Strong Couplings of the Octet Baryons to Pseudoscalar and Vector Mesons in QCD Sum Rules

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September 24, 2009

Outline

Outline

Phys. Dept. of METU

- Found in 1960 as Department of Physics and Dept. of Theoretical Physics.
- United in 1970
- 37 Prof.'s, 14 Assoc. Prof.'s, 4 Assis. Prof.'s, 44 TA's
- Fields: Astrophysics, Atomic and Molecular Physics, HEP, Mathematical Physics, Nuclear Physics, Plasma Physics, Solid State Physics
- http://www.physics.metu.edu.tr

Phenomenology Group

- E. O. Iltan: Models Beyond the Standard Model, Multi Higgs Doublet Models
- N. K. Pak, and T. M. Aliev: Unparticle Physics, Models Beyond Standard Model
- G. Turan, T. M. Aliev: B-physics
- T. M. Aliev, A. Ozpineci: QCD Sum Rules, Hadron Physics, B decays
- A. Gokalp, O. Yilmaz: Nuclear Physics, Sum Rules for (scalar) mesons

Outline

TÜBİTAK

ISSCSMB

- Annual school on “INTERNATIONAL SUMMER SCHOOL AND CONFERENCE ON HIGH ENERGY PHYSICS: STANDARD MODEL AND BEYOND” in Mugla

ISSCSMB

- A school for graduate students
- Organizers: T. M. Aliev (METU), S. Oktik (MU), M. Serin (METU)
- 27 August-4 September 2009
- http://milonga.physics.metu.edu.tr/schools/mugla_2009/index.html (under constructions)

TROIA'09

- A biannual conference on hadron physics held in Canakkale (where the ancient cities of Troy are)

TROIA'09

- Organizers: A. Kucukarslan (COMU), A. Ozpineci (METU)
- 10-14 September 2009
- Special emphasis is given to Sum Rules, Chiral Perturbation Theory, and Lattice Results
- http://milonga.physics.metu.edu.tr/hep-th/troia09 (under constructions)

Outline

Physics

- QCD has an $SU(3)_f$ symmetry when $m_u = m_d = m_s$
- Mesons: $3 \otimes \bar{3} = 1 \oplus 8$
  Baryons: $3 \otimes 3 \otimes 3 = 1 \oplus 8 \oplus 8 \oplus 10$

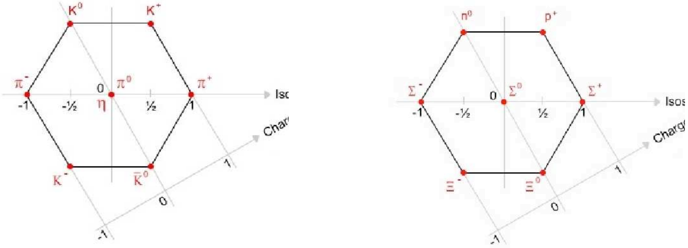


Figure: Octet of pseudoscalar mesons and spin-1/2 baryons

$SU(3)_f$ Limit

- In the $SU(3)_f$ limit, the octet baryons can be represented as the matrix:

$$B^{\alpha}_{\beta} = \begin{pmatrix} \frac{1}{\sqrt{2}}\Sigma^0 + \frac{1}{\sqrt{6}}\Lambda & \Sigma^+ & p \\ \Sigma^- & -\frac{1}{\sqrt{2}}\Sigma^0 + \frac{1}{\sqrt{6}}\Lambda & n \\ \Xi^- & \Xi^0 & -\frac{2}{\sqrt{6}}\Lambda \end{pmatrix}$$

- The (pseudoscalar) octet mesons as:

$$P^{\alpha}_{\beta} = \begin{pmatrix} \frac{1}{\sqrt{2}}\pi^0 + \frac{1}{\sqrt{6}}\eta & \pi^+ & K^+ \\ \pi^- & -\frac{1}{\sqrt{2}}\pi^0 + \frac{1}{\sqrt{6}}\eta & K^0 \\ K^- & \bar{K}^0 & -\frac{2}{\sqrt{6}}\eta \end{pmatrix}$$

and the singlet η'

- Vector mesons can be represented similarly with $\pi \to \rho$, $\eta \to \omega_8$, $K \to K^*$, $\eta' \to \omega_0$.
- In the vector meson case, mixing between ω_8 and ω_1 is large.
- In terms of the physical ω and ϕ, to a good approximation

$$\omega_8 = \frac{1}{\sqrt{3}}\omega - \sqrt{\frac{2}{3}}\phi$$
$$\omega_1 = \sqrt{\frac{2}{3}}\omega + \frac{1}{\sqrt{3}}\phi$$

where $\omega = \frac{1}{\sqrt{2}}(u\bar{u} + d\bar{d})$ and $\phi = s\bar{s}$

- The most general $SU(3)_f$ interactions can be described by three terms:
    - $\mathrm{Tr}\bar{B}\{P, B\}$
    - $\mathrm{Tr}\bar{B}[P, B]$
    - $\eta_0 \mathrm{Tr}\bar{B}B$
- The most general interaction lagrangian:

$$\mathcal{L} = \sqrt{2}\left(D\mathrm{Tr}\bar{B}\{P, B\} + F\mathrm{Tr}\bar{B}[P, B]\right) - \sqrt{\frac{2}{3}}(D - 3F)\eta_0 \mathrm{Tr}\bar{B}B$$

  where the last coefficient is chosen so that the $s\bar{s}$ component of the mesons do not couple to the nucleon
- 3 pairs of F and D coefficient are required to parameterize the couplings to the pseudoscalar, electric and magnetic like couplings of the vectors.

- The coupling constants can be read off as:

$$
\begin{aligned}
g_{\pi^0 pp} &= F + D,\ g_{\pi^0 \Sigma^+ \Sigma^+} = 2F,\ g_{\pi^- \Sigma^+ \Sigma^0} = -2F \\
g_{\pi^0 \Xi^0 \Xi^0} &= F - D,\ g_{\pi^+ \Xi^+ \Xi^0} = -\sqrt{2}(F - D),\ \text{etc.}
\end{aligned}
$$

Light Cone QCD Sum Rules

- In light cone QCD sum rules, the hadronic parameters are expressed in terms of the properties of the vacuum and the distribution amplitudes.
- One starts with a correlation function of the form

$$\Pi = i \int d^4 x e^{ipx} \langle \mathcal{M}(q) | \mathcal{T} \eta_{B_1}(x) \bar{\eta}_{B_2}(0) | 0 \rangle$$

- η are composite operators made of quark fields that have the same quantum numbers as the corresponding baryons.

- Inserting a complete set of hadronic states

$$\Pi^{phen} = \sum_{h,h'} \frac{\langle 0|\eta_{B_1}|B_1^h\rangle}{p_1^{h2} - m_1^{h2}} \langle \mathcal{M} B_1^h | B_2^{h'} \rangle \frac{\langle B_2^{h'}|\eta_{B_2}|0\rangle}{p_2^{h'2} - m_2^{h'2}}$$

- The matrix elements $\langle 0|\eta|B^h(p)\rangle = \lambda u_B(p)$ where $u_B(p)$ is the wavefunction (a spinor in our case) and λ is called the corresponding residue.
- The matrix element $\langle \mathcal{M}(q) B_1(p) | B_2(p+q)\rangle$ can be expressed in terms of coupling constants

- The correlation function contains different Dirac structures:

$$
\begin{aligned}
&\Pi^{B_2\to B_1\mathcal{M}}(p_1^2,p_2^2) \\
= \quad & i\frac{g_{B_2B_1\mathcal{M}}\lambda_{B_1}\lambda_{B_2}}{(p_1^2-M_1^2)(p_2^2-M_2^2)}\Big(-\not{p}\,\not{q}\gamma_5 - M_1\,\not{q}\gamma_5 \\
+ \quad & (M_2-M_1)\,\not{p}\gamma_5 + (M_1M_2-p^2)\gamma_5\Big) + \cdots
\end{aligned}
$$

- Each structure gives a different sum rule having different convergence properties.
- The contributions of higher states are parameterized by quark hadron duality, introducing an auxiliary parameter s_0.

- When $p_1^2 \to -\infty$ and $p_2^2 \to -\infty$, the main contribution is from small distances and times.
- Perturbative techniques can be applied:

$$\mathcal{T}\eta_{B_1}(x)\bar{\eta}_{B_2}(0) \simeq \sum_t C_t(x^2) : \mathcal{O}_t(x) :$$

where $: \cdots :$ stand for the normal product, and the first operators are of the form $\bar{q}(x)\Gamma q(0)$.
- The correlation function contains matrix elements of the form $\langle \mathcal{M} | : \mathcal{O}_t(x) : | 0 \rangle$

- The matrix elements $\langle \mathcal{M}| : \mathcal{O}_t(x) : |0\rangle$ are expanded around $x^2 \sim 0$ (hence the name light cone).

$$\langle \mathcal{M}(q)| : \bar{q}(x)\gamma_\mu\gamma_5 q(0) : |0\rangle = -if_{\mathcal{M}} q_\mu \int_0^1 du e^{i\bar{u}qx} \left(\varphi_{\mathcal{M}}(u) + \frac{1}{16} m_{\mathcal{M}}^2 x^2 \mathbb{A}(u) \right)$$

- With these inputs, one can calculate Π when $p_1^2 << 0$ and $p_2^2 << 0$.
- The two represantations are matched using spectral representations
- Sum rules are obtained through

$$\Pi^{hadronic} = \int_0^{s_0} ds_1 \int_0^{s_0'} ds_2 \rho^{OPE}(s_1, s_2) e^{-\frac{s_1}{M_1^2} - \frac{s_2}{M_2^2}} \qquad (1)$$

after Borel transformations and continuum subtraction.

Relations Between Correlation Functions

- To express the correlation function, first suitable currents have to be chosen:

$$
\begin{aligned}
\eta^{\Sigma^0} &= \sqrt{\frac{1}{2}}\epsilon^{abc}\left[\left(u^{aT}Cs^b\right)\gamma_5 d^c + t\left(u^{aT}C\gamma_5 s^b\right)d^c\right. \\
&\quad \left. - \left(s^{aT}Cd^b\right)\gamma_5 u^c - t\left(s^{aT}C\gamma_5 d^b\right)u^c\right] \\
\eta^{\Sigma^+} &= -\frac{1}{\sqrt{2}}\eta^{\Sigma^0}(d\to u)\,, \qquad \eta^{\Sigma^-} = \frac{1}{\sqrt{2}}\eta^{\Sigma^0}(u\to d) \\
\eta^{p} &= \eta^{\Sigma^+}(s\to d)\,, \qquad \eta^{n} = \eta^{\Sigma^-}(s\to u) \\
\eta^{\Xi^0} &= \eta^{n}(d\to s)\,, \qquad \eta^{\Xi^-} = \eta^{p}(u\to s)
\end{aligned}
$$

$$
\begin{aligned}
\eta^{\Lambda} &= -\sqrt{\frac{1}{6}}\epsilon^{abc}\left[2\left(u^{aT}Cd^b\right)\gamma_5 s^c + 2t\left(u^{aT}C\gamma_5 d^b\right)s^c + \left(u^{aT}Cs^b\right)\gamma_5 d^c\right. \\
&+ \left. t\left(u^{aT}C\gamma_5 s^b\right)d^c + \left(s^{aT}Cd^b\right)\gamma_5 u^c + t\left(s^{aT}C\gamma_5 d^b\right)u^c\right]
\end{aligned}
$$

- The parameter t is an arbitrary, unphysical parameter.
- $t = -1$ corresponds to the Ioffe current
- The Λ current can also be obtained from that of the Σ^0 by:

$$\begin{aligned} 2\eta_{\Sigma^0}(d \leftrightarrow s) + \eta_{\Sigma^0} &= -\sqrt{3}\eta_\Lambda \\ 2\eta_{\Sigma^0}(u \leftrightarrow s) - \eta_{\Sigma^0} &= -\sqrt{3}\eta_\Lambda \end{aligned}$$

Outline

1. Introduction
   - Physics Department of Middle East Technical University (METU)
   - Regular Meetings
   - Physics
2. Light Cone QCD Sum Rules
3. Strong Baryon Pseudoscalar Meson Couplings
   - Relations Between Correlation Functions
   - Results
4. Strong Baryon Vector Meson Couplings

Relations Between Correlation Functions

- Convention: Let $\pi^0 = g_{\pi uu}\bar{u}u + g_{\pi dd}\bar{d}d + g_{\pi ss}\bar{s}s$
- Denote $\Pi^{B_2 \to B_1 \mathcal{M}} = \langle \mathcal{M} | B_1 \bar{B}_2 | 0 \rangle$
- Then:

$$\Pi^{\Sigma^0 \to \Sigma^0 \pi^0} = g_{\pi uu}\langle \bar{u}u | \Sigma^0 \bar{\Sigma}^0 | 0 \rangle + g_{\pi dd}\langle \bar{d}d | \Sigma^0 \bar{\Sigma}^0 | 0 \rangle + g_{\pi ss}\langle \bar{s}s | \Sigma^0 \bar{\Sigma}^0 | 0 \rangle$$

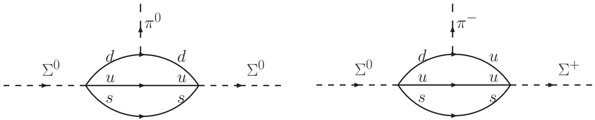
- Let $\Pi_1(u,d,s) = \langle \bar{u}u | \Sigma^0 \bar{\Sigma}^0 | 0 \rangle$, $\Pi_2(u,d,s) = \langle \bar{s}s | \Sigma^0 \bar{\Sigma}^0 | 0 \rangle$
- $\langle \bar{d}d | \Sigma^0 \bar{\Sigma}^0 | 0 \rangle = \Pi_1(d,u,s)$ since $\Sigma^0(u \leftrightarrow d) = \Sigma^0$

Relations Between Correlation Functions

- Consider $\Pi^{\Sigma^+\to\Sigma^+\pi^0} = g_{\pi\bar{u}u}\langle\bar{u}u|\Sigma^+\bar{\Sigma}^+|0\rangle + g_{\pi\bar{s}s}\langle\bar{s}s|\Sigma^+\bar{\Sigma}^+|0\rangle$
- Note that $\Sigma^0(d\to u) = -\sqrt{2}\Sigma^+$
- Hence $\langle\bar{u}u|\Sigma^0\bar{\Sigma}^0|0\rangle(d\to u) = 2\langle\bar{u}u|\Sigma^+\bar{\Sigma}^+|0\rangle'$
- $\langle\bar{u}u|\Sigma^+\bar{\Sigma}^+|0\rangle = 4\langle\bar{u}u|\Sigma^+\bar{\Sigma}^+|0\rangle' =$
  $= 2\langle\bar{u}u|\Sigma^0\bar{\Sigma}^0|0\rangle(d\to u) = 2\Pi_1(u,u,s)$
- Hence $\Pi^{\Sigma^+\to\Sigma^+\pi^0} = \sqrt{2}\Pi_1(u,u,s)$

Relations Between Correlation Functions

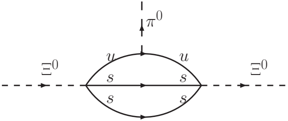
- What about charged mesons? Consider $\Pi^{\Sigma^0 \to \Sigma^+ \pi^-}$

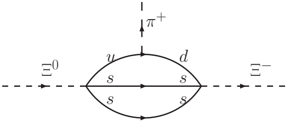


- Hence it is natural to expect that $\langle \bar{d}d|\Sigma^0\bar{\Sigma}^0|0\rangle$ to be proportional to $\langle \bar{u}d|\Sigma^+\bar{\Sigma}^0|0\rangle$
- Indeed $\Pi^{\Sigma^0 \to \Sigma^+ \pi^-} = \langle \bar{u}d|\Sigma^+\bar{\Sigma}^0|0\rangle = -\sqrt{2}\langle \bar{d}d|\Sigma^0\bar{\Sigma}^0|0\rangle = -\sqrt{2}\Pi_1(d,u,s)$
- Exchanging u and d quarks, one also obtains $\Pi^{\Sigma^0 \to \Sigma^- \pi^+} = \langle \bar{d}u|\Sigma^-\bar{\Sigma}^0|0\rangle = \sqrt{2}\Pi_1(u,d,s)$

Relations Between Correlation Functions

- Similarly $\Pi^{\Xi^0\to\Xi^-\pi^+} = \langle\bar{d}u|\Xi^-\Xi^0|0\rangle = -\sqrt{2}\langle\bar{u}u|\Xi^0\bar{\Xi}^0|0\rangle = -\Pi_2(s,s,u)$





- Exchanging u and d, one obtains $\Pi^{\Xi^-\to\Xi^0\pi^-} = -\Pi_2(s,s,d)$

Relations Between Correlation Functions

- What about Λ?
- Using $2\Sigma^0(d \leftrightarrow s) = -\sqrt{3}\Lambda - \Sigma^0$ and the result $\Pi^{\Sigma^0 \to \Sigma^- \pi^+} = \sqrt{2}\Pi_1(u,d,s)$, we have $2\sqrt{2}\Pi_1(u,s,d) = \sqrt{3}\Pi^{\Lambda \to \Xi^- K^+} + \Pi^{\Sigma^0 \to \Xi^- K^+}$
- How to separate the two correlation functions? Define $\Pi_3(u,d,s) = -\Pi^{\Sigma^0 \to \Xi^- K^+} = -\langle \bar{s}u | \Xi^- \bar{\Sigma}^0 | 0 \rangle$ and $\Pi_4(u,d,s) = -\Pi^{\Xi^- \to \Sigma^0 K^-} = -\langle \bar{u}s | \Sigma^0 \bar{\Xi}^- | 0 \rangle$

Relations Between Correlation Functions

- How are the functions related to the F and D constants in the $SU(3)_f$ limit?
- In the $SU(3)_f$ limit, $\Pi_1 \propto \sqrt{2}F$, $\Pi_2 \propto \sqrt{2}(F - D)$, and $\Pi_4 = \Pi_3 \propto -(F + D)$

Outline

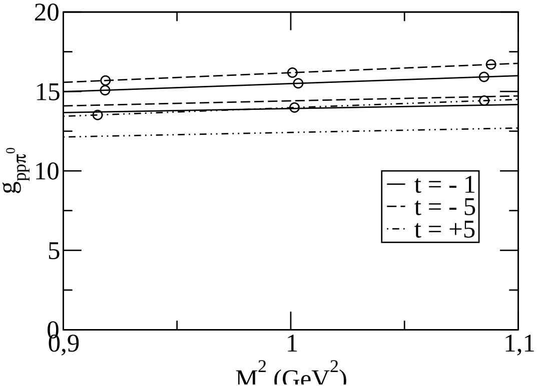


Figure: The M^2 dependence of the $g_{pp\pi}$ coupling constant.

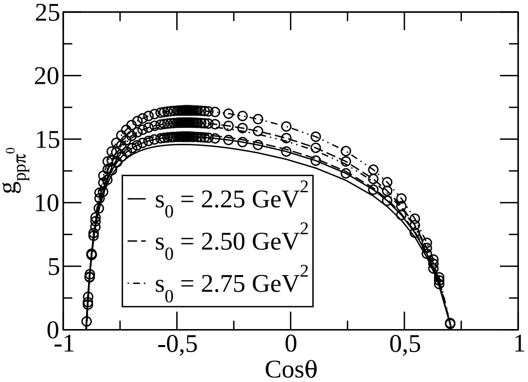


Figure: The θ dependence of the $g_{pp\pi}$ where $\tan\theta = t$

Channel	Gen. Current	$t=-1$	$SU(3)_f$	QSR*	QSR†	Exp.
$\Lambda \to nK$	-13 ± 3	-9.5 ± 1	-13.6	-2.37	-2.49	-13.5
$\Lambda \to \Sigma^+\pi^-$	10 ± 3	12 ± 1	9.58			
$\Lambda \to \Xi^0 K^0$	4.5 ± 2	-2.5 ± 0.5	4.04			
$n \to p\pi^-$	21 ± 4	20 ± 2	18.95			21.2
$n \to \Sigma^0 K^0$	-3.2 ± 2.2	-9.5 ± 0.5	-3.2	-0.025	-0.40	-4.25
$p \to \Lambda K^+$	-13 ± 3	-10 ± 1	-13.6	-2.37	-2.49	-13.5
$p \to p\pi^0$	14 ± 4	15 ± 1	13.4	13.5		14.9
$p \to \Sigma^+ K^0$	4 ± 3	14 ± 1	4.52			
$\Sigma^0 \to nK^0$	-4 ± 3	-9.5 ± 1	-3.2	-0.025	-0.40	-4.25
$\Sigma^0 \to \Lambda\pi^0$	11 ± 3	12 ± 1.5	9.58	6.9		
$\Sigma^0 \to \Xi^0 K^0$	-13 ± 3	-13.5 ± 1	-13.4			
$\Sigma^- \to nK^-$	5 ± 3	15 ± 2	-3.2			
$\Sigma^+ \to \Lambda\pi^+$	10 ± 3.5	12.5 ± 1	9.58			
$\Sigma^+ \to \Sigma^0\pi^+$	-9 ± 2	-7.5 ± 0.7	-10.2	-11.9		
$\Xi^0 \to \Lambda K^0$	4.5 ± 1	-2.6 ± 0.3	4.04			
$\Xi^0 \to \Sigma^0 K^0$	-12.5 ± 3	-13.5 ± 1	-13.4			
$\Xi^0 \to \Sigma^+ K^-$	18 ± 4	19 ± 2	18.95			
$\Xi^0 \to \Xi^0\pi^0$	10 ± 2	0.3 ± 0.6	-3.2	-1.60		

Table: Comparison our our results and other approaches. The third column corresponds to $F/D = 5.2/8.3 = 0.61$, which is the best $SU(3)_f$ fit. (Phys.Rev. D74:116001,2006)

Strong Baryon Vector Meson Couplings

- The couplings are defined as:

$$\langle \mathcal{O}_2 V | \mathcal{O}_1 \rangle = \epsilon^\mu \bar{u}_{\mathcal{O}_2} \left(f_1 \gamma_\mu - i \frac{f_2}{m_1 + m_2} \sigma_{\mu\nu} q^\nu \right) u_{\mathcal{O}_1} \qquad (2)$$

- At $q^2 = m_V^2$, f_1 is the electric like and $f_1 + f_2$ is the magnetic like coupling.

$\lvert f_1 \rvert$	General Current	Ioffe Current	$SU_f(3)$	[Wang, 2007]	[Erkol, 2006]	[Zhu, 1999]
$p \to p\rho^0$	2 ± 1	5.5 ± 0.5	2.5	3.2 ± 0.9	2.4 ± 0.6	2.5 ± 0.2
$p \to p\omega$	9 ± 1	8.5 ± 1.5	10.3	—	7.2 ± 1.8	18 ± 8
$\Xi^0 \to \Xi^0\rho^0$	3 ± 1	2.05 ± 0.20	3.9	1.5 ± 1.1	2.4 ± 0.6	—
$\Sigma^0 \to \Lambda\rho^0$	1.8 ± 0.8	1.7 ± 0.8	0.8	—	—	—
$\Sigma^+ \to \Lambda\rho^+$	1.8 ± 0.8	1.7 ± 0.8	0.8	—	—	—
$\Sigma^+ \to \Sigma^0\rho^+$	6.2 ± 0.8	8.6 ± 0.8	6.4	—	—	—
$n \to p\rho^-$	4.1 ± 0.7	8.1 ± 0.5	3.5	4 ± 1	—	—
$\Sigma^+ \to \Lambda\rho^+$	1.75 ± 0.5	3.0 ± 0.5	0.8	—	—	—
$p \to \Lambda K^{*+}$	5.1 ± 0.8	7.4 ± 0.8	5.1	—	—	—
$\Sigma^- \to nK^{*-}$	6.6 ± 0.9	1.8 ± 0.4	5.5	—	—	—
$\Xi^0 \to \Sigma^+K^{*-}$	6.6 ± 0.9	10.6 ± 1.4	3.5	—	—	—
$\Xi^- \to \Lambda K^{*-}$	5.5 ± 0.5	6.4 ± 0.4	5.9	—	—	—
$\Xi^0 \to \Sigma^0\bar{K}^{*0}$	3.4 ± 0.6	7.2 ± 1.2	2.5	—	—	—
$\Sigma^0 \to \Xi^0K^{*0}$	3.2 ± 0.8	7.2 ± 1.2	2.5	—	—	—
$\Lambda \to \Xi^0K^{*0}$	5.8 ± 0.7	6.3 ± 0.2	5.9	—	—	—
$n \to \Sigma^0K^{*0}$	3.6 ± 0.8	1.6 ± 0.2	3.9	—	—	—
$p \to \Sigma^+K^{*0}$	6.2 ± 0.9	1.7 ± 0.3	5.5	—	—	—
$\Lambda \to \Lambda\omega$	6.8 ± 0.9	4.8 ± 0.2	7.3	—	4.8 ± 1.2	—
$\Xi^0 \to \Xi^0\phi$	9 ± 2	13 ± 1	9.0	—	—	—
$\Lambda \to \Lambda\phi$	6.2 ± 0.8	8 ± 1	4.2	—	—	—
$\Sigma^0 \to \Sigma^0\phi$	5 ± 1	0.00 ± 0.01	5.5	—	—	—

Table: $\lvert f_1 \rvert$ values for various channels. $SU(3)_f$ values corresponds to $F/(F+D) = (-3.2)/(-3.2+0.7) = 1.28$ (work in progress)

$\vert f_1 + f_2\vert$	General Current	Ioffe Current	$SU_f(3)$	[Wang, 2007]	[Erkol,2006]	[Zhu,1999]
$p \to p\rho^0$	20 ± 3	22 ± 1	20.4	36.8 ± 13	10.1 ± 3.7	21.6 ± 6.6
$p \to p\omega$	13.5 ± 1.5	21 ± 1	15.6	—	5.0 ± 1.2	32.4 ± 14.4
$\Xi^0 \to \Xi^0\rho^0$	2 ± 1	2.2 ± 0.5	2.4	-5.3 ± 3.3	-3.6 ± 1.6	—
$\Sigma^0 \to \Lambda\rho^0$	13 ± 2	14 ± 1	13.2	—	—	—
$\Sigma^+ \to \Lambda\rho^+$	13 ± 2	14 ± 1	13.2	—	—	—
$\Sigma^+ \to \Sigma^0\rho^+$	20 ± 3	18 ± 1	18.0	53.5 ± 19	7.1 ± 1	—
$n \to p\rho^-$	30 ± 5	32 ± 1	28.9	4 ± 1	—	—
$\Sigma^+ \to \Lambda\rho^+$	12 ± 2	13 ± 1	13.2	—	—	—
$p \to \Lambda K^{*+}$	22 ± 3	27 ± 1	22.2	—	—	—
$\Sigma^- \to nK^{*-}$	3 ± 1	3 ± 1	3.4	—	—	—
$\Xi^0 \to \Sigma^+K^{*-}$	35 ± 5	32 ± 3	28.9	—	—	—
$\Xi^- \to \Lambda K^{*-}$	10 ± 1	8 ± 1	9.0	—	—	—
$\Xi^0 \to \Sigma^0\bar{K}^{*0}$	25 ± 5	28 ± 2	20.4	—	—	—
$\Sigma^0 \to \Xi^0K^{*0}$	25 ± 5	28 ± 2	20.4	—	—	—
$\Lambda \to \Xi^0K^{*0}$	9 ± 1	14 ± 1	9.0	—	—	—
$n \to \Sigma^0K^{*0}$	3 ± 1	0.3 ± 0.1	2.4	—	—	—
$p \to \Sigma^+K^{*0}$	3 ± 1	0.3 ± 0.1	3.4	—	—	—
$\Lambda \to \Lambda\omega$	2 ± 1	6.5 ± 0.5	2.8	—	-5.7 ± 1.0	—
$\Xi^0 \to \Xi^0\phi$	26 ± 3	35 ± 2	25.5	—	—	—
$\Lambda \to \Lambda\phi$	16 ± 3	21 ± 1	18.1	—	—	—
$\Sigma^0 \to \Sigma^0\phi$	3 ± 1	0.9 ± 0.1	3.4	—	—	—

Table: $|f_1 + f_2|$ values for various channels. $SU(3)_f$ corresponds to $F/(F + D) = 9.0/(9.0 + 11.4) = 0.44$ (work in progress)

Conclusion

- All the strong coupling constants are expressed in terms of four analytic functions
- The predicted coupling constants respect the $SU(3)_f$ symmetry
- There is good agreement with the experimental results.