Zeeman effect

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

$$E = \frac{E_0}{n^2}\left[1 + \frac{\alpha^2}{n^2}\left(\frac{n}{j+\frac{1}{2}} - \frac{3}{4}\right)\right] + g_J m_j \mu_B B$$

where

$$E_0 = -\frac{\mu c^2 \alpha^2}{2} \approx -13.5983\,\mathrm{eV}$$

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

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

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
2	1	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{E_0}{4}\left(1 + \frac{1}{16}\alpha^2\right) + 2\mu_B B$
2	1	$\frac{3}{2}$	$-\frac{3}{2}$	$\frac{E_0}{4}\left(1 + \frac{1}{16}\alpha^2\right) - 2\mu_B B$
2	1	$\frac{3}{2}$	$\frac{1}{2}$	$\frac{E_0}{4}\left(1 + \frac{1}{16}\alpha^2\right) + \frac{2}{3}\mu_B B$
2	1	$\frac{3}{2}$	$-\frac{1}{2}$	$\frac{E_0}{4}\left(1 + \frac{1}{16}\alpha^2\right) - \frac{2}{3}\mu_B B$
2	1	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{E_0}{4}\left(1 + \frac{5}{16}\alpha^2\right) + \frac{1}{3}\mu_B B$
2	1	$\frac{1}{2}$	$-\frac{1}{2}$	$\frac{E_0}{4}\left(1 + \frac{5}{16}\alpha^2\right) - \frac{1}{3}\mu_B B$
2	0	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{E_0}{4}\left(1 + \frac{5}{16}\alpha^2\right) + \mu_B B$
2	0	$\frac{1}{2}$	$-\frac{1}{2}$	$\frac{E_0}{4}\left(1 + \frac{5}{16}\alpha^2\right) - \mu_B B$