

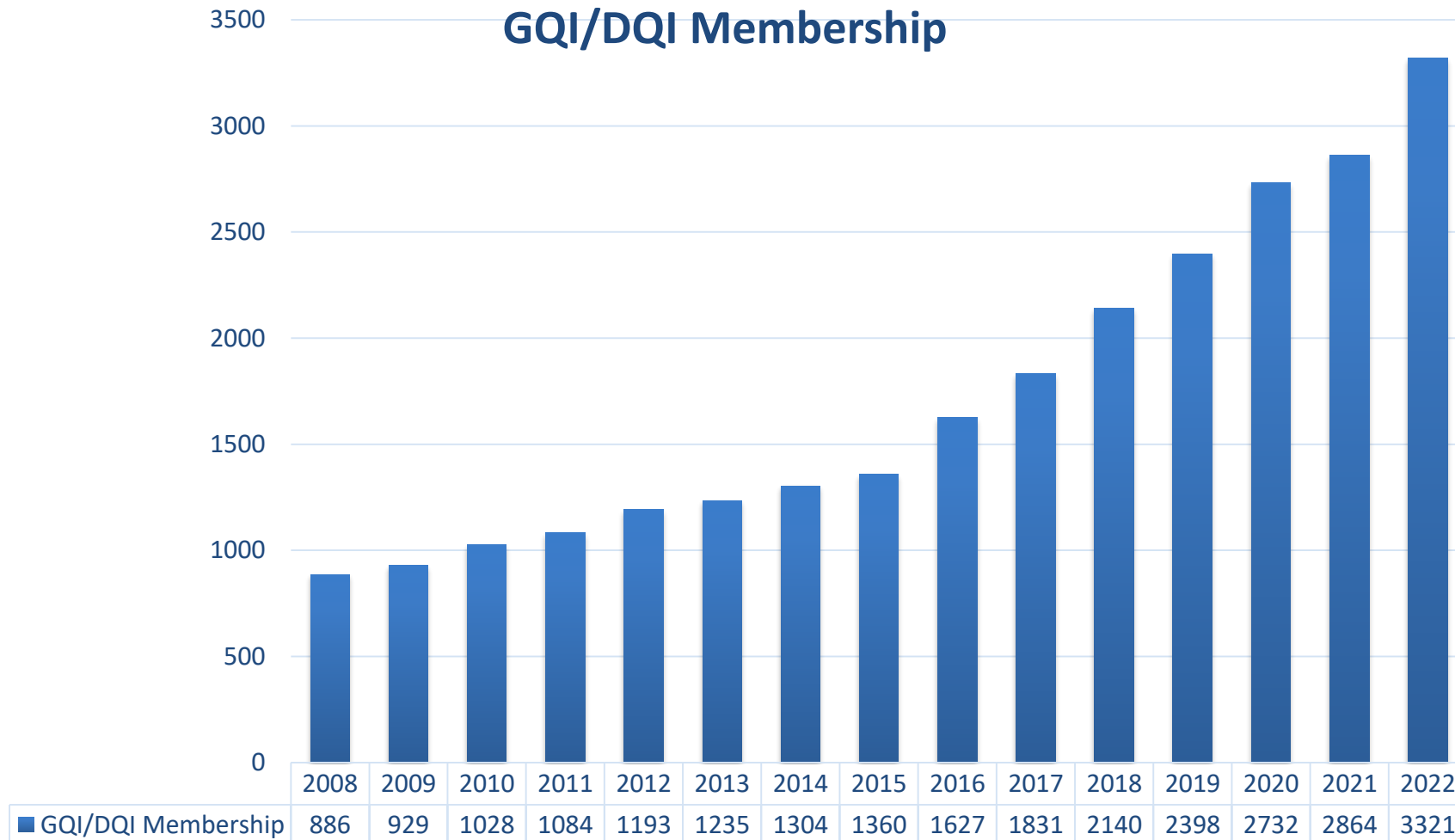
Quantum information science and engineering



*John Preskill, Caltech
QISE @ APS March
6 March 2023*



APS Division of Quantum Information



<http://www.aps.org/membership/units/statistics.cfm>

(Founded 2005. Now 6.7% of APS. **Membership is 54% students.**)

Science First

“The Government should maintain robust and diverse platforms and research thrusts that continue to stimulate transformative and fundamental scientific discoveries by taking an approach that puts the science first.”

National Strategic Overview for Quantum Information Science

Quantum Information Science and Engineering

Sensing

Sensitivity, spatial resolution. In vivo, in situ. Quantum 2.0

Cryptography

Quantum foundations for privacy. Protocols, applications

Networking

Distributing quantumness. Transduction, modular devices, integrated systems

Simulation

Exotic quantum many-body phenomena. Near term and longer term

Computing

Applications, hardware, software, systems, architecture, error correction

Materials

Properties, applications, device performance, fabrication, characterization

And ...

Fundamental advances in our understanding of computation, information, and physical science.

NQI Quantum Centers

Give them time.

They are laying foundations that will fuel future progress.

Connections

Information scrambling: quantum circuits, chaotic dynamics, black holes, ...

Quantum error correction: scalable computing, topological phases of matter, holographic correspondence.

Computational complexity: hardness of computational problems, preparing quantum phases of matter, geometry of the black hole interior.

Lots more.

Prospects for the next 5 years

- Advances in **quantum metrology** from improved control of quantum many-body systems.
- Encouraging progress toward scalable **fault-tolerant quantum computing**.
- Scientific discoveries enabled by **programmable quantum simulators** and circuit-based quantum computers.

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We've only just begun.