D0 Latest Run I Results

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On behalf of the D0 collaboration.

I. The inclusive jet cross section.

1. **The inclusive jet cross section in $p\bar{p}$ collisions at sqrt(s)=1.8 TeV using the kT algorithm.** **Phys. Lett. B 525 211 (2002)**

2. **High-pT Jets in $p\bar{p}$ collisions at sqrt(s)=630 and 1800 GeV.** **Phys. Rev. D 64, 032003 (2001)**

II. The ratio of Jet Cross Sections at sqrt(s)=630 GeV and 1800 GeV.
Phys. Rev. Lett. (86), 2523 (2001),
Phys. Rev. D 64, 032003 (2001)

III. The inclusive photon production.

1. **The Isolated Photon Cross Section in ppbar Collisions at sqrt(s)=1.8 TeV** **Phys. Rev. Lett. B 84 2786 (2000)**

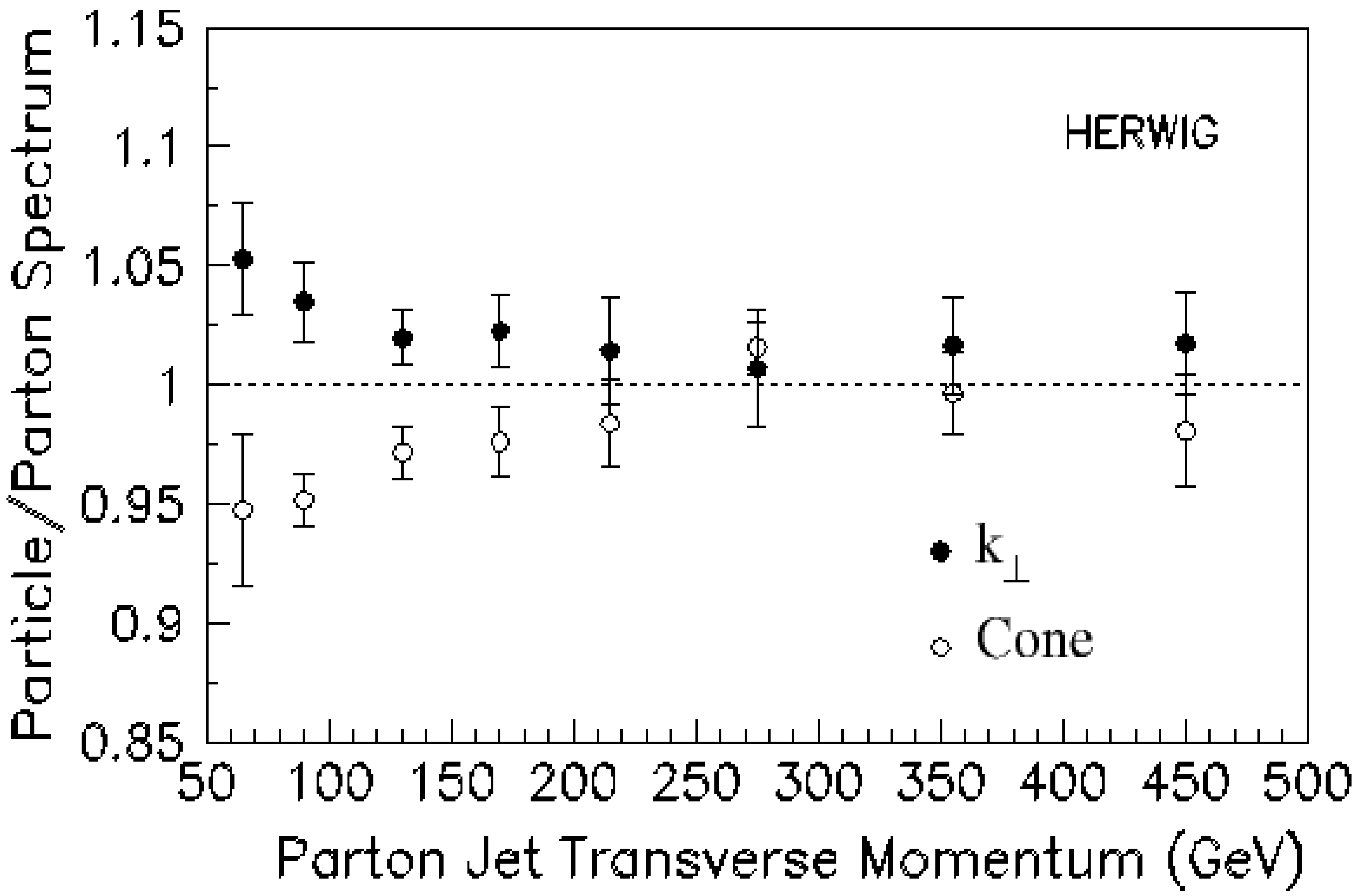
2. **The ratio of isolated photon cross sections in pbarp collisions at sqrt-s=630 and 1800 GeV**
Phys. Rev. Lett. B 87 251805 (2001)

IV. Hard single diffraction at sqrt(s)=630 and 1800 GeV
Phys. Lett. B 531, 52 (2002)

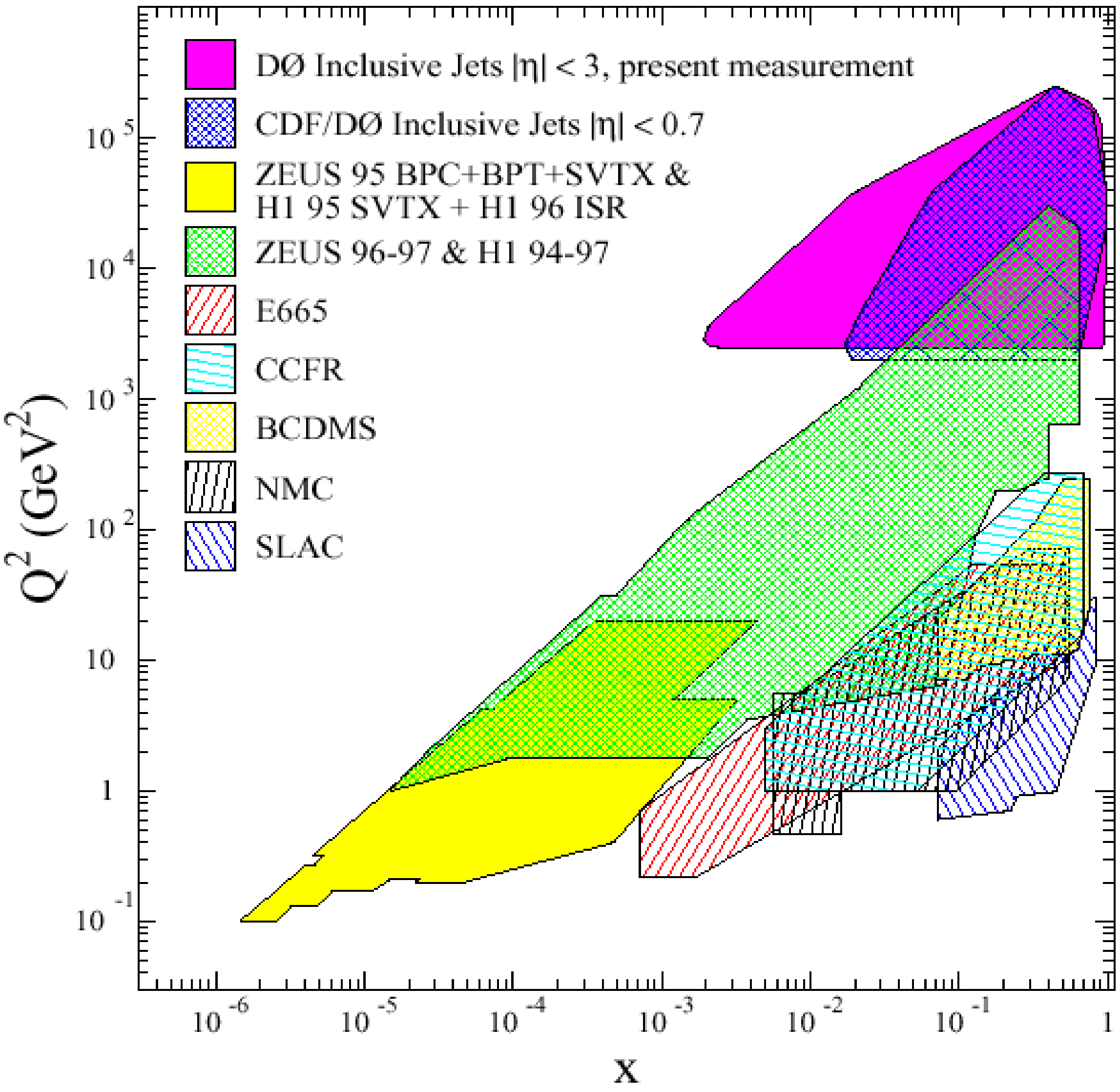
V. Subjet multiplicity of gluon and quark jets
Phys. Rev. D 65 052008 (2002)

VI. Pt spectra of W and Z bozon production
Phys. Lett. B 517 299 (2001)

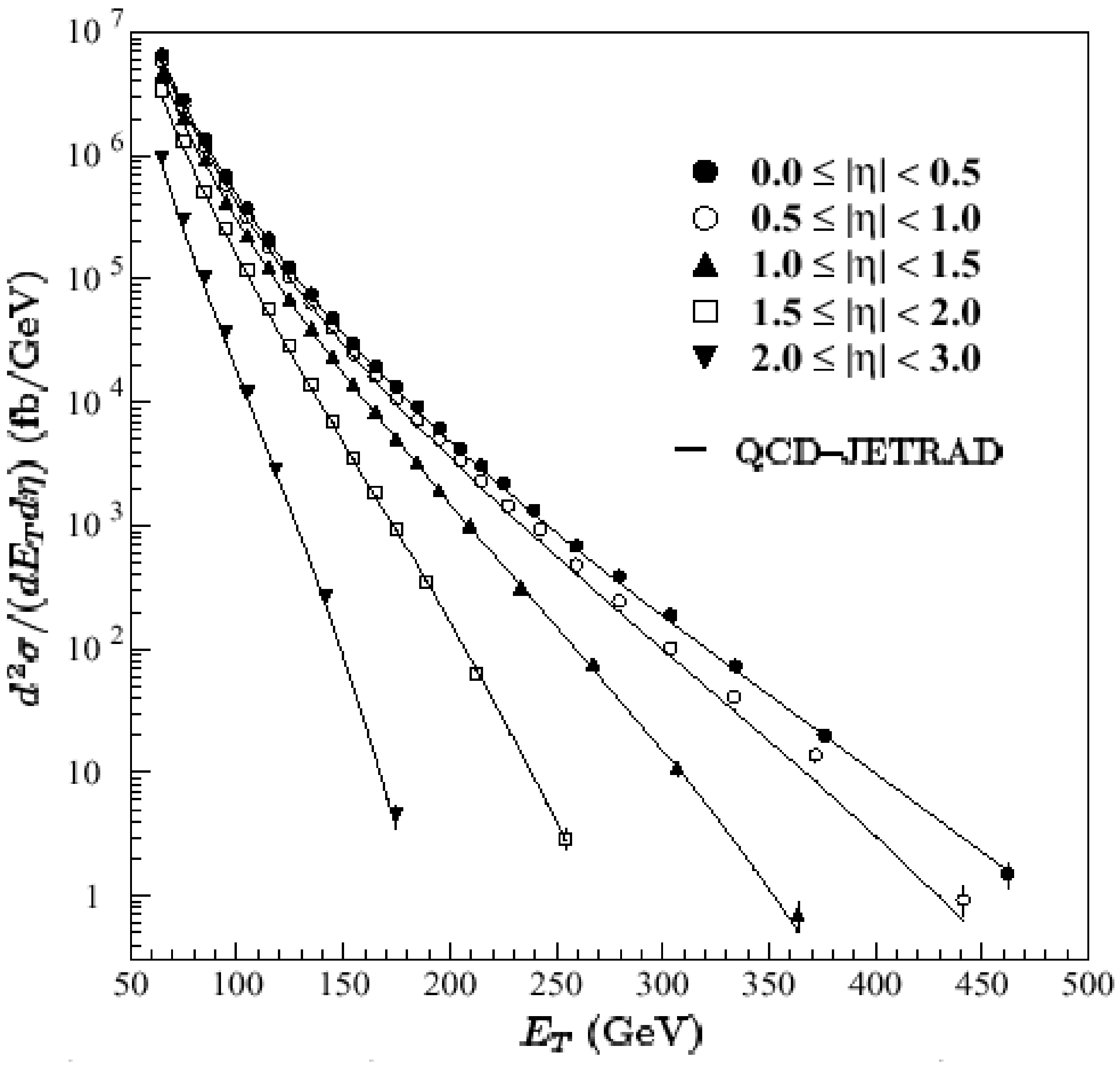
VII. $t\bar{t}$ production cross section
Phys. Rev. D67 012004 (2003)



Ratio of particle-level over parton-level HERWIG P_t spectra for jets, as a function of the parton jet transverse momentum.

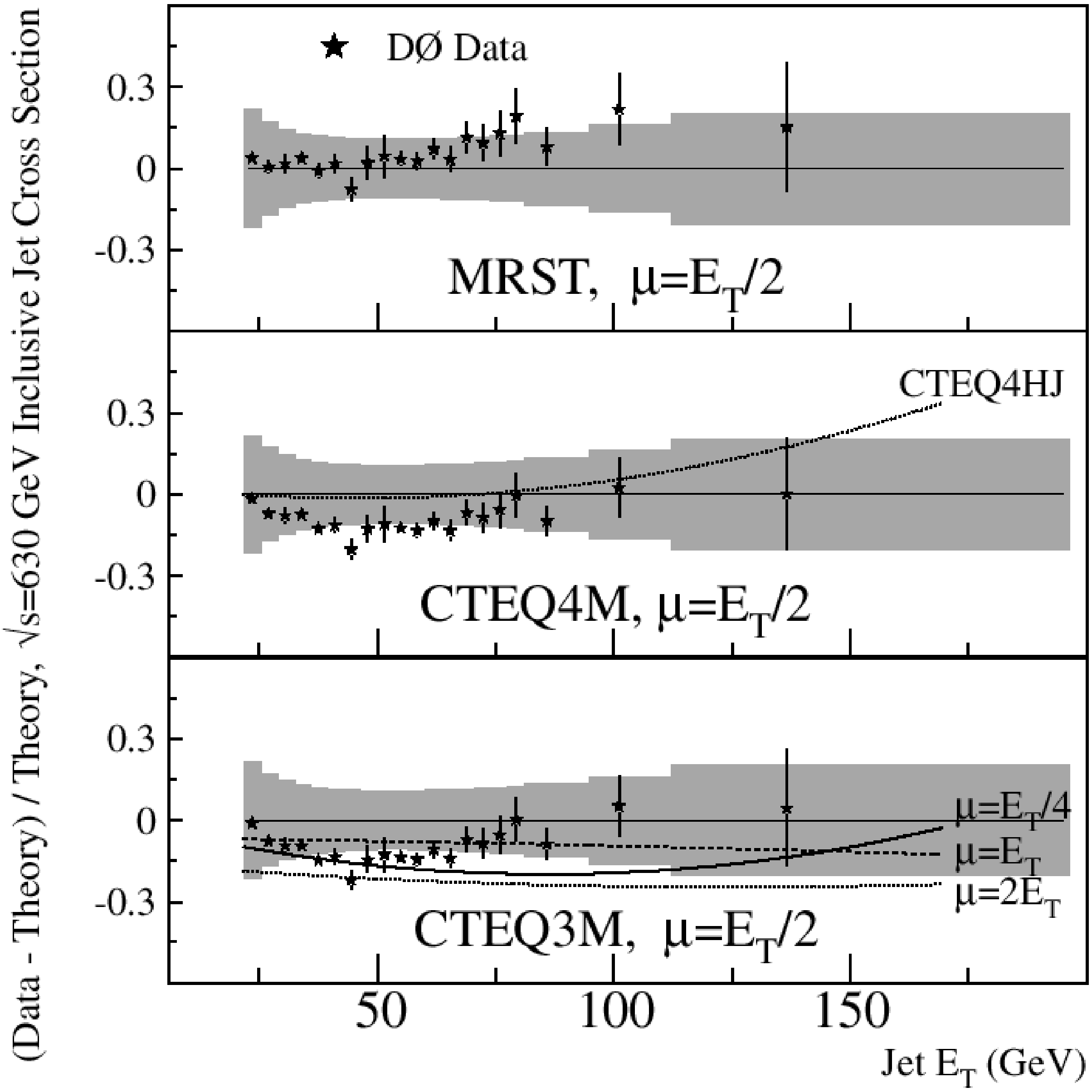


The kinematic reach in the plane of the parton momentum fraction x and the square of the momentum transfered Q^2.

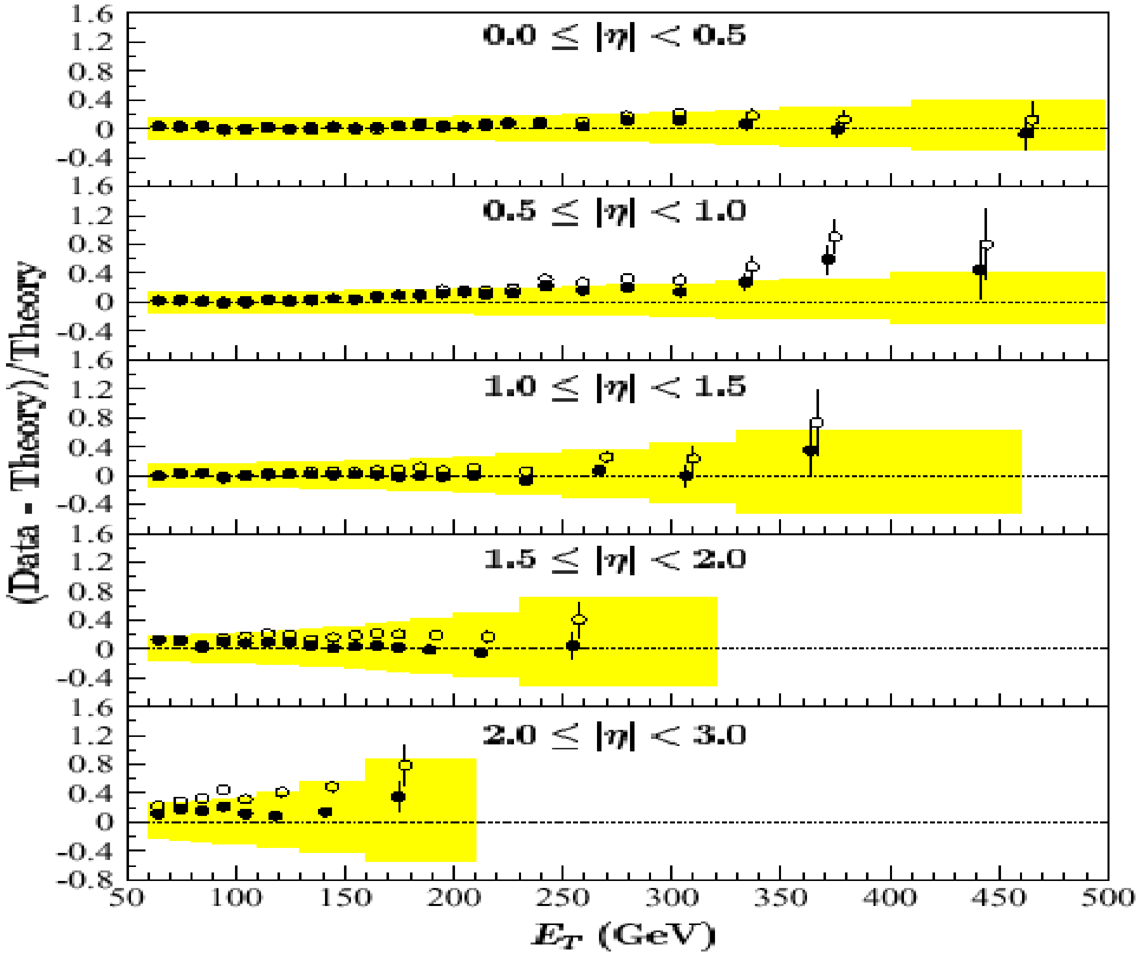


The single inclusive jet cross section in 5 η intervals vs. JETRAD predictions $\sqrt{s} = 1800\ GeV$.

D0 data – theory comparison at $\sqrt{s} = 630\ GeV$



D0 data – theory comparison at $\sqrt{s} = 1800\ GeV$ (1)

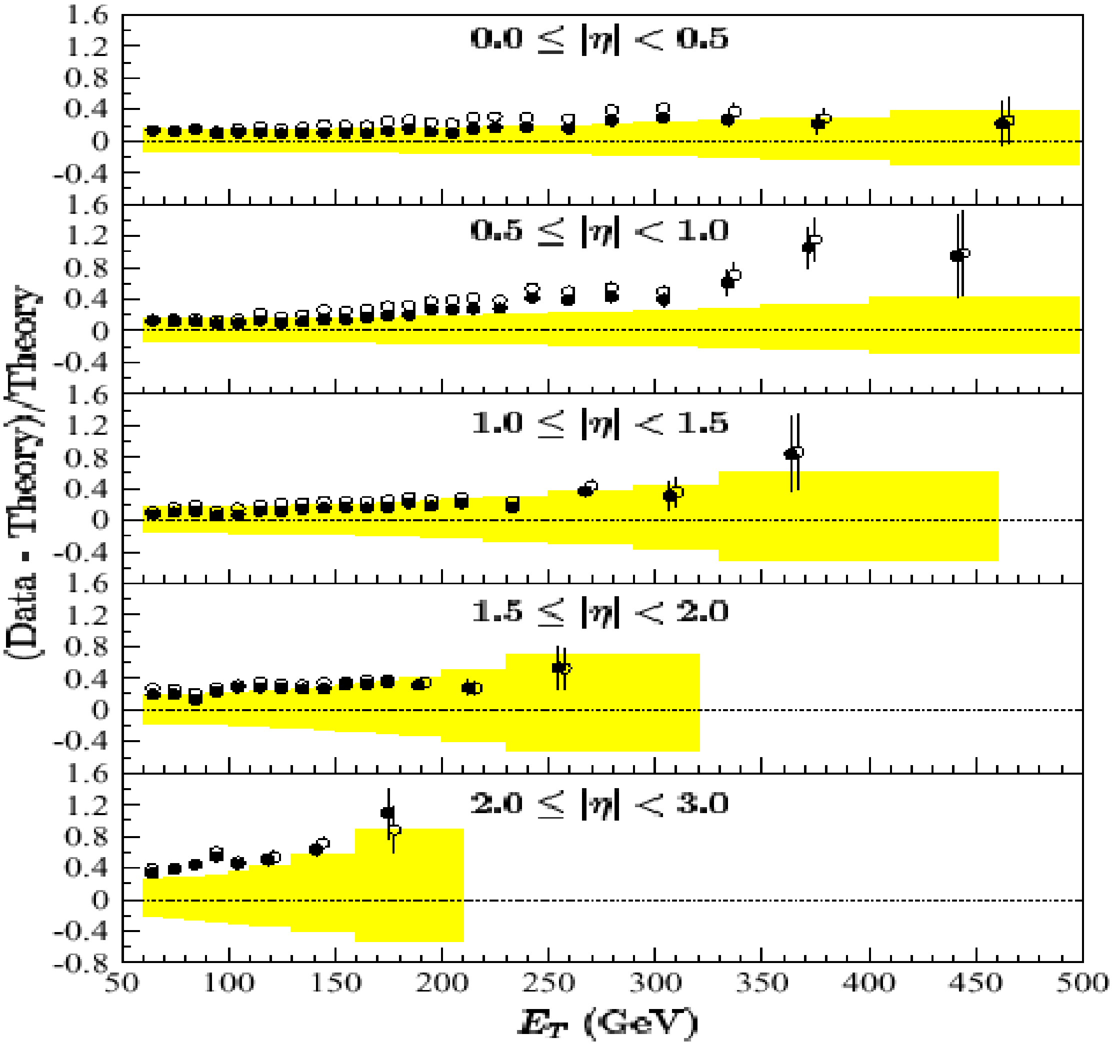


Comparisons between the D0 single inclusive jet cross sections and $O(\alpha_s^3)$ QCD predictions calculated by help of JETRAD with the CTEQ4HJ (●) and CTEQ4M (○) PDFs.

Conclusion

The data indicate an preference for CTEQ4HJ and CTEQ4M PDFs

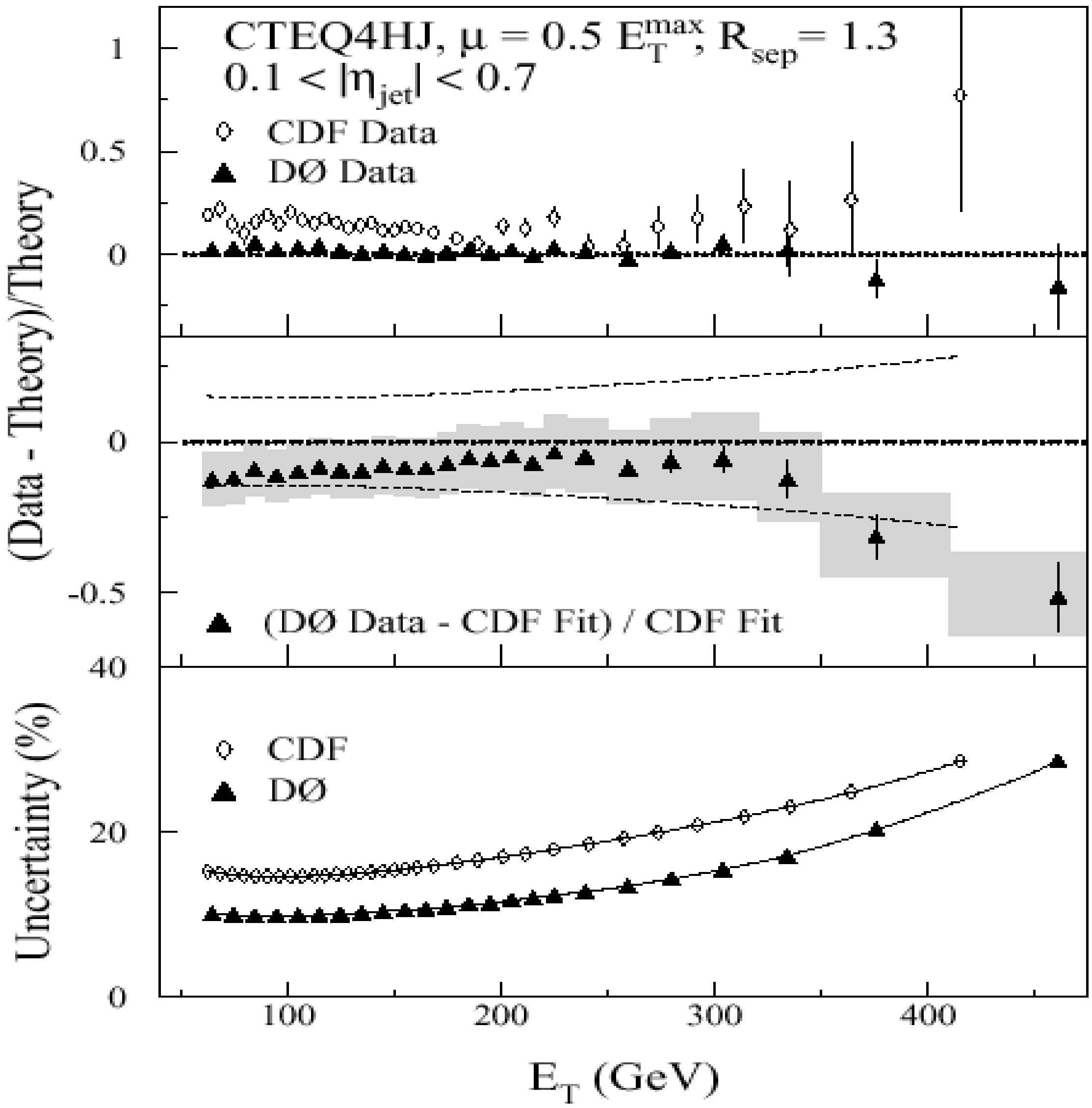
D0 data – theory comparison at $\sqrt{s} = 1800\ GeV$ (2)



Comparisons between the D0 single inclusive jet cross sections and $O(\alpha_s^3)$ QCD predictions calculated by help of JETRAD with the MRST$g\uparrow$ (•) and MRST (○) PDFs.

PDF	χ^2	χ^2/dof	Probability
CTEQ3M	121.56	1.35	0.01
CTEQ4M	92.46	1.03	0.41
CTEQ4HJ	59.38	0.66	0.99
MRST	113.78	1.26	0.05
MRSTg↓	155.52	1.73	<0.01
MRSTg↑	85.09	0.95	0.63

D0,CDF data and theory comparison at $\sqrt{s} = 1800\ GeV$



TOP: THEORY = JETRAD + CTEQ4HJ

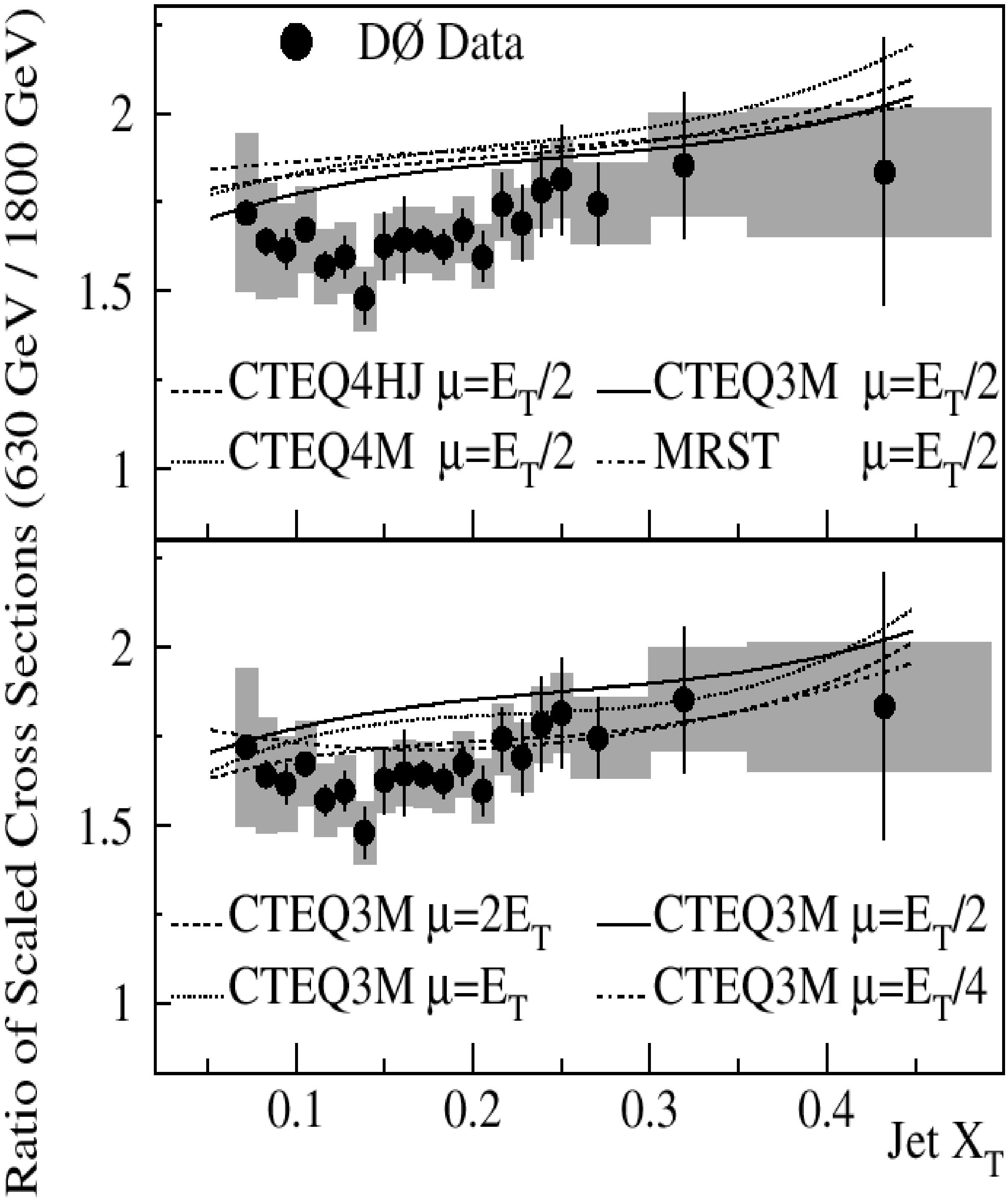
MIDDLE: DIFFERENCE (D0 data - smoothed CDF data)/CDF FitSHADED: $\pm\ 1\sigma$

BOTTOM: systematic errors

CONCLUSION:

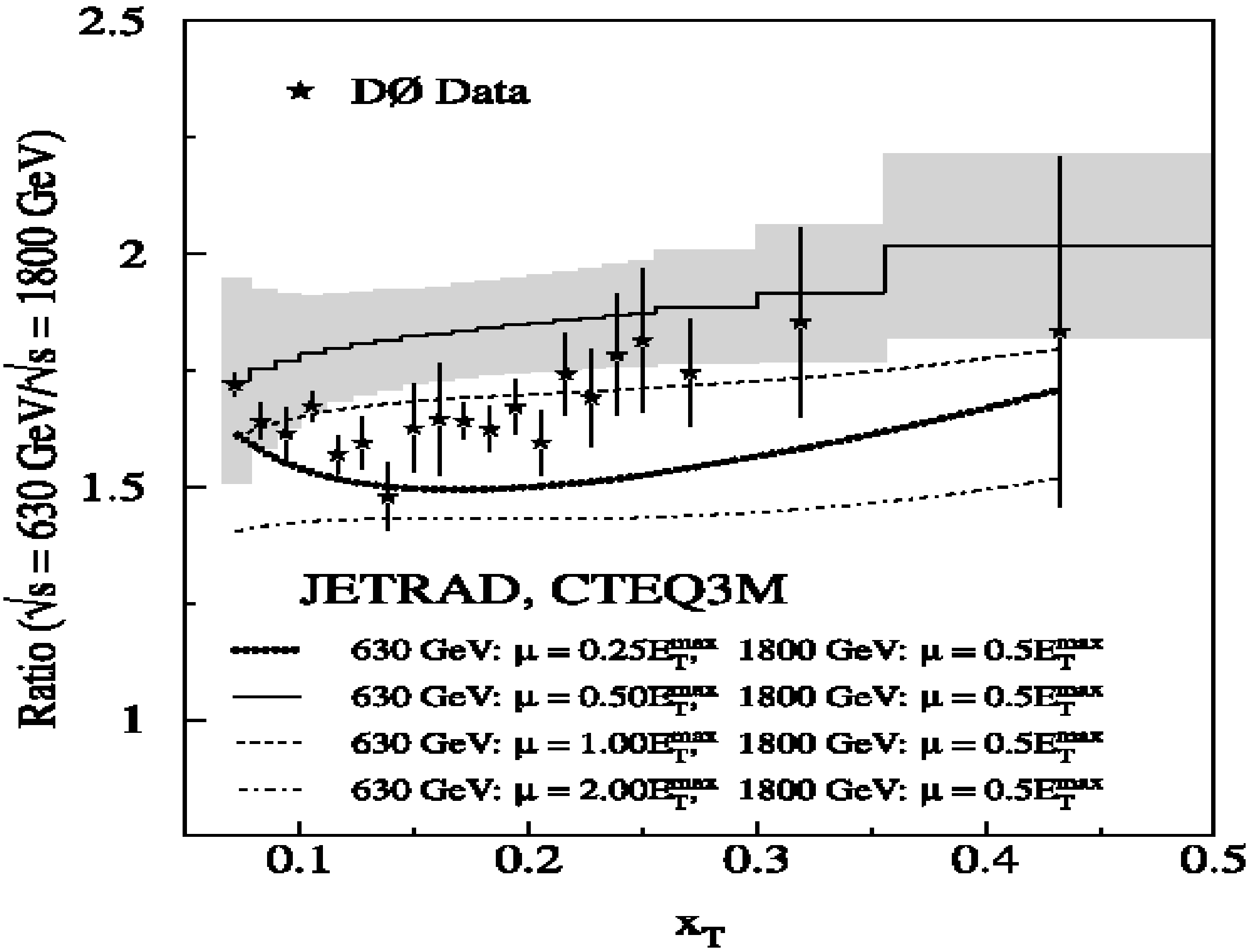
No excess production of high-ET jets is observed

Ratio of jet cross sections at $\sqrt{s} = 630$ and $1800\ GeV$ (1)



- The ratio is nearly insesitive to the choice of PDF
- Variation of renormalization scale μ improves agreement with data ($\mu = 2Et^{max}$ or $\mu = 0.25Et^{max}$).
- Different renormalization scales ($\mu = 1Et^{max}$ at $\sqrt{s} = 630\ GeV$ and $\mu = 0.5Et^{max}$ at $\sqrt{s} = 1800\ GeV$) give better agreement (see next page).

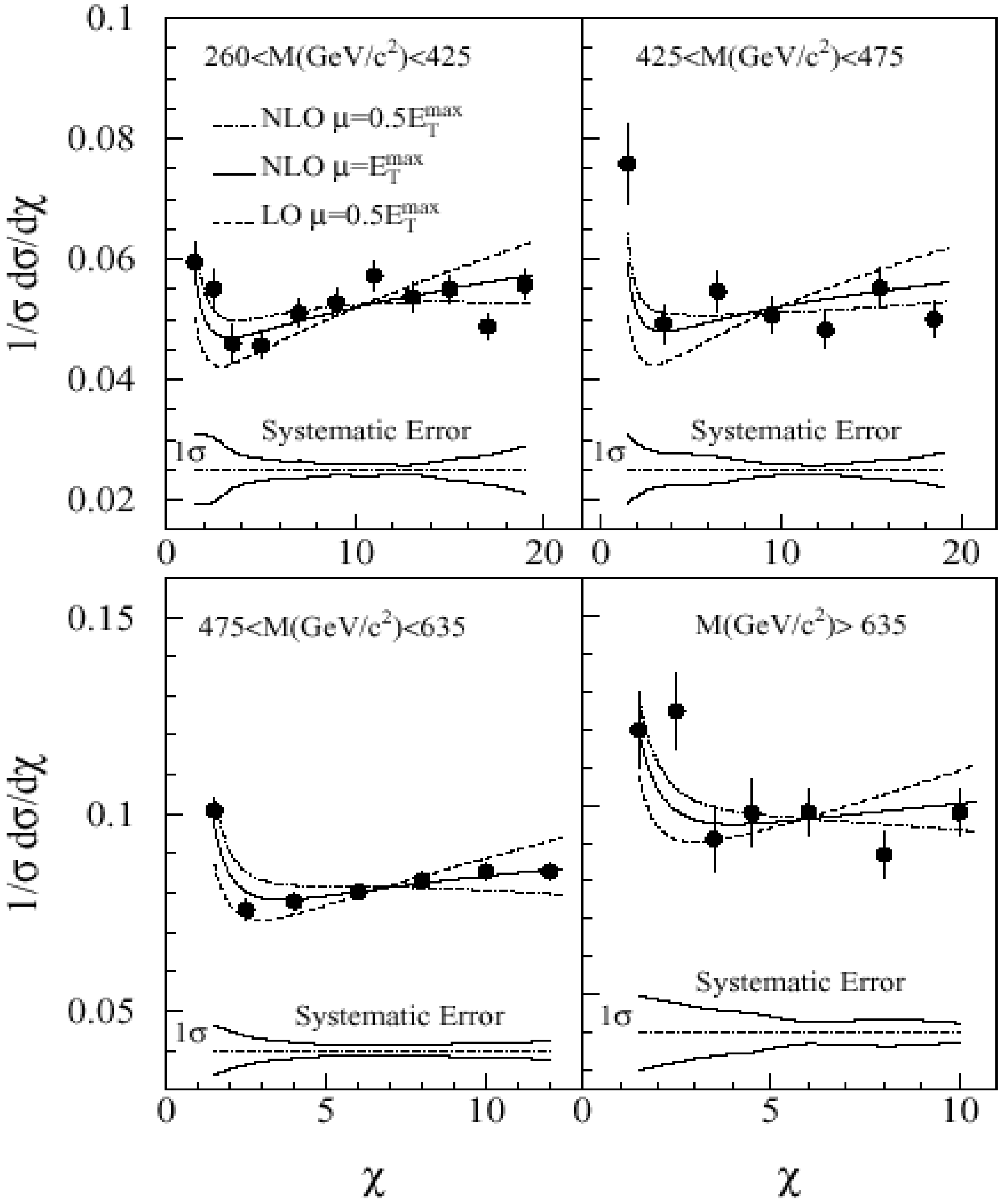
Ratio of jet cross sections at $\sqrt{s} = 630$ and $1800\ GeV$ (2)



- $\sigma(630)/\sigma(1800)$ is a test of QCD matrix elements (JETRAD)

PDF	Renormalization scale	χ^2	Prob.
CTEQ3M	$2E_T^{\max}$	17.9	60%
	$E_T^{\max}$	21.6	36%
	$0.75E_T^{\max}$	23.1	28%
	$0.5E_T^{\max}$	20.5	43%
	$0.25E_T^{\max}$	15.1	77%
CTEQ4M	$0.5E_T^{\max}$	22.4	32%
CTEQ4HJ	$0.5E_T^{\max}$	21.0	40%
MRST	$0.5E_T^{\max}$	22.2	33%
MRST($g\uparrow$)	$0.5E_T^{\max}$	19.5	49%
MRST($g\downarrow$)	$0.5E_T^{\max}$	24.1	24%

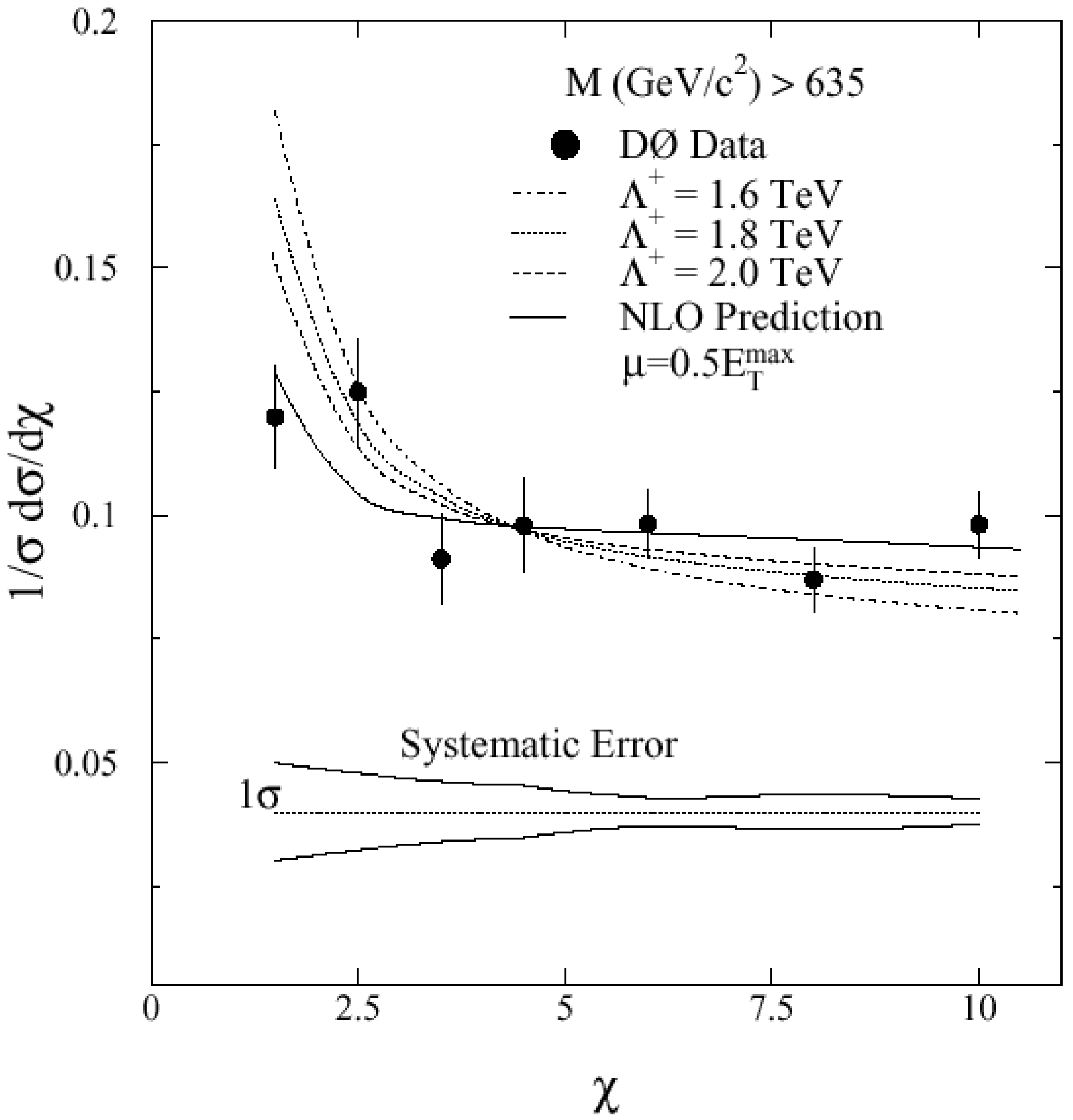
Dijet angular distribution at $\sqrt{s} = 1800\ GeV$ (1)



$$\chi = exp(|\Delta\eta|);$$

$$\Delta\eta = |\eta_1 - \eta_2|$$

Dijet angular distribution at $\sqrt{s} = 1800\ GeV$ (2)

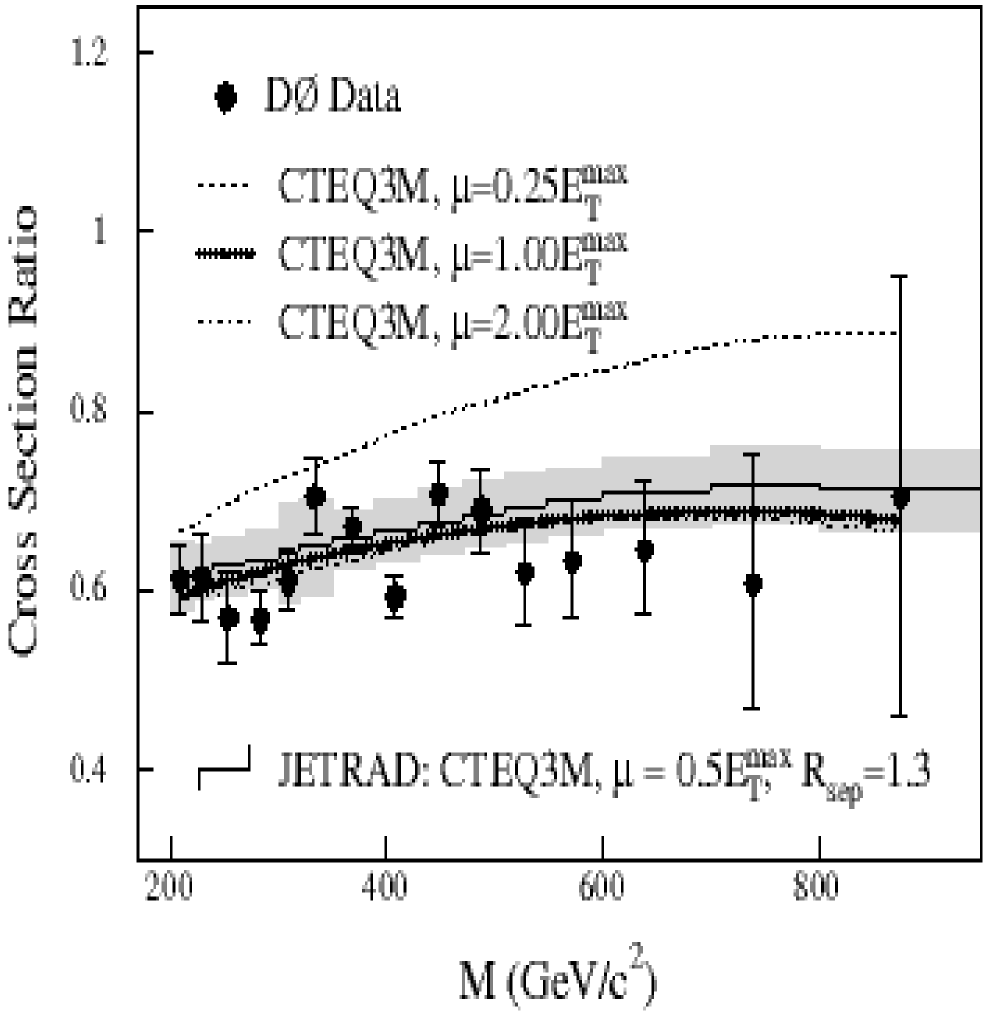


Dijet angular distribution measured over a large angular range.

Models of quark compositeness with a contact interaction scale of less than 2 TeV are ruled out at the 95 % C.L.

Compositeness scale	$\mu = E_T^{max}$	$\mu = 0.5E_T^{max}$
Λ_{LL}^{+}	2.0 TeV	2.0 TeV
Λ_{LL}^{-}	1.9 TeV	2.1 TeV
$\Lambda_{LL(ud)}^{+}$	1.7 TeV	1.7 TeV
$\Lambda_{LL(ud)}^{-}$	1.7 TeV	1.9 TeV

Dijet mass spectrum at $\sqrt{s} = 1800\ GeV$ (1)



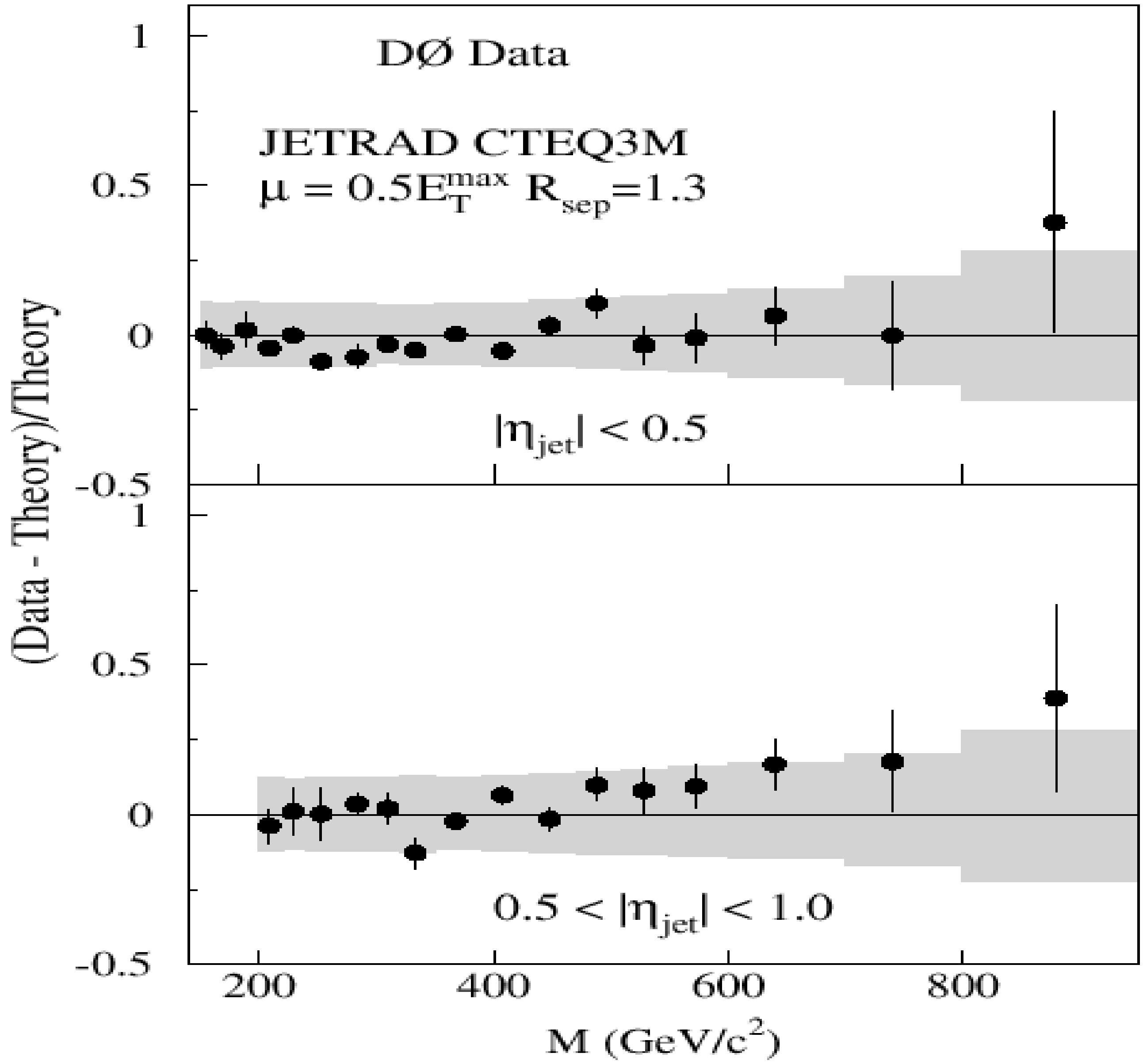
The ratio of cross section for $|\eta^{jet}| < 0.5\ and\ 0.5 < |\eta^{jet}| < 1.0$ for data (solid circles) and theory (various lines). The shaded region represets the $\pm\ 1\sigma$ systematic uncertainties about the prediction. The effects on the prediction of changing the renormalization scale are also shown.

$$M^2 = 2E_T^{jet1}E_T^{jet2}[cosh(\Delta\eta) - cos(\Delta\phi)]$$

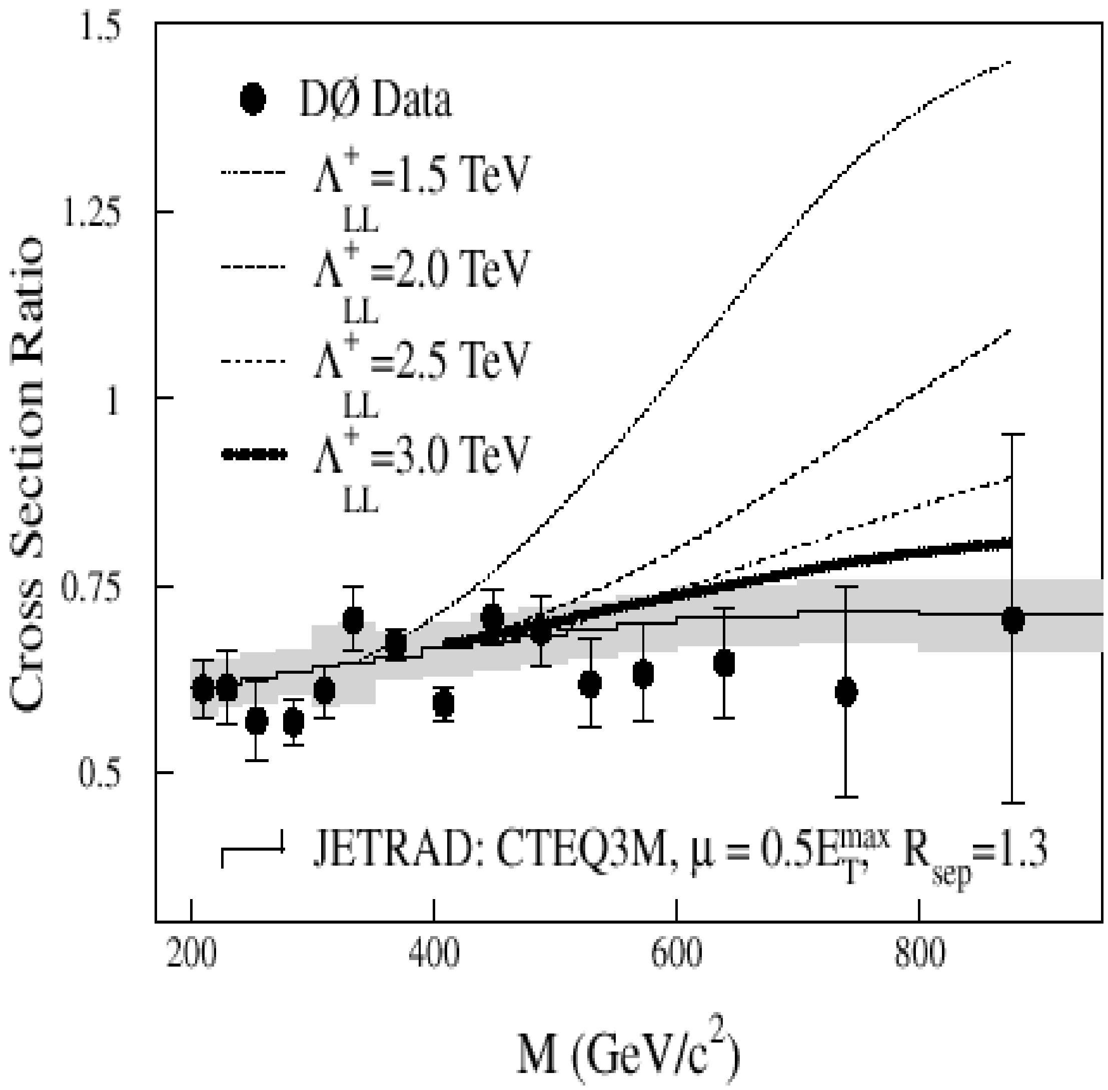
$$\Delta\eta = |\eta_1 - \eta_2|$$

$$\Delta\phi = \phi_1 - \phi_2$$

Dijet mass spectrum at $\sqrt{s} = 1800\ GeV$ (2)



Dijet mass spectrum at $\sqrt{s} = 1800\ GeV$ (3)



CONCLUSION:

the inclusive dijet mass spectrum measured for:

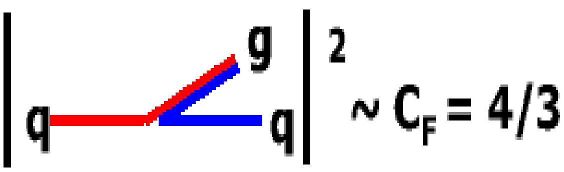
$|\eta^{jet}| < 0.5$ *and* $0.5 < |\eta^{jet}| < 1.0$ and

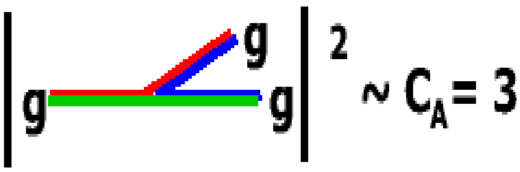
200<M<1400 GeV at $\sqrt{s} = 1.8\ TeV$
to an accuracy of 10% to 30% as a function of mass.

Models of quark compositeness with a contact interacion scale of less than 2.2 TeV are excluded at the 95% confidence level.

Quark jets and gluon jets

- Probability to radiate proportional to color factors:

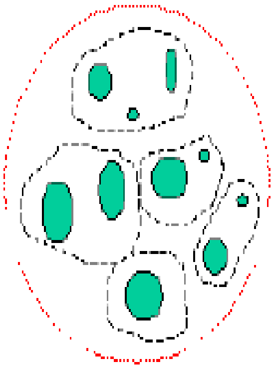




- We might then naively expect

$$r \equiv \frac{<n_g>}{<n_q>} \equiv \frac{<\text{gluon jet multiplicity}>}{<\text{quark jet multiplicity}>} \sim \frac{C_A}{C_F} = \frac{9}{4}$$

- Instead of counting tracks, look at energy flow: use k_T algorithm to find subjets inside jets
  - subjets separated by y = 0.001



- Compare jets of same (E_T,η) produced at different $\sqrt{s}$
  - assume relative q/g content is as given by MC (= 33% g at 630 GeV, 59% g at 1800 GeV) and q/g jet multiplicities do not depend on $\sqrt{s}$

John Womersley

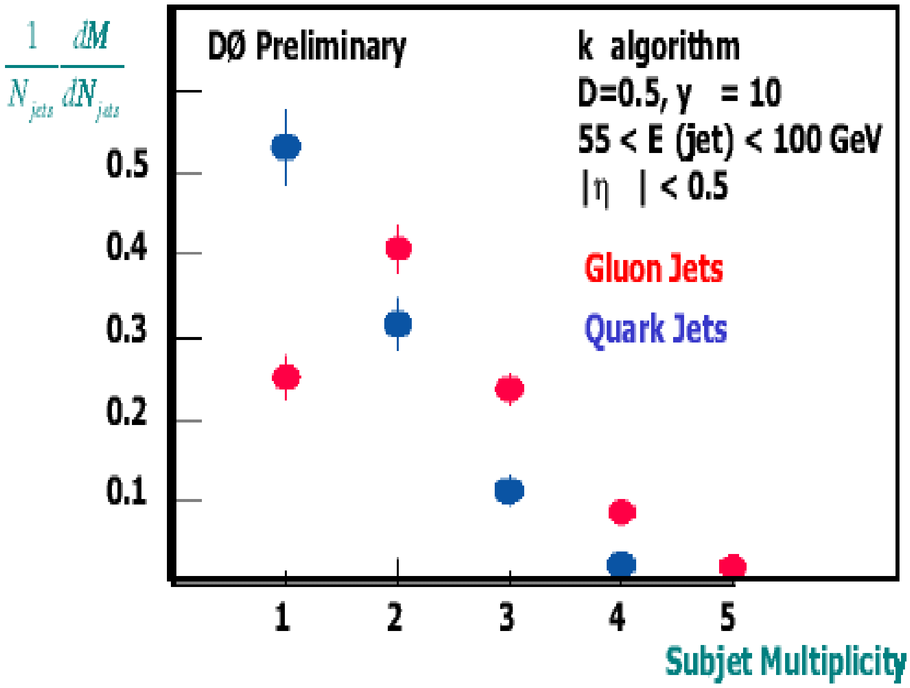
Subjet multiplicity of gluon and quark jets reconstructed using the kT algorithm in pbarp collisions.
Phys. Rev. D (65) 052008, (2002)

Quark and Gluon Subjet Multiplicities

- measure $M^{630} = f_g^{630}\ M_g + (1 - f_g^{630})\ M_q$

  $M^{1800} = f_g^{1800}\ M_g + (1 - f_g^{1800})\ M_q$

Dominant uncertainties come from g jet fraction and jet E_T scale



DØ Data

$$R = \frac{\langle M_g \rangle - 1}{\langle M_q \rangle - 1} = 1.91 \pm 0.04$$

HERWIG 5.9

$$R = 1.86 \pm 0.04$$

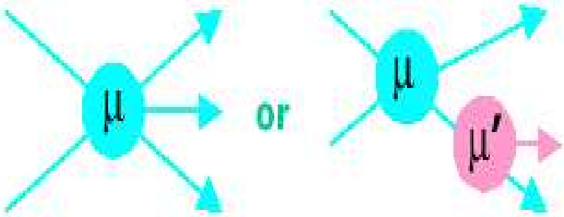
- Have we glimpsed the holy grail (quark/gluon jet separation)?
  - The real test will be to use subjet multiplicity in (for example) the top $\rightarrow$ all jets analysis, but unfortunately this will probably have to wait for Run II

John Womersley

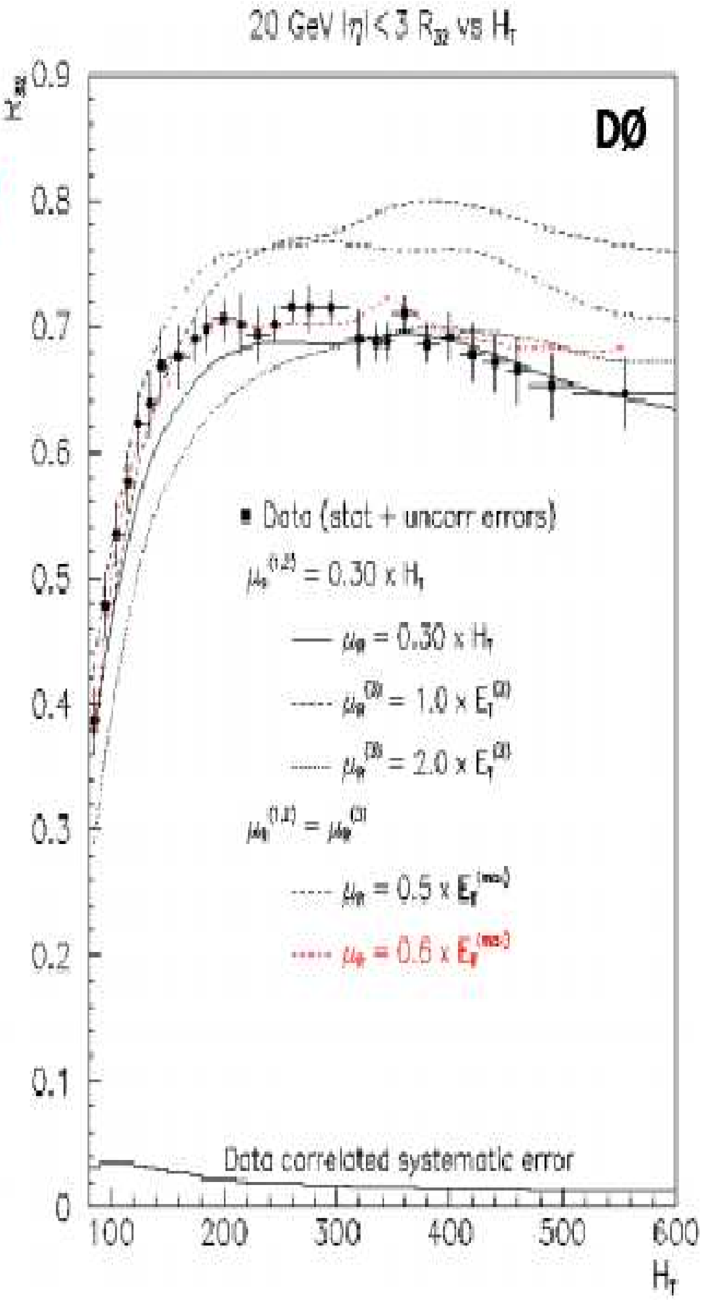
Subjet multiplicity of gluon and quark jets reconstructed using the kT algorithm in pbarp collisions.
Phys. Rev. D (65) 052008, (2002)

Ratio of 3-jet/2-jet events at DØ

- Can this ratio be predicted by QCD?
  - Yes, reasonably well even by JETRAD (a leading order prediction of R_{32})
- Can any information be extracted on the best renormalization scale for the emission of the third jet?



  - Same scale as the first two jets seems better than a scale tied to E_{T3}
  - $\mu = 0.6\ E_T^{max}$ is pretty good
  - $\mu = 0.3\ H_T$ is best as $E_{T3}\uparrow$



John Womersley

Ratios of Multijet Cross Sections in pbarp Collisions at sqrt(s)=1800 GeV.
Phys. Rev. Lett. (86) 1955, (2001)

Ratio of 3-jet/2-jet events at DØ

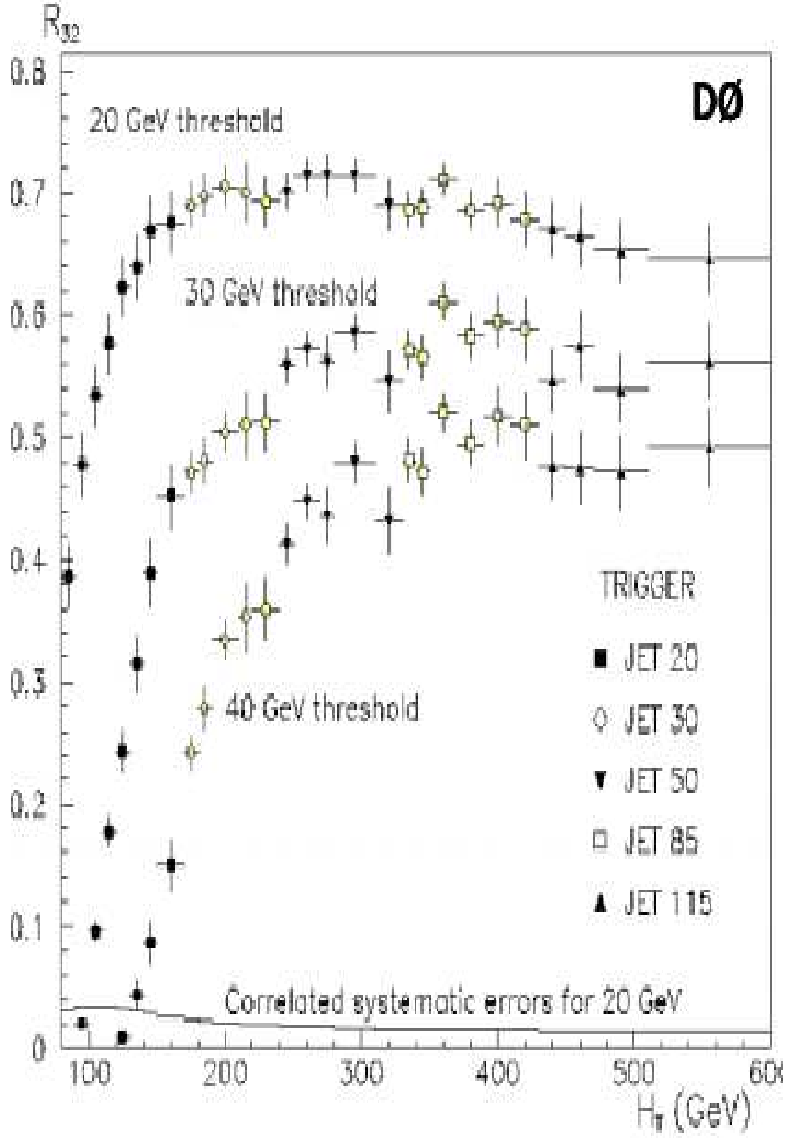
- Plot ratio for various third jet thresholds as a function of $H_T = \Sigma E_T^{jets}$

- Note how large the ratio is:

  70% of high E_T jet events have a third jet above 20 GeV,

  50% have a third jet above 40 GeV

- Insensitive to PDF's



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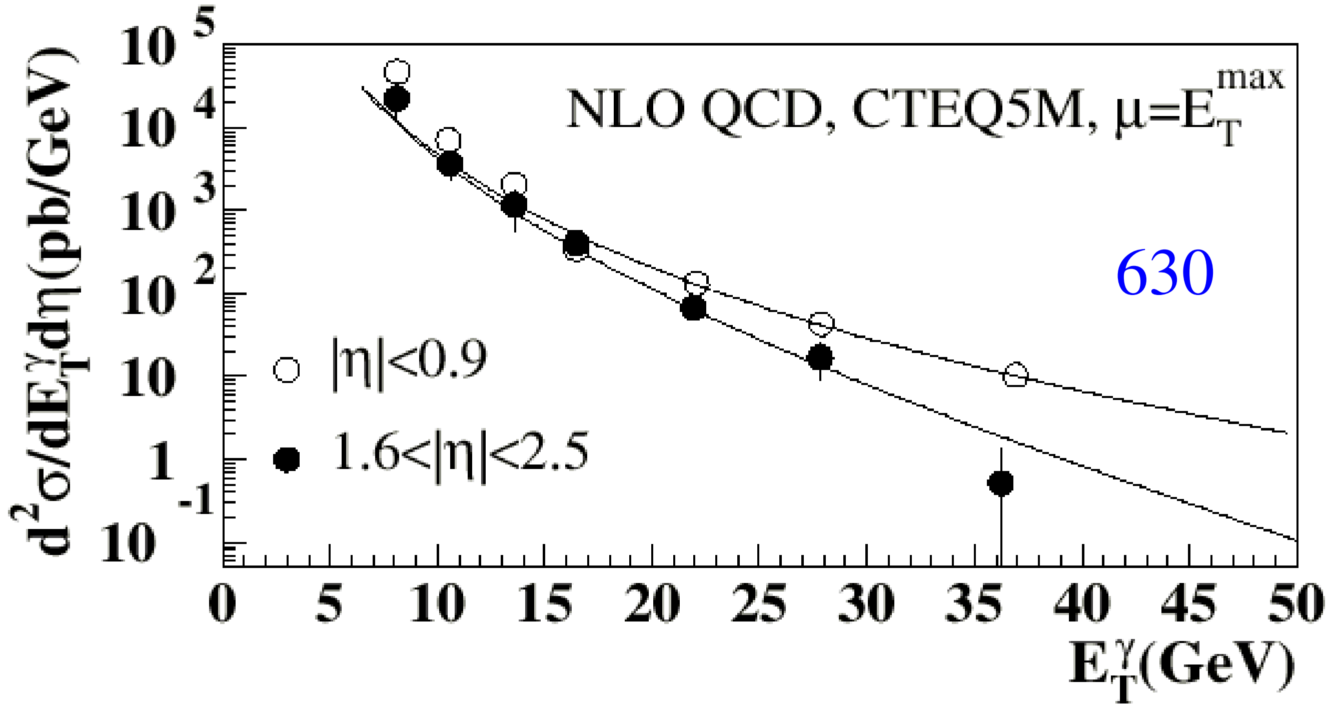
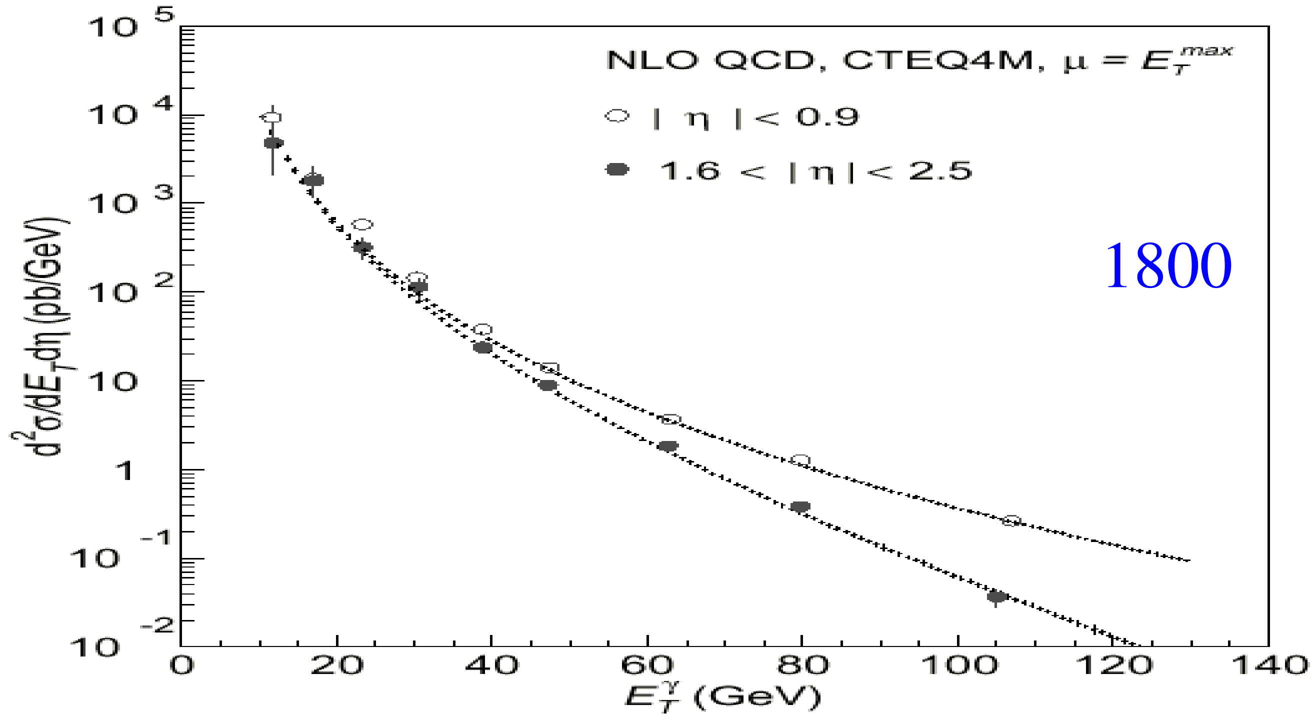
Ratios of Multijet Cross Sections in pbarp Collisions at sqrt(s)=1800 GeV.
Phys. Rev. Lett. (86) 1955, (2001)

Inclusive photon production D0 data vs. NLO QCD

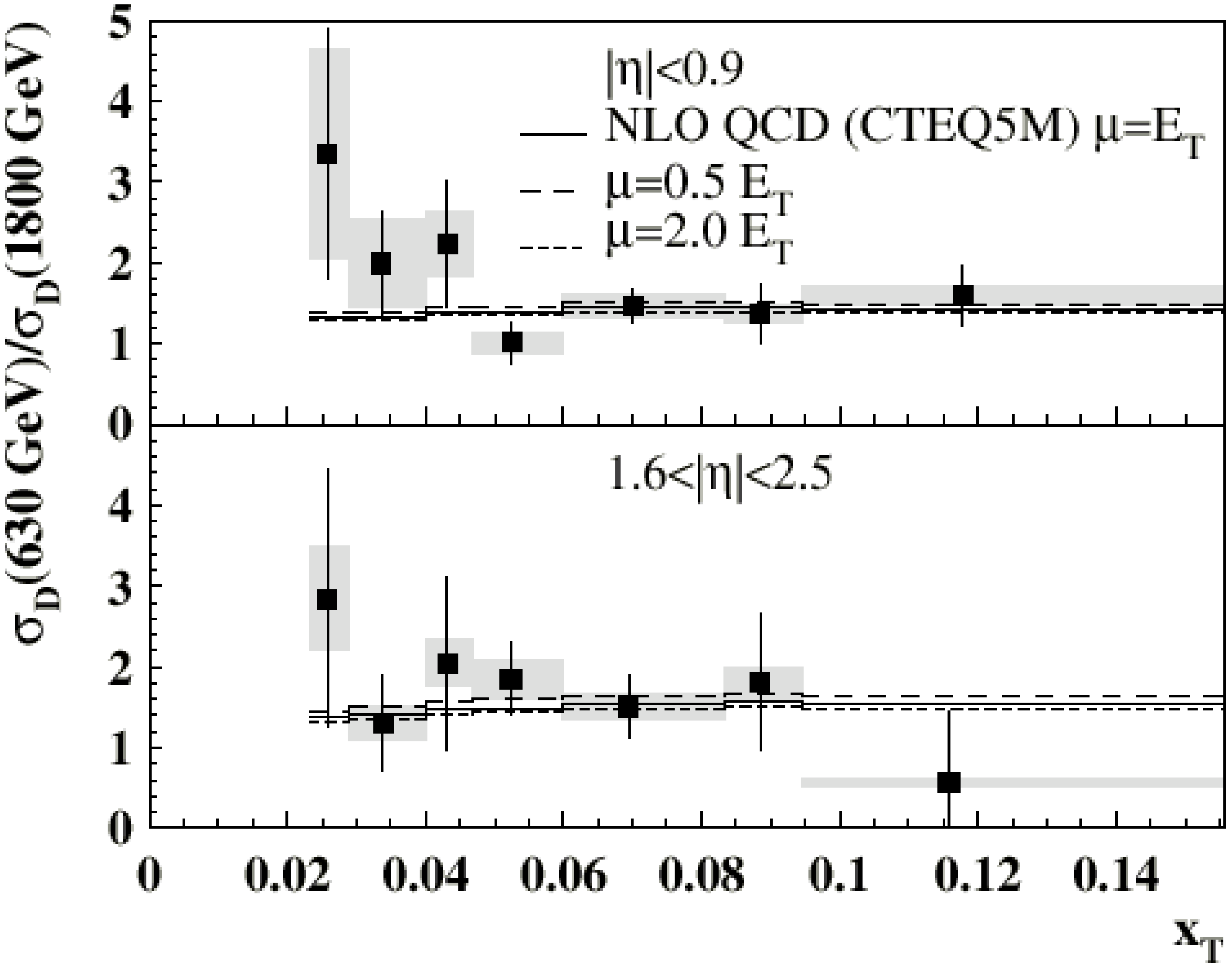




- Phys. Rev. Lett. **84** 2786 (2000);
- Phys. Rev. Lett. **87**, 251805 (2001).

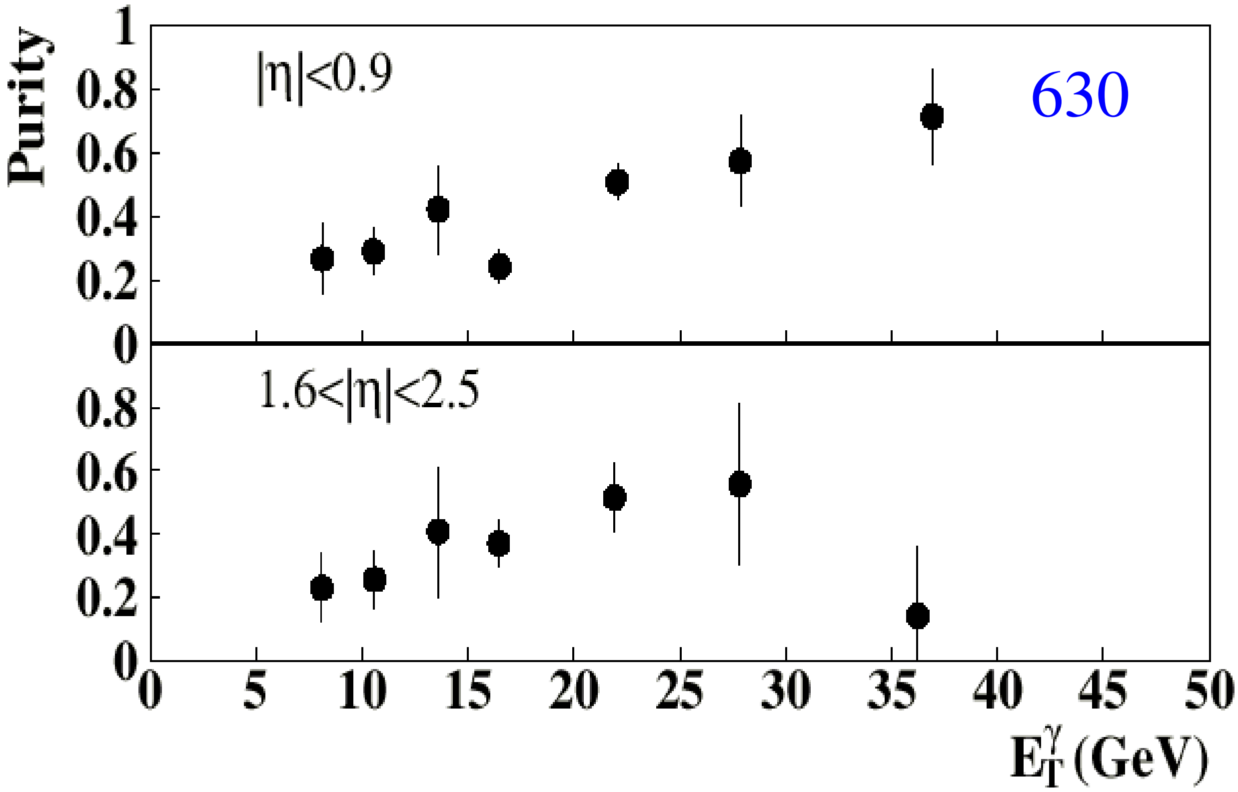
⇐ Published in

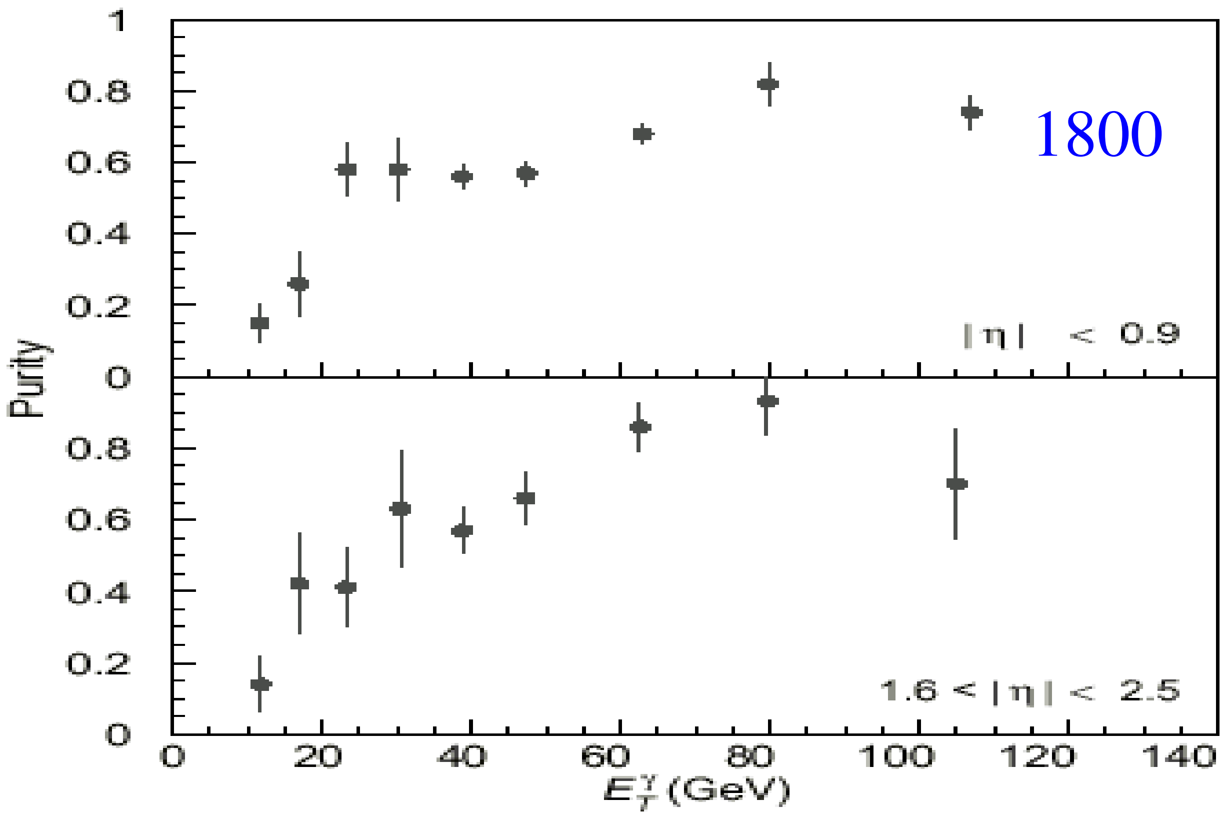
Ratio of cross sections $\sigma(630)/\sigma(1800)$



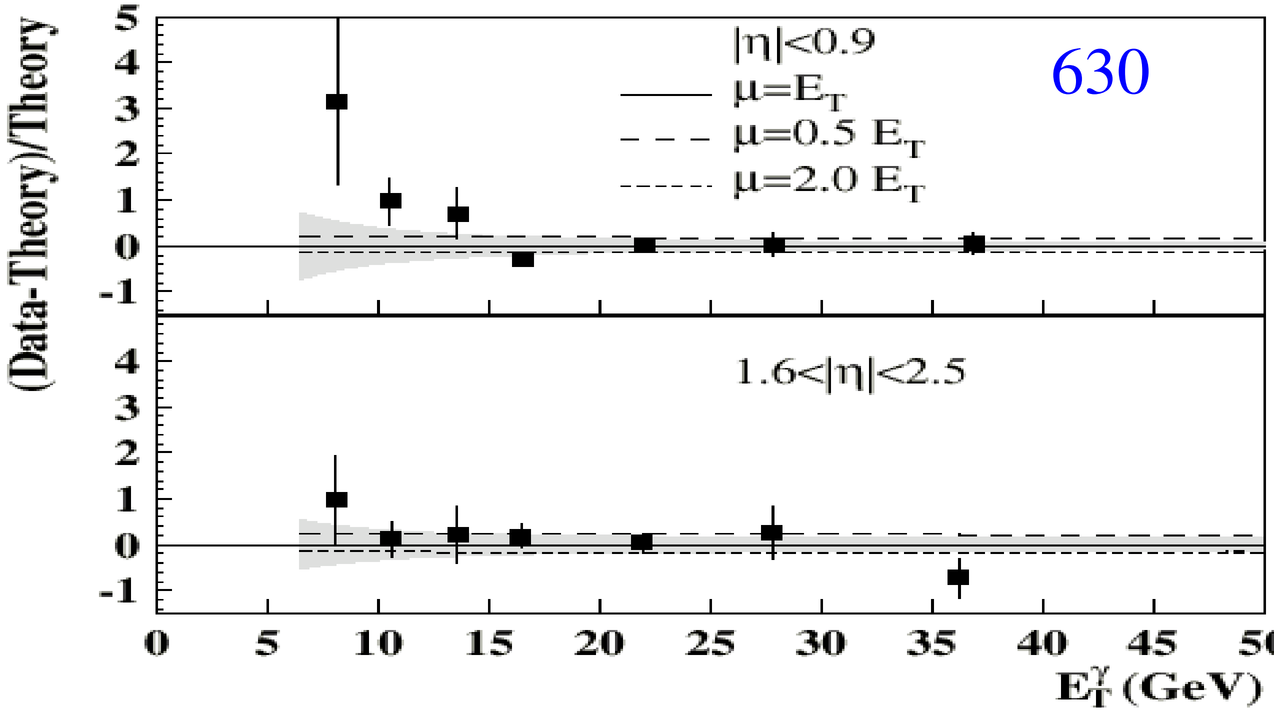
Inclusive photon production

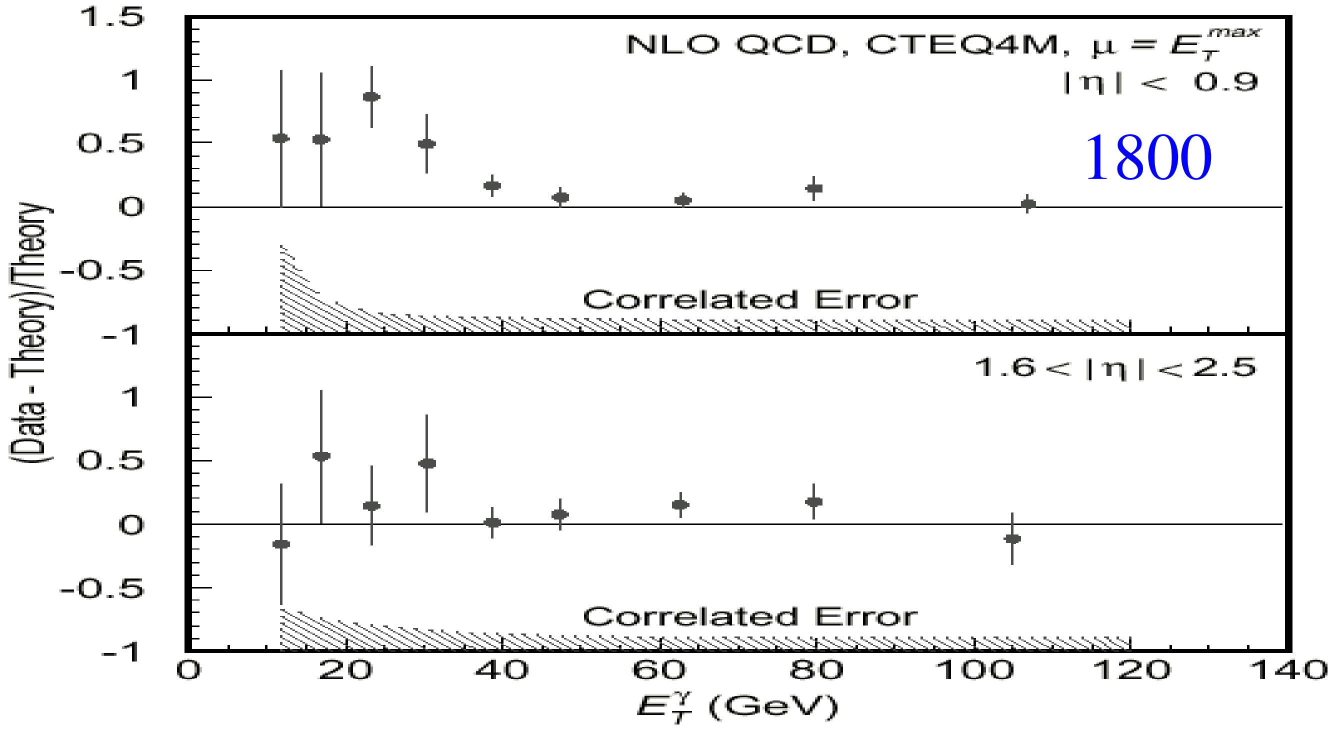
Photon purities at $\sqrt{s} = 630$ and $1800\ GeV$





Data – theory comparison at $\sqrt{s} = 630$ and $1800\ GeV$





The data

— at low Et: higher than the theoretical prediction in the central region;

— at high Et: agrees with theory (as well as in the forward rapidity region)