Photon Structure from High E_T jet Photoproduction

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on behalf of the H1 collaboration

Outline:

- Introduction
- New High E_T Dijet Data
  $\hookrightarrow$ test of QCD dynamics
  $\hookrightarrow$ photon (proton) structure
- Summary

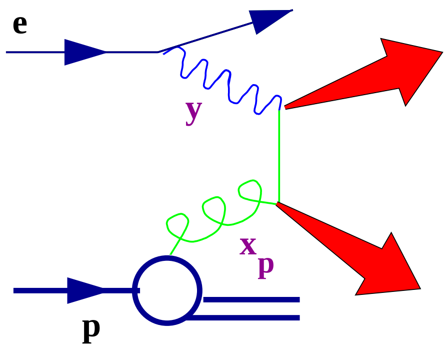
DIS Workshop, 28.04.2001

Introduction

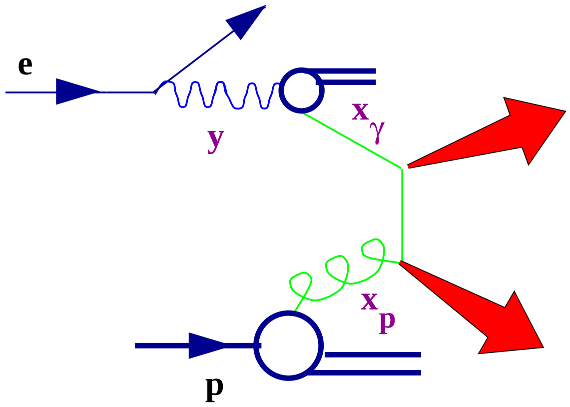
Jets with quasi real photon at HERA

e^+ (27.6 GeV) $\longrightarrow$ $\longleftarrow p$ (820 GeV)

Jet production in γp:



DIRECT ($x_\gamma = 1$)



RESOLVED ($x_\gamma < 1$)

Sensitive to:

· α_s,
· color dynamics $\leftarrow$ calculable in pQCD at NLO,
· proton PDF $\leftarrow$ strongly constrained at low and medium x_p,
· photon PDF $\leftarrow$ partial knowledge from e^+e^- colliders.
$\rightarrow \gamma p$: complementary informations (q,g,higher scale)

Why Study High E_T Jets in γp ?

· influence of the soft underlying event is reduced,
· fragmentation/hadronization effects are expected to be small,
· hard scale $\rightarrow$ reliable pQCD predictions at NLO

$\hookrightarrow$ jets at high E_T can be directly compared with QCD calculations

Physics motivations:

· Test of perturbative QCD for description of high E_T jet data.

· Access the structure (quark and gluon) of the photon at large x_γ which is not strongly constrained by F_2^γ measurements.

· Test of QCD evolution of photon PDFs at the highest reached scales.

New Measurement of Dijet Cross Sections in Photoproduction

H1 1995-97 (L=$34.9\,\mathrm{pb}^{-1}$)
Kinematic region:
$Q^2 \leq 1\,\mathrm{GeV}^2$, $95 \leq W_{\gamma p} \leq 285\,\mathrm{GeV}$

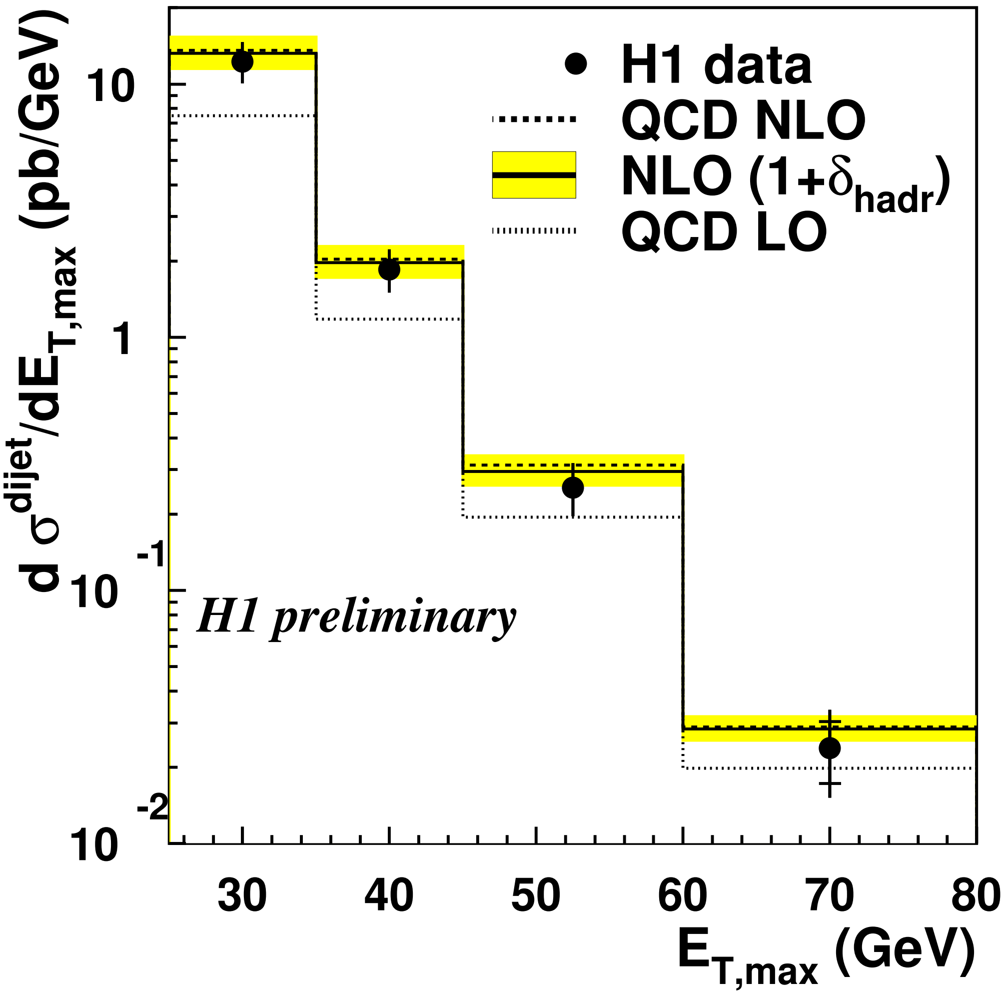
Jets search using the invariant $k_\perp$ cluster algorithm in the laboratory frame.

$$E_{T,1,2}^{jet} \geq 25, 15\,\mathrm{GeV}, \;\; -0.5 \leq \eta^{jet} \leq 2.5$$

Comparison to NLO QCD calculation:

Frixione/Ridolfi, Nucl. Phys. B507(1997)315
Substraction method
2-loop α_s, $N_f = 5$, $\alpha_s = 0.118$
proton PDFs: CTEQ5M
γ PDFs: GRV94, GSG, AFG
Renormalization/factorization scales: $\mu_r = \mu_f = \frac{\sum E_T}{2}$

Measurement of $\frac{d\sigma}{dE_{T,max}}$

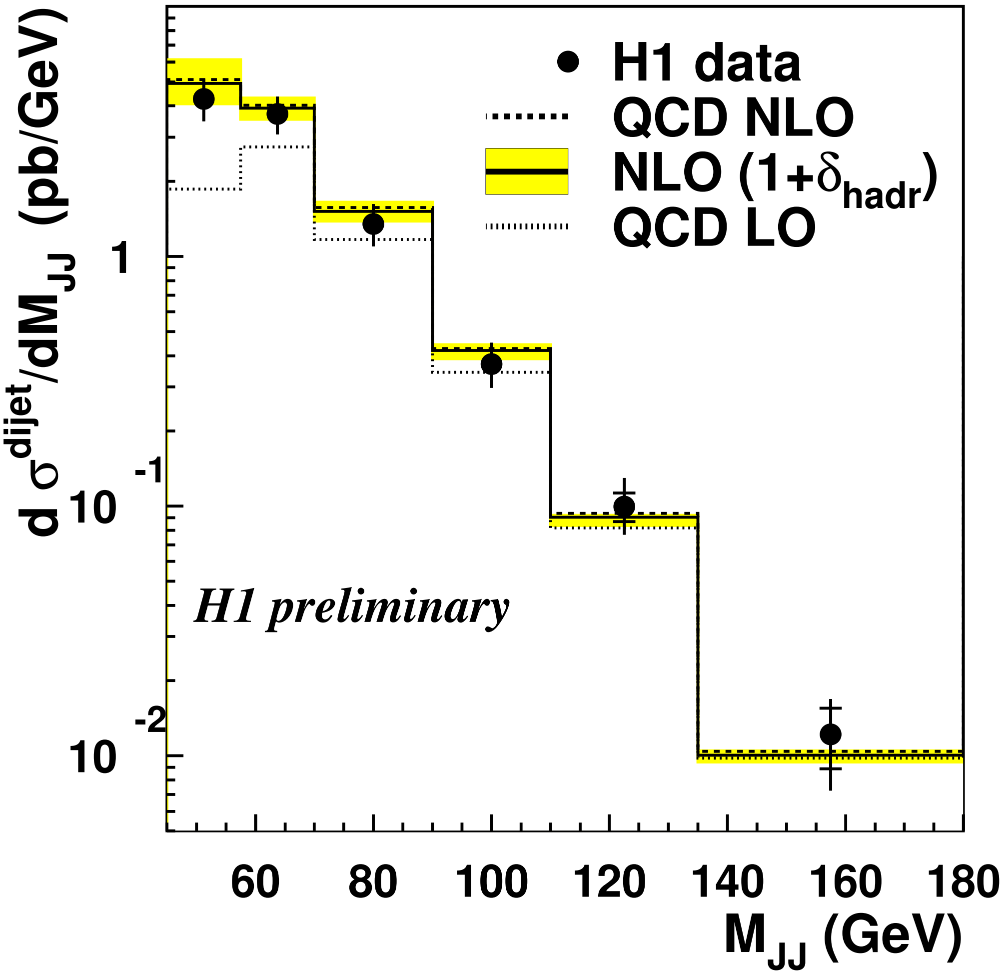


Small hadronization corrections ($< 10\%$).

Steeply falling distributions described by NLO QCD calculation using CTEQ5M and GRV PDFs.

Measurement of $\frac{d\sigma}{dM_{jj}}$

M_{jj}: invariant mass of the dijet system.

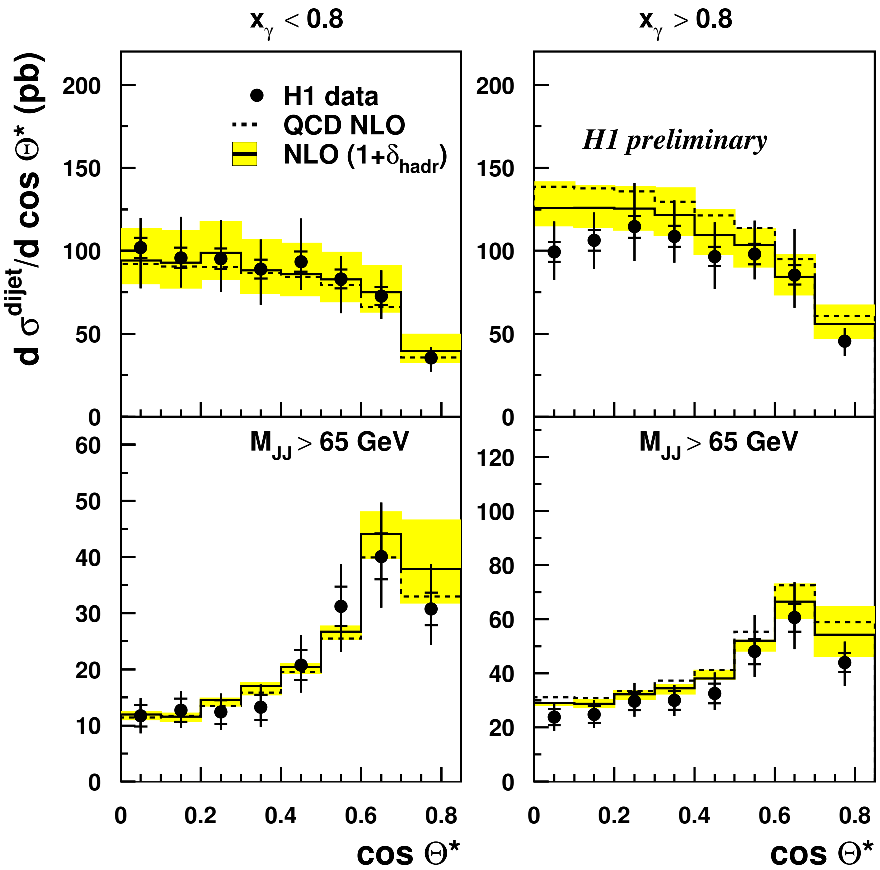


No deviation of the data to the NLO QCD prediction using CTEQ5M and GRV PDFs.

Underlying parton dynamics

$cos\theta^* = \left|tanh\frac{(\eta^1-\eta^2)}{2}\right|$ is sensitive to ME $\otimes$ Phase Space

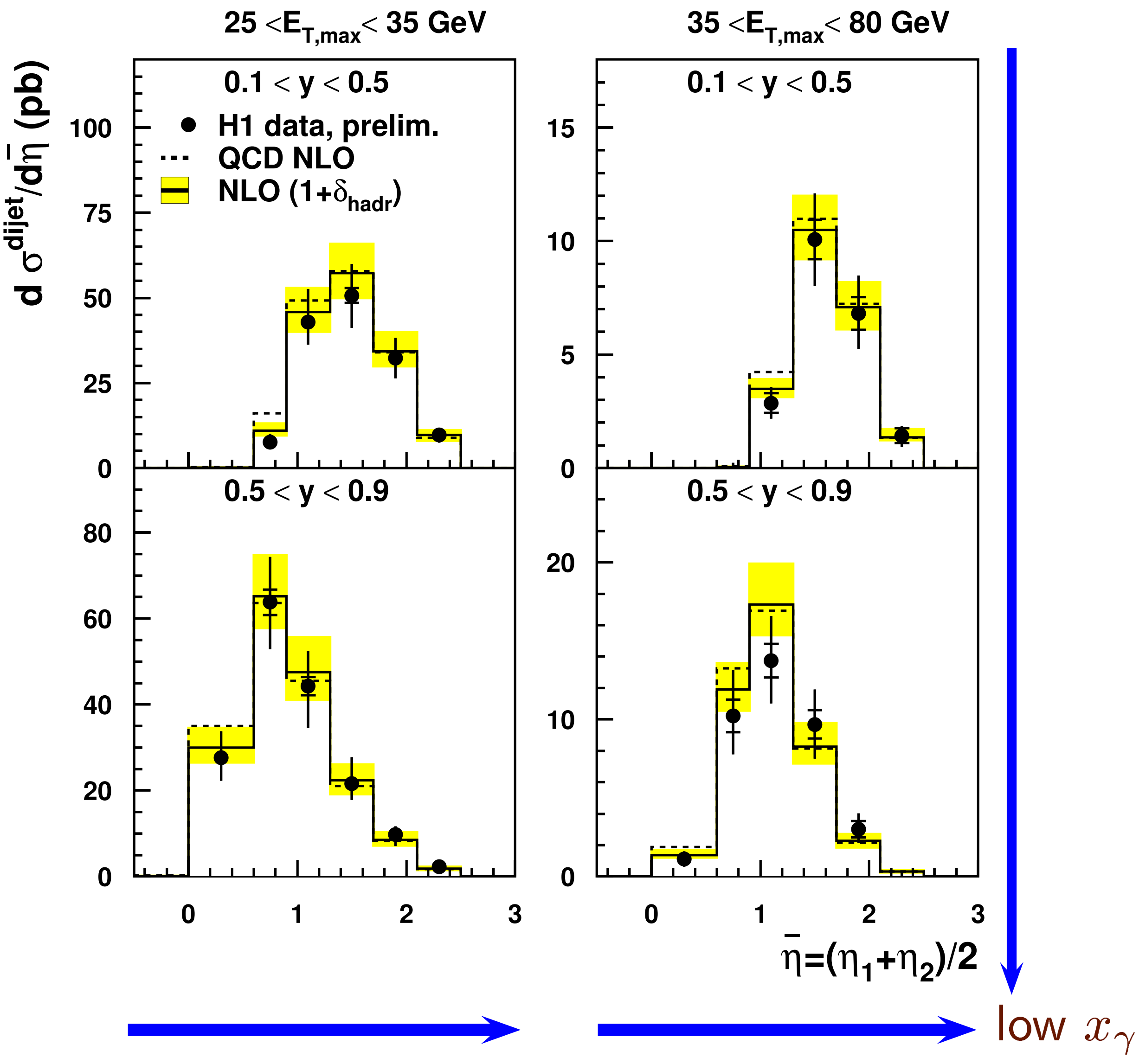
Two regions of $x_\gamma^{obs} = (E_{T,1}e^{-\eta_1} + E_{T,2}e^{-\eta_2})/2yE_e$:



M_{jj} cut: the rise of $\frac{d\sigma}{dcos\theta*}$ with increasing $cos\theta^*$ is steeper for $x_\gamma < 0.8$ than for $x_\gamma > 0.8$.

NLO QCD calculation gives a correct description of the data.

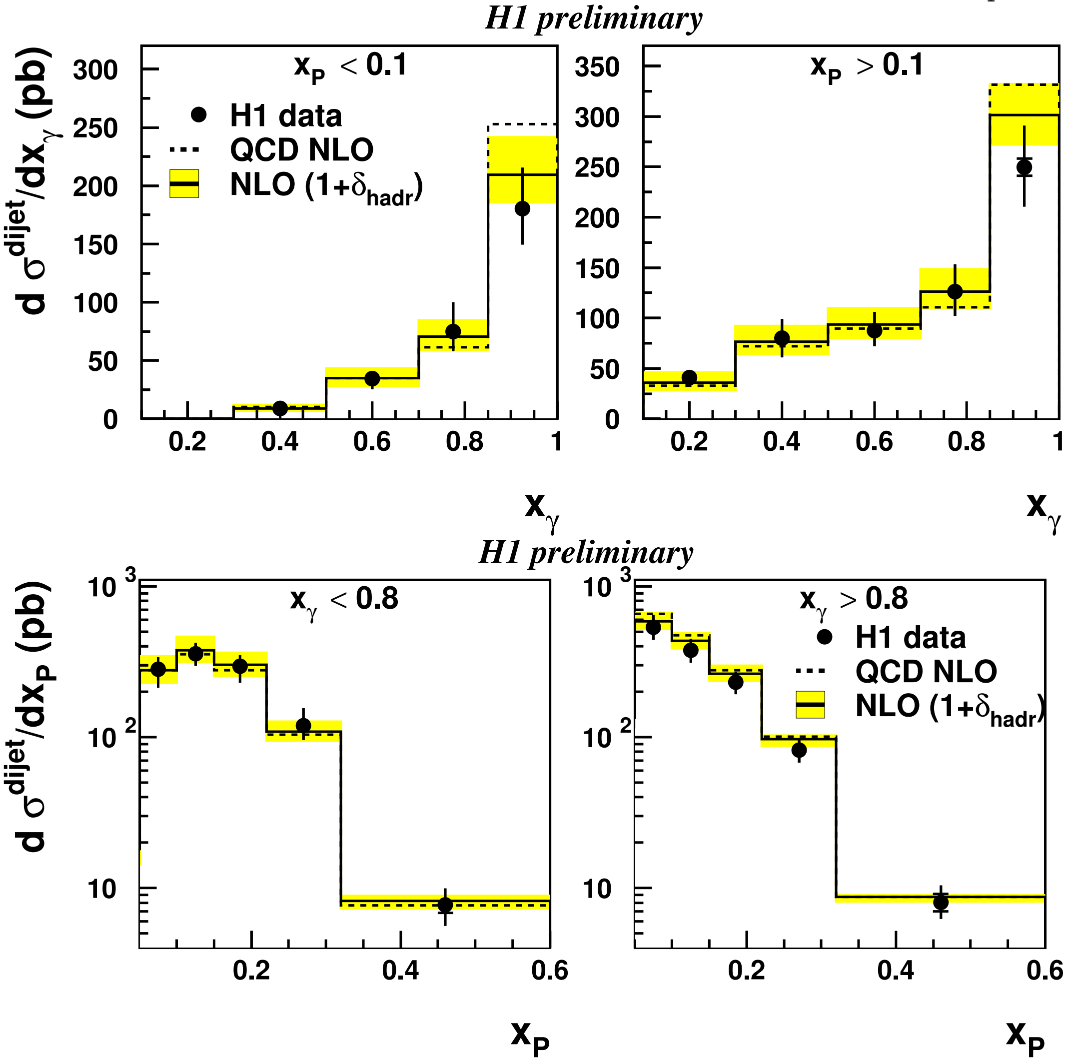
Sensitivity to PDFs: $\overline{\eta} = (\eta_1 + \eta_2)/2$



$\overline{\eta}$ dependence is described by NLO QCD calculations using GRV and CTEQ5M PDFs.

Testing γ and proton PDFs

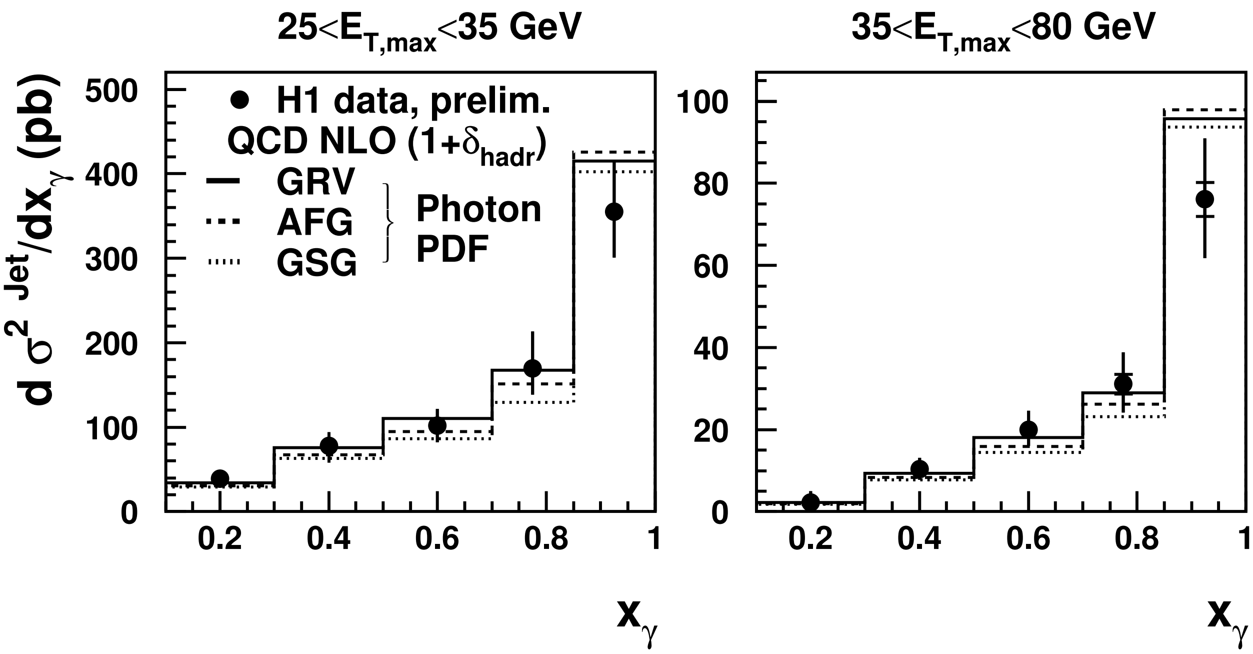
$$x_\gamma^{obs} = \frac{E_{T,1}e^{-\eta 1} + E_{T,2}e^{-\eta 2}}{2yE_e} \qquad x_p^{obs} = \frac{E_{T,1}e^{\eta 1} + E_{T,2}e^{\eta 2}}{2E_p}$$



Using CTEQ5M and GRV PDFs, NLO calculation describes the data up to $x_p \sim 0.6$.

Measurement of $\frac{d\sigma}{dx_\gamma}$

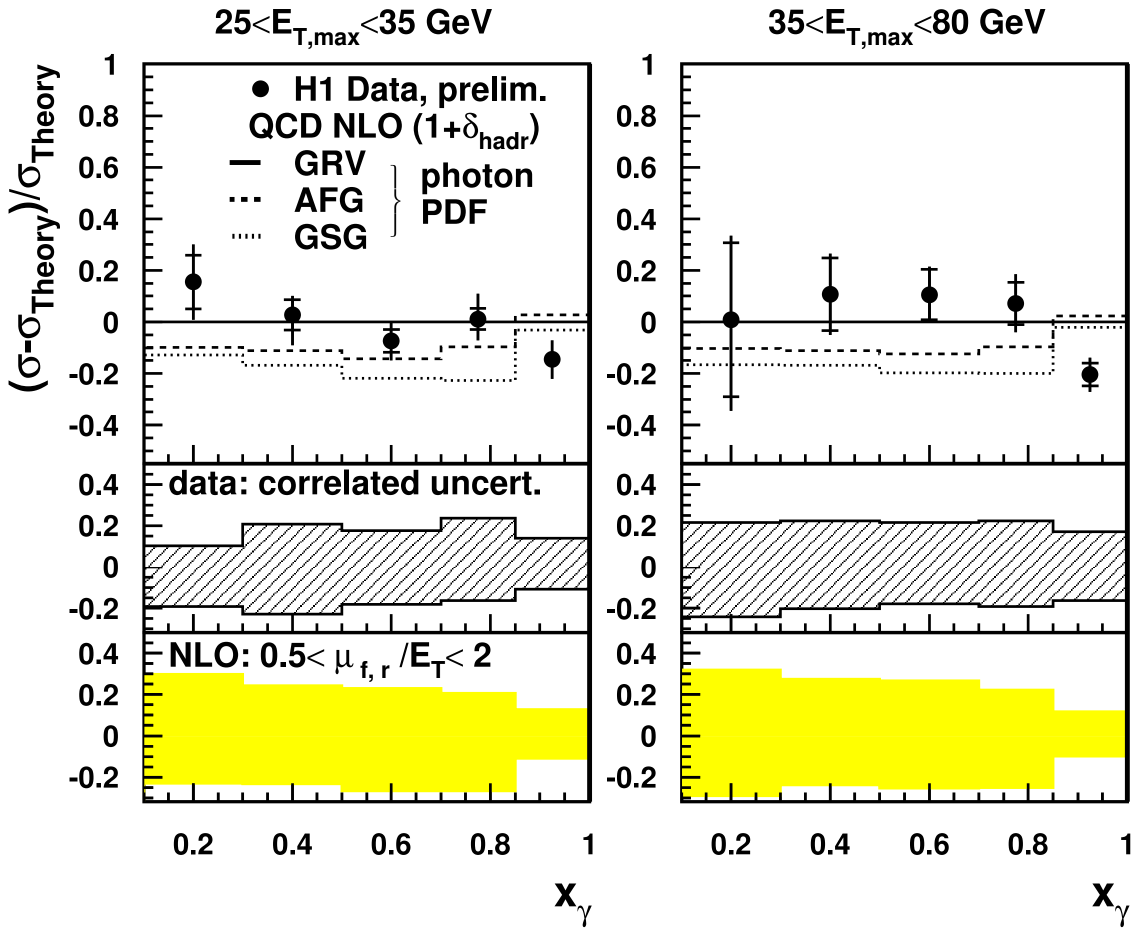
$$x_\gamma^{obs} = \frac{E_{T,1}e^{-\eta_1} + E_{T,2}e^{-\eta_2}}{2yE_e}$$



Test of three different parametrisations of photon PDFs: GRV, GSG, AFG.

Measurement of $\frac{d\sigma}{dx_\gamma}$

Difference between data and theory:



Upper plot: only uncorrelated part of the systematic errors are shown.

NLO predictions describe the x_γ distribution

Summary

- New measurement of high E_T dijet photoproduction cross sections are compared to NLO QCD calculations
- Data shows no deviation to pQCD predictions for $25 \leq E_{T,max} \leq 80\,\mathrm{GeV}$ and $45 \leq M_{jj} \leq 150\,\mathrm{GeV}$
- NLO QCD predictions using available photon PDFs describe the measured cross sections as a function of x_γ and do not confirm the disagreement observed by ZEUS