

Non-reciprocal dynamics in exactly solvable interacting open system

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Exact solutions for strongly correlated systems are scarce - especially when introducing coupling to an external environment - and often require heavy analytical machinery. Here, we investigate a 1D open quantum system featuring long-range interactions, supplemented with incoherent loss and gain within the Lindbladian framework. We establish the exact solvability of the equations of motion of this model and we show that the interplay between non-reciprocity and interactions qualitatively reshapes both the propagation and decay dynamics of the excitations. We provide compact analytic expressions and diagnostics that quantify directional and interaction-tuned propagation under periodic boundary conditions, establishing a minimal, exactly solvable platform for interaction-driven, non-reciprocal many-body dynamics.

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