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SU_6 AND NON LEPTONIC HYPERON DECAYS

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ʼ in the present paper that, from the
that the s-wave hyperon decay am-
ınsform according to the regular re-
n of SU6, one obtains, in addition to
ıs following from $\Delta T = \frac{1}{2}$, two more
: relations among the observed am-
ne of the two relations has already
ːd by Gell-Mann as a consequence of
pothesis under SU3 together with *CP*-
[1]. When we use *CP*-invariance in
our assumption on the SU6 behaviour
itudes we obtain a further independent
e hyperon decay amplitudes are then

all expressed in terms of a single
parison with the data shows a sati
ment.

As well-known, the $\Delta T = \frac{1}{2}$ rul
following three relations among tl
able non leptonic hyperon decay a
Λ^0_0, Σ^+_+, Σ^-_-, Σ^+_0, Ξ^-_-, and Ξ^0_0 (w
cates $\Lambda^0 \rightarrow p + \pi^-$, etc.):

$$\Lambda^0_- = -\sqrt{2}\ \Lambda^0_0$$

$$\sqrt{2}\ \Sigma^+_0 = -\Sigma^-_- + \Sigma^+_+$$

Table 1
Particular choices of the hyperon decay amplitudes among the possible fits to the data [2].

	Λ^0_-	Ξ^-_-	Σ^+_0, (i)	Σ^+_0, (ii)	Σ^+_+	Σ^-_-
$S\times 10^{-5}$ sec^{-1}m$_\pi^{-1}$	0.31 ± 0.01	0.41 ± 0.02	-0.17 ± 0.02	-0.36 ± 0.035	-0.012 ± 0.03	0.39 ± 0.015
$P\times 10^{-5}$ sec^{-1}m$_\pi^{-1}$	2.0 ± 0.25	-1.4 ± 0.12	3.6 ± 0.35	1.7 ± 0.2	4.09 ± 0.14	-0.39 ± 0.60

$$\Xi^-_- = \sqrt{2}\,\Xi^0_0 \tag{3}$$

The further assumption of octet behaviour of the non leptonic decay amplitudes does not produce additional relations. When however, the octet hypothesis is used in conjunction with *CP*-invariance the following new relation

$$2S(\Xi^-_-) - S(\Lambda^0_-) = -\sqrt{3}\,S(\Sigma^+_0) \tag{4}$$

is obtained for the s-wave decay amplitudes in the strict unitary limit. We make the more stringent assumption that the non leptonic s-wave amplitude transforms as a term of the regular representation of SU_6 (with behaviour (8, 1) under $SU_3 \otimes SU_2$). From such assumption we obtain:

- the Gell-Mann relation, eq. 4, without recourse to *CP*-invariance;
- the new relation

$$S(\Sigma^+_0) - \sqrt{2}\,S(\Sigma^+_+) = -\frac{1}{\sqrt{3}}\,S(\Lambda^0_-) \tag{5}$$

also without invoking *CP*-invariance;

- the relation

$$S(\Sigma^+_+) = 0 \tag{6}$$

when *CP*-invariance is used.

To compare with the data we assume that *CP*-invariance is valid, at least approximately, in these decays and we write the hyperon decay matrix in the form

$$\bar{u}_f(S - P\gamma_5)u_i\varphi \tag{7}$$

where S and P are the s-wave (parity violating) and p-wave (parity conserving) amplitudes respectively, u_f and u_i are the initial and final spinors, and φ is the pion wave. Additional derivative terms can be reduced to the form (7), except that S and P would then depend on the baryon mass differences: we assume such possible dependence to be negligible. For each decay different (S, P) sets are determined from the measured lifetime and asymmetry parameter [2]. The choices reported in table 1 provide fair fits to our predictions. The three equations (4), (5) and (6) are equivalent to

$$S(\Xi^-_-) = S(\Lambda^0_-) \tag{8}$$

$$S(\Sigma^+_0) = -\frac{1}{\sqrt{3}}\,S(\Lambda^0_-) \tag{9}$$

$$S(\Sigma^+_+) = 0 \tag{10}$$

These equations, together with the $\Delta T = \frac{1}{2}$ predictions, eq. (1), (2) and (3), provide a complete determination of all the seven s-wave hyperon decay amplitudes in terms of $S(\Lambda^0_-)$. With the amplitudes of table 1, eq. (10) becomes (-0.012 ± 0.03) = 0, eq. (9) becomes (-0.18 ± 0.1) = (-0.17 ± 0.02) for the solution (i), and eq. (8) gives (0.31 ± 0.01) for $S(\Xi^-_-)$ instead of (0.41 ± 0.02). We have also reported in table 1 the solution (ii) for Σ^+_0 which is usually preferred to (i) on the ground that it fits better the Gell-Mann relation, eq. (4).

Our results are derived for the assignment [3] of the stable baryons to the <u>56</u> and of the pseudoscalar mesons to the <u>35</u>. Multiplying <u>56</u> ⊗ <u>56</u> = <u>1</u> + <u>35</u> + <u>405</u> + <u>2695</u> by <u>35</u> one obtains the regular representation four times: once from <u>1</u> ⊗ <u>35</u>, twice from <u>35</u> ⊗ <u>35</u>, and once in <u>405</u> ⊗ <u>35</u>. However, only the tensor from <u>405</u> ⊗ <u>35</u> and one of the two tensors from <u>35</u> ⊗ <u>35</u> contribute to the observed amplitudes. All the amplitudes can be expressed in terms of two constants. Their elimination gives rise to the relations (4) and (5) in addition to the $\Delta T = \frac{1}{2}$ relations (1), (2) and (3). The further assumption of *CP*-invariance excludes the tensor obtained from the product <u>405</u> ⊗ <u>35</u>. One then obtains eq. (6) as an additional relation.

One can try the assumption that the p-waves transform according to the regular representation of SU_6 (with behaviour (8, 3) under $SU_3 \otimes SU_2$). The *P*-amplitudes can then be expressed all in terms of two independent parameters. We find relations that are inconsistent with the data of table 1. The addition of terms transforming like the representation <u>189</u> does not improve the situation: it only amounts to redefining the contribution from one of the tensors of the <u>35</u> (precisely the contributing tensor from <u>35</u> ⊗ <u>35</u>).