

## 1 Correlation Functions

This analysis studies the momentum correlations of both  $\Lambda K$  and  $\Xi^- K^\pm$  pairs using the two-particle correlation function, defined as  $C(k^*) = A(k^*)/B(k^*)$ , where  $A(k^*)$  is the signal distribution,  $B(k^*)$  is the reference (or background) distribution, and  $k^*$  is the momentum of one of the particles in the pair rest frame. In practice,  $A(k^*)$  is constructed by binning in  $k^*$  pairs from the same event. Ideally,  $B(k^*)$  is similar to  $A(k^*)$  in all respects excluding the presence of femtoscopic correlations [?]; as such,  $B(k^*)$  is used to divide out the phase-space effects, leaving only the femtoscopic effects in the correlation function.

This analysis presents correlation functions for three centrality bins (0-10%, 10-30%, and 30-50%), and is currently pair transverse momentum ( $k_T = 0.5|\mathbf{p}_{T,1} + \mathbf{p}_{T,2}|$ ) integrated (i.e. not binned in  $k_T$ ). The correlation functions are constructed separately for the two magnetic field configurations, and, after assuring consistency, are combined using a weighted average:

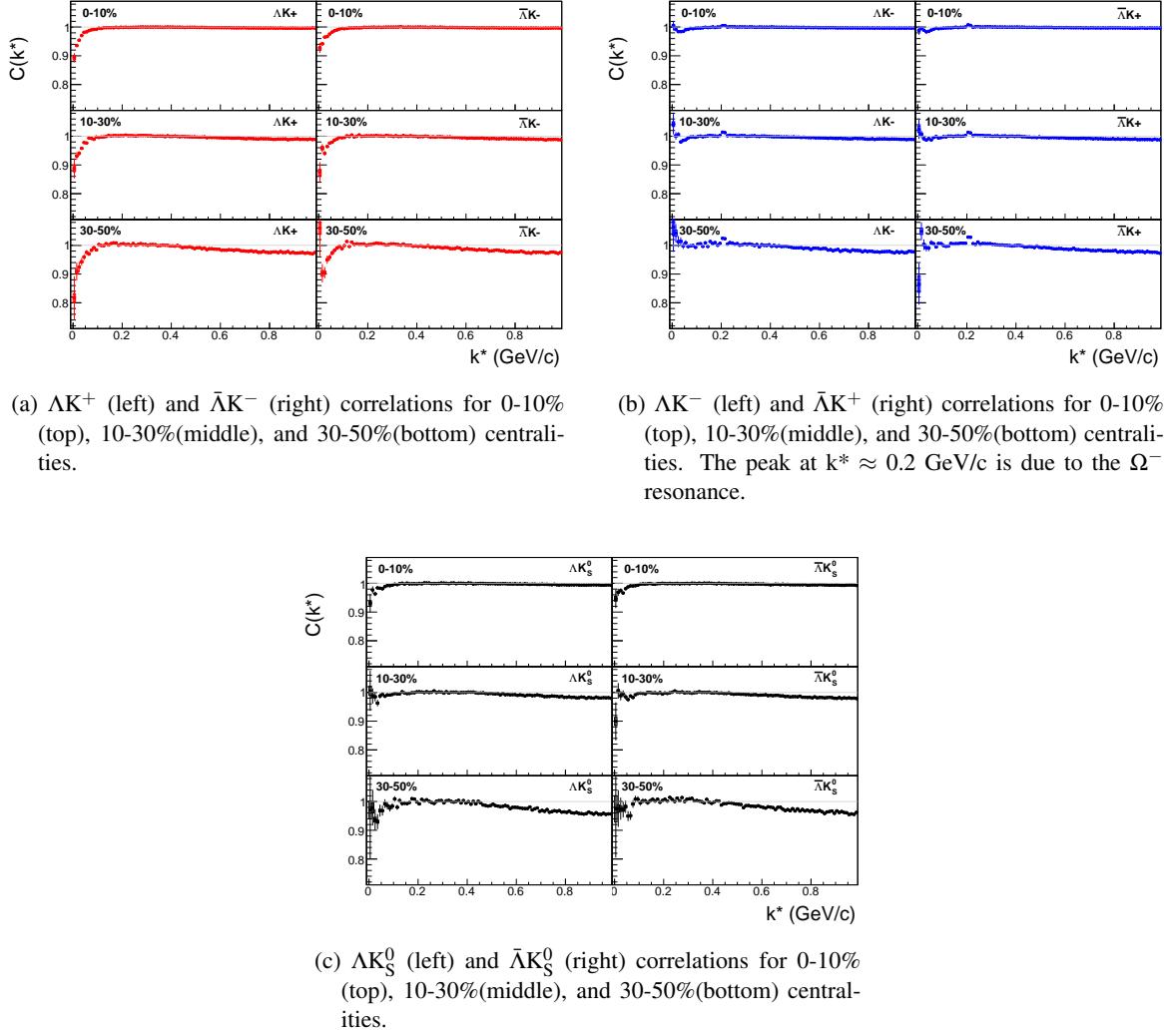
$$C_{combined}(k^*) = \frac{\sum_i w_i C_i(k^*)}{\sum_i w_i} \quad (1)$$

where the sum runs over the correlation functions to be combined, and the weight,  $w_i$ , is the number of numerator pairs in  $C_i(k^*)$ . Here, the sum is over the two field configurations (++ and - -).

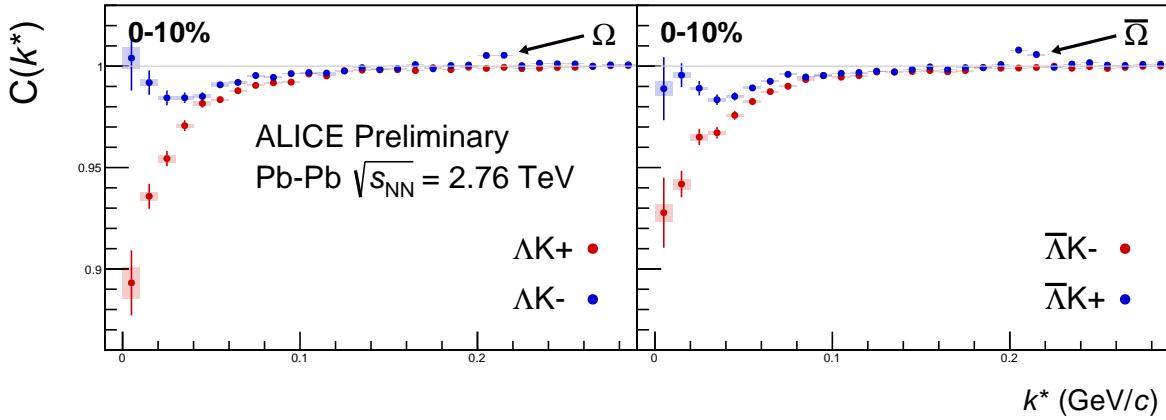
### 1.1 Typical Correlation Function Construction

Typically, in practice,  $B(k^*)$  is obtained by forming mixed-event pairs, i.e. particles from a given event are paired with particles from  $N_{mix}(= 5)$  other events, and these pairs are then binned in  $k^*$ . In forming the background distribution, it is important to mix only similar events; mixing events with different phase-spaces can lead to artificial signals in the correlation function. Therefore, in this analysis, we mix events with primary vertices within 2 cm and centralities within 5% of each other. Also note, a vertex correction is also applied to each event, which essentially recenters the the primary vertices to  $z = 0$ .

Figures 1a, 1b, 1c show the correlation functions for all centralities studied for  $\Lambda K^+(\bar{\Lambda} K^-)$ ,  $\Lambda K^-(\bar{\Lambda} K^+)$ , and  $\Lambda(\bar{\Lambda})K_S^0$ , respectively. All were normalized in the range  $0.32 < k^* < 0.4$  GeV/c. It is interesting to note that the average of the  $\Lambda K^+(\bar{\Lambda} K^-)$  and  $\Lambda K^-(\bar{\Lambda} K^+)$  correlation functions is consistent with our  $\Lambda K_S^0(\bar{\Lambda} K_S^0)$  measurement.



**Fig. 1:**  $\Lambda K$  and  $\bar{\Lambda} K$  correlation functions for 0-10%, 10-30%, and 30-50% centralities. The lines represent the statistical errors, while the boxes represent the systematic errors.



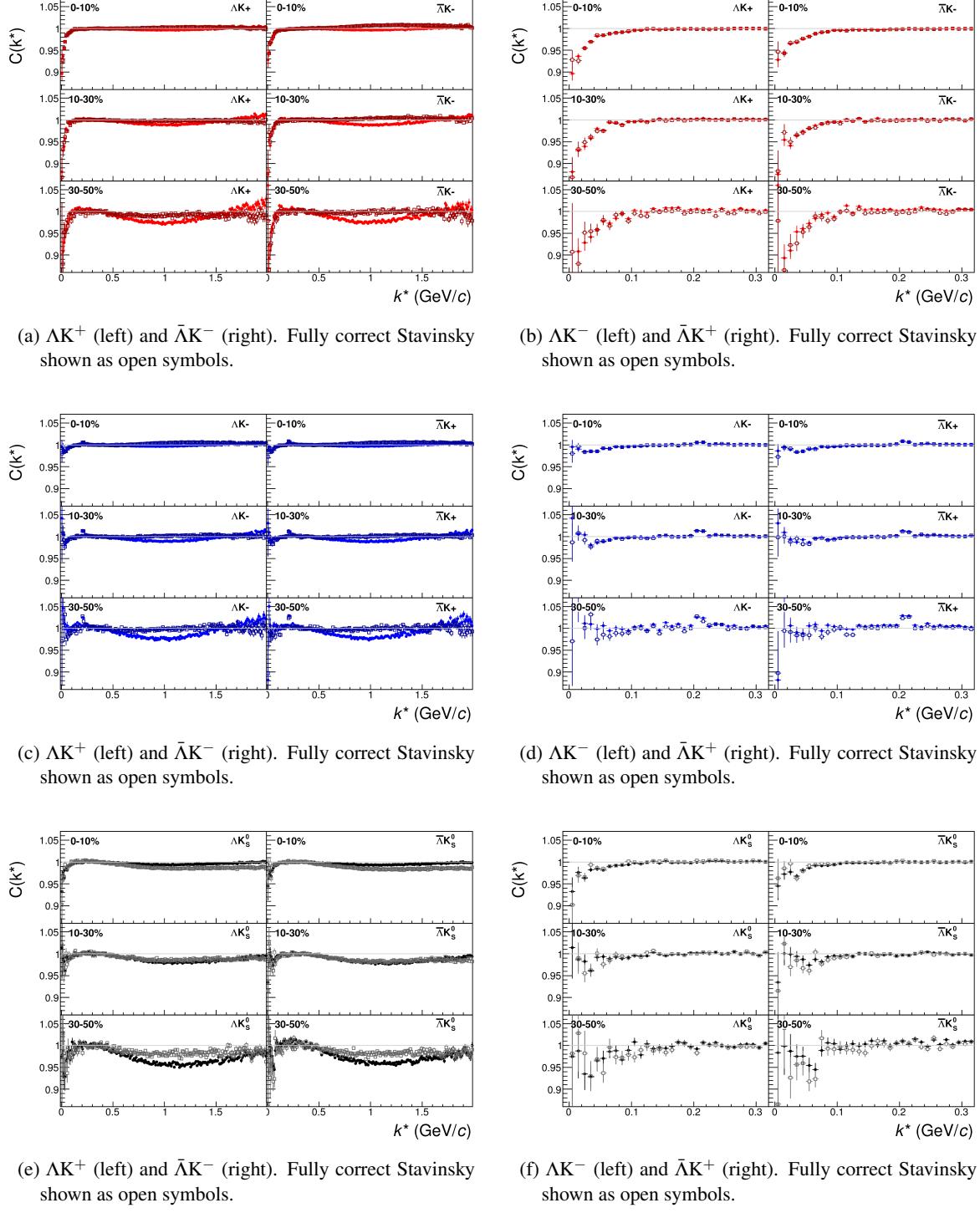
**Fig. 2:** Correlation Functions:  $\Lambda K^+$  vs  $\Lambda K^-$  ( $\bar{\Lambda} K^+$  vs  $\bar{\Lambda} K^-$ ) for 0-10% centrality. The peak in  $\Lambda K^-$  ( $\bar{\Lambda} K^+$ ) at  $k^* \approx 0.2$  GeV/c is due to the  $\Omega^-$  resonance. The lines represent the statistical errors. (NOTE: This figure is slightly dated, and a new one will be generated which includes both statistical and systematic uncertainties)

## 1.2 Stavinsky Correlation Function Construction

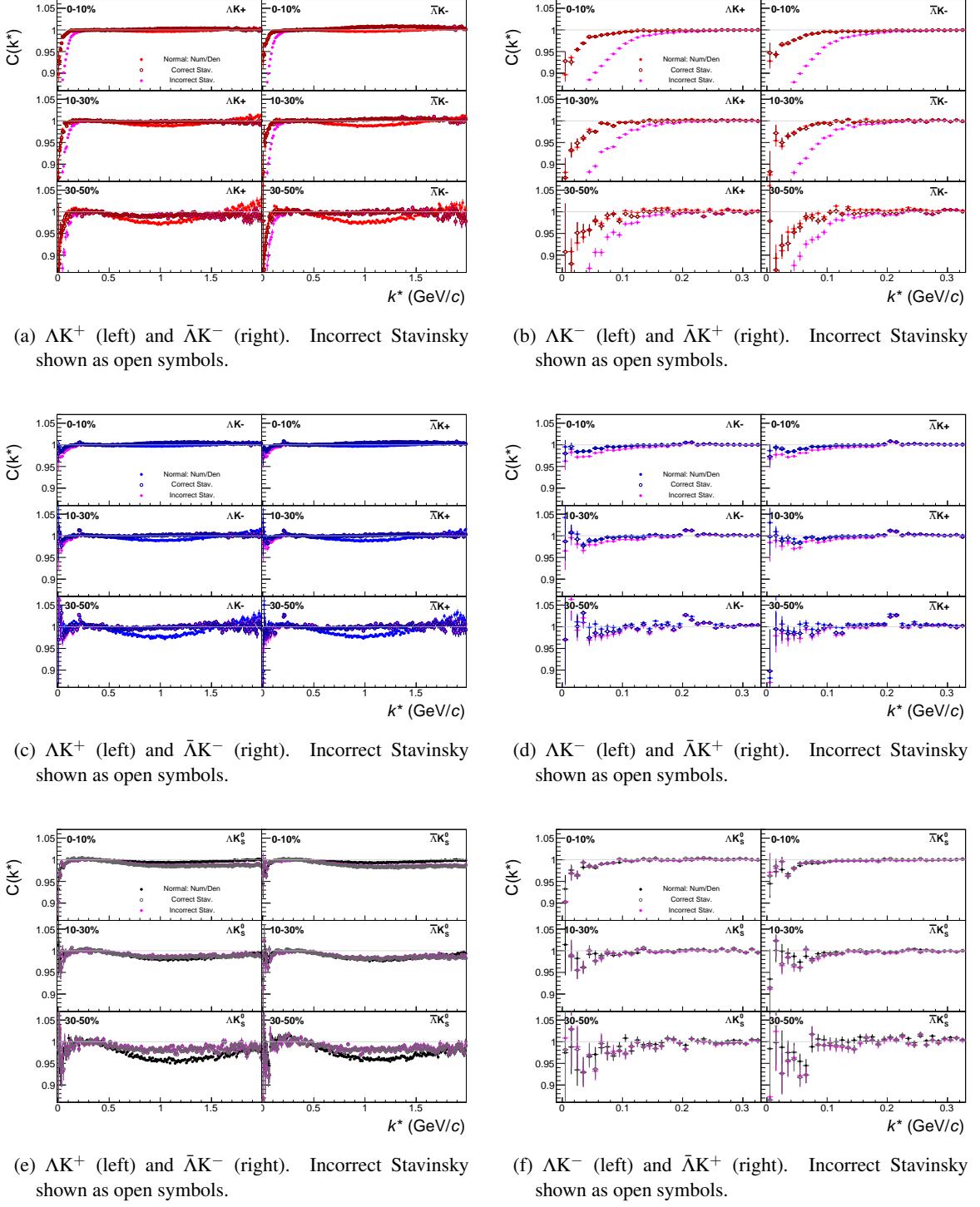
The purpose of the Stavinsky method is to rid the correlation functions of the non-femtoscopic background. More specifically, this method is intended to handle background contributions from elliptic flow, and other sources having reflection symmetry in the transverse plane. With the Stavinsky method, mixed-event pairs are not used for the background; instead, same-event sudo-pairs, formed by rotating one particle in a real pair by  $180^\circ$  in the transverse plane, as used as a background. This rotation rids the pairs of any femtoscopic correlation, while maintaining correlations due to elliptic flow (and other properly symmetric contributors).

The results of correctly implementing such a procedure are shown in Figure 3. The figure shows the Stavinsky method does a very good job of ridding the  $\Lambda K^\pm$  correlations of their non-femtoscopic backgrounds. We also see the procedure does not work as well on the  $\Lambda K_S^0$  system.

Now, one must be somewhat careful when applying this Stavinsky method. We found that, in order to obtain correct results, we had to run our pseudo-pairs through the same pair cuts used in our analyses. In an ideal world, our pair cut would only remove truly bad pairs results from splitting, merging, etc. In the real world, the pair cut always throws out some of the good with the bad. For the pseudo-pairs to form a reliable background, they too must experience the pair cut, and the loss of "good" pairs. We found this issue affected mainly our  $\Lambda K^+$  &  $\bar{\Lambda} K^-$  analysis, as can be seen in Figure 4, which shows both a correct implementation of the Stavinsky method, and an incorrect implementation lacking the additional pair cut on the pseudo-pairs.



**Fig. 3:**  $\Lambda K$  and  $\bar{\Lambda} K$  correlation functions built using the fully correct Stavinsky method for 0-10%, 10-30%, and 30-50% centralities. In the full correct method, the pseudo-pairs (same-event pairs with one particle rotated by  $180^\circ$  in the transverse plane) are also run through the pair cuts used in the analysis. Closed symbols represent correlations built using the normal mixed-event background, while open symbols represent correlations formed using the Stavinsky same-event pseudo-pairs as a background. Figures in the right column are zoomed-in versions of figures in the left column.



**Fig. 4:**  $\Lambda K$  and  $\bar{\Lambda}K$  correlation functions built using the Stavinsky method for 0-10%, 10-30%, and 30-50% centralities. The closed, (red, blue, black) symbols represent correlation functions formed using the normal method with mixed-event background pairs. The open, cyan symbols represent correlation functions formed using the correct Stavinsky method. The closed, magenta symbols represent correlation functions formed using the incorrect Stavinsky method. In the incorrect method, the pseudo-pairs (same-event pairs with one particle rotated by 180° in the transverse plane) are not run through the pair cuts used in the analysis. Figures in the right column are zoomed-in versions of figures in the left column.