GetFocus

The new quantum computing era, or just the beginning?

How GetFocus' improvement rates predicted Microsoft approach

Introduction

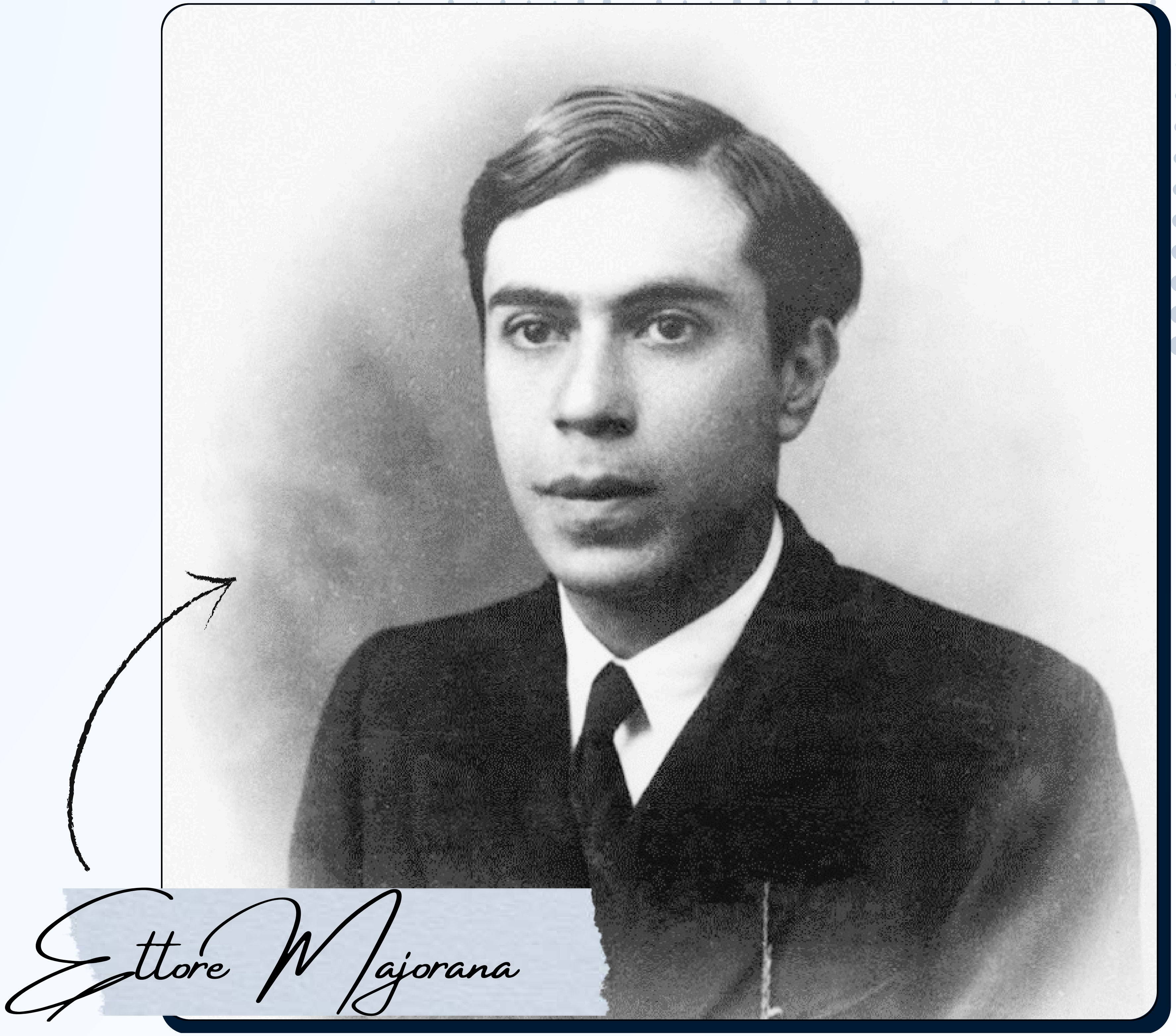
Quantum computers have long struggled with finicky qubits that easily lose their way due to environmental noise, leading to frustratingly high error rates.

Microsoft's answer? **Topological qubits**, a game-changing approach built for stability and resilience. These qubits harness the power of **Majorana particles**, exotic quasiparticles that double as their own antiparticles, to store information in a way that's naturally shielded from interference.

The result? **A more reliable, noise-resistant quantum future.**

Majorana Particles

A particle so elusive that it exists as its own antiparticle, Majorana particles, first theorized in 1937 by the Italian physicist **Ettore Majorana**, are some of the most mysterious quasiparticles in the quantum world.

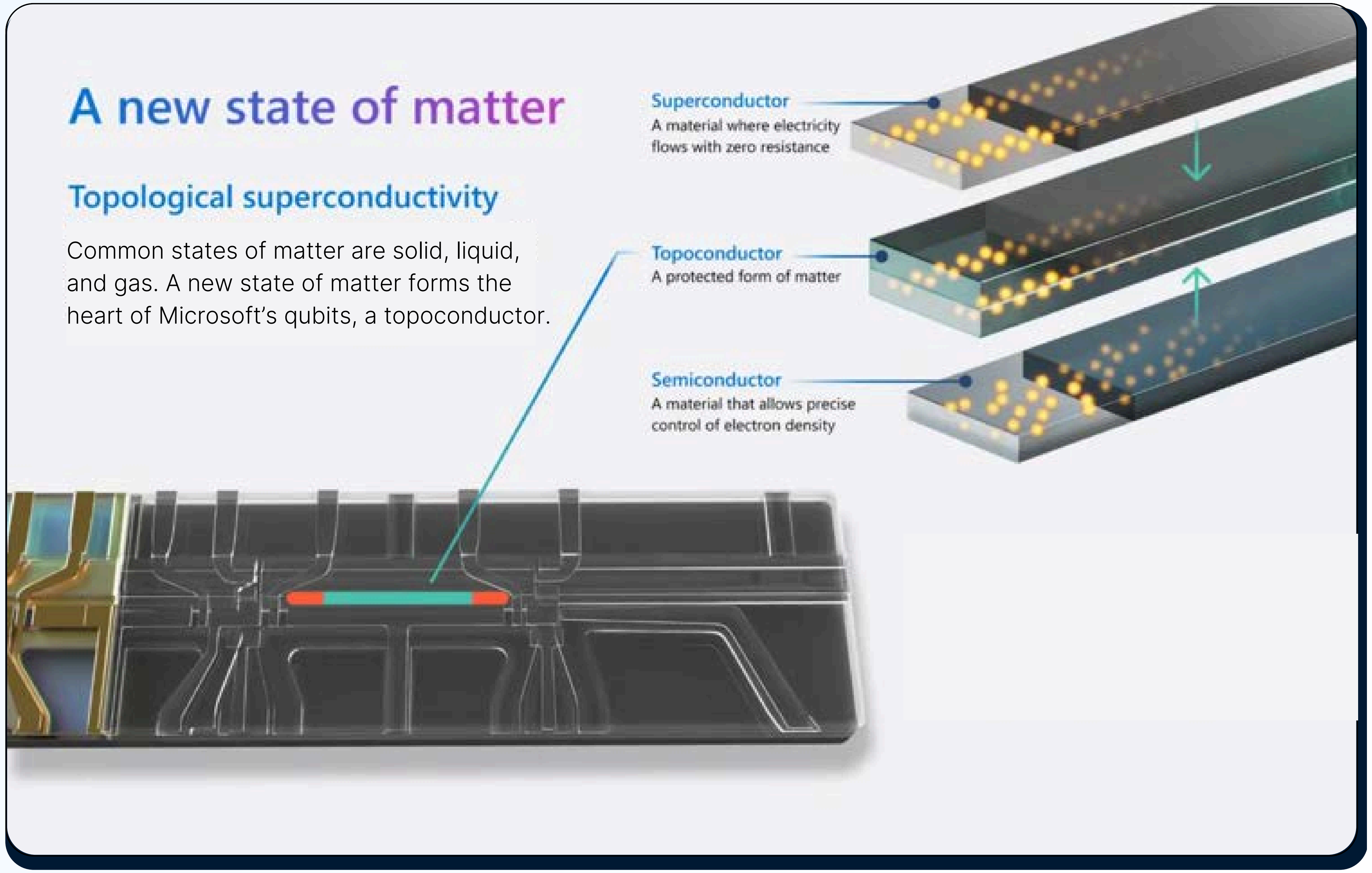


Unlike ordinary particles that have distinct opposites (like electrons and positrons), Majorana particles are perfectly **self-dual**, meaning they cancel themselves out in a dance of quantum symmetry without needing a separate "**antiparticle**" counterpart.

But their true potential lies in their **topological nature.**

When bound in special superconducting materials, they form **Majorana zero modes**, exotic states that are remarkably resistant to noise and decoherence. This makes them **prime candidates for next-generation quantum computers**, where they could enable qubits that are inherently stable, immune to the errors that plague today's fragile quantum systems.

Microsoft, other tech giants and research teams worldwide are racing to harness these enigmatic quasiparticles. If successful, Majorana-based quantum computers could revolutionize everything from cryptography to materials science, solving problems that classical computers could never dream of tackling.



Credit Image: Microsoft

Anticipating Breakthroughs: GetFocus' Predictive Edge

Quantum breakthroughs, as any other technological development, don't happen overnight. They follow patterns of progress hidden in data.

We decode these patterns using improvement rates that reveal which emerging technologies will dominate before they make headlines.

Microsoft's Majorana 1 launch may seem like a sudden leap, but our analysis shows that its rise could have been foreseen.

GetFocus Forecasting Methodology

At GetFocus, we developed a quantitative method inspired by MIT research to **forecast the technological future** based on metrics that can be identified in patent data.

Using the latest advancements in AI technology, we have created a system that can estimate how rapidly any area of technology is improving.

Our method revolves around **3 key steps.**

1

We identify every single patent that relates to an area of technology using AI. The resulting dataset represents the entire developmental history of an area of technology.

2

Once this dataset is created we measure 2 key metrics.

Cycle Time - How many years it takes for a technology to produce a new generation of itself.
The lower the cycle time, the better.

Knowledge Flow - How significant of a step forward a new generation represents.
The higher the knowledge flow, the better.

3

Using the previous metrics, we calculate the **'Technology Improvement Rate',** which represents the average percentage (%) increase in performance per dollar that can be expected from an area of technology in one year.

By using the above methodology, technology improvement speeds can be accurately measured, and those speeds can be used to predict technological disruption well ahead of time.

Already in 2019 we detected the first signs of Microsoft true commitment to fine-tuning majorana particles

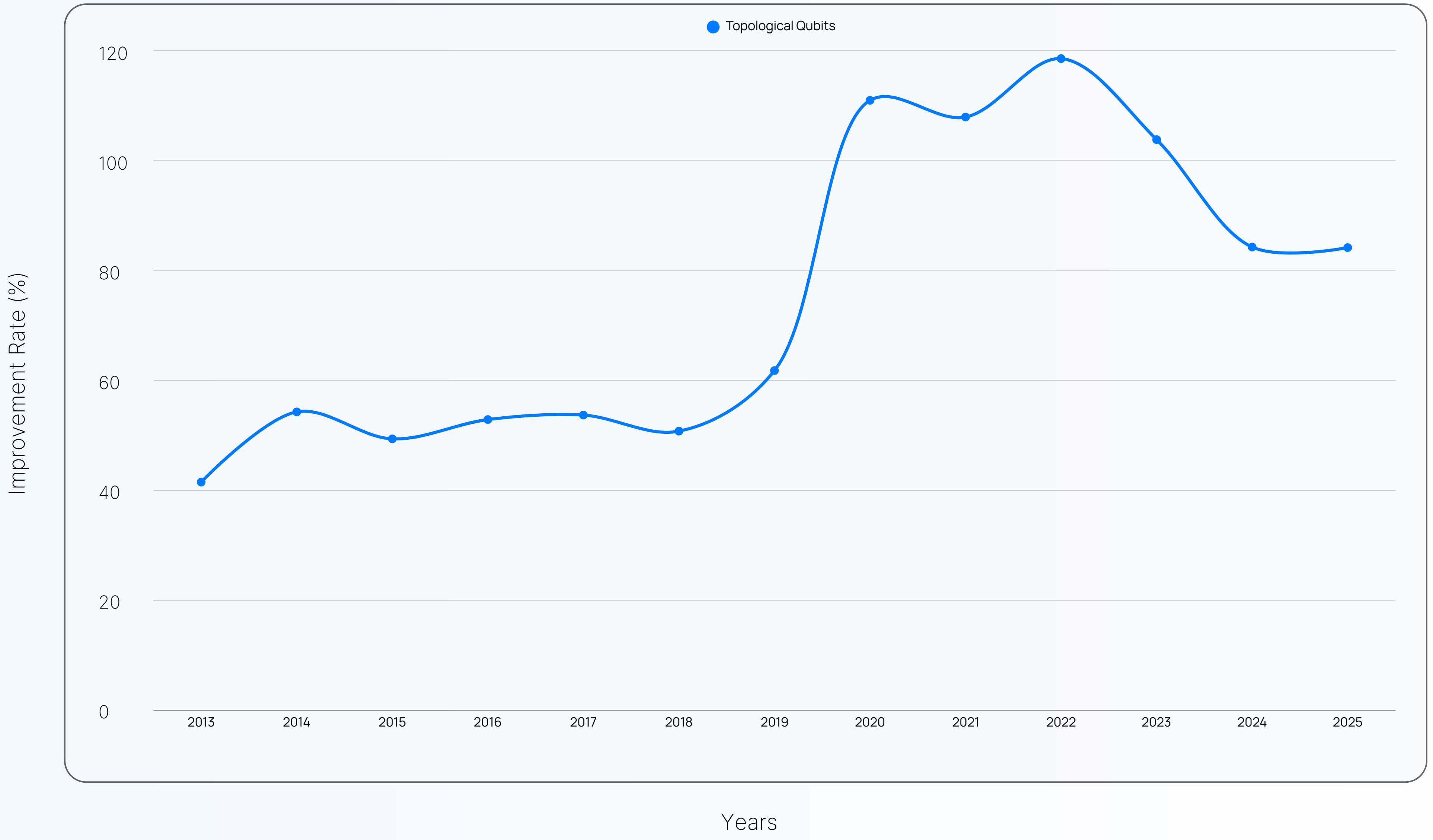
A significant spike occurred in 2020, where the improvement rate jumped to **110.897%**, indicating a rapid acceleration in technological advancement.

If the current improvement rate of **84.128%** continues, technological progress for topological quantum computers will outpace **Moore's Law**, which sits at around 40%.

This rapid acceleration suggests that advancements in Majorana-based quantum computing are unfolding at an **exceptional pace**, with significant implications for R&D and market adoption.

Majorana Particles Improvements Rate for Microsoft

Microsoft's Majorana Push: Improvement Rate Surges to 110.9%



Source: GetFocus Platfrom

Beyond Majorana: The Quantum Race

Microsoft's **Majorana 1** marks a major step forward, but topological qubits are not the only contender. Other quantum technologies, each with unique strengths and challenges, are also advancing in the race for quantum supremacy.

Superconducting Qubits: superconducting qubits use circuits made of superconducting materials that can exhibit quantum phenomena at very low temperatures.

- **Pros**: Fast gate times and relatively easy to integrate into existing infrastructure.
- **Cons:** Requires extremely low temperatures (close to absolute zero), and decoherence can be a challenge.

Neutral Atoms: this approach uses arrays of neutral atoms trapped and manipulated using laser beams. These atoms serve as qubits, and their quantum state is controlled through optical techniques.

- **Pros**: High scalability potential and long coherence times.
- **Cons:** Technologically complex and still relatively in early stages of development.

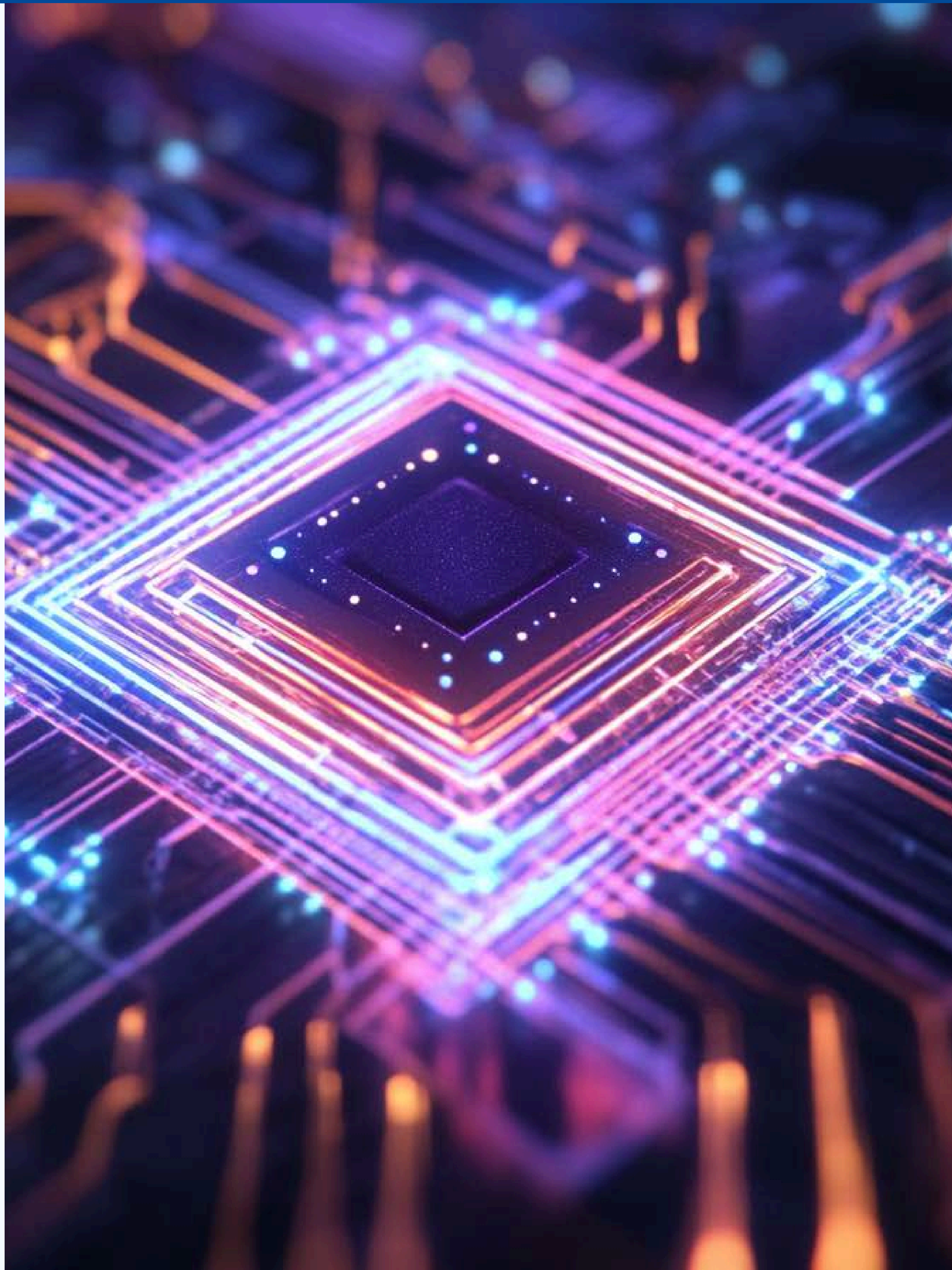
Photonic Quantum Computing: photons, particles of light, are used to carry and process quantum information. They can be manipulated using linear optical components like beam splitters and phase shifters.

- **Pros**: Operates at room temperature and uses existing fiber optics technology for communication.
- **Cons:** Challenges with creating deterministic photon sources and ensuring efficient quantum gates.

Trapped-Ion Qubits: Ions are trapped using electromagnetic fields and manipulated with lasers to perform quantum operations. The ions serve as the qubits.

- **Pros**: Long coherence times and high-fidelity quantum operations..
- **Cons:** Slower gate operations compared to some other technologies and scalability can be challenging.

By analyzing their **improvement rates**, we can examine these leading quantum architectures and the speed at which they're improving, to uncover which approaches are accelerating, which are plateauing, and which may emerge as the dominant force in quantum computing.



Topological Qubits Showed Early Promise and Long-Term Dominance

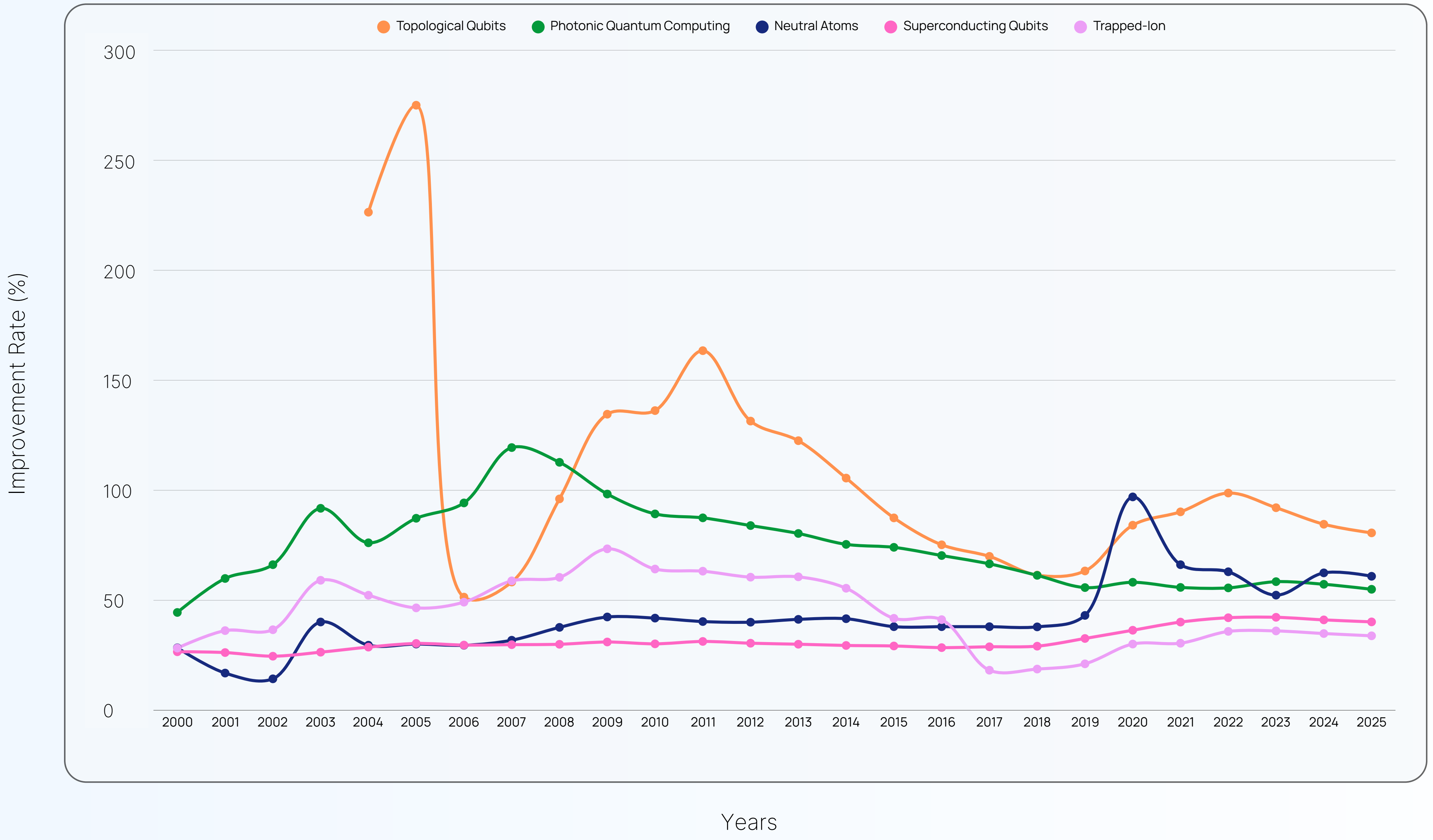
Microsoft bet on developing Topological qubits for their Majorana 1 quantum computing chip Topological qubits' improvement rate showed signs of the technology true potential **as early as 2009**

Even during a descendant phase after the peak of 2011, **topological qubits maintained a leading improvement rate** compared to other quantum platforms.

GetFocus' predictive approach identified **topological qubits as a leading candidate for future dominance over a decade ago**, long before Microsoft's Majorana 1 announcement.

How Early Could We Have Predicted Topological Qubits' Rise?

The Quantum Race: Topological Qubits Are Leading the Charge



Source: GetFocus Platfrom

Non-Abelian Anyons: The Key to Microsoft's Quantum Error Correction Strategy

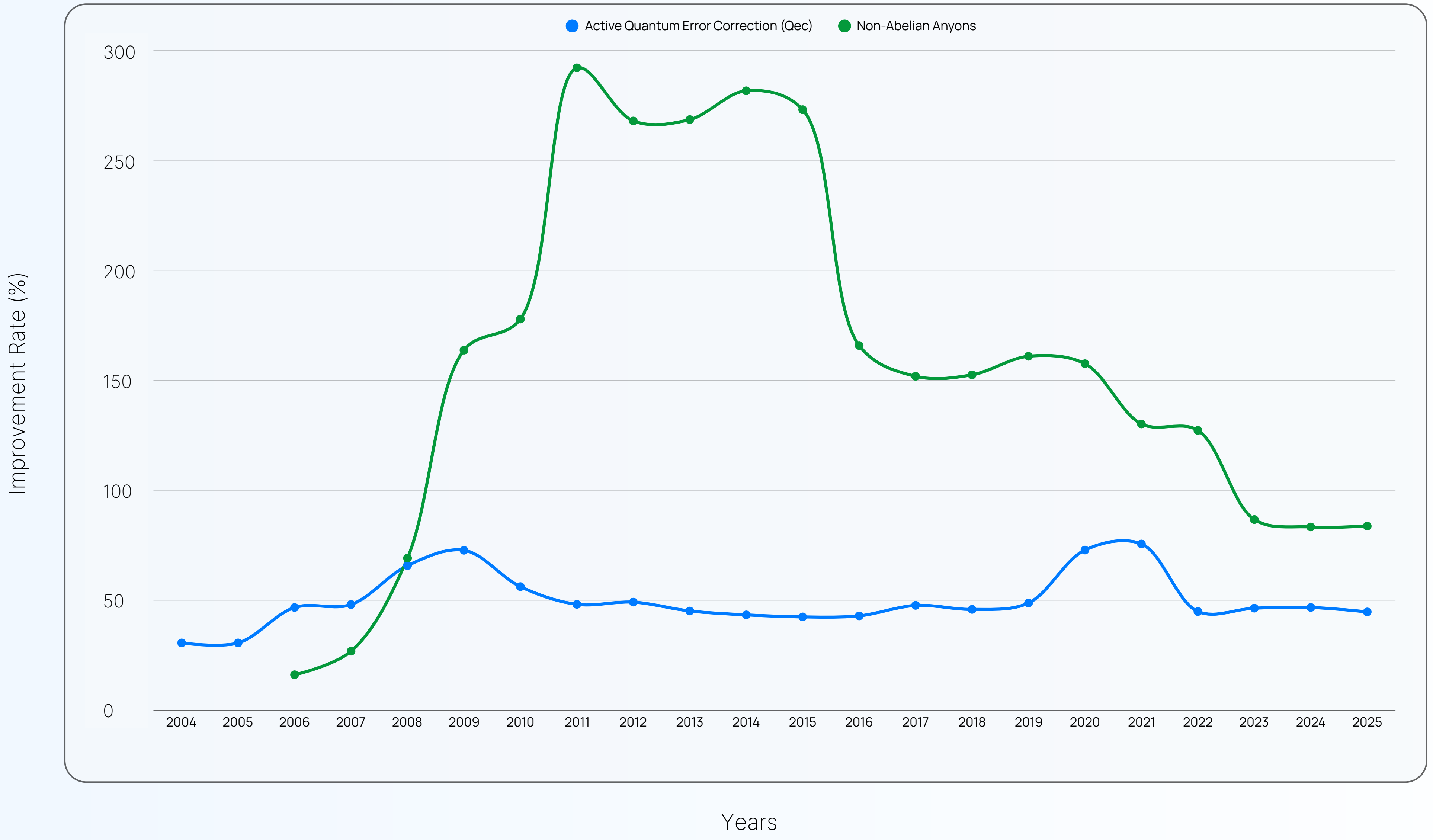
Patent data showed already in 2008 signs that non-abelian anyons would represent the most promising error correction strategy.

Error correction strategies

A critical component of Majorana 1 is the integration of topoconductors, a new class of materials introduced by Microsoft. These materials facilitate the creation and stabilization of Majorana zero modes, which are essential for forming topological qubits.

Topoconductors are engineered to host non-Abelian anyons, enabling more stable qubit operations and enhancing error resistance in quantum computations

Microsoft chose non-abelian anyons to provide error resistance, as opposed to the established active quantum error correction (QEC)



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What's Next for Quantum Computing?

Fusion-Based Quantum Computing (FBQC) – A New Take on Majorana Qubits: Instead of braiding non-Abelian anyons like Microsoft's approach, fusion-based quantum computing (FBQC) manipulates Majorana zero modes through fusion and measurement rather than intricate braiding operations.

- Could simplify hardware requirements for topological quantum computing.
- Might require fewer physical qubits for fault tolerance compared to Microsoft's braiding-based approach.

Floquet Qubits (Time Crystals & Driven Systems):A cutting-edge approach where qubits are stabilized using periodic driving (Floquet engineering) instead of conventional cooling or error correction.

- Could extend coherence times by dynamically stabilizing quantum states.
- Might enable new error-resistant qubit designs.

Chiral Photonic Qubits (Topological Photonics for Quantum Computing): Uses light-based topological states (instead of Majorana quasiparticles) to encode and process quantum information

- Can naturally protect against errors without requiring superconducting circuits.
- Potential for room-temperature quantum computing, unlike cryogenically cooled systems.

Rydberg Atom Qubits (Neutral Atom Computing): Uses neutral atoms trapped in optical lattices to encode and manipulate quantum information.

- Allows for highly interconnected qubits, which could help scale quantum processors more efficiently.
- Naturally leverages long-range interactions, enabling new types of quantum gates.

Topological Qubits from New Quantum Materials: Some researchers are investigating alternative topological materials, including:

- Fractional quantum Hall states
- Anyons in high-temperature superconductors
- New classes of spin liquids

These could offer topological protection similar to Majorana qubits but with different physical foundations.

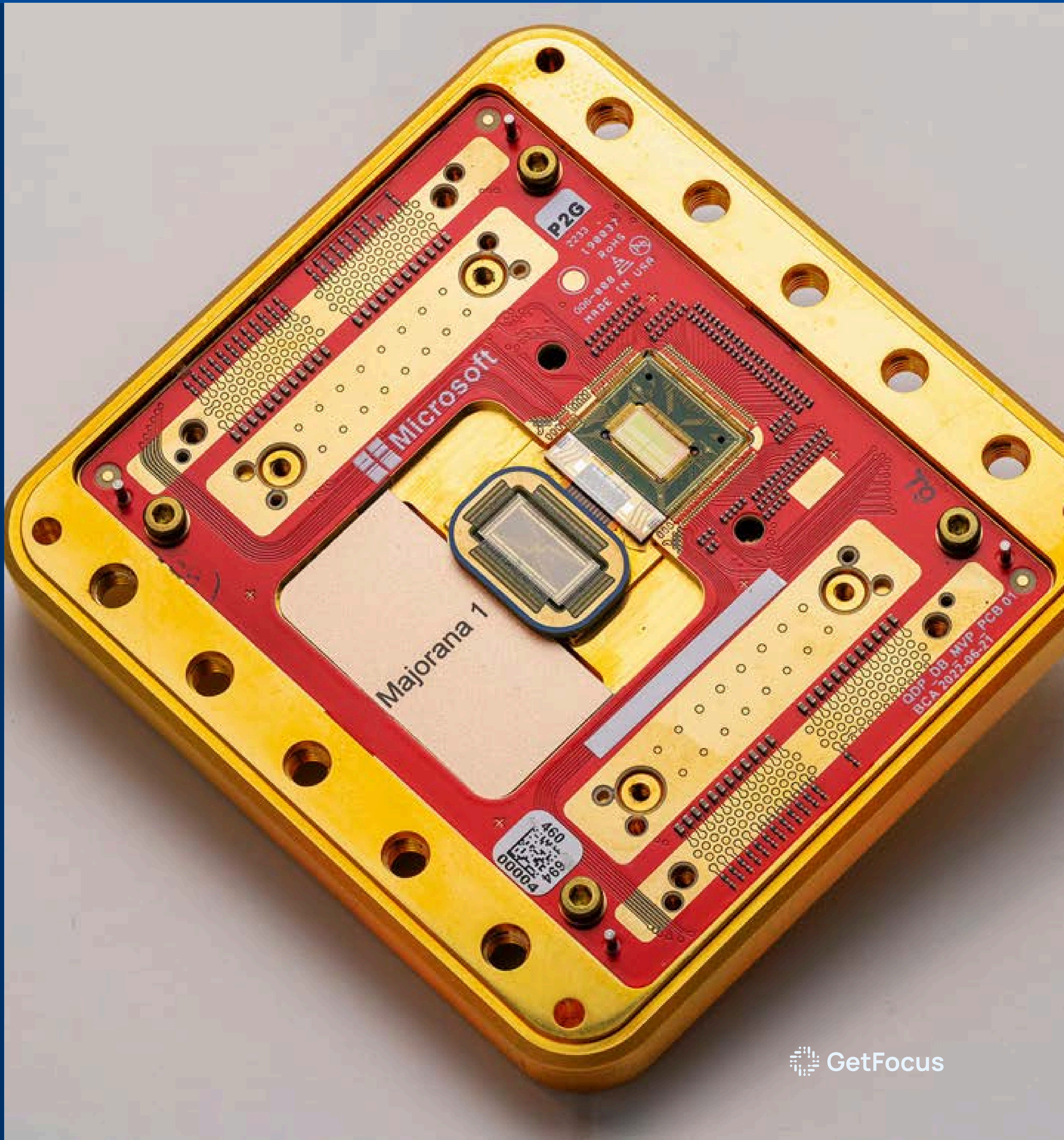
Conclusion

As quantum computing ventures into uncharted territory, uncertainty looms over which technologies will ultimately prevail. With Microsoft's Majorana 1 and topological qubits challenging conventional approaches, the stakes have never been higher.

Our insights reveal not just where the field is today, but where it is heading.

At GetFocus we catch early indicators of technological breakthroughs, reducing speculation and offering a data-driven perspective on the technological future, to help You spot the winner technology in your market before its true potential becomes evident.

By staying ahead of the curve, we turn everyone's uncertainty into your opportunity.



About GetFocus

We are on a mission to **fast-track technological progress worldwide**.
What started with foundations laid by MIT researchers, is now a full blown technology forecasting system. By equipping innovators with **data-driven technological foresight**, we help them make the right investment decisions and innovate faster.

Emerging technologies that turn into winners show clear and measurable signals early on in their development. By giving you access to this data, we help you innovate faster.

Our method has been verified to work on more than **50 technological areas.**

If GetFocus and our method had been around in the past, one could have known that:

- Lithium-ion batteries would eventually become cheaper than combustion engines for vehicles by 1995,
- Digital photography would disrupt film by 1975.
- SSDs would become cheaper than HDDs by the early '80s

If you'd like to see the full data set of this report or discuss a technology you'd like us to analyse, please contact us via :

contact@getfocus.eu

Invest in Winning Technologies

without the Guesswork

Eliminate blind spots	**AI technology scouting** Instant overview of all emerging technologies in your area
See which tech works for you	**AI technology evaluation** Compare and analyze technologies using AI, reducing months of work to minutes
Spot winners early	**Forecasting** Predict which emerging technologies will dominate and when
Summarized in actionable insight	**Reporting & Monitoring** Competitive intelligence, partnering options, AI patent analysis, landscaping & more

GetFocus

Trusted by Innovators Globally

What customers says about us

LVMH

Christophe Perthuisot
Head of R&D – Moët Hennessy

“In **one week with GetFocus**, we gained more technology insights than we previously could in 9 months”