Kaon Lifetime and Decay

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Abstract

The Standard Model presumes that there are two different types of neutral kaons, i.e., short-lived K_S kaons which decay to 2 pions and long-lived kaons K_L which decay to 3 pions. This article shows that in reality there is only one type of neutral kaons. The lifetime of kaons depends on their velocity in the gravity field. The fast kaons have more energy, more lifetime and therefore they can decay to 3 pions. If the fast kaons slow down they lose energy and therefore can decay only to 2 pions.

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PACS Classification codes:

01.55.+b General physics; 04. General relativity and gravitation; 13.20.-v Leptonic, semileptonic, and radiative decays of mesons; 13.30.-a Decays of baryons; 13.35.-r Decays of leptons; 14.65.-q Quarks; 13.66.Bc Particle production by electron-positron collisions

Introduction

According to the Standard Model there are two types of neutral kaons having apparently identical masses but very different lifetimes. The short-lived kaons K_S decay to 2 pions, but the long-lived kaons K_L decay to 3 pions. A beam of neutral kaons decays in flight so that the short-lived K_S disappear, leaving a beam of the pure long-lived K_L [1, 2]. Afterwards some long-lived kaons decay to 2 pions. The Standard Model

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explains this as the K_S regeneration by passing a K_L beam through matter. The lifetime for K_L is about $\tau = 5.2*10^{-8}$ s, but for K_S the lifetime is about $\theta = 8.9*10^{-11}$ s. The production of kaons proceeds much faster, with a time scale of 10^{-23} s This $\theta - \tau$ puzzle was partially solved by Abraham Pais and Murray Gell-Mann who postulated the new quantum number called "strangeness".

Lifetime and velocity of particles

The Standard Model presumes that the lifetime of particles is constant for each particular kind of particles. The Relativity theory predicts that time in the frame of fast particles dilates [3]. Therefore the lifetime of particles increases in the reference frame of observer.

The below-mentioned shows that lifetime is bound with the velocity of particles according to the gravity field. The decay momentum of particles [3] is a product of lifetime and a binding force:

$$F\,t = m\,v = \text{const.}, \qquad (1)$$

where: F – binding force;
t – lifetime;
m – mass of particle;
v – velocity according to gravity field.

The decay momentum is constant for all interactions [4]. According to the equation (1), the lifetime is:

$$t = v\,(m/F). \qquad (2)$$

The equation (2) refers to all elementary particles.

Kaon decay

Kaons generated in the collisions have different velocities. For this reason, according to the equation (2) kaons have different lifetimes. The generated kaons are a mix of slow (short-lived) kaons K_S and fast (long-lived) kaons K_L. The velocity and therefore the energy of fast kaons is sufficient for creating 3 pions. Therefore they decay to 3 particles. There are many variants of decay [5]. Some of them are given below:

$$K^0_L \rightarrow \pi^+ + \pi^- + \pi^0 \quad \text{or} \quad K^0_L \rightarrow \pi^0 + \pi^0 + \pi^0 ,$$

Parity: $0 \rightarrow -1 + 1 + 0 = 0$, i.e., parity conserved.

Charge: $0 \rightarrow +1 - 1 + 0 = 0$, i.e., charge conserved.

The slow kaons K_S have energy for creating only 2 pions. $K^0_S \rightarrow \pi^+ + \pi^-$. Some of the fast kaons K_L passing through the matter lose energy and therefore decay to 2 pions. Regeneration of K_S does not take place.

Conclusions

There is no mixing of different kinds of kaons. There is only one neutral kaon type with different velocities. There is no regeneration of kaons. The hypothesis of time dilatation is not necessary. There is no need for an additional quantum number, i.e., strangeness. There is CP conservation in all modes of decay. Parity violation takes place only in the Standard Model.

References

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