Some slides on B production at LHCb

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(with useful input from M. Cacciari, M. L. Mangano, P. Nason)

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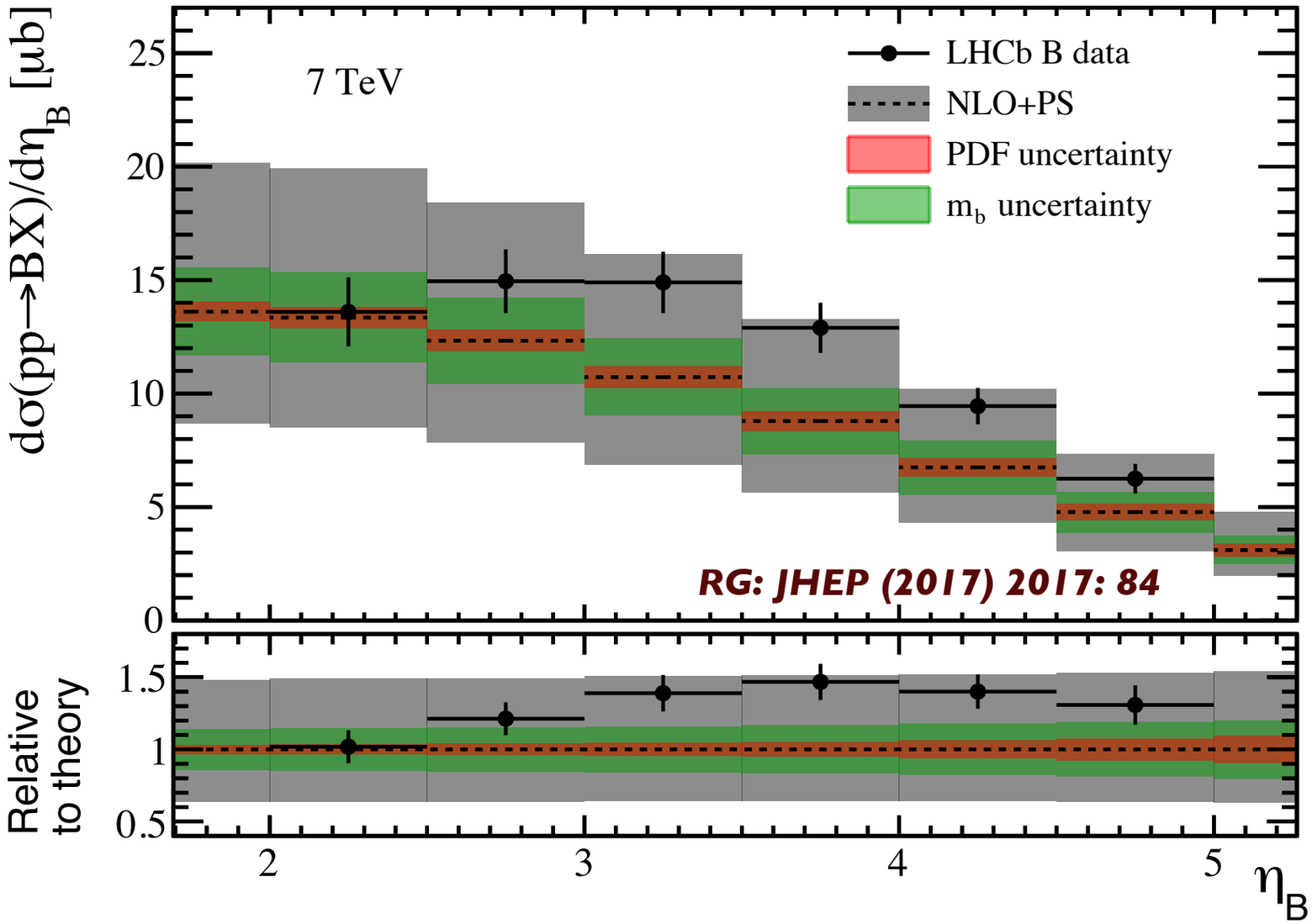
B cross-section (absolute)

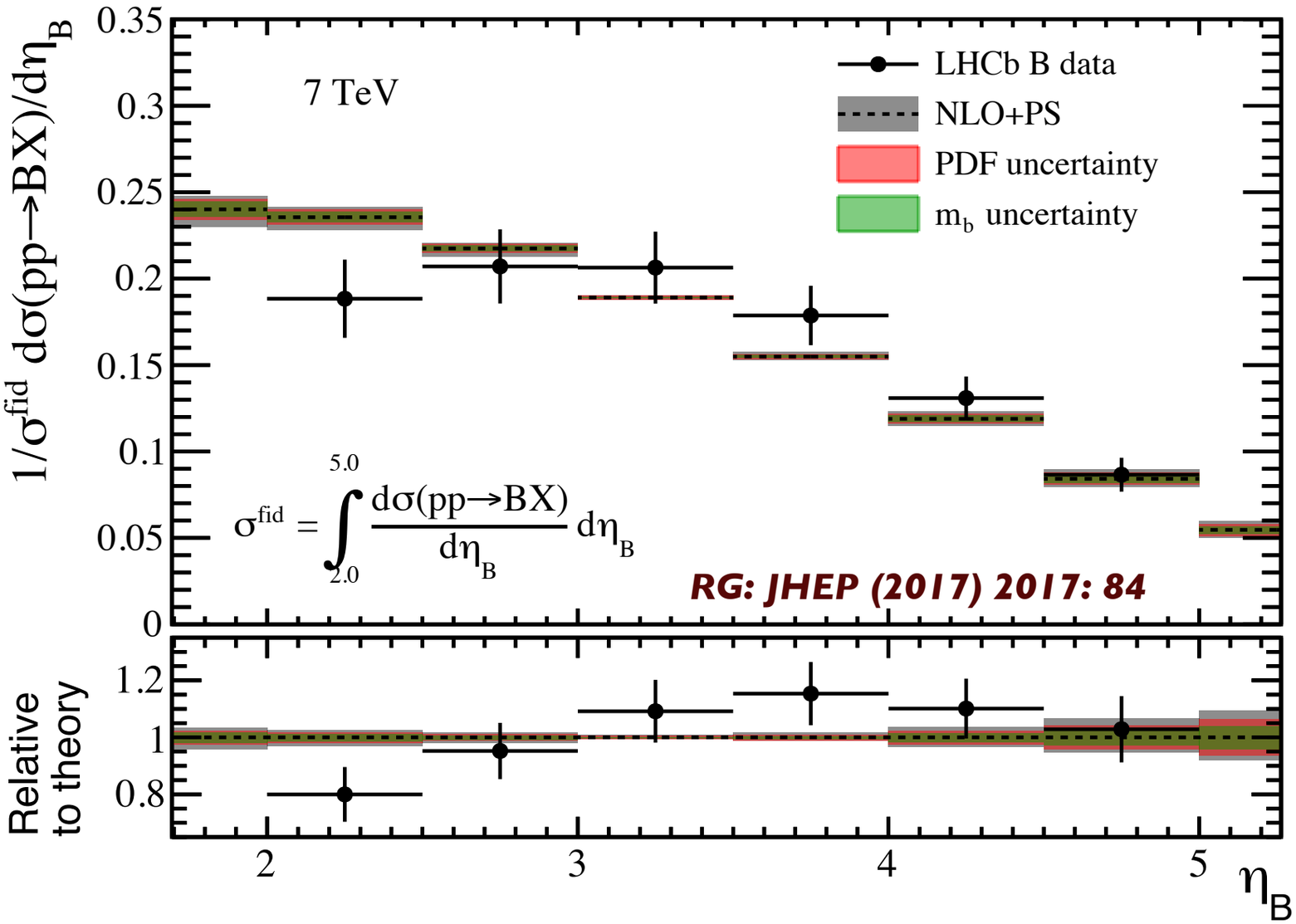
LHCb data from Erratum: Phys. Rev. Lett. 118, 052002 (2017)



1) Differential and fiducial rate measurements
   * Test of pQCD predictions, and baseline for other analyses

B cross-section (normalised)

LHCb data from Erratum: Phys. Rev. Lett. 118, 052002 (2017)

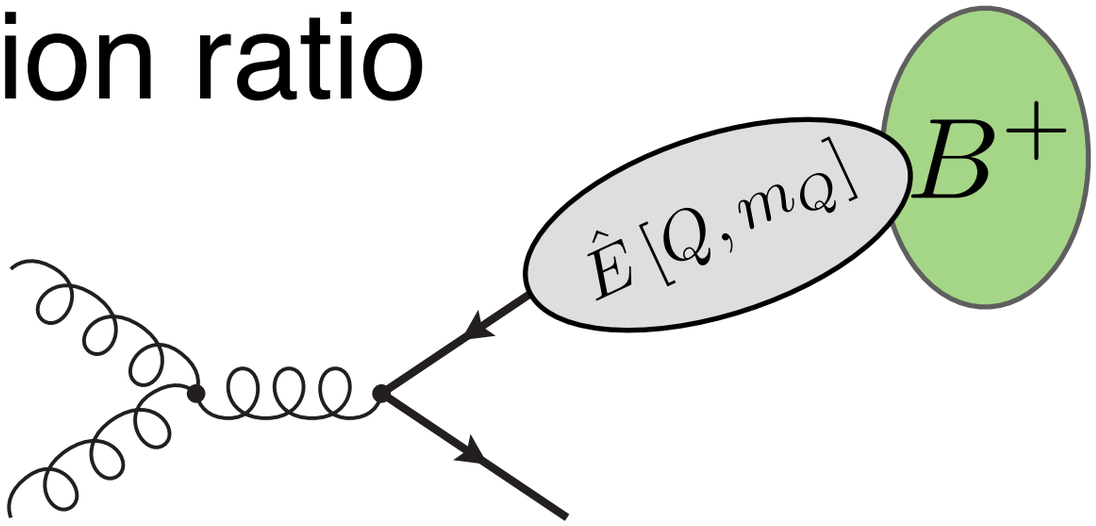


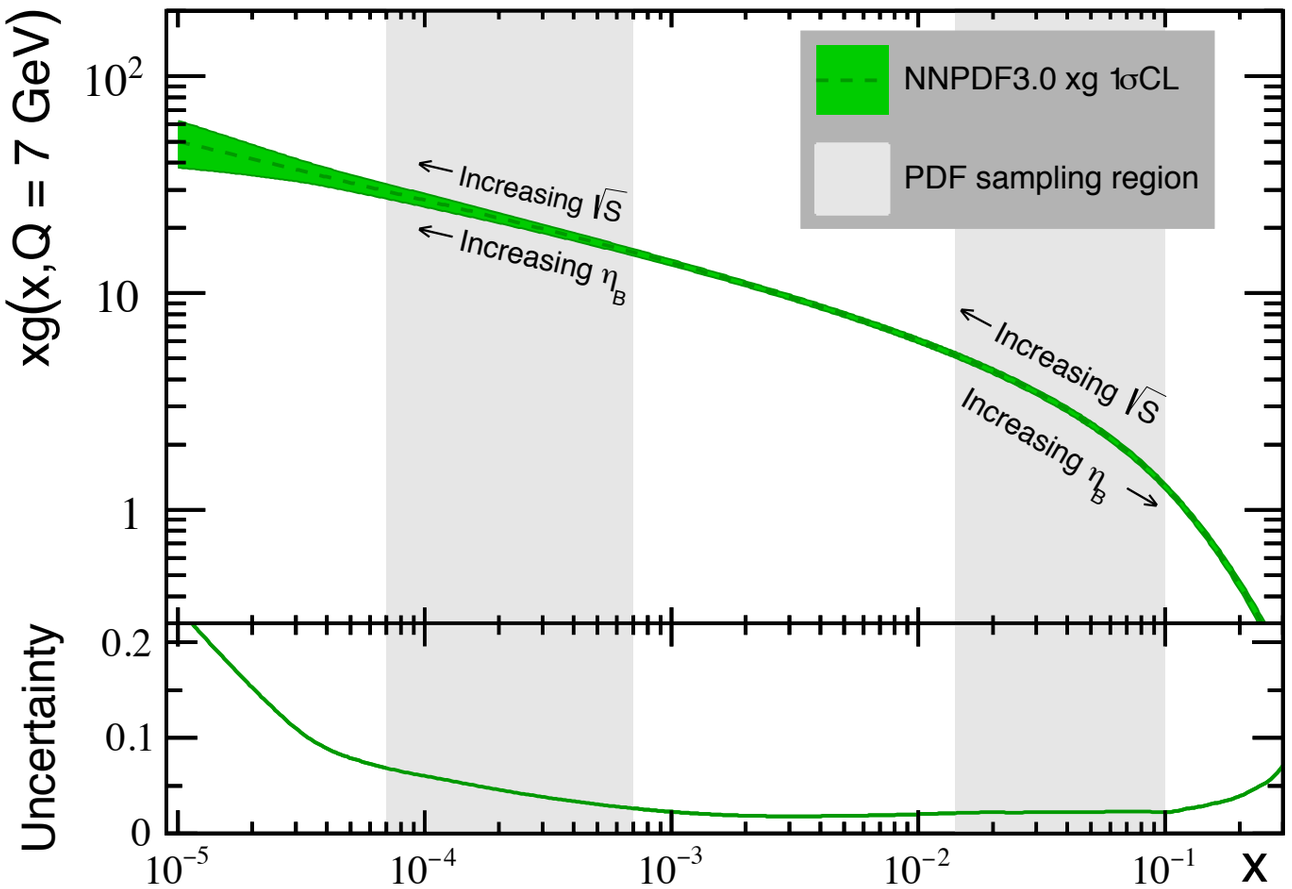
1) Differential and fiducial rate measurements
   * Test of pQCD predictions, and baseline for other analyses

2) Normalised cross-section measurement
   * Test of shape of pQCD predictions (generally more precise)

B cross-section ratio

$$x_{1,(2)} = \frac{m_T}{\sqrt{S}}\left(e^{(-)y_3} + e^{(-)y_4}\right)$$



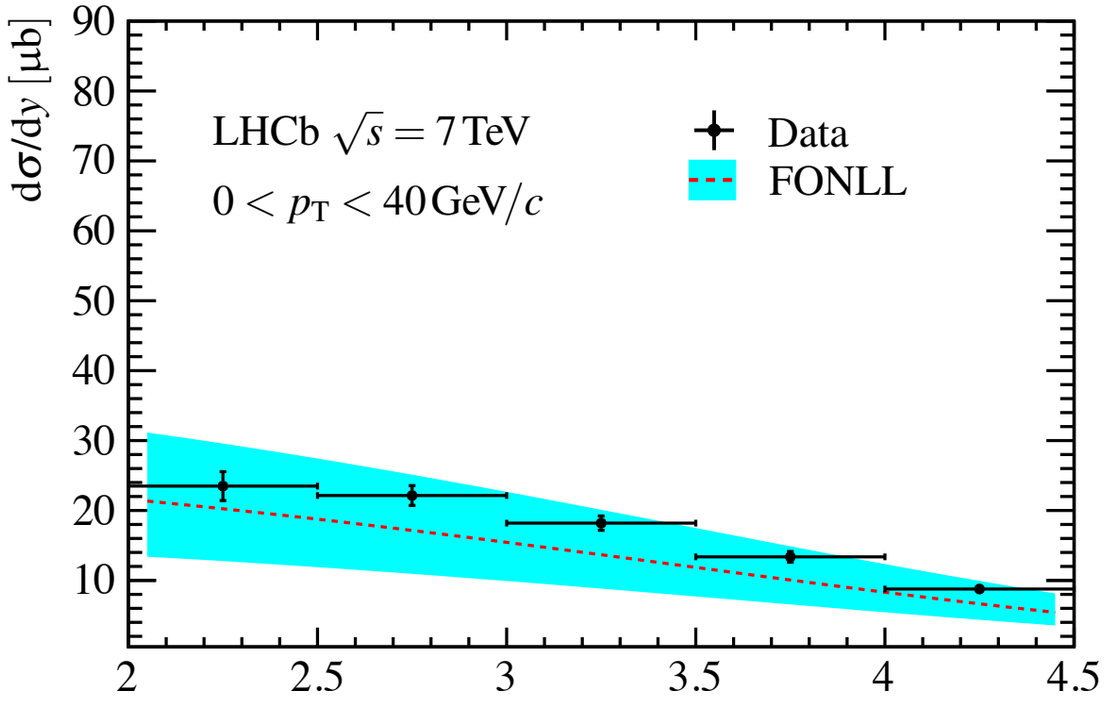


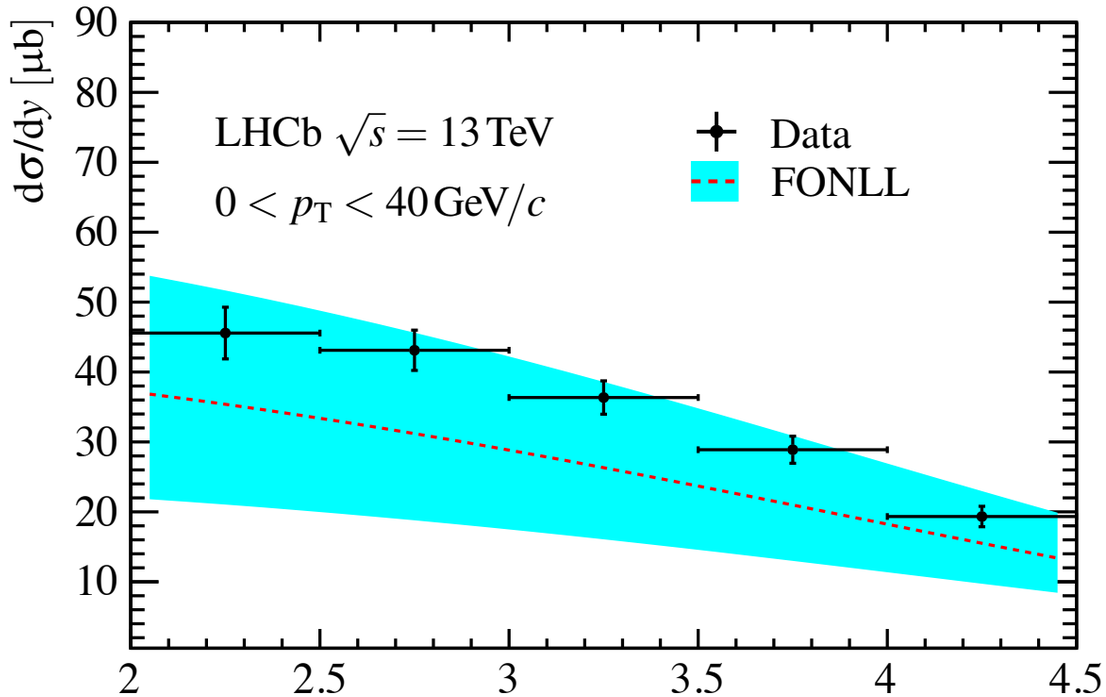
1) Tests the rate of growth of gluon PDF at both small and large-x
   * See for example:

RG et al.: JHEP (2015) 2015: 9
Cacciari et al.: EPJC 75 (2015) no.12, 610
RG: JHEP (2017) 2017: 84

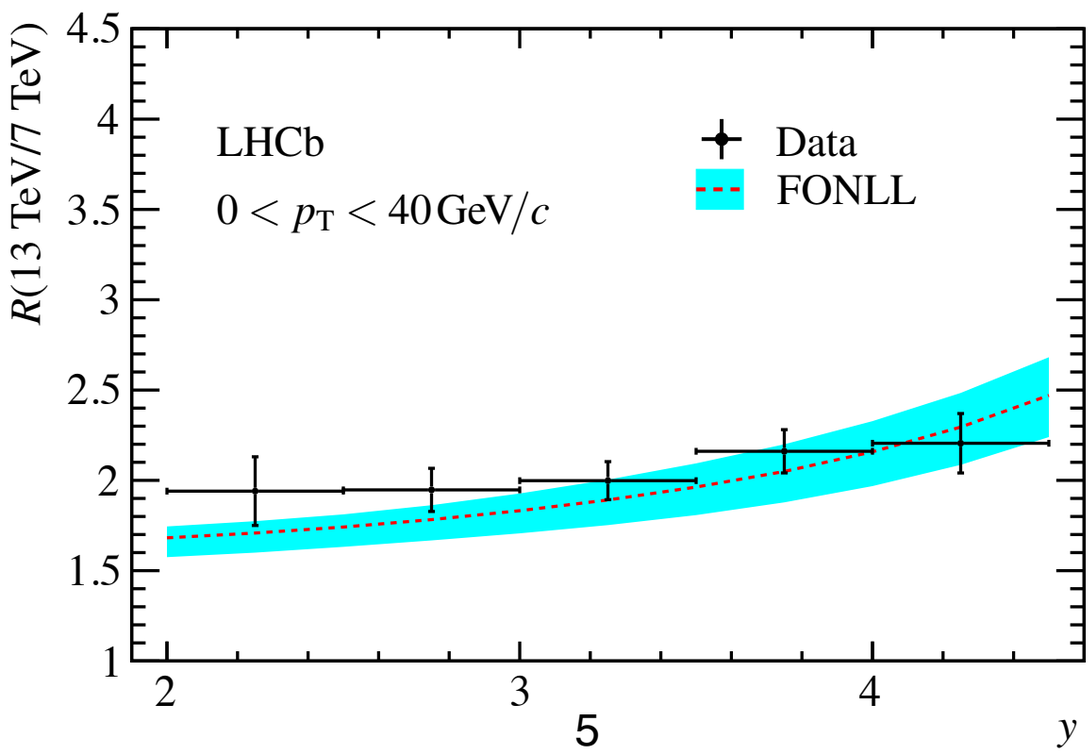
B cross-section: $B \to J/\psi K$ data

Absolute cross-section



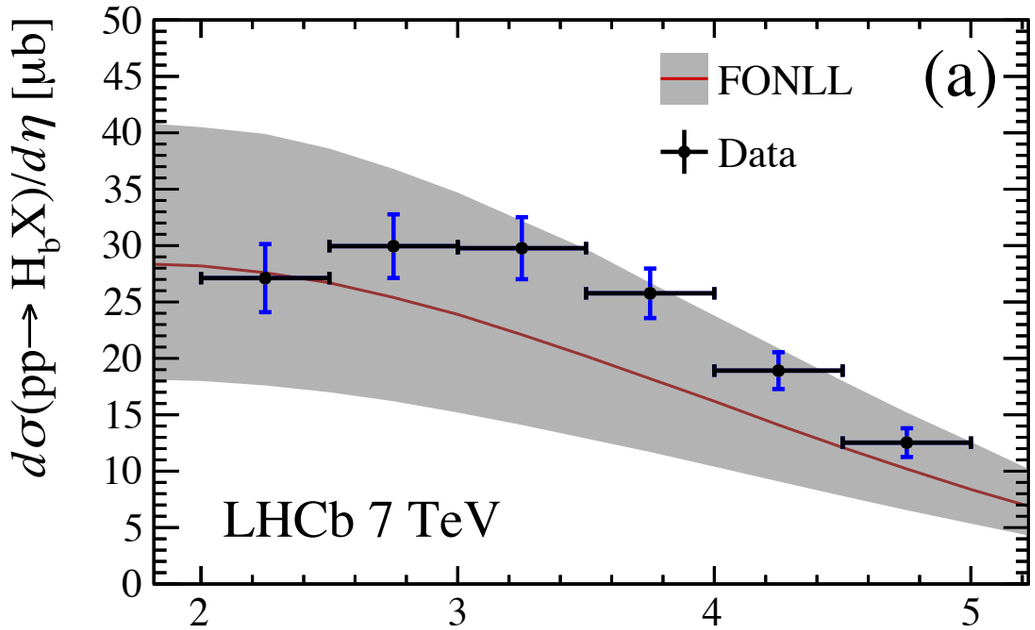


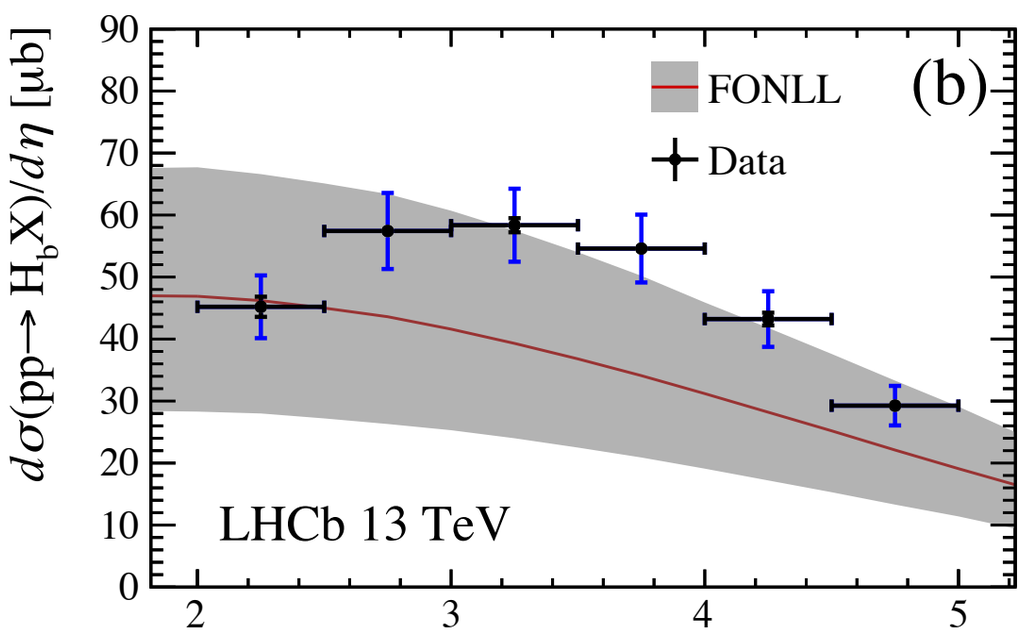
Cross-section ratio



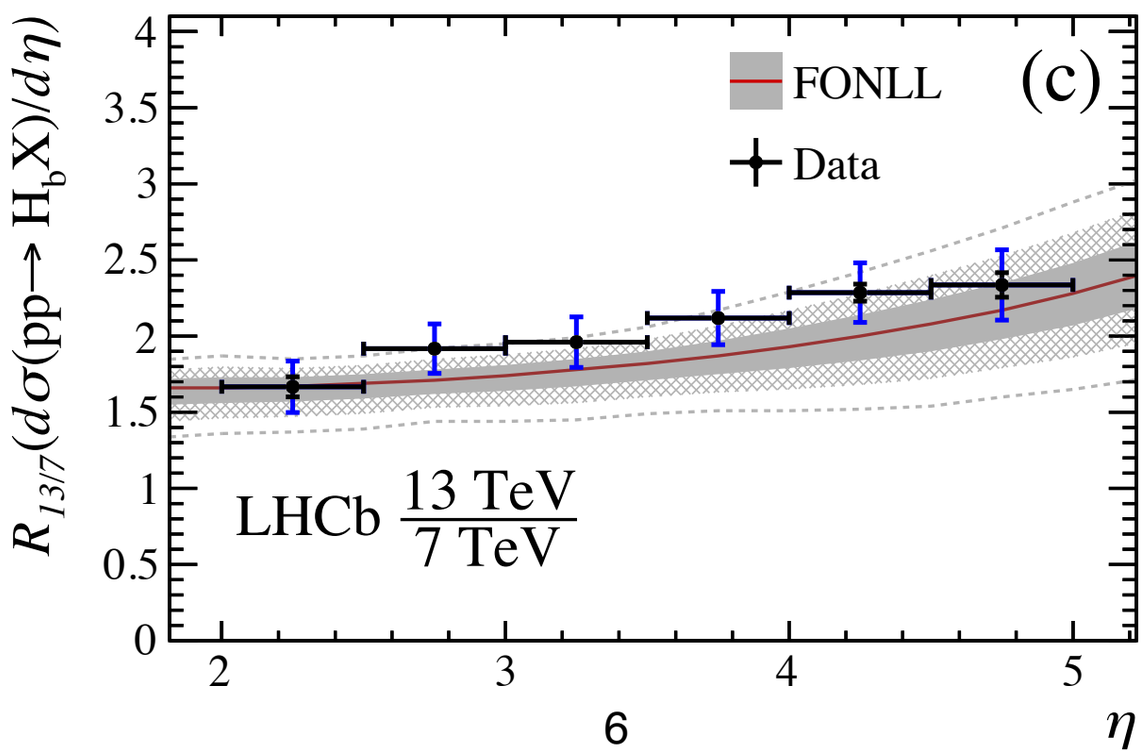
B cross-section: $B \to D\mu\nu$ data

Absolute cross-section



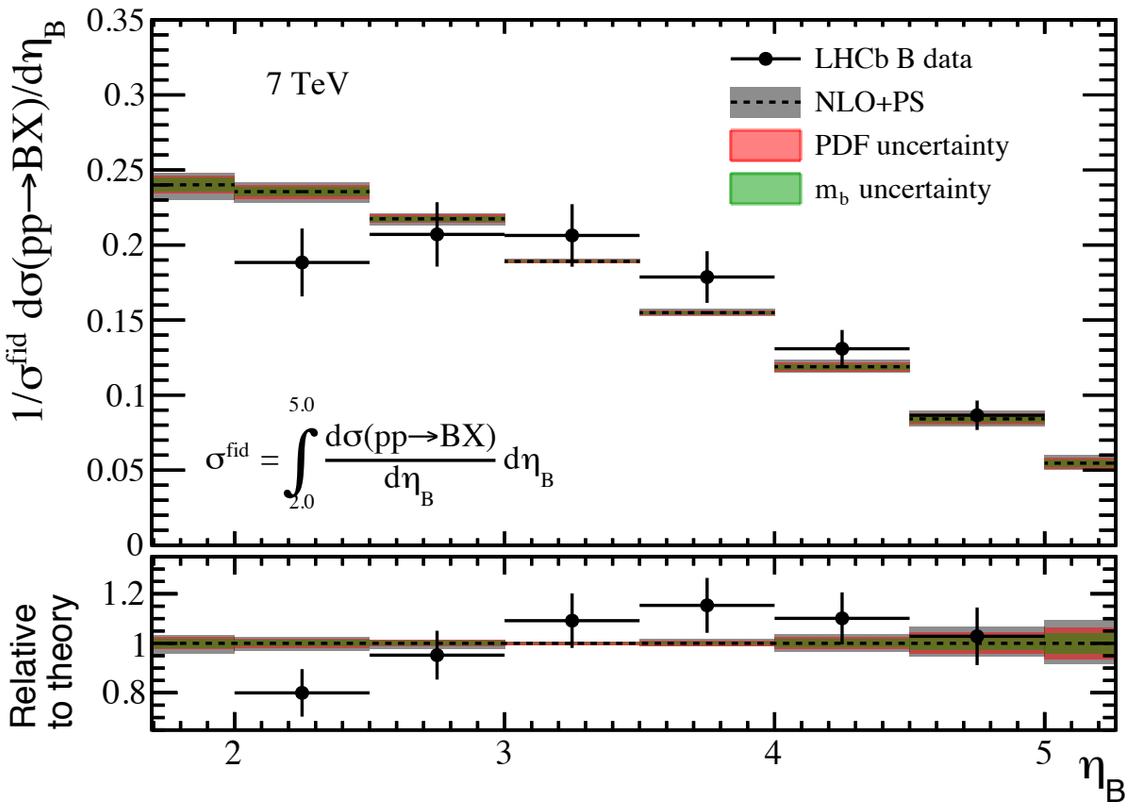


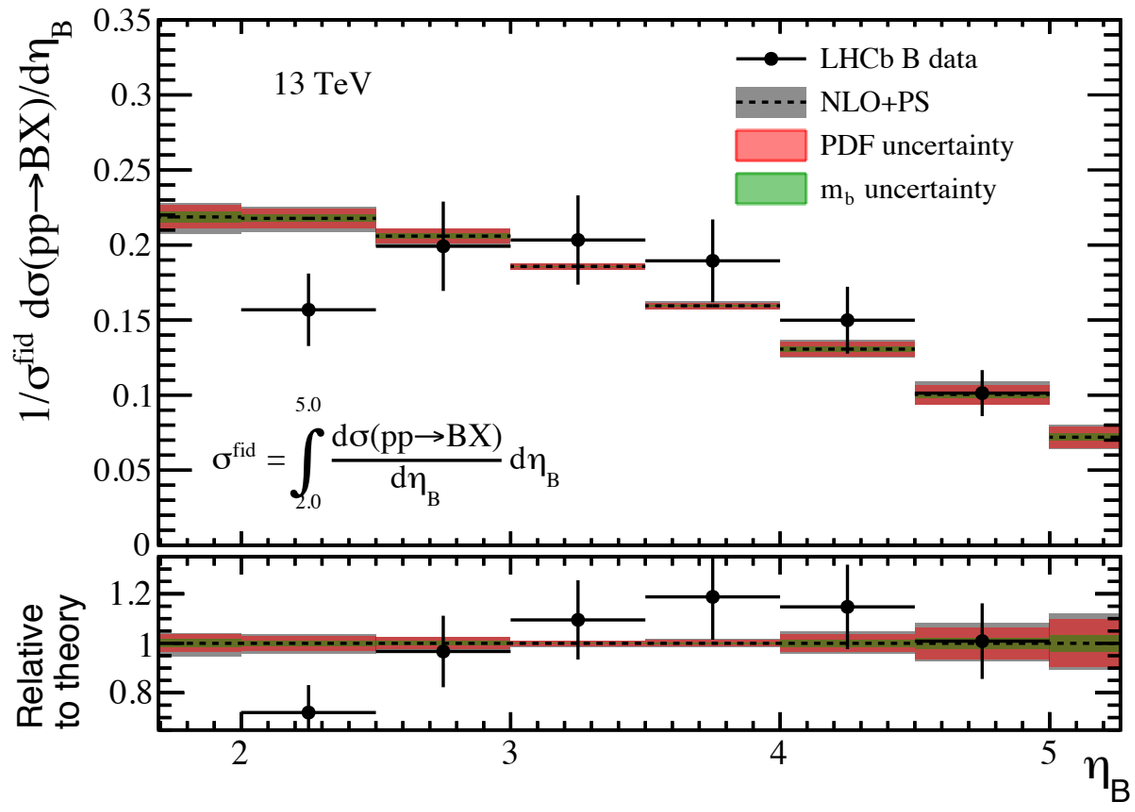
Cross-section ratio



B cross-section: $B \to D\mu\nu$ data

Normalised cross-section





1) Shape of normalised distributions not well described by pQCD

2) Large `dip' observed in the region of $\eta_B \in [2.0, 2.5]$, $P_{T,B} > 0$ GeV

3) Such behaviour **not** observed in B (->J/PsiK) or D-hadron rapidity distributions

See slides in `back-up'

Cross-checks

1) Please always provide systematic bin-by-bin correlations
   * Can then construct normalised distributions
   * Needed to test consistency of theory to data
   * … important when including data in PDF fit

See for example PROSA analysis (Maria V.'s talk)

2) Is it possible to clarify the consistency of these two B-hadron measurements?

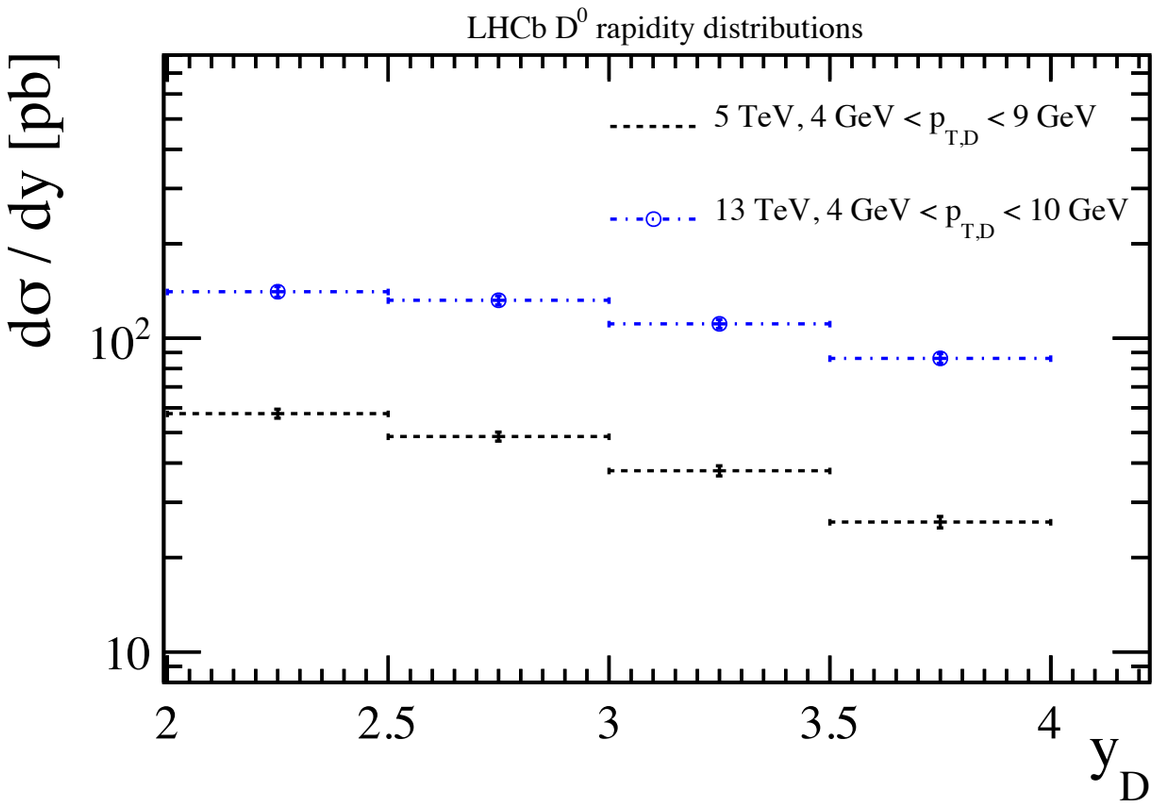
Future studies

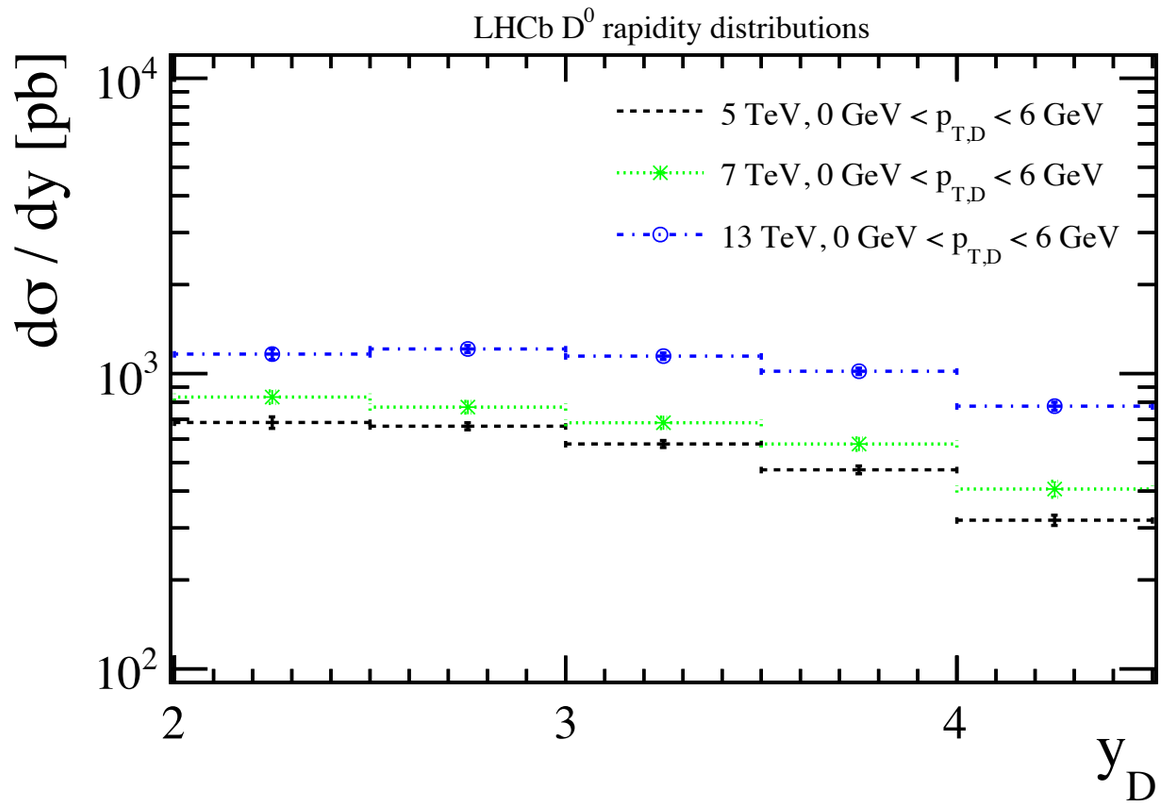
1) With large data samples, measurement of B hadron production at large-pT
   * Probes region of quasi-collinear gluon emission + sensitivity to large-x gluon

2) Are (can) the bin-by-bin cross correlations between different CoM be provided?
   * Would allow construction of `shifted CoM ratios', see RG JHEP (2017) 2017:84

$$\overline{R}_{13/7}\left[d\sigma(pp \to BX)/dy_B\right] = \frac{d\sigma_{13}(pp \to BX)}{dy'_B} \Big/ \frac{d\sigma_7(pp \to BX)}{dy_B} \qquad y'_B = y_B + \ln\left[\frac{13\ \text{TeV}}{7\ \text{TeV}}\right]$$

D-hadron rapidity distributions





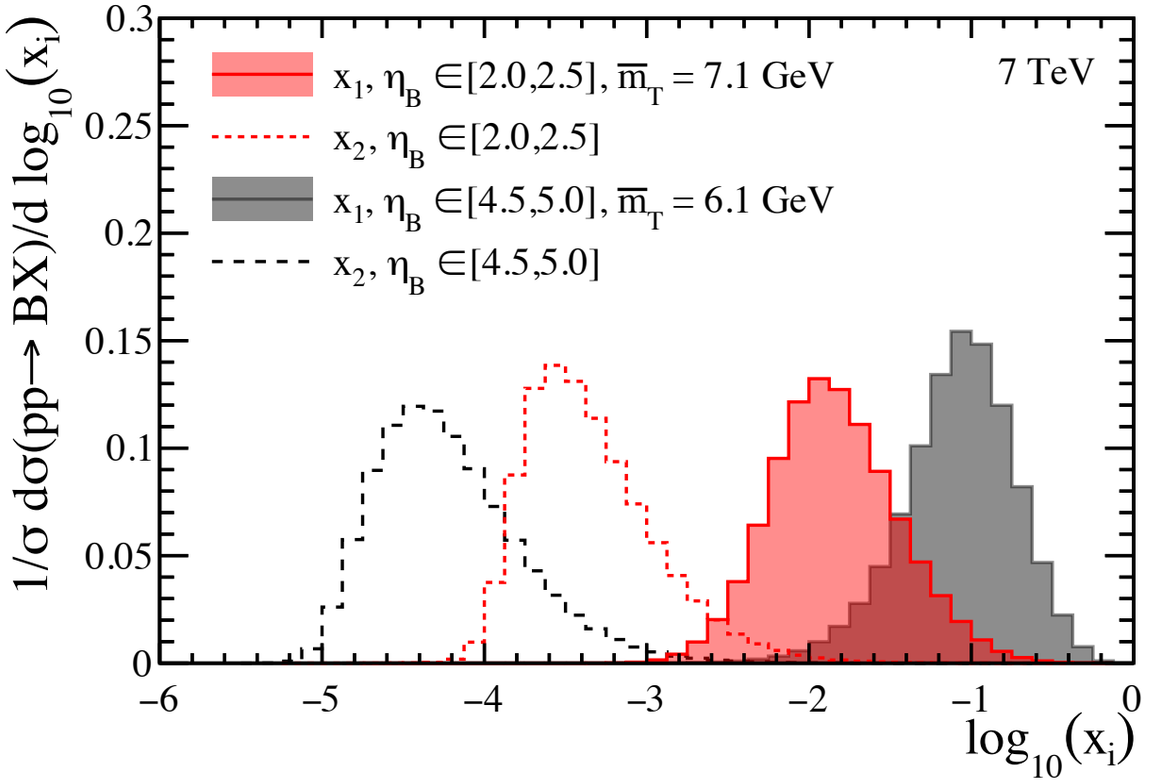
1) These are pT integrated D hadron distributions (various pT ranges)
   - Data from 5, 7, 13 TeV measurements in pp collisions

2) region of (4 < pT < 9) GeV approximately mimics pT inclusive B hadron pred.

PDF sampling in B production at LHCb

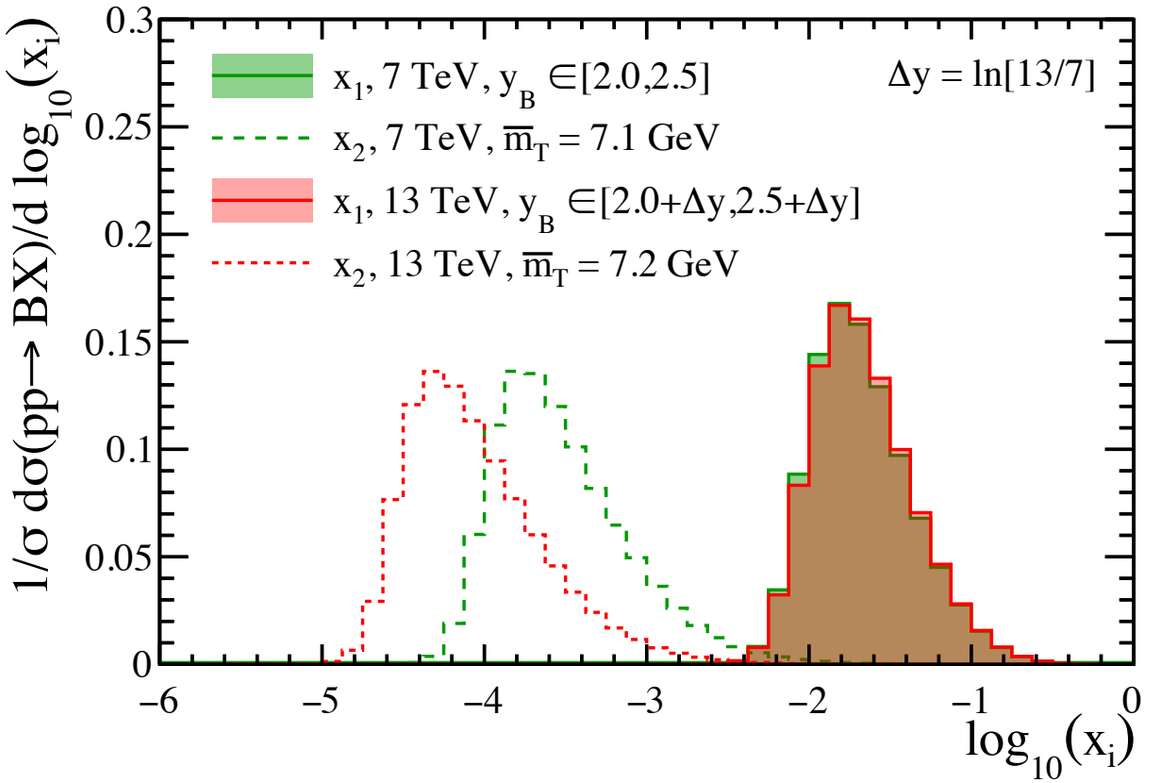
$$x_{1,(2)} = \frac{m_T}{\sqrt{S}}\left(e^{(-)y_3} + e^{(-)y_4}\right)$$

PDF sampling region:
- B hadron production at 7 TeV
- LHCb pseudorapidity bins



PDF sampling region:
- effect of aligning x-regions
- can align either low or high-x regions

$$y'_B = y_B + \ln\left[\frac{13\ \text{TeV}}{7\ \text{TeV}}\right]$$



pT dependent cross-section ratio