Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

A mean-field model for condensates in the BEC-BCS crossover regime CHENG CHIN, The University of Chicago — We present a new mean-field model to describe Fermionic condensates in the BEC-BCS crossover regime. By introducing an effective mean-field potential, this approach allows us to analytically evaluate the chemical potential, the equation of states, and the pair wave function. The results agree surprisingly well with recent quantum Monte Carlo calculations. Density profiles and the collective mode frequencies of a trapped gas can thus be analytically determined. In particular, the pair wave function can be expressed in terms of Airy function. We show that this wave function naturally approaches molecular wave function in the BEC limit. In the presence of strong interaction, the wave function is compressed to a smaller size, which implies an upshift of the pairing energy. This effect can be understood based on the repulsive interaction between two pairs (Petrov et al.) and has been observed in rf spectroscopy experiment. Although the mean-field approach does not explicitly include anti-symmetric fermionic correlations, it does provide a complementary picture to view the crossover physics. The validity of this approach is based on the fact that a degenerate Fermi gas constitutes the same quantum phase as that of a condensate of pairs. Both descriptions should therefore be similarly effective in the crossover. One advantage of the bosonic approach is that the molecular mean-field term can conveniently capsulate four-fermion interactions. It is, however, more difficult to do so in the BCS-type calculation.

Cheng Chin
The University of Chicago

Date submitted: 30 Nov 2005 Electronic form version 1.4