### 0.0.1 Fit Method Comparisons

In Figure 1, we show extracted fit parameters for the case of $\Lambda K^+(\bar{\Lambda}K^-)$ sharing radii with $\Lambda K^-(\bar{\Lambda}K^+)$. The figure shows results for three different treatments of the non-femtoscopic background: a polynomial fit to THERMINATOR 2 simulation to model the background (circles), a linear fit to the data to model the background (squares), and the Stavinskiy method (crosses).
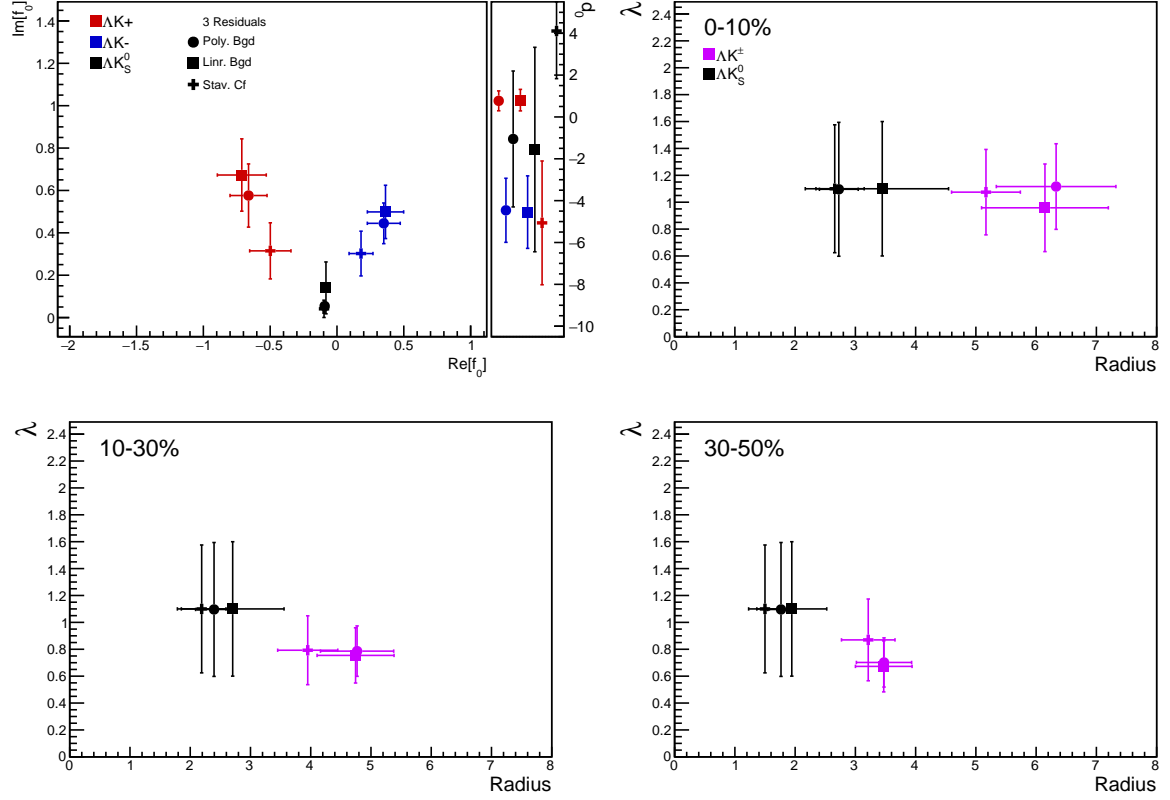


**Fig. 1:** Compare Fit Parameters: Background treatment: Extracted fit results for all of our $\Lambda(\bar{\Lambda})K^\pm$ systems across all studied centrality bins (0-10%, 10-30%, 30-50%). The $\Lambda K^+(\bar{\Lambda}K^-)$ and $\Lambda K^-(\bar{\Lambda}K^+)$ systems share both a radius and a $\lambda$ parameter for each centrality bin (i.e. 3 total radius parameters, 3 total $\lambda$ parameters). The figure shows results for three different treatments of the non-femtoscopic background: a polynomial fit to THERMINATOR 2 simulation to model the background (circles), a linear fit to the data to model the background (squares), and the Stavinskiy method (crosses). The green [**?**] and yellow [**?**] points show theoretical predictions made using chiral perturbation theory.
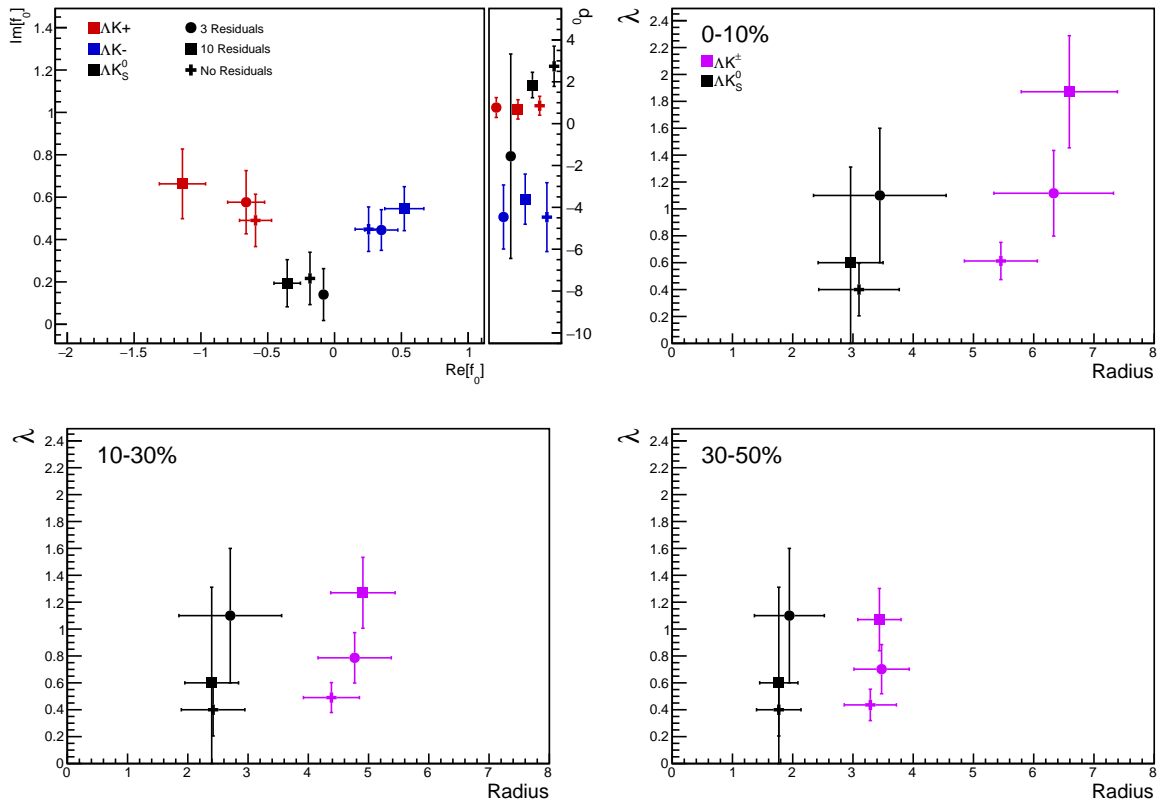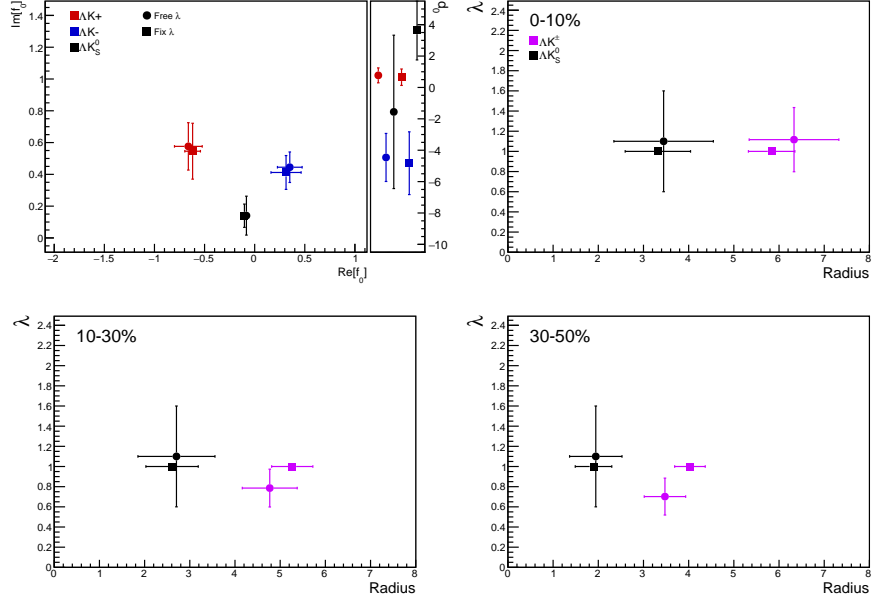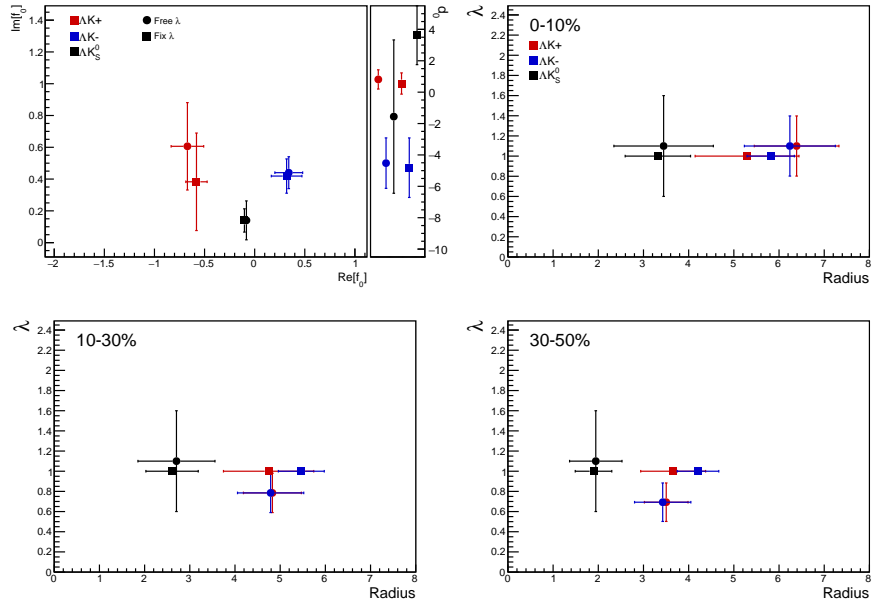
**Fig. 2:** Compare Fit Parameters: Number of residuals: Results shown for the case of 3 (+), 10 (X), and no (circles) residual contributors.
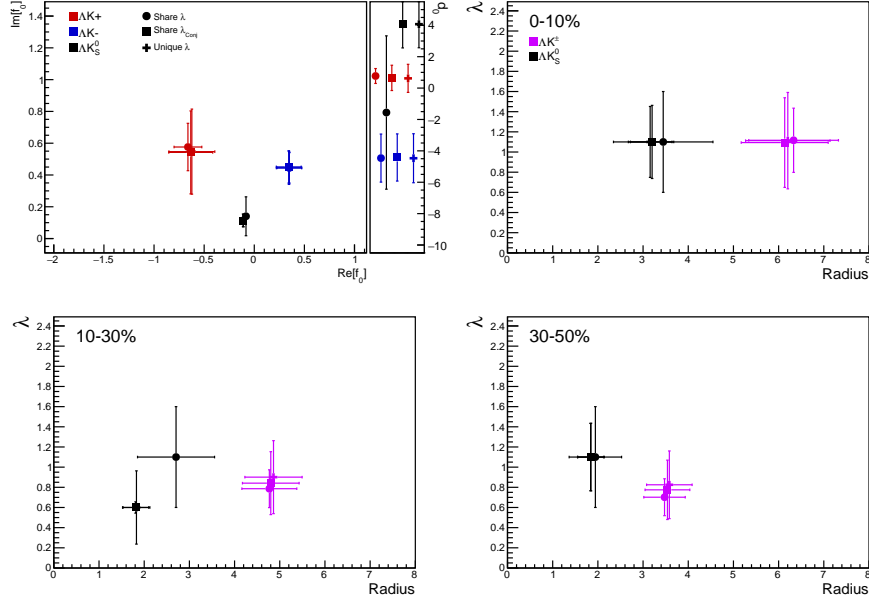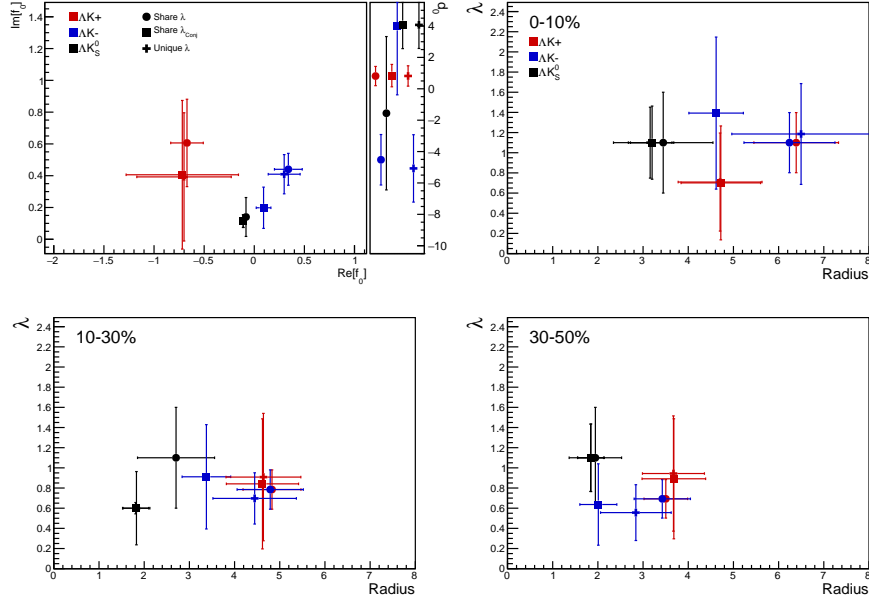
(a) Shared radii



(b) Separate radii

**Fig. 3:** Compare Fit Parameters: Free vs fixed $\lambda$: Results shown for $\lambda$ parameters left free (filled symbols) and fixed to 1 (open symbols). In the top plot (3a), the $\Lambda K^+$ and $\Lambda K^-$ analyses share radii, whereas in the bottom (3b) they have unique radii.

(a) Shared radii



(b) Separate radii

**Fig. 4:** Compare Fit Parameters: Shared vs unique $\lambda$: Results shown for different sharing of the $\lambda$ parameters between analyses and systems. In the top (4a), the $\Lambda K^+$ and $\Lambda K^-$ analyses share radii, whereas in the bottom (4b), they do not. "Share $\lambda$" (circles) is the case where a single $\lambda$ is shared amongst all analyses for a given centrality bin (i.e., in 4a, 3 radius parameters and 3 $\lambda$ parameters). "Share $\lambda_{Conj}$" (squares) means that conjugate pairs (ex. $\Lambda K^+$ and $\bar{\Lambda} K^-$) share a $\lambda$ parameter for each centrality. This corresponds to 6 total $\lambda$ parameters (for each of the 3 centrality bins, the $\Lambda K^+ (\bar{\Lambda} K^-)$ receives a unique $\lambda$, as does $\Lambda K^- (\bar{\Lambda} K^+)$). Finally, in "Unique $\lambda$" (+), each analysis received its own unique $\lambda$ parameter. This corresponds to 12 $\lambda$ parameters (for each of the 3 centrality bins, each $\Lambda K^+$, $\bar{\Lambda} K^-$, $\Lambda K^-$, and $\bar{\Lambda} K^+$ receives a unique $\lambda$).

(a) Shared radii



(b) Separate radii

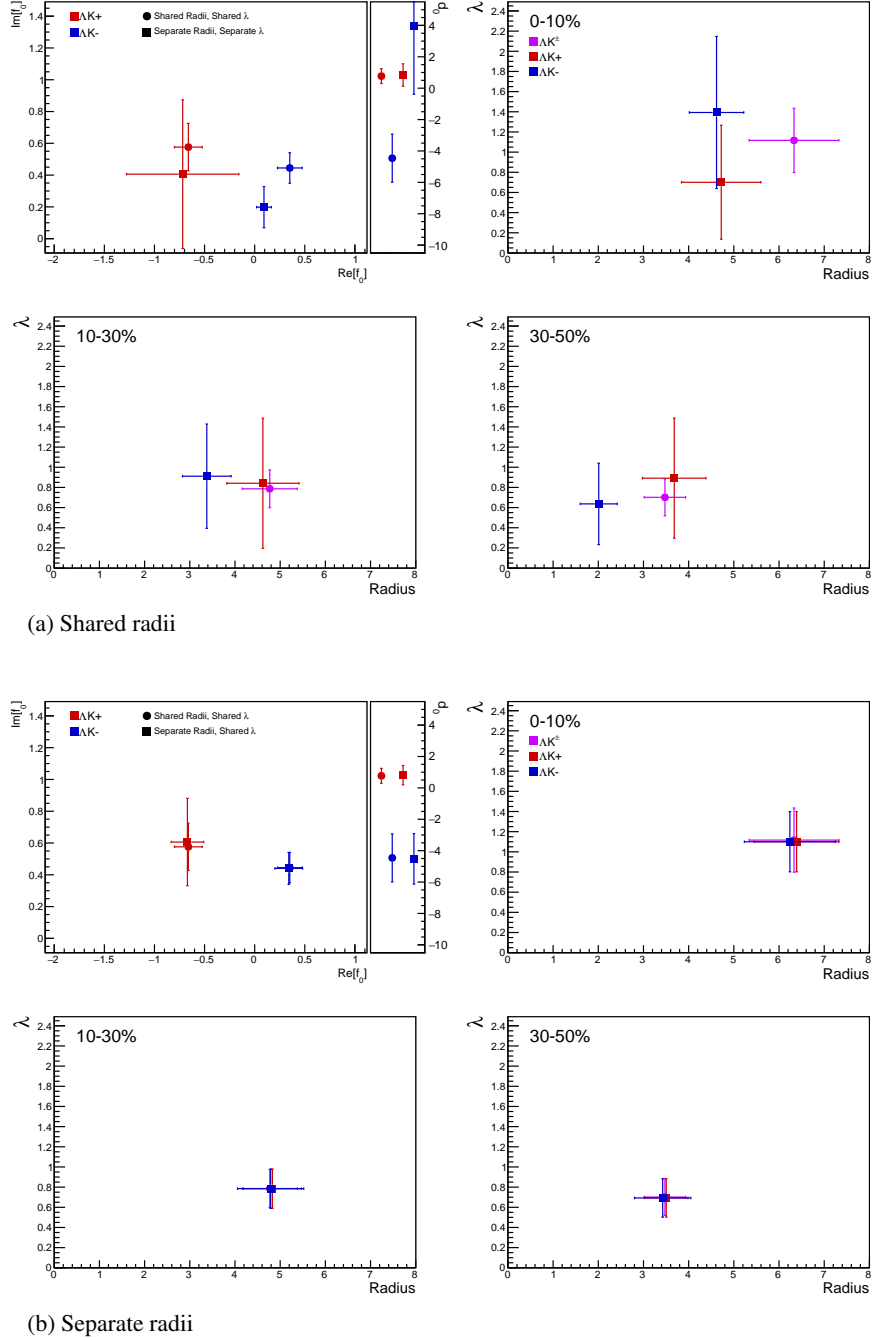**Fig. 5:** Compare Fit Parameters: Shared vs. Separate Radii: Results shown for the case of radii being shared between $\Lambda K^+$ and $\Lambda K^-$ (circles) vs not shared (squares). In (a), when the radii are not shared between $\Lambda K^+$ and $\Lambda K^-$, neither are the $\lambda$ parameters. In (b), the $\lambda$ parameters are always shared between $\Lambda K^+$ and $\Lambda K^-$