

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

\$1,295,560,000
-\$4,242,000 / -0.3%

MPS Funding

(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over FY 2014 Estimate	
				Amount	Percent
Astronomical Sciences (AST)	\$232.17	\$239.06	\$236.24	-\$2.82	-1.2%
Chemistry (CHE)	229.39	235.79	237.23	1.44	0.6%
Materials Research (DMR)	291.09	298.01	298.99	0.98	0.3%
Mathematical Sciences (DMS)	219.02	225.64	224.40	-1.24	-0.5%
Physics (PHY)	250.45	266.30	263.70	-2.60	-1.0%
Office of Multidisciplinary Activities (OMA)	27.22	35.00	35.00	-	-
Total, MPS	\$1,249.34	\$1,299.80	\$1,295.56	-\$4.24	-0.3%

Totals may not add due to rounding.

About MPS

MPS supports fundamental research that serves the Nation by making discoveries at the forefront of science. These discoveries are the seed corn of future innovation and many of them ultimately transform the lives of our citizens. The primary goal of the FY 2015 Request for MPS is supporting a robust collection of disciplinary and multidisciplinary research programs that allow the university research enterprise to foster high-risk, long-term endeavors and serve as the training ground for the technical workforce of the future. The research programs in MPS provide the foundation of basic research in astronomical sciences (AST), chemistry (CHE), materials research (DMR), mathematical sciences (DMS), and physics (PHY) that transforms the frontiers of science.

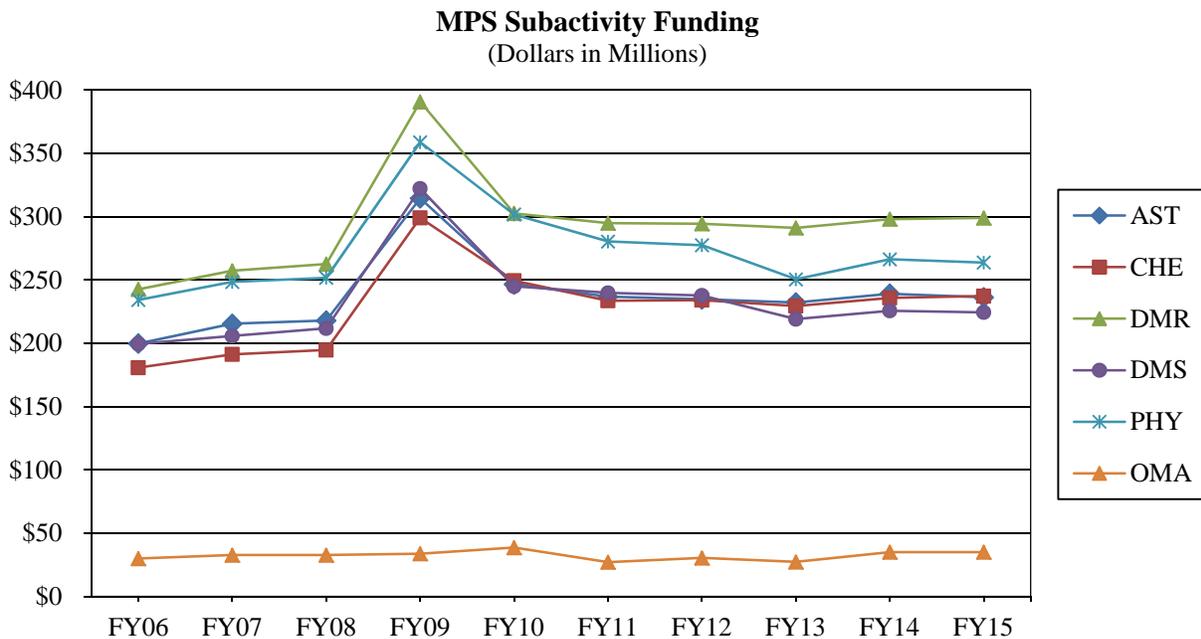
Awards in MPS core programs drive new discoveries that are building blocks of innovation. Much of this funding is in the form of individual investigator awards, but MPS also makes larger awards that include centers, institutes, and multi-user facilities. Examples of larger awards are the midscale research infrastructure programs in AST, DMR, and PHY, which address the need for intermediate-scale projects in these three divisions. AST and PHY launched their midscale research infrastructure programs last year, and in this Request, DMR initiates its own. The directorate will also use its core program funding to seize new opportunities in optics and photonics research. MPS division programs respond to special intellectual opportunities and reflect careful choices to identify directions that provide the greatest return on the research investment.

Facilities are an integral part of MPS and enable unique science that would be impossible without the special resources of a shared, multi-user environment. Some of these facilities are observatories for photons, neutrinos, or gravitational waves and others provide unique resources such as the largest controlled magnetic fields in the world or beams of rare ions. The FY 2015 Request provides increased funding in AST for the Atacama Large Millimeter/Submillimeter Array (ALMA) and in PHY for the Laser Interferometer Gravitational-Wave Observatory (LIGO) as they move from construction into full operation. Stewardship of the facilities portfolio and the balance among the different awards programs are critical issues for MPS and have engendered extensive community consultation. The FY 2015 Request places funds in the Office of Multidisciplinary Activities for careful assessment of environmental issues

and for the costs of transitions and potential partnerships as MPS looks to the future of its facilities in a complex funding environment.

The directorate continues to actively participate in Foundation-wide initiatives. MPS maintains funding in Science, Engineering, and Education for Sustainability (SEES), and through AST, continues to partner with the Directorates for Engineering (ENG) and Computer and Information Science and Engineering (CISE) in Enhancing Access to the Radio Spectrum (EARS). The directorate maintains its investments in other cross-Foundation priorities such as Research at the Interface between Biological and Mathematical and Physical Sciences (BioMaPS), including research to help understand the brain at all levels, Cyber-Enabled Materials, Manufacturing, and Smart Systems (CEMMSS), which includes both Advanced Manufacturing and Designing Materials to Revolutionize and Engineer the Future (DMREF), Secure and Trustworthy Cyberspace (SaTC), and Innovation Corps (I-Corps). Core research funds also contribute to research in Clean Energy Technology and support the Research Experiences for Undergraduates (REU) program.

MPS provides about 46 percent of the federal funding for basic research at academic institutions in the mathematical and physical sciences.



FY 2009 funding reflects both the FY 2009 omnibus appropriation and funding provided through the American Recovery and Reinvestment Act of 2009 (P.L. 111-5).

FY 2015 Summary by Division

- AST's FY 2015 Request will provide support for individual investigator awards and astronomical observatories, as well as investment in EARS and the major MPS priority area of midscale research infrastructure. Funding for individual research is balanced against funding for facilities, and among facilities, ALMA and the Daniel K. Inouye Solar Telescope (DKIST)¹ receive increased funding while the Large Synoptic Survey Telescope (LSST) transitions into construction.
- CHE's FY 2015 Request provides enhanced support for core programs and features a focus on Sustainable Chemistry, Engineering, and Materials (SusChEM) as an important component in the NSF-wide SEES investment. CHE will continue commitment to research in the areas of clean energy technologies, advanced manufacturing, and DMREF. CHE also strongly supports research at the interfaces with biology and materials research, within both experimental and theoretical/computational frameworks.
- DMR's FY 2015 Request includes plans to increase its portfolio of individual investigator awards, specifically in NSF focus areas where advanced materials are essential such as SEES, CEMMSS through DMREF, and BioMaPS. DMR will initiate a midscale research infrastructure program, Materials Innovation Platforms (MIP), and will continue a strong commitment to research in the area of clean energy technologies.
- DMS's FY 2015 Request is focused on enhancing support for frontier research, training a diverse group of researchers in mathematical and statistical sciences with computational skills, investing in mathematical sciences institutes and network structures, and providing support through efficient mechanisms to foster multidisciplinary research activities in, but not limited to, Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21), SEES, BioMaPS, CEMMSS, and SaTC.
- PHY's FY 2015 Request includes continued support for individual investigator awards, particularly those in NSF-wide priority areas such as CIF21 and BioMaPS. PHY also requests increased funding for investigators using its major facilities, and for operations and maintenance of these facilities. In FY 2015, PHY will maintain its program in accelerator science and will also increase its commitment to the MPS priority area of midscale research infrastructure.
- OMA will continue its role of providing support for multidisciplinary research and activities in education and broadening participation. OMA will emphasize research relevant to NSF priorities such as SEES, CIF21, BioMaPS (including research related to the Administration's BRAIN Initiative), and CEMMSS. OMA will coordinate MPS activities related to I-Corps, NSF Research Traineeship (NRT) program, and INSPIRE. In addition, OMA will support responsible decisions regarding portfolio composition, including studies of possible environmental issues, stewardship transition costs, or partnership start-up costs; in FY 2015, the focus will be on implementing the recommendations of the AST Portfolio Review.

¹ On December 15, 2013, the Advanced Technology Solar Telescope was renamed after the late Senator Daniel K. Inouye.

Major Investments

MPS Major Investments

(Dollars in Millions)

Area of Investment	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over	
				FY 2014 Estimate Amount	Percent
Advanced Manufacturing	\$37.13	\$45.00	\$37.20	-\$7.80	-17.3%
BioMaPS	14.89	11.62	11.96	0.34	2.9%
CAREER	73.32	64.90	65.65	0.75	1.2%
CEMMSS	37.13	45.00	37.20	-7.80	-17.3%
CIF21	25.60	21.00	11.50	-9.50	-45.2%
Clean Energy Technology	119.63	153.95	140.82	-13.13	-8.5%
Cognitive Science and Neuroscience	-	1.60	3.90	2.30	143.8%
DMREF	21.75	20.00	11.00	-9.00	-45.0%
EARS	6.00	7.00	6.00	-1.00	-14.3%
I-Corps	0.90	2.50	1.00	-1.50	-60.0%
NRT ¹	5.29	4.46	4.48	0.02	0.4%
SaTC	0.50	2.00	0.50	-1.50	-75.0%
SEES	33.42	21.50	22.50	1.00	4.7%
Midscale Research Infrastructure	-	20.75	29.00	8.25	39.8%

Major investments may have funding overlap and thus should not be summed.

¹ The FY 2013 Actual level represents Integrative Graduate Education and Research Traineeship (IGERT) program funding. Outyear commitments for IGERT are included in the NRT line and are \$2.50 million in FY 2014 and \$3.93 million in FY 2015.

- **Advanced Manufacturing:** MPS funding for all advanced manufacturing research will total \$37.20 million (-\$7.80 million). Investments will be in nanomanufacturing, industry/university partnerships, DMREF, and Centers programs. Advanced manufacturing is an area of continued interest, especially in light of the heightened emphasis on sustainability (via SusChEM). Reductions in funding are due to competing priorities within the individual investigator portfolio.
- **Research at the Interface of the Biological, Mathematical, and Physical Sciences (BioMaPS):** Support will increase by \$340,000 to a total of \$11.96 million. The study of biological complexity necessitates new developments in mathematical and physical sciences, leading to new theoretical and experimental approaches. Interdisciplinary efforts in partnership with the Directorates for Biological Sciences (BIO) and ENG will result in accelerated understanding of biological systems, as well as uncovering of new mathematical and physical concepts, leading to innovations in such areas as renewable fuels, bio-based materials, bio-imaging, and bio-inspired sensors.
- **CAREER:** MPS continues its strong commitment to early career faculty development (+\$750,000 to a total of \$65.65 million). CAREER awards support young investigators who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the context of the mission of their organizations. The purpose and scope of the CAREER program varies across the cultures of the five MPS Divisions. In some disciplinary communities, a CAREER award is a widely accepted mechanism for developing new faculty, while in others it is an honor reserved for a few exceptionally meritorious young scientists.

- Cyber-enabled Materials, Manufacturing, and Smart Systems (CEMMSS): Support decreases by \$7.80 million to a total of \$37.20 million. In partnership with ENG and CISE, MPS will continue a strong CEMMSS investment with a focus on Designing Materials to Revolutionize and Engineer our Future (DMREF) as discussed below. This is a major effort to design and synthesize materials with specific and desired functions or properties through synergistic integration of theory and computation, experiment, and data mining. Reductions in funding are due to competing priorities within the individual investigator portfolio.
- Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21): Support decreases by \$9.50 million to a total of \$11.50 million. All MPS divisions, including the Office of Multidisciplinary Activities, contribute to computational and data-enabled science and engineering activities, including fundamental mathematical algorithms, software, data services, and network infrastructure needed to serve scientists wherever they are located. Reductions in funding are due to competing priorities within the individual investigator portfolio.
- Clean Energy Technology: Investment decreases by \$13.13 million to a total of \$140.82 million. MPS continues to refine the categorization of Clean Energy Technology, counting appropriate research in its core programs in fuel cells, solar research and development, battery research, biomass conversion, hydrocarbon conversion, and energy storage. The funding decrease is chiefly due to the sunset of special competitions focused on energy-related research, such as the SOLAR solicitation.
- Cognitive Science and Neuroscience: MPS increases its commitment to this area by \$2.30 million to a total of \$3.90 million. CHE, DMR, DMS, and PHY all contribute to this growing area of research relevant to the national BRAIN initiative.
- Designing Materials to Revolutionize and Engineer our Future (DMREF): As the direct response to the national Materials Genome Initiative (MGI), DMREF is an important priority for MPS. Funding is \$11.0 million (-\$9.0 million). Reductions in funding are due to competing priorities within the individual investigator portfolio.
- Enhancing Access to the Radio Spectrum (EARS): MPS slightly decreases its support by \$1.0 million to a total of \$6.0 million for the basic research that underpins EARS, an on-going partnership with ENG and CISE. The MPS investment will concentrate on the materials science, radio frequency interference mitigation, advanced receiver design, and mathematical foundations of radio spectrum access and hardware design, as well as key national and international regulatory and public policy foundations for radio spectrum management.
- NSF Innovation Corps (I-Corps): MPS will reduce its investment in the I-Corps program (-\$1.50 million to \$1.0 million). Demand from the MPS community for this program has not been consistent with higher funding levels.
- NSF Research Traineeship (NRT): In FY 2015 MPS will participate in the NSF-wide activity, NSF Research Traineeship (NRT) program, which is a modernization of the Integrative Education and Research Traineeship (IGERT) program. For more information regarding NRT, see the Major Investments in Science, Technology, Engineering, and Mathematics (STEM) Graduate Education narrative in the NSF-Wide Investments chapter.
- Science, Engineering, and Education for Sustainability (SEES): MPS will increase its investment in SEES by \$1.0 million to a total of \$22.50 million. Within this amount, MPS will focus on the SusChEM, including critical materials, hazards, and food systems.

- Secure and Trustworthy Computing (SaTC): Support for SaTC decreases by \$1.50 million (to a total of \$500,000). MPS will partner with CISE to support frontier research needed to keep the Nation’s data confidential and transactions secure. Reductions in funding are due to competing priorities within the individual investigator portfolio.
- Midscale Research Infrastructure: MPS expands this directorate top-priority program (+\$8.25 million to a total of \$29.0 million). Begun in AST and PHY in FY 2014, a large initial investment of \$8.0 million will be made in DMR in FY 2015. This funding addresses the major gap between small laboratory-scale instrumentation and large multi-user facilities.

MPS Funding for Centers Programs and Facilities

MPS Funding for Centers Programs

(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over FY 2014 Estimate	
				Amount	Percent
Total, Centers Programs	\$88.37	\$93.74	\$95.26	\$1.52	1.6%
Centers for Analysis and Synthesis (DMS)	0.10	0.10	0.10	-	-
Centers for Chemical Innovation (CHE)	30.19	29.25	32.00	2.75	9.4%
Materials Centers (DMR)	46.51	56.00	56.00	-	-
Nanoscale Science & Engineering Centers (CHE, DMR, PHY)	7.57	1.20	0.52	-0.68	-56.7%
Science & Techology Centers (DMR)	4.00	7.19	6.64	-0.55	-7.6%

Totals may not add due to rounding.

For detailed information on individual centers, please see the NSF-Wide Investments chapter.

- Centers for Chemical Innovation: The CCI program inspires research on strategic, transformative "grand challenges" in chemical research. CCI awards are strengthened by direct links to chemical industry and governmental laboratories, which encourage successful transitions from the lab to innovation to societal applications. In FY 2015, MPS expects to support nine Phase II CCIs – eight continuing and one new. The total funding required to support nine Phase II CCIs is \$36.0 million. Of this amount, \$32.0 million is provided in this Request; the remaining \$4.0 million is provided via forward funding from prior years through the MPS Office of Multidisciplinary Activities and for a specific center through an interagency agreement with NASA.
- Materials Centers: The Materials Centers advance materials research through collaborations of groups of principal investigators, and provide students with a rich, interdisciplinary education. The Centers address fundamental research problems of intellectual and strategic importance that will advance U.S. competitiveness. In FY 2015, MPS expects to support 18 centers, all in continuing grant increments, pending successful annual reviews. These 18 centers come from two cohorts: 14 on-going centers from FY 2008 are re-competing in FY 2014 along with new proposals, with funding available for nine awards; and nine on-going centers from FY 2011 are expected to re-compete in FY 2017. FY 2015 funding at \$56.0 million is flat with FY 2014 Estimate.
- Nanoscale Science & Engineering Centers (NSEC): Funding totals \$520,000 (-\$680,000). Support decreases due to expiring awards, as planned, in FY 2014. Support continues for new efforts at

continuing NSECs, \$125,000 each from CHE and DMR and \$20,000 from PHY. These awards are focused on nanoscience and the environmental and health effects of nanoparticles.

MPS Funding for Facilities

(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over FY 2014 Estimate	
				Amount	Percent
Total, Facilities	\$270.78	\$271.42	\$277.87	\$6.45	2.4%
Arecibo Observatory	5.00	4.50	4.00	-0.50	-11.1%
Atacama Large Millimeter Array (ALMA)	32.92	34.27	40.17	5.90	17.2%
Cornell High Energy Synchrotron Source (CHESS)	20.00	10.00	10.00	-	-
Daniel K. Inouye Solar Telescope (DKIST)	2.00	2.00	7.00	5.00	250.0%
Gemini Observatory	18.15	19.59	20.61	1.02	5.2%
IceCube Neutrino Observatory (IceCube)	3.45	3.45	3.45	-	-
Large Hadron Collider (LHC)	18.00	17.37	18.00	0.63	3.6%
Large Synoptic Survey Telescope (LSST)	7.50	6.50	-	-6.50	-100.0%
Laser Interferometer Gravitational-wave Observatory (LIGO)	30.50	36.43	39.43	3.00	8.2%
National High-Magnetic Field Laboratory (NHMFL)	31.62	32.63	33.67	1.04	3.2%
National Nanotechnology Infrastructure Network (NNIN)	2.98	2.88	2.88	-	-
National Optical Astronomy Observatory (NOAO)	25.50	25.50	25.50	-	-
National Radio Astronomy Observatory (NRAO)	41.00	43.14	40.00	-3.14	-7.3%
National Solar Observatory (NSO) ¹	8.00	8.00	8.00	-	-
National Superconducting Cyclotron Laboratory (NSCL) (MSU Cyclotron)	21.50	22.50	22.50	-	-
Center for High Resolution Neutron Scattering (CHRNS)	2.66	2.66	2.66	-	-

Totals may not add due to rounding.

¹The total presented in FY 2015 does not include \$5.0 million for operations and maintenance support for the DKIST facility construction project. That funding is captured within the total presented on the DKIST line above.

For detailed information on individual facilities, please see the Facilities chapter.

MPS has preserved or increased operations and maintenance budgets for most facilities in order to maintain and enhance operations. A few facilities will see lowered budgets as explained below and in the Facilities chapter.

- Arecibo: AST funding for the Arecibo radio telescope decreases (-\$500,000 to a total of \$4.0 million), consistent with a long-term agreement between MPS and the Directorate for Geosciences (GEO) for the 5-year duration of the Arecibo cooperative agreement (ending in FY 2016).
- ALMA: Funding (+\$5.90 million to a total of \$40.17 million) constitutes the final ramp to full operations of ALMA, supporting both Chilean operations and core science support activities in North America.

- **CHES:** The request for CHES (no change from FY 2014 for a total of \$10.0 million) will support this national user facility for work in cancer research, new materials for electronics, aircraft, biotechnology, batteries, fuel cells, solar cells, and other energy applications. In FY 2014, the Directorates of Biological Sciences (BIO) and Engineering (ENG) became partners in funding this facility, each contributing \$5.0 million per year.
- **DKIST:** Of total funding (\$7.0 million, +\$5.0 million), the \$5.0 million increase is for the beginning of operations support for DKIST through the National Solar Observatory. This includes support for the development of the operations and data center concepts as DKIST begins to move toward its fully operational state in FY 2019. The remaining \$2.0 million (no change over FY 2014 Estimate) funds the cultural mitigation process for DKIST construction. (See the MREFC chapter for more on DKIST.)
- **Gemini:** Increased support for Gemini (+\$1.02 million to a total of \$20.61 million) represents an increment in operations and maintenance funding (+\$430,000 to \$18.02 million) committed to the international Gemini partnership as well as an increment in the Instrument Development Fund (+\$590,000 to \$2.59 million).
- **LHC:** FY 2015 support for operations of the ATLAS and CMS detectors at the Large Hadron Collider (LHC) during the first period of data-taking after the maintenance period of 2013-2014 will increase by \$0.63 million to \$18.0 million.
- **LSST:** Directorate design and development funding ends for LSST (-\$6.50 million to zero) as the facility moves into the construction phase. (See the MREFC chapter for more on LSST).
- **LIGO:** Support for the Laser Interferometer Gravitational Wave Observatory is increased by \$3.0 million to a total of \$39.43 million as the Advanced LIGO project is completed and full-time operation of the upgraded facility gets underway. (See the MREFC chapter for more on Advanced LIGO.)
- **NHMFL:** Funds are requested (+\$1.04 million for a total of \$33.67 million) to continue transformational research using high magnetic fields. This facility serves researchers in fields ranging from biology to materials to condensed matter physics.
- **NSO:** The total presented (\$8.0 million, no change) does not include \$5.0 million for the beginning of the ramp up to full operations of DKIST. That funding is captured within the DKIST line in the table above.
- **NRAO:** A reduction of -\$3.14 million (to a total of \$40.00 million) represents a return to the prioritization of ALMA over domestic NRAO operations, as endorsed by the astronomy research community in advisory committee reports in 2006 and 2012.
- **NSCL:** Support for the National Superconducting Cyclotron Laboratory (NSCL) is kept constant at \$22.50 million.

Summary and Funding Profile

MPS supports investment in core research and education as well as research infrastructure, including a growing midscale research infrastructure program.

In FY 2015 MPS will spend \$95.26 million for Centers, accounting for 7.3 percent of the MPS budget. This total is up from the FY 2014 Estimate, as MPS is increasing its investments in the Centers for Chemical Innovation. Centers are an important modality for MPS sciences as research in many MPS-supported disciplines has evolved to more collaborative and interdisciplinary approaches.

Operations and maintenance funding for MPS-supported user facilities is 21.4 percent of MPS's FY 2015 Request. MPS has maintained operations budgets as close to flat as possible, accounting for expected increases in ALMA, DKIST, and LIGO as those facilities come on line.

MPS does not anticipate significant changes between FY 2014 and FY 2015 in the numbers of awards made, grant size, grant duration, and funding rate, as shown in the chart below.

MPS Funding Profile			
	FY 2013		
	Actual	FY 2014	FY 2015
	Estimate	Estimate	Estimate
Statistics for Competitive Awards:			
Number of Proposals	8,903	9,000	9,100
Number of New Awards	2,201	2,290	2,290
Funding Rate	25%	25%	25%
Statistics for Research Grants:			
Number of Research Grant Proposals	7,785	7,800	7,850
Number of Research Grants	1,748	1,700	1,700
Funding Rate	22%	22%	22%
Median Annualized Award Size	\$115,905	\$115,000	\$115,000
Average Annualized Award Size	\$130,145	\$130,000	\$130,000
Average Award Duration, in years	3.2	3.2	3.2

Program Monitoring and Evaluation

External Program Evaluations and Studies:

- The Astronomy and Astrophysics Advisory Committee (AAAC) completed their annual report on interagency activities by Department of Energy (DOE), NASA, and NSF in March 2013. The next annual report is expected in March 2014.
- The Committee on Astronomy and Astrophysics of the National Academy of Sciences, National Research Council, has been commissioned to carry out a study of “A Strategy to Optimize the U.S. Optical/Infrared System in the Era of the Large Synoptic Survey Telescope.” This study is expected to be completed by mid-FY 2015.
- A Subcommittee of the MPS Advisory Committee conducted an Astronomical Sciences Portfolio Review, “Advancing Astronomy in the Coming Decade: Opportunities and Challenges,” which was completed in August of 2012. In December 2013, MPS/AST issued a Dear Colleague Letter to the community describing the next step of environmental reviews of various alternatives for facilities recommended for divestment in the Portfolio Review Committee report; reviews are expected to be completed in FY 2015.
- NSF initiated a broad-based community study through the National Research Council on opportunities in high magnetic field research. This report, “High Magnetic Field Science and Its Application in the United States,” was published in December 2013 and will be presented to the National Science Board in May 2014. Public town halls are planned at several relevant professional society meetings by both DMR and CHE. The report will inform future plans for investments in this area.
- DMR will continue to respond to recommendations of the 2007 National Research Council’s report “MRSECs: Looking Back, Moving Forward,” which included a recommendation to increase award size; this was begun in the FY 2011 competition and an additional three to five percent increase is planned for the FY 2014 competition. The MRSEC program will continue to support the Materials Research Facilities Network (MRFN), which links the instrumentation and subject matter expertise of MRSECs to the larger materials community and encourages MRSEC-to-MRSEC collaborations.
- A Subcommittee of the MPS Advisory Committee plans to release a report on “Data Science at NSF”

in July 2014.

- The Nuclear Science Advisory Committee (NSAC) issued a report in 2013 on major facilities funding for nuclear physics. A recommendation was that DOE give priority to funding construction of the Facility for Rare Isotope Beams at Michigan State University. This new facility will replace NSCL that is currently funded by the NSF Physics Division. To learn more, see the NSCL narrative in the Facilities chapter.
- NSF and DOE have asked the Nuclear Science Advisory Committee (NSAC) to form a subcommittee charged with developing evaluation criteria for a next-generation detector of neutrino-less nuclear double beta decay. A report is expected in 2014.
- NSF and DOE have asked the High-Energy Physics Advisory Panel (HEPAP) to reform the Particle Physics Project Prioritization Panel (P5), charged with developing a strategic plan for particle physics covering the next 10 years. A report is expected in mid-2014.
- The National Academy of Sciences Committee on Undergraduate Physics Education Research and Implementation issued a report “Adapting to a Changing World - Challenges and Opportunities in Undergraduate Physics Education.” This study was commissioned by NSF to examine the present status of undergraduate physics education, including the state of physics education research, and, most importantly, to develop a series of recommendations for improving physics education that draws from the knowledge we have about learning and effective teaching. For more, see: www.sites.nationalacademies.org/BPA/BPA_059078.

Science and Technology Policy Institute (STPI) Reports:

- STPI is working with DMS on a pilot study of the Mathematical Institutes, expected to be completed in FY 2014.

Workshops and Reports:

- AST is co-sponsoring the “IUCAF 4th School on Spectrum Management for Radio Astronomy,” which will be held at the Joint ALMA Observatory in Santiago, Chile in April 2014. IUCAF is the International Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science, operating under the auspices of the International Council for Science. This school offers a comprehensive view of both technical and regulatory issues related to radio astronomers’ use of the spectrum, and includes lecturers and attendees from around the world.
- CHE sponsored a workshop entitled “Strengthening Forensics Science through Connections with the Analytical Sciences” in December 2012. The workshop was attended by a range of scientists from the measurement, informatics, and forensics communities in universities and government agencies as well as one individual from industry and representatives from the Netherlands. It is the first forensic workshops/symposium to be sponsored by NSF in response to the recent NAS report “Strengthening Forensic Science in the US.” See: www.chem.purdue.edu/docs/ForensicWorkshopFinalReport.pdf.
- CHE sponsored several activities related to the SusChEM activity, following the introductory workshop held in January of 2012 (final workshop report not published yet). CHE and ENG, along with the American Chemical Society (ACS) and the American Institute of Chemical Engineers (AIChE), co-sponsored a 1-day “Presidential Event” ACS symposium, titled “Ensuring the Sustainability of Critical Materials and Alternatives: Addressing the Fundamental Challenges in Separation Science and Engineering (SSE)” at the fall ACS annual meeting in 2012. www.aiche.org/sites/default/files/docs/conferences/critical_materials_separations_sciences_final.pdf.
- CHE sponsored the “NSF Workshop on Non-Precious Metal Catalysis: Opportunities and Impacts,” that concluded with a special 1.5 day symposium on “Non-Precious Metal Catalysis” held in September 2013 at the national meeting of the ACS in Indianapolis, Indiana. A preliminary draft report was received by NSF in February of 2014 and is expected to be published shortly.
- CHE sponsored a workshop on Laboratory Safety in March 2012 at the National Academy of Sciences’ Beckman Center in Irvine, California. Outcomes and recommendations were published in

the Journal of Chemical Health & Safety, January/February 2013. For more information, see: <http://dx.doi.org/10.1016/j.jchas.2012.10.002>.

- In context with the focus on Advanced Manufacturing, CHE funded a proposal to conduct a workshop on the "Molecular Design of Commercial Chemicals for Minimal Unintended Biological Activity," which is currently scheduled to be held in 2014.
- CHE and the NASA Astrobiology Program co-sponsored an international workshop on "Alternative Chemistries of Life." The workshop was led by two chemists and a marine microbiologist. The final report is expected in 2014.
- DMR sponsored "Materials Genome Initiative Workshop" in December 2012. The goal was to elicit input from the community about the scientific opportunities and next steps needed for integrating calculations, experiments and data-enabled science for the purpose of discovering and developing advanced materials. The report will be published as "Materials Genome Initiative: the Interplay of Experiment, Theory and Computation 2013" in the Current Opinion in Solid State and Materials Science in 2014.
- The report from the DMR-supported workshop "Emerging Science and National Priorities in Metals and Metallic Nanostructures" in 2012 will be published in the Journal of Metals in May 2014.
- The report on the DMR-supported NSF CAREER Workshop for Materials Scientists and Engineers 2013 is at www.bc.edu/sites/nsworkshop/NSF_CAREER_Workshop/Reports.html.
- DMS sponsored an effort by several of the mathematics and statistics professional societies to solicit commentary on current needs and challenges in workforce development. Entitled "Investing in the Next Generation through Innovative and Outstanding Strategies for Mathematics and Statistics" (INGenIOuS), the project engaged stakeholders from academic institutions, professional societies, government agencies, and industry in developing strategies for future investments in mathematical sciences training. The effort included web-based working groups that developed white papers and a well-attended July 2013 in-person workshop.
- DMS funded a forward-looking study on trends in the mathematical sciences. The report, released in January 2013, is entitled "The Mathematical Sciences in 2025." The study was conducted by the Board on Mathematical Sciences and their Applications of the National Academy. There are two components to this study. The brochure "Fueling Innovation and Discovery: The Mathematical Sciences in the 21st Century" is available at www.nap.edu/catalog.php?record_id=13373. The full report is available at www.nap.edu/catalog.php?record_id=15269.
- The American Physical Society (APS) and the American Association of Physics Teachers (AAPT) hosted a two-day conference in January 2013 to focus national attention on graduate education in physics. There were 107 participants. See: www.aps.org/programs/education/graduate/conf2013.
- PHY, MPS, and the BIO Division of Integrated and Organismal Systems joined with the Kavli Foundation to fund a workshop on "Physical and Mathematical Principles of Brain Structure and Function" in May 2013 to solicit community input into the development of an MPS response to the BRAIN initiative. This workshop was attended in person by over 100 members of the MPS community who presently conduct research in the field of neuroscience, with additional individuals joining via web link. For more, see: <http://physicsoflivingsystems.org/brainstructureandfunction/>.
- PHY and the Directorate for Social, Behavioral and Economic Sciences (SBE) are sponsoring a workshop "Quantitative Theories of Learning, Memory, and Prediction" in May 2014 to obtain community input into the efforts needed to include the role of theory in the BRAIN initiative.

Directorate for Mathematical and Physical Sciences

Committees of Visitors (COV):

- In FY 2013, COVs reviewed CHE and DMS. The COV reports and the divisions' responses can be found on the MPS Advisory Committee (MPS AC) website at <http://www.nsf.gov/mps/advisory.jsp>. The divisions are responding to and implementing recommendations from these reviews.
- In FY 2015, COVs will review AST, DMR, and PHY.

The Performance 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.

Number of People Involved in MPS Activities			
	FY 2013	FY 2014	FY 2015
	Actual	Estimate	Estimate
	Estimate	Estimate	Estimate
Senior Researchers	8,386	8,700	8,700
Other Professionals	2,830	2,900	2,900
Postdoctorates	2,110	2,200	2,200
Graduate Students	8,627	9,000	9,000
Undergraduate Students	5,912	6,200	6,100
K-12 Teachers	-	-	-
K-12 Students	-	-	-
Total Number of People	27,865	29,000	28,900

DIVISION OF ASTRONOMICAL SCIENCES (AST)

\$236,240,000
-\$2,820,000 / -1.2%

AST Funding
(Dollars in Millions)

	FY 2013	FY 2014	FY 2015	Change Over	
	Actual	Estimate	Request	FY 2014 Estimate Amount	Percent
Total, AST	\$232.17	\$239.06	\$236.24	-\$2.82	-1.2%
Research	70.20	63.26	62.40	-0.86	-1.4%
CAREER	4.51	4.75	4.75	-	-
Education	5.65	6.45	6.31	-0.14	-2.2%
Infrastructure	156.32	169.35	167.53	-1.82	-1.1%
Arecibo Observatory	5.00	4.50	4.00	-0.50	-11.1%
Atacama Large Millimeter Array (ALMA)	32.92	34.27	40.17	5.90	17.2%
Daniel K. Inouye Solar Telescope (DKIST)	2.00	2.00	7.00	5.00	250.0%
Gemini Observatory	18.15	19.59	20.61	1.02	5.2%
National Optical Astronomy Observatory (NOAO)	25.50	25.50	25.50	-	-
National Radio Astronomy Observatory (NRAO)	41.00	43.14	40.00	-3.14	-7.3%
National Solar Observatory (NSO) ¹	8.00	8.00	8.00	-	-
Research Resources	16.25	25.85	22.25	-3.60	-13.9%
Facilities Pre-Construction Planning (total)	7.50	6.50	-	-6.50	-100.0%
Large Synoptic Survey Telescope (LSST)	7.50	6.50	-	-6.50	-100.0%

Totals may not add due to rounding.

¹ The total presented in FY 2015 does not include \$5.0 million for operations and maintenance support for the DKIST facility construction project. That funding is captured within the total presented on the DKIST line above.

The Division of Astronomical Sciences (AST) is the federal steward for ground-based astronomy in the United States, funding research with awards to individual investigators and small research groups, and via cooperative agreements with large telescope facilities. The national and international telescope facilities provide world-leading, one-of-a-kind, observational capabilities. These facilities offer access to a wide range of telescopes on a competitive basis and enable research by thousands of astronomers each year. AST also supports the development of advanced technologies and instrumentation as well as managing the electromagnetic spectrum for scientific use by the entire NSF community.

AST supports research to understand the origins and characteristics of planets, stars, and galaxies, as well as the structure that has evolved in the Universe since its origin more than 13 billion years ago. The results of this research will lead to a better understanding of the cosmos in which we live, the possibility of life existing on planets circling other stars, and the nature of the mysterious dark matter and dark energy that comprise more than 95 percent of the mass-energy of the Universe.

In general, 16 percent of the AST portfolio is available for new research grants and 84 percent is available for continuing grants. Approximately 71 percent of AST's budget goes to support the forefront instrumentation and facilities that are necessary to make progress at the frontiers of observational astronomy, while the remaining 29 percent goes to support awards to individual investigators. The largest facility supported by AST is NRAO, which includes two recently completed and unique radio telescopes: the international ALMA and the Karl G. Jansky Very Large Array (VLA). Through the MREFC account, AST also oversees the construction of the Large Synoptic Survey Telescope (LSST) and the Daniel K. Inouye Solar Telescope (DKIST).

FY 2015 Summary

All funding decreases/increases represent change over the FY 2014 Estimate.

Research

- The University Radio Observatories (URO) program was concluded (-\$1.19 million to zero) and folded into the new Midscale Innovations Program accounted for in Research Resources.
- The commitment to the interdisciplinary program in Enhancing Access to the Radio Spectrum (EARS) returns to its FY 2013 level (-\$1.0 million to a total of \$6.0 million).
- As part of the AST commitment to core research, the request for the Astronomy and Astrophysics research Grants (AAG) program is increased by 5 percent (+\$1.12 million to a total of +\$41.0 million).

Education

- AST commits \$810,000 to the NSF Research Traineeship program (NRT), of which \$700,000 is for outyear commitments to IGERT.
- The program Partnerships in Astronomy and Astrophysics Research and Education (PAARE) continues at its previous level (\$1.0 million) to broaden participation of under-represented minorities in the future scientific workforce.
- AST is home to the Astronomy and Astrophysics Postdoctoral Fellowships Program (AAPF), which continues at \$2.30 million in FY 2015. AAPF supports approximately 25 Fellows with awards that typically last three years. The fellowships include a required component of education activities by the Fellows as well as contributing to their training as incoming members of the research community.

Infrastructure

- ALMA (+\$5.90 million to a total of \$40.17 million): Funding constitutes the final ramp to full operations of ALMA, supporting both Chilean operations and core science support activities in North America.
- NRAO (-\$3.14 million, to a total of \$40.0 million): Support for domestic operations decreases as greater support is given to ALMA as endorsed by the astronomy research community in advisory committee reports in 2006 and 2012. For more information on the operating components of NRAO and related funding, please see the Facilities chapter.
- DKIST (+\$5.0 million to a total of \$7.0 million): The full increase represents the beginning of operations and maintenance support for DKIST provided through the National Solar Observatory. This includes development of the operations and data center concepts as DKIST begins to move toward its fully operational state in FY 2019. \$2.0 million (no change over FY 2014 Estimate) of the total is to support the cultural mitigation process for DKIST construction. For more information, see the MREFC chapter.
- Gemini (+\$1.02 million to a total of \$20.61 million): This increase is an increment in operations and maintenance (+\$430,000 to \$18.02 million) as committed to in the international Gemini partnership as well as an increment in the Instrument Development Fund (+\$590,000 to \$2.59 million).
- NSO (no change to a total of \$8.0 million): The total presented does not include \$5.0 million for the beginning of the ramp up in operations of DKIST. That funding is captured within the total presented in the DKIST line in the table above. For more information, see the Facilities chapter.
- Research Resources (-\$3.60 million to a total of \$22.25 million): Decreased support stems largely from the conclusion of several medium-scale instrumentation programs that were funded in FY 2014. The more general Midscale Innovations Program (MSIP) in AST (-\$750,000 to \$13.0 million), which enters its second year in FY 2015, replaces these programs. MSIP will support a variety of astronomical activities within a range of \$4.0 million to \$40.0 million and will emphasize both strong scientific merit and a well-developed plan for student training in instrumentation, facility

development, community telescope access, and/or provision of data to the community. Other activities supported within research resources include \$7.50 million for the Advanced Technologies and Instrumentation program, \$1.50 million for the Dark Energy Survey Data Management, and \$250,000 for the Giant Segmented Mirror Telescope.

- A Subcommittee of the MPS Advisory Committee conducted an Astronomical Sciences Portfolio Review, “Advancing Astronomy in the Coming Decade: Opportunities and Challenges,” which was completed in August of 2012. In December 2013, MPS/AST issued a Dear Colleague Letter (www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf14022) to the community describing the next step of environmental reviews of various alternatives for facilities recommended for divestment in the AST Portfolio Review Committee report; these reviews are expected to be completed in FY 2015.

DIVISION OF CHEMISTRY (CHE)

\$237,230,000
+\$1,440,000 / 0.6%

CHE Funding
(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over	
				FY 2014 Estimate Amount	Percent
Total, CHE	\$229.39	\$235.79	\$237.23	\$1.44	0.6%
Research	217.34	224.58	225.43	0.85	0.4%
CAREER	25.69	23.00	23.25	0.25	1.1%
Centers Funding (total)	31.74	29.65	32.25	2.60	8.8%
Centers for Chemical Innovation (CCI)	30.19	29.25	32.00	2.75	9.4%
Nanoscale Sci.& Eng. Centers (NSEC)	1.55	0.40	0.25	-0.15	-37.5%
Education	7.33	6.87	6.66	-0.21	-3.1%
Infrastructure	4.72	4.34	5.14	0.80	18.4%
National High Magnetic Field Laboratory	1.62	1.74	1.84	0.10	5.7%
Nat'l Nanotech. Infrastruct. Network (NNIN)	0.40	0.30	0.30	-	-
Research Resources	2.70	2.30	3.00	0.70	30.4%

Totals may not add due to rounding.

CHE supports a large and vibrant research community engaged in fundamental research linked to key national priorities. CHE will enable research in sustainability and clean energy, providing new molecules and materials that are essential to our economy and well-being. Through the development of new methodologies in chemical synthesis, CHE is a natural contributor to advancing manufacturing technology. CHE strongly supports research at the interfaces with biology and materials research, within both experimental and theoretical/computational frameworks. CHE's programs invite research in catalysis for energy capture and storage as well as for the formation of new chemical bonds, appreciation of, and insight into, the chemistry of life processes, new nanostructured materials that will revolutionize electronics and photonics, and better awareness of how nano-size aerosols and particles impact our environment. In addition, CHE supports curiosity-driven research that leads to increased understanding of molecules and materials and their chemical transformations, as well as the development of new instrumentation to study and detect molecules.

In general, 55 percent of the CHE portfolio is available for new research grants and 45 percent goes to continuing grants; the Centers for Chemical Innovation program constitutes 54 percent of continuing grant commitments in FY 2015. Almost 85 percent of CHE's budget is used to support individuals and small groups of researchers, while about 15 percent of the budget supports centers and facilities.

FY 2015 Summary

All funding decreases/increases represent change over the FY 2014 Estimate.

Research

- CHE continues its commitment to young investigators and increases its investment in CAREER by 1.1 percent to \$23.25 million (+\$250,000).
- Centers for Chemical Innovation Program continues to grow (+\$2.75 million to a total of \$32.0 million) as additional Phase II Centers are being brought online. The Phase I competition was suspended in FY 2014 so that no new Phase I Centers are supported in FY 2015.

- Investment in NSEC decreased as CHE has paid off past award commitments. CHE currently co-funds two ENG Centers for the Environmental Implications of Nanotechnology at \$125,000 million per year each for a total of \$250,000.
- Advanced Manufacturing continues to be important for CHE, with projects supported both through unsolicited individual investigator grants and through the Centers for Chemical Innovation program (-\$5.90 million to a total of \$14.10 million). Reductions in funding are due to competing priorities within the individual investigator portfolio.
- CHE's investment in SEES (\$13.0 million) remains constant. Funded activities include SusChEM (\$10.50 million), the SEES postdoctoral fellows program (\$1.50 million), and Food Systems (\$1.0 million).
- Funding for Cyberinfrastructure Framework for the 21st Century Science and Engineering (CIF21) decreases by \$1.75 million to a total of \$1.85 million, with a focus on the interdisciplinary Computation and Data-Enabled Science and Engineering program. Reductions in funding are due to competing priorities within the individual investigator portfolio.

Education

- The Education portfolio maintains a commitment to Research Experiences for Undergraduates (REU) (-\$130,000 to a total of \$5.05 million).
- CHE commits \$810,000 to the NSF Research Traineeship program (NRT), of which \$700,000 is for outyear commitments to IGERT.
- CHE maintains its commitment to diversity through programs such as ADVANCE.

Infrastructure

- NHMFL: Funding (+\$100,000 to a total of \$1.84 million) will enable maintenance and operation of the newly installed 21-Tesla magnet at the Ion Cyclotron Resonance (ICR) facility.
- NNIN (no change for a total of \$300,000): CHE continues support for NNIN, which received a renewal award in FY 2014.
- Research Resources (+\$700,000 to a total of \$3.0 million): Within Resource Resources, the total increase is for ChemMatCARS (\$970,000) at Argonne National Laboratory. Funding also provides for supplements to highly competitive Major Research Instrumentation awards since the division suspended its instrumentation program (CRIF) in FY 2012.

DIVISION OF MATERIALS RESEARCH (DMR)

\$298,990,000
+\$980,000 / 0.3%

DMR Funding
(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over FY 2014 Estimate	
				Amount	Percent
Total, DMR	\$291.09	\$298.01	\$298.99	\$0.98	0.3%
Research	243.23	248.67	245.71	-2.96	-1.2%
CAREER	24.56	20.68	20.93	0.25	1.2%
Centers Funding (total)	55.17	63.99	62.89	-1.10	-1.7%
Materials Centers	46.51	56.00	56.00	-	-
Nanoscale Science & Engineering Centers	4.66	0.80	0.25	-0.55	-68.8%
STC: Center for Layered Polymer Systems	4.00	3.32	2.66	-0.66	-19.9%
STC: Center for Integrated Quantum Materials	-	3.87	3.98	0.11	2.8%
Education	7.40	8.09	6.71	-1.38	-17.1%
Infrastructure	40.46	41.25	46.57	5.32	12.9%
Cornell High Energy Synchrotron Source (CHESS)	20.00	10.00	10.00	-	-
National High Magnetic Field Laboratory (NHMFL)	30.00	30.89	31.83	0.94	3.0%
National Nanotechnology Infrastructure (NNIN)	2.58	2.58	2.58	-	-
Other MPS Facilities: Center for High Resolution Neutron Scattering (CHRNS)	2.66	2.66	2.66	-	-
Research Resources	5.22	5.12	9.50	4.38	85.5%

Totals may not add due to rounding.

Research in DMR focuses on advancing materials discovery and characterization, including condensed matter physics, solid-state chemistry, and the science of materials that are multifunctional, hybrid, electronic, photonic, metallic, superconducting, ceramic, polymeric, biological, and nanostructured. DMR awards enable the community to advance understanding of electronic, atomic, and molecular mechanisms and processes that govern macroscale properties so that we can learn how to manipulate and control them, to discover new synthesis and processing strategies that lead to new materials with unique and novel properties, and to discover and to understand emerging phenomena. The discoveries and advancements transcend traditional scientific and engineering disciplines, and can eliminate roadblocks to enabling new technology including those with the goal of sustainability. A key and critical enabler to these scientific advances is the investment in development and support of the materials workforce, in cyberinfrastructure, and in next generation instruments and facilities, through the creation of a midscale research infrastructure program, Materials Innovation Platforms (MIP). Finally, conveying the excitement, significance, and societal benefit enabled by materials research to students and to the general public remains an important aspect of the Division’s mission.

In general, 27 percent of the DMR portfolio is available for new research grants and 73 percent funds continuing grants.

FY 2015 Summary

All funding decreases/increases represent change over the FY 2014 Estimate.

Research

- DMREF (-\$5.0 million to a total of \$7.0 million): DMREF is the MPS response to MGI, and at NSF, is part of CEMMSS. Partners include ENG, CISE, and other MPS divisions (CHE and DMS). DMREF is a major effort to accelerate the discovery and deployment of new materials with a specific and desired function or property through synergistic integration of theory and computation, experiments, and systematic use of materials data.
- Advanced Manufacturing: Also a part of CEMMSS, advanced manufacturing (-\$3.90 million to a total of \$16.10 million) particularly addresses nanomanufacturing. Reductions in funding are due to competing priorities within the individual investigator portfolio.
- CIF21 (-\$1.75 million to total of \$1.85 million): DMR will support research, especially related to DMREF/CEMMSS, by investing in new functional capabilities in computational methods, algorithms, tools and data core methods, and technologies. Reductions in funding are due to competing priorities within the individual investigator portfolio.
- SEES (-\$500,000 to a total of \$7.0 million): Investments will continue in SEES. In the SusChEM component, DMR will focus on the preservation and extension of natural resources such as critical elements for improved material usage and overall lifecycle management. Topics include: enhanced recyclability; materials designed to be reclaimed, reused or repurposed; the replacement, substitution, or elimination of toxic or critical materials; discovery of new materials withstanding extreme conditions; use of new (non-petroleum-based) raw materials as feedstocks for society's materials; and materials synthesis and processing to optimize the use of raw materials, water, chemicals, and energy in an environmentally benign way.
- Clean Energy Technology (+\$1.57 million to a total of \$68.40 million): Additional research in Clean Energy will include hydrogen, fuel cells, biomass, solar energy, hydrocarbon conversion, the capture and utilization of CO₂, and energy storage.
- BioMaPS (+\$80,000 to a total of \$2.98 million): DMR supports a large and growing amount of research at the intersection of the life and physical sciences, not only in its Biomaterials program, but throughout the portfolio including centers and facilities. The BioMaPS request includes \$970,000 for the BRAIN initiative.
- CAREER (+\$250,000 to a total of \$20.93 million): Support for CAREER is a high priority in order to develop a pipeline of new faculty in materials research that will help form the community of the future.
- Materials Centers (\$56.0 million, no change): The Materials Research Science and Engineering Centers (MRSEC) advance materials research through collaborations of groups of principal investigators, and provide students with a rich, interdisciplinary education. The centers address fundamental research problems of intellectual and strategic importance that will advance U. S. competitiveness. They also provide a network of user facilities that is available to external scientists from academia, government labs, and industry. The FY 2015 request will support 18 MRSECs. (For more information, see the Centers narrative in the NSF-wide Investments chapter).
- NSEC (-\$550,000 to a total of \$250,000): Two DMR-supported nano centers received their last funding increments in FY 2013. Two DMR co-funded SBE NSECs received their last increments in FY 2014 as planned. DMR will continue to co-fund two Environmental Health and Safety NSECs with BIO in FY 2015.
- STC (-\$550,000 to a total of \$6.64 million): Funding reflects the planned increase in the Center on Integrated Quantum Materials, which will explore the fundamental science of quantum materials and quantum devices (+\$110,000 to a total \$3.98 million), and decreased support for the planned sunset of the Center for Layered Polymeric Systems, which has been a highly successful center spawning three startup companies, including one developing terabyte optical data storage (-\$660,000 to a total \$2.66 million for its last year in FY 2015).
- After ten years, the Materials World Network (MWN) program is being revised to reflect current priorities and a changing landscape in which international collaborations can be part of many

programs. In FY 2015, DMR will determine how to optimize international collaborations, which will significantly change MWN or reformulate it to another program.

Education

- The Education portfolio maintains a strong commitment to the Research Experiences for Undergraduates (REU) program (\$210,000 to a total of \$5.47 million).
- DMR commits \$810,000 to the NSF Research Traineeship program (NRT), of which \$700,000 is for outyear commitments to IGERT.

Infrastructure

- CHES (no change to a total of \$10.0 million): Funding will support this national user facility for work in cancer research, new materials for electronics, aircraft, biotechnology, batteries, fuel cells, solar cells, and other energy applications. In FY 2014, BIO and ENG became funding partners, each contributing \$5.0 million per year.
- NHMFL (+\$940,000 to a total of \$31.83 million for the DMR portion): Funds will continue to support transformational research using high magnetic fields. This facility serves researchers in fields ranging from biology to materials to condensed matter physics.
- Research Resources (+\$4.38 million to a total of \$9.50 million):
 - Funding includes \$8.0 million to begin the MIP midscale research infrastructure program, based on critical needs identified by the Materials 2022 report and by National Academy studies. (Materials 2022, www.nsf.gov/attachments/124926/public/DMR_Materials_2022_Report.pdf; Frontiers in Crystalline Matter, www.nap.edu/openbook.php?record_id=12640; and Condensed-Matter and Materials Physics: The Science of the World Around Us, www.nap.edu/download.php?record_id=11967. MIP will focus on technical priorities for advancing materials research and consist of specialized instrumentation and computation capabilities for characterization, modeling, synthesis, and processing of new materials. Open to users from academia and industry, sites of the proposed MIP program will emphasize instrument development and cross-disciplinary training of users and students.
 - The total also includes \$1.50 million to support DMR helium gas projects as the price of this increasingly rare element has increased dramatically.
 - Support of the Coherent Light Source project (-\$2.62 million to zero) ended in FY 2014.
- NNIN and CHRNS funding levels are consistent at \$2.58 million and \$2.66 million respectively.

DIVISION OF MATHEMATICAL SCIENCES (DMS)

\$224,400,000
-\$1,240,000 / -0.5%

DMS Funding
(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over FY 2014 Estimate	
				Amount	Percent
Total, DMS	\$219.02	\$225.64	\$224.40	-\$1.24	-0.5%
Research	197.49	207.26	210.41	3.15	1.5%
CAREER	10.46	9.13	9.38	0.25	2.7%
Centers Funding (total)	0.10	0.10	0.10	-	-
Centers for Analysis and Synthesis	0.10	0.10	0.10	-	-
Education	21.53	18.38	13.99	-4.39	-23.9%

Totals may not add due to rounding.

NSF plays a critical role in funding the mathematical and statistical sciences as it provides more than sixty percent of all federal support for basic research in this area. In certain core areas of the mathematical sciences, this percentage is much higher, since the 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 also enables discovery and innovation in other fields of science, engineering, and education. In turn, advances in science and engineering inspire development of ever more sophisticated mathematical and statistical methodology, theory, and tools. DMS plays a key role in these developments, in training future researchers in the mathematical and statistical sciences, and in training the Nation's scientific and engineering workforce.

DMS supports core research programs in: algebra and number theory; analysis; applied mathematics; computational mathematics; geometrical analysis and topology; mathematical biology; probability, combinatorics, and foundations; and various areas within statistics. In addition, DMS supports: national mathematical and statistical sciences research institutes; training and mentoring of a diverse group of postdoctoral, graduate, and undergraduate students; and infrastructure, such as workshops, conferences, and equipment.

In general, 44 percent of the DMS portfolio is available for new research grants and 56 percent is available for continuing grants.

FY 2015 Summary

All funding decreases/increases represent change over the FY 2014 Estimate.

Research

- Because support for early-career researchers is a DMS priority, the division's investment in CAREER grants increases by +\$250,000 to a total of \$9.38 million.
- BioMaPS (+\$90,000 to a total of \$3.0 million): DMS invests in innovative research at the intersection of the mathematical and physical sciences and the biological sciences in a comprehensive approach to acquire insight into and inspiration from the living world. The BioMaPS request includes \$980,000 for the BRAIN initiative.

Directorate for Mathematical and Physical Sciences

- SEES (+\$1.50 million to a total of \$2.50 million): This activity addresses challenges in climate, hazards, sustainability, and energy research and education through data analysis, modeling, and simulation. DMS investments in SEES will also support effective training and networking opportunities for collaborations between mathematical and statistical scientists and domain scientists.
- CEMMSS (+\$2.0 million to a total of \$4.0 million): Funding will accelerate fundamental discoveries in materials science by investing in new capabilities for mathematical modeling, computational simulation, numerical algorithms, and data analysis and management.
- Clean Energy Technology is maintained at \$4.92 million.
- Mathematical and Statistical Sciences Institutes (level at \$29.50 million): Eight domestic DMS-supported institutes will continue to catalyze frontier research through an array of varied scientific programs.

Education

- DMS commits \$810,000 to the NSF Research Traineeship program (NRT), of which \$700,000 is for outyear commitments to IGERT.
- DMS invests in a number of additional education and diversity activities, including the Mathematical Sciences Postdoctoral Research Fellowships (MSPRF), in which investment is maintained at \$4.10 million.
- Investment in the overall Education portfolio (-\$4.39 million to a total of \$13.99 million in FY 2015) reflects mainstreaming into core programs support for graduate students and postdoctoral researchers.

DIVISION OF PHYSICS (PHY)

\$263,700,000
-\$2,600,000 / -1.0%

PHY Funding
(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over	
				FY 2014 Estimate Amount	Percent
Total, PHY	\$250.45	\$266.30	\$263.70	-\$2.60	-1.0%
Research	164.72	165.99	159.35	-6.64	-4.0%
CAREER	7.68	7.34	7.34	-	-
Centers Funding (total)	1.16	0.02	0.02	-	-
Nanoscale Science & Engineering	1.16	0.02	0.02	-	-
Education	5.31	6.98	5.97	-1.01	-14.5%
Infrastructure	80.42	93.33	98.38	5.05	5.4%
IceCube	3.45	3.45	3.45	-	-
Large Hadron Collider (LHC)	18.00	17.37	18.00	0.63	3.6%
Laser Interferometer Grav. Wave Obs.	30.50	36.43	39.43	3.00	8.2%
Nat'l Superconducting Cyclotron Lab.	21.50	22.50	22.50	-	-
Research Resources	6.97	13.58	15.00	1.42	10.5%

Totals may not add due to rounding.

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 major 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 have major impact in other scientific and engineering fields.

In general, 18 percent of the PHY portfolio is available for new research grants and 82 percent is available for continuing grants. Of the continuing grants, about 49 percent represents commitments made in previous years and about 33 percent supports operations and maintenance for four facilities that are a key part of the division portfolio: LIGO, LHC, NSCL, and IceCube.

FY 2015 Summary

All funding decreases/increases represent change over the FY 2014 Estimate.

Research

- A reduction of \$6.64 million (to a total of \$159.33 million) will be taken in research grants to accommodate increased support of major facilities and Research Resources.
- BioMaPS (+\$90,000 to a total of \$3.0 million): This will fund programs that support research at the interface between the mathematical and physical sciences and the life sciences. Of this total, \$980,000 (+\$580,000) will support activities in the BRAIN initiative.

Education

- Funding for REU sites and supplements will decrease \$830,000 to a total of \$5.06 million. Reductions in funding are due to competing priorities within the individual investigator portfolio.
- PHY commits \$810,000 to the NSF Research Traineeship program (NRT), of which \$700,000 is for outyear commitments to IGERT.

Infrastructure

- IceCube funding is maintained at \$3.45 million as approved by the NSB.
- LHC (+\$630,000 to \$18.0 million): Operations support increases for the ATLAS and CMS detectors at LHC during the first period of data-taking after the maintenance period of 2013-2014.
- LIGO (+\$3.0 million to a total of \$39.43 million): Funding increases as the Advanced LIGO construction project is completed and full-time operation of the upgraded facility gets underway. (See the MREFC chapter for more details on Advanced LIGO.)
- National Superconducting Cyclotron Laboratory (NSCL) funding is constant at \$22.50 million.
- Research Resources (\$1.42 million to a total of \$15.0 million): Funding supports physics midscale research infrastructure (\$8.0 million) and the PHY program in accelerator science (\$7.0 million), both initiated in FY 2014.

OFFICE OF MULTIDISCIPLINARY ACTIVITIES (OMA)

\$35,000,000
\$0 / 0.0%

OMA Funding
(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over	
				FY 2014 Estimate Amount	Percent
Total, OMA	\$27.22	\$35.00	\$35.00	-	-
Research	26.65	29.79	26.97	-2.82	-9.5%
CAREER	0.42	-	-	-	N/A
Education	0.57	0.21	1.03	0.82	390.5%
Infrastructure	-	5.00	7.00	2.00	40.0%
Portfolio Analysis	-	5.00	7.00	2.00	40.0%

Totals may not add due to rounding.

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, as well as cross-NSF and interagency activities.

In general, approximately 64 percent of the OMA portfolio is available for new research grants and 36 percent is available for continuing grants.

In FY 2015, OMA will focus on multidisciplinary research that emphasizes the mathematical and physical scientific foundations of sustainability; fundamental science critical to the understanding, design, and development of new materials; basic 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 to promote better understanding of the brain and mapping of its activity; computational and data-enabled science across the MPS divisions; multidisciplinary explorations into the control and manipulation of the behavior of quantum matter and the limitations of quantum information processing; basic research in optics and photonics; and team efforts aimed at the development of next-generation instrumentation to enable fundamental advances across a wide spectrum of disciplines. OMA also will provide leadership and support for INSPIRE and I-Corps activities within MPS.

FY 2015 Summary

All funding decreases/increases represent change over the FY 2014 Estimate.

Research

- OMA will focus on multidisciplinary research that addresses the key MPS and NSF-wide priority areas of I-Corps, INSPIRE, SEES, CIF21, CEMMSS, Advanced Manufacturing, BioMaPS, clean energy, optics and photonics, and neuroscience, including brain activity mapping.
- OMA will invest \$1.0 million (-\$1.50 million) in I-Corps and \$3.0 million (+\$3.0 million) in INSPIRE.
- In CIF21, OMA will continue to coordinate MPS' participation with other NSF Directorates.

Education

- Career Life Balance (+\$400,000 to \$400,000): OMA will contribute to this cross-agency effort.
- Pan-American Advanced Studies Institute program (PASI) (\$200,000): Funding is equal to FY 2014.
- OMA commits \$430,000 to the NSF Research Traineeship program (NRT), all of which is for continuing commitments to IGERT. All MPS funding for NRT will be made from the MPS divisions.

Facilities

- Portfolio Analysis (+\$2.0 to a total of \$7.0 million): MPS divisions have undertaken, or are engaged in, wide ranging reviews of their facilities portfolios. Of particular note is the AST Portfolio Review carried out by the MPS Advisory Committee (MPS AC), which is addressed in the AST division narrative. OMA will invest up to \$7.0 million in FY 2015 to enable responsible decisions regarding the components of the AST facilities portfolio. This investment will support studies of possible environmental issues, stewardship transition costs, and partnership start-up costs.
- Support of the Coherent Light Source project (-\$1.0 million to zero) ended in FY 2014.