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Physics in the FY 2009 Budget

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HIGHLIGHTS

- The Administration requested budgetary increases between 4.4 and 72.1 percent for physics research programs at the Department of Energy.

- The National Science Foundation's (NSF) Physics Division's budget would increase by 18.8 percent; the Materials Research Division's budget would increase 24.7 percent.

- Funding for physics program activities at the National Institute of Standards and Technology (NIST) would increase 34.2 percent.

The Bush Administration reaffirmed its commitment to the American Competitiveness Initiative (ACI) in its FY 2009 budget requests for the Department of Energy's (DOE) Office of Science, the National Science Foundation (NSF), and the research program of the National Institute of Standards and Technology (NIST). Under this Initiative, total funding for the three agencies, providing significant support for physical sciences research, would double over ten years. FY 2009 is the third year of this Initiative.

Basic research in the physical sciences has been the foundation for multibillion-dollar industries providing thousands of high-paying jobs in the United States. Well-known examples include the research leading to the development of semiconductors, lasers, medical devices and instruments, and global positioning systems. National security has been enhanced by stealth technology, night vision, and new materials. Often many years elapse between a basic research finding and its application in a new technology.

There is growing recognition that federal support for physics research has stagnated or declined, in constant dollars, during recent decades. Congress and the Administration responded last year by enacting the

America COMPETES Act and with initial versions of the FY 2008 appropriations bills that would have funded the Administration's "ten-year doubling" requests for NSF, NIST research programs, and DOE Office of Science.

Funding in the final 2008 Consolidated Appropriations Act was dramatically short of the Administration's requests and initial versions of the appropriations bills. Funding for the Office of Science, which would have risen 15.8 percent under the request, increased by only 2.6 percent after adjusting for earmarking. This resulted in employee layoffs at some of DOE's physics laboratories, the reduction or suspension of research programs at its laboratories and 300 public and private universities, and no U.S. contribution to ITER, an international experimental fusion facility being built in France. The NSF budget, for which an increase of 8.7 percent was requested, rose 2.5 percent. As a result, NSF estimates it will make significantly fewer research grants, defer the establishment of physics and materials research centers, and reduce funding for physics facilities. A 15.1 percent increase was requested for NIST's Scientific and Technical Research and Services; it received a 1.4 percent increase. NIST will slow the development of nanotechnology measurement methods and standards, delay by at least one year advances in a quantum computing research program, slow staff hiring, and curtail facility repairs and upgrades.

The larger-than-usual FY 2009 requests are intended to get the budgets for these agencies that support a large percentage of physical sciences research back on the doubling track. In his January 2008 State of the Union Address, President Bush reiterated the importance of increasing funding for physical research, saying, "I ask Congress to double federal support for critical basic research in the physical sciences and ensure America remains the most dynamic nation on Earth."

Federal support for physics research is also provided by the National Aeronautics and Space Administration (Chapter 9), Department of Defense (Chapter 5), and National Institutes of Health (Chapter 7).

DEPARTMENT OF ENERGY (DOE)

The DOE Office of Science provides almost half of all federal research funding for physics research. The Administration requested an increase in the budget for the Office of Science of 18.8 percent, or $748.8 million,

from $4.0 billion to $4.7 billion. The FY 2007 budget was $3.8 billion. The DOE Office of Science was included in the American Competitiveness Initiative and the congressional leadership's Innovation Agenda. (See Table II-11 for DOE funding details.)

The Office of Science supports world-leading physics research facilities that are of great importance for basic research and industrial purposes. The FY 2009 request would support the Spallation Neutron Source and High Flux Isotope Reactor that are used to study the behavior of atoms in materials such as superconducting ceramics. Four Synchrotron Light Sources can be used to determine protein structures, study the properties of new materials, and examine chemical reactions. Five Nanoscale Science Research Centers provide scientists with fabrication, synthesis, and characterization capabilities. DOE proposed two next generation tools: the Linac Coherent Light Source and the National Synchrotron Light Source-II that would provide state-of-the-art tools to researchers.

Five research programs provide significant support for physics research: high energy physics, nuclear physics, basic energy sciences, fusion energy sciences, and biological and environmental research.

High Energy Physics: DOE requested an increase of 16.8 percent, or $115.6 million, from $689.3 million to $805.0 million. The budget request gives priority to two major facilities at Fermi National Accelerator Laboratory. Research in high energy physics examines the elementary building blocks of energy and matter, studying areas such as dark energy and dark matter, neutrinos, and the behavior of particles and forces at extremely high energies.

Nuclear Physics: Funding would increase by 17.9 percent or $77.4 million, from $432.7 million to $510.1 million. Funding would support major operations at the Thomas Jefferson National Accelerator Facility and Brookhaven National Laboratory, as well as at smaller facilities. This research examines the structure and interactions of atomic nuclei, forces and particles, and can be applied to the development of nuclear energy, nuclear medicine, and national security.

Basic Energy Sciences: Funding for Basic Energy Sciences would increase 23.5 percent or $298.3 million, from $1.3 billion to $1.6 billion. Research and facilities supported by this program investigate new or improved energy technologies. DOE has proposed the establishment of

Energy Frontier Research Centers housing multiple investigators for basic research in areas such as solar energy, electrical energy storage, superconductivity, advanced nuclear energy systems, and materials.

Fusion Energy Sciences: Support would increase 72.1 percent or $206.5 million, from $286.6 million to $493.1 million. Both domestic and international research is supported by DOE through this program in plasma science, fusion science, and fusion technology. Fusion is the force powering the sun, and could provide large-scale energy in an environmentally safe and economic manner. The budget would provide $214.5 million for the International Thermonuclear Experimental Reactor (ITER) for in-kind components, personnel and funding. According to DOE, "ITER will, for the first time, demonstrate the technical and scientific feasibility of a sustained, magnetically confined fusion burning plasma." The U.S. is one of seven nations participating in this partnership.

Biological and Environmental Research: DOE has requested an increase of 4.4 percent, or $24.1 million, from $544.4 million to $568.5 million. Research in this field supports energy production and environmental protection in areas such as climate change, carbon dioxide sequestration, and radioactive waste. (For more on the DOE budget, see Chapter 8.)

NATIONAL SCIENCE FOUNDATION (NSF)

NSF supports physics research through the Physics Division and Materials Research Division, both of which are within the Mathematical and Physical Sciences Directorate. NSF also provides support for physics research through the construction of major research equipment and facilities. NSF is one of the three agencies in the American Competitiveness Initiative, and is also a component of the congressional leadership's Innovation Agenda. (See Table II-7 for NSF funding details.)

Physics Division: The FY 2009 budget for the Physics Division would increase 18.8 percent, or $47.2 million, from $250.5 million to $297.7 million. The FY 2007 budget was $248.5 million.

NSF provides 34 percent of all federal funding for basic research in physics at academic institutions. It supports research and education

grants, ranging from individual investigators to major user groups. The foundation estimates that $213.7 million would be distributed through a peer-review process for these grants in FY 2009. Of this amount, approximately 34 percent will be allocated to new research grants. Another $6.4 million would be distributed to its Centers.

The Physics Division has budgeted $77.7 million for its facilities in FY 2009. Funding would be increased by 43.3 percent for operations at the IceCube Neutrino Observatory, while funding would decline by 38.0 percent at the Cornell Electron Storage Ring as this high-energy research facility is phased out of operations.

The Division has two major FY 2009 priorities. Its first priority is "a strong, flexible program of research and education grants to create new ideas and technology and attract and train students." The focus will be on using previous discoveries that could lead to the development of new technologies, the development of new cyberinfrastructure, and for physics research on living systems. The second priority will be on a joint program, the Physics of the Universe, supported by the Physics Division and the Astronomical Sciences Division. The foundation describes this program as addressing "compelling questions at the interface of physics and astronomy."

Materials Research Division: NSF has requested an increase of 24.7 percent, or $64.4 million, from $260.2 million to $324.6 million.

This division supports research in the fundamental behavior of matter and materials and the development of new materials by supporting individual investigators, small groups, centers, and instrumentation and facilities. Approximately $193 million would be allocated to research and education grants, $79.7 million for up to 29 Materials Research Science and Engineering Centers, and the remainder to facilities, including the National High Magnetic Field Laboratory and the National Nanofabrication Infrastructure Network. The Division estimates that 15 percent of the money it has requested will be available for new peer-reviewed research grants.

Three major priorities were identified for FY 2009. The first is "support for materials research programs that explore new phenomena, develop novel materials, and undergird technology innovation." The second is to increase participation in materials research by undergraduates, pre-

college students, and pre-college teachers and under represented groups. The third priority is maintaining support of user facilities for synchrotron radiation, high magnetic fields, and neutron scattering.

Major Research Equipment and Facilities Construction: NSF is requesting $51.4 million for the Advanced Laser Interferometer Gravitational-Wave Observatory. This money would be used to upgrade the observatory's facilities in Washington and Louisiana that will, according to NSF, "approach the ground-based limit of gravitational-wave detection."(For more on the NSF budget, see Chapter 6.)

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

The National Institute of Standards and Technology has a unique role in its support of physics research through the development of measurement instrumentation in atomic and optical physics, electronic and magnetic technologies, and ionizing radiation. The NIST research laboratories are the third component of the Administration's American Competitiveness Initiative, and are also a part of the congressional leadership's Innovation Agenda. (See Table II-14 for NIST funding details.)

NIST has ten research laboratories at its Maryland and Colorado campuses. Funding for physics research at these laboratories would increase by 34.2 percent or $18.8 million, from $54.8 million to $73.6 million. The FY 2007 budget was $54.8 million.

The research conducted at these laboratories makes important contributions to advances in medical radiation, quantum information processing, time and frequency, metrology innovation, optical technology and public health and safety. In FY 2009, NIST's budget priorities include nanotechnology environment, health, and safety measurements and standards; nanotechnology processing; bioscience measurement and standards; optical communications and computing; quantum information science; improvements to the NIST Center for Neutron Research; climate change; hydrogen as a fuel; materials science; and improvements to its laboratory facilities. (For more on the Department of Commerce and NIST, see Chapter 12.)