



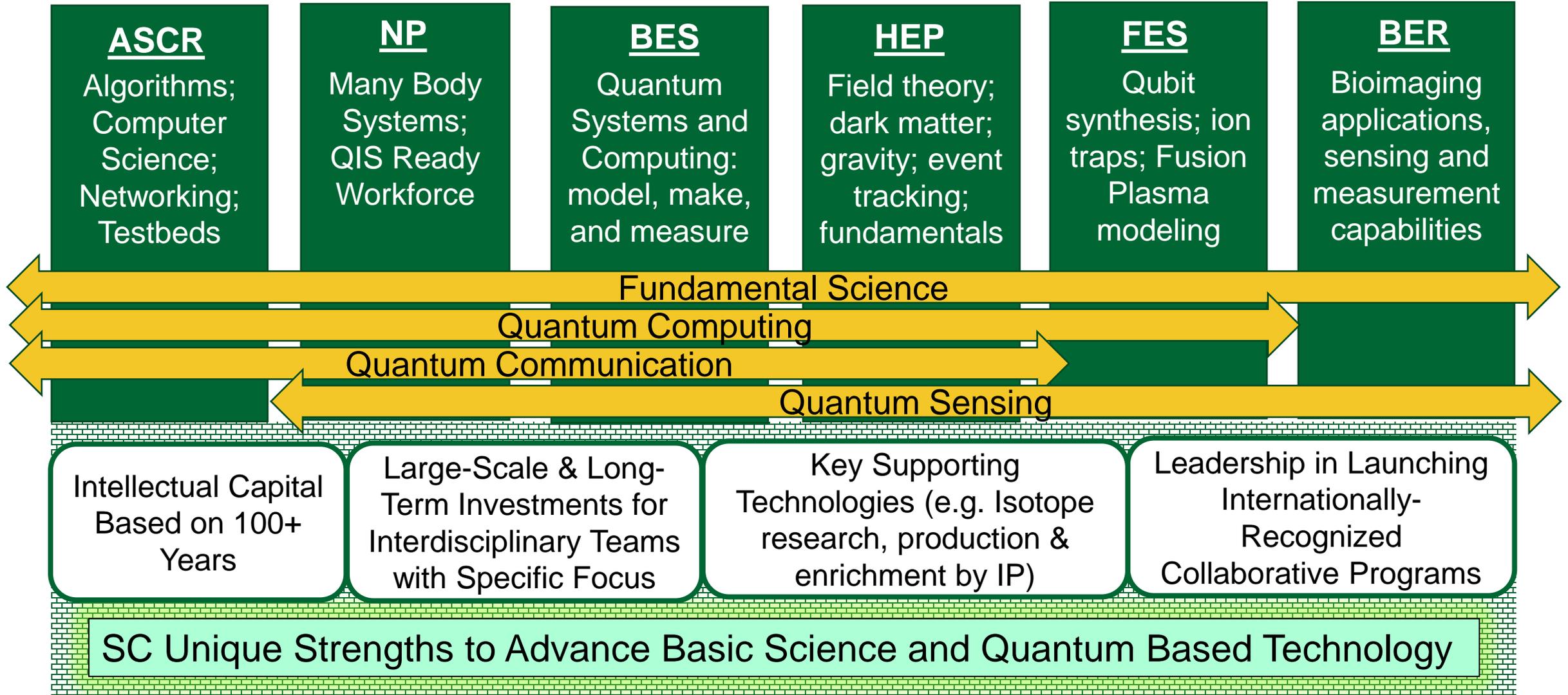
U.S. DEPARTMENT OF
ENERGY

Office of
Science

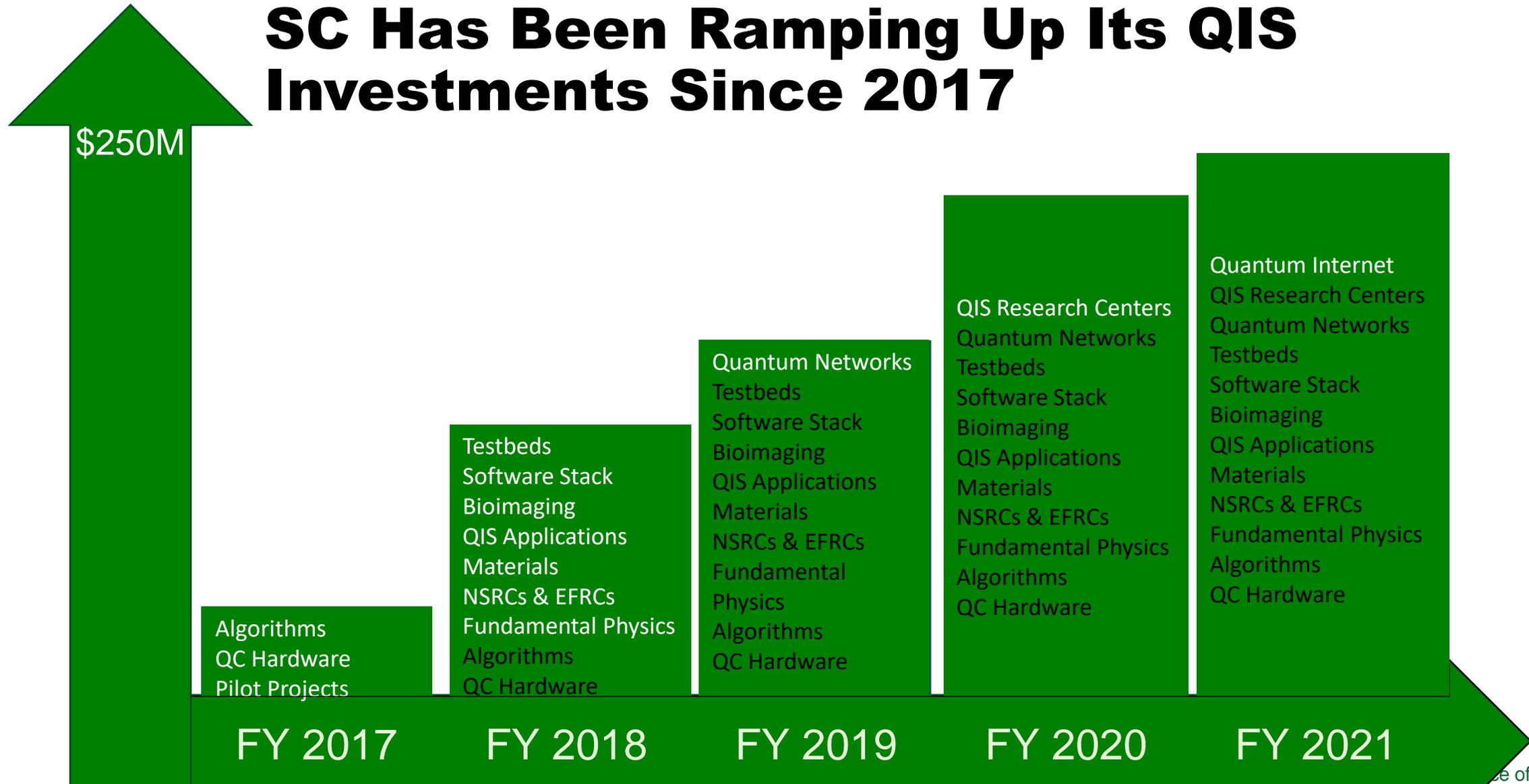
Quantum Information Science at the Department of Energy

Ceren Susut, PhD
Advanced Scientific Computing Research
October 27, 2020

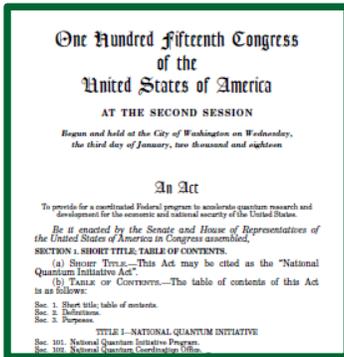
QIS Crosses the Technical Breadth of the Office of Science



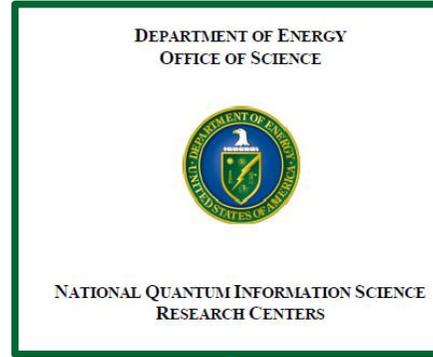
SC Has Been Ramping Up Its QIS Investments Since 2017



A Long Path to National QIS Research Centers



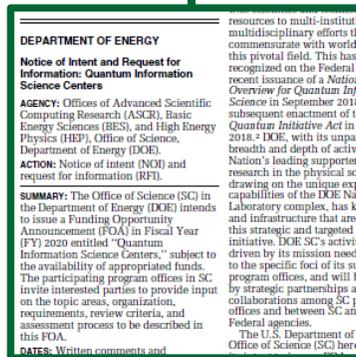
May 2019
RFI



February-
Mid August 2020
Review Process



December 2018
NQI ACT



January 2020
FOA

August 26th, 2020
Announcement

Five National QIS Research Centers

Q-NEXT • Next Generation
Quantum Science and Engineering
(David Awschalom, ANL)



C²QA • Co-design Center for
Quantum Advantage
(Steve Girvin, BNL)



SQMS • Superconducting Quantum
Materials and Systems Center
(Anna Grassellino, FNAL)



- ✓ QIS S&T Innovation Chain
- ✓ Technical Areas of Interest
- ✓ QIS Ecosystem Stewardship
- ✓ Management Structure
- ✓ Instrumentation and Facilities



QSA • Quantum System Accelerator
(Irfan Siddiqi, LBNL)

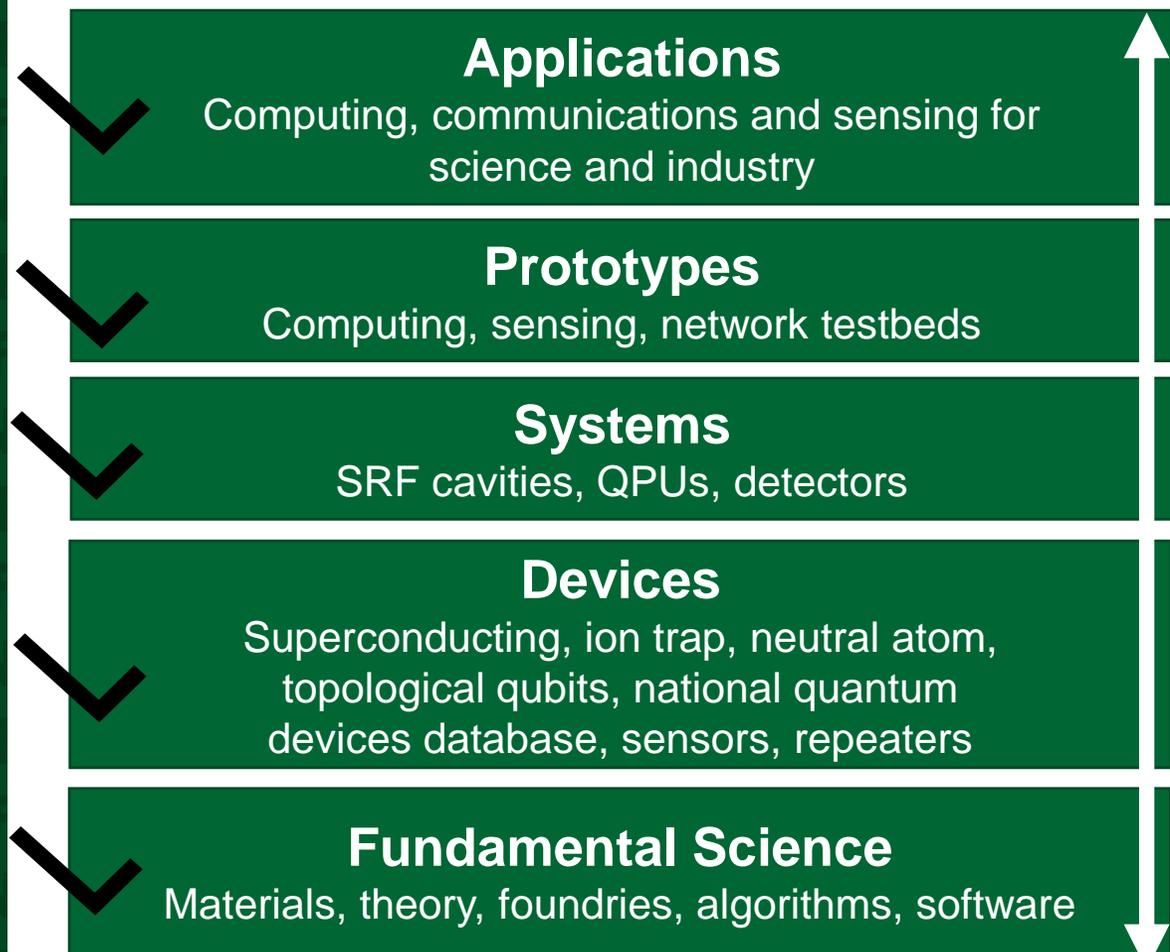


QSC • The Quantum Science Center
(David Dean, ORNL)

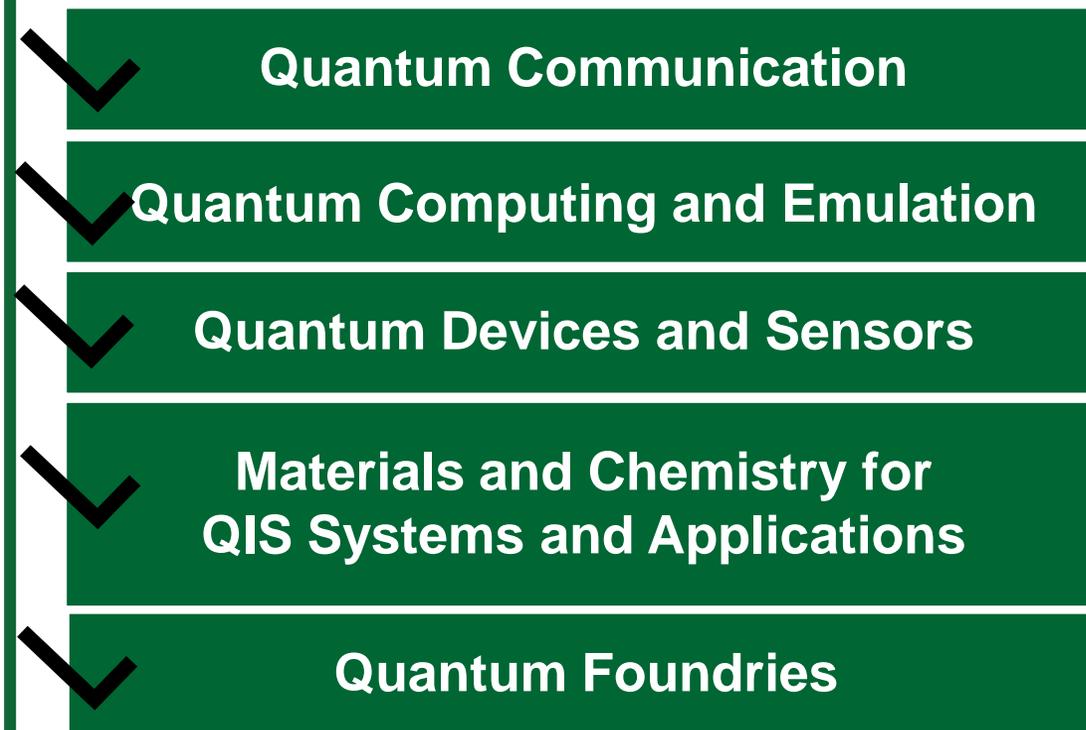
<https://science.osti.gov/Initiatives/QIS>

National QIS Research Centers Portfolio

S&T Innovation Chain with Targets



Complementary Technical Areas of Interest



Office of Science programs well-covered

National QIS Research Centers Portfolio

Diverse Management Structures

- Center Directors: 4 senior males, 1 mid-career female
- Deputy Directors: 4 males, 1 female; 4 senior, 1 early-career; 3 labs, 2 universities
- Recognition of project management best practices: ECP-like (ORNL) to Lean (FNAL)
- BEST experts in the world, clear commitment to significant national impact

Instrumentation & Facilities

- Full leverage of DOE facilities across the lab complex
- Building new capabilities: e. g. ANL and SLAC quantum foundries
- Incorporating industry: e. g. ANL (Intel testbed)
- Using international facilities: e.g. FNAL (Gran Sasso, largest underground laboratory in the world)

QIS Ecosystem Stewardship

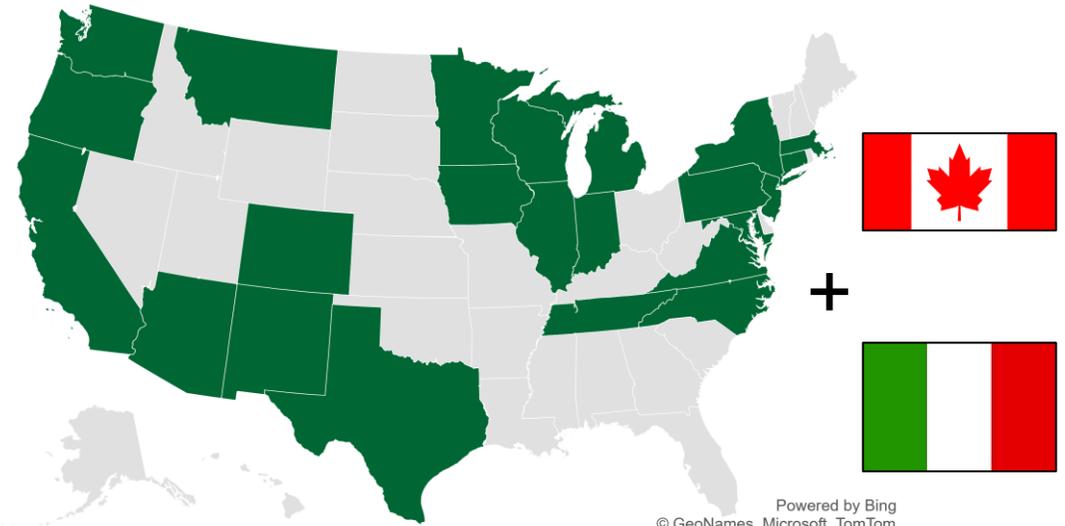
39 Academic institutions + 11 DOE Labs + 14 Companies +
3 Other agency entities + 2 Foreign institutions =

69 Institutions from 23 states + DC + Canada + Italy

Members of QED-C, connections to NSF Quantum Leap
Challenge Institutes (e.g. Jun Ye in LBNL-led Center)

Unique approaches for workforce development and industry
outreach (e.g. Simons Institute, pilot programs)

Leveraging other DOE investments (e.g. Testbeds, JCESR)



Office of Science's QIS Goals Encompass Multiple Time Scales

Investments with National Impact

E.g National QIS Research Centers, Quantum Internet

Whole of SC & Whole of QIS

Keep all SC programs involved to advance basic research, technology development and workforce

Community Engagement

Continue with information exchanges

Collaboration

Industry: Innovation Economy

Other agencies: Coordination

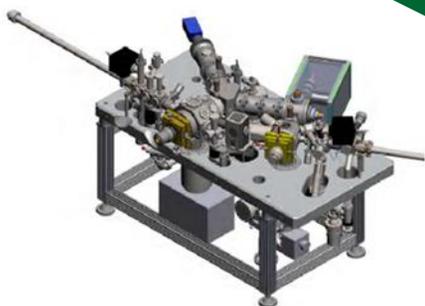
International: Awareness

QIS in SC is a long-term effort

DOE's QIS Programs are well-aligned with the National Quantum Strategy



Quantum sensors for laboratory detection of dark matter (FNAL)



Quantum cryo-electron microscope with a spin polarized electron source to measure decoherence (LBNL)



OLCF's quantum computing user program enables access to IBM, D-Wave, Rigetti and Atos platforms

Science

An expansive portfolio to support QIS solutions for DOE grand challenges

Workforce

Leverage unique resources to support QIS careers

Industry

Labs are partnering with industry for QIS research and for access to technology

National Security

Invest in a secure quantum internet & isotope R&D

Infrastructure

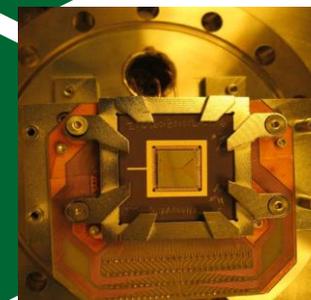
QIS specific technologies are added to existing facilities' capabilities

International

Multiple collaboration models with the international community

Economic Growth

Exploration of precompetitive technology mitigates risk for industry



Quantum scientific open user testbed at SNL develops early stage trapped ion platforms