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Exact Random Matrix Spectral Form Factor in Locally Interacting Spin Chains

One of the key goals of quantum chaos is to establish a clean relationship between the observed universal spectral fluctuations of simple quantum systems and random matrix theory. For single particle systems with fully chaotic classical counterparts, the problem is essentially solved within the so-called diagonal approximation of semiclassical periodic-orbit sums.

In recent years, the questions of long-time dynamics at high energies, for which the full many-body energy spectrum becomes relevant, are coming at the forefront also for simple many-body quantum systems, such as locally interacting spin chains. Such systems seem to display two universal types of of behavior which are nowadays usually termed as “many-body localized phase” and “ergodic phase”. In the ergodic phase, the spectral fluctuations are typically excellently described by random matrix theory, despite simplicity of interactions and lack of external source of disorder.

In my talk I will present an exact result on random matrix spectral form factor for a class of non-integrable locally interacting spin chains, a prominent example of which is the Ising chain in a tilted (transverse + longitudinal) periodically kicking magnetic field. I will show how computation of the spectral form factor reduces to an evaluation of a partition function of a complex-weight two-dimensional classical Ising model in an external field.

The computation of the latter, in the so-called self-dual regime, can be reduced to a simple algebraic problem which can be rigorously solved, yielding precisely the random matrix spectral fluctuations in the thermodynamic limit.

Reference: B. Bertini, P. Kos, T. Prosen, Phys. Rev. Lett. 121, 264101 (2018)