Chaos and thermalization with few-mode Bose-Hubbard systems

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Abstract

Few-mode Bose-Hubbard (BH) systems serve as minimal models for a broad variety of physical phenomena. I will present two recent projects pertaining to the appearance of chaos in such systems and its implications for the emergence of mesoscopic thermodynamics.

In the first project we consider the dynamics of the kicked two-mode BH model, starting with arbitrary spin preparations [1]. For preparations lying in the chaotic regions of phase space we find generic behavior with Floquet participation numbers that scale as the entire N-particle Hilbert space, resulting in the rapid loss of one-particle coherence. The chaotic behavior is not uniform throughout the chaotic sea and we observe 'scars' with unique statistics at the vicinity of hyperbolic points that are embedded in it.

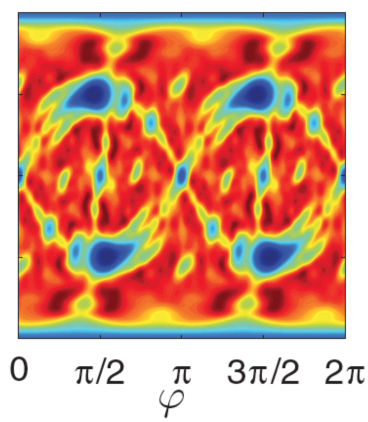

Fig. 1. Scars in a kicked Bose-Hubbard dimer

In the second project we study the relation between chaos and thermalization in a minimal paradigm consisting of two weakly coupled BH trimmers [2]. The emergence of chaotic ergodicity results in diffusive energy spreading in each of the subsystems, insensitive to the details of the drive exerted on it by the other. This supports the hypothesis that thermalization can be described by a Fokker-Planck equation. Interesting deviations from diffusive to Levy-flight behavior are observed around regular-chaotic boundaries of the mixed phase-space. Finally, a grand-canonical Fokker-Planck behavior will be discussed in a closed BH tetramer consisting of a trimer coupled to a monomer.

[1] C. Khripkov, D. Cohen, and A. Vardi, Phys. Rev. E **87**, 012910 (2013)
[2] I. Tikhonenkov, A. Vardi, J. R. Anglin, and D. Cohen, Phys. Rev. Lett. **110**, 050401 (2013).