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MEASUREMENT OF THE INCLUSIVE JET CROSS SECTION AT DZERO.

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This note presents, on behalf of the DØ collaboration, preliminary measurements of the inclusive jet cross section in $p\bar{p}$ collisions at the center-of-mass energy $\sqrt{s} =$ 1.96 TeV. Jets are reconstructed using an iterative cone algorithm with radius $R_{cone} =$ 0.7. Data were collected by the DØ detector during the years 2002 and 2003, and correspond to an integrated luminosity of $\mathcal{L} \simeq$ 140 pb^{-1}. Results from next-to-leading order perturbative QCD calculations are compared to our cross section measurements.

1 Motivation

Hadronic jet production with large transverse momentum (p_T) provides a useful test of perturbative QCD (pQCD) calculations. The inclusive jet cross section at large p_T is directly related to the strong coupling constant α_S, parton distribution functions (PDF) and pQCD matrix elements. The cross section measurement offers a reliable test of parton-level next-to-leading order (NLO) calculations and pQCD matrix elements. Potential deviations from the theoretically predicted cross section at high p_T, not explained by PDFs and α_S, might indicate a new physics beyond the Standard Model.

We present preliminary measurements of the inclusive jet cross section at $\sqrt{s} =$ 1.96 TeV, based on the sample corresponding to the integrated luminosity of $\mathcal{L} \simeq$ 140 pb^{-1}. The data were acquired with the upgraded DØ detector [1] in Run II of the Tevatron at Fermilab. Events, used in this analysis, were triggered by jet triggers based on the energy deposited in calorimeter towers. The data selection was based upon the run quality, event properties and jet quality criteria.

2 Jets and Cone Algorithm

Jets were defined using the "Run II jet cone algorithm" [2] which combines particles within a cone of radius $R_{\rm cone} =$ 0.7 in rapidity, $y = \frac{1}{2}\log_{10}\left(\frac{E+p_z}{E-p_z}\right)$, and azimuth, ϕ, around the cone axis. All particles were combined into jets in the "$E-scheme$" (adding four-vectors); in the case of data, by "particles" we understand calorimeter towers, all stable particles in the case of Monte Carlo (MC), and partons in the case of pQCD. The four-vectors of all particles were used as seeds in the first stage of the iterative procedure. The algorithm was re-run using the midpoints between pairs of jets as additional seeds (this made the procedure infrared safe). Jets with overlapping cones were merged if the overlap area contained more than 50% of the

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lower p_T jet, otherwise, particles in the overlap region were assigned to the nearest jet.

3 Jet Energy Scale

Data were corrected for the jet energy scale, selection efficiencies and for the migration due to the p_T resolution. The jet energy scale was determined by minimizing the missing energy in "photon plus jets" events. In an iterative procedure a parameteried ansatz function was smeared with the resolution determined from the data and fit to the observed p_T spectrum. Ratios of the original to the smeared ansatz function were used to correct the data for migration effects.

4 Data and Cross Section Measurement

The highest p_T event in the data sample had $p_T = 616$ GeV/c, see Table 1. The

	1^{st} jet	2^{nd} jet
p_T [GeV/c]	616	557
η	-0.19	0.25
ϕ [rad]	0.65	3.68
$M_{\text{jj}} = 1206$ GeV/c		

Table 1. The quantities of the two leading jets in the event containing the highest p_T jet. This event also has the highest invariant dijet mass.

inclusive jet cross section was measured in the central rapidity region with $|y| < 0.5$, and also, in two forward rapidity regions: $1.5 < |y| < 2.0$, and $2.0 < |y| < 2.4$. The largest experimental uncertainty was due to the jet energy scale. Further contributions were from the efficiencies in the data selection, from trigger efficiencies, from uncertainties in the unsmearing procedure and from the determination of the jet p_T resolution. In addition, the luminosity measurement contributed with the uncertainty of 6.5%.

Distributions in Figures 1-3 show the inclusive jet cross section in three rapidity regions as a function of p_T. Data are shown are with statistical errors only. One can see how the inclusive jet cross section at large y falls more steeply towards high p_T in Figure 1. The same distributions are displayed in Figure 2, but with shaded bands indicating systematic experimental uncertainties which are dominated by the jet energy scale uncertainty.

Next-to-leading order (NLO) pQCD calculations are compared to data in Figures 1-3. The NLO calculations were done using JETRAD [3]. The renormalization and factorization scales were set to the half of the leading jet p_T, $\mu_r = \mu_f = 0.5\, p_T^{\max}$. We used the CTEQ6M [4] parametrization of the PDFs and $\alpha_S(M_Z) = 0.118$. The maximum distance of particles within a jet was limited to $R_{\text{sep}} \cdot R_{cone}$ with $R_{\text{sep}} = 1.3$ [5]. The ratio of data over theory is shown in Figure 3. Uncertainties in NLO calculations due to PDFs uncertainties are indicated by the

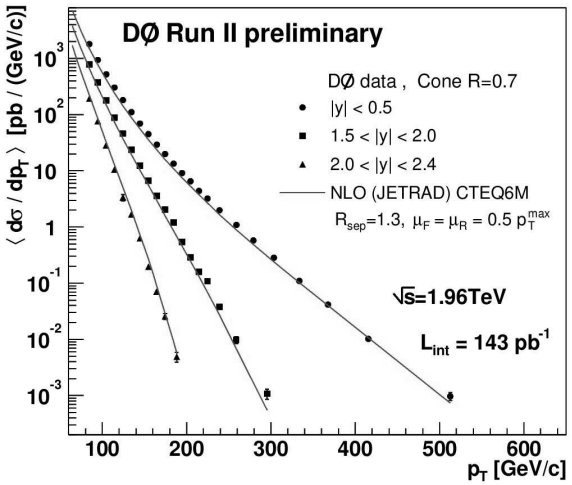

Figure 1. The inclusive jet cross section measured in different ranges of the jet rapidity (with statistical errors only). NLO pQCD calculations overlay the data.

grey bands and the experimental uncertainties are displayed as solid lines. Theory is in good agreement with data given the large uncertainties.

5 Summary

We measured the inclusive cross section in $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV based on data sample corresponding to $\mathcal{L} \simeq 140$ pb^{-1}. The measurement was extended from the central region to the larger rapidities. The data are well described by NLO pQCD throughout the whole kinematic region.

Acknowledgments

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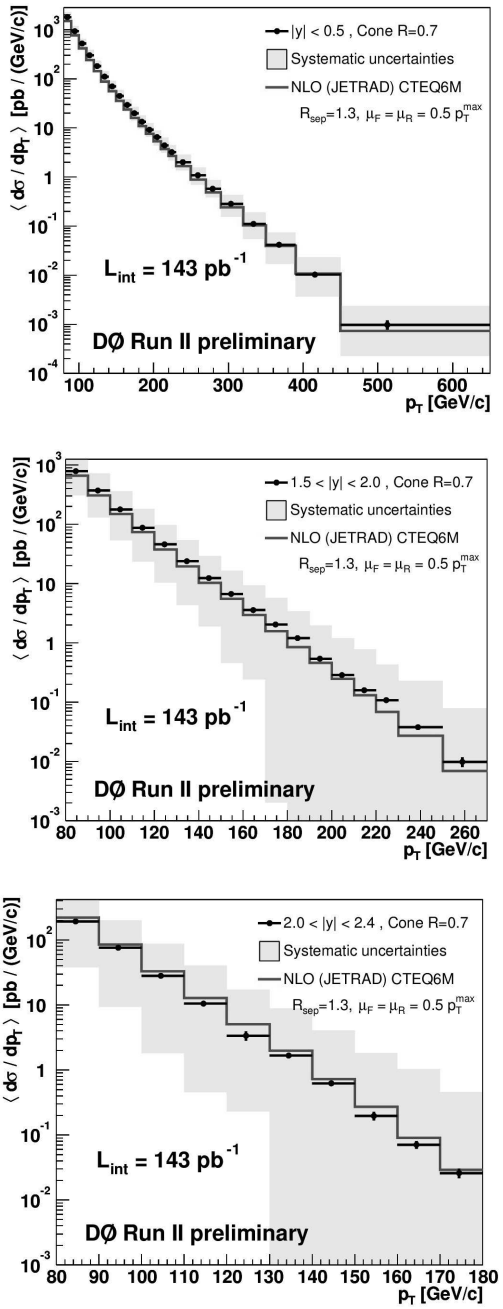

Figure 2. The inclusive jet cross sections measured in three different jet rapidity regions - from the top to the bottom: $|y| > 0.5$, $1.5 < |y| < 2.0$ and $2.0 < |y| < 2.4$. Shaded bands indicate systematic uncertainties. The data are displayed with statistical errors only. The solid line represents NLO pQCD calculation.

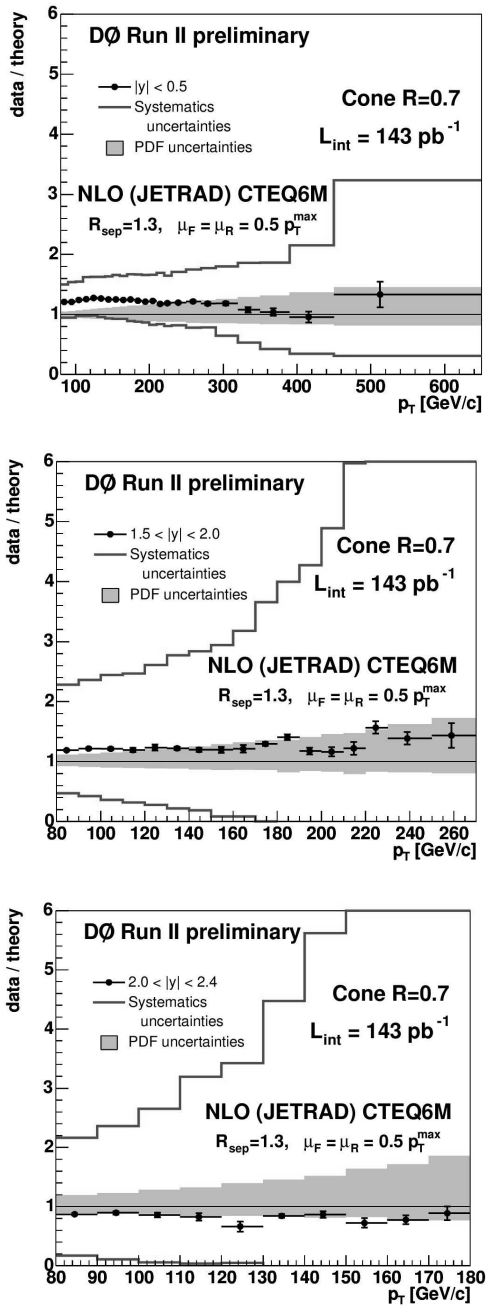

Figure 3. The ratio of the measured inclusive jet cross section and the NLO pQCD calculations in three jet rapidity regions. Shaded bands represent uncertainties in the NLO calculation due to PDFs uncertainties. Solid lines indicate experimental uncertainties.