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Inhibition of ground-state superradiance and light-matter decoupling in circuit QED ZELIANG XIANG, TUOMAS JAAKO, Atominstitut, Vienna University of Technology, JUAN JOS GARCIA-RIPOLL, Instituto de Fsica Fundamental, IFF-CSIC, PETER RABL, Atominstitut, Vienna University of Technology — We study effective light-matter interactions in a circuit QED system consisting of a single LC resonator, which is coupled symmetrically to multiple superconducting qubits. Starting from a minimal circuit model, we demonstrate that in addition to the usual collective qubit-photon coupling the resulting Hamiltonian contains direct qubit-qubit interactions, which prevent the otherwise expected superradiant phase transition in the ground state of this system. Moreover, these qubit-qubit interactions are responsible for an opposite mechanism, which at very strong couplings completely decouples the photon mode and projects the qubits into a highly entangled ground state. These finfings shed new light on the controversy over the existence of superradiant phase transitions in cavity and circuit QED systems, and show that the physics of ultrastrong light-matter interactions in two- or multi-qubit settings differ drastically from the more familiar one qubit case.

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