QUANTUM INFORMATION AT NIST

BY THE NUMBERS

4 Nobel Prizes
awarded to NIST employees in the past 18 years for "quantum science"

225+
Quantum information papers published by NIST and Joint Quantum Institute scientists in 2013

100x
Performance increase in NIST atomic clocks during the past decade, thanks to quantum technology

£270 million
(approximately $421 million)
Amount the U.K. is investing during the next 5 years in quantum technologies

The Challenge

Multiple nations are vying for leadership in the emerging field of quantum information science (QIS), which uses non-intuitive physical laws that rule at very small scales (nanoscale) to engineer entirely new technologies. Quantum computers will rely on qubits, or quantum bits, which can store much more information than the bits of today's transistor-based computers. With their expanded capabilities, quantum computers will make many of today's encryption methods obsolete, while opening new possibilities in solving intractable computational challenges. The field is poised to create the measurement tools, standards, and sensors that define future innovative technologies and the primary drivers of national economies and security concerns.

What NIST Does

- Performs fundamental research in quantum science and related areas.
- Conducts applied research to create improved sensors at the highest levels of precision and for cheap, ubiquitous sensing of the environment.
- Investigates the power of quantum information and its application to computationally intractable problems and post-quantum cryptography.

Program Goals

- Demonstrate, characterize, and engineer robust small quantum systems for improved sensing and better and/or cheaper quantum standards for a variety of applications.
- Create, develop, and characterize robust and efficient technologies that allow different quantum systems to work together for quantum computing and communications applications.
- Develop tools for understanding, manipulating, controlling,

(continued)

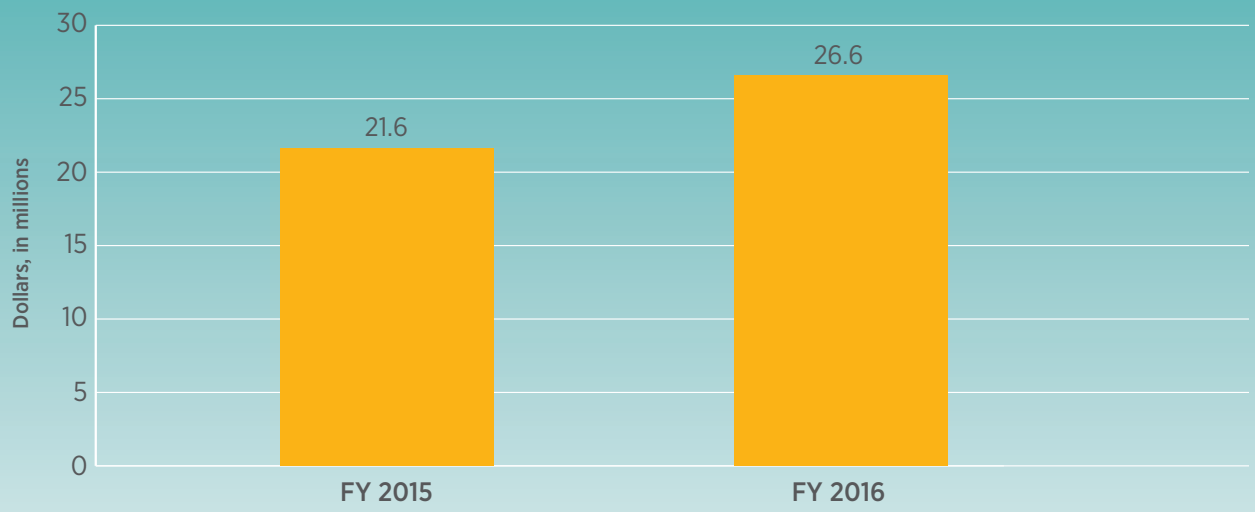
and measuring complex quantum systems to create the measurement science and scientific knowledge needed for future technologies and innovation, including the simulation of complex quantum systems that cannot be simulated with current technologies.

- Develop and explore quantum materials and solid-state qubits for future advanced quantum devices.

Recent Program Highlights

- In 2014, NIST established the Joint Center for Quantum Information and Computer Science (QuICS) at the University of Maryland, College Park, to explore the power of quantum information and its application to computationally intractable problems and post-quantum cryptography.
- Demonstrated a component for a flexible quantum simulator that could be scaled up and configured to model quantum systems of a complexity that overwhelms traditional computer simulations.
- Showed that it is possible to "push" part of a light beam past the speed of light, then showed that this effort would result in a loss of the quantum data the light carries.

Budget



New for 2016

NIST is requesting an additional $5 million to focus on:

- Accelerating widespread use of quantum science
  - Creating capabilities needed for mass production of solid-state qubits
  - Developing a roadmap for enabling business adoption of quantum science
- Supporting the development of next-generation quantum devices
  - Advancing simulation capabilities of complex quantum systems
  - Improving commercial single-photon detectors tenfold