Committee on Increasing Diversity and Inclusion in the Leadership of Competed Space Missions Meeting

Sean L. Jones, PhD
Assistant Director
Mathematical and Physical Sciences
National Science Foundation
April 27, 2021

AGENDA

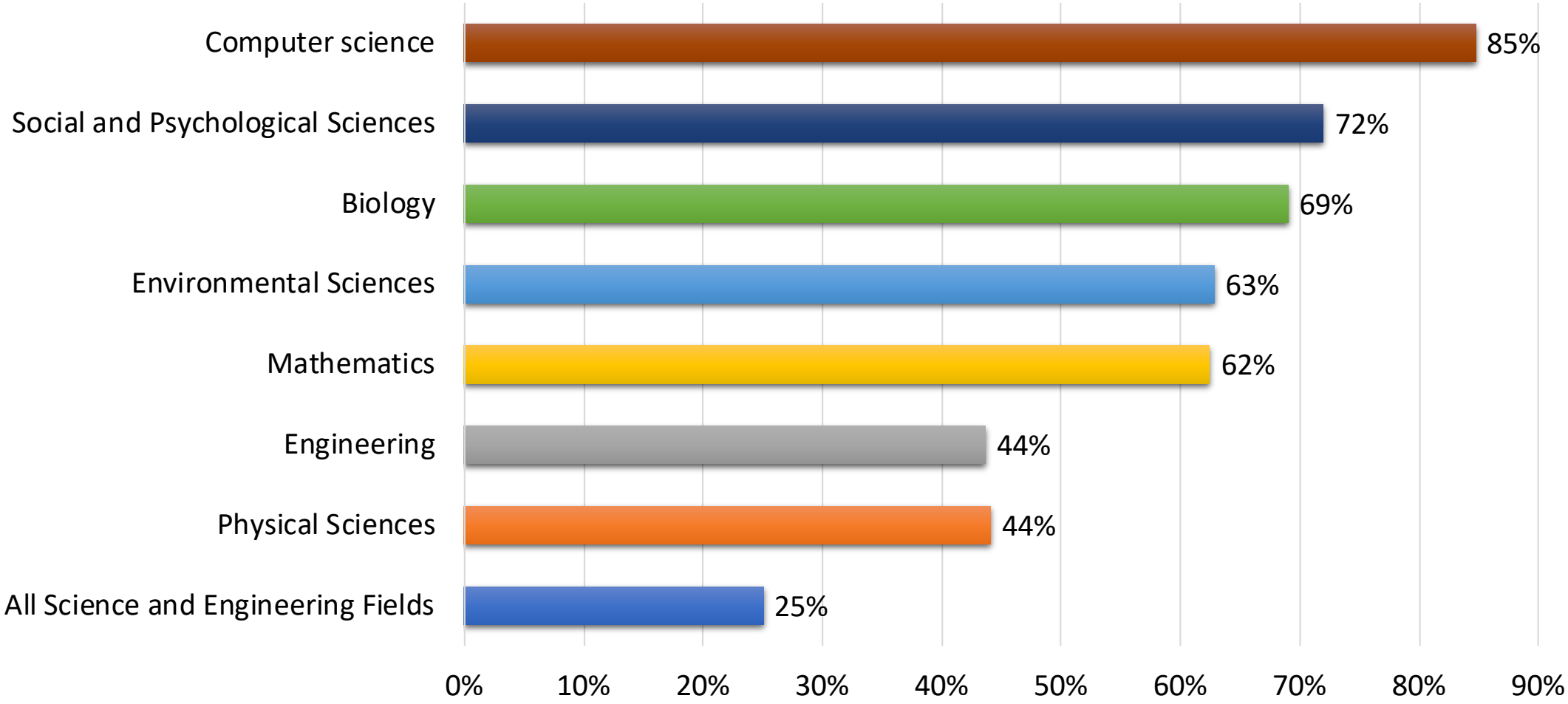
- Introduction to NSF
- Introduction to MPS
- Materials Research Science and Engineering Centers
- MPS and Broadening Participation Efforts
- Partnership for Research and Education in Materials

NSF Mission

“To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…”

NSF Support of Academic Basic Research in Selected Fields

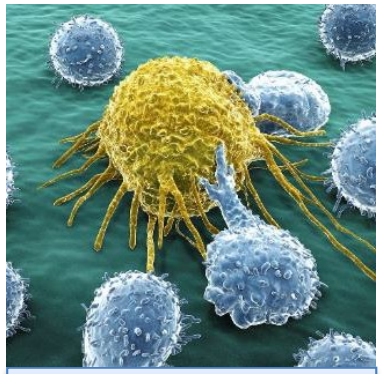
(as a percentage of total federal support, FY 2016)



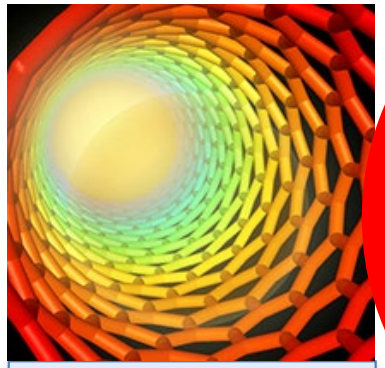
Note: Biology includes Biological Sciences and Environmental Biology. Biology and Psychological Sciences exclude National Institutes of Health funding from the total amount of federal support.

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

NSF Funds Research and Education across All Fields of Science and Engineering

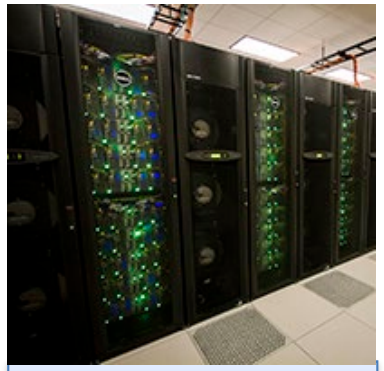


Biological Sciences



Engineering

Mathematical & Physical Sciences



Computer & Information Science & Engineering

Geosciences (including Polar Programs)

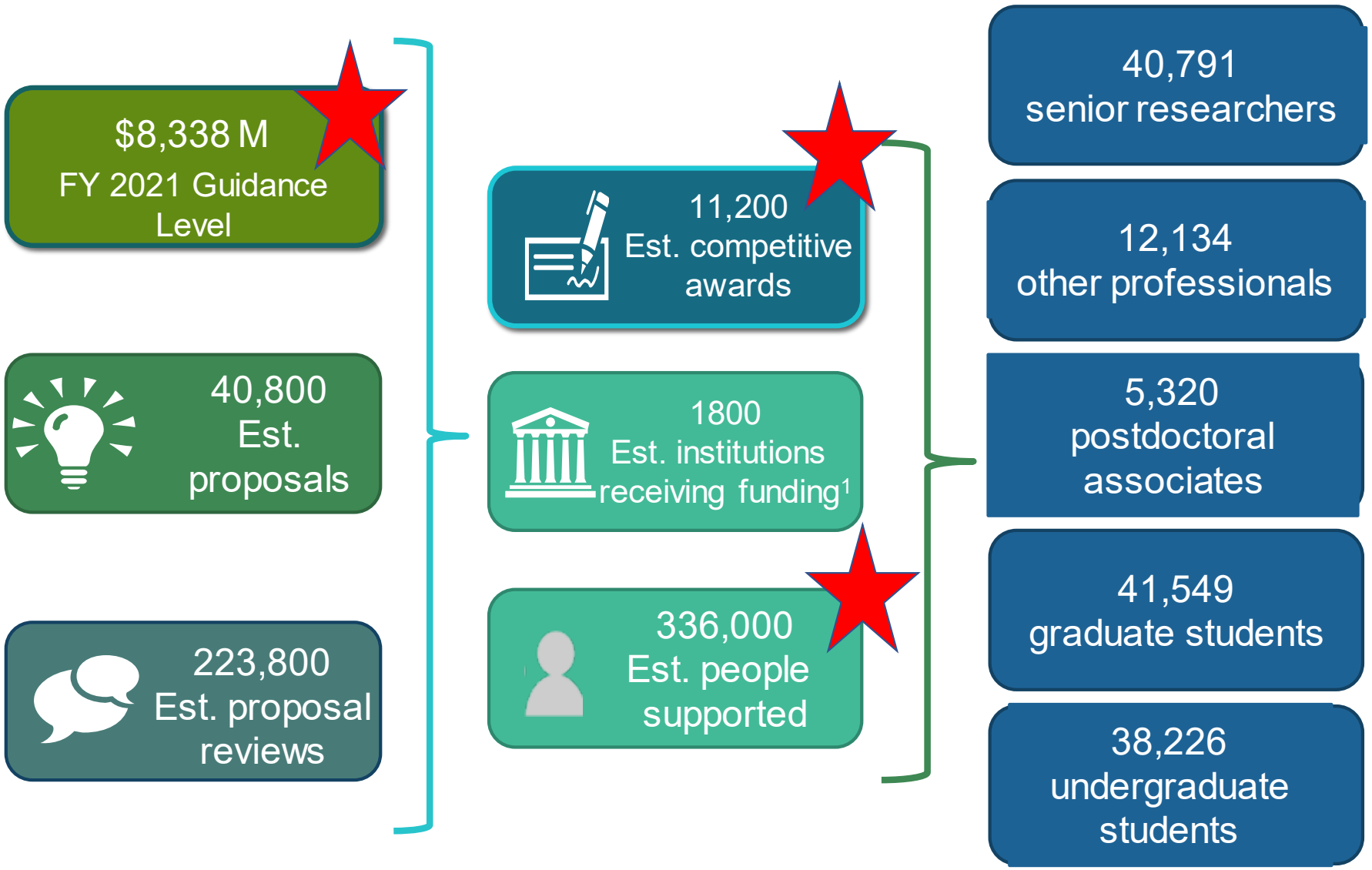
Integrative Activities

Education & Human Resources

Social, Behavioral & Economic Sciences

International Science & Engineering

NSF by the Numbers: It's all about the people

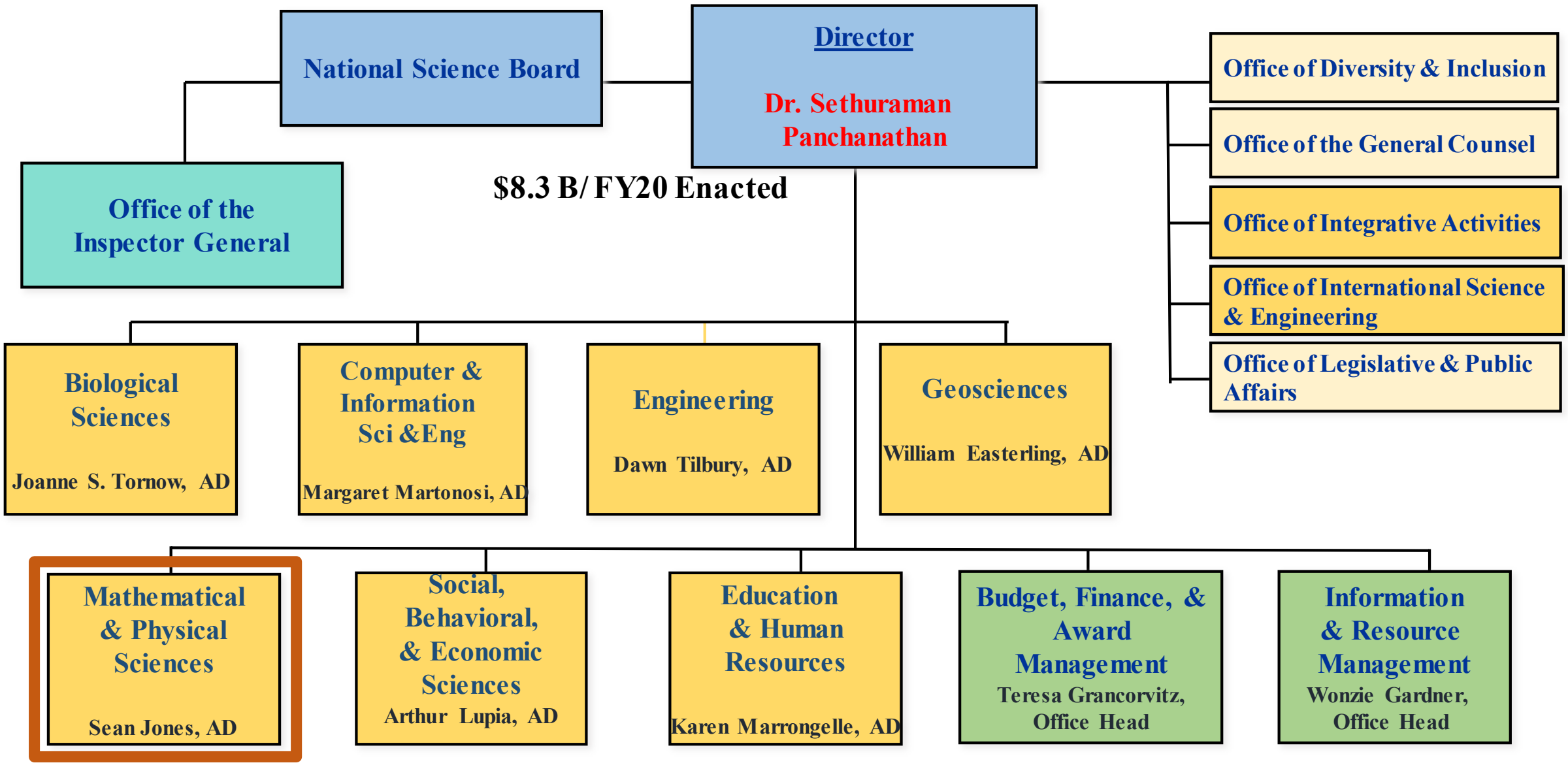


https://www.nsf.gov/pubs/2021/nsf21003/nsf21003.pdf

FY 2019 Numbers

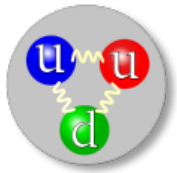
NSF by the Numbers: It's all about what they enable

National Science Foundation (NSF)



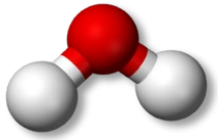
Science at the Scales of the Universe

Images from
Wikipedia Commons

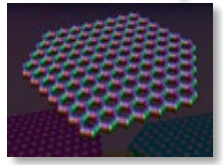


quarks

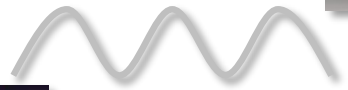
nuclei
proton



molecules
atoms



nanostructures
polymers
proteins



100 Hz
gravitational
wave

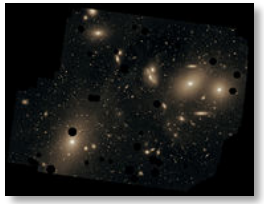
planets

Sun

solar
system

Crab
Nebula

galaxies
Milky Way



Virgo
cluster

observable
universe

10^{-20} 10^{-16} 10^{-12} 10^{-8} 10^{-4} 1 10^{4} 10^{8} 10^{12} 10^{16} 10^{20} 10^{24}

CHE, DMR

PHY

AST

DMS

DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES

[$1.49B]

Sean L. Jones, Assistant Director
Tie Luo, Deputy Assistant Director

Budget and Human Resources (BLG)
Amanda May, Directorate Operations Officer

Facility Oversight
Chris Smith, Senior Advisor for Facilities

Office of Multidisciplinary Activities [$35M]
Dean Evasius, OMA Head & Senior Science Advisor

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[$287.01M]

Ralph Gaume, Division Director
James Neff, Deputy (DDD)

Division of Chemistry (CHE)

[$247.27 M]

David Berkowitz, Division Director
Michelle Buschey, Acting DDD

Division of Materials Research (DMR)

[$302.99M]

Linda Sapochak, Division Director
Alexios Klironomos, DDD

Division of Mathematical Sciences (DMS)

[$237.03M]

Juan Meza, Division Director
Tracey Kimbrel, Acting DDD

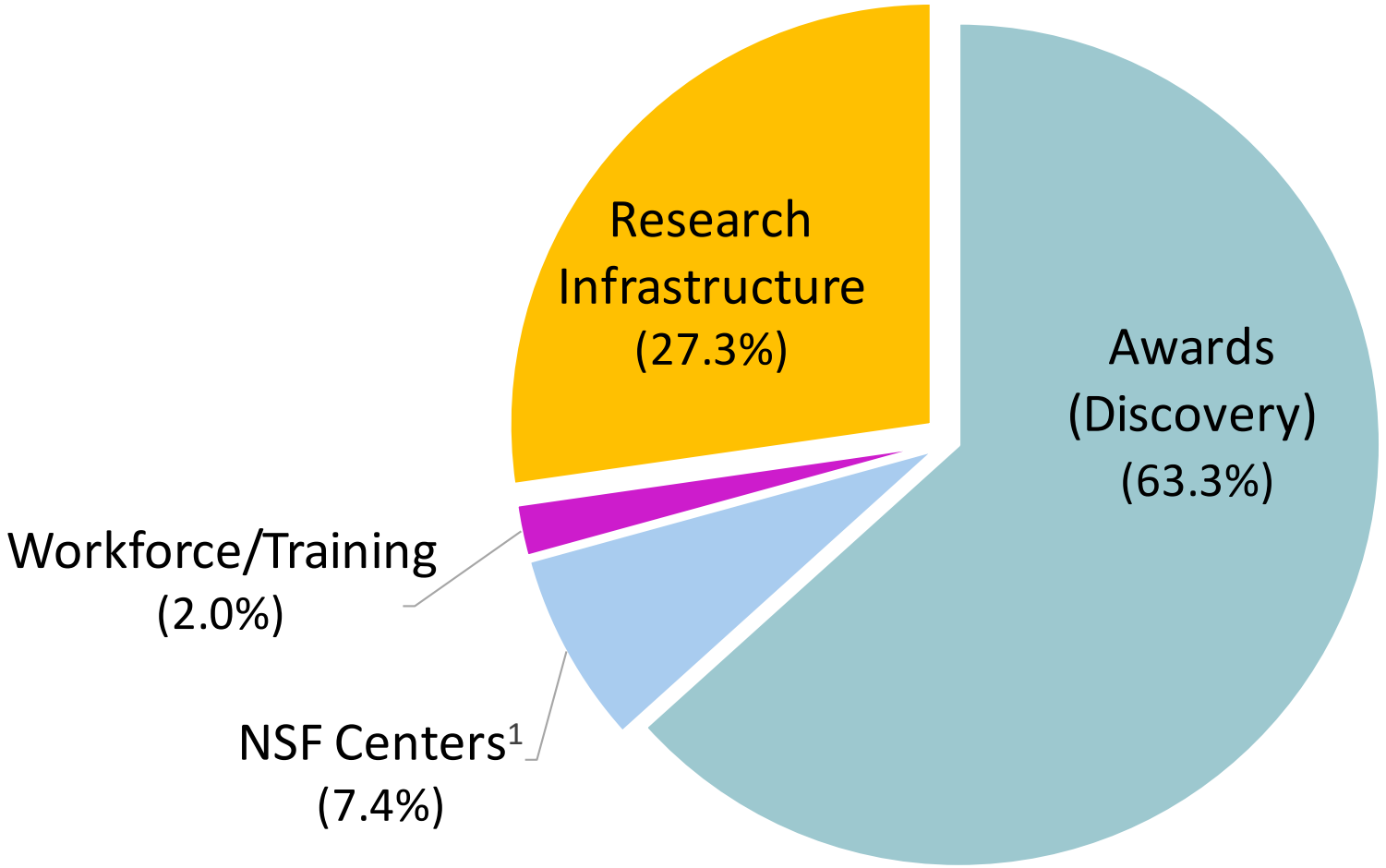
Division of Physics (PHY)

[$285.23M]

Denise Caldwell, Division Director
Jean Cottam Allen, DDD

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.

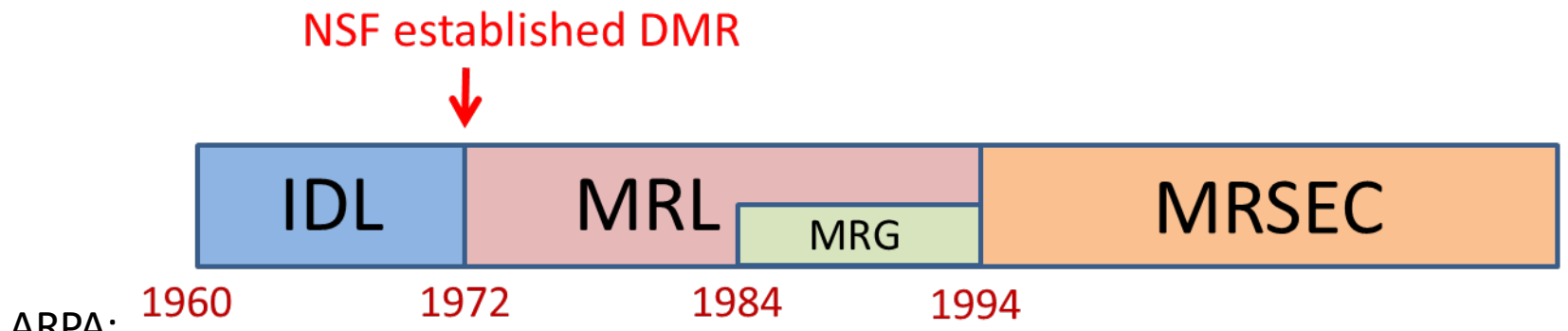
Mathematical and Physical Sciences Funding Distribution



Centers:

- Chemical Centers for Innovation (CCI)
- Physics Frontier Centers (PFC)
- Mathematical Sciences Research Institutes (MSRI)
- Materials Research Science and Education Centers (MRSECs)

History of the MRSEC Program



ARPA: Interdisciplinary Research Labs (IDL)

1985 Engineering Res Centers

1989 Science & Tech Centers

Nanoscale Science & Engineering Centers NSEC
2001

Physics Frontier Centers PFC
2002

Centers for Chemical Innovation CCI
2004

National Science Foundation
MRSEC
Materials Research Science and Engineering Centers

Materials Research Science and Engineering Centers
MRSECs - an overview

- MRSECs stimulate and support cutting-edge **interdisciplinary materials research and education** at a scope and complexity requiring a Center.
- MRSECs comprise 2-3 topically distinct core research units – **Interdisciplinary Research Groups (IRGs)**.
- Each IRG employs interdisciplinary research to address unique, **fundamental materials research problems** that are intellectually challenging and important to society.
- Research typically encompasses theory, synthesis, characterization, evaluation, and applications, and is conducted in a highly **synergistic** manner within an IRG.
- Six-year awards, Individual Center support from ~$1.6M to ~$4M/yr.
- **MRSECs do not "sunset", but can recompete.**
- Currently **19 active MRSECs**, comprising a total of **42 IRGs**. Total budget $56M/yr.

www.mrsec.org

Materials Research Science and Engineering Centers
Additional Considerations

The Center as a Whole – Focus on a few areas where the Center exhibits unique strengths, and matters that the new Center should pay particular attention to:

- **Seeds** and Emerging Areas: Selection Process; Transformative?
- Education and Human Resource Development: **Research & Education Integration**; Impact.
- **Diversity Strategic Plan**: Implementation? Diversity at all levels?
- Materials Research Facilities Network (MRFN) **Shared Experimental Equipment**: Access, use, and impact.
- **External Collaborations** with Industry, International, and other Sectors: Value added?
- Institutional Support, Management Plan, and Budget: Effective? Appropriate?

Materials Research Science and Engineering Centers
Additional Considerations

Seed projects

- All-inclusive internal competition
- ~10% of total MRSEC budget, 1-2 year projects, **1-2 PIs/Seed project**
- **Mechanism for drawing in and mentoring junior faculty as well as diversity**
- Enable testing high-risk/reward ideas and emerging areas
- Programs to link the university effort in materials research with industry, national laboratories, and other sectors
- Development of cyber infrastructure for remote access to instrumentation
- Development of innovative, interdisciplinary educational ventures
- Complementary to IRGs or to nucleate new IRGs

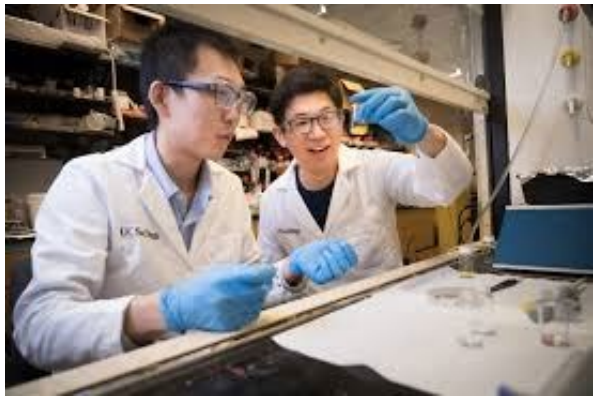
iSuperSeed supplemental projects

Awarded by the MRSEC Program, after internal competition, and subject to availability of funds. Main aim is to seed new IRGs; **3 or more PIs/project**.

Materials Research Facilities Network

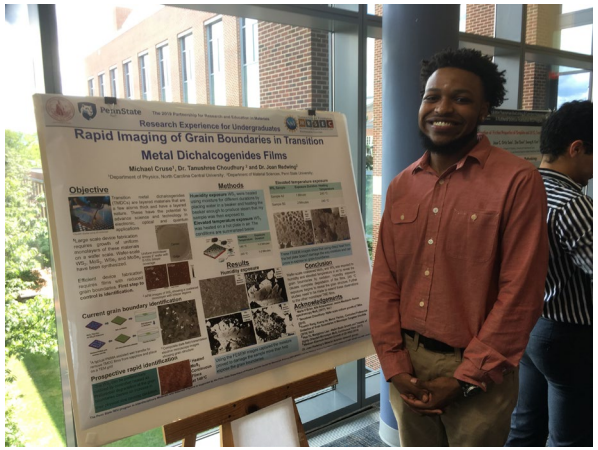
MRFN Stats:

19 Centers
1159 instruments
263 experts



Yearly Users of MRSEC Facilities

> 1380 Academic **(diversity)**
> 530 Industry
>50 National Labs



>700 Publications acknowledge MRSEC Facilities

75 MRSEC Technical Staff in SEFs
31 Other Technicians
51 Administrative Staff
37 Education Staff

MRFN Please visit https://mrfn.org/

The Impact of MRSECs in 2020

1132 publications total

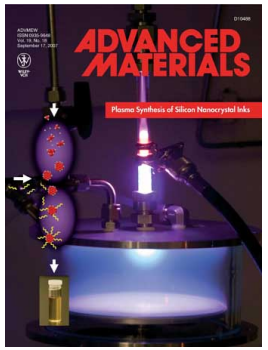
61 patents awarded

980 Publications acknowledged MRSEC SF in 2017

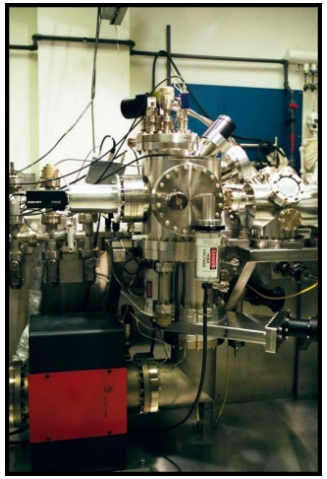
318 supported Postdocs

931 supported graduate students

151 supported UG students



Since 1985: 166 companies in 22 states plus 5 abroad employing ~ 2600 individuals; More than 1500 patents awarded in total



Review Process

1.Pre-proposal

- Intellectual Merit
- Broader Impacts
- Vision for the Center

2.Full proposal

❖ Initial down select

- Intellectual Merit
- Broader Impacts
- Vision for the Center
- Center-specific review criteria

3.Reverse Site Visit

❖ Comparison across Centers

- Vision for the Center
- Center Attributes

Post award Management

Immediate

- Cooperative Agreement (CA)
- Informal PD visit

Ongoing Program Management

- CA increment reliant on detailed Annual Report
- Site Visits with experts Yr2
- Site Visit with experts Yr4
- Annual Directors Meeting
- Education Directors Meeting

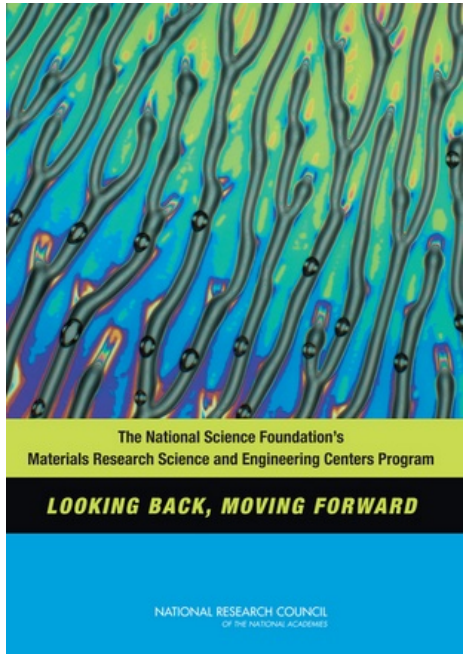
Program Monitoring

Continuous Improvement

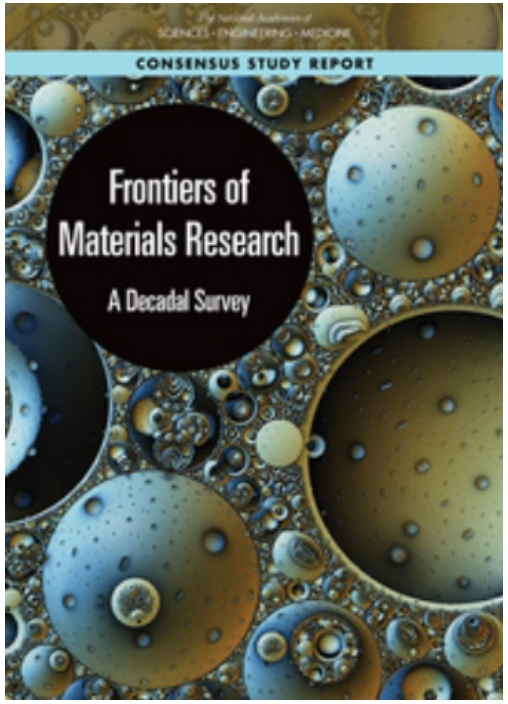
- Site Visits
- Annual Directors Meeting

- Committee of Visitors
- Advisory Committees
- External Input

Continual Improvement



Research Priorities: Community



Research Priorities: Agency and Administration

QIS

AI

Adv Wireless

Bio technology

Adv Mfg

MRSECs and Diversity

- During the proposal review process MRSECs are partially evaluated based on their Diversity Strategic Plan. In addition, implementation and efficacy of the Plan are addressed at annual reviews and site visits.
- MRSECs are expected to demonstrate a meaningful inclusion of participants from underrepresented groups: faculty, post-docs, graduate and UG students, and staff.
- MRSECs must describe plans to broaden participation at all levels. Include metrics for assessment and desired, attainable outcomes.

Some MRSEC diversity efforts

Wisconsin: Long-standing partnership with UPR Mayaguez: led to several UPR Faculty receiving their Ph.D.s from Wisconsin.

U Penn: MRSEC Diversity Committee (1) Faculty opportunity Fund: 50% of salary and 50% of startup for URM hires; (2) Penn PD Fellow: 50% support for URM; (3) Fontaine Fellows Society: full support for URM grad students. Many years partnership with UPR Humacao and UPRH PREM.

Harvard: Science and Cooking program: 18 Hopi Navajo spend 3-weeks on campus. Veterans participation. Seed funding for "little" PREM with Navajo College.

Minnesota: American Indian Day for High School and Middle School. PREM with UTRGV in its second term.

Ohio State: Innis Program, K-5 school, economically disadvantaged students. Scientific thinkers. Mansion Day School: 6-weeks after school program.

U Washington: Materials ALVA – a summer program for underrepresented and underserved students during their transfer summers, designed to enhance success and retention.

MRSECs and Diversity: How are we doing?

	Women	URM
Faculty	23%	6%
Post Docs	26%	5%
Grad Students	31%	7.5%
Undergrad Students (no REU)	40%	22%

However,
6 of 20 MRSECs do not have affiliated URM Faculty
13 of 20 MRSECs do not have a URM postdoc
1 of 20 MRSECs does not have a URM graduate student

MPS Broadening Participation Efforts Beyond MRSECs

MPS-wide Activities

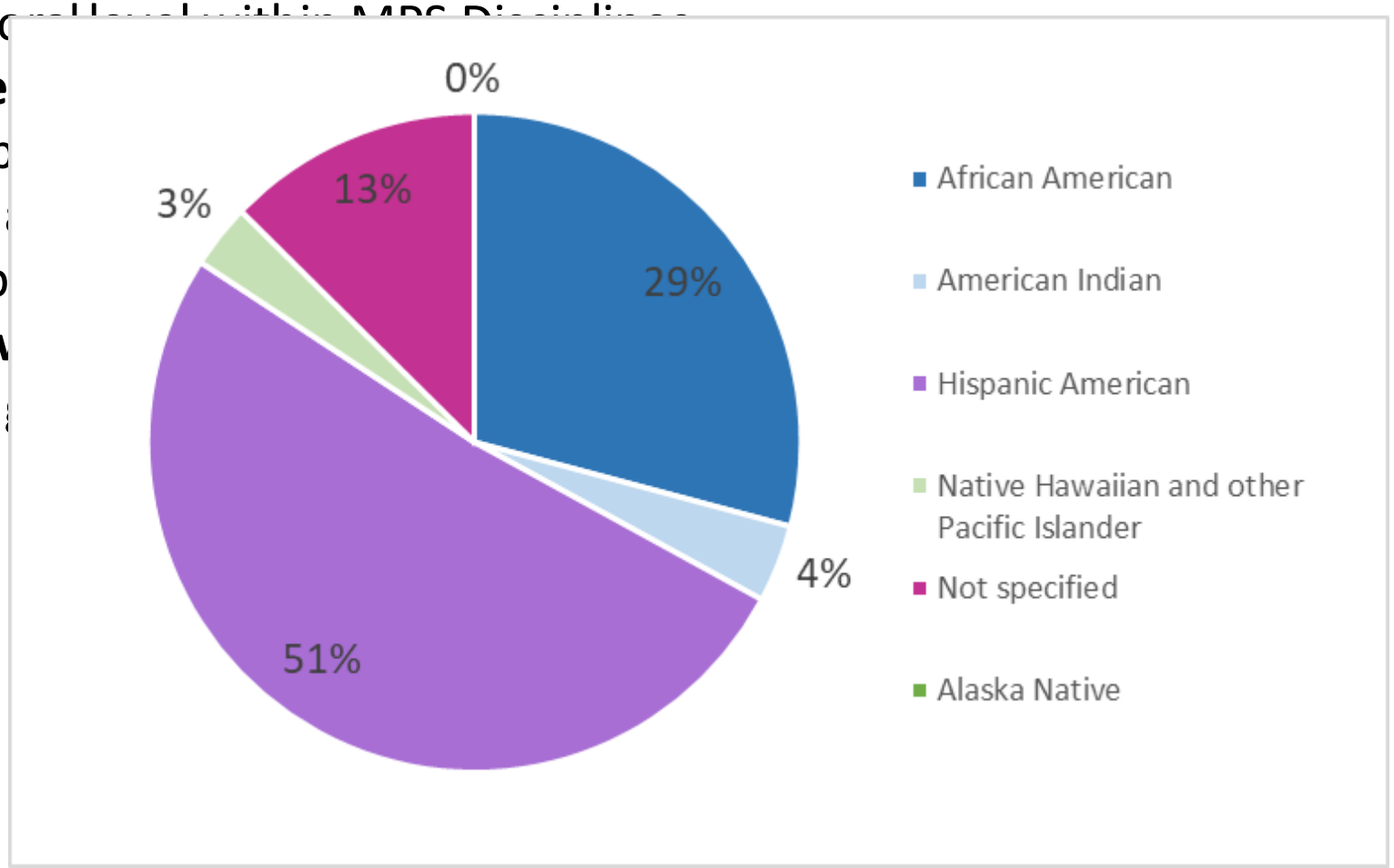
- Diversity Strategic Plans for all MPS Centers and Major Facilities
- MPS AGEP–Graduate Research Supplements (AGEP-GRS)
- MPS Graduate Research Supplement for Veterans (MPS-GRSV)
- INCLUDES Inclusive Graduate Education Network – Prof Societies (IGEN)
- Excellence in Research program- OIA/HBCU-UP (EiR)

❖Launching Early-Career Academic Pathways in the Mathematical and Physical Sciences: LEAPS-MPS (NSF 21-570)

❖Mathematical and Physical Sciences Ascending Postdoctoral Research Fellowships: MPS-Ascend (NSF 21-573)

MPS AGEP Graduate Research (AGEP-GRS) Fellows

- Collaboration between the NSF Alliances for Graduate Education and the Professoriate (AGEP) program in the Education and Human Resources(EHR) Directorate and MPS.
- The goal is to create an opportunity to engage **additional** students in research and **to improve diversity and retention** at the docto
- Supplement for a **current MPS rese**
- PIs requesting a supplement must b
  institution → access to mentoring
- Focused on broadening the particip
  Indians, Alaska Natives, Native Hav
- MPS supported **206** students throu



Towards A National Movement

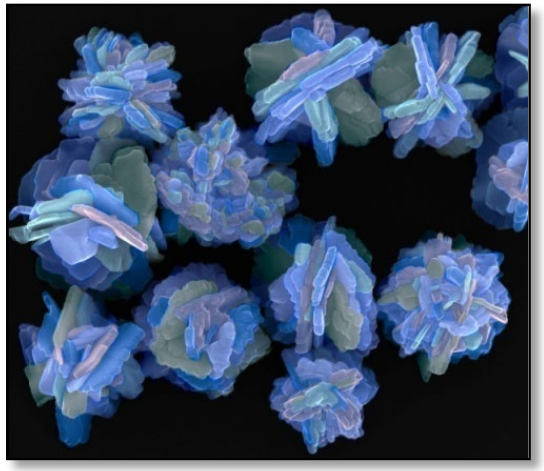
American Physical Society: (2011)
The APS Bridge Program is an effort with the National Science Foundation to increase the number of physics PhDs awarded to underrepresented minority (URM) students, including Black, Latinx, and Indigenous students. (award HRD - 1143070 co-funded between the Physics Division and the Division of Human Resource Development)

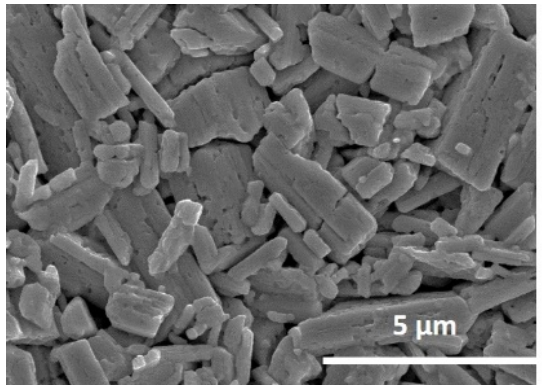
The **American Physical Society**, the **American Chemical Society**, the **American Geophysical Union**, the **American Astronomical Society**, and the **Materials Research Society:**
The Inclusive Graduate Education Network (IGEN) https://igenetwork.org/ seeks to dramatically increasing the number of physical science doctoral degrees earned by Black, Latinx and Indigenous students. Supported by the NSF INCLUDES program (Collaborative proposal HRD 1834516, 1834528, 1834540, 1834545 co-funded between the Physics Division and the Division of Human Resource Development)

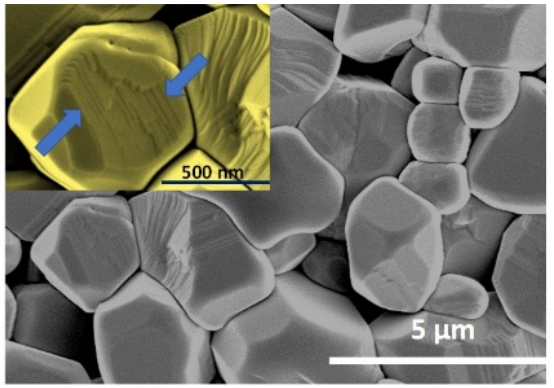
MPS Division Highlights

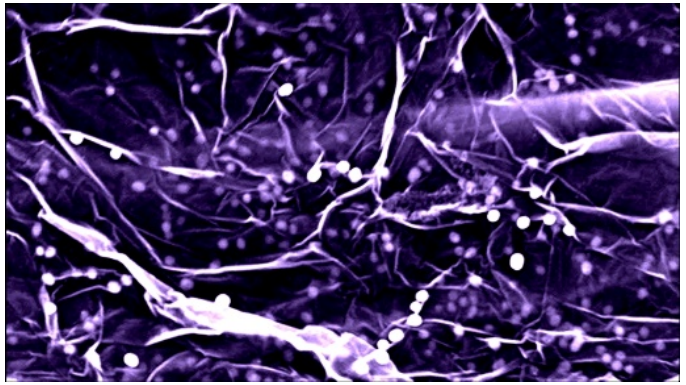
- AST: Astronomy & Astrophysics Postdoctoral Fellowships (AAPF)
- AST: Partnerships in Astronomy & Astrophysics Research and Education (PAARE)
- CHE: National GEM Consortium w/ PHY and ENG/CBET (GEM Partners)
- DMR: Partnerships for Research and Education in Materials (PREM)
- DMS: Mathematical Sciences Postdoctoral Research Fellowships (MSPRF)
- PHY: Growing a Strong, Diverse Workforce (supplements)

Partnerships for Research and Education in Materials (PREM)

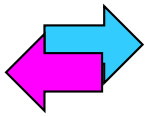








Partnership between Minority Serving Colleges & Universities and DMR-supported Centers and Facilities



Minority-Serving Colleges & Universities	DMR-Supported Centers & Facilities
• Hispanic Serving/High Hispanic Enrollment Institutions (HSI/HHE) • Historically Black Colleges and Universities (HBCUs) • Minority Serving Institutions (MSI) • Alaska Native Serving Institutions (ANSI) • Native American-serving non-Tribal Institutions and Tribal Colleges and Universities (TCU) • Native Hawaiian Serving Institutions (NHSI)	• Materials Research Science and Engineering Centers (MRSECs) • DMR supported Science and Technology Centers (STCs) • DMR supported Materials Innovation Platforms (MIP) • National High Magnetic Field Laboratory (NHMFL) • Cornell High Energy Synchrotron Source (CHESS) • Center for High Resolution Neutron Scattering (CHRNS)

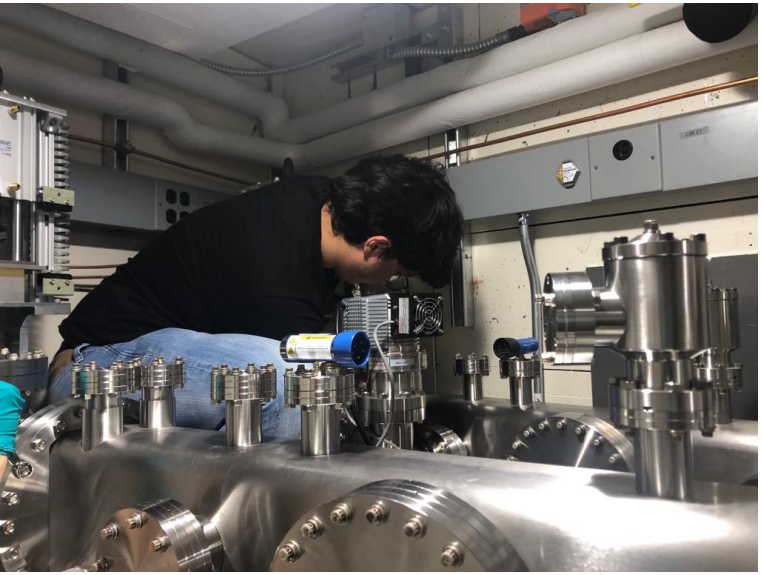
PREM Expectations

- Create new opportunities for students at minority-serving institutions
  - *Exposure to cutting-edge research and high-quality education, access to facilities and instrumentation, access to mentors*
- Enhance research productivity and infrastructure
- Impact both institutions' research and culture
- Develop integrated research and education programs
- Pursue close interactions with partner institution and NSF

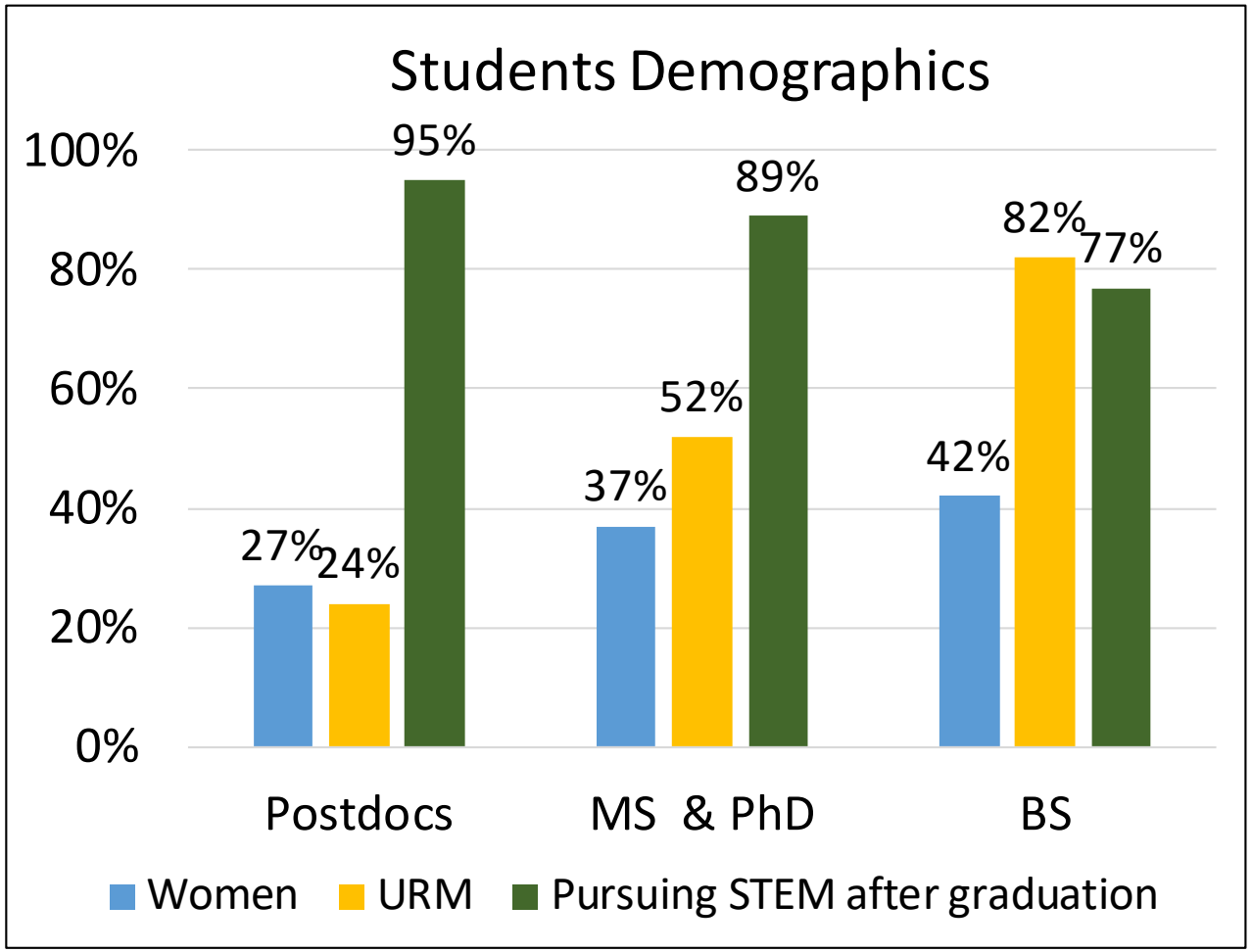
PREM in Numbers & Graphs

- **Since inception (2004)**

38 awards + **2** seed funding awards have been made; current average award ~ **$630k**/ year for **6** years; program trained **123** postdocs, graduated **498** MS and PhD students, and **990** BS students; produced **2193** publications and **5249** presentations.

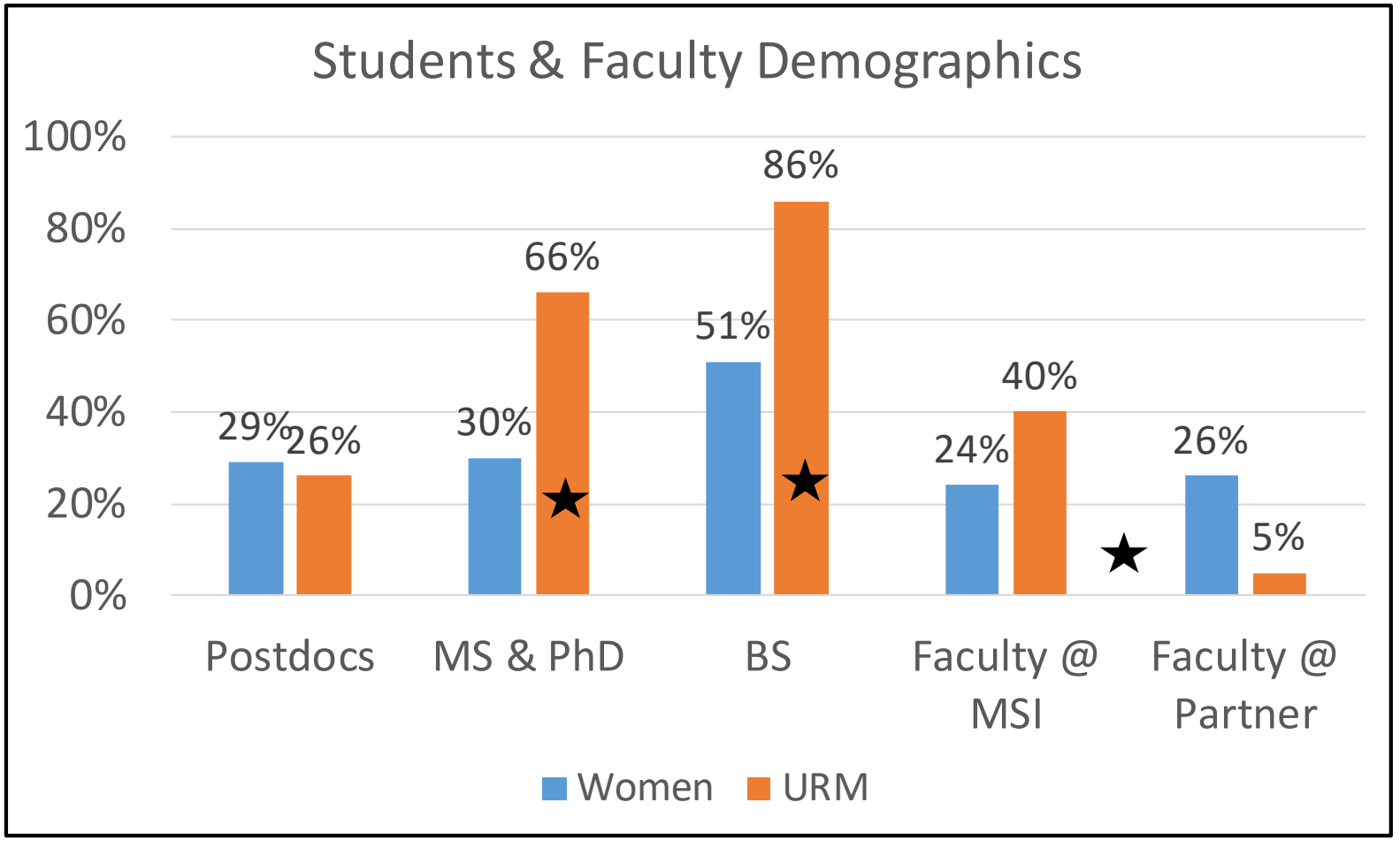


PREM in Numbers & Graphs



Data since inception: graduating 123 Postdocs, 498 MS & PhD, 990 BS students

PREM in Numbers & Graphs



Data from 2020 active PREMs: engaging 31 Postdocs, 141 MS &PhD, 245 BS students; 140 faculty members at MSI and 110 faculty members at Partner institution.

Partnership for Research and Education in Materials (PREM)

University of Puerto Rico, Humacao (UPenn MRSEC)

- Research on electro-deposition of nanowires for electronics
- UPRH partnership with local HS. Partner HS student with UG student after school and summer research
- 33% of current PREM UGs began their materials research careers while in High School
- A **top 20 institution** producing Hispanic women with doctorates in Physics (NCSES)


Sabrina Rosa
Experimenta con PREM 2010
BS Physics, UPRH 2016
PhD Candidate, EE, USF

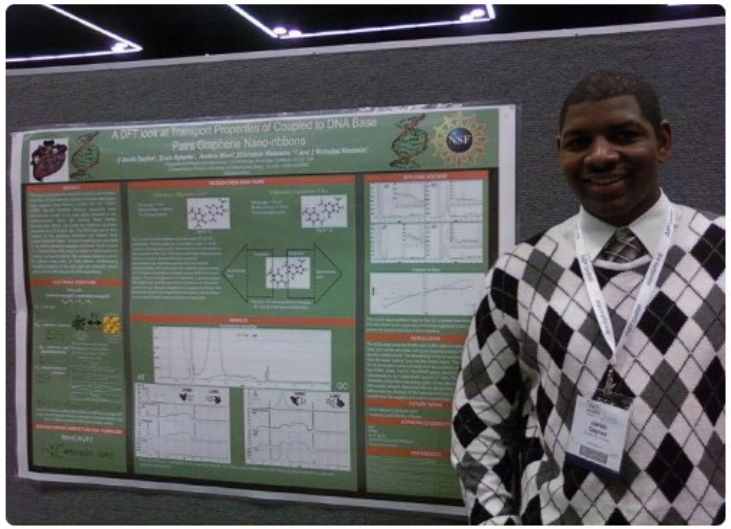

Adriana Santiago
Experimenta con PREM 2011
BS Chemistry, UPRC 2018
Grad Student Bio Chem, PENN

PREM

PROGRAM OVERVIEW | PREM AWARDS | PEOPLE | NEWS | EVENTS | RESEARCH | LOGIN | DMR SITES

From California to Germany, PREM Alumnus Builds a Career in Quantum Materials

Jacob Gayles always thought he'd be an architect until he took a physics class in his final year of high school. It was interesting enough that when the time came to go to college, he applied to a handful of architecture programs and one physics program at California State University Northridge (CSUN). He chose to go to the latter and so began a career in science.



Jacob Gayles presents his work on electrically detecting DNA base pairs using graphene nanoribbons at an American Physical Society meeting in Portland, Oregon. Image courtesy of Jacob Gayles.

Today, Gayles is a postdoctoral researcher at the Max-Planck Institute (MPI) in Germany where he is working on quantum materials and spintronics under the direction of Claudia Felser, a physics and chemistry professor at the Institute. As part of his research, Gayles is exploring the topological properties of quantum materials that contribute to the development of modern technology. At MPI, he collaborates with fellow theorists as well as experimentalists on addressing and solving experimental problems.

Dr. Jacob Gayles

CSUN (PREM)
(Donna Sheng/Nick Kioussis student)

↓

Texas A&M (Jairo Sinova student)

↓

Johannes Gutenberg University- Mainz (Jairo Sinova student)

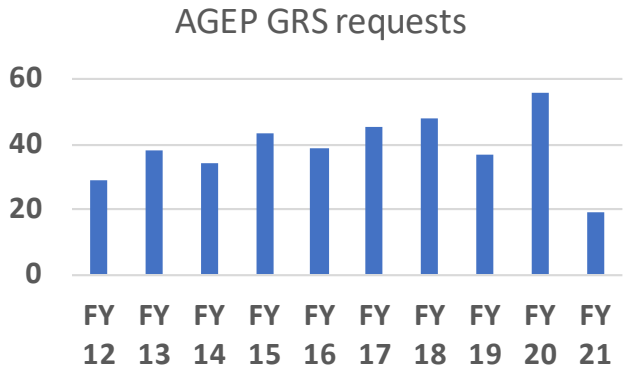
↓

Max-Planck Institute

↓

University of South Florida

Thank you!



In late FY 2020 MPS contacted every MPS PI at an AGEP institution to advertise the program. The number of requests in FY 2021 are well on track to exceed previous years .

MPS AGEP Graduate Research Fellows

- Collaboration between the NSF Alliances for Graduate Education and the Professoriate (AGEP) program in the Education and Human Resources(EHR) Directorate and the Directorate of Mathematics and Physical Sciences (MPS). **PIs requesting a supplement must be either at or collaborating with faculty at an institution that has received an EHR AGEP award (such as Rutgers).**

- **Description**: Supplement for a **current** MPS **research** awardee for one (additional) Ph.D. The goal is to create an opportunity to engage **additional** students in research, to develop a positive learning environment for students, and **to improve diversity and retention** at the doctoral level within the mathematical and physical sciences.

- Focused on broadening the participation of **African Americans, Hispanic Americans, American Indians, Alaska Natives, Native Hawaiians, and Native Pacific Islanders.**

- MPS supported **206** students through AGEP-GRS supplements (5 to Rutgers) from FY2012 -2020.