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G. Parisi and F. Zirilli : ANGULAR CORRELATIONS OF THE DECAY PRODUCTS OF TWO HEAVY LEPTONS

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Angular Correlations of the Decay Products of Two Heavy Leptons.

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It is well known that there is no experimental evidence against the existence of a third heavy lepton, if its mass is greater than the kaon mass.

If this particle is not too heavy it can be produced very easily in colliding-beam experiments; the cross-section for $e^+e^- \to X^+X^-$ is

$$\sigma_{e^+e^-\to X^+X^-} = \frac{\pi\alpha^2}{3E^2}\left(1+\frac{2M^2}{E^2}\right)\sqrt{1-\frac{4M^2}{E^2}}\,. \tag{1}$$

If the heavy lepton has the same weak interaction as the electron or the muon, its branching ratio can be computed.

The one-prong decays $X^+ \to \mu^+\nu\bar{\nu}$, $e^+\nu\bar{\nu}$, $\pi^+\nu$, $K^+\bar{\nu}$, turn out to be dominant (1,2), so the main process in colliding beams is $e^+e^- \to 2$ charged + neutrals.

To analyse the data it is interesting to know the angular distribution of the produced charged particles.

We denote by E the beam energy, by θ the angle between the direction of the produced heavy lepton and the beam, by ω^+ the angle between the direction of X^+ and of its charged decay product in the c.m. frame of the heavy lepton and by ω^- the same angle for X^-.

One finds

$$\frac{d\sigma}{d(\cos\theta)\,d(\cos\omega^-)\,d(\cos\omega^+)} \propto [1+\cos^2\theta]\{1+\alpha^+\cdot\alpha^-\cdot\cos(\omega^+ + \omega^-)\} + \\ + \frac{M}{E}\sin 2\theta\cdot\alpha^+\cdot\alpha^-\sin(\omega^+ + \omega^-) + \frac{M^2}{E^2}\sin^2\theta\{1-\alpha^+\cdot\alpha^-\cdot\cos(\omega^+ + \omega^-)\}\,, \tag{2}$$

where α^+ and α^- are the asimmetry parameters of the decay of X^+ and X^-.

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(1) J. J. SAKURAI: *Lett. Nuovo Cimento*, **1**, 624 (1971).
(2) E. W. BEIER: *Lett. Nuovo Cimento*, **1**, 1118 (1971).

Their values are

(3) $$\alpha = -1 \text{ for the decays } X^{\pm} \to \pi^{\pm}\nu,\ X^{\pm} \to K^{\pm}\nu;$$

(4) $$\alpha = \frac{4E_1 - M_X}{3M_X - 4E_1} \text{ for the decays } X^{\pm} \to \mu^{\pm}\nu\bar{\nu},\ X^{\pm} \to e^{\pm}\nu\bar{\nu};$$

where E_1 is the energy of the e or μ in the centre of mass of the X.

Formula (2) can be computed from the helicity amplitudes for the production and for the decay of an heavy lepton using the methods of ref. (3).

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(3) G. PARISI and F. ZIRILLI: *A general method for computing high-order Feynman diagrams*, Frascati Internal Report, to be published.