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Erratum: Measurement of the inclusive semileptonic branching fraction $\mathcal{B}(B_s^0 \to X^- \ell^+ \nu_\ell)$ at Belle [Phys. Rev. D 87, 072008 (2013)]

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We recently discovered an error in the way the Belle installation of EvtGen [1] treated semileptonic B_s^0 decays. It was found that the generated distribution of the lepton decay angle in the rest frame of the virtual W boson was uniform. This also led to incorrectly modeled lepton momentum spectra in the simulation. There were two consequences of this modeling error: the normalization of the signal component obtained in the fit to the lepton momentum distributions was incorrect, and the acceptance within the selected fiducial region was incorrectly estimated. We have addressed this problem by correcting the affected Monte Carlo (MC) distributions. Below, we report on the resulting changes in the measurement. All values that change with respect to the original publication are also summarized in Table I.

The corrected signal acceptances for the $p(\ell^+) > 0.6$ GeV selection criterion are 93% and 94% for electrons and muons, respectively. The signal lepton identification efficiencies multiplied by the geometrical acceptance are estimated to be 77% (electrons) and 71% (muons). We repeat the fit to the measured lepton momentum spectra with the correct MC distribution of prompt leptons (see Fig 1). The χ^2/d.o.f. value of the fits are 3.6/7 and 5.7/7 for the electron and muon modes, respectively. The efficiency-corrected yields of prompt leptons are $[3.91 \pm 0.18(\text{stat})] \times 10^3$ electrons and $[4.37 \pm 0.21(\text{stat})] \times 10^3$ muons. These yields translate into the following ratios $\mathcal{R}_\ell = N_{D_s^+ \ell^+}/N_{D_s^+}$:

$$\mathcal{R}_e = [394 \pm 19(\text{stat}) \pm 13(\text{syst})] \times 10^{-4},$$
$$\mathcal{R}_\mu = [432 \pm 22(\text{stat}) \pm 17(\text{syst})] \times 10^{-4},$$
$$\mathcal{R}_{e,\mu} = [409 \pm 15(\text{stat}) \pm 14(\text{syst})] \times 10^{-4}.$$

The combination of the e^+ and μ^+ modes, $\mathcal{R}_{e,\mu}$, takes into account the correlations between the two modes. The correction of the signal MC distributions also modifies the systematic uncertainties in the "signal modeling" category in Table II of the original publication. The uncertainty on $\mathcal{R}$ due to the modeling of the shape of the prompt lepton spectra is reevaluated to be 1.0% for both electrons and muons. The uncertainty due to the composition of the semileptonic width becomes 1.6% and 2.1% for electrons and muons, respectively. The total systematic uncertainties on $\mathcal{R}$ are recalculated to be 3.3% (3.1%) for the electron mode and 4.0% (3.6%) for the muon mode, where the values in parentheses are the fully correlated errors between both modes. Based on the ratios, $\mathcal{R}_\ell$, we obtain the following values for the semileptonic branching fraction $\mathcal{B}(B_s^0 \to X^- \ell^+ \nu_\ell)$:

TABLE I. Comparison of the affected numbers and results in the original publication (Old) and after correcting the signal MC distribution from EvtGen (New). The quantities are shown for the electron and muon modes; those for the combined mode are given in the text.

		Electrons	Muons
Acceptance for $p(\ell^+) > 0.6$ GeV selection [%]	Old	91	92
	New	93	94
Lepton identification efficiency including geometrical acceptance [%]	Old	75	68
	New	77	71
Goodness of lepton momentum fit [χ^2/d.o.f.]	Old	6.4/7	6.7/7
	New	3.6/7	5.7/7
Signal yield [10^3]	Old	4.26 ± 0.19(stat)	4.76 ± 0.23(stat)
	New	3.91 ± 0.18(stat)	4.37 ± 0.21(stat)
Ratio $\mathcal{R}$ [10^{-4}]	Old	428 ± 20(stat) ± 13(syst)	470 ± 23(stat) ± 16(syst)
	New	394 ± 19(stat) ± 13(syst)	432 ± 22(stat) ± 17(syst)
Lepton momentum shape uncertainty [%]	Old	0.6	0.7
	New	1.0	1.0
Signal composition uncertainty [%]	Old	1.0	1.1
	New	1.6	2.1
Total correlated uncertainty between e and μ mode [%]	Old	2.7	2.8
	New	3.1	3.6
Total systematic uncertainty [%]	Old	3.0	3.5
	New	3.3	4.0
Uncertainty due to external measurements [%]	Old	5.8	6.3
	New	5.6	5.9
Branching fraction [%]	Old	10.1 ± 0.6(stat) ± 0.7(syst)	11.3 ± 0.7(stat) ± 0.8(syst)
	New	9.1 ± 0.5(stat) ± 0.6(syst)	10.2 ± 0.6(stat) ± 0.8(syst)

$$\ell = e\colon\ [9.1 \pm 0.5(\text{stat}) \pm 0.6(\text{syst})]\%,$$
$$\ell = \mu\colon\ [10.2 \pm 0.6(\text{stat}) \pm 0.8(\text{syst})]\%,$$
$$\ell = e, \mu\colon\ [9.6 \pm 0.4(\text{stat}) \pm 0.7(\text{syst})]\%.$$

The systematic uncertainty includes the systematic uncertainty on $\mathcal{R}$ and the uncertainty due to the external measurements used in the branching fraction extraction. The latter uncertainty depends also on the value of $\mathcal{R}$ and is reevaluated to be 5.6% (electron mode), 5.9% (muon mode), and 5.6% (combined mode).

Although the updated branching fractions are significantly lower than before, they are still consistent with the expectation from SU(3) symmetry [2,3].

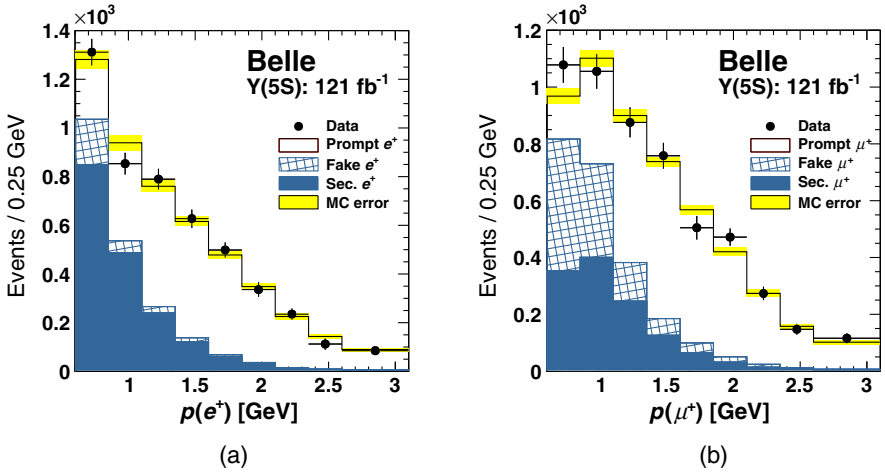

FIG. 1 (color online). Momentum spectra obtained from $KK\pi$ mass fits in the $D_s^+\ell^+$ samples in bins of $p(e^+)$ and $p(\mu^+)$, respectively. The continuum backgrounds have been subtracted using off-resonance data. The MC uncertainty includes both statistical and systematic uncertainties. [Replacement for Figs. 2(b) and 2(c) in the original publication.]

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