

Inclusive-jet and Diffractive Dijets Photoproduction (Comparison of ZEUS data with Pythia8)

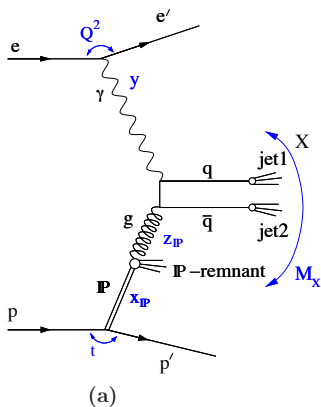
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Goa University

EIC Software MC-Data Validation Meeting
3 March 2021

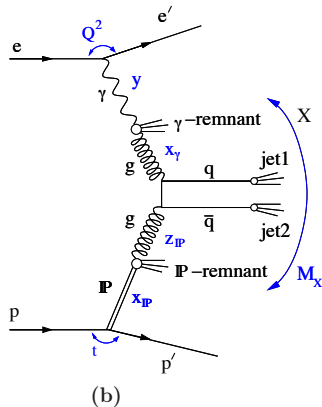


Diffractive Dijets in Photoproduction

- Comparison of Diffractive Dijets in Photoproduction at ZEUS (ZEUS_2008_I763404) arXiv:0710.1498 with Pythia8



Direct ($x_\gamma \approx 1$)



Resolved ($x_\gamma < 1$)

Dijets Production Specific Observables

- Invariant Mass the hadronic final state excluding the leading proton

$$M_X^2 = P_X^2$$

- The longitudinal momentum fraction lost by the incoming proton

$$x_{\mathbb{P}} = \frac{q \cdot (p - p')}{q \cdot p}$$

- The four-momentum transfer squared at the proton vertex

$$t = (p - p')^2$$

- Longitudinal momentum fraction of photon (entering hard sub-process)

$$x_{\gamma} = \frac{p \cdot u}{p \cdot q}$$

- Longitudinal momentum fraction of Pomeron (entering hard sub-process)

$$z_{\mathbb{P}} = \frac{q \cdot v}{q \cdot (p - p')}$$

- Invariant mass of the dijet system M_{12}^2 (c.o.m of the hard sub-process)

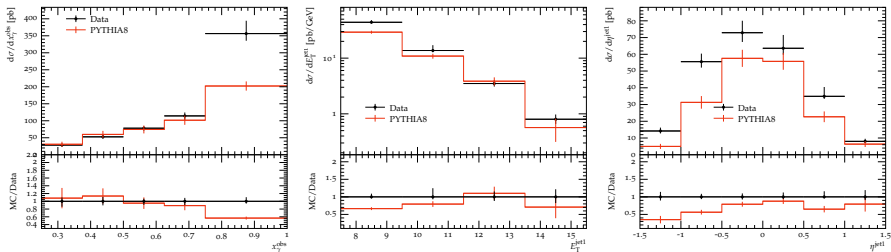
$$M_{12}^2 = (u + v)^2$$

Event Selection and MC Generator inputs

- Beam energies of the proton & positron are 920 GeV and 27.5 GeV resp.
- Total integrated luminosity is 77.2 pb^{-1} (ZEUS)
- In today's study we used 1.5 M Pythia8 events
- $Q^2 < 1 \text{ GeV}^2$ and $0.2 < y < 0.85$
- $x_{\mathbb{P}} < 0.025$
- $E_T^{jet1} > 7.5 \text{ GeV}$, $E_T^{jet2} > 6.5 \text{ GeV}$ and $-1.5 < \eta^{jet} < 1.5$

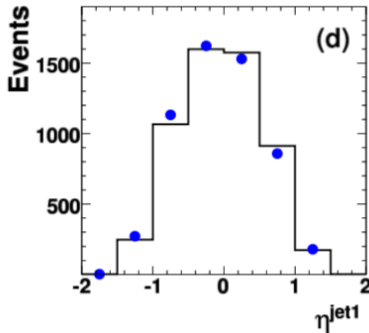
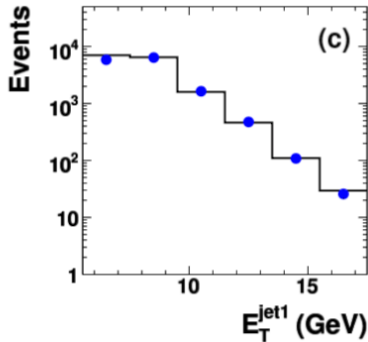
Diffractive Dijets in Photoproduction - Results 1

- x_γ , Transverse energy, and pseudo-rapidity of leading jet.



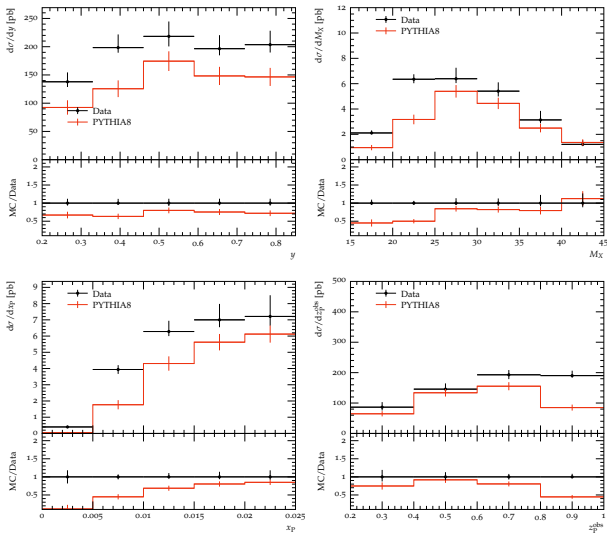
Diffraction Dijets in Photoproduction - RAPGAP

- ZEUS and RAPGAP comparison



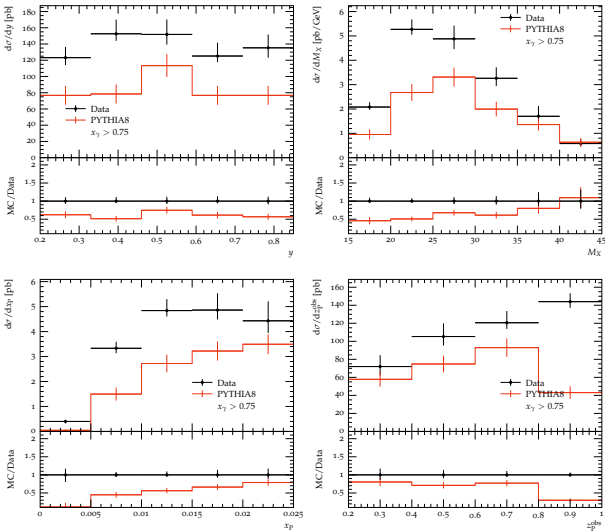
Diffractive Dijets in Photoproduction - Results 2

- Inclusive distributions for the Dijets photoproduction



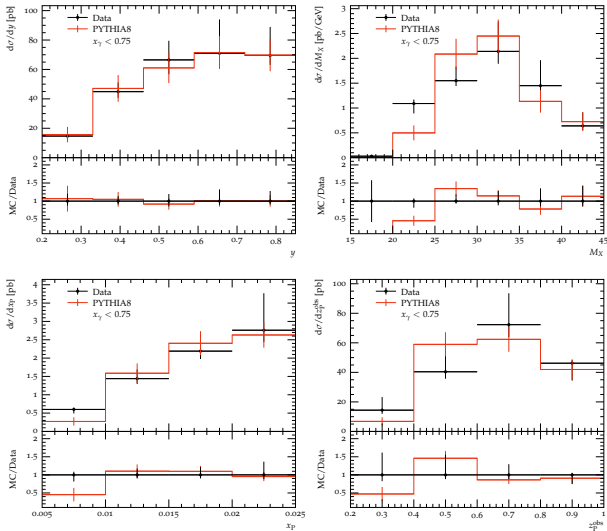
Diffractive Dijets in Photoproduction - Results 3

- Direct-photon-enriched Dijet photoproduction



Diffractive Dijets in Photoproduction - Results 4

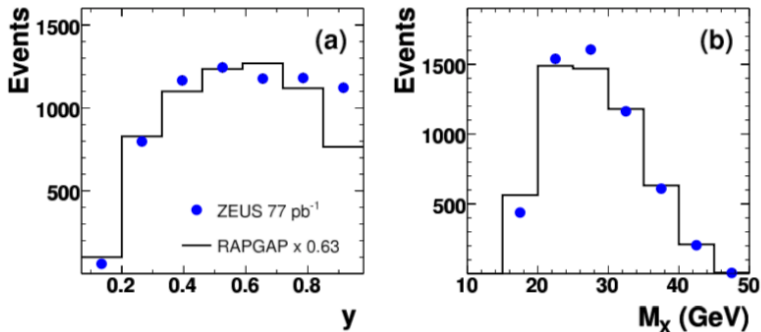
- Resolved photon Dijet photoproduction



Diffractive Dijets in Photoproduction - RAPGAP

- ZEUS and RAPGAP comparison

ZEUS

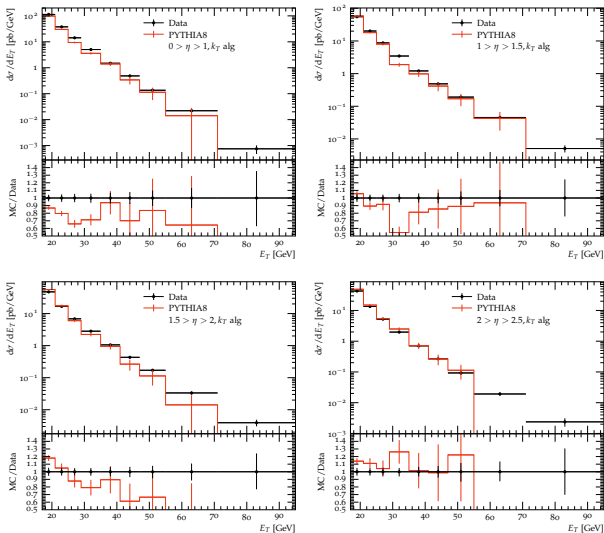


Event Selection (Inclusive Jet production)

- Comparison of Inclusive jet production at ZEUS (ZEUS_2012_I1116258) arXiv:1205.6153 with Pythia8
- Beam energies of the proton & positron are 920 GeV and 27.5 GeV resp.
- Total integrated luminosity is 300 pb^{-1} (ZEUS)
- In today's study we used 1.0 M Pythia8 events
- $Q^2 < 1 \text{ GeV}^2$ and $0.2 < y < 0.85$
- $142 < W_{\gamma p} < 293 \text{ GeV}$
- $E_T^{jet} > 17 \text{ GeV}$ and $-1.0 < \eta^{jet} < 1.5$
- x region covered by the measurements $0.003 < x < 0.95$

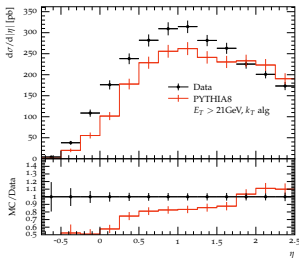
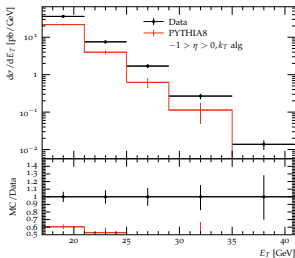
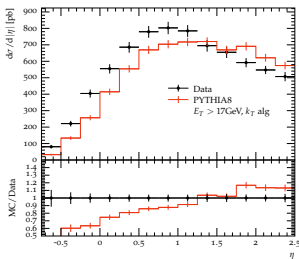
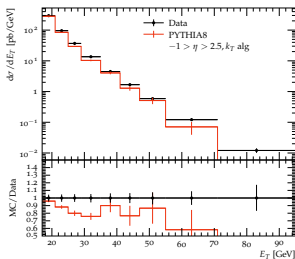
Inclusive-jet production - Results 1

- Jet Transverse Energy and η distributions (with k_T Alg)



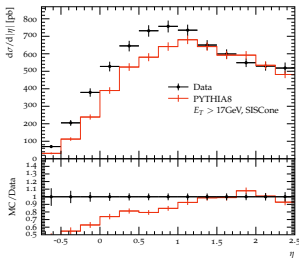
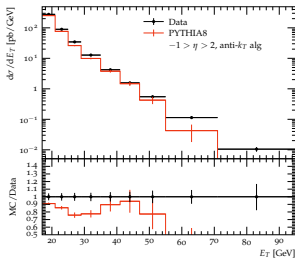
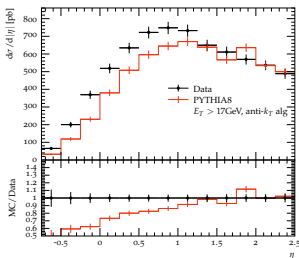
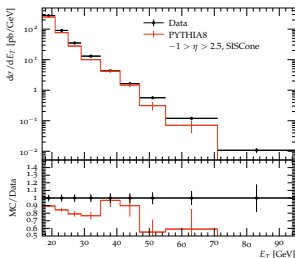
Inclusive-jet production - Results 2

- Jet Transverse Energy and η distributions (with k_T Alg)



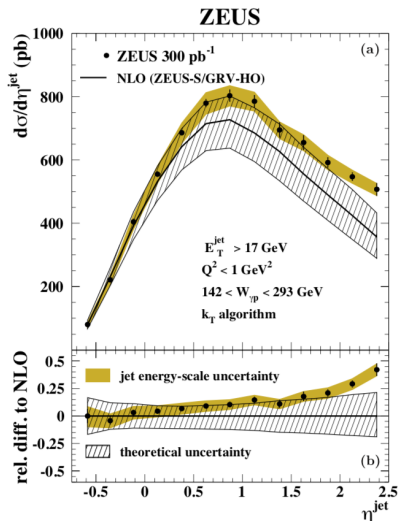
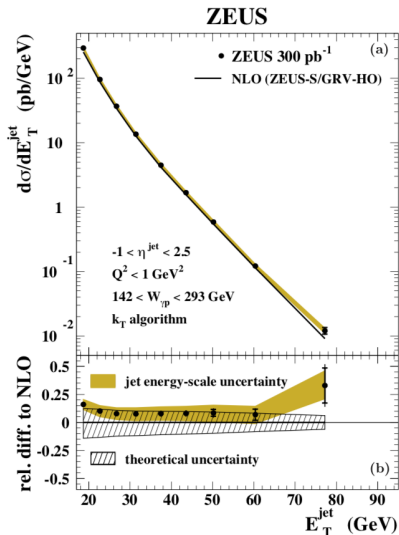
Inclusive-jet production - Results 3

- Jet Transverse Energy and η distributions (with SIS Cone & Anti- k_T)



Inclusive-jet production - NLO comparison

- NLO QCD calculations based on the (ZEUS-S/GRV-HO) PDF set



- Resolved photon-riched distributions has fairly better agreement with Pythia8 in Dijets photoprouction
- Inclusive-jet production at ZEUS compared with PYTHIA8
- Inclusive-jet production shows larger discrepancies specially at higher transverse energies and in backward η region
- SIS cone jet algorithm shows marginally better results ?

BACKUP

Common DIS Kinematics Observables

- Photon virtuality (negative of electron four-momentum transfer squared)

$$Q^2 = -q^2 = -(k - k')^2 = sxy \approx 4E_e E'_e \sin^2\left(\frac{\theta_e}{2}\right)$$

- The energy transferred by the electron

$$\nu = \frac{p \cdot q}{m_p} = E'_e - E_e$$

- Inelasticity (fraction of the electron energy transferred to the proton)

$$y = \frac{p \cdot q}{p \cdot k} = \frac{\nu}{E_e} \approx 1 - \frac{E'_e}{E_e} \sin^2\left(\frac{\theta_e}{2}\right)$$

- Bjorken - x (momentum fraction of proton carried by the struck quark)

$$x = \frac{Q^2}{2p \cdot q} = \frac{Q^2}{2m_p \nu}$$

- Squared centre-of-mass energy of the electron-proton collision system

$$s = (k + p)^2$$

- Squared centre-of-mass energy of the photon-proton collision system

$$W_{\gamma p}^2 = (q + p)^2 = M_X^2 = m_p^2 - Q^2 + sy$$