Alice & Bob Demonstrates New Approach to Stabilising Cat Qubits with DC Voltage Bias

New approach could make future quantum computers simpler to build at scale

PARIS, FRANCE, September 30, 2026 /EINPresswire.com/ -- Alice & Bob, a leader in fault-tolerant quantum computing, and the École Normale Supérieure de Lyon today announced a new and faster approach to stabilising cat-qubits in superconducting quantum systems enabling more compact designs that generate less heat.

Cat qubits, which store information in a microwave resonator, are stabilised by a process that dissipates photons from the resonator into the environment strictly in pairs. This process takes place in a component called a coupler. In Alice & Bob's current cat qubits, the coupler is driven by a carefully engineered microwave signal, an approach the company has refined over many years.

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> *Benjamin Huard, Scientific Advisor, Alice & Bob*

In this new experiment, the researchers explored an alternative coupler. They drove the same kind of process using a steady voltage of about one millionth of a volt, with no microwave signal required. Key findings include:

-- Faster than any pumped coupler: The new coupler exchanged photons faster than any previous pumped-drive cat-qubit coupler (two-photon exchange rate of 3 MHz. The data suggests that the design could reach considerably higher rates.

-- Several operations, one chip: Changing only the voltage switched the device between exchanging photons one, two or four at a time (two-photon process at a bias of about 1.1 microvolts).

-- Suppression of unwanted nonlinearity: Usual cat stabilisation usually comes with an unwanted

change of frequency with the number of photons, which is harmful to cat codes. This new strategy suppresses this parasitic effect.

-- Photons seen leaving in pairs: The team directly imaged the memory ‘s state using Wigner tomography and saw photons being dissipated in pairs.

Rather than replacing existing approaches, the new mechanism adds to the toolbox for building cat qubits, providing access to higher-order processes such as four-photon interactions. These could support the development of four-component cat qubits, which encode information across four coherent states. Four-photon processes are very difficult to achieve with existing methods, but with this approach it can be realistically achieved.

“This new approach could support the development of four-component cat qubits, which encode information across four coherent states. Four-to-one photon processes are very difficult to achieve with sufficient strength, but dc-biasing junctions seem to be a viable approach to that goal," said Benjamin Huard, Scientific Advisor, Alice & Bob and Professor at Ecole Normale Supérieure de Lyon.

The approach could also make future quantum computers simpler to build at scale. Voltage lines are compact, easy to wire, and produce little heat inside the ultra-cold refrigerators that quantum computers need.

The research was carried out at ENS Lyon in collaboration with Alice & Bob, with the findings published in a preprint in August 2026 (here).

Technical note
The device couples a high-quality "memory" resonator to a lossy "buffer" resonator through a SQUID biased with a dc voltage. A Cooper pair tunneling across the SQUID exchanges an energy 2eV with the circuit, so it is only allowed to tunnel if the SQUID's environment can absorb or supply exactly that energy.

The bias voltage V is set to a value such that 2eV matches the energy difference between two memory photons and one buffer photon. Therefore, the tunneling of Cooper pairs makes the two-to-one photon swap between memory and buffer energetically allowed. Each tunneling event converts a pair of memory photons into a single buffer photon, which quickly leaks out of the buffer, resulting in an effective two-photon dissipation of the memory at a rate of up to 1.3 MHz.

On the same device, researchers showed that the same technique can be used to activate one-to-one and four-to-one photon swaps.

About Alice & Bob

Alice & Bob is a quantum computing company based in Paris and Boston whose goal is to create the first universal, fault-tolerant quantum computer. Founded in 2020, Alice & Bob has raised €180 million in funding and employs more than 250 people.

Advised by Nobel Prize winning researchers, Alice & Bob specializes in cat□qubits, a technology developed by the company's founders. Demonstrating the power of its cat architecture, Alice & Bob recently showed that it could reduce the hardware requirements for building a useful large-scale quantum computer up to 200 times compared with competing approaches.

Mike Kilroy
HKA, Inc. Marketing Communications
+1 714-426-0444
email us here

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