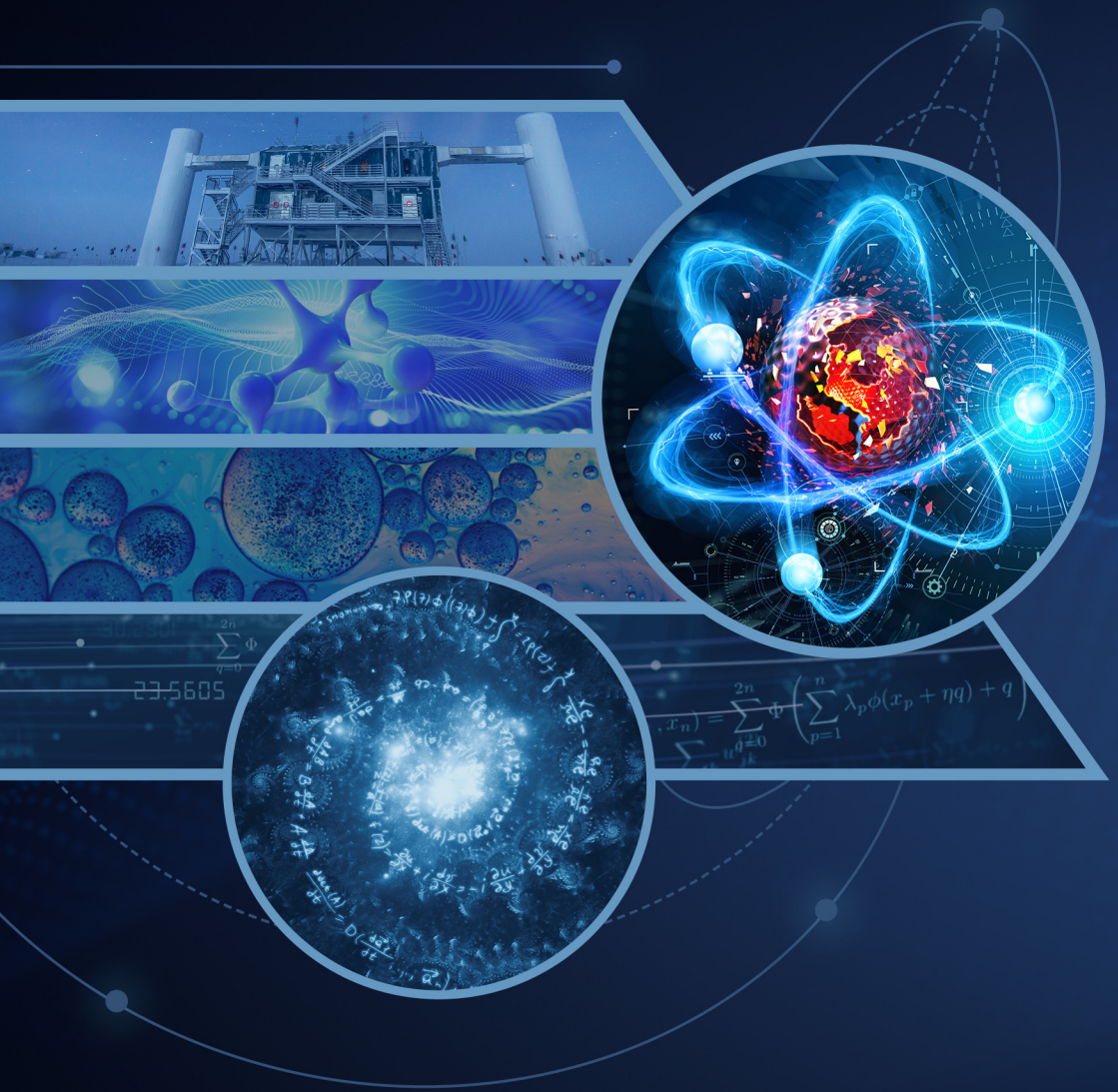
MPS | DIRECTORATE FOR MATH AND PHYSICAL SCIENCES



MPS Update NSAC Meeting

C. DENISE CALDWELL

DIVISION DIRECTOR, DIVISION OF PHYSICS

March 2023

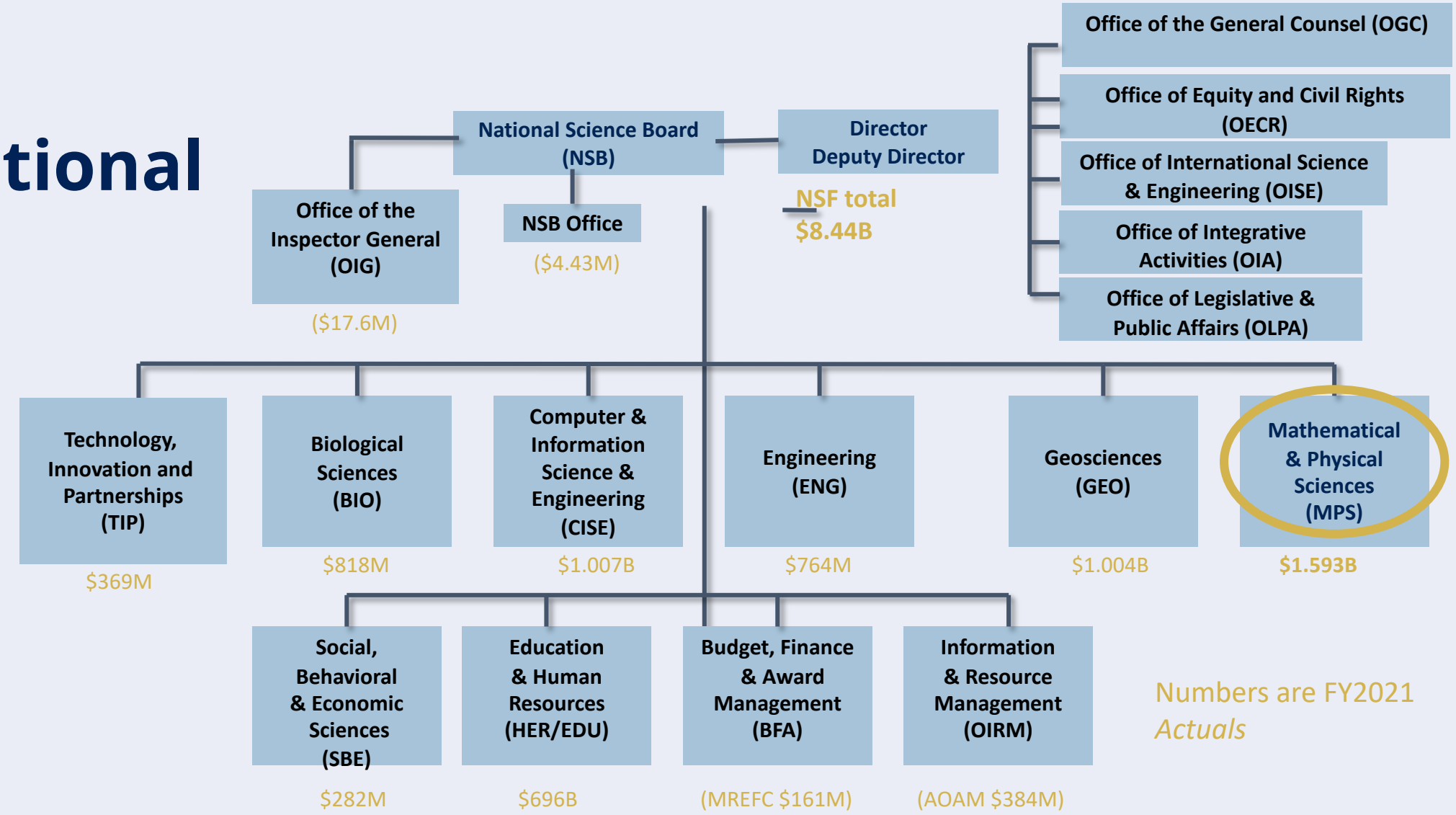
National Science Foundation
Directorate for Mathematical and Physical Science (MPS)

NSF Mission

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

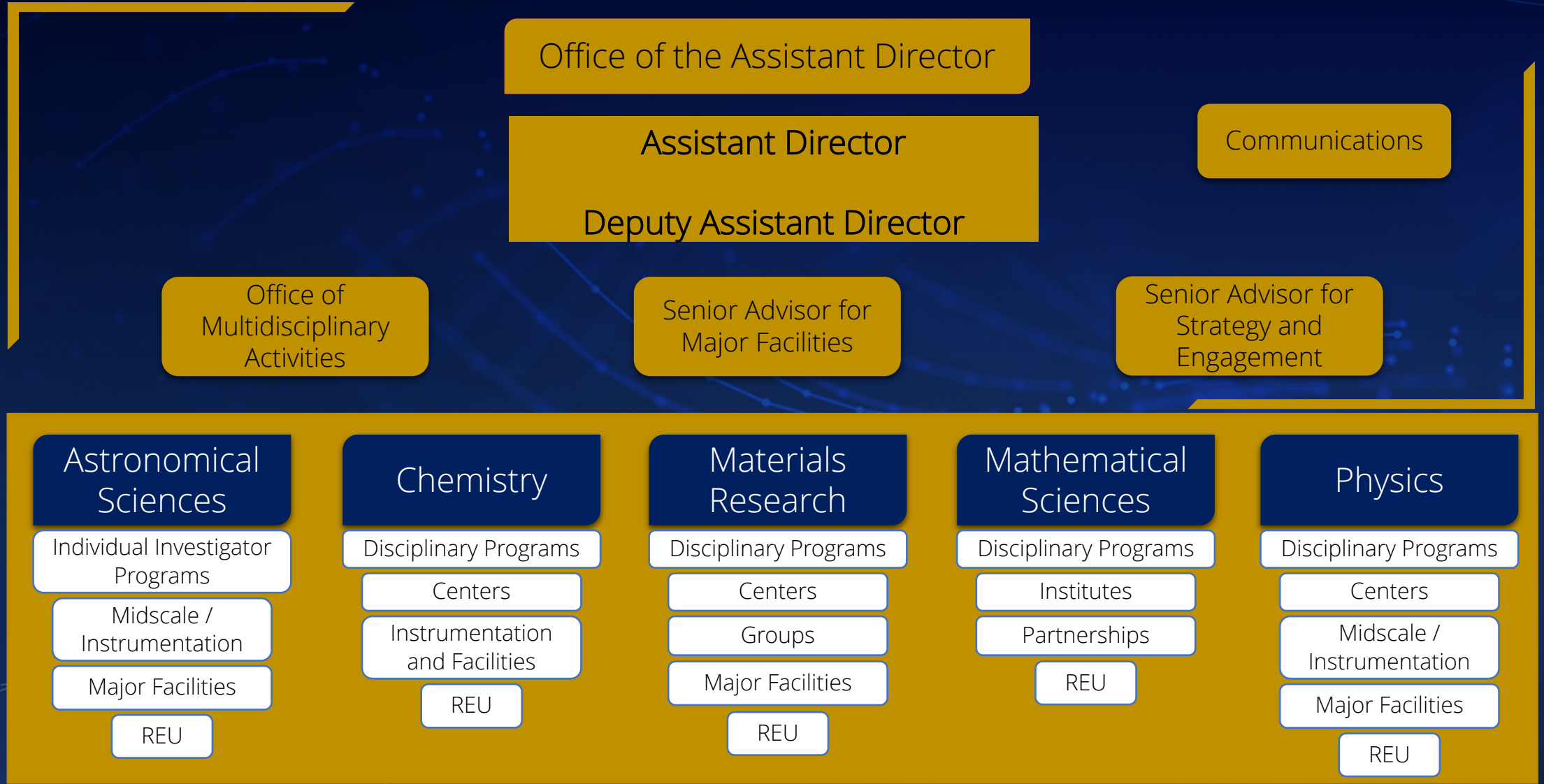
Programmatic Directorates and Offices Supporting the NSF Mission

NSF Organizational Chart



Numbers are FY2021 *Actuals*

MPS ORGANIZATIONAL STRUCTURE



FY 2023 Enacted

$9.9 Billion

+$1.03 billion
+11.8% above
FY 2022 Current Plan

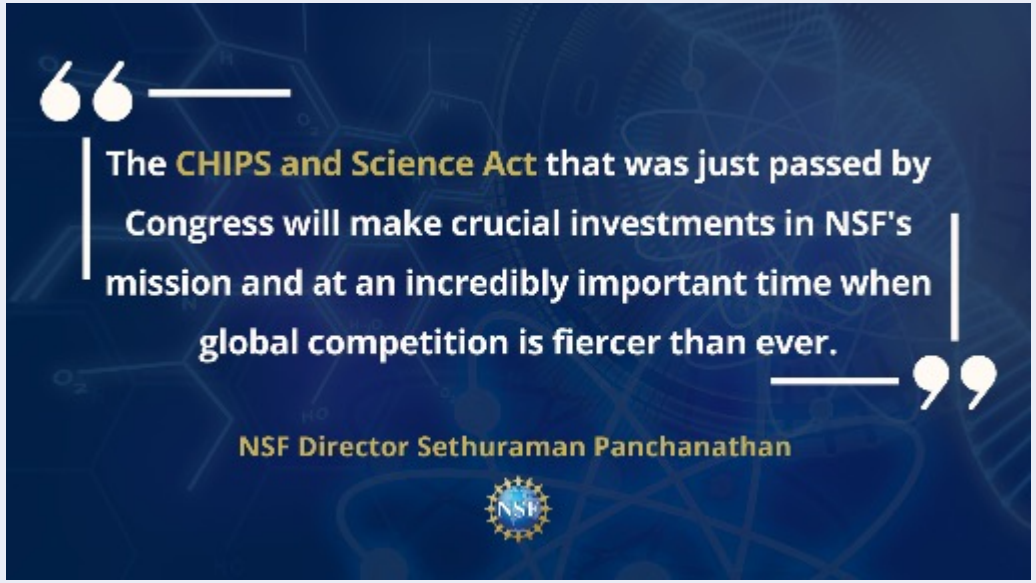
Signed by the President December 29, 2022
(*Current Plan due to Congress February 13, 2023*)

- Provides NSF with a total $9.876 billion between Omnibus (Division B) and Disaster Relief Supplemental Act – DRS (Division N) funding

- DRS funding parsed into three categories
  - Base activities - $700 million
  - CHIPS+ Science Set-Aside - $335 million **(2-year)**
  - Damaged Research Facilities and Science Equipment - $2.5 million

CHIPS and Science Act

- Creates Directorate for Technology, Innovation and Partnerships (TIP)
  - Authorization of $1.85 billion in FY 2023
- Increases overall NSF authorization (not including TIP) to $10 billion in FY 2023
- Supports research and workforce development related to:
  - Biotechnology
  - Climate change and clean energy
  - Manufacturing
  - Semiconductors and microelectronics
  - Research and infrastructure
  - Other emerging technology areas



- Puts NSF on a path to increase investments in EPSCoR jurisdictions

TIP: Accelerating Research To Impact

Fostering Innovation and Technology Ecosystems

Nurtures regional and national innovation and technology ecosystems to support researchers and innovators to converge, develop and accelerate use-inspired research for societal impact.

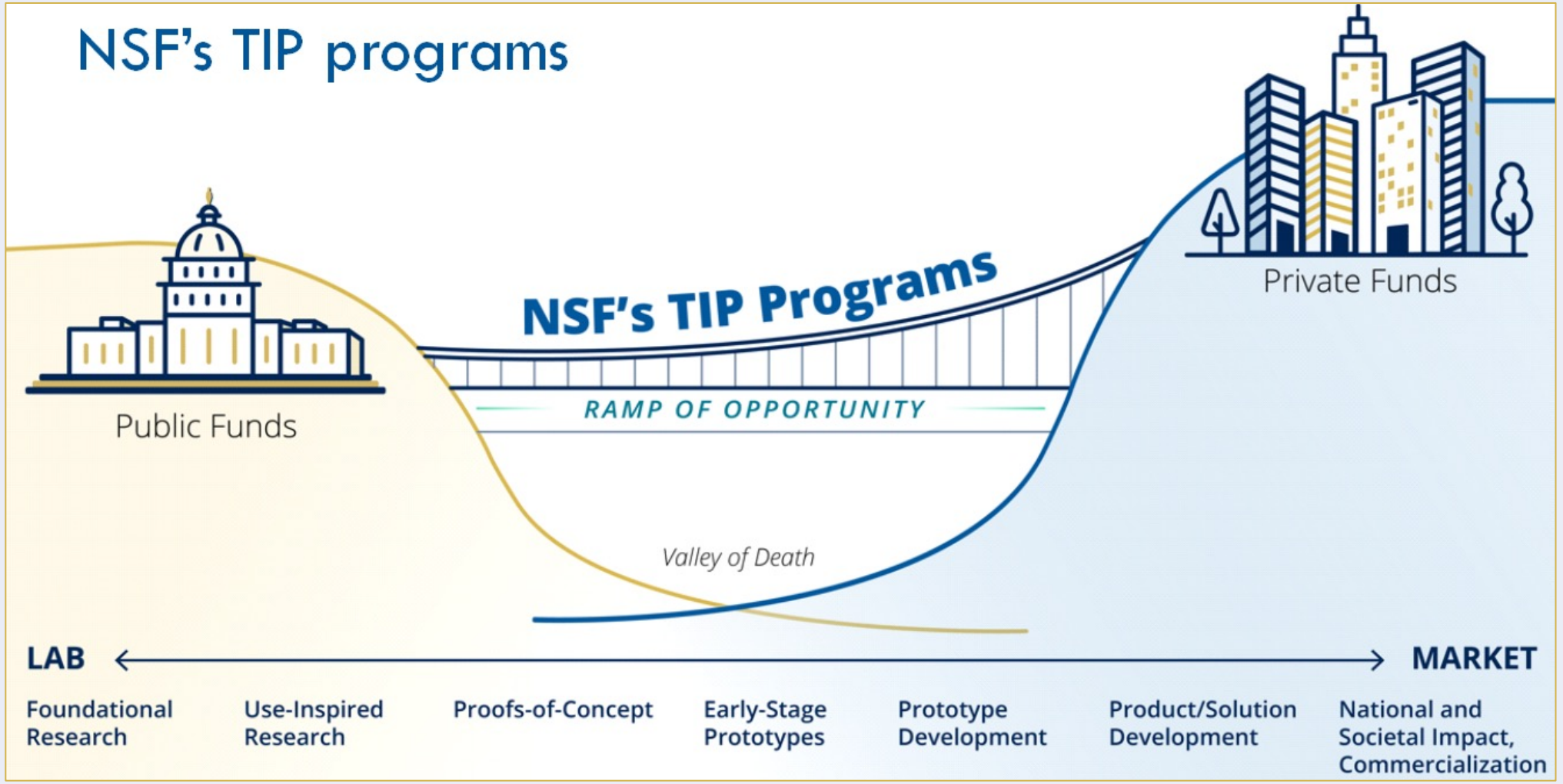
Establishing Translation Pathways

Supports startups through a lab-to-market platform and establishes new pathways for translating research results for society.

Partnering to Engage the Nation's Diverse Talent

Advances and deepens high-impact, public and private partnerships across all areas of science, engineering and education to cultivate innovation ecosystems, create technology solutions, and support future STEM leaders.

Translation, Innovation and Partnership (TIP)



DIRECTORATE FOR TECHNOLOGY, INNOVATION AND PARTNERSHIPS (TIP)

Technology Translation

- PFI
- SBIR/STTR
- Innovative Pathways

Technology & Innovation Ecosystem

- Convergence Accelerator
- I-Corps
- Emerging Technologies
- Regional Innovation
- Entrepreneurial Fellows

Partnerships as a Foundation

- Accelerate Partnerships

Realigned investments

New investments

Find Your Opportunities

Academia

- America's Seed Fund
- Convergence Accelerator
- Enabling Partners to Increase Innovation Capacity
- Experiential Learning for Emerging and Novel Technologies
- Entrepreneurial Fellowship
- Innovation Corps (I-Corps™)
- Partnerships for Innovation
- Pathways to Enable Open-Source Ecosystems
- Regional Innovation Engines

Business & Industry

- America's Seed Fund
- Pathways to Enable Open-Source Ecosystems
- Regional Innovation Engines

Government

- Regional Innovation Engines
- Visionary Interdisciplinary Teams Advancing Learning

NSF's 3 Major Priorities

STRENGTHENING ESTABLISHED NSF

With **investments that expand the frontiers of knowledge and technology**.

INSPIRING THE MISSING MILLIONS

Using **interventions and capacity building** that enhance and broaden participation.

ACCELERATING TECHNOLOGY AND INNOVATION

Through innovative, **cross-cutting partnerships** and programs.

12

NSF Programs Addressing the Missing Millions and Strengthening the Established NSF

- EiR: Excellence in Research
- MRI: Major Research Instrumentation
- MSRI-1: Mid-scale Research Infrastructure
- MSRI-2: Mid-scale Research Infrastructure

- CRII: CISE Research Initiation Initiative
- CSGrad4 US: Fellowship Program
- ExpandAI

- ExpandQISE
- LEAPS
- ASCEND
- "P5"
- AGEP-GRS: Graduate Research Supplement

Launching Early-Career Academic Pathways in the Mathematical and Physical Sciences (LEAPS-MPS) FY22

- A discussion of how activities will facilitate development of a subsequent research proposal.
- A specific plan on broadening participation activities will increase (1) the participation of scientists from underrepresented groups and (2) the numbers of such individuals that serve as role models for the scientific workforce of the future.
- LEAPS Impact Statement (3 pages): (1) impact on institutional research environment, (2) impact on career of PI and department's ability to prepare students to enter STEM careers, including provisions for increasing broader participation.
- 58 LEAPS- MPS Awards Made

National Science Foundation
Directorate for Mathematical and Physical Science (MPS)

NSF 22-604 LEAPS-MPS, DEADLINE JAN. 26TH , 2023
ANTICIPATING 32-48 AWARDS

MPS Ascend Postdoctoral Fellows FY22

12 to 36 Months, $100,000 per year

- A monthly stipend of $5,833 (up to $70,000 annually)

- An annual allowance of $30,000 for:

  a) expenses directly related to the conduct of the research and/or

  b) support of fringe benefits, dependent care, and moving expenses.

31 MPS Ascend Awards Made

NSF 23-501 MPS-Ascend: Deadline Jan. 25, 2023.
Anticipating 20-50 awards

OMA-2220322 MPS-Ascend EM: A Postdoc Community of Mentoring and Networking : in-person workshops planned for Jan. or Feb. 2023.

National Science Foundation
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MPS – Partnership Programs

Partnerships for Research and Education in Materials (**PREM**)

Partnerships in Astronomy and Astrophysics Research and Education (**PAARE**)

Partnerships for Research and Education in Chemistry (**PREC**)

Partnerships for Research in and Education in Physics (**PREP**)

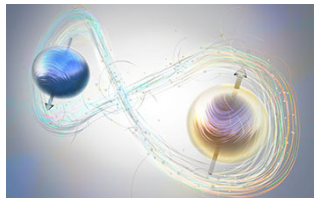
Partnerships for Research innovation in Methods and Education (**PRIMES**)

Emerging Industries, FY 2021-FY 2023

Emerging Industries - NSF	FY 2021 Actuals	FY 2023 Request
Advanced Manufacturing	$452.11	$421.51
Advanced Wireless	$131.03	$168.56
Artificial Intelligence	$701.78	$734.41
Biotechnology	$336.47	$392.26
Quantum Information Science	$255.06	$261.00

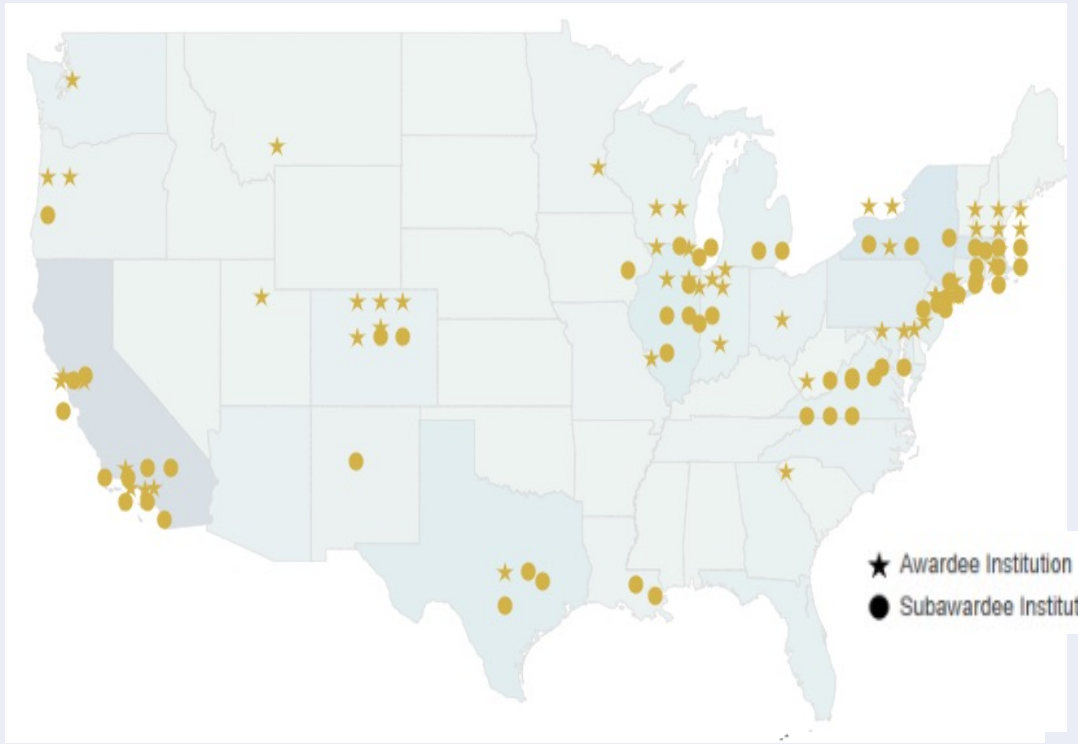
Transformational Advances in Quantum Systems (TAQS Series)

- ***Goal:*** **Innovative interdisciplinary research for incubating new ideas, concepts, and technologies**
  - **focus on quantum functionality**
  - **result in experimental demonstrations and/or proof-of-concept validations**
- ***How:*** **Interdisciplinary teams required (minimum of 3 different areas). Research topic goals vary.**
- ***Why:*** **Building and growing a community of cross-disciplinary QL research teams**
  - Broadly distributed, yet feasible, cross-disciplinary teams
  - Education/training of next generation QIS engineers and scientists
  - Enhancing connection between distinct disciplines
  - Growing less-mature communities



NSF TAQS Programs

- **TAQS Pilot** (RAISE-TAQS) NSF 18-035
  - $25 Million for 24 Awards started in 2018
- **Quantum Idea Incubator** (QII-TAQS) NSF 19-532
  - $25 Million for 19 Awards started in 2019
- **Quantum Interconnects** (QuIC-TAQS) NSF 21-553
  - $25 Million for 10 Awards started in 2021
- **Quantum Sensors** (QuSeC-TAQS) NSF 22-630
  - $25 Million for 10-12 Awards - NEW in 2023

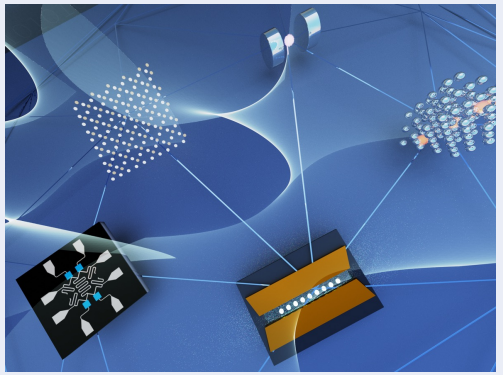


- For examples see NSF Award Search
  - https://www.nsf.gov/awardsearch/
  - Keyword: TAQS

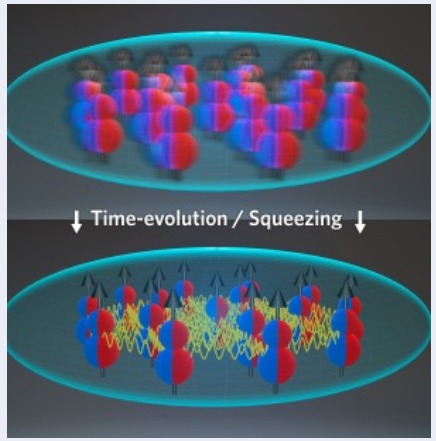
RAISE = Research Advanced by Interdisciplinary Science and Engineering

Quantum Leap Challenge Institutes (QLCI)

- Support **large-scale projects** driven by a ***cross-disciplinary challenge research theme*** at the frontier of quantum information science and engineering.
- Maintain a timely and bold research agenda aimed at making **breakthroughs** on compelling challenges in a 5-year period.
- Conceptualize, develop, and implement **revolutionary** new approaches and technologies for quantum information processing.
- Enable the development of a **well-trained workforce** with strong cross-disciplinary skill sets needed for quantum information science and engineering.
- Establish **synergistic partnerships**, both national and international, in pursuit of the Institute's vision and goals.



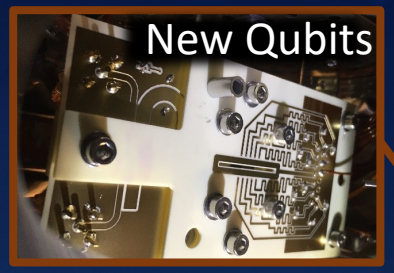
Courtesy: HQAN

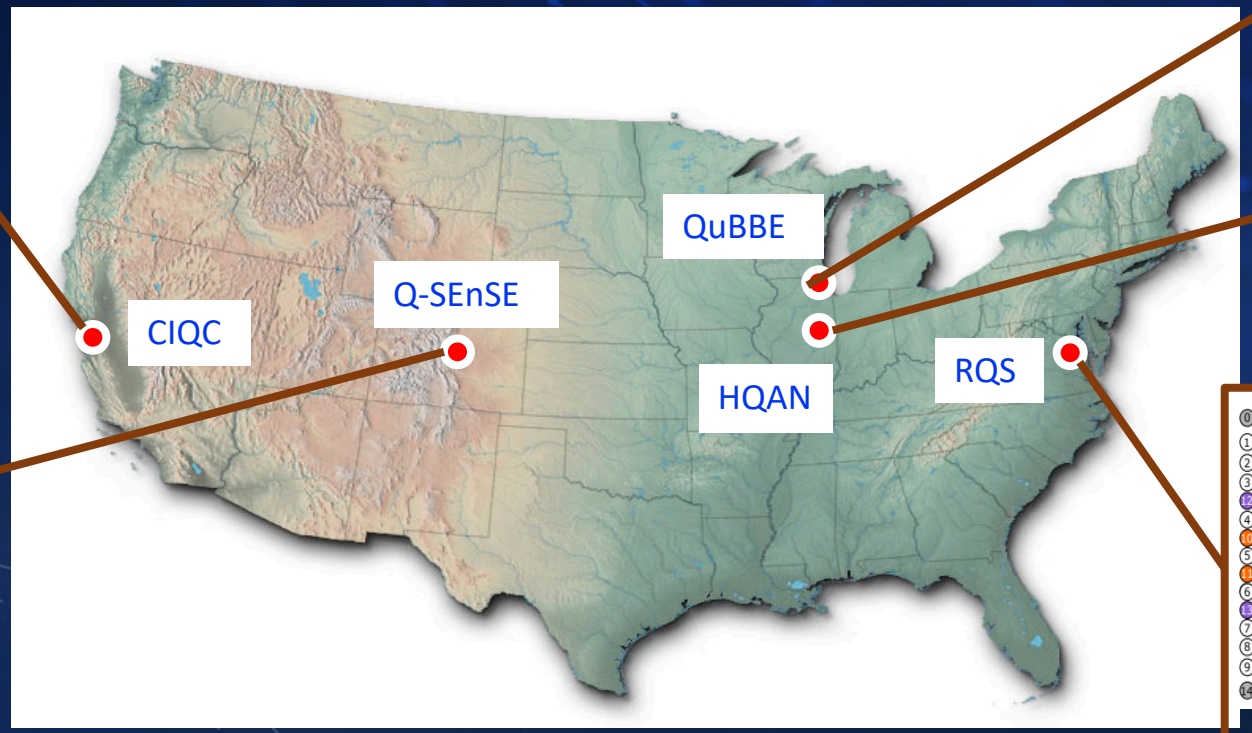


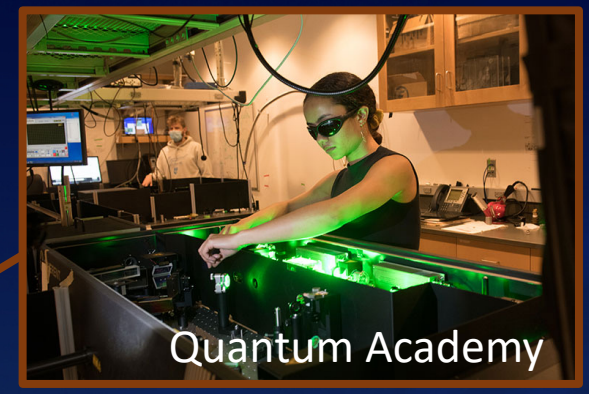
Credits: S. Burrows, J. Ye and A.M Rey

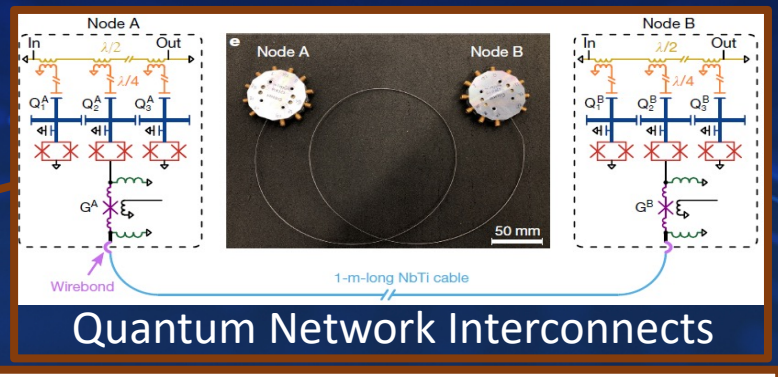
NSF Quantum Leap Challenge Institutes

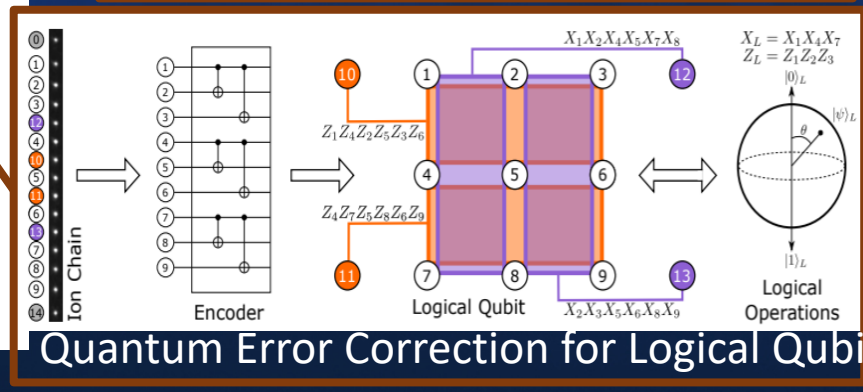
- CIQC: Challenge Institute for Quantum Computation
- Q-SEnSE: Quantum Systems through Entangled Science and Engineering
- HQAN: Hybrid Quantum Architectures and Networks
- QuBBE: Quantum Sensing for Biophysics and Bioengineering
- RQS: Institute for Robust Quantum Simulation











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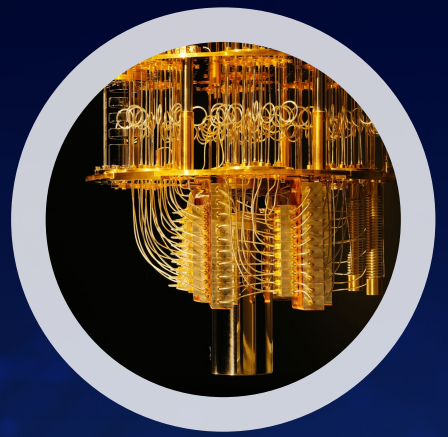
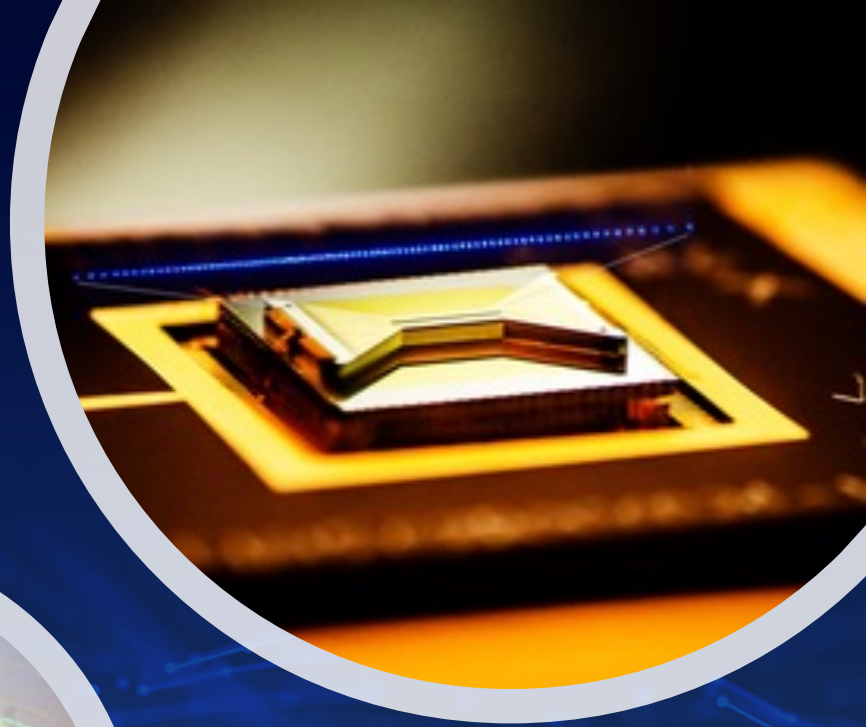
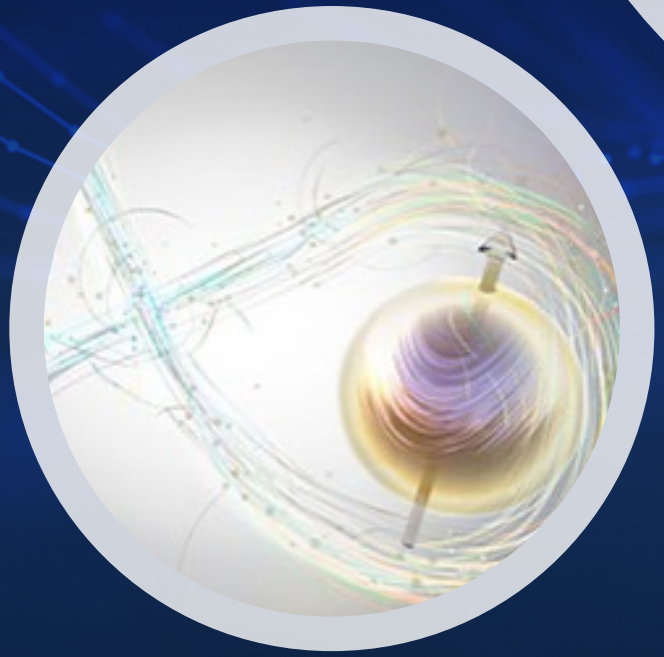
QLCI Impacts

- 31 Academic Institutions
- 175 Faculty Investigators
- 31 Other Professionals
- 104 Postdocs
- 307 Graduate Students
- 52 Undergraduate Students
- 67 Industrial Affiliates
- 12 Government Laboratories
- 41 International Partners







National Science Foundation
Directorate for Mathematical and Physical Science (MPS)

Expanding Capacity in Quantum Information Science and Engineering (Expand-QISE) – NEWEST PROGRAM

- Aims to increase nation's research capacity and broaden participation in QISE.

- Lower barriers for access and expand the diverse pool of education opportunities are activities central to NQI Act.

- The NQI Act authorizes specific roles for agencies such as NSF, DOE and NIST, in implementing the all-of-government approach to ensure the continued leadership of the United States in QISE. (*Workforce Development National Strategic Plan*)

- Minority-serving institutions (MSIs) and R2s, are especially encouraged to apply.

- Science focus areas support NQI Act goals:
  - Quantum Fundamentals
  - Quantum Metrology and Control
  - Co-Design and Quantum Systems
  - Education and Workforce Development

- Expand-QISE Solicitation: NSF 22-561

- https://nsf.gov/pubs/2022/nsf22561/nsf22561.htm

Expanding Capacity in Quantum Information Science and Engineering (Expand-QISE) – NEWEST PROGRAM

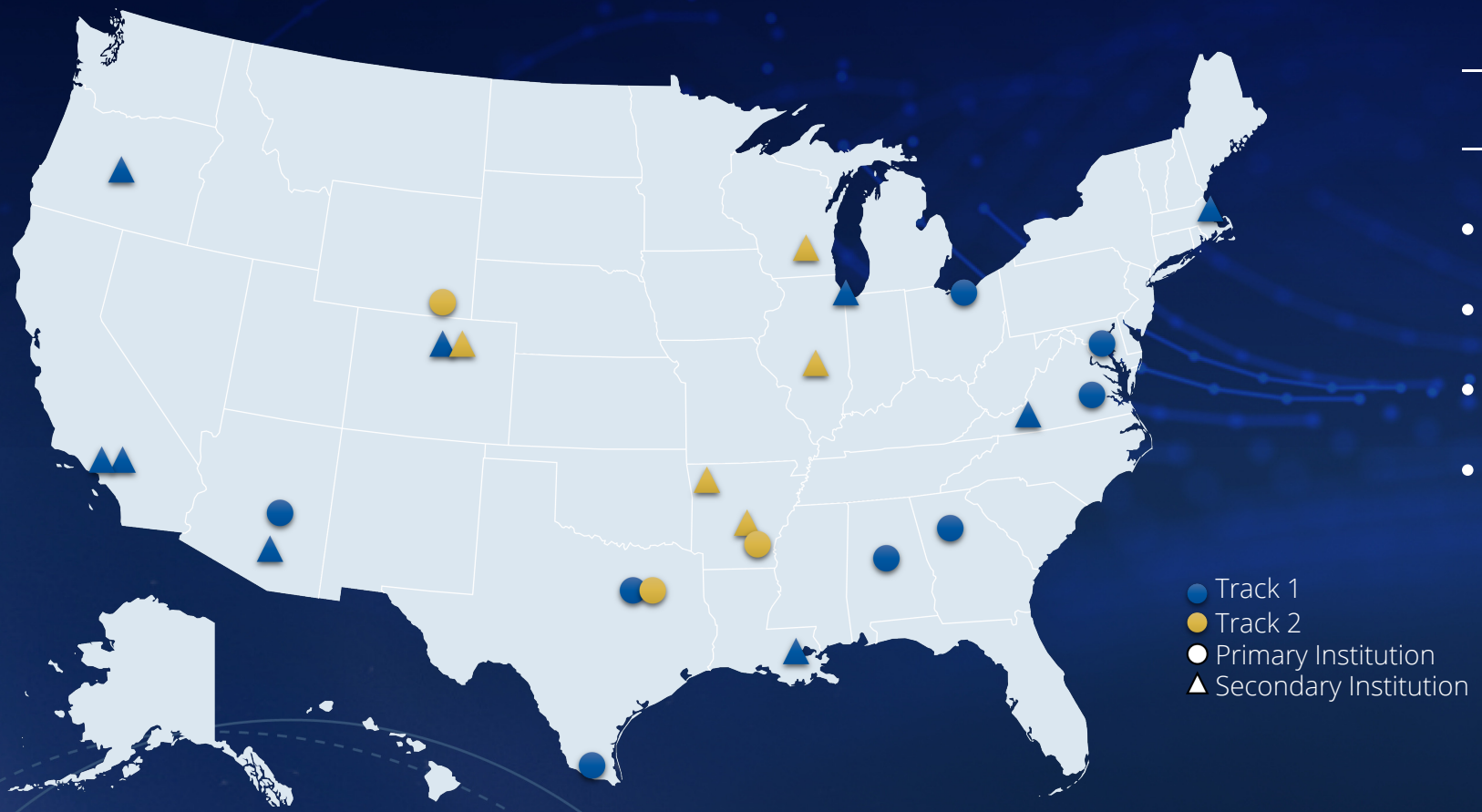
The ExpandQISE program offers two distinct funding tracks:

- **Track 1:** Institutions with minimal current focus on research (Up to $800,000 per award; up to three years)
  - Target individual PIs initiating planning for research program
  - Provide opportunity for institution to establish research-support infrastructure if needed
  - Support engagement with existing centers to build up expertise

- **Track 2:** Institutions with strong research activity, but no substantial investment in QISE (Up to $5M per award; up to five years)
  - Target faculty heavily engaged in research but not in QISE
  - Focus on small teams of 2-3 investigators to build strong competitive program
  - Provide larger-scale resources to enable development of competitive research program in QISE
  - Support engagement with existing centers to build up expertise and get quick access to infrastructure

Along with 1 of the science focus areas, **each proposal must address** a specific focus activity in Education and Workforce Development that accompanies the scientific thrust

Expanding Capacity in Quantum Information Science and Engineering (Expand-QISE) – NEWEST PROGRAM

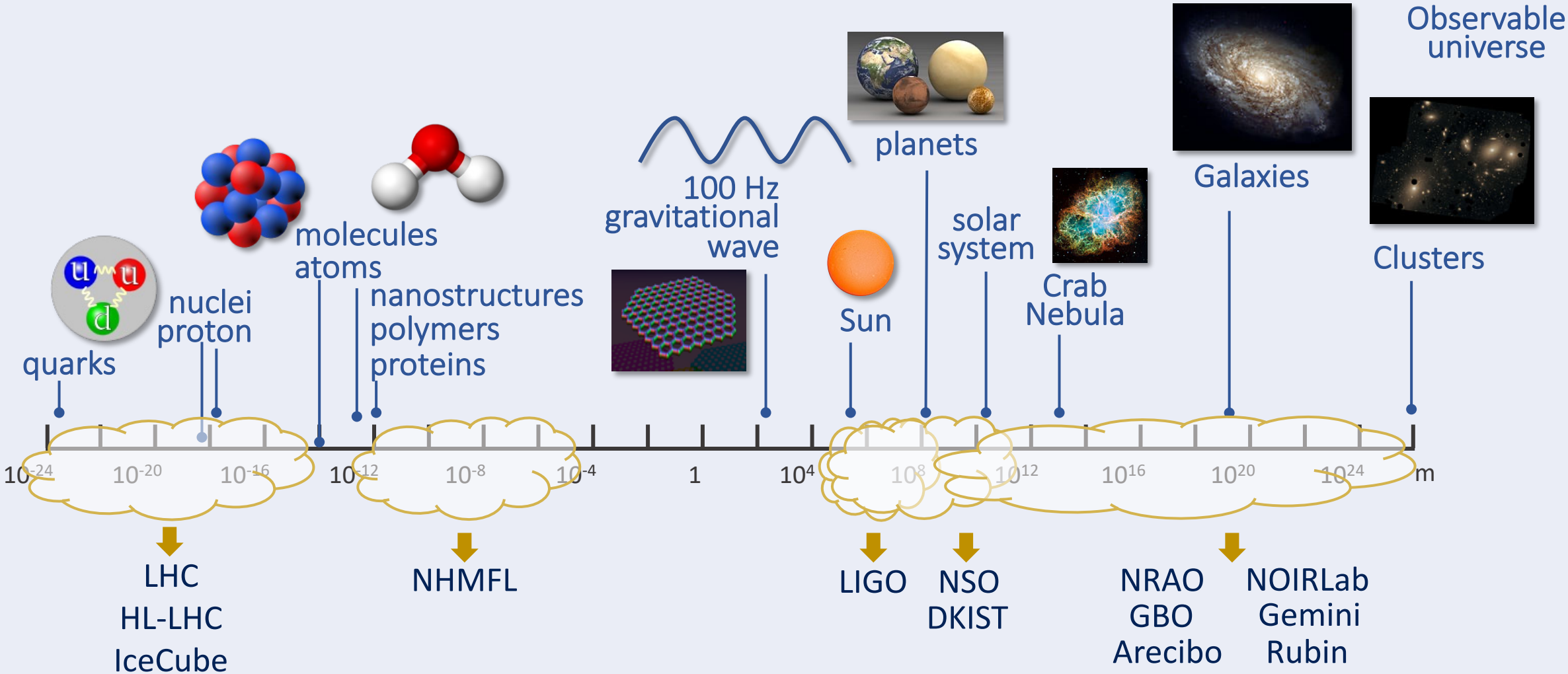


- First cohort, 11 awards ($21.4M)
- 3 HBCUs, 3 HSIs, 3 EPSCOR states
- Focus Areas:
- Quantum Fundamentals,
- Quantum Metrology and Control
- Co-Design and Quantum Systems
- Education and Workforce Development (ALL)

Track 1:
Full proposals: April 07, 2023
Track 2:
LOI: February 03, 2023
Full Proposals: March 03, 2023

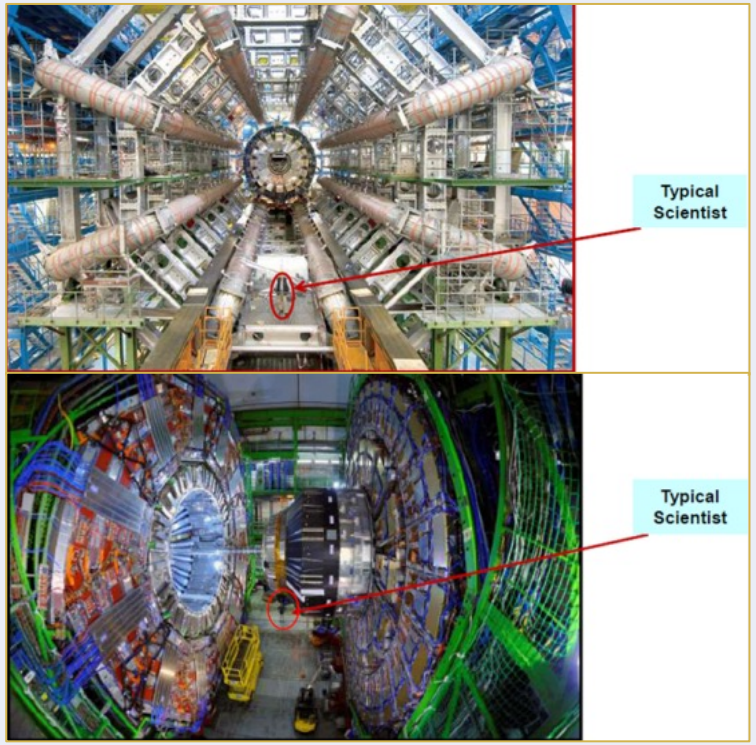
National Science Foundation
Directorate for Mathematical and Physical Science (MPS)

MPS Major Facilities Portfolio

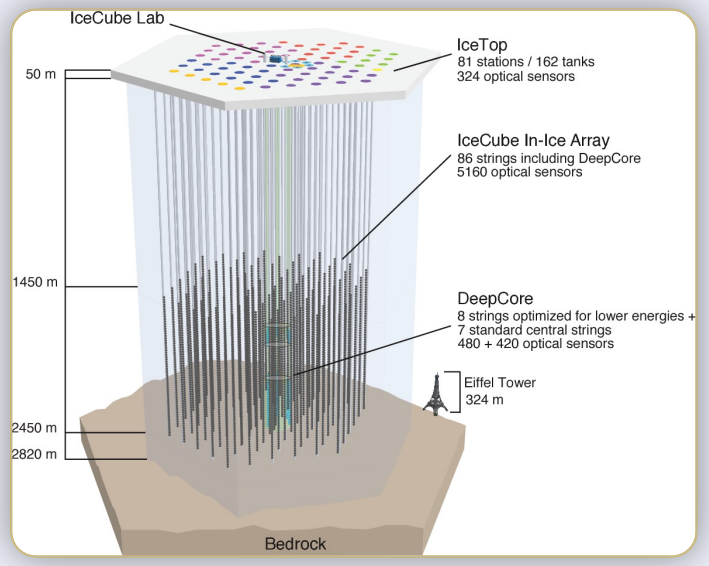


MPS Major Physics Facilities

ATLAS and CMS Detectors at the Large Hadron Collider (LHC)

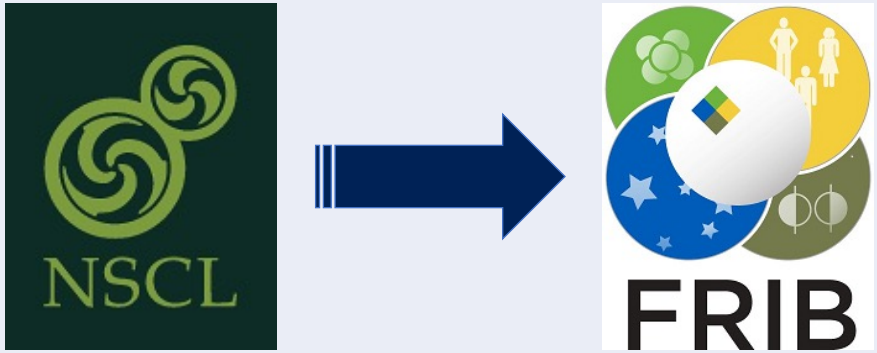


Ice-Cube Neutrino Observatory (ICNO)



Laser-Interferometry Gravitational Wave Observatory (LIGO)

Transition from NSF's NSCL to DOE's FRIB



- NSF/DOE Joint Oversight Group working since 2010
- NSF-NSCL → DOE-FRIB Transition MOU
- Last NSCL PAC approved experiment completed May 31, 2022

Job Announcement

We are currently looking for a Division Director for the Division of Physics

Appointment to begin January 2024

Details can be found at:

SES Career/SES Limited Term appointment options:
https://www.usajobs.gov/job/707560000

IPA appointment option:
https://www.usajobs.gov/job/707560800

Thank You !

Contact Information:
MPS: dcaldwel@nsf.gov