

## Physics in the FY 2008 Budget

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### HIGHLIGHTS

- Funding for physics research programs supported by the Department of Energy's (DOE) Office of Science would increase between 4 and 34 percent.
- The National Science Foundation (NSF) Physics Division's budget would increase 8.3 percent, while the Materials Research Division's budget would see a 9.8 percent increase.
- The physics research budget at the National Institute of Standards and Technology (NIST) would increase 30.9 percent; materials science and engineering research would see an 8.1 percent increase.

FY 2008 is the second year of the Bush Administration's ten-year American Competitiveness Initiative, which would double total funding for the DOE Office of Science, NSF, and NIST research programs. In describing the request, the Office of Science and Technology Policy stated that the "continued investment in physical science research drives innovation in high priority areas such as nanotechnology, advanced networking and supercomputing, new energy technologies, national and homeland defense, and space exploration, and has been a significant contributor to our Nation's prosperity."

Support for increasing federal funding for physical sciences research has been strong on Capitol Hill, and comes in response to reports warning of the dangers of largely flat funding in recent decades. Stringent FY 2007 budgetary restrictions resulted in just half of the first year's requested increase being appropriated for the American Competitiveness Initiative.

The National Aeronautics and Space Administration (NASA; Chapter 9), Department of Defense (Chapter 5) and National Institutes of Health

(Chapter 7), which also support physics research, are covered in other sections of this report.

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

The Department of Energy's Office of Science is the largest provider of federal physics research funding. The Administration requested \$4.4 billion for Science in FY 2008, an increase in the total budget of 15.8 percent or \$601 million, from \$3.8 billion. FY 2006 funding was \$3.6 billion. (See Table II-11 for DOE funding details.)

The request would support the research of an estimated 25,500 faculty, postdoctoral researchers, and graduate students. In addition, the request would allow DOE to "maintain optimum operations" at its scientific user facilities that enable transformational science in energy, environment, and national security. There are approximately 21,000 users of these facilities every year, half of which come from universities.

**High Energy Physics:** DOE requested a 4.1 percent or \$30 million increase for the High Energy Physics program, from \$752 million to \$782 million. FY 2006 funding was \$698 million. DOE provides more than 90 percent of total federal support for U.S. high energy physics research. DOE explains that this research "strives to understand the universe at a more basic level by investigating the elementary particles that are the fundamental constituents of matter and the forces between them."

The FY 2008 request gives priority to Fermilab (IL) and Stanford Linear Accelerator Collider (CA) operations to investigate particles, forces, and questions surrounding matter and antimatter. Fabrication of U.S. components is complete for the Large Hadron Collider under construction on the Swiss-French border. R&D funding would continue for the proposed International Linear Collider.

**Nuclear Physics:** Funding for DOE's Nuclear Physics program would increase 11.5 percent or \$49 million, from \$423 million to \$471 million. FY 2006 funding was \$358 million. DOE states that its Nuclear Physics program, which provides 90 percent of all federal funding in the field, focuses on "the study of the structure, properties, and interactions of the atomic nuclei" to "develop the scientific knowledge, technologies and trained manpower that are needed to underpin the Department of

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Energy's missions for nuclear-related national security, energy, and environmental quality." The scale of investigation ranges from sub-atomic particles to supernova.

The FY 2008 request would fund major user operations at the Jefferson National Accelerator Laboratory (VA), Brookhaven National Laboratory (NY), Argonne National Laboratory (IL), and Oak Ridge National Laboratory (TN), as well as research programs at universities and laboratories.

***Fusion Energy Sciences:*** DOE requested a 34.1 percent, or \$109 million increase in the budget for Fusion Energy Sciences, from \$319 million to \$428 million. FY 2006 funding was \$281 million. Fusion, which is the force that powers the sun, holds the promise of being an environmentally safe and economic energy source. The U.S. is a full partner in the International Thermonuclear Experimental Reactor (ITER), which will demonstrate fusion's scientific and technical feasibility for eventual electrical generation. DOE requested \$160.0 million for ITER. Joining the U.S. in this project under construction in France are China, the European Union, India, Japan, the Republic of Korea, and the Russian Federation.

The program also supports the operation of U.S. research facilities, and is enhancing burning plasma research at DIII-D (CA), Alcator C-Mod (MA), National Spherical Torus Experiment (NJ) and the National Compact Stellarator Experiment (NJ).

***Basic Energy Sciences:*** The FY 2008 request for Basic Energy Sciences would increase its budget by 19.9 percent or \$248 million, from \$1.3 billion to \$1.5 billion. FY 2006 funding was \$1.1 billion. The Basic Energy Sciences program supports basic research in energy resources, production, conversion, efficiency and waste handling. Under this program the groundbreaking Spallation Neutron Source (TN) was completed under budget and ahead of schedule in FY 2006. Fabrication and commissioning of instruments for this facility will continue in FY 2008.

Five Nanoscale Science Research Centers (TN, CA, IL, NM, NY) will be fully operational in the next fiscal year. Construction of the Linac Coherent Light Source at the Stanford Linear Accelerator Center (CA) will continue. Funding will be provided for the Scientific Discovery

through Advanced Computing program which uses computer stimulation to study chemically reacting flows and molecular properties.

***Biological and Environmental Research:*** R&D supported by this program would increase 10.0 percent or \$48 million, from \$483 million to \$532 million. The FY 2006 budget was \$564 million. Basic research supported by this activity investigates energy, environmental, and health areas. The Genomics: GTL program would be expanded in FY 2008. Three Bioenergy Research Centers, for research in the development of biofuels and bioenergy production, will be fully operational in FY 2008. Funding would also be provided for climate and Earth system modeling. (For more on the DOE budget, see Chapter 8.)

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

The NSF provides significant support to academic institutions for basic research in the physical sciences. Approximately 36 percent of academic research in physics is supported by the NSF, with 55 percent of academic research in materials research provided by the foundation. NSF supports highly sophisticated instruments and facilities for physical sciences research. (See Table II-7 for NSF funding details.)

***Physics Division:*** NSF requested an 8.3 percent increase for the division's budget in FY 2008. The \$21 million increase would bring the Division budget to \$269 million. NSF projects that 20 percent of the FY 2008 request would be provided for new research grants. The remaining funding would be allocated to existing grants, facilities, instrumentation, and education and outreach programs.

The Physics Division supports research in many subfields of the discipline. The congressional budget document lists "atomic, molecular, optical, and plasma physics; elementary particle physics; gravitational physics; nuclear physics; astrophysics; theoretical physics; biological physics; physics cyber-enabled discovery and cyberinfrastructure; accelerator physics; and complex systems."

The division's "highest scientific priority" is coordinated with NSF's Astronomical Sciences Division, DOE, and NASA. "Physics of the Universe" is a research program that studies, as described by NSF, "compelling questions that have arisen at the interface of physics and astronomy." Other division priorities include an Elementary Particle

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Physics Investment, biological physics, cyberinfrastructure, instrumentation, and research and education grants for student training.

The Physics Division awarded 277 competitive research grants in FY 2006, which represents a funding rate of 44 percent.

**Materials Research Division:** Under the FY 2008 request, division funding would increase 9.8 percent or \$25 million, from \$257 million to \$283 million. FY 2006 funding was \$243 million. The Division, as explained in the congressional budget document, supports experimental and theoretical research to “make new discoveries about the fundamental behavior of matter and materials; to create new materials and new knowledge about materials phenomena; to address questions about materials that often transcend traditional scientific and engineering disciplines and lead to new technologies; to prepare the next generation of materials researchers; to develop and support the instruments and facilities that are crucial to advance the field; and to share the excitement and significance of materials and condensed matter science with the public at large.”

Research centers are an important component of the Division’s activities. The Division projects that under the FY 2008 request it would support up to 29 interdisciplinary Materials Research Science and Engineering Centers, six International Materials Institutes at U.S. universities, and other centers and facilities.

In FY 2008, 20 percent of the requested budget would be allocated for new competitive research grants. Ten percent of the funding would be provided for the competition for the Materials Research Science and Engineering Centers. Existing research, facilities, instrumentation, and education and outreach programs would be supported with the remainder of the budget.

The Materials Research Division awarded 297 research grants in FY 2006, representing a success rate of 20 percent.

**Major Research Equipment and Facilities Construction:** NSF supports important instruments and facilities through this account that enable highly sophisticated physics research. The foundation ranks as first priority ongoing projects, among which is the IceCube Neutrino Observatory, for which \$22 million is requested. This unique high-

energy neutrino observatory will be located within the icecap in Antarctica. Full operations will ramp up in FY 2011 for this international collaboration for which the U.S. contribution will total \$242 million. As a second funding priority, the account lists a single new start. NSF requests \$33 million to significantly increase the sensitivity of the Laser Interferometer Gravitational Wave Observatory (LIGO) operating at two sites in Washington and Louisiana. LIGO and Advanced LIGO (AdvLIGO) are intended to detect gravitational waves on Earth, first predicted by Einstein's theory of general relativity. NSF projects the total cost of this upgrade, AdvLIGO, at \$205 million, which will begin commissioning in FY 2015. (For more on the NSF budget, see Chapter 6.)

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

Physics research is conducted throughout NIST's seven in-house Measurement and Standards Laboratories located at NIST facilities in Gaithersburg, MD and Boulder, CO. The Physics Laboratory works with industry to develop measurement services, methods and technologies for applications such as information networking, remote sensing, data transmission, and the safe use of radiation. Its research and services are focused on four strategic areas: electronic and magnetic devices; optical technologies; radiation applications and control; and fundamental physical quantities. The Materials Science and Engineering Laboratory addresses industrial and national needs in such industries as microelectronics, automotive and health care. It has five broad areas of focus: Nanometrology, Materials for Electronics, Advanced Manufacturing Processes, Biomaterials, and Safety and Reliability.

Under the request, the Physics Laboratory budget would increase 30.9 percent, or \$17 million, from \$55 million to \$72 million. FY 2006 funding was \$43 million. The Materials Science and Engineering Laboratory budget would increase 8.1 percent, or \$3 million, from \$37 million to \$40 million. FY 2006 funding was \$33 million. (For more on the Department of Commerce and NIST, see Chapter 12.)