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My continuing interest in relaxation times in NMR began when I was starting my thesis work in 1953 at Illinois under the direction of Professor H.S. Gutowsky, who pioneered high resolution NMR using specially manufactured permanent magnets. No commercial NMR machines were available at Illinois. One of the duties of a new student was to "shim" the magnet. This involved measuring the NMR frequency at various locations in the magnet gap with a small sample and then making the magnetic field more homogeneous by grinding down the magnet pole caps at regions of high NMR frequencies. Needless to say, this procedure was uninspiring. Then, when measuring the chemical shift of a liquid sample, I found that sudden frequency shifts of the radio frequency oscillator (quartz stabilized frequency synthesizers were far in the future) made the procedure even more tedious. I readily agreed to do this, and I built the first pulse NMR spectrometer in a university chemistry department (a pulse NMR spectrometer is a pulse Fourier transform NMR spectrometer in a university chemistry department). The nuclear spin relaxation times $T_1$ and $T_2$ are calculated for two identical atomic nuclei of spin $\frac{1}{2}$ in an ellipsoid undergoing rotational Brownian motion in the motionaly narrowed regime. Five correlation times are obtained for a completely asymmetric ellipsoid. For nonviscous liquids $T_1 = T_2$. [The SI indicates that this paper has been cited in over 520 publications.]

NMR Relaxation and Nonspherical Molecular Rotation

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My research at Mobil also entailed NMR relaxation measurements on liquids such as hydrocarbons. Since such molecules can be nonspherical, I realized that a proper interpretation of such data in terms of molecular motion must be based on rotational anisotropy. My earlier work was based on internal motion within a body reorienting isotropically, and I needed a more general model. In this work I used F. Perrin's elegant (but ignored) approach to calculate in a simple fashion the rates of change of average values of orientational functions for ellipsoids subject to anisotropic rotational diffusion. I tried to present the theoretical material in a form most useful to the experimentalist (many theoretical papers are incomprehensible to experimentalists). I think that is one reason this paper is highly cited. Actually, it was cited infrequently for many years, probably because few experimenters had the equipment capable of the measurements required to apply the theory. The frequency of citation rose greatly with the advent of pulse Fourier transform NMR spectrometers and with the application of NMR to medical research. Also, this work led, in part, to my receiving in 1975 the W.T. Doherty Award of the Dallas-Fort Worth Section of the American Chemical Society. Recently, this approach has been modified and generalized for the case of methyl groups in liquids.3