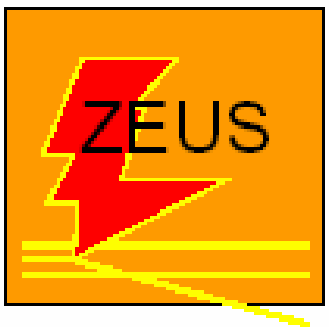
Neutral and Charged Currents at High Q^2 in Collisions of Longitudinally Polarized Positrons with Protons at HERA II



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On behalf of the ZEUS Collaboration

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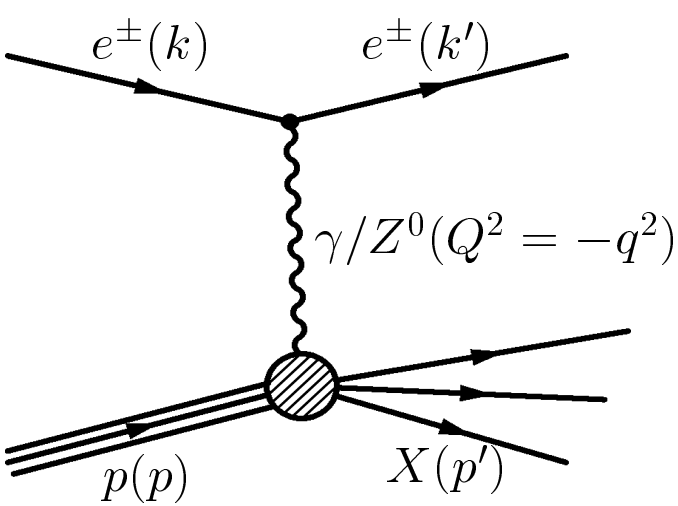
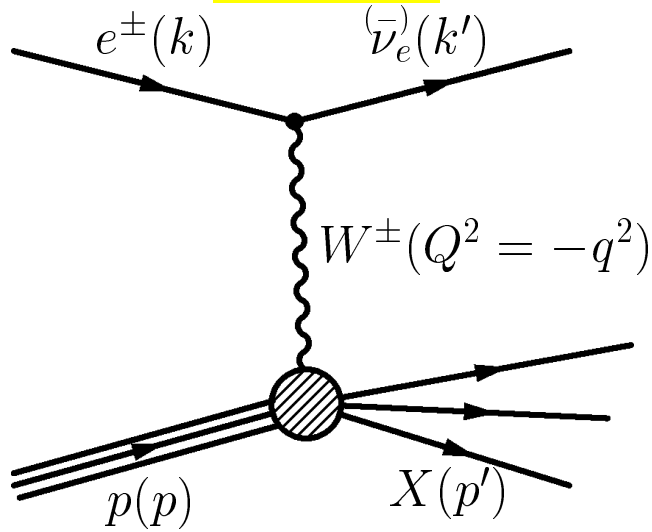
Contents

Deep Inelastic Scattering in HERA ~NC & CC

NC



CC



Polarized lepton(HERA II) in SM

Neutral Current :

-- Z^0 couples differently to the left and right handed lepton.

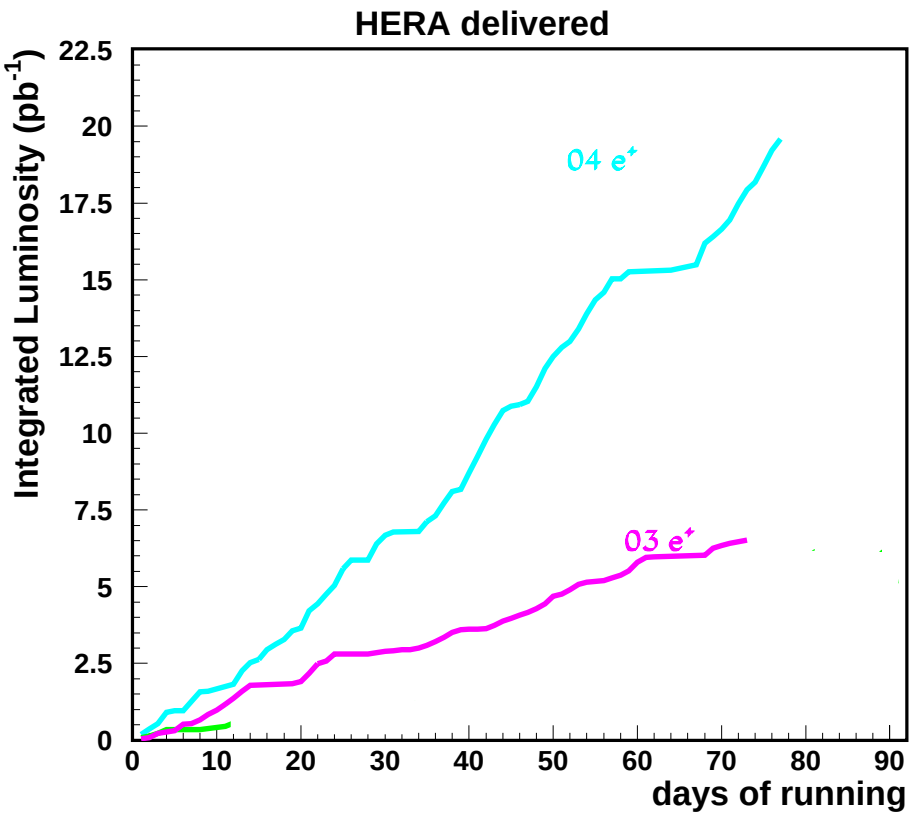
-- Effect of polarization in high Q^2 only.

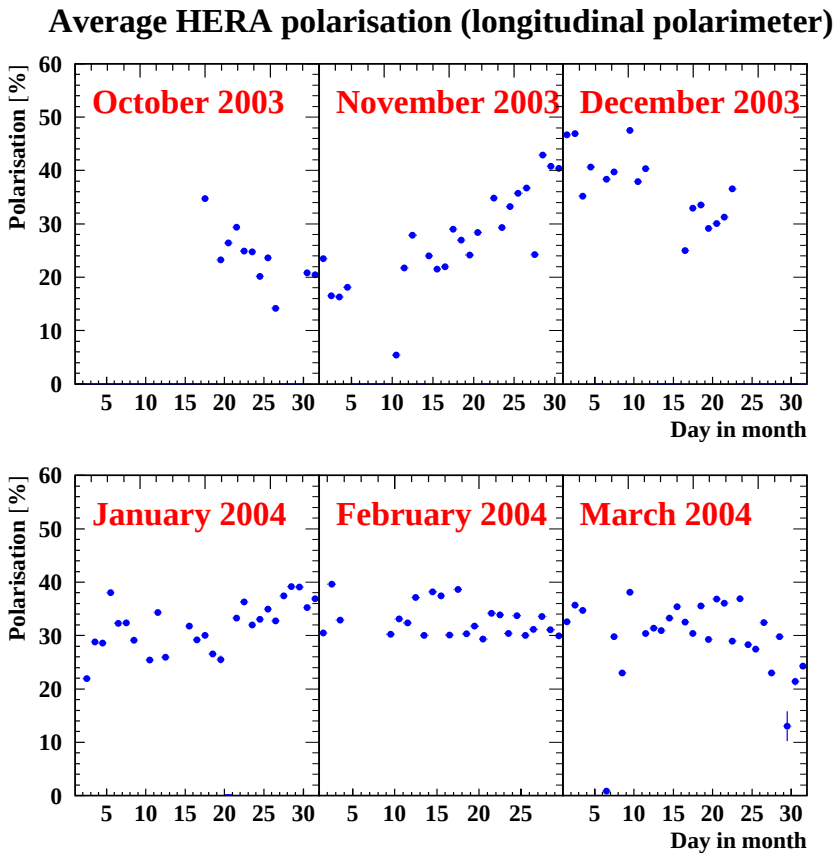
Charged Current :

-- W couples only to the left handed lepton.

-- Effect of polarization largely in all Q^2 region.

Luminosity and polarization in HERA II

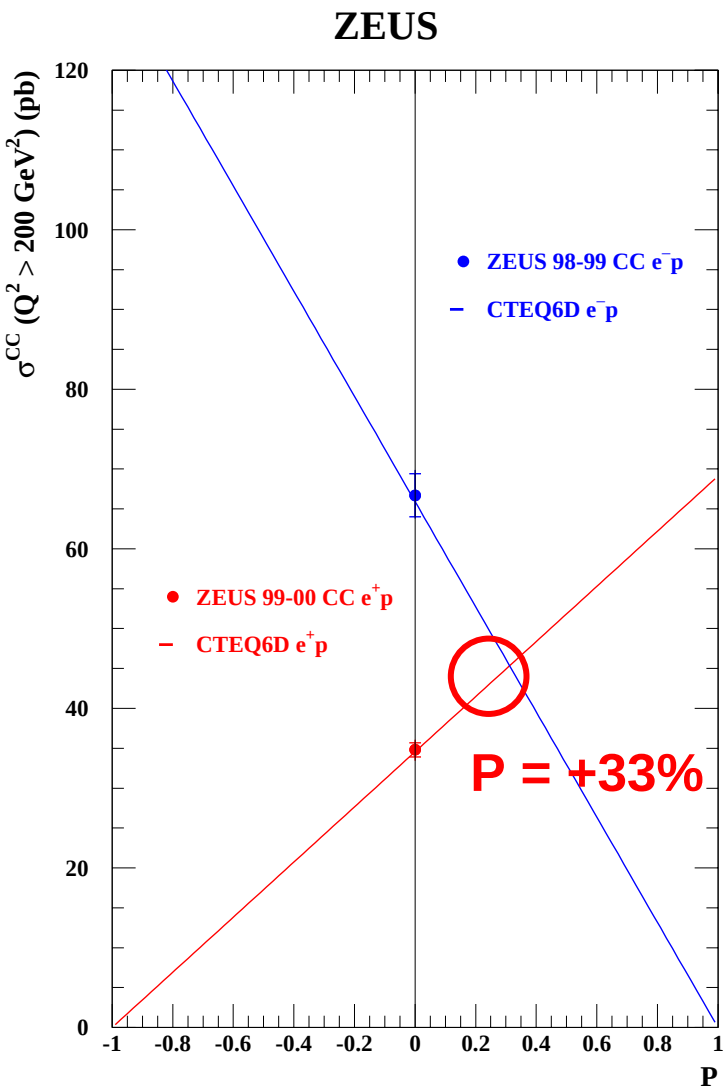




03-04 polarized data : 6.6 pb $^{-1}$

Polarization : 33%+-2.0%

CC cross section expectation in SM



In the Standard Model,

* electron: $\sigma_{CC}(p=P) = (1-P)\,\sigma_{CC}(p=0)$
* positron: $\sigma_{CC}(p=P) = (1+P)\,\sigma_{CC}(p=0)$

-- **Unpolarized lepton (HERA I)**

CC cross section (e^+, e^-) were measured

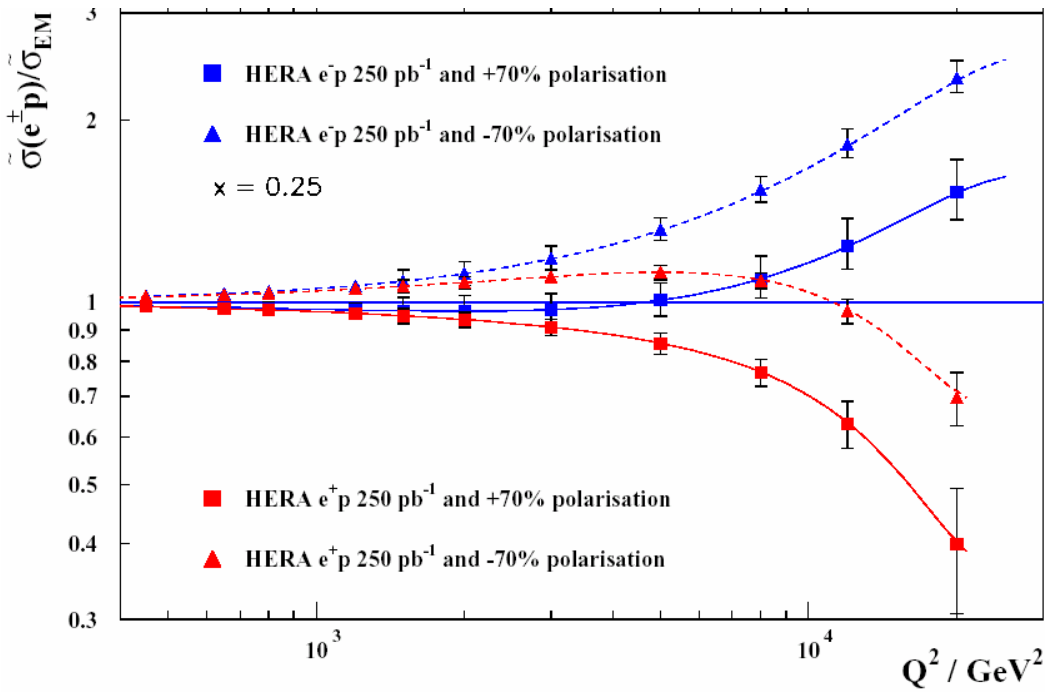
-- **Polarized lepton (HERA II)**

→ test the Standard Model

-- **Cross section were measured @ P = 33%**

NC cross section expectation in SM

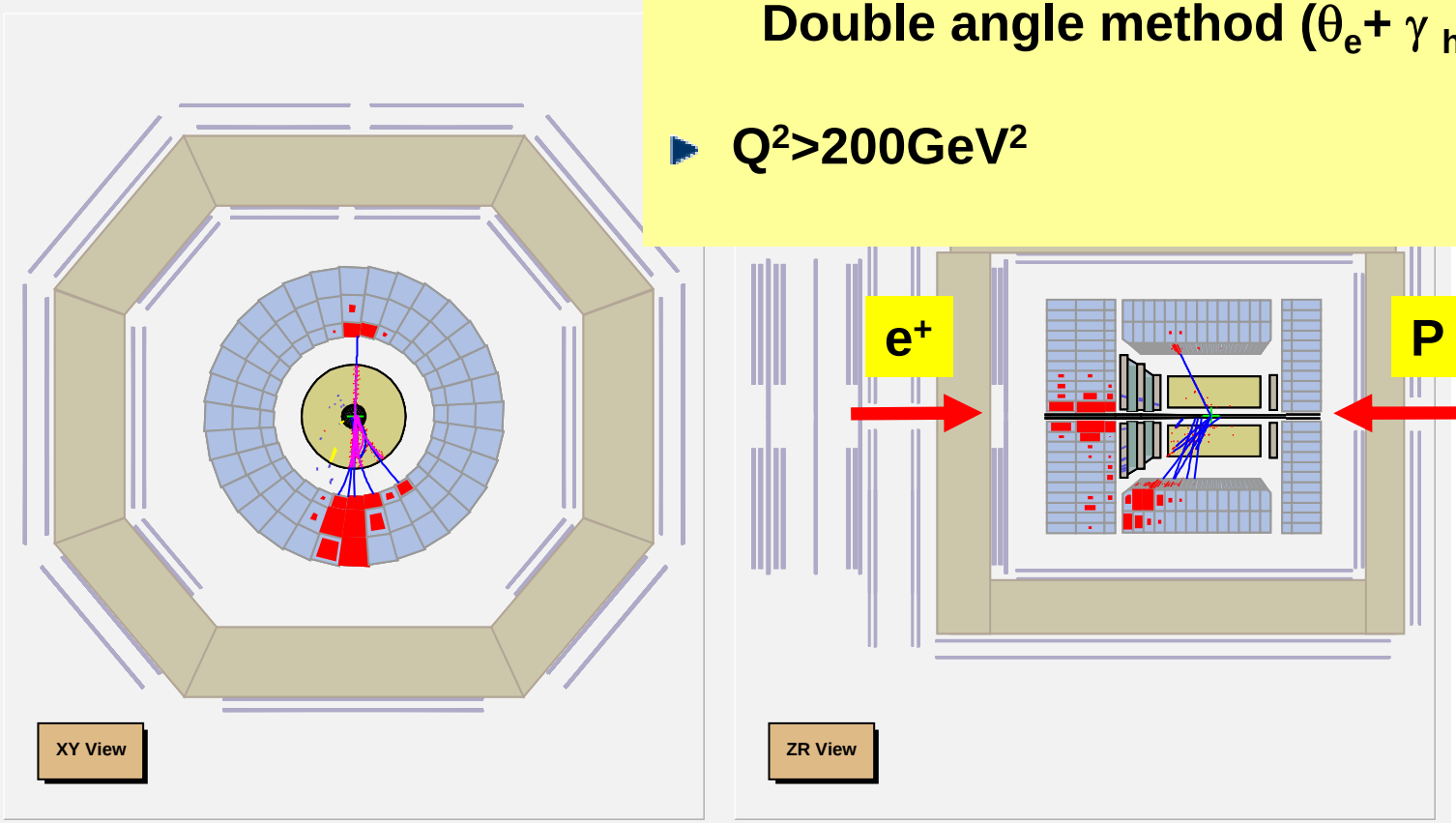
Simulation at Lumi.=250pb^{-1},P=+-70%



- **NC cross section in high Q^2 changed by polarization in SM largely.**
- **need large luminosity to see polarization effect.**
- **With about 7pb-1, do not see effect of polarization yet.**
- **NC events are important to check detector response.**

Neutral Current event selection

- **Positron finding**
  - **-- Positron energy (Ee >10 GeV)**
  - **-- CAL-track matching**
- **Reconstruction method:**
  Double angle method (θ_e+ γ_h)
- **Q^2>200GeV^2**



Neutral Current events

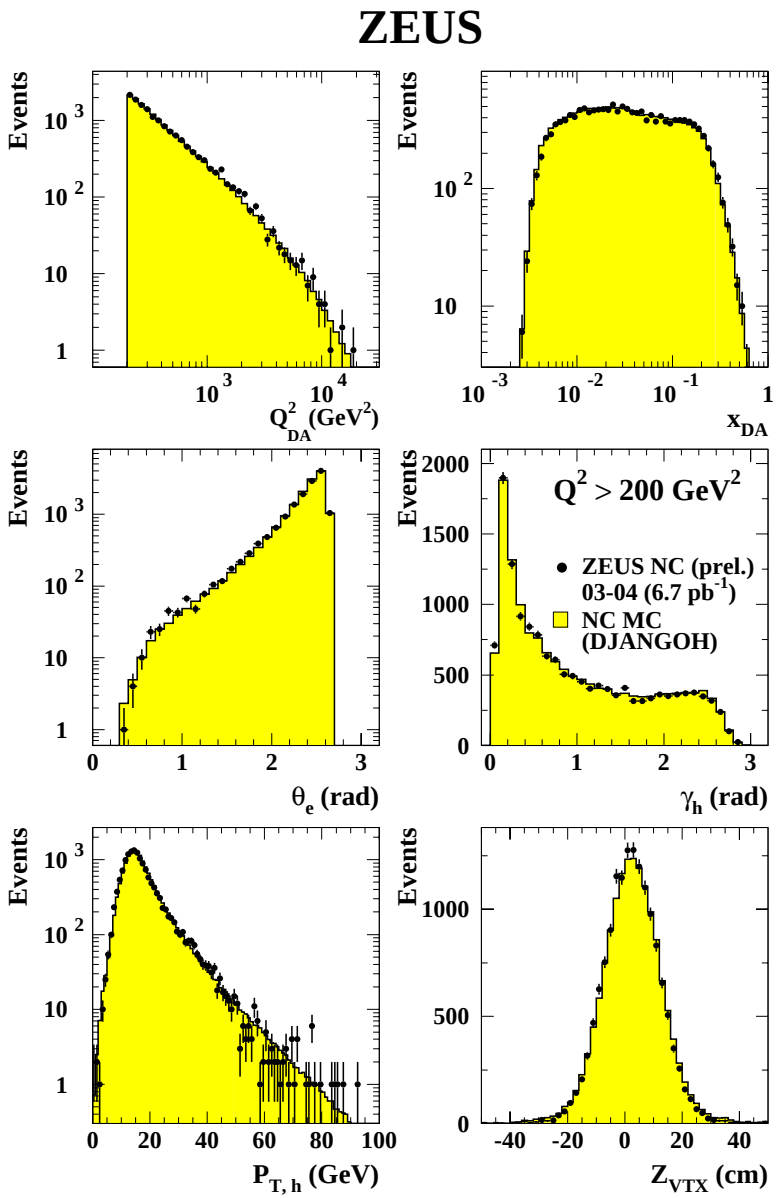
-- Observed about 15000 events in $Q^2>200\ GeV^2$

(Lumi. = 6.7pb-1).

-- DATA has good agreement to MC (luminosity normalized).

-- Reconstruction of the hadron system is fine ($P_{T,h}$,γ_h distribution).

→ let's see CC event



Kinematic Variables of Charger Current

Missing transverse momentum due to escaping neutrino

$\not{P}_T$

The Jaquet Blondel method

(Hadron system only)

$$y_{JB} = \frac{E - P_Z}{2E_e}$$

$$Q^2_{JB} = \frac{\not{P}_T^2}{1 - y_{JB}}$$

$$\gamma = \text{acos}\left(\frac{\not{P}_T^2 - (E - P_Z)^2}{\not{P}_T^2 + (E - P_Z)^2} \right)$$

$$\not{P}_T = \sqrt{\left(\sum_i P^i_{x,h} \right)^2 + \left(\sum_i P^i_{y,h} \right)^2}$$

CC event selection

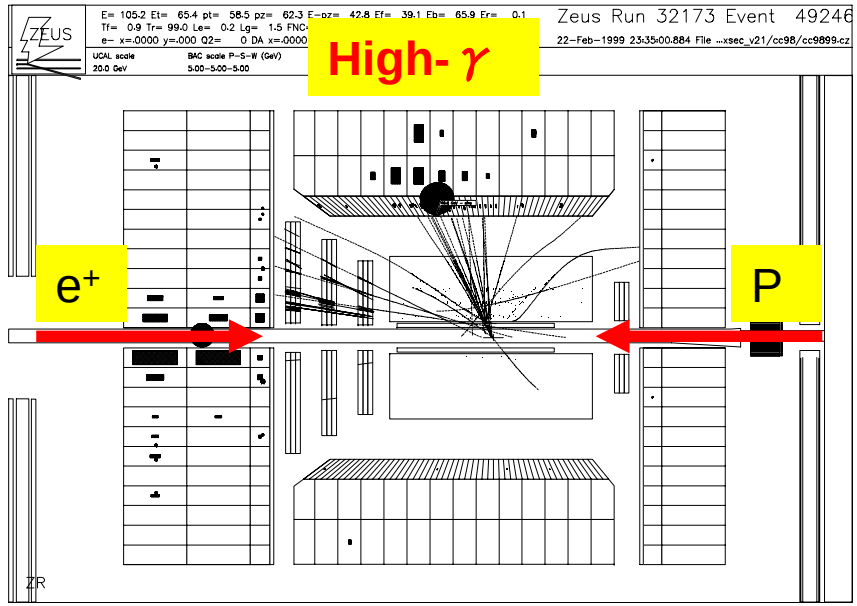
γ :scattering angle of the struck quark

High-γ (γ > 23 deg.)

- Struck quark in central region

→ Use tracking information

- $\not{P}_T$ > 12GeV + tracking cuts against beam-gas.



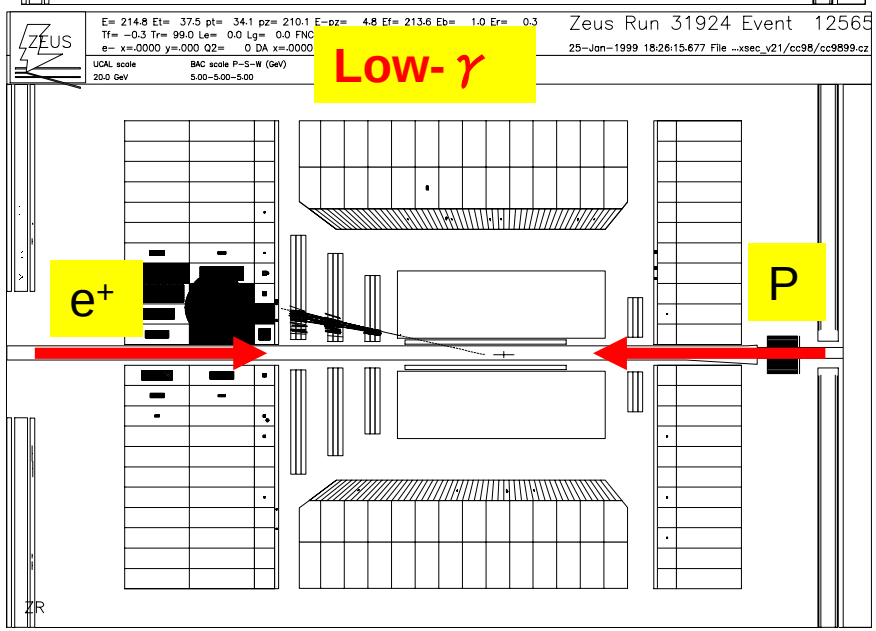
Low-γ (γ < 23 deg.)

- Struck quark in forward (high-x)

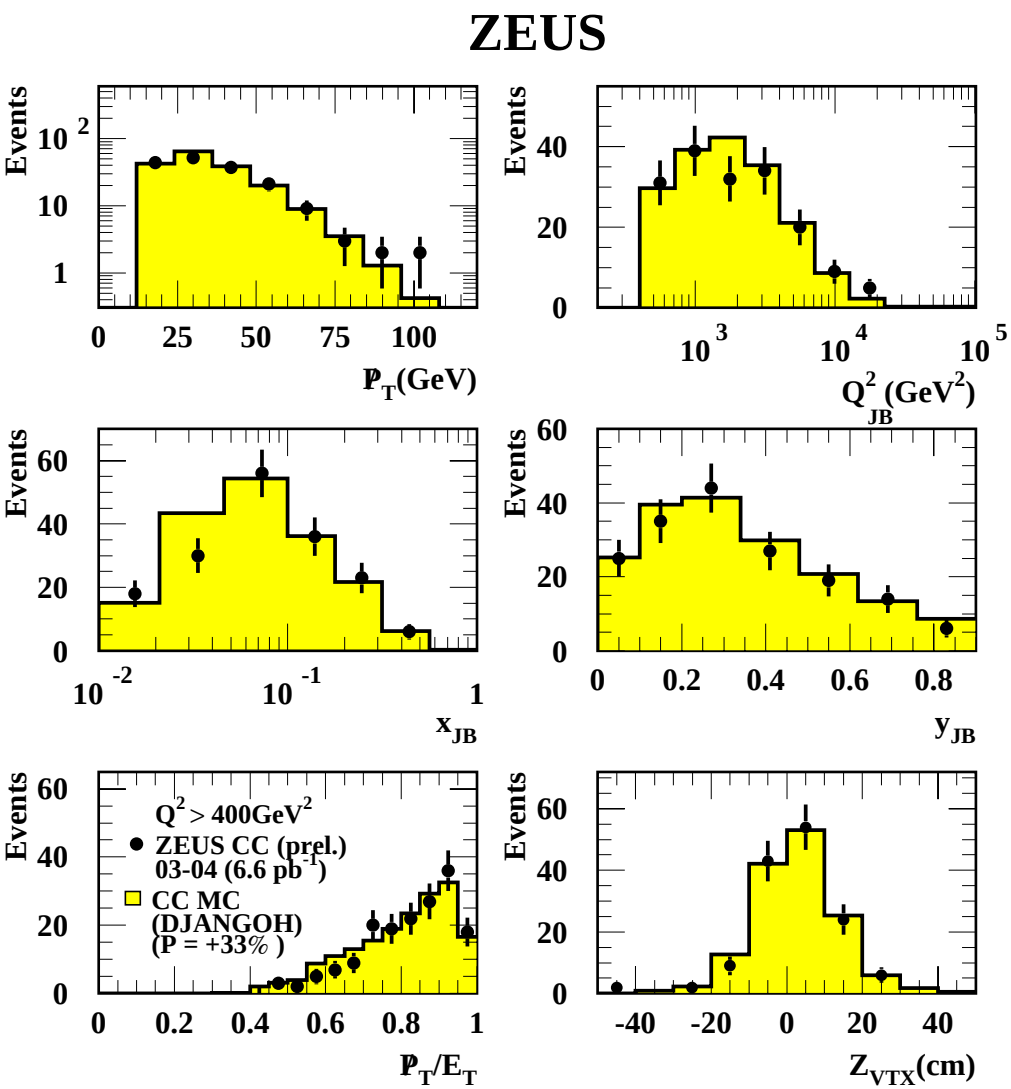
→ do not use tracking cut

Tighter $\not{P}_T$ cut ($\not{P}_T$ > 14GeV) +

Halo-mu rejection based on shower shape in CAL.



Charged Current variables



Data :

Lumi = 6.6 pb^{-1} , P = 33%

Kinematic region :

-- Q^2_{JB}>400GeV^2

-- y_{JB} < 0.9

CC MC @ P= 33% reproduced Data well.

Charged Current cross section

$$\sigma^{CC}_{Born}(pol.=P) = \frac{N_{DATA}}{N_{MC}} \cdot \sigma^{CC}_{SM}(pol.=0)$$

- N_{DATA} : Number of CC events measured
- N_{MC} : Number of CC events expected at $pol.=0$
- $\sigma^{CC}_{Born}(pol.=0)$: SM CC cross section at $pol.$=0

Systematic checks :

-- CAL energy scale

-- CC selection threshold

-- PDF uncertainty

-- Trigger uncertainty

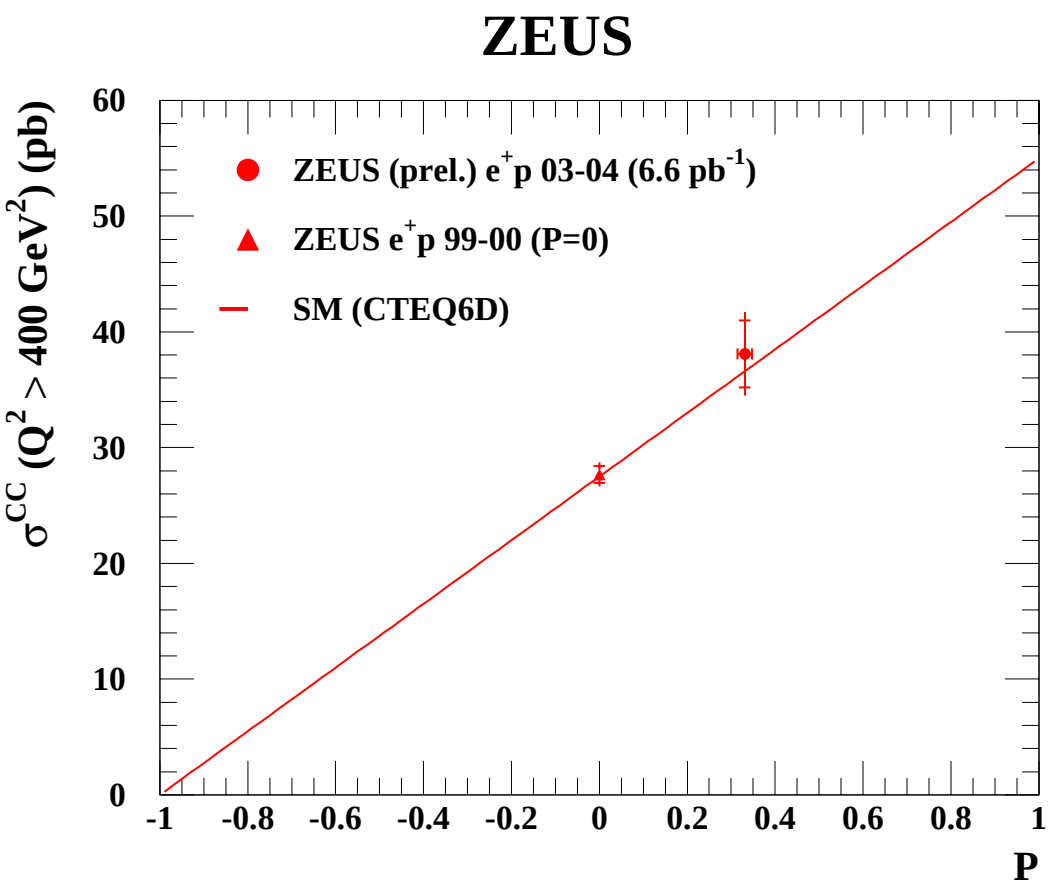
Total ~2%

Lumi.=6.6pb^{-1}, pol.=33%, $Q^2 > 400 GeV^2$,

$$\sigma^{Q^2>400GeV^2}_{CC} = 38.1 \pm 2.9(stat.) \pm 0.8(sys.) \pm 2.0(lumi.) \pm 0.8(pol)\, pb$$

CC cross section vs. polarization 1

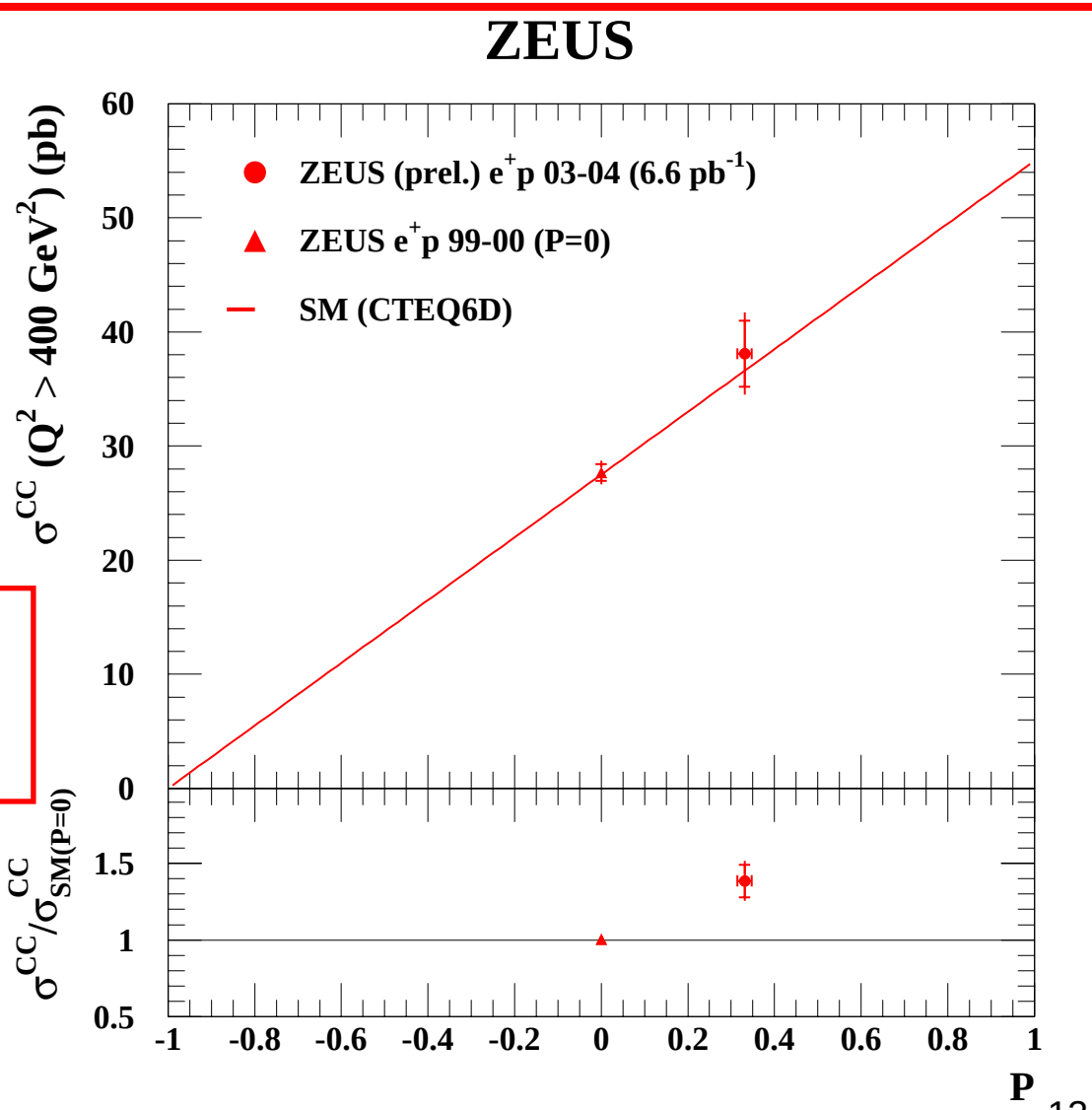
2.8σ above the HERA I results with unpolarized lepton (99-00 data)



CC cross section vs. polarization 2

Consistent with SM

(pol.=33%)



Summary

- **First measurement of CC cross section with polarized positron and proton scattering was presented.**
- **The cross section at P=33% was**

$$\sigma_{cc}^{Q^2>400GeV^2} = 38.1 \pm 2.9(stat.) \pm 0.8(sys.) \pm 2.0(lumi.) \pm 0.8(pol)\ pb$$

Consistent with the SM prediction