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High-Q 3D coaxial resonators for cavity QED TAEKWAN YOON, JOHN C OWENS, RAVI NAIK, AMAN LACHAPELLE, RUICHAO MA, JONATHAN SIMON, DAVID I SCHUSTER, Univ of Chicago — Three-dimensional microwave resonators provide an alternative approach to transmission-line resonators used in most current circuit QED experiments [1]. Their large mode volume greatly reduces the surface dielectric losses that limits the coherence of superconducting circuits, and the well-isolated and controlled cavity modes further suppress coupling to the environment. In this work, we focus on unibody 3D coaxial cavities which are only evanescently coupled and free from losses due to metal-metal interfaces, allowing us to reach extremely high quality-factors. We achieve quality-factor of up to 170 million using 4N6 Aluminum at superconducting temperatures, corresponding to an energy ringdown time of ˜4ms. We extend our methods to other materials including Niobium, NbTi, and copper coated with Tin-Lead solder. These cavities can be further explored to study their properties under magnetic field or upon coupling to superconducting Josephson junction qubits, e.g. 3D transmon qubits. Such 3D cavity QED system can be used for quantum information applications, or quantum simulation in coupled cavity arrays. References: [1] Matthew Reagor et al., A quantum memory with near-millisecond coherence in circuit QED. arXiv: 1508.05882 (2015)

Taekwan Yoon
Univ of Chicago

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