Supplementary material for LHCb-PAPER-2020-038

This appendix contains supplementary material that will be posted on the public CDS record but will not appear in the paper.

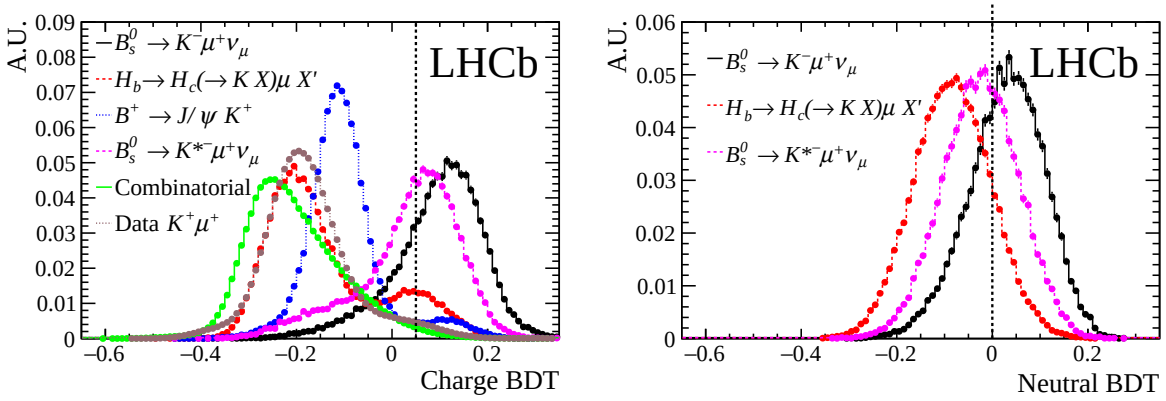

Figure 1: Distributions of the charged and neutral BDT classifiers for the $B_s^0 \to K^-\mu^+\nu_\mu$ signal and various background components.

Table 1: Absolute branching fractions with uncertainty split according to the sources. The signal yield uncertainty $\sigma(N_K)$ and the experimental systematic uncertainty (exp. syst.) are uncorrelated. The uncertainty from the normalization yield, $\sigma(N_{D_s}$, and all other sources are fully correlated between low and high q^2 bins. The external sources (ext.) combine the uncertainties on $\mathcal{B}(D_s^- \to K^+K^-\pi^-)$, τ_{B_s}, $|V_{cb}|$ and FF_{D_s}.

Baseline ($\times 10^{-4}$)	$\mathcal{B}(B_s^0 \to K^-\mu^+\nu_\mu)$	$\sigma(N_K)$	$\sigma(N_{D_s})$	exp. syst.	ext.
All q^2	1.06	0.04	0.03	0.04	0.07
$q^2 < 7\mathrm{GeV}^2/\mathrm{c}^4$	0.36	0.01	0.01	0.02	0.02
$q^2 > 7\mathrm{GeV}^2/\mathrm{c}^4$	0.70	0.04	0.02	0.04	0.05

Table 2: Efficiency ratio $\epsilon_K/\epsilon_{D_s}$ and fitted yields.

MILC2019, A. Bazavov *et al.* [1]	$\epsilon_K/\epsilon_{D_s}$	$B_s^0 \to K^-\mu^+\nu_\mu$ Yield
All q^2	0.670 ± 0.008	13895 ± 491
$q^2 < 7\mathrm{GeV}^2/\mathrm{c}^4$	1.160 ± 0.021	7497 ± 325
$q^2 > 7\mathrm{GeV}^2/\mathrm{c}^4$	0.517 ± 0.008	6398 ± 368

Table 3: Efficiency ratio $\epsilon_K/\epsilon_{D_s}$ and fitted yields.

HPQCD2015, C. Bouchard *et al.* [2]	$\epsilon_K/\epsilon_{D_s}$	$B_s^0 \to K^-\mu^+\nu_\mu$ Yield
All q^2	0.820 ± 0.011	13249 ± 467
$q^2 < 7\mathrm{GeV}^2/\mathrm{c}^4$	1.104 ± 0.017	6712 ± 285
$q^2 > 7\mathrm{GeV}^2/\mathrm{c}^4$	0.606 ± 0.010	6537 ± 370

Table 4: Efficiency ratio $\epsilon_K/\epsilon_{D_s}$ and fitted yields.

UKQCD2014, J. M. Flynn *et al.* [3]	$\epsilon_K/\epsilon_{D_s}$	$B_s^0 \to K^-\mu^+\nu_\mu$ Yield
All q^2	0.704 ± 0.010	13726 ± 482
$q^2 < 7\mathrm{GeV}^2/\mathrm{c}^4$	1.150 ± 0.020	7307 ± 313
$q^2 > 7\mathrm{GeV}^2/\mathrm{c}^4$	0.539 ± 0.009	6419 ± 366

Table 5: Efficiency ratio $\epsilon_K/\epsilon_{D_s}$ and fitted yields.

LCSR, Khodjamirian and Rusov [4]	$\epsilon_K/\epsilon_{D_s}$	$B_s^0 \to K^-\mu^+\nu_\mu$ Yield
All q^2	0.795 ± 0.011	13412 ± 466
$q^2 < 7\mathrm{GeV}^2/\mathrm{c}^4$	1.120 ± 0.018	6922 ± 294
$q^2 > 7\mathrm{GeV}^2/\mathrm{c}^4$	0.602 ± 0.010	6490 ± 362

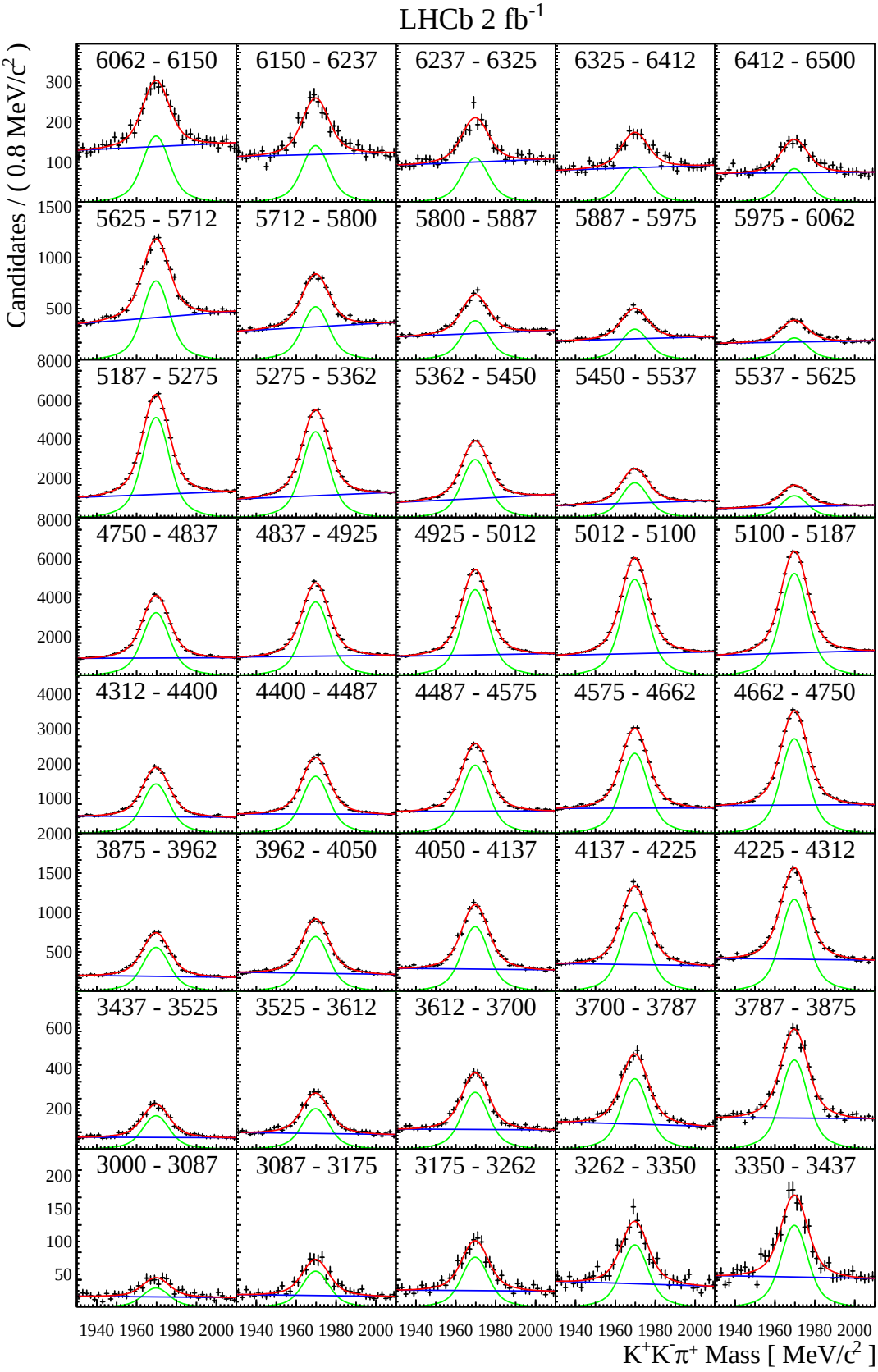

Figure 2: Fits to the $K^+K^-\pi^+$ mass in intervals of $m_{\rm corr}$ (in MeV/c^2), in preparation to the fit to the $B_s^0 \to D_s^-\mu^+\nu_\mu$ normalization channel.

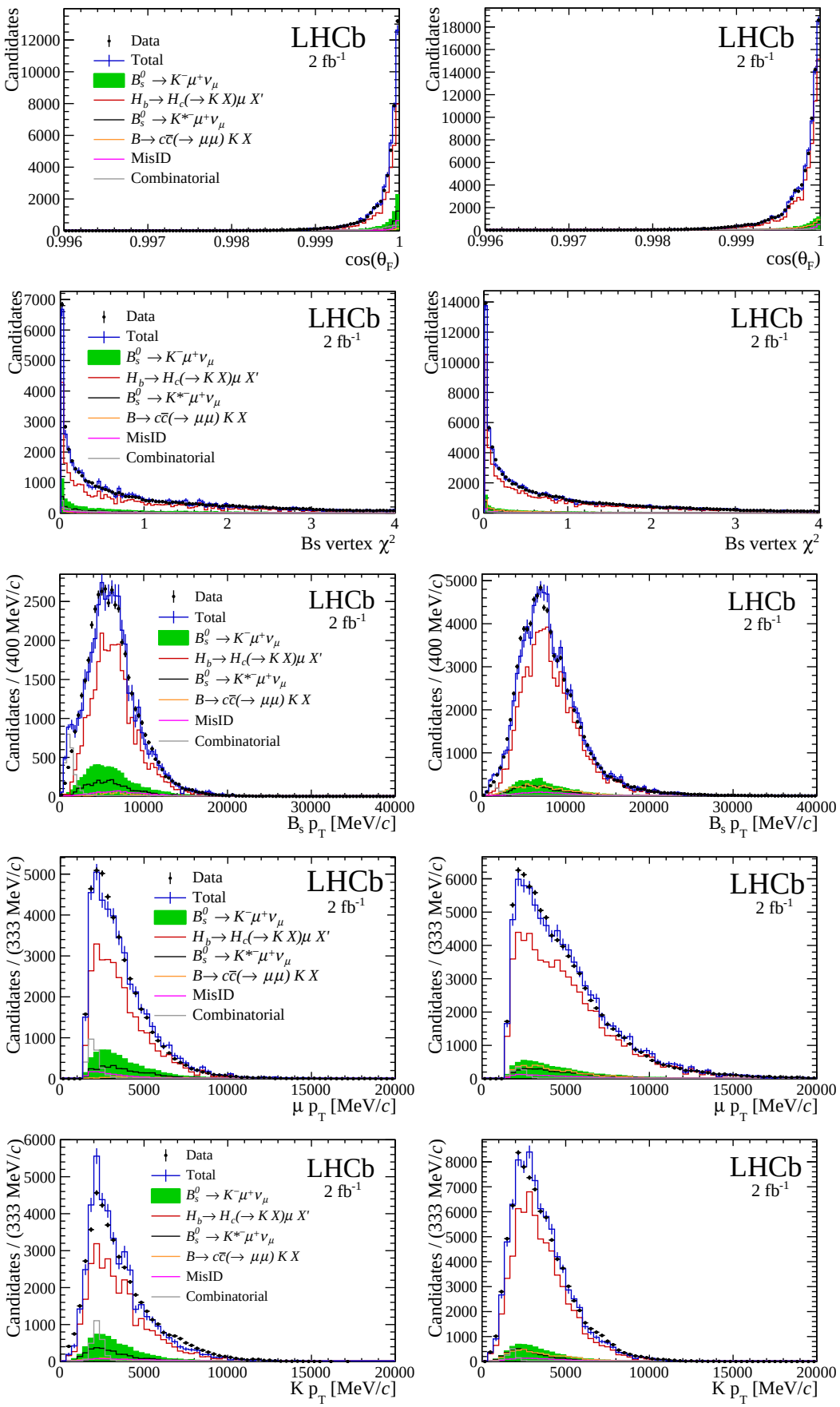

Figure 3: Projections of the $B_s^0 \to K^-\mu^+\nu_\mu$ fit on control variables for (left) low and (right) high q^2 ranges.

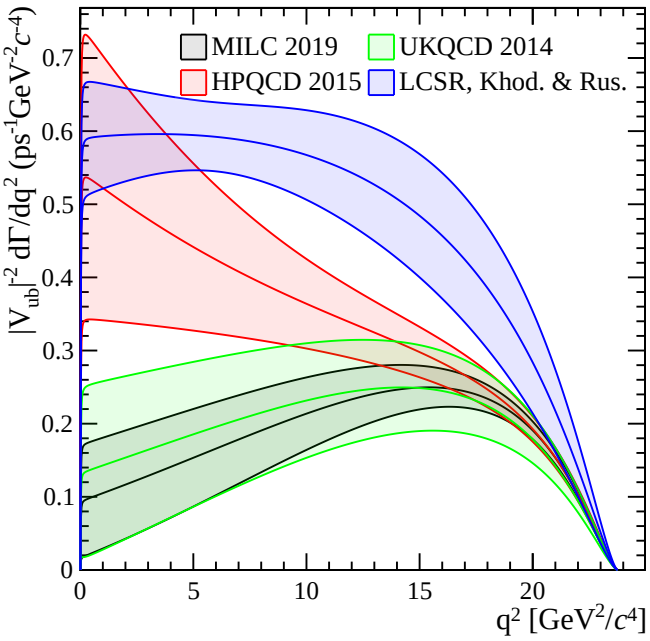

Figure 4: $|V_{ub}|^{-2}\ \frac{d\Gamma(B_s \to K\mu\nu)}{dq^2}$ distribution for different LQCD [1–3] and LCSR [4] models.

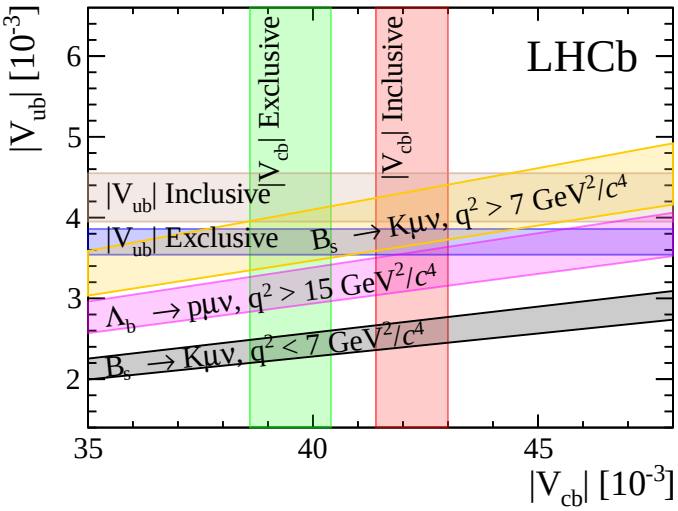

Figure 5: PDG averages [5] (based on exclusive $B \to \pi\ell\nu$, $B \to D^*\ell\nu$ and inclusive $B \to X_{u,c}\ell\nu$ results) and measurements of $|V_{ub}|/|V_{cb}|$ shown in the $(|V_{cb}|, |V_{ub}|)$ plane.

References

[1] Fermilab Lattice, MILC collaborations, A. Bazavov *et al.*, $B_s \to K\ell\nu$ *decay from lattice QCD*, Phys. Rev. **D100** (2019) 034501, arXiv:1901.02561.

[2] C. M. Bouchard *et al.*, $B_s \to K\ell\nu$ *form factors from lattice QCD*, Phys. Rev. **D90** (2014) 054506, arXiv:1406.2279.

[3] J. M. Flynn *et al.*, $B \to \pi\ell\nu$ *and* $B_s \to K\ell\nu$ *form factors and* $|V_{ub}|$ *from 2+1-flavor lattice QCD with domain-wall light quarks and relativistic heavy quarks*, Phys. Rev. **D91** (2015) 074510, arXiv:1501.05373.

[4] A. Khodjamirian and A. V. Rusov, $B_s \to K\ell\nu_\ell$ *and* $B_{(s)} \to \pi(K)\ell^+\ell^-$ *decays at large recoil and CKM matrix elements*, JHEP **08** (2017) 112, arXiv:1703.04765.

[5] Particle Data Group, P. A. Zyla *et al.*, *Review of particle physics*, Prog. Theor. Exp. Phys. **2020** (2020) 083C01.