CO.CO.MAT

SFB/TRR 21 - Seminar

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Shortcuts to optimal control: The LMG model

Coherently controlling quantum systems has long stood as a difficult task, an issue that is compounded when we move beyond small sizes and truly wish to manipulate interacting many-body quantum systems. By virtue of the adiabatic theorem, we are able to ensure a quantum system remains in an eigenstate (e.g., its ground state) during any given evolution. However, the obvious limitation of this technique is it operates on a long-time scale and thus requires equally long control times, rendering it extremely difficult experimentally. Motivated by the need for practical means to manipulate any given quantum system, current efforts have developed along two paths: optimal control and shortcuts to adiabaticity. In particular, the latter can be achieved by means of transitionless quantum driving (TQD) which involves adding a correction term to the original Hamiltonian to ensure there are no transitions between the eigenstates, and will be our focus. We examine the requirements when TQD is applied to the many-body interacting Lipkin-Meshkov-Glick model. By means of both numerical and analytical approaches we assess the requirements for full TQD, as well as examining the performance of 'non-optimal' shortcuts, i.e., simplified correction terms that do not achieve perfect TQD but that do not require complete knowledge of the spectrum and/or may be experimentally easier to implement. With the help of optimal control type techniques we find this approach can be remarkably effective.

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