Heavy Flavour Production at HERA

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Talk at Moriond 2001.

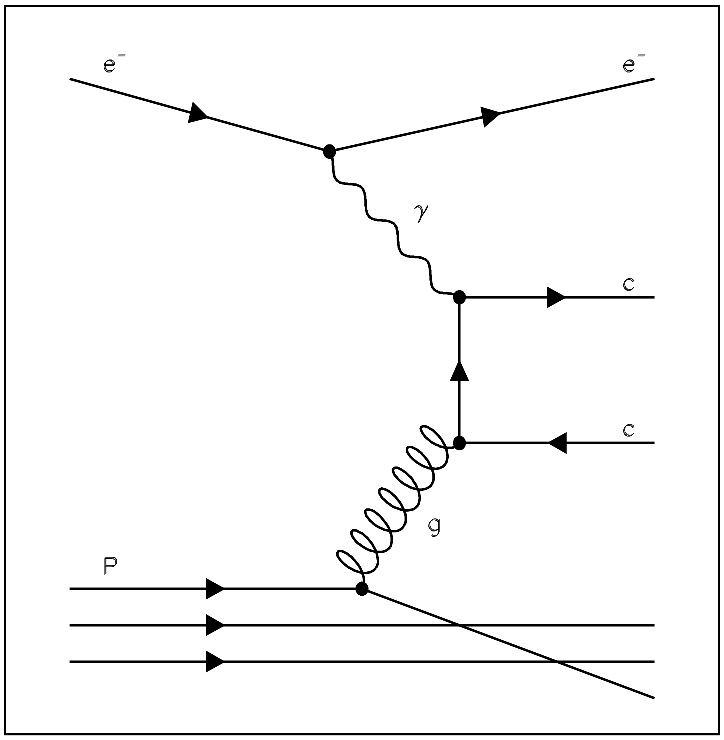
Synopsis

Inclusive Charm Production in Deep Inel.Scatt. (DIS)

Inclusive Beauty production in Photoproduction

Inclusive Beauty Production in DIS

Photon-gluon fusion is known to be the chief contributing amplitude to charm production in DIS.

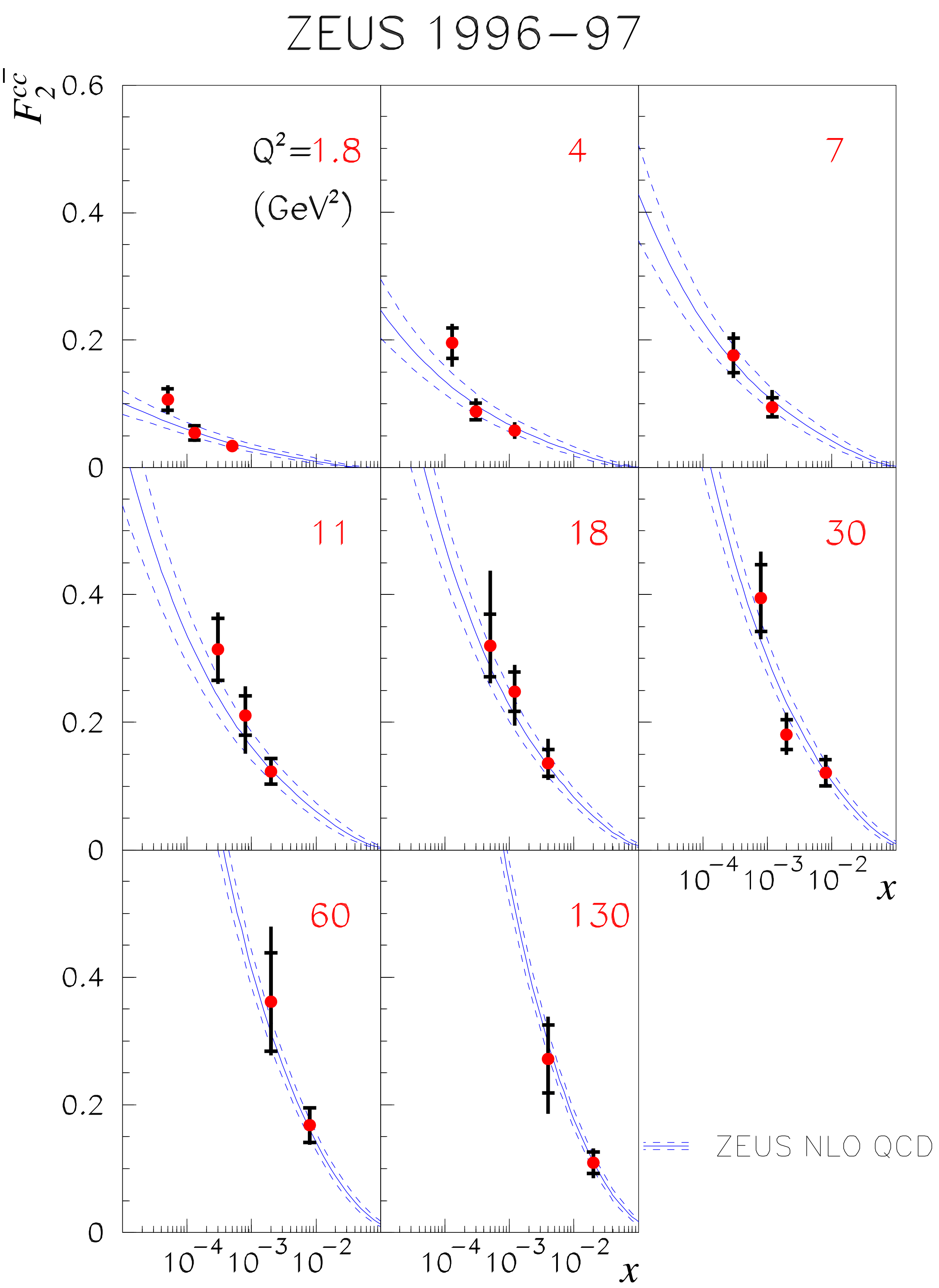


LO model works at fixed target energies - EMC (1980).

NLO model needed at HERA energies.

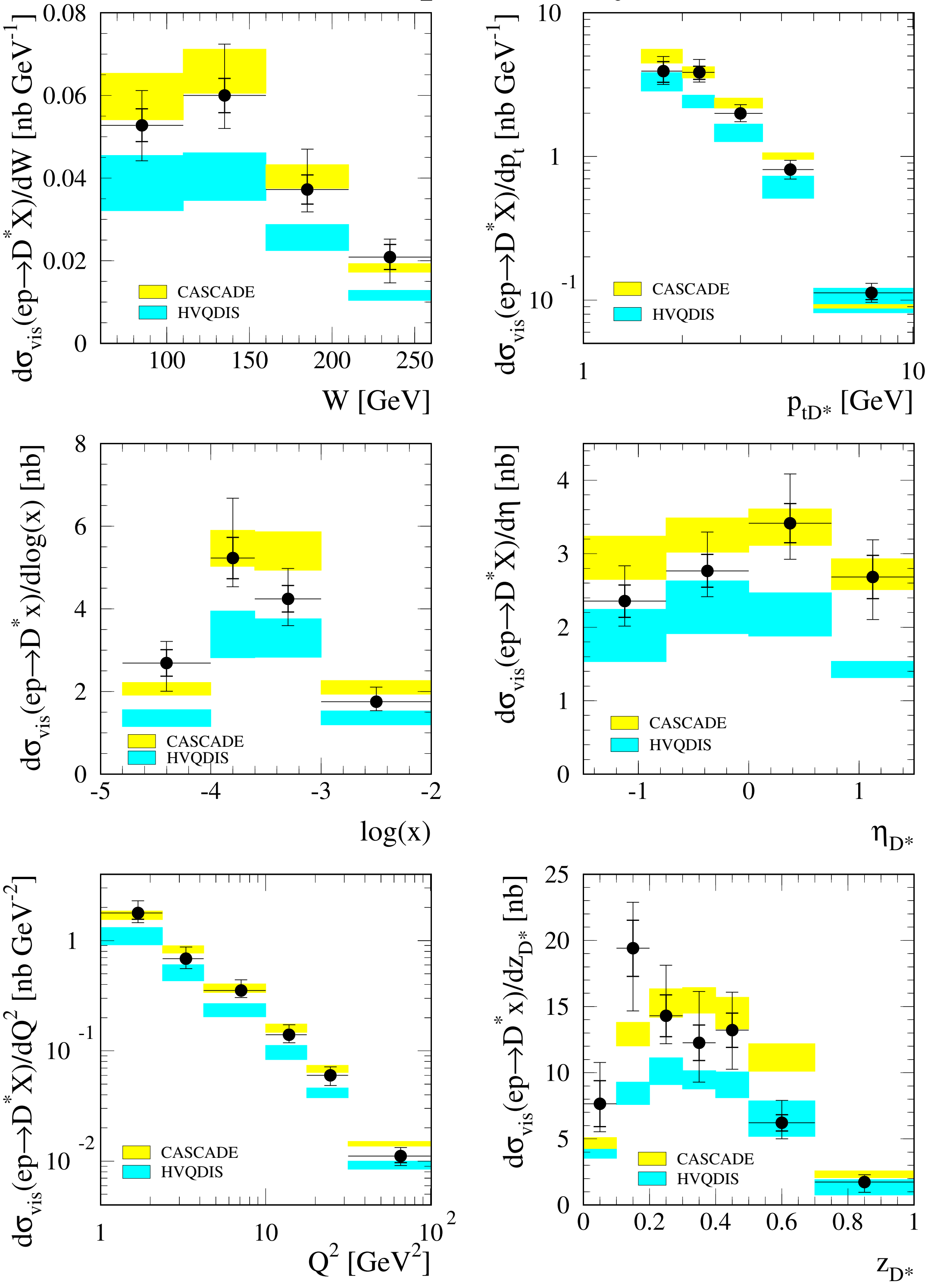
HVQDIS usually used for the NLO calculation.

New MC -CASCADE based on a solution of the CCFM equation (which becomes the BFKL equation as x $\rightarrow$ 0) is compared to new H1 data.

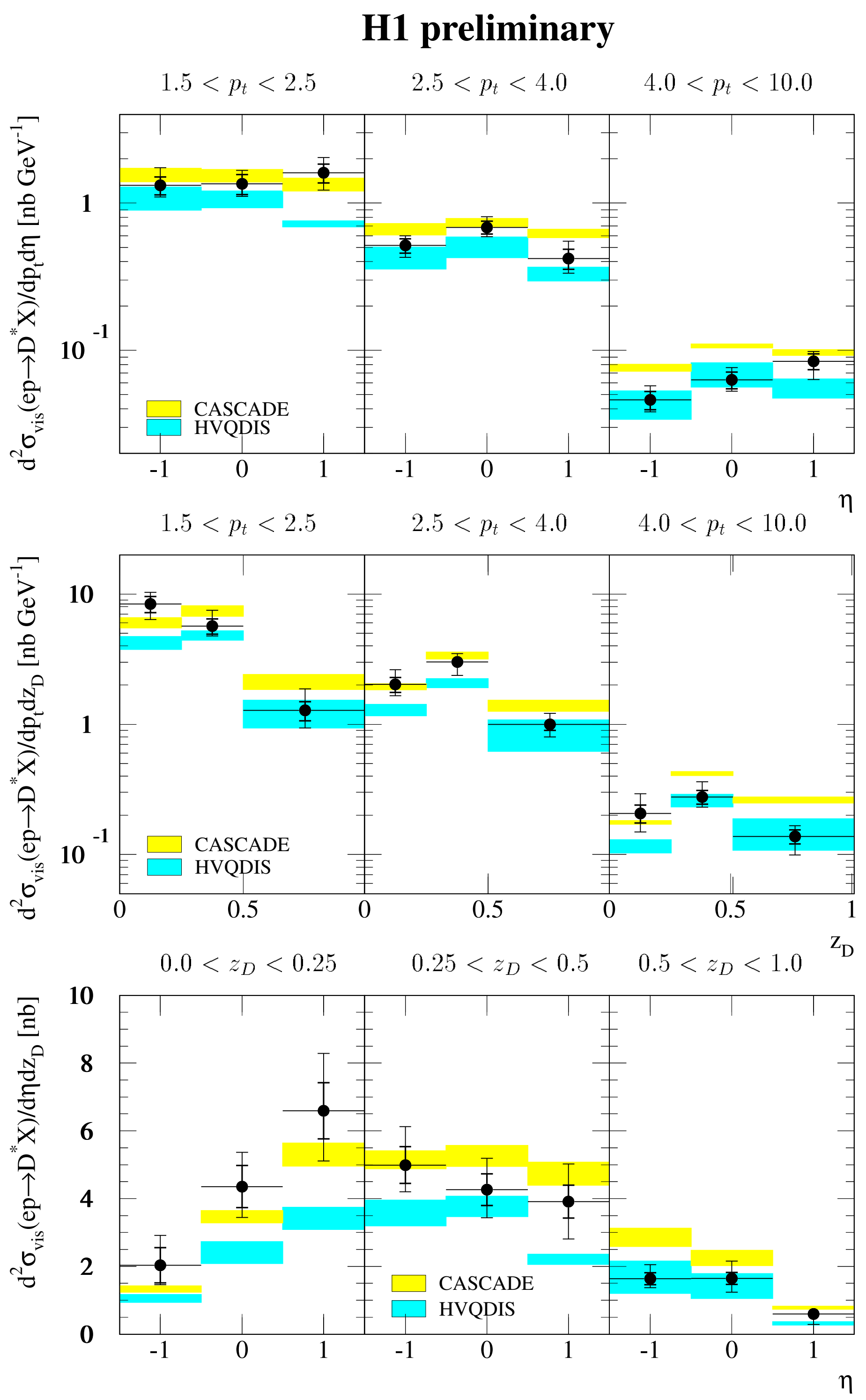


ZEUS 1996−97
$F_2^{c\bar{c}}$
0.6
0.4
0.2
0
Q^2=1.8
(GeV^2)
4
7
11
18
30
60
130
10^{-4} 10^{-3} 10^{-2}
x
ZEUS NLO QCD

H1 preliminary

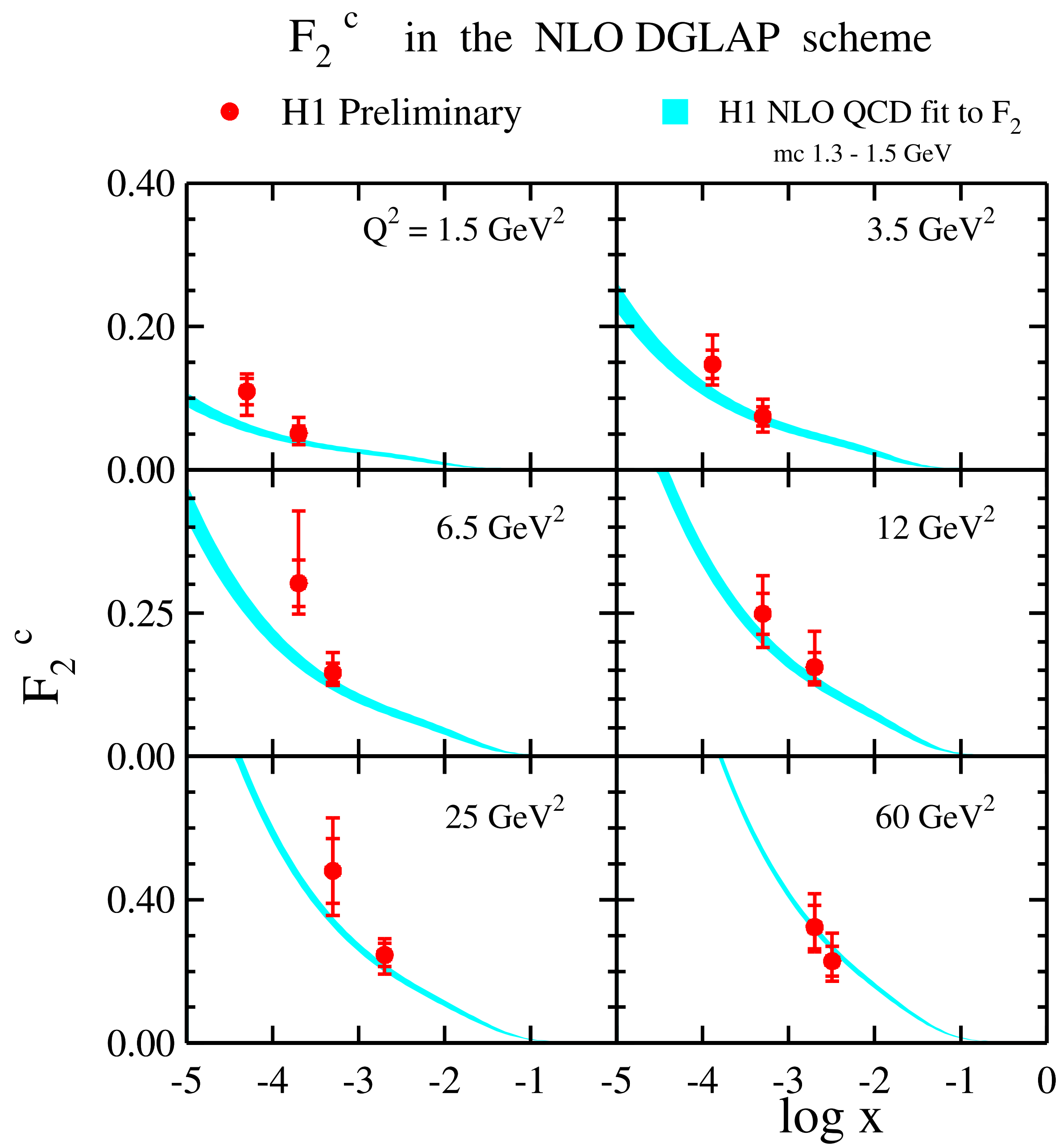


- Differential cross sections in the visible range
- $1 < Q^2 < 100$ GeV^2
- $-1.5 < \eta(D*) < 1.5$ and $p_t(D^*) > 1.5$ GeV

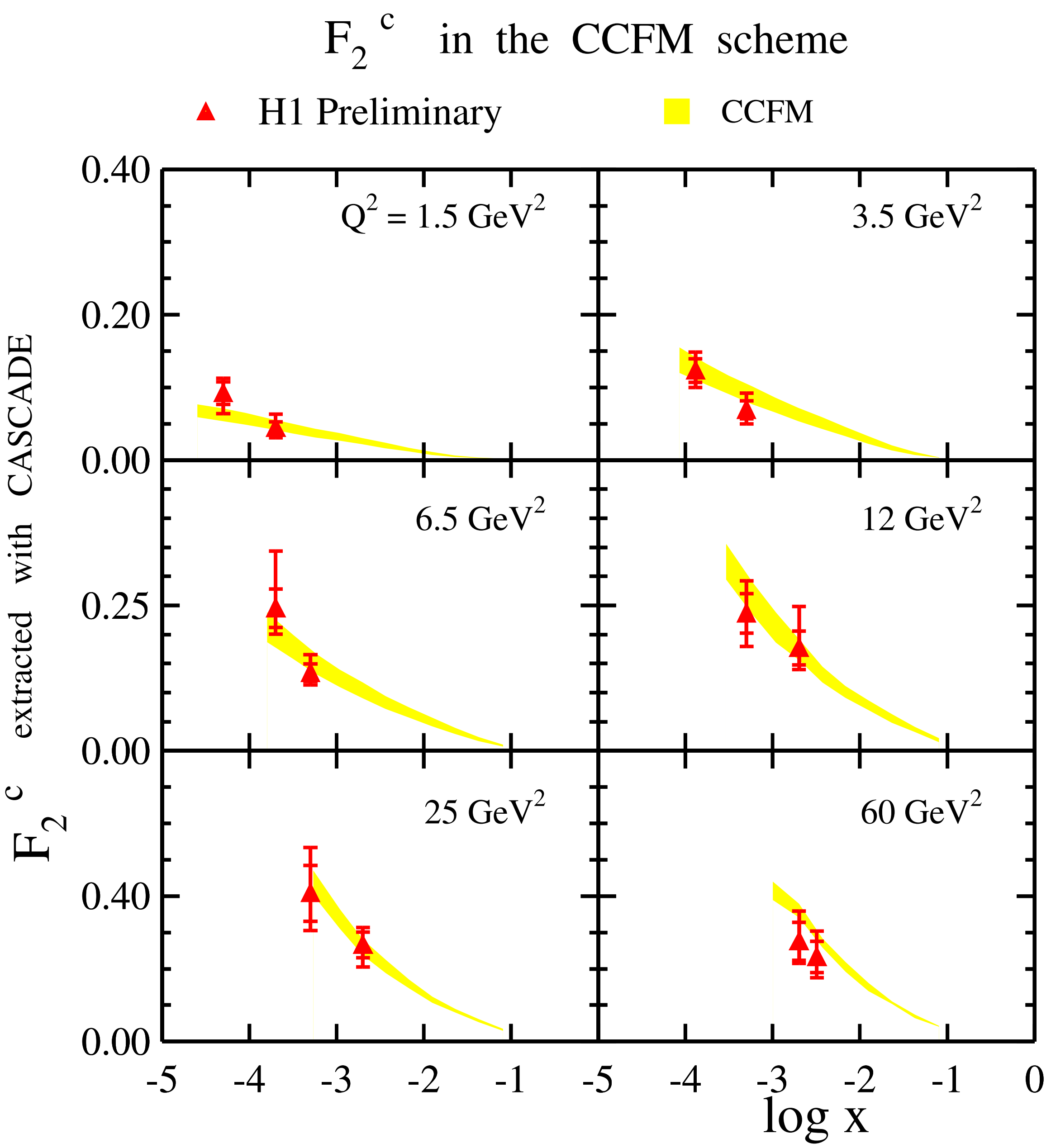


- Differential cross sections in the visible range.

- CCFM better (not at higher p_t)



F2 c in the NLO DGLAP scheme
H1 Preliminary
H1 NLO QCD fit to F2
mc 1.3 - 1.5 GeV
Q2 = 1.5 GeV2
3.5 GeV2
6.5 GeV2
12 GeV2
25 GeV2
60 GeV2
0.40
0.20
0.00
0.25
0.00
0.40
0.00
F2 c
-5
-4
-3
-2
-1
-5
-4
-3
-2
-1
0
log x



-CCFM better and gluon dist from F2 compatible with charm.

- Overlay the two to compare

BEAUTY PRODUCTION - Publications from H1 and Zeus

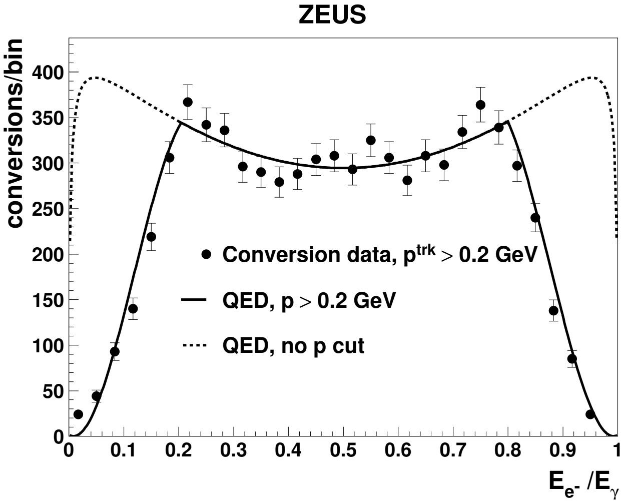
- Similar techniques used by each collaboration.

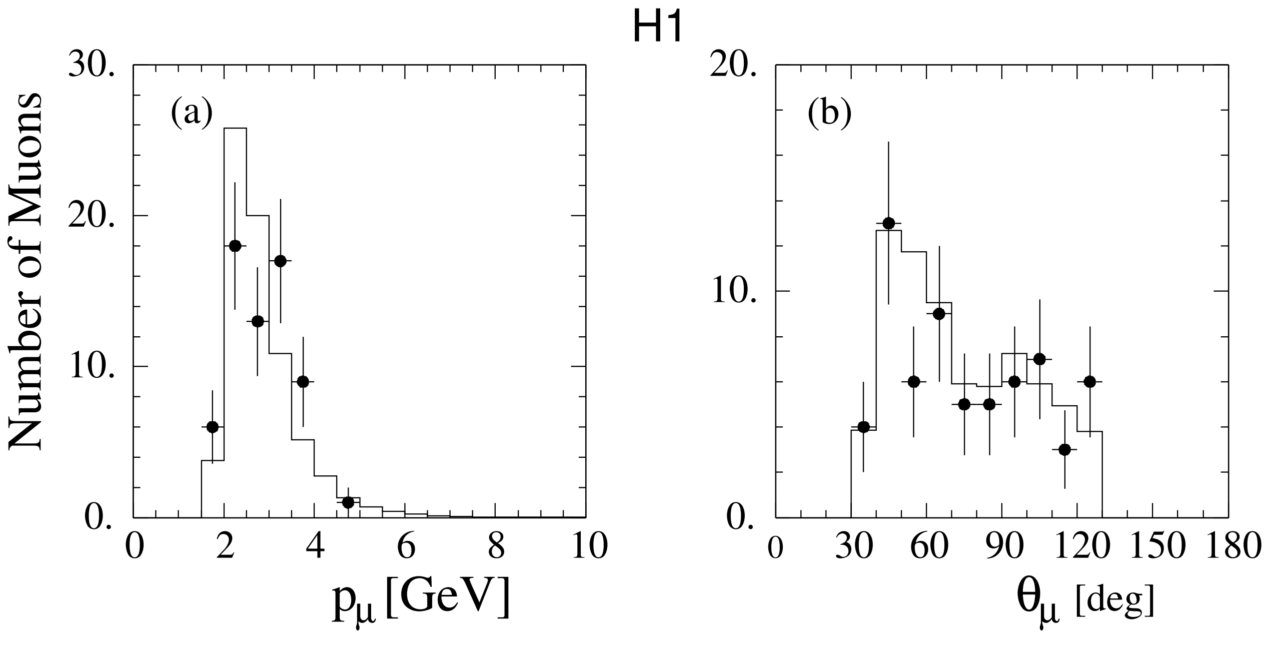
Both Groups look for leptons within jets. Events selected with 2 or more jets per event, both jets with $E_T > 6$ GeV (typically). H1 looks for $\mu^{\pm}$ and ZEUS for e^{-}.

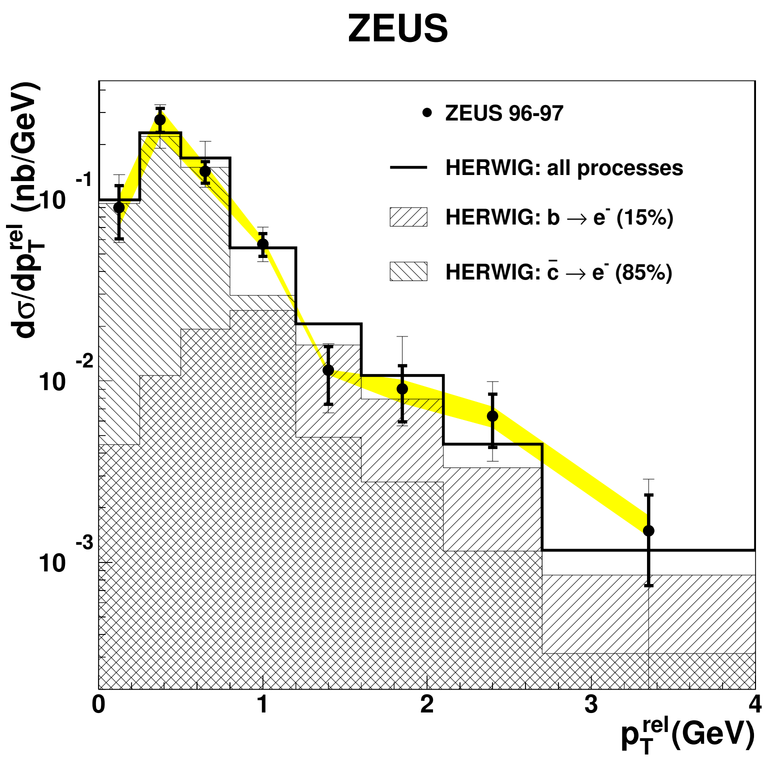
$P_{T,rel}$ **distribution** of lepton measured by each group ($P_{T,rel}$ is P_T of lepton relative to jet axis).

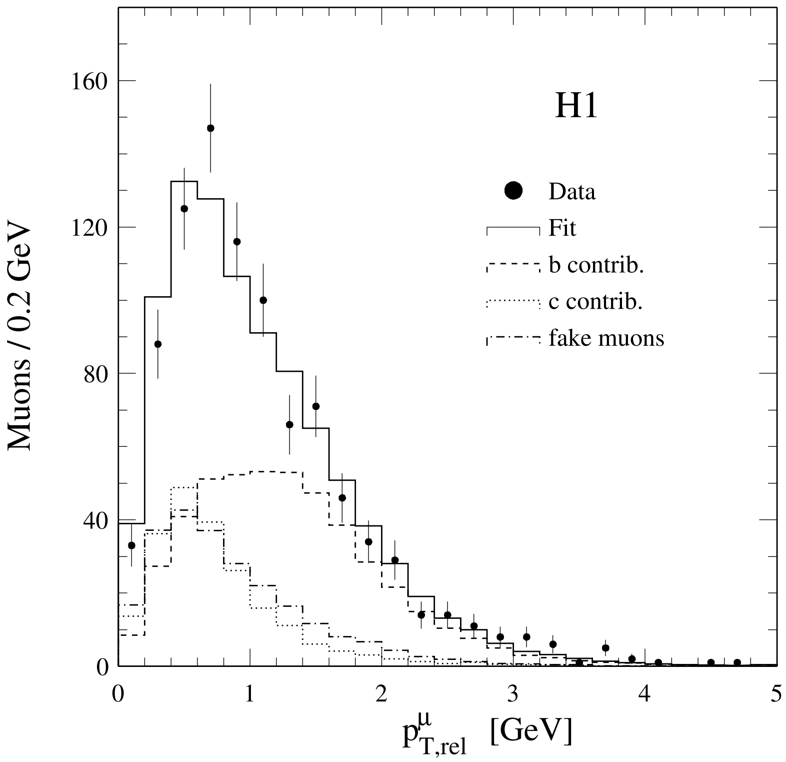
Distributions are mixtures of semileptonic decays from b and c and fake e^{-} or $\mu^{\pm}$ from hadrons. Proportions of each determined statistically.

Fake lepton contribution measured from the data.


ZEUS
conversions/bin
Conversion data, $p^{trk} > 0.2$ GeV
QED, $p > 0.2$ GeV
QED, no p cut
E_{e^-}/E_γ

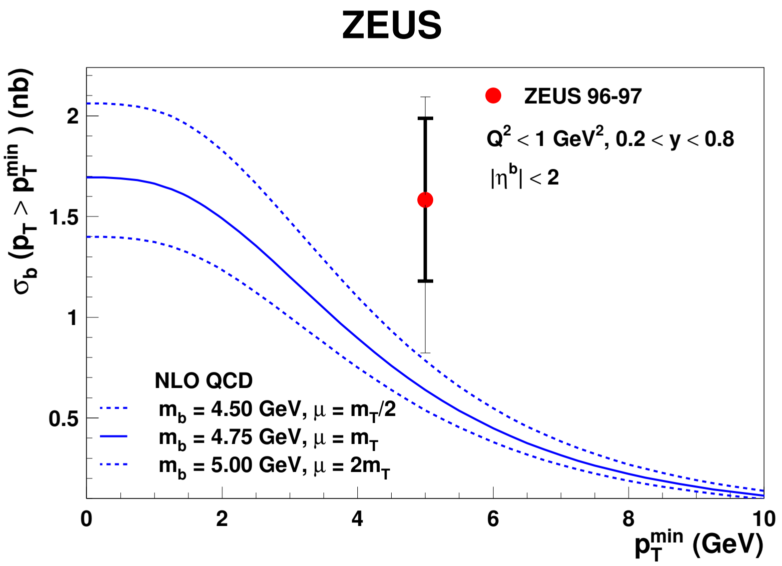

H1
Number of Muons
(a)
p_μ [GeV]
(b)
θ_μ [deg]

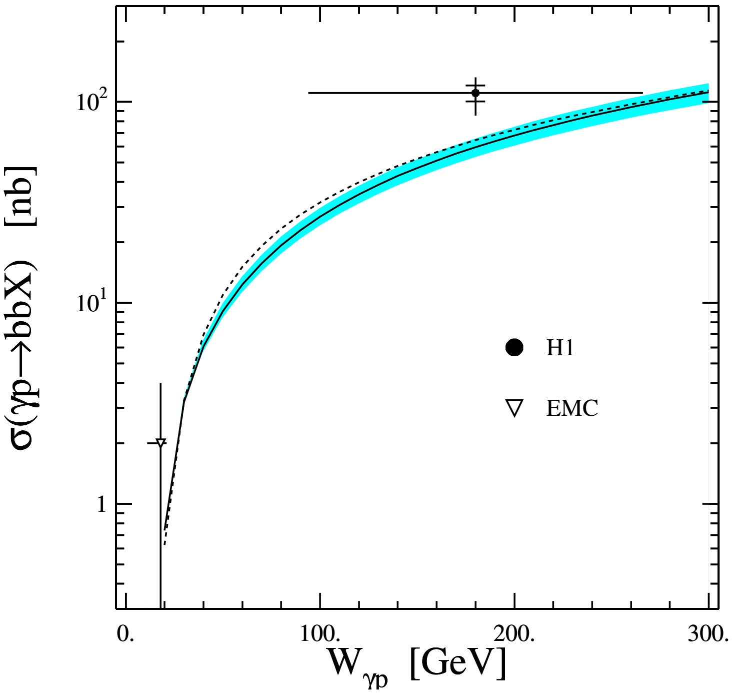




Shapes of b and c distributions in $P^{\mu}_{T,rel}$ from Monte Carlo (H1- AROMA, ZEUS-PYTHIA and HERWIG). No. of b events from fit to data of b,c shapes.

Cross section determined from number of b events.

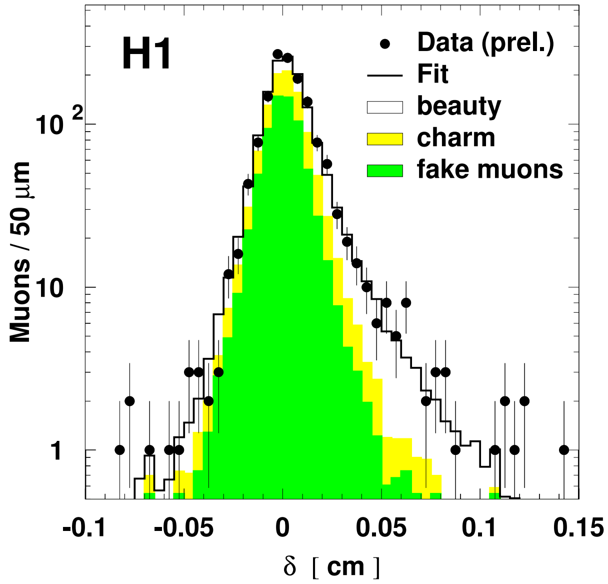


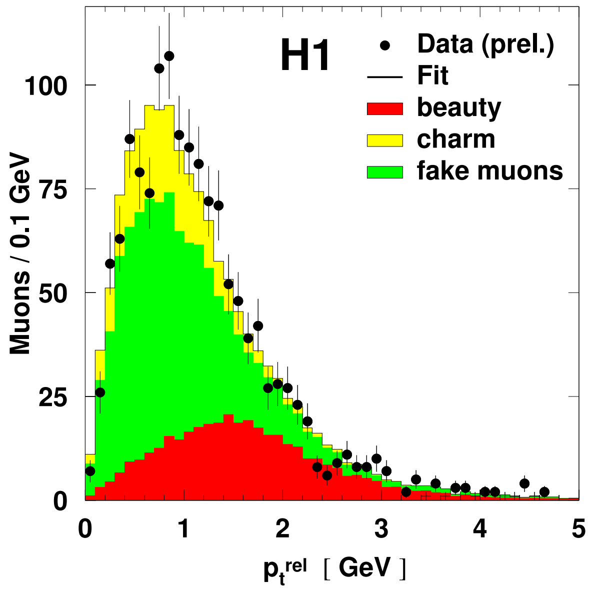


Curves are NLO predictions. Zeus cross section in sensitive range. H1 extrapolate to full phase space. NLO QCD a factor ~ 2 below the data.

SILICON MICROSTRIP DETECTORS IN H1 operational - improved photoproduction and first DIS measurement. Impact parameter, δ, of the μ reconstructed and fitted.

Photoproduction. σ_{vis} =159 $\pm$ 30(stat) $\pm$ 29 (syst) pb, agrees with published 176 $\pm$ 16(stat) $^{+27}_{-17}$(syst) pb. NLO QCD factor $\sim$ 1.5 below data.

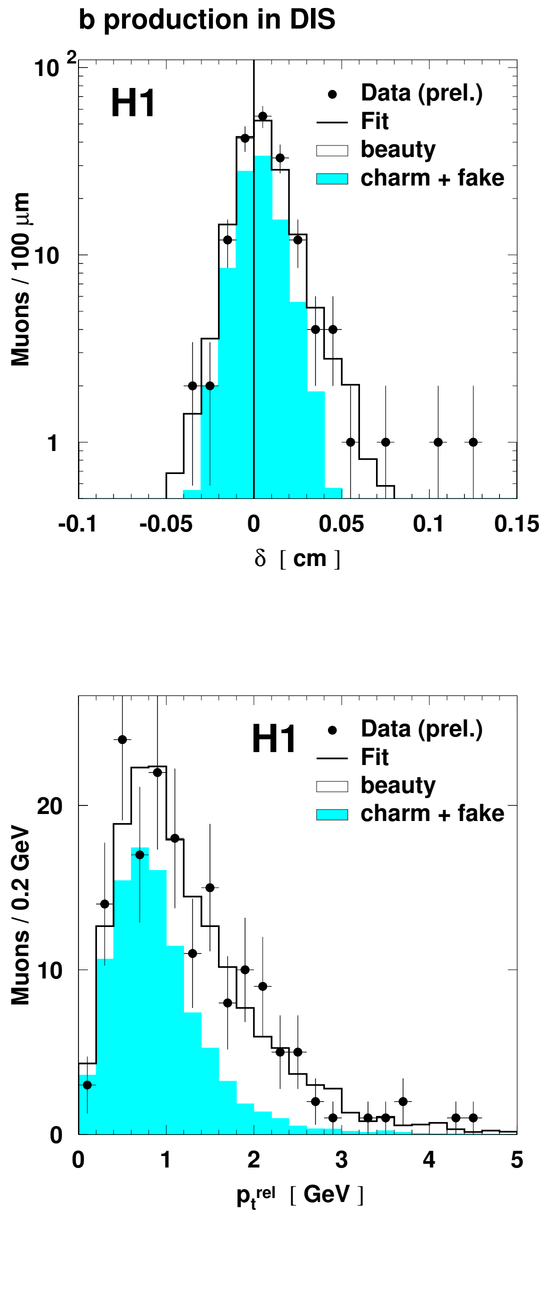




DIS Similar technique for DIS events $2 < Q^2 < 100$ GeV^2.

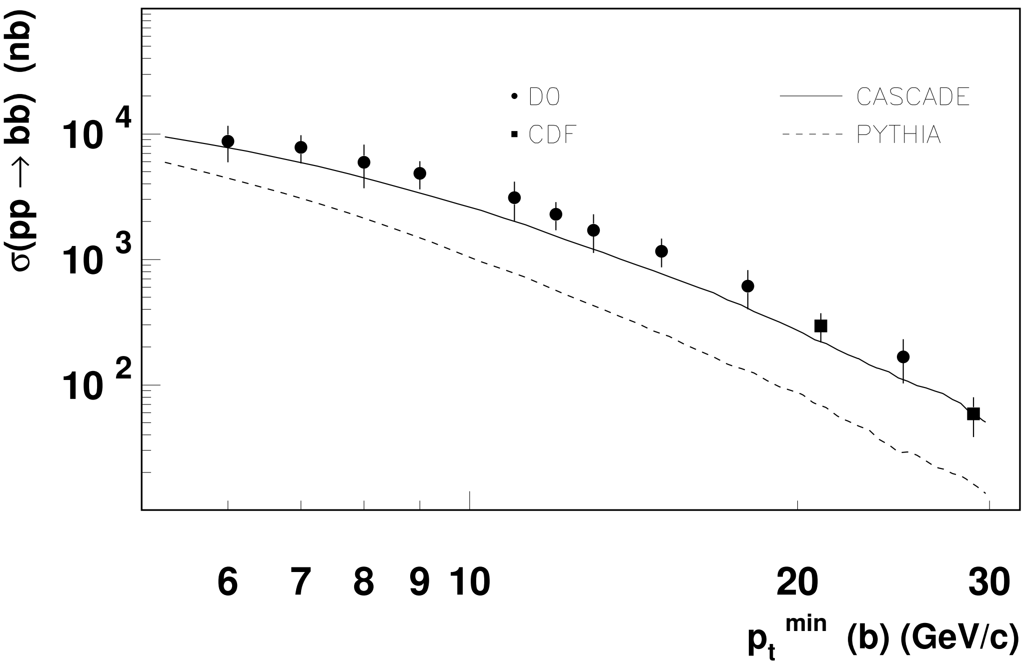
Combined fit gives $\sigma_{vis} = 46 \pm 9 \pm 11$ pb

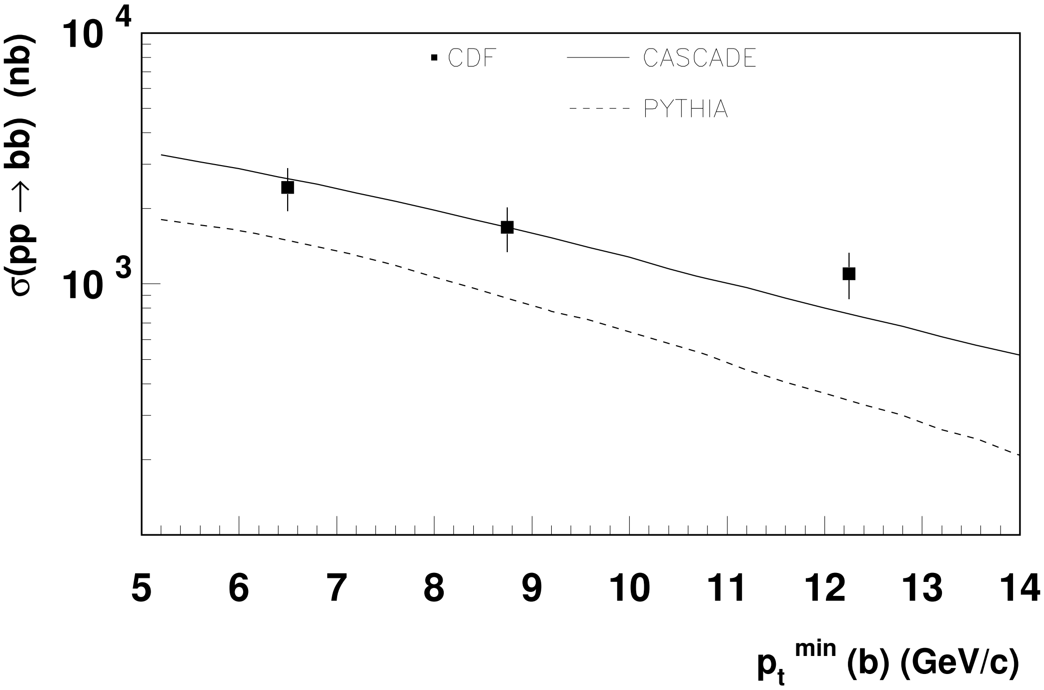
i.e. NLO QCD $\sim$ 3 below data.



CDF-D0 find NLO QCD a factor 2-3 below data.

CCFM Monte Carlo does somewhat better - factor ~ 1.5 below data. (H.Jung)





CONCLUSIONS

LO PGF works for charm production at fixed target energy.

NLO PGF is needed at HERA for charm production but HVQDIS scheme shows some discrepancies with data.

The CCFM equation , through the CASCADE Monte Carlo, gives improved agreement with the HERA charm data compared to the HVQDIS scheme. NB. CCFM incorporates BFKL at small x and DGLAP at large x.

b production NLO QCD predictions are factor 1.5-3 below data for photoproduction, DIS and pp collisions.

What is the problem ? Are NNLO corrections large or is it something else ??? .