

**DIRECTORATE FOR MATHEMATICAL
AND PHYSICAL SCIENCES (MPS)**

**\$1,409,910,000
+\$58,070,000 / 4.3%**

MPS Funding
(Dollars in Millions)

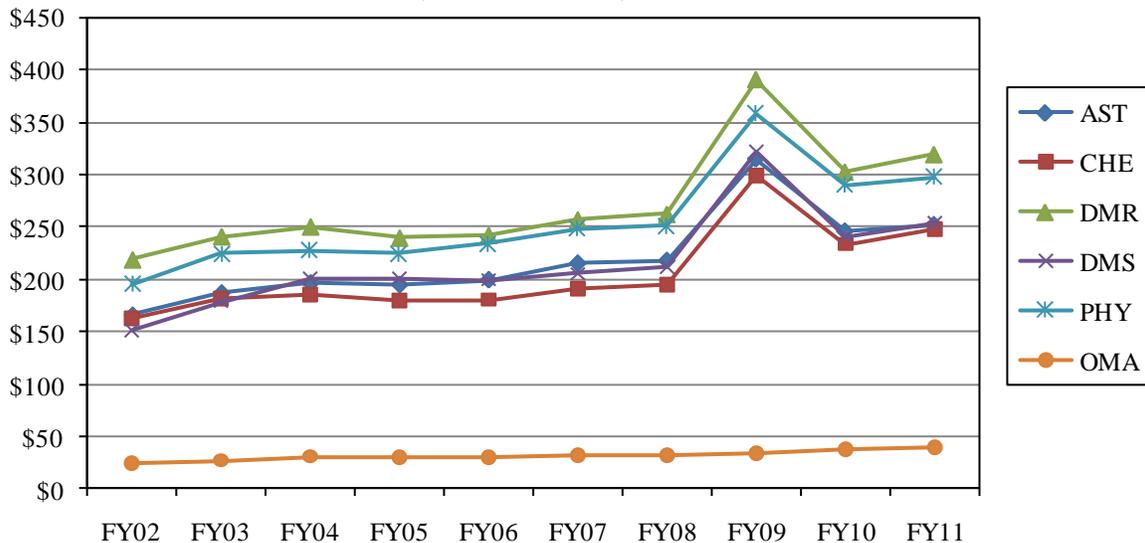
	FY 2009	FY 2009	FY 2010 Estimate	FY 2011 Request	Change Over	
	Omnibus Actual	ARRA Actual			FY 2010 Estimate	FY 2011 Request
Astronomical Sciences	\$228.67	\$85.80	\$245.69	\$251.77	\$6.08	2.5%
Chemistry ¹	211.67	87.36	233.73	247.56	13.83	5.9%
Materials Research	282.52	108.17	302.67	319.37	16.70	5.5%
Mathematical Sciences	224.84	97.34	241.38	253.46	12.08	5.0%
Physics	262.47	96.30	290.04	298.19	8.15	2.8%
Office of Multidisciplinary Activities	33.70	-	38.33	39.56	1.23	3.2%
Total, MPS	\$1,243.88	\$474.97	\$1,351.84	\$1,409.91	\$58.07	4.3%
Research	840.82	357.50	911.09	972.35	61.26	6.7%
Education	61.68	44.71	65.54	65.01	-0.53	-0.8%
Infrastructure ¹	322.58	72.76	353.73	349.10	-4.63	-1.3%
Stewardship	18.80	-	21.48	23.45	1.97	9.2%

Totals may not add due to rounding.

¹ \$15.0 million of FY 2009 ARRA funding was carried over into FY 2010.

MPS supports a broad portfolio of investments in fundamental research, facilities, and instruments that enable discovery and development as well as in integrated education and research activities that contribute to the development of the science and engineering workforce. The portfolio includes MPS participation in NSF-wide and interagency research and education, and emphasizes discovery, innovation, and learning aligned with the overall goals of the Administration and NSF’s mission and vision.

MPS Subactivity Funding
(Dollars in Millions)



MPS in Context

MPS provides approximately 50 percent of the total federal support for basic research at academic institutions in the mathematical and physical sciences, ranging from about 35 percent in physics to over 60 percent in the mathematical sciences.

MPS-supported research in the physical and mathematical sciences provides the basis for advances in other engineering, technical, and health-related disciplines and for industrial and technological development. MPS researchers investigate the structure and evolution of the universe and the fundamental particles and processes of matter, the behavior and control of molecules at the nanoscale to the complexity of their chemical interactions in materials and life processes. Research in MPS fields has resulted in the development of new mathematical structures and theories and connections to computation, experimentation, and observation. MPS-supported research has contributed to the technological leadership of the United States.

MPS is the steward of numerous major research facilities (astronomical observatories, gravitational-wave and neutrino observatories, light sources, high magnetic field laboratories, nuclear physics laboratories), which together form an important component of the Nation's scientific research infrastructure. MPS strategically invests in the development of the next generation of facilities and is increasing its Centers programs while protecting funding for individual investigators and small group investigators. MPS emphasizes the entire pipeline of the science and technology workforce, supporting undergraduate and graduate students as well as postdoctoral fellows.

MPS also invests in research in sustainable energy, climate, nano-science, cyber-enabled discovery and innovation, and the interface of the physical sciences with the life sciences.

Factors Influencing the Allocation Across Divisions and Major Programs

- In FY 2011, maintaining a healthy core program is the top priority for MPS and is reflected in the requested increases for all divisions.
- Additional funding requested in FY 2011 for Science, Engineering and Education for Sustainability will be used to support research in existing programs in this area. SEES funding impacts the budgets in CHE, DMR, and DMS.
- Training a technically competent scientific workforce remains a high priority for NSF in FY 2011 and is reflected in the MPS funding levels requested for CAREER and the Graduate Research Fellowship (GRF) program. Increases for both programs are requested in all five divisions; the largest increases for CAREER are requested in CHE, DMR, and PHY, while the largest increases for GRF are in CHE and PHY.
- MPS requests funding for pre-construction planning for facilities; this planning is required in order to fully understand the resources needed for potential new Major Research Equipment and Facilities Construction (MREFC) projects. Funding for pre-construction planning is requested in FY 2011 for AST, DMR, and PHY.
- As scientific questions become more complex, some MPS divisions have found that the Centers model is an effective way to encourage interdisciplinary approaches; therefore, funding for two MPS Centers programs (Centers for Chemical Innovation in CHE and Materials Research Science and Engineering Centers in DMR) is increased in FY 2011.
- In partnership with the Directorate for Biological Sciences (BIO), MPS will invest \$5.57 million to identify and support potentially transformative research projects that explore the intersection of the biological and physical sciences: Support is focused across CHE, DMS, DMR, and PHY.
- In FY 2011, MPS will meet its international agreements for facilities operations.

- Where able, MPS has increased FY 2011 operational budgets for facilities to maintain facilities operations at the FY 2010 level. Where increases were not possible, MPS has maintained facilities' operations budgets as close to constant as possible.

MPS Funding for Centers and Facilities

MPS Funding for Centers and Facilities

(Dollars in Millions)

	FY 2009	FY 2009	FY 2010	FY 2011	Change Over	
	Omnibus	ARRA			FY 2010 Estimate	FY 2011 Request
	Actual	Actual	Estimate	Request	Amount	Percent
Centers	\$107.48	-	\$105.06	\$107.98	\$2.92	2.8%
<i>Nanocenters</i>	13.67	-	13.56	7.50	-6.06	-44.7%
<i>STC: Center for Adaptive Optics</i>	2.66	-	-	-	-	N/A
<i>STC: Center for Environ. Responsible Solvents & Processes</i>	2.66	-	-	-	-	N/A
<i>STC: Materials & Devices for Inform. Tech. Research</i>	4.00	-	3.32	2.66	-0.66	-19.9%
<i>STC: Center for Biophotonics Science & Eng.</i>	3.96	-	3.28	2.62	-0.66	-20.1%
<i>STC: NSF Center for Layered Polymeric Systems</i>	4.00	-	4.00	4.00	-	-
<i>Centers for Analysis & Synthesis</i>	0.20	-	0.20	0.20	-	-
<i>Centers for Chemical Innovation</i>	15.50	-	24.00	28.00	4.00	16.7%
<i>Materials Research Sci & Engr Ctrs</i>	60.84	-	56.70	63.00	6.30	11.1%
Facilities	\$251.35	\$45.58	\$259.80	\$269.07	\$9.27	3.6%
<i>Adv. Tech. Solar Telescope (ATST)</i>	3.57	3.10	0.00	2.00	2.00	N/A
<i>Atacama Large Millimeter Array (ALMA)</i>	11.00	-	17.57	23.50	5.93	33.8%
<i>Cornell High Energy Synchr. Source\</i> <i>Cornell Electron Storage Ring (CHESS)\CESR)</i>	13.60	14.99	9.00	13.45	4.45	49.4%
<i>GEMINI Observatory</i>	18.71	-	19.10	19.58	0.48	2.5%
<i>IceCube Neutrino Observatory</i>	2.16	-	2.15	2.50	0.35	16.3%
<i>Large Hadron Collider (LHC)</i>	18.00	-	18.00	18.00	-	-
<i>Large Interfer. Grav. Wave Observatory (LIGO)</i>	30.30	-	28.50	30.30	1.80	6.3%
<i>Nat'l Astronomy and Ionosphere Ctr. (NAIC)</i>	9.60	3.10	8.40	6.00	-2.40	-28.6%
<i>Nat'l High Magnetic Field Laboratory (NHMFL)</i>	26.50	5.00	35.56	34.00	-1.56	-4.4%
<i>Nat'l Nanotechnology Infra. Network (NNIN)</i>	3.71	-	3.38	3.38	-	-
<i>Nat'l Optical Astronomy Observatory (NOAO)</i>	30.48	5.60	31.50	33.33	1.83	5.8%
<i>Nat'l Radio Astronomy Observatory (NRAO)</i>	49.79	5.40	49.52	44.37	-5.15	-10.4%
<i>National Solar Observatory (NSO)</i>	7.83	1.40	9.10	9.51	0.41	4.5%
<i>Nat'l Superconducting Cyclotron Lab (NSCL)</i>	20.50	2.00	21.00	21.50	0.50	2.4%
<i>Other MPS Facilities</i> ¹	5.60	4.99	7.02	7.65	0.63	9.0%

¹ Other MPS Facilities: Synchrotron Radiation Center (SRC), Center for High Resolution Neutron Scattering (CHRNS), and ChemMatCARS.

Centers

MPS manages or co-funds more than forty different individual centers in five centers program areas. Major funding changes in FY 2011 include:

- *Nanocenters* (-\$6.06 million to a total of \$7.50 million). The Class of 2001 Nanocenters had their last year of funding in FY 2010; the investment of \$7.50 million maintains the remaining centers as intended.

- *Science and Technology Centers (STCs) (-\$1.32 million to a total of \$9.28 million).* The Class of 2000 STCs (Center for Adaptive Optics and Center for Environmentally Responsible Solvents and Processes) sunsets in FY 2010. The Class of 2002 STCs (Materials and Devices for Information Technology Research and the Center for Biophotonics Science and Engineering) ramps down in FY 2011 as they receive their tenth and final year of funding; this results in a decrease of -\$1.32 million to a total of \$5.28 million. FY 2011 support for the Class of 2006 STCs (NSF Center for Layered Polymeric Systems) remains flat with the FY 2010 estimate of \$4.0 million.
- *Centers for Chemical Innovation (CCI) (+\$4.0 million, to a total of \$28.0 million).* CCIs promote the integration of research and education through the extensive involvement of students and postdoctoral fellows in all phases of work, as well as partnerships with industry and National Laboratories. CCIs are expected to be agile, responding to opportunities as they arise, and to creatively engage the public. The request reflects the establishment of one additional Phase II Center (for a total of six) and four new Phase I Centers (for a total of twelve).
- *Materials Research and Engineering Centers (MRSEC) (+\$6.30 million, to a total of \$63.0 million).* MPS will run a MRSEC competition in FY 2011 with two distinct award categories: larger and smaller awards. The FY 2006 class will be able to re-compete in the FY 2011 competition. It is anticipated that 25 MRSECs will be funded, including four to six new centers established as a result of the FY 2011 competition.

Detailed information on individual Centers can be found in the NSF-Wide Investments chapter.

Facilities

- As mentioned above, MPS has increased operational budgets for facilities to maintain facilities operations at the FY 2010 level. Where increases were not possible, MPS has maintained operational budgets as close to constant as possible.
- Although the budgets appear to increase for CHESS\CESR, ARRA funding in FY 2009 allowed MPS to forward-fund \$4.27 million in FY 2010 operations for these facilities, resulting in a distorted lower FY 2010 funding level.
- Funding for ALMA increases by \$5.93 million to a total operations budget of \$23.50 million consistent with the planned ramp-up of operations. Base funding for the National Radio Astronomy Observatory drops \$5.15 million to a total of \$44.37 million due to the planned roll-off of construction funding for the Expanded Very Large Array. Funding for the National Astronomy and Ionosphere Center drops in line with recommendations of the 2006 Astronomy Senior Review, while funding for the Gemini Observatory, the National Optical Astronomy Observatory and the National Solar Observatory are held relatively constant.
- The \$350,000 increase in FY 2011 for the IceCube Neutrino Observatory at the South Pole is part of the post-construction ramp-up in operations. MPS cofounds this observatory in partnership with the Office of Polar Programs.

For further detail about individual Facilities, please see the Facilities chapter.

MPS Administration Priority Programs and NSF Investments

MPS Administration Priority Programs and NSF Investments

(Dollars in Millions)

	FY 2009	FY 2009	FY 2010 Estimate	FY 2011 Request	Change Over	
	Omnibus	ARRA			FY 2010	FY 2011
	Actual	Actual			Estimate	Request
Faculty Early Career Development (CAREER)	\$53.53	\$49.23	\$47.92	\$50.68	\$2.76	5.8%
Graduate Research Fellowships (GRF)	-	17.40	4.11	6.62	2.51	61.1%
Science, Engineering, and Education for Sustainability (SEES)	N/A	N/A	87.00	110.50	23.50	27.0%
Science and Engineering Beyond Moore's Law (SEBML)	36.53	9.82	18.68	32.18	13.50	72.3%

MPS’s FY 2011 budget will significantly expand two key NSF programs that support students, early-career researchers, and the next generation of environmentally engaged scientists and engineers. The budget also encourages potentially transformative research and supports critical priorities in global climate change, sustainable energy research, and Science and Engineering Beyond Moore’s Law.

- MPS will increase its investment in CAREER by \$2.76 million in FY 2011 to a total of \$50.68 million. The CAREER program remains the primary mechanism for jump-starting junior faculty toward independent careers in research and education, an Administration priority. All MPS divisions invest in CAREER.
- To promote the education and participation in the research enterprise of the next generation of mathematical and physical scientists, MPS is contributing to the NSF-wide Graduate Research Fellowship (GRF) program. This is part of an Administration priority to triple the number of new fellowships by FY 2013. MPS will continue its support of GRF with a total investment of \$6.62 million in FY 2011, an increase of \$2.51 million over the FY 2010 Estimate.
- MPS will increase its investment in Science, Engineering and Education for Sustainability (SEES) by \$23.5 million to a total of \$110.50 million in FY 2011. This increase will be used to support research in sustainable energy and related areas.
- MPS leads NSF’s effort in Science and Engineering Beyond Moore’s Law (SEBML), a multidisciplinary research investment with strong ties to economic competitiveness and potential for transformation. SEBML activities include research into new materials, devices, and processes that exploit the capability to create and manipulate specific quantum states and new algorithms that take advantage of hardware and architecture characteristics to deliver maximal total computing power, including those that use quantum interactions. MPS works with other directorates in appropriate SEBML research areas. For more detail on SEBML, see the NSF-wide Investments section.

For more information on Administration priority programs and NSF investments, please refer to the Overview and NSF-wide Investments sections.

Program Evaluation and Performance Improvement

In February of FY 2010, there will be Committee of Visitors (COV) reviews for the Divisions of Chemistry and Mathematical Sciences. COVs for the Divisions of Materials Research and Astronomical Sciences are planned for FY 2011. The Performance Information chapter provides details regarding the periodic reviews of programs and portfolios of programs by external Committees of Visitors and directorate Advisory Committees. Please see this chapter for additional information.

MPS program evaluations assess program quality and impact, and the results of these evaluation activities are essential in the continued shaping of program directions and emphases. For example, MPS relied on performance information and external program evaluation in deciding to end the Grants for Vertical Integration of Research and Education (VIGRE) program. At NSF's request, the National Research Council of the National Academy of Sciences appointed a committee to conduct an assessment of VIGRE. Overall, the committee found that the goals of the VIGRE program are worthwhile and that VIGRE is an appropriate way to foster these goals. The committee recommended the continuation of VIGRE; however, the committee believed VIGRE should continue only if eight further recommendations are implemented, including allowing international students and postdoctoral fellows to receive financial support through VIGRE projects. This recommendation was particularly problematic as international students cannot be funded on such training grants. Internal review of the VIGRE program's performance information revealed that the two most recent competitions yielded a very small number of proposals, a sign that the program had reached its final stage. Thus, while the overall external evaluation recommended continuation of the program, the low proposal pressure and the fact that the additional recommendations would make the program unsustainable led to the decision to terminate the VIGRE program.

The full external evaluation report may be found at: nap.edu/catalog.php?record_id=12716.

Number of People Involved in MPS Activities

	FY 2009 Omnibus Estimate	FY 2009 ARRA Estimate	FY 2010 Estimate	FY 2011 Estimate
Senior Researchers	7,078	1,544	7,639	7,801
Other Professionals	2,171	376	2,363	2,393
Postdoctorates	2,124	558	2,297	2,341
Graduate Students	7,472	3,757	8,042	8,235
Undergraduate Students	5,553	1,642	5,986	6,120
K-12 Students	501	-	538	552
K-12 Teachers	146	-	157	161
Total Number of People	25,045	7,877	27,022	27,603

MPS Funding Profile

	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Statistics for Competitive Awards:			
Number of Proposals	7,887	8,500	8,700
Number of New Awards	3,128	2,150	2,200
Regular Appropriation	2,006	2,150	2,200
ARRA	1,122	-	-
Funding Rate	39.7%	25.3%	25.3%
Statistics for Research Grants:			
Number of Research Grant Proposals	6,754	7,200	7,400
Number of Research Grants	2,445	1,600	1,650
Regular Appropriation	1,501	1,600	1,650
ARRA	944	-	-
Funding Rate	36.2%	22.2%	22.3%
Median Annualized Award Size	113,207	115,000	117,000
Average Annualized Award Size	138,302	140,000	142,000
Average Award Duration, in years	3.1	3.1	3.1

DIVISION OF ASTRONOMICAL SCIENCES (AST)

\$251,770,000
+\$6,080,000 / 2.5%

AST Funding

(Dollars in Millions)

	FY 2009	FY 2009	FY 2010	FY 2011	Change Over	
	Omnibus	ARRA			FY 2010 Estimate	FY 2011 Request
	Actual	Actual	Estimate	Request	Amount	Percent
AST	\$228.67	\$85.80	\$245.69	\$251.77	\$6.08	2.5%
Research	61.86	54.81	70.26	71.02	0.76	1.1%
<i>STC: Center for Adaptive Optics</i>	2.66	-	-	-	-	N/A
Education	6.27	5.12	7.09	6.63	-0.46	-6.5%
Infrastructure	157.30	25.86	164.42	169.88	5.46	3.3%
<i>Gemini Observatory</i>	18.71	-	19.10	19.58	0.48	2.5%
<i>Atacama Large Millimeter Array (ALMA)</i>	11.00	-	17.57	23.50	5.93	33.8%
<i>Nat'l Astronomy & Ionosphere Ctr (NAIC)</i>	9.60	3.10	8.40	6.00	-2.40	-28.6%
<i>Nat'l Optical Astronomy Observ. (NOAO)</i>	30.48	5.60	31.50	33.33	1.83	5.8%
<i>Nat'l Radio Astronomy Observ. (NRAO)</i>	49.79	5.40	49.52	44.37	-5.15	-10.4%
<i>National Solar Observatory (NSO)</i>	7.83	1.40	9.10	9.51	0.41	4.5%

AST is the federal steward for ground-based astronomy in the U.S., working in partnership with private institutions to enhance overall observing capacity and capability. Research support covers observational, theoretical, computational, and laboratory work to understand the origins and characteristics of planets, the Sun, other stars, our galaxy, extragalactic objects, and the structure and origin of the Universe through awards to individual investigators, small groups, and national facilities. AST supports the development of advanced technologies and instrumentation, the planning and design of future facilities, and management of the electromagnetic spectrum for scientific use. AST provides U.S. funding for operation and maintenance (O&M) of the international Gemini Observatory and the international Atacama Large Millimeter/submillimeter Array (ALMA). AST also supports O&M for the national facilities: NAIC, NOAO, NRAO, and NSO. These major world-class facilities provide access to a wide range of observational resources on a competitive basis and serve thousands of users each year. Funding is also provided to various private facilities with varied arrangements for community access, as part of the ground-based public-private U.S. astronomy system.

In general, about 12 percent of the AST portfolio is available for new research grants. The remaining 88 percent funds continuing grants made in previous years, including facility support at about 54 percent of the division's budget.

Factors Influencing the Allocation Across AST Programs

- Funding for ALMA increases consistent with the planned ramp-up of operations.
- Funding for NAIC, the Arecibo radio telescope, decreases as recommended by the Senior Review of AST-supported facilities and programs. A new cooperative agreement with sufficient funding to preserve a viable base facility is expected to be issued as a result of a solicitation in 2010;
- NSO is now presented separately from NOAO; new, separate, cooperative agreements will be executed in FY 2010;

- The reduction in base funding for NRAO is a planned roll-off of construction funding for the Expanded Very Large Array; and
- Planning continues for a wide array of potential future facilities, coming out of the latest Astronomy and Astrophysics Decadal Survey report by the National Research Council, expected in early FY 2011.

DIVISION OF CHEMISTRY (CHE)**\$247,560,000**
+\$13,830,000 / 5.9%**CHE Funding**

(Dollars in Millions)

	FY 2009	FY 2009	FY 2010	FY 2011	Change Over	
	Omnibus	ARRA			FY 2010	FY 2011
	Actual	Actual ¹	Estimate	Request	Amount	Percent
CHE	\$211.67	\$87.36	\$233.73	\$247.56	\$13.83	5.9%
Research	182.86	63.18	202.25	218.55	16.30	8.1%
<i>STC: Center for Environmentally</i>	2.66	-	-	-	-	N/A
<i>Responsible Solvents and Processes</i>						
<i>Centers for Chemical Innovation</i>	15.50	-	24.00	28.00	4.00	16.7%
<i>Nano Science & Eng Centers</i>	2.85	-	2.85	1.55	-1.30	-45.6%
Education	10.23	9.45	12.30	12.47	0.17	1.4%
Infrastructure	15.27	14.73	15.40	12.40	-3.00	-19.5%
<i>Nat'l High Magn. Field Lab. (NHMFL)</i>	1.50	-	4.06	1.50	-2.56	-63.1%
<i>Nat'l Nanofabrication Infra. Network</i>	0.40	-	0.40	0.40	-	-
<i>(NNIN)</i>						

¹ \$15.0 million of FY 2009 ARRA funding was carried over into FY 2010.

The Division of Chemistry (CHE) supports a large and vibrant research community engaged in fundamental research linked to key national priorities. Basic research in chemistry underpins improving climate models, understanding the environmental health and safety of nanoparticles, developing catalysts that enable sustainability and energy research, and the molecular basis of the life sciences. CHE has recently realigned its programs incorporating input from its stakeholders and partners. The new disciplinary research programs include Chemical Structure; Dynamics and Mechanisms; Chemical Synthesis; Chemical Measurement and Imaging; Theory, Models and Computational Methods; Environmental Chemical Sciences; Chemistry of Life Processes, Chemical Catalysis and Macromolecular, Supramolecular and Nanochemistry. These new programs are poised to collaborate with other agencies and other divisions of NSF.

In general, 38 percent of the CHE portfolio is available for new research grants. The remaining 62 percent funds continuing grants made in previous years.

Factors Influencing the Allocation Across CHE Programs

- The major driver for the increase in Research (+\$16.30 million) is the positive response of the chemistry research community to programmatic realignment within the Chemistry Division. Also, a recategorization of CHE's instrument development program shifted \$3.0 million from Infrastructure into Research. Under its new structure, CHE expects an increase in interdisciplinary proposals that advance fundamental chemical sciences and education, capitalize on FY 2009 ARRA investments, and impact national priorities.
- Within the Research portfolio, CHE has significant investments planned for key priority areas, including Science, Engineering and Education for Sustainability (SEES)/Energy and Climate Research (\$50.50 million), Science and Engineering Beyond Moore's Law (\$9.68 million), and Environmental Sciences (\$25.15 million);

- The request also supports the Centers for Chemical Innovation program, which inspires research on strategic, transformative “big questions” in basic chemical research. CHE will invest an additional \$4.0 million for a total of \$28.0 million. The request reflects the establishment of one additional Phase II Center (for a total of six) and four new Phase I Centers (for a total of twelve). One Nano Center is phasing out in FY 2011 for a decrease of \$1.30 million;
- The Discovery Corps Fellowship Program will merge with the American Competitiveness in Chemistry Fellowship Program, which provides consistent bridges to the top ranked young talent in chemistry as they progress to the professoriate. CHE will increase its contribution to the Graduate Research Fellowship Program from \$1.59 million to \$2.56 million. The Undergraduate Research Collaborative program will phase out in FY 2011 resulting in a decrease of \$1.0 million; and
- Within infrastructure, the CHE Request includes increased investments (+\$3.0 million) in a multi-user instrumentation acquisition program and other research resources. The FY 2010 Estimate for the National High Magnetic Field Laboratory (NHMFL) includes a one-time award of \$2.56 million for development of a magnet. In FY 2011, base funding for NHMFL is maintained at \$1.50 million.

DIVISION OF MATERIALS RESEARCH (DMR)**\$319,370,000**
+\$16,700,000 / 5.5%**DMR Funding**
(Dollars in Millions)

	FY 2009	FY 2009	FY 2010	FY 2011	Change over	
	Omnibus	ARRA			FY 2010 Estimate	FY 2011 Request
	Actual	Actual	Estimate	Request	Amount	Percent
DMR	\$282.52	\$108.17	\$302.67	\$319.37	\$16.70	5.5%
Research	221.61	75.46	220.78	230.87	10.09	4.6%
<i>Materials Research Sci. & Engr. Ctrs.</i>	60.84	-	56.70	63.00	6.30	11.1%
<i>Nanoscale Sci. & Engr. Centers</i>	8.04	-	8.31	4.81	-3.50	-42.1%
<i>STC: Materials and Devices for Inform. Technology Research</i>	4.00	-	3.32	2.66	-0.66	-19.9%
<i>STC: NSF Center for Layered Polymeric Systems</i>	4.00	-	4.00	4.00	-	-
Education	10.22	3.82	9.48	10.05	0.57	6.0%
Infrastructure	47.24	28.89	67.93	73.82	5.89	8.7%
<i>Nat'l High Magn. Field Lab. (NHMFL)</i>	25.00	5.00	31.50	32.50	1.00	3.2%
<i>Cornell High Ener. Synchr. Source (CHESS)/ Cornell Electron Storage Ring (CESR)</i>	4.10	13.70	9.00	13.45	4.45	49.4%
<i>Nat'l Nanofabrication Infra. Network (NNIN)</i>	2.98	-	2.65	2.98	0.33	12.5%
<i>Other MPS Facilities¹</i>	5.60	4.99	7.02	7.65	0.63	9.0%

¹ Other MPS Facilities: SRC, CHRNS, ChemMatCARS

Awards from DMR cover a wide spectrum of materials research and education ranging from condensed matter and materials physics, solid-state and materials chemistry, multifunctional, hybrid, electronic, photonic, metallic, superconducting, ceramic, polymeric, biomaterials, composites, and nanostructures. These awards enable the DMR community to make new discoveries about the fundamental behavior of matter and materials from the biological and molecular realm to metallic nanostructures. The community creates new materials and new knowledge about materials, such as their optoelectronic, structural, and thermoelectric properties. Materials phenomena are also studied, including carrier charge transport and superconductivity. Awards enable researchers to address questions about materials that often transcend traditional scientific and engineering disciplines and lead to new technologies. Preparing the next generation of materials researchers, developing and supporting the instruments and facilities that are transforming the field, and sharing the excitement and significance of materials research with students (K-12 and beyond) and the public are also important aspects of the Division's mission.

In general, 21 percent of the DMR portfolio is available for new research grants. The remaining 79 percent funds continuing grants made in previous years.

Factors Influencing the Allocation Across DMR Programs

- Increases in the Research portfolio (+\$10.09 million) emphasize materials research relevant to Science and Engineering Beyond Moore's Law (SEBML), Cyber-Enabled Discovery and Innovation (CDI), and Science, Engineering, and Education for Sustainability (SEES)/Energy Research;
- Centers include the Materials Research Science and Engineering Centers (MRSEC) competition, which will be run in FY 2011 (allowing the FY 2006 class to re-compete) with a new format involving larger and smaller awards. Center decreases include the phase-out of a "sunsetting" Science and

Technology Center (STC) at the University of Washington and the closing of five Nanoscale Science and Engineering Centers (NSEC) as they complete their 10-year life cycle;

- The Education portfolio emphasizes a continued strong commitment to Research Experiences for Undergraduates (REU) as well as the Integrative Graduate Education and Research Traineeship (IGERT) program, both level with FY 2010. The Graduate Research Fellowship (GRF) program is increased 62 percent (+\$310,000) over FY 2010 and the ADVANCE program is increased 23.9 percent (+260,000) over FY 2010; and
- Facilities include a \$4.45 million increase for the operation of the Cornell High Energy Synchrotron Source/Cornell Electron Storage Ring (CHESS/CESR) as it converts from a high energy physics facility to a photon science facility, where research utilizing X-ray synchrotron radiation is conducted. This CHESS/CESR facility serves also as a platform for coherent light source research and development. FY 2011 provides phase-out support for the Synchrotron Radiation Center (SRC) as well as increased support for upgrades and operational costs of the National High Magnetic Field Laboratory (NHMFL), the Center for High Resolution Neutron Scattering (CHRNS) at NIST, and ChemMatCARS at the Advanced Photon Source. Funding (\$4.24 million) is requested in FY 2011 for research and development of a potential future energy recovery linac project. This project is co-funded by the MPS Office of Multidisciplinary Activities (OMA) at \$3.0 million for a total investment of \$7.24 million.

DIVISION OF MATHEMATICAL SCIENCES (DMS)

\$253,460,000
+\$12,080,000 / 5.0%

DMS Funding						
(Dollars in Millions)						
	FY 2009	FY 2009			Change Over	
	Omnibus	ARRA	FY 2010	FY 2011	FY 2010 Estimate	
	Actual	Actual	Estimate	Request	Amount	Percent
DMS	\$224.84	\$97.34	\$241.38	\$253.46	\$12.08	5.0%
Research	194.82	75.11	209.52	223.17	13.65	6.5%
<i>Centers for Analysis and Synthesis</i>	<i>0.10</i>	-	<i>0.10</i>	<i>0.10</i>	-	-
Education	25.56	22.23	27.15	25.05	-2.10	-7.7%

NSF plays a critical role in the mathematical sciences, as it provides more than 60 percent of all federal support for basic research in the Nation’s colleges and universities. In certain core areas of the mathematical sciences this percentage is even higher, since NSF supports a broader range of fundamental and multidisciplinary research topics than do other federal agencies.

DMS supports research at the frontiers of fundamental, applied and computational mathematics and statistics and enables discovery in other fields of science and engineering. In turn, advances in science and engineering – especially those generating large data sets or that are driven by powerful computing environments – require development of ever more sophisticated mathematical tools. DMS plays a key role in training the Nation’s scientific and engineering workforce.

DMS supports core research programs in algebra & number theory; analysis; applied mathematics; computational mathematics; geometry & topology; mathematical biology; probability, combinatorics & foundations; and statistics. In addition, DMS supports national mathematical sciences research institutes; postdoctoral, graduate and undergraduate training opportunities; and infrastructure, such as workshops, conferences, and equipment.

In general, 60 percent of the DMS portfolio is available for new research grants. The remaining 40 percent is used primarily to fund continuing grants made in previous years.

In FY 2009, DMS received 2,306 research proposals and made 844 awards using the FY 2009 appropriation and ARRA funds for a funding rate of 37 percent.

Factors Influencing the Allocation Across DMS Programs

- *Core Research Programs (+\$13.55 million to a total of \$219.74 million).* Maintaining adequate support for investigator initiated research in the mathematical sciences is the division’s top priority. DMS continues support for Mathematical Sciences Research Institutes in FY 2011.
- *Climate and Energy Research (+\$2.50 million to a total of \$9.50 million).* As part of the Science, Engineering, and Education for Sustainability (SEES) portfolio, DMS will support development of potentially transformative mathematical, statistical, and computational methods needed for analysis and simulation of climate models and will increase its investment in the CHE-DMR-DMS Solar Energy Initiative (SOLAR), a program supporting multi-disciplinary teams engaged in research on the efficient harvesting, conversion, and storage of solar energy.
- *Science and Engineering Beyond Moore’s Law (SEBML) (+\$1.20 million to a total of \$3.95 million).* In parallel with Moore’s Law for hardware, SEBML continues the algorithmic “Moore’s Law”, i.e.,

the exponential increase in speed of basic computations due to innovative new algorithms, and develops new mathematical frameworks for computation.

- *MPS-Life Sciences Interface* (+\$2.39 million to a total of \$2.39 million). This interdisciplinary activity supports potentially transformative research in mathematical and computational biology.
- *Consolidation of Workforce and Infrastructure Portfolios* (Net reprogramming of \$3.54 million). DMS will terminate the following programs: Vertical Integration in Research and Education (VIGRE), Proactive Recruitment in Introductory Science and Mathematics (PRISM), Scientific Computing Research Environments in the Mathematical Sciences (SCREMS), Interdisciplinary Grants in the Mathematical Sciences (IGMS), University-Industry Cooperative Research Programs in the Mathematical Sciences, and Computational Science Training for Undergraduates in the Mathematical Sciences (CSUMS). The Division will re-invest savings of this consolidation in higher priority workforce and infrastructure programs.

DIVISION OF PHYSICS (PHY)

\$298,190,000
+\$8,150,000 / 2.8%

PHY Funding
(Dollars in Millions)

	FY 2009	FY 2009	FY 2010	FY 2011	Change Over	
	Omnibus	ARRA			FY 2010 Estimate	FY 2011 Request
	Actual	Actual	Estimate	Request	Amount	Percent
PHY	\$262.47	\$96.30	\$290.04	\$298.19	\$8.15	2.8%
Research	156.11	88.93	173.79	193.54	19.75	11.4%
<i>STC: Center for Biophotonics Science & Eng.</i>	3.96	-	3.28	2.62	-0.66	-20.1%
<i>Nanoscale Sci. Eng. Centers</i>	2.40	-	2.40	1.14	-1.26	-52.5%
Education	6.91	4.08	9.42	10.61	1.19	12.6%
Infrastructure	95.47	3.29	102.65	89.30	-13.35	-13.0%
<i>Cornell High Ener. Synchr. Source (CHESS)/</i>	8.50	1.29	-	-	-	N/A
<i>Cornell Electron Storage Ring (CESR)</i>						
<i>Large Hadron Collider</i>	18.00	-	18.00	18.00	-	-
<i>Large Interfer. Grav. Wave Observatory (LIGO)</i>	30.30	-	28.50	30.30	1.80	6.3%
<i>Nat'l Superconducting Cyclotron Lab (NSCL)</i>	20.50	2.00	21.00	21.50	0.50	2.4%
<i>Ice Cube</i>	2.16	-	2.15	2.50	0.35	16.3%

PHY supports fundamental research addressing frontier areas of physics that lead to the understanding of the make-up of the Universe, from the formation of stars and galaxies to the principles of life processes on earth. This research is spread across a range of physics subfields: atomic, molecular, optical and plasma physics, elementary particle physics, gravitational physics, nuclear physics, particle and nuclear astrophysics, physics of living systems, physics at the information frontier, and theoretical physics. PHY is the primary supporter of all U.S. research in gravitational physics and the leading supporter of fundamental research in atomic, molecular, and optical physics in the U.S. PHY is a partner with the Department of Energy (DOE) in support of elementary particle physics, nuclear physics, and plasma physics. PHY also has the only U.S. program designed for the support of physics research in living systems. The development of the most advanced cutting-edge computational resources, innovative technology, and new instrumentation is a key part of physics research, and tools developed by the physics community continuously have major impact in other scientific and engineering fields.

In general, 14 percent of the PHY portfolio is available for new research grants. The remaining 86 percent is used primarily to fund continuing grants made in previous years (48 percent) and to support operations and maintenance for four facilities that are a key part of the division portfolio (25 percent): LIGO, LHC, NSCL, and IceCube.

Factors Influencing the Allocation Across PHY Programs

- An increase of \$19.75 million to a total of \$193.54 million for Research will enable increased support of projects at the discovery frontiers of physics. Special emphasis will be given to:
 - Increases in those programs that support quantum information science as part of Science and Engineering Beyond Moore’s Law (+\$3.0 million to a total of \$6.0 million);
 - Physics research on living systems (+\$2.40 million to a total of \$9.90 million);

- Support for increasing the number of junior investigators through CAREER awards (+\$1.40 million to a total of \$7.0 million); and
- Center decreases include the phase-out of a “sunsetting” Science and Technology Center (STC), the Center for Biophotonics Science and Engineering (-\$660,000), and the closing of one Nano Center (-\$1.26 million) as they complete their 10-year life cycle.
- Funding for Infrastructure decreases by \$13.35 million to a total of \$89.30 million. Changes include:
 - An increase of \$1.80 million in funding for the LIGO facility to a total of \$30.30 million reflects a change in the operations and maintenance profile to coordinate with the construction profile for the Advanced LIGO project. (See the Major Research Equipment and Facilities Construction (MREFC) chapter for more details on Advanced LIGO);
 - An increase of \$500,000 for NSCL to a total of \$21.50 million maintains the funding level at the planned funding profile;
 - An increase of \$350,000 for IceCube to a total of \$2.50 million as part of the post-construction ramp-up in operations; and
 - A total of \$12.0 million is requested for pre-construction planning and related research and development for the Deep Underground Science and Engineering Laboratory (DUSEL), reflecting the planned conclusion of preliminary design activities in FY 2011. Funding for these activities was provided in FY 2009 and FY 2010. The MPS Office of Multidisciplinary Activities provides an additional \$700,000, for total FY 2011 of \$12.70 million. The next step in the planning phase will be an interagency review of NSF and DOE’s roles and responsibilities for this proposed joint project. A key resource for this interagency review will be input from the ongoing study of DUSEL by the National Research Council.

Detailed narratives on each facility can be found in the Facilities chapter.

OFFICE OF MULTIDISCIPLINARY ACTIVITIES (OMA)

\$39,560,000
+\$1,230,000 / 3.2%

OMA Funding
(Dollars in Millions)

	FY 2009	FY 2009	FY 2010 Estimate	FY 2011 Request	Change Over	
	Omnibus Actual	ARRA Actual			FY 2010 Estimate	FY 2011 Request
OMA	\$33.70	-	\$38.33	\$39.56	\$1.23	3.2%
Research	23.55	-	34.49	35.20	0.71	2.1%
<i>Center for Analysis & Synthesis</i>	<i>0.10</i>	-	<i>0.10</i>	<i>0.10</i>	-	-
Education	2.48	-	0.10	0.20	0.10	100.0%
Infrastructure	7.30	-	3.33	3.70	0.37	11.1%
<i>NNIN</i>	<i>0.33</i>	-	<i>0.33</i>	-	<i>-0.33</i>	<i>-100.0%</i>
<i>Cornell High Ener. Synchr. Source (CHESS)/</i>	<i>1.00</i>	-	-	-	-	<i>N/A</i>
<i>Cornell Electron Storage Ring (CESR)</i>						

OMA enables and facilitates MPS support of novel, challenging, or complex projects of varying scale, in both research and education, which are not readily accommodated by traditional organizational structures and procedures. This is done primarily in partnership with MPS disciplinary divisions and is especially directed at activities by multi-investigator, multidisciplinary teams.

Factors Influencing the Allocation Across OMA

- In FY 2011, OMA will focus on multidisciplinary research addressing the fundamental science critical to advancing computing and communications technologies beyond Moore’s Law; multidisciplinary research into controlling, manipulating, and exploring the behavior of quantum matter and the limitations of quantum information processing; multidisciplinary research emphasizing the mathematical and physical scientific foundations of energy sustainability, climate, and the environment; multidisciplinary research at the interface between the mathematical and physical sciences and the life sciences to provide insight into the molecular basis of life processes; and team efforts aimed at developing next-generation instrumentation to enable fundamental advances across a wide spectrum of disciplines.
- OMA will continue to support the National Institute for Mathematical and Biological Synthesis, a Center for Analysis and Synthesis primarily managed by the Directorate for Biological Sciences, at the level of \$100,000 in FY 2011.
- OMA will begin co-funding of research and development for a potential future energy recovery linac project in FY 2011 at \$3.0 million.
- OMA support for the National Nanofabrication Infrastructure Network will end in FY 2010 resulting in a \$330,000 decrease in FY 2011. This decrease is offset by an increase in the Division of Materials Research.
- OMA investment in pre-construction planning for the Deep Underground Science and Engineering Laboratory (DUSEL) is ramping down by \$2.30 million for a total of \$700,000 with the conclusion of preliminary design activities.

