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Physics in the FY 2014 Budget

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Highlights

- Funding requested for physics-related programs supported by the Department of Energy's Office of Science (DOE-SC) would vary from an increase of 0.8 percent to an increase of 16.6 percent from FY 2012 to 2014. Those programs would increase a net of $357 million over the two fiscal years.

- The National Science Foundation (NSF) supports physics research through its Division of Physics and its Division of Materials Research. Between FY 2012 and 2014, funding for the Division of Physics would increase 4.2 percent. The Division of Materials Research would increase 6.9 percent. The combined budgets for these divisions would grow $32 million over this period.

- The National Institute of Standards and Technology (NIST) conducts physics research in two laboratories, a center and a user facility. Detailed budget information about these activities was not available at the time of this writing.

Introduction

Physics is the science of matter and energy and how they interact in space-time. Physicists work on the frontiers of the subatomic world, the cutting edge of the marketplace, and the outer reaches of space. The discipline spans fields like electromagnetism, optics, thermodynamics, acoustics, and mechanics – shaping the future of healthcare, energy, commerce, defense, and the environment.

Physics also reflects something fundamental to humanity. For centuries

men and women have labored to understand how the universe works, driven as much by curiosity as by how new knowledge might be applied.

Physics research is largely funded through DOE-SC, NSF, and NIST. The Obama Administration FY 2014 request prioritizes these three agencies, with an 8.0 percent increase proposed between FY 2012 and FY 2014 for their combined budgets, totaling $13.5 billion. On average, the proposed physics budgets under these agencies (where data is available) would rise by 7.5 percent.

Table 1. Physics in the Federal R&D Budget
(budget authority in millions of dollars)

	FY 2012 Actual	FY 2013* Estimate	**FY 2014 Budget**	Change FY 12-14* Amount	Percent
Department of Energy					
Office of Science	4,935	4,632	**5,152**	217	4.4%
Basic Energy Sciences	*1,645*	*1,604*	***1,862***	*217*	*13.2%*
Bio and Environ Research	*592*	*579*	***625***	*33*	*5.6%*
Fusion Energy Sciences	*393*	*381*	***458***	*65*	*16.6%*
High Energy Physics	*771*	*752*	***777***	*6*	*0.8%*
Nuclear Physics	*535*	*520*	***570***	*35*	*6.6%*
National Science Foundation	7,105	6,884	**7,626**	520	7.3%
Math and Physical Scis	1,309	1,256	**1,386**	77	5.9%
Physics	*277*	*266*	***289***	*12*	*4.2%*
Materials Research	*294*	*283*	***315***	*20*	*6.9%*
Maj Res Equip & Facil	198	183	**210**	12	6.1%
Natl Inst of Standards and Tech	751	769	**1,928**	1,178	156.8%
Physical Measures Lab**	124	--	**--**	--	--
Materials Measurement Lab**	106	--	**--**	--	--
Center for Neutron Research**	42	--	**--**	--	--
Center for Nanoscale S&T**	33	--	**--**	--	--

*Best AAAS estimates of funding levels after across-the-board rescissions and sequestration.
**Figures taken from last year's report. Current figures unavailable at press time.
Source: *FY 2014 Budget of the United States,* agency budget requests, NIST Budget Office.
All figures rounded to the nearest million. Changes calculated from unrounded figures.

John Holdren, Director of the Office of Science and Technology Policy, testified April 17, 2013, before the House Science, Space and Technology Committee. He noted that the three agencies "have been identified as especially important to this Nation's continued scientific and economic leadership by the President's Plan for Science and Innovation, the America COMPETES Act of 2007, the Administration's Innovation Strategy, and

the America COMPETES Reauthorization Act of 2010."[1] He emphasized that other reductions were proposed in the budget to offset the increased investment in compliance with the Budget Control Act.

Additional federal support for physics research is provided by the National Aeronautics and Space Administration, the Department of Defense, and the National Institutes of Health.

Department of Energy

The Department of Energy Office of Science supports fundamental research for energy and is the nation's largest sponsor of basic research in the physical sciences, in areas including physics, chemistry, biology, environmental science, applied mathematics, and computational science. DOE-SC also pursues long-term progress in energy-related domains such as nanotechnology, advanced materials and high performance computing. The office supports roughly 25,000 investigators at about 300 U.S. academic institutions and ten DOE national laboratories. DOE-SC also provides state-of-the-art user facilities — the large machines for modern science that enable U.S. researchers and industries to remain at the forefront of science, technology, and innovation. Approximately 29,000 researchers from universities, national laboratories, industry, and international partners are expected to use the DOE-SC user facilities in FY 2014.

The FY 2014 DOE-SC budget of $5.2 billion million represents an increase of 4.4 percent ($217 million) from the FY 2012 appropriation.

DOE's FY 2014 request states that DOE-SC programs contribute to the goals of clean energy, innovation, and the future jobs. The Office of Science supports physics research through the following programs:

Basic Energy Sciences (BES): BES supports fundamental research to understand, predict, and control matter and energy. Such research promotes new energy technologies and new ways to reduce the environmental impacts of energy use. In FY 2014, BES will support Energy Frontier Research Centers (EFRCs) and two innovation hubs (Fuels from Sunlight and Batteries and Energy Storage). The EFRCs will undergo an open competition for renewal of existing centers and the selection of new

1 http://www.whitehouse.gov/administration/eop/ostp/library/test

EFRCs. BES also will support the National Synchrotron Light Source-II construction and early operations, Linac Coherent Light Source-II construction, the operations of the five synchrotron light source facilities, five Nanoscale Science Research Centers, and the three neutron scattering facilities. Equipment projects will continue for the Advanced Photon Source and the National Synchrotron Light Source-II Experimental Tools.

The BES budget of $1.9 billion represents a 13.2 percent increase ($218 million) from the FY 2012 appropriation.

Biological and Environmental Research (BER): BER supports research for diverse challenges, including the use of genomic information to design microbes and plants for sustainable biofuels production, improved carbon storage, and contaminant bioremediation. BER research also advances understanding of climate dynamics and planning for future energy and resource needs. Increased investments target the development of biosystems design tools and the development of integrative analysis of experimental data sets in support of bioenergy, climate, and environmental research.

The BER budget request of $625 million represents a 5.6 percent increase ($33 million) from the FY 2012 appropriation.

Fusion Energy Sciences (FES): FES supports research to develop fusion as a future energy source. Research explores how to measure the properties of plasma and create theoretical and computational models to resolve critical physics principles. The FES request also supplies U.S. contributions to the ITER project. The majority of these contributions will be spent on in-kind hardware sourced from U.S. industries, national laboratories, and universities.

The FES budget request of $458 million represents a 16.6 percent increase ($65 million) from the FY 2012 appropriation.

High Energy Physics (HEP): HEP supports research to understand how the universe works at its most fundamental level. Support for Large Hadron Collider (LHC) detector operations, maintenance, computing, and R&D for detector upgrades would continue. Project engineering and design for the Muon to Electron Conversion Experiment (Mu2e) continues as well as research for the Long Baseline Neutrino Experiment. Projects also would

continue on dark matter, dark energy, neutrino properties, and advanced accelerators and detectors.

The HEP budget request of $777 million represents a 0.8 percent increase ($6 million) from the FY 2012 appropriation.

Nuclear Physics (NP): NP supports research to discover, explore, and understand all forms of nuclear matter. NP supports three national user facilities: the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory; the Continuous Electron Beam Accelerator Facility (CEBAF) at the Jefferson Lab; and the Argonne Tandem Linac Accelerator System (ATLAS). These major scientific facilities provide research beams for a community of approximately 3,000 scientists.

The FY 2014 request supports construction of the Facility for Rare Isotope Beam (FRIB) at Michigan State University to provide world-leading capability in nuclear structure and astrophysics.

The NP budget request of $570 million represents a 6.6 percent increase ($35 million) from the FY 2012 appropriation.

National Science Foundation

NSF supports physics research in its Directorate for Mathematical and Physical Sciences (MPS) and by its support of the construction of facilities and instrumentation through the Major Research Equipment and Facilities Construction account.

MPS supplies about half of all federal funds for basic research in mathematics and the physical sciences at U.S. academic institutions. The MPS request of $1.4 billion represents a 5.9 percent increase ($77 million) from the FY 2012 appropriation. Two of the six MPS divisions support physics research directly.

Division of Physics (PHY): PHY supports fundamental research across several physics subfields including atomic, molecular, optical, and plasma physics. The division also funds research in elementary particle physics, gravitational physics, nuclear physics, physics of living systems and theoretical physics.

The division also supports operations and maintenance for four facilities: the Laser Interferometer Gravitational Wave Observatory (LIGO), the Large Hadron Collider (LHC), the National Superconducting Cyclotron Facility (NSCL), and the Ice Cube Neutrino Observatory.

PHY's FY 2014 request includes support for NSF-wide priorities such as Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21) and Biological, Mathematical and Physical Sciences (BioMaPS) programs. The division also will support new research on mid-scale instrumentation and new approaches to accelerator science.

The Physics Division budget request of $289 million represents a 4.2 percent increase ($12 million) from the FY 2012 appropriation.

Division of Materials Research (DMR): DMR supports research on condensed matter physics, solid-state chemistry, and the science of materials. DMR-funded research advances the ability to manipulate materials and to discover new synthesis and processing strategies. Developing novel materials has enormous commercial, security, environmental, health, and energy implications.

In FY 2014, DMR plans to increase its portfolio of awards in NSF focus areas where advanced materials are essential, such as the Science, Engineering and Education for Sustainability program and the Cyber-enabled Materials, Manufacturing, and Smart Systems framework.

The DMR request of $315 million represents a 6.9 percent increase ($20 million) from the FY 2012 appropriation.

Major Research Equipment and Facilities Construction: NSF will continue construction in FY 2014 of two projects of interest to the physics community. The Advanced Laser Interferometer Gravitational-Wave Observatory (AdvLIGO) is an upgrade of the existing LIGO. It will be ten times more sensitive and powerful enough to approach the ground-based limit of gravitational wave detection. AdvLIGO would receive $15 million in FY 2014. The Advanced Technology Solar Telescope (ATST) would receive $42 million. The ATST will enable study of the sun's magnetic

fields, thereby advancing the understanding of solar variability and activity that could affect life on Earth.

The MREFC request of $210 million represents a 6.1 percent increase ($12 million) from the FY 2012 appropriation.

National Institute of Standards and Technology

Physics research at NIST is conducted through two in-house laboratories, a center, and a user facility. NIST facilitates industry research or conducts research in partnership with industry on matters such as communications, defense, microelectronics, energy, environment, health, manufacturing, radiation, remote sensing and transportation.

Although the budgets for the Physical Measurement Laboratory (PML), the Material Measurement Laboratory (MML), the NIST Center for Neutron Research (NCNR), and the Center for Nanoscale Science and Technology (CNST) were not available at the time of publication, the NIST budget justification lists several priorities for these facilities.

The PML has identified FY 2014 priorities in areas such as advanced communications, nanomanufacturing, medical imaging technology, and radiation detection near public transit facilities.

The MML FY 2014 priorities include several measurement advances in subjects such as advanced materials, biomedicine, electronics, energy, environment, food safety, advanced manufacturing, and environment.

The NCNR has set priorities in energy efficiency, fuel cell design, data storage, and drug and vaccine development. The center also will work to advance materials linked to computer processing, industrial products, national defense, and public infrastructure.

CNST priorities include nanoscale materials characterization and fabrication, photovoltaic technologies, solar fuels, and training new nanotechnologists.

The overall FY 2014 NIST budget would increase substantially under the request due to proposed manufacturing initiatives. The request of $1.9 billion represents a 156.8 percent increase ($1.2 billion) from the FY 2012 appropriation.