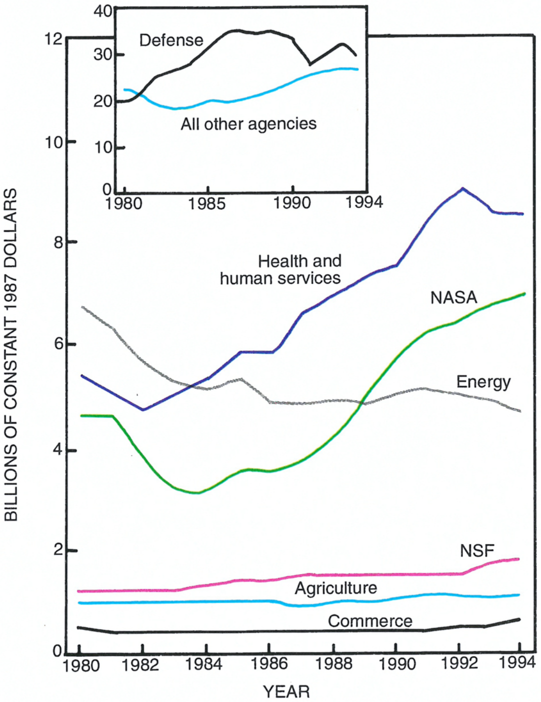
COUNTING WHAT COUNTS: 1995 BUDGET SKIMPS SCIENCE, BOOSTS TECHNOLOGY

The message by President Clinton in the first eight pages of his fiscal 1995 budget request to Congress is clear enough: "America has always sought to be the world's leader in science and technology. In some arenas in recent years, we have lost that status. But in the remainder of this decade and in the 21st century we must be sure that the United States is on the cutting edge of research and technological advances. To that end the 1995 budget proposes critical investments in the National Institute of Standards and Technology's Advanced Technology Program; NASA's research, space and technology programs; the National Science Foundation; the information superhighway, on which the Vice President has worked so hard; and energy research and development." The trouble with the rest of the budget's 2013 pages is that Clinton's promises for R&D don't always match the rhetoric.

The contrast is sometimes stark. In his $1.5 trillion budget sent to Capitol Hill on 7 February, Clinton asks for a 4% increase in R&D, which would raise such expenditures by $2.5 billion, to a total of $71 billion in the next fiscal year, beginning on 1 October. Though last year's budget brought down the lopsided ratio of military and civilian R&D to 53%–47%, from the 59% versus 41% split during Ronald Reagan's "Star Wars" buildup, the 1995 balance would remain exactly the same as in the current budget. Of course, as in previous years, the emphasis in both defense and nondefense R&D is on applied research and technology. The Administration's proposed increase for basic research next year is about 2% for both military and civilian sectors—below the anticipated 3% inflation rate. Even so, support for university research programs would go up by 3.7% (or $437 million), to a total of $12.2 billion—not a whale of a lot compared with some previous years but better than some expected under the circumstances.

Last December, when the number crunchers and bean counters had finally completed their work on the fiscal 1995 budget, Clinton let it leak that he was submitting a "bare bones" request to Congress, eliminating 115 programs and reducing 300 more. By announcing that he was making drastic cuts in mass transit, agribusiness and defense technologies, Clinton appeared resolute in reducing the annual deficit and in distributing the pain. But, as Clinton pledged in his budget statement, R&D was to be different.



R&D spending in the past 15 years, in constant 1987 dollars, shows large increases for medical and space science and technology. In the same period, the Department of Energy and the National Science Foundation have gained little. (Source: NSF's Science & Engineering Indicators–1993.)

Clinton's 'critical investments'

Explaining the 1995 budget at a news briefing on 7 February, John H. Gibbons, Clinton's top adviser for science and technology, declared that the President looks upon R&D as "critical investments" to further the nation's economic growth and societal well-being. Accordingly, despite the angst about zero-based budgeting, the Administration proposed modest increases of 6% for NSF and 4.7% for the National Institutes of Health. Then there is NIST, the standardbearer of the Clinton Administration's industrial policy. In Clinton's first budget last year, NIST, the little agency that had been known for its first 91 years as the National Bureau of Standards, got a 35% increase. In 1995 NIST is marked for a whopping 78% boost, and its Advanced Technology Program would jump 126%, so that the agency might better assist American corporations in adopting new technologies and manufacturing processes and in raising productivity and improving quality.

To be sure, NIST's budget request for 1995 is far more generous than that of any other R&D agency or, for that matter, any agency in the government. The Energy Department, by contrast, shows a 13.6% decline, to $2.9 billion, for basic research, mainly as an aftermath of the cancellation last fall of the Superconducting Super Collider. While the

Department of Energy physics-related programs

	FY 93 actual	FY 94 request	FY 94 current	FY 95 request
		(millions of dollars)		
High-energy physics				
Physics research	144.4	148.6	147.3	139.9
Technology research, including existing and proposed accelerators, colliders and detectors	65.8	59.4	59.4	58.2
Facilities operations				
Fermilab	144.6	140.7	139.0	134.3
SLAC	88.9	80.0	78.9	73.9
Brookhaven	45.0	42.9	41.8	41.6
Other operations, including computer networks	1.2	4.9	4.7	4.6
Capital equipment				
Fermilab, including detector improvements	32.4	28.3	27.0	26.6
SLAC, including detector development	14.9	12.0	10.7	11.2
Brookhaven, including magnet upgrades	6.4	8.4	8.8	5.2
Universities and other laboratories	15.5	11.4	9.7	10.8
Brookhaven general purpose equipment	4.1	3.9	3.9	3.9
Construction				
Accelerator improvements and modifications	15.1	13.1	13.1	12.5
General plant (roads, utilities, safety, environmental and security projects)	12.8	12.1	12.1	12.1
Fermilab main injector	15.0	25.0	25.0	43.0
SLAC B-factory	0	36.0	36.0	44.0
Total high-energy physics	606.1	626.7	617.5	621.9
Nuclear physics				
Low-energy research				
Universities, mainly Triangle Universities Nuclear Lab, Texas A&M and U. of Washington	3.3	3.0	3.2	3.1
National laboratories, mainly Oak Ridge and Argonne	3.4	2.9	2.8	3.2
Reactors, mainly at NIST, Berkeley and Oak Ridge	1.2	1.1	1.1	0.8
Other research, including solar neutrinos	4.9	6.4	6.0	5.7
Accelerator operations, mainly at Duke and Oak Ridge	3.6	5.1	5.1	6.0
Data measurement and evaluation	9.0	7.2	7.0	6.0
Medium-energy research, mainly CEBAF and MIT Bates	28.6	33.4	42.2	44.8
Facilities operations	27.9	58.2	66.8	48.9
Heavy-ion research, mainly Brookhaven AGS and Lawrence Berkeley Bevalac	39.2	40.7	40.2	40.1
Facilities operations	28.7	26.7	25.6	21.4
Nuclear theory	14.5	14.8	14.6	14.7
Capital equipment, mainly for CEBAF	31.2	29.0	32.0	28.0
Construction				
CEBAF	33.0	16.6	16.6	1.0
Brookhaven Relativistic Heavy Ion Collider	71.4	70.0	78.0	70.0
Accelerator improvements and modifications	3.2	3.8	3.8	3.2
General plant projects	3.5	3.6	3.6	3.9
Total nuclear physics	306.6	322.5	348.6	300.8
Superconducting Super Collider				
Research and development	104.2	97.0	0	0
Capital equipment, including accelerator and detector components and systems	40.5	50.0	0	0
Construction	359.7	480.6	0	0
Program direction	11.0	12.4	12.4	10.0
Termination	0	0	627.6	170.0
Total SSC	515.4	640.0	640.0	180.0
Basic energy sciences				
Materials sciences, including solid-state physics				
Research, mainly at Ames, Argonne, Brookhaven, Oak Ridge, Berkeley and universities	138.5	143.1	141.2	138.3
Facilities operations	134.8	133.9	130.5	135.9
Chemical sciences, including atomic physics				
Research—mainly at Oak Ridge	106.8	110.4	108.3	106.9
Facilities operations	56.8	58.6	57.9	55.1
Applied mathematical sciences, including computer sciences research and advanced computation and communications	83.9	106.2	103.7	109.4
Engineering and geosciences	36.5	37.9	37.2	36.8
Advanced energy projects—to investigate feasibility of novel, high-risk ideas*	11.0	11.4	11.2	11.1
Energy biosciences, mainly at universities	24.9	26.7	26.6	26.0
Program direction	8.4	9.4	9.4	9.9
Capital equipment and instrumentation	45.4	44.9	44.9	41.5
Construction, mainly at Argonne 6–7-GeV light source	109.5	119.5	119.5	70.4
Congressionally directed projects ("pork")	94.8	0	0	0
Total basic energy sciences	851.3	802.0	790.4	741.3

continued on page 51

budget calls for the SSC to get $180 million in 1995 to continue its shutdown, none of the money designated on paper for the "out years" has any chance of being spent on other DOE research activities. Universities with faculty and graduate students who banked on the continued financing of the SSC will be hit hardest by the project's demise. Without any R&D on the SSC, such as work on detector designs, DOE's high-energy physics program in 1995 would rise by less than 1%, to $622 million. DOE's nuclear physics program would suffer a drop of 14%, to $300.8 million from the current appropriation of $348.6 million. The funding loss results mainly because of the completion of the $313 million Continuous Electron Beam Accelerator Facility at Newport News, Virginia, and because funds for operating several other machines would be cut. Another DOE program that would be battered by the 1995 budget is basic energy sciences. Its funds would fall by 6.2%, to $741.3 million from this year's $790.4 million. Such a decrease is bound to cause distress among many of the 4500 researchers (about half of whom are located at universities and nearly one-quarter of whom come from government labs) who use the program's facilities—notably, the High Flux Beam Reactor and the National Synchrotron Light Source at Brookhaven, the Intense Pulsed Neutron Source at Argonne and the Stanford Synchrotron Radiation Laboratory at Stanford University.

An ITER for the world

The bright spot in DOE's proposed budget is magnetic fusion. After taking repeated hits over the past decade, the fusion energy program would be allowed to grow 8.4%, from the current $343.6 million to $372.6 million in fiscal 1995. One reason for the increase is that construction would start on the Tokamak Physics Experiment facility at the Princeton Plasma Physics Laboratory. Estimated to cost $624 million when finished in the year 2000, the TPX would replace the nation's major machine in the field, the Tokamak Fusion Test Reactor at Princeton. TFTR, which set a world record last December by producing more than 6 million watts of fusion power during a deuterium–tritium experiment, is scheduled for shutdown later this year. (See PHYSICS TODAY, January, page 17.) The proposed TPX is considered essential to understanding how to achieve ignition and burn of a magnetically confined fusion plasma before building the International Thermonuclear Experimental Reactor, now undergoing engineering design by its four international partners—the European Community, Japan, Russia and the US. DOE support for ITER would increase from $62.6 million to $70.6 million in 1995.

But before fusion researchers rejoice at the prospect of largess for the field, they should recall the warning issued by Senator J. Bennett Johnston, the Louisiana Democrat, to Martha Krebs at her confirmation hearing as DOE's director of energy research. Johnston, the powerful chairman of both the Senate Energy and Water Committee and the Senate energy appropriations subcommittee, told Krebs it was highly unlikely that DOE would get as much as it seeks for fusion. He admitted he and other members of Congress are becoming increasingly frustrated by the funding demands for fusion machines when the prospects for fusion energy are so remote.

NASA's overall budget request calls for a 2% loss, which translates into a decrease of $227 million from its current $14.55 billion allocation. NASA's science programs would get a paltry 1% increase in 1995, but such a meager rise is not likely to be meaningful after inflation is taken into account. Researchers had expected a big cut in their programs, but NASA officials say some last minute pleading with the White House Office of Management and Budget enabled them to avoid the worst. The additional money, however, is already spoken for by a new mission to partially replace the scuttled Mars Observer and, in keeping with NASA Administrator Daniel S. Goldin's maxim of "smaller, faster, cheaper" projects, the proposed Mars orbiter could be launched by 1996.

Still, all is not rosy in NASA's future. Goldin himself told news reporters on 7 February that NASA budget projections for the next five years indicate a 30% cut in the last two of those years. "We must hold the line at the 1995 level," said Goldin, "and we will work closely with Congress to do so." Goldin's remark represents the dilemma all agency heads find themselves in as the caps on "discretionary" funding squeeze R&D programs. The Congressional Budget Office has concluded that Goldin's strategy for exploring the solar system and observing the universe, while conducting piloted missions on the space station and shuttles, was doomed to fail as the cost increased. In a report to Congress last month, the CBO argued that NASA's shrinking budget

Department of Energy physics-related programs, continued

	FY 93 actual	FY 94 request	FY 94 current	FY 95 request
		(millions of dollars)		
Major user facilities, mainly light sources at Brookhaven, Stanford and Berkeley	191.6	192.5	188.4	191.0
Advanced Neutron Source to be built at Oak Ridge				
Operating expenses	0	17.0	17.0	12.3
Capital equipment	0	0	0	1.0
Construction	0	0	0	26.7
Total ANS	0	17.0	17.0	40.0
Energy research analysis	4.0	4.0	3.8	3.5
University and science education				
Cooperative science centers at DOE labs	26.5	35.8	35.7	30.8
University programs, including postdoc research	20.4	12.8	12.8	17.4
University research instrumentation	5.6	5.6	5.6	5.6
University reactor fuel assistance	3.4	3.7	3.7	3.7
Program direction, including EPSCOR and pre-college and undergraduate education	0	0	0	2.9
Laboratory technology transfer for collaborations with industry and small business	9.7	39.4	39.2	53.5
Advisory and oversight program direction**	10.2	13.8	13.8	12.5
Environmental safety and health				
Health physics***	8.3	8.1	8.1	7.2
Magnetic fusion energy				
Confinement systems, including shutdown of TFTR and completion of DIII-D	171.4	157.4	168.2	150.5
Applied plasma physics, including theory, and scientific computing network	61.9	59.8	59.0	54.3
Development and technology, including ITER design	66.4	81.3	80.3	89.0
Planning and projects†	0.2	4.9	4.9	5.9
Inertial fusion (nondefense) at Berkeley and Livermore	8.2	4.0	4.0	6.0
Program direction	8.8	9.2	9.2	9.6
Capital equipment and instrumentation, mainly to improve and upgrade C-Mod and DIII-D	14.1	16.0	16.0	10.3
Construction, mainly for TPX in FY 1995	4.2	15.0	2.0	47.0
Total magnetic fusion energy	335.2	347.6	343.6	372.6
Inertial fusion (DOE weapons R&D)				
Indirect drive with glass laser—Nova and Trident	108.8	110.0	100.0	103.5
Direct drive with glass laser—Omega	15.6	14.0	14.0	13.0
KrF laser—Nike	11.6	14.4	10.3	8.0
Light-ion beam—PBFA II	28.4	27.9	24.9	25.6
Capsule fabrication and development	14.4	14.0	13.9	14.6
Supporting activities, including design of National Ignition Facility	2.4	2.6	6.1	2.1
Capital equipment, including Omega upgrade at U. of Rochester	31.0	15.9	15.9	9.7
Total inertial fusion	212.2	198.8	185.1	176.5
Weapons activities				
Research and development	1499.9	1285.5	1241.4	1139.8
Testing	419.4	456.0	397.4	362.4
Stockpile—fabrication, maintenance, dismantling and surveillance	2295.3	1892.5	1572.9	1464.1
Program direction	335.8	284.1	281.1	159.9
New production reactor	193.0	0	0	0
Materials production and enrichment	1602.4	1137.2	1081.9	928.3
Nonproliferation, verification and control	325.4	368.8	362.0	358.1
Nuclear safeguards and security	95.7	90.3	85.8	85.8
Environmental restoration and waste management (nondefense)	692.1	715.0	706.6	744.0
Environmental restoration and waste management (defense)	4828.2	5515.9	5181.8	5234.9

*This program evaluates research projects and programs by peer review to judge their significance and to identify duplication and gaps. It provides support for R&D review by JASON, the Foreign Applied Sciences Assessment Center and the Japanese Technology Evaluation Center.

**This program funds technical analysis and appraisals by peer review and "tiger teams" of statutory environmental and occupational health and safety requirements at DOE facilities; supports meetings of lab directors and advisory panels; and supports Lawrence and Fermi Awards process.

***This program supports environmental analysis and radiological dose assessments in regions contaminated by nuclear tests and DOE activities; it also funds special studies to assemble data and techniques relating to exposure to radionuclides.

†More than $4.7 million in FY 1994 will be transferred to Small Business Innovative Research. All of the requested $5.9 million for FY 1995 is likely to go to SBIR.

National Science Foundation physics-related programs

	FY 93 actual	FY 94 request	FY 94 current	FY 95 request
		(millions of dollars)		
Mathematical and physical sciences				
Physics research*				
Elementary particles	40.5	45.8	43.4	46.5
Nuclear sciences	40.3	43.7	40.7	43.1
Atomic, molecular and optical	18.5	20.9	19.5	20.7
Theoretical	18.7	20.9	19.4	20.1
Gravitational	10.3	11.3	10.8	11.4**
Total physics	128.2	142.6	133.7	141.7
Materials research				
Condensed matter physics	23.8	28.6	25.8	27.6
Solid-state chemistry and polymers	21.5	24.1	23.6	25.9
Metals, ceramics and electronic materials	22.7	25.2	24.9	27.3
Materials theory	12.6	14.6	13.6	14.5
National facilities and instrumentation	32.4	34.1	32.9	34.9
Materials research science and engineering centers***	51.5	56.4	54.8	55.3
Total materials research	164.5	183.0	175.6	185.5
Chemistry, including physical chemistry and interdisciplinary materials chemistry	112.3	130.9	121.4	129.9
Mathematical sciences	77.6	88.0	82.2	88.7
Astronomical sciences				
Research projects	36.1	40.8	41.0	43.2
National Astronomy and Ionosphere Center†	9.7	9.1	8.6	9.0
National Optical Astronomy Observatories, including Kitt Peak and Cerro Tololo	27.6	31.2	27.5	28.8
National Radio Astronomy Observatory, including enhanced operation of VLBA	29.8	32.9	29.3	30.9
Total astronomical sciences	103.2	114.0	106.4	111.9
Major research facilities				
National High Magnetic Field Laboratory	14.0	12.0	12.0	12.0
Laser Interferometer Gravitational Wave Observatory	20.0	43.0	35.0	50.0
Gemini 8-meter telescopes	14.0	17.0	17.0	20.0
Geosciences				
Atmospheric sciences research	69.4	81.9	75.5	83.7
National Center for Atmospheric Research	50.2	59.2	51.8	56.5
Upper-atmosphere facilities	6.9	7.9	7.1	7.7
Earth sciences research, including geophysics, geochemistry, instrumentation and facilities	75.8	89.7	80.6	87.3
Ocean sciences research, including global climate processes	91.8	112.6	100.0	114.0
Oceanographic centers and facilities	51.7	56.8	50.3	54.0
Ocean drilling program	35.9	40.5	38.7	40.0
Total geosciences	381.6	448.6	403.9	443.1
Computer and information science and engineering				
Theory and research	34.8	46.1	37.7	41.9
Information, robotics and intelligent systems	27.0	40.6	29.8	34.7
Microelectronic information processing systems	21.6	32.8	23.8	27.6
Advanced scientific computing, including four NSF supercomputing centers	70.0	91.3	74.9	85.2
Networking and communications research and infrastructure, mainly NSFNet operation	39.9	54.9	51.5	58.3
Cross-disciplinary activities, inclusing improving computer capabilities and educational software	22.3	30.3	23.0	25.9
Total computer and information science and engineering	215.6	296.0	240.6	273.5
Academic research facilities and infrastructure				
Research facilities renovation and modernization	37.3	27.5	50.0	27.5
Research instrumentation	12.5	27.5	50.0	27.5
Critical Technologies Institute††	1.0	1.0	1.5	2.0
Education and human resources				
Elementary, secondary and informal education	184.7	198.0	198.3	199.3
Undergraduate education	61.9	74.8	81.0	83.0
Graduate education and research development	85.4	66.5	66.5	71.1
Human resource development, mainly females and underrepresented minorities	49.6	65.9	66.4	66.4
Research, evaluation and dissemination	41.2	48.0	47.5	48.3
Systemic reform, including Statewide Systemic Initiatives, urban and rural initiatives, EPSCOR	82.3	103.0	110.0	118.0
Total education and human resources	505.1	556.1	569.6	586.0

*In FY 1995 the division proposes to provide $20 million for CESR at Cornell, $8.8 million for the Indiana University Cyclotron Facility and $9.2 million for Michigan State's National Superconducting Cyclotron Lab.

**Includes $4 million for the Laser Interferometer Gravitational Wave Observatory.

***Include University of Wisconsin's Synchrotron Radiation Center, the Francis Bitter Magnet Lab at MIT, Arizona State University's Center for High Resolution Electron Microscopy and the Center for High Resolution Neutron Scattering.

†Cost of upgrading the radio–radar telescope at Arecibo, Puerto Rico, is shared with NASA.

††This institute, created by Congress, provides analytic support to the White House Office of Science and Technology Policy. While funded in the NSF budget, the institute is operated by the Rand Corporation.

and its sorry history of cost overruns and mechanical failures have caught up with its ambitions. It favored NASA's adoption of "narrower objectives," which include cancelling the space station and concentrating on robotic science missions.

The key to understanding this year's science budget is in a treaty worked out between the White House and Congress last August, after attempts to approve a balanced-budget amendment to the Constitution failed in both legislative chambers. The agreement is a five-year austerity plan that limits the growth of discretionary spending—in effect, the one-third of the total budget that pays for every nonentitlement program in the civilian and military sectors, including research, of course, as well as interest on the national debt. By law, the fiscal 1995 discretionary appropriations were capped at $545 billion, some $8 billion less than those in this fiscal year. As a result, the Administration must identify "losers" to offset funding increases for programs it considers important. The "winners" include new and existing programs that taken together increase the 1995 budget by 18%, according to Leon Panetta, director of OMB. Most of these are termed "investments" in agency budget accounts. To adhere to the caps agreed upon in the budget reduction act, 9 of the 14 Cabinet-level departments and agencies were placed on the chopping block. But many of the programs that the Administration proposes to cut or cancel have strong public constituencies and powerful political backers, who are likely to reverse some decisions during the budget cycle on Capitol Hill.

This year's budget struggles no longer can be characterized as a zero-sum game, concedes John H. Gibbons, the President's science adviser. He prefers to call it "a negative-sum game" in which discretionary spending declines to meet the levels of the preordained caps. The situation almost beggars description: Clinton must identify cuts to offset every increase he proposes, and he needs to persuade Congress to go along. Worse still, the caps will stay on for another four years beyond 1995, while inflation takes its toll on R&D and all other discretionary programs, and even then the annual deficit would rise from $175 billion next year to $201 billion in 1999. The budget reduction law allows the White House and Congress little elbow room, thus making drastic changes in the President's request most unlikely in Congress.

In an analysis of the 1995 budget last February, George E. Brown Jr, the California Democrat who chairs the House Science, Space and Technology Committee, says that deficit reduction "heralds tough times ahead for the nation's R&D programs." Brown believes under the circumstances that much worthwhile science will be "seriously squeezed" in fiscal 1995 and that "the long-term outlook for many science and R&D budgets is very grim." As a percentage of gross domestic product, Brown observes, the 1995 R&D budget, if enacted as presented, will be lower than in any year since the Soviet Sputnik. Indeed, the proposed budget for the space agency, says Brown, "is the first time since 1974, when the Apollo project was terminated, that a President has requested a decrease in NASA funding." A space booster since he first came to the House in 1963, Brown has often lamented the cannibalizing of space science to accommodate reductions in NASA's long-range plans. Brown warns that the space station will face a rough ride through Congress this year and may be junked along the route to a more balanced and less expensive space program.

Under the five-year caps on discretionary outlays, Brown argues, "by 1999 the budget for the traditional space sciences will decline to the level we had in 1983. . . . Although the Mission to Planet Earth program is still in the budget, the entire program, after the first launch, has been underfunded and will slip. The irony is that the parts of the program that will be most affected are precisely those [that] will help us answer the important climate policy questions such as global warming"—one of Vice President Gore's pet programs.

A dismal academic outlook

This gloomy picture could become gloomier. Even as R&D budgets dwindle, the number of university researchers and graduate students clamoring for research grants grows. NSF's budget in fiscal 1995 is estimated to support some 19 000 projects in research and education, directly involving almost 150 000 students, teachers, scientists, mathematicians and engineers. Yet, for instance, at NSF, where more than 61 000 proposals for research grants were received and processed in 1993, only 18 216 awards were made. By 1995 the foundation expects to get 67 000 proposals and to bestow about 19 500 research grants. The situation in the mathematical and physical sciences is somewhat better. Of

Department of Defense basic research funding (6.1 budget category)

	FY 93 actual	FY 94 request	FY 94 current	FY 95 request
		(millions of dollars)		
Army				
Research sciences, including physics and materials	199.9	203.7	190.6	195.3
In-house laboratories, independent research	11.5	11.0	10.9	13.7
Electromagnetics and hypervelocity physics	3.7	3.7	5.7	5.1
Navy				
Research sciences, including physics and materials	408.8	416.9	395.7	408.0
In-house laboratories, independent research	16.7	17.0	17.0	17.1
Air Force				
Research sciences, including physics and materials	232.8	241.3	234.8	235.8
In-house laboratories, independent research	2.0	5.2	5.1	0*
Geophysics technology	37.0	30.1	34.1	29.9
Advanced Research Projects Agency				
Research sciences, including physics and materials	109.6	79.7	86.5	87.7
Materials and electronics technology	254.4	198.5	261.2	224.8
Computing systems and communications technology	348.3	368.6	321.2	419.6
Office of the Secretary of Defense				
Research sciences	0	2.0	0	0
In-house laboratories, independent research	0	3.4	2.3	0
University research initiatives**	315.5	242.6	244.7	232.5
Focused research initiatives	0	29.5	11.7	20.0
Ballistic Missile Defense Organization	3628.3	3637.1	2617.2	2979.9

*To be funded from other Air Force program elements in FY 1995.
**Includes $188.5 million for Congressional earmarks, also known as "pork-barrel" allocations, in FY 1993 and $31 million for pork projects, mainly at universities, in FY 1994. Many earmarks have been accepted by the Defense Department and incorporated into the budgets for FY 1994 and FY 1995.

NOAA physics-related programs

	FY 93 actual	FY 94 request	FY 94 current	FY 95 request
		(millions of dollars)		
Oceanic and atmospheric research				
Interannual and seasonal climate, including studies of El Nino–Southern Oscillation	8.5	7.9	7.9	8.0
Long-term climate and air quality, including high-performance computing program	25.0	31.1	27.4	47.0
Climate and global change	46.1	69.9	63.0	84.0
Weather research, including numerical modeling and forecasting techniques	33.2	36.7	38.1	33.9
Solar–terrestrial research	5.1	5.4	5.0	5.6
Marine prediction, including numerical modeling	18.6	17.2	18.3	14.3
Undersea Research Program*	19.3	2.0	18.1	0
Total oceanic and atmospheric research	155.8	170.2	177.8	192.8

*The agency proposes to cancel this program, which, since it was initiated in FY 1981, has supported marine research at six regional centers, including those in the Caribbean, Hawaii and Alaska, and funded 40 principal investigators.

National Institute of Standards and Technology physics-related budget

	FY 93 actual	FY 94 request	FY 94 current	FY 95 request
		(millions of dollars)		
Scientific and technical research and services				
Physics	26.4	26.9	26.7	27.5
Materials science and engineering	35.6	47.2	43.3	61.7
Chemical science and technology	19.3	23.1	22.2	32.8
Electronics and electrical engineering	26.5	30.7	29.5	30.0
Computer systems	12.1	37.1	28.9	68.5
Applied mathematics and scientific computing	6.8	7.0	7.0	7.3
Industrial technology services				
Advanced Technology Program	67.9	199.5	199.5	451.0
Manufacturing Extension Partnership	18.2	30.2	30.2	61.1
Quality improvement program	0	2.8	2.8	6.9

NASA physics-related programs

	FY 93 actual	FY 94 request	FY 94 current	FY 95 request
		(millions of dollars)		
Physics and astronomy				
Advanced X-Ray Astrophysics Facility development	168.3	260.3	241.3	234.3
Global geospace science*	72.6	13.3	13.3	0
Relativity mission development, mainly Gravity Probe B	27.0	40.0	42.4	50.0
Shuttle–Spacelab payload support**	94.1	0	0	0
Payload and instrument development				
Collaborative solar–terrestrial research	50.8	25.1	31.2	23.2
Tethered satellite system	1.5	2.4	2.4	3.8
Astrophysics payloads	20.7	24.3	24.3	20.5
Space physics payloads	1.2	1.6	1.6	0.4
Explorer series development				
X-Ray Timing Explorer	65.4	45.6	36.9	36.7
Advanced composition explorer	0	28.0	33.2	44.1
Small explorer and others	50.4	49.7	53.2	39.6
Mission operations and data analysis				
Hubble Space Telescope operations and servicing	216.7	222.2	219.4	226.7
Hubble Space Telescope data analysis	42.3	38.5	38.5	42.7
Astrophysics	88.3	84.5	84.5	89.0
Advanced X-Ray Astrophysics Facility	14.9	11.6	11.6	18.9
Space physics	53.2	59.4	66.7	64.4
Research and analysis				
Space physics supporting research and technology	37.3	37.8	35.7	35.7
Astrophysics supporting research and technology	34.3	34.4	35.4	35.4
Suborbital programs				
Sounding rockets	36.4	39.5	39.5	38.0
Airborne science and applications	13.0	13.6	13.6	13.2
Balloon program	15.4	16.4	16.4	16.0
Information systems	25.0	26.5	26.5	26.1
Total physics and astronomy	1128.8	1074.7	1067.6	1058.7
Planetary exploration				
Mars '94	3.5	3.5	3.5	1.4
Mars Surveyor program***	0	0	0	78.4
Discovery				
Mars Environmental Survey Pathfinder	0	68.1	60.8	77.5
Near Earth Asteroid Rendezvous	0	68.1	66.6	52.2
Cassini	205.0	206.6	266.6	255.0
Mission operations and data analysis				
Galileo operations	59.4	57.6	59.9	70.7
Magellan operations	7.0	5.1	11.8	0
Mars Observer operations	40.5	34.3	10.3	0
Voyager–Neptune data analysis	5.0	5.7	4.3	0
Planetary flight support	51.5	58.0	55.4	57.0
Research and analysis	101.7	126.4	115.1	115.1
Total planetary exploration	473.6	497.2	654.3	707.3
Mission to Planet Earth				
Earth Observing System (EOS)	263.6	322.7	318.8	455.1
EOS Data Information System (EOSDIS)	130.7	182.7	188.2	284.9
Earth probes development	99.4	97.3	96.4	82.0
Advanced Communications Technology Satellite	4.0	3.0	3.0	2.3
Payload and instrument development	35.4	22.9	22.9	19.5
Mission operations and data analysis	147.6	160.8	97.4	97.5
Landsat†	0	0	54.1	62.4
Consortium for International Earth Science Information Networks†	0	0	5.0	6.0
Interdisciplinary research	4.5	5.0	5.0	4.6
Modeling and data analysis	42.6	45.0	44.2	41.2
Process studies				
Radiation dynamics and hydrology	31.6	34.7	34.3	31.8
Ecosystems dynamics and biochemical cycles	23.7	26.8	26.5	25.4
Atmospheric chemistry	28.1	32.0	31.7	25.7
Solid Earth science	27.7	28.7	28.1	28.9
Laser research facilities for crystal deformation studies	8.2	9.3	9.1	7.6
Airborne science and applications	20.7	25.2	25.2	26.0
Information systems	0	11.8	11.2	9.8
Space station attached payloads	0	0	0	9.8
Research operations support††	70.1	67.0	0	0
Total Mission to Planet Earth	937.9	1074.9	1001.1	1220.5
Advanced concepts and technology†††	437.1	521.4	432.7	608.4
Academic programs				
Education programs	70.2	51.3	54.3	56.3
Minority university research and education	22.7	23.2	31.2	40.9
Space station and new technology	2162.0	2300.0	1937.0	1889.6
Russian cooperation	79.5	170.8	170.8	150.1

*Pending results from program review.
**Transferred to the Life and Microgravity Sciences and Applications program in FY 1994.
***Includes an orbiter and a series of small missions.
†Formerly included in mission operations and data analysis.
††Now associated directly with specific projects.
†††Now funds advanced-concept projects formerly distributed throughout NASA, such as the old Commercial Programs Office and the advanced-technology portion of Aeronautics and Space Technology.

the nearly 10 000 proposals sent to NSF in those fields last year, 4400 awards were granted, for a funding rate of 38%. The grants covered 5668 senior scientists, 1782 postdocs, 5631 graduate students and 2090 undergrads. By 1995, though, the agency reckons that the funding rate in math and the physical sciences will fall to 32% and involve no more than 500 additional researchers.

The figures indicate that many university researchers will be disappointed and dismayed in their quest for funding. The implications for the country are self-evident: Cuts in R&D dim the prospects for learning more about natural phenomena, developing new technologies, improving economic competitiveness and raising living standards.

Here are some highlights of the fiscal 1995 budget by agency:

National Science Foundation. "A very good budget in a very tough year" is how Neal Lane, NSF's director, described NSF's \$3.2 billion request, a 6% increase over the current total of \$3 billion. The research portion of the budget would come to \$2.3 billion, an increase of 8.3% over this year's. Physics would rise 5.6% to \$103.7 million, materials research 7.8% to \$95.3 million, astronomy 5.4% to \$43.2 million and the geosciences 9.7% to \$443.1 million.

One reason for the growth in geosciences is its participation in the US Global Change Research Program, which would receive an increase of 46.2%, bringing the agency's contribution to the program to \$207 million. Of that, the geosciences would receive \$134.5 million, a 35.5% jump, to enlarge international data collection, ocean-atmosphere studies, cloud radiation and ocean circulation research and climate system modeling and prediction.

Global change research is one of the components in NSF's new "strategic" research and education activities that endorses the concepts promulgated by Barbara Mikulski, the Maryland Democrat who heads the Senate appropriations subcommittee that rules on the budgets of NSF, NASA and other science agencies. It was Mikulski's committee report last September that scolded NSF for neglecting to advance so-called strategic programs "to maximize the return on the public's investment in science and technology" to yield more immediate economic and social benefits (PHYSICS TODAY, October, page 109).

Not surprisingly, NSF's proposed budget contains seven programs it identifies as "directly relevant to national priorities"—all with substantial funding increases. They are termed Presidential initiatives, and two are close to the heart of Vice President Gore: global change and the information superhighway. The foundation was one of the first government agencies to promote both programs, having originated these in 1986. The High Performance Computing and Communications initiative would receive $328.6 million, a boost of 23.1% (almost $62 million) over this year. The request includes more than $50 million for an information infrastructure component that would develop the kind of services necessary to bring about Gore's vision for a nationwide information system that would reach into schools, libraries, museums, government offices, businesses and eventually homes. Besides supporting four supercomputer centers and NSFNet, the electronic centerpiece for distributing information and messages to the entire US scientific community. NSF is the interagency leader of the National Research and Education Network and backs four science and technology centers that work in parallel computation, computer graphics, cognitive science and computer theory. The agency's other strategic initiatives are in advanced manufacturing (up 2.7%), advanced materials and processing (0.7%), biotechnology (3.1%), civil infrastructure systems (5.9%), environmental research (8%) and science, math and technology education (4%).

While Congress usually trims the Administration's requests for big increases in NSF's research budget, it customarily increases two politically popular programs: education, for which Clinton has proposed a 2.9% increase to $586 million, and academic research facilities, which the President wants to cut almost in half, from $100 million to $55 million. This year Congress may be expected to adhere to its usual practice of hiking both programs.

Department of Energy. DOE's budget for 1995 is "lean," says Energy Secretary Hazel O'Leary. The total request is $18.5 billion, a 3% decrease of $5 million from this year. "We realize that our mission and focus as an agency have changed," O'Leary told reporters at her budget briefing. "We must ensure that our budget request is completely aligned with our newly defined mission and goals." DOE's new mission places the emphasis on environmental concerns, industrial competitiveness and nuclear nonproliferation. In fact, for the first time in its 10-year history, Congress gave DOE a larger appropriation for civilian R&D than for defense R&D programs.

A virtually flat research budget in 1995 contains three projects to bolster the spirits of a physics community still smarting from the cancellation of the SSC. The department seeks $44 million to begin building a $240 million electron collider called the "B-factory," a Presidential initiative at SLAC, near Palo Alto, California. It wants $47 million to start TPX at Princeton. Then, for the second year in a row, it asks Congress to fund construction of the $2.9 billion Advanced Neutron Source, which would replace two high-flux reactors built in the 1960s (at Los Alamos and at Brookhaven) with a neutron facility for studying the structure and dynamics of materials, for producing certain isotopes and for understanding radiation effects on human genetics and disease. Last year Congress trimmed the ANS request for $39 million to $17 million, which went towards continued design and research but not construction. DOE now seeks $40 million for the ANS as a separate line item in the budget, to begin building the machine at Oak Ridge National Laboratory in fiscal 1995 for completion in 2003.

NASA. One of the few NASA programs that would receive an increase is Mission to Planet Earth, which would rise 22% to $1.2 billion. As the centerpiece of the interagency global change research initiative, this program is intended to observe and monitor environmental processes on Earth and its atmospheric envelope. More than 40% of the program's funds would be allocated to the Earth Observing System, a series of satellites that would be launched from 1998 on, and to a smaller flotilla called Earth Probes, which would keep tabs on tropical rainfall, ocean winds and global ozone.

Budgets for human space flight would drop from the 1994's $6 billion to $5.7 billion next year. Funds for the frequently redesigned space station would fall from $1.9 billion to $1.8 billion and spending to fly the shuttle would decline from $3.5 billion to $3.3 billion next year.

The space science budget appears virtually flat, with $1.06 billion for physics and astronomy, down $10 million from this year. Planetary exploration would receive $707.3 million, compared to $654.3 in FY 1994. The Mars Surveyor is a new activity for 1995. Scheduled for launching in 1996, it is intended to obtain most of the same data about the Red Planet that the Mars Observer was expected to gather, but to do this faster, better and cheaper.

NIST. Clinton's commitment to a technology policy is a metaphor for the National Institute of Standards and Technology's Advanced Technology Program, which would receive a 126% increase, after tripling in size in 1994. His request for this program is $451 million, which is $252 million more than the current appropriation and $384 million above that in fiscal 1993. Though ATP was established as a small effort of the Bush Administration to fund joint projects with industry, it has grown prodigiously under Clinton. The 1995 increase would enable the Commerce Department to award about 200 new grants, primarily to help shift US industry from military to civilian technology—a strategy favored by many members of Congress. Another large increase is proposed for the Manufacturing Extension Partnership Program, which would more than double, to $68 million from $33 million. Both ATP and the manufacturing partnership reflect the "strategic shift in thinking" about the way the Federal government is spending R&D dollars, according to NIST's director, Arati Prabhakar, who came to the agency last year from Defense's Advanced Research Projects Agency.

NOAA. Slightly reduced from last year's appropriation of $2 billion to $1.96 billion, the agency's budget is now driven by its tactically called strategic plan: to unify its disparate parts and to maximize some coherent objectives. The plan organizes NOAA's program responsibilities into two broad portfolios: Environmental Stewardship and Environmental Assessment and Prediction. Both are designed to advance the Administration's Global Change Research Program and High Performance Computing and Communications program. Even so, NOAA's part of the global change program would decrease $1.3 million to $78.1 million. But the agency would get a $7.7 million increase to maintain critical observations and to advance the understanding of long-term climate changes. Several NOAA activities would be eliminated, including the Undersea Research Program, the mid-ocean ridge VENTS program and some regional climate centers—all ostensibly to save money for higher priority research operations. But if past NOAA budgets are any guide, the Undersea Research Program, which NOAA cut back the last few years, will receive ample funding from Congress and so will the regional centers.

—Irwin Goodwin ■