The following Hamiltonians may be responsible for the decay of a vector $K_{\mu 3}$-meson at rest:

$$H_1' = g_1 (\overline{\psi}_\mu \psi_\nu) A_i \partial\varphi_\pi/\partial x_i, \quad H_2' = g_2 (\overline{\psi}_\mu \gamma_i \psi_\nu) A_i \varphi_\pi,$$

$$H_3' = g_3 (\overline{\psi}_\mu \gamma_i \gamma_k \psi_\nu) A_i \partial\varphi_\pi/\partial x_k,$$

where A_i is the vector wave function of the $K_{\mu 3}$-meson. If we calculate the probability for emission of polarized μ-mesons in the decay of spin-1 polarized $K_{\mu 3}$-mesons as was done by Okun',[7] we obtain the following results. The interactions H_i' separately do not lead to polarized μ-mesons. Neither does the "mixture" $H_i' + H_3'$. The "mixtures" $H_1' + H_2'$ and $H_2' + H_3'$, on the other hand, lead in general to polarized μ-mesons.

I take this opportunity to express my gratitude to Professor G. R. Khutsishvili for aid and discussions of the results of the present work.

[1] S. G. Matinian, J. Exptl. Theoret. Phys. (U.S.S.R.) 31, 529 (1956), Soviet Physics JETP 4, 434 (1957).
[2] S. A. Bludman, M. A. Ruderman, Phys. Rev. 101, 109 (1956).
[3] Crussard, Fouche, Hennesy, Kayas, Leprince-Ringuet, Morellet, and Renard, Nuovo cimento 3, 731 (1956).
[4] Ritson, Pevsner, Fung, Widgoff, Goldhaber, and Goldhaber, Phys. Rev. 101, 1085 (1956).
[5] B. d'Espagnat, Compt. rend. 228, 744 (1949).
[6] M. A. Ruderman and R. Finkelstein, Phys. Rev. 76, 1458 (1949).
[7] L. B. Okun', *Dissertation*, Akad. Sci. U.S.S.R., Moscow, 1956.

Translated by E. J. Saletan
194

On Strong Interaction between the *K*-Particle and the π-Particle

S. G. MATINIAN
Institute of Physics
Academy of Sciences of the Georgian SSR

J. Exptl. Theoret. Phys. (U.S.S.R.) 32, 930-931 (April, 1957)

EXPERIMENTAL DATA concerning K-mesons lead to two different conclusions which are difficult to reconcile. On the one hand, experiment gives the same (within the limits of experimental error) masses and lifetimes for different K-particles. In experiments performed under varying conditions, different K decay schemes are observed with equal frequency[1]. In addition, experiments with a beam of K^+-mesons before and after scattering[2] lead to the conclusion that the θ and τ-particles have the same interaction cross sections with matter. All this would seem to imply that the different K-meson decay schemes correspond to alternate modes of decay for the same particle. On the other hand, analysis of τ-decays and the existence of the $\theta^0 \to 2\pi^0$ decay implies that the θ and τ are different particles.

In order to eliminate this contradiction, Lee and Yang introduced the concept of parity doublets[3] and parity nonconservation in weak interactions[4]. Schwinger postulated a strong interaction between pions and K-mesons. In the present note the hypothesis of a strong π-K interaction is applied to obtaining certain relations between the probabilities of K decays according to various schemes.

We thus start from the following isotopic invariant interaction scheme between the π- and K-mesons.

$$K' \rightleftarrows K'' + \pi. \tag{1}$$

On the basis of Eq. (1) we may relate, for instance, the decay of the τ-meson with the decay of the θ-meson, and determine, in particular, the ratio of the probabilities for the two decays

$$\tau^{\pm\prime} (\to 2\pi^0 + \pi^\pm) \text{ and } \tau^\pm (\to \pi^+ + \pi^- + \pi^\pm).$$

According to (1) we may write the τ^+ decay

$$\tau^+ \xrightarrow{g_{K\pi}} \pi^+ + \theta^0 \xrightarrow{f} \pi^+ + \pi^+ + \pi^-, \tag{2}$$

where $g_{K\pi}$ is the coupling constant of the strong π-K interaction, and f is the coupling constant of the weak interaction between the θ-field and the π-field. For the $\tau^{+\prime}$ decay we have two possibilities:

$$\tau^{+\prime} \xrightarrow{g_{K\pi}} \begin{cases} \pi^+ + \theta^0 \xrightarrow{f} \pi^+ + \pi^0 + \pi^0, \\ \pi^0 + \theta^+ \xrightarrow{f} \pi^0 + \pi^0 + \pi^+. \end{cases} \tag{2'}$$

The probability of one or another τ decay is given by the product of the probability for formation of one or another $\pi + \theta$ configurations (this probability is found from the hypothesis of isotopic invariance) and the probability w for the decay of the θ-meson according to one or another scheme. The ratio of the θ-meson decay probabilities can be found by assuming that in this decay the isotopic spin selection rule $|\Delta T| = 1/2$ is operative[5]. There exist two possibilities depending on the spin of the θ-meson.

1. The spin of the θ-meson is odd. Then the $\theta^0 \to 2\pi^0$ decay is impossible. According to the above, the ratio R of the τ' decay to that of the τ decay is

$$R = w(\theta^+ \mid 0+)/2w(\theta^0 \mid +-), \tag{3}$$

where, for instance, $w(\theta^+|0+)$ is the probability that the θ^+-meson decays into a π^0 and a π^+. According to Gatto[5], if the spin of the θ-particle is odd

$$w(\theta^+ \mid 0+) = 2w(\theta^0 \mid +-)$$

and $R = 1$.

2. The spin of the θ-meson is even. Then according to Gatto[5], $w(\theta^+ | +0) = 0$ (if the selection rule $|\Delta T| = ½$ is operative), and

$$w(\theta^0 \mid +-) = 2w(\theta^0 \mid 00).$$

We then obtain $R = 0.5$.

As is well known, the ratio R can be found from the selection rule $|\Delta T| = ½$ alone[5,6] and lies in the interval $¼ \leqslant R \leqslant 1$. The case $R = ¼$ occurs when the total isotopic spin of the system of three π-mesons is equal to unity in our case of a strong π-K interaction, R is subjected to another restriction. We note that the experimental values of R as found by various observers differ among themselves to a great extent. Recently Birge, Perkins, *et al.*,[1] have obtained $R = 0.39 \pm 0.096$.

Using the concept of a strong π-K interaction, we can also determine the ratio R_0 of the decays

$$\tau^{0\prime}(\to 3\pi^0) \text{ and } \tau^0(\to \pi^+ + \pi^- + \pi^0).$$

We obtain $R_0 = 0$ if the spin of the θ-particle is odd, and $R_0 = 0.5$ if the spin of the θ-particle is even.

Several experiments have indicated the existence of the so-called anomalous θ^0-decay[7], among which there are cases which have been interpreted according to the scheme

$$K^0_{\mu 3} \to \mu^\pm + \pi^\mp + \nu. \tag{4}$$

For $K^+_{\mu 3}$ and $K^0_{\mu 3}$ decays we may write (see also an earlier work by the present author[8])

$$K^+_{\mu 3} \to K^+_{\mu 2} + \pi^0 \to \mu^+ + \nu + \pi^0,$$
$$K^0_{\mu 3} \to K^+{}_2 + \pi^- \to \mu^+ + \nu + \pi^-. \tag{5}$$

The ratio R_μ of the $K^+_{\mu 3}$ and $K^0_{\mu 3}$ decay probabilities is then $R_\mu = 0.5$ independent of the spin of the $K_{\mu 2}$ (in this case the absence of a neutral μ-meson is relevant).

I take this opportunity to express my gratitude to Professor G. R. Khutsishvili for discussions of the results.

[1] Birge, Perkins, Peterson, Stork, and Whitehead, Nuovo cimento 4, 834 (1956).

[2] M. Shapire *et al.*, Bull. Am. Phys. Soc. s. II 1, 185 (1956).

[3] T. D. Lee and C. N. Yang, Phys. Rev. 102, 290 (1956). (1956).

[4] G. Morpurgo, Nuovo cimento 4, 1222 (1956).

[5] R. Gatto, Nuovo cimento 2, 318 (1956).

[6] G. Wentzel, Phys. Rev. 101, 1215 (1956).

[7] Ballam, Grisaru, and Treiman, Phys. Rev. 101, 1438 (1956).

[8] S. G. Matinian, J. Exper. Theoret. Phys. (U.S.S.R.) 31, 529 (1956), Soviet Physics JETP 4, 434 (1957).

Translated by E. J. Saletan
195

Application of a Renormalized Group to Different Scattering Problems in Quantum Electrodynamics

V. Z. BLANK
Moscow State University

(Submitted to JETP editor December 28, 1956)
J. Exptl. Theoret. Phys. (U.S.S.R.) 32, 932-933 (April, 1956)

THE METHOD of renormalized group was applied[1, 2] to obtain the assymptotic expressions for the quantum electrodynamic Green function and for the vertex part. The use of the renormalized group presents also a considerable interest in the case of concrete scattering processes.

For this purpose, let us first formulate the renormalized group for the transition probabilities. This is conveniently done by using the generalization of the Feynman diagrams proposed by Abriko-