Thermalization universality classes for weakly nonintegrable many-body dynamics

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We observe different universality classes in the slowing down of thermalization of many-body dynamical systems upon approaching integrable limits. We identify two fundamentally distinct long-range and short-range classes which stem from the type of nonintegrable perturbations - weak two-body interactions (nonlinearities) versus weak lattice coupling (hopping) [1,2,3]. We study the scaling properties of the full Lyapunov spectrum [4,5]. The long-range class results in a single parameter scaling of the Lyapunov spectrum, with the inverse largest Lyapunov exponent being the only diverging time control parameter and the rescaled spectrum approaching an analytical function [4]. The short-range class results in a dramatic slowing down of thermalization and a rescaled Lyapunov spectrum approaching a non-analytic function. An additional diverging length scale controls the exponential suppression of all Lyapunov exponents relative to the largest one [4].

References

[1] M. Thudiyangal, C. Danieli, Y. Kati, S. Flach, Dynamical Glass Phase and Ergodization Times in Classical Josephson Junction Chains, Phys. Rev. Lett. 122 054102 (2019).
[2] Carlo Danieli, Thudiyangal Mithun, Yagmur Kati, David K. Campbell and Sergej Flach, Dynamical glass in weakly non-integrable Klein-Gordon chains, Phys. Rev. E 100 032217 (2019).
[3] T. Mithun, C. Danieli, M. V. Fistul, B. L. Altshuler and S. Flach, Fragile Many Body Ergodicity From Action Diffusion, Phys. Rev. E 104, 014218 (2021).
[4] M. Malishava, S. Flach, Lyapunov spectrum scaling for classical many-body dynamics close to integrability, Phys. Rev. Lett. 128, 134102 (2022).
[5] M. Malishava, S. Flach, Thermalization dynamics of macroscopic weakly nonintegrable maps, Chaos 32, 063113 (2022).