Physics 829: Problem Set 7

Due Wednesday, May 21 at 11:59 P. M.

1. (25 pts.)

   (a). Write down the angular wave functions in the ${}^1D_2$, ${}^3P_0$, ${}^3P_1$, ${}^3P_2$, and ${}^1S_0$ levels of the ground state configuration of carbon.

   (b). Write down the fully antisymmetrized ${}^1D_2$ wave function as a linear combination of Slater determinants.

2. (15 pts.) As mentioned in class, the (1s)(2s) configuration of He represents an excited state of this atom. There are two possible states, known as ortho and para helium, corresponding to spin 0 and spin 1. Calculate the energy difference between these states by first order perturbation theory (that is, obtain this energy difference in the form of a specific integral).

3. (10 pts.) Fill in the missing steps in the variational calculation described in class for the Hartree approximation. Thus, explicitly obtain the coupled Hartree equations for the single-particle wave functions of N electrons in an external potential V($\mathbf{r}$).