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On the Angular Distribution of β-Radiation. II

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THE analysis of β-radiation from oriented nuclei is of considerable interest, as relative measurements of angular distribution of β-radiation, in conjunction with theory, can give valuable information about the spins, parities and magnetic moments of β-radioactive nuclei.

A theoretical analysis of angular distribution of β-radiation has been carried out in references 1 and 2. Reference 2 in particular gives the expression $W(E, \theta)$ for the distribution (as a function of energy and of angle) of β-particles emitted by oriented nuclei for the transition $\Delta I = \pm 2$, "yes" (I is the nuclear spin, "yes" denotes that the parity of the nucleus changes upon emission of a β-ray). However the introduction of this expression in reference 2 applies only in the Born approximation.

By comparing the expression for $W(E, \theta)$ obtained in the Born approximation with the expression for the β-spectrum of the corresponding transition (including Coulomb effects[3]), it becomes quite simple to include Coulomb effects in the formula for angular distribution: in order to carry this out it is sufficient to multiply by ϕ_1 the term proportional to p^2 in the square brackets of Eq. (2), reference 3, and to multiply by ϕ_0 the term proportional to q^2; according to reference 3 (using the notation and units of reference 2):

$$\varphi_0 = \frac{1 + s_0}{2} F_0(Z, E), \tag{1}$$

$$\varphi_1 = \frac{2 + s_1}{4} F_1(Z, E). \tag{2}$$

where

$$s_n = \sqrt{(n+1)^2 - (\alpha Z)^2}, \tag{3}$$

$$\xi = Z\alpha / \beta, \tag{4}$$

and the Coulomb factors F_0 and F_1 are given by the formula

$$F_n(Z, E) = \frac{[(2n+2)!]^2}{(n!)^2 [\Gamma(1 + 2s_n)]^2} \times (2pR)^{2(s_n - n - 1)} \exp(\pi\xi) \, | \Gamma(s_n + i\xi) |^2. \tag{5}$$

In Eqs. (1) - (5), α denotes the fine structure constant, R the nuclear radius, β the electron velocity, Z the nuclear charge (in the case of positron emission, ξ must be replaced by $-\xi$).

Finally we obtain for the distribution of β-radiation as a function of energy and angle, for the transition $\Delta I = \pm 2$, "yes":

$$W(E, \vartheta) = \tfrac{1}{3} (2\pi)^{-5} \pi G^2 \, | B_{ik} |^2 \, pEq^2 \times \{q^2 \varphi_0 + p^2 \varphi_1 [1 - a(I) f_2 P_2(\cos\vartheta)]\}. \tag{6}$$

Note that Eq. (6) can be transformed into Eq. (2) of reference 2 by neglecting terms of the order of $(\alpha Z)^2$.

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The Absorption of Ultrasonic Waves in Armco Iron and Plexiglass

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THERE are a number of works devoted to the measurement of the ultrasonic absorption coefficient in solids, although the number is still comparatively small. In many metals and dielectrics, no measurements have as yet been made, and the existing theory of the mechanism of this