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Expansion dynamics of interacting bosons in homogeneous lattices STEPHAN LANGER, University of Pittsburgh, LMU Munich, JENS P. RONZHEIMER, MICHAEL SCHREIBER, SIMON BRAUN, SEAN HODGMAN, LMU and MPQ Munich, IAN P. MCCULLOCH, University of Queensland, FABIAN HEIDRICH-MEISNER, FAU Erlangen and LMU Munich, IMMANUEL BLOCH, ULRICH SCHNEIDER, LMU and MPQ Munich — Due to independent real-time control of Hamiltonian parameters in optical lattices, the non-equilibrium transport properties of interacting bosons and fermions can be studied in experiments with ultra-cold atomic gases (see [1] for a sudden expansion experiment with fermions). In this work, we experimentally and numerically investigate the expansion of initially localized bosons in homogeneous one- and two-dimensional optical lattices. Dimensionality has a crucial influence, since one-dimensional systems expand ballistically both in the non-interacting and the strongly interacting limit, separated by a pronounced minimum in the expansion velocity at intermediate interaction strengths. For two-dimensional and sufficiently strongly coupled one-dimensional systems, even weak interactions lead to a dramatic suppression of the expansion, indicative of diffusive dynamics. In the case of one dimension, we find an excellent agreement between the experimental results and time-dependent density-matrix renormalization group simulations. [1] Schneider et al. Nature Phys. 8, 213 (2012)

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