Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Webinar

Driven-Dissipative Dynamics of Coupled Atomic Clocks

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We study the dynamics of two mesoscopic ensembles of ultra-cold two level atoms, which are collectively coupled to an optical cavity and are being pumped incoherently to the excited state. Whereas the time independent steady states are well understood [1], little is known about the time dependent ones. We explore and categorise various time dependent steady states, e.g. limit cycles and chaotic behaviour [2, 3]. We draw a non-equilibrium phase diagram indicating different steady-state behaviours in different parts of the parameter space. We discuss the synchronisation of the two ensembles in the time dependent steady states. We show the onset of chaos via quasi-periodicity. We show that in a small parameter regime even the chaos gets synchronised in some hyper-planes of the state space. The rich time dependent steady-state behaviour, especially the existence of chaos, opens up possibilities for several engineering applications.

References:

[1] Minghui Xu, D. A. Tieri, E. C. Fine, James K. Thompson and M. J. Holland, Synchronization of Two Ensembles of Atoms, Phys. Rev. Lett. 113, 154101 (2014).
[2] A. Patra, B. L. Altshuler and E. A. Yuzbashyan, Driven-Dissipative Dynamics of Atomic Ensembles in a Resonant Cavity: Nonequilibrium Phase Diagram and Periodically Modulated Superradiance, Phys. Rev. A 99, 033802 (2019).
[3] A. Patra, B. L. Altshuler and E. A. Yuzbashyan, Driven-Dissipative Dynamics of Atomic Ensembles in a Resonant Cavity: Nonequilibrium Phase Diagram and Periodically Modulated Superradiance, Ann. Phys. 417, 168106 (2020).

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