Homework Assignment 2 due Friday January 30.

5. Let $\psi(\mathbf{x},t)$ be the field operator for a spin-½ fermion, in the Heisenberg picture. Derive the field equation for $\psi(\mathbf{x},t)$, in the form $i\hbar\, \partial\psi / \partial t = F[\psi]$ where $F[\psi]$ is a functional, which may involve derivatives and integrals. Simplify the result as much as possible.

[Assume $T(\mathbf{x}) = - \hbar^2\nabla^2/2m$ and that $V(\mathbf{x_1},\mathbf{x_2})$ is spin independent.]

6. (a) The first-order approximation for the ee interaction in the ground state of the degenerate electron gas is given by equation 3.34 . Evaluate the integrals and obtain the result 3.36.

(b) Hand in a graph of E/N versus r_0 (defined in eqs 3.20-3.22); superimpose on the same graph the function 3.43 for a "Wigner solid". Do it accurately (with a computer) and be sure to label the axes. Use eV for the units of E/N, and angstroms for the unit of r_0.

7. The charges in a metal are screened by surrounding charge and therefore the Coulomb interaction is modified. Replace e^2/r by $e^2/r \exp(-r/d)$ where d is the screening length. Repeat the calculations in Section 3. Hand in a graph of E/N versus r_0, for $d = 3\, a_{Bohr}$.

8. FW Problem 1.2.