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Exotic interactions mediated by a non-Hermitian photonic bath

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We study the exotic interaction between emitters mediated by the photonic modes of a lossy photonic lattice described by a non-Hermitian Hamiltonian, where structured losses can seed exotic emission properties. Photons can mediate dissipative, fully non-reciprocal, interactions between emitters with range critically dependent on the loss rate. At the bare-lattice exceptional point, the effective couplings are exactly nearest-neighbour, implementing a dissipative, fully non-reciprocal, Hatano-Nelson model. Counter-intuitively, this occurs irrespective of the lattice boundary conditions. Thus photons can mediate an effective emitters' Hamiltonian which is translationally-invariant despite the fact that the field is not. We interpret these effects in terms of metastable atom-photon dressed states, which can be exactly localized on only two lattice cells or extended across the entire lattice.

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