Exploring the Possibility of Collapse in a Degenerate Fermi Gas[1]
J. VON STECHER, S. T. RITTENHOUSE, C. H. GREENE, Department of Physics and JILA, University of Colorado, Boulder, Colorado 80309-0440, M. J. CAVAGNERO, Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506-0055 — Trapped ultracold atomic gases with tunable attractive interactions can, in principle, collapse to a deep many-body bound state. Mean-field theories have predicted collapse of Bose-Einstein condensates with negative scattering length a [1], which has been confirmed experimentally [2]. Mean field treatments of degenerate Fermi gases have also predicted collapse [3]. In a recent study, we proposed [4] a hyperspherical coordinate treatment of a two-component degenerate Fermi gas in an isotropic oscillator trap, for which the atoms interact through a zero-range pseudopotential. Ref.[4] predicts a ($T = 0$) collapse at $k_f a = $ *-1.21*. Using Monte Carlo methods, we study variationally the collapse for different two body finite range interactions. We introduce Jastrow-type correlations in the many-body wave function, which allows us to test the validity of the mean-field approach and the zero-range interaction. [1] E. V. Shuryak, Phys. Rev. A 54, 3151 (1996). [2] E. A. Donley et al, Nature 412, 295-299 (2001). [3] M. Houbiers et al, Phys. Rev. A 56, 4864 (1997). [4] S. T. Rittenhouse et al, arXiv:cond-mat/0510454.

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