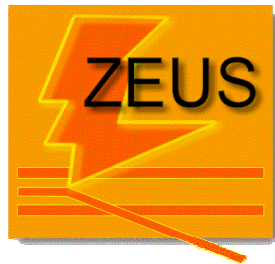


High Q^2 Charge Current Events with Large Rapidity Gap

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on behalf of the ZEUS Collaboration*

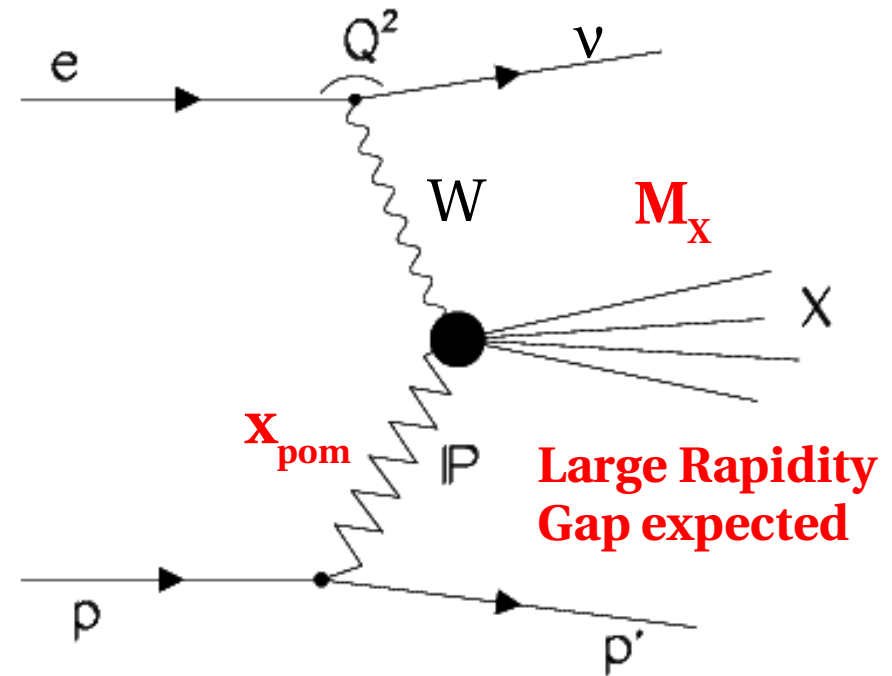


- Introduction
- Data Sample & Selection Cuts
- Cross Section
- Summary&Conclusion



Diffraction Charge Current

- do diffractive processes go also via weak interactions?
- if yes, they probe parton content of diffractive exchange
- high Q^2 diff. events connected with diff. Higgs production at LHC

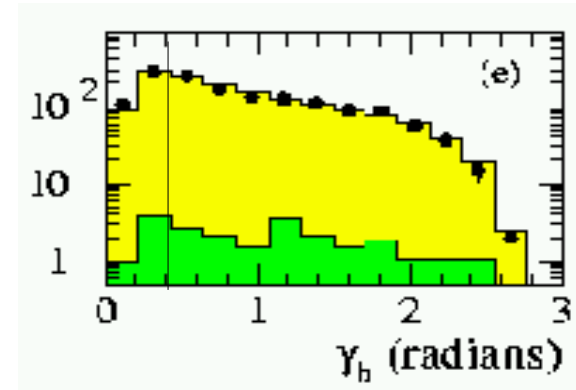


Diffractive variables:

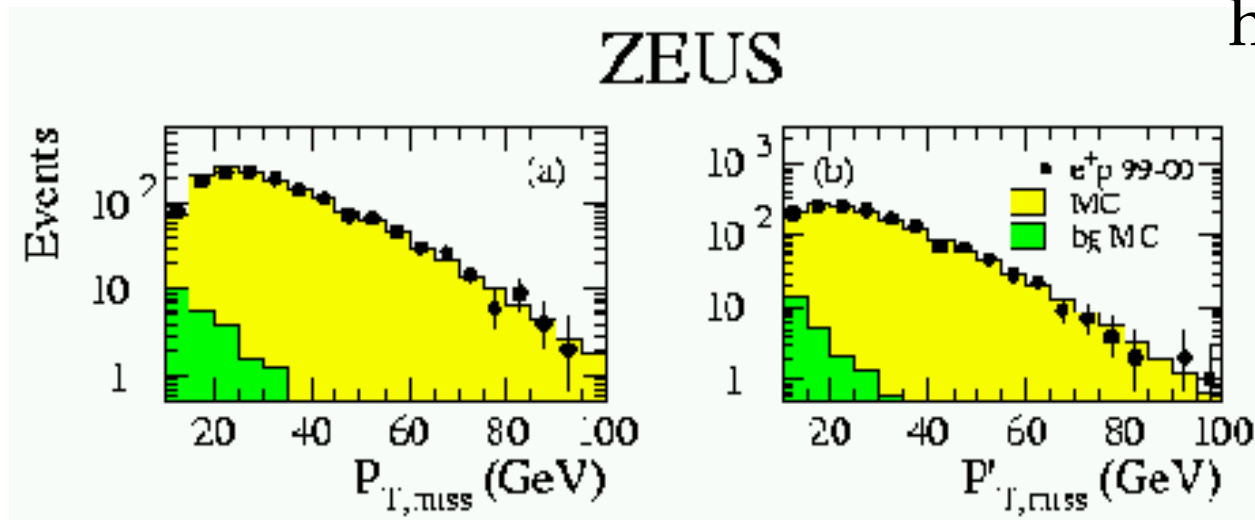
- x_{pom} : fraction of proton momentum carried by diff. exchange
- $M_X^2 = (Q^2 + M_X^2) / (Q^2 + W^2)$
- M_X^2 – invariant mass of system X
- $\beta = x/x_{pom}$

CC Selection

- ZEUS 99-00 data, $\mathcal{L} = 60.9 \text{ pb}^{-1}$
- standard CC selection
- kinematic range:
 - $Q^2 > 200 \text{ GeV}^2$
 - $p_{T, \text{miss}} > 12 \text{ GeV}$ ($p_{T, \text{miss}}' > 10 \text{ GeV}$)
- MC used: Ariadne

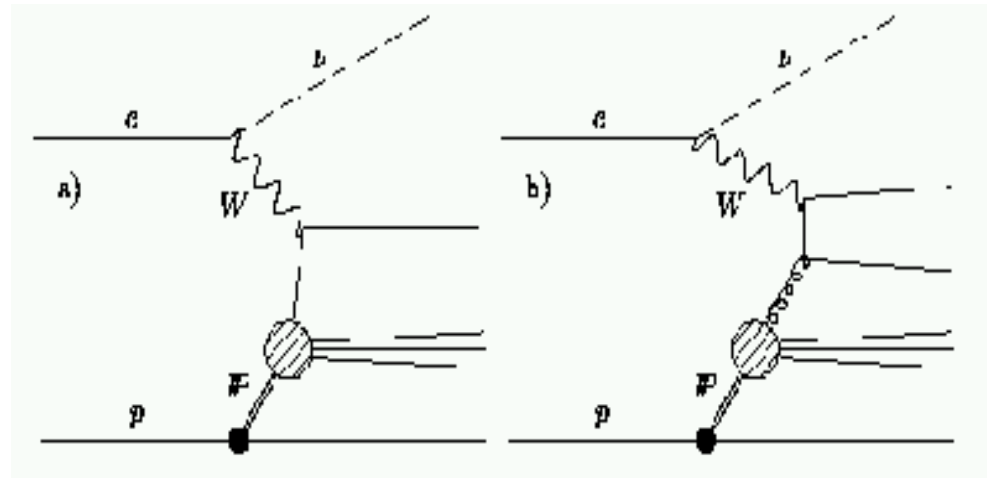


polar angle of
hadronic system



Diffractive CC MC

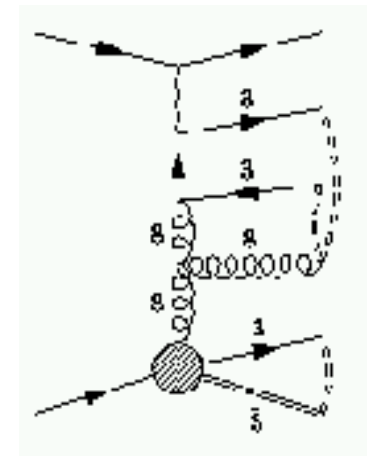
- **RAPGAP** with H1 fit2
 - **Regge and Pomeron exchange**
 - **resolved Pomeron Model**



- RAPGAP cross section for $Q^2 > 200 \text{ GeV}^2$: **1.2 pb**
- data could be described by a sum of diffractive (RAPGAP) and non-diffractive MC samples (Ariadne for CC, NC and photoproduction MCs, GRAPE for di-tau and EPVEC for single W)

- MEPS with Soft Color Interaction

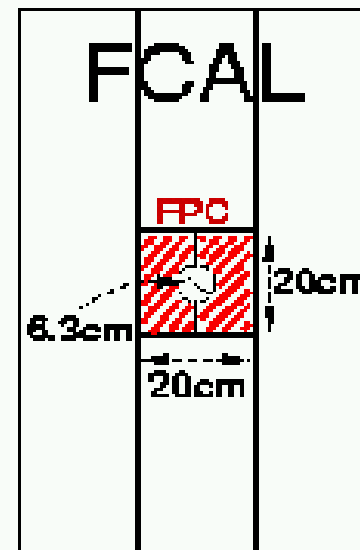
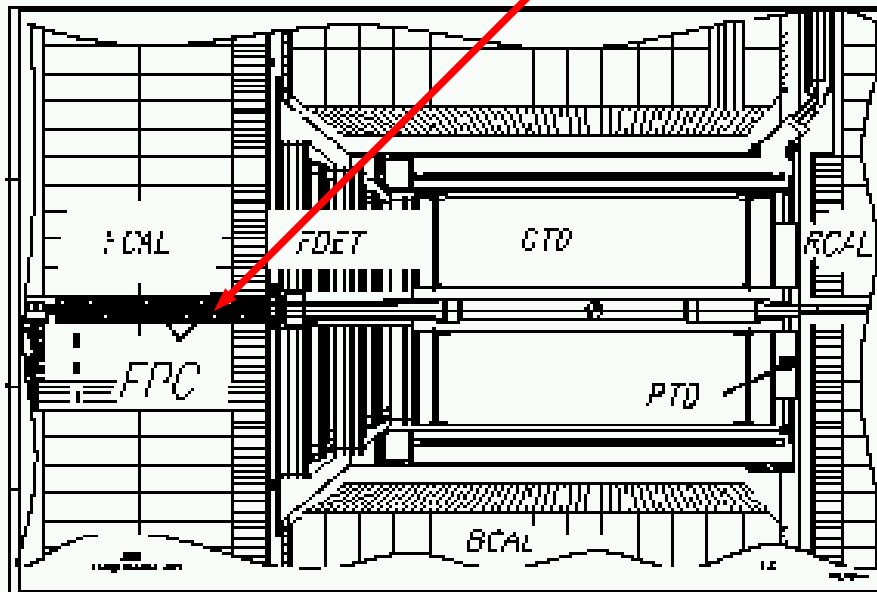
- another possibility to account for LRG events
- in this case data could be described by SCI MC only



Large Rapidity Gap Selection

- LRG selection

- uses η_{\max} : maximum pseudorapidity observed in the detector
- and **Forward Plug Calorimeter (FPC)**



- FPC covers pseudorapidity $4 < \eta < 5$

LRG CC Selection

- Ariadne not enough to describe η_{\max} for $E_{\text{FPC}} < 1 \text{ GeV}$ and $x < 0.05$

- adding RAPGAP improves description of data

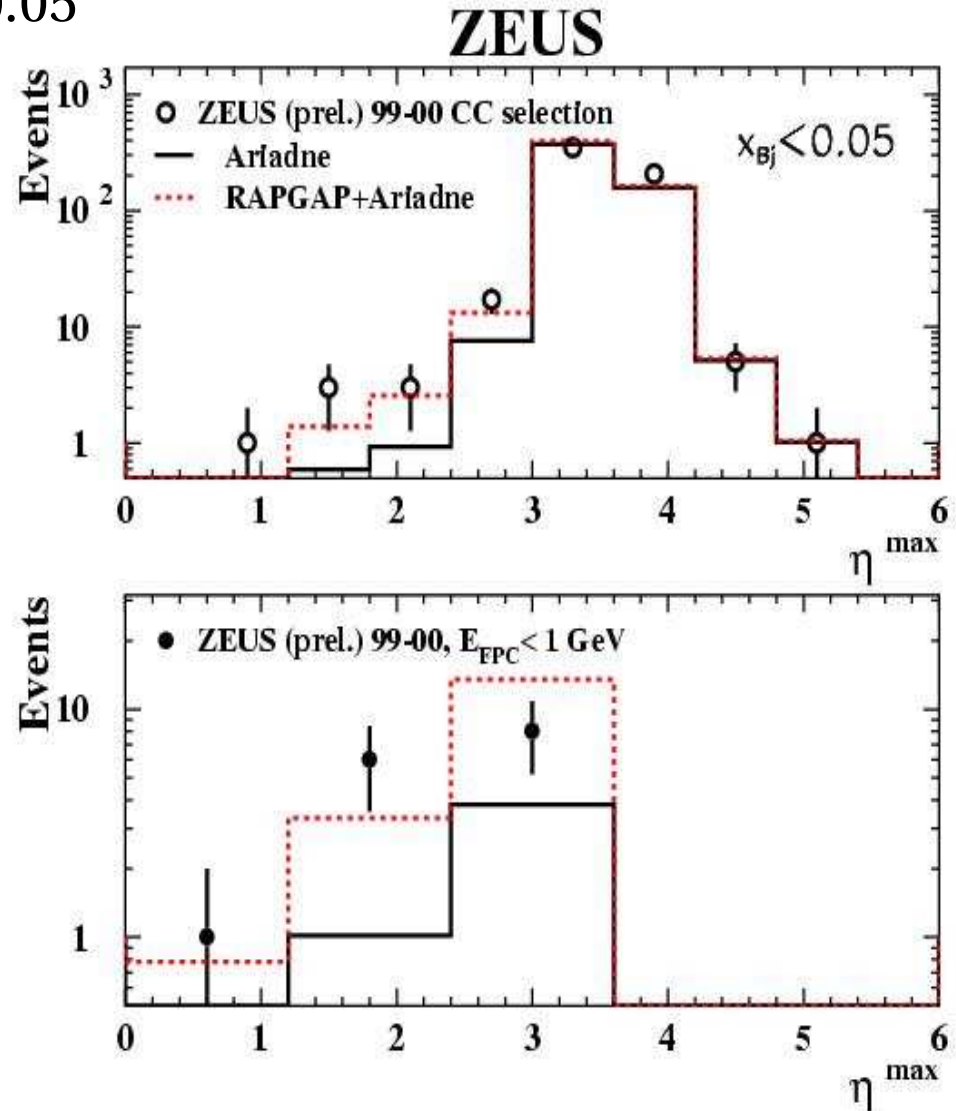
- LRG cuts:

- $E_{\text{FPC}} < 1 \text{ GeV}$

- $\eta_{\max} < 2.9$

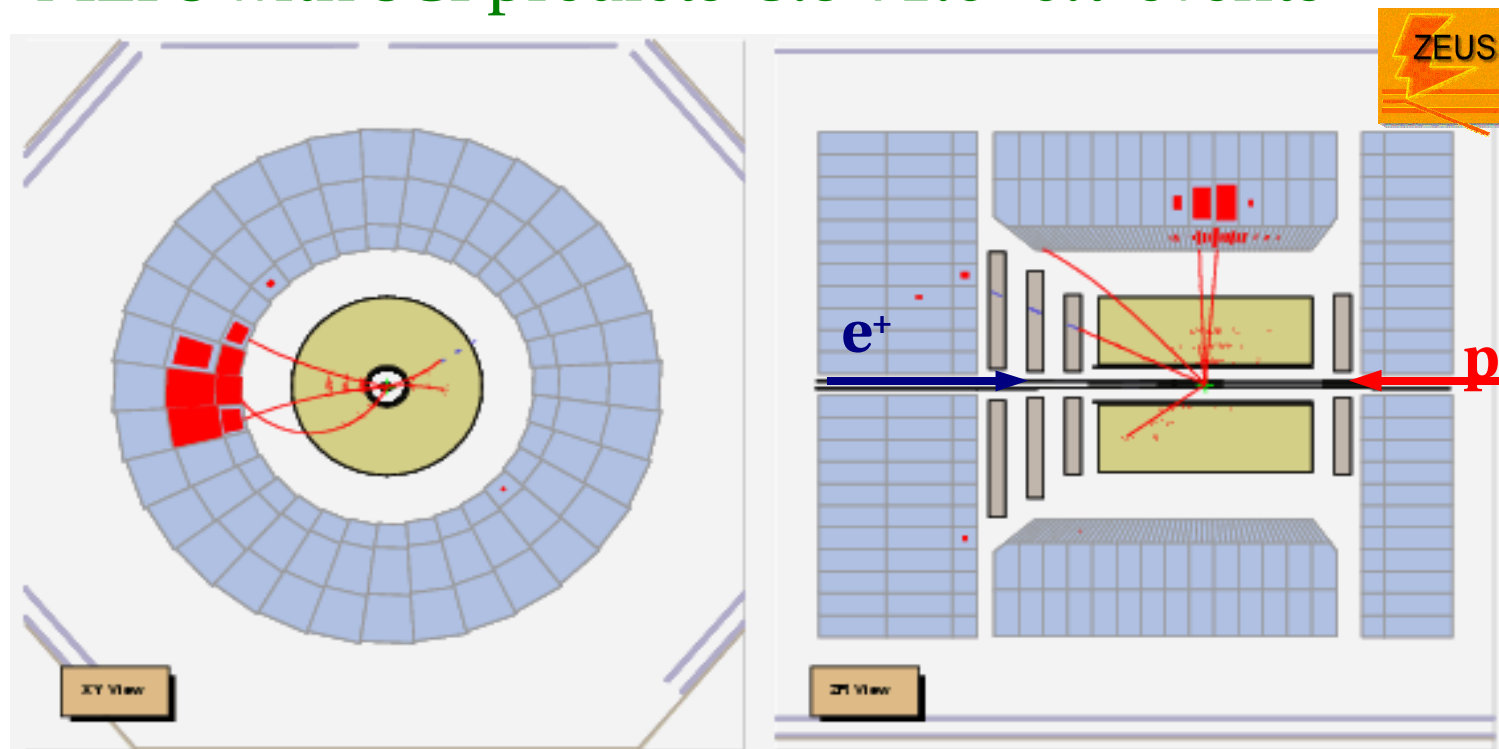
ensures gap of 2 units in rapidity between X and p

- $x_{\text{pom}} < 0.05$



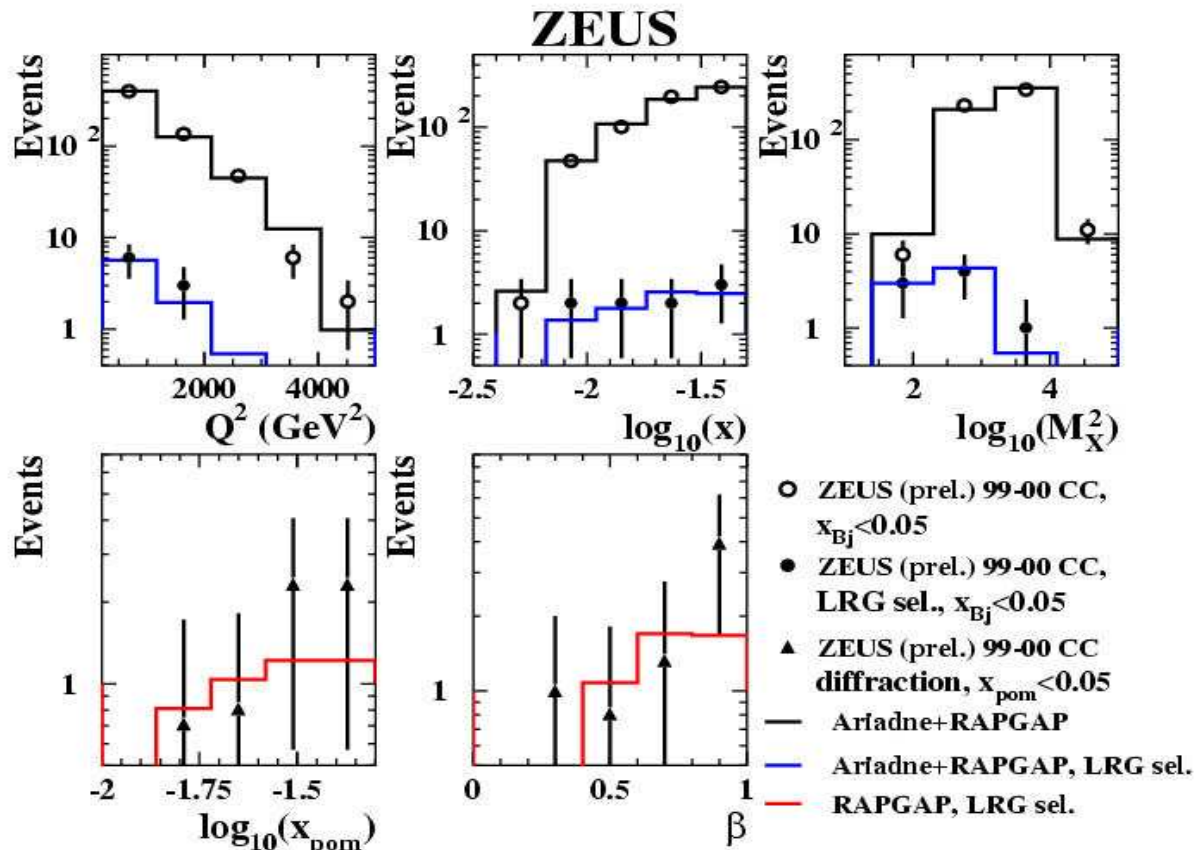
CC LRG Events with high Q^2

- after CC LRG selection **9 events** remain
- RAPGAP predicts **5.6 ± 0.7**
- expected from non-diffractive background: **1.7 ± 0.4 events** from Ariadne and **0.4 ± 0.1 events** from di-tau
- MEPS with SCI predicts **$3.9 +1.0 -0.7$ events**



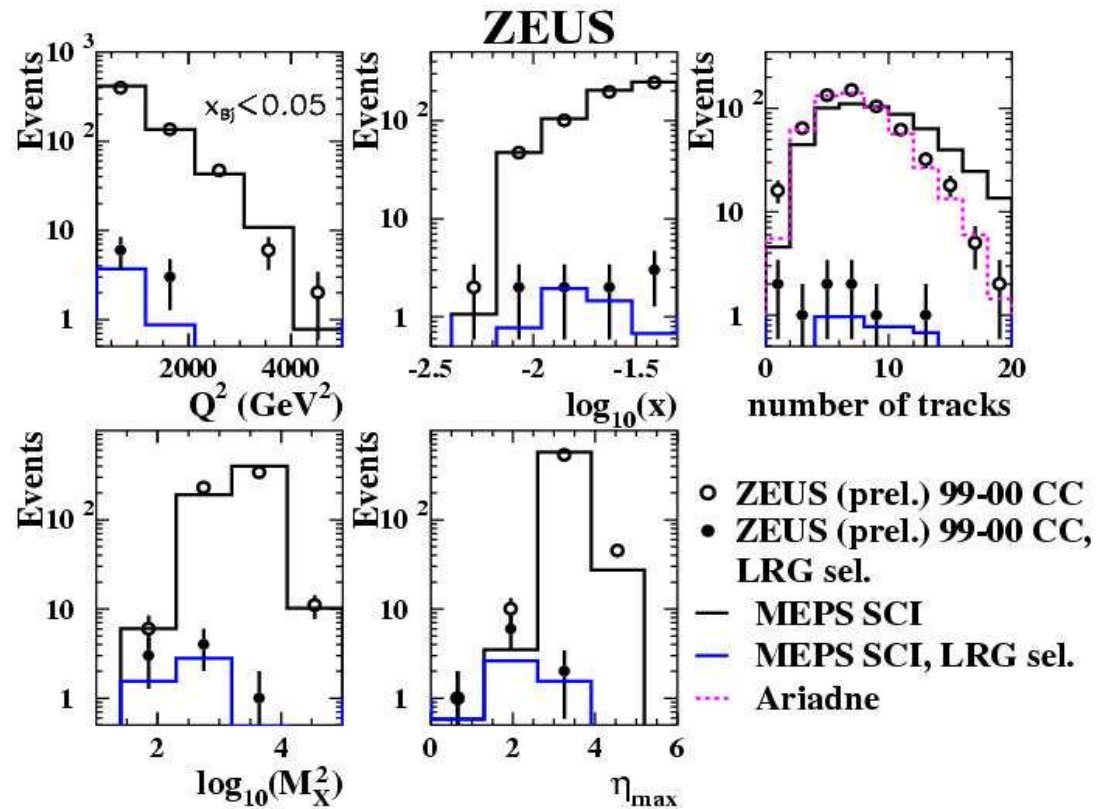
Data-MC Comparison: RAPGAP & Ariadne

- good agreement between data and MC, for CC and LRG events
- Ariadne+RAPGAP describes data well
- RAPGAP describes diffraction sample well



Data-MC Comparison: MEPS with SCI

- generally MEPS SCI describes data for inclusive CC, however problems for #tracks
- MEPS SCI a bit too low for LRG events
- description of inclusive and LRG CC a little better for Ariadne+RAPGAP



Cross Section Calculation

- diffractive cross section definition:

$$\sigma^{\text{CC DIFF}}(Q^2 > 200 \text{ GeV}^2, x_{\text{pom}} < 0.05) =$$

$$(N_{\text{DATA}} - N_{\text{MC}}^{\text{backg}}) / (\mathcal{L} * A)$$

- $A = (N^{\text{REC}} / N^{\text{GEN}})_{\text{RAPGAP}}, A = 23\%$
- $\mathcal{L} = 60.9 \text{ pb}^{-1}$
- $N_{\text{MC}}^{\text{backg}}$ from **Ariadne (1.7)** + **GRAPE di-tau (0.4)** = **2.1 events**

- ratio of diffractive to total cross section:

$$\sigma^{\text{CC DIFF}} / \sigma^{\text{CC TOT}} =$$

$$\sigma^{\text{CC DIFF}}(Q^2 > 200 \text{ GeV}^2, x_{\text{pom}} < 0.05) / \sigma^{\text{CC TOT}}(Q^2 > 200 \text{ GeV}^2, x_{\text{JB}} < 0.05)$$

Results

- cross section:

$$\sigma^{\text{CC DIFF}}_{(Q^2 > 200 \text{ GeV}^2, x_{\text{pom}} < 0.05)} =$$

$$= \mathbf{0.49 \pm 0.20 \text{ (stat)} \pm 0.13 \text{ (syst) pb}}$$

- in good agreement with RAPGAP prediction: 0.4 pb

- ratio:

$$\sigma^{\text{CC DIFF}}_{(Q^2 > 200 \text{ GeV}^2, x_{\text{pom}} < 0.05)} / \sigma^{\text{CC TOT}}_{(Q^2 > 200 \text{ GeV}^2, x_{\text{JB}} < 0.05)} =$$

$$= \mathbf{(2.9 \pm 1.2)\% \text{ (stat)} \pm 0.8\% \text{ (syst)}}$$

Summary & Conclusion

- **9 events** with Large Rapidity Gap in CC process were observed at high Q^2 with ZEUS detector
- Non-diffractive MCs (Ariadne+GRAPE) predict **2.1 ± 0.4** events
- RAPGAP predicts **5.6 ± 0.7**
- MEPS with Soft Color Interaction predicts events **$3.9 +1.0 -0.7$**
- $\sigma^{\text{CC DIFF}} (Q^2 > 200 \text{ GeV}^2, x_{\text{pom}} < 0.05)$
 $= 0.49 \pm 0.20 \text{ (stat)} \pm 0.13 \text{ (syst) pb}$
- $\sigma^{\text{CC DIFF}} (Q^2 > 200 \text{ GeV}^2, x_{\text{pom}} < 0.05) / \sigma^{\text{CC TOT}} (Q^2 > 200 \text{ GeV}^2, x_{\text{TB}} < 0.05) =$
 $= (2.9 \pm 1.2)\% \text{ (stat)} \pm 0.8 \text{ (syst)}$
- RAPGAP+Ariadne and MEPS SCI both give reasonable description of incl. and LRG CC, however RAPGAP+Ariadne seems to do better
- measurement not conclusive, more data needed - HERAII