

# Supplementary material for LHCb-PAPER-2018-020

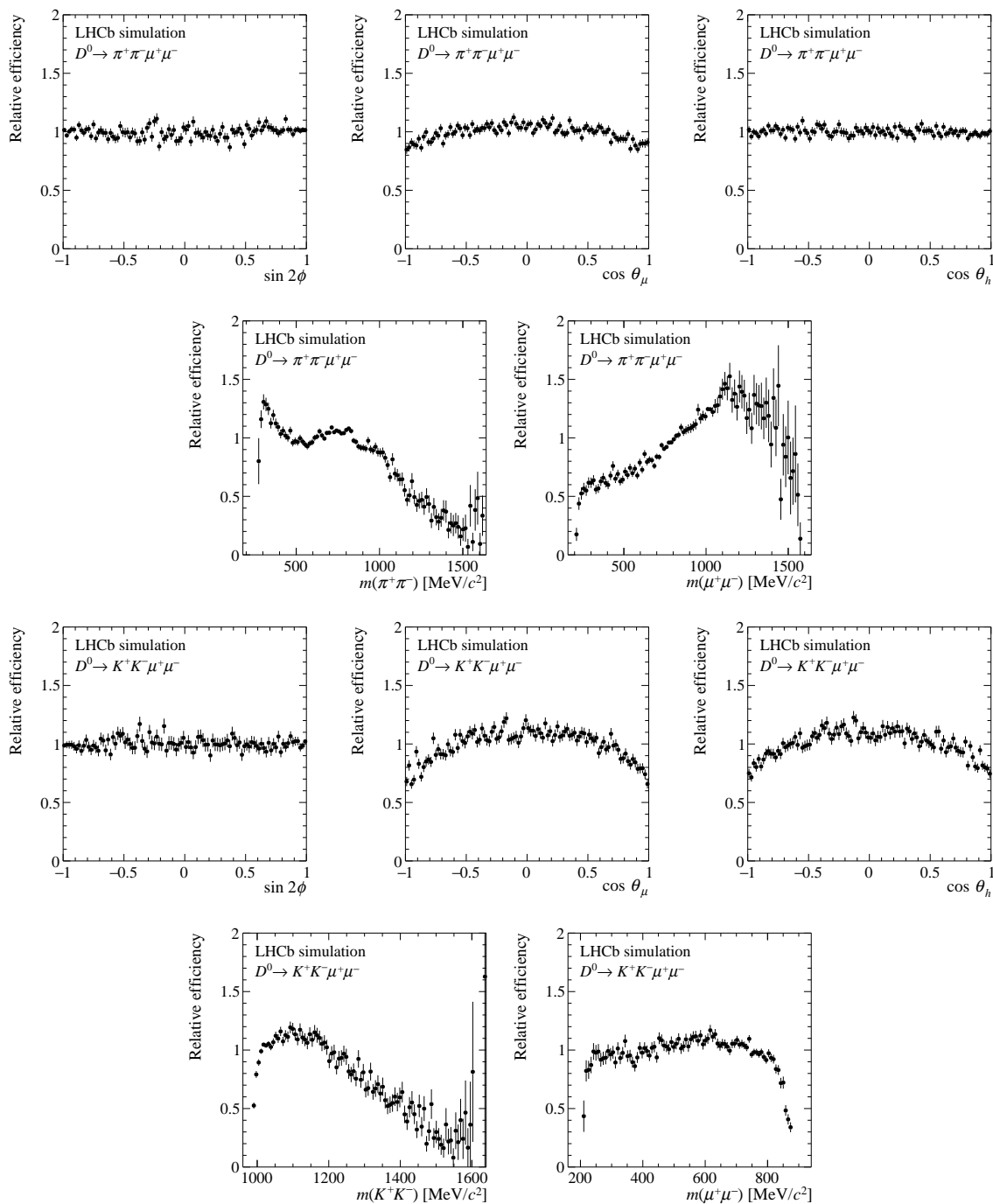


Figure 3: Efficiency relative to average as a function of the phase-space variables, separately for simulated (top)  $D^0 \rightarrow \pi^+ \pi^- \mu^+ \mu^-$  and (bottom)  $D^0 \rightarrow K^+ K^- \mu^+ \mu^-$  decays.

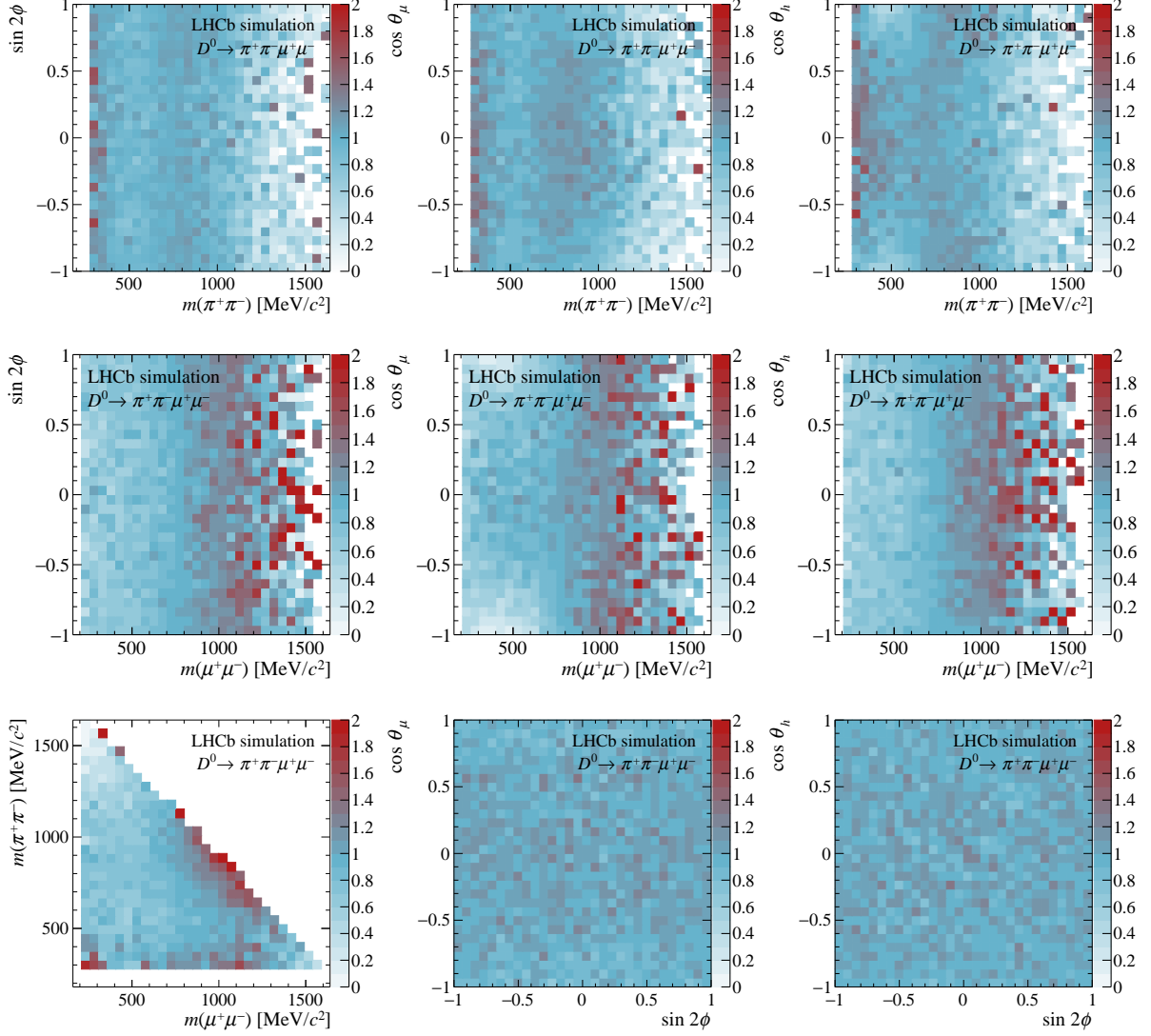


Figure 4: Efficiency relative to average as a function of pairs of phase-space variables for simulated  $D^0 \rightarrow \pi^+ \pi^- \mu^+ \mu^-$  decays.

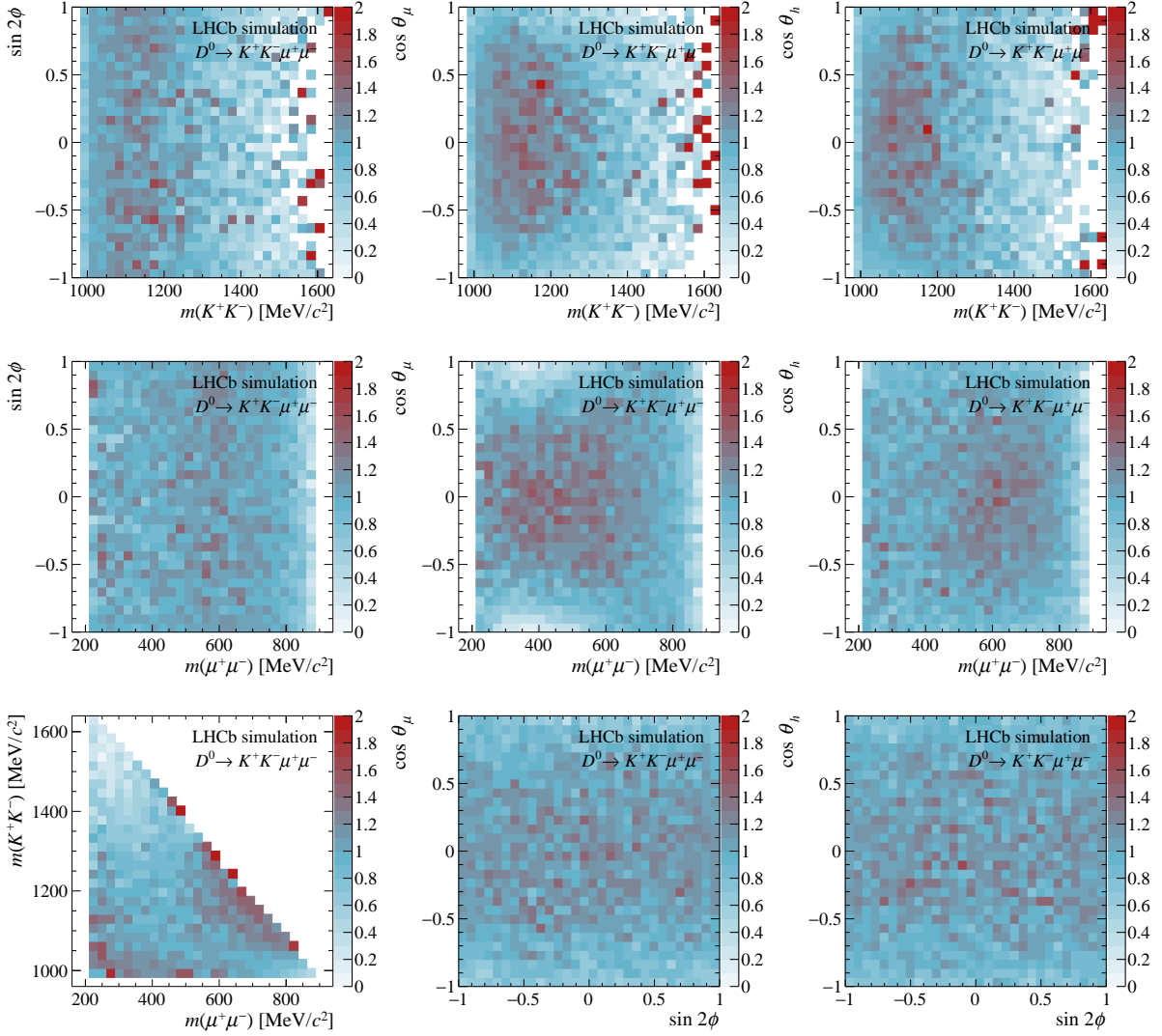


Figure 5: Efficiency relative to average as a function of pairs of phase-space variables for simulated  $D^0 \rightarrow K^+K^-\mu^+\mu^-$  decays.

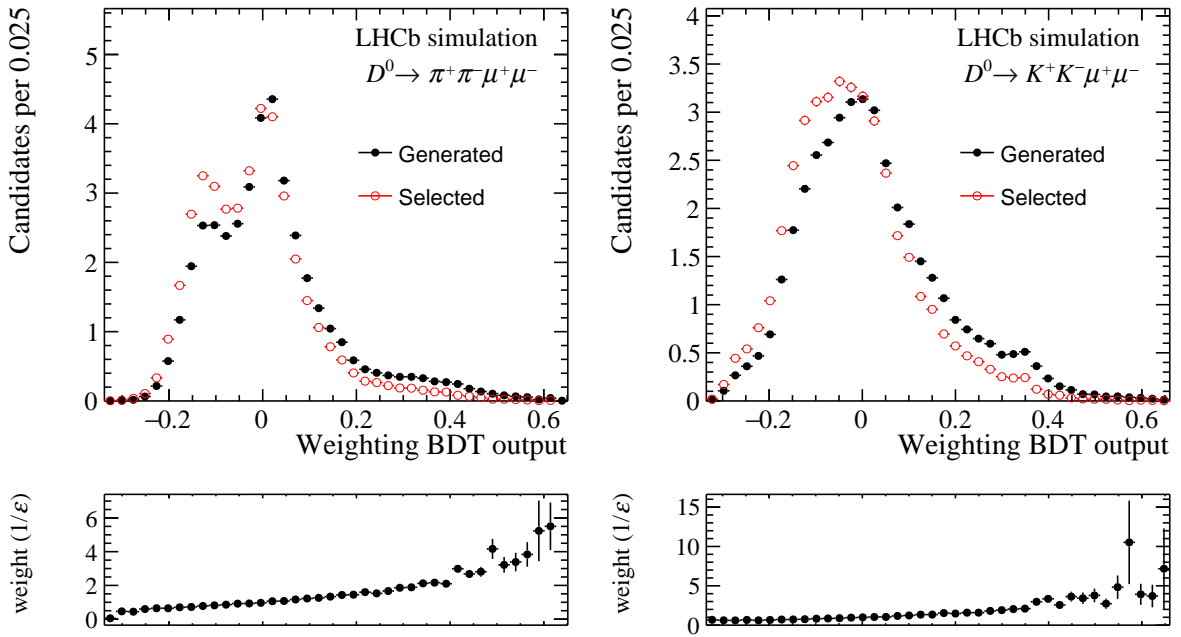


Figure 6: Output distributions of the weighting BDT for simulated samples of (left)  $D^0 \rightarrow \pi^+\pi^-\mu^+\mu^-$  and (right)  $D^0 \rightarrow K^+K^-\mu^+\mu^-$  decays at (closed black) generator level and (open red) after selection. The bottom panels show the ratio between generated and selected decays (*i.e.* the inverse of the efficiency) as a function the reweighter output.

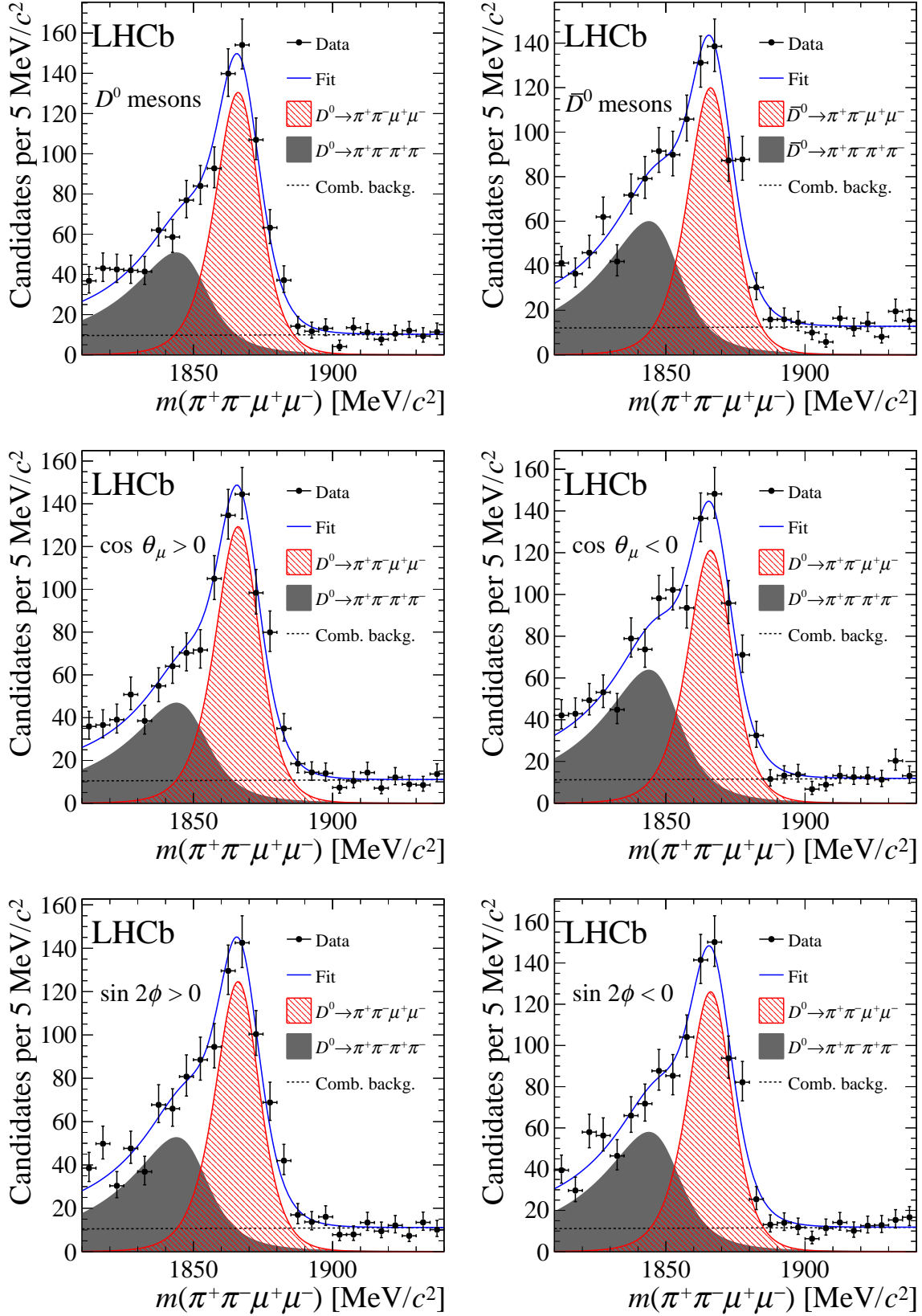


Figure 7: Distribution of  $m(h^+ h^- \mu^+ \mu^-)$  for  $D^0 \rightarrow \pi^+ \pi^- \mu^+ \mu^-$  candidates in the full dimuon-mass range, with fit projections overlaid. From top-left to bottom-right candidates are separated between  $D^0$  and  $\bar{D}^0$  mesons,  $\cos \theta_\mu > 0$  and  $\cos \theta_\mu < 0$ , and  $\sin 2\phi > 0$  and  $\sin 2\phi < 0$ .

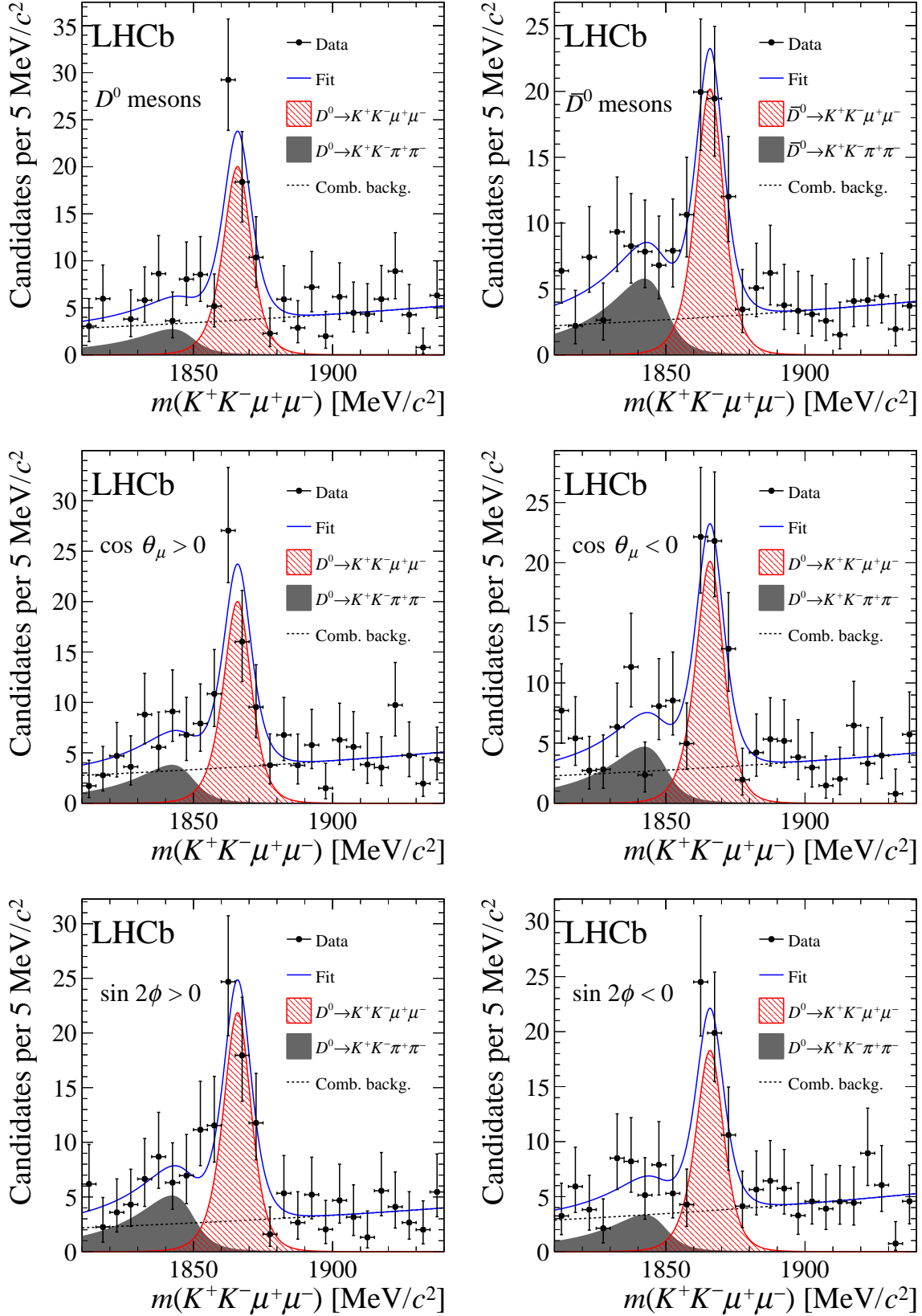


Figure 8: Distribution of  $m(h^+h^-\mu^+\mu^-)$  for  $D^0 \rightarrow K^+K^-\mu^+\mu^-$  candidates in the full dimuon-mass range, with fit projections overlaid. From top-left to bottom-right candidates are separated between  $D^0$  and  $\bar{D}^0$  mesons,  $\cos \theta_\mu > 0$  and  $\cos \theta_\mu < 0$ , and  $\sin 2\phi > 0$  and  $\sin 2\phi < 0$ .

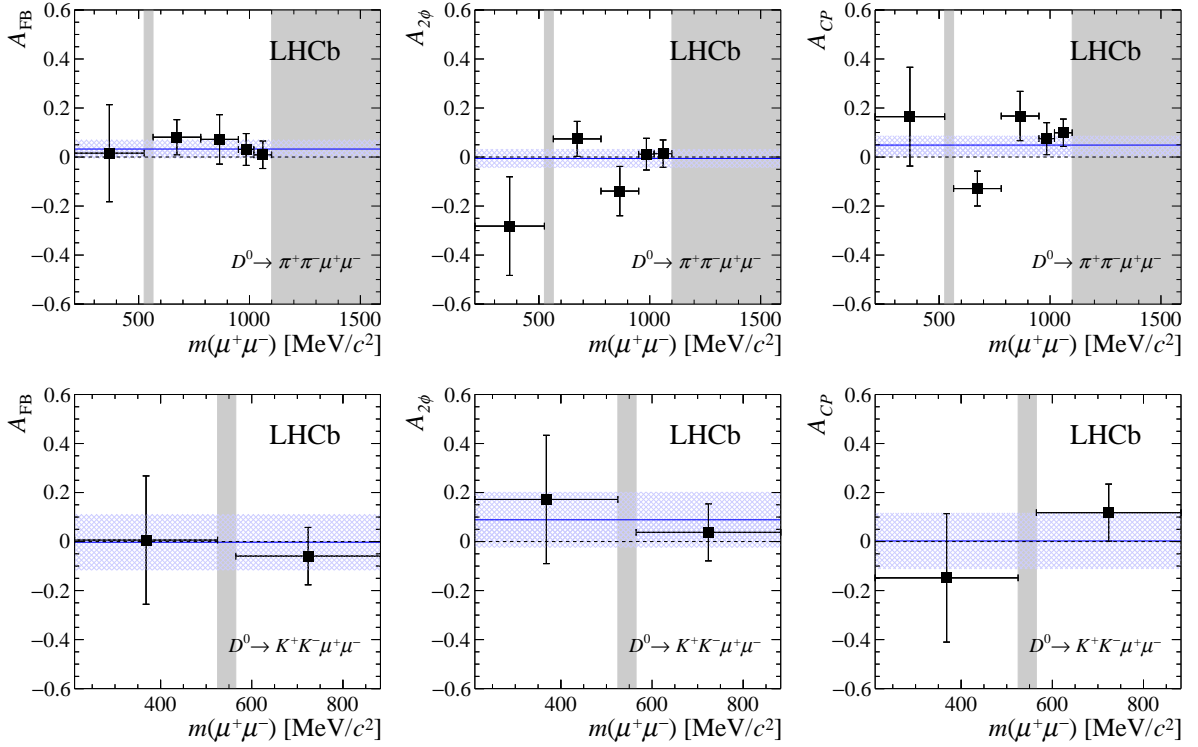


Figure 9: Measured values of (left)  $A_{FB}$ , (center)  $A_{2\phi}$  and (right)  $A_{CP}$  for (top)  $D^0 \rightarrow \pi^+ \pi^- \mu^+ \mu^-$  and (bottom)  $D^0 \rightarrow K^+ K^- \mu^+ \mu^-$  decays in the dimuon-mass regions. No measurement is performed in the regions indicated by the vertical gray bands. The horizontal blue line corresponds to the measurement integrated in the full dimuon-mass range, with the hatched area representing the  $\pm 1\sigma$  band. The uncertainties include both statistical and systematic sources.