

V. NUCLEAR MAGNETIC RESONANCE AND MAGNETO-OPTICS

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A. THE HYPERFINE STRUCTURE OF THE 3P_1 LEVEL OF MERCURY

An apparatus has been constructed in which 3100 Mc/sec microwaves act on the mercury vapor in a quartz cell in a cavity. Although the transitions between F-levels involve greater frequencies, the required intervals may be calculated from observed resonances in a magnetic field. In a preliminary experiment, transitions between m-levels of even isotopes were observed.

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B. NUCLEAR MAGNETIC RESONANCES IN GASES

The relaxation times observed in nuclear magnetic resonances in gas are a measure of the effectiveness of collisions in producing nuclear reorientation. By observing a nuclear resonance in one component of a mixture of gases for various mixtures it is possible to get information on the relative effectiveness of collisions between different species of molecules in producing nuclear reorientation. The results of observations on H^1 and B^{11} resonances in mixtures of H_2 , BF_3 , N_2 , and He are tabulated below. Here, R is proportional to the ratio of the number of reorienting collisions per second computed from observed relaxation times to the number of kinetic theory collisions per second calculated by using the same collision cross section for all molecules. Since the absolute value of the observed relaxation time is at present still uncertain, results have been normalized: in a pure gas R is taken as 1.

Resonance Observed	In Collision With	R
H^1 in H_2	H_2	1
	BF_3	11
	N_2	2.5
	He	0.3
B^{11} in BF_3	BF_3	1
	N_2	0.8
	H_2	0.1

Note that in both sets of experiments collisions with BF_3 are about ten times as effective as collisions with H_2 .

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C. THE OPTICAL PROPERTIES OF ATOMIC VAPORS

A technical report on this subject is being prepared. It summarizes the results that are to be expected when a vapor is normally illuminated with radiation in the vicinity of a resonance frequency. In particular, the reflection coefficient, phase shift, and absorption coefficient are computed for small vapor densities. The most promising type of experiment under various conditions of total number of atoms available and density of atoms available is briefly discussed.

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