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Beyond-mean-field calculation of atomic BEC energies in an anisotropic trap with tunable interaction[1] W. BLAKE LAING, MARTIN DUNN, DEBORAH K. WATSON, University of Oklahoma — We report progress in extending our beyond-mean-field calculations to a larger number of atoms by pushing our perturbation series to next order. In our many-body approach, we use a dimensional perturbation theory treatment of N atoms with hard-sphere interactions. Our treatment of a condensate in a cylindrical trap depends on the high degree of symmetry of the condensate at zeroth order to include every two-body interaction. We are able to use symmetry to obtain analytic results for the ground state energy and excitation frequencies through first order for a few thousand atoms. Motivated by the substantial improvement of the ground state energy in going from zeroth to first order, we expect to obtain second order results valid for a larger number of atoms. We can also use the lowest and higher-order wave functions to obtain the density profile of the condensate. Because the number of atoms and the scattering length are simply parameters in this treatment, this method is well-suited to treat condensates over a wide range of N and interaction strengths, for example in the presence of a Feshbach resonance. This work was supported by ONR and ARO.

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