

Because of the large quadrupole coupling found for this molecule, $eQ\partial^2V/\partial z^2 = -1422$ mc, second order effects¹ cause slight deviations of the observed from the calculated spectrum for 7/2 spin. For example, these effects make one of the lines appear as a doublet, which according to first order theory would be a single line, composed of three components.

The quadrupole moment of I^{129} is negative—that is, the nucleus is oblate, or flattened along the spin axis. The ratio of $Q(I^{129})$ to $Q(I^{127})$ is 0.7353. If the quadrupole moment of I^{127} from atomic spectra,² -0.46×10^{-24} cm², is used, the value for the quadrupole moment of I^{129} is determined as -0.34×10^{-24} cm². With the value of -0.59×10^{-24} cm² for the quadrupole moment³ of I^{127} , obtained from microwave measurements⁴ for CH_3I^{127} , the quadrupole moment of I^{129} is found to be -0.43×10^{-24} cm². We are inclined to favor the latter value, which depends on the calculation of $\partial^2V/\partial z^2$ from the doublet separation of iodine, according to the formula⁵

$$\partial^2V/\partial z^2 = 8e\Delta\nu/15Z_1R\alpha^2a_0^3.$$

The C—I bond in methyl iodide is close to a pure single bond formed by a p -orbital of the iodine. The bond should have very little ionic character since the electro-negativities of iodine and carbon are approximately equal. Hence, the application of this formula to methyl iodide should give a more accurate value of the $\partial^2V/\partial z^2$ than it would when applied to ICN, where the C—I bond is complicated by appreciable resonance with double bond structures, or to ICl, where there is a fairly large electro-negativity difference of the bonded atoms.

I^{129} is known to emit beta-rays and to decay to Xe^{129} , with a long half-life.⁶ Since the spin of Xe^{129} is $\frac{1}{2}$, the spin change in this reaction is therefore 3. The long half-life of I^{129} is consistent with this spin change, and its spectrum should be of the second forbidden type or higher.

We are now attempting to determine the nuclear magnetic moment of I^{129} from the Zeeman effect on the hyperfine structure and are using the present data to obtain a more accurate determination of the structure of the methyl iodide molecule. This information, with details on experimental procedure, will be given in a later publication.

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² K. Murakawa, *Zeits. f. Physik* **114**, 651 (1939); T. Schmidt, *Zeits. f. Physik* **113**, 140 (1939).

³ W. Gordy, *Rev. Mod. Phys.* **20**, 714 (1948).

⁴ Gordy, Simmons, and Smith, *Phys. Rev.* **74**, 243 (1948).

⁵ H. A. Bethe and R. F. Bacher, *Rev. Mod. Phys.* **8**, 226 (1936); C. H. Townes, *Phys. Rev.* **71**, 909 (1947).

⁶ G. T. Seaborg and I. Perlman, *Rev. Mod. Phys.* **20**, 585 (1948); personal communication with Mr. George Parker; details to be published at a later date.

Observed	(1)	2.0327±0.001
Observed	(3)	2.038 ±0.01
Calculated	(2)	2.0261±0.0003.

The interaction between the optical electron and the nucleus is of two kinds—electrostatic and magnetic—and it is of interest to determine whether the observed effect can be accounted for on the basis of either of these two forces. The effect of spreading the nuclear charge, usually considered concentrated at a point at the origin, over a finite sphere of radius R_0 , is to reduce the electronic density $\psi^2(0)$ at the nucleus. This effect was shown by Rosenthal and Breit⁴ to lead to a correction in calculating hyperfine structure of the order of zR_0/a_0 for atoms having a nuclear charge in the range of rubidium. The a_0 is the radius of the first Bohr hydrogen orbit. While this ratio is 0.5 percent for rubidium, and can account for discrepancies in the hyperfine structure of the order of the observed discrepancy (0.3 percent), it is very unlikely that this is the explanation, as it would require an enormous difference in size of Rb^{85} and Rb^{87} . Besides the fact that all available evidence supports a slowly varying nuclear radius proportional to the cube root of the mass number, we have specific evidence⁵ that there is no observable isotope shift in the spectrum of rubidium, and therefore no such very large difference in nuclear size. Effects due to a magnetic structure inside the nucleus, first proposed by Kopfermann⁶ in the days when such effects could well be dismissed as negligible, and recently applied by Bohr⁷ to the proton-deuteron problem, also lead to a correction of the order of zR_0/a_0 . This is a much more reasonable explanation, since there is no objection to assuming the wave function for the odd proton in rubidium to be quite different for the two isotopes. In fact, this might be expected on the basis of a vector model⁸ of the nucleus, which would assign to Rb^{87} with $I=3/2$, $l+s=1+1/2$, and to Rb^{85} with $I=5/2$, $l-s=3-1/2$.

The fact that effects of this order of magnitude have not been observed for the gallium isotopes⁹ or for the thallium isotopes¹⁰ is not unreasonable since, in both cases, the two isotopes have the same nuclear spin and comparable nuclear moments, and it is therefore not unreasonable to assume that they also have comparable wave functions for the odd proton.

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⁷ A. Bohr, *Phys. Rev.* **73**, 1109 (1948).

⁸ See, for example, Brookhaven National Laboratory publication 1-5, by Goldsmith and Inglis, on "Spins, Magnetic Moments, and Electric Quadrupole Moments," dated October 1, 1948.

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¹⁰ H. Poss, *Phys. Rev.* **75**, 600 (1949).

Nuclear Magnetic Moments and Hyperfine Structure of the Rubidium Isotopes*

F. BITTER

Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts

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A RECENT determination¹ of the nuclear moments of the rubidium isotopes indicates that, as was first suspected by Millman and Kusch,² the observed ratio of the magnetic moments does not agree with the ratio calculated from hyperfine structure,

$$\mu Rb^{87}/\mu Rb^{85},$$

Hall Effect in Metal-Semiconductor Point Contacts

S. BENZER

Department of Physics, Purdue University,* Lafayette, Indiana

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TRANSVERSE Hall effect determinations have been a very useful tool in the study of conductivity in bulk semiconductors. According to the elementary theory of the Hall effect, if a current I passes through a parallelepiped (Fig. 1(a)) and a perpendicular magnetic field H is applied, a transverse e.m.f. is observed given by the formula $E = RHI(1/t)$, where t is the thickness of the specimen (in the H direction) and R is a constant characteristic of the material. The magnitude and sign of R yield information regarding the density of current carriers and whether they are predominantly electrons or holes; studies of Hall effect