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Quantum Coherence of the Fluxonium Superconducting Artificial Atom

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Artificial atoms built from superconducting tunnel junctions illustrate the problem of engineering a controllable electrodynamic quantum system, starting from basic elements. Can circuit architecture mitigate or even eliminate coherence limitations due to defects in the basic electrical constituents? This central question will be discussed from the perspective of recent experimental results of our group, obtained on the fluxonium[1], a novel superconducting quantum circuit. It consists of a Cooper-pair box junction which is shunted by a long array of larger junctions. Immunity to offset charge noise and only a weak sensitivity to flux noise is observed for the qubit transition. The combination of the very large inductance of the array, which has negligible parasitic resistance, and large phase fluctuations of the small junction, distinguishes fundamentally the fluxonium from the flux qubit. Significant improvement of the relaxation time has been obtained, when one compares with qubits of the same family. Finally, fluxonium displays the type of 3-level-atom physics which should prove useful for continuous, high-fidelity monitoring of a state. Work supported by the IARPA, ARO and NSF.

[1] V.E. Manucharyan, Jens Koch, L.I. Glazman and M.H. Devoret, Science 326, 113-116 (2009).