

Results from xFitter since the last xFitter meeting: March 2017-2018

A M Cooper-Sarkar University of Oxford on behalf of the xFitter team

- CMS
- ATLAS
- HERA
- Xfitter developer's team
- Markov Chain Monte Carlo
- Senman U.
- Beyond DGLAP, TMD's, Higher twists, Dipoles
- Diffraction

EPJC 77 (2017)459



Gluon PDF constraints from **double differential top distributions**, beware predictions are still NLO

arXIV:1711.03143 Addition of **5TeV top cross section** gives **constraints on the high-x gluon**





Triple differential di-jet production at 8TeV: arXIV 1705.02628, EPJC77(2017)746

In this paper, a measurement of the triple-differential dijet cross section is presented as a function of the average transverse momentum $p_{1,avg} = (p_{1,1} + p_{1,2})/2$ of the two leading jets, half of their rapidity separation $y^* = |y_1 - y_2|/2$, and the boost of the dijet system $y_b = |y_1 + y_2|/2$. The dijet event topologies are illustrated in Fig. 1.

 $\alpha_{\rm S}(M_{\rm Z}) = 0.1199 \pm 0.0015(\exp)^{+0.0002}_{-0.0002}(\mathrm{mod})^{+0.0002}_{-0.0004}(\mathrm{par})^{+0.0026}_{,-0.0016}$ (scale, refit).

Measurement of alpha_s, constraint on gluon— Note NLO only.



ATLAS

So what do we see now with the W,Z 2011 precision data? arXIV:1612.03016 We see that strangeness is unsuppressed just as it was for the 2010 data AND the experimental uncertainty is considerably reduced





We consider strangeness in ratio to the light quark PDFs as a function of x Not just at a single x,Q2 point

Profiling other PDFsets tells the same story- more strangeness at low-x



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Study of ATLAS and CMS W and Z inclusive data at 7,8 TeV together CSKK arxiv:1803.00968



No tension between CMS and ATLAS data sets, Strangeness is unsuppressed at low-x



Simultaneous analyses of different data sets:

ATLAS measurement **of inclusive t-tbar to Z cross-sections** at 7, 8 and 13 TeV (arXiv:1612.03636) With accounting for correlations between them



T-tbar data mostly relates to the gluon Z data mostly relates to the quarks ABM12 had too little gluon at high x, Many other PDFs do not have quite enough Z (recall strangeness study)



As expected the ABM12 prediction is higher than others for this ratio– but it is not out of line with data PLUS ABMP16 comes closer

Top-antitop in the dilepton channel and the top quark mass arXIV: 1709.09407, EPJC(2017)804



Comparison to PDFs

HERA

Charm and beauty combination using HERAverager, extraction of heavy quark running masses using xFitter in FFN scheme. Conference proceedings PoS DIS2017(2018)005



$$m_c(m_c) = 1290^{+46}_{-41}(\text{fit})^{+62}_{-14}(\text{mod})^{+7}_{-31}(\text{par}) \text{ MeV},$$

$$m_b(m_b) = 4049^{+104}_{-109}(\text{fit})^{+90}_{-32}(\text{mod})^{+1}_{-31}(\text{par}) \text{ MeV}.$$

Contact interactions: thesis Oleksii Turkot, ZEUS publication: PLB ZCIPDFs

Simultaneous fit of BSM and PDF parameters



The results of the limit-setting procedure using the simultaneous fit to PDF parameters and R_q^2 , based on sets of Monte Carlo replicas testing the possible cross-section modifications due to a quark form factor, yield the 95% C.L. limits on the effective quark radius of

$$-(0.47 \cdot 10^{-16} \,\mathrm{cm})^2 < R_q^2 < (0.43 \cdot 10^{-16} \,\mathrm{cm})^2$$
.

xFitter developer's team

Impact of heavy quark matching scales in PDF fits: arXIV: 1707.05343, EPJC&&(2017)837 and see also arXIV:1711.03355

Abstract We investigate the impact of displaced heavy quark matching scales in a global fit. The heavy quark matching scale μ_m determines at which energy scale μ the QCD theory transitions from N_F to N_F + 1 in the Variable Flavor Number Scheme (VFNS) for the evolution of the Parton Distribution Functions (PDFs) and strong coupling $\alpha_S(\mu)$. We study the variation of the matching scales, and their impact on a global PDF fit of the combined HERA data. As the choice of the matching scale μ_m effectively is a choice of scheme, this

represents a theoretical uncertainty; ideally, we would like to see minimal dependence on this parameter. For the transition across the charm quark (from $N_F = 3$ to 4), we find a large $\mu_m = \mu_c$ dependence of the global fit χ^2 at NLO, but this is significantly reduced at NNLO. For the transition across the bottom quark (from $N_F = 4$ to 5), we have a reduced $\mu_m = \mu_b$ dependence of the χ^2 at both NLO and NNLO as compared to the charm. This feature is now implemented in xFitter 2.0.0, an open source QCD fit framework.



Fig. 3 We display the b-quark PDF $xf_b^{(5)}(x,\mu)$ for different choices of the matching scales $\mu_m = \{m_b/2, m_b, 2m_b\}$ (indicated by the vertical lines) computed at NLO (Fig.-a) and NNLO (Fig.-b).

Impact of low-x resummation on QCD analysis of HERA data arXiV:1802.00064



Better description of low Q2, low x, high y data

Because better description of high-y turn over, due to better description of FL

Also steep low-x gluon, now gluon at low-x is bigger than sea at low-x



Markov Chain Monte-Carlo (PoS(DIS2017)213)



Figure 2: Comparison of the PDF uncertainties, normalized by the best fit value, as determined by the Hessian and MCMC methods at NLO for the valence distribution xu_{val} and the gluon distribution xg, at a scale $Q^2 = 10 \text{ GeV}^2$.

We propose a Bayesian parameter inference approach to determine Parton Distribution Functions (PDFs) and we show that we can replace the standard χ^2 minimisation used in most existing PDF global analysis procedures, by Markov chain Monte Carlo (MCMC) techniques. These methods, widely used in statistics, lead to reliable estimates of uncertainties in terms of confidence limit intervals of probability distributions, and offer additional insight into the rich field of PDFs. The formulation of PDF determination in terms of Bayesian inference, the Monte Carlo algorithm we have implemented in the xFitter code and a selection of first results we have obtained are presented in this contribution.

Semnan University Iran

The role of different schemes in the QCD analysis and determination of alphas Nucl.Phys.B921(2017)472, arXiV:1709.08346, A Vafaee, A Khorramian Impact of HERA charm data and determination of alphas Chin.Phys.C41(2017)113104, arXiV:1709.08402, A Vafaee, A Khorramian NLO analysis of HERA combined +charm/beauty data in RT and RTOPT schemes Impact of HERA charm and beauty data and determination of alphas arXiV:1711.06573, A Vafaee, A Khorramian impact of the HERA charm/beauty data

Impact of CMS inclusive jet data (13 TeV) on PDFs –impact of CMS data IJMPA32(2017)1750134, A. Aleedaneshvar, A Khorramian

NLO QCD analysis of PDFs with LHC data- impact of LHC data Nucl.Part.Phys.Proc.282-284(2017)32 , A Vafaee, A Khorramian

Impact of intrinsic charm on PDFs with EMC and LHC data Nucl.Part.Phys.Proc.282-284(2017)27, H Abdolmaleki, A Khorramian, A Aleedaneshwar

Effect of profiling on PDFs using LHCb data Effect on low-x gluon of LHCb open charm /beauty arXIV:1709.07247, A Khorramian, A Aleedaneshwar

QCD analysis of non-singlet structure functions xF3 from CCFR, NuTeV, Chorus, CDHSW EPJWebConf164(2017)08007, H Abdolmaleki, A Khorramian, A Ghaffari-Turan¹⁴

Beyond DGLAP

Collinear and TMD quark and Gluon Densities from Parton Branching Solution of QCD Evolution Equations, JHEP 1801(2018)070

ArXiv:1708.03279, F Hautmann, H Jung, A Lelek, V Radescu, R Zlebcik



Figure 7: Transverse momentum gluon distribution versus k_t at $x = 10^{-2}$ and $\mu = 100$ GeV (upper row), $\mu = 1000$ GeV (lower row) for different values of the resolution scale parameter $z_M = 1 - 10^{-3}, 1 - 10^{-5}, 1 - 10^{-8}$: (left) angular ordering; (right) transverse momentum ordering.

Evidence of quasi-partonic higher twist effects in DIS at HERA at moderate Q2 arXIV:1707.05992, L Motyka, M Slazikowski, W Slominski and K Wichmann



Parton distribution functions from dipole models -predictions for the LHC EPJWeb Conf 164(2017)07024, A Luszczak, H Kowalski– see also arXIV:1611.10100





Diffraction

The dipole cross sections have also been used to make predictions for Diffractive production of J/ψ and Y on heavy nuclei, arXIV:1712.04502, A Luszczak and W Schafer

Diffractive PDFs have been determined at NLO

First global NLO determination of diffractive PDFs and uncertainties using xFitter

arXiv: 1802.01363, M Goharipour, H Khanpur, V Guzey Using HERA combined diffractive data **CGK-18DPDFs**



Summary Xfitter has been used extensively in ways that we expected and ways we did not expect Keep going