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Nuclear Magnetic Resonance-P410/510 Overview

It is impossible to overestimate the importance of NMR for physics, chemistry, biology and medicine. Yet, before 1946, the nuclear spin resonance had not been observed, despite several attempts to see it.

In the P410/510 Lab you have a unique opportunity to get direct experience with NMR and a basic understanding of the physics involved. There are three experiments:

G7: The cw(continuous wave) experiment. Probably this is the one you should do if you have had no previous contact with NMR. It is, however, a fairly long and difficult experiment, yet worth the effort it takes. The effect of "saturation" and of small amounts of paramagnetic ions is studied in detail.

G7a: The spin-echo experiment. This is a special, extremely clever, technique for measuring spin-spin relaxation times in different materials. The emphasis is on the physics of spin relaxation rather than the NMR itself. This technique avoids the problem of magnet inhomogeneity, but not self diffusion. However, the diffusion effect often can be separated from T_2 in the data analysis.

G7b: This is our most sophisticated NMR experiment. $\mathbf{H^1}$, $\mathbf{F^{19}}$ and $\mathbf{Li^7}$ resonances are studied. A computer is used to control various sequences of pulses to make T_2^* and T_2 measurements (the latter is unaffected by magnet inhomogeneity and self diffusion), accurate T_1 measurements (this experiment is the only one which can do this), the chemical shifts for fluorine and lithium in different chemical environments, and the Knight shift in metallic lithium. It will represent a certain investment of time to do this experiment, but the pay-off is an introduction to important techniques used in real experiments with NMR. It is recommended that you do the G7 experiment first unless you already have some NMR background.