

MAR08-2007-004508

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Few-body physics of trapped unequal mass fermions¹

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The behavior of a two-component dilute Fermi gas exhibits an interesting dependence on the mass ratio between the two species. Our study tackles this system with 3-20 particles, using two independent techniques. First, an essentially exact diagonalization for 3-6 particles determines both the ground state and also the pattern of excited state energies, and our analysis permits an extraction of the dimer-dimer scattering length and effective range. Secondly, the nature of the system ground state is studied as a function of the mass ratio and the number of particles, up to $N=20$, using fixed-node diffusion Monte Carlo (DMC) techniques. By using two different solution techniques in their overlapping range of applicability from $N=3-6$, we are able to assess the accuracy of the nodal surface employed in the fixed-node DMC calculation. Physical properties such as the excitation gap will be analyzed over this range of particle number, and the intriguing unitarity limit is also considered.

¹In collaboration with J. von Stecher and D. Blume