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Dynamics and description after relaxation of disordered quantum systems after a sudden quench

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After a sudden quench, the dynamics and thermalization of isolated quantum systems are topics that have generated increasing attention in recent years. This is in part motivated be the desire of gaining a deeper understanding of how statistical behavior emerges out of the unitary evolution in isolated quantum systems and in part by novel experiments with ultracold gases. Several studies have found that while unitary dynamics in generic systems lead to thermal behavior of observables after relaxation, the same is not true for integrable systems. The latter need to be described using generalized ensembles, which take into account the existence of relevant sets of conserved quantities. In this talk, we discuss how delocalization-to-localization transitions in integrable and non-integrable disordered quantum systems change the picture above. We find that the relaxation dynamics, whenever relaxation takes place, is close to power law in those systems. In addition, statistical mechanics descriptions break down in the localized regimes. We discuss how this relates to the failure of eigenstate thermalization in the presence of localization.