

The UK's position in the global quantum race is strong – we must be bold to lead the quantum revolution

In recent years, quantum computing has shifted from a distant possibility to a reality within touching distance. Areas with the potential to revolutionise the economy and society, investment has exponentially increased, and breakthroughs are now being announced more regularly.

You'd be forgiven for thinking that the quantum computing race was just a big money, big corporation race. Google and IBM dominate the headlines – but the UK is keeping pace, and has a significant role to play in achieving this long-awaited goal.

In the UK, focused investment has been underway since 2014, with the inception of the [National Quantum Technologies Programme](#). The total investment through this programme will pass a major £1B investment milestone in 2021, a considerable feat and a signal that the UK is serious about quantum technology and its potential to transform society, livelihoods and essentially the structure of all our digital systems.

Quantum supply chains, hardware and software projects are starting consistently to support the establishment of a commercial ecosystem in the UK. In 2020, DISCOVERY, a £10m research programme designed to address technology barriers to commercial quantum computing – the largest industry-led quantum computing scheme in Britain to date – went online as a prime example.

The UK now holds a status as a world-leader in quantum science and technologies, keeping pace with the US and China. Around one in five of the world's quantum hardware companies are based in the UK, and all the various methods of building a quantum computer are in evidence. But how does it differ in terms of quantum approach?

The computers we use in our daily lives – from our laptops to our smartphones – rely on bits, which exist in two states, either a 0 or 1. Quantum technology relies on atoms in a 'quantum state' which are called qubits, and these can be in multiple states at the same time – exponentially increasing their power and ability to process data.

Getting atoms into this state is, however, where approaches differ. Those utilising super-conducting methods, including Google, Rigetti and IBM, are working on an approach which artificially simulates how an atom should respond in this state – think of it as a *synthetic atom* to produce the quantum effect. While this method has been demonstrated for longer and has achieved early success, on the downside, there is a large margin for error in creating the *perfect* synthetic atom, and these systems often generate undesirable 'noise'.

Several UK groups are, however, pioneering alternative approaches. One of these is the use of super-cooled natural atoms, which can be manipulated with lasers to achieve a quantum state at incredibly low temperatures. It is challenging, but now the fidelities are increasing and this approach has pathways to scale – as a result, it's a method that could be much more effective in the long term.

This natural atom approach is something the UK can pioneer – leading the quantum frontier on a global scale. We need to be advancing the UK's quantum industry as a whole, and this ranges from hardware to software, supply chains, skills and investment. We are creating an entirely new sector, and we need all the components to be moving in-step, supported financially and with highly skilled staff.

The talent pool and research in the UK are at a very high level – and it is not reserved in the 'Golden Triangle' of Oxford, Cambridge and London. There are hubs in Glasgow, York and other regions which utilise the incredible university base in the UK. This ties in well with the Government's levelling up agenda – highlighting our regions and their expertise, demonstrating that a young

person with ambition can succeed out of the traditional high-growth areas.

We must be ambitious. It is essential then that the UK leverages government support for the emerging industry, its unrivalled university base, academic prowess and businesses. Demonstratable progress in a quantum operating system will prove vital in Britain's endeavour to be a leading quantum nation.

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