

Phys 3707, Assignment 4 –Galitskii's Equation

1. [F&W 4.6]

A uniform spin-1/2 Fermi gas interacts only through a p-wave hard core potential of range a so that $\delta_1 \rightarrow -(ka)^3/3$.

(a) Show from Galitskii's equation that the proper self energy is given to order $(k_F a)^3$ by

$$\Sigma^*(k) = \frac{k_F^2}{2m} \frac{(k_F a)^3}{\pi} \left[\frac{3}{5} + \left(\frac{k}{k_F} \right)^2 \right]$$

(b) Show that the first two terms in the expansion of the ground state energy as a power series in k_F are

$$\frac{E}{N} = \frac{k_F^2}{2m} \left[\frac{3}{5} + \frac{3}{5\pi} (k_F a)^3 \right]$$

(c) Show that the spectrum is strictly quadratic with an effective mass given by $m^*/m = 1 - (k_F a)^3/\pi$, correct to order $(k_F a)^3$.