Researchers Develop First Quantum Device Of Its Kind

A photograph of the nine qubit device. The device conists of nine superconducting 'Xmon' transmon in a row. Qubits interact with their nearest neighbors to detect and correct errors. Credit: Julian Kelly

Sonia Fernandez | Phys.Org When scientists develop a full quantum computer, the world of computing will undergo a revolution of sophistication, speed and energy efficiency that will make even our beefiest conventional machines seem like Stone Age clunkers by comparison.

But, before that happens, quantum physicists like the ones in UC Santa Barbara's physics professor John Martinis' lab will have to create circuitry that takes advantage of the marvelous computing prowess promised by the quantum bit ("qubit"), while compensating for its high vulnerability to environmentally-induced error.

In what they are calling a major milestone, the researchers in the Martinis Lab have developed quantum circuitry that self-checks for errors and suppresses them, preserving the qubits' state(s) and imbuing the system with the highly sought-after reliability that will prove foundational for the building of large-scale superconducting quantum computers.

It turns out keeping qubits error-free, or stable enough to reproduce the same result time and again, is one of the major hurdles scientists on the forefront of quantum computing face.

“One of the biggest challenges in quantum computing is that qubits are inherently faulty,” said Julian Kelly, graduate student researcher and co-lead author of a research paper that was published in the journal *Nature*. “So if you store some information in them, they’ll forget it.”

Unlike classical computing, in which the computer bits exist on one of two binary (“yes/no”, or “true/false”) positions, qubits can exist at any and all positions simultaneously, in various dimensions. It is this property, called “superpositioning,” that gives quantum computers their phenomenal computational power, but it is also this characteristic which makes qubits prone to “flipping,” especially when in unstable environments, and thus difficult to work with.

“It’s hard to process information if it disappears,” said Kelly.

However, that obstacle may just have been cleared by Kelly, postdoctoral researcher Rami Barends, staff scientist Austin Fowler and others in the Martinis Group.

The error process involves creating a scheme in which several qubits work together to preserve the information, said Kelly. To do this, information is stored across several qubits.

Read the rest of the article.