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BRANCHE DU CONTRÔLE DES OPÉRATIONS COMMERCIALES ET D'ADMINISTRATION GÉNÉRALE

SPÉCIALITÉ « TRAITEMENT AUTOMATISÉ DE L'INFORMATION — PROGRAMMEUR »

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Scientists are one step closer to error-correcting quantum computers

(...) Computers that harness the rules of quantum mechanics show promise for making calculations far out of reach for standard computers (...). But without a mechanism for fixing the computers' mistakes, the answers that a quantum computer spits out could be gobbledygook[1] (...).

Combining the power of multiple qubits[2] into one can solve the error woes, researchers report October 4 in *Nature*. Scientists used nine qubits to make a single, improved qubit called a logical qubit, which, unlike the individual qubits from which it was made, can be probed to check for mistakes.

"This is a key demonstration on the path to build a large-scale quantum computer," says quantum physicist Winfried Hensinger of the University of Sussex (...).

Still, that path remains a long one, Hensinger says. To do complex calculations, scientists will have to dramatically scale up the number of qubits in the machines. But now that scientists have shown that they can keep errors under control, he says, "there's nothing fundamentally stopping us to build a useful quantum computer."

In a logical qubit, information is stored redundantly. That allows researchers to check and fix mistakes in the data. "If a piece of it goes missing, you can reconstruct it from the other pieces, like *Voldemort*," says quantum physicist David Schuster of the University of Chicago, (...) (The *Harry Potter* villain kept his soul safe by concealing it in multiple objects called Horcruxes.)

In the new study, four additional, auxiliary qubits interfaced with the logical qubit, in order to identify errors in its data. Future quantum computers could make calculations using logical qubits in place of the original, faulty qubits, repeatedly checking and fixing any errors that crop up.

To make their logical qubit, the researchers used a technique called a Bacon-Shor code, applying it to qubits made of ytterbium ions hovering above an ion-trapping chip inside a vacuum, which are manipulated with lasers. The researchers also designed sequences of operations so that errors don't multiply uncontrollably, what's known as "fault tolerance."

Thanks to those efforts, the new logical qubit had a lower error rate than that of the most flawed components that made it up, says quantum physicist Christopher Monroe of the University of Maryland in College Park and Duke University. (...)

Emily Conover
https://www.sciencenews.org/article/quantum-computer-error-correction-multiple-qubits-detect-mistakes
October 4, 2021 at 11:00 am

[1] galimatias
[2] bit quantique