A Supplementary material for LHCb-PAPER-2024-028

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

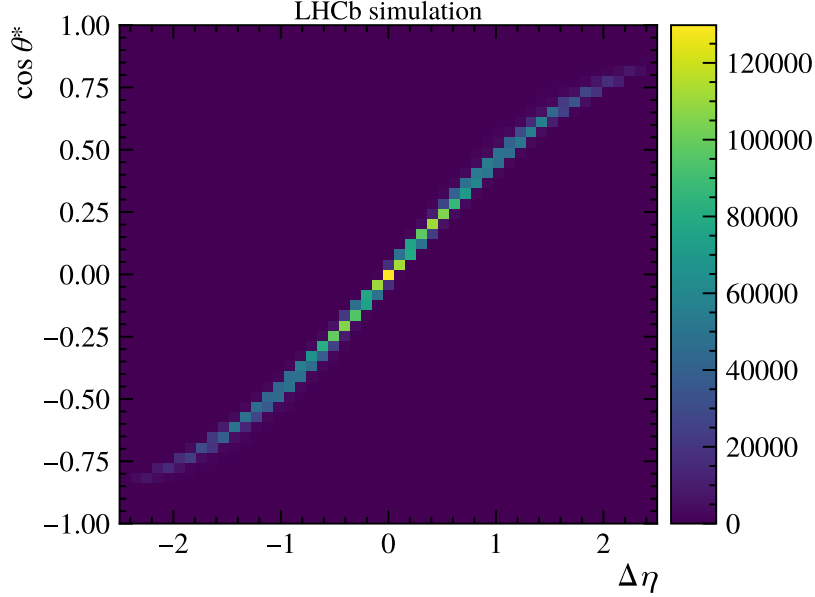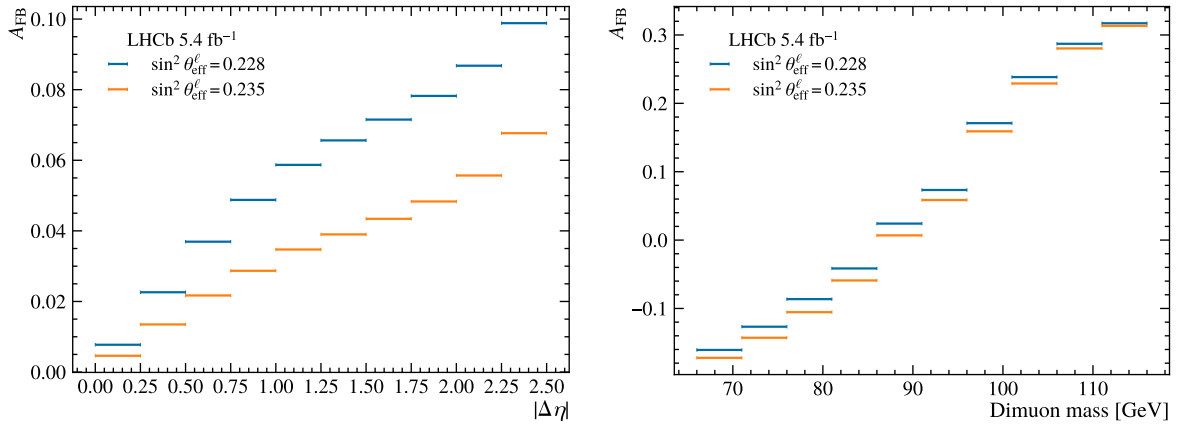Figure 1: Distribution of $\cos\theta^*$ versus $\Delta\eta$ in simulated $Z \to \mu^+\mu^-$ decays.

Figure 2: Predictions of A_{FB} in intervals of (left) $|\Delta\eta|$ and (right) mass for two different $\sin^2\theta^\ell_{\mathrm{eff}}$ values.

Figure 1 shows that $\Delta\eta$ is closely related to $\cos\theta^*$, following the approximation $\cos\theta^* \sim \tanh(\Delta\eta/2)$ is, thereby demonstrating why the sensitivity to $\sin^2\theta^\ell_{\mathrm{eff}}$ is improved by finding A_{FB} as a function of $|\Delta\eta|$. Figure 2 shows how predictions of A_{FB} change as a function of $|\Delta\eta|$ or the dimuon invariant mass when the value of $\sin^2\theta^\ell_{\mathrm{eff}}$ is varied, thereby showing the power of measuring A_{FB} as a function of $|\Delta\eta|$. Figure 3 shows the absolute variation in A_{FB} corresponding to the NNPDF 3.1 parton distribution function uncertainties and to a variation in $\sin^2\theta^\ell_{\mathrm{eff}}$. Figure 4 shows the χ^2 parabola associated with the fit to A_{FB} to determine the weak mixing angle. Figure 5 shows the mass and $|\Delta\eta|$ distributions of the selected signal candidates, compared to the simulation including the signal and backgrounds.
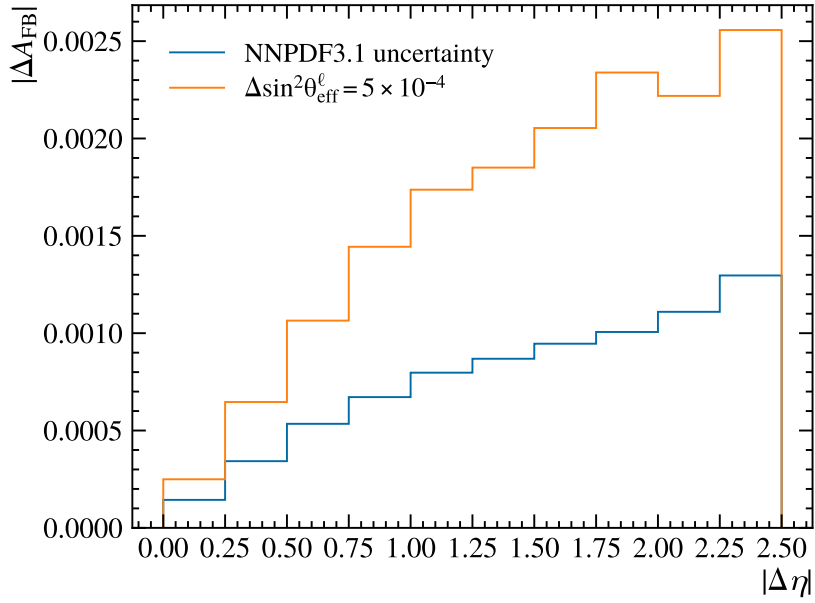
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Figure 3: Absolute variation in A_{FB}, in intervals of $|\Delta\eta|$, corresponding to the uncertainty on the NNPDF3.1 parton distribution functions and to a variation in $\sin^2\theta_{\mathrm{eff}}^{\ell}$.
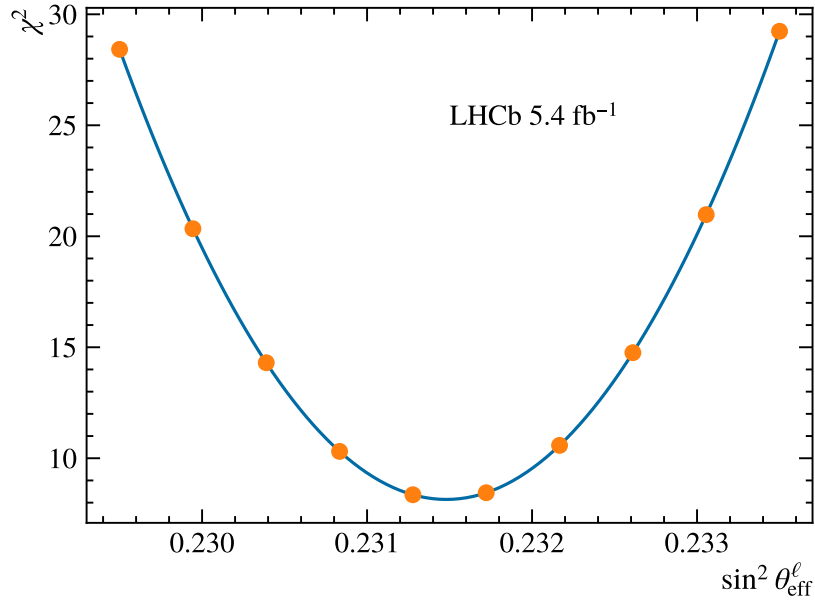

Figure 4: Graph of the χ^2 values comparing the measured A_{FB} with the interpolated templates, using the Powheg-ewnlo predictions with the NNPDF3.1 PDF parameterisation. A parabolic fit is overlaid. This corresponds to using two base templates, with linear interpolation of the A_{FB} predictions to intermediate values.
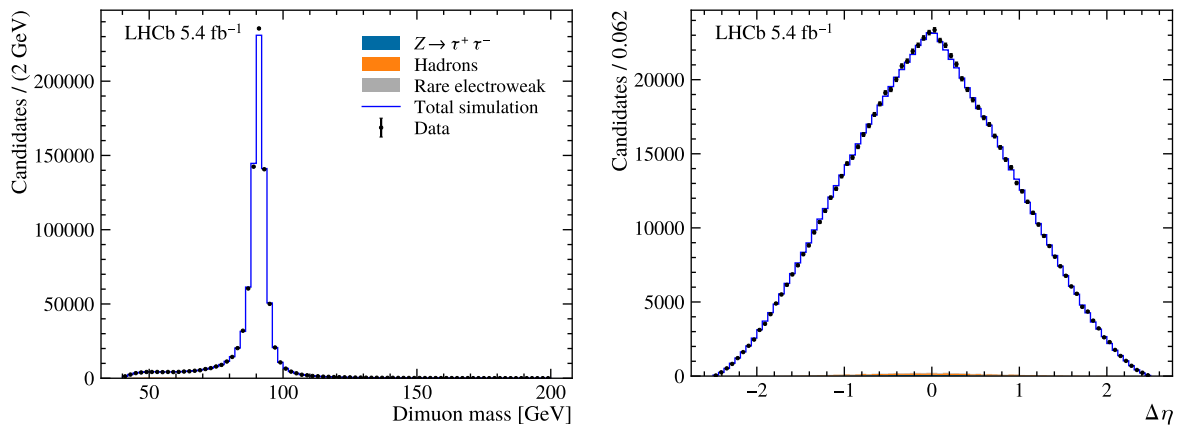
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Figure 5: Distributions of (left) the dimuon invariant mass and (right) $\Delta\eta$ for the selected signal candidates, compared to the simulation including the signal and backgrounds.