Abstract Submitted
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A Quasi-3D, Purcell-Filtered Hardware Module for Quantum Information[1] C. AXLINE, M. REAGOR, K. SHAIN, P. REINHOLD, T. BRECHT, E. HOLLAND, C. WANG, R. HEERES, L. FRUNZIO, R.J. SCHOELKOPF, Department of Applied Physics, Yale University — The advent of 3D circuit quantum electrodynamics has provided an ultra-low-loss environment for superconducting qubits, boosting qubit coherences above 100 microseconds and linear resonator lifetimes above 10 milliseconds. Planar devices, however, allow lithographic control of parameters and suggest greater scalability. We have developed a single-chip, seamless-cavity architecture that answers the call[1] for a modular computational element, comprising 3D transmon, fast, Purcell-filtered readout, and long-lived storage cavity. This design incorporates advantages of both 2D and 3D architectures. It also serves as a novel testbed for qubit loss mechanisms, as resonator and qubit modes have similar material participations. Initial results—T1 and T2 comparable to the best 3D transmons—shift blame away from the metal-substrate interfaces widely considered to be the limiting loss channel in current-generation transmons, and further experiments using this system will probe these losses more carefully. We propose several modifications and extensions to these modules, both to miniaturize the design and to build more sophisticated quantum systems. [1] M. H. Devoret and R. J. Schoelkopf, Science 8 March 2013: 339 (6124), 1169-1174.

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