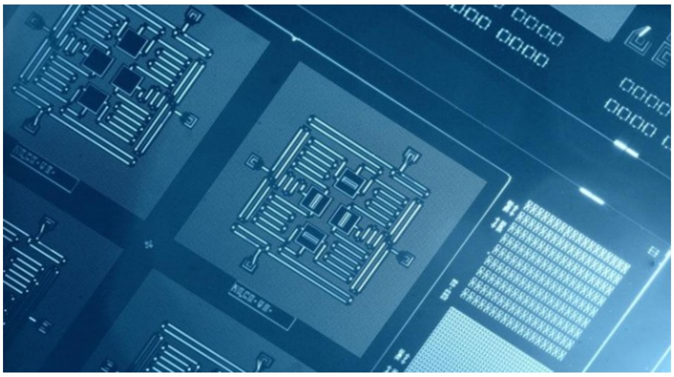
IBM announces what it describes as two "critical advances" in the creation of a practical quantum computer-- a means to simultaneously detect and measure two kinds of quantum errors and a square quantum bit design.



Work on quantum computers has been going at IBM since 1981, following the first workshop on the "physics of information" by Nobel Prize winner Richard Feynman. IBM believes Moore's Law will soon run out of steam, and as such only quantum computing can open further innovation across the industry.

Quantum computers are based on qubits, the quantum equivalent of regular bits. Qubits can simultaneously exist as both 0 and 1, in what is known as a "superposition state." This should allow for the crunching of calculations far too complex for current hardware-- so much so Big Blue claims a quantum computer built using just 50 qubits can outperform any supercomputer on the TOP500 list.

However, quantum computing also involves two types of error, bit-flip (where a qubit representing 0 changes to 1 or vice-versa) and phase-flip (where a qubit's superposition state gets distorted). Previous attempts at such machines can only handle one type of quantum error at a time, but IBM's "novel and complex" quantum bit circuit detects both types simultaneously via "square lattice of four superconducting qubits on a chip roughly one-quarter-inch square."

The square design appears to be key, since qubits can detect phase flip errors only when working together within a 2D array.

“Up until now, researchers have been able to detect bit-flip or phase-flip quantum errors, but never the two together. Previous work in this area, using linear arrangements, only looked at bit-flip errors offering incomplete information on the quantum state of a system and making them inadequate for a quantum computer," IBM says. "Our 4 qubit results take us past this hurdle by detecting both types of quantum errors and can be scalable to larger systems, as the qubits are arranged in a square lattice as opposed to a linear array."

The prototype is built using superconducting materials, which are cooled to 15 milliKelvin (a fraction of absolute zero) inside a super-refrigerator.

Next for IBM is the Holy Grail of quantum computing-- a perfect, incorruptible qubit making the basis of a scalable quantum computer. To do so the company plans to extend the architecture into an 8-bit lattice, before extending it further to create a perfect machine.

Go IBM Scientists Achieve Critical Steps to Building First Practical Quantum Computer