Phys 3707, Assignment 6 – Zero Sound

1. Zero Sound [F&W 5.8]

(a) For a uniform spin-s Fermi system with a short range potential $V(q) = V_0$ (= constant), show that all proper polarization insertions with repeated horizontal lines across the fermion loop can be summed to give

$$\Pi^\star(q) = (2s+1)\frac{\Pi^0(q)}{2 + \Pi^0(q)V_0}. \tag{1}$$

(b) Show that zero sound is now described by the equation

$$\Phi(x) = \frac{\pi^2}{smk_F V_0} \tag{2}$$

where $x = c_0/v_F$.