

VI: MAGNET LABORATORY RESEARCH

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A. NUCLEAR MAGNETIC RESONANCES

1. Ratio of Moments of Rubidium 85 and 87

A run has been made to measure by direct comparison the ratio of the nuclear magnetic moments of Rb 85 and Rb 87. Some 88 separate observations were made, but only an arbitrarily selected 37 have been analyzed. These yield: moment 87/moment 85 = 2.033380 ± 0.000028 , i. e. ± 1 in 73,000; line width 87 = 0.47 gauss; line width 85 = 0.38 gauss; signal to noise 87 = 10:1; signal to noise 85 = 6:1. The audio-frequency modulation was measured to be 0.4 gauss, peak to peak, and was about 30 cps. A large radio-frequency field was applied to the 87 nuclei, and an even larger radio-frequency field applied to the 85 nuclei.

An auxiliary experiment indicates that the steady field varies by about 1/4 gauss over the sample used, which was a double-wound cylinder of internal height and radius 1/4 inch with its axis parallel to the steady field. The barrel-type electromagnet was used to give a field of 10960 gauss. The lower frequency, 4.5 Mc from a crystal oscillator, was multiplied by 10 and mixed with the third harmonic of the upper frequency, 15.25 Mc from a General Radio 805A signal generator. The lower frequency and the beat frequency were measured periodically throughout the run on the same BC221 frequency meter. The estimated error in the determination of the frequency ratio is less than 10 percent of the quoted error, which is a little larger than the spread of all the data so far analyzed.

An auxiliary set of experiments was done to compare the signal to noise, using samples composed of tap water plus RbCl to saturation, plus: 1) nothing; 2) a little NiCl; 3) NiCl to about half saturation; 4) a little MnCl; 5) MnCl to half saturation. 1, 2, and 3 were about the same, 4 was poor, and 5 was very poor. So 1 (no added ion) was used. The moment ratio obtained from the molecular beam value of the hfs splittings ratio is 2.0261 ± 0.0003 . The discrepancy (discussed by Bitter, Phys. Rev. 76, 150, 1949) is thus 0.00728 ± 0.00033 , or $(0.358 \pm 4.5 \text{ percent})$ percent.

N. I. Adams III

2. Low Field Homogeneity of the Barrel-Type Electromagnet

In 1060 gauss in a gap of $4 \frac{3}{8}$ inches, a proton resonance was obtained from an oil sample in a movable probe and was displayed on an oscilloscope in the usual way. In order to reduce the gradient of the field due to finite size of the poles, rings of rectangular cross section of the type discussed by M. E. Rose, Phys. Rev. 53, 715, (1938) were used. Two pairs of rings were available, each having an outer diameter equal to that of

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the poles (11 inches). The smaller were 1/8 inch thick and 3/16 inch wide; the larger, 5/32 inch thick and 5/16 inch wide. Field plots were made in the axial and in both radial directions. In each case the two radial gradients were about equal, and the sum of all three gradients about zero, as expected. Consider a disk of zero thickness and diameter D, placed in a plane perpendicular to the axis of the magnet. For a given pair of rings there is a certain value of the difference between the least and the greatest field within the disk, which value is smallest in the most homogeneous part of the field. The field plots give:

Rings Used	Greatest Value of D for a Field Difference of	
	One Unit	Two Units
None	13/40"	20/40"
Small Only	15/40"	23/40"
Large Only	22/40"	30/40"
Large Next to Poles, Small On Top	31/40"	42/40"
Small Next to Poles, Large On Top	37/40"	57/40"

One unit is about 1/62000 of the total field.

N. I. Adams III

3. Deuteron-Proton Moment Ratio

The major part of the radio-frequency circuits has been completed. Frequency multipliers, dividers and mixers which produce the proton and deuteron resonance frequencies from a single crystal oscillator have been constructed. The driving oscillator for the deuteron resonance with control circuits for "phase-locking" it with the proper frequency obtained in the mixer circuits is now in operation. There remains to be constructed a similar oscillator for the proton resonance. Control circuits required for the latter must lock its frequency to the sum of a crystal-derived frequency plus a small audio frequency.

T. F. Wimett

B. DOUBLE RESONANCE EXPERIMENTS

1. Effects in Mercury

Experimental check of the main features of the calculations relative to the case of the even isotopes of mercury has progressed satisfactorily.

The dependence of the peak intensity at resonance and of the half width of the resonance line as a function of the radio-frequency field intensity has been extensively studied. The data fit in very well with the results of the computation. The complete line shape has been found in good agreement with theory.

Considerable improvement and greater stability and reproducibility have been obtained through increased sensitivity of detection and use of higher r-f fields.

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The dependence of the resonant frequency of the steady field is being measured.

A few measurements of the relative intensity of the resonances of the even and Hg 199 isotopes have been made. They agree satisfactorily with the computation. A systematic study of the problem is being prepared using an enriched sample of Hg 199.

J. Brossel

2. Effects in Alkalis

Apparatus for the optical detection of magnetic resonance in the $^2P_{3/2}$ state of sodium vapor has been constructed. The background from scattered light has been reduced sufficiently to make it possible to observe the optical resonance radiation easily. Assembly of a radio frequency transmitter is underway.

P. Sagalyn

C. MAGNETIC PROPERTIES OF SOLIDS

1. The Rare Earths

Work is continuing on the development of methods for measuring magnetization curves of ferromagnetic materials using very small samples.

H. H. Plotkin

2. Adiabatic Demagnetization

A discussion of this work will be found in section IV-C.