Chimie de la Matière Condensée de Paris

Chemistry of Condensed Matter in Paris

SMILES

Spectroscopy, Modelisation, Interfaces for LifE Sciences

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Nuclear Magnetic Resonance and Biomineralization

Biomin & Biomat Confined Seminar

SCIENCES SORBONNE UNIVERSITÉ

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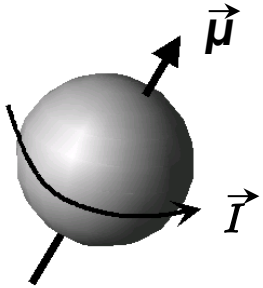
1. Definitions

Spin : intrinsic quantum property associated to nuclei which corresponds to the rotation of the particle characterized by an **angular momentum** $\vec{I}$

The rotation of the nuclei induces a small magnetic field called **nuclear magnetic moment** $\vec{\mu}$

$$\vec{\mu} = \gamma . \hbar . \vec{I}$$



$\hbar = h/2\pi = 1{,}054.10^{-34}$ J.s
h : Planck constant ($6{,}626.10^{-34}$ J.s)

γ : gyromagnetic ratio intrinsic to each nucleus (rad.s^{-1}.T^{-1})
Angular velocity depending on the magnetic field

I **:** Nuclear quantic number associated to the angular momentum

if $I = 0$ No NMR !!!

2. Zeeman effect

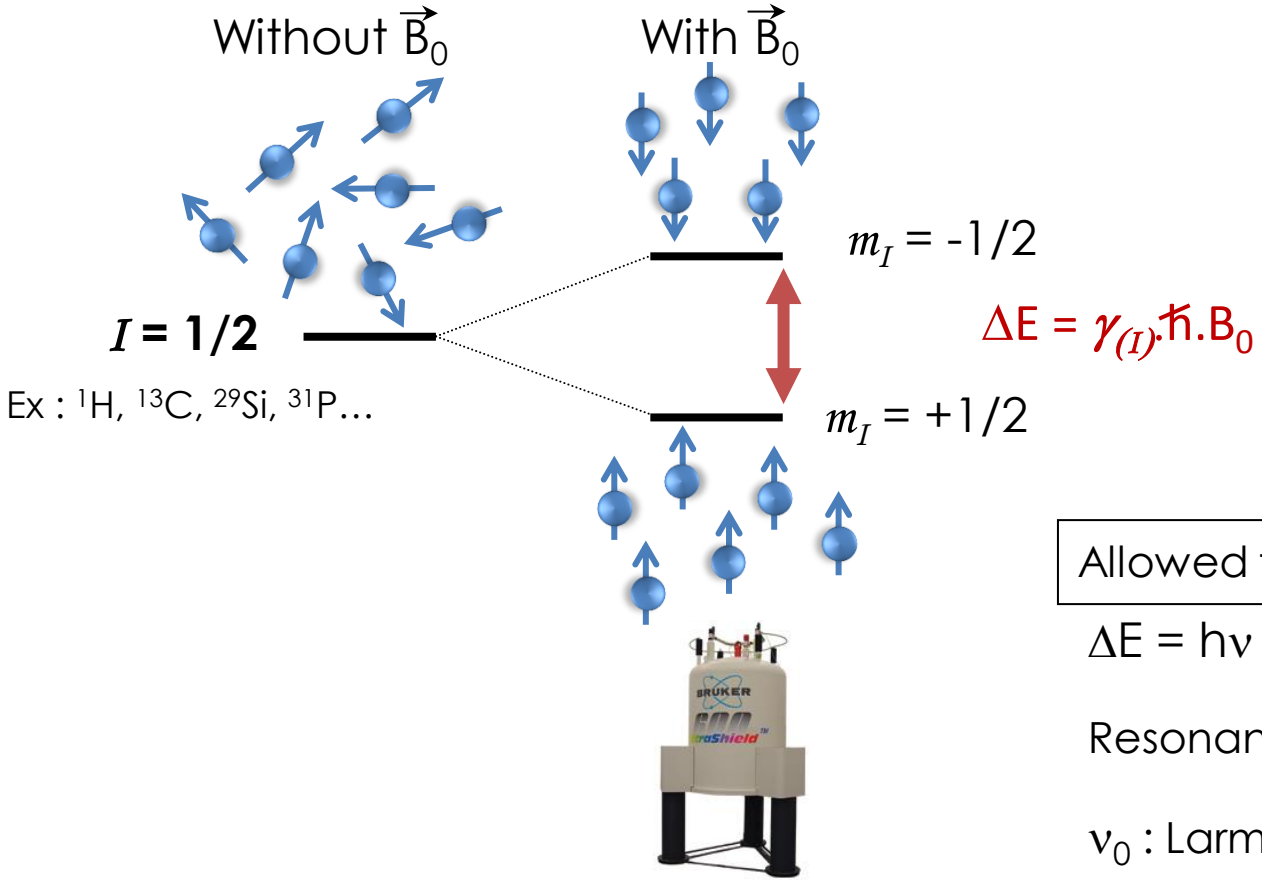
- The **nuclear spin** I determines the number of different states (aka orientations) that a nucleus can adopt in the presence of an **external magnetic field B_0**.
- **$2I + 1$** states are defined and characterized by the **magnetic quantic number** m_I
- as a consequence the possible values of m_I are the following

$$-I \leq m_I \leq +I \text{ with } \Delta m_I = 1$$

$I = 1/2$
Ex : ^{1}H, ^{13}C, ^{29}Si, ^{31}P…
$m_I = +1/2$ and $-1/2$

Similarly for an electron
$S = 1/2$
$m_S = +1/2$ and $-1/2$

2. Zeeman effect



Allowed transition: $\Delta m_I = 1$

$\Delta E = h\nu$

Resonance only if $\nu_0 = \gamma_{(I)} B_0 / 2\pi$

ν_0 : Larmor frequency

for ^{1}H: ν_0 = 100 MHz at B_0 = 2,3 Tesla

But $\Delta E = 6{,}6.10^{-26}$ J → very low !!!