caused by a variation of the potential V (r, λ) $\to V$ (r, $\lambda + \epsilon\lambda$), where λ is some parameter. From Equation (5) we have

$$\partial (v_2^+ F(\mathbf{v}_1, \mathbf{v}_2))/\partial\lambda = -\frac{pE}{2\pi}\int \psi_2^+ \frac{\partial V}{\partial \lambda}\psi_1 dr. \tag{9}$$

Variational principles (5) and (6) and the virial theorem (7), (8) are also valid for a Coulomb field for r $\to\infty$, if we take account of the fact that in this case the asymptotic form of the wave functions should include terms in ln (pr).

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The Internal Compton Effect

E. G. MELIKIAN
Moscow State University

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SPRUCH and Goertzel[1] have calculated the relative probability of the internal Compton effect for magnetic 22-pole transitions and Iakobson[2] has obtained an approximate relativistic formula for electric 2^j-pole transitions, but only for small gamma-ray energies. In the present work a general formula is derived for the relative probability of this effect for both magnetic and electric transitions in the Born approximation and numerical calculations are carried through for some specific cases.

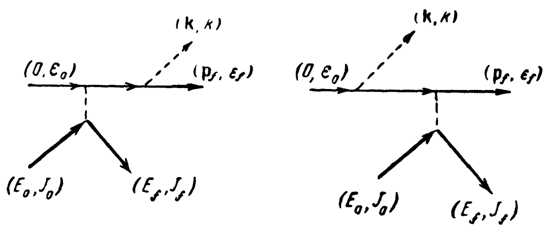

Figure 1.

The process under consideration is characterized by the Feynman diagrams in Fig. 1, where the heavy lines correspond to a nucleus and the thin dashed lines correspond to an electron and photon. In the initial state we have an excited nucleus with charge Z, energy E and angular momentum J_0, and an electron in the K shell with energy ϵ_0. In the final state, the energy and angular momentum of the nucleus are designated by E_f and J_f, and the energy and momentum of the electron and photon by ϵ_f, $\mathbf{p}_f$ and k, $\mathbf{k}$, respectively. Hereinafter, we shall use the system of units in which $h = c = 1$.

Using the general methods of quantum electrodynamics in our calculations (see Ref. 3) we obtain the relative probability of the internal Compton effect (the ratio of the absolute probability of the effect to the probability of a radiation transition of the nucleus) which for the magnetic $2j$-pole transition is expressed by

$$\beta_j^{(0)} = \frac{2\pi\alpha^2 (Zm\alpha)^3 (2j+1)\, p_f}{pk} |L|^2 \Big\{\Big[1 + \frac{k}{m} + \frac{\Delta E}{mp'}\Big]\frac{p_f k}{p^2}(x^2 - 1) - \frac{2\varepsilon_f(\Delta E m + kp')}{mp'} - \Big[\frac{1}{m^2} + \frac{1}{p'^2}\Big][\Delta E m^2 + k(m+k)p']\sin\vartheta d\vartheta dk, \tag{1}$$

$$L = (2/\pi)(p/\Delta E)^{j+1/2}(p^2 - \Delta E^2 - 2iZm\alpha\Delta E)^{-1},$$

$$p' = p_f x - \varepsilon_f,\ x = \cos\vartheta,\ \Delta E = E_0 - E_f,\ \varepsilon_0 \sim m,$$

$$p = |\mathbf{p}_f + \mathbf{k}|,\ j = |I_0 - I_f|,$$

where ϑ is the angle between the vectors $\mathbf{p}_f$ and $\mathbf{k}$.

This formula is in agreement with the results of Spruch and Goertzel[1] if we neglect the width of

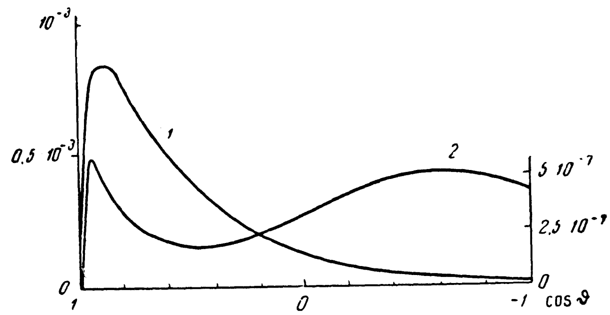

FIG. 2

the nuclear energy level in the latter. It should be noted that in the present problem the width of the nuclear energy level is of no importance.

In the case of an electric transition, the relative probability of the internal Compton effect is given by the following:

$$\beta_j^{(1)} = \frac{2\pi (Zm\alpha)^3 (2j+1) p_f \alpha^2}{(j+1) pk} \mid L \mid^2 \Big\{\Big(\frac{1}{m^2} + \frac{1}{p'^2}\Big) [\Delta E m^2 + k(m+k) p'] \tag{2}$$

$$\times \Big[j - (2j+1)\frac{\Delta E^2}{p^2}\Big] - \frac{2jm^3}{p'^2} + \Big(\frac{\Delta E}{mp'} + \frac{m+k}{m^2}\Big)\frac{k\Delta E^2}{p^2} p_f [(j+1)\cos\vartheta$$

$$+ (j-1)\cos(\widehat{pp_f})\cos(\widehat{pk})] + \frac{1}{mp'}[2j\varepsilon_f [k(\Delta E - m) - 2m^2]$$

$$-(2j+1)\frac{m\Delta E^3 \varepsilon_f}{p^2} - \frac{2k\Delta E}{p} j [m\Delta E + \varepsilon_f(\Delta E + m)]\cos(\widehat{pk})$$

$$+ \frac{2\Delta E m}{p} j p_f [(\Delta E + m)\cos(\widehat{pp_f})] + \frac{1}{m^2}\Big[2j[k(\varepsilon_f - m)(k - 2m) - m^2\varepsilon_f]$$

$$-(2j+1) mk\varepsilon_f \frac{\Delta E^2}{p^2} - \frac{2\Delta E k}{p} j\Big[k\varepsilon_f + m(\Delta E + m)\cos(\widehat{pk})$$

$$-\frac{2\Delta E j}{p} p_f [k(k+m) - m^2]\cos(\widehat{pp_f})\Big]\Big\}\sin\vartheta d\vartheta dk.$$

Figure 2 presents curves of the angular distribution of gamma rays emitted as a result of the internal Compton effect; these were obtained by numerical integration from (1) and (2) with the photon energy k in the range from 0.05 to 0.4 mev for curve 1 and up to 0.7 mev for curve *2*. Curve *1* refers to a transition in Ba^{137m} (*M*4 transition, ΔE = 0.662 mev), while curve *2* refers to a transition in Mg^{24} (*E*2 transition, $\Delta E \approx 1.38$ mev).

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On the Magnetization Mechanism of Some NiZn Ferrites in Very Weak Fields

L. A. FOMENKO
Central Laboratory for the Combatting of Industrial Radio Noise

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RATHENAU and Fast recently published the results[1] of their investigation of the initial permeability σ_a of two types of NiZn ferrites: $Ni_{0.5}Zn_{0.5}Fe_2O_4$ and $Ni_{0.36}Zn_{0.64}Fe_2O_4$ under different external stresses σ_a. The experimental data were interpreted in terms of rotations of the direction of magnetization of ferromagnetic domains. This interpretation has in particular been used by Smit and Wijn[2] as one proof that Snoek[3] was right in attributing the magnetic radio-frequency spectra of NiZn ferrites to gyromagnetic resonance.

As a basis for this view Rathenau and Fast took the agreement between the experimental data and the theoretical formula which they derived for the rotation; this formula (1) establishes a relation between $\Delta\mu_a$ and σ_a:

$$\Delta\mu_a = (9/40\pi)(\lambda_s \sigma_a \mu_a / I_s^2)\,\mu_a, \tag{1}$$

where I_s is the saturation magnetization and λ_s is the saturation magnetostriction.

Formula (1) was obtained (neglecting the correction for porosity of the sample) by inserting in

$$\Delta\mu_a = {}^1/_5\,({}^3/_2\,\lambda_s\sigma_a\mu_a / {}^2/_3\,K) = (9\lambda_s\sigma_a / 20K\mu_a), \tag{2}$$

the value of K from the equation

$$\mu_{a\,\mathrm{rot}} - 1 = 2\pi I_s^2 / K, \tag{3}$$

which was given by Wijn[2] and which follows from the theory of pure rotation processes that was first developed by Akulov[4].

Rathenau and Fast[1] arbitrarily assumed