FIG. 2. $F-K$ plot of the positrons from Cu^{64} using the same source as in Fig. 1.

sistent with linearity to less than 50 kev. This strongly suggests that previous deviations found in the $F-K$ plot of this isotope were a result of finite source thickness.

[1] J. Backus, Phys. Rev. 68, 59 (1945); C. S. Cook and L. M. Langer, Phys. Rev. 73, 601 (1948); G. E. Owen and H. Primakoff, Phys. Rev. 74, 1406 (1948); C. S. Wu and R. D. Albert, Phys. Rev. 75, 1107 (1949).
[2] G. E. Owen and C. S. Cook, Phys. Rev. 76, 1536 (1949).
[3] G. E. Owen and C. S. Cook, Rev. Sci. Inst. 20, 768 (1949).

Magnetic Resonance Absorption of Diluted Iron Ammonium Alum*

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MEASUREMENTS have been made on the paramagnetic absorption spectra of iron ammonium alum at room temperatures and at 9375 mc/sec. The method used is similar to that described earlier;[1] however, the method has been modified so that the absorption is measured directly through a measurement of χ'' alone.

Bagguley et al.[2] have reported measurements at room temperature on undiluted single crystals of iron ammonium alum which indicate a zero-field splitting no greater than 0.10 cm^{-1}. Because of the large spin-spin interactions the individual lines to be ex-
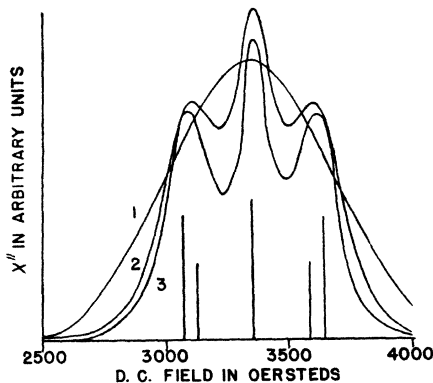
TABLE I. Theoretical absorption pattern.

Orientation	$A = h\nu/g\beta$; $B = \delta c/\nu$.	Peak positions	
(100)	A	$A(1\pm(4/6)B)$	$A(1\pm(5/6)B)$
(111)	A	$A(1\pm(4/9)B)$	$A(1\pm(5/9)B)$
(110)	A	$A(1\pm(4/24)B)$	$A(1\pm(5/24)B)$
		Relative intensities	
All 3	9	5	8

pected were unresolved. We have been able to resolve the lines partially by using diluted single crystals in which some of the iron ions are replaced by aluminum.

Figures 1, 2, and 3 show measured absorption curves for the orientations of the d.c. field perpendicular to the crystalline faces (100), (111), and (110), respectively. The absorption for the undiluted salt is shown by curve 1; curves 2 and 3 apply respectively to the dilutions of 1 iron to 13 aluminum atoms and 1 iron to 38 aluminum atoms. No attempt has been made to measure absolute absorption, and the ordinate scales are not identical for the several curves; however, for all orientations the intensity decreased with dilution. The lines in the figures indicate the positions and relative intensities of the resonances as computed from the theory.
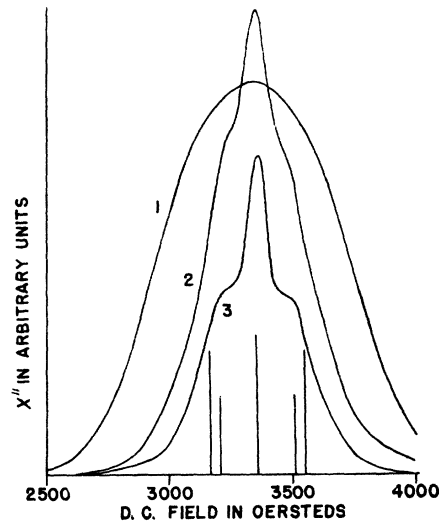

FIG. 2. Absorption curves for the (111) orientation.

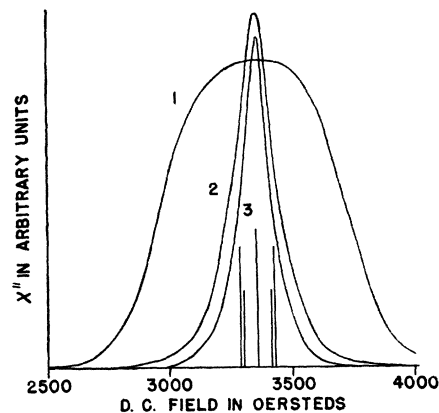FIG. 1. Absorption curves for the (100) orientation.

FIG. 3. Absorption curves for the (110) orientation.

The electric field acting on the iron ion is taken to be due to the octahedron of water molecules surrounding the ion and is, therefore, of predominantly cubic symmetry. The single energy level of the ^6S state of the normal ion splits,[3] under the influence of the crystalline field, into two levels, one doubly degenerate, the other quadruply degenerate. The expected relative intensities and positions in oersteds of the absorption lines are shown in Table I for the three orientations used in these measurements. δ is the level separation, or zero-field splitting in cm^{-1}, and g is the effective g value of the paramagnetic ion.

The patterns for the three orientations differ only in the separation of the side peaks from the central maximum. The side peaks are resolved from the central peak only in the (100) orientation of the diluted salts, although here, too, the overlapping of lines is appreciable. The theoretical spectra shown in the figure are those obtained with $\delta = 0.032$ cm^{-1}; this value of δ was chosen to give the best fit between the weighted mean of the side peaks in the theoretical spectrum and the observed side peaks of the (100) orientation. Because of the overlapping of the lines and their unknown shapes this value is approximate.

The curves for the (111) and (110) orientations are not inconsistent with this choice of δ. Although it is impossible to assign a value to the splitting for the undiluted salt, it appears that there is very little change in the splitting with changes in dilution.

The position of the central peak is the same for all curves and corresponds to $g = 1.99 \pm 0.01$.

A rough graphical analysis of the observed pattern made on the assumption of a Gaussian line shape and a constant line width for all resonances in a given orientation does not yield agreement with the theoretical intensities, the intensity of the observed central peak being relatively too strong.

* This work was supported by the Joint Program of the ONR and the AEC, by the RCA Research Laboratories, and by the Rutgers University Research Council.
** Deceased October 8, 1949.
[1] Whitmer, Weidner, Hsiang, and Weiss, Phys. Rev. 74, 1478 (1948).
[2] Bagguley, Bleaney, Griffiths, Penrose, and Plumpton, Proc. Phys. Soc. 61, 551 (1948).
[3] H. Bethe, Ann. d. Physik 3, 133 (1929).

Energy for Diffusion by Direct Interchange

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WE are much indebted to Professor Zener for calling our attention to an error in the value given in our paper[1] for the electrostatic energy associated with the saddle-point configuration (Fig. 2A in reference 1) for direct-interchange diffusion in copper. The original value was 11 ev. On recalculation the energy for the same configuration turns out to be 4.8 ev.

Besides the electrostatic term there is an increase in the energy of this configuration associated with the closed shell repulsion of the ion cores. This has been estimated to be 6.2 ev on the basis of a repulsive potential of exponential form with parameters chosen to fit with the known elastic constants of copper. It is admittedly a severe extrapolation to use the elastic data to calculate the interaction energy of copper ions at distances of approach as close as those occurring in this configuration. We decided to re-examine also this part of the direct interchange calculation to find out to what extent the result had been prejudiced by the choice of an exponential repulsion. Recent measurements on the compressibility of copper have been reported by Bridgman[2] for pressures up to 30,000 kg/cm^2. They can be interpreted to give a variation of bulk modulus of 7.8×10^{10} dy/cm^2 for one percent change in

volume. This turns out to be only about 20 percent more than the value obtained from the fourth term in the expansion of the exponential potential. While the closeness of this agreement may be some extent fortuitous, the general validity of the original approach appears to be substantiated. If one constructs a cubic expression for the potential, using the same constant term as in the expansion of the exponential and evaluating the other coefficients from the elastic constants and the high pressure data, one obtains for the energy of repulsion for the saddle-point about 5.5 ev against 6.2 as previously quoted.

Within the limits of this calculation, the results indicate that direct interchange is ruled out for the self-diffusion of copper by energetic considerations.

[1] H. B. Huntington and Frederick Seitz, Phys. Rev. 61, 315 (1942).
[2] P. W. Bridgman, Proc. Am. Acad. Arts Sci. 77, 198 (1949).

Erratum: The Equation of State of Gaseous He³

[Phys. Rev. 76, 998 (1949)]

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IN consequence of an unfortunate misunderstanding this letter has been printed with the following errors:

The formula (1) for B should read:

$$ B = -\frac{N}{2\pi^2}\left(\frac{h^2}{\pi m \kappa T}\right)^{5/2} \int_0^\infty \sum_l (2l+1)\delta_l \eta_l(k) \exp\left(-\frac{h^2k^2}{m\kappa T}\right)kdk $$
$$ + N\left(\frac{h^2}{\pi m \kappa T}\right)^{3/2} \sum_n \sum_l (2l+1)\delta_l(e^{-E_{nl}/\kappa T}-1) + \frac{N}{32}\left(\frac{h^2}{\pi m \kappa T}\right)^{3/2}, $$

where $\delta_l = \frac{1}{2} - (-1)^l \frac{1}{4}$."

The last sentence in the lines following the equation should read:
"The influence of the statistics, i.e., of the symmetry character of the wave functions is reflected, firstly in the last term which is positive for F.D. statistics and negative for B.E. statistics, and secondly in the value of δ_l which transforms into $\frac{1}{2}+(-1)^l\frac{1}{4}$ in the case of B.E. statistics."

The table should be corrected as follows:

T	He³ B.T³ᐟ²	He⁴ B.T³ᐟ²
0.51	−107	−388
1.02	−205	−401
2.04	−331	−477
3.07	−412	−543
4.09	−469	−592
5.11	−511	−625
6.13	−541	−644
7.15	−561	−654

"The contribution of the last term of (1) to $BT^{3/2}$ is constant and equal to 45.5 cm^3 degree $^{3/2}$/mole. A detailed account of these calculations will appear shortly in Physica."

On the Magnetic Moments of Sn¹¹⁵, Cd¹¹¹, Cd¹¹³, Pt¹⁹⁵, and Hg¹⁹⁹ *

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USING the nuclear induction spectrometer described in an earlier letter,[1] the magnetic moments of Sn^{115}, Cd^{111}, Cd^{113}, Pt^{195}, and Hg^{199} have been measured, in good agreement with these results from hyperfine structure measurements: $\mu(Sn^{115}) = -0.89\mu_N$;[2] $\mu(Cd^{111}) = -0.65\mu_N$;[3] $\mu(Cd^{113}) = -0.65\mu_N$;[3] $\mu(Pt^{195}) = 0.6\mu_N$;[4] $\mu(Hg^{199}) = 0.547\mu_N$.[5] Resonance amplitudes were consistent with a spin of $\frac{1}{2}$, as obtained by hyperfine structure ob-