The Effect of Recent Jet Results on MSTW PDFs

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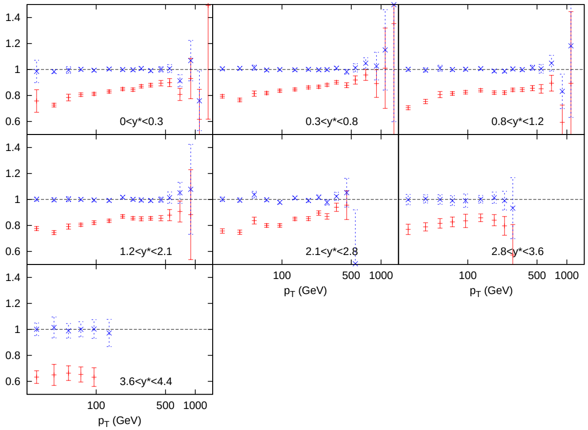
Outline

- Effect of latest ATLAS inclusive jet (7 TeV,37 pb^{-1}) data on MSTW
- Calculation of D0 & ATLAS dijet cross section
- Treatment of errors
- Effect of scale variations
- Comparison of scale choices

Inclusive Jets

- Inclusive jet calculation performed using published APPLgrid grids, convoluted with MSTW PDFs.



- ATLAS inclusive jets (R=0.4), red points unshifted, blue points after systematic shifts.

χ^2 Definition

$$\chi^2 = \sum_{i=1}^{N_{pts}} \left(\frac{D_i - \sum_{k=1}^{N_{corr}} r_k \sigma_{k,i}^{corr} - T_i}{\sigma_i^{uncorr}} \right)^2 + \sum_{k=1}^{N_{corr}} r_k^2 \quad (1)$$

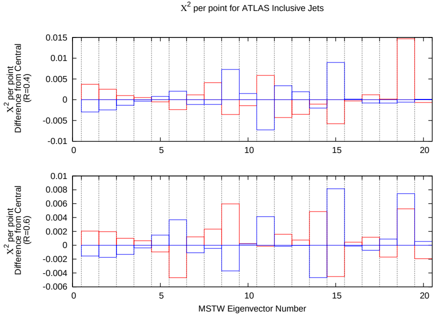
Table 1: χ^2 per point (90 points)

Scale	pT/2	pT	2pT
R=0.4	0.75	0.78	0.70
R=0.6	0.85	0.79	0.72

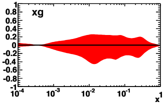
Table 2: Distribution of r_ks (Total 88)

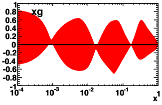
$\|r_k\| <$	0.5	1.5	2.5	3.5
R=0.4	72	15	1	0
R=0.6	74	13	1	0

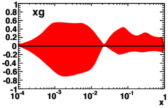
Inclusive Jets

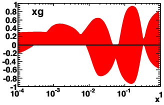


- Some eigenvector variation
- 6, 9, 15 & 19 most effective across both R parameters, correspond mostly to gluon.

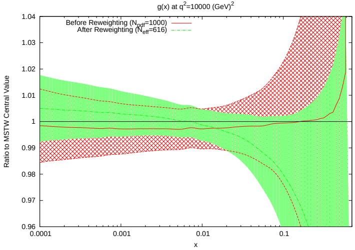


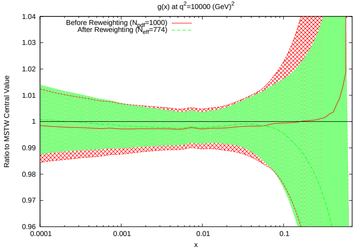






Inclusive Jets



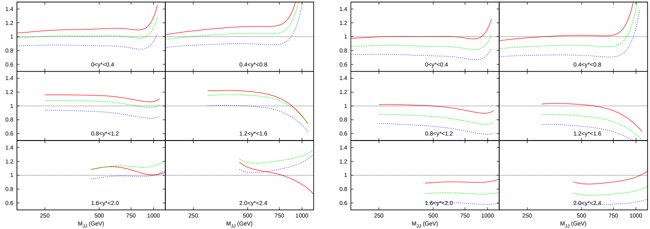


- Create 1000 replica PDFs using prescription presented in arXiv:1205.4024 (G.Watt & R.S. Thorne)
  $F(S_k) = F(S_0) + \sum_{j=1}^{n} [F(S_j^{\pm}) - F(S_0)]|R_{jk}|$
- Reweight gluon according to: $w_i(\chi_i^2) = \dfrac{W_i(\chi_i^2)}{\frac{1}{N_{pdf}} \sum_{j=1}^{N_{pdf}} W_j(\chi_j^2)}$

  $W_i(\chi_i^2) = [\chi_i^2]^{\frac{N_{pts}-1}{2}} \exp\left(-\frac{\chi_i^2}{2}\right)$ (NNPDF Nucl.Phys. B849 (2011) 112-143)
- Minimal effect observed, systematic shifts improve χ^2 too much to probe physics.

D0 Dijet Calculation

- Seperate APPLgrid grids generated for D0 Dijet cross section.

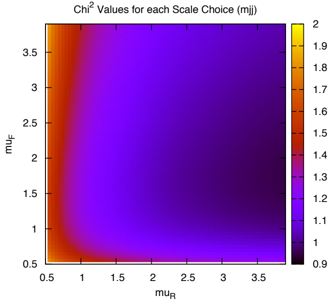


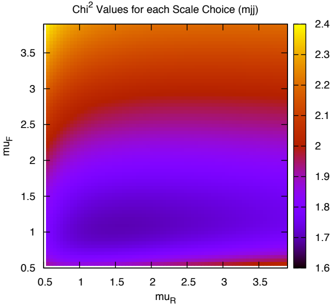
Red: 0.5∗Scale
Green: 1∗Scale
Blue: 2∗Scale

- Two scale choices - $p_T^{av} = (p_{T,1} + p_{T,2})/2$ & M_{JJ}
- High y_{max}, p_T^{av} becomes unstable, M_{JJ} not so.

	0.5	1.0	2.0
$2 * p_T^{av}$	2.34	1.61	1.23
M_{JJ}	1.88	1.30	1.06
$M_{JJ}/\cosh(0.7y)$	3.05	2.14	1.44

D0 Dijets - Multiplicative vs. Additive Errors - M_{JJ}

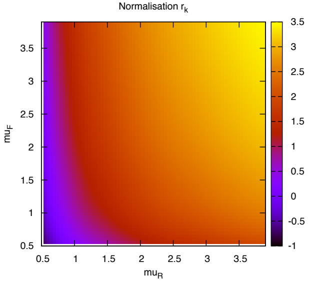


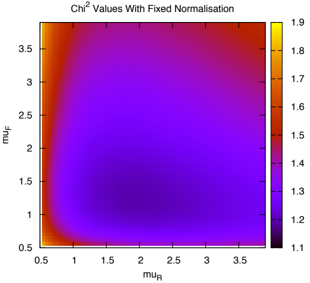


Axes:
$\mu_{(R,F)} = (x, y) * M_{JJ}$

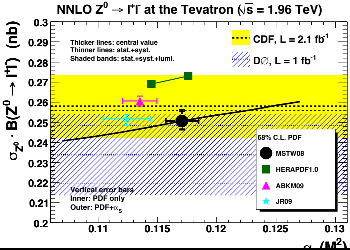
- Multiply (percentage) systematic errors by data (left), or theory (right).
- χ^2 lower for additive errors, but minimized at more sensible scale choice for multiplicative.

D0 Dijets - Normalisation uncertainty



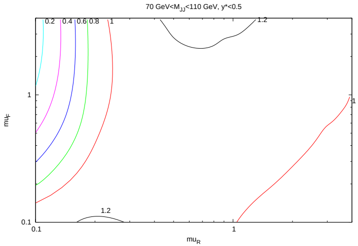


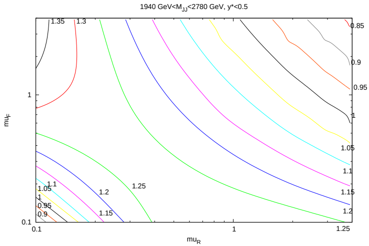
- Normalisation shift (left) becomes very large where the χ^2 is minimised.
- Fix normalisation - χ^2 minimised at lower scale choice (M_{JJ})



From arXiv:1106.5789 (R.S. Thorne, G.Watt) - Normalisation strongly fixed by W,Z

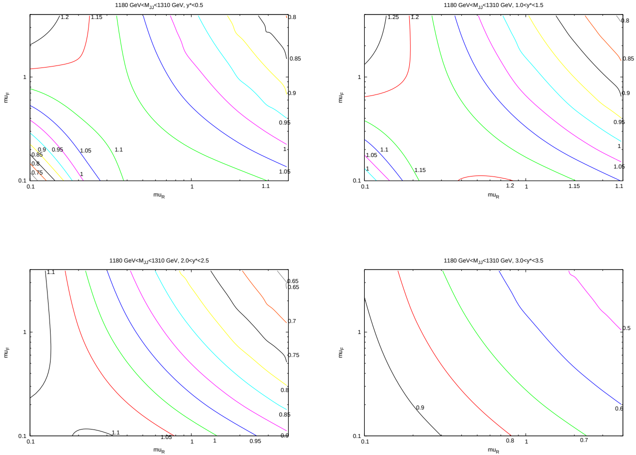
ATLAS Dijets - Scale Behaviour (M_{JJ})





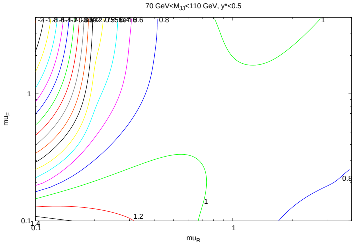
- Data/theory for all scale choices - saddle point centred on central scale choice.
- Rotation of saddle point as M_{JJ} increases.
- Similar behaviour to other cross sections - J Huston (https://indico.cern.ch/contributionDisplay.py?contribId=3&confId=226756)

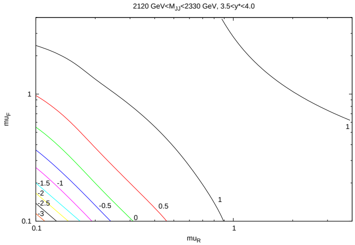
ATLAS Dijets - Scale Behaviour (M_{JJ})



- Keep M_{JJ} constant, increase rapidity bin - angle of rotation unchanged, saddle point moves.

ATLAS Dijets - Scale Choice - $M_{JJ}/\cosh(0.7y)$

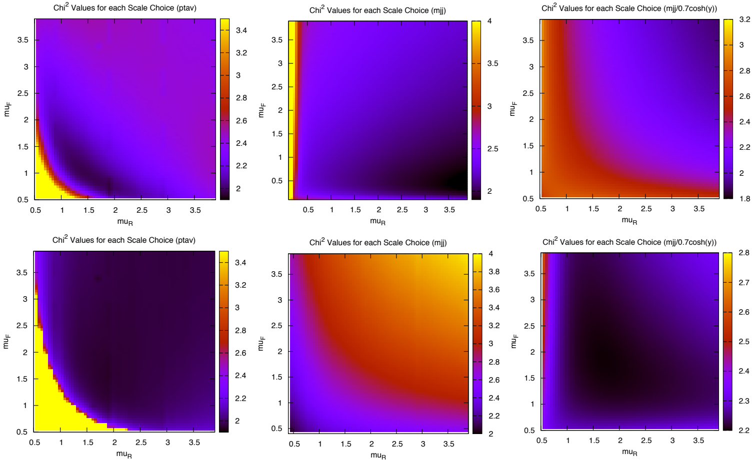




- Include rapidity dependent term in the scale choice - $M_{JJ}/\cosh(0.7y)$.
- Saddle point remains at central scale choices - more stable calculation.

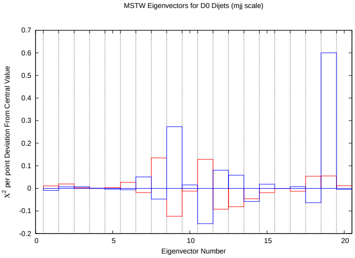
	0.5	1.0	2.0
$2 * p_T^{av}$	6.66	1.95	1.90
M_{JJ}	2.05	2.41	2.98
$M_{JJ}/\cosh(0.7y)$	2.14	2.03	2.01

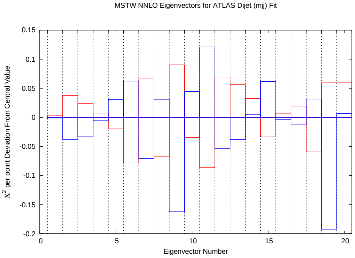
χ^2 Distributions



- Top row - Multiplicative Errors
- Bottom row - Additive Errors

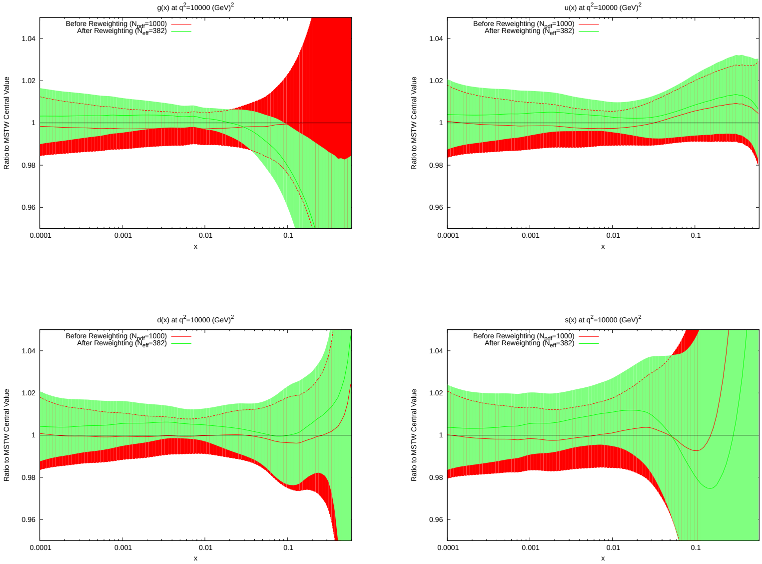
D0 & ATLAS Dijets - Eigenvector Sensitivity



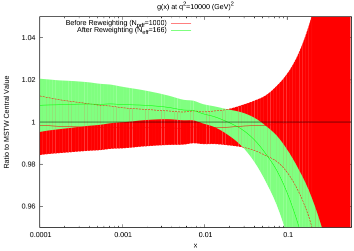


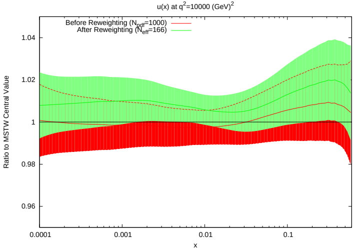
- More variation in eigenvectors for ATLAS dijets than D0.
- Again Eigenvector 9, 11 & 19 dominate.

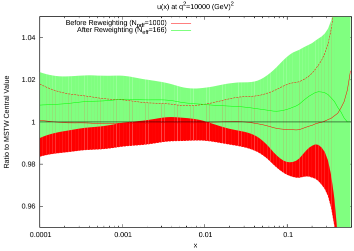
D0 Dijet PDF effects -M_{JJ}

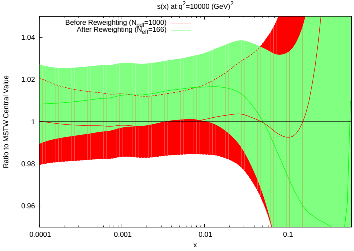


D0 Dijet PDF effects - p_T^{av}

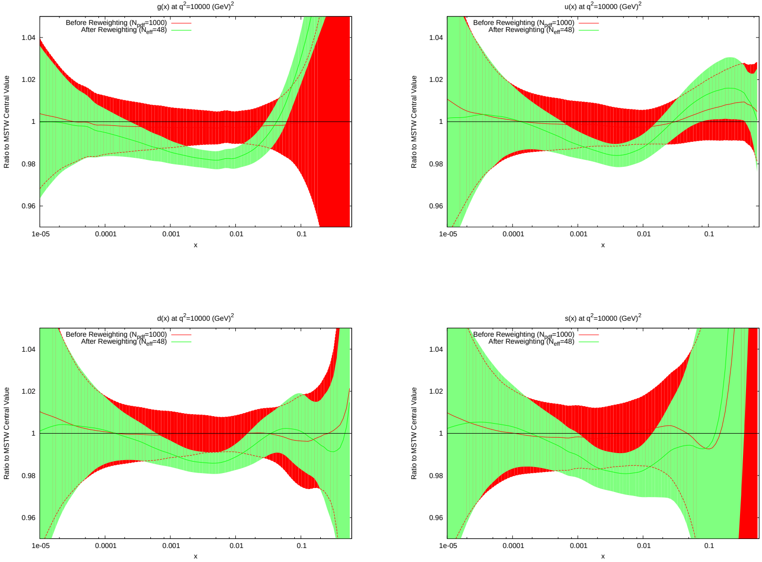




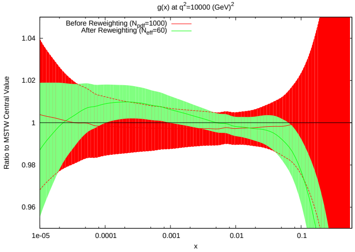


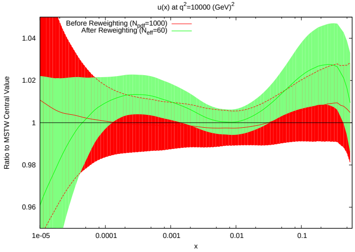


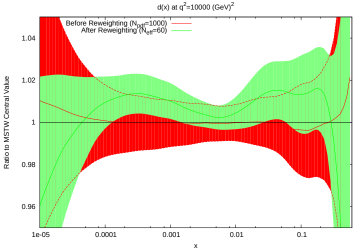
ATLAS Dijet PDF effects - M_{JJ}

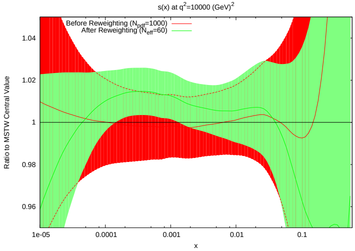


ATLAS Dijet PDF effects - $M_{JJ}/\cosh(0.7y)$



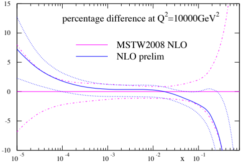


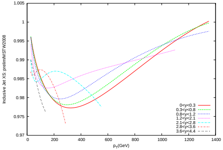


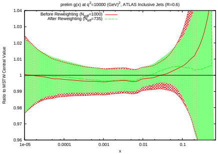


New prelim PDFs

- Preliminary PDFs (prelim) include recent Chebyshev Polynomial parameterisation (CP), deuteron corrections & additional ZEUS data.



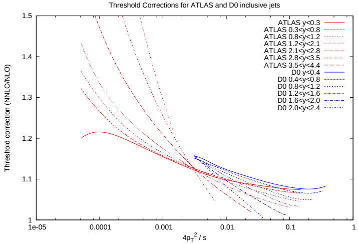


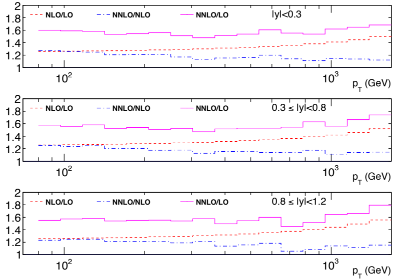


- Very slight χ^2 improvement from MSTW2008:

	MSTW2008	prelim
$R = 0.4$	0.78	0.74
$R = 0.6$	0.79	0.79

Threshold Corrections





- Threshold corrections taken from FastNLO interface.
- Leading colour gluon NNLO from A. Gehrmann-De Ridder, T. Gehrmann, E. Glover, J Pires (http://arxiv.org/abs/1301.7310v1)

Conclusions & Outlook

- ATLAS Inclusive Jet ($36pb^{-1}$) in good agreement with theory.
- Large systematic shifts prevent PDF differentiation.
- Dijet calculation dependant on kinematic scale choice.
- p_T^{av} poor unless large multiplying factors used - M_{JJ} more stable.
- $M_{JJ}/\cosh(0.7y)$ stabler across all rapidity bins, gives best χ^2 for ATLAS dijets for sensible k where ($\mu = k*$(Scale Choice))
- Best χ^2 for high values of k, but these require unrealistic normalisation shifts $r_{norm} >> 1$
- Effect on PDFs from dijet data dependant on scale choice used. Work ongoing.
- Recently published 2.76 TeV ratio data & CMS 5fb$^-1$ should give better insight into PDF effects.