2025: The Year of Quantum

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NOTION

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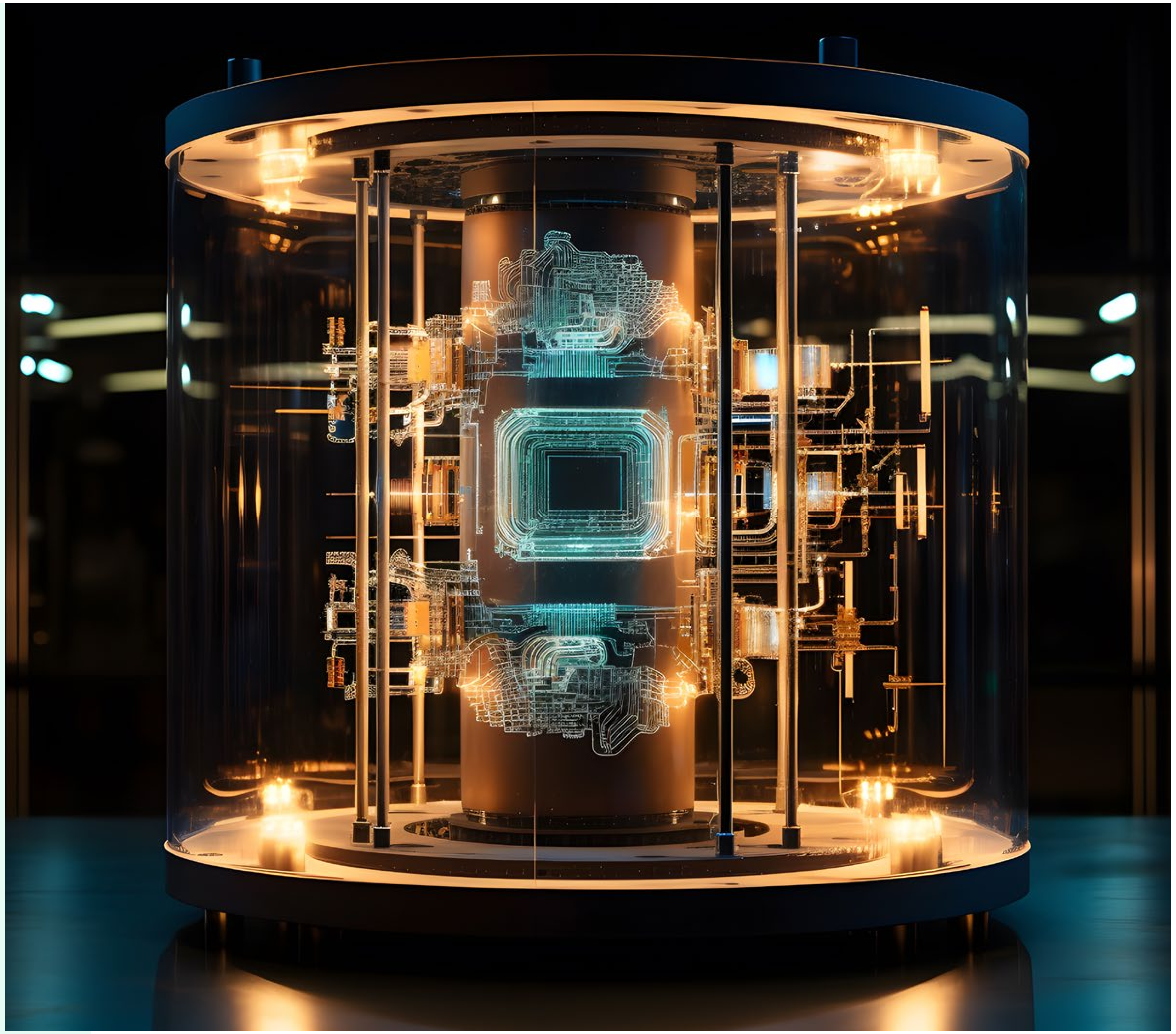
01

Introduction

Fault-tolerant quantum may still be years away, but the investable opportunity is here now, across cybersecurity, networking, middleware, and sensing. Here's where the quantum stack is forming, and where Notion Capital is looking to invest before 2030.

- Fault-tolerant, cryptography-relevant quantum is still ~ 5-10 years away, but investable companies are being built now in the stack above hardware.
- The biggest near-term driver is cybersecurity: "harvest now, decrypt later" makes quantum-safe networking and key management urgent today.
- The UK and Europe has genuine home-field advantage in research, talent, and spin-outs.



On London's South Bank, a few minutes' walk from Waterloo Station, look through the windows of IBM's office and you'll see something that looks like an overwrought chandelier encased in glass.

That's IBM Quantum System One, the first circuit-based commercial quantum computer, launched in January 2019.

Most of what you're looking at is the cryogenics keeping the computer cool, because these things are fragile. They need to be very cold (around -273°C) to work, and even a tiny bit of heat or vibration messes them up. That's why Elon Musk, only partly in jest, suggested that "Quantum computing is best done in the permanently shadowed craters on the Moon."[1]

The fact that you can see a quantum computer from the pavement tells you that quantum is no longer confined to the lab. The UN General Assembly designated 2025 as the International Year of Quantum Technology and Science, celebrating the 100th anniversary of the discovery of quantum mechanics. It's more than a neat milestone. Quantum technology is moving from experimentation to practical and investible applications with commercial roadmaps.

As a partner at Notion Capital and CEO of Arqit[2], I split my time between the venture side and the sharp end of quantum cybersecurity. I want to answer a few questions in this piece:

- Do we have to wait for a fully error-corrected, cryptography-breaking quantum computer before meaningful companies can be built?
- Does the UK and Europe have an advantage?
- And where, specifically, is Notion Capital looking to invest as this new technology emerges?

Andy Leaver
Operating Partner, Notion Capital & CEO, Arqit

02

The state of quantum

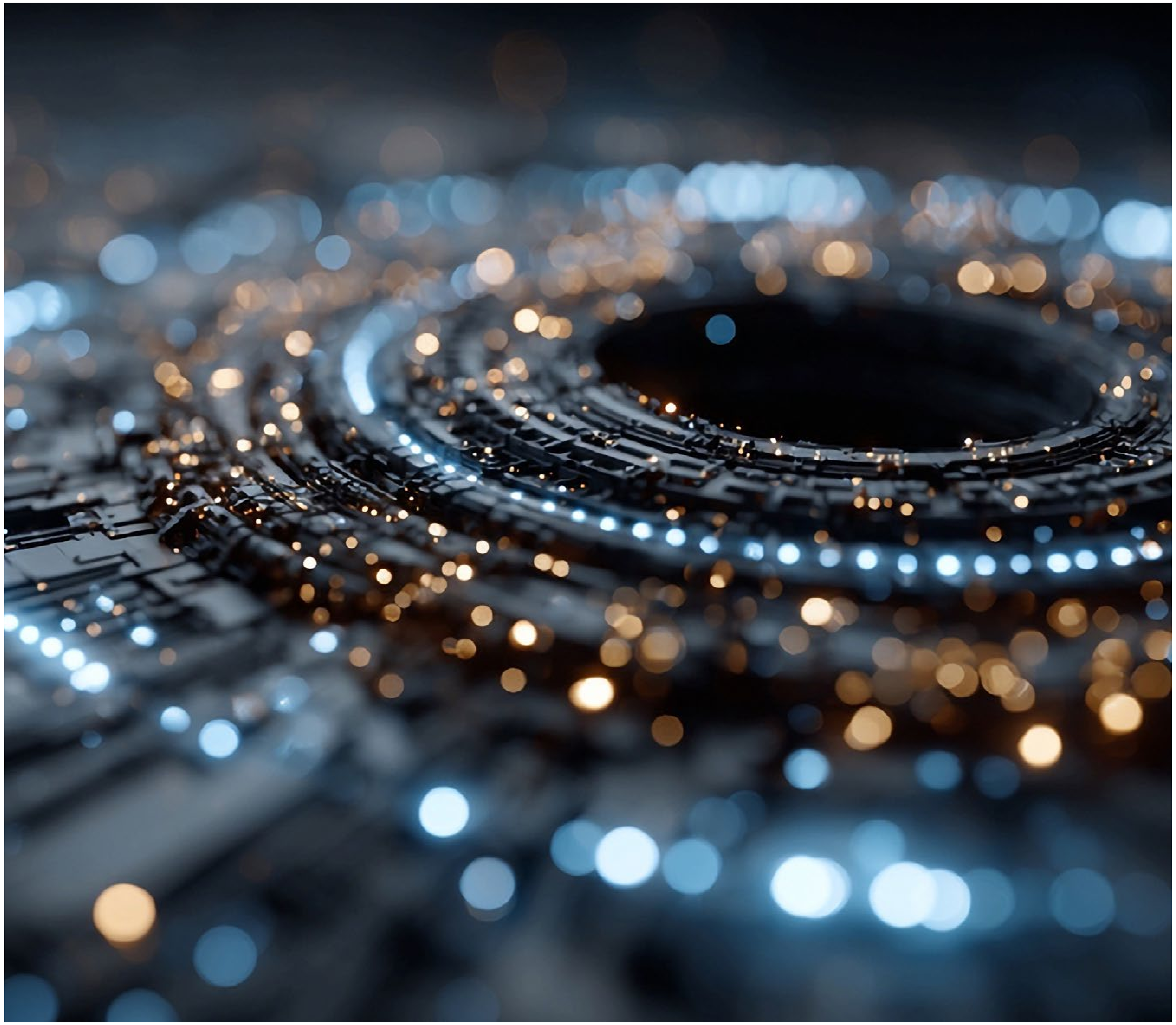
We've already passed quantum supremacy, the point at which a quantum machine solves a problem beyond what conventional supercomputers can handle in a reasonable time.

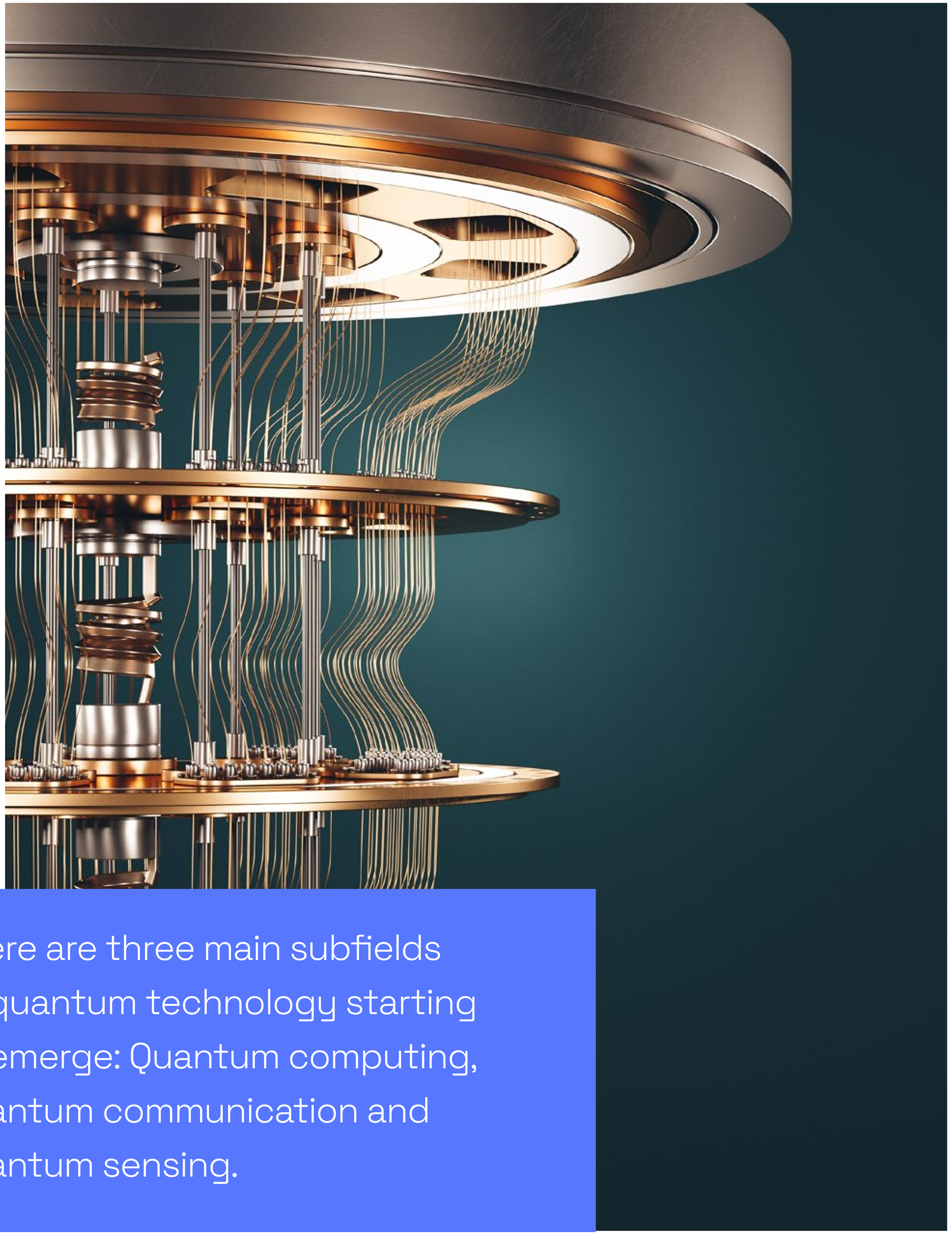
In 2019, Google's Sycamore processor completed a

200

seconds[3] that would have taken classical supercomputers ~10,000 years.

And last December, Google's Willow processor performed a standard benchmark computation in about five minutes[4], a task that would take today's fastest supercomputers 10 septillion years (a period of time that vastly exceeds the age of the universe).





There are three main subfields of quantum technology starting to emerge: Quantum computing, Quantum communication and Quantum sensing.

There's been a lot of progress and new players since then. In January 2025, China's Zuchogzhi-3 105-qubit quantum computer performed on par with Google's Willow[5]. In February, Microsoft[6] and Amazon[7] announced their first quantum chips. Rigetti is expected to deliver a 108-qubit quantum computer[8] by the end of this year. And, in June, IBM announced it will complete its Starling[9] fault-tolerant commercial scale quantum computer by 2029.

The next big milestone is large-scale, fault-tolerant quantum computing. A cryptography-relevant quantum computer (CRQC) – one that can break today's public-key cryptography (RSA, ECC) – is widely expected around 2030. Useful quantum computing will improve chemical processes, battery design, and pharmaceutical research before a CRQC appears.

Unlike AI, we haven't had the "transformer moment". There's no single dominant architecture. DARPA has deliberately advanced multiple companies and architectures – trapped ions, photonics, superconducting, silicon spin qubits – into the next phase of its Quantum Benchmarking Initiative[10], precisely because no one knows which path will win. In other words, we're still early days in getting the underlying technology in place.

It's analogous to the early internet. We started with the pipes, then came the data centres, networking, cloud services, and whole new software categories built on top. Quantum is at a similar moment. We're making progress on the hardware, and the layers that make it usable – networking, orchestration, developer tooling, security, applications – are only now starting to form.

There are three main subfields of quantum technology starting to develop:

- **Quantum computing** uses quantum mechanics to solve certain classes of problems far more efficiently than classical computing.
- **Quantum communication** aims to secure information in transit in new ways, even against adversaries with unlimited quantum computing power. Transmitting quantum information allows distributed quantum computing and distributed quantum sensing which multiplies the value of the other areas.
- **Quantum sensing** uses quantum systems to measure various quantities (for example, time, gravity, electromagnetic fields) with a precision orders of magnitude more sensitive than classical sensors.

This unfinished stack is where the investment case is.

03

The state of quantum markets

Large-scale, fault-tolerant quantum computers may still be at least five years away, but meaningful companies are being built, invested in, and bought up – and early investors are already seeing their first exits.

The big public pure-play quantum companies, like IonQ, D-Wave, and Rigetti, are acquiring smaller companies to accelerate their roadmaps. This year alone, IonQ acquired Lightsynq, Capella Space, ID Quantique, Vector Atomic, and Oxford Ionics[11]. The $1.08bn[12] Oxford Ionics – a University of Oxford spin-out – deal was the biggest in the quantum sector to date.

Public markets are also opening up. Infleqtion – the US-UK quantum hardware and sensing firm spun out from ColdQuanta – plans to list via a SPAC at a pre-money valuation of $1.8bn[13]. Quantinuum, which in September raised $600m[14] at a pre-money equity valuation of $10bn, has announced plans to go public in the next two years[15]. Quantum companies know the capital requirement is significant enough – and investors believe that the upside is large enough – that public markets are part of the playbook.

And governments are treating quantum as critical national infrastructure. The UK has committed £670m[16] to quantum computing and agreed a 10-year funding settlement for the National Quantum Computing Centre (NQCC). The EU's Quantum Act will turn its Quantum Europe Strategy into law, creating a framework to align research programmes, build industrial capacity for quantum technologies, and strengthen supply-chain resilience.

This was already a growing ecosystem. From 2023-24, quantum technology saw a +50%[11] year-on-year increase in overall investments, including a +19 percentage point increase in public funding. The recent activity shows that momentum is continuing to grow. In the first few months of this year, Japan announced $7.4bn[11] for the sector and Spain $900m, bringing announcements for public funding to more than $10bn. Quantum computing alone is expected to grow from $4bn[11] in revenue in 2024 to as much as $72bn in 2035. And the global market for quantum technology as a whole – quantum computing, quantum communication, and quantum sensing – is expected to reach up to $97bn[11] by 2035.

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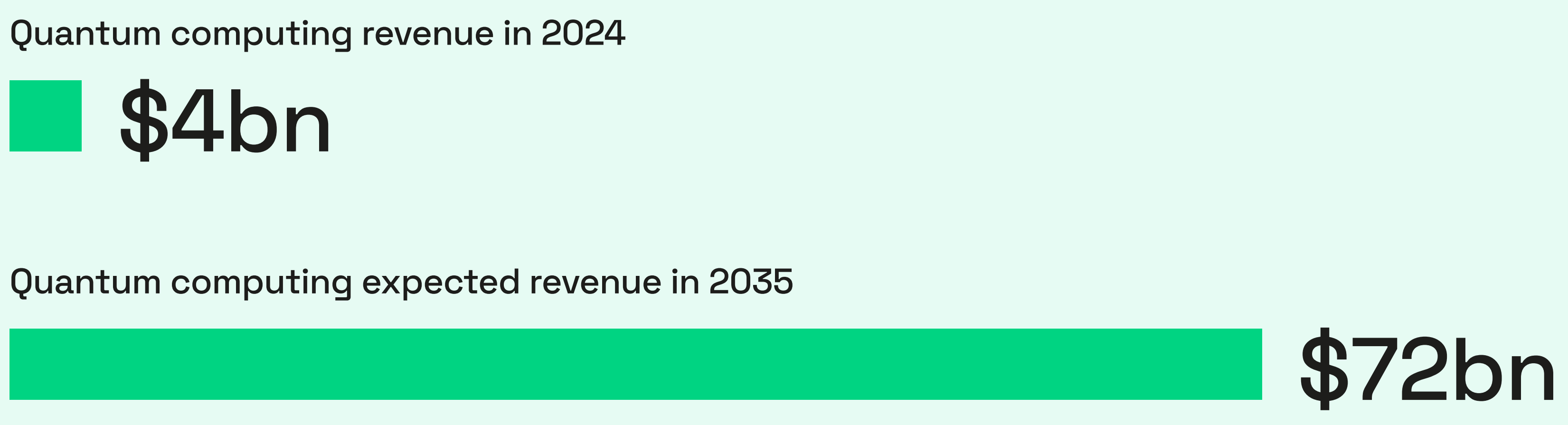


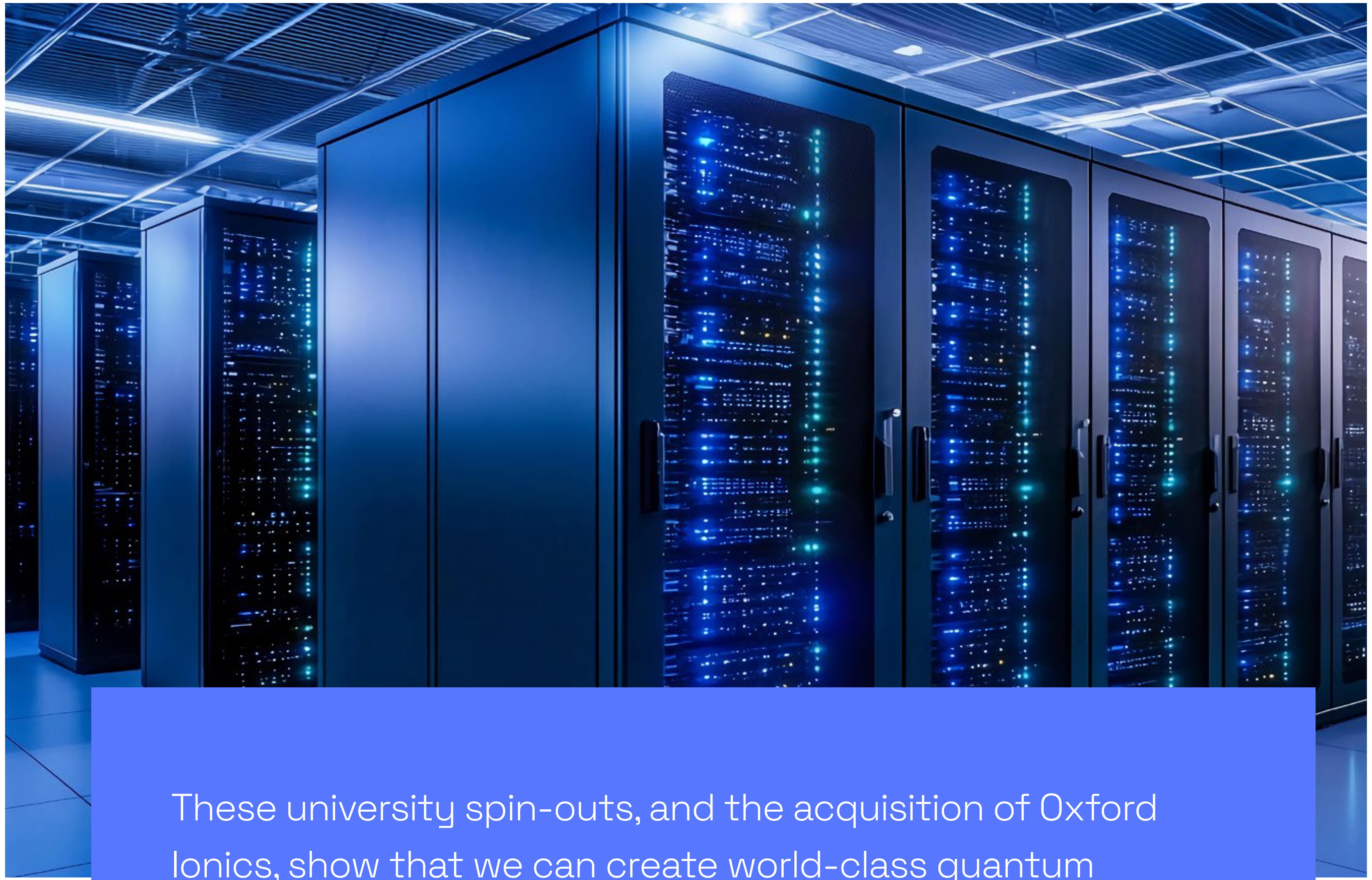
04

Europe's quantum advantage

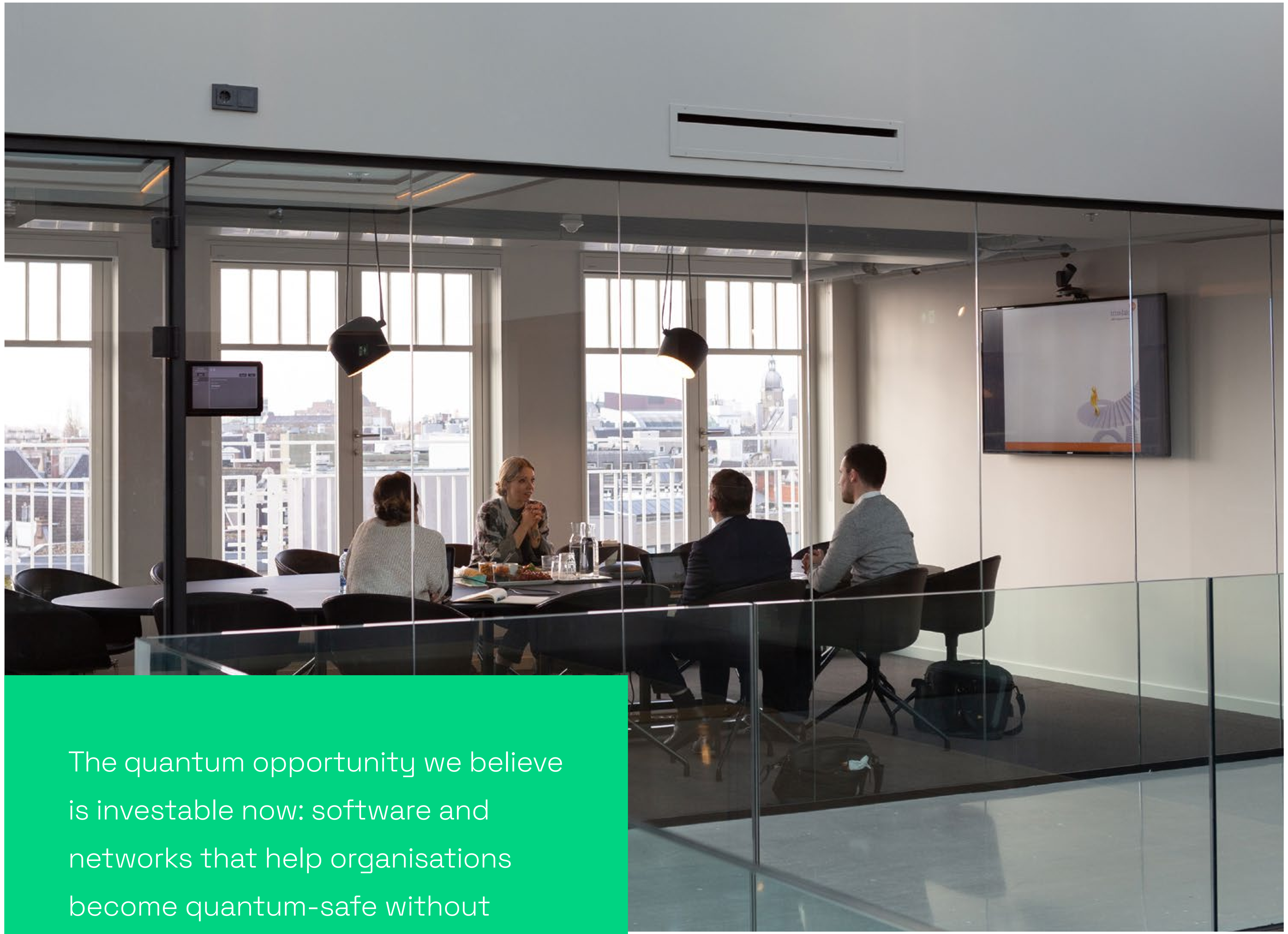
For the UK and Europe, quantum technology is unusually home-field. After the US and China, the UK and Germany tie for third place for the most highly cited papers in quantum computing[17]. And, along with the US, the UK had a combined share of more than 60% of the total global quantum technology funding across 2012 to 2024[17].

The UK has a dense cluster of high-quality spin-outs. Quantum Motion (spun out from UCL and Oxford) has delivered the industry's first full-stack quantum computer[18] to be built using a standard silicon CMOS chip fabrication process – the same transistor technology used in conventional computers. Nu Quantum (spun out from Cambridge) is building quantum networking units that entangle multiple processors into a single distributed machine. And ORCA Computing (spun out from Oxford) is delivering photonic quantum computers.

So we're seeing the early investments in the hardware, but also the whole stack above that: the networking, how to offer it into a cloud, how you think about developers, and so on.



These university spin-outs, and the acquisition of Oxford Ionics, show that we can create world-class quantum companies, and global players are willing to pay over a billion dollars for the IP. The real challenge is whether Europe can go beyond building the next generation of quantum computing companies and scale them to lead their categories globally.



> The quantum opportunity we believe is investable now: software and networks that help organisations become quantum-safe without waiting for large-scale, fault-tolerant quantum computing.

05

Where Notion Capital is focusing

There's one area where the future of quantum is already here: cybersecurity.

Quantum computers strong enough to break today's cryptography may be 5-10 years away, but attackers don't have to wait. In "harvest now, decrypt later" attacks, adversaries steal encrypted data today, store it, and wait until quantum machines can decrypt it.

The Salt Typhoon[19] hacks against Western telecoms, critical infrastructure, and the US National Guard show that state-backed bad actors are hoovering up sensitive communications now.

This is why we backed Arqit, where I now serve as CEO. Arqit focuses on quantum-safe encryption using symmetric key agreement. It's an architectural change in how we secure networks, endpoints and edge devices, from drones to sensors to industrial IoT. And it's a good example of the kind of quantum opportunity we believe is investable now: software and networks that help organisations become quantum-safe without waiting for large-scale, fault-tolerant quantum computing.

This lens is also a useful way to explain Notion's broader approach to quantum investing. We're looking at the layers of the quantum stack that will become important as the hardware matures, but don't require us to pick a single winning architecture today.

In short, we're interested in those areas where quantum is already starting to meet real-world constraints and workloads.

01. Infrastructure and orchestration

Most organisations won't "switch to quantum". They'll consume it as part of a heterogeneous compute environment – classical CPU/GPU, AI, quantum processors – routed and metered behind the scenes. That creates an opportunity for orchestration layers, developer tooling, and middleware that abstract away hardware complexity, decide what runs where, and make quantum accessible to teams that aren't quantum native. The history of computing is the history of abstraction, and this is the next abstraction layer.

02. Data sovereignty and quantum-safe networking

As more workloads cross borders and clouds, quantum-safe networking and key management will be essential to keeping control of data, especially in regulated sectors and defence.

03. Quantum software and algorithms

Domain-specific algorithms and large quantitative models (LQMs) will help with problems of optimisation, simulation, and search (finance risk, logistics, materials and energy modelling). Companies like Phasecraft and Algorithmiq are working on this. In parallel, startups like Riverlane and Qedma are working on error correction hardware and software, turning noisy physical qubits into reliable logical qubits. Right now, quantum computers have high error rates – around one error in every few hundred operations. Once you reduce that to one in a million, you start unlocking truly useful applications.

04. Sensing and robotics

Quantum sensing may commercialise earlier, because many sensing applications don't rely on large-scale, error-corrected quantum processors before they can be deployed as products. Aquark Technologies, for instance, is working on cold-atom timing systems for telecoms, helping to keep networks and digital services online during satellite disruptions. Paired with robotics and edge devices, quantum sensors also unlock new ways to perceive, navigate, and analyse the physical world. That could mean GPS-independent navigation, new forms of medical imaging, or industrial monitoring that isn't possible with classical sensors.

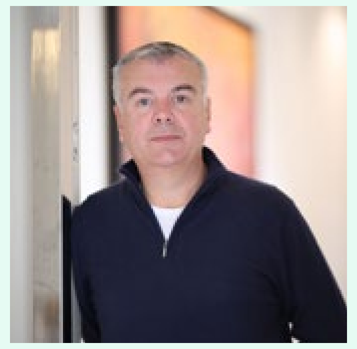
06

Building the quantum stack

The year of quantum isn't about one big breakthrough. It's about a thousand small ones, compounding into an entirely new computing, networking, and security stack.

The hardware still has a way to go, but consensus says it's coming in the next 5-10 years, and we've already hit important milestones and useful quantum computing for simulation is likely ahead of this timeline. Public quantum companies snapping up startups. A growing number of university spin-outs in the UK and Europe raising large rounds and landing early deployments. Governments increasingly treating quantum as critical strategic infrastructure, and funding it accordingly. And an increasing share of the value shifting to the layers above the hardware.

If this is anything like cloud, enterprise adoption will lag. Most organisations will move cautiously, and plenty of "quantum-enabled" claims will be little more than marketing. But that's why this moment matters. We're early enough that the fundamentals are still being defined, but late enough that the categories are emerging and real companies are being built.



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Thank you for reading our 2025 Year of Quantum Computing report.

Let's talk.

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