Hints for Homework Assignment 4

- Use the Feynman rules in momentum space. (page 102 - 103).
- The free fermion propagator is

$$G^0_{\alpha\beta}(\vec{k},\omega) = \delta_{\alpha\beta}\left[\frac{\theta(|\vec{k}|-k_F)}{\omega-\omega_k+i\eta} + \frac{\theta(k_F-|\vec{k}|)}{\omega-\omega_k-i\eta}\right]$$

- The interaction for a spin independent interaction is

$$U_{\lambda\lambda',\mu\mu'}(q) = V_0(\vec{q})\,\delta_{\lambda\lambda'}\,\delta_{\mu\mu'}$$

Important: $U(q)$ depends on $\vec{q}$ (momentum) but not on q^0 (frequency).

- 4 momentum is conserved at every vertex.
- $d^4K/(2\pi)^4$ for every independent 4 momentum.
- $\int_{-\infty}^{\infty} d\omega\,(\ldots)$ may require a convergence factor; i.e., $\int_{-\infty}^{\infty} d\omega\, e^{i\omega\eta}(\ldots)$ where $\eta \to 0+$. (Feynman Rule #8)
- The <u>full</u> propagator is, by Dyson's equation,

$$G_{\alpha\beta}(\vec{k},\omega) = \frac{\delta_{\alpha\beta}}{\omega - \omega_k - \Sigma^*(\vec{k},\omega)} \qquad (9.33)$$

Σ^*: proper self energy