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ALGEBRA OF CURRENT AND $\rho^{\pm} \longrightarrow \eta + \pi^{\pm}$ DECAY

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We study in this paper, the G-parity violating decay mode $\rho \longrightarrow \eta\pi^{\pm}$ using current algebra [1] of scalar densities and relate it to the dominant decay mode $\rho \longrightarrow 2\pi$ governed by strong interactions. The decay under consideration may provide an independent test of the hypothesis involved in the current algebra approach.

The algebra of scalar and pseudo-scalar densities has been recently applied in deriving coupling constant sum rules [2] of the type derived by Murashkin and Glashow [3] using group theoretic methods. Scalar densities have been used in weak non-leptonic decays calculations [4]. They have also been applied to give a uniform picture of mass splitting [5] within a multiplet. Recently, they have been used with fair success, to describe the G-parity violating decay of η-meson [6].

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The current algebra technique can be applied to the study of the decay $\rho \longrightarrow \eta\pi$ if we assume that the effective electromagnetic interaction responsible for η-π^0 mixing[7] and this decay is given by the scalar density $S_3(x)$, carrying negative G-parity and positive charge conjugation. We write the interaction as $\mathcal{H}(x) =$ $= \lambda S_3(x)$ where λ is a constant with the dimensions of mass.

Considering the quantity

$$q_\mu \int d^4x \, e^{iq.x} \langle \pi^\pm | T(A_8^\mu(x) \mathcal{H}(0)) | \rho \rangle$$

with the η-pole subtracted out we obtain by straightforward method[8]

$$\lim_{q \to 0} C_\eta \langle \eta_8 \, \pi^\pm | \mathcal{H}(0) | \rho \rangle = \langle \pi^\pm | \left[\int d^3x \, A_8^0(\vec{x},0), \mathcal{H}(0) \right] | \rho \rangle$$

where we have used the PCAC hypothesis[9] $\partial_\mu A_8^\mu = C_\eta \, m_{\eta_8}^2 \, \eta_8$

Making use of the commutation relation[4] suggested by quark model:

$$\left[\int A_8^0(\vec{x},0) d^3x , \; S_3(0) \right] = \frac{i}{\sqrt{3}} \, S_3^5(0)$$

and admitting the ansatz[10] that we may identify the pseudoscalar density S_3^5 by the current density of the corresponding pseudoscalar field π_3, that is, $S_3^5 = a \, J_{\pi_3}$ we obtain[11], in the lowest order of the interaction:

$$\langle \eta \pi^\pm | \mathcal{H}(0) | \rho \rangle = \frac{\lambda}{\sqrt{3}} \; \frac{a}{C_\eta} \; \langle \pi^\pm | J_{\pi^0}(0) | \rho \rangle$$

Here η and π^0 are the physical pseudoscalar fields. The η-π^0 mixing angle is thus given by

$$\text{tang.}\, \theta \simeq + \frac{\lambda}{\sqrt{3}} \left(\frac{a}{C_\eta} \right)$$

This relation may be used to estimate the value of λ. The PCAC constant C_η may be obtained by using universality hypothesis [12] $C_\pi \simeq C_k \simeq C_\eta$. The constant of proportionality 'a' may be obtained [10] using Gell-Mann's quark model or it may be related to the quark-meson scattering form factor whose value can be estimated using SU(6) quark model [13] or from a reciprocal bootstrap model [14]. Taking the values $C_\pi \simeq 1.21 \times 10^2$ MeV and [10] $a = 0.2$ and tang. $\theta =$ $= 0.011$ for the mixing angle [7] we obtain $\lambda = 11.5$ MeV.

If, further, we assume that the interaction postulated above is a part of the interaction responsible for the electromagnetic mass differences we can write the complete electromagnetic interaction as $H_{e.m.} = \lambda(S_3 + \frac{1}{\sqrt{3}} S_8)$. The medium-strong interaction responsible for the medium-strong mass splitting may be described by [15, 5] $H_{m.s.} = g\ S_8$. The ratio λ / g may be then obtained [15] from the Coleman-Glashow type relations [16] discussed in reference 15 and thus gives $g = 6.64 \times 10^2$ MeV.

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