

Supplementary material for LHCb-PAPER-2019-038

Fit to the dimuon invariant mass

The results from the unbinned maximum-likelihood fit to the dimuon invariant mass for the two trigger categories and twenty BDT bins can be seen in Figs. 1–4. For the first BDT bins in each trigger category, tighter muon-identification requirements make the contribution from doubly misidentified $K_S^0 \rightarrow \pi^+\pi^-$ decays smaller than for the last, whilst backgrounds from random combination of tracks and material interactions dominate, due to looser BDT requirements. In the highest BDT bins, the opposite happens, due to less stringent muon-identification and tighter BDT requirements.

Estimate of $\mathcal{B}(K_L^0 \rightarrow \mu^+\mu^-)$

An additional fit to the dimuon invariant mass, removing the $K_S^0 \rightarrow \mu^+\mu^-$ component, and leaving $K_L^0 \rightarrow \mu^+\mu^-$ free yields

$$\mathcal{B}(K_L^0 \rightarrow \mu^+\mu^-) = 5.0_{-2.9}^{+3.2} \times 10^{-8},$$

with a significance of 1.6σ with respect to the background-only hypothesis, where both statistic and systematic uncertainties are included.

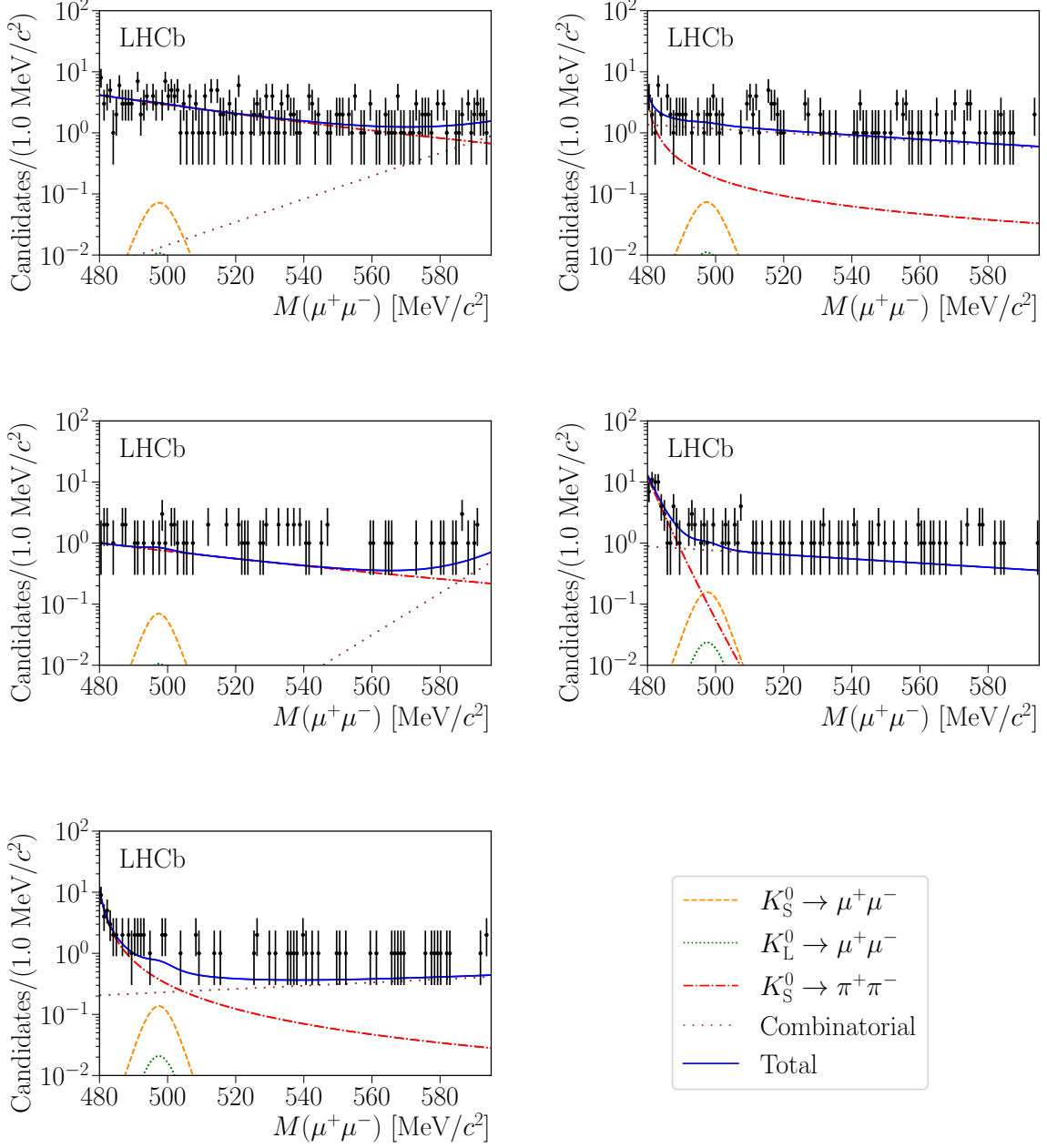


Figure 1: Results for the unbinned maximum-likelihood fit to the dimuon invariant mass in the first five BDT bins of the TIS trigger category. The signal-to-background ratio increases from left to right, and from top to bottom.

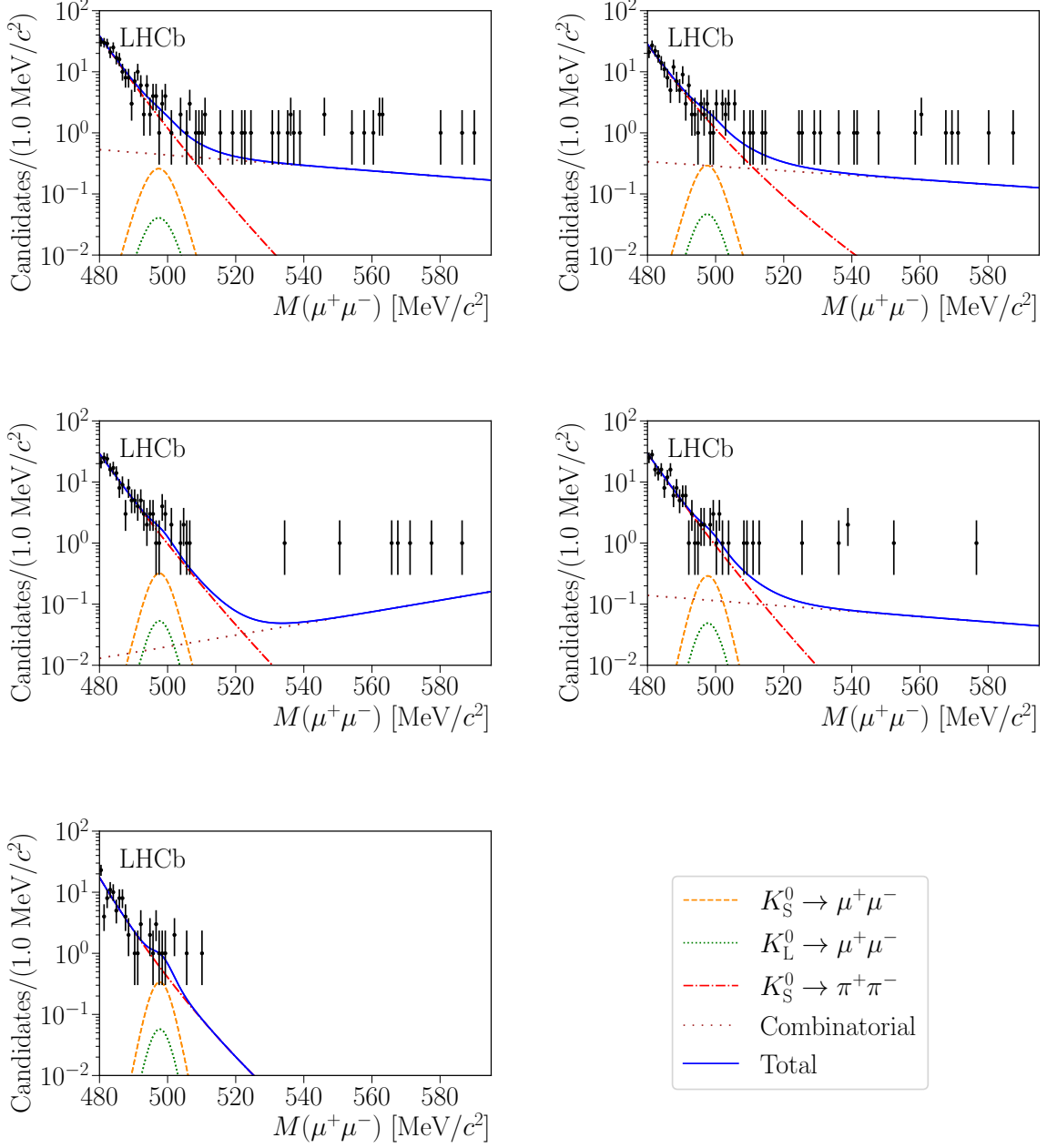


Figure 2: Results for the unbinned maximum-likelihood fit to the dimuon invariant mass in the last five BDT bins of the TIS trigger category. The signal-to-background ratio increases from left to right, and from top to bottom.

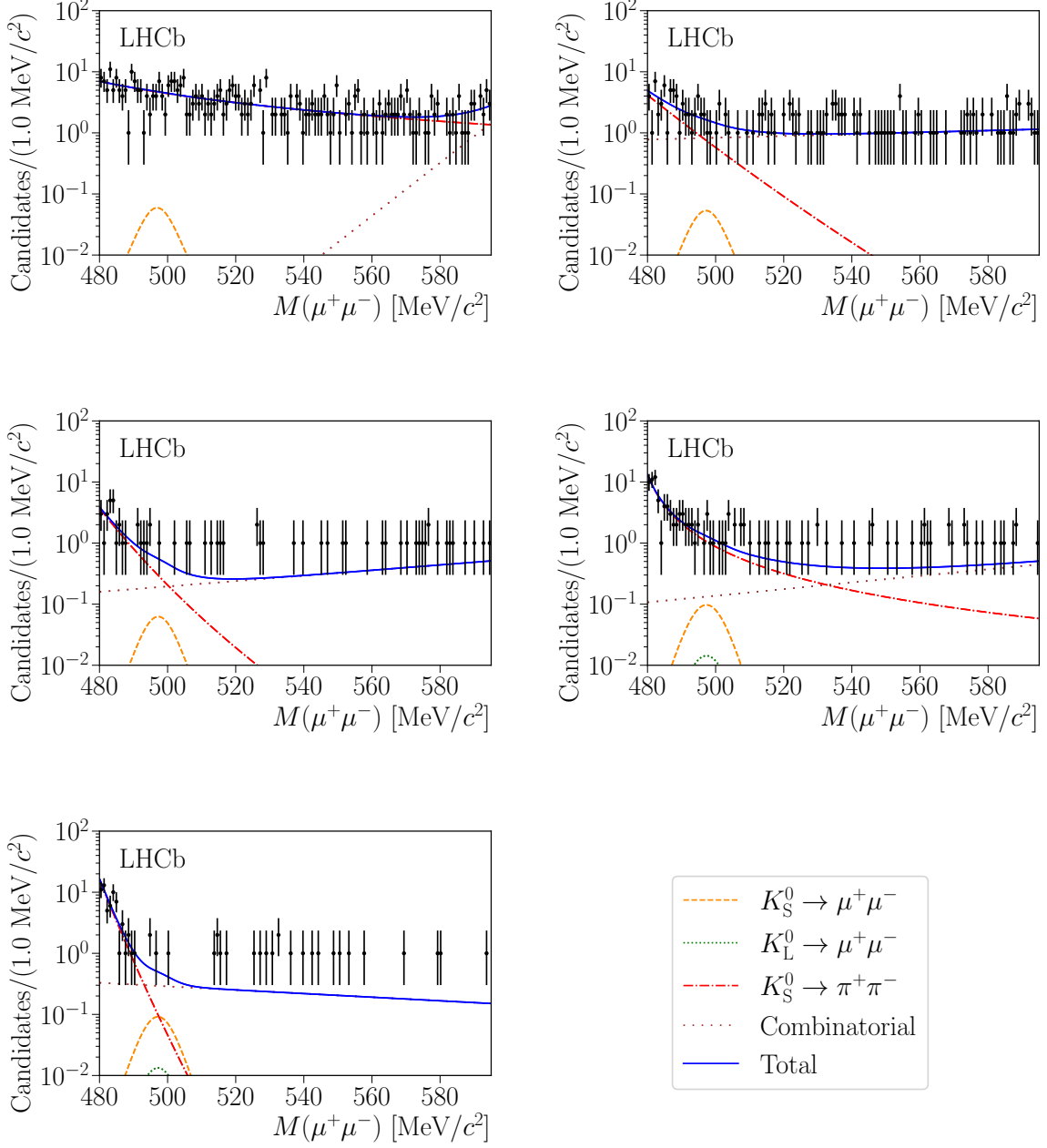


Figure 3: Results for the unbinned maximum-likelihood fit to the dimuon invariant mass in the first five BDT bins of the TOS trigger category. The signal-to-background ratio increases from left to right, and from top to bottom.

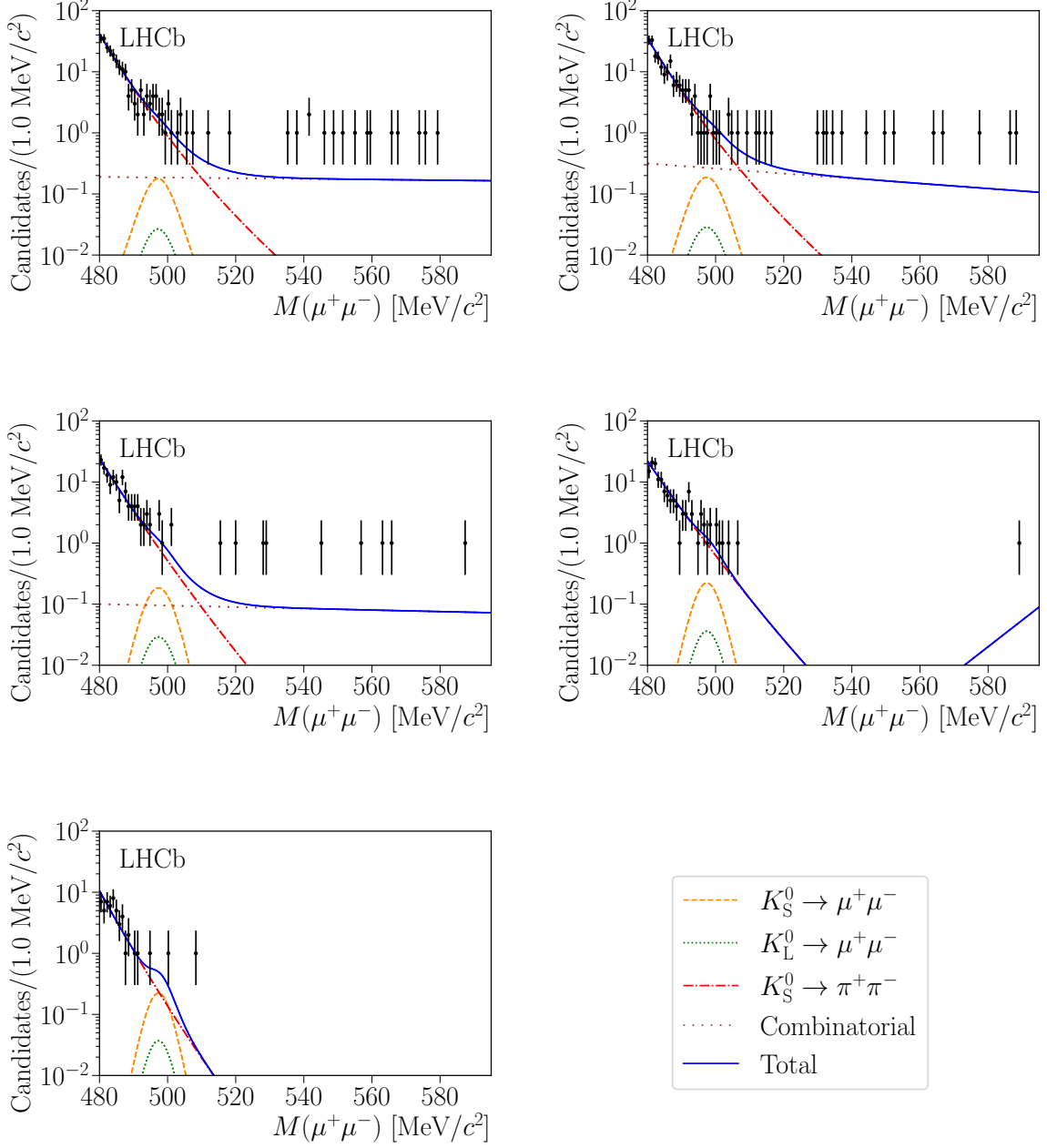


Figure 4: Results for the unbinned maximum-likelihood fit to the dimuon invariant mass in the last five BDT bins of the TOS trigger category. The signal-to-background ratio increases from left to right, and from top to bottom.