

# Impact of heavy-flavour production cross sections measured by the LHCb experiment on parton distribution functions at low $x$

EPJC 75 (2015) 396, DESY-15-034, arXiv 1503.04581  
see also O. Zenaiev, EPJC 77 (2017) 151

A. Geiser for the PROSA Collaboration  
collaboration of theorists and experimentalists from  
different theory/experimental groups/collaborations



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DIS15, Dallas, 30.4.15

- motivation
- results
- conclusions

main message:

LHCb charm and beauty data (in conjunction with HERA data) can be used to directly constrain gluon PDF down to  $x \sim 5 \times 10^{-6}$

(preliminary at QCD@LHC, Suzdal, Aug. 2014)

# Input data sets

HERA I combined inclusive + HERA combined charm + ZEUS beauty  
+ LHCb charm + LHCb beauty

JHEP 01 (2010) 109

HERA Inclusive DIS  $3.5 < Q^2 < 30000 \text{ GeV}^2$ ,  $4.32 \times 10^{-4} < x_{Bj} < 0.65$

JHEP 1409 (2014) 127

ZEUS beauty  $6.5 < Q^2 < 600 \text{ GeV}^2$ ,  $1.5 \times 10^{-4} < x_{Bj} < 3.5 \times 10^{-2}$

Eur. Phys. J. C 73 (2013) 2311

HERA charm  $2.5 < Q^2 < 2000 \text{ GeV}^2$ ,  $3 \times 10^{-5} < x_{Bj} < 5 \times 10^{-2}$

LHCb beauty  $y=4.5$ ,  $0 < p_T < 40 \text{ GeV}$

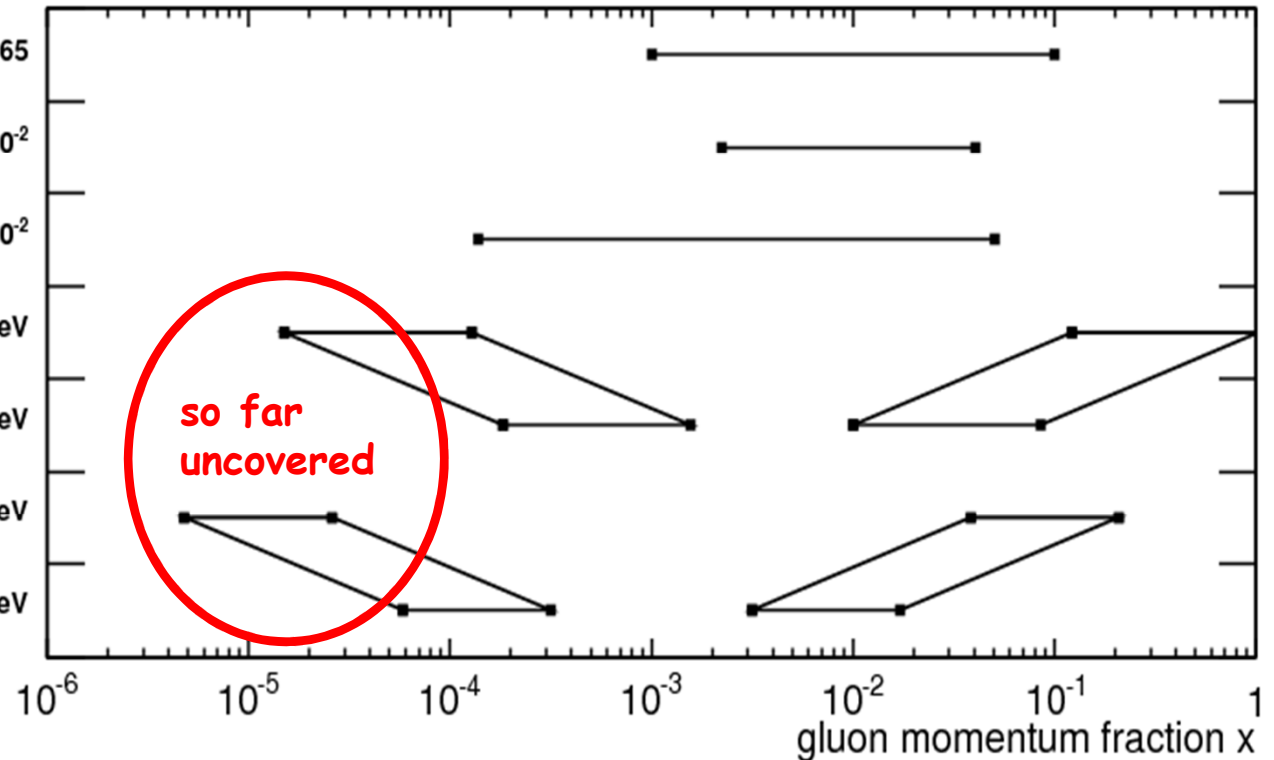
JHEP 08 (2013) 117

LHCb beauty  $y=2.0$ ,  $0 < p_T < 40 \text{ GeV}$

LHCb charm  $y=4.5$ ,  $0 < p_T < 8 \text{ GeV}$

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LHCb charm  $y=2.0$ ,  $0 < p_T < 8 \text{ GeV}$



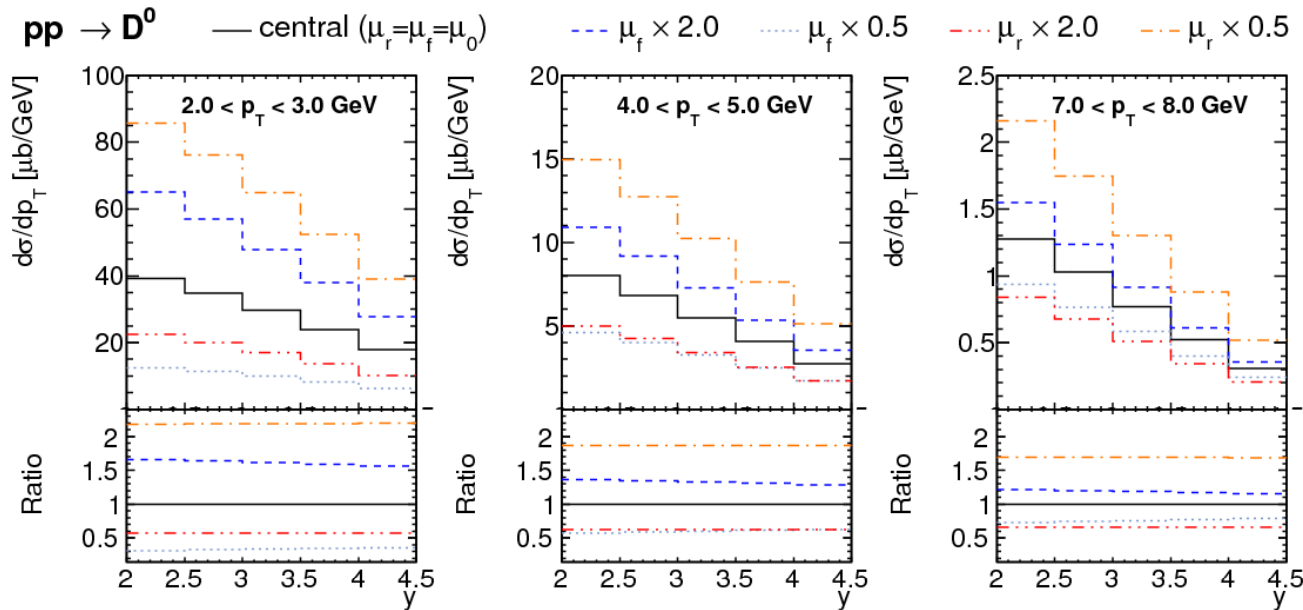
combination of data sets "bridges" complete  $x$  range

# NLO scale dependence

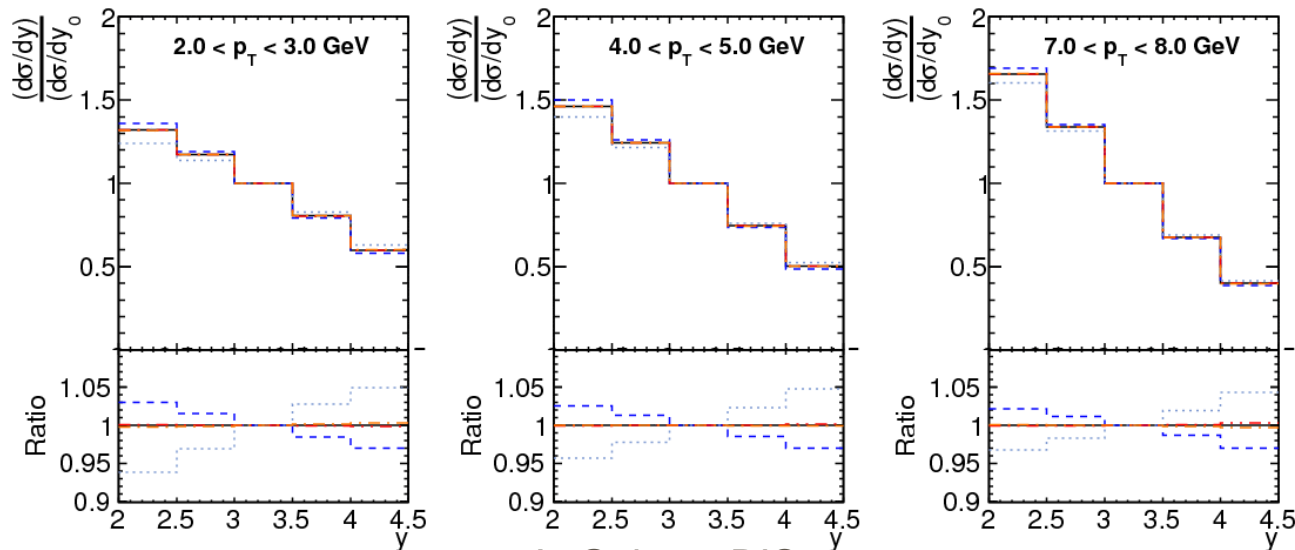
charm at LHCb

(similar for beauty, see backup)

## PROSA



absolute cross section:  
~factor 2



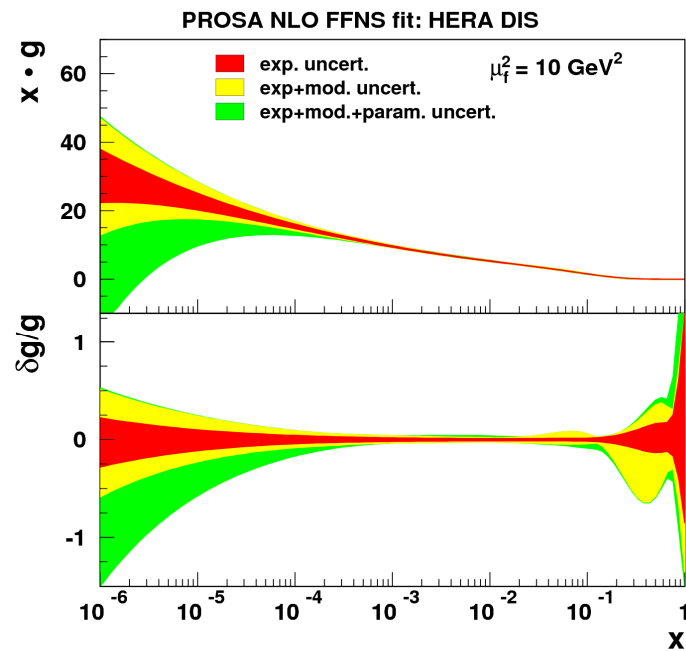
$p_T$ -normalized cross section:  
(use shape in  $y$  for each  $p_T$  bin, normalized to central  $y$  bin)

~ few %

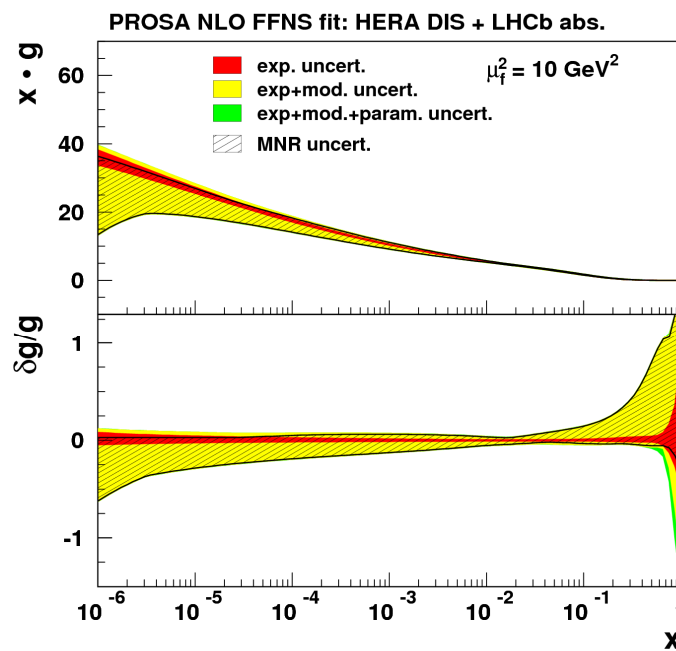
# Comparison of uncertainties

Example: gluon PDF

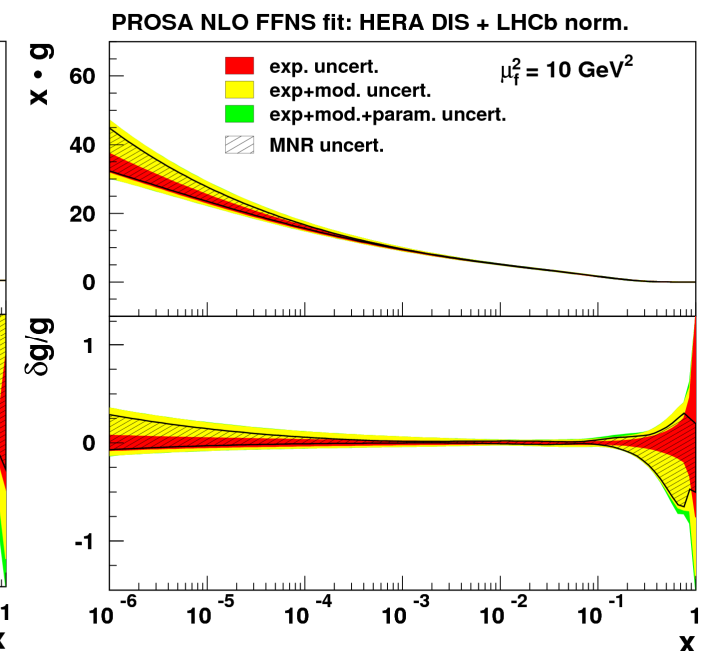
HERA only



HERA + LHCb absol.

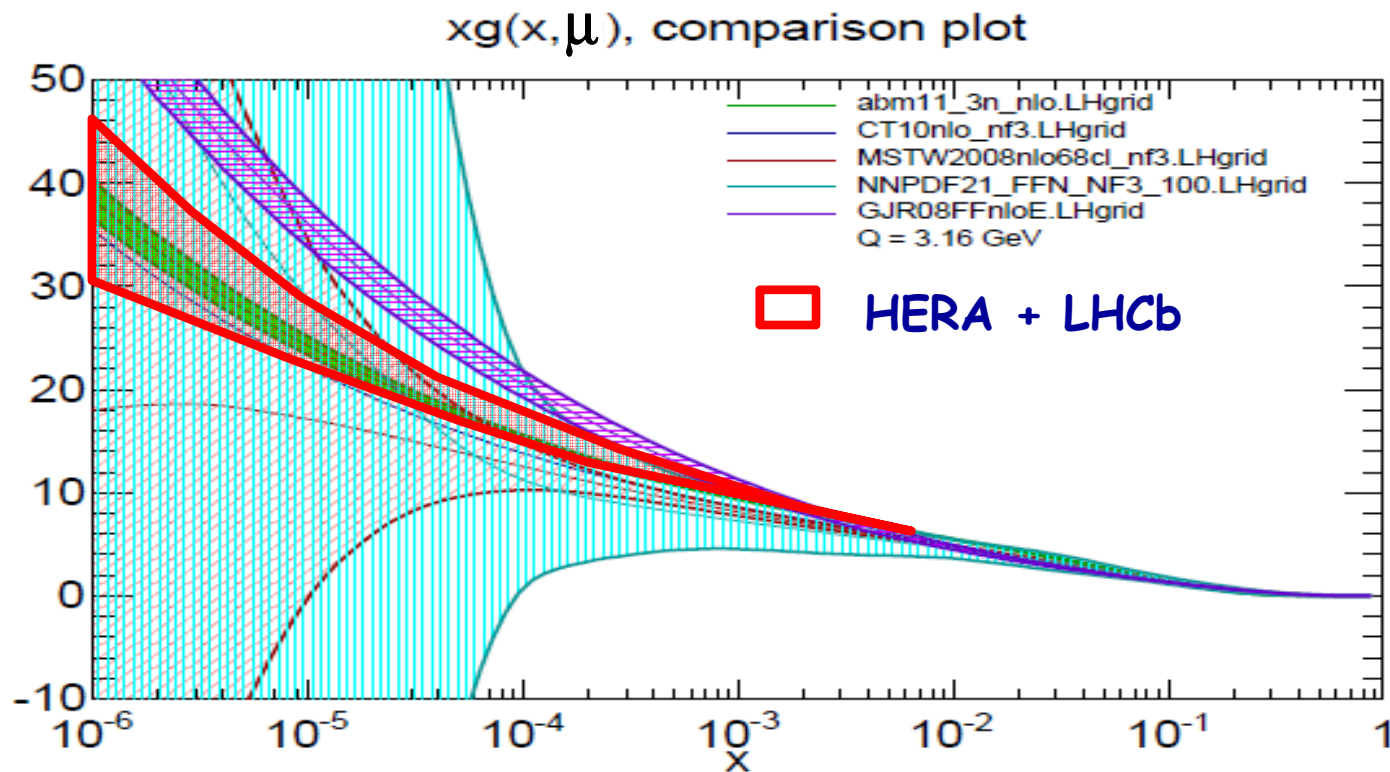


HERA absol.  
+ LHCb norm.



# Comparison to 'old' global PDFs

HERAPDF style parameterization with sizeable  
'negative gluon' term (but net positive gluon)



in good agreement with constrained ABM11  
parameterization at low  $x$