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RENORMALIZATION OF CONSERVED CURRENTS BY SYMMETRY BREAKING

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A study of the influence of octet asymmetry on the strange current of the SU(3) 8-multiplet has demonstrated the renormalizability of the corresponding vector constant[1].

The strange current and the octet breakdown are vectors from the point of view of the V-isogroup.[1)] We therefore consider the change in the V-spin current when V-symmetry is broken.

The correction to the current of the i-th component of the V-spin, necessitated by the isovector disturbance along the third axis, can be written in the form

$$a_1\delta_{i3} + a_2[V_iV_3] + a_3\{V_iV_3\} \tag{1}$$

(here V_i and V_3 are V-spin matrices, [ ] the commutator, and $\{ \}$ the anti-commutator; we have written out only the isotopic structure of the correction). When i = 3, current is conserved and the corresponding vector constant (charge) does not change when symmetry is broken. Consequently $a_1 = a_3 = 0$. Furthermore, the isotopic part of the correction to the charge should be of even parity in the charge (see also [1]). This means that upon transposition of the matrices V_i and V_3 expression (1) should become transposed without change in sign. Therefore $a_2 = 0$, i.e., there is no correction at all.

This fact offers a simple proof of the theorem of Ademollo and Gatto[1], a proof suitable for any supermultiplet. To take into account the second order in octet breakdown, we consider the tensor corrections, which take the form (the breakdown is directed along the k and ℓ axes):

$$a_1\epsilon_{ik\ell} + a_2\delta_{ik}V_\ell + a_3\delta_{k\ell}V_i + a_4\delta_{i\ell}V_k + a_5\{[V_iV_k]V_\ell\} + + a_6\{[V_iV_\ell]V_k\} + a_7\{\{V_iV_k\}V_\ell\} \quad (2)$$

there are no other terms, by virtue of the identity

$$\{V_i[V_kV_\ell]\} + \{V_\ell[V_iV_k]\} + \{V_k[V_\ell V_i]\} = 2i\vec{V}^2\epsilon_{ik\ell} \quad (3)$$

Let $i = k = \ell = 3$. Then there is no correction, i.e., $a_2 + a_3 + a_4 = 0$ and $a_7 = 0$. For $i \neq k = \ell = 3$ we are left with the terms

$$A_1V_i + A_2\{[V_iV_3]V_3\} \quad (4)$$

(A_1 and A_2 are constants). As before, charge parity calls for transposition of expression (4) without change in sign upon transposition of the matrix V_1. Therefore $A_2 = 0$.

For the strange current $V_+ \equiv V_1 + iV_2$ the third-order correction takes the form BV_+, where B is a constant. If we apply this relation, say, to the V-triplet (p, Σ_V^0, Ξ^-), where $\Sigma_V^0 = -(\sqrt{3}/2)\Lambda^0 - (1/2)\Sigma^0$, we obtain for the vector constants the formula

$$-\sqrt{3}\,(g_{p\Lambda} + g_{\Lambda\Sigma^-}) = g_{p\Xi^0} + g_{\Sigma^0\Xi^-} \quad (5)$$

Analogously, for the V-quadruplet (Δ^{++}, Σ_*^+, Ξ_*^0, Ω^-) we have

$$g_{\Delta^{++}\Sigma_*^+} = -(1/2)\sqrt{3}\, g_{\Sigma_*^+\Xi_*^0} = g_{\Xi_*^0\Omega^-} \tag{6}$$

The remaining V-multiplets which are contained in the decuplet yield relations that duplicate (6).

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1) Concerning the V-spin concept, see, for example, the review [2].

TRANSFORMATION PROPERTIES OF THE WEAK INTERACTION LAGRANGIAN AND OF THE S AMPLITUDE OF HADRON DECAYS OF HYPERONS IN SU(6) SYMMETRY

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Several authors[1-3] recently derived, on the basis of SU(6) symmetry, relations between the amplitudes of the S-waves of hyperon hadron decays. These relations are in satisfactory agreement with experiment. Of particular importance is the deductions that there is no S-wave in $\Sigma^+ \to n\pi^+$ decay, a deduction related in [2] to the absence of decay of a strange quark with emission of a π^+ meson[1)].

It is possible to apply with sufficient justification to the S-wave amplitudes of hadron decays an SU(6) symmetry broken only by weak interaction. It is all the more important that the relations obtained in [1-3] for the S-wave, using CP invariance, are apparently "stable" against the violation of SU(6) symmetry by a moderately strong interaction which is a linear combination of the representations 38, 189, and 405 (see [4]).