

Quantum Information Science and Technology Update

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Goal: Accelerate the Buildout and Scale-Up of the U.S. Quantum Industrial Base

NIST will advance U.S. quantum sector leadership and accelerate:

- Manufacturing of **new quantum sensors**.
- Manufacturing of **scalable, high-performance quantum components and systems**.
- **Development of quantum networks**, including deployable atomic clocks.



The Hub:

- Develops core quantum technologies, pursuing fundamental and translational research
- Ensures cross-cutting impact of key innovations in sensor science
- Accelerates commercial development of sensors
- Builds, tests, and demonstrates synchronized high-accuracy network of optical atomic clocks

**NIST
Quantum
Hub**

Spoke 1

Spoke 2

Spoke 3

The Spokes:

- Develop scalable, high-performance quantum components and systems
- Advance timing, synchronization, and networking
- Advance quantum sensing and precision measurement

The Quantum Technology “Spokes” will overcome
3 Grand Challenges:

**Reducing size, weight,
power, and cost (SWaP-C)**

**Achieving high
performance and
scalability necessary for
economic impact by
overcoming major
engineering barriers**

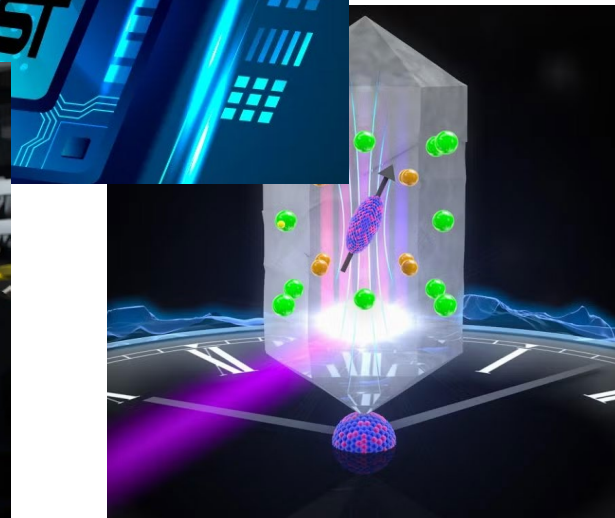
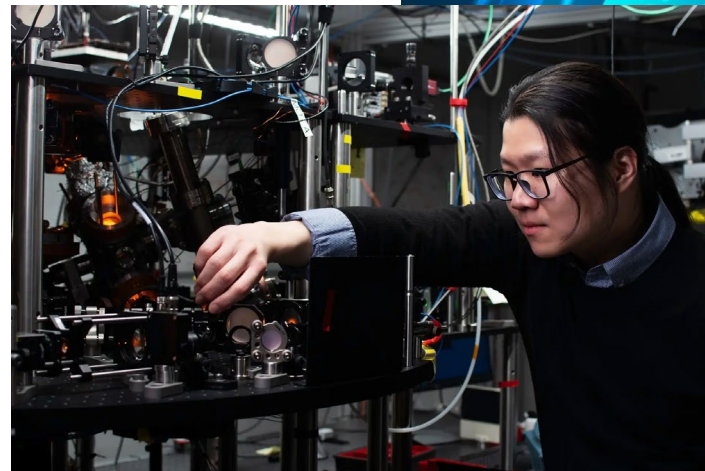
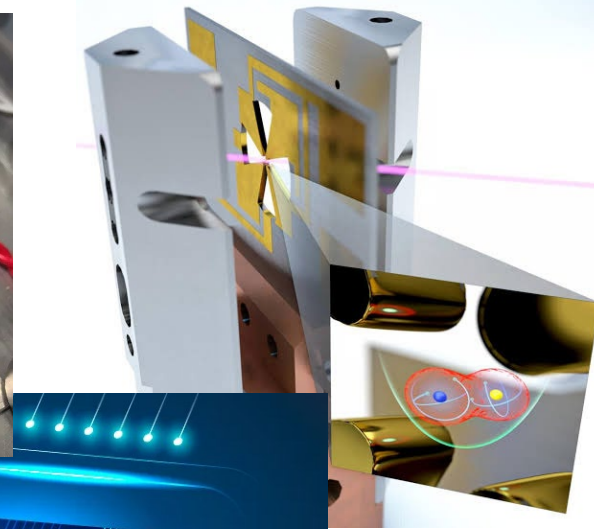
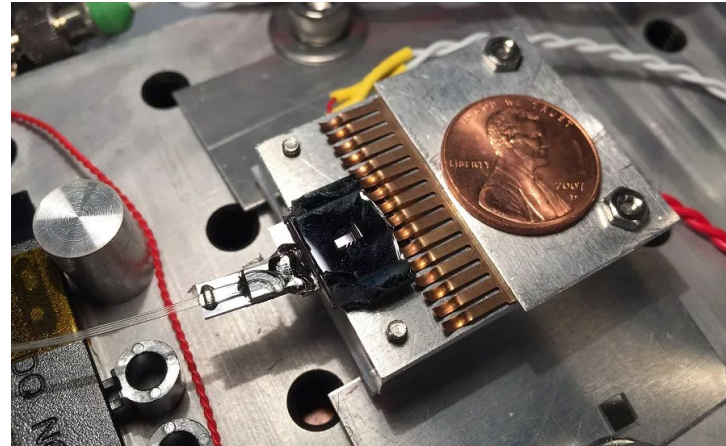
**Enabling field deployment
through rugged design and
advanced manufacturing**

...by leveraging and enhancing NIST’s core research and standards mission capabilities and essential private sector capabilities to co-develop technological advances.

Quantum Research in the Laboratories (“Hub”)

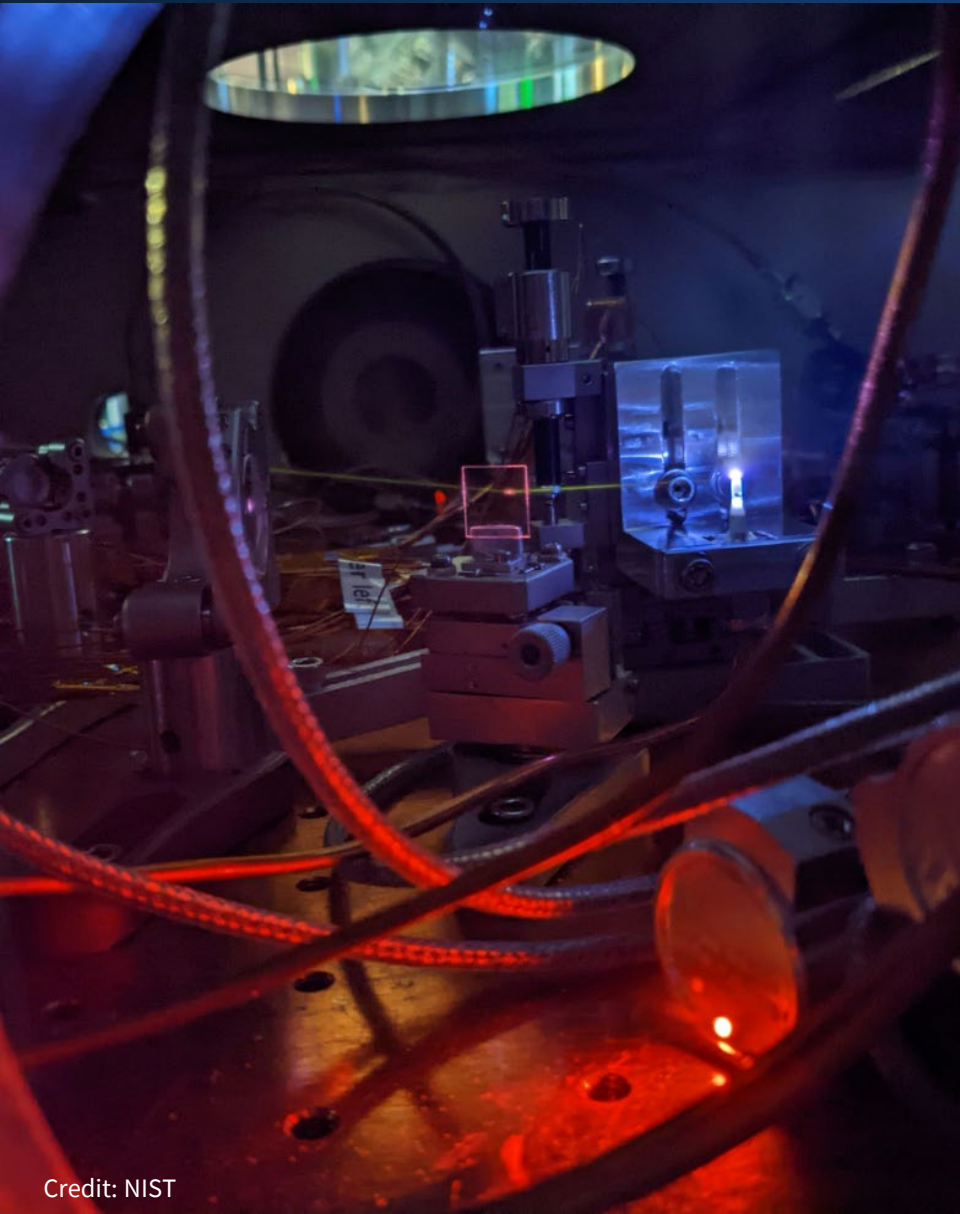
NIST is advancing research in the following areas:

- **Quantum Sensing and Precision Measurement** e.g. optical atomic clocks (compact and high-performance) for time keeping and navigation, nano-mechanical and opto-mechanical devices, atomic magnetometers, chemical and biological systems.
- **Quantum Networking** e.g. quantum repeater, quantum transduction, optical networks (both quantum and classical, fiber and free-space), single photon sources and detectors, testbeds.
- **Quantum Computing** e.g. improving qubit performance across all major platforms, benchmarking, error correction, new technologies for scaling.
- **Fundamental Quantum Science** e.g. quantum simulation, understanding complex quantum systems, searches for ‘beyond Standard Model’ physics e.g. dark matter, tests of gravity and quantum mechanics.
- **Enabling Technologies** e.g. integrated photonics, optical frequency combs, materials and fabrication, cryogenics, control electronics.



- **Precision measurement at the absolute limits of physics** – Atomic clocks, quantum sensors, foundational physics, understanding and controlling complex quantum systems, and future standards.
- **Hybrid and connected quantum systems** – Overcoming the limitations of individual modalities and a path to scaling. Transduction.
- **Scaling to large high-performing quantum systems** – Decoherence, noise, loss, fabrication, control, architectures, integration, repeaters and networking, quantum error correction, and fault tolerance.
- **Metrology beyond component benchmarking** – Characterizing the performance of complex quantum systems, and across different platforms.
- **Materials and fabrication for quantum** – Performance, reproducibility, reliability, yield, and manufacturing of quantum devices.
- **Applications and quantum advantage** – Connecting quantum advantage to real-world applications. Developing practical uses cases from abstract quantum gain.

Quantum Research Program by the Numbers



- Involves 120+ Feds (+ Associates) and 200+ projects across both campuses and at joint institutes

- Industry: 25+ active CRADAs with U.S. quantum companies and NIST researchers engaging with QED-C

- Strong partnerships with other federal agencies

- A growing portfolio of quantum-related IP

NIST is establishing the **Quantum Manufacturing Engineering Center (QME-C)** with a private sector partner (to be announced soon)

- Accelerate manufacturing of quantum components and systems by partnering with U.S. quantum manufacturers to overcome engineering challenges for high performance, scalability, and commercial viability of quantum components and devices
- NIST is very strong in all these areas - an excellent partner for industry
 - Co-development R&D projects will be based on both technical and commercial merit
 - Industry partners within the QME-C must have an existing manufacturing footprint

Program Focus Areas:

1. Lasers and photonics
2. Cryogenics
3. Miniature vapor cells
4. Materials, fabrication, and control systems

1. High-Impact Opportunities

- Identify at least 5 highly impactful technology development opportunities that can act as force multipliers.

2. Manufacturability Acceleration

- Reduce the production time for new or updated quantum components and devices by at least 50%.

3. Production Scaling

- Demonstrate scaling volume of production of quantum components and devices by a factor of at least 50.

4. SWaP-C Reduction

- Demonstrate reduced size, weight, power, or cost by a factor of at least 10.

Out of Scope: fundamental research, feasibility studies, one-off prototypes, new facilities, incremental development

Quantum Economic Development Consortium (QED-C)

Mission: to grow the quantum economy through community-building and collaboration

Established in 2019 in response to the NQI, managed by SRI in partnership with NIST (with guidance from a Steering Committee), funded by members and NIST (and others), and industry led.

Organized into Volunteer Technical Advisory Committees (TACS)

- Enabling Technologies
- Commercialization and Use Cases
- Law and Policy
- Quantum for National Security
- Standards and Performance Metrics
- Workforce

Members

- 250 members – quantum companies (all U.S.), universities, and government partners
- 39 countries

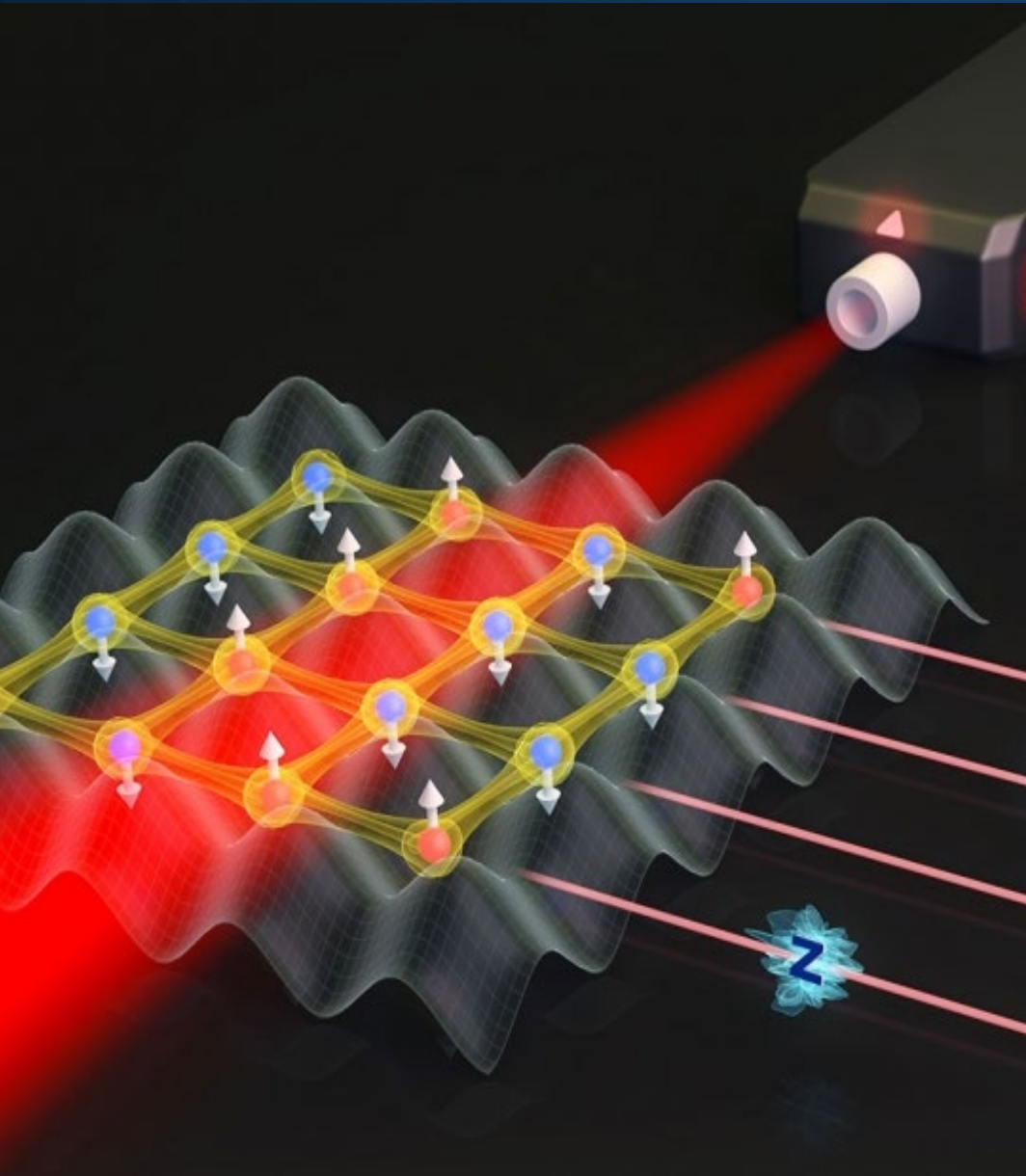
Activities (of critical value to NIST)

- Frequent activities for identifying technology gaps, collaboration opportunities, and industry needs and priorities (Feds can join for free and participate)
- 36 reports, studies, and analyses (so far)



**Report: State of the
Global Quantum
Industry**

National Quantum Initiative (NQI)



The **National Quantum Initiative (NQI)** is a coordinated U.S. federal program originally enacted in 2018 to accelerate quantum research, workforce development, and technology commercialization. The initiative is undergoing reauthorization.

NIST NQI activities:

- Basic and applied quantum research
- Measurement and standards infrastructure
- Industry and academic collaborations
- Industry consortium (QED-C)
- Workforce development

Thank you!

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