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ON NEUTRAL LEPTONIC CURRENTS AND *CP* VIOLATION

L. PALGI. NEUTRAALSETEST LEPTONIVOOLUDEST JA *CP* INVARIANTSUSE RIKKUMISEST

Л. ПАЛЬГИ. О НЕЙТРАЛЬНЫХ ЛЕПТОННЫХ ТОКАХ И НАРУШЕНИИ *CP* ИНВАРИАНТНОСТИ

B. d'Espagnat's and Y. Villachon's theory of the weak interaction [1] was extended to include the neutral leptonic currents by M. L. Good, L. Michel and E. de Rafael [2]. Considering the intermediate vector bosons with equal masses which form a triplet of U_3, the neutral leptonic currents were included with the absence of the weak neutral leptonic currents in all the processes involving hadrons.

But the masses of the neutral intermediate bosons in the U_3 triplet may differ as an effect of the semistrong interaction. In this case, several hadronic decays with neutral leptonic currents and some *CP* violating effects are possible. The rate of the decay $K^+ \to \pi^+ + \mu^+ + \mu^-$ compared with the experimental upper limit gives a restriction for the value of a parameter, which characterises the difference of the masses of the neutral intermediate bosons. As a result, the predicted *CP* violation in $K_L \to 2\pi$ decays is too small, as compared with the observed one.

The fundamental interaction between the hadronic currents and the triplet intermediate bosons contains an octet or nonet of hadronic currents. When the 6-dimensional representation of intermediate bosons is used, the fundamental interaction contains hadronic currents belonging to the octet and the decuplet of hadronic currents [1]. Here we point to the possibility of including neutral leptonic currents in this case, too.

For shortness we write down only a part of the fundamental interaction, namely between the neutral intermediate bosons in the 6-dimensional representation and the neutral hadronic currents

$$L^{(0)}_{hadron} \sim \{\cos\alpha\Big[\big(J^{(0)}_{1/2} w^{(0)}_{1/2} - \sqrt{2} J^{(0)\dagger}_{1} w^{(0)}_{1}\big) + \delta\big(j^{(0)\dagger}_{1} w^{(0)}_{1} + \sqrt{2}\, j^{(0)\dagger}_{1/2} w^{(0)}_{1/2}\big)\Big] -$$

$$- \sin\alpha\Big[\Big(J^{(0)\dagger}_{1/2} w^{(0)}_{1} + \frac{1}{\sqrt{2}} J^{(0)\dagger}_{1} w^{(0)}_{1/2} - \sqrt{\frac{3}{2}} J^{(0)\dagger}_{0} w^{(0)}_{1/2}\Big) + \delta\big(j^{(0)\dagger}_{1} w^{(0)}_{1/2} + \sqrt{2} j^{(0)\dagger}_{3/2} w^{(0)}_{1}\big)\Big]\Big\} + h.c.$$

Here $J^{(\Delta Q)}_{\Delta T}$ are the octet hadronic currents and $j^{(\Delta Q)}_{\Delta T}$ the decuplet hadronic currents; the coefficient δ is a small real parameter characterising the mixture of the hadronic currents belonging to the decuplet representation of U_3. The connection of the angle α with the Cabibbo angle [3] depends on what charged bosons in 6-dimensional representation are coupled with the charged leptonic currents [1]. We add to this interaction the interaction between the neutral leptonic currents and the neutral intermediate bosons in the following form:

$$L^{(0)}_{lepton} \sim i[\cos\alpha J^{(0)} w^{(0)}_{1/2} - \sin\alpha J^{(0)} w^{(0)}_{1}] + h.c.$$

where $J^{(0)}$ is the neutral leptonic current. With this form of interaction the cancellation is achieved, and there are no strangeness-conserving or strangeness-violating processes with neutral leptonic currents caused by the octet hadronic currents in case the neutral intermediate bosons have the same mass.

Now, taking into account the neutral decuplet currents $j^{(0)}_{1/2}$ and $j^{(0)}_{3/2}$, only the rate of $K_L \to \pi^0 +$ *neutral lepton pair* is different from zero and is proportional to δ^2. But the lack of experimental data gives no restrictions for the parameter. There are no such decays as $K_S{}^0 \to \mu^+ + \mu^-$, $K_L{}^0 \to \mu^+ + \mu^-$, $K^\pm \to \pi^\pm + \mu^+ + \mu^-$ or similar leptonic and semileptonic decays with other neutral lepton pairs. The *CP* violation in $K_L \to 2\pi$ decay is possible due to the non-zero imaginary part of $\langle K^0 | M | \bar{K}^0 \rangle$ in the mass matrix of the neutral kaon system, which is proportional to the small parameter δ.

A comparison with the experimental $K^0_L \to 2\pi$ data gives $\delta \approx 0,1$, which is not in contradiction with other experimental data [1, 4]. The *CP* violation effects due to the probable mass difference of the neutral intermediate bosons are also possible, but considering the experimental upper limits for the kaon decays with neutral leptonic currents [4] they are small.

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