MAR05-2004-003101

Abstract for an Invited Paper
for the MAR05 Meeting of
the American Physical Society

Quantum optics with superconducting qubits in the dispersive limit

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Several recent experiments have demonstrated that superconducting circuits are ideal systems for the study of quantum mechanical effects on large scale and promising candidates for quantum computation. It was recently proposed [1] and experimentally demonstrated [2,3] that superconducting circuits fabricated inside a high quality on-chip transmission line resonator can be used to study solid-state analogs of quantum optics experiments and, in particular, to reach the strong-coupling regime of cavity quantum electrodynamics (CQED). In this talk, this theoretical proposal will be reviewed and experimental results in the dispersive regime will be presented, for both the time and frequency domain. Results in the time domain show our ability to coherently control the state of the qubit, while detailed analysis of the frequency domain results yields insights into the measurement process and its backaction.

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

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

[3] D. Schuster, A. Wallraff, A. Blais, L. Frunzio, R.-S. Huang, J. Majer, S. M. Girvin and R. J. Schoelkopf, cond-mat/0408367.

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