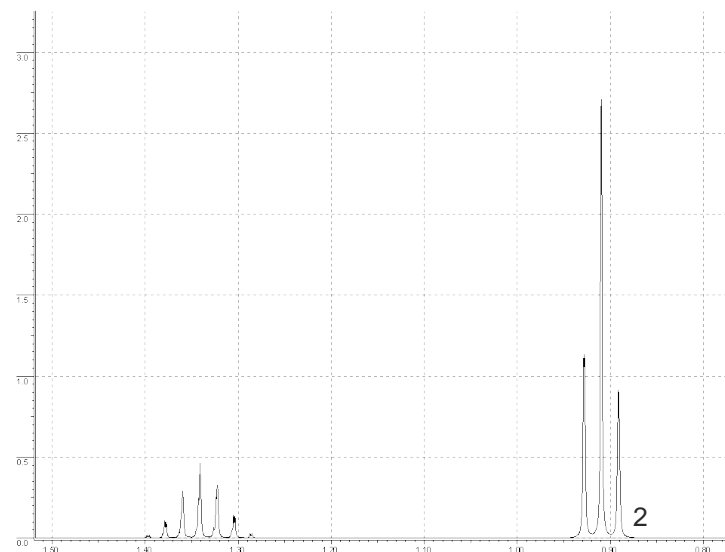




# [ Nuclear Magnetic Resonance ]

# [ Selection Rules ]

- Probe magnetic dipole moment of nuclei in molecules resulting from intrinsic spin angular momentum
- Simplest and most useful is  $^1\text{H}$ .
- Study interaction of nuclear magnetic moment with applied magnetic field
- Nuclear Zeeman interaction



# [ Classical Mechanics ]

- Magnetic moment of a charged particle moving along a circular path
- Current of charged particle
- Magnetic moment
- Towards a nucleus

# [ Angular Momentum ]

- Framework comes from the rigid rotator model
- $^1\text{H}$  has two state of angular momentum
- Wavefunctions represented by spherical harmonics
- Define the states

# [ Hamiltonian ]

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- Eigenstates of angular momentum
- Magnetic moment interacts with magnetic field

# [ Proton in magnetic field ]

- Proton in magnetic field it interacts via Hamiltonian previously specified.

$1/2$

- Energy level diagram

# [ Proton in magnetic field ]

- What is the frequency of the radiation necessary to drive the transition in an applied magnetic field of 7 Tesla?

# [ Iclicker: Proton resonance ]

- Using a 300 MHz NMR spectrometer to measure the  $^1\text{H}$  spectrum of a variety of compounds you prepared the proton resonance occurs at precisely 300.000 MHz. What is the strength of the magnetic field in the NMR?

A – 7 T

B – 8 T

C – 9 T

D – 10 T

E – 11 T



# [ Iclicker: Other Nuclei ]

- Using the same NMR what frequency would be required to record a  $^{13}\text{C}$  spectrum ( $g_{\text{N}} = 1.4042$ )?

A – 75 MHz  
B – 85 MHz  
C – 95 MHz  
D – 105 MHz  
E – 115 MHz

# [ Historical Perspective ]

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- Absorption as a function of applied magnetic field.