1 Data Selection

1.1 Event Selection and Mixing

The events used in this study were selected with the class AliFemtoEventCutEstimators according to the following criteria:

- Triggers
  - minimum bias (kMB)
  - central (kCentral)
  - semi-central (kSemiCentral)
- z-position of reconstructed event vertex must be within 10 cm of the center of the ALICE detector
- the event must contain at least one particle of each type from the pair of interest

The event mixing was handled by the AliFemtoVertexMultAnalysis class, which only mixes events with like vertex position and centrality. The following criteria were used for event mixing:

- Number of events to mix = 5
- Vertex position bin width = 2 cm
- Centrality bin width = 5

The AliFemtoEventReaderAODChain class is used to read the events. Event flatteneing is not currently used. FilterBit(7). The centrality is determined by the "V0M" method of AliCentrality, set by calling AliFemtoEventReaderAOD::SetUseMultiplicity(kCentrality). I utilize the SetPrimaryVertexCorrectionTPCPoints switch, which causes the reader to shift all TPC points to be relative to the event vertex.

1.2 $K^{\pm}$ Track Selection

Charged kaons are identified using the AliFemtoESDTrackCutNSigmaFilter class. The specific cuts used in this analysis are as follows:

- PID Probabilities:
  - K: > 0.2
  - π: < 0.1
  - μ: < 0.8
  - p: < 0.1
- Most probable particle type must be Kaon (fMostProbable=3)
- $0.14 < p_T < 1.5$
- $|\eta| < 0.8$
- Minimum number of clusters in the TPC (fminTPCncls) = 80
- Remove particles with any kink labels (fRemoveKinks = true)
- Maximum allowed χ^2/N_{DOF} for ITS clusters = 3.0
- Maximum allowed χ^2/N_{DOF} for TPC clusters = 4.0

- Maximum allowed sigma to primary vertex (fMaxSigmaToVertex) = 3.0
- Maximum XY impact parameter = 2.4
- Maximum Z impact parameter = 3.0
- TPC and TOF N_{σ} cuts:
  - p $<$ 0.4 GeV/c: $N_{\sigma K,TPC} < 2$
  - 0.4 $<$ p $<$ 0.45 GeV/c: $N_{\sigma K,TPC} < 1$
  - 0.45 $<$ p $<$ 0.8 GeV/c: $N_{\sigma K,TPC} < 3$ & $N_{\sigma K,TOF} < 2$
  - 0.8 $<$ p $<$ 1.0 GeV/c: $N_{\sigma K,TPC} < 3$ & $N_{\sigma K,TOF} < 1.5$
  - p $>$ 1.0 GeV/c: $N_{\sigma K,TPC} < 3$ & $N_{\sigma K,TOF} < 1$
- Electron Rejection: Reject if $N_{\sigma e-,TPC} < 3$
- Pion Rejection: Reject if:
  - p $<$ 0.65
    * if TOF and TPC available: $N_{\sigma\pi,TPC} < 3$ & $N_{\sigma\pi,TOF} < 3$
    * else
      - p $<$ 0.5: $N_{\sigma\pi,TPC} < 3$
      - 0.5 $<$ p $<$ 0.65: $N_{\sigma\pi,TPC} < 2$
  - 0.65 $<$ p $<$ 1.5: $N_{\sigma\pi,TPC} < 5$ & $N_{\sigma\pi,TOF} < 3$
  - p $>$ 1.5: $N_{\sigma\pi,TPC} < 5$ & $N_{\sigma\pi,TOF} < 2$

1.3 V0 Selection

Λ ($\bar{\Lambda}$) and K^0_S are neutral particles which cannot be directly detected, but must instead be reconstructed through detection of their decay products, or daughters. In general, particles which are topologically reconstructed in this fashion are called V0 particles. The class AliFemtoV0TrackCutNSigmaFilter (which is an extension of AliFemtoV0TrackCut) is used to reconstruct the V0s.

1.3.1 Λ Reconstruction

The following cuts were used to select good Λ ($\bar{\Lambda}$) candidates:

1. Cuts Common to Both Daughters
   (a) $|\eta| < 0.8$
   (b) SetTPCnclsDaughters(80)
   (c) SetStatusDaughters(AliESDtrack::kTPCrefic)
   (d) SetMaxDcaV0Daughters(0.4)
2. Pion Specific Daughter Cuts
   (a) $p_T > 0.16$
   (b) DCA to prim vertex $>$ 0.3
3. Proton Specific Daughter Cuts
   (a) $p_T >$
      - 0.5 (p)

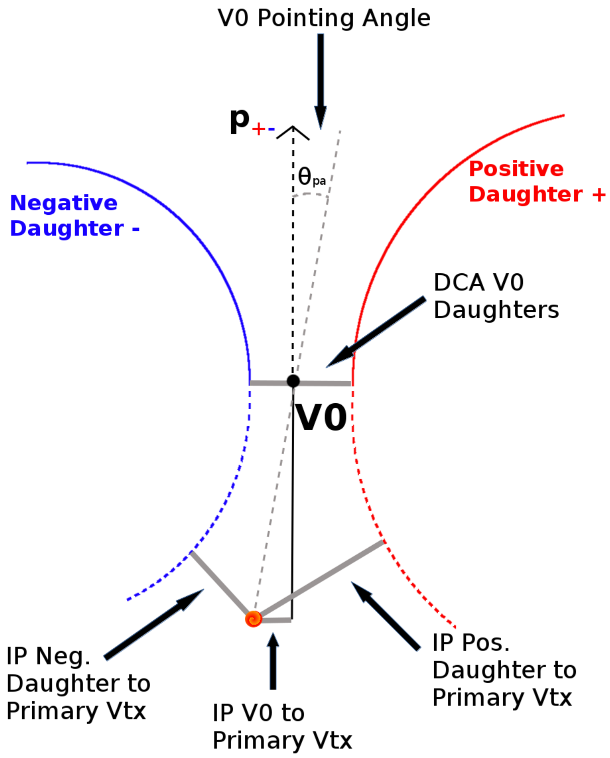

Fig. 1: V0 Reconstruction

  - 0.3 ($\bar{p}$)

(b) DCA to prim vertex > 0.1

4. Lambda Cuts

   (a) $|\eta| < 0.8$
   (b) $p_T > 0.4$
   (c) $|m_{inv} - m_{PDG}| < 3.8$ MeV
   (d) Cosine of pointing angle > 0.9993
   (e) OnFlyStatus = false
   (f) Decay Length < 60 cm

1.3.2 K^0_S Reconstruction

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

1. Pion Daughter Cuts

   (a) $|\eta| < 0.8$
   (b) SetTPCnclsDaughters(80)
   (c) SetStatusDaughters(AliESDtrack::kTPCrefic)
   (d) SetMaxDcaV0Daughters(0.3)
   (e) $p_T > 0.15$
   (f) DCA to prim vertex > 0.3

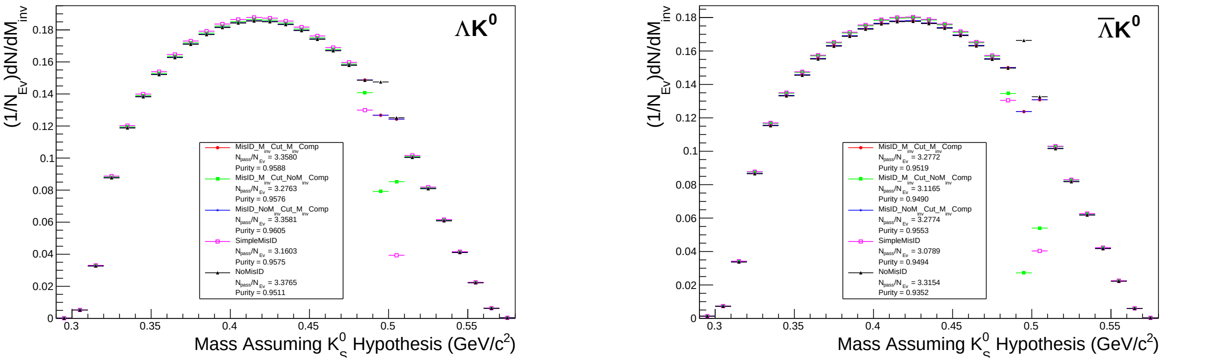

Fig. 2: Mass assuming K^0_S-hypothesis for V0 candidates passing all Λ ($\bar{\Lambda}$) cuts, i.e. assume the daughters are $\pi^+\pi^-$ instead of $p^+\pi^-$ ($\pi^+\bar{p}^-$). The slight peak around m_{inv} = 0.5 GeV/c^2 likely contains misidentified K^0_S particles in our Λ collection. If one simply cuts out the entire peak, good Λ particles will be lost. Ideally, the Λ selection and K^0_S misidentification cuts are selected such that the peak is removed from this plot while leaving the distribution continuous.

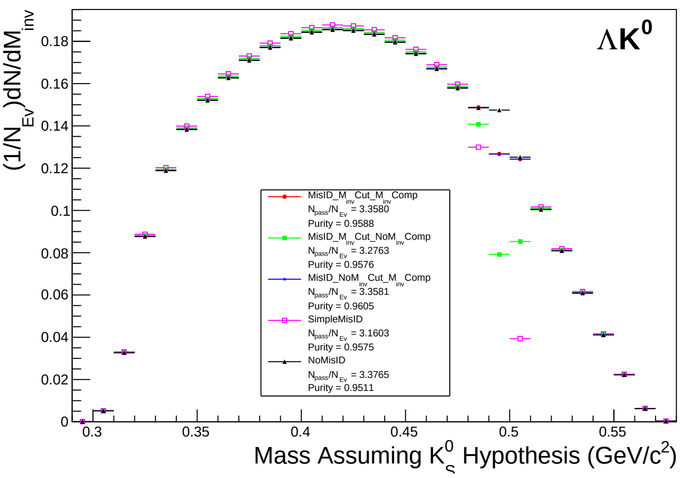

Fig. 3: Mass assuming K^0_S-hypothesis for V0 candidates passing all Λ cuts, i.e. assume the daughters are $\pi^+\pi^-$ instead of $p^+\pi^-$. The slight peak around m_{inv} = 0.5 GeV/c^2 likely contains misidentified K^0_S particles in our Λ collection. If one simply cuts out the entire peak, good Λ particles will be lost. Ideally, the Λ selection and K^0_S misidentification cuts are selected such that the peak is removed from this plot while leaving the distribution continuous.

2. K^0_S Cuts
   (a) $|\eta| < 0.8$
   (b) $p_T > 0.2$
   (c) $m_{PDG}-$ 13.677 MeV $< m_{inv} < m_{PDG}+$ 2.0323 MeV
   (d) Cosine of pointing angle > 0.9993
   (e) OnFlyStatus = false
   (f) Decay Length $<$ 30 cm

As can be seen in Figures 6 and 7, some misidentified Λ and $\bar{\Lambda}$ particles contaminate our K^0_S sample. Figure 6 shows the mass assuming Λ-hypothesis for V0 candidates passing all K^0_S cuts, i.e. assume the

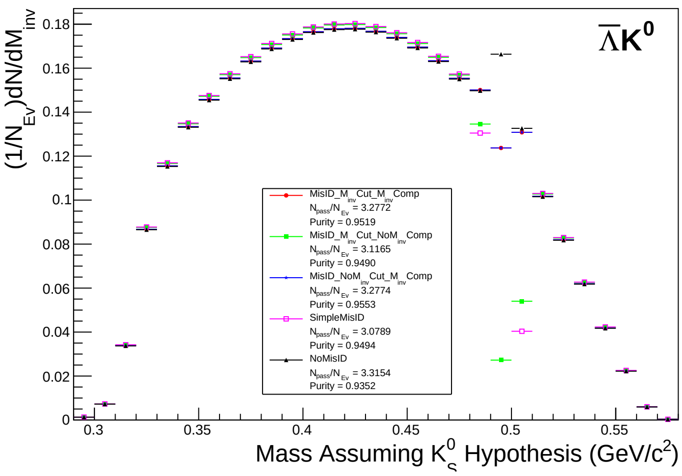

Fig. 4: Mass assuming K^0_S-hypothesis for V0 candidates passing all $\bar{\Lambda}$ cuts, i.e. assume the daughters are $\pi^+\pi^-$ instead of $\pi^+\bar{p}^-$. Similar to Figure 3

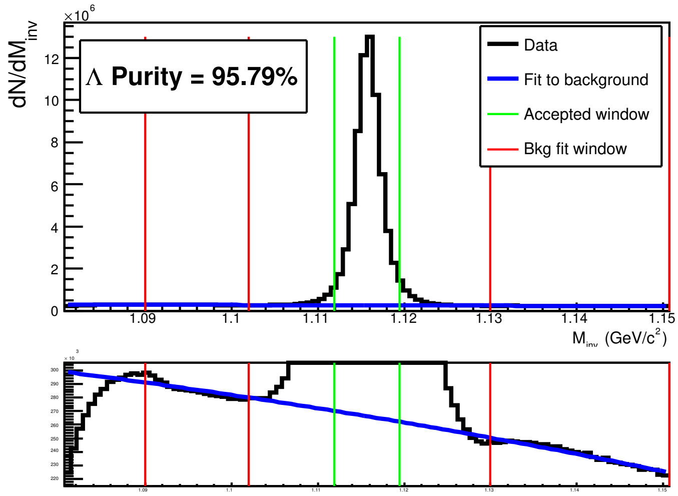

Fig. 5: Λ Purity

daughters are $p^+\pi^-$ instead of $\pi^+\pi^-$. Figure 7 is similar, but shows the mass assuming $\bar{\Lambda}$ hypothesis for the same K^0_S collection, i.e. assume the daughters are $\pi^+\bar{p}^-$ instead of $\pi^+\pi^-$. The Λ contamination can be seen in Figure 6, and the $\bar{\Lambda}$ contamination in Figure 7, in the peaks around m_{inv} = 1.115 GeV/c^2. Additionally, the $\bar{\Lambda}$ contamination is visible in Figure 6, and the Λ contamination visible in Figure 7, in the region of excess around $1.65 < m_{inv} < 2.1$ GeV/c^2. This is confirmed as the number of misidentified Λ particles in the sharp peak of Figure 6 (misidentified $\bar{\Lambda}$ particles in the sharp peak of Figure 7) approximately equals the excess found in the $1.65 < m_{inv} < 2.1$ GeV/c^2 region of Figure 7 (Figure 6).

The peak around $m_{inv} = 1.115$ GeV/c^2 in Figure 6 (Figure 7)contains both misidentified Λ ($\bar{\Lambda}$) particles and good K^0_S. If one simply cuts out the entire peak, some good K^0_S particles will be lost. Ideally, the K^0_S 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^0_S particles, the following misidentification cuts are imposed; a K^0_S candidate is rejected if all of the following criteria are satisfied:

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

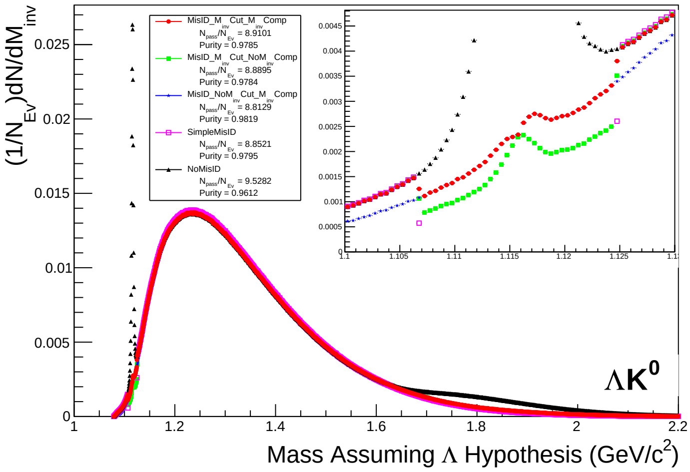

Fig. 6: Mass assuming Λ-hypothesis for V0 candidates passing all K^0_S cuts, i.e. assume the daughters are $p^+\pi^-$ instead of $\pi^+\pi^-$. The peak around $m_{inv} = 1.115$ GeV/c^2 contains misidentified Λ particles in our K^0_S collection. If one simply cuts out the entire peak, some good K^0_S particles will be lost. Ideally, the K^0_S selection and $\Lambda(\bar{\Lambda})$ misidentification cuts can be selected such that the peak is removed from this plot while leaving the distribution continuous. Also note, the excess around $1.65 < m_{inv} < 2.1$ GeV/c^2 shows misidified $\bar{\Lambda}$ particles in our K^0_S collection.

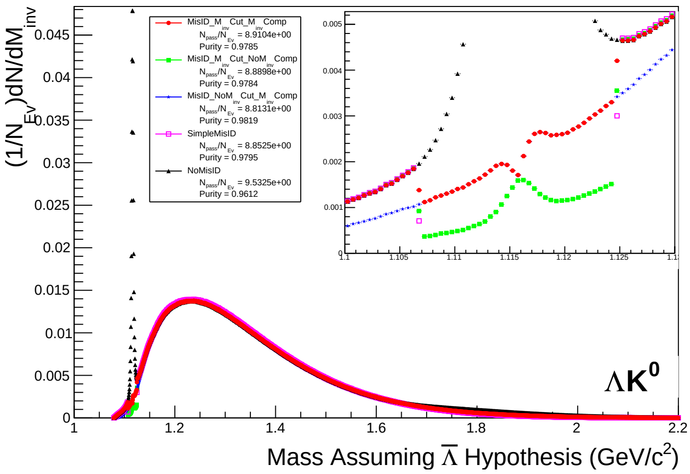

Fig. 7: Mass assuming $\bar{\Lambda}$-hypothesis for V0 candidates passing all K^0_S cuts, i.e. assume the daughters are $\pi^+\bar{p}^-$ instead of $\pi^+\pi^-$. Similar to Figure 6

- 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

1.4 Cascade Reconstruction

Talk about reconstruction cascades

1.5 Pair Selection

Some general remarks on forming pairs

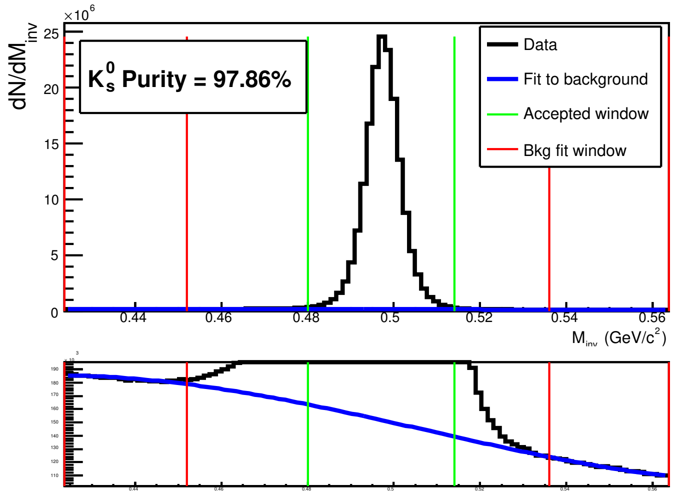

Fig. 8: K_S^0 Purity

It is important to obtain true particle pairs in the analysis. In particular, contamination from pairs constructed with split or merged tracks can introduce an artificial signal into the correlation function, obscuring the actual physics.

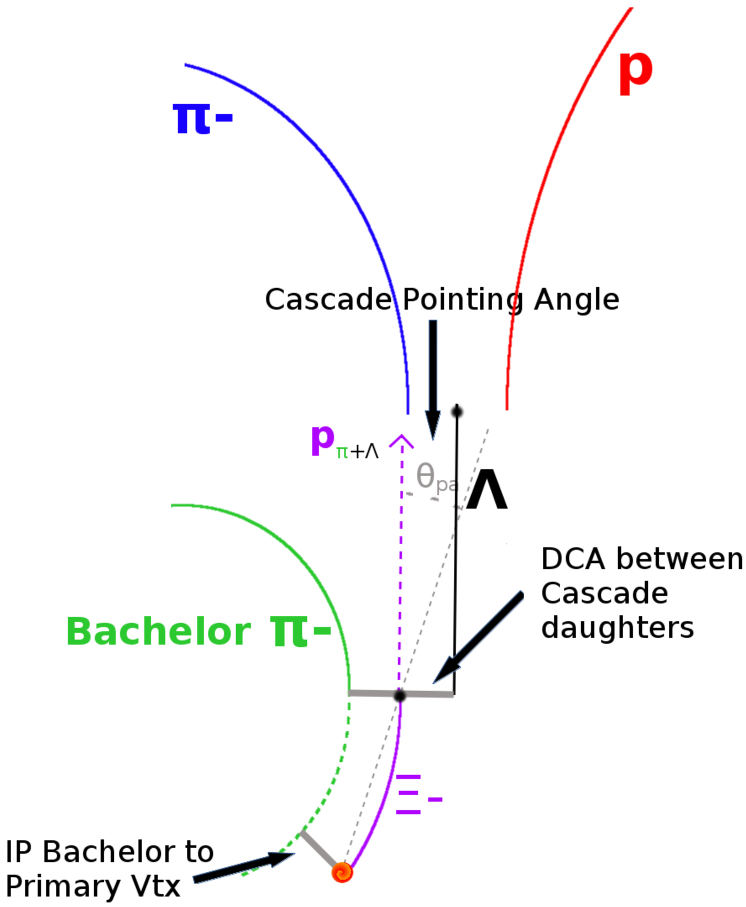

Fig. 9: Ξ Reconstruction

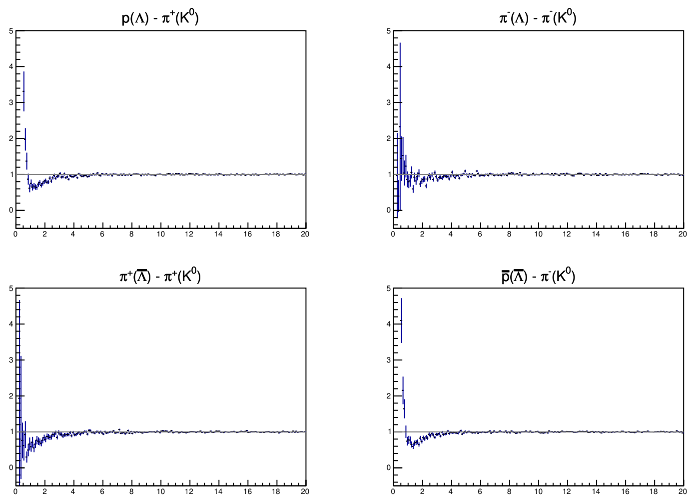

Fig. 10: Avgerage Separation $\Lambda(\bar{\Lambda})K_S^0$

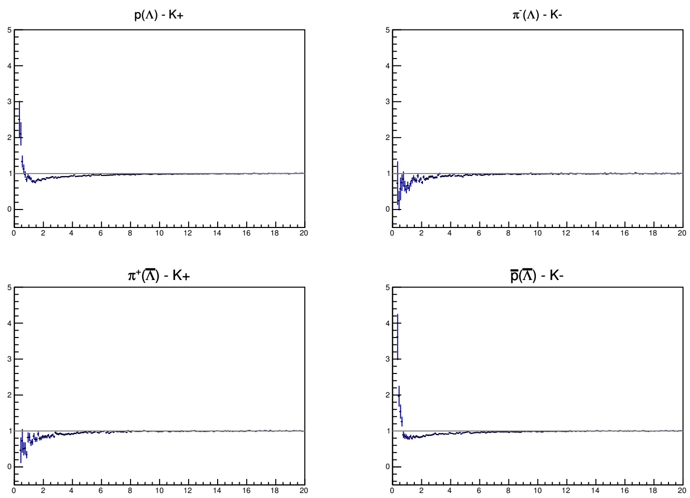

Fig. 11: Avgerage Separation $\Lambda(\bar{\Lambda})K^{\pm}$