1 Supplementary material for CDS

In what follows, ratios of acceptances are determined as follows: a weight is calculated for each simulated candidate, $w \equiv 1$ for B^0 decays and $w \equiv e^{t_{\rm true}(1/\tau^{\rm fs}_{B^0_s} - 1/\tau_B)}$ for B^0_s decays, where $t_{\rm true}$ is the true decay time and $\tau^{\rm fs}_{B^0_s}$ and τ_B are the $B^0_{(s)}$ lifetimes in simulation; a histogram is filled with the decay time of each candidate weighted with w; the ratio of acceptances is the ratio of the histograms.

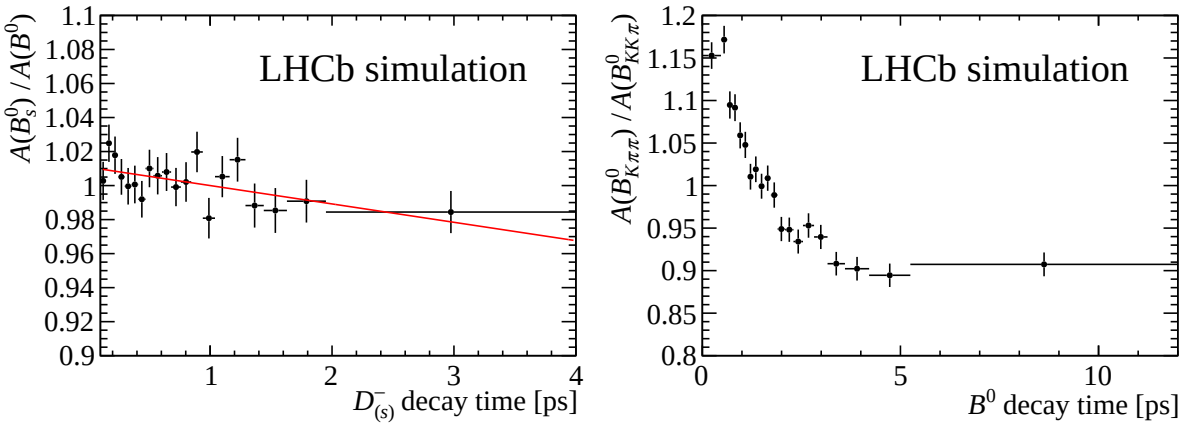

Figure 1: (Left panel) ratio between decay-time acceptances of simulated signal and reference decays as a function of the $D^-_{(s)}$ decay time. (Right panel) ratio between decay-time acceptances of simulated control and reference decays as a function of the B^0 decay time. A linear fit to the signal-to-reference ratio yields a slope of -0.0108 ± 0.0043 ps^{-1} with $\chi^2/{\rm ndf} = 14.3/18$ (71% p-value).

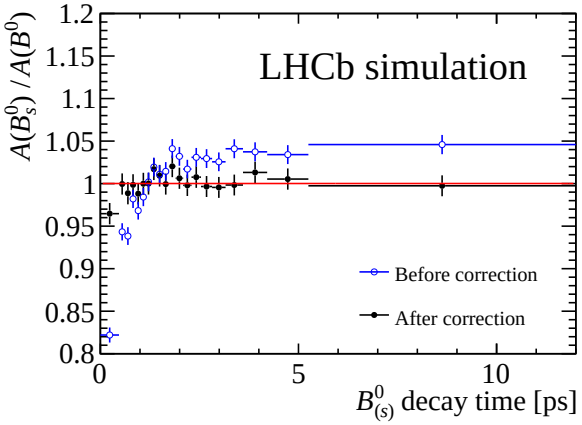

Figure 2: Ratio between decay-time acceptances of simulated signal and reference decays as a function of the $B^0_{(s)}$ decay time, (open circles) excluding and (full circles) including the correction for differing D^- and D^-_s lifetimes. A fit with a constant function is overlaid on the corrected-ratio data, which are compatible with a uniform distribution with $\chi^2/{\rm ndf} = 13.2/18$ (83% p-value).

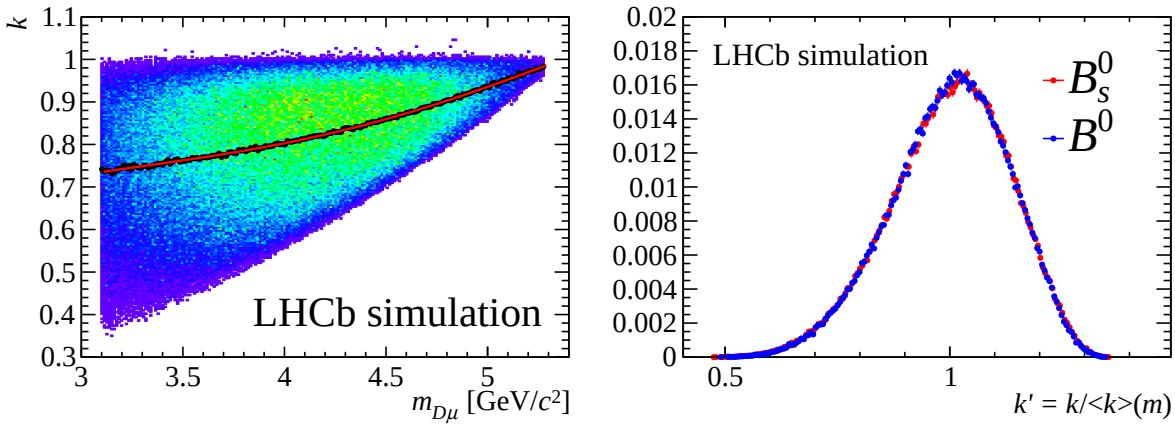

Figure 3: (Left panel) distribution of k-factor as a function of $D_s^-\mu^+$ mass for simulated signal decays. The corresponding mean value as a function of $m_{D\mu}$, $\langle k\rangle(m_{D\mu})$, is represented by black markers, with a fit to an empirical function overlaid in red. (Right panel) distribution of k-factor for simulated signal and reference decays. The k-factors in the latter distributions are scaled to their mean value for presentation purposes.

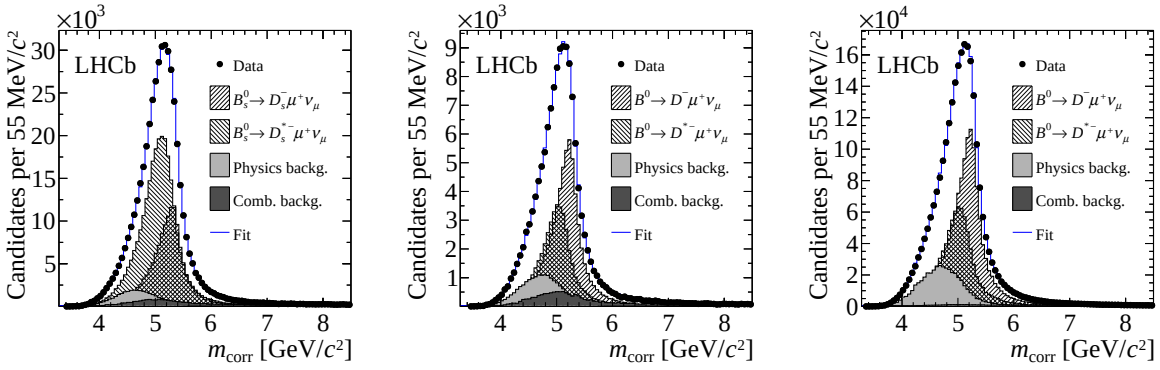

Figure 4: Corrected mass plot for (left panel) B_s^0, (middle panel) $B^0 \to [K^+K^-\pi^-]_{D^{(*)-}}\mu^+\nu_\mu$, and (bottom panel) $B^0 \to [K^+\pi^-\pi^-]_{D^{(*)-}}\mu^+\nu_\mu$ candidates, with fits overlaid.

Table 1: Results of the fit to the corrected B_s^0 mass distribution. Uncertainties are statistical only.

Component	Fit fraction [%]
$B_s^0 \to D_s^-\mu^+\nu$	29.20 ± 0.52
$B_s^0 \to D_s^{*-}\mu^+\nu$	57.77 ± 0.91
$B_s^0 \to D_{(s)}^{(**)}(\to \mu\nu_\mu)X$	3.21 ± 0.74
$B_s^0 \to D_s(\to K\mu\nu_\mu)\tau\nu_\tau$	4.00 ± 0.28
Comb. backg	5.82 ± 0.13

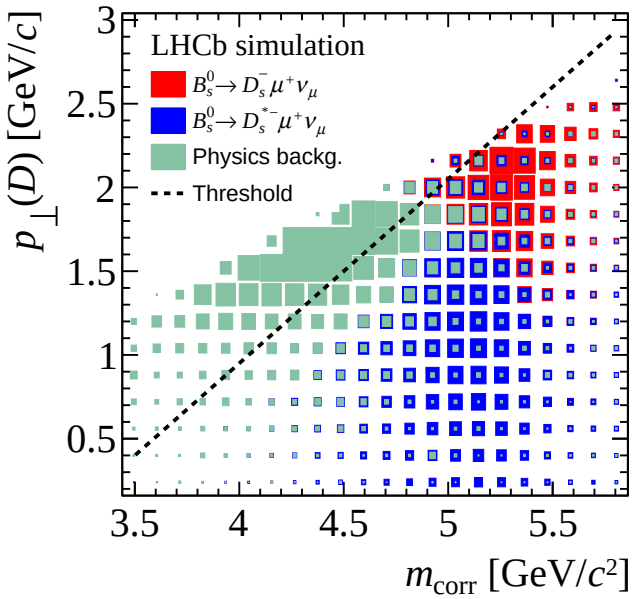

Figure 5: Distribution of the classes of simulated events in the two-dimensional plane of the D momentum component perpendicular to the B meson flight direction versus corrected mass. The region accepted in our selection is below the dashed line.

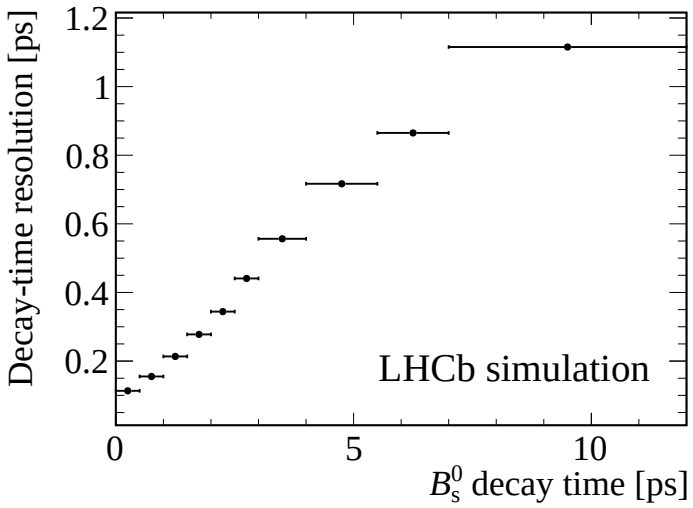

Figure 6: Decay-time resolution as a function of the B_s^0 decay time for $B_s^0 \to [K^+K^-\pi^-]_{D_s^{(*)-}}\mu^+\nu_\mu$ decays.

Table 2: Results of the fit to the corrected B^0 mass distribution of the $B^0 \to [K^+K^-\pi^-]_{D^{(*)-}}\mu^+\nu_\mu$ and $B^0 \to [K^+\pi^-\pi^-]_{D^{(*)-}}\mu^+\nu_\mu$ samples. Uncertainties on the branching ratios of the decays are included in the expected fractions. The $B^0 \to D^-\tau^+\nu_\tau X$ component is shown in parenthesis because it is neglected in the fit to the $B^0 \to [K^+K^-\pi^-]_{D^{(*)-}}\mu^+\nu_\mu$ sample. The "prediction" refers to the composition of a sample simulated using form-factors parametrized following Nucl. Phys. **B530** (1998) 153 [arXiv:hep-ph/9712417], with numerical values taken from the *Heavy Flavor Averaging Group* [arXiv:1612.07233], and passed through the analysis selection. Uncertainties are statistical only.

	$K^+K^-\pi^-$		$K^+\pi^-\pi^-$	
Component	Fit fraction [%]	Prediction [%]	Fit fraction [%]	Prediction [%]
$B^0 \to D^-\mu^+\nu_\mu$	45.39 ± 0.67	45.83 ± 3.04	49.17 ± 0.53	50.47 ± 3.05
$B^0 \to D_s^-\mu^+\nu_\mu$	31.16 ± 0.92	32.57 ± 0.99	31.24 ± 0.93	35.10 ± 0.96
$B^0/B^+ \to D^{(**)-}\mu^+\nu_\mu X$	13.46 ± 0.47	10.83 ± 1.90	15.96 ± 1.22	11.27 ± 1.90
$B^0 \to D^-\tau^+\nu_\tau X$	(-1.1 ± 0.9)	0.78 ± 0.22	1.26 ± 0.77	0.79 ± 0.21
Comb. backg.	9.99 ± 0.33	–	2.37 ± 0.07	–

Table 3: Summary of uncertainties.

Source	Uncertainty on $\Delta_\Gamma(D)$ [ps^{-1}]	Uncertainty on $\Delta_\Gamma(B)$ [ps^{-1}]
Fit bias	0.0004	0.0009
$B_s^0 \to D_s^{*-}$ decay model	0.0005	0.0025
Sample composition	0.0007	0.0005
B^0-to-B_s^0 $p_{\rm T}$ differences	0.0018	0.0028
Decay-time acceptance	0.0049	0.0004
Decay-time resolution	0.0039	0.0004
B_c^+ feed-down	–	0.0010
Total systematic uncertainty	0.0065	0.0041
Statistical uncertainty	0.0117	0.0053