

Talking to Superconducting Qubits with Millimeter Waves

A new device uses millimeter-wave radiation to accurately read the states of superconducting qubits without altering them.

By **Sophia Chen**

The state of a superconducting qubit after a logical operation is determined by a device called a readout resonator. Unfortunately, resonators typically struggle to consistently read their qubits without altering their states. Now Akash Dixit of the National Institute of Standards and Technology in Colorado and colleagues have demonstrated a readout resonator that reads states accurately and undistruptively by operating in the millimeter band at a frequency of 35 GHz, which is about 10 times the frequency of most readout resonators [1].

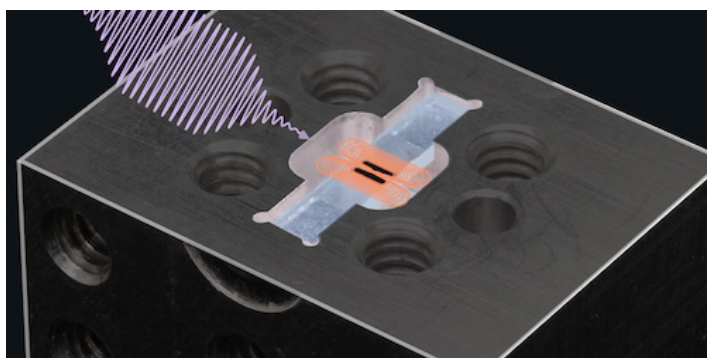
The readout resonator is essentially a microwave cavity coupled to a superconducting qubit. The frequency of the cavity's resonant mode shifts by an amount that depends on whether the qubit is in the ground or the excited state. Consequently, a frequency measurement can determine the qubit's state. However, reading the cavity's frequency entails driving it with weak light pulses, which can inadvertently kick the qubit into a different state, corrupting its information.

The researchers demonstrate a readout resonator that reads a qubit with more than 99% fidelity after driving it with more than 100 photons. They achieve this fidelity by making the cavity resonant in the millimeter-wave band, about an order of magnitude higher in frequency than the qubit's transition frequency. This frequency disparity reduces the likelihood of accidentally kicking the qubit into a different state. In addition, the millimeter band could be useful for connecting superconducting quantum computers to other quantum platforms that operate in the same range—such as Rydberg atoms and optomechanical devices—to create a combined, multiapplication quantum network.

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REFERENCES

1. A. V. Dixit *et al.*, “Millimeter wave readout of a superconducting qubit,” *Phys. Rev. Lett.* **137**, 180803 (2026).



Credit: A. Dixit/NIST