

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

**\$1,386,120,000
+\$77,180,000 / 5.9%**

MPS Funding
(Dollars in Millions)

	FY 2012	FY 2012	FY 2014	Change Over	
	Actual	Enacted/ Annualized FY 2013 CR	Request	FY 2012 Enacted Amount	Percent
Division of Astronomical Sciences (AST)	\$234.72	\$234.55	\$243.64	\$9.09	3.9%
Division of Chemistry (CHE)	234.03	234.06	253.65	19.59	8.4%
Division of Materials Research (DMR)	294.40	294.55	314.63	20.08	6.8%
Division of Mathematical Sciences (DMS)	237.72	237.77	244.54	6.77	2.8%
Division of Physics (PHY)	277.44	277.37	289.02	11.65	4.2%
Office of Multidisciplinary Activities (OMA)	30.37	30.64	40.64	10.00	32.6%
Total, MPS	\$1,308.70	\$1,308.94	\$1,386.12	\$77.18	5.9%

Totals may not add due to rounding.

About MPS

The MPS request of \$1,386.12 million is a balance of strategic investments in the core research programs of each of the five MPS divisions, initiation of programs that address directorate-specific priorities, and continuing participation in Foundation-wide programs. The support for robust core programs in MPS provides the healthy foundation of basic research in astronomical sciences, chemistry, materials research, mathematical sciences, and physics that transforms the frontiers of science. Closely related aspects of this request are the initiation of a midscale instrumentation program and the continued support for major multi-user facilities, clean energy research, CAREER, and Research Experiences for Undergraduates (REU). The directorate will also use its core research funding to seed new efforts in grand challenge communities, food and water security, and neuroscience. MPS will continue to be a major participant in NSF-wide efforts such as Science, Engineering, and Education for Sustainability (SEES), under which it will launch a new effort in critical elements, minerals, and materials.

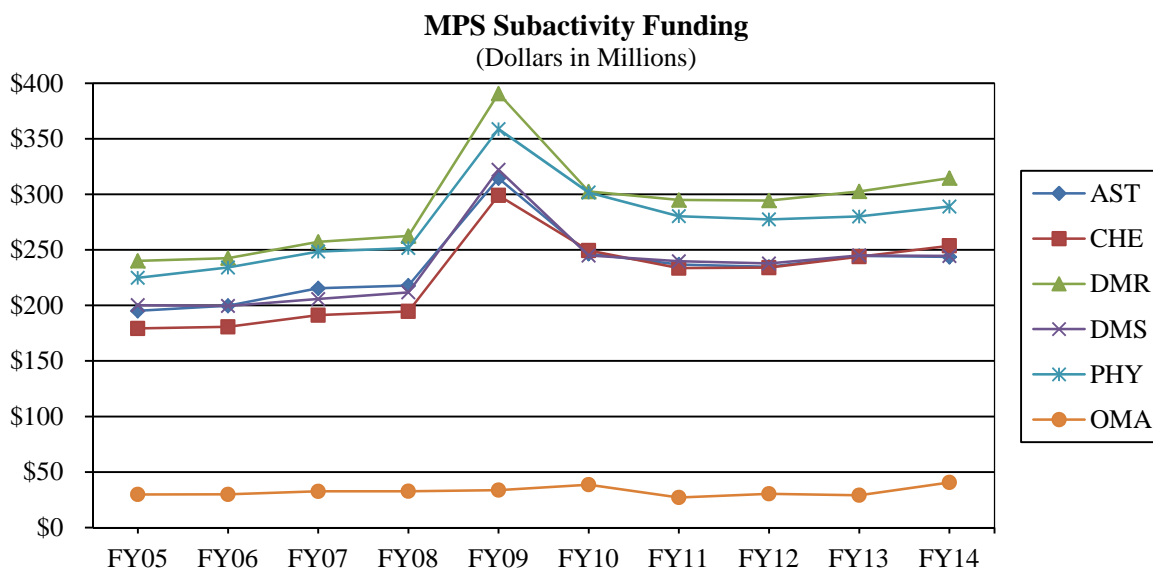
All MPS divisions will continue to invest substantially in their core research programs to drive new discoveries that strengthen the building blocks of innovation. This funding will be used to initiate a midscale instrumentation program in AST and PHY, begin exploratory activities in food and water security, and augment clean energy research investments. PHY will launch a new effort in accelerator and detector science. DMR and DMS will invest in complex problem solving to support strategic investments in cyberinfrastructure, instrumentation, and fundamental science to enable development of grand challenge communities; DMR will develop Materials Innovation Platforms (MIP) as the first exemplar of this investment.

Facilities are a priority in the MPS request. Within the facilities portfolio, AST support design and development for the Large Synoptic Survey Telescope (LSST) as it transitions into its construction stage, and begin the ramp down for the University Radio Observatories while increasing operations funding for the Atacama Large Millimeter Array (ALMA), as planned. As part of the ramp up to full operations, PHY expects to increase support for operations of the Advanced Laser Interferometer Gravitational Wave Observatory (AdvLIGO). The request also increases Office of Multidisciplinary Activities (OMA) funding to enable MPS to make responsible decisions regarding its facilities portfolio components by

means of appropriate studies of possible environmental issues, stewardship transition costs, or partnership start-up costs.

The directorate continues to participate vigorously in Foundation-wide activities. MPS increases its investment in SEES/Sustainable Chemistry, Engineering and Materials (SusChEM) within CHE and DMR to launch a critical materials activity. Through AST, MPS 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). MPS grows or maintains investments in other cross-Foundational priorities such as Research at the Interface of Biological, Mathematical and Physical Sciences, and Engineering (BioMaPS); Secure and Trustworthy Cyberspace (SaTC); Innovation Corps (I-Corps); and Cyber-Enabled Materials Manufacturing and Smart Systems (CEMMSS), which includes Designing Materials to Revolutionize and Engineer our Future (DMREF).

MPS provides about 48 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 2014 Summary by Division

- AST’s FY 2014 Budget Request will support individual investigator awards, astronomical observatories, and increased investment in EARS and the major MPS priority of mid-scale instrumentation. Funding for individual research is balanced against funding for facilities, and among facilities, increased support over FY 2012 levels for ALMA and LSST is requested.
- CHE’s FY 2014 Budget Request is for enhancing support for core programs, and features a focus on SusChEM as an important component in the NSF-wide SEES investment. SusChEM will fund research in sustainable chemistry, and increased funding for Centers for Chemical Innovation (CCI) will continue the SusChEM focus within this program. CHE will continue strong commitment to research in the area of clean energy technologies, advanced manufacturing, and DMREF.

- DMR’s FY 2014 Budget Request includes plans to increase its portfolio of individual investigator awards, specifically in NSF focus areas where advanced materials are essential, such as SEES through SusChEM, including a new effort in critical elements, minerals, and materials; CEMMSS through DMREF; and BioMaPS. DMR will also continue a strong commitment to research in clean energy technologies. Centers and facilities receive enhanced funding as well.
- DMS’s FY 2014 Budget Request focuses 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 2014 Request includes continued support for individual investigator awards, particularly in NSF-wide priority areas such as CIF21 and BioMaPS. PHY also requests sufficient funding for investigators using its major facilities, and for operations and maintenance of these facilities. In FY 2014, PHY will support mid-scale instrumentation and new approaches to accelerator science.
- OMA in FY 2014 will continue its tradition of providing assistance for multidisciplinary research and activities in education and broadening participation. OMA will emphasize research relevant to NSF priorities such as SEES, CIF21, BioMaPS, and CEMMSS. OMA will coordinate MPS activities related to I-Corps and INSPIRE. In addition, OMA will support responsible decisions regarding the MPS facilities portfolio, including studies of possible environmental issues, stewardship transition costs, or partnership start-up costs.

Major Investments

MPS Major Investments

(Dollars in Millions)

Area of Investment	FY 2012	FY 2012	FY 2014	Change Over	
	Actual	Annualized FY 2013 CR Enacted/	Request	FY 2012 Enacted Amount	Percent
Advanced Manufacturing	\$27.15	\$32.15	\$40.00	\$7.85	24.4%
BioMaPS	14.29	7.69	16.60	8.91	115.9%
CAREER	70.11	54.02	58.57	4.55	8.4%
CEMMSS	34.82	32.15	66.00	33.85	105.3%
CIF21	27.60	11.50	22.30	10.80	93.9%
Clean Energy Technology	135.81	137.31	153.95	16.64	12.1%
EARS	3.00	3.00	12.00	9.00	300.0%
I-Corps	0.65	1.00	3.30	2.30	230.0%
INSPIRE	1.97	3.00	7.00	4.00	133.3%
SEES	17.03	16.50	35.26	18.76	113.7%
SaTC	0.50	0.50	2.00	1.50	300.0%

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

- Advanced Manufacturing (\$40.0 million, +\$7.85 million over FY 2012 Enacted): Investments will be made in nanomanufacturing, industry/university partnerships, BioMaPS, DMREF, and Centers

programs. Advanced manufacturing is an area of continued growth, especially in light of the heightened emphasis on sustainability (via SusChEM).

- BioMaPS (\$16.60 million, +\$8.91 million over FY 2012 Enacted). 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 Directorate 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, bioimaging, and bio-inspired sensors.
- CAREER (\$58.57 million, +\$4.55 million over FY 2012 Enacted): MPS continues its strong commitment to early career faculty development. 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. MPS expects to make about 130 CAREER awards in FY 2014. 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.
- CEMMSS (\$66.0 million, +\$33.85 million over FY 2012 Enacted): In partnership with ENG and CISE, MPS investments in CEMMSS will focus on DMREF, in support of the national Materials Genome Initiative. 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.
- CIF21 (\$22.30 million, +\$10.80 million over FY 2012 Enacted): All MPS divisions and OMA will 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. The CIF21 emphasis within the new NSF Research Traineeships (NRT) is part of this investment as well.
- Clean Energy Technology (\$153.95 million, +\$16.64 million over FY 2012 Enacted): Investment is focused in core program research in fuel cells, solar research and development, hydrocarbon conversion, and energy storage.
- EARS (\$12.0 million, +\$9.0 million over FY 2012 Enacted): Support will be for basic research that underpins this ongoing partnership with ENG and CISE. The MPS investment will concentrate on 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.
- I-Corps (\$3.30 million, +\$2.30 million over FY 2012 Enacted): MPS increases investment in the NSF-wide I-Corps program to stimulate innovative industrial partnerships.
- INSPIRE (\$7.0 million, +\$4.0 million over FY 2012 Enacted): All MPS divisions will contribute to this NSF-wide activity, which supports transformative, high risk, interdisciplinary research. OMA provides the largest share of MPS support, at \$3.0 million in FY 2014.
- SEES (\$35.26 million, +\$18.76 million over FY 2012 Enacted): Funding will focus most strongly on the SusChEM activity and a secondary effort in critical elements, minerals, and materials. Existing

programs, including centers as well as core programs, will be re-focused to support sustainable chemistry, engineering, and materials.

- SaTC (\$2.0 million, +\$1.50 million over FY 2012 Enacted): In partnership with CISE, funding will support frontier research needed to keep the Nation’s data confidential and transactions secure.

MPS Funding for Centers Programs and Facilities

MPS Funding for Centers Programs

(Dollars in Millions)

	FY 2012		FY 2014 Request	Change Over	
	FY 2012 Actual	Enacted/ Annualized FY 2013 CR		FY 2012 Enacted Amount	Percent
Centers Programs Total	\$87.36	\$78.72	\$93.62	\$14.90	18.9%
Centers for Analysis & Synthesis (DMS, OMA)	0.20	0.20	0.10	-0.10	-50.0%
Centers for Chemical Innovation (CHE)	26.03	24.00	33.25	9.25	38.5%
Materials Centers (DMR)	49.56	44.35	56.00	11.65	26.3%
Nanoscale Science & Engineering Centers (CHE, DMR, DMS, PHY)	7.57	6.17	0.95	-5.22	-84.6%
Science & Technology Centers (DMR)	4.00	4.00	3.32	-0.68	-17.0%

Totals may not add due to rounding.

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

- Centers for Analysis and Synthesis (\$100,000, -\$100,000 below FY 2012 Enacted): Funding will extend support for a sixth year to the National Institute for Mathematical and Biological Synthesis, a Center for Analysis and Synthesis primarily managed by BIO.
- Centers for Chemical Innovation (CCI) (\$33.25 million, +\$9.25 million over FY 2012 Enacted): This 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.
- Materials Centers (\$56.0 million, +\$11.65 million over FY 2012 Enacted): The request will support 18 Materials Research Science and Engineering Centers (MRSECs). 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. A competition in FY 2014 will reduce the number of centers from 23 to 18 but increase funding to each center, in keeping with the recommendation of the 2007 National Research Council report on MRSECs.
- Nanoscale Science & Engineering Centers (NSEC) (\$950,000, -\$5.22 million below FY 2012 Enacted): As planned, support for the Center for Probing the Nanoscale will end in FY 2013.
- Science and Engineering Centers (\$3.32 million, -\$680,000 below FY 2012 Enacted): Funding for the Center for Layered Polymeric Systems ramps down as planned in FY 2014 in preparation for the sunset of this Science and Technology Center (STC) in FY 2015.

MPS Funding for Facilities

(Dollars in Millions)

	FY 2012		FY 2014 Request	Change Over	
	FY 2012 Actual	Enacted/ Annualized FY 2013 CR		FY 2012 Enacted Amount	FY 2012 Enacted Percent
Facilities Total	\$266.11	\$264.99	\$285.38	\$20.39	7.7%
Advanced Technology Solar Telescope (ATST)	2.00	2.00	2.00	-	-
Arecibo Observatory	5.63	5.50	4.50	-1.00	-18.2%
Atacama Large Millimeter Array (ALMA)	28.61	28.61	36.41	7.80	27.3%
Cornell High Energy Synchrotron Source (CHESS)	19.67	19.67	20.00	0.33	1.7%
Gemini Observatory	21.57	22.07	19.59	-2.48	-11.2%
IceCube Neutrino Observatory (IceCube)	3.45	3.45	3.45	-	-
Large Hadron Collider (LHC)	18.00	18.00	18.00	-	-
Large Synoptic Survey Telescope (LSST)	4.50	4.50	6.50	2.00	44.4%
Laser-Interferometer Gravity-wave Observatory (LIGO)	30.40	30.40	39.50	9.10	29.9%
National High-Magnetic Field Laboratory (NHMFL)	26.80	25.80	32.64	6.84	26.5%
National Nanotechnology Infrastructure Network (NNIN)	2.98	2.98	2.88	-0.10	-3.4%
National Optical Astronomy Observatory (NOAO)	26.25	25.50	25.50	-	-
National Radio Astronomy Observatory (NRAO)	43.14	43.14	41.00	-2.14	-5.0%
National Solar Observatory (NSO)	9.10	9.10	8.00	-1.10	-12.1%
National Superconducting Cyclotron Laboratory (NSCL) (MSU Cyclotron)	21.50	21.50	22.50	1.00	4.7%
Other MPS Facilities ¹	2.52	2.77	2.91	0.14	5.1%

Totals may not add due to rounding.

¹ Other MPS Facilities is the Center for High Resolution Neutron Scattering (CHRNS) for all years and the Giant Segmented Mirror Telescope (GSMT) for FY 2012 Enacted/Annualized FY 2013 CR and FY 2014 Request.

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

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

- Arecibo (\$4.50 million, -\$1.0 million below FY 2012 Enacted): AST funding plus added support from the Directorate for Geosciences of \$3.50 million (+\$300,000 over FY 2012 Enacted) will provide total NSF support of \$8.0 million (-\$700,000 below FY 2012 Enacted). NASA is also expected to provide support at about \$2.0 million.
- ALMA (\$36.41 million, +\$7.80 million over FY 2012 Enacted): Funding is consistent with a planned ramp-up of operations as this facility comes on line and continues early science activities.
- CHESS (\$20.0 million, +\$330,000 over FY 2012 Enacted): The actual award amount will depend on the outcome of the review of a renewal proposal. The CHESS user program supports work in cancer research, new materials for electronics, aircraft, biotechnology, batteries, fuel cells, solar cells, and other energy applications.

- Gemini (\$19.59 million, -\$2.48 million below FY 2012 Enacted): Funding is primarily for observatory operations and maintenance, reflecting the international partner agreement, with a decreased contribution to the long-term instrumentation fund.
- LHC (\$18.0 million, flat with FY 2012 Enacted): Funding will support operations of the ATLAS and CMS detectors.
- LIGO (\$39.50 million, +\$9.10 million over FY 2012 Enacted): Support is increased as the Advanced LIGO construction project is completed and commissioning of the upgraded interferometer begins. See the MREFC chapter for more details on Advanced LIGO.
- NHMFL (\$32.64 million, +\$6.84 million over FY 2012 Enacted): Funds will allow the continuation of transformational research using high magnetic fields. This facility serves researchers in fields ranging from biology to materials and condensed matter physics. The requested budget reflects a new cooperative agreement that started in FY 2013.
- NRAO (\$41.0 million, -\$2.14 million below FY 2012 Enacted): Reduced support reflects the planned budget realignment to support ALMA operations as it transitions from construction to full operations.
- NSO (\$8.0 million, -\$1.10 million below FY 2012 Enacted): Funding assumes that closure of one or more current facilities is concluded in FY 2014, as planned for a long-term transition to the Advanced Technology Solar Telescope (ATST).
- NSCL (\$22.50 million, +\$1.0 million over FY 2012 Enacted): Increased support will promote enhanced operations.

Summary and Funding Profile

MPS supports investment in core research and education as well as research infrastructure such as centers and facilities.

In FY 2014, MPS will dedicate \$93.62 million for Centers, accounting for 6.8 percent of the MPS Request. This total is up from FY 2012 Enacted by \$14.90 million, as MPS increases investments in the Centers for Chemical Innovation and Materials Centers. Centers are an important modality for MPS sciences as research in many MPS-supported disciplines has evolved to be more collaborative and interdisciplinary.

Operations and maintenance funding for MPS-supported user facilities constitutes 20.6 percent of MPS's FY 2014 Request. MPS has increased operations budgets for facilities to maintain current operational capacity, with several facilities seeing large increases for enhanced operations. Where increases were not possible, MPS has maintained operations budgets as close to constant as possible.

MPS Funding Profile

	FY 2012 Actual Estimate	FY 2012 Enacted/ Annualized FY 2013 CR Estimate	FY 2014 Estimate
Statistics for Competitive Awards:			
Number of Proposals	9,007	9,200	9,750
Number of New Awards	2,524	2,355	2,700
Funding Rate	28%	26%	28%
Statistics for Research Grants:			
Number of Research Grant Proposals	7,892	7,650	8,200
Number of Research Grants	2,006	1,813	2,100
Funding Rate	25%	24%	26%
Median Annualized Award Size	\$116,985	\$110,000	\$117,000
Average Annualized Award Size	\$143,321	\$139,000	\$145,000
Average Award Duration, in years	3.1	3.1	3.1

¹ Award Estimates shown for FY 2013, such as numbers of awards and size/duration, are based on the FY 2012 Enacted level.

Program Monitoring and Evaluation

External Program Evaluations and Studies:

- A Subcommittee of the MPS Advisory Committee (MPS A/C) conducted an Astronomical Sciences Portfolio Review, “Advancing Astronomy in the Coming Decade: Opportunities and Challenges,” which was completed in August of 2012.
- A Subcommittee of the MPS A/C conducted a review of the DMR portfolio balance of facilities and instrumentation, which was completed in August of 2012.
- The Astronomy and Astrophysics Advisory Committee (AAAC) completed their annual report on interagency activities by DOE, NASA, and NSF in March 2012. The next annual report is expected in summer of 2013.
- The National Academy of Sciences, National Research Council, conducted a study on underground science, completed in February of 2012. NAS is conducting additional studies on Nuclear Physics (expected 2013) and Undergraduate Physics Education (expected late 2013 or early 2014). NAS has conducted several surveys of MPS fields as well, but these are not program evaluations.

Science and Technology Policy Institute (STPI) Reports:

- STPI is working with DMS on a pilot study of the Mathematical Institutes.

Workshops and Reports:

- CHE sponsored a workshop entitled “Strengthening Forensics Science through Connections with the Analytical Sciences” in December 2012. Attendees included a range of scientists from the measurement, informatics, and forensics communities in universities and government agencies (Office of Science and Technology Policy (OSTP), National Institute for Standards and Technology (NIST), Department of Justice (DOJ), Department of Homeland Security (DHS), National Institute of Justice (NIJ), Naval Research Laboratory (NRL), Food and Drug Administration (FDA)) as well as one individual from industry. Representatives from parallel organizations in the Netherlands also

attended the workshop. NSF sponsored this workshop in response to the recent NAS report “Strengthening Forensic Science in the US.” A workshop report is expected in April 2013 and additional workshops are planned for the future.

- CHE and the NASA Astrobiology Program co-sponsored an international workshop on “Alternative Chemistries of Life” in Washington, DC. The workshop was led by two chemists and a prominent marine microbiologist. The highly interdisciplinary nature of the workshop produced suggestions for future areas/lines of research, and a report is due in the next few months.
- CHE and ENG partners, along with 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. Issues discussed related to stresses in the global market and the key and enabling role of SSE in ensuring a sustainable supply and use of critical materials, and brought into focus crosscutting research needs and Scientific Grand Challenges in SSE associated with the sustainable extraction, recovery, recycling, and purification of critical materials. A website for permanent dissemination of symposium materials has been created, and a comprehensive report will be provided by late spring of 2013.
- DMR sponsored a workshop in December 2012 entitled “Workshop on Ethnic Diversity in Materials Science and Engineering.” The goal was to bring department chairs and key stakeholders together for the purpose of discussing and recommending practices that can broaden participation in the field, particularly among ethnic and racial minority groups. A report will be disseminated to the community.
- DMR sponsored a workshop in December 2012 entitled the “Materials Genome Initiative Workshop.” 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 DMR-sponsored Biomaterials Workshop examined the scientific opportunities and role of agencies in supporting the rapidly growing biomaterials field, both in research and education. The three leaders rolled out recommendations at a webcast at NSF in December 2012, and a report will be widely disseminated by mid-June 2013.
- 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.
- PHY funded a two-day conference to focus national attention on current issues facing graduate education in physics. The American Physical Society (APS) and the American Association of Physics Teachers (AAPT) jointly organized the conference. The conference took place at the American Center for Physics in College Park, MD in fall 2012 and brought together about 100 participants who provided informed recommendations for change and, as Directors of Graduate Studies on their respective campuses, were able to implement those changes. The topics included curriculum; exam/exam structure; climate and diversity; admissions; advising and mentoring; non-academic careers; developing “soft” skills including oral and written communication; team building and leadership; multi-disciplinary coursework and degrees; outcome assessment of graduate programs; and shaping a holistic and effective graduate education experience. The conference provided a forum to learn about the progress made in various graduate programs since the first conference and find ways to identify, adapt, and implement best practices within local constraints.
- PHY also funded five simultaneous conferences on women in physics, aimed at attracting and retaining undergraduate women in physics. Each conference was attended by 50 to 100

undergraduate women. The conferences were coordinated and had a common keynote speaker (available by video-conferencing) as well as some common events on mentoring, application to graduate school, etc. The five universities involved were chosen to allow coverage of a wide geographical area so that as many undergraduate women as possible would be able to attend one of the conferences.

Committees of Visitors (COV):

- In 2012, a COV reviewed PHY. The division is responding to and implementing recommendations from this review, as presented to the MPS A/C.
- In 2013, COVs will review CHE and DMS. The results of those COVs will be reported out in April 2013 to the MPS A/C.
- In 2014, COVs will review DMR and AST.

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 2012		
	Actual Estimate	FY 2013 Estimate	FY 2014 Estimate
Senior Researchers	11,281	9,100	11,400
Other Professionals	3,173	2,800	3,300
Postdoctorates	2,246	2,400	2,300
Graduate Students	8,887	9,100	9,000
Undergraduate Students	6,949	6,800	7,200
Total Number of People	32,536	30,200	33,200

Totals may not add due to rounding.

DIVISION OF ASTRONOMICAL SCIENCES (AST)

\$243,640,000
+\$9,090,000 / 3.9%

AST Funding
(Dollars in Millions)

	FY 2012		FY 2014 Request	Change Over	
	FY 2012 Actual	Enacted/ Annualized FY 2013 CR		FY 2012 Enacted Amount	Percent
Total, AST	\$234.72	\$234.55	\$243.64	\$9.09	3.9%
Research	66.30	73.23	74.71	1.48	2.0%
CAREER	4.30	4.30	4.75	0.45	10.5%
Education	6.65	6.65	5.83	-0.82	-12.3%
Infrastructure	161.77	154.67	163.10	8.43	5.5%
Adv. Technology Solar Tel. (ATST)	2.00	2.00	2.00	-	-
Arecibo Observatory	5.63	5.50	4.50	-1.00	-18.2%
Atacama Large Millimeter Array (ALMA)	28.61	28.61	36.41	7.80	27.3%
Gemini Observatory	21.57	22.07	19.59	-2.48	-11.2%
Nat'l Optical Astron. Obs. (NOAO)	26.25	25.50	25.50	-	-
Nat'l Radio Astron. Obs. (NRAO)	43.14	43.14	41.00	-2.14	-5.0%
Nat'l Solar Observatory (NSO)	9.10	9.10	8.00	-1.10	-12.1%
Research Resources	20.98	14.00	19.35	5.35	38.2%
Pre-Construction Planning (total)	4.50	4.75	6.75	2.00	42.1%
Large Synoptic Survey Telescope (LSST)	4.50	4.50	6.50	2.00	44.4%
Giant Segmented Mirror Telescope (GSMT) ¹	-	0.25	0.25	-	-

Totals may not add due to rounding.

¹ Pursuant to solicitation NSF 12-526, published in December 2011, AST has selected the Thirty Meter Telescope (TMS) for the further development and improvement of the partnership model for a GSMT project. It is expected that NSF construction funding would not be available before FY 2020.

AST is the federal steward for ground-based astronomy in the United States. Through awards to individual investigators, small groups, and national facilities, AST funding covers research to understand the origins and characteristics of planets, stars, and galaxies, as well as the structure and origin of the Universe. AST also supports the development of advanced technologies and instrumentation, the planning and design of future astronomical research facilities, and management of the electromagnetic spectrum for scientific use. Working in partnership with private institutions to enhance the Nation's overall astronomical observing capacity and capabilities, AST funds the operations and maintenance of several world-class national and international facilities. These facilities provide access to a wide range of observational resources on a competitive basis and serve thousands of users each year.

In 2010, the National Academy of Sciences released a decadal survey report recommending a comprehensive ground-based astronomy program for the coming decade. In anticipation of funding that is more constrained than assumed in that report, AST carried out a community-based review of its entire portfolio in order to maximize the delivery of the recommended science. The AST Portfolio Review was completed in FY 2012. In light of the more constrained budget outlook, the review recommended re-balancing the AST portfolio by FY 2017. In order to maintain the balance of large facilities, mid-scale projects, and individual investigator grants that is needed to make progress on key decadal survey science goals, the recommendations included divestment of some components of major research facilities, as described in the Facilities chapter. AST is presently engaged in exploring partnership and scope options for the various facilities given lower priority in the Portfolio Review, and no decisions on divestment

have been made. Funding to support NSF-wide efforts on its facilities portfolio are provided through OMA.

Approximately 59 percent of AST's budget is used to support current operations and future development of large multi-user astronomy facilities, while 32 percent supports individual investigator grants and 8 percent supports the development and operation of advanced instrumentation and experiments based on such instrumentation. In general, about 16 percent of the AST budget is available for new research grants, while the remainder funds long-term facilities and continuing awards for grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- Changes in NSF-wide investments are accommodated through strategic investments through AST core programs, accompanied by small reductions to programs not receiving proposals in these areas. These NSF-wide investments include:
 - CIF21 (+\$1.98 million to a total of \$3.68 million): This includes \$1.50 million to implement the Theoretical and Computational Astrophysics Networks recommendation of the decadal survey, in collaboration with NASA.
 - EARS (+\$9.0 million to a total of \$12.0 million): This investment will concentrate on the radio-frequency-interference mitigation, advanced receiver design, propagation studies, and other foundations of radio spectrum access and hardware design, as well as key regulatory and public policy foundations for radio spectrum management.
- Other grants programs, including the Astronomy and Astrophysics Research Grants (AAG), remain approximately constant in the FY 2014 Request. AAG supports foundational research in all areas of astronomy, such as extra-solar planets, near-Earth objects, and cosmology. The stable level of AAG is enabled by reductions to select areas within AST facility infrastructure (see below) and is made to support the AST commitment to maintaining individual research that is critical to advancement of the field.

Education

- Research Experiences for Undergraduates Site and Supplements program (+\$230,000 to a total of \$2.63 million): This additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics*.
- AST eliminates funding for ADVANCE (-\$850,000 to a total of zero) in order to continue support for other activities, including REU (above), Astronomy and Astrophysics Postdoctoral Fellowship (-\$200,000 to a total of \$2.20 million), and Partnerships in Astronomy and Astrophysics Research and Education (constant at \$1.0 million).

Infrastructure

AST oversees an array of infrastructure projects and programs. Reductions in facility support reflect the maintenance of funding balance between facilities and individual research. Future trends for these facilities will consider the recommendations of the AST Portfolio Review. For detailed information on individual AST facilities, please see the Facilities chapter.

- ATST operations: Funding is constant at \$2.0 million, to mitigate the cultural impacts of construction in Hawaii as agreed to in the permitting process.

- Arecibo: AST funding decreases (-\$1.0 million to a total of \$4.50 million); additional funding is provided by GEO (\$3.50 million) and NASA (\$2.0 million).
- ALMA: Support (+\$7.80 million to a total of \$36.41 million) is consistent with a planned ramp-up of operations as this observatory comes online and continues early science activities.
- Gemini: Support (-\$2.48 million to \$19.59 million) is primarily for observatory operations and maintenance, reflecting the international partner agreement, with a decreased contribution to the long-term instrumentation fund.
- NRAO: Funding is reduced (-\$2.14 million to a total of \$41.0 million) as part of the budget realignment plan to support ALMA operations.
- NSO: Funding (-\$1.1 million to \$8.0 million) assumes that closure of one or more current facilities is concluded in FY 2014, as planned for a long-term transition to the Advanced Technology Solar Telescope (ATST), currently under construction (see the MREFC chapter for more details).
- Research resources: Funding growth (+\$5.35 million to a total of \$19.35 million) reflects the initiation of a competed Mid-Scale Innovations Program (MSIP) at \$7.0 million, together with a decrease (-\$2.0 million to \$8.50 million) for the Advanced Technologies and Instrumentation program. A vigorous MSIP was recommended by the 2010 decadal survey, which cited “many highly promising projects for achieving diverse and timely science.” MSIP will support a variety of astronomical activities within the \$4.0 to \$40.0 million range 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.
- LSST: Design and development (D&D) funding increases (+\$2.0 million to \$6.50 million) following the successful NSF Preliminary Design Review and coordinated DOE camera review, for this top-ranked ground-based large-scale project in the decadal survey. Support covers enhanced systems management, continued work on data management issues, and improved project management and quality assurance, which were recommended by the reviews, and other D&D that will reduce risk before a construction start. Funds to support an FY 2014 construction start for LSST are separately requested in the MREFC chapter.
- GSMT: Funding maintained at \$250,000 to support the Thirty Meter Telescope (TMT) project to define and develop a model by which the federal government could potentially become a partner in this GSMT candidate after 2020.

DIVISION OF CHEMISTRY (CHE)

\$253,650,000
+\$19,590,000 / 8.4%

CHE Funding

(Dollars in Millions)

	FY 2012		FY 2014 Request	Change Over	
	FY 2012 Actual	Enacted/ Annualized FY 2013 CR		FY 2012 Enacted Amount	Percent
Total, CHE	\$234.03	\$234.06	\$253.65	\$19.59	8.4%
Research	218.94	224.07	235.95	11.88	5.3%
CAREER	24.33	21.38	23.00	1.62	7.6%
Centers Funding (total)	27.58	24.15	33.40	9.25	38.3%
Centers for Chemical Innovation	26.03	24.00	33.25	9.25	38.5%
Nanoscale Science & Engineering Centers	1.55	0.15	0.15	-	-
Education	10.30	6.95	6.65	-0.30	-4.3%
Infrastructure	4.79	3.04	11.05	8.01	263.5%
NHMFL	1.50	1.50	1.75	0.25	16.7%
NNIN	0.40	0.40	0.30	-0.10	-25.0%
Research Resources	2.89	1.14	9.00	7.86	689.5%

Totals may not add due to rounding.

CHE supports a large and vibrant research community engaged in fundamental research linked to key national priorities. Basic research supported by CHE will enable research in sustainability in general, and sustainable chemistry in particular, providing new molecules that are essential to our economy and well-being. CHE strongly supports research at the interface of biology and chemistry. CHE's programs invite research in catalysis for energy capture and storage as well as to enable the formation of new chemical bonds, appreciation of and insight into the chemistry of life processes, new nanochemistry advances that will revolutionize electronics and photonics, and better awareness of how nanosized aerosols and particles impact our environment. In addition, CHE supports curiosity-driven research that leads to increased understanding of molecules and their chemical transformations and the development of new instrumentation to study and detect molecules.

Approximately 87 percent of CHE's budget is used to support individuals and small groups of researchers, while about 13 percent of the budget goes to centers and facilities. There are currently eight Phase I and six Phase II Centers supported in the Centers for Chemical Innovation (CCI) program. In general, 60 percent of CHE's portfolio is available for new research grants. The remaining 40 percent funds continuing grants made in previous years.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- CAREER (+\$1.62 million to a total of \$23.0 million): At this level, funding rates for CAREER proposals are increased (>20 percent) consistent with CHE objectives for CAREER support.
- Chemistry Centers (+\$9.25 million to a total of \$33.25 million): Center co-funding by NASA has ended, so resources from CHE are increasing in FY 2014. (See the Centers narrative in the NSF-Wide Investments chapter for more details).
- Cognitive Science and Neuroscience (\$400,000): Funding supports cross-Foundation fundamental research relevant to cognitive science and neuroscience.

- Changes in NSF-wide investments are accommodated through strategic investments through CHE core programs, accompanied by small reductions to programs not receiving proposals in these areas. These NSF-wide investments include:
 - BioMaPS (+\$2.23 million to a total of \$4.15 million): Support will strengthen research in advanced spectroscopic and imaging techniques for biomolecules and biosystems, metal speciation, coordination and function, chemical studies of enzyme and ribozyme catalysis, and other studies at the chemistry-biology frontier.
 - CEMMSS (+\$15.80 million to a total of \$29.0 million): CEMMSS is comprised of two components in MPS:
 - Advanced Manufacturing (+\$6.80 million to a total of \$20.0 million): This is closely entwined with the chemical enterprise for new and more efficient chemical production.
 - DMREF (+\$9.0 million to a total of \$9.0 million): This contributes to the Administration's Materials Genome Initiative (MGI).
 - CIF21 (+\$1.73 million to a total of \$3.48 million): Investment in CIF21 is targeted at Scientific Software Elements (SSE) and Scientific Software Integration (SSI).
 - Clean Energy (+\$20.20 million to a total of \$81.70 million). The CHE portfolio includes chemical research in Clean Energy Technology such as solar energy conversion, biomass conversion, energy storage, and photocatalysis.
 - SEES (+\$11.83 million to a total of \$19.33 million): Funding for programs supporting SEES, including activities in Sustainable Chemistry, Engineering, and Materials (SusChEM), will be achieved by refocusing existing programs, such as Centers for Chemical Innovation (CCI), International Collaboration in Chemistry (ICC), and individual investigator awards. Under the SEES umbrella, CHE is also investing in a postdoctoral fellows program and Sustainable Energy Pathways (SEP). CHE will also use a small amount of core funding plus some SEES funding to initiate community-building activities such as workshops, research coordination networks, and exploration of alternative programs to advance fundamental research in food and water security.

Education

- Research Experiences for Undergraduates Site and Supplements program (+\$1.28 million to a total of \$5.78 million): \$640,000 of this additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics*. The remaining \$640,000 million will support REU Site proposals with a specific focus on broadening participation.
- Integrative Graduate Education and Research Traineeship program (IGERT) (-\$1.58 million to zero): All final funding increments in this program are consolidated into OMA. IGERT will sunset in FY 2014 with the initiation of the NSF Research Traineeships (NRT) program.

Infrastructure

- NHFML (+\$250,000 to a total of \$1.75 million): Funding supports the Fourier Transform Ion Cyclotron Resonance (FTICR) Laboratory at NHMFL. This request will allow the facility to continue operations, focus on magnet development, and strengthen education, training, user support, and in-house research, consistent with prior levels for this activity.
- NNIN (-\$100,000 to a total of \$300,000): Support decreases because the research needs of the chemistry community are better served by the chemistry infrastructure programs. CHE supports a growing fraction of the nanoscience community research through the macromolecular, supramolecular, and nanochemistry (MSN) program.
- Research Resources (+\$7.86 million up to a total of \$9.0 million): Added funding is for the Chemistry Research Instrumentation and Facilities (CRIF) program, suspended in FY 2012.

DIVISION OF MATERIALS RESEARCH (DMR)

\$314,630,000
+\$20,080,000 / 6.8%

DMR Funding
(Dollars in Millions)

	FY 2012		FY 2014 Request	Change Over FY 2012 Enacted	
	FY 2012 Actual	Enacted/ Annualized FY 2013 CR		FY 2012 Enacted Amount	Percent
Total, DMR	\$294.40	\$294.55	\$314.63	\$20.08	6.8%
Research	229.27	231.84	243.92	12.08	5.2%
CAREER	23.79	18.00	19.35	1.35	7.5%
Centers Funding (total)	58.22	53.23	60.12	6.89	12.9%
Materials Centers	49.56	44.35	56.00	11.65	26.3%
Nanoscale Science & Engineering Centers	4.66	4.88	0.80	-4.08	-83.6%
STC: Center for Layered Polymeric Systems	4.00	4.00	3.32	-0.68	-17.0%
Education	9.20	9.06	7.96	-1.10	-12.1%
Infrastructure	55.93	53.65	62.75	9.10	17.0%
CHESS	19.67	19.67	20.00	0.33	1.7%
NHMFL	25.30	24.30	30.89	6.59	27.1%
NNIN	2.58	2.58	2.58	-	-
Other MPS Facilities ¹	2.52	2.52	2.66	0.14	5.6%
Research Resources	5.87	4.58	6.62	2.04	44.5%

Totals may not add due to rounding.

¹ Other MPS Facilities is the Center for High Resolution Neutron Scattering (CHRNS) for all years.

DMR focuses on research aimed at 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 result in elimination of 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.

In general, 29 percent of the DMR portfolio is available for new research grants and 71 percent funds continuing grants.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- CAREER (+\$1.35 million for a total of \$19.35 million): These awards are a high priority and are used to develop a pipeline of new faculty in materials research that will form the community of the future.
- Centers:
 - Materials Centers (+\$11.65 million to a total of \$56.0 million): Funding will support 18 Materials Research Science and Engineering Centers (MRSECs). A competition in FY 2014 will reduce the number of centers from 23 to 18 but increase funds to each center, in keeping with the recommendation of the 2007 NRC report on MRSECs. (For more information, see the Centers narrative in the NSF-Wide Investments section).
 - Nanoscale Science and Engineering Centers (-\$4.08 million for a total of \$800,000) are sunseting as planned, but DMR will continue to fund those projects that advance environmental health and safety and societal impacts of nanotechnology.
 - Science and Technology Centers (-\$680,000 for a total of \$3.32 million): This decrease reflects the planned sunseting of the Center for Layered Polymeric Systems.
- Cognitive Science and Neuroscience (\$400,000): Funding supports cross-Foundation fundamental research relevant to cognitive science and neuroscience.
- Changes in NSF-wide investments are accommodated through strategic investments through DMR core programs, accompanied by small reductions to programs not receiving proposals in these areas. These NSF-wide investments include:
 - BioMaPS (+\$2.23 million for a total of \$4.15 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 its portfolio, including the centers and facilities.
 - Clean Energy (-\$4.55 million to a total of \$66.83 million): Funding in the DMR portfolio supports research in clean energy, including hydrogen, fuel cells, biomass, solar energy, hydrocarbon conversion, and energy storage.
 - CEMMSS (+\$22.80 million to a total of \$35.0 million): CEMMSS is comprised of two components in MPS:
 - Advanced Manufacturing (+\$7.80 million for a total of \$20.0 million): This addresses nanomanufacturing.
 - DMREF (+\$15.0 million for a total of \$15.0 million): DMR leads the DMREF activity, which is based on the national Materials Genome Initiative (MGI). The DMREF competition is run in partnership with CHE and DMS, as well as with the Directorates for Engineering and Computer and Information Science and Engineering. DMREF is a major effort to accelerate the discovery and deployment of new materials with a specific and desired function or property through integration of theory and computation, experiments and systematic use of materials data.
 - CIF21 (+\$1.73 million for a total of \$3.48 million): Funding will accelerate research, especially related to DMREF/CEMMSS, by investing in new functional capabilities in computational methods, algorithms, tools and data core methods, and technologies.
 - SEES (+\$6.43 million for a total of \$11.93 million). DMR is a major contributor to SEES. In the Sustainable Chemistry, Engineering and Materials (SusChEM) program, DMR focuses work to enable the capture and use of CO₂, discover new materials that can withstand extreme conditions, use new (non-petroleum based) raw materials as feedstocks for society's materials, and synthesize and process materials to optimize the use of raw materials, water, chemicals, and energy in an environmentally benign way. In FY 2014, DMR will lead the initiation of a new component of the SusChEM program to address critical elements, minerals, and materials.

Education

- Research Experiences for Undergraduates Sites and Supplements program (REU) (+\$800,000 to a

total of \$6.27 million.): \$400,000 of this additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics*. The remaining \$400,000 will support efforts to broaden participation to groups including veterans and others that are under-represented in science, technology, engineering, and mathematics.

- IGERT (-\$1.90 million to zero): All final funding increments in this program are consolidated into OMA. IGERT will sunset in FY 2014 with the initiation of the NSF Research Traineeships (NRT) program.

Infrastructure

- NHMFL (+\$6.59 million to a total of \$30.89 million): Funds will continue to support transformational research using high magnetic fields. This facility serves researchers in disciplines ranging from biology to materials and condensed matter physics. The requested level reflects a new cooperative agreement for operations that started in FY 2013.
- CHESS (+\$330,000 to an estimated total of \$20.0 million): The CHESS user program supports work in cancer research, new materials for electronics, aircraft, biotechnology, batteries, fuel cells, solar cells and other energy applications. The current cooperative agreement with CHESS ends in FY 2014 and a renewal is currently being reviewed.
- Research Resources (+\$2.04 million to a total of \$6.62 million): This includes support to pilot activities associated with the Material Innovation Platforms (MIPs) (+\$3.0 million to a total of \$3.0 million). In addition, decreased funding for Coherent Light Source development (CLS) reflects the planned end, in April 2014, of the current cooperative agreement (-\$960,000 to a total of \$3.62 million).

DIVISION OF MATHEMATICAL SCIENCES (DMS)

\$244,540,000
+\$6,770,000 / 2.8%

DMS Funding

(Dollars in Millions)

	FY 2012		FY 2014 Request	Change Over	
	FY 2012	Enacted/ Annualized		FY 2012 Enacted	Percent
	Actual	FY 2013 CR		Amount	
Total, DMS	\$237.72	\$237.77	\$244.54	\$6.77	2.8%
Research	212.04	219.11	227.05	7.94	3.6%
CAREER	9.61	3.33	4.13	0.80	24.0%
Centers Funding (total)	0.10	0.10	0.10	-	-
Centers for Analysis & Synthesis	0.10	0.10	0.10	-	-
Education	25.68	18.66	17.49	-1.17	-6.3%

Totals may not add due to rounding.

NSF plays a critical role in the mathematical and statistical sciences, as it provides more than sixty percent of all federal support for basic research for these fields in the Nation’s colleges and universities. In certain core areas of the mathematical sciences this percentage is much higher, since NSF funds 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, engineering, and education, especially those that generate big and complex data sets, or that are driven by powerful computing environments, require 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 funds 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.

Approximately 53 percent of the DMS portfolio is available for new research grants. The remaining 47 percent is used primarily to fund continuing grants made in previous years. DMS receives approximately 2,500 research proposals annually, of which less than a third receive awards.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- CAREER (+\$800,000 to a total of \$4.13 million): This increase reflects a continued emphasis on fostering career development of junior mathematical scientists.
- 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.

- Cognitive Science and Neuroscience (\$400,000): Funding supports cross-Foundation fundamental research relevant to cognitive science and neuroscience.
- Changes in NSF-wide investments are accommodated through strategic investments through DMS core programs. These NSF-wide investments include:
 - BioMaPS (+\$2.23 million to a total of \$4.15 million): Funding supports innovative research at the intersection of the mathematical and physical sciences and the biological sciences in a comprehensive new approach to acquire insight into and inspiration from the living world.
 - CIF21 (+\$4.36 million to a total of \$7.66 million): DMS research will focus on mathematical, statistical, and computational sciences, supporting theoretical and methodological developments in mathematics and statistics, the development of new models and algorithms, and visualization methods and computational tools that help solve complex scientific problems involving large and complex data sets and that enable scientific discovery and innovation. This investment expands upon some existing programs supporting research in the analysis of large data sets, development of novel algorithms, and new computational methods in mathematics and statistics. It will also support training and working activities and help develop new theoretical foundations in mathematics and statistics related to CIF21.
 - Clean Energy (+\$440,000 to a total of \$4.92 million): Increased funding will support efforts in solar energy conversion, energy storage, and smart grid technology.
 - SaTC (+\$2.0 million to a total of \$2.0 million): Addressing the challenges of cybersecurity requires multi-disciplinary expertise in human, statistical, mathematical, computational, and computer sciences. DMS invests in fundamental research in cryptographic methods, new algorithms, risk assessments, and mathematical and statistical methods for cybersecurity.
 - SEES (+\$1.0 million to a total of \$3.50 million): This investment addresses challenges in climate, hazards, sustainability, and energy research and education through data analysis, modeling, and simulation. DMS investment in SEES will also support effective training and networking opportunities for collaborations among mathematical and statistical scientists and with domain scientists.

Education

- Education for Mathematics and Statistics through Quantitative Explorations of Data (EXTREEMS-QED) (+\$2.0 million to a total of \$2.0 million): This investment supports enhanced training in computational and data-enabled science for the next generation of mathematical and statistical scientists.
- Research Experiences for Undergraduates Sites and Supplements program (REU) (+\$430,000 to a total of \$3.39 million.): All of this increased funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics*.
- Other education and diversity activities (-\$1.17 million to a total of \$17.49 million): DMS invests in a number of education and diversity activities, including the Mathematical Sciences Postdoctoral Research Fellowships (MSPRF), Research Training Groups (RTG), and Mentoring through Critical Transition Points (MCTP) programs. Decreased funding here is offset by greater use of core research program awards to support graduate students and postdoctoral researchers.

DIVISION OF PHYSICS (PHY)

\$289,020,000
+\$11,650,000 / 4.2%

PHY Funding
(Dollars in Millions)

	FY 2012		FY 2014 Request	Change Over	
	FY 2012 Actual	Enacted/ Annualized FY 2013 CR		FY 2012 Enacted Amount	Percent
Total, PHY	\$277.44	\$277.37	\$289.02	\$11.65	4.2%
Research	192.73	193.68	177.48	-16.20	-8.4%
CAREER	8.03	7.01	7.34	0.33	4.7%
Centers Funding (total)	1.16	1.14	-	-1.14	-100.0%
Nanoscale Science & Engineering Centers	1.16	1.14	-	-1.14	-100.0%
Education	5.61	5.34	6.09	0.75	14.0%
Infrastructure	79.10	78.35	105.45	27.10	34.6%
IceCube	3.45	3.45	3.45	-	-
Large Hadron Collider (LHC)	18.00	18.00	18.00	-	-
Laser Interferometer Grav. Wave Obs. (LIGO)	30.40	30.40	39.50	9.10	29.9%
Nat'l Superconducting Cyclotron Lab. (NSCL)	21.50	21.50	22.50	1.00	4.7%
Research Resources	5.75	5.00	22.00	17.00	340.0%

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 covers 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 continuously have major impact in other scientific and engineering fields.

In general, 26 percent of the PHY portfolio is available for new research grants. The remaining 74 percent is used primarily to fund continuing grants made in previous years (49 percent) and to support operations and maintenance for four facilities that are a key part of the division portfolio (29 percent).

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

A decrease of \$16.20 million to a total of \$177.48 million for Research Grants will be redirected to increased support of major facilities. Changes in disciplinary research support that reflect priorities include:

- CAREER (+\$330,000 to a total of \$7.34 million): This increase shows a continued emphasis on fostering career development of junior scientists.

Directorate for Mathematical and Physical Sciences

- Center for Probing the Nanoscale, a Nanoscale Science and Engineering Center (-\$1.14 million to a total of zero): As planned, support for this center will end in FY 2014.
- Cognitive Science and Neuroscience (\$400,000): Funding supports cross-Foundation fundamental research relevant to cognitive science and neuroscience.
- Changes in NSF-wide investments are accommodated through strategic investments through PHY core programs. These NSF-wide investments include:
 - BioMaPS (+\$2.22 million to a total of \$4.15 million): This provides for programs that support research at the interface between the mathematical and physical sciences and the life sciences.
 - CIF21: (+\$750,000 to a total of \$3.75 million): This funds programs that support CIF21.

Education

- Research Experiences for Undergraduates Sites and Supplements program (REU) (+\$750,000 to a total of \$5.89 million): \$100,000 of this additional funding will support enhanced research experiences for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics*. The remaining \$650,000 will support efforts to broaden participation by groups traditionally underrepresented in the physical sciences.

Infrastructure

- IceCube (level at \$3.45 million): Funding reflects the NSB-approved post-construction ramp up in operations.
- LHC (level at \$18.0 million): This supports operations of the ATLAS and CMS detectors at LHC.
- LIGO (+\$9.10 million to a total of \$39.50 million): Funding for LIGO increases as the Advanced LIGO (AdvLIGO) construction project is completed and commissioning of the upgraded interferometer begins. (See the MREFC chapter for more details on AdvLIGO).
- NSCL (+\$1.0 million to a total of \$22.50 million): This investment increases in order to promote enhanced operations.
- Research Resources (+\$17.0 million to a total of \$22.0 million): This funding covers support for mid-scale instrumentation and a new program in accelerator science.

OFFICE OF MULTIDISCIPLINARY ACTIVITIES (OMA)

\$40,640,000
+\$10,000,000 / 32.6%

OMA Funding

(Dollars in Millions)

	FY 2012		FY 2014 Request	Change Over	
	FY 2012 Actual	Enacted/ Annualized FY 2013 CR		FY 2012 Enacted Amount	Percent
Total, OMA	\$30.37	\$30.64	\$40.64	\$10.00	32.6%
Research	27.05	27.44	26.75	-0.69	-2.5%
CAREER	0.05	-	-	-	N/A
Centers Funding (total)	0.10	0.10	-	-0.10	-100.0%
Centers for Analysis & Synthesis	0.1	0.10	-	-0.10	-100.0%
Education	0.32	0.20	3.89	3.69	1845.0%
Infrastructure	3.00	3.00	10.00	7.00	233.3%
Research Resources	3.00	3.00	-	-3.00	-100.0%
Portfolio Analysis	-	-	10.00	10.00	N/A

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 54 percent of the OMA portfolio is available for new research grants and 46 percent is available for continuing grants.

In FY 2014, OMA will focus on research that emphasizes the mathematical and physical scientific foundations of sustainability, including issues that affect food and water security; 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; 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 MPS activities related to agency-wide efforts in INSPIRE and I-Corps.

MPS divisions have undertaken, or are engaged in, wide ranging reviews of their facilities portfolios. Of particular note are the AST Portfolio Review carried out by the MPS Advisory Committee (A/C), the ongoing MPS A/C study of the role of the Division of Materials Research in synchrotron science, and the National Research Council study of high magnetic field science, all of which are addressed under the Program Monitoring and Evaluation section previously described. OMA will invest \$10.0 million to enable responsible decisions regarding the components of the MPS facilities portfolio. This investment will support studies of possible environmental issues, stewardship transition costs, or partnership start-up costs.

FY 2014 Summary

All funding decreases/increases represent change over the FY 2012 Enacted level.

Research

- In FY 2014, OMA will focus on multidisciplinary research that addresses the key MPS and NSF-wide priorities of I-Corps, INSPIRE, SEES, CIF21, CEMMS, BioMaPS, clean energy, and optics and photonics, and neuroscience
- I-Corps (+\$2.30 million to a total of \$3.30 million): OMA will increase its funding for this cross-agency effort.
- INSPIRE (level at \$3.0 million): OMA will maintain its investment in this cross-agency effort.
- CIF21 (+\$250,000 to a total of \$250,000). OMA will continue to coordinate MPS' participation with BIO, CISE, and ENG, providing funding for Software Infrastructure for Sustained Innovation and Scientific Software Innovation Institutes.

Education

- Alliances for Graduate Education and the Professoriate (AGEP) research supplements (level at \$2.0 million): This is consistent with support that began in FY 2012.
- IGERT (+\$3.44 million to a total of \$3.44 million): All final funding increments for MPS awards in this program are being consolidated into OMA. IGERT will sunset in FY 2014 with the initiation of the NSF Research Traineeships (NRT) program.

Infrastructure

- Portfolio analysis (+\$10.0 million to a total of \$10.0 million): OMA will support responsible decision making regarding portfolio composition, including studies of possible environmental issues, stewardship transition costs, and partnership start-up costs.