Diffractive Dijets in Photoproduction

with the ZEUS–Experiment

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on behalf of the
ZEUS–Collaboration

— DIS 2005 —
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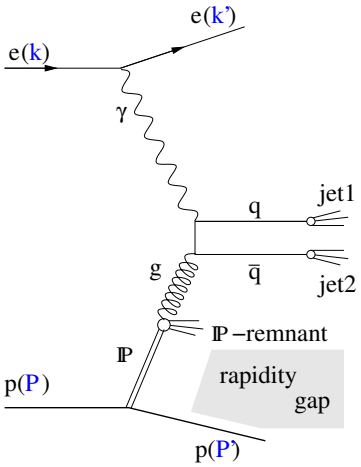
Outline

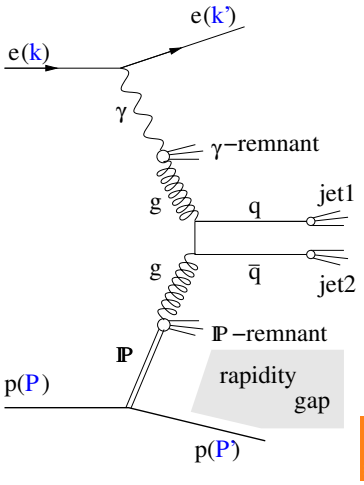
1. Introduction
   - LO processes
   - Motivation
   - Kinematics
2. Experimental setup
   - Data sample, LO MC and NLO QCD calculations
   - Event topology and selection
3. Results
   - Data versus LO MC
   - Data versus NLO QCD calculations
4. Conclusions

LO processes

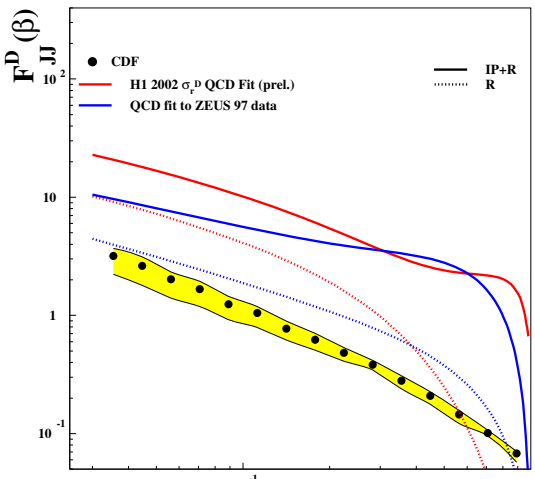
direct PhP



resolved PhP



Results on diffractive dijets at Tevatron



plot from Arneodo, Proskuriakov and Yamazaki presented at HERA-LHC workshop 11-13/10/04

CDF dijet cross sections

lower than

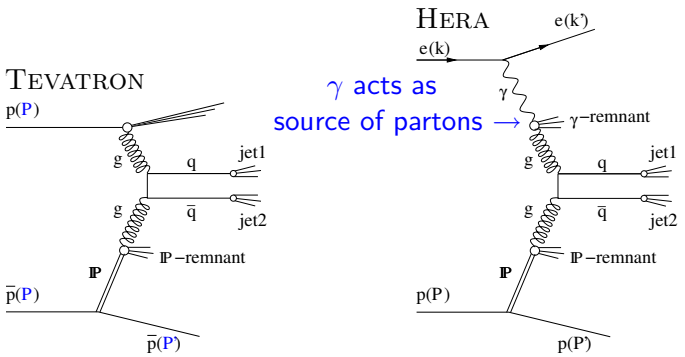
theoretical prediction

suppression factor

on theoretical calculations required to account for factorisation breaking

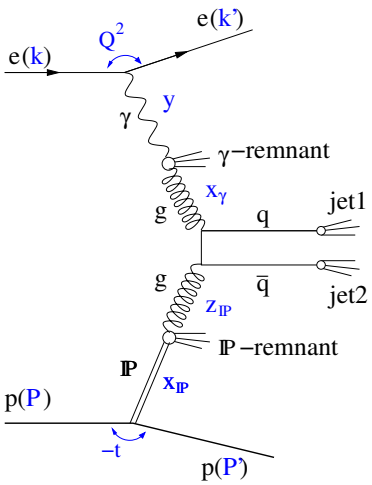
Expectations for HERA

production of diffractive dijets in $p\bar{p}$–collisions
similar to resolved γ-process in ep–collisions:



⇒ suppression also expected for resolved PhP at HERA
suppression factor predicted to be $R = 0.34$ *(Kaidalov et al.)*

Kinematics



Photoproduction: $Q^2 < 1\,\mathrm{GeV}^2$

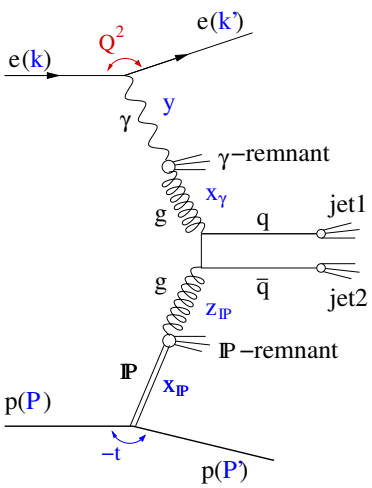
y energy fraction of e taken by γ

x_γ longitudinal momentum fraction of γ taken by parton

$z_{I\!P}$ longitudinal momentum fraction of the diffractive exchange taken by parton

$x_{I\!P}$ longitudinal momentum fraction of p entering the diffr. exchange

Kinematics



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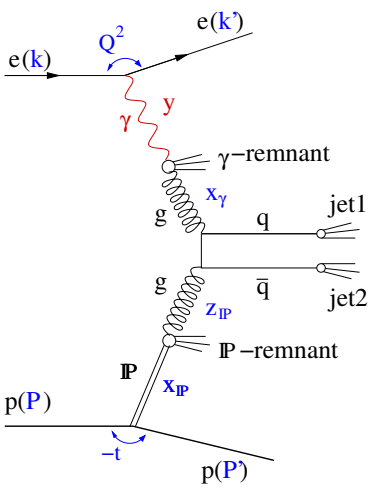

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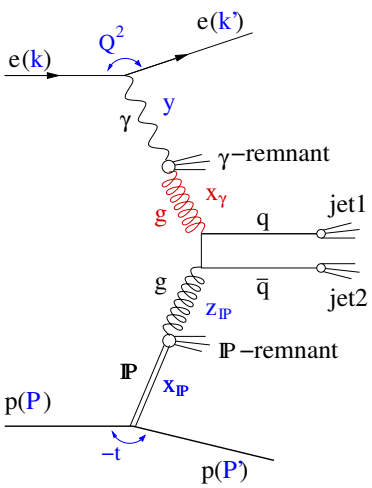

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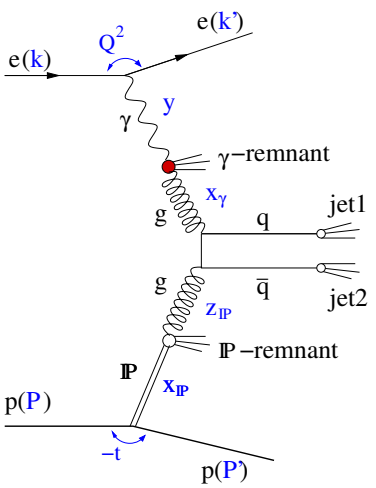

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y energy fraction of e taken by γ

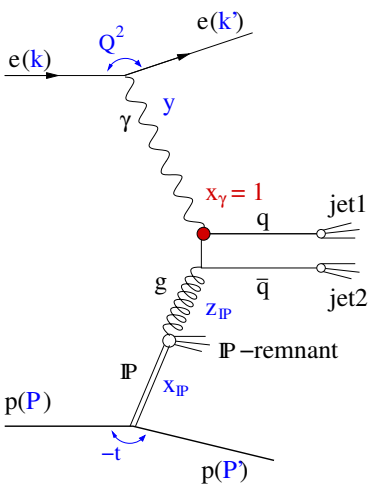
x_γ longitudinal momentum fraction of γ taken by parton

resolved PhP: $x_\gamma < 1$

$z_{I\!P}$ longitudinal momentum fraction of the diffractive exchange taken by parton

$x_{I\!P}$ longitudinal momentum fraction of p entering the diffr. exchange

Kinematics



Photoproduction: $Q^2 < 1\,\mathrm{GeV}^2$

y energy fraction of e taken by γ

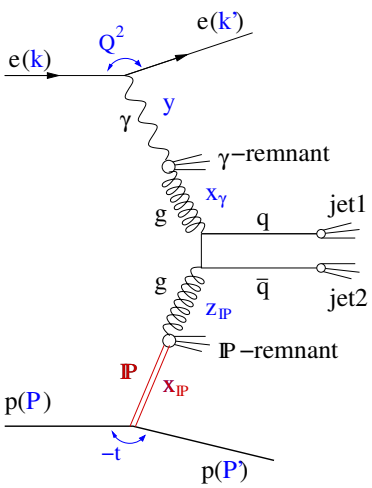
x_γ longitudinal momentum fraction of γ taken by parton

direct PhP: $x_\gamma \simeq 1$

z_{IP} longitudinal momentum fraction of the diffractive exchange taken by parton

x_{IP} longitudinal momentum fraction of p entering the diffr. exchange

Kinematics



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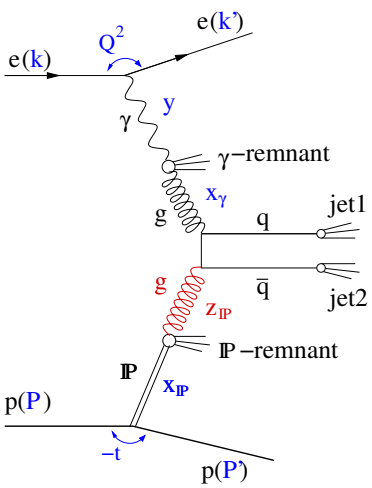

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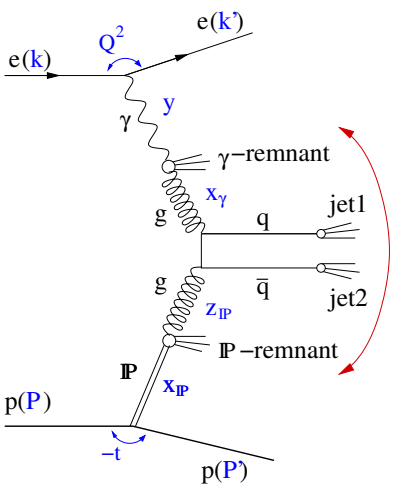


Photoproduction: $Q^2 < 1\,\mathrm{GeV}^2$

y energy fraction of e taken by γ

x_γ longitudinal momentum fraction of γ taken by parton

M_X hadronic mass

z_{IP} longitudinal momentum fraction of the diffractive exchange taken by parton

x_{IP} longitudinal momentum fraction of p entering the diffr. exchange

Data sample

99e$^-$p and '99/00e$^+$p ZEUS data ($E_p = 920\,\text{GeV}, E_e = 27.6\,\text{GeV}$)
Total integrated luminosity $\mathcal{L} = 77.6\,\text{pb}^{-1}$

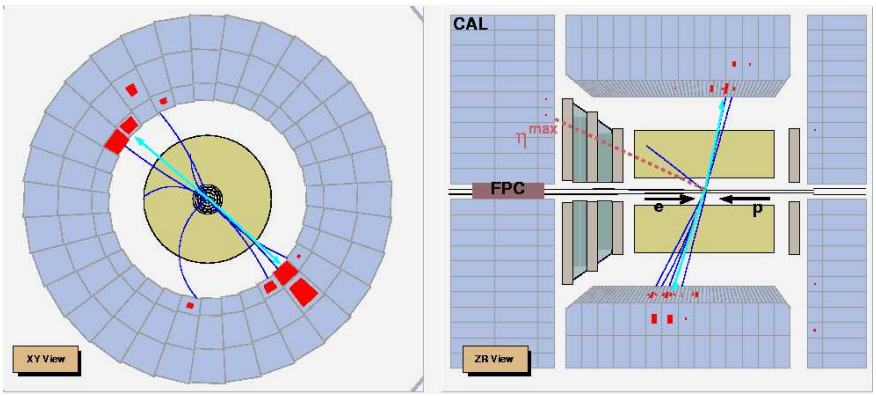
LO Monte Carlo

Events generated with RAPGAP v3.00 for $Q^2, -t < 1\,\text{GeV}^2$
Structure functions used:
p: CTEQ 5M1 γ: GRV-G-HO IP: H1 fit2

NLO QCD calculations

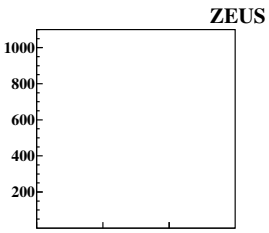
On parton level by Klasen & Kramer [H1 2002 fit (prel.)]
compared with data ▷ with resolved PhP suppressed ($R = 0.34$)
▷ with no suppression applied ($R = 1$)

Event topology at ZEUS and event selection

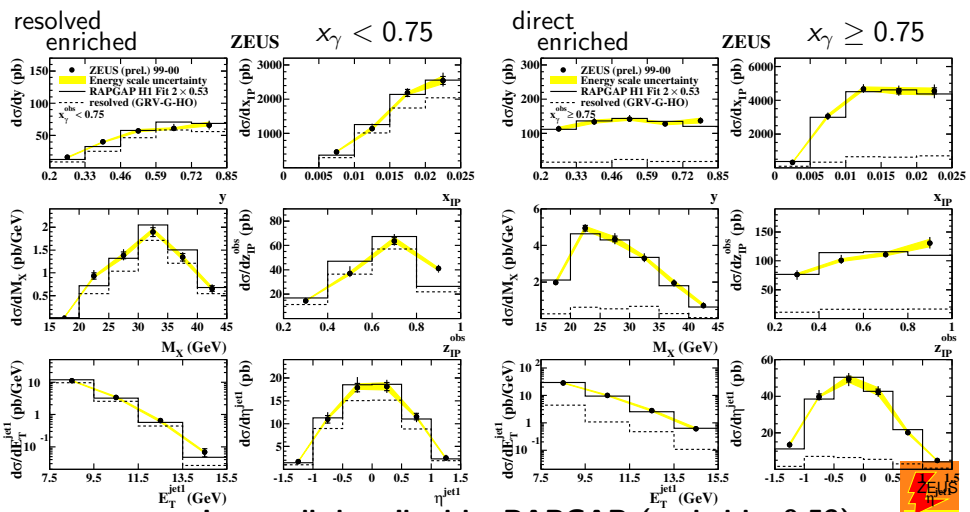


diffractive cuts		dijet cuts	PhP cuts
η_{max}	< 2.8	≥ 2 jets (k_T–algorithm),	no scattered e
M_Y	$\lesssim 2.3$ GeV	$E_T^{jet1(2)} > 7.5\,(6.5)$ GeV	in the CAL
$x_{I\!P}$	< 0.025	$-1.5 < \eta^{jet1,2} < 1.5$	$0.20 < y_{JB} < 0.85$

Result shown at ICHEP04

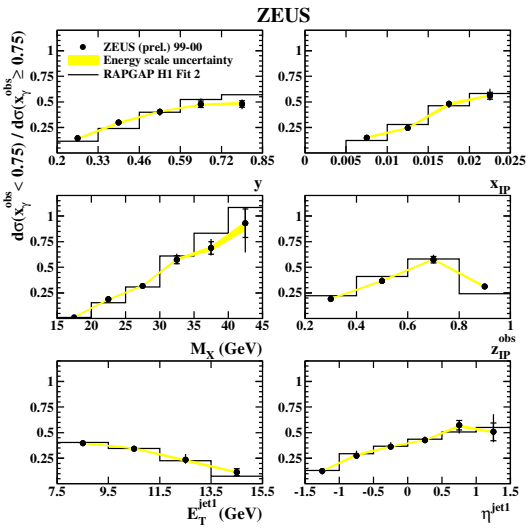


Data versus LO MC



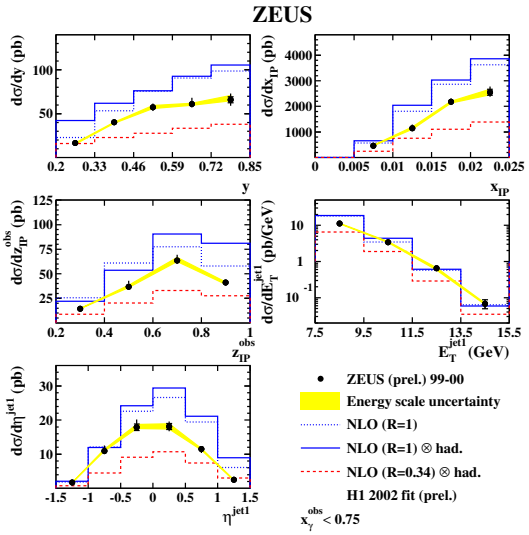
cross sections well described by RAPGAP (scaled by 0.53)

Data versus LO MC — ratio resolved/direct



- scaling factor cancels
- ratio well described by LO RAPGAP

Data versus NLO calculations — resolved enriched

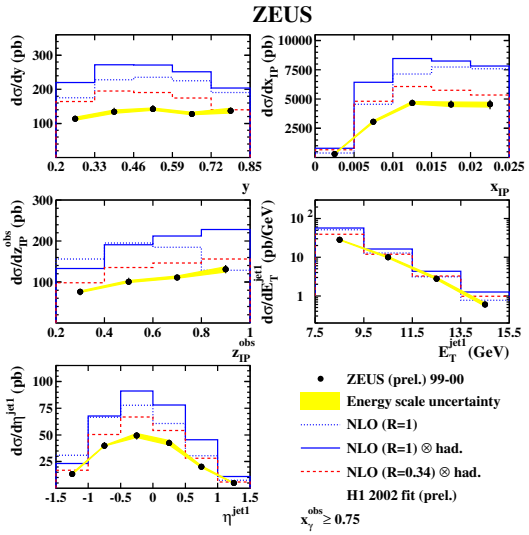


$x_\gamma < 0.75$

NLO predictions

- describe **shapes**
- do not reproduce **normalization**:
  - ▷ too high for $R = 1$ (no suppression)
  - ▷ too low for $R = 0.34$ (resolved suppression)

Data versus NLO calculations — direct enriched



$x_\gamma \geq 0.75$

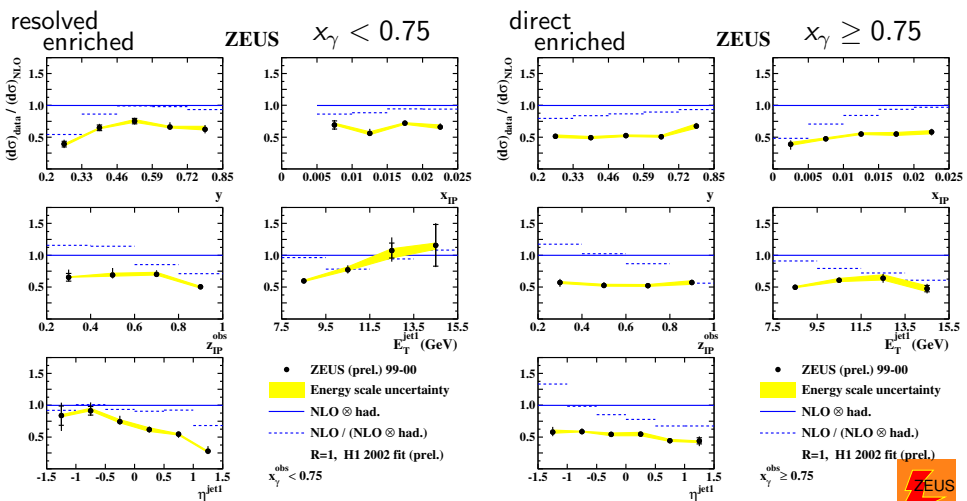
NLO predictions

- describe **shapes**
- do not reproduce **normalization**:
  - ▷ too high for both models
    $R = 1$, $R = 0.34$

$\Downarrow$

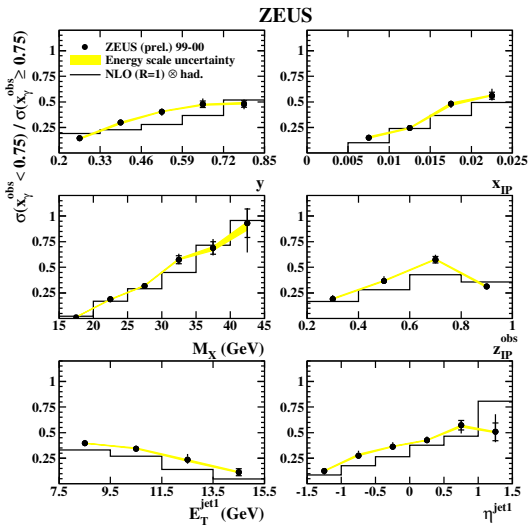
indication of a global suppression for both direct & resolved PhP

Data versus NLO (R=1) — ratio resolved(direct)/NLO



NLO ($R = 1$) overestimates data by a factor ~ 2

Data versus NLO (R=1) — ratio resolved/direct



- ratio fairly well described by NLO ($R = 1$)
- no indication of suppression of resolved PhP wrt. direct PhP

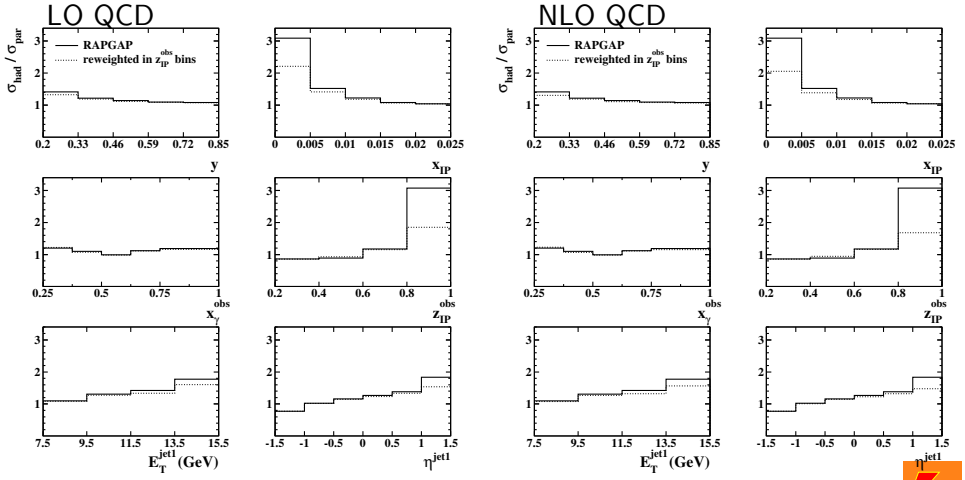
Conclusions

- ZEUS measured first double differential cross sections
  for resolved enriched PhP ($x_\gamma < 0.75$)
  for direct enriched PhP ($x_\gamma \geq 0.75$)
- Data well described in shape by LO MC RAPGAP
- NLO QCD predictions without suppression of res. PhP
  describe the shape of cross sections, but
  overestimate measurements by a factor ~ 2
- data indicate global suppression of
  both direct and resolved PhP

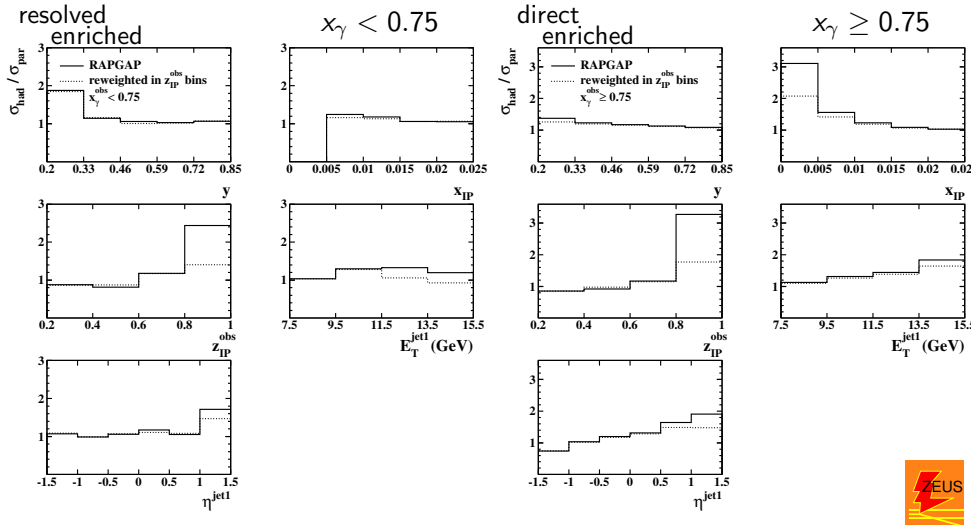
Hadronisation corrections — LO & NLO

LO QCD

NLO QCD



- ▷ hadronisation corrections estimated with RAPGAP MC
- ▷ reweighted in bins of z_{IP}^{obs}

Hadronisation corrections — resolved & direct enriched

resolved enriched $x_\gamma < 0.75$ direct enriched $x_\gamma \geq 0.75$