Nonequilibrium dynamics and dissipative chaos in open anisotropic Dicke model

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Abstract: I will discuss the nonequilibrium dynamics of an atom-photon interacting system described by an anisotropic Dicke model in the presence of photon loss. Such systems provide an ideal platform to explore intriguing non-linear dynamical phenomena, including self-trapping phenomena, resulting in a photon population imbalance between the cavities, multistability of nonequilibrium phases, limit cycles, etc. These dynamical phases can be investigated both semiclassically, using stochastic differential equations, and fully quantum mechanically, by analyzing individual quantum trajectories through the stochastic wave-function method. Interestingly, the presence of a limit cycle can give rise to the formation of a time-crystalline phase. The absence of stable dynamical phases leads to the onset of chaos even in the presence of dissipation. Quantum signatures of this chaotic behavior can be identified by analyzing the statistical properties of the emergent steady state within the chaotic regime.