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Quantum optics with giant artificial atoms in a 1D waveguide ANTON FRISK KOCKUM, RIKEN, Japan, GÖRAN JOHANSSON, Chalmers University of Technology, Sweden, FRANCO NORI, RIKEN, Japan — In quantum optics experiments with both natural and artificial atoms, the atoms are usually small enough that they can be approximated as point-like compared to the wavelength of the electromagnetic radiation they interact with. However, a recent experiment coupling a superconducting transmon qubit to surface acoustic waves shows that a single artificial atom can be coupled to a bosonic field at several points which are wavelengths apart. This concept of a "giant artificial atom" could also be realized with a superconducting qubit coupled to a meandering microwave transmission line. In a previous theoretical study, we showed that interference effects due to the positions of the coupling points for a single giant artificial atom give rise to a frequency dependence in the atom's relaxation rate and Lamb shift. In the present work, we study two or more giant artificial atoms coupled to a 1D waveguide in various configurations. We investigate collective decay effects (super- and subradiance) and exchange interaction between the atoms, and find striking differences compared to the case of small atoms.

Anton Frisk Kockum
RIKEN - Saitama

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