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Rectangular waveguide QED with superconducting qubits

Coupling superconducting artificial atoms to the continuum of modes in a waveguide opens a door for probing a vast range of atom-light interactions in an open space configuration. In this talk, I will show how field-mediated interactions between the atoms can be used to generate sub- and super-radiant states, which, when combined with the nonlinear saturability of superconducting artificial atoms, leads to nonreciprocal transmission of light. Long-lived subradiant states can be also exploited to generate steady-state entanglement between two artificial atoms embedded in a waveguide. Moreover, we can make use of the characteristic cutoff of rectangular waveguides to produce localized atom-photon bound states in the bandgap. I will show evidence of photon localization in our system, as well as a tunable interaction between two bound states mediated by the evanescent, localized fields.