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SKYRME MODEL AND WEAK NONLEPTONIC DECAYS OF HYPERONS

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We calculate nonleptonic hyperon decay amplitudes in the framework of Skyrme model. Agreement with experiment depends crucially on the short distance enhancement coefficients and particular dynamical assumptions.

1. Introduction

The Skyrme model has been very successful in providing a description of the long distance properties of strong interactions.

The QCD origin, beauty and simplicity of the Skyrme model, together with its reasonable description of the nonperturbative quantities like a mass spectrum and static properties of the ground-state baryons, is our main motivation for examining dynamical processes such as nonleptonic weak decays.

The main aim of this paper is not a new attempt to explain nonleptonic weak interactions, but rather to provide a test of the Skyrme model's ability to predict both s- and p-wave nonleptonic hyperon decay amplitudes through straightforward calculations which employ only current low energy elementary particle physics theories. More precisely, we are going to test the SU(3) flavour Skyrme model ability to deal with dimension six operators of the current $\times$ current type and than to apply it to the certain physical processes.

At that point we are making the assumption that SU(3) Noether currents of the Skyrme model are at the level of the effective theory equivalent to the quark currents usually appearing in the effective Hamiltonian. This assumption seems to be the most natural one can make, however there exists in the literature a different approach on which we comment later.

The paper is organized as follows: first we briefly describe the dynamics of non-leptonic weak decays (the effective weak Hamiltonian and relevant contributions to the amplitudes) and qualitative features of the Skyrme model. Then we determine the currents and evaluate the current × current matrix elements. Finally, matrix elements and amplitudes are displayed in the form of tables. We also mention how modified dynamical assumptions would lead to different results. Comparison with experiment is discussed.

2. *Theory of the nonleptonic week decays*

It has been argued that nonleptonic decays of baryons can be reasonably described in the framework of the standard Weinberg-Salam (WS) model. The starting point in such analysis is the effective weak Hamiltonian, which usually takes the form of the current × current interaction, renormalized by quantum chromodynamics (QCD)[1].

The techniques then used to describe nonleptonic hyperon and Ω^- decays ($1/2^+ \to 1/2^+ + 0^-$ and $3/2^+ \to 1/2^+ + 0^-$ reactions) are known as a modified current-algebra approach. The general form is[2,3]

$$\langle \pi B' | H_w | B \rangle = \frac{1}{F_\pi} \langle B' | \hat{H}_w | B \rangle + P(q) + S(q). \tag{1}$$

Here the first term is the current-algebra contribution (CA), the second is the modified pole term and the third is a term which vanishes in the soft-meson limit. The term $P(q)$ contains contribution from the surface term, the soft-meson Born-term contraction and the baryon-pole term, combined in the well known way[2,3]. It represents a continuation of the CA result from the soft-meson limit. Further continuation is contained in the $S(q)$ term, which is directly proportional to the meson four-momenta. This then is calculated inserting vacuum states. It is therefore a separable product of two current matrix elements. Since $S(q)$ terms are not essential for the purpose of this paper we neglect them.

At this point we define the parity violating (A) and parity conserving (B) amplitudes of nonleptonic hyperon s-wave, p-wave decays, respectively, in $B(p) \to \to B'(p') + \pi(q)$,

$$\bar{u}(p_s)(A + B\gamma_5)\, u(p). \tag{2}$$

Parity-violating amplitudes A recive contributions A^c from current algebra commutator terms, while the main contributions to the B amplitudes come from baryon pole terms $P(q)$.

The current algebra (CA) and the baryon-pole terms contains the important »4-quark operator« matrix elements. This is exactly the point in which our Skyrme model takes place. A few explanations for the reader unfamiliar with the Skyrme model are in order.

The idea of Skyrme[4] that baryons are solitons of an SU(2) × SU(2) chiral theory (or solitons in the nonlinear sigma model) has recently received renewed attention[5]. We know that in that model the topological number is interpreted as the baryon number[4]. In the $N_c \to \infty$ limit baryons appear as solitons in the effective mesonic field theory[6].

Because of the above nice feature, one can of course ask what sort of numbers can be expected from the Skyrme model. Recently, the static properties of nucleons were evaluated[7,8], and the results generate within about 30% of experimental values were obtained. However, the nucleon matrix element of the pure axial coupling g_A turns out to be two times smaller than the experimental value[7]. Finally, the most unpleasant feature of the model is the value of F_π (pion decay constant) which is two to four times smaller[7,9] than $F_\pi^{exp} = 186$ MeV. The calculations of the »4-quark operator« matrix elements between two baryon states have been already performed. For the $\Delta s = \Delta I = 0$ calculation[10] the collective variable representations of the nucleon wave functions[7] were used. In the evaluation of the $|\Delta s| = 1$, $|\Delta I| = 1/2$ matrix elements[11] the wave function were given[12] as the representation functions of the $SU(3)_L$-flavour and $SU(2)_R$-spin groups.

The weak Hamiltonian which includes QCD corrections is of the form[1]

$$H_w^{eff}(\Delta s = 1) = \sqrt{2}\, G_F \sin\Theta_c \cos\Theta_c \sum_i c_i O_i \tag{3}$$

where G_F is the Fermi constant, Θ_c — Cabibbo angle. It contains the very well known »4-quark operators«[1,3]. The coefficients appearing in formula (3) were derived in Ref. 1:

$$c_1 = -2.54, \quad c_2 = c_3 = 0.008, \quad c_4 = 0.4. \tag{4}$$

Without QCD enhancements the c_i's would have the following values:

$$c_1 = -1, \quad c_2 = 1/5, \quad c_3 = 2/15, \quad c_4 = 2/3. \tag{5}$$

In this paper we simply consider the both possibilities and compare the results keeping in mind the results of Ref. 8.

The SU (4)-flavour symmetry breaking effect, which introduces, through the renormalization procedure of the bare weak Hamiltonian, so called Penguin operators, were not included in $H_w^{eff}(\Delta s = 1)$[1]. Namely, according to the previous evaluation of nonleptonic hyperon and Ω^- decays[3], (which shows explicitly that the Penguin contributions can at most fine tune total amplitudes), we neglect them consequently in all contributions to the A and B amplitudes.

The current-algebra and baryon-pole contributions are[2,3]:

$$A^c(\Lambda^0_-) = \frac{\sqrt{2}}{F_\pi} a_{\Lambda n}; \quad A^c(\Xi^-_-) = \frac{\sqrt{2}}{F_\pi} a_{\Xi^0 \Lambda} \tag{6}$$

$$A^c(\Sigma^+_0) = \frac{-1}{F_\pi} a_{\Sigma^+ p}; \quad A^c(\Sigma^-_-) = \frac{2}{F_\pi} a_{\Sigma^0 n}$$

$$A^c(\Sigma^+_+) = \frac{\sqrt{2}}{F_\pi} (a_{\Sigma^+ p} - \sqrt{2}\, a_{\Sigma^0 n}).$$

F_π is the pion-decay coupling constant, while Λ^0_-, for example, signifies decay mode $\Lambda \to p\pi^-$.

$$B^p(\Lambda^0_-) = 2g(N + \Lambda)\left[\frac{a_{\Sigma^+ p}}{\sqrt{3}} \frac{f - 1}{(N - \Sigma)(\Sigma + \Lambda)} - \frac{a_{n\Lambda}}{\sqrt{2}} \frac{1}{(\Lambda - N)(2N)}\right]$$

$$B^p(\Xi^-_-) = 2g(\Xi + \Lambda)\left[\frac{-a_{\Xi^-\Sigma^-}}{\sqrt{3}} \frac{1 - 2f}{(\Xi - \Sigma)(\Sigma + \Lambda)} - \frac{a_{\Xi^0 \Lambda}}{\sqrt{2}} \frac{1 - 2f}{(\Lambda - \Xi)(2\Xi)}\right]$$

$$B^p(\Sigma^0_+) = g(\Sigma + N)\, a_{\Sigma^+ p}\left[\frac{-2f}{(N - \Sigma)(2\Sigma)} + \frac{1}{(\Sigma - N)(2N)}\right] \tag{7}$$

$$B^p(\Sigma^-_-) = 2g(\Sigma + N)\left[\frac{-f a_{\Sigma^0 n}}{(N - \Sigma)(2\Sigma)} + \frac{a_{n\Lambda}}{\sqrt{3}} \frac{f - 1}{(N - \Lambda)(\Lambda + N)}\right]$$

$$B^p(\Sigma^+_+) = 2g(\Sigma + N)\left[\frac{a_{\Sigma^+ p}}{\sqrt{2}} \frac{1}{(\Sigma - N)(2N)} + \frac{f\, a_{\Sigma^0 n}}{(N - \Sigma)(2\Sigma)} - \right.$$

$$\left. - \frac{a_{n\Lambda}}{\sqrt{3}} \frac{f - 1}{(N - \Lambda)(\Lambda + \Sigma)}\right].$$

The $g = 13.55$ is a strong dimensionless $NN\pi$ coupling constant, and each capital letter N, Λ, ... represents the mass of the relevant particle. For example $\Lambda \equiv m_\Lambda$. The $f + d = 1$, $f = 0.345$ are the SU(3) strong coupling parameters[3].

Here we are using the experimental values for the g coupling and the baryon masses, however it would be perfectly legitimate to use the Skyrme model predictions for these quantities. We think that this ambiguity introduces some uncertainties for the B amplitudes, whereas A amplitudes depend only upon the choice of F_π.

3. *Calculation of the weak matrix elements*

The amplitudes A^c and B^p contains the weak matrix elements $a_{BB'} = \langle B' | H_w^{P.C.} | B \rangle$ which have the following general structure:

$$a_{BB'} = \sqrt{2}\, G_F \cos \Theta_c \sin \Theta_c \sum_{i=1} c_i \langle B' | O_i | B \rangle. \tag{8}$$

Now, we proceed to the calculation of the weak matrix element in the Skyrme model. Each operator O_i from (8) contains four types of operators: $\bar{d}u\bar{u}s$, $\bar{d}s\bar{u}u$, $\bar{d}s\bar{d}d$, $\bar{d}s\bar{s}s$, and takes the form of product of the two SU(3) currents:

$$O_{\alpha\beta} = \sum_{\mu} J^L_{\alpha\mu} \times J^L_{\beta\mu}. \tag{9}$$

In our calculations we are dealing with the operators

$$\begin{gathered}
\frac{1}{2} \bar{q}\gamma_\mu (1-\gamma_5)(\lambda_1 + i\lambda_2) q\, \bar{q}\gamma_\mu (1-\gamma_5)(\lambda_4 - i\lambda_5) q, \\
\frac{1}{2} \bar{q}\gamma_\mu (1-\gamma_5)(\lambda_6 + i\lambda_7) q\, \bar{q}\gamma_\mu (1-\gamma_5)\left(\frac{1}{3} + \frac{1}{2}\lambda_3 + \frac{1}{2\sqrt{3}}\lambda_8\right) q, \\
\frac{1}{2} \bar{q}\gamma_\mu (1-\gamma_5)(\lambda_6 + i\lambda_7) q\, \bar{q}\gamma_\mu (1-\gamma_5)\left(\frac{1}{3} - \frac{1}{2}\lambda_3 + \frac{1}{2\sqrt{3}}\lambda_8\right) q, \\
\frac{1}{2} \bar{q}\gamma_\mu (1-\gamma_5)(\lambda_6 + i\lambda_7) q\, \bar{q}\gamma_\mu (1-\gamma_5)\left(\frac{1}{3} - \frac{1}{\sqrt{3}}\lambda_8\right) q,
\end{gathered} \tag{10}$$

where the SU(3) properties are expressed explicitly in terms of the Gell-Mann's λ-matrices. The Skyrme model counterparts of the currents[10] have been calculated in Ref. 14. Here we only quote the main results.

We start from the Skyrme model Lagrangian which can be found in Refs. 7, 9—13. The space-time dependent SU(3) matrix field $U(\vec{r}, t)$ takes the form:

$$U(\vec{r}, t) = A(t)\, U_0(\vec{r})\, A^\dagger(t), \tag{11}$$

where $A(t) \in SU(3)$ defines the generalized velocities $\dot{a}^\alpha$:

$$A^\dagger(t)\, \dot{A}(t) = \frac{i}{2} \sum_{\alpha=1}^{8} \lambda_\alpha \dot{a}^\alpha, \tag{12}$$

λ_α being Gell-Mann's SU(3) matrices. $U_0(\vec{r})$ is the static soliton (Hedgehog) solution of the form

$$U_0(\vec{r}) = \exp\left(i \sum_{A=1}^{3} \lambda_A \frac{r^A}{|\vec{r}|} \Theta(r)\right) \tag{13}$$

whose function $\Theta(r)$ is a solution of the Lagrange-Euler equation[4,7]. The radial functions $\Theta(r)$ have the boundary conditions $\Theta(0) = \pi$ and $\Theta(\infty) = 0$. Pion decay constant F_π and Skyrme term coupling constant are considered to be free parameters. Some additional comments on our Skyrme model parametrizations are necessary.

Introducing the collective coordinates one can derive the formula for the baryon masses[7,12,13], and then adjust F_π and e in such a way that the realistic baryon mass spectrum is obtained. In our previous paper we have considered the two parametrizations obtained: 1) by fitting the average values of the octet and decuplet mass in the chiral model with massless pseudoscalar mesons, and 2) by fitting two baryon masses on the model with massive pseudoscalar mesons. We find that the second parametrization is very unrealistic; it requires F_π smaller than 70 MeV[9] and the baryon matrix elements are incompatible with the quark model[11]. Therefore throughout this paper we use the parametrization 1) with $F_\pi = 114$ MeV and $e = 5.3$. This parametrization can provide the realistic mass spectrum for baryons if one neglects the additional term in the static soliton mass which is generated by meson (see for example Ref. 9) treating the mass splittings as a sort of perturbation to the chiral mass formula. The mass splittings are given by the formula[12]

$$(\Delta M)_B^R = (\Delta m)\, d_B^R \tag{14}$$

where R stands for octet or decuplet and B denotes the baryon. The group theoretical factors d_B^R can be found in Ref. 11 or 9. The value of Δm obtained by means of the parametrization 1) reads

$$\Delta m = 507 \text{ MeV (exp. } 385 < \Delta m < 1224 \text{ MeV)} \tag{15}$$

and the baryon masses agree with the experiment better than 10%. One can also add additional terms to the Lagrangian which takes care of the electromagnetic splittings (Guadagnini[12]). Then with our parametrization we get for Δm:

$$\begin{aligned} M_n - M_p &= 0.9 \text{ MeV (exp. 1.3 MeV)} \\ M_{\Sigma^-} - M_{\Sigma^+} &= 4.6 \text{ MeV (exp. 8.0 MeV)} \\ M_{\Xi^-} - M_{\Xi^0} &= 3.7 \text{ MeV (exp. 6.4 MeV)} \end{aligned} \tag{16}$$

which is by far better than the previous results (M. Sriram et al.[12]). Therefore we think that our parametrization is realistic. It gives good mass spectrum, requires not to low F_π and provides baryon matrix elements of the operators[10] which are compatible with the quark model.

The formula for the matrix element of the product of the two SU(3) currents (9) between two octet states reads[11]:

$$\langle B_2 | O_{\alpha\beta} | B_1 \rangle = \sum_{\substack{R=8,27 \\ \varphi,\Gamma}} \begin{pmatrix} 8 & 8 & R \\ \alpha & \beta & \varphi \end{pmatrix} \begin{pmatrix} R & 8 & 8_\Gamma \\ \varphi & b_1 & b_2 \end{pmatrix} S_\Gamma (R)\, \Phi, \tag{17}$$

where $b_{1,2}$ denote the flavour quantum number of baryons $B_{1,2}$ and the factor $S_\Gamma(R)$ is a product of spin Clebsch-Gordan coefficients:

$$S_\Gamma(R) = \begin{cases} \dfrac{1}{30\sqrt{6}} & \text{for } R = 27 \\ \dfrac{-1}{10} & \text{for } R = 8,\ \Gamma = S \\ \dfrac{-1}{\sqrt{5}} & \text{for } R = 8,\ \Gamma = A. \end{cases} \tag{18}$$

Note that both symmetric and antisymmetric octets contribute ($\Gamma = S, A$) according to the old parametrization in terms of F and D coefficients[2]. The constant Φ is given in terms of the radial integrals of the soliton profile $\Theta(r)$ and for the parametrization mentioned earlier it is given by[11]

$$\Phi = 0.033 \text{ GeV}^3 = 22\, F_\pi^3. \tag{19}$$

Since a small value of F_π is a usual shortcoming of the model, we are going to express everything (Φ and the amplitudes) in terms of an unspecified F_π.

A comment on our approximation $\dot{a}^\alpha = 0$ should be made. Let us observe that the matrix elements of the operator $(\bar{d}u)(\bar{u}s)$ presented in the previous paper[11] are exact in a sense that each part of the quark current has its equivalent in the Skyrme model. On the other hand the operators $(\bar{d}s)(\bar{u}u)$, $(\bar{d}s)(\bar{d}d)$ and $(\bar{d}s)(\bar{s}s)$ contain a part proportional to $(\bar{u}u + \bar{d}d + \bar{s}s)$ baryon current, which is not Noether current and, in the Skyrme model, it should be identified with a topological current[7]. The latter however vanishes in our approximation, so it is not a surprise that the matrix elements of the above operators are the subject to much bigger uncertainties than the ones of the $(\bar{d}u)(\bar{u}s)$ operator. It is well known that $1/N_c$ corrections are important[14], they may even change the sign of some observables like Σ^- magnetic moment. Certainly the $1/N_c$ corrections would affect both $(\bar{d}u)(\bar{u}s)$ and $(\bar{d}s)(\bar{q}q)$ operators ($q = u, d, s$). We are not going to discuss these corrections in full detail, therefore we adopt two different assumptions in order to see what sort of answer one can expect to get in the Skyrme model. In any case we first assume that $(\bar{d}u)(\bar{u}s)$ operator is not affected by $1/N_c$ corrections. Then we assume that the other operators which contain the topological current have to be corrected and for this we consider two different possibilities.

(a) $(\bar{d}s)(\bar{u}u)$ matrix elements are, as in the quark model equal to the $-(\bar{d}u)(\bar{u}s)$ matrix elements and other operators vanish.

(b) The second possibility is based on the following observation. What we calculate in the Skyrme model is the value of A where

$$(\bar{d}s) \otimes (\bar{q}q) = A + (\bar{d}s) \otimes (1) \qquad (20)$$

and $(\bar{d}s) \otimes (1)$ is schematically the contribution of the baryon current. Now A, as defined by the r. h. s. of Eq. (20) can be calculated in the quark model and it turns out that

$$A|_{QM} = \frac{2}{3}(\bar{d}s)(\bar{u}u)|_{QM} = -\frac{2}{3}(\bar{d}u)(\bar{u}s)|_{QM} \qquad (21)$$

where we have used the Pati-Woo theorem[15] for the quark model matrix elements. As shown previously[11] $(\bar{d}u)(\bar{u}s)|_{QM} = (\bar{d}u)(\bar{u}s)|_{SK}$. So finally we get

$$(\bar{d}s) \otimes (1) = -1/3\,(\bar{d}u) \otimes (\bar{u}s). \qquad (22)$$

This correction should be added to A in order to obtain the corrected values of the matrix elements of the operators $(\bar{d}s) \otimes (\bar{q}q)$. The results are summarized in Table 1.

TABLE 1.

$\langle B' \vert O_i \vert B \rangle$		O_1	O_2	O_3	O_4
$\langle p \vert O_i \vert \Sigma^+ \rangle$	(a)	−40	0	0	0
	(b)	−46	4	−8	−7
$\langle n \vert O_i \vert \Sigma^0 \rangle$	(a)	−28	0	0	0
	(b)	−33	3	−5	−8
$\langle n \vert O_i \vert \Lambda \rangle$	(a)	26	0	0	0
	(b)	29	1	1	5
$\langle \Lambda \vert O_i \vert \Xi^0 \rangle$	(a)	−36	0	0	0
	(b)	−42	−8	9	−7
$\langle \Xi^- \vert O_i \vert \Sigma^- \rangle$	(a)	10	0	0	0
	(b)	11	−2	−3	3
$\langle \Xi^0 \vert O_i \vert \Sigma^0 \rangle$	(a)	8	0	0	0
	(b)	8	0	3	0

The matrix elements of the $O_1, \ldots, O_4$ operators calculated in the Skyrme model. Each matrix element should be multiplied by a factor $10^{-3}\,\Phi$. The choices (a) and (b) are explained in the text.

TABLE 2.

Amplitude (10^{-7})		$A(\Lambda^0_-)$	$A(\Xi^-_-)$	$A(\Sigma^+_0)$	$A(\Sigma^-_-)$	$A(\Sigma^+_+)$	$B(\Lambda^0_-)$	$B(\Xi^-_-)$	$B(\Sigma^+_0)$	$B(\Sigma^-_-)$	$B(\Sigma^+_+)$
F_π^{Skyrme}	(1)	0.2	−0.3	−0.3	0.4	0.02	5.4	2.7	1.4	−0.7	4.8
	(2)	0.7	−1.0	−0.7	1.0	0.00	15.1	7.6	3.8	−2.0	13.1
F^π_{exp}	(1)	1.0	−1.5	−1.2	1.6	0.08	23.3	11.8	5.9	−3.2	20.7
	(2)	2.9	−4.2	−3.2	4.6	0.01	65.4	32.9	16.5	−8.6	57.1
Experiment		3.2	−4.4	−3.2	4.2	0.13	21.6	14.5	26.0	−1.4	41.5

Hyperon nonleptonic decay amplitudes. Experimental values are from Ref. 18. The choices (1) and (2) correspond to the amplitudes calculated without and with inclusion of the short distance enhancement coefficients, respectively.

The case (a) completely satisfies the Pati-Woo theorem and in that sense is in full agreement with any quark-model calculation. In (b) we have Pati-Woo theorem violation due to the 27-contamination of the effective weak Hamiltonian H_w^{eff} (see formula (17)), and the fact that the operators $O_i \in H_w^{eff}$ contains parts proportional to the baryon current identified as a topological current. Namely, matrix elements between two baryon states of the »Topological current × Noether current« like Hamiltonian do not necessary need to satisfy the Pati-Woo theorem. Physically this is a »good thing«, since pure 27-transition amplitude $A_{exp}(\Sigma_+^+)$ ($= 1.6 \times 10^{-6}\, F_\pi^3$) is nonzero and all other amplitudes *are* more or less 27-contaminated. The latest point is easy to see by brief inspection of Table 1. All amplitudes receive contribution from $O_4 \in H_w^{eff}$ (27). Now we are calculating the nonleptonic hyperon decay amplitudes by using matrix elements of the operators $O_1, \ldots, O_4$ from Table 1 and with the help of formulae (4—8). The final results are presented in Table 2.

In spite of F_π-puzzle in the Skyrme model, from some other point of view it might still be surprising that the model lead to reasonable results at all. Namely, what one is actually calculating is a product of the QCD enhancement (suppress) factor c_i and the matrix element of the 4-quark operator O_i between the baryon states (B, B'):

$$c_i(\mu^2)\, \langle B' |O_i| B\rangle (\mu^2). \tag{23}$$

The operators O_i are made out of Skyrme model currents. Without any transformation they are used to act as operators in the space of group representations constituting baryon state $|B\rangle = \psi(A)$. It is not at all clear (obvious) that such matching should be good (or bad) for Skyrme model. Furthermore, the product $c_i \langle B' |O_i| B\rangle$ should be independent of the renormalization mass μ. This can come about only if the renormalization mass is selected in such a way that the matrix element $\langle B' |O_i| B\rangle$ carries a proper calculated μ dependence. Again, this can easily depend on particular model for baryons (Skyrme model). Naturally this last statement loses its meaning if QCD-short distance-corrections turn out to be unimportant and if everything depends on the modification of baryon states.

4. *Conclusions*

The main aim of this paper is to learn how the most common approach[2,3] including the Skyrme model applies to nonleptonic hyperon decays. As already mentioned there exist a different approach of Bijnens et al.[16] and Donoghue et al.[16] where the meson-baryon couplings are directly obtained from the chiral Lagrangian. Donoghue et al.[16] predict a new contact term for the p-wave amplitudes, which is obviously not present in our case. The correspondence between the two approaches can in principle be established providing the solution to the ambiguity of the short distance corrections c_i. Comparison of the line one to four in Table 2 with experiment shows the following:

(a) The short distance corrections to the effective weak Hamiltonian are beyond doubt very important;

(b) The signs and order of magnitudes of all amplitudes are always correctly reproduced;

(c) s-wave amplitudes are in very good agreement with experiment (for F_π^{exp});

(d) The Pati-Woo theorem violation and the 27-contaminations can be traced due to the $(a) - (b)$ difference for each operator in Table 1. It is clear that the nonvanishing $A(\Sigma_+^+)$ amplitude is still to small in good accord with very small values of the 27-contaminations, and that an additional contributions are needed[17];

(e) p-waves are subject to some uncertainties. As we have already pointed out one could use in Eq. (7) the Skyrme model dictated values for g and baryon masses. For example as a rough estimate one could take for g the value 8.9 as obtained in the SU(2) model (Ref. 7) instead of 13.55; this would lead to the decrease of the B amplitudes improving our results. Donoghue et al.[16] showed that in the Skyrme model a new contact term appears which should be added to our results for p-waves. Therefore we think that B amplitudes are not fully described by our formulae, nevertheless they agree with experiment reasonably well.

The results in Table 2 are given in dimensionless units. The question arises what value of F_π one should use for the constant (Eq. (19)). Obviously F_π as dictated by the Skyrme model underestimates the matrix elements (Ref. 11) as can be seen from Table 2. On the other hand one may hope that the inclusion of higher derivative terms[19] and Casimir effect would improve the value of F_π. Therefore in Table 2 we also display numbers obtained for $F_\pi^{exp} = 186$ MeV. Even if F_π is not correctly reproduced by the Skyrme model and hence the amplitudes are too small, their ratios remain in good agreement with experiment, since F_π dependence cancels out.

Irrespective of all these open questions and possible shortcomings, it seems that the general dynamical scheme, outlined in the introduction, supported by Skyrme model leads in good direction. Obviously, we have not controlled all details, neither minor dynamical one, nor really important ones such as Skyrme-model-F_π-puzzle and short distance corrections. However, it seems that with Skyrme model applied in the framework of a relative simple dynamics (this paper), or more complicate dynamics[16], we might be on the right track.

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SKYRME MODEL I SLABI NELEPTONSKI RASPADI HIPERONA

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Računate su amplitude neleptonskih raspada hiperona u Skyrme modelu. Slaganje sa eksperimentima ovisi krucijalno o koeficijentima pojačanja na malim udaljenostima i određenim dinamičkim pretpostavkama.