SFB/TRR 21 - Seminar

7. Oktober 2013, Ulm

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Adiabatic evolution of the XY model in a transverse magnetic field

The purpose of this work is to study the time evolution of the XY model in a transverse magnetic field, when the Hamiltonian parameters vary slow over time, from both a theoretical and numerical point of view. In particular, taking a cue from the work of Lieb, Schultz and Mattis, the Hamiltonian is diagonalized, the spectrum of excitations is derived and the quantum phase transitions of the model are studied. In particular we study what happens to the anisotropic transverse XY spin-1/2 chain when it is driven across various quantum critical lines at a steady and finite rate. The time dependence is introduced in the model by varying adiabatically both the magnetic feld and the anisotropy parameter. We describe the mathematical process that allows us to obtain numerically the evolution operator and an interesting physical quantities: the Locshmidt echo, which can be taken as an indicator of how far we are from the adiabatic regime. After a summer of the numerical tecniques used, Mathematica code and the time-dependent DMRG, novel results are presented. In particular, the DMRG data are compared with those obtained numerically with the Mathematica code and the main differences are discussed. To complete the analysis, we discuss the error introduced by the DMRG and Runge-Kutta algorithms analyzing the trend in time of the Locshmidt echo.

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