ZEE曼 EFFECT FOR N = 3: STRONG FIELD

To continue our analysis of the $n = 3$ line in hydrogen, we’ll look at the Zeeman effect in the strong field limit. In this case, the energies are given by

\[ E_{n1} = E_{n0} + E_{fs1} + E_{Z1} \]

\[ = -\frac{13.6 \text{ eV}}{n^2} + \frac{13.6 \text{ eV} \alpha^2}{n^2} \frac{3}{4n} - \frac{\ell (\ell + 1) - \ell_z s_z}{\ell (\ell + \frac{1}{2}) (\ell + 1)} + \mu_B B_{ext} (\ell_z + 2s_z) \]

(2)

For $n = 3$, we get

\[ E_{fs1} = \frac{13.6 \text{ eV}}{27} \alpha^2 \left( \frac{1}{4} - \frac{\ell (\ell + 1) - \ell_z s_z}{\ell (\ell + \frac{1}{2}) (\ell + 1)} \right) \equiv 4\gamma \left( \frac{1}{4} - \frac{\ell (\ell + 1) - \ell_z s_z}{\ell (\ell + \frac{1}{2}) (\ell + 1)} \right) \]

\[ E_{Z1} = \mu_B B_{ext} (\ell_z + 2s_z) \equiv \beta (\ell_z + 2s_z) \]

(3)

(4)

This time, the relevant quantum numbers are $\ell$, $\ell_z$, and $s_z$, so by plugging in the values we get (remember that for $\ell = 0$, the second term in parentheses for $E_{fs1}$ is 1):
The total energy for each level is

\[ E_{n1} = -\frac{13.6 \text{ eV}}{9} + E_{fs1} + E_{Z1} \quad (5) \]
\[ = -1.51 \text{ eV} + E_{fs1} + E_{Z1} \quad (6) \]

There are 14 energies with degeneracy 1 and 2 energies with degeneracy 2 (the four states that don’t depend on \( B_{ext} \)).

PINGBACKS

Pingback: Zeeman effect for n = 3: general case