SFB/TRR 21 - Seminar

5. Juli 2012, Ulm

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Adiabatic preparation of a Heisenberg antiferromagnet using an optical superlattice

We present an adiabatic protocol for the realization of a Heisenberg antiferromagnet (AFM) with ultracold fermions in an optical lattice [1]. The preparation of magnetic order in such a system is a highly desirable goal, as an intermediate step towards a true quantum simulator of the fermionic Hubbard model. However, realizing the AFM currently represents a big challenge for optical lattice experiments, since a very low entropy per particle is required.

We propose to create this state adiabatically, starting from a low entropic band insulator and slowly changing the lattice depth. By numerically simulating the dynamics with Matrix Product States (MPS) in 1D and Projected Entangled Pair States (PEPS) in 2D we demonstrate the feasibility of our protocol even in the presence of experimental imperfections. We observe a highly destructive effect of holes and devise a strategy to control them via the harmonic trap. Additionally, we show that it is possible to realize magnetic order on a part of the sample in a shorter time than required for the whole system.

[1] M. Lubasch et al., Phys. Rev. Lett. 107, 165301 (2011).

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