



Quantum Leap and the National Science Foundation

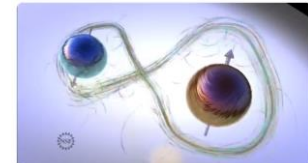
RIT Photonics for Quantum 2

July 20th, 2020

Dominique Dagenais

Directorate for Engineering

National Science Foundation



Looking Ahead: Ten Big Ideas

10 Big Ideas

Opportunities for investment at the frontiers of science & engineering



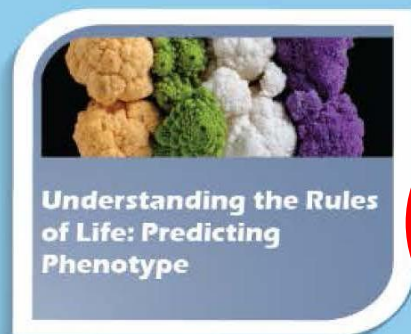
Navigating the New Arctic



Harnessing Data for 21st Century Science and Engineering



Work at the Human-Technology Frontier: Shaping the Future

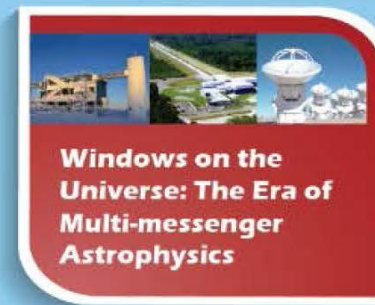


Understanding the Rules of Life: Predicting Phenotype

RESEARCH IDEAS



The Quantum Leap: Leading the Next Quantum Revolution



Windows on the Universe: The Era of Multi-messenger Astrophysics

PROCESS IDEAS



Growing Convergent Research at NSF



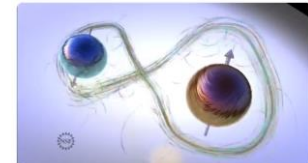
NSF-Includes: Enhancing Science and Engineering through Diversity



Mid-scale Research Infrastructure

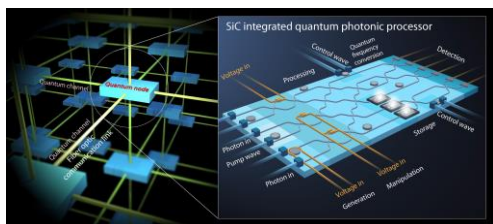


NSF 2050: Seeding Innovation

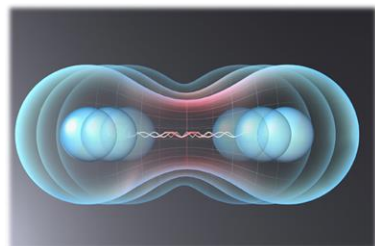


Quantum Leap: Leading the next Quantum Revolution

Next generation quantum devices and technologies



Materials, metrology, sensing, secure communications, information processing, computing

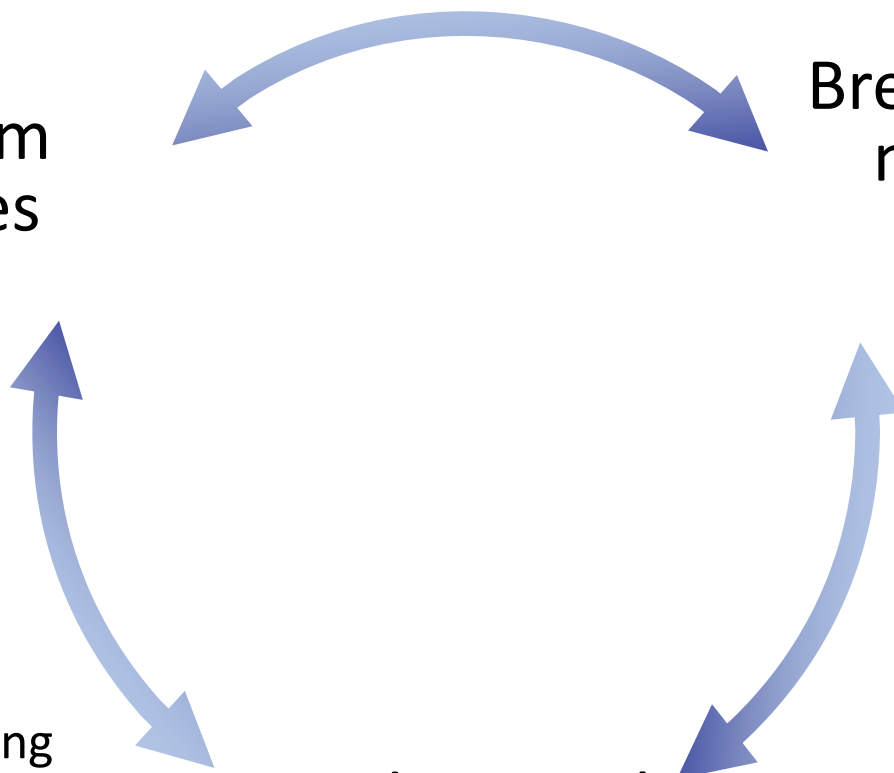
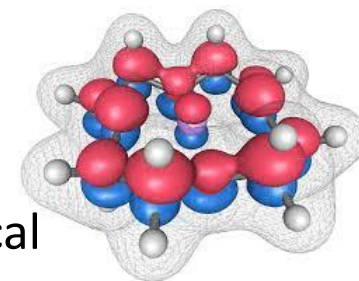


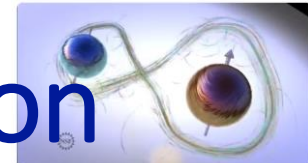
Fundamental science

Understanding basic quantum properties of entanglement, superposition, coherence, interference, and squeezing

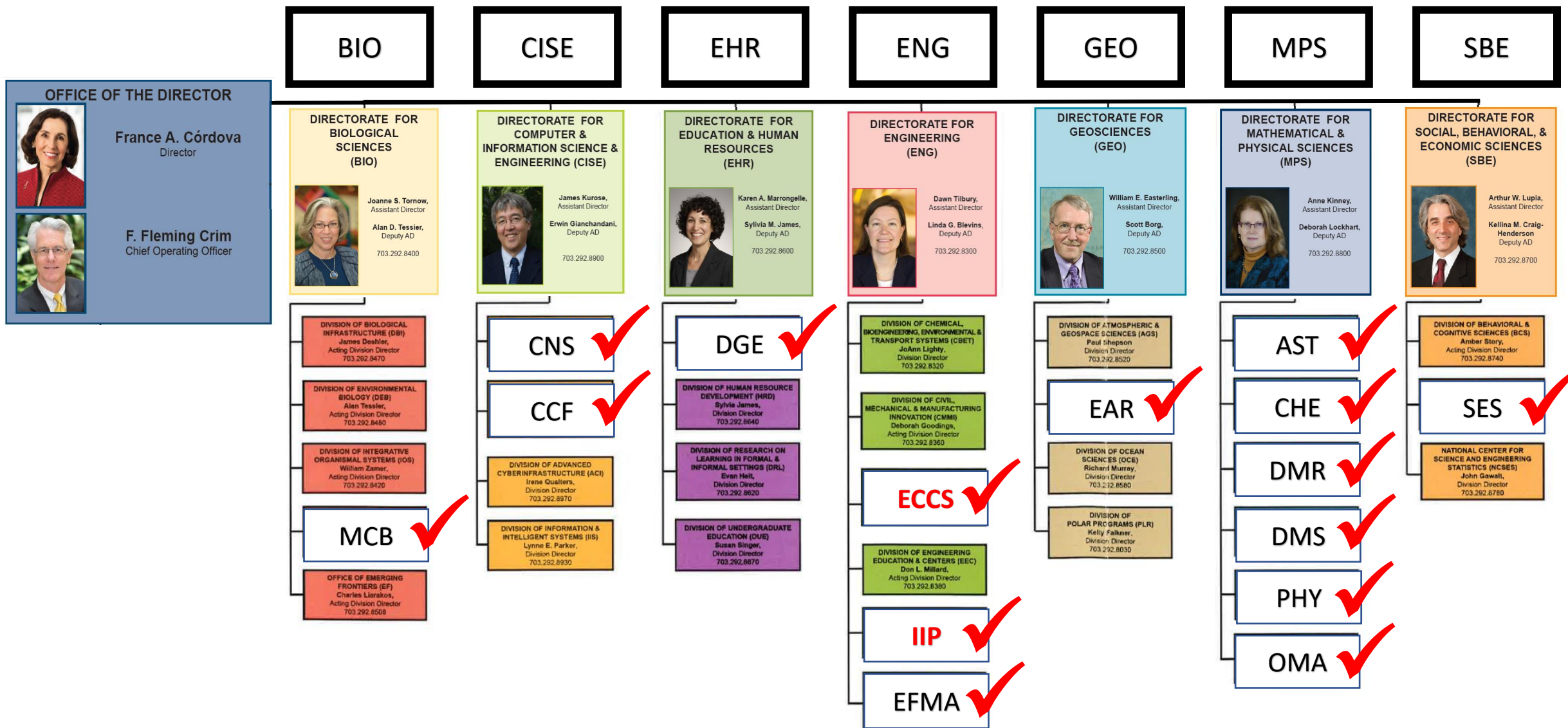
Breakthrough discoveries in natural and engineered quantum systems

Complexity, simulation, emergent behavior, theory, quantum/classical





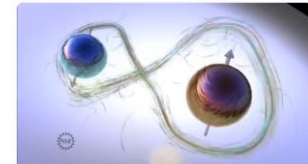
Quantum Leap Funding Across the Foundation



From all NSF programs combined: Over 2000 QIS-related Awards (✓)



The NSF Approach



The 3 C's



Electrical, Communications and Cyber Systems

Industrial Innovation & Partnerships

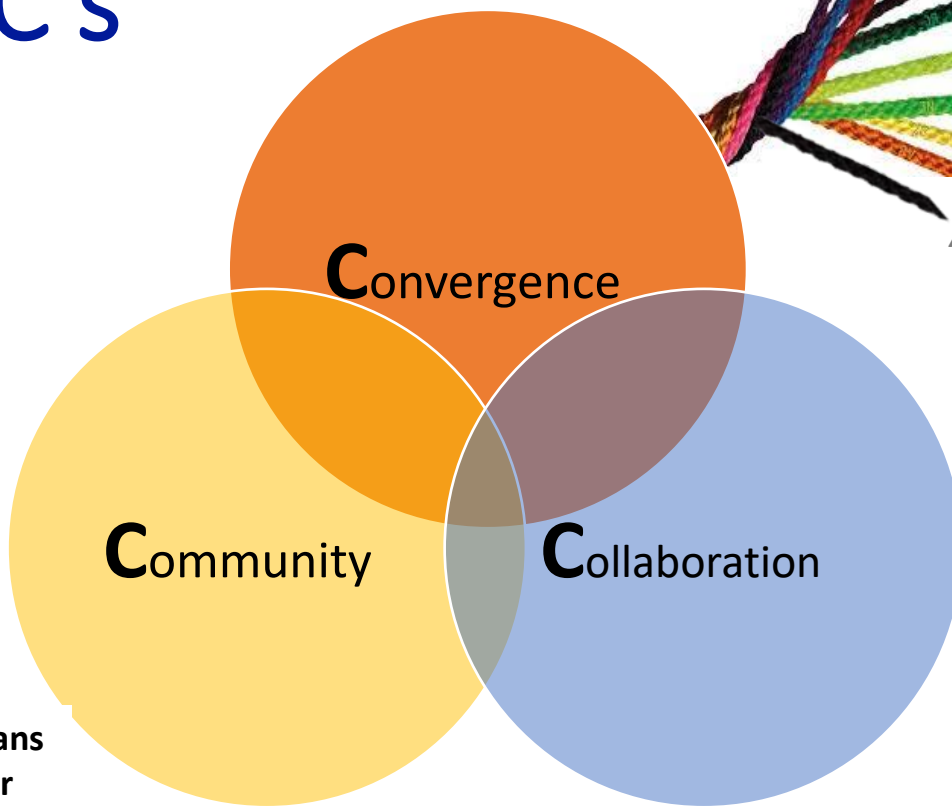
Education and Workforce

Information and Intelligent Systems

Computing and Communication Foundations

Computer and Networked Systems

Advanced Cyberinfrastructure



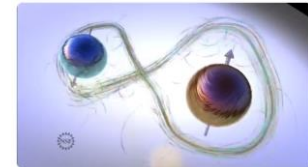
Quantum
Workfor
ce

$$\begin{aligned}
 & C_1 \left| \begin{array}{c} \text{Materials} \\ \text{Researchers} \\ \text{\& Chemists} \end{array} \right\rangle + C_2 \left| \begin{array}{c} \text{Engineers} \end{array} \right\rangle \\
 & + C_3 \left| \begin{array}{c} \text{Physicists} \end{array} \right\rangle + C_4 \left| \begin{array}{c} \text{Mathematicians} \\ \text{\& Computer} \\ \text{Scientists} \end{array} \right\rangle
 \end{aligned}$$

Partnerships with other government agencies and laboratories, industry, and international collaborators



NSF programs supporting Quantum Leap



Convergence Accelerator, Track C, Quantum Technologies

QL Challenge Institutes (support NQI)

TAQS Incubators: Transformational Advances in Quantum Systems

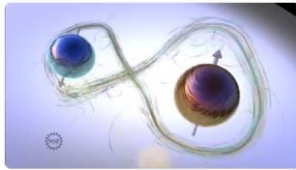
Q-AMASE-i - quantum materials and device foundry

Ideas Lab: Practical Fully-Connected Quantum Computer Challenge (PFCQC)

QISE-Net – “TRIPLETS”; NSF/DOE/AFOSR: Quantum Science Summer School; 2017-2020

EFRI-ACQUIRE; Advancing Communication Quantum Information Research in Engineering





Thank You!

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Questions about the Challenge Institutes, please email directly to QLCI@nsf.gov.



NSF Quantum Leap Activities



- NSF 16-502 EFRI ACQUIRE. Quantum Communication and Networking; \$18M; 9 Awds.
- NSF 17-548 Ideas Lab: Practical Fully-Connected Quantum Computer; \$15M / 5yrs
- NSF 1730449 “EPIQC: Enabling Practical-scale Quantum Computing”; \$10M / 5 yrs
Expeditions in Computing program in CISE/CCF; See NSF news release 18-011
- NSF 1743059 (NSF, DOE, & AFOSR): Quantum Science Summer School (QS³)
- NSF 1747426 “Triplets” QISE-Net Workshop Series: Cross-Sector Connections; \$2.5M
- NSF 17-053 “Braiding” DCL: EAGER Awards for Demonstrating Topological QC;
- NSF 18-035 TAQS DCL: Transformational Advances in Quantum Systems; \$25M; 25 Awds.
- NSF 18-051 DCL: Enabling Quantum Leap in Chemistry; \$6.4M in FY 2018
- NSF 18-046 DCL: Room-Temperature Q. Logic through Improved Low-D Materials
- NSF 18-062 EQuIP DCL: Engineering Q. Integrated Platforms for Q. Comm.; \$6M; 8 Awds.
- NSF 18-578 QAMASEi: Foundries for Q. Materials Science, Engineering, and Info. \$20M - \$25M
- NSF 19-507 QCIS Faculty Fellows; FY’19 and FY’20; \$6.7M
- NSF 19-532 QII-TAQS Transformational Advances in Quantum Systems; \$26M in FY’19
- NSF 19-559 QLCI Quantum Leap Challenge Institutes; \$5M/year for each of several centers