Q-NEXT
NEXT-GENERATION QUANTUM SCIENCE AND ENGINEERING

We advance the state-of-the-art in quantum information science and technology to ensure U.S. leadership in this economically crucial arena.

Q-NEXT, a U.S. Department of Energy National Quantum Information Science Research Center led by Argonne National Laboratory, is a partnership of national lab, academic and industry collaborators, formed to accelerate progress in quantum information science.

IMPACT

Advances in quantum information science, known as QIS, have the potential to revolutionize the way we process and share information. QIS research could have profound impacts such as advanced medical imaging, the creation of novel materials, and ultrasecure communication networks.

The U.S. must maintain a leadership position in R&D to ensure its global competitiveness in the new quantum economy and to maintain an edge in secure communications. Q-NEXT is uniquely qualified to help realize that vision.

MISSION

Q-NEXT's mission is to develop the science and technology to control and distribute quantum information, enabling pivotal discoveries and U.S. competitiveness in quantum science and engineering.

Q-NEXT partners accomplish this by

- Advancing research in quantum communication, materials, sensing and simulation.
- Creating and strengthening connections between science organizations and industry to build a national quantum ecosystem.
- Launching foundries dedicated to the development of quantum materials and technologies.
- Leveraging world-class science facilities, including supercomputers, light sources, and materials fabrication labs at the national laboratories, to accelerate QIS research.
- Building the quantum workforce.

NEXT-GENERATION SCIENCE AND ENGINEERING

Q-NEXT researchers are advancing the technology to share quantum information over distances as small as the width of a computer chip or as large as the distance between Chicago and San Francisco.

To fulfill its mission, Q-NEXT is enabling breakthroughs in:

- Communication: developing the technologies to distribute quantum information robustly and securely over long distances, laying the foundation for networks that transmit signals in the form of entangled states.
- Materials: creating materials for building qubits—the basic unit of quantum information—and integrating them into quantum memories, analogous to the memory on your desktop computer.
- Sensing: developing sensors that detect signals with unprecedented sensitivity—with some measuring signals with an accuracy below the standard quantum limit of detection—and integrating them into larger systems.
- Simulation: developing open-source simulation tools to study the behavior of quantum materials and algorithms, improving scientists' ability to control and scale quantum devices and systems.

CROSS-SECTOR, CROSS-DISCIPLINE COLLABORATION

By integrating both industry and academia in every level of the organization, Q-NEXT bridges these sectors, providing each with resources and capabilities that would not otherwise be available to them. The center's roughly 100 collaborators are leaders in quantum information theory, high-performance computation, quantum experimental science, materials science, and high-energy physics, fostering a fruitful, cross-disciplinary environment for advancing QIS.

Q-NEXT members are developing a technology roadmap to guide center activity. The roadmap outlines the R&D milestones needed to be able to process information through quantum entanglement on a 10- to 15-year timescale, and it will help inform the growth of a national quantum ecosystem.

NATIONAL QUANTUM RESOURCES

Q-NEXT is both building and leveraging national resources to provide a robust supply chain of quantum materials and devices, which are critical for a vibrant quantum economy.

These include two new quantum foundries—one at Argonne, one at SLAC National Accelerator Laboratory—to provide sources of high-quality, standardized materials and devices that will support quantum-enabled applications. The center will also establish the first-ever National Quantum Devices Database and the Intel Solid-State Test Bed.

Q-NEXT leverages forefront scientific facilities at its partner institutions as well as advanced instrumentation at member companies, increasing partner access to these facilities and accelerating research.

CAREERS FOR THE NEXT GENERATION

The quantum technologies of the future will need scientists and engineers to build, program and maintain them and to harness the barely tapped potential of quantum materials.

Q-NEXT is creating new programs that take advantage of the breadth of its partnerships and give students the opportunity to learn in an environment that lies at the intersection of the national labs, academia and industry. These include novel institutional degree programs, cooperative training programs with industry, and retraining certificate programs that help classically trained scientists and engineers prepare for careers in QIS.

WE BRING TOGETHER

- World-leading experts
- State-of-the-art research facilities
- Existing projects and collaborations

OUR TEAM

- 3 national laboratories
- 10 universities
- 12 industry partners

Q-NEXT RESEARCH WILL HAVE IMPACTS IN

- Computing
- Telecommunications
- Energy
- Financial services
- Materials and chemicals
- Meteorology
- Pharmaceuticals
- Transportation and logistics

NATIONAL LABORATORIES

Argonne NATIONAL LABORATORY
SLAC NATIONAL ACCELERATOR LABORATORY
Pacific Northwest NATIONAL LABORATORY

ACADEMIA

Caltech
Cornell University
Massachusetts Institute of Technology
Northwestern University
PennState
Stanford
UC SANTA BARBARA
THE UNIVERSITY OF CHICAGO
ILLINOIS
WISCONSIN UNIVERSITY OF WISCONSIN-MADISON

INDUSTRY

APPLIED MATERIALS
BOEING
ColdQuanta
GENERAL ATOMICS
HRL LABORATORIES
IBM
intel
KEYSIGHT TECHNOLOGIES
Microsoft
Quantum Opus
verizon
Zurich Instruments

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