Understanding non-adiabatic effects in bosonic models

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Abstract

Adiabaticity can be used to improve accuracy and precision of many quantum control procedures such as quantum annealing, adiabatic quantum computing and ground state preparation (1). However, processes need to be implemented very slowly to achieve the adiabatic limit, lengthening control sequences and increasing the susceptibility of the system to decoherence. One approach to overcoming this problem is to apply counterdiabatic driving, which can be defined via a quantity known as the Adiabatic Gauge Potential (AGP) (2). The AGP characterises the adiabaticity of a system, and has been used to study properties of systems, such as measuring quantum chaos (3). Within the literature the focus has so far been on spin half models, due to the difficulty of computing the AGP. Using our new approach we developed earlier this year (4), we approach the problem of computing the AGP in bosonic models. We find there to be two main issues that arise unique to bosonic models, which we show via the example of the quantum harmonic oscillator. We then use this understanding to compute the AGP for the Rabi model, and explore the scaling around the phase transition present in the large spin splitting limit.

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