

# Democrats and Republicans: What's the Record on Physical Science?

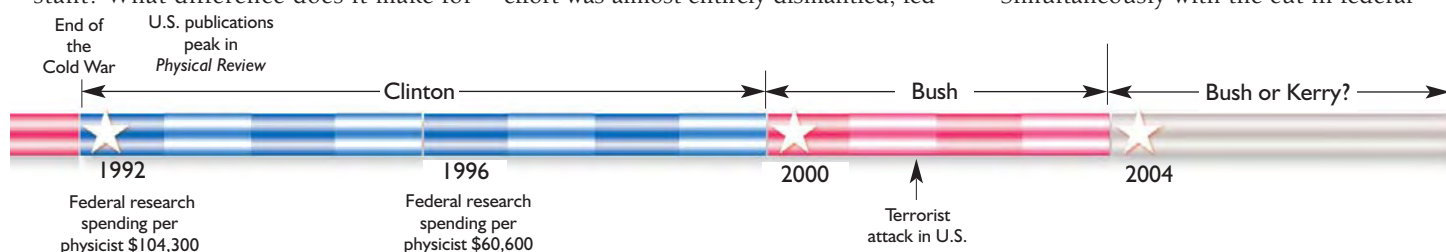
With a closely contested election in the United States, and with an electorate increasingly skeptical of candidates' promises, both parties want to stand on their records—that of the current Bush administration versus that of the Clinton years. Although many factors influence how anyone votes, physical scientists have concerns about how Democratic and Republican administrations and Congresses affect the course of physics R&D. What policies have changed between the two administrations, and which ones have remained constant? What difference does it make for

R&D Budget and Policy Program at the American Association for the Advancement of Science (AAAS).

The National Science Foundation (NSF) compiles the most reliable figures on federal funding for physics and the physical sciences overall. In 1992, the last year of the Cold War, the federal government spent \$104,300 on physics research for each U.S. Ph.D. physicist. (All funding comparisons are in constant 2004 dollars.) By 1996, after the rivalry with the Soviet Union had ended and its once-formidable physics effort was almost entirely dismantled, fed-

Since 1996, funds for the physical sciences have somewhat stabilized but at drastically reduced levels. In the second Clinton administration, per-scientist real spending increased by 2.0%, entirely because of increases in 2000, which were too little to overcome the sharp cuts of the first Clinton term. Erosion resumed under the Bush administration, although at a slower pace than in the early post-Cold War years. By 2004, real spending for physical sciences research per scientist had dropped by another 5.3%.

Simultaneously with the cut in federal



U.S. physics which party holds power in Washington? This special TIP report explores these questions.

## Constant trends

Since the Cold War ended, physicists in the United States have faced a continuing problem: no matter who has controlled the White House or Capitol Hill, federal research funds per scientist have continued to erode. "Physical science funding has remained flat in real terms for 15 years, but it is spread among more and more physicists," says Kei Koizumi, director of the

eral research spending per physicist had fallen by 42% to \$60,600 (see table, p.14). These cuts occurred in defense-related research but also hit civilian-oriented work in places such as NSF and the Department of Energy. The reductions took place despite an expanding U.S. economy and a sharp decrease in defense expenditures for personnel and weapons procurement.

"In the early years of the Clinton administration, the push was on technology, not science," says Neal Lane, who was presidential science advisor in the second Clinton administration. "The old rationale for funding physics was, indeed, the Cold War rivalry with the Soviets, and there was no new rationale to support it. Although research in physics has greatly increased our standard of living and made possible much of modern technology, that is not an argument that is accepted in Washington. The politicians have always had a more short-term mentality."

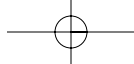
support, other indicators have dropped since the early 1990s. The number of U.S.-authored papers in *Physical Review*, which had risen steadily for decades, peaked in 1993 and dropped about 20% by 1997 (see figure, p.13). A small rebound occurred until 2002, when the downturn renewed. A reduction in the number of students entering physics accompanied the fall in research money. From 1994 to 1999, physics bachelor's degrees fell by 27%, although a slight uptick occurred between 1999 and 2001. Physics Ph.D.s dropped 22% during the same period and continue to decline.

Federal funding policies alone did not cause these trends. During the same period, major multinational corporations cut back or eliminated large central research laboratories and basic research in physics to concentrate on product development.

Within these overall trends, the contrasts between the Clinton and Bush administrations are less clear than the differences between the first and second Clinton administrations. "The first Clin-

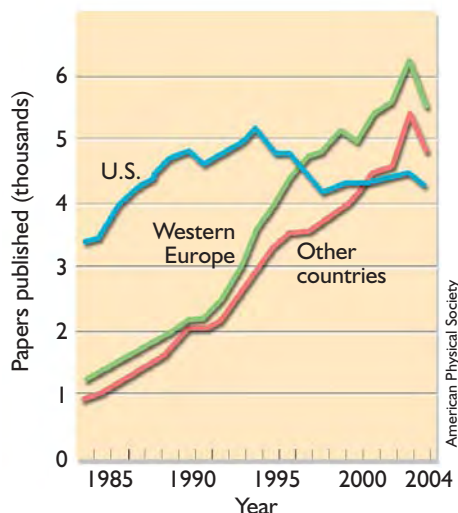


"Physical science funding has remained flat in real terms for 15 years, but it is spread among more and more physicists."  
Kei Koizumi, American Association for the Advancement of Science



ton years were not good years for physics research,” says Mike Lubell, director of public affairs for the American Physical Society. “The administration was less than supportive on funding requests and did not fight it when Congress cut them.” The shift in control of the House of Representatives to Republicans from Democrats in 1994 did little to stem the cuts.

However, the situation changed after 1996, in Lubell’s view, because of efforts by a few critical people in the administration and Congress. “The administration started to ask for really substantial increases of 12 to 18%,” Lubell points out. But the appropriations by Congress, even with a Democratic-controlled Senate, were less for physics, which recov-



**The number of articles published by U.S. authors in *Physical Review* each year peaked in 1993 and has now been surpassed by authors from Western Europe and other countries.**

Technology’s Advanced Technology Program (ATP)—which funds high-risk, high-reward applied research by small and large businesses—is one area where the parties differ. The Clinton administration increased the program’s budget from \$68 million to \$225 million during its two terms, with most of the increase in the first few years. ATP was conceived as a way to fill the gap left as companies withdrew from long-term applied research. It encourages collaborations among companies, universities, and government laboratories.

The Bush administration has sought to abolish ATP each year. The Democrats’ defense, led by Ernest Hollings (D-SC) in the Senate and aided by several Republicans, has kept the program going, although at a funding level slightly more than half of its peak level in 1998. “We do not think the government should be funding development of products as ATP does. That is for the private sector to do,” says Marburger. However, ATP regulations prohibit funding of product development and limit funding to applied

programs receive more or less money than sought by the White House. Congress may not decide the final 2005 budget until it convenes in January.

John Marburger, the director of the Office of Science and Technology Policy and President Bush’s chief science advisor, defends the administration’s 2005 budget proposals as an increase—not a decrease—in support for the physical sciences. “You have to take into account physical science expenditures by the National Institutes of Health,” he argues. “In addition, we

expect Congress will earmark additional funds. But there is no doubt that the budget reflects fiscal realities. We do not have unlimited funds.”

### Significant changes

Although the trend toward reduced physics funding has not changed, the emphasis on many programs and policies has shifted between administrations. Programs out of favor with the Republicans have been cut significantly. Environmental Protection Agency funding for physical science research, for example, has dropped more than 20% since Bush took office, and similar financial cuts have occurred at the Department of Transportation.

The National Institute of Standards and



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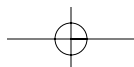
ered only about 10% of the losses in per-scientist funding by 2000. Overall, physics support per scientist was 38% lower at the end of the Clinton era than at the beginning.

Under the Bush administration, total physical science funding has fluctuated, but in 2004, it remains about 3% below its 2000 level, according to NSF figures. “The administration has consistently submitted budgets that cut overall real funding,” says Lubell, “but Congress has restored much of this.” The president’s 2005 budget request, now under debate in Congress, could prove an example of this trend because it cuts physical science research programs by 8.2% from the amount Congress appropriated for 2004, based on program-by-program analysis published by *Physics Today* (April 2004, p. 35). However, Congress rarely accepts a president’s budget as submitted, and, thus,



**“The old rationale for funding physics was ... the Cold War rivalry with the Soviets, and there was no new rationale to support it.”** Neal Lane, presidential science advisor in the second Clinton administration

research at stages too early or high-risk to receive private capital. Although clearly a partisan issue, ATP funding at its peak represented only 5% of federal spending for physical science research, and not all ATP funds went to the physical sciences.



News



**“You just have to look at threats such as North Korea to understand why we need to support weapons development.”**  
*John Marburger, director of the Office of Science and Technology Policy and President Bush’s chief science advisor*

why we need to support weapons development. In any case, these expenditures do not compete with research commitments. They come from a completely different

The Bush administration clearly believes that one set of products—weapons—needs federal funds on a large scale. By far, the largest increase in research or development funds is the \$37 billion increase for weapons development, from \$30 billion 4 years ago to the \$67 billion proposed for 2005, a doubling in real terms for a category that excludes basic and applied research. The increase dwarfs the \$5.4 billion a year in federal funds spent in all physical science research in

pot of money.” AAAS’s Koizumi disagrees. “The defense boosts obviously leave less money available for research, especially defense research,” he says. “It really tends to squeeze everything else out.”

The proposed 2005 increase of \$3.7 billion for weapons development is more than the total spending in physics research. Although the increase represents a big shift from the Clinton policies, which kept real spending on weapons fairly flat, weapons

**FEDERAL RESEARCH SPENDING IN 2004 DOLLARS FOR FISCAL YEAR**

	Physics (\$ billion)	Physical sciences (\$ billion)	Per physicist (\$)	Per physical scientist (\$)
1992	3.72	6.62	104,300	60,200
1996	2.39	4.78	60,600	40,000
2000	2.66	5.29	61,800	41,200
2003	NA	5.10	NA	38,200
2004	NA	5.42	NA	39,000

National Science Foundation, American Physical Society

**After the Cold War ended in 1992, federal research spending per physicist and per physical scientist plunged and has remained flat (some figures for 2003 and 2004 not available at publication).**

2004. It brings real weapons-development spending to a level nearly 41% higher than that of the peak Cold War year of 1989.

Many of the expanding weapons programs began during the Cold War, including the ballistic missile defense system, which has been under development for nearly a quarter century, and the Joint Strike Fighter, whose origins date back to 1991. Although the administration justified the huge expansion as a response to the post-September 11 environment, critics have questioned the usefulness of such weapons in combating enemies wielding low-tech devices such as rocket-propelled grenades or box cutters.

“These are not Cold War holdovers,” replies Marburger. “You just have to look at threats such as North Korea to understand

development currently enjoys sweeping Democratic support. “No one wants to appear weak on defense these days,” comments Lubell.

The Bush administration has also increased funding for specific research programs, including nanotechnology, where funding has doubled since 2001, and the hydrogen-fuel initiative, which focuses on developing ways to use hydrogen to transport energy.

Given the overall flat-to-shrinking physical science research budget, such initiatives have left representatives of scientific societies unimpressed. When asked in which areas the Bush administration has improved the situation for physical science funding, Koizumi replied, “I can’t think of any.”

## Visa policies

Aside from funding allocations, government polices affect scientists in other ways. In the past few years, changing immigration policies have had a dramatic impact on all high-tech professionals, including physicists. For one thing, in the past year, the number of H-1B visas—which permit technical personnel, including physical scientists, to work only for a specific employer—dropped by two-thirds to 65,000 a year. This reduction has made it more difficult for foreign scientists attending graduate schools in the United States to stay in the country to work after getting their degrees.

“This is not mainly a result of the change of administrations,” comments Vin O’Neill, senior legislative representative for the Institute of Electrical and Electronics Engineers-USA (IEEE-USA). H-1B visas were capped at 65,000 during most of the Clinton years but went to 195,000 in the late 1990s because of a growing demand for technical professionals. With the recent recession and a prolonged jobless recovery that has hit white-collar workers particularly hard, the cap fell back to 65,000.

IEEE-USA has lobbied Congress on H-1B and other immigration issues during both the Clinton and Bush administrations. “Rather than continuing to tinker with the existing patchwork of broken temporary-visa programs, we think Congress should be trying to fix the nation’s legal permanent immigration system,” O’Neill says. “The best and the brightest from other countries, especially those who have been educated here, ought to be granted legal permanent resident status and put on a fast track to full-fledged citizenship. They deserve better than the second-class status that so often comes with a temporary work visa.”

Neither administration responded positively. Indeed, the Clinton administration tightened restrictions with the 1996 Illegal Immigration Act, passed after the Oklahoma City bombing, although the perpetrator was a native-born citizen, Timothy McVeigh.

One change by the Bush administration

that has enraged many scientists is the increased difficulty of obtaining student visas and visas for scientists attending conferences in the United States. “It is a serious problem,” agrees Marburger. Changes made by the State Department in visas procedure, as mandated by the Enhanced Border Security and Visa Entry Reform Act of 2002, have increased delays in issuing visas. As a result, many foreign students now seek their education in other countries, and organizers have relocated some conferences outside the United States. The new regulations, for example, require visiting students or scientists to prove they do not intend to overstay their visas. This requirement actively discourages students educated in the United States from remaining to use their knowledge.

The Bush administration also has expanded a program called MANTIS, which reviews visa applications to ensure that individuals are not terrorists or spies. The number of applications reviewed jumped 14-fold in the year after Sept. 11. Another program called CONDOR, set up after Sept. 11, has added to the delays. In the past, if the State Department received no derogatory information from other federal agencies within 30 days about an individual, it approved the visa. The new policy requires a wait for affirmative clearances from all agencies, no matter how long that takes.

Although Marburger promised to work to reduce delays, Lubell and others at U.S. scientific organizations report no improvements. “The problem is that neither the administration nor Congress wants to touch immigration issues. They think that in light of Sept. 11, it is too dangerous politically to advocate a more open policy on visas,” says Lubell.

Visa restrictions, of course, affect all scientists. But the biological sciences have at least received steady funding increases during both the Clinton and Bush administrations. For U.S. physicists, despite some differences between the administrations, the post-Cold War era has remained rough, no matter who has controlled the federal government. □

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