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Abstract for an Invited Paper
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Circuit Quantum Electrodynamics: Doing Quantum Optics on a Chip[1]

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I will describe experiments in which the strong coupling limit of cavity quantum electrodynamics has been realized for the first time using superconducting circuits. In our approach, we use a Cooper-pair box as an artificial atom, which is coupled to a one-dimensional cavity formed by a transmission line resonator. When the Cooper-pair box qubit is detuned from the cavity resonance frequency, we perform high-fidelity dispersive quantum non-demolition read-out of the qubit state. Using this read-out technique, we have characterized the qubit properties spectroscopically, performed Rabi and Ramsey experiments with the qubit, and attained coherence times greater than 500 ns and a visibility greater than 90 percent, indicating that this architecture is extremely attractive for quantum computing and control. In the case when the qubit is tuned into resonance with the cavity, we observe the vacuum Rabi splitting of the cavity mode, indicating that the strong coupling regime is attained, and coherent superpositions between the qubit and a single photon are generated.

[1]work done in collaboration with A. Wallraff, D. Schuster, A. Blais, L. Frunzio, J. Majer, and S. Girvin