



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science

# Quantum Information Science in the Department of Energy Accelerating Scientific Discovery

Carol Hawk  
Advanced Scientific Computing Research  
July 20, 2021

[https://https://science.osti.gov/Initiatives/QIS](https://science.osti.gov/Initiatives/QIS)

**DOE Mission:** The mission of the Energy Department is to ensure America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions.

**<https://www.energy.gov/mission>**

**DOE Office of Science (SC) Mission:** The mission of DOE's Office of Science is to deliver scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic, and national security of the United States.

**<https://www.energy.gov/science/mission>**

# The DOE Office of Science Research Portfolio

Basic Energy Sciences  
(BES)

- Understanding, predicting, and ultimately controlling matter and energy flow at the electronic, atomic, and molecular levels

Advanced Scientific  
Computing Research  
(ASCR)

- Delivering world leading computational and networking capabilities to extend the frontiers of science and technology

Biological and  
Environmental Research  
(BER)

- Understanding complex biological, climatic, and environmental systems

Fusion Energy Sciences  
(FES)

- Building the scientific foundations for a fusion energy source

High Energy Physics  
(HEP)

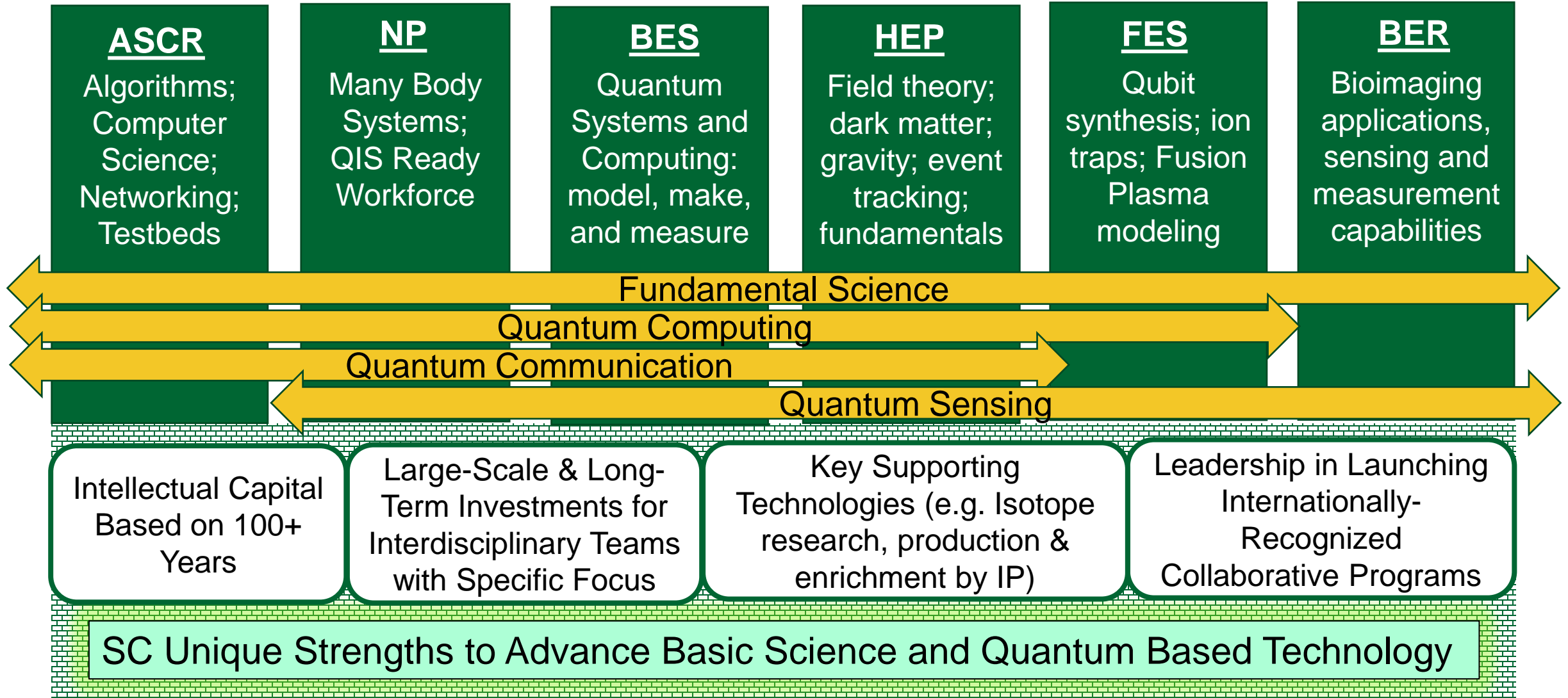
- Understanding how the universe works at its most fundamental level through research, projects, and facilities

Nuclear Physics (NP)

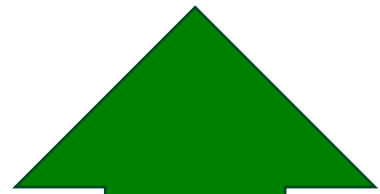
- Discovering, exploring, and understanding all forms of nuclear matter

<https://www.energy.gov/science/office-science>

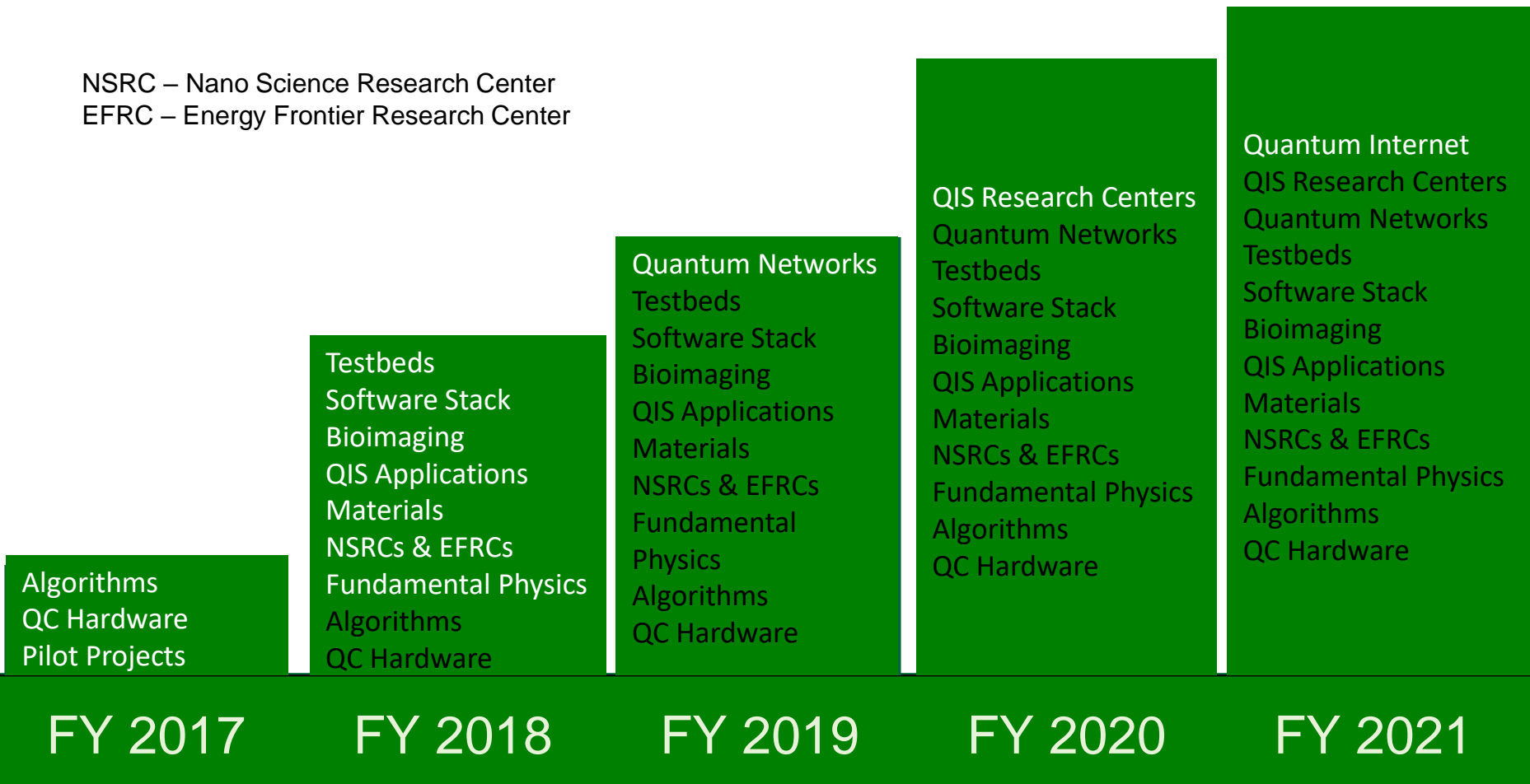
# QIS Crosses the Technical Breadth of the Office of Science



# SC Has Been Ramping Up Its QIS Investments Since 2017



NSRC – Nano Science Research Center  
EFRC – Energy Frontier Research Center



# DOE's Role in Science and Engineering Education

DOE has a more than 60-year history of training and educating scientists and engineers in the United States—Its primary role in STEM education:

- Training highly skilled workers that are the foundation of DOE's science and technology enterprise
- Promoting targeted areas of science and energy literacy at all levels
- Thousands of undergraduates, graduate students, and postdocs supported annually on R&D awards and projects at universities and national laboratories. (*e.g. over 4,400 grad students supported on SC awards*)
- Over 1,400 internships and graduate training opportunities at all 17 DOE Labs that are specifically **WDTS programs**, expanding the reach of SC WD efforts.
- SC program offices also support tailored training opportunities specific to the fields and disciplines that are not adequately addressed by other Federal programs (*e.g. computational science, accelerator science, and nuclear chemistry*)
- DOE has been an engaged partner in inter-agency STEM efforts (*e.g. White House Committee on STEM Education [OSTP/NSTC/CoSTEM]*)



# Partnerships to Deliver Future Leaders

## DOE Computational Science Graduate Fellowship (CSGF)

- **Started in 1991 to broadly train advanced computational scientists**
- **Funded by both DOE-SC/ASCR and NNSA/ASC**
  - Currently, CSGF supports 99 students at 41 universities in 22 states.
  - More than 500 students at 65 U.S. universities have trained as fellows.
- **Requires that fellows**
  - plan and follow a plan of study that transcends the bounds of traditional academic disciplines
  - participate in 12-week research experience at DOE lab
- **Benefits**
  - Up to four years of support, including full tuition/ required fees paid
  - Yearly stipend of \$38,000 plus an Academic allowance
  - Annual program review with peers, Alumni and DOE/Lab scientists
- **CSGF Longitudinal Study (2017)**
  - “Academia can be very isolating at time ... one of the biggest effects [of the CSGF] is just opening your eyes to what else is going on in computational science around the country in different fields by different people. That made the groundwork, I think, for future leaders of both their domains and this cross-domain collaboration.” (page 4-27)
  - “[In the DOE complex] you're actually paid attention to because you're valuable and people didn't care what gender you were or what race you're from and I think that's definitely not the case in academia.” (page 4-26)

2019 incoming class of Computational Science Graduate Fellows



CSGF alumni work in DOE laboratories, industry and educational institutions



The Subcommittee believes that the CSGF is unique in its focus on Computational Science. It provides features that other Graduate research Fellowships do not, such as the Plan of Study, the Practicum, the Annual CSGF Conference and efforts to keep alumni engaged. In this regard, the CSGF is an exceptional program that produces interdisciplinary scientists uniquely qualified to address current and future computational science challenges...The Subcommittee recommends that the funding for the CSGF be put on a path to double over the next five years.

*2011 ASCAC Review of DOE Computational Science Graduate Fellowship Program*



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science

# SC STEM Training and Workforce Development

- **Computational Sciences Graduate Fellowship** (ASCR [w/NNSA])  
Supports graduate students obtaining a Ph.D. in high performance computational science and engineering. Requires a DOE lab practicum. (FY 2020 \$12M). ~20-25 fellowships awarded/year. Program has been on operation for over 28 years. (Evaluated by ASCAC periodically, renewal proposal solicited every 5 years)
- **Nuclear Chemistry & Radiochemistry Summer School** (BES and NP)  
An intensive 6-week undergraduate course at an East Coast and West Coast location. Classroom and laboratory work covers areas of nuclear chemistry and radiochemistry no longer part of university chemistry departments. Students earn undergraduate course credit. (~24 students per year). Most go into fields relevant to DOE. In operation since 1984. (University-lab partnership, renewal proposal solicited every 4-5 years)
- **U.S. Particle Accelerator School** (HEP[*lead*], BES, and NP)  
An intensive 2-week course curriculum for graduate students, postdocs, and DOE laboratory staff, and industry to learn the latest in accelerator and detector research and development. Held 2 times per year. Students can obtain course credit. Instructors come from DOE labs and universities and are volunteers. In operation since 1981. Over 350 participants a year. (Fermilab led, multi-lab/university partnership; reviewed and renewal proposal solicited every 3-4 year.)
- **Accelerator Science Traineeship** (HEP)  
University-led graduate program focused on accelerator science training at the graduate level. 3-4 year award, eligible for renewal. To build university capacity to train in accelerator and detector science



# STEM Workforce Training Opportunities for Students and Faculty at DOE National Laboratories

**Goal:** To help develop the next generation of scientists and engineers to support Department missions, and conduct the research that will help realize the Nation's science and innovation agenda.

**SC's Office of Workforce Development for Teachers and Scientists (WDTS) sponsors DOE Laboratory Based Workforce Training Programs:**

- **Science Undergraduate Laboratory Internship - SULI**
- **Community College Internship - CCI**
- **Visiting Faculty Program - VFP**
- **Office of Science Graduate Student Research Program - SCGSR**



**The DOE system of National Laboratories is a unique asset for training and workforce development:**

- DOE Labs Employ >30,000 Scientists and Engineers (~14,000 at SC Labs)
- World-class scientific user facilities, capabilities, and resources
- Culture of Team Science, Mentoring, and Learning through Discovery