

WASHINGTON REPORTS

After Two Years of Budget Battles on Capitol Hill, Clinton's R&D Plan for 1998 Gets Surprising Support

Wherever scientists gather—at meetings of the American Physical Society in Kansas City or the American Association for the Advancement of Science in Seattle or in corridors and offices of colleges and universities throughout the country—the talk turns invariably to a troublesome issue: funding for research, equipment and graduate students. On 6 February, President Clinton sent Congress his fiscal 1998 budget request, containing a modest 2.2% increase for scientific research and development (see PHYSICS TODAY, March, page 61). It included a 4.6% boost to just under \$35 billion for nondefense R&D and a stagnant \$40.5 billion for defense-related programs. For the first time, funding for basic research fared better than that for applied research—by \$144 million. In fact, Clinton's budget would raise basic research funding by 3% to \$15.3 billion, but basic research at universities would go up by a paltry 2%, which is less than last year's 2.6% rate of inflation, to a total of \$13.3 billion.

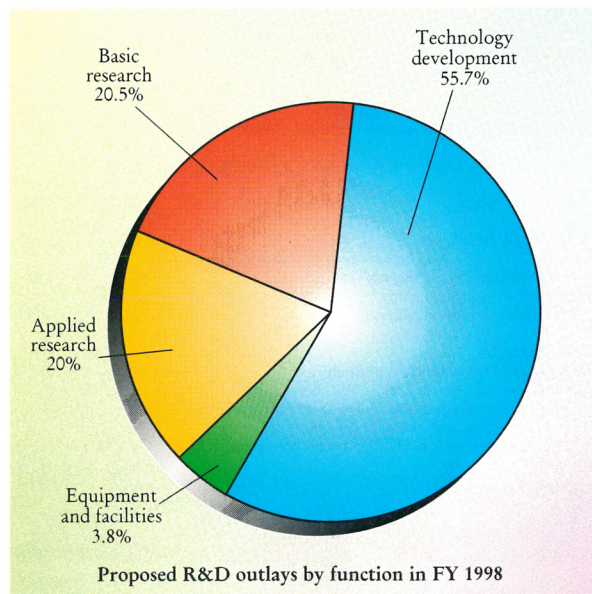
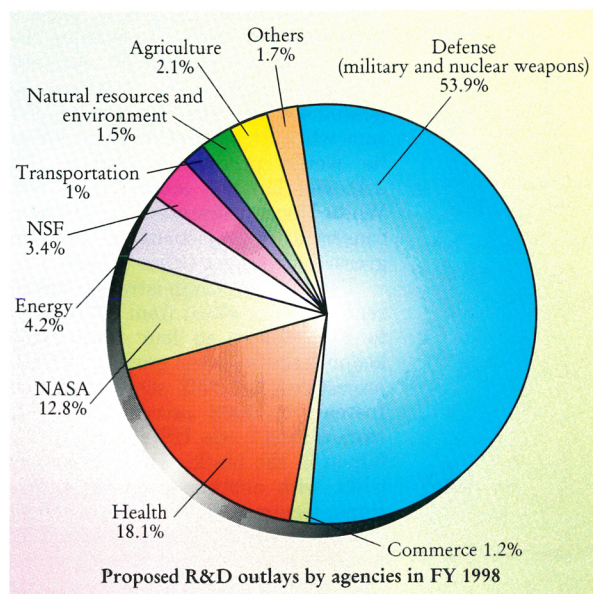
All things considered, the proposed budget gave little cheer to many scientists—particularly those who have endured years of flat Federal spending for research.

Except for a few prominent members of the House and Senate who have expressed worry that such miserly levels of R&D spending will bring about dire consequences for the nation's economic and technological growth (see page 53), the 105th Congress has many other matters on its mind—among them, election campaign fund-raising, late-term abortions, a balanced-budget amendment to the Constitution, the management of Washington, DC, and posting the Ten Commandments in public buildings. As it happens, both bodies of Congress appeared dysfunctional in the first two months of the session. Republicans, still bruised over last year's budget battles, hadn't even bothered to draft an alternative to Clinton's plan, and Democrats decided to wait out their opponents. In an effort to achieve at least a dollop of

sweetness in their dealings on Capitol Hill, 200 of the 435 House members spent a weekend discussing civility in early March on a "retreat" at the Hershey Food convention center in Pennsylvania.

The game plan this year is different from those of the last two budget cycles, when Republicans dominated both chambers. Both sides now say a budget agreement is essential before the fiscal year runs out on 30 September. Republicans admit they do not dare risk another government shutdown. "We don't have any choice but to work together," said Senator Don Nickles, an Oklahoma Republican who serves on the budget committee. "A repeat of last year is not acceptable to anybody." Democrats need a show of unity to overcome the campaign financing scandal and to prepare for the 1998 elections.

What's happened to the in-your-face confrontations? Congressional sources cite several factors that may be responsible for the decreased hostility. The public is tired of political squabbles and simply wants the good times to



What a difference between budget authority and budget outlays! The Clinton Administration's budget for fiscal 1998 would authorize \$75.5 billion for R&D, an increase of 2.2% more than in the current year. But the actual spending outlays are estimated to be \$70.2 billion. Of this, more than half, \$37.4 billion, would be spent for defense R&D. Nondefense outlays would be \$32.8 billion—to go largely for the National Institutes of Health, NASA's space programs and the Energy Department's research programs. Under the President's budget, basic research expenditures would be 2% above this year's estimated outlays, to \$14.9 billion, and applied research would rise by a similar percentage to \$14.5 billion. Just about half of the total amount designated for basic and applied research would be available next year to university scientists and engineers—nearly \$13 billion.

Department of Energy physics-related activities

	FY 96 actual	FY 97 request (millions of dollars)	FY 97 current	FY 98 request
General science and research				
High-energy physics				
Physics research				
Fermilab	10.3	10.0	9.9	10.0
SLAC	10.5	10.3	10.1	10.3
Brookhaven	7.9	7.8	7.6	7.7
Lawrence Berkeley	10.3	10.1	9.9	10.1
Argonne	5.7	5.5	5.5	5.6
Universities and other laboratories	96.2	97.6	97.6	97.1
Total high-energy physics research	141.0	141.3	140.6	140.8
Program operations, including personnel and power costs				
Fermilab	182.9	142.8	182.4	197.2
SLAC	91.2	72.9	98.0	103.5
Brookhaven	59.7	43.5	56.1	57.8
Universities and other laboratories	13.3	12.0	10.3	9.5
Large Hadron Collider (to be built at CERN)	0.8	15.0	15.0*	35.0
Waste management activities**	—	—	—	5.0
Technology R&D for existing and proposed accelerators, detectors and magnets, including work for the LHC	63.5	74.9	66.7	62.4
Capital equipment and construction, including plant projects, completion of Fermilab main injector and SLAC B-factory and upgrade of master substation	104.0	191.7	100.0	50.9
Transfer of Superconducting Super Collider balances to Energy supply R&D	—	—	—	(15.0)
Small business research program	—	—	10.3	10.9
Total high-energy physics	656.4	694.1	679.4	673.0
Nuclear physics***				
Low-energy nuclear physics				
Radioactive ion beams at Oak Ridge National Laboratory	11.1	N/A	11.8	12.3
University research	9.1	N/A	8.9	9.0
National laboratory research at Sudbury Neutrino Observatory, a joint US-Canada-Britain project	4.5	N/A	3.7	3.7
Nuclear data program at Brookhaven	4.6	N/A	4.9	4.9
Medium-energy nuclear physics				
University research	11.5	N/A	11.5	11.6
National laboratory research at DESY in Germany, Brookhaven's AGS and the Laser Electron Gamma Source, and Los Alamos's Anderson Meson Physics Facility	14.2	N/A	14.3	14.6
Thomas Jefferson National Laboratory (CEBAF) research	27.3	N/A	25.4	24.9
Thomas Jefferson National Laboratory program operations	39.6	N/A	42.1	42.0
MIT Bates Laboratory program operations	17.3	N/A	17.7	18.2
Heavy-ion nuclear physics				
University research, mainly at Yale and Texas A&M and use of Brookhaven's AGS and CERN's SPS	15.9	N/A	16.3	16.3
National laboratory research at Argonne's Atlas, Berkeley's 88-inch cyclotron and Brookhaven's AGS	31.0	N/A	36.5	35.9
National users facilities operations	19.2	N/A	20.2	17.8
Brookhaven RHIC pre-operations	9.5	N/A	11.0	19.0
Lawrence Berkeley plant and equipment maintenance	5.3	N/A	5.5	5.5
Nuclear theory	14.9	15.4	15.2	15.3
Construction, largely RHIC's magnets and detectors	65.0	65.0	65.0	76.0
Total nuclear physics	299.9	318.4	315.9	327.0
Energy supply R&D				
Solar and renewable resources technologies, including photovoltaic and solar thermal systems	284.2	368.9	269.9	342.5
Nuclear energy, including isotope production, reactor research and advanced radioisotope power systems	229.1	248.1	222.7	301.1
Energy research				
Biological and environmental research	399.6	379.1	382.4	376.7
Fusion energy sciences				
Experimental research on tokomaks and alternative concepts, including design of International Thermonuclear Experimental Reactor (ITER) and proposed spherical torus experiment	62.1	72.0	69.4	72.4
Fusion theory	26.2	18.0	25.3	17.5
Basic plasma science	0.2	4.0	3.0	4.0
Facility operation at Princeton Plasma Physics Laboratory, General Atomics and MIT; also shutdown of TFTR	68.1	66.3	58.2	47.5
Engineering and materials research, including ITER	73.6	84.0	66.4	67.3
Capital equipment and plant projects	6.2	11.3	7.2	15.4
Total fusion energy sciences	238.9	255.6	230.4	225.0
Basic energy sciences				
Materials sciences research, including condensed matter physics and solid-state and polymer chemistry	173.3	161.5	166.1	192.9
Chemical sciences research, including atomic physics	130.9	112.1	128.3	130.3
Major user facility operations for materials and chemical sciences				
National Synchrotron Light Source	30.8	26.9	28.3	30.6

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roll on with excellent economic indicators such as low rates of unemployment and inflation. At the same time, reducing the Federal deficit should now be easier because of higher corporate and individual tax revenues.

Nevertheless, some Congressional leaders are troubled. "I'm frustrated by the new entitlement programs in the budget, for education, expanded Medicaid eligibility and the like, at the same time the White House tells us it's getting the budget under control," said Senator Pete Domenici, the influential Republican of New Mexico who chairs the budget committee. "I'm not dumping on the budget. In fact, the budget proposal is a very good starting point. Basic science could even get a little more, if we can balance the increases with reductions in other programs." Representative Jerry Lewis, the California Republican who heads the House Appropriations subcommittee that controls funds for the National Science Foundation, NASA and environmental research, warns that he is not satisfied with the Administration's request. "I feel strongly about promoting basic and applied research, and I'll look for more funds for NSF in particular and research in general." And Senate Majority Leader Trent Lott, a Republican of Mississippi, told his appropriators to hike allocations for basic research and protect the Pentagon's research programs.

Last year, whatever their differences, both sides seemed at least to have resolved their long-running dispute about whose budget estimates should be used. The question appeared settled in favor of the Republicans when President Clinton promised he would produce a budget that achieved balance according to both White House estimates and the more conservative projections of the Congressional Budget Office (CBO).

The Clinton Administration has already cut the deficit from \$290 billion to \$107 billion in four years while keeping the economy growing. OMB's projections for 2002 show no deficit. Instead, by 2002, according to OMB statisticians, the US should be \$17 billion in the black. The nonpartisan CBO, with another group of statisticians, declared that the Clinton budget, if enacted without changes, would fail to achieve a balanced budget in five years and, in fact, would leave a deficit of \$69 billion in 2002. The CBO report prompted some Republicans to submit a revised budget that comes closer to eliminating the deficit in 2002. Though harshly critical of Clinton's budget, House Budget Committee Chairman John R. Kasich, an Ohio Republican and fiscal hard-liner, did

not issue an ultimatum for a new budget—as he has done in previous years. “We’re not drawing any lines in the sand,” said Kasich.

But with just about everyone now serious about eliminating the Federal deficit by 2002, stable budgets may be the best that scientists can hope for. Under the President’s current plan, support for civilian research would creep up by only 2% for all of the next five years. Within that time frame, basic research funding is projected to rise by nearly 5%. Last year, the White House proposed that Federal R&D funds would fall by the year 2000, perhaps by as much as 8.5%, and then rise slightly in 2001 and 2002. The projected decline raised a hue and cry among researchers, and budget watchers dismissed the post-2000 bonus as a gimmick. Such projections for the “out years” have been dropped from the 1998 budget.

AAAS’s budget experts had calculated in 1995 that R&D funding would plunge 33% by 2002 under the Clinton budget scenario. The AAAS’s revised projections, based on the new budget, indicate that R&D would suffer a 9.5% decrease between 1995 and 2002. T. J. Glauthier, associate director of the White House Office of Management and Budget (OMB), has sought to put a rosy glow on the figures. “The balanced budget plan is based on a stable and predictable track,” he told the President’s Council of Advisers on Science and Technology on 6 March. “In this environment, being frozen in place is a pretty good thing.”

But when inflation is factored into the projections, the small increase for R&D becomes a loss. “Science and technology over the next four years will lose as much as 8% of their buying power,” as the country moves toward a balanced budget, John H. Gibbons, the President’s science adviser, told news reporters before the budget was released.

“You won’t see an increase in funding,” David Goldston, a legislative aide to Representative Sherwood L. Boehlert, a New York Republican, told a AAAS audience of scientists who hoped for better news. “But you won’t be slaughtered either.”

“It’s OMB’s policy to hold us to a flat budget over the next four years,” said Neal Lane, the National Science Foundation’s director. “And it’s our policy not to be flat. So every year, we will argue for an increase.”

NSF, along with the National Institutes of Health and other science agencies, have gained an unexpected champion in Senator Phil Gramm, a Republican of Texas and chairman of the Appropriations Subcommittee on Commerce, Justice, State, the Judiciary

Department of Energy physics-related programs, continued

	FY 96 actual	FY 97 request	FY 97 current	FY 98 request
			(millions of dollars)	
High Flux Beam Reactor	26.3	24.1	24.0	25.4
Intense Pulsed Neutron Source	11.6	11.0	10.6	11.6
High Flux Isotope Reactor, Oak Ridge	7.1	7.3	6.7	7.1
Radiochemical Engineering Development Center, Oak Ridge	28.2	27.2	27.2	27.8
Stanford Synchrotron Radiation Laboratory	21.9	17.8	20.5	21.0
Manuel Lujan Jr Neutron Scattering Center, Los Alamos	7.5	6.7	7.3	7.7
Advanced Light Source, Berkeley	31.9	28.9	32.9	35.0
Advanced Photon Source, Argonne	84.2	80.0	81.4	84.7
Combustion Research Facility, Sandia-Livermore	5.4	4.4	4.9	5.1
Offsets for energy research	5.1	—	2.0	—
Total user facility operations [†]	259.9	234.3	245.8	256.0
Engineering and geosciences	39.6	41.3	42.9	41.4
Energy biosciences	28.7	28.2	28.6	27.5
Construction and facility improvements	10.0	11.5	11.5	11.0
Energy research analysis ^{††}	3.3	2.0	2.0	1.5
Computational and technology research ^{†††}	111.1	158.1	151.0	175.9
University and science education [§]	18.9	19.9	—	—
Weapons activities (defense programs)				
Inertial confinement fusion (ICF)				
Target physics, theory and modeling	83.4	86.5	86.5	86.7
Target development, fabrication and handling	32.1	30.6	30.7	30.7
Laser and optics technology development	46.7	46.7	46.7	55.1
National Ignition Facility (NIF) design and operation ^{§§}	23.6	59.2	59.2	31.3
Construction of NIF, Livermore	37.4	131.9	131.9	—
Advanced driver development	15.5	8.8	8.8	8.6
Other ICF activities	2.2	2.8	2.7	4.6
Total inertial confinement fusion	240.9	366.5	366.5	217.0
Weapons stockpile stewardship				
Core stockpile operations and maintenance, including physics and materials science and Accelerated Strategic Computing Initiative (ASCI)	1095.4	1467.6	1220.9	1444.3
Enhanced surveillance and evaluation of weapons	18.9	55.0	55.0	60.0
Advanced manufacturing design and production technologies	44.4	100.0	100.8	103.2
Radiological/nuclear accident response	70.0	79.6	75.8	79.3
Tritium source for nuclear weapons	75.0	100.0	150.0	184.5
Materials surveillance, safeguards and security	109.8	112.1	112.1	107.0
Stockpile management	1727.6	1825.0	1834.5	1828.5
Assets acquisition—request for full construction funding including NIF (\$876.4 million)	—	—	—	1034.2
Fissile materials storage and disposition	70.2	93.8	103.8	103.8
Nonproliferation and verification R&D and arms control	562.7	632.0	632.6	668.0
International nuclear safety and Chernobyl shutdown initiative	104.0	66.2	68.5	81.0
Environmental restoration and waste management (nondefense)	583.3	651.4	575.9	682.4
Environmental restoration and waste management (defense)	5453.7	5409.3	5289.3	5218.2

*DOE has made a preliminary agreement with CERN to contribute \$450 million to the LHC accelerator and detectors over the period of fiscal 1996 to fiscal 2004. DOE proposes to contribute \$250 million toward the detectors and \$200 million for the accelerator (some \$90 million for direct purchases by CERN from US firms and \$110 million for fabrication of accelerator components by US laboratories).

**Waste management activities in fiscal 1996 and 1997 were funded by DOE’s environmental management program. Henceforth, such activities will be borne by the high-energy physics program.

***Nuclear physics line items are reported differently from previous years, making it difficult (if not impossible) to use last year’s budget requests.

†Funding for this activity is provided in the materials sciences and chemical sciences programs. In FY 1996, some 4500 researchers from academia and industrial organizations used the facilities. The request for FY 1998 includes a total of \$276.8 million to continue support of the user facilities by researchers in materials and chemical sciences, Earth and geosciences, environmental sciences, structural biology, medical research and superconductor technology.

††This program supports staff and peer reviews of programs and projects to judge the quality of research and the relevance to DOE’s basic energy sciences. It also funds reviews by advisory committees, such as the National Research Council and the JASON group. The proposed budget decrease reflects a drop in the number of reviews from 275 in FY 1996 to about 100 in FY 1997.

†††The facilities in this program include the National Energy Research Supercomputer Center, which had been supported at Lawrence Livermore National Laboratory by DOE’s fusion energy sciences program. The center was moved in FY 1996 to Lawrence Berkeley National Laboratory, where it is now funded as a distinct program in energy research and calls on the knowledge and skills of researchers at universities, national labs and industrial organizations. The program is involved in the interagency development of the Next Generation Internet, the High Performance Computing and Communications Initiative and the Accelerated Strategic Computing Initiative (ASCI).

§This program was terminated by Congress in FY 1997.

§§NIF is an experimental inertial confinement fusion facility equipped with a 192-beam neodymium glass laser, which is expected to achieve controlled thermonuclear fusion by imploding a small capsule containing a mixture of deuterium and tritium. By producing ignition and modest energy gain in ICF targets, NIF is designed to carry out experiments in regimes of plasma temperatures and densities similar to those in a nuclear weapon.

National Science Foundation physics-related programs

	FY 96 actual	FY 97 request	FY 97 current	FY 98 request
(millions of dollars)				
NSF total	3206.3	3325.0	3270.0	3367.0
Mathematical and physical sciences				
Physics research project support	94.3	102.7	101.8	103.8
Physics facilities support	37.6	39.6	36.9	44.4
Total physics research	131.9	142.3	138.7	148.2
Materials research project support	84.5	92.6	87.4	88.4
Materials research science and engineering centers	57.3	58.6	58.0	58.9
National facilities and instrumentation support	33.4	37.9	37.9	38.9
Total materials research	175.1	189.1	183.4	186.3
Chemistry research project support	112.0	111.7	116.9	118.0
Instrumentation and infrastructure support	15.7	24.9	16.4	17.4
Total chemistry research	127.7	136.6	133.3	135.4
Mathematical research project support	64.5	69.5	72.9	74.0
Infrastructure support	23.2	22.0	20.3	23.0
Total mathematical sciences	87.7	91.5	93.2	97.0
Astronomy research and instrumentation	39.6	45.3	45.0	46.0
Astronomy facilities*	69.1	71.6	71.3	72.8
Total astronomical sciences	108.7	116.9	116.3	118.8
Multidisciplinary research project support**	29.5	31.5	31.0	30.0
Research facilities and major equipment	5.2	21.9	21.9	22.9
Total mathematical and physical sciences	660.5	708.0	695.9	715.7
Major research facilities and equipment				
Laser Interferometer Gravitational Wave Observatory***	70.0	70.0	55.0	26.0
Millimeter Array†	—	—	—	9.0
Polar Cap Observatory††	—	—	—	25.0
South Pole Station†††	—	25.0	25.0	25.0
Geosciences				
Atmospheric sciences research support	84.3	92.1	89.9	90.5
National Center for Atmospheric Research	60.1	61.2	60.1	60.8
Earth sciences research, including geophysics	57.6	58.8	58.4	58.6
Continental dynamics	7.9	9.4	8.5	8.5
Instrumentation and facilities	21.1	27.7	26.8	28.0
Ocean sciences research support	106.5	110.2	109.3	112.2
Oceanographic centers and facilities	47.5	53.7	52.3	52.3
Ocean drilling program operations	39.6	41.0	40.3	41.8
Total geosciences	424.5	454.0	446.1	452.6
Computer and information science and engineering				
Computer theory and research, including system software	40.2	43.2	42.9	46.4
Information, robotics and intelligent systems	32.9	35.6	35.1	39.8
Microelectronic information processing systems	26.3	28.4	28.1	30.4
Advanced scientific computing infrastructure	80.4	80.0	80.0	80.0
Networking and communications research and NSFNet	55.0	55.7	55.7	62.3
Cross-disciplinary activities	27.5	31.9	31.6	35.4
Total computer and information systems	262.4	277.0	273.4	294.2
Education and human resources	601.2	619.0	619.0	625.5

*Facilities include National Radio Astronomy Observatory, National Astronomy and Ionospheric Center and National Optical Astronomy Observatories. This line item also includes construction and, in 1998, operation of the twin 8-meter Gemini telescopes, which are an international collaboration of the US, United Kingdom, Canada, Argentina, Brazil and Chile.

**Initiated in fiscal 1994, this program supports particularly innovative, irregular or intricate research and education projects that bridge traditional disciplines and cross existing organizational and procedural barriers. While the program may involve two or more divisions in the mathematical and physical sciences, it can reach out to other NSF activities or to public and private partners outside the agency. Examples include investigations of mathematics and physical sciences with biological sciences and partnerships in energy research with the Department of Energy and Defense Advanced Research Projects Agency. This line item also supports research collaborations between colleges and universities and the private sector in a program called Grant Opportunities for Academic Liaison with Industry (GOALI).

***LIGO's two L-shaped units, 4 km on each side, are to be installed at the Department of Energy's Hanford site in the state of Washington and in Livingston Parish in Louisiana.

†The request is for initial funding for design and development of a prototype array. The MMA is intended to combine an angular resolution comparable to that of NASA's Hubble Space Telescope with the sensitivity of a single antenna more than 50-meters in diameter. The MMA will be an oval shaped ring of 40 radiotelesopes, each 8-meters in diameter, that operates in the wavelength range from 3 to 0.4 mm.

††The Polar Cap Observatory will consist of a large state-of-the-art radar facility with an accompanying array of smaller optical and radiowave remote sensing instruments. It is to be located near the Earth's northern magnetic pole at Resolute Bay in Canada.

†††The funding request is for modernizing the US station at the South Pole for studies involving infrared and submillimeter astronomy and seismic and atmospheric waves.

and Related Agencies. On the Senate's opening day in January, Gramm introduced legislation that would double Federal outlays on basic science and medical research in ten years. "If we don't restore the high priority once afforded science and technology in the Federal budget and increase Federal investment in research, it will be impossible to maintain the country's position as technological leader of the world," he said in introducing his measure. Notwithstanding, Gramm opposes Federal support for commercial product development. During the 104th Congress, he tried to eliminate the Commerce Department's Advanced Technology Program, Clinton's favorite technological activity.

Gramm and many scientists long to turn back the clock to the 1960s, when the government poured billions of dollars into science as part of President Kennedy's promise, after the Soviet Sputnik, to put a man on the Moon before the end of the decade. It's Gramm's intention to set up US science and technology as a national crisis worthy of extraordinary Federal spending.

The Clinton Administration has targeted more than a dozen programs for new or increased funding. These include the Next Generation Internet project, which would receive \$100 million divvied up among five agencies each year for the next three years. Multiyear construction of several large science projects, including US participation in the Large Hadron Collider at CERN in Geneva, Switzerland, the National Ignition Facility, which will be built at Lawrence Livermore National Laboratory, and the National Spallation Neutron Source, now under design, would lift the Department of Energy's R&D budget by 18%, or more than \$1 billion, next year. Without these projects, DOE's R&D allocations would rise by 4%.

Highlights of the Clinton Administration's 1998 budget for R&D follow:

National Science Foundation.

To Congress and the White House, NSF is one of the most favored research agencies, along with NIH, in these stringent fiscal times. Its principal mission, support for academic basic science, would increase by 3.4% to \$2.5 billion in fiscal 1998. Spending on mathematical and physical sciences would rise by 2.8%, or somewhat more than inflation. The biggest single new research activity in the proposed budget is a \$356 million program labeled Knowledge and Distributed Intelligence, a phrase coined by Vice President Al Gore in describing how new computer and communications technologies are changing the way people gather information and use it.

KDI, as it is called at the agency, is "perhaps the most encompassing venture NSF has ever pursued," said Lane. "It cuts across all fields of research and touches education at all levels. It is inseparable from the trends and technologies that are driving growth and opportunity in our economy and society—from networks to sensors to virtual reality systems."

NSF also has requested a \$9 million down payment for the first phase of a \$180 million array of 40 millimeter-wavelength telescopes to explore the early universe and star formation, and \$25 million for a radar observatory in Canada's Northwest Territory to study auroral and other phenomena in the upper atmosphere. The growth of funding for the foundation's education programs, which increased rapidly with the help of Congress in the past decade, would increase by only 1% in the proposed budget. The agency also plans to integrate research and training in a new approach to supporting graduate education.

Department of Energy. The president's proposed budget calls for \$19.2 billion for DOE—\$2.7 billion more than fiscal 1997. Much of the increase is the result of changes in the way big-ticket facilities would be financed. The major item is up-front funding for the National Ignition Facility at Lawrence Livermore National Laboratory, an inertial confinement fusion center fitted with a 192-beam neodymium glass laser. NIF is designed to produce, for the first time in a laboratory setting, conditions of temperature and density of matter close to those that occur during the explosion of a thermonuclear warhead. DOE's science-based stockpile stewardship program is asking for \$876.4 million in fiscal 1998 to pay for the construction of NIF in the next six years.

Nondefense energy research would remain virtually flat in the Clinton budget for next year. The Administration wants \$35 million—\$20 million more than this year's allocation—for US participation in CERN's LHC, part of a \$394 million request to support construction through 1994 and to design and help build two detectors.

DOE also wants \$23 million to study a new spallation neutron source and to upgrade an existing neutron source at Los Alamos National Laboratory. The cost of the spallation source, which would most likely be located at Oak Ridge National Laboratory, may exceed \$1 billion, but a decision on whether to go ahead is unlikely this year. Two years ago, the White House pulled the plug on an Advanced Neutron Source, based on reactor technology, proposed for Oak Ridge.

Department of Defense physics-related funding

	FY 96 actual	FY 97 request (millions of dollars)	FY 97 current	FY 98 request
Army				
Research sciences	121.8	141.7	119.7	138.2
In-house laboratory independent research	13.7	14.7	14.4	15.1
University and industry research centers	46.2	47.3	44.9	45.6
Total basic research (6.1)	181.7	203.7	179.1	198.9
Total applied research (6.2)	450.8	447.6	551.6	462.9
Navy				
Research sciences	356.5	371.9	337.5	366.3
In-house laboratory independent research	15.0	15.3	14.7	15.8
Total basic research (6.1)	371.5	387.2	352.1	382.1
Total applied research (6.2)	537.7	463.5	534.8	490.3
Air Force				
Total basic research (6.1)	216.3	234.5	210.8	226.8
Total applied research (6.2)	627.1	638.5	653.9	593.4
Defense-wide				
Research sciences	76.5	74.9	90.7	76.0
In-house laboratory independent research	3.4	2.2	3.1	2.2
University research initiatives	214.9	209.2	214.7	237.8
Focused research initiatives	8.3	15.6	—	—
Government-industry cosponsorship of university research	—	—	—	14.7
Chemical and biological defense programs	26.5	28.7	29.3	25.2
Total basic research (6.1)	329.6	330.6	337.8	355.9
Total applied research (6.2)	1220.3	1148.6	1132.8	1267.5
Defense Advanced Research Projects Agency				
Total basic research sciences (6.1)	76.5	74.9	90.7	80.9
Total applied research (6.2), including materials, electronics and Next Generation Internet program	754.2	728.4	710.0	829.9
Ballistic Missile Defense Organization	3045.2	2534.2	3373.4	2581.9
Applied research and support technologies (6.2)	96.1	80.5	102.5	101.9

NOAA physics-related programs

	FY 96 actual	FY 97 request (millions of dollars)	FY 97 current	FY 98 request
Oceanic and atmospheric programs				
Interannual and seasonal climate, including studies of the El Niño–Southern Oscillation effects	65.0*	8.0	68.0*	12.9
Long-term climate and air quality	36.1	39.0	35.9	36.9
Global Learning and Observation to Benefit the Environment (GLOBE)	1.0	—	6.0	7.0
Climate and global change (NOAA-wide)	[60.0]*	75.7	[60.0]*	62.0
Weather research, including numerical modeling and forecasting	37.7	38.3	38.0	38.0
Solar-terrestrial research	5.4	5.5	5.5	5.5
Marine prediction research, including numerical modeling	15.4	17.3	20.9	17.3
Sea Grant	53.7	48.8	54.3	50.2
Undersea research**	11.9	—	12.0	5.4
Acquisition of data	—	—	12.7	12.9
Total oceanic and atmospheric research	226.2	232.5	253.2	248.1

*Displeased once again with the Clinton Administration's global climate change program, the House made a draconian cut in NOAA's budget request for that account. The Senate disagreed, however, and placed funds for the program in the interannual and seasonal climate account, from which NOAA supports global climate change studies.

**For the fifth successive year, the agency had attempted to cancel this program. Each time, Congress has refused to go along and has funded the program, which supports six regional research centers, including ones in the Caribbean, Hawaii and Alaska.

National Institute of Standards and Technology physics-related budget

	FY 96 actual	FY 97 request (millions of dollars)	FY 97 current	FY 98 request
Laboratory research and core services				
Physics	26.9	27.8	27.8	27.8
Materials science and engineering	49.4	50.9	50.9	50.9
Electronics and electrical engineering	34.3	38.9	35.8	38.1
Chemical sciences and technology	30.7	31.8	31.8	31.8
Computer science and applied mathematics	41.5	43.0	43.0	43.1
Research support activities, including postdoctoral fellows	27.7	28.6	28.6	28.6
Manufacturing engineering	18.3	18.9	18.9	18.9
Technology assistance	14.4	14.9	14.9	18.9
Building and fire research	12.5	13.0	13.4	13.4
Advanced Technology Program (ATP)	221.0	345.0	225.0	275.6
Manufacturing Extension Partnership (MEP)	80.0	105.2	95.0	123.4

NASA physics-related programs

	FY 96 actual	FY 97 request (millions of dollars)	FY 97 current	FY 98 request
Space science and exploration				
Advanced X-Ray Astrophysics Facility (AXAF) development	237.6	178.6	178.6	92.2
Space Infrared Telescope Facility (SIRTF) development	—	—	—	81.4
Relativity mission (Gravity Probe B) development	51.5	59.6	59.6	45.6
Cassini development	191.5	106.7	89.6	9.0
Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics (TIMED) development	—	15.0	18.2	48.2
Payload and instrument development				
Tethered satellite system (collaboration with Italy)	4.2	—	—	—
X-ray spectrometer (on Japan's Astro-E mission)	7.4	5.6	5.6	7.1
Mars oxidation experiments (for Russia's Mars mission)	2.6	—	—	—
Shuttle-international astrophysics projects, including Russia's Radioastron and Germany's Interstellar Medium Absorption Profile Spectrograph (IMAPS)	11.7	11.3	11.3	5.2
Explorer series development				
Advanced Composition Explorer (ACE)	18.5	24.7	18.7	5.5
Far Ultraviolet Spectroscopic Explorer (FUSE)	56.6	39.6	22.0	26.8
Medium Explorers, including Microwave Anisotropy Probe (MAP) and Imager for Magnetopause to Aurora Global Exploration (IMAGE)	13.7	41.2	41.2	62.4
Small Explorers, including Fast Auroral Snapshot (FAST) and Submillimeter Wave Astronomy Satellite (SWAS)	33.7	35.0	35.0	37.8
University Class Explorer program	3.0	3.0	2.4	4.2
Explorer planning	6.7	6.7	5.7	6.0
Discovery series development				
Near Earth Asteroid Rendezvous (NEAR)	8.3	—	—	—
Mars Pathfinder	33.7	—	—	—
Lunar Prospector	36.4	19.8	19.8	—
Future missions, including Stardust	10.3	55.0	4.8	64.2
Mars Surveyor series development				
Mars Global Surveyor	58.1	—	—	—
Mars Surveyor 98 Orbiter and Lander	52.4	86.5	86.9	40.5
Future missions	1.4	3.0	3.1	99.2
New Millennium spacecraft development*	43.5	549.0	48.6	75.7
Advanced space technology**	143.3	143.0	132.0	151.2
Mission operations and data analysis				
Hubble Space Telescope operations and servicing	190.7	193.4	202.0	163.8
Hubble Space Telescope data analysis	43.5	43.1	40.9	45.7
AXAF mission operations and data analysis	40.4	41.3	41.3	45.4
Global geospace science operations and data analysis	26.5	25.5	25.5	15.7
Collaborative solar-terrestrial research data analysis	31.9	28.4	28.4	8.5
Gamma Ray Observatory operations and data analysis	13.7	16.3	10.6	4.0
Galileo operations	71.5	66.4	64.4	29.8
Cassini operations and data analysis	—	—	—	38.1
NEAR operations	4.9	8.5	1.4	9.5
Mars Surveyor operations	—	16.4	16.4	19.6
Mars Pathfinder operations	—	9.6	9.6	5.8
Lunar Prospector operations	—	0.8	0.8	4.3
Planetary flight support	49.4	42.9	42.9	36.6
Other mission operations and data analysis	91.1	99.8	99.1	80.6
Supporting research and technology				
Space physics research and analysis	31.1	38.5	35.9	41.6
Astrophysics research and analysis	31.7	44.4	36.6	35.4
Planetary research and analysis	93.4	108.3	94.3	130.5
SIRTF advanced technology development	15.0	24.9	24.9	—
TIMED advanced technology development	15.0	15.0	1.8	—
Origins advanced technology development***	—	—	—	25.0
Exploration technology development	—	—	—	20.0
Mission study and technology development	26.7	24.4	24.4	28.6
Information systems	25.9	24.9	24.9	24.5
High performance computing and communications	0.6	3.0	3.2	5.6
Suborbital program				
Kuiper airborne observatory	3.4	—	—	—
Stratospheric Observatory for Infrared Astronomy (SOFIA)	30.0	24.9	21.3	45.8
Balloon program	16.0	14.0	14.0	13.7
Sounding rockets	38.6	28.8	28.8	24.9
Launch services	245.3	253.5	240.6	236.3
Life sciences research and analysis	109.6	106.2	97.4	85.5
Microgravity science research	106.5	144.3	105.3	101.4
Mission to Planet Earth				
Earth Observing System (EOS), including Landsat-7	554.2	585.7	586.7	679.7
EOS Data Information System (EOSDIS)	247.2	261.1	254.6	244.7
Earth probes, including Total Ozone Mapper	80.1	47.1	57.2	40.7
Applied research and data retrieval and analysis	350.5	379.1	373.4	325.3
Global Observations to Benefit the Environment (GLOBE)	5.1	5.0	5.0	5.0
Launch services	107.1	124.1	84.7	121.9
Space station research and development	2143.6	2149.0	2148.6	2121.3
US-Russian cooperative program, including Mir support	100.0	138.2	100.0	—

*New Millennium is an aggressive program to design and develop bold new technologies for science spacecraft and instruments that will increase safety and reliability and decrease cost and flight time.

**Advanced space technology addresses joint technological developments for NASA and the aerospace industry that will reduce mission costs and increase performance and flexibility.

***The Origins program focuses on finding answers to fundamental questions about the creation of the universe and planetary systems through the use of the Space Interferometer Mission, Next Generation Space Telescope and Terrestrial Planet Finder.

National Aeronautics and Space Administration.

A proposed decrease of \$207 million in its current \$13.7 billion budget makes NASA one of the few losers among R&D agencies in Clinton's request for fiscal 1998. Even so, NASA Administrator Dan Goldin is enthusiastic about the Administration's budget. That's because the request includes a 3.8% increase for space science, which would get slightly more than \$2 billion, thereby enabling the agency to conduct a series of activities known as the Origins program. The purpose of Origins is to gain understanding about the creation of the universe, stars and the solar system and to determine if extraterrestrial life existed or still exists beyond Earth.

Once again, the international space station would receive \$2.1 billion. The cap on the station's total cost is \$17.4 billion, with construction scheduled for completion in June 2002. NASA's challenges are not limited to operating within a falling budget allocation. With the Russians eight months behind schedule in building a module for the space station, and in need of about \$100 million more to complete the job, the agency has decided to study whether a US service module, already designed by the Naval Research Laboratory, could fill the gap. The House science committee has held hearings on the problem, and its chairman, F. James Sensenbrenner Jr of Wisconsin, has suggested that Russia be asked to give up its full partnership in the station if it cannot fulfill its obligations.

NASA's major decreases would come in life and microgravity sciences and applications and in the number of space shuttle missions.

Department of Defense. DOD's basic research has been in decline since reaching a peak of \$1.4 billion in 1993, and all programs were hit last year when Congress and the Administration diverted \$1 billion from the Pentagon to support new activities in the Education Department. DOD research didn't argue the cuts because, as one program officer explained, "research has no active lobby." As an example of DOD's indifference, another official pointed to the impending demise of the Joint Services Electronics Program, which has produced five Nobel Prize winners since its inception in 1945.

In fiscal 1998 the Administration's budget seeks to reverse the trend. Basic research would rise by 8%, to \$1.2 billion, while DOD's total R&D budget of \$36.6 billion would fall by \$600 million. University research initiatives would go up 11% to \$237.8 million. Best of all, however, are the increases proposed for 6.1 basic research supported by the three services.

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