

File-2: Nuclear Hyperfine Splitting.

Hydrogen atom

The **Energy levels** of an odd electron due to nuclear splitting is given by

$$E = E_s g \beta H + a h M_s M_1.$$

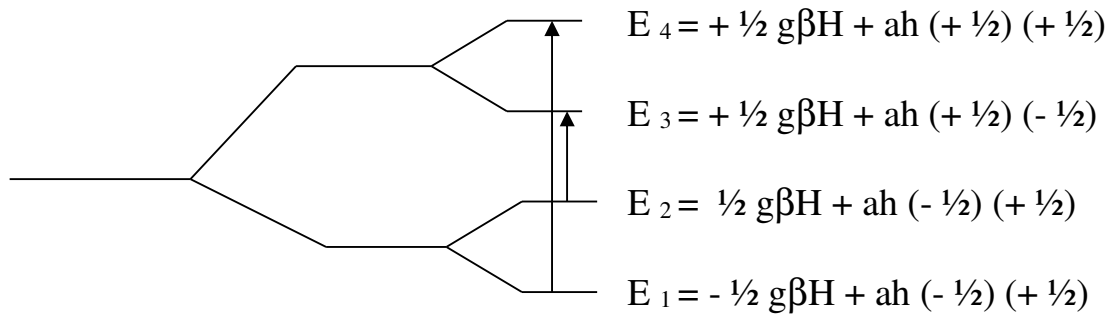
Where

$$M_s = \text{Electron spin } (-\frac{1}{2} \text{ or } +\frac{1}{2})$$

$$M_1 = \text{Nuclear spin } (I, I-1, I-2, \dots, -1)$$

$$a = \text{Hyperfine coupling constant.}$$

The different energy levels for a nuclear spin $\frac{1}{2}$ in the decreasing order of energy can be obtained as follows:



Selection rule:

$$\Delta m_1 = 0; \quad \Delta m_s = 1$$

$$\Delta E_a = E_4 - E_1 = g \beta H + \frac{1}{2} a h \quad (\text{High energy line})$$

$$\Delta E_b = E_3 - E_2 = g \beta H - \frac{1}{2} a h \quad (\text{High energy line})$$

$$\Delta E_a - \Delta E_b = a h.$$

Hence, the hyper fine coupling constant, 'A' can be calculated.