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Ballistic expansion of interacting fermions in one-dimensional optical lattices FABIAN HEIDRICH-MEISNER, STEPHAN LANGER, LMU Munich, MARTIN J.A. SCHUETZ, MPQ Garching and LMU Munich, IAN MCCULLOCH, U Queensland, Brisbane, Australia, ULRICH SCHOLLWOECK, LMU Munich — In most quantum quenches, no net particle currents arise. Access to studying transport properties can be gained by letting a two-component Fermi gas that is originally confined by the presence of a trapping potential expand into an empty optical lattice. In recent experiments, this situation was addressed in 2D and 3D optical lattices [1]. We focus on the 1D case in which an exact numerical simulation of the time-evolution is possible by means of the DMRG method. Concretely, we study the expansion in the 1D Hubbard model with repulsive interactions, driven by quenching the trapping potential to zero, and we concentrate on the most direct experimental observable, namely density profiles [2]. In the strict 1D case, we identify conditions for which the expansion is ballistic, characterized by an increase of the cloud's radius that is linear in time. This behavior is found whenever initial densities are smaller or equal to one, both for the expansion from box and harmonic traps. We make quantitative predictions for the expansion velocity as a function of onsite repulsion and initial density that can be probed in experiments.

[1] Schneider et al., arXiv:1005.3545
[2] Langer et al., arXiv:1109.4364

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