NEUTRINO COUNTING

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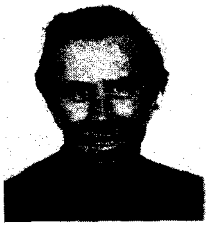

ABSTRACT

By counting the massless neutrinos which exist in Nature the number of massive sequential leptons ("asthenons") are also counted. A laboratory experiment based on the chain of reactions

$$e^+e^- \to V' \to V\pi\pi$$
$$\hookrightarrow \nu\bar{\nu}$$

can count the number of neutrinos. V' is the first excited state of the quark-antiquark bound system. When $q\bar{q}$ ground state V decays weakly into $\nu\bar{\nu}$, the only detected particles in the final state are the two pions recoiling against the missing mass corresponding to the V.

RESUME

Le nombre des neutrinos de masse nulle est égal à celui des leptons massifs séquentiels ("asthenons"). Une expérience à faire avec un anneau de stockage e^+e^- sur la chaîne de réactions

$$e^+e^- \to V' \to V\pi\pi$$
$$\hookrightarrow \nu\bar{\nu}$$

est capable de compter le nombre des neutrinos différents. V' est le premier état excité du système lié quark-antiquark ($q\bar{q}$). Quand V, l'état fondamental ($q\bar{q}$), se désintègre faiblement en $\nu\bar{\nu}$, les seules particules détectées dans l'état final sont les deux pions qui reculent contre une masse manquante égale à la masse du V.

One of the most striking features of what has been discovered in particle physics in the last few years is the regular pattern followed by the "fundamental" particles. Quarks and leptons appear in doublets and family relations can be foundbased upon the value of the mass and/or the charge. The leptons (which could more properly be called "asthenons") appear in doublets; the neutral partner of the charged leptons, the neutrino, has very light or zero mass. An important question to be answered is whether this regular pattern of the "fundamental" particles will repeat itself. If heavier asthenons exist in nature and their neutral partner, the neutrinos, have zero mass, an experimental possibility to verify the existence of these particles at energies lower than their masses would be the counting of neutrinos. Many possibilities for neutrino counting have been suggested. [1] This note describes an experimental possibility for neutrino cpunting, based on the chain reaction.

$$e^+e^- \longrightarrow V' \longrightarrow V\ \pi\pi, \quad V \longrightarrow \nu\bar{\nu} \qquad (1)$$

The reaction (1) involves three steps: i) the production of a bound system of a quark-antiquark system ($q\bar{q}$) in the first radially excited state V', ii) the decay of V' into the ground state V of the ($q\bar{q}$) system and two charged pions, iii) the decay of V into a neutrino-antineutrino. The experimental signature for reaction (1) is the detection of the $\pi\pi$ system that will show that the missing mass corresponding to the V mass has disappeared.

In the following we calculate the possibility of detecting the reaction (1) for V = Y, the recently discovered heavy meson [2) 3)]. The decay probability of the V into two neutrinos divided by that of the decay into e^+, e^- is

$$R = N_\nu (M^2{}_V/Q^2 e)^2 \ G_F^2 \ (Q_L + Q_R)^2,$$

where N is the number of neutrino flavors, M_V is the mass of the vector meson, e the electron charge, Q_L, Q_R, Q are the weak and electric quark charges, G_F is the Fermi constant. Assuming universality of the weak neutral current coupling as in the Weinberg-Salam theory and $\sin^2\theta_W = 0.2$

$$R = \begin{cases} N_\nu \; 10^{-8} \; (M_V/M_P)^4 \times 1.2 \; ; & Q = 1/3 \\ N_\nu \; 10^{-8} \; (M_V/M_P)^4 \times 0.12 \; ; & Q = 2/3 \end{cases}$$

This quantity has been calculated for $V = J/\psi$ [4] and is for V = Y

$$R_Y = 1.2 \times 10^{-4} \times N_\nu$$

The expected event rate from reaction (1) for V = Y is

$$n_{\nu\bar{\nu}} = R_Y \, N_{Y'} B_{Y'} B_{Y\to e^+e^-}$$

where $N_{Y'}$ is the number of produced Y', $B_{Y'}$ is the branching ratio for the decay $Y' \to Y\pi\pi$ and $B_{Y\to e^+e^-}$ is the branching ratio for the Y decay into e^+e^-.
The value of the $B_{Y'}$ [5] is =0.2 and that of $B_{Y\to e^+e^-}$ is =0.03[6].

To detect few events from reaction (1) the number of produced Y' has to be larger than 10^6 for N_ν =3. If the number of new neutrinos is small, the background from the decay

$$Y' \to Y\,\pi\pi, \quad \pi\pi \text{ undetected}, \quad Y \to \begin{cases} e^+e^- \\ \mu^+\mu^- \end{cases} \qquad (2)$$

is the most severe and the experimental acceptance for reaction (2) has to be very close to one.

References

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