Physics 224 **Fall 1998**

Phenomenology **due 11:00 am Thursday Oct. 29**

PROBLEM SET 4

Oct. 23 Colloquium: "Pure Electron Plasma Experiments"

Dr. Joel Fajans, University of California, Berkeley

3 pm, 101 Rowland Hall (formerly PS I)

1. Using the attached energy level diagrams for the formation of molecular orbitals, describe the bonding of H_2, He_2, Be_2, and B_2 by stating or diagraming which orbitals are occupied by electrons. In other words, draw spin up and spin down electrons in the energy levels for the molecular orbitals.

2. Eisberg and Resnick problem 15.20.

3. (a) Calculate the angular frequency of the Larmor precession of a classical symmetric top whose angular momentum is $\vec{I}$ and whose magnetic moment is $\vec{\mu} = g_N(e/2M)\vec{I}$ in a magnetic field whose induction is $\vec{B}$.

   (b) Calculate the energy levels of a nucleus whose spin quantum number is $\vec{I}$ and whose magnetic moment is $\mu = g_N(e/2M_P)\vec{I}$ in a magnetic field $\vec{B}$. Using the selectrion rule $\Delta_I = \pm 1$, evaluate the angular frequency of a photon which will induce the system to jump from one orientation to another.

4. If the nuclear relaxation time (the time required for a nucleus to return from the upper to the lower state by spin–lattice relaxation) is approximately 10 μs, compute the approximate maximum power absorbed by the protons in 1 cm^3 of ice in a field of 10^4 gauss. Assume the nuclear g–factor for protons to be $g_p = 2.8$.

5. Eisberg and Resnick problem 11.19.

6. Eisberg and Resnick problem 11.20.