Homework 3

1. Consider a system of fermions interacting via a short range two body force with potential $V(r)$. Compute the effective mass to lowest order in $V(r)$.

2. Construct the state

$$|q> = \Omega a^+_q |\phi_o> = A^+_q |\psi_o>$$

(1)

to lowest order in the interaction ($|\phi_o>$ and $|\psi_o>$ are the ground state of the non interacting and interacting system respectively.

3. Compute the expectation value of the charge density and the current density in the state $|q>$

4. Repeat this calculation in a wave packet state

$$|x_o> = \sum_q e^{-\alpha(q-q_0)^2} e^{-iq.x_o} |q>.$$ 

Is the charge density and the current density localized around $x_o$? Discuss your findings.

5. Show that the conductivity has the form $\sigma(\omega) = \frac{e}{i\omega}$

Compute $c$ to lowest order in $V(r)$. 