Scrambling the spectral form factor

J.Molina-Vilaplana[1], A. del Campo[2], J. Sonner[3]

(1) Universidad Politécnica de Cartagena. C/Dr Fleming S/N. 3 0202. Cartagena. Spain
(2) Department of Physics, University of Massachusetts, Boston, MA 02125, USA
(3) Department of Theoretical Physics, University of Geneva, 24 quai Ernest-Ansermet, 1211 Genève 4, Switzerland.
(javi.molina@upct.es)

Quantum speed limits set an upper bound to the rate at which a quantum system can evolve and as such can be used to analyze the scrambling of information. To this end, we consider the survival probability of a thermofield double state under unitary time-evolution which is related to the analytic continuation of the partition function. We provide an exponential lower bound to the survival probability with a rate governed by the inverse of the energy fluctuations of the initial state. Further, we elucidate universal features of the non-exponential behavior at short and long times of evolution that follow from the analytic properties of the survival probability and its Fourier transform, both for systems with a continuous and a discrete energy spectrum. We find the spectral form factor in a number of illustrative models, notably we obtain the exact answer in the Gaussian unitary ensemble for any N with excellent agreement with recent numerical studies. We also discuss the relationship of our findings to models of black hole information loss, such as the Sachdev-Ye-Kitaev model dual to AdS_2 as well as higher-dimensional versions of AdS/CFT.

[1] A. del Campo, J. Molina-Vilaplana, J. Sonner, arXiv:1702.04350 [hep-th]