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Title: Quantum adiabaticity in many-body systems.

Abstract:

We discuss various notions of adiabaticity in quantum many-body systems and report several results on this topic. A genuine quantum adiabaticity understood as the proximity of the dynamical many-body wave function to an eigenstate of the Hamiltonian normally requires that the ramp rate of the Hamiltonian vanishes in the thermodynamic limit. We quantitatively substantiate this well-known statement by proving a rigorous relation between the adiabaticity breakdown and the orthogonality catastrophe [1]. This general result is followed by an analysis of a number of specific systems [1-4]. It appears that in many cases the genuine quantum adiabaticity is sufficient but not necessary for various "adiabatic" phenomena. Instead, a thermodynamic adiabaticity suffice. The latter corresponds to the ramp rates which are small as compared to intensive characteristics of the system (e.g. Fermi energy, band width, etc.) but large compared to level spacing (and finite in the thermodynamic limit). On the other hand, in some cases genuine adiabatic regime is drastically different in its physical outcomes from the thermodynamically adiabatic regime, as we show by several examples [1,2,5]. Intriguingly enough, both situations can occur in the same system in different sectors of the parameter space or for different initial conditions [5].

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