Abstract Submitted
for the DAMOP11 Meeting of
The American Physical Society

Dimensionality and spatial entanglement in Bose-Einstein condensates ALEXANDRE TACLA, CARLTON CAVES, CQuIC, University of New Mexico — We investigate the effects of the emergence of three-dimensional behavior on a quasi-one-dimensional Bose-Einstein condensate (BEC) trapped by a highly elongated potential. By analytically performing the Schmidt decomposition of the condensate wave function in the perturbative regime, we derive corrections to the 1D approximation due to the reshaping of the BEC in the tightly confined direction with increasing nonlinearity strength. This approach provides a straight- forward way to redefine the transverse and longitudinal wave functions as well as to calculate the amount of entanglement that arises between the two spatial directions. Numerical integration of the three-dimensional Gross-Pitaevskii equation for different trapping potentials and experimentally accessible parameters reveals good agreement with our analytical model even for relatively high nonlinearities. In particular, we show that even for such stronger nonlinearities the entanglement remains remarkably small, which allows the condensate to be well described by a separable wave function that corresponds to a single Schmidt term.

Alexandre Tacla
CQuIC, University of New Mexico

Date submitted: 03 Feb 2011