Concerning the Lifetime of the Two Forms of the π^0 Meson.

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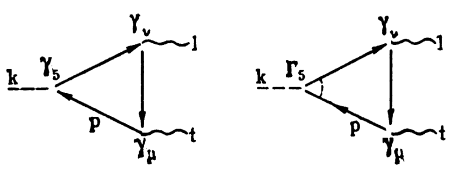
(Submitted to JETP editor February 12, 1956)
J. Exptl. Theoret. Phys. (U.S.S.R.) 32, 615 (March, 1957)

According to the theory of Fermi and Jang[1], it is assumed that π mesons are formed by nucleons in contact interaction (potential well of width $\hbar/Mc \sim 10^{-14}$ and depth 25×10^9 ev. According to this theory there exist two forms of π^0 mesons; π^0 $(P+\bar{P})$ and $\pi^0(N+\bar{N})$; where P denotes proton, N neutron, $\bar{P}$ antiproton, $\bar{N}$ antineutron. In this note are presented results of calculations of the lifetime for the two form of the π^0 meson.

Computations were made by the general method of the invariant perturbation theory for a pseudoscalar meson with pseudoscalar coupling in the approximation $(\mu/M)^2 \ll 1$, where μ denotes the mass of the meson and M the mass of the nucleon, under the assumption that the expansion in the power of $g^2/\hbar c$ is valid. It was considered that the disintegration of the two forms of π^0 mesons occurs according to two mutually exclusive Feynman diagrams (Figs. 1a and b),



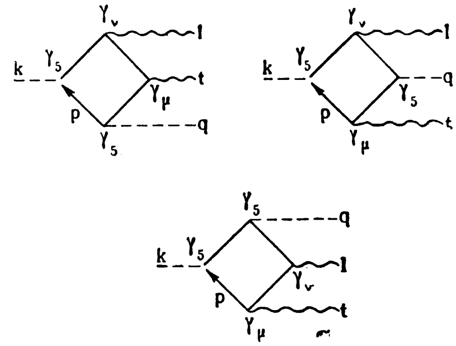
where k is the 4-momentum of the meson, t, l are 4-momentum quanta, p is the 4-momentum of the virtual nucleon, $\gamma_i = -i\beta a_i$ $(i = 1, 2, 3)$, $\gamma_4 = \beta$, $\gamma_5 = \gamma_1, \gamma_2, \gamma_3, \gamma_4$, $\gamma_5^2 = 1$, $\hbar = c = 1$, the upper portion which includes the charged meson, computed in Refs. 2 and 3.

The life time obtained was:

$$\frac{1}{\tau}\approx \left[1;\ \frac{3}{\pi^2}\left(\frac{g^2}{\hbar c}\right)^2\right]\frac{1}{16\pi^2}\left(\frac{g^2}{\hbar c}\right)\left(\frac{e^2}{\hbar c}\right)^2\left(\frac{\mu}{M}\right)^2\frac{\mu c^2}{\hbar},$$

where the first term in the square parenthesis corresponds to the $\pi^0(P+\bar{P})$ meson, the second term to the $\pi^0(N+\bar{N})$ meson. Within the limits of the method used, the life times of the two π^0 mesons, are generally speaking, different.

By the same method and using the same approximations the conversion probability of one π^0 meson into the other was evaluated by the simpler diagram (Fig. 2)



where q denotes the 4-momentum of the end meson. The logarithmic deviation was removed by subtraction. For the life time in this process we obtained the value:

$$1/\tau \approx (N^4/192\pi)\,(g^2/\hbar c)^2\,(e^2/\hbar c)^2\,(\mu/M)^4\,(m/\mu)^3\,mc^2/\hbar,$$

where m denotes the mass of the electron, $N=(\mu_1-\mu_2)/m$ the mass difference of the mesons.

[1] E. Fermi and C. Jang, Phys. Rev. 76, 1739 (1949).
[2] A. D. Galanin, J. Exptl. Theoret Phys. (U.S.S.R.) 26, 417 (1954).
[3] A. D. Galanin and V. G. Solovev, J. Exptl. Theoret Phys. (U.S.S.R.) 27, 112 (1954).

Translated by J. L. Herson
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On the Derivation of the Low Equation in the Theory of Meson Scattering

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(Submitted to JETP editor November 27, 1956)
J. Exptl. Theoret. Phys. (U.S.S.R.) 32, 616-617 (March, 1957)

There is shown in this note a new method of deriving Low's equations, the analysis of which is very important in discussions pertaining to the theory of scattering of mesons by nucleons. It is shown that they may be written in a form, where the concrete type of interaction enters in a simple way through a nonhomogeneous term.* In the analysis of

*It should be noted that a series of causality conditions and renormalization, assumed in the derivation of the dispersion relations, are thereby imposed on the interaction and also the condition of sufficiently rapid decay of certain expressions under the integral in Refs. 3, 4.