has become the catch phrase for those pushing for more science funding on Capitol Hill: "No science, no surplus. It's that simple."

Gingrich, the Republican icon of fiscal restraint, recently told a House committee, "I think it was clearly not correct for the long-term security of this country to not increase the basic science funding in the budget. . . ." President Bill Clinton's science adviser, Neal Lane, was less polite than Gingrich, calling Bush's budget proposals for science, "stark and frightening." Lane, now at Rice University, wrote in the *Houston Chronicle* that, "in order to make room for a huge tax cut, the administration proposes major cutbacks in investments in the basic science and technology that have provided Americans with the highest paying jobs and greatest prosperity of any time in our nation's history."

At this time last year there was concern in the physics community about how well science funding was doing on Capitol Hill, but the playing field was much different. Republicans were cutting President Clinton's R&D budget, which Lane was touting as "historic" in its scope. The concern then was the budget caps, but everyone involved knew that, as pressure mounted toward the end of summer, the caps would be broken and money would flow. The caps predictably vanished and, due in part to the large surplus, total federal R&D spending topped $90 billion.

But with Clinton gone, and President Bush and the Congress moving toward a consensus on a tax cut of at least $1.35 trillion, there isn't nearly as much "surplus" money to fund discretionary federal programs. Bush called for discretionary spending to be held to 4%, and Congress hasn't been inclined to raise that ceiling by more than a percent or two. With the entire increase going to Bush's priorities—the DOD, NIH, and the Department of Education—there simply isn't much money left for increasing other programs.

It is clear from early reactions to the science allocations that money for at least some programs will likely increase, but because this is Bush's

first budget, no one on Capitol Hill is sure how the process will play out. Several days before President Bush released the full budget, the Senate passed a resolution that included an amendment offered by Sen. Christopher Bond (R-MO), adding $1.44 billion beyond Bush's proposal for funding NSF, NASA, and DOE. The amendment would boost DOE's money by $469 million, and divide the remainder between the two other agencies. Sen. Pete Domenici (R-NM), the powerful chairman of the Energy and Water Appropriations Subcommittee that funds DOE, was a cosponsor of the amendment.

On the House side, Rep. Rush Holt (D-NJ) tried and failed in late March to add more science money to the House Budget Committee spending plan. "I'm really concerned about research and development in general," Holt said in a recent interview about the budget proposal. "It makes me question whether anyone in the Bush administration has learned the lesson that R&D pays off economically. They can't see beyond their fixation with tax cuts." Holt and Rep. Vern Ehlers (R-MI) are the two physicists in Congress.

With discretionary spending held to 4% or 5% growth, staff members of science committees in both the House and Senate say it will be a long, tough summer for science as appropriators spread a dwindling amount of money around a lot of programs. The appropriations subcommittees will make the final determination of who gets what. Those who want increased nondefense science funding at DOE, for example, will have to battle proponents of other projects. Nuclear weapons/stockpile stewardship advocates want more, as do supporters of renewable and nuclear energy programs.

The following are some of the budget highlights:

National Science Foundation. After being the centerpiece of Clinton's FY 2001 science budget with a record increase of about 13% last year, the main new task for NSF this year will be supporting Bush's Math and Science Partnerships program. NSF would receive $200 million for the program, but $110 million of that amount is money that would be redirected from the foundation's existing Education and Human Resources program. The budget also provides $8 million to increase stipends for graduate research fellowships and related research programs from $18 000 to $20 500 per academic year.

NSF Director Rita Colwell, who has been careful not to criticize the Bush budget, recently told a congressional committee that, in addition to the education funding, the foundation's priorities are biocomplexity and the environment (up 6%), information technology research (up 5%), nanoscale science and engineering (up 16%), and learning for the 21st century (up 3.3%). The physics research budget would decline 5.3%, from $131.6 million to $124.7 million. The facilities budget would increase by 5.3%, to allow "effective use" of Michigan State University's National Superconducting Cyclotron Laboratory's ion beam upgrade project, and to increase operating support for LIGO (Laser Interferometer Gravitational Wave Observatory). The foundation's astronomical sciences division budget would increase 5.1%, with the bulk going to facilities support for the Gemini observatories and a handful of other projects. NSF's funding of the ATLAS and CMS detectors for the Large Hadron Collider at CERN would be $16.9 million. NSF and DOE both contribute funds for the US work on the LHC.

Department of Energy. Despite being perceived as a dysfunctional

Department of Energy Physics-Related Programs (continued)

	FY 2000 actual	FY 2001 request	FY 2001 current	FY 2002 request
	(millions of dollars)			
Spallation Neutron Source, Oak Ridge	17.9	19.1	19.0	15.1
Radiochemical Engineering Development Center, Oak Ridge	6.8	7.1	6.7	6.7
Combustion Research Facility, Sandia–California	4.7	5.8	5.5	5.5
Small business research programs	0.0	15.3	17.0	16.6
Engineering and geosciences, includes geophysical imaging, mineral thermodynamics, and climate change	35.6	40.8	39.8	38.9
Energy biosciences, includes plant genomics, biomaterials, and climate change	29.8	33.7	33.2	32.4
Construction projects				
Spallation Neutron Source, Oak Ridge	100.0	261.9	258.9	276.3
Design and engineering for nanoscale science research centers	0.0	0.0	0.0	4.0
Energy supply R&D				
Solar and renewable resources technologies, includes photovoltaic, geothermal, and electric energy systems	306.0	409.5	373.2	237.5
Nuclear energy, includes isotope production, reactor research, and advanced radioisotope power systems	225.6	293.9	277.5	223.1
Advanced scientific computing research				
Mathematical, information and computational sciences, includes the National Energy Research Scientific Computing Center	113.9	160.0	156.2	156.2
Weapons activities				
National Nuclear Security Administration				
Directed stockpile work##	732.1	910.6	914.5	1043.8
Stockpile stewardship campaigns to increase scientific knowledge for sustaining nuclear weapons	1831.0	2105.0	2023.2	1996.4
Readiness in technical base and facilities operations	1312.8	1642.4	1413.8	1447.0
Secure transportation assets	104.5	115.7	115.1	121.8
Safeguards and security	393.8	377.6	394.7	448.9
Program direction	238.0	224.1	250.6	271.1
Total weapons activities	4612.1	5375.2	5111.9	5329.0
Other defense activities				
Nonproliferation and national security, including international materials protection, control and accounting and Russian plutonium disposition	761.7	0.0	873.9	773.7
Intelligence, includes nuclear materials protection and accountability of former Soviet weapons	38.8	38.1	35.8	40.8
Counterintelligence, includes cyber protection against espionage and sabotage	36.5	45.2	45.0	46.4
Security and emergency operations	210.3	320.4	230.5	268.5
Environment, safety, and health	100.2	125.6	125.3	104.6

*The DOE budget is being amended to transfer $5 million from HEP and $5 million from other programs to add $10 million to its fusion program.
†The university research supports groups at 100 universities and at 6 foreign labs.
‡Includes $1 million for Scientific Discovery through Advance Computing (SDAC), $1.1 million for the US share of the Pierre Auger project in Argentina, and money for US involvement for the LHC research program at CERN.
§The major focus of the accelerator R&D program will be the continuing effort to design and install modifications to improve luminosity and efficiency of the Tevatron complex at Fermilab, and improving the *B*-Factory complex at SLAC.
||Includes $3.9 million for the SDAC program.
#Includes funds for the Holifield Radioactive Ion Beam Facility (HRIBF), the Argonne Tandem Linac Accelerator System (ATLAS), and the 88-inch Cyclotron facility at Lawrence Berkeley National Laboratory.
**The Bates facility will commission the BLAST detector in 2002 to observe collisions in thin gas targets. When the research is completed in 2004, a two-year phaseout will take place.
††For researchers primarily using the NSF-supported National Superconducting Cyclotron Laboratory at Michigan State University and investigating nuclear reactions at intermediate energies at several other facilities in the US and Europe. Also for research using relativistic heavy-ion beams involving experiments at RHIC. The $500 000 decrease reflects the completion of RHIC capital equipment projects.
‡‡Support for research at four national labs (BNL, LBNL, LANL, and ORNL) that is focused on instrumentation.
||||In 1996, the HFBR was shut down for refueling. Before its restart, a plume of tritiated water from the reactor's spent fuel tank was discovered. In 1999, the Secretary of Energy announced the permanent closing of the HFBR. Responsibility for the reactor has been transferred to the Office of Environmental Management for decommissioning.
##Program to maintain the safety, reliability, and performance of the nuclear weapons stockpile, including refurbishment of warheads.

NASA Physics-Related Programs

	FY 2000 actual	FY 2001 request	FY 2001 current	FY 2002 request
	(millions of dollars)			
Space science and exploration				
Chandra X-ray Observatory	4.1	0.0	0.0	0.0
Space Infrared Telescope Facility (SIRTF) development	123.4	117.6	118.3	105.9
Hubble Space Telescope development and upgrades	183.5	168.1	179.5	161.8
Relativity (Gravity Probe-B) mission development*	49.9	13.8	41.2	40.2
Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics (TIMED)†	27.5	0.0	13.2	0.0
Stratospheric Observatory for Infrared Astronomy (SOFIA)	42.0	33.9	38.9	37.0
Solar Terrestrial Relations Observatory (STEREO) design and development	—	—	—	50.3
Gamma-Ray Large Area Space Telescope (GLAST) development	—	—	—	19.4
Payload and instrument development	14.4	7.1	33.4	44.8
Rosetta (ESA comet mission) instrument development	6.9	1.4	7.3	1.3
Solar-B, joint project with Japan and UK	—	—	15.9	21.9
Spartan reusable spacecraft, can be flown aboard the space shuttle	0.5	0.5	0.5	0.5
Herschel Observatory (formerly called Far Infrared and Submillimetre Telescope)	—	—	—	14.6
Other shuttle/international payloads, including projects supporting Europe's International Gamma Ray Astrophysics Laboratory	6.0	5.2	9.8	6.5
Explorer series				
Medium-class Explorers, including Microwave Anisotropy Probe, Swift gamma-ray burst mission, and Full-Sky Astrometric Mapping Explorer (FAME)	61.8	15.1	87.4	109.1
Small-class Explorers, including the High Energy Solar Spectroscopic Imager, and Galaxy Evolution Explorer	48.8	17.9	37.0	8.4
Explorer planning (other projects)	11.9	—	16.8	37.5
Discovery series				
Genesis solar wind mission	62.3	7.3	25.5	0.0
Comet Nucleus Tour (CONTOUR)	52.1	45.6	53.9	26.5
Mercury Surface, Space Environment, Geochemistry and Ranging (MESSENGER)	—	—	31.7	97.4
Deep Impact‡	—	—	57.2	84.2
Future missions	35.9	35.9	44.7	9.0
Mars Exploration Program§				
2001 Mars Odyssey Orbiter	109.2	—	38.3	0.0
2003 Mars Exploration Rovers (MER)‖	18.9	—	302.0	207.0
Future missions, including a Mars Reconnaissance Orbiter in 2005, and a Deep Space Network Antenna system	120.7	257.5	87.2	223.9
Mission operations and data analysis, including the Hubble Space Telescope	78.7	80.0	85.3	105.3
Technology program#				
Core program, emphasizing development of computation and information technologies	245.2	272.0	96.5	108.0
Focused programs, for developing high-priority technologies needed for specific science missions	322.2	424.5	301.1	307.0
New Millennium program, designed to flight-test new technologies	13.8	—	21.6	63.8
Research program				
Research and analysis	239.4	211.6	244.6	246.2
Data analysis	291.1	312.0	310.5	319.2
Suborbital program				
Balloon experiments	13.3	15.3	15.3	14.0
Sounding rockets	23.6	23.6	26.3	27.1
Biological and physical research	274.7	302.4	312.9	360.9
Earth sciences				
Earth Observing System (EOS), including multiple Earth-monitoring spacecraft	479.8	447.1	414.3	371.9
EOS data information system (EOSDIS)	278.9	252.0	281.4	252.6
Earth Explorers, including Total Ozone Mapping Spectrometer	163.1	120.4	141.2	84.5
Research and technology, including applications and commercialization	466.3	533.3	579.6	516.6
Mission operations	48.0	42.7	57.8	52.2
Academic programs	138.8	100.0	132.7	153.7
Space station development**	2323.1	1724.5	2112.8	2087.4

*This mission is to verify Albert Einstein's theory of general relativity by measuring the "dragging of space." The launch is now scheduled for late 2002.

†Now scheduled for launch this summer, TIMED has been delayed because of problems with another spacecraft sharing the same launch vehicle.

‡Deep Impact is designed to fire a large copper projectile into the comet P/Tempel 1, excavating a crater more than 20 m deep to expose its pristine interior ice and rock. The mission is under development.

§NASA's "reformulated" Mars Exploration Program focuses current and future missions to the planet on determining if life ever arose on Mars and, if it still exists, characterizing the ancient and present climate, understanding the planet's geological processes, and gathering environmental information to prepare for eventual human exploration.

‖The mission hopes to put two rovers on Mars to determine whether water-related minerals exist at or near the surface, and if so, whether they were produced by biological processes.

#Formerly known as the program "Supporting Research and Technology."

**The "Russian Program Assurance" funding that is typically part of the space station budget ($24 million in FY 2001) is currently under review and FY 2002 funding has not been determined. Funding for the X-38 crew return vehicle ($89.8 million in FY 2001) has been "redirected back" to the main space station program. No funds are allocated for FY 2002 and NASA says the X-38 project is under review.

department unable to maintain security in the weapons labs, the department last year received a 12.5% increase, with science-related R&D going up 14%. Under Bush's budget, overall R&D would fall 4.5%, with the leaderless Office of Science getting its 0.1% increase. A bright spot in the funding is the Spallation Neutron Source, which would receive a $13 million increase, bringing its funding up to more than $270 million.

In the budget document sent to Capitol Hill, President Bush called for high-energy physics (HEP) funding that is overstated by $5 million. To maintain fusion energy sciences at $248.5 million, $5 million is being shifted from HEP and an additional $5 million is coming from other science accounts. The amended HEP budget would increase 0.6%, or $4.1 million, from $712 million to $716.1 million. James Decker, the Office of Science acting director, said the DOE's magnetic fusion energy program for 2002 includes "basic research in plasma science in partnership with NSF, plasma containment research, and investigation of tokamak alternatives, along with continued operation of DIII-D, Alcator C-Mod, and the National Spherical Torus Experiment."

With money so tight at DOE, officials were forced to make hard choices to keep two key physics programs on track. Fermilab's Tevatron, believed to be able to reach the luminosity needed to find the Higgs boson, got "what it needed," a DOE official said. DOE requested a budget increase from $289.5 million in FY 2001 to $314.8 million this year for Fermilab's HEP account. The B Factory at SLAC is expected to shed light on the preponderance of matter over antimatter if progressive small upgrades are made. SLAC's high-energy physics budget request is up slightly, from $158.6 million in FY 2001, to $164.3 million this year, enough to keep the B Factory running. To give the money to these programs, the smaller labs and the university programs were cut back by between 4% and 5%.

DOE scientists are also concerned that the flat funding for nuclear physics will mean that several programs, such as Brookhaven National Lab's Relativistic Heavy Ion Collider (RHIC), will only be able to operate at about 60% of capacity. Construction of the controversial National Ignition Facility, funded under DOE's defense programs, would continue with a 24% increase to $245 million.

National Oceanic and Atmospheric Administration Physics-Related Programs

	FY 2000 actual	FY 2001 request	FY 2001 current	FY 2002 request
	(millions of dollars)			
Oceanic and atmospheric research				
Climate and air quality research				
Interannual and seasonal climate research, including Climate Change Research Center	16.7	14.9	14.9	15.2
Long-term climate and air quality research, including high-performance computing and numerical modeling	42.6	43.3	45.7	47.5
Climate observation and services, including climate reference network and Climate Prediction Center	0.0	24.0	12.2	24.0
Climate and global change, including Global Atmospheric Baseline Observatories	69.6	72.1	68.3	68.7
Global Learning and Observations to Benefit the Environment (GLOBE)	3.0	5.0	3.0	3.0
Atmospheric programs				
Weather research, including numerical modeling and forecasting	43.3	41.4	42.1	45.5
Solar–terrestrial services and research	6.9	6.2	6.0	6.2
Sea Grant college program	58.6	59.3	62.1	62.4
Undersea research program	13.7	5.6	15.8	13.8
Acquisition of data	12.9	12.9	12.9	0.0

NIST Physics-Related Programs

	FY 2000 actual	FY 2001 request	FY 2001 current	FY 2002 request
	(millions of dollars)			
Laboratory research and core services				
Physics	28.4	39.5	32.7	37.1
Materials science and engineering	51.0	59.0	56.4	62.7
Electronics and electrical engineering	38.4	40.0	40.8	41.2
Chemical science and technology	32.1	33.0	34.8	38.5
Computer science and applied mathematics	44.2	56.3	56.0	59.7
Research support activities	31.9	49.3	32.0	44.0
Manufacturing engineering	19.1	23.8	20.0	20.4
Technology assistance	17.4	17.2	17.7	17.8
Building and fire research	14.7	13.9	17.7	16.0
Total NIST laboratories	277.2	332.3	308.1	336.9
Baldrige National Air Quality Awards program	4.9	5.2	5.2	5.4
Advanced Technology Program*	142.6	175.5	145.4	13.0
Manufacturing Extension Partnership	104.2	114.1	104.9	106.3
Construction of research facilities	106.9	—	34.8	20.9

*The $12.9 million request for ATP, combined with the estimated carryover from the previous year and recoveries, would provide an operating budget of $79.9 million. That amount would cover funding requirements for previous ATP awards. The administration proposes that no new awards be made in FY 2002 while the Department of Commerce evaluates ATP.

One of the more contentious aspects of the Bush budget is the cuts in energy R&D, including a 30.8% decrease in solar and renewable energy research, a 29.4% decline in nuclear energy research, and a 28.3% cut in energy conservation research. Even fossil energy R&D declines 25.3%. Cuts in these research fields, because of their implications for long-range federal energy policy, are attracting both a great deal of attention and demands for increased funding on Capitol Hill. That could make it less likely that extra funding for physics-related programs will be available.

NASA. In testimony before Congress, NASA administrator Daniel Goldin described his agency's proposed FY 2002 budget, with its 1.8% increase, as "solid and businesslike." That translates specifically to an increase in spending on missions to Mars, at the cost of the Pluto–Kuiper Express and Solar Probe missions. Goldin is calling for a 7.3% boost, to $2.4 billion for aerospace technology, about 75% of which will go to the space launch initiative to develop technologies for the next generation of reusable launch vehicles.

The budget contains $2.1 billion for the International Space Station, and Goldin said that to curtail cost growth projections of $4 billion by 2006, he was scaling back the station by canceling the propulsion and habitation modules, as well as the crew return vehicle. The loss of the habitation module is expected to reduce the already limited amount of science to be done on the space station. The entire program is undergoing review and a significantly scaled-down station might result.

Earth science takes a big hit, losing 11.7% in funding compared to FY 2001. Goldin said the Earth Observing System has been so good at gathering data that his agency is "taking a pause as we absorb the wealth of data being returned from the first set of EOS satellites." Goldin said he was "proud" of the budget, but noted that it was "essential that the Congress fully fund this budget."

NIST. Commerce Secretary Donald Evans, who oversees NIST, announced the 18.3% cut in the institute's budget by saying Bush had put "first things first." The president focused on "the people's priorities," Evans said, "starting with a fair, responsible, and much needed tax cut." Translated into money, that means NIST's budget would be down to $487.5 million from the FY 2001 funding of $597 million. Most of the NIST cut, as noted earlier, comes with the proposed 91.9% cut in the ATP program.

The NIST laboratories would fare relatively well under the proposal, with a request of $336.9 million, an increase of $35.2 million, or 11.7%, over FY 2001. The labs are responsible, according to an agency fact sheet, for providing industry and the science community with "measurement capabilities, standards, evaluated reference data, and methods."

NOAA. While NOAA would see a 2% decline in its overall budget, the $60.8 million decrease, to $3.15 billion, "reflects the elimination of most congressionally mandated earmarks" from FY 2001, according to agency documents. NOAA's National Ocean Service (NOS) division, responsible for marine mapping and management of coastal zone environments, would see a 33% decrease from $593.6 million to $394.6 million. Of that decrease, $150 million would come from the fund that helps repair damage associated with oil extraction.

The Oceanic and Atmospheric Research division (OAR), NOAA's primary research agency, would get $340 million, a 3% decrease from last year. About $28 million of the decrease comes from the elimination of congressional mandates such as a marine facilities construction project at the University of New Hampshire (down $13 million), and an aquatic ecosystems project in West Virginia (down $4.3 million). But OAR would receive an increase of $13 million for its climate observations program, and $10 million more for its ocean exploration initiative. The biggest winner within NOAA is the National Environmental Satellite, Data and Information Service (NEDIS), which provides launch, operation, data collection, and storage for polar orbiting and geostationary environmental satellites. The NEDIS budget would increase 15%, to $738 million. When the congressional earmarks are removed, the overall R&D budget actually increases by about 6.4%.

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