



The QCD/HFS status report

S.Chekanov (ANL)

ZEUS general meeting
(June 19, 2003)

Group Overview

Coordinators: M.Sutton, J.Terrón, N.Brook (ext.), S.Chekanov

DQM: S.Hanlon → M.Vazquez

Funnel: A.Ziegler (left)

Trigger coordinator: S.Lammers → P.Ryan

Subgroup meetings:

- **Jets in DIS/PHP:** contact persons: J.Terron / S.Chekanov
- **Rapidity gaps between jets:** contact persons: A.Savin / M.Sutton
- **Event shapes in DIS** contact persons: A.Savin
- **Instantons in DIS** contact persons: E.Lohrmann/M.Sutton

New group member(s): Thomas Schoerner-Saddens

Left: Andy Ziegler, Arzu Ziegler, Sonja Hiller, Stathes Paganis

Paper status for the EPS03 conference

17-23 July 2003, Aachen, Germany: EPS-HEP03

- 1) Multijets in DIS (N.Krumnack, L.Li)
- 2) Inclusive jet production in DIS and parton dynamics at low x (S.Lammers, J.Terron)
- 3) Forward jets in DIS with FPC (A.Benen, S.Magill)
- 4) Prompt photons in DIS (M.Bell, D.Saxon)
- 5) Search for instantons in DIS (S.Hillert, A.Barakbaev, B.Levchenko, E.Lohrmann)
- 6) Bose-Einstein effect in DIS (L.Zawiejski, K.Olkiewicz, S.Chekanov, M.Derrick)
- 7) Prompt photons with jets in PHP (S.Chekanov, S.Magill, B.Musgrave)
- 8) Strange particle production in DIS (A. Ziegler, Ar. Ziegler, A.Raval)
- 9) Substructure dependence of jet cross sections at HERA (C.Glasman, J.Terron, M.Wing)
- 10) Study of color dynamics in photoproduction at HERA (C.Glasman, J.Terron)

Published (or at the EB stage):

- 1) **K0sK0s in DIS** (S.Paganis, M.Barbi)
- 2) **Low Q^2 dijets and photon structure** (D.Kcira, A.Lupi, H.Labes, M.Lightwood)
- 3) **Jets in CC DIS** (DESY-03-055) (M.Vazquez, C.Glasman)
- 4) Scaling violations and determination of α_s
(DESY-02-228, Phys. Lett. B 560 (2003) 7)
- 5) Measurement of subjet multiplicities in DIS at and determination of α_s
(DESY-02-217, Phys. Lett. B 558 (2003) 41)
- 6) Measurement of event shapes in deep inelastic scattering at HERA
(DESY-02-198, Eur. Phys. J. C 27 (2003) 531)
- 7) Observation of the strange sea in the proton via inclusive phi(1020)
(DESY-02-184, Phys. Lett. B553 (2003) 141)
- 8) Study of the azimuthal asymmetry of jets in DIS at HERA
(DESY-02-171, Phys. Lett. B551 (2003) 3)

DIS03 prel.
DIS03 prel.
New
DIS03 prel.
DIS03 prel.
DIS03 prel.
New
DIS03 prel.
New
Not ready

Status of group papers

Papers in the editorial board:

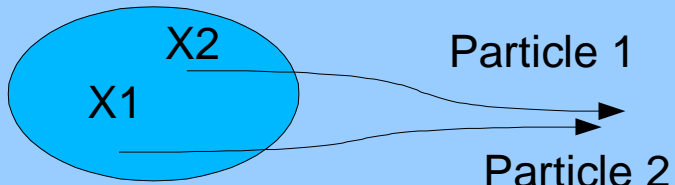
- 1) Dijet production at low Q^2 (D.Kcira, H.Labes, A.Lupi, M.Lightwood)
- 2) 1D and 2D Bose-Einstein effect in DIS (K.Olkiewicz, L.Zawiejski, S.Chekanov, M.Derrick)
- 3) Search for instanton events (S.Hillert, A.Barakbaev, B.Levchenko, E.Lohrmann)

Recently completed papers:

- 1) $K_0\bar{K}_0$ production in DIS (S.Paganis, M.Barbi)
- 2) Jets in CC DIS (M.Vazquez, C.Glasman)

Status of group papers: BE effect in DIS

K.Olkiewicz, L.Zawiejski, S.Chekanov, M.Derrick



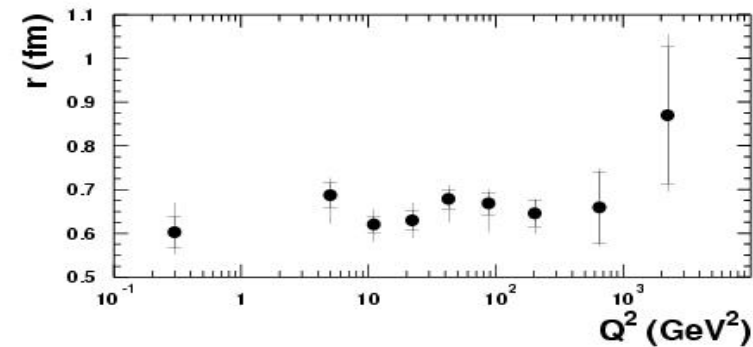
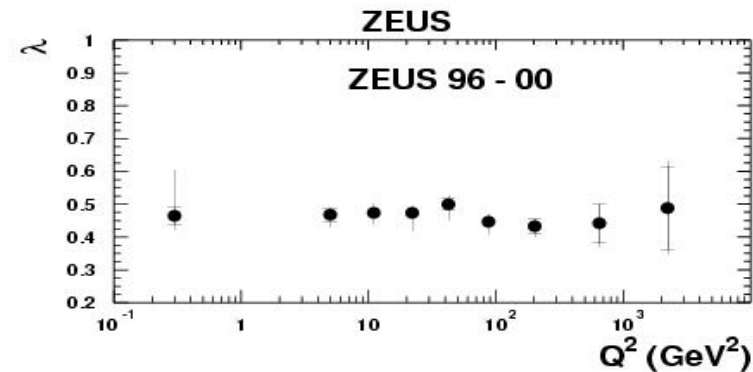
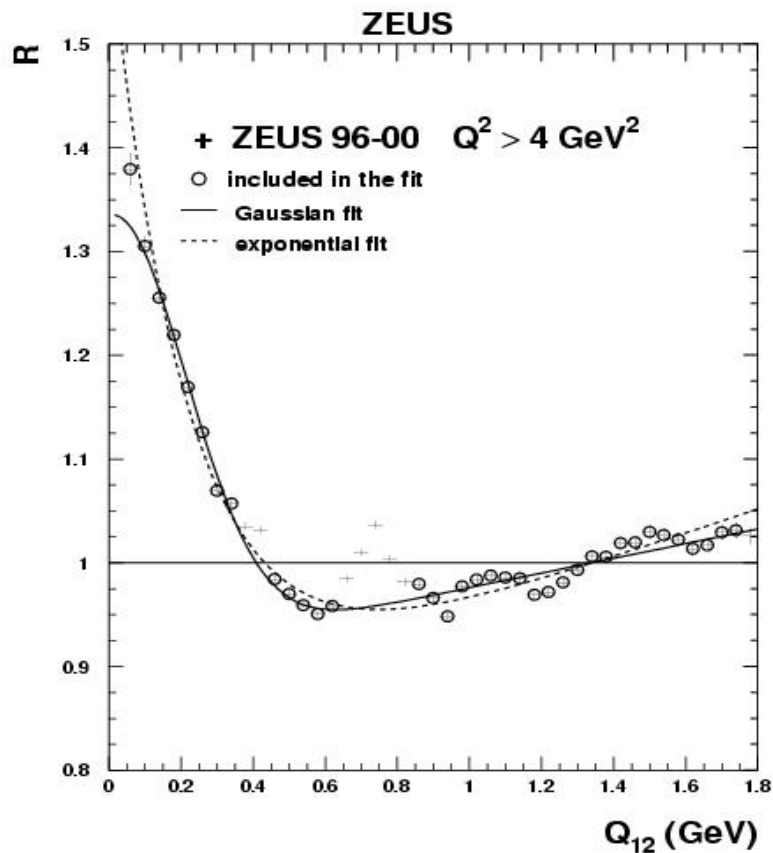
$$Q_{12} = \sqrt{-(p_1 - p_2)^2}$$

$R(Q_{12}) \sim 1$ no correlation (no BE interference)

$$R(Q_{12}) \sim \lambda \exp(-r^2 Q_{12}^2)$$

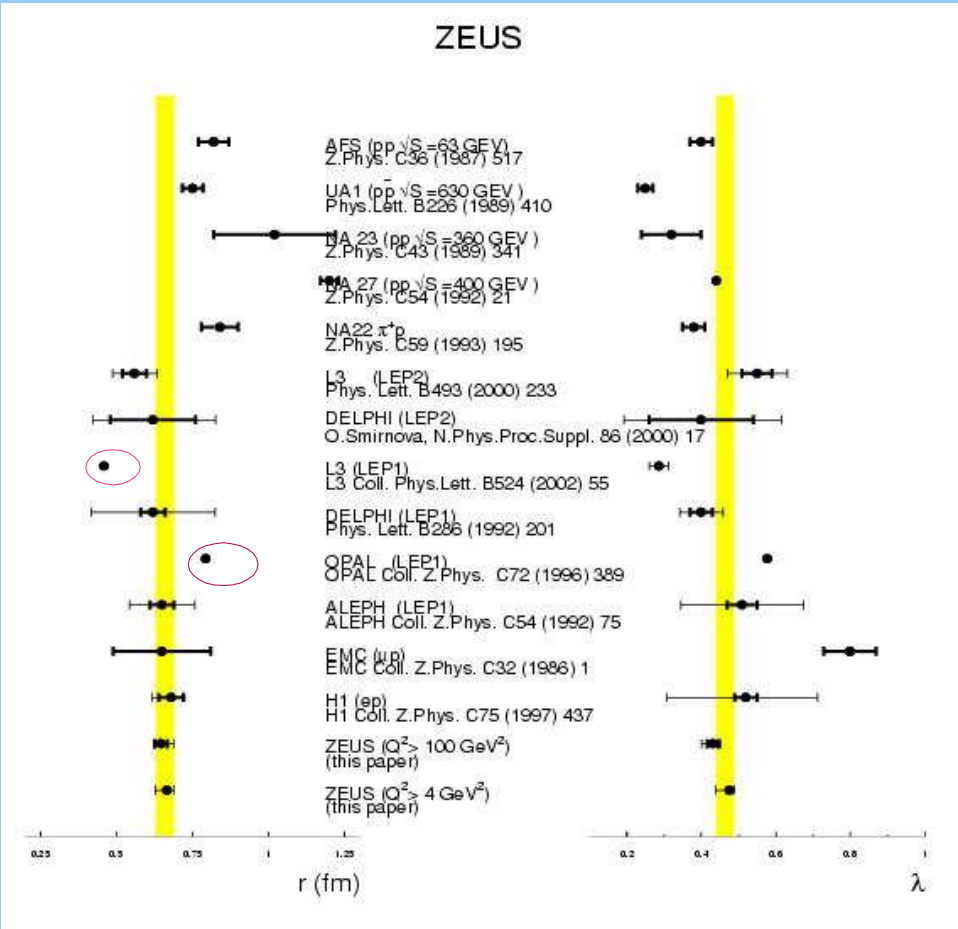
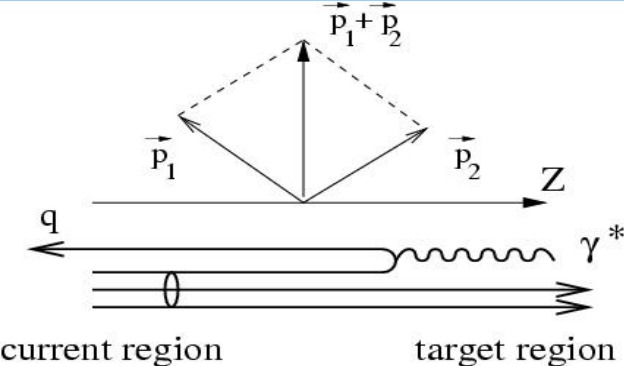
Or

$$R(Q_{12}) \sim \lambda \exp(-r Q_{12})$$

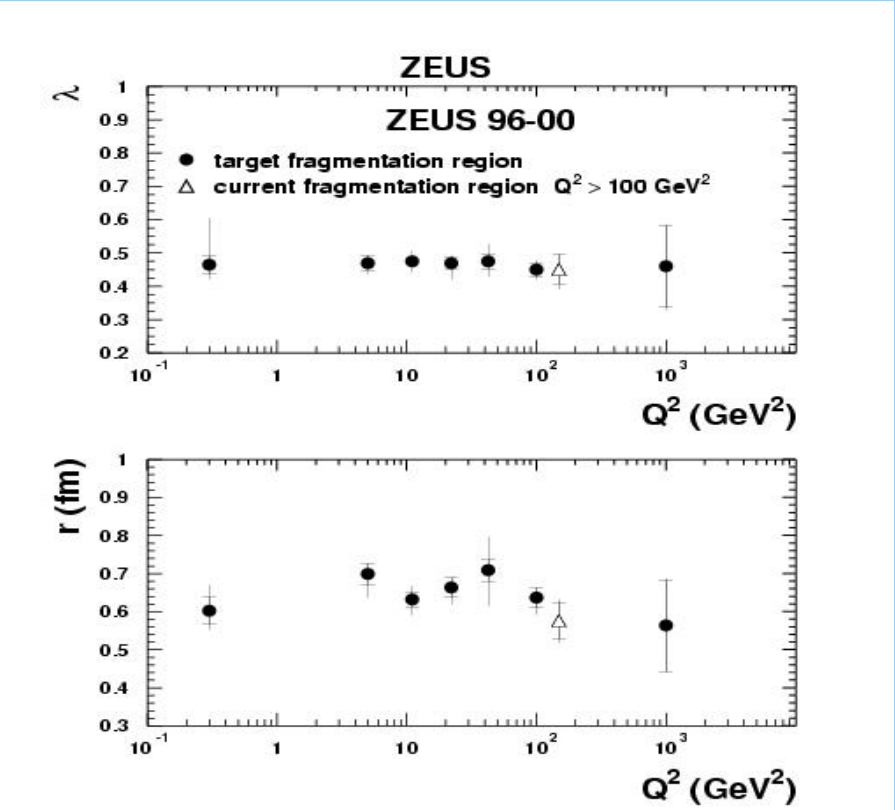


Status of group papers: BE effect in DIS

K.Olkiewicz, L.Zawiejski, S.Chekanov, M.Derrick



Very competitive results
 BE does not depend on Q^2 /different dynamics
 Favors interpretation in terms of the LUND string model



Status of group papers: Jets in CC DIS (updates)

M.Vazquez, C.Glasman

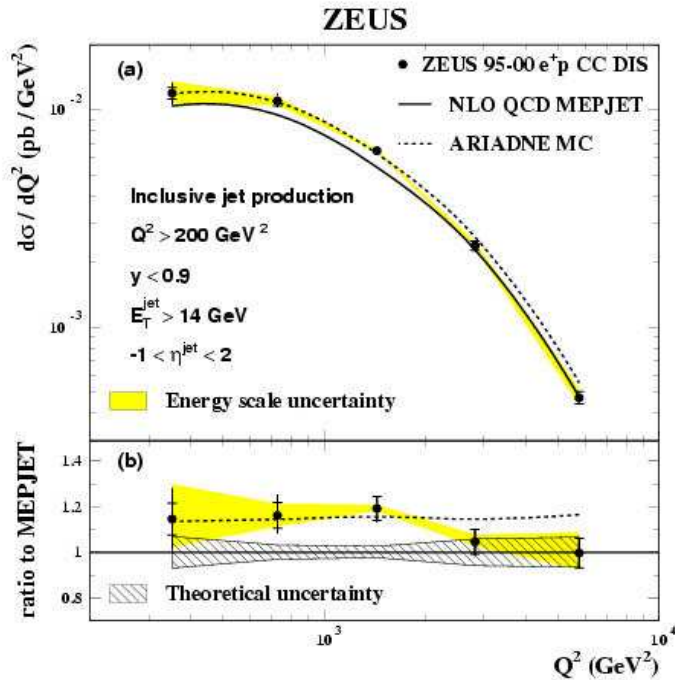


Figure 1: (a) The differential cross-section $d\sigma/dQ^2$ for inclusive jet production with $E_T^{\text{jet}} > 14 \text{ GeV}$ and $-1 < \eta^{\text{jet}} < 2$ in the kinematic region $Q^2 > 200 \text{ GeV}^2$ and $y < 0.9$ for the 1995-2000 e⁺p data (black dots). The data are corrected to hadron level. The inner error bars represent the statistical uncertainty of the data, the outer error bars show the statistical and the systematic uncertainties (not associated with the uncertainty in the absolute energy scale) added in quadrature. The shaded band displays the uncertainty due to the absolute energy scale of the CAL. The parton shower Monte Carlo prediction given by ARIADNE at hadron level (dashed line) and the next-to-leading-order prediction obtained with MEPJET corrected to hadron level (solid line) are shown. (b) The ratio of the measured $d\sigma/dQ^2$ to the next-to-leading-order calculation. The theoretical uncertainty is indicated by the hatched band.

25

Approved by ZEUS

After MEPJET modifications (G_f , M_z , α_{em} are input, like for HERACLES)

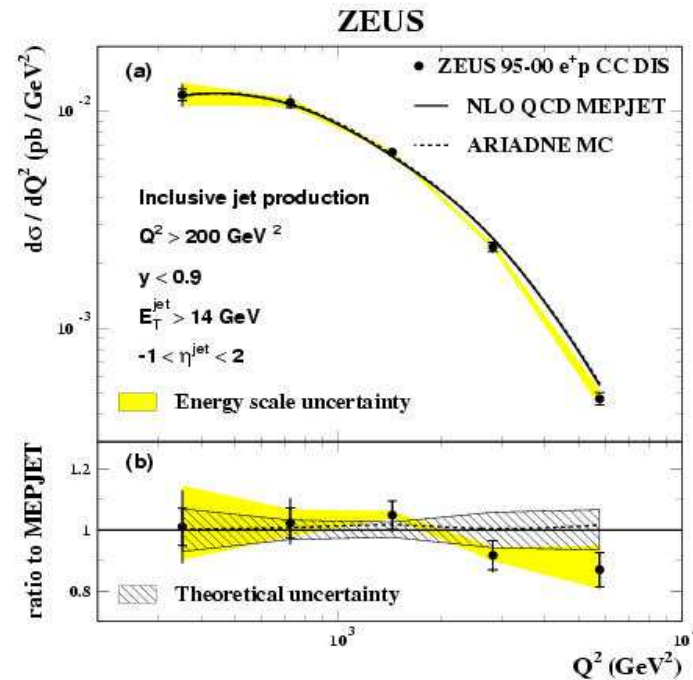


Figure 1: (a) The differential cross-section $d\sigma/dQ^2$ for inclusive jet production with $E_T^{\text{jet}} > 14 \text{ GeV}$ and $-1 < \eta^{\text{jet}} < 2$ in the kinematic region $Q^2 > 200 \text{ GeV}^2$ and $y < 0.9$ for the 1995-2000 e⁺p data (black dots). The data are corrected to hadron level. The inner error bars represent the statistical uncertainty of the data, the outer error bars show the statistical and the systematic uncertainties (not associated with the uncertainty in the absolute energy scale) added in quadrature. The shaded band displays the uncertainty due to the absolute energy scale of the CAL. The parton shower Monte Carlo prediction given by ARIADNE at hadron level (dashed line) and the next-to-leading-order prediction obtained with MEPJET corrected to hadron level (solid line) are shown. (b) The ratio of the measured $d\sigma/dQ^2$ to the next-to-leading-order calculation. The theoretical uncertainty is indicated by the hatched band.

24

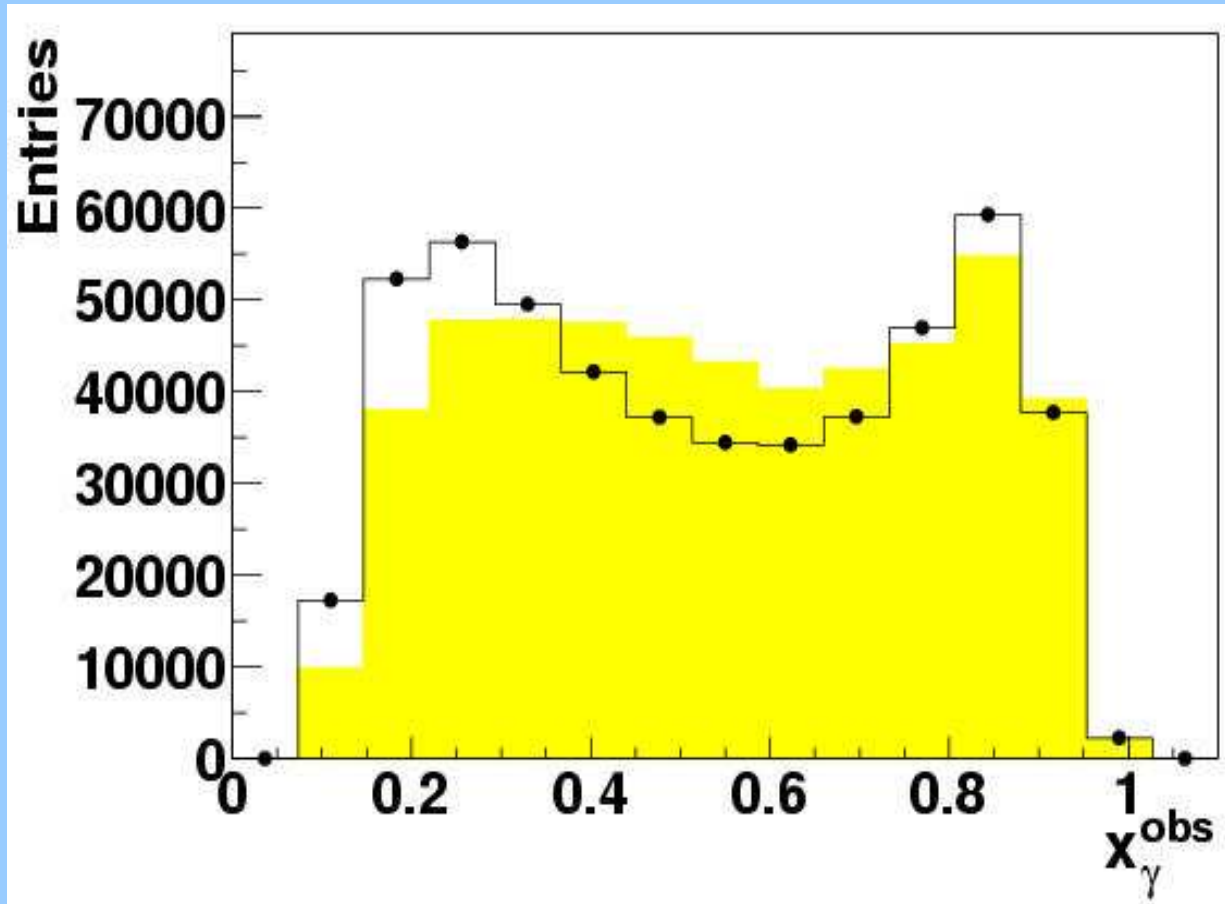
Sent

Status of group analyses: PHP studies

- Multi-jet production in PHP (C. Gwenlan, M.Sutton, T.Namsoo) *Work on second analysis*
- Rapidity gaps in PHP (C.Gwenlan, M.Sutton, P.Ryan) *See presentation of C.G*
- Prompt photon + jet in PHP (S.Magill, B.Musgrave, S.Chekanov) *See presentation of S.C.*
- Inclusive prompt photons in PHP (J.Hamilton, P.Bussey) *In progress*
- Jets in PHP for high x_p region (C.Targett-Adams, J.Butterworth) *In progress*
- Photon structure in dijet production (D.Kcira, H.Labes, A.Lupi, M.Lightwood) *In progress*
- Substructure dependence of jet cross sections (C.Glasman, M.Wing, J.Terron)
*Plans for EPS03:
released for the QCD group*

Photon structure from dijets in PHP

M. Lightwood



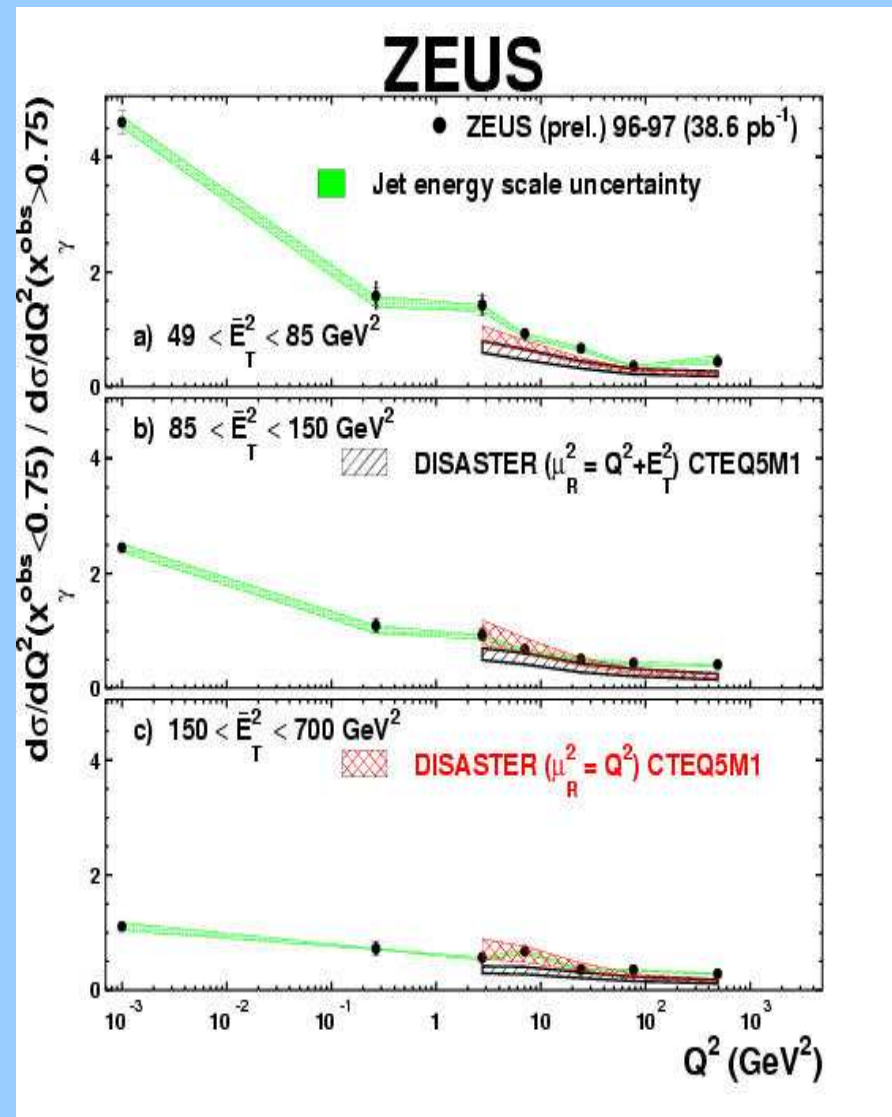
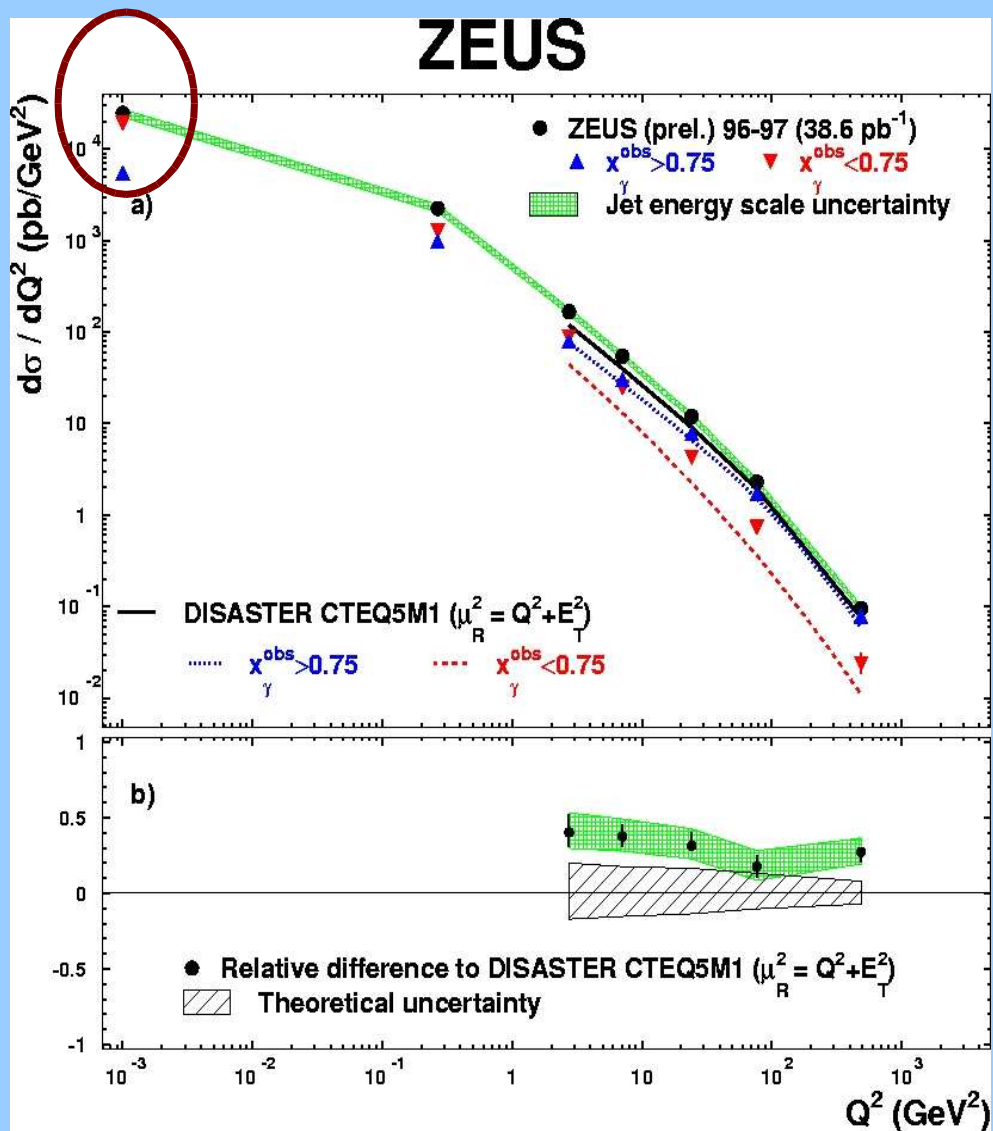
- Kt jets using ZUFOS
- $ET(1) > 6.5$ GeV
- $ET(2) > 7.5$ GeV
- $-3 < \eta < 0$ (HCM)

$$0.2 < y(jb) < 0.55$$

Significant difference in shapes between data and HERWIG

Photon structure from dijets in PHP

M. Lightwood



Second analysis ?
Theoretical predictions?

Status of group analyses: DIS final state

- O Inclusive jets in DIS (T.Schoerner-Saddens, J. Standage) *Use all HERAI statistics in progress*
- O Inclusive jets at low Q^2 (S.Lammers and J.Terrón) *EPS03 paper/ DIS03 prel.*
- O Forward jet with FPC in DIS (A.Bennen, S.Magill, H.Hessling) *See presentation of A.B.*
- O Forward pi0 with FPC in DIS (L.Khein) *See progress*
- O Multi-jet studies in DIS (N.Krumnack, L. Li) *DIS03 prel.
see presentation by L.L.*
- O Azimuthal asymmetry in DIS (A.Tymieniecka, A.Ukleja) *See presentation by A.U.*
- O Prompt photons in DIS (M.Bell, D.Saxon, J.Hamilton) *DIS03 prel, EPS03 paper*

Status of FPC analysis

Forward pi0's with FPC in DIS (L.Khein)

Highly energetic clusters in the EMC are predominantly due to π^0

Electromagnetic showers are more compact than hadronic, thus are better separated

EMC finely transversely segmented & uncertainty of the EMC calibration is smaller

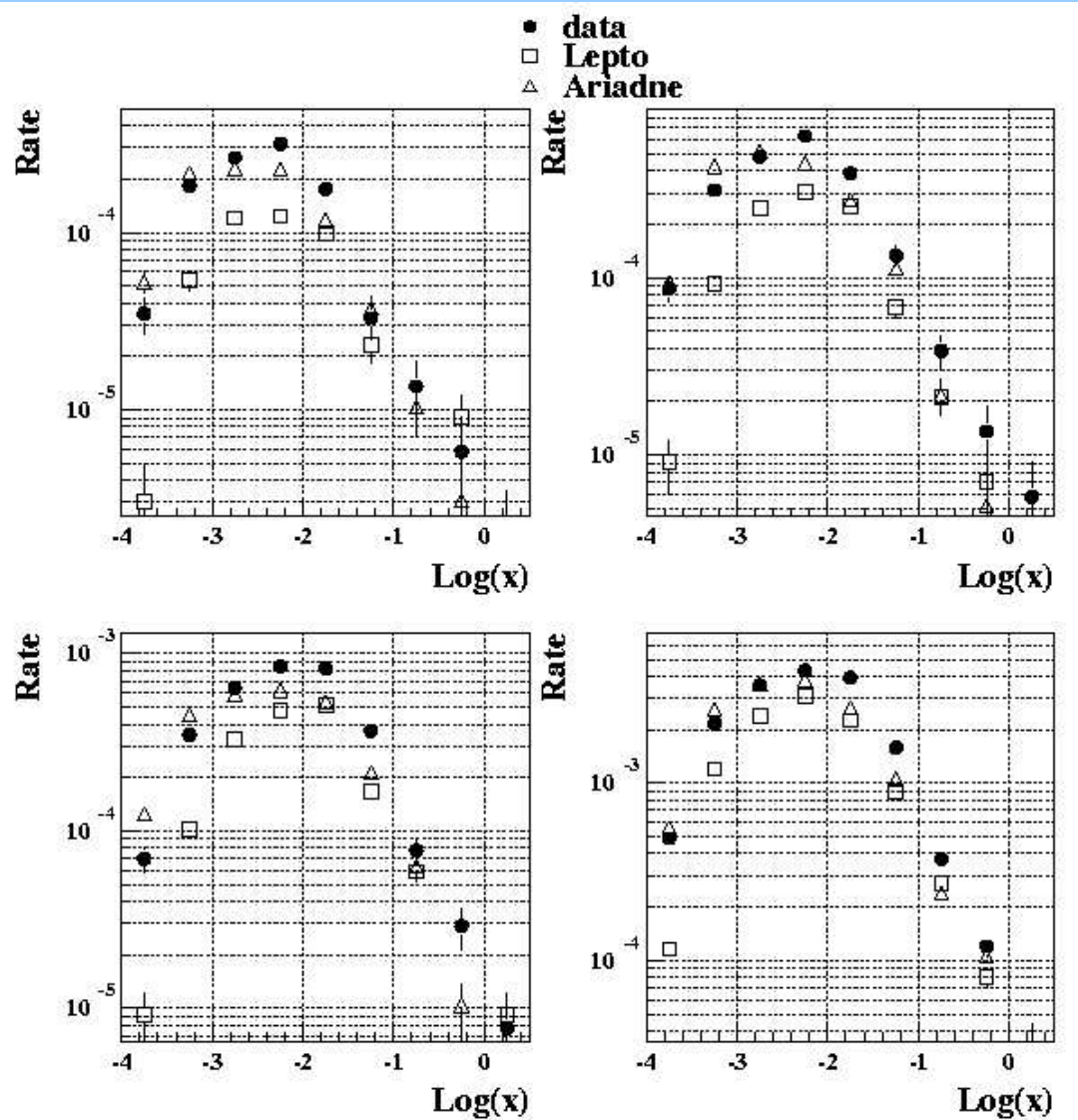
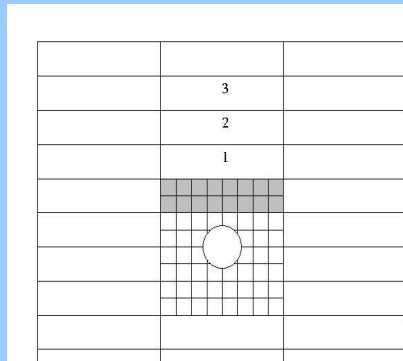
Distributions for EMC clusters for 2000 data

$E(y) > 1.5 \text{ GeV}$

$Q^2 > 7.5 \text{ GeV}^2$

$E_e > 10 \text{ GeV}$

$\eta(\text{max}) > 3.6$



Data are closer to ARIADNE than to LEPTO

Consistent with jet analysis (Arno's talk)

Status of group analyses (cont'd)

O Event shapes in DIS (S. Hanlon, A.Everett, A.Savin)

See presentation of A.E.

O Multiplicity distributions in DIS (M.Rosin)

See presentation of M.R.

Continuation of work by L.Shcheglova, A.Solomin, S.Zotkin

O Inclusive strange particle production in DIS:

A.Ziegler, Ar.Ziegler  left

J.Velthuis  left

A.Raval, Z.Ren, M.Barbi

Prel. for DIS03

See presentation of A.R.

See presentation of Z.R.

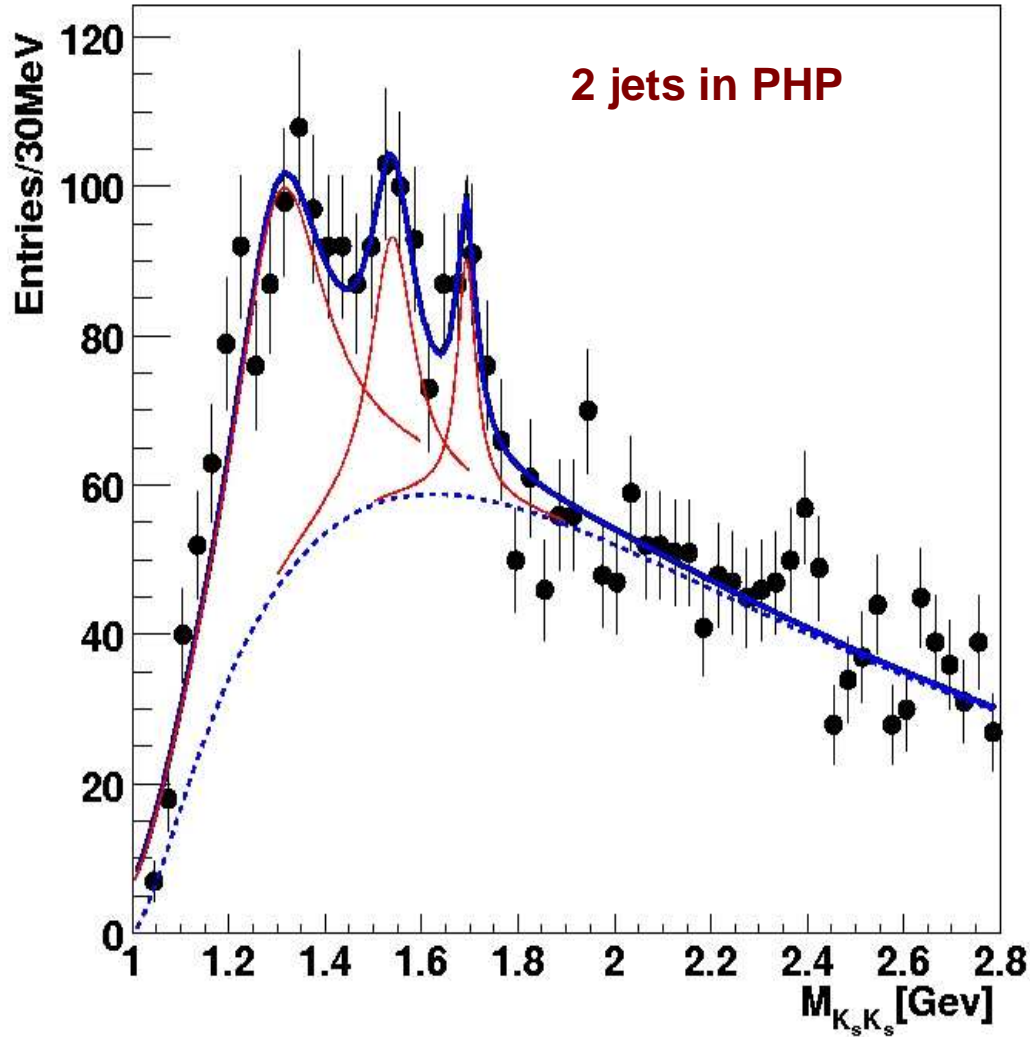
O K0sK0s studies in DIS/PHP (A.Raval, Y.Ning)

See progress.

O Strange hadron production in PHP (M.Sutton, S.Boogert-left)

K0sK0s in photoproduction

Y.Ning



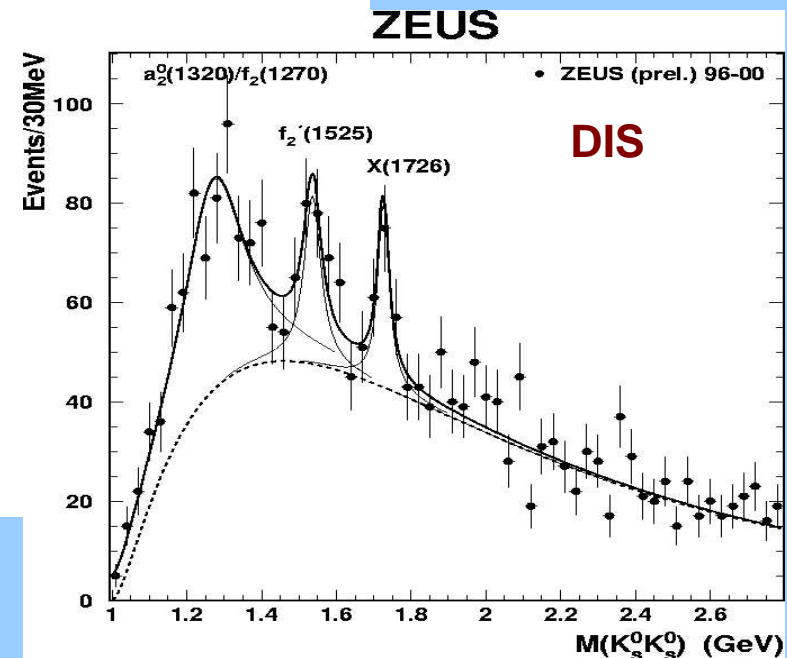
Fit Result
M(1270) 1.304 ± 0.013
FWHM 0.234 ± 0.021
M(1525) 1.539 ± 0.013
FWHM 0.108 ± 0.025
M(1710) 1.693 ± 0.008
FWHM 0.047 ± 0.024

96-00 data
2 jets:
ET > 6 GeV
ET > 7 GeV
-1 < Eta < 2.4

Standard "K0s" cuts
cos(K0sK0s) < 0.92

Work on K0sK0s
trigger

Interesting first result
DIS signal looks cleaner



Future papers

Multijet production in PHP (C.Gwenlan, M.Sutton, T.Namsoo)

Rapidity gaps in PHP (C.Gwenlan, M.Sutton, P.Ryan)

Prompt photons in DIS (M.Bell, D.Saxon, J.Hamilton)

Strange particle production in DIS (A. Raval, A.Ziegler, Ar.Ziegler, Z.Ren, M.Barbi)

Multijets in DIS (L.Li, N.Krumnack)

<1 year

Inclusive jet production in DIS and low x (S.Lammers, J.Terrón)

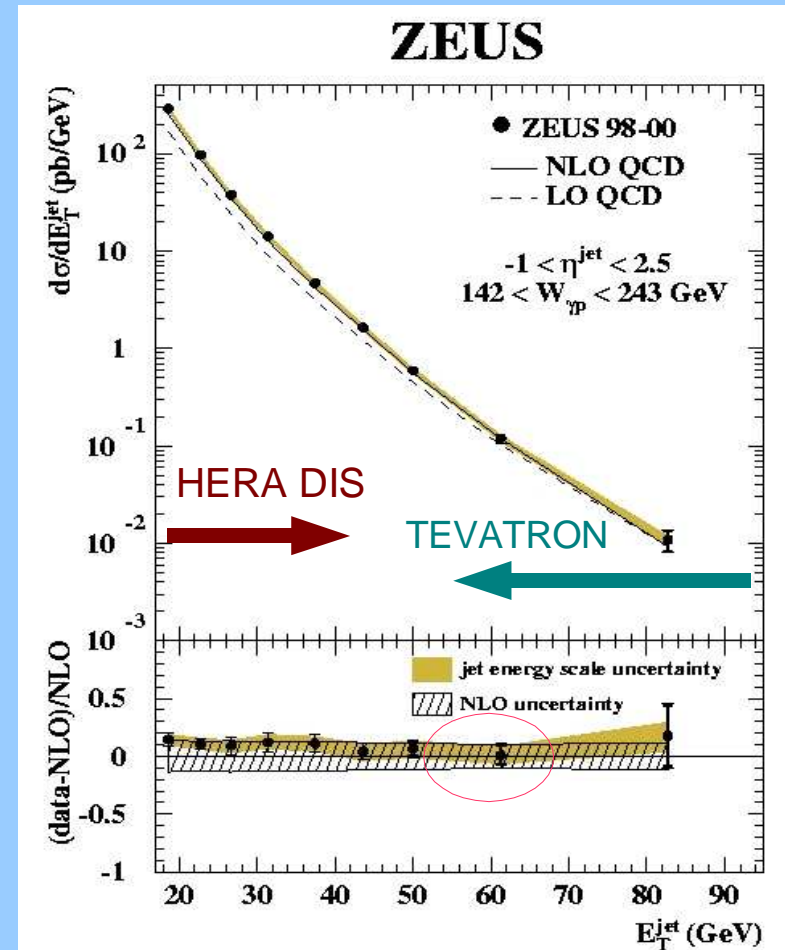
< 1 year

Prompt photons in PHP (S.Magill, S.Chekanov, J.Hamilton, P.Bussey)

< 1 year

Prospects for HERAII

- High ET-jet measurements in the regions where the data is less precise than theoretical predictions; measurements of the strong coupling constant, constrain gluon at high xp region; Multijet studies require high statistics – get the strong coupling constant/ color factors;
- Strange particle productions at large Pt, K0sK0s with new QCD/HFS triggers and MVD
- Studies in the forward regions using STT: strange productions, charge multiplicities in the target region with a better acceptance
- Prompt photons in DIS/PHP. Still limited statistics for DIS, go to high ET's in PHP



A lot of studies based on HERAII data need to be finished and converted into ZEUS papers

Startup strategy

•Jets in DIS	CTD/MVD vertex +CAL
•Jets in PHP	CTD/MVD vertex +CAL
•Prompt photons in DIS	CTD/MVD vertex +CAL+BPRES+CTD tracking
•Prompt photons in PHP	CTD/MVD vertex +CAL+BPRES+CTD tracking
•Identified strange particles in DIS	CTD/MVD vertex +CAL+CTD/STT tracking
•Identified strange particles in PHP	CTD/MVD vertex +CAL+CTD/STT tracking
•Particle production (event shapes, multiplicity's, correlations)	CTD/MVD vertex + CAL+CTD/MVD tracking

3 possible scenarios:

- 1) Background conditions significantly better than for 2002/3 – normal tracking;
- 2) Slightly better than for 2002/3 data: degraded CTD/MVD tracking/vertexing at start of fill (reduced HV); normal CTD HV near end of fill
- 3) Background the same as for 2002/03 : no CTD tracking at start of the fill
+ some tracking (reduced hit efficiency, HV not at 100%).

General strategy for cases 2) - 3):

Increase of ET trigger thresholds, go to large Q^2 , after more studies with high statistics – to optimize event selections.

The major aim of this group – to go to high ET jets with high statistics runs can be achieved for all scenarios, while low-statistics parts of the runs can be used for looking at traditional phase-space regions and/or using new components (MVD/STT)

Looking forward to new data