

CQD Kolloquium – Poster Session

Transport in a Many-Body Wannier-Stark Setup

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Ultra-cold atoms in optical lattices

Ultra-cold atoms in optical lattices are systems showing rich and complex behaviour

- Bose-Einstein condensates are easily created and loaded into optical lattices
- physical parameters can be controlled almost at will and many different Hamiltonians realized
- quantum effects can be studied in detail



We focus on ultra-cold bosons in deep optical lattices, which allow to realize the Wannier-Stark Hamiltonian for interacting particles

(Phys. Rev. Lett. 107, 045701 (2012))

Methods of investigation

We use different theoretical methods to investigate steady state transport, transport problems and the influence of different parameters on the number of interactions. These methods are:

- algebraic renormalization
- Floquet-Lanczos algorithm
- full diagonalization and matrix renormalization
- variational approaches
- time-dependent perturbation theory
- dual effective models
- compare results with existing results (see [1])

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On the band coupling: avoided crossings

• Single particle's Wannier-Stark spectrum

- the tilt F is the control parameter
- single particle avoided crossing at this $F_c = \frac{1}{2} \sqrt{2t^2 - \epsilon^2}$
- typical exchange of character of F_c (interacting case: $\sqrt{2t^2 - \epsilon^2}$ hidden)

Manifold



On the dynamics: EF's diffusion!

Through E_c ...

- many-body avoided crossing is visible at deep Lattices (see above)
- negative diffusion, $D(E) = -D_0 \ln |E - E_c|$



The total conductance $G(E)$ is the diffusion coefficient $D(E)$ (see above)

(see [1])

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