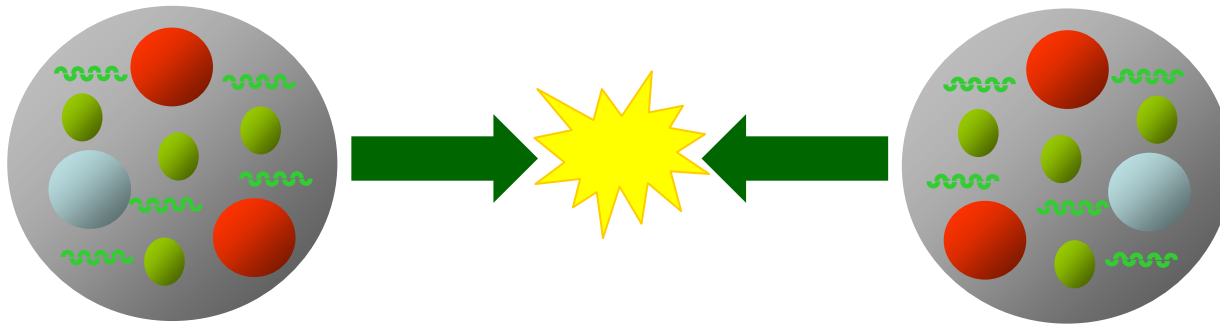


News From MSTW



James Stirling
Cambridge University

with

Alan Martin, Robert Thorne, Graeme Watt



recent MSTW publications

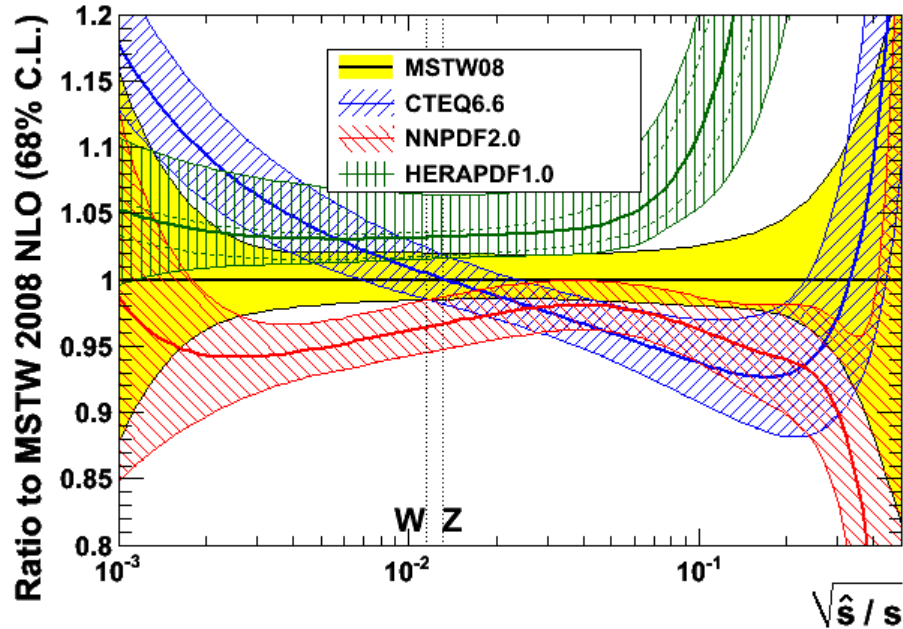
- arXiv:0901.0002 “Parton distributions for the LHC”
[MSTW2008 sets]
- arXiv:0905.3531 “Uncertainties on α_s in global PDF analyses and implications for predicted hadronic cross sections”
- arXiv:1006.2753 “The effects of combined HERA and recent Tevatron $W \rightarrow l\nu$ charge asymmetry data on the MSTW PDFs”
- arXiv:1007.2624 “Heavy-quark mass dependence in global PDF analyses and 3- and 4-flavour parton distributions”
- (in preparation) Graeme Watt, “Parton distribution function dependence of benchmark Standard Model cross sections at the 7 TeV LHC”

 no new published global fit since MSTW2008 ... but plenty of ongoing studies

we note convergence of pdfs!

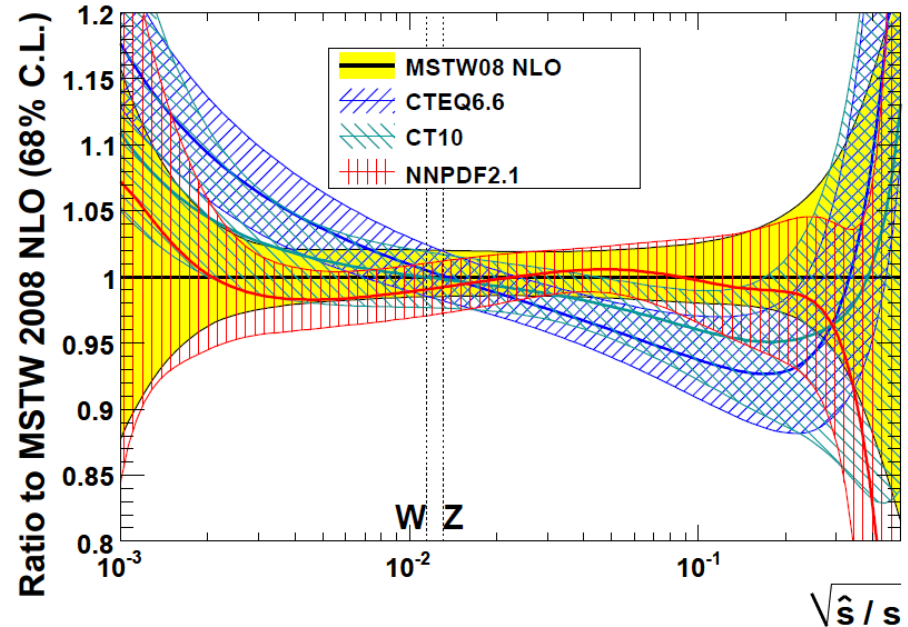
plots from Graeme Watt

$\Sigma_q(q\bar{q})$ luminosity at LHC ($\sqrt{s} = 7$ TeV)



2010

$\Sigma_q(q\bar{q})$ luminosity at LHC ($\sqrt{s} = 7$ TeV)

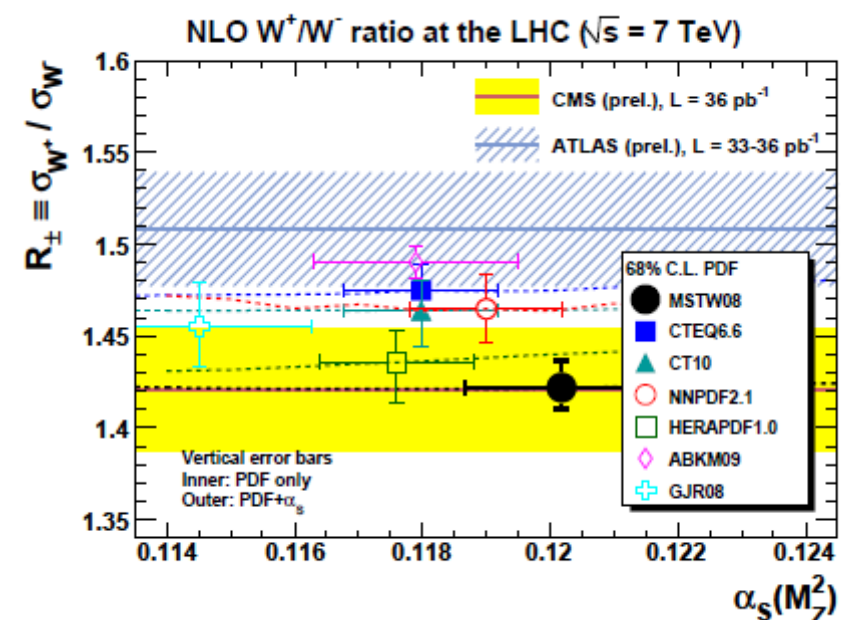
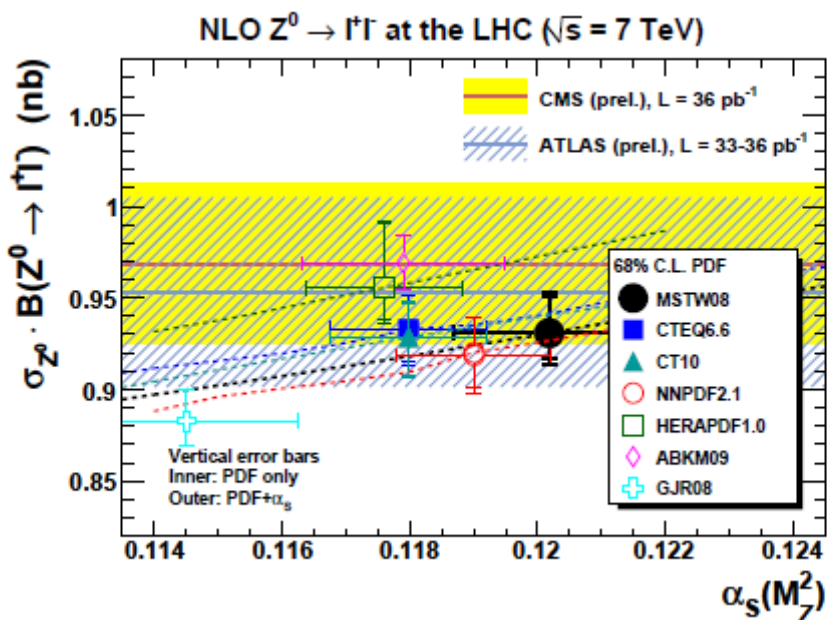
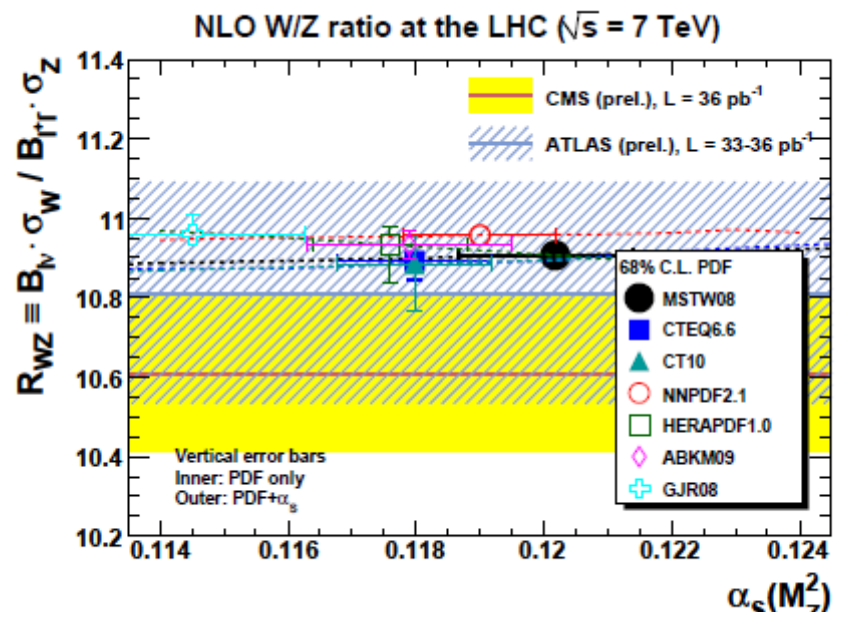
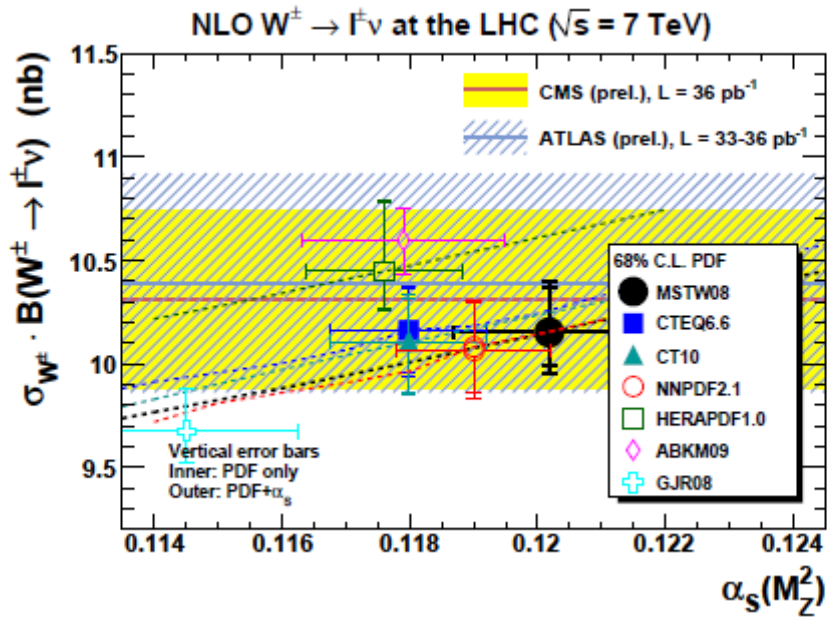


2011

... although still some differences with ABKM, JR, HERAPDF

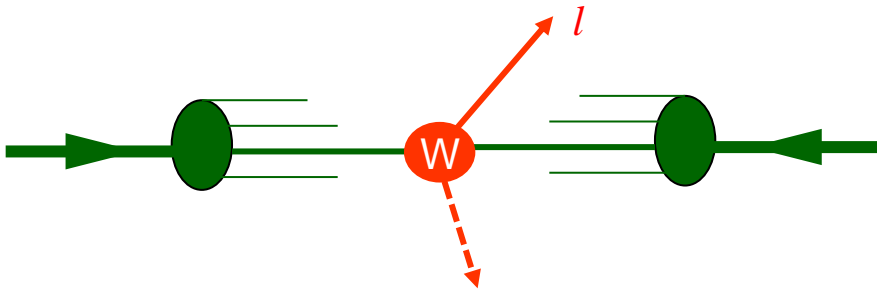
MSTW08 *vs.* recent LHC data

- W, Z production cross sections and ratios
- W charged lepton rapidity asymmetry
- top pair production cross section

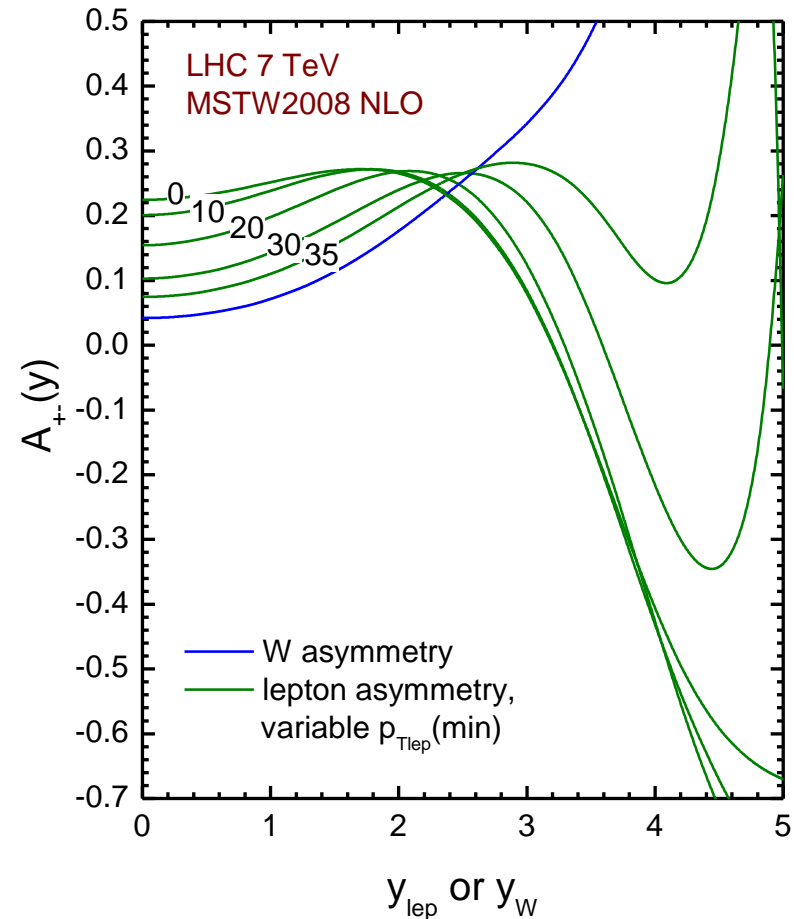


plots from Graeme Watt

$W \rightarrow l\nu$ rapidity asymmetry at LHC

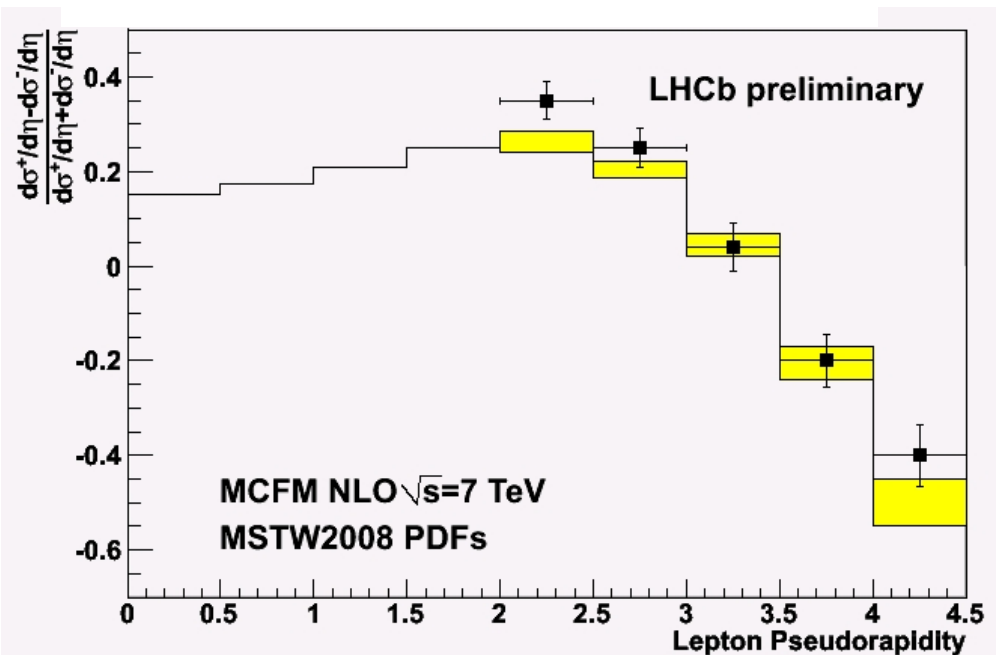
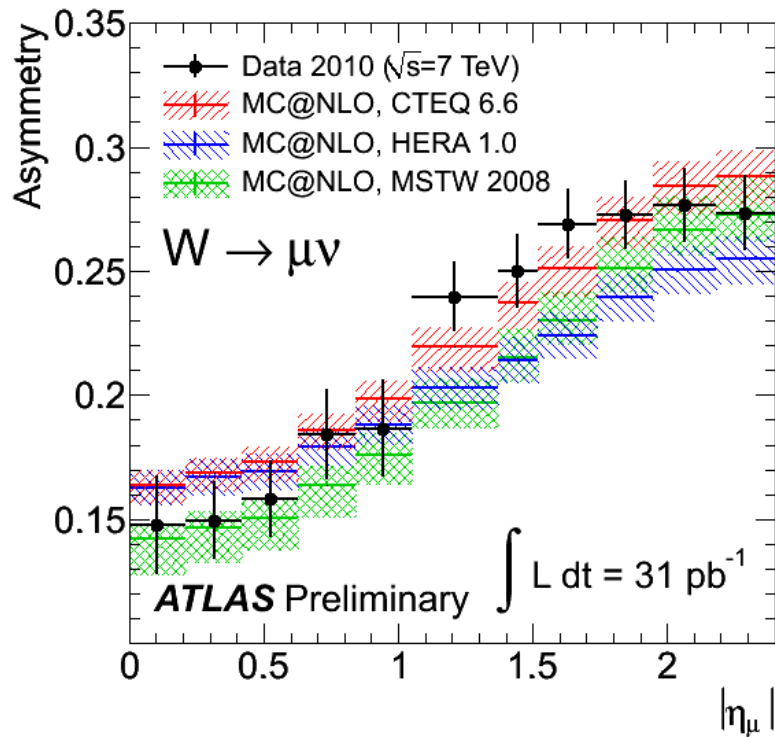
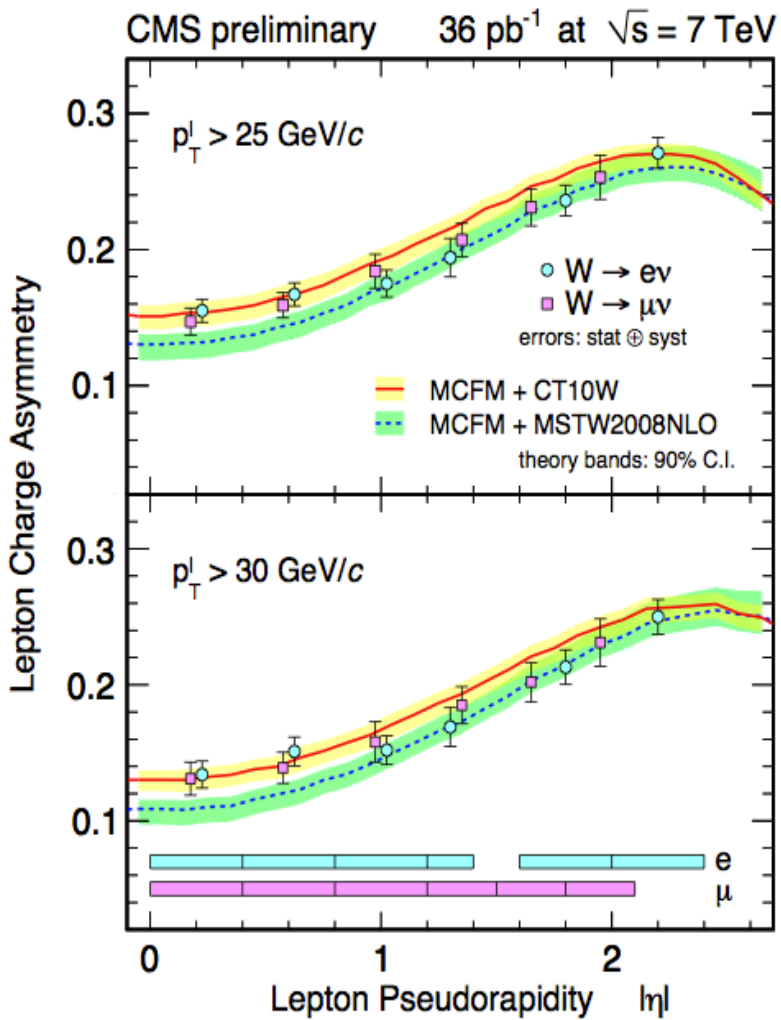


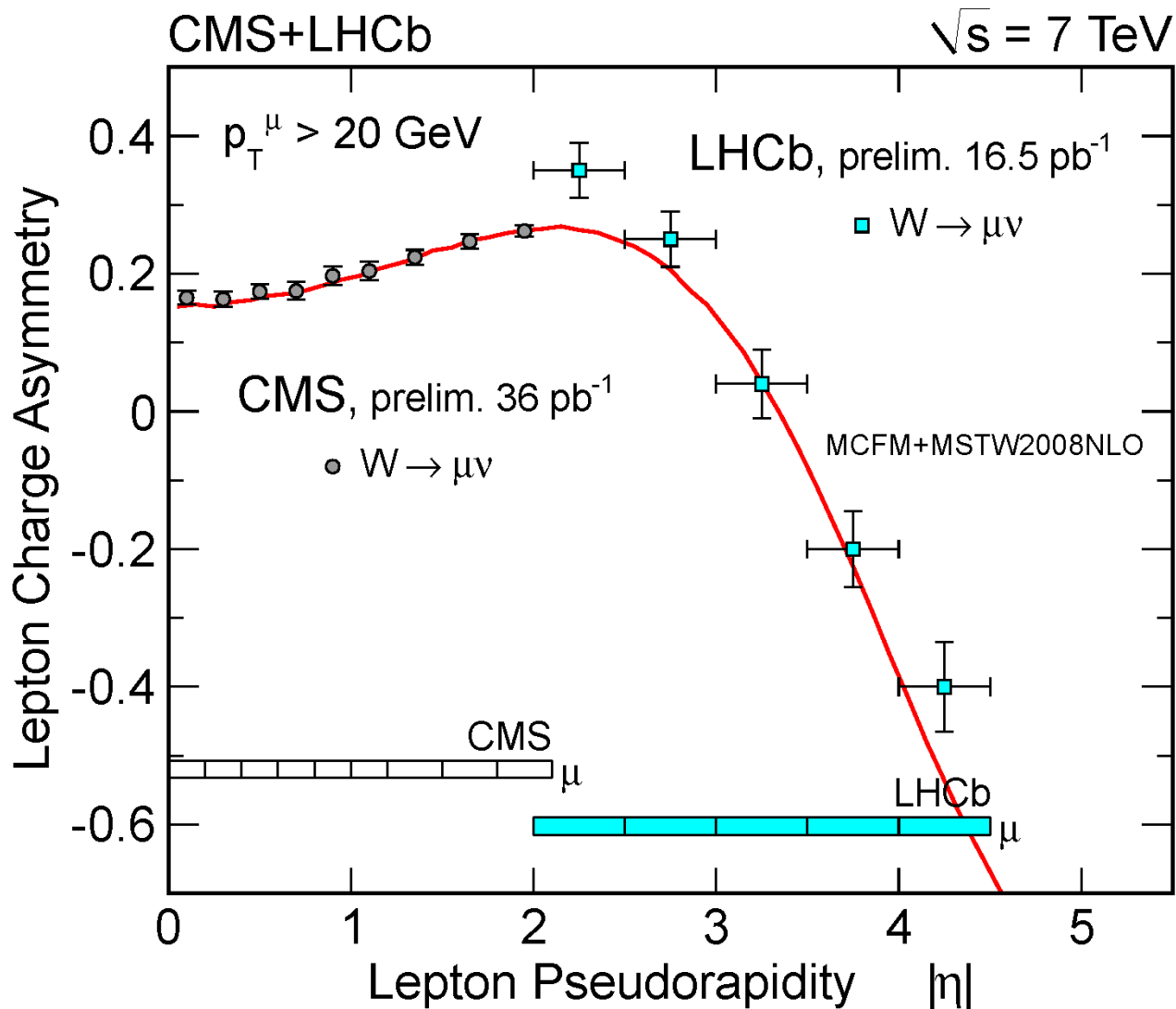
- very sensitive to pdfs
- complex interplay of u_V , d_V , Sea, $V \pm A$ decay
- 7 TeV data!



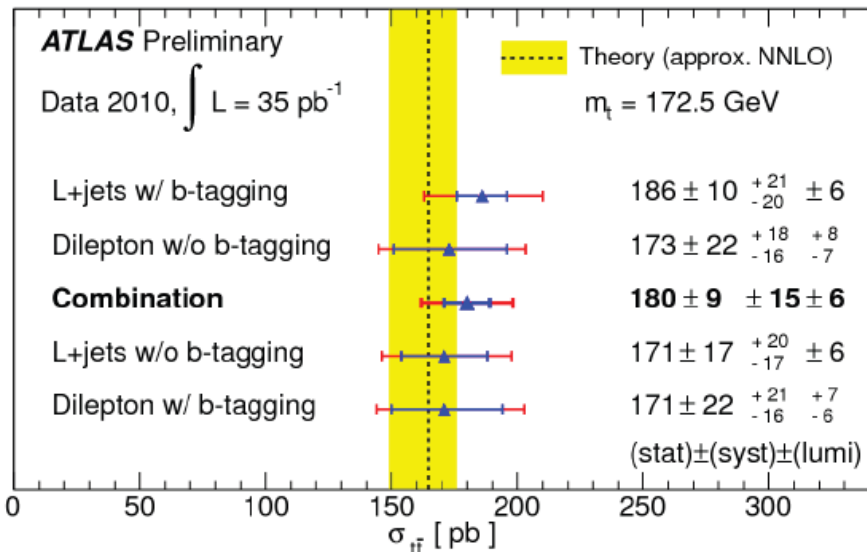
$$A_{\pm}(y_{\ell}) \approx \frac{S(x_1)u_V(x_2) - d_V(x_1)S(x_2)}{S(x_1)u_V(x_2) + d_V(x_1)S(x_2) + 2S(x_1)S(x_2)}.$$

... apart from at large y_l

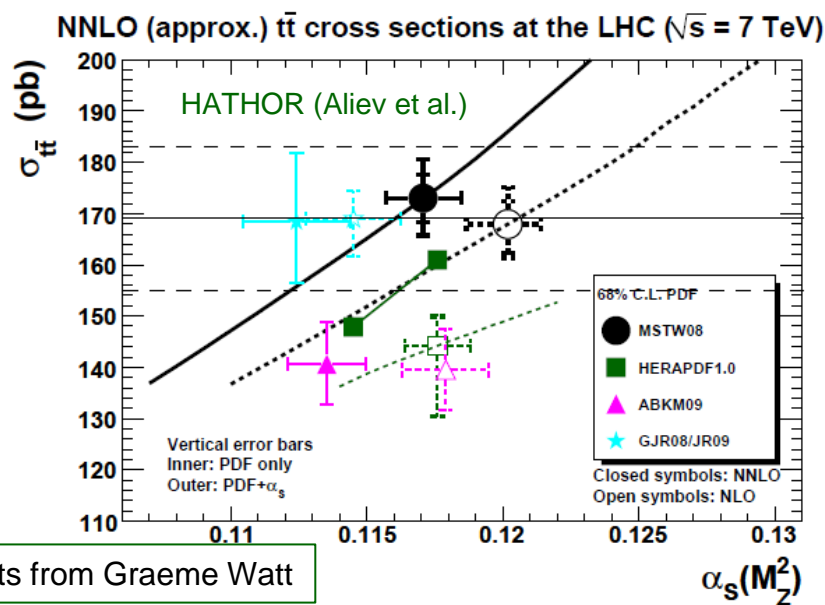
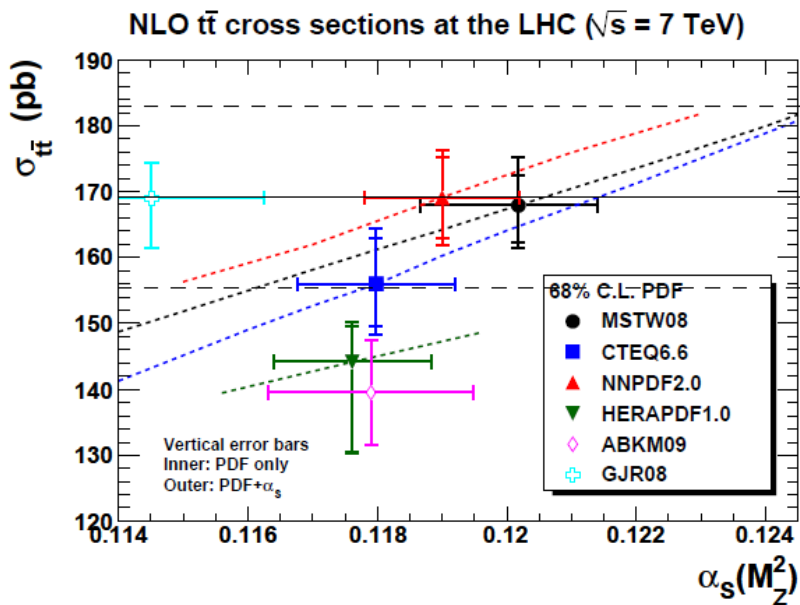
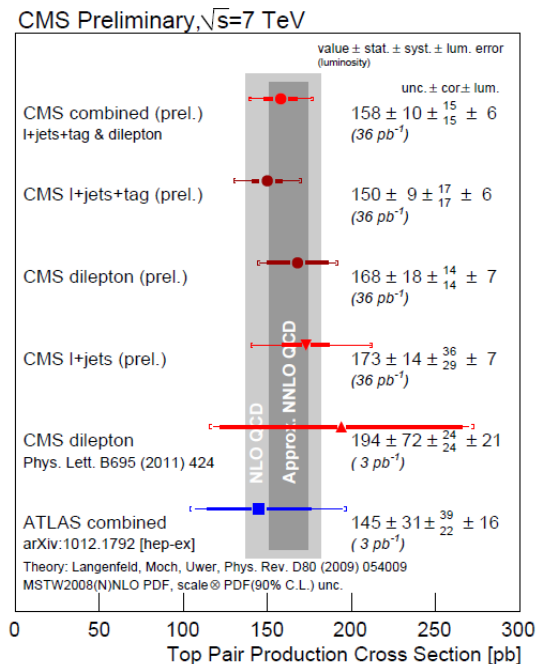




<https://twiki.cern.ch/twiki/bin/view/CMSPublic/LeptonChargeAsymmetryEWK10006> : “This plot, produced for the first LPCC Electroweak Working Group Meeting, is **very preliminary**”



top



plots from Graeme Watt

'data' is (naively) combined ATLAS+CMS: $0.169 \pm 0.014 \text{ pb}$

impact of NMC data on MSTW08 fit

$$\frac{d^2\sigma}{dx dQ^2} \simeq \frac{4\pi\alpha^2}{xQ^4} \left[1 - y - \frac{y^2/2}{1 + R(x, Q^2)} \right] F_2(x, Q^2)$$

ideally, fit differential cross section directly with calculated $R = \sigma_L / \sigma_T$ and HT contributions if appropriate (ABKM)

or fit to extracted F_2 using parametrisation of R (MSTW08): $R(x, Q^2) = \begin{cases} R_{\text{NMC}}(x) & \text{if } x < 0.12 \\ R_{1990}(x, Q^2) & \text{if } x > 0.12 \end{cases}$

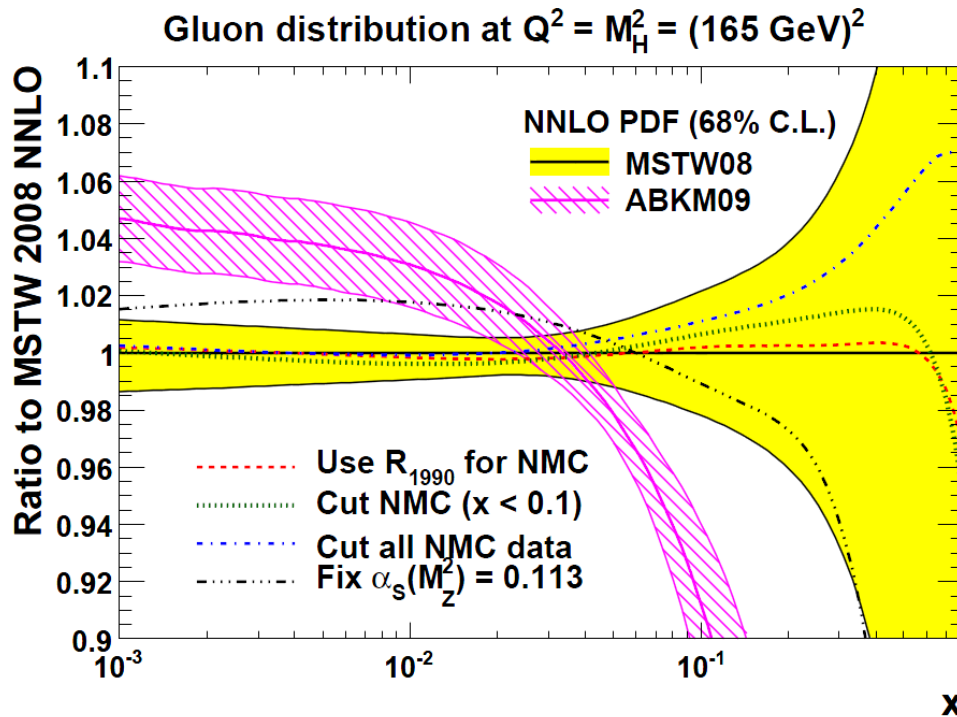
parametrisation of SLAC data 

— can this account for ABKM/MSTW08 differences in α_S , σ_H , ...?

Alekhin, Bluemlein, Moch, arXiv:1101.5261

Thorne & Watt have studied impact on α_S and cross sections of using different R , and cutting out all or partial NMC data from global fit → minimal changes

NNLO PDF	$\alpha_S(M_Z^2)$	σ_H at Tevatron	σ_H at 7 TeV LHC
MSTW08	0.1171	0.342 pb	7.91 pb
Use R_{1990} for NMC	0.1167	-0.7%	-0.9%
Cut NMC ($x < 0.1$)	0.1162	-1.2%	-2.1%
Cut all NMC data	0.1158	-0.7%	-2.1%
Fix $\alpha_S(M_Z^2)$	0.1130	-11%	-7.6%
ABKM09	0.1135	-26%	-11%



Thorne, Watt
in preparation

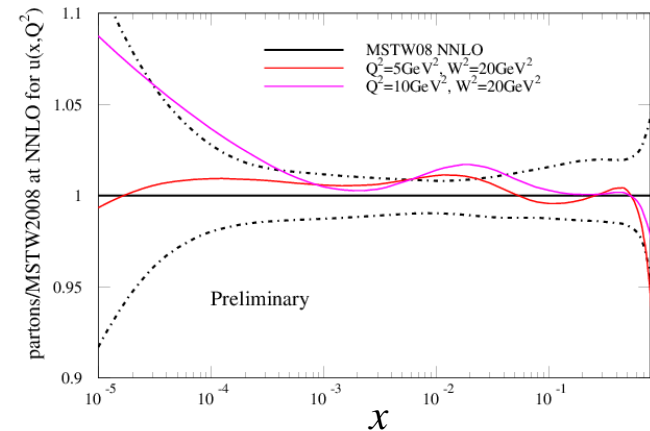
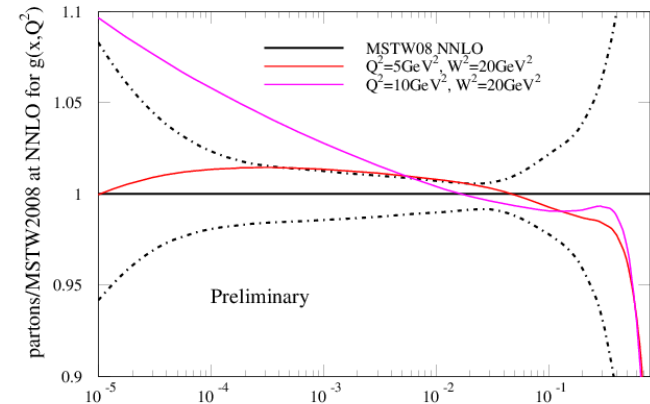
impact of low Q^2 F_2 data on benchmark cross sections and α_s

R. Thorne

study sensitivity of MSTW08 partons and benchmark predictions to choice of $Q^2_{\min} = 2 \text{ GeV}^2$ cut*

$\sigma(\text{NNLO})$ wrt MSTW08	$Q^2 > 5$	$Q^2 > 10$
W Tevatron	-0.7%	-0.4%
Z Tevatron	-0.4%	-0.0%
W LHC 7TeV	-0.2%	-0.2%
Z LHC 7TeV	-0.4%	-0.5%
W LHC 14TeV	0.3%	0.8%
Z LHC 14TeV	0.2%	0.4%
Tevatron H(165GeV)	-1.2%	-3.2%
LHC 7TeV H(165GeV)	0.4%	-1.8%
LHC 14TeV H(165GeV)	1.0%	-0.8%

*also $W^2 = Q^2(1/x - 1) + m_N^2 > 15 \text{ GeV}^2$



$Q^2_{\min}(\text{GeV}^2)$	$\alpha_s(\text{NLO})$	$\alpha_s(\text{NNLO})$
2	0.1202	0.1176
5	0.1192	0.1171
10	0.1175	0.1164

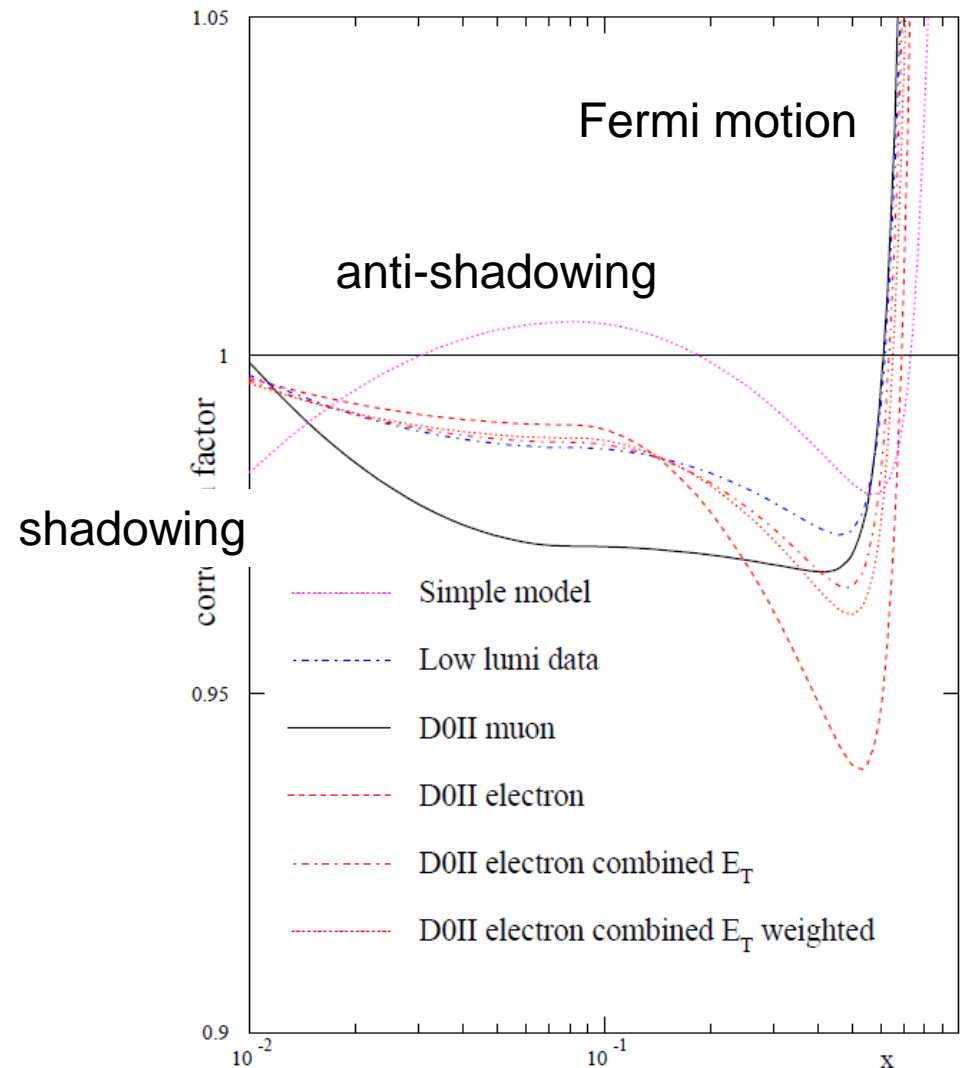
central values only; errors inflate slightly with increasing Q^2 cut

treatment of deuterium F_2^D data

$$F_2^D \neq \frac{1}{2} (F_2^p + F_2^n)$$

$$\Rightarrow d^{W_{\text{asy}}} \neq d^D$$

- should correct F_2^D data in global fit*
- MSTW08 use shadowing-only (Badelek-Kwiecinski) D correction factor; improves quality of global fit, but not taken into account in pdf uncertainties
- CTEQ, NNPDF, ... no D correction factor
- can we extract the correction factor from comparison of F_2^D and W_{asy} ?

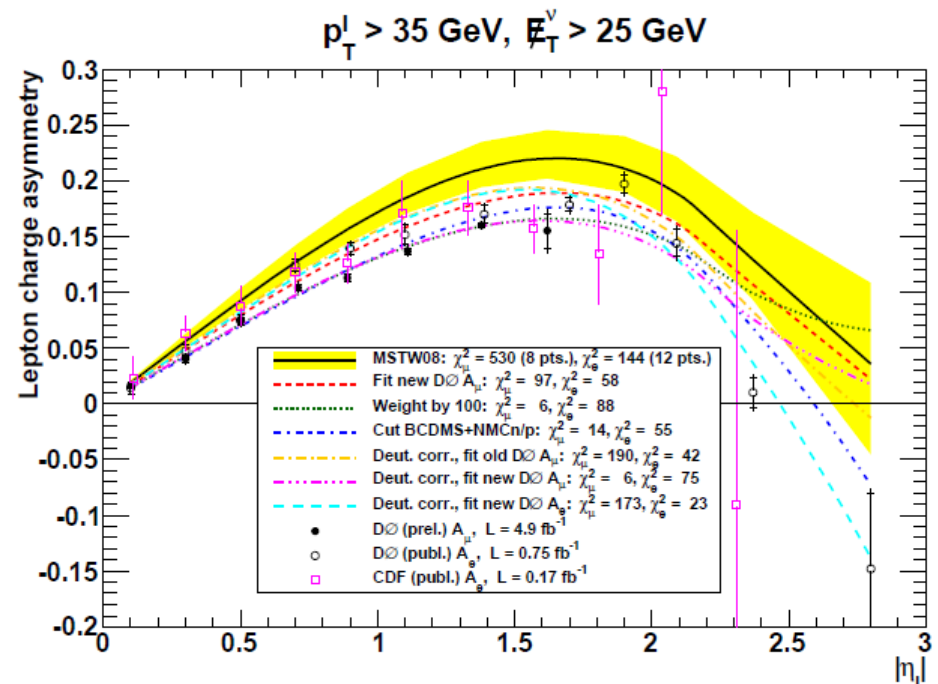
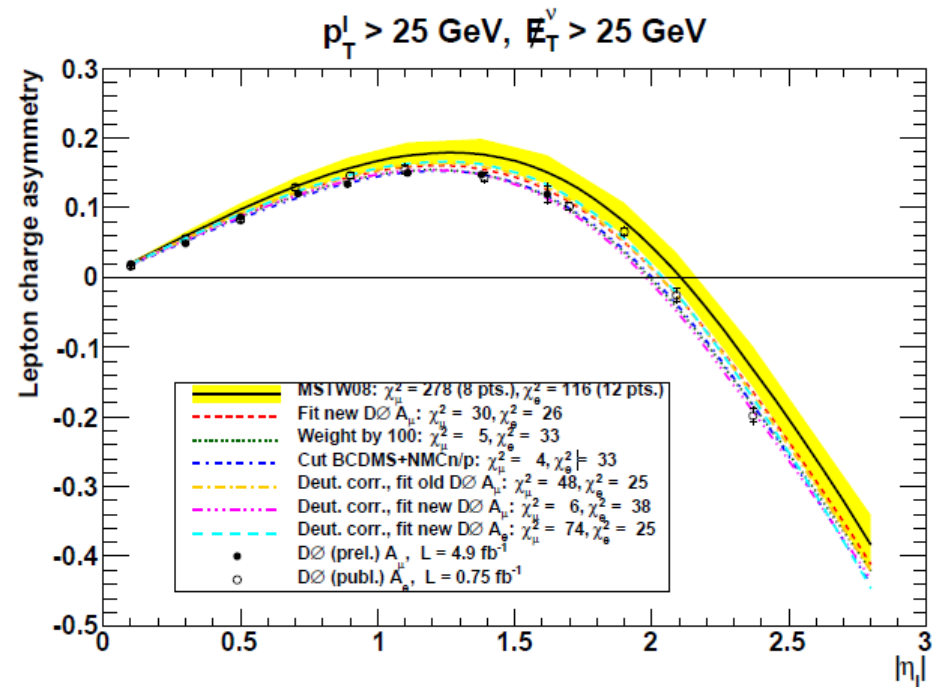


*For a review see e.g. Alekhin, Kulagin, Liuti, Phys. Rev. D69 114009 (2004)

global fits to Tevatron $W \rightarrow l\nu$ asymmetry data

→ differences in asymmetry data result in differences in empirical deuterium correction factors

MSTW
arXiv:1006.2753



conclusions

- good agreement between MSTW08 NLO, NNLO pdf predictions and 2010 7 TeV LHC SM cross section data
- eagerly await new round of 2011 7 TeV data
- ATLAS, CMS differences? pQCD NLO, NNLO technology allows to predict W, Z cross sections in experimental acceptance → avoid large and model dependent acceptance corrections
- MSTW ongoing studies, particularly of sensitivity to aspects of FT DIS structure function data → Standard Candle predictions at Tevatron and LHC appear robust