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**Design and Fabrication of Novel Resonators for Scalable 3D cQED**[1] T. BRECHT, C. WANG, C. AXLINE, M. REAGOR, M. HATRIDGE, P. REINHOLD, L. FRUNZIO, R.J. SCHOELKOPF, Departments of Applied Physics and Physics, Yale University — Experiments in three-dimensional circuit quantum electrodynamics (3D cQED) champion the use of superconducting microwave cavities as a quantum resource. The transmon qubit coupled to a 3D superconducting waveguide cavity [1] has yielded enormous gains in coherence times. Cavity coherence times are now approaching 10 milliseconds at single photon power [2]. By virtue of their low surface-to-volume ratio and concomitant low surface dielectric participation, microwave cavities machined out of bulk pieces of superconducting metal are longer lived than planar resonator geometries in the presence of surface losses. However, issues of reproducibility, assembly, and integration become more challenging as we design systems containing many resonators and many qubits. We present a novel architecture for superconducting resonators that retains the superb coherence of 3D structures while achieving superior scalability and compatibility with planar circuitry and integrated readout electronics.

[1] Paik, et al., Phys Rev Lett 107 240501 (2011)
[2] Reagor, et al., Appl Phys Lett 102 192604 (2013)

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