Two-resonator Circuit Quantum Electrodynamics: A superconducting Quantum Switch

We introduce a systematic formalism for two-resonator circuit QED, where two on-chip microwave resonators are simultaneously coupled to one superconducting qubit. Within this framework, we demonstrate that the qubit can function as a quantum switch between the two resonators. We also show that our quantum switch represents a flexible architecture for the manipulation and generation of nonclassical microwave field states as well as the creation of controlled multipartite entanglement in circuit QED. In addition, we propose a realistic implementation of two-resonator circuit QED.

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