Erratum: Measurement of the b-quark production cross-section in 7 and 13 TeV pp collisions [Phys. Rev. Lett. 118, 052002 (2017)]

The LHCb collaboration[1]

A mistake was made in the detector simulation that changes the results of the 13 TeV b-quark production cross-section and consequently the ratio of 13 to 7 TeV cross-sections [1]. The charge collected in the LHCb VELO sensors is affected by radiation damage. One such effect, which is more pronounced in the outer regions of downstream sensors, arises from charge induction on second metal layer routing lines [2]. Prior to the running with 13 TeV pp collisions modifications were made to the digitization step in the LHCb simulation framework to model this effect. An error was made in the parametric implementation resulting in a reduction of the track reconstruction efficiency in simulation compared to data for tracks with low pseudorapidity. The tracking efficiency calibration procedure that was applied to the data and simulation [3] was unable to correct the mismodeling. The updated results of the analysis are presented in this erratum.

To set the final systematic uncertainty on the tracking efficiency we implemented a "standard candle" measurement where we determined the efficiency corrected yield of $B \to D^0\mu^+\nu$ decays, where the D^0 was reconstructed both in the $K^-\pi^+\pi^+\pi^-$ and $K^-\pi^+$ modes. The ratio of branching fractions of these modes has been well measured as $R = 2.11 \pm 0.03$ [4]. Furthermore, the tracking acceptance was narrowed to exclude regions where the tracking efficiency corrections were poorly determined; the minimum pseudorapidity η region allowed is now 1.9, the maximum 4.9, and the minimum track momentum is 5.0 GeV. Our result is $R = 2.15 \pm 0.07 \pm 0.03$. This ratio provides a check on the efficiencies of two extra tracks, allowing a determination of the systematic uncertainty of our knowledge of the tracking efficiency, including the pion identification efficiency to 1.8% per track, consistent with that in the original publication. The 7 TeV data were unaffected, so all the changes are in the 13 TeV data. We include here substantive changes in Figs. 2(b) and 2(c), and in the Table of results, which replaces Table 3 of the original publication.

The b-quark production cross-section at 13 TeV integrated over η is $144 \pm 1 \pm 21$ μb in agreement with the theoretical expectation of 111^{+51}_{-44} μb. The ratio of 13 TeV/7 TeV cross-sections is $2.00 \pm 0.02 \pm 0.26$.

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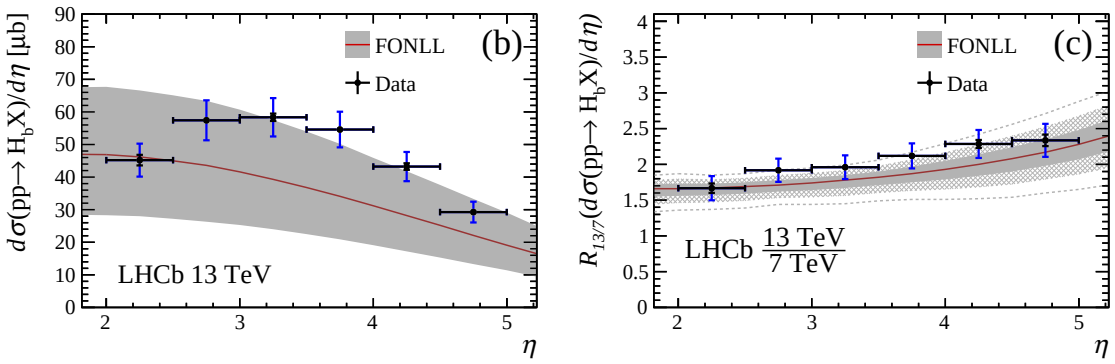

Figure 2: Cross-section at 13 TeV center-of-mass energy (b), and cross-section ratio (c) for 13 TeV/7 TeV as functions of η for $\sigma(pp \to H_b X)$, where H_b is a hadron that contains either a b or an $\bar{b}$ quark, but not both. The smaller (black) error bars show the statistical uncertainties only, and the larger (blue) ones have the systematic uncertainties added in quadrature. The solid line (red) gives the theoretical prediction, while the shaded band gives the estimated uncertainty on the prediction at ± 1 σ, the cross-hatched at 2 σ, and the dashes at 3 σ.

Table 1: Cross-sections for $pp \to H_b X$ in η bins for 7 TeV and 13 TeV collisions and their ratio, where H_b is a hadron that contains either a b or an $\bar{b}$ quark, but not both. The first uncertainty is statistical and the second systematic. To get the differential cross-section in each interval multiply by a factor two.

η	7 TeV (μb)	13 TeV (μb)	Ratio 13/7
2.0–2.5	13.6±0.2±1.5	22.6±0.8±2.4	1.67±0.07±0.16
2.5–3.0	15.0±0.1±1.4	28.7±0.4±3.0	1.92±0.03±0.16
3.0–3.5	14.9±0.1±1.4	29.2±0.6±2.9	1.96±0.04±0.16
3.5–4.0	12.9±0.1±1.1	27.3±0.4±2.7	2.12±0.04±0.17
4.0–4.5	9.5±0.1±0.8	21.6±0.5±2.2	2.29±0.06±0.19
4.5–5.0	6.3±0.1±0.6	14.6±0.5±1.5	2.34±0.08±0.22

References

[1] LHCb collaboration, R. Aaij *et al.*, *Measurement of the b-quark production cross-section in 7 and 13 TeV pp collisions*, Phys. Rev. Lett. **118** (2017) 052002, arXiv:1612.05140.

[2] A. Affolder *et al.*, *Radiation damage in the LHCb vertex locator*, JINST **8** (2013) P08002, arXiv:1302.5259.

[3] LHCb collaboration, R. Aaij *et al.*, *Measurement of the track reconstruction efficiency at LHCb*, JINST **10** (2015) P02007, arXiv:1408.1251.

[4] CLEO collaboration, G. Bonvicini *et al.*, *Updated measurements of absolute D^+ and D^0 hadronic branching fractions and $\sigma(e^+e^- \to D\overline{D})$ at $E_{\rm cm} = 3774$ MeV*, Phys. Rev. **D89** (2014) 072002, Erratum ibid. **D91** (2015) 019903, arXiv:1312.6775.