D* meson production in diffractive DIS

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on behalf of the H1 Collaboration

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D* meson production in diffractive DIS

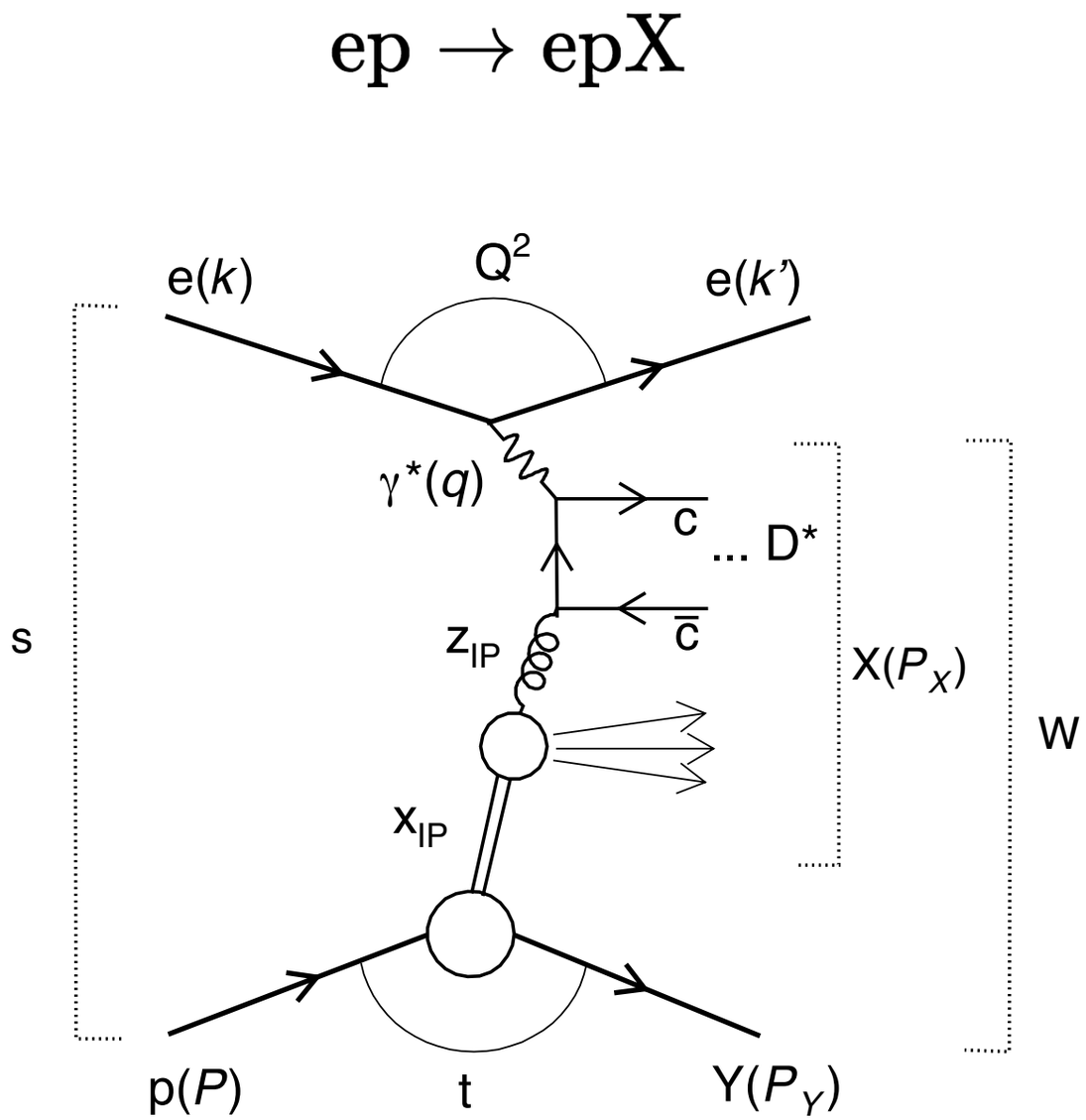
Diffractive deep-inelastic scattering

- Characterized by large rapidity gap between proton and hadronic system X
- QCD description as exchange of collective colorless partonic states (pomerons) based on
  - collinear factorization
  - proton vertex factorization

➜ extraction of diffractive PDFs (DPDFs), with DGLAP evolution equations

- D* mesons are produced via photon-gluon fusion

➜ probe gluon content of the pomeron and test factorization ansatz



NLO calculation

Adapting HVQDIS for diffraction

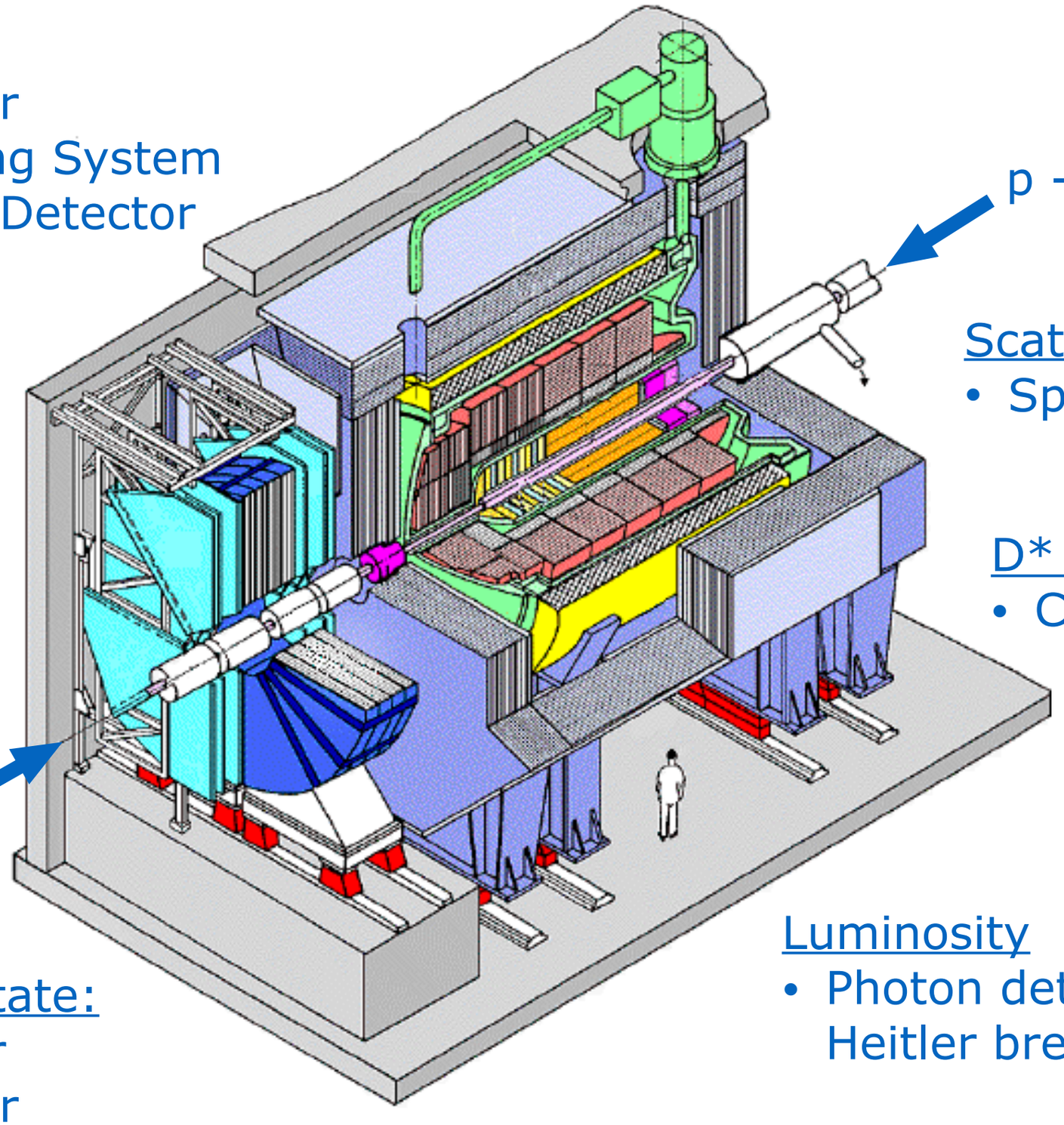
- Collinear factorization with H1 2006 DPDF Fit B NLO parton densities
- Massive charm produced via photon-gluon fusion
- Charm quarks fragmented independently in to D* mesons
  - $f(c \to D^*) = 0.235 \pm 0.007$
  - Kartvelishvili parametrization for reweighting longitudinal part
- Factorization and renormalization scales set to

$$\mu_r = \mu_f = \sqrt{Q^2 + 4m_c^2}$$

  with m_c = 1.5 GeV
- The following uncertainties are added in quadrature:
  - factorization and renormalisation scale variation with factor 0.5 and 2
  - charm pole mass between 1.3 and 1.7 GeV
  - uncertainties on Kartvelishvili parameters
  - DPDF uncertainties
- Contribution of B hadrons decaying to D* (3% in nondiffractive DIS) is neglected

The H1 detector

Rapidity Gap:
- LAr Calorimeter
- Forward Tagging System
- Forward Muon Detector



Scattered electron:
- SpaCal

D* decay products:
- Central Tracker

Hadronic Final State:
- Central Tracker
- LAr Calorimeter
- SpaCAl

Luminosity
- Photon detector for Bethe-Heitler bremsstrahlung

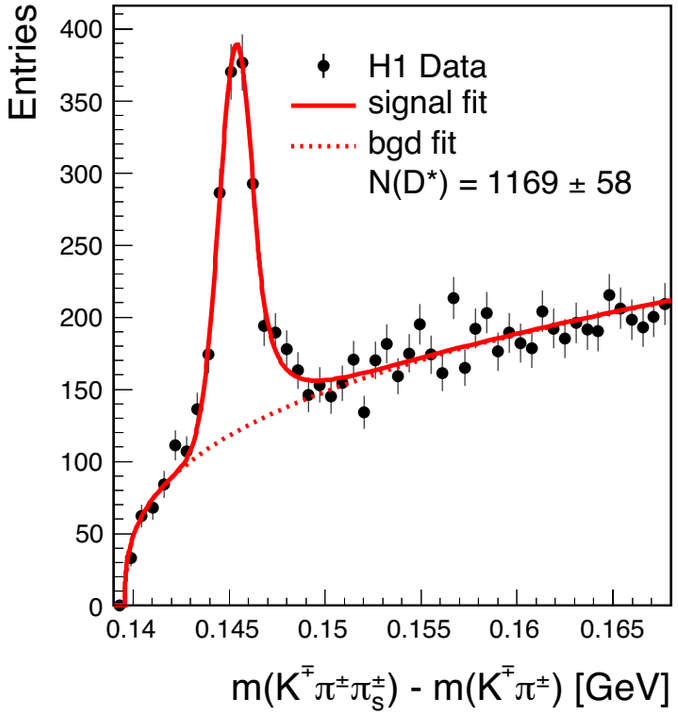
D* reconstruction

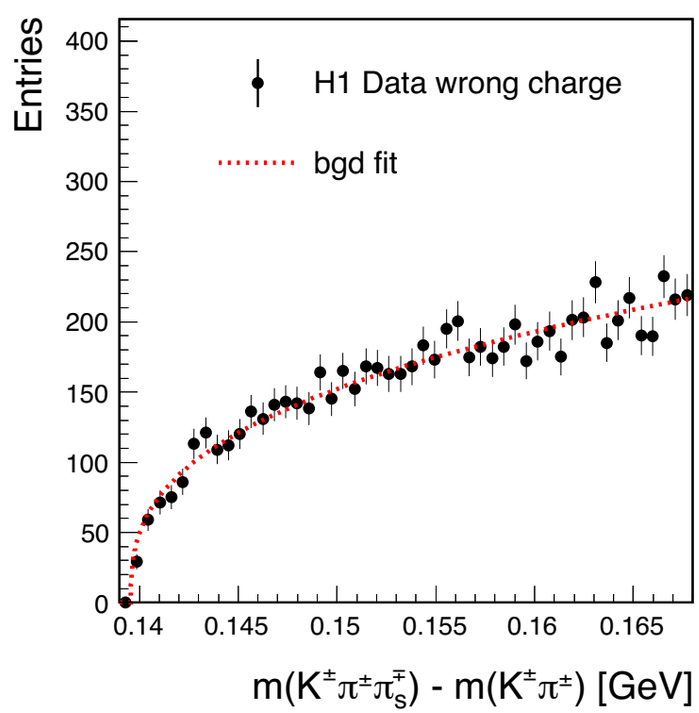
Full reconstruction of "golden" decay channel

$$D^{*+} \to D^0 \pi^+_{\text{slow}} \to (K^- \pi^+) \pi^+_{\text{slow}} \qquad (+\text{C. C.})$$

- Branching ratio of 2.66 ± 0.03%
- $K^-\pi^+$ invariant mass within 80 MeV of nominal D^0 mass
- Simultaneous fit to Δm for right and wrong charge combination to extract signal and background

D* in diffractive DIS





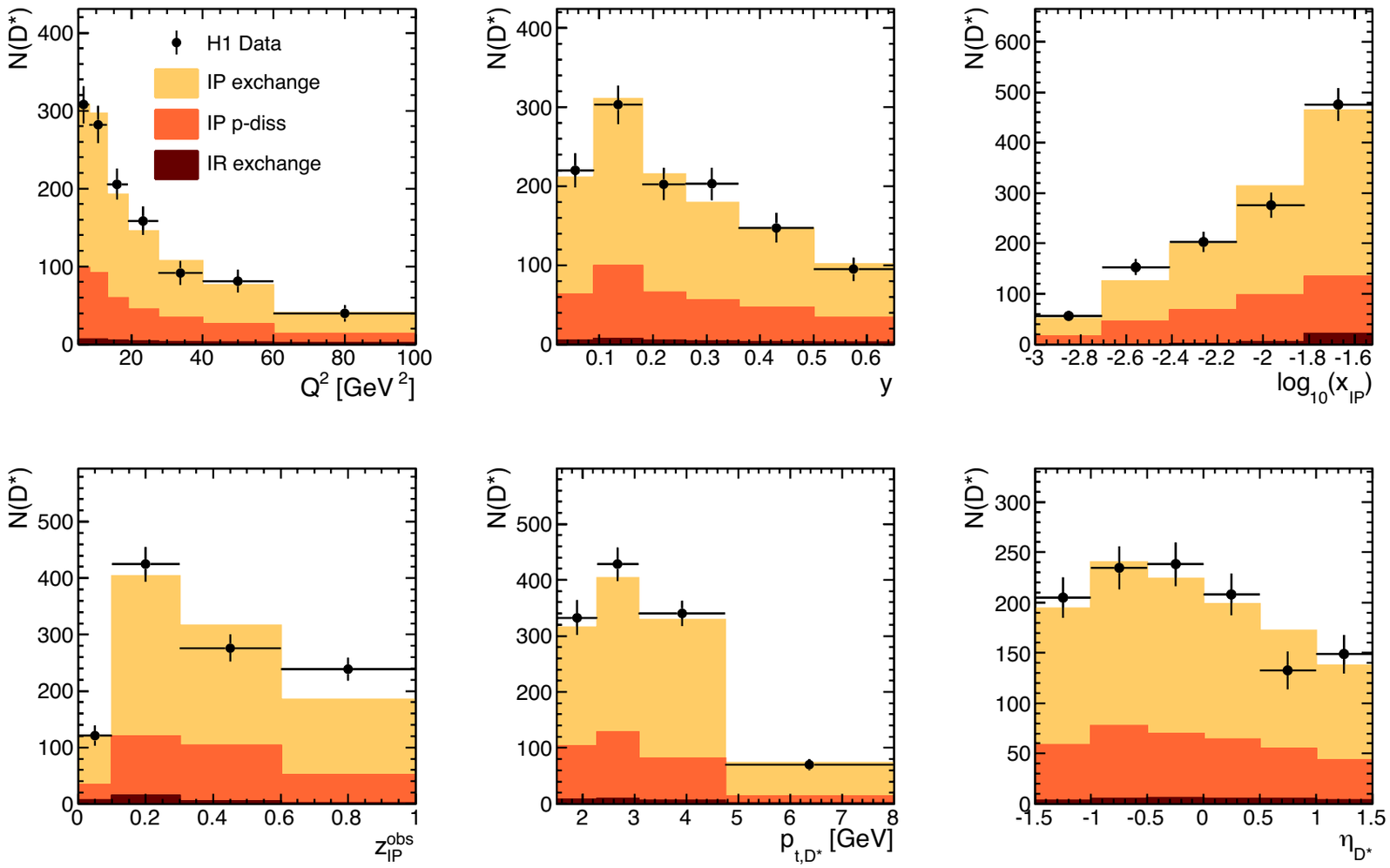
➜ total number of D* mesons = 1169 +/- 58

Data analysis

- Data collected in 2005-2006 at $\sqrt{s}$ = 319 GeV
- Integrated luminosity = 287 pb^{-1}
- Data corrected for
  - background
  - trigger efficiency
  - acceptance
  - QED radiation
- Systematic uncertainty dominated by p-diss

DIS phase space
$5 < Q^2 < 100\ \mathrm{GeV}^2$
$0.02 < y < 0.65$
D^* kinematics
$p_{t,D^*} > 1.5\ \mathrm{GeV}$
$-1.5 < \eta_{D^*} < 1.5$
Diffractive phase space
$x_{I\!P} < 0.03$
$M_Y < 1.6\ \mathrm{GeV}$
$\lvert t \rvert < 1\ \mathrm{GeV}^2$

Detector level comparison of data vs. RAPGAP (reweighted)



Integrated cross section

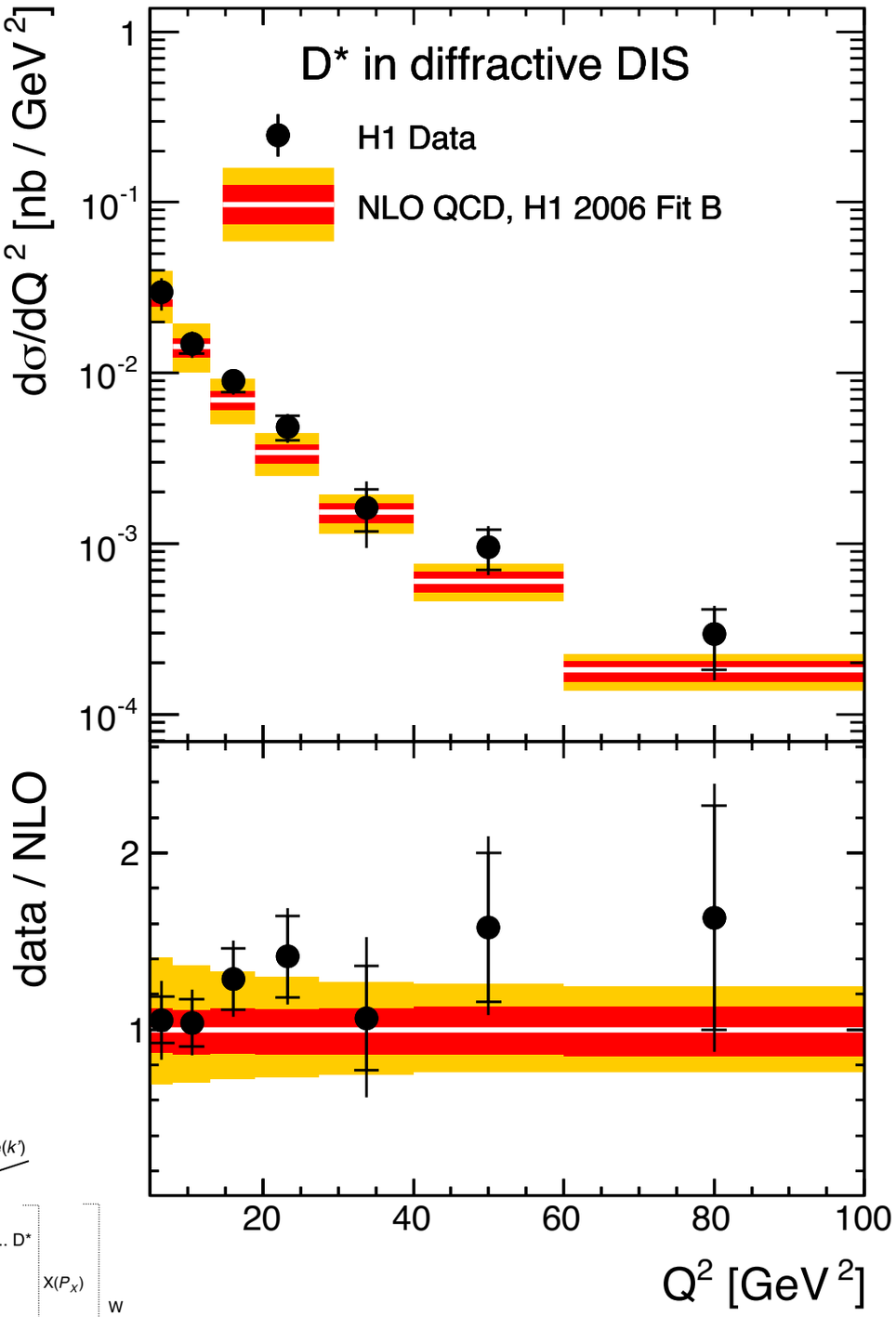
Result from data

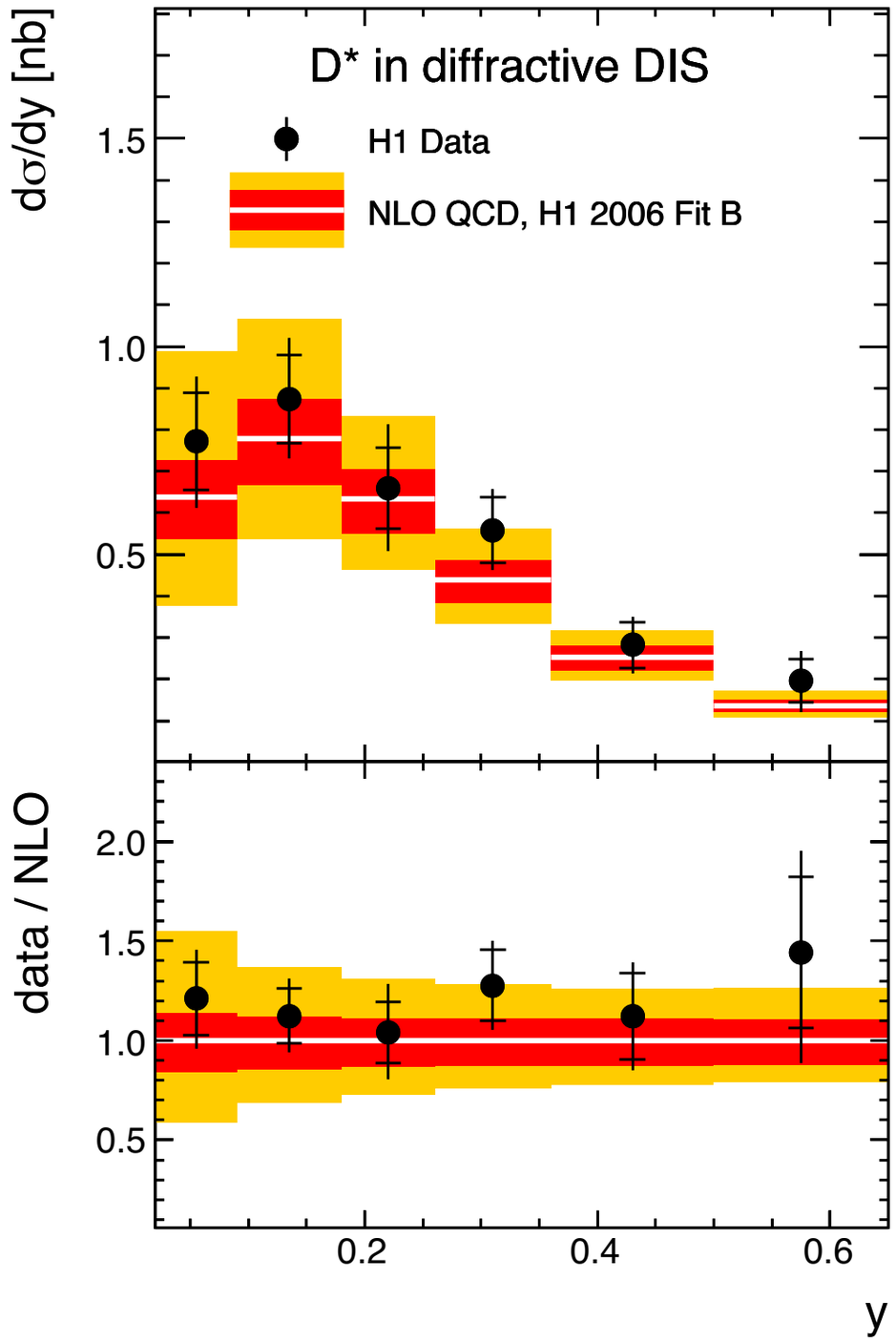
$$\sigma_{\mathrm{ep}\to\mathrm{eYX}(\mathrm{D}^*)} = 314 \pm 23\,(\mathrm{stat.}) \pm 35\,(\mathrm{syst.})\,\mathrm{pb}$$

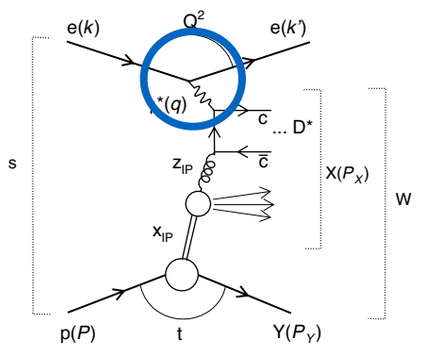
NLO HVQDIS calculation based on H1 2006 DPDF Fit B

$$\sigma^{\mathrm{theory}}_{\mathrm{ep}\to\mathrm{eYX}(\mathrm{D}^*)} = 265\,{}^{+54}_{-40}\,(\mathrm{scale})\,{}^{+68}_{-54}\,(m_\mathrm{c})\,{}^{+7.0}_{-8.2}\,(\mathrm{frag.})\,{}^{+31}_{-35}\,(\mathrm{DPDF})\,\mathrm{pb}$$

Differential cross sections







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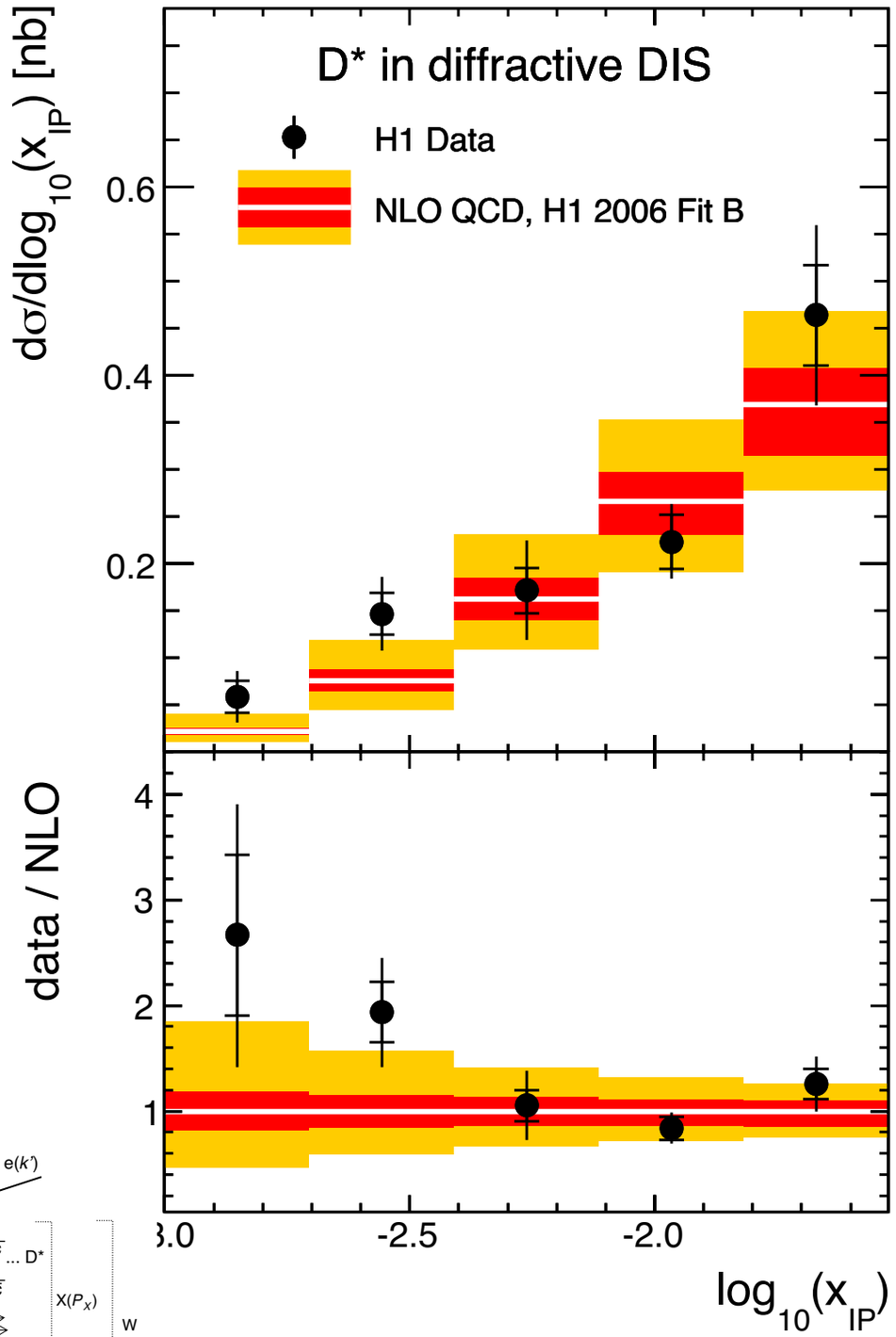

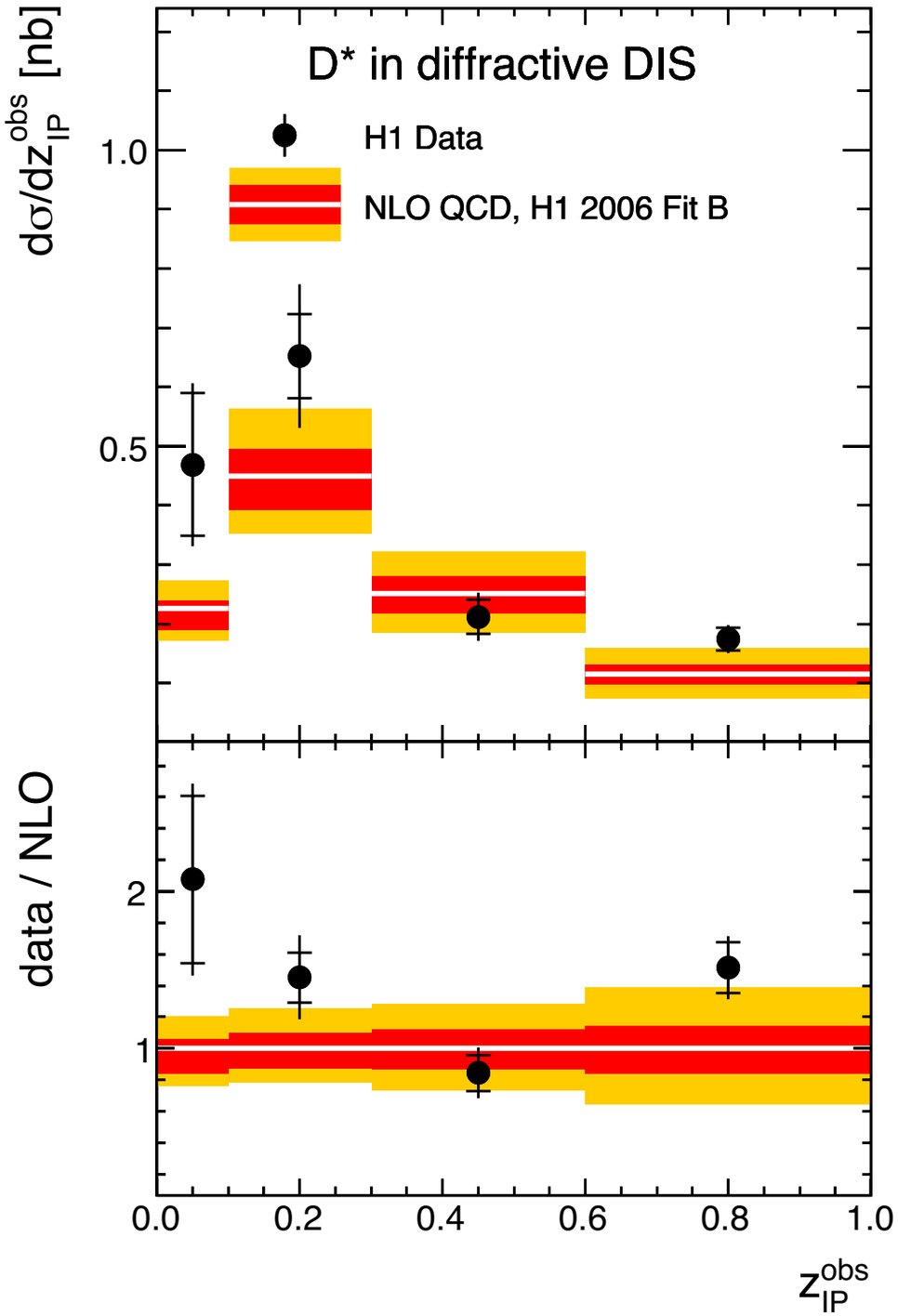

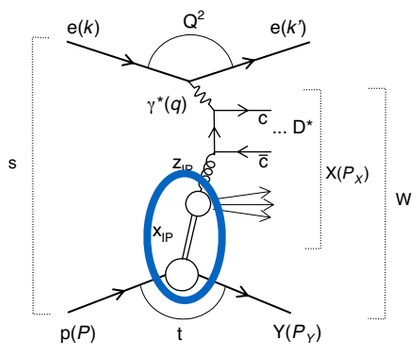

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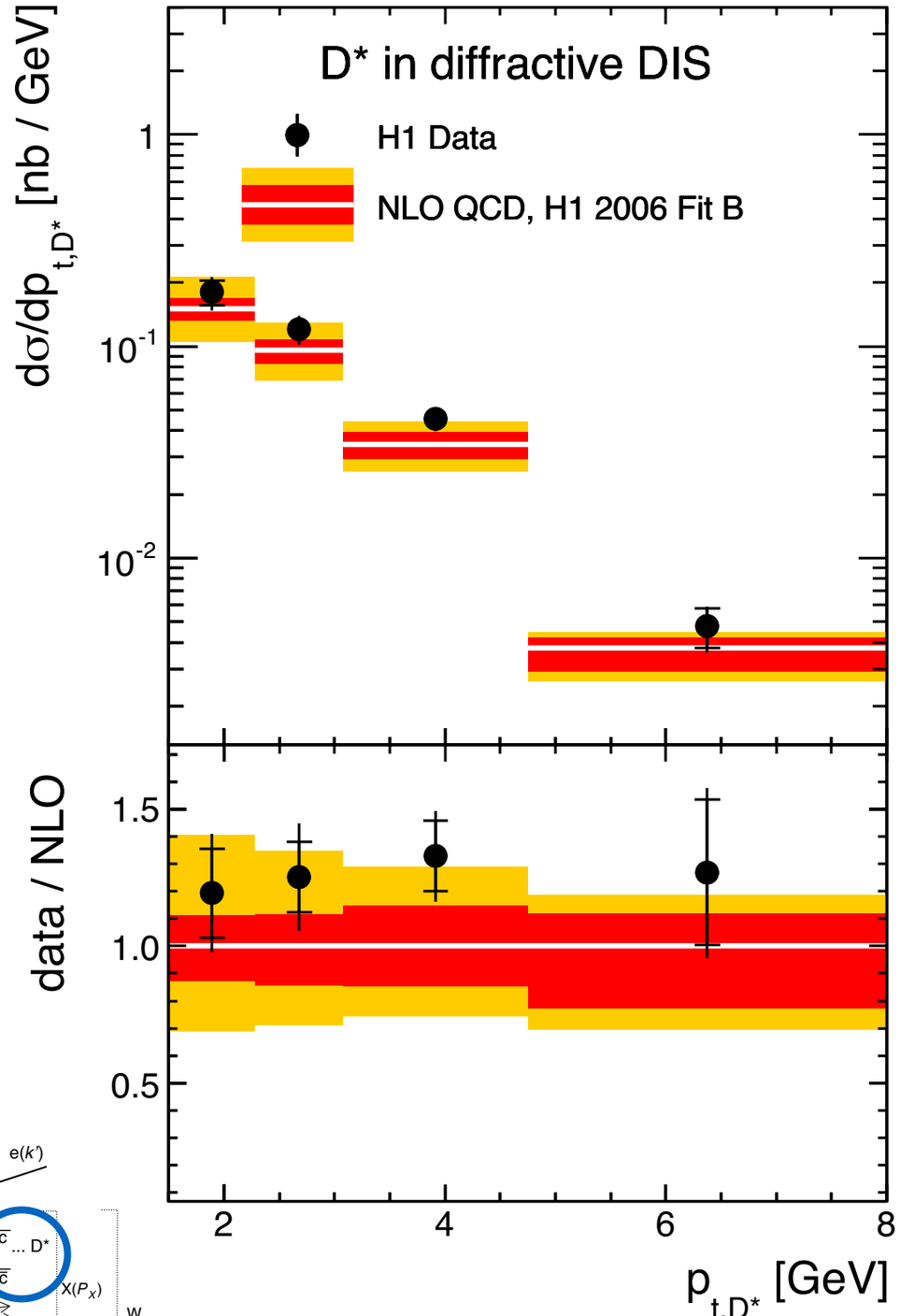
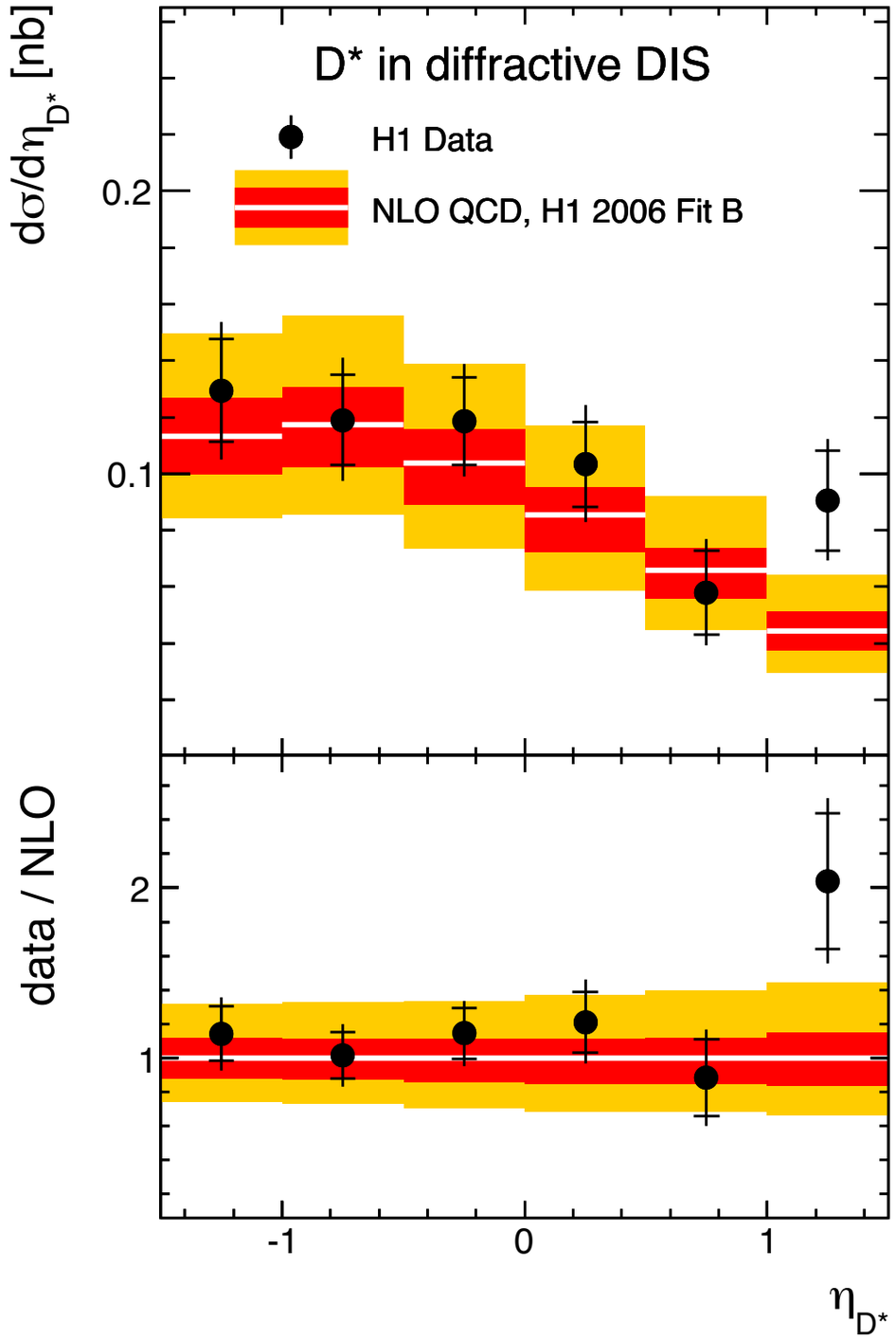
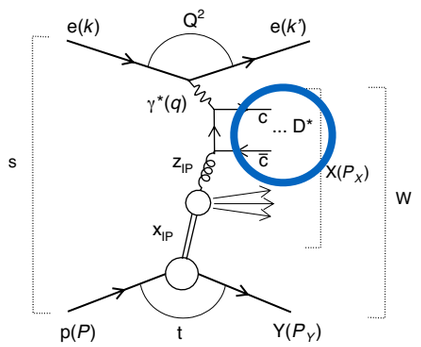






Diffractive-to-nondiffractive ratio

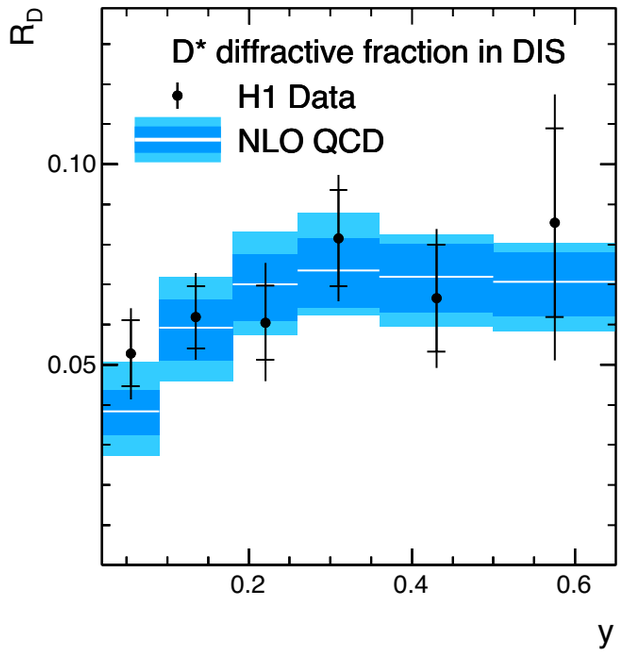
Result from data

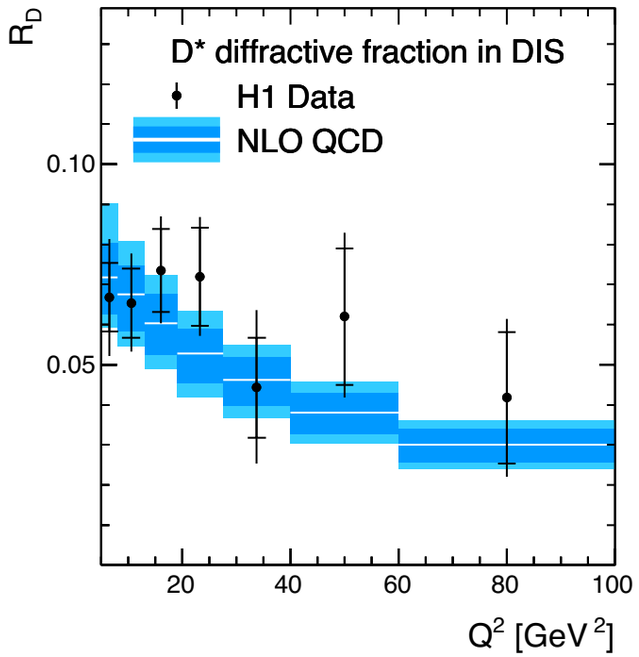
$$R_{\mathrm{D}} = 6.6 \pm 0.5\,(\mathrm{stat.})\,^{+0.9}_{-0.8}\,(\mathrm{syst.})\%$$

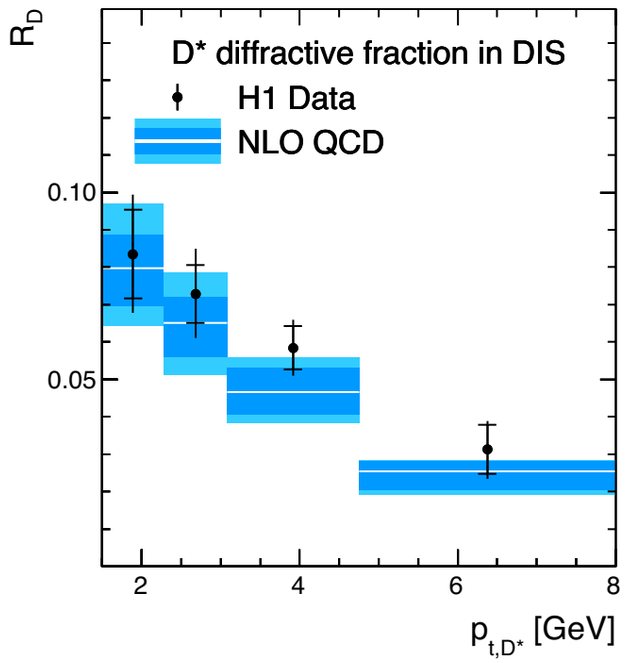
NLO HVQDIS calculation based on H1 2006 DPDF Fit B

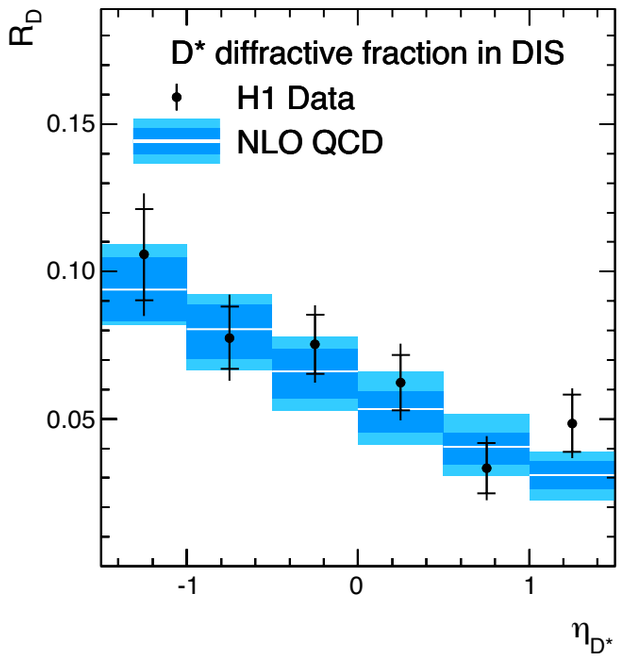
$$R_{\mathrm{D}}^{\mathrm{theory}} = 6.0\,^{+1.0}_{-0.7}\,(\mathrm{scale})\,^{+0.5}_{-0.4}\,(m_{\mathrm{c}})\,^{+0.7}_{-0.8}\,(\mathrm{DPDF})\,^{+0.02}_{-0.04}\,(\mathrm{frag.})\%$$

Diffractive-to-nondiffractive ratio

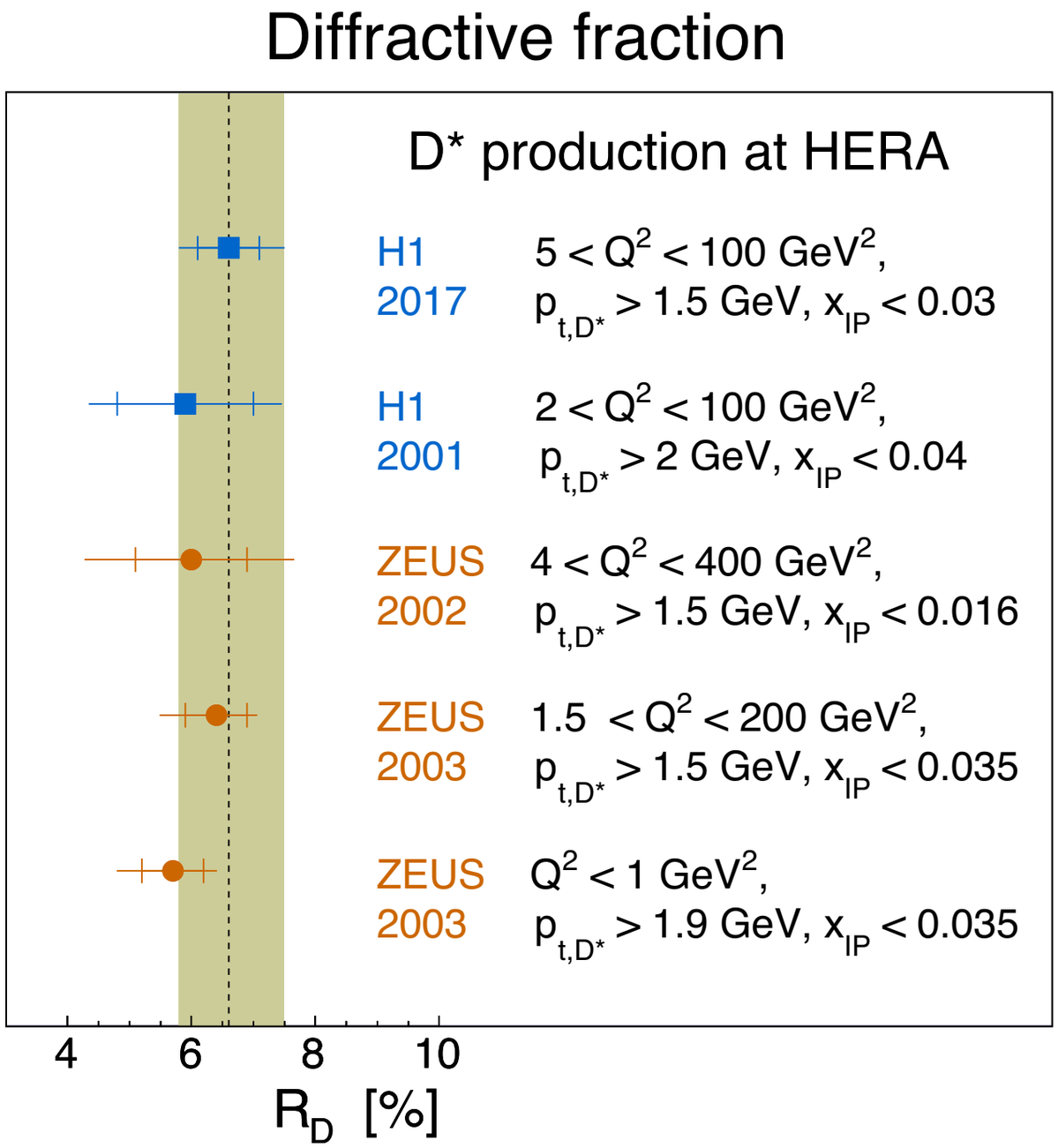








Comparison to previous measurements



- Agreement with previous results
- Compatible ratios in DIS and photoproduction

Summary

- New results with 6-fold increase in integrated luminosity
  - Smaller uncertainty, more differential

- Well described by NLO calculations
  - Support for collinear factorization in diffraction

- Diffractive-to-nondiffractive ratios also in agreement with NLO calculations
  - No sign for different rapidity gap probability in DIS and photoproduction