Homework Assignment 4 due Friday February 20.

11. Using *first-order perturbation* theory...
/a/ Calculate the self energy $\Sigma_{\alpha\beta}^{(1)}$ for a spin-independent interaction with $V_0(\mathbf{x_1}\text{-}\mathbf{x_2}) = (A/r)\exp(-r/d)$. (There are two Feynman diagrams to calculate.)
/b/ Calculate the single-particle excitation energy ; see Eq. 9.35.
/c/ Calculate the ground state energy per particle ; see Eq. 9.36.

12. (This problem is based on FW Problem 3.12, parts a and b only.)
Using *second-order perturbation* theory...
/a/ Calculate the proper self energy $\Sigma_{\alpha\beta}{}^{*(2)}$ for a spin-independent interaction $V_0(\mathbf{x_1}\text{-}\mathbf{x_2})$. (There are six Feynman diagrams to calculate, but 4 of them are equal to zero after evaluating the frequency integrals.) Leave the answers in terms of V_0, i.e., integrals involving the function $V_0(\mathbf{q})$, which is the Fourier transform of $V_0(\mathbf{x_1}\text{-}\mathbf{x_2})$. Evaluate all the *frequency* integrals.
/b/ Calculate the ground state energy per particle ; compare your answer to the result stated FW Problem 3.12.

13. FW Problem 3.14.