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Dynamics of correlations in long-range quantum systems follwing a quantum quench[1] LORENZO CEVOLANI, Institut fur theoretische Physik, Goerg-August-Universitat, Gttingen, GIUSEPPE CARLEO, Theoretical Physics and Station Q Zurich, ETH Zurich, Switzerland, LAURENT SANCHEZ-PALENCIA, Laboratoire Charles Fabry, Institut dOptique, CNRS, Univ. Paris Sud 11,France — We study how and how fast correlations can spread in a quantum system abruptly driven out of equilibrium by a quantum quench. This protocol can be experimentally realized and it allow to address fundamental questions concerning the quasi-locality principle in isolated quantum systems with both short- and long-range interactions. We focus on two different models describing, respectively, lattice bosons, and spins. Our study is based on a combined approach, based on one hand on accurate many-body numerical calculations and on the other hand on a quasi-particle microscopic theory. We find that, for sufficiently fast decaying interaction potential the propagation is ballistic and the Lieb-Robinson bounds for long-range interactions are never attained. When the interactions are really long-range, the scenario is completely different in the two cases. In the bosonic system the locality is preserved and a ballistic propagation is still present while in the spin system an instantaneous propagation of correlations completely destroys locality. Using the microscopic point of view we can quantitatively describe all the different regimes, from instantaneous to ballistic, found in the spin model and we explain how locality is protected in the bosonic model leading to a ballistic propagation.

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