MORGAN CREEK DIGITAL
ALTERNATIVE THINKING ABOUT INVESTMENTS

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Investing in Nature's Quantum Architecture: Why Pasqal?

Quantum computing is at an inflection point, shifting from theoretical promises to more practical deployment and paths to commercialization. The fundamental question may no longer be whether quantum computing has a role in the evolution of computer architecture, but instead, which modalities will scale first to achieve quantum advantage.

The Evolution of Computing Architectures

Mainframes (1940s–1970s)

The first era of computing was defined by centralized mainframes, exemplified by systems such as the IBM System/360. These machines consolidated computational power for governments and enterprises, enabling large-scale batch processing through shared terminals.

Microprocessors and Personal Computing (1970s–1990s)

The introduction of the microprocessor marked a shift from centralized to personal computing. Innovations like Intel's 4004 and 8086 democratized access to computation, allowing processing power to move from institutions to individuals and setting the stage for the software revolution.

Parallel Computing and GPUs (1990s–2010s)

As performance gains from Moore's Law began to plateau, the industry turned to parallel processing. Originally designed for visual rendering, Graphics Processing Units (GPUs) evolved into versatile accelerators capable of executing thousands of simultaneous operations, laying the foundation for modern AI and high-performance computing.

Domain-Specific Accelerators (2010s–2020s)

The next phase emphasized specialization. Purpose-built chips such as Google's Tensor Processing Unit (TPU), Graphcore's IPU, and Groq's LPU were designed to optimize specific workloads like machine learning inference and dataflow computation, trading generality for efficiency and scalability.

Quantum Computing (2020s–2030s)

We believe today's frontier is quantum computing, which departs entirely from classical architectures. Quantum processors leverage superposition and entanglement to perform operations in parallel across many states, offering potential breakthroughs in fields such as optimization, materials science, and cryptography.

Quantum Computing Modalities

For years, superconducting circuits and trapped ions (as well as photonic qubits) have competed for dominance, each balancing tradeoffs between coherence, connectivity, and scalability. Superconducting qubits are tiny electrical circuits made from superconducting materials like aluminum or niobium that exhibit artificial atom behaviors with zero electrical resistance when cooled to extremely low temperatures, or in other words, fabricated circuit loops. They have achieved fast gate speeds but suffer from noise and manufacturing variability.

Most leading quantum efforts, Google, IBM, and Rigetti, rely on superconducting qubits, which require cryogenic temperatures near absolute zero to maintain coherence. Others, such as IonQ, use trapped ions, offering excellent qubit fidelity (precision and stability) but limited scalability due to linear trap geometries and slow gate speeds. Neutral atoms, by contrast, operate at room temperature, require no complex cooling, and leverage natural uniformity; each atom of a given isotope is an identical quantum bit produced by nature itself. Given the identical design, each neutral atom is inherently coherent and has the same energy levels, allowing for the manufacturing of highly interconnected, stable quantum processors with thousands or tens of thousands of qubits. The "aha moment" is that the neutral atom architecture leverages the system's inherent physics rather than forcing artificial systems to behave coherently. Reminiscent of hemoglobin in the human body, among billions of possible configurations, it consistently finds the energetically optimal pathway for oxygen transport, not through brute computational force but through the inherent efficiency of its structure.

Analyzing this manufacturing process one layer deeper, these atoms are actually trapped and manipulated by precisely tuned laser light and then arranged into massive 2D and 3D arrays, which function as said quantum processors; processors that can scale without introducing the same exponential rise in error correction or manufacturing complexity as other modalities. For most of the last 25 years, neutral atoms were seen as too resistant to manipulation due to their lack of electric charge and unresponsiveness to traditional electromagnetic fields. That changed recently with the convergence of laser cooling, optical tweezers, and precision beam steering advances, which unlocked atom-by-atom control and moved a predominantly R&D field into scalable engineering.

Brief History of Neutral Atoms (For the History Buffs)

In 1999, physicists Ivan Deutsch and Poul Jessen proposed using ultracold neutral atoms in optical lattices for quantum computation, building on Nobel-winning discoveries in laser cooling and trapping from the 1980s and 1990s. Dieter Jaksch, Peter Zoller, and Mikhail Lukin later introduced the Rydberg blockade mechanism, the ability for one excited atom to prevent neighboring atoms from entering the same state, a natural way to entangle qubits. Experimentalists like Mark Saffman, Antoine Browaeys, and Immanuel Bloch translated these ideas into early demonstrations of quantum gates. By 2018, Browaeys' group at Université Paris-Saclay and Lukin's team at Harvard were deterministically assembling 50 to 75 atom arrays, marking the beginning of the journey toward commercially viable quantum processors. That same year, several startups emerged to bring this technology to market, among them Pasqal.

Pasqal

Pasqal, SAS, is a company developing systems and methods for quantum computation using neutral atoms as qubits, a process often referred to as "qubit addressing." Their work spans device architecture, control, and computational methods, including innovations in atom-trapping site determination, strontium laser excitation, and optimization problem-solving using quantum processors. Pasqal was founded in 2019 by Nobel laureate Alain Aspect, whose work in quantum entanglement laid the scientific foundation for confirming the reality of quantum entanglement itself, alongside Georges-Olivier Reymond, Christophe Jurczak, and other pioneers from the Institut d'Optique. In addition, the company has raised over €140 million from private and institutional backers, solidifying itself as one of the global leaders in neutral atom quantum computing.

Why Pasqal?

Technology

At its core, Pasqal's technology harnesses arrays of individually trapped and controlled neutral atoms in 2D or 3D Lattices, confined and manipulated with precisely tuned laser light to build scalable and reconfigurable quantum processors, performing both analog simulations and gate-based digital operations. This dual capability is a distinguishing feature that allows enterprises to extract commercial value today through analog simulation while developing expertise and algorithms for future digital quantum computing. In analog mode, the processor directly simulates complex quantum systems, which is ideal for applications in optimization, materials modeling, and physics research. Digital mode, meanwhile, supports universal gate-based computation, paving the way toward fault-tolerant quantum machines. Further, Pasqal's robust intellectual property portfolio covers atom arrangement geometries, Rydberg excitation control, and laser-based manipulation, all core to its scalability, flexibility, and operational precision.

Commercial Traction

Their systems have demonstrated the ability to load over 1,000 atoms in a single register and are being deployed across industrial and national research centers. Clients, including Aramco, CEA/GENCI, and Jülich, access Pasqal's systems via on-premise installations or through national supercomputing infrastructure. Pasqal's 324-qubit processor, the largest of its kind when announced, is available via Microsoft Azure Quantum and is being leveraged by industry leaders like Siemens, EDF, and Crédit Agricole CIB for multi-year collaborations in energy, materials science, and finance. Pasqal's efficient mapping of complex optimization and simulation problems is demonstrating value. In finance, Pasqal's QBoost algorithm reduced credit downgrade model runtimes from three hours to under one hour with equivalent accuracy; in logistics, it optimized EV charging and fleet scheduling with over 98% approximation efficiency. From a business perspective, Pasqal monetizes through hardware sales and managed service contracts, such as the Aramco agreement, established in May 2024, for a 200-qubit processing unit (QPU), generating recurring revenue and strong longterm margins. The company also acquired AEPONYX, a Canadian photonics firm, to advance qubit addressing precision and reduce cross-talk, a critical step toward building modular, fault-tolerant systems that can extend beyond 10,000 qubits in 3D arrays. With industrial "quantum factories" underway in Paris and Sherbrooke, Pasqal is positioning itself as a potential transatlantic quantum leader.

Its ecosystem also extends well beyond hardware…

Pasqal's open-source Pulser software framework allows developers to design, simulate, and deploy quantum pulse sequences, while Pulser Studio, a commercial layer, integrates seamlessly into enterprise workflows. These software tools are compatible with hybrid computing platforms like Nvidia CUDA-Q and Microsoft Azure Quantum, positioning Pasqal at the intersection of quantum and AI. This strategy, open-core for adoption and commercial tools for monetization, creates an expanding developer community while driving recurring software revenues at high incremental margins. Further, the democratized access via major providers, Microsoft, Nvidia, and IBM, enables its users to pay per computation rather than investing in on-premise hardware, resulting in robust quantum-classical hybrid ecosystems.

Leadership

We think Pasqal's scientific and operational depth stands out as one of the strongest in the global quantum landscape. Co-founded by Nobel laureate Alain Aspect, whose pioneering experiments on quantum entanglement confirmed the nonlocal nature of quantum mechanics, alongside Antoine Browaeys and Christophe Jurczak, Pasqal combines world-class physics with strategic execution. Browaeys is widely regarded as a leader in optical tweezers and Rydberg atom control, while Jurczak, a physicist turned entrepreneur, bridges the gap between research and commercialization. They are joined by Wasiq Bokhari, Pasqal's executive chairman, a seasoned technology executive with prior leadership roles at Google and Meta, who brings a strong track record in scaling advanced hardware and software platforms. Loïc Henriet, the company's CEO, leads the integration of hardware, software, and algorithmic innovation. Under this multidisciplinary leadership, Pasqal has built a team of over 75 PhDs across quantum physics, photonics, and computer science, many of whom are drawn from top research institutions such as École Polytechnique, Harvard, and MIT. The company also maintains a portfolio of more than 400 patents and scientific publications, encompassing breakthroughs in Rydberg excitation, hybrid analog-digital architectures, and large-scale qubit array control. We believe the combination of deep scientific credibility, proven technical innovation, and industrial-scale leadership gives Pasqal one of the most formidable foundations in the quantum computing industry.

Conclusion

At Morgan Creek Digital, our conviction in Pasqal stems from three beliefs. First, quantum computing is not a single-architecture race but a multi-modal evolution, and neutral atoms represent a balanced path between scalability, stability, and coherence. Second, we think Pasqal's leadership team, founded by Nobel-caliber scientists and seasoned operators backed by a strong IP moat in atom control, scalability, and precision engineering, has both the technical depth and execution discipline to deploy commercial quantum systems at scale. And third, we believe that the future of computation will increasingly resemble nature, distributed, parallel, and inherently efficient. Pasqal embodies this philosophy by combining analog simulation and digital gate-based operations within a single neutral-atom platform, deriving value from optimization and simulation use cases while futureproofing its capabilities for the next era of universal quantum computing.

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