ESI Erwin Schrödinger International Institute for Mathematics and Physics

universität wien

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Seminar

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Error suppression in adiabatic quantum computing with qubit ensembles

Thursday, October 17, 2019

at 14:00 h

ESI, Boltzmann Lecture Hall

Abstract: In the standard approach to adiabatic quantum computing (AQC), quantum information stored on qubits are adiabatically evolved to find the ground state of a problem Hamiltonian. I would like to talk about a variation of AQC where qubit ensembles are used in place of qubits. The use of ensembles duplicates the quantum information, and allows errors to be suppressed during the adiabatic evolution. Two distinct regimes for a given problem Hamiltonian under this mapping as a function of the ensemble size N can be identified. At a critical ensemble size Nc, the nature of the first excited state changes from being macroscopically distinct spin configuration to a single particle perturbation of the ground state. Above Nc the minimum gap for large ensembles is well predicted by mean-field theory and the AQC performance improves with N, realizing error-suppression due to duplication of the quantum information. While below Nc the performance is mixed, and can increase with N. For randomly chosen problem instances Nc tends to be smaller than realistic ensemble sizes, hence we expect the ensemble version of AQC to work well in a great majority of cases. This approach shows it is possible to perform AQC without the necessity of controlling individual qubits, allowing an alternative route towards implementing AQC.

R. Zeier

October 11, 2019