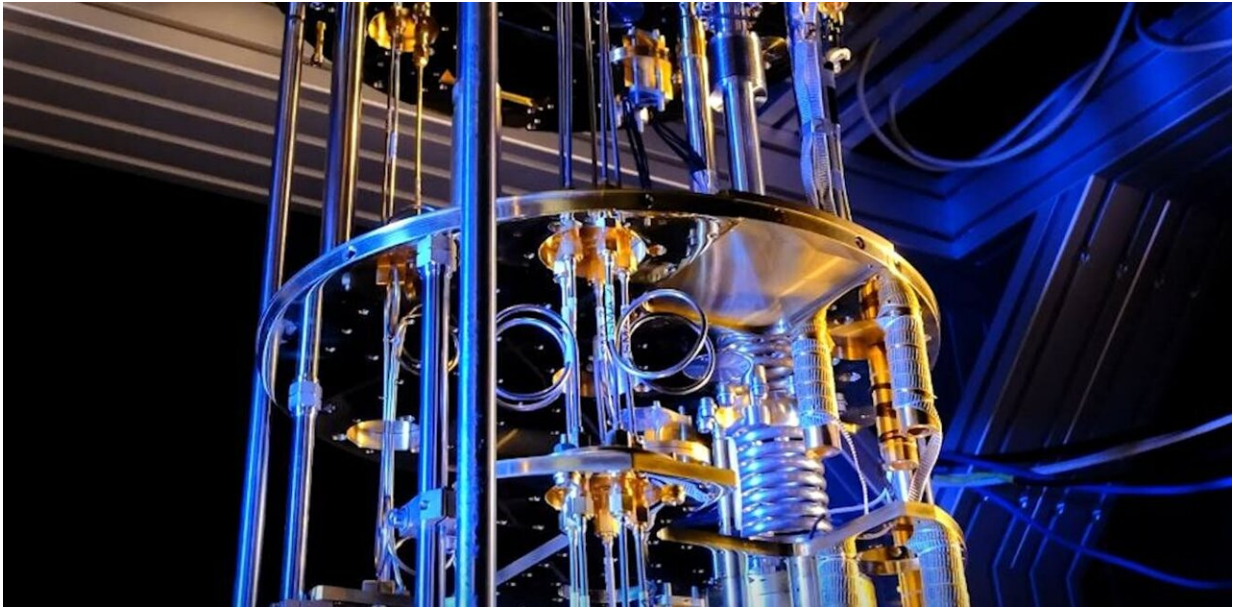


Quantum computing just got hotter: One degree above absolute zero

March 28 2024, by Andrew Dzurak and Andre Luiz Saraiva De Oliveira



Credit: Diraq

For decades, the pursuit of quantum computing has struggled with the need for extremely low temperatures, mere fractions of a degree above absolute zero (0 Kelvin or -273.15°C). That's because the quantum phenomena that grant quantum computers their unique computational abilities can only be harnessed by isolating them from the warmth of the familiar classical world we inhabit.

A single quantum bit or "qubit," the equivalent of the binary "zero or one" bit at the heart of classical computing, requires a large refrigeration apparatus to function. However, in many areas where we expect quantum computers to deliver breakthroughs—such as in designing new materials or medicines—we will need large numbers of qubits or even whole quantum computers working in parallel.

Quantum computers that can manage errors and self-correct, essential for reliable computations, are anticipated to be gargantuan in scale. Companies like Google, IBM and PsiQuantum are preparing for a future of entire warehouses filled with cooling systems and consuming vast amounts of power to run a single quantum computer.

But if quantum computers could function at even slightly higher temperatures, they could be much easier to operate—and much more widely available. In new research [published in *Nature*](#), our team has shown a certain kind of qubit—the spins of individual electrons—can operate at temperatures around 1K, far hotter than earlier examples.

The cold, hard facts

Cooling systems become less efficient at lower temperatures. To make it worse, the systems we use today to control the qubits are intertwining messes of wires reminiscent of [ENIAC](#) and other huge computers of the 1940s. These systems increase heating and create physical bottlenecks to making qubits work together.

The more qubits we try to cram in, the more difficult the problem becomes. At a certain point the wiring problem becomes insurmountable.

After that, the [control systems](#) need to be built into the same chips as the qubits. However, these integrated electronics use even more power—and

dissipate more heat—than the big mess of wires.

A warm turn

Our new research may offer a way forward. We have demonstrated that a particular kind of [qubit](#)—one made with a quantum dot printed with metal electrodes on silicon, using technology much like that used in existing microchip production—can operate at temperatures around 1K.

This is only one degree above absolute zero, so it's still extremely cold. However, it's significantly warmer than previously thought possible. This breakthrough could condense the sprawling refrigeration infrastructure into a more manageable, single system. It would drastically reduce operational costs and power consumption.

The necessity for such technological advancements isn't merely academic. The stakes are high in fields like [drug design](#), where [quantum computing](#) promises to revolutionize how we understand and interact with molecular structures.

The research and development expenses in these industries, running into billions of dollars, underscore the potential cost savings and efficiency gains from more accessible quantum computing technologies.

A slow burn

"Hotter" qubits offer new possibilities, but they will also introduce new challenges in error correction and control. Higher temperatures may well mean an increase in the rate of measurement errors, which will create further difficulties in keeping the computer functional.

It is still early days in the development of quantum computers. Quantum

computers may one day be as ubiquitous as today's silicon chips, but the path to that future will be filled with technical hurdles.

Our recent progress in operating qubits at higher temperatures is as a key step towards making the requirements of the system simpler.

It offers hope that quantum computing may break free from the confines of specialized labs into the broader scientific community, industry and commercial data centers.

More information: Jonathan Y. Huang et al, High-fidelity spin qubit operation and algorithmic initialization above 1 K, *Nature* (2024). [DOI: 10.1038/s41586-024-07160-2](https://doi.org/10.1038/s41586-024-07160-2)

This article is republished from [The Conversation](#) under a Creative Commons license. Read the [original article](#).

Provided by The Conversation

Citation: Quantum computing just got hotter: One degree above absolute zero (2024, March 28) retrieved 27 April 2024 from <https://phys.org/news/2024-03-quantum-hotter-degree-absolute.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.