First-Forbidden Beta-Spectra and the Beta-Spectrum of $Sr^{90}-Y^{90}$

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SEVERAL investigations supporting the applicability of the correction factor $(W_0-W)^2+(W^2-1)$ to first-forbidden beta-spectra have been reported[1] recently. The theoretically expected shape of such spectra, as reported by Marshak[2] and by Greuling,[3] suggests that a more precise form for this correction factor would be $a=(W_0-W)^2+\Lambda(W^2-1)$, where the coefficient Λ is not strictly independent of the electron momentum and may differ appreciably from unity when Z is large.

In terms of Greuling's notation,[3]

$$\Lambda=[(S_1+2)/(2S_0+2)][F_1/F_0];$$

a plot[4] of Λ as a function of electron momentum is shown in Fig. 1, for $Z=40$ and $Z=60$. Although the introduction of the coefficient Λ may result in no more than a very small modification of the spectral form expected for a first-forbidden beta-transition when Z is in the neighborhood of 40, recent work[5] here with Pr^{142} has indicated that the introduction of this coefficient can result in a noticeable change in the spectral shape of $Z=60$. This note is submitted at this time with the thought that the application of the modified correction factor indicated here may be of interest to other investigators.

In a previous letter[6] the beta-spectra of Sr^{90} and Y^{90} were reported as of the first-forbidden form discussed above. An indication of the rather small improvement obtained in this case by including the coefficient Λ in a comparison of the experimental data with theory is afforded by the following weighted r.m.s. relative differences between the theoretical curves and the individual counting rates observed in the Y^{90} spectrum (for the interval $2.079 \leqslant W \leqslant 5.256$): with $\Lambda=1$, r.m.s. deviation $=1.5$ percent; with Λ from Fig. 1, r.m.s. deviation $=0.8$ percent; and from statistical counting error, expected r.m.s. deviation $=0.6$ percent.

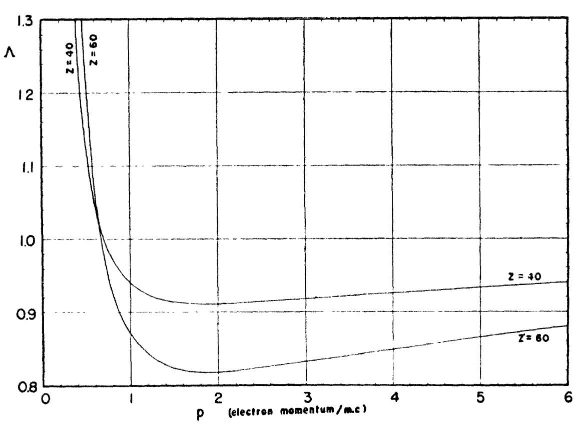

FIG. 1. Graph of the coefficient Λ, which appears in the correction factor $a=(W_0-W)^2+\Lambda(W^2-1)$.

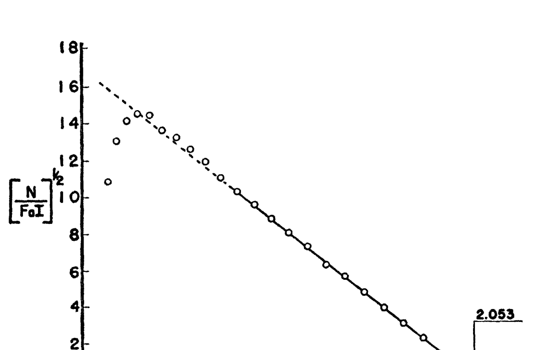

FIG. 2. Modified Kurie plot, $(N/FaI)^{\frac{1}{2}}$ *vs.* W, for a separated Sr^{90} source.

A more adequate separated source of Sr^{90} was obtained[7] since our first work on this activity was performed and a modified Kurie plot of the more recent data is shown in Fig. 2 to supplement the results previously reported.[6] Upper limits of 2.24 and 0.54 Mev (kinetic energy) are obtained for the Y^{90} and Sr^{90} beta-spectra, respectively.

The *ft*-values were calculated with the more precise correction factor a included with the Fermi function in the integral expression for f. Values of 1.7×10^9 and 2.0×10^9 were obtained for Sr^{90} (19.9 yr.[8]) and Y^{90} (62 hr.), respectively.

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1 L. M. Langer and H. C. Price, Jr., Phys. Rev. **75**, 1109 (1949), **76**, 641 (1949); C. L. Peacock and A. C. G. Mitchell, Phys. Rev. **75**, 1272 (1949); E. N. Jensen and L. J. Laslett, Phys. Rev. **75**, 1949 (1949); Braden, Slack, and Shull, Phys. Rev. **75**, 1964 (1949); Slack, Braden, and Shull, Phys. Rev. **75**, 1965 (1949); C. S. Wu and L. Feldman, Phys. Rev. **76**, 696 (1949); D. Saxon and J. Richards, Phys. Rev. **76**, 982 (1949); L. M. Langer, Phys. Rev. **77**, 50 (1950); and H. M. Agnew, Phys. Rev. **77**, 655 (1950).

2 R. E. Marshak, Phys. Rev. **61**, 431 (1942).

3 E. Greuling, Phys. Rev. **61**, 568 (1942).

4 The values of F_0 were computed by means of a series expression for the logarithm of the modulus of the gamma-function appearing as a factor in F_0 and were in agreement with those given in a preliminary coarse-mesh table subsequently obtained from the Computation Laboratory of the National Bureau of Standards through the kindness of Dr. Fano. The computation of F_1/F_0 was based on the use of a similar series to represent F_1.

5 Jensen, Laslett, and Zaffarano (manuscript in preparation).

6 E. N. Jensen and L. J. Laslett, Phys. Rev. **75**, 1949 (1949).

7 We are indebted to Dr. A. F. Voigt and Mr. E. Dewell in the Radiochemistry Section of this Laboratory for their assistance in performing this separation.

8 R. Powers and A. F. Voigt (private communication).

The Effect of Nuclear Structure on the Elastic Scattering of Fast Electrons

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THE cross section for the scattering of electrons by atomic nuclei has been investigated at energies for which the nuclei can no longer be treated as point charges. Three nuclear models were used: (A) point charge, (B) uniform spherical charge distribution of radius R, (C) uniform spherical shell charge distribution of radius R. The radius R is taken to be[1] $R=e^2A^{\frac{1}{3}}/2mc^2$, in the usual notation.

Preliminary calculations, based on Born's approximation, showed that significant deviations from the cross sections using a point nucleus should occur for a light element, such as Al, at about 30 Mev, and for a heavy element, such as Au, at about 15 Mev. For Al, Born's approximation is valid,[2] but for Au it is not. Hence an exact calculation without any approximation was carried out for Au and 20-Mev electrons by calculating the phases for the lower order partial cross sections, using models (B) and (C). It was found that only the zero-order phases $(\eta_0-\eta_{-2})$ were significantly different for model (A) and for models (B) and (C). The calculations for model (A) by Bartlett and Watson[3] (these were done for Hg, but are sufficiently accurate also for Au) were then modified accordingly in the zero-order phases. The ratio $R_{B,C}=I_{B,C}(\theta)/I_A(\theta)$ of the differential cross section for an extended nucleus to that of a point nucleus is given in Table I, where the values for Al are calculated by Born's approximation and those for Au are calculated exactly. The energy has been adjusted to 16.5 Mev, so that comparison can be made with the experimental results,[4] R_{exp}. Because of the electrostatic repulsion of the charges inside the nucleus, the charge density is likely to increase with the radius, and so the true distribution is likely to be somewhere