Asymmetric jet cuts in dijet measurements at ZEUS

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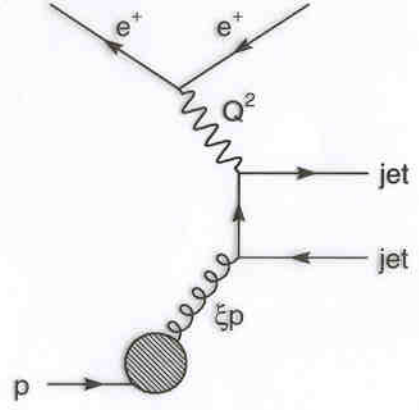
Outline

Dijets in e–p collisions
Infrared Sensitivity at NLO
Study with DISENT
Impact on ZEUS Measurements

Dijets in e–p collisions

Leading Order QCD Dijet Diagrams:

Boson–Gluon Fusion



$$\sigma^{2+1} \sim \hat{\sigma}_{BGF} \cdot g(x,Q^2)$$

$E_p = 920$ GeV

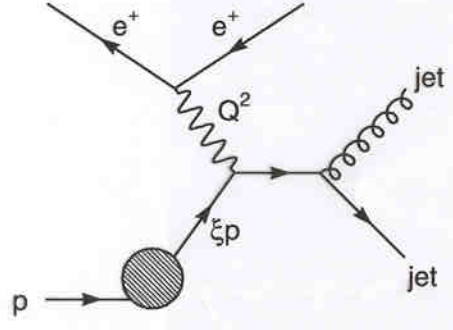
$E_{e+} = 27.5$ GeV

318 GeV
center–of–mass energy

$$\xi = x\left(1+\frac{M_{ij}^2}{Q^2}\right)$$

Momentum fraction of incident parton

QCD Compton

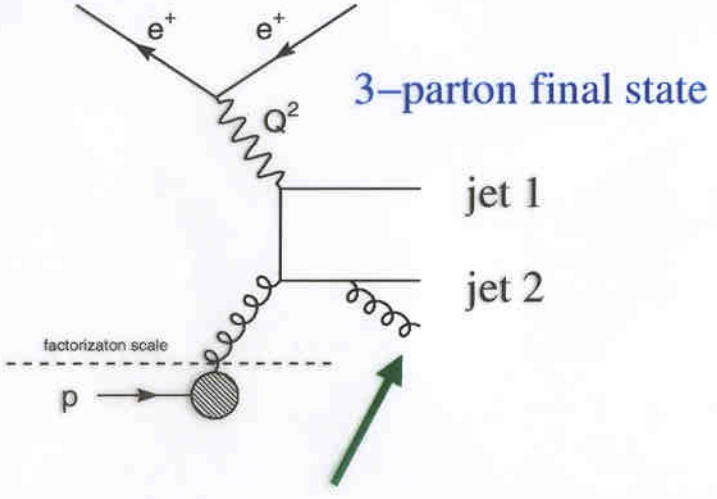


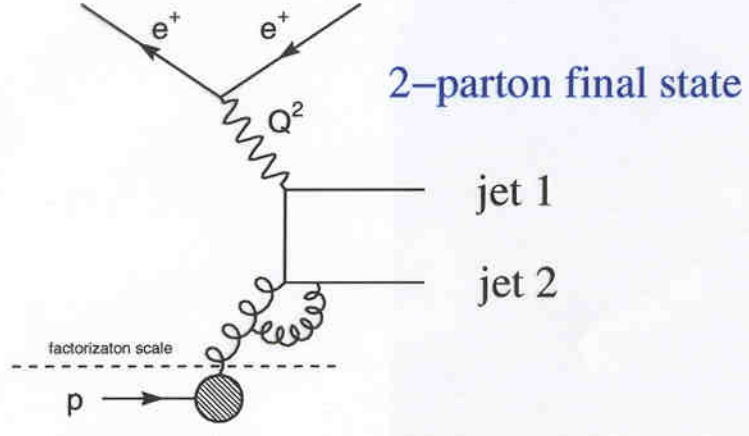
$$\sigma^{2+1} \sim \hat{\sigma}_{QCDC} \cdot q(x,Q^2)$$

BGF (QCDC) contribution directly proportional to gluon (quark) density in the proton.

Asymmetric Jet Cuts I: Infrared Sensitivity

NLO calculations for BGF process receive contributions from LO Born cross sections and O (α_s^2) real (positive) and virtual (negative) corrections.





Soft gluon emission reduces transverse energy of second jet

Symmetric cut ($E_{T,jet\,1} = E_{T,jet\,2}$) limits the 3–body phase space, introducing infrared sensitivity and disrupting the compensation between real and virtual corrections.

$$\text{Asymmetric cut} \Rightarrow E_{T,jet\,2}(\text{cut}) < E_{T,jet\,1}$$

S. Frixione and G.Ridolfi
Nucl.Phys.B 507 (1997)

Asymmetric Jet Cuts II: Study with DISENT

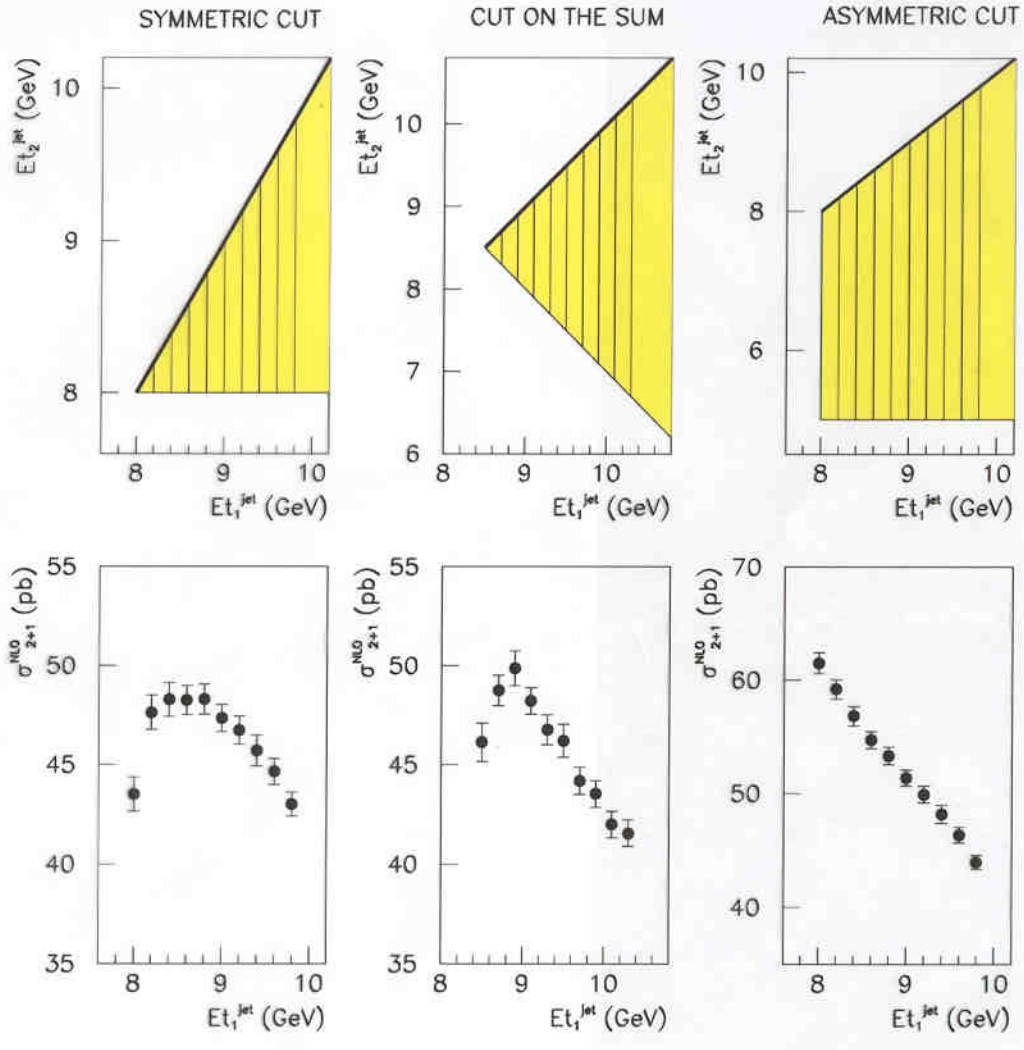
To study the effect, 3 scenarios were considered:

(a) $E_{T,jet\ 1} > 8$ GeV
$E_{T,jet\ 2} > 8$ GeV

(b) $E_{T,jet\ 1} > 5$ GeV
$E_{T,jet\ 2} > 5$ GeV
$E_{T,jet\ 1} + E_{T,jet\ 2} > 17$ GeV

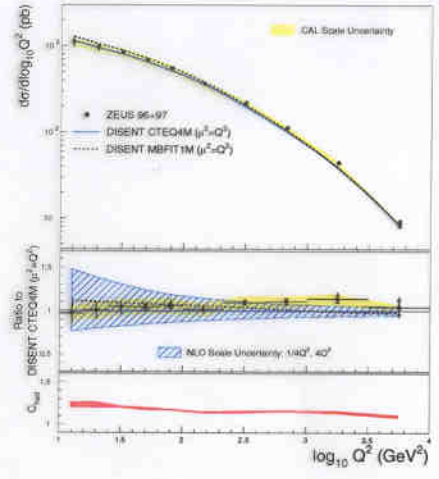
(c) $E_{T,jet\ 1} > 8$ GeV
$E_{T,jet\ 2} > 5$ GeV

Purely asymmetric jet cuts cure dijet cross section of unphysical behavior near the symmetric cut



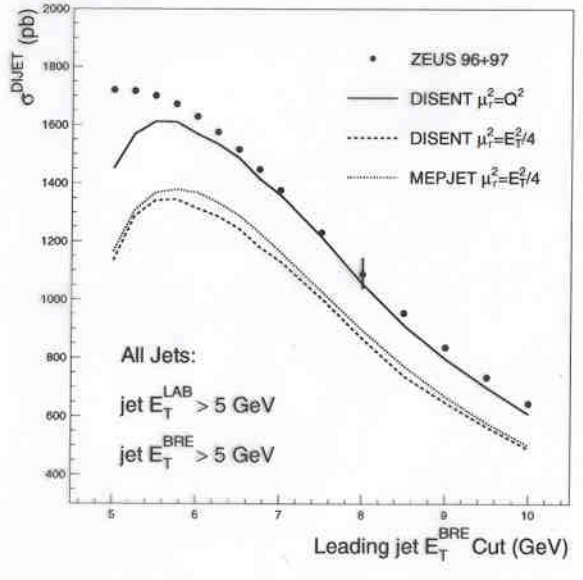
NLO cross sections calculated with DISENT

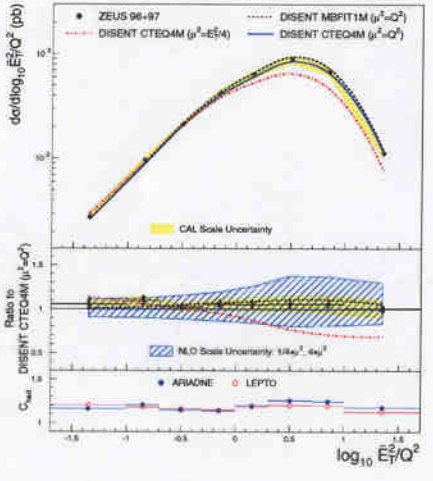
Impact on Dijet Analyses



With asymmetric cuts, agreement between dijet measured cross sections and NLO predictions in a variety of different observables!

Data and NLO comparison:
symmetric vs. asymmetric cuts





Conclusion:

Asymmetric jet cuts give increased phase space region for 3–parton final states, allowing proper cancellation of NLO corrections and physically meaningful cross sections.

Infrared sensitivity observed with other NLO programs:
MEPJET : see hep–ex/0109029
JetVip : see B.Potter, Comput.Phys.Commun. 133(2000)