

ACS 346 1/18 263

# Advances in Global QCD Analysis and High $E_t$ Jets at Hadron Colliders

Presented by  
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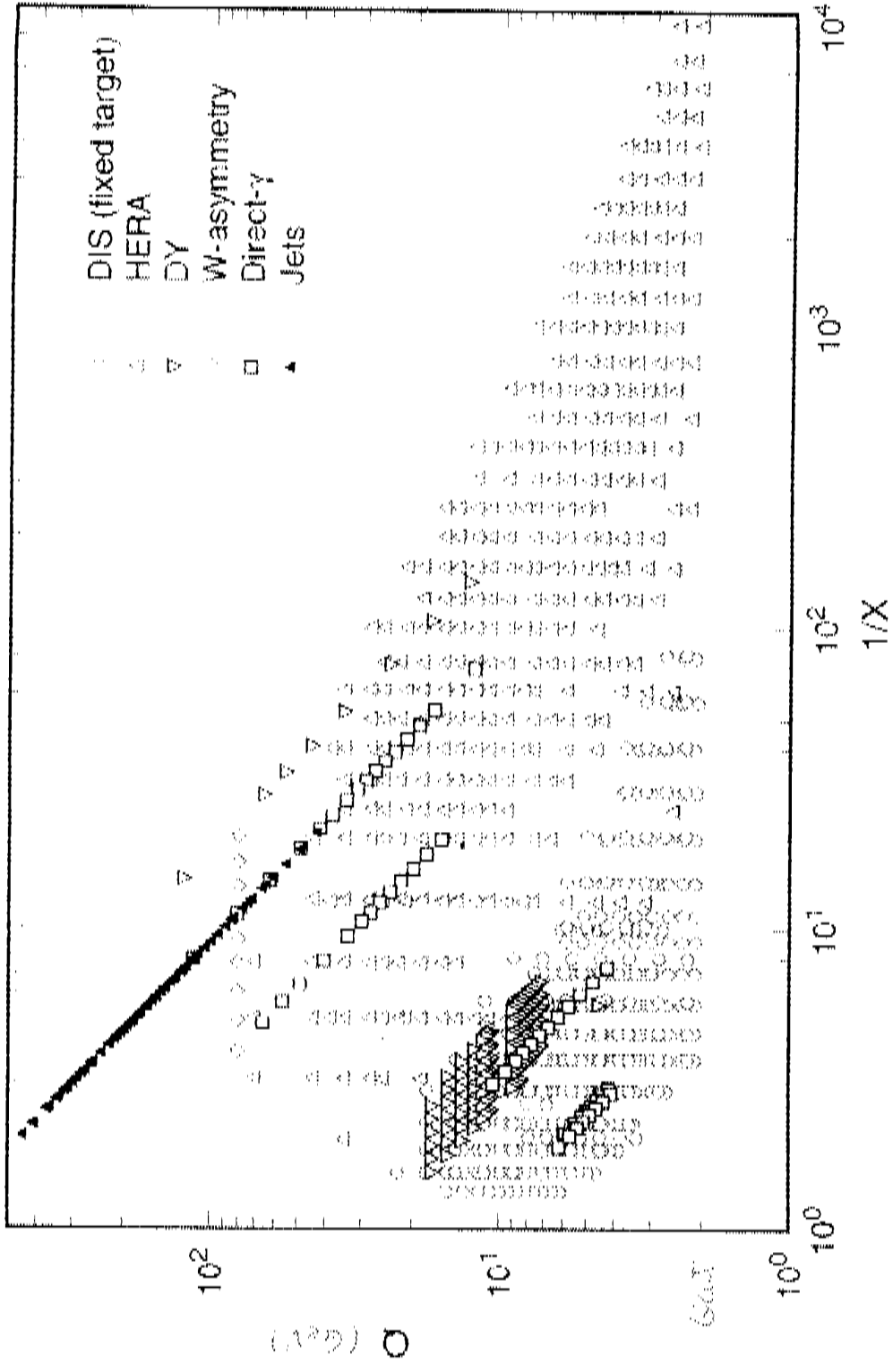
1. How do the new precision *DIS* data (*HERA* & *NMC*) and Jet Inclusive X-sections (*CDF* & *D0*) impact the global analysis of parton distributions — especially the determination of the gluon density  $G(x, Q)$ ?

=> New *CTEQ4* Parton Distributions

2. Can the high  $E_t$  Jet data from *CDF* be acomodated in the conventional QCD framework ? (How compelling is the need for new Physics)

## Processes and Experiments used in CTEQ Global QCD Analysis

Process	Experiment	Measurable	# Points	Note
DIS	BCDMS	$F_{2H}^{\mu}, F_{2D}^{\mu}$	324	PL B223 '89
	NMC	$F_{2H}^{\mu}, F_{2D}^{\mu}, F_{2n/p}^{\mu}$	297	PL B364 '95
	E665	$F_{2H}^{\mu}, F_{2D}^{\mu}$	70	FNAL-95/396
	H1	$F_{2H}^e$	172	DESY 96-039
	ZEUS	$F_{2H}^e$	179	DESY 96-076
	CCFR	$F_{2Fe}^{\nu}, x F_{3Fe}^{\nu}$	126	'93 (Pri. Com.)
Drell-Yan	E605	$sd\sigma/d\sqrt{\tau}dy$	119	PR D43 '91
	NA-51	$A_{DY}$	1	PL B332 '94
W-prod.	CDF	Lepton asym.	9	PRL 74 '95
Direct $\gamma$	WA70	$Ed^3\sigma/d^3p$	8	Z.Phys.C38 '88
	UA6	$Ed^3\sigma/d^3p$	16	PL B317 '93
Incl. Jet	CDF	$d\sigma/dE_t$	36	PRL 77 '96, APS '96
	D0	$d\sigma/dE_t$	26	Moriond '96



## Summary of the Six series of studies

	Data		Parameters	Varying	Remarks
	<1995	NewDIS Jet			
A	x		m.	$\alpha_s$	$G(x)$ varies systematically with $\alpha_s$ ; $\Delta G$ band wide
B	x	x	m.	$\alpha_s$	$G(x)$ pinned down, esp. at small $x$ ; $\Delta G$ underestimated?
C	x	x	2-m.	$\alpha_s$	Additional para. widen $\Delta G$ ; Unstable results $\Rightarrow$ under-constrained system?
D	x	x	m.	$\alpha_s$	Perfectly consistent with B-series; pin-down $G(x)$ @ large $x$
E	x	x	2-m.	$\alpha_s$	Jet data render C-series stable; Yield reasonable range of $\Delta G$ ?
F	x	x	2-m.	$Q_{cut}$	For fixed $\alpha_s$ , varying $Q_{cut} \Rightarrow$ 5-10% variation in $G(x,Q)$

## CTEQ4 Parton Distribution Sets

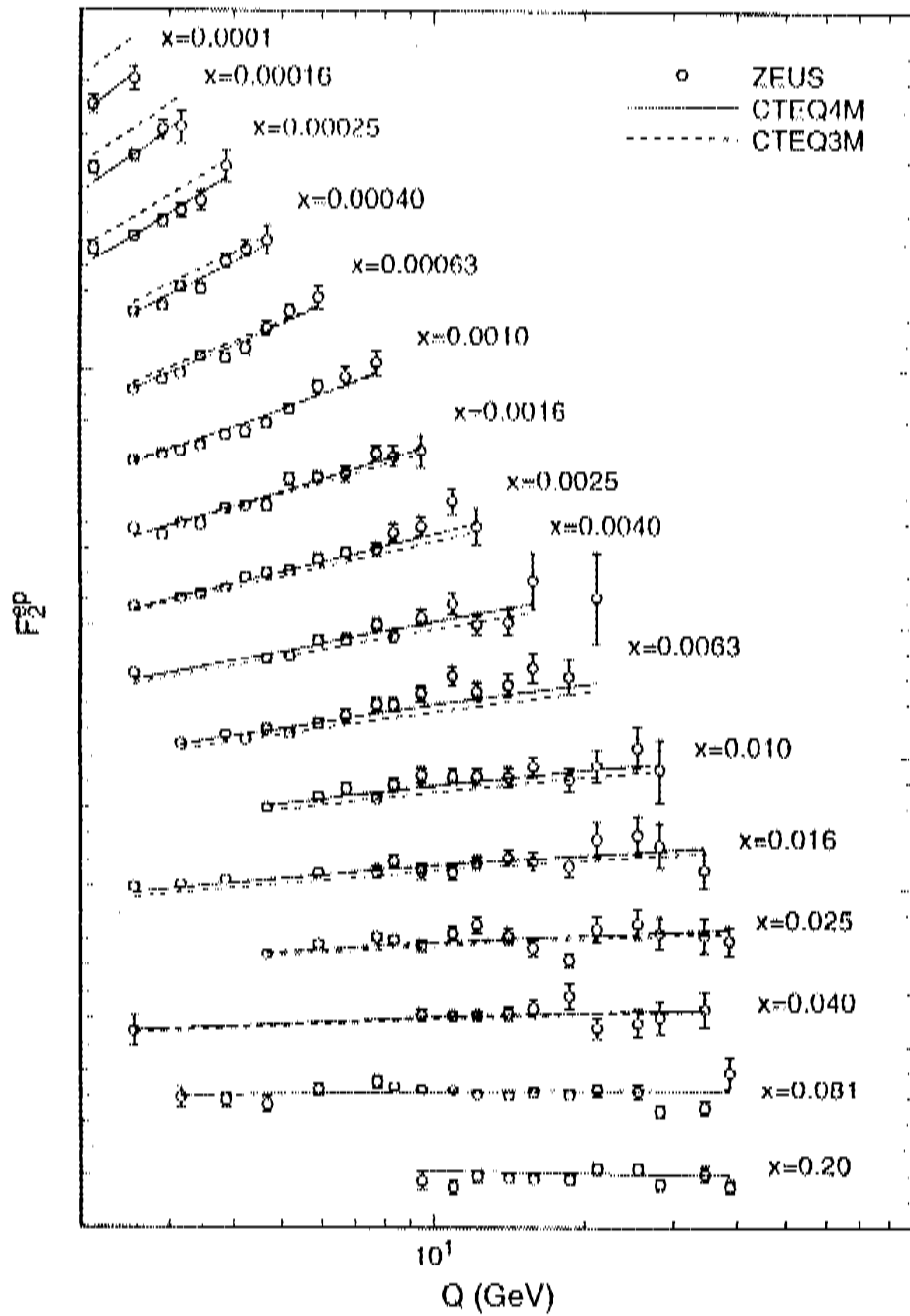
PDF set	Description	$\alpha_s(m_z)$	$Q_0^2$ (GeV <sup>2</sup> )
	Standard Sets		
CTEQ4M	$\overline{MS}$ scheme	0.116	2.56
CTEQ4D	DIS scheme	0.116	2.56
CTEQ4L	Leading Order	0.132	2.56
	$\alpha_s$ series		
CTEQ4A1	1	0.110	2.56
CTEQ4A2	2	0.113	2.56
CTEQ4A3	Same as CTEQ4M	0.116	2.56
CTEQ4A4	4	0.119	2.56
CTEQ4A5	5	0.122	2.56
	Specials		
CTEQ4HJ	"Hi-Jet"	0.116	2.56
CTEQ4LQ	"Low $Q_0$ "	0.114	0.49

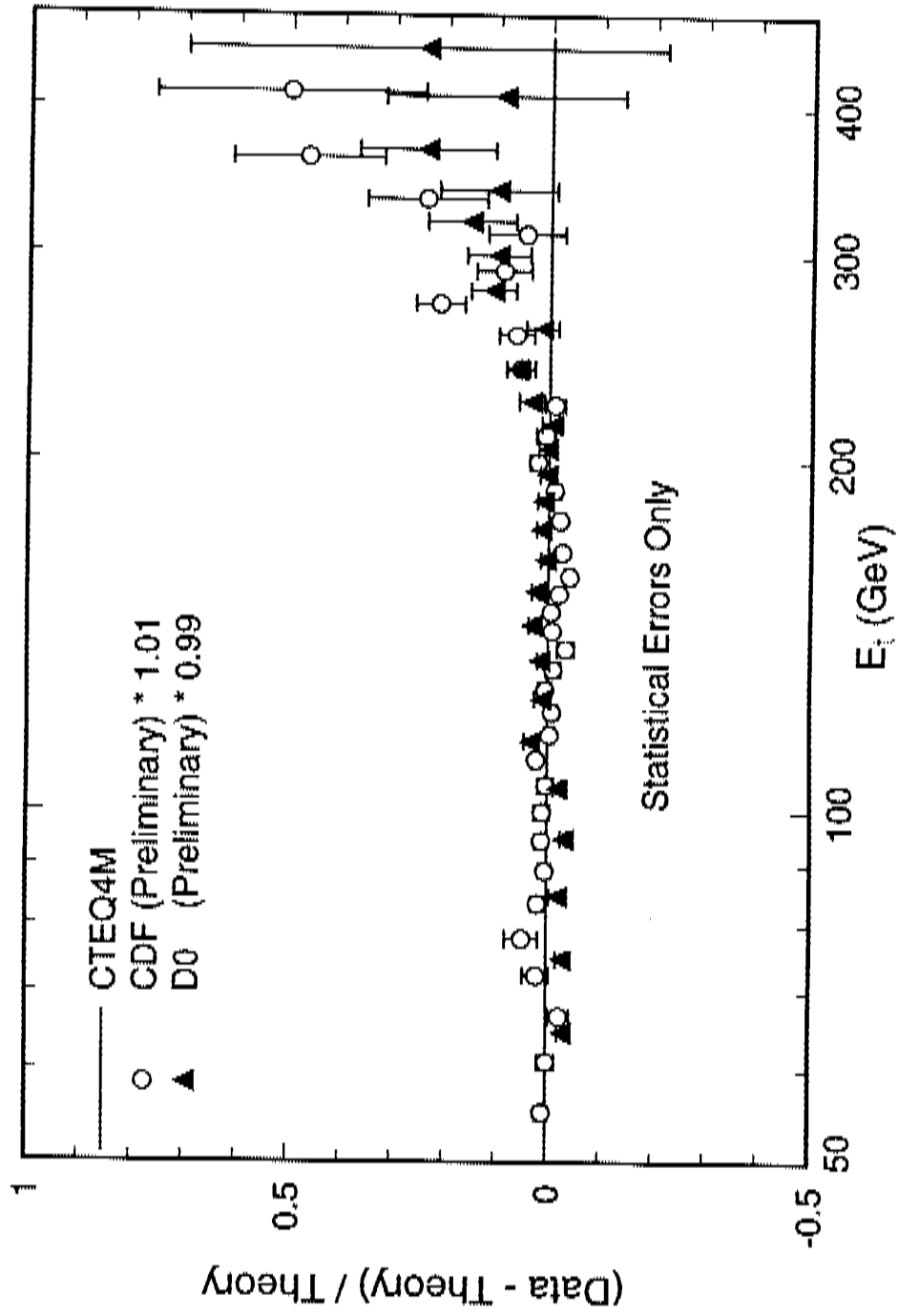
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Expt.	#pts	CTEQ4M	CTEQ4HJ	MRS R1	MRS R4	CTEQ3M
DIS-F.T.	817	855.2(1.05)	884.3(1.08)	879.9(1.08)	933.8(1.14)	937.4(1.15)
HERA	351	362.3(1.03)	352.9(1.01)	374.5(1.07)	378.0(1.08)	769.7(2.19)
DY	129	102.6(0.80)	105.5(0.82)	101.5(0.79)	99.5(0.77)	96.0(0.74)
Total	1297	1320	1343	1356	1411	1803

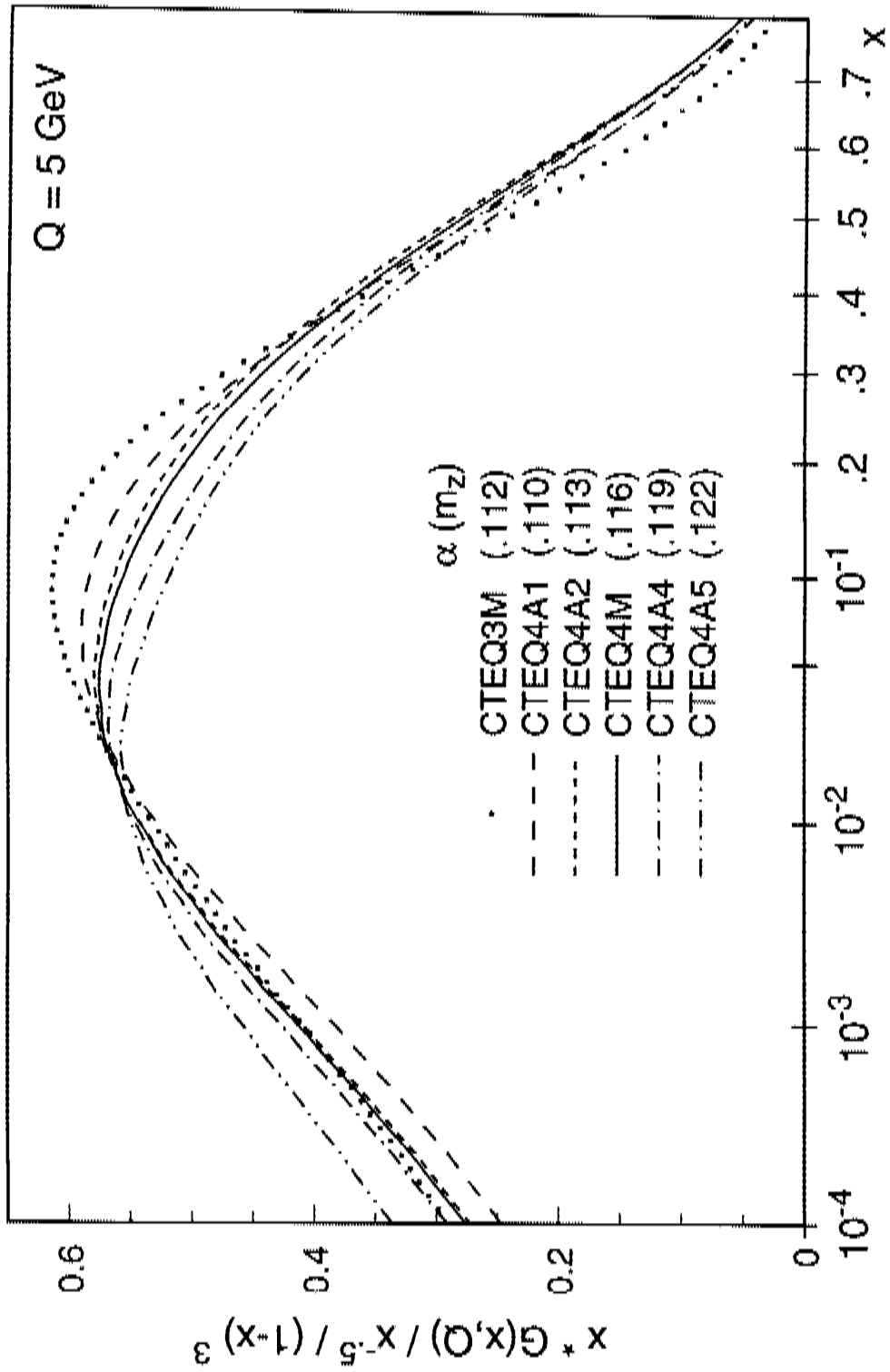
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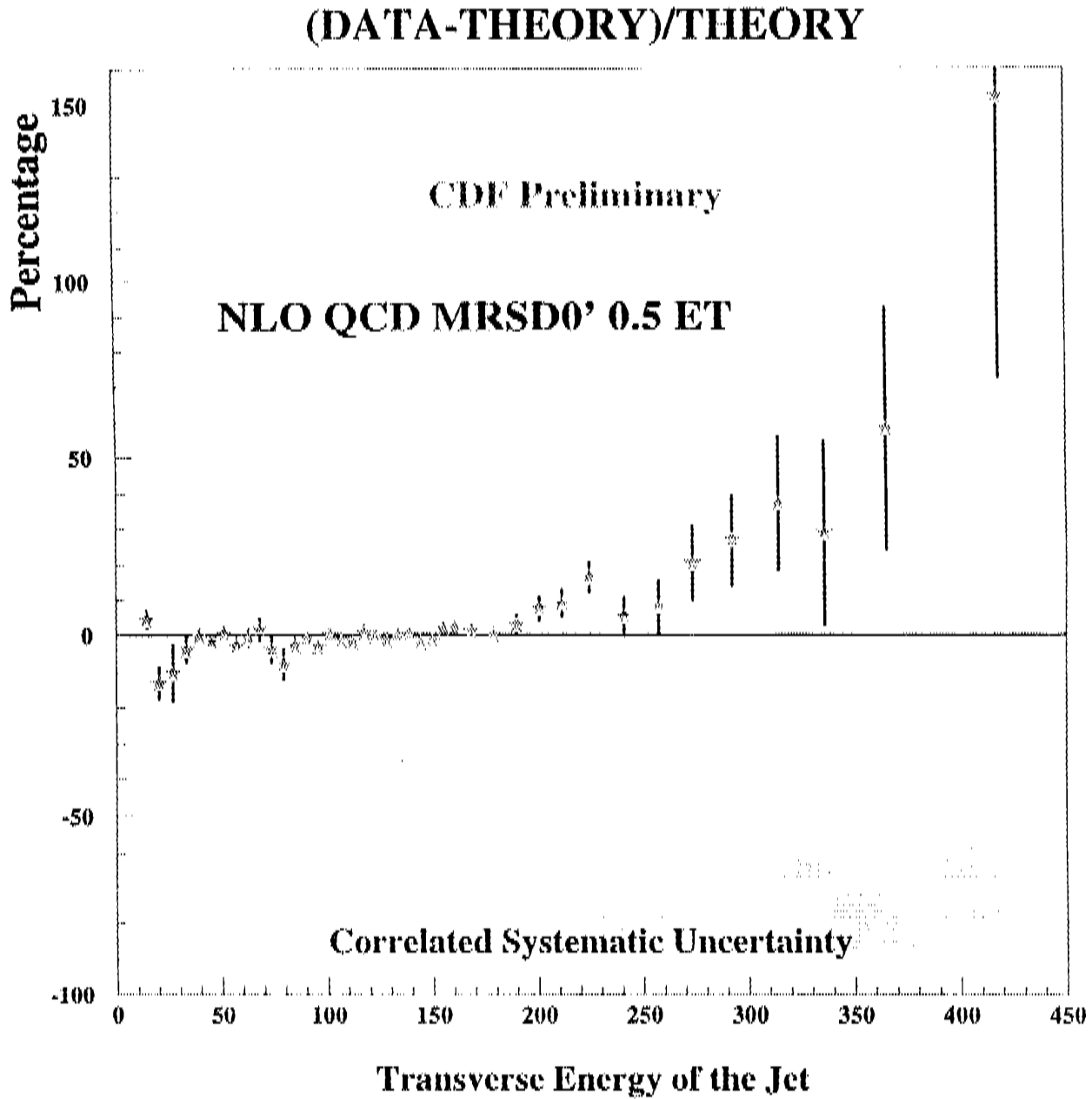
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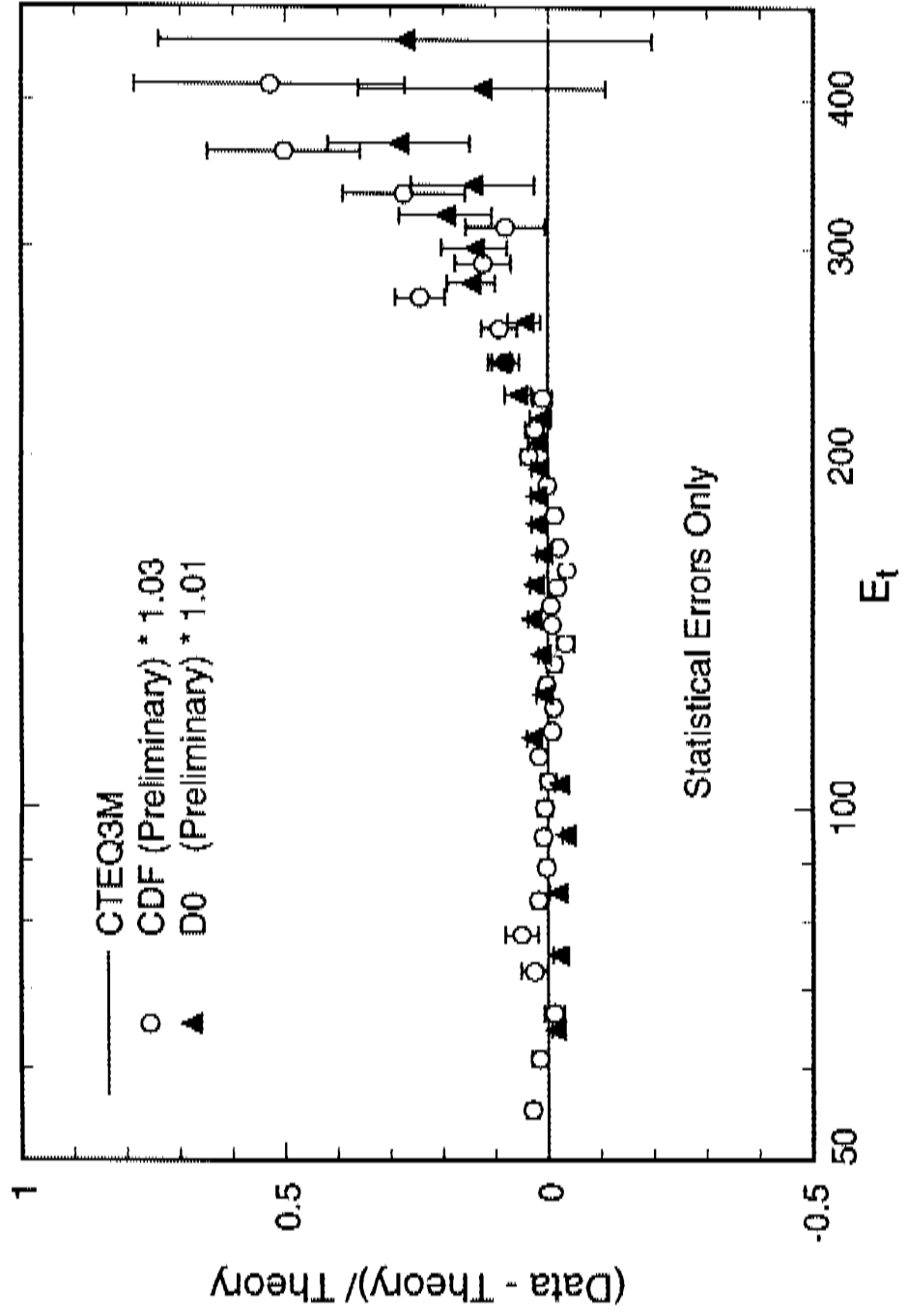
Can the High  $E_t$  Jet Data from CDF  
Be accomodated  
in the conventional QCD framework ?

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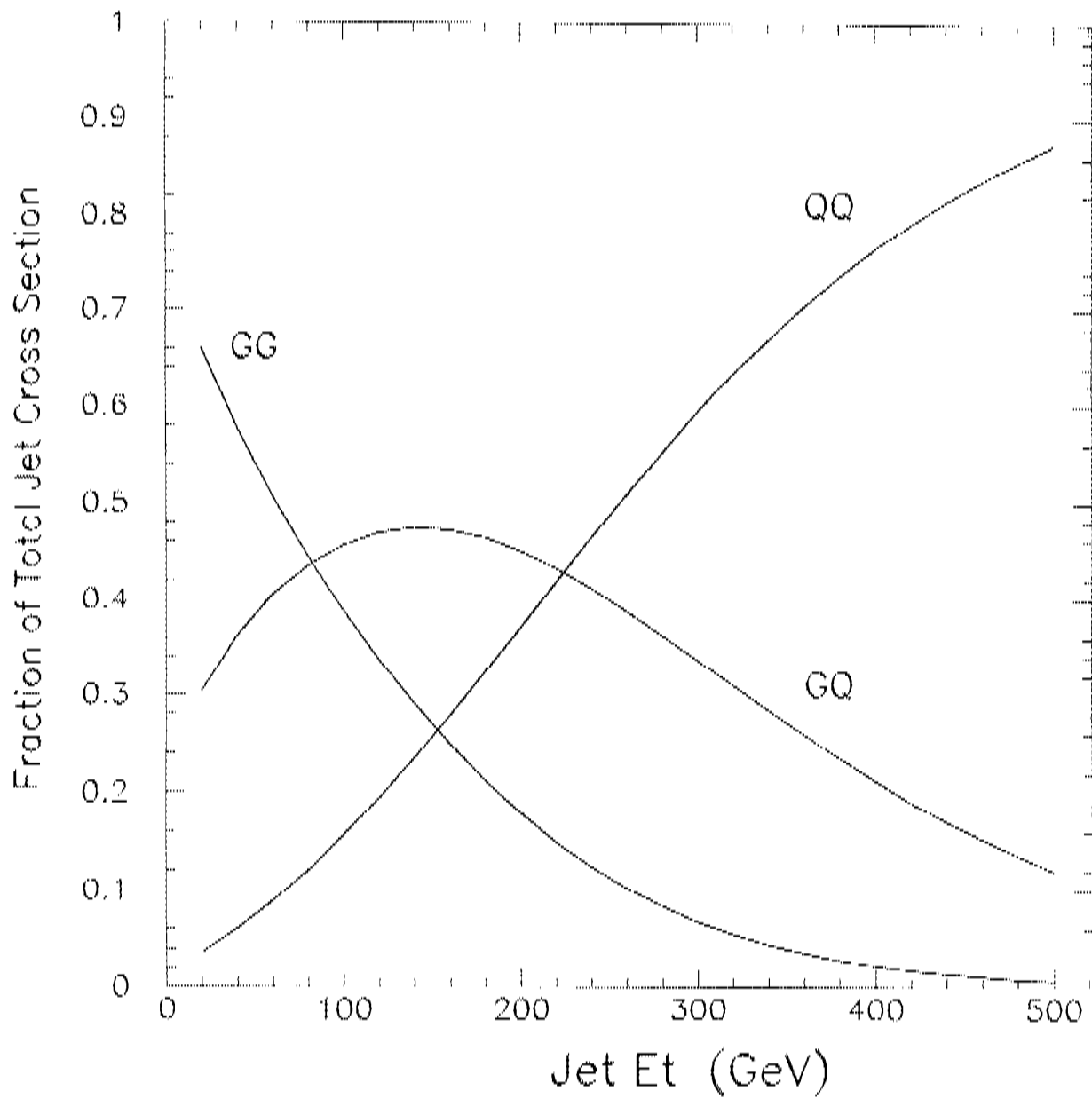


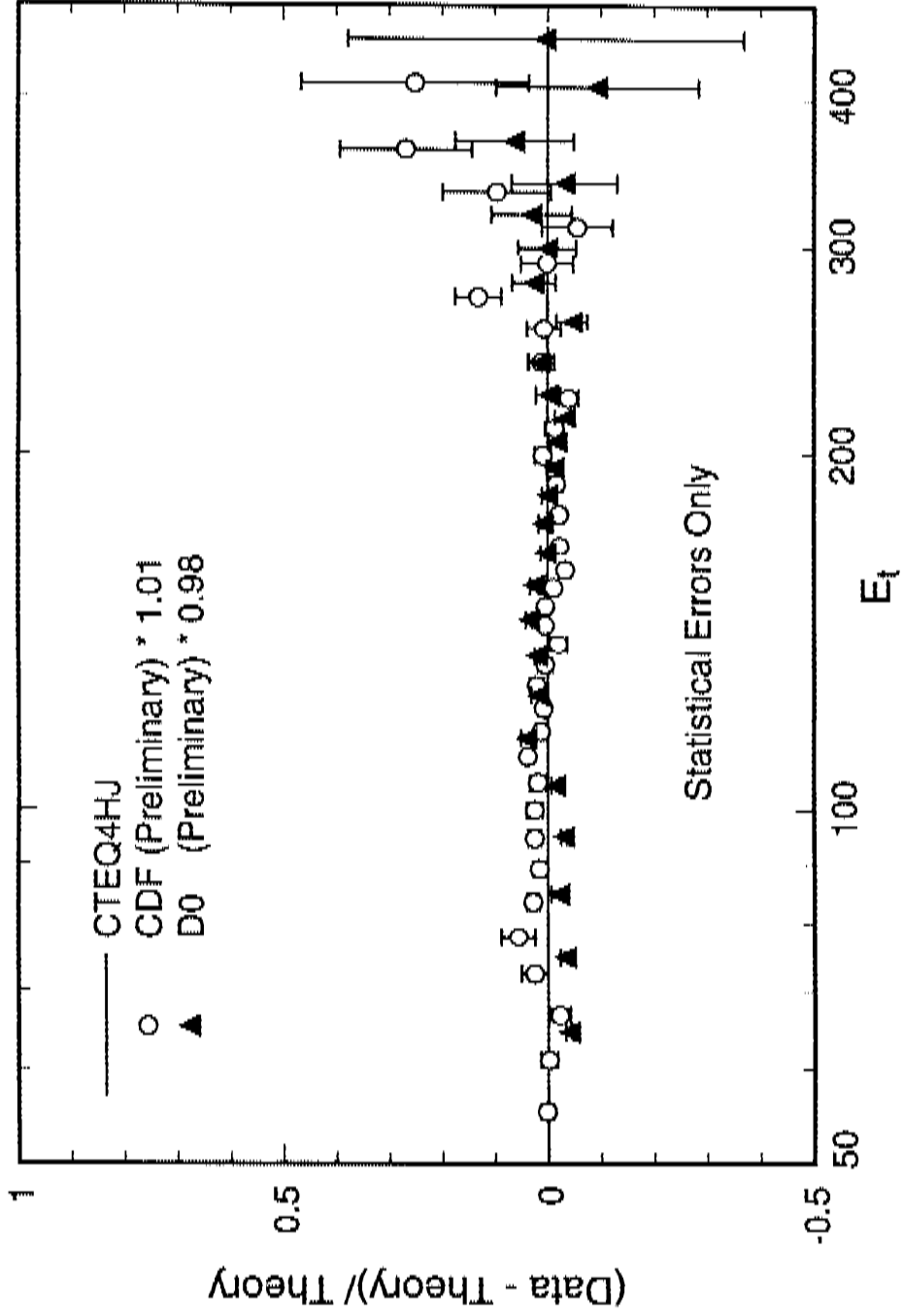
PRL 77, 438 (1996).

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*Handwritten:* ref: H.L. Laithwaite, J. Phys. G: Nucl. Part. Phys. 1987, 13, 105-117

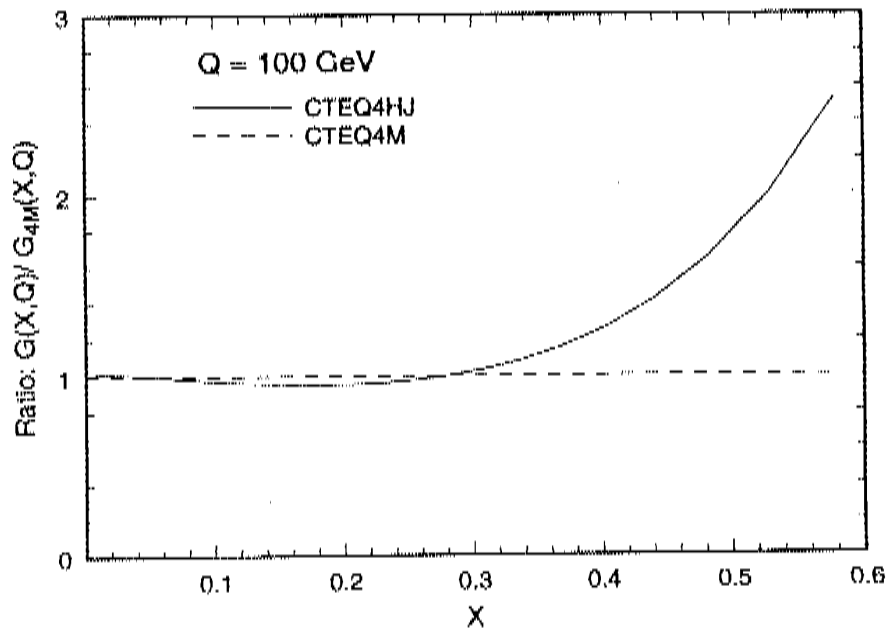
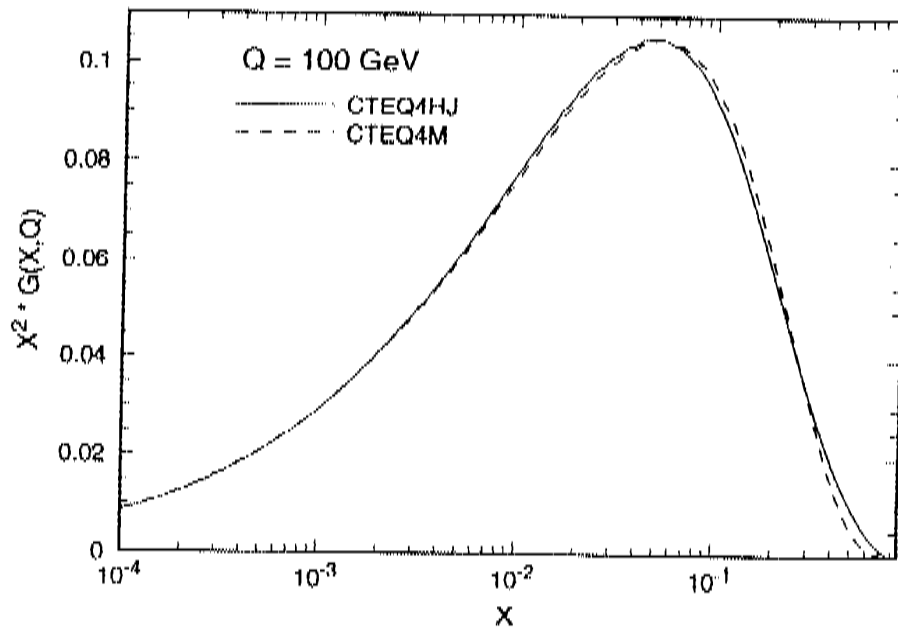




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Expt.	#pts	CTEQ4M	CTEQ4HJ	MRS R1	MRS R4	CTEQ3M
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A05346 17/18



## Summary

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1. New precision *DIS* data (esp. *HERA*) and new process ( inclusive jets at Tevatron) provide very tight constrains on the PDF's.

=> New generation of parton distributions

— *CTEQ4x* (also *MRS Rx*)

2. These new data allow the uncertainty of  $G(x, Q)$  to be systematically studied. The dominant effect is due to the variation of  $\alpha_s$  within the currently allowed range. This is quantified in the *CTEQ4An* series.

3. The *CDF* and *D0* inclusive jet X-sections are compatible with each other if consistent theoretical calculations are applied to both.

4. The apparent rise in high  $E_t$  jet X-sections can be accommodated in the conventional QCD framework by exploring the remaining flexibility in the shape of  $G(x, Q)$  at large  $x$  without jeopardizing the agreement with all the other data.