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Swimming in the Fermi Sea

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Abstract:

The recent experiments at Rice and MIT on polarized Fermi gases have offered the opportunitiy to explore experimentally the rich phase diagram of fermionic superfluids with spin imbalanced populations. One of the most salient feature of these experiments is the confirmation of the Clogston-Chandraseckar prediction concerning the robustness of the BCS superfluid, since it is observed that, in a trap and at unitarity, the cloud form concentric shells surrounding a fully paired superfluid core.

Theoretical arguments have demonstrated that the most prominent properties of the outer normal phase could be related to the study of the behaviour of a minority impurity immersed in a Femi sea. Using Monte-Carlo simulations, B. Svistunov and N. Prokov'ev have demonstrated that, depending on the scattering length, the impurity would behave like a boson (molecule), or a fermion (polaron). We will show that this transition can be recovered by a simple variational argument. In particular, we show that in the deep BEC regime (scattering length small and positive) the impurity pairs with a majority atom to form a bosonic dimer behaving as a point-like boson, with no composite structure.