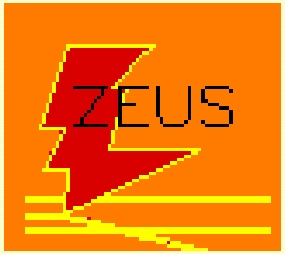
MEASUREMENT OF CHARM PRODUCTION IN DIS WITH THE ZEUS DETECTOR



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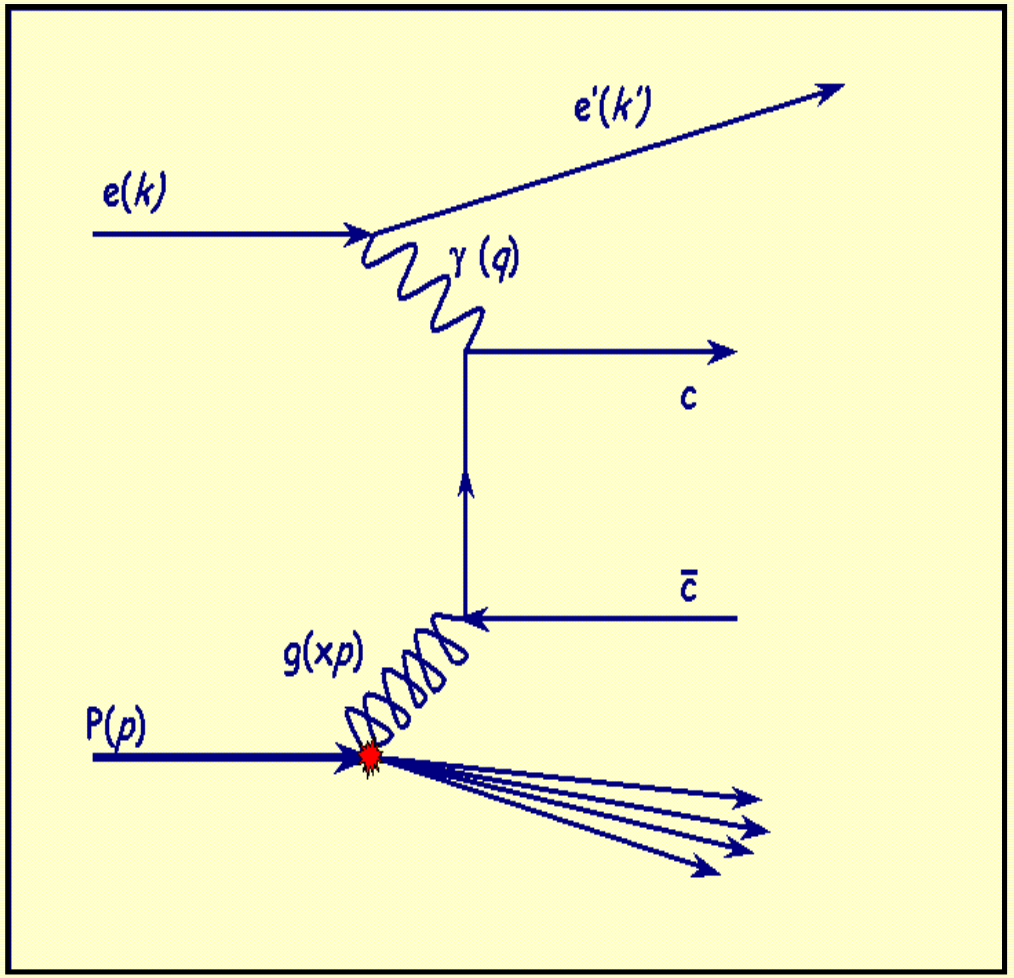
on behalf of the
ZEUS Collaboration

OUTLINE OF THE TALK

- Charm production
- The ZEUS detector
- D* tagged in 95-00 running
- The semi-leptonic decay in 96+97 running
- F_2^{charm} with ZEUS 96-97 data

CHARM PRODUCTION

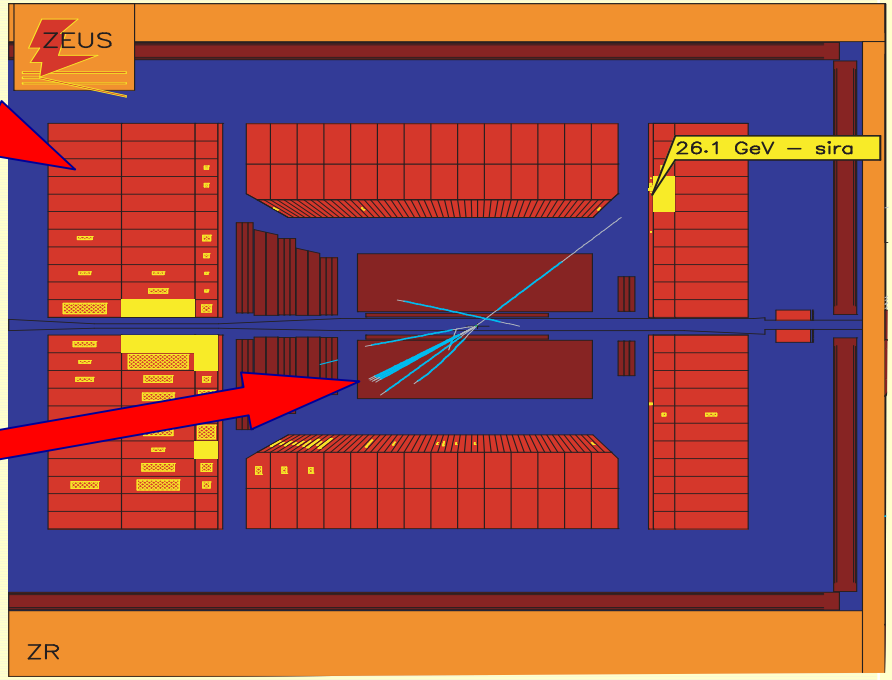
- Boson Gluon Fusion produces charm
- Fixed 3 Flavour Number Scheme used for pQCD predictions
- Measured by
  - ➔ D*-tagged
  - ➔ $\overline{c} \rightarrow e^- \nu_e s$



THE ZEUS DETECTOR

- Calorimeter
  - Ur.-Scintillator
  - Compensating
  - HAC: $\sigma/E = 35\%/\sqrt{E}$
  - EMC: $\sigma/E = 18\%/\sqrt{E}$
- Central Tracking Detector
  - Drift Chamber
  - dE/dx with 10% resolution

(E in GeV)

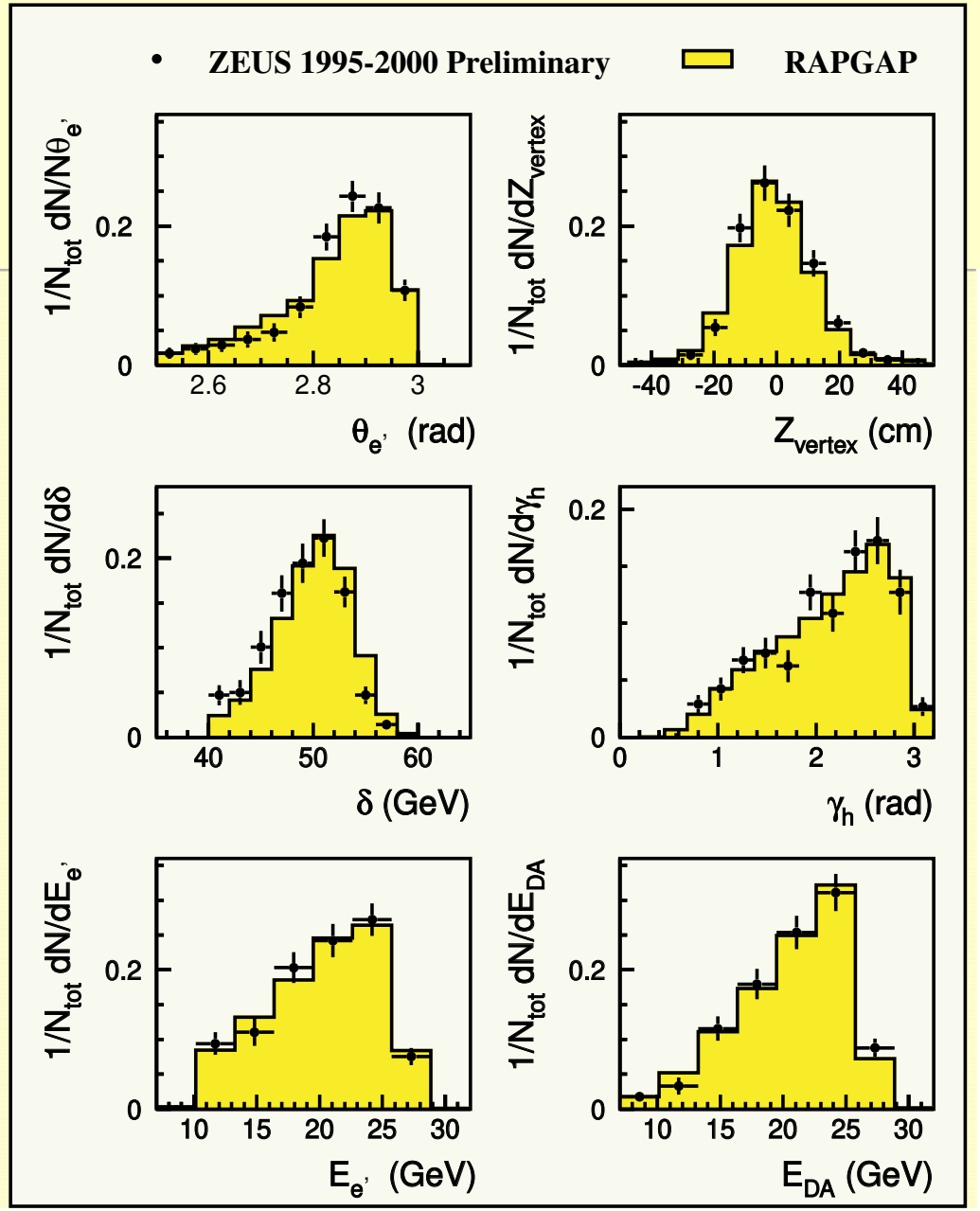


RUNNING PARAMETERS

- Over time HERA has run with different beam energies
  - ➔ 1995-1997 : e^+p , with $E_e = 27.6$ GeV, $E_p = 820$ GeV
    a total of 45 pb^{-1} of data was collected
  - ➔ 1999-2000 : e^+p , with $E_e = 27.6$ GeV, $E_p = 920$ GeV
    a total of 66 pb^{-1} of data was collected
- The D* analysis used the '95-'97 and '99 and '00 datasets (83 pb^{-1})
- For the semi leptonic analysis the '96 and '97 (34 pb^{-1}) datasets were used

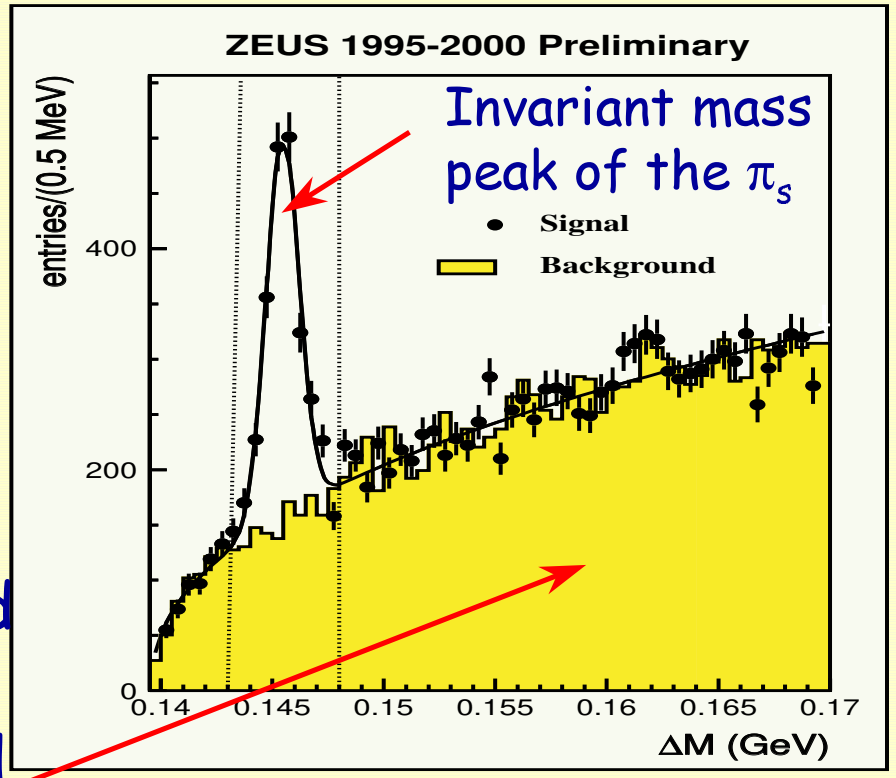
D* ANALYSIS

- DIS events with:
  - $E_{e'} > 10$ GeV
  - $Q^2_{DA} > 10$ GeV^2
  - $40 \leq \delta \leq 60$ GeV
    ($\delta = \Sigma E - p_z$)
  - Vertex within 50 cm of nominal I.P.
  - Scattered positron far from the rear beam pipe hole



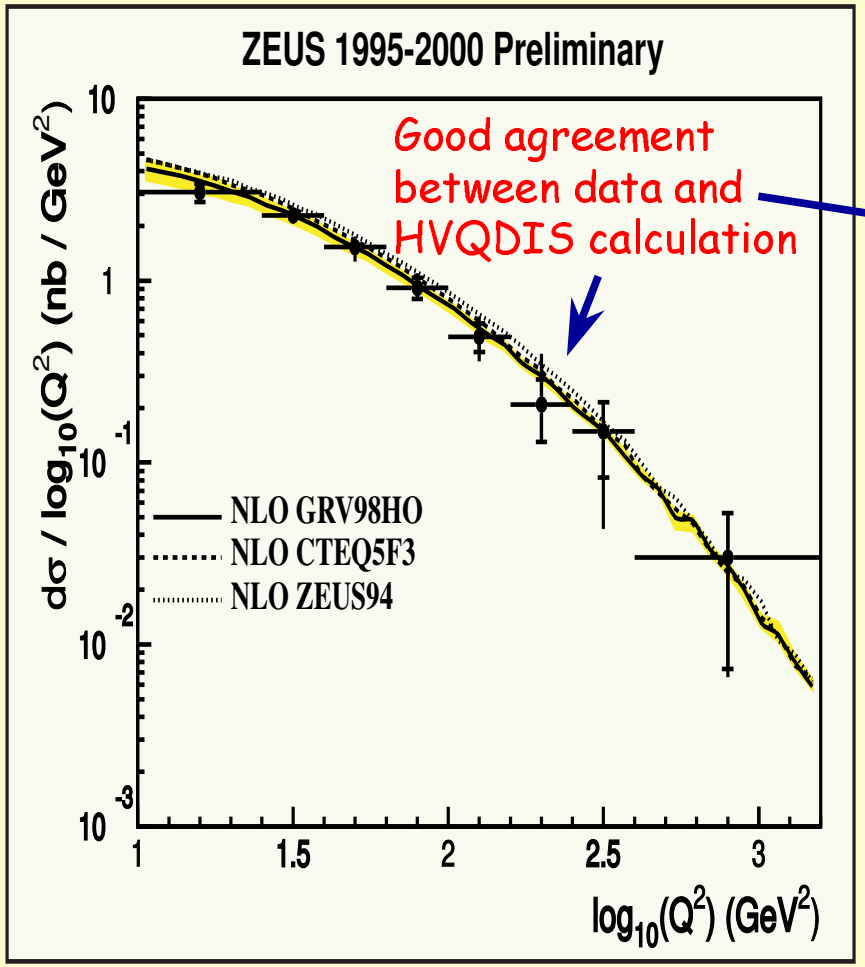
D* CANDIDATE SELECTION

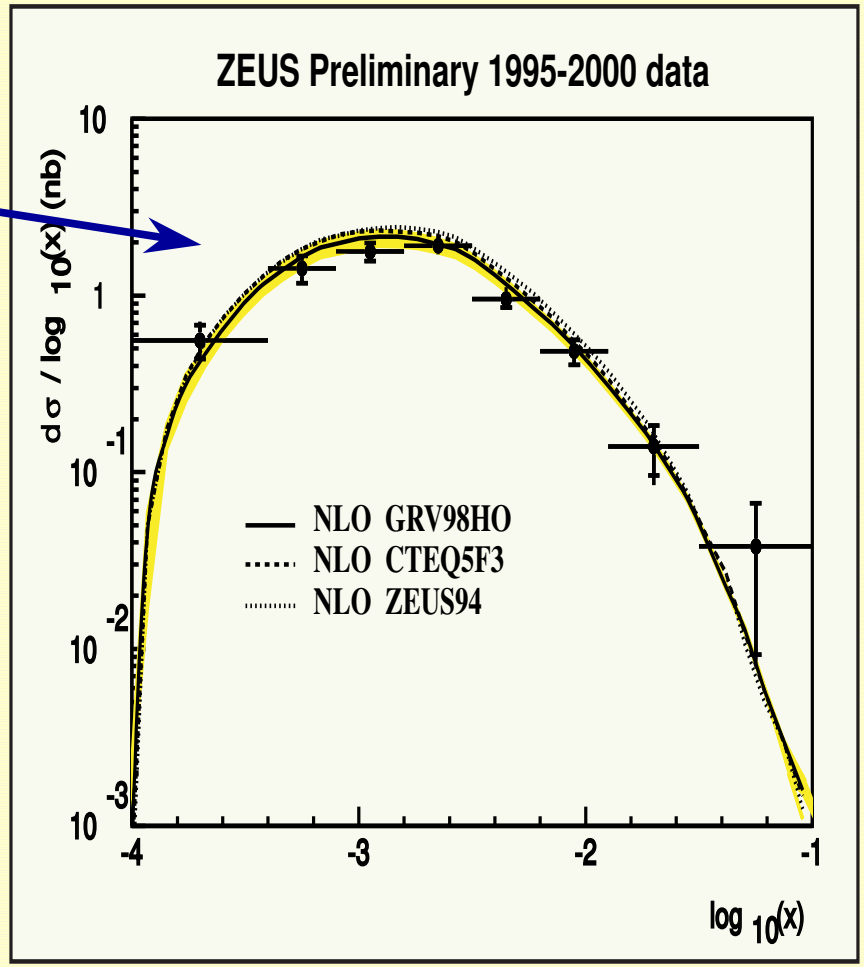
- $D^{*+} \rightarrow D^0 \pi_s^+$
  $D^0 \rightarrow K^- \pi^+$ and c.c.
- $\Delta M = M_{k\pi\pi_s} - M_{k\pi}$
- Use tracks fully containted in the central tracking detector
- Combine tracks to find D^0 and D*
- Determine background by wrong-sign combinations



- $1.5 < p_t(D^*) < 15$ GeV, $|\eta(D^*)| < 1.5$
- $1.80 < M(D^0) < 1.92$ GeV

D* DIFFERENTIAL CROSS SECTIONS





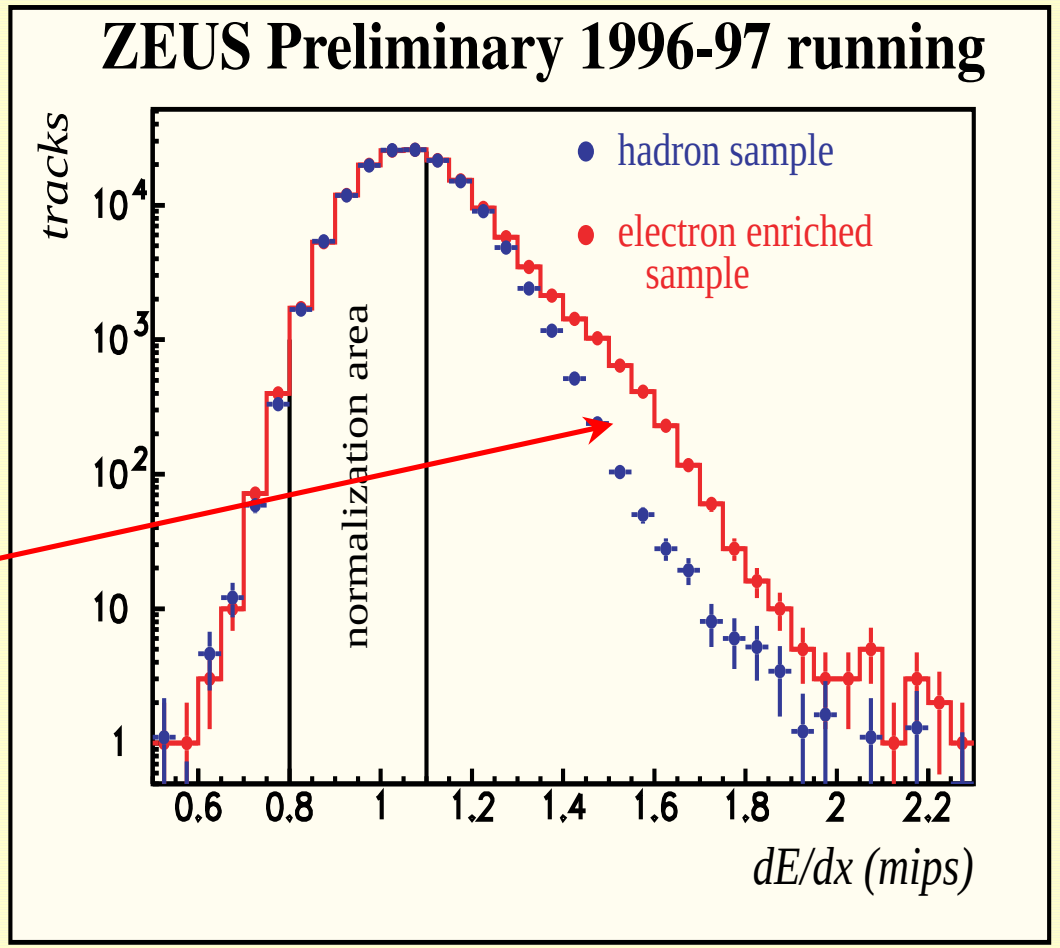
OUTLINE SEMI-LEPTONIC ANALYSIS

Goal: find the electrons from the weak decay of charm quarks/charmed hadrons.

- Select DIS events
  - ➔ $1 < Q^2_{DA} < 1000\ GeV^2$
  - ➔ $0.03 < y_{DA} < 0.70$
- Use Calorimeter cluster associated to tracks to select electron candidates.
- Use the dE/dx spectrum of these candidates.

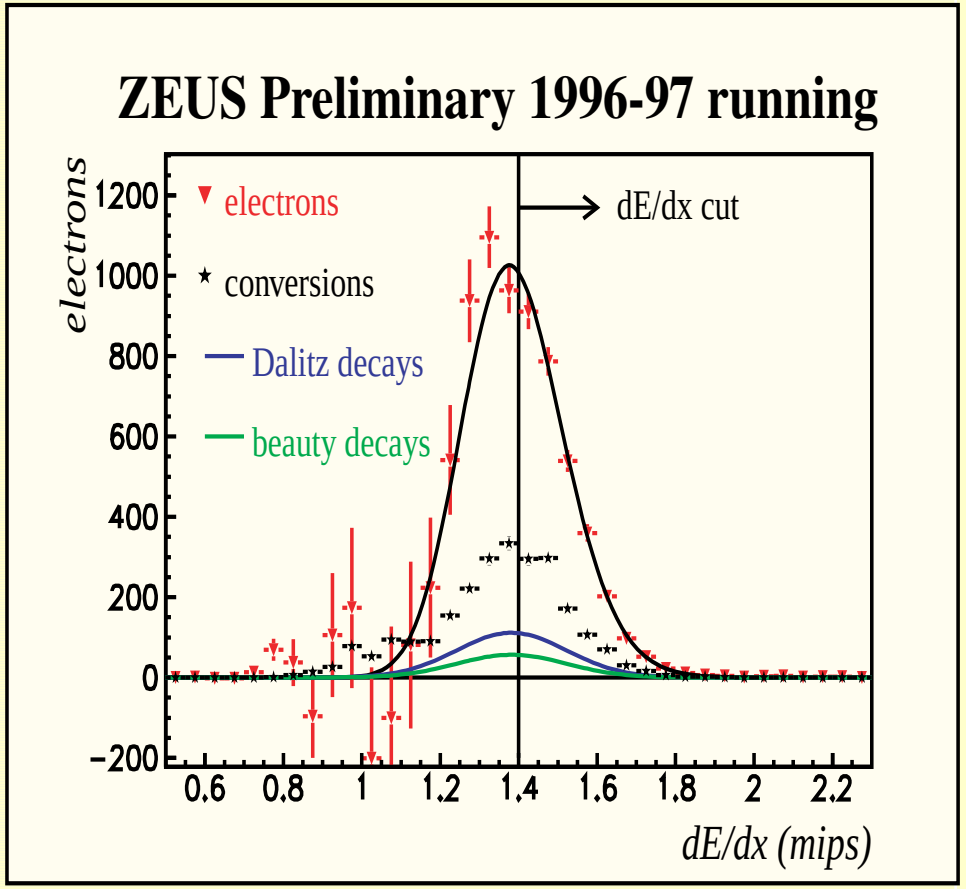
DE/DX MEASUREMENT

- dE/dx is scaled to the MIP π signal
- Corrected for screening and multiplicity effects
- A clear electron signal can be seen

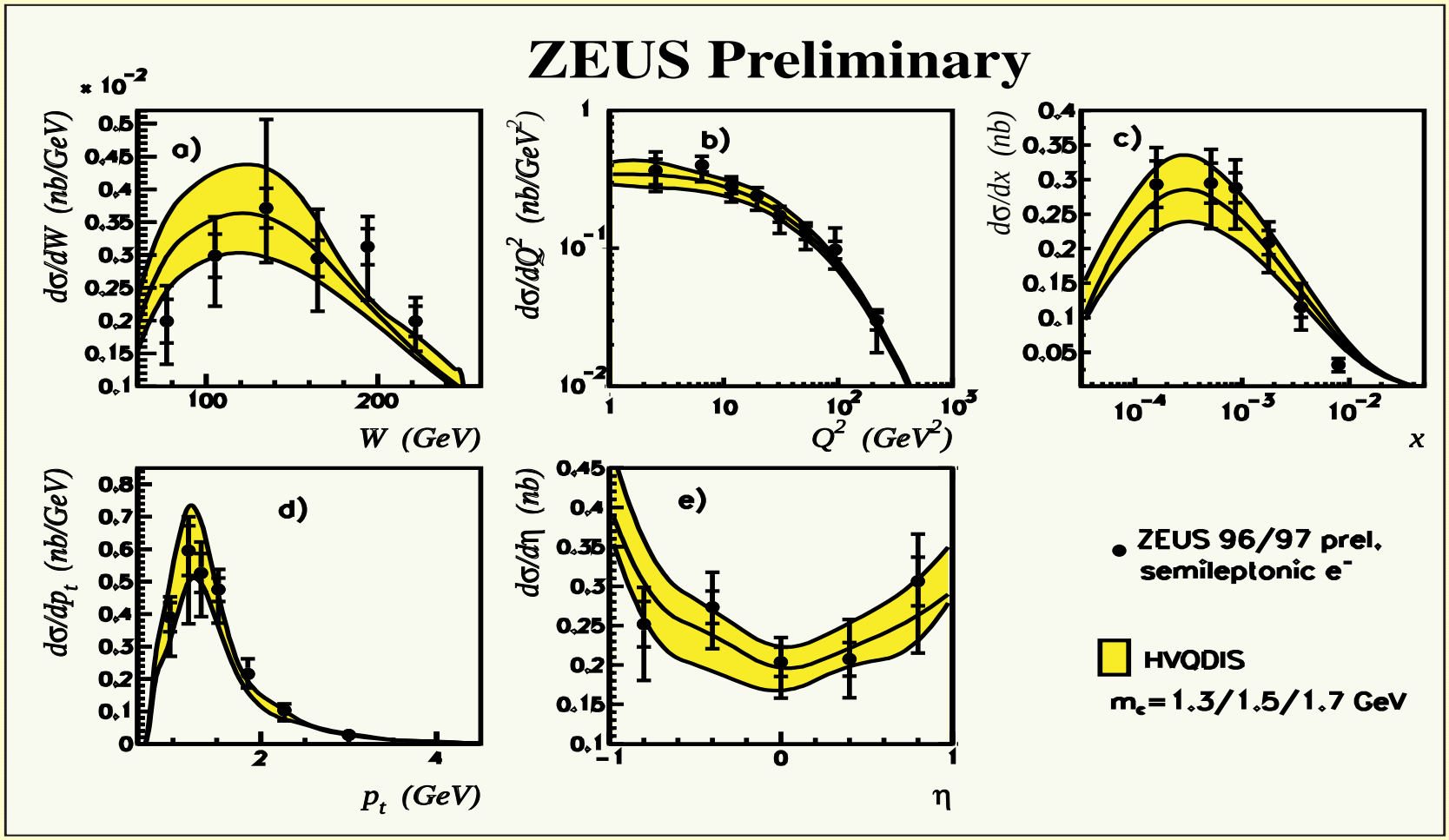


ELECTRON SIGNAL

- The hadronic sample is subtracted from the electron enriched sample
- The conversions are tagged in data
- The Dalitz background is estimated from data
- Beauty contribution from Monte Carlo



DIFFERENTIAL CROSS SECTIONS

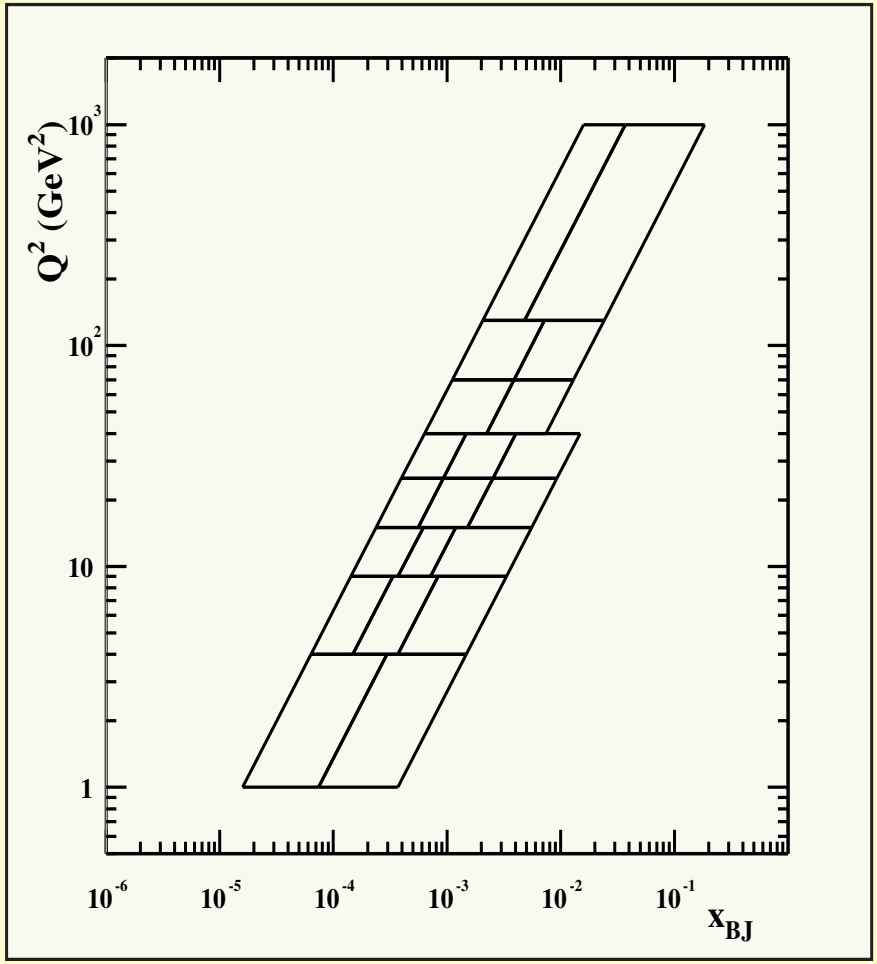


F_2^{CHARM} IN THE KINEMATICAL PLANE

- $\frac{d^2\sigma}{dxdQ^2} = \frac{2\pi\alpha^2}{xQ^4}(1+(1-y)^2)F_2^{c\bar{c}}(x,Q^2)$
- F_2^{charm} is extracted in 20 bins of (x,Q^2)
- Unfolding done with

$$F_{2\ data}^{c\bar{c}} = \frac{\sigma_{data}}{\sigma_{theory}} F_{2\ theory}^{c\bar{c}}$$

- Results are compared to the published 96-97 D* data ($37pb^{-1}$)



SUMMARY AND CONCLUSIONS

- ZEUS has made two very different measurements of charm production in DIS: a semi leptonic and a D* analysis
  - ➔ Good agreement between the two.
- BGF, incorporated in HVQDIS, does a very good job at describing the ZEUS-charm data
- Almost 3 times more statistics available for the extraction of F_2^{charm}