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Dynamics of Bose-Einstein condensates and wave chaos IVA BREZINOVA, Vienna University of Technology, LEE A. COLLINS, Los Alamos National Laboratory, BARRY I. SCHNEIDER, National Science Foundation, AXEL U.J. LODE, ALEXEJ I. STRELTSOV, Heidelberg University, OFIR E. ALON, University of Haifa at Oranim, LORENZ S. CEDERBAUM, Heidelberg University, JOACHIM BURGDORFER, Vienna University of Technology — We study theoretically the expansion of BECs in a one-dimensional trap in the presence of external periodic, aperiodic, and disordered potentials. Disordered potentials are of special interest in the connection of Anderson localization. We investigate the dynamics of BECs within both the Gross-Pitaevskii equation (GPE) as well as the multiconfigurational time-dependent Hartree for bosons (MCDTHB) method. The GPE is strictly valid only for the condensate. We find that for certain potentials the solutions of the GPE exhibit wave chaos as measured by the exponential divergence of nearby wave functions in Hilbert space. We provide numerical evidence for the connection between wave chaos within the GPE and depletion of the condensate. We show that the ability of the GPE to predict the density on length scales of the potential variations is limited by the appearance of wave chaos. Surprisingly, despite a strong depletion of the condensate, coarse-grained observables averaged over larger scales, e.g. the width of the atom cloud, are well reproduced within the GPE. Accordingly, experimental results for these observables may agree with the predictions of the GPE although the system is strongly excited. The depletion can be detected experimentally through decay of coherence.

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