Strong three-photon correlations from coupled quantum emitters

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The interaction between photons and a highly nonlinear optical medium has the potential to create a strongly correlated many-body photonic system. Photon-photon interactions can be mediated by individual atoms that are coupled to the light field. To explore the regime of many-body quantum optics, it is necessary for many photons to interact simultaneously. However, scaling the nonlinear photonic response to higher-order correlations poses a significant challenge. In this study, we realize a strongly correlated photonic system that can be controlled by the number of quantum emitters involved in the interactions. We demonstrate that the scattering of two coupled quantum dots in a waveguide leads to enhanced three-photon correlations and suppresses lower-order contributions. As a result, the interaction with the collectively coupled system produces genuine three-photon correlations. These advancements could enable functionalities for photonic quantum gates and the generation of multipartite entangled states, while also opening up new possibilities for studying many-body physics with photons.

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