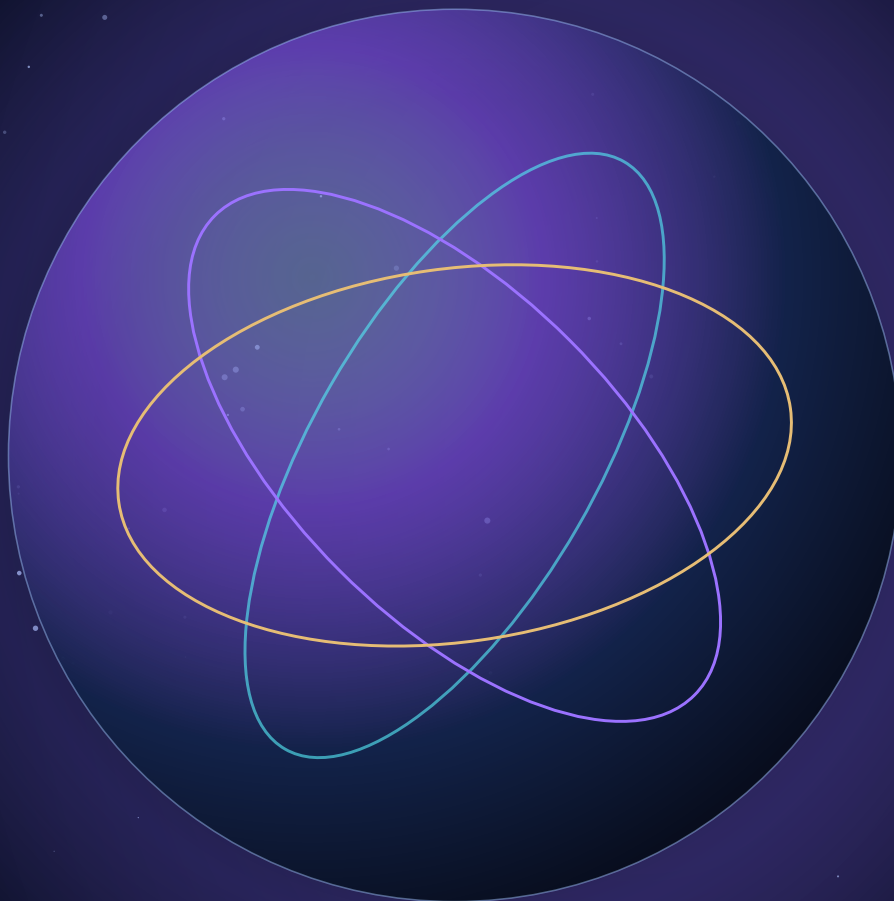




◆ OBSERVATORY ANALYSIS

Helios Reports 99.9995% Logical Memory Fidelity

A trapped-ion record in protected memory, and what it does
and does not tell us about the race to fault tolerance

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Abstract

About five logical errors per million on a trapped-ion system, reported by Quantinuum as a ten-fold improvement on the previous world record. Development: 19 October 2026 · Quantinuum · Helios · Company-reported experiment.

KEYWORDS Quantum Observatory · experiment · L2

Helios Reports 99.9995% Logical Memory Fidelity

The result

Quantinuum reported a logical memory fidelity of 99.9995%, about five errors per million, using a colour code on its trapped-ion Helios system. The company describes the result as a ten-fold improvement on the previous world record and reports that each increase in code distance reduced the remaining logical errors by a factor of about twelve [1][2].

What it establishes

Two things stand out. The absolute level of protection is exceptional, and the reported suppression with code distance is steep, which is the property that makes larger codes pay off. Trapped ions trade speed for fidelity and connectivity, so the result also strengthens the case that more than one hardware platform can reach the fault-tolerant regime. The figures come from the company's announcement and associated research; they describe a protected memory, and their comparison with other platforms depends on matching definitions of what counts as an error and an operation.

Position in the Civilizational Compute Stack

L2, logical computation. Together with the superconducting threshold result [3], it shows that the lower layers of the stack are advancing on at least two physical architectures at once.

Why it matters

Platform plurality is a strategic fact. If several architectures reach fault tolerance, quantum capability will not be determined by a single supply chain or a single national programme, and competition will shift toward speed, cost per logical operation and access. If one architecture pulls decisively ahead, the geography of the quantum age will concentrate around it. Records like this one are the evidence from which that outcome will be read.

The open question

How do logical gate speed and cost on trapped-ion systems compare with superconducting systems for the same algorithm, measured end to end?

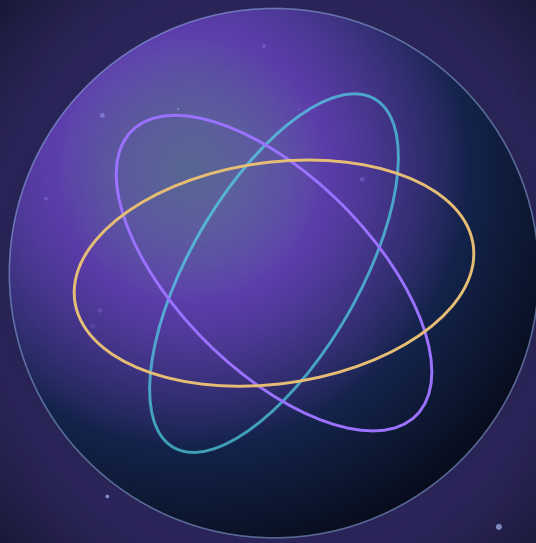
Signposts

Peer-reviewed publication of the full method; logical gates at comparable fidelity; Quantinuum's progress against its stated 2029 fault-tolerance target, read as a roadmap rather than a result.

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Sources

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Institutions will decide what becomes of it.