



# HIGH ENERGY PHYSICS ADVISORY PANEL

*C. Denise Caldwell*

*Division Director, Division of Physics, Mathematical and  
Physical Science Directorate*

*National Science Foundation*

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# Programmatic Directorates and Offices Supporting the NSF Mission



# 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

# 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.



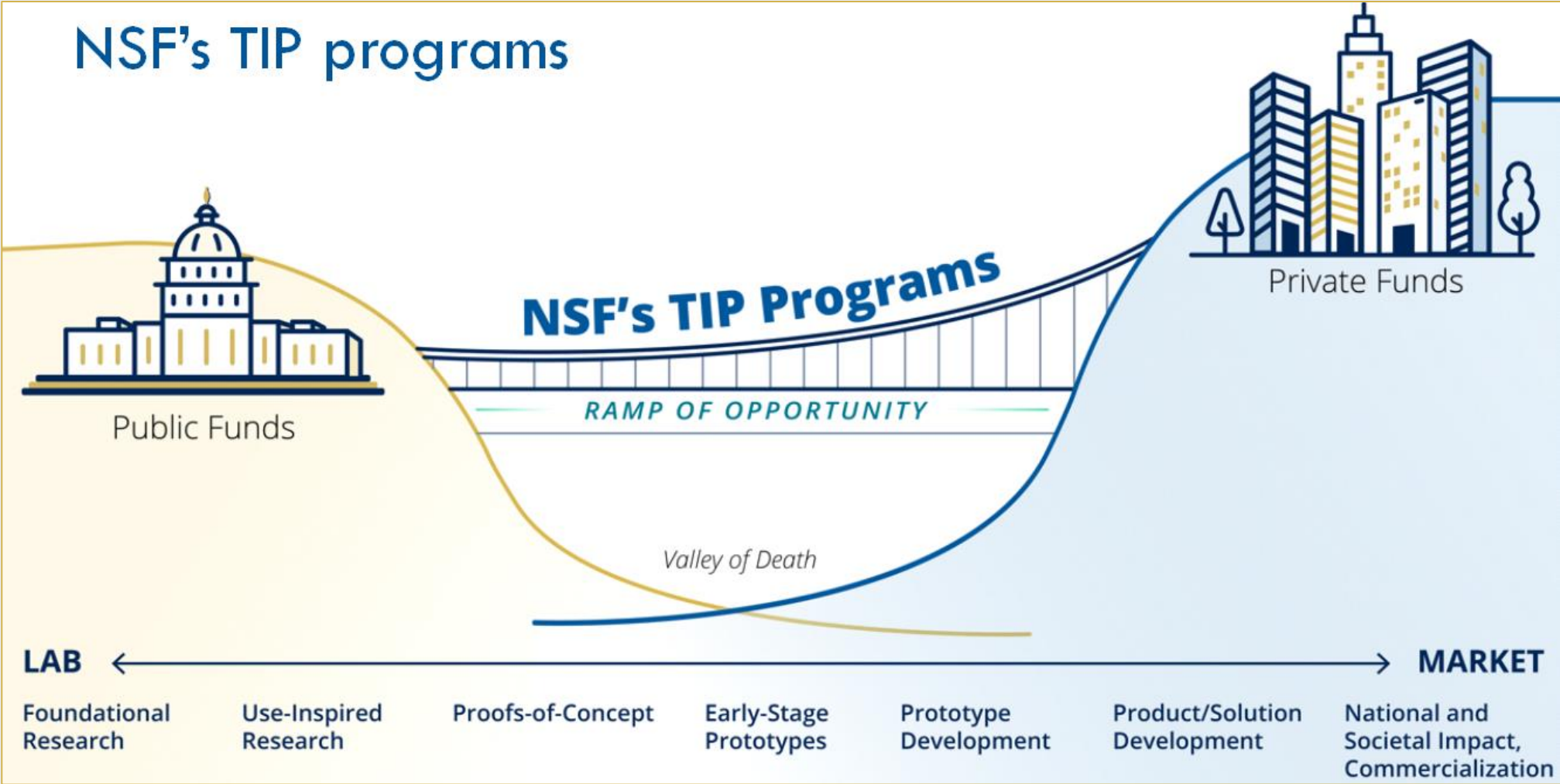
## ACCELERATING TECHNOLOGY AND INNOVATION

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



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# Technology, Innovation and Partnerships (TIP)



# NSF Programs Addressing the Missing Millions and Strengthening the Established NSF



**Integrative  
Activities**

**EiR:  
Excellence  
in  
Research**

**MRI:  
Major Research  
Instrumentation**

**MSRI-1:  
Mid-scale  
Research  
Infrastructure**

**MSRI-2:  
Mid-scale  
Research  
Infrastructure**



**Computer &  
Information  
Science &  
Engineering**

**CRII:  
CISE  
Research  
Initiation  
Initiative**

**CSGrad4  
US:  
Fellowship  
Program**

**ExpandAI**



**Mathematical &  
Physical Sciences**

**ExpandQISE**

**LEAPS**

**ASCEND**

**"P5"**

**AGEP-GRS:  
Graduate  
Research  
Supplement**



# Mid-scale Research Infrastructure Program (MsRI 1 and 2)

- **Mid-scale Research Infrastructure-1 (MsRI-1) [NSF 21-505](#)**
  - Total request: \$6M - \$20M
  - Implementation = “shovel ready”
  - Design/development = to prepare MsRI implementation proposal
  
- **Mid-scale Research Infrastructure-2 (MsRI-2) [NSF 21-537](#)**
  - Total request: \$20M - \$100M
  - “Shovel ready”
  
- Solicitations published in alternate years; next publication in FY23
  
- Solicitation scope: NSF-wide





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

- 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 in FY 2022; FY 2023 Announcement in August



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# MPS Ascend Postdoctoral Fellows

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 in FY 2022; FY 2023 Announcement in August**



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# MPS – Partnership Programs



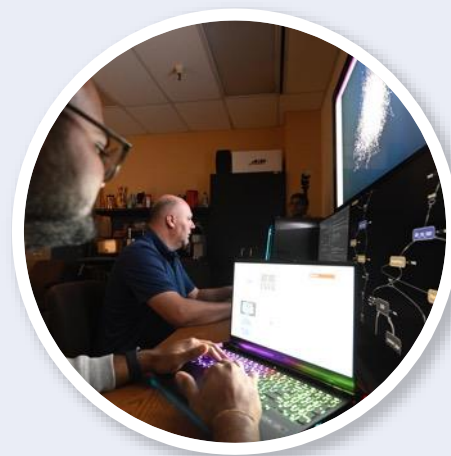
Partnerships for  
Research and  
Education in  
Materials  
(**PREM**)



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**)



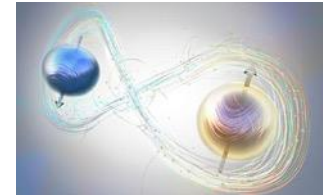
# Emerging Industries, FY 2021-FY 2023

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



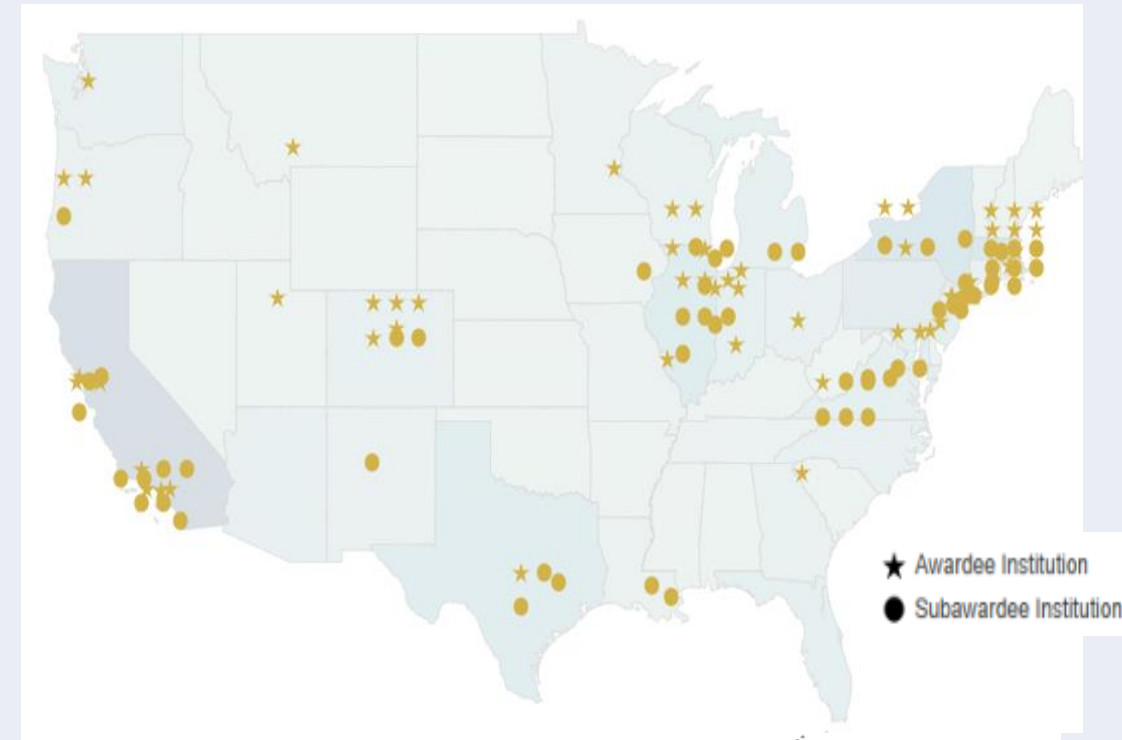
# Transformational Advances in Quantum Systems (TAQS Series)

- **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

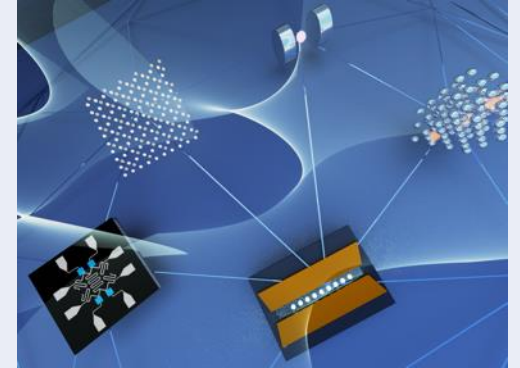
- **TAQS Pilot (RAISE-TAQS) NSF 18-035**
  - \$25 Million for 24 Awards started in 2018
- **Quantum Idea Incubator (QII-TAQS) NSF 19-532**
  - \$25 Million for 19 Awards started in 2019
- **Quantum Interconnects (QuIC-TAQS) NSF 21-553**
  - \$25 Million for 10 Awards started in 2021
- **Quantum Sensors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



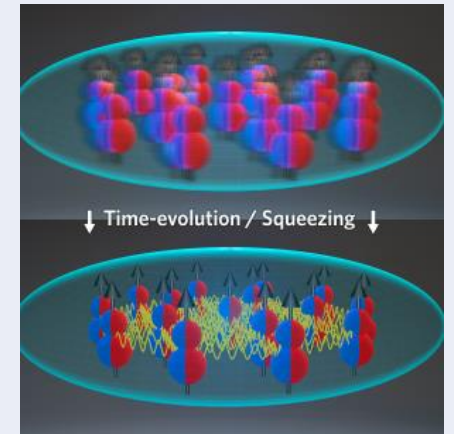
RAISE = Research Advanced by Interdisciplinary Science and Engineering

# 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



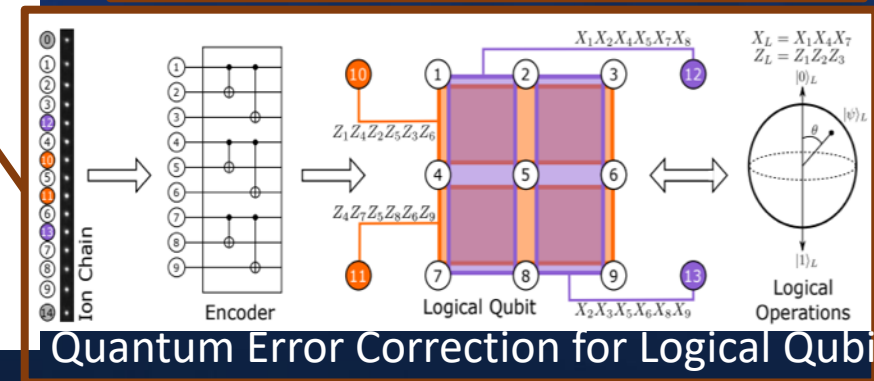
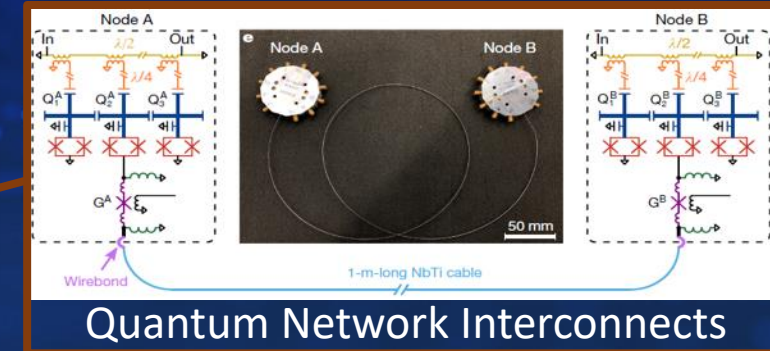
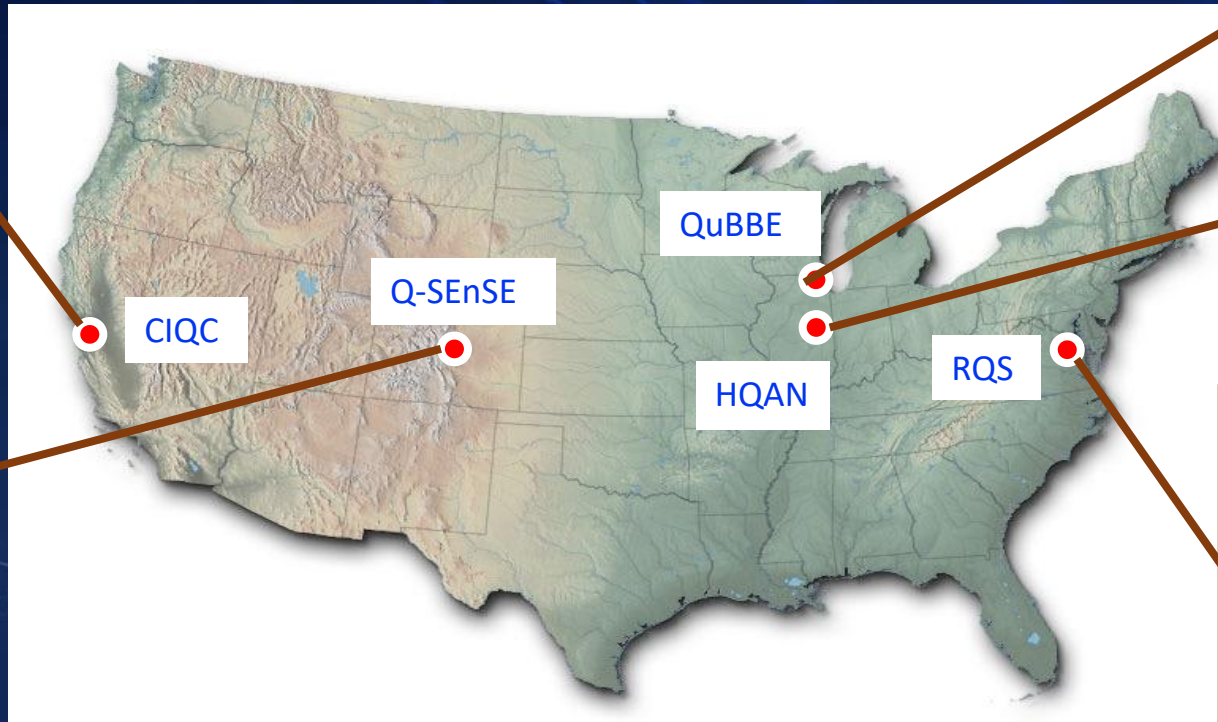
Credits: S. Burrows, J. Ye and A.M Rey



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# NSF Quantum Leap Challenge Institutes

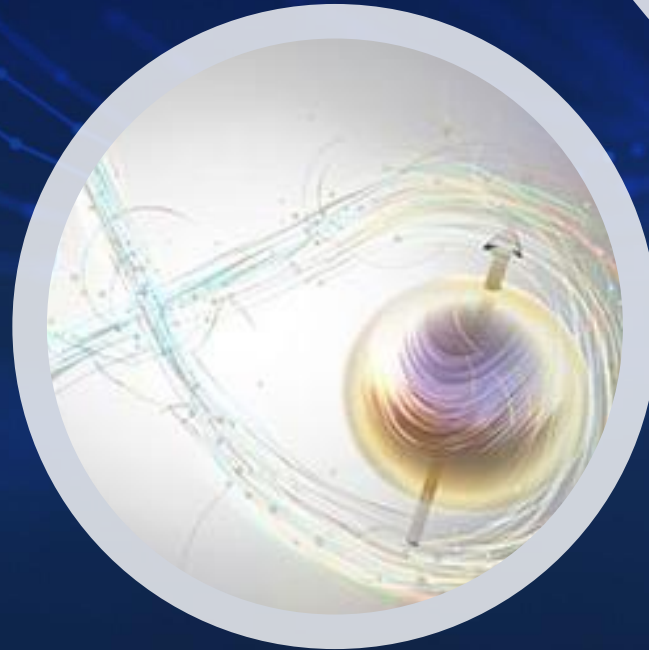
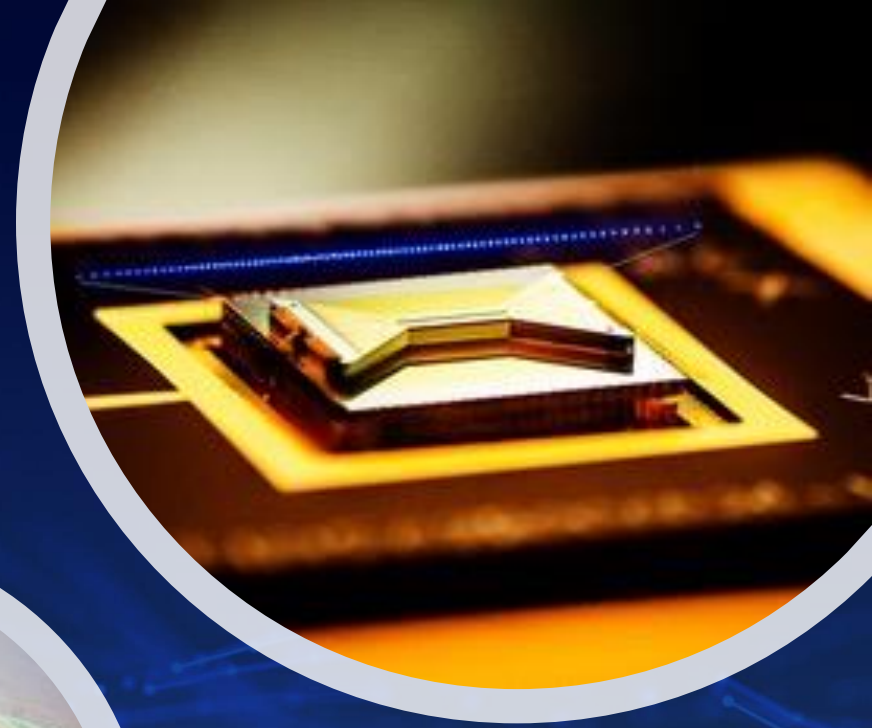
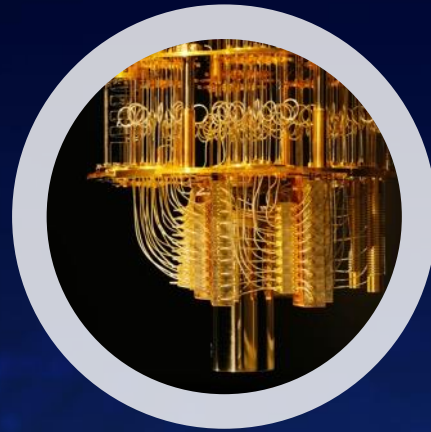
- CIQC: Challenge Institute for Quantum Computation
- Q-SEnSE: Quantum Systems through Entangled Science and Engineering
- HQAN: Hybrid Quantum Architectures and Networks
- QuBBE: Quantum Sensing for Biophysics and Bioengineering
- RQS: Institute for Robust Quantum Simulation





# 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



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# Expanding Capacity in Quantum Information Science and Engineering (Expand-QISE)

- 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)

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) –



- 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)
- FY 2023 Cohort to be announced in August

- Track 1
- Track 2
- Primary Institution
- △ Secondary Institution

# NEW: National Quantum Virtual Laboratory (NQVL)

From NQIAC Report on Renewing the National Quantum Initiative – Recommendation D  
“To realize the potential of QIST for society, the NQI must accelerate the development of valuable technologies.”

## Accelerate Innovation

Co-Design approach from basic science to commercial handoff  
Built-in mechanism for attacking potential barriers to success  
Incorporates participation from all sectors, academic, government labs, private  
Long-term major NSF project covering 5+ years

Launched 7/17/2023 NSF 23-604

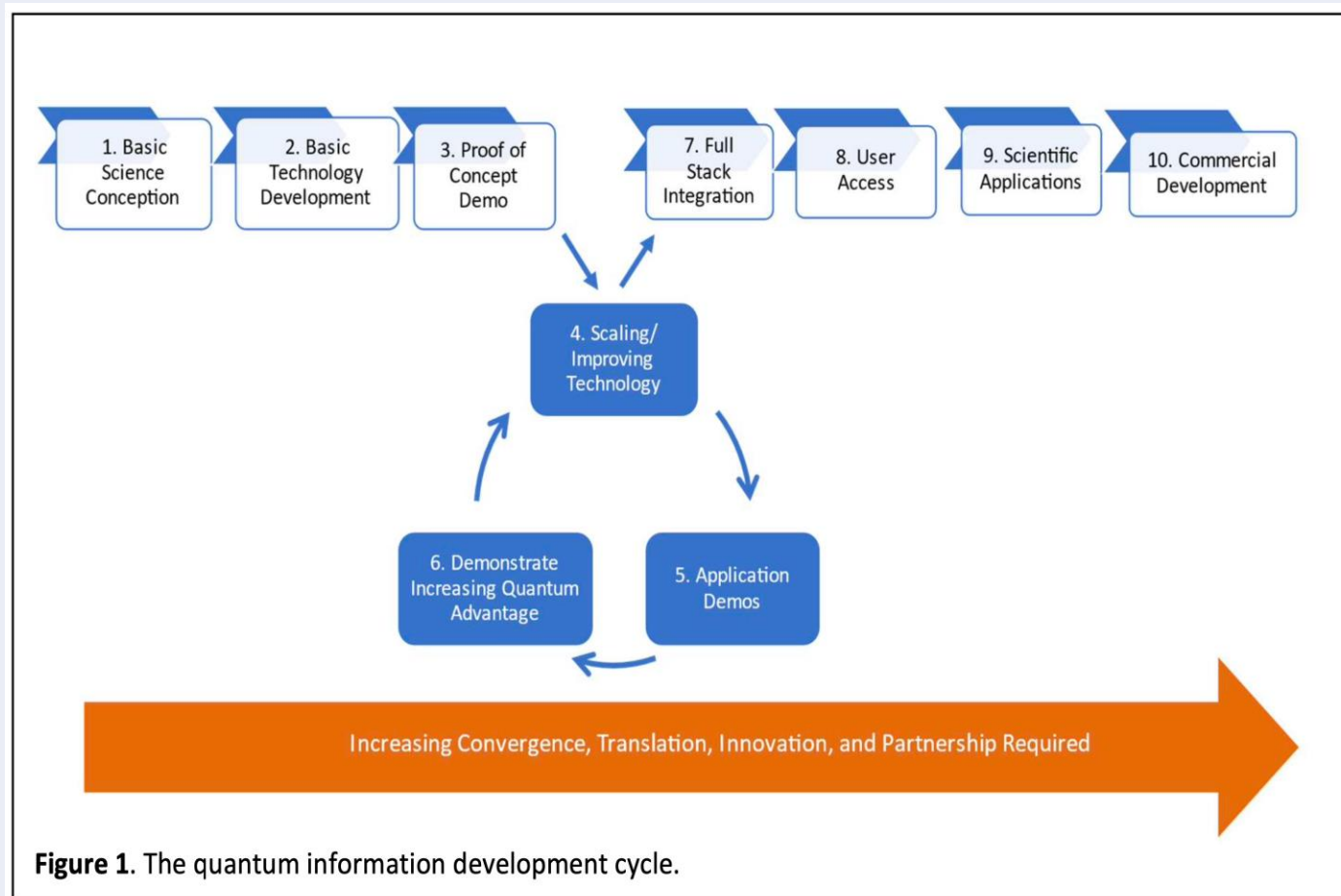
[NSF National Quantum Virtual Laboratory \(NQVL\) | NSF - National Science Foundation](#)



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# National Quantum Virtual Laboratory (NQVL)



## Co-design

Discoverers, developers, builders, end users



## Contributors

Across diverse NSF networks like QLCIs and ExpandQISE

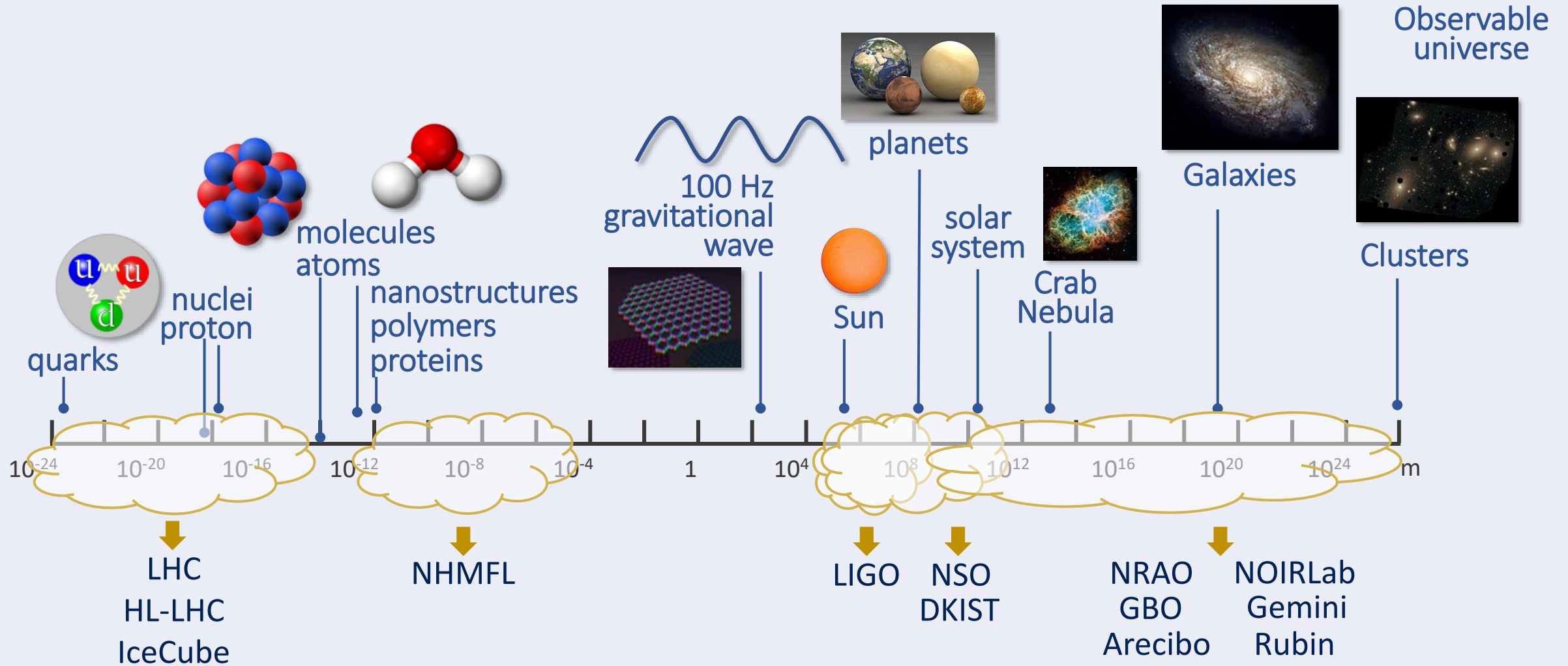


## Prototypes

Tools and materials are available to all in the network



# MPS Major Facilities Portfolio



# Construction: Facilities coming soon

- Rubin Observatory
  - Construction started in 2014
  - Significant COVID-19 impacts
    - Rebaselined in Spring 2022
  - ETA: Operations in mid/late-2024
- High-luminosity LHC Detector Upgrades: ATLAS and CMS
  - Started in April 2020
  - Impacts due to COVID-19, CERN Schedule delay, Ukraine (loss of Russian contribution)
    - Rebaseline in Spring 2023
  - ETA: New CERN schedule = installation in January 2026 (+1yr)





# Development: Facilities on the Horizon

- AST: Astro2020
  - Several Major Facility recommendations critical to advances in the field
- PHY: What is next in Gravitational Wave observations?
  - Cosmic Explorer “Horizon Study”
  - AC Subcommittee on next-generation facility concepts
- DMR: What is next in high magnetic field instrumentation?
  - National Academies Study





**Thank You !**

Contact Information:  
[MPS: dcaldwel@nsf.gov](mailto:dcaldwel@nsf.gov)