

(加速器データをもちいた)  
v相互作用シミュレーションの研究

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RCCN, ICRR

# $\nu$ 相互作用シミュレーションの研究

実験データ

e 散乱等

$\nu$  相互作用事象

理論

$\nu$ 相互作用モデル

$\pi$ 、K等の核内相互作用



$\nu$ 相互作用の理解

$\nu$ interaction simulation (NEUT)の改良  
核内相互作用simulationの改良



ニュートリノ振動

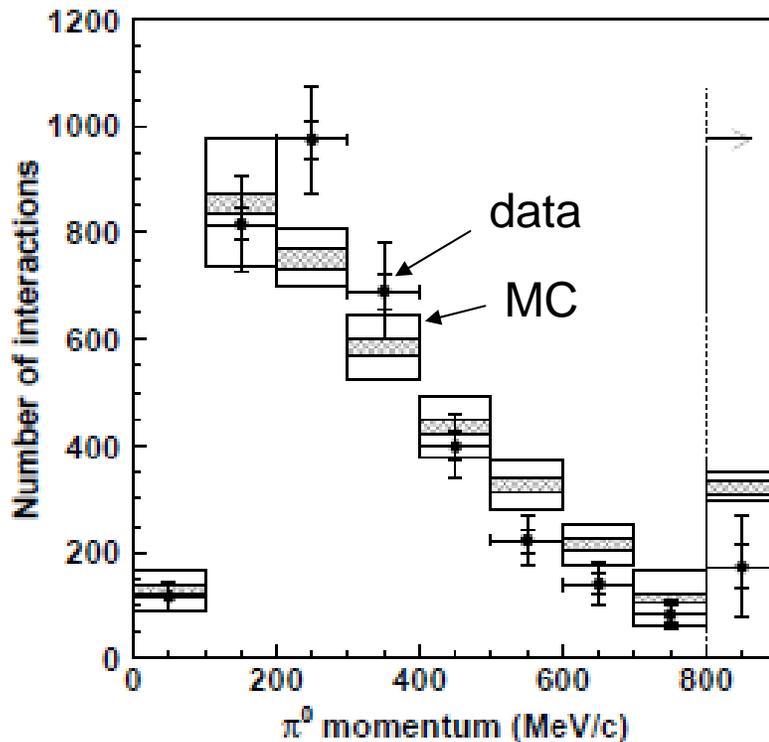
大気ニュートリノ

長基線ニュートリノ実験

核子崩壊の探索

# $\pi^0$ measurement at 1KT detector

Momentum distribution of NC  $1\pi^0$



K2K 1KT detector で検出された  
 $H_2O$  targetでのNC  $1\pi^0$  eventの  
運動量分布

MC reproduce data well

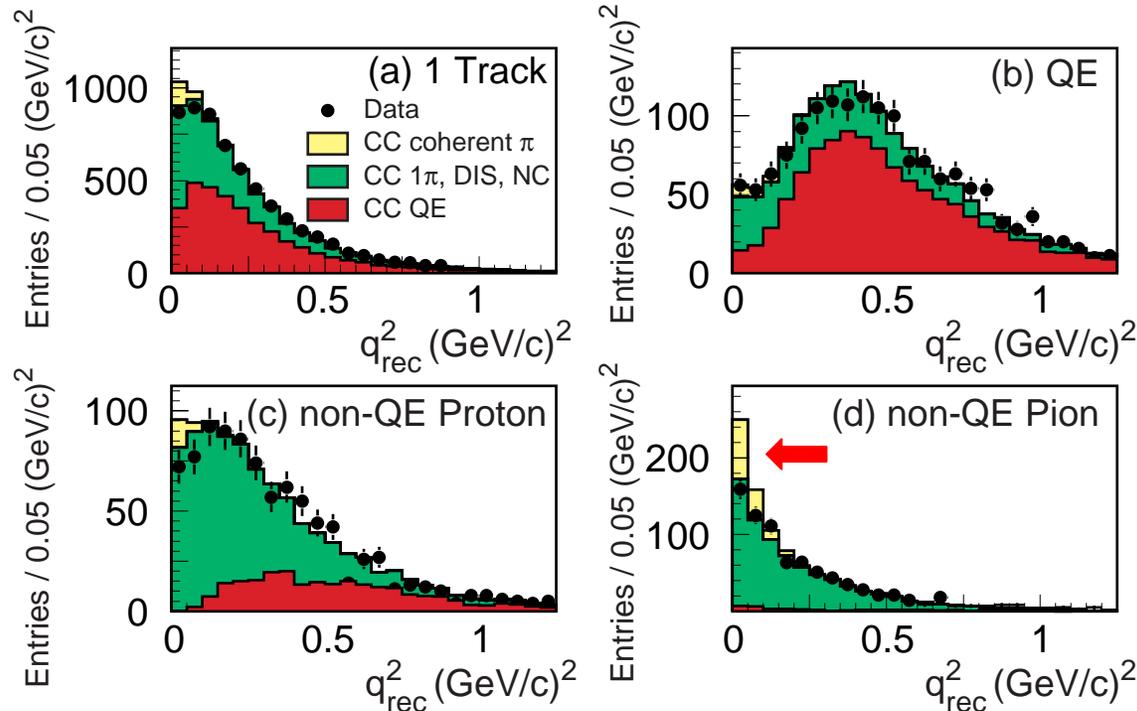


T2K 実験での $\nu_e$  appearance探索で  
BGとなる $\pi^0$ 事象の理解

Nakayama et al,  
Phys. Lett. B619 (2005) 255-262

# Coherent $\pi^\pm$ measurement at K2K ND

SciBar検出器で測定された事象の $q^2$ 分布



CC coherent  $\pi$  production induced by  $\nu_\mu$  ( $\langle E \rangle \sim 1.3 \text{ GeV}$ )

No evidence for coherent  $\pi$  production.

$$\sigma_{\text{CC coherent } \pi} / \sigma_{\text{CC all}} < 0.60 \times 10^{-2} \quad (90\% \text{ C.L.})$$

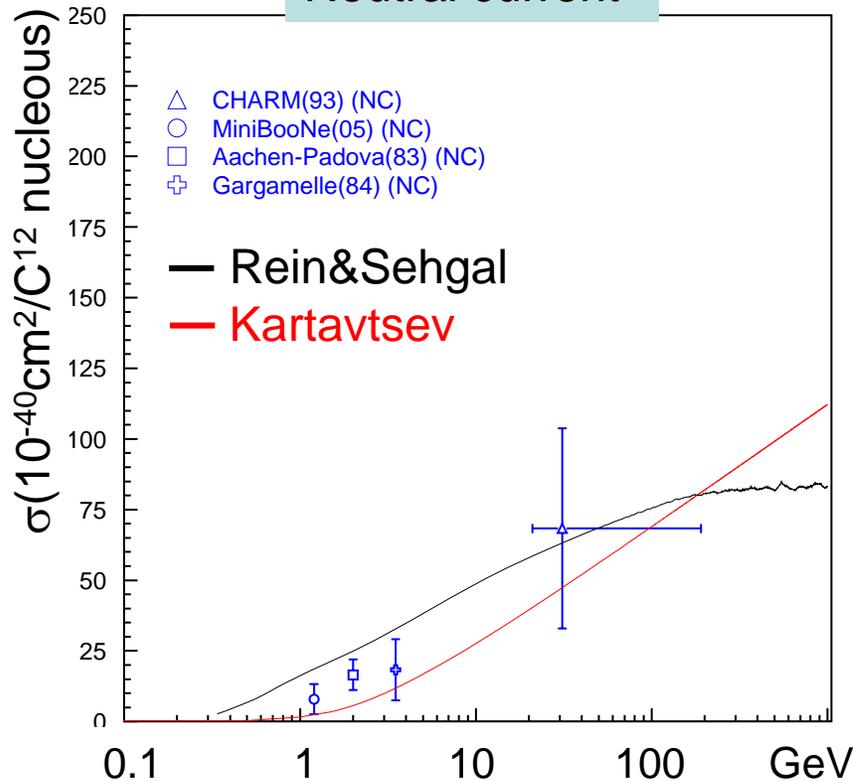
Maesaka et al.  
Phys. Rev. Lett. 95 (2005)

# Coherent pion production

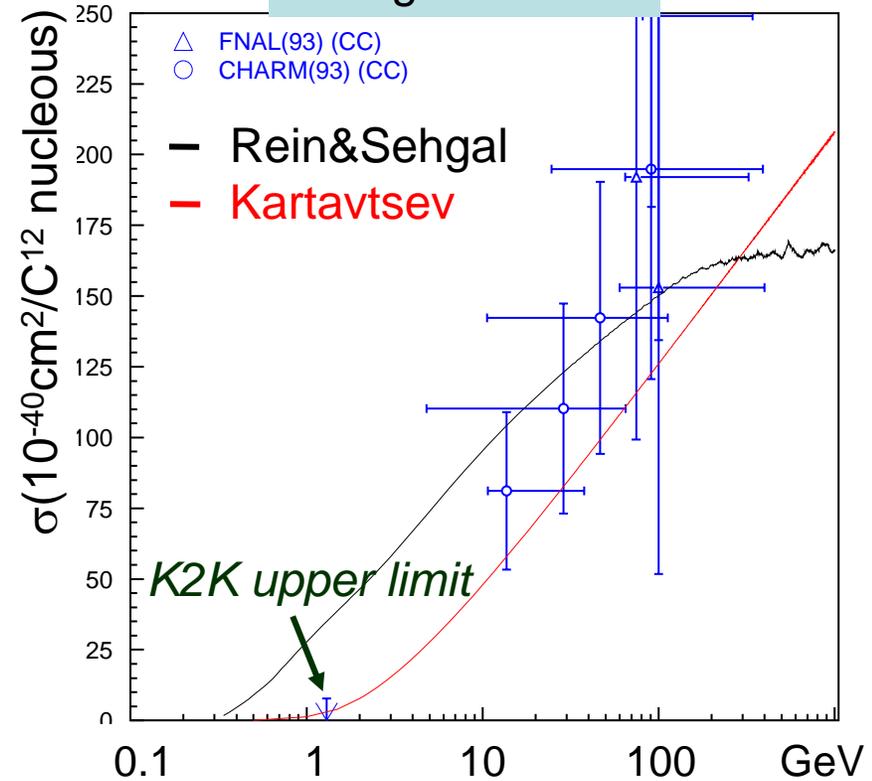
Comparison of Rein & Sehgal and Kartavtsev, Paschos & Gounars model

by Mitsuka, Hayato

## Neutral current



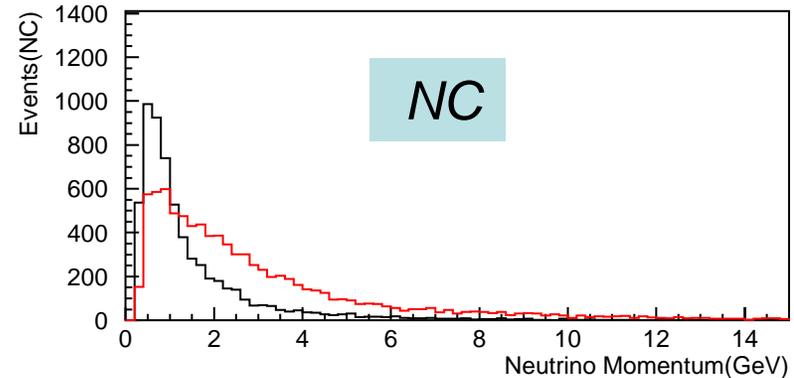
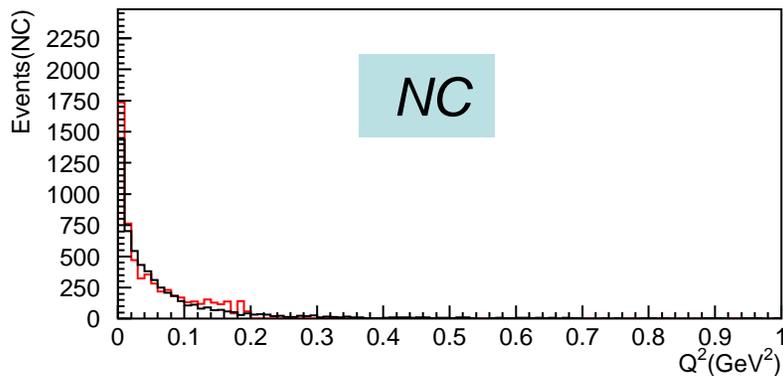
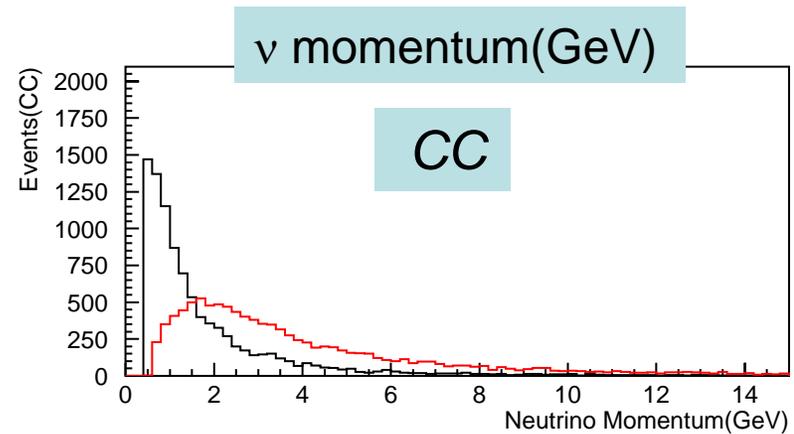
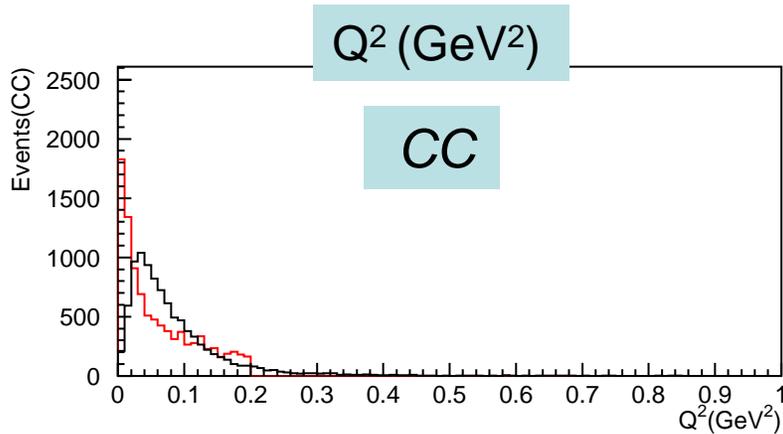
## Charged current



- Both Rein&Sehgal and Kartavtsev model agree experimental data in view of the large experimental errors, except for K2K result in CC
- *Kartavtsev model agrees K2K result*

# Coherent pion production

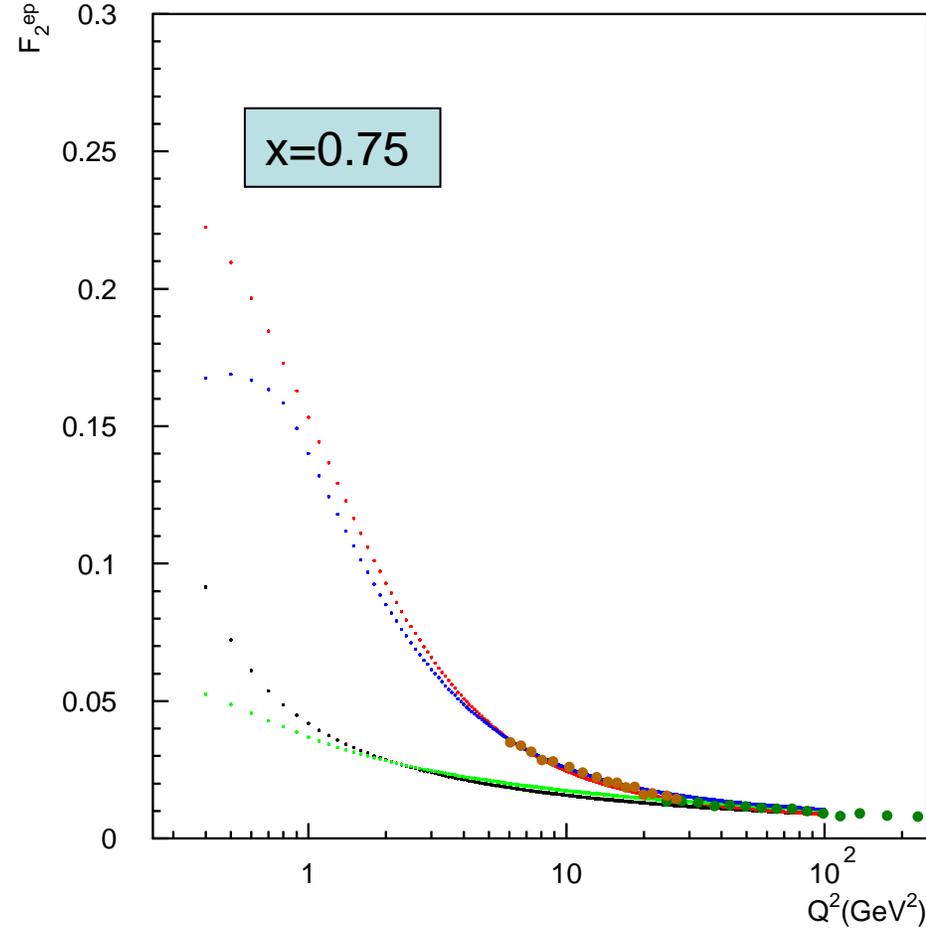
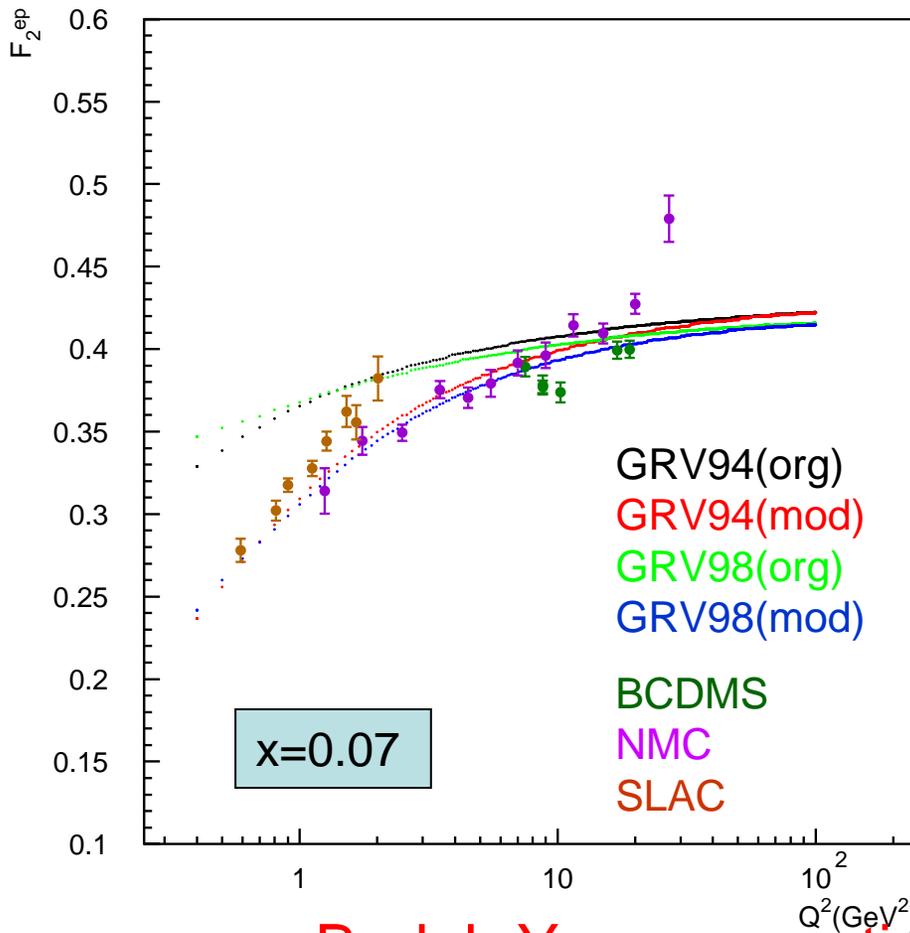
Black : Rein&Sehgal, Red : Kartavtsev (normalized by number of events)



We need more data and study of the effect for neutrino oscillation study.

# Deep inelastic scattering

## Comparison in $F_2(e^- \rightarrow p)$

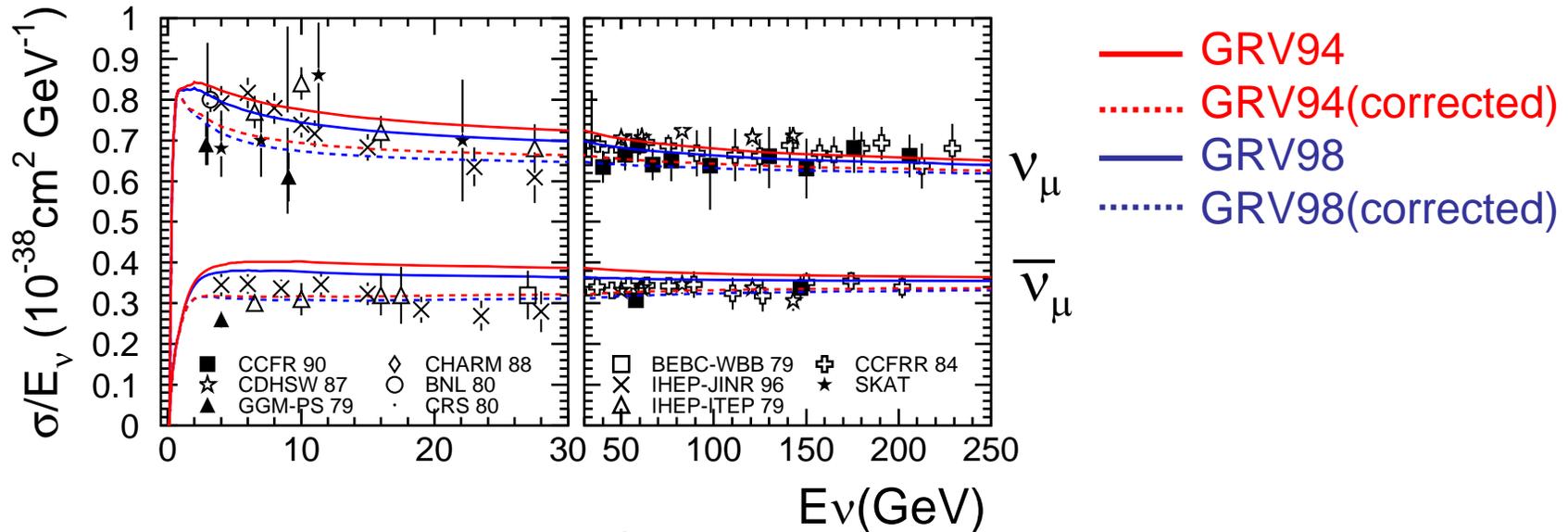


Bodek-Yang correction

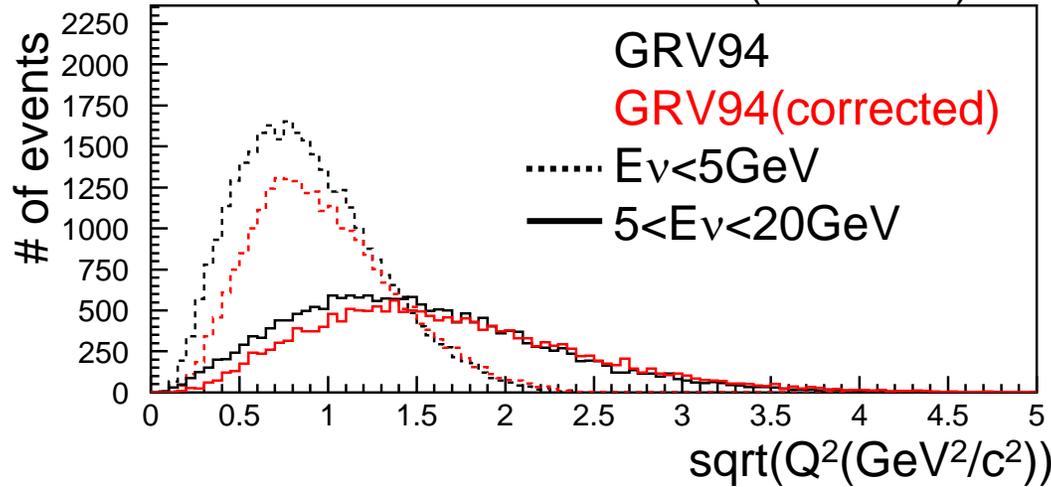
Corrected PDFs show good agreement with experimental data in both  $x$  region

# Deep inelastic scattering

## CC muon neutrino cross section



## CC muon neutrino $Q^2$ dist(Honda03)



# Future related experiments

MINOS near detector	on going
SciBOONE	2007春 $\nu, \bar{\nu}$
T2K near detector	2009-
MINERvA	2009-
(HARP)	completed

より高統計のニュートリノ事象を使い、  
ニュートリノ相互作用の理解を深める。  
それにより、ニュートリノの研究を進める。

backup

# Deep inelastic scattering

## Summary of Bodek-Yang correction

1. Bjorken scaling  $x \rightarrow x_w$

$$x_w = x \frac{Q^2 + B}{Q^2 + Ax}$$

*A : target mass effect*

*higher twist effect*

*B : nonzero  $F_2$  as  $Q^2 \rightarrow 0$*

2. Structure function  $F_2$

$$F_2(x) \rightarrow \frac{Q^2}{Q^2 + C} F_2(x_w)$$

*In order to fit both intermediate-x  
and low-x*

3. d/u ratio

$$d_v \rightarrow d'_v(d_v, u_v)$$

$$u_v \rightarrow u'_v(d_v, u_v)$$

*Correction for conversion  $F_2^d \rightarrow F_2^n$*

4. Longitudinal R

$$2xF_1 = F_2 \frac{1 + 4Mx^2/Q^2}{1 + R}$$

*Correction for spin of target particle*