Abstract Submitted
for the DAMOP05 Meeting of
The American Physical Society

The Gross-Pitaevskii Equation for Bose Particles in a Double Well Potential: Two-Mode Models and Beyond[1] DAVID ANANIKIAN, THOMAS BERGEMAN, SUNY Stony Brook — Recent experiments (notably by the Oberthaler group in Heidelberg) have obtained quantitative information on tunneling oscillations and self-trapping of Bose ensembles in a double well potential. To develop a more versatile theoretical model to deal with varying conditions of atom number and potential shape, we have used the lowest symmetric and antisymmetric wavefunctions obtained from the Gross-Pitaevskii equation (GPE) for a double well potential, and solved coupled equations for two modes exactly. This yields effective tunneling parameters that depend on the number and phase of atoms in each well, hence is time-dependent, unlike previous models. We find that this "variable tunneling model" (VTM) yields results that agree more closely with numerical solutions of the time-dependent GPE, even for relatively large atom-atom interactions, for which two-mode models with localized wavefunctions fail. Our 3D solutions with the time-dependent GPE reproduce the above experimental results well, while the 3D two-mode model is not far off. Improved parameters for second quantization are also obtained. We will present extensive comparisons of results from the VTM and other approaches.

[1]Supported by NSF and ONR

Thomas Bergeman
SUNY Stony Brook

Date submitted: 28 Jan 2005 Electronic form version 1.4