Ay121

Fall 2001

RADIATIVE PROCESSES

Problem Set 7

Due in class November 29, 2007

1. Spectroscopy of neutral carbon.
   a. Determine the spectroscopic terms for the ground $2s^2 2p^2$ and excited state $2s2p^3$, $2s^2 2p3s$, $2s^2 2p3p$, and $2s^2 3p3d$ configurations of neutral carbon using the L-S coupling. Specify parity and J values.
   b. Identify the ground state.
   c. Evaluate the degeneracy for each of the configurations in part (a) from (1) the individual l values, (2) the L and S values, and (3) the J values.

2. Dipole Transitions. Indicate the allowed dipole transitions between the ground and excited states of carbon given in problem 1.

3. Problem 10.3 in Rybicki and Lightman. Try to do the problem by yourself before looking at the solution. I prefer that you consult your favorite quantum mechanics book if you need to, rather than look at the solutions at the back of the book.

4. Problem 10.4 in Rybicki and Lightman. Again, avoid referring to the solutions.

5. The purpose of this problem is to consider a hydrogen plasma and then explore the cross sections for an electron to undergo a hard elastic scatter from a proton and to be captured by a proton. Express the cross sections in terms of the Bohr radius a_0, the fine-structure constant α, and the ratio of the electron velocity to that of light v/c.
   a. Use the expression for σ_{bf} and the Milne relation to derive an order-of-magnitude expression for σ_{fb}.
   b. Provide an order-of-magnitude estimate for the cross section σ_{el} for large-angle Coulomb (elastic) scattering.
   c. Use Larmor's formula to estimate the energy radiated during a large-angle scattering for $v/c = \alpha$. Calculate the ratio of this energy to the Rydberg.
   d. Compare your answer in (c) with the ratio σ_{fb}/σ_{el} evaluated for $v/c \simeq \alpha$.