News from CTEQ-TEA PDF analysis

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CT10.1 global PDF analysis

Tentative release: this summer

General-purpose CT10 and CT10W NLO PDFs: published in Physical Review D82, 074024 (2010)

- CT10.1 NLO set: extension of the CT10W analysis, with alternative treatment of some data sets
  - Tevatron Run-2 electron charge asymmetry (A_ℓ)
  - Inclusive jet production
- CT10.2 NNLO PDFs
  - Validation of heavy-quark S-ACOT scheme at $O(\alpha_s^2)$
  - $\alpha_s(M_Z) = 0.118$, $m_c^{pole} = 1.3$ GeV, $m_b^{pole} = 4.75$ GeV (same as in CT10.1 NLO PDFs)

CT10.2 NNLO fit

- Candidate central fits are available (cf. the next slide)

- In progress: studies of parametrization dependence, PDF errors, α_s and m_Q dependence

- Slightly worse χ^2 at NNLO, due to no particular data set:

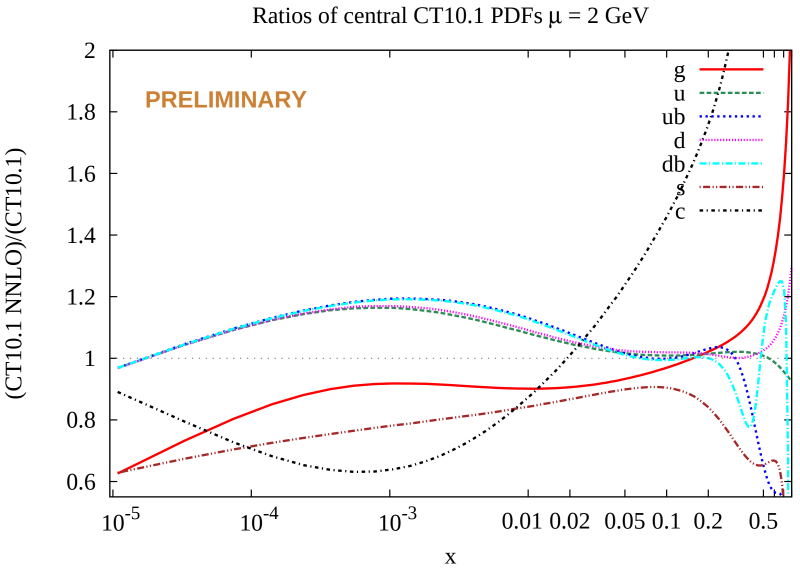
  $\chi^2_{NNLO}/Npt \approx 3154/2765 \approx 1.14$; $\chi^2_{NLO} \approx 3090$

  - Within χ^2 tolerance from CT10 NLO

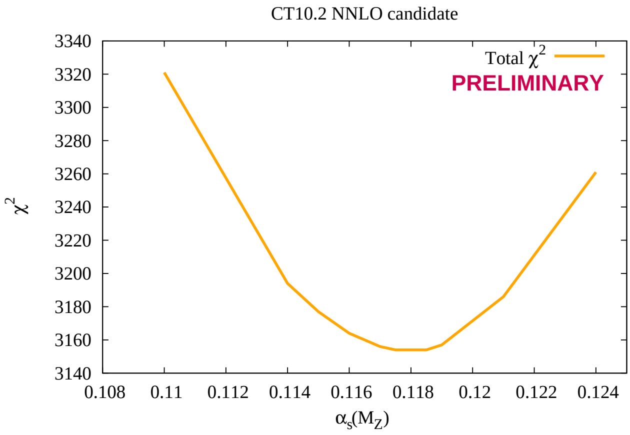
- Differences between NLO and NNLO sets are comparable to such differences in ABM & MSTW NNLO PDF sets

- Reduced gluon at $x \to 0$; increased light quarks at $x \approx 10^{-3}$; lower strangeness

Candidate NNLO fit (compared to CT10.1 NLO)



Dependence on α_s in the CT10.1 fit

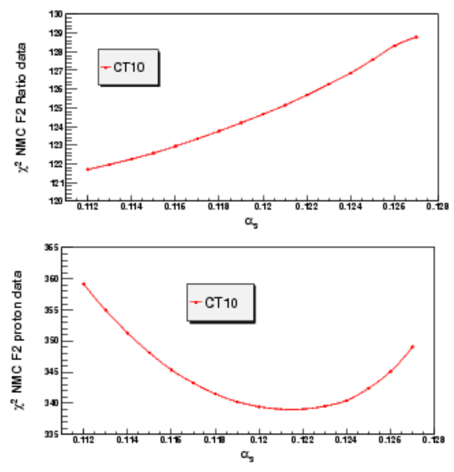


α_s decreases slightly at NNLO, has about the same PDF uncertainty as at NLO

- NLO: $\alpha_s(M_Z) = 0.11964 \pm 0.0064$ at 90% c.l.
- NNLO: $\alpha_s(M_Z) = 0.118 \pm 0.005$

CT10AS fit: NMC F_2^d/F_2^p and F_2^p data vs. α_s

Total χ^2 vs. $\alpha_s(M_Z)$ in the CT10AS series



- We did not find a significant effect of the NMC F_2^d/F_2^p data on α_s, even though a smaller value is mildly preferred. $\chi^2(F_2^d/F_2^p) \approx N_{points} = 123$.

- NMC F_2^p data prefer a larger α_s, but χ^2 is larger than $N_{points} = 201$.

- Replacing F_2^p by the NMC reduced cross section does not significantly change the best-fit value of α_s and its error.

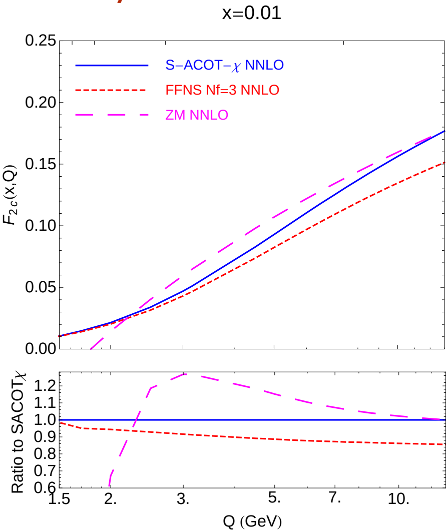
Simplified Aivazis-Collins-Olness-Tung scheme

ACOT, PRD 50 3102 (1994); Collins, PRD 58 (1998) 094002; Kramer, Olness, Soper, PRD (2000) 096007

- Derivation is based upon, and closely follows, the proof of QCD factorization for DIS with massive quarks *(Collins, 1998)*
- Relatively simple
  - One value of N_f (and one PDF set) in each Q range
  - Straightforward matching based on kinematical rescaling
  - Sets $m_Q = 0$ in ME with incoming c or b
- Reduces to the ZM $\overline{MS}$ scheme at $Q^2 \gg m_Q^2$, without additional renormalization
- Reduces to the FFN scheme at $Q^2 \approx m_Q^2$
  - has reduced dependence on tunable parameters at NNLO

S-ACOT scheme: merging FFN and ZM

Preliminary



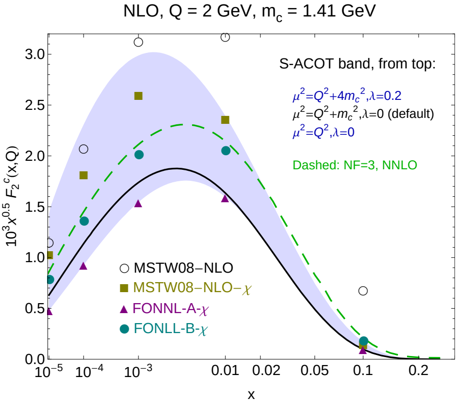
ACOT reduces to FFNS at $Q \approx m_c$ and to ZM at $Q \gg m_c$

Les Houches toy PDFs, evolved at NNLO with threshold matching terms

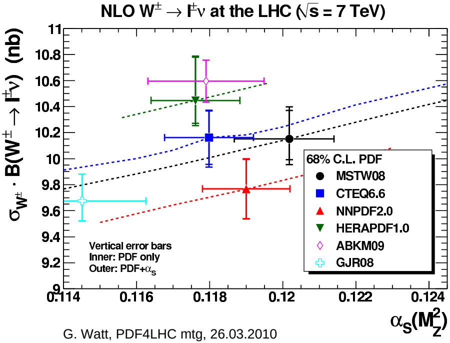
Cancellations between subtractions and other terms at $Q \approx m_c$ and $Q \gg m_c$; details in backup slides

Input parameters of the S-ACOT scheme

At NLO, the charm mass m_c, factorization scale μ, and rescaling variable ζ of CTEQ PDFs are **tuned** to best describe the DIS data



2009 Les Houches HQ benchmarks with toy PDFs; default $\mu = Q$



G. Watt, PDF4LHC mtg, 26.03.2010

W, Z cross sections; $m_c = 1.3$ GeV in CTEQ6.6

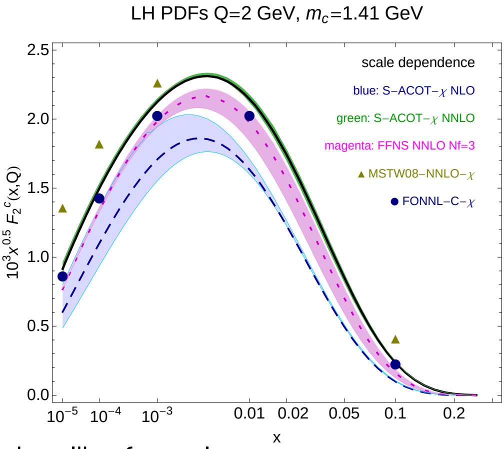
NNLO results for $F_2^{(c)}(x, Q^2)$ - Preliminary

At NNLO and $Q \approx m_c$:

S-ACOT-χ $(N_f = 4)$ $\approx$ FFN $(N_f = 3)$
without tuning

- S-ACOT is numerically close to other NNLO schemes
- NNLO expressions are close to the FONLL-C scheme

(Forte, Laenen, Nason, arXiv:1001.2312).



- ACOT formalism provides recipe-like formulas for implementing NNLO in the GM scheme

Components of inclusive $F_{2,L}(x,Q)$

Components of inclusive $F_{2,L}(x,Q^2)$ are classified according to the quark couplings to the photon

$$F = \sum_{l=1}^{N_l} F_l + F_h \quad (1)$$

$$F_l = e_l^2 \sum_a \left[C_{l,a} \otimes f_{a/p}\right](x,Q), \quad F_h = e_h^2 \sum_a \left[C_{h,a} \otimes f_{a/p}\right](x,Q). \quad (2)$$

At $\mathcal{O}(\alpha_s^2)$:

$$F_h^{(2)} = e_h^2 \left\{ c_{h,h}^{NS,(2)} \otimes (f_{h/p} + f_{\bar{h}/p}) + C_{h,l}^{(2)} \otimes \Sigma + C_{h,g}^{(2)} \otimes f_{g/p} \right\}$$

$$F_l^{(2)} = e_l^2 \left\{ C_{l,l}^{NS,(2)} \otimes (f_{l/p} + f_{\bar{l}/p}) + c^{PS,(2)} \otimes \Sigma + c_{l,g}^{(2)} \otimes f_{g/p} \right\}. \quad (3)$$

Structure of factorized expressions is reminiscent of the ZM scheme (e.g., in MVV 2005)

Components of inclusive $F_{2,L}(x,Q)$

- Lower case $c_{a,b}^{(2)}$, $\hat{f}_{a,b}^{(k)} \to$ ZM expressions
  Zijlstra and Van Neerven PLB272 (1991), NPB383 (1992)
  S. Moch, J.A.M. Vermaseren and A. Vogt, NPB724 (2005)

- Upper case $C_{a,b}^{(2)}$, $F_{a,b}^{(k)}$ $A_{a,b}^{(k)} \to$ coeff. functions, structure functions and subtractions with $m_c \neq 0$,
  Buza *et al.*, NPB 472 (1996); EPJC1 (1998);
  Riemersma, *et al.* PLB 347 (1995); Laenen *et al.* NPB392 (1993)

- All building blocks are available from literature

Components of inclusive $F_{2,L}(x,Q)$

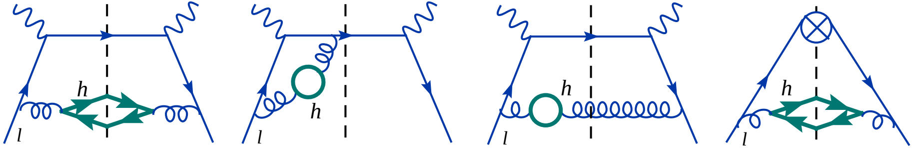
The separation into F_l and F_h (according to the quark's electric charge e_i^2) is valid at all Q

The "light-quark" F_l contains some subgraphs with heavy-quark lines, denoted by "$G_{l,l,heavy}$".

The "heavy-quark" $F_h \neq F_2^c$:

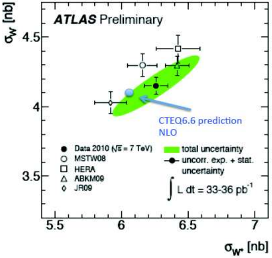
$$F_2^c = F_h + (G_{l,l,heavy})_{real},$$

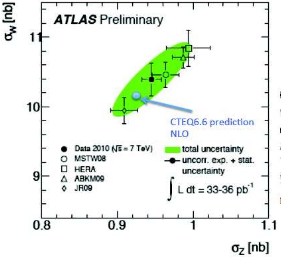
where $G_{i,j} = C_{i,j}^{(2)},\ \ F_{i,j}^{(2)}$, and $A_{i,j}^{(2)}$

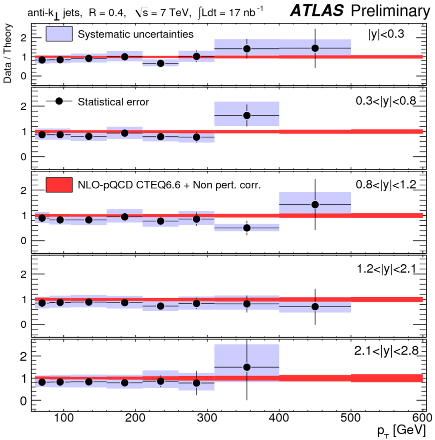


CTEQ PDFs vs. the latest data: LHC

Agreement with many LHC measurements







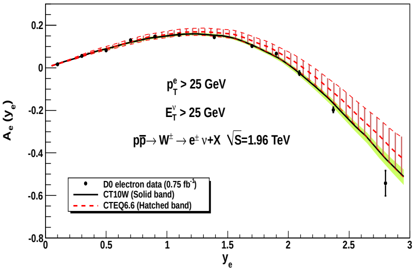
+data on σ_W/σ_Z, $t\bar{t}$, $\gamma\gamma$, etc.

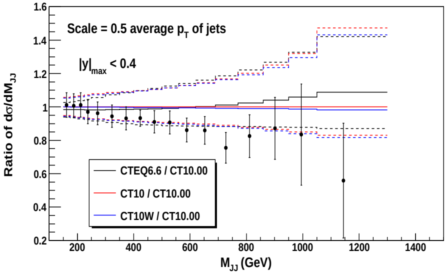
Figures are from ATLAS. Similar results from CMS

Role of assumptions in fits to the Tevatron data

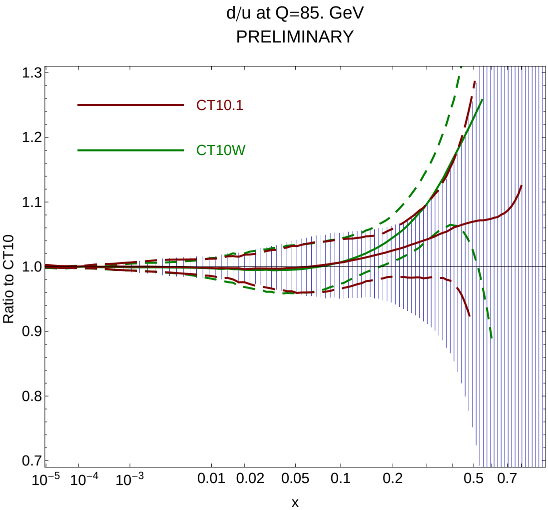
Explored by the CT10.1 analysis

- Only one bin of D0 Run-2 electron charge asymmetry $A_e(y_e)$ with the weakest p_{Te} cut is included
  - reduced theoretical uncertainty
- No D0 Run-2 muon $A_\mu(y_\mu)$ (experim. data for 4.9 fb^{-1} still preliminary)
- Fact. scale $\mu = p_T$ (instead of $p_T/2$) in Tevatron jet cross sections





$d(x,Q)/u(x,Q)$ **at** $Q = 85$ **GeV**



CT10W set:

- is fitted to 3 p_T^e bins of $A_e(y_e)$ and one bin of $A_\mu(y_\mu)$
- prefers a larger slope of d/u than CT10
- has reduced d/u uncertainty
- shows tension with NMC, BCDMS $F_2^{p,d}$ data

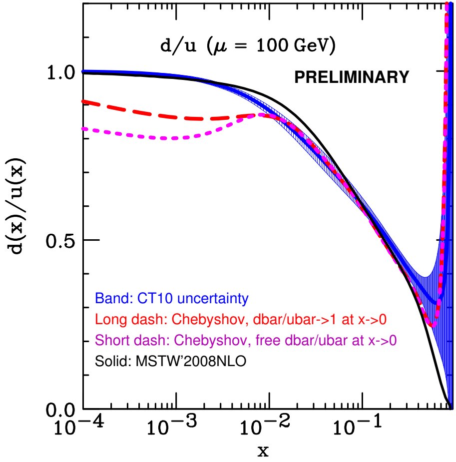
- CT10.1 is fitted only to the $p_T^e > 25$ GeV bin of CDF Run-2 $A_e(y_e)$; does not include $A_\mu(y_\mu)$; has a smaller d/u than CT10W

$A_\ell(y_\ell)$ and PDF parametrization dependence

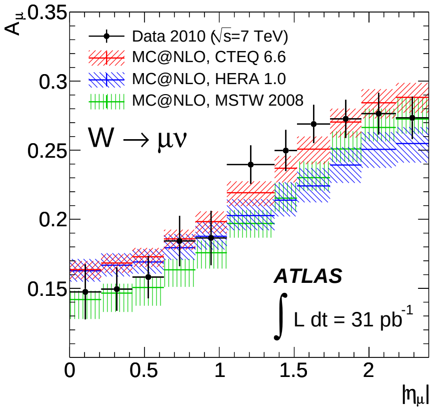
At $x > 0.5$, the slope of d/u is not constrained by the data. Existing parametrizations underestimate the PDF uncertainty on d/u at $x > 0.1$ and $\bar{u}/\bar{d}$ at $x < 0.01$.

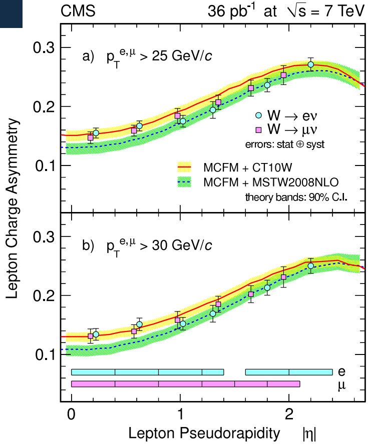
PDFs based on Chebyshov polynomials improve agreement with D0 Run-2 A_e, but are outside of current CTEQ/MSTW bands *(Pumplin)*

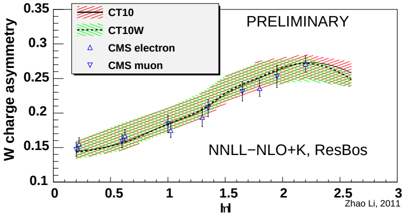
This ambiguity is reduced by $A_\ell(y_\ell)$ at the LHC, which constrains d/u and $\bar{d}/\bar{u}$ at $x \sim 0.01$.



CT10(W) vs. A_ℓ at the LHC



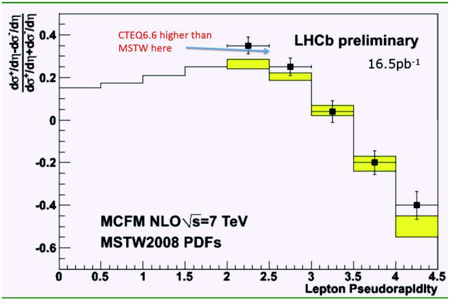


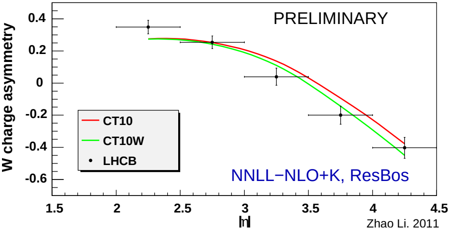


CT10(W) agrees well with the LHC A_ℓ; some differences between NLO and NNLL+NLO

CT10(W) vs. A_ℓ: LHC-B

LHCb asymmetry measurement; from PDF4LHC Mar 7





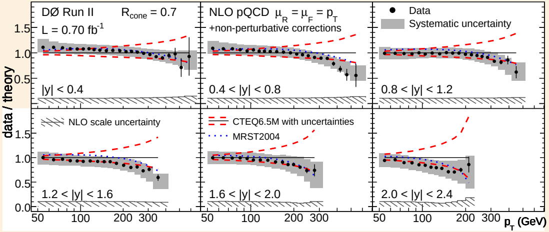
LHC-B marginally prefers CT10W to CT10

Do CTEQ PDFs disagree with D0 (di)-jet data?

Pumplin et al., PRD 80 (2009) 014019: no significant tension between CTEQ PDFs and incl. jet data; D0 presentation exaggerates the "discrepancy"

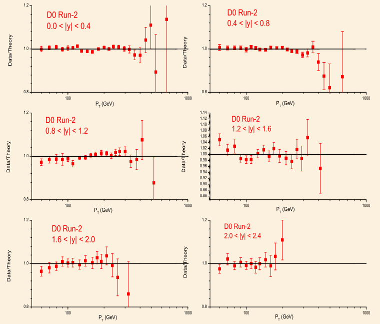
Data and NLO theory, from the D0 paper and CT09 analysis

D0 Coll., arXiv:0802.2400 (700 pb^{-1})



"Discrepancy"?

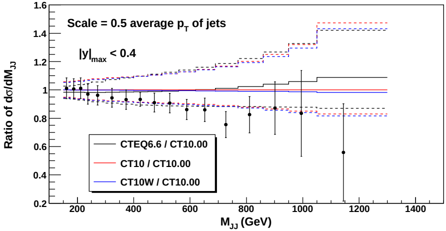
(Shifted D0-Run 2 data)/CT09



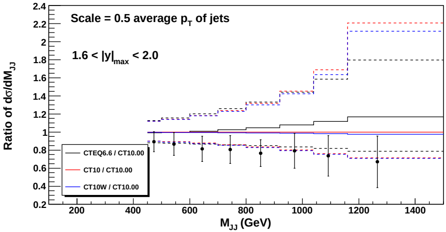
Good agreement

Jet production: issues to consider

- Significant scale dependence
  - Comparisons to CT10 PDFs must use $\mu = p_T^{jet}/2$, the same scale as in the CT10 fit



- Differences between NLO codes; sensitivity to resummation of jet differential distributions *(Alioli et al., arXiv:1012.3380)*



- Correlated systematic shifts reconcile the data with a wider range of PDFs than in the standalone experimental analysis

Resummation effects in (di)jet production

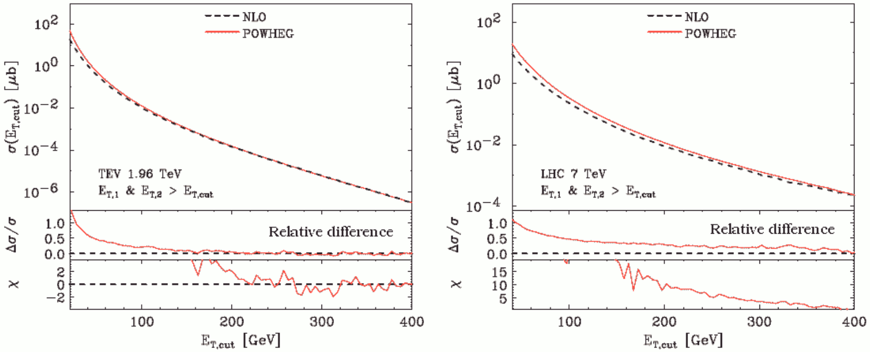


Figure 8: Predictions for the fixed-order NLO cross sections to the analogous POWHEG hardest-emission one, for symmetric cuts on the transverse energies of both the highest and second highest E_T jets, at the Tevatron and LHC, in the left- and right-hand plots respectively.

Alioli et al., arXiv:1012.3380

Les Houches 2011 workshop: ongoing benchmark comparisons of codes for jet cross section calculations

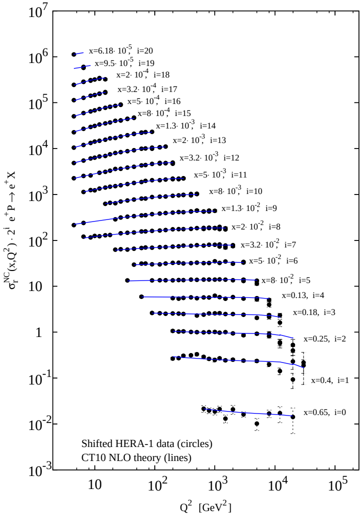
Conclusions

- In the CTEQ-TEA fit, an NNLO calculation for $F_{2,L}^{c,b}$ in the S-ACOT scheme is demonstrated to be viable.
- First NNLO fits are being investigated
- CT10.1: a study of new Tevatron data sets, PDF parametrization issues
- **arXiv:1101.0561**: synopsis of recent CTEQ-TEA publications
  - Search for deviations from DGLAP evolution at small x (not found); PDFs for leading-order showering programs; constraints on color-octet fermions

Backup slides

CT10 parton distribution functions (PRD82, 074024 (2010))

- General-purpose NLO PDFs
- include combined HERA-1 DIS and Tevatron Run-2 inclusive jet data
- detailed analysis of the Tevatron Run-2 W asymmetry (A_ℓ) data
  - CT10 and CT10W sets, with different treatment of A_ℓ
- Additional PDF sets with a varied α_s and for 3 and 4 active flavors



Backup slides

1. Details on S-ACOT-χ scheme at NNLO

S-ACOT input parameters

At $Q \approx m_c$, F_2^c depends significantly on

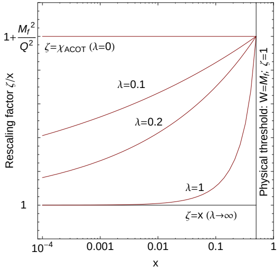
1. **Charm mass:** $m_c = 1.3$ GeV in CT10

2. **Factorization scale:** $\mu = \sqrt{Q^2 + \kappa m_c^2}$; $\kappa = 1$ in CT10

3. **Rescaling variable** $\zeta(\lambda)$ for matching in $\gamma^* c$ channels
(*Tung et al., hep-ph/0110247; Nadolsky, Tung, PRD79, 113014 (2009)*)

$$F_i(x, Q^2) = \sum_{a,b} \int_\zeta^1 \frac{d\xi}{\xi}\, f_a(\xi, \mu)\, C^a_{b,\lambda}\left(\frac{\zeta}{\xi}, \frac{Q}{\mu}, \frac{m_i}{\mu}\right)$$

$$x = \zeta \Big/ \left(1 + \zeta^\lambda \cdot (4m_c^2)/Q^2\right), \text{ with } 0 \le \lambda \lesssim 1$$



CT10 uses

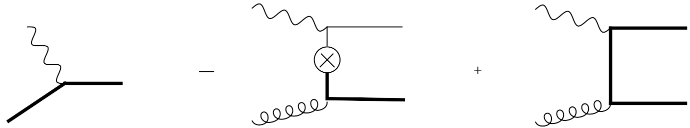
$$\zeta(0) \equiv \chi \equiv x\left(1 + 4m_c^2/Q^2\right),$$

motivated by momentum conservation

Details of the NNLO computation

- NNLO evolution for α_s and PDFs (HOPPET)
  - matching coefficients relating the PDFs in N_f and N_{f+1} schemes *(Smith, van Neerven, et al.)*
- NNLO Wilson coefficient functions for $F_2(x,Q)$, $F_L(x,Q)$
- Pole quark masses or $\overline{MS}$ quark masses as an input
- CT10.1: pole masses $m_c = 1.3$ GeV, $m_b = 4.75$ GeV (as in CT10)

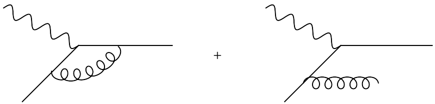
Classes of Feynman diagrams I



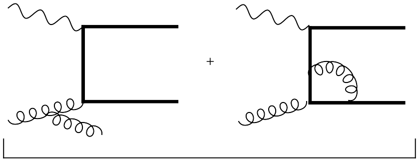
NLO Subtraction

NLO γ^* g

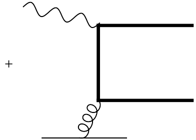
ACOT I: Phys.Rev.D50:3085−3101,1994
ACOT II: Phys.Rev.D50:3102−3118,1994



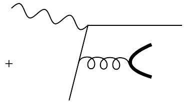
NLO γ^* c



NNLO: γ^* g



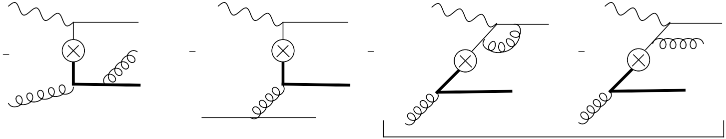
NNLO: γ^* Σ



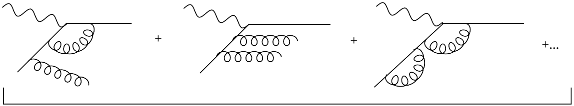
NNLO: γ^* q NS

Riemersma et. al. Phys.Lett. B347 (1995)

Classes of Feynman Diagrams II



NNLO Subtractions   Buza, Matiounine, Smith, Van Neerven, Eur. Phys. J. C 1998



NNLO γ^* c   Moch, Vermaseren and Vogt, Nucl.Phys.B724, 2005

Cancellations between Feynman diagrams

Validity of the S-ACOT calculation was verified by checking for certain cancellations at $Q \approx m_c$ and $Q \gg m_c$

- $Q \approx m_c$:

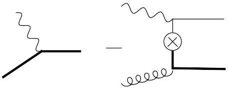
$$D_{C1}^{(2)} \ll D_{C0}^{(2)} \ll D_{C0}^{(1)} \leq F_2^c(x,Q)$$

- $Q \gg m_c$:

$$D_g^{(2)} \ll D_g^{(1)} < F_2^c(x,Q)$$

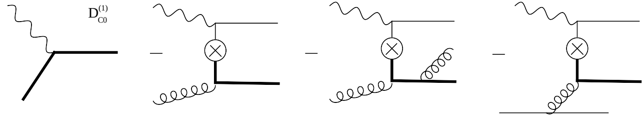
These cancellations are indeed observed in our results

NNLO: Cancellations at $Q^2 \approx m_c^2$



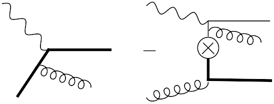
$$D^{(1)}_{C0} = C^{(0)}_Q \otimes c - a_s C^{(0)}_Q \otimes A^{(1)}_{Qg} \otimes g; \qquad a_s = \frac{\alpha_s}{(4\pi)} \qquad (1)$$

$D^{(1)}_{C0}$



$D^{(2)}_{C0}$

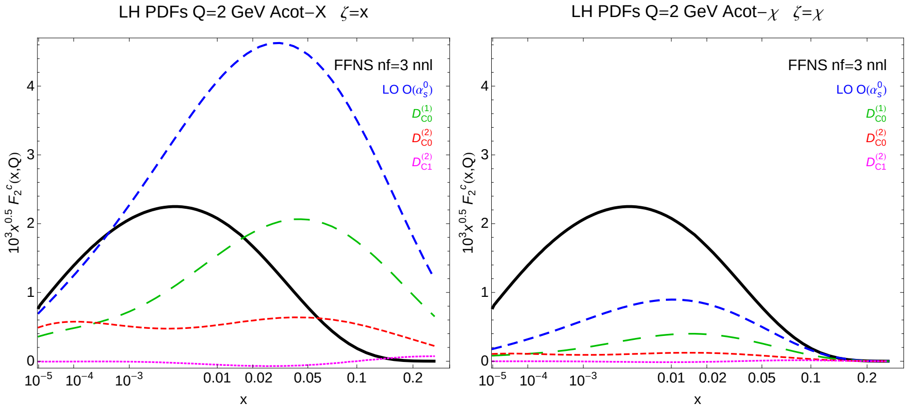
$$D^{(2)}_{C0} = D^{(1)}_{C0} - a_s^2 C^{(0)}_Q \otimes A^{(2),S}_{Qg} \otimes g - a_s^2 C^{(0)}_Q \otimes A^{(2),PS}_{Q\Sigma} \otimes \Sigma \qquad (2)$$



$$D^{(2)}_{C1} = C^{(1)}_Q \otimes c - a_s^2\, C^{(1)}_Q \otimes A^{(1)}_{Qg} \otimes g \qquad (3)$$

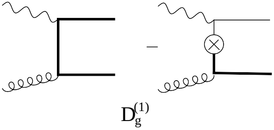
$D^{(2)}_{C1}$

NNLO: Cancellations at $Q^2 \approx m_c^2$

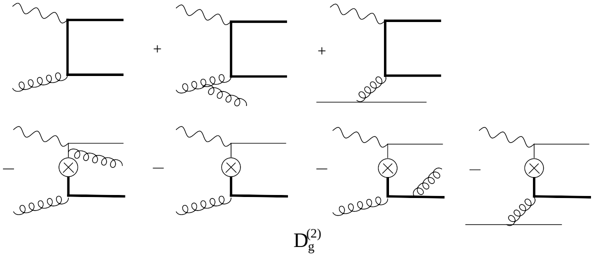


$D_{C1}^{(2)} \ll D_{C0}^{(2)} \ll D_{C0}^{(1)} \leq$ FFN at NNLO both for $\zeta = x$ and $\zeta = \chi$.

NNLO: Cancellations at $Q \gg m_c$



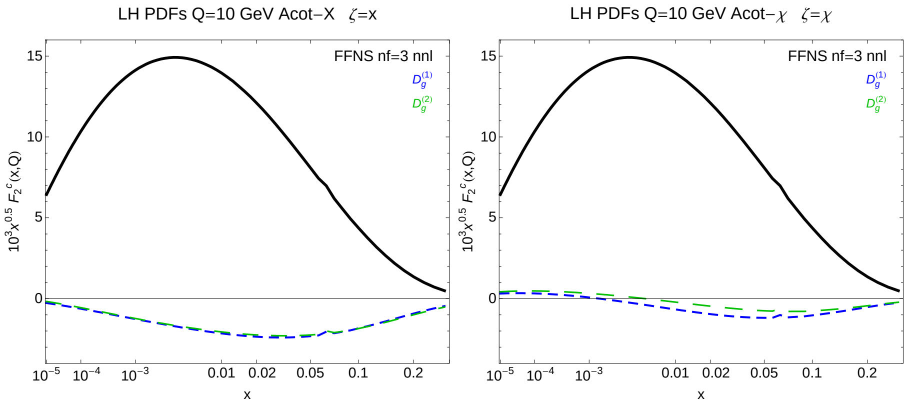
$$D_g^{(1)} \equiv C_g^{(1)} = a_s \left(F_g^{(1)} \otimes g - C_Q^{(0)} \otimes A_{Qg}^{(1),S} \otimes g \right) \qquad (4)$$



$$D_g^{(2)} = D_g^{(1)} + a_s^2 \Big[\tilde{F}_g^{(2)} \otimes g + \tilde{F}_\Sigma^{(2)} \otimes \Sigma - C_Q^{(1)} \otimes A_{Qg}^{(1),S} \otimes g$$
$$- C_Q^{(0)} \otimes A_{Qg}^{(2),S} \otimes g - C_Q^{(0)} \otimes A_{Q\Sigma}^{(2),PS} \otimes \Sigma \Big] \qquad (5)$$

$D_g^{(1)}$ is of order of α_s^2 while $D_g^{(2)}$ is of order of α_s^3.

F_2^c at NNLO: Cancellations at $Q = 10$ GeV



$D_g^{(2)} \ll D_g^{(1)} <$ FFN at NNLO $<$ ACOT

$\log \frac{Q^2}{m_c^2}$ terms in FFN are cancelled well by subtractions.

NNLO results for $F_2^{(c)}(x, Q^2)$ - Preliminary

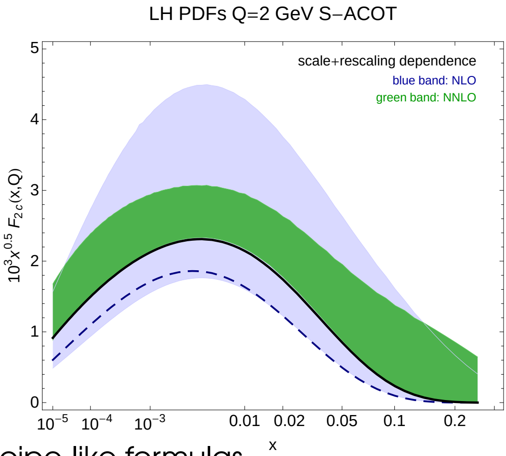
At NNLO and $Q \approx m_c$:

S-ACOT-χ $(N_f = 4) \approx$ FFN $(N_f = 3)$
without tuning

- S-ACOT is numerically close to other NNLO schemes

- NNLO expressions are close to the FONLL-C scheme

(Forte, Laenen, Nason, arXiv:1001.2312).



- ACOT formalism provides recipe-like formulas for implementing NNLO in the GM scheme

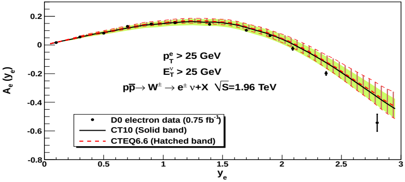
- Dependence on rescaling is also reduced

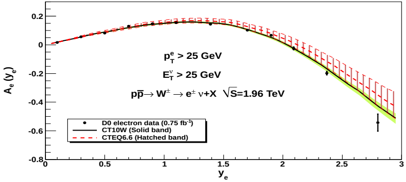
Backup slides
2. W charge asymmetry

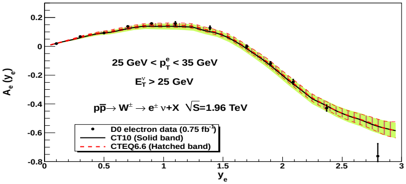
CT10(W): radiative contributions to $A_\ell(y_\ell)$

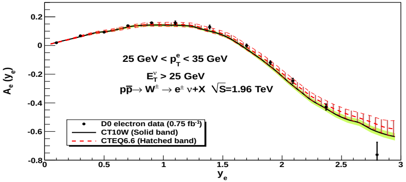
- **Default calculation:** $A_\ell(y)$ at NNLL-NLO, using lookup tables for $\sigma(p_T^\ell, y_\ell)_{NNLL+NLO}/\sigma(p_T^\ell, y_\ell)_{LO}$ from ResBos *(Balazs, Yuan, PRD 56, 5558 (1997); Landry, Brock, P.N. Yuan, PRD67, 073016 (2003))*.
- **Cross check:** include NNLO corrections at $Q_T \approx M_W$ *(Arnold & Reno, 1989)*; $A_\ell(y_\ell)$ changes by a few percent at the highest y_ℓ and $p_T > 35$ GeV
  - magnitude of changes is comparable with full NNLO terms *(Catani, Ferrera, and Grazzini, JHEP 05, 006 (2010))*
  - **changes are small compared to the experimental errors**

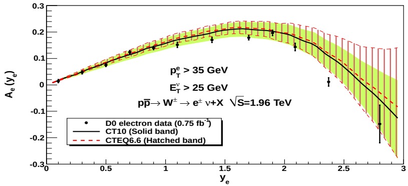
CT10 and CT10W predictions for $A_e(y_e)$ (D0 Run-2)

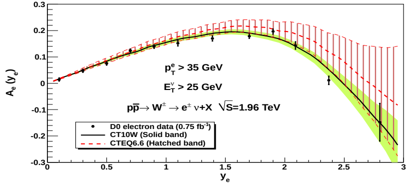












CDF Run-2 and D0 Run-2 W lepton asymmetry

- CT10 does not include the Run-2 $A_\ell \Rightarrow$ disagrees with A_ℓ, due to tension between A_ℓ and DIS F_2^d/F_2^p.
- CT10W includes 3 $p_{T\ell}$ bins of the electron $A_e(y_e)$ and one bin of $A_\mu(y_\mu)$ from D0 Run-2 (2008).
- CT10.1 includes only the $p_T > 25$ bin of $A_e(y_e)$
- Many other PDFs fail.

Agreement of PQCD with D0 $A_e(y_e)$	χ^2/npt	Source or comments
CTEQ6.6, NLO	191/36=5.5	*Our study;* *Resbos, NNLL-NLO*
CT10W, NLO	**78/36=2.2** **With $A_\mu(y_\mu)$: 88/47=1.9**	
ABKM'09, NNLO	540/24=22.5	*Catani, Ferrera, Grazzini, JHEP 05, 006 (2010)*
MSTW'08, NNLO	205/24=8.6	
JR09VF, NNLO	113/24=4.7	

Why difficulties with fitting $A_\ell(y_\ell)$?

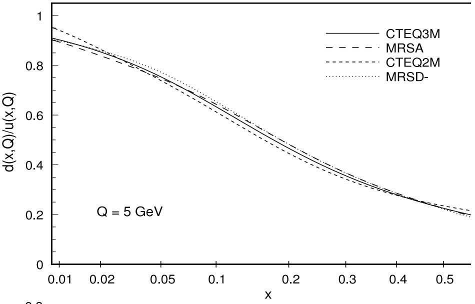
1. $A_\ell(y_\ell)$ is very sensitive to the average slope s_{du} of $d(x, M_W)/u(x, M_W)$

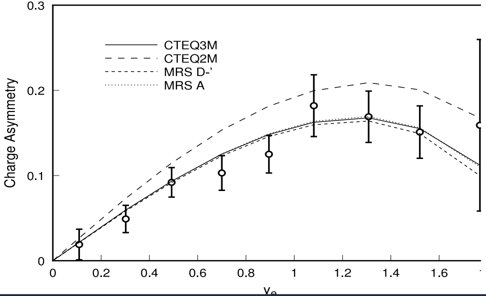
$$A_\ell(y_\ell) \sim A_\ell(y_W)|_{LO} \propto \frac{1}{x_1 - x_2}\left[\frac{d(x_1)}{u(x_1)} - \frac{d(x_2)}{u(x_2)}\right]; \quad x_{1,2} = \frac{Q}{\sqrt{s}} e^{\pm y_W}$$

Berger, Halzen, Kim, Willenbrock, PRD 40, 83 (1989); Martin, Stirling, Roberts, MPLA 4, 1135 (1989); PRD D50, 6734 (1994); Lai et al., PRD 51, 4763 (1995)

2. Constraints on s_{du} by fixed-target $F_2^d(x,Q)/F_2^p(x,Q)$ are affected by nuclear and higher-twist effects
Accardi, Christy, Keppel, Monaghan, Melnitchouk, Morfin, Owens, PRD 81, 034016 (2010)

Challenges with fitting $A_\ell(y_\ell)$





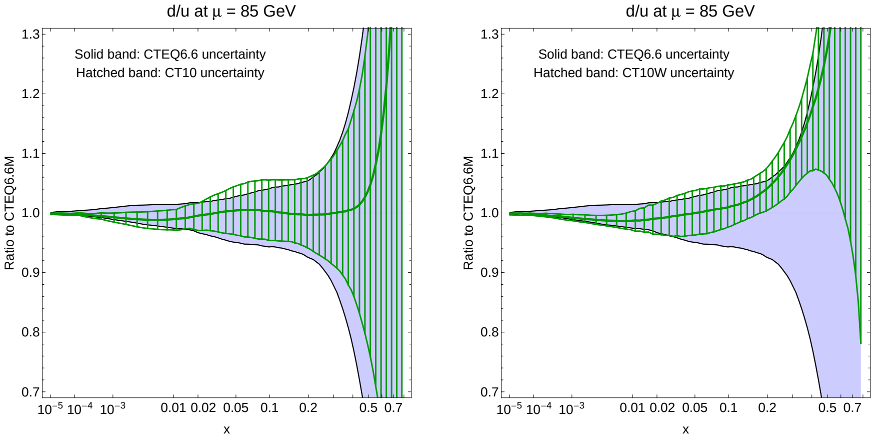
Small changes in s_{du} cause significant variations in A_ℓ

Lai et al., PRD 51, 4763 (1995)

Alternative constraints on d/u by $F_2^d(x,Q)/F_2^p(x,Q)$ from fixed-target DIS are affected by nuclear and higher-twist effects

Accardi, Christy, Keppel, Monaghan, Melnitchouk, Morfin, Owens, PRD 81, 034016 (2010)

$d(x,Q)/u(x,Q)$ at $Q = 85$ GeV

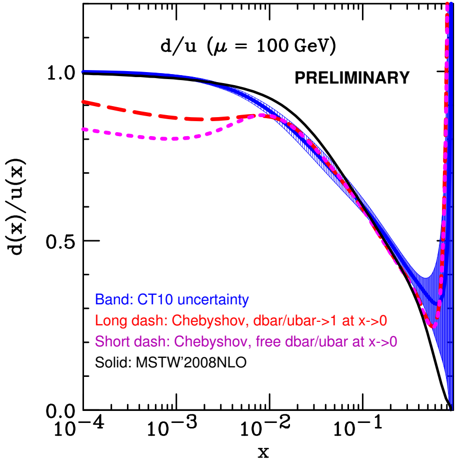


- CT10W prefers a larger slope of d/u, has a smaller uncertainty than CTEQ6.6 or CT10
- CT10W shows tension with NMC, BCDMS $F_2^{p,d}$ data

Why difficulties with fitting $A_\ell(y_\ell)$?

3. Existing parametrizations underestimate the PDF uncertainty on d/u

PDFs based on Chebyshov polynomials improve agreement with D0 Run-2 A_e, but are outside of current CTEQ/MSTW bands *(Pumplin)*



This ambiguity is reduced by $A_\ell(y_\ell)$ at the LHC, which constrains d/u and $\bar{d}/\bar{u}$ at $x \sim 0.01$.

Why difficulties with fitting $A_\ell(y_\ell)$?

4. Experimental A_ℓ with lepton $p_{T\ell}$ cuts is sensitive to $d\sigma/dq_T$ of W boson at transverse momentum $q_T \to 0$.

- Fixed-order (N)NLO calculations (DYNNLO, FEWZ, MCFM,...) predict a wrong shape of $d\sigma/dq_T$ at $q_T \to 0$.
- Small-q_T resummation correctly predicts $d\sigma/dq_T$ in this limit.
- CT10(W) PDFs are fitted using a NNLL-NLO+K resummed prediction for A_ℓ (ResBos); **must not be used with fixed-order predictions for A_ℓ.**

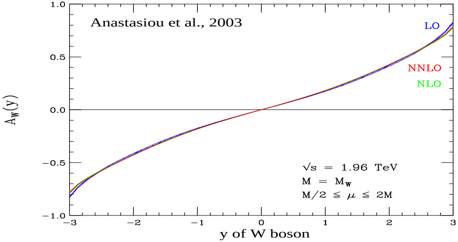
For example:

$$\chi^2(\text{CT10W+ResBos}) = 1.9\, N_{pt} \text{ (us)};$$

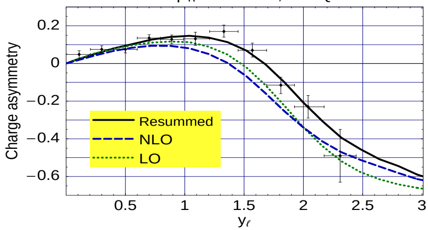
$$\chi^2(\text{CT10W+DYNNLO}) = 8.4\, N_{pt} \text{ (NNPDF)}$$

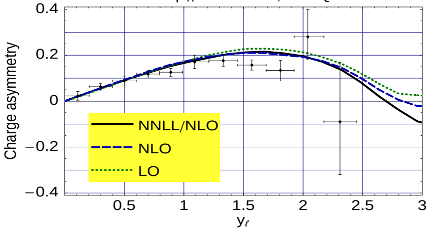
Charge asymmetry in p_T^e bins (CDF Run-2, 207 pb^{-1})

Without the p_T^e cut (FEWZ):



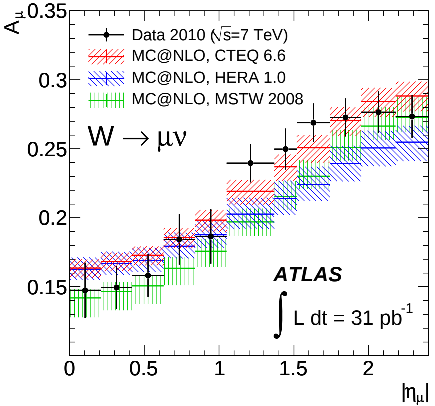
With p_{Te} cuts imposed, $A_{ch}(y_e)$ is sensitive to small-Q_T resummation

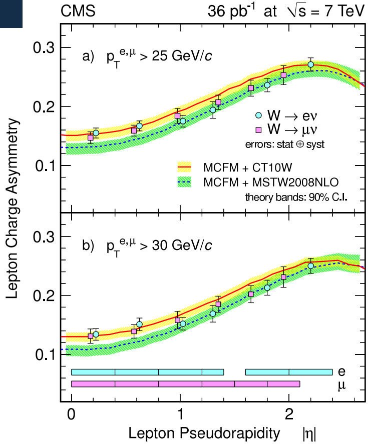


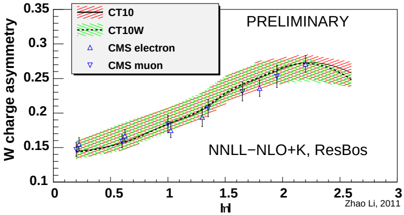


PN, 2007, unpublished; arXiv:1101.0561

CT10(W) vs. A_ℓ at the LHC



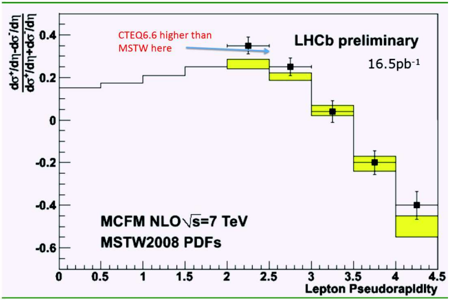


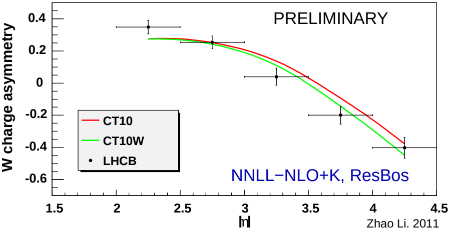


CT10(W) agrees well with the LHC A_ℓ; some differences between NLO and NNLL+NLO

CT10(W) vs. A_ℓ: LHC-B

LHCb asymmetry measurement; from PDF4LHC Mar 7

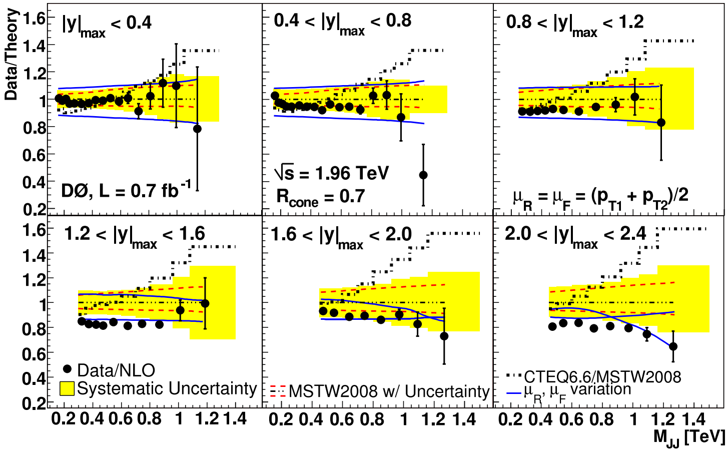




LHC-B marginally prefers CT10W

Dijet mass distributions from D0 Run-2

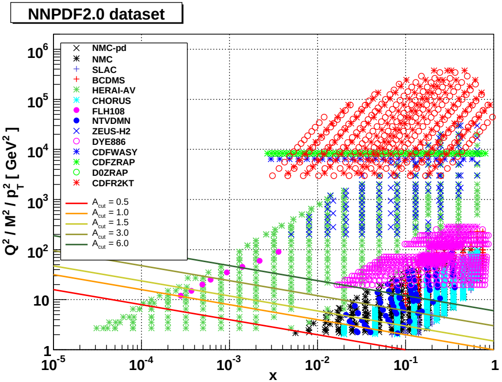
0.7 fb^{-1}, arXiv:1002.4594



The data appear to disfavor CTEQ6.x/CT10 NLO predictions, for the selected theory parameters

Backup slides
3. Search for deviations from DGLAP evolution at small x and Q

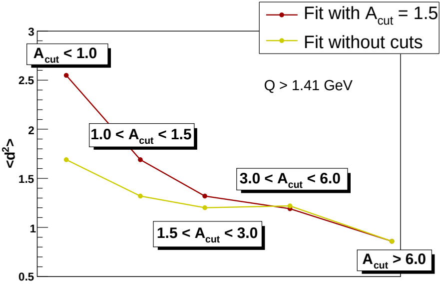
A_{cut} fits to combined HERA data



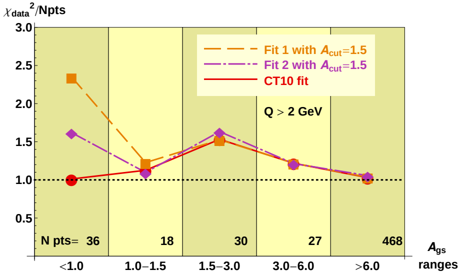
Fitting procedure:

- Include only DIS data above an A_{cut} line
- Compare the resulting PDFs with DIS data below the A_{cut} line, in a region that is "connected" by DGLAP evolution

CT10: A_{cut} fits to DIS data at $Q > Q_0 = 2$ GeV



Caola, Forte, Rojo, arXiv:1007.5405v2

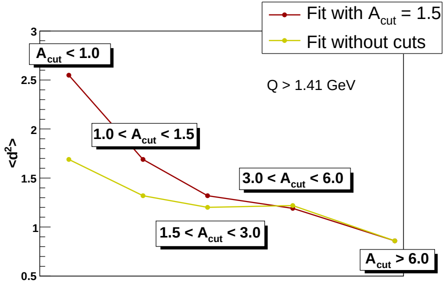


Motivation

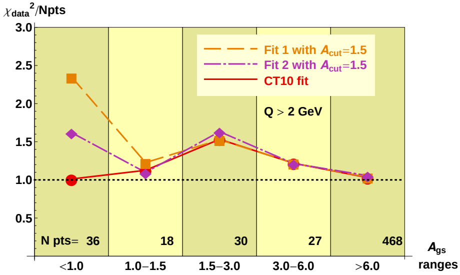
Search for deviations from DGLAP evolution at smallest x and Q

- Follow the procedure proposed by NNPDF *(Caola, Forte, Rojo, arXiv:1007.5405)*

CT10: A_{cut} fits to DIS data at $Q > Q_0 = 2$ GeV



Caola, Forte, Rojo, arXiv:1007.5405v2



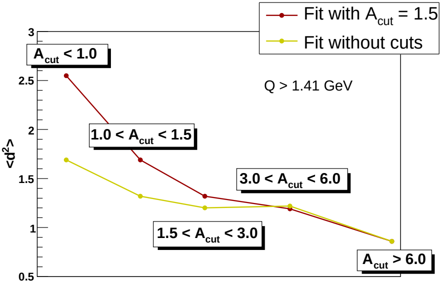
CT10

Two CT10-like fits to data at $A_{gs} > 1.5$, with different parametrizations of $g(x, Q)$

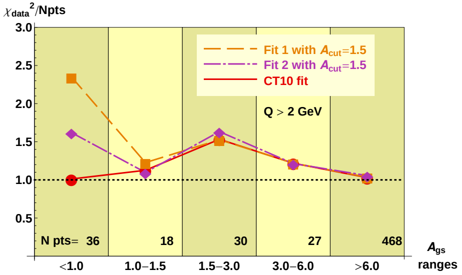
$$\chi_i^2 = \frac{(\text{Shifted Data} - \text{Theory})^2}{\sigma_{uncor}^2}$$

Large syst. shifts at $A_{gs} < 1.0$, in a pattern that could mimic a slower Q^2 evolution

CT10: A_{cut} fits to DIS data at $Q > Q_0 = 2$ GeV



Caola, Forte, Rojo, arXiv:1007.5405v2



CT10, cont.

$\delta\chi^2 \sim 0$ at $A_{gs} > 1.0$

(no difference)

$\delta\chi^2 = 0 - 1.5$ at $A_{gs} < 1.0$,

with large uncertainty

$\Rightarrow$ Disagreement with the "DGLAP-connected" data at $A_{gs} < A_{cut}$ is not supported by the CT10 fit