Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Control of Decoherence of Many-Body Excitations in a Bose-Einstein Condensate NIR BAR-GILL, EITAN ROWEN, NIR DAVIDSON, Weizmann Institute of Science — In this work we discuss collective, many-body excitations of a BEC, and their decay into the condensate continuum. We measure the excitation spectrum of a BEC loaded into a 1D optical lattice, and the decoherence of these excitations due to Beliaev damping, as a function of the lattice depth. The cause for decoherence is the Beliaev decay of Bogoliubov quasi-particles, both of which (the excitation and decay products) are observable experimentally. The unique structure of the BEC reservoir, which is composed of a continuum of initially unoccupied quasi-particle modes, results from the quantum interference between the hole and particle amplitudes of these modes. This structure can be modified in a well- controlled manner by adiabatically loading the BEC into and optical lattice. Therefore, by changing the depth of the lattice, we can control the decoherence rate of the excitations. Our experimental results are compared to 1D calculations of the Bloch-Bogoliubov theory. We find that the rate of decay is either enhanced or suppressed as a function of lattice depth. These results can be explained in the framework of the general formula for decay, which also accounts for both the quantum zeno and anti-zeno effects. Such control of the coherence time could allow further studies of dynamics and phase fluctuations of this many-body system.

Nir Bar-Gill
Weizmann Institute of Science

Date submitted: 27 Nov 2007 Electronic form version 1.4