NSF Mathematical and Physical Sciences Update

Denise Caldwell

Division Director
Division of Physics
Fundamental Research in the Mathematical and Physical Sciences

Advancing Discovery

Building Blocks for Innovation

Forefront Facilities

Inspiring the Next Generation
The Excitement of Advancing Discovery

Chemistry Nobel Laureates

Warshel  Karplus  Levitt

Higgs Particle LHC

MPS-Supported MacArthur Fellows

Baran (CHE)  Fennie (DMR)  Katabi (AST)  Murphy (DMS)  Rey (PHY)  Seager (AST)

Katabi  Rey  Fennie

Physics World “Discovery of the Year” 2012
The Excitement of Advancing Discovery

Chemistry Nobel Laureates
- Warshel
- Karplus
- Levitt

High Energy Neutrinos
- Ice Cube

Physics World
“Discovery of the Year”
2013

MPS-Supported MacArthur Fellows
- Baran (CHE)
- Fennie (DMR)
- Katabi (AST)
- Murphy (DMS)
- Rey (PHY)
- Seager (AST)
NSF Supports Academic Basic Research

All Science and Engineering Fields 24% Fraction of Federal Support

Engineering 40%
Physical Sciences 44%
Social Sciences 55%
Mathematics 59%
Environmental Sciences 60%
**Biology (excluding NIH)** 66%
Computer Science 87%

Source: NSF/ Center for National Science and Engineering Statistics, FY 2011
People Do Science

29,000 People in MPS Activities*

- Graduate Students: 31%
- Undergraduates: 21%
- Senior Researchers: 30%
- Postdoctoral Researchers: 8%
- Other Professionals: 10%

*Estimated for FY 2015
NSF Funding History

* (Constant 2012$)

Amount (Millions)*

Fiscal Year


ARRA
MISSION: To promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense.

—From the National Science Foundation (NSF) Act of 1950

VISION: A Nation that creates and exploits new concepts in science and engineering and provides global leadership in research and education.

—From Investing in Science, Engineering, and Education for the Nation’s Future: NSF Strategic Plan for 2014-2018
# FY 2015 Budget Request

**NSF Budget by Appropriation**

($ in millions)

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>FY 2015 Request</th>
<th>Change from FY 2014</th>
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<td>$ 5,807</td>
<td>$ -1, $ -0.03%</td>
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<td>Education &amp; Human Resources</td>
<td>890</td>
<td>43, 5.1%</td>
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<td>201</td>
<td>1, 0.4%</td>
</tr>
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<td>338</td>
<td>40, 13.5%</td>
</tr>
<tr>
<td>National Science Board</td>
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<td>* 1.6%</td>
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<td><strong>$ 7,255</strong></td>
<td><strong>$ 83, 1.2%</strong></td>
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(* Denotes < $ 0.5 M)
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<tr>
<td>Opportunity, Growth, and Security Initiative</td>
<td>$ 552</td>
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MPS Budgets

FY 2012: $1309 M (−4.5%)$
FY 2013: $1250 M

Amount (Millions)

$0 $50 $100 $150 $200 $250 $300

AST CHE DMR DMS PHY
MPS Budgets

FY 2012  $1309 M, -4.5%  FY 2013  $1250 M

<table>
<thead>
<tr>
<th>Department</th>
<th>FY12</th>
<th>FY13</th>
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</thead>
<tbody>
<tr>
<td>AST</td>
<td></td>
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<tr>
<td>CHE</td>
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<td>DMR</td>
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<td>DMS</td>
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<td>PHY</td>
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MPS Budgets

FY 2012: $1309 M, -4.5%
FY 2013: $1250 M, +4.0%
FY 2014: $1300 M (estimate)

Amount (Millions)

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<tr>
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<td>FY14</td>
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MPS Budgets

FY 2012: $1309 M
-4.5% vs. FY 13
FY 2013: $1250 M
+4.0% vs. FY 13
FY 2014: $1300 M (estimate)
FY 2015: $1296 M (request)

2.8% vs. FY 13

<table>
<thead>
<tr>
<th>Department</th>
<th>FY 2012</th>
<th>FY 2013</th>
<th>FY 2014</th>
<th>FY 2015</th>
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<tbody>
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<td>AST</td>
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Selected MPS Major Investments

Science, Engineering, and Education for Sustainability

FY 2014
FY 2015

*MPS only
Selected MPS Major Investments

Designing Materials to Engineer and Revolutionize Our Future

**DMREF**
(Materials Genome Initiative)

*MPS only*
Selected MPS Major Investments

- Biological, Mathematical, and Physical Sciences
- Cognitive Science and Neuroscience

BRAIN INITIATIVE
BRAIN RESEARCH THROUGH ADVANCING INNOVATIVE NEUROTECHNOLOGIES

CNS in BioMaPS

*MPS only
Selected MPS Major Investments

Mid-Scale Research Infrastructure

FY 2015: AST, DMR, PHY

FY 2014: AST, PHY

FY 2014
FY 2015

*MPS only
MPS Participation in NSF-Wide Initiatives

Cognitive Science and Neuroscience
Cyber-Enabled Materials, Manufacturing, and Smart Systems
Cyberinfrastructure Framework for the 21st Century Science, Engineering, and Education for Sustainability
Secure and Trustworthy Cyberspace

CNS, CEMMSS, CIF21, SEES, SaTC

$75.6M

5.8% of MPS Budget
Building the STEM Pipeline Through MPS Research

**CAREER**
Young Teacher-Scholars

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<tr>
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<th>FY2015 Request</th>
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<tr>
<td>MPS</td>
<td>$ 65M</td>
<td>$ 66M</td>
</tr>
<tr>
<td>NSF</td>
<td>$ 210M</td>
<td>$ 213M</td>
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31% of CAREER funding from MPS

**Research Experiences for Undergraduates (REU)**
Undergraduate Research Programs

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<tr>
<td>MPS</td>
<td>$ 22.4M</td>
<td>$ 21.2M</td>
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<tr>
<td>NSF</td>
<td>$ 75.3M</td>
<td>$ 75.1M</td>
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28% of REU funding from MPS
MPS-Supported Multi-user Facilities

- ALMA
- Gemini South
- DKIST (ATST)
- Blanco
- IceCube
- NHMFL
- LIGO
FY 2015 Request: $1,296M

- Astronomical Sciences (AST) - $236M
  - IIA, Small Teams: 84%
  - Facilities: 57%
- Chemistry (CHE) - $237M
  - Small Teams: 18%
- Materials Research (DMR) - $299M
  - IIA, Small Teams: 56%
- Mathematical Sciences (DMS) - $224M
  - Facilities: 30%
- Physics (PHY) - $264M
  - IIA, Small Teams: 63%
Two Different Budget Lines for Facilities

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### FY 2015 MPS Budget Request to Congress

**MPS Funding**

(Dollars in Millions)

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<th>Field</th>
<th>FY 2013 Actual</th>
<th>FY 2014 Estimate</th>
<th>FY 2015 Request</th>
<th>Change Over FY 2014 Estimate</th>
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<tr>
<td>Astronomical Sciences (AST)</td>
<td>$232.17</td>
<td>$239.06</td>
<td>$236.24</td>
<td>-$2.82</td>
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<tr>
<td>Chemistry (CHE)</td>
<td>229.39</td>
<td>235.79</td>
<td>237.23</td>
<td>1.44</td>
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<tr>
<td>Materials Research (DMR)</td>
<td>291.09</td>
<td>298.01</td>
<td>298.99</td>
<td>0.98</td>
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<tr>
<td>Mathematical Sciences (DMS)</td>
<td>219.02</td>
<td>225.64</td>
<td>224.40</td>
<td>-1.24</td>
</tr>
<tr>
<td>Physics (PHY)</td>
<td>250.45</td>
<td>266.30</td>
<td>263.70</td>
<td>-2.60</td>
</tr>
<tr>
<td>Office of Multidisciplinary Activities (OMA)</td>
<td>27.22</td>
<td>35.00</td>
<td>35.00</td>
<td>-</td>
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<td><strong>Total, MPS</strong></td>
<td><strong>$1,249.34</strong></td>
<td><strong>$1,299.80</strong></td>
<td><strong>$1,295.56</strong></td>
<td><strong>-$4.24</strong></td>
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Totals may not add due to rounding.
Physics Division Request for FY 2015 is $263.7 M

Approximately 2% for Operations -
  Panels, IPA Appointments, IPA Travel, M&S

Approximately 32% for M&O for Facilities –
  ATLAS and CMS, IceCube, LIGO, NSCL

Approximately 8% for Physics Frontiers Centers – Competition Underway

Approximately 3% for Education and Broadening Participation –
  REU Sites, LIGO Education Center, QuarkNet

Leaves 55% ($145 M) to Cover Five Major Areas of Physics –
  Experimental and Theoretical
PHY Perspective

Balance: Facilities ↔ Individual Investigator Awards
        → Operations Costs ↔ Research Support

Balance: Atomic, Molecular, Optical and Plasma Physics ↔ Gravitational Physics ↔
        Nuclear Physics ↔ Particle Physics ↔ Physics of Living Systems

Responsive: NSF responds to proposals.
            Primary source of ideas are the proposals that are submitted
            Vetted by a vigorous merit review procedure

Community Input: Workshops
                Advisory Committees (HEPAP, NSAC)

Looking Forward to Recommendations of P5
Connections

Core ↔ Priority Areas

Obvious and Not-So-Obvious

**CDS&E:** Impacts all research areas in the Division

**BRAIN:** Imaging and Detector Technology; Theoretical Approaches

Program ↔ Program

**Cross-Cutting Programs:** Accelerator Science, Computational Physics, Physics Frontiers Centers