

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

**\$1,345,180,000
+\$36,240,000 / 2.8%**

MPS Funding
(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over	
				FY 2012 Estimate Amount	Percent
Division of Astronomical Sciences (AST)	\$236.78	\$234.55	\$244.55	\$10.00	4.3%
Division of Chemistry (CHE)	233.55	234.06	243.85	9.79	4.2%
Division of Materials Research (DMR)	294.91	294.55	302.63	8.08	2.7%
Division of Mathematical Sciences (DMS)	239.79	237.77	245.00	7.23	3.0%
Division of Physics (PHY)	280.34	277.37	280.08	2.71	1.0%
Office of Multidisciplinary Activities (OMA)	27.06	30.64	29.07	-1.57	-5.1%
Total, MPS	\$1,312.42	\$1,308.94	\$1,345.18	\$36.24	2.8%

Totals may not add due to rounding.

About MPS

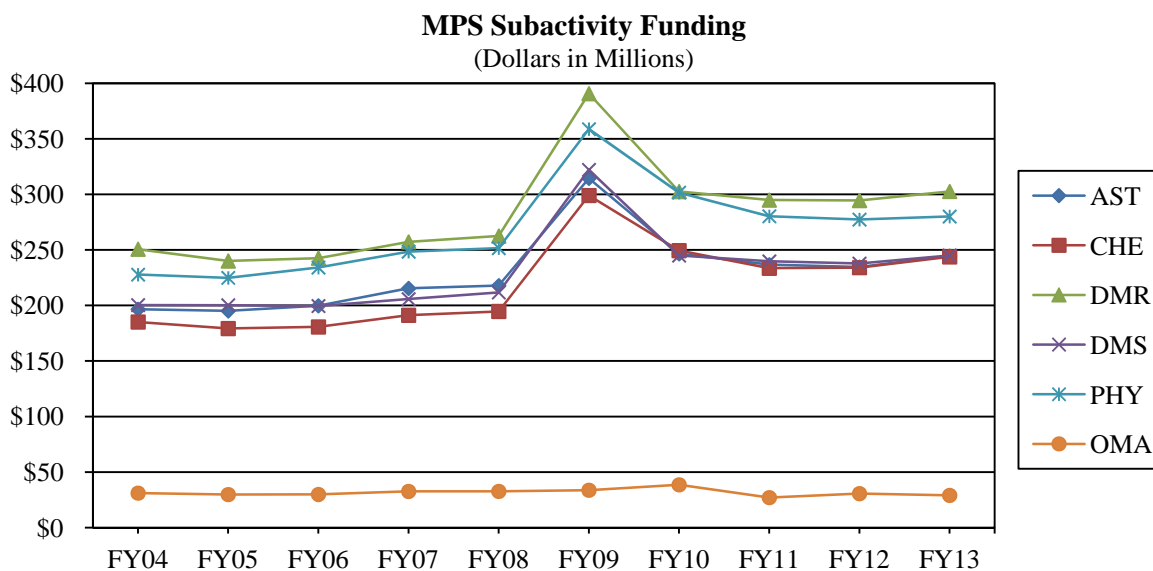
The Directorate for Mathematical and Physical Sciences (MPS) request of \$1,345.18 million embodies the integrative OneNSF framework for FY 2013. Building on a foundation of robust scientific disciplines represented by its five divisions, MPS activities will address cutting-edge challenges in science and education through innovative investments and efficient organizational practices. MPS will focus on three key priorities: (1) *transforming frontiers* by strengthening innovation in basic research programs, by participating in re-envisioned interdisciplinary and educational programs including INSPIRE and Expeditions in Education (E²), and by facilitating a highly integrative, computational and data-enabled approach to Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21); (2) *innovating for society* by providing funding for targeted basic research areas, including a new Sustainable Chemistry, Engineering, and Materials (SusChEM) effort under the NSF-wide Science, Engineering, and Education for Sustainability (SEES) investment area, the national Materials Genome Initiative through a new effort in Designing Materials to Revolutionize and Engineer our Future (DMREF) under the NSF-wide Cyber-Enabled Materials, Manufacturing, and Smart Systems (CEMMSS) investment area, the interface between biological and mathematical and physical sciences (BioMaPS), Enhancing Access to the Radio Spectrum (EARS), as well as directly feeding the innovation ecosystem by participating in the I-Corps program; and (3) *supporting essential facilities* for basic science.

A principal driver of the FY 2013 allocation is funding for core research programs, with all MPS divisions making substantial investments. These awards drive new discoveries in the mathematical and physical sciences, directly strengthening the building blocks of innovation. The MPS commitment to core research strengthens science, seeds longer-term innovation, and develops the foundation for translational activities in NSF as well as other agencies, industry, and society. MPS has reduced funding for the Office of Multidisciplinary Activities (OMA) to enhance core research programs in the MPS divisions.

MPS continues to fund the operations and management of 14 major multi-user facilities, allowing thousands of scientists and students to press the bounds of scientific knowledge, and to invest in potential future projects needed to remain at the cutting-edge of research, such as the Large Synoptic Survey

Telescope (LSST), which would rapidly scan the sky, charting objects that change or move and tracing billions of remote galaxies, providing multiple probes of the mysterious dark matter and dark energy.

MPS provides about 51 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 2013 Summary by Division

- AST’s FY 2013 Request will provide support for individual investigator awards, astronomical observatories, and increased investment in the NSF priority areas of EARS and CIF21. Funding for individual research is balanced against funding for facilities, and among facilities, increased support for ALMA and LSST is requested.
- CHE’s FY 2013 Request is focused on enhancing support for core programs and instrumentation, and features the launch of SusChEM, in response to the America COMPETES Reauthorization Act of 2011, as an important new thrust in the NSF-wide SEES investment. SusChEM will fund research in sustainable chemistry, and increased funding for Centers for Chemical Innovation (CCI) will provide a SusChEM focus to this program.
- DMR’s FY 2013 Request includes plans to increase its portfolio of individual investigator awards, specifically in NSF focus areas where advanced materials are key such as SEES through SusChEM, BioMaPS, and CEMMSS through DMREF. The latter is initiated this year to support the national Materials Genome Initiative. Centers and facilities receive enhanced funding as well.
- DMS’s FY 2013 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, CIF21, SEES, BioMaPS, CEMMSS, and Secure and Trustworthy Cyberspace (SaTC).

- PHY's FY 2013 Request includes continued support for individual investigator awards, particularly those in NSF-wide priority areas such as CIF21 and BioMaPS, as well as divisional priorities such as quantum information science. PHY also requests sufficient funding for investigators using its major facilities, and for operations and maintenance of these facilities.
- OMA will continue its tradition of providing support for multidisciplinary research and activities in education and broadening participation. OMA will emphasize key NSF priorities such as SEES, CIF21, BioMaPS, and CEMMSS. OMA will coordinate MPS activities related to I-Corps and INSPIRE.

Major Investments

MPS Major Investments

(Dollars in Millions)

Area of Investment	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over FY 2012 Estimate	
				Amount	Percent
Advanced Manufacturing	\$23.42	\$32.15	\$40.00	\$7.85	24.4%
BioMaPS	3.37	7.69	11.60	3.91	50.8%
CAREER	66.08	54.02	56.74	2.72	5.0%
CEMMSS	-	32.15	50.00	17.85	55.5%
CIF21	-	11.50	19.55	8.05	70.0%
Clean Energy Technology	132.00	137.31	137.31	-	-
E ²	-	-	5.00	5.00	N/A
EARS	0.03	3.00	12.00	9.00	300.0%
I-Corps	0.20	1.00	1.30	0.30	30.0%
INSPIRE	-	3.00	7.00	4.00	133.3%
SEES	2.72	16.50	27.20	10.70	64.8%
SaTC	-	0.50	2.00	1.50	300.0%

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

- Advanced Manufacturing: MPS funding will be \$40.0 million. These investments will be made in the areas of 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: MPS support for BioMaPS will increase by 50.8 percent in FY 2013 to \$11.60 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 Engineering (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. 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 approximately 125 CAREER awards in FY

2013. 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: In partnership with ENG and the Directorate for Computer and Information Science and Engineering (CISE), MPS will launch the new CEMMSS investment area with an initial focus on Designing Materials to Revolutionize and Engineer our Future, in support of the national Materials Genome Initiative. This is a major new 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: MPS support for this NSF-wide investment will nearly double in FY 2013 to \$19.55 million. All Divisions in MPS 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.
- Clean Energy Technology: MPS investment remains constant in FY 2013. The support is focused in core program research in fuel cells, solar research and development, hydrocarbon conversion, and energy storage.
- Expeditions in Education (E²): All MPS Divisions will contribute to this new NSF-wide priority area through strategic partnerships with the Directorate for Education and Human Resources (EHR).
- EARS: MPS will quadruple its support in FY 2013 to \$12.0 million for the basic research that underpins EARS, an on-going partnership with ENG, CISE, and the Directorate for Social, Behavioral, and Economic Sciences (SBE). 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.
- I-Corps: MPS will increase its investment in the NSF-wide I-Corps program to \$1.30 million in FY 2013 to stimulate innovative industrial partnerships.
- INSPIRE: All MPS Divisions will contribute to this NSF-wide priority area, which supports transformative, high risk, interdisciplinary research. MPS will increase its investment from \$3.0 million to \$7.0 million in FY 2013.
- SEES: MPS will increase its investment in SEES by \$10.70 million to a total of \$27.20 million to support the new SusChEM activity. Existing programs, including centers as well as core programs, will be re-focused to support sustainable chemistry, engineering, and materials, in response to the America COMPETES Reauthorization Act of 2011.
- SaTC: MPS will partner with CISE in launching SaTC in FY 2013, to 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 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over	
				FY 2012 Estimate Amount	Percent
Centers Programs Total	\$104.11	\$78.72	\$90.47	\$11.75	14.9%
Centers for Analysis & Synthesis (DMS, OMA)	0.10	0.20	0.10	-0.10	-50.0%
Centers for Chemical Innovation (CHE)	26.28	24.00	29.25	5.25	21.9%
Materials Centers (DMR)	61.33	44.35	51.20	6.85	15.4%
Nanoscale Science & Engineering Centers (CHE, DMR, PHY)	7.12	6.17	5.92	-0.25	-4.1%
Science & Technology Centers (DMR, PHY)	9.28	4.00	4.00	-	-

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:** Funding (-\$100,000 to a total of \$100,000) 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:** The CCI program, which inspires research on strategic, transformative "grand challenges" in chemical research, increases by \$5.25 million to \$29.25 million. 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:** In FY 2013, DMR requests an increase of \$6.85 million to a total of \$51.20 million for the Materials Centers, an interdisciplinary vehicle for increasing materials research and educating students.
- **Nanoscale Science & Engineering Centers:** DMR is slightly decreasing (-\$250,000) its investment in FY 2013 bringing MPS' total investment to \$5.92 million.

MPS Funding for Facilities

(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over	
				FY 2012 Estimate Amount	Percent
Facilities (Total)	\$262.13	\$260.24	\$263.01	\$2.77	1.1%
Arecibo Observatory	6.19	5.50	5.00	-0.50	-9.1%
Advanced Technology Solar Telescope (ATST)	2.00	2.00	2.00	-	-
Atacama Large Millimeter Array (ALMA)	23.28	28.61	32.92	4.31	15.1%
Cornell High Energy Synchr. Source (CHESS)	14.12	19.67	20.00	0.33	1.7%
GEMINI Observatory	19.50	22.07	18.15	-3.92	-17.8%
IceCube Neutrino Observatory (IceCube)	3.45	3.45	3.45	-	-
Large Hadron Collider (LHC)	18.00	18.00	18.00	-	-
Laser Interfer. Grav. Wave Observatory (LIGO)	30.30	30.40	30.50	0.10	0.3%
Nat'l High Magnetic Field Laboratory (NHFML)	32.68	25.80	31.75	5.95	23.1%
Nat'l Nanotechnology Infra. Network (NNIN)	3.38	2.98	2.58	-0.40	-13.4%
Nat'l Optical Astronomy Observatory (NOAO)	29.50	25.50	25.50	-	-
Nat'l Radio Astronomy Observatory (NRAO)	44.27	43.14	41.00	-2.14	-5.0%
National Solar Observatory (NSO)	9.10	9.10	8.00	-1.10	-12.1%
Nat'l Superconducting Cyclotron Lab (NSCL)	21.50	21.50	21.50	-	-
Other MPS Facilities ¹	4.86	2.52	2.66	0.14	5.6%

Totals may not add due to rounding.

¹ Other MPS Facilities are the Center for High Resolution Neutron Scattering (CHRNS) and the Chemistry and Materials Consortium for Advanced Radiation Sources (ChemMatCARS) for all years, and the Synchrotron Radiation Center (SRC) for FY 2011 only.

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

- ALMA: FY 2013 support (+\$4.31 million to a total of \$32.92 million) is consistent with a planned ramp-up of operations as this observatory comes on line and continues early science activities.
- Gemini: FY 2013 support (-\$3.92 million to \$18.15 million) is primarily for observatory operations and maintenance, reflecting the international partner agreement, with a decreased contribution to the long-term instrumentation fund.
- Arecibo: Funding for the Arecibo radio telescope decreases (-\$500,000 to a total of \$5.0 million), with additional funding supplied from the Division of Atmospheric and Geospace Sciences in the Directorate for Geosciences (GEO/AGS) and NASA. A collaboration led by SRI International took over Arecibo management in FY 2012 as the result of a management recompetition.
- Funding for NHMFL (+\$5.95 million to a total of \$31.75 million) returns the activity to previous funding levels. The FY 2012 Estimate appears lower as it reflects forward funding of activities in prior years.
- Funding for NNIN (-\$400,000 to a total of \$2.58 million) as CHE follows a planned phase-out of its funding.

- NRAO: Funding in FY 2013 is reduced (-\$2.14 million to \$41.0 million) as part of the budget realignment plan to support ALMA operations.
- NSO: Funding (-\$1.10 million to \$8.0 million) assumes that closure of one or more current facilities begins in FY 2012 and is concluded in FY 2013, as planned for a long-term transition to the Advanced Technology Solar Telescope (ATST).

Summary and Funding Profile

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

In FY 2013 MPS will spend \$90.47 million for Centers, accounting for 6.7 percent of the MPS budget. This total is up from FY 2012, as MPS is increasing its 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 comprises 19.6 percent of MPS's FY 2013 Request. MPS has increased operations budgets for facilities to maintain current operational capacity. Where increases were not possible, MPS has maintained operations budgets as close to constant as possible.

MPS Funding Profile

	FY 2011 Actual Estimate	FY 2012 Estimate	FY 2013 Estimate
Statistics for Competitive Awards:			
Number of Proposals	8,798	9,000	9,200
Number of New Awards	2,355	2,355	2,375
Funding Rate	27%	26%	26%
Statistics for Research Grants:			
Number of Research Grant Proposals	7,387	7,500	7,650
Number of Research Grants	1,813	1,813	1,830
Funding Rate	25%	24%	24%
Median Annualized Award Size	\$110,000	\$110,000	\$110,000
Average Annualized Award Size	\$136,805	\$139,000	\$140,000
Average Award Duration, in years	3.1	3.1	3.1

Program Monitoring and Assessment

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.

Committees of Visitors (COV):

- In 2011, COVs reviewed AST and DMR. The COVs presented their reports to the MPS Advisory Committee, which convened in April and November of 2011. Recommendations from the DMR

COV included a review of the instrumentation and facilities portfolio, which is now underway as a subcommittee of the MPS Advisory Committee (“Materials 2022”). AST has also constituted a subcommittee of the MPS Advisory Committee to carry out a complete portfolio review.

- In 2012, a COV will review PHY.
- In 2013, COVs will review CHE and DMS.

Workshops and Reports:

- CHE sponsored a 2011 workshop on “Basic Research to Advance Sustainable Chemistry” hosted by the National Research Council Board on Chemical Sciences and Technology. The workshop was organized around four panels that discussed sustainable chemistry challenges in specific industrial sectors (electronics and telecommunications; traditional chemical industry; pharmaceuticals; and consumer products). The themes emerging from the workshop informed the division in strategizing FY 2013 investments in sustainable chemistry.
- CHE is planning to increase its focus on the development of graduate education in the chemical sciences. On January 23/24, 2012, the Board on Chemical Sciences and Technology (BCST) of the National Research Council will conduct a workshop to examine graduate education in chemistry in the context of current societal challenges and employment opportunities for Ph.D. chemists. The BCST will convene stakeholders from academe, industry, and government to discuss these issues and issue a summary report.
- CHE has requested that the American Chemical Society convene a Presidential Commission on Graduate Education in the Chemical Sciences to consider issues that affect the recruitment, retention, and development of high-quality graduate students. The goal of the Commission’s work will be to identify a small number of innovative models for graduate education in the chemical sciences that will help CHE strategize investments in FY 2013.

Science and Technology Policy Institute (STPI) Reports and Evaluations:

- In FY 2012, DMS is conducting a STPI study to develop a strategy for evaluation of the mathematical sciences research institutes at the portfolio level.

Program Evaluations:

- In FY 2012, AST initiated a full portfolio review through a subcommittee of the MPS Advisory Committee. Final results from this study are expected during FY 2012.
- In FY 2012, DMR initiated a review of its instrumentation and facilities portfolio, “NSF Materials 2022,” as a subcommittee of the MPS Advisory Committee. Final results from this study are expected during FY 2012.

Number of People Involved in MPS Activities

	FY 2011	FY 2012	FY 2013
	Actual	Estimate	Estimate
	Estimate	Estimate	Estimate
Senior Researchers	9,073	9,070	9,100
Other Professionals	2,785	2,780	2,800
Postdoctorates	2,362	2,370	2,380
Graduate Students	9,078	9,080	9,100
Undergraduate Students	6,782	6,780	6,800
K-12 Teachers	-	-	-
K-12 Students	-	-	-
Total Number of People	30,080	30,080	30,180

DIVISION OF ASTRONOMICAL SCIENCES (AST)

\$244,550,000
+\$10,000,000 / 4.3%

AST Funding
(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over	
				FY 2012 Estimate Amount	Percent
Total, AST	\$236.78	\$234.55	\$244.55	\$10.00	4.3%
Research	65.52	73.23	83.86	10.63	14.5%
<i>CAREER</i>	4.28	4.30	4.60	0.30	7.0%
Education	6.14	6.65	5.80	-0.85	-12.8%
Infrastructure	165.12	154.67	154.89	0.22	0.1%
<i>Adv. Technology Solar Tel. (ATST)</i>	2.00	2.00	2.00	-	-
<i>Arecibo Observatory</i>	6.19	5.50	5.00	-0.50	-9.1%
<i>Atacama Large Mm Array (ALMA)</i>	23.38	28.61	32.92	4.31	15.1%
<i>Gemini Observatory</i>	19.50	22.07	18.15	-3.92	-17.8%
<i>Nat'l Optical Astron. Obs. (NOAO)</i>	29.50	25.50	25.50	-	-
<i>Nat'l Radio Astron. Obs. (NRAO)</i>	44.27	43.14	41.00	-2.14	-5.0%
<i>Nat'l Solar Observatory (NSO)</i>	9.10	9.10	8.00	-1.10	-12.1%
<i>Pre-Construction Planning (Total)</i>	5.31	4.75	7.75	3.00	63.2%
<i>Giant Segmented Mirror Telescope (GSMT)</i>	-	0.25	0.25	-	-
<i>Large Synoptic Survey Telescope (LSST)</i>	5.31	4.50	7.50	3.00	66.7%
<i>Research Resources</i>	25.87	14.00	14.57	0.57	4.1%

Totals may not add due to rounding.

AST is the federal steward for ground-based astronomy in the U.S., working in partnership with private institutions to enhance overall observing capacity and capability. Funding covers research to understand the origins and characteristics of planets, stars, and galaxies, as well as the structure and origin of the Universe through awards to individual investigators, small groups, and national facilities. AST supports the development of advanced technologies and instrumentation, the planning and design of future facilities, and management of the electromagnetic spectrum for scientific use. AST funds operations and maintenance for several world-class national and international facilities, which 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 is carrying out a community-based review of its entire portfolio in order to maximize the delivery of the recommended science. It is expected that this review will be completed during FY 2012, and its output will be used to inform FY 2013 budget execution and future budget requests.

Approximately 57 percent of AST's budget is used to support current operations and future development of large multi-user astronomy facilities, while 33 percent supports individual investigator grants and 6 percent supports the development and operation of advanced instrumentation and experiments based on such instrumentation. In general, about 19 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 2013 Summary

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

Research

- Enhancing Access to the Radio Spectrum (EARS) increases +\$9.0 million, to a total of \$12.0 million. AST is the home of radio spectrum management for the entire NSF, and is where the EARS program was founded. The AST EARS investment will concentrate on the radio-frequency-interference mitigation, advanced receiver design, propagation studies, and other radio-astronomy-related foundations of radio spectrum access and hardware design, as well as key national and international regulatory and public policy foundations for radio spectrum management.
- Cyberinfrastructure Framework for the 21st Century (CIF21) increases by +\$1.48 million to \$3.18 million; this includes \$1.50 million to initiate the Theory and Computation Networks recommendation of the decadal survey, in collaboration with NASA.
- Other grants programs, including the Astronomy and Astrophysics Research Grants, remain approximately constant in the FY 2013 request. This stability is enabled by spending reductions in the AST facility infrastructure (see below), which have been made to support the AST commitment to maintaining the individual research that is critical to advancement in the field.

Education

- The reduction (\$-850,000 to \$5.80 million) reflects a cessation in contributions to funding of the ADVANCE program, in order to maintain the Research Experiences for Undergraduates (REU) and Astronomy and Astrophysics Postdoctoral Fellowship programs funded by AST.
- AST maintains its commitment to diversity through its Partnerships in Astronomy and Astrophysics Research and Education program, advancing the opportunities through institutions that historically serve under-represented minorities.

Infrastructure

AST oversees an array of infrastructure projects and programs. Reductions in facility funding reflect the maintenance of funding balance between facilities and individual research. Future trends for these facilities will depend critically on the results of the ongoing AST portfolio review, described above. For detailed information on individual AST facilities, please see the Facilities chapter.

- Gemini: FY 2013 support (-\$3.92 million to \$18.15 million) is primarily for observatory operations and maintenance, reflecting the international partner agreement, with a decreased contribution to the long-term instrumentation fund.
- ALMA: FY 2013 support (+\$4.31 million to a total of \$32.92 million) is consistent with a planned ramp-up of operations as this observatory comes on line and continues early science activities.
- Arecibo: Funding for the Arecibo radio telescope decreases (-\$500,000 to a total of \$5.0 million), with additional funding supplied from GEO/AGS and NASA. A collaboration led by SRI International took over Arecibo management in FY 2012 as the result of a management recompetition.
- NOAO: Funding in FY 2013 is the same as in FY 2012, pending the results of the ongoing AST portfolio review.
- NRAO: Funding in FY 2013 is reduced (-\$2.14 million to \$41.0 million) as part of the budget realignment plan to support ALMA operations.
- NSO: Funding (-\$1.10 million to \$8.0 million) assumes that closure of one or more current facilities begins in FY 2012 and is concluded in FY 2013, as planned for a long-term transition to the Advanced Technology Solar Telescope (ATST).
- ATST Operations: Funding is constant at \$2.0 million, to mitigate effects of construction in Hawaii.
- LSST: Design and development (D&D) funding increases (+\$3.0 million to \$7.50 million) in the

wake of the successful NSF Preliminary Design Review and coordinated DOE camera review, for this top-ranked ground-based project in the decadal survey. This support covers enhanced systems management, continued work on critical data management issues, and improved project management and quality assurance, which were recommended by the reviews, and other D&D that will reduce the risk before a potential construction start. NSF expects DOE to request continued D&D and preliminary camera fabrication and integration support.

- GSMT: Funding initiated (\$250,000) for a new solicitation for planning for a potential partnership solicitation.
- Research Resources: Funding growth (+\$570,000 to a total of \$14.57 million) reflects planned commitments to existing mid-scale experiment and instrumentation projects, together with a decrease (-\$500,000 to \$8.50 million) for the Advanced Technology and Instrumentation program.

DIVISION OF CHEMISTRY (CHE)**\$243,850,000**
+\$9,790,000 / 4.2%**CHE Funding**
(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over	
				FY 2012 Estimate Amount	Percent
Total, CHE	\$233.55	\$234.06	\$243.85	\$9.79	4.2%
Research	209.14	224.07	225.46	1.39	4.2%
<i>CAREER</i>	24.24	21.38	22.28	0.90	4.2%
<i>Centers Funding (total)</i>	25.58	24.15	29.40	5.25	21.7%
<i>Centers for Chemical Innovation</i>	24.28	24.00	29.25	5.25	21.9%
<i>Nanoscale Science & Engineering Centers</i>	1.30	0.15	0.15	-	-
Education	11.87	6.95	7.50	0.55	7.9%
Infrastructure	12.54	3.04	10.89	7.85	258.2%
<i>Nat'l Nanotechnology Infrastructure Network</i>	0.40	0.40	-	-0.40	-100.0%
<i>NHMFL</i>	1.50	1.50	1.75	0.25	16.7%
<i>Research Resources</i>	10.24	1.14	9.14	8.00	701.8%

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 molecules and materials that are essential to our economy and well-being. CHE strongly supports research at the interface of biology and chemistry. Chemistry's programs invite research in catalysis for power generation and storage as well as to enable 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 nanosized aerosols and particles impact our environment. In addition, CHE supports research that leads to increased understanding of molecules and materials and their chemical transformation and the development of new instrumentation to study and detect molecules.

Approximately 72 percent of CHE's budget is used to support individuals and small groups of researchers, about 8 percent of the budget goes to instrumentation, 11 percent to facilities and centers, and the remainder goes to education and outreach. About 47 percent of CHE's budget is targeted at new awards, and the remainder toward continuing grant increments. A small percentage (less than one percent) provides review panel support.

FY 2013 Summary

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

Research

- An increase (+\$1.39 million to a total of \$225.46 million) for core research programs will enable greater support of projects at the frontier of chemistry, including strategic investments in SEES, (specifically initiating SusChEM), CIF21, CEMMSS, (specifically initiating DMREF), and BioMaPS.
- CAREER: This program is particularly important to the development of strong academic departments and the training of the next generation of scientists and engineers. CHE has a long and strong tradition in supporting junior researchers through the CAREER program. Funding will remain at 9

percent of the total CHE Request. The planned investment in FY 2013 increases by \$900,000 over the FY 2012 estimate to \$22.28 million.

- The Centers for Chemical Innovations (CCI) program, which inspires research on strategic, transformative "Grand Challenges" in chemical research, increases by \$5.25 million to \$29.25 million. 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. CHE plans to initiate three new Phase I CCIs and fund one Phase II CCI in FY 2013. The Phase II awards will be selected competitively from a pool of Phase I awards and Phase II awards eligible for renewal.

Education

- Support will remain constant for the Integrative Graduate Education and Research Traineeship (IGERT) program and increase by \$500,000 for Research Experiences for Undergraduates (REU) Sites to a total of \$5.0 million.

Infrastructure

- NHMFL: Co-funding support increases by \$250,000 to \$1.75 million. This increase is to offset rising operating expenses for the 21 T magnet, and the staffing that is required to provide full access to the user community.
- Funding for Coherent Light Source (CLS) and ChemMatCARS continues at \$400,000 and \$740,000, respectively through continuing grant increments.
- Research Resources: The Chemistry Research Instrumentation and Facilities program was suspended in FY 2012 and will restart in FY 2013 at the FY 2011 level of \$8.0 million, increasing the overall budget to \$9.14 million. The remaining \$1.14 million are continuing grant increments to support ChemMatCARS and CLS (see above).

DIVISION OF MATERIALS RESEARCH (DMR)**\$302,630,000**
+\$8,080,000/ 2.7%**DMR Funding**

(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over	
				FY 2012 Estimate Amount	Percent
Total, DMR	\$294.91	\$294.55	\$302.63	\$8.08	2.7%
Research	227.15	231.84	233.13	1.29	0.6%
<i>CAREER</i>	21.78	18.00	18.75	0.75	4.2%
<i>Centers Funding (total)</i>	72.65	53.23	59.83	6.60	12.4%
<i>Materials Centers</i>	61.33	44.35	51.20	6.85	15.4%
<i>Nanoscale Science & Engineering Centers</i>	4.66	4.88	4.63	-0.25	-5.1%
<i>STC: Ctr for Layered Polymeric Systems</i>	4.00	4.00	4.00	-	-
<i>STC: Materials & Devices for InfoTech</i>	2.66	-	-	-	N/A
Education	10.54	9.06	9.06	-	-
Infrastructure	57.22	53.65	60.44	6.79	12.7%
<i>Nat'l Nanotechnology Infrastructure Network</i>	2.98	2.58	2.58	-	-
<i>CHESS</i>	14.12	19.67	20.00	0.33	1.7%
<i>NHMFL</i>	31.18	24.30	30.00	5.70	23.5%
<i>Other MPS facilities</i>	4.86	2.52	2.66	0.14	5.6%
<i>Research Resources</i>	4.11	4.58	5.20	0.62	13.5%

Totals may not add due to rounding.

¹ Other MPS Facilities are the Center for High Resolution Neutron Scattering (CHRNS) and the Chemistry and Materials Consortium for Advanced Radiation Sources (ChemMatCARS) for all years, and the Synchrotron Radiation Center (SRC) for FY 2011 only.

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 new 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, and in next-generation instruments and facilities. DMR will continue to educate the public about the benefits enabled by materials research..

In general, 22 percent of the DMR grant portfolio is available for new research grants and 78 percent for continuing grants.

FY 2013 Summary

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

Research

- DMR leads the NSF investment in Designing Materials to Revolutionize and Engineer our Future (DMREF), which is in response to the national Materials Genome Initiative. DMREF, which is part of CEMMSS, is a major effort to accelerate the design and synthesis 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. DMREF was run as a pilot in FY 2012 with the Directorate for Engineering (ENG) divisions of Civil, Mechanical and Manufacturing Innovation (CMMI), Chemical, Bioengineering, Environmental, and Transport Systems (CBET), CHE, and DMS. In FY 2013 DMR's request is +\$10.50 million for a total of \$10.50 million.
- DMR will participate in the new Sustainable Chemistry, Engineering and Materials (SusChEM), which is part of SEES. DMR's fundamental research in sustainability includes work to enable the capture and utilization of carbon dioxide (for new materials, for example), 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. In lieu of Sustainable Energy Pathways in FY 2013, DMR will direct \$5.0 million and request an additional \$2.40 million for a total of \$7.40 million for SusChEM.
- In CIF21, DMR will accelerate research, especially related to DMREF, by investing in new functional capabilities in computational methods, algorithms, tools, and data methods and technologies. Through partnership with the Office of Cyberinfrastructure and other NSF divisions, DMR will support these tools at individual investigator to focused research group levels of support, including EAGERs and CREATIVs. DMR requests an increase of \$1.48 million for a total of \$3.23 million.
- In FY 2013, DMR requests \$51.20 million (+\$6.85 million) for Materials Centers, an interdisciplinary vehicle for supporting materials research and educating students. No new awards will be made in FY 2013, as the program is competed triennially with the next competition planned for FY 2014. FY 2013 support is for continuing grant increments supporting 23 centers. (For more information, see the Centers narrative in the NSF-Wide Investments tab).

Education

- DMR will maintain its investments in REU Sites and Supplements, IGERT, and RET supplements at the FY 2012 Current Plan levels in the FY 2013 Request.
- DMR's focus on Expeditions in Education (E²) will introduce Materials Genome Initiative concepts into student learning.

Infrastructure

- Increased funding of +\$330,000 (for a total of \$20.0 million) is requested for the synchrotron light source, CHESS. This will allow continued operation as a national user facility. 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 FY 2013 Request for NHMFL (\$30.0 million) will allow the facility to continue operations, focus on magnet development, and strengthen education, training, user support, and in-house research. The FY 2012 Estimate appears lower as it reflects forward funding of activities in prior years. As noted in the Facilities chapter, a 5-year renewal proposal for the operation of the NHMFL beginning in FY 2013 was submitted to NSF in summer 2011 and is currently under review with results expected in summer 2012.
- An increase in DMR support for the Coherent Light Source (CLS) research project (+\$620,000 for a total of \$5.20 million) is requested as scheduled in the cooperative agreement. Additional funding in FY 2013 is provided by CHE (\$400,000) and OMA (\$2.0 million) for a total of \$7.60 million.

DIVISION OF MATHEMATICAL SCIENCES (DMS)

\$245,000,000
+\$7,230,000 / 3.0%

DMS Funding

(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over	
				FY 2012 Estimate Amount	Percent
Total, DMS	\$239.79	\$237.77	\$245.00	\$7.23	3.0%
Research	214.10	219.11	224.17	5.06	2.3%
<i>CAREER</i>	8.16	3.33	4.00	0.67	20.1%
<i>Centers Funding (total)</i>	-	0.10	0.10	-	-
<i>Centers for Analysis & Synthesis</i>	-	0.10	0.10	-	-
Education	25.69	18.66	20.83	2.17	11.6%
Infrastructure	-	-	-	-	N/A

Totals may not add due to rounding.

The National Science Foundation plays a critical role in the mathematical and statistical sciences, as it provides more than sixty percent of all federal support for basic research in the Nation’s colleges and universities. In certain core areas of the mathematical sciences this percentage is 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 and engineering. In turn, advances in science and engineering, especially those generating big and complex data sets or that are driven by powerful computing environments, require development of ever more sophisticated mathematical and statistical tools. DMS plays a key role 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; geometry 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.

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

FY 2013 Summary

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

Research

- Support for CIF21 increases by \$3.11 million to a total of \$6.41 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 big and complex data 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 networking activities, and help develop new theoretical foundations in mathematics and statistics related to CIF21 goals.

- SEES increases by +\$1.0 million to a total of \$3.50 million. This activity addresses challenges in climate, sustainability, and energy research and education through data analysis, modeling, and simulation. The investment in SEES will also support effective training and networking opportunities for collaborations among mathematical and statistical scientists and with domain scientists.
- Support for DMREF under the NSF-wide CEMMSS investment area is initiated at a total of \$4.50 million. DMS seeks to invest in innovative partnerships between academic mathematical and statistical scientists and other physical scientists, and to support research in Materials by Design as it relates to computational, mathematical, and statistical sciences in CIF21.
- BioMaPS support increases by \$980,000 to a total of \$2.90 million. DMS will invest in 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.
- SaTC is initiated at \$2.0 million. Addressing the challenges of cybersecurity requires multi-disciplinary expertise in human, statistical, mathematical, computational, and computer sciences. DMS will invest in fundamental research in cryptographic methods, new algorithms, risk assessments, and methods for cybersecurity.
- Support for mathematical and statistical sciences institutes remains at \$29.50 million. Eight domestic DMS-supported institutes will continue to catalyze frontier research through an array of varied scientific programs.
- Consistent with this longstanding priority, funding for CAREER will increase (+\$670,000 to a total of \$4.0 million).

Education

- Support for E² is initiated at \$2.0 million. DMS will invest in the training through research involvement of the next generation of mathematicians and statisticians who are highly conversant in computational and data-enabled science and engineering.
- DMS invests in a number of additional education and diversity activities, including the Mathematical Sciences Postdoctoral Research Fellowships (MSPRF), Research Training Groups (RTG), Mentoring through Critical Transition Points (MCTP), and Research Experiences for Undergraduates (REU) programs. Investment in this portfolio increases by +\$2.17 million to a total \$20.83 million in FY 2013.

DIVISION OF PHYSICS (PHY)

\$280,080,000
+\$2,710,000 / 1.0%

PHY Funding

(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over	
				FY 2012 Estimate Amount	Percent
Total, PHY	\$280.34	\$277.37	\$280.08	\$2.71	1.0%
Research	179.03	193.68	196.29	2.61	1.3%
<i>CAREER</i>	7.42	7.01	7.11	0.10	1.4%
<i>Centers Funding (total)</i>	3.58	1.14	1.14	-	-
<i>Nanoscale Science & Engineering Centers</i>	0.96	1.14	1.14	-	-
<i>STC: Cntr.for Bio. Sci.&Tech.</i>	2.62	-	-	-	N/A
Education	9.62	5.34	5.34	-	-
Infrastructure	91.69	78.35	78.45	0.10	0.1%
<i>Large Hadron Collider (LHC)</i>	18.00	18.00	18.00	-	-
<i>Laser Interferometer Grav. Wave Obs. (LIGO)</i>	30.30	30.40	30.50	0.10	0.3%
<i>Nat'l Superconducting Cyclotron Lab. (NSCL)</i>	21.50	21.50	21.50	-	-
<i>IceCube</i>	3.45	3.45	3.45	-	-
<i>DUSEL</i>	10.19	-	-	-	N/A
<i>Research Resources</i>	8.25	5.00	5.00	-	-

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 continuously have major impact in other scientific and engineering fields.

In general, 25 percent of the PHY portfolio is available for new research grants. The remaining 75 percent is used primarily to fund continuing grants made in previous years (50 percent) and to support operations and maintenance for four facilities that are a key part of the division portfolio (25 percent): the Laser Interferometer Gravitational Wave Observatory (LIGO), the Large Hadron Collider (LHC), the National Superconducting Cyclotron Facility (NSCL), and Ice Cube.

FY 2013 Summary

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

Research

- An increase of \$2.61 million to a total of \$196.29 million for Research Grants will enable increased support of projects at the discovery frontiers of physics. Major changes include:
 - Increase of support for programs that support Cyberinfrastructure Framework for 21st Century (CIF21) (+\$500,000 to a total of \$3.50 million)
 - Increase of funding for programs that support research at the interface between the mathematical and physical sciences and the life sciences (BioMaPS) (+\$970,000 to a total of \$2.90 million)
 - CAREER funding increases by \$100,000 to a total of \$7.11 million in FY 2013, reflecting a continued emphasis on fostering career development of junior scientists.

Education

- Funding for Research Experiences for Undergraduates (REU) sites remains at the current level of \$4.54 million in order to maintain the existing number of sites. PHY's remaining \$800,000 investment in Education is for research grant supplements for Research Experiences for Teachers (RET) and REU, equal to the FY 2012 Estimate.

Infrastructure

- FY 2013 support for operations of the ATLAS and CMS detectors at the Large Hadron Collider (LHC) during the first period of data-taking remains at the current level (\$18.0 million).
- Support for the Laser Interferometer Gravitational Wave Observatory is increased by \$100,000 to a total of \$30.50 million in accord with the agreed-upon funding profile for operations during the Advanced LIGO construction project. (See the MREFC chapter for more details on Advanced LIGO)
- Support for the National Superconducting Cyclotron Laboratory (NSCL) remains at the current level while design of the proposed new DOE-supported FRIB facility to be built on the NSCL platform continue.
- Funding for IceCube is maintained at \$3.45 million as part of the NSB-approved post-construction ramp-up in operations.

OFFICE OF MULTI-DISCIPLINARY ACTIVITIES (OMA)

\$29,070,000
-\$1,570,000 / -5.1%

OMA Funding
(Dollars in Millions)

	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Change Over FY 2012 Estimate	
				Amount	Percent
Total, OMA	\$27.06	\$30.64	\$29.07	-\$1.57	-5.1%
Research	21.93	25.44	24.87	-0.57	-2.2%
<i>I-Corps</i>	0.20	1.00	1.30	0.30	30.0%
<i>Inspire</i>	-	3.00	3.00	-	-
<i>Centers Funding (total)</i>	2.10	0.10	-	-0.10	-100.0%
<i>Centers for Analysis & Synthesis</i>	0.10	0.10	-	-0.10	-100.0%
<i>Centers for Chemical Innovation</i>	2.00	-	-	-	N/A
Education	2.13	2.20	2.20	-	-
<i>REU Sites</i>	2.00	-	-	-	N/A
<i>Pan-American Advanced Studies Institutes</i>	0.13	0.20	0.20	-	-
<i>AGEP Graduate Research Supplements</i>	-	2.00	2.00	-	-
Infrastructure	3.00	3.00	2.00	-1.00	-33.3%
<i>Research Resources</i>	3.00	3.00	2.00	-1.00	-33.3%

Totals may not add due to rounding.

The Office of Multidisciplinary Activities (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 65 percent of the OMA portfolio is available for new research grants and 35 percent is available for continuing grants.

In FY2013, OMA will focus on: multidisciplinary research emphasizing the mathematical and physical scientific foundations of sustainability, including new synthetic methods to replace rare raw materials with abundant chemicals and to incorporate green principles in scaled-up processes; multidisciplinary research addressing the fundamental science critical to designing new materials; multidisciplinary research at the interface between the mathematical and physical sciences and the life sciences to provide insight into the molecular basis of life processes; computational and data-enabled science across the MPS divisions; multidisciplinary research into controlling, manipulating, and exploring the behavior of quantum matter and the limitations of quantum information processing; and team efforts aimed at developing next-generation instrumentation to enable fundamental advances across a wide spectrum of disciplines. OMA will also provide leadership and support for INSPIRE and I-Corps activities within MPS.

FY 2013 Summary

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

Research

- In FY 2013, OMA will focus on multidisciplinary research addressing the key NSF-wide priority areas of I-Corps, INSPIRE, SEES, CIF21, CEMMS, BioMaPS, clean energy, and advanced manufacturing.
- OMA will increase its investment in I-Corps (+\$300,000) to \$1.30 million in FY 2013.
- OMA will maintain its investment in INSPIRE at \$3.0 million in FY 2013.
- OMA completes its planned five-year investment to support the National Institute for Mathematical and Biological Synthesis (-\$100,000 to zero), a Center for Analysis and Synthesis primarily managed by BIO, in FY 2012. No support is planned for FY 2013.
- In the area of CIF21 OMA will coordinate MPS' participation with OCI, BIO, CISE, and ENG, and provide funding for Software Infrastructure for Sustained Innovation (+\$2.25 million) and Scientific Software Innovation Institutes (+\$500,000).

Education

- Funding for the Pan-American Advanced Studies Institutes will be maintained at \$200,000 in FY 2013.
- OMA launched a new investment AGEP Graduate Research Supplements at the level of \$2.0 million in FY 2012. OMA will continue its \$2.0 million investment in FY 2013.

Facilities

- OMA will invest \$2.0 million (-\$1.0 million below the FY 2012 Estimate) in co-funding with the Divisions of Chemistry (CHE) and Materials Research (DMR) for Coherent Light Source (CLS) in FY 2013.