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Symmetry-broken momentum distributions induced by matter-wave diffraction during time-of-flight expansion of ultracold atoms JULIETTE SIMONET, MALTE WEINBERG, OLE JUERGENSEN, CHRISTOPH OELSCHLAEGER, DIRK-SOEREN LUEHMANN, KLAUS SENGSTOCK, Institut fuer Laserphysik, Universitaet Hamburg — The information about quantum gas systems is still commonly inferred from time-of-flight measurements. Here, we demonstrate that interaction during the time-of-flight expansion can strongly alter the measurement of the initial atomic momentum distribution. We discuss the observation of symmetry-broken momentum distributions for bosonic mixtures in state-dependent honeycomb lattices due to scattering processes within the first milliseconds of the expansion time. These findings are of fundamental importance in a broad range of systems, including state-dependent lattices and superlattices, where the lattice symmetry does not cancel the influence of the scattering processes on the interference pattern. Beyond that, the interactions during a free expansion can be used as an interferometric probe to reveal novel quantum phases, such as supersolids.

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