

Beauty production at HERA

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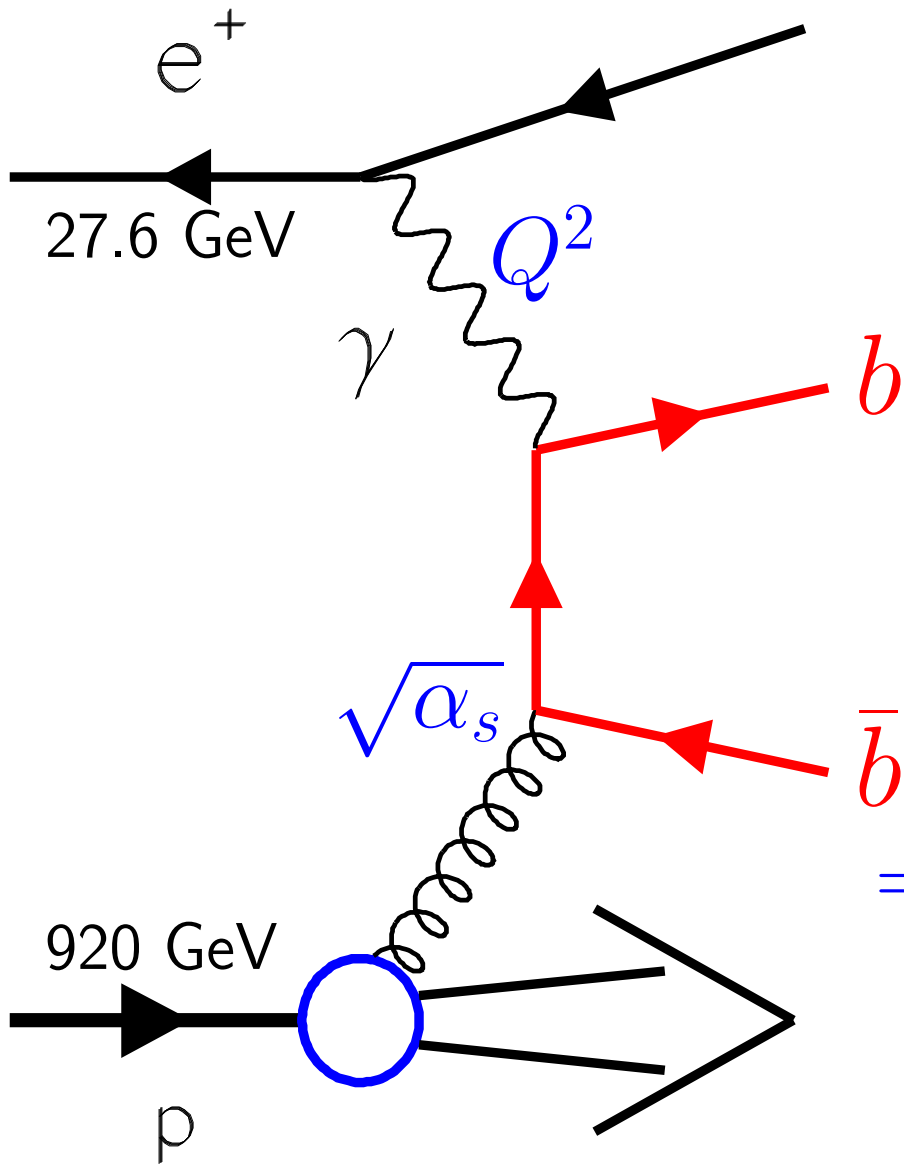
for

H1 and **ZEUS**

July 19, 2003

EPS 2003 Aachen

Beauty production at HERA



- Driven by **gluons** in the proton

Kinematic region	Hard scales
$\gamma p: Q^2 < 1 \text{ GeV}^2$	m_b, p_T^b
DIS: $Q^2 > 1 \text{ GeV}^2$	m_b, Q^2, p_T^b

\Rightarrow Always ≥ 1 hard scale for α_s available \Rightarrow pQCD should work!

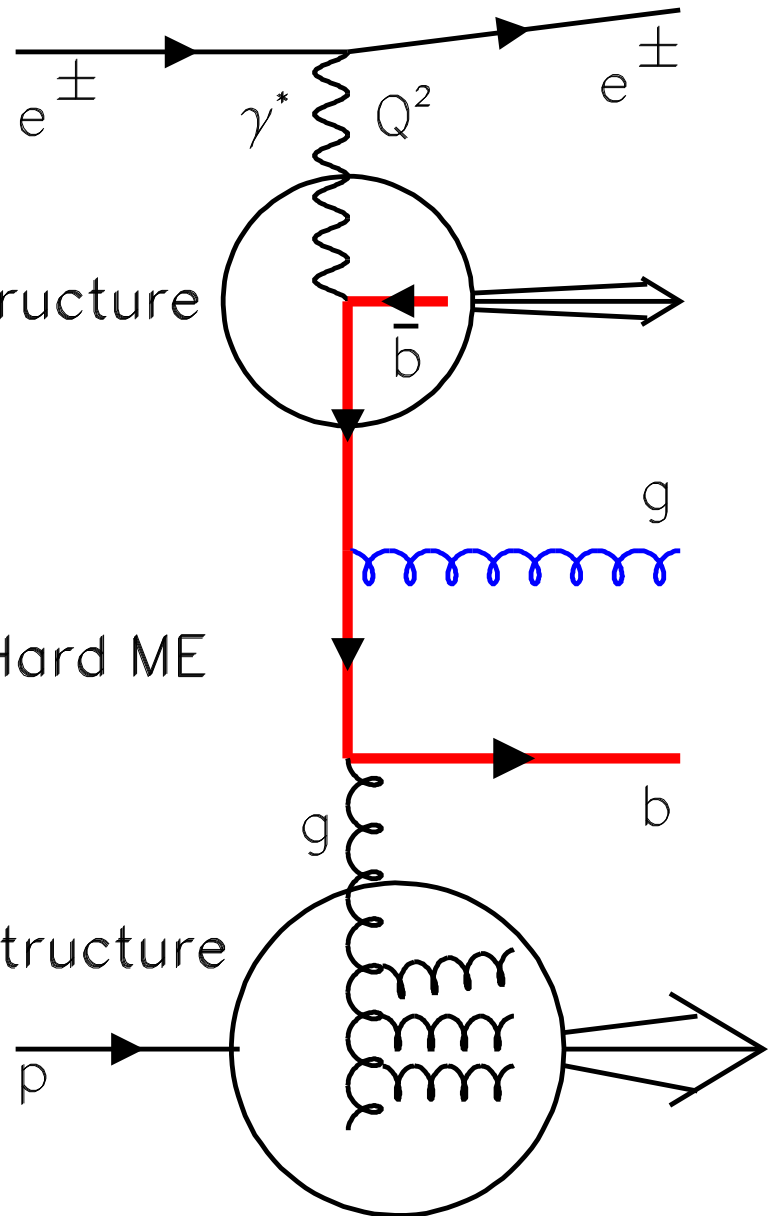
Description in pQCD

Factorised in

γ^* Structure

Hard ME

p Structure

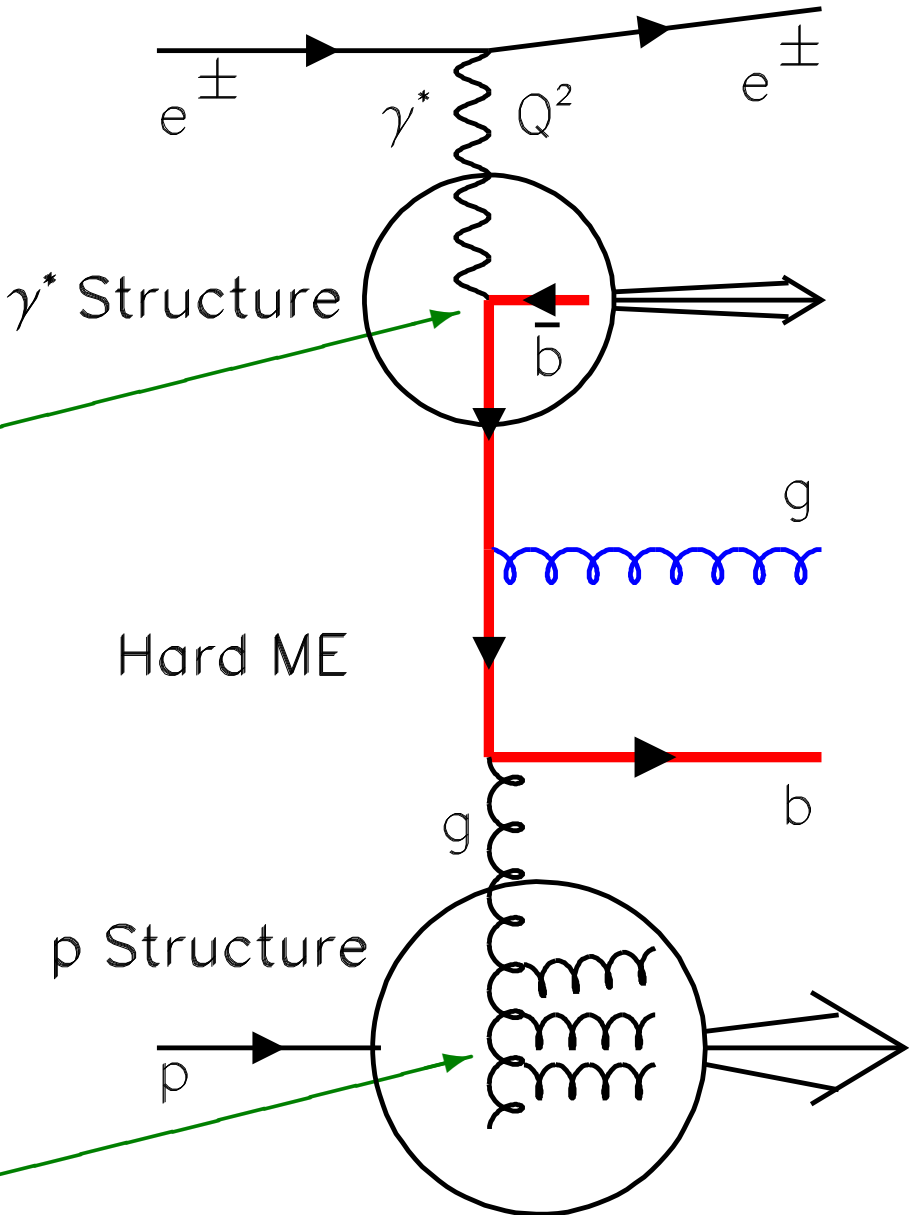


Description in pQCD

Key questions:

Role of resolved photons
for beauty production?

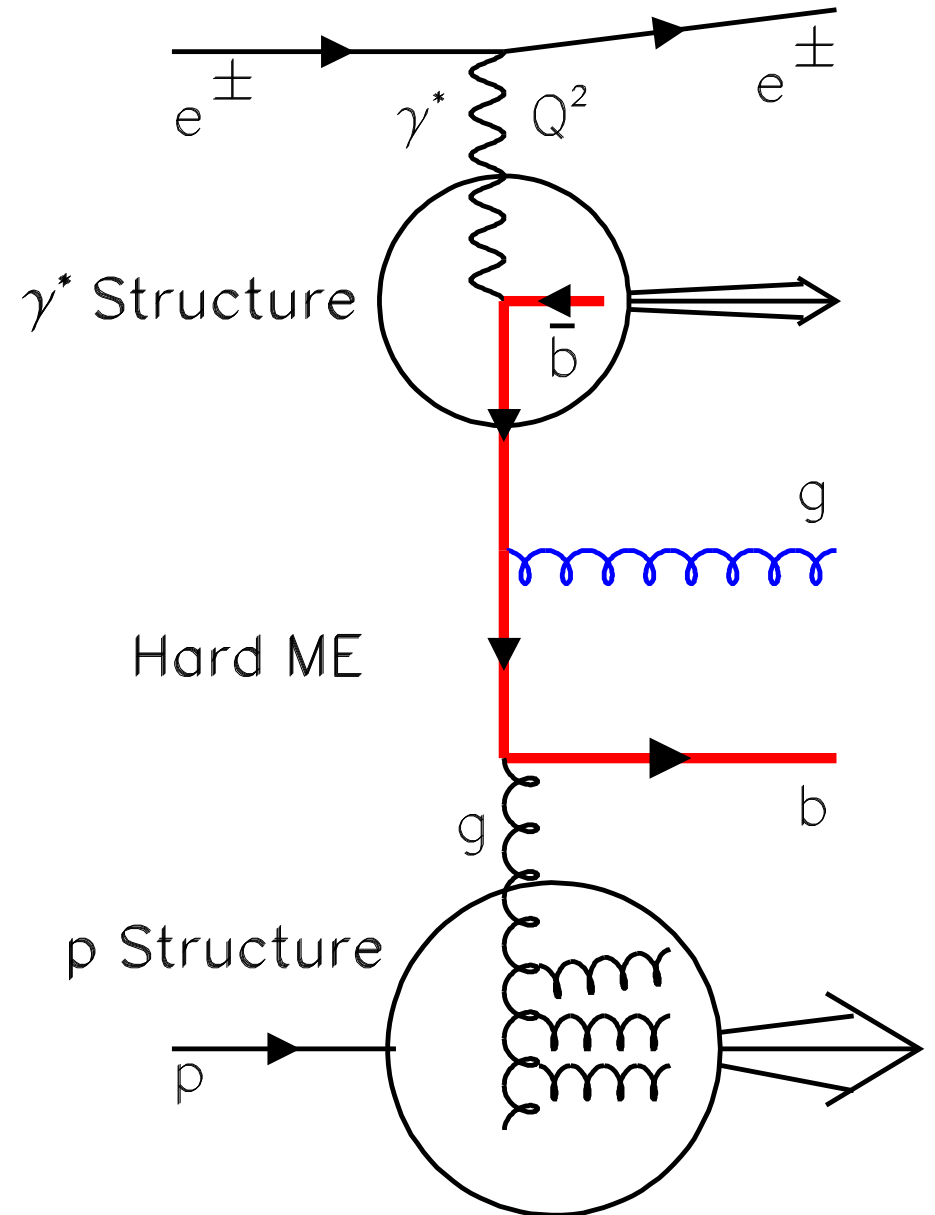
Test pQCD approxima-
tion for gluon radiations:
DGLAP, CCFM, BFKL



Description in pQCD

QCD models compared to data:

- NLO $\mathcal{O}(\alpha_s^2)$ calculations:
 - γp : FMNR
 - DIS: HQVDIS
- LO $\mathcal{O}(\alpha_s)$ + Parton shower:
 - Pythia MC (DGLAP)
 - Cascade MC (CCFM)

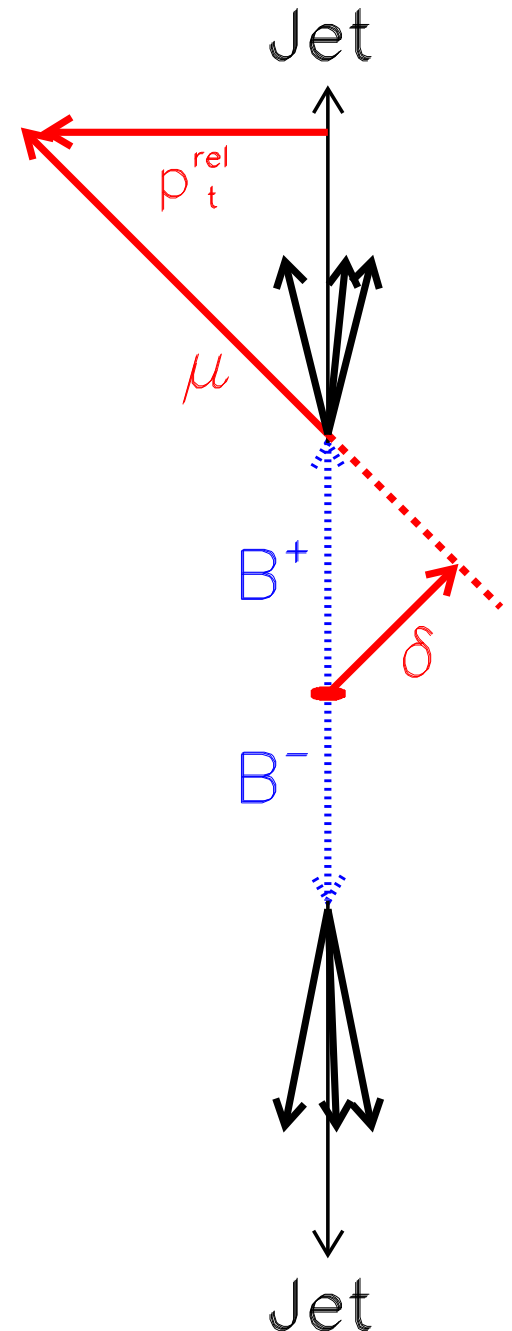


Beauty measurement technique in inclusive muon analyses

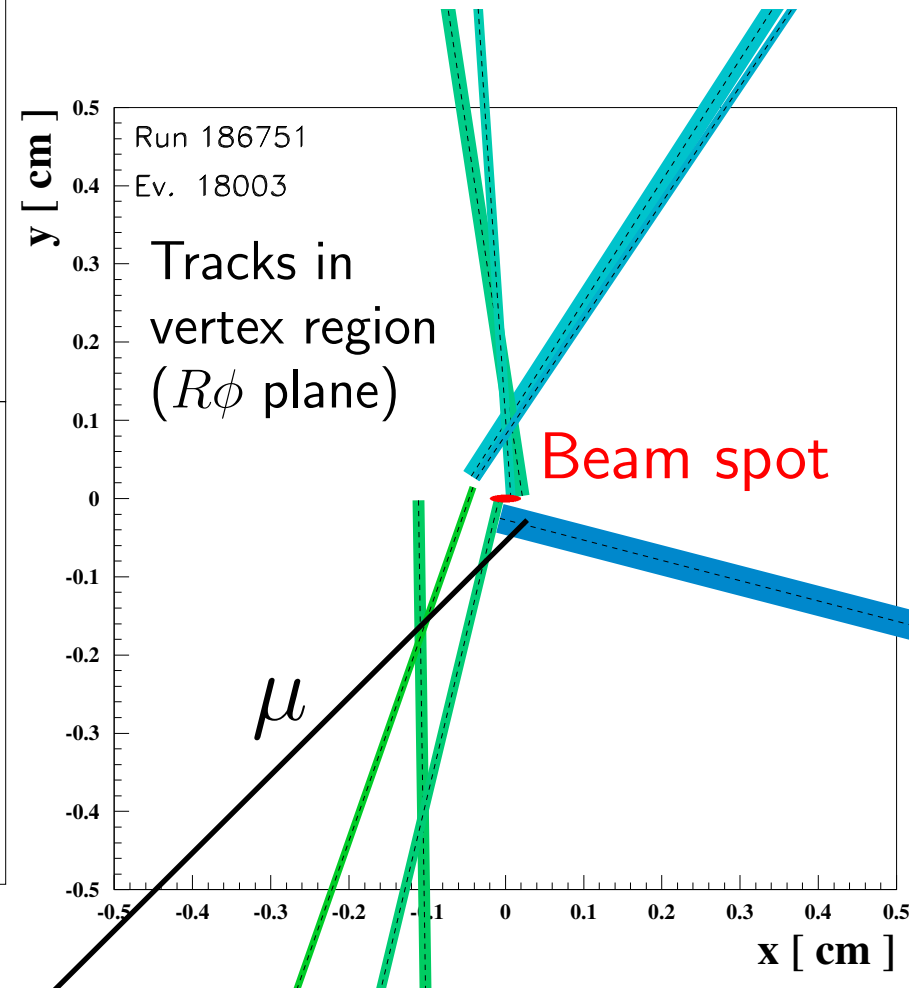
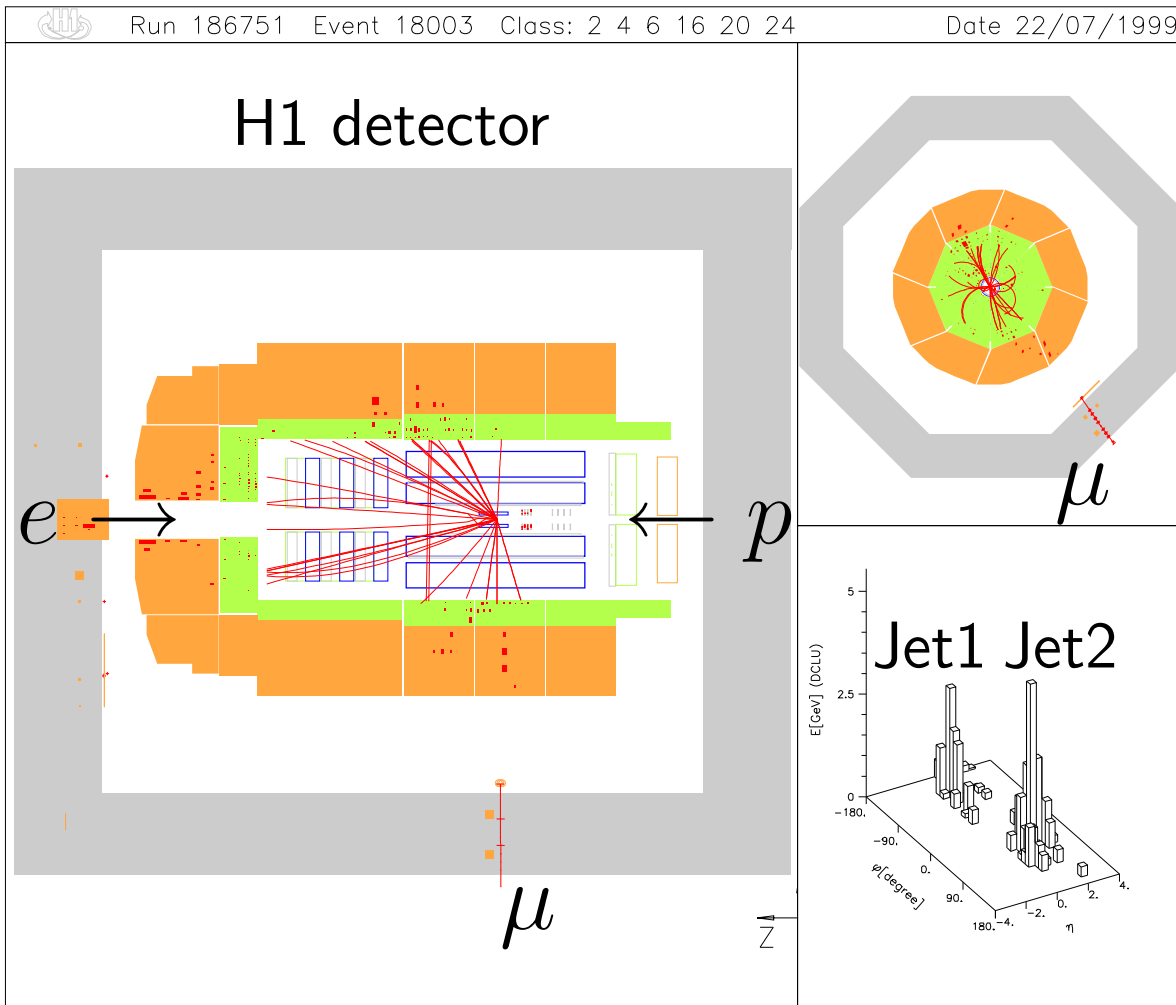
- Find muons from b,c-decays in dijet events
- For b,c and fake separation use:

Large b mass \rightarrow muon p_T^{rel}
(H1 and ZEUS)

Long b lifetime \rightarrow muon signed
impact-parameter δ
(H1)

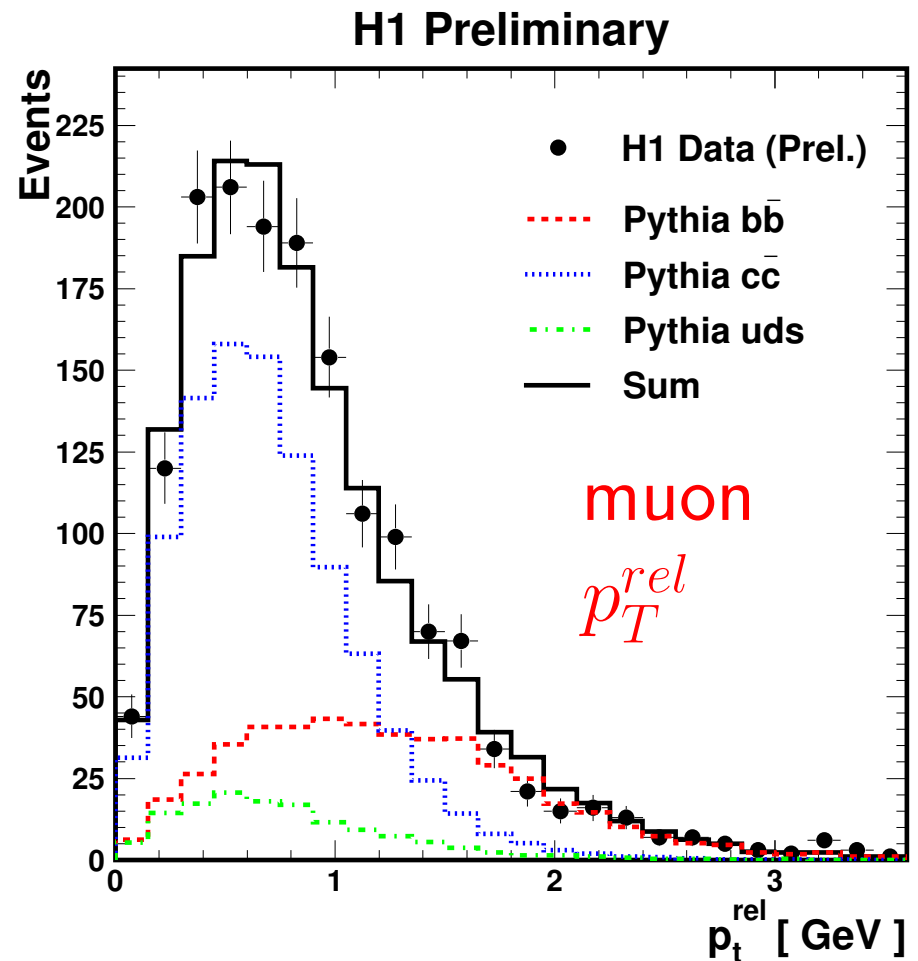
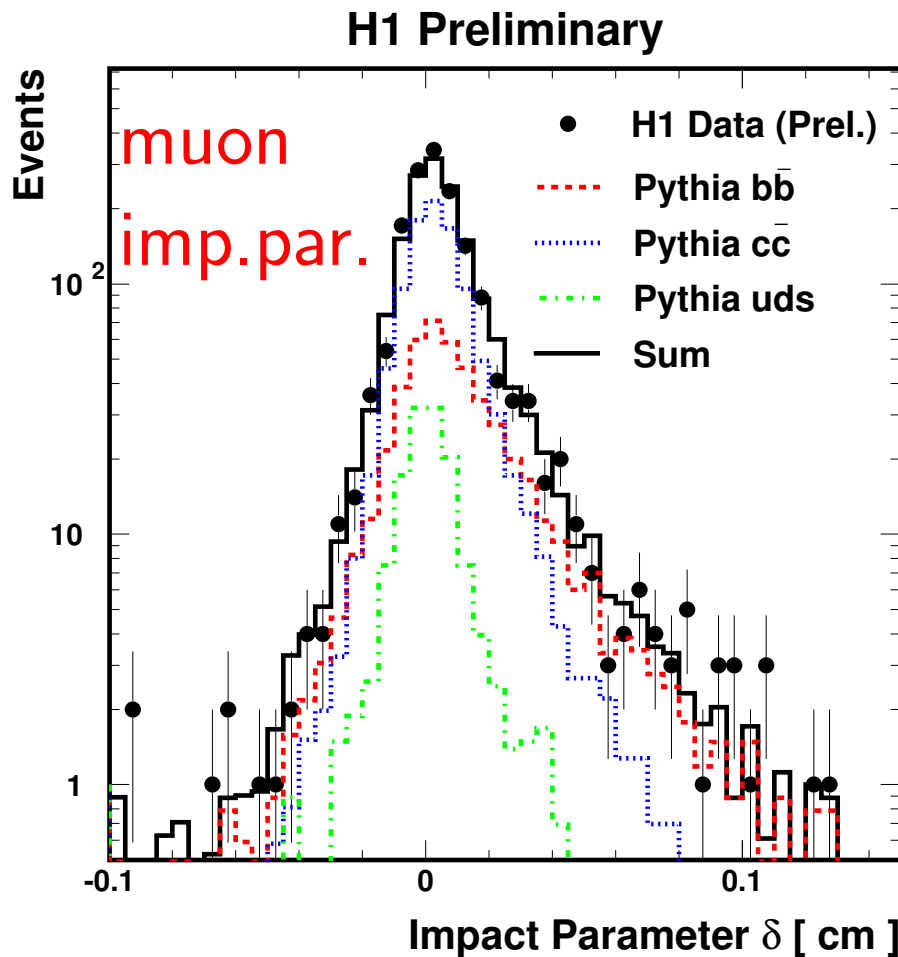


$B \rightarrow \mu X$ event candidate



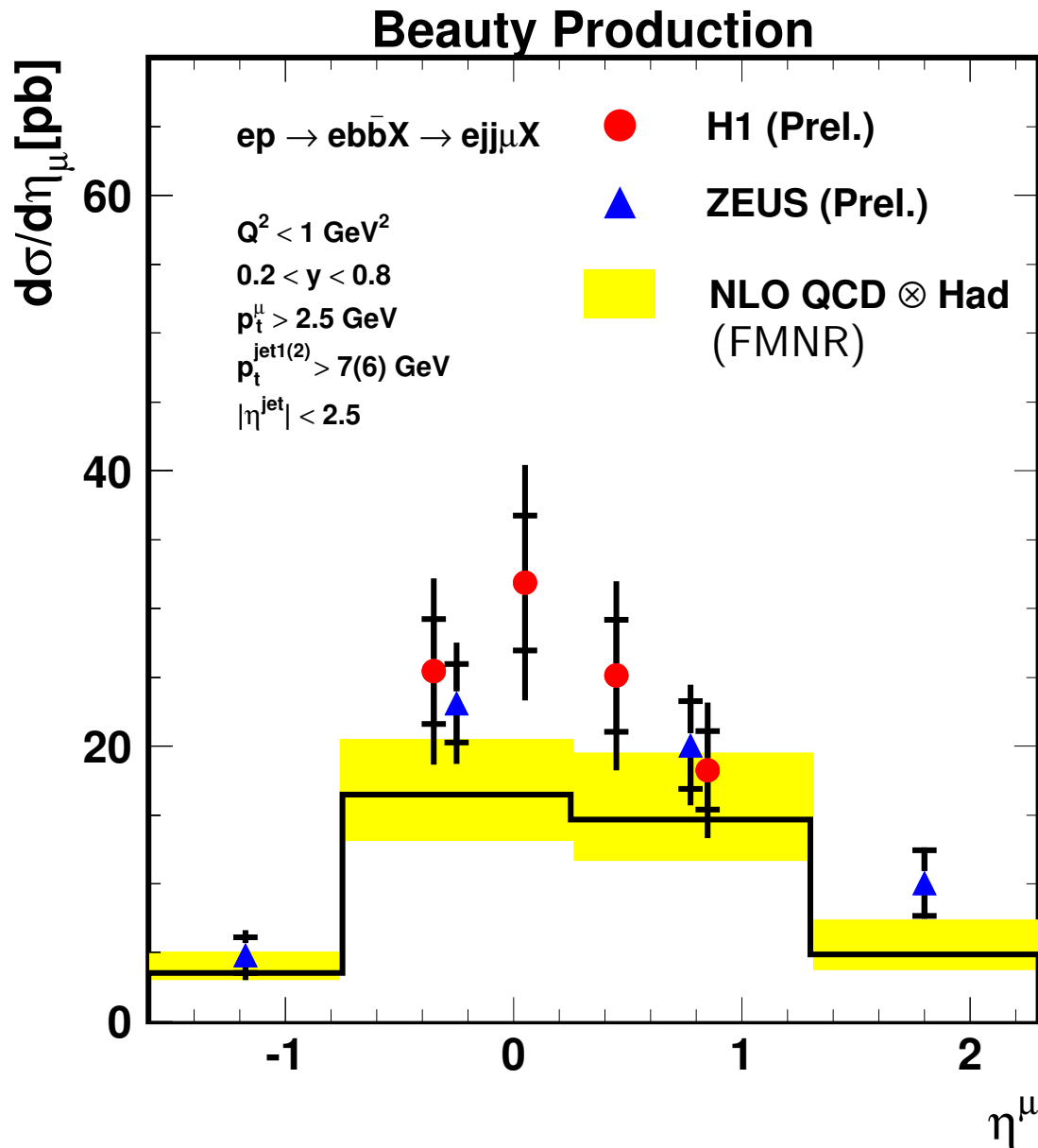
$B \rightarrow \mu X$ signal in γp

- Cuts: $Q^2 < 1 \text{ GeV}^2$, $p_T^\mu > 2.5 \text{ GeV}$, $p_T^{jet1(2)} > 7(6) \text{ GeV}$
- Data: 99/00 with $L = 48 \text{ pb}^{-1} \Rightarrow \approx 1500$ events



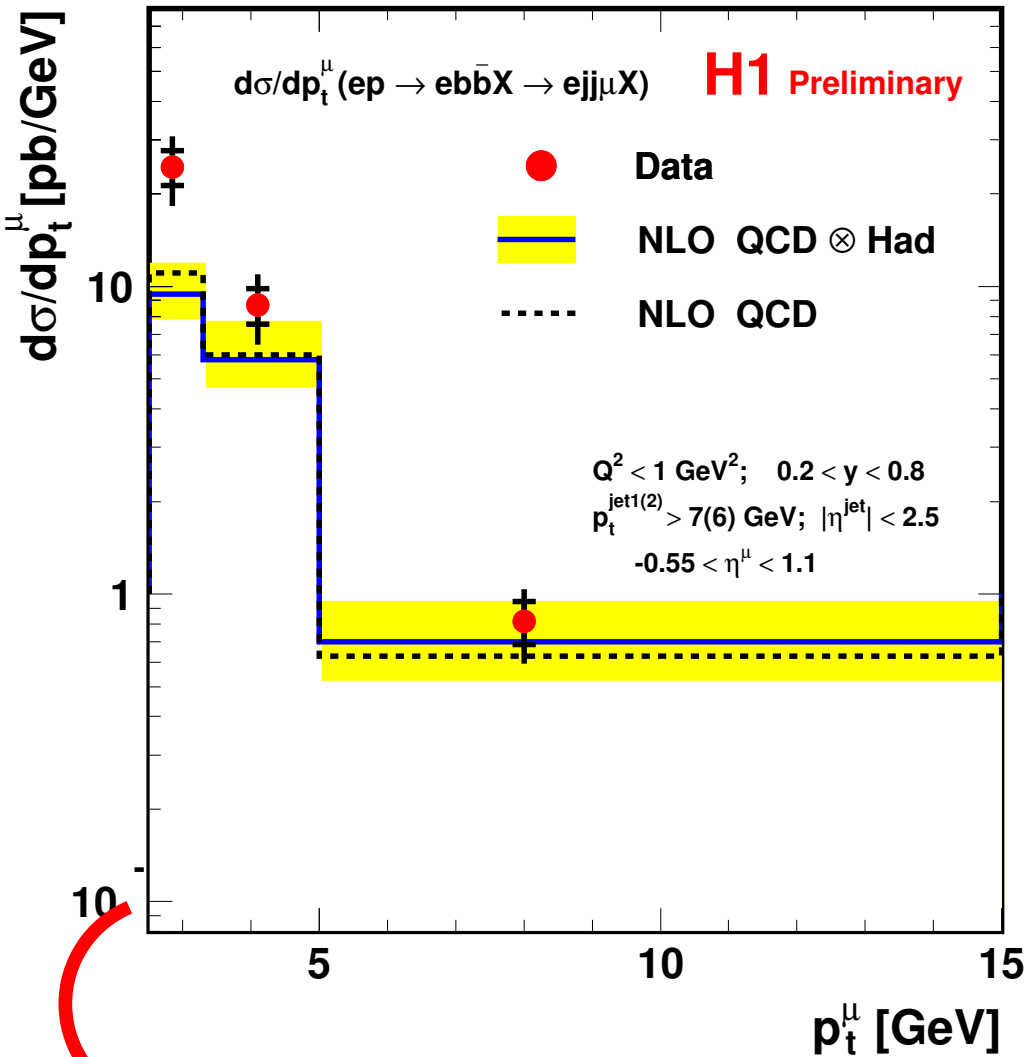
2-dim-Likelihood fit (δ, p_T^{rel}) : $\rightarrow f_b = 31 \pm 3\%$

$B \rightarrow \mu X$ in $\gamma p \rightarrow$ cross sections in bins of η^μ

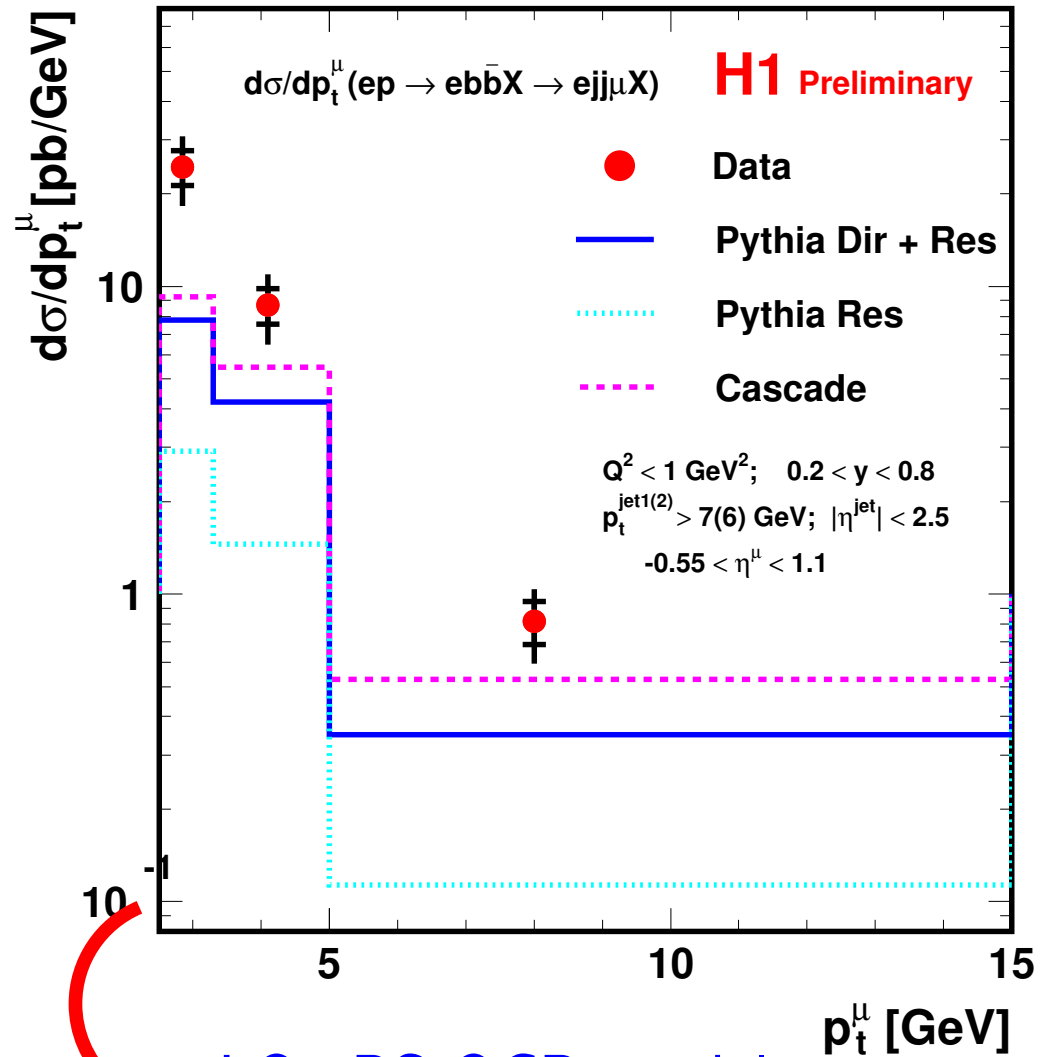


- H1 and ZEUS agree
- All data points above NLO QCD
- Reasonable agreement of data and NLO QCD

$d\sigma/dp_T^\mu$ compared with QCD models

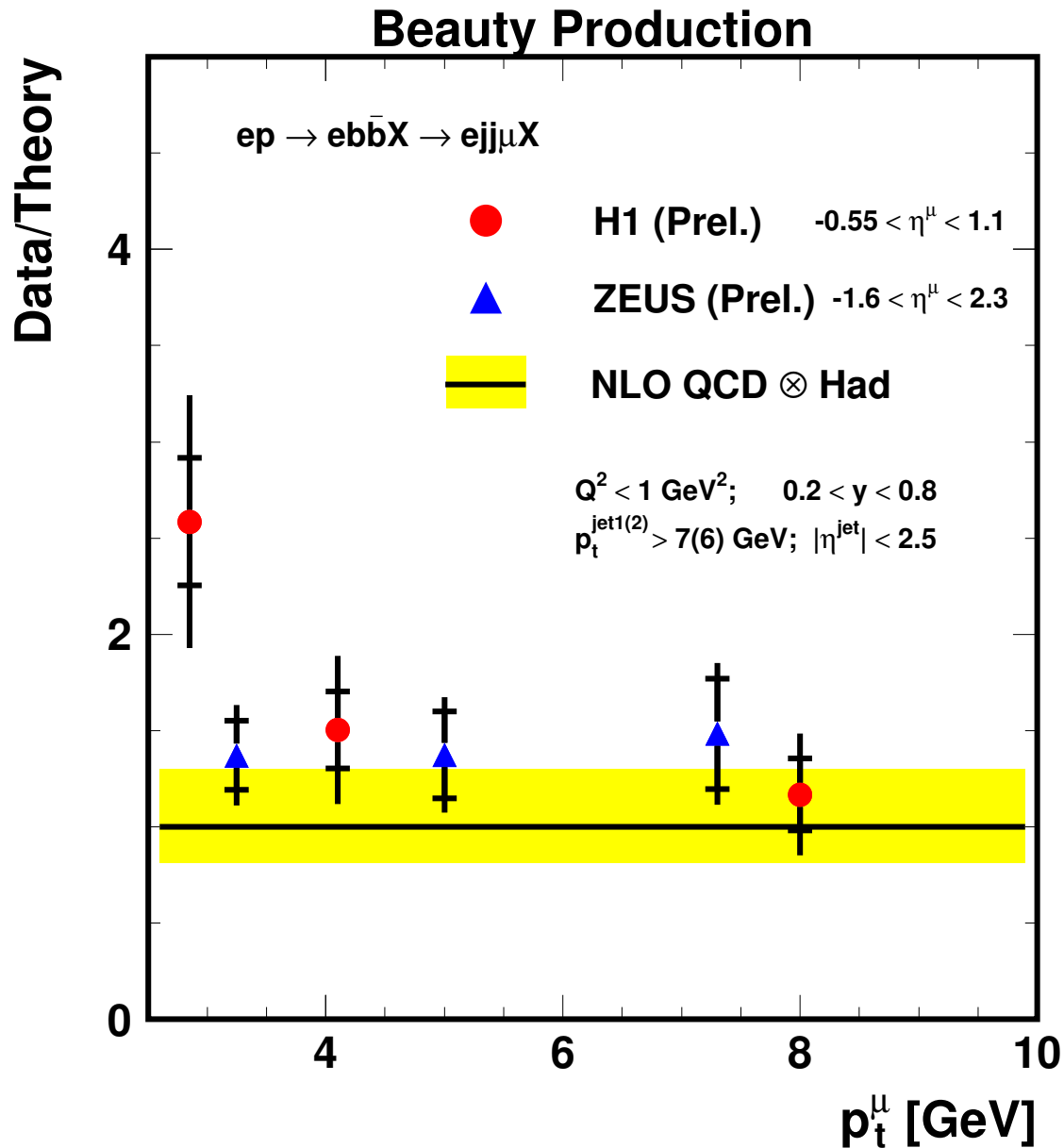


NLO QCD: Too low at low p_T^μ



LO+PS QCD models:
Too low in normalisation

$d\sigma/dp_T^\mu$ Data/NLO QCD

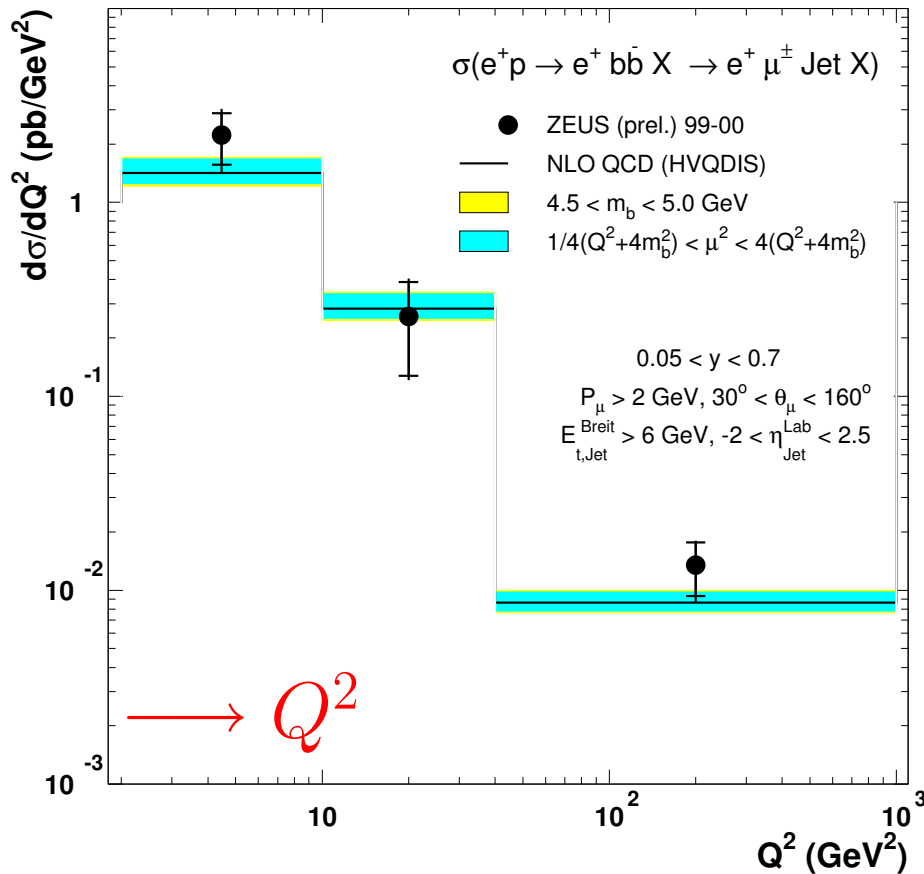


- All data points above NLO QCD, but agreement within errors

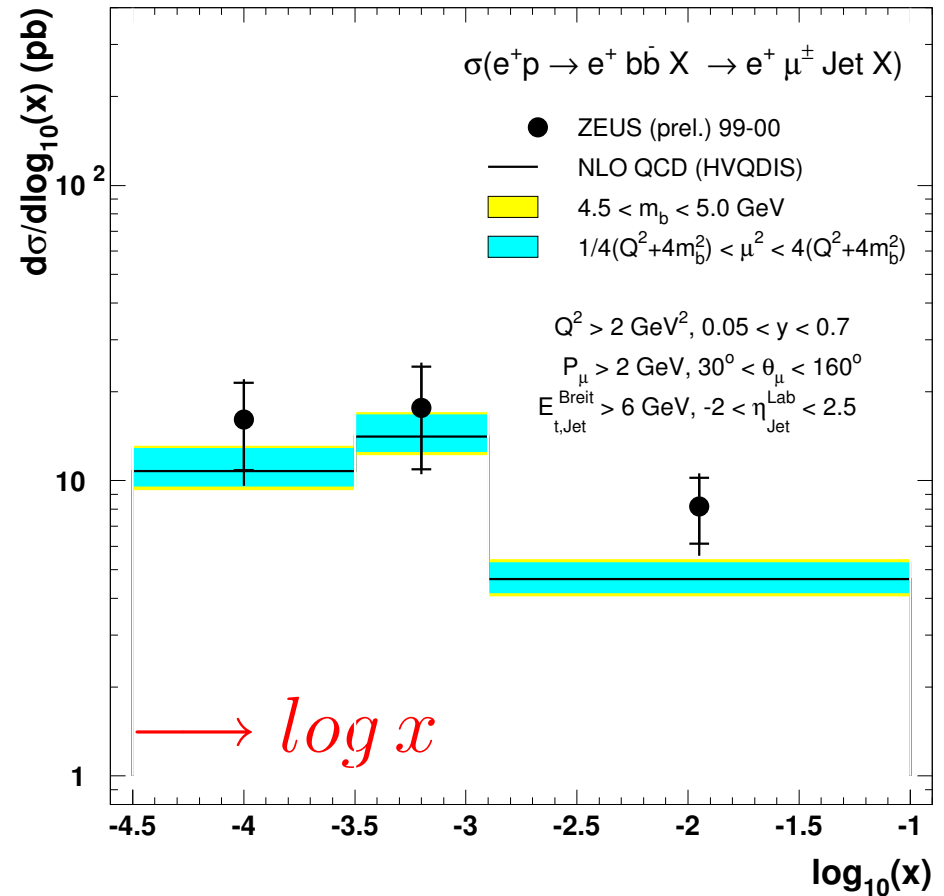
Beauty production in DIS

- Cuts: $Q^2 > 2 \text{ GeV}^2$, $p_\mu > 2 \text{ GeV}$, ≥ 1 jet with $E_t^* > 7 \text{ GeV}$
- Data: 99/00 with $L = 60 \text{ pb}^{-1} \Rightarrow \approx 840$ events

ZEUS

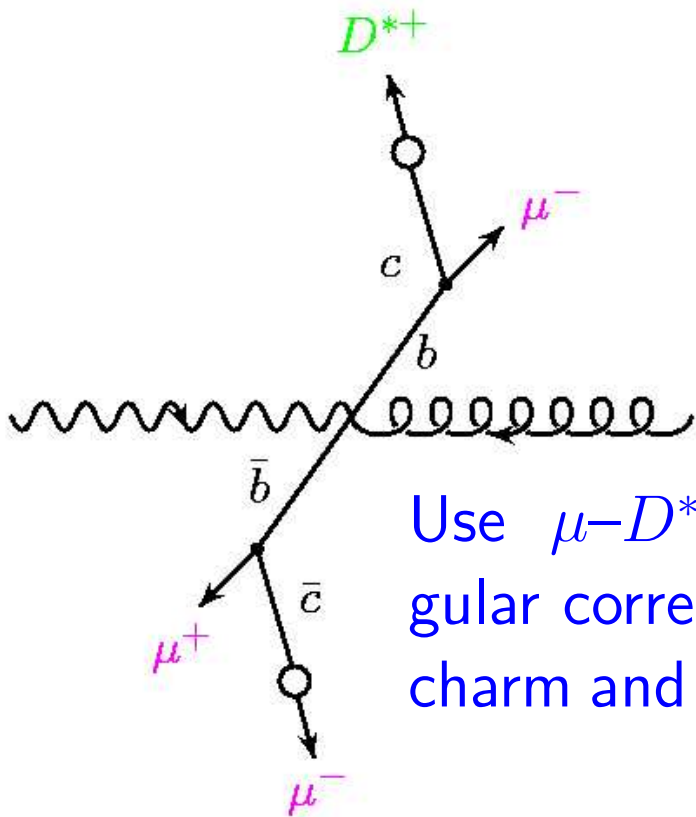


ZEUS

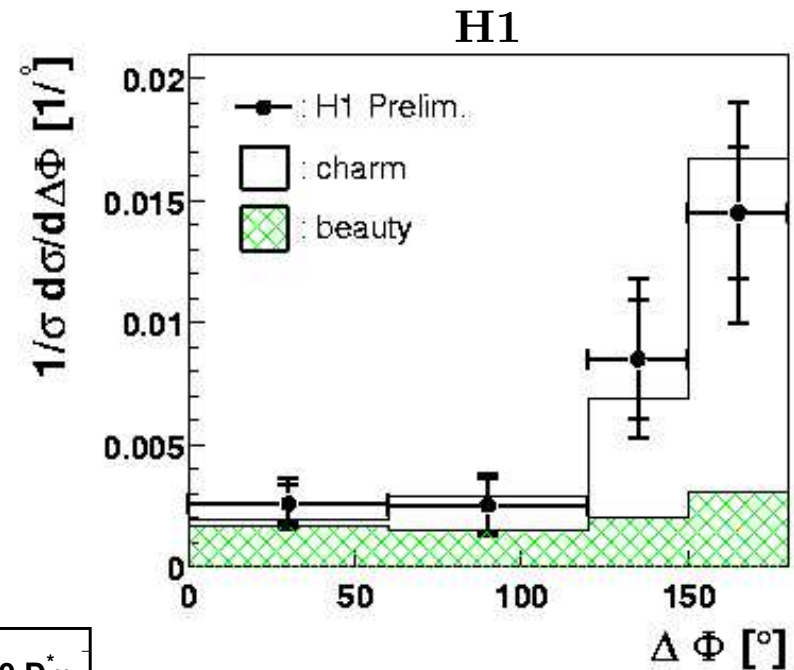


\Rightarrow Data and NLO agree (within errors)

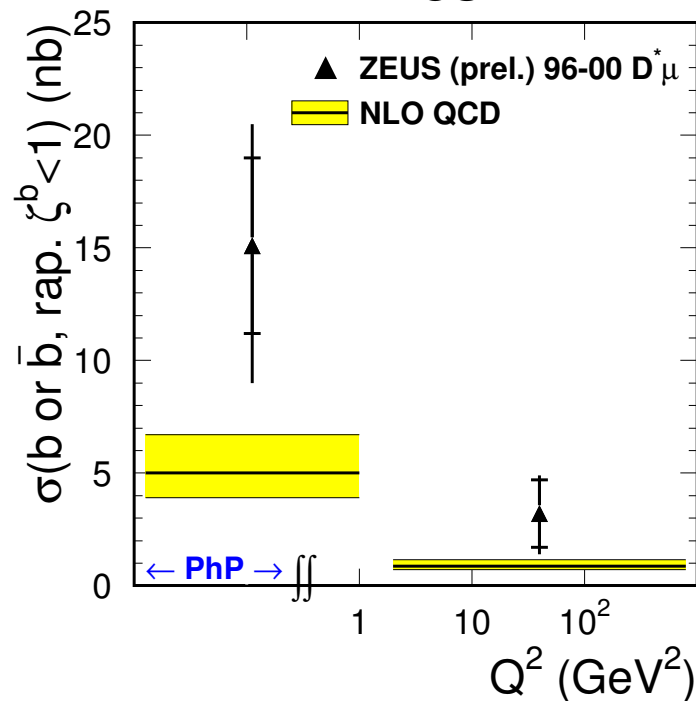
Beauty double tagging with $D^*\mu$



Use $\mu-D^*$ charge and angular correlations to separate charm and beauty events \Rightarrow



ZEUS



Data vs NLO
QCD \Rightarrow

\Rightarrow Data $>$ NLO QCD

\Rightarrow Large errors

Conclusion

- New precise differential b-cross-section measurements
- H1 and ZEUS measurements agree
- Measurements are mostly above NLO QCD predictions:
 - Discrepancies ≤ 1.5 sigma
 - Better description towards large Q^2 , p_T^μ (?)

Outlook: Beauty at HERA II

- Increase statistics (\approx factor 5 in luminosity)
 - Improved detectors (Silicon)
- \Rightarrow More precise, double differential measurements

Beauty at HERA: Summary plot

b Cross Sections at HERA

