Non-Hermitian Hamiltonian-like dynamics of bosonic modes without breaking time-reversal symmetry

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Correlation and unidirectional properties of two bosonic modes under the influence of reservoir are investigated when the modes are coupled through the simultaneously applied linear mode-hopping and nonlinear squeezing interactions. Under such coupling, it is found that while the Hamiltonian of the system is clearly Hermitian the dynamics of the quadrature components of the field operators can be attributed to non-Hermicity of the system. It results in an asymmetric coupling between the quadrature components which then leads to a variety of remarkable features. In particular, we identify how the emerging exceptional point controls the conversion of thermal states of the modes into single-mode classically or quantum squeezed states. Furthermore, for reservoirs being in squeezed states, we find that the unidirectional flow of populations and correlations among the modes can be maintained by appropriate tuning of the mutual orientation of the squeezed noise ellipses. We find that the flow of the population creates the first-order coherence between the modes which, on the other hand rules out an enhancement of the two photon correlations responsible for entanglement between the modes.

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