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Phase versus flux coupling between resonator and superconducting flux qubit[1] J.S. BIRENBAUM, S.R. O'KELLEY, S.M. ANTON, UC Berkeley, C.D. NUGROHO, V. ORLYANCHIK, A.H. DOVE, Z.R. YOSCOVITS, G.A. OLSON, D.J. VAN HARLINGEN, J. ECKSTEIN, University of Illinois at Urbana-Champaign, D.A. BRAJE, R.C. JOHNSON, W.D. OLIVER, MIT Lincoln Laboratory, JOHN CLARKE, UC Berkeley — The dispersive coupling of qubits to microwave resonators has become widely used for qubit readout. Recent advances in coupling qubits to 3D resonators have demonstrated the importance of the nature of the qubit-resonator coupling in determining the qubit relaxation and decoherence times, T_1 and T_2^*. We study the effect of phase versus flux coupling on flux qubits coupled to planar resonators. Using an aluminum shadow evaporation technique we fabricate a low-loss planar resonator, consisting of a meandering inductor and interdigitated capacitor, and a flux qubit, all in a single processing step. Whereas the qubit and resonator are always flux coupled via a geometric mutual inductance, a phase coupling can be added by including a shared trace between the qubit and resonator. This technique allows us to control both the magnitude and nature of the qubit-resonator coupling without significantly affecting either the qubit or resonator design. We characterize the dependence of the qubit parameters T_1, T_2^*, and spin echo time T_{echo} on the resonator coupling parameters to gain insight into possible sources of decoherence and loss.

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