The Pure Plays: Five Companies Building Quantum from the Ground Up

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Key Takeaways

- IonQ's successful entanglement-based networking of two commercial quantum computers shows the industry moving from standalone machines toward scalable architectures, strengthening the case for companies building core quantum infrastructure.
- While trapped-ion, superconducting, neutral-atom and photonic platforms each face unique challenges, recent advances in fidelity, error correction and scaling suggest multiple modalities could achieve commercial success.
- With pure-play quantum leaders pursuing distinct strategies across computing, networking, sensing and optimization, investors can access broad exposure to the theme through the WisdomTree Quantum Computing Fund (WQTM).

What It Means to Link Two Machines

On April 14, 2026, World Quantum Day, IonQ announced it had photonically interconnected two independent trapped-ion quantum computers, marking the first time two commercial quantum systems had been linked via quantum entanglement at a distance. The work was conducted in collaboration with the Air Force Research Laboratory, and IonQ's contribution to the associated DARPA HARQ program centers on quantum memories fabricated from quantum-grade synthetic diamond, technology the company acquired through its 2024 purchase of Lightsynq.1

The result matters because quantum computers cannot scale the way classical computers do. Quantum information cannot be copied or amplified in transit; the only way to connect processors across distance while preserving quantum state is through entanglement.

Demonstrating this on commercial hardware rather than a laboratory setup is a meaningful engineering step toward the distributed, modular architectures that every serious long-term quantum roadmap requires.

We all see revenue figures being reported quarterly, but the ability to network two quantum machines is something you either build or you do not.

First, the Modality Question

The single most important concept for understanding the pure-play quantum landscape is that these companies are not all building the same thing. The term 'quantum computer' obscures a fundamental divide in hardware approach, and that divide matters enormously for assessing both near-term commercial viability and long-term scaling potential.

Each of these will tend to have certain significant strengths and then other significant weaknesses, making the question 'which of these is the best?' a very difficult question to answer without further context.

The four leading modalities as of roughly mid-year 2026 are:

- Trapped ion
- Superconducting qubits
- Neutral atom
- Photonic

Trapped-ion systems, like those from IonQ, use electrically charged atoms held in place and manipulated by lasers. They tend to produce higher-fidelity operations and longer coherence times, meaning that qubits maintain their quantum state for longer, but they are generally slower in clock speed than superconducting alternatives.

Superconducting qubits, used by Rigetti and by most of the big tech players, operate at temperatures close to absolute zero and are faster but harder to maintain at scale without significant error accumulation.

Neutral-atom systems, Infleqtion's approach, offer flexibility in qubit connectivity and are attracting serious attention for error correction.

Photonic quantum computing, Xanadu's domain, uses particles of light as qubits and promises room-temperature operation and compatibility with existing semiconductor manufacturing, though achieving deterministic entanglement between photons remains a core challenge.

The competition between these modalities is genuine and that different use cases may favor different modalities. The company profiles below are inseparable from the hardware bets each one has made.

IonQ: The Commercial Leader

IonQ's core argument is that gate fidelity matters more than qubit count. Its Tempo system achieved 99.99% two-qubit gate fidelity in 2025, a world record,2 and the threshold most researchers consider necessary for fault-tolerant quantum computing to become viable.

IonQ also uses a proprietary metric called algorithmic qubits, or AQ, which attempts to measure practical computational capacity rather than raw qubit count. Reaching AQ 64 ahead of schedule in 2025 represents an exponential expansion in the complexity of problems the system can actually run, not just in theory, but on deployed hardware.3

The aforementioned April 14 photonic interconnect milestone extends that argument into architecture. By linking two commercial trapped-ion systems via quantum entanglement, IonQ demonstrated that its platform can participate in distributed, modular quantum computing, the design pattern that most serious roadmaps require at scale. The quantum memory technology enabling that link, fabricated from synthetic diamond, came through IonQ's 2024 acquisition of Lightsynq.

IonQ's January 2026 agreement to acquire SkyWater Technology, the largest U.S.-based pure-play semiconductor foundry, with shareholder approval secured in May 2026 and regulatory close expected in Q2 or Q3 2026, follows the same logic. Controlling fabrication of semiconductor ion trap chips means the combined entity can target 200,000-qubit QPUs with 8,000 logical qubits in functional testing by 2028, a milestone that depends entirely on the iteration speed that in-house manufacturing enables.4

These are manufacturing decisions in service of a scientific thesis. The commercial result, enterprise and government customers paying for cloud access to systems that can demonstrate this fidelity, follows from the science rather than driving it.

D-Wave: Annealing, Optimization, and a Second Platform

Quantum annealing solves a fundamentally different class of problem than gate-model computing.

- Gate-model systems pursue general-purpose quantum algorithms.
- Annealing systems are purpose-built to find the lowest-energy configuration of a complex system, which maps directly onto optimization problems in routing, supply chain scheduling, drug molecule configuration, financial portfolio construction, and materials discovery.

These are among the most computationally expensive tasks in industry, and classical computers address them through approximation rather than exact solution.

D-Wave's Advantage2 system demonstrated this concretely in March 2025, when an international collaboration published results in *Science* showing the system had simulated the quantum dynamics of programmable spin glasses, a class of disordered magnetic materials with applications in materials science and electronics, in minutes. The same simulation on the Frontier supercomputer at Oak Ridge National Laboratory would have required nearly one million years to complete at comparable accuracy.5

The January 2026 acquisition of Quantum Circuits, completed for $550 million, adds a second instrument. Quantum Circuits' dual-rail qubits combine the speed of superconducting gate-model systems with the fidelity typically associated with trapped-ion and neutral-atom approaches, which is a design that simplifies error correction and targets a commercially available gate-model system in 2026.6

D-Wave is now the only company building both annealing and gate-model quantum systems simultaneously, able to direct optimization problems to its annealers and general quantum computation workloads to its gate-model platform as that matures.

Rigetti: The Modular Superconducting Bet

Rigetti's central argument is architectural. Scaling quantum computers by building ever-larger monolithic chips runs into a hard wall, meaning that error rates climb with system size, and control complexity multiplies.

Rigetti's answer is chiplets, which are smaller, high-fidelity superconducting processors networked together into larger systems. Cepheus-1-108Q, which reached general availability in April 2026, comprises twelve interconnected 9-qubit chiplets achieving 99.1% median two-qubit gate fidelity at a gate speed of roughly 60 nanoseconds, and this is about 1,000 times faster than trapped-ion systems, a meaningful throughput advantage for certain workload types.

The roadmap targets a 1,000+ qubit system by 2027 using the same modular approach, with each new generation adding chiplets rather than redesigning from scratch. India's C-DAC national computing center purchased a 108-qubit deployment for $8.4 million, signalling institutional validation that the architecture is credible enough for a national lab to build research programs around.7

Rigetti's revenue today is early-stage; the thesis is entirely about whether modular superconducting scales as the architecture predicts.

Xanadu: Photonic Qubits and the Room-Temperature Argument

Photonic quantum computing uses particles of light rather than superconducting circuits or trapped atoms as qubits. The practical consequence is significant:

Where superconducting systems require cooling to near absolute zero and trapped-ion systems demand precisely controlled electromagnetic environments, photonic systems can operate at room temperature.

Xanadu's Aurora, introduced in early 2025 and detailed in a peer-reviewed *Nature* publication, demonstrated this at architectural scale, with 35 integrated photonic chips linked by 13 kilometers of optical fiber across four modular server racks, all operating at room temperature. The modularity matters as much as the temperature, in that Aurora is designed to scale by adding racks rather than redesigning the underlying chip, extending in principle toward the quantum data center architecture Xanadu is building toward.8

This led to two important results:

Result 1: The core technical challenge in photonic quantum computing is optical loss, which means photons that leak from the system before contributing to computation. Xanadu reduced optical loss by 60% in 2025, representing a 20-fold improvement over the prior three years.9

Result 2: In parallel, the company demonstrated 12 logical GKP qubits, which stands for Gottesman-Kitaev-Preskill states, a form of error-resistant photonic qubit encoding, with real-time error correction, also published in *Nature.*10

Both results are necessary steps toward fault tolerance; neither fully resolves the loss problem at commercial scale. The roadmap targets up to 500 logical qubits by 2029–2030. A further manufacturing advantage underpins the long-term thesis, specifically that silicon-photonic fabrication is compatible with existing semiconductor foundry processes, meaning scale-up does not require building an entirely new industrial supply chain.

Infleqtion: Neutral Atoms, and Quantum Beyond the Computer

Neutral-atom quantum computing uses individual atoms in their natural, uncharged state, held in place and manipulated by laser-controlled optical tweezers. Because these atoms are physically identical, unlike manufactured superconducting or photonic qubits, which must be individually calibrated for defects, the platform carries a structural uniformity advantage that simplifies error correction and supports scaling.

Infleqtion's Sqale system holds the neutral-atom industry record for entangling gate fidelity at 99.73%, published in *PRX Quantum* in 2024, and in December 2025 delivered the UK's only operational 100-qubit quantum computer to the National Quantum Computing Centre. The roadmap targets more than 30 logical qubits in 2026 and over 100 logical qubits by 2028.11

What distinguishes Infleqtion from every other company in this article is that quantum computing is not its only quantum product. Its Tiqker optical atomic clock delivers timing precision far beyond GPS, and this is a capability with direct applications in defense, space, and GPS-denied navigation. Infleqtion's quantum sensing platform has been demonstrated in quantum flight trials and deployed on underwater autonomous vehicles. The April 2026 DARPA HARQ contract for its Multistaq software,12 designed to manage heterogeneous quantum systems across different qubit modalities, points to a third dimension: Infleqtion is positioning itself as infrastructure for the broader quantum ecosystem, not just a hardware vendor.

Reading the Landscape

The five companies here are not competing for the same customers.

- IonQ's cloud-accessible trapped-ion systems are attracting enterprise users in drug discovery, financial modeling, and logistics, notably commercial organizations running real workloads, not research pilots.
- D-Wave's annealing platform has its deepest traction in industrial optimization, where enterprises pay for recurring access to solve problems classical computers handle only approximately.
- Rigetti and Xanadu are primarily serving research institutions, national laboratories, and government programs at this stage, customers whose value is as much scientific validation as commercial revenue.
- Infleqtion occupies a different category entirely, in that its defense and sensing products serve government and military customers whose procurement decisions are driven by operational need, not technology curiosity.

What the Modality Question Means Going Forward

The scientific results detailed in this article, for example entangled commercial processors, below-threshold error correction, room-temperature photonic architectures, and record fidelity on neutral-atom and trapped-ion systems, collectively represent something real.

Quantum Computing is a field making measurable, verifiable progress on the hard problems that have always stood between quantum hardware and practical utility.

Which modality ultimately scales to fault-tolerant computing at commercial cost remains genuinely an open question. The five companies profiled here have made five different bets on the answer, and the honest position is that the evidence does not yet decisively favor any one of them.

What has changed is that these bets are now being tested in the open, on deployed hardware, with paying customers and peer-reviewed results. That is a different kind of journey than the one quantum computing was on five years ago, and the steps being taken are consequential, even if the destination is not yet in view.

The WisdomTree Quantum Computing Fund (WQTM) focuses on a spectrum of companies that are involved in pushing quantum computing forward, and we appreciate that many investors have a lot of interest in developments in this space.

1 Source: IonQ. (2026, April 14). *IonQ achieves key photonic interconnect milestone, demonstrating networked quantum systems using entanglement* [Press release].

2 Source: IonQ. (2025, October 21). *IonQ achieves landmark result, setting new world record in quantum computing performance* [Press release].

3 Source: IonQ. (2025, September 25). *IonQ achieves record breaking quantum performance milestone of #AQ 64* [Press release].

4 Source: IonQ & SkyWater Technology. (2026, January 26). *IonQ to acquire SkyWater Technology, creating the only vertically integrated full-stack quantum platform company* [Press release].

5 Source: King, A. D., et al. (2025). Beyond-classical computation in quantum simulation. *Science*.

6 Source: D-Wave Quantum Inc. (2026, January 20). *D-Wave completes acquisition of Quantum Circuits Inc., creating world's leading quantum computing company* [Press release].

7 Source: Rigetti Computing. (2026, April 7). *Rigetti announces general availability of 108-qubit system* [Press release].

8 Source: Aghaee Rad, H., et al. (2025). Scaling and networking a modular photonic quantum computer. *Nature*, *638*(8052), 912–919.

9 Source: Xanadu Quantum Technologies. (2026, April 9). *Xanadu announces fourth quarter and full year 2025 results* [Press release].

10 Source: Larsen, M. V., et al. (2025). Integrated photonic source of Gottesman–Kitaev–Preskill qubits. *Nature*.

11 Sources: Evered, S. J., et al. (2024). High-fidelity parallel entangling gates on a neutral-atom quantum computer. *PRX Quantum*; Infleqtion. (2026, March 16). *Infleqtion delivers the UK's only operational 100-qubit quantum computing system at the National Quantum Computing Centre* [Press release].

12 Source: Infleqtion. (2026, April 21). *Infleqtion selected by DARPA to advance next-generation heterogeneous quantum software* [Press release].

Important Risks Related to this Article

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