

Hadronic Final States and Spectroscopy in ep Collisions at HERA

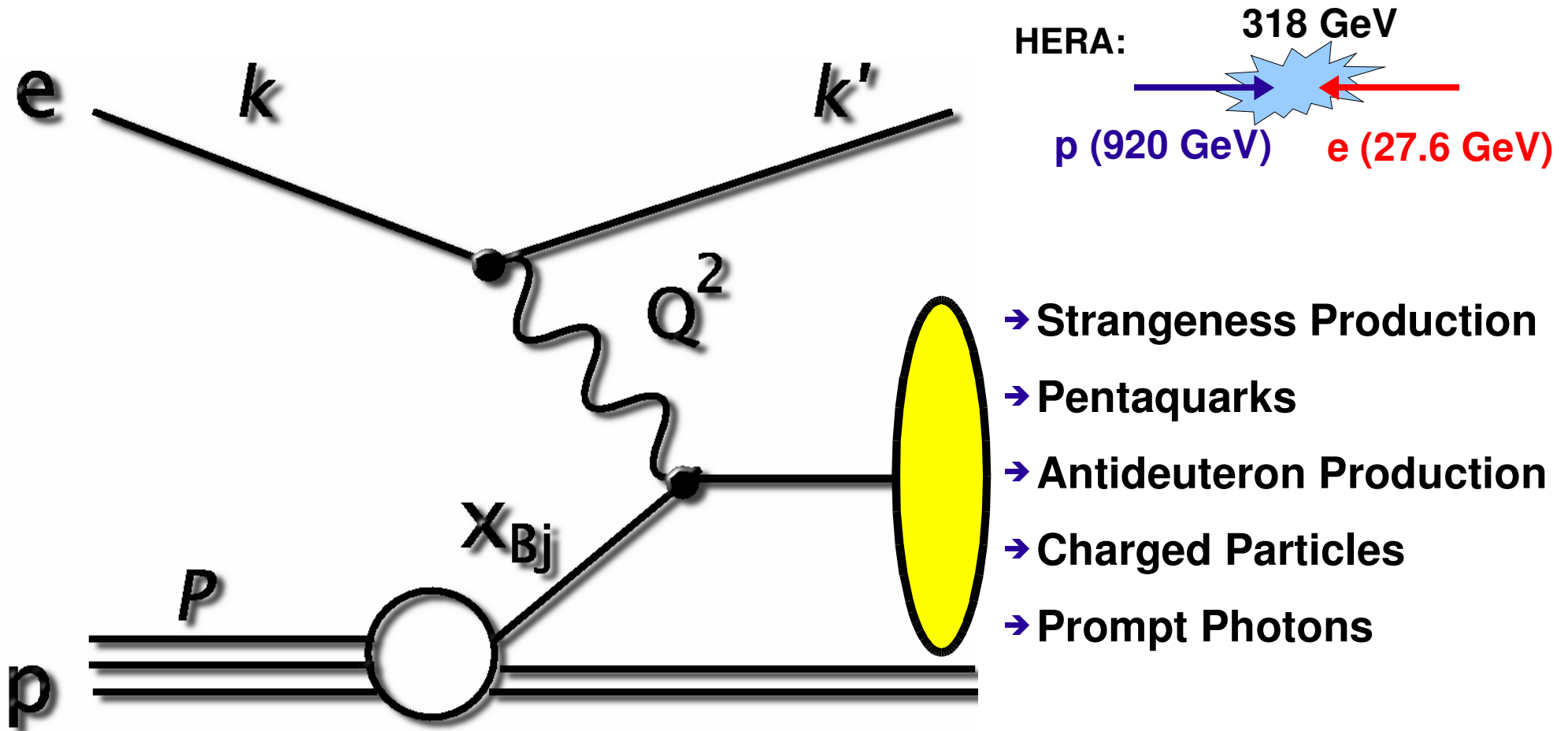
XLII^e Rencontres de Moriond

QCD and Hadronic interactions, 17.03 - 24.03.2007

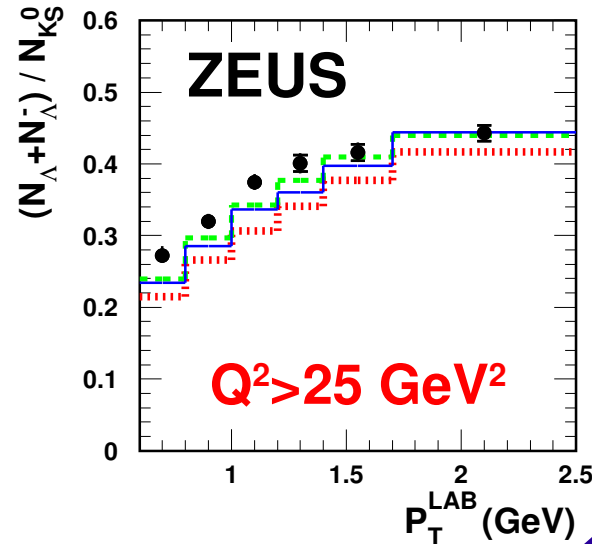
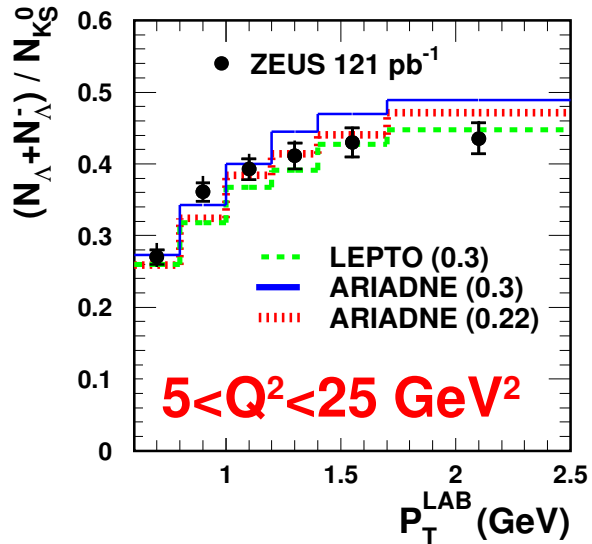
Carsten Schmitz (University of Zurich)
for the H1 and ZEUS Collaborations



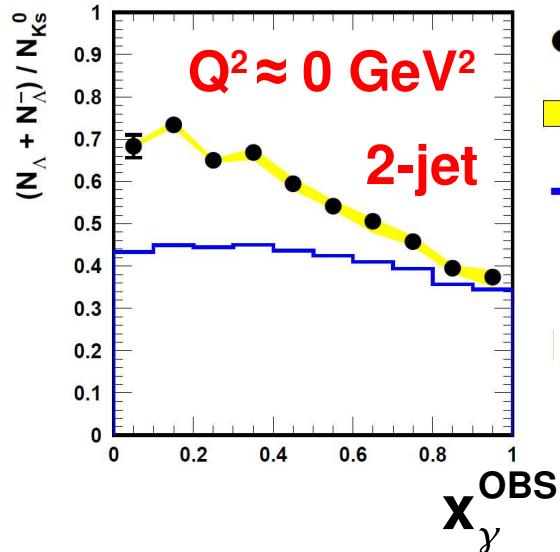
Hadronisation and Spectroscopy in ep



Strangeness: Baryon to Meson Ratio



$$(N_{\Lambda} + N_{\bar{\Lambda}}) / N_{K_S^0}$$



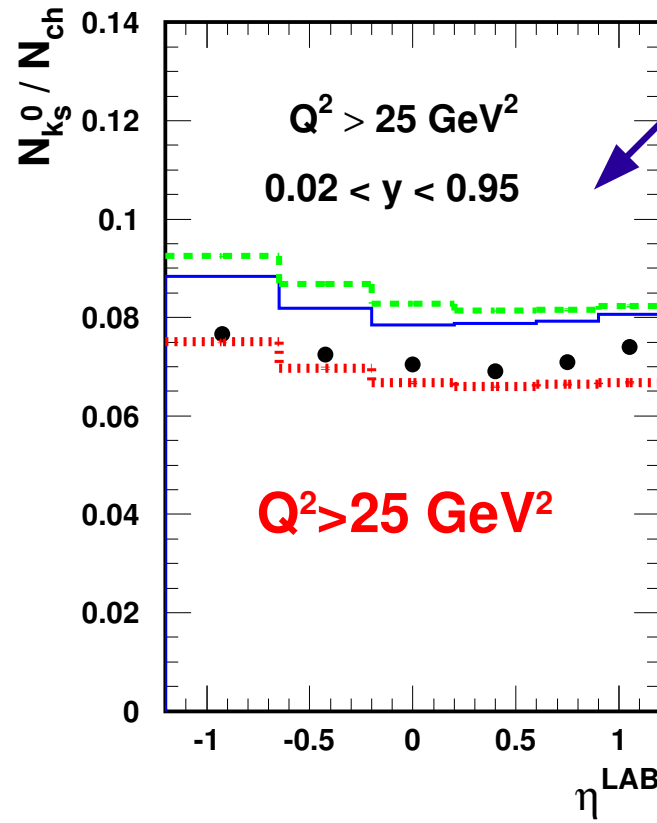
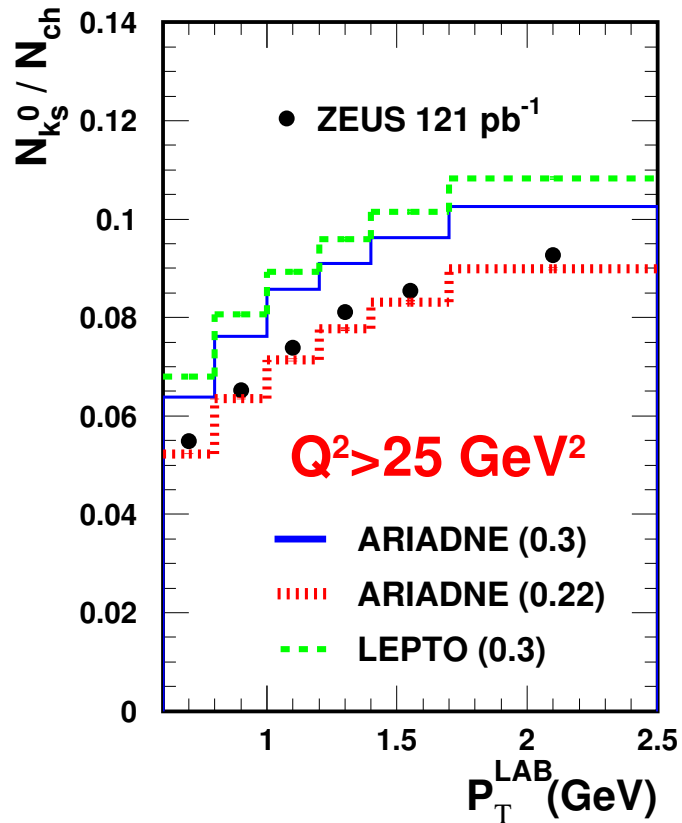
λ_s strangeness suppression factor

- ARIADNE ($\lambda_s=0.3$) describes the data at 10-20% level
- x_{γ} in photoproduction not described (by PYTHIA)
- At $x_{\gamma} \approx 1$ same ratio as in DIS
- Ratio similar to measurements in e^+e^-

Strangeness: Strange to Light Ratio

$$\frac{N_{K_s^0}}{(N_{K^\pm} + N_{\pi^\pm} + N_p + N_{\bar{p}})}$$

ZEUS

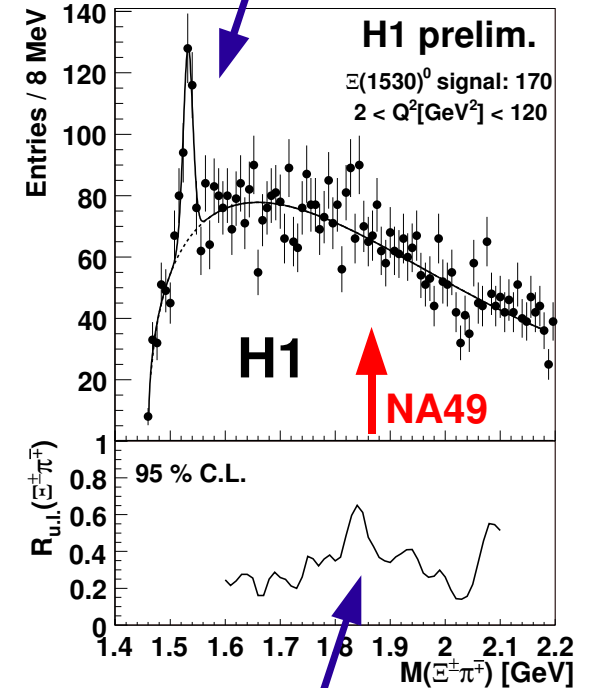
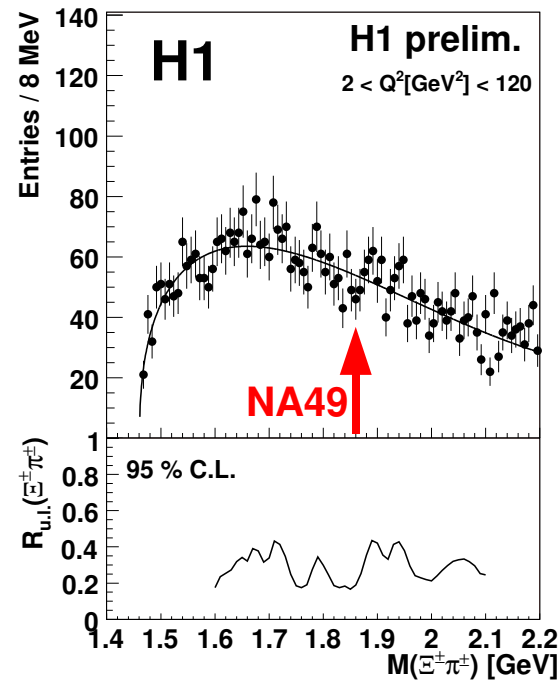
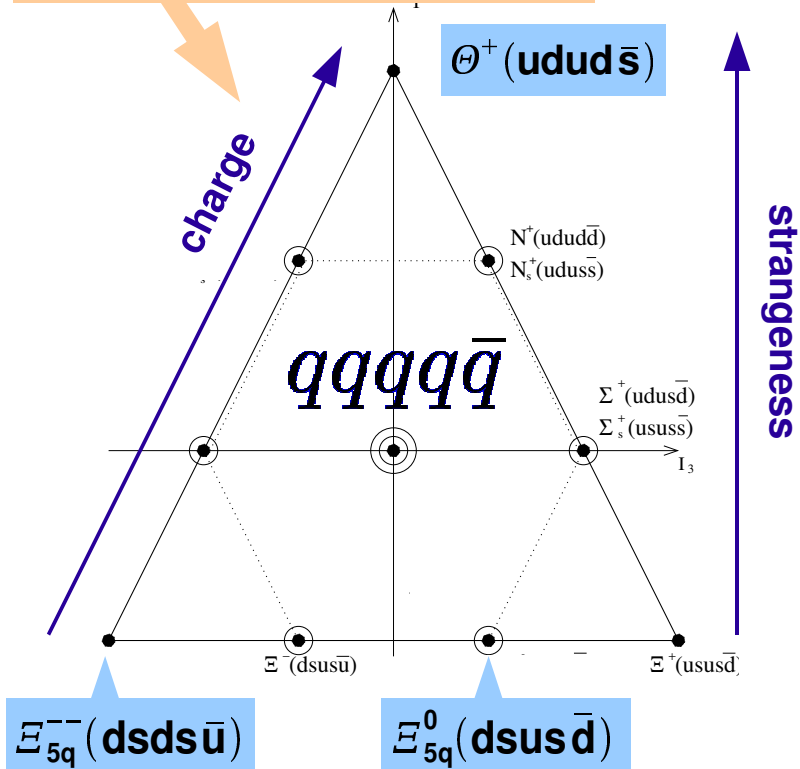


✗ No Baryon-Antibaryon asymmetry was observed (not shown)

Baryonic States decaying to $\Xi \pi$ in DIS

Pentaquark Anti-decuplet

Well known $\Xi(1530)^0$ resonance seen



- H1: Search for Ξ_{5q}^{--} and Ξ_{5q}^0 decaying to $\Xi \pi$
- NA49 reported observation at mass 1862 MeV

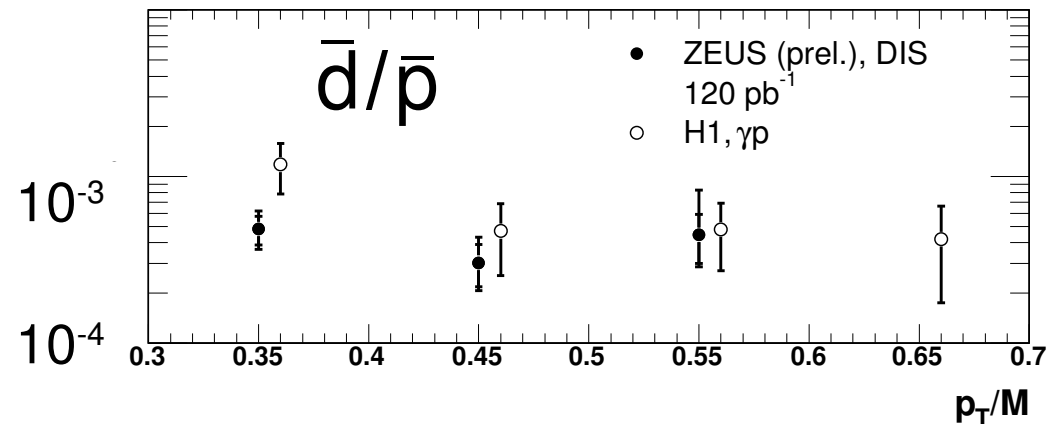
Upper limits relative to $\Xi(1530)^0$

- ✓ No evidence for exotic 5q state
- ✓ Agrees with ZEUS (DESY-05-018)

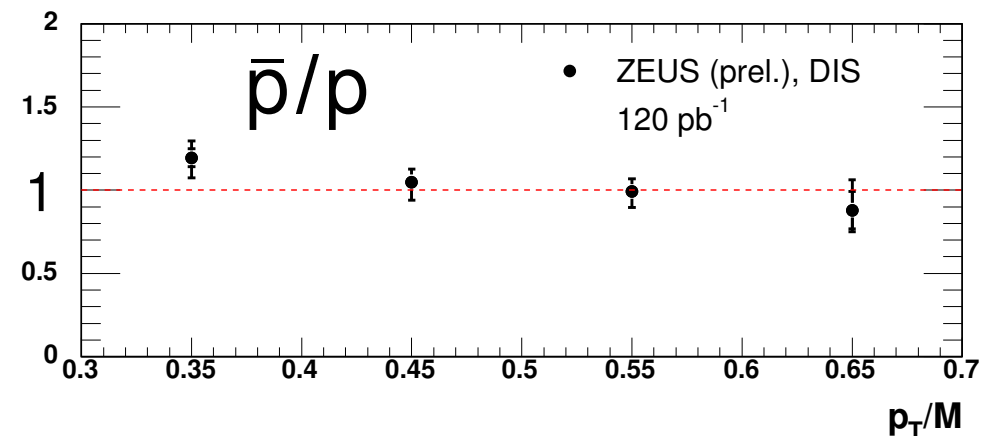
Heavy Stable Particle Production (DIS)

ZEUS

→ Production of antideuterons



- ✓ \bar{p}/p ratio is consistent with unity
- ✓ Antideuteron rate 3-4 orders of magnitude lower than antiproton yield
- ✓ \bar{d}/\bar{p} ratio: good agreement with H1



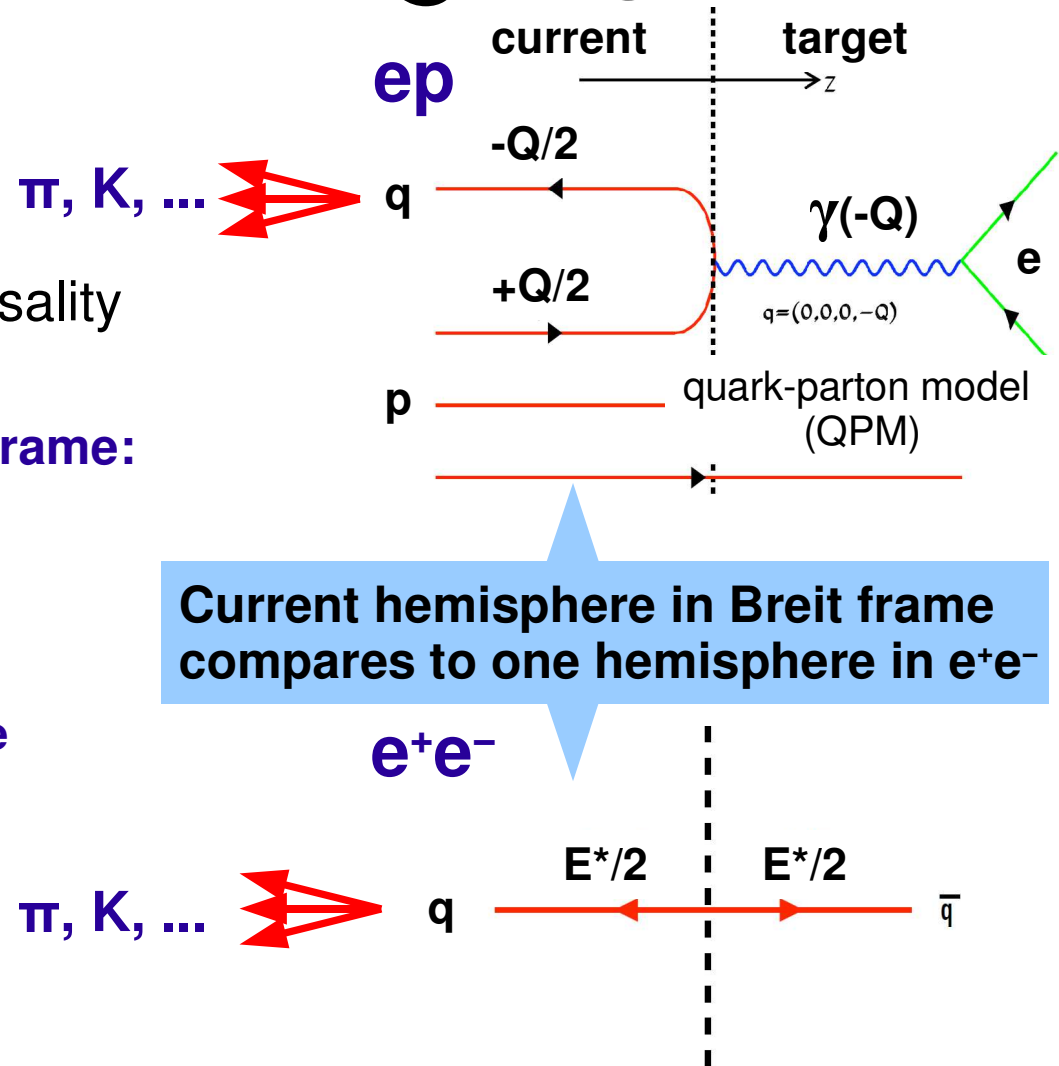
Scaled Charged Particle Momentum Distributions at High Q^2

→ Test Quark Fragmentation Universality

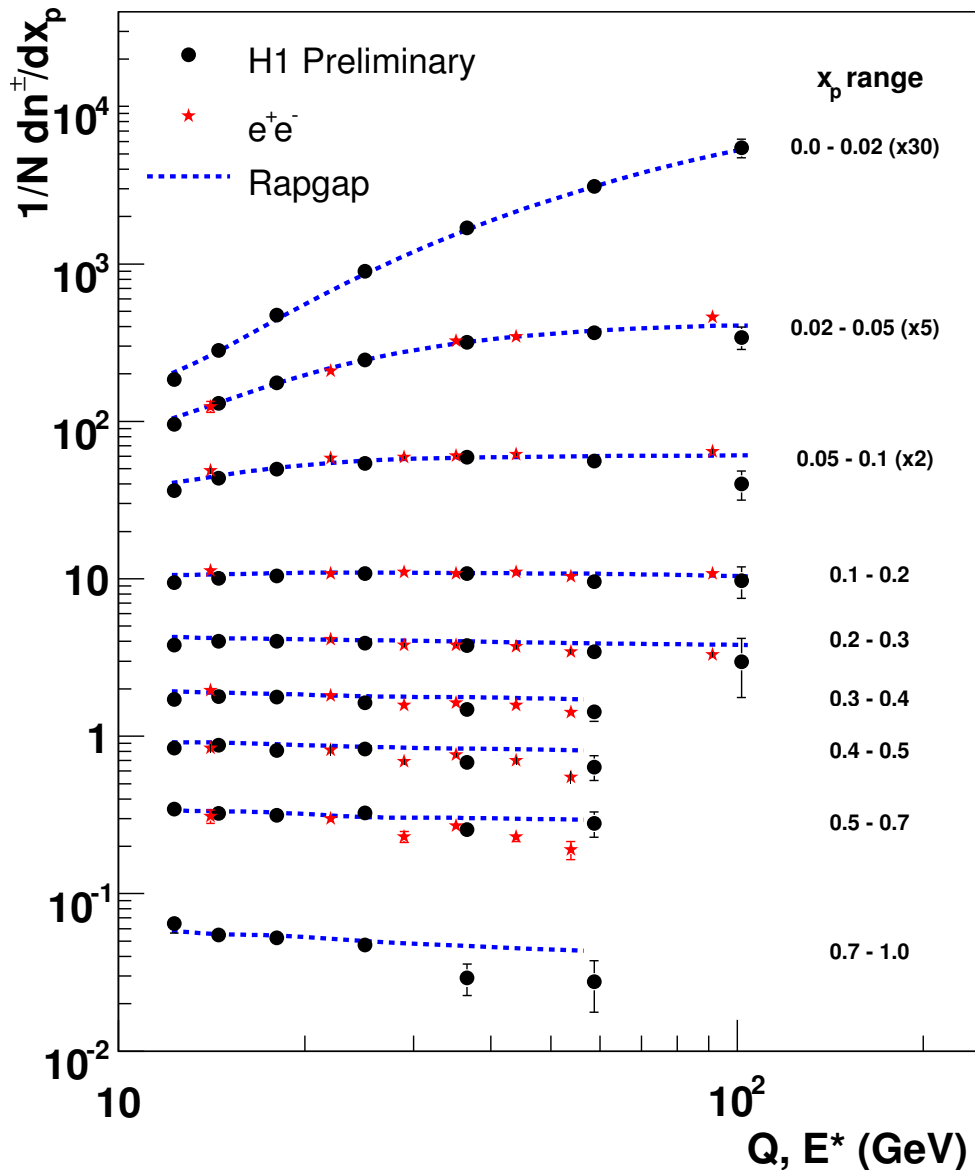
For *tracks* in current region of Breit frame:

$$x_p = \frac{(2P_h)}{Q}$$

scaled momentum variable

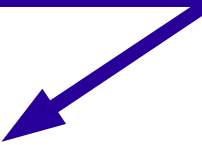


Scaling Violations



charged particle
scaled momentum spectrum

$$D(x_p) = \frac{1}{N_{event}} \frac{dn}{dx_p}$$

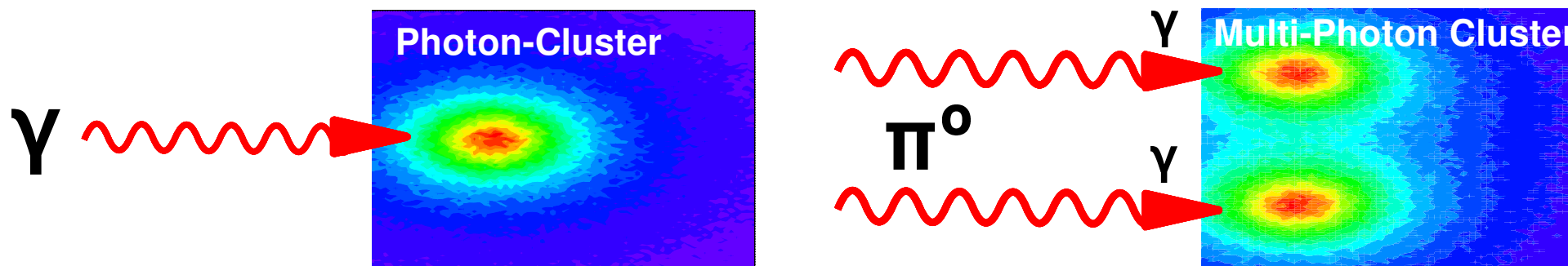


- ✓ Clear scaling violations
- ✓ Good agreement with e⁺e⁻
- ✓ Well described by RAPGAP

Prompt Photons in ep Collisions

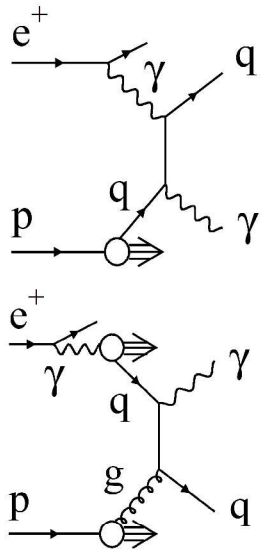
Why Prompt Photons?

- Directly related to partonic event structure
- Important for New Physics searches at LHC (Background to $H \rightarrow \gamma\gamma$)
- Main difficulty: Separation of photons from neutral hadrons decaying into multiple photons



- 2 new analyses:
- Photons + Jets in Photoproduction
 - Inclusive Photons in DIS

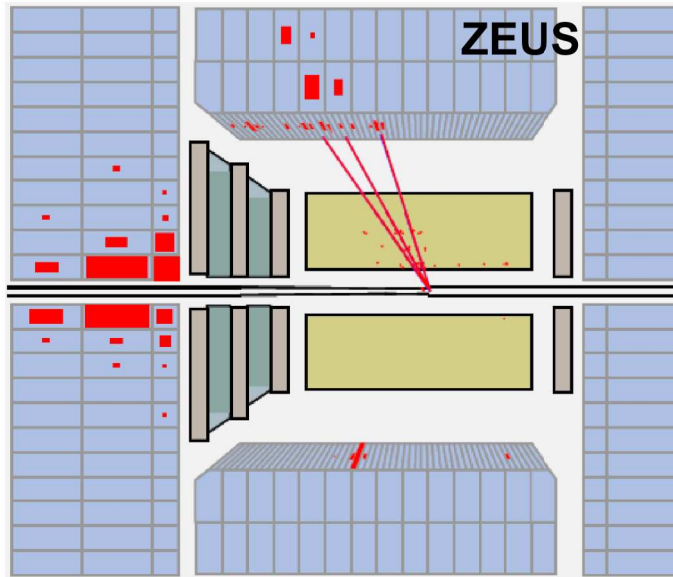
Prompt Photons in the Detectors



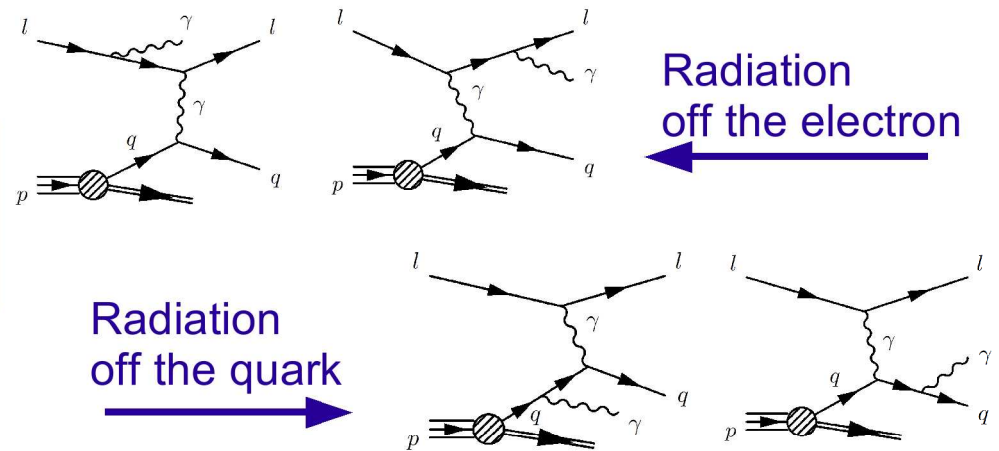
Direct production

ZEUS
Prompt photons with jets
in photoproduction

Resolved production

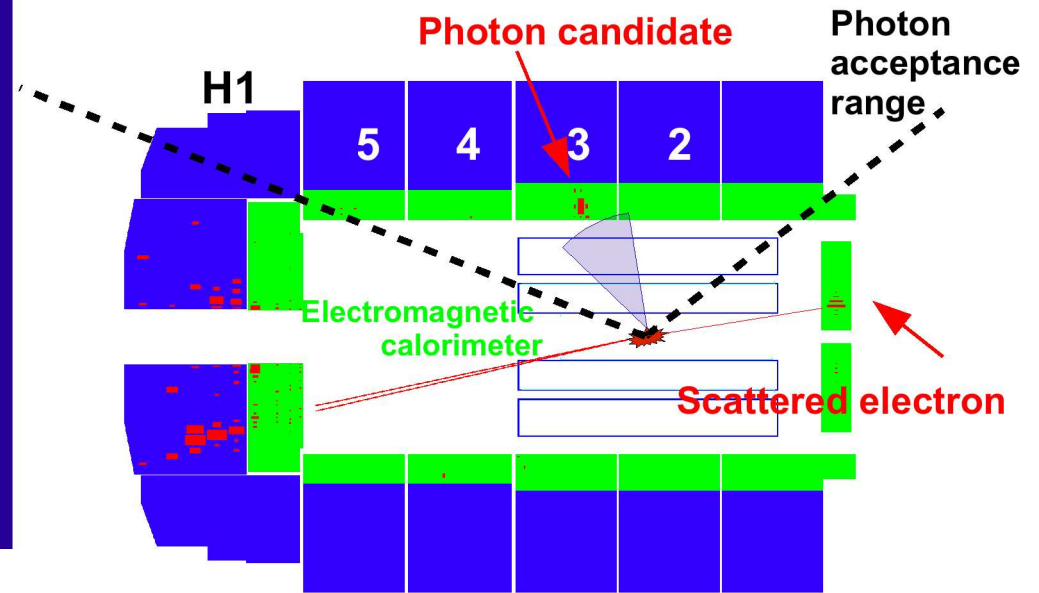


H1: Inclusive prompt photons in DIS



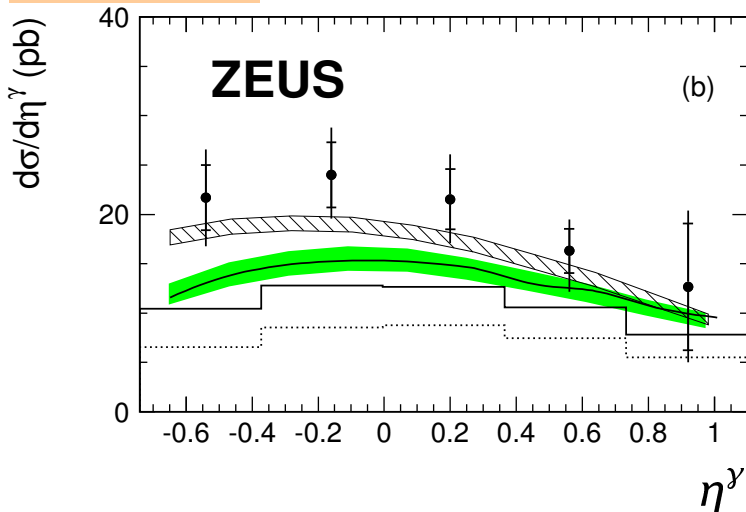
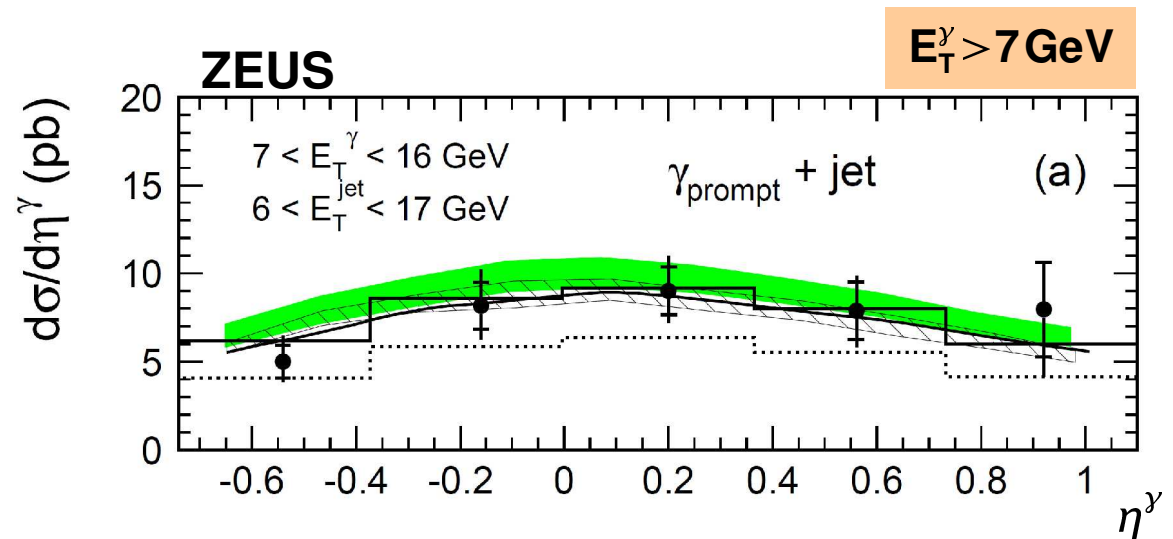
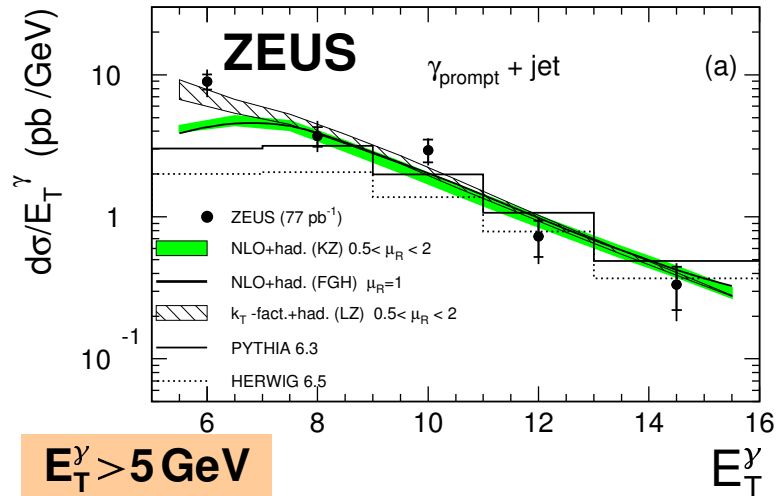
Radiation
off the electron

Radiation
off the quark



Prompt Photons with associated Jets in Photoproduction

High transverse energies: $E_T < 17$ GeV



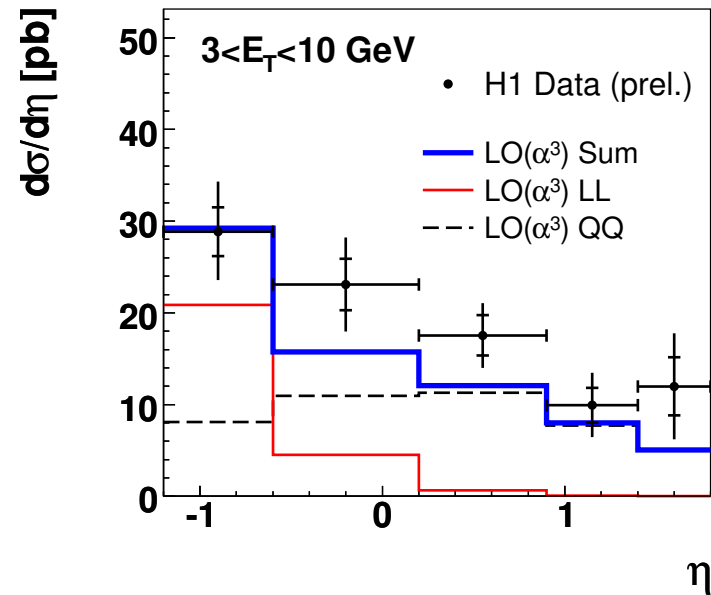
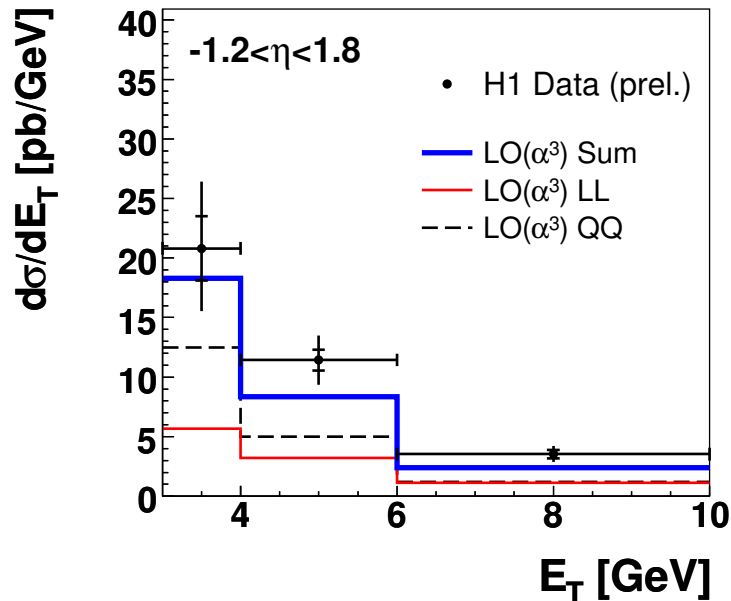
- Overshoot at low E_T
- Good description for $E_T > 7$ GeV
- Best description with kt-factorisation approach

Inclusive Prompt Photons in DIS

→ $Q^2 > 4 \text{ GeV}^2$, $E_T > 3 \text{ GeV}$, $-1.2 < \eta < 1.8$

Extended range ($\times 10$) w.r.t. previous HERA measurement

LO-calculation for inclusive cross section
 Gehrman-De Ridder, Gehrman, Poulsen
 (hep-ph/0601073, hep-ph/0604030)



- ✓ E_T described in shape, calculation is slightly too low in normalisation
- ✓ Overshoot mainly at central pseudorapidities

Summary/Outlook

→ Strangeness Production

- ✓ Similar Baryon/Meson Ratio as in e^+e^-
- ✓ Strange/Light Ratio favours $\lambda_s = 0.22$

→ Pentaquarks

- ✓ No evidence for exotic $5q$ state decaying to $\Xi\pi$ (agreement with ZEUS)

→ Antideuteron Production

- ✓ 3-4 orders of magnitude lower than antiproton yield (agreement with H1)

→ Charged Particle Momentum Distributions

- ✓ Good agreement with e^+e^- (quark fragmentation universality)
- ✓ Clear scaling violations

→ Photons + Jets in Photoproduction

- ✓ Overshoot at low E_T (well described at higher E_T)
- ✓ Best description with kt -factorisation approach

→ Inclusive Photons in DIS

- ✓ Calculation slightly low in normalisation
- ✓ Overshoot mainly at central pseudorapidities

Most analyses will profit from new HERA II data. A factor 2-4 luminosity to be gained!

References

- Measurement of K_S^0 , Λ and $\bar{\Lambda}$ production at HERA
ZEUS: submitted to Eur.Phys.J.C, hep-ex/0612023
- Search for baryonic states decaying to $\Xi \pi$ in DIS at HERA
H1prelim-06-131
- Heavy stable particle production in NC-DIS at HERA
ZEUS-prel-06-008
- Scaled charged particle momentum distributions at high Q^2 at HERA
H1prelim-06-033
- Measurement of prompt photons with associated jets in photoproduction
ZEUS: Eur.Phys.J.C49:511-522,2007
- Inclusive prompt photon production in DIS at HERA
H1prelim-06-031