An EFT for the weak ΛN interaction

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- Is it possible to build a model independent theory for the $|\Delta S| = 1$ ΛN interaction?

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- Can a low order EFT describe the present available data for $\Lambda N \to NN$ (hypernuclear decay data)?
- Is this a valid scenario to learn something new on the $|\Delta S| = 1$ interaction?
  - $\Delta I = 3/2$ transitions?
  - SU(3) breaking?

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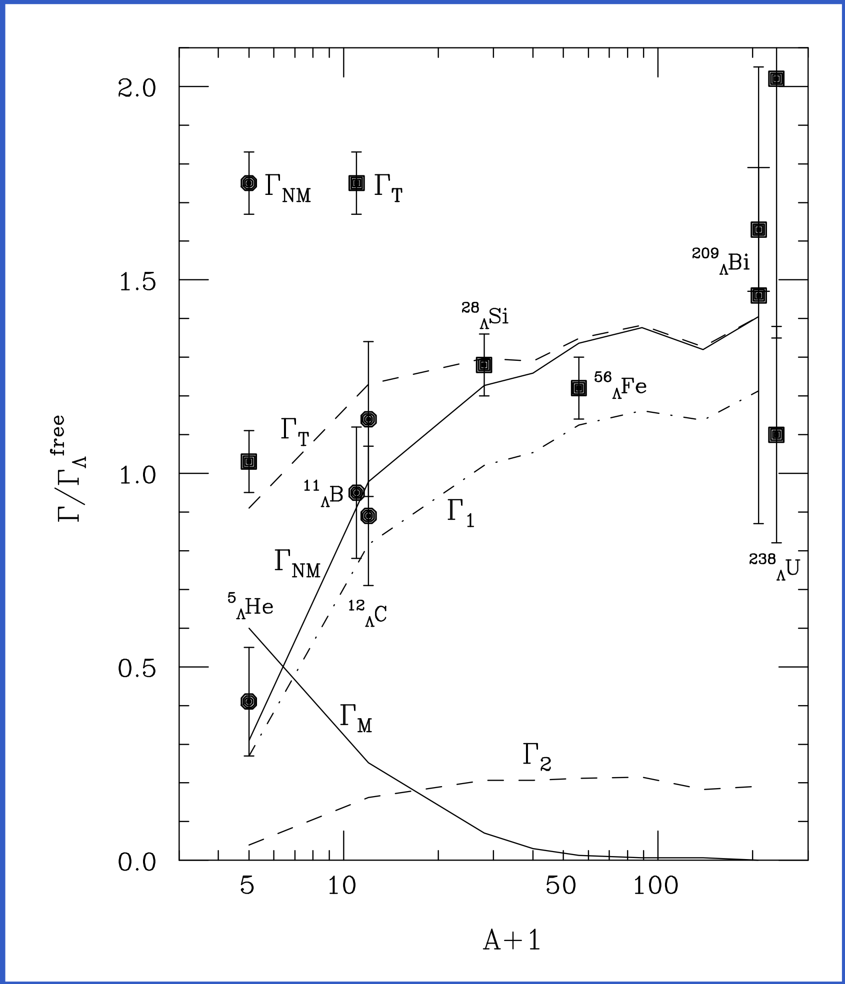
Hypernuclear lifetimes — Decay rates

Fair agreement for the NMD rates



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$$= \Gamma_{\pi^-} + \Gamma_{\pi^0}$$
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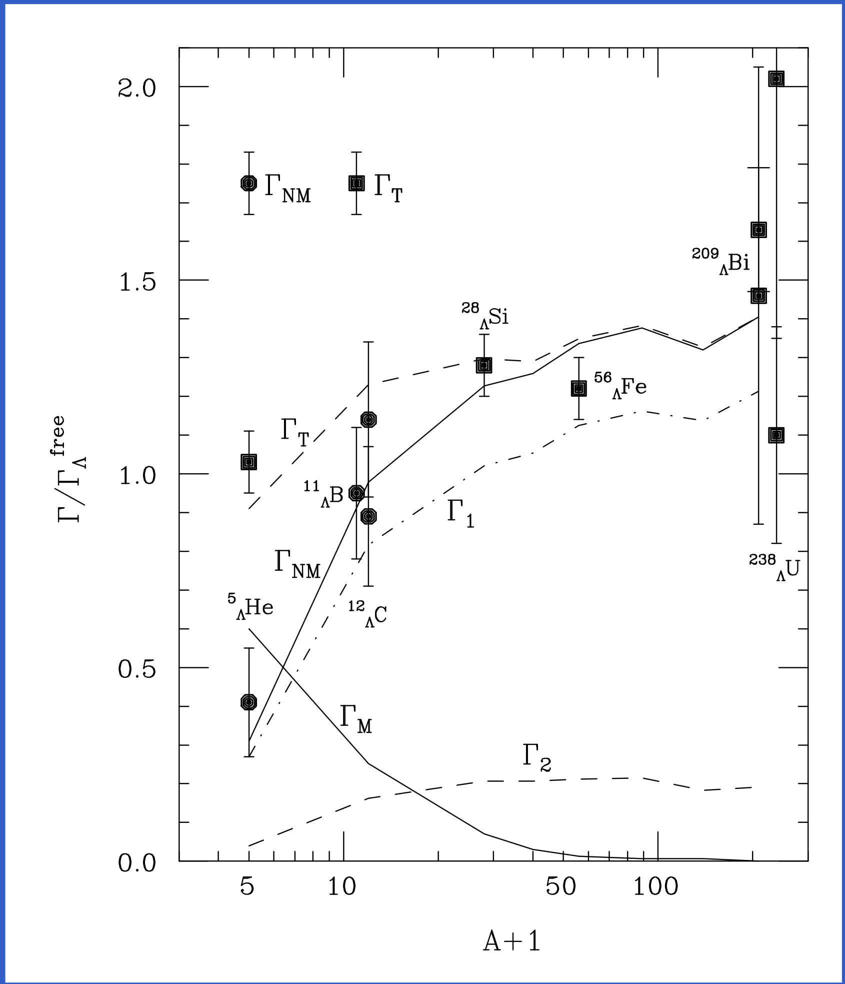
$$\Lambda \to N\pi$$



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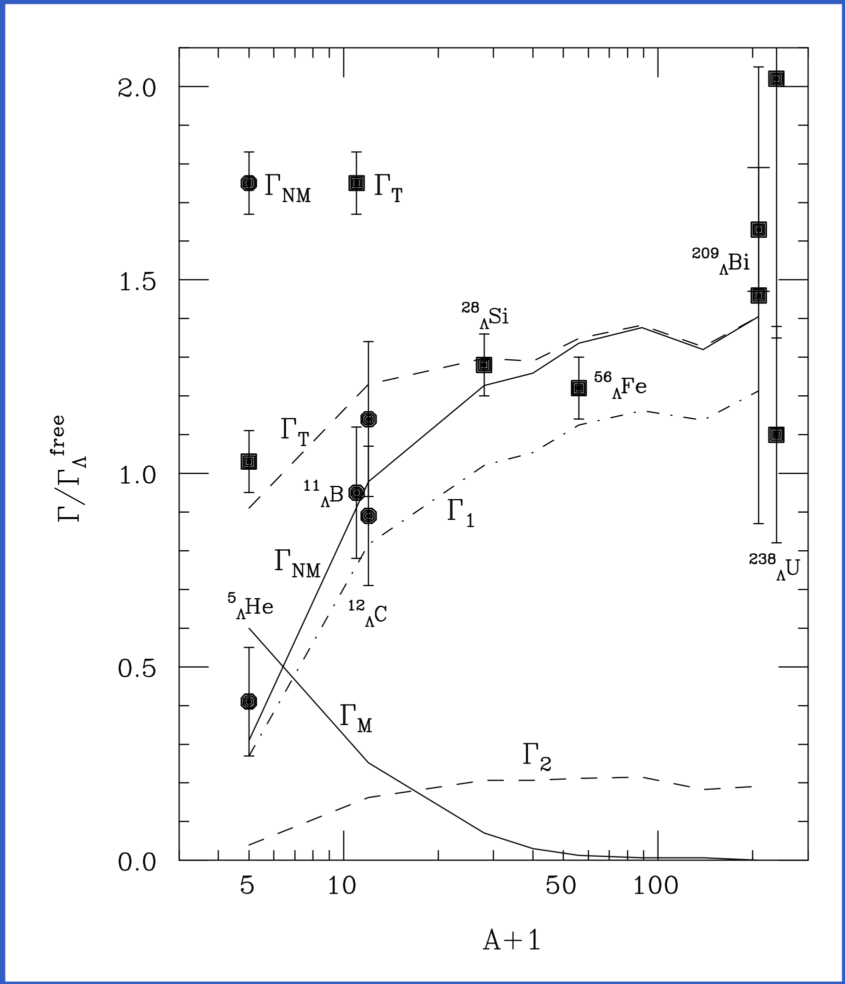

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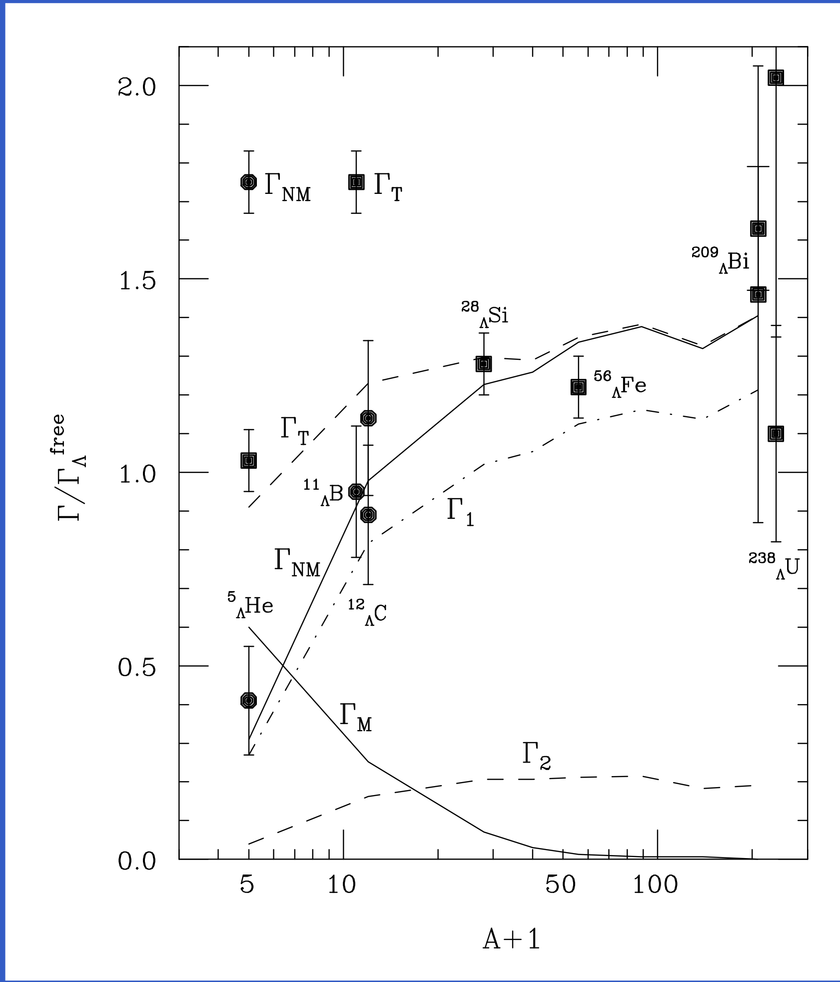

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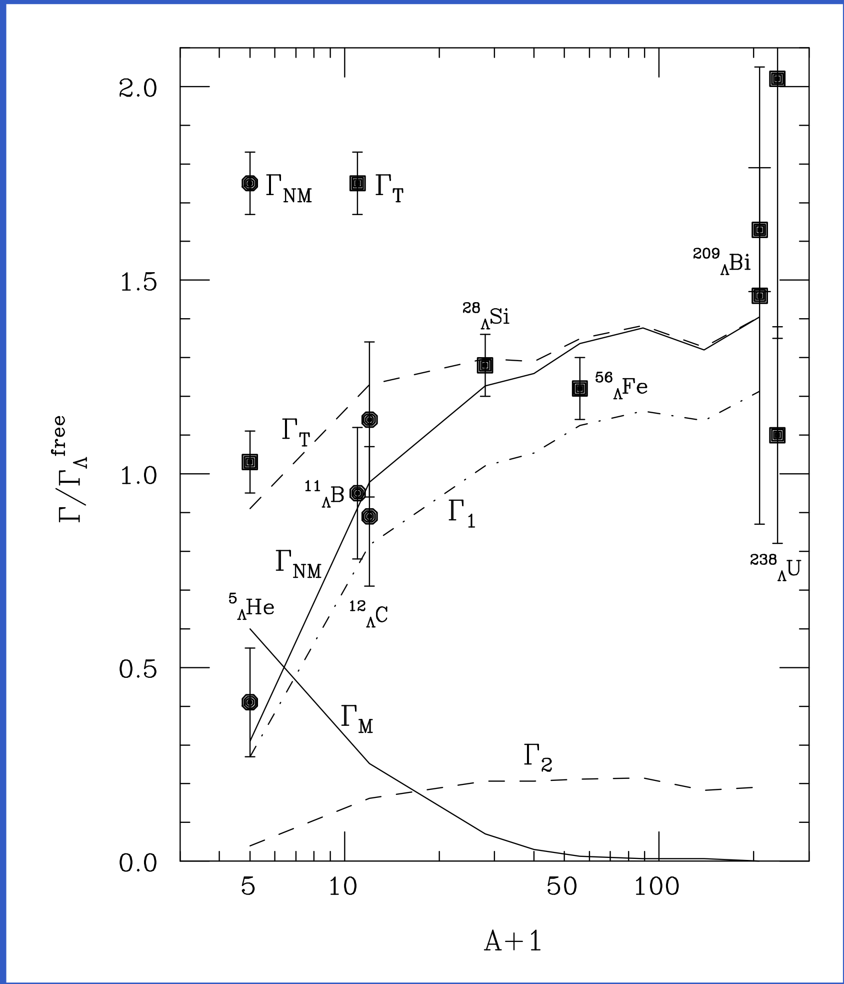
$${}^{A}_{\Lambda}Z \to NN + {}^{(A-2)}Z'$$



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Experiment and theory getting closer

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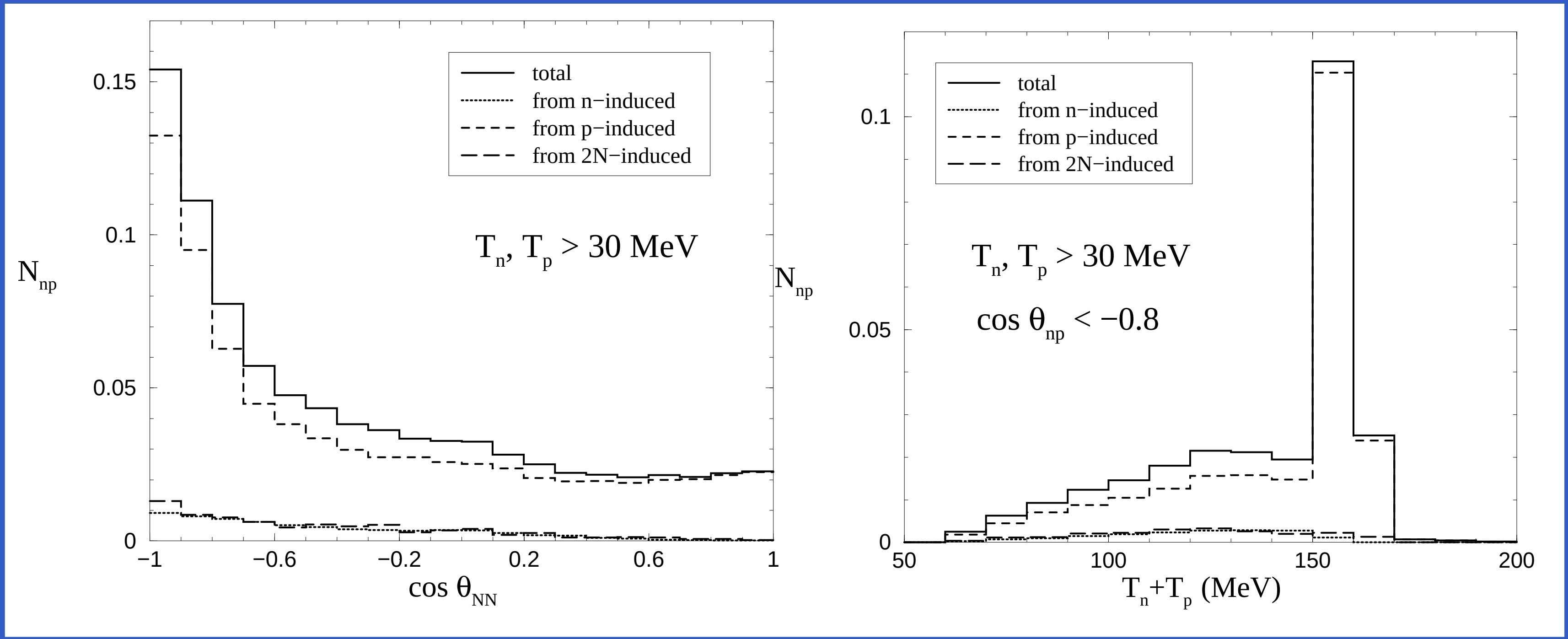
Experiment and theory getting closer

Study of double coincidence observables: KEK-E462 (H. Outa's talk)

Theory: G. Garbarino's talk, Garbarino, Parreño, Ramos, PRL 91 112501 (2003)



Parity Violating Asymmetry, $\mathcal{A}$

$$I(\chi) = I_0\ (1+\mathcal{A}), \qquad I_0 = \frac{Tr(\mathcal{M}\mathcal{M}^\dagger)}{2J+1}$$

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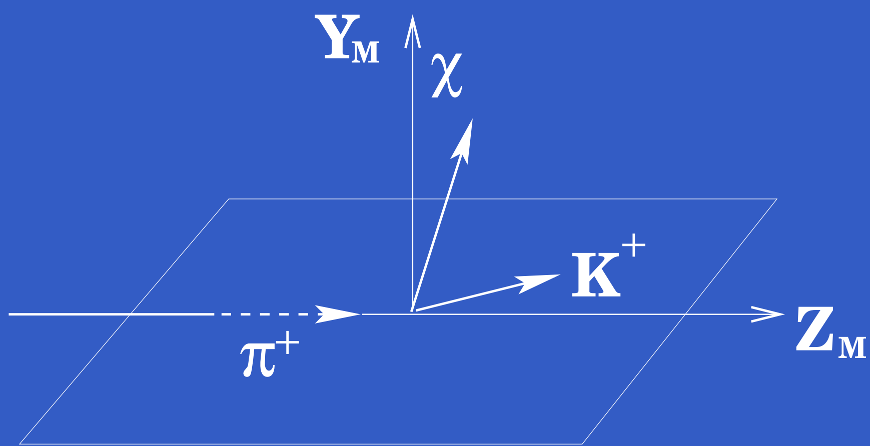

KEK $n(\pi^+, K^+)\Lambda$

$p_\pi = 1.05\text{GeV}$

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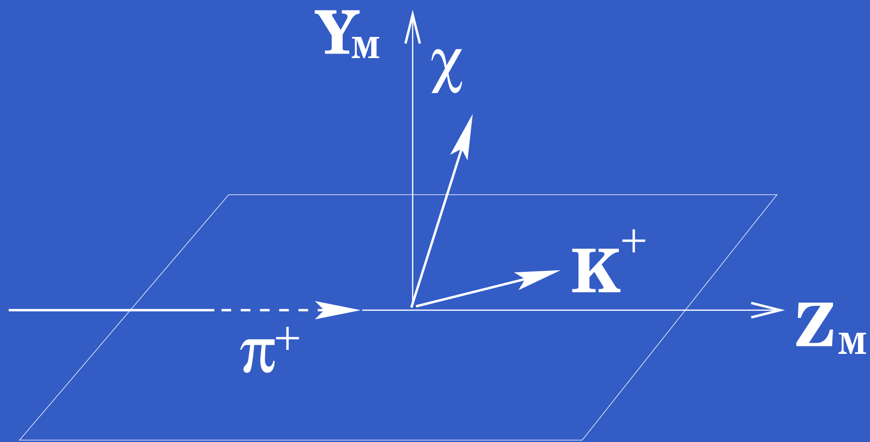

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	$\mathcal{A}$ Theory	$\mathcal{A}$ Experiment
${}^5_\Lambda$He	~ -0.7	0.24 ± 0.22 [KEK00]
${}^{12}_\Lambda$C	~ -0.07	-0.01 ± 0.10 [KEK92]

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- Effective Field Theories based in chiral expansions
  - Remarkable success in the SU(2) sector

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    $$\Rightarrow C_n \mathcal{O}((\frac{p}{M})^n)$$

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  - Significant degree of SU(3) breaking.
  - Problems facing SU(3) χPT: weak PC $Y \rightarrow N\pi$ amplitudes
  - Energy released in $(\Lambda N \rightarrow NN)_{\rm th} \sim$ 177 MeV ($|\vec{p}| \sim 417$ MeV/c) $\Longrightarrow$ Successful low-energy expansion?

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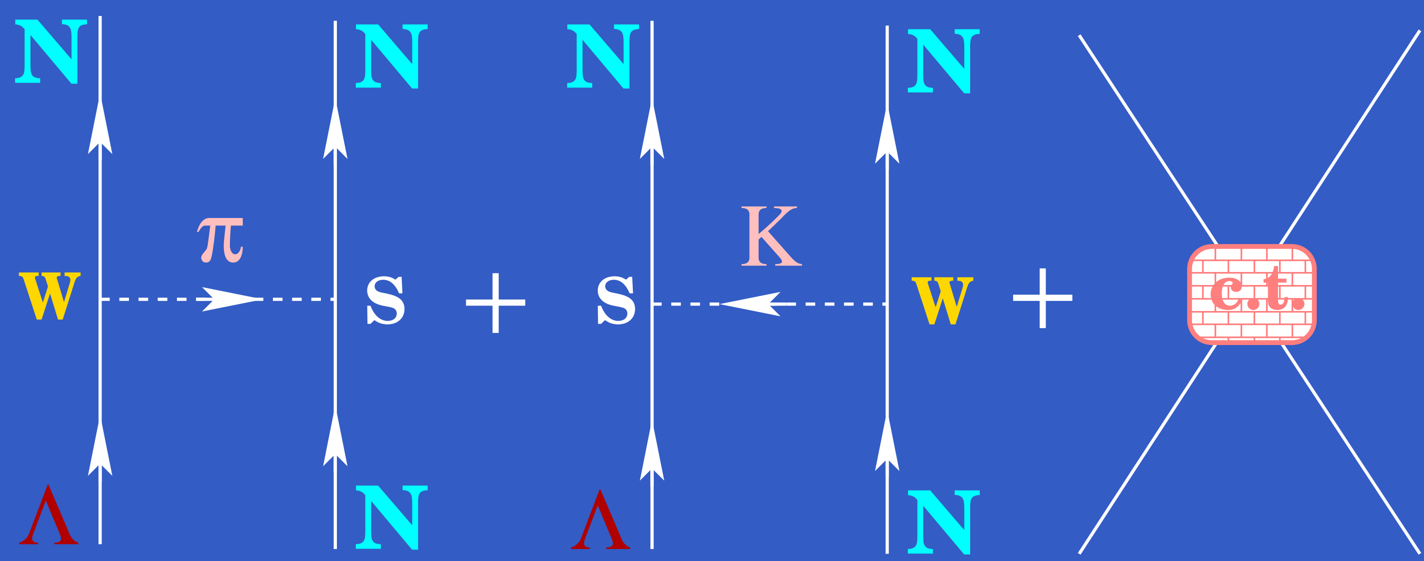
- At leading order: $\pi + K +$ LO contact terms



OPE and OKE potentials

$$\mathcal{L}^{\mathrm{W}}_{\Lambda\mathrm{N}\pi} = -\mathrm{i} G_F m_\pi^2 \overline{\psi}_{\mathrm{N}} (A_\pi + B_\pi \gamma_5 \gamma^\mu) \vec{\tau} \cdot \partial_\mu \vec{\phi}^{\,\pi} \psi_\Lambda \binom{0}{1}$$

$$\mathcal{L}^{\mathrm{S}}_{\mathrm{NN}\pi} = -\mathrm{i}\, g_{\mathrm{NN}\pi} \overline{\psi}_{\mathrm{N}} \gamma_5 \gamma^\mu \vec{\tau} \cdot \partial_\mu \vec{\phi}^{\,\pi} \psi_{\mathrm{N}}$$

$$V_{\mathrm{OPE}}(\vec{q}) = -G_F m_\pi^2 \frac{g_{\mathrm{NN}\pi}}{2M_{\mathrm{S}}} \left(A_\pi + \frac{B_\pi}{2M_{\mathrm{W}}} \vec{\sigma}_1 \, \vec{q} \right) \frac{\vec{\sigma}_2 \, \vec{q}}{\vec{q}^{\,2} + \mu_\pi^{\;2}} \, \vec{\tau}_1 \, \vec{\tau}_2$$

OPE and OKE potentials

$$\mathcal{L}^{\rm W}_{\Lambda {\rm N}\pi} = -{\rm i} G_F m_\pi^2 \overline{\psi}_{\rm N} (A_\pi + B_\pi \gamma_5 \gamma^\mu) \vec{\tau} \cdot \partial_\mu \vec{\phi}^{\,\pi} \psi_\Lambda \binom{0}{1}$$

$$\mathcal{L}^{\rm S}_{{\rm NN}\pi} = -{\rm i}\, g_{{\rm NN}\pi}\, \overline{\psi}_{\rm N} \gamma_5 \gamma^\mu\, \vec{\tau} \cdot \partial_\mu\, \vec{\phi}^{\,\pi} \psi_{\rm N}$$

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$$\mathcal{L}^{\rm W}_{\rm NNK} = -{\rm i}\, G_F m_\pi^2 \left[\overline{\psi}_{\rm N} \binom{0}{1} \left(C_{\rm K}^{\rm PV} + C_{\rm K}^{\rm PC} \gamma_5\, \gamma^\mu\, \partial_\mu \right) (\phi^{\rm K})^\dagger \psi_{\rm N} + \overline{\psi}_{\rm N} \psi_{\rm N} \left(D_{\rm K}^{\rm PV} + D_{\rm K}^{\rm PC} \gamma_5\, \gamma^\mu\, \partial_\mu \right) (\phi^{\rm K})^\dagger \binom{0}{1} \right]$$

$$\mathcal{L}^{\rm S}_{\Lambda {\rm NK}} = -{\rm i}\, g_{\Lambda {\rm NK}}\, \overline{\psi}_{\rm N} \gamma_5\, \gamma^\mu\, \partial_\mu\, \phi^{\rm K} \psi_\Lambda$$

$$g_{{\rm NN}\pi} \to g_{\Lambda {\rm NK}} \;,\; \mu_\pi \to \mu_{\rm K}$$

$$\hat{A}_\pi \to \left(\frac{C_{\rm K}^{\rm PV}}{2} + D_{\rm K}^{\rm PV} + \frac{C_{\rm K}^{\rm PV}}{2} \vec{\tau}_1 \vec{\tau}_2 \right) \frac{M_{\rm S}}{M_{\rm W}},\; \hat{B}_\pi \to \left(\frac{C_{\rm K}^{\rm PC}}{2} + D_{\rm K}^{\rm PC} + \frac{C_{\rm K}^{\rm PC}}{2} \vec{\tau}_1\, \vec{\tau}_2 \right)$$

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$$^3S_1 \to ^3P_1, \quad A\,(\sigma_1 + \sigma_2)\,\{p_1 - p_2\,,\,\delta(\vec{r})\,\} + B\,(\sigma_1 + \sigma_2)\,[\,p_1 - p_2\,,\,\delta(\vec{r})\,]$$

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$$^1S_0 \to ^3P_0, \quad +E\ \mathrm{i}\,(\sigma_1 \times \sigma_2)\,\{p_1 - p_2\,,\,\delta(\vec{r})\,\} + F\ \mathrm{i}\,(\sigma_1 \times \sigma_2)\,[\,p_1 - p_2\,,\,\delta(\vec{r})\,]$$

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- PC $\Lambda N \to NN$ transitions:

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partial wave	operator	order	isospin
$^1S_0 \to {}^1S_0$	$\hat{1},\ \vec\sigma_1\vec\sigma_2$	1	1
$^1S_0 \to {}^3P_0$	$(\vec\sigma_1-\vec\sigma_2)\vec q,\ (\vec\sigma_1\times\vec\sigma_2)\vec q$	q/M_N	1
$^3S_1 \to {}^3S_1$	$\hat{1},\vec\sigma_1\vec\sigma_2$	1	0
$^3S_1 \to {}^1P_1$	$(\vec\sigma_1-\vec\sigma_2)\vec q,\ (\vec\sigma_1\times\vec\sigma_2)\vec q$	q/M_N	0
$^3S_1 \to {}^3P_1$	$(\vec\sigma_1+\vec\sigma_2)\vec q$	q/M_N	1
$^3S_1 \to {}^3D_1$	$(\vec\sigma_1\times\vec q)(\vec\sigma_2\times\vec q)$	$q^2/{M_N}^2$	0

Equivalently, build up the Lorentz invariant Lagrangian from:

$$\overline{\Psi}\Psi,\ \overline{\Psi}\gamma^\mu\Psi,\ \mathrm{i}\overline{\Psi}[\gamma^\mu,\gamma^\nu]\Psi = \overline{\Psi}2\sigma^{\mu\nu}\Psi,\ \overline{\Psi}\gamma^\mu\gamma^5\Psi,\ \mathrm{i}\overline{\Psi}\gamma^5\Psi$$

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Γ^μ	n.r. reduction of $\Psi(\vec{k}_2)\,\Gamma^\mu\,\Psi(\vec{k}_1)$
$\hat{1} \longrightarrow$	$1 - \frac{(\vec{\sigma}\vec{k}_1)(\vec{\sigma}\vec{k}_2)}{4M_1M_2}$
$\gamma^5 \longrightarrow$	$\frac{\vec{\sigma}\vec{q}}{2\overline{M}}$
$i\,\frac{\sigma^{\mu\nu}}{2\overline{M}}\,q_\nu \longrightarrow$	$\left\{\frac{(\vec{\sigma}\vec{q})(\vec{\sigma}\vec{q})}{4\,\overline{M}\,\overline{M}},\, i\,\frac{(\vec{\sigma}\times\vec{q})^{\,i}}{2\overline{M}} - i\,\frac{\vec{\sigma}\vec{k}_2}{2M_2}\,\frac{(\vec{\sigma}\times\vec{q})^{\,i}}{2\overline{M}}\,\frac{\vec{\sigma}\vec{k}_1}{2M_1}\right\}$
$\gamma^\mu \longrightarrow$	$\left\{1 + \frac{(\vec{\sigma}\vec{k}_1)(\vec{\sigma}\vec{k}_2)}{4M_1M_2},\, \vec{\sigma}^{\,i}\,\frac{\vec{\sigma}\vec{k}_1}{2M_1} + \frac{\vec{\sigma}\vec{k}_2}{2M_2}\vec{\sigma}^{\,i}\right\} =$
	$\left\{1 + \frac{(\vec{\sigma}\vec{k}_1)(\vec{\sigma}\vec{k}_2)}{4M_1M_2},\, \frac{(\vec{k}_1+\vec{k}_2)^{\,i}}{2\overline{M}} - i\,\frac{(\vec{\sigma}\times\vec{q})^{\,i}}{2\overline{M}}\right\}$
$\gamma^\mu\gamma^5 \longrightarrow$	$\left\{\frac{\vec{\sigma}\vec{k}_1}{2M_1} + \frac{\vec{\sigma}\vec{k}_2}{2M_2},\, \vec{\sigma}^{\,i} + \frac{\vec{\sigma}\vec{k}_2}{2M_2}\,\vec{\sigma}^{\,i}\,\frac{\vec{\sigma}\vec{k}_1}{2M_1}\right\}$

4P potential

$$V_{4P}(\vec{q}) = \begin{cases} C_0^0 + C_0^1\,\vec{\sigma}_1\vec{\sigma}_2 & \text{LO PC} \end{cases}$$

Isospin part for the 4-fermion interaction: $\hat{\mathcal{O}} \sim C_{\text{IS}}\,\hat{1} + C_{\text{IV}}\,\vec{\tau}_1\vec{\tau}_2$

Note that the $\Delta I = 1/2$ rule is assumed.

Number of parameters:
to LO PC: $2 + 2$ parameters

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to LO PC: 2 $+$ 2 parameters
to LO PV: 2 $+$ 3 $+$ 2 parameters

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Number of parameters:
to LO PC: 2 $+$ 2 parameters
to LO PV: 2 $+$ 3 $+$ 2 parameters
to NLO PC: 2 $+$ 3 $+$ 4 $+$ 2 parameters

... etc.

(Method: Migrad minimizer (Minuit, CERN))

$V(\vec{r})$ at Lowest Order

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$$V_\mu(\vec{r}) = \frac{e^{-\mu r}}{4\pi r} \times \left[C_\mu^{SC} \vec{\sigma}_1 \, \vec{\sigma}_2 + C_\mu^T \left(1 + \frac{3}{\mu r} + \frac{3}{(\mu r)^2}\right) \times S_{12}(\hat{r}) \right.$$
$$\left. + C_\mu^{PV} \left(1 + \frac{1}{\mu r}\right) \vec{\sigma}_2 \cdot \hat{r} \right] \times \left[\hat{1}, \vec{\tau}_1 \, \vec{\tau}_2\right]$$

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$$V_{4P}(\vec{r}) = \begin{cases} C_0^0 + C_0^1\,\vec{\sigma}_1\vec{\sigma}_2 & \text{LO PC} \\ +\dfrac{2r}{\delta^2}\left[C_1^0\,\dfrac{\vec{\sigma}_1\hat{r}}{2\overline{M}} + C_1^1\,\dfrac{\vec{\sigma}_2\hat{r}}{2M} + C_1^2\,\dfrac{(\vec{\sigma}_1 \times \vec{\sigma}_2)\,\hat{r}}{2\tilde{M}}\right] & \text{LO PV} \\ \times\ \dfrac{e^{-\frac{r^2}{\delta^2}}}{\delta^2\pi^{3/2}} \times [C_{IS}\,\hat{1} + C_{IV}\,\vec{\tau}_1\vec{\tau}_2] & \end{cases}$$

$\delta \sim \rho$ meson range $\sqrt{2}m_\rho^{-1} \approx 0.36$ fm

Finite nucleus calculation for $^{5}_{\Lambda}$He, $^{11}_{\Lambda}$B, $^{12}_{\Lambda}$C

$$\Gamma = \int \frac{d^3 k_1}{(2\pi)^3} \int \frac{d^3 k_2}{(2\pi)^3} \sum_{\substack{M_i \{R\} \\ \{1\}\{2\}}} (2\pi)\, \delta(M_H - E_R - E_1 - E_2) \frac{1}{(2J+1)} \mid \mathcal{M}_{fi} \mid^2$$

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$$\mathcal{M}_{fi} \sim \langle \vec{k}_1 m_1 \vec{k}_2 m_2 ; \Psi_{\mathrm{R}}^{A-2} \mid \hat{O}_{\Lambda\mathrm{N}\to\mathrm{NN}} \mid^{A}_{\Lambda} Z \rangle$$

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$\mid {}^{A}_{\Lambda} Z\rangle \to \mid \Lambda N\rangle \otimes \mid \Psi_{\mathrm{R}}^{A-2}\rangle$ Weak coupling scheme for the Λ:

- $$\mid {}^{A}_{\Lambda} Z\rangle^{J_I\, M_I}_{T_I\, T_{3_I}} = \mid \alpha_\Lambda\rangle \otimes \mid A-1\rangle = \sum \langle j_\Lambda m_\Lambda\, J_C M_C \mid J_I M_I\rangle \mid (n_\Lambda l_\Lambda s_\Lambda) j_\Lambda m_\Lambda\rangle \mid J_C M_C\, T_I T_{3_I}\rangle$$
- Technique of coefficients of fractional parentage:

$$\Psi_{\mathrm{as}}^{J_C T_C \alpha}(1....N) = \sum_{J_{R_0} T_{R_0} \alpha_0 j_{\mathrm{N}}} \langle J_C T_C \alpha \{\mid J_{R_0} T_{R_0} \alpha_0, j_{\mathrm{N}}\rangle \times [\Psi_{\mathrm{as}}^{J_{R_0} T_{R_0} \alpha_0}(1....N-1) \otimes \phi^{j_{\mathrm{N}}}(N)]^{J_C T_C} \,,$$

Finite nucleus calculation for ${}^{5}_{\Lambda}$He, ${}^{11}_{\Lambda}$B, ${}^{12}_{\Lambda}$C

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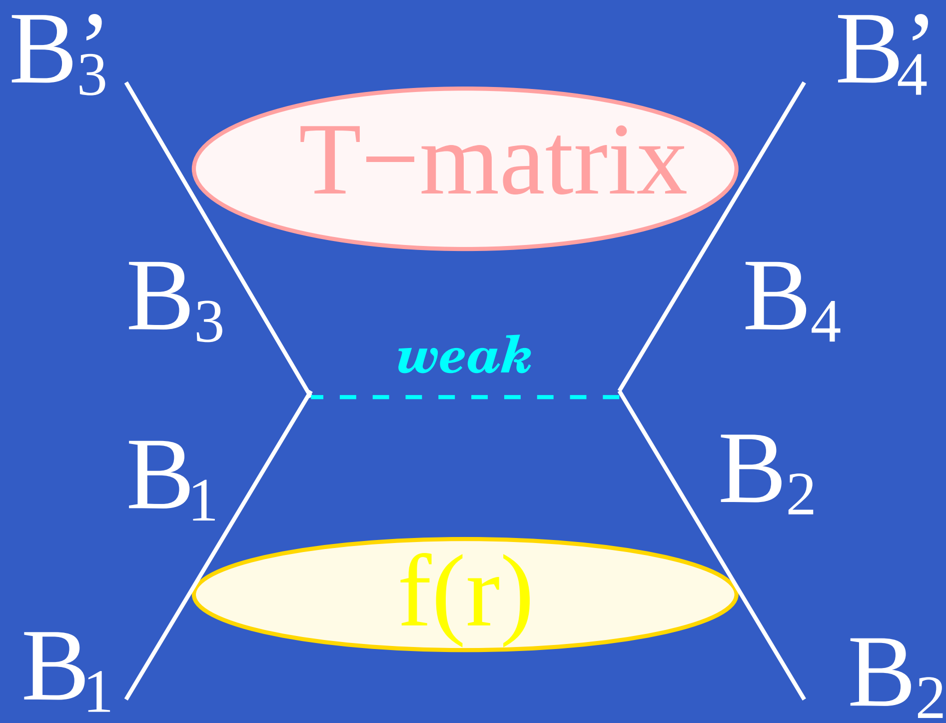
$$\mathcal{M}_{fi} \sim t_{\Lambda\mathrm{N}\to\mathrm{NN}}(S, M_S, T, T_3, S_0, M_{S_0}, T_0, T_{3_0}, l_\Lambda, l_{\mathrm{N}}, \vec{P}, \vec{k})$$

Incorporate the strong BB interaction



$$\Psi_{\Lambda N}(r) = \phi^{ho}_{\Lambda N}(r)\, f(r)$$

$$f(r) = \left(1 - \mathrm{e}^{-r^2/a^2}\right)^n + br^2\mathrm{e}^{-r^2/c^2}$$

$\Psi_{NN}(r)$

a=0.5 fm, b=0.25 fm^{-2}, c=1.28 fm, n=2   T-matrix $\Longleftrightarrow$ NSC97f

Experimental data used in the fit (10 points)

	Γ	Γ_n/Γ_p	Γ_p	$\mathcal{A}$
${}^{5}_{\Lambda}$He	0.41 ± 0.14[B91]	0.93 ± 0.55[B91]	0.21 ± 0.07[B91]	0.24 ± 0.22 [K00]
	0.50 ± 0.07[K95]	1.97 ± 0.67[K95]		
		0.50 ± 0.10 [K02]		
${}^{11}_{\Lambda}$B	0.95 ± 0.14[K95]	$1.04^{+0.59}_{-0.48}$[B91]	$0.30^{+0.15}_{-0.11}$[K95]	-0.20 ± 0.10[K92]
		$2.16 \pm 0.58^{+0.45}_{-0.95}$[K95]		
		$0.59^{+0.17}_{-0.14}$[B74]		
${}^{12}_{\Lambda}$C	0.83 ± 0.11[K98]	$1.33^{+1.12}_{-0.81}$[B91]	$0.31^{+0.18}_{-0.11}$[K95]	-0.01 ± 0.10[K92]
	0.89 ± 0.15[K95]	$1.87 \pm 0.59^{+0.32}_{-1.00}$[K95]		
	1.14 ± 0.2[B91]	$0.59^{+0.17}_{-0.14}$[B74]		
		0.87 ± 0.23[K02]		

RESULTS

	π	$+K$	$+$ LO PC	$+$ LO PC+PV	EXP:
$\Gamma({}^5_\Lambda\mathrm{He})$	0.42	0.23	0.43	0.44	0.41 ± 0.14[B91]
					0.50 ± 0.07[K95]
$n/p({}^5_\Lambda\mathrm{He})$	0.09	0.50	0.56	0.55	0.93 ± 0.55[B91]
					0.50 ± 0.10[K02]
$\mathcal{A}({}^5_\Lambda\mathrm{He})$	-0.25	-0.60	-0.80	0.15	0.24 ± 0.22[K00]

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$\mathcal{A}(^5_\Lambda\mathrm{He})$	-0.25	-0.60	-0.80	0.15	0.24 ± 0.22[K00]
$\Gamma(^{11}_\Lambda\mathrm{B})$	0.62	0.36	0.87	0.88	0.95 ± 0.14[K95]
$n/p(^{11}_\Lambda\mathrm{B})$	0.10	0.43	0.84	0.92	$1.04^{+0.59}_{-0.48}$[B91]
$\mathcal{A}(^{11}_\Lambda\mathrm{B})$	-0.09	-0.22	-0.22	0.06	-0.20 ± 0.10[K92]
$\Gamma(^{12}_\Lambda\mathrm{C})$	0.74	0.41	0.95	0.93	1.14 ± 0.2[B91] 0.89 ± 0.15[K95] 0.83 ± 0.11[K98]
$n/p(^{12}_\Lambda\mathrm{C})$	0.08	0.35	0.67	0.77	0.87 ± 0.23[K02]
$\mathcal{A}(^{12}_\Lambda\mathrm{C})$	-0.03	-0.06	-0.05	0.02	-0.01 ± 0.10[K92]
$\hat{\chi}^2$			0.98	1.50	

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					0.50 ± 0.10[K02]
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Low-Energy Coefficients

	$+$ LO PC	$+$LO PC+PV
C_0^0	-1.51 ± 0.38	-1.09 ± 0.36
C_0^1	-0.86 ± 0.24	-0.63 ± 0.35
C_1^0	$---$	-0.45 ± 0.42
C_1^1	$---$	0.17 ± 0.22
C_1^2	$---$	-0.48 ± 0.20
C_{IS}	5.08 ± 1.27	5.69 ± 0.74
C_{IV}	1.47 ± 0.39	1.49 ± 0.23
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C_1^0	$---$	-0.45 ± 0.42	(-0.47 ± 0.17)
C_1^1	$---$	0.17 ± 0.22	(0.20 ± 0.19)
C_1^2	$---$	-0.48 ± 0.20	(-0.48 ± 0.22)
C_{IS}	5.08 ± 1.27	5.69 ± 0.74	(5.83 ± 0.82)
C_{IV}	1.47 ± 0.39	1.49 ± 0.23	(1.52 ± 0.24)
$\hat{\chi}^2$	0.98	1.50	(1.15)

Strong interaction model dependence

$\pi + K + \mathrm{LO\ PC} + \mathrm{LO\ PV}$		
	NSC97f	NSC97a
$\Gamma({}^5_\Lambda\mathrm{He})$	0.44	0.44
$n/p({}^5_\Lambda\mathrm{He})$	0.55	0.55
$\mathcal{A}({}^5_\Lambda\mathrm{He})$	0.24	0.24
$\Gamma({}^{11}_\Lambda\mathrm{B})$	0.88	0.88
$n/p({}^{11}_\Lambda\mathrm{B})$	0.92	0.92
$\mathcal{A}({}^{11}_\Lambda\mathrm{B})$	0.09 ♠	0.11 ♠
$\Gamma({}^{12}_\Lambda\mathrm{C})$	0.93	0.93
$n/p({}^{12}_\Lambda\mathrm{C})$	0.77	0.78
$\mathcal{A}({}^{12}_\Lambda\mathrm{C})$	0.03 ♠	0.03 ♠
C_0^0	-1.02 ± 0.35	-0.87 ± 0.46
C_1^0	-0.57 ± 0.29	-0.53 ± 0.37
C_0^1	-0.47 ± 0.17	-0.53 ± 0.22
C_1^1	0.20 ± 0.19	0.25 ± 0.16
C_2^1	-0.48 ± 0.22	-0.57 ± 0.17
C_{IS}	5.83 ± 0.82	5.76 ± 0.74
C_{IV}	1.52 ± 0.24	1.50 ± 0.22
$\hat{\chi}^2$	1.15	1.15

Dependence on the smearing (δ) function

	$\delta \approx 0.3$fm (≈ 900MeV)	$\delta \approx 0.36$fm (≈ 770MeV)	$\delta \approx 0.4$fm (≈ 500MeV)
$\Gamma({}^{5}_{\Lambda}\mathrm{He})$	0.44	0.44	0.44
$n/p({}^{5}_{\Lambda}\mathrm{He})$	0.55	0.55	0.55
$\mathcal{A}({}^{5}_{\Lambda}\mathrm{He})$	0.24	0.24	0.24
$\Gamma({}^{11}_{\Lambda}\mathrm{B})$	0.88	0.88	0.88
$n/p({}^{11}_{\Lambda}\mathrm{B})$	0.93	0.92	0.94
$\mathcal{A}({}^{11}_{\Lambda}\mathrm{B})$	$\diamondsuit$ 0.08 $\diamondsuit$	$\diamondsuit$ 0.09 $\diamondsuit$	$\diamondsuit$ 0.06 $\diamondsuit$
$\Gamma({}^{12}_{\Lambda}\mathrm{C})$	0.93	0.93	0.93
$n/p({}^{12}_{\Lambda}\mathrm{C})$	0.78	0.77	0.78
$\mathcal{A}({}^{12}_{\Lambda}\mathrm{C})$	$\diamondsuit$ 0.02 $\diamondsuit$	$\diamondsuit$ 0.03 $\diamondsuit$	$\diamondsuit$ 0.02 $\diamondsuit$
C_0^0	-1.91 ± 0.56	-1.02 ± 0.35	-0.73 ± 0.19
C_0^1	-1.08 ± 0.52	-0.57 ± 0.29	-0.73 ± 0.16
C_1^0	-0.61 ± 0.28	-0.47 ± 0.17	-0.39 ± 0.26
C_1^1	0.24 ± 0.35	0.20 ± 0.19	0.17 ± 0.26
C_1^2	-0.60 ± 0.46	-0.48 ± 0.22	-0.25 ± 0.23
C_{IS}	6.45 ± 0.66	5.83 ± 0.82	5.83 ± 0.96
C_{IV}	1.79 ± 0.26	1.52 ± 0.24	1.48 ± 0.29
$\hat{\chi}^2$	1.15	1.15	1.15

More recent (unpublished) data

$$\mathcal{A}({}^{5}_{\Lambda}\mathrm{He}) = 0.24 \pm 0.22 \longrightarrow 0.09 \pm 0.08$$ Kang, KEK-PS E462 (2003)

$$\mathcal{A}({}^{12}_{\Lambda}\mathrm{C}) = -0.01 \pm 0.10 \longrightarrow 0.01 \pm 0.02$$ Maruta, KEK (2003)

	$+LO$ $\mathrm{PC}+\mathrm{PV}$	EXP:
$\Gamma({}^{5}_{\Lambda}\mathrm{He})$	0.45	$0.41 \div 0.50$
$n/p({}^{5}_{\Lambda}\mathrm{He})$	0.46	$0.50 \div 0.93$
$\mathcal{A}({}^{5}_{\Lambda}\mathrm{He})$	0.07	0.09 ± 0.08
$\Gamma({}^{11}_{\Lambda}\mathrm{B})$	0.92	0.95 ± 0.14
$n/p({}^{11}_{\Lambda}\mathrm{B})$	0.31	$1.04^{+0.59}_{-0.48}$
$\mathcal{A}({}^{11}_{\Lambda}\mathrm{B})$	-0.03	-0.20 ± 0.10
$\Gamma({}^{12}_{\Lambda}\mathrm{C})$	0.98	$0.83 \div 1.14$
$n/p({}^{12}_{\Lambda}\mathrm{C})$	0.28	0.87 ± 0.23
$\mathcal{A}({}^{12}_{\Lambda}\mathrm{C})$	-0.01	0.01 ± 0.02
$\hat{\chi}^2$	3.27	

	$+LO$ $\mathrm{PC}+\mathrm{PV}$
C^0_0	0.36 ± 0.16
C^1_0	-0.41 ± 0.25
C^0_1	-0.12 ± 0.05
C^1_1	0.13 ± 0.06
C^2_1	0.12 ± 0.03
C_{sc}	4.84 ± 0.25
C_{vec}	-2.42 ± 0.88
χ^2	3.27

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- The largest contact term corresponds to an isoscalar, spin-independent central operator.
- There is no indication of any contact terms violating the $\Delta I = 1/2$ rule.

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- The next generation of data from recent high-precision weak decay experiments currently under analysis holds the promise to provide much improved constraints for studies of this nature.
- Work in progress:
  ♣ Error propagation under analysis
  ♣ Go to NLO? $\Longrightarrow$ Need of more independent data.
  The $np \to \Lambda p$ reaction at RCNP, Osaka (S. Minami's talk on friday)

Gràcies.