DAMOP13-2013-000159

Abstract for an Invited Paper
for the DAMOP13 Meeting of
the American Physical Society

Expansion dynamics of interacting bosons and fermions in one dimensional optical lattices

FABIAN HEIDRICH-MEISNER, FAU Erlangen-Nuremberg

This talk will provide an overview over the fascinating phenomena that can be encountered in the sudden expansion of interacting fermions or bosons in a lattice, starting from a trapped gas of particles. We simulate the dynamics using the time-dependent density matrix renormalization group method. In the transient regime, the expansion can dramatically alter correlations. I will discuss the dynamical emergence of coherence [1] and the quantum distillation mechanism [2]. The latter results in a spatial separation of repulsively or attractively bound pairs from unbound particles, which can be used to dynamically purify a band insulator [2]. Another topical example is the expansion of a spin-imbalanced gas, starting from the Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) state [3], relevant in the context of a recent experiment on 1D FFLO states [4]. In this case, the transient dynamics completely destroy the FFLO correlations. Nevertheless, experimentally accessible quantities may still preserve information on the initial state. First, the expansion velocity is sensitive to the presence of a Mott-insulator in the initial state [4]. Second, we argue that the asymptotic momentum distributions of integrable models are constrained by non-trivial integrals of motion [3].

[1] Heidrich-Meisner et al., Phys. Rev. A 78, 013620 (2008)
[2] Heidrich-Meisner et al., Phys. Rev. A 80, 041603(R) (2009)
[3] Bolech et al., Phys. Rev. Lett. 109, 110602 (2012)
[4] Liao et al. Nature 467, 567 (2010)
[5] Langer et al., Phys. Rev. A 85, 043618 (2012)