ENTANGLEMENT CRITICAL LENGTH AT THE MANY-BODY LOCALIZATION TRANSITION

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We study the details of the distribution of the entanglement spectrum (eigenvalues of the reduced density matrix) of a disordered spin chain exhibiting a many-body localization (MBL) transition. In the thermalizing region we identify the evolution under increasing system size of the eigenvalue distribution function, whose thermodynamic limit is close to (but possibly different from) the Marchenko-Pastur distribution. The aim of this talk is to show that deviations from Marchenko-Pastur of the probability distribution of the entanglement spectrum in the ergodic phase provide an important characterization of the ergodic phase of such a disordered system. Moreover, such deviations from Marchenko-Pastur can be used to define a correlation length $L_s(h)$, which determines the minimum system size to enter the asymptotic region and diverges at the MBL transition, and to predict the location and finite-size scaling exponents of the MBL transition. Finally, we discuss the nature of the subleading corrections to the entanglement spectrum distribution and to the entanglement entropy. We show that the entanglement spectrum therefore appears to be a crucial quantity, being able to identify even the most subtle correlations that are present in the ergodic phase of a disordered quantum system.

[1] Francesca Pietracaprina, Giorgio Parisi, Angelo Mariano, Saverio Pascazio, Antonello Scardicchio, *Entanglement critical length at the many-body localization transition*, **arXiv:1610.09316** (2016).