Photon-Qubit Entanglement and Hong-Ou-Mandel Interference at Microwave Frequencies

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Résumé

Using modern micro and nano-fabrication techniques combined with superconducting materials we realize quantum electronic circuits in which we create, store, and manipulate individual microwave photons. The strong interaction of photons with superconducting quantum two-level systems allows us to probe fundamental quantum effects of microwave radiation and also to develop components for applications in quantum technology. Previously we have realized on-demand single microwave photon sources which we have characterized using correlation function measurements [1] and full quantum state tomography [2]. For this purpose we have developed efficient methods to separate the quantum signals of interest from the noise added by the linear amplifiers used for quadrature amplitude detection [3]. Employing superconducting parametric amplifiers [4] we perform nearly quantum limited detection of propagating electromagnetic fields. This enables us to probe the entanglement which we generate on demand between stationary qubits and microwave photons freely propagating down a transmission line [5]. Using two independent microwave single photon sources we perform Hong-Ou-Mandel experiments at microwave frequencies [6] and probe the coherence of two-mode multi-photon states at the out-puts of a beam-splitter. The non-local nature of such states may prove to be useful for distributing entanglement in future small-scale quantum networks.

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