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Photon Blockade in Non-Hermitian Optomechanical Systems with Nonreciprocal Couplings

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Abstract : We study the photon blockade at exceptional points for a non-Hermitian optomechanical system coupled to the driven whispering-gallery-mode microresonator with two nanoparticles under the weak optomechanical coupling approximation, where exceptional points emerge periodically by controlling the relative angle of the nanoparticles. We find that conventional photon blockade occurs at exceptional points for the eigenenergy resonance of the single-excitation subspace driven by a laser field and discuss the physical origin of conventional photon blockade. Under the weak driving condition, we analyze the influences of the different parameters on conventional photon blockade. We investigate conventional photon blockade at nonexceptional points, which exists at two optimal detunings due to the eigenstates in the single-excitation subspace splitting from one (coalescence) at exceptional points to two at nonexceptional points. Unconventional photon blockade can occur at nonexceptional points, while it does not exist at exceptional points since the destructive quantum interference cannot occur due to the two different quantum pathways to the two-photon state not being formed. The realization of photon blockade in our proposal provides a viable and flexible way for the preparation of single-photon sources in the non-Hermitian optomechanical system.

Keywords : optomechanical systems, photon blockade, non-hermitian, exceptional points
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