Abstract Submitted
for the DAMOP13 Meeting of
The American Physical Society

Collective Modes of One-Dimensional Bose Gases: From Few to Many Particles LUSHUAI CAO, Center for Optical Quantum Technologies, Hamburg University & The Hamburg Centre for Ultrafast Imaging, RÜDIGER SCHMITZ[1], Center for Optical Quantum Technologies, Hamburg University, SVEN KRÖNKE, PETER SCHMELCHER, Center for Optical Quantum Technologies, Hamburg University & The Hamburg Centre for Ultrafast Imaging, CENTER FOR OPTICAL QUANTUM TECHNOLOGIES HAMBURG UNIVERSITY TEAM — We study the breathing oscillations of Bose gases in a one-dimensional harmonic trap via numerically exact simulations, and we focus on the crossover from few- to many-body systems. We firstly study the breathing properties of few-particle system (2-6 bosons) with varying the contact interaction strength, and reveal the transition from two-mode beating to single-mode breathing as well as breathing frequency shifting as the interaction strength increasing from zero to approaching infinity. We also present an extensive study of the breathing properties of systems covering a wide particle-number regime from few-body (∼10 bosons) to many-body systems (∼150 bosons). Even in the low interaction regime the numerically exact simulations show deviations with respect to the results obtained by mean-field approximations, which indicates the arising of beyond-mean-field effects in the low interaction regime. The numerically exact simulations are done by the Multi-layer Multi-Configurational Time-Dependent Hartree method for Bosons (ML-MCTDHB), which is developed particularly for the time propagation study of many-body system containing arbitrary bosonic species in various dimensions.

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Date submitted: 10 Apr 2013 Electronic form version 1.4