so that q_{min} does not differ strongly from κ.

5. When the primary particle moves in a crystal, it looses energy. This imposes limitations on the crystal thickness within which coherence is maintained. The corresponding value is obtained from the condition that the phase will not change over the thickness by more than π:

$$\frac{q_{min} l \Delta\epsilon}{2\epsilon} \approx \pi . \tag{10}$$

We note that this condition also calls for high-energy particles.

6. We remark in conclusion that, in principle, a process which in some sense is the inverse of that considered above can exist, namely a specific Coulomb excitation of an individual nucleus by the periodic field of a crystal lattice. This phenomenon, to which attention was first called by V. V. Okorokov [5], calls for a special study.

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τ DECAY AND CURRENT ALGEBRA

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Submitted 12 December 1966
ZhETF Pis'ma 5, No. 5, 170-173, 1 March 1967

1. Nonleptonic decays of K mesons were considered in a number of papers [1-4] within the framework of the hypothesis of partially conserved axial current (PCAC) and current algebra. Assuming that the weak-interaction Hamiltonian H is in the form of a product of a current by a current, and that the matrix elements vary slowly when the 4-momenta of the pions approach zero symmetrically, Suzuki [1] proved the $\Delta = 1/2$ rule and obtained a relation between the probabilities of the $K \to 3\pi$ and $K \to 2\pi$ decays. However, inasmuch as in the limit of zero pion momenta the amplitude depends on the method of going to the limit, the assumed slow variation is not justified. To take into account a fast variation, it was proposed in [3] to expand the amplitudes in the pion energies, but the cause of the rapid variation was not discussed.

In the case of the $K \to 2\pi$ decay, as noted in [4], the ambiguity in the calculation of the limit of the amplitude can be explained by means of a pole diagram (Fig. 1).

2. In this note we consider the consequences of the assumption that the $K \to 3\pi$ decay amplitude is a constant plus a rapidly-varying contribution from the pole diagrams shown in

Fig. 2. In the physical region, the rapid variation is then connected with the strong dependence [5,6] of the π-π and π-K scattering amplitudes on the momenta, and when the pion momenta tend to zero, allowance for the pole diagrams explains the ambiguity in the calculation of the limit. Within the framework of the model under consideration, we prove the $\Delta T = 1/2$ rule, obtain the probability ratios of the $K \to 2\pi$ and $K \to 3\pi$ decays, and determine the pion spectra. The results coincide with those obtained in [3].

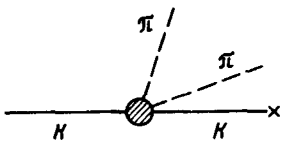

Fig. 1

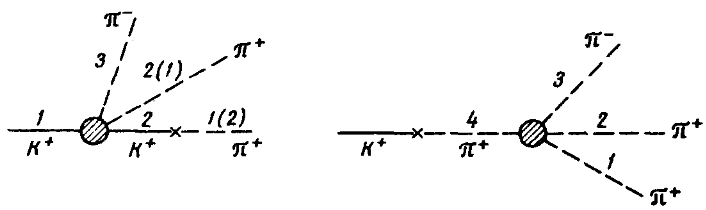

Fig. 2

3. We shall show that the $\Delta T = 1/2$ rule is satisfied in the present model, if H is the form of a product of a current by a current.

It is easy to see that in the pole diagrams of Fig. 2 the change in the isotopic spin is determined by the properties of the matrix element $\langle \pi | H | K \rangle$. In the $\pi \to 0$ limit, $\langle \pi | H | K \rangle$ is proportional to the matrix element of the transition of the K-meson to vacuum, and contains consequently only transitions with $\Delta T = 1/2$. Assuming that the matrix element $\langle \pi | H | K \rangle$ does not depend on the pion momentum, we obtain the rule $\Delta T = 1/2$ for the pole diagrams.

The $\Delta T = 1/2$ rule for the constant part of the amplitude follows from the connection between the matrix elements $\langle 3\pi | H | K \rangle \to \langle 2\pi | H | K \rangle \to \pi | H | K \rangle \to \langle 0 | H | K \rangle$. We emphasize once more that it is assumed here that the entire rapid variation of the amplitudes $K \to 2\pi$ and $K \to 3\pi$ decays is connected with the pole diagrams.

To prove the $\Delta T = 1/2$ rule we must consider matrix elements at zero pion momentum, meaning nonconservation of the 4-momentum. It can be assumed [4] that in the diagrams of Figs. 1 and 2 the weak-interaction spurion, marked with a cross, carries away the missing 4-momentum. Such a continuation of the amplitude to the point $\pi_i = 0$ is natural, for example, when the reduction formula is used.

4. According to the assumption made, the amplitude of the $K \to 3\pi$ decay can be written in the following form (for concreteness, we consider the τ decay $K^+ \to \pi^+\pi^+\pi^-$)

$$M = r + \langle \pi^+ | H | K^+ \rangle \left\{ \frac{T_{\pi K}(K_1 \to \pi_3 \pi_1 K_2)}{(K_1 - \pi_3 - \pi_1)^2 - m^2} + \frac{T_{\pi K}(K_1 \to \pi_3 \pi_2 K_2)}{(K_1 - \pi_3 - \pi_2)^2 - m^2} + \frac{T_{\pi\pi}(\pi_4 \to \pi_1 \pi_2 \pi_3)}{(\pi_1 + \pi_2 + \pi_3)^2 - \mu^2} \right\}, \qquad (1)$$

where $T_{\pi K}$ and $T_{\pi\pi}$ are the πK and $\pi\pi$ scattering amplitudes, and μ, π_i, m, and K_i are the masses and momenta of the π and K mesons (see Fig. 2).

It is shown in [5] that the PCAC hypothesis leads to vanishing of $T_{\pi K}$ and $T_{\pi\pi}$ at the point where the momentum of one of the pions vanishes, and the other particles are on the mass shell. Confining ourselves to terms quadratic in the 4-momenta, we write out the most general form of the $T_{\pi K}$ and $T_{\pi\pi}$ satisfying this condition

$$T_{\pi K}(K_1 \to \pi_3 \pi_2 K_2) = A[(\pi_1 + \pi_3)^2 - \mu^2] + B[(K_1 - \pi_3)^2 - (K_1 - \pi_2)^2] + \\ + C(\pi_2^2 + \pi_3^2 - \mu^2) + D(K_2^2 - m^2) + E(K_1^2 - m^2), \quad (2)$$

$$T_{\pi\pi}(\pi_4 \to \pi_1 \pi_2 \pi_3) = a[(\pi_1 + \pi_3)^2 - \mu^2 + (\pi_2 + \pi_3)^2 - \mu^2] + \\ + b[\pi_1^2 + \pi_2^2 + \pi_3^2 + \pi_4^2 - 3\mu^2], \quad (3)$$

with account taken in formula (3) of the identity of the mesons π_1 and π_2 (see Fig. 2).

Using the assumption concerning the simultaneous commutator of the axial charges, we can find the isotopically odd parts of the amplitudes $T_{\pi K}$ and $T_{\pi\pi}$ [6] in the limit when $\pi_2 = -\pi_3 \to 0$, which leads to the relations

$$B = c^2/2, \quad a = -2c^2, \quad (4)$$

where $c = g_{\pi NN}/\sqrt{2} m_N g_A$.

Let us consider now the limiting value of the amplitude of the τ decay $\pi_i \to 0$. Under the usual assumptions concerning the commutation relations between the current operators, we can show that

$$M \to 0 \text{ for } \pi_3 \to 0; \quad (5)$$

$$M \to c\langle \pi^+\pi^- | H^- | K^+ \rangle \quad \text{for } \pi_2 \to 0. \quad (6)$$

($\langle \pi^+\pi^- | H^- | K^+ \rangle$ are connected by the isotopic relations with the matrix element of the $K^0 \to \pi^+\pi^-$ decay). In the derivation of (5) and (6) we took account of the fact that the rule $\Delta T = 1/2$ is effectively satisfied.

The matrix element $\langle \pi^+\pi^- | H^- | K^+ \rangle$ which enters in relation (6), is written under the previously made assumptions in the form

$$\langle \pi^+\pi^- | H^- | K^+ \rangle = \langle 0 | H^- | K^+ \rangle \{ -B - D + \frac{T_{\pi K}(K_1 \to \pi_3 \pi_1 K_2)}{(K_1 - \pi_3 - \pi_1)^2 - m^2} \}, \quad (7)$$

where we made use of the fact that $\langle \pi^+\pi^- | H^- | K^+ \rangle \to 0$ as $\pi_1 \to 0$. Determining with the aid of condition (5) the constant r in formula (1) in terms of the parameters of the πK and $\pi\pi$ scattering, we can readily verify that relation (6) is satisfied without any assumptions whatever concerning the constants A, C, D, E, and b.

Thus, the application of the PCAC hypothesis to nonleptonic decays of K mesons and to π-K and π-π scattering is selfconsistent.

5. Neglecting terms of order μ^2/m^2, we can represent the amplitude of the τ decay in the physical region in the form

$$M(K^+ \to \pi^+\pi^+\pi^-) = c\sqrt{2}\,\frac{E_-}{m}\,M(K_1^0 \to \pi^+\pi^-), \qquad (8)$$

where E is the total energy of the π^- meson.

Relation (8), which was first derived in [3], makes it possible to relate the probabilities of the $K \to 3\pi$ and $K \to 2\pi$ decays, and also to calculate the spectrum of the π mesons in $K \to 3\pi$ decay in good agreement with the experiment [7]. The agreement between relation (8) and the result of [3] is connected with the fact that on going from the physical region of the $K \to 3\pi$ decay to the physical region of the $K \to 2\pi$ decay the pole denominator in the diagrams of Fig. 2 remains constant with accuracy to terms $\sim\mu^2/m^2$.

The authors are grateful to I. Yu. Kobzarev and L. B. Okun' for interest in the work.

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DISCHARGE-CONDENSATION METHOD OF DETECTING CHARGED-PARTICLE TRACKS

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Submitted 9 January 1967
ZhETF Pis'ma 5, No. 5, 173-175, 1 March 1967

The new discharge-condensation method proposed below for the detection of charged-particle tracks combines the high time resolution of spark chambers and the long time of memorization of a selected event which is characteristic of condensation chambers.

The principle of the discharge-condensation method is as follows: the ionization electrons produced by a charged particle in a mixture of the working gas and the condensate initiates a gas discharge in a pulsed electric field. The amplitude and duration of the electric pulse are chosen such as to prevent the discharge from becoming visible. The ions produced by the gas discharge act as condensation centers when the working volume is adiabatically expanded. The degree of expansion is chosen to be much lower than the threshold value necessary for ordinary operation of condensation chambers, but sufficient for condensation on large ion clusters, such as are characteristic of Townsend cascades.

Thus, the high time resolution of the events, amounting to several microseconds, is due, as in spark chambers, to the fact that the discharge is initiated by electrons, whereas the information concerning the selected event is stored in the form of a column of ions, thus ensuring a long memory time - several dozen milliseconds, as in condensation chambers.