

For: Thursday, February 2, 2006

Remember, you can volunteer to explain any of these at the board, for 50 points of credit maximum per problem. You don't need to work them all out, these are the problems most closely related to the recent lectures.

Problems in Jackson's 3rd ed.:

9.6 Dipole radiation fields for arbitrary time variations

9.9a,d Power and angular momentum radiated for arbitrary time variations

9.9b,c Certain applications of these results to particles in potentials

9.18 Analysis of AC reactance of a short dipole antenna

Other Problem:

W4. A positronium atom consists of a bound state of a positron and an electron mutually orbiting each other at separation  $2R$ . Suppose you analyzed its classical electric dipole radiation. Imagine it starts in the lowest Bohr orbital from Bohr's simple theory (i.e., circular motion with  $1\hbar$  of orbital angular momentum).

- a) Determine its time-dependent electric dipole moment.
- b) Describe the angular distribution of EM power radiated, and the total power radiated. Does it make sense to use time-averaging over the orbital period?
- c) Make some reasonable analysis, comparing the power radiated with the energy and other orbital parameters, and formulate a simple theory for the lifetime of the atom (i.e., if the radius  $R(t)$  drops to zero, the pair annihilates!).