Internal Compton Effect (*).

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Summary. — In this paper an experimental check on the internal Compton effect (I.C.E.) is presented. The experiment, performed using a $^{137}$Ba source, consists of the measurement of the differential cross-section of the effect at $30^\circ$, $45^\circ$, $60^\circ$, $90^\circ$, $120^\circ$, $150^\circ$ and $180^\circ$ angles. The results are in satisfactory agreement with the theoretical calculation of Spruch and Goertzel.

1. Introduction.

The internal Compton effect is a nuclear transition through which the excited nucleus decays emitting a $\gamma$-ray and an orbital electron simultaneously (more frequently a $K$-electron). The transition probability for I.C.E. was investigated by several authors. An earlier theory, due to COOPER and MORRISON (1), is valid for high-energy electric-dipole transition, but does not take into account the gamma-electron angular correlation. If one considers the process as an internal bremsstrahlung of the conversion electron, one can apply the theory formulated by CHANG and FALKOFF (2) for the internal bremsstrahlung in the $\beta$-decay. The theory of Chang and Falkoff was applied to the experiment of BROWN and STUMP (3) who firstly showed the presence of a continuous $\gamma$-spectrum in connection with internal conversion in the decay of $^{137}$Cs.

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Later, a theory of the I.C.E. has been worked out by Spruch and Goertzel. The $\gamma$-electron angular correlation is calculated in the Born approximation and for magnetic transition.

The I.C.E. for electric and magnetic transition was considered by Jakobson. This theory is valid for nonrelativistic energies and does not take the $\gamma$-electron angular correlation into account. Finally Melikian has extended the Spruch and Goertzel theory to electric transitions.

Experimentally the $\gamma$-electron angular correlation is studied in the work of Brown and Stump. The experimental results show an isotropic behaviour and do not agree with the theoretical prevision. Another experiment has been made by Lindqvist, Pettersson and Sieghahn; the $\gamma$-electron angular correlation is found to be consistent with the theory of Spruch and Goertzel.

2. -- Theory.

In the theory of Spruch and Goertzel for magnetic transition, the relative differential probability of the I.C.E. is calculated.

The relative differential probability $B_k(L, q, \theta)/\partial \Omega_{\gamma} \partial q$ is the ratio of the probability of the effect (for K-electron, magnetic multipole of order $L$, per unit photon energy interval and per unit solid angle of $\gamma$-ray) to the probability of a conversion transition of the nucleus.

The theory of Spruch and Goertzel gives:

\[
\frac{\partial^2 B_k(L, \theta, q)}{\partial \Omega_{\gamma} \partial q} = \frac{e^2 m^2}{\pi^2 W^{2-1}(W + 2m)^{L+1}} \frac{P}{q} Q^{2L} H \cdot F,
\]

where

\[
H = (E')^{-2} \left[ WP^2 (1 - \mu^2) + q^2 E' \right] - \\
\quad - (mE')^{-1} \left[ qP^2 (1 - \mu^2)(mq + P^2 + Pqu)Q^{-2} \right] + \frac{q}{m^2} qE' - P^2 q^2 (1 - \mu^2)Q^{-2},
\]

\[
F = [(Q^2 - W^2)^2 + (2mWZ)^2]^{-1},
\]

$W =$ energy of the transition,

$E =$ energy of the electron.


