

VI. MAGNET LABORATORY RESEARCH

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RESEARCH OBJECTIVES

The magnet laboratory was established by M. I. T. in 1937. Its facilities are primarily of two kinds, based on two sources of power for operating magnets. One of these is a 1700-kw motor generator set capable of delivering currents up to 10,000 amp, dc, at voltages up to 170 volts. This facility is being used principally by the Metallurgy Department in a study of the magnetic susceptibility of the elements. It is also occasionally used by the Spectroscopy group for Zeeman effect studies, by the Low Temperature group for adiabatic demagnetization, and by our own group for magnetic scanning experiments.

The second source of power is a bank of submarine storage batteries capable of giving currents up to 400 amp at voltages up to 50 volts. This facility is being used primarily by our own group for nuclear resonance studies.

There are also a variety of magnets run by other power sources, such as the dc mains, small motor generator sets, and so on.

The program of the group reporting here centers around (a) studies of nuclear structures based on the observation of the hyperfine structure and isotope shift of atomic energy levels, and (b) around nuclear resonance studies and their bearing on atomic interactions. The first study has involved a combination of magneto-optics, and radio-frequency and microwave techniques. So far, work has been limited to sodium and mercury. The investigations now under way have as their aim the obtaining of precise data on the nuclear moments of a series of stable and radioactive mercury nuclei. A paper on this subject is appearing in a current number of the Physical Review. The nuclear resonance program is at present concerned with relaxation times in gases and problems of molecular structure.

F. Bitter

A. NUCLEAR ORIENTATION IN MERCURY VAPOR

Attempts have again been made to produce nuclear orientation in mercury vapor by the absorption of circularly polarized light – again without success. The failure is presumably the result of disorienting collisions at the cell walls.

J. R. Stanley

B. STEPWISE EXCITATION IN MERCURY

The hyperfine structure of the 4047 Å line for radioactive mercury has been investigated, and a faint component of the isomeric state of Hg^{197} with $I = 13/2$ has been detected. The significance of this result will be discussed in the next report.

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C. NUCLEAR RESONANCES IN SOLIDS

By measurements of linewidth in solid powder samples, it has been shown that rapid reorientation of complex cations in $(\text{Co}(\text{NH}_3)_6)\text{Cl}_3$, $(\text{Co}(\text{NH}_3)_6)\text{Br}_3$, and $(\text{Co}(\text{NH}_3)_6)\text{I}_3$ occurs at room temperature and is frozen out well above liquid nitrogen temperature. Related complexes that have been studied, in which one or more of the coordinated NH_3 molecules are replaced by other groups, show partially or completely hindered reorientation at the highest temperatures available at present. Work is in progress to determine the energies of activation necessary for the reorientation process and to correlate them with the structures of the materials.

Additional work is in progress on reorientation processes in solid acetylenic hydrocarbons and in hydrogen-bearing substances adsorbed on silica gel.

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