

Quantum Computing Startup Alice & Bob Unveils Major 'Cat Qubit' Design Advances

Paris-based firm publishes new research conducted in collaboration with scientists from top French academic institutions

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/EINPresswire.com/ -- French quantum computing startup Alice & Bob today announced new research, conducted in collaboration with its academic partners at Laboratoire de Physique de l'ENS, Mines Paris and Laboratoire de Physique de l'ENS de Lyon, demonstrating major design advances for its superconducting 'cat qubit.'

The company published the following two preprints describing new design features:

[Quantum control of a cat-qubit with bit-flip times exceeding ten seconds](#)

In this work, a new way to access the cat qubit information is introduced called TIGRO. This approach enables the removal of the "transmon," a key structure in most other superconducting processors, previously used for readout. TIGRO also reduces the bit-flip errors by four orders of magnitude compared to the state-of-the-art and decreases the qubit footprint by 50%. It also reduces the number of IO ports from 4 to 3 while maintaining quantum control over the qubit.

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Théau Peronnin, CEO and co-founder of Alice & Bob

[Autoparametric resonance extending the bit-flip time of a cat qubit up to 0.3 s](#)

In this research, the cat-qubit stabilization mechanism is drastically simplified while being made stronger, a scheme the company calls AutoCat. Stabilization strength, the



performance metric which matters for error correction and gate speed, is improved by a factor of ten compared to the previous state of the art. The simplification makes the calibration faster and allows for reducing the number of control lines and ports, while energy consumption is reduced as the stabilization mechanism requires one less signal.

According to the researchers, the new designs enable critical improvements towards building a useful quantum computer in several key areas:

performance, with a large stabilization rate compared to the qubit decay rate; error suppression, as single qubit bias-preserving gates are truly bias-preserving; and scalability, with a reduced number of lines per qubit and an increased ease of operation in general.

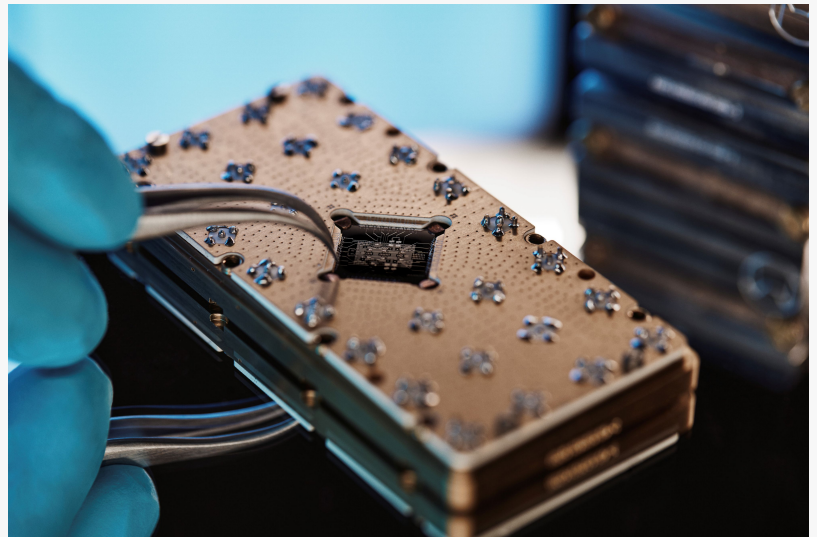
“These new designs can further enhance cat qubit performance beyond its already record-breaking error resistance,” said Théau Peronnin, CEO and co-founder of Alice & Bob. “This research demonstrates our focus on design creativity as a key ingredient in building a fault-tolerant quantum computer based on superconducting circuits.”

The new designs are still in the prototype phase and further engineering and testing will be required before these improvements appear on the startup's quantum processors. The new readout approach, TIGRO, needs to improve to reach the fidelity of previous schemes. In the AutoCat chip, the presence of a transmon still limits the attainable bit-flips lifetime to 300ms. Researchers are confident they can resolve both issues.

Bit-flip protected by design, the promise of cat qubits is to make quantum error correction hardware efficient. Quantum error correction is critical to run algorithms requiring deep circuits and enable the full impact of quantum computers. In this regard, Alice & Bob researchers previously demonstrated that using a quantum computer using cat qubits would need 60 times less qubits to run Shor's algorithm.

To support this work, Alice & Bob is building a dedicated project management framework inspired by the Manifesto for Agile Software Development and modified to suit the constraints of deep-tech innovation and hardware R&D.

Today, the company is also releasing a description of this framework called “[Deeptech Motion](#)” which includes the current state of the framework and plans to move it forward.



Alice & Bob's latest chip

"I had never realized herding cats could ever become a real job description," said Blaise Vignon, Chief Product Officer. "I am very proud of the framework we have built and what it enables the company to accomplish at an accelerated pace."

The specific academic partners involved in this latest research include the Laboratoire de Physique de l'ENS and Mines Paris under the leadership of Professor Zaki Leghtas, and the Laboratoire de Physique de l'ENS de Lyon, under the leadership of Professor Benjamin Huard.

About Alice & Bob

Alice & Bob is a French start-up whose goal is to realize the first universal, fault-tolerant quantum computer. Founded in 2020, Alice & Bob has already raised 30M€ in VC capital, hired over 70 employees, and demonstrated experimental results surpassing those of technological giants developing superconducting quantum computers.

A laureate of the French Tech DeepNum 20 and French Tech 2030 programs, Alice & Bob specializes in cat qubits, a technology reducing hardware requirements by up to 60 times compared to competing approaches.

The impact of fault-tolerant quantum computing is expected to reach hundreds of billions of dollars in fields as diverse as material science, energy, artificial intelligence, logistics, aeronautics, automotive, pharmaceuticals, finance and more.

For more information, visit <https://www.alice-bob.com/>.

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