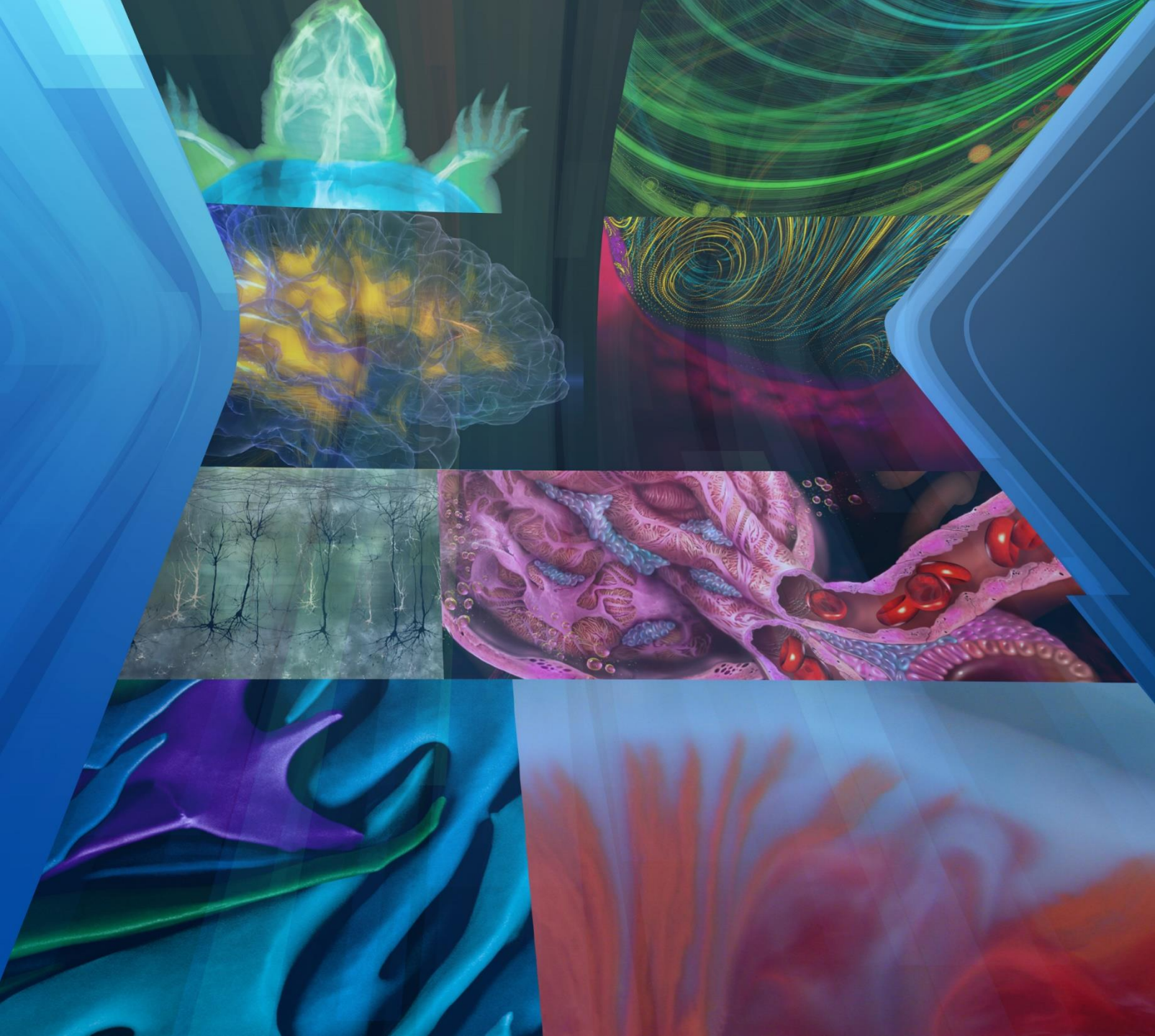


NSF Funding for Quantum Technologies

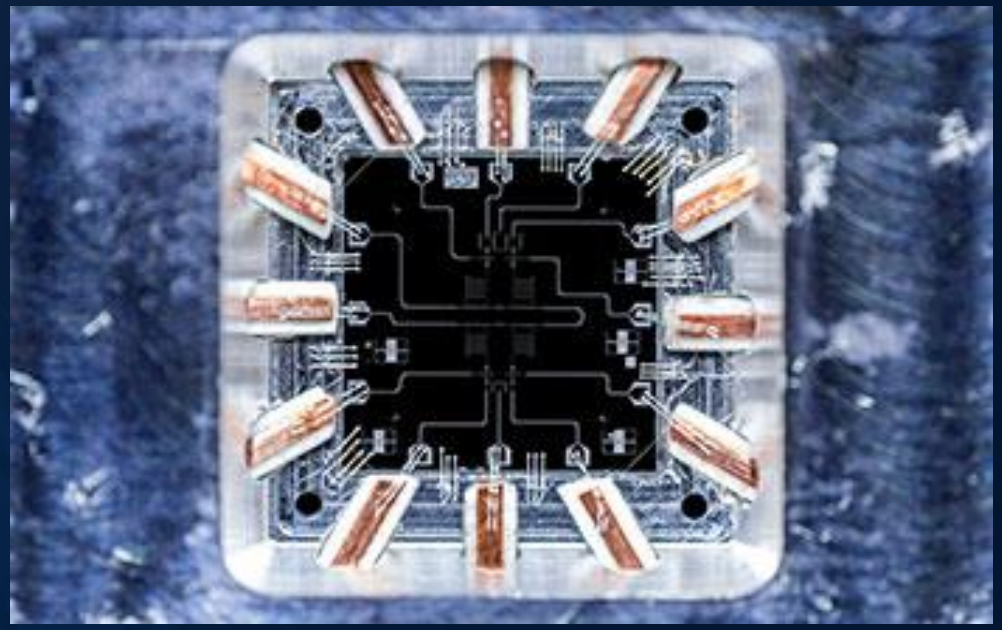
Peter Atherton

Division of Industrial Innovation and Partnerships (IIP)

October 25, 2018

In a Nutshell …

- Quantum technologies are vitally important to the security and prosperity of the United States
- United States' lead in some quantum technologies is at risk
- The transfer of quantum R&D outcomes to practice should be accelerated to realize economic, societal and national security benefits
- NSF has funding mechanisms in place



Credit: *Michael T. Fang, Martinis Group, UC Santa Barbara*

NSF's Ten Big Ideas

In 2016, NSF unveiled a set of "Big Ideas" - ten bold, long-term research and process ideas …

- Harnessing the Data Revolution
- The Future of Work at the Human-Technology Frontier
- Navigating the New Arctic
- Windows on the Universe: The Era of Multi-Messenger Astrophysics
- ***The Quantum Leap: Leading the Next Quantum Revolution***
- Understanding the Rules of Life: Predicting Phenotype
- Mid-Scale Research Infrastructure
- NSF 2026: Seeding Innovation
- Growing Convergence at NSF
- NSF INCLUDES: Enhancing STEM through Diversity and Inclusion

The Quantum Leap

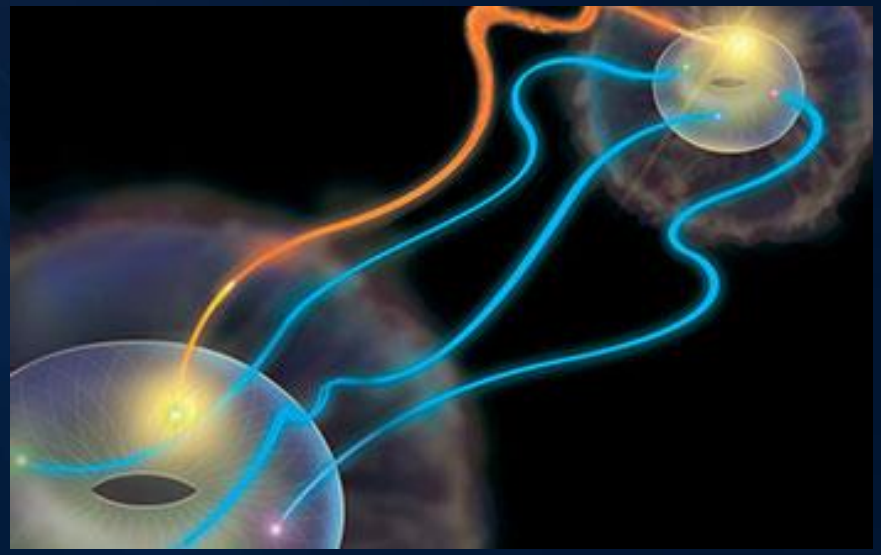
- … cross-NSF approach to identifying and supporting research that … develops the means of accessing and manipulating quantum systems
- … goal is to couple together experiment, computation, and theory to attack fundamental questions, with an eye toward enabling more efficient computation, communication, sensing and simulation
- … strong connections between industry, federal agencies, and international partners

The Quantum Leap

- Focus to date has been mainly on education, research, and engineering
- Important additional focus is to encourage transition of quantum R&D to practice to realize economic and societal benefits
- Development and commercialization of quantum technologies as products and services
- In line with the NSF Mission: *"… to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense, …"*

Why Quantum Technologies, Why Now?

- Important to national security and future economic growth:
  - secure communications, cryptography, materials development, healthcare, weather prediction, machine learning
- Inflection point in quantum science and engineering
- U.S. lead in quantum technologies may be shrinking



Credit: *Image by Precision Graphics; copyright Paul Kwiat, University of Illinois at Urbana-Champaign*

NSF Can Help!

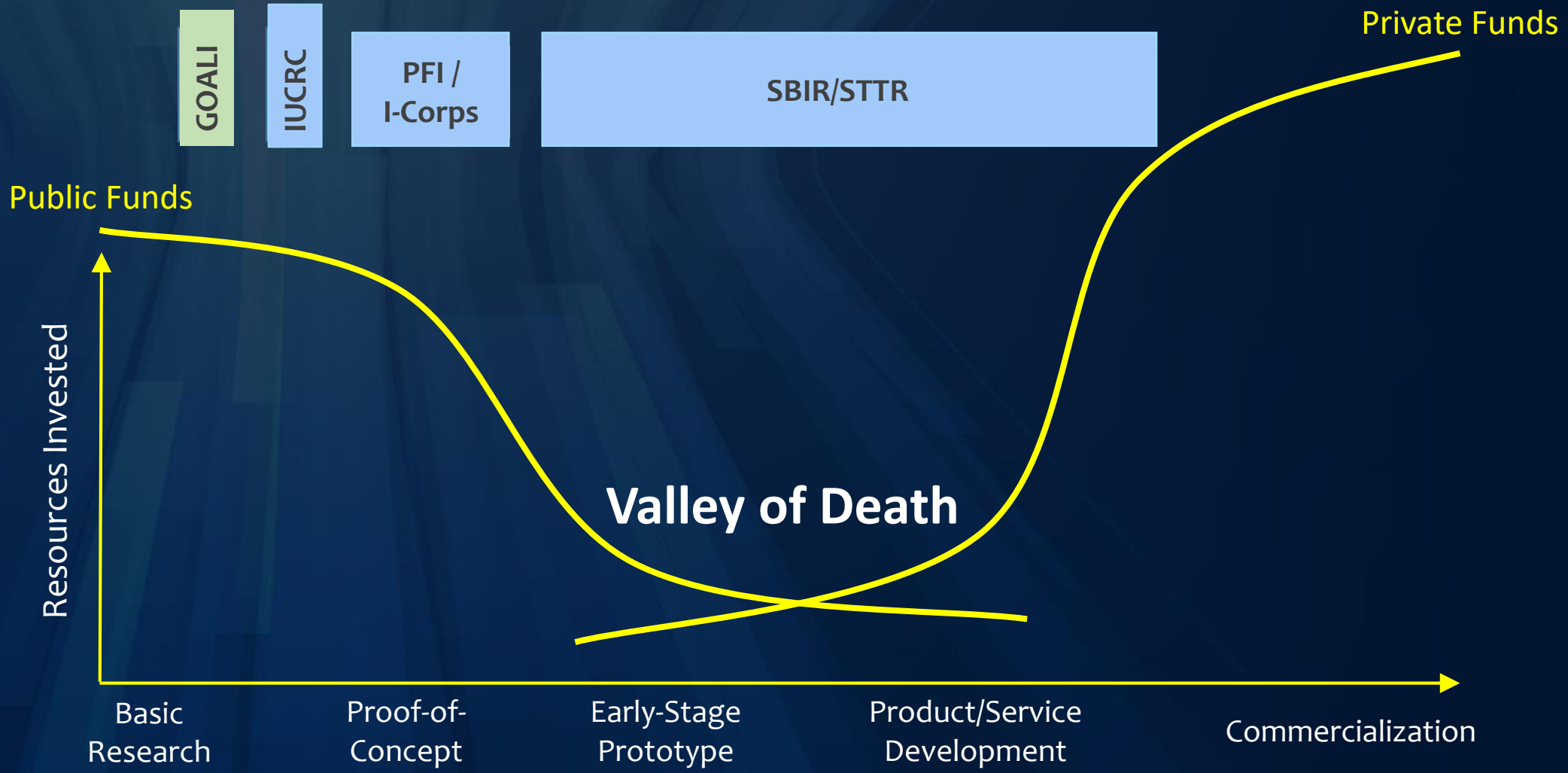
Division of Industrial Innovation and Partnerships (IIP)

"IIP will enhance our nation's economic competitiveness by catalyzing the transformation of discovery into societal benefits …"

IIP Funding Opportunities

- GOALI – Grant Opportunities for Academic Liaison with Industry
- IUCRC – Industry-University Cooperative Research Center
- PFI – Partnerships for Innovation
- I-Corps™ – Innovation Corps
- America's Seed Fund @ NSF – Small Business Innovation Research-Small Business Technology Transfer (SBIR/STTR)

Industrial Innovation & Partnerships (IIP)



IUCRC – Industry/University Cooperative Research Centers

- Long-term partnerships between industry, universities, and government
  - Industrially motivated, use-inspired research
  - Highly collaborative partnerships between academia and industry
- Initial financial & procedural support from NSF, major funding from Center industry members
- Each Center usually involves research groups from multiple universities
- March 2018 – Industry-Inspired IUCRC workshop in quantum
  - *Objective: "…determine what type of industry-inspired, industry-initiated academic research consortia will help U.S. industry maintain and enhance its global leadership and competitive position …"*

    https://www.uidp.org/publication/catalyzing-industry-university-collaboration-in-quantum-technologies-workshop-report/

Partnerships for Innovation (PFI)

- Aim is to support proof-of-concept and prototype development that has potential for accelerated commercialization
- Two Tracks:
  - PFI-Technology Translation (PFI-TT)
  - PFI-Research Partnerships (PFI-RP)
  - NSF lineage requirements – research or I-Corps Teams
- Already receiving quantum proposals

Partnerships for Innovation (PFI)

- PFI-Technology Translation (PFI-TT):
  - Single team moving 1 basic research project into early stage development
  - Smaller project: up to $250,000 over 18 months
- PFI-Research Partnerships (PFI-RP):
  - Multi-disciplinary teams, multi-organizational collaborations
  - More complex projects: up to $550,000 over 3 years

Innovation Corps (I-Corps™)

- Researchers learn to identify commercial opportunities that can emerge from academic research, and gain skills in entrepreneurship
- Through 100+ customer interviews, companies can avoid the #1 failure mode for start-ups – building something nobody wants

Innovation Corps (I-Corps)

- Funding used for participation in I-Corps curriculum and customer discovery – not for R&D
- 440 start-ups funded; raised over $250M to date
- “Phase Zero” I-Corps program launched recently to support non-academic teams
- Taught by I-Corps faculty that have deep entrepreneurship, investment & business experience
- Most academic teams find I-Corps eye-opening

Small Business Innovation Research Small Business Technology Transfer (SBIR/STTR)

- Shared SBIR and STTR Congressional Goals:
  - Stimulate technological innovation
  - Increase private-sector commercialization of innovations derived from Federal research and development funding
- Fund ~400 companies per year
- High-risk, high-impact innovations
- Focus on start-up and early-stage companies
  - 85% with <5 employees
  - 91% with no prior Phase II awards (from any agency)

America's SEED FUND
SBIR.STTR

SBIR/STTR

Phase I award

- $225,000, 6-12 months
- Establish technical feasibility – in a commercial context
- Includes ‘Boot Camp’ training – customer discovery
- Quantum Information Technologies currently part of IT topic
- Next Deadline: December 4th!

SBIR/STTR

Phase II award

- Competitively assessed, follows on from Phase I award
- $750,000, 24 months - plus supplements
- Pre-commercialization R&D – prototype, pilot programs

SBIR/STTR

Quantum Information Technologies:

- Technology agnostic - Sensing, Communications, Simulation, Computing
- Component, sub-system or system level innovations
- Commercial potential + economic/societal impact
- Proposals received in a variety of areas, e.g.: sensing for medical and other applications; photon sources; photon detectors; quantum memories; quantum repeaters; new materials for communication; secure communication systems; qubit generation; QC algorithms; etc.

Key Takeaways

- Transitioning quantum science and engineering R&D to practice is vitally important for the long-term security and prosperity of the nation
- The U.S. is at risk of falling behind in some quantum technologies
- NSF has programs specifically aimed at commercializing high-risk, high-impact innovations in quantum

IIP Program Contacts:

- GOALI, INTERN, IUCRC:
  - Prakash Balan - pbalan@nsf.gov
  - Andre Marshall - awmarsha@nsf.gov
- PFI:
  - Jesus Soriano - jsoriano@nsf.gov
- I-Corps:
  - Nancy Kamei - nkamei@nsf.gov
- SBIR/STTR:
  - Peter Atherton - patherto@nsf.gov

IIP Program Links:

IUCRC: IUCRC.org

PFI: nsf.gov/pfi

I-Corps: nsf.gov/icorps

SBIR/STTR: seedfund.nsf.gov

INTERN: nsf.gov/INTERN

GOALI: *Part of the PAPPG*

America's SEED FUND
SBIR.STTR

Thank You!