Weak Effects in the Decay Spectra of Neutral Pseudoscalar Mesons (*).

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(riccuto il 25 Gennaio 1978)

Summary. — The effect of the neutral weak current on the decay mode of a neutral pseudoscalar meson ($\pi^0$ or $\eta$) into a photon and a lepton-antilepton pair has been calculated within the framework of the Weinberg-Salam model. A parity-violating contribution to the decay spectrum is found to be larger for the decay $\eta \rightarrow \gamma \mu^+\mu^-$. In this case it can be of the order $10^{-6}$ strongly depending on the value of the Weinberg angle and thus is still beyond the present experimental possibilities. However, a measurement of this effect would not only give a strong hint on the value of the Weinberg angle, but could also help to resolve the difficulties of the Weinberg-Salam model in atomic-physics experiments.

1. – Introduction and results.

First experimental results seem to indicate that the Weinberg-Salam model (1) fails in atomic physics (2), while no contradiction is found in nearly all other experimental results which involve neutrinos (3). It is, therefore,

(*) To speed up publication, the authors of this paper have agreed to not receive the proofs for correction.

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desirable to investigate neutral-current effects in experiments which
hitherto not been considered. In this spirit ABEI~S and SHARIF calculated
parity-violating effects to the decay $\Sigma^0 \rightarrow \Lambda e^+ e^-$ \(^{(4)}\). It
might be possible to get meson beams of high intensity in the future,
so that one can think also about a careful study of even the rare
decay modes of mesons \(^{(5)}\).

In this paper we calculate the decay of a neutral pseudoscalar meson
$M (\pi^0$ or $\gamma$) into $\gamma$ and a pair of leptons $l^+ l^-$ ($e^+ e^-$ or $\mu^+ \mu^-$):

\[ M(p) \rightarrow \gamma(k) + l^-(l) + l^+(l'). \]

The moments of the particles are given in the brackets of eq. (1). The mass
of the meson or lepton will be denoted by $m_M$ or $m_l$, respectively.

The main decay mode of the neutral pseudoscalar mesons $\pi^0$ and $\gamma$ is

\[ M(p) \rightarrow \gamma(k) + \gamma(k'). \]

The corresponding coupling constant, in the soft-meson limit, can be ob-
tained from a consideration of the Adler-Bell-Jackiw triangle \(^{(6)}\). The soft-
meson value can successfully be used in particular for the real pion, but also
for the $\gamma$-meson.

If one of the gammas is converted internally to a $l^+ l^-$ pair, one obtains
process (1). The corresponding graph is shown in fig. 1a). Figure 1b) shows
the neutral-weak-current contribution to that process. Its contribution be-
comes effective in the interference term of both graphs.

\[ Fig. 1. - Graphs contributing to the decay $M \rightarrow \gamma l^+ l^-$. The quantities in brackets denote the momenta. \]