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00.03.14

MC SIMULATION

- THE PROGRAMS
- SOME SIMULATIONS
  - α_s
  - CC
  - Assymetries
  - Prompt Photons
  - Heavy flavours
  - Event shapes
  - Forward Jets

THE PROGRAMS

NLO:

MEPJET	DISAGREES AT HERA
DISENT, DISASTER++	LACKING W/Z POLARIZATION

STANDARD DIS:

ARIADNE	OK
LEPTO	PROBLEMS WITH BACKWARD EVOLUTION
RAPGAP	NEEDS X-TRA p_t cut FOR RESOLVED γ^*
PYTHIA	(NOT CHECKED YET BUT PROBABLY OK)
SMALLX	OK
CASCADE	NOT YET
HERWIG	

ELECTROWEAK CORRECTIONS:

HERACLES	NEEDS PARAMETER CORRECTIONS.

PHOTO PRODUCTION: NO PROBLEMS FORSEEN

HEAVY QUARKS : AROMA NO CC ?

PYTHIA

HERWIG

PDFLIB:

WARNING!

MOST DISTRIBUTIONS STOP AT $x = 10^{-5}$ (SOMETIMES WITHOUT ERROR MESSAGE)

USE GRV

α_s

CAN WE COMPETE WITH LEP?

AT THERA WE CAN GO TO HIGHER Q^2
⇒ SMALLER NLO SCALE DEPENDENCE

THEORETICAL ERROR FROM FEW % TO BELOW 1 %

HOW MUCH LUMINOSITY IS NEEDED TO BE COMPETITIVE?

CHARGED CURRENT

CROSS SECTION IS A FACTOR 5 × HERA

WILL WE GET LUMINOSITY ENOUGH?

DO WE KNOW WHAT TO DO WITH IT?

AZIMUTHAL JET ASSYMETRIES

HAS JUST BEEN MEASURED BY ZEUS

CAN WE DO MORE AT THERA?

ELECTRON POLARIZATION GIVES
ACCESS TO T_{QQ} ?

Cross section for THERA:

DIS x section (RAPGAP):

proton structure fct: GRV-HO(DIS)
electron: 250 GeV
proton: 920 GeV

x-sections in nb for sigma_tot(Q^2>Q^2_min):

Q^2_min	NC (THERA)	NC (HERA)	CC (THERA)	CC (HERA)
2	1297.2	713.9	0.19	0.043
4	717.5	370.2	0.19	0.043
10	286.0	136.2	0.19	0.043
100	19.1	7.5	0.17	0.038
1000	0.83	0.25	0.11	0.018

Here are some xsec plots as a function of Q2 and x for different cuts on the scattering angle of the electron (Theta > 179.5, 178, 177, 176, 175 deg)

(comment for ARIADNE: The plain 'ariadne' is Ariadne version 4.10 with everything default, while 'arihiq2' is with the 'high Q2 fix' (explained here). In principle the former is uninteresting and is included just for reference)

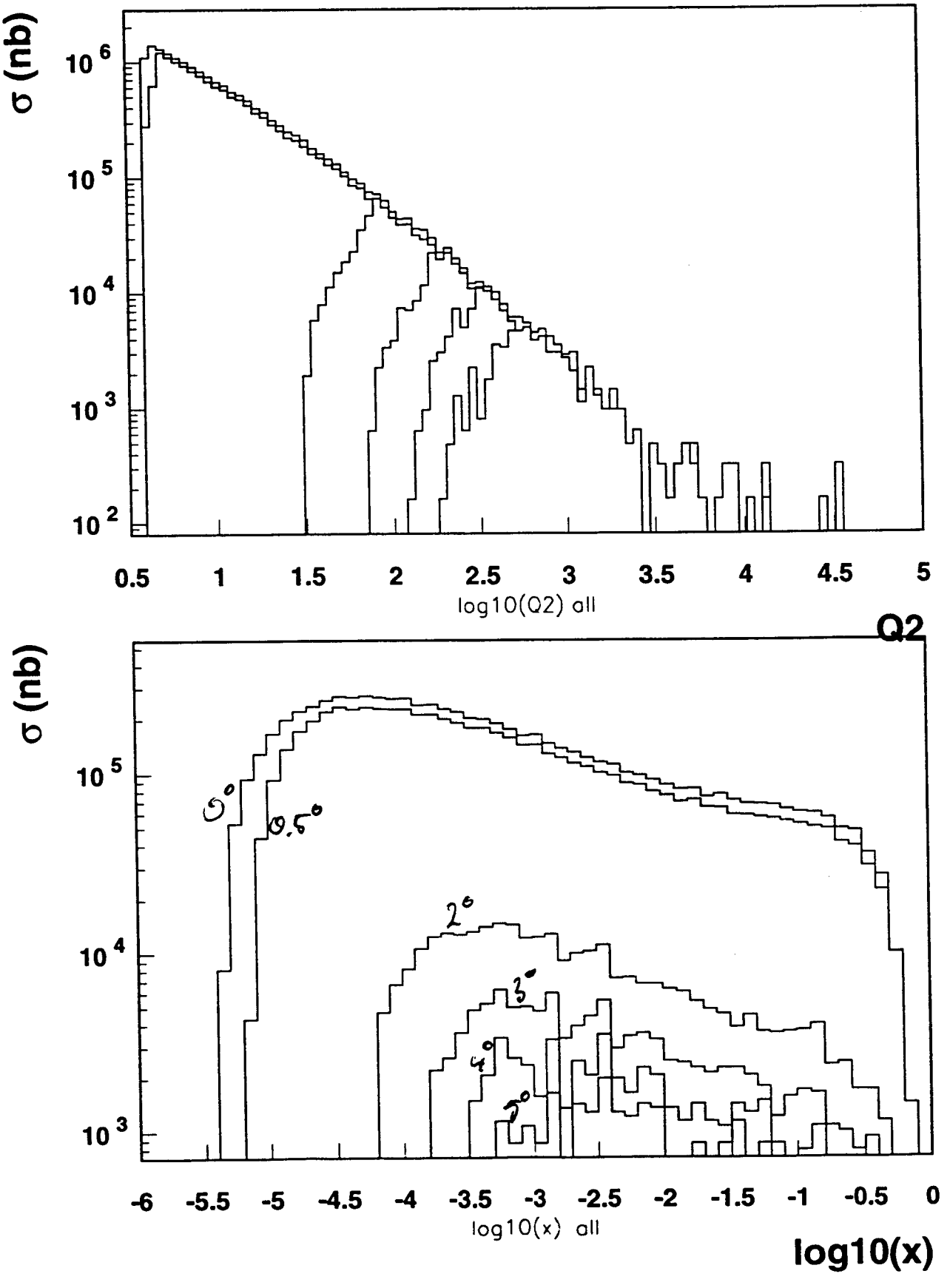
- RAPGAP: cross section fct q2,x,y
- ARIADNE: cross section as fct of q2,,x,y
- ARIHIQ2: cross section as fct of q2,,x,y
- LEPTO: cross section as fct of q2,,x,y

Check of x_min in PDF lib:

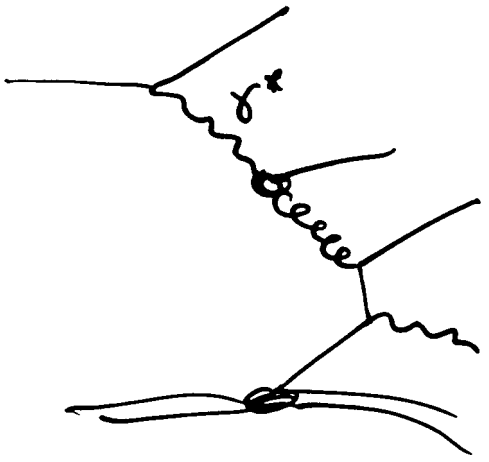
GRV (since 94): xmin=10^-6
MRS (92,95,96 sets): xmin= 10^-5
CTEQ (2,4 sets): xmin= 10^-5
recommended pdf set for THERA studies: GRV (since x can be below 10^-5)

Here are the expected fwd jet cross sections as fct of xbj (for

arihiq2-250x920



PROMPT PHOTONS



LARGER CM ENERGY MAY GIVE ACCESS TO GLUON DISTRIBUTION OF VIRTUAL PHOTON ?

HEAVY QUARKS

CROSS SECTIONS ARE

2-4 x HERA

WILL WE GET LUMINOSITY?

LARGER CM ENERGY MAY

INCREASE OUR UNDERSTANDING

OF THE RAPIDITY DISTRIBUTION

EG. D^* vs c

different cuts on the fwd jet angle):

- SMALLX: fwd jets (ZEUS cuts)
- ARIADNE: fwd jets (ZEUS cuts)
- ARIHIQ2 fwd jets (ZEUS cuts)
- LEPTO fwd jets (ZEUS cuts)

photoproduction x sections:

proton structure fct: GRV-HO(DIS)
m_t = 173.8 GeV
electron: 250 GeV
proton: 920 GeV

x-sections in nb (obtained from RAPGAP):

	direct photon (THERA)	direct photon (HERA)	res. photon (THERA)	res. photon (HERA)	CC (THERA)	CC(HERA)
charm mc =1.5 GeV	1542.6	619.2	193.0	51.9	0.00165	??
bottom mb = 5 GeV	14.6	3.9	3.9	0.56	0.0087	??
top mt=173.8 GeV	8.6 10^-6	-----	0.2 10^-6	-----	1. 10^-4	??

x-sections in nb (obtained from AROMA 2.24 (J. Gassner):

	direct photon (THERA)	direct photon (HERA)	res. photon (THERA)	res. photon (HERA)	CC (THERA)	CC(HERA)
charm mc = 1.5 GeV	1524	617	-----	-----	??	??
bottom mb = 5 GeV	14.1	3.8	-----	-----	??	??
top mt= 173.8 GeV	9.7 10^-6	-----	-----	-----	??	??

Heavy quark production at THERA (from Pawel Jankowski and Maria Krawczyk)

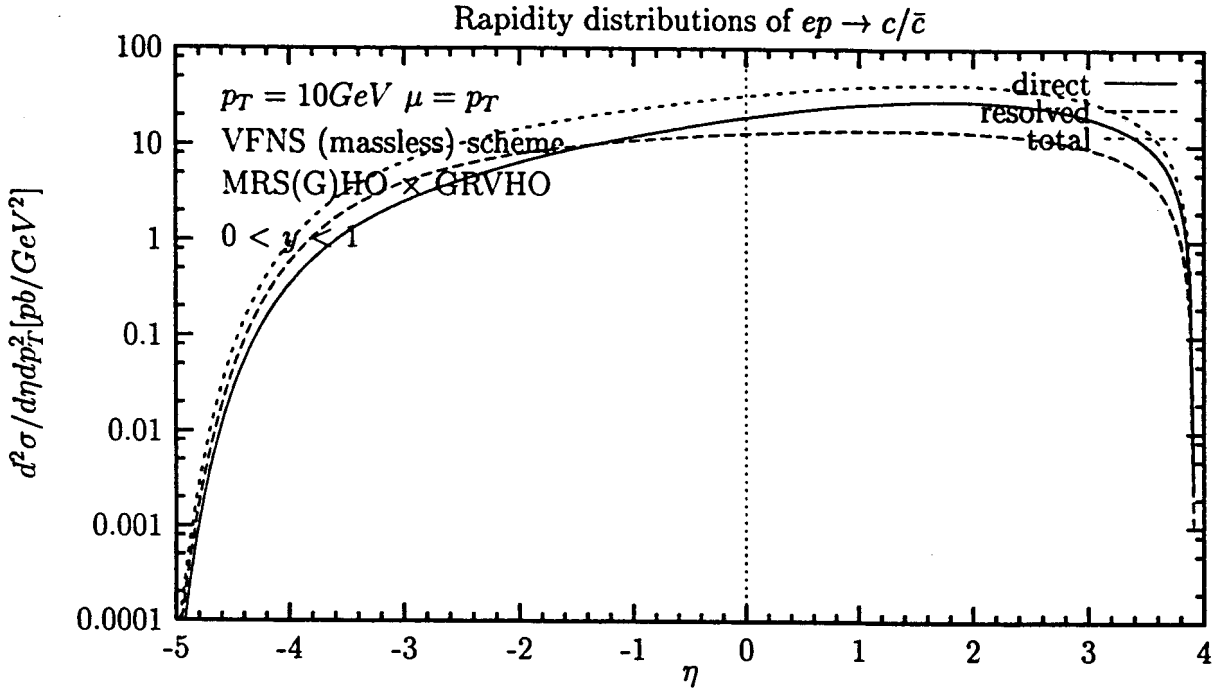


Figure 3: $c/\bar{c}$ production, TERA, $Ep = 920$ GeV, $Ee = 250$ GeV

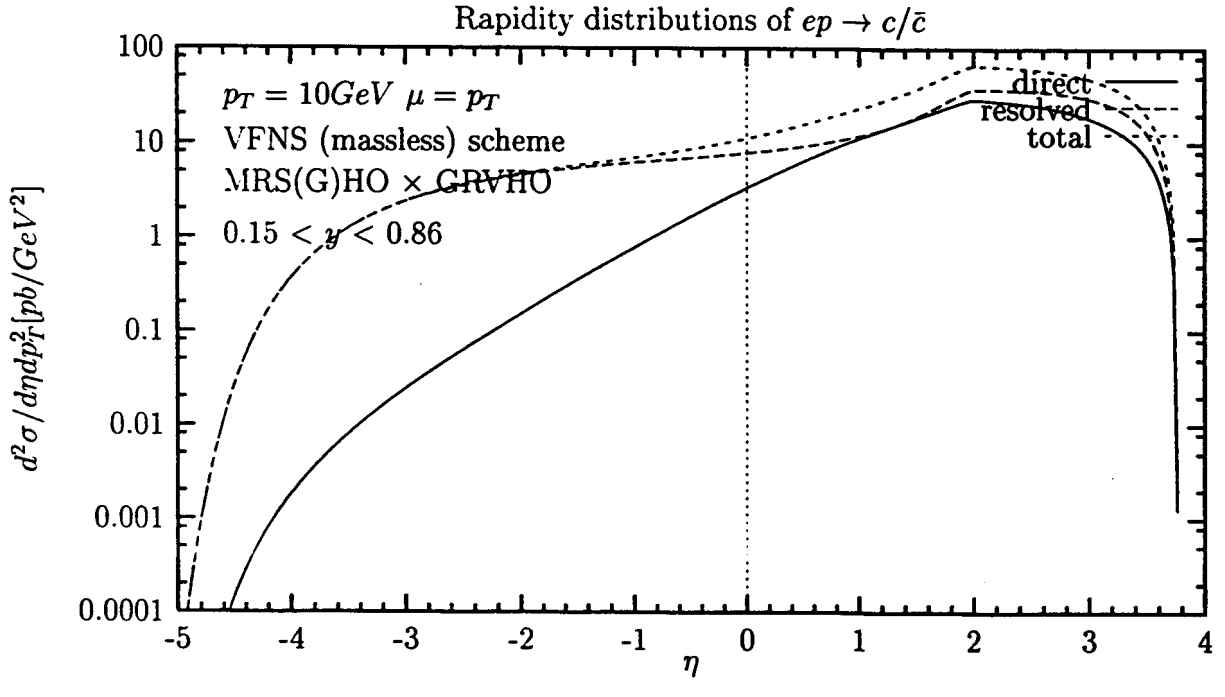


Figure 4: $c/\bar{c}$ production, TERA, $Ep = 920$ GeV, $Ee = 250$ GeV

EVENT SHAPES

LARGER CM ENERGY

⇒ LARGER XSEC

WE CAN GO TO HIGHER Q^2

AND MAYBE REDUCE HADRONIZATION CORRECTIONS

FORWARD JETS

WE GAIN A FACTOR 10 IN x

WITH ENOUG ANGULAR COVERAGE

WE CAN STUDY DETAILS OF

BFKL / CCFM

DGLAP IS OUT!

forward jets

$E_{e'} > 10$ GeV, $y > 0{,}1$ $\quad 4{,}5 \cdot 10^{-4} < x < 4{,}5 \cdot 10^{-2}$

$E_{T\,jet} > 5$ GeV, $x_{jet} > 0{,}036$, $0{,}5 < E_T^2/Q^2 < 2.0$

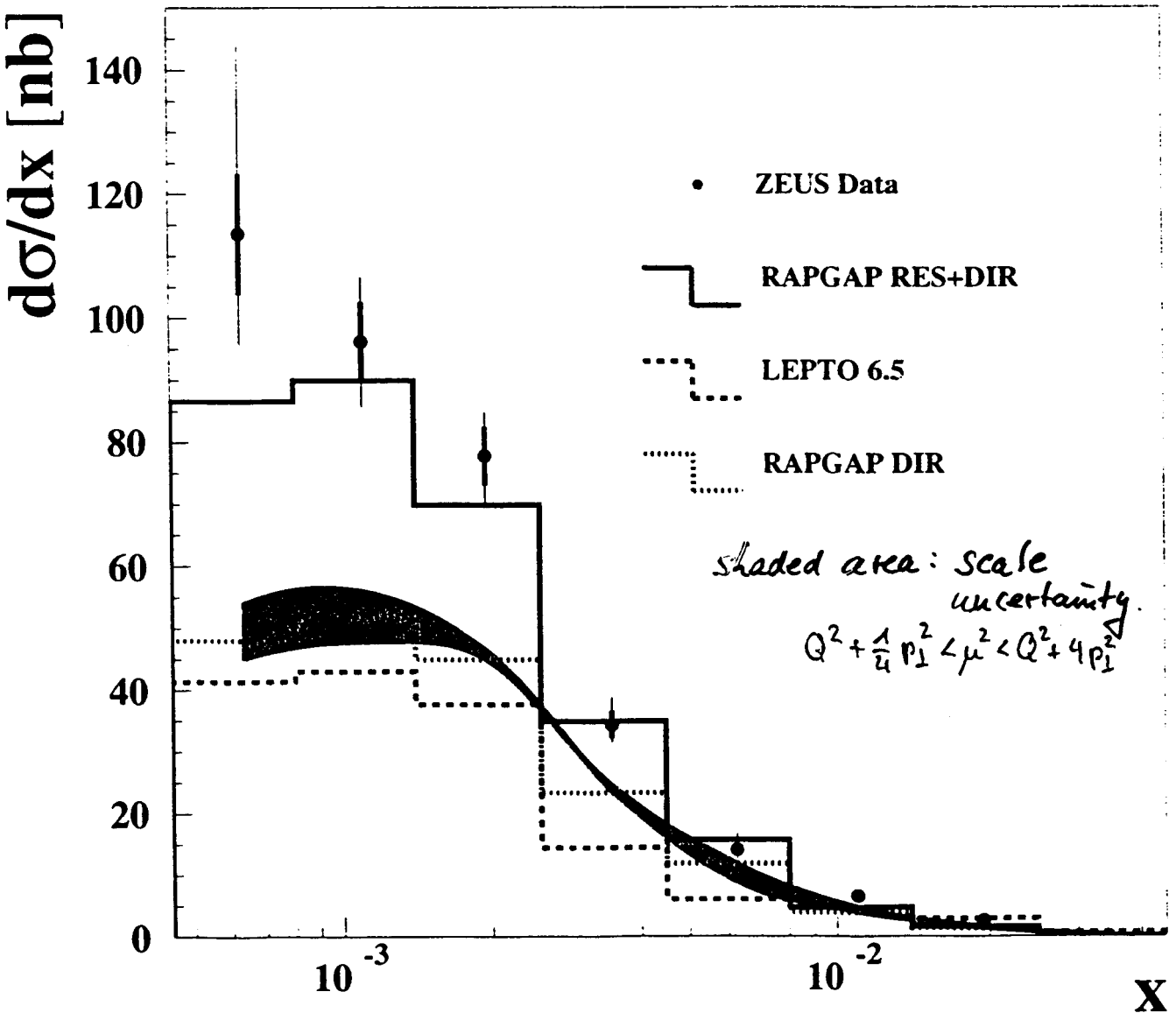
$p_{z\,jet}^{Breit} > 0$

$\eta_{jet} < 2{,}6 \;\hat{=}\; \theta_{jet} > 8{,}5°$

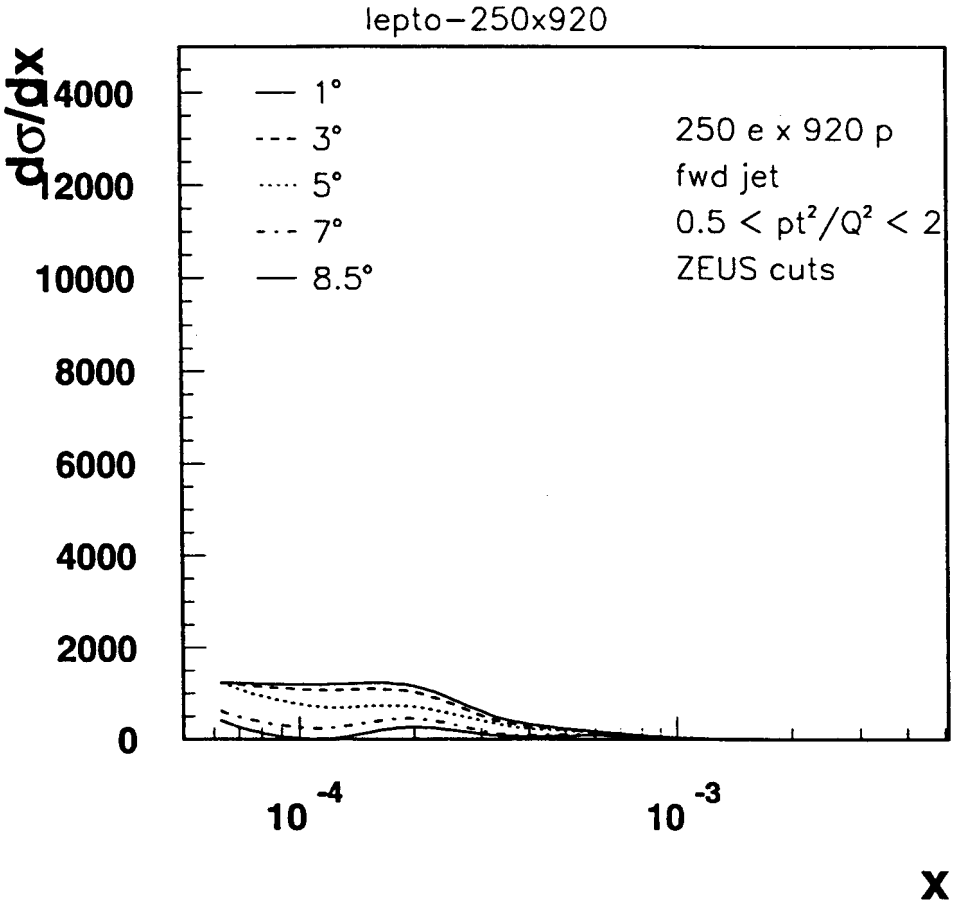
$0{,}5 < \frac{E_\perp}{Q^2} < 2.0$ → suppress DGLAP

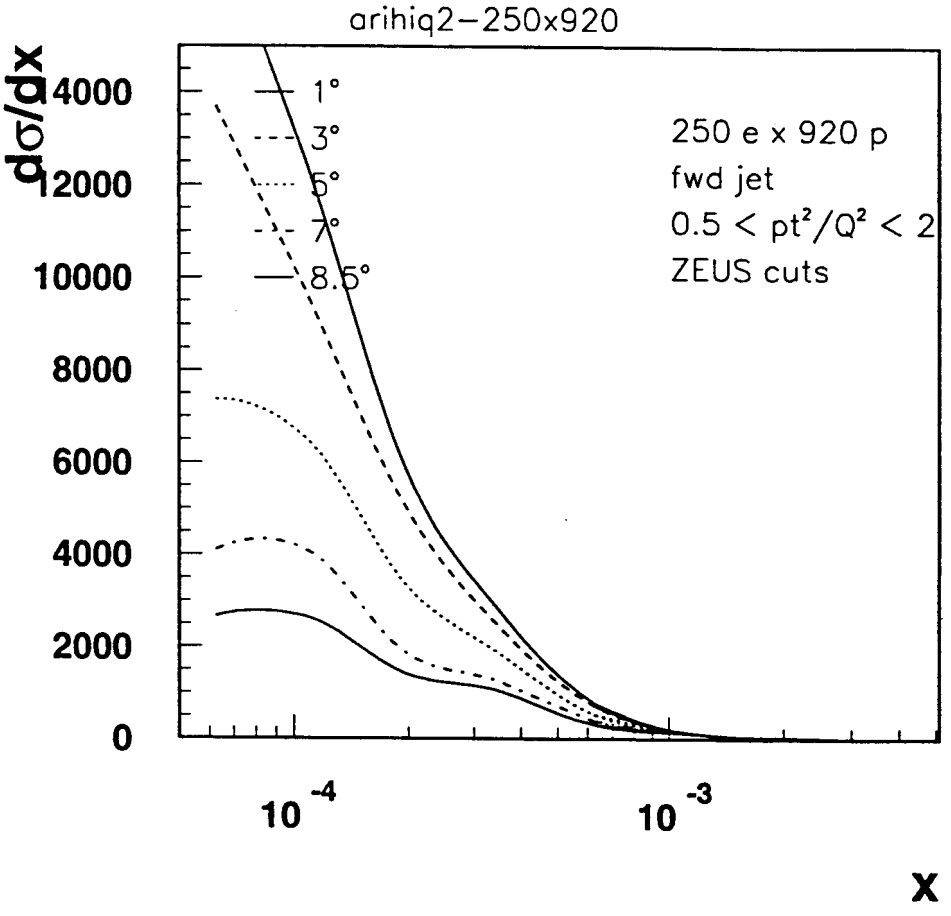
but: $E_\perp$ measured in LAB → additional $p_\perp$ from Q

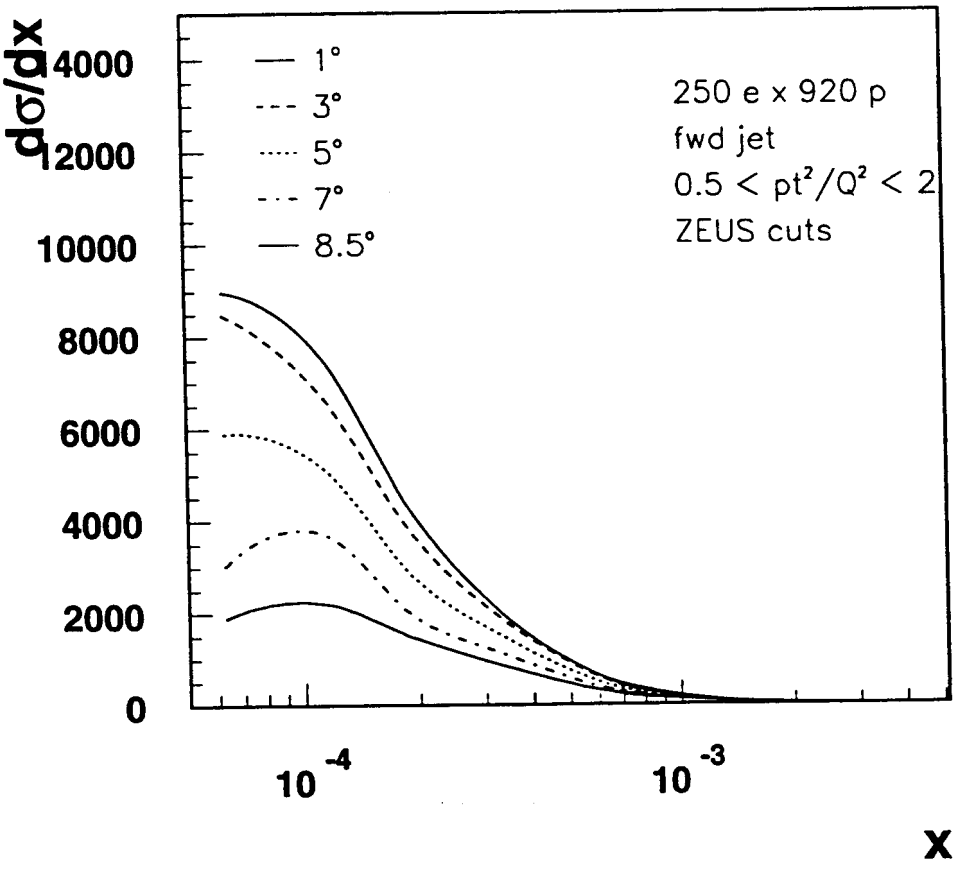
ZEUS 1995



→ res+dir fits data very well!


lepto−250x920
dσ/dx
4000
2000
10000
8000
6000
4000
2000
0
— 1°
--- 3°
····· 5°
--- 7°
— 8.5°
250 e x 920 p
fwd jet
0.5 < pt²/Q² < 2
ZEUS cuts
10 -4
10 -3
X


arihiq2−250x920
dσ/dx
14000
12000
10000
8000
6000
4000
2000
0
1°
3°
5°
7°
8.5°
250 e x 920 p
fwd jet
0.5 < pt²/Q² < 2
ZEUS cuts
10 -4
10 -3
X


dσ/dx
4000
12000
10000
8000
6000
4000
2000
0
1°
3°
5°
7°
8.5°
250 e x 920 p
fwd jet
0.5 < pt²/Q² < 2
ZEUS cuts
10 -4
10 -3
X

CONCLUSIONS

- MOST MC's ARE TECHNICALLY OK
- FOR HIGH Q^2 WE NEED HIGH LUMINOSITY
- FOR SMALL-X WE NEED ANGULAR COVERAGE