# Physics 451- Fall 2012

## Homework #23

Due Tuesday, Dec 4, by 7pm

Please place your assignment in the "Physics 451" slot across from N373 ESC.
Help sessions T Th: from 4pm to 6pm – room 337 ESC

List of problems (from the textbook):

**5.9**
**5.12**
**5.13**
**5.14**

*Hints:*
Problem **5.9:** In the initial state, the two electrons are in the excitation level n=2. One of the electrons is going to transit back to ground state, and the energy released will be used to eject the other electron from the atom. You are asked to calculate the remaining energy of the released electron, once ejected.

Problem **5.12** and **5.13**: you are asked to identify the value of S, L and J for each atom. To list all the possibilities for S, L and J, first start with maximum value for S and for L, and (if there is more than one particle) investigate all the possible values by increment of 1 down to 0 or 1/2. Then, the possible values of J (for given L, S) are from L+S down to $|L-S|$.

To find out the actual values of S, L, J for a given atom, follow the general procedure:

- first use the 1st Hund's rule to find out S (maximization of the spin)
- then use the 2nd rule to find out L: here you have to find the L value that satisfies the symmetrization requirement, given the symmetry of your spinor (the total wave function for fermions must be antisymmetrical). For the angular part, use the fact that the wave function at the top of the ladder (L max) is always symmetrical. When combining only 2 electrons, you may use the Clebsch-Gordan table to check the symmetry of a given L (when exchanging the 2 particles).
- Also use Pauli exclusion principle when filling the electronic shells

*Note*: the Nitrogen case is extremely tricky! For this assignment you may just use the fact that, out of all the possibilities for L, the only one that is antisymmetrical is L=0
-finally, use the 3rd rule to find out which J value is suitable.