Experimental detection of the correlation Renyi entropy in the central spin model

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A major open question in studies of nonequilibrium quantum dynamics is how long it takes for an isolated many-body quantum system to reach equilibrium. We show that there is not a single answer for this question. The equilibration time depends not only on the model and the initial state, but also on the quantity and the dynamical features considered. We discuss a recent NMR experiment, where we measured a new entropy – the correlation Rényi entropy – and showed that it keeps growing even after the evolution of the entanglement entropy has already saturated [1]. We also discuss the case of chaotic models, where the equilibration time can scale either exponentially or polynomially with system size depending on whether dynamical manifestations of spectral correlations in the form of the correlation hole ("ramp") are taken into account or not [2].

[1] M. Niknam et al., Phys. Rev. Lett. 127, 080401 (2021).

[2] T. Lezama et al, Phys. Rev. B 104, 085117 (2021).