

— CHAPTER 06 · THE MACHINES · WILDCARDS

# Photonic, topological, and *the long shots*.

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Three bets that are still maturing, one announcement that broke the news cycle in February 2025, and one machine that does something completely different. By the end you can place every 2026 vendor on the right shelf — and tell a marketed claim from a measured result.

## WHAT YOU'LL LEARN

● How photonic QC works

● The Majorana 1 controversy

● Where annealing fits

## — MODALITY · PHOTONIC QUANTUM COMPUTING

# Light is the qubit. Silicon is the factory.

## How it works

Single photons travel through silicon-photon waveguides. Beam-splitters and phase-shifters act as quantum gates. Measurement is by single-photon detection. The hard part is making two photons interact — solved indirectly by *fusion-based quantum computing*, where measurements on entangled resource states stitch the computation together.

No dilution refrigerator. Standard semiconductor fabs. That is the structural bet.

## PsiQuantum Omega · the 2026 frontrunner

**1M**

TARGET PHYSICAL QUBITS  
single chip roadmap

**300 K**

OPERATING TEMP  
photons + detectors only

**Si**

STANDARD CMOS FAB  
GlobalFoundries partnership

**—**

SHIPPED HARDWARE  
pre-production · May 2026

— FEBRUARY 19, 2025 · MICROSOFT AZURE QUANTUM

# Majorana 1 — the topological qubit, announced.

A device claimed to host Majorana zero modes — quasi-particles predicted by *Ettore Majorana* in 1937 — in indium-arsenide nanowires coupled to aluminium. Marketed as the world's first QPU with a Topological Core and a roadmap to one million qubits on a single chip.

• SUBSTRATE

## InAs + Al

Indium-arsenide nanowires proximity-coupled to aluminium superconductor.

• QUBIT TYPE

## Topological

Information encoded non-locally in Majorana zero modes — in principle, immune to local noise.

• CLAIMED ROADMAP

## 1M on a chip

Microsoft's stated path — "years not decades." Treat as marketing horizon, not measured fact.

• STATUS · MAY 2026

## Contested

Published in *Nature*; results disputed by editors and outside experts. Next slide.

— DIALOGUE · THE MAJORANA 1 CONTROVERSY

# Did Microsoft demonstrate a topological qubit?



Ava · host

● live debate

Marcus — Majorana 1 went out as a Nature paper and a Microsoft press release. Is the topological qubit real?

## The evidence trail

Feb 2025 announcement → community response



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### Aaronson FAQ

Detailed, sympathetic, sceptical — same week



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### 2018 precedent

Prior Microsoft Majorana paper retracted from *Nature*

— IN PRINCIPLE · WHY THE FIELD CARES

# Topology hides information from local noise.

## The promise

Encode a qubit non-locally — in the braiding of two non-Abelian anyons separated in space. A local disturbance can only touch one anyon at a time, so it cannot read or corrupt the joint state. *Error correction at the hardware level, not the software level.*

Every other modality fights decoherence with surface codes and a thousand physical qubits per logical one. Topological qubits would change that ratio.

## Why we are not there yet

### STEP 1 · EXISTENCE

Demonstrate Majorana zero modes unambiguously. *Contested in 2026.*

### STEP 2 · CONTROL

Braid them on demand and read out the result. *Not demonstrated.*

### STEP 3 · SCALE

A useful processor needs hundreds, then thousands. *Roadmap, not data.*

— OUTSIDE THE GATE-MODEL · D-WAVE

# Quantum annealing — five thousand qubits doing one thing.

A D-Wave Advantage 2 system has more qubits than every gate-model machine combined. It also cannot run Shor. Annealing solves one problem: find the low-energy state of an Ising model. Useful for some combinatorial optimisation — with caveats, because classical solvers keep catching up.

• WHAT IT IS

## Quantum annealer

Adiabatic evolution toward a problem Hamiltonian. Not a universal computer.

• SCALE

## 5000+ qubits

Advantage 2, superconducting flux qubits with sparse connectivity.

• WHERE IT HELPS

## QUBO / Ising

Scheduling, portfolio, routing — when the problem maps cleanly. Benchmark against simulated annealing first.

• WHAT IT CANNOT DO

## Shor · Grover

No gate model — no factoring, no general-purpose quantum algorithms. Different machine, different question.

## — WILDCARDS · THE REST OF THE BOARD

# Money is in. A winning modality is not.

## Ankaa-3

RIGETTI

Superconducting, cloud-accessible, smaller scale. A practical platform for learning and small experiments.

## Cold atoms

INFLEQTION

Neutral-atom platform. Public sector and quantum-sensing customers. Compute roadmap maturing.

## ~\$20B

QUANTINUUM · IPO FILING JAN 2026

Trapped ions. Helios shipped Nov 2025 — 48 logical qubits, 99.92 percent two-qubit fidelity.

## \$130M

IONQ · 2025 REVENUE

Trapped-ion vendor. Public since 2021. Tempo barium system on the roadmap.

## \$4.5B+

PRIVATE QUANTUM FUNDING 2024-2025

PitchBook aggregate. The capital is committed; the modality winner is not yet decided.

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LIVE MODALITIES IN 2026

Superconducting · ion · atom · photonic · topological. The race is still open.

— EXERCISE · NO CODE THIS CHAPTER

# Read two things. Then write one honest paragraph.

In 2026, the skill that separates a practitioner from an audience is knowing which claims to trust. This exercise is a critical-reading drill — sources from the actual Majorana 1 debate.

— STEP 1 · READ

## Scott Aaronson's FAQ

Detailed, sympathetic, sceptical. Walks through what the Microsoft paper does and does not show — and why the question matters beyond one company.

[scottaaronson.blog/?p=8669](https://scottaaronson.blog/?p=8669)

— STEP 2 · READ

## The Nature editor note

Attached to the Microsoft Majorana 1 paper. Short, unusual, and load-bearing — read every word.

[nature.com](https://www.nature.com/articles/444269a) · [Majorana 1 paper](#) · [editor note](#)

— STEP 3 · WRITE

## One paragraph, honest

Answer the question: *did Microsoft demonstrate a topological qubit in February 2025?*

There is no required answer — there is a required quality of reasoning. Cite the evidence on both sides. Distinguish what the device showed from what the press release claimed.

**~120 words · cite both sources**

— NEXT CHAPTER

## Quantum error correction

Surface codes, qLDPC, Stim — the layer that turns noisy physical qubits into reliable logical ones. Where 2024-2026 actually crossed below threshold.