Weak Strangeness and Eta Production

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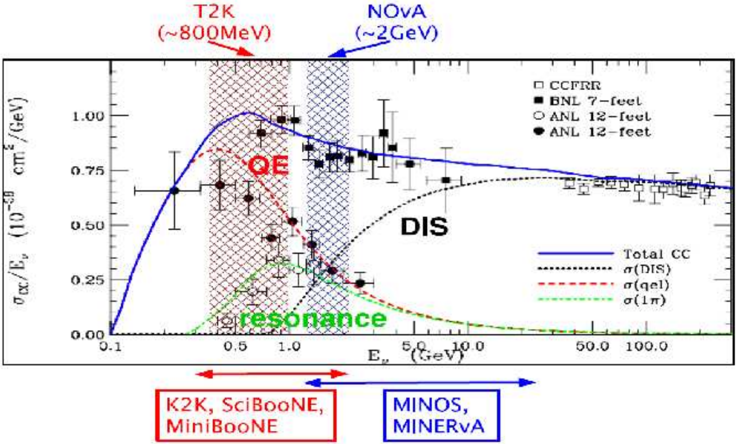
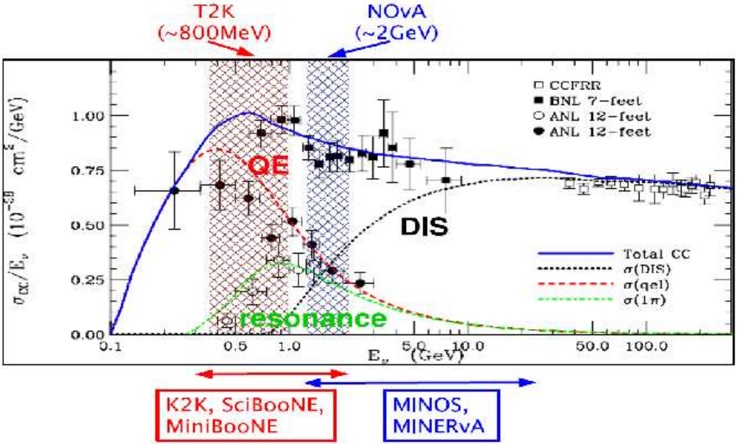
NuFact'2013 , Beijing

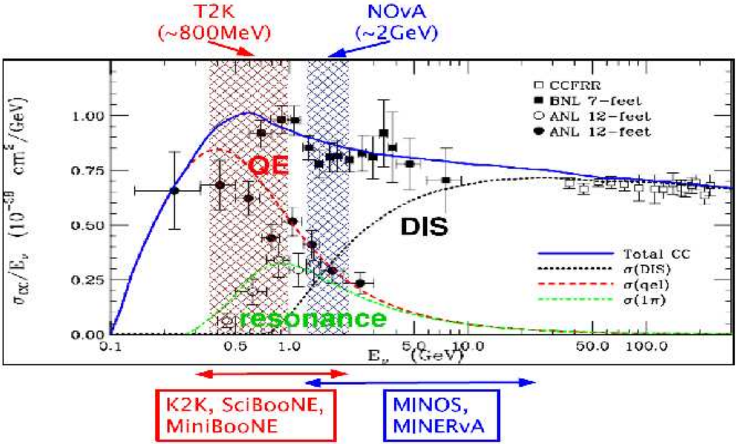
Outline

Outline


T2K
(~800MeV)
NOvA
(~2GeV)
CCFRR
BNL 7-feet
ANL 12-feet
ANL 12-feet
1.00
0.75
0.50
0.25
0.00
QE
DIS
resonance
Total CC
σ(DIS)
σ(qel)
σ(1π)
0.1
0.5
1.0
5.0
10.0
50.0
100.0
E_ν (GeV)
K2K, SciBooNE, MiniBooNE
MINOS, MINERvA



$$\sigma^{Total} = \sigma^{QE} + \sigma^{Inelastic} + \sigma^{DIS}$$



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$$\sigma^{Inelastic} = \sigma^{1\pi} + \sigma^{2\pi} + \cdots + \sigma^{YK} + \sigma^{1K} + \sigma^{1Y} + \sigma^{\eta} + \cdots$$

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- In the understanding of the basic symmetries of the SM, strange quark content of the nucleon, structure of weak hadronic form factors, etc.

Processes

Single Kaon Production ($\Delta S = 1$)

$$\nu_\mu p \rightarrow \mu^- K^+ p \qquad \bar{\nu}_\mu p \rightarrow \mu^+ K^- p$$
$$\nu_\mu n \rightarrow \mu^- K^0 p \qquad \bar{\nu}_\mu p \rightarrow \mu^+ \bar{K}^0 n$$
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Single Hyperon Production

$$\bar{\nu}_\mu p \to \mu^+ \Sigma^0$$
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$\nu_\mu n \to \mu^- K^+ \Lambda$	$\bar{\nu}_\mu p \to \mu^+ K^0 \Lambda$
$\nu_\mu p \to \mu^- K^+ \Sigma^+$	$\bar{\nu}_\mu p \to \mu^+ K^0 \Sigma^0$
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Eta Production

$$\nu_\mu n \to \mu^- p \eta \qquad \bar{\nu}_\mu p \to \mu^+ n \eta$$

Outline

Formalism

The general expression for the scattering cross-section is given by,

$$d^9\sigma = \frac{(2\pi)^4}{4ME}\prod_{f=1}^{n}\frac{d\vec{k}_f}{2k_f^0(2\pi)^3}\delta^4(k_i-k_f)\bar{\Sigma}\Sigma|\mathcal{M}|^2,$$

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$$\mathcal{M} = \frac{G_F}{\sqrt{2}} j_\mu^{(L)} J^{\mu(H)} = \frac{g}{2\sqrt{2}} j_\mu^{(L)} \frac{1}{M_W^2} \frac{g}{2\sqrt{2}} J^{\mu(H)},$$

$j_\mu^{(L)}$ is Leptonic Current
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$$\mathcal{L} = -\frac{g}{2\sqrt{2}}\left[W_\mu^+\bar{\nu}_l\gamma^\mu(1-\gamma_5)l + W_\mu^-\bar{l}\gamma^\mu(1-\gamma_5)\nu_l\right].$$

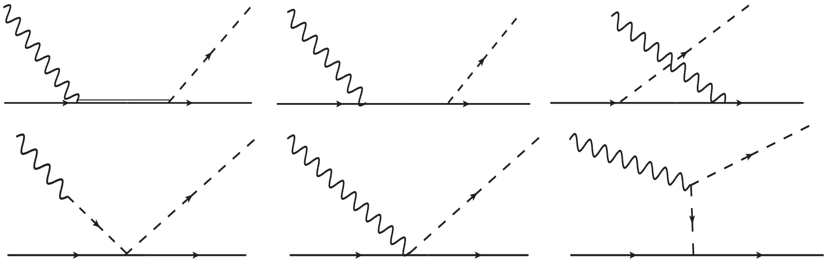


Figure: Feynman diagrams contributing to the $J^{\mu(H)}$

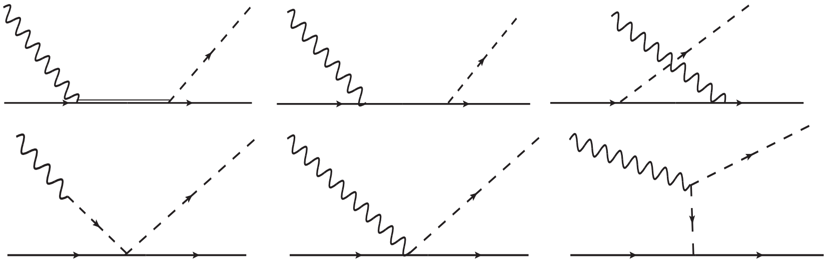
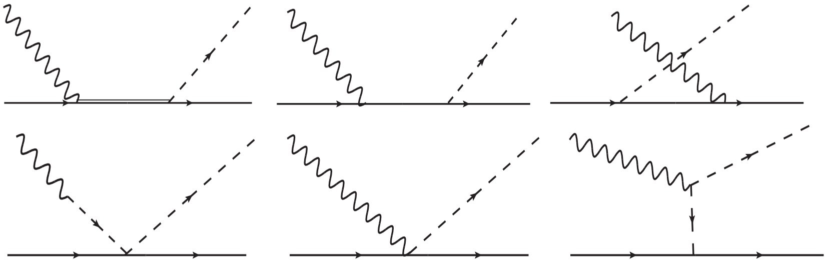


Figure: Feynman diagrams contributing to the $J^{\mu(H)}$

For the background terms we used

Chiral Perturbation Theory (χPT)



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Resonant Terms

Used in $\bar{\nu}$ induced K-production

- M. Rafi Alam et.al.
  "*Weak Kaon Production off the Nucleon*,"
  Phys. Rev. D 82, 033001 (2010)
- M. Rafi Alam et.al.
  "*Antineutrino induced antikaon production off the nucleon*,"
  Phys. Rev. D 85, 013014 (2012)

Currents for $\Delta S = 1$ K production

$$J^\mu|_{CT} = iA_{CT} V_{us} \frac{\sqrt{2}}{2f_\pi} \bar{N}(p')\,(\gamma^\mu + B_{CT}\,\gamma^\mu\gamma_5)\,N(p)$$

$$j^\mu|_{Cr\Sigma} = iA_{Cr\Sigma} V_{us}(D-F)\frac{\sqrt{2}}{2f_\pi}\bar{N}(p')\left(\gamma^\mu + i\frac{\mu_p + 2\mu_n}{2M}\sigma^{\mu\nu}q_\nu + (D-F)(\gamma^\mu - \frac{q^\mu}{q^2 - M_k^2}\not{q})\gamma^5\right)\frac{\not{p} - \not{p}_k + M_\Sigma}{(p-p_k)^2 - M_\Sigma^2}\not{p}_k\gamma^5 N(p),$$

$$j^\mu|_{Cr\Lambda} = iA_{Cr\Lambda} V_{us}(D+3F)\frac{\sqrt{2}}{4f_\pi}\bar{N}(p')\left(\gamma^\mu + i\frac{\mu_p}{2M}\sigma^{\mu\nu}q_\nu - \frac{D+3F}{3}(\gamma^\mu - \frac{q^\mu}{q^2 - M_k^2}\not{q})\gamma^5\right)\frac{\not{p} - \not{p}_k + M_\Lambda}{(p-p_k)^2 - M_\Lambda^2}\not{p}_k\gamma^5 N(p),$$

$$J^\mu|_{\Sigma} = iA_\Sigma(D-F)V_{us}\frac{\sqrt{2}}{2f_\pi}\bar{N}(p')\not{p}_k\gamma_5\frac{\not{p} + \not{q} + M_\Sigma}{(p+q)^2 - M_\Sigma^2}\left(\gamma^\mu + i\frac{(\mu_p + 2\mu_n)}{2M}\sigma^{\mu\nu}q_\nu(D-F)\left\{\gamma^\mu - \frac{q^\mu}{q^2 - M_k{}^2}\not{q}\right\}\gamma^5\right)N(p)$$

$$J^\mu|_{\Lambda} = iA_\Lambda V_{us}(D+3F)\frac{1}{2\sqrt{2}f_\pi}\bar{N}(p')\not{p}_k\gamma^5\frac{\not{p} + \not{q} + M_\Lambda}{(p+q)^2 - M_\Lambda^2}\left(\gamma^\mu + i\frac{\mu_p}{2M}\sigma^{\mu\nu}q_\nu\frac{(D+3F)}{3}\left\{\gamma^\mu - \frac{q^\mu}{q^2 - M_k{}^2}\not{q}\right\}\gamma^5\right)N(p)$$

$$J^\mu|_{KP} = iA_{KP} V_{us}\frac{\sqrt{2}}{2f_\pi}\bar{N}(p')\not{q}\,N(p)\frac{q^\mu}{q^2 - M_k^2}$$

$$J^\mu|_{\pi} = iA_\pi\frac{M\sqrt{2}}{2f_\pi}V_{us}(D+F)\frac{2p_k{}^\mu - q^\mu}{(q-p_k)^2 - m_\pi{}^2}\bar{N}(p')\gamma_5 N(p)$$

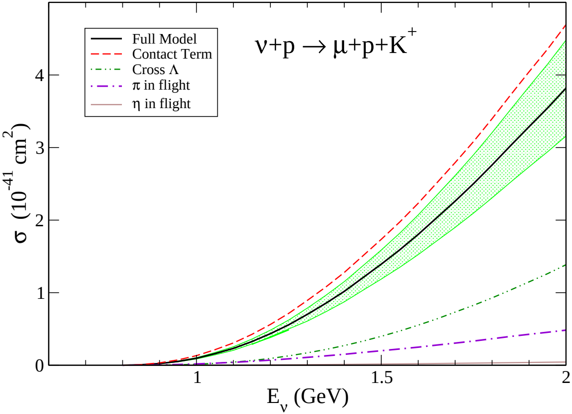
$$J^\mu|_{\eta} = iA_\eta\frac{M\sqrt{2}}{2f_\pi}V_{us}(D-3F)\frac{2p_k{}^\mu - q^\mu}{(q-p_k)^2 - m_\eta{}^2}\bar{N}(p')\gamma_5 N(p)$$

$$J^\mu|_{\Sigma^*} = -iA_{\Sigma^*}\frac{C}{f_\pi}\frac{1}{\sqrt{6}}V_{us}\frac{p_k^\lambda}{P^2 - M_{\Sigma^*}^2 + i\Gamma_{\Sigma^*}M_{\Sigma^*}}\bar{N}(p')P_{RS_{\lambda\rho}}(\Gamma_V^{\rho\mu} + \Gamma_A^{\rho\mu})N(p)$$

Process	B_{CT}	A_{CT}	A_{Σ}	A_{Λ}	$A_{Cr\Sigma}$	$A_{Cr\Lambda}$	A_{KP}	A_{π}	A_{η}	A_{Σ^*}
$\nu n \rightarrow l^- K^+ n$	D-F	-1	0	0	-1	0	-1	-1	-1	0
$\nu p \rightarrow l^- K^+ p$	-F	-2	0	0	$-\frac{1}{2}$	1	-2	1	-1	0
$\nu n \rightarrow l^- K^0 p$	-D-F	-1	0	0	$\frac{1}{2}$	1	-1	2	0	0
$\bar{\nu} n \rightarrow l^+ K^- n$	D-F	1	-1	0	0	0	-1	1	1	2
$\bar{\nu} p \rightarrow l^+ K^- p$	-F	2	$-\frac{1}{2}$	1	0	0	-2	-1	1	1
$\bar{\nu} p \rightarrow l^+ \bar{K}^0 n$	-D-F	1	$\frac{1}{2}$	1	0	0	-1	-2	0	-1

Table: Constant factors appearing in the hadronic current

σ for $\nu_\mu + p \to \mu^- + K^+ + p$



Q^2 Distribution

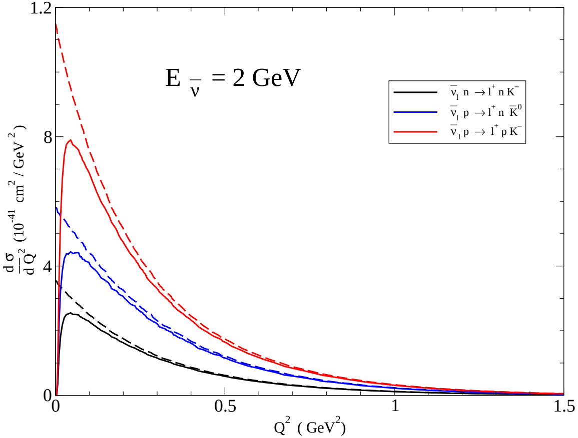
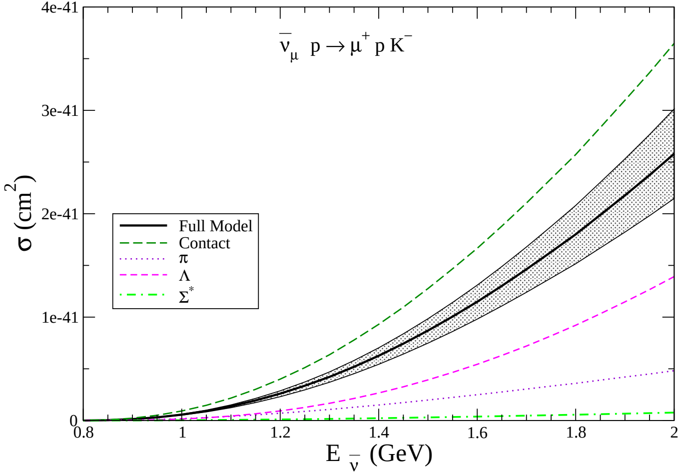
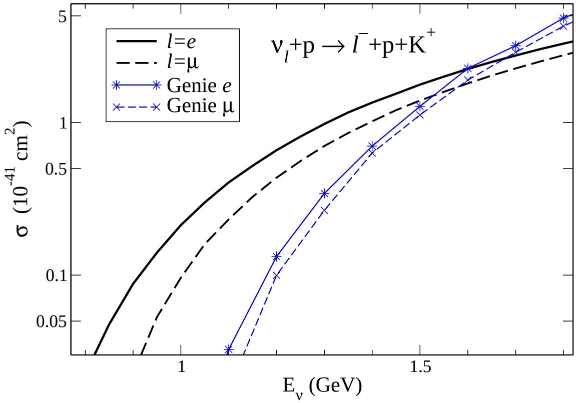


Figure: Differential Cross-section for the processes $\bar{\nu}_\mu N \to \mu^+ N' \bar{K}$ (Solid lines) and $\bar{\nu}_e N \to e^+ N' \bar{K}$ (Dashed lines)

σ for $\bar{\nu}_\mu + p \rightarrow \mu^+ + K^- + p$



Compared with Associated kaon production cross section used in GENIE



Outline

Single Hyperon Production

$$
\begin{aligned}
\bar{\nu}_l(k) + p(p) &\rightarrow l^+(k') + \Lambda(p') \\
\bar{\nu}_l(k) + p(p) &\rightarrow l^+(k') + \Sigma^0(p') \\
\bar{\nu}_l(k) + n(p) &\rightarrow l^+(k') + \Sigma^-(p')
\end{aligned}
$$

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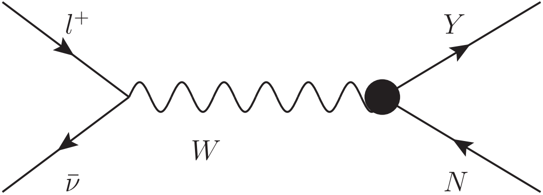

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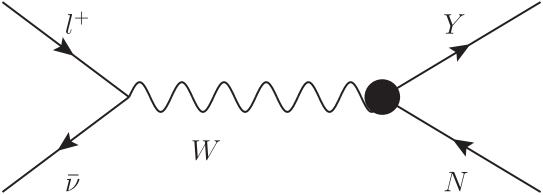

No process is possible with ν

Current for Single Hyperon Production

$$J_\mu \approx \gamma_\mu f_1(q^2) + i\sigma_{\mu\nu}\frac{q^\nu}{M+M_Y}f_2(q^2) - \gamma_\mu g_1(q^2) - \frac{q_\mu}{M_Y}g_2(q^2)$$

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$$\begin{aligned} f_i(q^2) &= \alpha F_i^V(q^2) + \beta D_i^V(q^2), \\ g_i(q^2) &= \alpha F_i^A(q^2) + \beta D_i^A(q^2), \end{aligned}$$

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The Q^2 dependence in FF are taken

$$F_i(Q^2) = F(0)\left(1+\frac{Q^2}{M_A^2}\right)^{-2} \qquad D_i(Q^2) = D(0)\left(1+\frac{Q^2}{M_A^2}\right)^{-2}$$

With F(0) = F and D(0) = D are determined from the baryon semileptonic decays.

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D = 0.804 and F = 0.463

Nuclear Effects

PAULI BLOCKING AND FERMI MOTION:

Local Fermi Gas Model
Effect is negligible

Nuclear Effects

Pauli Blocking and Fermi Motion:

Local Fermi Gas Model
Effect is negligible

Final State Interaction

For the FSI we took the prescription of S. K. Singh and M. J. V. Vacas. Phys. Rev. D **74**, 053009 (2006)

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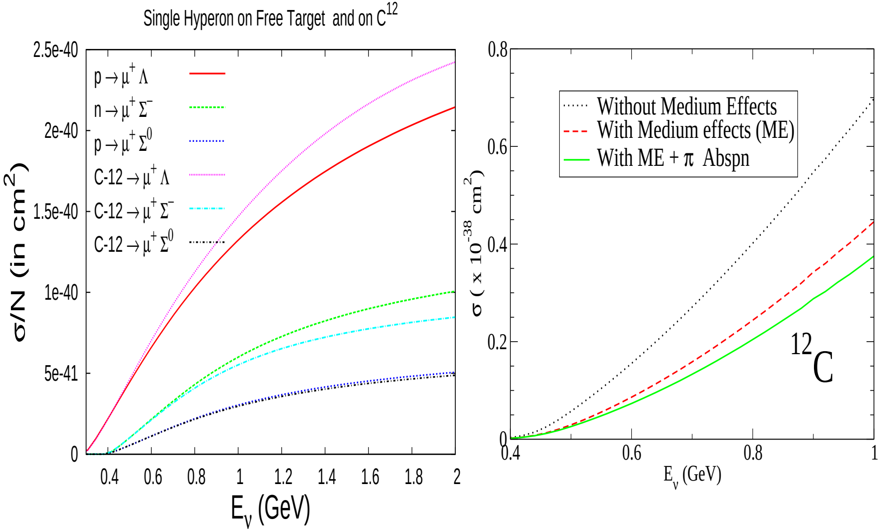
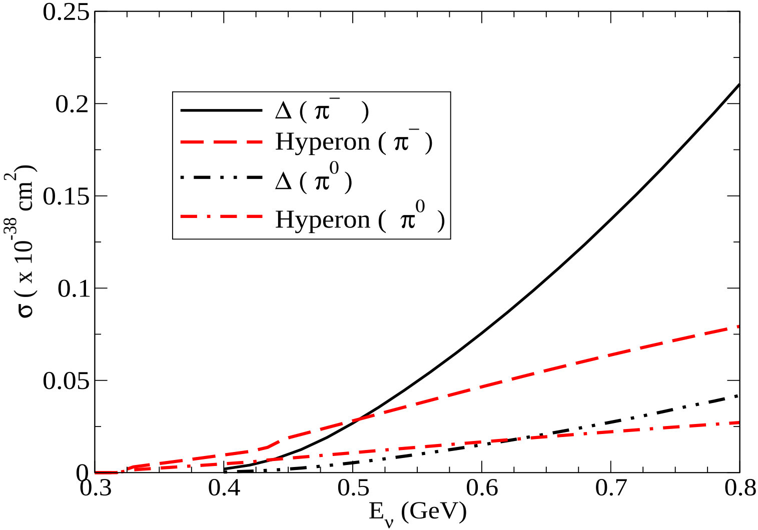
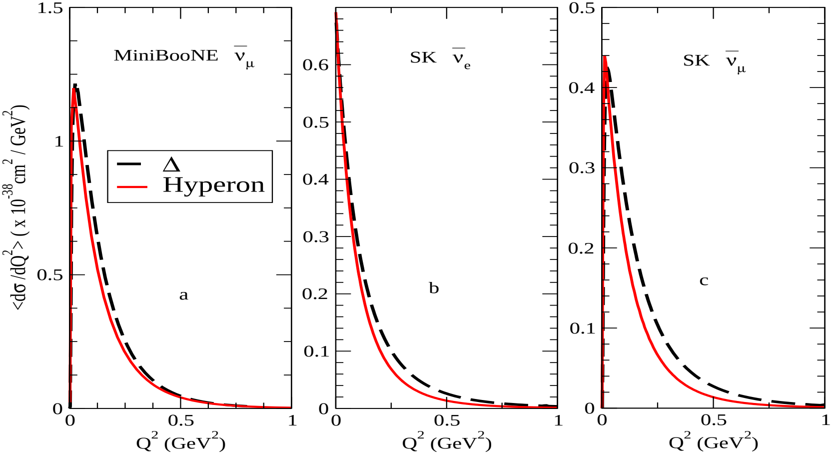
Effect is ~ 5 %

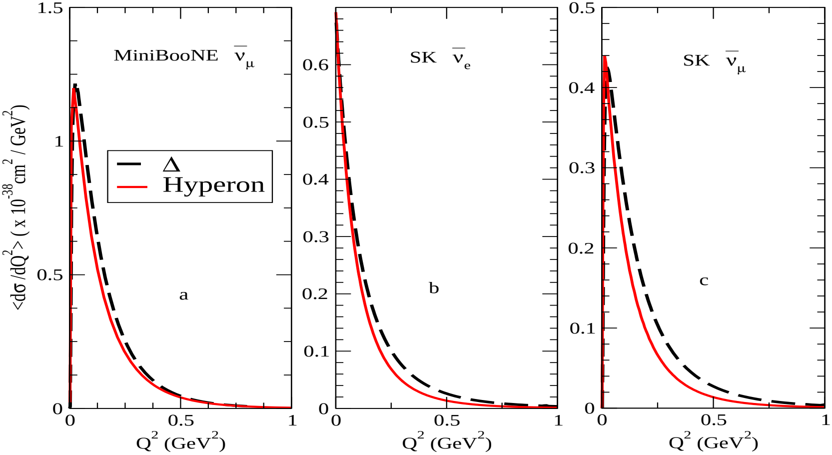

Single Hyperon on Free Target and on C12
p → μ+ Λ
n → μ+ Σ−
p → μ+ Σ0
C-12 → μ+ Λ
C-12 → μ+ Σ−
C-12 → μ+ Σ0
σ/N (in cm2)
Eν (GeV)
Without Medium Effects
With Medium effects (ME)
With ME + π Abspn
σ (x 10−38 cm2)
12C
Eν (GeV)



σ vs E, for π^- & π^0 production induced by $\bar{\nu}_\mu$ in ^{12}C, in the Δ dominance model, and via an intermediate hyperon.



Q^2 distribution (a) for $\bar{\nu}_\mu$ induced reaction in ^{12}C averaged over the MiniBooNE flux and (b & c) for ^{16}O averaged over the SuperK flux for e^+ & μ^+. The results are presented for the incoherent π^- production with medium effect and pion absorption, and for the π^- production from the quasielastic hyperon production



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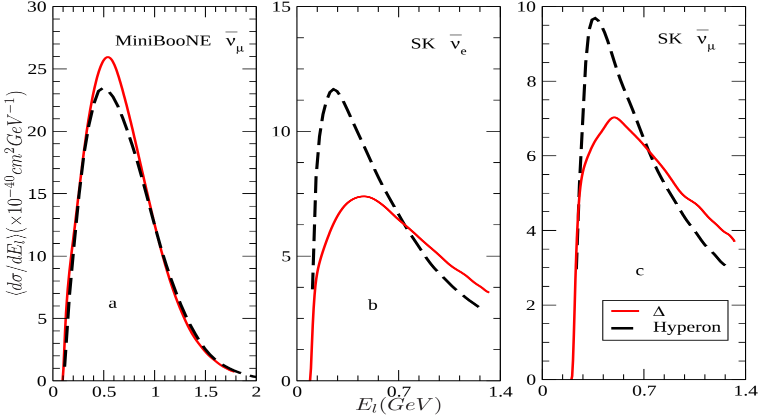
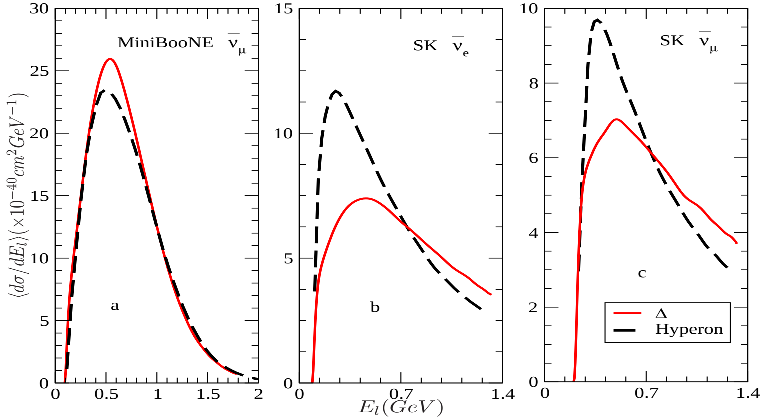
scaled by a factor of 2.5 i.e $\sim$ 40%



E_l distribution (a) for $\bar{\nu}_\mu$ induced reaction in ^{12}C averaged over the MiniBooNE flux and (b & c) for ^{16}O averaged over the SuperK flux for e^+ & μ^+. The results are presented for the incoherent π^- production with medium effect and pion absorption, and for the π^- production from the quasielastic hyperon production



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scaled by a factor of 2.5 i.e $\sim$ 40%

Outline

Processes

Neutrino

$$
\begin{aligned}
\nu_l n &\rightarrow l^- \Sigma^+ K^0 \\
\nu_l n &\rightarrow l^- \Lambda K^+ \\
\nu_l n &\rightarrow l^- \Sigma^0 K^+ \\
\nu_l p &\rightarrow l^- \Sigma^+ K^+
\end{aligned}
$$

Anti-neutrino

$$
\begin{aligned}
\bar{\nu}_l p &\rightarrow l^+ \Sigma^- K^+ \\
\bar{\nu}_l p &\rightarrow l^+ \Lambda K^0 \\
\bar{\nu}_l p &\rightarrow l^+ \Sigma^0 K^0 \\
\bar{\nu}_l n &\rightarrow l^+ \Sigma^- K^0
\end{aligned}
$$

$$
\begin{aligned}
j^{\mu}|_{s} &= iA_{SY}V_{ud}\frac{\sqrt{2}}{2f_{\pi}}\,\bar{u}_{Y}(p')\not{p}_{k}\gamma^{5}\frac{\not{p}+\not{q}+M}{(p+q)^{2}-M^{2}}\mathcal{H}^{\mu}u_{N}(p) \\
j^{\mu}|_{u} &= iA_{UY}V_{ud}\frac{\sqrt{2}}{2f_{\pi}}\,\bar{u}_{Y}(p')\mathcal{H}^{\mu}\frac{\not{p}-\not{p}_{k}+M_{Y'}}{(p-p_{k})^{2}-M_{Y'}^{2}}\not{p}_{k}\gamma^{5}u_{N}(p) \\
j^{\mu}|_{t} &= iA_{TY}V_{ud}\frac{\sqrt{2}}{2f_{\pi}}(M+M_{Y})\,\bar{u}_{Y}(p')\gamma_{5}\,u_{N}(p)\;\;\frac{q^{\mu}-2p_{k}^{\mu}}{(p-p')^{2}-m_{k}^{2}} \\
j^{\mu}|_{CT} &= iA_{CT}V_{ud}\frac{\sqrt{2}}{2f_{\pi}}\,\bar{u}_{Y}(p')\left(\gamma^{\mu}+B_{CT}\,\gamma^{\mu}\gamma^{5}\right)u_{N}(p) \\
j^{\mu}|_{\pi F} &= iA_{\pi}V_{ud}\frac{\sqrt{2}}{4f_{\pi}}\,\bar{u}_{Y}(p')(\not{q}+\not{p}_{k})u_{N}(p)\frac{q^{\mu}}{q^{2}-m_{\pi}^{2}} \\
\mathcal{H}^{\mu} &= F_{1}^{V}\gamma^{\mu}+i\frac{F_{2}^{V}}{2M}\sigma^{\mu\nu}q_{\nu}-G_{A}\left(\gamma^{\mu}-\frac{\not{q}q^{\mu}}{q^{2}-m_{\pi}^{2}}\right)\gamma^{5}
\end{aligned}
$$

Where, $\mathcal{H}^{\mu}$ is the transition current for $Y \leftrightarrows Y'$ with $Y = Y' \equiv$ Nucleon and/or Hyperon.

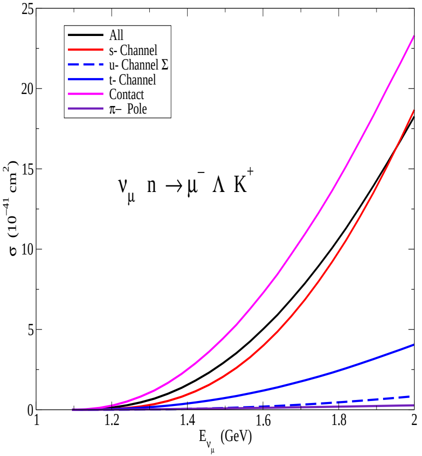
Currents for $\Delta S = 0$ K production

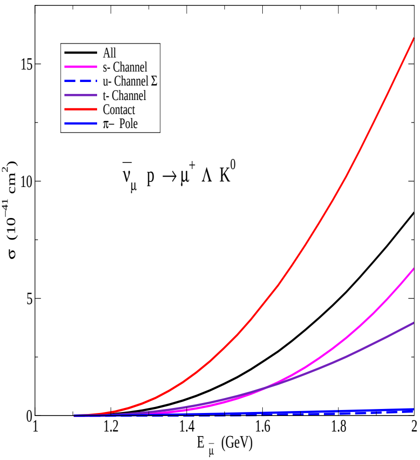
Process	A_{CT}	B_{CT}	A_{SY}	A_{UY} $Y' = \Sigma$	A_{UY} $Y' = \Lambda$	A_{TY}	A_{π}
$\bar{\nu}_l p \to l^+ \Sigma^- K^+$ $\nu_l n \to l^- \Sigma^+ K^0$	0	0	$D-F$	$D-F$	$\frac{1}{3}(D+3F)$	0	0
$\bar{\nu}_l p \to l^+ \Lambda K^0$ $\nu_l n \to l^- \Lambda K^+$	$-\sqrt{\frac{3}{2}}$	$\frac{-1}{3}(D+3F)$	$\frac{-1}{\sqrt{6}}(D+3F)$	$-\sqrt{\frac{2}{3}}(D-F)$	0	$\frac{-1}{\sqrt{6}}(D+3F)$	$\sqrt{\frac{3}{2}}$
$\bar{\nu}_l p \to l^+ \Sigma^0 K^0$ $\nu_l n \to l^- \Sigma^0 K^+$	$\mp\frac{1}{\sqrt{2}}$	$D-F$	$\mp\frac{1}{\sqrt{2}}(D-F)$	$\mp\sqrt{2}(D-F)$	0	$\pm\frac{1}{\sqrt{2}}(D-F)$	$\pm\frac{1}{\sqrt{2}}$
$\bar{\nu}_l n \to l^+ \Sigma^- K^0$ $\nu_l p \to l^- \Sigma^+ K^+$	-1	$D-F$	0	$F-D$	$\frac{1}{3}(D+3F)$	$D-F$	1

Table: Constant factors appearing in the hadronic current. The upper sign corresponds to the processes with $\bar{\nu}$

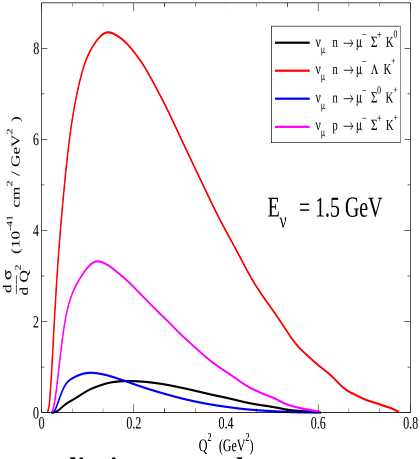
Weak transition	$F_1(Q^2)$	$F_2(Q^2)$	$G_A(Q^2)$
$p \to n$	$f_1^p(Q^2) - f_1^n(Q^2)$	$f_2^p(Q^2) - f_2^n(Q^2)$	$g_A(Q^2)$
$\Sigma^{\pm} \to \Lambda$	$-\sqrt{\frac{3}{2}} f_1^n(Q^2)$	$-\sqrt{\frac{3}{2}} f_2^n(Q^2)$	$\sqrt{\frac{2}{3}} \frac{D}{F+D} g_A(Q^2)$
$\Sigma^{\pm} \to \Sigma^0$	$\mp \frac{1}{\sqrt{2}}[2f_1^p(Q^2) + f_1^n(Q^2)]$	$\mp \frac{1}{\sqrt{2}}[2f_2^p(Q^2) + f_2^n(Q^2)]$	$\mp \sqrt{2} \frac{F}{F+D} g_A(Q^2)$

The standard form factors for weak CC transitions of the $SU(3)$ baryon octets.

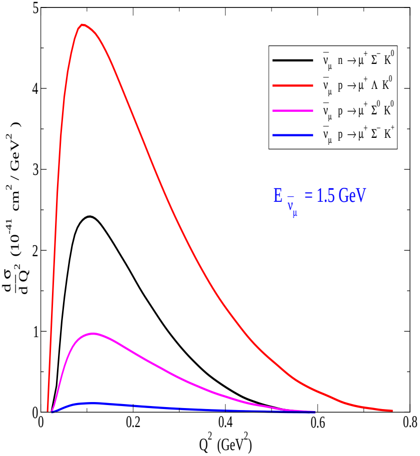


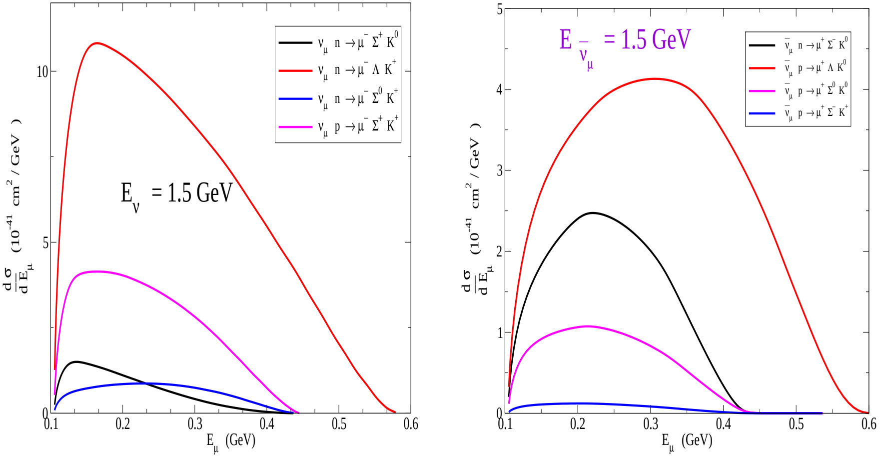


preliminary result

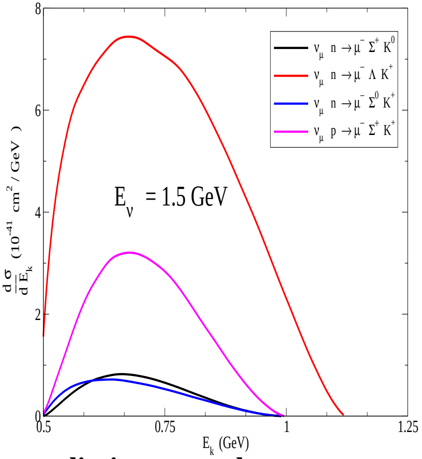


preliminary result

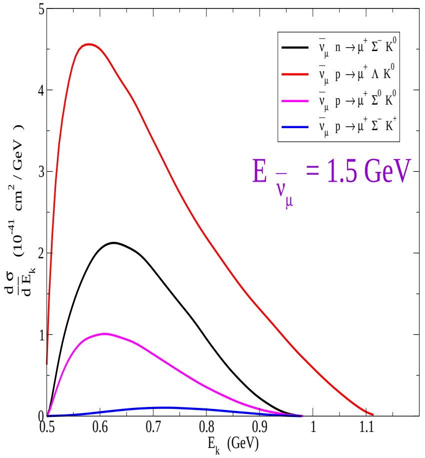




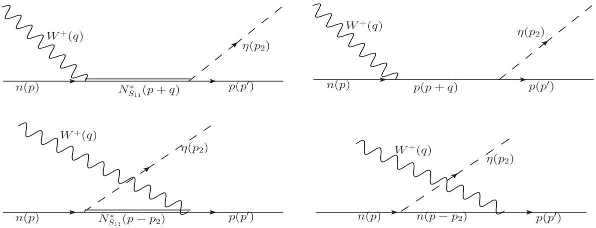
preliminary result



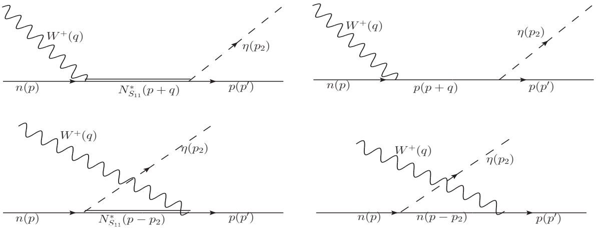
preliminary result



Outline



$$\begin{aligned} \nu_l(k) + n(p) &\rightarrow l^-(k') + p(p') + \eta(p_2) \\ \bar{\nu}_l(k) + p(p) &\rightarrow l^+(k') + n(p') + \eta(p_2). \end{aligned}$$



$$
\begin{aligned}
\nu_l(k) + n(p) &\rightarrow l^-(k') + p(p') + \eta(p_2) \\
\bar{\nu}_l(k) + p(p) &\rightarrow l^+(k') + n(p') + \eta(p_2).
\end{aligned}
$$

"Weak η production off the nucleon,"
arXiv:1303.5951 [hep-ph].

$$
\begin{aligned}
\mathcal{J}^{\mu}_{N(s)} &= \frac{gV_{ud}}{2\sqrt{2}}\frac{D-3F}{2\sqrt{3}f_\pi}\bar{u}_N(p')\not{p}_2\gamma^5\frac{\not{p}+\not{q}+M}{(p+q)^2-M^2}\left(\gamma^\mu-(D+F)\gamma^\mu\gamma^5\right)u_N(p)\\
\mathcal{J}^{\mu}_{N(u)} &= \frac{gV_{ud}}{2\sqrt{2}}\frac{D-3F}{2\sqrt{3}f_\pi}\bar{u}_N(p')\left(\gamma^\mu-(D+F)\gamma^\mu\gamma^5\right)\frac{\not{p}-\not{p}_2+M}{(p-p_2)^2-M^2}\not{p}_2\gamma^5u_N(p)\\
\mathcal{J}^{\mu}_{R(s)} &= \frac{gV_{ud}}{2\sqrt{2}}ig_{\eta NS_{11}}\bar{u}_N(p')\frac{\not{p}+\not{q}+M_R}{(p+q)^2-M_R^2+i\Gamma_RM_R}O^\mu u_N(p)\\
\mathcal{J}^{\mu}_{R(u)} &= \frac{gV_{ud}}{2\sqrt{2}}ig_{\eta NS_{11}}\bar{u}_N(p')O^\mu\frac{\not{p}-\not{p}_2+M_R}{(p-p_2)^2-M_R^2+i\Gamma_RM_R}u_N(p)\\
O^\mu &= \frac{F_1^V(Q^2)}{(2M)^2}(Q^2\gamma^\mu+\not{q}q^\mu)\gamma_5\pm\frac{F_2^V(Q^2)}{2M}i\sigma^{\mu\rho}q_\rho\gamma_5-F_A(Q^2)\gamma^\mu\mp\frac{F_P(Q^2)}{M}q^\mu
\end{aligned}
$$

The upper (lower) sign in O^μ applies to the s-(u-)channel current.

The isovector form factors $F^V_{1,2}$, are given in terms of the electromagnetic transition form factors of protons and neutrons as

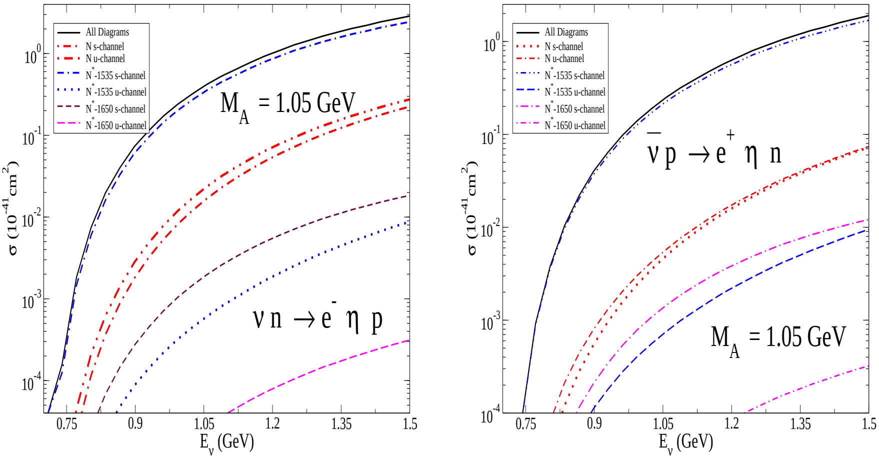
$$F_1^V(Q^2) = F_1^p(Q^2) - F_1^n(Q^2); \quad F_2^V(Q^2) = F_2^p(Q^2) - F_2^n(Q^2).$$

$F^{p,n}_{1,2}(Q^2)$ can then be obtained from the helicity amplitudes $A^{p,n}_{\frac{1}{2}}$, and $S^{p,n}_{\frac{1}{2}}$, which have been conveniently parametrized as

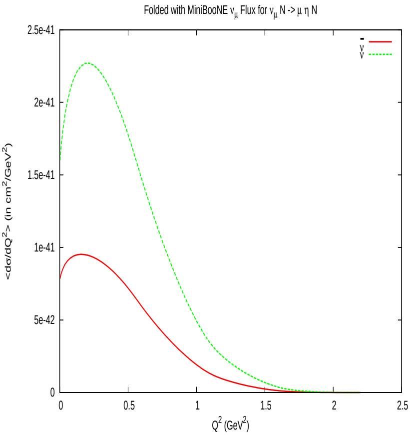
$$\begin{aligned}
A^{p,n}_{\frac{1}{2}} &= \sqrt{\frac{2\pi\alpha_e}{M}\frac{(M_R+M)^2+Q^2}{M_R^2-M^2}}\left(\frac{Q^2}{4M^2}F_1^{p,n}(Q^2)+\frac{M_R-M}{2M}F_2^{p,n}(Q^2)\right) \\
S^{p,n}_{\frac{1}{2}} &= \sqrt{\frac{\pi\alpha_e}{M}\frac{(M_R-M)^2+Q^2}{M_R^2-M^2}}\frac{(M_R+M)^2+Q^2}{4M_RM}\left(\frac{M_R-M}{2M}F_1^{p,n}(Q^2)-F_2^{p,n}(Q^2)\right)
\end{aligned}$$

For the axial form factor $F_A(Q^2)$ we have adopted a dipole form with $M_A = 1.05$ GeV. The pseudoscalar form factor is related to $F_A(Q^2)$ through the PCAC relation

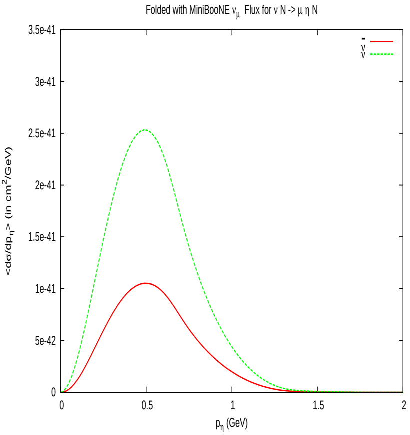
$$
\begin{aligned}
F_A(Q^2) &= F_A(0)\left(1+\frac{Q^2}{M_A^2}\right)^{-2}; \\
F_P(Q^2) &= \frac{(M_R-M)M}{Q^2+m_\pi^2}F_A(Q^2).
\end{aligned}
$$


All Diagrams
N s-channel
N u-channel
N*-1535 s-channel
N*-1535 u-channel
N*-1650 s-channel
N*-1650 u-channel
M_A = 1.05 GeV
ν n → e⁻ η p
σ (10⁻⁴¹cm²)
E_ν (GeV)
0.75
0.9
1.05
1.2
1.35
1.5
ν̄ p → e⁺ η n

MiniBooNE

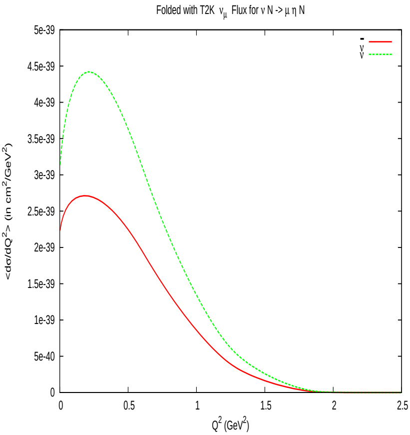


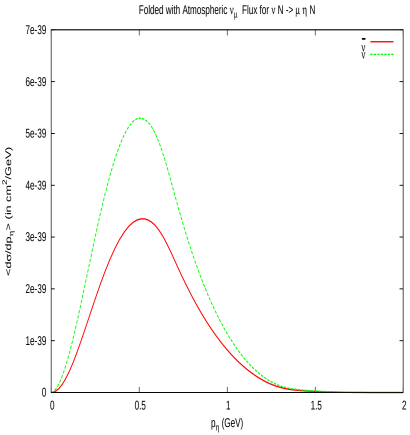
Folded with MiniBooNE νμ Flux for νμ N -> μ η N
<dσ/dQ2> (in cm2/GeV2)
Q2 (GeV2)
2.5e-41
2e-41
1.5e-41
1e-41
5e-42
0
0.5
1
1.5
2
2.5



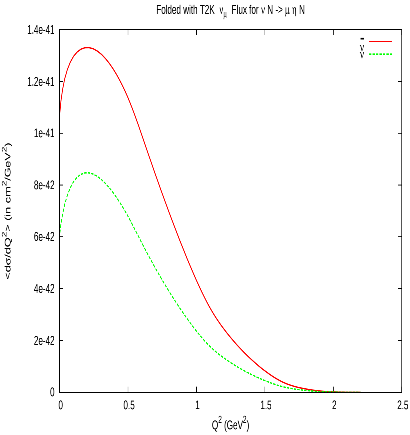
Folded with MiniBooNE νμ Flux for ν N -> μ η N
<dσ/dpη> (in cm2/GeV)
pη (GeV)
3.5e-41
3e-41
2.5e-41
2e-41
1.5e-41
1e-41
5e-42
0
0.5
1
1.5
2

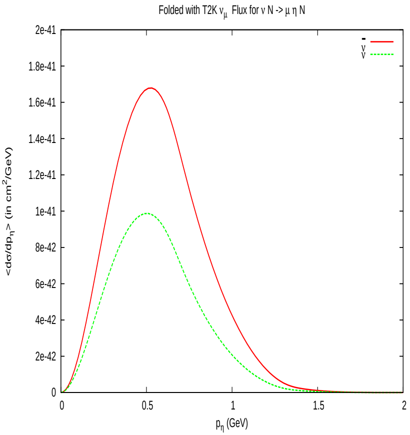
Atmospheric





T2K


Folded with T2K ν_μ Flux for ν N -> μ η N
<dσ/dQ²> (in cm²/GeV²)
Q² (GeV²)
1.4e-41
1.2e-41
1e-41
8e-42
6e-42
4e-42
2e-42
0
0.5
1
1.5
2
2.5


Folded with T2K ν_μ Flux for ν N -> μ η N
<dσ/dp_η> (in cm²/GeV)
p_η (GeV)
2e-41
1.8e-41
1.6e-41
1.4e-41
1.2e-41
1e-41
8e-42
6e-42
4e-42
2e-42
0
0.5
1
1.5
2

Outline

Conclusion

- We find the contribution of contact term to be significant in single kaon production as well as in the associated particle production processes.
- The study may be useful in the analysis of neutrino/antineutrino experiments at MINERνA, NOνA, T2K and others with high statistics and/or higher antineutrino energies.
- Antineutrino induced hyperon production is quite important at the energies of MiniBooNE, T2K or in the analysis of atmospheric neutrino experiments.
- The contribution of background terms in the associated particle production has been presently taken into account and work is in progress to include resonant terms.
- S11-1535 has the dominant contribution to the η-production cross section and the contribution of background terms are also not negligible.

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THANKS FOR YOUR ATTENTION !!