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Difference between ergodicity, level statistics and localization transitions for the Anderson model on the Bethe lattice

I will present some results on an ongoing work on the ergodicity properties of the Anderson model defined on the Bethe lattice. Our study is motivated by the conjectured existence of a phase for intermediary disorder strength values whose ergodicity properties are distinct from the fully ergodic extended phase, as well as from the completely ergodicity broken localized one. Apart from the intrinsic interest in studying these different ergodicity regimes, the relevance of this investigation also bares on the relation of the aforementioned model to the many-body localization problem, through a mapping of the decay of quasi-particle states of the interacting system in Fock space representation onto an appropriate Anderson (single-particle) localisation problem on a tree. For an ensemble of system's realizations, we have studied eigenvalues and eigenstates statistics through exact diagonalization. In particular we analysed the neighboring gaps ratio statistics, the statistics of inverse participation ratios, including multifractality analysis. We find evidence of the presence of an intermediary delocalized non-ergodic phase and of the fact that ergodicity-level statistics and Anderson localization transitions are distinct. These results are also confirmed by the analysis of the "exact" solution of the recurrence equations for the probability distributions of local Green functions, which shows anomalous power-law decays in the intermediate phase.