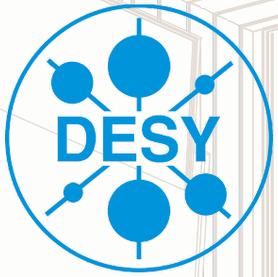
H1 Status Report

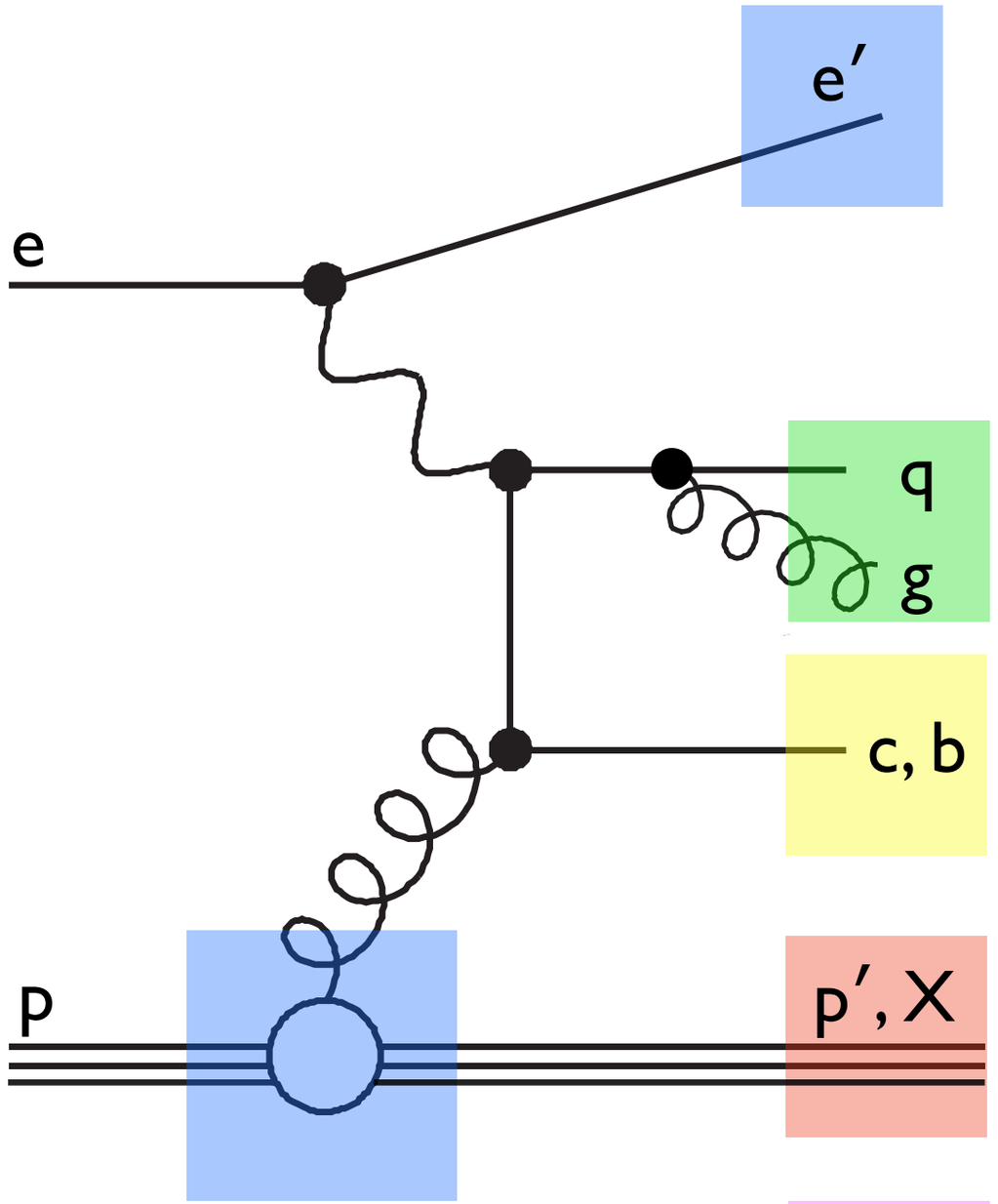
Roman Kogler

71st PRC Meeting

DESY Hamburg, April 28, 2011



HERA Physics



Inclusive Measurements

Jets and Hadronic Final State

Heavy Flavour

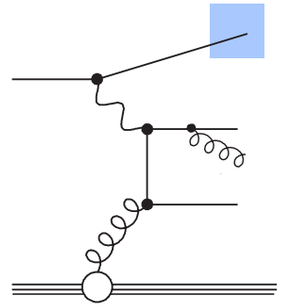
Diffraction, Proton Dissociation

Beyond Standard Model Searches

Recent H1 Results
(new since last PRC)

Proton Structure	
DESY-10-228	Measurement of the Inclusive ep Scattering Cross Section at High Inelasticity y and of the Structure Function F_L
H1prelim-11-042	HERAPDF1.5 NNLO + ZEUS
H1prelim-11-034	QCD analysis with determination of α_s based on HERA inclusive and jet data + ZEUS
Jets And Hadronic Final State	
H1prelim-11-032	Measurement of Multijet Production and α_s in Deep-Inelastic ep Scattering at High Q^2
H1prelim-11-035	Transverse Momentum of Charged Particles in an Extended η Range
Heavy Flavour	
H1prelim-11-071	Measurement of the photoproduction of b-quarks at threshold at HERA
DESY-11-066	Measurement of D* Meson Production and Determination of F_2^{cc} at low Q^2
H1prelim-11-011	Exclusive diffractive J/ψ production at low $W_{\gamma p}$
Diffraction	
H1prelim-11-013	Dijet production in diffractive deep-inelastic scattering using VFPS
H1prelim-11-012	Forward photon spectra measured in FNC
Searches, Beyond Standard Model Physics	
DESY-10-181	Search for Squarks in R-parity Violating Supersymmetry in ep Collisions at HERA
DESY-11-044	Search for Lepton Flavour Violation at HERA

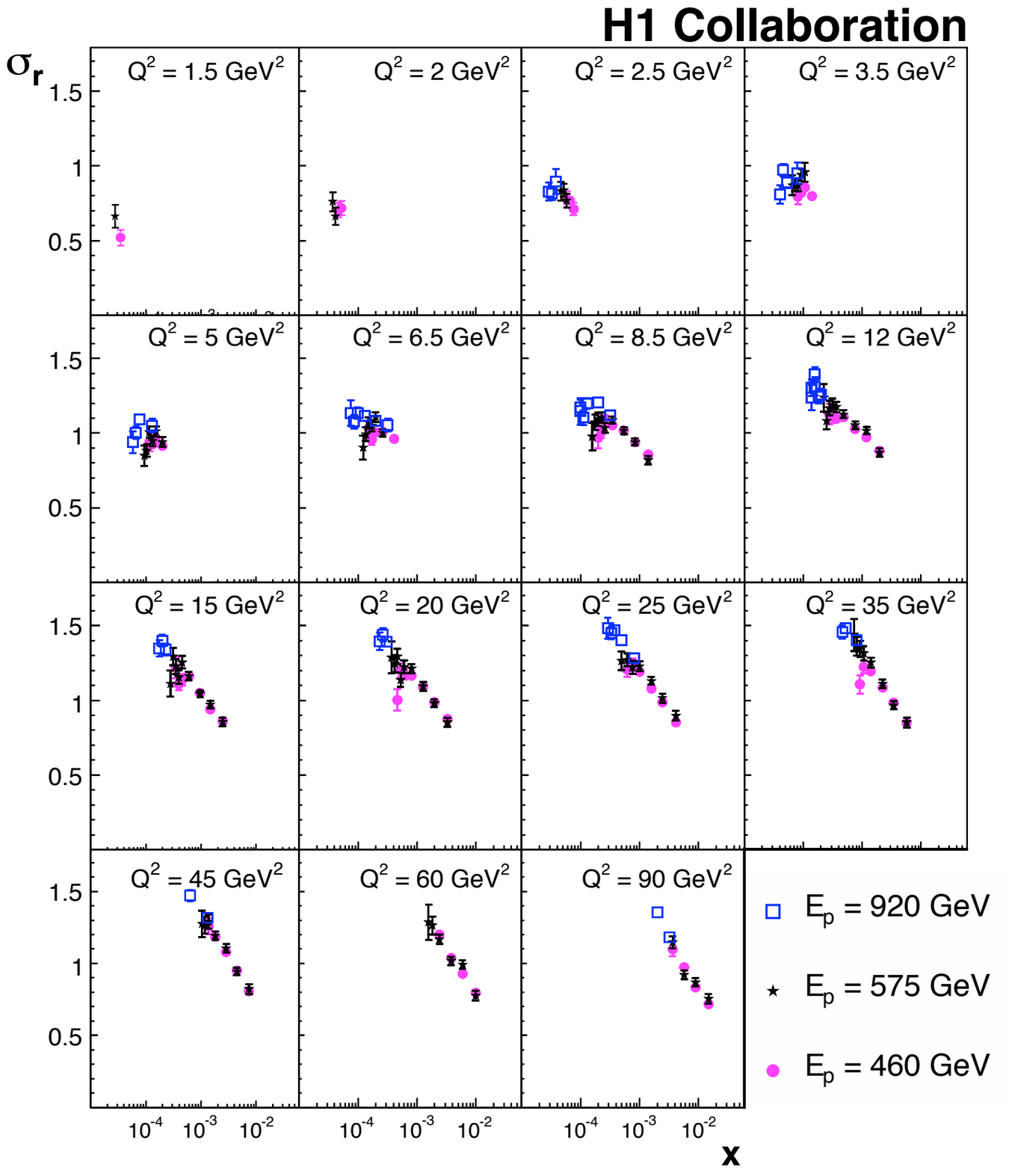
Inclusive Measurement



Proton Structure

[DESY-10-228]

(Eur. Phys. J C71)



Measurement at low Q^2 at different centre-of-mass energies

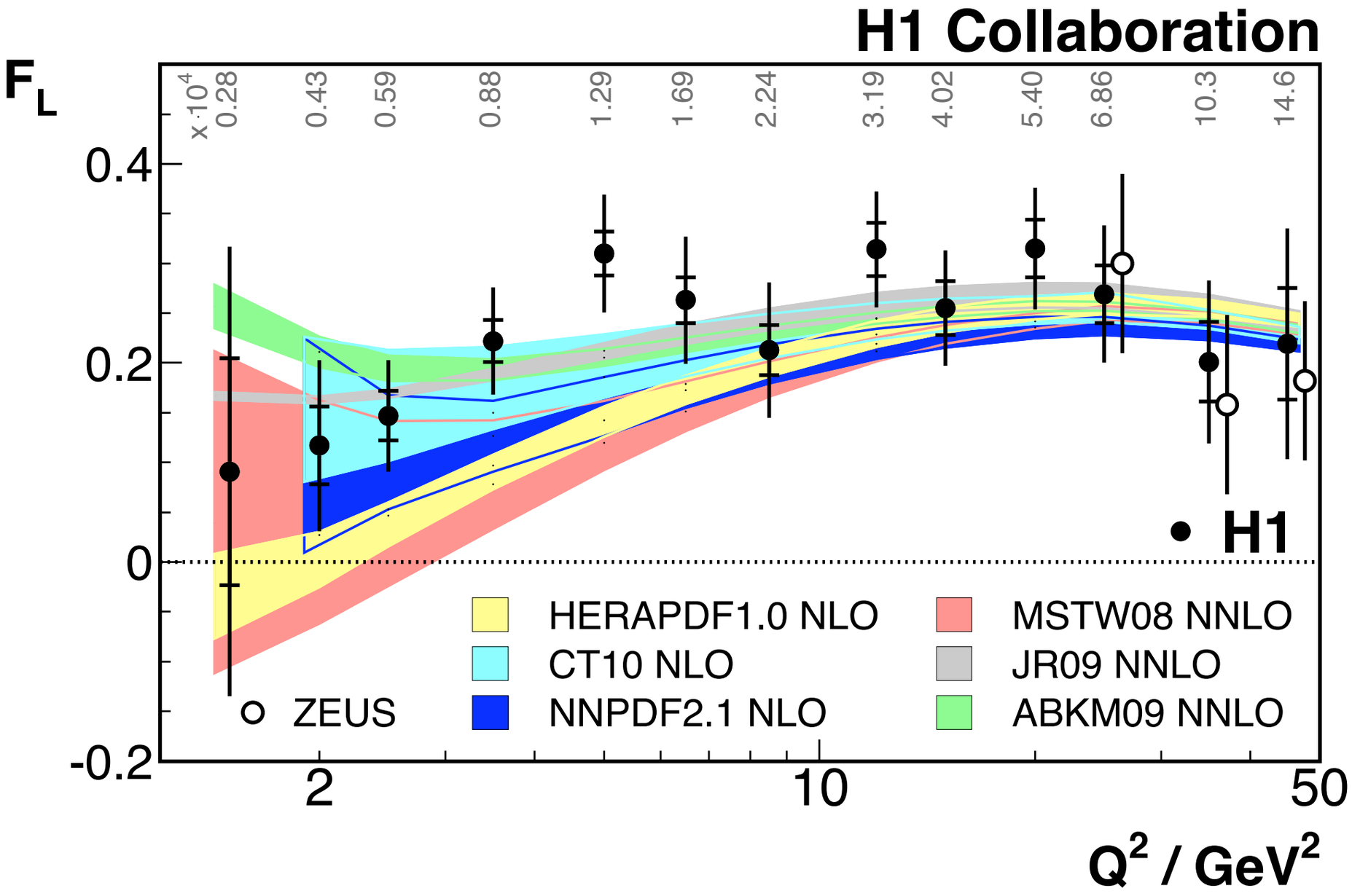
Reduced cross section given by

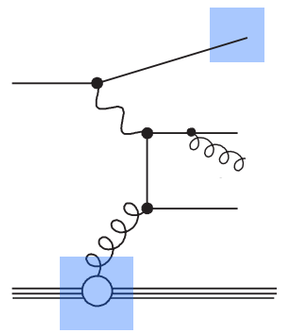
$$\sigma_{\mathrm{r}}(x,Q^2) = F_2(x,Q^2) - \frac{y^2}{Y_+} F_L(x,Q^2)$$

Dominated by F_2, only at high y non-negligible contribution from F_L

High precision measurement with data from low energy runs

F_L Determination





Proton Structure

[DESY-10-228]

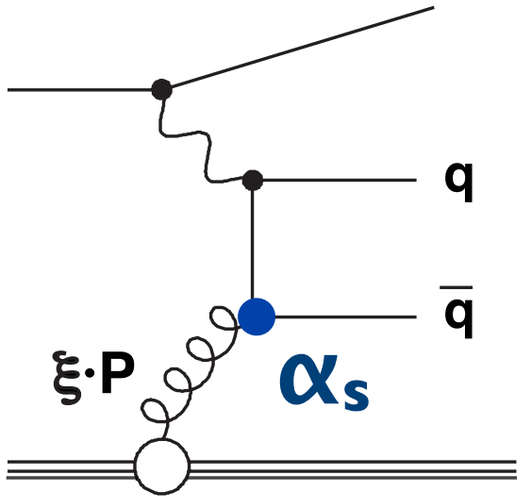
(Eur. Phys. J C71)

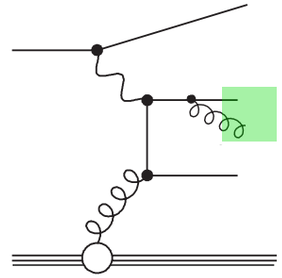
Milestone of H1 physics programme

F_L measurement extends down to $Q^2 \approx 1.5$ GeV^2

Reasonable description by predictions using different PDFs

Multijet Measurement



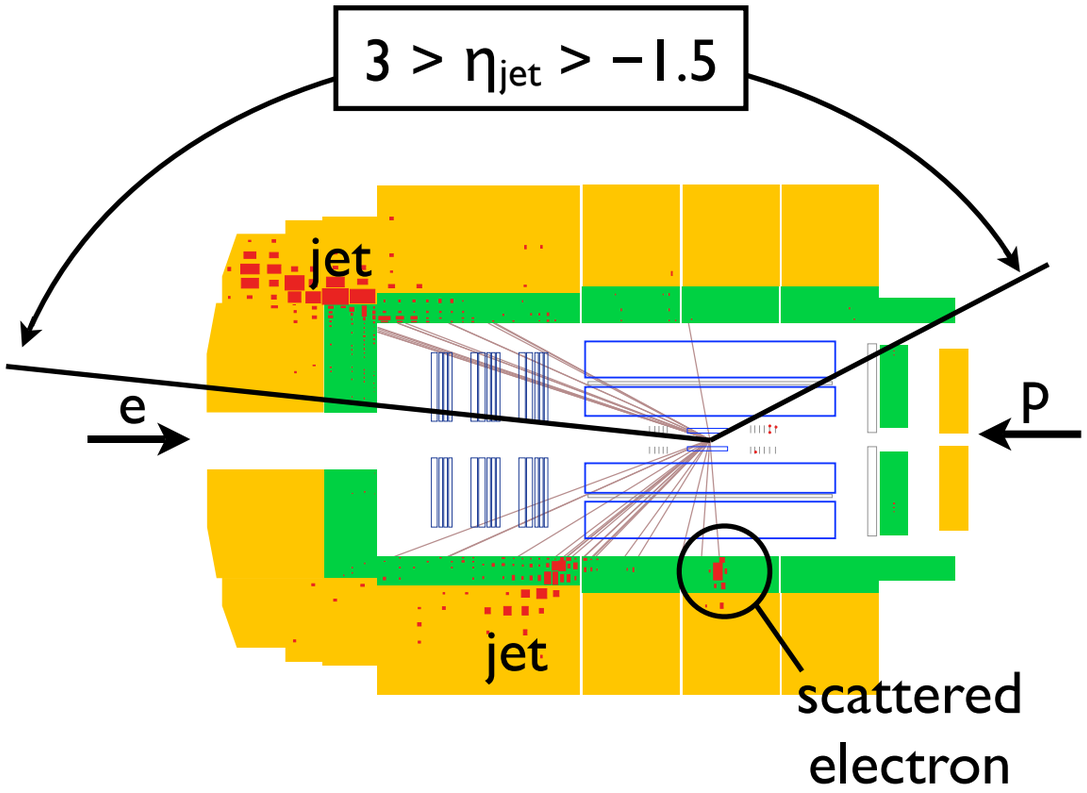


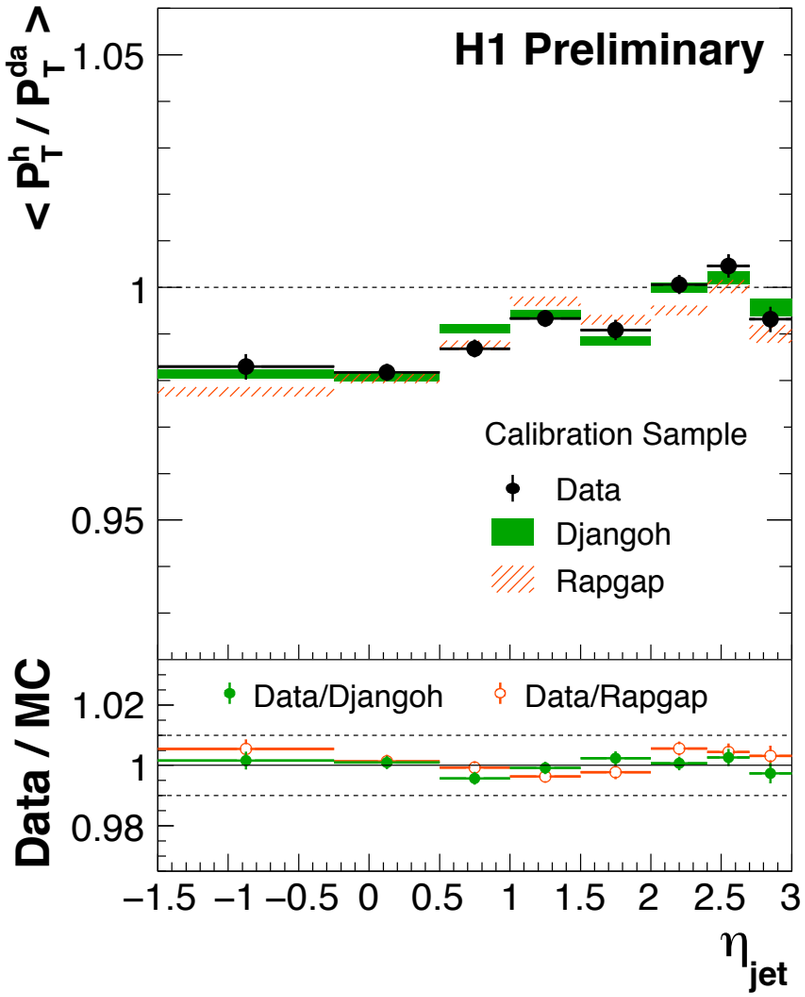
Jets, HFS

[H1prelim-11-032]

Directly sensitive to gluon content of proton

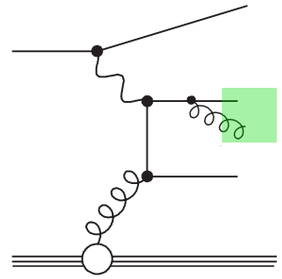
Sensitivity to strong coupling





Jet Energy Scale Uncertainty: 1%

Multijet Measurement



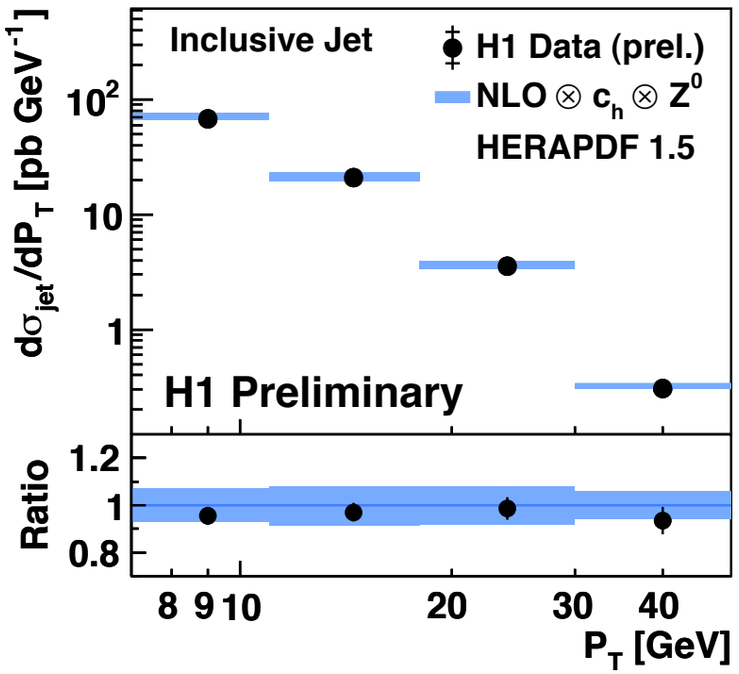
Jets, HFS

[H1prelim-11-032]

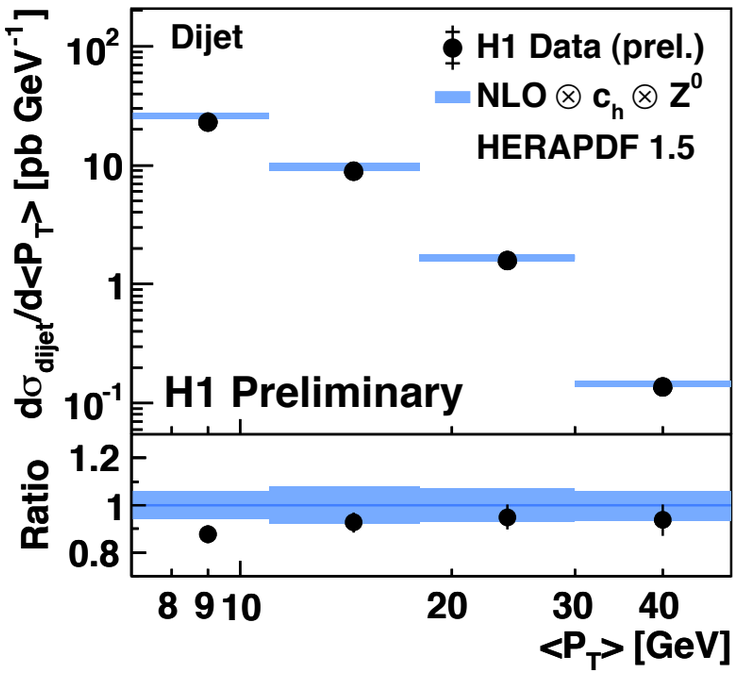
Single and double differential cross sections for inclusive jet, dijet and trijet

First double-differential trijet cross section measurement at high Q^2

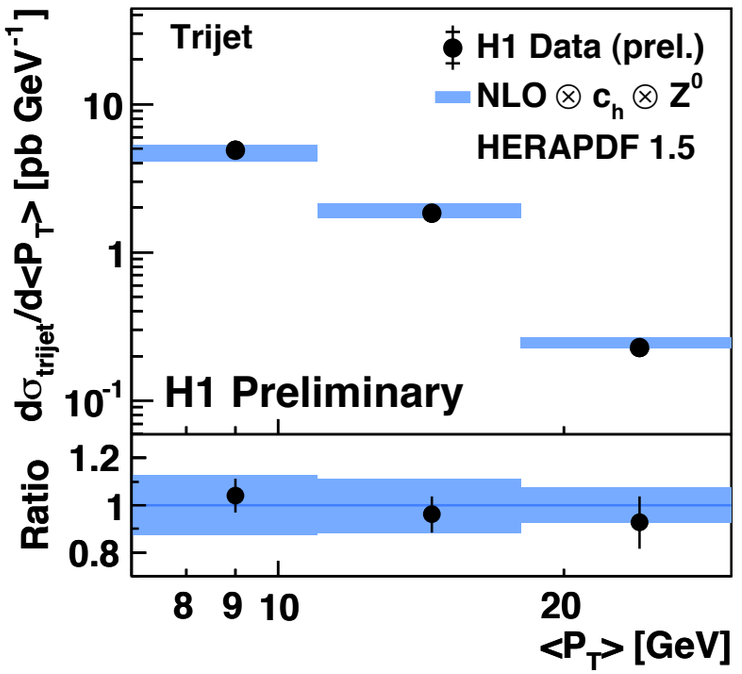
Inclusive Jet



Dijet

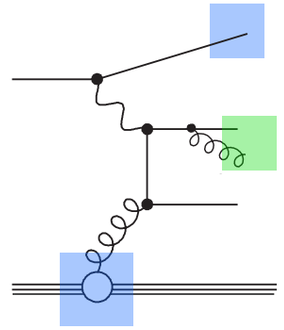


Trijet



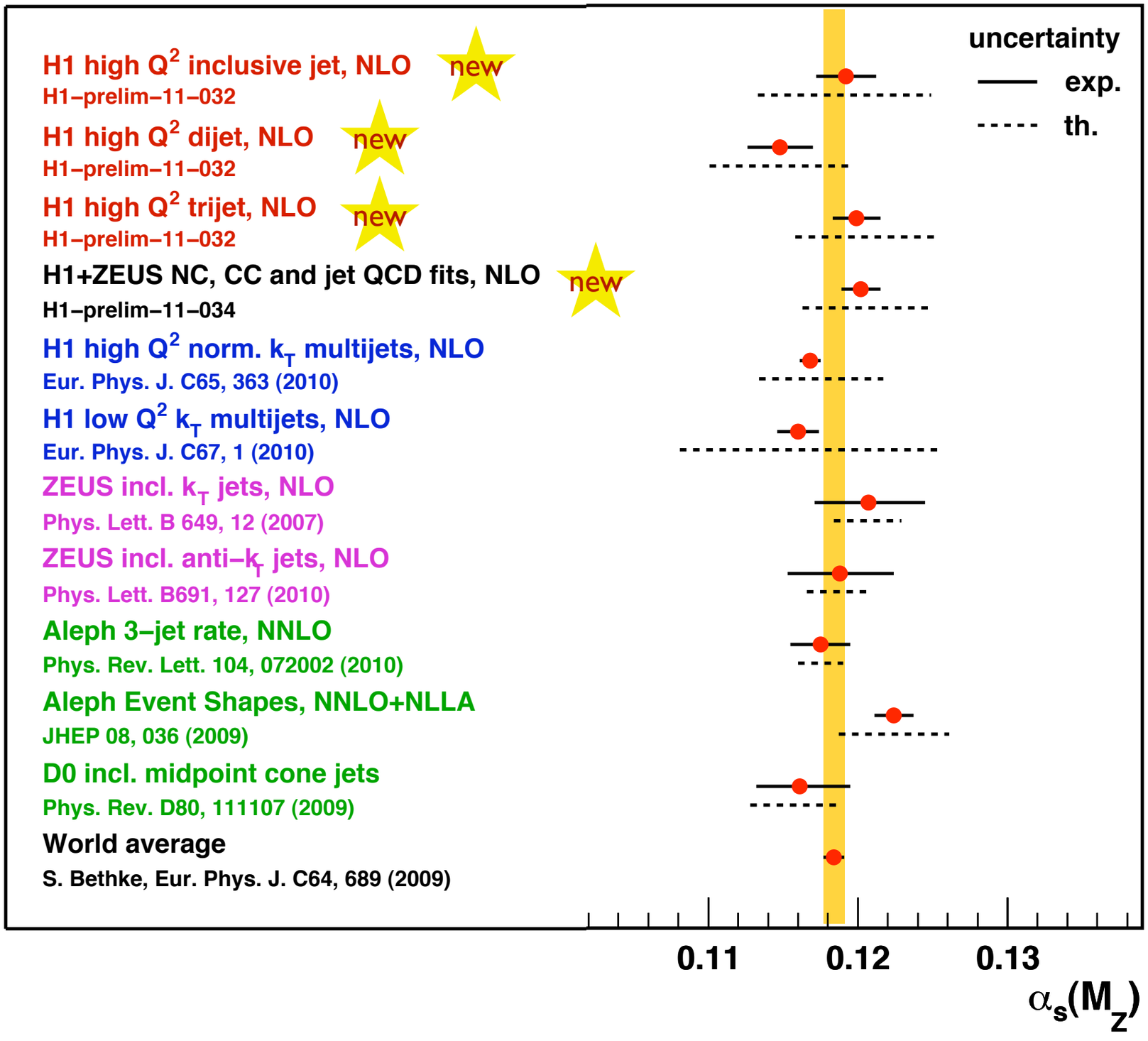
High precision jet measurement

Recent α_s Determinations



Proton Structure

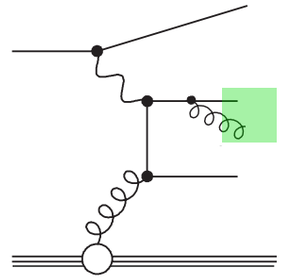
Jets, HFS



Good agreement between $\alpha_s(M_Z)$ values obtained from simultaneous PDF+α_s fit and independent determination

Values of $\alpha_s(M_Z)$ competitive with other determinations

Charged Particle Spectra

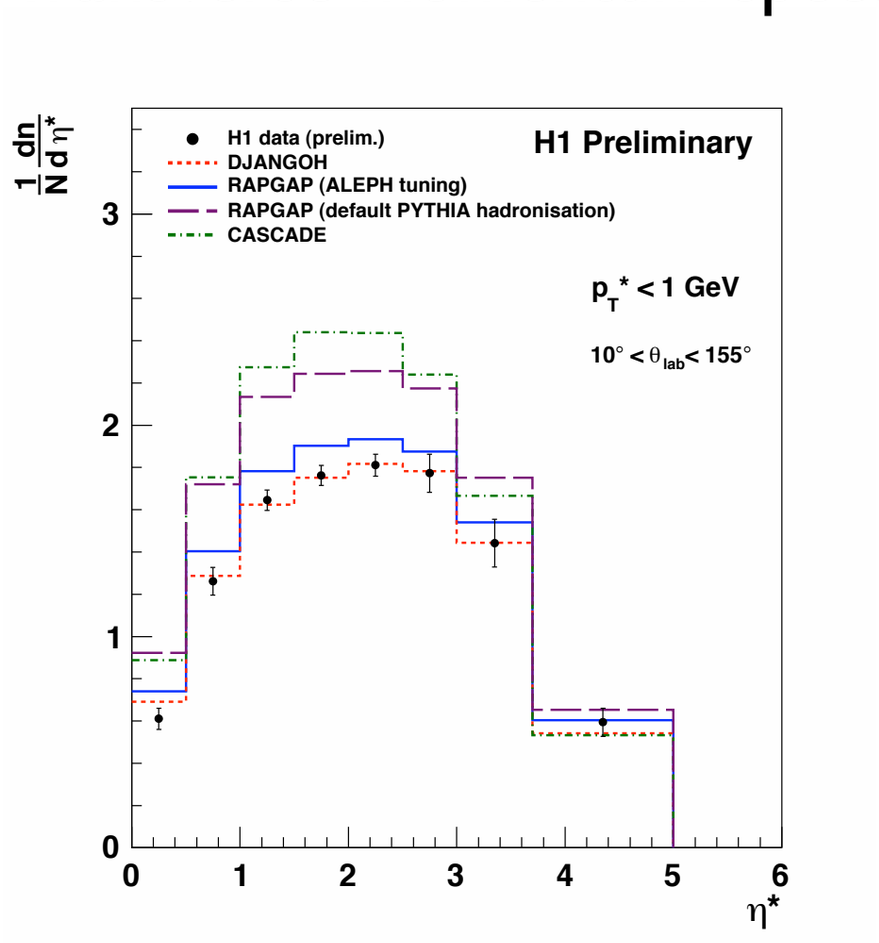


Jets, HFS

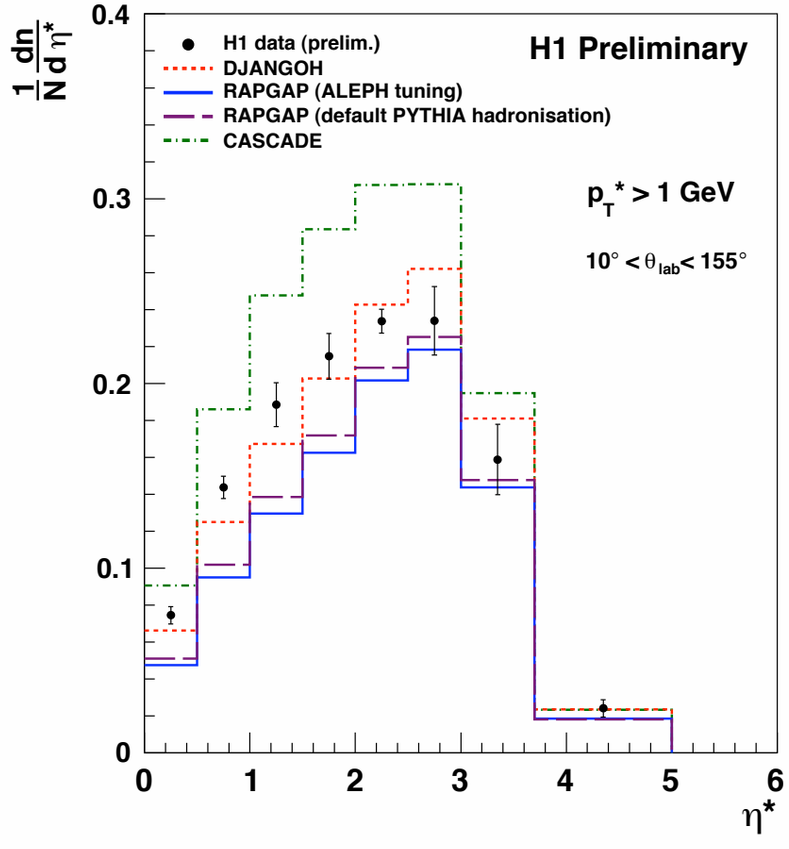
[H1prelim-11-035]

F_2 little discriminating power for DGLAP or non-DGLAP parton dynamics

Transverse momentum spectra of charged particles



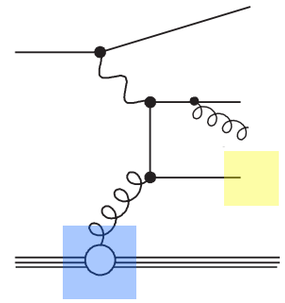
low P_T: high sensitivity to hadronisation effects



high P_T: high sensitivity to parton dynamics

Extension in phase space made possible through reprocessing with DST7

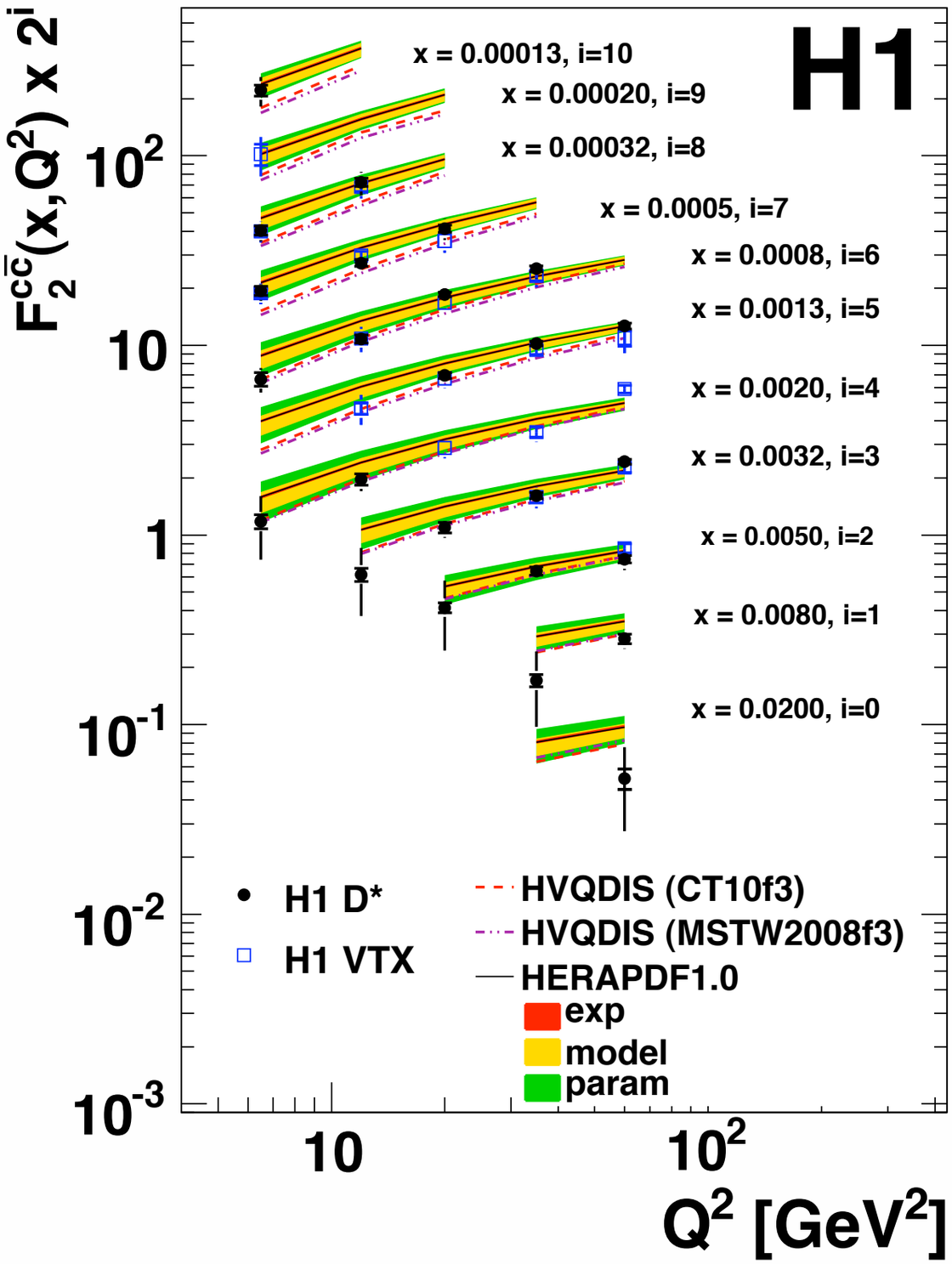
Determination of $F_2^{c\bar{c}}$



Proton Structure

Heavy Flavour

[DESY-11-066]



Milestone of H1 physics programme

Measurement of $D^{*\pm}$ production at low Q^2

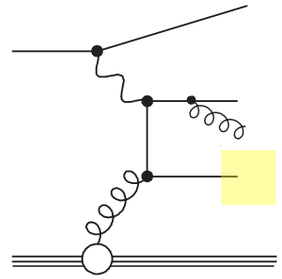
Charm cross section related to $F_2^{c\bar{c}}$ via

$$\frac{\mathrm{d}^2\sigma^{c\bar{c}}}{\mathrm{d}x\,\mathrm{d}Q^2} = \frac{2\pi\alpha_{em}^2}{Q^4 x}\left([1+(1-y)^2]\,F_2^{c\bar{c}}(x,Q^2) - y^2 F_L^{c\bar{c}}(x,Q^2)\right)$$

Good agreement of extracted $F_2^{c\bar{c}}$ with predictions using HERAPDF

Gluon from scaling violations consistent with gluon observed in charm production

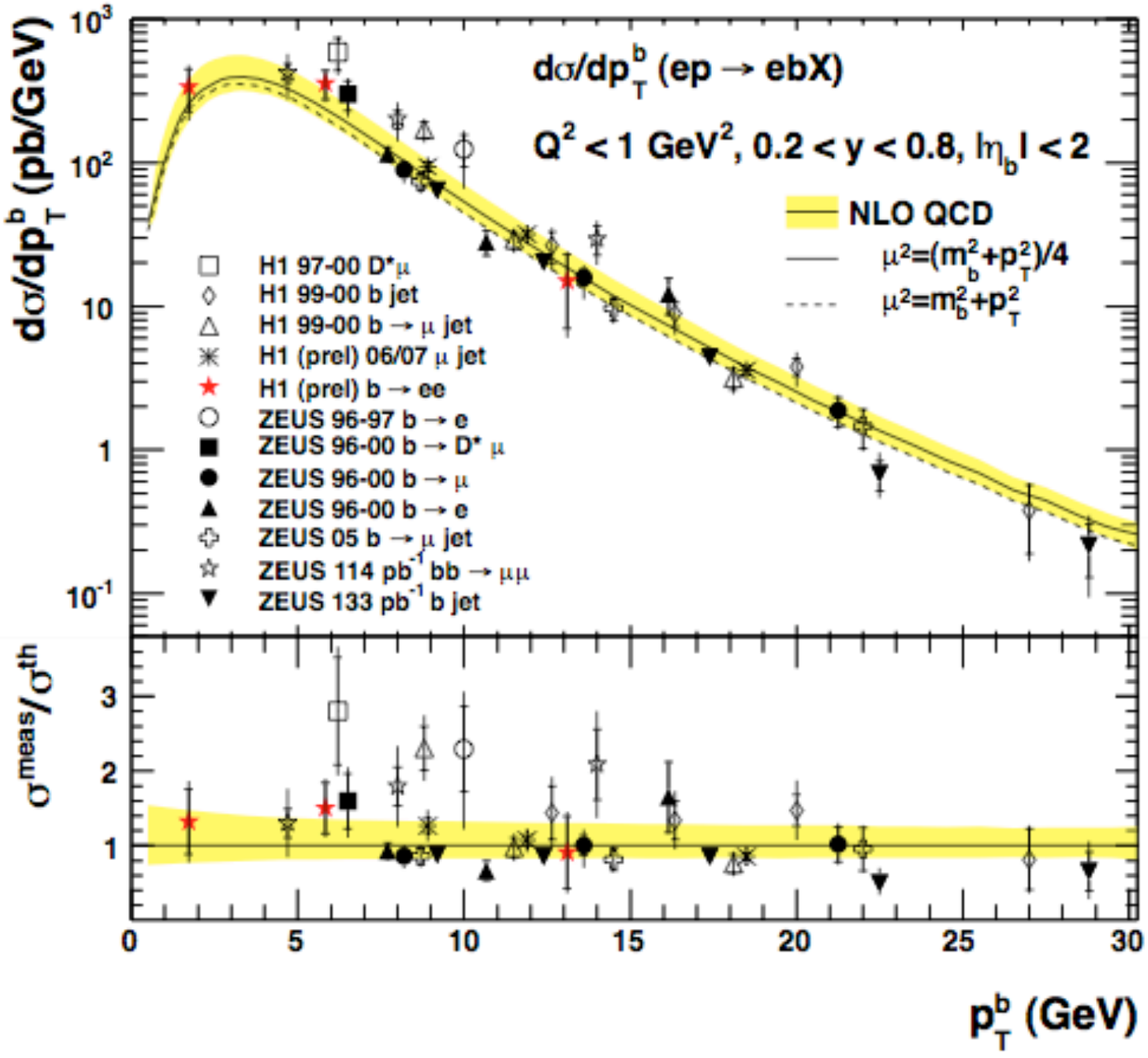
Beauty Production At Threshold



Heavy Flavour

[H1prelim-11-071]

Measurement of beauty production in photoproduction at threshold: m_b only hard scale as $Q^2 \to 0$ and $p_T \to 0$



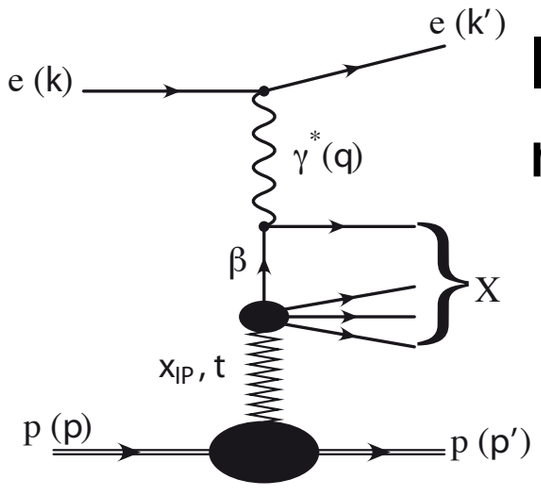
Tag of two electrons from semi-leptonic decays

Excellent performance of Jet Trigger (JT) and Fast Track Trigger (FTT)

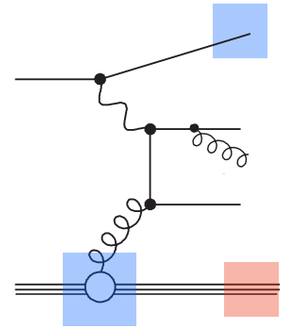
Measurement extends p_T^b to very low values

Good agreement with NLO calculation at threshold

Diffraction



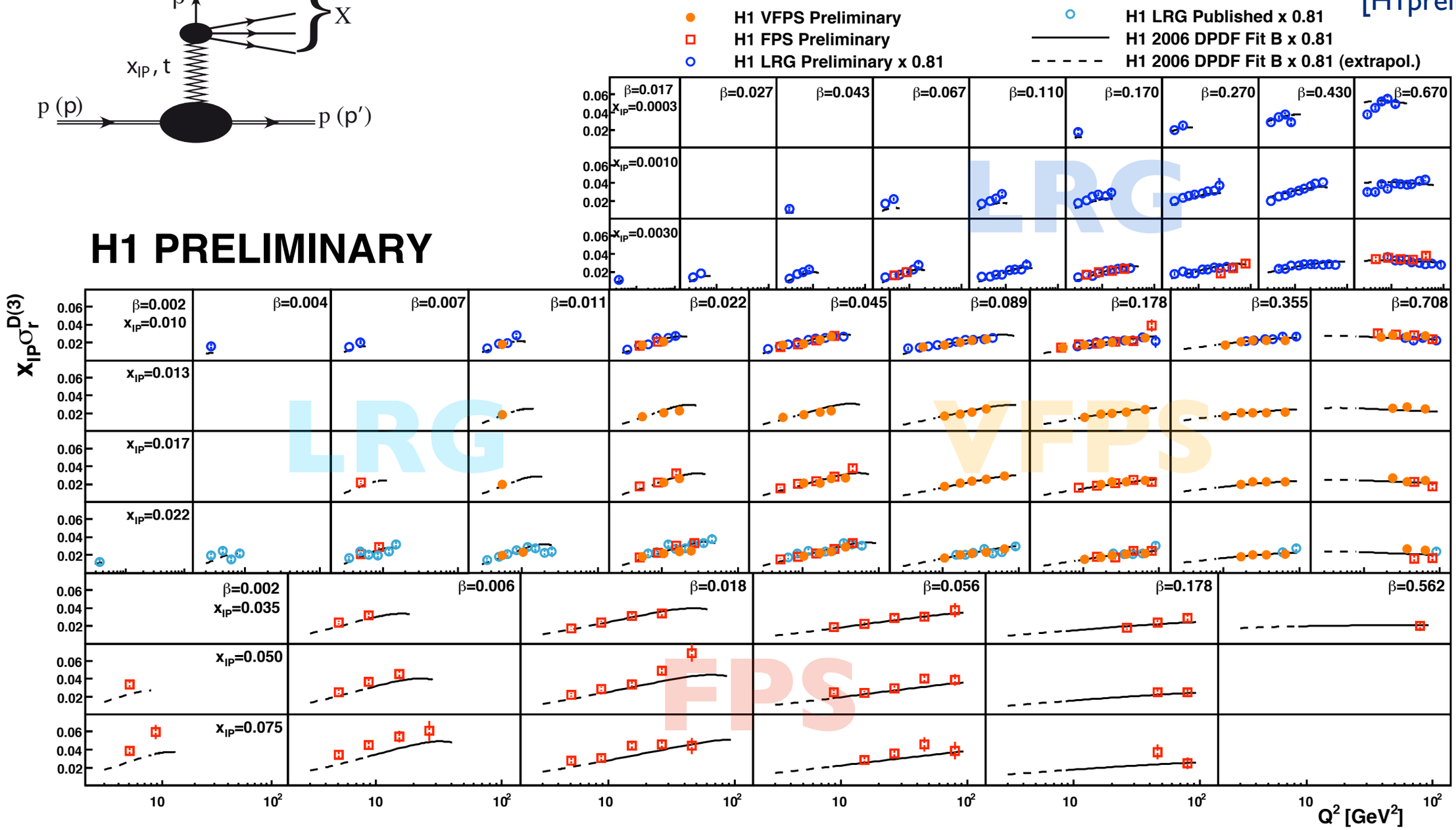
Inclusive diffraction measured with large rapidity gap (LRG), FPS and VFPS



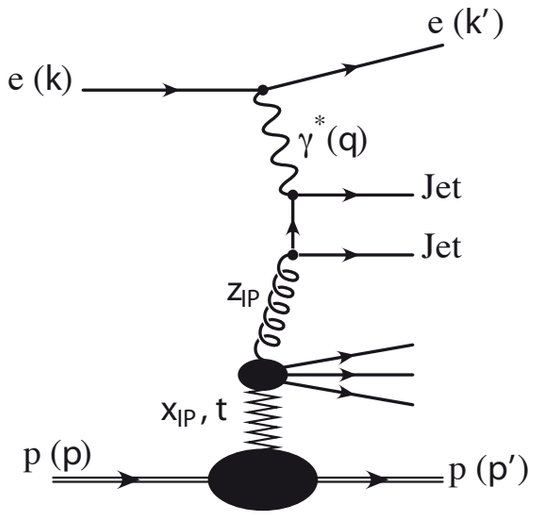
Proton Structure

Diffraction

[H1prelim-10-014]

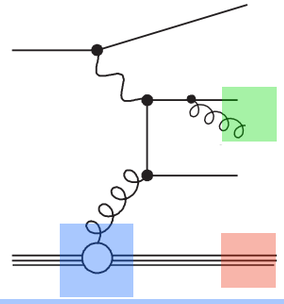


Diffractive Dijet Production



Direct sensitivity to the gluon density of the Pomeron

Data can be used in DPDF fit

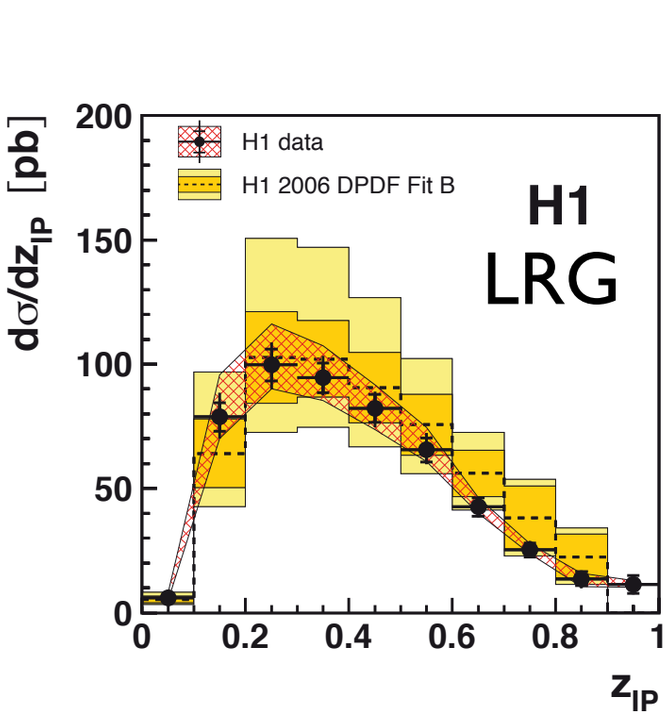


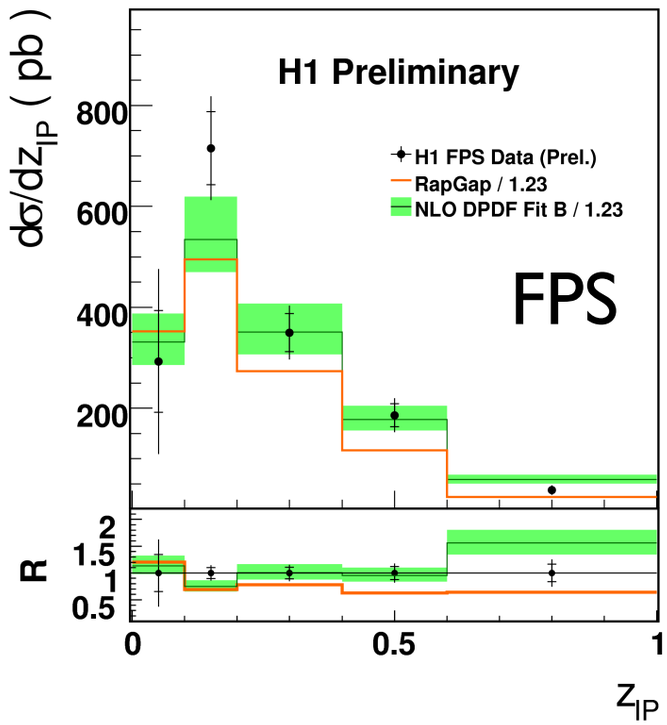
Proton Structure

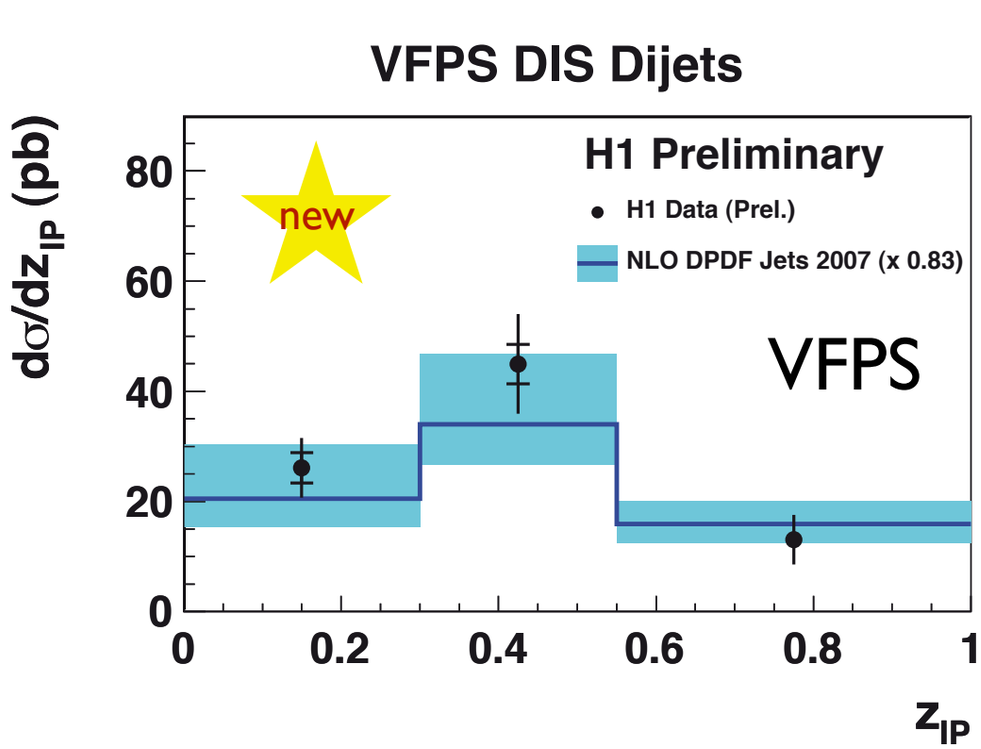
Diffraction

Jets, HFS

[H1prelim-11-013]

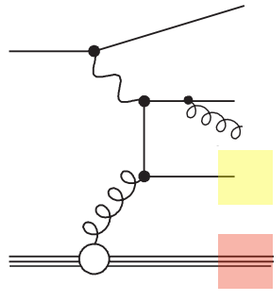






Validity of factorisation in diffractive DIS

Diffractive Vector Mesons

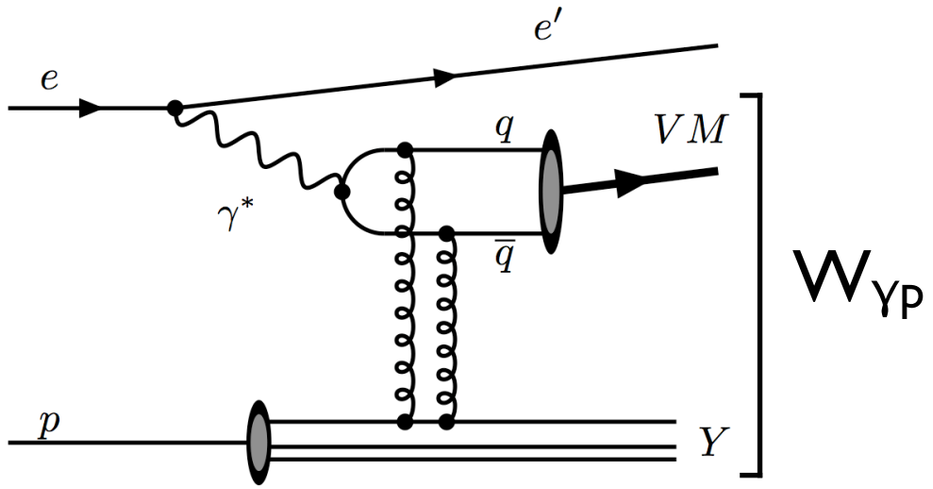


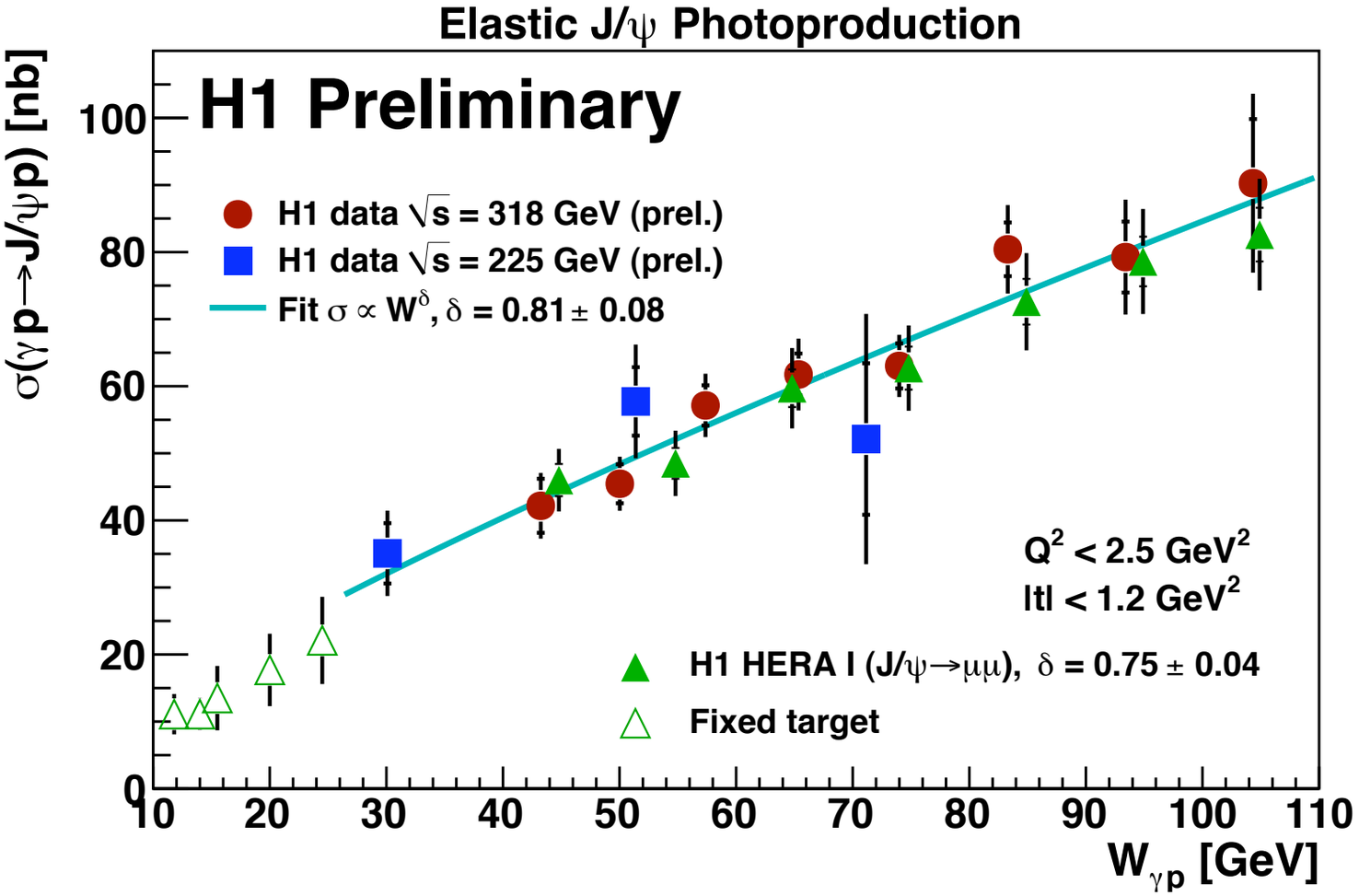
Diffraction

Heavy Flavour

[H1prelim-11-011]

Measurement of diffractive J/ψ production at low $W_{\gamma p}$ in photoproduction





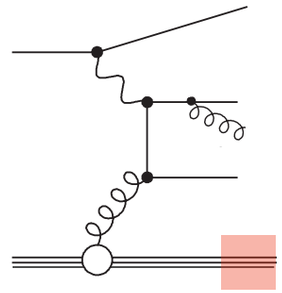
Bridge gap between fixed target data and high energy collision data

Access to low $W_{\gamma p}$ through different beam energies

$J/\psi \rightarrow e^+e^-$, excellent performance of FTT

New measurement using low E_p runs

Forward Photon Production



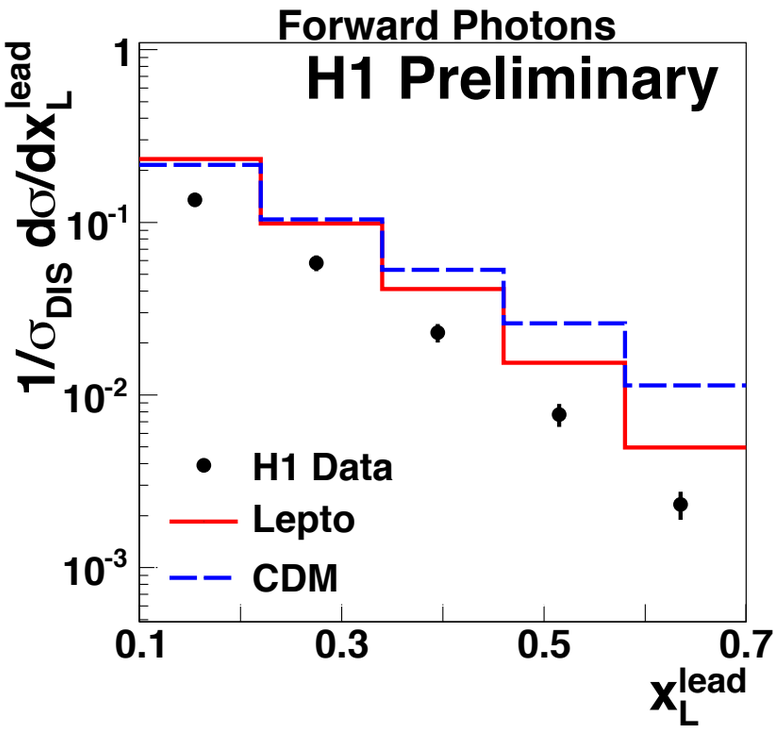
Diffraction

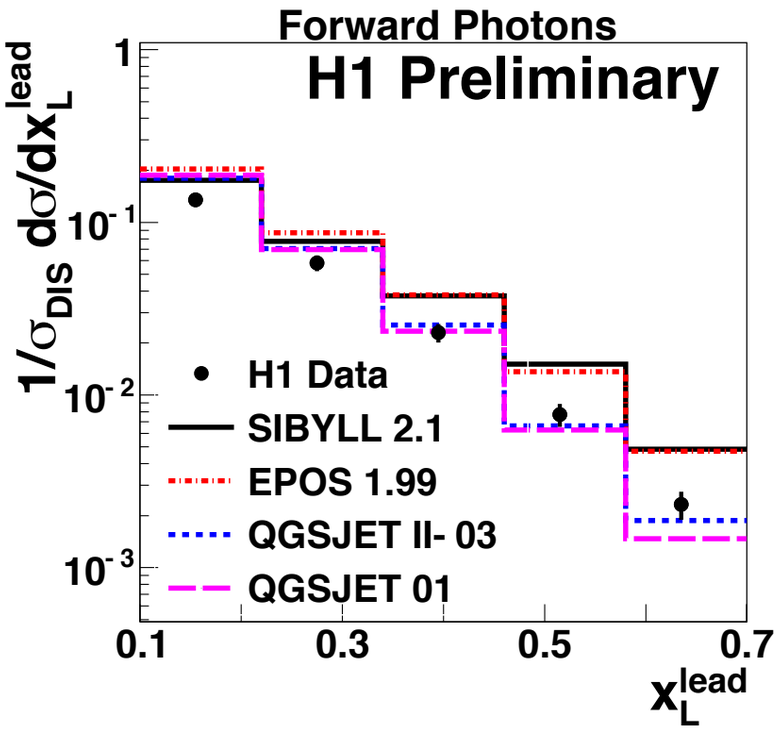
[H1prelim-11-012]

Test our understanding of proton fragmentation

Forward photons: mostly from π^0 decays measured with Forward Neutron Spectrometer (FNC)

Possible because of preshower calorimeter of FNC





longitudinal momentum fraction of leading photon:

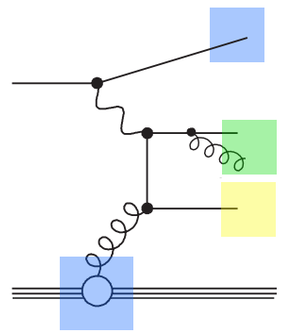
$x_L = E_\gamma / E_p$

$100 \lesssim E_\gamma \lesssim 650$ GeV

First measurement of $ep \rightarrow e' + X + \gamma\,(\pi^0)$ with $\eta_\gamma > 7.9$ at HERA

Data provide important input for understanding of cosmic ray showers

BSM Searches



Searches

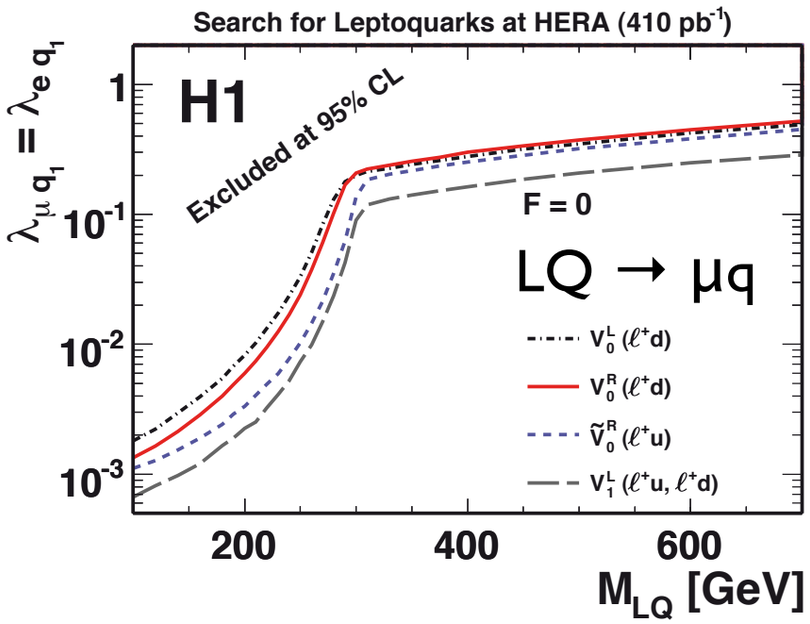
[DESY-10-181]
(Eur. Phys. J C71)

[DESY-11-044]
(submitted to PLB)

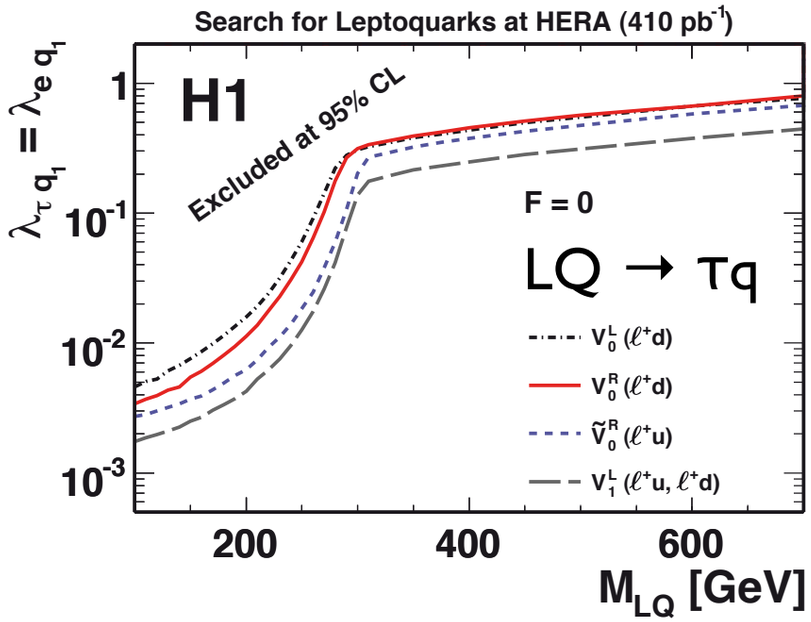
Searches for lepton flavour violation and R-parity violating SUSY performed

Full HERA I+II dataset

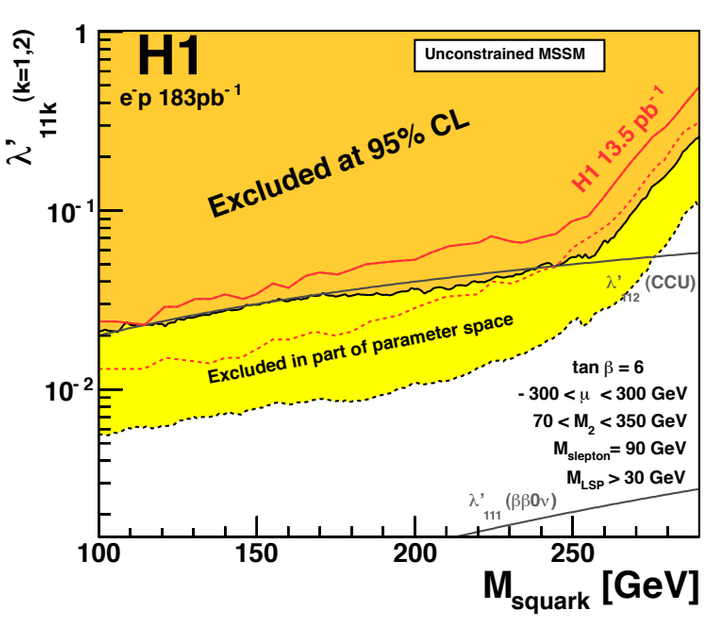
No evidence: new limits on leptoquark production, MSSM and mSUGRA



for $\lambda = 0.3$
eq → LQ → μq excluded up to 712 GeV at 95% CL



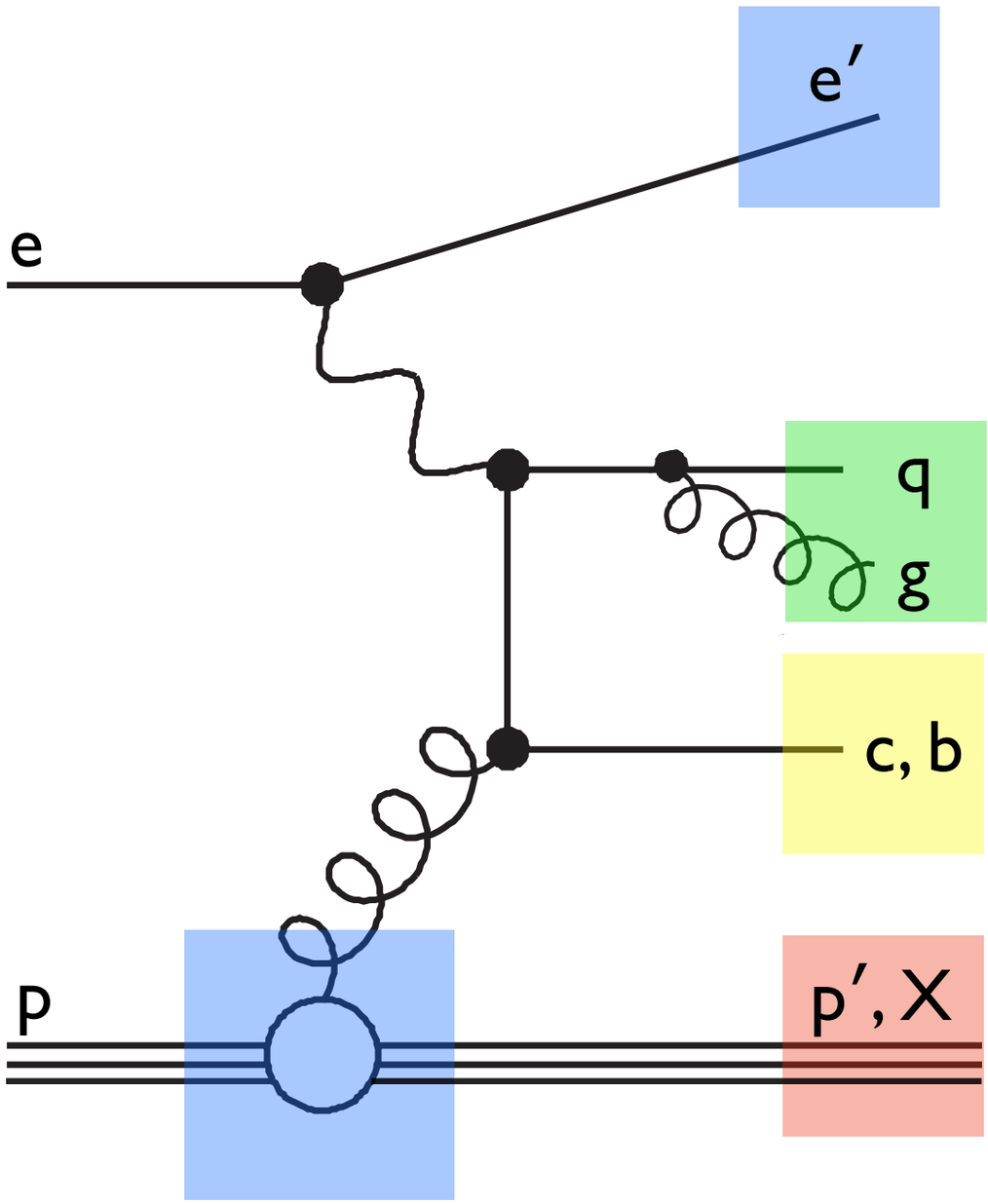
for $\lambda = 0.3$
eq → LQ → τq excluded up to 479 GeV at 95% CL



for $\lambda' = 0.3$
squarks excluded up to M = 275 GeV at 95% CL

Limits competitive with present LHC results

Prospects



High Q^2 measurement with best precision, combination with ZEUS

Jets at low and high Q^2 exploiting HERA-2 dataset, high precision α_s
Strangeness production

Combination of charm data with ZEUS
Beauty measurements

Combination with ZEUS
DPDFs using diffractive jet data

HERAPDF: inclusion of charm, low energy and jet data

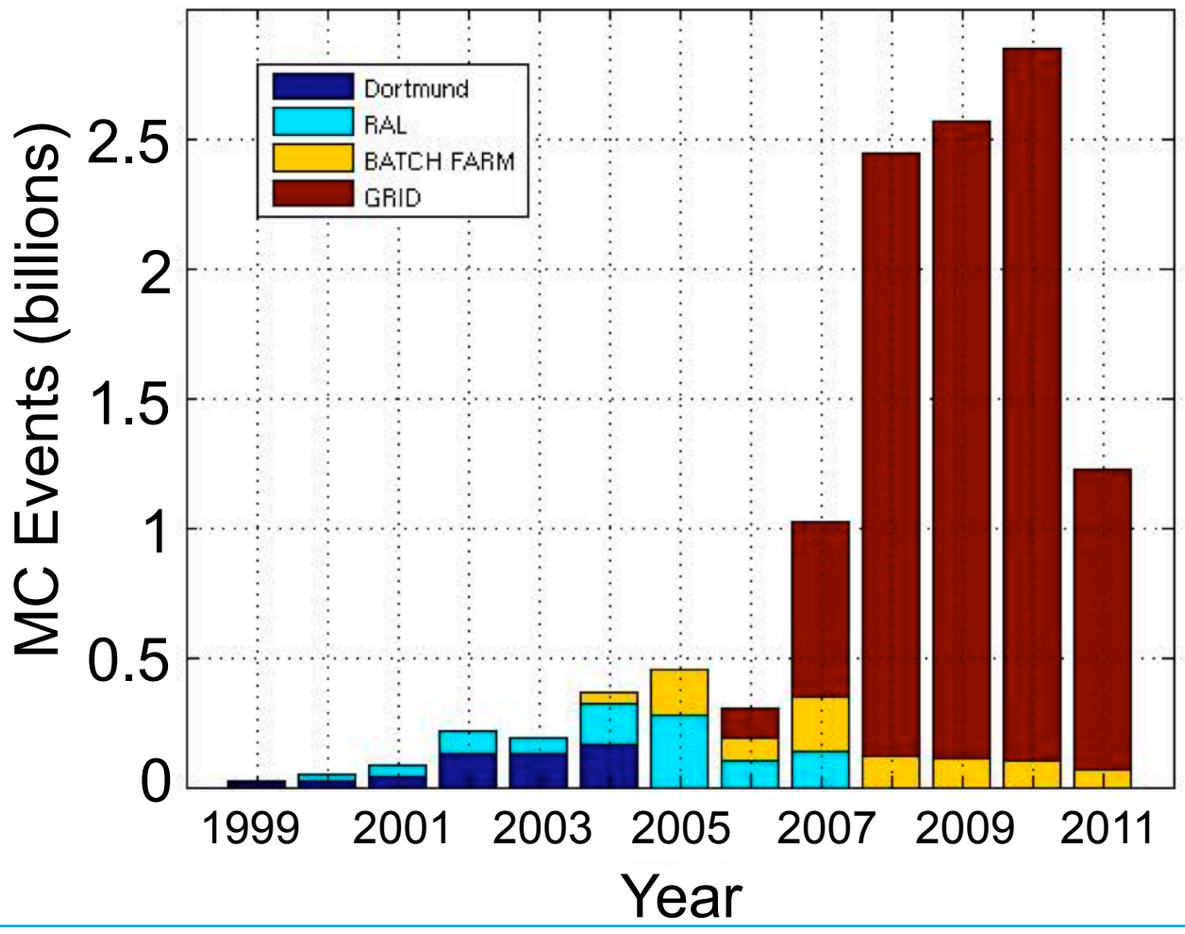
Final BSM searches

Computing

Renewal of H1 hardware to improve efficiency for physics analyses

Transition to SLD5 planned for next month

DST7 reprocessing finished, consistent dataset for all HERA data (1996-2007)



MC production mostly done on GRID with exceptional efficiency

Good computing performance crucial for high statistics, high precision analyses

Many thanks to DESY IT for excellent cooperation and support

Continued support from DESY vital for next few years

H1 Data Preservation

Validation

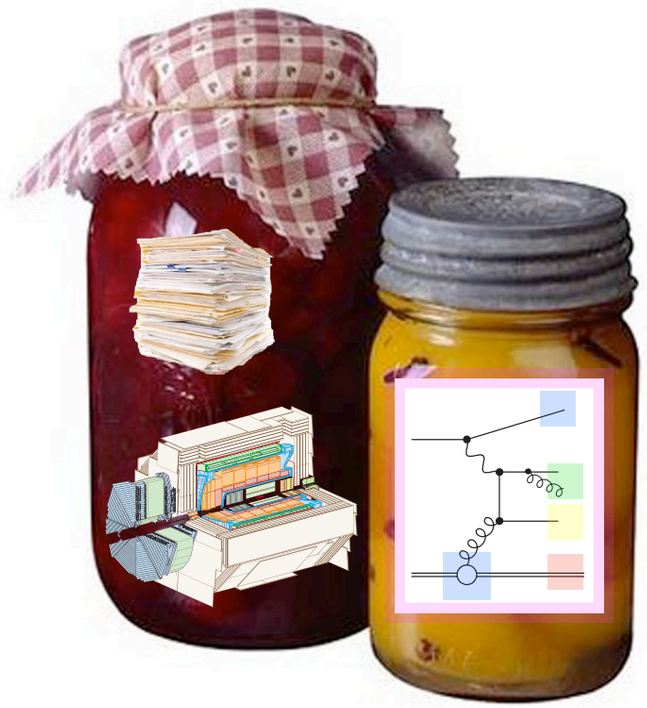
- Crucial for possibility of long-term analysis
- Validate all chains of reconstruction an analyses chains: survey of available tools in progress
- Definition of common interface and structure as joint effort within DESY data preservation task force

Documentation

- Collection of digital and non-digital documentation in progress
- Combined effort with INSPIRE: explore possibilities of data storage and accessibility

DPHEP

- Worldwide initiative supported by all major laboratories and computing centres
- H1 strongly involved
- 5th DPHEP meeting at FNAL, May 16-18



Summary

H1 continues to be very active, some milestones reached

- Many (~30) analyses ongoing, publications planned for 2011/2012

Measurements profit largely from well understood detector, high precision achieved in all physics areas

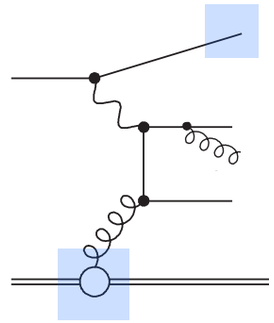
- Computing, MC production and software in excellent shape, vital for achievement of physics goals

Data preservation efforts continuing

- Close cooperation with DESY and other HERA experiments

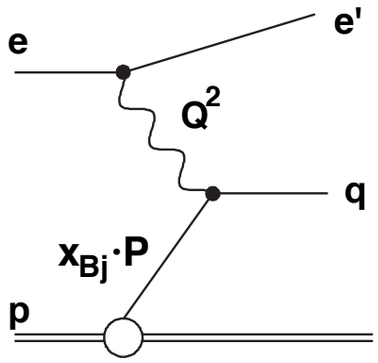
Additional Material

HERAPDF 1.5 NNLO



Proton Structure

[H1prelim-11-042]



Virtuality of exchanged boson: $Q^2 = -(k - k')^2$

Bjorken scaling variable: $x = \frac{Q^2}{2P \cdot q}$

$$\frac{\mathrm{d}^2\sigma^{\pm}_{\mathrm{NC}}}{\mathrm{d}x\mathrm{d}Q^2} = \frac{2\pi\alpha_{\mathrm{em}}}{xQ^4}\left[Y_+F_2(x,Q^2) - y^2F_L(x,Q^2) \mp Y_-xF_3(x,Q^2)\right]$$

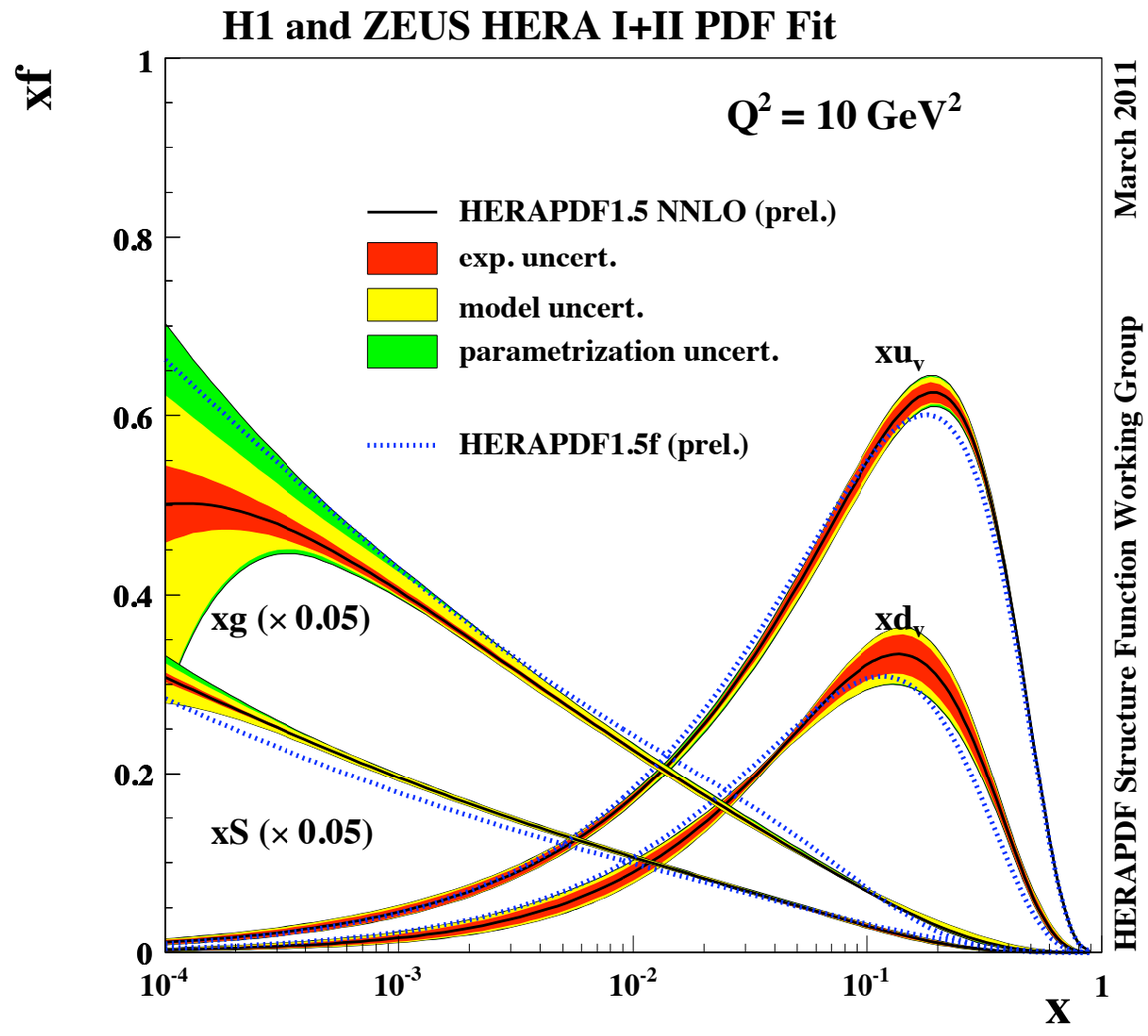
HERA I+II combined NC and CC data

QCD analysis in NNLO of the DGLAP splitting kernels

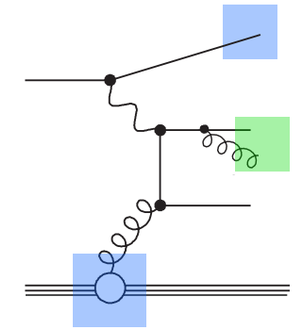
14 free parameters for PDF parametrisation

Fixed value of $\alpha_s = 0.1176$

NNLO PDFs needed at LHC



QCD Analysis Using Jets



Proton Structure

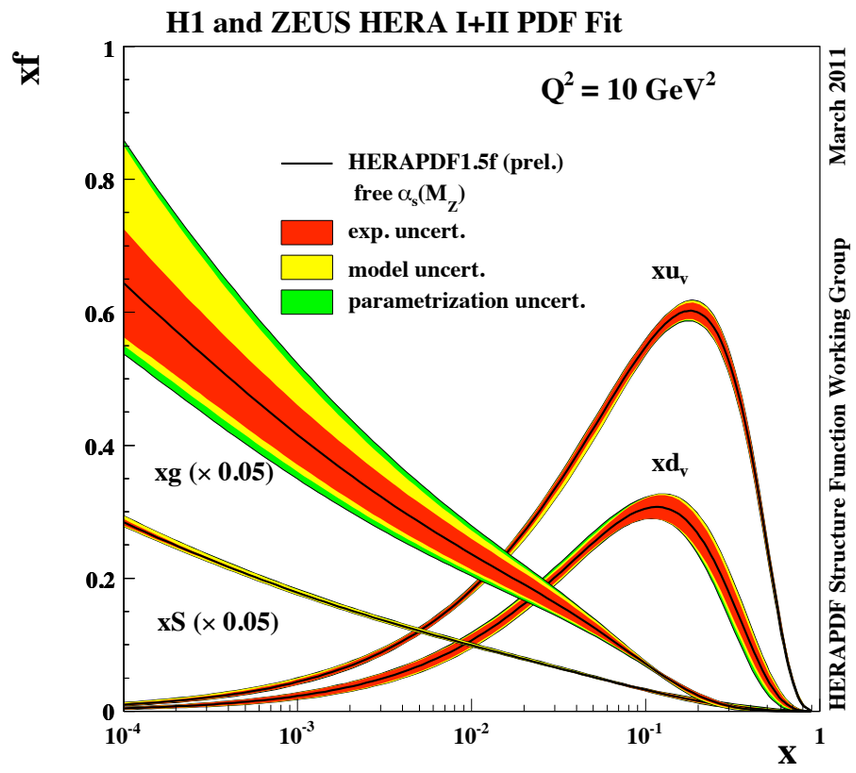
Jets, HFS

[H1prelim-11-034]

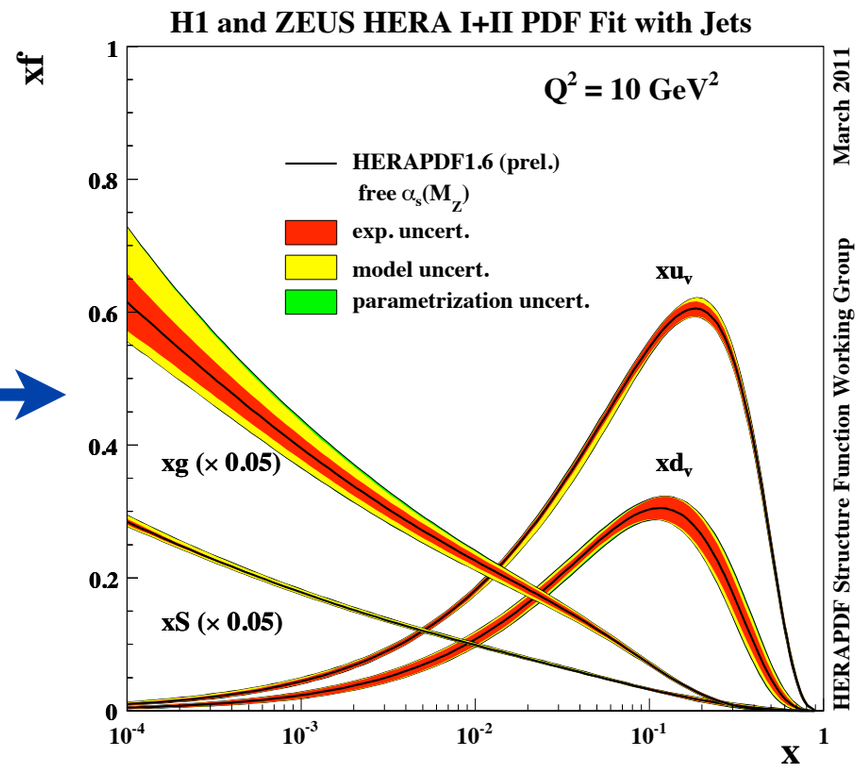
In QCD analysis of inclusive data the gluon PDF is obtained through scaling violations, α_s not well constrained

Use of jet data to stabilise fit for free α_s

free α_s, no Jets

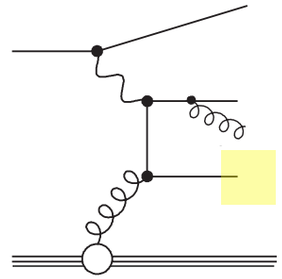


free α_s, with Jets



$$\alpha_s(M_Z) = 0.1202 \pm 0.0013\,(\text{exp}) \pm 0.0007\,(\text{par}) \pm 0.0012\,(\text{had})\,^{+\,0.0045}_{-\,0.0035}\,(\text{scale})$$

D* Cross Section Measurement



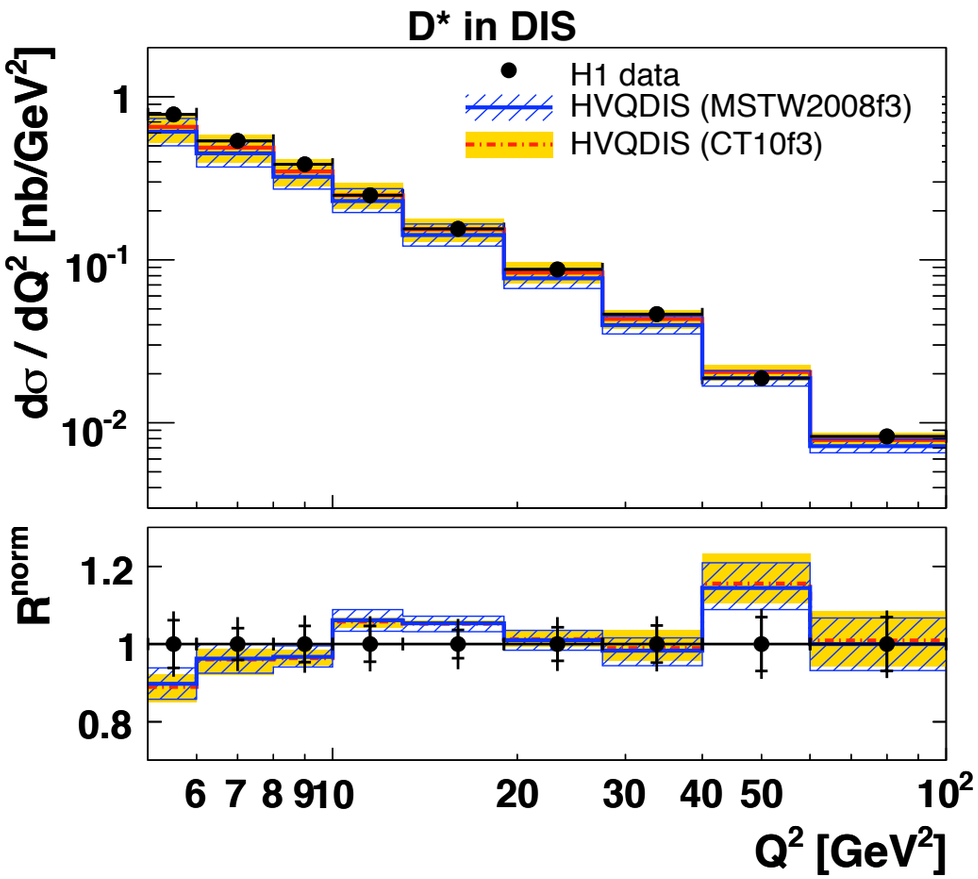
Heavy Flavour

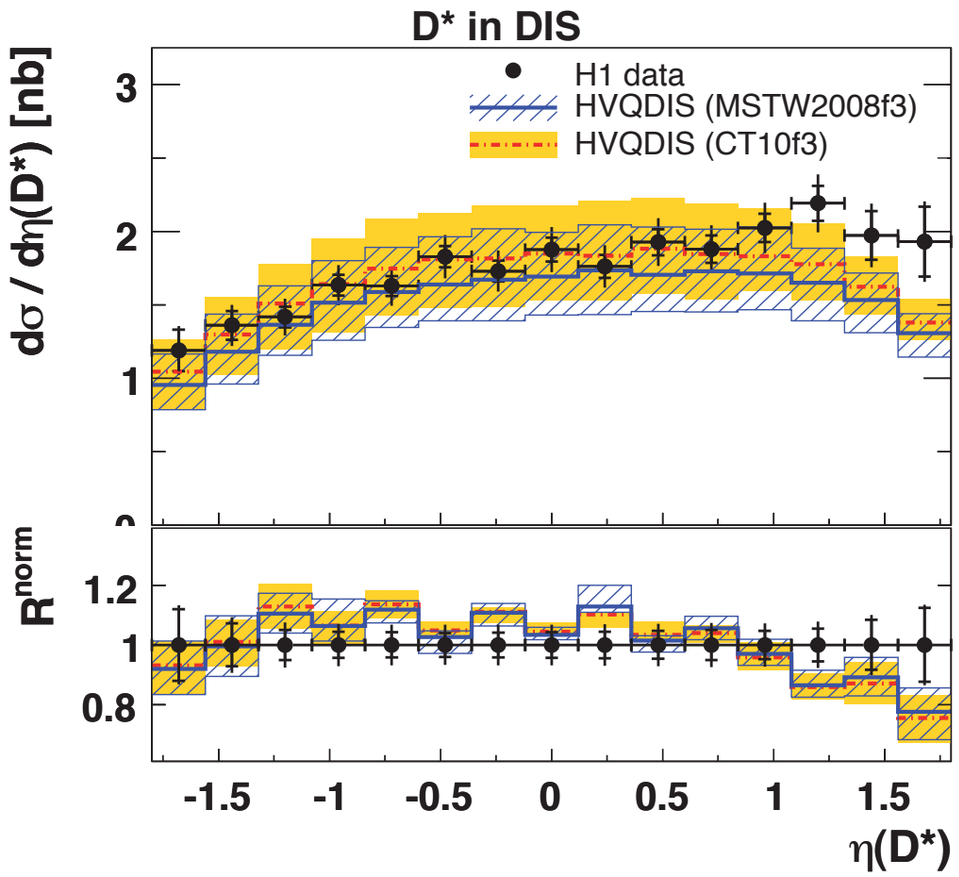
[DESY-11-066]

Charm cross section up to 20% of the inclusive ep cross section

Measurement of $D^{*\pm}$ production at low Q^2

Test of the gluon density and massive QCD calculations





Very precise charm data, well described by HVQDIS