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Longitudinal qubit-resonator interaction in circuit QED[1] PHILIP KRANTZ, SIMON GUSTAVSSON, FEI YAN, DANIEL L. CAMPBELL, MIT, DAVID KIM, JONILYN L. YODER, MIT, Lincoln Laboratory, ARNE L. GRIMSMO, JEROME BOURASSA, ALEXANDRE BLAIS, Université de Sherbrooke, ANDREW J. KERMAN, MIT, Lincoln Laboratory, TERRY P. ORLANDO, MIT, WILLIAM D. OLIVER, MIT, MIT Lincoln Laboratory, MIT TEAM, MIT, LINCOLN LABORATORY TEAM, UNIVERSIT DE SHERBROOKE TEAM —
We investigate an experimental implementation of a longitudinal interaction between a superconducting qubit and a half-wavelength coplanar microwave resonator. As opposed to the transverse coupling, commonly used when dispersively reading out qubits in circuit QED, the longitudinal coupling has several potential advantages, including reduced read-out times, absence of the Purcell effect, and increased signal-to-noise ratio (SNR). Instead of detecting a dispersive frequency shift of the resonator, the readout mechanism for our system is based on a parametric modulation of the qubit-resonator coupling that is on resonance with the resonator. This resonant modulation gives rise to a difference in amplitude between the two qubit states. To enhance this interaction and thus improve the state discrimination, we inductively couple the qubit to the resonator using an array of Josephson junctions placed in the center of the half-wavelength microwave resonator, which increases the participation ratio of inductance at the coupling point. I will present our latest experimental progress.

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