

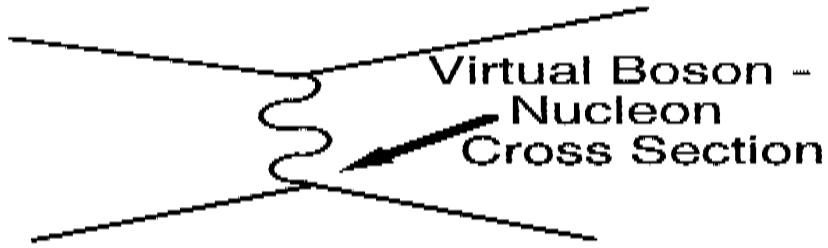
# **R**longitudinal from the **CCFR Experiment**

**Cindy McNulty**  
**Columbia University**  
**DPF Aug 1996**

- \* **Why is R interesting?**
- \* **The CCFR Experiment**
- \* **The fit method**
- \* **Results**

$$R = \sigma_{\text{long}} / \sigma_{\text{trans}}$$

**DIS**  
( $E \gg m$ )

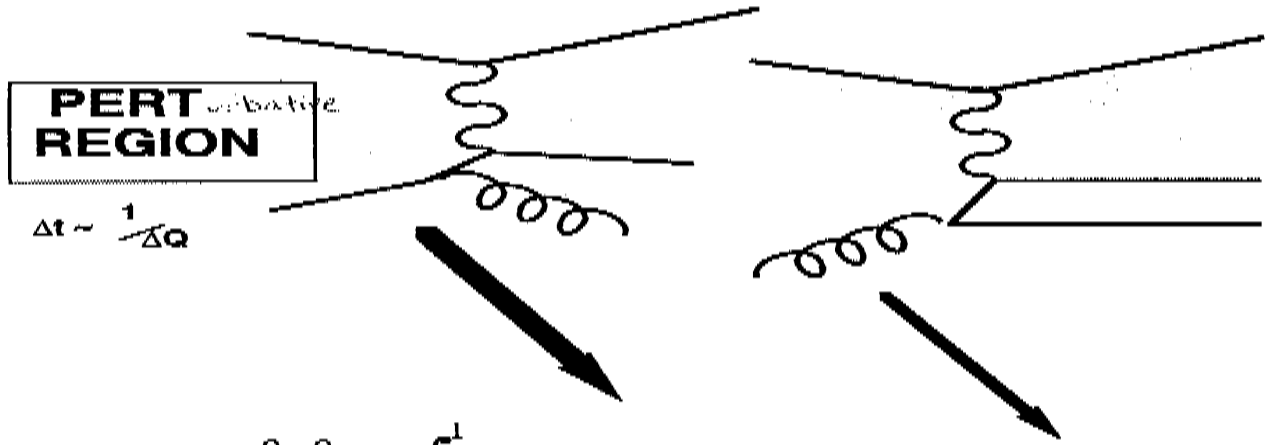


if  $S_{\text{parton}} = 1/2$  then helicity conservation requires a parton spin flip:

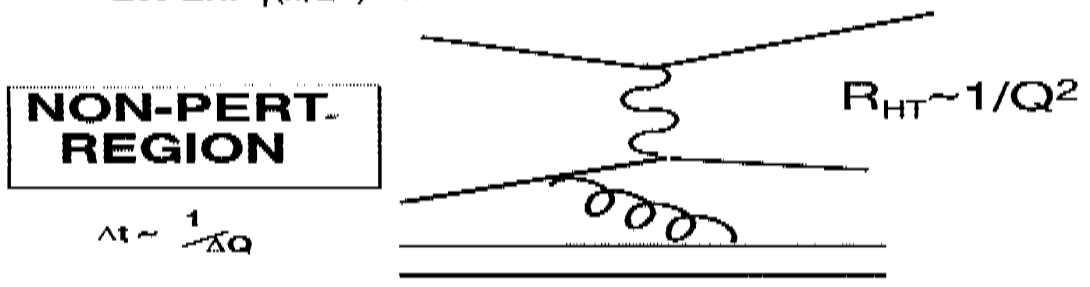
$BOSON S=1$	$PARTON S=1/2$	
→	←	
$m_S = \begin{cases} 0 \text{ (long)} \\ +1 \text{ (trans)} \end{cases}$	$m_S = -1/2$ $h = +1$	<b><math>R = 0</math></b>
	→	
	$m_S = +1/2$ $h = +1$	

**.... $R=0$  unless the partons have  $p_t$**

**...where does a parton get  $p_t$  ?**

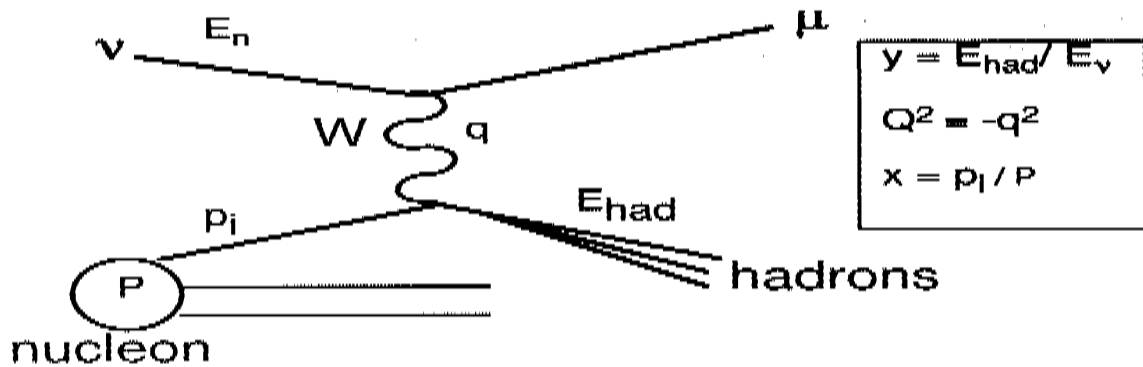


$$R_{\text{QCD}} = \frac{\alpha_S(Q^2)x^2}{2\pi 2xF_1(x,Q^2)} \int_x^1 \frac{dz}{z^3} \frac{8}{3} [F_2(z,Q^2) + 4f(1-x/z) zG(z,Q^2)]$$



$$R_{\text{TM}} \sim 1/Q^2 \text{ \& } 1/Q^4$$

## The CCFR Experiment at Fermilab's Tevatron



$$\frac{d^2\sigma^{\nu N}}{Edxdy} \sim F_2^{\nu}(x, Q^2) \left[ 1 - y + \frac{y^2}{2(1+R(x, Q^2))} \right] \pm xF_3^{\nu}(x, Q^2) (y - y^2/2)$$

LO QCD:

$$F_2 = xq + x\bar{q}$$


$$xF_3^{\nu} = xq - x\bar{q} \pm (xs - xc)$$

(use CCFR NLO dimuon measurement)

3 parameter fit:  $F_2$  ,  $R$  ,  $xF_3^{\nu}$

## STRUCTURE FUNCTION EXTRACTION

Form in each  $(x, Q^2)$  separately :

$$\chi^2_{(x, Q^2)} = \sum_{20 \text{ } y \text{ bins}}^v \frac{[N_{\text{DATA}} - N_{\text{MCMC}}]^2}{\text{error}^2} + \sum_{(same)}^{\bar{v}}$$


the sum of monte carlo event weights generated  
in that  $(x, y, Q^2)$  bin  
[each explicitly depends on  $F_2$ ,  $R$ , and  $x F_{av_3}$   
through its cross section]

Find the values of  $F_2$ ,  $R$ ,  $x F_{av_3}$  that minimize

$\chi^2$  in that  $(x, Q^2)$  bin

## CUTS

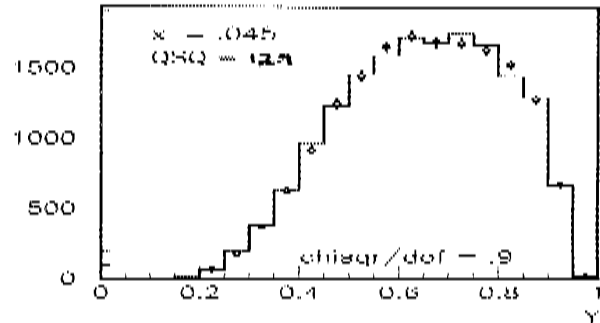
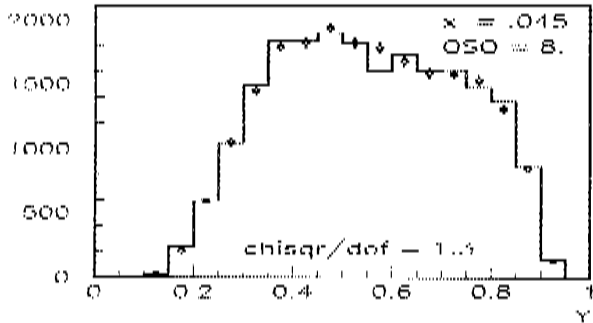
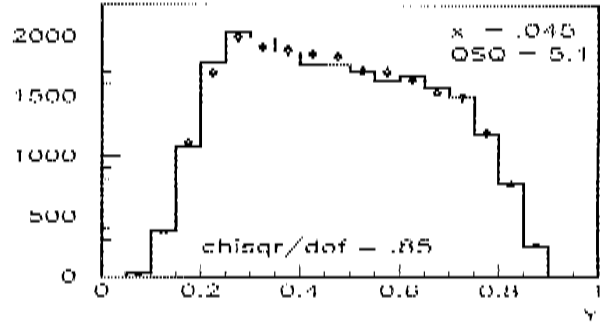
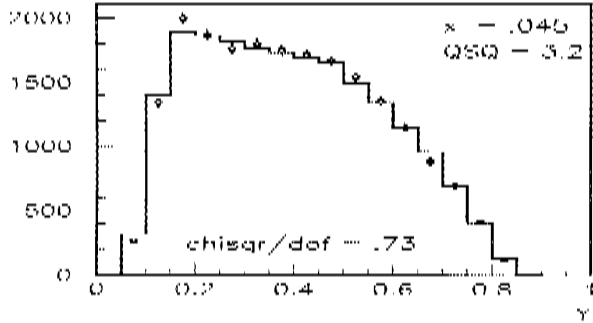
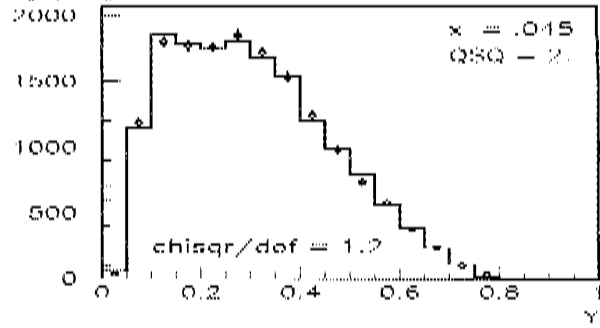
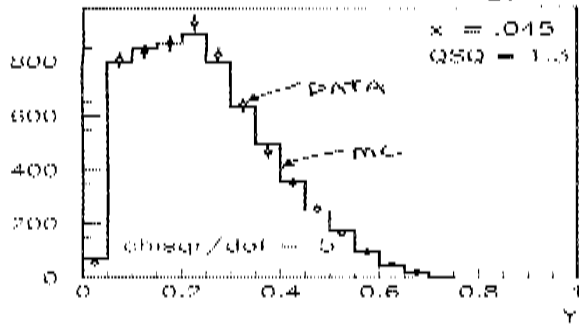
- \* Fiducial Volume
- \* Quality of Tracking
- \* Dimuons
- \* Kinematic:
  - $15 < E_\nu < 360 \text{ GeV}$
  - $10 < E_{\text{had}} < 360 \text{ GeV}$
  - $30 < E_\mu < 360 \text{ GeV}$
  - $\theta_\mu < 0.15$

$1.2 * 10^6 \nu$  events  
 $.2 * 10^6 \bar{\nu}$  events

### Detector effects in the Monte Carlo

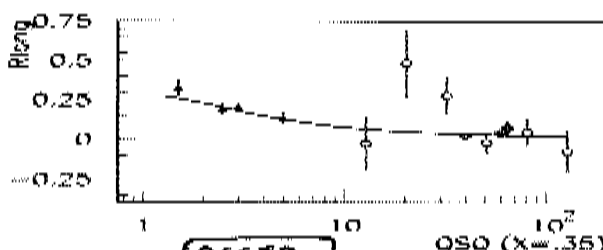
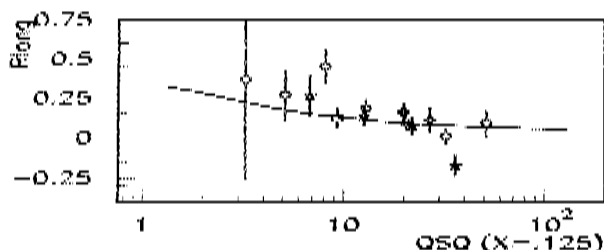
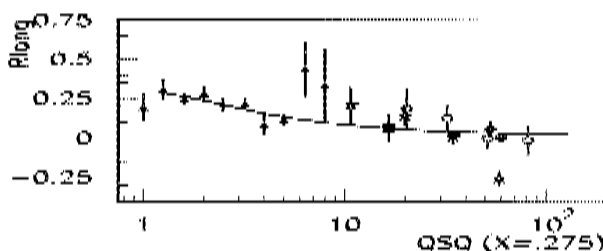
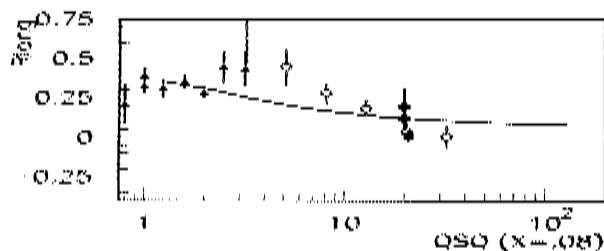
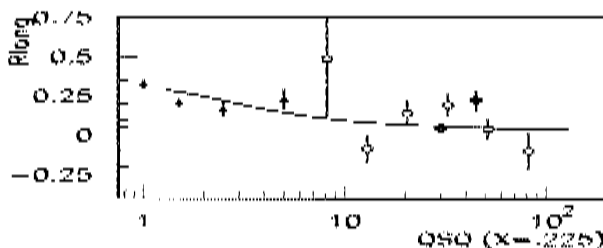
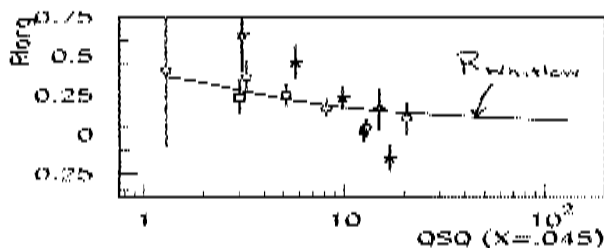
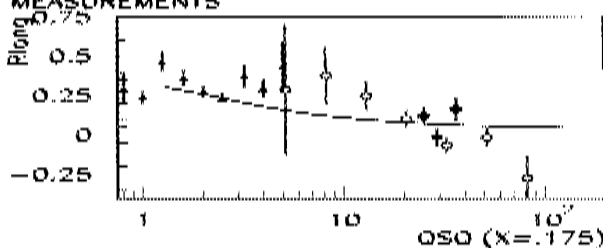
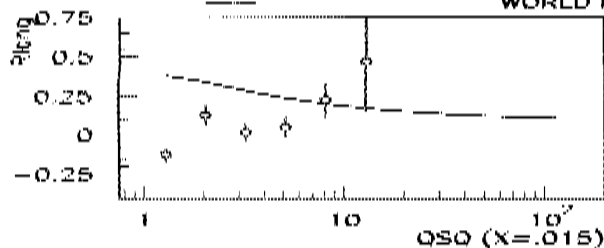
- \* Correction for non-isoscalar target (iron)
- \* "Slow Rescaling" (charm mass)
- \* Smearing
- \* Radiative corrections (calc. by Bardin)

NEUTRINO Y DISTRIBUTIONS



# Preliminary CCFR in open circles

WORLD R MEASUREMENTS



○ CCFR  
 \* CDAS  
 □ CHARM  
 △ SLAC  
 ■ EMC  
 ⊕ BCDMS

## **CONCLUSIONS**

- \* precise R measurements offer a way to measure gluon dist., HT & TM effects
- \* Work in progress:
  - \* systematic errors not calculated
  - \* low x region still under investigation
  - \* improved statistics expected with tracking cut changes
- \* Agrees with world data in regions where measurements are available
- \* Explores new regions of  $(x, Q^2)$  space important to the gluon distribution