Role of quantum fluctuations in the dissipative dynamics of a 1D Bose gas in an optical lattice

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— We will present a theoretical treatment[1] of the surprisingly large damping observed recently in an experiment done at NIST [2] where the transport properties of a harmonically trapped 1D Bose gas in a periodic (optical lattice) potential were studied by observing small amplitude dipole oscillations. In the absence of the lattice these oscillations are expected to be undamped (generalized Kohn’s theorem), however, large damping of the dipole mode was observed in the experiment for very weak optical lattices and very small cloud displacements. We will show that the observed damping can be derived from a model whose main ingredients are (a) a large noncondensate fraction that arises as a direct consequence of the enhanced effective on-site interaction due to the tight transverse confinement, (b) the fact that a non-negligible part of it occupies high-momentum states and is therefore affected by dynamical instabilities, and (c) the interaction of the condensate atoms with the random field created by these noncondensate atoms when their equilibrium state is perturbed. We find good agreement between the model and the experimental results. [1] Julio Gea-Banacloche et al. cond-mat/0410677. [2] C. D. Fertig, K. et al.cond-mat/0410491.

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