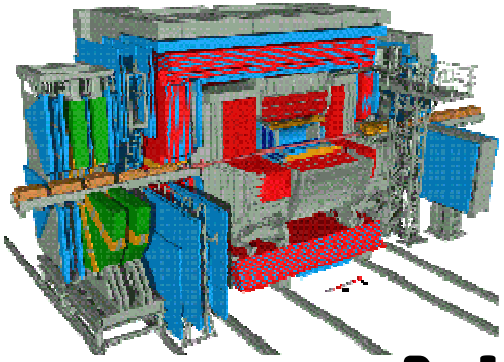


NC $(e^{-}p)$ at high x

HERA-II + new x reconstruction method

DIS2010

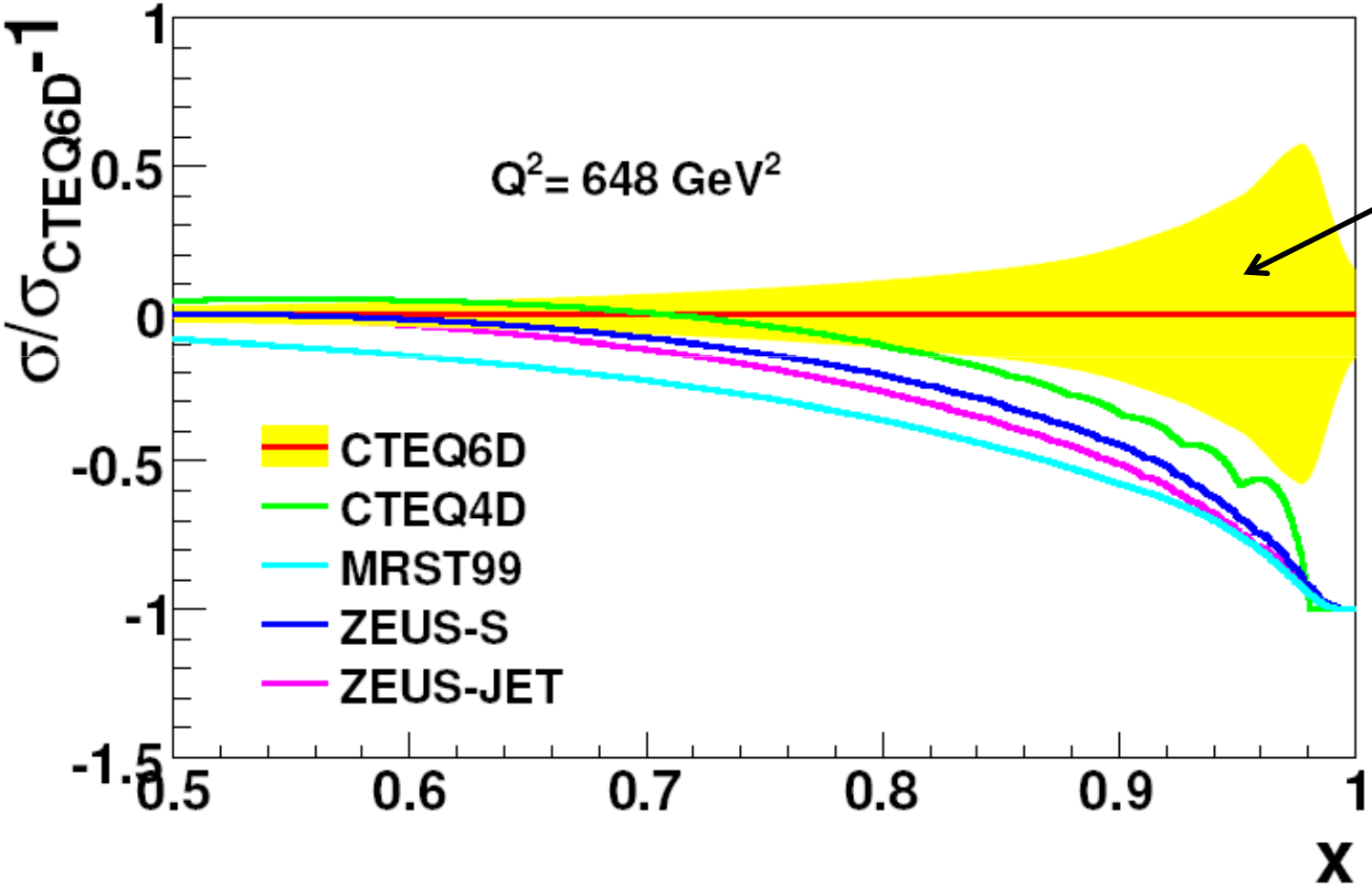
21.04.2010

Ronen Ingbir
Tel Aviv University

On behalf of the **ZEUS** Collaboration

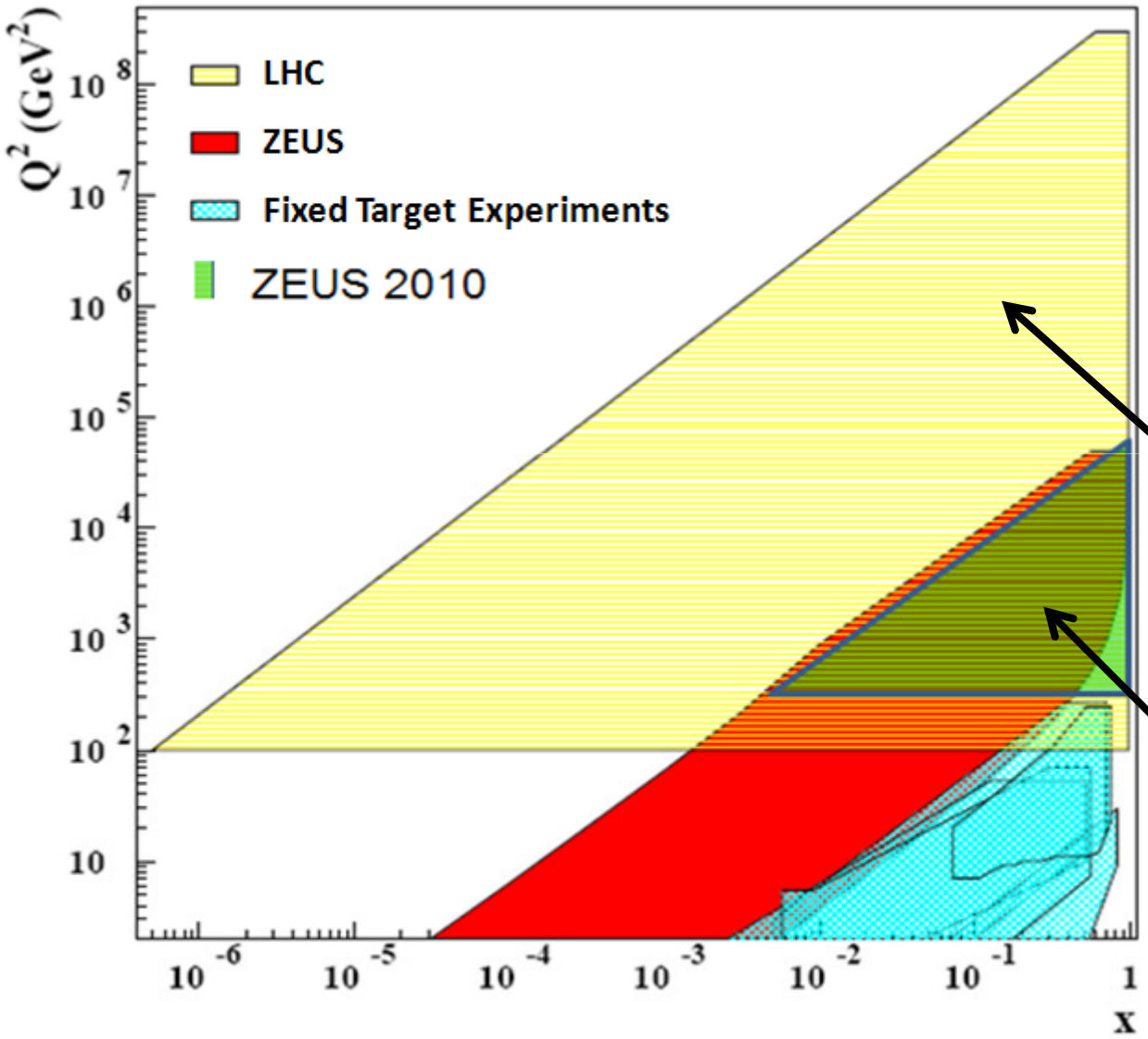
Motivation

PDFs uncertainties



1/σ uncertainty to CTEQ6D

HERA & LHC



Large-x needed for precision measurements at LHC.

DGLAP evolution – sensitive to values of x up to x=1

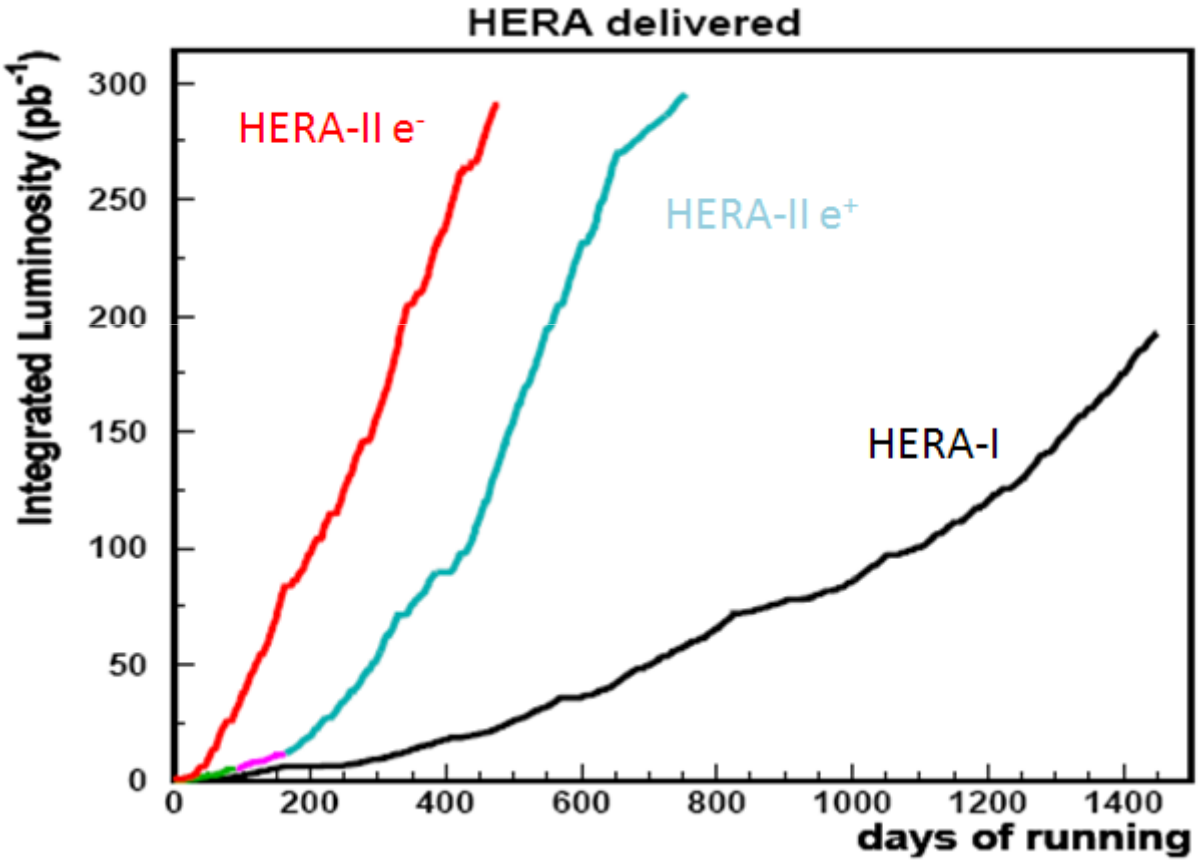
Measurements from HERA up to x=1.

HERA-II Luminosity

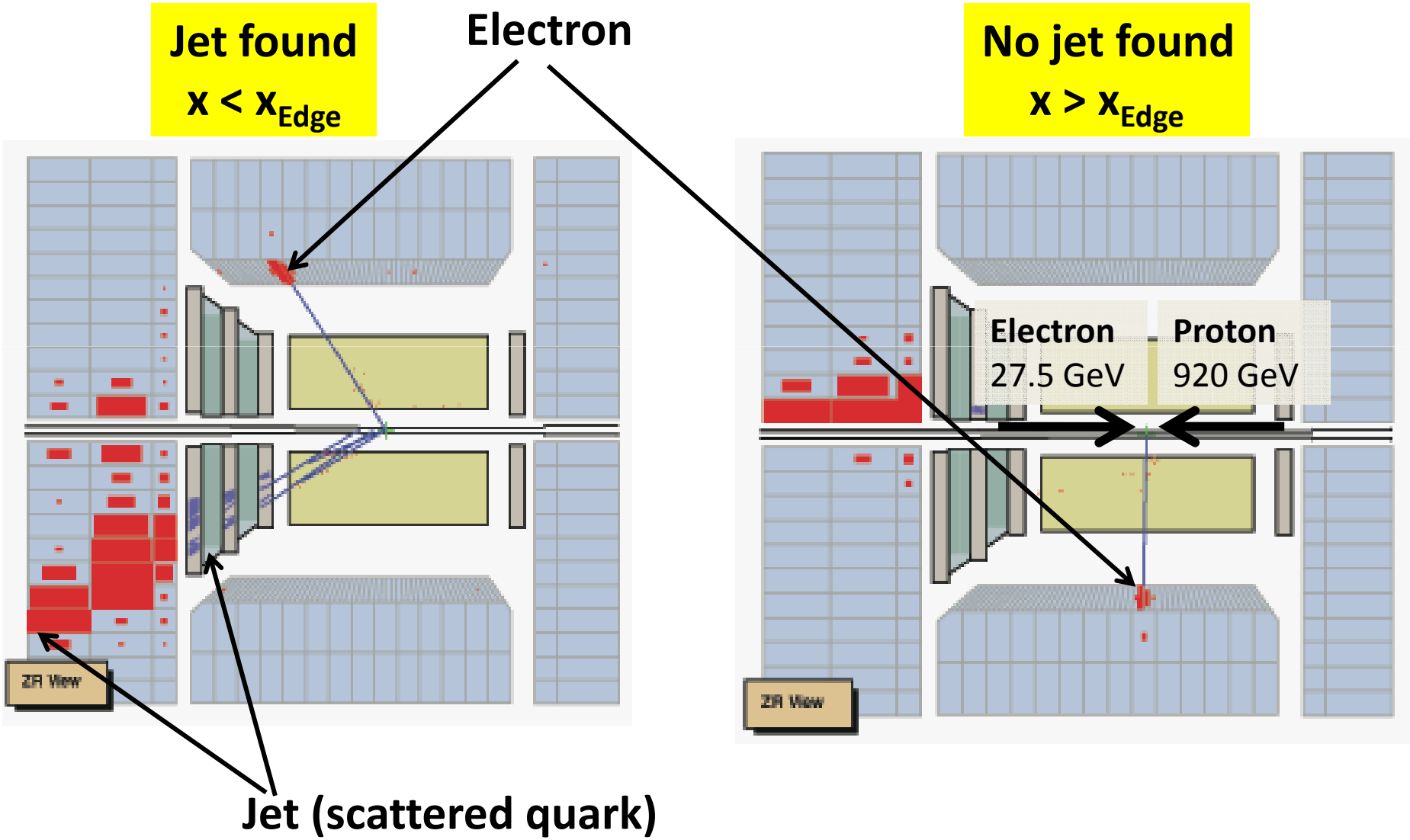
HERA-II luminosity is 3 times bigger than HERA-I

In HERA-II the electron beams are polarized.

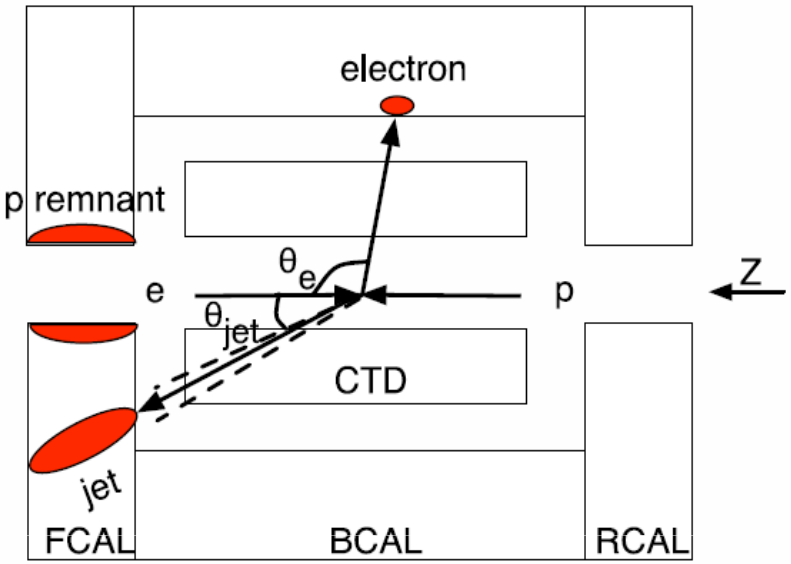
Our sample as both polarization which adds to a non polarized sample



Event topology at HERA at large-x



Q^2 and x reconstruction



$$Q^2 = 2E_e E'_e(1+\cos\theta_e)$$

$$x = \frac{Q^2}{sy}$$

$$Q^2 = \frac{p^2_{T_{\rm jet}}}{1-y}$$

$$y = \frac{(E-P_z)_{\rm jet}}{2E_0}$$

$$\Rightarrow \quad x = \frac{E_{\rm jet}(1+\cos\theta_{\rm jet})}{2E_p\left(1-\frac{E_{\rm jet}(1-\cos\theta_{\rm jet})}{2E_e}\right)}$$

$$p_{Te} = p_{T\,jet}$$

$$\Rightarrow \quad x = \frac{(p_{t_e}/sin\theta_{jet})(1+cos\theta_{jet})}{2E_p(1-\frac{(p_{t_e}/sin\theta_{jet})(1-cos\theta_{jet})}{2E_e})}$$

Reconstruction of x

Best resolution achieved

multi jets events

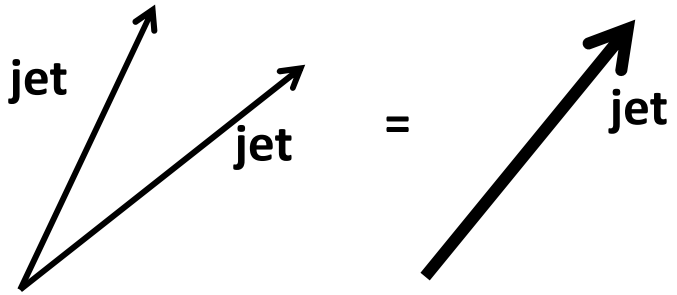
$$x = \frac{p_{t_{jets}}^2}{s\, y_{jb}(1 - y_{jb})}$$

$$p_{t_{jets}}^2 = \left(\sum_i p_{x_{jet}}\right)^2 + \left(\sum_i p_{y_{jet}}\right)^2$$

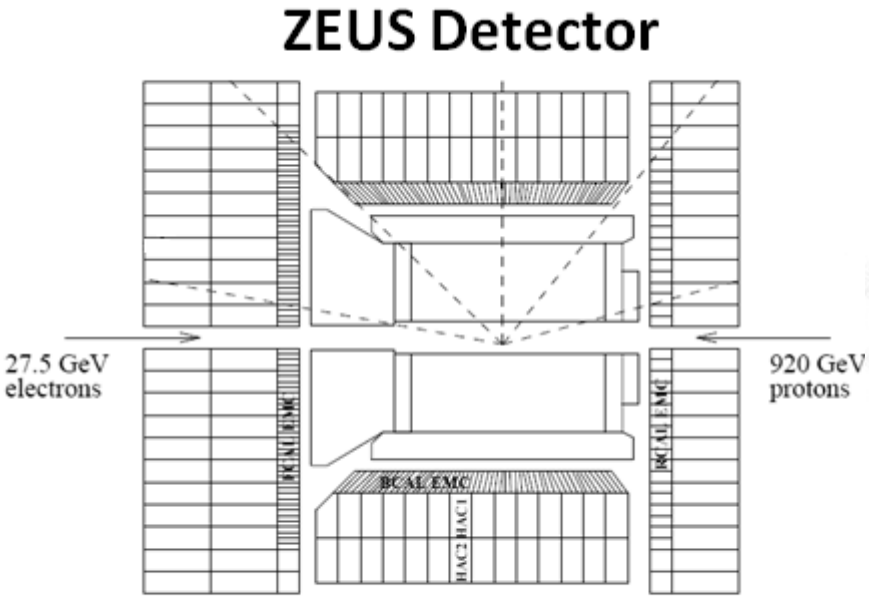
$$y_{jb} = \frac{\sum_i [E_{jet_i}(1 - cos\theta_{jet_i})]}{2E_e}$$

One jet events

$$x = \frac{(p_{t_e}/sin\theta_{jet})(1 + cos\theta_{jet})}{2E_p(1 - \frac{(p_{t_e}/sin\theta_{jet})(1 - cos\theta_{jet})}{2E_e})}$$

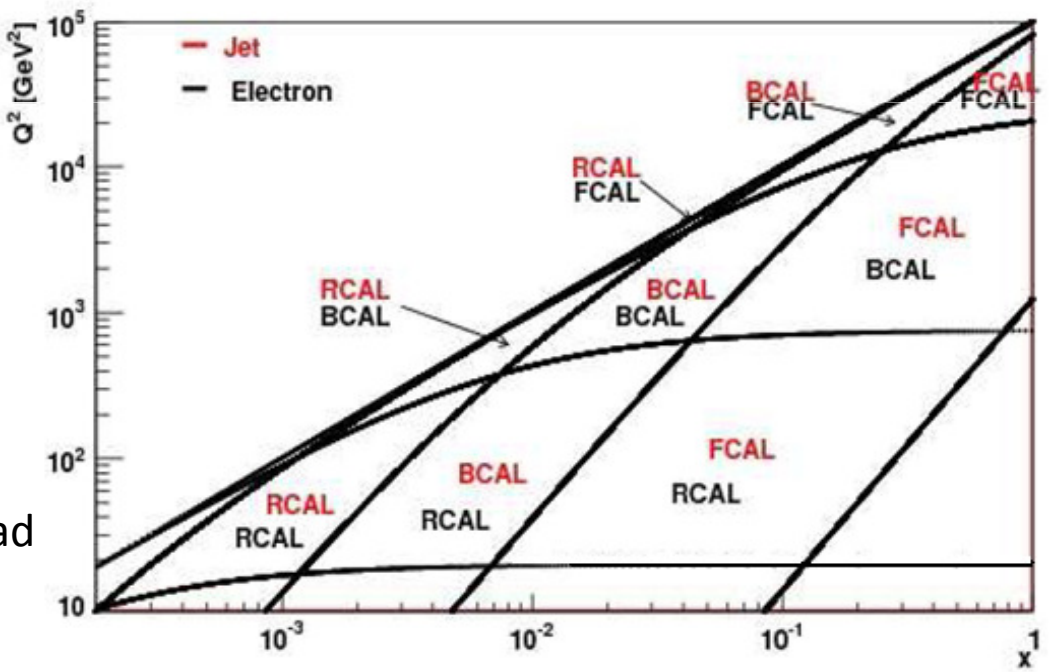


ZEUS detector projected onto x and Q^2 plane



Important to understand FCAL and BCAL Had and EM energy scales

At high x and high Q^2 events the jets and electron can be found in the BCAL and FCAL



Calibration scheme

BCAL Electron Calibration

Measured Energy is compared to expected energy (DA method)

electron energy scale better than 1%

The BCAL electron calibration is the Key to whole detector calibration

BCAL + FCAL Jet Energy Scale

Jet Energy Scale relies on electron energy in BCAL

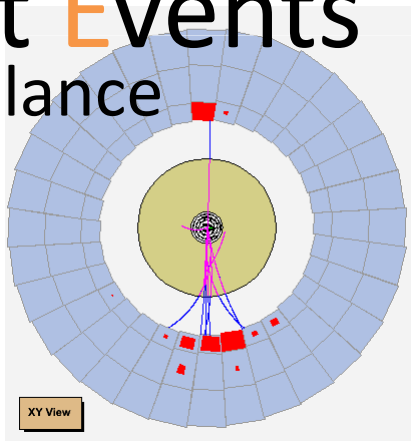
Jet energy scale better than 2%

FCAL Electron Energy Scale

FCAL electron scale relies on jet energy scale

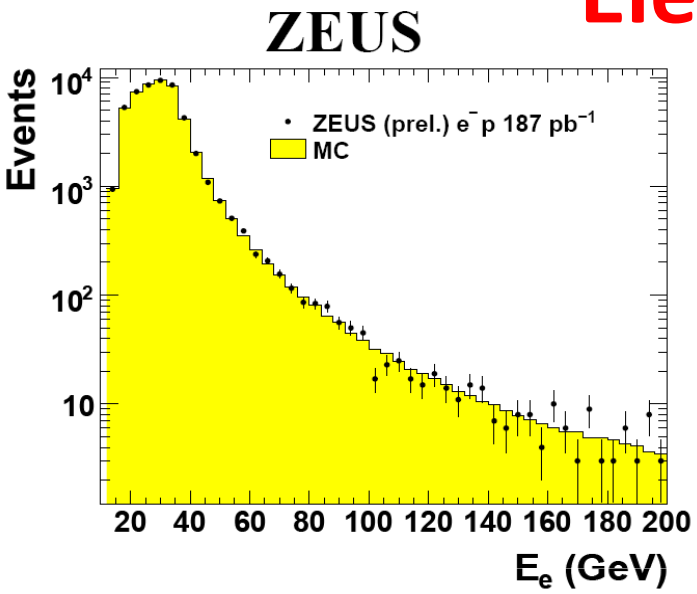
One Jet Events

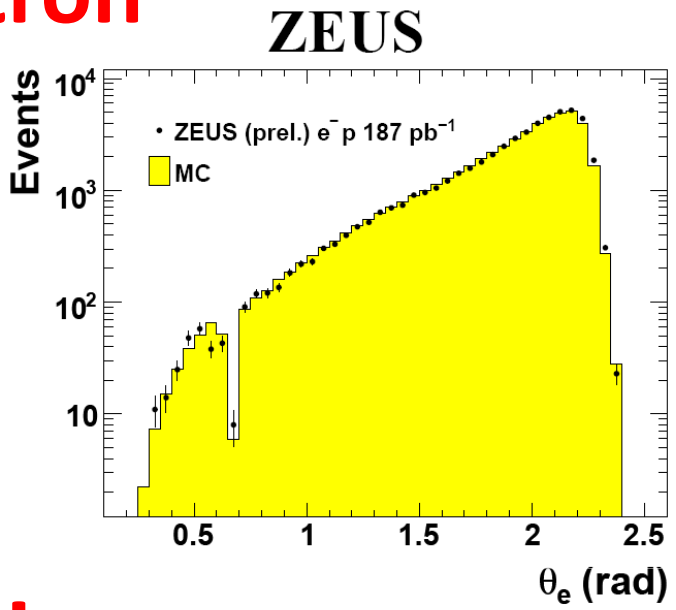
P_T balance



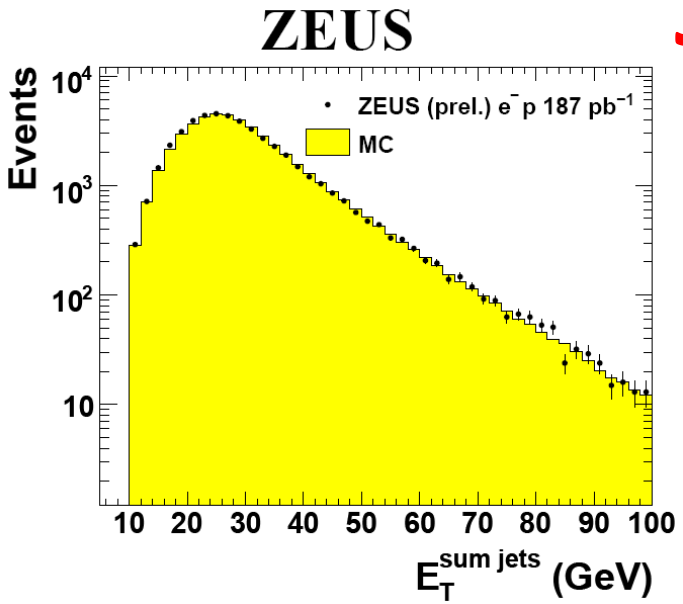
DATA and MC comparison

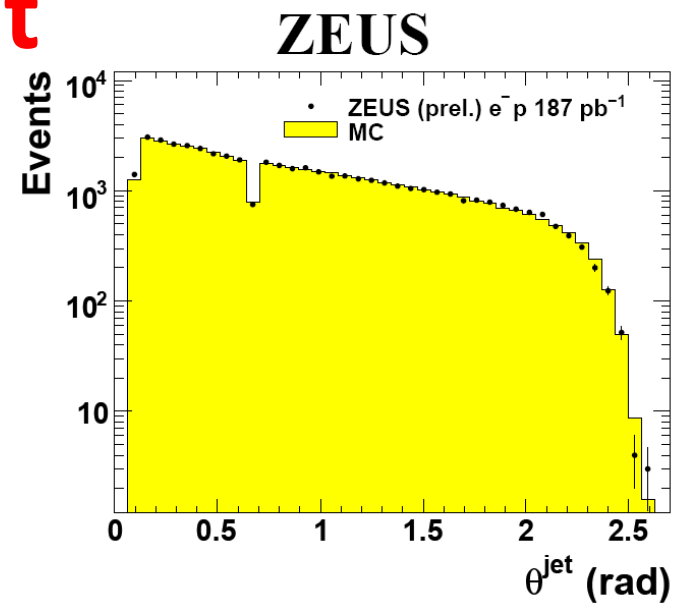
Electron



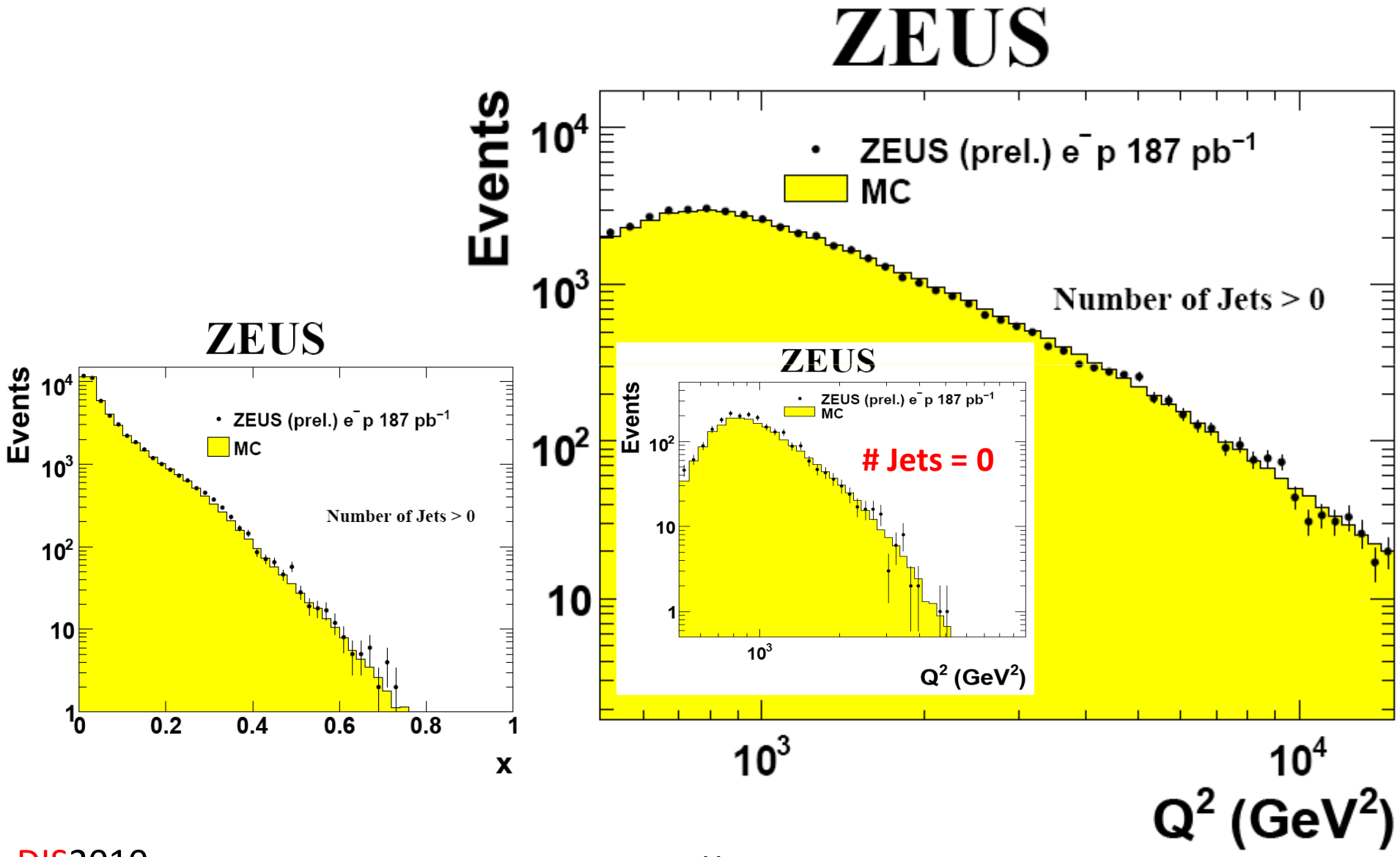


Jet

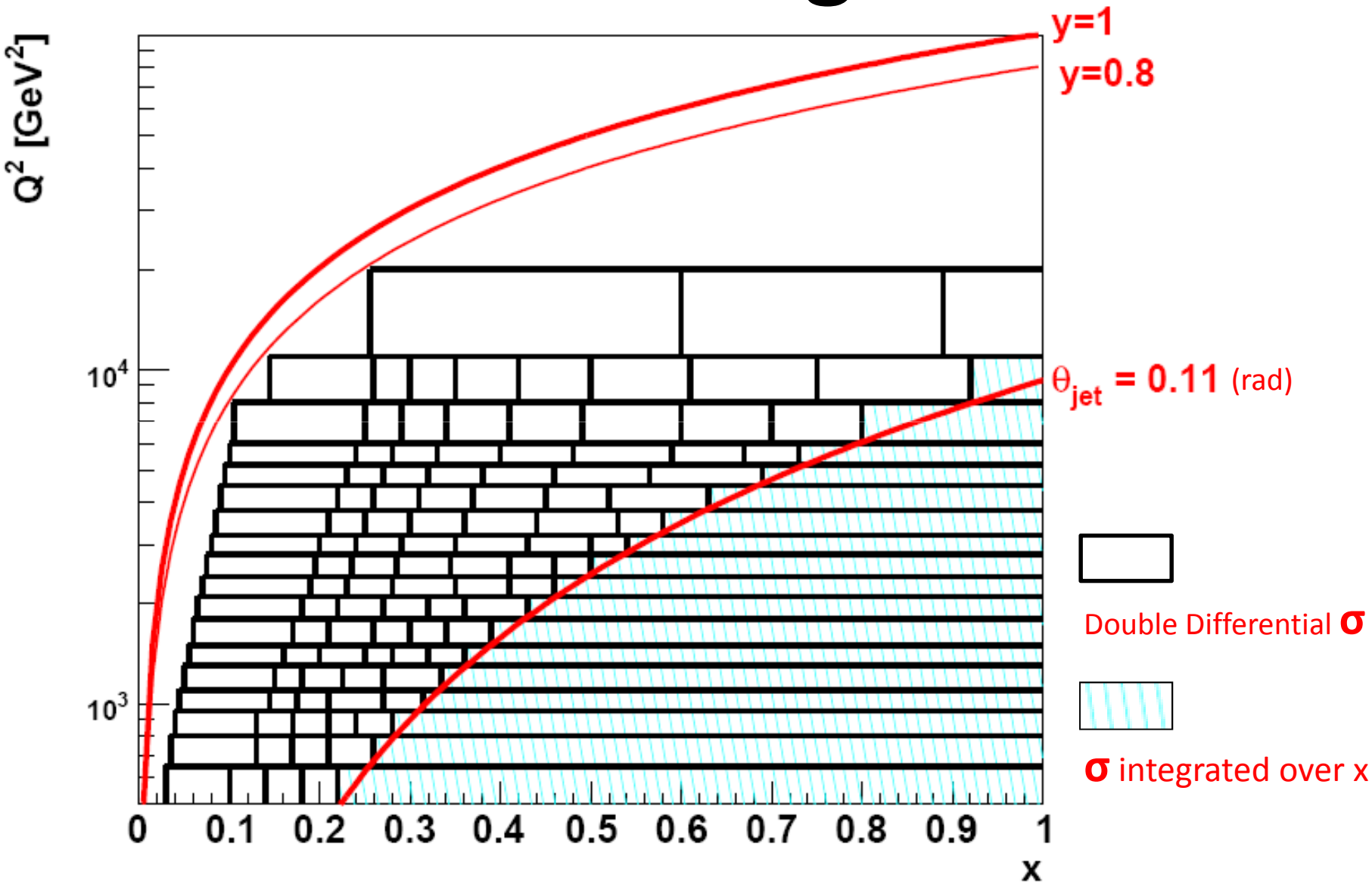




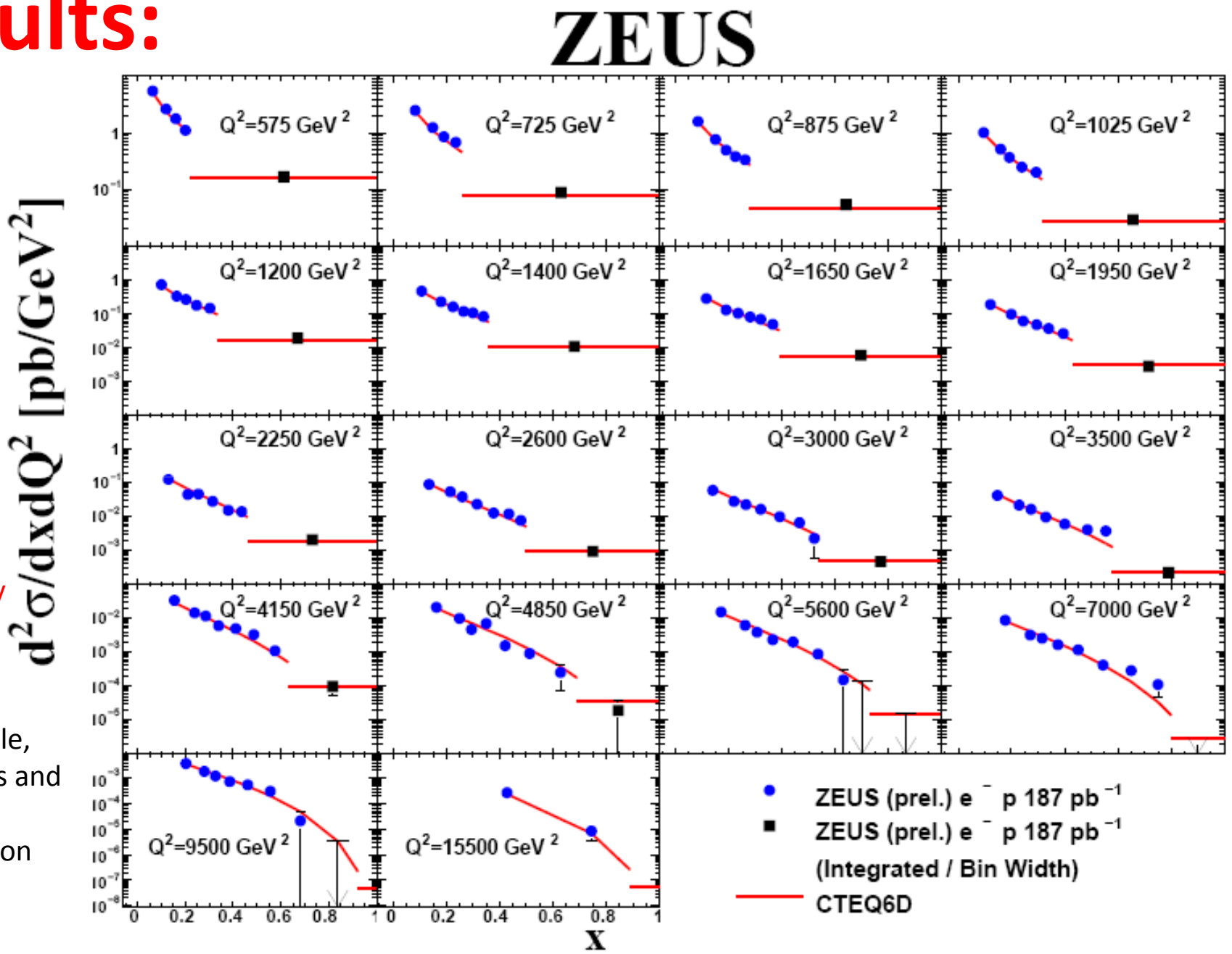
DATA and MC comparison



Binning

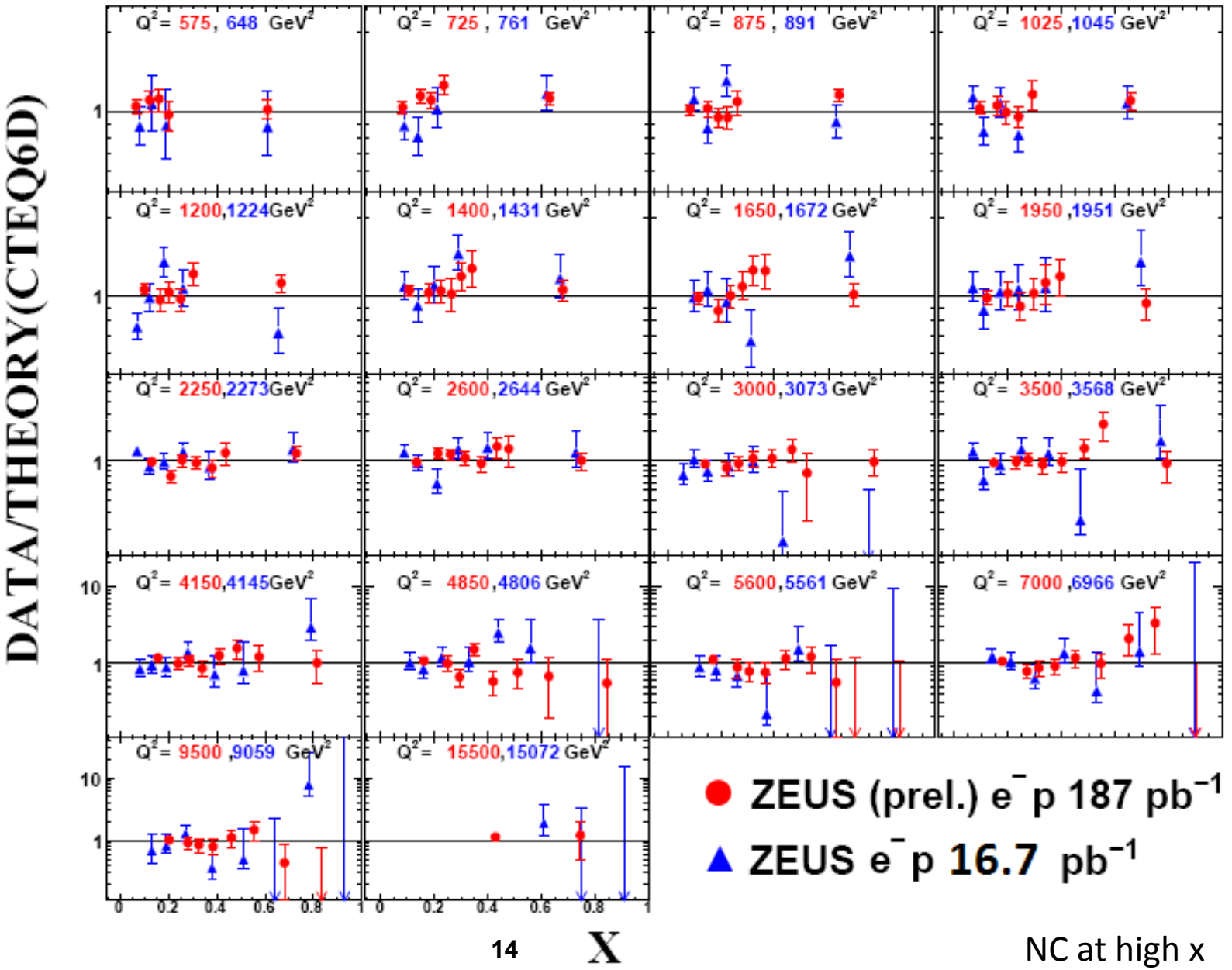

y=1
y=0.8
Q^2 [GeV^2]
10^4
10^3
θ_{jet} = 0.11 (rad)
Double Differential σ
σ integrated over x
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
x

Results:



Uncertainty includes systematic effects (energy scale, fiducial cuts and overall 4% normalization error)

Comparison:


ZEUS
DATA/THEORY(CTEQ6D)
X
Q^2= 575, 648 GeV^2
Q^2= 725, 761 GeV^2
Q^2= 875, 891 GeV^2
Q^2= 1025,1045 GeV^2
Q^2= 1200,1224GeV^2
Q^2= 1400,1431 GeV^2
Q^2= 1650,1672 GeV^2
Q^2= 1950,1951 GeV^2
Q^2= 2250,2273GeV^2
Q^2= 2600,2644 GeV^2
Q^2= 3000,3073 GeV^2
Q^2= 3500,3568 GeV^2
Q^2= 4150,4145GeV^2
Q^2= 4850,4806 GeV^2
Q^2= 5600,5561 GeV^2
Q^2= 7000,6966 GeV^2
Q^2= 9500,9059 GeV^2
Q^2= 15500,15072 GeV^2
ZEUS (prel.) e$^-$p 187 pb^{-1}
ZEUS e$^-$p 16.7 pb^{-1}

Summary

New in this analysis:

1. HERA-II statistics (187 pb^{-1}), previous study (16.7 pb^{-1})
2. Multi jet events (previous 0 + 1 jets)
3. New x-reconstruction method – leading to better resolution
4. Better understanding of the detector calibration

Results:

1. Higher x.
2. More x bins.
3. Smaller error.

Expected outcome:

Reduce PDFs uncertainty at high x.