

Abstract Submitted
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A Study of the Multi-Mode Purcell Effect for a Transmon in 3D Circuit QED ANDREI PETRENKO, LUYAN SUN, JACOB BLUMOFF, SIMON NIGG, STEVE GIRVIN, ROBERT SCHOELKOPF, Yale University Department of Applied Physics — Although superconducting 3D transmon qubits offer a promising path toward realizing an architecture for quantum computation, they are still limited by decoherence processes that are not yet fully understood. Qubit T_1 relaxation due to the Purcell Effect presents one such limitation on coherence times, but thus far a complete model of Purcell processes for transmons in 3D cavities, beyond the approximation of a single cavity mode and lumped element qubit, has been absent. Employing a simple scheme to vary the decay rate κ (or quality factor Q) of our cavities in-situ we explore in detail how multiple cavity modes contribute to qubit T_1 decay in the Purcell regime. In addition, we show the continued dependence of qubit T_1 on cavity κ as we systematically decouple from our cavity and are no longer Purcell-limited and how this dependence is related to a steady rise in qubit excited state population. Our findings are consistent with theory we have developed based on an effective circuit model for the cavity-qubit system, and set the stage for continuing the study of the multi-mode Purcell Effect by means of in-situ tuning of not just the cavity coupling, but the qubit frequency itself.

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