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Relaxation Dynamics and Transport in the One-Dimensional Fermi-Hubbard Model

The Hubbard model harbors the key ingredients to obtain Mott-insulating behavior and antiferromagnetism and is thus a paradigmatic model for the description of strongly correlated electron systems. Besides its relevance for condensed matter systems, several experiments with ultra-cold quantum gases have realized this system using optical lattices. A major interest is in the non-equilibrium dynamics of strongly interacting closed many-body systems, aiming at an understanding of thermalization and relaxation dynamics. I will describe the relaxation dynamics in this model in the quantum quench starting from a perfect Neel state. Since a spontaneous breaking of a continuous symmetry is prohibited in one dimension, the order parameter decays to zero. Our numerical analysis unveils the characteristic time scales for the dynamics of spin- and charge-excitations and their fingerprints in the time evolution of observables. In a second part, I will turn to the discussion of transport properties. Integrable one-dimensional quantum systems are known to be prone to possess anomalous conductivities.

We compute the thermal conductivity, show that it diverges, and discuss implications for experiments with real materials and ultracold atoms in optical lattices.