H1 High y DIS Cross-section Measurement

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on behalf of the H1 Collaboration

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Outline

- Motivation
- Analysis strategy
- Principle of the measurement
- Results
- Summary

Motivation

$$\frac{d^2\sigma}{dxdQ^2} = \frac{2\pi\alpha^2 Y_+}{Q^4 x}\sigma_r \qquad Y_+ = 1+(1-y)^2$$

$$\sigma_r = F_2(x,Q^2) - \frac{y^2}{Y_+}F_L(x,Q^2) \qquad 0 \le F_L \le F_2$$

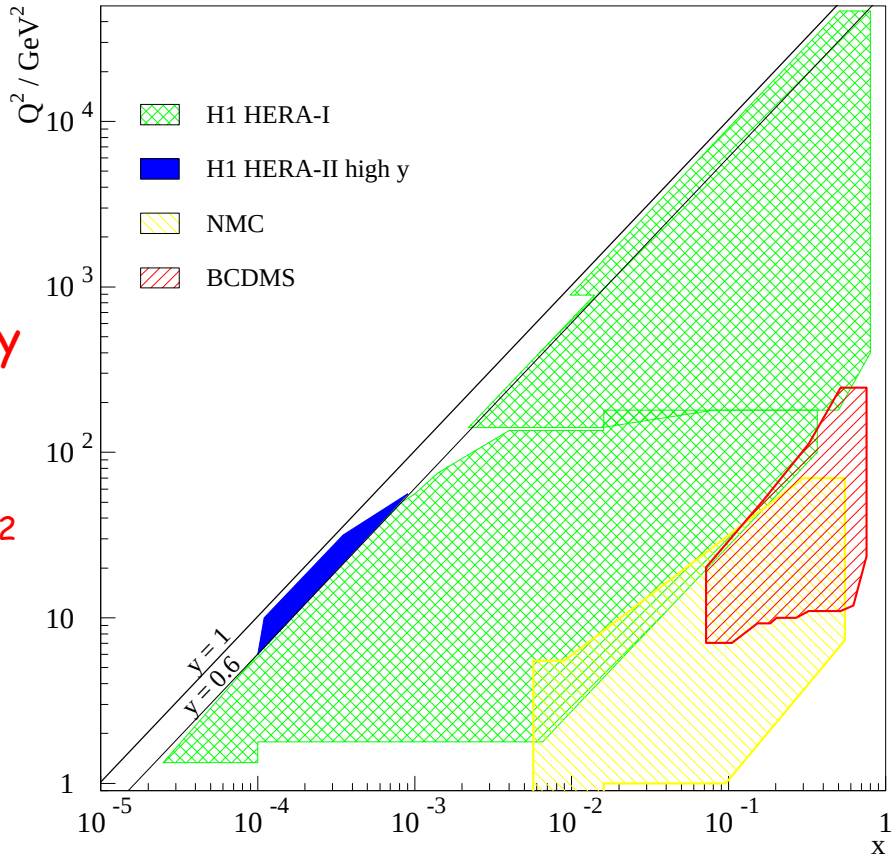
F_L gives sizable contribution only at high y

$$y = 1 - \frac{E_e'}{E_e}\sin^2(\theta_e/2) \qquad x = Q^2/sy$$

- This analysis: high y, low and medium Q^2
  → as low as possible low E'_e required

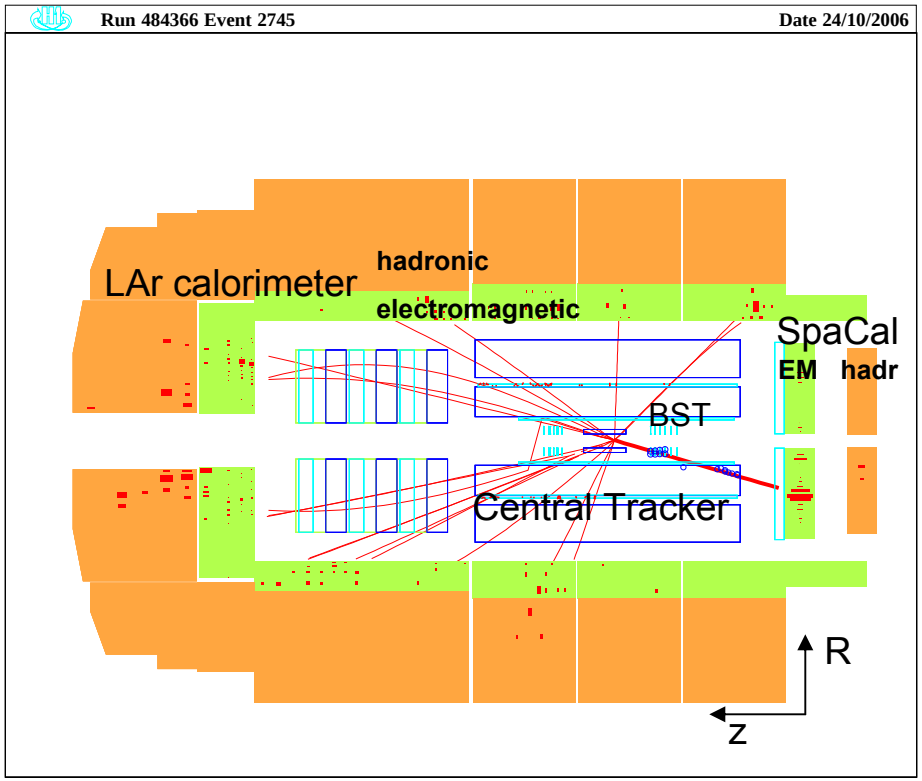
- From **pQCD:** $xg(x) \sim F_L$ (at low x)

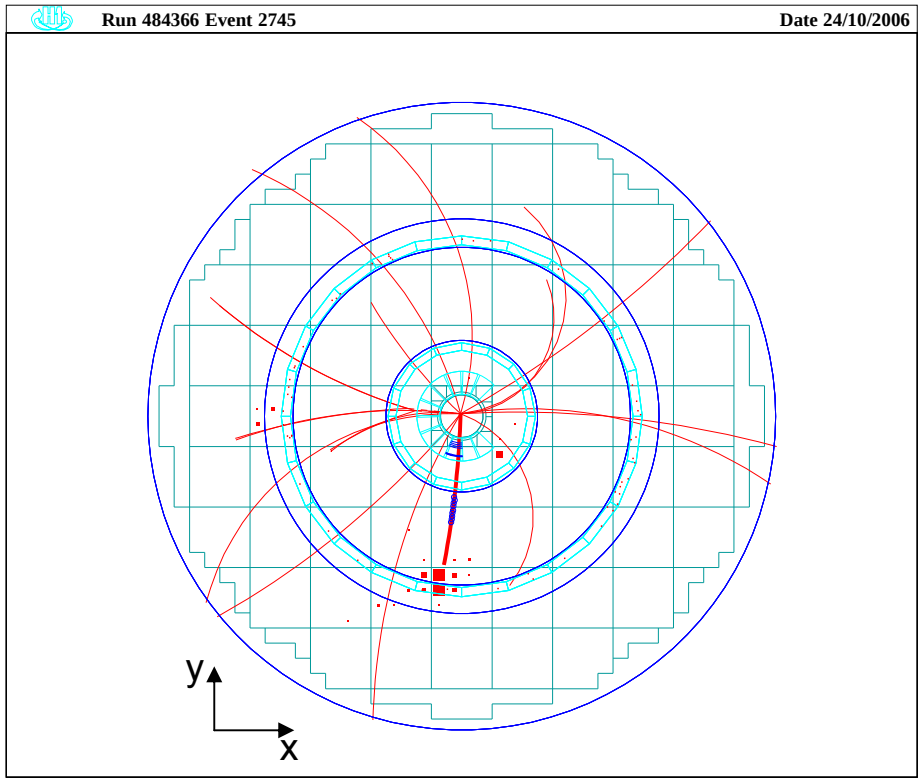
  xg(x) – gluon density function



- Experimental challenges of this analysis are similar to the ones for analysis of low energy run.

Analysis strategy





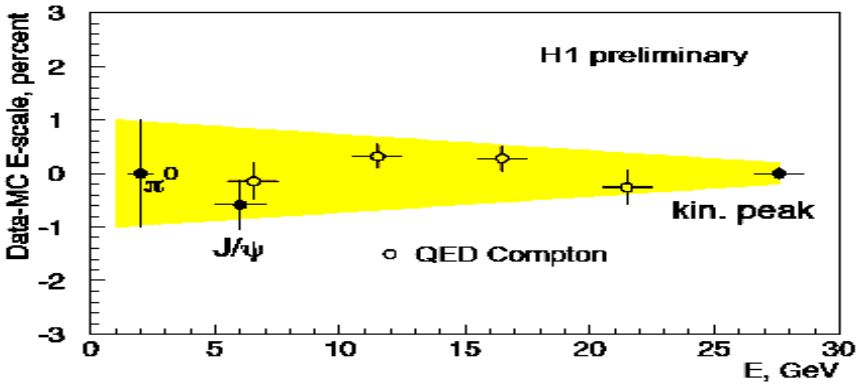
- Scattered lepton is identified by a cluster from SpaCal linked to a track in the Central Tracker which is used to identify its charge.

Luminosities used in the analysis: e^+p interactions – 51 pb^{-1}, e^-p interactions – 45 pb^{-1}.

The main issues to understand in the analysis of events with low energy cluster (E'_e > 3.4 GeV):

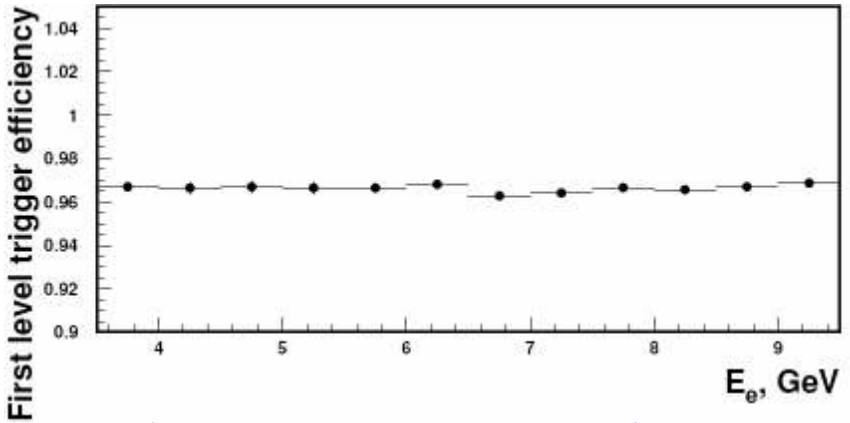
- Calorimeter linearity
- Trigger efficiency
- Background subtraction
- Radiative corrections

Electron energy scale control



→ Uncertainty for the energy reconstruction is 1% at 3 GeV

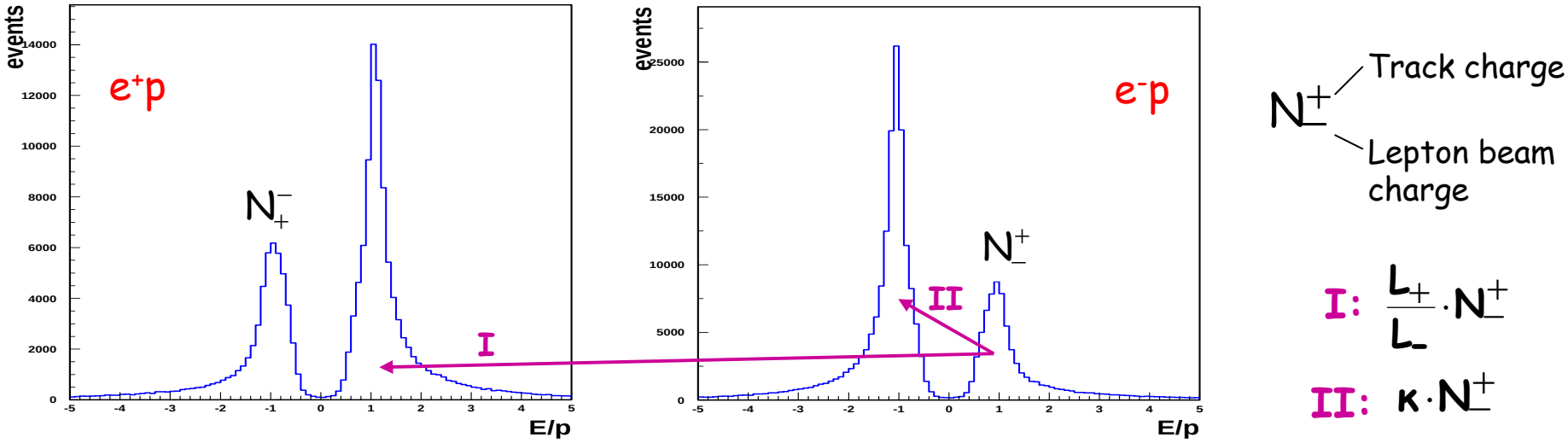
First level trigger efficiency



→ Flat in energy in SpaCal

Background determination

- At high y there is a large photoproduction background in which hadronic final state can mimic the signature of the scattered lepton with low energy.
- Background is measured using data events with the charge opposite to the lepton beam charge.



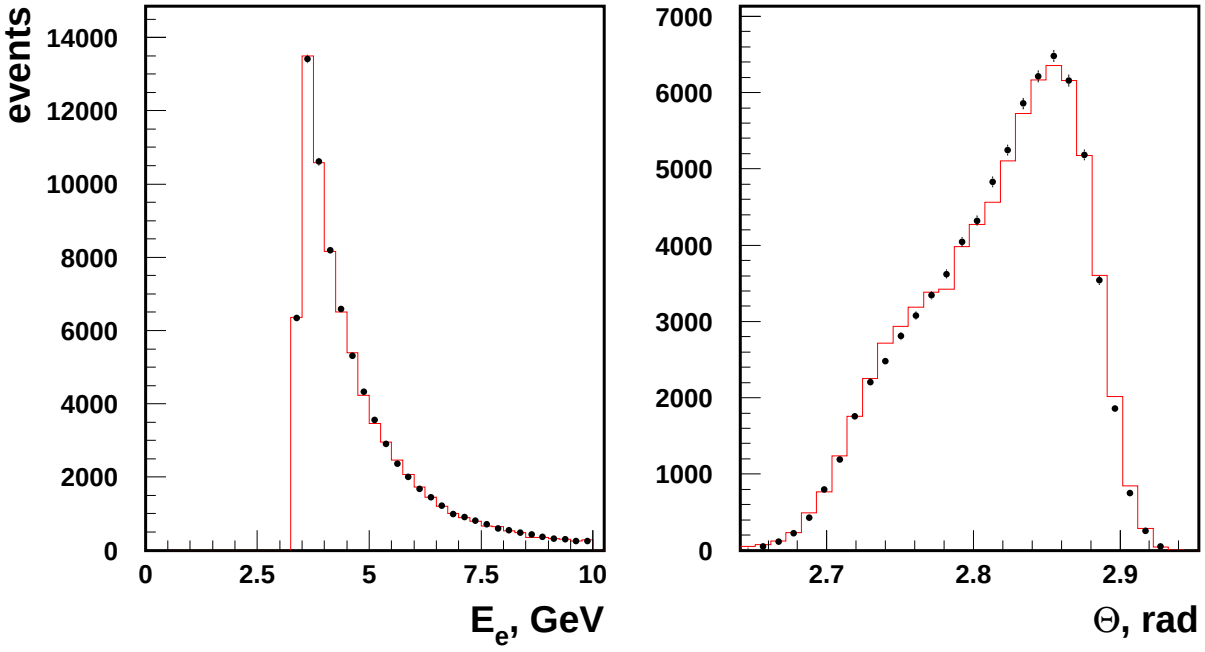
Two ways to subtract background

- **Variant I** – use data collected with opposite beam charge correcting for luminosity difference.
- **Variant II** – use data collected with the same beam charge correcting for background charge asymmetry (κ).

Charge asymmetry factor

$$\kappa = \frac{N_+^-}{N_-^+} \cdot \frac{L_-}{L_+}$$

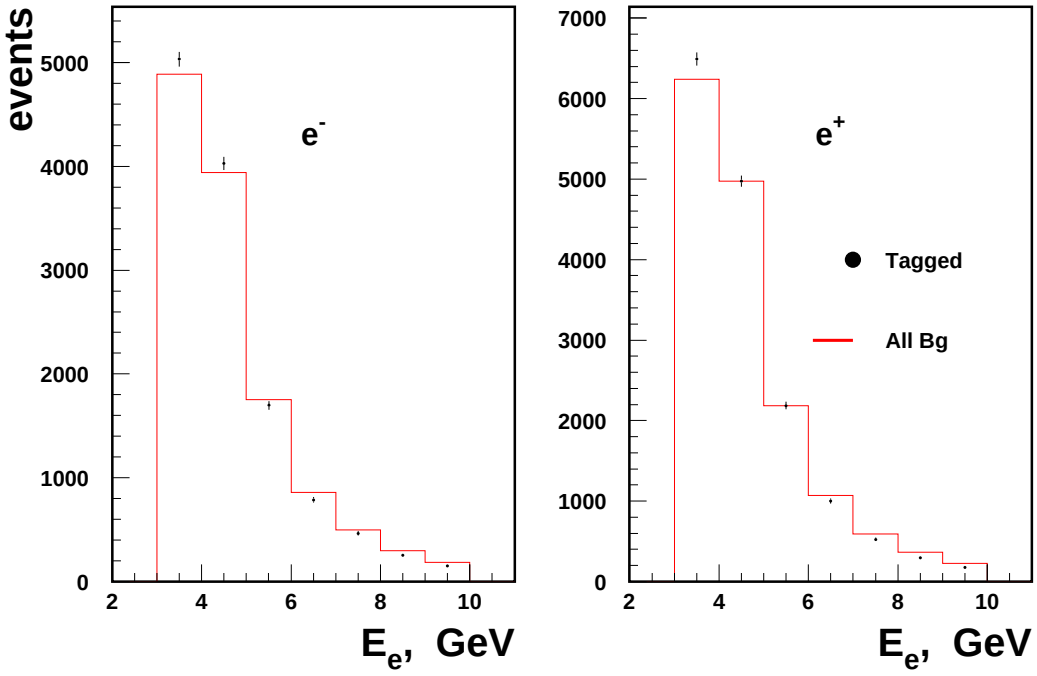
Background distributions



- Positive tracks from e-p interactions
- Negative tracks from e+p interactions

→ Positively and negatively charged background kinematic distributions are consistent.

- A fraction of the photoproduction events ($Q^2 < 0.01$ GeV^2) has the scattered electron detected by the electron tagger – "tagged events".



→ κ can also be obtained from the tagged events

$$\kappa = \frac{N_-^{tagged}}{N_+^{tagged}}$$

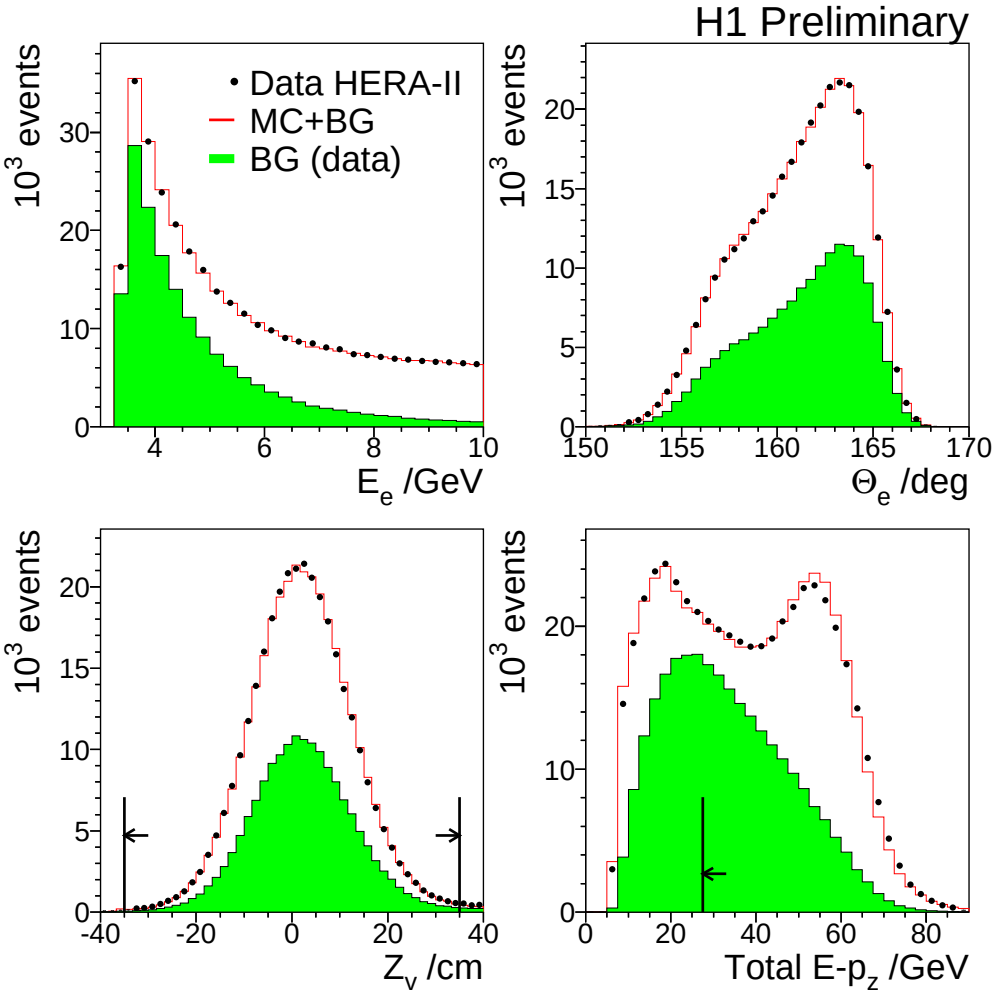
- Charge asymmetry factor is obtained by averaging different methods
  → $\kappa = (6.0 \pm 0.5)$ %.

Summary of systematic uncertainties

Source	Uncertainty of the source	Effect on the cross section
	Uncorrelated errors	
Trigger efficiency	1.2%	1.2%
Tracking efficiency	1.5%	1.5%
Track charge determination	0.5%	1%
Electron identification	0.5%	0.5%
	Correlated errors	
E'_e energy scale	1% at 2 GeV and 0.2% at 27.5 GeV	~ 0.7%
Θ_e measurement	1 mrad	~ 0.4%
SpaCal hadronic energy scale	± 1 GeV	~ 0.8%

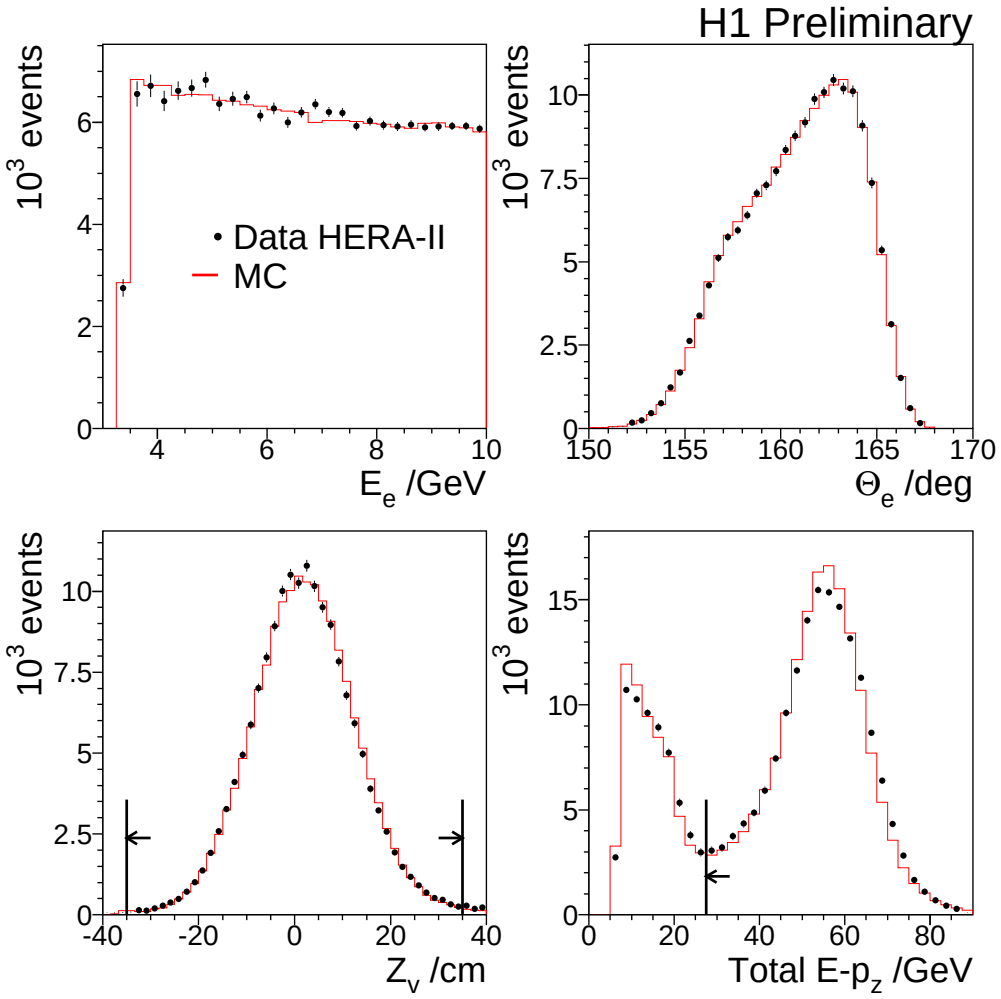
- Dominant systematic error source is tracking efficiency – can be improved by exploiting the Backward Silicon Tracker (BST).

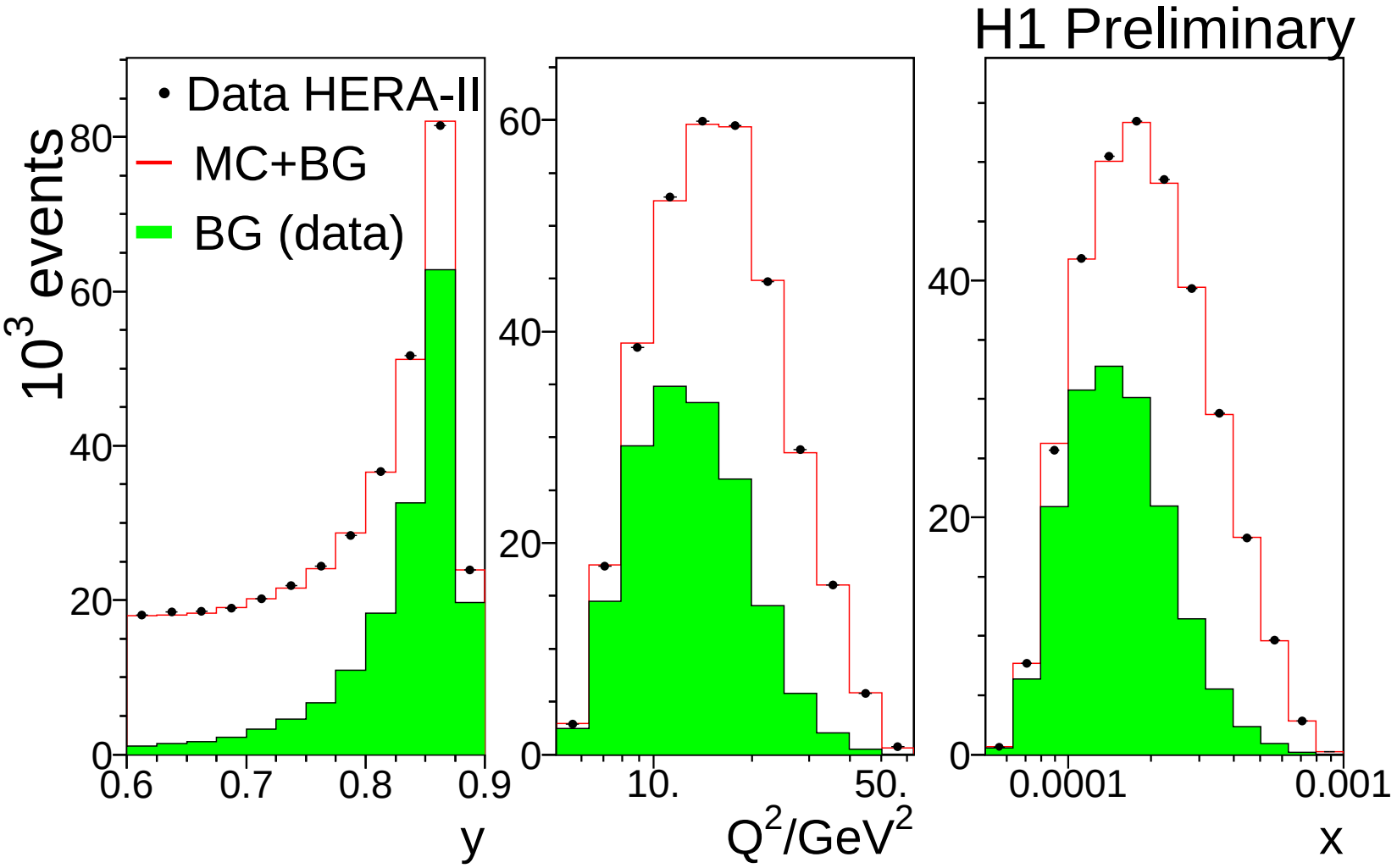
Control plots

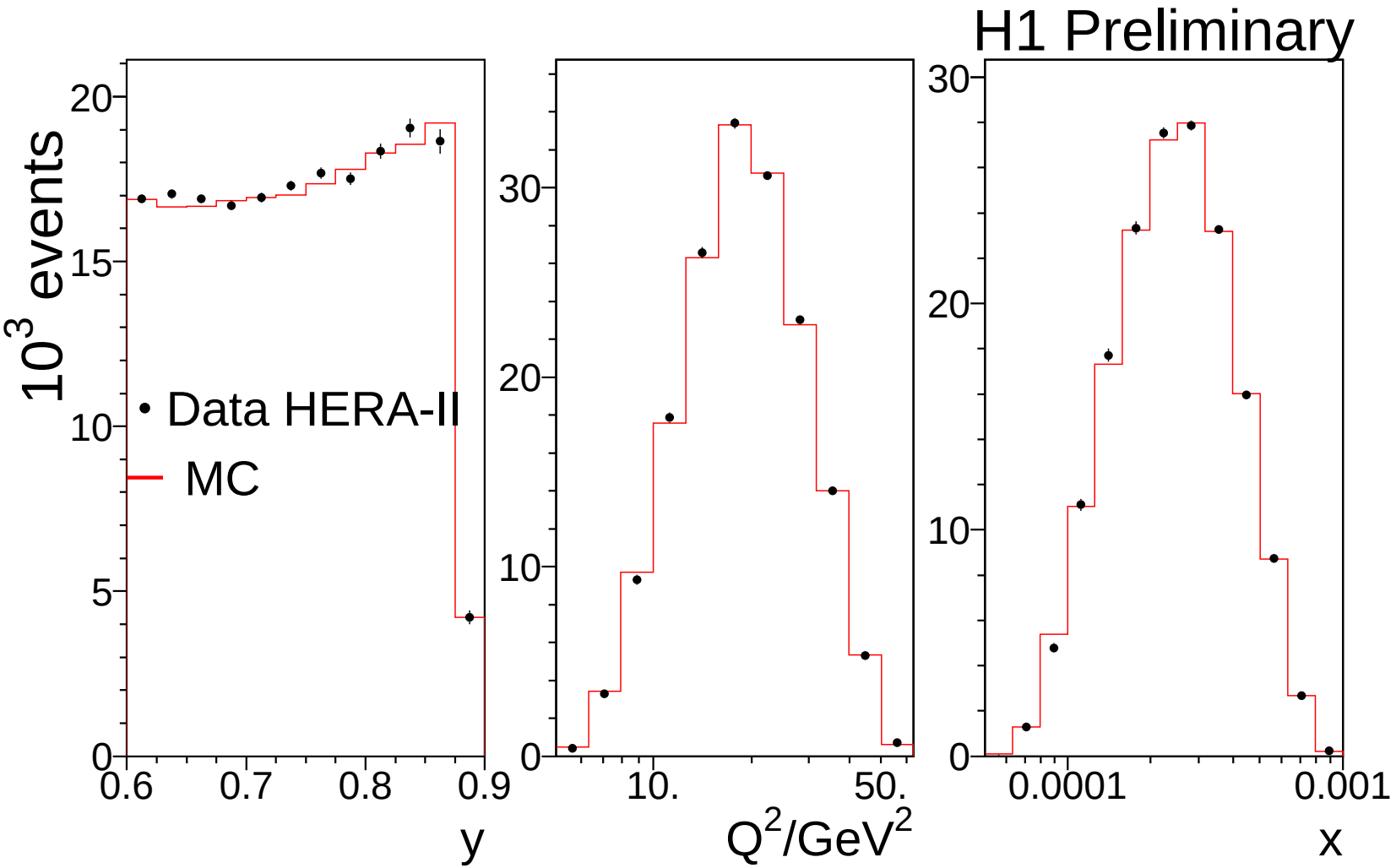


$E\text{-}p_z = (E - p_z)_{HFS} + (E - p_z)_{e'} = 2 \cdot$(measured beam energy)

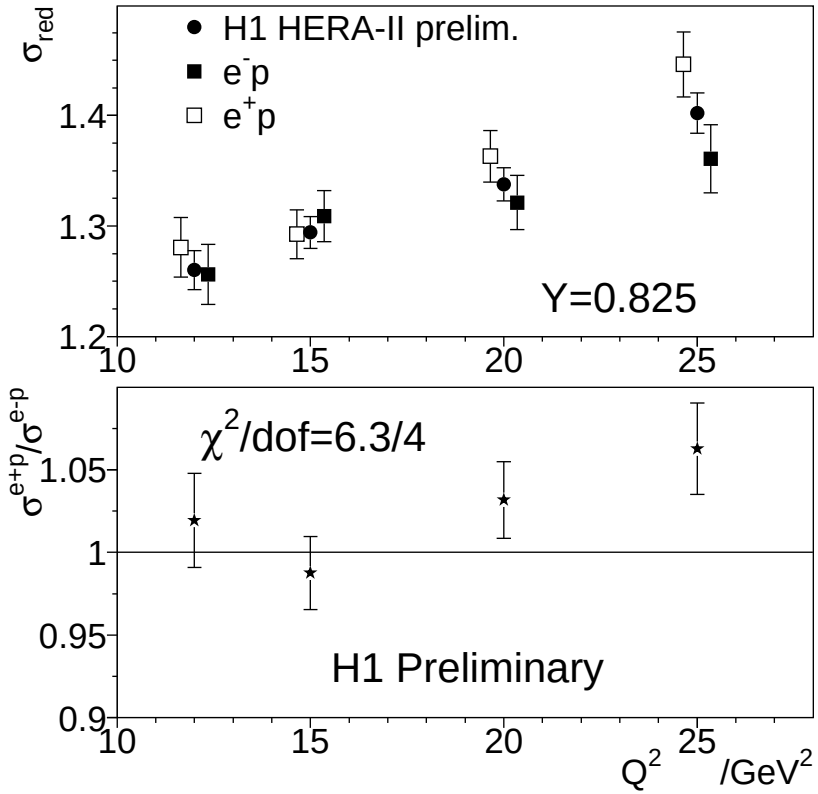
Signal control plots (background subtracted)




H1 Preliminary
• Data HERA-II
MC+BG
BG (data)
10^3 events
y
Q^2/GeV^2
x


H1 Preliminary
10^3 events
• Data HERA-II
MC
y
Q^2/GeV^2
x

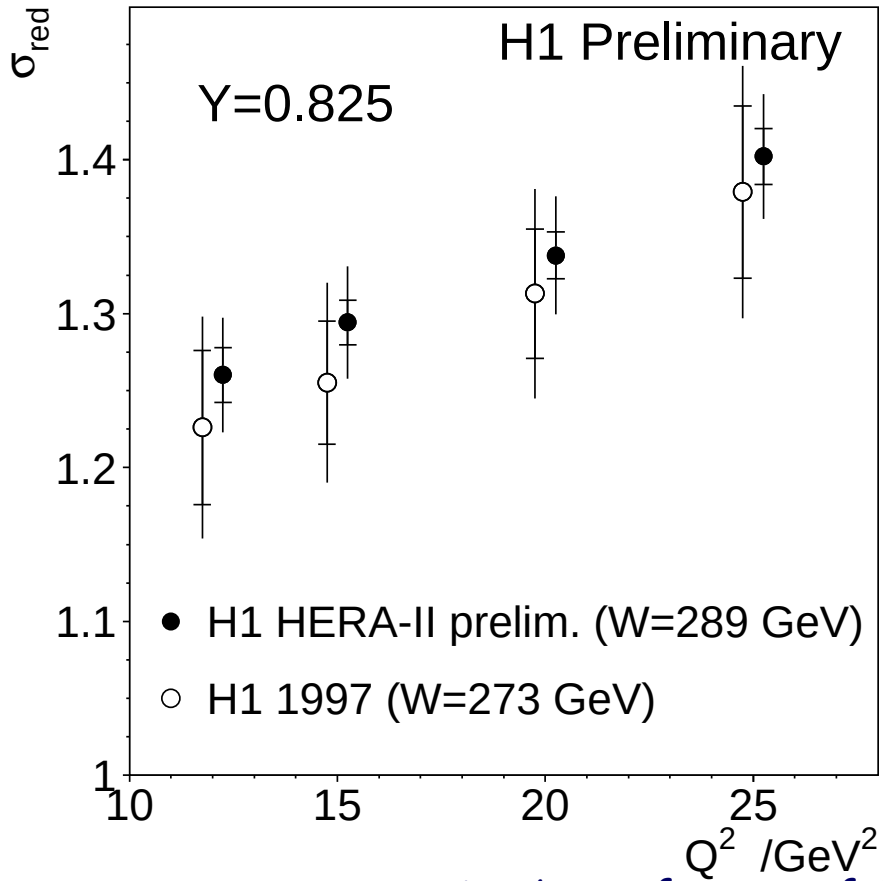
Cross section at the y=0.825 from e+p and e-p interactions from HERA II



Only statistical errors shown

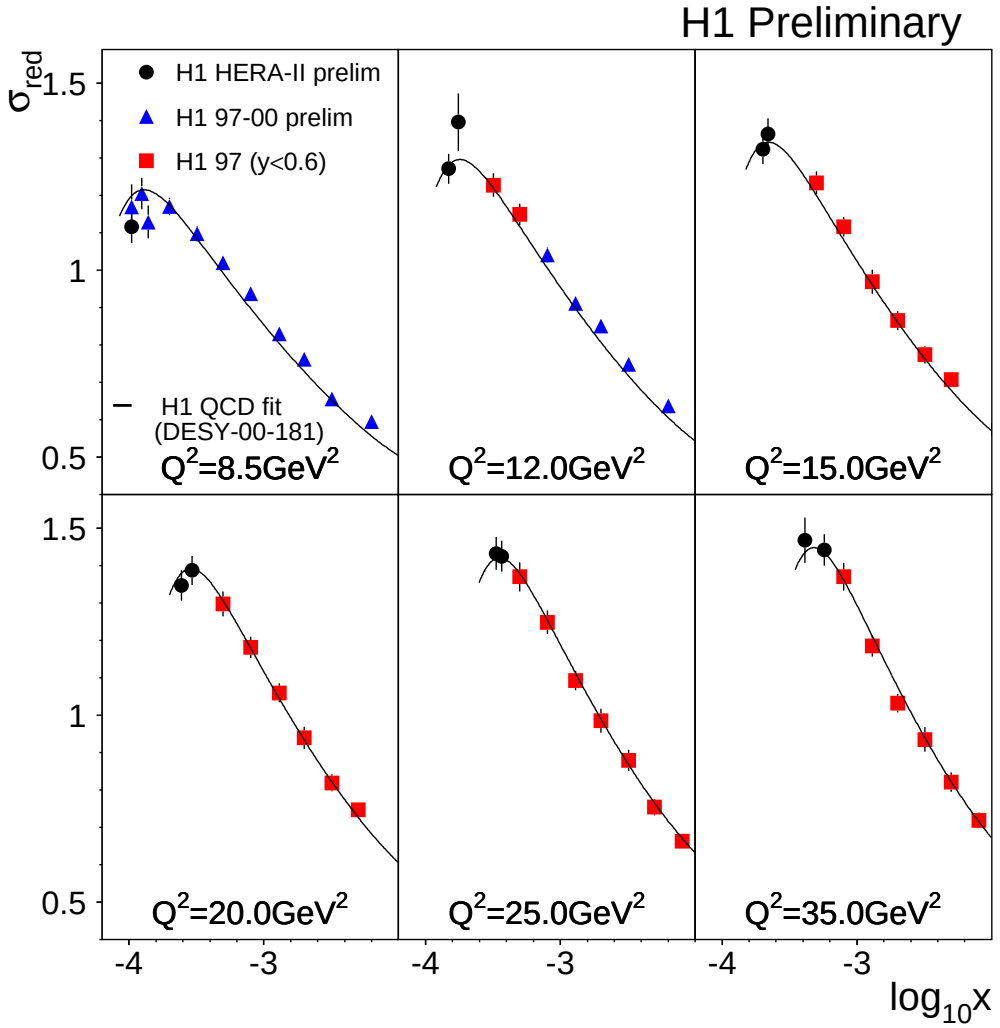
→ e^+p and e^-p cross section measurement are consistent → an import cross check since the two measurements are oppositely sensitive to the background charge asymmetry.

Cross section at the y=0.825 for complete HERA II data - 96 pb^{-1}



- The precision of the new measurements is about factor of 2 better than in the published results based on HERA-I data.
- Systematic cross section uncertainty 2-3%.

Cross section measurements from HERA II data in comparison with HERA I data



Summary

- Cross section measurements obtained for high inelasticity, $0.6 < y < 0.9$, using HERA II data – 96 pb^{-1} (51 pb^{-1} from e^+p and 45 pb^{-1} from e^-p interactions).
- Cross sections measured separately from e+p and e-p interactions are consistent.
- The precision of the new measurements is about factor of 2 better than in the published measurements from H1 based on HERA-I data.
  Total uncertainty 2-3%.