Measuring Spin Echo Responses in Nuclear Magnetic Resonance

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1. Introduction

Nuclear Magnetic Resonance (NMR) is a broadly utilized tool for determining the structure, density, and chemical environment of atomic nuclei, amongst other quantities and characteristics.

For NMR to work, the atomic nuclei must carry a non-zero magnetic dipole moment so it may couple to the external magnetic field. For ^{1}H, we have a spin of $\frac{1}{2}$. With our gyromagnetic ratio γ, we have our magnetic dipole moment:

$$\vec{\mu} = \gamma \vec{S}. \tag{1}$$

The state of our spin $\frac{1}{2}$ nucleus is represented by a spinor (α, β), where $\alpha, \beta \in \mathbb{C}$ and $\|\alpha\|^2 + \|\beta\|^2 = 1$. Our spin vector $\vec{S}$ is a vector of 3 operators: S_x, S_y, S_z, where $S_i = \frac{\hbar}{2}\sigma_i$ and σ_i are the Pauli matrices. Because of the quantization of our spin, our magnetic dipole moments are also quantized. Since our spin can be measured to be either $\frac{\hbar}{2}$ or $-\frac{\hbar}{2}$, our magnetic dipole moment is either $\frac{\gamma \hbar}{2}$ or $-\frac{\gamma \hbar}{2}$ (along our axis of measurement).

2. Methods

3. Results

4. Discussion

5. Acknowledgements