Fermilab FERMILAB-Conf-01/285-E D0 Oct. 2001

The Inclusive Jet Cross Section in $p\overline{p}$ Collisions at $\sqrt{s} = 1.8$ TeV using the $k_\perp$ Algorithm

The DØ Collaboration *
Fermi National Accelerator Laboratory, Batavia, Illinois 60510
(June 11, 2001)

Abstract

We present a preliminary measurement of the central inclusive jet cross section using a successive combination algorithm based on relative transverse momenta ($k_\perp$) for jet reconstruction. We analyze a $87.3\,pb^{-1}$ data sample collected by the DØ detector at the Fermilab Tevatron $p\overline{p}$ Collider during 1994-1995. The cross section, reported as a function of transverse momentum ($p_T > 60$ GeV) in the central region of pseudo-rapidity ($|\eta| < 0.5$), is in reasonable agreement with next-to-leading order QCD predictions. This is the first jet production measurement in a hadron collider using a successive combination type of jet algorithm.

*Submitted to the *International Europhysics Conference on High Energy Physics*, July 12-18, 2001, Budapest, Hungary,
and *XX International Symposium on Lepton and Photon Interactions at High Energies* July 23 – 28, 2001, Rome, Italy.

V.M. Abazov,[23] B. Abbott,[58] A. Abdesselam,[11] M. Abolins,[51] V. Abramov,[26] B.S. Acharya,[17] D.L. Adams,[60] M. Adams,[38] S.N. Ahmed,[21] G.D. Alexeev,[23] G.A. Alves,[2] N. Amos,[50] E.W. Anderson,[43] Y. Arnoud,[9] M.M. Baarmand,[55] V.V. Babintsev,[26] L. Babukhadia,[55] T.C. Bacon,[28] A. Baden,[47] B. Baldin,[37] P.W. Balm,[20] S. Banerjee,[17] E. Barberis,[30] P. Baringer,[44] J. Barreto,[2] J.F. Bartlett,[37] U. Bassler,[12] D. Bauer,[28] A. Bean,[44] M. Begel,[54] A. Belyaev,[35] S.B. Beri,[15] G. Bernardi,[12] I. Bertram,[27] A. Besson,[9] R. Beuselinck,[28] V.A. Bezzubov,[26] P.C. Bhat,[37] V. Bhatnagar,[11] M. Bhattacharjee,[55] G. Blazey,[39] S. Blessing,[35] A. Boehnlein,[37] N.I. Bojko,[26] F. Borcherding,[37] K. Bos,[20] A. Brandt,[60] R. Breedon,[31] G. Briskin,[59] R. Brock,[51] G. Brooijmans,[37] A. Bross,[37] D. Buchholz,[40] M. Buehler,[38] V. Buescher,[14] V.S. Burtovoi,[26] J.M. Butler,[48] F. Canelli,[54] W. Carvalho,[3] D. Casey,[51] Z. Casilum,[55] H. Castilla-Valdez,[19] D. Chakraborty,[39] K.M. Chan,[54] S.V. Chekulaev,[26] D.K. Cho,[54] S. Choi,[34] S. Chopra,[56] J.H. Christenson,[37] M. Chung,[38] D. Claes,[52] A.R. Clark,[30] J. Cochran,[34] L. Coney,[42] B. Connolly,[35] W.E. Cooper,[37] D. Coppage,[44] S. Crépé-Renaudin,[9] M.A.C. Cummings,[39] D. Cutts,[59] G.A. Davis,[54] K. Davis,[29] K. De,[60] S.J. de Jong,[21] K. Del Signore,[50] M. Demarteau,[37] R. Demina,[45] P. Demine,[9] D. Denisov,[37] S.P. Denisov,[26] S. Desai,[55] H.T. Diehl,[37] M. Diesburg,[37] G. Di Loreto,[51] S. Doulas,[49] P. Draper,[60] Y. Ducros,[13] L.V. Dudko,[25] S. Duensing,[21] L. Duflot,[11] S.R. Dugad,[17] A. Duperrin,[10] A. Dyshkant,[39] D. Edmunds,[51] J. Ellison,[34] V.D. Elvira,[37] R. Engelmann,[55] S. Eno,[47] G. Eppley,[62] P. Ermolov,[25] O.V. Eroshin,[26] J. Estrada,[54] H. Evans,[53] V.N. Evdokimov,[26] T. Fahland,[33] S. Feher,[37] D. Fein,[29] T. Ferbel,[54] F. Filthaut,[21] H.E. Fisk,[37] Y. Fisyak,[56] E. Flattum,[37] F. Fleuret,[30] M. Fortner,[39] H. Fox,[40] K.C. Frame,[51] S. Fu,[53] S. Fuess,[37] E. Gallas,[37] A.N. Galyaev,[26] M. Gao,[53] V. Gavrilov,[24] R.J. Genik II,[27] K. Genser,[37] C.E. Gerber,[38] Y. Gershtein,[59] R. Gilmartin,[35] G. Ginther,[54] B. Gómez,[5] G. Gómez,[47] P.I. Goncharov,[26] J.L. González Solís,[19] H. Gordon,[56] L.T. Goss,[61] K. Gounder,[37] A. Goussiou,[28] N. Graf,[56] G. Graham,[47] P.D. Grannis,[55] J.A. Green,[43] H. Greenlee,[37] S. Grinstein,[1] L. Groer,[53] S. Grünendahl,[37] A. Gupta,[17] S.N. Gurzhiev,[26] G. Gutierrez,[37] P. Gutierrez,[58] N.J. Hadley,[47] H. Haggerty,[37] S. Hagopian,[35] V. Hagopian,[35] R.E. Hall,[32] P. Hanlet,[49] S. Hansen,[37] J.M. Hauptman,[43] C. Hays,[53] C. Hebert,[44] D. Hedin,[39] J.M. Heinmiller,[38] A.P. Heinson,[34] U. Heintz,[48] T. Heuring,[35] M.D. Hildreth,[42] R. Hirosky,[63] J.D. Hobbs,[55] B. Hoeneisen,[8] Y. Huang,[50] R. Illingworth,[28] A.S. Ito,[37] M. Jaffré,[11] S. Jain,[17] R. Jesik,[28] K. Johns,[29] M. Johnson,[37] A. Jonckheere,[37] M. Jones,[36] H. Jöstlein,[37] A. Juste,[37] W. Kahl,[45] S. Kahn,[56] E. Kajfasz,[10] A.M. Kalinin,[23] D. Karmanov,[25] D. Karmgard,[42] Z. Ke,[4] R. Kehoe,[51] A. Khanov,[45] A. Kharchilava,[42] S.K. Kim,[18] B. Klima,[37] B. Knuteson,[30] W. Ko,[31] J.M. Kohli,[15] A.V. Kostritskiy,[26] J. Kotcher,[56] B. Kothari,[53] A.V. Kotwal,[53] A.V. Kozelov,[26] E.A. Kozlovsky,[26] J. Krane,[43] M.R. Krishnaswamy,[17] P. Krivkova,[6] S. Krzywdzinski,[37] M. Kubantsev,[45] S. Kuleshov,[24] Y. Kulik,[55] S. Kunori,[47] A. Kupco,[7] V.E. Kuznetsov,[34] G. Landsberg,[59] W.M. Lee,[35] A. Leflat,[25] C. Leggett,[30] F. Lehner,[37,*] J. Li,[60] Q.Z. Li,[37] X. Li,[4] J.G.R. Lima,[3] D. Lincoln,[37] S.L. Linn,[35] J. Linnemann,[51] R. Lipton,[37] A. Lucotte,[9] L. Lueking,[37] C. Lundstedt,[52] C. Luo,[41] A.K.A. Maciel,[39] R.J. Madaras,[30] V.L. Malyshev,[23] V. Manankov,[25] H.S. Mao,[4] T. Marshall,[41] M.I. Martin,[39] R.D. Martin,[38] K.M. Mauritz,[43] B. May,[40] A.A. Mayorov,[41] R. McCarthy,[55] T. McMahon,[57] H.L. Melanson,[37] M. Merkin,[25] K.W. Merritt,[37] C. Miao,[59] H. Miettinen,[62] D. Mihalcea,[39] C.S. Mishra,[37] N. Mokhov,[37] N.K. Mondal,[17] H.E. Montgomery,[37] R.W. Moore,[51] M. Mostafa,[1] H. da Motta,[2] E. Nagy,[10] F. Nang,[29] M. Narain,[48] V.S. Narasimham,[17] H.A. Neal,[50] J.P. Negret,[5] S. Negroni,[10] T. Nunnemann,[37] D. O'Neil,[51] V. Oguri,[3] B. Olivier,[12] N. Oshima,[37] P. Padley,[62] L.J. Pan,[40] K. Papageorgiou,[38] A. Para,[37] N. Parashar,[49] R. Partridge,[59] N. Parua,[55] M. Paterno,[54] A. Patwa,[55] B. Pawlik,[22]

J. Perkins,[60] M. Peters,[36] O. Peters,[20] P. Pétroff,[11] R. Piegaia,[1] B.G. Pope,[51] E. Popkov,[48] H.B. Prosper,[35] S. Protopopescu,[56] J. Qian,[50] R. Raja,[37] S. Rajagopalan,[56] E. Ramberg,[37] P.A. Rapidis,[37] N.W. Reay,[45] S. Reucroft,[49] M. Ridel,[11] M. Rijssenbeek,[55] F. Rizatdinova,[45] T. Rockwell,[51] M. Roco,[37] P. Rubinov,[37] R. Ruchti,[42] J. Rutherfoord,[29] B.M. Sabirov,[23] G. Sajot,[9] A. Santoro,[2] L. Sawyer,[46] R.D. Schamberger,[55] H. Schellman,[40] A. Schwartzman,[1] N. Sen,[62] E. Shabalina,[38] R.K. Shivpuri,[16] D. Shpakov,[49] M. Shupe,[29] R.A. Sidwell,[45] V. Simak,[7] H. Singh,[34] J.B. Singh,[15] V. Sirotenko,[37] P. Slattery,[54] E. Smith,[58] R.P. Smith,[37] R. Snihur,[40] G.R. Snow,[52] J. Snow,[57] S. Snyder,[56] J. Solomon,[38] V. Sorín,[1] M. Sosebee,[60] N. Sotnikova,[25] K. Soustruznik,[6] M. Souza,[2] N.R. Stanton,[45] G. Steinbrück,[53] R.W. Stephens,[60] F. Stichelbaut,[56] D. Stoker,[33] V. Stolin,[24] A. Stone,[46] D.A. Stoyanova,[26] M. Strauss,[58] M. Strovink,[30] L. Stutte,[37] A. Sznajder,[3] M. Talby,[10] W. Taylor,[55] S. Tentindo-Repond,[35] S.M. Tripathi,[31] T.G. Trippe,[30] A.S. Turcot,[56] P.M. Tuts,[53] P. van Gemmeren,[37] V. Vaniev,[26] R. Van Kooten,[41] N. Varelas,[38] L.S. Vertogradov,[23] F. Villeneuve-Seguier,[10] A.A. Volkov,[26] A.P. Vorobiev,[26] H.D. Wahl,[35] H. Wang,[40] Z.-M. Wang,[55] J. Warchol,[42] G. Watts,[64] M. Wayne,[42] H. Weerts,[51] A. White,[60] J.T. White,[61] D. Whiteson,[30] J.A. Wightman,[43] D.A. Wijngaarden,[21] S. Willis,[39] S.J. Wimpenny,[34] J. Womersley,[37] D.R. Wood,[49] R. Yamada,[37] P. Yamin,[56] T. Yasuda,[37] Y.A. Yatsunenko,[23] K. Yip,[56] S. Youssef,[35] J. Yu,[37] Z. Yu,[40] M. Zanabria,[5] H. Zheng,[42] Z. Zhou,[43] M. Zielinski,[54] D. Zieminska,[41] A. Zieminski,[41] V. Zutshi,[56] E.G. Zverev,[25] and A. Zylberstejn[13]

(DØ Collaboration)

[1]Universidad de Buenos Aires, Buenos Aires, Argentina
[2]LAFEX, Centro Brasileiro de Pesquisas Físicas, Rio de Janeiro, Brazil
[3]Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil
[4]Institute of High Energy Physics, Beijing, People's Republic of China
[5]Universidad de los Andes, Bogotá, Colombia
[6]Charles University, Center for Particle Physics, Prague, Czech Republic
[7]Institute of Physics, Academy of Sciences, Center for Particle Physics, Prague, Czech Republic
[8]Universidad San Francisco de Quito, Quito, Ecuador
[9]Institut des Sciences Nucléaires, IN2P3-CNRS, Universite de Grenoble 1, Grenoble, France
[10]CPPM, IN2P3-CNRS, Université de la Méditerranée, Marseille, France
[11]Laboratoire de l'Accélérateur Linéaire, IN2P3-CNRS, Orsay, France
[12]LPNHE, Universités Paris VI and VII, IN2P3-CNRS, Paris, France
[13]DAPNIA/Service de Physique des Particules, CEA, Saclay, France
[14]Universität Mainz, Institut für Physik, Mainz, Germany
[15]Panjab University, Chandigarh, India
[16]Delhi University, Delhi, India
[17]Tata Institute of Fundamental Research, Mumbai, India
[18]Seoul National University, Seoul, Korea
[19]CINVESTAV, Mexico City, Mexico
[20]FOM-Institute NIKHEF and University of Amsterdam/NIKHEF, Amsterdam, The Netherlands
[21]University of Nijmegen/NIKHEF, Nijmegen, The Netherlands
[22]Institute of Nuclear Physics, Kraków, Poland
[23]Joint Institute for Nuclear Research, Dubna, Russia
[24]Institute for Theoretical and Experimental Physics, Moscow, Russia

[25]Moscow State University, Moscow, Russia
[26]Institute for High Energy Physics, Protvino, Russia
[27]Lancaster University, Lancaster, United Kingdom
[28]Imperial College, London, United Kingdom
[29]University of Arizona, Tucson, Arizona 85721
[30]Lawrence Berkeley National Laboratory and University of California, Berkeley, California 94720
[31]University of California, Davis, California 95616
[32]California State University, Fresno, California 93740
[33]University of California, Irvine, California 92697
[34]University of California, Riverside, California 92521
[35]Florida State University, Tallahassee, Florida 32306
[36]University of Hawaii, Honolulu, Hawaii 96822
[37]Fermi National Accelerator Laboratory, Batavia, Illinois 60510
[38]University of Illinois at Chicago, Chicago, Illinois 60607
[39]Northern Illinois University, DeKalb, Illinois 60115
[40]Northwestern University, Evanston, Illinois 60208
[41]Indiana University, Bloomington, Indiana 47405
[42]University of Notre Dame, Notre Dame, Indiana 46556
[43]Iowa State University, Ames, Iowa 50011
[44]University of Kansas, Lawrence, Kansas 66045
[45]Kansas State University, Manhattan, Kansas 66506
[46]Louisiana Tech University, Ruston, Louisiana 71272
[47]University of Maryland, College Park, Maryland 20742
[48]Boston University, Boston, Massachusetts 02215
[49]Northeastern University, Boston, Massachusetts 02115
[50]University of Michigan, Ann Arbor, Michigan 48109
[51]Michigan State University, East Lansing, Michigan 48824
[52]University of Nebraska, Lincoln, Nebraska 68588
[53]Columbia University, New York, New York 10027
[54]University of Rochester, Rochester, New York 14627
[55]State University of New York, Stony Brook, New York 11794
[56]Brookhaven National Laboratory, Upton, New York 11973
[57]Langston University, Langston, Oklahoma 73050
[58]University of Oklahoma, Norman, Oklahoma 73019
[59]Brown University, Providence, Rhode Island 02912
[60]University of Texas, Arlington, Texas 76019
[61]Texas A&M University, College Station, Texas 77843
[62]Rice University, Houston, Texas 77005
[63]University of Virginia, Charlottesville, Virginia 22901
[64]University of Washington, Seattle, Washington 98195

* Visitor from University of Zurich, Zurich, Switzerland.

I. INTRODUCTION

Jet production in hadronic collisions is understood within the framework of Quantum Chromodynamics (QCD) as a hard scattering of constituent partons (quarks and gluons), which, having undergone the interaction, manifest themselves as showers of collimated particles called jets. Jet algorithms associate clusters of these particles into jets in a way that the kinematic properties of the hard-scattered partons can be inferred and thereby compared to predictions from perturbative QCD (pQCD).

Historically, only the cone algorithm has been used to reconstruct jets at hadron colliders [1]. Although well suited to implement the experimental corrections needed in the complex environment of hadron colliders, the cone algorithms used in previous measurements by the hadron collider experiments at the Fermilab Tevatron present several difficulties, because (a) an arbitrary procedure must be implemented to split and merge overlapping cones, (b) an ad-hoc parameter, $\mathcal{R}_{\rm sep}$, is required to accommodate the differences between jet definitions at the parton and detector levels [2], and (c) improved theoretical predictions calculated at the Next-to-Next-to-Leading-Order (NNLO) in pQCD are not infrared safe, because they exhibit a marked sensitivity to soft radiation [3].

Inspired by QCD, a second class of jet algorithms, which does not suffer from these shortcomings, has been developed by several groups [4–6]. These clustering or recombination algorithms successively merge pairs of nearby vectors (partons, particles or calorimeter towers) in order of increasing relative transverse momentum ($p_{\rm T}$). A single arbitrary parameter, D, which characterizes approximately the size of the resulting jets, is used to determine when this merging stops. No splitting-merging is involved, because each vector is assigned to a unique jet. There is no need for introducing any ad-hoc parameters, because the same algorithm is applied at the theoretical and experimental level. Furthermore, by design, clustering algorithms are infrared and collinear safe to all orders of calculation. The dependence of the inclusive jet cross section on the choice of reconstruction algorithms or parameters is particularly relevant for studying the effect of hadronization and background from spectator partons in the event. In contrast to previous work from hadron colliders [7–11], this paper presents the first measurement of the inclusive jet cross section using the $k_\perp$ algorithm to reconstruct jets.

II. JET RECONSTRUCTION AND SELECTION

The differential jet cross section was measured in bins of p_T and pseudo-rapidity, $\eta \equiv -\ln[\tan(\theta/2)]$, where a right handed coordinate system is adopted with the z axis pointing in the proton beam direction, and θ is the polar angle. The $k_\perp$ algorithm implemented at DØ [12] is based on the clustering algorithm suggested in Ref. [6]. The algorithm starts with a list of pre-clusters or "vectors". For each vector $p_{T,i}$, $d_{ii} = p_{T,i}^2$ and for each pair of vectors, $d_{ij} = min(p_{T,i}^2, p_{T,j}^2)\,\Delta R_{i,j}^2/D^2$ are defined, where D is the free parameter of the algorithm and $\Delta R_{i,j}^2 = \Delta\phi_{ij}^2 + \Delta\eta_{ij}^2$ is the square of the angular separation between the vectors. If the minimum of all d_{ii} and d_{ij} is a d_{ij}, then the vectors i and j are merged, becoming the merged four-vector $(E_i + E_j,\ \vec{p}_i + \vec{p}_j)$. If the minimum is a d_{ii}, the vector i is defined as a jet.

This procedure is repeated until all vectors are combined into jets. Thus $k_\perp$ jets do not have to include all vectors in a cone of radius D, and can include vectors outside of this cone.

The primary tool for jet detection at DØ is the uranium-liquid argon calorimeter [13], which has full coverage for pseudo-rapidity $|\eta| < 4.1$. The initial hardware trigger selected inelastic collisions as defined by hodoscopes located near the beam axis on both sides of the interaction region. The next stage required energy deposition in any $\Delta\eta \times \Delta\phi = 0.8 \times 1.6$ region of the calorimeter, corresponding to a transverse energy ($E_{\rm T}$) above a preset threshold. Selected events were digitized and sent to an array of processors. Jet candidates were reconstructed with a cone algorithm (with radius $R = 0.7$), and the event was recorded if any jet E_T exceeded a specified threshold. Jet E_T thresholds of 30, 50, 85 and 115 GeV were used to accumulate integrated luminosities of 0.34, 4.46, 51.5 and 87.3 pb^{-1}, respectively [10].

Jets were reconstructed offline using the $k_\perp$ algorithm, with $D = 1.0$. This value of D was chosen because, at next-to-leading-order (NLO), it produces a theoretical cross section that is essentially identical to the cone prediction for $R = 0.7$ [6], as used by DØ in its previous publications on jet production [10]. The imbalance in transverse momentum, "missing transverse energy", was calculated from the vector sum of the E_T values in all cells of the calorimeter. The vertices of the events were reconstructed using the central tracking system [13]. A significant portion of the data was taken at high instantaneous luminosity, where more than one interaction per beam crossing was probable. When an event had more than one reconstructed vertex, the quantity $S_T = |\Sigma \vec{p}_T^{\,jet}|$ was defined for the two vertices that had the largest number of tracks, and the vertex with the smaller S_T was retained for calculating all kinematic variables. To preserve the pseudo-projective nature of the DØ calorimeter, the selected vertex was required to be within 50 cm of the center of the detector. This requirement rejected $(10.6 \pm 0.1)\%$ of the events, independent of jet transverse momentum.

Isolated noisy calorimeter cells were suppressed using online and offline algorithms [14]. Background introduced by electrons, photons, detector noise and accelerator losses that mimicked jets were eliminated with quality cuts. The efficiency of jet selection was approximately 99.5% and nearly independent of jet p_T. Background events from cosmic rays or misvertexed events were eliminated by requiring the missing transverse energy in each event to be less than 70% of the p_T of the leading jet. This criterion was nearly 100% efficient.

The DØ jet momentum calibration [12], applied on a jet by jet basis, corrects on average the reconstructed p_T for background from spectator partons (the "underlying event", determined from minimum-bias events), additional interactions, pileup from previous $p\overline{p}$ crossings, noise from uranium radioactivity, detector non-uniformities, and for the global response of the detector to hadronic jets. Unlike the cone algorithm, the $k_\perp$ algorithm does not require additional corrections for showering in the calorimeter [12]. For $|\eta| < 0.5$, the mean total multiplicative correction factor to an observed p_T of 100 GeV [400 GeV] was 1.094 ± 0.015 [1.067 ± 0.020].

III. INCLUSIVE CROSS SECTION

The inclusive jet cross section for $|\eta| < 0.5$ was calculated in four ranges of transverse momentum, using data from only one trigger in each case. The more restrictive trigger

was used as soon as it became fully efficient. The average differential cross section for each p_T bin, $d^2\sigma/(dp_T d\eta)$, was calculated as $N/(\Delta\eta\Delta p_T \epsilon \int Ldt)$, where $\Delta\eta$, Δp_T are the η, p_T bin sizes, N the number of jets observed in that bin, ϵ is the overall efficiency for jet and event selection, and $\int Ldt$ represents the integrated luminosity of the data sample.

The measured cross section is distorted in p_T by the momentum resolution of the DØ calorimeter. Although the resolution in jet p_T is essentially Gaussian, the steepness of the p_T spectrum shifts the observed cross section to larger values. The fractional momentum resolution was determined from the imbalance in p_T in two-jet events [14]. At 100 GeV [400 GeV] the fractional resolution was 0.061 ± 0.006 [0.039 ± 0.003]. The distortion in the cross section due to the resolution was corrected by assuming an ansatz function, $A\, p_T^{-B}(1 - 2\,p_T/\sqrt{s}\,)^C$, smearing this with the measured resolution, and fitting the parameters A, B and C so as to best describe the observed cross section. The bin-to-bin ratio of the original ansatz to the smeared one was used to remove the distortion due to resolution. The unsmearing correction reduces the observed cross section by $(5.7 \pm 1)\%$ [$(6.1 \pm 1)\%$] at 100 GeV [400 GeV].

The final, fully corrected, cross section for $|\eta| < 0.5$ is shown in Fig. 1, along with statistical uncertainties. Listed in Table I are the p_T ranges, the point positions, the cross section, and uncertainties in each bin. The systematic uncertainties include contributions from jet and event selection, unsmearing, luminosity and the uncertainty in the momentum scale, which dominates at all transverse momenta. The fractional uncertainties for the different components are plotted in Fig. 2 as a function of the jet transverse momentum.

IV. COMPARISON WITH THEORY

The results are compared to the pQCD NLO prediction from JETRAD [15], with the renormalization and factorization scales set to $p_T^{max}/2$, where p_T^{max} refers to the p_T of the leading jet in an event. The comparisons are made using parametrizations of the parton distributions functions (PDFs) of the CTEQ [16] and MRST [17] families. Figure 3 shows the ratios of $(D - T)/T$, where D refers to data and T to the theoretical prediction. To quantify the comparison in Fig. 3, the fractional systematic uncertainties are multiplied by the predicted cross section and a χ^2 comparison is carried out. The results are shown in Table II. The agreement is reasonable (χ^2/dof ranges from 1.56 to 1.12, the probabilities from 4 to 31%), although the differences in normalization and shape, especially at low p_T, are quite large. The points at low p_T have the highest impact on the χ^2. If the first four data points are not used in the χ^2 comparison, the probabilities increase to the $60 - 80\%$ range.

V. CONCLUSIONS

In conclusion, a preliminary measurement in proton-antiproton collisions at $\sqrt{s} = 1.8$ TeV of the inclusive jet cross section based on the $k_\perp$ algorithm has been presented. The quantitative test shows reasonable agreement between data and NLO pQCD predictions.

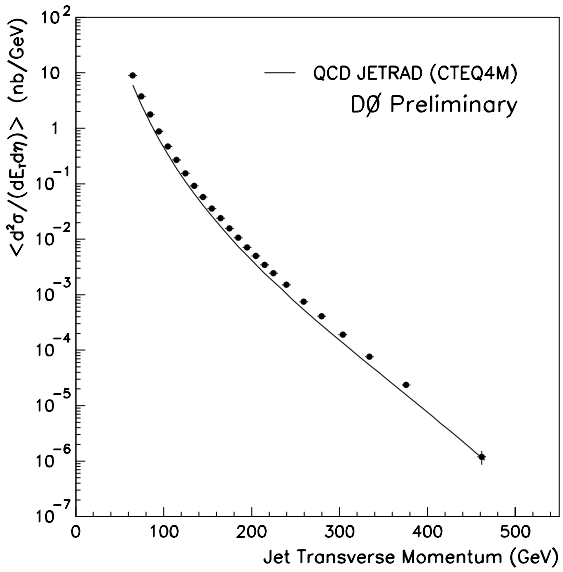

FIG. 1. The central ($|\eta| < 0.5$) inclusive jet cross section obtained with the $k_\perp$ algorithm at $\sqrt{s} = 1.8$ TeV. Only statistical errors are included. The solid line shows a prediction from NLO pQCD.

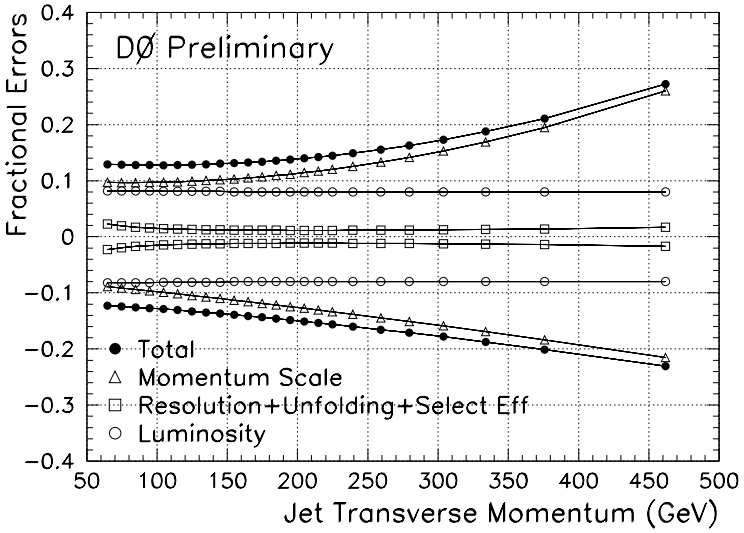

FIG. 2. Fractional experimental uncertainties on the cross section.

Bin Range (GeV)	Plotted p_T (GeV)	Cross Sec. ± Stat. (nb/GeV)	Systematic Uncer (%)
60 – 70	64.6	$(8.94 \pm 0.06) \times 10^{0}$	-13, +14
70 – 80	74.6	$(3.78 \pm 0.04) \times 10^{0}$	-13, +14
80 – 90	84.7	$(1.77 \pm 0.02) \times 10^{0}$	-13, +14
90 – 100	94.7	$(8.86 \pm 0.25) \times 10^{-1}$	-13, +14
100 – 110	104.7	$(4.68 \pm 0.04) \times 10^{-1}$	-14, +14
110 – 120	114.7	$(2.68 \pm 0.03) \times 10^{-1}$	-14, +14
120 – 130	124.8	$(1.53 \pm 0.02) \times 10^{-1}$	-14, +14
130 – 140	134.8	$(9.19 \pm 0.16) \times 10^{-2}$	-14, +14
140 – 150	144.8	$(5.77 \pm 0.12) \times 10^{-2}$	-14, +14
150 – 160	154.8	$(3.57 \pm 0.03) \times 10^{-2}$	-15, +14
160 – 170	164.8	$(2.39 \pm 0.02) \times 10^{-2}$	-15, +14
170 – 180	174.8	$(1.56 \pm 0.02) \times 10^{-2}$	-15, +14
180 – 190	184.8	$(1.05 \pm 0.02) \times 10^{-2}$	-15, +14
190 – 200	194.8	$(7.14 \pm 0.13) \times 10^{-3}$	-16, +15
200 – 210	204.8	$(4.99 \pm 0.08) \times 10^{-3}$	-16, +15
210 – 220	214.8	$(3.45 \pm 0.07) \times 10^{-3}$	-16, +15
220 – 230	224.8	$(2.43 \pm 0.06) \times 10^{-3}$	-16, +15
230 – 250	239.4	$(1.50 \pm 0.03) \times 10^{-3}$	-17, +16
250 – 270	259.4	$(7.52 \pm 0.23) \times 10^{-4}$	-17, +16
270 – 290	279.5	$(4.07 \pm 0.17) \times 10^{-4}$	-18, +17
290 – 320	303.8	$(1.93 \pm 0.09) \times 10^{-4}$	-18, +18
320 – 350	333.9	$(7.61 \pm 0.59) \times 10^{-5}$	-19, +19
350 – 410	375.8	$(2.36 \pm 0.23) \times 10^{-5}$	-20, +21
410 – 560	461.8	$(1.18 \pm 0.33) \times 10^{-6}$	-23, +27

TABLE I. Single inclusive cross section with jets reconstructed using the $k_\perp$ algorithm in the central pseudo-rapidity region.

PDF	χ^2	χ^2/dof	**Probability** (%)
MRST	26.8	1.12	31
MRSTg↑	33.1	1.38	10
MRSTg↓	28.2	1.17	25
CTEQ3M	37.5	1.56	4
CTEQ4M	31.2	1.30	15
CTEQ4HJ	27.2	1.13	29

TABLE II. χ^2 comparisons (24 degrees of freedom) between JETRAD, with renormalization and factorization scales set to $p_T^{max}/2$, and data for various PDFs.

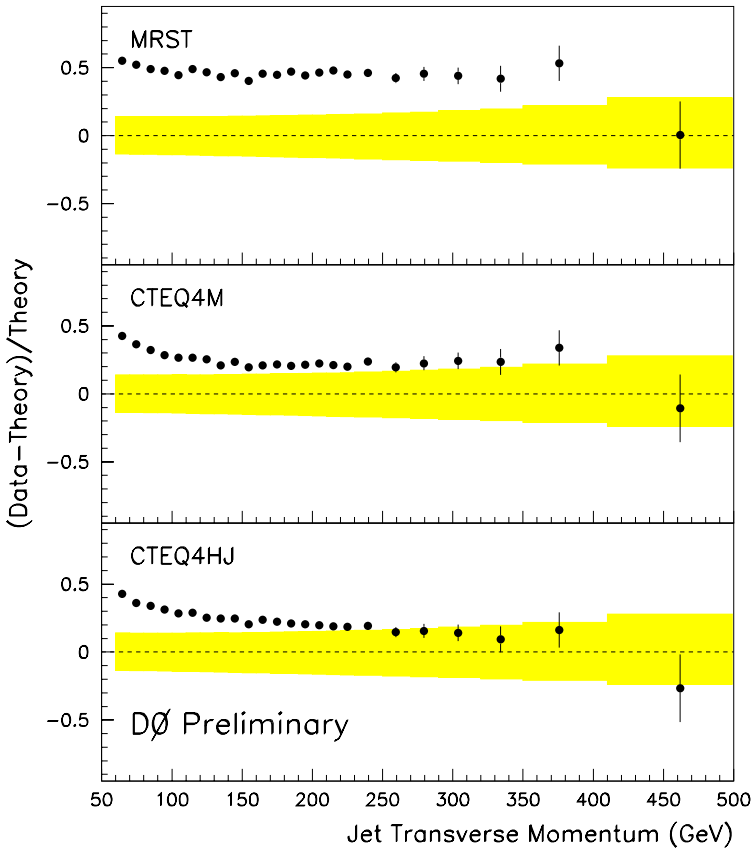

FIG. 3. Difference between data and JETRAD pQCD normalized to predictions. The outer error bars represent the total systematic uncertainty.

ACKNOWLEDGEMENTS

We thank the staffs at Fermilab and collaborating institutions, and acknowledge support from the Department of Energy and National Science Foundation (USA), Commissariat à L'Energie Atomique and CNRS/Institut National de Physique Nucléaire et de Physique des Particules (France), Ministry for Science and Technology and Ministry for Atomic Energy (Russia), CAPES and CNPq (Brazil), Departments of Atomic Energy and Science and Education (India), Colciencias (Colombia), CONACyT (Mexico), Ministry of Education and KOSEF (Korea), CONICET and UBACyT (Argentina), The Foundation for Fundamental Research on Matter (The Netherlands), PPARC (United Kingdom), Ministry of Education (Czech Republic), and the A.P. Sloan Foundation.

REFERENCES

[1] J. Huth *et al.*, in proceedings of *Research Directions for the Decade, Snowmass 1990*, edited by E.L. Berger (World Scientific, Singapore, 1992).
[2] B. Abbott *et al.* (DØ Coll.), FERMILAB-Pub-97/2442-E (1997).
[3] W.T. Giele and W.B. Kilgore, Phys. Rev. D **55** 7183 (1997).
[4] S. Catani, Yu.L. Dokshitzer, M.H. Seymour, and B.R. Webber, Nucl. Phys. B **406** 187 (1993).
[5] S. Catani, Yu.L. Dokshitzer, and B.R. Webber, Phys. Lett. B **285** 291 (1992).
[6] S.D. Ellis and D.E. Soper, Phys. Rev. D **48** 3160 (1993).
[7] F. Abe et al., (CDF Coll.), Phys. Rev. Lett. **77** 438 (1996).
[8] B. Abbott *et al.* (DØ Coll.), Phys. Rev. Lett. **82** 2451 (1999).
[9] B. Abbott *et al.* (DØ Coll.), Phys. Rev. Lett. **86** 1707 (2001)
[10] B. Abbott *et al.* (DØ Coll.), hep-ex/0012046 submitted to Phys. Rev. D.
[11] T. Affolder *et al.*, (CDF Coll.), submitted to Phys. Rev. D, January 18, 2001.
[12] W.T. Giele *et al.* (Jet Physics Working Group), in Proceedings of the Fermilab Run II Workshop on QCD and Weak Boson Physics (2000) (to be published).
[13] S. Abachi *et al.* (DØ Coll.), Nucl. Instr. Meth. Phys. Res. A **338**, 185 (1994).
[14] S. Grinstein, Ph.D. thesis, Univ. de Buenos Aires, Argentina, 2001 (in preparation).
[15] W.T. Giele, E.W.N. Glover, and D.A. Kosower, Phys. Rev. Lett. **73** , 2019 (1994).
[16] H.L. Lai *et al.*, Phys. Rev. D **55**, 1280 (1997).
[17] A. D. Martin *et al.*, Eur. Phys. J. C **4**, 463 (1998).