Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter

Monday, August 17th 2015 - 11:00 am
Seminar room IV, 01.111, CFEL, Bldg. 99

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Heating Dynamics and Thermalization of Interacting Luttinger Liquids

Recent studies of heating and thermalization of interacting one-dimensional (1D) bosons in cold atom setups have triggered the general interest in non-equilibrium dynamics of bosons in low dimensions. In the framework of a Keldysh path integral, we analyse in the first part of the talk a single wire of interacting bosons driven constantly out of equilibrium by permanent heating. We determine the universal scaling behavior of the phonon life-time, which differs from thermal equilibrium. This modifies the scaling of relevant experimental signatures, such as the dynamical structure factor or the density of states compared to a thermal state. In order to trace the thermalization dynamics and estimate the relevant time-scales, we compute the non-equilibrium phonon distribution function in the presence of heating and phonon scattering. This allows us for a separation of the universal non-equilibrium long-wavelength behavior from the short distance dynamics. The latter is dominated by thermal fluctuations, described by an effective time-dependent temperature. In the second part, we focus on a series of experiments on the dynamics of two uncoupled one-dimensional (1D) Bose gases with initially identical longitudinal phase profiles. The local spreading of information and thereby the reduction of the initial relative phase coherence is verified by matter-wave interference. For this setting, we analyse the interplay of phonon scattering and dephasing and their effect on experimentally relevant observables, such as the mentioned phase coherence. Three regimes occur in the relative phase coherence function (RPC), with a new algebraic-exponential decay for small relative distances. On intermediate ranges the light-cone propagation has overtaken the interaction and generates a purely algebraic regime.

Host: Martin Eckstein

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