A Nuclear Magnetic Resonance (NMR) study on Glycerin and Fluorine

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Nuclear Magnetic Resonance (NMR): A physical phenomenon in which magnetic nuclei in a magnetic field absorb and re-emit electromagnetic radiation.

\[ \Delta E = \gamma \hbar B_0 \]

\[ \hbar \omega_0 = \gamma \hbar B_0 \]

\[ \omega_0 = \gamma B_0 \]

Resonance Frequency.
Symantec of setup
Modulating (sweeping) Field

\[ B_m = B_{m0} \sin \omega_m t \]

Samples:

Glycerin $^1$H

Fluorine $^{19}$F
Results and Discussion

Gyromagnetic Ratios

Measured:
\[
\frac{\gamma_g}{(2\pi)} = 42.5 \pm 2.4 \text{ MHz/T} \\
\frac{\gamma_f}{(2\pi)} = 40.1 \pm 0.3 \text{ MHz/T} \\
\frac{\gamma_g}{\gamma_f} = 1.06 \pm 0.06
\]

Published:
\[
\frac{\gamma_g}{(2\pi)} = 42.576 \text{ MHz/T} \\
\frac{\gamma_f}{(2\pi)} = 40.053 \text{ MHz/T} \\
\frac{\gamma_g}{\gamma_f} = 1.063
\]
**Transverse Relaxation Time**

\[ A(t) = A_0 e^{-t/T_2^*} \]

with \[ \frac{1}{T_2^*} = \frac{1}{T_2} + \gamma \delta B_0 \]

Glycerin \(467.4 \pm 1.3 \mu s\) < Fluorine \(687.0 \pm 6.8 \mu s\)
Homogeneity of the Magnetic Field

$$\omega_{induced} = \gamma B_0 + \gamma \frac{dB}{dt} t = \gamma B_0 + \gamma \omega_m B_m t$$

$$\omega = \gamma B_0$$

$$\delta \phi = \int_0^t (\omega_{ind} - \omega) dt = \frac{1}{2} \gamma \omega_m B t^2$$

$$\delta B = \frac{2\pi}{(\gamma \omega_m \text{ slop})}$$

Glycerin 0.0022T  Fluorine 0.0085T
Results and Discussion

$T_2$ Relaxation Time

A more sophisticated experimental method is required to measure $T_2$. 

$$\frac{1}{T_2^*} = \frac{1}{T_2} + \gamma \delta B_0$$
Conclusion

- Gyromagnetic ratios:
  42.5±2.4 MHz/T for glycerin,
  40.1±0.3 MHz/T for fluorine.

- Glycerin has a shorter transverse relaxation time than fluorine.
THANK YOU