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Non-classical correlations of scattered photons in a one-dimensional waveguide with multiple atoms[1] DIBYENDU ROY, Theoretical Division and Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, New Mexico 87545, USA — We study the scaling of photon-photon correlations mediated by resonant interactions of photons with atoms in a one-dimensional photonic waveguide. Recently a new theoretical approach based on the Bethe-ansatz technique has been developed to study transport in an open quantum impurity. Here we generalize the approach to study multiple atoms. We derive the exact solution of single and two-photon scattering states, and the corresponding photon transmission through the atomic ensemble. We show how various two-photon nonlinear effects, such as spatial attraction and repulsion between photons as well as background fluorescence can be tuned by changing the number of atoms and the coupling between atoms (controlled by the separation). Finally we propose a simple scheme for nonreciprocal optical transmission in the waveguide by placing different atoms. Our fully quantum-mechanical approach provides a better understanding of cascaded optical nonlinearity at the microscopic level.

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