The cross section in the present experiment is larger than that given for 2.5-Mev neutrons in the preliminary report by Graves and Coon. If the present measurements are averaged over the larger energy spread used by these authors, a cross section of about 20 millibarns is obtained compared to 5 millibarns observed by Graves and Coon. The shape of the cross section curve given in Fig. 2 is in agreement with the yield curve published by Sikkema.[3]

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† AEC Predoctoral Fellow.

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On the Type of Interaction in β-Decay

STEVEN A. MOSZKOWSKI
Argonne National Laboratory, Chicago, Illinois
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A KNOWLEDGE of the type of interaction responsible for β-decay would help in understanding the fundamental character of β-decay and its connection with other nuclear phenomena. According to Konopinski,[1] the β-decay interaction may be a linear combination of several types of interaction. These are the Fermi interactions (scalar and vector), the Gamow-Teller interactions (tensor and axial vector), and the pseudoscalar interaction. The possibility of the β-decay interaction including both scalar *and* vector or both tensor *and* axial vector interactions is ruled out by the observed shapes of allowed β-spectra.[2]

Let us assume that the type of interaction responsible for β-decay is the same for all transitions and that it is a linear combination of Fermi (scalar or vector), Gamow-Teller (tensor or axial vector), and pseudoscalar interactions.

The matrix elements squared for any β-transition can then be written as follows:[2]

$$|M|^2=C_F^2|M_F|^2+C_G^2|M_G|^2+C_P^2|M_P|^2.$$

Here $|M|$ denotes the total matrix element, $|M_F|$, $|M_G|$, $|M_P|$ are the matrix elements of Fermi, Gamow-Teller, and pseudoscalar interactions. The relative amounts of the different interactions are indicated by C_F, C_G, C_P with the relation

$$C_F^2+C_G^2+C_P^2=1$$

For superallowed transitions, $|M_F|^2$ and $|M_G|^2$ are given by Konopinski on the basis of the Wigner supermultiplet model.[1,3] $|M_P|^2=0$; thus the amount of pseudoscalar interaction, given by C_P, cannot be ascertained by a study of superallowed transitions. However, a study of recent, accurate, measurements on superallowed β-decays makes it possible to draw conclusions as to the relative contributions of Fermi and Gamow-Teller interactions, C_F^2/C_G^2, which is here denoted by K.

A possible method of obtaining the value of K is to compare the β-transitions H^3-He^3 and He^6-Li^6. Wu[4] lists the results of latest measurements. For the decay of H^3, the value of ft is 1125 (±12 percent); for He^6, $ft=584$ (±2 percent). According to the Wigner model, the above transitions may be represented as $S_{1/2}-S_{1/2}$ and S_0-S_1. The value of $|M|^2$ for the H^3-He^3 decay, in our notation, is $C_F^2+3C_G^2$; for the He^6-Li^6 decay, $|M|^2=6C_G^2$. Equating $|M|^2ft$ for the two transitions,[1] and solving for K, it is found that $K=0.11\pm0.45$.

Another method of estimating the value of K is the study of branching in the decay of Be^7 by orbital electron capture to the ground state or the excited state of Li^7. According to both the Wigner model and the Mayer shell model,[5] the ground states of Be^7 and Li^7 are $P_{3/2}$ states, while there is evidence that the excited state of Li^7, denoted here by Li^{7*}, has spin $\frac{1}{2}$.[6] The energies of decay to ground and excited states are 0.88 and 0.40 Mev, respectively.[7] The fraction of all Be^7 decays going to Li^{7*} is 0.118 ± 0.01.[8] The Be^7-Li^7 and Be^7-Li^{7*} transitions may be represented as $P_{3/2}-P_{3/2}$ and $P_{3/2}-P_{1/2}$. The matrix elements have the following values:

$$|M|^2 \text{ for } Be^7-Li^7=C_F^2+5/3C_G^2$$
$$|M|^2 \text{ for } Be^7-Li^{7*}=4/3C_G^2.$$

The application of the Fermi β-decay theory to orbital electron capture[1] and the use of these matrix elements yields the result $K=0.39\pm0.20$.

It appears from the previous argument that β-decay is primarily determined by a Gamow-Teller interaction, with an additional amount of Fermi interaction of relative magnitude $K=0.2-0.4$, and an unknown amount of pseudoscalar interaction, provided the values of matrix elements given by the Wigner theory are correct. This excludes such interactions as the one proposed by Critchfield,[9] according to which $K=1$.

It is expected that the Wigner model tends to break down for excited states, such as Li^{7*}, and for states involving more than one odd nucleon, such as Li^6. This would result in a reduction of the matrix elements for the He^6-Li^6 and the Be^7-Li^{7*} transitions, but not for the H^3-He^3 and the Be^7-Li^7 transitions. The result would be a reduction in the value of K. Perhaps K vanishes when the correct matrix elements are used. In this case the β-decay would be determined entirely by a Gamow-Teller interaction, plus an unknown amount of pseudoscalar interaction.

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Variation of Dielectric Constants of Ionic Crystals with Pressure

D. A. A. S. NARAYANA RAO
Physics Department, Andhra University, Waltair, India
(Received October 2, 1950)

MAYBURG[1] determined the variation of dielectric constants of five ionic crystals with pressure and discussed the results on the basis of Mott and Littleton's theory of the static dielectric constants. But $\partial\gamma/\partial \ln\rho$ values calculated by the author on the same basis from the equation

$$(1-\gamma)=\frac{K+2}{K-1}\left\{1\pm\left[\frac{K-1}{K+2}\cdot\frac{K_0+2}{K_0-1}-1\right]^{\frac{1}{2}}\times\left[\frac{K-1}{K+2}\,\frac{9L^4(1-4px/3)}{\pi(Ze)^2x}-1\right]^{\frac{1}{2}}\right\} \quad (1)$$

are at variance with those reported by Mayburg[1] in Table IV of his paper. In view of the importance of these values in supporting the theory, it is found necessary to report and discuss the recalculated values.

The variation of dielectric constants of ionic crystals with pressure may be discussed from a different point of view. Born and Mayer[2] gave the relation

$$K-K_0=C_1\rho/\nu^2, \quad (2)$$

where K is the dielectric constant, K_0 the optical dielectric constant, C_1 a quantity independent of pressure, ρ the density, and ν the infrared absorption frequency. The variation of ν with pressure is not known, but it may be replaced by another quantity whose variation with pressure is known. For this purpose, the relations developed by Born and Brody[3] for ν and χ (compressibility) of ideally heteropolar solids are useful.

$$\nu^2=\frac{1}{4\pi^2\mu}\,\frac{S_0(m)}{3}\,\frac{e^2}{L^3}\left\{\frac{(n-1)S_0'(n+2)}{S_0(n)}-\frac{(m-1)S_0'(m+2)}{S_0(m)}\right\}, \quad (3)$$