Summary of Structure Functions WG
– High x from JLab to HERA -

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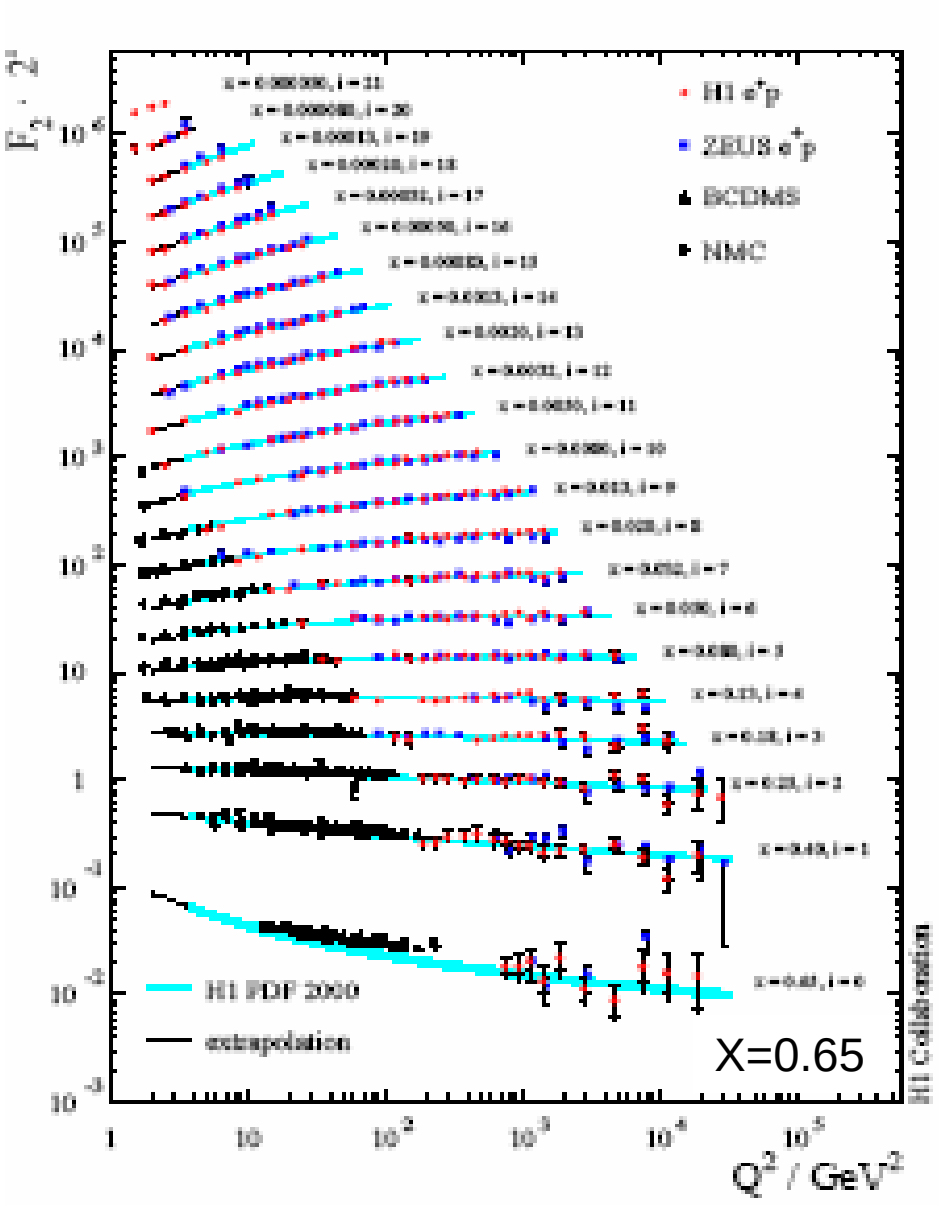
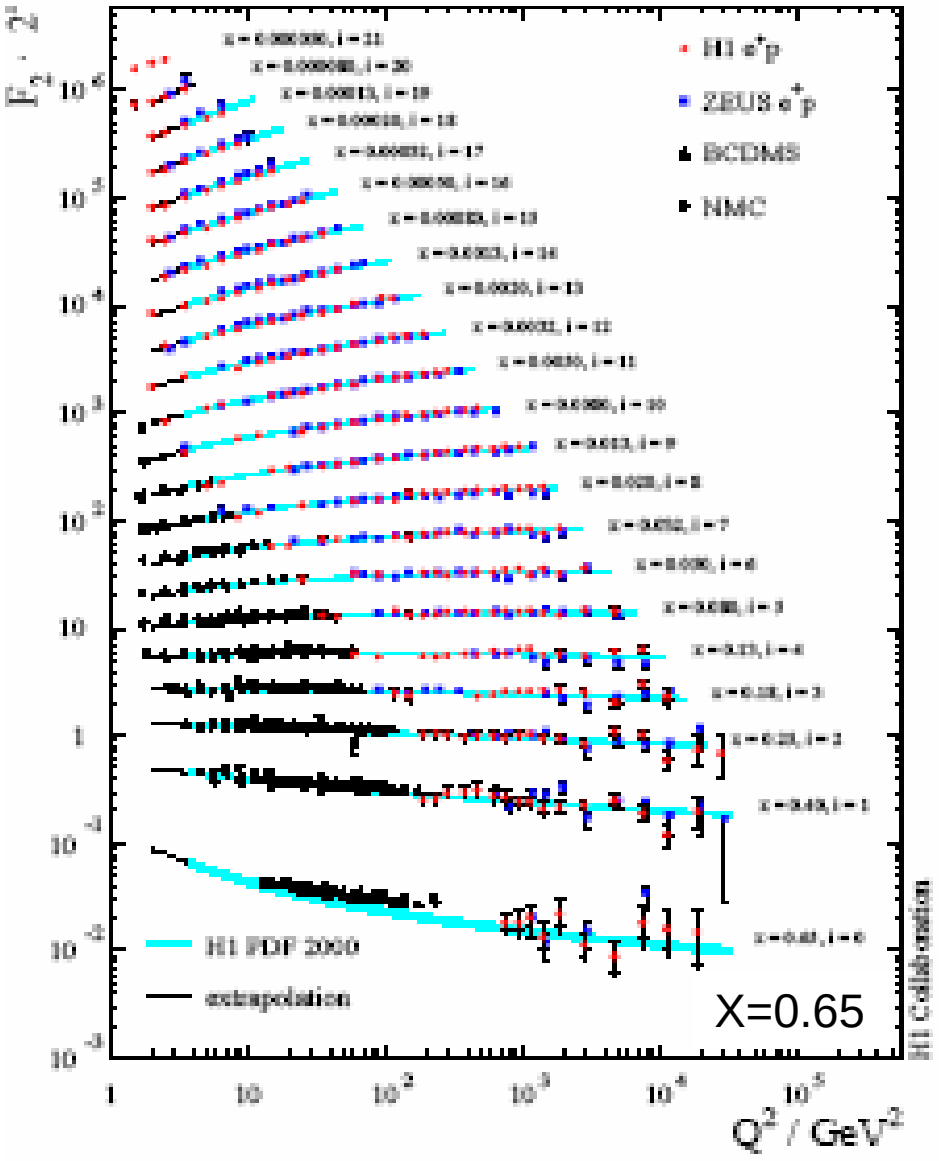
University of Chicago

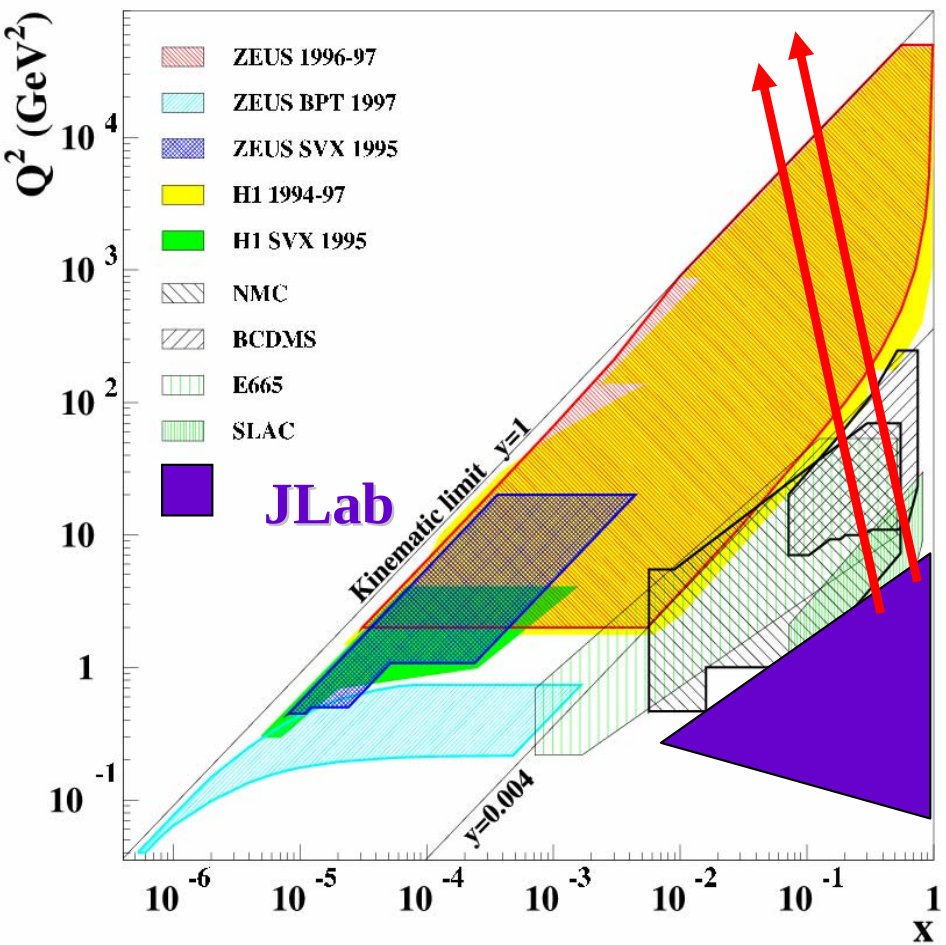
DIS05, Madison

After impressive success, why do we concern at high x?



After impressive success, why do we concern? (evolution effect)

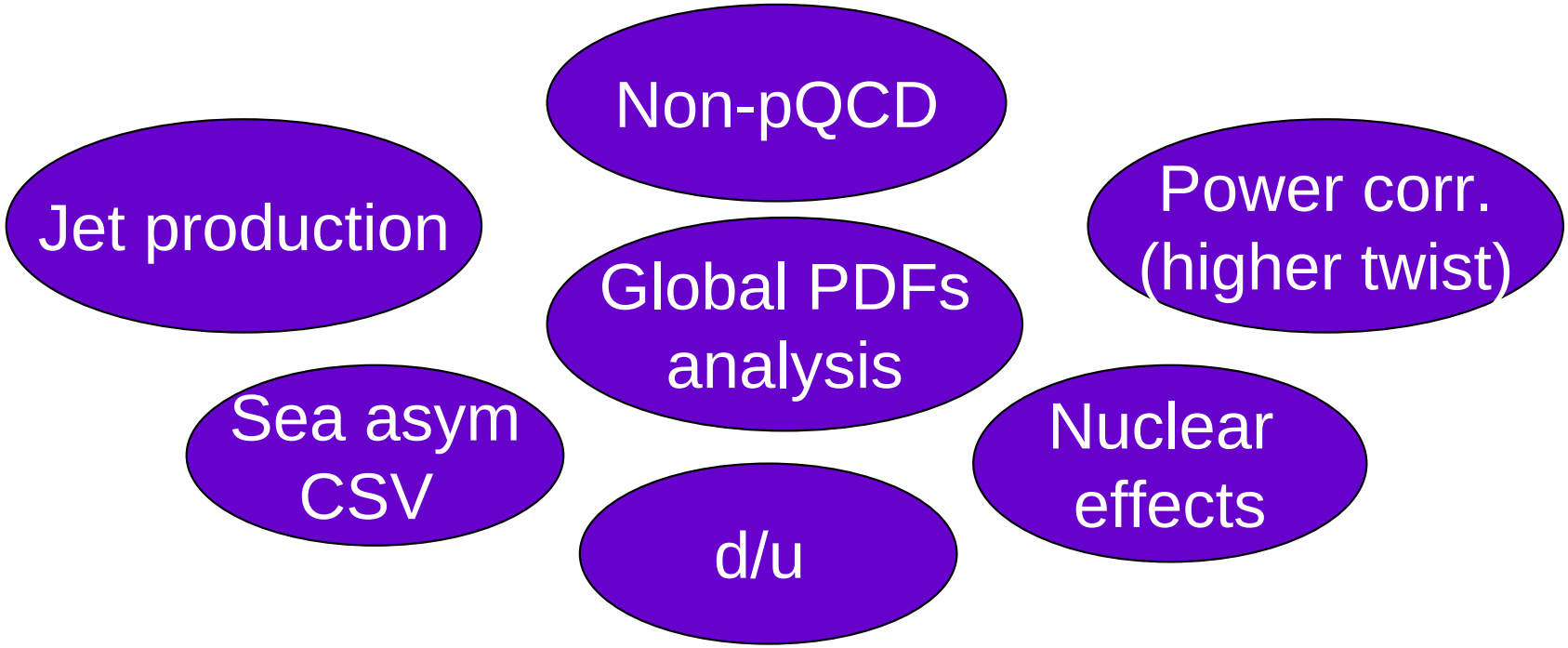




High x region

PDFs at high x

- Crucial for precise EWK measurements, search for new physics at HERA, Tevatron and LHC
- Neutrino Oscillation Physics

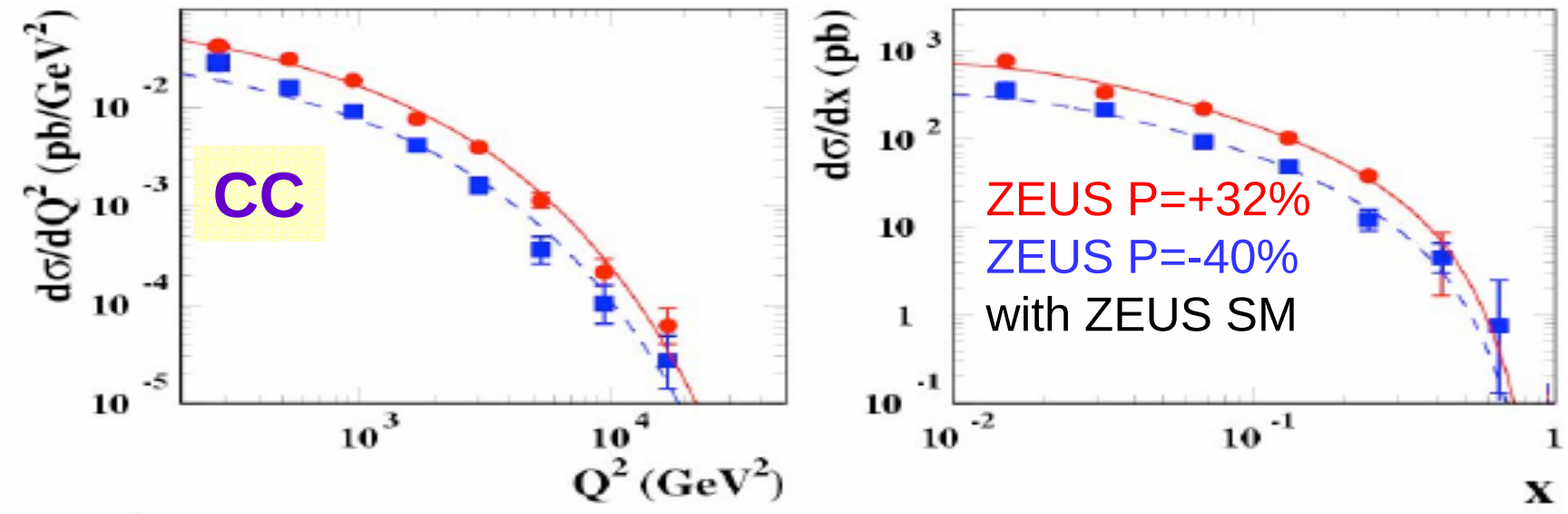


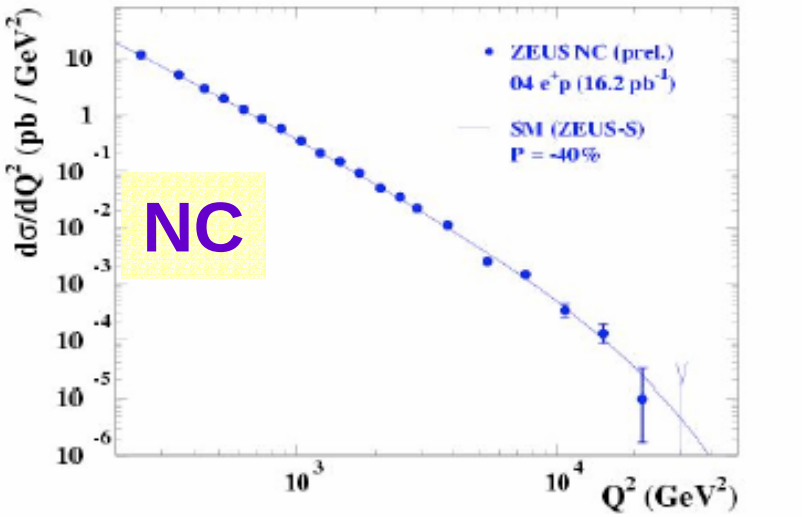
- Main Players: **JLab**, DIS fixed exp., **NuTeV**, E866 DY

HERA, Tevatron, and theorists

Polarized NC/CC Cross Sections at HERA

- ZEUS(NC/CC) by A. Tapper, H1(CC) by A. Nikiforov

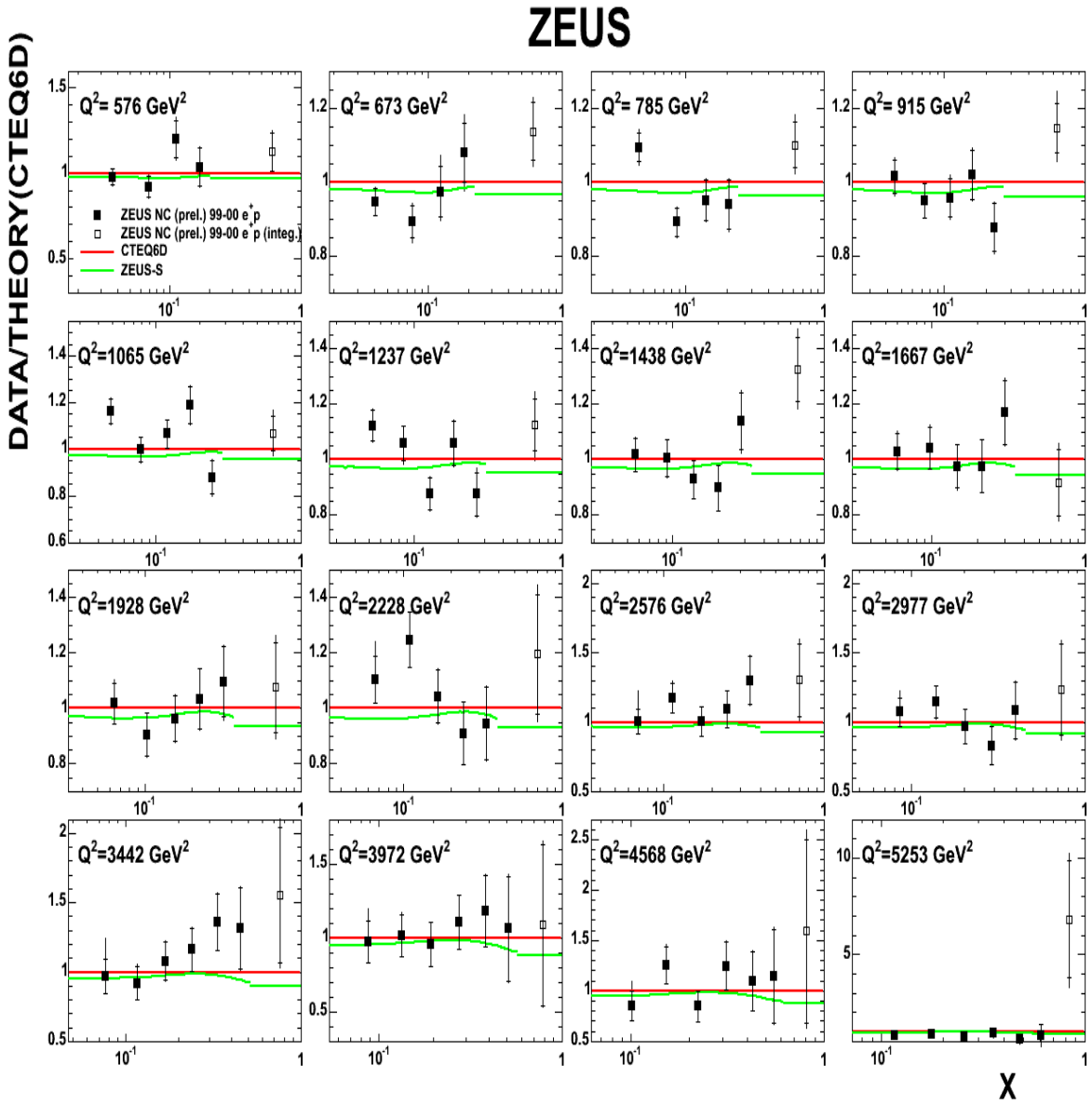


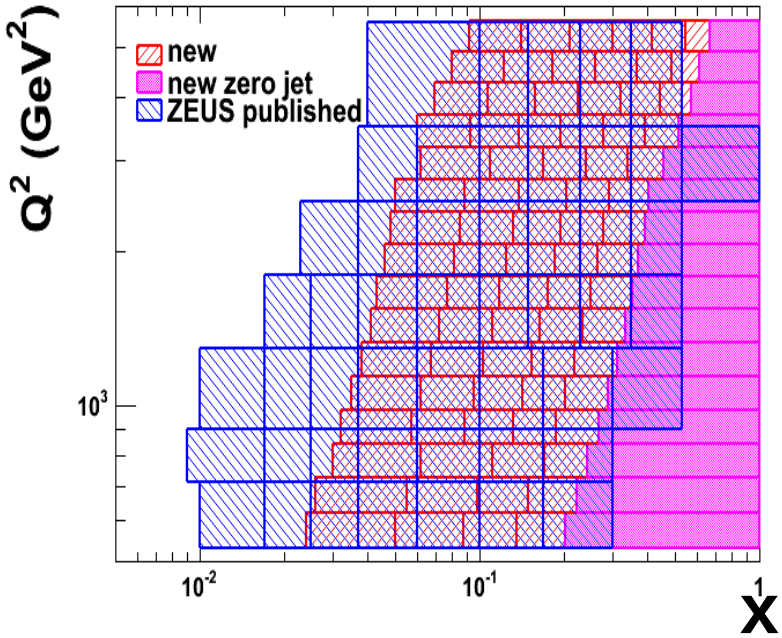


- Well described by the SM
- Test with more data
  at very high Q^2
  ➔ precise PDFs at high x

NC at high x from ZEUS

Y. Ning





- Extended to higher x region using E_{jet} and θ_{jet} up to x=1
- First results from 99-00 data (65 pb^{-1}):

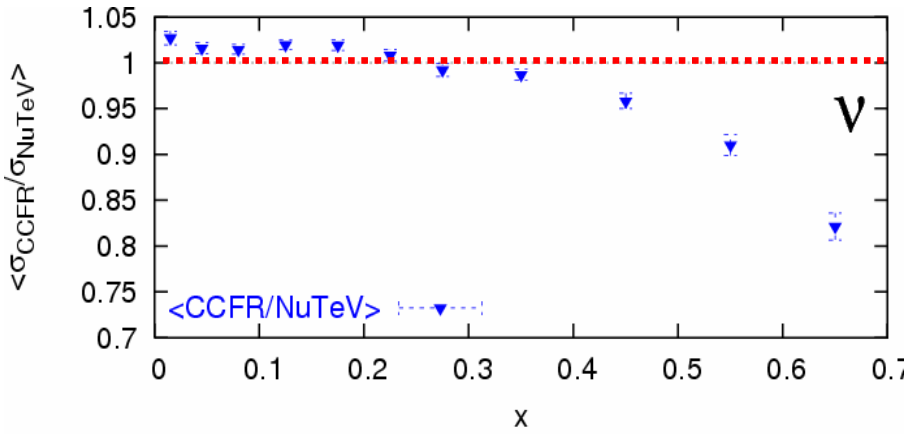
  very promising!!!
- Other dataset (x2)

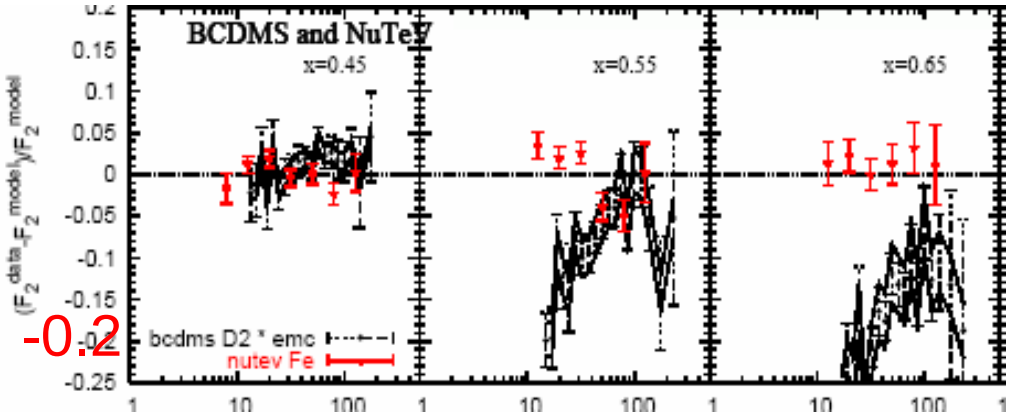
  in progress

NuTeV SFs

M. Tzanov

- Final NuTeV diff. cross sections (Eν = 20-360 GeV, x=0.01-0.7)
- F2, xF3 are finalized too.



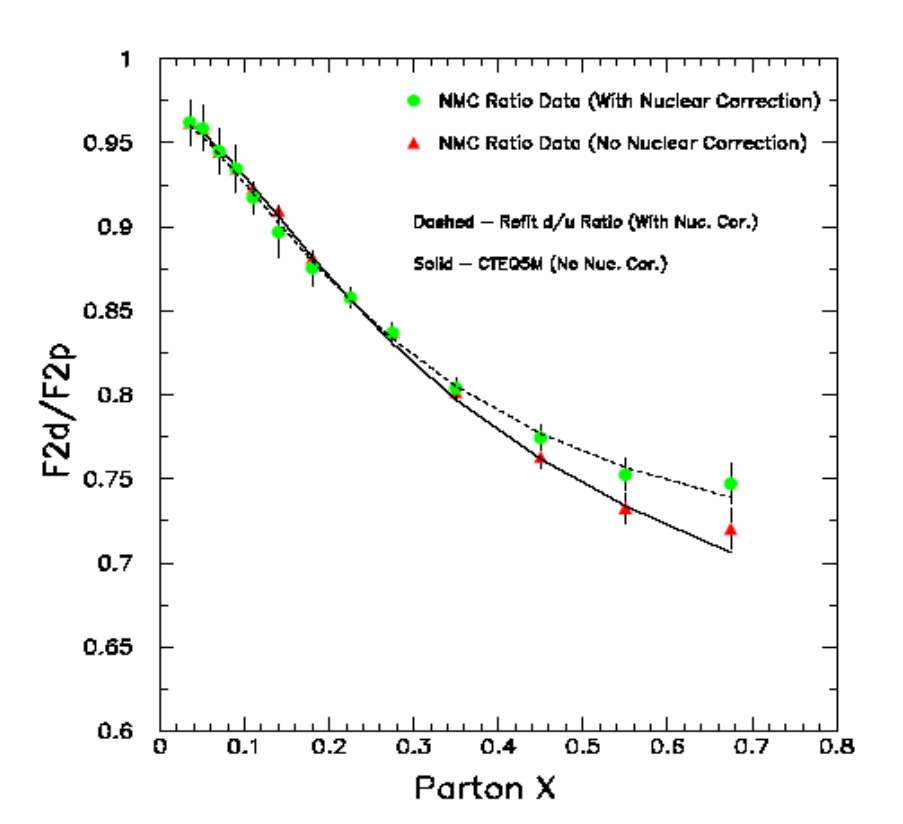


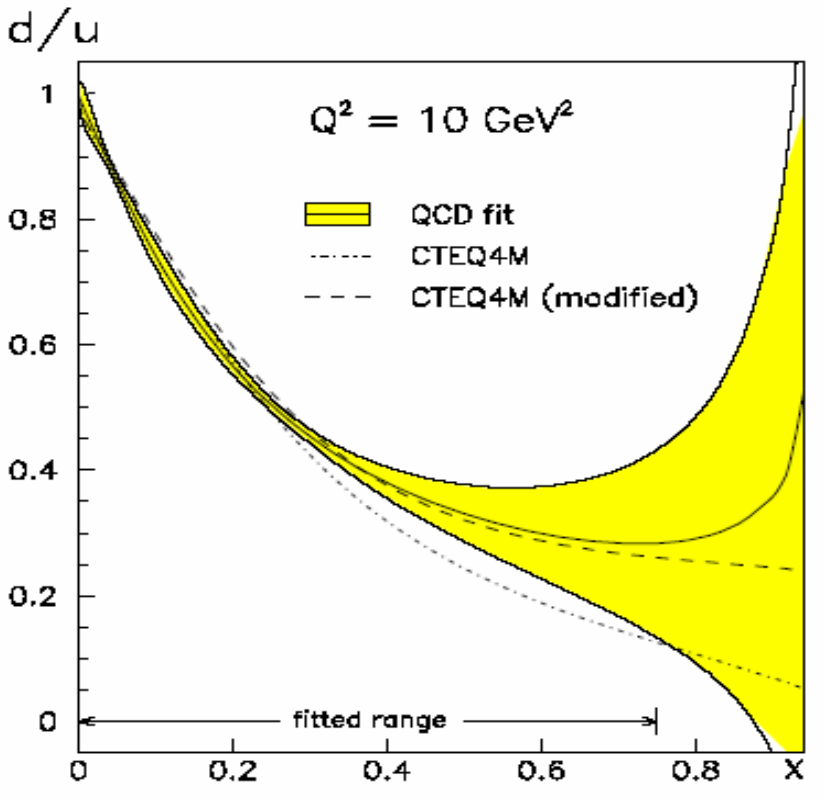
-0.2

nucl. corr at x=0.65:0.85

- NuTeV F2, xF3 at x=0.65 are 20% higher than CCFR, 10-15% higher than charged lepton data
- Improved calibration of B-field, calorimeter, MC model: explain 11%
- Higher F2: < 5% nuclear effect at x=0.65? need to be understood before NuTeV high-x data can be used in the global PDFs analysis
- CHORUS(lead) data can resolve, and future MINOS/Minerva

d/u at high x

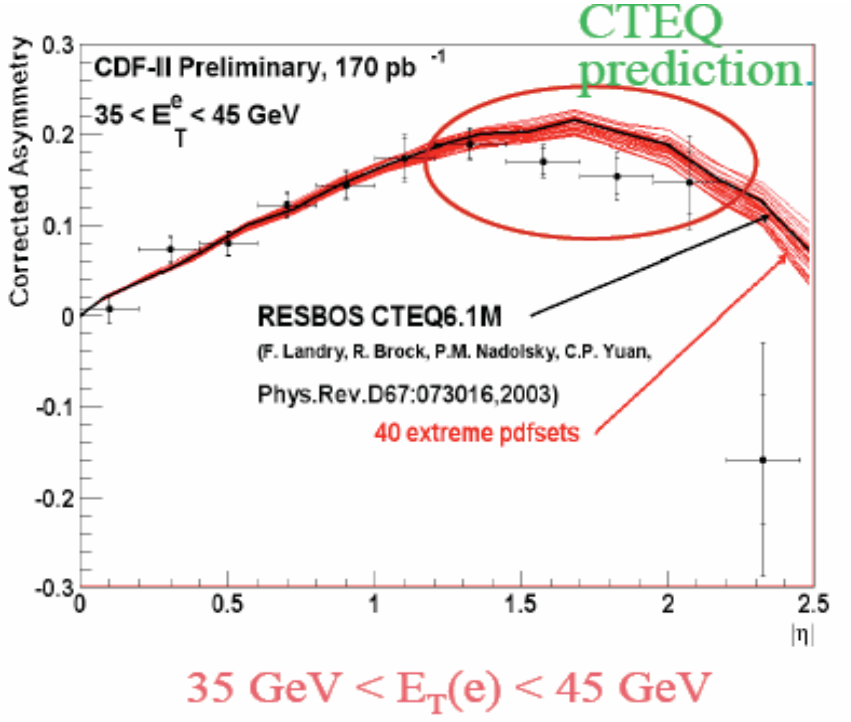




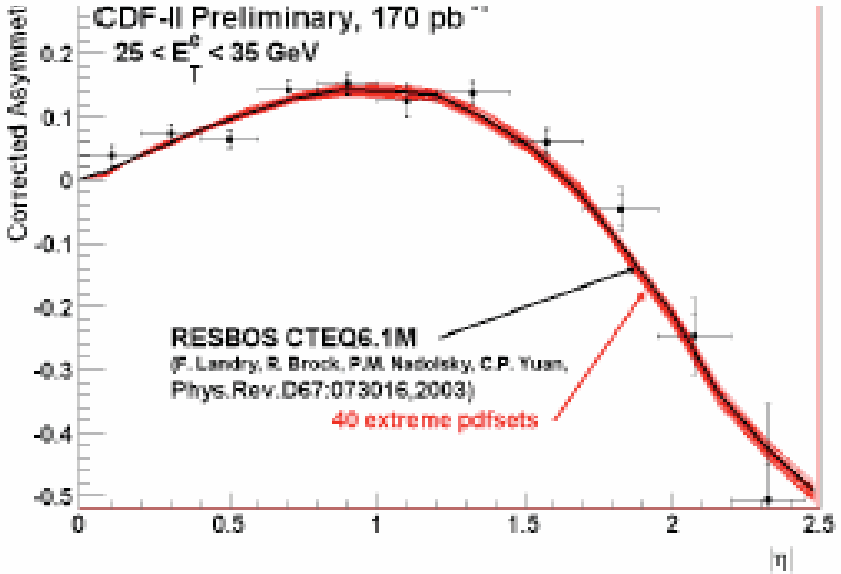
- δd/u at high x: driven by the uncertainty of nuclear effect on deuterium
- PDFs (d/u->0 & 0.2 at x=1): consistent with NMC F2(d)/F2(p) and CDF Run I W asymm., though a huge difference in dv.

W charge asymmetry at Tevatron

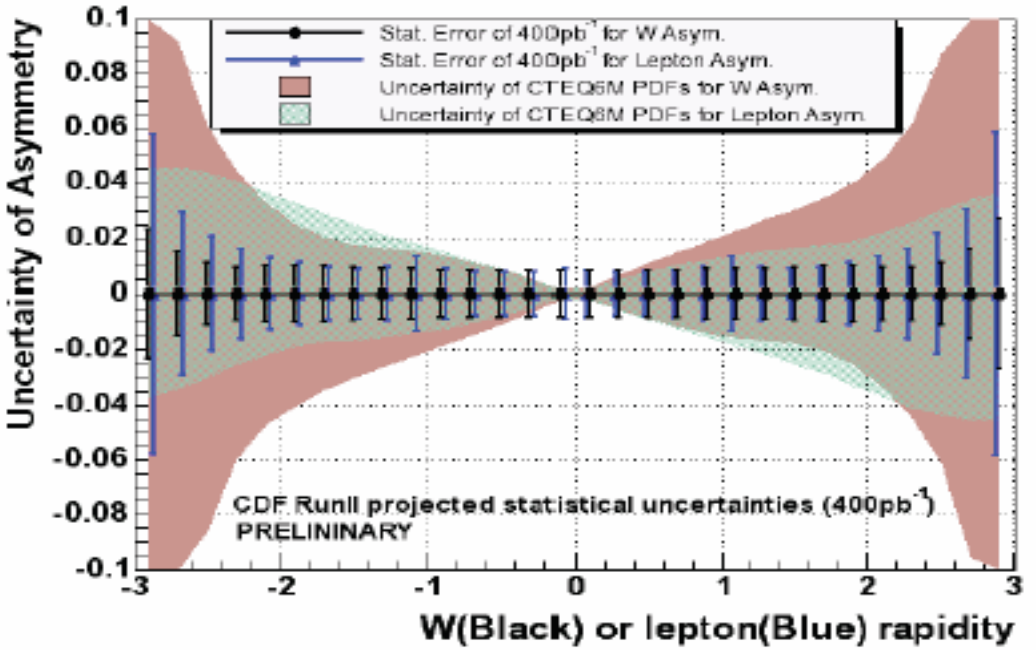
Y.S. Chung



35 GeV < E_T(e) < 45 GeV



25 GeV < E_T(e) < 35 GeV

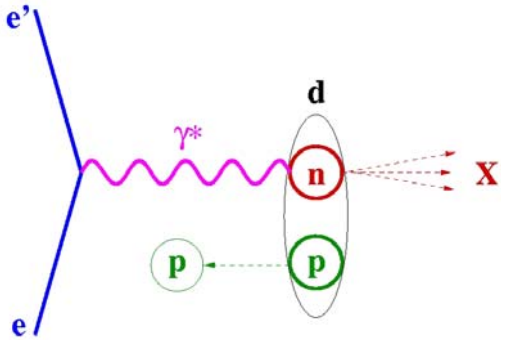


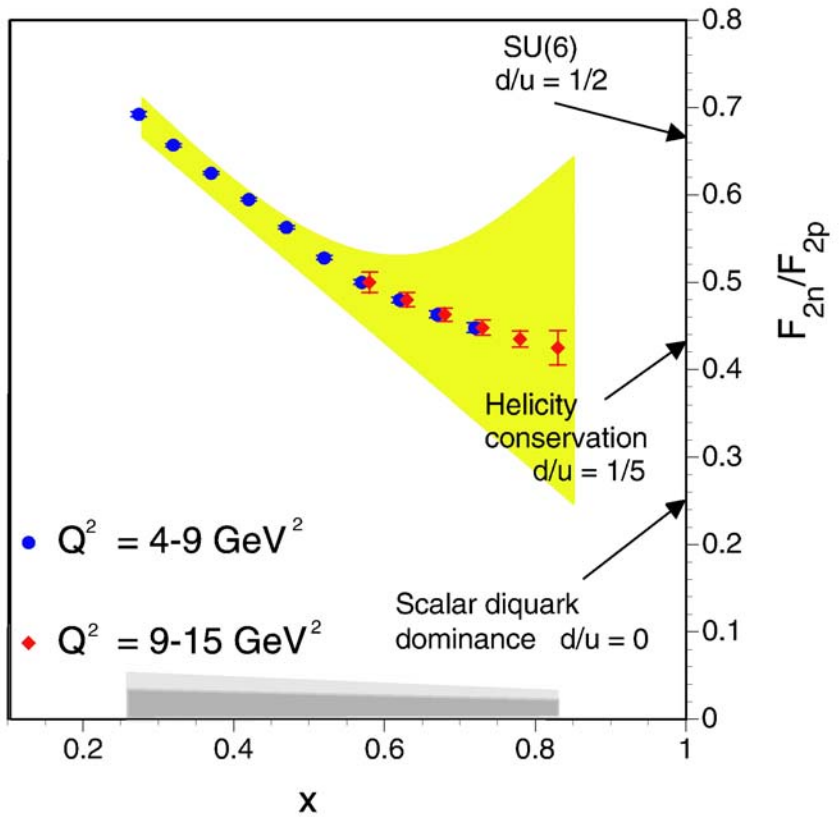
- RunII CDF measurements with higher Et cut to prove d/u at higher x
- Would be interesting how the PDF with nucl. Corr (d/u->0.2) compare with the CDF data
- Big improvement with direct W asymm. mea is expected.

Dedicated efforts to prove d/u at high x from JLab

- Measure SF of nearly on-shell neutron by detecting slow spectator proton in semi-inclusive ed -> ep X reaction : JLab CLAS++,

  BONUS exp. (almost scattering off free nucleon): talk by S. Kuhn





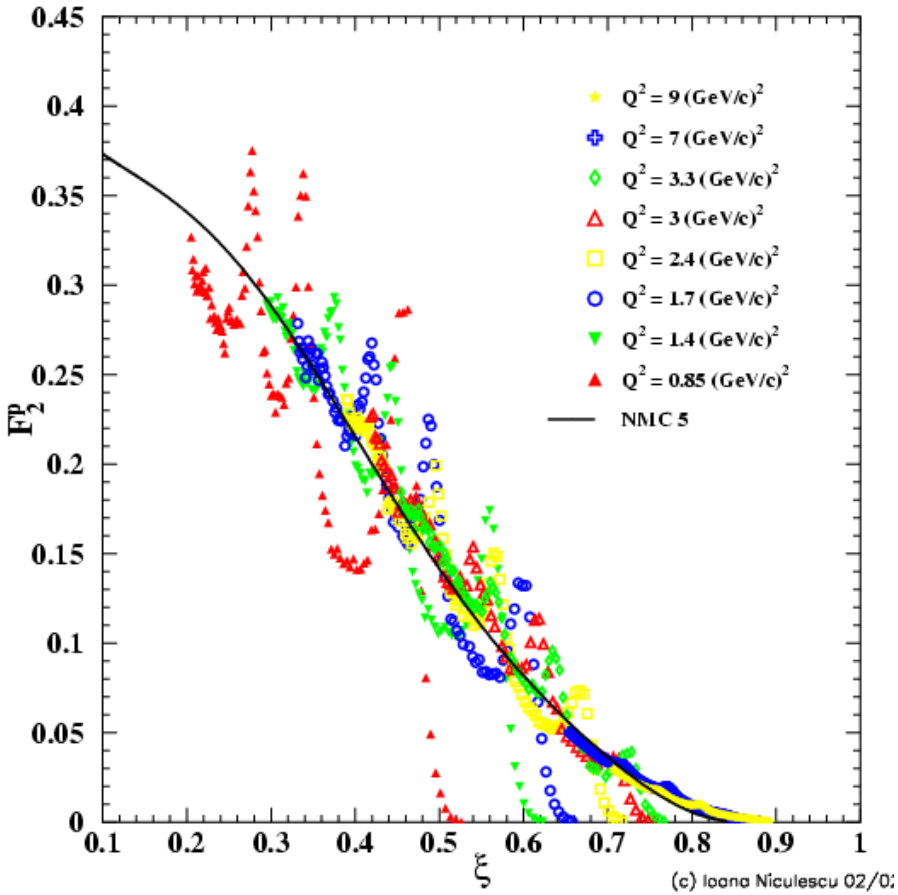
- Parity violation in DIS on ^{1}H: very sensitive to d/u: talk by P.A. Souder

$$A_{PV} = \frac{G_F Q^2}{\sqrt{2}\pi\alpha}\left[a(x) + f(y)b(x)\right] \qquad a(x) = \frac{u(x) + 0.91d(x)}{u(x) + 0.25d(x)}$$

SFs in Resonance region

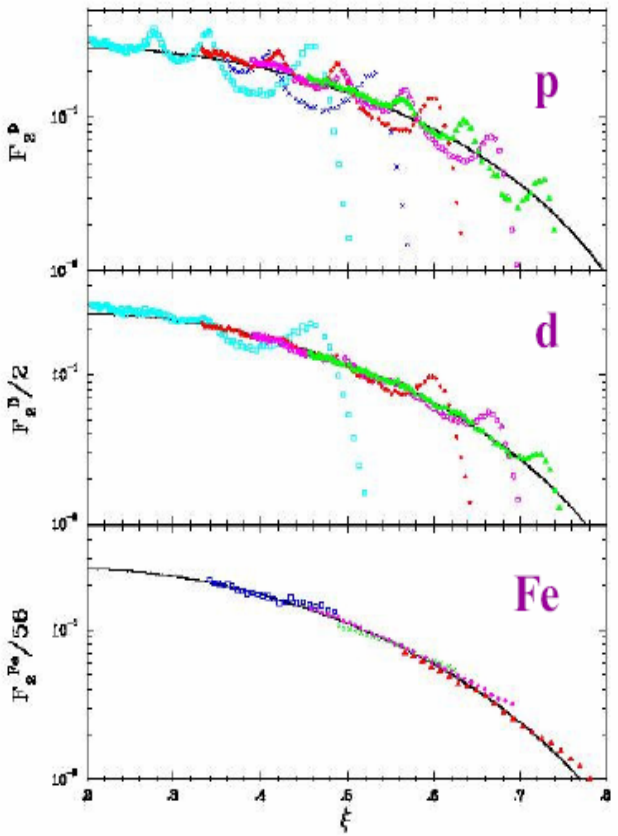
Niculescu, Keppel, Liuti

- Precise JLab at high x, low Q2 (resonance)
- Can we use to obtain precise PDFs at high x?
- Duality: averaged over W, log scaling observed to work also for $Q^2 > 0.5$ GeV^2, $W^2 < 4$ GeV^2
  - F2(p, heavy), R, EMC
  - Spin SF
- Theoretical challenges
  - same higher twist between DIS and resonance
  - DGALP work?
  - Factorization work?



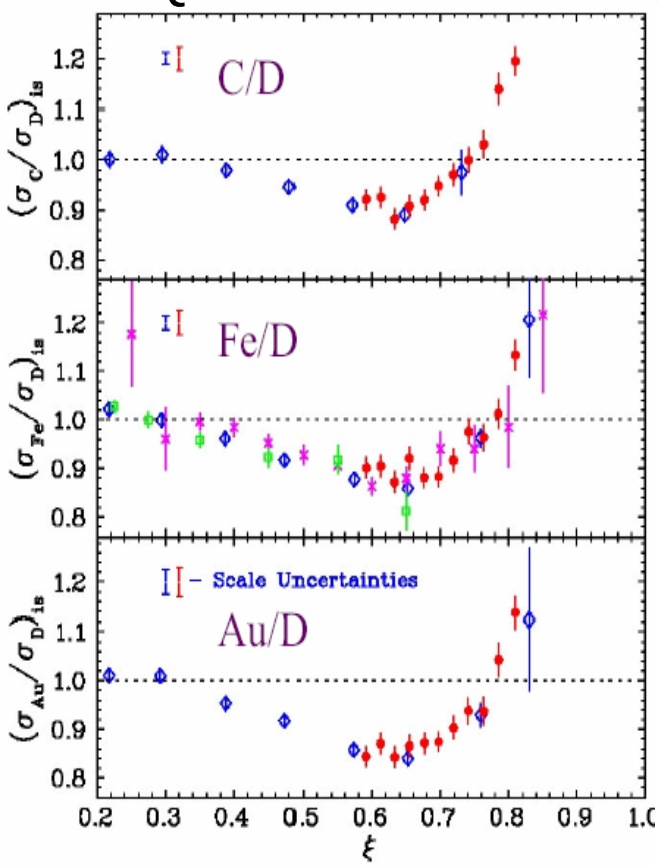
$$\Sigma_{\text{hadrons}} = \Sigma_{\text{quarks+gluons}}$$

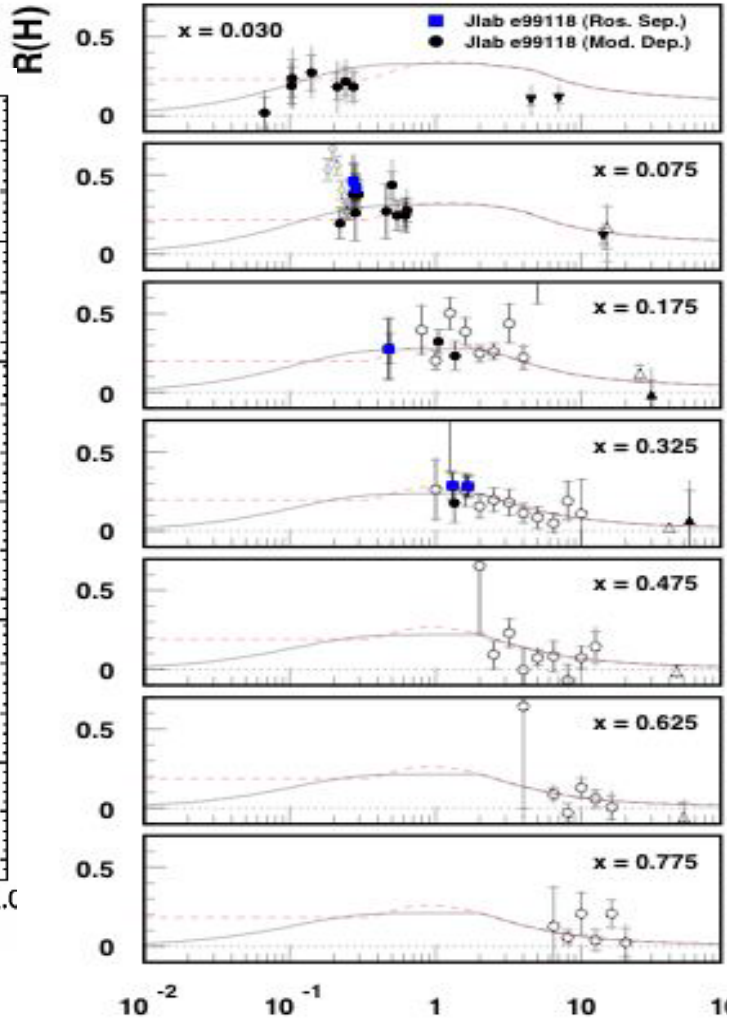
F2(p, heavy), EMC effects, and R



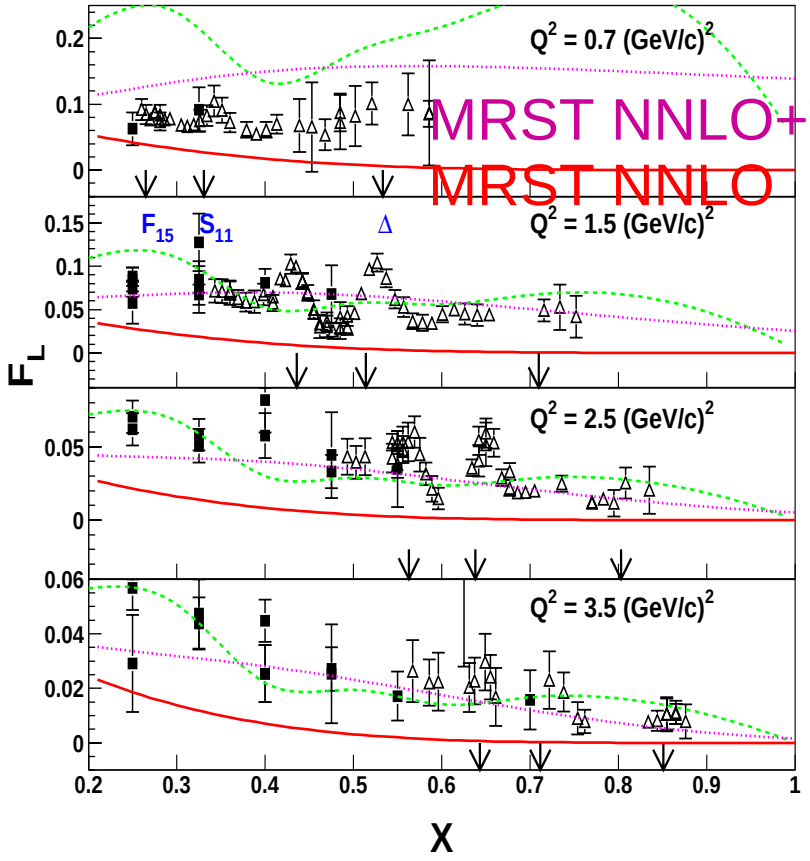
$$\xi = \frac{2x}{1+\left(1+\frac{4M^2x^2}{Q^2}\right)^{1/2}}$$

Q2: 0.7-5 GeV2



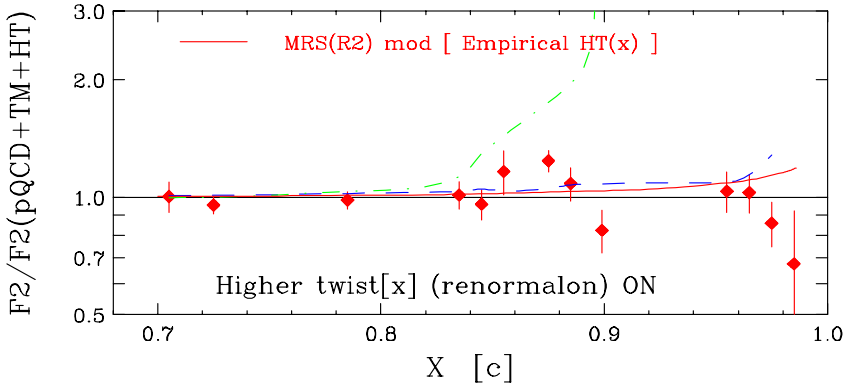


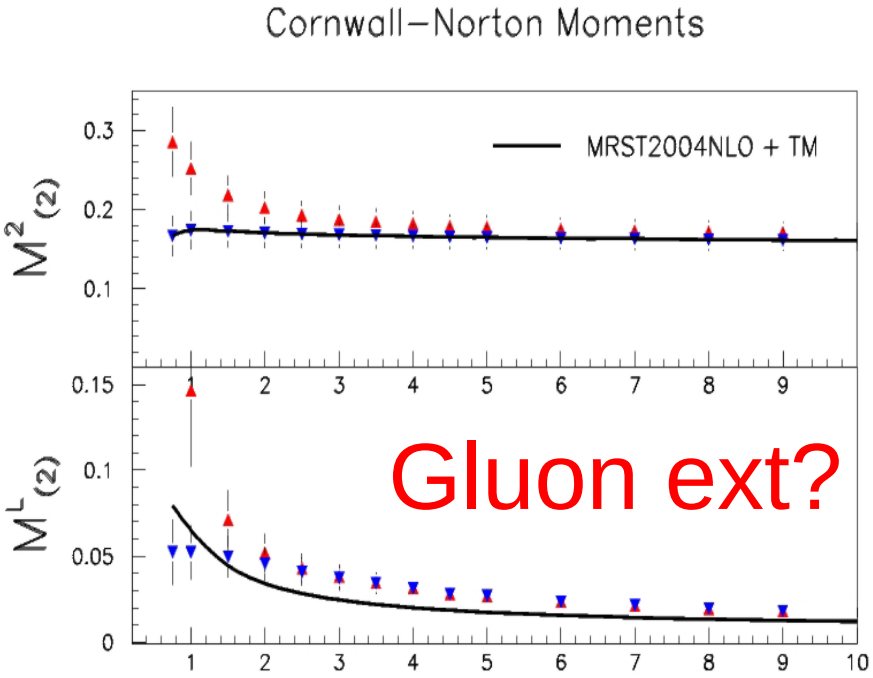
F2, FL, and moments



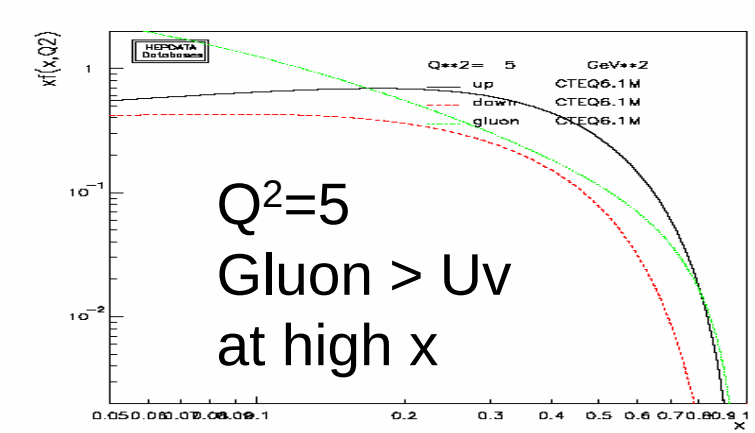
MRST NNLO+TM

MRST NNLO





Gluon ext?



Q^2=5

Gluon > Uv

at high x

Described by the MRST NNLO +TM

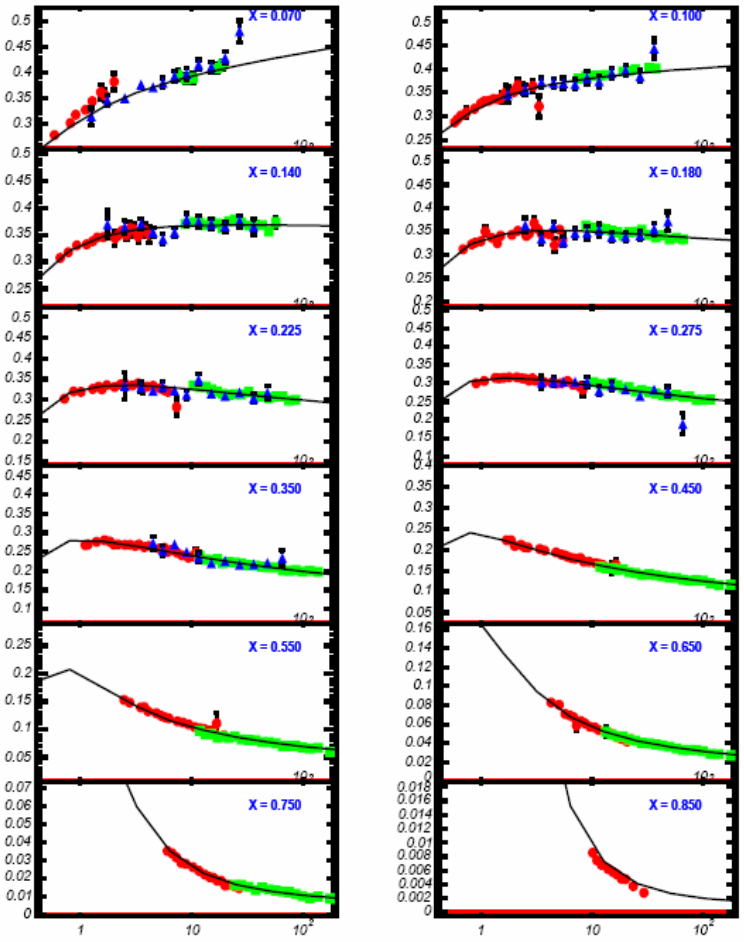
possible to pin down valence and gluon

Unified model for e/ν-N at all Q^2

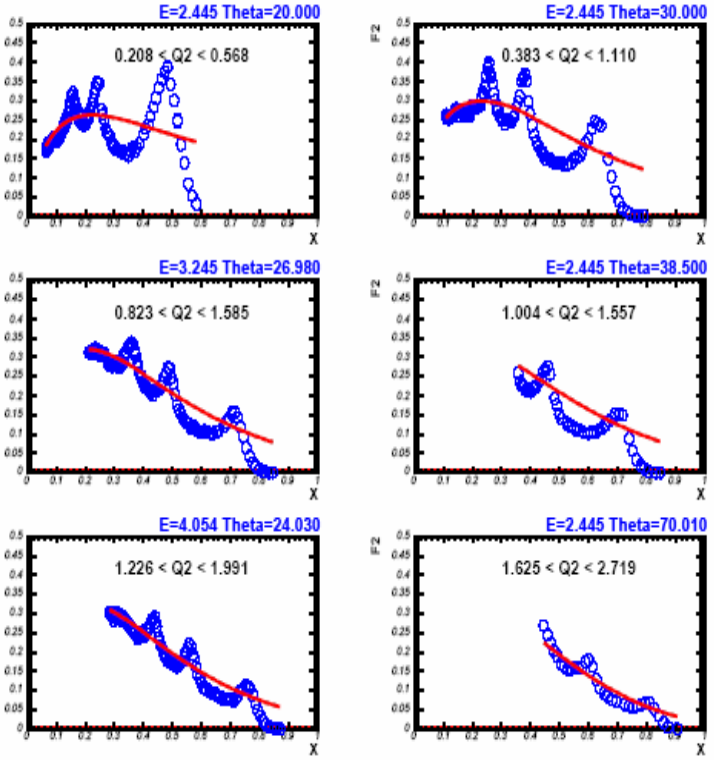
A. Bodek

- Effective LO approach: use LO PDFs with a new scaling variable, ξw to absorb target mass, higher twist, missing higher orders ;

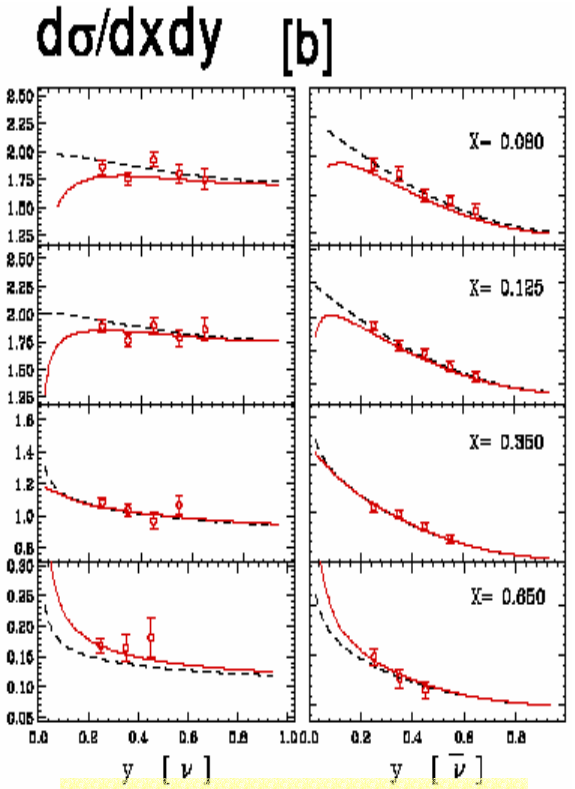
➔ DIS, resonance, even photo- production (Q^2=0) well described



DIS F2



Resonance F2

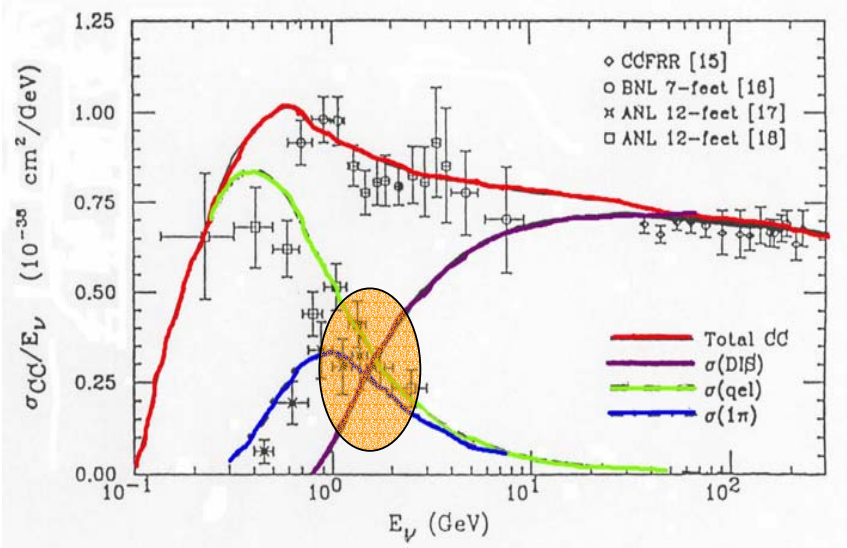


CCFR Xsection

Impact of SFs on the neutrino oscillation

H. Gallagher

- Correct modeling of ν-A cross sections over a broad range in kinematics and A important for current and future exp.
- Good description in the transition region from pQCD to non-pQCD by Bodek & Yang model
- More electron data from JUPITER at Jlab, and neutrino data MINERvA for various heavy targets (collaborative efforts from nuclear physics, neutrino, and DIS communities)

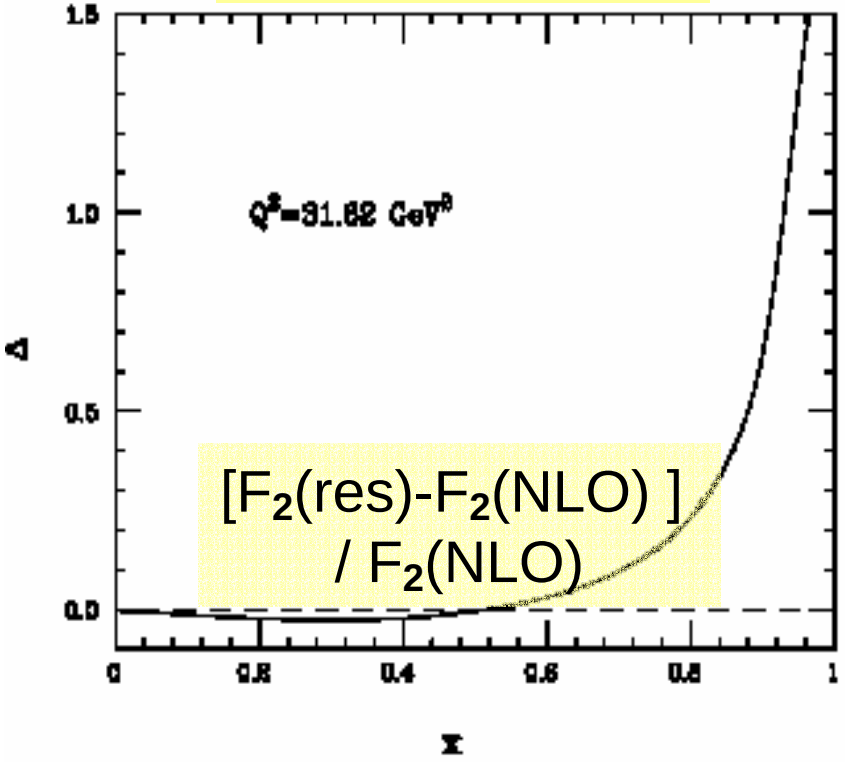


- Quasi-elastic/elastic (W=Mn)
  $\nu_\mu + n \rightarrow \mu^- + p$
- Resonance (low Q^2, W< 2)
  $\nu_\mu + p \rightarrow \mu^- + p + \pi$
- Deep Inelastic (high Q^2)
  $\nu_\mu + p \rightarrow \mu^- + X$

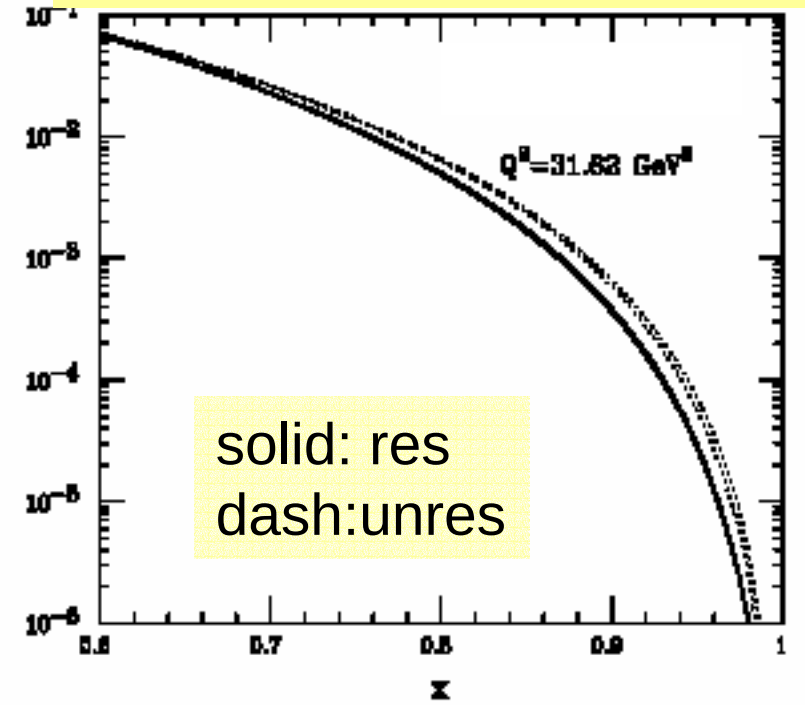
Impact of large-x resummation

G. Corcella

F2(neutrino)



Res NLO Uv (extracted)



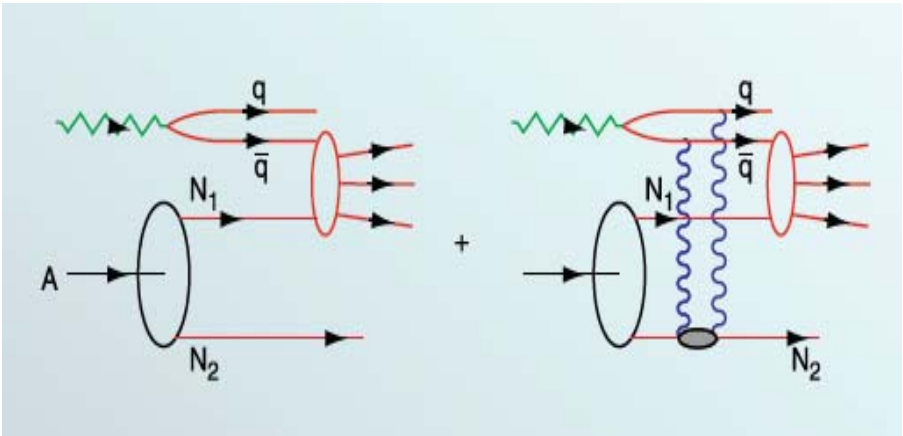
Effect of the resummation on valence quark is big (25% at x=0.8)

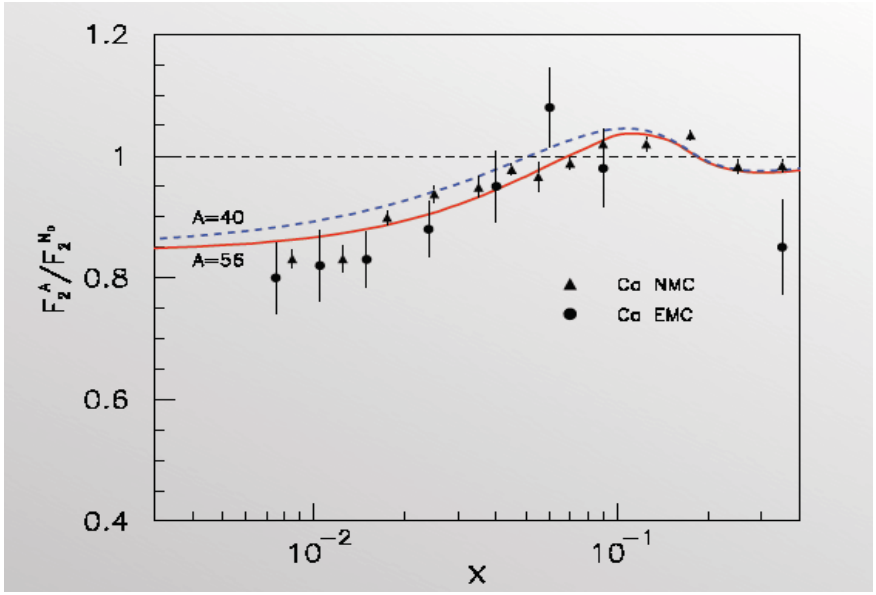
Implementation of the DGALP and application to the Tevatron and LHC physics in progress (can be covered in NNLO?)

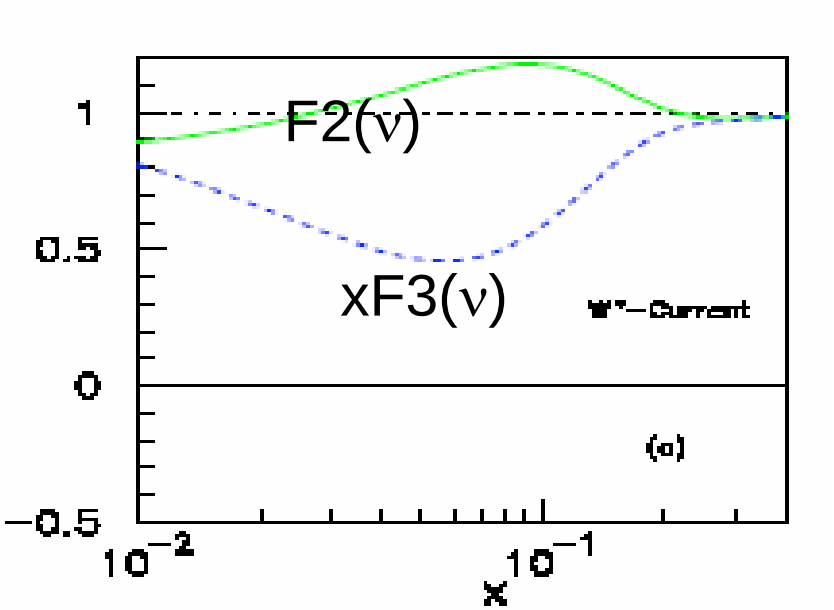
Shadowing/Anti- in neutrino scattering

S. Brodksy

- Shadowing and anti-shadowing: from interference of multi-nucleon process in nucleus
  - Constructive (anti-shadowing)
  - Destructive (shadowing)







➢ Perhaps, NuTeV xF3 data at x=0.1 disfavors 40% shadowing effect,.

PDF uncertainties at Tevatron and impact on various measurements

By F. Chlebana, Hays, and Harel

- How do PDF uncertainties impact on Tevatron measurements?
- What Tevatron measurements can be used to reduce PDF uncertainties?
- What tools are available to estimate uncertainties?

Gluon distribution

→ *Inclusive jet, forward jets*

Strange and anti-strange quarks, strange asymmetry

→ *Tagged final states* $W/Z/\gamma + c/b$

Details in the u, d quark sector, u/d ratio

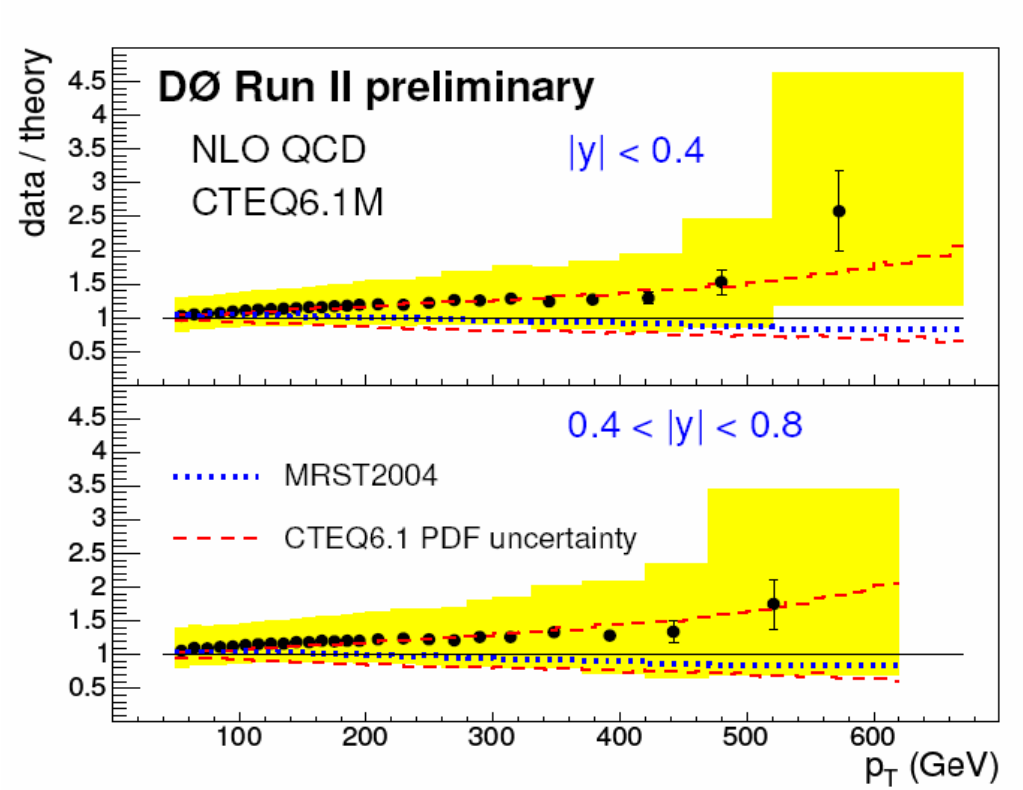
→ *W charge asymmetry*

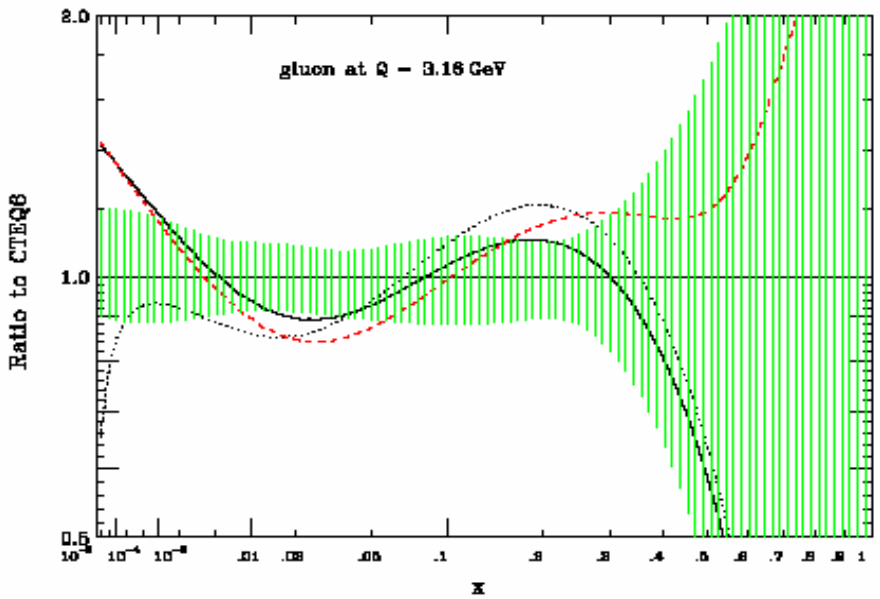
→ *W rapidity distribution*

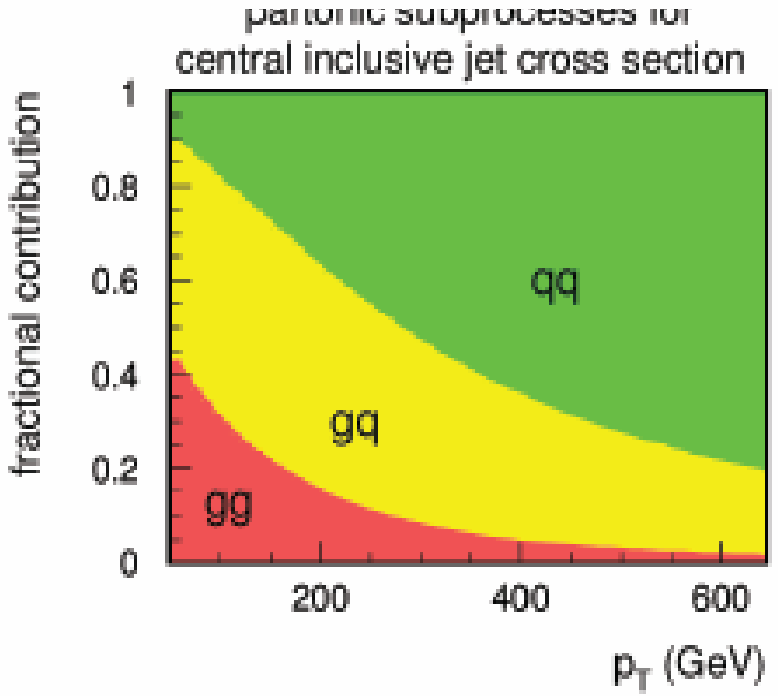
Heavy quark distribution

→ *Tagged final states* $W/Z/\gamma + c/b$

Inclusive Jet Cross Sections







- Exp. error is dominated by the jet energy scale:
- Theory error is dominated by the gluon uncertainty
- We may miss new physics signal if we don't reduce both exp. error and gluon distributions

Conclusions

Looking for new physics based
on precision measurements at low/high Q2
or search for new signals at very high Q2

Coherent collaborative approach
JLAB, Tevatron, HERA, LHC, and theorist
HERA to LHC
TEV to LHC
JLab to LHC

Apology for not able to cover all topics