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Technology

Microsoft under fire for claiming it has a new quantum computer

Researchers have criticised Microsoft's new Majorana 1 quantum computer, saying the company has made claims about the way it works that aren't fully backed up by scientific evidence

By Karmela Padavic-Callaghan

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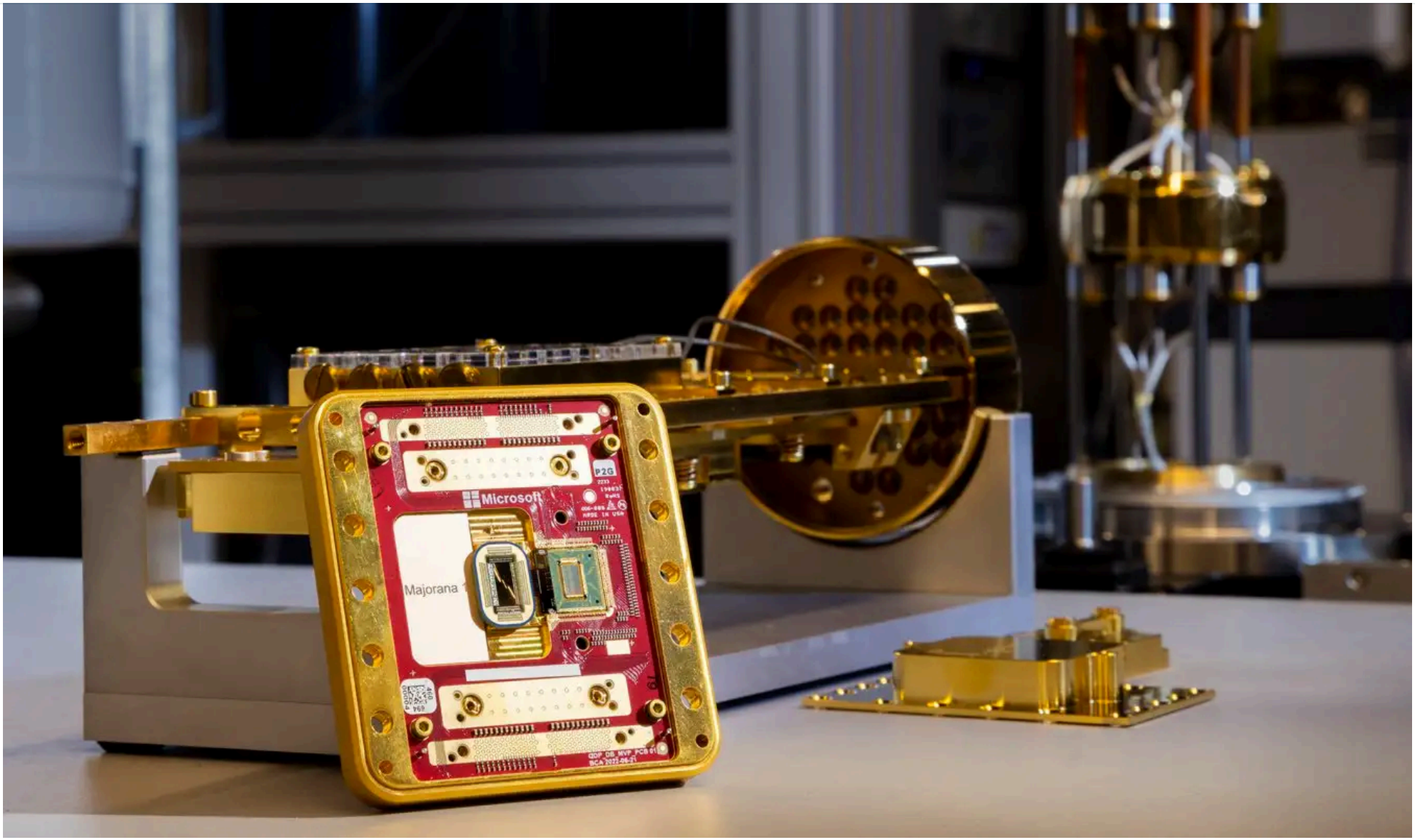

Microsoft's Majorana 1 quantum computer
John Brecher/Microsoft

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but-does-it-actually-work/ that could lead to machines "capable of solving meaningful, industrial-scale problems in years, not decades 🔗 https://news.microsoft.com/source/features/innovation/microsofts-majorana-1-chip-carves-new-path-for-quantum-computing/".

But since then, the tech giant has increasingly come under fire from researchers who say it has done nothing of the sort. "My impression is that the response of the expert physics community has been overwhelmingly negative. Privately, people are just outraged," says Sergey Frolov 🔗 https://www.physicsandastronomy.pitt.edu/people/sergey-frolov at the University of Pittsburgh, Pennsylvania.

Microsoft's claim rests on elusive and exotic quasiparticles called Majorana zero modes (MZMs). These can theoretically be used to create a topological qubit, a new type of quantum bit – the building blocks of information processing within a quantum computer. Because of their inherent properties, such qubits could excel at reducing errors, addressing a big shortcoming of all quantum computers in use today.

MZMs have been theorised to emerge from the collective behaviour of electrons at the edges of thin superconducting wires. Microsoft's new Majorana 1 chip contains several such wires and, according to the firm, enough MZMs to make eight topological qubits. A Microsoft spokesperson told *New Scientist* that the chip was "a significant breakthrough for us and the industry".

Yet researchers say Microsoft hasn't provided enough evidence to support these claims. Alongside its press announcement, the company published a paper in the journal *Nature* that it said confirmed its

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also reliably measure that information from them," said a Microsoft press release https://news.microsoft.com/source/features/innovation/microsofts-majorana-1-chip-carves-new-path-for-quantum-computing/.

But editors at *Nature* made it explicitly clear that this statement is incorrect. A publicly available report on the peer-review process states: "The editorial team wishes to point out that the results in this manuscript do not represent evidence for the presence of Majorana zero modes in the reported devices."

In other words, Microsoft and *Nature* are directly contradicting each other. "The press releases have said something totally different [than the *Nature* paper]," says Henry Legg https://www.st-andrews.ac.uk/physics-astronomy/people/hl29/ at the University of St Andrews in the UK.

Quantum computers have finally arrived, but will they ever be useful?

Hundreds of quantum computing firms around the world are racing to commercialise these once-exotic devices, but the jury is still out on who is going to pull ahead and produce a machine that actually does something useful

/article/2467128-quantum-computers-have-finally-arrived-but-will-they-ever-be-useful/

This isn't the only unorthodox aspect of Microsoft's paper. Legg points out that two of the four peer reviewers initially gave rather critical and negative feedback, which, in his experience, would typically

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signed off on it. A spokesperson for *Nature* told *New Scientist* that the ultimate decision to publish came down to the potential they saw for experiments with future MZMs in Microsoft's device, rather than necessarily what it had achieved so far.

It is also unusual that one of the reviewers, Hao Zhang https://www.phys.tsinghua.edu.cn/phyen/info/1067/1389.htm at Tsinghua University in China, had previously worked with Microsoft on MZM research, says Legg. That work, published in *Nature* in 2018, was later retracted, with the team apologising for "insufficient scientific rigour https://www.nature.com/articles/s41586-021-03373-x" after other researchers identified inconsistences in the results. "It's quite shocking that *Nature* could choose a referee that only a few years ago had a paper retracted," says Legg.

Zhang says there was no conflict of interest. "I have never been an employee of Microsoft, nor was I affiliated to [the firm]. Among the 100+ authors of the recent Microsoft paper, I have worked with three of them before," he says. "That was seven years ago, and at that time, they were students of TU Delft [in the Netherlands], not Microsoft employees."

Microsoft says its team wasn't involved in selecting reviewers and wasn't aware of Zhang's participation until after the review process was complete. *Nature* also stands by the decision, with a spokesperson saying "the quality of the advice received can be seen from the reviewers' comments".

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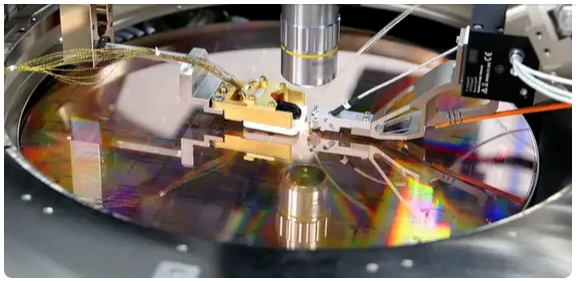

world's largest quantum computer by 2027

With an investment of AU$1 billion, PsiQuantum is planning to build a photonic quantum computer with a million qubits, far larger than any in existence today – and the firm says it will be ready in just two years

quantum-computer-by-2027/

Review issues aside, both Legg and Frolov have more fundamental objections to Microsoft's methodology. Experiments with MZMs have proven extremely difficult to perform over the past few decades, because imperfections and disorder in the device can produce spurious signals that mimic the quasiparticles, even if they aren't present. This has been a challenge for researchers associated with Microsoft, including in the retracted 2018 paper – the retraction notice explicitly references new insights concerning the effects of disorder. To address this, in 2023, Microsoft published a procedure in the journal *Physical Review B* 🔗 https://journals.aps.org/prb/abstract/10.1103/PhysRevB.107.245423 called the "topological gap protocol", that it claimed would tease out these differences.

"The whole idea of this protocol was that it's a binary test for whether or not there's Majoranas there," says Legg. His own analysis of the code and data 🔗 https://arxiv.org/abs/2502.19560 that Microsoft used to implement this protocol in 2023, however, showed it to be less reliable than expected, with a data formatting change being enough to turn a fail into a pass. Legg says he raised these issues with Microsoft before the publication of its *Nature* paper, yet the firm still used the protocol in its new research.

issue that we were also aware of during the peer-review process." Through that process, reviewers determined that this wasn't a key issue after all, says the spokesperson.

Microsoft says it will respond to Legg's analysis of its 2023 paper if asked to do so by *Physical Review B.* "The criticism can be summarised as Legg constructing a false straw man of our paper and then attacking that," said Chetan Nayak at Microsoft. He disputes Legg's work on several points and says that the 2023 paper "showed that we could create the topological phase and Majorana zero modes with high confidence" and the new paper only strengthens those claims.

A Microsoft spokesperson says that in the year since the *Nature* paper was submitted for review, the firm has built on that confidence and not only created a multi-qubit chip, but also tested ways to manipulate those qubits, as would be required for a working topological quantum computer. The firm will be releasing further details at the American Physical Society's Global Physics Summit in March, says the spokesperson. "We look forward to sharing our results along with additional data behind the science that is turning our 20-plus-year vision for quantum computing into a tangible reality."

But for Frolov, the claim that imperfect results from the past can be neglected because the firm has gone on to build more sophisticated devices rests on faulty logic. Legg shares this view. "Fundamental problems of disorder and material science aren't going to go away just because you start fabricating some fancier device," he says.