

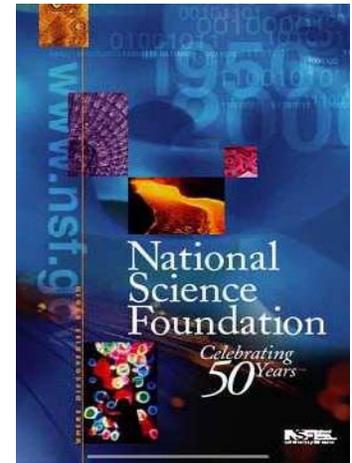
Overview of NSF Directorate for Mathematical and Physical Sciences

NSF Regional Grants Conference
October 2011

Dean M. Evasius
Program Director
Division of Mathematical Sciences

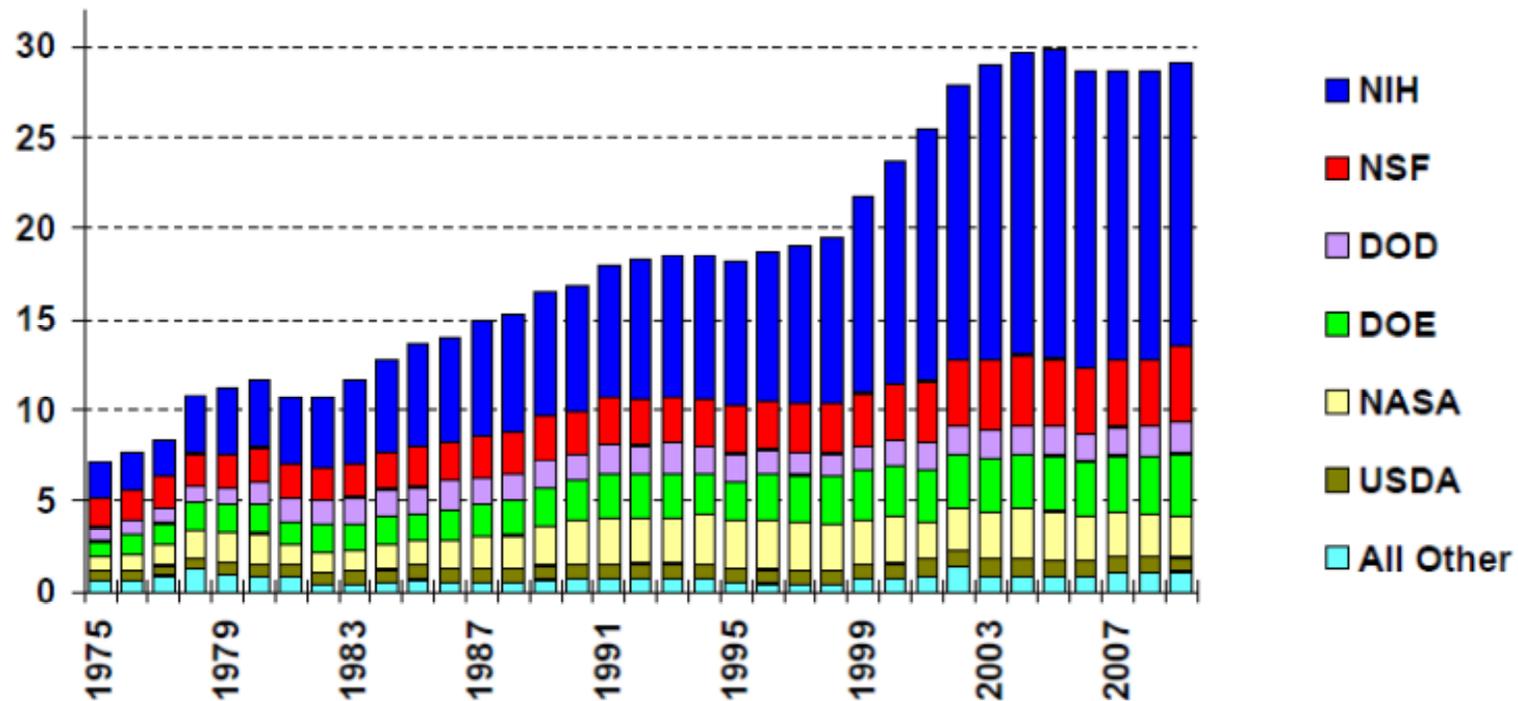
NSF in a Nutshell

- Independent agency
- Support basic research and education
- Use grant mechanism in two forms:
 - Unsolicited, curiosity driven (majority of \$)
 - Solicited, more focused
- Peer reviews: intellectual merit & broader impacts
- Support all fields of science/engineering
- Discipline-based structure
- Cross-disciplinary mechanisms
- Support large facilities



Trends in Basic Research by Agency, FY 1975-2009 *

in billions of constant FY 2008 dollars

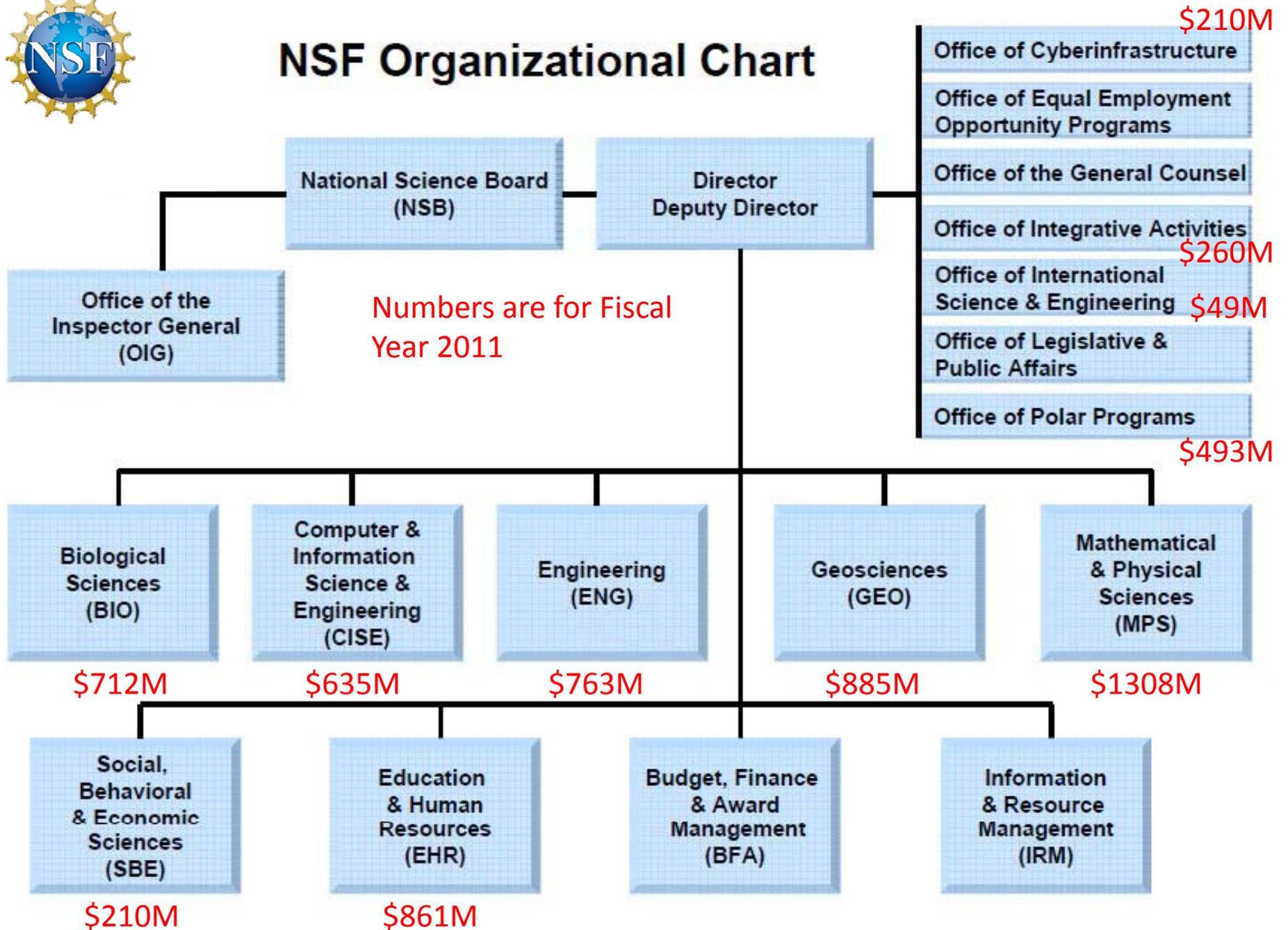


Source: AAAS analyses of R&D in *AAAS Reports VIII-XXXIII*. * FY 2009 figures are latest AAAS estimates of FY 2009 request.
 Basic research only.
 MARCH '08 REVISED © 2008 AAAS

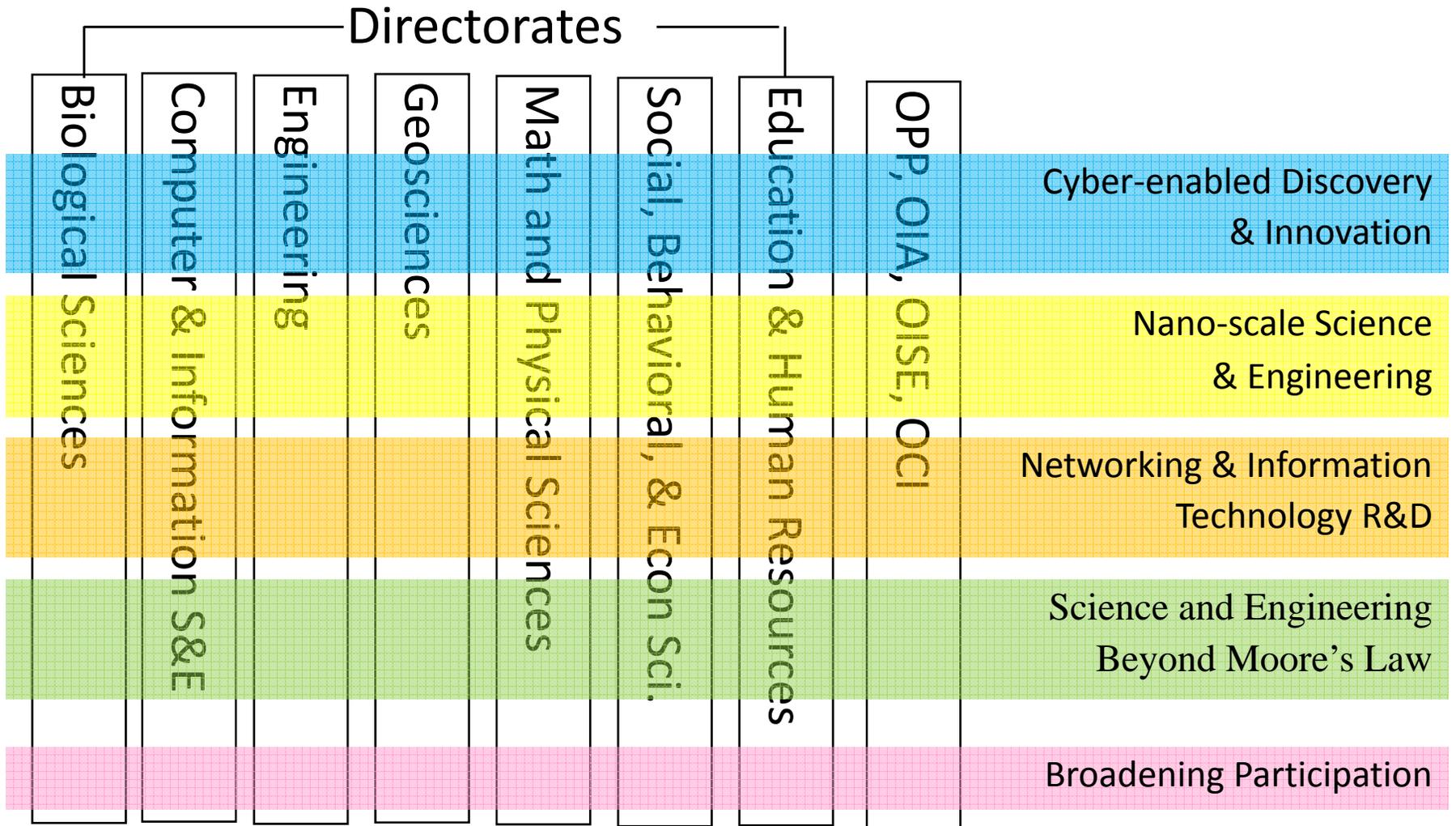




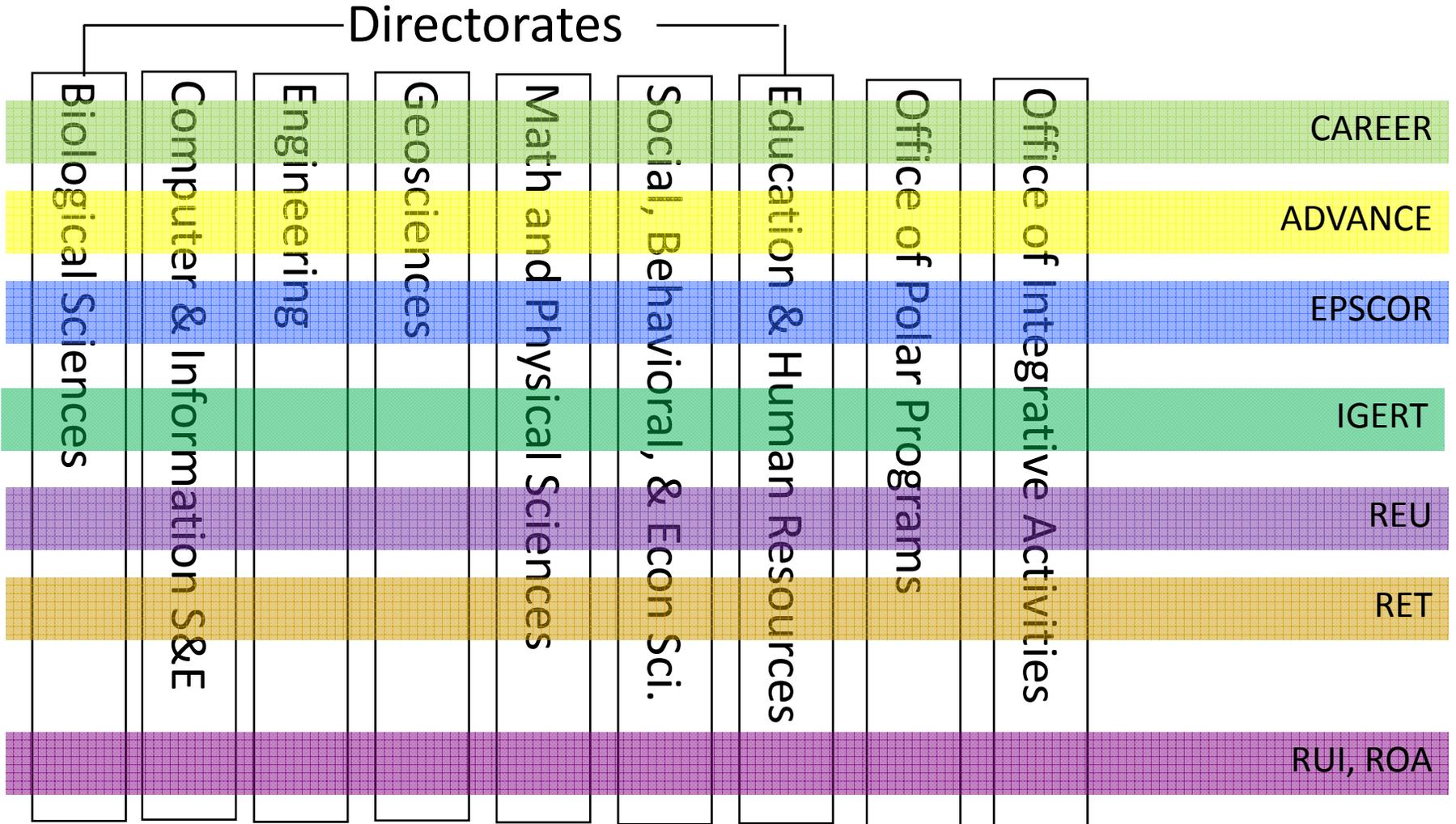
NSF Organizational Chart



NSF-Wide Scientific Investments



NSF-Wide Programs



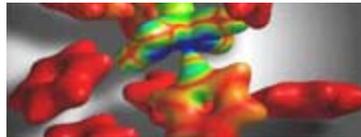
MPS

Directorate for Mathematical and Physical Sciences

Astronomical
Sciences (AST)



Chemistry (CHE)



Materials
Research (DMR)



Mathematical
Sciences (DMS)



Physics (PHY)



MPS Mission Statement

- To make discoveries about the Universe and the laws that govern it;
- To create new knowledge, materials, and instruments which promote progress across science and engineering;
- To prepare the next generation of scientists through research, and to share the excitement of exploring the unknown with the nation.

MPS Scientific Themes

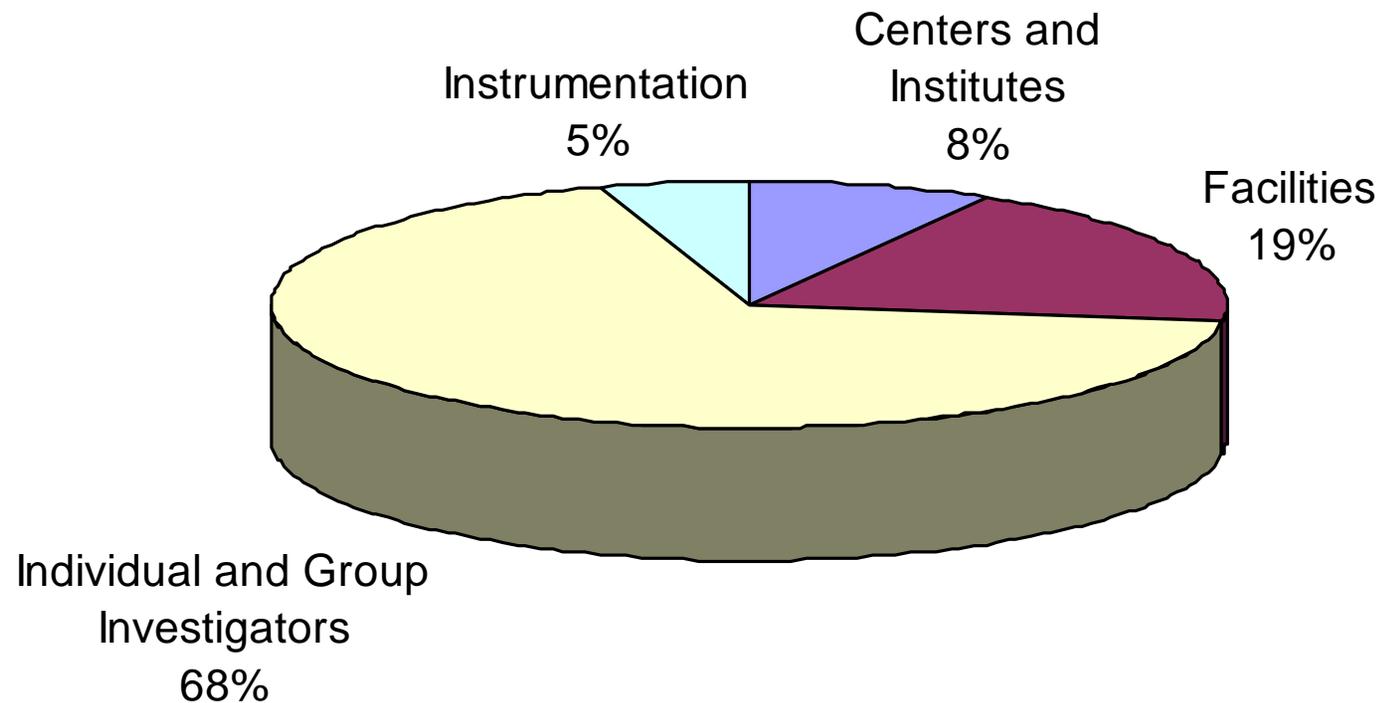
- Charting the evolution of the Universe from the Big Bang to habitable planets and beyond
- Understanding the fundamental nature of space, time, matter, and energy
- Creating the molecules and materials that will transform the 21st century
- Developing tools for discovery and innovation throughout science and engineering
- Understanding how microscopic processes enable and shape the complex behavior of the living world
- Discovering mathematical structures and promoting new connections between mathematics and the sciences
- Conducting basic research that provides the foundation for our national health, prosperity, and security

About the Directorate of Mathematical and Physical Sciences

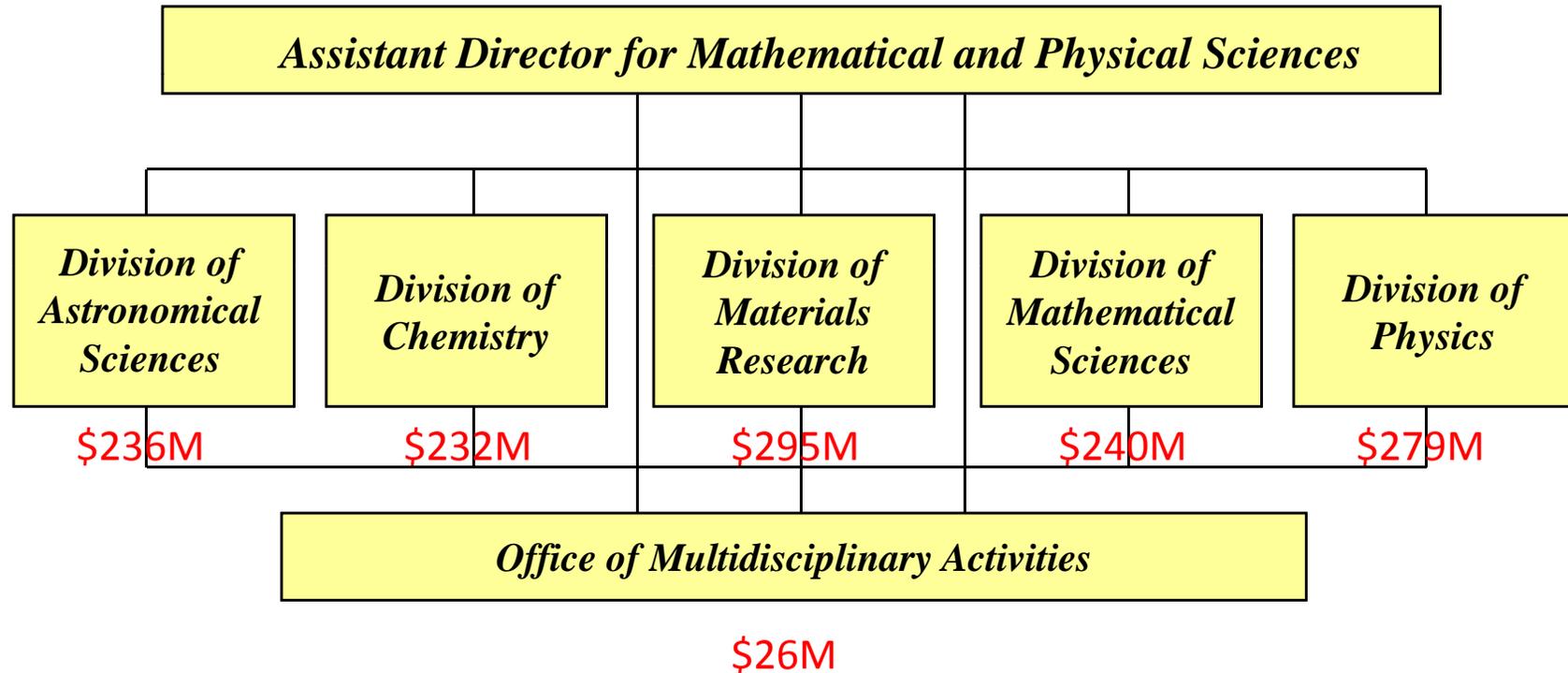
- Largest directorate
 - » ~25% of R&RA, ~18% of proposals, FY11 request \$1410m
- Nearly half of NSF's large facilities
- Responsible for the three “core” university disciplines - Physics, Chemistry, Mathematics – plus Astronomy and Materials Research
- Over 40% of university federal funding in the physical sciences
 - » More than 80% in mathematics, and (was) growing
 - » Federal steward for ground-based astronomy
- Science scope - extension on every scale
 - » Femtoseconds and attoseconds to petaseconds and exaseconds
 - » From the Planck size to the Cosmic size
 - » From nanoKelvin to GigaKelvin
 - » From fundamental research to marketable technologies
 - » Every mental horizon from n-dimensions to infinity and beyond ...



MPS Funding Modality in the FY2011 Budget Request

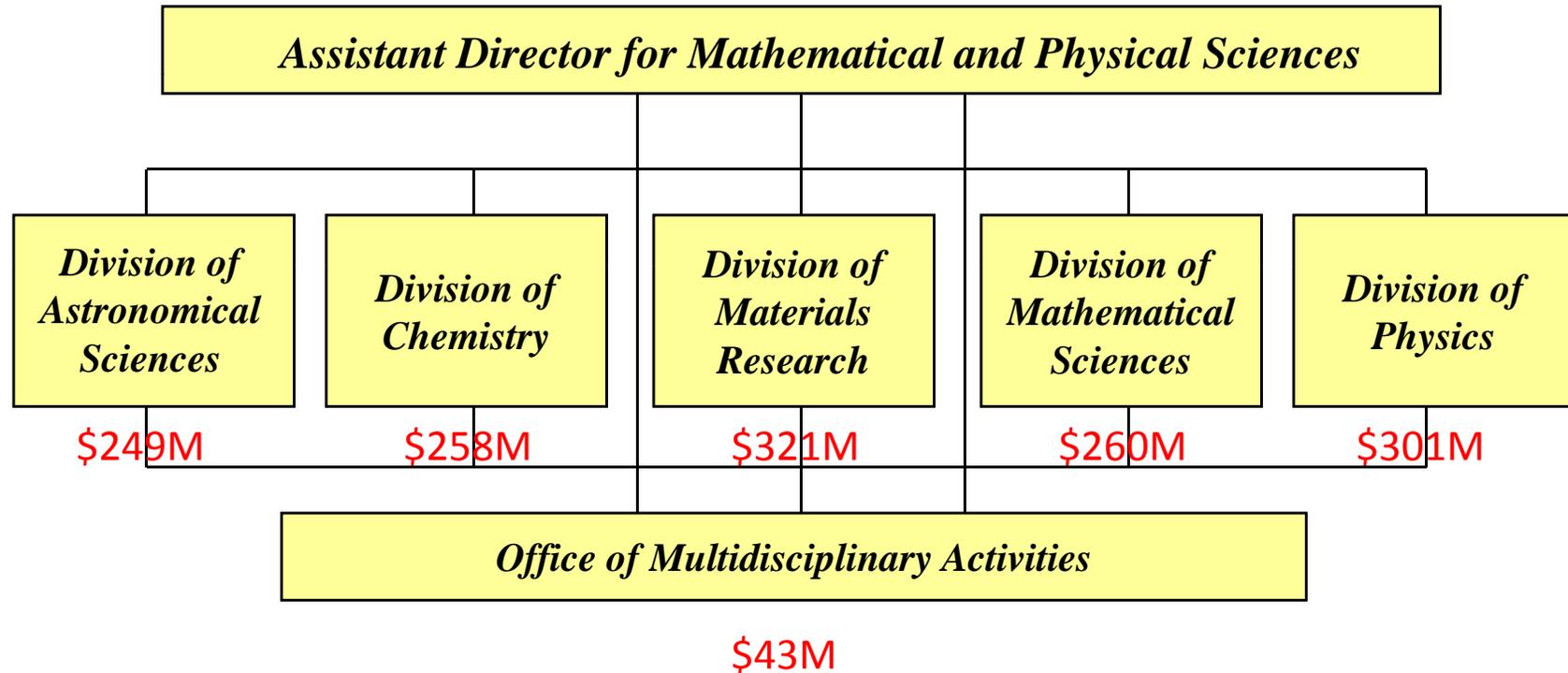


Directorate for Mathematical and Physical Sciences (MPS)



Numbers are for Fiscal Year 2011.
Total = \$1308M

Directorate for Mathematical and Physical Sciences (MPS)



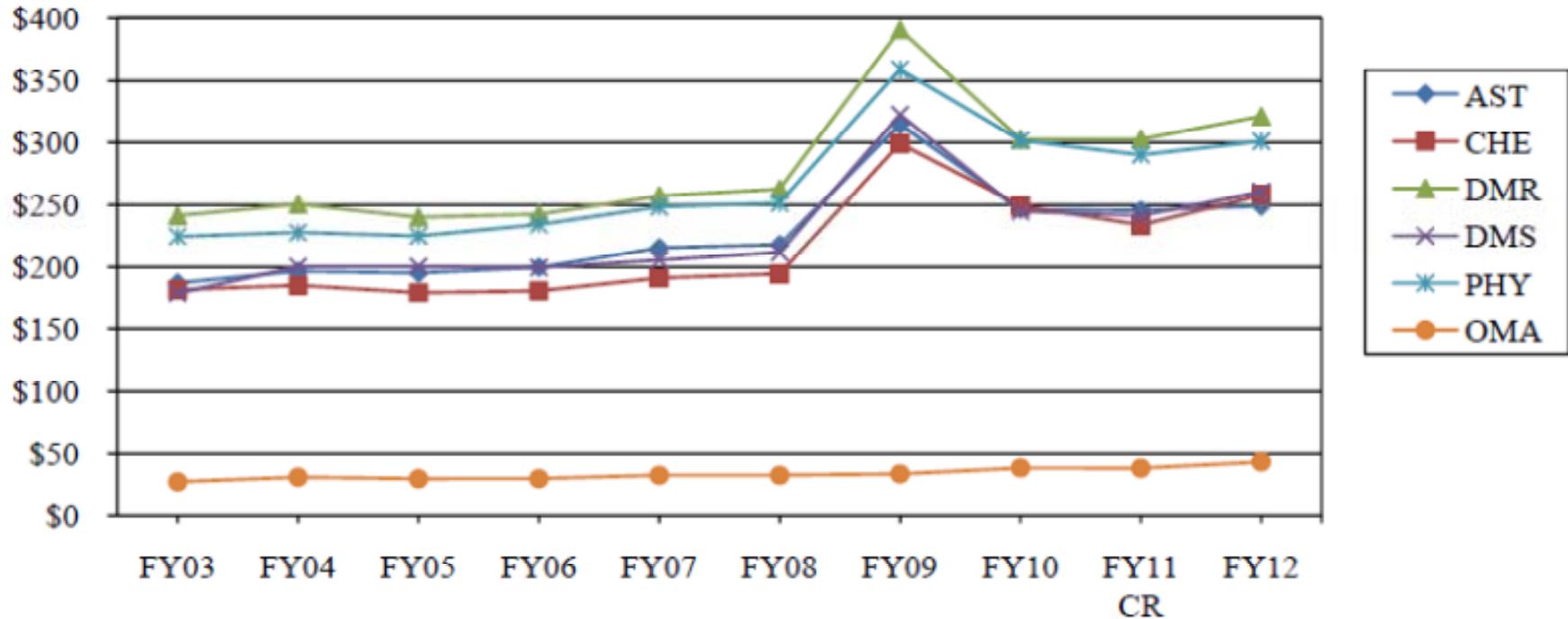
Fiscal Year 2012 Request
Total = \$1433M



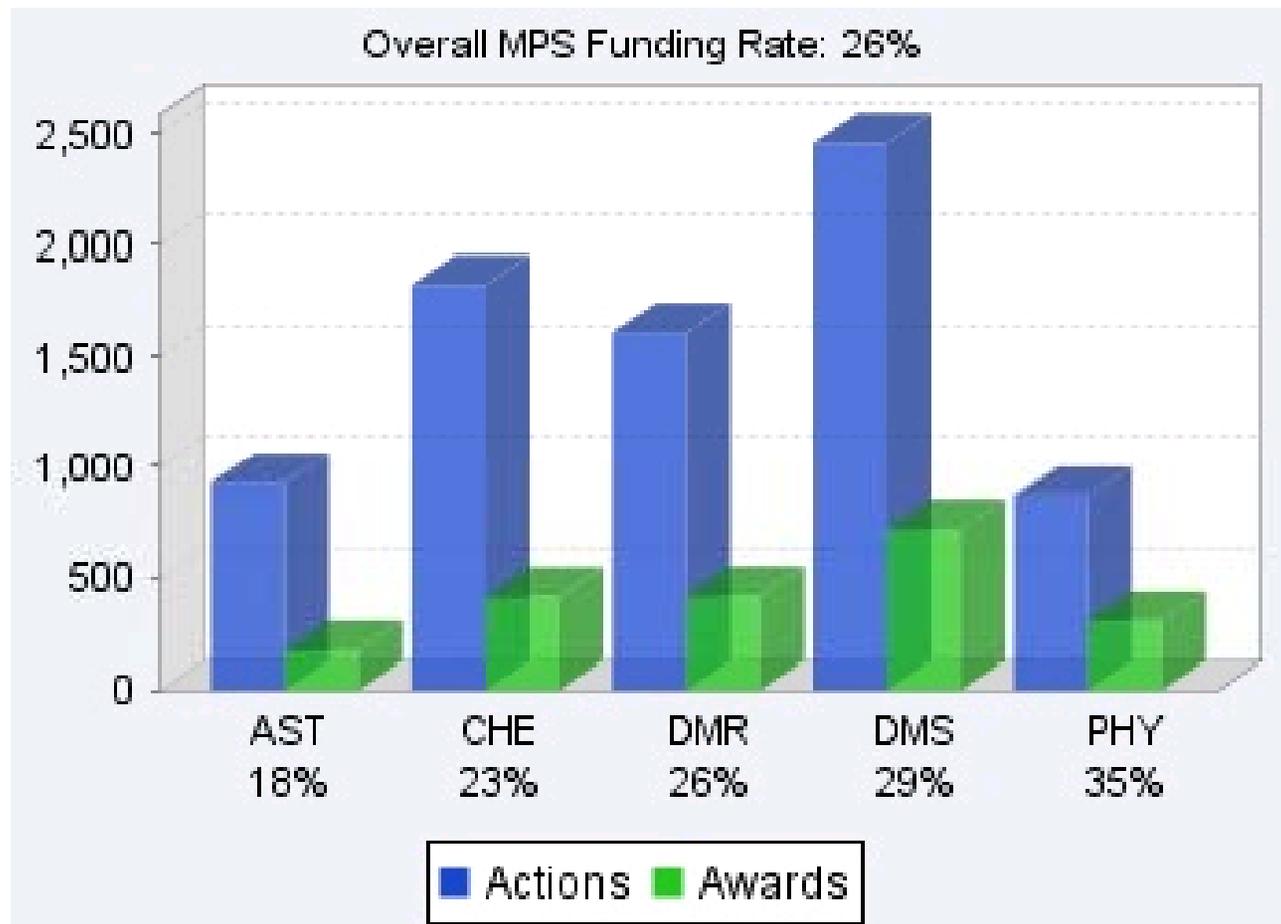
MPS Division Funding

(dollars in millions)

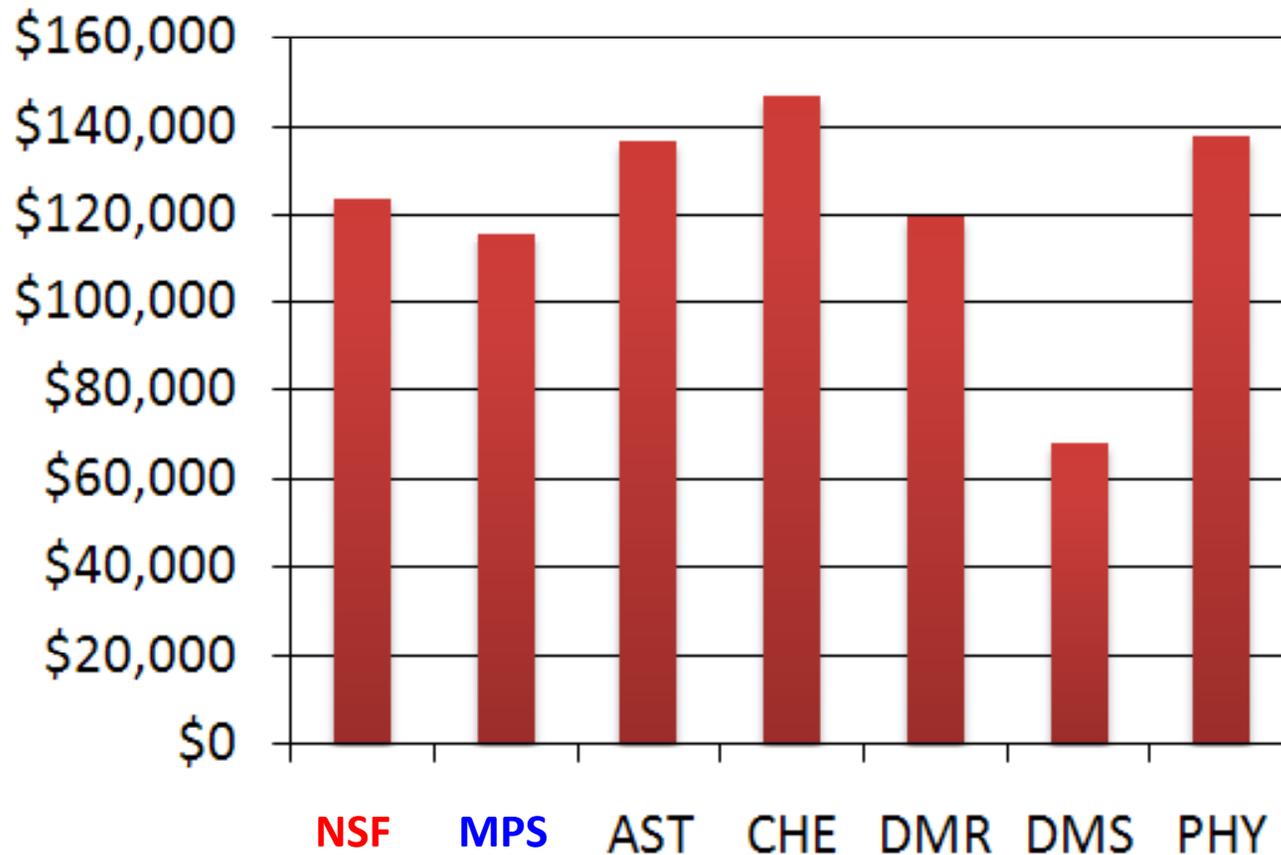
MPS Subactivity Funding
(Dollars in Millions)



Funding Rates (2010)



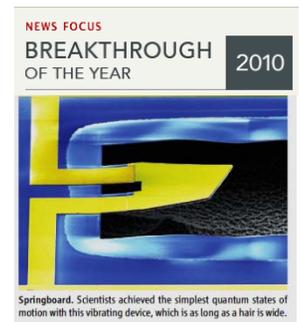
Median Annualized Award Size (2010)



Mean Award Duration: About Three Years

MPS Core Programs: Building Blocks of Innovation

- Support researchers to investigate
 - *Structure/evolution of the universe*
 - *Behavior/control of molecules at nanoscale*
 - *New mathematical/statistical theories, connections to computation, experiment, and massive data*
- Catalyze advances in science impacting innovation in medicine, industry, technology
- 2011 Physics Nobel Prize
 - *Saul Perlmutter, Brian P. Schmidt, Adam G. Riess*
 - *"for the discovery of the accelerating expansion of the Universe through observations of distant supernovae".*



Science, Engineering, and Education for Sustainability (SEES)

NSF: \$998M;
MPS Request:
\$160M (+84%)

MPS is partnering in an NSF-wide effort to achieve an environmentally and economically sustainable future

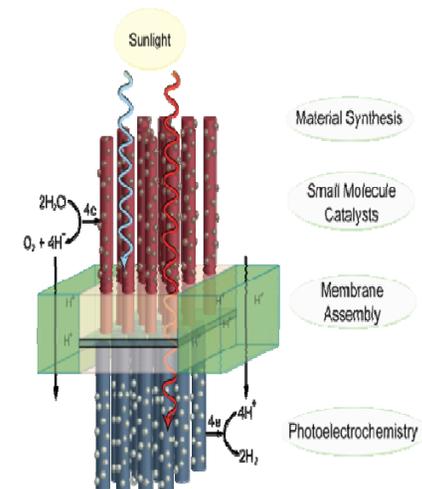
➤ Sustainable Energy Pathways

- *Novel earth-abundant materials for creating efficient solar cells*
- *Efficient materials for converting photons into hydrogen via water electrolysis*

➤ Sustainable Materials and Chemistry

- *Replacing rare, expensive and toxic chemicals with abundant, inexpensive, and environmentally benign alternatives*

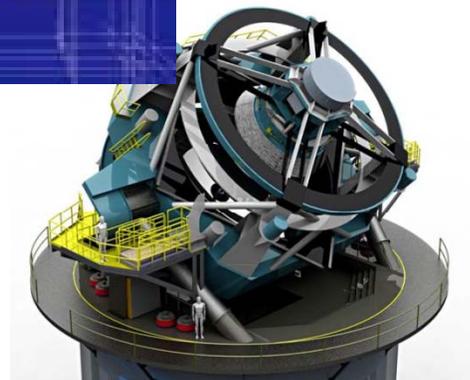
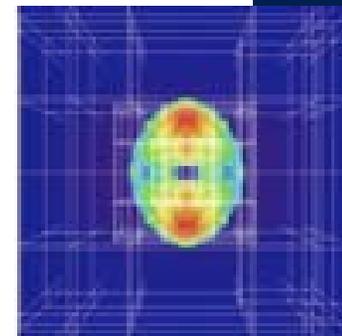
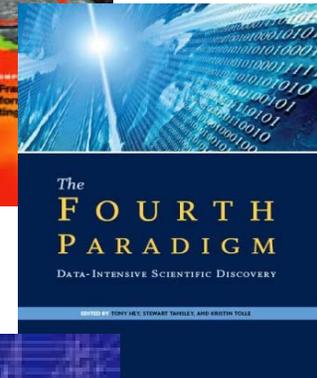
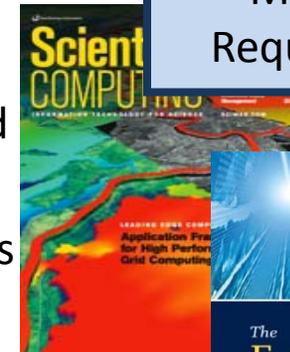
➤ Sustainability Research Networks



Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21)

NSF: \$117M;
MPS CIF 21
Request: \$20M

- Cyberinfrastructure to transform research, innovation and education
- Coherent program building on other CI investments across NSF
 - *eXtreme Digital (XD), Software Infrastructure for Sustained Innovation(SI2)*
- Four major components
 - *Data-enabled science*
 - *New computational infrastructure, including “matter-by-design”*
 - *Community research networks*
 - *Access and connections to cyberinfrastructure facilities*

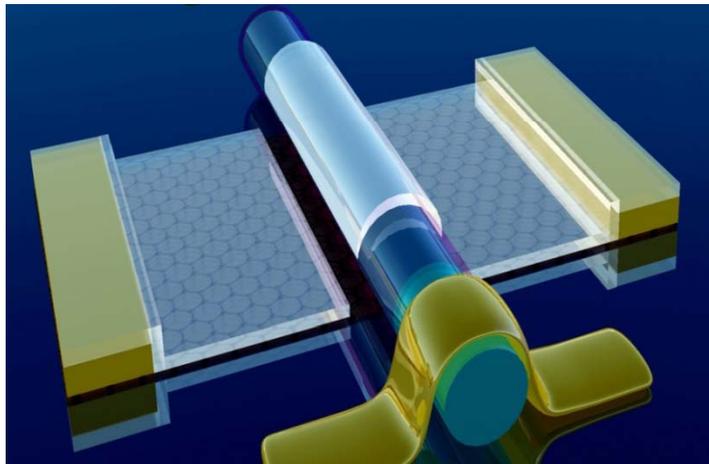


Science and Engineering Beyond Moore's Law (SEBML)

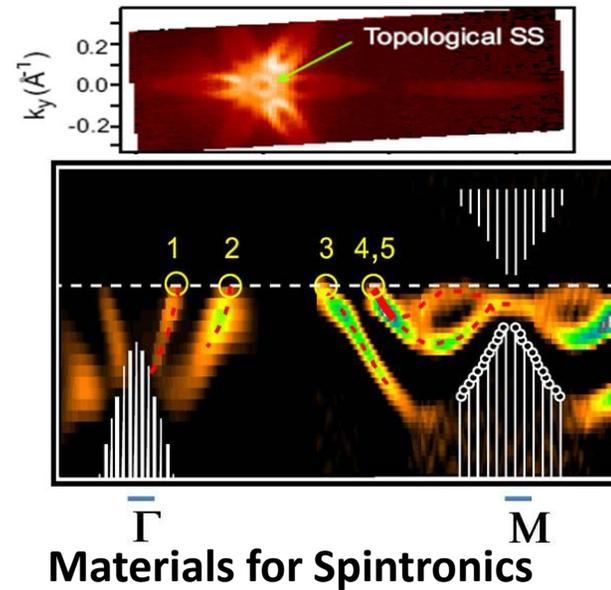
NSF: \$96.18M;
MPS Request:
\$42.18M (+125%)

- Partnering with CISE, ENG on fundamental research for economic competitiveness
- Component of NSF's National Nanotechnology Initiative

Materials for ultrafast computing Quantum Information Science



Graphene Nanostructures for High Performance Electronics



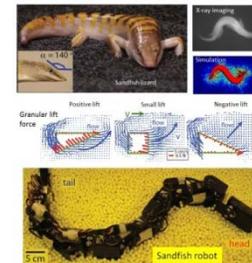
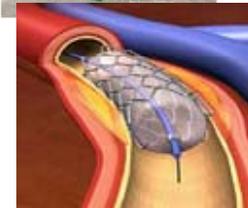
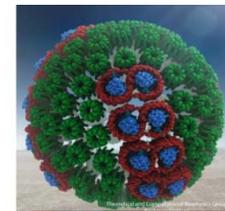
Materials for Spintronics

BioMaPS

NSF: \$76M;
MPS BioMaPS Request:
\$25.57M

Research at the interface between BIO, MPS, and ENG

- Renewable fuels; bio-based materials; bio-imaging; supports SEES and Advanced Manufacturing activities
- Computational modeling for visualizing the geometrical structure of photosynthetic vesicles
- Improved mathematical models for blood vessel stents lead to a better stent with less chance of buckling
- Sandfish swimming in sand inform studies of motion in granular media



CAREER

MPS Request:
\$53.78M
(+12.2%)

Investing in the next generation S&T Workforce

- MPS accounts for 25% of all CAREER awards
- Important science: optical studies of quantum dots, materials for next generation electronic devices, gamma-ray bursts
- Impact in outreach and education: innovative university curricula, outreach efforts to schools and MSIs

Keivan Stassun: Physics and Astronomy, Vanderbilt

- The Bridge program: 43 students; 38 minorities; 55% female; retention rate 93%
- Fisk awards the most MA degrees in physics to African American U.S. citizens

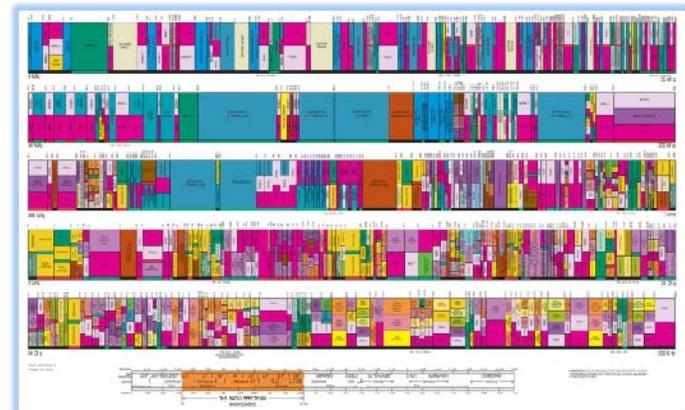


Enhancing Access to the Radio Spectrum (EARS)

NSF: \$15M;
MPS EARS
Request: \$3M

MPS partnership with ENG, CISE, and SBE

- Cross-cutting research on efficient use of the radio spectrum
- Interdisciplinary themes: technology, economics, social science, and public policy
- Responsive to national broadband priorities established by the White House and Congress
- Wireless Innovation Fund to support spectrum-related R&D
 - \$1B over 5 years into NSF programs
 - EARS, Cyber-Physical Systems, Wireless Testbeds



MPS Support for Multidisciplinary Research: Institutes, Centers, and Networks



➤ Office of Multidisciplinary Activities (+\$5M)

➤ Institutes and Centers

– *Physics Frontier Centers*

• Kavli Institute of Theoretical Physics (KITP)

– *Materials Research Centers and Teams (MRCT)*

• The Centers of Excellence for Materials Research and Innovation (CEMRI)

• Materials Interdisciplinary Research Teams (MIRT)

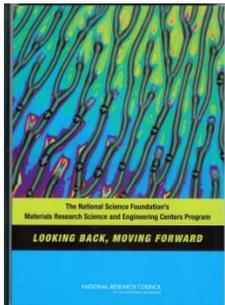
– *Mathematics Institutes Programs*

• Institute for Computational and Experimental Mathematics (ICERM)

➤ Networks

– *Sustainability Research Networks*

– *Research Networks in the Mathematical Sciences*



MPS Large Facilities in 2012

	FY 2012 Request
<i>Adv. Tech. Solar Telescope (ATST)</i>	2.00
<i>Atacama Large Millimeter Array (ALMA)</i>	30.65
<i>Cornell High Energy Synchr. Source (CHESS)/ Cornell Electron Storage Ring (CESR)</i>	15.47
<i>GEMINI Observatory</i>	20.07
<i>IceCube Neutrino Observatory</i>	3.45
<i>Large Hadron Collider (LHC)</i>	18.00
<i>Laser Interfer. Grav. Wave Observatory (LIGO)</i>	30.40
<i>Nat'l Astronomy and Ionosphere Ctr. (NAIC)</i>	5.50
<i>Nat'l High Magnetic Field Laboratory (NHMFL)</i>	33.30
<i>Nat'l Nanotechnology Infra. Network (NNIN)</i>	2.68
<i>Nat'l Optical Astronomy Observatory (NOAO)</i>	29.17
<i>Nat'l Radio Astronomy Observatory (NRAO)</i>	42.89
<i>National Solar Observatory (NSO)</i>	9.79
<i>Nat'l Superconducting Cyclotron Lab (NSCL)</i>	21.50
<i>Other MPS Facilities</i>	3.90
	\$268.77

Dollars in millions

ALMA

- 33 (of 66) antennas now in Chile
- Early Science with 16 antennas begins in 2011

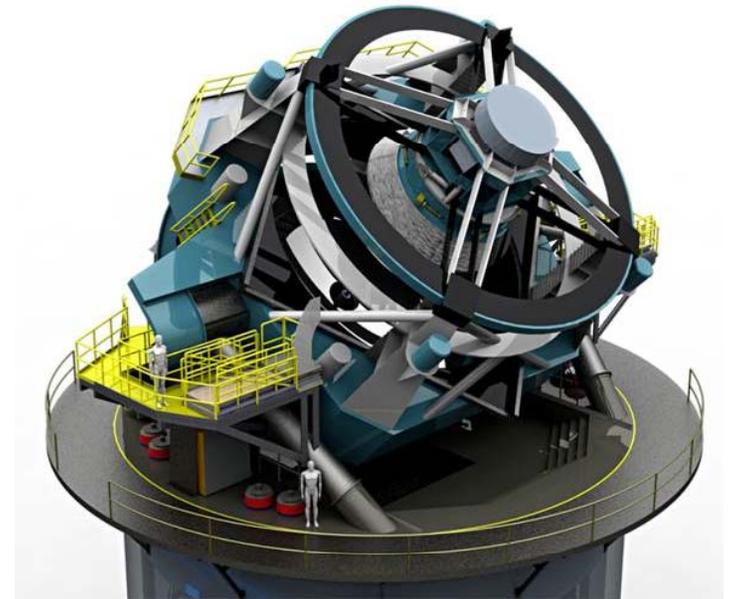


LIGO

- Latest, highest-sensitivity run ended Oct 2010
- Facility handed over to Advanced LIGO project

Summary

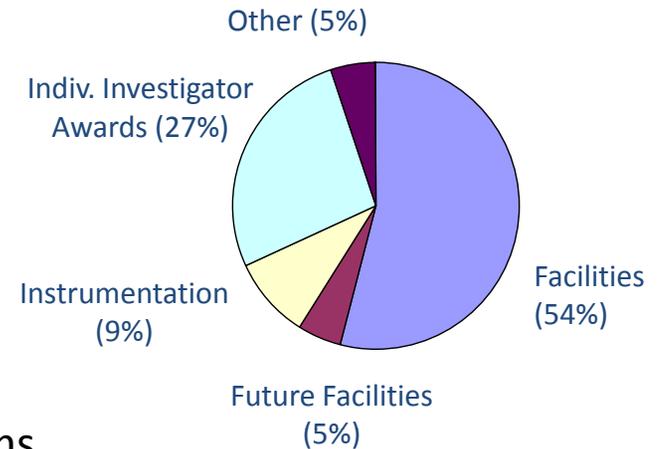
- \$1.43B budget requested for FY 2012 for MPS
- Sustaining basic research in fundamental science
 - *AST, CHE, DMR, DMS, PHY*
- Investing in national priorities
 - *SEES, CIF 21*
 - *BioMaPS, SEBML, EARS*
 - *Supporting young researchers: REU to CAREER*
- Continued investments in developing and operating facilities critical for fundamental research



LSST

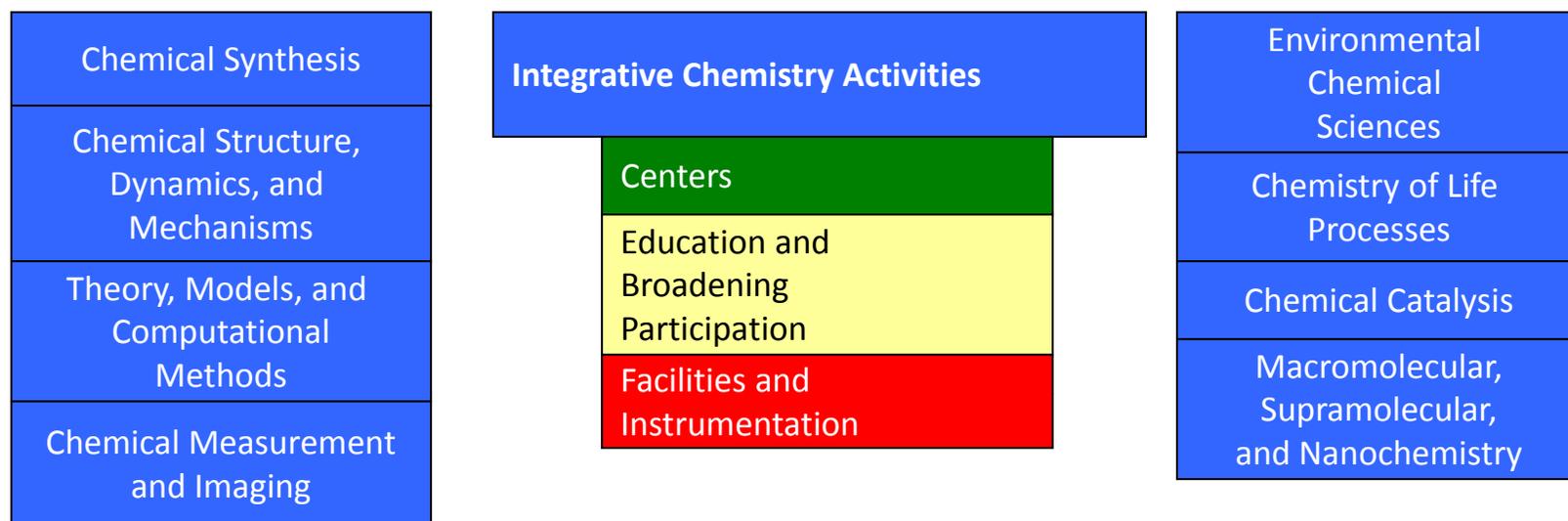
Astronomical Sciences (AST)

- From the Big Bang to DNA
 - » Origin and evolution of the Universe
 - » Origin and evolution of galaxies
 - » Origin and evolution of planetary and stellar systems
- National astronomy portfolio
 - » Three agencies – NSF, NASA, and DoE – and international partnerships
 - » Strong tradition of private funding
 - » NSF assigned federal stewardship of ground-based astronomy
 - » **Includes open-access facilities and mission-free unrestricted grants**

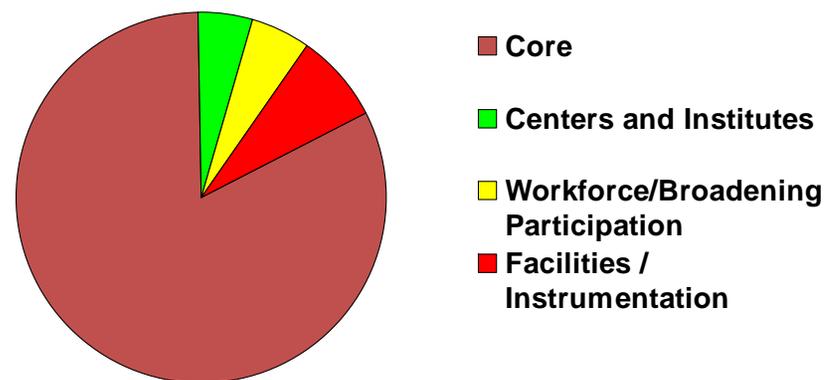


AST has a strong program in Education and Special Programs (including a major investment in post-docs)

Chemistry (CHE)



- Major CAREER and REU support
- Centers program growing
- Collaborations with NIH and DOE
- Critical areas of research for FY 2010: Energy, Element and Molecule Recycling, Designed Emergent Behavior, Imaging the Ultrasmall



Materials Research (DMR)

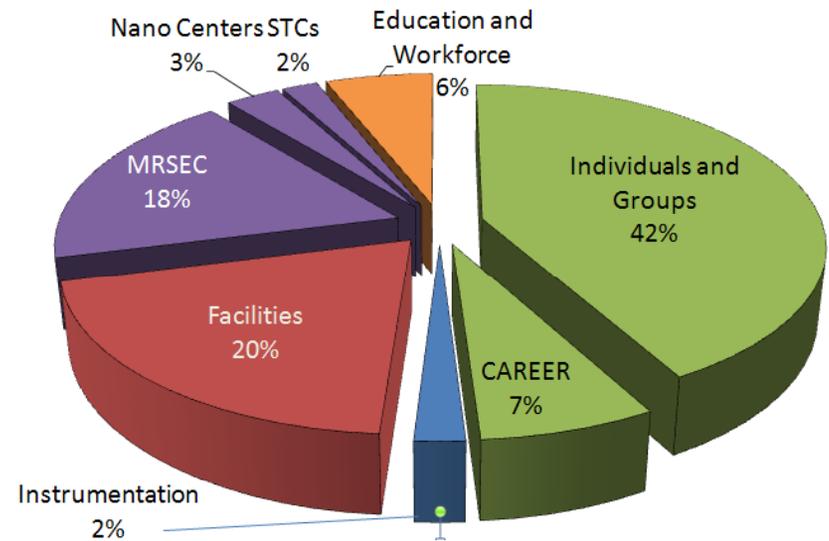
DMR Programs:

- Ceramics, Electronic and Photonic Materials, Metals and Metallic Nanostructures
- Condensed Matter Physics, Condensed Matter and Materials Theory
- Biomaterials, Polymers, Solid-State and Materials Chemistry
- **Materials Research Science and Engineering Centers**
- **National Facilities and Instrumentation**
- Office of Special Programs (international collaboration; education)

Key Research Areas for FY 2010:

- Environmental, energy, and economic sustainability
- Matter by design
- The quantum realm
- Physical-chemical-biological interfaces

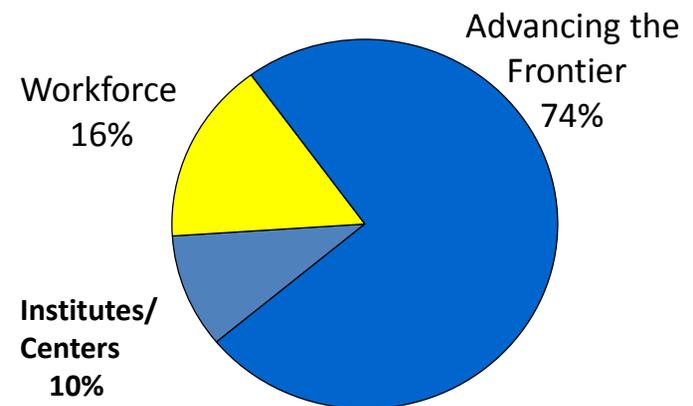
DMR supports a wide breadth of science – fundamental research to the development of technological applications.



Mathematical Sciences (DMS)



- “Core business:” single investigator and group proposals through targeted solicitations
Covers the entire mathematical spectrum
- Institutes: 5 NSF-initiated, support for 3 others
 - Visitors to long term programs, workshops
- Workforce: responding to a major challenge.
 - EMSW21 training grants
 - Postdoctoral fellowships
 - Research for Undergraduates



In addition to the fundamental research in mathematical sciences, DMS plays an enabling role of all other sciences; DMS has been successful in partnering with other NSF Divisions and Directorates and with other government agencies.

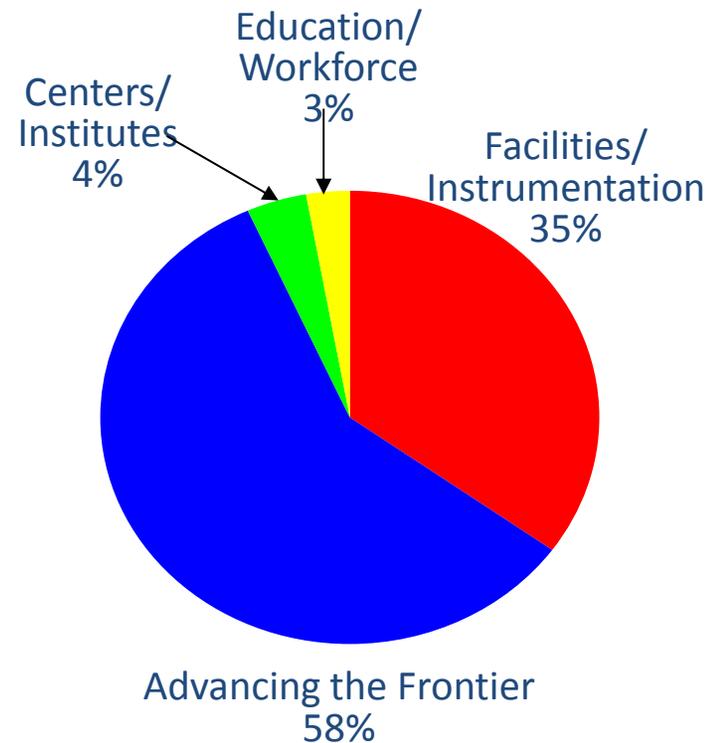
Physics (PHY)

Facilities:

LHC, LIGO, IceCube, NSCL, ...

Programs:

- Atomic, Molecular, Optical, and Plasma Physics
- Biological Physics
- Elementary Particle Physics
- Gravitational Physics
- Nuclear Physics
- Particle and Nuclear Astrophysics
- Physics at the Information Frontier
- Physics Frontiers Centers
- Theoretical Physics
- Education and Interdisciplinary Programs



PHY collaborates closely with DOE and international partners to support science at large facilities. NSF's physics portfolio is more diverse than physics portfolios at any other federal agency.

Office of Multidisciplinary Activities (OMA)

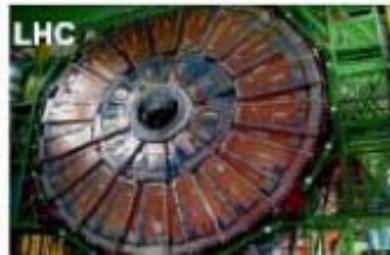
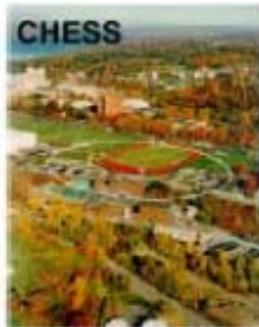
- Catalyzes cross-cutting research in areas of strategic emphasis in MPS, as well as areas that may emerge as strategic
- Facilitates partnerships with other agencies, industries, state and local governments, and international organizations
- Supports innovative experiments in education and broadening participation

OMA neither receives nor reviews proposals; rather, OMA co-invests with MPS Divisions



World Class Major Facilities

Keep University Researchers at the Frontier



Get Involved

- Proposals: Send your best ideas to NSF
- Reviewers and panelists: Create an informative web site and update it at least once a year
- Workshop participants and organizers
- Rotators

For information on a particular MPS division and program, go to the following web address and pick a Division:

<http://www.nsf.gov/home/mps>

Contact NSF Program Directors for questions & suggestions

Some Useful Web Sites

- NSF: www.nsf.gov
- MPS: <http://www.nsf.gov/home/mps>
- Guide to Program:
http://www.nsf.gov/funding/browse_all_funding.jsp
- Award information: <http://www.nsf.gov/awardsearch>
- FastLane: <https://www.fastlane.nsf.gov>
- Broader impacts:
<http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf>
- Data management plan:
<http://www.nsf.gov/bfa/dias/policy/dmp.jsp>
- CAREER: <http://www.nsf.gov/CAREER>

Contact Information

- Dean Evasius, Program Directors, Division of Mathematical Sciences, devasius@nsf.gov, 703-292-8132
- Office of the Assistant Director: 703-292-8800
- Division of Astronomical Sciences: 703-292-8820
- Division of Chemistry: 703-292-8840
- Division of Materials Research: 703-292-8810
- Division of Mathematical Sciences: 703-292-8870
- Division of Physics: 703-292-8890

Thank You