Industries of the Future

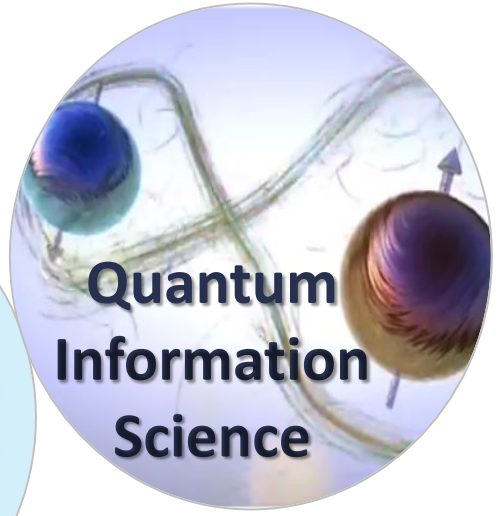
DAWN TILBURY, NSF ASSISTANT DIRECTOR FOR ENGINEERING

DIRECTORATE FOR ENGINEERING ADVISORY COMMITTEE MEETING

APRIL 7, 2020

Industries of the Future

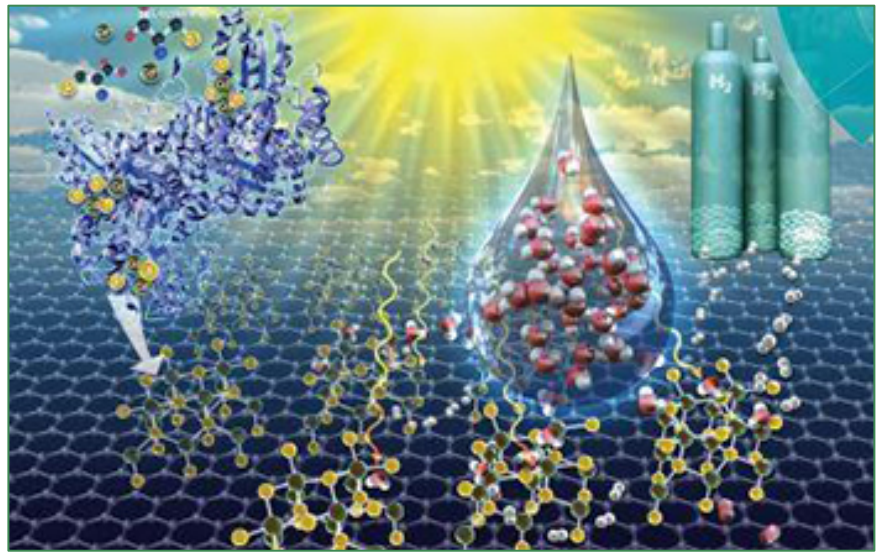
"The Industries of the Future are cross-cutting, convergent, and interdependent fields of research that collectively offer enormous economic potential and are critical to the Nation's long-term economic and national security." *NSF Director France Córdova*



Advanced Manufacturing

To transform manufacturing capabilities, methods, and practices

- Advance competitiveness through discoveries that lead to manufacturing innovations
- Secure the supply chain by growing and maximizing the use of U.S. resources
- Grow the manufacturing workforce
- Rapidly translate discoveries into useful products and create jobs through collaborations



Advanced, scalable nanomanufacturing methods offer new capabilities and greater efficiency. Here, Lehigh University researchers designed catalyst nanostructures that use sunlight to sustainably split water molecules and make hydrogen.

Future Manufacturing

Future manufacturing is manufacturing that either *does not exist today or exists only at such small scales that it is not viable*.

$40M FY 2020 investment in research grants, seed grants, and networks

- Bio-manufacturing 
- Cyber-manufacturing 
- Eco-manufacturing 

Funding for workshops for long-term strategies to transform manufacturing

Advanced Wireless

To advance areas critical to future generations of wireless technologies and networks beyond 5G and make them faster, smarter, more responsive, and more robust

- new wireless sensors, devices, circuits, protocols, networks and systems
- AI and inference on mobile devices
- human-machine-network interactions
- dynamic spectrum allocation/sharing
- integration with infrastructure systems and IoT

Advanced Wireless Investments

Spectrum and Wireless Innovation enabled by Future Technologies (SWIFT)

Spectrum Innovation Initiative: National Center for Wireless Spectrum Research (SII-Center)

DCL: Secure Analog-RF Electronics and Electromagnetics (SARE)

DCL: Supplemental Funding Requests to Conduct Experimental Research on the NSF-funded Platforms for Advanced Wireless Research (PAWR)

Artificial Intelligence

To expand the frontiers of AI to create transformational technologies and breakthroughs benefiting both science and society

- Machine learning, natural language processing, knowledge representation and reasoning, and computer vision
- Safety, security, robustness, and explainability of AI systems.
- Sectors including agriculture, manufacturing, transportation, personalized medicine
- Investment in education and learning, including developing the next generation of AI researchers and practitioners

AI Investments

National AI Research Institutes

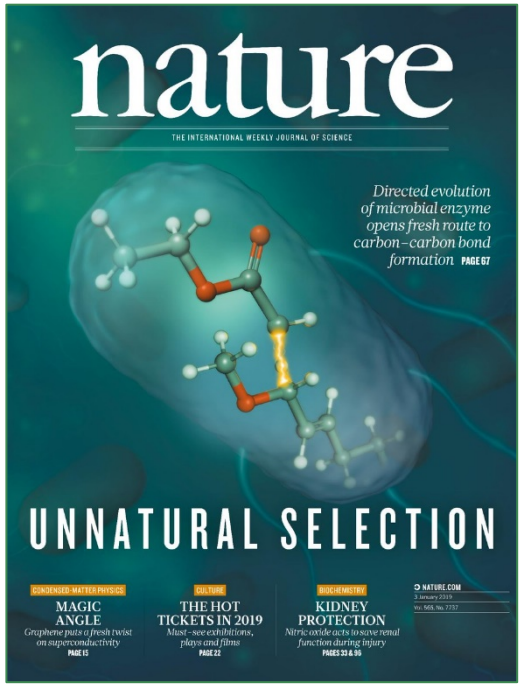
- Planning grant proposals in any area
- Institute proposals in given themes
- With NSTC coordination; in partnership with USDA/NIFA, DHS, DoT FHA, VA

NSF-Simons Research Collaborations on the Mathematical and Scientific Foundations of Deep Learning

Foundational Research in Robotics (Robotics) program

DCL on Research Opportunities in AI for Engineering

Biotechnology



Directed evolution offers a new, efficient way to build organic molecules with the help of bacteria.

To understand and harness biological processes, enabling future innovations in the therapeutics, biopharmaceutical, biochemical, and biotechnology industries

- synthetic biology, biotechnology, engineering biology, metabolic engineering, tissue engineering, biomechanics, the microbiome, biomaterials, bio-based microelectronics, and biomanufacturing.
- social and environmental implications of synthetic biology and other biotechnologies.

Biotechnology Investments

DCL on opportunities in Plant Synthetic Biology

Reproducible Cells and Organoids via Directed-Differentiation Encoding (RECODE)

Semiconductor Synthetic Biology (SemiSynBio)

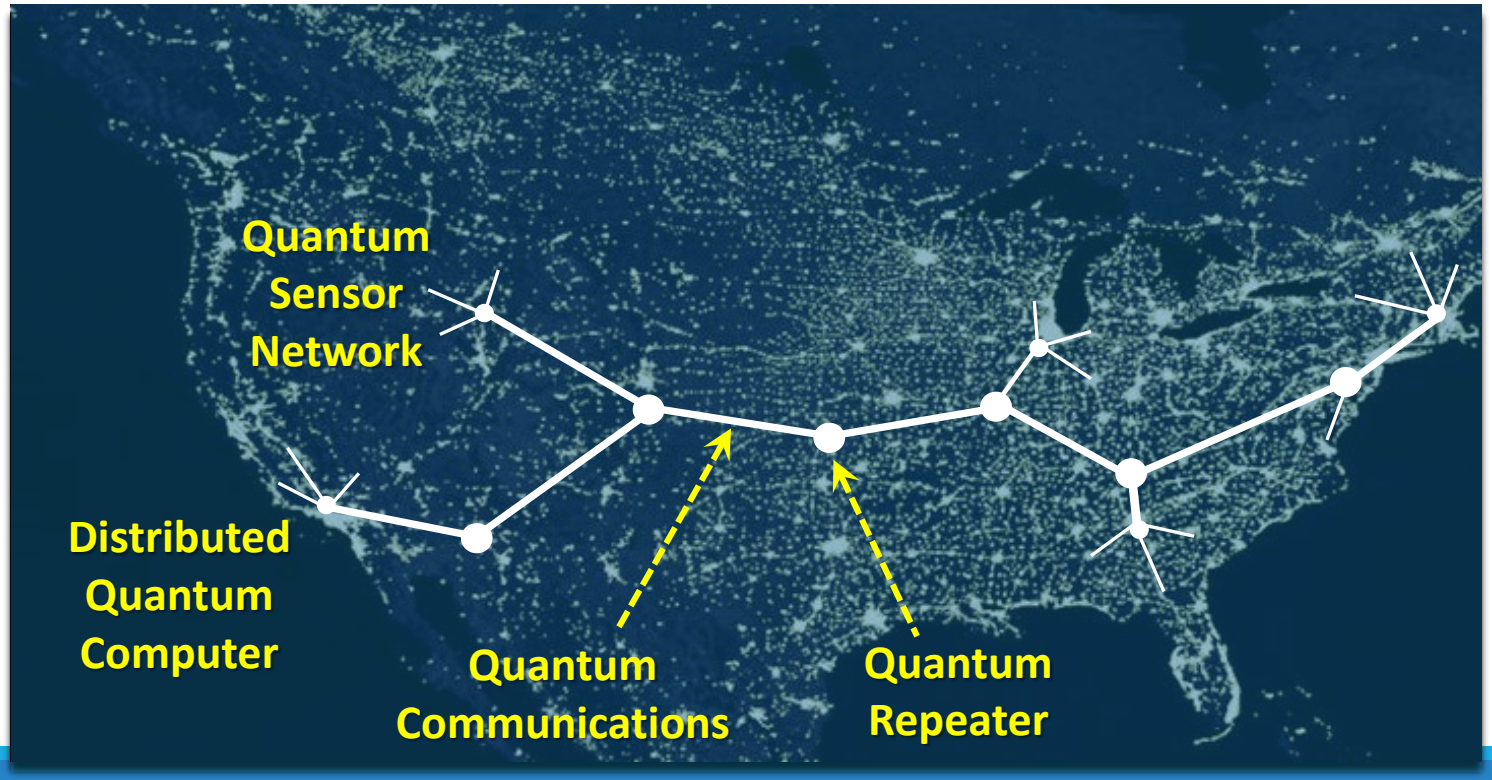
NSF-funded University of Maryland researchers led by William Bentley reengineered cell consortia to autonomously coordinate their subpopulation behavior — a technique that could help people improve bio-based products and processes.
Image credit: NIAID

Quantum Information S&E

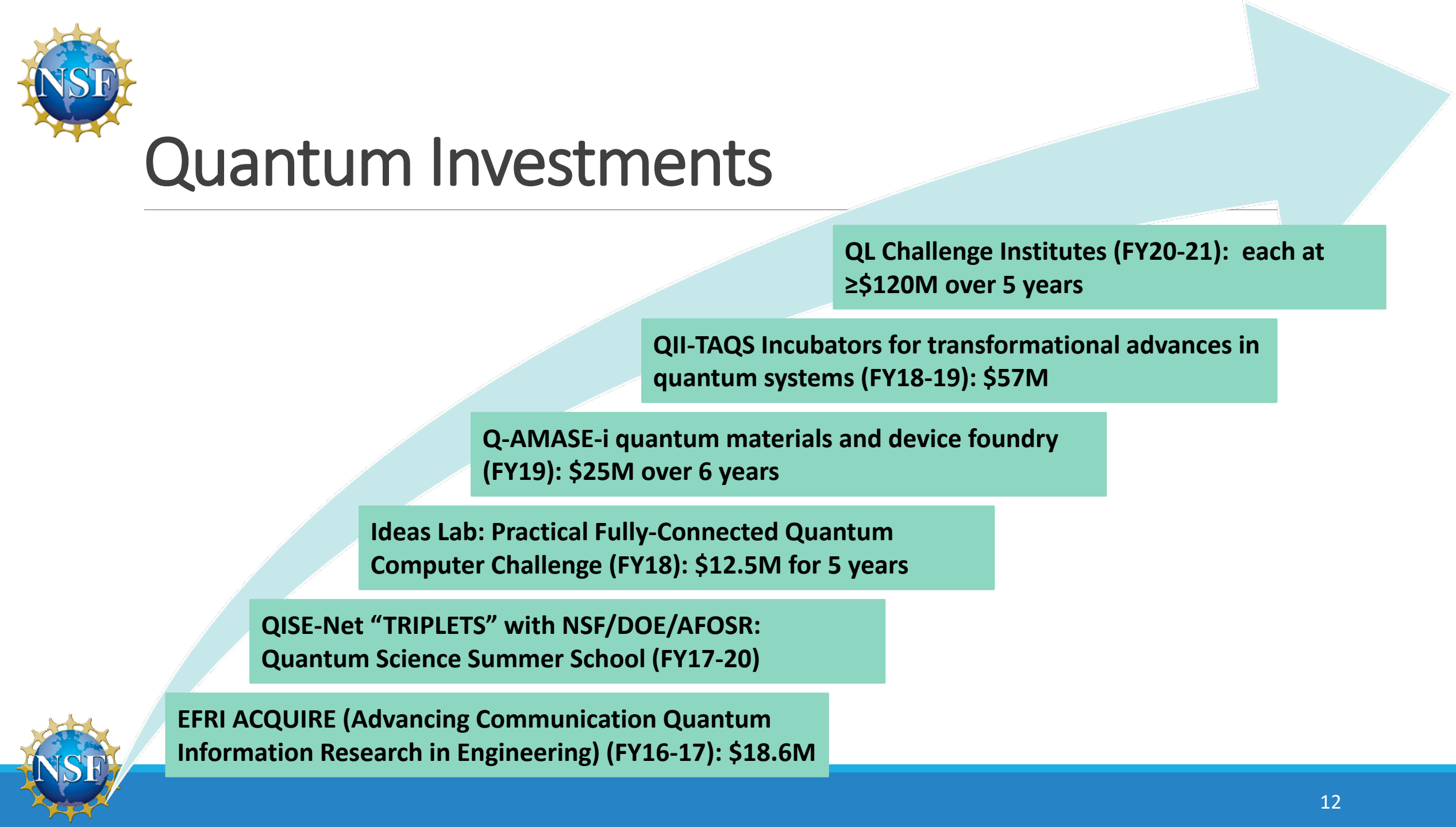
To design devices, applications, tools, or systems with a quantum-based advantage over their classical counterparts

Example: A quantum internet that connects secure communications, computing, and sensing networks

Needs: Quantum interconnects, memories, repeaters, and workforce



Quantum Investments



Discussion Questions

How can NSF help create Industries of the Future that are diverse and inclusive? Are there special concerns or considerations for the different IotF?

Are there any areas of education and workforce development for IotF that need special attention from NSF?

How can NSF researchers work with current industry partners (both small and large companies) to help further basic research in IotF?