THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

$K_L + p \rightarrow \pi^+ + \Lambda$

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HTTPS://WWW.LINKEDIN.COM/IN/MARSHALL-SCOTT-PH-D-17AB191B9

K LONG FACILITY

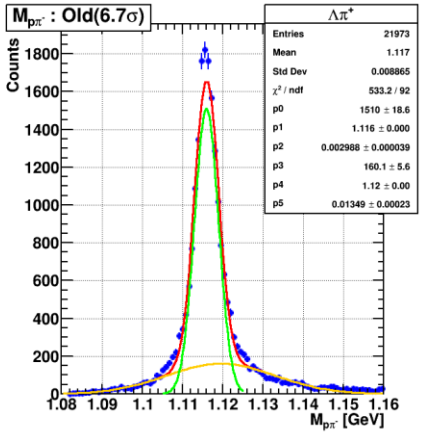
Jefferson Lab

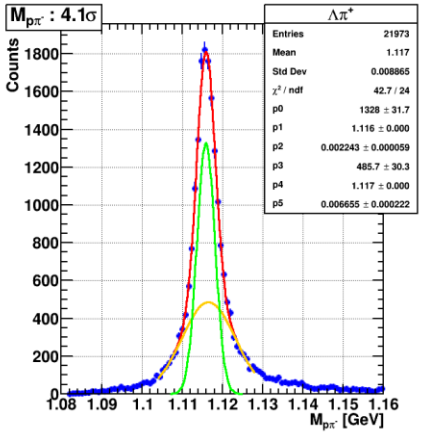
KL4 RXN AND GENERATING STEPS

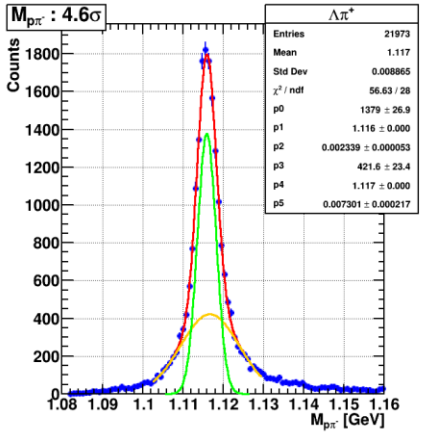
- Kl4 : $K^0_L + p \rightarrow \pi^+ + \Lambda$
  - $\Lambda \rightarrow p + \pi^-$ (63.9%) ; Current priority
  - $\Lambda \rightarrow n + \pi^0$ (35.8%)
- Backgrounds : (Primary) $K^0_L + p \rightarrow \pi^+ + \Sigma^0$, (Secondary) $K^0_L + p \rightarrow K^+ + \Xi^0$
- Generated histograms/root files (Monitoring Histograms, ReactionFilter, mcthrown_tree)
  - hd_root --nthreads=8 -PPLUGINS=PEVENTRFBUNCH:USE_TAG=KLong -PVERTEX:USEWEIGHTEDAVERAGE=1 -PPLUGINS=monitoring_hists foo_smeared.hddm
  - hd_root --nthreads=8 -PPLUGINS=PEVENTRFBUNCH:USE_TAG=KLong -PVERTEX:USEWEIGHTEDAVERAGE=1 -PPLUGINS=ReactionFilter –PReaction1=10_14__8_18 foo_smeared.hddm
  - hd_root --nthreads=8 -PPLUGINS=PEVENTRFBUNCH:USE_TAG=KLong -PVERTEX:USEWEIGHTEDAVERAGE=1 -PPLUGINS=mcthrown_tree foo_smeared.hddm

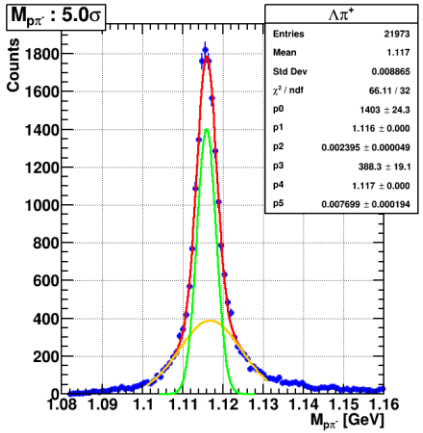
IMPROVED FIT

- I altered the fit range I was using to improve the fit.
- The results below show that by decreasing the background range, the fit is improved.



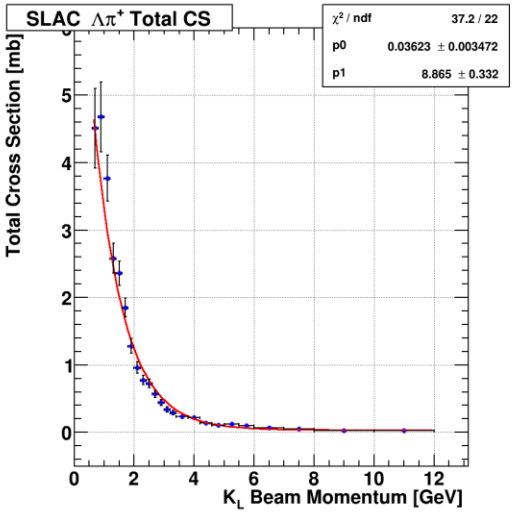


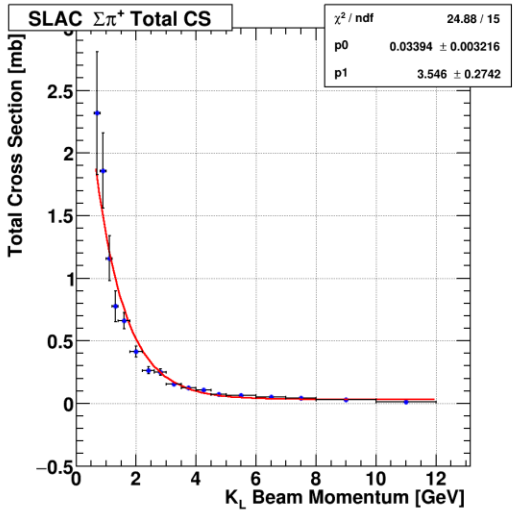




Cross sections from SLAC

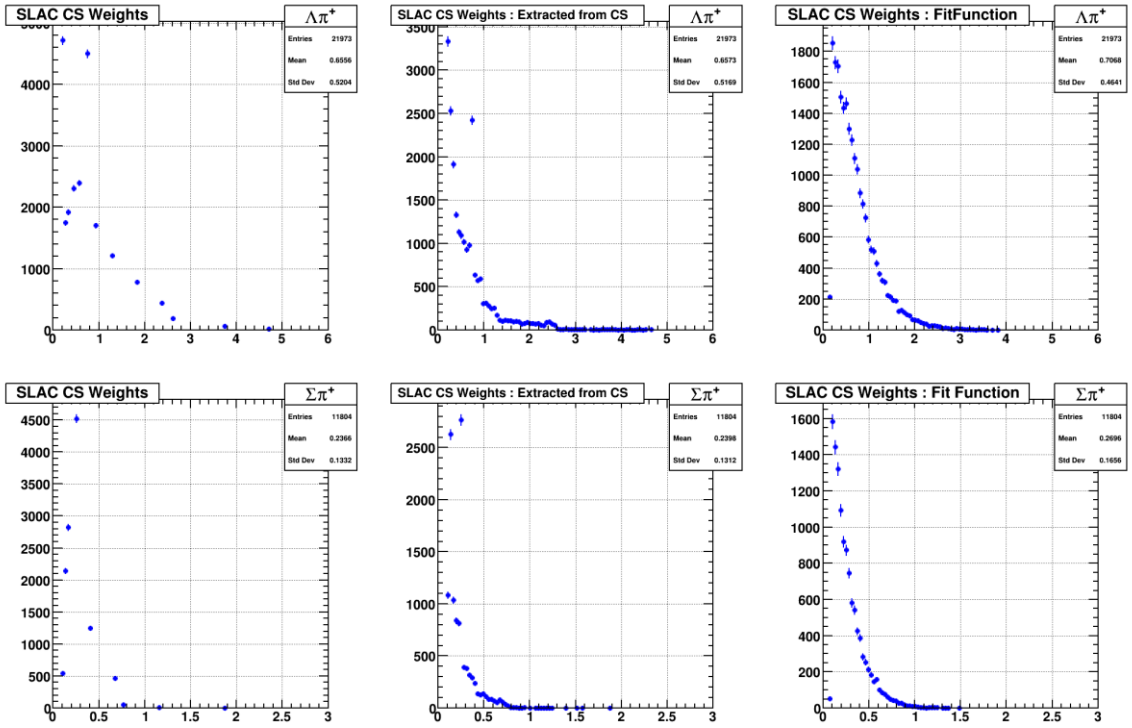
- Cross sections were taken from the SLAC neutral kaon scattering paper : Yamartino *et al.*(https://journals.aps.org/prd/abstract/10.1103/PhysRevD.10.9)
- The total cross sections, in mb, are plotted vs. K_L beam momentum.
- Fitted with Function = $A + Be^{-x}$





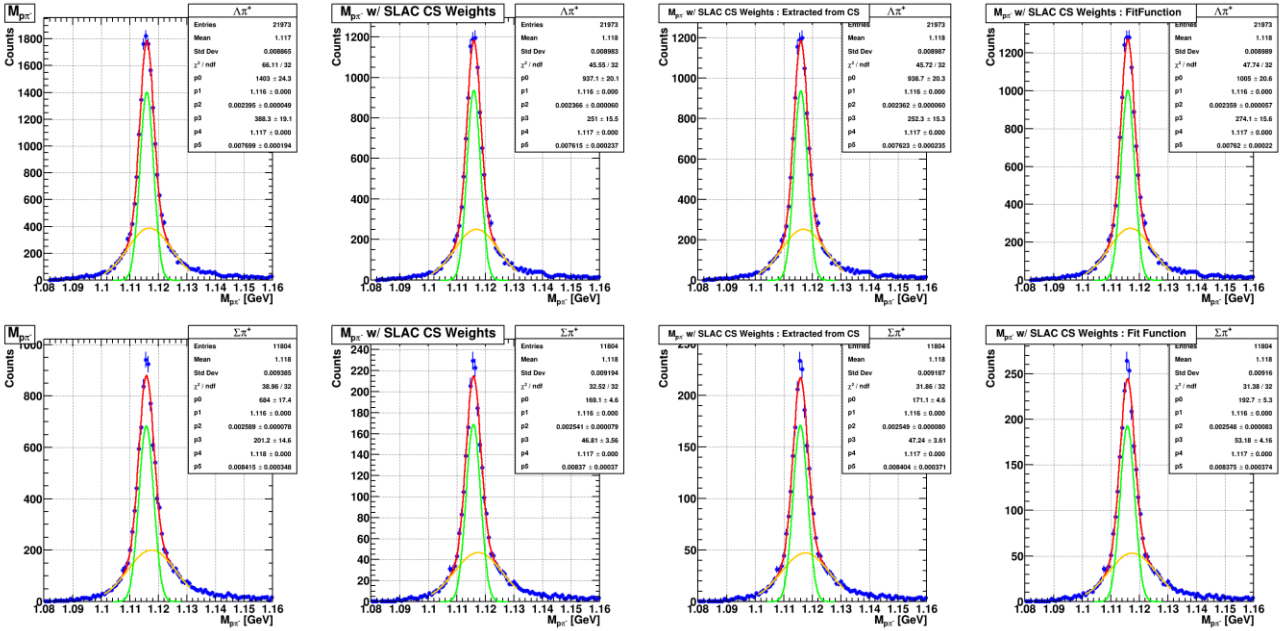
Cross sections from SLAC : Weight distributions

- The plots to the right depict the weight distributions using the SLAC CS weights and our data.
- Column 1 : binned weights
- Column 2 : binned weights with extractions
- Column 3 : weights from the fit function on the previous slide



Cross section weighted Invariant mass distributions

- Plots to the right show the invariant mass distributions of the with and without the cross section weighting.
- The only significant difference between the unweighted vs weighted distributions beyond the integrals is the χ^2 improves by a factor of 1.45(1.2) for Λ(Σ).



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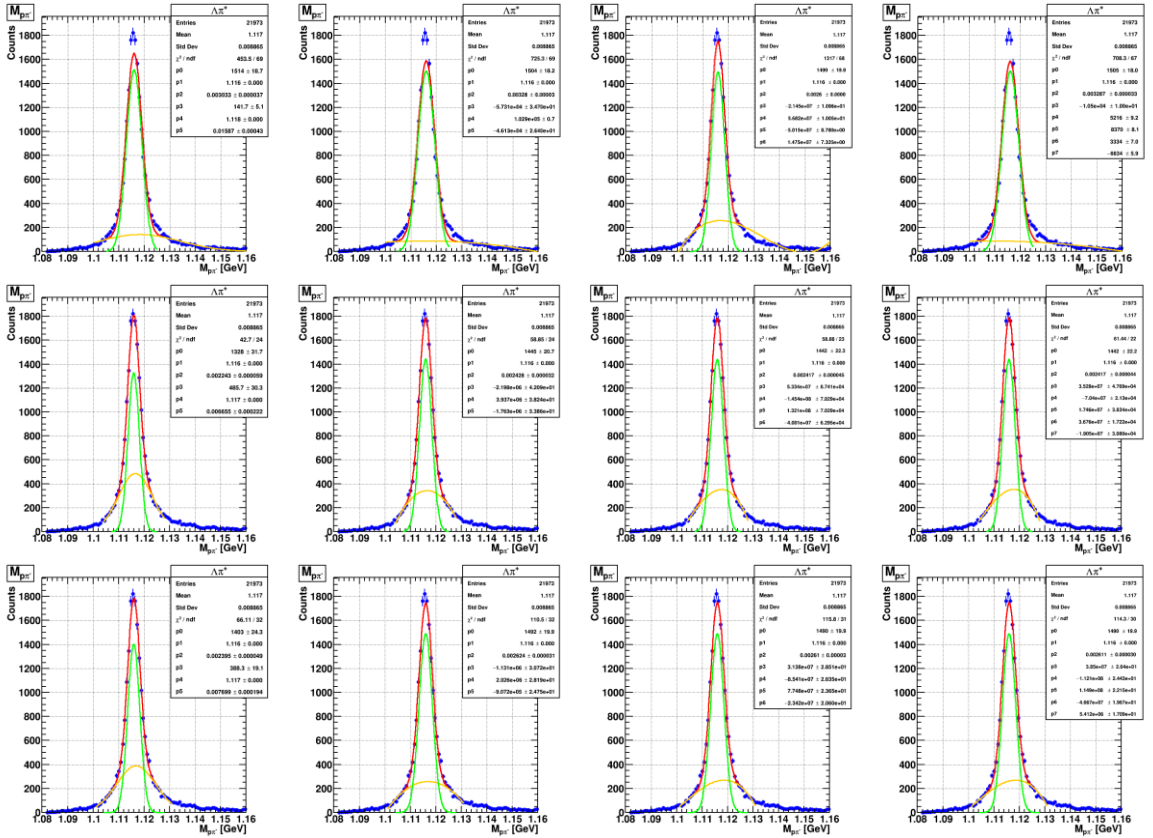
Backup Slides

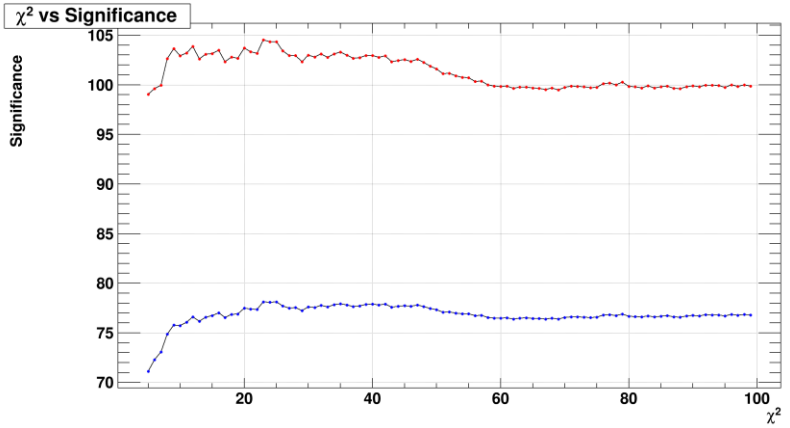
Fit Study

- All of the plots have a gaussian signal and a background of a gaussian or a polynomial
- Row 1 (Default) : S(1.105,1.125), B(1.080,1.160)
- Row 2 : S(1.107,1.125), B(1.104,1.128)
- Row 3 : S(1.104,1.128), B(1.101,1.131)

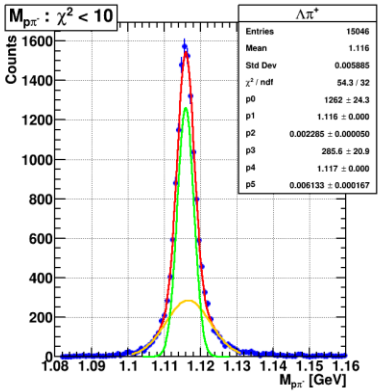
S(Gaus)B(Gaus) S(Gaus)B(pol2) S(Gaus)B(pol3) S(Gaus)B(pol4)

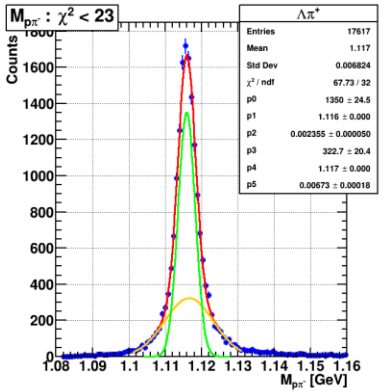


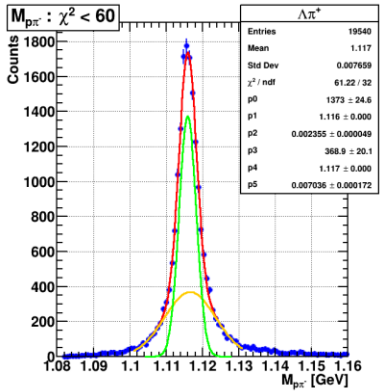
SIGNIFICANCE AND χ^2 TESTING

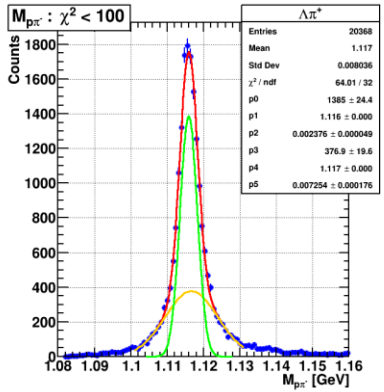


- Tested the significance as a function of kin fit χ^2
  - Blue line : $S/(S+B)^{0.5}$
  - Red line : $(2(S+B)\ln(1+S/B)-2S)^{0.5}$
- Maximum significance using the signal area
  - S1(23-25)
  - S2(23)



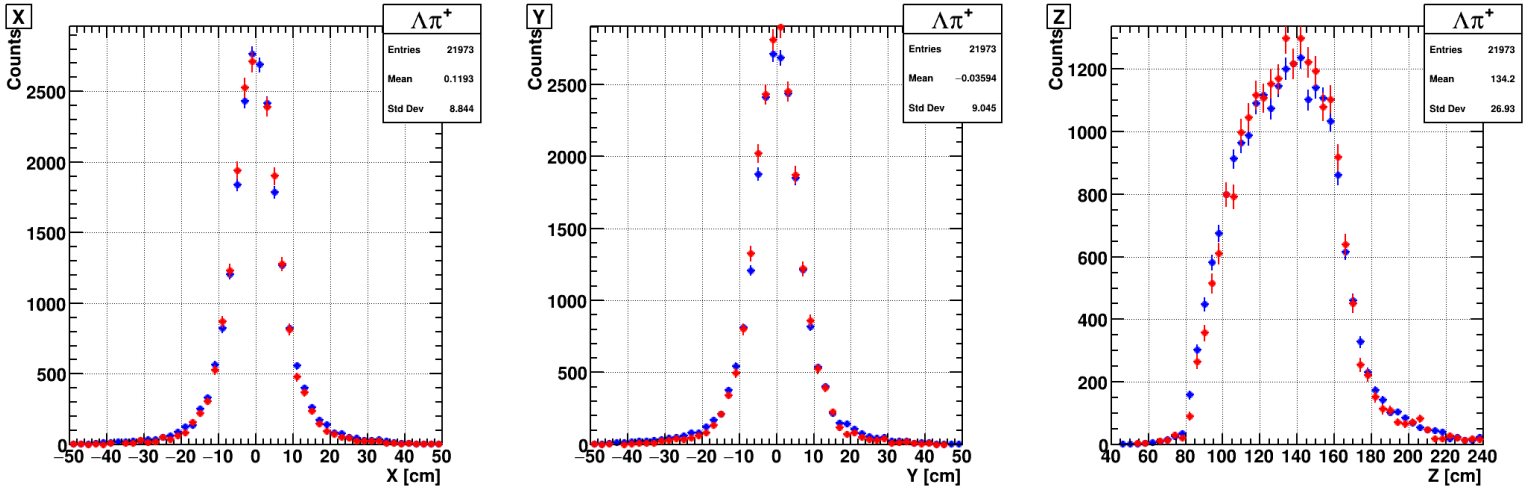






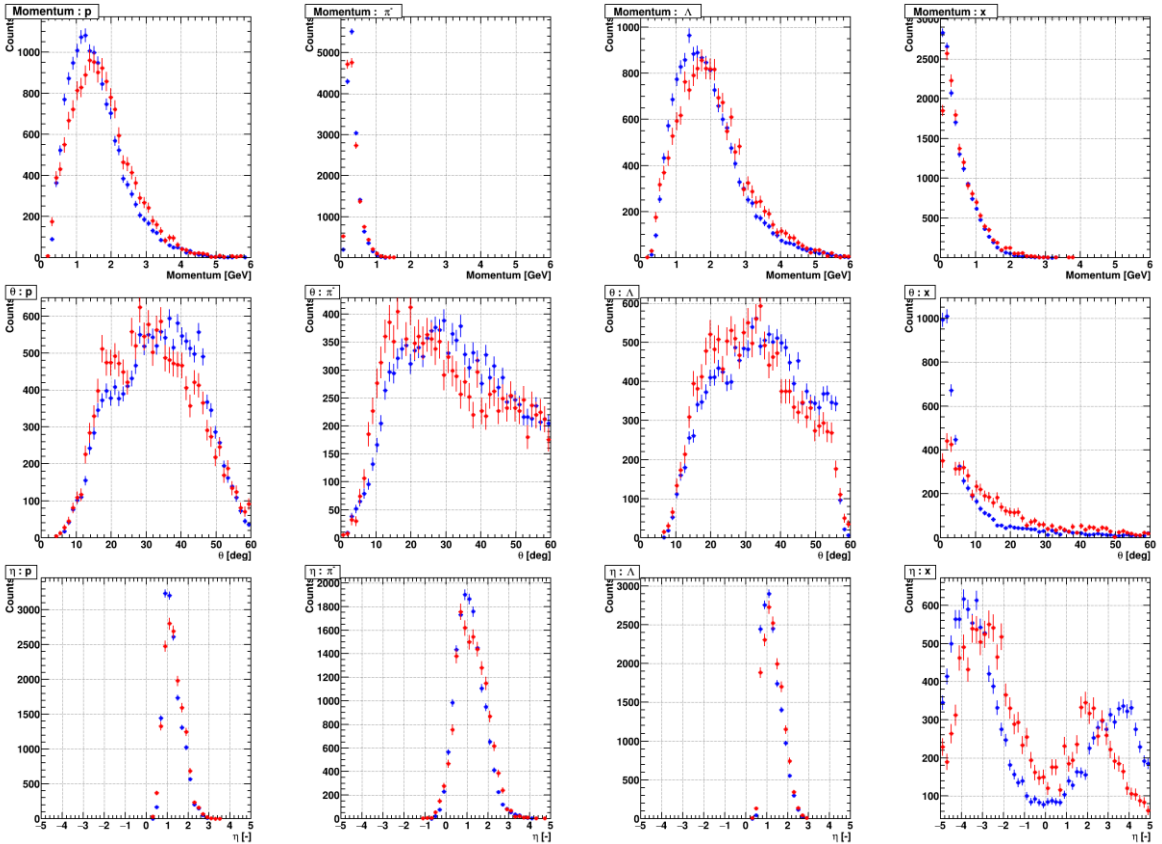
Λ Vertexing

- Below are plots of the position vertex of the Λ for events within(outside) 3σ.
- No particular differences.



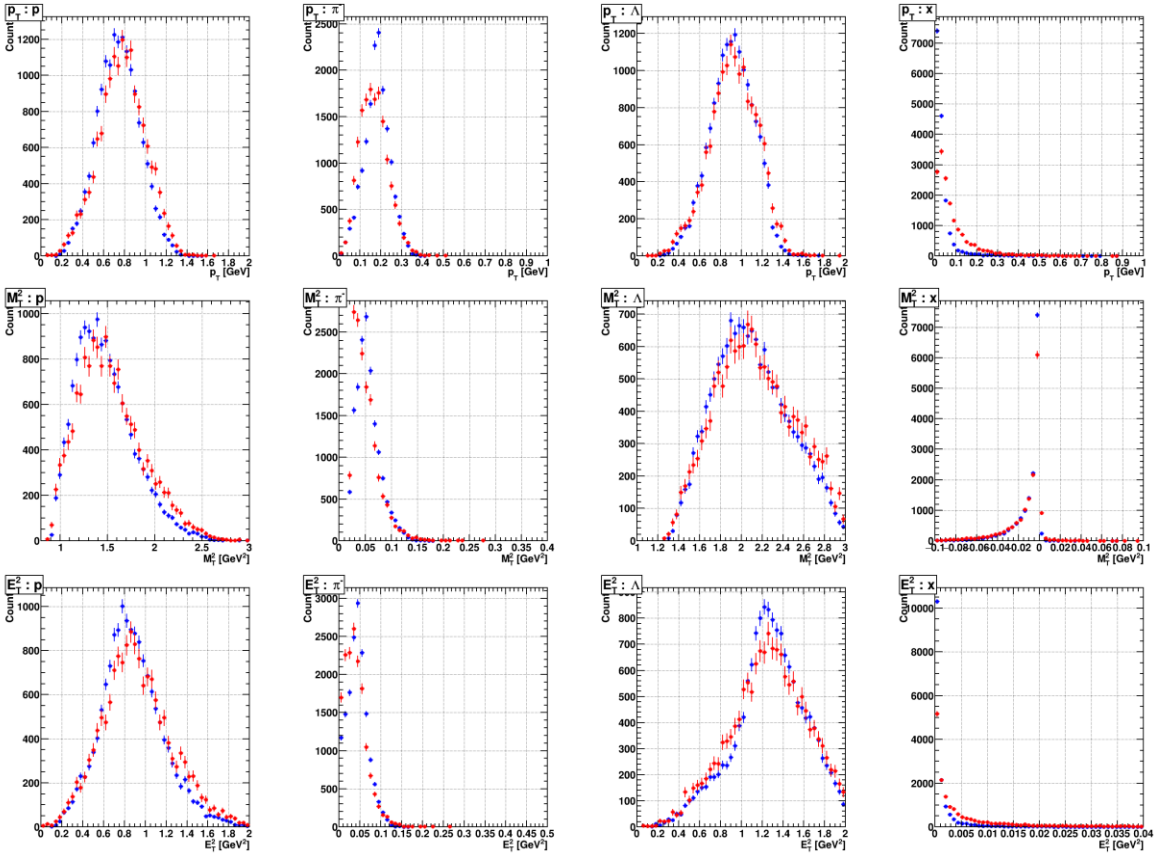
Kinematic Differences

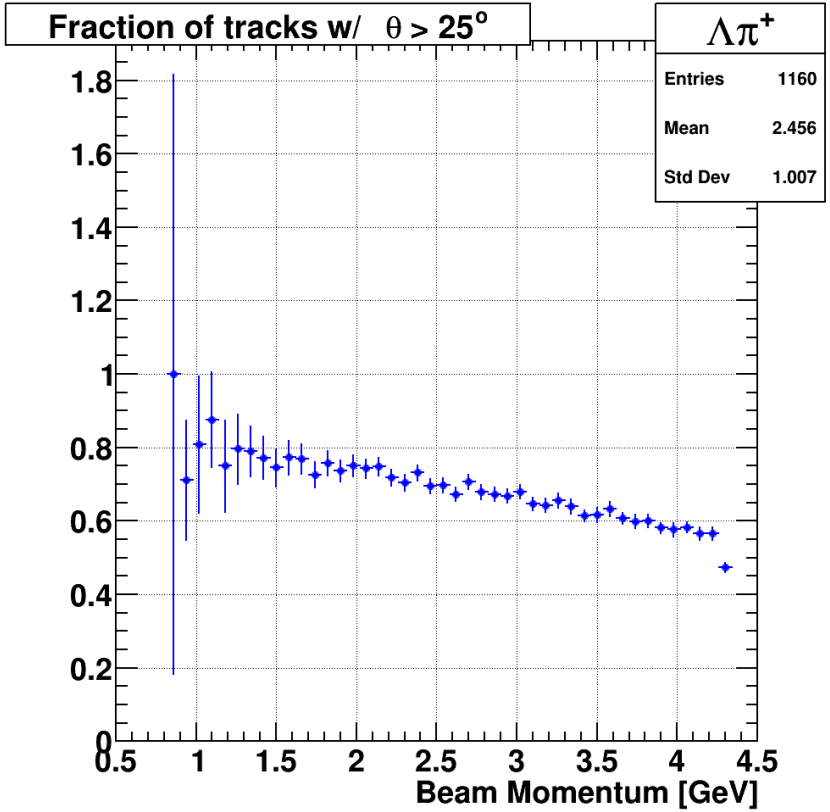
- To the right are plots of the momentum, theta, and pseudorapidity for the Λ, proton, π^+, and π^- for events within(outside) 3σ.
- No particular differences.



KINEMATIC DIFFERENCES 2

- To the right are plots of the p_T, m_T^2, and E_T^2 for the Λ, proton, π^+, and π^- for events within(outside) 3σ.
- No particular differences




Fraction of tracks w/ θ > 25°
Λπ+
Entries 1160
Mean 2.456
Std Dev 1.007
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Beam Momentum [GeV]

M. B. C. Scott