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Circuit quantum electrodynamics with a multi-mode cavity¹

NEEREJA SUNDARESAN, DEVIN UNDERWOOD, WILLIAM SHANKS, HAKAN TURECI, ANDREW HOUCK, Princeton Univ — In most single-cavity experiments studied using circuit quantum electrodynamics, the quantum dynamics consist of superconducting qubit(s) interacting with the fundamental electromagnetic mode of the cavity. For these cavities, the modes are very widely separated and thus higher modes fall outside the microwave regime, inaccessible using standard experimental setup. In a multi-mode cavity, mode spacing is significantly smaller. Specifically, the multi-mode cavity allows us to access a new type of ultra-strong coupling in which the qubit-cavity coupling can be large compared with the mode spacing. In this regime, pulsed revivals on the timescale of half the cavity round-trip time have been predicted [1]. Here, we report preliminary transmission measurements of 0.7 meter long multi-mode cavities with fundamental frequencies less than 100 MHz and evenly spaced harmonics out to 10 GHz. [1] D. O. Krimer, et al. arXiv:1306.4787 [quant-ph]

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