MARSHALL GERSTEIN ip

Quantum Technologies

Quantum Computing & Quantum Technologies

Quantum computing has crossed a critical threshold, transitioning from primarily theoretical research to early-stage real-world deployment. By exploiting quantum mechanical phenomena such as superposition — which allows qubits to exist in multiple states simultaneously — and entanglement — which enables strong correlations across physically separated qubits — quantum systems can solve certain classes of problems that are computationally intractable for classical computers.

The potential applications of quantum computing span a wide range of industries, including encryption and communications, high-performance compute (HPC), chemicals and pharmaceuticals, advanced materials, finance, environmental impact and energy, artificial intelligence, national security, and data protection. As global investment in quantum computing accelerates across government, technology, and defense sectors, participants in this field encounter a rapidly evolving legal landscape that requires technically fluent, forward-looking counsel.

Marshall Gerstein advises entities including research institutions and national laboratories, as well as companies operating at every stage of the quantum technology development lifecycle — from early benchtop research and development through commercialization, collaboration, and scaling.

Understanding the Legal Landscape for Quantum Technologies

Quantum technologies present legal challenges with few direct precedents in traditional software or hardware practice. These challenges include the following areas.

- **Intellectual Property Strategy**: Protecting quantum inventions requires technical engagement with subject matter that often lacks clear analogs in conventional software or hardware, including quantum algorithms, qubit architectures, error-correction schemes, and hybrid quantum-classical systems. Patentability analysis, claim scope, inventorship, and trade secret strategy require tailoring to the realities of quantum research and collaboration.
- **Commercialization and Collaboration**: Quantum innovation frequently emerges from partnerships among startups, universities, national laboratories, and industry consortia. These multi-party relationships require agreements that carefully allocate intellectual property ownership, publication rights, and government funding obligations.
- **Standards, Consortia and Patent Positioning**: Quantum innovation is increasingly shaped by standards bodies, research consortia, and pre-competitive collaborations. Companies must position patent portfolios within these ecosystems while balancing participation and disclosure obligations with long-term enforcement, licensing, and commercialization objectives.
- **Data Security and Post-Quantum Readiness**: A sufficiently powerful fault-tolerant quantum computer would be capable of breaking widely deployed public-key encryption schemes, including RSA and elliptic-curve cryptography, using algorithms such as Shor’s algorithm. While such systems do not yet exist at scale, this is no longer a purely theoretical concern. In 2024, NIST finalized its first post-quantum cryptography (PQC) standards, and regulatory agencies and major procurement frameworks have begun mandating transition timelines. Organizations must assess cryptographic exposure and develop PQC migration plans while navigating contractual, regulatory, and liability obligations.

Our attorneys work across practice areas — including intellectual property, government and regulatory affairs, data privacy, and commercial contracting — to provide integrated advice aligned with the quantum ecosystem.

Our Experience in the Quantum Technology Ecosystem

We have experience advising clients across the quantum technology spectrum, including early-stage innovators and established enterprises. Representative experience includes:

- **Quantum Computing IP Portfolios:** Advising on patent and trade secret strategies covering quantum processors, control systems, algorithms, and hybrid quantum-classical architectures.
- **Research & Development Collaborations:** Structuring and negotiating research agreements among startups, universities, and national laboratories, including government-funded research.
- **Commercialization & Licensing:** Supporting licensing of core quantum technologies, including field-of-use restrictions, milestone-based royalties, and joint development frameworks.
- **Venture Formation & Investment:** Advising on formation, financing, governance, and spin-outs from academic or research institutions.
- **Regulatory & Export Controls:** Counseling on compliance with export controls, foreign collaboration rules, and national-security-related regulations.
- **Data Security & Risk Management:** Advising on cybersecurity, data protection, and post-quantum preparedness, including contractual risk allocation.

While client details are anonymized, our experience reflects sustained engagement with the legal challenges unique to quantum innovation.

A Practical, Business-Focused Approach

Quantum technologies involve long development timelines and evolving policy and national security priorities. We help clients pursue legal strategies grounded in the realities of quantum research, commercialization, and early deployment.

Our work commonly addresses:

- Post-quantum cryptography (PQC) transition planning
- Bayh-Dole considerations for federally funded quantum research
- Export controls, foreign investment review, and national security constraints
- IP and collaboration structures for multi-party research environments
- Commercialization pathways from lab-stage innovation through early deployment

Quantum computing is already being deployed in research, defense, and early commercial settings. Legal and strategic decisions made today — around IP, regulation, security, and collaboration — will shape competitive position over the coming years.

Partnering with Innovators Defining the Future

Quantum technologies represent one of the most consequential technological transitions of this century. We are proud to work alongside the companies and institutions leading this transition. By combining deep technical literacy in quantum science, legal depth, and practical commercial insight, we help quantum innovators protect their ideas, structure the partnerships that advance them, and navigate the legal complexities that accompany science at this scale.

To learn more about our Quantum Computing and Quantum Technologies capabilities, please contact any member of our technology or intellectual property teams.

Example Quantum Computing Functionality and Features

Marshall Gerstein's experienced group advises on the following aspects of quantum computing systems and technologies, among others:

- **Qubits and superposition**: Quantum computers use qubits rather than classical bits. A qubit can be prepared in a superposition of 0 and 1, which allows a quantum system to encode and process probability amplitudes across many possible states before measurement.
- **Entanglement**: Qubits can be entangled so that the state of one qubit is correlated with the state of another in ways that have no classical analog. Entanglement is a key resource for quantum algorithms, quantum communications, and error-correction schemes.
- **Quantum gates and circuits**: Computation is performed through sequences of quantum gates that manipulate qubit states and their phase relationships. These gates are orchestrated as quantum circuits that must be compiled and optimized for the constraints of a particular quantum hardware platform.
- **Measurement and probabilistic outputs**: Reading a quantum state typically collapses the qubits into a classical result, so useful outputs are often obtained by running the same circuit many times. Quantum processing therefore commonly produces probabilistic distributions that must be interpreted statistically.
- **Hybrid classical-quantum operation**: Quantum computers generally do not operate as standalone replacements for classical machines. A classical computer typically prepares input data, compiles and schedules the quantum circuit, controls the quantum hardware, and post-processes the measured results in a hybrid workflow.
- **Decoherence, noise, and error mitigation**: Qubits are highly sensitive to noise from their environment, and quantum information can degrade through decoherence and imperfect gate operations. As a result, calibration, error mitigation, and, ultimately, quantum error correction are central features of practical quantum computing systems.
- **Hardware architecture and qubit connectivity**: Quantum computers can be implemented using different physical modalities, including superconducting circuits, trapped ions, neutral atoms, photonics, and silicon-spin systems. The underlying architecture, qubit count, and connectivity map directly affect performance, scalability, control requirements, and the types of algorithms that can be run efficiently.
- **Application-specific acceleration**: Quantum computers are expected to offer advantages for selected problem classes, such as quantum simulation, certain optimization workflows, and aspects of cryptography and scientific computing. In most commercial settings, they are better understood as specialized accelerators that work alongside classical infrastructure rather than as general-purpose replacements.

Related Reading

- Quantum Computing Patent Trends in the US: Are Breakthroughs Just Around the Corner?