This work was supported in part by the University Research Committee with funds made available by the Wisconsin Alumni Research Foundation.

[1] R. T. Overman, Abstracts Am. Chem. Soc. Meeting **111**, p. 44P, paper 70 (1947).

[2] D. Grahame and H. Walke, Phys. Rev. **60**, 909 (1941).

[3] U. S. Atomic Energy Commission Isotopes Catalog No. 2, Item 16. The sample used in this work was of much higher specific activity than the standard sample listed in the catalog and had been chemically purified from S^{35} formed by the $Cl^{35}(n, p)S^{35}$ reaction. With unpurified samples a high background of bremsstrahlung from the intense S^{35} beta-radiation is observed.

[4] L. E. Glendenin, Nucleonics **2**, 29, Fig. 15 (1948).

[5] L. C. Miller and L. F. Curtiss, Bur. Stand. J. Research **38**, 359 (1947).

[6] C. D. Coryell, *The Use of Isotopes in Biology and Medicine* (University of Wisconsin Press, Madison, 1948), p. 127.

Magnetic Multipole Internal Conversion

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The use of the ratio of the K to L shell internal conversion coefficients has been suggested for determining the multipole nature of radiation emitted from the atomic nucleus.[1] Curves showing the values of this ratio as a function of energy for $Z=35$ have been given for electric multipoles[1] valid for the region of low energies.

To facilitate the comparison with the experimental data, it is desirable to have curves for the magnetic multipole case valid in the same region of energy. This has been accomplished by using for the K shell a rigorously correct expression specialized to the case of non-relativistic energies for the magnetic multipole internal conversion, due to Bessey,[2] based on the Dirac equation, and an analogously derived formula for the L shell internal conversion. Figure 1 shows curves for the K to L ratio evaluated for $Z=35$ in the magnetic multipole case taking into account screening as in Hebb and Nelson. For the sake of comparison, the curves of Hebb and Nelson for the electric case are included. The Hebb and Nelson curve for $l=4$ has been omitted, whereas for the experimental application, this must of course be used with the $l=3$ magnetic case.

The K to L ratios for the magnetic multipole radiation have been previously calculated by the Born approximation[1,3] for use with the K to L electric multipole low energy curves. For comparison of the relative values of the magnetic multipole ratios in the two approximations, we have shown in Fig. 2 curves for the Born approximation as well as those mentioned above for the rigorous low energy case. From these curves it appears that the Born approximation ratios for $l=1$, 2 differ from our low energy approximation by less than 10 percent in the neighborhood of 10^5 ev, and greater, gamma-ray energy. However, it should not be concluded that the K and L magnetic internal conversion coefficients, β_K and β_L, calculated in the two ways agree that well. For example, for $l=1$ and 2×10^5-ev gamma-ray energy the difference in the β_K's so determined is approximately 15 percent and in the β_L's approximately 12 percent. For $l=3$ it is clear that the difference in the ratios for the two approximations is appreciably larger than for $l=1$, 2. Consequently, caution is required in assuming equivalence of the two approximations for the ratio in this energy range in the general case, at least for $Z=35$ and higher.

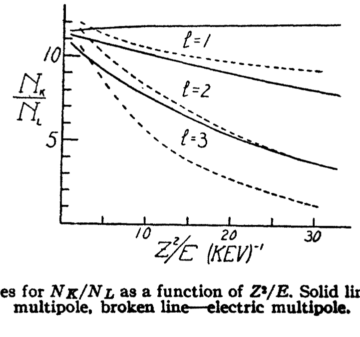

FIG. 1. Curves for N_K/N_L as a function of Z^2/E. Solid line—magnetic multipole, broken line—electric multipole.

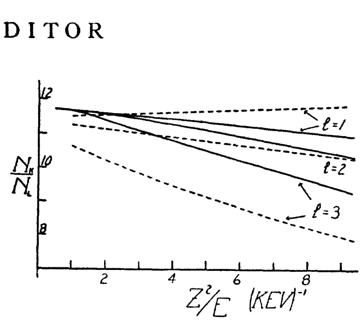

FIG. 2. Curves for N_K/N_L for magnetic multipoles as a function of Z^2/E. Solid line—Born approximation, broken line—Pauli approximation.

Finally the L shell electric multipole conversion has been calculated in the region of low energies, starting from the Dirac equation, to ascertain whether additional contributions from the spin might alter the value for this quantity as determined by Hebb and Nelson using Schroedinger theory. The answer is in the negative.

In conclusion, we wish to express our gratitude to Dr. J. R. Bessey for sending us the correct expression for the low energy K conversion in the magnetic case[4] before publication and to Professor G. E. Uhlenbeck for his kind interest in this work.

[1] M. H. Hebb and E. Nelson, Phys. Rev. **58**, 486 (1940).

[2] Bessey, Thesis, University of Michigan, 1942. Cf. also Drell, Bull. Am. Phys. Soc. **23**, 18 (1948).

[3] M. H. Hebb and G. E. Uhlenbeck, Physica **7**, 605 (1938); S. M. Dancoff and P. Morrison, Phys. Rev. **55**, 122 (1939).

[4] The results of G. Goertzel and I. S. Lowen, Phys. Rev. **67**, 203 (1945) and of V. Berestetzky, J. de Phys. U.S.S.R. **10**, 137 (1946), using the elementary Pauli theory for the K shell, while in agreement with each other, are incorrect owing to failure of the simple Pauli theory which does not take into account correctly contributions from the origin in the case of the highly singular magnetic multipole potentials. See reference 2.

O^{17} and S^{36} in the Rotational Spectrum of OCS*

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The transitions $J=1\rightarrow2$ of $O^{16}C^{12}S^{36}$ and $O^{17}C^{12}S^{32}$ have been detected. Abundance and mass of S^{36} were determined. The spin of S^{36} appears to be zero, and there is some indication that the spin of O^{17} is $\frac{1}{2}$.

S^{36} was discovered by Nier[1] who stated its abundance as 1:6000, so that a very sensitive spectrograph was needed