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Vacuum mediated dipole-dipole interaction and collective Lamb shift in circuit QED systems KUAN-TING LIN, TING HSU, Department of Physics, National Taiwan University, IO-CHUN HOI, Department of Physics, National Tsing Hua University, GUIN-DAR LIN, Department of Physics, National Taiwan University — This work investigates the dipole-dipole interaction between two artificial atoms in a 1D geometry, implemented by two transmon qubits coupled through transmission lines. Here we effectively set one end of the transmission line to be a mirror, in front of which two qubits are placed. We calculate the reflected field as probing the dipole-dipole shifts and linewidths of the reflective spectrum while separations between qubits can vary. We clearly observe that one qubit's response to the field can be affected by another qubit even when the second one is located in the node of the resonant mode and is thought to be decoupled from the pumping field. We observe the so-called collective Lamb shift indicating dipole-dipole interaction mediated by exchanging virtual photons. We also generalize our calculation to multi-atom cases and discuss how these effects scale with the qubit number

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