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Ultra-strong coupling in a transmon circuit architecture[1] SAL BOSMAN, MARIO GELY, VIBHOR SINGH, ALESSANDRO BRUNO, GARY STEELE, Delft Univ of Tech — New unexplored phenomena are predicted in cQED for the ultra-strong coupling (USC) regime and beyond. Here, we explore two strategies to increase the coupling between a transmon qubit and a microwave resonator. In the first approach, we increase the impedance of the resonator, enhancing its voltage zero-point fluctuations, and measure a vacuum Rabi splitting of 916 MHz. In a second approach, we create a transmon qubit by making a superconducting island suspended above the center conductor of the resonator and which is shorted to ground by two Josephson junctions. Doing so, we maximize the dipole moment of the qubit and observe a vacuum Rabi splitting of 1.2 GHz with a qubit linewidth of 1 MHz. This first transmon qubit in the USC regime improves the coherence time by a factor of 100 compared to other systems in the USC limit. Finally we predict that by combining both approaches, a coupling of ~ 3.6 GHz is possible, reaching close to the deep strong coupling limit.

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