VIII. NUCLEAR MAGNETIC RESONANCE*

Academic and Research Staff

Prof. J. S. Waugh
Dr. Paul Van Hecke

Graduate Students

J. L. Ackerman
S. Kaplan
B. Neff
S. V. Pausak
J. C. Weaver

RESEARCH OBJECTIVES

The main emphasis in our laboratory is on the development of new and sophisticated magnetic resonance measurements which may be useful to chemists, biologists, and others in permitting types of studies that were formerly considered impossible by magnetic resonance. Our recent work has centered primarily on two types of experiment, both involving nuclear magnetic resonance of solids under conditions that permit high resolution. The first of these, generally called the multiple-pulse method, is useful for the study of abundant nuclear spins such as protons in organic molecules of fluorine-19 in fluorocarbons, and this method has now been developed to quite an advanced state. We are currently applying it to the determination of chemical shielding tensors in single crystals in the hope of obtaining more detailed information about electronic structure of molecules and chemical binding.

The second class of experiments, proton-enhanced nuclear induction spectroscopy, is adapted to the study of rather dilute nuclear spin species such as the natural isotopic abundances of carbon-13 or nitrogen-15 in organic systems or of chemical labels inserted into large molecules. This method not only permits the attainment of high resolution in the detection of the spectrum of the dilute spins but results also in a greatly enhanced sensitivity. Surrounding abundant spins, usually protons, are used as a reservoir of polarization that can be communicated to the rare spins by various appropriate double-resonance methods. This method appeared to be widely applicable to a number of chemical problems and also seems to have some promise in biological investigations. We are now beginning to apply it to a study of the structure and dynamics of biological cell membranes using biosynthetically inserted carbon-13 labels.

J. S. Waugh

*This work is supported by the National Institutes of Health (Grant 5 RO1 GM 16552-04) and by the National Science Foundation (Grant GP-28490X1).