A chiral one-dimensional atom using a quantum dot in an open microcavity

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In a chiral one-dimensional atom, a photon propagating in one direction interacts with the atom; a photon propagating in the other direction does not. Chiral quantum optics has applications in creating nanoscopic single-photon routers, circulators, phase-shifters, and two-photon gates. Here, we implement chiral quantum optics using a low-noise quantum dot in an open microcavity. We demonstrate the non-reciprocal absorption of single photons, a single-photon diode. The non-reciprocity, the ratio of the transmission in the forward-direction to the transmission in the reverse direction, is as high as 10.7 dB. This is achieved by tuning the photon-emitter coupling in situ to the optimal operating condition ($\beta = 0.5$). Proof that the non-reciprocity arises from a single quantum emitter lies in the photon statistics—ultralow-power laser light propagating in the diode's reverse direction results in a highly bunched output ($g(2)(0) = 101$), showing that the single-photon component is largely removed.
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