Abstract

Title: Charge Transport in Many Body Localizing Systems with Quasi-periodic Potentials

In 1958 Anderson argued that in a system of non-interacting particles, sufficiently strong disorder can localize all energy eigenstates. In dimensions $d \leq 2$ any arbitrary amount of disorder can induce localization of all single particle eigenstates. A generalization of this phenomenon in presence of interactions, which is known as many body localization(MBL), has been shown to exist in one dimension and has attracted a lot of interest recently. These isolated MBL systems fail to thermalize on their own and due to lack of diffusion can retain their memory of initial conditions for arbitrarily long times. Typically, for sufficiently weak disorder and strong interactions the eigenstates remain ergodic whereas with increasing disorder strength this ergodicity breaks down and the system undergoes thermal-MBL transition.

In ergodic systems the energy eigenstates are generally extended while in the MBL side the eigenstates are localized. However there have been some recent studies on models with quasi-periodic potentials that have single particle mobility edges which show the presence of an intermediate non-ergodic extended phase. In this work we explore this non-ergodic extended phase using some known diagnostics of thermal-MBL transition. We have also calculated low frequency optical conductivity and dc conductivity to show that in presence of non-ergodic extended phase the system behaves neither like thermal phase(diffusive) nor like MBL phase(no dc transport). Instead it indicates a sub-diffusive behavior where the dc conducitvity goes to zero in the thermodynamic limit following a power law instead of the expected exponential decrease in MBL phase.