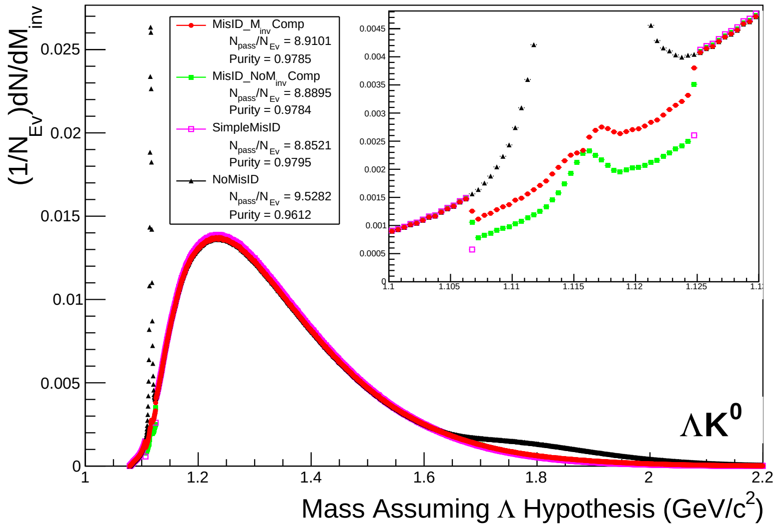
0.0.1 K_S^0 Reconstruction

The following cuts were used to select good K_S^0 candidates:

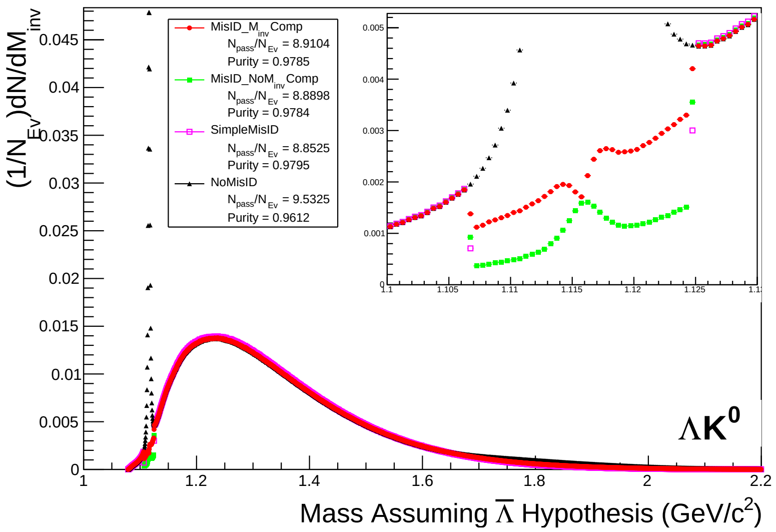
1. Pion Daughter Cuts
   (a) $|\eta| < 0.8$
   (b) SetTPCnclsDaughters(80)
   (c) SetStatusDaughters(AliESDtrack::kTPCrefic)
   (d) DCA $\pi^+\pi^-$ Daughters < 0.3 cm
   (e) $p_{\mathrm{T}} > 0.15$ GeV/c
   (f) DCA to prim vertex > 0.3 cm
   (g) TPC and TOF Nσ Cuts
      i. $p < 0.5$ GeV/c : N$\sigma_{\mathrm{TPC}} < 3$
      ii. $p > 0.5$ GeV/c :
         – if TOF & TPC available: N$\sigma_{\mathrm{TPC}} < 3$ & N$\sigma_{\mathrm{TOF}} < 3$
         – else N$\sigma_{\mathrm{TOF}} < 3$
2. K_S^0 Cuts
   (a) $|\eta| < 0.8$
   (b) $p_{\mathrm{T}} > 0.2$ GeV/c
   (c) $m_{PDG} - 13.677$ MeV $< m_{\mathrm{inv}} < m_{\mathrm{PDG}} + 2.0323$ MeV
   (d) DCA to prim. vertex < 0.3 cm
   (e) Cosine of pointing angle > 0.9993
   (f) OnFlyStatus = false
   (g) Decay Length < 30 cm
3. Shared Daughter Cut for V0 Collection
   – Iterate through V0 collection to ensure that no daughter is used in more than one V0 candidate

As can be seen in Figure 1, some misidentified Λ and $\bar{\Lambda}$ particles contaminate our K_S^0 sample. Figure 1a shows the mass assuming Λ-hypothesis for the K_S^0 collection, i.e. assume the daughters are $p^+\pi^-$ instead of $\pi^+\pi^-$. Figure 1b is similar, but shows the mass assuming $\bar{\Lambda}$ hypothesis for the collection, i.e. assume the daughters are $\pi^+\bar{p}^-$ instead of $\pi^+\pi^-$. The Λ contamination can be seen in 1a, and the $\bar{\Lambda}$ contamination in 1b, in the peaks around m_{inv} = 1.115 GeV/c^2. Additionally, the $\bar{\Lambda}$ contamination is visible in Figure 1a, and the Λ contamination visible in Figure 1b, in the region of excess around 1.65 $< m_{\mathrm{inv}} <$ 2.1 GeV/c^2. This is confirmed as the number of misidentified Λ particles in the sharp peak of Figure 1a (misidentified $\bar{\Lambda}$ particles in the sharp peak of Figure 1b) approximately equals the excess found in the 1.65 $< m_{\mathrm{inv}} <$ 2.1 GeV/c^2 region of Figure 1a (Figure 1b).

The peaks around $m_{\mathrm{inv}} = 1.115$ GeV/c^2 in Figure 1 contain both misidentified Λ ($\bar{\Lambda}$) particles and good K_S^0. If one simply cuts out the entire peak, some good K_S^0 particles will be lost. Ideally, the K_S^0 selection and $\Lambda(\bar{\Lambda})$ misidentification cuts can be selected such that the peak is removed from this plot while leaving the distribution continuous. To attempt to remove these Λ and $\bar{\Lambda}$ contaminations without throwing away good K_S^0 particles, the following misidentification cuts are imposed; a K_S^0 candidate is rejected if all of the following criteria are satisfied (for either Λ or $\bar{\Lambda}$ hypothesis):



(a) Mass assuming Λ-hypothesis for K^0_S collection, i.e. assume the daughters are $p^+\pi^-$ instead of $\pi^+\pi^-$.



(b) Mass assuming $\bar{\Lambda}$-hypothesis for K^0_S collection, i.e. assume the daughters are $\pi^+\bar{p}^-$ instead of $\pi^+\pi^-$.

Fig. 1: Mass assuming Λ-hypothesis (1a) and $\bar{\Lambda}$-hypothesis (1b) for K^0_S collection. The "NoMisID" distribution (black triangles) uses the V0 finder without any attempt to remove misidentified Λ and $\bar{\Lambda}$. The peak in the "NoMisID" distribution around $m_{\rm inv} = 1.115$ GeV/c^2 contains misidentified Λ (1a) and $\bar{\Lambda}$ (1b) particles in our K^0_S collection. "SimpleMisID" (pink squares) simply cuts out the entire peak, which throws away some good K^0_S particles. "MisID_NoM$_{inv}$Comp" (green squares) uses the misidentification cut outlined in the text, but does not utilize the invariant mass comparison method. "MisID_M$_{inv}$Comp" (red circles) utilizes the full misidentification methods, and is currently used for this analysis. "N$_{pass}$/N$_{ev}$" is the total number of K^0_S particles found, normalized by the total number of events. The purity of the collection is also listed. Also note, the relative excess of the "NoMisID" distribution around $1.65 < m_{\rm inv} < 2.1$ GeV/c^2 shows misidified $\bar{\Lambda}$ (1a) and Λ (1b) particles in our K^0_S collection.

– $\left| m_{\rm inv,\ \Lambda(\bar{\Lambda})\ Hypothesis} - m_{\rm PDG,\ \Lambda(\bar{\Lambda})} \right| < 9.0$ MeV/c^2

- Positive daughter passes $p^+(\pi^+)$ daughter cut implemented for $\Lambda(\bar{\Lambda})$ reconstruction
- Negative daughter passes $\pi^-(\bar{p}^-)$ daughter cut implemented by $\Lambda(\bar{\Lambda})$ reconstruction
- $\left| m_{\text{inv, }\Lambda(\bar{\Lambda})\text{ Hypothesis}} - m_{\text{PDG, }\Lambda(\bar{\Lambda})} \right| < \left| m_{\text{inv, K}^0_S\text{ Hypothesis}} - m_{\text{PDG, K}^0_S} \right|$

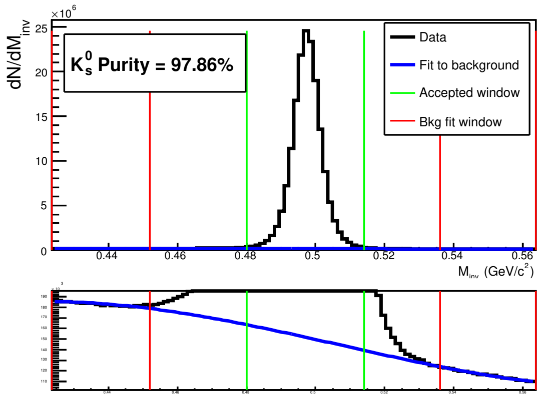


Fig. 2: Invariant mass (m_{inv}) distribution of all K^0_S candidates immediately before the final invariant mass cut. The bottom figure is zoomed to show the background with fit. The vertical green lines represent the m_{inv} cut used in the analyses, the red vertical lines delineate the region over which the background was fit, and the blue line shows the background fit. This distribution is used to calculate the collection purity, Purity(K^0_S) $\approx$ 98%.