Mathematical & Physical Sciences

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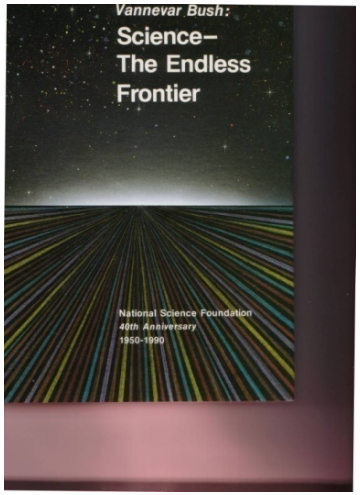
Division of Mathematical Sciences

NSF Vision and Goals

- Vision
  - A Nation that creates and exploits new concepts in science and engineering and provides global leadership in research and education
- Mission
  - To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense
- Strategic Goals
  - Transform the frontiers of science and engineering
  - Stimulate innovation and address societal needs through research & education
  - Excel as a Federal Science Agency




National Science Foundation
Strategic Plan for 2014 – 2018

NATIONAL SCIENCE FOUNDATION

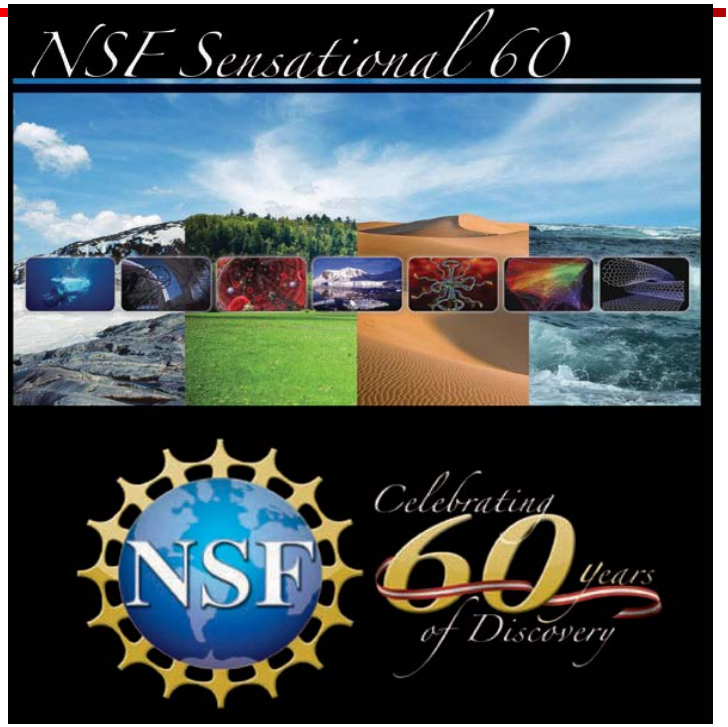
Investing in Science, Engineering, and Education for the Nation's Future

Strategic Plan for 2014 – 2018
March 2014

1

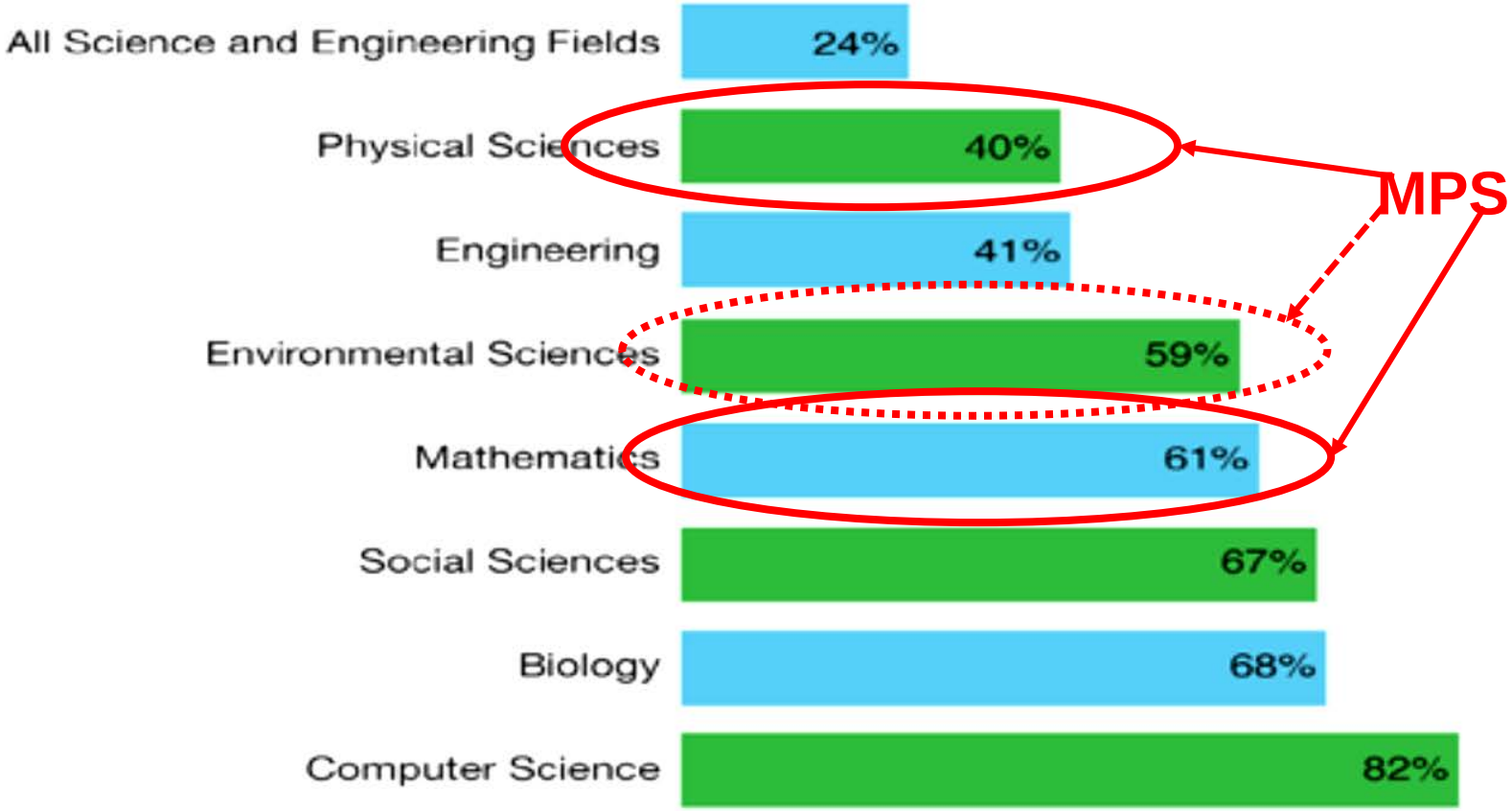
NSF in a Nutshell

- Independent agency to support basic research & education
- Grant mechanism in two forms:
  - Unsolicited, curiosity driven (the majority of the $)
  - Solicited, more focused
- All fields of science/engineering
- Merit review: Intellectual Merit & Broader Impacts
- Discipline-based structure, some cross-disciplinary
- Support large facilities



NSF Support of Academic Basic Research in Selected Fields

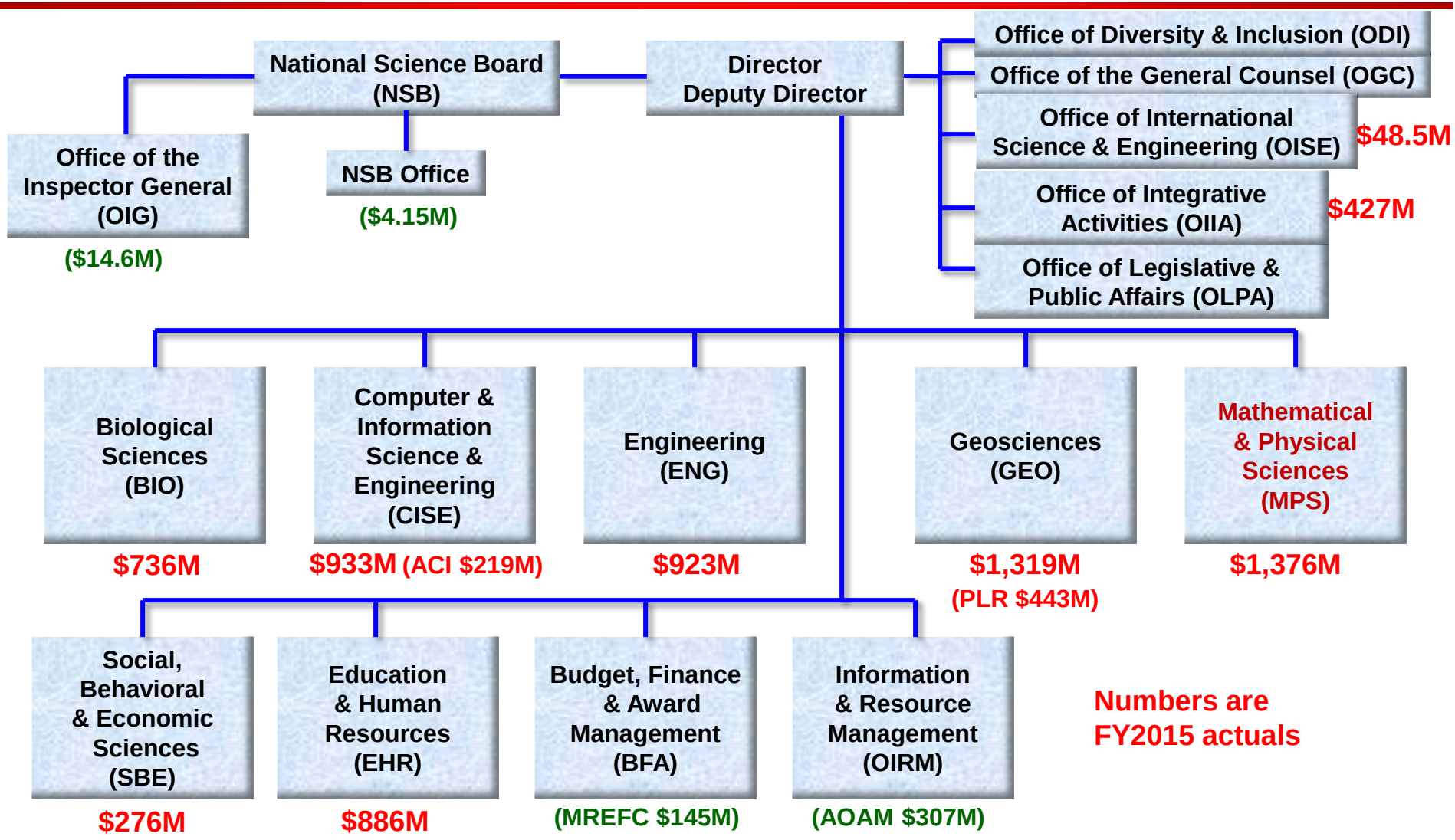
(as a percentage of total federal support)



Note: Biology includes Biological Sciences and Environmental Biology; excludes National Institutes of Health.

Source: NSF/National Center for Science and Engineering Statistics, Survey of Federal Funds for Research & Development, FY 2014

NSF Organization Chart



Directorate for Mathematical and Physical Sciences (MPS)

- The mission of MPS is to harness the collective efforts of the mathematical and physical sciences communities to address the most compelling scientific questions, educate the future advanced high-tech workforce, and promote discoveries to meet the needs of the Nation.

- The MPS Divisions support both disciplinary and interdisciplinary activities and partner with each other and with other NSF Directorates in order to effectively encourage basic research across the scientific disciplines.

NSF 10 Big Ideas

Meant to define a set of cutting-edge research agendas and processes

1. NSF INCLUDES (Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science): Enhancing Science and Engineering through Diversity
2. NSF 2050: The Integrative Foundational Fund
3. Understanding the Rules of Life: Predicting Phenotype
4. Work at the Human-Technology Frontier: Shaping the Future
5. Mid-scale Research Infrastructure
6. Windows on the Universe: The Era of Multi-messenger Astrophysics
7. Navigating the New Arctic
8. Harnessing Data for 21st Century Science and Engineering
9. The Quantum Leap: Leading the Next Quantum Revolution
10. Growing Convergent Research at NSF

MPS Scientific Opportunities

- Understanding the Brain
- Optics and Photonics
- Midscale Infrastructures
- Physical sciences at the nanoscale
- Quantum Information Science
- Complex systems (multi-scale, emergent phenomena)
- Fundamental mathematical and statistical science
- Sustainability (energy, environment, climate)
- Interface between the physical and life sciences
- CDS&E: Computational and data-enabled science and engineering

NSF-Wide & Other Directorate Programs

Of interest to MPS proposers

Computational- and Data-Enabled Science and Engineering (CDS&E)

CAREER– apply to Divisions

Career-Life Balance

ADVANCE - to develop systemic approaches to increase the representation & advancement of women in academic STEM careers

Nano-scale Science & Engineering

Understanding the Brain

Clean Energy Technologies

Optics & Photonics

Software Infrastructure for Sustained Innovation

REU, RET

Graduate Research Fellowship (GRF)

BIGDATA

Science, Engineering & Education for Sustainability (SEES)
Shrinking – last chances!

EPSCoR - Experimental Program to Stimulate Competitive Research

Ethics Education in Science & Engineering (EESE)

Cyber-Enabled Materials Manufacturing and Smart Systems (CEMMSS)

Enhancing Access to the Radio Spectrum (EARS)
on hold – may go away

NSF Research Traineeship (NRT, successor to IGERT)

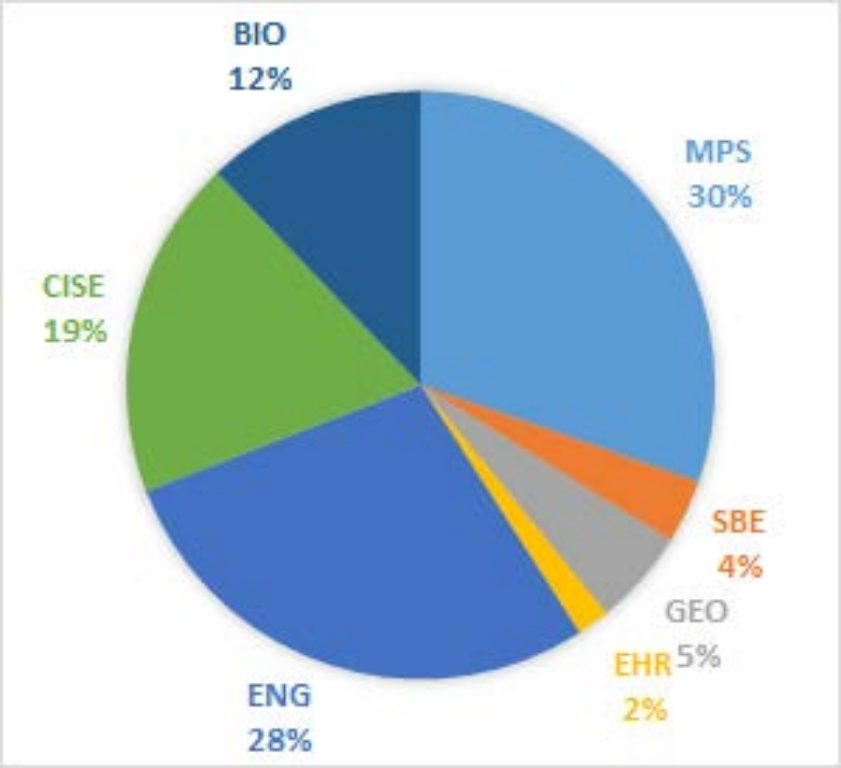
Innovations at the Nexus of Food, Energy and Water Systems (INFEWS)

RUI – self-identify as RUI, impact statement, extra considerations
ROA – part of RUI – research university submits proposal

GOALI & I-Corps

CAREER Program

- NSF's most prestigious awards for junior faculty
- Awardees are selected based on their plan of outstanding research, excellent education, and the integration of research and education within the context of the mission of their organizations, building a firm foundation for a lifetime of leadership.



FY2016

- Increased participation of those traditionally under-represented in science and engineering is encouraged.

Transdisciplinary Research In Principles Of Data Science (TRIPODS)

TRIPODS aims to bring together the statistics, mathematics, and theoretical computer science communities to develop the theoretical foundations of data science through integrated research and training activities.

- Phase I will support the development of small collaborative Institutes.
- Phase II (to be described in an anticipated future solicitation, subject to availability of funds) will support a smaller number of larger Institutes, selected from the Phase I Institutes via a second competitive proposal process.

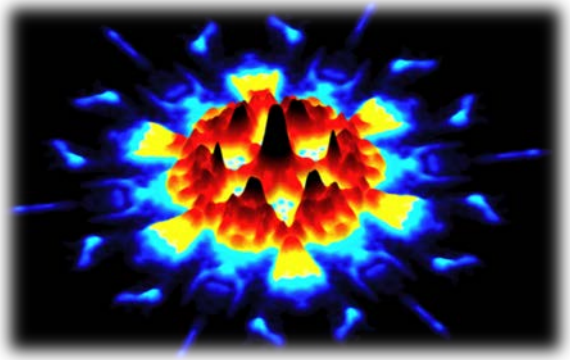
Computational and Data-enabled Science and Engineering (CDS&E)

- MPS disciplines are both leading consumers and hard drivers of cyber-capability: their needs force, & their research creates, breakthroughs – in algorithms, in simulation & modeling methods, and in materials for emerging cyber-technology
- CDS&E is a cross-directorate program involving MPS, ENG, and CISE/ACI ***"to identify and capitalize on opportunities for major scientific and engineering breakthroughs through new computational and data analysis approaches"***

- Support for development, adaptation, or utilization of the capabilities offered by advancing both research and infrastructure in computation and data handling
- A "meta-program" – submit through pre-existing funding opportunities – see announcement PD12-8084

Cyber-Enabled Materials Manufacturing and Smart Systems (CEMMSS)

Topological Insulators

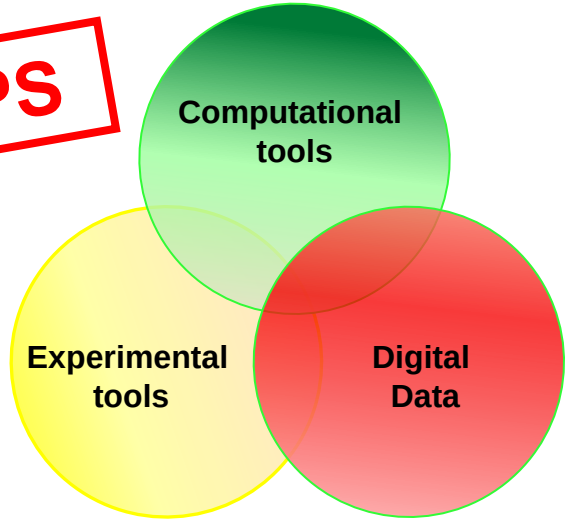


- Partnership with BIO, ENG & CISE
- Advanced Manufacturing
- Designing Materials to Revolutionize and Engineer our Future (DMREF)

- Fundamental research for discovering, modeling, making, optimizing and manufacturing with new materials and material systems

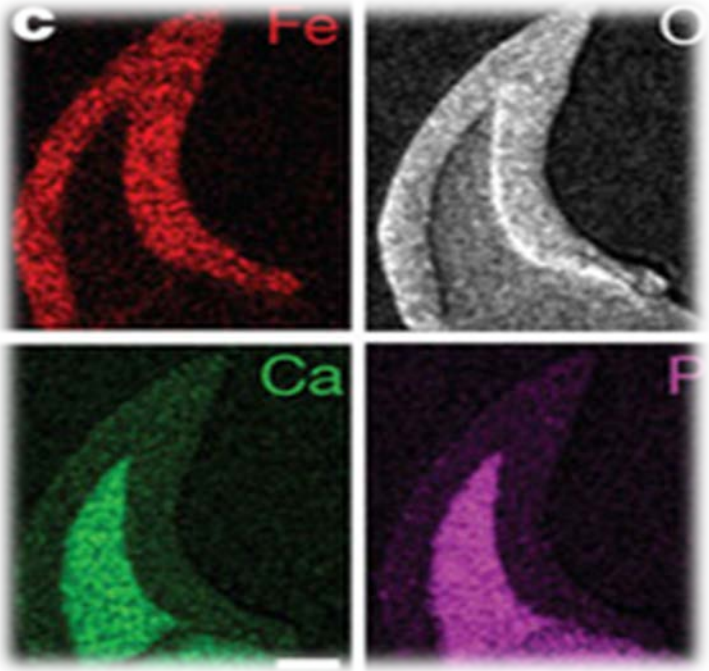
~$65M MPS

Materials Innovation Infrastructure



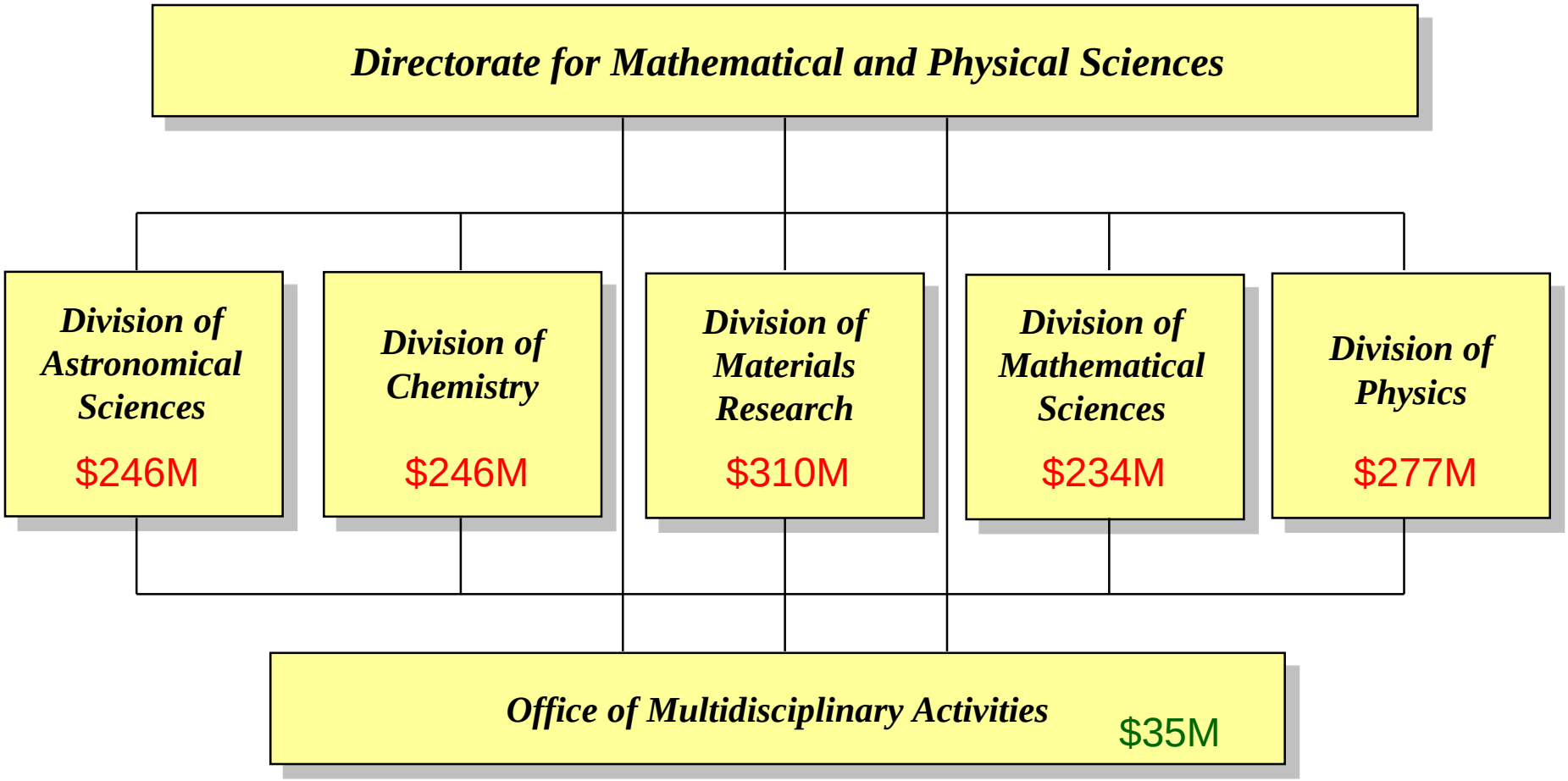
Research at the Interface of Biological, Mathematical, & Physical Sciences (BioMaPS)

- Adaptive network models
- Biological design strategy for better composite materials
- Computational, Mathematical and Statistical modeling
- Cognitive Science
- Neuroscience



NSF $35M, MPS $18M in FY 2015

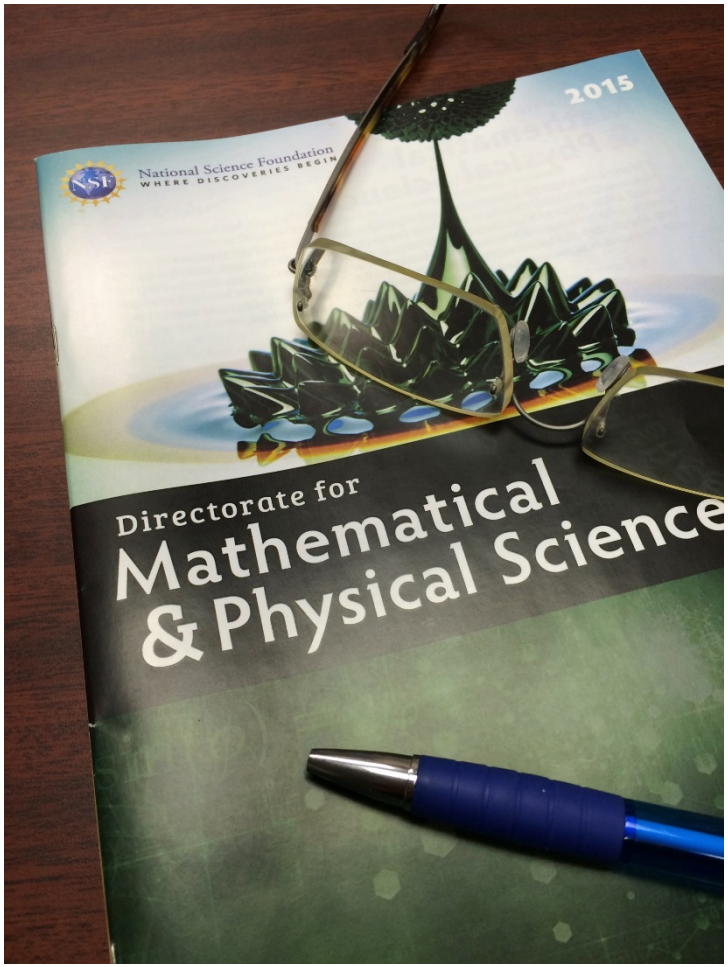
Directorate for Mathematical and Physical Sciences (MPS)



Numbers are actual FY 2016 expenditures

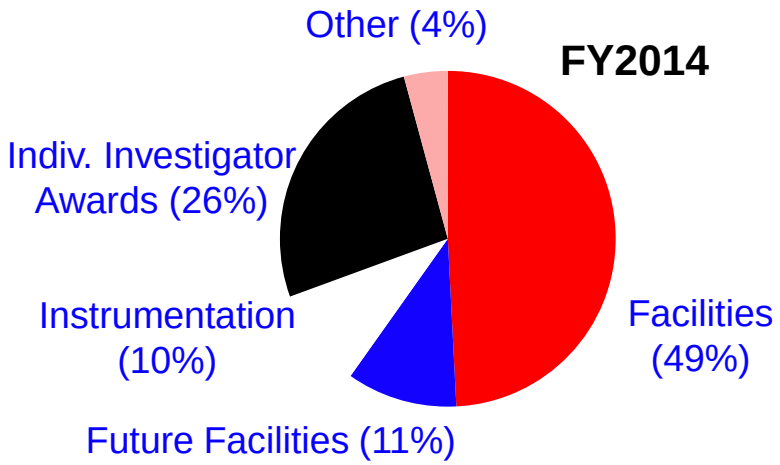
2015 Directorate Brochure (NSF 15-038)

- Gives statistics, mission statements, initiatives, funding rates, lots of information
- Much material also available from the NSF website
- Latest version 2015



http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf15038

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 – & international partnerships
  - » Strong tradition of private funding
  - » NSF assigned federal stewardship of ground-based astronomy
  - » **Includes open-access facilities & mission-free unrestricted grants**

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

Chemistry (CHE)

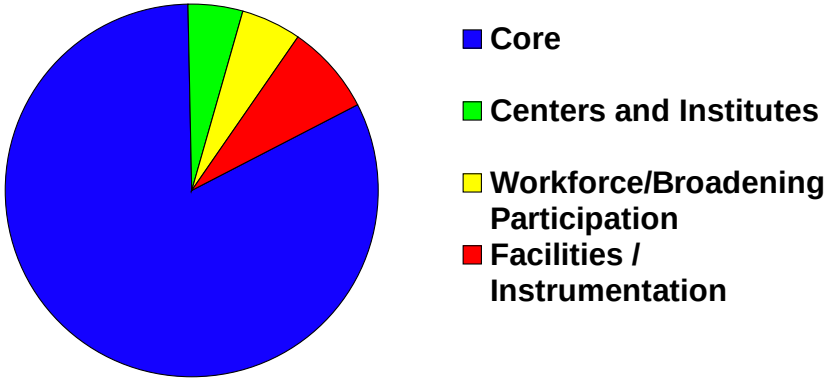
- Chemical Synthesis
- Chemical Structure, Dynamics, and Mechanisms A&B
- Theory, Models, and Computational Methods
- Chemical Measurement and Imaging

Integrative Chemistry Activities

- Centers
- Education and Broadening Participation
- Facilities and Instrumentation

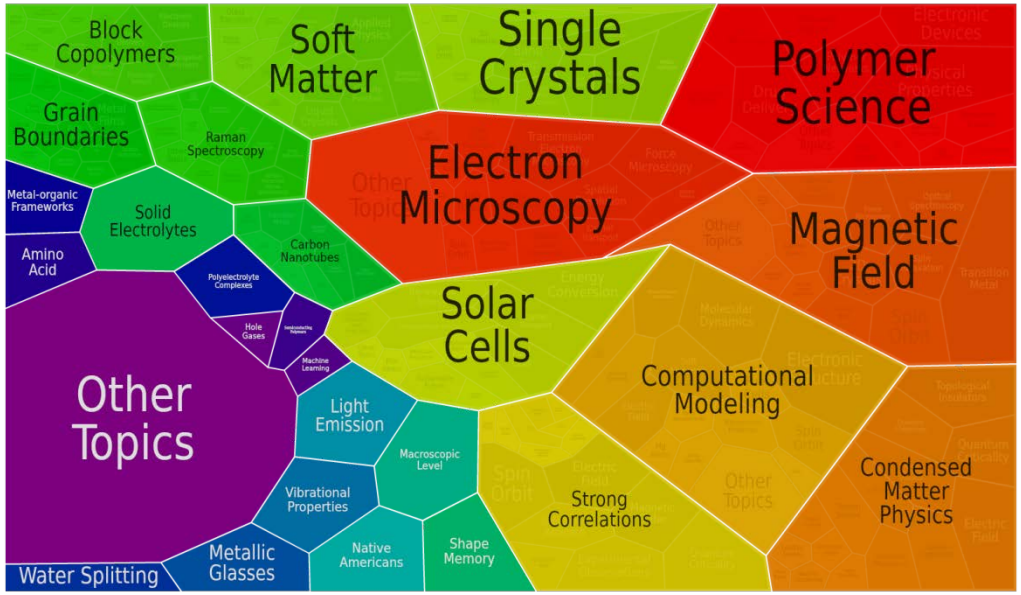
- Environmental Chemical Sciences
- Chemistry of Life Processes
- Chemical Catalysis
- Macromolecular, Supramolecular, and Nanochemistry

- **Major CAREER and REU support**
- **Collaborations with NIH, DOE, EPA, & USDA**
- **Core Activities are Individual Investigator Programs**
- **Critical areas of research:**



Advanced Manufacturing; Computational and Data Enabled Science & Engineering, Sustainability; BioMAPS; DMREF; Food-Energy-Water

Materials Research (DMR)

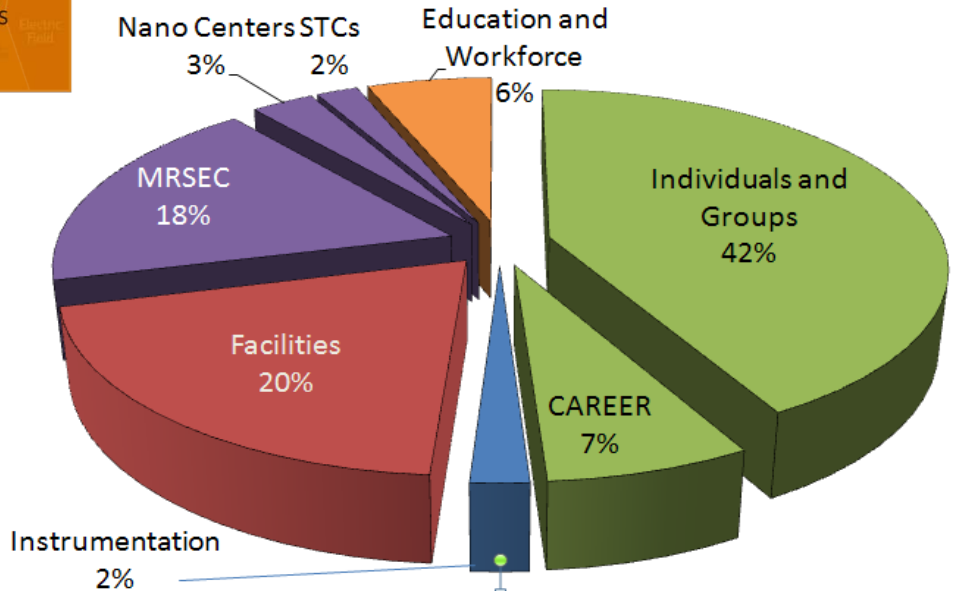


DMR Programs

- Eight Major Areas:
  1) Ceramics, 2) Electronic and Photonic Materials, 3) Metals and Metallic Nanostructures 4) Condensed Matter Physics, 5) Condensed Matter & Materials Theory

6) Biomaterials, 7) Polymers, 8) Solid-State and Materials Chemistry

- Materials Research Science and Engineering Centers (MRSEC)
- National Facilities and Instrumentation



Mathematical Sciences (DMS)

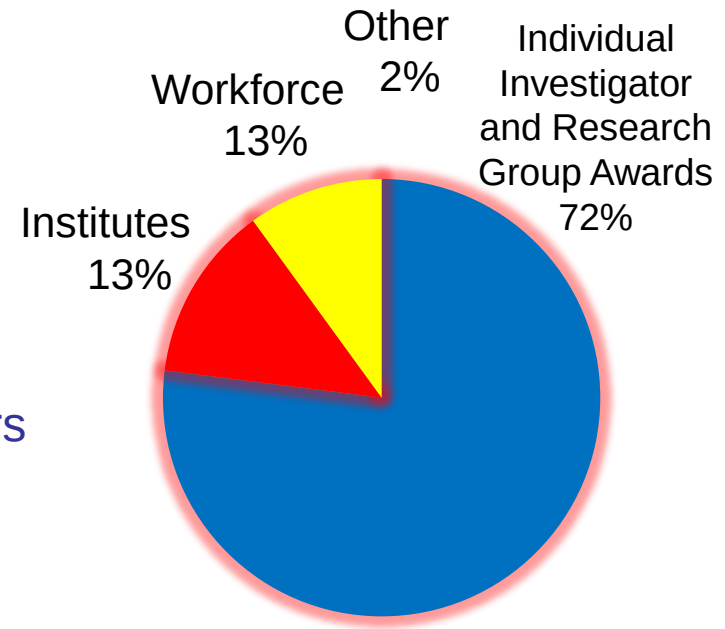
Analysis	Algebra Number Theory Combinatorics	Geometry Topology	Applied Math	Comp. Math	Probability Statistics	Workforce	Institutes

Covers the entire mathematical spectrum

Individual-investigator and group research grants
- » Disciplinary programs (unsolicited)
- » Special Research programs (solicited)

Institutes: National infrastructure for math. sciences
- » Visitors to long term programs, workshops

Workforce: Training the next generation of researchers
- » Postdoctoral fellowships
- » Graduate research training
- » Research experiences for undergraduates



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

Mathematical Sciences (DMS)

Priorities

Disciplinary

- Algebra and Number Theory
- Analysis
- Applied Mathematics
- Combinatorics
- Computational Mathematics
- Foundations
- Geometric Analysis
- Mathematical Biology
- Probability
- Statistics
- Topology

Interdisciplinary

- Mathematical Sciences Innovation Incubator (MSII)
- Optics and Photonics
- Interface of the Biological and Mathematical Sciences (DMS/NIGMS)
- Algorithms for Threat Detection (ATD)
- Interaction in Basic and Applied Scientific Research in BIO, ENG & MPS (BIOMaPS)
- Secure & Trustworthy Cyberspace (SaTC)
- Designing Materials to Revolutionize and Engineer our Future (DMREF)
- QIS, CIF21, SEES, INSPIRE, BRAIN
- BIGDATA: TRIPODS, QuBBD

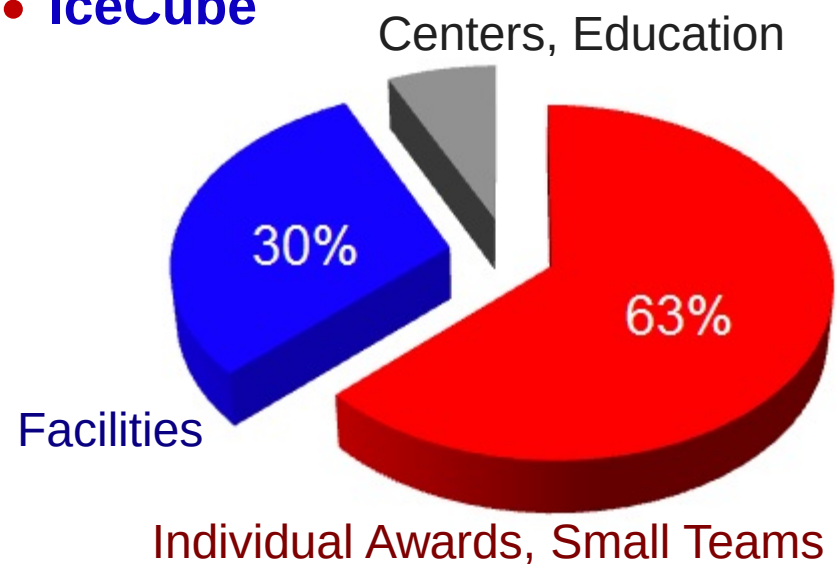
Physics (PHY)

Programs (Experiment & Theory)

- Accelerator Science
- Atomic, Molecular, & Optical Physics
- Computational Physics
- Elementary Particle Physics
- Education and Interdisciplinary Research
- Gravitational Physics
- Nuclear Physics
- Particle Astrophysics
- Physics of Living Systems
- Physics Frontiers Centers
- Quantum Information Science

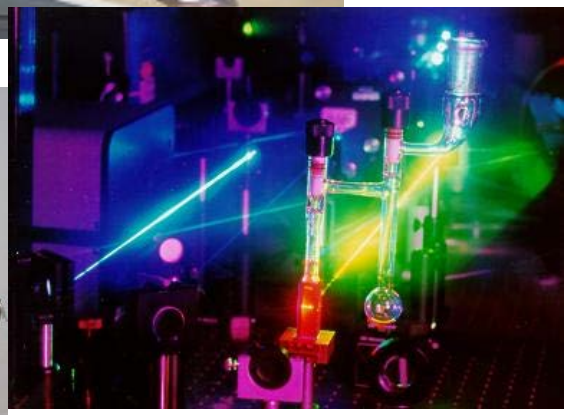
Facilities:

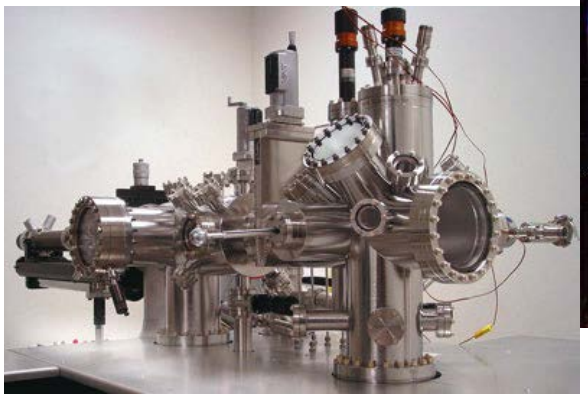
- **Large Hadron Collider (LHC)**
- **Laser Interferometer Gravitational wave Observatory (LIGO)**
- **National Superconducting Cyclotron Laboratory (NSCL)**
- **IceCube**



Instrumentation

- **Both acquisition and development**
- **Major Research Instrumentation (MRI)**
- **Divisional instrumentation programs**
- **Research grants**

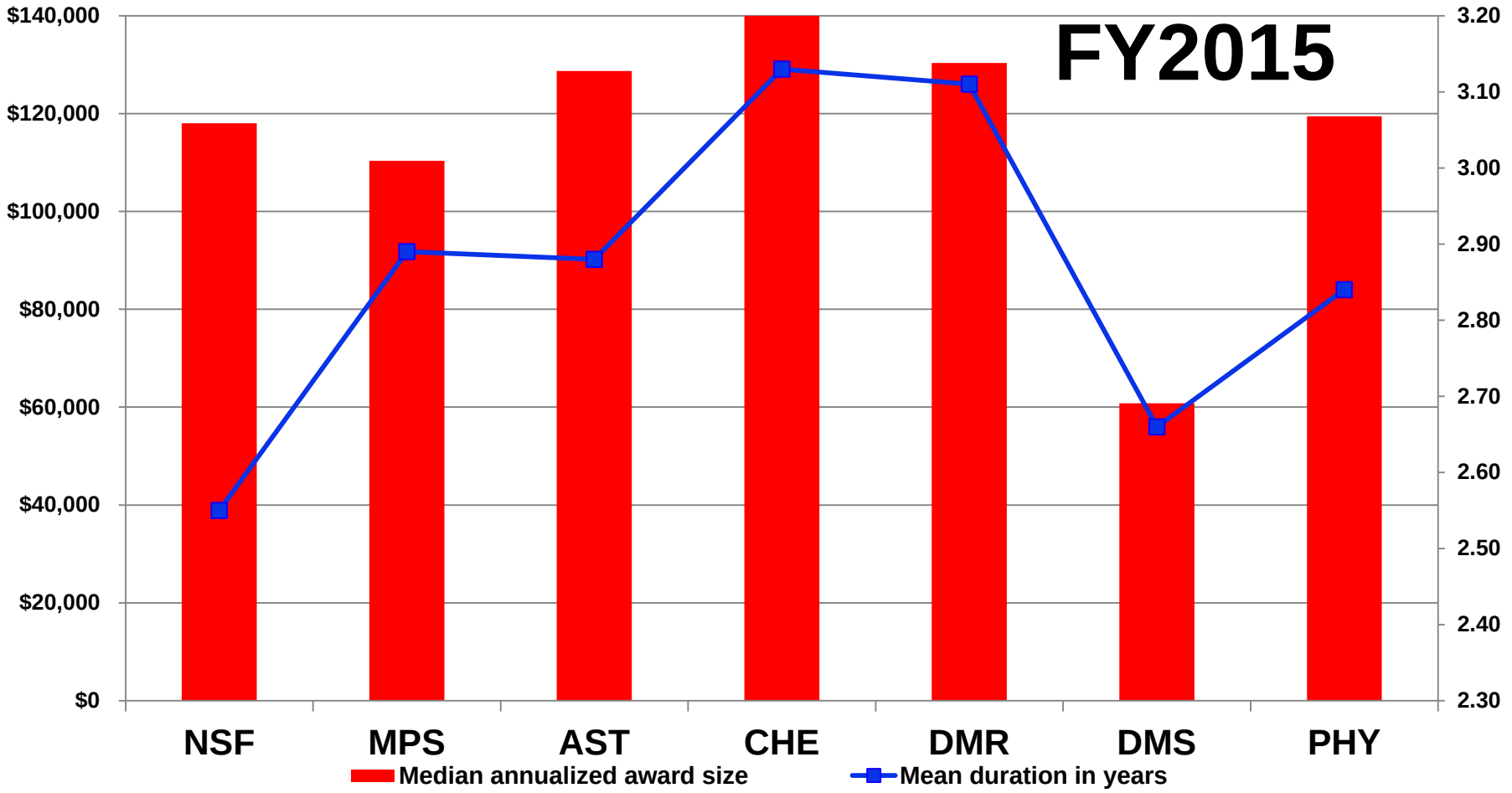




World Class Major Facilities

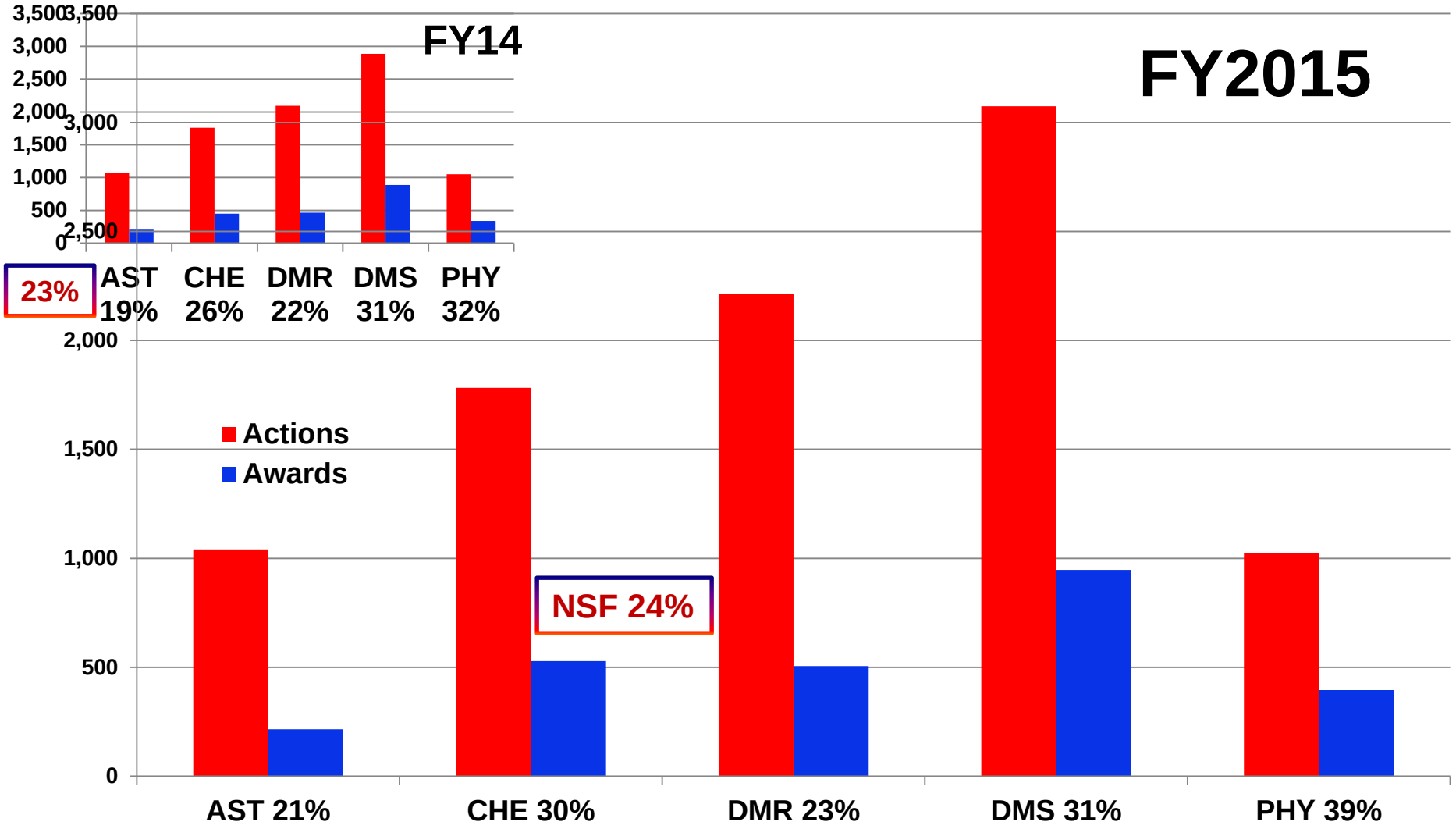
Keeping Researchers at the Frontier

Median Annualized Award Size and Duration



Award duration from one to five years (longer allowed, but rare)

Funding Rates

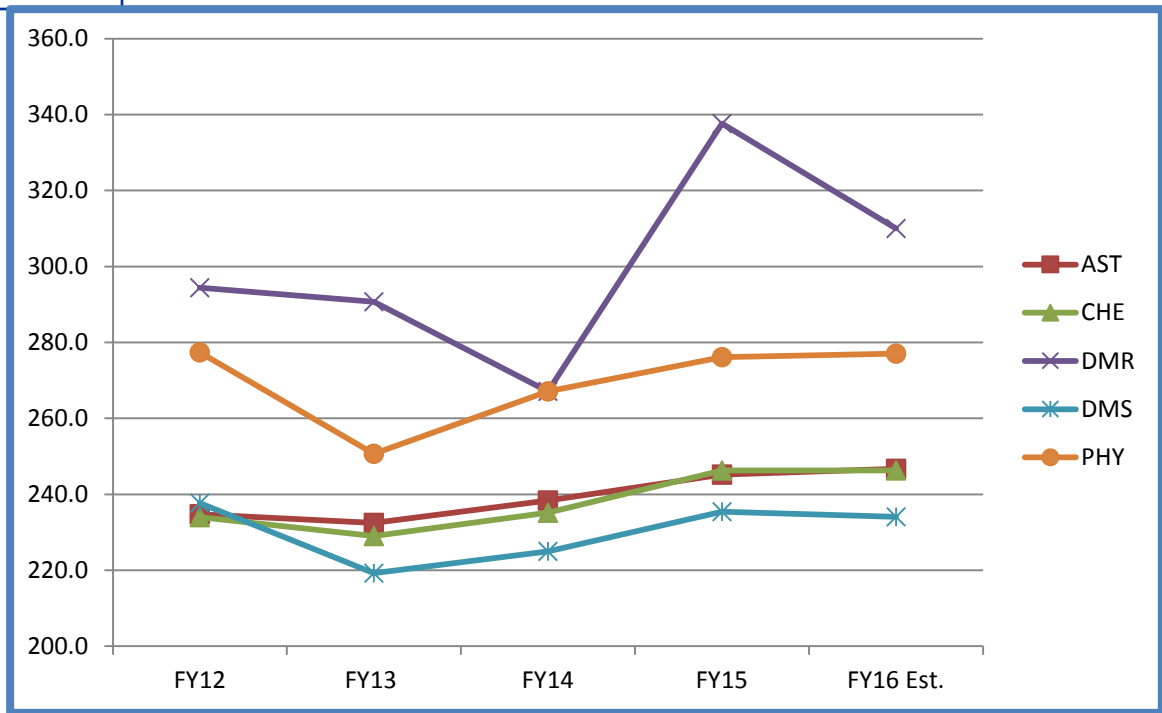


Funding

	FY12	FY13	FY14	FY15	FY16 Est.
MPS	1308.7	1249.5	1267.9	1376.3	1349.2
AST	234.7	232.5	238.4	245.2	246.7
CHE	234.0	229.0	235.2	246.3	246.3
DMR	294.4	290.7	267.1	337.6	310.0
DMS	237.7	219.2	225.0	235.4	234.1
PHY	277.4	250.7	267.1	276.1	277.0
OMA	30.4	27.4	35.2	35.7	35.0

Funding in then-year dollars

No adjustment for inflation



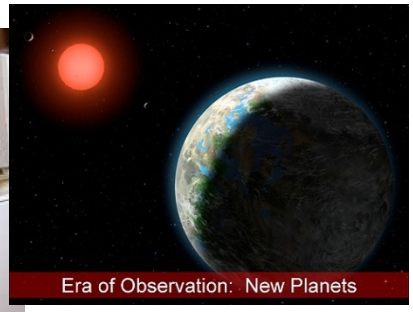
Merit Review Criteria

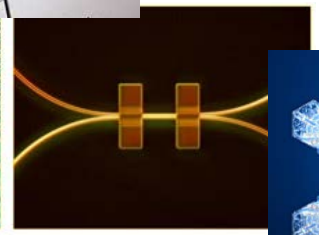
- Three Principles
  1. Highest quality: advance, even transform, the frontiers of knowledge.
  2. In aggregate, contribute more broadly to achieving societal goals.
  3. Based on appropriate metrics.
- Two Criteria *(unchanged)*
  1. Intellectual Merit
  2. Broader Impact
- Five Elements
  1. Potential to advance knowledge & benefit society
  2. Creative, original, or potentially transformative concepts?
  3. Well-reasoned, well-organized, sound rationale, & assessed?
  4. Qualified (individual, team, institution)?
  5. Adequate resources?

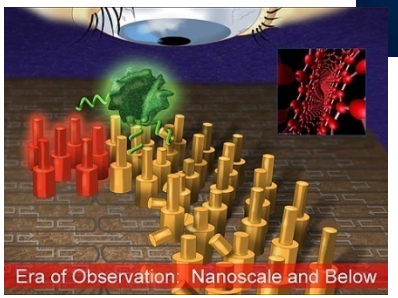
Merit Review Criteria: Intellectual Merit

- How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields?
- How well qualified is the proposer (individual or team) to conduct the project?
- To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts?
- How well conceived and organized is the proposed activity?
- Is there sufficient access to resources?

EXAMPLES







Merit Review Criteria: Broader Impacts

- How well does the activity advance discovery and understanding while **promoting teaching, training, and learning**?
- How well does the proposed activity broaden the participation of **underrepresented groups**?

EXAMPLES

- To what extent will it enhance the **infrastructure** for research and education, such as facilities, instrumentation, networks, and partnerships?

- Will the **results be disseminated** broadly to enhance scientific and technological understanding?
- What may be the benefits of the proposed activity to **society**?

How (not) to Apply

- Ineffective Strategies
  - » “Shop a proposal around” from Program to Program
    - – It can waste years (not only yours).
    - – Program Directors talk to each other
    - – We may transfer a proposal to another program
  - » Resubmit the same proposal next year
  - » Re-brand, combine, stretch or shoehorn
  - » Submit multiple proposals without consulting with the Program Director(s)

How to Apply

- How to select a Program a) wrong:
  - » Which one has the most money?
  - » Which one has the highest success rate?
  - » Which one has not turned me down before?
- How to select a Program b) right:
  - » Does your topic match the program?
    - – Look at previous awards from that program
  - » Does your proposal advocate something novel?
  - » Is your proposal competitive with funded ones?
    - – Volunteer to serve as a reviewer when not applying

NSF Proposal Preparation

- **ASK EARLY, ASK OFTEN**
- Read the paperwork (descriptions, solicitations etc.) with care; ask a Program Director for clarifications
- Contact the Program Director(s) to discuss your project: email with questions or call
- Be familiar with programs and funded projects
  - Guide to Programs:
    http://www.nsf.gov/funding/browse_all_funding.jsp
  - Award information, including abstracts:
    http://www.nsf.gov/awardsearch
- Know the audience for your proposal review - it **really** is a **competition!**

NSF Proposal Submission

- Know and follow the ***current*** Grant Proposal Guide (GPG) - it changes! (data management, postdoc mentoring, bio.sketch contents … *ad infinitum*)
- ***Explicitly*** address Intellectual Merit & Broader Impacts in Project Summary & Project Description & Prior Support
- Match and justify the budget to the scope of the proposed work - ask for what you need
- Submit proposals **before the last day/hour/minute !!**
  - **Automated compliance – you won't see the submit button**
- Download your completed proposal back to you to check that what we got is really what you think you sent

What Makes a Strong Proposal?

- New and original ideas (what?)
- Sound, succinct, detailed focused plan (how?)
- Preliminary data and/or feasibility calculations
- Relevant experience (why me/us?)
- Important & timely within field (why now?)
- Clarity concerning future direction (so what?)
- Well-articulated broader impacts

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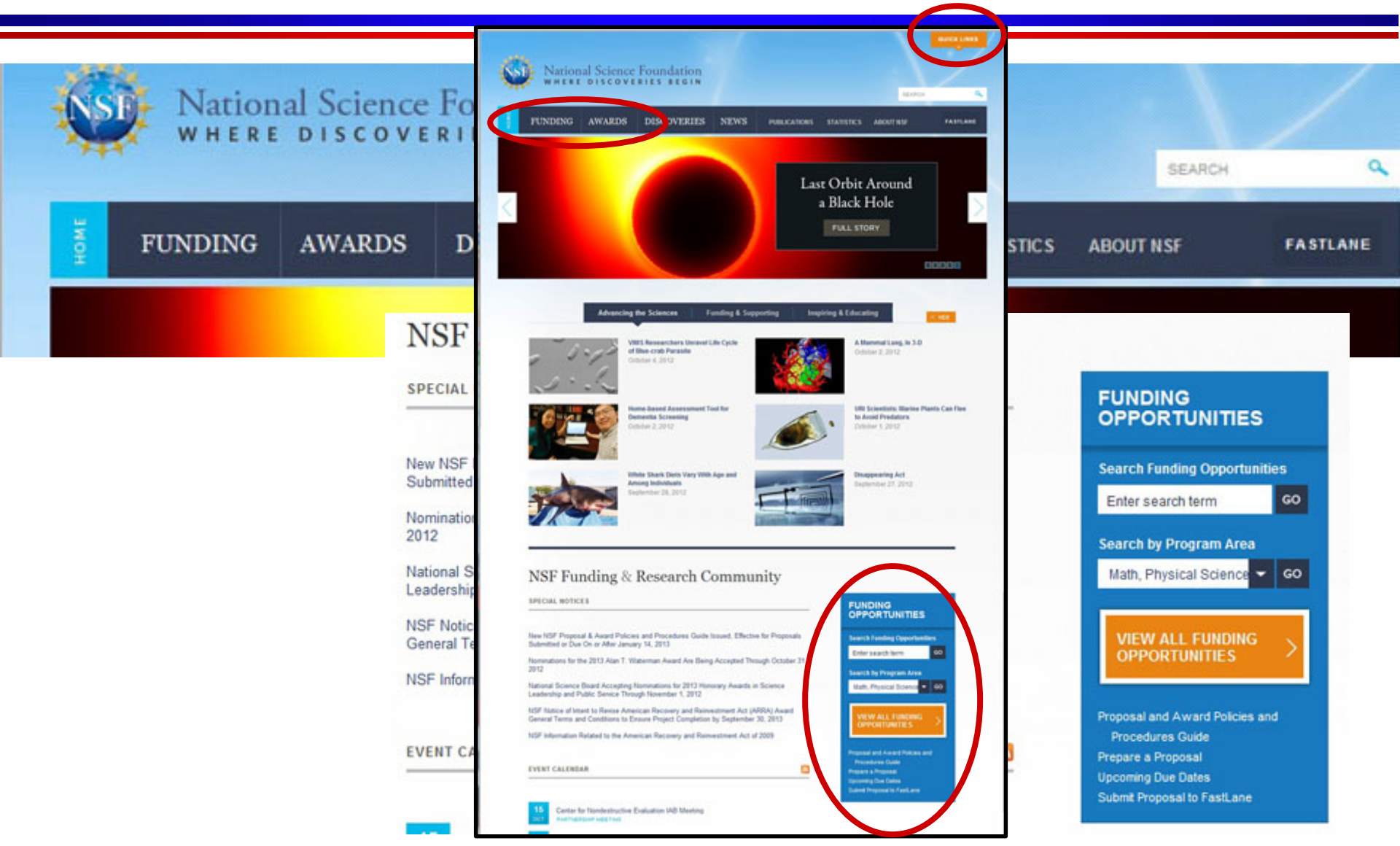
National Science Foundation
WHERE DISCOVERIES BEGIN
FUNDING
AWARDS
NEWS
Last Orbit Around a Black Hole
FULL STORY
Advancing the Sciences
Funding & Supporting
Inspiring & Educating
NSF Funding & Research Community
SPECIAL NOTICES
EVENT CALENDAR
FUNDING OPPORTUNITIES
Search Funding Opportunities
Enter search term
GO
Search by Program Area
Math, Physical Science
VIEW ALL FUNDING OPPORTUNITIES
Proposal and Award Policies and Procedures Guide
Prepare a Proposal
Upcoming Due Dates
Submit Proposal to FastLane
SEARCH
HOME
FUNDING
AWARDS
ABOUT NSF
FASTLANE

Get Involved

- Volunteer to be a reviewer and panelist
- Participate in NSF-funded events, workshops, meetings
- Proposals: send your best ideas to NSF
- Get to know your Program Directors
- Keep us informed of your accomplishments
- Work to support collaborative, interdisciplinary research
- Call our attention to things that need improvement
- Suggest strategies to go from basic research to production
- Serve as a program officer (“rotator”) or division director

For a specific MPS program, choose “Quick Links”, top right of http://www.nsf.gov, & click Mathematical & Physical Sciences

Contact NSF Program Directors for questions & suggestions

NSF Grants Conference

Ask Early, Ask Often

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