

## VI. MAGNET LABORATORY RESEARCH

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### A. NUCLEAR MAGNETIC RESONANCES

#### 1. Medium-Field Homogeneity of the Barrel-Type Electromagnet

A systematic program for homogenizing the field of the barrel-type electromagnet has been partly carried out for fields of about 14,500 gauss with poles 11 inches in diameter and a gap of 2-1/2 inches. Thin rings about 6 inches in diameter with rectangular cross section were placed on both pole faces. By proper adjustment of their position and cross section, fields were obtained varying by only 0.1 gauss over an axial cylindrical volume 3/4 inch in length and 3/4 inch in diameter. For this homogeneity it was also necessary to adjust the relative number of ampere-turns around each pole. Because of instability of the field as a function of time, the uncertainty in measurements of field increments was of the order of 0.1 gauss. Therefore finer adjustments cannot be made until field stabilization equipment is developed. The homogeneity obtained is as good as that obtained so far in the Helmholtz coils, but is less by an order of magnitude than that required for proposed measurements of magnetic moment ratios of isotopic pairs and certain small "chemical shifts" in nuclear resonances.

#### 2. $\text{Li}^7$ - $\text{Li}^6$ Nuclear Magnetic Moment Ratio

The ratio of the nuclear magnetic resonance frequency of  $\text{Li}^7$  to that of  $\text{Li}^6$  was measured in the barrel magnet at frequencies of about 24 Mc and 9 Mc respectively. Using a double-wound 0.2 cc sample consisting of unenriched  $\text{LiCl}$  in a 0.1 molar  $\text{CrCl}_3$  solution, we obtained

$$\frac{\nu(\text{Li}^7)}{\nu(\text{Li}^6)} = 2.6409107 \pm 0.0000050$$

where the total spread of the eighteen determinations made is included in one-half of the assigned error. The other half is the uncertainty in the frequency measurements. Frequency ratios were determined by combining a measurement of the beat frequency between the eighth harmonic of the lower frequency and the third harmonic of the higher frequency with a measurement of the higher frequency. Resonance line widths were about 0.08 gauss in both isotopes with a large contribution coming from the 30-cps field modulation employed in the measurement.

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## B. DOUBLE RESONANCE EXPERIMENTS

## 1. Effects in Mercury

The study of the line shape of the resonance line has been extended to the case of the hfs  ${}_{3/2}^3P_1$  level of Hg 199. An enriched sample was used to fill the resonance lamp. More sensitive detection was necessary and higher r-f field values were used. As predicted by the theory, the general features of this case are similar to those already obtained for the even isotopes of Hg (level  ${}_{1}^3P_1$ ). The intensity at resonance and the half-width of the line depend on the r-f field intensity in a similar fashion. So far the measurements have been made in the neighborhood of 150 Mc (resonating field approximately 120 gauss) where the decoupling between J and the nuclear spin I is notable. Of the three frequencies that one might expect, only two ( $1/2 \rightarrow 3/2$  and  $-1/2 \rightarrow -3/2$ ) are actually active in our case. Their separation is  $\Delta\nu = \omega \times (\omega/\nu_0)$  where  $\omega$  = Larmor frequency and  $\nu_0$  = hfs interval  $1/2 \rightarrow 3/2$ . Those two lines are not resolved. The single observed line is merely broadened. The measured width agrees with the above formula, giving very nearly the same lifetime for the  ${}_{3/2}^3P_1$  level of Hg 199 and for the  ${}_{1}^3P_1$  level of the even isotopes. Measurements are being prepared at 50 Mc to check this point more accurately.

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## 2. Effects in Alkalis

All the equipment necessary for obtaining a resonance in the  ${}^2P_{3/2}$  level of sodium has arrived and is in the process of final adjustment.

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