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Purcell Effect Limits on the Lifetimes of Transmon Qubits BLAKE JOHNSON, STEVEN GIRVIN, ROBERT SCHOELKOPF, Yale University Dept of Physics, YALE CIRCUIT QED TEAM — Circuit QED couples a superconducting qubit to a transmission line cavity. The presence of the cavity can suppress or enhance the spontaneous emission of the qubit into the cavity, a phenomenon known as the Purcell effect. Consequently, the qubit excited-state lifetime depends on the qubit-cavity detuning. A quantum mechanical calculation of the Purcell effect for a single mode of the cavity does not account for T1s observed in our system. Here we show a semi-classical approximation for the Purcell effect for a multi-mode cavity which we compare with T1 measurements of several transmon [1] qubits. By designing an appropriate cavity we have improved T1 by a factor of 10.

[1] Charge-insensitive qubit design derived from the Cooper pair box. Jens Koch et al, Phys. Rev. A 76, 042319 (2007).

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