Entanglement Transition Through Hilbert-Space Localization

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Repeated measurements enable us to probe systematically the dynamic properties of many-body systems. Although these measurements can only be performed in practice for a finite number of times, this is sufficient to collect relevant information on the system's behavior. Some properties are universal and do not dependent on the specific details of the quantum system. We will discuss two measurement protocols. One is based on probing the same dynamics with measurements on different but identical systems at different times, the other is based on the monitored evolution with repeated measurements in a single experiment. We compare both protocols and discuss effective theories to describe their results for the return to the initial state and for the transition to other states. In particular, the mean time for a first detection of the return is analyzed for the monitored evolution. It turns out that it is related to the geometric phase of the wave function, which is quantized and proportional to the dimensionality of the accessible Hilbert space. Another aspect of our study is that the dimensionality of the accessible Hilbert space changes when spectral degeneracies occur, for instance, near phase transitions or under a change of time steps between measurements. This is accompanied by strong fluctuations of the first detected return or transition time. Finally, the difference between periodically and and randomly repeated measurements on these effects will be discussed.

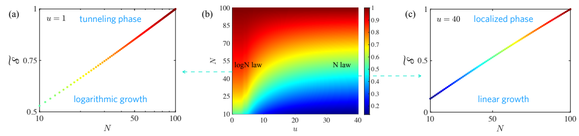

Figure 1: Entanglement entropy of N bosons with coupling parameter u