Zeeman effect

Hydrogen energy levels E_{nj} in a weak magnetic field $B = |\mathbf{B}|$ are approximately

$$E_{nj} = -\frac{\mu c^2 \alpha^2}{2n^2} \left[1 + \frac{\alpha^2}{n^2} \left(\frac{n}{j + \frac{1}{2}} - \frac{3}{4} \right) \right] + g_J m_j \mu_B B$$

where

$$j = \left| l \pm \tfrac{1}{2} \right|, \quad l = 0, 1, 2, \ldots, n - 1$$

$$m_j = -j, -j + 1, \ldots, j - 1, j$$

Symbol g_J is the Landé g-factor

$$g_J = 1 + \frac{j(j+1) - l(l+1) + \frac{3}{4}}{2j(j+1)}$$

For principal quantum number $n = 2$ and magnetic field $B \neq 0$ there are eight energy levels.

n	l	j	m_j	E_{nj}
2	1	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{1}{4}E_1(1 + \frac{1}{16}\alpha^2) + 2\mu_B B$
2	1	$\frac{3}{2}$	$-\frac{3}{2}$	$\frac{1}{4}E_1(1 + \frac{1}{16}\alpha^2) - 2\mu_B B$
2	1	$\frac{3}{2}$	$\frac{1}{2}$	$\frac{1}{4}E_1(1 + \frac{1}{16}\alpha^2) + \frac{2}{3}\mu_B B$
2	1	$\frac{3}{2}$	$-\frac{1}{2}$	$\frac{1}{4}E_1(1 + \frac{1}{16}\alpha^2) - \frac{2}{3}\mu_B B$
2	1	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{4}E_1(1 + \frac{5}{16}\alpha^2) + \frac{1}{3}\mu_B B$
2	1	$\frac{1}{2}$	$-\frac{1}{2}$	$\frac{1}{4}E_1(1 + \frac{5}{16}\alpha^2) - \frac{1}{3}\mu_B B$
2	0	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{4}E_1(1 + \frac{5}{16}\alpha^2) + \mu_B B$
2	0	$\frac{1}{2}$	$-\frac{1}{2}$	$\frac{1}{4}E_1(1 + \frac{5}{16}\alpha^2) - \mu_B B$

where

$$E_1 = -\frac{\mu c^2 \alpha^2}{2}$$