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Abstract for an Invited Paper
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Circuit Quantum Electrodynamics: A New Architecture for Superconducting Quantum Computation

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I will describe recent experiments in which the strong coupling limit of cavity quantum electrodynamics has been realized for the first time using superconducting circuits [1]. 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. In the case when the Cooper-pair box 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. When the qubit is detuned from the cavity resonance frequency, we perform high-fidelity dispersive quantum non-demolition readout of the qubit state. Using this readout technique, we have characterized the qubit properties spectroscopically, performed Rabi oscillations of the qubit, and attained coherence times greater than 500 ns, indicating that this architecture is extremely attractive for quantum computing and control [2].

[1] A. Wallraff, D. I. Schuster, A. Blais, L. Frunzio, R.-S. Huang, J. Majer, S. Kumar, S. M. Girvin and R. J. Schoelkopf Nature (London) **431**, 162 (2004)

[2] A. Blais, R.-S. Huang, A. Wallraff, S. M. Girvin and R. J. Schoelkopf Phys. Rev. A **69**, 062320 (2004)

[1]In collaboration with David Schuster, Alexandre Blais, Ren-Shou Huang, Hannes Majer, Luigi Frunzio, Steve Girvin and Rob Schoelkopf