Superconducting Quantum Memory with Tens of Milliseconds Coherence Time

DeepTech

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Quantum computing platforms based on superconducting qubits suffer from high error rates and short storage time of only a few milliseconds, limiting scalable computations. This invention integrates superconducting microwave cavity with a qubit on chip, minimizing lossy surface exposure while enabling high-fidelity quantum gates. By achieving coherence times above 30 ms, over an order of magnitude longer than the state of the art, it enable low-error quantum memories for longer and more complex computations.
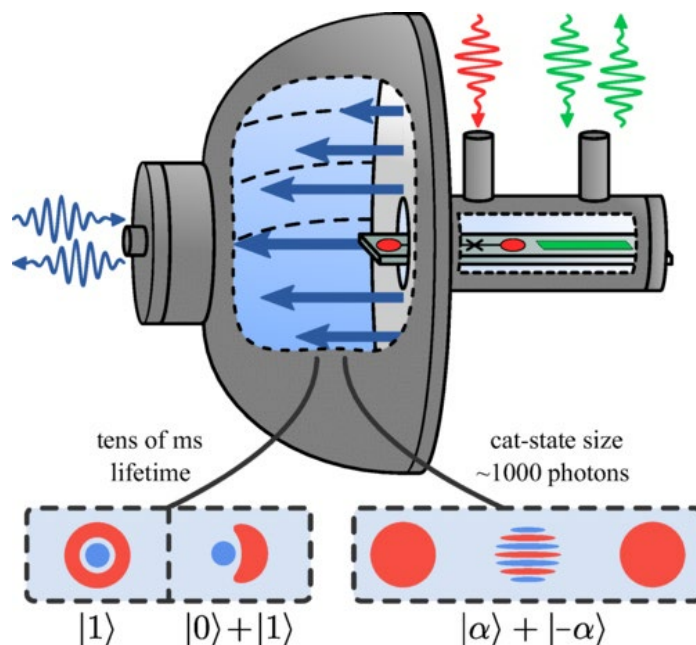

Illustration of the quantum memory

APPLICATIONS

- Quantum memory modules in superconducting quantum computers based on Transmon, SNAIL, or Fluxonium qubits.
- Processing qubits in bosonic quantum computers.
- Quantum repeaters for long-distance quantum communication networks.
- Quantum sensors with high frequency resolution.

DEVELOPMENT STAGE

The technology has been demonstrated showing a superconducting quantum memory with a coherence times of 34 ms and photon-lifetime exceeding 25 ms. A proof-of-concept experiment successfully storages large Schrödinger-cat states containing 1,024 photons.

DIFFERENTIATION

Record-long coherence time: >30ms versus 2-3 ms in current devices

Low-loss cavity design: Reduces photon loss by limiting electric-field surface exposure

Weakly coupled Transmon lowers decoherence while maintaining fast quantum gates

Enables bosonic quantum error correction (QEC)

REFERENCES

- :Milul et al, 2023