

Center for Quantum Networks

NSF Engineering Research Center



Thrust 4: Quantum Society

Jonathan Ruane

Thrust 4 Lead

MIT

jruane@mit.edu

Funded by National Science Foundation Award #1941583



UNIVERSITY OF
MARYLAND

University of
Massachusetts
Amherst RE REVOLUTIONARY



NAU
NORTHERN
ARIZONA
UNIVERSITY



UNIVERSITY OF
OREGON

Goals of a novel 4th Thrust

- Create, *for the first time*, a **research community** and agenda for the study of the societal impact of quantum communications technologies.
- Foster and **produce research** that:
 - Carefully describes societal opportunities, risks, and trade-offs
 - Identifies the range of credible predictions and the reasons for differing accounts
 - Conscientiously includes research about the distributional effects of quantum technologies and the needs of underserved communities
 - Remains neutral on ultimate policy conclusions about how priorities and trade-offs should be made where there is legitimate debate
- **Integrate the insights** from the social science research into the technical research, education, and innovation ecosystem work of the Center, and into business practices and regulatory fabric outside the Centre
- Originally a Working Group - decision to **expand into full thrust**.



T4 Research Project Areas

T4A. Internet Standards and Governance

T4B. The Quantum Technology Marketplace

T4C. Post-Quantum Privacy & Security

T4D. Equitable Access, Fairness & Accountability



Major Accomplishments (Yrs 1-3)

Year 1: Quantum Technologies, Law, and Public Policy Conference (online)

Year 2: Trans-Atlantic Quantum Forum: Yale, UCLA, Technology Institute of Munich. Law & Policy focus.

Year 3: Quantum Policy and Ethics Roadmap, Quantum Economics Conference; Engagement with NIST, NTIA, FCC, Q-EDC

Focused on:

- Community building
- Interdisciplinarity
- Law was primary anchor (led by Jane Bambauer)



Quantum Index Report

CQN Thrust 4



Quantum Index Report

Jonathan Ruane, Elif Kiesow, Johannes Galatsanos, Carl Dukatz, Edward Blomquist, Prashant Shukla

Comprehensive, data-driven assessment of the state of quantum technologies.

Tracks, measures, and visualizes trends across research, development, education and public acceptance.

Aggregates data from academia, industry and policy sources.

10 Chapters, 132 pages

Accenture partnership

1. Patents

2. Academic Research

3. Venture Funding

4. Quantum in Corporate Communications

5. Policy

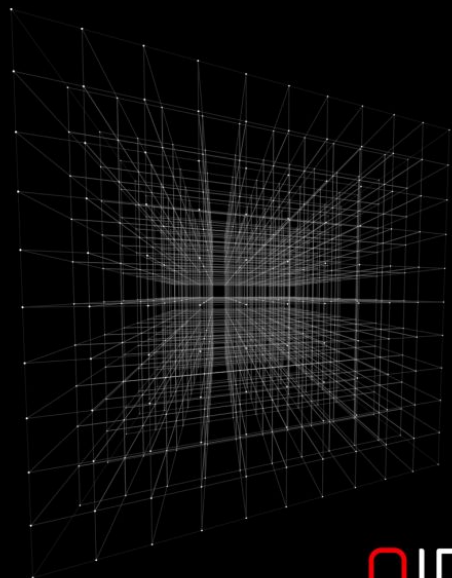
6. Workforce

7. Education

8. Public Opinion

9. Quantum Networking

10. Quantum Processor Benchmarking



QIR
Quantum
Index Report
2025

MIT INITIATIVE ON THE DIGITAL ECONOMY





QIR

Quantum Index Report

[HOME](#) [ABOUT](#) [RESOURCES](#) [INSIGHTS](#) [GET INVOLVED](#)



Presenting insights with

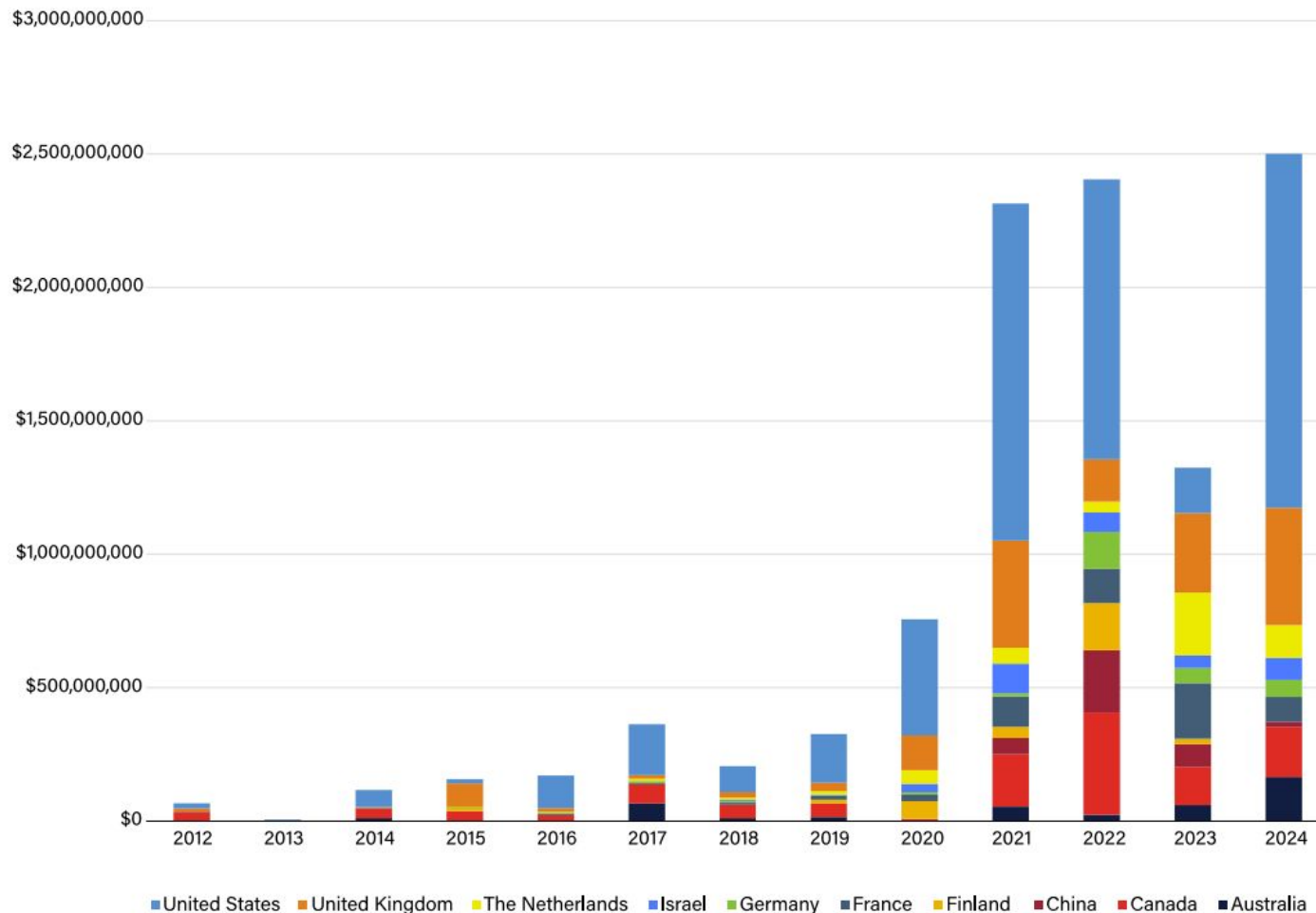
QUANTUM INDEX REPORT

Helping with tracking trends independently

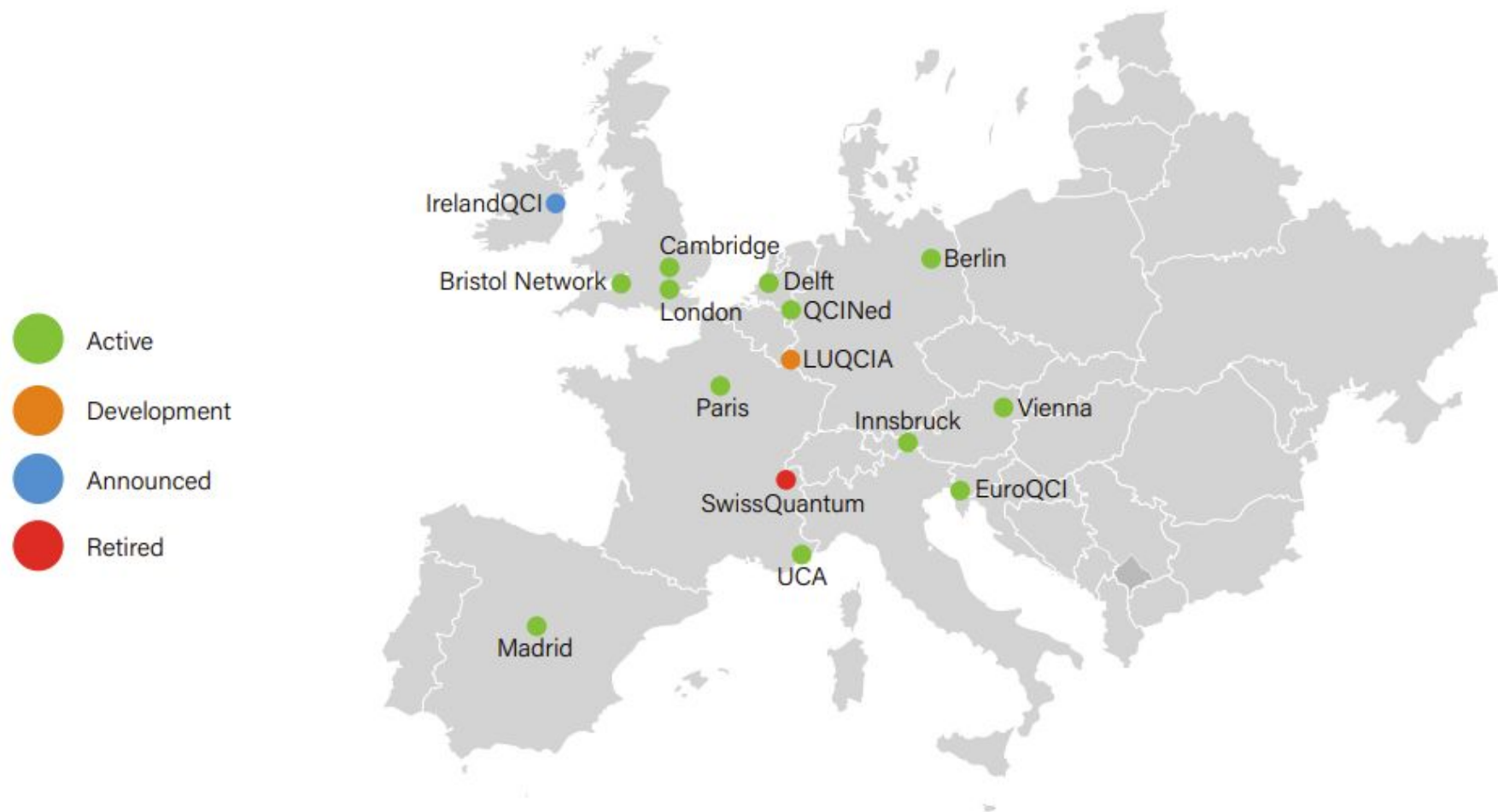
[ACCESS INSIGHTS](#)

[ABOUT QIR](#)

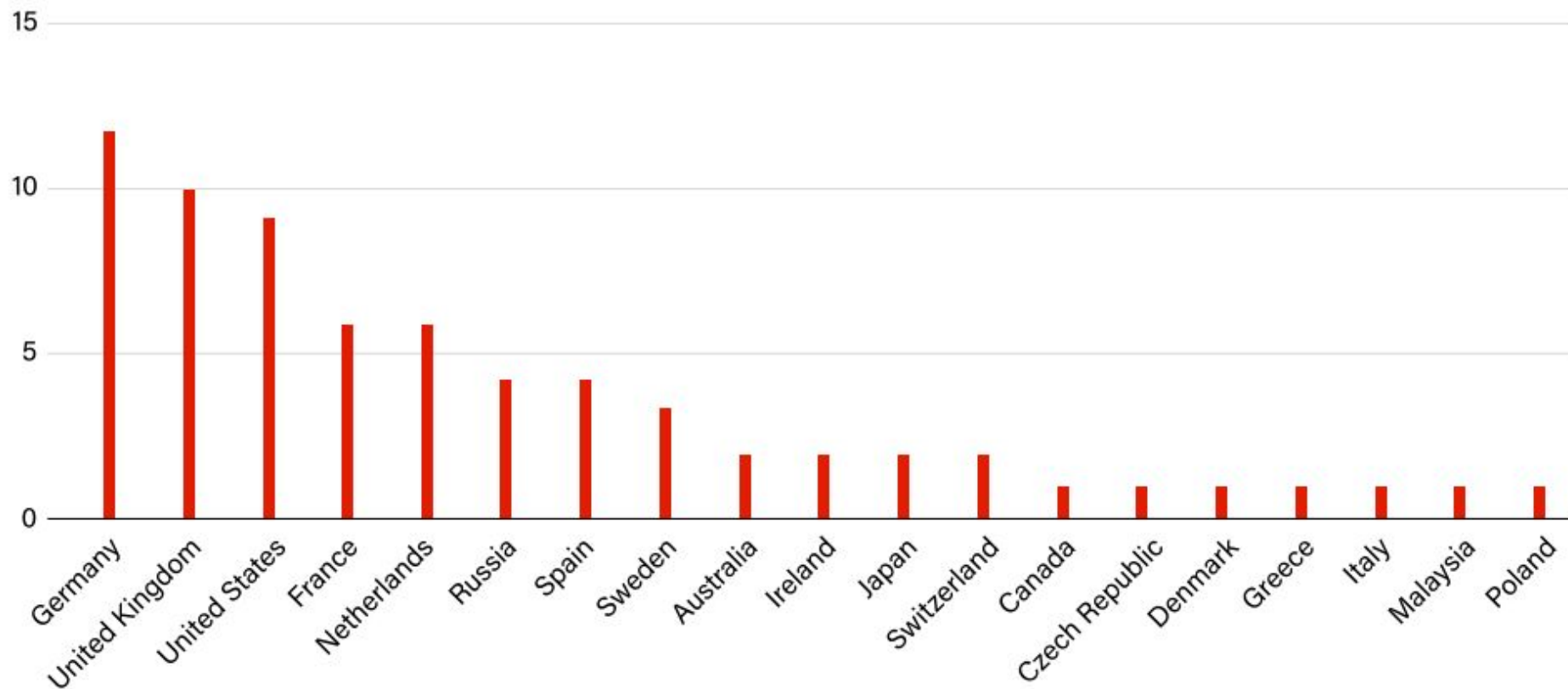
Quantum technology funding landscape by top 10 countries, 2012-2024



Quantum network testbeds in Europe



Master degrees with a specific reference to 'quantum' in the degree name



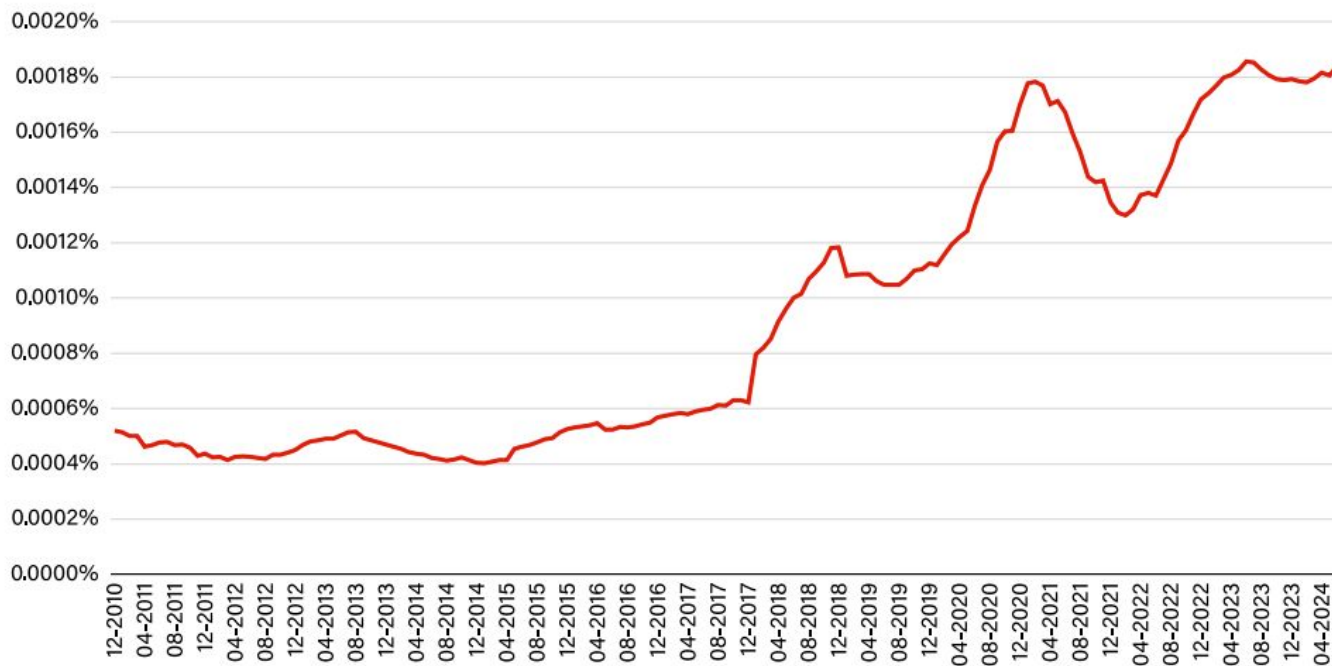


6.1 | Quantum skills in job postings



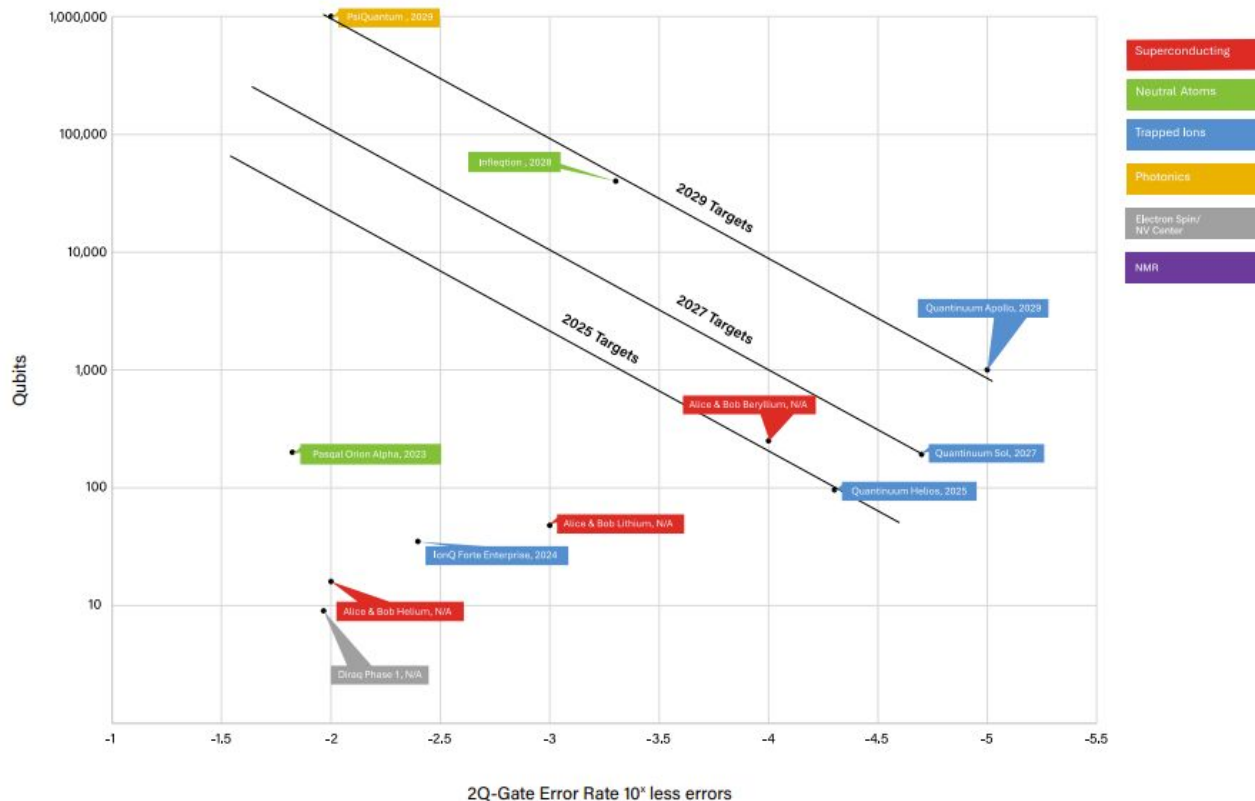
- ▶ The US labor market has shown relatively steady growth in demand for quantum skills since 2018.

US job postings requiring “quantum” skills as share of total job postings, 2011 to mid-2024



10.7.2 | A look into the future: qubit count and fidelity

QPU vs 2Q gate fidelity Announced QPUs





4.1.2. Quantum computing mentions by company



Total document count company (top 50)



WIRED

9 DE JUNIO DE 2025

Quién lidera la computación cuántica a nivel mundial según el MIT

China lidera la computación cuántica realizados en

HPC

wire

Since 1987 - Covering the Fastest Computers in the World and the People Who Run Them

- Topics
- Sectors
- QCwire Home
- QCwire Subscribe
- Exascale
- Specials
- Resource Library
- Podcast
- Events
- Job Bank
- About



IDEAS MADE TO MATTER | FUTURE OF WORK

Building a quantum world

by Beth Stackpole | Sep 15, 2025

What you'll learn:

- Quantum skills are in demand. Posts for jobs requiring d from 2011 to 2024.

physicsworld

Forbes



Business of Quantum Summit

CQN Thrust 4
Apr 4th, 2025 at MIT

Business of Quantum Summit



Speakers Orgs include:

- Google, MIT, NVIDIA, NIST, BCG, Microsoft Research
- Qunett, Lightsynq, Alice & Bob

Dedicated Quantum Networks panel



Get Your Tickets





150 Attendees





Quantum Research and Public Policy Workshop

CQN Thrust 4
29 May 2025

QUANTUM RESEARCH AND PUBLIC POLICY 2025

WEDNESDAY,
MAY 28

MAXWELL ROOM, ENGINEERING IV, UCLA

REGISTER HERE:



PANELS:

QUANTUM DEVELOPMENT AND
THE INTERCONNECTED WORLD

CORPORATE GOVERNANCE AND
THE PUBLIC-PRIVATE DYNAMIC

NATIONAL SECURITY AND
QUANTUM PROGRESS

QUANTUM NETWORKING AND THE
FUTURE OF COMMUNICATION

QUANTUM TECHNOLOGIES AND
PRIVACY CHALLENGES



Center for
Quantum Networks
NSF Engineering Research Center



Research, Innovation
& Impact



NARANGLAB



Dr. Sarah Young

Lecturer University of Arizona



Quantum Research and Public Policy Workshop

Legal, economic, and social implications of quantum communications technologies

Topic: **Policy questions** related to advances in quantum research, e.g. national security challenges, privacy challenges, equitable development challenges

Approach: **Interdisciplinary, international** panel of researchers, industry personnel, and government strategists.

Format: The five panels including dedicated 'Quantum networks and the future of communication'

CQN Thrust collaborators: Brian Smith, University of Oregon

Quantum Research and Public Policy Workshop

Legal, economic, and social implications of quantum communications technologies

55 Participants

20 Panelists (academia, industry, international:

- Edward Parker, RAND (Physics)
- Nikolas Guggenberger, University of Houston (Law)
- Lee Humphreys, Cornell University (Social Scientist)
- Brian Smith, University of Oregon (CQN T2)





Quantum Based Security Protocol For Cloud Computing & AI Applications

Research led by Dirk Englund

Quantum-secure multiparty deep learning

Kfir Sulimany^{*1}, Sri Krishna Vadlamani¹, Ryan Hamerly^{1,2}, Prahlad Iyengar¹, and Dirk Englund¹

¹Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, MA, USA

²Physics & Informatics Laboratories, NTT Research, Inc., Sunnyvale, CA, USA

Abstract

Secure multiparty computation enables the joint evaluation of multivariate functions across distributed users while ensuring the privacy of their local inputs. This field has become increasingly urgent due to the exploding demand for computationally intensive deep learning inference. These computations are typically offloaded to cloud computing servers, leading to vulnerabilities that can compromise the security of the clients' data. To solve this problem, we introduce a linear algebra engine that leverages the quantum nature of light for information-theoretically secure multiparty computation using only conventional telecommunication components. We apply this linear algebra engine to deep learning and derive rigorous upper bounds on the information leakage of both the deep neural network weights and the client's data via the Holevo and the Cramér-Rao bounds, respectively. Applied to the MNIST classification task, we obtain test accuracies exceeding 96% while leaking less than 0.1 bits per weight symbol and 0.01 bits per data symbol. This weight leakage is an order of magnitude below the minimum bit precision required for accurate deep learning using state-of-the-art quantization techniques. Our work lays the foundation for practical quantum-secure computation and unlocks secure cloud deep learning as a field.



Education Research Innovation Admissions + Aid

MIT News

ON CAMPUS AND AROUND THE WORLD

New security protocol shields data from attackers during cloud-based computation

The technique leverages quantum properties of light to guarantee security while preserving the accuracy of a deep-learning model.

Adam Zewe | MIT News
September 26, 2024

Leveraging quantum properties of light to guarantee security while preserving the accuracy of a deep-learning model.

A linear algebra engine that leverages the quantum nature of light for information-theoretically secure multiparty computation using only conventional telecommunication components.

Near-term application addressing vulnerabilities that compromise data security, which is crucial in applications such as business, finance, and healthcare

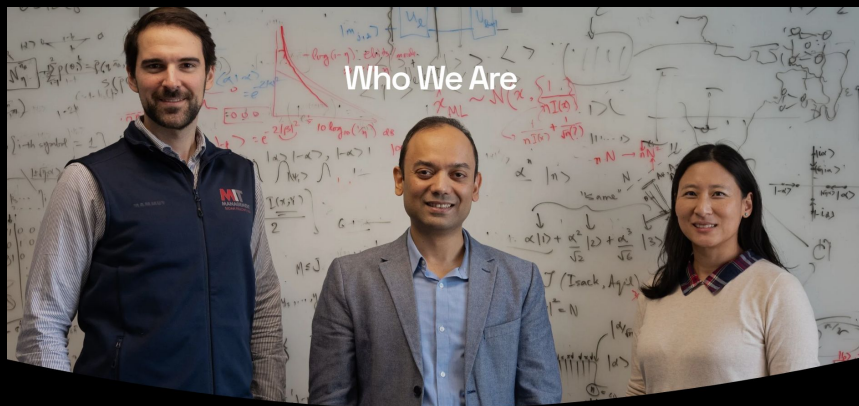


Commercial Spinout

CQN Thrust 4

Perfect Vision for Satellites and Machines

We are building the next generation of visual AI hardware and software to make satellites and machines see further and think faster.

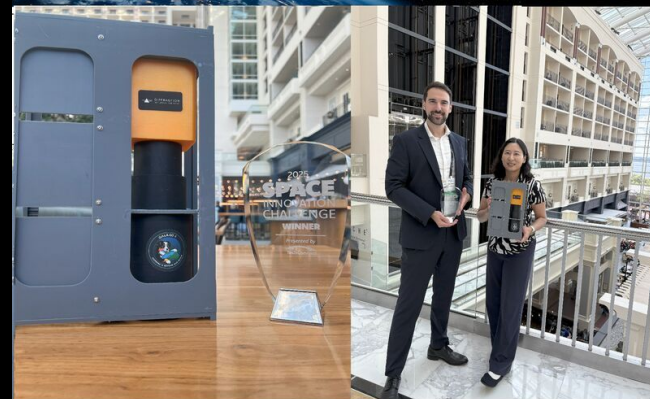


SPACE INNOVATION CHALLENGE

—▲—=DIFFRACTION
SEE FURTHER. THINK FASTER.

WINNER 1st PLACE

Produced by
TechConnect ATL





Other Notable Outcomes

CQN Thrust 4



Other Notable Outcomes T4 Yr 5

- Sponsorship of 2nd **Economics of Quantum conference** at University of Southern California
- **Panel at Optica Frontiers in Optics:** Impacts of Quantum Technologies on Society'. Brian Smith (T2) and organized by Sarah Young (T4).
- Sponsored the **Quantum Workforce Challenge at MIT Policy Hackathon** (student led initiative)
- **Quantum Networking included as part of MIT's xPro online course on [Quantum Strategy and Impact](#)**. Jonathan Ruane & Will Oliver & MIT Colleagues.



CerQual
NSF E



Courses ▾

Webinars

Blog

Sign In

Create Account



START DATE

October 20,
2025

[More Dates](#)

DURATION

10 hours

FORMAT

Online

CEUS

1

PRICE

\$1,500

[Overview](#)

[What You Will Learn](#)

[Who Should Enroll](#)

[How You Will Learn](#)

[Your MIT Faculty](#)

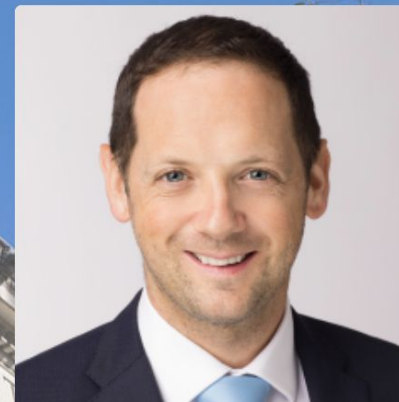
[ENROLL NOW](#)



William Oliver



Vinod Vaikuntanathan



Jonathan Ruane



START DATE

**February 2,
2026**



DURATION

**4 weeks per
course**

(2 courses)



PRICE

\$2,500

or \$1,600 per course

ENROLL NOW

COURSES IN THIS PROGRAM

KEY TAKEAWAYS

WHO SHOULD ENROLL

FACULTY

REVIEWS

RESOURCES



Isaac Chuang



William Oliver



Peter Shor



Year 6-10 Major Milestones

