Muon Number Nonconservation and Heavy Leptons.

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Recently a re-examination of the question of violation of the muon number conservation has been suggested [1], based on a possible *CP* noninvariant interaction which connects the (u, d, e^-, ν_e) quartet with the (c, s, μ^-, ν_μ) quartet, where u, d, s, c are the usual SU_4 quarks.

In this note we wish to point out that the possible existence of heavy leptons [2] might imply a violation of the muon number conservation rule. A first example is given by a lagrangian of the type

$$L = L_0 + g_1[(\bar{\ell}_0\gamma^\mu(1-\gamma^5)\,e)W_\mu + \text{h.c.}] + g_2[(\bar{\ell}_0\gamma^\mu(1-\gamma^5)\mu)W_\mu + \text{h.c.}],$$

where L_0 contains the usual weak-interaction terms, W_μ is the intermediate vector-boson field, ℓ_0 is a heavy-lepton field, the kinematical part of which is included in L_0. The ℓ_0-particle may decay into electrons and muons and thus carries the separate electronic- and muonic-lepton numbers, so that, for instance

$$\ell_0 \to e^- + W_\mu^+ \to e^- + \mu^+ + \nu_\mu\,,$$
$$\ell_0 \to \mu^- + W_\mu^+ \to \mu^- + \mu^+ + \nu_\mu\,.$$

As a second example, one may postulate a hypothetical leptonic world forming an octet representation of the $SU_{3\ell}$ group in complete analogy with the hadronic SU_{3h} octet. An isospin doublet (λ^+, λ^0) corresponds to the nucleon doublet (p, n), a triplet (L^+, ν_e, e^-) is similar to (Σ^+, Σ^0, Σ^-) and the muon doublet (μ^-, ν_μ) corresponds to (Ξ^0, Ξ^-).

Besides the heavy leptons λ^+, λ^0 and L^+ thus postulated there also exists in this model an isoscalar L_0, similar to the baryon Λ_0. This octet does not necessarily imply a quark substructure [3] for these leptons. However, the existence of an internal symmetry for the leptonic world might give rise to heavy leptons and explain the old problem of the muon mass. In the absence of any evidence on this symmetry we turn to an analogy with SU_3. All particles of this octet have the same leptonic number $\mathscr{L} = 1$. The role of separate leptonic numbers would be played by the values of the

(1) S. BARSHAY: *Phys. Lett.*, **58** B, 86 (1975).

(2) H. GEORGI and S. L. GLASHOW: *Phys. Rev. Lett.*, **28**, 1494 (1972); Y. S. TSAI: *Phys. Rev. D*, **4**, 2821 (1971).

(3) J. LEITE LOPES: *Rev. Bras. Fisica*, **5**, 37 (1975).

changes $\nu_e \rightleftarrows L_0$, $\nu'_1 \rightleftarrows \nu'_2$; other combinations are easily obtained. The symmetrical mixing might be more attractive because it keeps the electron-muon symmetry whereas the asymmetrical one breaks this symmetry. The branching ratios (1), (2) and (3) are modified in the symmetrical Euler mixing and are of order η^4, 1, η^4 respectively. An indication of whether the electron-muon symmetry is broken at this level or not would then be given by the branching ratio (2).

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