



National Science Foundation Mathematical and Physical Sciences Update

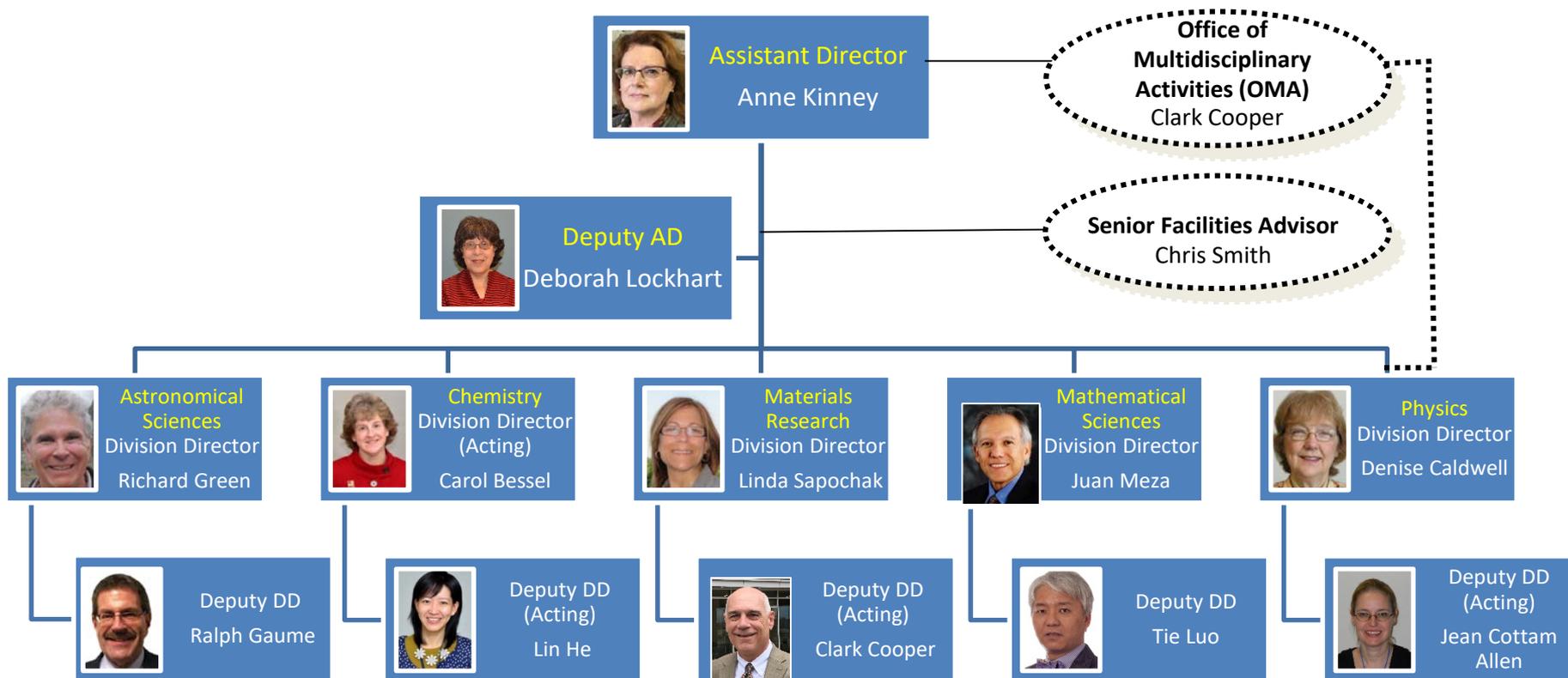
Nuclear Science Advisory Committee
Meeting
November 2, 2018

Deborah Lockhart
Deputy Assistant Director
Directorate for Mathematical and Physical Science



Directorate for Mathematical and Physical Sciences

As of 8/13/18



2018 Awardees Funded by NSF/MPS



2018 Nobel Laureates in Physics

Nobel Prize in Chemistry

- Frances Arnold

Nobel Prize in Physics

- Gérard Mourou

Fields Medal

- Alessio Figalli
- Akshay Venkatesh

Gauss Prize

- David Donoho

MacArthur Fellow

- Clifford Brangwynne
- Allan Sly





FY 2019 NSF Request \$7,472 M

**NATIONAL SCIENCE FOUNDATION
SUMMARY TABLE
FY 2019 BUDGET REQUEST TO CONGRESS**
(Dollars in Millions)

NSF by Account	FY 2017 Actual	FY 2018 Annualized CR	FY 2019 Request	FY 2019 Request change over FY 2017 Actual	
				Amount	Percent
Research & Related Activities	\$6,006.51	\$5,992.67	\$6,150.68	\$144.17	2.4%
Education & Human Resources	\$873.37	\$874.02	\$873.37	-	-
Major Research Equipment & Facilities Construction	\$222.78	\$207.58	\$94.65	-\$128.13	-57.5%
Agency Operations & Award Management	\$382.06	\$327.76	\$333.63	-\$48.43	-12.7%
National Science Board	\$4.27	\$4.34	\$4.32	\$0.05	1.2%
Office of Inspector General	\$15.10	\$15.10	\$15.35	\$0.25	1.6%
Total, NSF	\$7,504.10	\$7,421.47	\$7,472.00	-\$32.10	-0.4%



FY 2019 MPS Request \$1,345 M

MPS Funding

(Dollars in Millions)

	FY 2017 Actual	FY 2018 Current Plan	FY 2019 Request	Change over FY 2017	
				Amount	Percent
Astronomical Sciences (AST)	\$252.05	\$307.26	\$230.69	-21.36	-8.5%
Chemistry (CHE)	246.24	245.74	230.58	-15.66	-6.4%
Materials Research (DMR)	314.31	337.31	295.05	-19.26	-6.1%
Mathematical Sciences (DMS)	233.54	236.51	218.82	-14.72	-6.3%
Physics (PHY)	281.43	310.84	266.73	-14.70	-5.2%
Multidisciplinary Activities (OMA)	34.86	60.27	103.45	68.59	196.8%
Total	\$1,362.43	\$1,497.93	\$1,345.32	-17.11	-1.3%

- OMA delta reflects MPS Stewardship of Big Ideas: \$60M
- FY 2018 Actuals not yet available



NSF's 10 Big Ideas

RESEARCH IDEAS

<p>HARNESSING THE DATA REVOLUTION</p>	<p>Work at the Human-Technology Frontier: Shaping the Future</p>	<p>Windows on the Universe: The Era of Multi-messenger Astrophysics</p>	<p>The Quantum Leap: Leading the Next Quantum Revolution</p>
<p>Harnessing Data for 21st Century Science and Engineering</p>	<p>Navigating the New Arctic</p>		<p>Understanding the Rules of Life: Predicting Phenotype</p>

PROCESS IDEAS

<p>Mid-scale Research Infrastructure</p>	<p>NSF 2026</p>
<p>Growing Convergence Research at NSF</p>	<p>NSF INCLUDES: Enhancing STEM through Diversity and Inclusion</p>

Proposed FY 2019 Funding for NSF Big Ideas



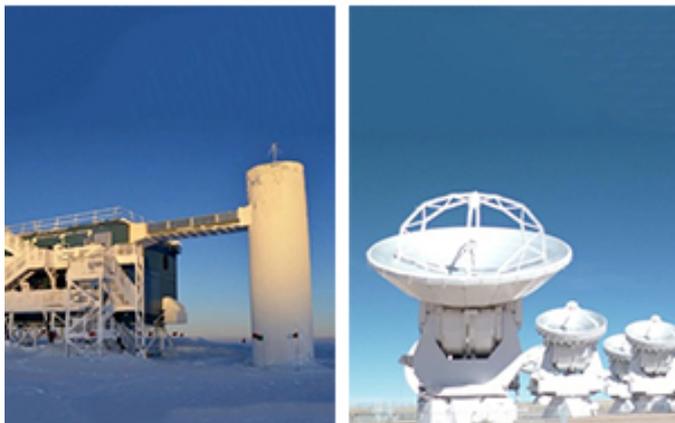
(Dollars in Millions)

Big Ideas	FY 2019 Request
Research Ideas	\$180.00
Harnessing the Data Revolution for 21st- Century Science and Engineering - HDR (CISE/ITR) ¹	30.00
Navigating the New Arctic - NNA (GEO/ICER)	30.00
The Future of Work at the Human-Technology Frontier - FW-HTF (ENG/EFMA) ¹	30.00
The Quantum Leap - QL (MPS/OMA)	30.00
Understanding the Rules of Life - URoL (BIO/EF)	30.00
Windows on the Universe - WoU (MPS/OMA)	30.00
Process Ideas	\$102.50
Growing Convergence Research - GCR (IA)	16.00
Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science - NSF INCLUDES (EHR)	20.00
Mid-Scale Research Infrastructure (IA)	60.00
NSF 2026 Fund (IA)	6.50
Total, NSF Big Ideas	\$282.50



PD 18-5115 July 31, 2018

Program Description: Windows on the Universe: The Era of Multi-Messenger Astrophysics



- Proposals submitted to participating programs in MPS/AST, MPS/PHY and GEO/OPP.
- Proposals funded through “Big Idea” allocation as well as existing programs.
- Criteria: any area of research supported through the participating divisions that address at least one of the following:
 - *Coordination:* Hardware, software, or other infrastructure to coordinate observations involving more than one messenger.
 - *Observations:* Observations of astrophysical objects or phenomena that are potentially sources of more than one messenger, including the use of existing observatories, experiments, and data archives, as well as the development and construction of new capabilities for advancing multi-messenger astrophysics.
 - *Interpretation:* Theory, simulations and other activities to understand or interpret observations of astrophysical objects that are sources of more than one messenger.

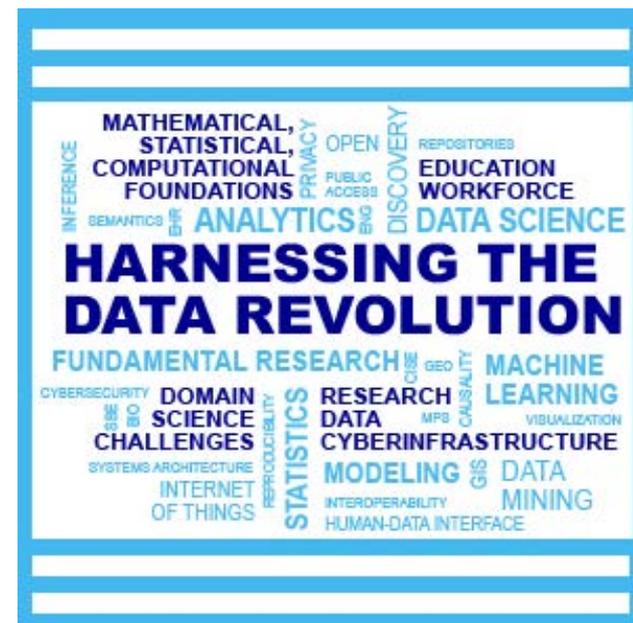
https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505593



Harnessing the Data Revolution

Engaging NSF's research community in the pursuit of fundamental research in data science and engineering, the development of a cohesive, federated, national-scale approach to research data infrastructure, and the development of a 21st-century data-capable workforce.

- Research – across all NSF Directorates
- Educational pathways – Innovations grounded in an education-research-based framework
- Advanced cyberinfrastructure – accelerating data-intensive research
- **Currently 4 funding opportunities:**
 - Critical Techniques, Technologies and Methodologies for Advancing ... (BIGDATA)
 - Cyberinfrastructure for Sustained Scientific Innovation (CSSI)
 - Resource Implementations for Data Intensive Research in SBE Sciences (RIDIR)
 - Partnerships between S & E Fields and the NSF TRIPODS Institutes (TRIPODS +X)



<https://www.nsf.gov/cise/harnessingdata/>

Quantum Leap

Exploiting quantum mechanics to observe, manipulate, and control the behavior of particles and energy at atomic and subatomic scales, resulting in next-generation technologies for sensing, computing, modeling, and communicating.

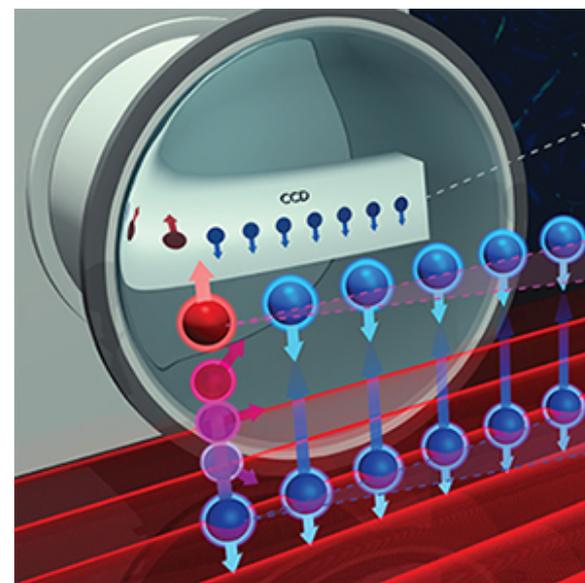
Today:

- Lasers, atomic clocks, GPS, semiconductors, storage media

Tomorrow:

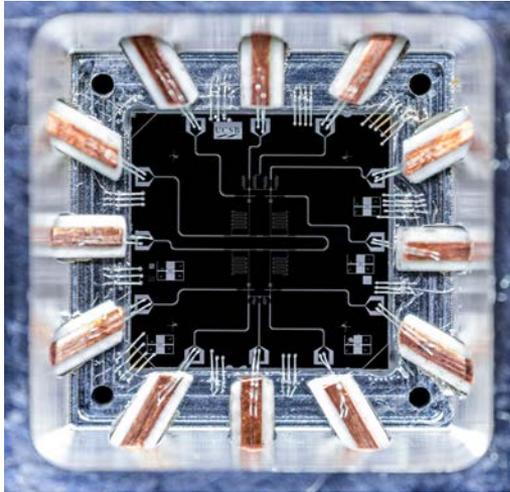
- Ultra- secure communication
- Ultra-precise sensing, measurement
- Quantum simulators
- Computing beyond the scale of supercomputing

https://www.nsf.gov/news/special_reports/big_ideas/quantum.jsp



NSF 18-035 December 14, 2017

Dear Colleague Letter: RAISE on Enabling Quantum Leap Transformational Advances in Quantum Systems



- **Research Advanced by Interdisciplinary Science and Engineering (RAISE) Awards**
 - 25 Projects awarded in September 2018
 - \$25 million overall
 - Broad array of research topics and support of future quantum workforce

RAISE: TAQS

- Innovative approaches, experimental demonstrations and transformative advances that will help lead to systems and proof-of-concept validations in quantum sensing, communication, computing, and simulations
- Intersections of multiple disciplines in areas such as physics, chemistry, mathematics, materials science, engineering, and computer/computational science



Bridging the Gap: Building a Sustained Approach to Mid-scale Research Infrastructure and Cyberinfrastructure at NSF

Report from the National Science Board in response to U.S House Appropriations Committee FY 2018 Report language about the gap between NSF's MRI Program and the MREFC account.

- Refers to NSF's October 2017 RFI

Responses	BIO	CISE	EHR	ENG	GEO	MPS	SBE	Total
Total	13	16	3	27	58	60	15	192
High Impact	2	7	1	5	33	36	2	86

- Four recommendations:
 - NSF should affirm and sustain the mid-scale Big Idea with a long-term agency-level commitment to mid-scale research infrastructure.
 - NSF should investigate the feasibility of using the MREFC account as one possible funding mechanism.
 - NSB and NSF should review existing infrastructure oversight and management structures to ensure compatibility with mid-scale range investments.
 - NSF, in cooperation with NSB, should develop an evaluation and assessment program to determine the full scope of the demand for mid-scale research infrastructure and ensure NSF's programs and processes address that demand.

NSF 19-013 October 15, 2018

Dear Colleague Letter: Mid-scale Research Infrastructure (Mid-scale RI) Opportunities



- Mid-scale RI is an NSF Big Idea to address the growing needs for RI to advance research.
 - NSF-wide program will support projects in the MRI – MREFC gap (~\$6 to \$70 million range).
 - RI is broadly defined, from disciplinary instrumentation to mid-scale facilities, upgrades, cyberinfrastructure, and others.
- NSF anticipates **two solicitations this fall**, pending the availability of funds: one for projects between ~\$6 M and ~\$20 M and one for ~\$20 - \$70 million.
 - Requirements: Strong scientific merit and responsive to identified community need; technical and management readiness; and plan for training and workforce diversity.

Stay tuned...

https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf19013



News Release 18-082 September 19, 2018

NSF announces new measures to protect research community from harassment

New term and condition "Notification Requirements Regarding Findings of Sexual Harassment, Other Forms of Harassment, or Sexual Assault" requires awardee organizations to notify NSF of:

- Any findings or determinations that an NSF-funded principal investigator or co-principal investigator committed harassment, including sexual harassment or sexual assault.
- The placement of the principal investigator or co-principal investigator on administrative leave, or of the imposition of any administrative action relating to a harassment or sexual assault finding or investigation.

NSF will consult with the awardee organization, and determine what action is necessary under NSF's authority. NSF actions may include substituting or removing principal investigators or co-principal investigators, reducing award funding, and – where neither of those options is available or adequate – suspending or terminating awards.

Effective October 22, 2018, new awards and funding amendments

https://www.nsf.gov/news/news_summ.jsp?cntn_id=296610