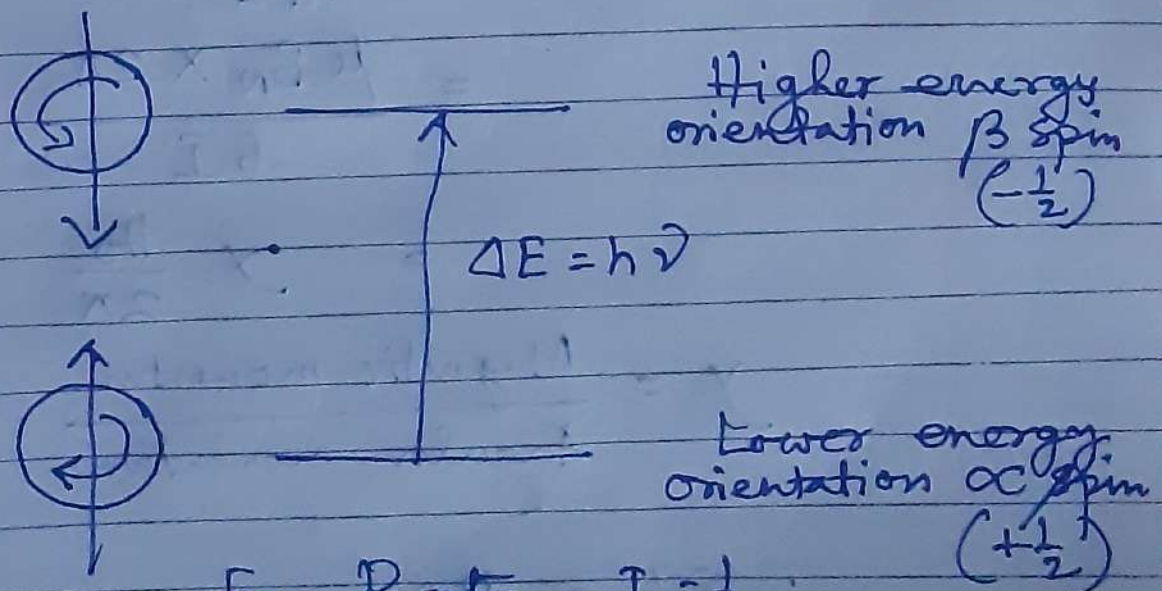


Why is it necessary for a nucleus to behave as a tiny magnet can be ~~examined~~ studied by this spectroscopy?

This is because when such a tiny nuclear magnet is placed in uniform external magnetic field it takes up one of the possible orientation $(2I+1)$.

This provides a situation where it is possible to induce nuclear transition to lower to higher orientation by absorbing energy of definite amount which is given by $\Delta E = h\nu$ and gives NMR signal.



For Proton $I = \frac{1}{2}$

$$2I + 1 = 2 \times \frac{1}{2} + 1 = 2$$

* What is the nature of the frequency of energy i.e., necessary for such nuclear transition and how it is related to the strength of the applied magnetic field (H_0)?

This is related by an equation i.e.,

$$\Delta E = h\nu = \frac{\mu B_N H_0}{I}$$

μ = Magnetic moment of the nucleus

B_N = Bohr magneton (for proton nucleus)

H_0 = Strength of the applied magnetic field

I = Spin no. of the nucleus

$$\Delta E = h\nu = \frac{\mu B_N H_0}{I}$$

$$\nu = \frac{\mu B_N H_0}{h I}$$

$$= \frac{\mu B_N \times 2\pi}{h I} \times \frac{H_0}{2\pi}$$

$$= \gamma \frac{H_0}{2\pi}$$

$$\gamma = \frac{\text{Magnetic momentum}}{\text{Angular momentum}}$$

$$\therefore \nu \propto H_0$$

($\gamma \rightarrow$ Gyro-magnetic ratio)
It is constant for a particular nucleus and different for different nucleus

Thus for a particular nucleus the frequency of energy which is necessary for nuclear transition is directly proportional to the strength of the applied magnetic field (H_0).

$$H_0 = 7.1 \text{ tesla}, \text{ then } \nu = 300 \text{ MHz}$$

Radio frequency region

H_0 (tesla)	\Rightarrow	1.4	2.1	2.3	5.1	5.8	7.1
1H		60 MHz	90 MHz	100 MHz	220 MHz	250 MHz	300 MHz
^{13}C		15.1 MHz	22.6 MHz	25.2 MHz	55 MHz	62.4 MHz	75.5 MHz

* When does a nucleus absorb energy of frequency (ν) in a magnetic field (H_0)?

The nucleus absorbs energy of frequency (ν) in a magnetic field strength (H_0) only when resonance condition is achieved.

Related questions / Further reading \Rightarrow

- (I) What is the value of H_0 when the frequency is 600 MHz?
- (II) What is the value of β_e and β_N ? (CGS & SI unit)
- (III) Why proton in different molecular environment gives different signals than a bare proton?
 \hookrightarrow Position (in Hz)