Nuclear Magnetic Resonance (NMR)

Introduction:-

Nuclear Magnetic Resonance (NMR) is a spectroscopy technique which is based on the absorption of electromagnetic radiation in the **radio frequency region 4 to 900 MHz** by nuclei of the atoms.

Proton Nuclear magnetic resonance spectroscopy is one of the most powerful tools for elucidating the number of hydrogen or proton in the compound.

It is used to study a wide variety of nuclei:

- ^{1}H ^{15}N
- ^{19}F ^{19}F
- ^{13}C ^{31}P

Theory of NMR

Spin quantum number (I) is related to the atomic and mass number of the nucleus.

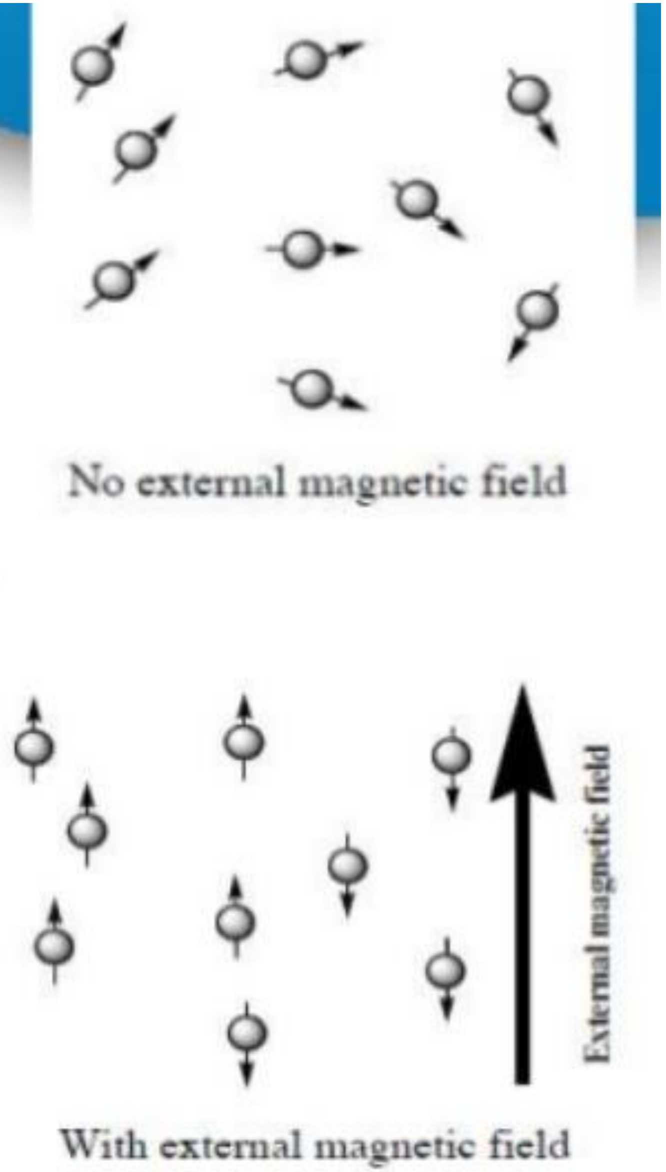
I	Atomic Mass	Atomic Number	Examples	
Half-integer	Odd	Odd	^{1}H (1/2)	NMR active
Half-integer	Odd	Even	^{13}C (1/2)	
Integer	Even	Odd	^{2}H (1)	
Zero	Even	Even	^{12}C (0)	Not NMR active

Elements with either odd mass or odd atomic number have the property of nuclear "spin".

Principle

The theory behind NMR comes from the spin of a nucleus and it generates a magnetic field. Without an external applied magnetic field, the nuclear spins are random in directions.

But when an external magnetic field(B_o), is present the nuclei align themselves either with or against the field of the external magnet.



If an external magnetic field is applied, an energy transfer (ΔE) is possible between ground state to excited state.

when the spin returns to its ground state level, the absorbed radiofrequency energy is emitted at the same frequency level.

The emitted radiofrequency signal that give the NMR spectrum of the concerned nucleus.

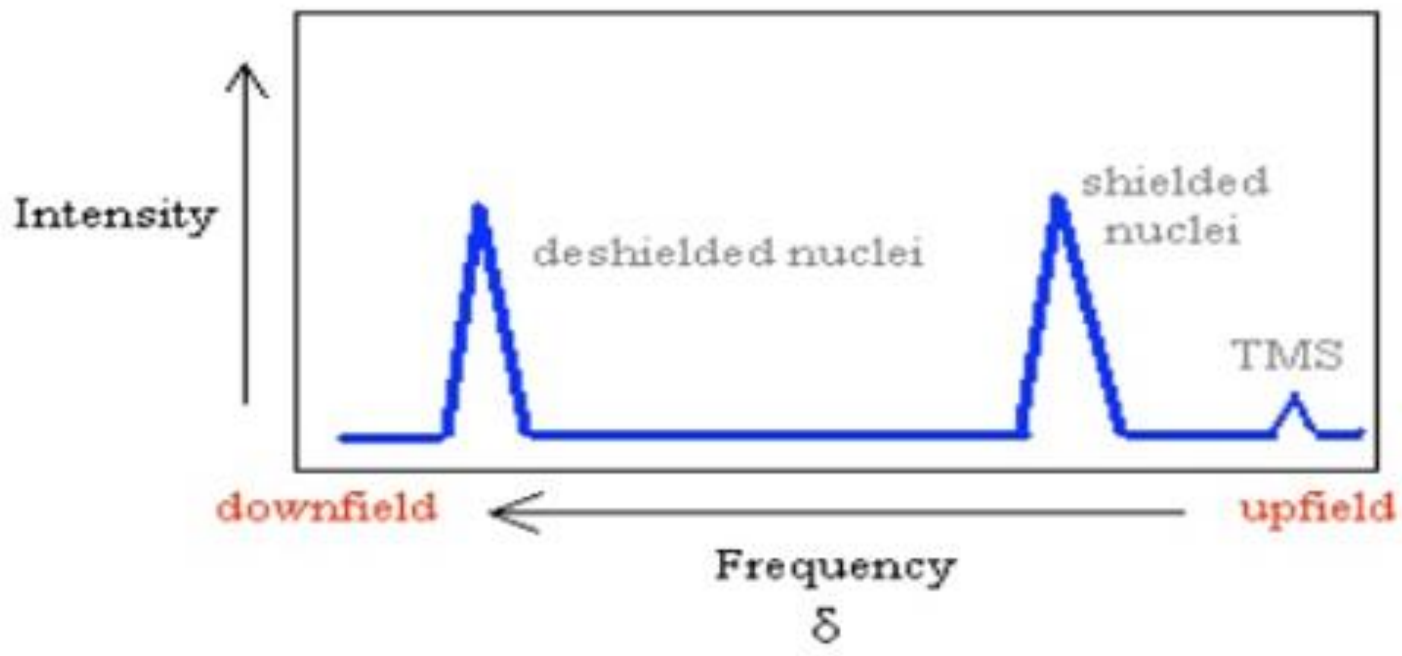
The emitted radio frequency is directly proportional to the strength of the applied field.

$$\nu = \frac{\gamma B_o}{2\Pi}$$

B_o = External magnetic field experienced by proton

γ = Magnetogyric ratio (The ratio between the nuclear magnetic moment and angular moment)

NMR spectrum



The NMR spectrum is a plot of intensity of NMR signals VS magnetic field (frequency) in reference to TMS