

# Supplementary material for LHCb-PAPER-2016-041

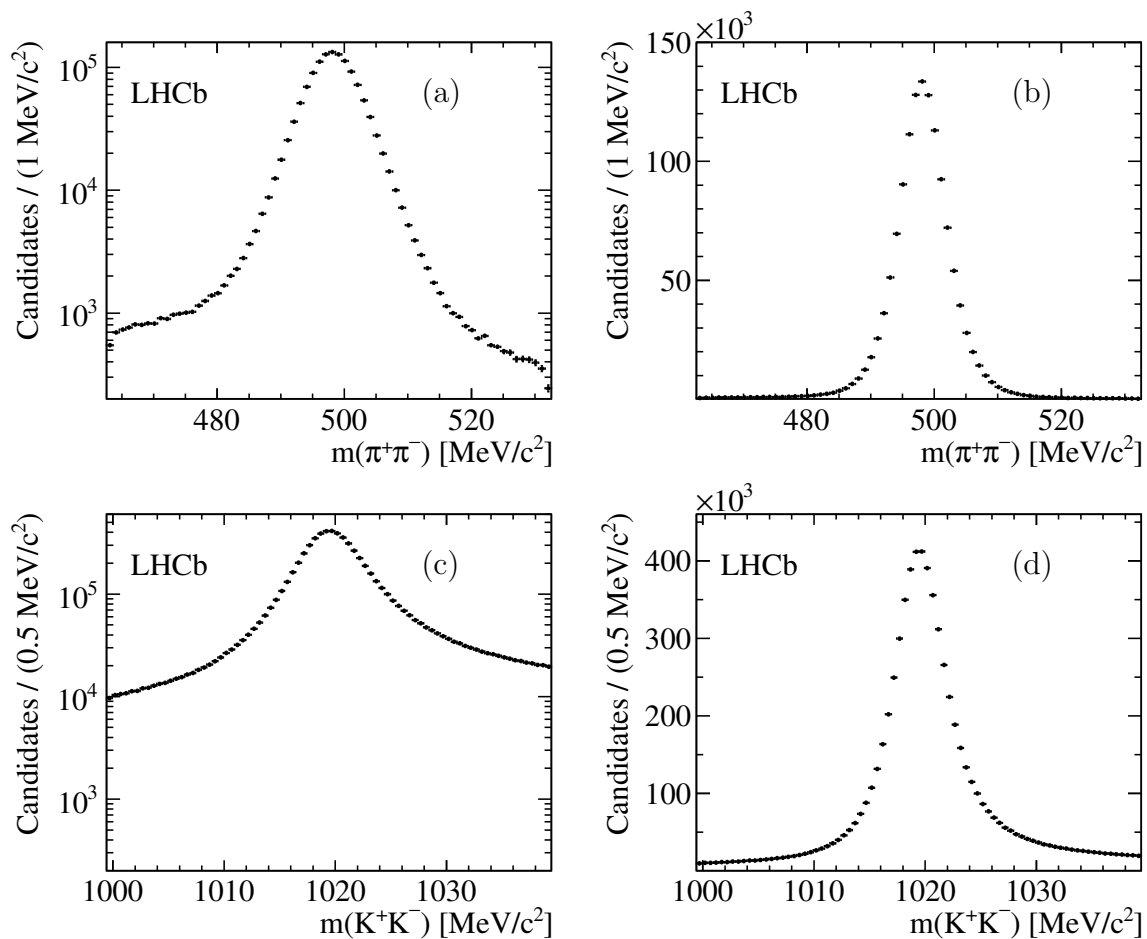


Figure 1: Top: distribution of  $m(\pi^+\pi^-)$  ( $K_s^0$ ) for  $D^\pm \rightarrow K_s^0 \pi^\pm$  candidates in (a) logarithmic and (b) linear scale. Bottom: distribution of  $m(K^+K^-)$  ( $\phi$ ) for  $D_s^\pm \rightarrow \phi \pi^\pm$  candidates in (c) logarithmic and (d) linear scale.

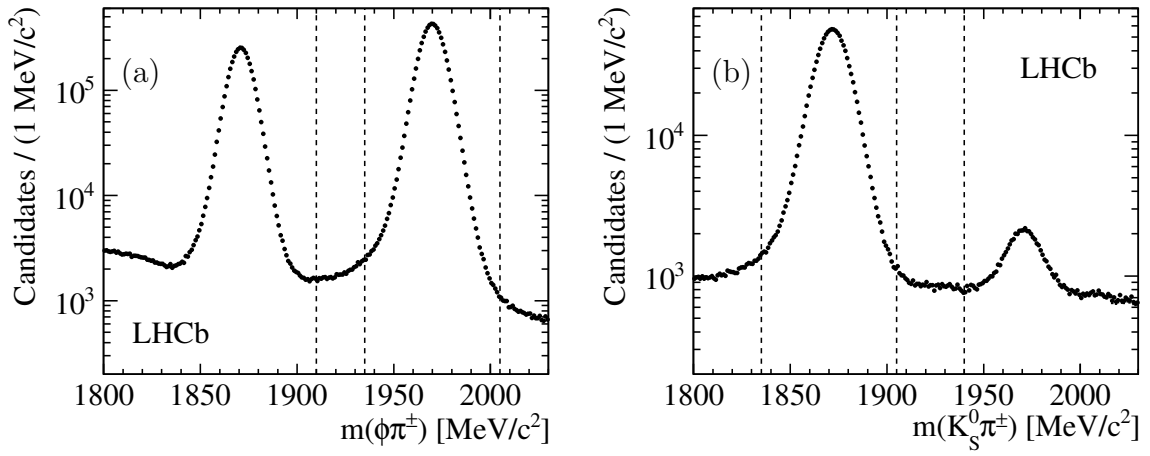


Figure 2: Distribution of (a)  $m(\phi\pi^\pm)$  and (b)  $m(K_S^0\pi^\pm)$  for  $D_{(s)}^\pm \rightarrow \phi\pi^\pm$  and  $D_{(s)}^\pm \rightarrow K_S^0\pi^\pm$  candidates, respectively.

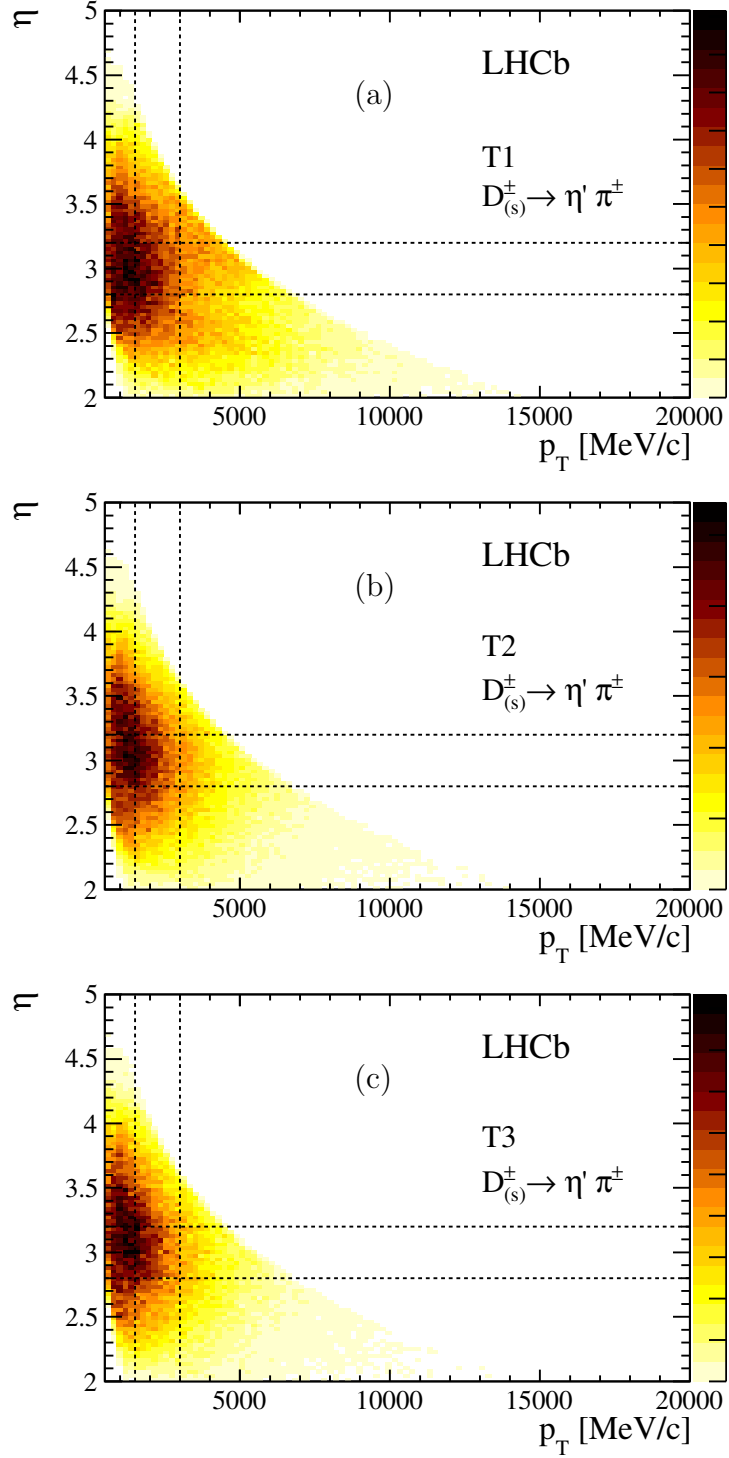


Figure 3: Distribution of  $\eta - p_T$  of the bachelon pion for  $D_{(s)}^\pm \rightarrow \eta' \pi^\pm$  candidates in the (a)  $T1$ , (b)  $T2$ , and (c)  $T3$  samples. The  $\eta - p_T$  bin edges are marked by dashed lines.

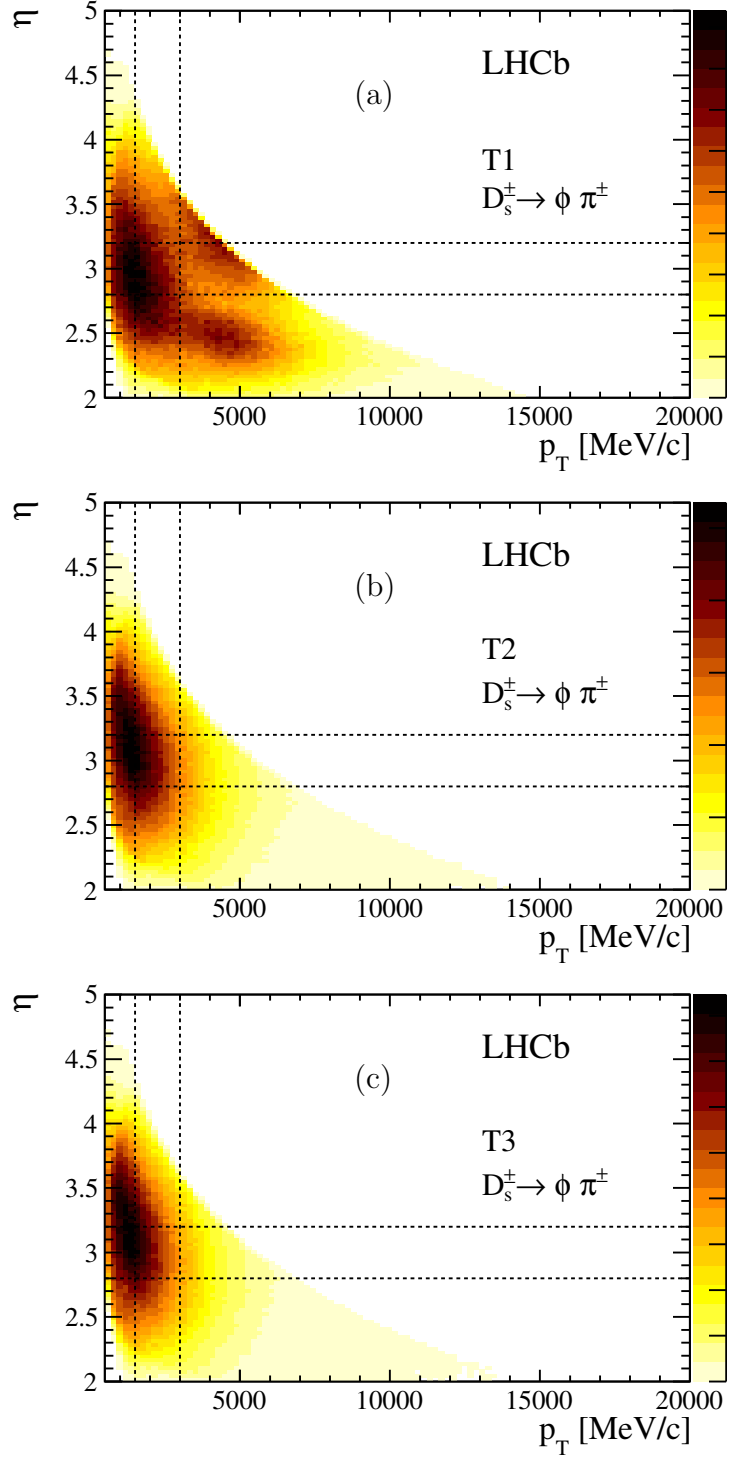


Figure 4: Distribution of  $p_T - \eta$  of the bachelon pion for  $D_s^\pm \rightarrow \phi \pi^\pm$  candidates in the (a)  $T1$ , (b)  $T2$ , and (c)  $T3$  samples. The  $p_T - \eta$  bin edges are marked by dashed lines.

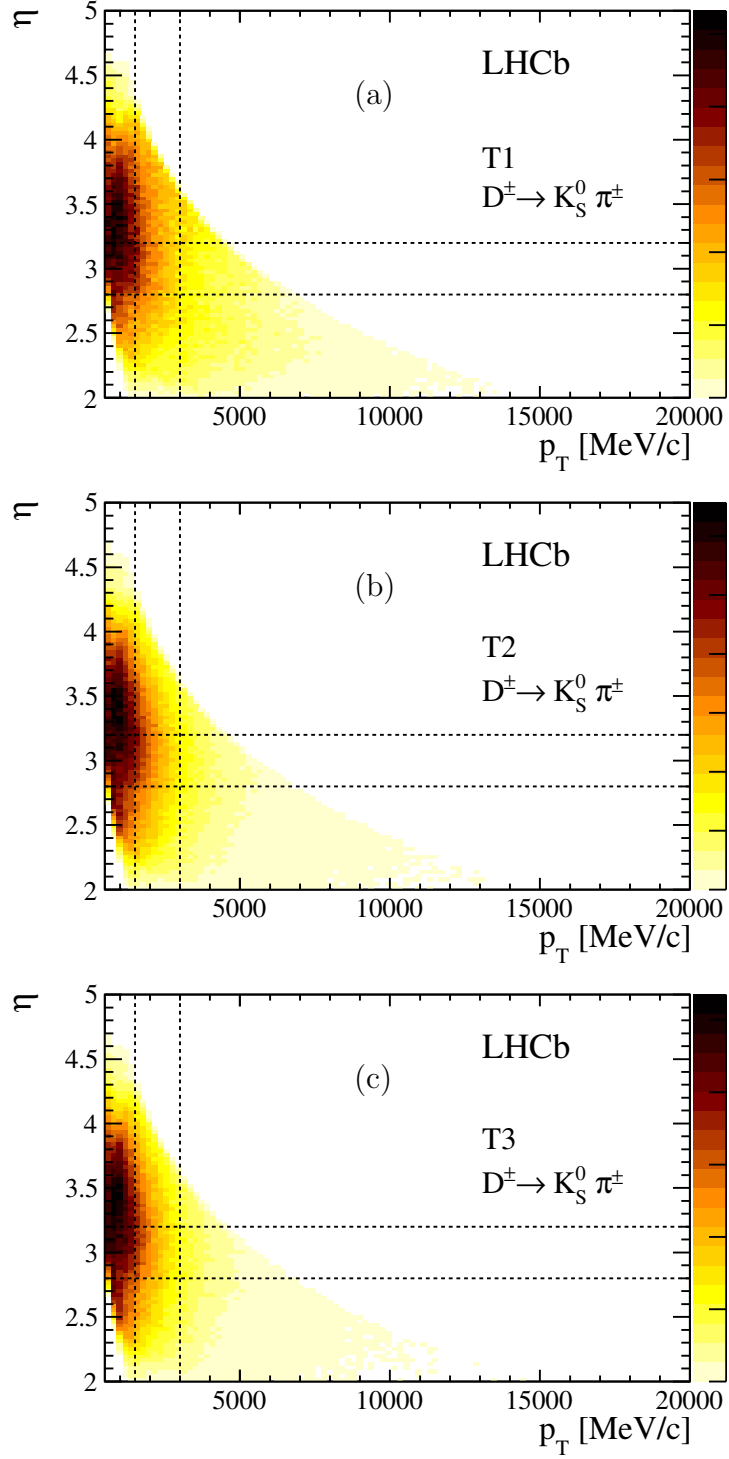


Figure 5: Distribution of  $p_T - \eta$  of the bachelor pion for  $D^\pm \rightarrow K_S^0 \pi^\pm$  candidates in the (a)  $T1$ , (b)  $T2$ , and (c)  $T3$  samples. The  $p_T - \eta$  bin edges are marked by dashed lines.

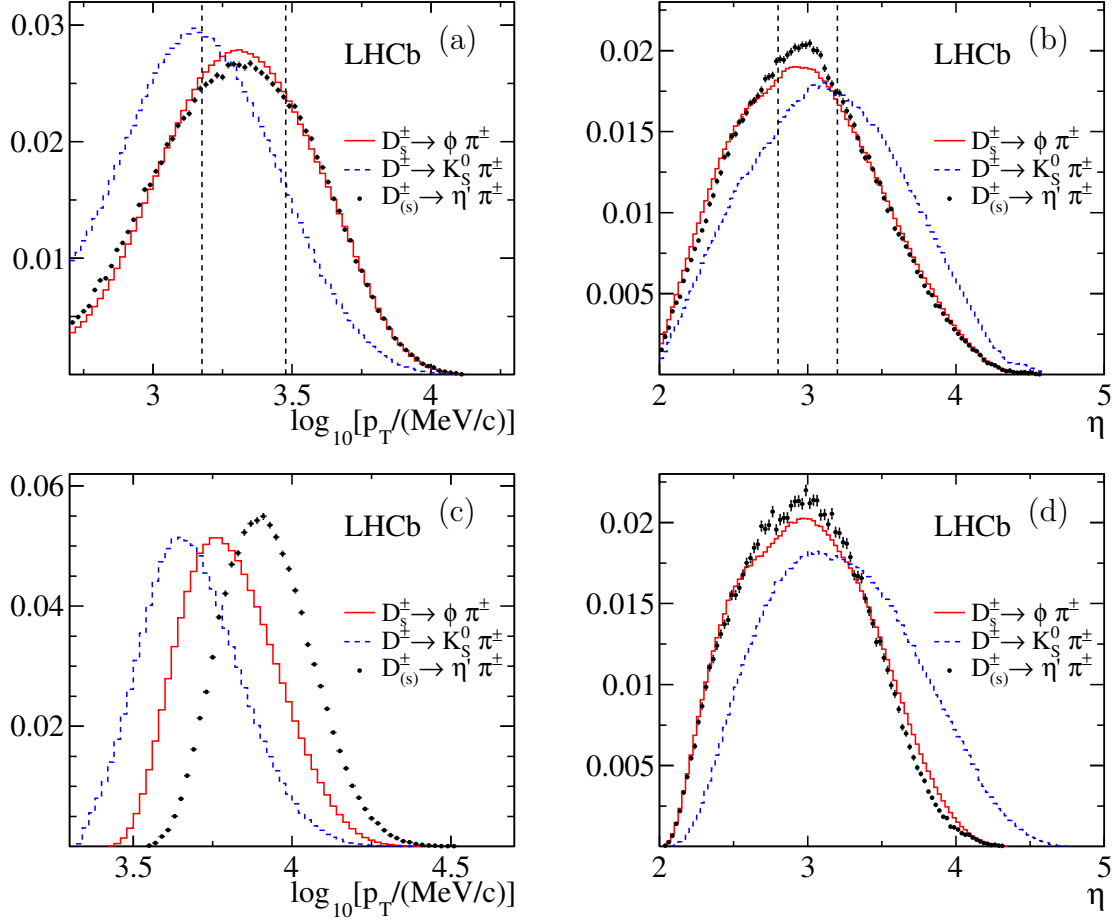


Figure 6: Top: normalized distributions of (a)  $\log_{10}(p_T [\text{MeV}/c])$  and (b)  $\eta$  of the bachelor pion in  $D_{(s)}^{\pm} \rightarrow \eta' \pi^{\pm}$  (points with errors),  $D_s^{\pm} \rightarrow \phi \pi^{\pm}$  (red, solid), and  $D^{\pm} \rightarrow K_S^0 \pi^{\pm}$  (blue, dashed) decays. Bottom: normalized distributions of (c)  $\log_{10}(p_T [\text{MeV}/c])$  and (d)  $\eta$  of the  $D_{(s)}^{\pm}$  candidates in  $D_{(s)}^{\pm} \rightarrow \eta' \pi^{\pm}$  (points with errors),  $D_s^{\pm} \rightarrow \phi \pi^{\pm}$  (red, solid), and  $D^{\pm} \rightarrow K_S^0 \pi^{\pm}$  (blue, dashed) decays.

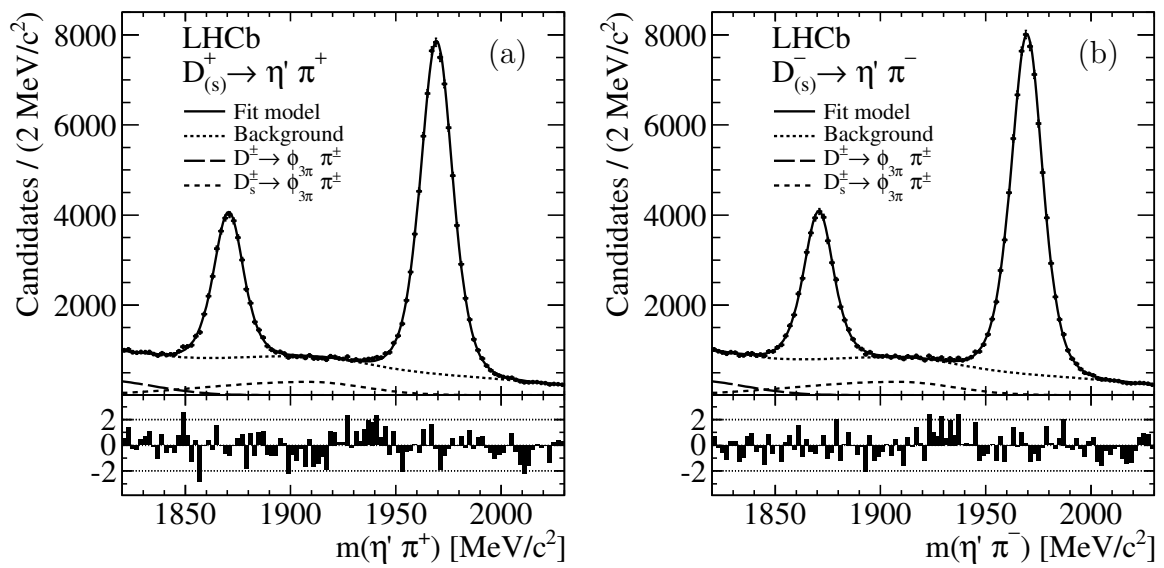


Figure 7: Mass distribution of  $\eta'/\pi^\pm$  candidates, combined over all kinematic bins,  $pp$  centre-of-mass energies, and hardware trigger selections, for (a) positively and (b) negatively charged  $D_{(s)}^\pm$  candidates. Points with errors represent data, while the curves represent the fitted model (solid), the  $D_s^\pm \rightarrow \phi_{3\pi} \pi^\pm$  (dashed) and  $D^\pm \rightarrow \phi_{3\pi} \pi^\pm$  (long-dashed) components, and the sum of all background contributions (dotted), including combinatorial background. Residuals divided by the corresponding uncertainty are shown under each plot.