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Generation of Quantum Dark Solitons via a Localized Driven Impurity[1] SIMEON MISTAKIDIS, GARYFALLIA KATSIMIGA, GEORGIOS KOUTENTAKIS, Univ Hamburg, PANAYOTIS KEVREKIDIS, University of Massachusetts, PETER SCHMELCHER, Univ Hamburg, GROUP OF FUNDAMENTAL PROCESSES IN QUANTUM PHYSICS COLLABORATION — The many-body nonequilibrium dynamics of a Bose Einstein Condensate upon a single and/or a periodic passing of a localized material impurity is investigated. The resulting defect formation consisting of gray solitons, occurring only for moderate impurity velocities, is examined comparing the mean-field to a correlated approach. In the former case gray solitons are formed and are found to interact remaining robust throughout the evolution. In contrast within the many-body scenario quantum dark solitons are formed which decay into daughter solitary waves soon after their generation. A multitude of excitations including dark-antidark states and domain-wall complexes building upon the distinct concurrently populated orbitals is observed. Signatures of these higher-lying orbital excitations emerge in the total density, and can be clearly captured by inspecting the one and two body coherences. Utilizing single-shot simulations we demonstrate that the correlated character of the dynamics can be experimentally inferred from both the in-situ single-shot images as well as the corresponding variance. Finally, the dependence of the defect characteristics on the interatomic interaction and the particle number is discussed.

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