



Overview of Mathematical and Physical Sciences (MPS)

NSF Grants Conference

May 20 - 21, 2019 / Los Angeles, CA

Kathleen McCloud kmcccloud@nsf.gov

Program Director

Integrative Activities in Physics

Physics Division

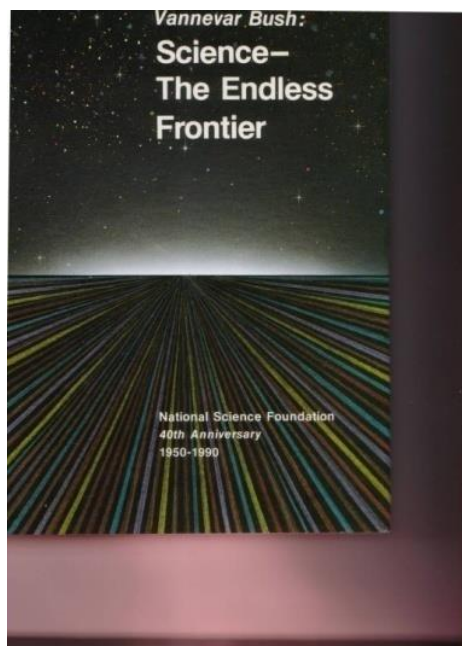
Directorate for Mathematical & Physical Sciences





NSF Vision and Goals

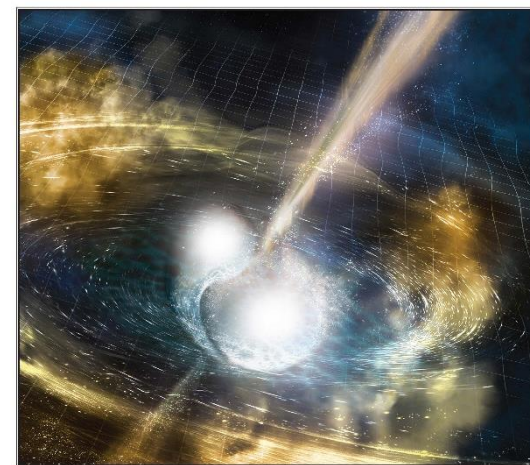
- **Vision:** *A nation that is the global leader in research and innovation*
- **Mission:** To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense ...
- **Strategic Goals:**
 - Expand knowledge in science, engineering, and learning.
 - Advance the capability of the Nation to meet current and future challenges.
 - Enhance NSF's performance of its mission.



National Science Foundation

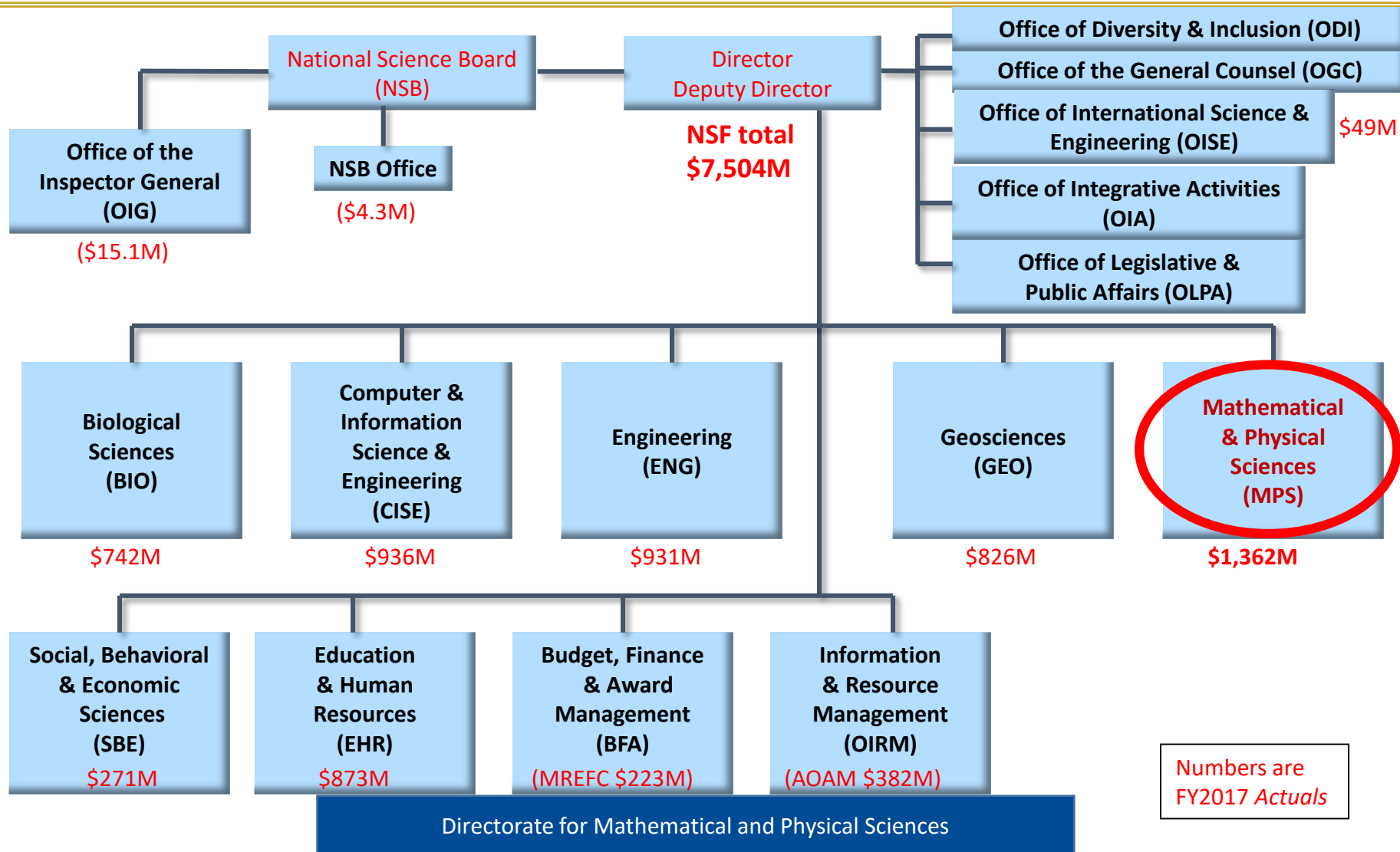
BUILDING THE FUTURE INVESTING IN DISCOVERY AND INNOVATION

NSF Strategic Plan for Fiscal Years (FY) 2018-2022



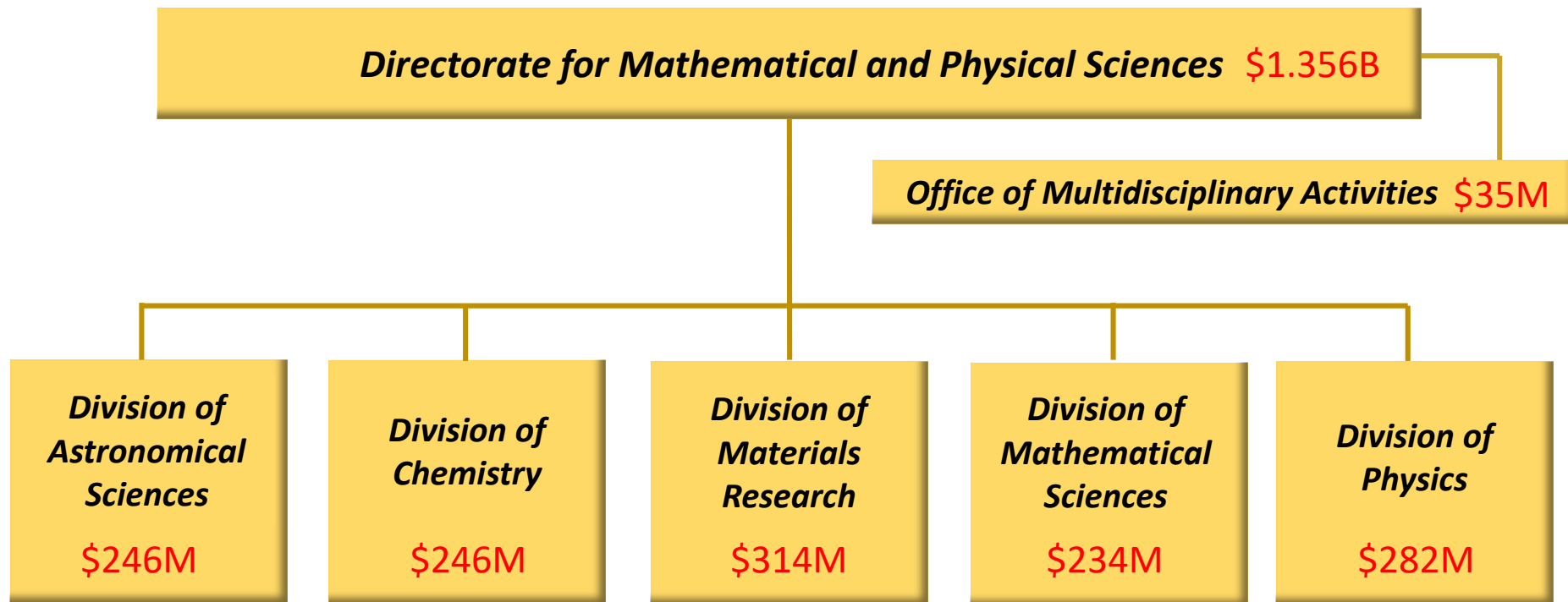


NSF Organization Chart





Directorate for Mathematical and Physical Sciences (MPS)



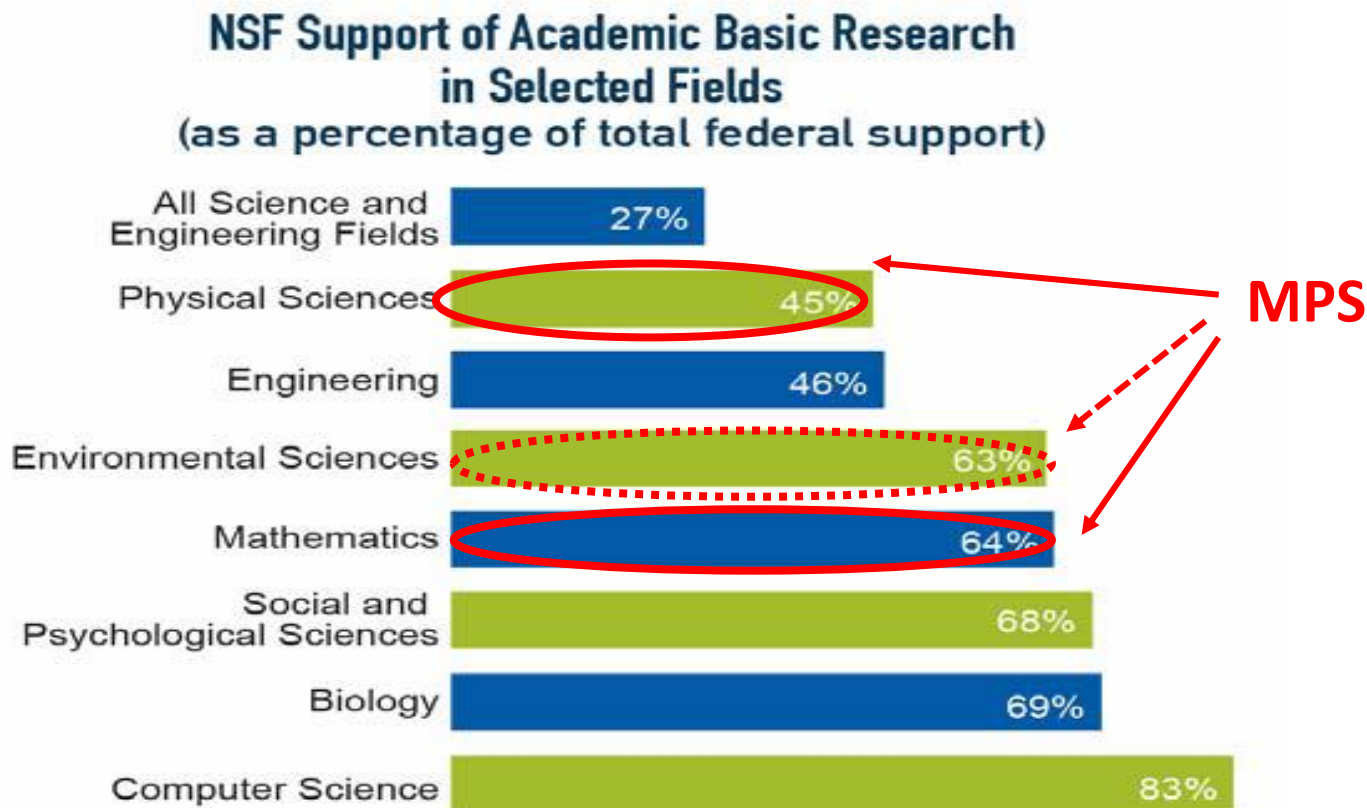


Directorate for Mathematical and Physical Sciences (MPS)

- 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 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 Support of Basic Research

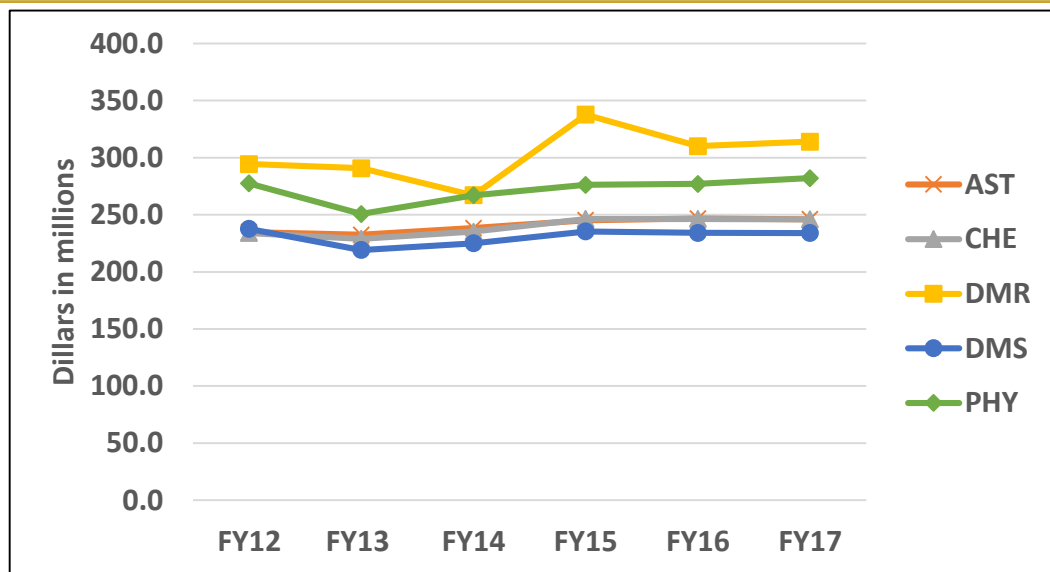


Notes: Biology includes Biological Sciences and Environmental Biology. Biology and Psychological Sciences exclude National Institutes of Health funding from the total amount of federal support.

Source: NSF/National Center for Science and Engineering Statistics, Survey of Federal Funds for Research and Development, FY 2015.



MPS Funding History

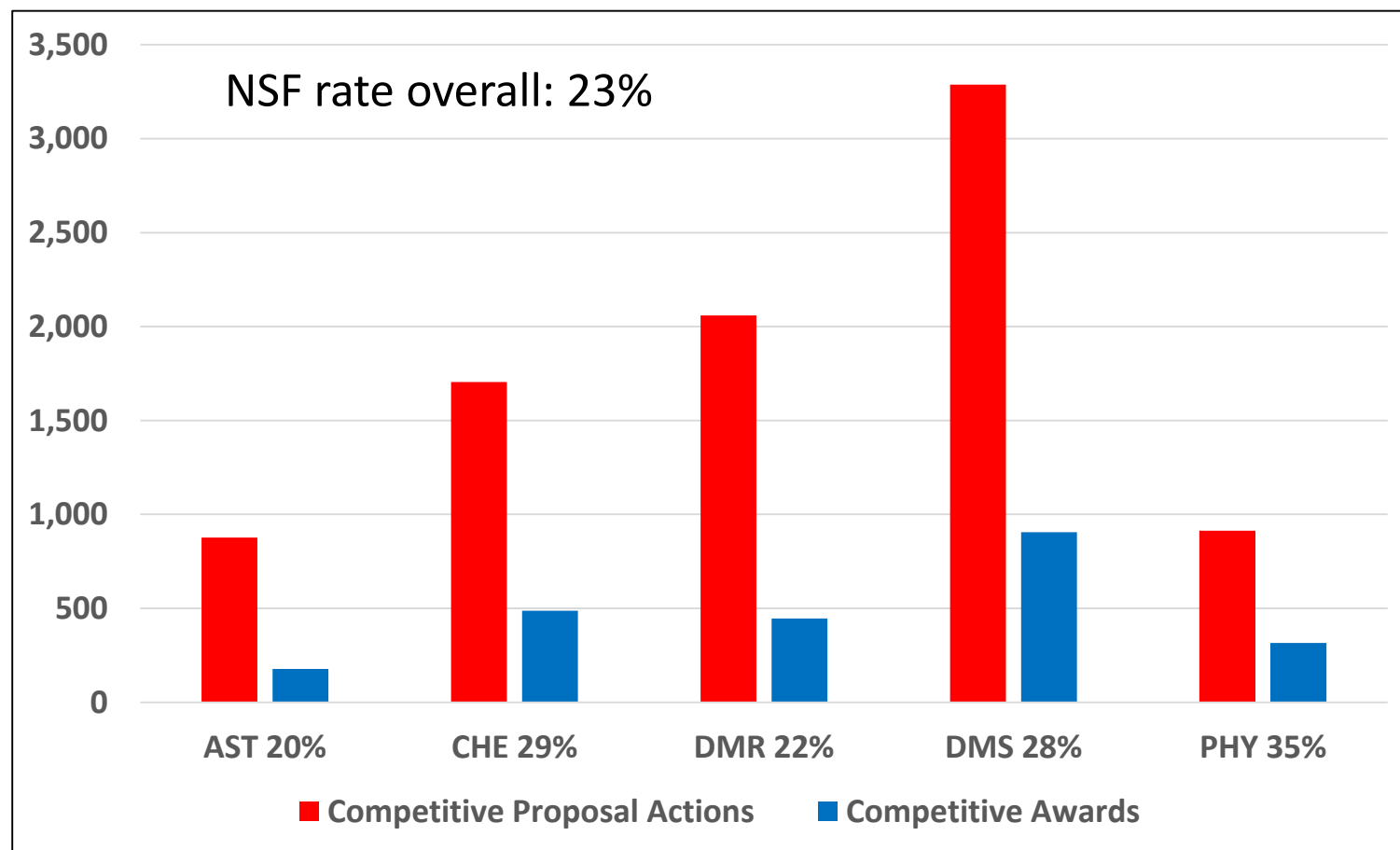


- Funding in then-year dollars
- No adjustment for inflation

<i>Dollars in millions</i>	FY12	FY13	FY14	FY15	FY16	FY17
MPS	1308.7	1249.5	1267.9	1376.3	1349.2	1356.0
AST	234.7	232.5	238.4	245.2	246.7	246.0
CHE	234.0	229.0	235.2	246.3	246.3	246.0
DMR	294.4	290.7	267.1	337.6	310.0	314.0
DMS	237.7	219.2	225.0	235.4	234.1	234.0
PHY	277.4	250.7	267.1	276.1	277.0	282.0
OMA	30.4	27.4	35.2	35.7	35.0	35.0

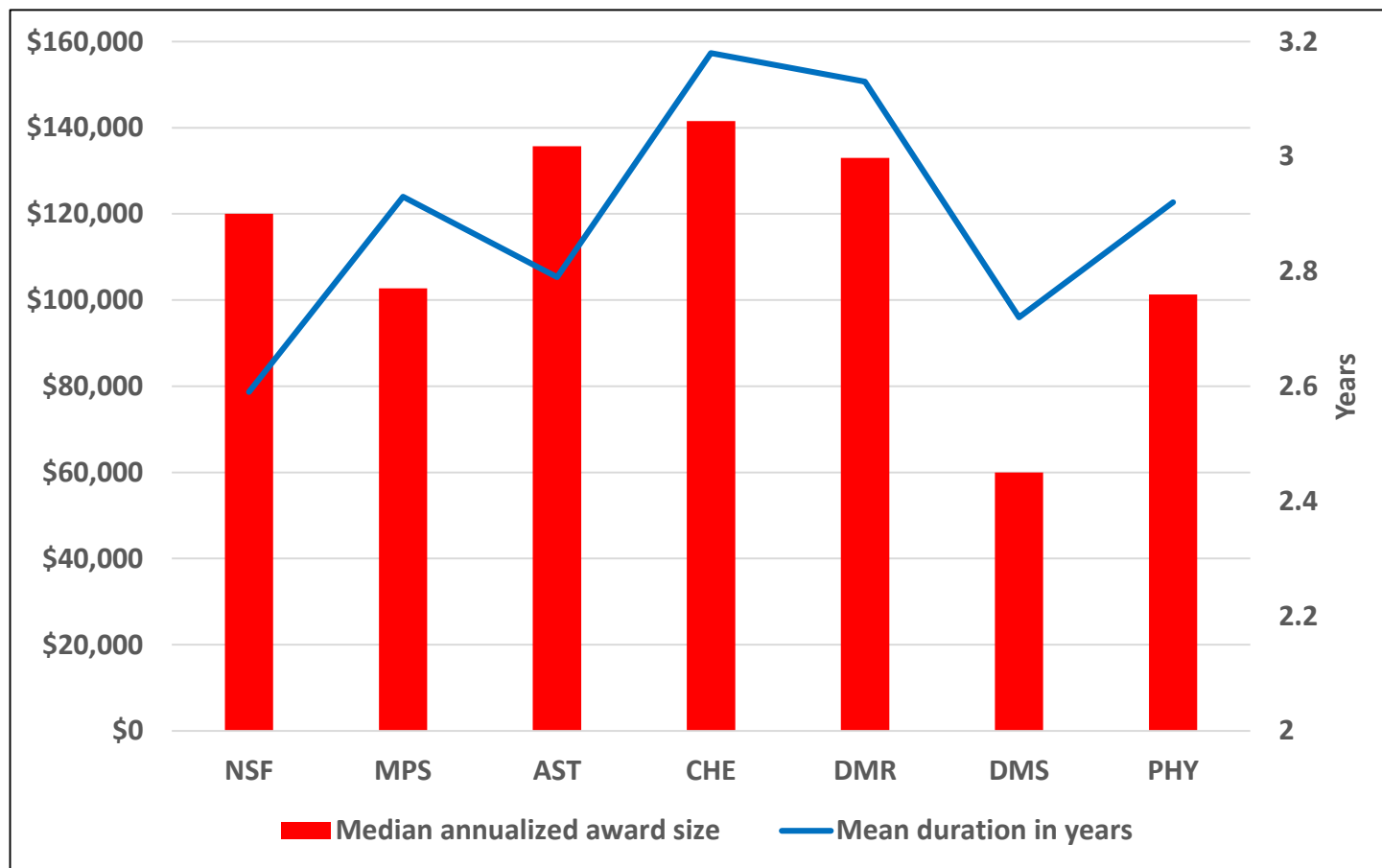


Funding Rates





Award Size & Duration Data



Award duration 1-5 years (longer allowed, but rare)

Directorate for Mathematical and Physical Sciences

Numbers are
from FY2017



MPS Science

The actual science of MPS comes through its five Divisions. Together, these span an astonishing breadth of fundamental lines of inquiry that collectively make MPS a major component of the entire NSF portfolio.



NSF-Wide & Other Directorate Programs

Of interest to
MPS proposers

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

Nano-scale Science
& Engineering

Software Infrastructure
for Sustained Innovation

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

Faculty Early Career
Development
CAREER— apply to
Divisions

Research Advanced by
Interdisciplinary Science
and Engineering (RAISE)

Graduate Research Fellowship (GRF)

NSF Research Traineeship
(NRT, successor to IGERT)

Optics & Photonics

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

REU, RET

BIGDATA

Cultivating Cultures
for Ethical STEM
(replaced EESE)

GOALI &
I-Corps

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



NSF's 10 Big Ideas

RESEARCH IDEAS

MATHEMATICAL
STATISTICAL
COMPUTATIONAL
FOUNDATIONS
ANALYTICS
DATA SCIENCE
HARNESSING THE
DATA REVOLUTION
FUNDAMENTAL RESEARCH
DOMAIN SCIENCE
CHALLENGES
RESEARCH DATA
CYBERINFRASTRUCTURE
LEARNING
MODELING
DATA MINING
INTERNET OF THINGS
HUMAN DATA INTERFACES

Harnessing Data for 21st Century Science and Engineering

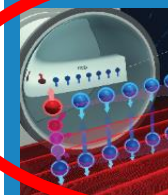
Work at the Human-Technology Frontier: Shaping the Future



Windows on the Universe: The Era of Multi-messenger Astrophysics



The Quantum Leap: Leading the Next Quantum Revolution



Understanding the Rules of Life: Predicting Phenotype



PROCESS IDEAS

Mid-scale Research Infrastructure



NSF 2026



Growing Convergence Research at NSF



NSF INCLUDES: Enhancing STEM through Diversity and Inclusion



MPS Scientific Opportunities

For example...

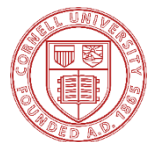
- CDS&E (Computational and Data-enabled Science and Engineering)
- Quantum Information Science
- Multi-messenger Astrophysics
- Intersection of physical and life sciences
- Midscale Infrastructure
- Complex systems (multi-scale, emergent phenomena)
- Sustainability (energy, environment, climate)
- Fundamental mathematical and statistical science



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 supported the development of small collaborative Institutes
 - 12 awards for \$500K per year for three years
 - First PI Meeting held in Oct. 2017
- Phase II (FY2020) will support a smaller number of larger Institutes, *selected from the Phase I Institutes* via a second competitive proposal process.
- TRIPODS+X: Partnerships between SCI/ENG Fields and TRIPODS Institutes (NSF 18-542)





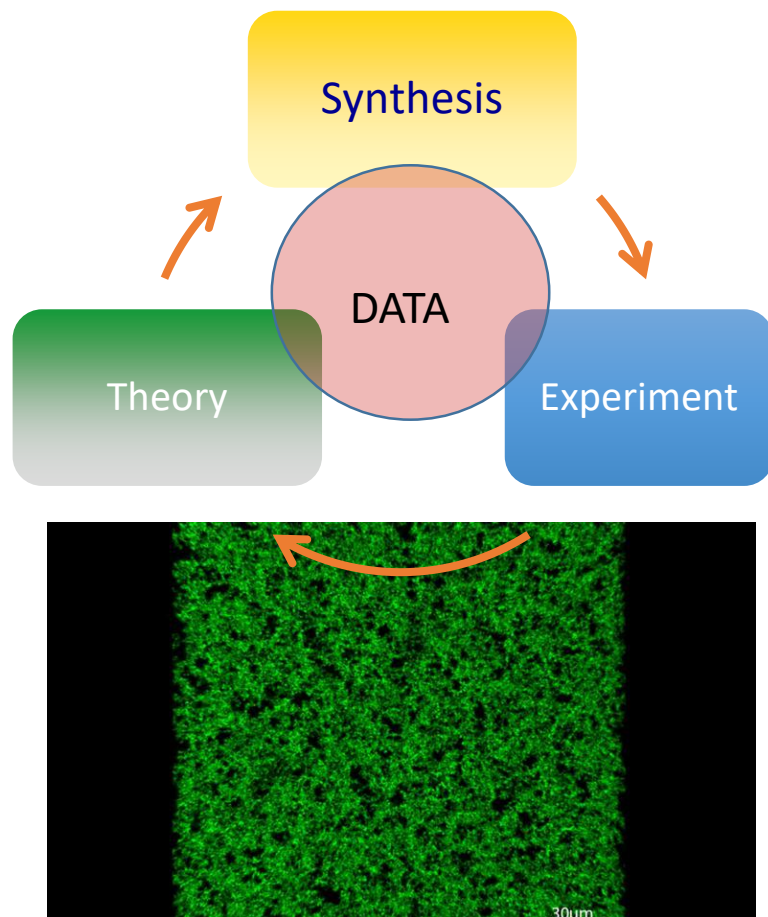
Computational and Data-enabled Science and Engineering (CDS&E)

- MPS disciplines are both leading consumers and hard drivers of **cyber-capability**
- MPS research requires and creates breakthroughs in algorithms, in simulation and modeling methods, and in materials for emerging cyber-technology.
- CDS&E is a cross-directorate program (MPS, ENG, and CISE/ACI)
- Designed ***“to identify and capitalize on opportunities for major scientific and engineering breakthroughs through new computational and data analysis approaches”***.
- CDS&E is a “meta-program” - submit through pre-existing funding opportunities.
- See announcement PD12-8084.





Designing Materials to Revolutionize and Engineer our Future (DMREF)



- Partnership with ENG & CISE directorates
- Build fundamental knowledge base needed to progress towards designing and making a material with a specific and desired function or property from first principles.
- Accelerate materials discovery and development.
- Collaborate and iterate “close the loop” between theory and experiment.
- Aspire to enable “data-driven” materials research.
- Solicitation **NSF 19-516**



MPS Broadening Participation Opportunities

Alliance for Graduate Education and the Professoriate – Graduate Research Supplement (MPS AGEP GRS)

- Designed to promote increased representation in MPS research.
- Available to PIs to support qualifying graduate students at AGEP or AGEP Legacy Institutions only!

https://www.nsf.gov/mps/broadening_participation/index.jsp

- Allows support of one (additional) Ph.D. student per award
- Graduate Student Eligibility
 - Emphasis placed on under-represented groups
 - Not currently supported by federal government (NSF, DOE, NIH,...)
 - US Citizen, US National, or US Permanent Resident
- Stipend, tuition, benefits, and IDC (~\$60k)

[See DCL 16-125 for more information](#)



MPS Broadening Participation: Two Highlights

- **NSF INCLUDES: Inclusive Graduate Education Network (IGEN) Alliance:** the American Physical Society, the American Chemical Society, the American Geophysical Union, the American Astronomical Society, and the Materials Research Society—have joined forces to increase participation of underrepresented students in graduate physical science programs.
- **A Future Faculty Workshop** (DMR/XC) – July 18-20, 2018 in Delaware.



IGEN

Inclusive Graduate Education Network



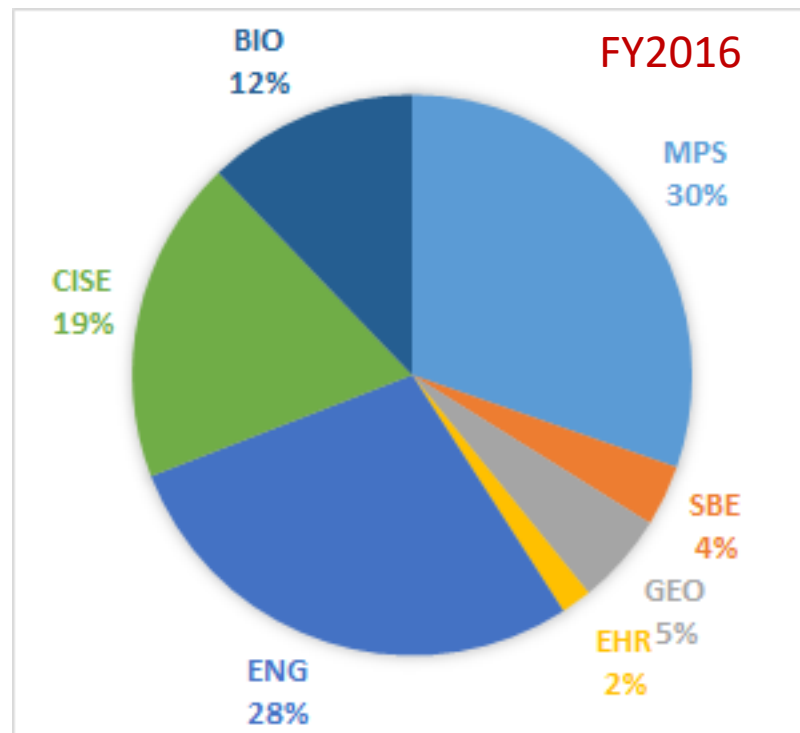
CAREER Program

Faculty Early Career Development Program, NSF 17-537

- NSF grants for junior-faculty “teacher scholars”
- Proposals 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.

Important points to bear in mind...

- Not a research excellence prize!
- Not intended as a default funding mechanism for new Assistant Professors.
- Has a specialized purpose which may not be suitable for all PI's. **Integration of research and education is key!**





RUI: Facilitating Research at Primarily Undergraduate Institutions

- RUI proposals from **eligible institutions** must be submitted in response to existing NSF funding opportunities and must abide by guidelines and deadlines in those documents.
- Current RUI solicitation is [NSF 14-579](#). You submit here and designate which Program should receive your proposal. ***RUI solicitation has extra requirements*** beyond the regular Program Solicitations and PAPPG.

There is no single Foundation-wide deadline for RUI proposals – see Division programs.



MPS Directorate Brochure

- Gives statistics, mission statements, initiatives, funding rates, lots of information
- Additional information about the directorate is available from the NSF website
- Latest version (FY2017) shown right and at link below



DIRECTORATE FOR
**MATHEMATICAL &
PHYSICAL SCIENCES**



https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf17115



Division of Astronomy (AST)



AST Programs

Individual Investigators

(Lead: James Neff)

AAG

Astronomy and
Astrophysics
Research Grants

SPG

Solar and Planetary
Research Grants

CAREER

Early Career Faculty

AAPF

Postdocs

ATI

Advanced Technologies
and Instrumentation

MRI

Major Research
Instrumentation

REU

Research Experiences for
Undergraduates

Research

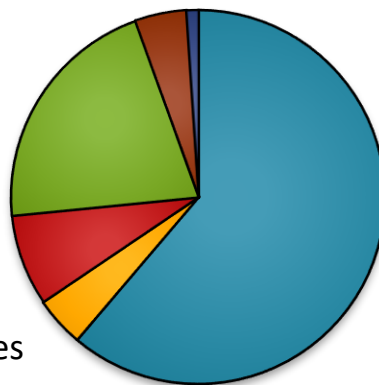
Technology/
Instrumentation

Education and
Special Programs

Mid-scale

(Lead: Rich Barvainis)

MSIP



Facilities

(Lead: Ralph Gaume)

ALMA

NRAO

Gemini

NOAO

NSO

Arecibo

LSST

Directorate for Mathematical and Physical Sciences



Individual Investigator Programs

- Astronomy and Astrophysics Research Grants
 - Solar and Planetary (now with no deadline)
 - Stellar Astronomy
 - Galactic Astronomy
 - Extragalactic Astronomy and Cosmology
- Annual AAG window: Oct. 1- Nov. 15
- Research grants for observational, theoretical, laboratory, and archival data studies in all areas of astrophysics
- Also support programs that *enable* new research capabilities
- Proposals may span multiple disciplines and/or areas of study and may utilize multiple techniques.





Individual Investigator Programs

- An award is made to an institution: university, observatory, center (like CfA), NOT directly to another federal agency (like NASA).
- Typical awards are 3 years, ~\$400K (including institutional indirect)
- Usual budget is for salary (grad student, postdoc, faculty summer, "soft money" academic year), travel, publication costs.
- Proposals that are solely or predominantly for the acquisition, analysis, or interpretation of space-based data from NASA-supported missions will be returned without review.

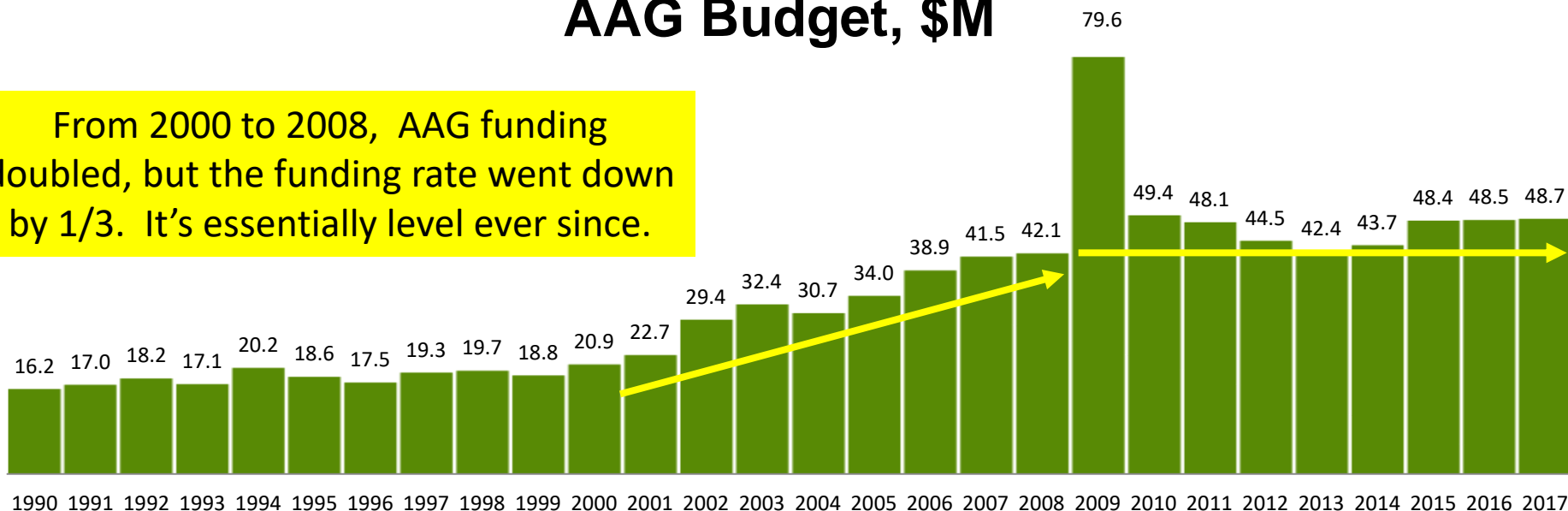




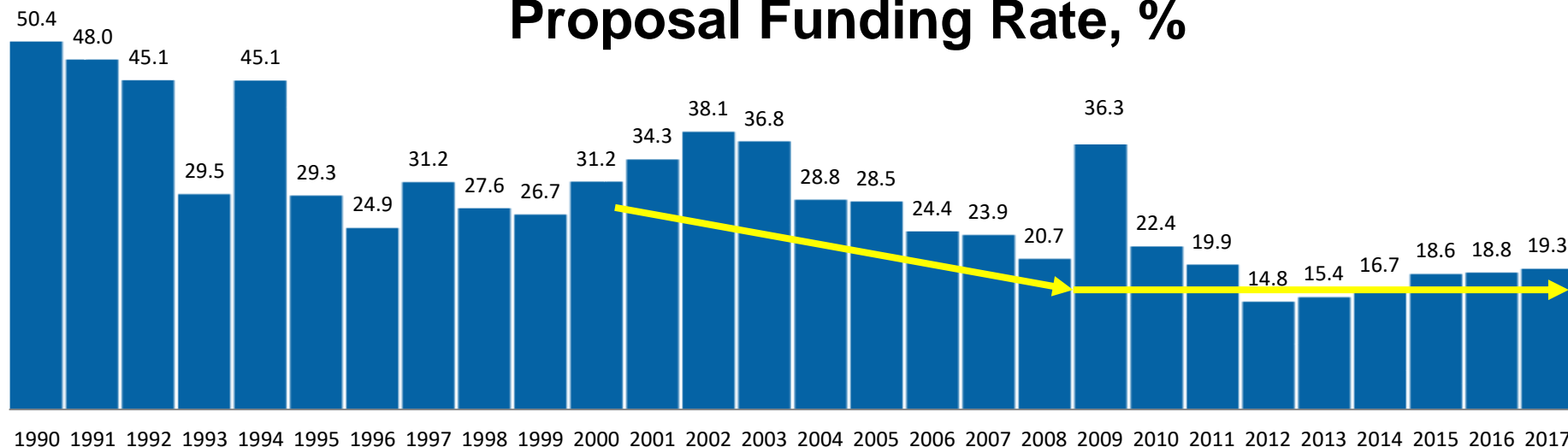
AAG Funding History, 1990-2017

AAG Budget, \$M

From 2000 to 2008, AAG funding doubled, but the funding rate went down by 1/3. It's essentially level ever since.



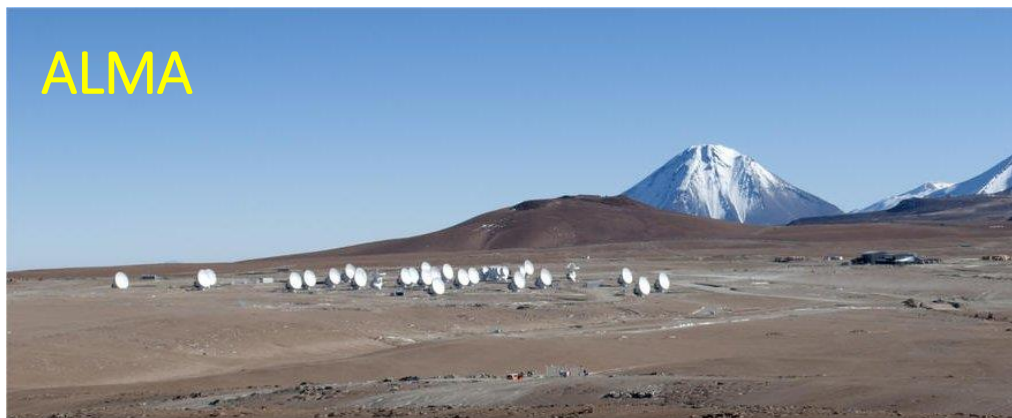
Proposal Funding Rate, %





Some of our AST Facilities

ALMA



LSST



Gemini



DKIST



Anyone may propose for observing time on NSF AST-funded facilities

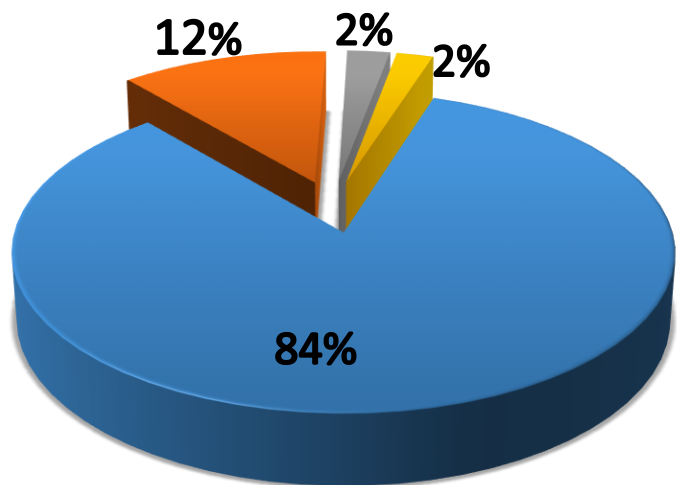


Division of Chemistry (CHE)

Directorate for Mathematical and Physical Sciences



Division of Chemistry (CHE)



Centers

Instrumentation

**Education and
broadening
participation**

**Individual Investigators
and Small Groups**

**Integrative
Chemistry
Activities**

Individual Investigator Awards and Core Chemistry Research

- Eight major program areas – four core and four with interdisciplinary flavor
- Major support for CAREER awards

Chemical Synthesis

**Chemical Structure,
Dynamics, and
Mechanisms A&B**

**Theory, Models, and
Computational
Methods**

**Chemical
Measurement
and Imaging**

**Environmental
Chemical
Sciences**

**Chemistry of Life
Processes**

Chemical Catalysis

**Macromolecular,
Supramolecular,
and Nanochemistry**



Individual Investigator Award Program

Chemical Synthesis



<http://www.polymersandcolors.eu/en/chemicals>

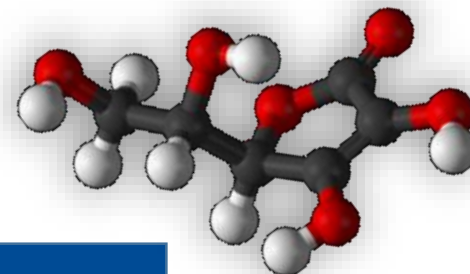
Inorganic, Organometallic, and Organic Synthesis. Experimental and computational research on new and efficient synthetic methodologies and on the synthesis of complex and/or challenging chemical structures.

Proposal Window: Sept. 1, 2019 – Sept. 30, 2019

Studies of chemical structure, dynamics, and chemical mechanisms. Physical Chemistry (CSDM-A) and physical inorganic and organic chemistry (CSDM-B).

Proposal Window: Sept. 1, 2019 – Sept. 30, 2019

Chemical Structure, Dynamics, and Mechanisms A&B



Directorate for Mathematical and Physical Sciences

https://rw.wikipedia.org/wiki/Vitamins_C



Individual Investigator Award Program

Theory, Models, and Computational Methods



<https://www.chemistryworld.com/>

Supports the discovery and development of theoretical and computational methods or models to address chemical challenges.

Proposal Window: Sept. 1, 2019 – Sept. 30, 2019

Chemically-relevant measurement science and imaging, targeting both improved understanding of new and existing methods and instrument development.

Proposal Window: Oct. 1, 2019 – Oct. 31 2019

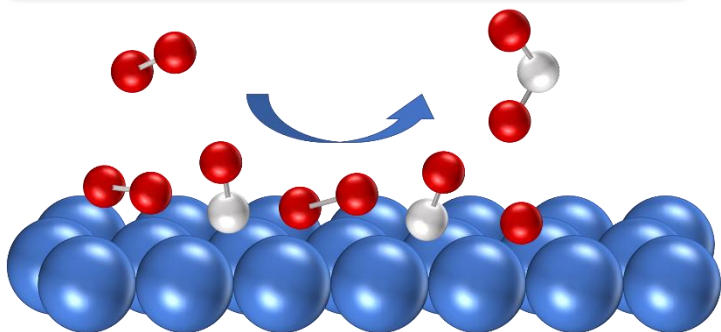
Chemical Measurement and Imaging





Individual Investigator Award Program

Chemical Catalysis



Experimental and computational research directed towards catalytic processes. Inorganic, organic, organometallic catalysts.

Proposal Window: Sept. 1, 2019 – Sept. 30, 2019

Experimental and computational research on chemical processes in the environment. No field studies.

Proposal Window: Oct. 1, 2019 – Oct. 31 2019

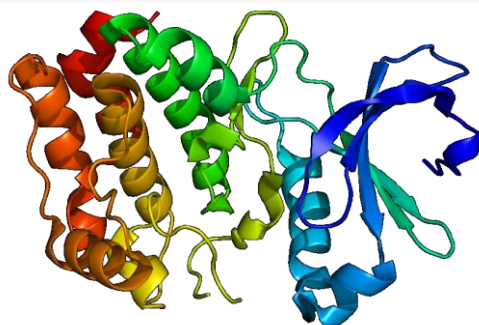
Environmental Chemical Sciences





Individual Investigator Award Program

Chemistry of Life Processes



<https://medicalxpress.com/news/2014-07-proteins-scientists-drug-discovery-tool.html>

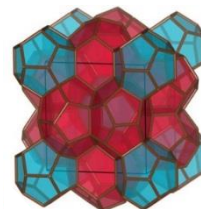
Experimental and computational studies of molecules and/or systems at the interface of chemistry and biology. Such studies would promote the fundamental understanding of the molecular underpinnings of life processes. Studies of function, not dysfunction.

Proposal Window: Oct. 1, 2019 – Oct. 31 2019

Synthesis and structure-function reactivity of macromolecular, supramolecular, and nanoscopic structures.

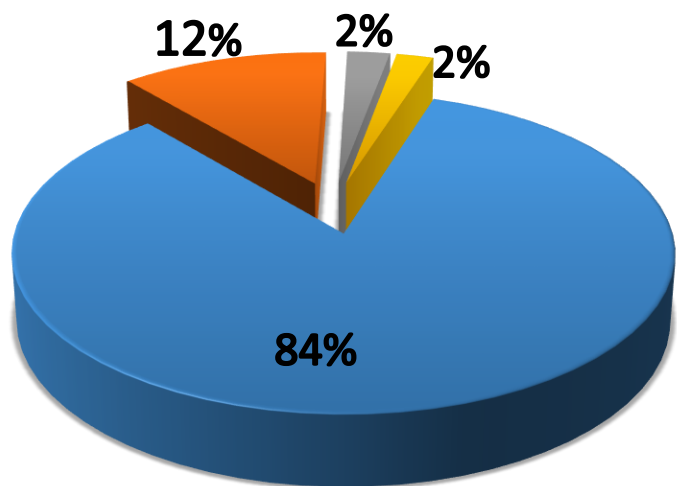
Proposal Window: Oct. 1, 2019 – Oct. 31 2019

Macromolecular, Supramolecular, and Nanochemistry





Integrative Chemistry Activities



Centers

Instrumentation
Education and broadening
participation

Individual Investigators
and Small Groups

Integrative
Chemistry
Activities

Centers for Chemical Innovation

Supports research centers focused on major, long-term fundamental chemical research challenges.
Phase 1: \$800 K/y (3y)
Phase 2: \$4 M/y (up to 10y)
See solicitation: [NSF 19-576](#)

Major Research Instrumentation

NSF wide program, funds acquisition or development of a shared research instrument, generally \$200K - \$4 M.
Solicitation: [NSF 18-513](#)

Research Experiences for Undergraduates

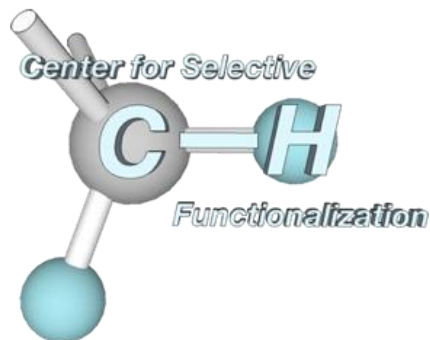
Offers two ways to support undergraduate research

- **Sites** engage a number of students in research at one site
- **Supplements** for support of individual students on ongoing NSF-funded research projects

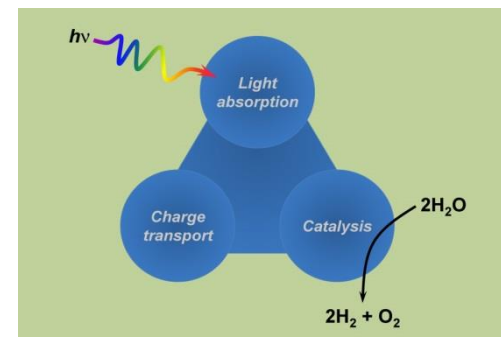
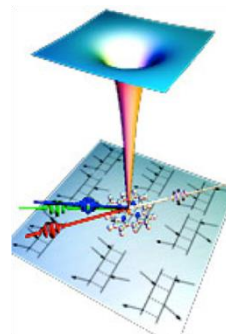
Proposals due in August



Chemical Centers for Innovation Phase II Centers



Center for
Chemistry
at the
Space-Time
Limit



CCI Solar Fuels



Center for Sustainable Polymers

UNIVERSITY OF MINNESOTA

Driven to DiscoverSM



CENTER FOR AEROSOL IMPACTS ON
CLIMATE AND THE ENVIRONMENT



REU Sites & Projects

- REU Sites are based on independent proposals to initiate and conduct projects that engage a number of students in research.
- REU Sites may be based in a single discipline or on interdisciplinary research opportunities with a coherent intellectual theme. Proposals with an international dimension are welcome.
- REU Projects involve students in meaningful ways in ongoing research programs or in research projects specifically designed for the REU program.
- **Proposals due in August**
- **Talk to the Program Directors.**



The screenshot shows the NSF website with the 'REU' banner at the top. The main navigation bar includes links for FUNDING, AWARDS, DISCOVERIES, NEWS, PUBLICATIONS, STATISTICS, ABOUT NSF, and FASTLANE. The 'Funding' section is highlighted, showing a sidebar with links like 'Find Funding', 'A-Z Index of Funding Opportunities', 'Recent Funding Opportunities', 'Upcoming Due Dates', 'Advanced Funding Search', 'Interdisciplinary Research', 'How to Prepare Your Proposal', and 'About Funding'. The main content area features a 'NOTE ON THE PROPOSAL DEADLINE FOR REU SITES' section, which states: 'Two due dates are listed for REU Site proposals each year. The May deadline applies only to REU Site proposals that require access to Antarctica, which must be submitted to one of the Antarctic Sciences Division (ANT) research programs in the Office of Polar Programs (OPP). The fall deadline (which is September 12 in 2012, and the fourth Wednesday in August in 2013 and beyond) applies to all other REU Site proposals.' Below this, there are sections for 'CONTACTS', 'NSF REU Site Contacts' (with a link to http://www.nsf.gov/crssprgm/reu/reu_contacts.jsp), 'PROGRAM GUIDELINES', 'Solicitation 13-542', and 'DUE DATES'. The 'DUE DATES' section lists: 'Full Proposal Deadline Date: August 27, 2014' and 'Deadline for REU Site proposals except those requiring access to Antarctica: Fourth Wednesday in August, Annually Thereafter'. It also lists: 'Full Proposal Deadline Date: May 22, 2015' and 'Deadline for REU Site proposals requiring access to Antarctica. All other REU Site proposals must be submitted to the August REU deadline. Fourth Friday in May, Annually Thereafter'.



Major Research Instrumentation Program (MRI)

NSF National Science Foundation
WHERE DISCOVERIES BEGIN

QUICK LINKS

SEARCH

HOME FUNDING AWARDS DISCOVERIES NEWS PUBLICATIONS STATISTICS ABOUT NSF FASTLANE

Funding

Find Funding
A-Z Index of Funding Opportunities
Recent Funding Opportunities
Upcoming Due Dates
Advanced Funding Search
Interdisciplinary Research
How to Prepare Your Proposal
About Funding

Proposals and Awards

Proposal and Award Policies and Procedures Guide
Introduction
Proposal Preparation and Submission
Grant Proposal Guide
Grants.gov Application Guide
Award and Administration
Award and Administration Guide
Award Conditions
Other Types of Proposals
Merit Review
NSF Outreach

NSF-wide

Major Research Instrumentation Program (MRI)

MRI ANNOUNCEMENTS

FREQUENTLY ASKED QUESTIONS POSTED

FAQs have been added for MRI Solicitation 11-503. To view the FAQs page click [here](#).

CONTACTS

Name	Email	Phone	Room
Dr. Randy L. Phelps	mri@nsf.gov	(703) 292-8040	

Additional contact information for NSF's Major Research Instrumentation Program is as follows:

Office of Integrative Activities
Major Research Instrumentation Program
National Science Foundation, Room 935
4201 Wilson Boulevard
Arlington, VA 22230
(703) 292-8040

E-Mail: mri@nsf.gov

Website: <http://www.nsf.gov/od/oa/programs/mri>

PROGRAM GUIDELINES

Solicitation [13-517](#)

Important Notice to Proposers

A revised version of the NSF Proposal & Award Policies & Procedures Guide (PAPPG), [NSF 13-1](#), was issued on October 4, 2012 and is effective for proposals submitted, or due, on or after January 14, 2013. Please be advised that, depending on the specified due date, the guidelines contained in [NSF 13-1](#) may apply to proposals submitted in response to this funding opportunity.

- Support acquisition of major state-of-the-art instrumentation
- Foster development of the next generation of major instrumentation
- Integrate research with education
- Use, advance, expand the nation's cyber-infrastructure and/or high performance computing capability
- Promote academic & private sector instrument development partnerships
- Solicitation: **NSF 18-513**



CHE Sponsored Facilities

NATIONAL HIGH MAGNETIC FIELD LABORATORY

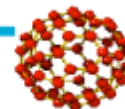
Ion Cyclotron Resonance Facility (ICR)



Developing and exploiting the unique capabilities of Fourier Transform Ion Cyclotron Resonance (FT-ICR) mass spectrometry, and leads the world in instrument and technique development as well as novel applications of FT-ICR mass spectrometry.

For more information or to apply see:
<https://nationalmaglab.org/user-facilities/icr>

ChemMatCARS



ChemMatCARS operates three experimental stations in the areas of advanced small-molecule crystallography, liquid surface and interface scattering, and small to wide-angle scattering at the Advanced Photon Source (APS).

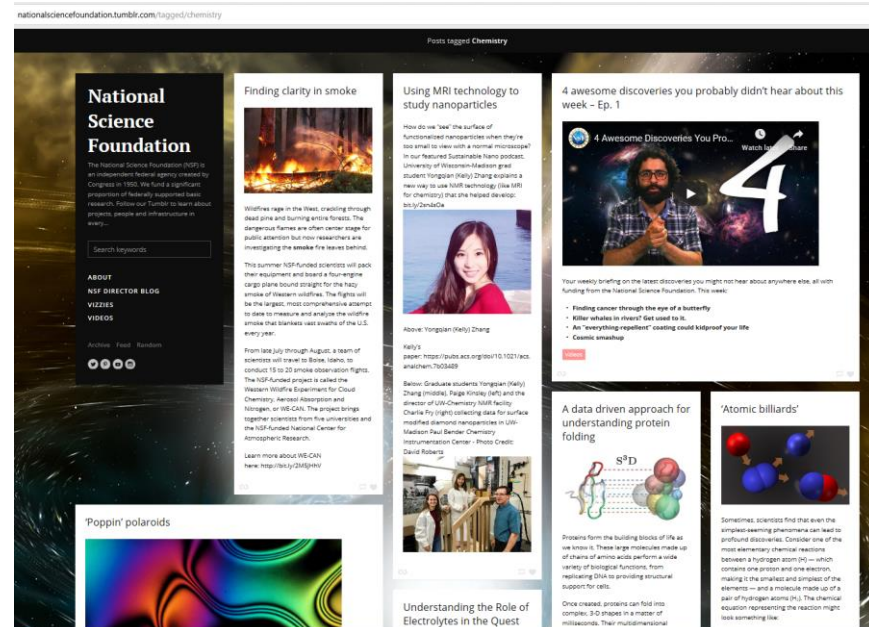
For more information or to apply see:
<https://chemmatcars.uchicago.edu/>



Chemistry in the Field

- CAREER workshop to introduce early career faculty to NSF CAREER program
 - Workshop held March 26-27, 2018
 - Workshop application deadline in December (next is TBD)
- Find the Chemistry Division at:
 - CHE Website
 - Quarterly newsletter
 - NSF Chemistry Tumblr

<http://nationalsciencefoundation.tumblr.com/tagged/chemistry>





Division of Materials Research (DMR)



Where Materials Begin & Society Benefits



DMR Activities

Topical Materials Research Programs (TMRPs)

Biomaterials
Ceramics
Electronic & Photonic Materials
Metals and Metallic Nanostructures
Polymers

Condensed Matter & Materials Theory
Condensed Matter Physics
Solid State and Materials Chemistry

Cross-Cutting Activities

Diversity
International
Education

Centers & Teams

Materials
Research
Science &
Engineering
Centers
(**MRSEC**)

Partnerships in
Research &
Education in
Materials
(**PREM**)

Designing Materials
to Revolutionize &
Engineer our Future
(**DMREF**)

National Facilities & Instrumentation Program

Cornell High Energy Synchrotron
Source (CHESS)

National High Magnetic Field
Laboratory (NHMFL)

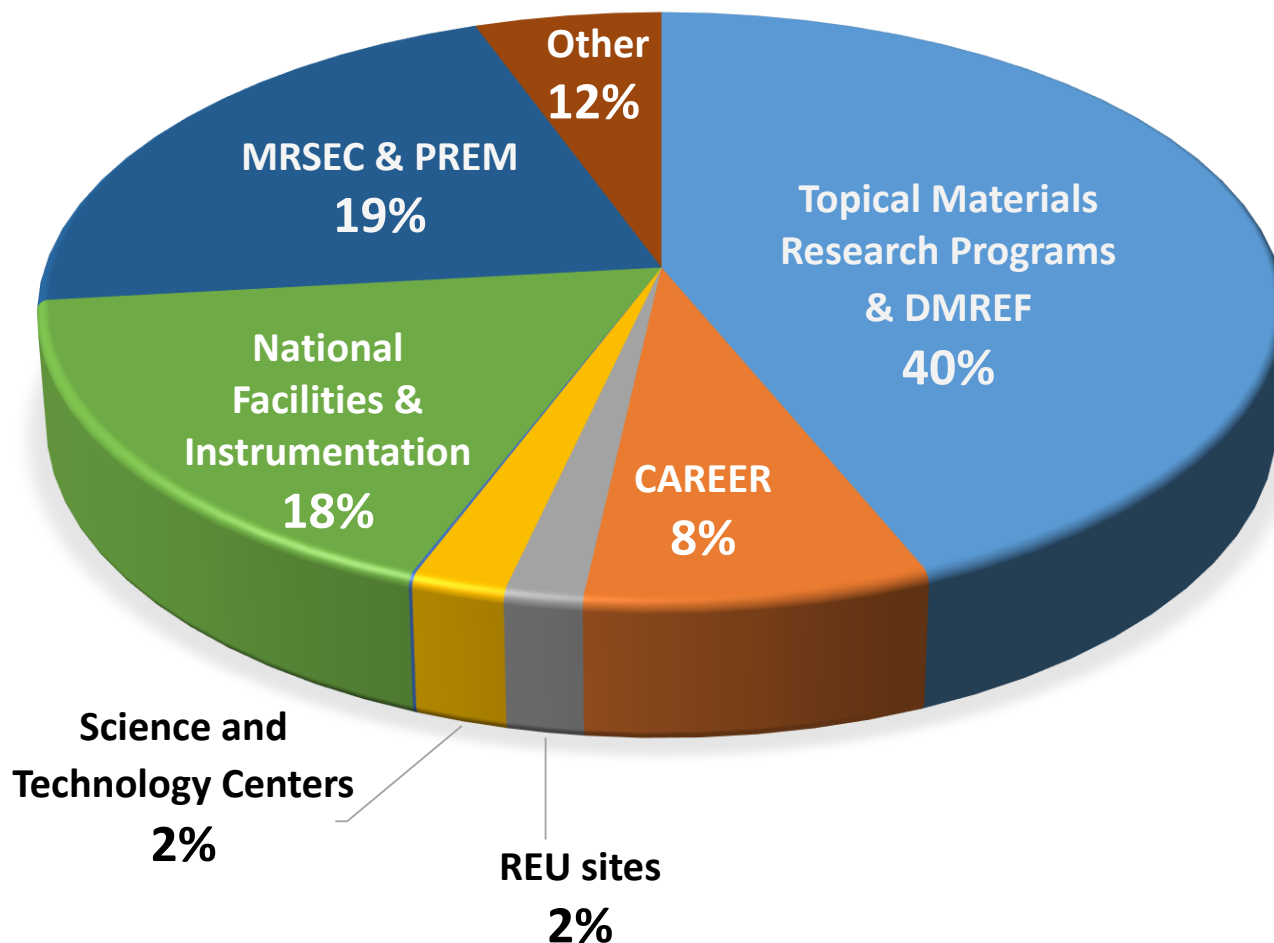
Center for High Resolution
Neutron Scattering (CHRNS)

National Nanotechnology
Coordination Network (NNCI)

Materials Innovation Platforms (**MIP**)



DMR Budget Distribution



FY16 \$310M
FY17 \$314M
FY18R \$283M
FY19R \$295M

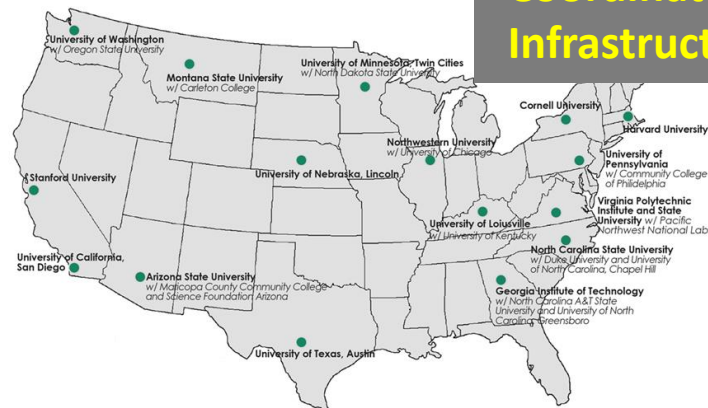


DMR Facilities & Instrumentation

**Cornell High Energy
Synchrotron Source
(Cornell, Ithaca)**



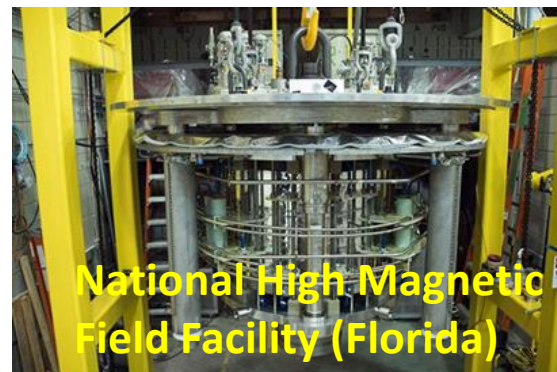
**National
Nanotechnology
Coordinated
Infrastructure**



**Center for High
Resolution Neutron
Scattering (NIST, MD)**

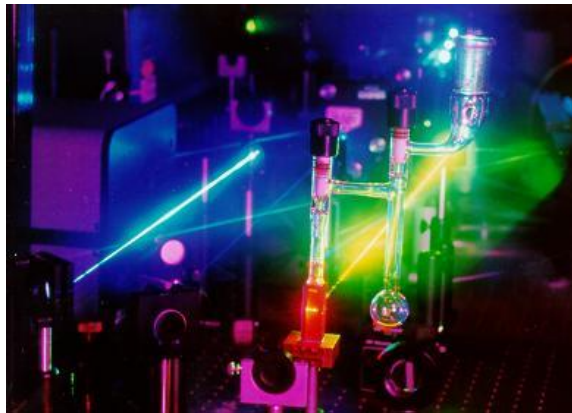


**National High Magnetic
Field Facility (Florida)**





Major Instrumentation Program (MRI)

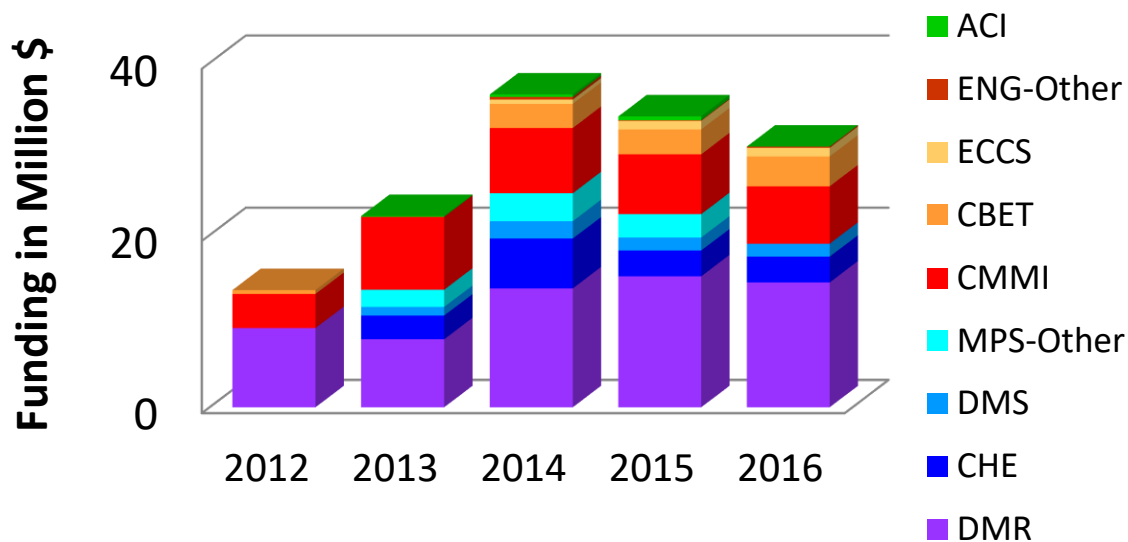


- **Next Deadline:** January 2020
- **Restrictions on organization submission eligibility**
- **Submission limit** - Three (3) per organization
- **Awards** - up to \$4M for development or acquisition proposals
- **Cost-sharing** at the level of 30% of the *total project cost* is required for Ph.D.-granting institutions and non-degree-granting organizations
- **Merit Review** - At the time of submission, PI's are asked to identify an NSF division(s) to review proposal. NSF reserves the right to place proposals in the appropriate division(s) for review.
- **New Solicitation: NSF 18-513**



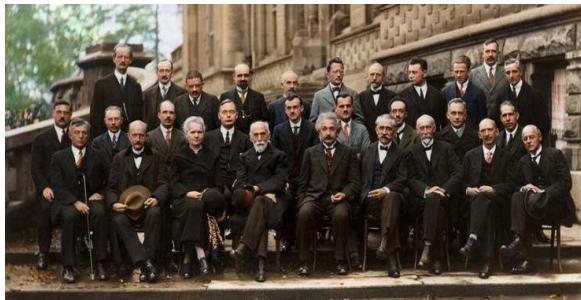
Designing Materials to Revolutionize & Engineer our Future (DMREF)

- Major program in DMR
- The program by which NSF participates in the Materials Genome Initiative (MGI) for Global Competitiveness
- Build the fundamental knowledge base needed to progress towards designing and making a material with a specific and desired function or property from first principles.

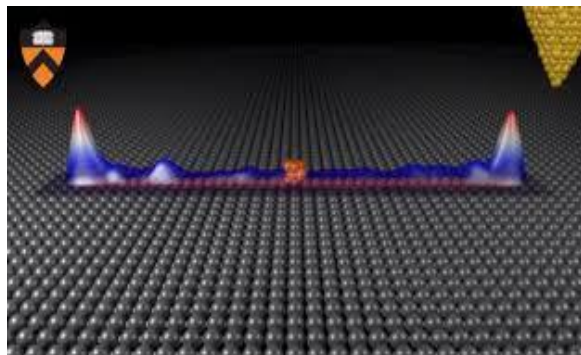




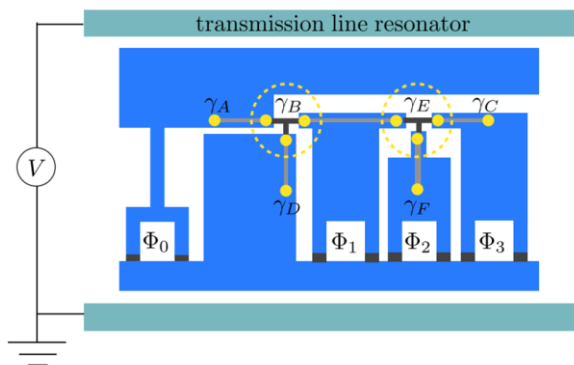
Quantum Leap: Leading the Next Quantum Revolution



A plan to build on the First Quantum Revolution in early 20th century and prepare for the Second one exploiting quantum phenomena like superposition, entanglement, and squeezing to enable the next wave of precision sensors and more efficient computation and simulation and communication



*EU, Netherlands, UK,
China, Japan, Canada...
investing in development
of quantum technologies.*



NSF would support research that addresses the manipulation of quantum states and the control of material light interactions involving physicists, mathematicians, and engineers. There will be strong connections to industry, other federal agencies, and international partnerships.



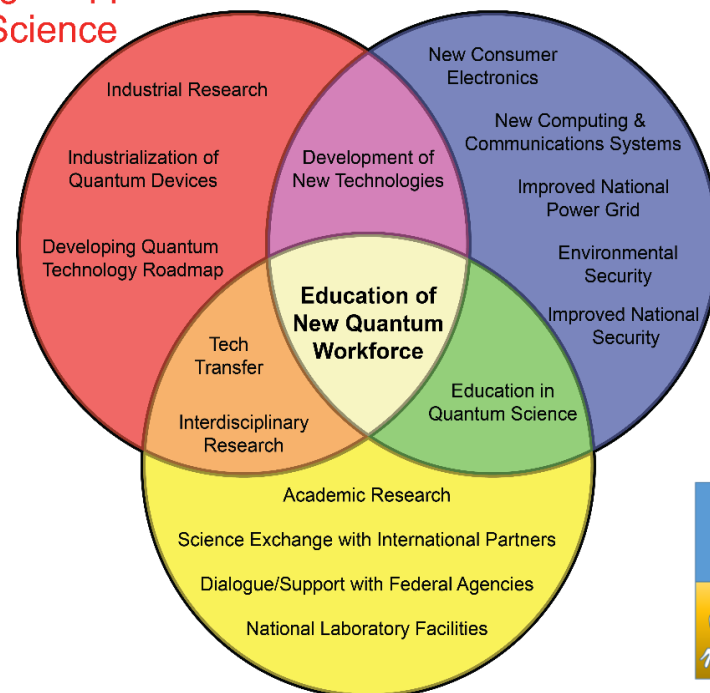
Quantum Leap: NSF/DOE Summer School on Quantum Science

Summer School

Sources of funding	NSF: Convergence DCL + individual Divisions: \$700k DOE/BES: \$300k
Organizing Team	Joe Checkelsky (MIT) Natalia Drichko (Johns Hopkins) Liang Fu (MIT) Kyle Shen (Cornell) Jun Zhu (Penn State)
Locations and Dates	Tentative Location and Dates Johns Hopkins University: June 5-16, 2017 Cornell University: June 18-30, 2018 Penn State University: June 9-21, 2019 University of Colorado: 2020
Rationale	Train transdisciplinary workforce for the second quantum revolution driven by convergence of multiple disciplines
Participants	50 Graduate Students and early-career Postdocs

Engineering & Applied
Quantum Science

Quantum Science
and Society



Fundamental
Quantum Science



Directorate for Mathematical and Physical Sciences



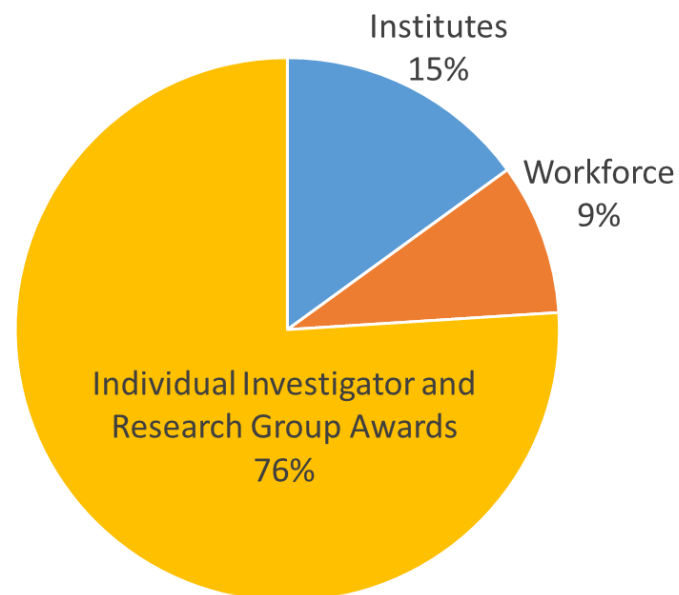
Division of Mathematical Sciences (DMS)



Mathematical Sciences (DMS)

DMS supports research covering the entire mathematical sciences spectrum

- Individual-investigator grants
 - Disciplinary programs (unsolicited)
 - Special Research programs (solicited)
- Mathematical Sciences Institutes:
 - National infrastructure and Community Resource:
- Workforce: Training the next generation of researchers
 - Postdoctoral fellowships
 - Research training groups
 - Research experiences for undergraduates





DMS Major Investment Areas





DMS Major Investment Areas

Disciplinary

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





DMS Major Investment Areas

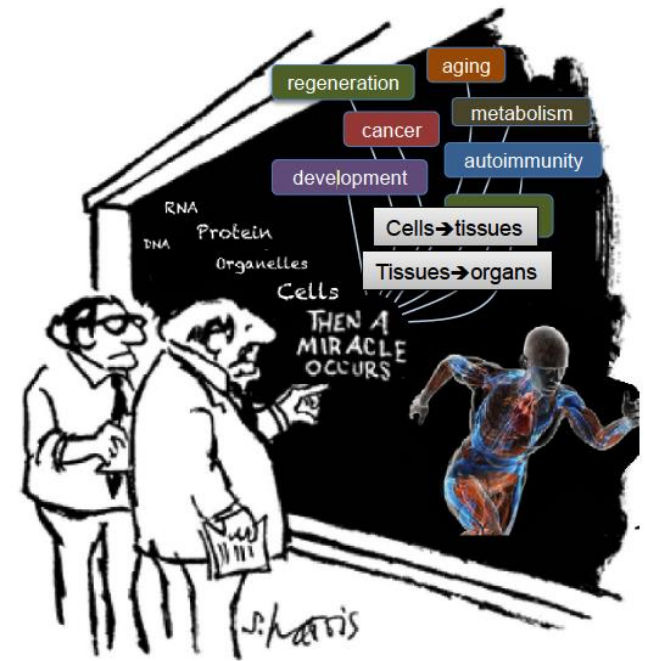
Interdisciplinary

- NSF/NIH Joint Initiative in Math Biology: supporting research at the interface of the mathematical and biological sciences (DMS/NIGMS)
- Algorithms for Threat Detection (ATD) partnership with the National Geospatial Intelligence Agency (NGA).
- Secure & Trustworthy Cyberspace (SaTC)
- Computational and Data-Enabled Science and Engineering in Mathematical and Statistical Sciences
- NSF wide BIGDATA program
- Transdisciplinary research in Foundations of Data Science (TRIPODS)



NSF-Simons Research Centers for Mathematics of Complex Biological Systems

- Five year, \$30M program funded equally by NSF and Simons Foundation
- 3 NSF Divisions: Mathematical Sciences, Integrative Organismal Systems, Molecular and Cellular Biosciences
- Support mathematical approaches aimed at understanding:
 - the complex causal relationships leading to emergent properties of molecular, cellular and organismal systems, or
 - to the emergent properties resulting from the complex integration across these levels of organization at different time scales
- Close, sustained collaborations between biologists and mathematical scientists that leverage their complementary expertise



"I think you should be more explicit here in step two."



Division of Physics (PHY)

Directorate for Mathematical and Physical Sciences



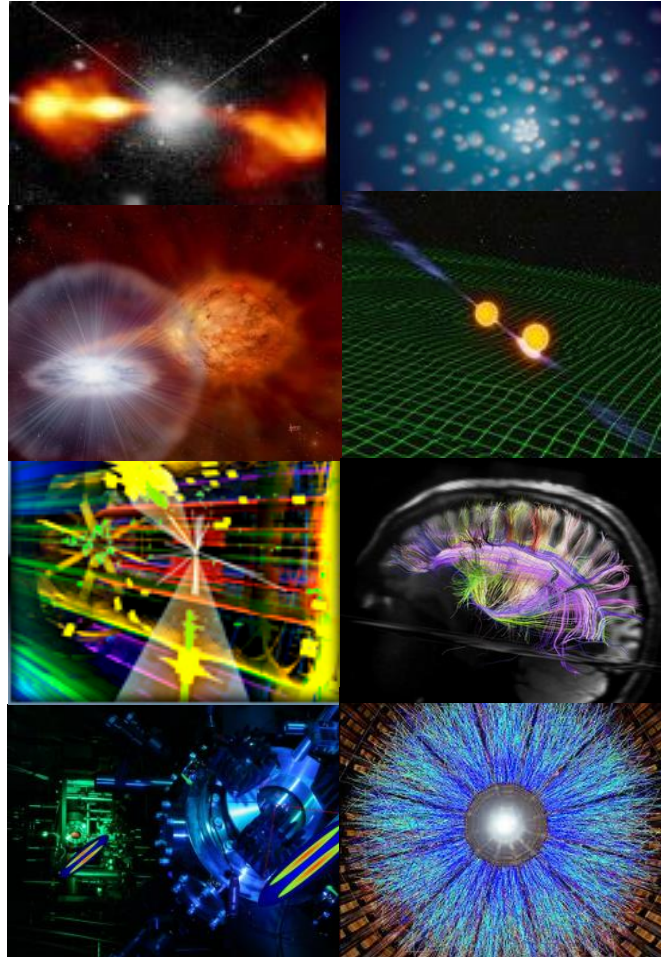
Physics Division – A Broad, Rich and Diverse Research Portfolio

Hot – Active Galactic Nuclei Produce High Energy Cosmic Rays in Pierre Auger Observatory

Large – Nucleosynthesis in Accreting White Dwarfs at JINA

Non-Living – Proton-Proton Collisions at CERN

New – Quantum Network at CalTech



Cold – Ultracold Molecules at JILA

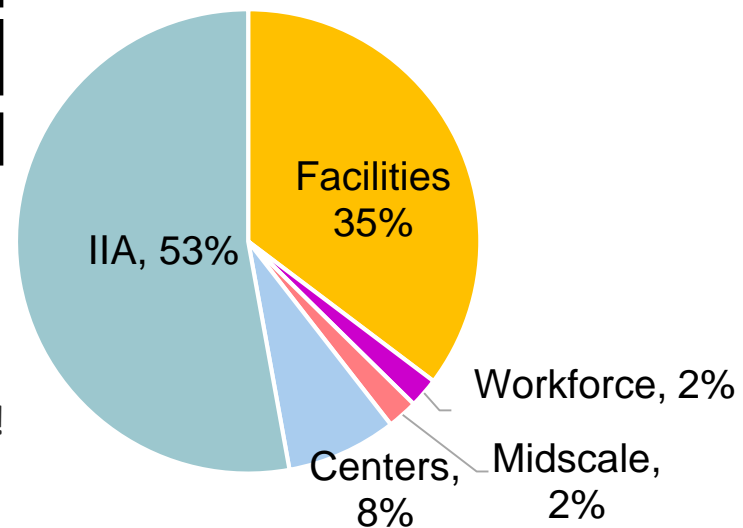
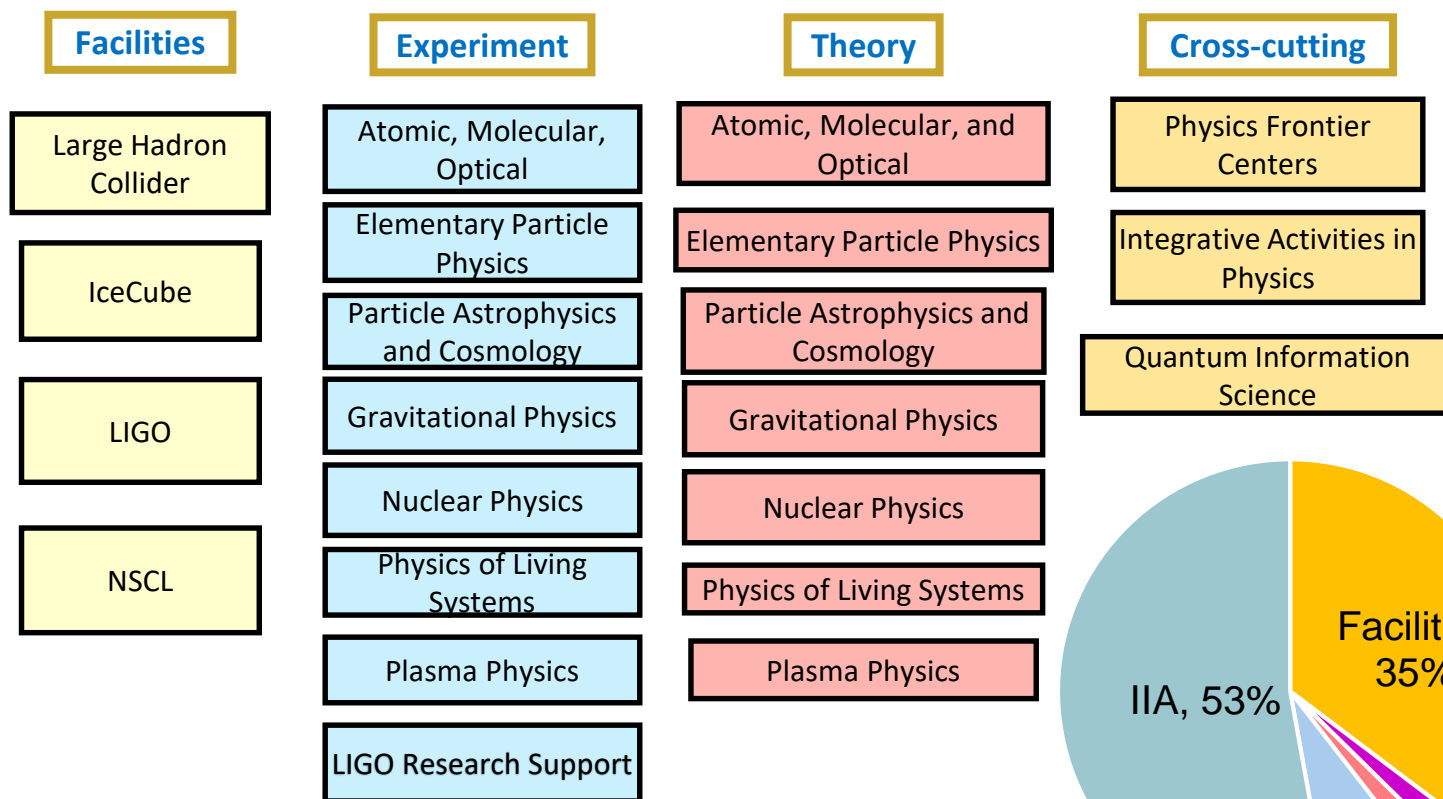
Small – Inspirals Produce Space-Time Distortion Less than Diameter of Proton in LIGO

Living – Brain Wave Images with Diffusion MRI

Old – Big-Bang Soup Recreated in Quark-Gluon Plasma at RHIC



PHY Portfolio



Note: Condensed-Matter Physics is within DMR, not PHY!



PHY Major Facilities





Investigator-Initiated Research Projects

Solicitation 18-564

<https://www.nsf.gov/pubs/2017/nsf17561/nsf17561.pdf>

Be aware:

- Does not override existing solicitations such as RUI, CAREER, REU sites, etc.
- Deadlines instead of target dates and separate deadlines for different Physics programs

Full Proposal Deadlines (due by 5 p.m. submitter's local time):

First Tuesday in December: Nuclear Physics - Experiment and Theory; Elementary Particle Physics - Experiment; Particle Astrophysics – Experiment; Computational Physics

Fourth Wednesday in November: AMO - Theory and Experiment; Gravitational Physics - Theory and Experiment; LIGO Research Support; Integrative Activities in Physics

Second Tuesday in December: Elementary Particle Physics - Theory; Particle Astrophysics and Cosmology – Theory; Physics of Living Systems; Quantum Information Science

Physics Frontiers Centers: Preliminary Proposal Due Date(s) (*required*) August 01, 2019

Full Proposal Deadline(s) January 30, 2020 by invitation only



Still have questions?

Ask early, ask often!

All NSF personnel are listed online. If uncertain about whom to contact, **Deputy Division Directors (below)** may be able to recommend appropriate individuals in their Divisions.

AST: Ralph Gaume, rgaume@nsf.gov, (703) 292-2335
CHE: Lin He, lhe@nsf.gov, (703) 292-4956
DMR: Clark Cooper, ccooper@nsf.gov, (703) 292-7899
DMS: Tie Luo, tluo@nsf.gov, (703) 292-8448
PHY: Jean Cottam Allen, jcallen@nsf.gov, (703) 292-8783