Lyapunov spectrum scaling near integrability

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Thermalization of closed many body systems is at the heart of fundamental quantum concepts like many body localization, eigenstate thermalization hypothesis, and quantum computers since several decades. More recently it also entered the world of classical many body systems through light propagation in nonlinear photonic multimode waveguides and waveguide networks, relating to such observations as e.g. spatial beam self cleaning.

I will introduce concepts of quantifying thermalization, which are tied up to measuring time scales (aka length scales in photonic wave guide applications). The paradoxical upshot is that easy to measure scales are footing on the concept of ergodicity and may quickly lead to ambiguous non- universal assessments. On the other side stands the universal and unambiguous concept of Lyapunov time scales, which are however much harder to be measured.

I will present results which show that Lyapunov spectra scale in distinct different ways for different classes of systems, depending on the type of weak coupling network between modes of a decoupled limit (e.g. low intensity light, or weak coupling in wave guide arrays). These results establish the existence of different thermalization universality classes in many body physics. They further allow to numerically determine the type of thermalization class for a variety of systems such as the FPUT chain, the Toda chain, and the BCS model, and quantum many body systems.