Detecting many-body mobility edge via quantum quench

Piero Naldesi[1,2,3], Elisa Ercolessi[1,3] & Tommaso Roscilde[2,4]

[1] *Dipartimento di Fisica e Astronomia dell'Università di Bologna, Via Irnerio 46, 40127 Bologna, Italy*

[2] *Laboratoire de Physique, CNRS UMR 5672, Ecole Normale Supérieure de Lyon, Université de Lyon, 46 Allée d'Italie, Lyon, F-69364, France*

[3] *INFN, Sezione di Bologna, Via Irnerio 46, 40127 Bologna, Italy*

[4] *Institut Universitaire de France, 103 boulevard Saint-Michel, 75005 Paris, France*

We study the many-body localization transition induced by a quasiperiodic chemical potential in a system of interacting spinless fermions in a chain. Crossing this dynamical transition, i.e. moving from the delocalized to the localized regime, the entanglement entropy scaling changes from a volume law to an area law and the distribution of level spacing in the spectrum varies from a statistics according to the Gaussian orthogonal ensemble to a Poissonian distribution. We provide numerical evidence for a many-body mobility edge in the spectrum of this fermionic system using the level statistics and the entanglement entropy as diagnostic quantities. We propose a method, and we provide numerical results of its validity, for detecting the mobility edge by studying the time evolution of the entanglement entropy after performing a global quench in the system. We show that increasing the amplitude of the quench it is possible to populate states at increasing energy, above and below the many-body mobility edge, i.e. in the delocalized and localized phases. The dynamical transition between the two regimes is highlighted by the change between area and volume law in the scaling of the long time value of the entanglement entropy when increasing the amplitude of the quench.