results presented here do not exclude the possible classification $E1+M2$.

V. CONCLUSIONS

Of the eight K-shell internal-conversion coefficients measured, only three of the transitions may be classified as predominantly pure multipole radiation. In the other cases the transitions must be classified as mixed multipole radiation. Unfortunately, the values of the conversion coefficients for some of these cases do not distinguish between mixtures involving parity-favored and parity-unfavored transitions. The directional angular correlation measurements,[18] in combination with the conversion coefficients, will probably remove the ambiguity in the classification of the 345-kev and 480-kev gamma rays of Ta^{181}.

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The Nuclear Magnetic Moments of K^{41}, Y^{87}, Ag^{107}, and Ag^{109}

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The gyromagnetic ratios of K^{41}, Y^{89}, Ag^{107}, and Ag^{109} have been measured by nuclear induction technique. With the known spin values the magnetic moments without diamagnetic corrections are:

$$\mu_{41}=-0.21453\pm0.00003 \text{ nm},$$
$$\mu_{89}=-0.136825\pm0.000004 \text{ nm},$$
$$\mu_{107}=-0.113014\pm0.000004 \text{ nm},$$
$$\mu_{109}=-0.129924\pm0.000004 \text{ nm}.$$

In metallic silver a paramagnetic shift of 0.53 percent is observed.

THE nuclear magnetic moments of K^{41}, Y^{87}, Ag^{107}, and Ag^{109} have been measured with a nuclear induction type spectrometer of greatly increased sensitivity of a design similar to one described by Weaver.[1] With the exception of K^{41}, whose gyromagnetic ratio was determined relative to K^{39}, the resonance frequencies were measured at a fixed magnetic field of about 9000 gauss in terms of the proton resonance frequency in a sample of 0.1-molar $MnSO_4$, which was located immediately adjacent to the sample containing the unknown substance.

The results quoted below were obtained with the sufficiently well known values of the nuclear spins from hfs and the diamagnetically uncorrected value of the proton magnetic moment of Sommer, Thomas, and Hipple[2] $\mu_P=2.79268\pm0.00006$ nm. No diamagnetic corrections have been applied. In every case the sign of the magnetic moment was determined by comparison with the signal of a known moment.

Resonances of the two potassium isotopes 39 and 41 were obtained in a 15-molar aqueous solution of KCO_2H. Both isotopes are known to have spin $\frac{3}{2}$. For K^{39} the magnetic moment measured relative to proton was found to be

$$\mu_{39}=+0.390873\pm0.000013 \text{ nm},$$

in agreement with the value of Collins[3]: $\mu_{39}=+0.39094 \pm0.00007$. The signal of K^{41} (abundance 6.9 percent) appeared with a signal-to-noise ratio of about 3:1. The ratio of the frequencies of the two isotopes is

$$\nu_{41}/\nu_{39}=0.54886\pm0.00008,$$

in agreement with the value 0.54891 ± 0.00005, as found from atomic beam measurements by Ochs, Logan, and Kusch.[4] The nuclear spin is $I=\frac{3}{2}$, and with the above value of μ_{39} one obtains

$$\mu_{41}=0.21453\pm0.00003 \text{ nm}.$$

Signals of the only stable isotope Y^{89} were obtained in a pure 3.3 molar aqueous solution of $Y(NO_3)_3$ with a signal-to-noise ratio of 20:1. The ratio of Yttrium to proton resonance frequency is

$$\nu_{89}/\nu_P=0.048994\pm0.000001.$$

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[2] Sommer, Thomas, and Hipple, Phys. Rev. **82**, 697 (1951).
[3] T. L. Collins, Phys. Rev. **80**, 103 (1950).
[4] Ochs, Logan, and Kusch, Phys. Rev. **78**, 184 (1950).

With $I=\frac{1}{2}$, this yields

$$\mu_{89}=-0.136825\pm0.000004 \text{ nm},$$

in agreement with the hfs value $\mu_{89}=-0.14$, as given by Crawford and Olson[5] and Kuhn and Woodgate.[6]

The resonances of Ag^{107} and Ag^{109} were observed in metallic silver and also in an aqueous solution of 7-molar $AgNO_3$ and 1-molar $Mn(NO_3)_2$. Du Pont colloidal silver paint with an approximate molarity of 25 was used for the observations of the resonances in metal where the signals appeared with a signal-to-noise ratio of 50:1 and 80:1, respectively. From the metallic sample we obtained the frequency ratios:

$$\nu_{107m}/\nu_P=0.040684\pm0.000001,$$
$$\nu_{109m}/\nu_P=0.046771\pm0.000001.$$

The ionic solution yielded:

$$\nu_{107i}/\nu_P=0.040468\pm0.000001,$$
$$\nu_{109i}/\nu_P=0.046523\pm0.000001.$$

It appears, therefore, that there is a considerable shift of the resonances in the metal caused by the paramagnetism of the free electrons as found by Knight[7] and Gutowsky and McGarvey.[8] By observation of the resonances at various field it was ascertained that the resonance frequency was proportional to the field, as is to be expected.[9] The ratio of the resonance frequencies of the two isotopes is equal within the limits of error for both samples:

$$(\nu_{109}/\nu_{107})_m=1.14961\pm0.00004,$$
$$(\nu_{109}/\nu_{107})_i=1.14962\pm0.00004,$$

and hence the fractional deviation of the resonance frequency of the metallic sample from that of the ionic sample at the same field is likewise the same:

$$S_{107}=(\nu_{107m}-\nu_{107i})/\nu_{107i}=(0.534\pm0.004) \text{ percent},$$
$$S_{109}=(\nu_{109m}-\nu_{109i})/\nu_{109i}=(0.533\pm0.004) \text{ percent}.$$

This is of a reasonable order of magnitude, since Gutowsky and McGarvey[8] find 0.449 ± 0.004 percent for Ga^{71} and 0.650 ± 0.005 percent for Rb^{85} and 0.653 ± 0.002 percent for Rb^{87}. The frequency ratio in the ionic solution is 0.41 percent lower than the ratio of the two hfs splittings as observed by Wessel and Lew.[10] This difference is apparently caused by the distribution of nuclear magnetism over the different nuclear volumes of the two isotopes.[11] From this fact one should conclude that there should also be a difference between the relative frequency shifts for the metallic samples of the two isotopes. The field caused by the paramagnetism of the conduction electrons is given by[9]

$$\Delta H=\chi_P M\langle|\psi_F(r)|^2\rangle_{Av}H,$$

where χ_P is the susceptibility of the free electrons per unit mass, M the nuclear mass, $\langle|\psi_F(r)|^2\rangle_{Av}$ the probability density of the conduction electrons averaged over the nuclear volume, and H the external field. Assuming that the ratio of these average densities for the two isotopes is similar for the atomic s electron (responsible for the hfs shift) and the conduction electrons, one should expect that $S_{109}/S_{107}=1.004$. The difference against the experimental value 0.998 ± 0.01, lies well within the limits of the present accuracy.

From the resonance frequencies determined in the ionic sample, by use of the known spin value $I=\frac{1}{2}$ for both isotopes, one obtains the magnetic moments:

$$\mu_{107}=-0.113014\pm0.000004 \text{ nm},$$
$$\mu_{109}=-0.129924\pm0.000004 \text{ nm},$$

as compared to the hfs values of Brix, Kopfermann, Martin, and Walcher,[12] *viz.*: -0.111 ± 0.008 and -0.129 ± 0.008, respectively.

All of the four isotopes measured in this work are odd-proton nuclei with $I=L-\frac{1}{2}$ having spins of $\frac{1}{2}$ and $\frac{3}{2}$, for which the Schmidt limit values are: $=-0.26$ nm for $I=\frac{1}{2}$, and $=+0.12$ nm for $I=\frac{3}{2}$. It is to be noted that the actual values for spin $I=\frac{1}{2}$ are only about one-half of the Schmidt limit value, while the moment of K^{41} is about 70 percent larger than the limiting value.

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