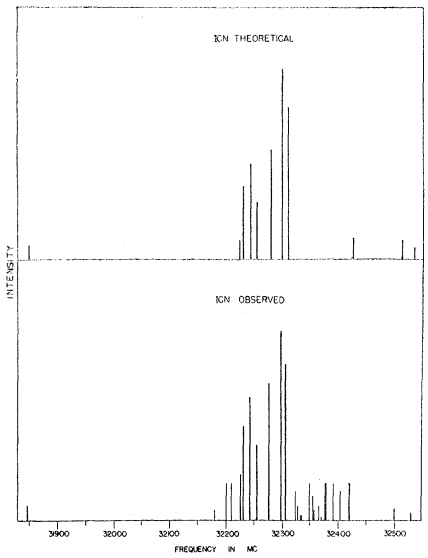

FIG. 2. Theoretical and observed hyperfine structure of the ICN spectrum for the rotational transition $J=4$ to $J=5$. The heavy lines are for the ground vibrational state; the light ones in the observed spectrum are due to excited vibrational states.

sponds to the stretching of the carbon-halogen bond, and in each case the stronger lines in the ground state are repeated with identical spacing in the excited vibrational state. From the separation of these groups it is possible to calculate the increase in the average bond length in the excited state over that for the ground state. They are: for BrC 0.0029A (0.17 percent increase); for IC 0.0037A (0.18 percent increase). This increase in length is due to the anharmonicity of the bond-stretching potential function. In the bending vibrational state the molecule is on the average shorter and the moment of inertia smaller. Hence, these lines fall on the high frequency side. Because of the interaction of the two modes of bending (L-type doubling) the hyperfine pattern of the ground state is not repeated exactly, as it is for the stretching vibration.

The moment of inertia and the structure of the BrCN molecule have been determined by Townes[2] from the rotational lines occurring at the lower frequencies. Our values for this molecule agree with his. The moment of inertia of ICN in its ground vibrational state is determined from our data as 260×10^{-40} g cm^2. Assuming the CN distance to be that observed for BrCN and ClCN (1.15A), the CI distance is 2.00A. No measurements from other sources are available for comparison, but this value should be accurate to 1 percent at least. To determine the structure of this molecule completely, we plan to search for the carbon isotope which should be detectable by our method.

The spin of the iodine nucleus is definitely established as 5/2. The quadrupole coupling factors, $eQ\partial^2V/\partial z^2$, are: for Br^{79}, 670±15 Mc; for Br^{81}, 567±15 Mc; for I^{127}, 2070±20 Mc. The quadrupole moment of I is negative, indicating that the iodine nucleus is flattened in the direction of the spin axis, i.e., it is oblate. That of Br is positive, indicating that the Br nucleus is elongated in the direction of the axis of spin, i.e., it is prolate. When the coupling coefficient $\partial V^2/\partial z^2$ is evaluated, the quadrupole moments of I and of Br can be determined from this data. We are now attempting to evaluate $\partial^2V/\partial z^2$ from data of other types.

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On the Inelastic Scattering of Neutrons in Crystals*

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THE inelastic scattering of a monochromatic neutron beam by crystal powders has been studied extensively by C. G. Shull and E. O. Wollan[1]; the experimental technique followed closely the well-known procedure in x-ray experiments. The very remarkable results obtained by these authors with a variety of scatterers seem to be in quantitative, and even qualitative disagreement with the presently accepted theories. It is, therefore, perhaps of interest to indicate an experimental approach to this problem which has no analogy in x-ray technique and promises to give valuable independent information. We suggest the study of the transmission of monochromatic neutron beams through single crystals of iron in a transverse magnetic field. Theory[2] then predicts very precisely that (apart from special angles of incidence here left out of consideration) no coherent scattering will occur. The weakening of the beam is due to incoherent nuclear scattering, inelastic lattice scattering, isotope disorder effects, and capture. Of these effects only inelastic lattice scattering will be influenced by a magnetic field. This special polarization effect has its origin in the fact that the incoherence of the inelastic scattering is due to energy exchange with the lattice while no element of incoherence enters into the interaction with the individual atom. Here the amplitudes of the wave scattered by the nucleus and by the magnetically active electron shell, superpose in the same way as we know them to interfere in the well-studied polarization effects obtained with polycrystalline iron.

In the present experiment the difference in transmission in the unmagnetized and saturated state of the scatterer is measured. This difference, $\Delta I/I$, will again be given in the customary approximation by the well-known formula

$$\Delta I/I=\tfrac{1}{2}p'^2d^2. \qquad (1)$$

In (1) p' denotes the excess cross section arising from the

interference term of nuclear and magnetic scattering in the inelastic process; d is the thickness of the crystal. The corresponding quantity p for coherent scattering has been assumed to be, and most likely is, much larger than p'; for this reason an arrangement eliminating coherent effects is here described.

Any observed "single transmission effect" is, therefore, determined by the inelastic scattering and can in turn be used to obtain quantitative information about its magnitude. One advantage of the arrangement here described lies in the replacement of a scattering by a transmission experiment. It is furthermore not difficult to obtain good saturation of the single crystal provided the magnetizing field is parallel to an easy axis of magnetization. Thus depolarization effects[3] can here be eliminated more easily than in previous experiments.

The presently accepted theoretical estimates[4] would lead to moderate but easily measurable effects; if, on the other hand, as suggested by the experiments quoted,[1] inelastic scattering should be much larger than expected, the "inelastic single-transmission effect" would become quite large. The isolation of the inelastic scattering would permit one to test the theory[4] rather precisely.

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