Physics Results Part II
- ZEUS UK Status Report -

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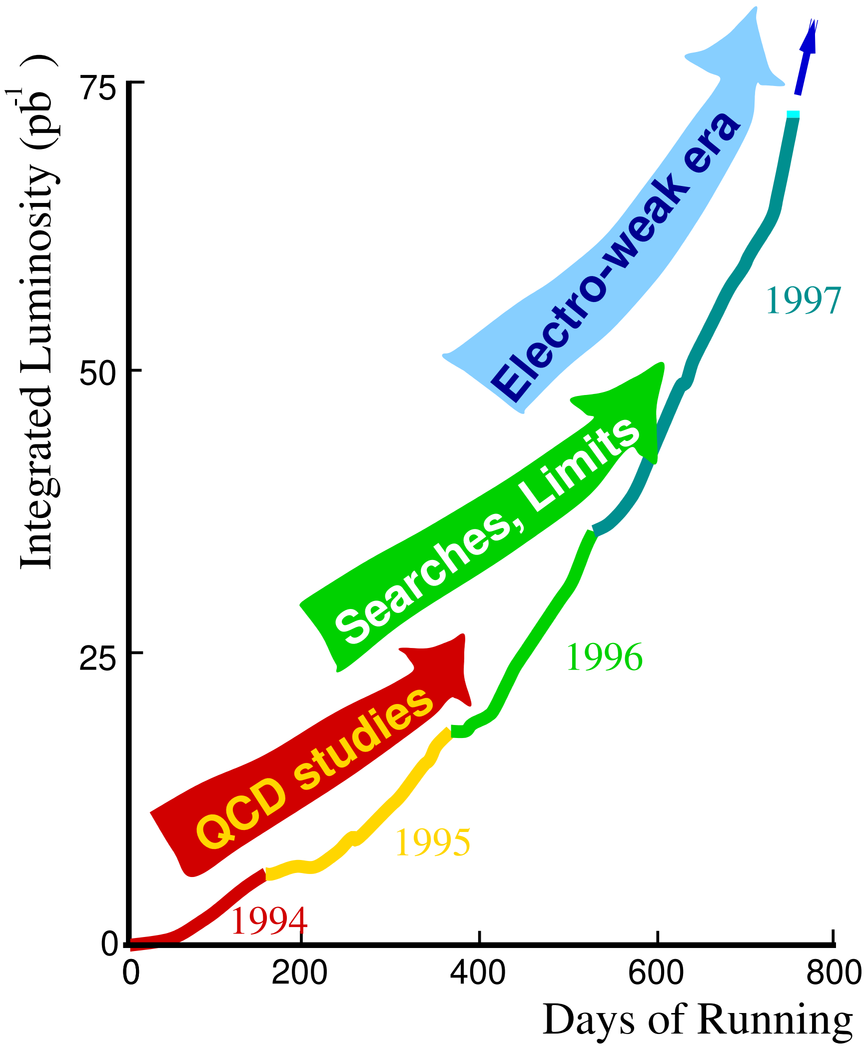
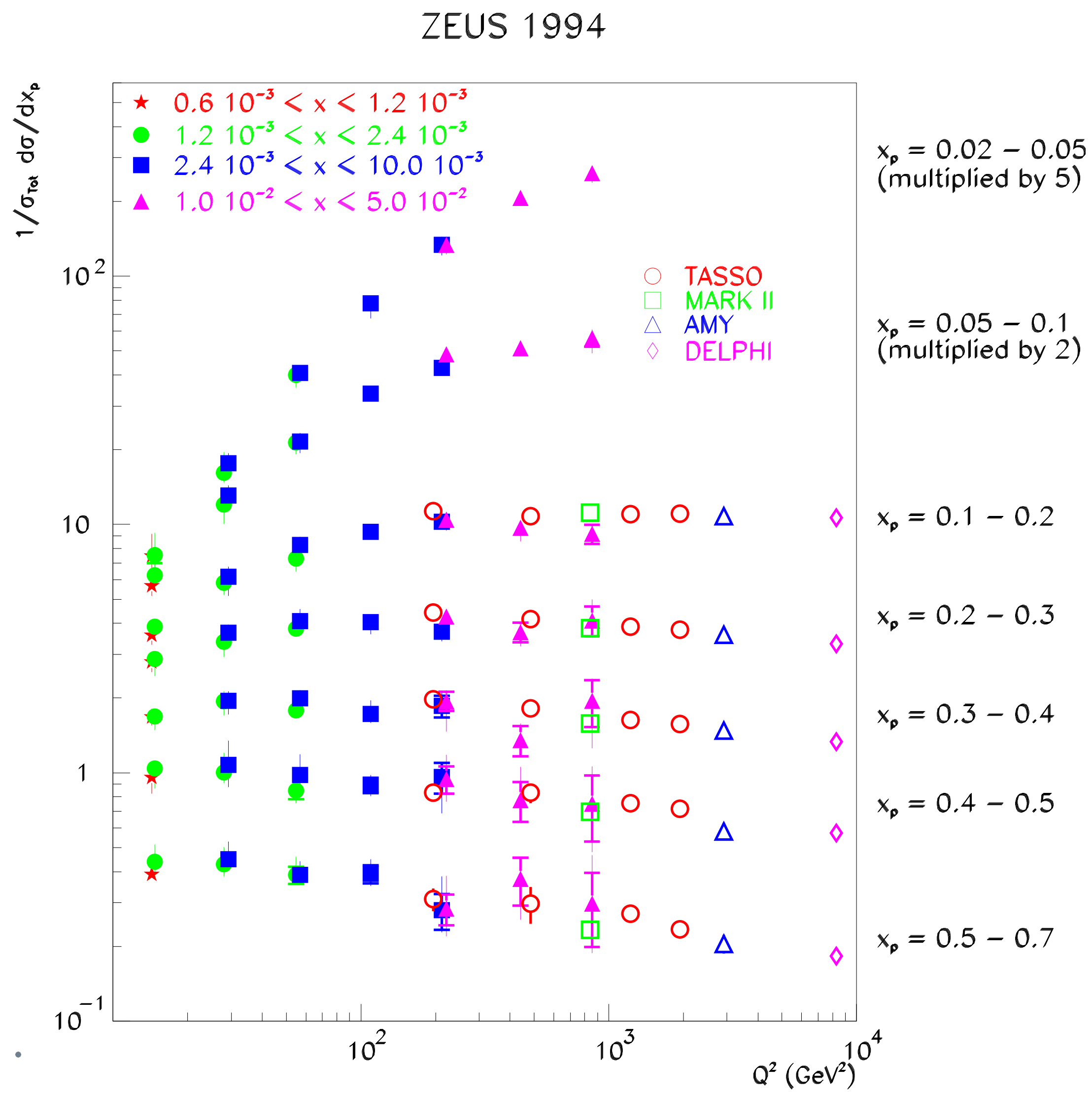
PROGRESS



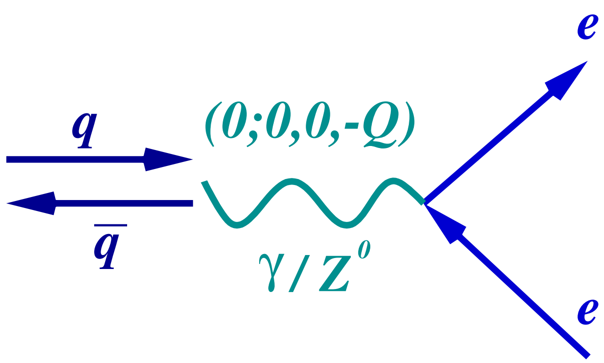
Outline:

- High x and Q^2 DIS
- High M_{3J} and E_T^{JET} γp
- prompt - γ
- $\gamma p \rightarrow$ DIS
- $e^+e^- \leftrightarrow ep \leftrightarrow p\bar{p}$

FRAGMENTATION IN DIS



Breit frame:



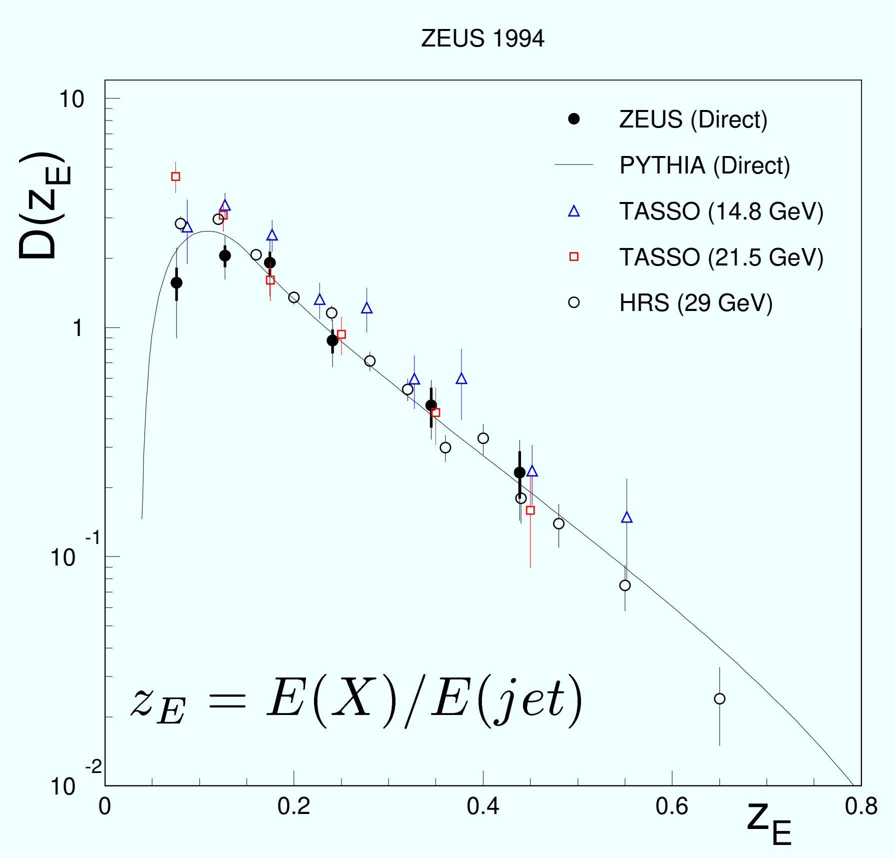
$$x_p = p_{\text{HADRON}}/p_{\text{MAX}}$$
$$p_{\text{MAX}} = Q/2$$

clear scaling violations

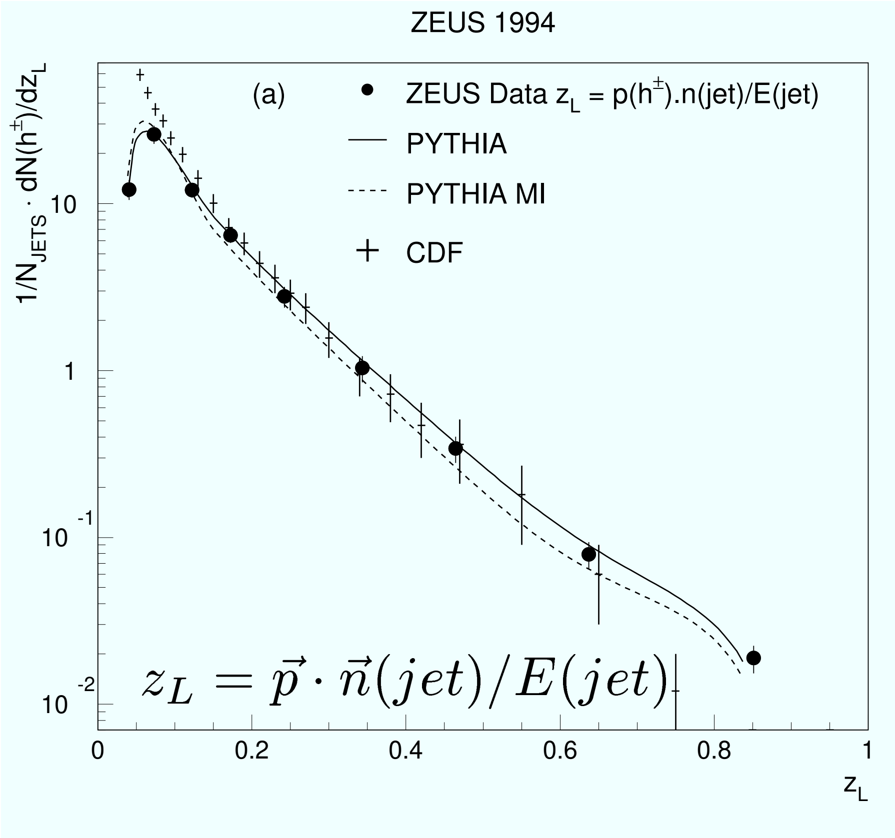
current hemisphere in DIS $\leftrightarrow$
one hemisphere of $e^+e^- \to q\bar{q}$
$\rightsquigarrow$ universality of fragmentation

FRAGMENTATION IN γp

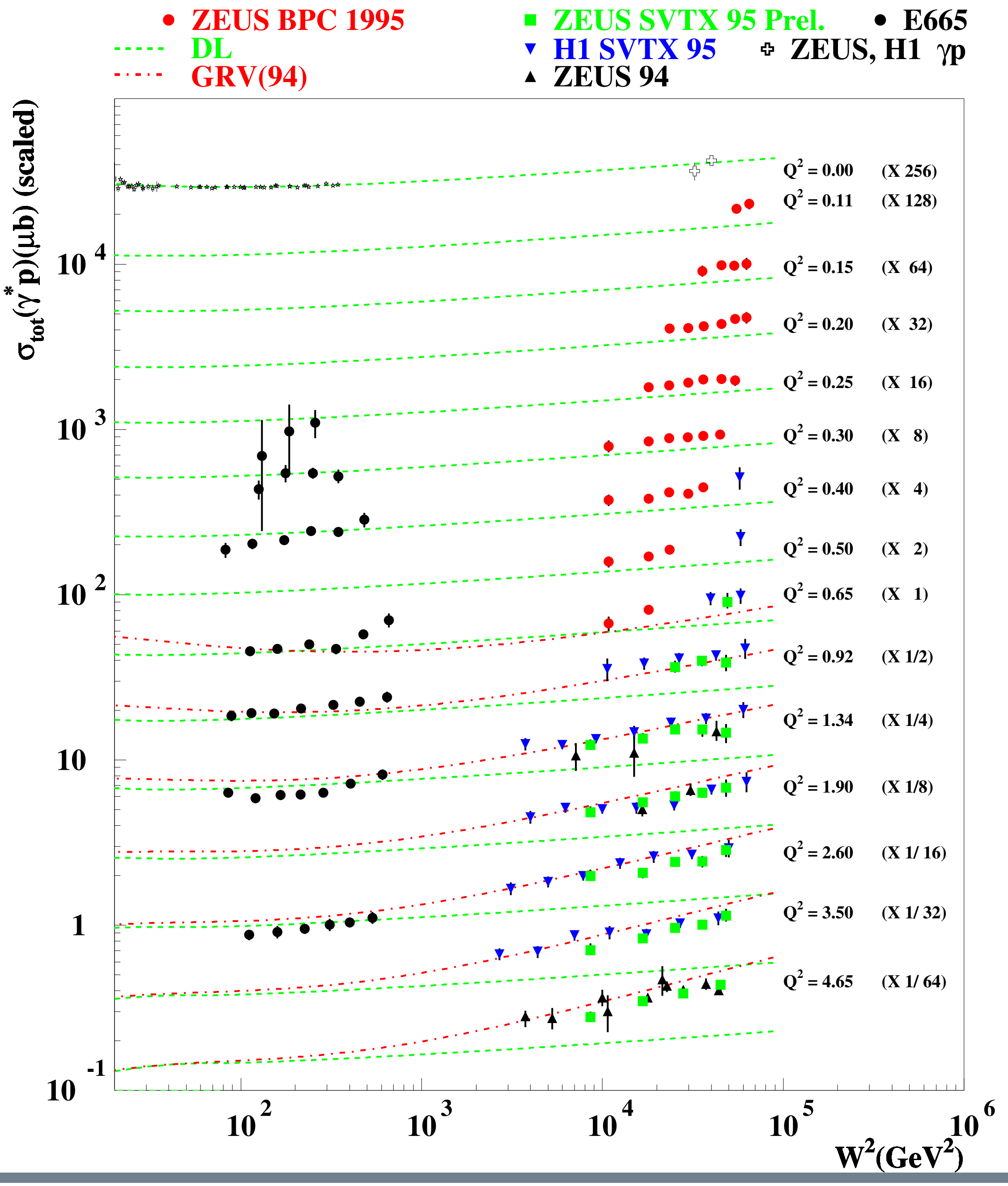
K^0 in e^+e^- and γp:



γp compared to $p\bar{p}$:



$\gamma p \leftrightarrow e^+e^-$ and $\gamma p \leftrightarrow p\bar{p} \rightsquigarrow$ HERA as a link between e^+e^- and $p\bar{p}$



← Regge parametrization successful for $Q^2 \sim 0$

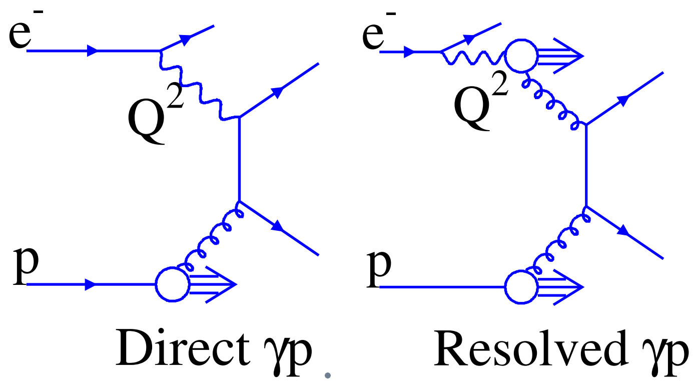
$$\sigma_{\rm tot}^{\gamma^* p}(W^2, Q^2) \approx \frac{4\pi^2\alpha}{Q^2} F_2(x, Q^2)$$

$$W^2 \approx Q^2/x$$

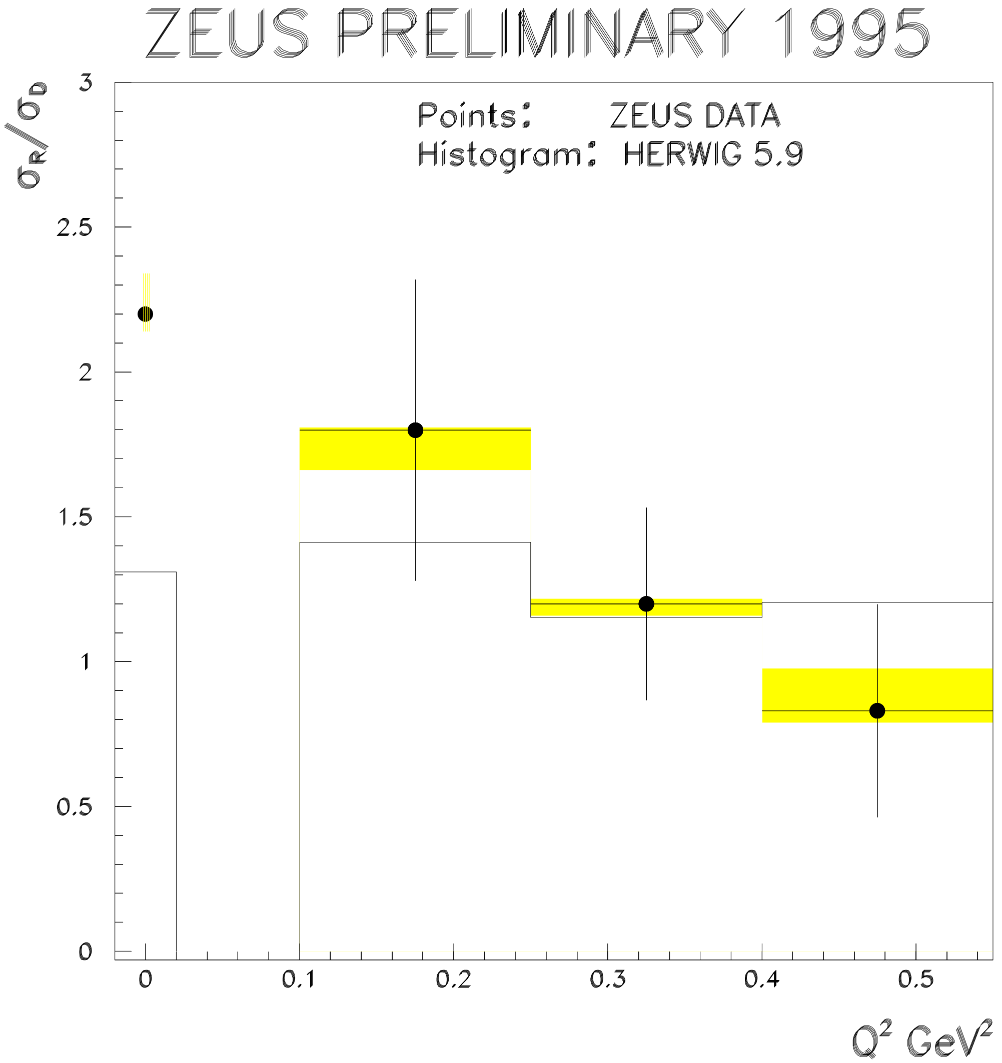
← pQCD apparently valid as low as $Q^2 \sim 1\,\mathrm{GeV}^2$

$\gamma p \longrightarrow$ DIS Transition

$\gamma p \rightarrow$ DIS Transition

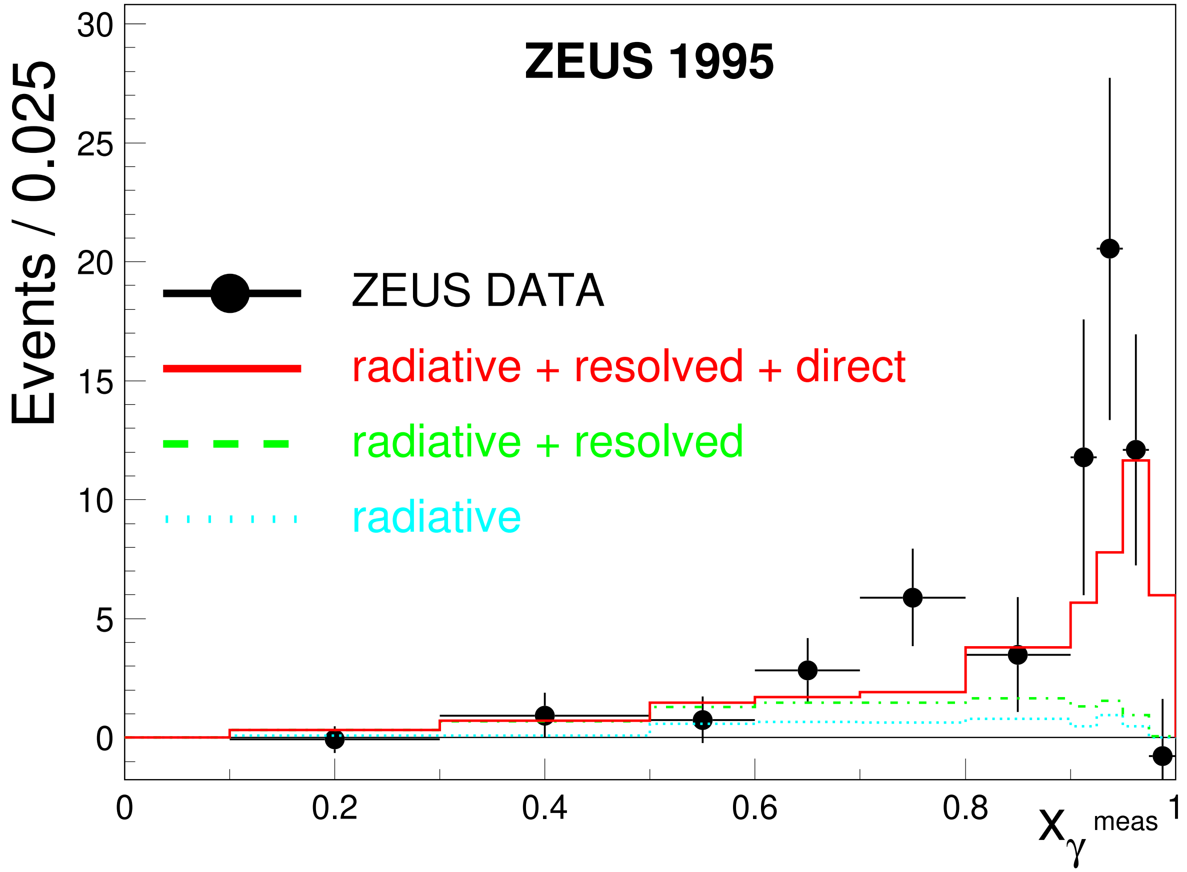


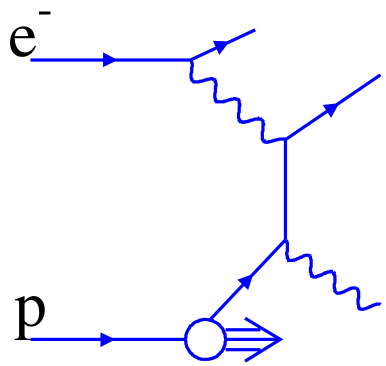
Resolved to Direct ratio in dijet photoproduction:



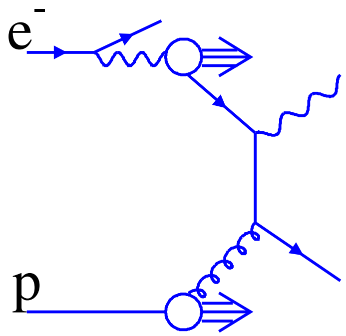
Hadronic component of the photon is suppressed as momentum transfer increases

Prompt Photon Production





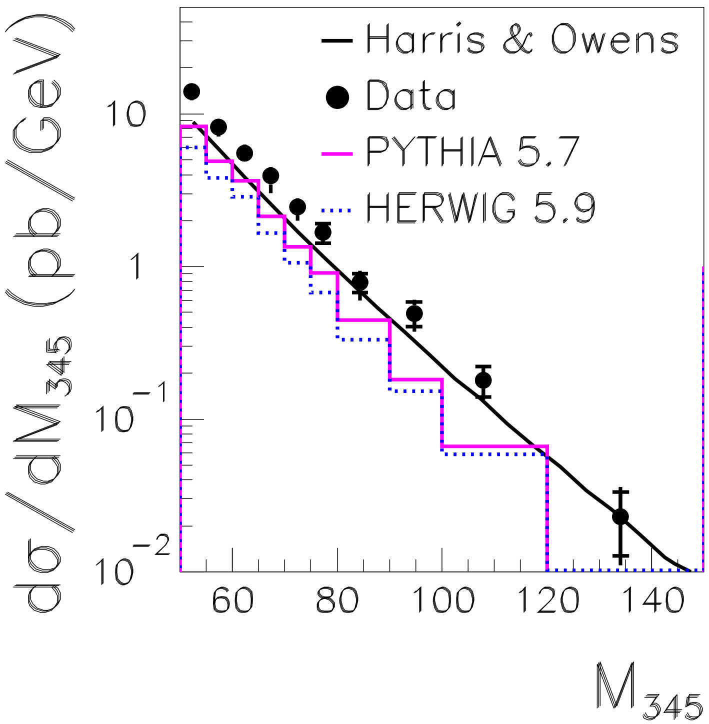
Direct Prompt γp

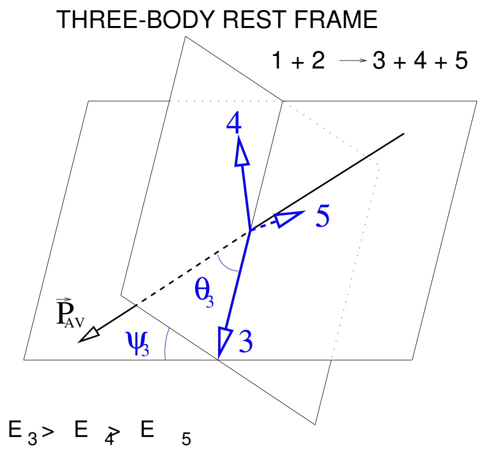


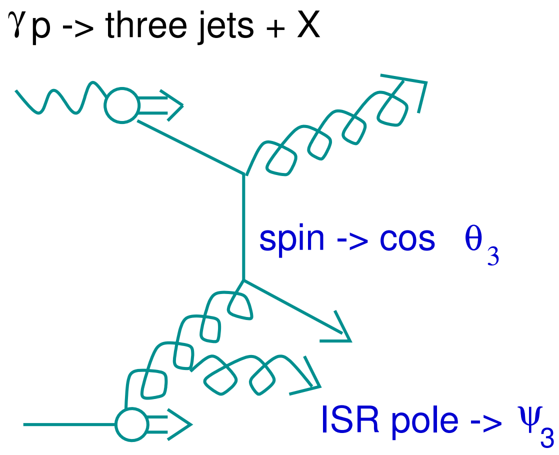
Resolved Prompt γp

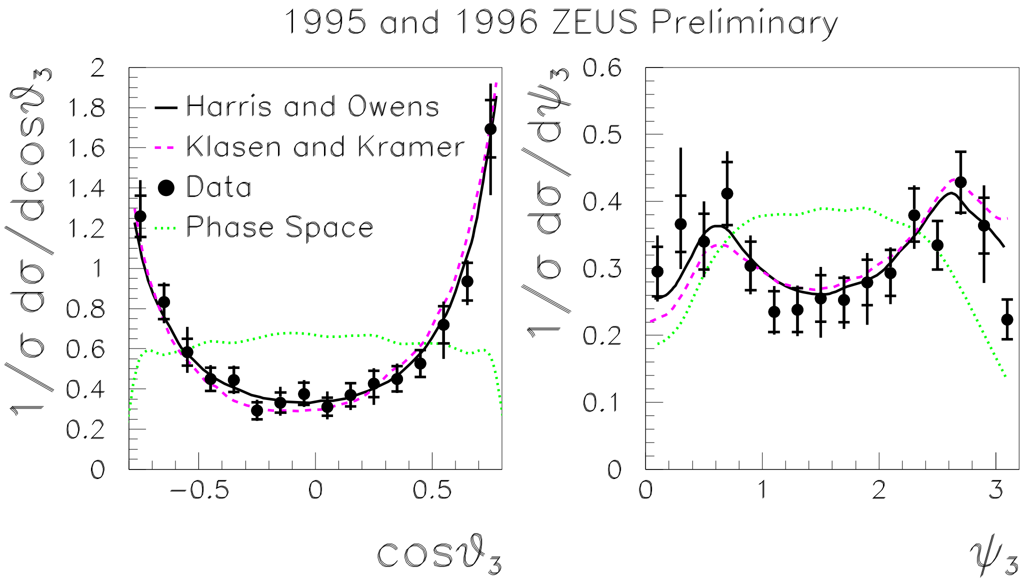
Prompt photon production at HERA offers unique and clean QCD laboratory

HIGH M_{3J} AND E_T^{JET} γp



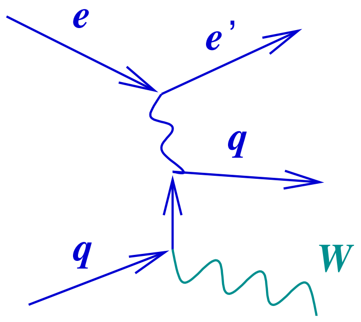




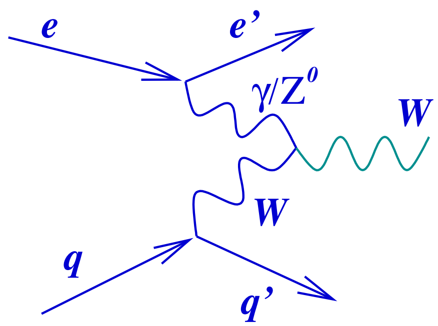


High E_T multijet γp is sensitive to spin of primary exchange and ISR in $\mathcal{O}(\alpha\alpha_s)$ pQCD matrix elements

LEPTON AND HIGH $\not{p}_t$



W from initial q



W from WWV vertex

$W \rightarrow e\nu$:

- Isolated Electron
- $\not{p}_t > 19$ GeV
- $\theta_{\mathrm{ACOP}} > 0.3$ rad

3 expected, 4 observed

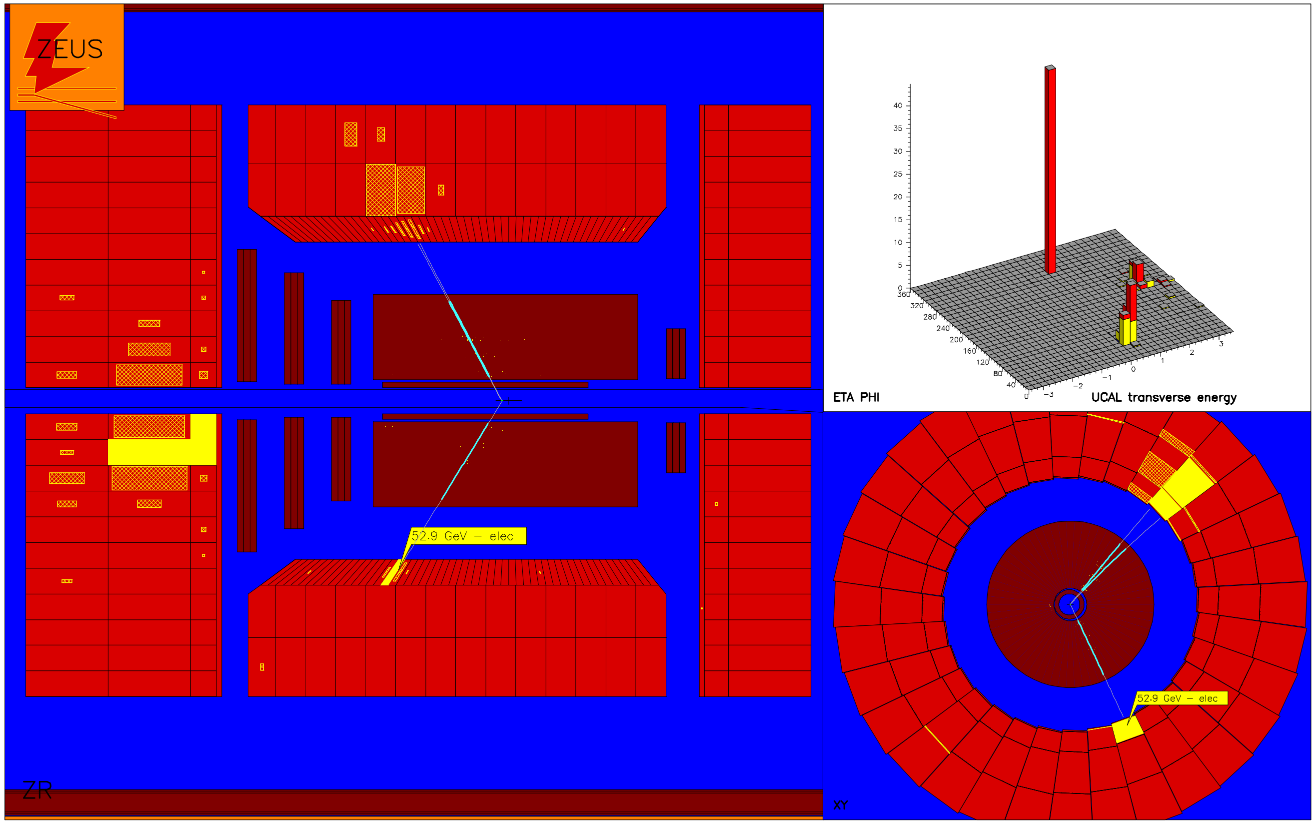
$W \rightarrow \mu\nu$:

- Isolated Muon
- $\not{p}_t > 18$ GeV
- $p_t > 18$ GeV

1 expected, 0 observed

$\rightsquigarrow$ anomalous $WW\gamma$ coupling limits of $\Delta\kappa < 4.7(\lambda = 0)$ and $|\lambda| < 8.7(\Delta\kappa = 0)$

Acoplanar e^+ + jet(s) event



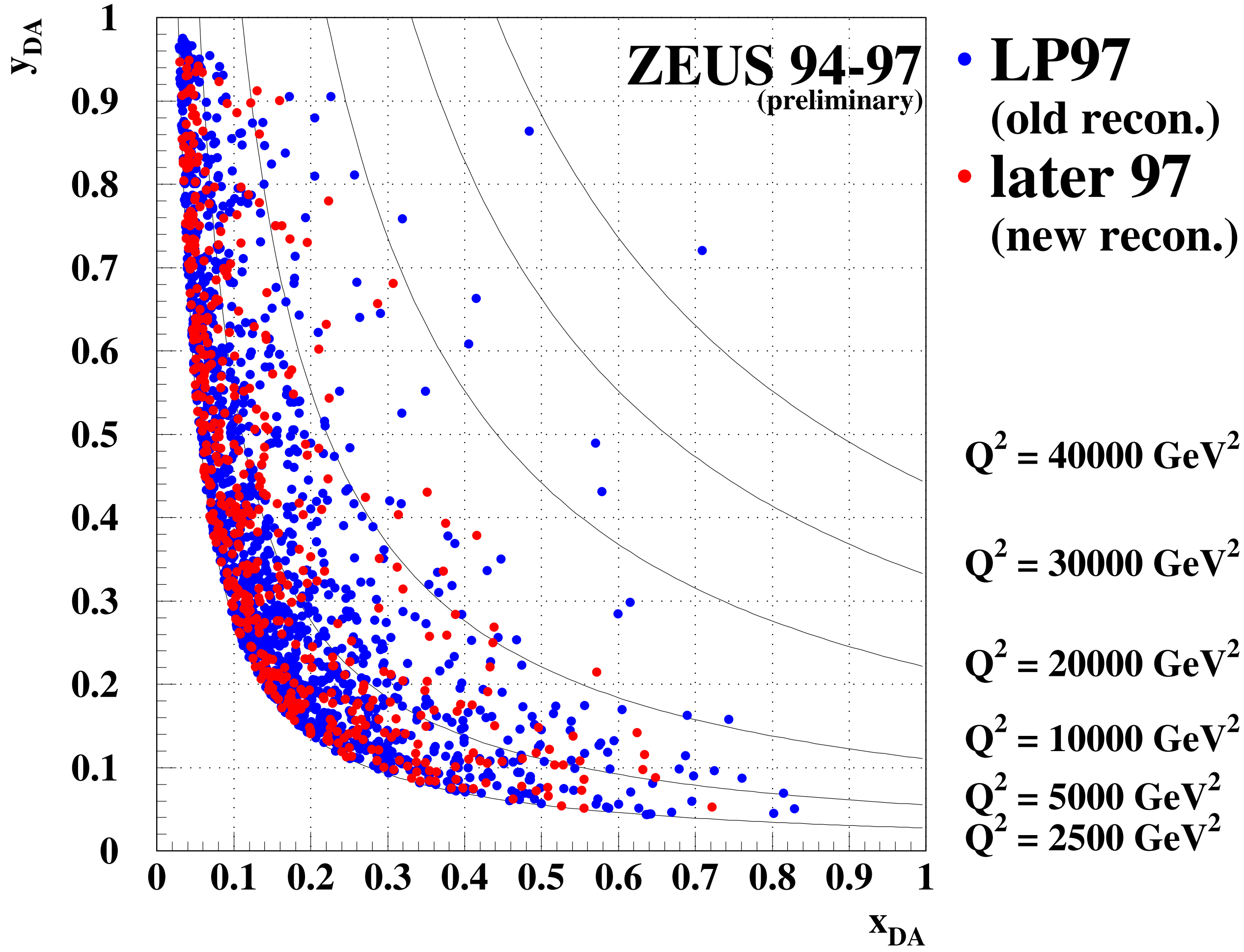
$$P_t(e^+) = 52.7\,\text{GeV} \qquad P_t(\text{had}) = 20.4\,\text{GeV}$$

$$\theta_e = 58.1^\circ \qquad \text{Acoplanarity} = 39.0^\circ$$

$$\not{P}_T = 39.1\,\text{GeV} \qquad E - P_z = 51.0\,\text{GeV}$$

$$M_t(l\nu) = 89.5\,\text{GeV}$$

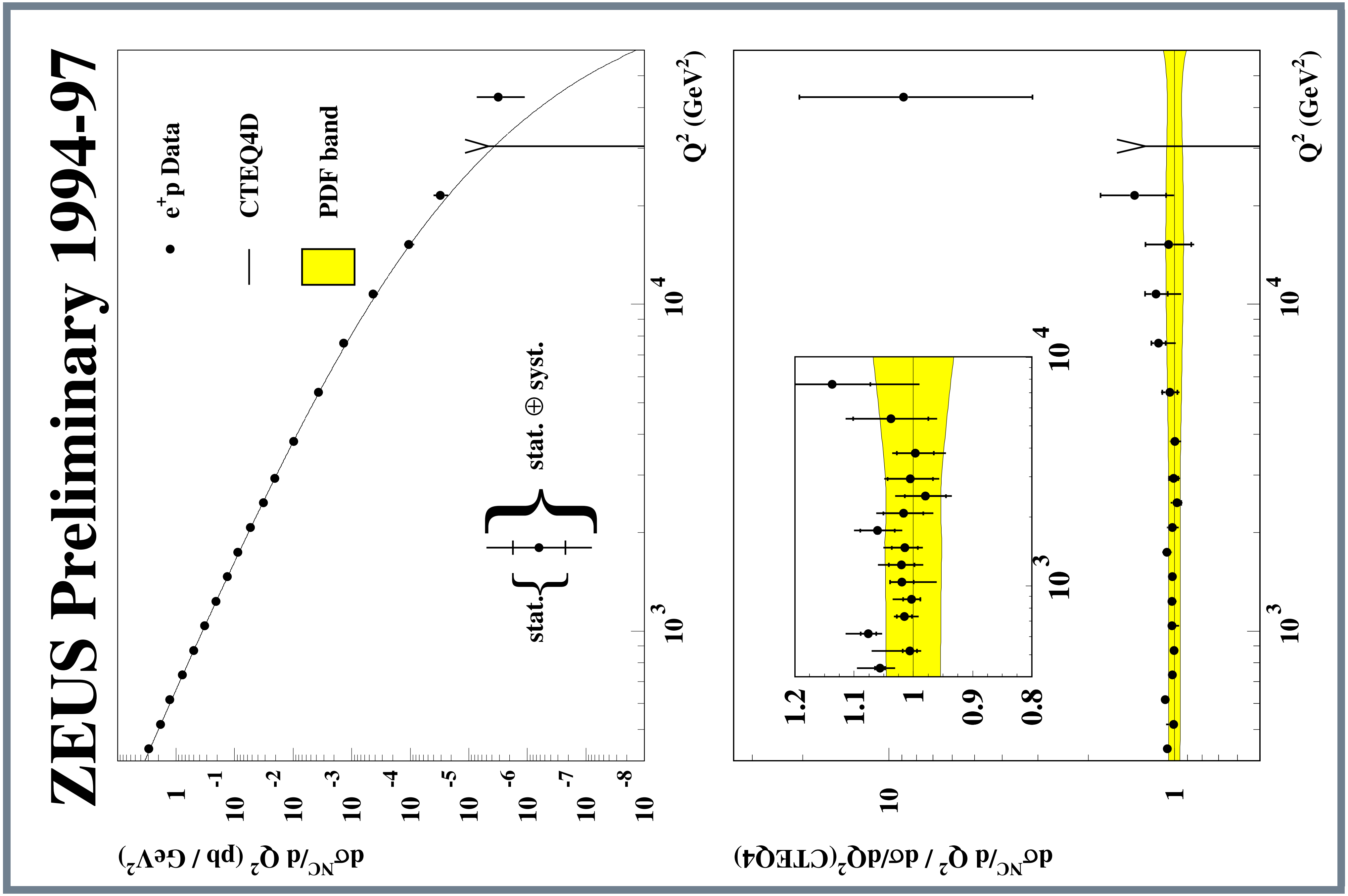
HIGH x AND Q^2 NC DIS



$Q^2 > 35000\text{GeV}^2$:

2 events observed where 0.29 ± 0.02 are expected (no new events)

$\Rightarrow$ measure $d\sigma/dQ^2$


ZEUS Preliminary 1994-97
e+p Data
CTEQ4D
PDF band
stat.
stat. ⊕ syst.
dσNC/d Q2 (pb / GeV2)
dσNC/d Q2 / dσ/dQ2(CTEQ4)
Q2 (GeV2)
1
10 -1
10 -2
10 -3
10 -4
10 -5
10 -6
10 -7
10 -8
10 3
10 4
10
1.2
1.1
0.9
0.8

HIGH x AND Q^2 CC DIS

$Q^2 > 20000\mathrm{GeV}^2$:

3 events observed where

$0.97^{+0.65}_{-0.47}$ are expected

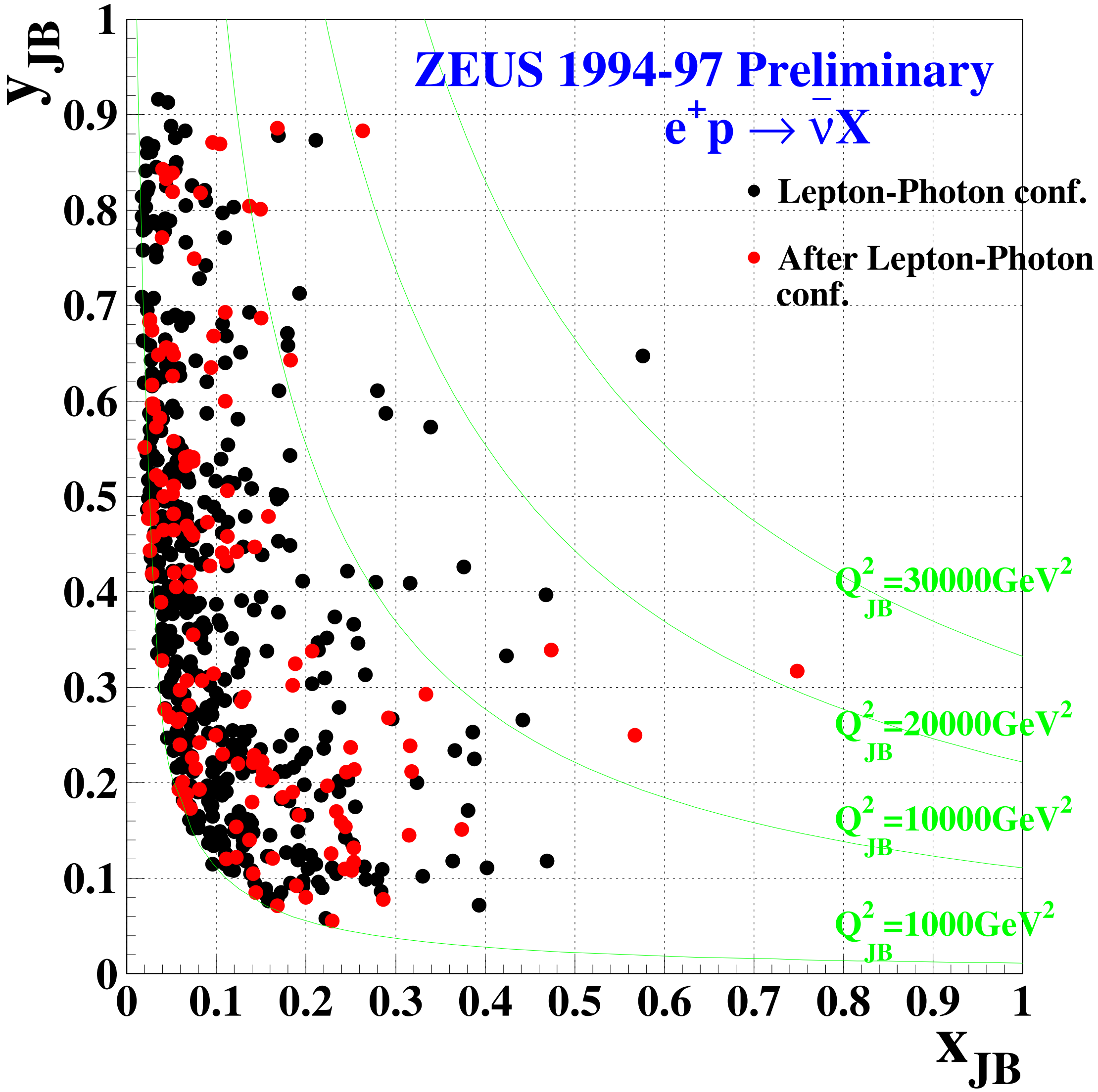
(2 new events)

$Q^2 > 30000\mathrm{GeV}^2$:

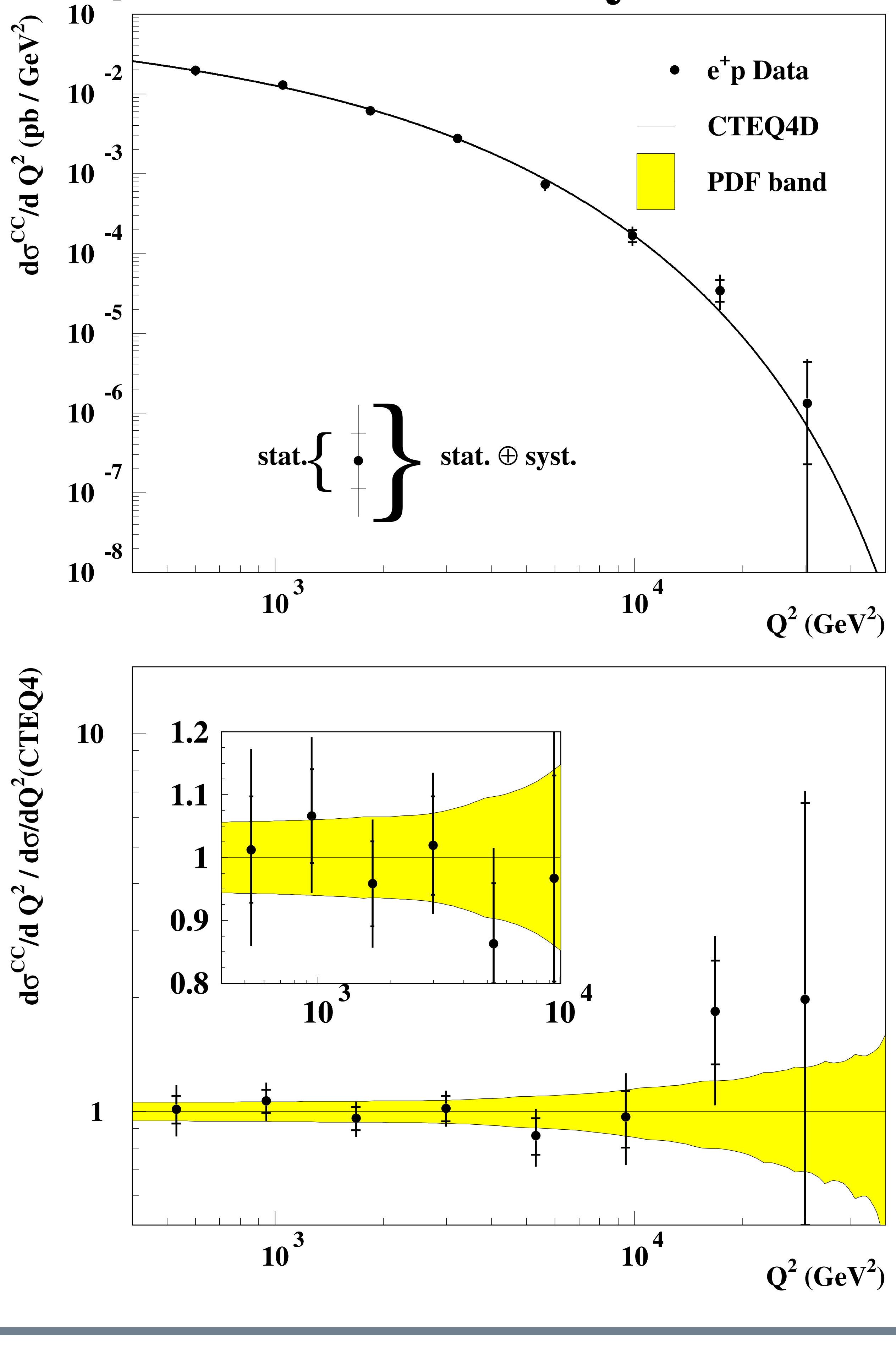
1 event observed where

$0.06^{+0.08}_{-0.04}$ are expected

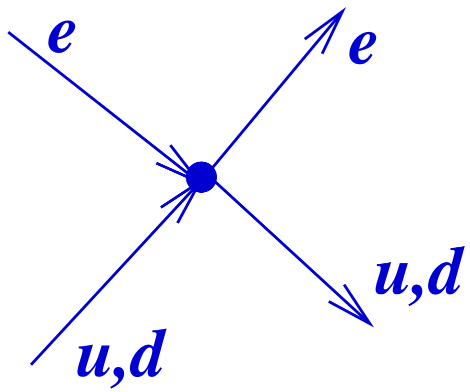
(no new events)



ZEUS Preliminary 1994-97



Extraction of Physical Parameters

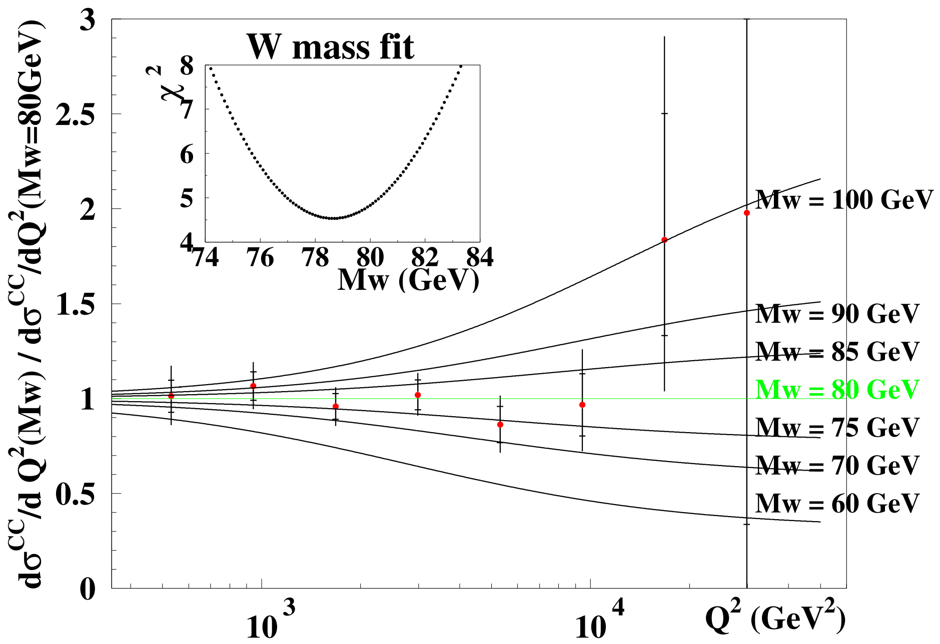


Contact Interactions:

- maximum likelihood fit to $d\sigma/dQ^2$ sets limits on NC contact terms
- effective mass limits are 2-5 TeV at 95% confidence depending on the model

W mass:

- W-mass dependence of CC $d\sigma/dQ^2$:
- $M_W = 78.6^{+2.5}_{-2.4}(stat.)^{+3.3}_{-3.0}(syst.)$GeV



Summary

Low-Q^2 DIS and moderate-E_T photoproduction investigations at HERA now constitute a mature field. Precision studies of these processes have been made and the comparison of final states produced by e^+e^- and $p\bar{p}$ machines is made possible by the HERA data.

Significant improvements in the experimental environment are planned:

- improved acceptance and resolution
- polarized beams
- incoming electrons
- $\sim 150\text{pb}^{-1}$ per year

Leading to:

- precision EW measurements;
  γZ^0 interference, qZ^0 couplings, ...
- QCD in new regimes;
  high E_T, high M_J, high $\Delta\eta$, ...
- detailed proton structure;
  xF_3, F_s, xU, F_2^{em}, ...

The UK physicists with the ZEUS collaboration have made important contributions to the field of high energy physics. We are looking forward to the exciting physics opportunities beyond 2000.