Supplemental material for "Towards establishing Lepton Flavour Universality violation in $\bar{B} \to \bar{K}^* \ell^+ \ell^-$ decays"

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An extension of the physics case of the proposed method is to investigate the sensitivity to the chirality-flipped counterparts of the usual Wilson coefficients, *i.e.* $\mathcal{C}_9^{\prime(\mu)}$ and $\mathcal{C}_{10}^{\prime(\mu)}$. Following the formalism discussed in this letter, the primed WCs are examined by considering in addition to the $\texttt{BMP}_{\mathcal{C}_{9,10}}$ three different modified NP scenarios for the muon only: $\mathcal{C}_{9,10}^{\prime(\mu)} = \mathcal{C}_{9,10}^{\prime\mathrm{SM}} = 0$; $\mathcal{C}_9^{\prime(\mu)} = \mathcal{C}_{10}^{\prime(\mu)} = 0.3$; and $\mathcal{C}_9^{\prime(\mu)} = -\mathcal{C}_{10}^{\prime(\mu)} = 0.3$. Notice that for the electron mode the $\mathcal{C}_{9,10}^{\prime(e)}$ is set and fixed to the SM value $\mathcal{C}_{9,10}^{\prime\mathrm{SM}} = 0$.

Figure 1 shows the fit results for different order of the analytic expansion for the non-local hadronic contribution for a NP scenario with $\mathcal{C}_9^{\prime(\mu)} = \mathcal{C}_{10}^{\prime(\mu)} = 0.3$ and yields corresponding to the LHCb Run II expected statistics. The dependency on the determination of $\mathcal{C}_9^{\prime(\mu)}$ and $\mathcal{C}_{10}^{\prime(\mu)}$ on the order of the expansion clearly saturates after $\mathcal{H}_\lambda[z^3]$ and allows a measurement of the primed Wilson coefficients for the muon decay channel $B^0 \to K^{*0}\mu^+\mu^-$ independent on the theoretical hadronic uncertainty. Figure 2 shows the prospects for the sensitivity to the $\mathcal{C}_9^{\prime(\mu)}$ and $\mathcal{C}_{10}^{\prime(\mu)}$ Wilson coefficients corresponding to the expected statistics at the LHCb upgrade with $50\,\mathrm{fb}^{-1}$ and $300\,\mathrm{fb}^{-1}$. Note that only with the full capability of the LHCb experiment it is possible to start disentangling the different NP hypotheses.

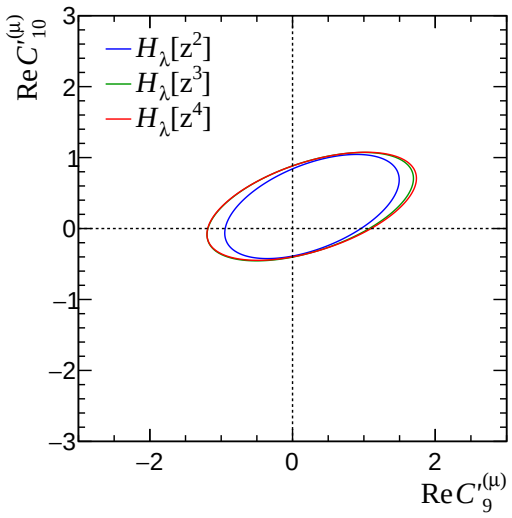

FIG. 1. Two-dimensional sensitivity scans for the pair of Wilson coefficients $\mathcal{C}_9^{\prime(\mu)}$ and $\mathcal{C}_{10}^{\prime(\mu)}$ for different non-local hadronic parametrisation models for a NP scenario with $\mathcal{C}_9^{\prime(\mu)} = \mathcal{C}_{10}^{\prime(\mu)} = 0.3$. The contours correspond to 99% confidence level statistical-only uncertainty bands evaluated with the expected statistics after LHCb Run II.

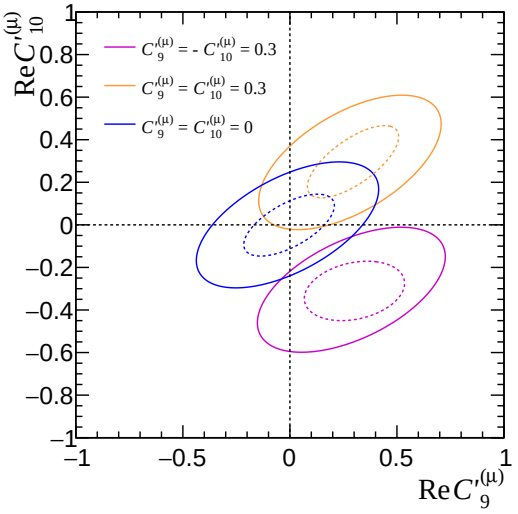

FIG. 2. Two-dimensional sensitivity scans for the pair of Wilson coefficients $\mathcal{C}_9^{\prime(\mu)}$ and $\mathcal{C}_{10}^{\prime(\mu)}$ for three NP scenarios: (blue) $\mathcal{C}_9^{\prime(\mu)} = \mathcal{C}_{10}^{\prime(\mu)} = 0$, (orange) $\mathcal{C}_9^{\prime(\mu)} = \mathcal{C}_{10}^{\prime(\mu)} = 0.3$ and (magenta) $\mathcal{C}_9^{\prime(\mu)} = -\mathcal{C}_{10}^{\prime(\mu)} = 0.3$. The contours correspond to 99% confidence level statistical-only uncertainty bands expected for the LHCb Upgrade (dotted) $50\,\mathrm{fb}^{-1}$ and (solid) $300\,\mathrm{fb}^{-1}$ statistics.

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