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Emergent “super-solitons” following an interaction strength quantum quench across a Luttinger liquid-Mott insulating phase boundary MATTHEW FOSTER, EMIL YUZBASHYAN, Rutgers, the State University of New Jersey — Rapid progress in cold atom experiments has motivated the study of non-equilibrium many-body dynamics following a sudden deformation of the system Hamiltonian (a “quantum quench”). Here, we consider the dynamics of localized excitations produced via a quench across a quantum phase boundary separating critical Luttinger liquid and gapped Mott insulating states. Our initial liquid ground state is labeled by a Luttinger interaction parameter K , and subject to a density-inhomogeneity forming external potential. For the Mott insulator, we employ the quantum Sine Gordon model at the Luther-Emery (LE) point. We find that over a wide range of initial K values, the quench induces the production of relativistic, non-dispersive traveling density waves, which we dub “super-solitons.” The super-solitons are generated from generic antecedent localized density lumps, and appear to be a robust feature of the post-quench dynamics. An isolated exception occurs for the case of $K = K_{LE}$; here, the density dynamics are generically dispersive, and depend sensitively upon the shape of the initial inhomogeneity. We show that the super-solitons do not interact, and we demonstrate that an inhomogeneous Luttinger parameter K can be used to produce super-solitons with different characteristics in the same system.

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