Squeezing and entanglement in a Bose-Einstein condensate

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Relative number squeezing, e.g. in the populations of different Fock modes in a condensate is an important property in the context of many-particle entanglement. Squeezing has been suggested by different authors as an interesting observable in degenerate quantum gases [1,2]. We study the limitations to the relative number squeezing between photons and atoms coupled out from a homogeneous Bose-Einstein condensate [3]. We consider the coupling between the translational atomic states by two photon Bragg processes, with one of the photon modes involved in the Bragg process in a coherent state, and the other initially unpopulated. We start with an interacting Bose-condensate at zero temperature and compute the time evolution for the system, including loss due to quasiparticle interactions beyond the Hartree-Fock-Bogoliubov approximation. We study the squeezing, i.e. the variance of the occupation number difference between the second photon and the atomic c.m. mode, and discuss how collisions between the atoms and photon rescattering affect the degree of squeezing which may be reached in experiments. Furthermore we briefly discuss other possibilities to produce squeezed states using condensates [4].