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Abstract for an Invited Paper
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Measurement and Generation of Single Photons in a Circuit

ANDREW HOUCK, Yale Univesity

I will describe the measurement and generation of single photons in a circuit quantum electrodynamics system. A one-dimensional transmission line cavity realizing well-defined microwave linear photon modes is coupled to a Cooper-pair box qubit. The qubit-photon coupling is exploited to realize a quantum non-demolition measurement of the qubit state by the photons, resulting in high visibility and long coherence times. The reverse measurement can also be performed: the qubit can used to measure the number of photons in the cavity. In this case, the qubit transition is resolved into separate spectral lines for each photon number, leading to a photon statistics analyzer. The same interaction can also be used to convert qubit states into a flying qubit consisting of superpositions of photon states, and to generate single microwave photons on demand, enabling a full range of quantum optics experiments. Work done in collaboration with D.I. Schuster, A. Wallraff, A. Blais, J. Schreier, L. Frunzio, J.A. Gambetta, J. Koch, J. Majer, B. Johnson, J. Chow, T. Yu, M. Devoret, S.M. Girvin, R.J. Schoelkopf.