

Emergent atom pump in a non-hermitian system

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The time evolution of a quantum system can be strongly affected by dissipation. Although this mainly implies that the system relaxes to a steady state, in some cases it can make new phases appear and trigger emergent dynamics. In our experiment, we study a Bose-Einstein Condensate dispersively coupled to a high finesse resonator. The cavity is pumped via the atoms, such that the sum of the coupling beam(s) and the intracavity standing wave gives an optical lattice potential. When the dissipation and the coherent timescales are comparable, we find a regime of persistent oscillations where the cavity field does not reach a steady state. In this regime the atoms experience an optical lattice that periodically deforms itself, even without providing an external time dependent drive. Eventually, the dynamic lattice triggers a pumping mechanism. We show complementary measurements of the light field dynamics and of the particle transport, proving the connection between the emergent non-stationarity and the atomic pump.

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