Answer on Question #64623, Physics / Atomic and Nuclear Physicsa

Derive the symbol for the ground state of carbon atom.

Answer:

Carbon, with Z= 6 has the 1S and 2S levels filled giving j = 0 as a base. It has two valence 2P electrons. Hund's first rule, maximum total S, tells us to couple the two electron spins to S = 1. This is the symmetric spin state so we'll need to make the space state antisymmetric. Hund's second rule, maximum l, doesn't play a role because only the l = 1 state is antisymmetric. Adding two P states together, we get total l = 0, 1, 2. The maximum state is symmetric, the next antisymmetric, and the l = 0 state is again symmetric under interchange. This means l = 1 is the only option. Since the shell is not half full we couple to the the lowest j = |l - S| = 0. So the ground state is $^3P_0$.