

INTERNATIONAL YEAR OF
Quantum Science
and Technology

Quantum technologies of the future could secure sensitive data from foreign adversaries, offer unparalleled precision for medical imaging, and unlock new battery chemistries to accelerate de-carbonization, among other applications.

Yet roughly one in two jobs in quantum technology in 2022 remained vacant globally as companies struggled to find workers, according to an analysis by management consulting firm McKinsey & Company. Demand for workers

in the field is expected to grow rapidly in the next decade as more quantum-enabled technologies go mainstream.

To meet that demand, recruiters will have to reach out to STEM workers who may not realize that they are competitive candidates for quantum roles, which can include programming, business development, basic research, and equipment manufacturing. "Even those with a fundamental scientific background often perceive quantum science as an overly

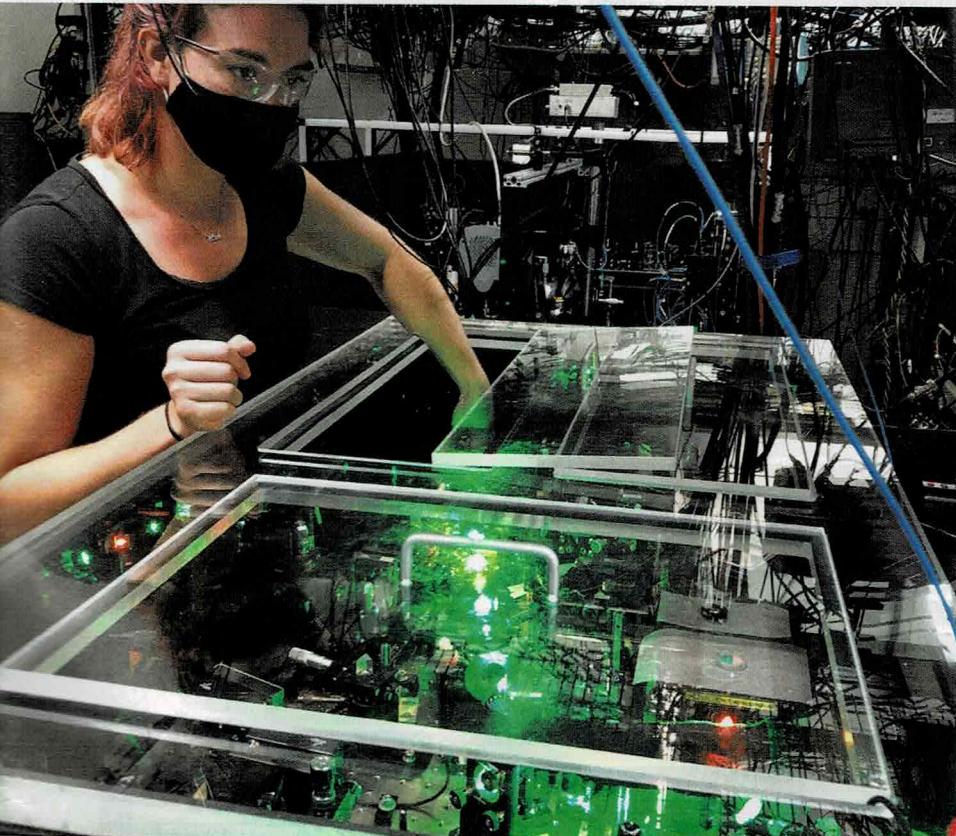
complex, counterintuitive theoretical subject confined to research labs," says Syracuse University's Moamer Hasanovic, a professor of electrical engineering who leads the EdQuantum project for developing quantum curricula. And emerging research in the US suggests that joining the quantum workforce doesn't require deep knowledge of quantum mechanics or, in some cases, any prior quantum experience at all.

For startups and tech giants looking to expand their pool of potential candidates, that's good news because the number of recent STEM graduates isn't large enough to fill the talent gap. The fastest and easiest way to fill that gap would be to retrain other STEM workers to come help in the quantum field, says Jacob Douglass, a technical business development specialist at Sandia National Laboratories.

The quantum workforce

Quantum technologies today can be divided into quantum computing, quantum sensing, and quantum communication. Quantum computing, the most well-known field, receives the lion's share of private investment. Quantum sensing houses some of the most mature technologies, including sensors found in everyday products such as GPS trackers and MRI scanners. Quantum communication is an emerging field that focuses on securely transferring encrypted information.

No estimate of the size of the US quantum workforce exists, but two regional tech hubs have published tallies. Colorado-based Elevate Quantum and Chicago-area Bloch Quantum both received special tech hub designation from the US Economic Development Administration in 2023 as part of the CHIPS and Science Act. Elevate Quantum reports that about 3000 workers in Colorado are



QUANTUM INDUSTRIES are hungry for workers to fill the workforce gap. Most quantum jobs are STEM-related roles and intersect with physics, engineering, computer science, math, and chemistry. Here, a NIST scientist conducts research in quantum logic spectroscopy. (Photo courtesy of A. Collopy/NIST.)

currently employed in quantum technologies, and the number could grow to around 30 000 by 2035. Chicago Quantum Exchange's Bloch Quantum estimates that more than 400 workers in the Chicago area are in quantum-related jobs, and the group projects a total of up to 191 000 jobs in the Illinois-Wisconsin-Indiana region in the next decade.

What companies are looking for

The most common roles that US quantum technology companies are trying to fill range from highly specific, like quantum algorithm developer and error-correction specialist, to much more general, like roles in business, software, and hardware, according to a 2020 survey of 57 US quantum companies by the Quantum Economic Development Consortium (QED-C). Many of the position skills that the surveyed companies listed as necessary were general STEM skills rather than quantum skills. For example, an engineer in quantum control systems must be proficient at circuit and systems testing, control theory, noise measurement, and analysis, none of which are quantum specific. Not surprisingly, jobs that are more closely related to quantum technology necessitate more quantum-specific

Resources for retraining

- The Quantum Economic Development Consortium maintains a public quantum jobs board on its website: <https://quantumconsortium.org/quantum-jobs>.
- Researchers at the Rochester Institute of Technology and the University of Colorado Boulder provide an interactive map of nearly 9000 quantum courses in the US: <https://quantumlandscape.streamlit.app>.
- Professional societies occasionally host quantum-related programming, such as events at the American Physical Society's Global Physics Summit: <https://summit.aps.org>.

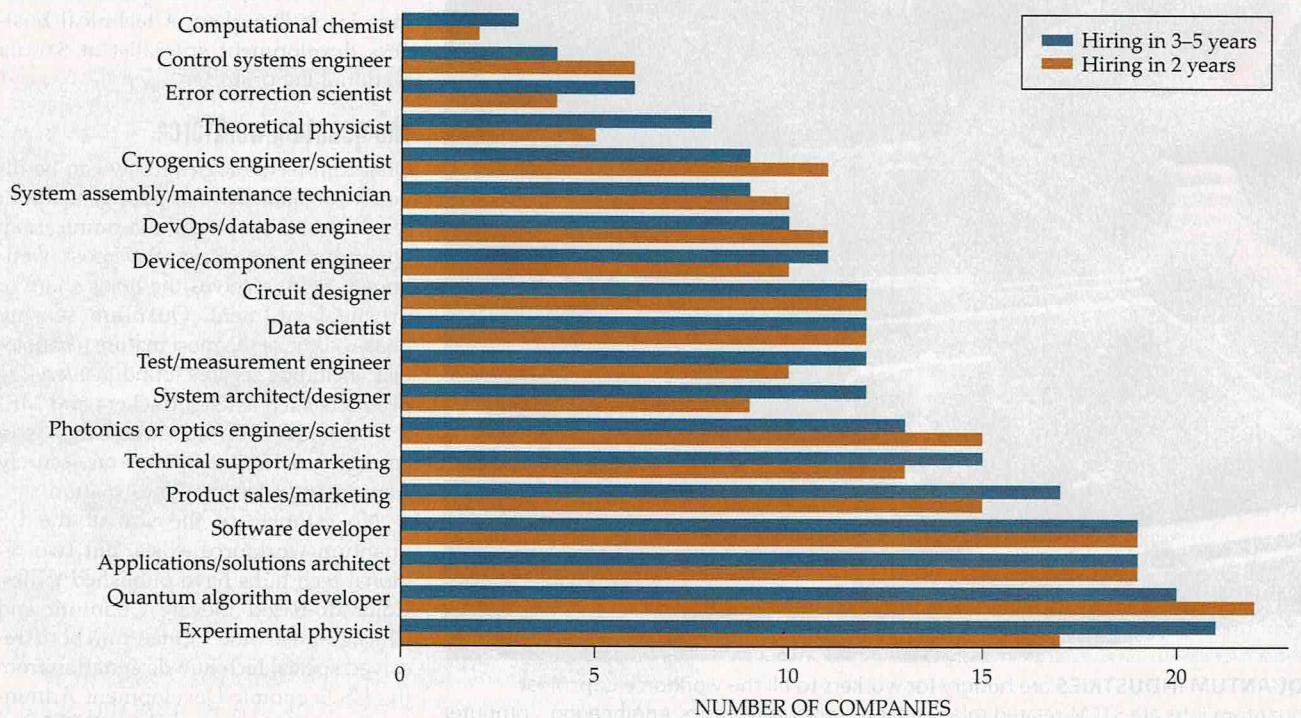
skills. An error-correction scientist requires knowledge in quantum algorithm development, quantum science, and theoretical mathematics and statistics.

The QED-C survey found that employers are looking for a range of degree levels to fill new positions. "If you have an undergraduate or master's, getting a little bit of quantum under your belt would make you quite well qualified for a lot of different kinds of positions," says Celia Merzbacher, QED-C executive director. A separate analysis by the Chicago Quantum Exchange obtained similar results: More than half the 5000 global quantum jobs posted between 2022 and 2023 required no more than a bachelor's degree.

Professionals who join quantum startups today could receive significant financial benefits if a venture succeeds. Sectors as wide ranging as chemicals, life science, and finance could gain as much as \$2 trillion in economic value by 2035 from advancements in quantum technology, according to a 2024 McKinsey report. Workers could also advance their careers in larger organizations by becoming a part of burgeoning quantum teams.

Entering a fast-paced field early puts workers at the leading edge, says Douglass. "You could have real, true, meaningful contributions to actually realize what this technology could do."

Jenessa Duncombe



IN-DEMAND QUANTUM JOBS, according to a 2020 survey of 57 US-based quantum companies. The positions span multiple STEM disciplines, and most do not require quantum-specific skills. (Figure adapted from C. Hughes et al., *IEEE Trans. Educ.* **65**, 592, 2022/CC BY 4.0)