

Physics in the FY 2005 Budget

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HIGHLIGHTS

- Funding for physics-related research programs at the Department of Energy (DOE) would increase from 0.5 percent to 5.5 percent, although it would decline 14.9 percent for one program. Funding for several major construction projects, including the Spallation Neutron Source, would continue to decline as the projects near completion (see Table II-11).
- The budget for the National Science Foundation's (NSF) Physics Subactivity would increase 3.6 percent over the current year, while that for the Materials Research Subactivity would increase 0.9 percent (see Table II-7).
- At the National Institute of Standards and Technology (NIST), the Physics Laboratory budget would increase 8.1 percent. The Materials Science and Engineering Laboratory budget would rise by 18.5 percent (see Table II-14).

Increasing attention has been given to federal funding of research in the physical sciences. For example, a task force of the Secretary of Energy Advisory Board found that: *"During the last 30 years, the federal investment in research in the physical sciences and engineering has been nearly stagnant, having grown less than 25 percent in constant dollars. The corresponding investment in life science research has grown over 300 percent."* The task force concluded, *"The underfunding of physical science and engineering research has put U.S. leadership at risk in certain important areas. Examples of critically important fields of science in which we are no longer clearly preeminent are high-energy physics and neutron sources for materials science and biology."*

The Department of Energy (DOE) provides the greatest amount of funding for physical sciences research, followed by the National Aeronautics and Space Administration (NASA), Department of Health

and Human Services (HHS), the National Science Foundation (NSF), and Department of Defense (DOD). This chapter reviews the FY 2005 physics-related budget requests of DOE, NSF, and NIST. See Chapters 6 (DOD), 8 (HHS), and 10 (NASA) for information on departments or agencies not included below.

DEPARTMENT OF ENERGY (DOE)

DOE's Office of Science is the primary federal source of support for physics and physical sciences R&D. Its 10 civilian national laboratories and world-class scientific user facilities are used by more than 19,000 academic, industry and government researchers for investigations into the nature of matter and energy. The Office of Science supports the research of 15,000 PhD and postdoctoral scientists and graduate students. DOE also participates in the construction of the international Large Hadron Collider (LHC) in Switzerland and in the International Thermonuclear Experimental Reactor (ITER) project to develop a demonstration fusion reactor.

For FY 2005, major priorities of the Office of Science include nanoscale science, engineering, and technology; climate change science; genomics; high end computing; and advancing the goal of a cleaner energy future through investments in fusion R&D, ITER, and R&D into the challenges of hydrogen production, storage, and use. The Office is also supporting R&D for several new science facilities and upgrades of current facilities.

High Energy Physics: The High Energy Physics (HEP) program investigates the nature of matter and the forces that act on it, with research conducted primarily at the Tevatron at Fermilab in Illinois and at the Stanford Linear Accelerator Center in California. Additionally, DOE participates in the construction of the LHC. The HEP program also supports research into black holes, dark energy, and other non-accelerator physics.

The FY 2005 request of \$737 million for HEP R&D represents an increase of 0.5 percent, or \$4 million, over FY 2004 funding of \$734 million (see Table II-11). FY 2003 funding was \$702 million. In FY 2005, funding is proposed for reliability and luminosity upgrades at Fermilab's Tevatron, and to begin engineering and design for a new BTeV experiment at Fermilab. LHC funding would decrease as

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construction nears completion, and preparations to participate in LHC research would be enhanced.

Nuclear Physics: DOE's Nuclear Physics program conducts research to understand atomic nuclei and nuclear matter, using facilities at the Thomas Jefferson National Accelerator Facility (TJNAF) in Virginia, the Relativistic Heavy Ion Collider (RHIC) in New York and other laboratory and university facilities.

The FY 2005 request of \$401 million for nuclear physics R&D represents an increase of 2.9 percent, or \$11 million, over FY 2004 funding of \$390 million. FY 2003 funding was \$371 million. The FY 2005 request would focus resources on TJNAF and RHIC, increasing operating hours at both facilities. Funding would be reduced for R&D on the proposed new Rare Isotope Accelerator. The Bates facility in Massachusetts would close in early FY 2005, while the 88-inch Cyclotron in California would continue operations.

Fusion Energy Sciences: The Fusion Energy Sciences (FES) program seeks to study and control plasmas and the process of fusion. In addition to participation in ITER, the FES program would continue to support facilities in California, New Jersey, and Massachusetts.

The FY 2005 request of \$264 million for fusion energy sciences R&D represents an increase of 0.6 percent, or \$2 million, over the FY 2004 level of \$263 million. FY 2003 funding was \$241 million. Under the FY 2005 request, the three primary facilities would be operated at reduced levels to support higher priority activities related to ITER, and design and fabrication of the National Compact Stellarator Experiment in New Jersey.

Basic Energy Sciences: R&D within the Basic Energy Sciences (BES) program provides the foundation for new and enhanced energy technologies. BES facilities are located in Illinois, California, New York, Tennessee, and New Mexico. The Spallation Neutron Source (SNS) in Tennessee, scheduled for completion in FY 2006, will be the world's most powerful neutron scattering facility.

The FY 2005 request of \$1,064 million for BES R&D represents an increase of 5.5 percent, or \$55 million, over the FY 2004 appropriation of \$1,008 million. FY 2003 funding was \$1,002 million. Funding for

SNS construction would continue to decrease as it approaches completion. Savings from the SNS and proposed new funding would enable increases in the Nanoscale Science program, the President's Hydrogen Initiative, and research, engineering and design for the next-generation Linac Coherent Light Source.

Biological and Environmental Research: The Biological and Environmental Research (BER) program supports research to clean and protect the environment, develop energy alternatives, and enhance health and medical care.

The FY 2005 request for R&D in BER is \$502 million. This is a decrease of 14.9 percent, or \$88 million, from the FY 2004 appropriation of \$590 million. FY 2003 funding was \$494 million. An increase is proposed for Genomics research, while the Human Genome and Climate Change programs would remain close to FY 2004 funding levels. (For more on the DOE budget, please see Chapter 9.)

NATIONAL SCIENCE FOUNDATION (NSF)

NSF provides a large proportion of total federal research dollars for basic research at academic institutions. Thirty-one percent of physics research at these institutions is supported by NSF; the ratio being even higher for academically-based materials research which receives 50 percent of its support from the foundation. NSF identifies Nanoscale Science and Engineering as one of five priority areas within the Mathematical and Physical Sciences Activity, and is requesting an 18.5 percent increase in this research funding, to \$21 million. This research will focus on structures, phenomena, and quantum control. NSF also provides funding for several important physics research facilities.

Physics Subactivity: NSF requested a 3.6 percent increase for this budget in FY 2005. Funding would increase by \$8 million to \$236 million from the current year level of \$228 million. FY 2003 funding was \$225 million. Funding within this subactivity can be divided into two major categories: research projects and centers, and facilities (see Table II-7).

About 60 percent of the Physics Subactivity budget is devoted to research projects and centers. Awards provide funding for faculty salaries, graduate students, postdoctoral associates, instrumentation, and

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other needs. The percent of university-based research in different physics sub-disciplines supported by NSF ranges from 30 to almost 100 percent. In addition to support for fundamental research in fields such as atomic, molecular, or particle physics, this subactivity provides funding for interdisciplinary research in areas such as biological physics and complex systems. In FY 2005, NSF will emphasize research on the “interface between physics and astronomy,” biological physics, computational physics, and nanoscale studies, as well as education and outreach activities. The budget would increase for research projects and centers by \$8 million to \$142 million.

The Physics Subactivity also funds facilities, for which the budget would decline by \$1 million to \$78 million. NSF proposes to increase funding for facilities in New York and Michigan, for early operation of detectors at the Large Hadron Collider, and for full operations of the Laser Interferometer Gravitational Observatory. Funding for the Rare Symmetry Violating Processes project will shift from this account to the NSF construction account in FY 2005.

Materials Research Subactivity: Physics research is also supported through this subactivity, which would receive a 0.9 percent increase in FY 2005. Funding would increase by \$2 million from \$251 million in the current year to \$253 million. The FY 2003 budget was \$241 million.

About one-half of all federally-funded university research in materials science is supported by the NSF. More than one-half of the subactivity’s budget is allocated to individual investigators and research groups. Twenty-eight Materials Research Science and Engineering Centers and shared-use experimental facilities are also supported by this activity. One of the primary objectives of this subactivity is the development of new materials that will eventually be used in electronics, communications, health care, energy, transportation, civil infrastructure, information technology, and manufacture.

NSF intends to increase funding for nanoscale science and engineering by 18.6 percent to \$91 million in FY 2005. Mid-scale research resources, including synchrotron and neutron beam lines could see an increase of up to \$3 million. NSF proposes to reduce funding for Information Technology Research and for lower-priority individual investigator, group, and center research. Other major program funding would remain stable, or increase by less than \$1 million in FY 2005.

Major Research Equipment and Facilities Construction: NSF maintains a separate account for “the acquisition, construction and commissioning of major research facilities and equipment.” Preliminary planning and design, and later operations and maintenance for the equipment and facilities are funded by the separate Research and Related Activities Account.

The IceCube Neutrino Observatory is an ongoing project, for which \$33 million is requested. Located at the South Pole beneath the ice, this observatory will study, among other phenomena, high energy cosmic rays and black holes. The observatory should begin full operations in FY 2011. A new construction start is proposed in the FY 2005 request for the Rare Symmetry Violating Processes project. A collaboration of 30 American and international institutions would conduct major experiments concerning “dark matter” at DOE’s Brookhaven National Laboratory. NSF is requesting \$30 million in FY 2005 for this project which is scheduled to produce its first data runs in FY 2010. (For more on NSF, see Chapter 7).

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST conducts physics research at a number of its in-house laboratories. The Physics Laboratory conducts research on physical standards and measurement methods for optical, electronic and radiation technologies. The Materials Science and Engineering Laboratory supports programs on materials measurement and standards, and manages the only cold neutron research facility in the United States.

Under the Administration’s FY 2005 request, the budget for the Physics Laboratory would increase 8.1 percent, or \$3 million, from the current year budget of \$35 million to \$38 million (see Table II-14). FY 2003 funding was \$34 million. The Materials Science and Engineering Laboratory budget would increase 18.5 percent, or \$10 million, from \$52 million to \$61 million. The FY 2003 budget was \$56 million.