## 0.1 Results: ΛK_S^0 and $\Lambda K^{\pm}$

I first collect all of the summary results, and will show the actual fits to the data in Sections 0.1.1, 0.1.2, and 0.1.3. In the first of the summary plots, we show the extracted scattering parameters in the form of a $Im[f_0]$ vs $Re[f_0]$ plot, which includes the d_0 values to the right side. The next three summary plots show the λ vs. Radius parameters. The first group of plots shows: 1) results without any residual correlations included in the fit (marked as "QM 2017"), 2) results with 10 residual pairs included, and 3) results with 3 residual pairs included. The second group of plots also includes the case where we fixed the d_0 parameter to zero.
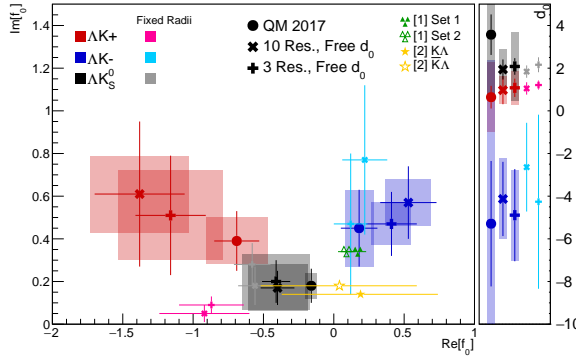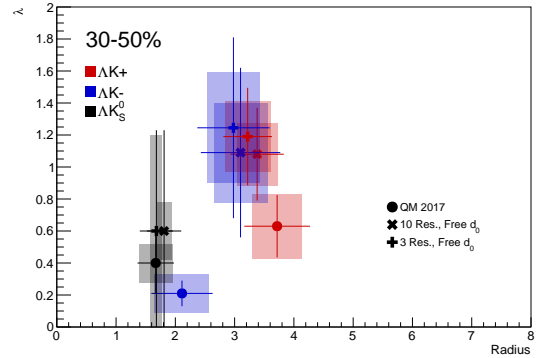

(a) Extracted scattering parameter results, $Im(f_0)$ vs. $Re(f_0)$, with d_0 to the right, for all of our ΛK systems.
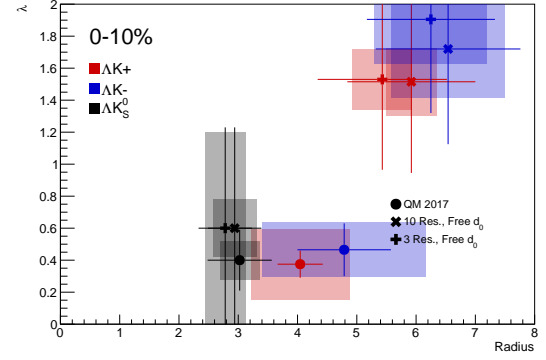
(b) Extracted λ vs Radius results, for the 0-10% centrality bin, for all of our ΛK^+ systems.
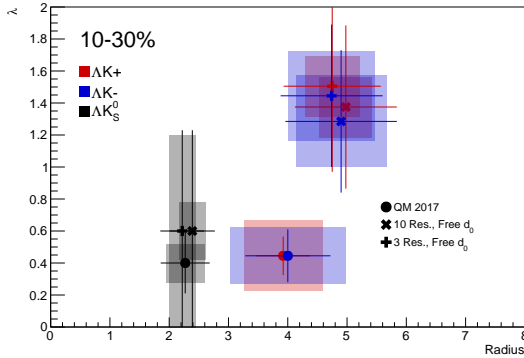
(c) Extracted λ vs Radius results, for the 10-30% centrality bin, for all of our ΛK^+ systems.

(d) Extracted λ vs Radius results, for the 30-50% centrality bin, for all of our ΛK^+ systems.

Fig. 1: Extracted fit results for all of our ΛK systems across all studied centrality bins (0-10%, 10-30%, 30-50%). The plots show results including no residuals (circles), 10 residual pairs (X), and 3 residual pairs (+). Note, ΛK^+ on the plot is shorthand for ΛK^+ and $\bar{\Lambda} K^-$, and similar for the others. In Fig. 1a, the lighter color markers (pink, sky blue, gray) show the extracted parameters when we fix the radii to roughly align with the m_T-scaling plot (Fig. 5). Additionally, the green [?] and yellow [?] points show theoretical predictions made using chiral perturbation theory.

0.1.1 Results: ΛK_S^0 and $\Lambda K^{\pm}$: No Residual Correlations Included in Fit

Figures 2, 3, and 4 (Section **??**) show experimental data with fits for all studied centralities for ΛK_S^0 with $\bar{\Lambda} K_S^0$, ΛK^+ with $\bar{\Lambda} K^-$, and ΛK^- with $\bar{\Lambda} K^+$, respectively. The parameter sets extracted from the fits can be found in Tables **??** and **??**. All correlation functions were normalized in the range $0.32 < k^* < 0.40$ GeV/c, and fit in the range $0.0 < k^* < 0.30$ GeV/c. For the ΛK^- and $\bar{\Lambda} K^+$ analyses, the region $0.19 < k^* < 0.23$ GeV/c was excluded from the fit to exclude the bump caused by the Ω^- resonance. The non-flat background was fit with a linear form from $0.6 < k^* < 0.9$ GeV/c. The theoretical fit function was then multiplied by this background during the fitting process.

In the figures (2, 3, and 4), the black solid line represents the "raw" fit, i.e. not corrected for momentum resolution effects nor non-flat background. The green line shows the fit to the non-flat background. The purple points show the fit after momentum resolution and non-flat background corrections have been applied. The initial values of the parameters is listed, as well as the final fit values with uncertainties.

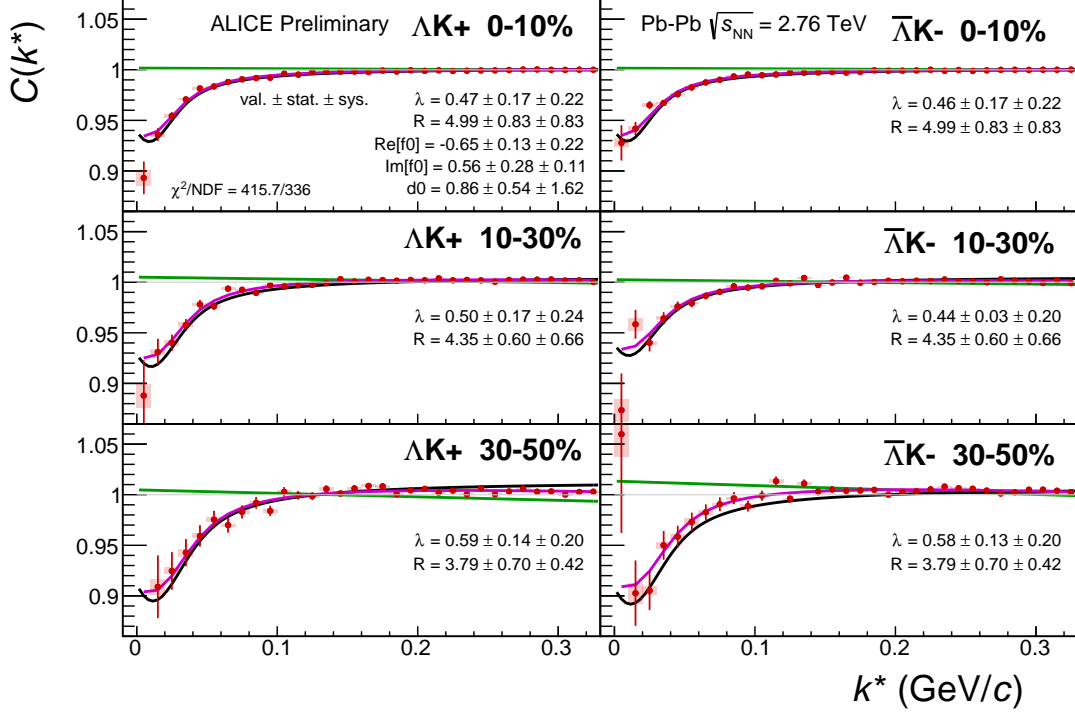For the ΛK_S^0 fits without residuals, λ was restricted to [0.4, 0.6].
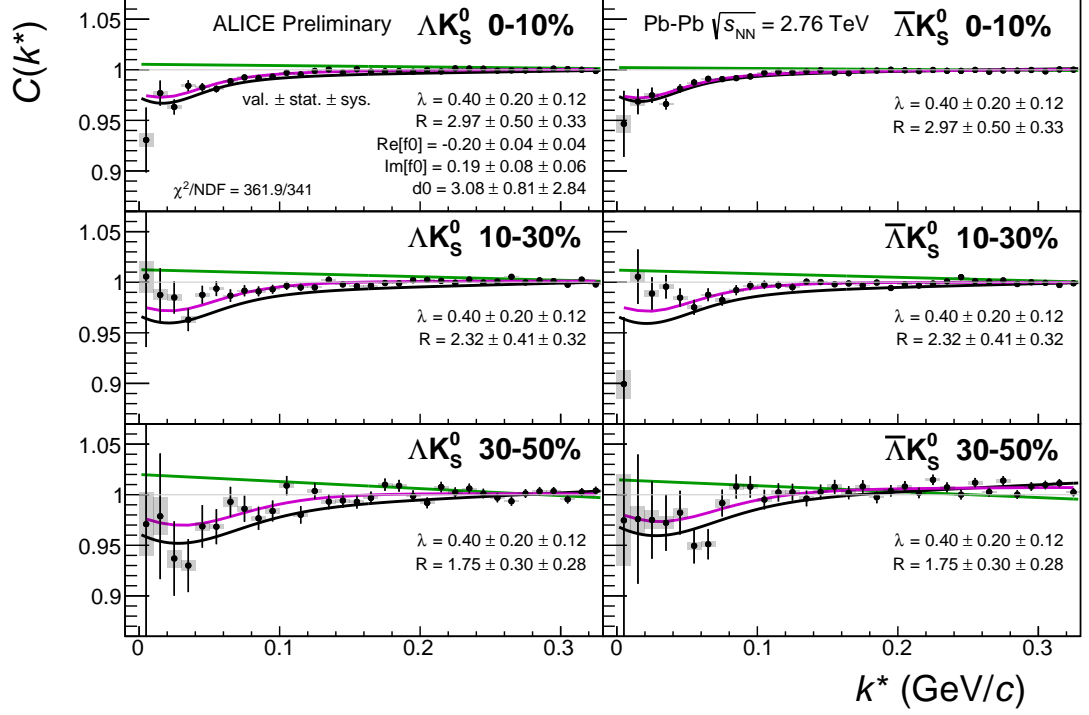
(a) Signal region view ($k^* \lesssim 0.3$ GeV/c)
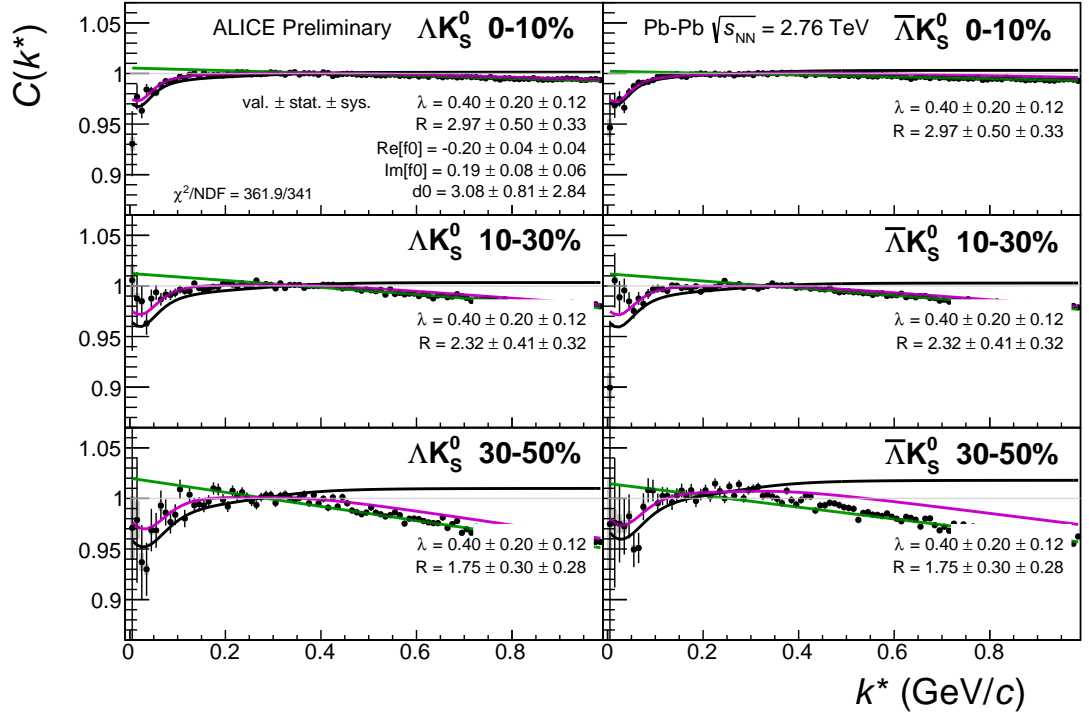
(b) Wide view ($k^* \lesssim 1.0$ GeV/c)

Fig. 2: Fits, with NO residual correlations included, to the ΛK_S^0 (left) and $\bar{\Lambda} K_S^0$ (right) data for the centralities 0-10% (top), 10-30% (middle), and 30-50% (bottom). The lines represent the statistical errors, while the boxes represent the systematic errors. Each has unique λ and normalization parameters. The radii are shared amongst like centralities; the scattering parameters ($\mathbb{R}f_0$, $\mathbb{I}f_0$, d_0) are shared amongst all. The black solid line represents the "raw" fit, i.e. not corrected for momentum resolution effects nor non-flat background. The green line shows the fit to the non-flat background. The purple points show the fit after momentum resolution and non-flat background corrections have been applied. The initial values of the parameters is listed, as well as the final fit values with uncertainties. Here, R was restricted to [2.,10.] and Λ was restricted to [0.1,0.8].
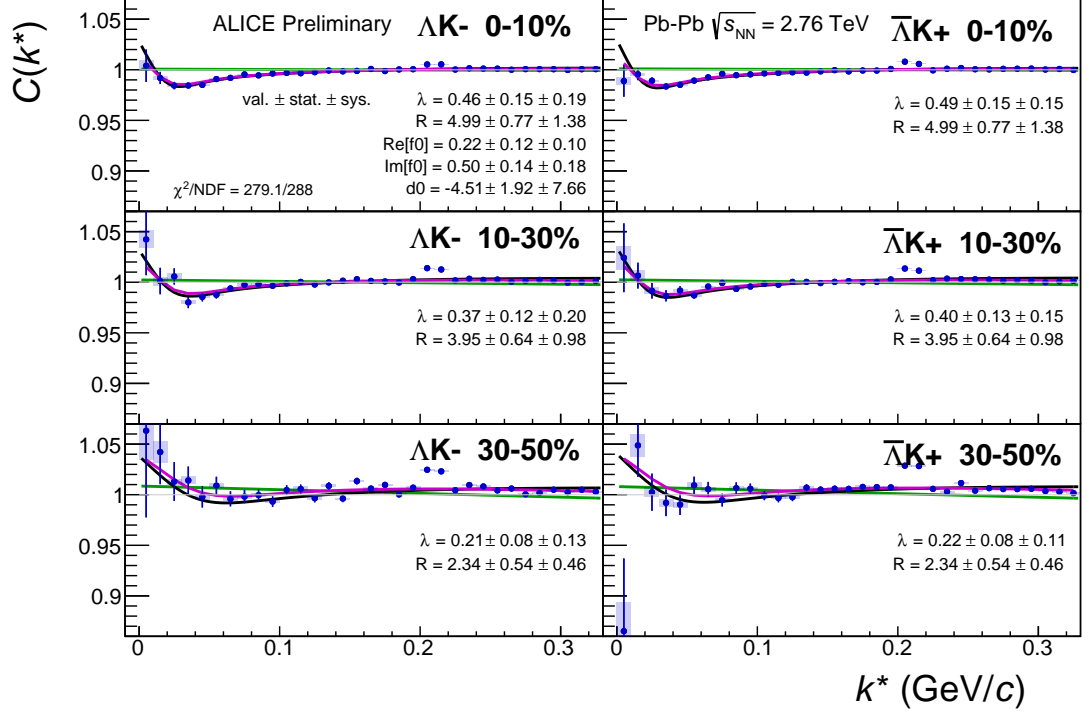
(a) Signal region view ($k^* \lesssim 0.3$ GeV/c)
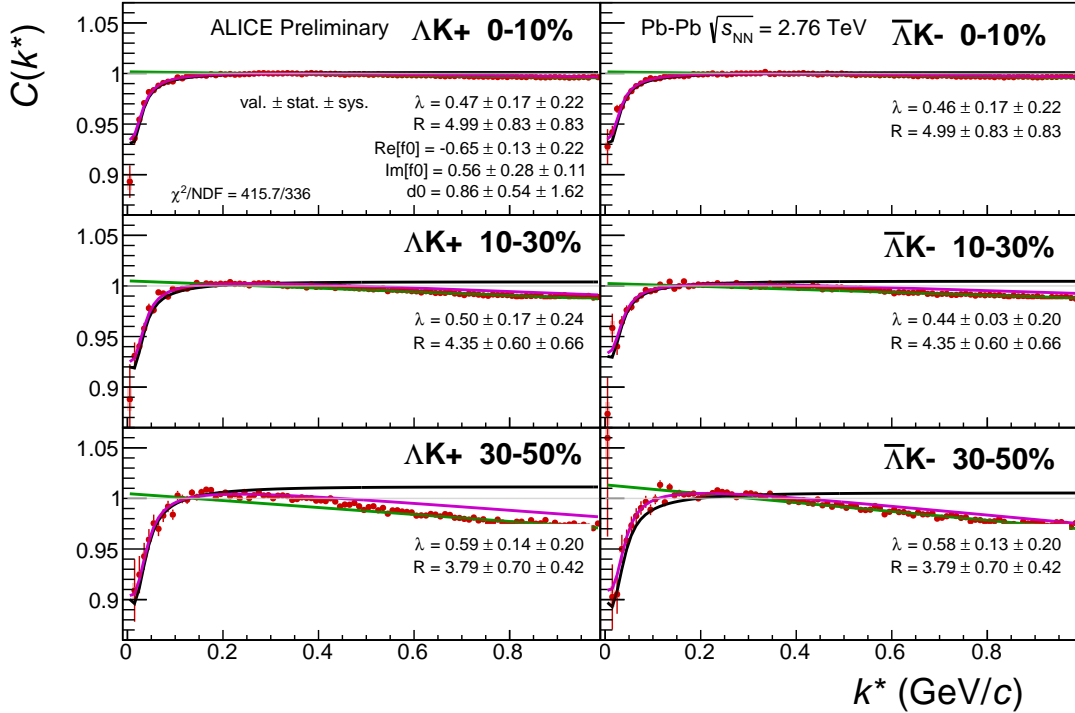
(b) Wide view ($k^* \lesssim 1.0$ GeV/c)

Fig. 3: Fits to the ΛK^+ (left) and $\bar{\Lambda}K^-$ (right) data for the centralities 0-10% (top), 10-30% (middle), and 30-50% (bottom). The lines represent the statistical errors, while the boxes represent the systematic errors. Each has unique λ and normalization parameters. The radii are shared amongst like centralities; the scattering parameters ($\mathbb{R}f_0$, $\mathbb{I}f_0$, d_0) are shared amongst all. The black solid line represents the "raw" fit, i.e. not corrected for momentum resolution effects nor non-flat background. The green line shows the fit to the non-flat background. The purple points show the fit after momentum resolution and non-flat background corrections have been applied. The initial values of the parameters is listed, as well as the final fit values with uncertainties.

(a) Signal region view ($k^* \lesssim 0.3$ GeV/c)
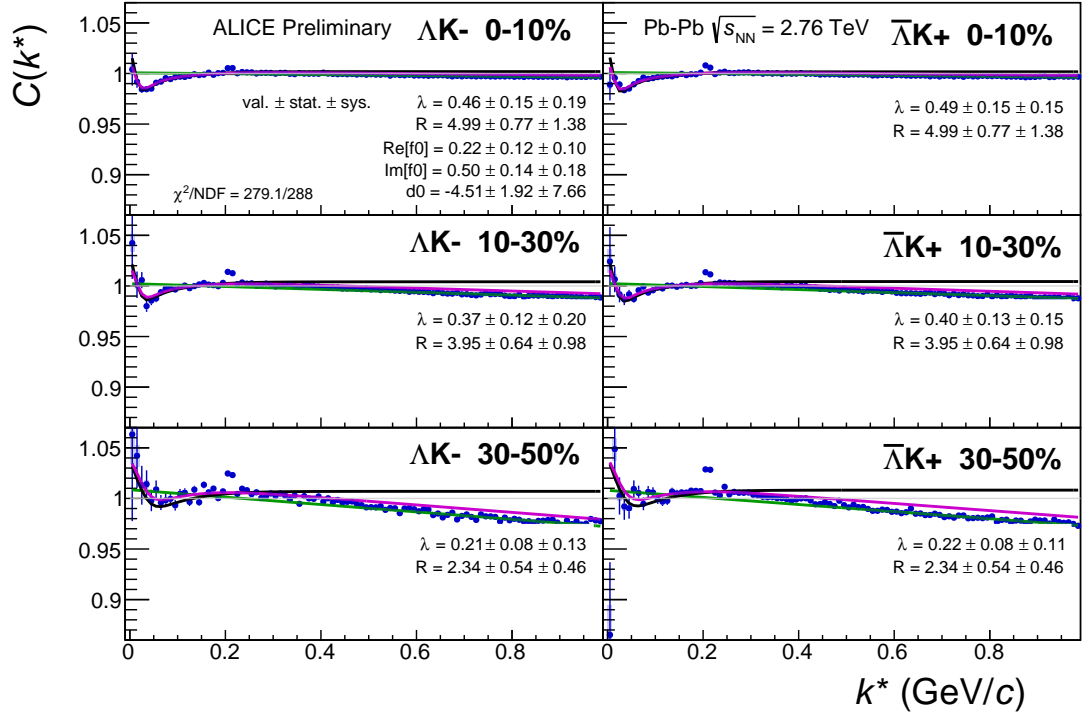
(b) Wide view ($k^* \lesssim 1.0$ GeV/c)

Fig. 4: Fits, with NO residual correlations included, to the ΛK^- (left) with $\bar{\Lambda} K^+$ (right) data for the centralities 0-10% (top), 10-30% (middle), and 30-50% (bottom). The lines represent the statistical errors, while the boxes represent the systematic errors. Each has unique λ and normalization parameters. The radii are shared amongst like centralities; the scattering parameters ($\mathbb{R} f_0$, $\mathbb{I} f_0$, d_0) are shared amongst all. The black solid line represents the "raw" fit, i.e. not corrected for momentum resolution effects nor non-flat background. The green line shows the fit to the non-flat background. The purple points show the fit after momentum resolution and non-flat background corrections have been applied. The initial values of the parameters is listed, as well as the final fit values with uncertainties.

Fit Results $\Lambda(\bar{\Lambda})K_S^0$						
		Fit Parameters				
Pair Type	Centrality	λ	R	$\mathbb{R}f_0$	$\mathbb{I}f_0$	d_0
ΛK_S^0	0-10%		3.024 ± 0.541 (stat.) ± 0.329 (sys.)			
	10-30%		2.270 ± 0.413 (stat.) ± 0.324 (sys.)			
	30-50%	0.400 ± 0.187 (stat.) ± 0.116 (sys.)	1.669 ± 0.307 (stat.) ± 0.280 (sys.)	-0.157 ± 0.031 (stat.) ± 0.043 (sys.)	0.176 ± 0.077 (stat.) ± 0.059 (sys.)	3.566 ± 0.947 (stat.) ± 2.836 (sys.)
$\bar{\Lambda} K_S^0$	0-10%		3.024 ± 0.541 (stat.) ± 0.329 (sys.)			
	10-30%		2.270 ± 0.413 (stat.) ± 0.324 (sys.)			
	30-50%		1.669 ± 0.307 (stat.) ± 0.280 (sys.)			

Table 1: Fit Results $\Lambda(\bar{\Lambda})K_S^0$, with NO residual correlations included. Each pair is fit simultaneously with its conjugate (ie. ΛK_S^0 with $\bar{\Lambda}K_S^0$) across all centralities (0-10%, 10-30%, 30-50%), for a total of 6 simultaneous analyses in the fit. Each analysis has a unique λ and normalization parameter. The radii are shared between analyses of like centrality, as these should have similar source sizes. The scattering parameters ($\mathbb{R}f_0$, $\mathbb{I}f_0$, d_0) are shared amongst all. The fit is done on the data with only statistical error bars. The errors marked as "stat." are those returned by MINUIT. The errors marked as "sys." are those which result from my systematic analysis (as outlined in Section **??**).

Fit Results $\Lambda(\bar{\Lambda})K^\pm$						
		Fit Parameters				
Pair Type	Centrality	λ	R	$\mathbb{R}f_0$	$\mathbb{I}f_0$	d_0
ΛK^+	0-10%	0.379 ± 0.085 (stat.) ± 0.220 (sys.)	4.045 ± 0.381 (stat.) ± 0.830 (sys.)			
	10-30%	0.485 ± 0.129 (stat.) ± 0.241 (sys.)	3.923 ± 0.454 (stat.) ± 0.663 (sys.)			
	30-50%	0.639 ± 0.195 (stat.) ± 0.204 (sys.)	3.717 ± 0.554 (stat.) ± 0.420 (sys.)	-0.687 ± 0.160 (stat.) ± 0.223 (sys.)	0.391 ± 0.143 (stat.) ± 0.111 (sys.)	0.639 ± 0.534 (stat.) ± 1.621 (sys.)
$\bar{\Lambda} K^-$	0-10%	0.371 ± 0.083 (stat.) ± 0.217 (sys.)	4.045 ± 0.381 (stat.) ± 0.830 (sys.)			
	10-30%	0.411 ± 0.111 (stat.) ± 0.201 (sys.)	3.923 ± 0.454 (stat.) ± 0.663 (sys.)			
	30-50%	0.616 ± 0.192 (stat.) ± 0.203 (sys.)	3.717 ± 0.554 (stat.) ± 0.420 (sys.)			
ΛK^-	0-10%	0.453 ± 0.162 (stat.) ± 0.186 (sys.)	4.787 ± 0.788 (stat.) ± 1.375 (sys.)			
	10-30%	0.395 ± 0.149 (stat.) ± 0.198 (sys.)	4.001 ± 0.719 (stat.) ± 0.978 (sys.)			
	30-50%	0.199 ± 0.077 (stat.) ± 0.132 (sys.)	2.112 ± 0.517 (stat.) ± 0.457 (sys.)	0.183 ± 0.134 (stat.) ± 0.095 (sys.)	0.453 ± 0.181 (stat.) ± 0.184 (sys.)	-5.292 ± 2.895 (stat.) ± 7.658 (sys.)
$\bar{\Lambda} K^+$	0-10%	0.479 ± 0.170 (stat.) ± 0.152 (sys.)	4.787 ± 0.788 (stat.) ± 1.375 (sys.)			
	10-30%	0.491 ± 0.179 (stat.) ± 0.148 (sys.)	4.001 ± 0.719 (stat.) ± 0.978 (sys.)			
	30-50%	0.224 ± 0.083 (stat.) ± 0.106 (sys.)	2.112 ± 0.517 (stat.) ± 0.457 (sys.)			

Table 2: Fit Results $\Lambda(\bar{\Lambda})K^\pm$, with NO residual correlations included. Each pair is fit simultaneously with its conjugate (ie. ΛK^+ with $\bar{\Lambda}K^-$ and ΛK^- with $\bar{\Lambda}K^+$) across all centralities (0-10%, 10-30%, 30-50%), for a total of 6 simultaneous analyses in the fit. Each analysis has a unique λ and normalization parameter. The radii are shared between analyses of like centrality, as these should have similar source sizes. The scattering parameters ($\mathbb{R}f_0$, $\mathbb{I}f_0$, d_0) are shared amongst all. The fit is done on the data with only statistical error bars. The errors marked as "stat." are those returned by MINUIT. The errors marked as "sys." are those which result from my systematic analysis (as outlined in Section **??**).

Fit Parameters (value $\pm$ statistical error $\pm$ systematic error)

Pair Type	Centrality	R		
ΛK^+ & $\bar{\Lambda}K^-$	0-10%	$4.04 \pm 0.38 \pm 0.83$		
	10-30%	$3.92 \pm 0.45 \pm 0.66$		
	30-50%	$3.72 \pm 0.55 \pm 0.42$		
		$\Re f_0$	$\Im f_0$	d_0
		$-0.69 \pm 0.16 \pm 0.22$	$0.39 \pm 0.14 \pm 0.11$	$0.64 \pm 0.53 \pm 1.62$
ΛK^- & $\bar{\Lambda}K^+$	0-10%	$4.79 \pm 0.79 \pm 1.38$		
	10-30%	$4.00 \pm 0.72 \pm 0.98$		
	30-50%	$2.11 \pm 0.52 \pm 0.46$		
		$\Re f_0$	$\Im f_0$	d_0
		$0.18 \pm 0.13 \pm 0.10$	$0.45 \pm 0.18 \pm 0.18$	$-5.29 \pm 2.94 \pm 7.66$
ΛK_S^0 & $\bar{\Lambda}K_S^0$	0-10%	$3.02 \pm 0.54 \pm 0.33$		
	10-30%	$2.27 \pm 0.41 \pm 0.32$		
	30-50%	$1.67 \pm 0.30 \pm 0.28$		
		$\Re f_0$	$\Im f_0$	d_0
		$-0.16 \pm 0.03 \pm 0.04$	$0.18 \pm 0.08 \pm 0.06$	$3.57 \pm 0.95 \pm 2.84$

| Fit Parameters (value $\pm$ statistical error $\pm$ systematic error)				
Pair Type	**Centrality**	**R**	**Scattering Parameters**	
ΛK^+ & $\bar{\Lambda} K^-$	0-10%	$4.04 \pm 0.38 \pm 0.83$	$\Re f_0$	$-0.69 \pm 0.16 \pm 0.22$
	10-30%	$3.92 \pm 0.45 \pm 0.66$	$\Im f_0$	$0.39 \pm 0.14 \pm 0.11$
	30-50%	$3.72 \pm 0.55 \pm 0.42$	d_0	$0.64 \pm 0.53 \pm 1.62$
ΛK^- & $\bar{\Lambda} K^+$	0-10%	$4.79 \pm 0.79 \pm 1.38$	$\Re f_0$	$0.18 \pm 0.13 \pm 0.10$
	10-30%	$4.00 \pm 0.72 \pm 0.98$	$\Im f_0$	$0.45 \pm 0.18 \pm 0.18$
	30-50%	$2.11 \pm 0.52 \pm 0.46$	d_0	$-5.29 \pm 2.94 \pm 7.66$
ΛK^0_S & $\bar{\Lambda} K^0_S$	0-10%	$3.02 \pm 0.54 \pm 0.33$	$\Re f_0$	$-0.16 \pm 0.03 \pm 0.04$
	10-30%	$2.27 \pm 0.41 \pm 0.32$	$\Im f_0$	$0.18 \pm 0.08 \pm 0.06$
	30-50%	$1.67 \pm 0.30 \pm 0.28$	d_0	$3.57 \pm 0.95 \pm 2.84$

Fit Parameters (**value ± statistical error ± systematic error**)

Pair Type	Centrality	R	$\Re f_0$	$\Im f_0$	d_0
ΛK^+ & $\bar{\Lambda}K^-$	0-10%	$4.04 \pm 0.38 \pm 0.83$	$-0.69 \pm 0.16 \pm 0.22$	$0.39 \pm 0.14 \pm 0.11$	$0.64 \pm 0.53 \pm 1.62$
	10-30%	$3.92 \pm 0.45 \pm 0.66$			
	30-50%	$3.72 \pm 0.55 \pm 0.42$			
ΛK^- & $\bar{\Lambda}K^+$	0-10%	$4.79 \pm 0.79 \pm 1.38$	$0.18 \pm 0.13 \pm 0.10$	$0.45 \pm 0.18 \pm 0.18$	$-5.29 \pm 2.94 \pm 7.66$
	10-30%	$4.00 \pm 0.72 \pm 0.98$			
	30-50%	$2.11 \pm 0.52 \pm 0.46$			
ΛK_S^0 & $\bar{\Lambda}K_S^0$	0-10%	$3.02 \pm 0.54 \pm 0.33$	$-0.16 \pm 0.03 \pm 0.04$	$0.18 \pm 0.08 \pm 0.06$	$3.57 \pm 0.95 \pm 2.84$
	10-30%	$2.27 \pm 0.41 \pm 0.32$			
	30-50%	$1.67 \pm 0.30 \pm 0.28$			

Figure 19 shows extracted R_{inv} parameters as a function of tranverse mass (m_{T}) for various pair systems over several centralities. The published ALICE data [?] is shown with transparent, open symbols. The new ΛK results are shown with opaque, filled symbols. The radii shown an increasing size with increasing centrality, as is expected from the simple geometric picture of the collisions. The radii decrease in size with increasing m_{T}, and we see an approximate scaling of the radii with transverse mass, as is expected in the presence of collective flow in the system.

ALI−PREL−125938
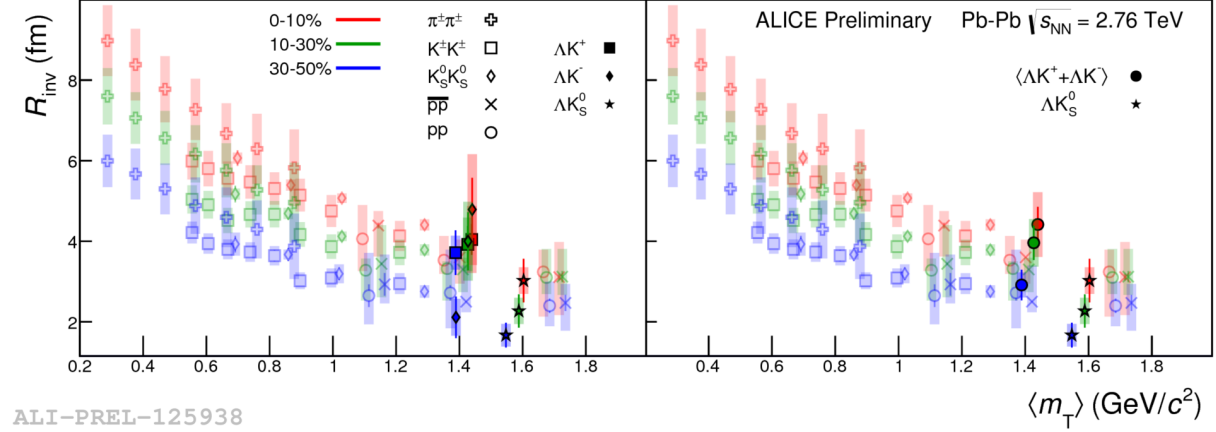
Fig. 5: No residual correlations in ΛK fits. Extracted fit R_{inv} parameters as a function of pair transverse mass (m_{T}) for various pair systems over several centralities. The ALICE published data [?] is shown with transparent, open symbols. The new ΛK results are shown with opaque, filled symbols. In the left, the ΛK$^+$ (with it's conjugate pair) results are shown separately from the ΛK$^-$ (with it's conjugate pair) results. In the right, all ΛK$^\pm$ results are averaged.

0.1.2   Results: ΛK_S^0 and $\Lambda K^{\pm}$: 3 Residual Correlations Included in Fit
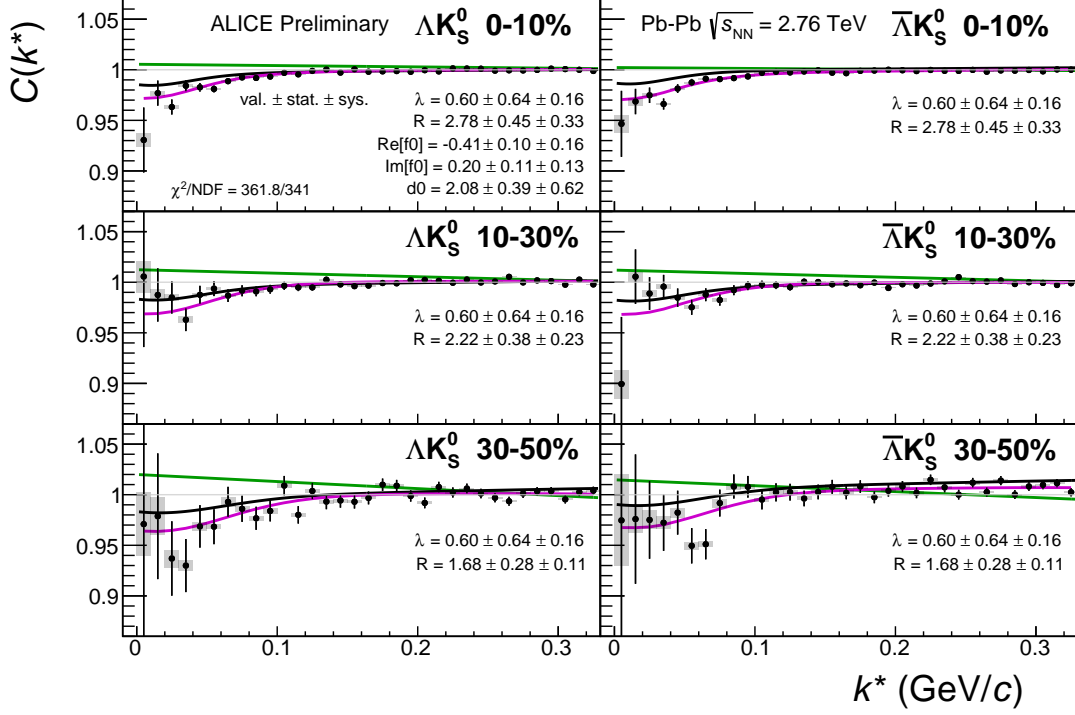
(a) Signal region view ($k^* \lesssim 0.3$ GeV/c)
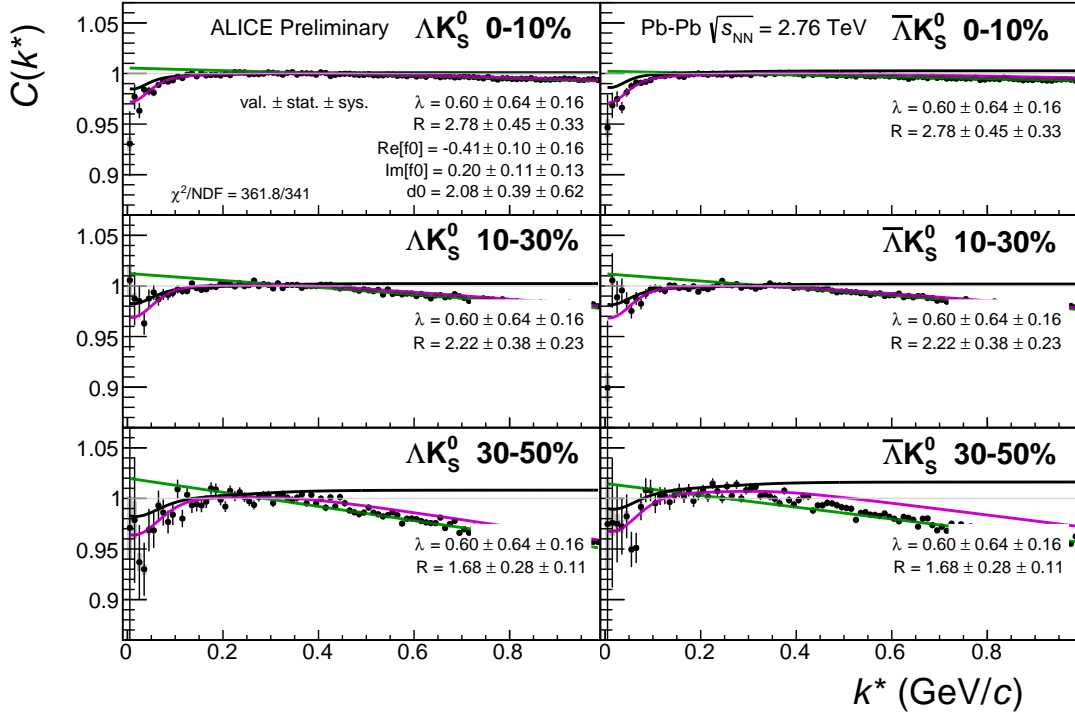
(b) Wide view ($k^* \lesssim 1.0$ GeV/c)

Fig. 6: Fits, with 3 residual correlations included, to the ΛK_S^0 (left) and $\bar{\Lambda} K_S^0$ (right) data for the centralities 0-10% (top), 10-30% (middle), and 30-50% (bottom). The lines represent the statistical errors, while the boxes represent the systematic errors. Each has unique λ and normalization parameters. The radii are shared amongst like centralities; the scattering parameters ($\mathbb{R}f_0$, $\mathbb{I}f_0$, d_0) are shared amongst all. The black solid line represents the "raw" fit, i.e. not corrected for momentum resolution effects nor non-flat background. The green line shows the fit to the non-flat background. The purple points show the fit after momentum resolution and non-flat background corrections have been applied. The initial values of the parameters is listed, as well as the final fit values with uncertainties. Here, R was restricted to [2.,10.] and λ was restricted to [0.1,0.8].

Fig. 7: Fits, with 3 residual correlations included and shown, to the ΛK_S^0 (left) and $\bar{\Lambda} K_S^0$ (right) data for the centralities 0-10% (top), 10-30% (middle), and 30-50% (bottom). The three parent pairs used for the residual correction to the ΛK_S^0 ($\bar{\Lambda} K_S^0$) fit are $\Sigma^0 K_S^0$, $\Xi^0 K_S^0$, and $\Xi^- K_S^0$ ($\bar{\Sigma}^0 K_S^0$, $\bar{\Xi}^0 K_S^0$, and $\bar{\Xi}^+ K_S^0$).
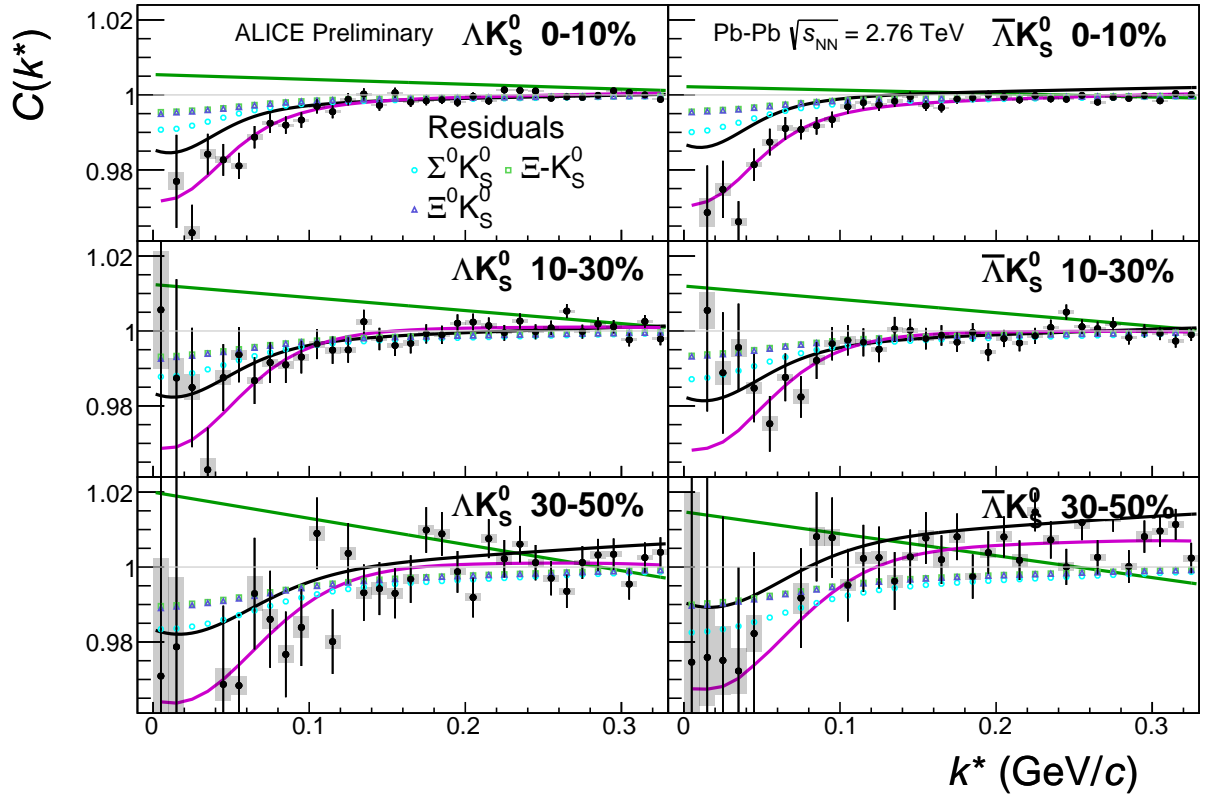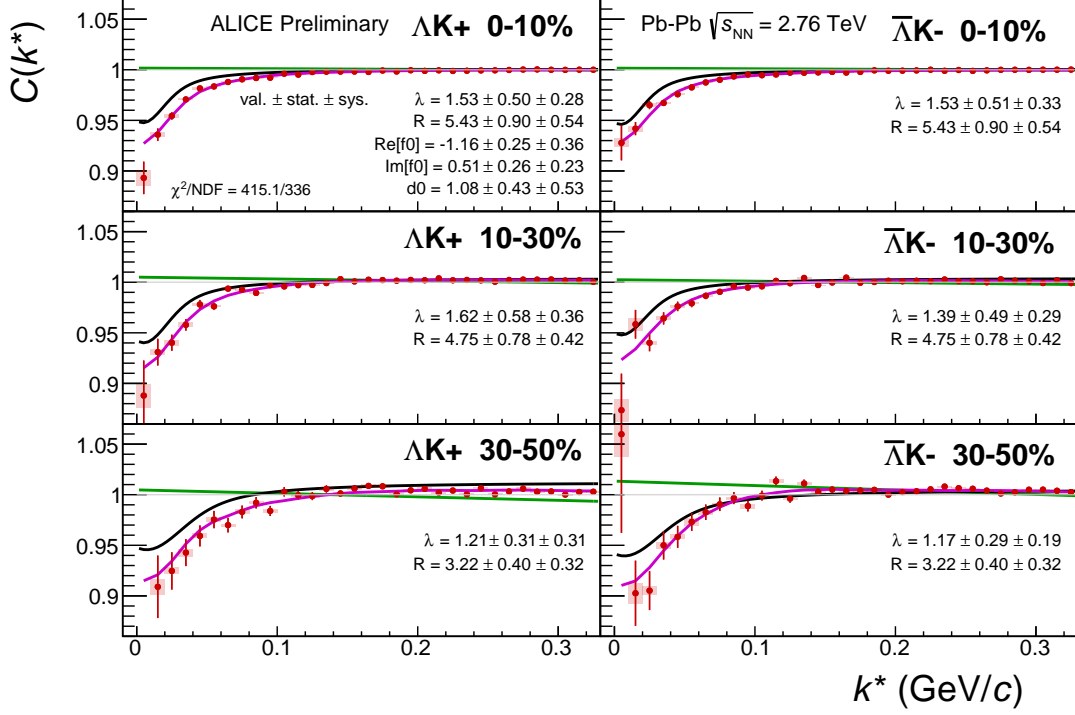
(a) Signal region view ($k^* \lesssim 0.3$ GeV/c)
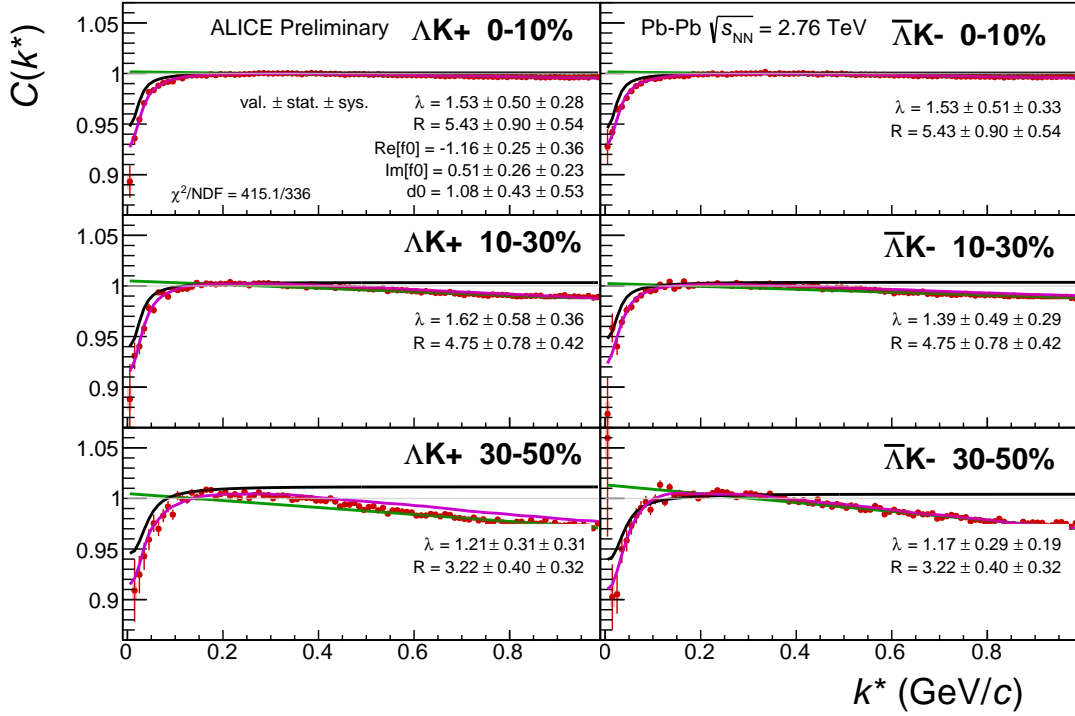

(b) Wide view ($k^* \lesssim 1.0$ GeV/c)

Fig. 8: Fits, with 3 residual correlations included, to the ΛK^+ (left) and $\bar{\Lambda} K^-$ (right) data for the centralities 0-10% (top), 10-30% (middle), and 30-50% (bottom). The lines represent the statistical errors, while the boxes represent the systematic errors. Each has unique λ and normalization parameters. The radii are shared amongst like centralities; the scattering parameters ($\mathbb{R}f_0$, $\mathbb{I}f_0$, d_0) are shared amongst all. The black solid line represents the "raw" fit, i.e. not corrected for momentum resolution effects nor non-flat background. The green line shows the fit to the non-flat background. The purple points show the fit after momentum resolution and non-flat background corrections have been applied. The initial values of the parameters is listed, as well as the final fit values with uncertainties.

Fig. 9: Fits, with 3 residual correlations included and shown, to the ΛK^+ (left) and $\bar{\Lambda} K^-$ (right) data for the centralities 0-10% (top), 10-30% (middle), and 30-50% (bottom). The three parent pairs used for the residual correction to the ΛK^+ ($\bar{\Lambda} K^-$) fit are $\Sigma^0 K^+$, $\Xi^0 K^+$, and $\Xi^- K^+$ ($\bar{\Sigma}^0 K^-$, $\bar{\Xi}^0 K^-$, and $\bar{\Xi}^+ K^-$).
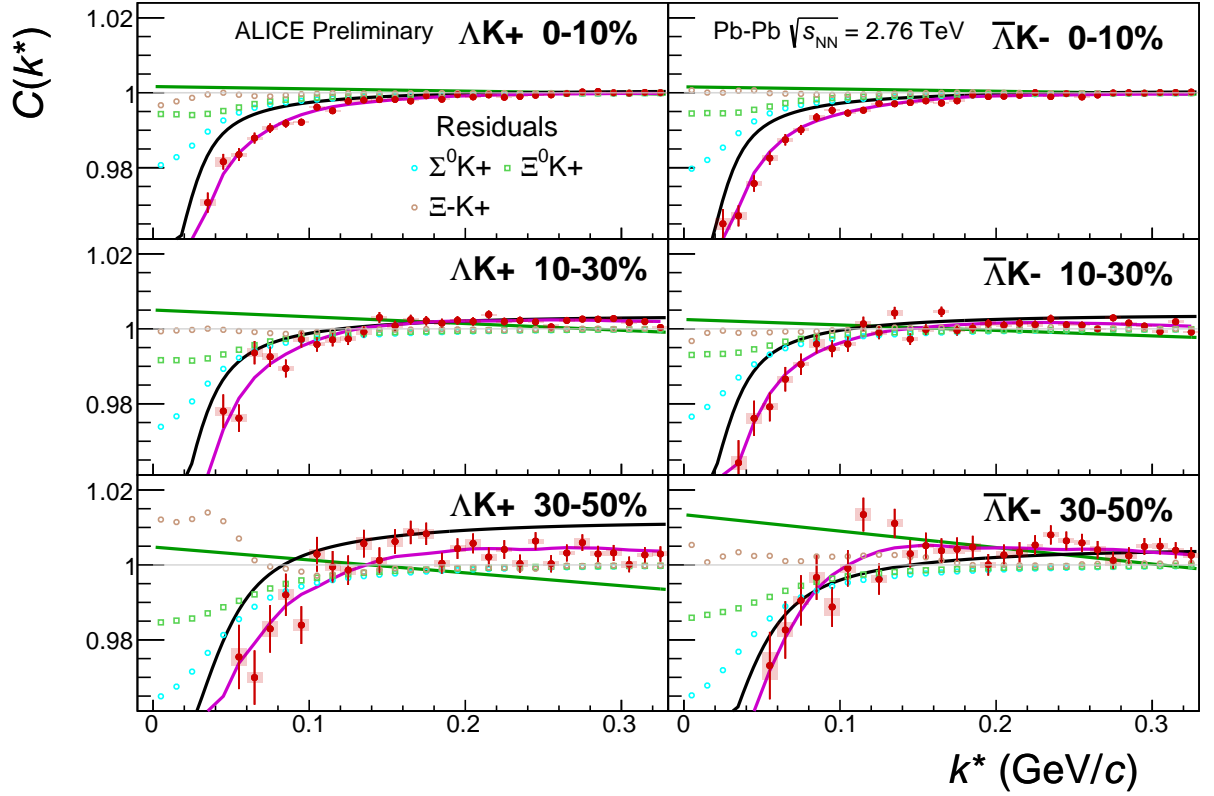
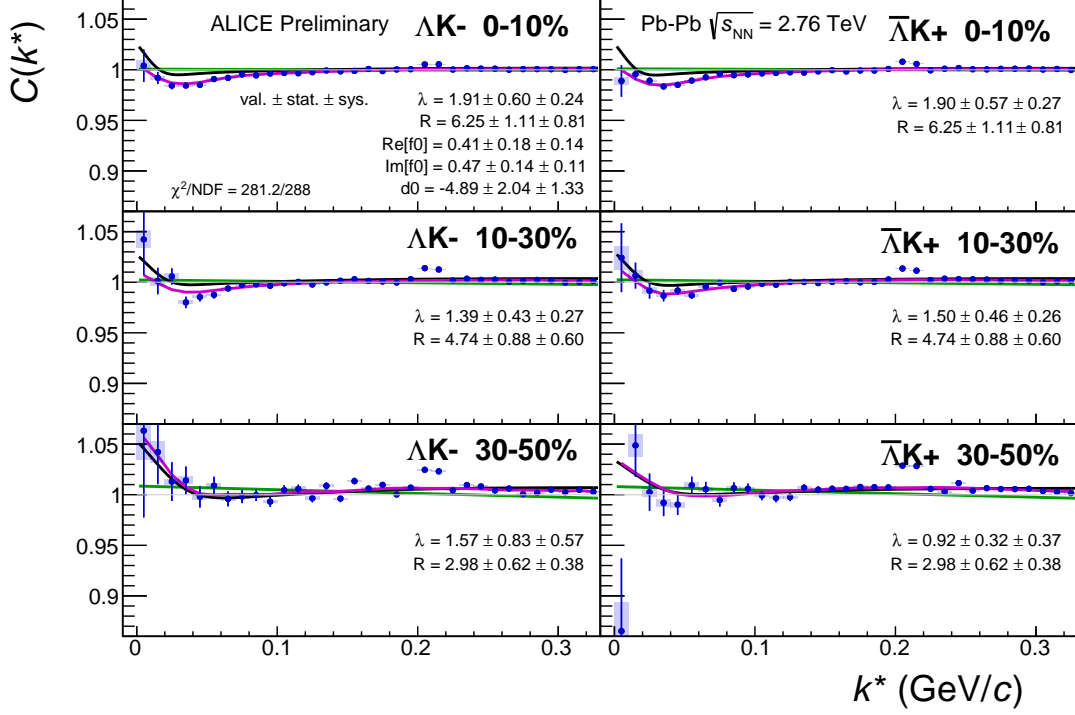(a) Signal region view ($k^* \lesssim 0.3$ GeV/c)
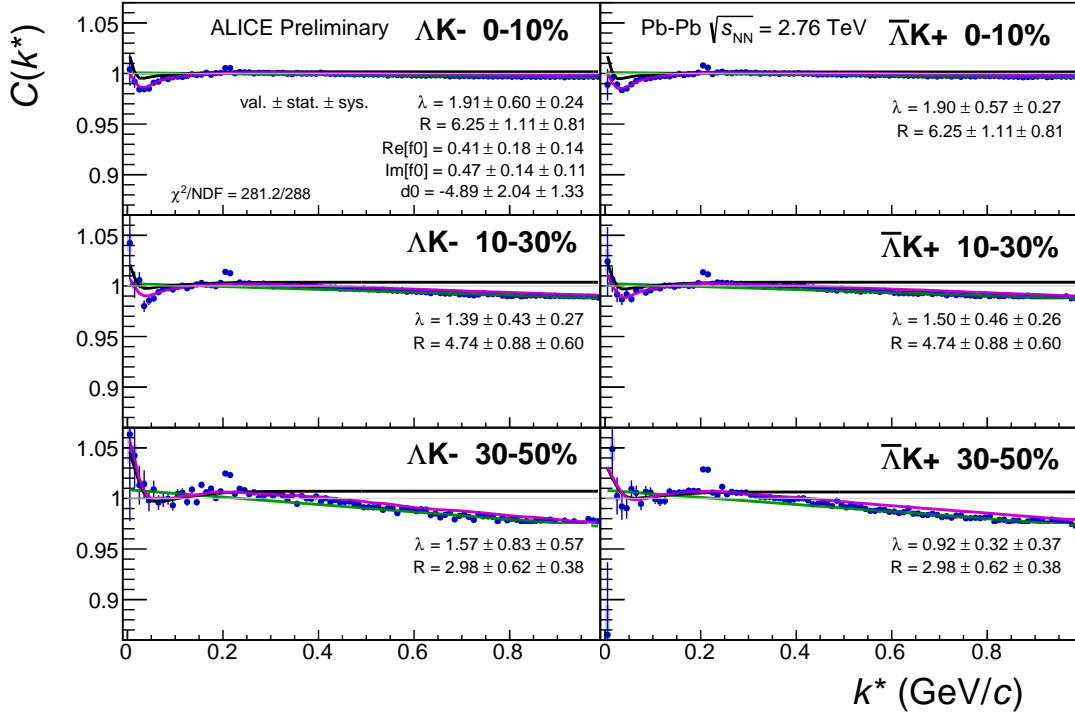

(b) Wide view ($k^* \lesssim 1.0$ GeV/c)

Fig. 10: Fits, with 3 residual correlations included, to the ΛK^- (left) with $\bar{\Lambda}K^+$ (right) data for the centralities 0-10% (top), 10-30% (middle), and 30-50% (bottom). The lines represent the statistical errors, while the boxes represent the systematic errors. Each has unique λ and normalization parameters. The radii are shared amongst like centralities; the scattering parameters ($\mathbb{R}f_0$, $\mathbb{I}f_0$, d_0) are shared amongst all. The black solid line represents the "raw" fit, i.e. not corrected for momentum resolution effects nor non-flat background. The green line shows the fit to the non-flat background. The purple points show the fit after momentum resolution and non-flat background corrections have been applied. The initial values of the parameters is listed, as well as the final fit values with uncertainties.

Fig. 11: Fits, with 3 residual correlations included and shown, to the ΛK^- (left) and $\bar{\Lambda}K^+$ (right) data for the centralities 0-10% (top), 10-30% (middle), and 30-50% (bottom). The three parent pairs used for the residual correction to the ΛK^- ($\bar{\Lambda}K^+$) fit are $\Sigma^0 K^-$, $\Xi^0 K^-$, and $\Xi^- K^-$ ($\bar{\Sigma}^0 K^+$, $\bar{\Xi}^0 K^+$, and $\bar{\Xi}^+ K^+$).
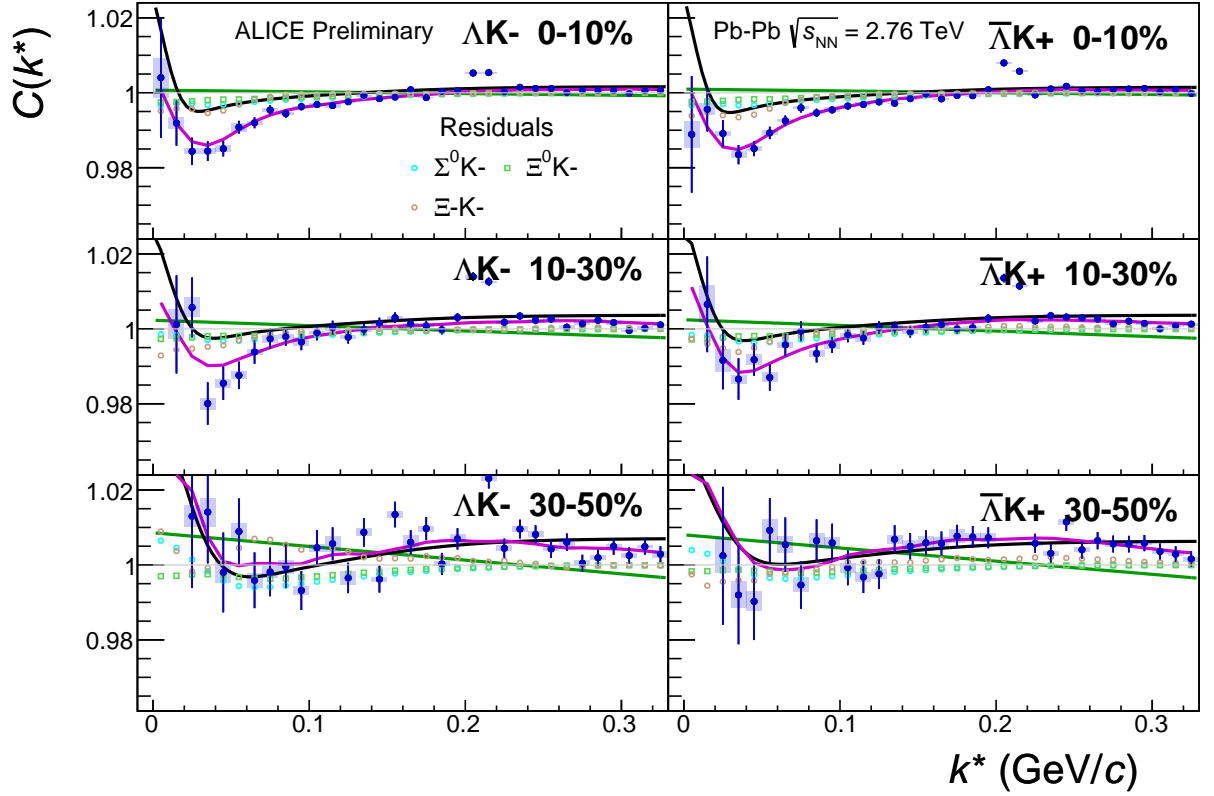
Fit Results $\Lambda(\bar{\Lambda})K_S^0$

System	Centrality	λ	R	$\mathbb{R}f_0$	$\mathbb{I}f_0$	d_0
			Fit Parameters			
	0-10%		2.78 ± 0.45 (stat.) ± 0.33 (sys.)			
ΛK_S^0 & $\bar{\Lambda}K_S^0$	10-30%	0.60 ± 0.63 (stat.) ± 0.16 (sys.)	2.22 ± 0.37 (stat.) ± 0.23 (sys.)	-0.41 ± 0.10 (stat.) ± 0.16 (sys.)	0.20 ± 0.10 (stat.) ± 0.13 (sys.)	2.08 ± 0.39 (stat.) ± 0.62 (sys.)
	30-50%		1.68 ± 0.28 (stat.) ± 0.11 (sys.)			

Table 3: Fit Results $\Lambda(\bar{\Lambda})K_S^0$, with 3 residual correlations included. Each pair is fit simultaneously with its conjugate (ie. ΛK_S^0 with $\bar{\Lambda}K_S^0$) across all centralities (0-10%, 10-30%, 30-50%), for a total of 6 simultaneous analyses in the fit. Each analysis has a unique λ and normalization parameter. The radii are shared between analyses of like centrality, as these should have similar source sizes. The scattering parameters ($\mathbb{R}f_0$, $\mathbb{I}f_0$, d_0) are shared amongst all. The fit is done on the data with only statistical error bars. The errors marked as "stat." are those returned by MINUIT. The errors marked as "sys." are those which result from my systematic analysis (as outlined in Section **??**).

Fit Results $\Lambda(\bar{\Lambda})K^{\pm}$

System	Centrality	Pair Type	λ	R	$\mathbb{R}f_0$	$\mathbb{I}f_0$	d_0
ΛK^+ & $\bar{\Lambda}K^-$	0-10%	ΛK^+	1.53 ± 0.56 (stat.) ± 0.28 (sys.)	5.43 ± 1.09 (stat.) ± 0.54 (sys.)	-1.16 ± 0.25 (stat.) ± 0.36 (sys.)	0.51 ± 0.28 (stat.) ± 0.23 (sys.)	1.08 ± 0.43 (stat.) ± 0.53 (sys.)
		$\bar{\Lambda}K^-$	1.53 ± 0.57 (stat.) ± 0.33 (sys.)				
	10-30%	ΛK^+	1.62 ± 0.58 (stat.) ± 0.36 (sys.)	4.75 ± 0.82 (stat.) ± 0.42 (sys.)			
		$\bar{\Lambda}K^-$	1.39 ± 0.49 (stat.) ± 0.29 (sys.)				
	30-50%	ΛK^+	1.21 ± 0.31 (stat.) ± 0.31 (sys.)	3.22 ± 0.41 (stat.) ± 0.32 (sys.)			
		$\bar{\Lambda}K^-$	1.17 ± 0.30 (stat.) ± 0.19 (sys.)				
ΛK^- & $\bar{\Lambda}K^+$	0-10%	ΛK^-	1.91 ± 0.60 (stat.) ± 0.24 (sys.)	6.25 ± 1.08 (stat.) ± 0.81 (sys.)	0.41 ± 0.18 (stat.) ± 0.14 (sys.)	0.47 ± 0.15 (stat.) ± 0.11 (sys.)	-4.89 ± 2.16 (stat.) ± 1.33 (sys.)
		$\bar{\Lambda}K^+$	1.90 ± 0.57 (stat.) ± 0.27 (sys.)				
	10-30%	ΛK^-	1.39 ± 0.43 (stat.) ± 0.27 (sys.)	4.74 ± 0.86 (stat.) ± 0.60 (sys.)			
		$\bar{\Lambda}K^+$	1.50 ± 0.46 (stat.) ± 0.26 (sys.)				
	30-50%	ΛK^-	1.57 ± 0.82 (stat.) ± 0.57 (sys.)	2.98 ± 0.61 (stat.) ± 0.38 (sys.)			
		$\bar{\Lambda}K^+$	0.92 ± 0.31 (stat.) ± 0.37 (sys.)				

Table 4: Fit Results $\Lambda(\bar{\Lambda})K^{\pm}$, with 3 residual correlations included. Each pair is fit simultaneously with its conjugate (ie. ΛK^+ with $\bar{\Lambda}K^-$ and ΛK^- with $\bar{\Lambda}K^+$) across all centralities (0-10%, 10-30%, 30-50%), for a total of 6 simultaneous analyses in the fit. Each analysis has a unique λ and normalization parameter. The radii are shared between analyses of like centrality, as these should have similar source sizes. The scattering parameters ($\mathbb{R}f_0$, $\mathbb{I}f_0$, d_0) are shared amongst all. The fit is done on the data with only statistical error bars. The errors marked as "stat." are those returned by MINUIT. The errors marked as "sys." are those which result from my systematic analysis (as outlined in Section **??**).

		Fit Parameters (value $\pm$ statistical error $\pm$ systematic error)		
Pair Type	**Centrality**	**R**		
ΛK^+ **&** $\bar{\Lambda}K^-$	0-10%	$5.43 \pm 1.09 \pm 0.54$		
	10-30%	$4.75 \pm 0.82 \pm 0.42$		
	30-50%	$3.22 \pm 0.41 \pm 0.32$		
		$\mathfrak{R}f_0$	$\mathfrak{I}f_0$	d_0
		$-1.16 \pm 0.25 \pm 0.36$	$0.51 \pm 0.28 \pm 0.23$	$1.08 \pm 0.43 \pm 0.53$
ΛK^- **&** $\bar{\Lambda}K^+$	0-10%	$6.25 \pm 1.08 \pm 0.81$		
	10-30%	$4.74 \pm 0.86 \pm 0.60$		
	30-50%	$2.98 \pm 0.61 \pm 0.38$		
		$\mathfrak{R}f_0$	$\mathfrak{I}f_0$	d_0
		$0.41 \pm 0.18 \pm 0.14$	$0.47 \pm 0.15 \pm 0.11$	$-4.89 \pm 2.16 \pm 1.33$
ΛK_S^0 **&** $\bar{\Lambda}K_S^0$	0-10%	$2.78 \pm 0.45 \pm 0.33$		
	10-30%	$2.22 \pm 0.37 \pm 0.23$		
	30-50%	$1.68 \pm 0.28 \pm 0.11$		
		$\mathfrak{R}f_0$	$\mathfrak{I}f_0$	d_0
		$-0.41 \pm 0.10 \pm 0.16$	$0.20 \pm 0.10 \pm 0.13$	$2.08 \pm 0.39 \pm 0.62$

Table 5: Fit Results $\Lambda(\bar{\Lambda})K^\pm$ and $\Lambda(\bar{\Lambda})K_S^0$, with 3 residual correlations included (λ parameters not shown). This table is a condensed version of Tables 3 and 4
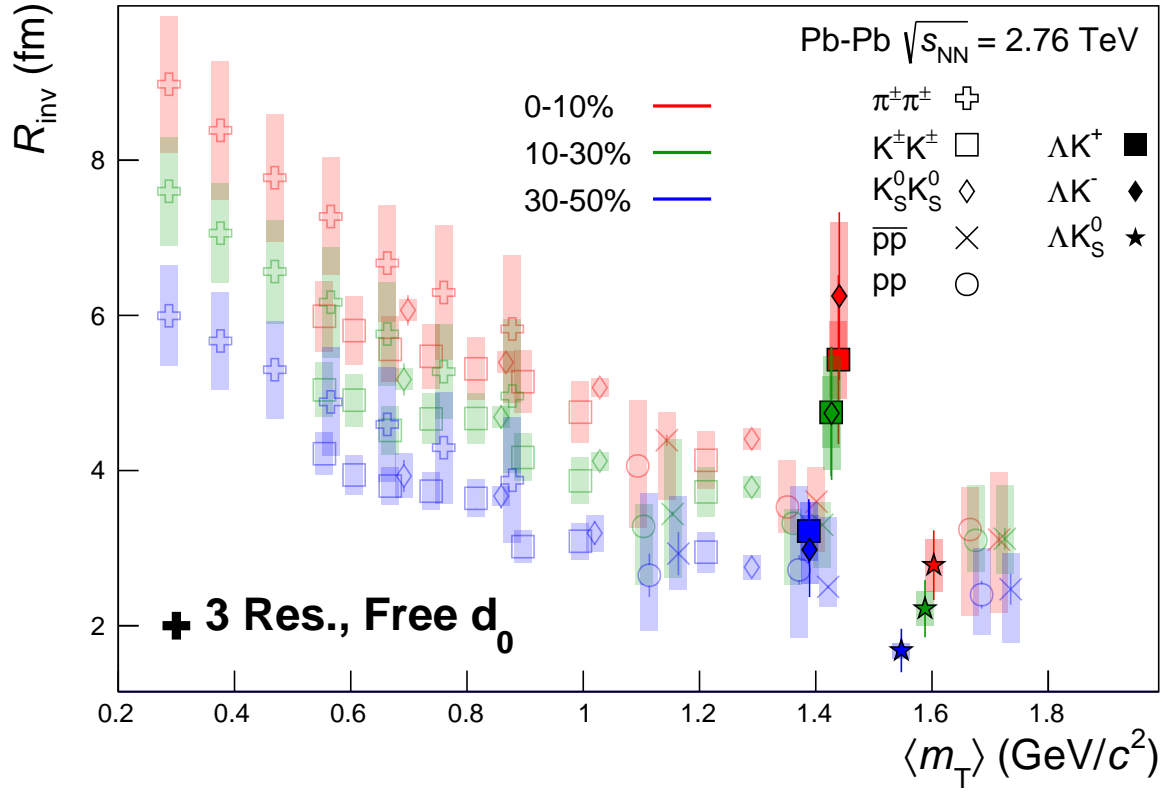
Fig. 12: 3 residual correlations in ΛK fits. Extracted fit R_{inv} parameters as a function of pair transverse mass (m_T) for various pair systems over several centralities. The ALICE published data [**?**] is shown with transparent, open symbols. The new ΛK results are shown with opaque, filled symbols. In the left, the ΛK^+ (with it's conjugate pair) results are shown separately from the ΛK^- (with it's conjugate pair) results. In the right, all $\Lambda K^{\pm}$ results are averaged.

Polynomial Bgds, THERM Bgds fit together

Centrality	System	Parameter	Methods			
			Separate	Share R	Share λ_{Conj}	Share Single λ
0-10%	ΛK^+	λ	1.70	2.18	2.16	1.92
	$\bar{\Lambda} K^-$	λ	1.72	2.21		
	ΛK^-	λ	2.20	2.10	1.91	
	$\bar{\Lambda} K^+$	λ	2.19	2.10		
	ΛK^+ & $\bar{\Lambda} K^-$	R	4.81	5.53	5.31	5.25
	ΛK^- & $\bar{\Lambda} K^+$	R	5.61			
10-30%	ΛK^+	λ	1.88	1.78	1.67	1.57
	$\bar{\Lambda} K^-$	λ	1.66	1.58		
	ΛK^-	λ	1.58	1.62	1.53	
	$\bar{\Lambda} K^+$	λ	1.67	1.71		
	ΛK^+ & $\bar{\Lambda} K^-$	R	4.38	4.37	4.22	4.26
	ΛK^- & $\bar{\Lambda} K^+$	R	4.20			
30-50%	ΛK^+	λ	1.44	1.30	1.18	1.20
	$\bar{\Lambda} K^-$	λ	1.33	1.21		
	ΛK^-	λ	1.80	2.05	1.22	
	$\bar{\Lambda} K^+$	λ	1.10	1.17		
	ΛK^+ & $\bar{\Lambda} K^-$	R	3.01	2.92	2.77	2.87
	ΛK^- & $\bar{\Lambda} K^+$	R	2.70			
	ΛK^+ & $\bar{\Lambda} K^-$	$\mathbb{R} f_0$	-0.88	-0.87	-0.83	-0.89
		$\mathbb{I} f_0$	0.28	0.33	0.29	0.34
		d_0	1.32	1.27	1.28	1.29
	ΛK^- & $\bar{\Lambda} K^+$	$\mathbb{R} f_0$	0.28	0.31	0.31	0.30
		$\mathbb{I} f_0$	0.35	0.37	0.40	0.39
		d_0	-5.75	-5.32	-4.81	-4.92

Table 6: Comparison: Polynomial non-flat background, THERMINATOR backgrounds fit together

Polynomial Bgds, THERM Bgds fit separate

Centrality	System	Parameter	Methods			
			Separate	Share R	Share λ_{Conj}	Share Single λ
0-10%	ΛK^+	λ	1.58	1.90	1.91	1.95
	$\bar{\Lambda}K^-$	λ	1.59	1.92		
	ΛK^-	λ	2.31	2.33	2.08	
	$\bar{\Lambda}K^+$	λ	2.29	2.31		
	ΛK^+ & $\bar{\Lambda}K^-$	R	4.93	5.37	5.12	4.97
	ΛK^- & $\bar{\Lambda}K^+$	R	5.20			
10-30%	ΛK^+	λ	1.70	1.59	1.52	1.57
	$\bar{\Lambda}K^-$	λ	1.50	1.41		
	ΛK^-	λ	1.67	1.77	1.65	
	$\bar{\Lambda}K^+$	λ	1.76	1.87		
	ΛK^+ & $\bar{\Lambda}K^-$	R	4.42	4.28	4.11	4.02
	ΛK^- & $\bar{\Lambda}K^+$	R	3.99			
30-50%	ΛK^+	λ	1.35	1.20	1.07	1.31
	$\bar{\Lambda}K^-$	λ	1.24	1.10		
	ΛK^-	λ	2.14	2.53	1.44	
	$\bar{\Lambda}K^+$	λ	1.29	1.41		
	ΛK^+ & $\bar{\Lambda}K^-$	R	3.10	2.93	2.73	2.83
	ΛK^- & $\bar{\Lambda}K^+$	R	2.64			
	ΛK^+ & $\bar{\Lambda}K^-$	$\mathbb{R}f_0$	-0.99	-0.96	-0.90	-0.83
		$\mathbb{I}f_0$	0.30	0.32	0.26	0.23
		d_0	1.14	1.09	1.10	1.08
	ΛK^- & $\bar{\Lambda}K^+$	$\mathbb{R}f_0$	0.23	0.27	0.27	0.28
		$\mathbb{I}f_0$	0.32	0.34	0.37	0.39
		d_0	-6.26	-5.79	-5.17	-4.87

Table 7: Comparison: Polynomial non-flat background, THERMINATOR backgrounds fit separately

### 0.1.3 Results: ΛK_S^0 and $\Lambda K^\pm$: 10 Residual Correlations Included in Fit

Linear Bgds

Centrality	System	Parameter	Methods			
			Separate	Share R	Share λ_{Conj}	Share Single λ
0-10%	ΛK^+	λ	1.53	1.88	1.78	1.66
	$\bar{\Lambda}K^-$	λ	1.54	1.89		
	ΛK^-	λ	1.91	1.81	1.60	
	$\bar{\Lambda}K^+$	λ	1.90	1.81		
	ΛK^+ & $\bar{\Lambda}K^-$	R	5.43	6.10	5.76	5.81
	ΛK^- & $\bar{\Lambda}K^+$	R	6.26			
10-30%	ΛK^+	λ	1.62	1.61	1.44	1.34
	$\bar{\Lambda}K^-$	λ	1.39	1.39		
	ΛK^-	λ	1.39	1.40	1.30	
	$\bar{\Lambda}K^+$	λ	1.50	1.50		
	ΛK^+ & $\bar{\Lambda}K^-$	R	4.75	4.82	4.58	4.61
	ΛK^- & $\bar{\Lambda}K^+$	R	4.74			
30-50%	ΛK^+	λ	1.21	1.13	1.04	1.02
	$\bar{\Lambda}K^-$	λ	1.17	1.10		
	ΛK^-	λ	1.57	1.70	1.00	
	$\bar{\Lambda}K^+$	λ	0.92	0.96		
	ΛK^+ & $\bar{\Lambda}K^-$	R	3.22	3.15	2.98	3.06
	ΛK^- & $\bar{\Lambda}K^+$	R	2.98			
	ΛK^+ & $\bar{\Lambda}K^-$	$\mathbb{R}f_0$	-1.16	-1.13	-1.12	-1.19
		$\mathbb{I}f_0$	0.50	0.58	0.50	0.58
		d_0	1.08	1.04	1.00	1.11
	ΛK^- & $\bar{\Lambda}K^+$	$\mathbb{R}f_0$	0.41	0.44	0.44	0.43
		$\mathbb{I}f_0$	0.47	0.49	0.54	0.52
		d_0	-4.89	-4.49	-4.04	-4.21

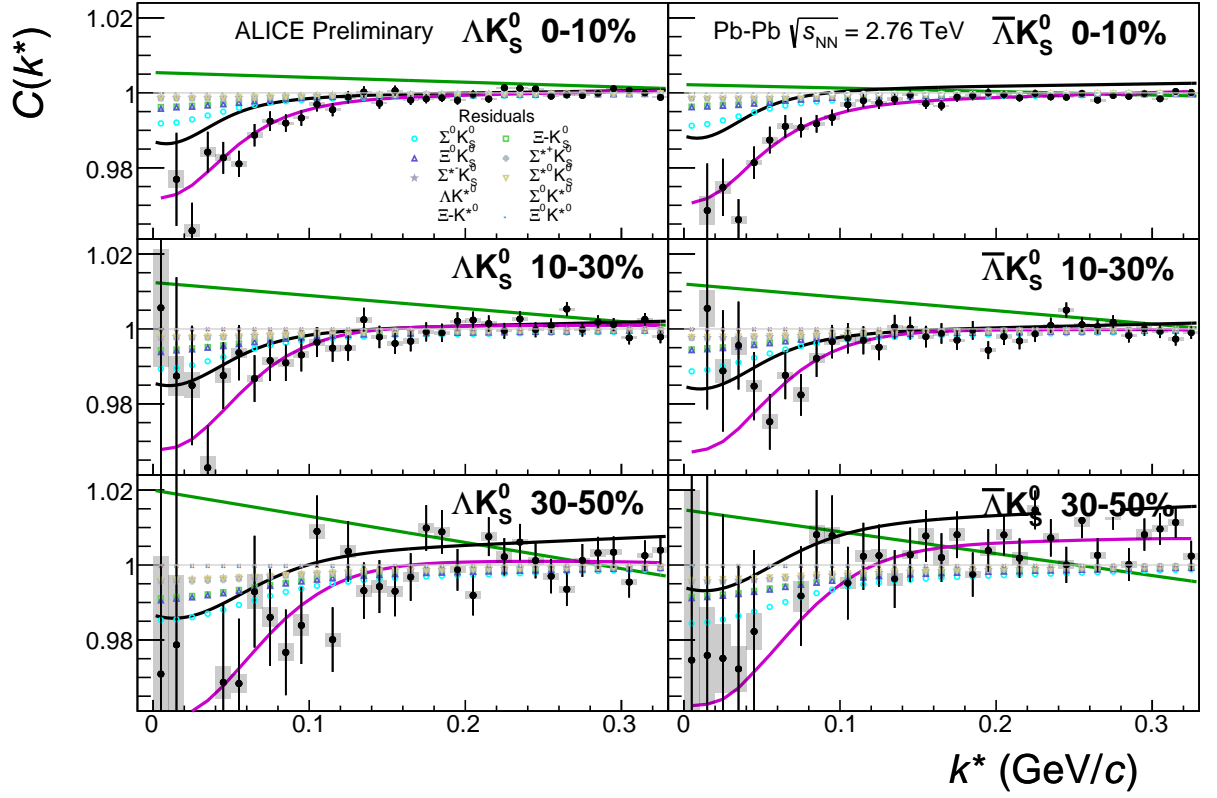Table 8: Comparison: Linear non-flat background
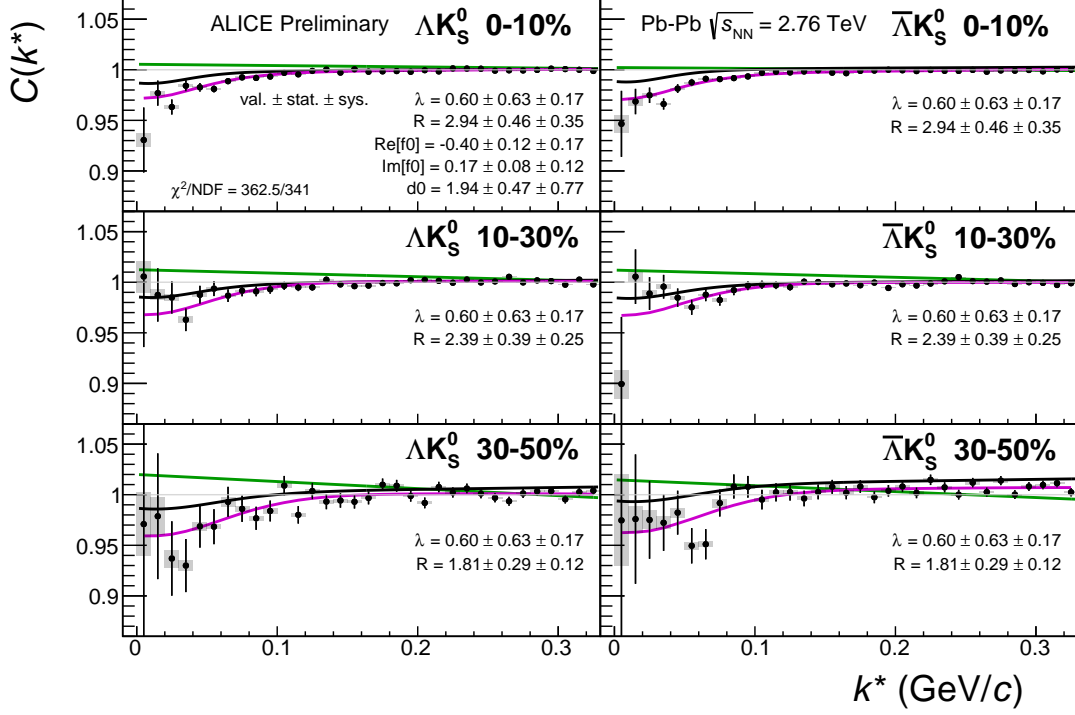
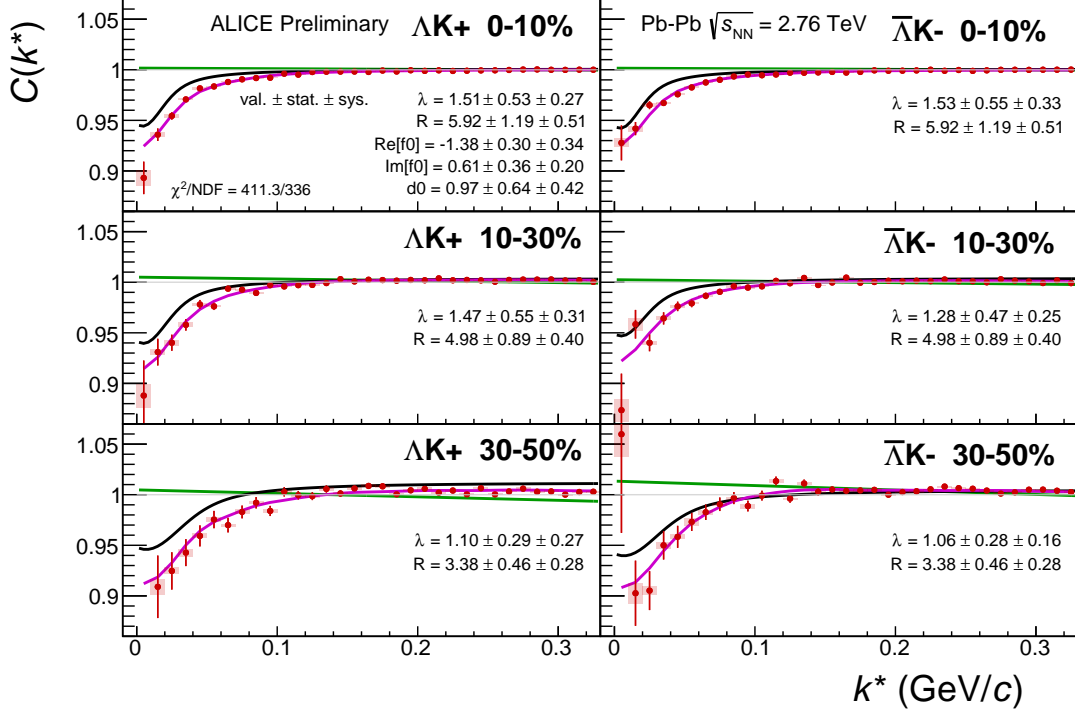(a) Signal region view ($k^* \lesssim 0.3$ GeV/c)
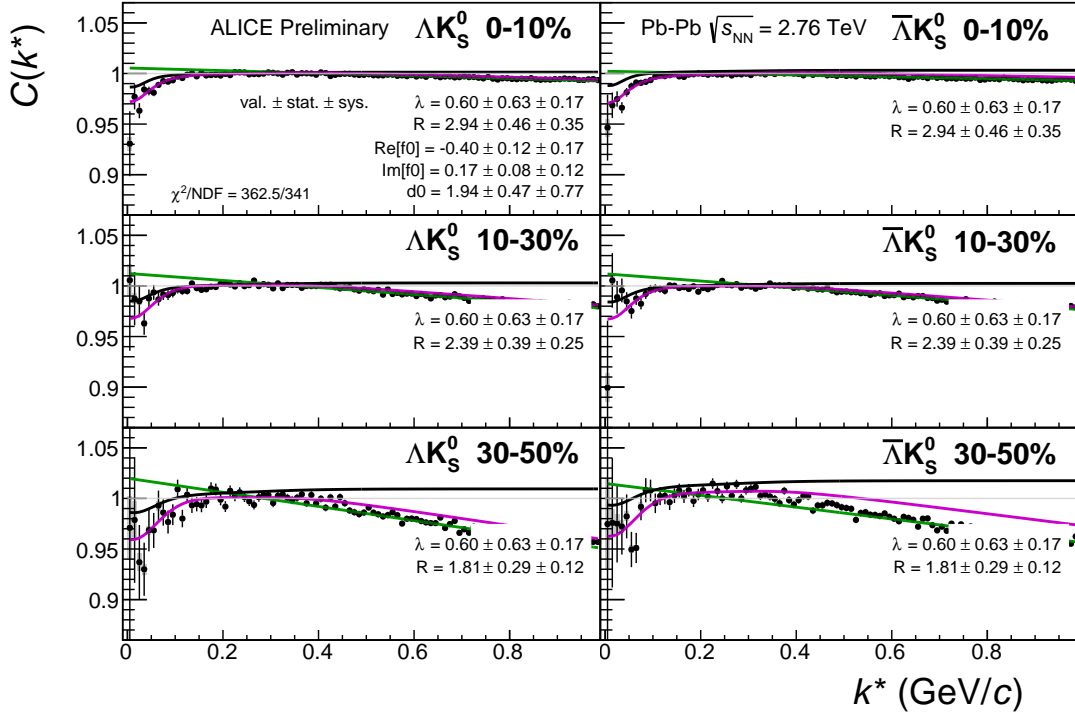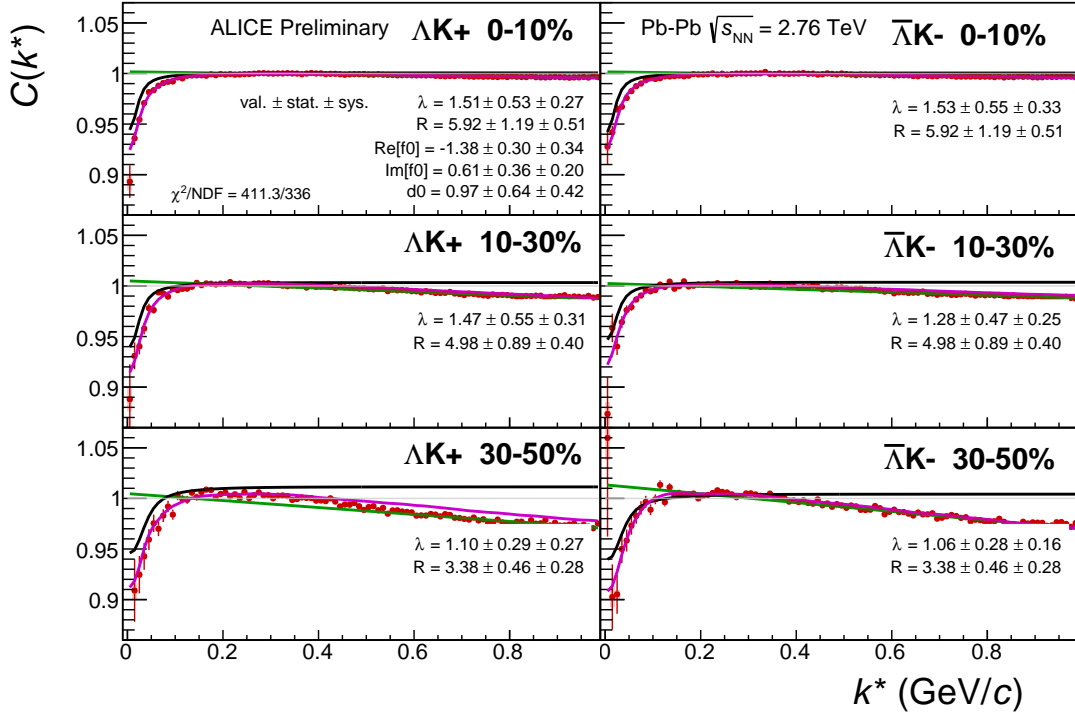

(b) Wide view ($k^* \lesssim 1.0$ GeV/c)

Fig. 13: Fits, with 10 residual correlations included, to the ΛK_S^0 (left) and $\bar{\Lambda} K_S^0$ (right) data for the centralities 0-10% (top), 10-30% (middle), and 30-50% (bottom). The lines represent the statistical errors, while the boxes represent the systematic errors. Each has unique λ and normalization parameters. The radii are shared amongst like centralities; the scattering parameters ($\mathbb{R}f_0$, $\mathbb{I}f_0$, d_0) are shared amongst all. The black solid line represents the "raw" fit, i.e. not corrected for momentum resolution effects nor non-flat background. The green line shows the fit to the non-flat background. The purple points show the fit after momentum resolution and non-flat background corrections have been applied. The initial values of the parameters is listed, as well as the final fit values with uncertainties. Here, R was restricted to [2.,10.] and Λ was restricted to [0.1,0.8].

Fig. 14: Fits, with 10 residual correlations included and shown, to the ΛK_S^0 (left) and $\bar{\Lambda} K_S^0$ (right) data for the centralities 0-10% (top), 10-30% (middle), and 30-50% (bottom). The ten parent pairs used for the residual correction to the ΛK_S^0 ($\bar{\Lambda} K_S^0$) fit are $\Sigma^0 K_S^0$, $\Xi^0 K_S^0$, $\Xi^- K_S^0$, $\Sigma^{*(+,-,0)} K_S^0$, ΛK^{*0}, $\Sigma^0 K^{*0}$, $\Xi^0 K^{*0}$, and $\Xi^- K^{*0}$ ($\bar{\Sigma}^0 K_S^0$, $\bar{\Xi}^0 K_S^0$, $\bar{\Xi}^+ K_S^0$, $\bar{\Sigma}^{*(+,-,0)} K_S^0$, $\bar{\Lambda} \bar{K}^{*0}$, $\bar{\Sigma}^0 \bar{K}^{*0}$, $\bar{\Xi}^0 \bar{K}^{*0}$, and $\bar{\Xi}^+ \bar{K}^{*0}$).
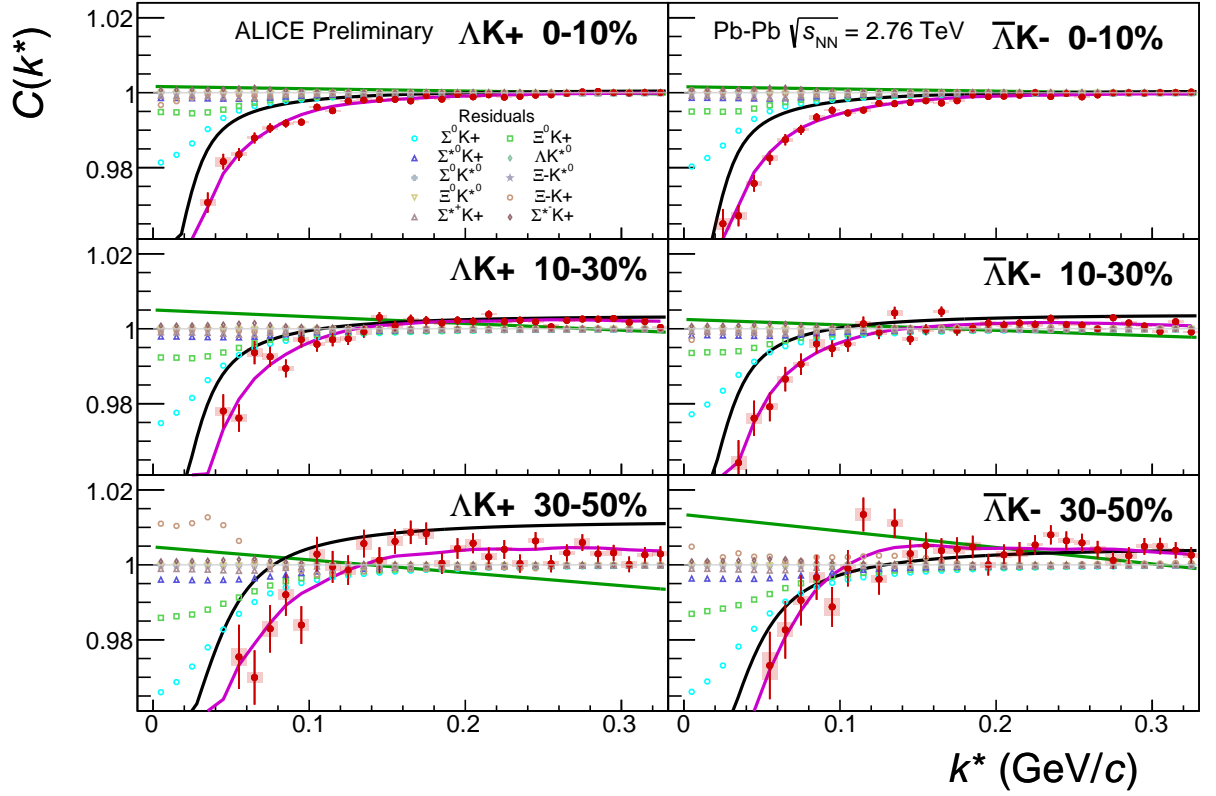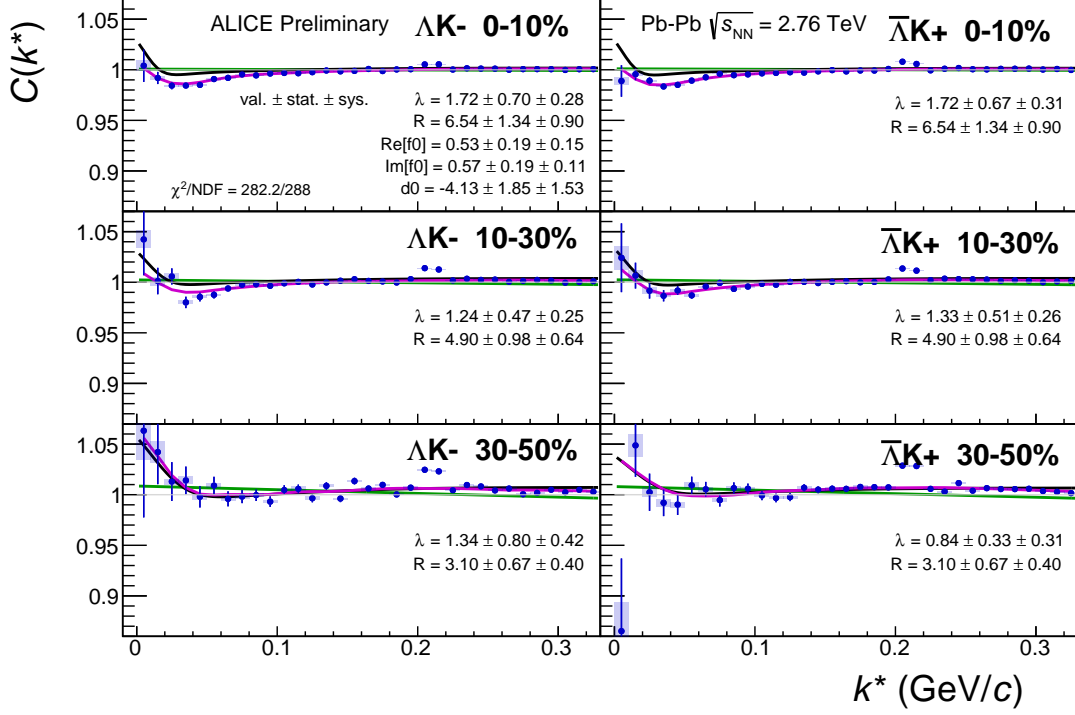
(a) Signal region view ($k^* \lesssim 0.3$ GeV/c)
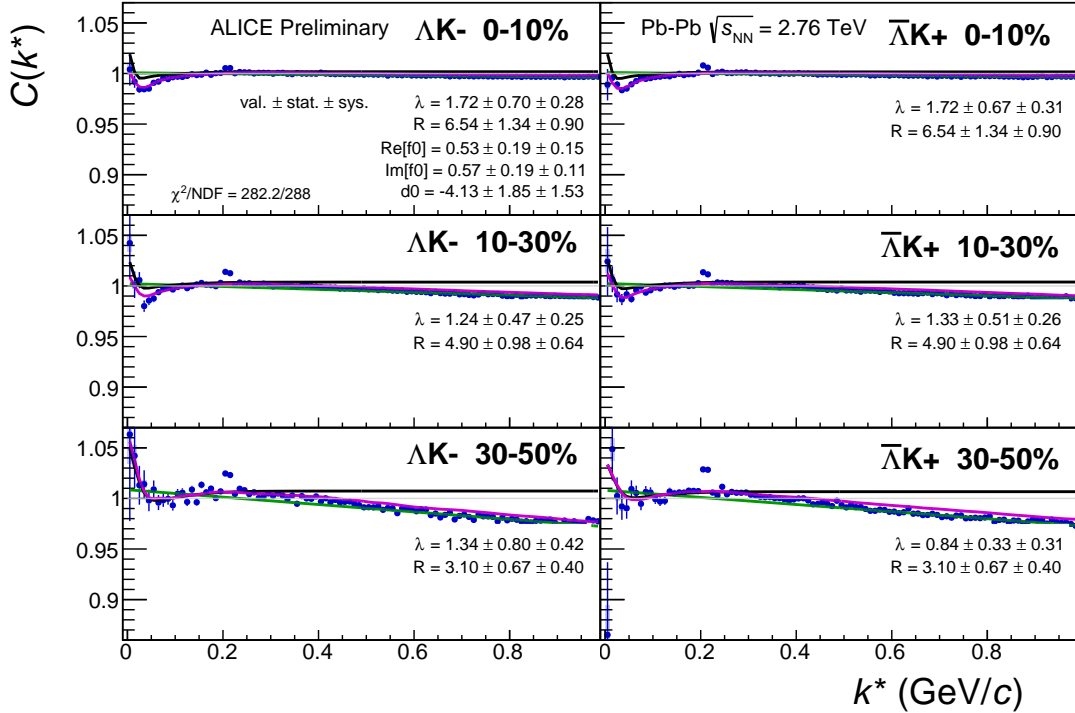

(b) Wide view ($k^* \lesssim 1.0$ GeV/c)

Fig. 15: Fits, with 10 residual correlations included, to the ΛK^+ (left) and $\bar{\Lambda} K^-$ (right) data for the centralities 0-10% (top), 10-30% (middle), and 30-50% (bottom). The lines represent the statistical errors, while the boxes represent the systematic errors. Each has unique λ and normalization parameters. The radii are shared amongst like centralities; the scattering parameters ($\mathbb{R} f_0$, $\mathbb{I} f_0$, d_0) are shared amongst all. The black solid line represents the "raw" fit, i.e. not corrected for momentum resolution effects nor non-flat background. The green line shows the fit to the non-flat background. The purple points show the fit after momentum resolution and non-flat background corrections have been applied. The initial values of the parameters is listed, as well as the final fit values with uncertainties.

Fig. 16: Fits, with 10 residual correlations included and shown, to the ΛK^+ (left) and $\bar{\Lambda} K^-$ (right) data for the centralities 0-10% (top), 10-30% (middle), and 30-50% (bottom). The ten parent pairs used for the residual correction to the ΛK^+ ($\bar{\Lambda} K^-$) fit are $\Sigma^0 K^+$, $\Xi^0 K^+$, $\Xi^- K^+$, $\Sigma^{*(+,-,0)} K^+$, ΛK^{*0}, $\Sigma^0 K^{*0}$, $\Xi^0 K^{*0}$, and $\Xi^- K^{*0}$ ($\bar{\Sigma}^0 K^-$, $\bar{\Xi}^0 K^-$, $\bar{\Xi}^+ K^-$, $\bar{\Sigma}^{*(+,-,0)} K^-$, $\bar{\Lambda} \bar{K}^{*0}$, $\bar{\Sigma}^0 \bar{K}^{*0}$, $\bar{\Xi}^0 \bar{K}^{*0}$, and $\bar{\Xi}^+ \bar{K}^{*0}$).
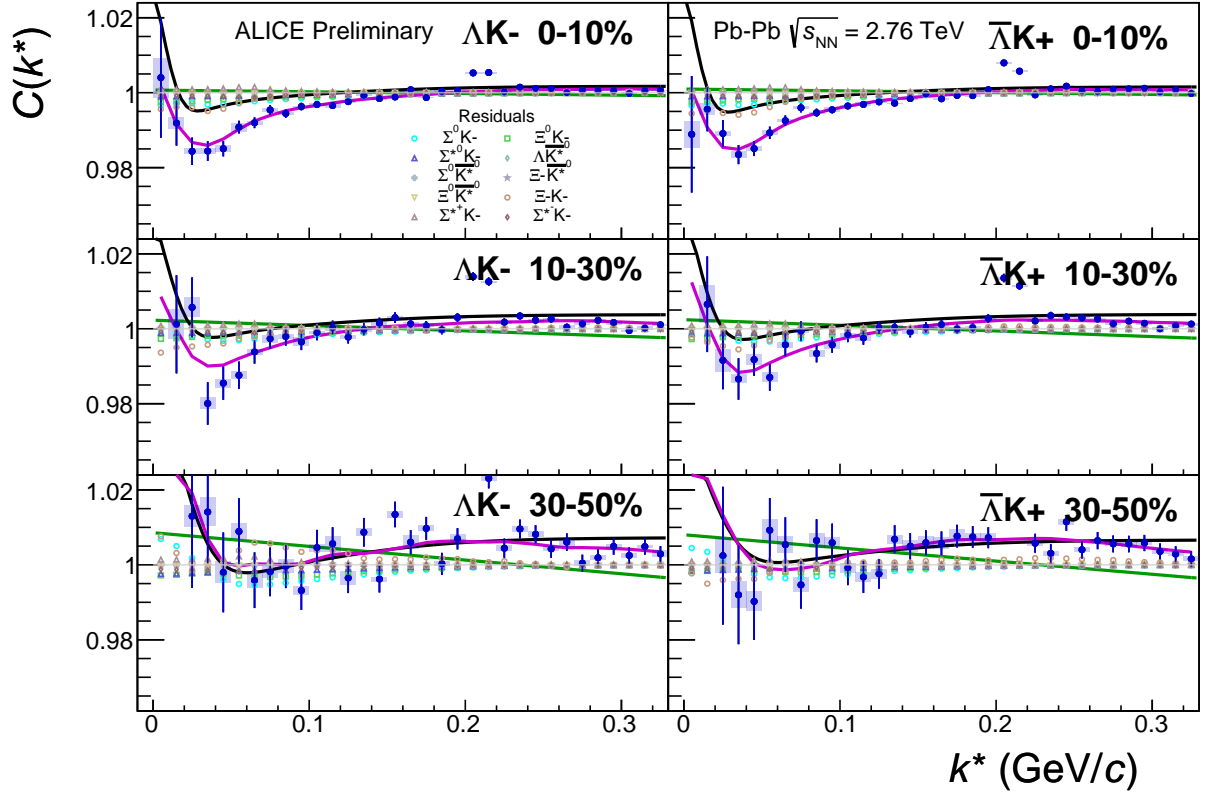
(a) Signal region view ($k^* \lesssim 0.3$ GeV/c)

(b) Wide view ($k^* \lesssim 1.0$ GeV/c)

Fig. 17: Fits, with 10 residual correlations included, to the ΛK^- (left) with $\bar{\Lambda} K^+$ (right) data for the centralities 0-10% (top), 10-30% (middle), and 30-50% (bottom). The lines represent the statistical errors, while the boxes represent the systematic errors. Each has unique λ and normalization parameters. The radii are shared amongst like centralities; the scattering parameters ($\mathbb{R}f_0$, $\mathbb{I}f_0$, d_0) are shared amongst all. The black solid line represents the "raw" fit, i.e. not corrected for momentum resolution effects nor non-flat background. The green line shows the fit to the non-flat background. The purple points show the fit after momentum resolution and non-flat background corrections have been applied. The initial values of the parameters is listed, as well as the final fit values with uncertainties.

Fig. 18: Fits, with 10 residual correlations included and shown, to the ΛK^- (left) and $\bar{\Lambda}K^+$ (right) data for the centralities 0-10% (top), 10-30% (middle), and 30-50% (bottom). The ten parent pairs used for the residual correction to the ΛK^- ($\bar{\Lambda}K^+$) fit are $\Sigma^0 K^-$, $\Xi^0 K^-$, $\Xi^- K^-$, $\Sigma^{*(+,-,0)} K^-$, $\Lambda \bar{K}^{*0}$, $\Sigma^0 \bar{K}^{*0}$, $\Xi^0 \bar{K}^{*0}$, and $\Xi^- \bar{K}^{*0}$ ($\bar{\Sigma}^0 K^+$, $\bar{\Xi}^0 K^+$, $\bar{\Xi}^+ K^+$, $\bar{\Sigma}^{*(+,-,0)} K^+$, $\bar{\Lambda} K^{*0}$, $\bar{\Sigma}^0 K^{*0}$, $\bar{\Xi}^0 K^{*0}$, and $\bar{\Xi}^+ K^{*0}$).

<div align="center">Fit Results $\Lambda(\bar{\Lambda})K_S^0$</div>

Pair Type	Centrality	λ	R	$\mathbb{R}f_0$	$\mathbb{I}f_0$	d_0
				Fit Parameters		
ΛK_S^0	0-10%	0.60 ± 0.63 (stat.) ± 0.17 (sys.)	2.94 ± 0.45 (stat.) ± 0.35 (sys.)	-0.40 ± 0.12 (stat.) ± 0.17 (sys.)	0.17 ± 0.08 (stat.) ± 0.12 (sys.)	1.94 ± 0.47 (stat.) ± 0.77 (sys.)
	10-30%		2.39 ± 0.38 (stat.) ± 0.25 (sys.)			
	30-50%		1.81 ± 0.29 (stat.) ± 0.12 (sys.)			
$\bar{\Lambda} K_S^0$	0-10%		2.94 ± 0.45 (stat.) ± 0.35 (sys.)			
	10-30%		2.39 ± 0.38 (stat.) ± 0.25 (sys.)			
	30-50%		1.81 ± 0.29 (stat.) ± 0.12 (sys.)			

Table 9: Fit Results $\Lambda(\bar{\Lambda})K_S^0$, with 10 residual correlations included. Each pair is fit simultaneously with its conjugate (ie. ΛK_S^0 with $\bar{\Lambda}K_S^0$) across all centralities (0-10%, 10-30%, 30-50%), for a total of 6 simultaneous analyses in the fit. Each analysis has a unique λ and normalization parameter. The radii are shared between analyses of like centrality, as these should have similar source sizes. The scattering parameters ($\mathbb{R}f_0$, $\mathbb{I}f_0$, d_0) are shared amongst all. The fit is done on the data with only statistical error bars. The errors marked as "stat." are those returned by MINUIT. The errors marked as "sys." are those which result from my systematic analysis (as outlined in Section **??**).
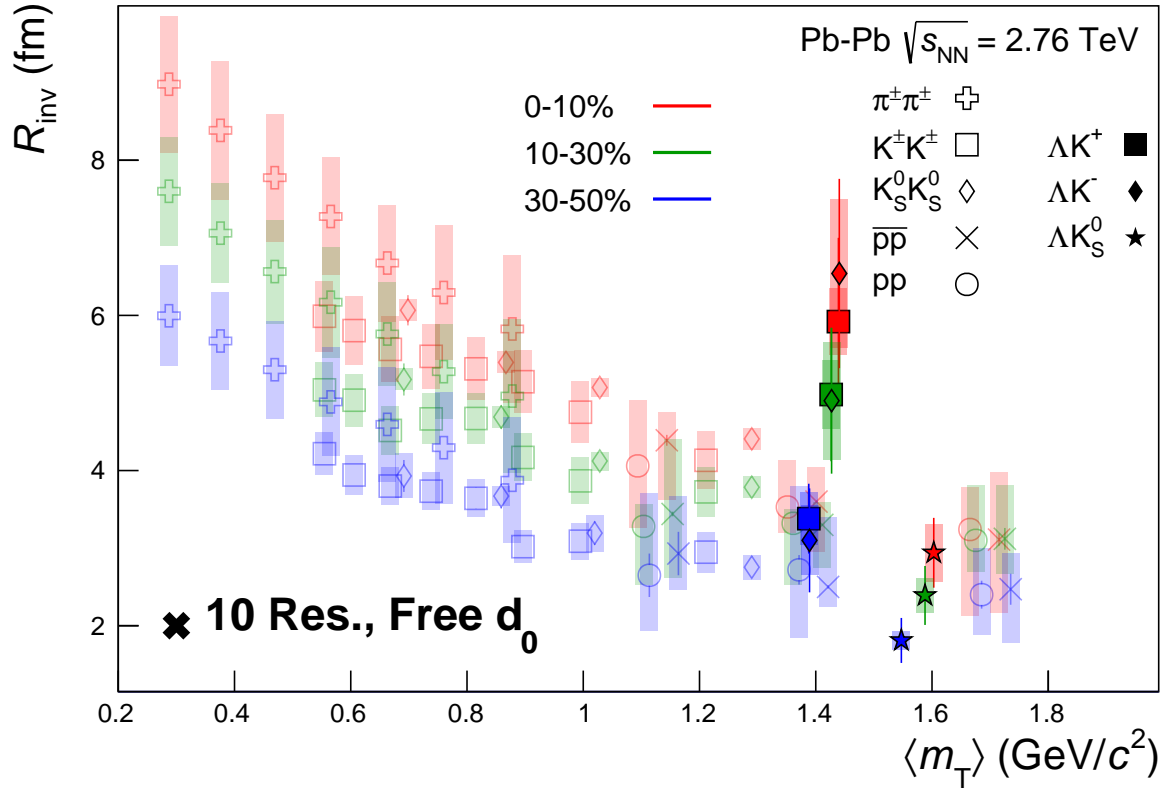
<div align="center">Fit Results $\Lambda(\bar{\Lambda})K^{\pm}$</div>

Pair Type	Centrality	Fit Parameters				
		λ	R	$\mathbb{R}f_0$	$\mathbb{I}f_0$	d_0
ΛK^+	0-10%	1.51 ± 0.56 (stat.) ± 0.27 (sys.)	5.92 ± 1.08 (stat.) ± 0.51 (sys.)			
	10-30%	1.47 ± 0.55 (stat.) ± 0.31 (sys.)	4.98 ± 0.86 (stat.) ± 0.40 (sys.)			
	30-50%	1.10 ± 0.30 (stat.) ± 0.27 (sys.)	3.38 ± 0.45 (stat.) ± 0.28 (sys.)	-1.38 ± 0.32 (stat.) ± 0.34 (sys.)	0.61 ± 0.34 (stat.) ± 0.20 (sys.)	0.97 ± 0.66 (stat.) ± 0.42 (sys.)
$\bar{\Lambda} K^-$	0-10%	1.52 ± 0.58 (stat.) ± 0.33 (sys.)	5.92 ± 1.08 (stat.) ± 0.51 (sys.)			
	10-30%	1.28 ± 0.47 (stat.) ± 0.25 (sys.)	4.98 ± 0.86 (stat.) ± 0.40 (sys.)			
	30-50%	1.06 ± 0.28 (stat.) ± 0.16 (sys.)	3.38 ± 0.45 (stat.) ± 0.28 (sys.)			
ΛK^-	0-10%	1.72 ± 0.61 (stat.) ± 0.28 (sys.)	6.54 ± 1.22 (stat.) ± 0.90 (sys.)			
	10-30%	1.24 ± 0.43 (stat.) ± 0.25 (sys.)	4.90 ± 0.94 (stat.) ± 0.64 (sys.)			
	30-50%	1.34 ± 0.75 (stat.) ± 0.42 (sys.)	3.10 ± 0.67 (stat.) ± 0.40 (sys.)	0.53 ± 0.20 (stat.) ± 0.15 (sys.)	0.57 ± 0.17 (stat.) ± 0.11 (sys.)	-4.13 ± 1.74 (stat.) ± 1.53 (sys.)
$\bar{\Lambda} K^+$	0-10%	1.72 ± 0.58 (stat.) ± 0.31 (sys.)	6.54 ± 1.22 (stat.) ± 0.90 (sys.)			
	10-30%	1.33 ± 0.46 (stat.) ± 0.26 (sys.)	4.90 ± 0.94 (stat.) ± 0.64 (sys.)			
	30-50%	0.84 ± 0.31 (stat.) ± 0.31 (sys.)	3.10 ± 0.67 (stat.) ± 0.40 (sys.)			

Table 10: Fit Results $\Lambda(\bar{\Lambda})K^{\pm}$, with 10 residual correlations included.. Each pair is fit simultaneously with its conjugate (ie. ΛK^+ with $\bar{\Lambda}K^-$ and ΛK^- with $\bar{\Lambda}K^+$) across all centralities (0-10%, 10-30%, 30-50%), for a total of 6 simultaneous analyses in the fit. Each analysis has a unique λ and normalization parameter. The radii are shared between analyses of like centrality, as these should have similar source sizes. The scattering parameters ($\mathbb{R}f_0$, $\mathbb{I}f_0$, d_0) are shared amongst all. The fit is done on the data with only statistical error bars. The errors marked as "stat." are those returned by MINUIT. The errors marked as "sys." are those which result from my systematic analysis (as outlined in Section **??**).

Fit Parameters (value ± statistical error ± systematic error)

Pair Type	Centrality	R		
ΛK^+ & $\bar{\Lambda}K^-$	0-10%	5.92 ± 1.08 ± 0.51		
	10-30%	4.98 ± 0.86 ± 0.40		
	30-50%	3.38 ± 0.45 ± 0.28		
		$\Re f_0$	$\Im f_0$	d_0
		-1.38 ± 0.32 ± 0.34	0.61 ± 0.34 ± 0.20	0.97 ± 0.66 ± 0.42
ΛK^- & $\bar{\Lambda}K^+$	0-10%	6.54 ± 1.22 ± 0.90		
	10-30%	4.90 ± 0.94 ± 0.64		
	30-50%	3.10 ± 0.67 ± 0.40		
		$\Re f_0$	$\Im f_0$	d_0
		0.53 ± 0.20 ± 0.15	0.57 ± 0.17 ± 0.11	-4.13 ± 1.74 ± 1.53
ΛK_S^0 & $\bar{\Lambda}K_S^0$	0-10%	2.94 ± 0.45 ± 0.35		
	10-30%	2.39 ± 0.38 ± 0.25		
	30-50%	1.81 ± 0.29 ± 0.12		
		$\Re f_0$	$\Im f_0$	d_0
		-0.40 ± 0.12 ± 0.17	0.17 ± 0.08 ± 0.12	1.94 ± 0.47 ± 0.77

Table 11: Fit Results $\Lambda(\bar{\Lambda})K^\pm$ and $\Lambda(\bar{\Lambda})K_S^0$, with 10 residual correlations included. (λ parameters not shown). This table is a condensed version of Tables 9 and 10

Fig. 19: 10 residual correlations in ΛK fits. Extracted fit R_{inv} parameters as a function of pair transverse mass (m_T) for various pair systems over several centralities. The ALICE published data [**?**] is shown with transparent, open symbols. The new ΛK results are shown with opaque, filled symbols. In the left, the ΛK^+ (with it's conjugate pair) results are shown separately from the ΛK^- (with it's conjugate pair) results. In the right, all $\Lambda K^\pm$ results are averaged.