Asymmetric jet cuts in dijet measurements at

Dijets in e-\(p\) collisions
Infrared Sensitivity at NLO
Study with DISENT
Impact on ZEUS Measurements

Outline

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Dijets in $e^-p$ collisions

**Leading Order QCD Dijet Diagrams:**

**Boson–Gluon Fusion**

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

\[ E_p = 920 \text{ GeV} \]
\[ E_{e^+} = 27.5 \text{ GeV} \]
\[ 318 \text{ GeV} \]

center-of-mass energy

\[ \xi = x(1 + \frac{M_{jj}^2}{Q^2}) \]

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 \( O(\alpha_s^2) \) real (positive) and virtual (negative) corrections.

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.

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

S. Frixione and G. Ridolfi
Asymmetric Jet Cuts II: Study with DISENT

To study the effect, 3 scenarios were considered:

(a) $E_{T,jet_1} > 8 \text{ GeV}$
    $E_{T,jet_2} > 8 \text{ GeV}$

(b) $E_{T,jet_1} > 5 \text{ GeV}$
    $E_{T,jet_2} > 5 \text{ GeV}$
    $E_{T,jet_1} + E_{T,jet_2} > 17 \text{ GeV}$

(c) $E_{T,jet_1} > 8 \text{ GeV}$
    $E_{T,jet_2} > 5 \text{ GeV}$

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

NLO cross sections calculated with DISENT

Recontres de Moriond – 3/15/02

Dijet Measurements at ZEUS
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