



Colloquium

Quantum control of a cat-qubit with bit-flip times exceeding ten seconds

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Quantum bits (qubits) are prone to several types of errors due to uncontrolled interactions with their environment. Common strategies to correct these errors are based on architectures of qubits involving daunting hardware overheads. A hopeful path forward is to build qubits that are inherently protected against certain types of errors, so that the overhead required to correct remaining ones is significantly reduced. However, the foreseen benefit rests on a severe condition: quantum manipulations of the qubit must not break the protection that has been so carefully engineered. A recent qubit - the cat-qubit - is encoded in the manifold of metastable states of a quantum dynamical system, thereby acquiring continuous and autonomous protection against bit-flips. Here, in a superconducting circuit experiment, we implement a cat-qubit with bit-flip times exceeding 10 seconds. This is a four order of magnitude improvement over previous cat-qubit implementations. We prepare and image quantum superposition states, and measure phase-flip times above 490 nanoseconds. Most importantly, we control the phase of these quantum superpositions without breaking bit-flip protection. This experiment demonstrates the compatibility of quantum control and inherent bit-flip protection at an unprecedented level, showing the viability of these dynamical qubits for future quantum technologies. / Ref : <https://arxiv.org/abs/2307.06617>, to appear in Nature.

Tuesday, June 4, 2024 11:00am - 11:00am

Heinzel Seminar Room / Ground Floor / Office Building West



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