

## Physics in the FY 2006 Budget

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### HIGHLIGHTS

- Funding for civilian physics-related research programs at the Department of Energy (DOE) would decline by 4.0 percent from current year funding. Several major new facilities and centers, including the Spallation Neutron Source and four Nanoscale Science Research Centers, would begin operations in FY 2006, while operating times at some older facilities would be reduced.

- At the National Science Foundation (NSF), the budget for the Physics Division would increase 2.3 percent over this year (see Table II-7). The budget for the Materials Research Division would increase 2.2 percent.

- The budget for the National Institute of Standards and Technology's (NIST) Physics Laboratory would increase 9.5 percent over the current year. The Materials Science and Engineering Laboratory budget would see a 3.0 percent increase.

- *"Research in the physical sciences and engineering is at the heart of technological innovation for priority areas of space exploration, nanotechnology, networking and information technologies, and defense technologies,"* declared a FY 2006 budget document issued by the Office of Science and Technology Policy (OSTP). Although physical sciences research has long been recognized as the foundation for multibillion dollar industries, significant advances in medical research and technologies, and a stronger national defense, federal obligations for total research in the physical sciences have, when adjusted for inflation, had an annual growth rate of just 0.5 percent in the period 1982-2001. For physics, the average annual funding rate declined 0.5 percent during the same period.

- A large portion of civilian research in physics and materials research is funded by DOE's Office of Science and NSF, with additional support

from NIST in the Department of Commerce. Research in the physical sciences is also provided by the National Aeronautics and Space Administration (NASA), Department of Health and Human Services (HHS), and the Department of Defense (DOD). See chapters 10, 8, and 6, respectively, for analyses of these budget requests.

#### **DEPARTMENT OF ENERGY (DOE)**

DOE's Office of Science is the primary federal supporter of R&D in physics and the physical sciences. More than 19,000 scientists from academia, industry and government use its civilian national laboratories and world-class scientific user facilities to explore the fundamental nature of matter and energy. The Office of Science supports the research of over 23,000 PhD and postdoctoral scientists and graduate students. DOE (along with NSF) also participates in the construction of the international Large Hadron Collider (LHC) in Switzerland and in the International Thermonuclear Experimental Reactor (ITER) burning plasma fusion experiment, for which a site has not yet been selected.

According to Office of Science Director Ray Orbach, the request gives priority to new facilities over many older ones, to keep U.S. science "at the very forefront" of world scientific leadership.

**High Energy Physics:** The High Energy Physics (HEP) program conducts basic research into the nature of matter and the forces that act on it. This research is conducted primarily at the Tevatron at Fermilab in Illinois and at the Stanford Linear Accelerator Center (SLAC) 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 2006 request of \$714 million for HEP R&D represents a decrease of 3.1 percent, or \$23 million, from FY 2005 funding of \$736 million (see Table II-11 for DOE funding details). Part of the requested decrease for FY 2006 would be due to a transfer of \$30 million to the DOE Basic Energy Sciences program for operation of a facility at SLAC. Operating times would be increased over FY 2005 levels for both the Fermilab Tevatron (by 6 percent) and SLAC (by 54 percent). A proposed new experiment at Fermilab, the BTeV, would be cancelled.

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**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 2006 request of \$371 million for nuclear physics R&D represents a decrease of 8.4 percent, or \$34 million, from FY 2005 funding of \$405 million. This decrease would substantially affect operating times at TJNAF and RHIC, which would be reduced by 29 percent and 61 percent, respectively. Additionally, funding would be reduced for R&D on the proposed new Rare Isotope Accelerator (RIA).

**Fusion Energy Sciences:** The Fusion Energy Sciences (FES) program seeks to investigate and control plasmas and the process of fusion. In addition to participation in the international ITER project, the FES program would support operations at the DIII-D in California and the Alcator C-Mod in Massachusetts.

The FY 2006 request of \$291 million represents an increase of 6.1 percent, or \$17 million, over FY 2005 funding of \$274 million. The request would increase funding for U.S. participation in ITER, and support the first year of equipment fabrication for the U.S. contribution. Two of the three primary U.S. facilities (DIII-D and Alcator C-Mod) would operate at below FY 2005 levels, while the third facility, the National Spherical Tokamak Experiment in New Jersey, would not operate in FY 2006. Fabrication of the National Compact Stellarator Experiment in New Jersey would continue.

**Basic Energy Sciences:** R&D within the Basic Energy Sciences (BES) program provides the foundation for new and enhanced energy technologies. The request of \$1.1 billion represents an increase of 3.7 percent, or \$41 million, over FY 2005 funding. In FY 2006, construction will be completed, and operations started, on the Spallation Neutron Source in Tennessee, which will be the world's most powerful neutron scattering facility. Also scheduled to begin operations in FY 2006 are four of the five planned Nanoscale Science Research Centers, while construction will continue on the fifth. Funding would be increased for the President's Hydrogen Initiative, and for engineering, design and construction of a Linac Coherent Light Source at SLAC. As part of this

project, \$30 million has been transferred from HEP to operate the SLAC Linac.

**Biological and Environmental Research:** This program supports research to clean and protect the environment, develop energy alternatives, and enhance health and medical care. The FY 2006 request of \$456 million represents a decrease of 21.7 percent, or \$126 million, from FY 2005 funding of \$582 million. Funding would increase for the Genomics: GTL program, while funding for the Human Genome and Climate Change programs would be maintained close to FY 2005 levels. (For more on the DOE budget, please see Chapter 9.)

#### **NATIONAL SCIENCE FOUNDATION (NSF)**

The National Science Foundation supports research that is generally of an exploratory nature at academic institutions. The foundation provides 32 percent of federal funding for basic research in physics at academic institutions, and 55 percent of similar work in materials research. The foundation funds researchers ranging from single investigators to large research teams, and invests in equipment from small tabletop instruments to large facilities providing cutting-edge opportunities in a variety of fields. As was true in FY 2005, Nanoscale Science and Engineering is one of NSF's priority areas in FY 2006.

**Physics Division:** NSF requested a 2.3 percent increase in the Physics Division's budget for FY 2006. Funding would increase \$5 million, from \$225 million to \$230 million. The FY 2005 budget is less than that for FY 2004, which was \$228 million (see Table II-7).

There are three major components of the budget request of \$230 million. Research and Education Grants funding would total \$127 million or 55.2 percent of the request. The Centers Programs request is \$26 million. The remaining \$78 million, or 33.9 percent of the request, would provide funding for four large facilities.

The Physics Division supports ten Physics Frontiers Centers, two Nanoscale Science and Engineering Centers, and a Science and Technology Center for Biophotonics Science and Technology.

In the budget submission to Congress, the highest Physics Division priority in FY 2006 is implementing the recommendations of a National

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Research Council report and a National Science and Technology Council Report. NSF, the National Aeronautics and Space Administration, and DOE would examine important questions at the interface of physics and astronomy in an effort entitled the Physics of the Universe. Ten important questions were identified for study, including those surrounding the nature of dark energy and dark matter.

The highest facility stewardship priority involves increased funding (up 28.6 percent) for maintenance, operations and data analysis support for early operations of two detectors at the LHC.

The Division would also give priority to maintaining a robust program of research and education grants, emphasizing cyberinfrastructure and cyberscience, theoretical research, and biological physics.

The budget submission also requests level funding for operational support at the Laser Interferometer Gravitational-Wave Observatory (LIGO) in Washington and Louisiana. Support for the Rare Symmetry Violating Process (RSVP) project is being transferred from the Division to the Major Research Equipment and Facilities Construction account. Funding will continue at the FY 2005 level for the National Superconducting Cyclotron Laboratory in Michigan and decline by 11.5 percent for the Cornell Electron Storage Ring in New York.

**Materials Research Division:** NSF is seeking a 2.2 percent increase in the Materials Research Division budget. Under this request, funding would increase \$5 million, from \$241 million to \$246 million. The current budget is less than that for FY 2004, which was \$251 million.

As is true for the Physics Division, the Materials Research Division has three components. Of the \$246 million request, \$138 million, or 56.1 percent, would be devoted to Research and Education Grants. The Centers Program would receive \$69 million, or 28.0 percent of the request. The remaining \$38 million would be allocated to Facilities.

Interdisciplinary problems in materials and condensed matter sciences are studied in 27 Materials Research Science and Engineering Centers. Important support is provided to 11 centers that conduct research in nanoscience and other materials sciences, as well as six International Materials Institutes based at U.S. universities.

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The Division identified three priorities for FY 2006. They are maintaining strong support for programs that will emphasize “research on materials and condensed-matter phenomena at the nanoscale, biomolecular and bio-inspired materials, computational and theoretical materials research, and materials for future cyberinfrastructure.” The Division will also broaden participation in materials research at several educational levels, and continue its support for user facilities.

Level funding would be provided for the National High Magnetic Field Laboratory in Florida and for the National Nanofabrication Infrastructure Network of 13 user facilities across the U.S.

**Major Research Equipment and Facilities Construction (MREFC):**

NSF has a separate account for “the acquisition, construction and commissioning of major research facilities and equipment.” Within this account, \$51 million would go to the IceCube Neutrino Observatory that is being built under the ice at the South Pole (FY 2005 funding of \$48 million) that will provide unique data on cosmic phenomena. Full operation is scheduled for FY 2011. NSF requested \$42 million for the international Rare Symmetry Violating Process project that is being conducted by almost 30 institutions. FY 2005 funding is \$15 million. This research will advance the frontiers of particle physics, and is expected to have the first data runs in FY 2010. (For more on NSF, please see Chapter 7.)

**NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)**

NIST funds important physics research at several of its in-house laboratories. The Physics Laboratory supports work on physical standards and measurement methods for electronic, optical, and radiation technologies. The Materials Science and Engineering Laboratory conducts research on materials measurement and standards, and manages the only cold neutron research facility in the U.S.

The Administration has requested an increase of 9.5 percent in the Physics Laboratory budget for FY 2006. Under its request, funding would increase \$4 million, from \$41 million to \$45 million. The Materials Science and Engineering budget would increase \$1 million, from \$33 million to \$34 million. (For more on NIST, please see Chapter 13.)