Leading Baryon Production in DIS and Photoproduction

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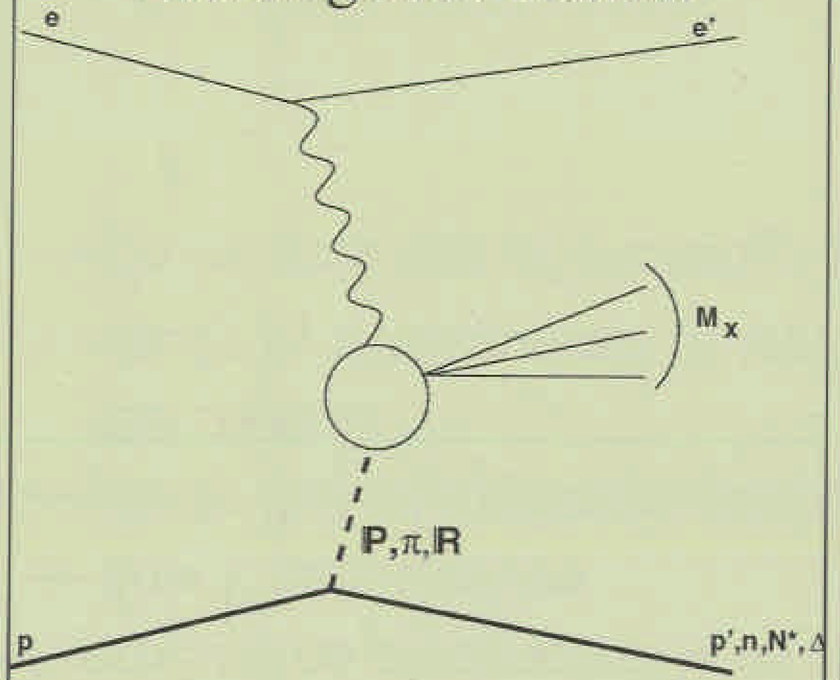
Introduction

Exchange mechanism

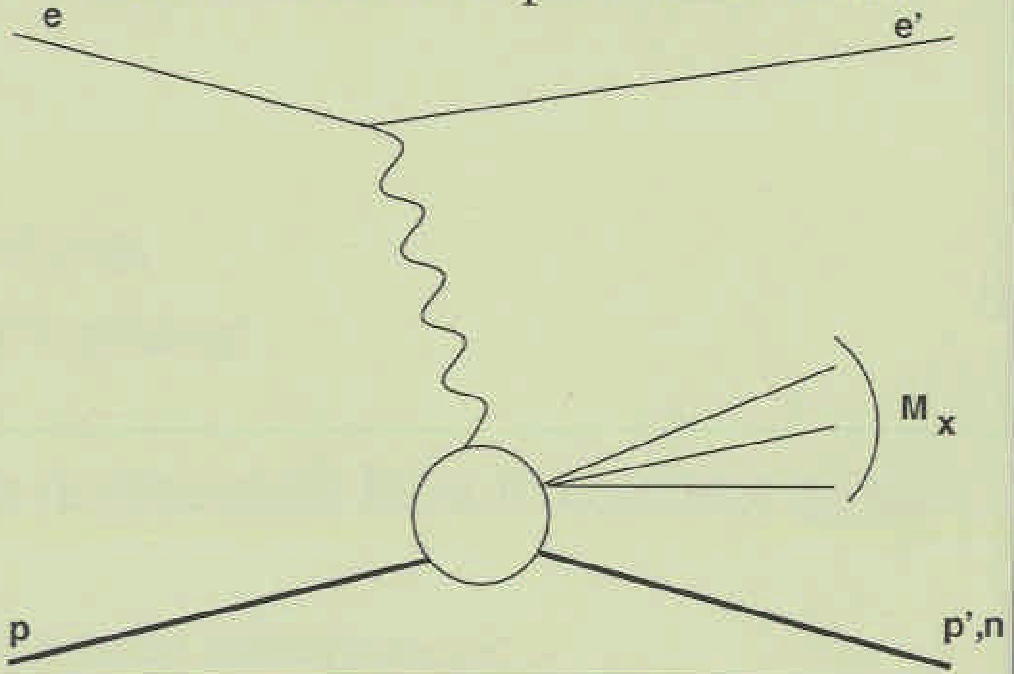


• factorization:

$\sigma(ep \to e'nX) = f_{\pi/p}\sigma(e\pi \to e'X)$

• rescattering effects

hadronization of proton remnant



Kinematic Quantities

$$x_L = z = \frac{E_{LB}}{E_p}$$

$$t = (p_{LB} - p_p)^2 = -\frac{p_T^2}{x_L} - \frac{(1-x_L)\cdot(m_n^2 - m_p^2 x_L)}{x_L}$$

Motivation

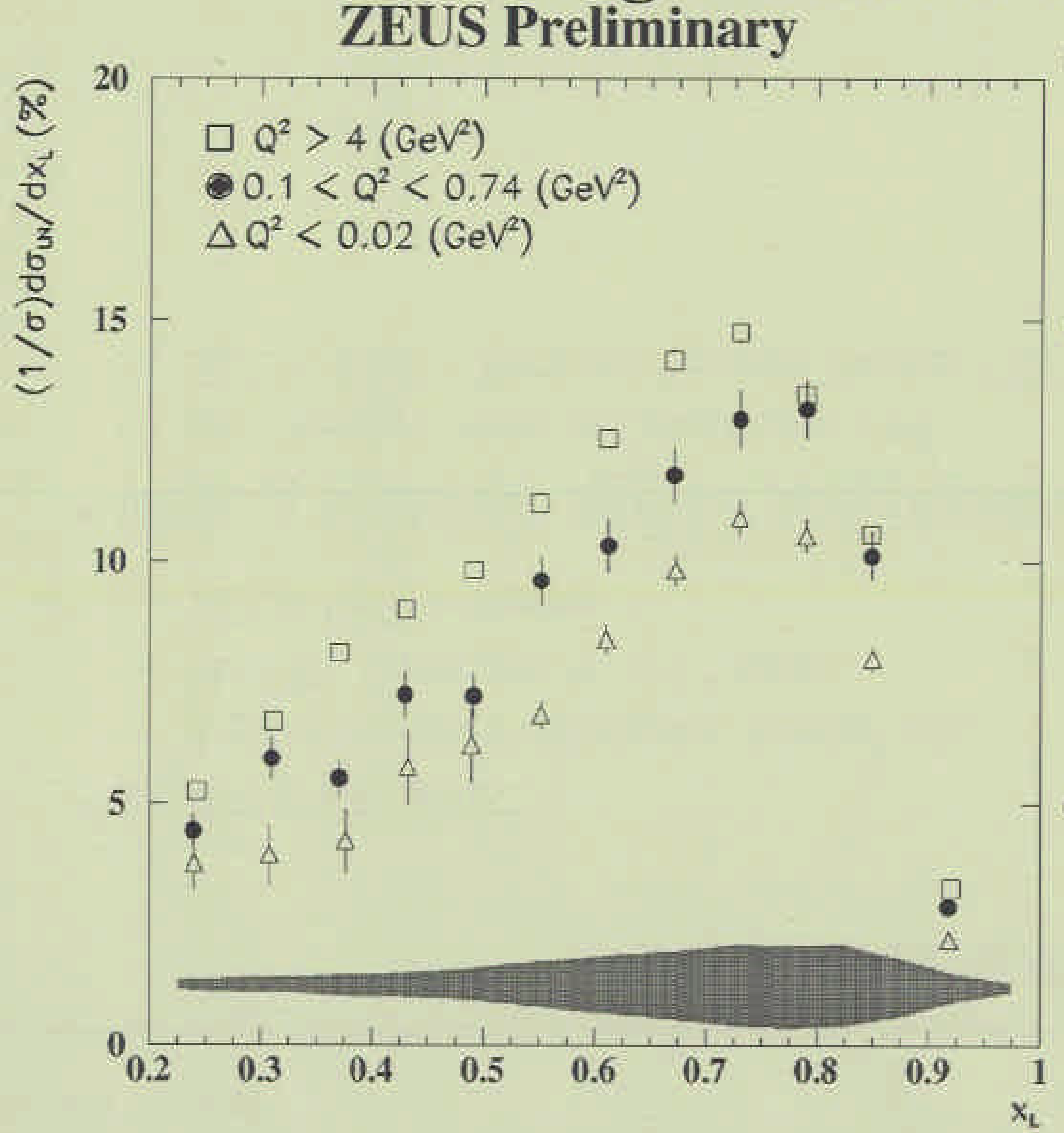
- study production mechanisms for leading baryons
- if production mechanism is an exchange mechanism:
  - check factorization
  - study flux of exchange particle in incoming proton, compare different models
  - study p_T-distributions of leading baryon
  - probe structure of exchange particle

Detectors

- leading protons:
  - employ standard techniques: Roman pots
  - H1 FPS: 2 stations, $\theta_p < 0.5$ mrad
  - ZEUS LPS: 6 stations
- leading neutrons: angular acceptance: $\theta_n < 0.8$ mrad
  - H1: Forward Neutron Calorimeter FNC
  - ZEUS: FNC + Forward Neutron Tracker FNT

$e\,p \rightarrow e\,n\,X$

Leading Neutron Production

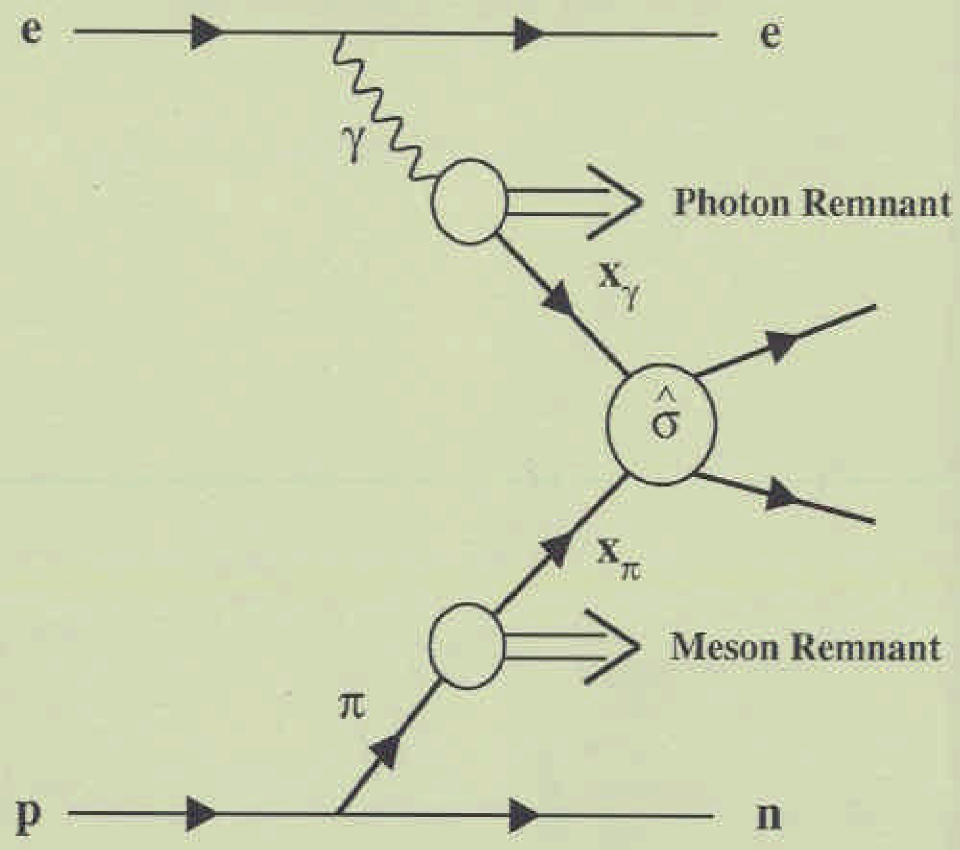


- fractional neutron yield increases with Q^2, saturates at about 4 GeV^2 (not shown)
- can be attributed to absorptive effects: as Q^2 increases, size of virtual photon decreases, probability of rescattering resulting in loss of neutron decreases
- shaded band shows systematic uncertainty due to FNC acceptance uncertainty

Abstract 883

Dijet Photoproduction with LN

- H1:
  - — tagged photoproduction
  - — Jets: cone algorithm with R=1, $E_T>4(7)$ GeV, $-1 < \eta < 2$
  - — neutron: $E_n > 400$ GeV, $\theta_n < 0.8$ mrad
- ZEUS:
  - — $0.2 < y < 0.8$
  - — Jets: k_T algorithm, $E_T > 6$ GeV, $-2<\eta<2$
  - — neutron: $E_n > 400$ GeV, $\theta_n < 0.8$ mrad
- measured: neutron energy spectra, differential dijet cross section as function of E_T, η, x_γ, x_π
- goals: n production mechanism, check factorization, compare pion flux models



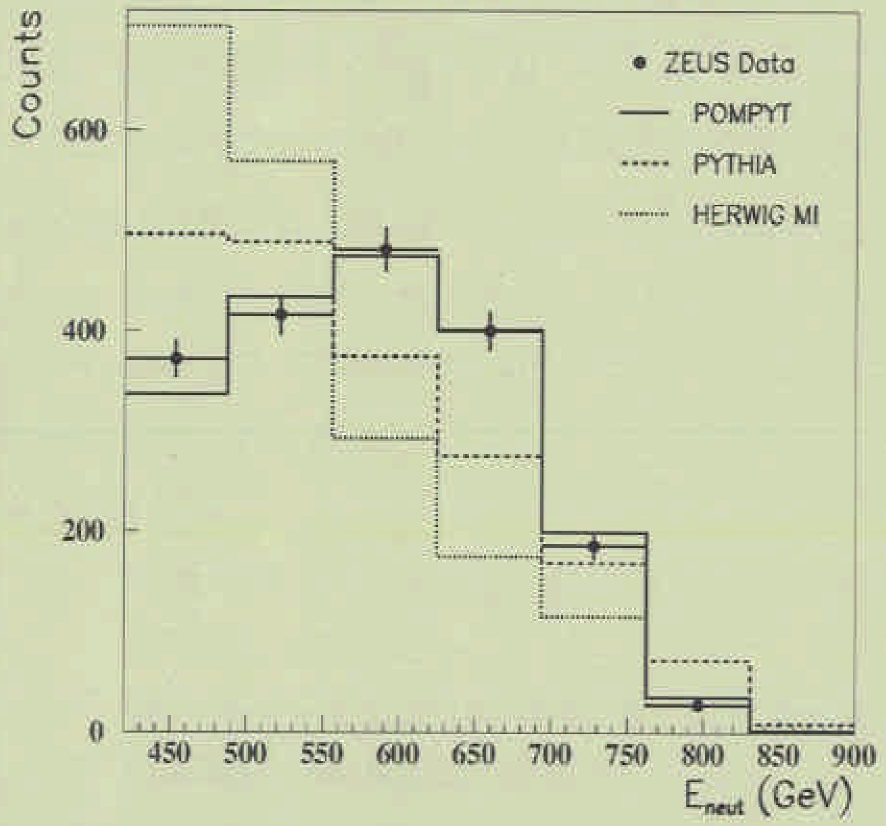
Abstracts 967 and -

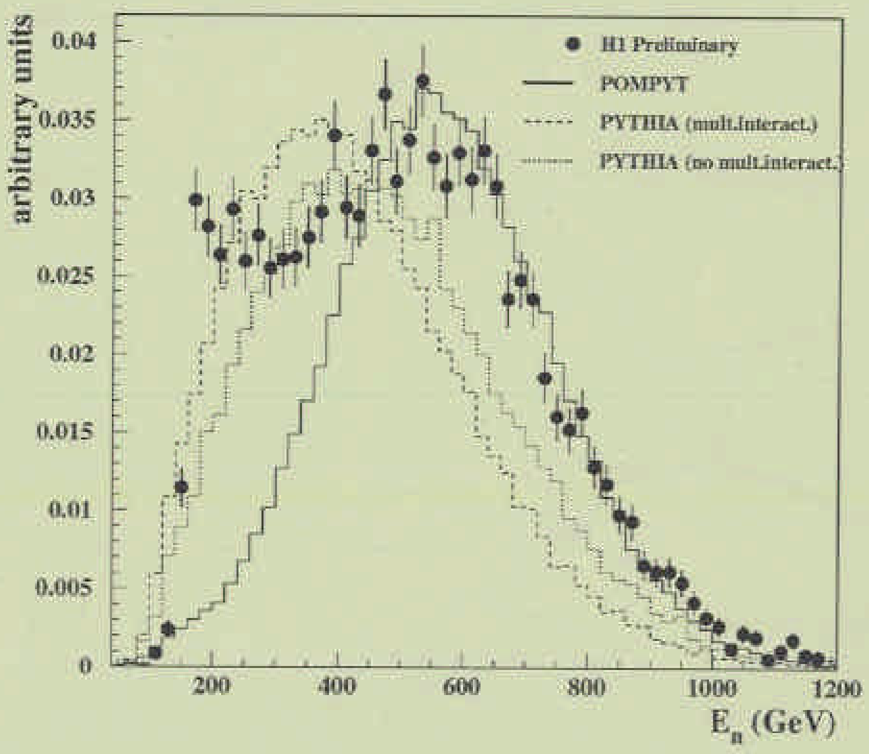
$e\,p \rightarrow e\,n\,jet\,jet\,X$

ICHEP2000

Leading Neutron Production Mechanisms

ZEUS 1995 Preliminary

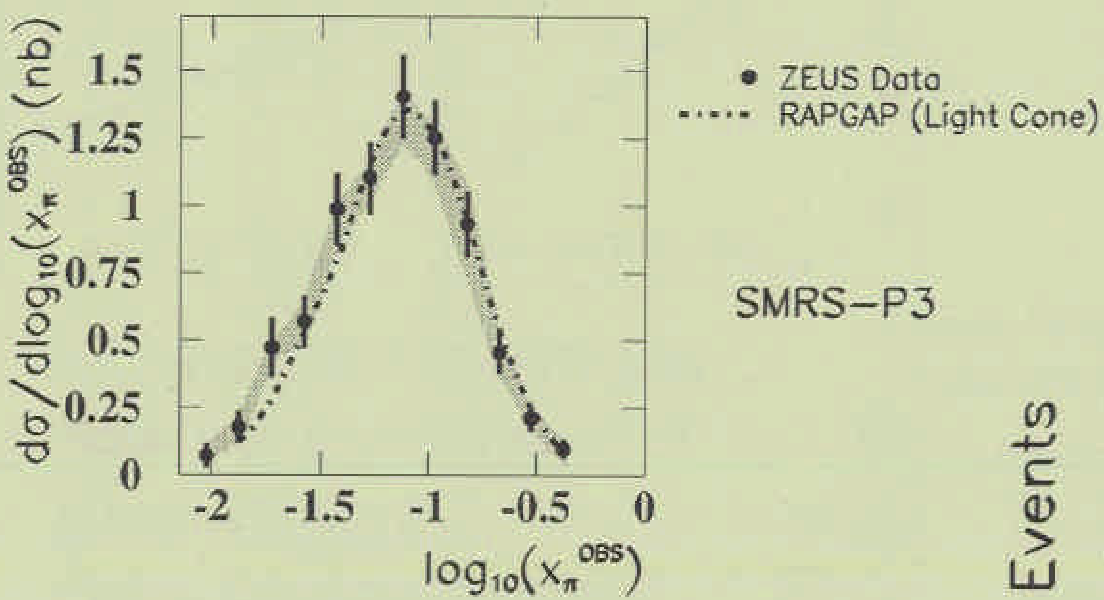




for $x_L > 0.5$ MCs with one-pion-exchange (POMPYT, RAPGAP) describe shape (and normalization) of neutron energy spectrum, inclusive MCs do not

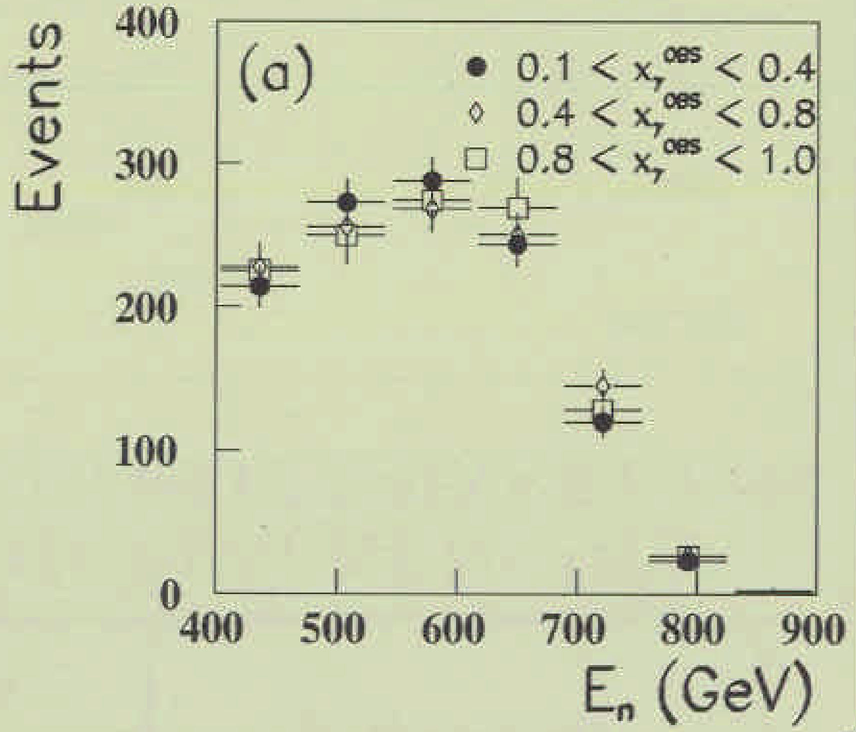
Abstracts 967 and -

Dijet Photoproduction with LN (cont'd)



OPE also describes the jet distributions

$$x_\pi^{OBS} = \frac{\Sigma_{jet} E_T e^{\eta}}{2E_\pi}$$



factorization: shape of neutron energy spectrum independent of

$$x_\gamma^{OBS} = \frac{\Sigma_{jet} E_T e^{-\eta}}{2E_\gamma}$$

Abstracts 967 and -

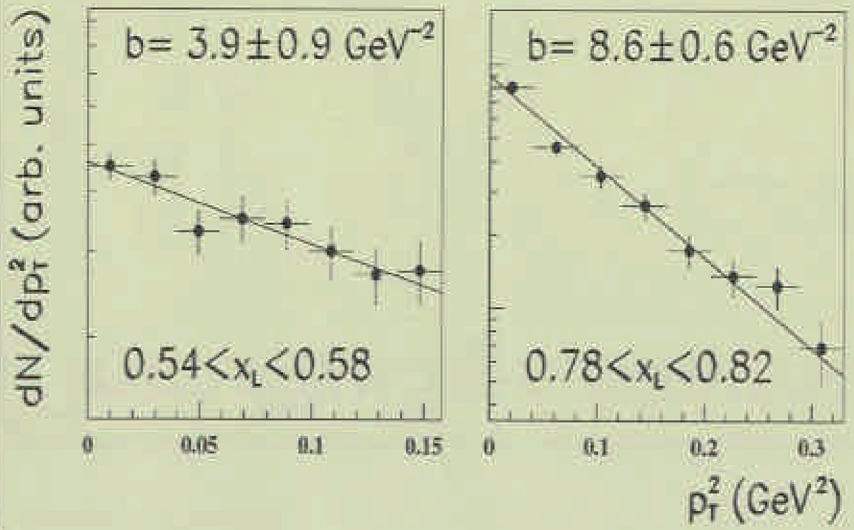
$e p \rightarrow e n X$

Leading Neutron p_T Distributions in DIS

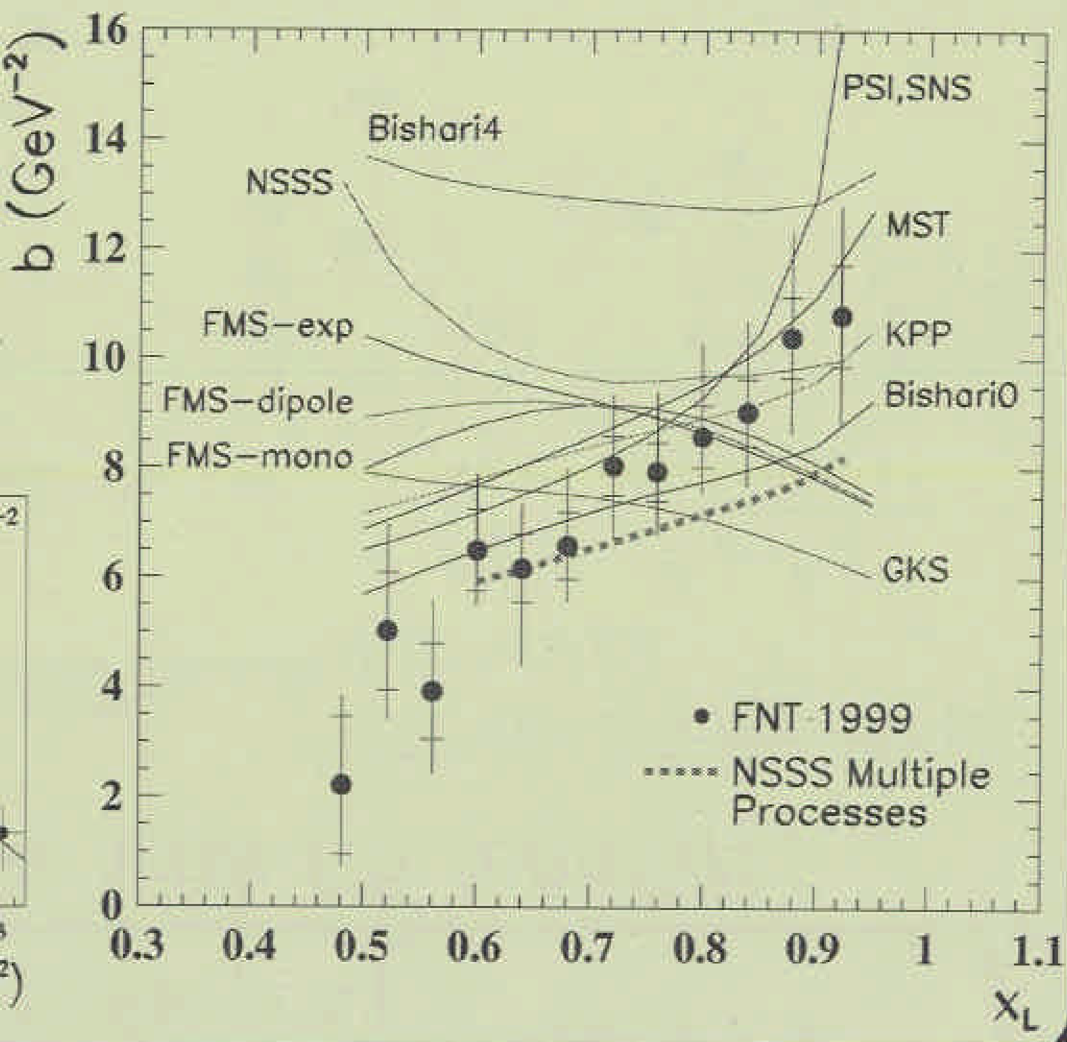
$$\frac{dN}{dp_T^2} \propto e^{-b(x_L)p_T^2}$$

- measurement uses the ZEUS Forward Neutron Tracker (FNT)
- slope b is a function of x_L

ZEUS PRELIMINARY 1999



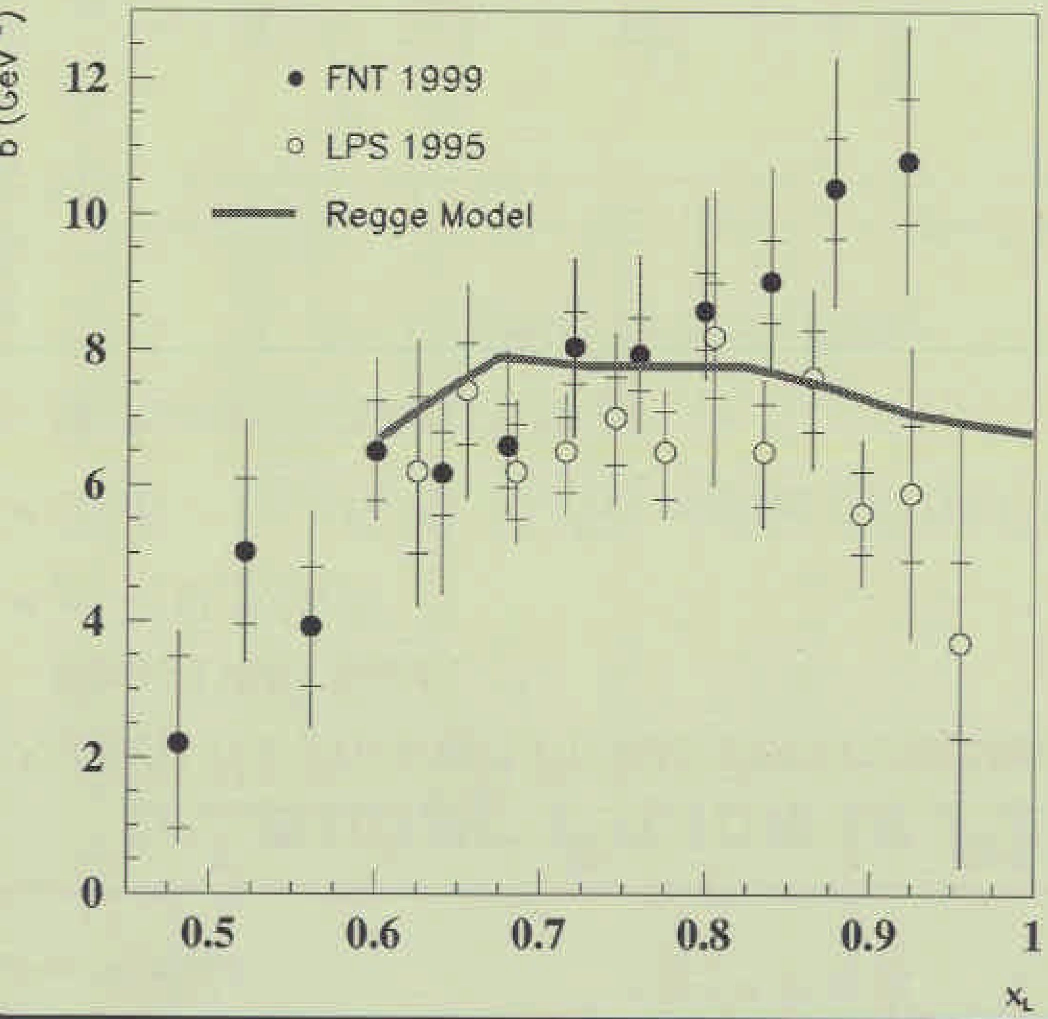
ZEUS PRELIMINARY 1999



Abstract 882

Leading Neutron p_T Distributions in DIS

ZEUS PRELIMINARY

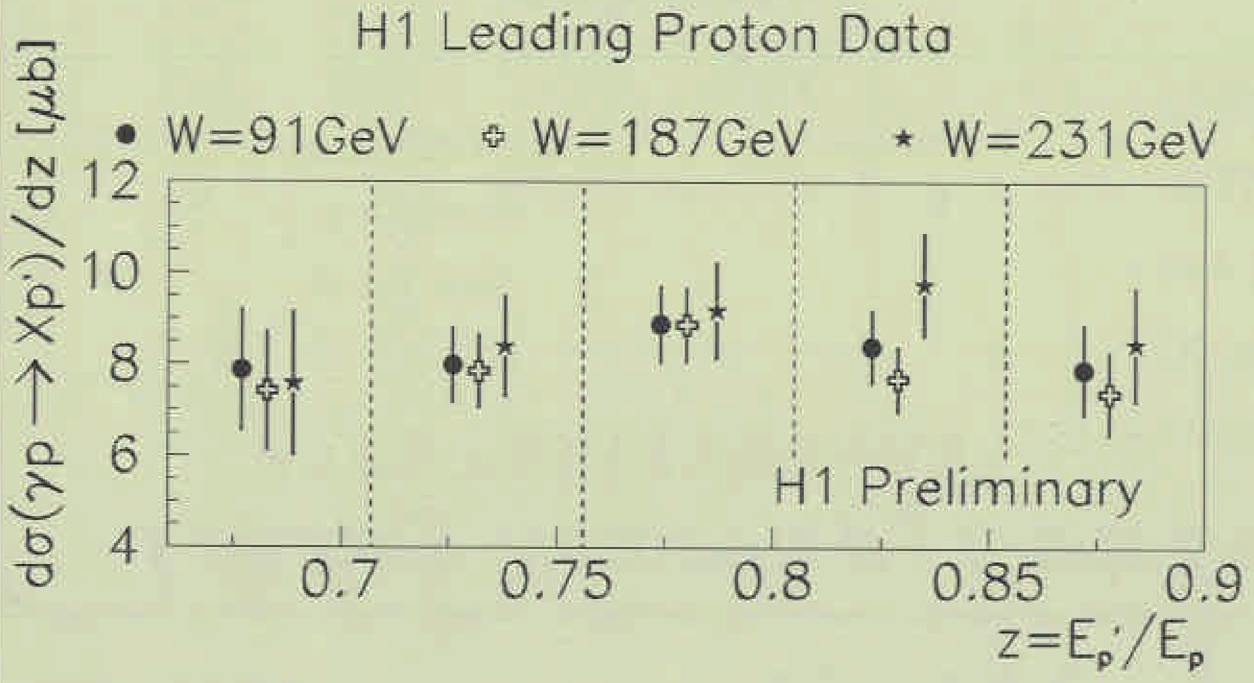


- comparison with leading proton p_T distributions
- for leading protons, iso-scalar exchanges can also contribute

Abstract 882

Leading Proton in Photoproduction

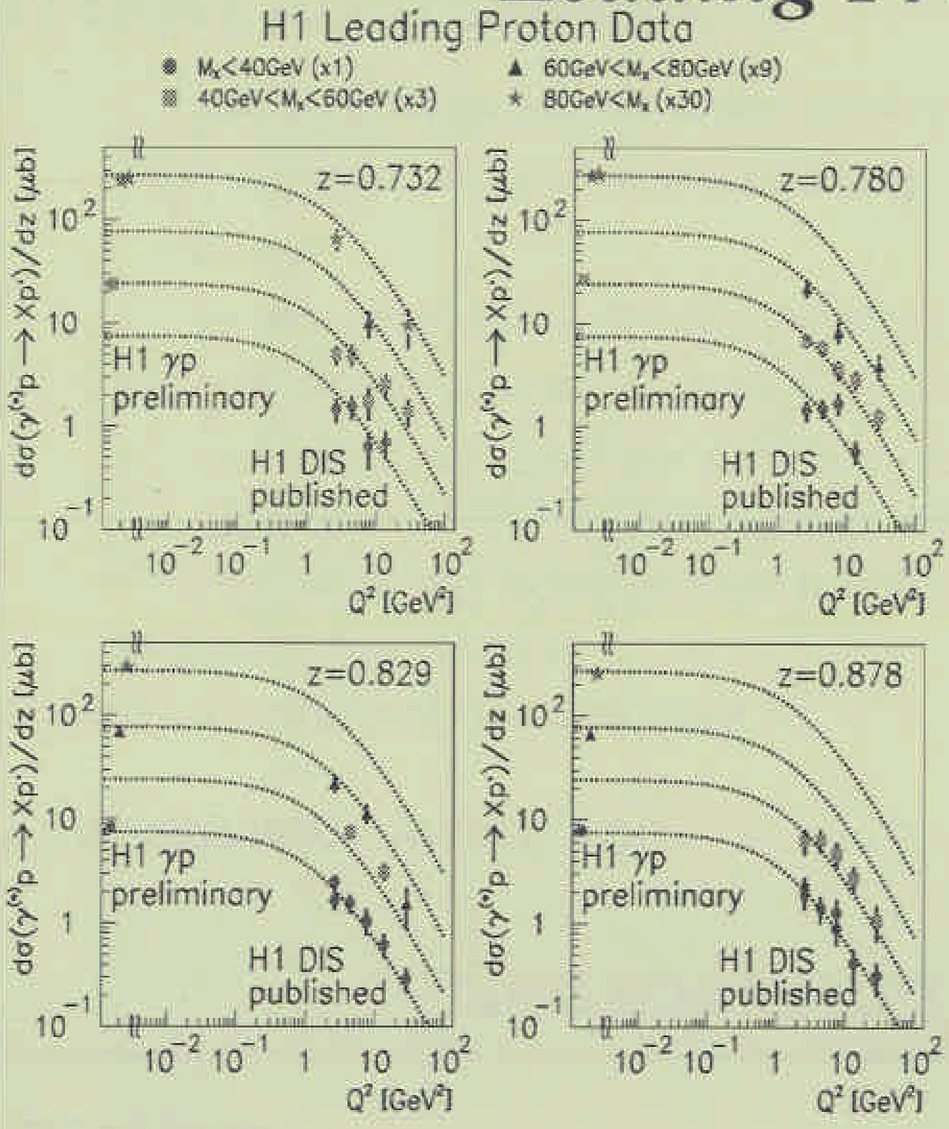
- using H1 Forward Proton Spectrometer (FPS), tagged photoproduction, 1996 data
- $p_T < 0.2$ GeV
- $0.66 < x_L < 0.90$: in this region diffractive process suppressed relative to π, reggeon exchange



- cross section approximately constant as function of W and x_L (=z)
- agrees with factorization assumption

Abstract 967

Leading Proton cont'd



- model F_2 as sum of VMD term and partonic term with 2 free parameters, $Q_{VM}{}^2$, C_{VM}

$$F_2^{LP} = F\left(C_{VM}^{LP} C_{VM} \cdot F_2^{VMD} + \frac{Q^2}{Q^2 + Q_{VM}^2} \cdot F_2^{part}\right)$$

- use $Q_{VM}{}^2$, C_{VM} from fit to inclusive F_2, use global scale factor F
- fit with $C_{VM}{}^{LP}$ as free parameter: $C_{VM}{}^{LP} = 0.23$ ⇨
  — VMD part suppressed in LP events compared to inclusive

Abstract 967

Summary and Conclusions

- Factorization works well
- Leading neutron production:
  - in dijet photoproduction
    - MCs with OPE model describe neutron spectrum and jet distributions for $x_L > 0.5$
    - diffraction plays small role in that domain
    - data sensitive to pion flux, insensitive to pion PDF
  - p_T^2 distributions well described by $exp(-b(x_L)\, p_T^2)$
    - slope b rises linearly with x_L; measured dependence compared to various exchange models
  - yield of leading neutrons as function of Q^2
    - at low Q^2 quick rise, saturation above 4 GeV^2
- Leading proton production
  - cross section approximately constant as function of W and x_L
  - VMD part of LP cross section appears suppressed compared to inclusive cross section