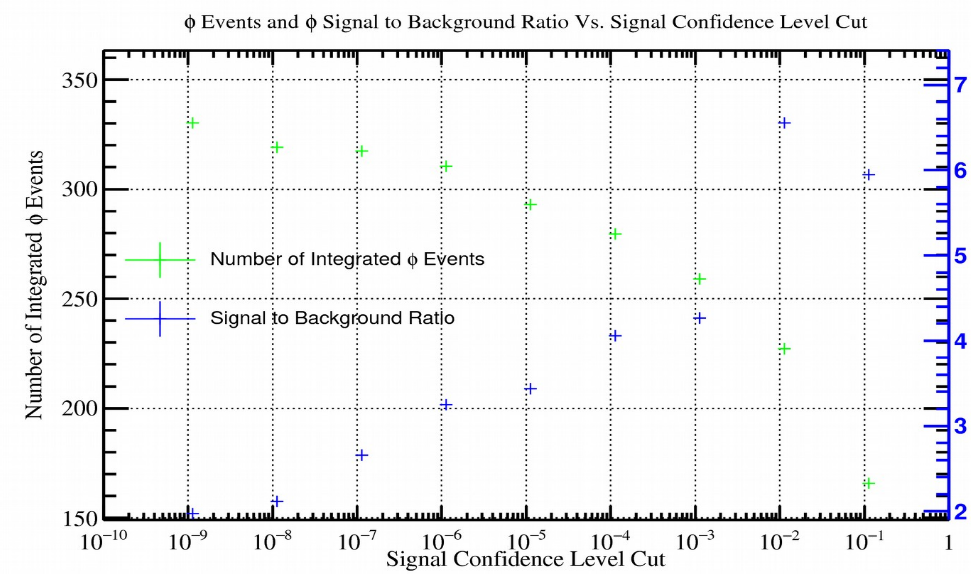
List of things this talk will discuss:

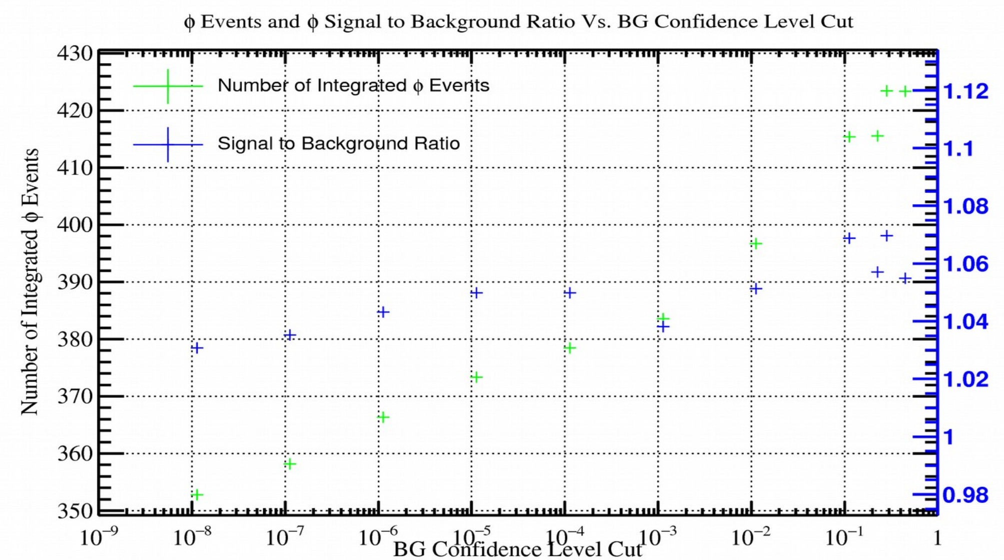
- Kinematic Fit Cut Value Plots (new and old)
- QValue Study
- Kaon Timing Detector Study
- Unused Energy Cut
- Preliminary results of entire data set

Kin Fit Results

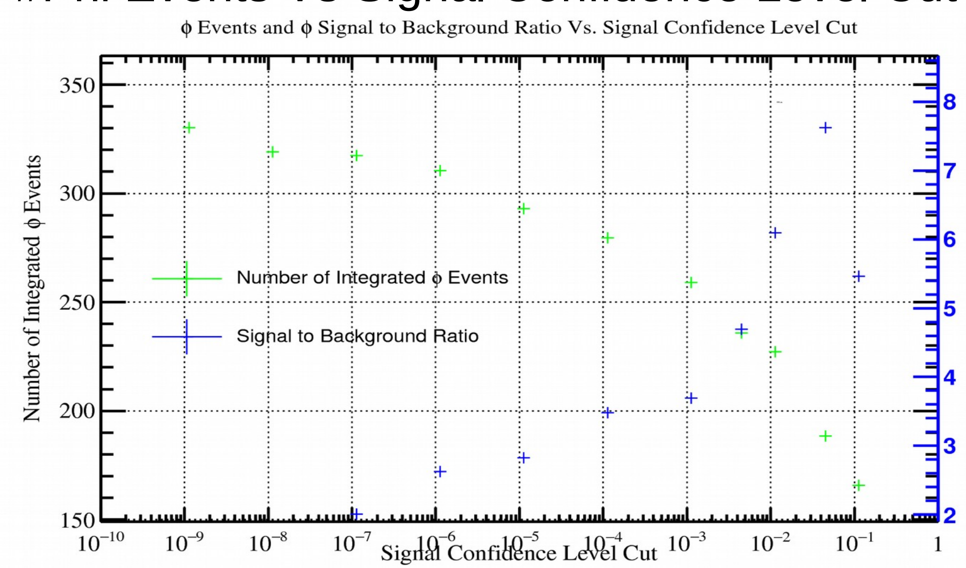
#Phi Events Vs Signal Confidence Level Cut



#Phi Events Vs BG Confidence Level Cut



#Phi Events Vs Signal Confidence Level Cut (more points)



Thoughts on the Kinematic Fitter:

- CONS:
- The Kinematic Fit cut does not cut the proportional amount of signal (removes too much signal, loss of statistics)
- The fitter is a function of covariance matrices***

- PROS:
- Clearly improves signal to background ratio
- Appears to produce an exclusive Phi Eta final state

- Is there another approach or cut we can make to reduce the same amount of background while preserving more of the signal statistics?

The Qvalue Approach:

- Idea came from a paper written by Mike Williams and Curtis Meyer "Separating Signals from Non-Interfering Backgrounds using Probabilistic Event Weightings."

- Algorithm:
  - Involves a double loop over all events
  - For a given event, calculate a kinematic distance between that event and all other events
  - Only accept the N nearest neighbors to that event
  - Plot the invariant mass that you are interested in using only the nearest neighbors
  - Fit the invariant mass distribution with a Gaussian plus a polynomial background
  - Estimate the number of signal and background events with the fits
  - Calculate the Qvalue = s / (s+bg)

- The idea is if an event close to a resonance, it will have a higher QValue than an event that is farther away

My Qvalue Study:

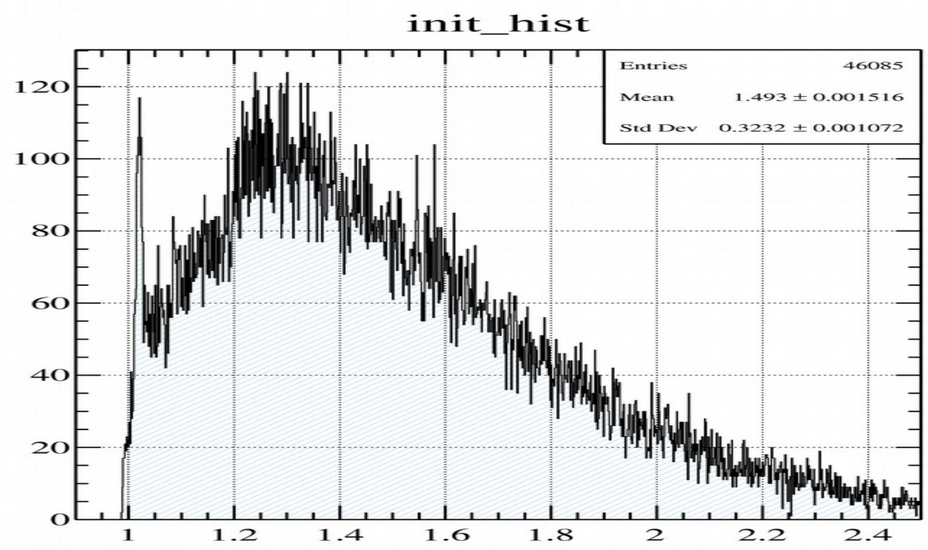
- I tried the study with two different kinematic distance measures:
  - One considered the phi distributions in the GJ frame
  - The other considered beam energy, t, missing energy, missing mass squared, and the kaon distributions in the HE frame

- Since the code is doing a double loop over the data, picking the nearest neighbors, and performing a fit; the time it took to test this approach was very long.

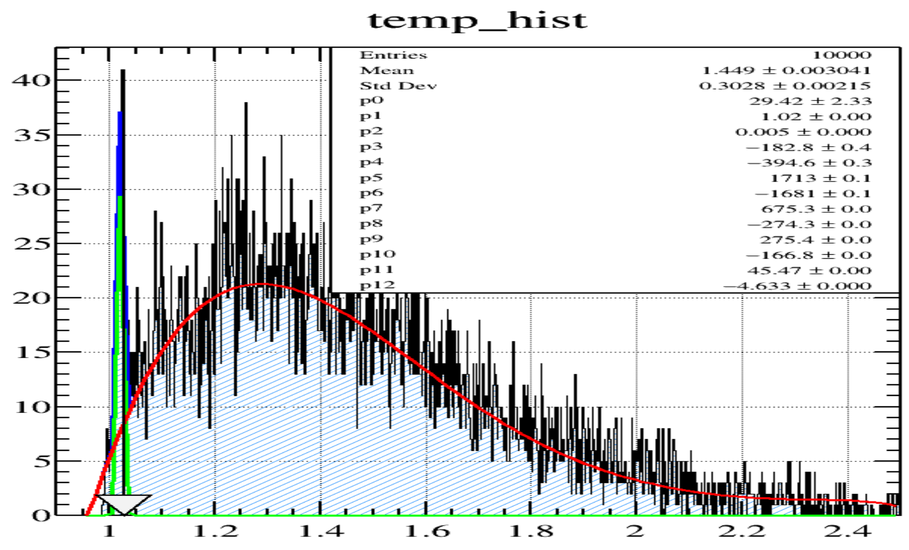
- Therefore, I only looked at two regions for the K+K- invariant mass; one that included the phi and one that included the rho background.

Qvalue Example Hists

Initial Hist (All Data)

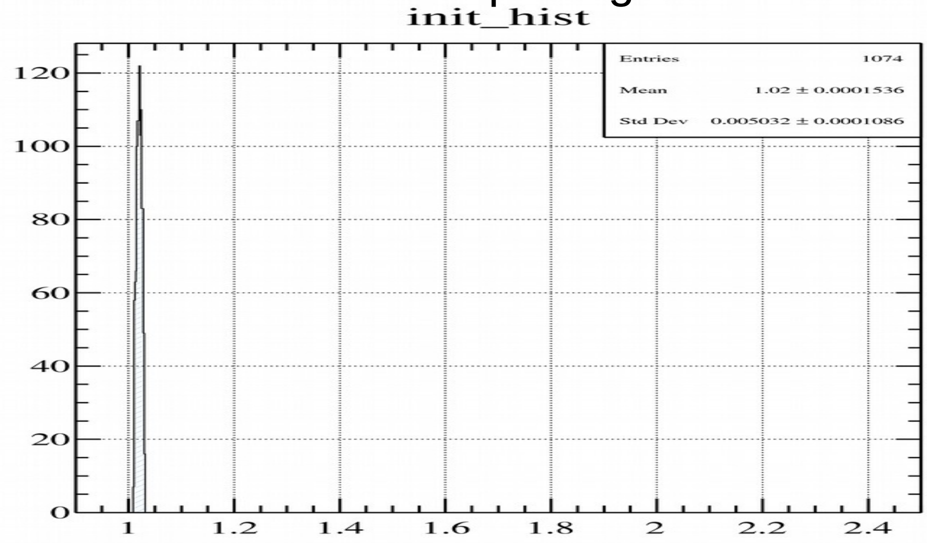


Example nearest neighbor fit

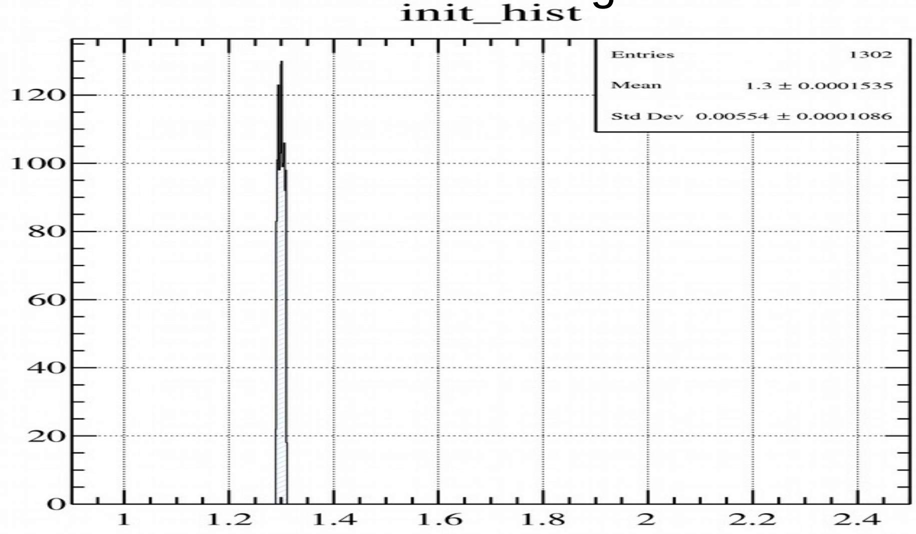


QValue Results for first kinematic distance hypothesis

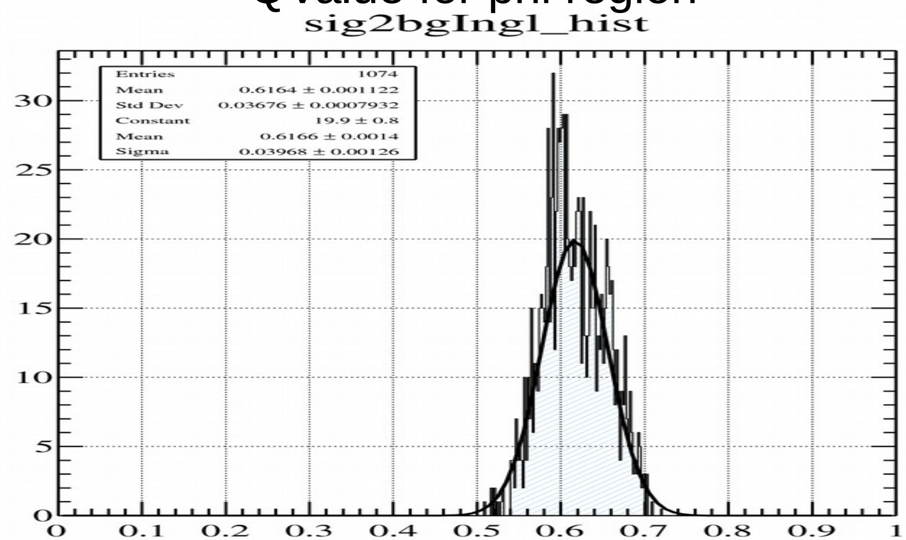
Selected phi region



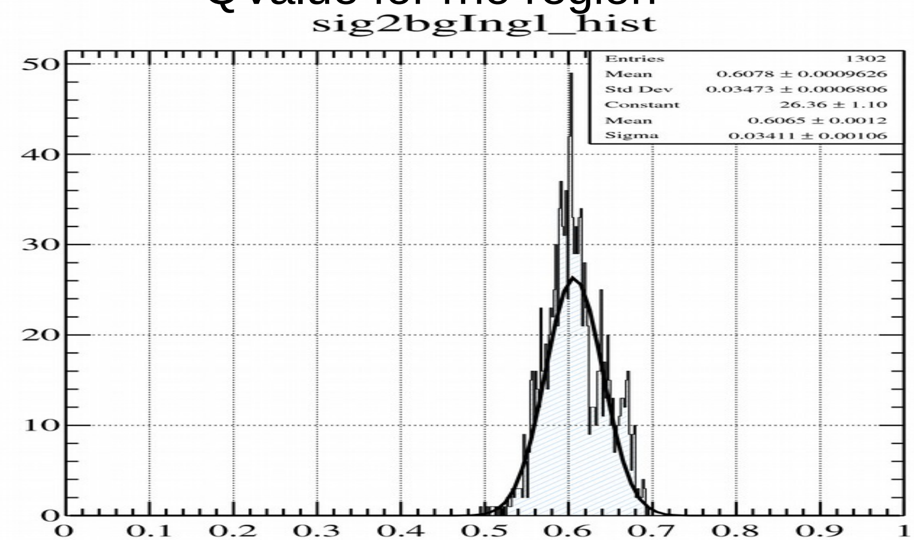
Selected rho region



QValue for phi region

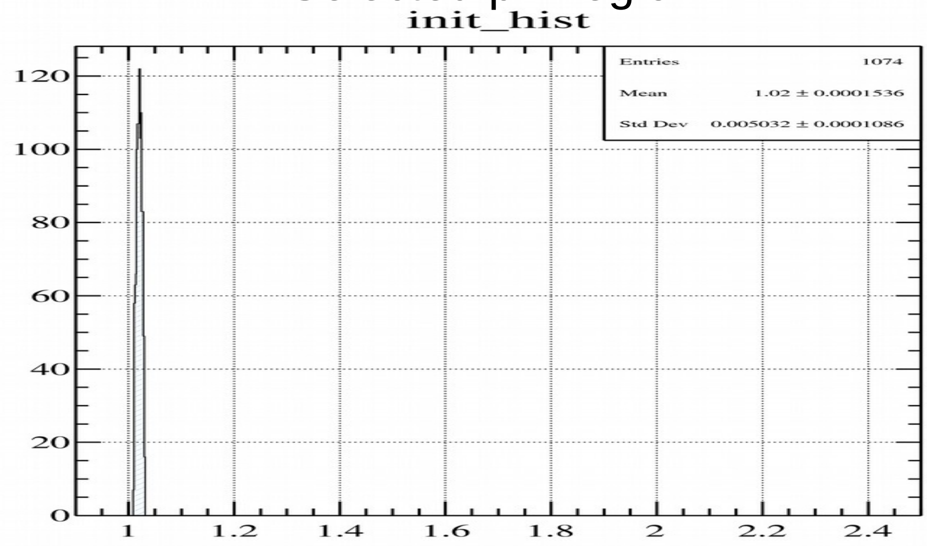


QValue for rho region

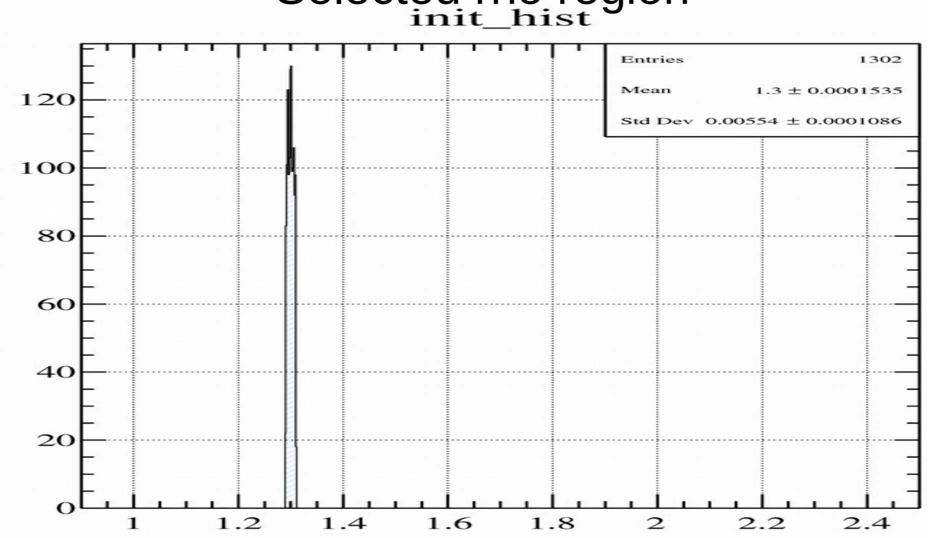


QValue Results for second kinematic distance hypothesis

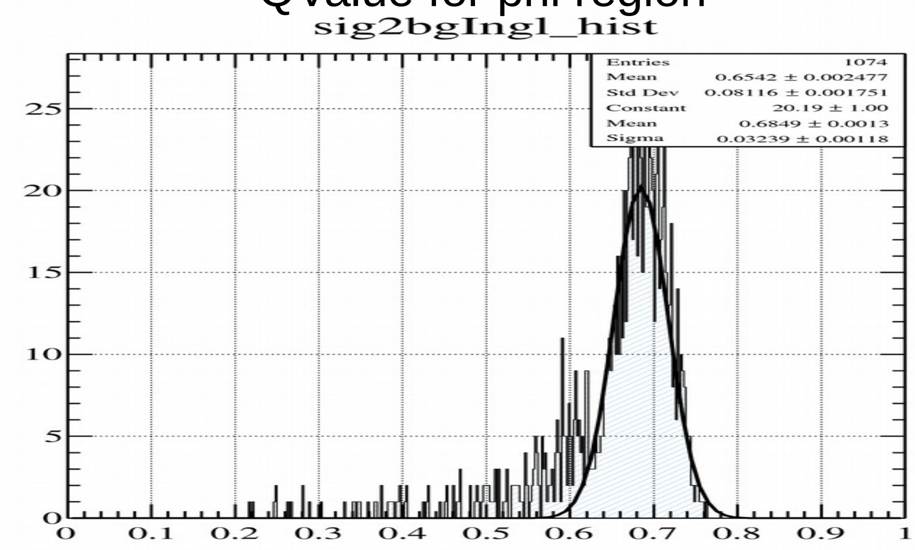
Selected phi region



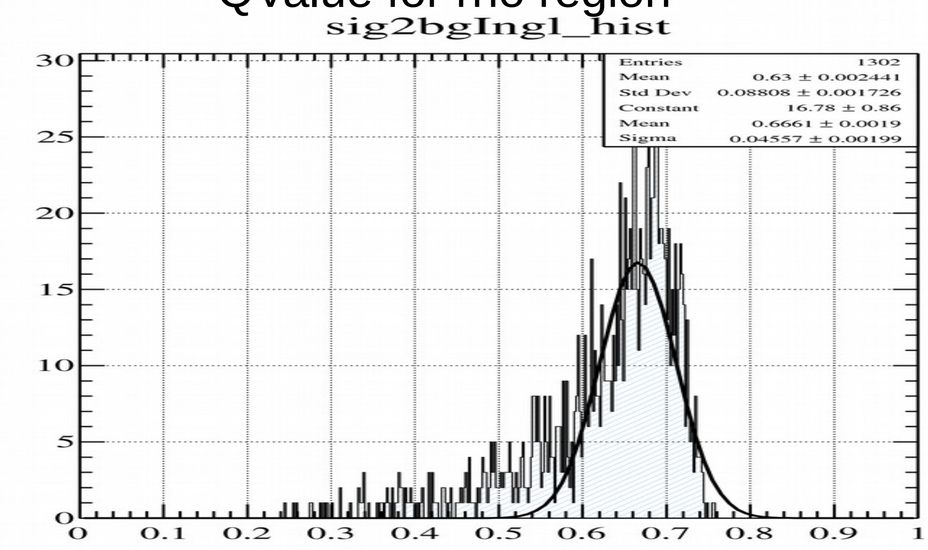
Selected rho region



QValue for phi region

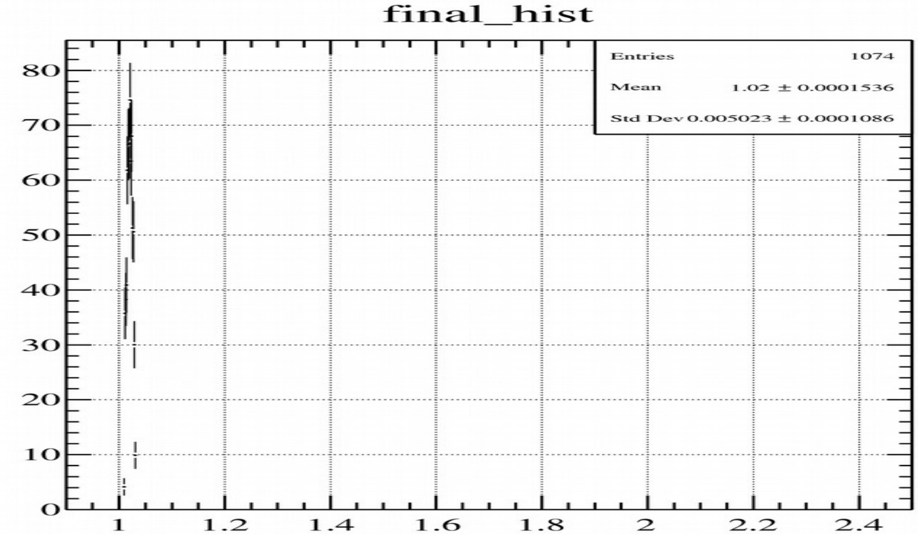


QValue for rho region

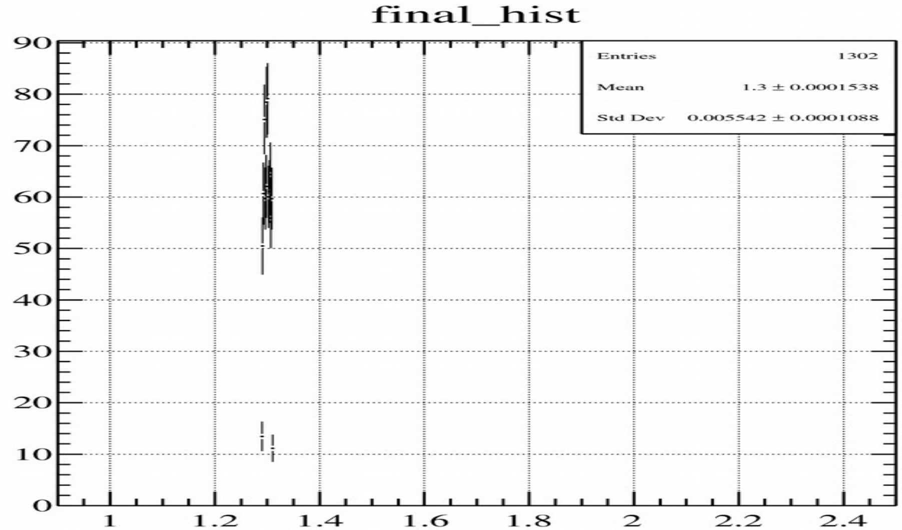


Invariant Mass results using QValues

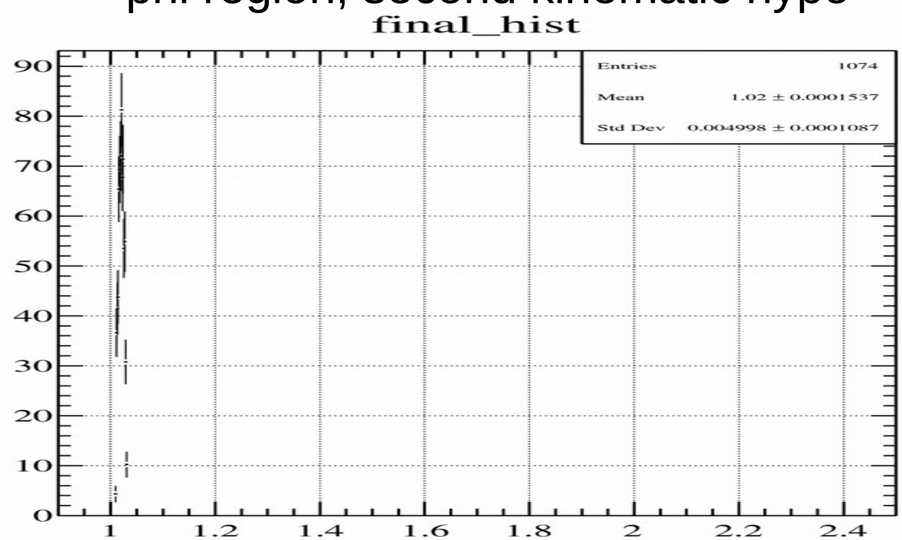
phi region, first kinematic hypo



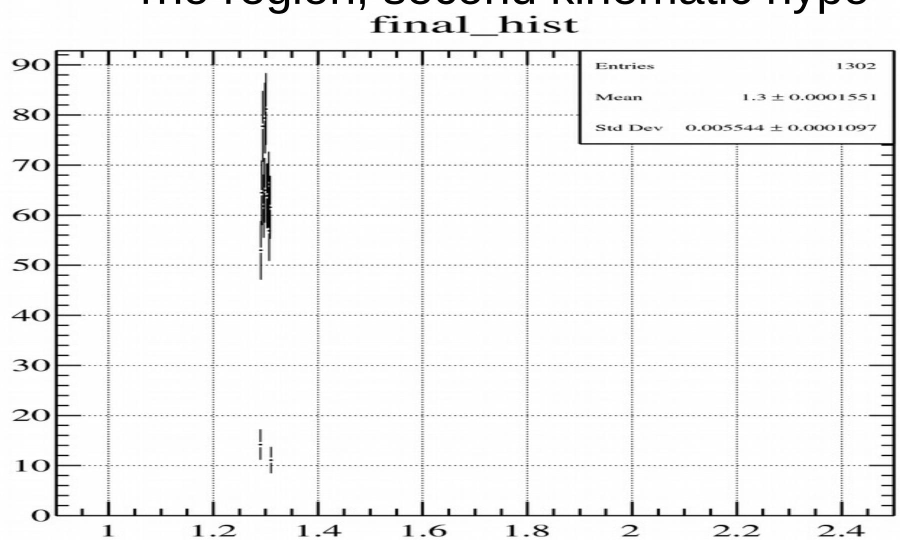
rho region, first kinematic hypo



phi region, second kinematic hypo



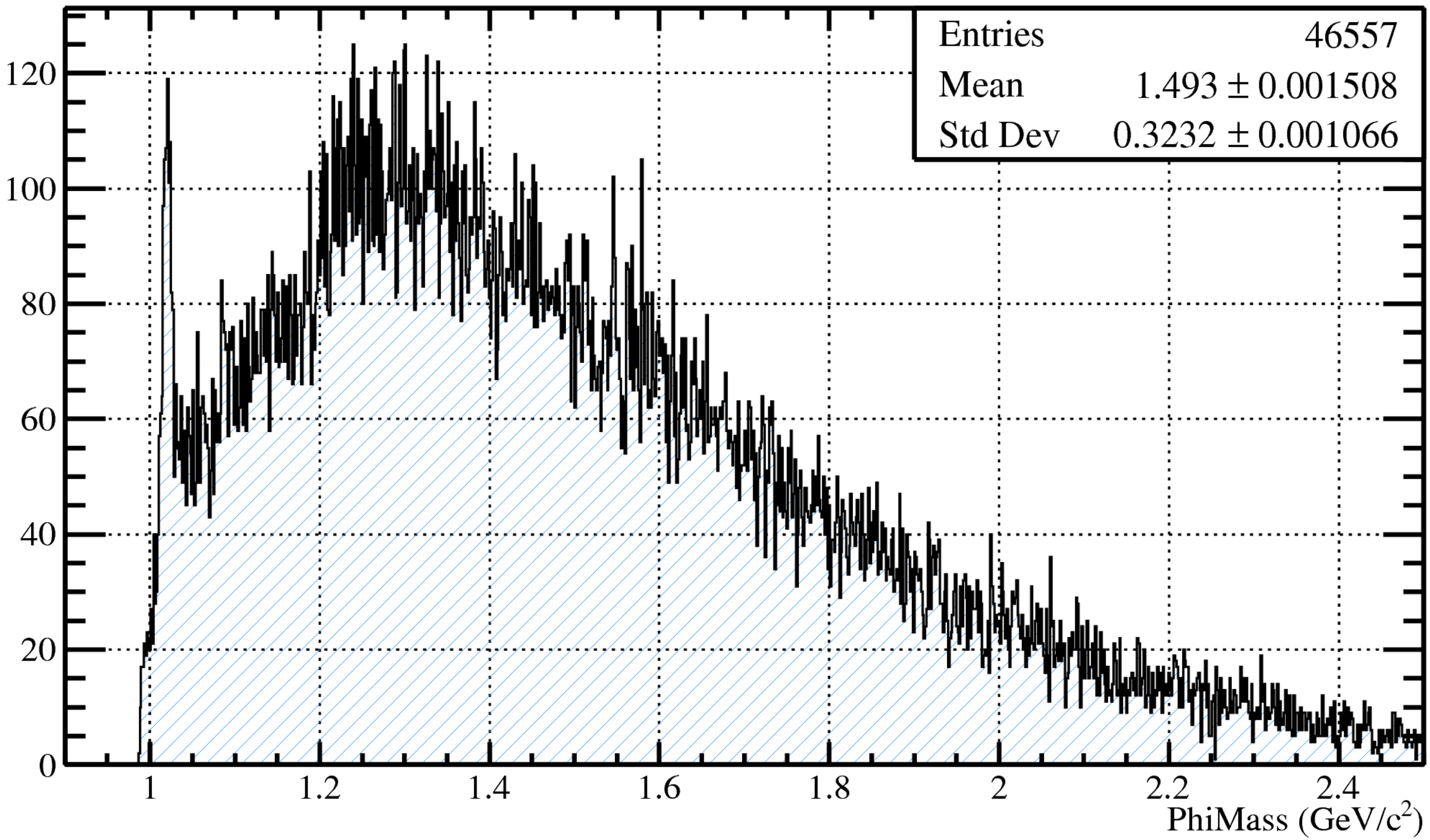
rho region, second kinematic hypo



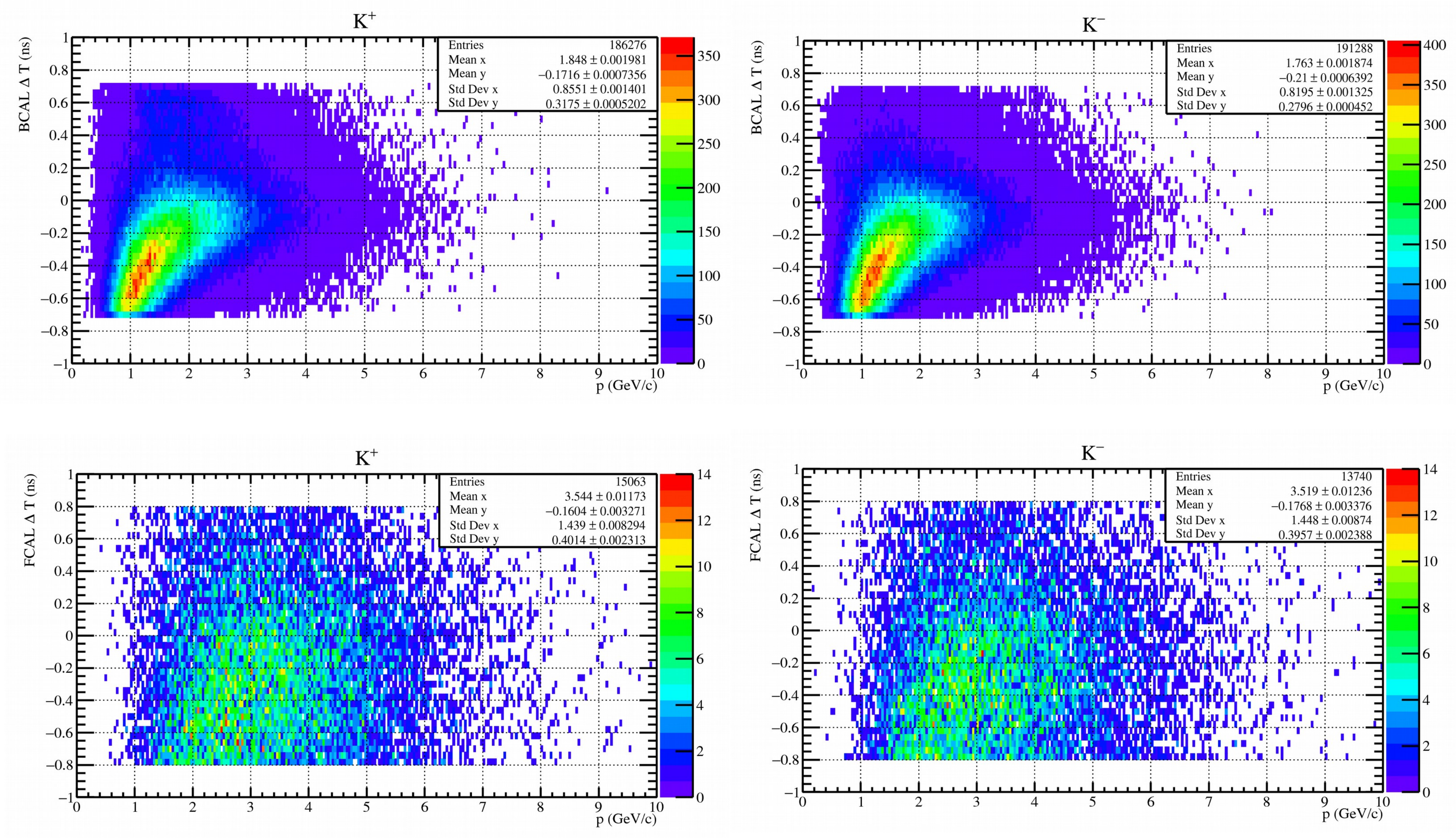
Thoughts on the QValue:

- Clearly did not show any sign of being able to differentiate between signal and background for this channel.
- Even if it did work, it would have been a headache to implement
- Running over the phi or rho regions took about 3hrs + 45 min for only ~1000 events!
- Is there another approach or cut we can make to reduce the background while preserving signal statistics? (Yes, next slide)

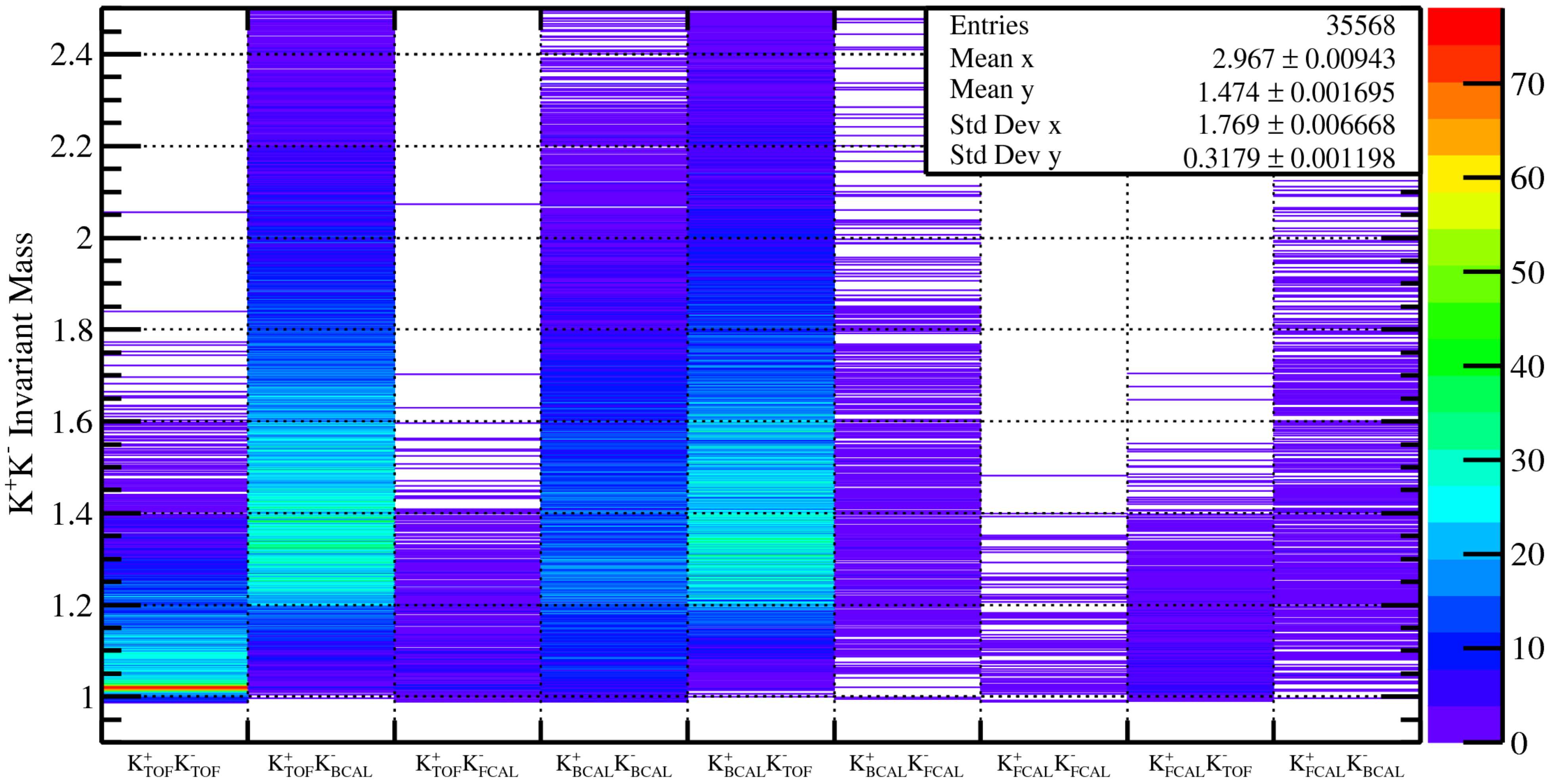
Where does the majority of the background in the K+K- invariant mass spectrum come from?



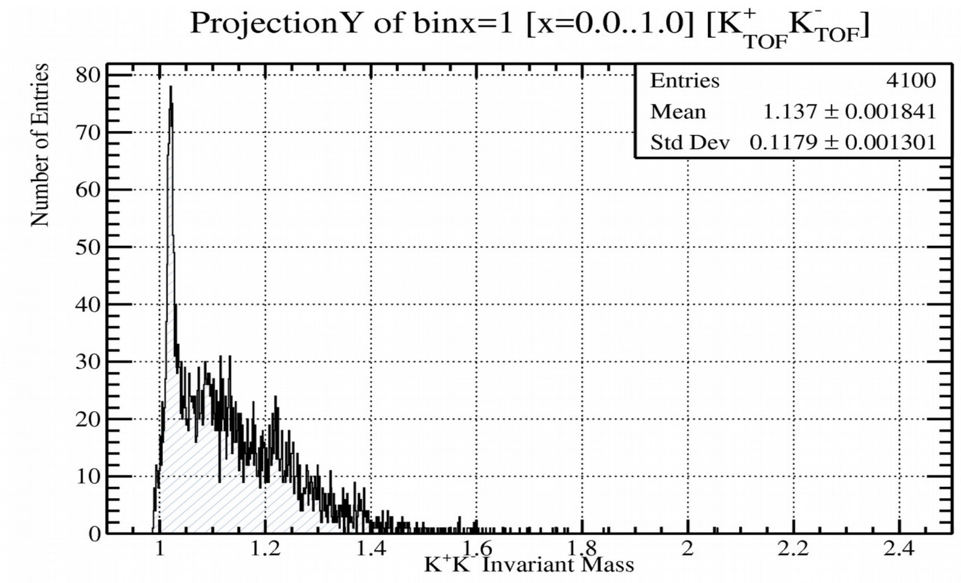
Kaon Timing Plots other than TOF:

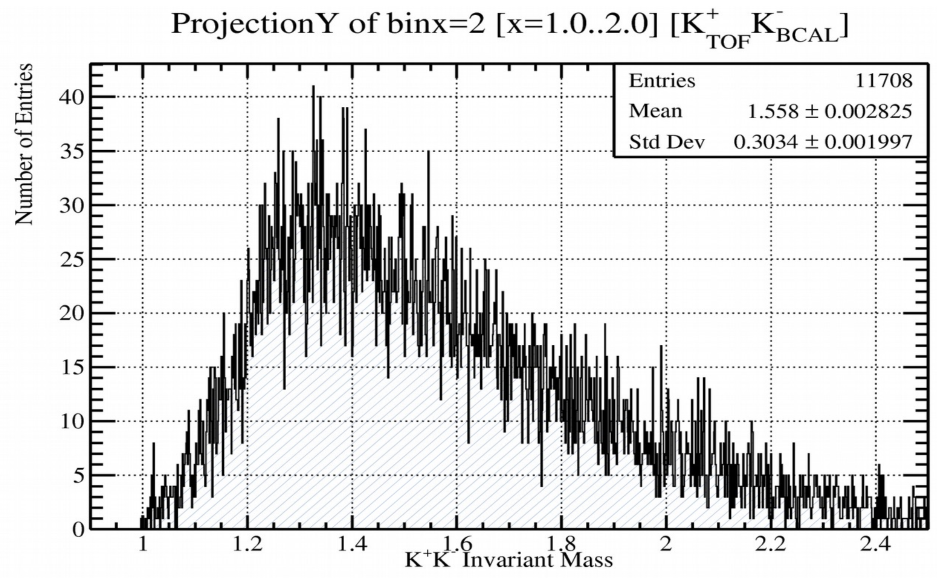


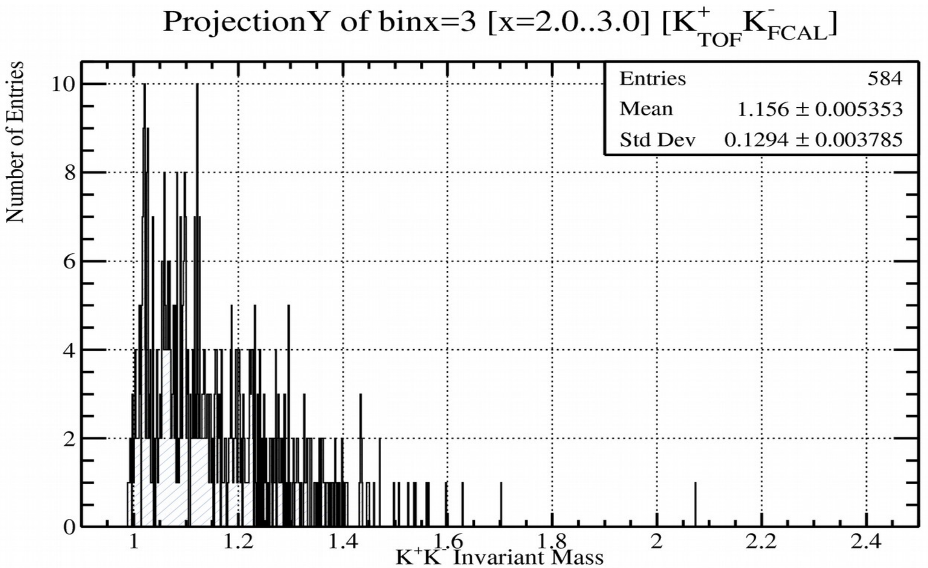
K+K- Invariant mass Vs K+/- Timing Detectors



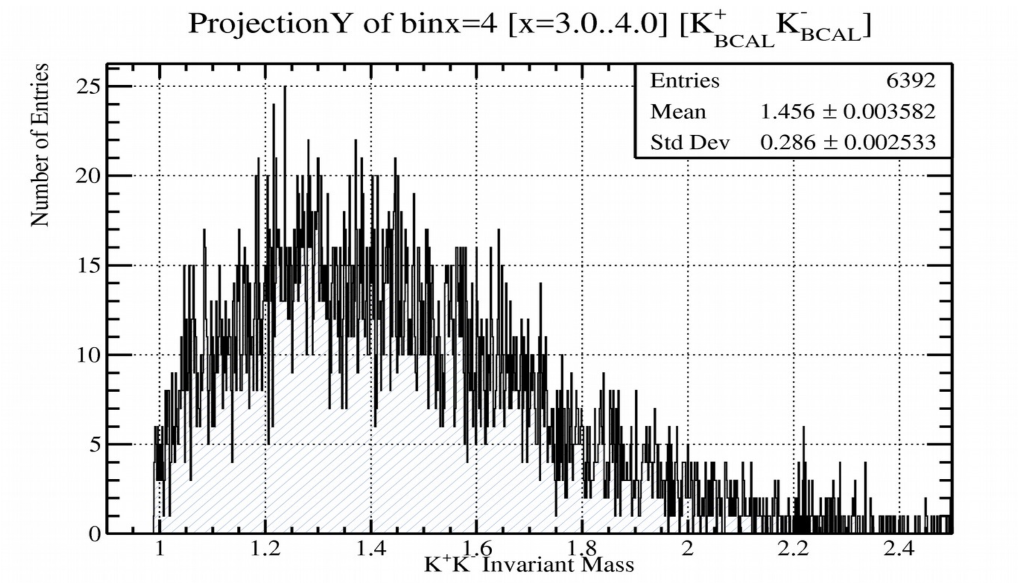
K+K- Invariant mass Vs K+/- Timing Detectors Projections

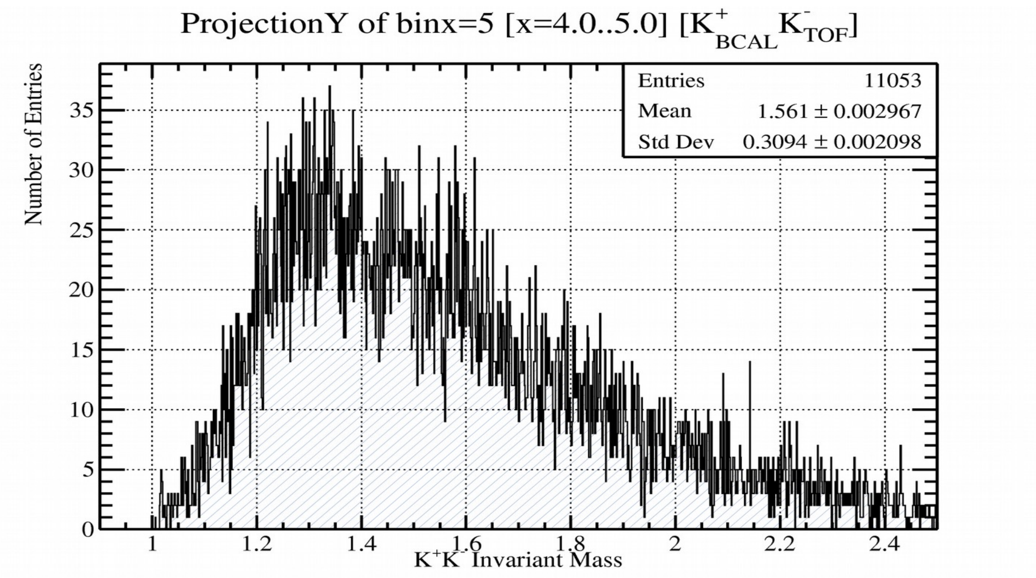


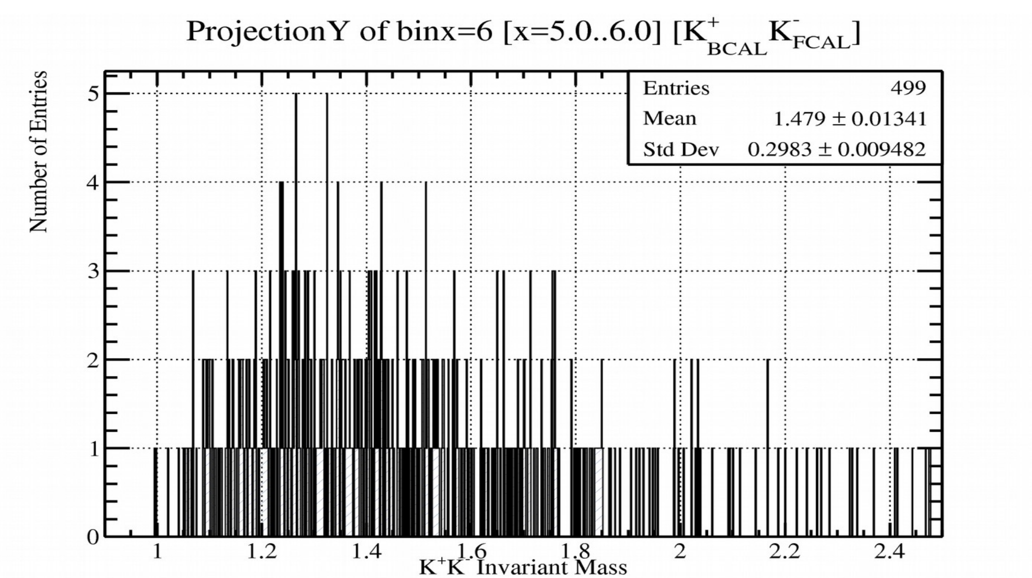




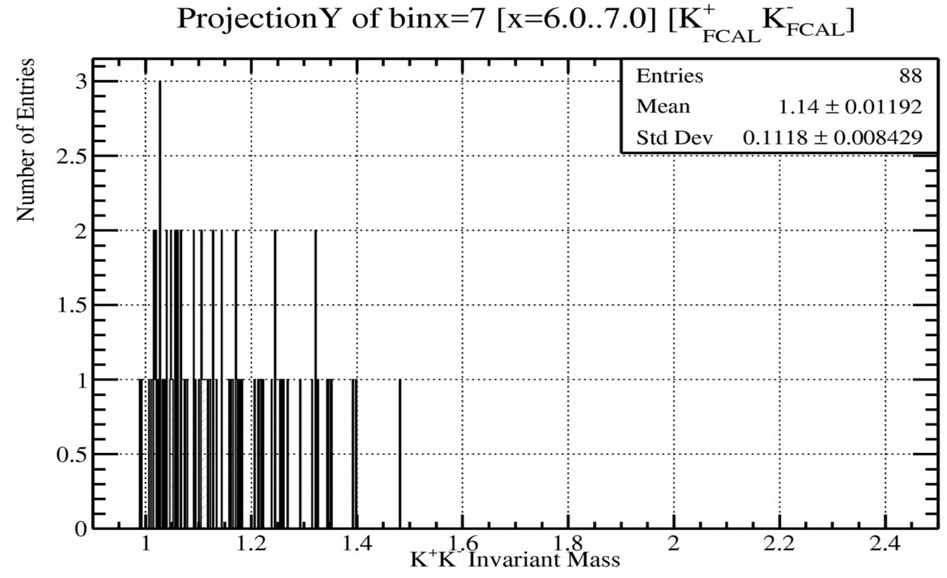
K+K- Invariant mass Vs K+/- Timing Detectors Projections

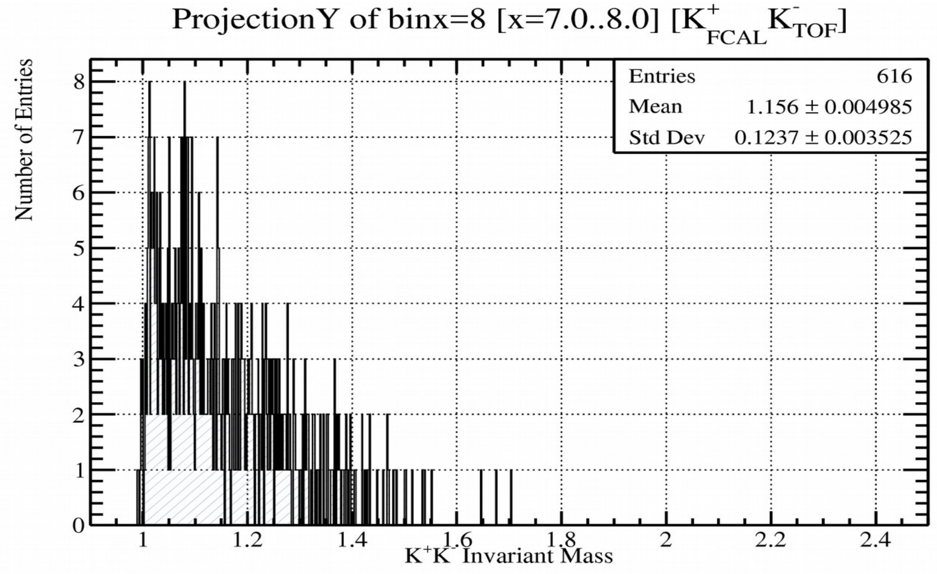


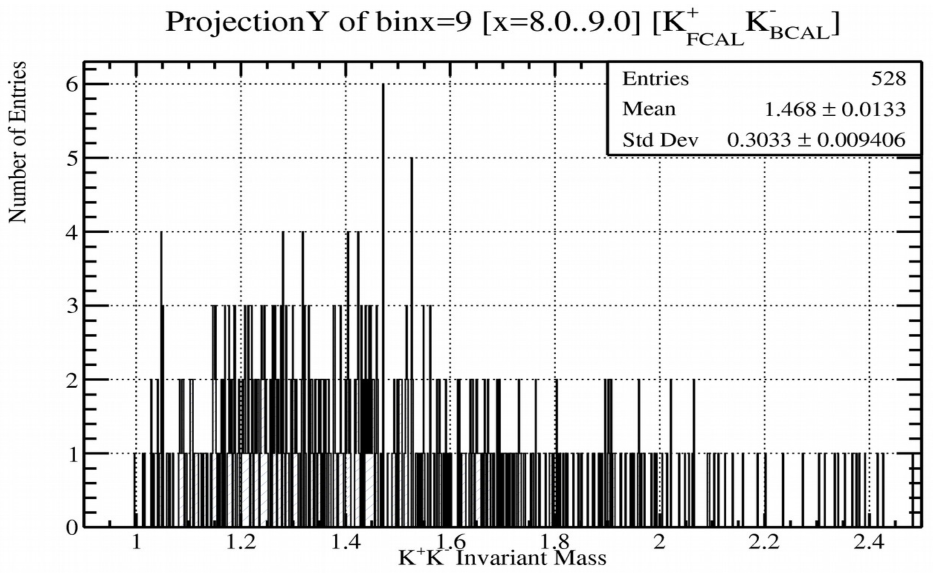




K+K- Invariant mass Vs K+/- Timing Detectors Projections





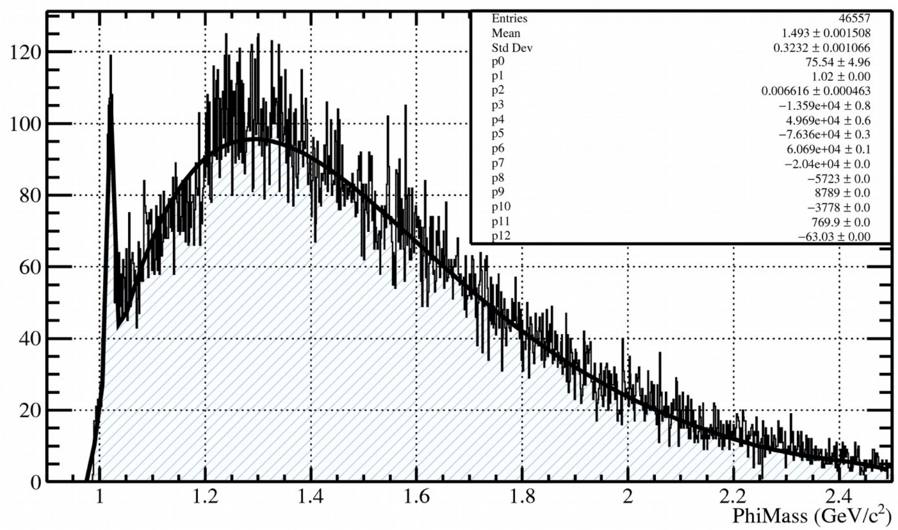


Thoughts on the Kaon Timing:

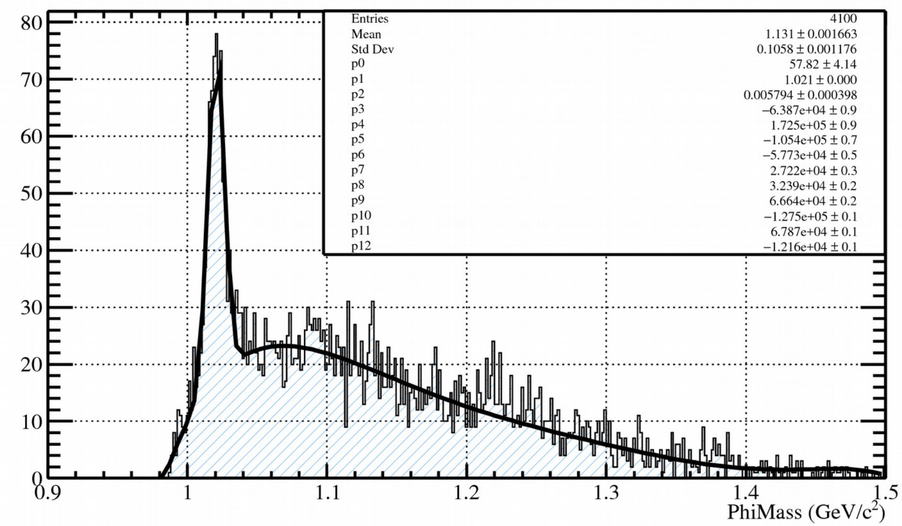
- The best way to identify the phi with my channel is using only the TOF and nothing else
- There may be other detectors that observe a phi. However, there appears to be so much background associated with the FCAL/BCAL that it seems more logical to just throw them out
- Initially I didn’t want to perform a cut like this out of fear that it would hurt any possibility of performing an angular distribution study
- You both may think of a better way to perform this cut. But for now I allow kaon timing to only come from the TOF.

Kaon Timing Cut Impact

Before Cut



After Cut



Fit Results:

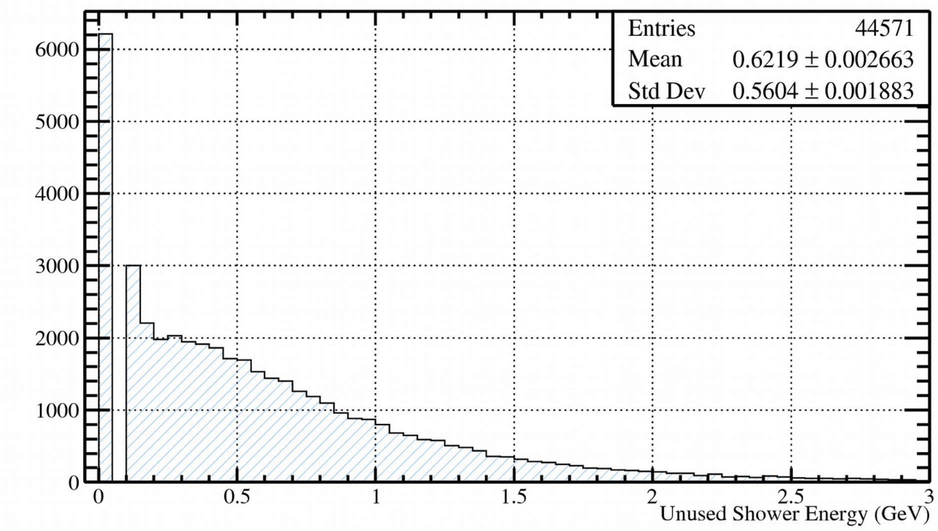
Signal Events: 533
Background Events: 518
S/BG: 1.029
Total BG: 25417

Fit Results:

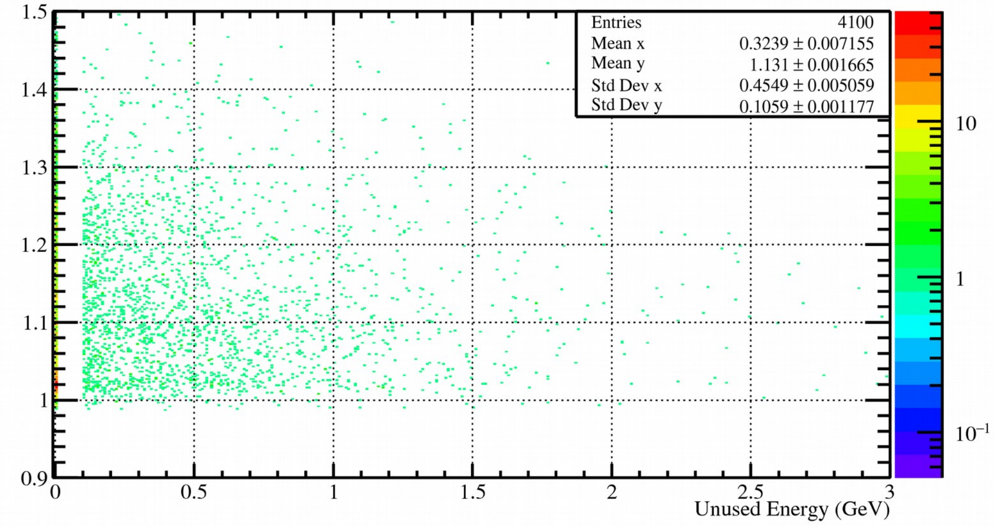
Signal Events: 469 (-12%)
Background Events: 219 (-58%)
S/BG: 2.138 (+208%)
Total BG: 3293 (-87%)

Unused Energy Cut (after TOF Cut)

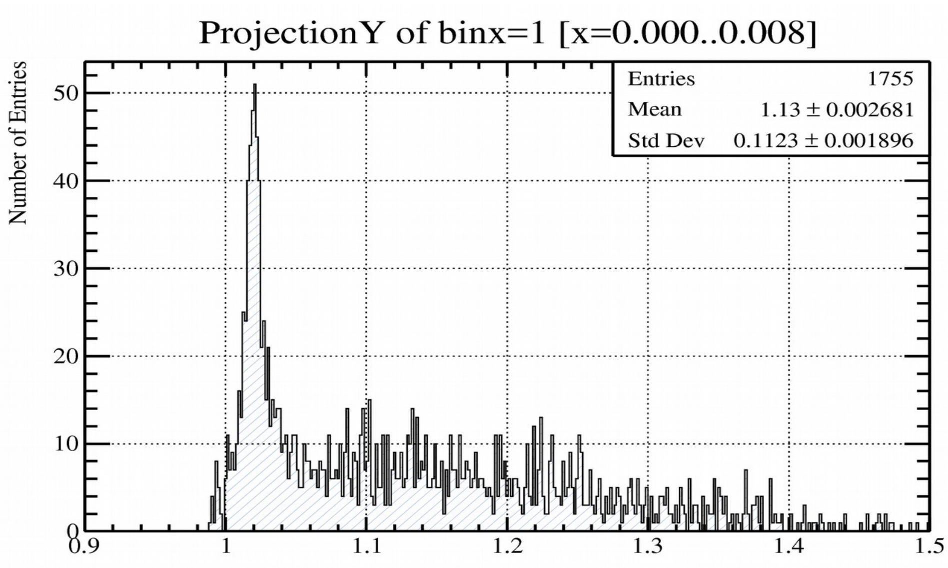
Unused Energy Distribution



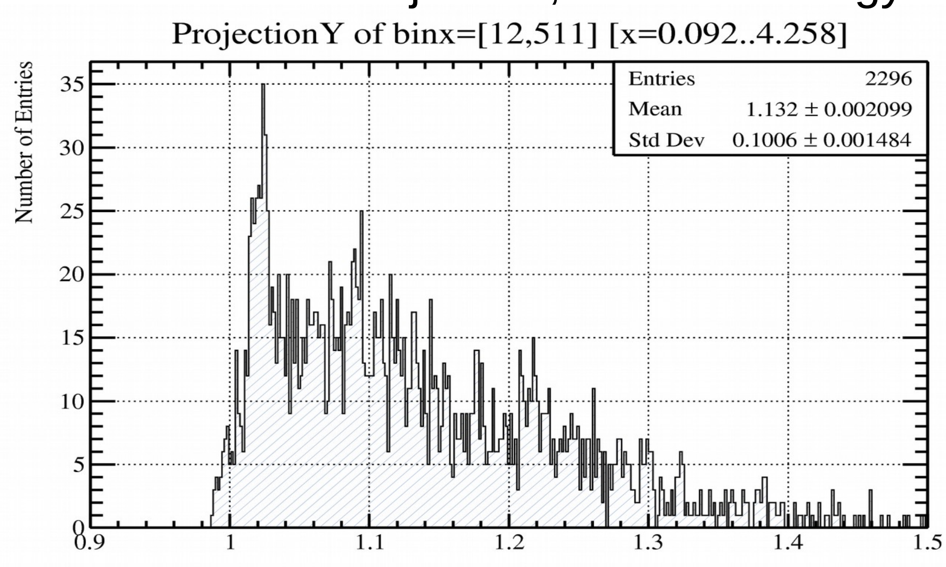
K+ K- Mass Vs Unused Energy Distribution



K+ K- Mass Projection; Unused Energy = 0

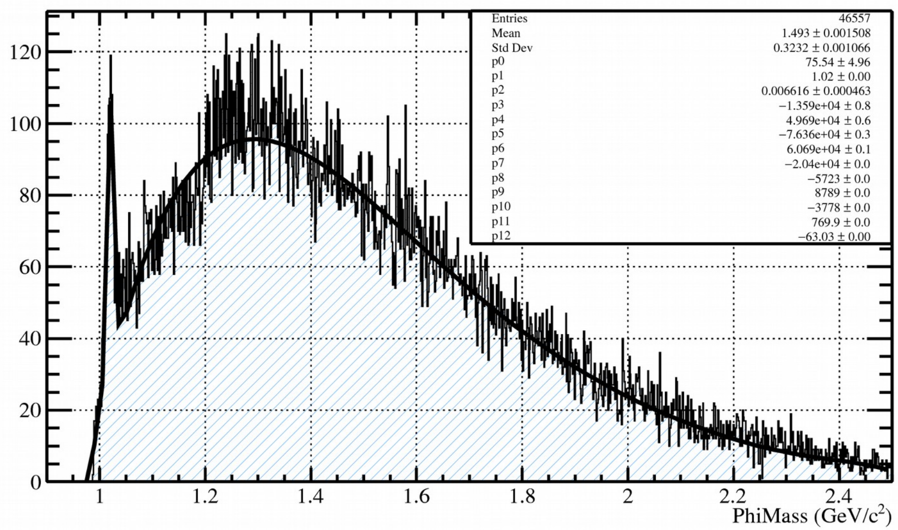


K+ K- Mass Projection; Unused Energy > 0



TOF+Unused Energy Cut Impact

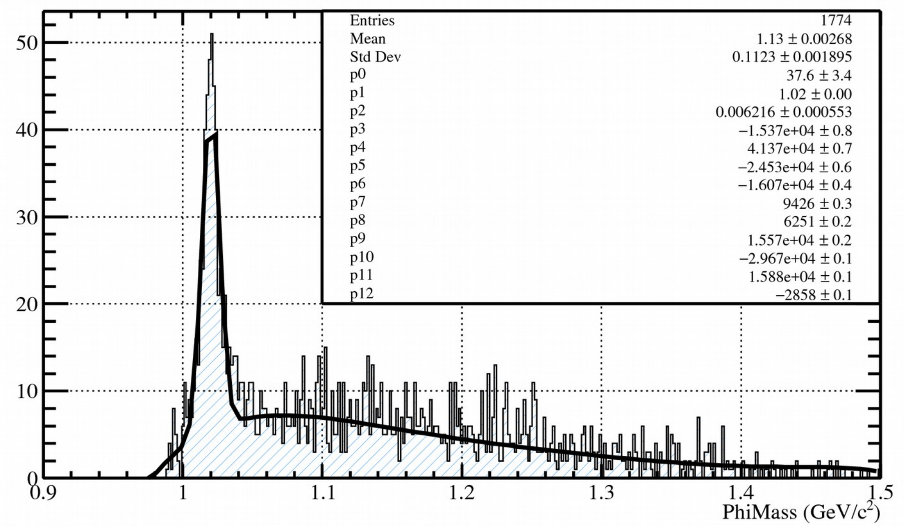
Before Cuts



Fit Results:

Signal Events: 533
Background Events: 518
S/BG: 1.029
Total BG: 25417

After Cuts



Fit Results:

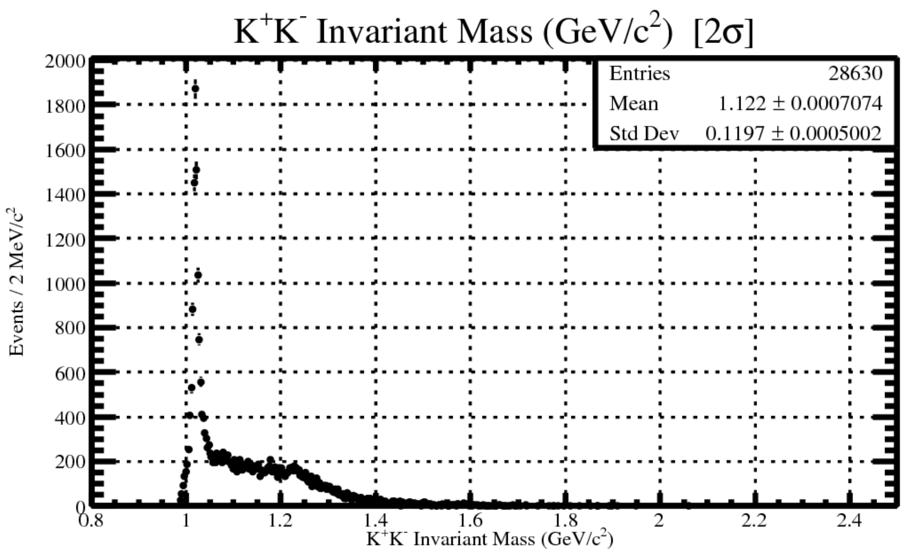
Signal Events: 303 (-43%)
Background Events: 94 (-82%)
S/BG: 3.205 (+311%)
Total BG: 1244 (-95%)

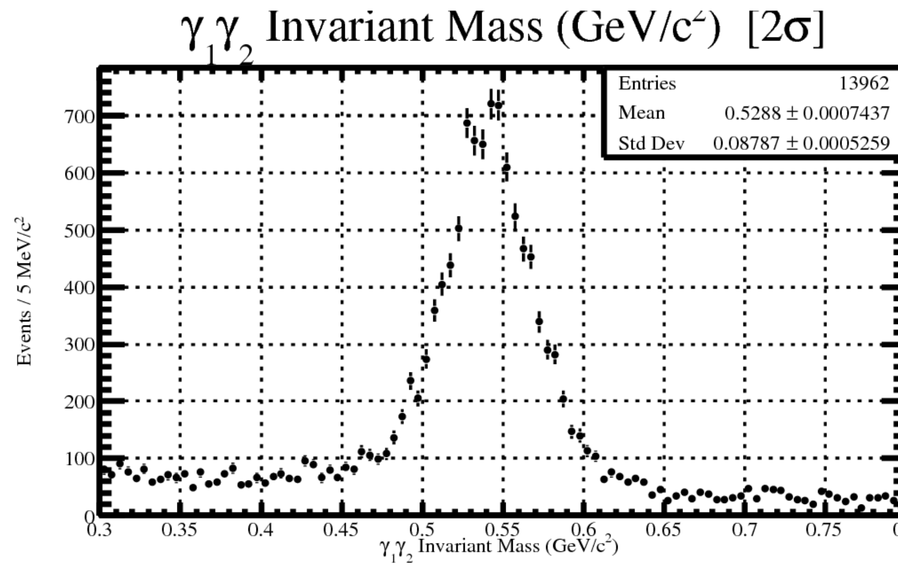
List of Preliminary Final Cuts:

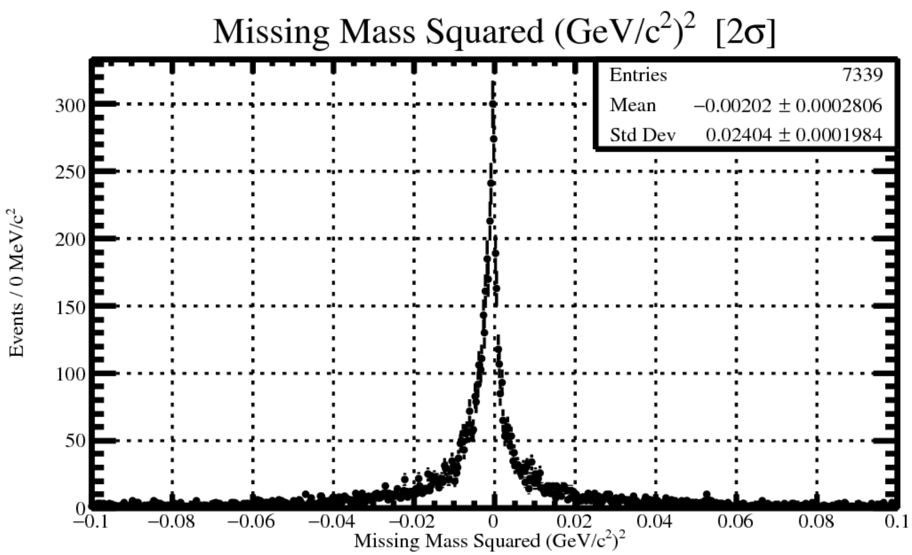
- Delta T for each particle species and sub detector
- Beam Energy Cut
- Beam Bunch Cut (RF Time)
- Vertex Cuts
- P vs Theta Cut for Photons (Reduces Secondaries)
- Number of photons reconstructed in the event
- Kaons are only allowed to get timing from TOF
- Unused Energy < 50 MeV

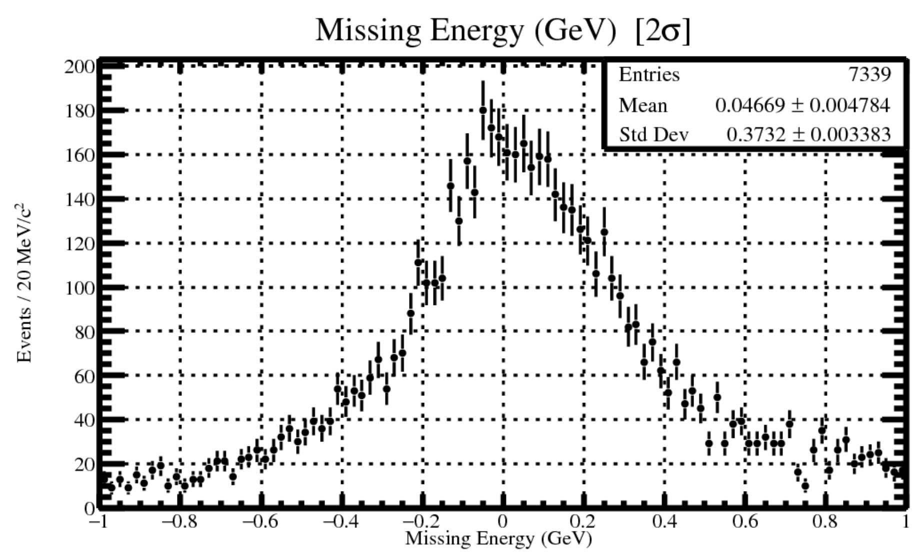
- NOT INCLUDED: Signal Kinematic Fitter Confidence Level
- NOT INCLUDED: Background Kinematic Fitter Confidence Level

Results for All Data, All Cuts

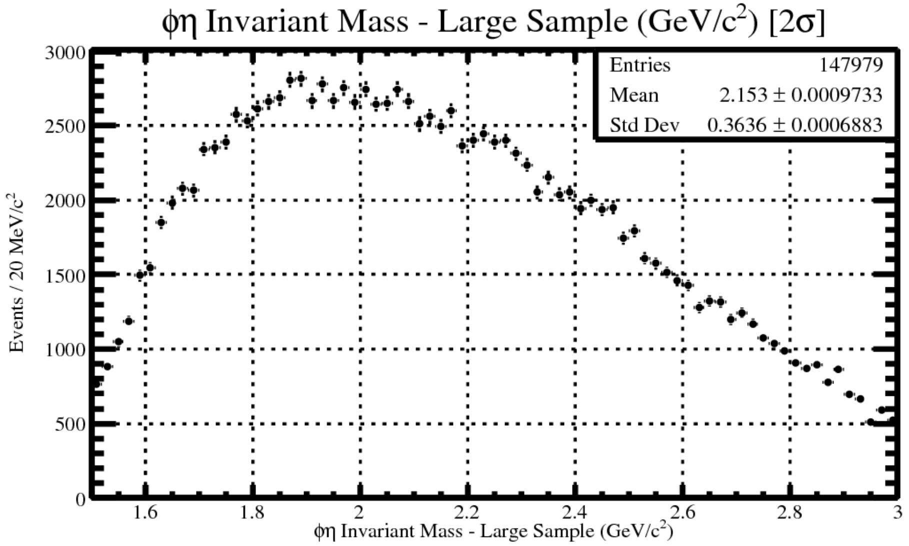


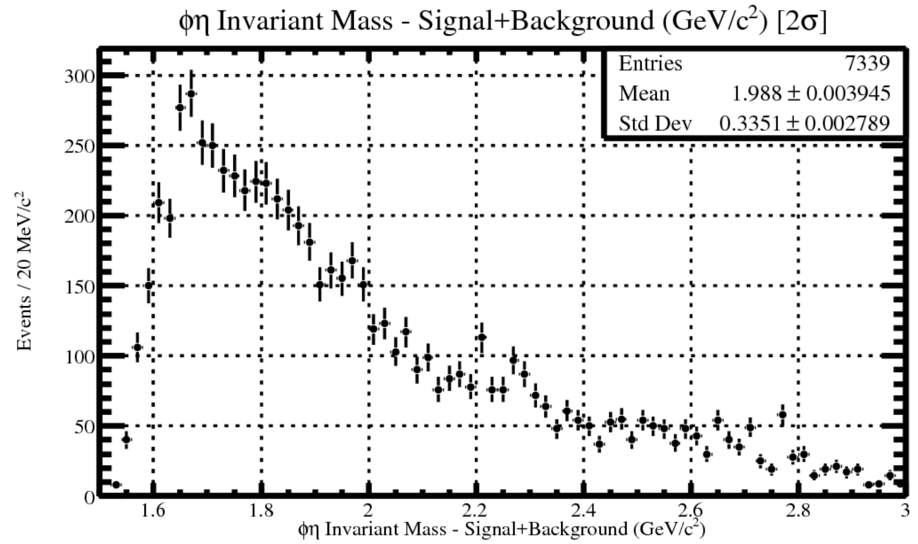


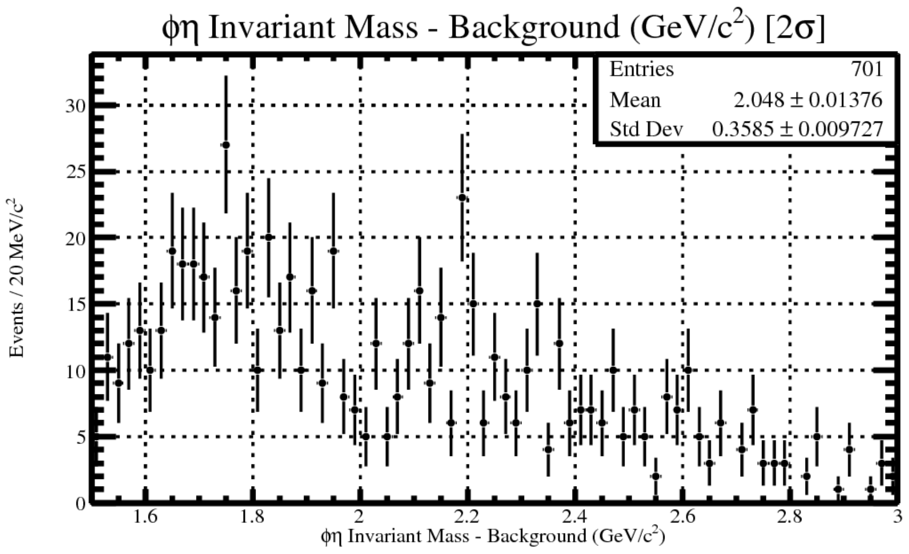


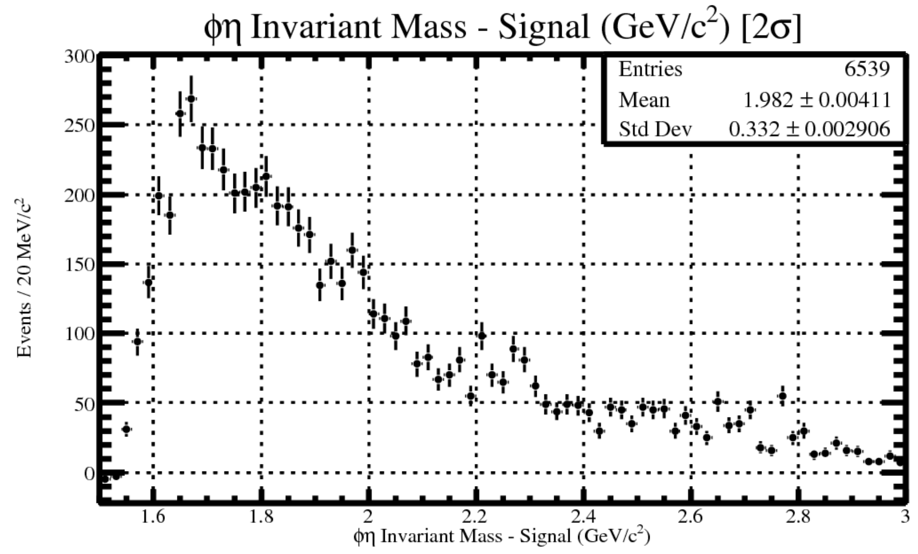


Results for All Data, All Cuts

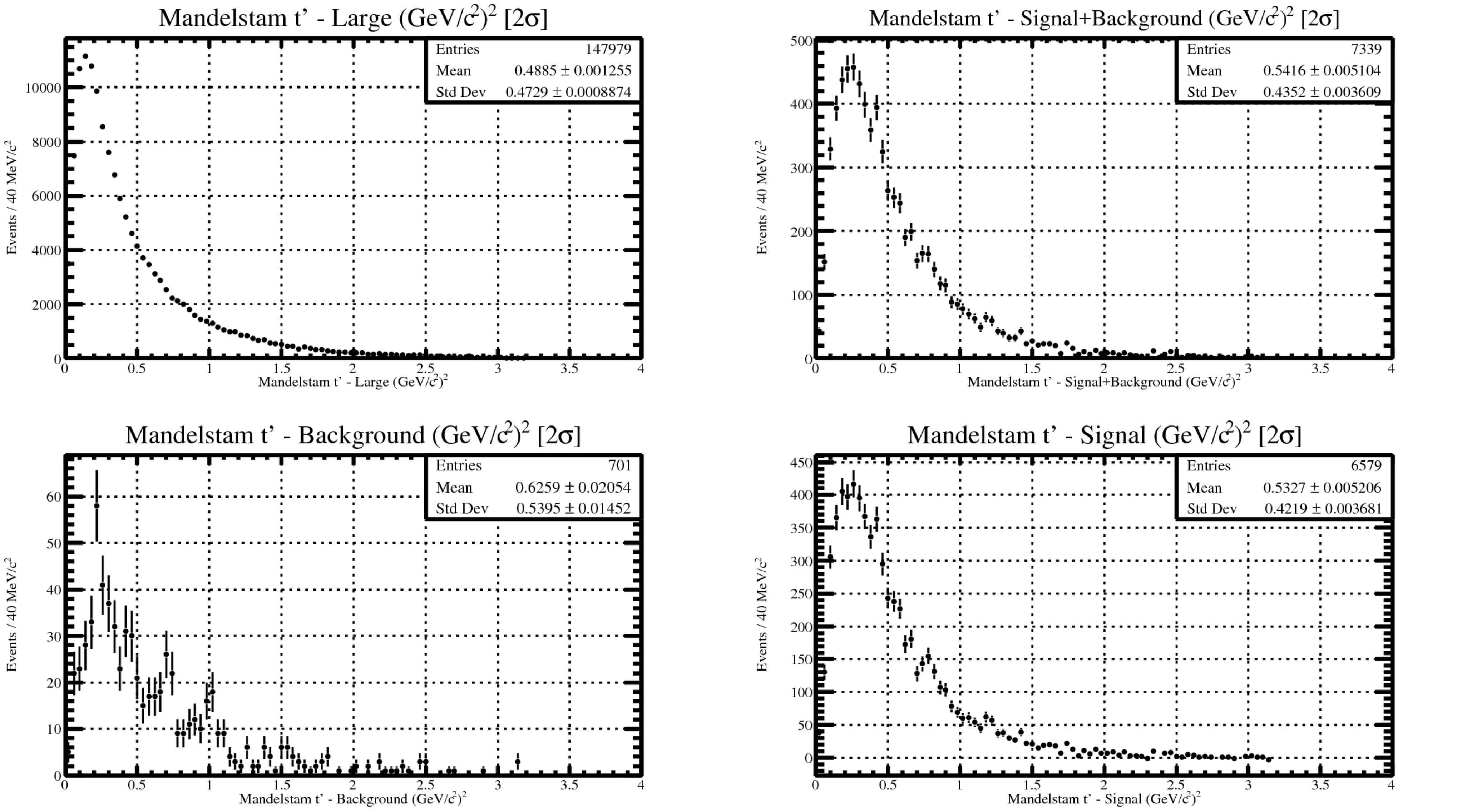




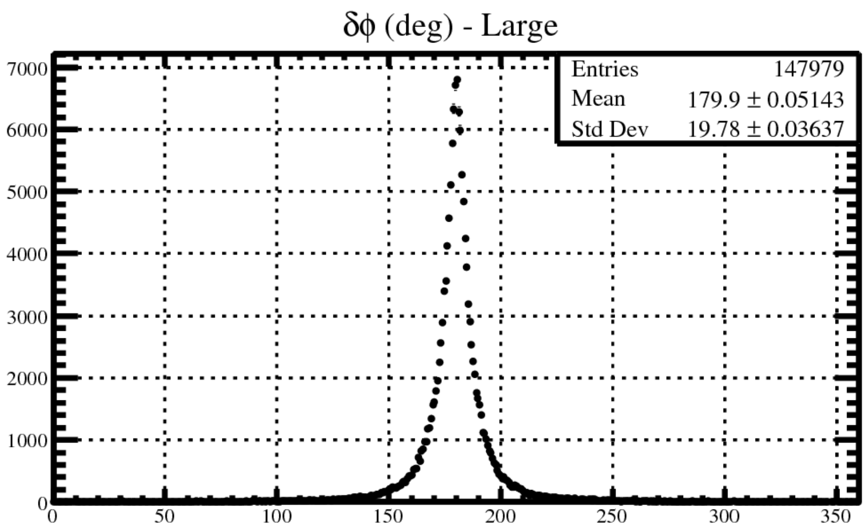


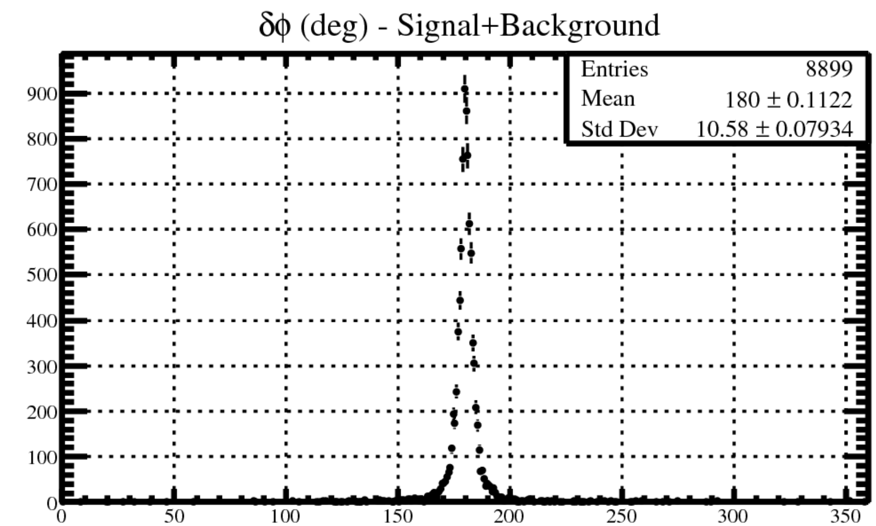


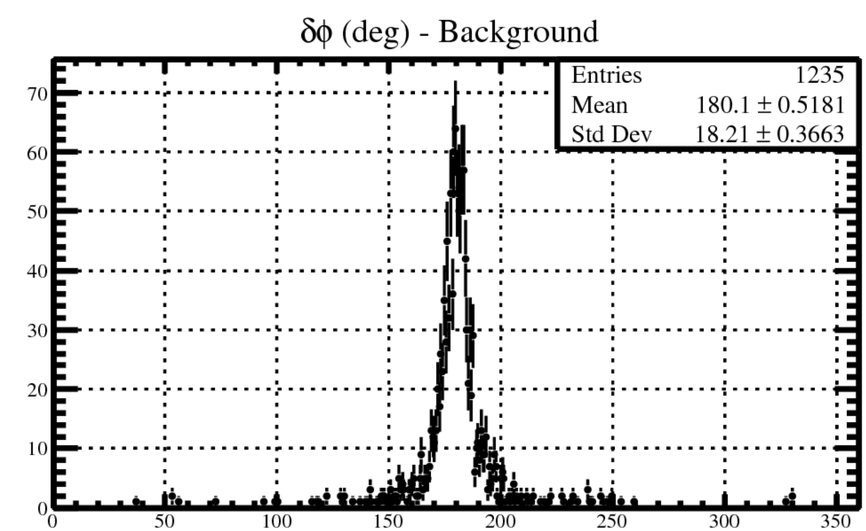
Results for All Data, All Cuts

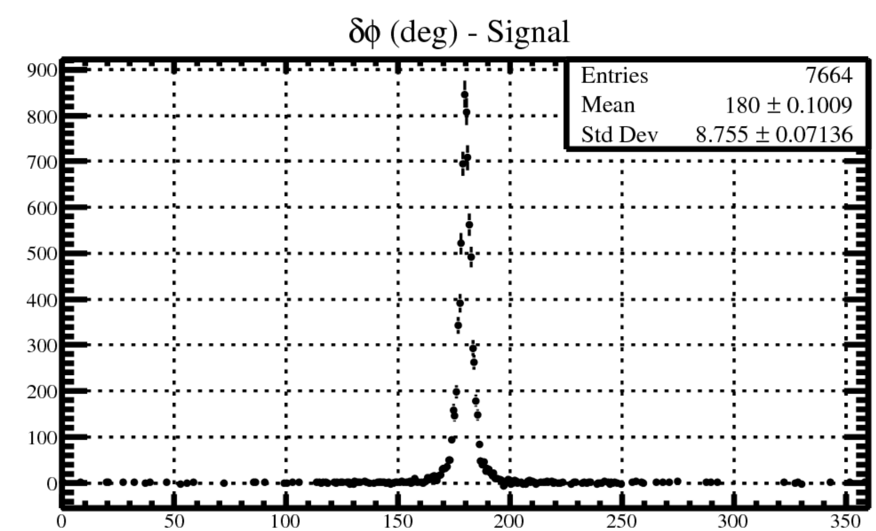


Results for All Data, All Cuts

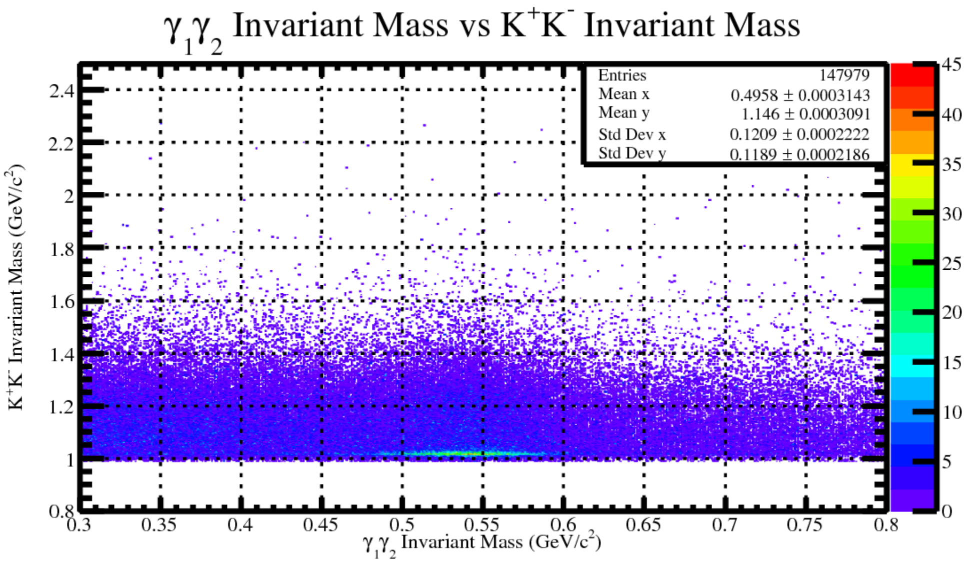


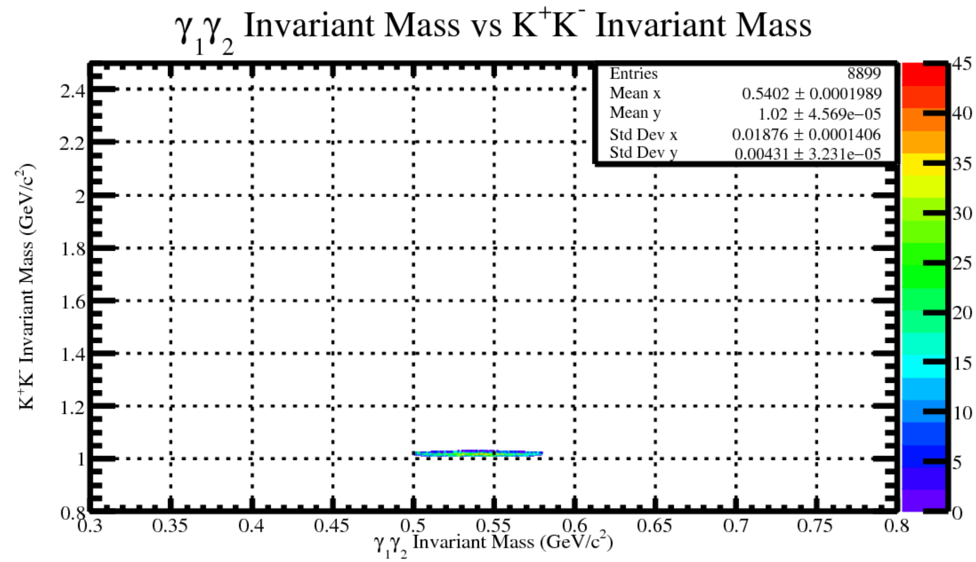


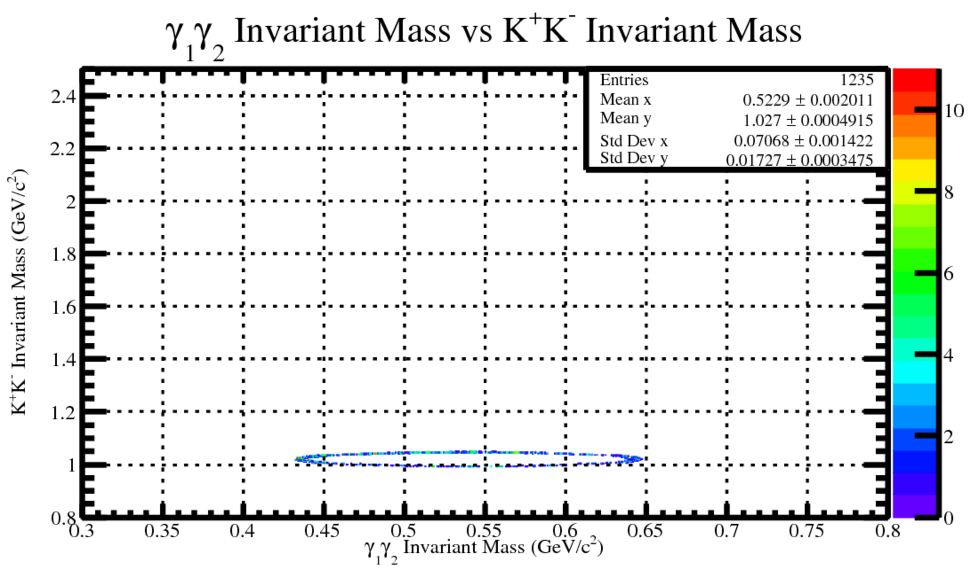


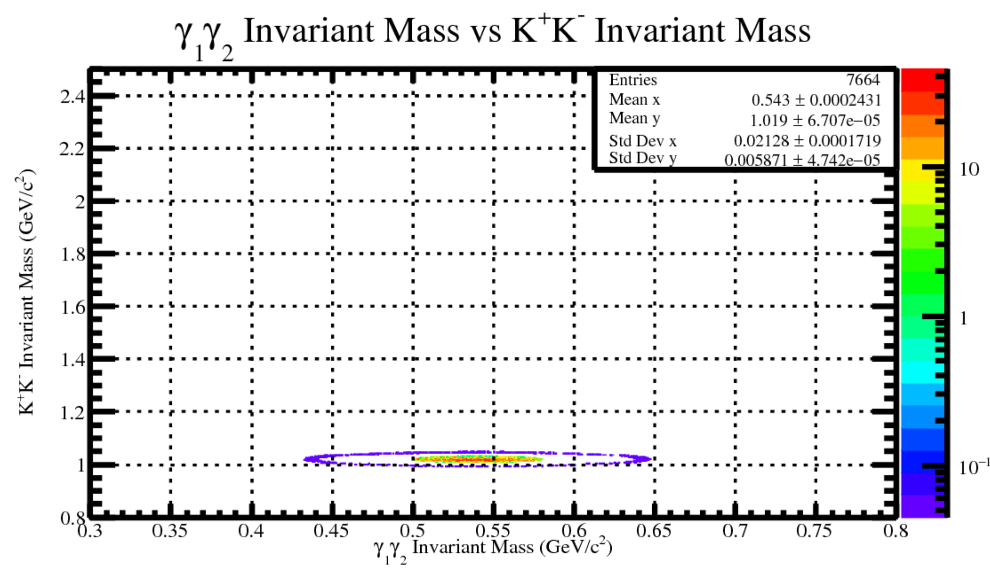


Results for All Data, All Cuts









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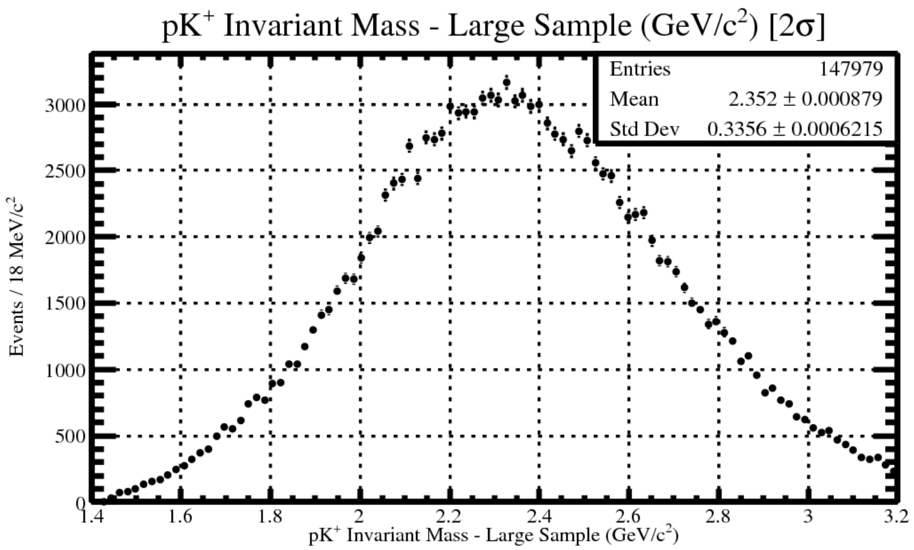
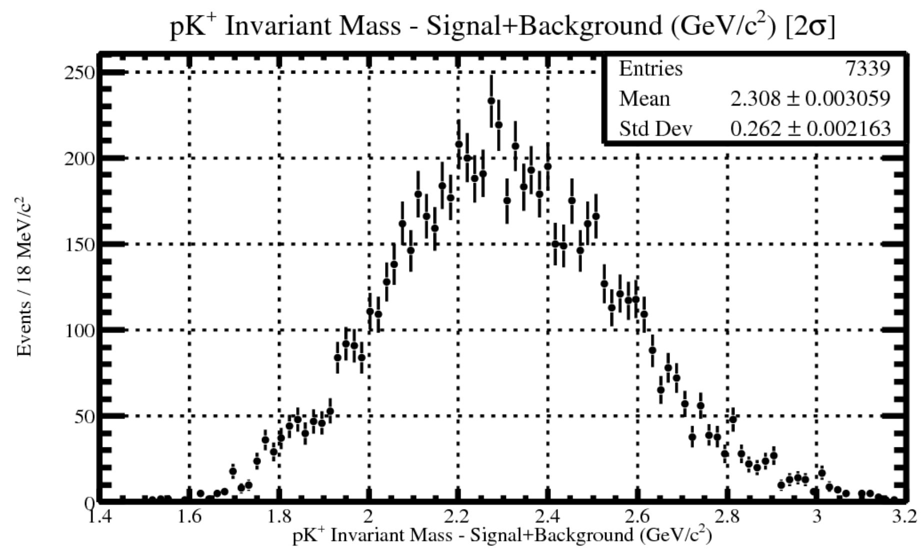
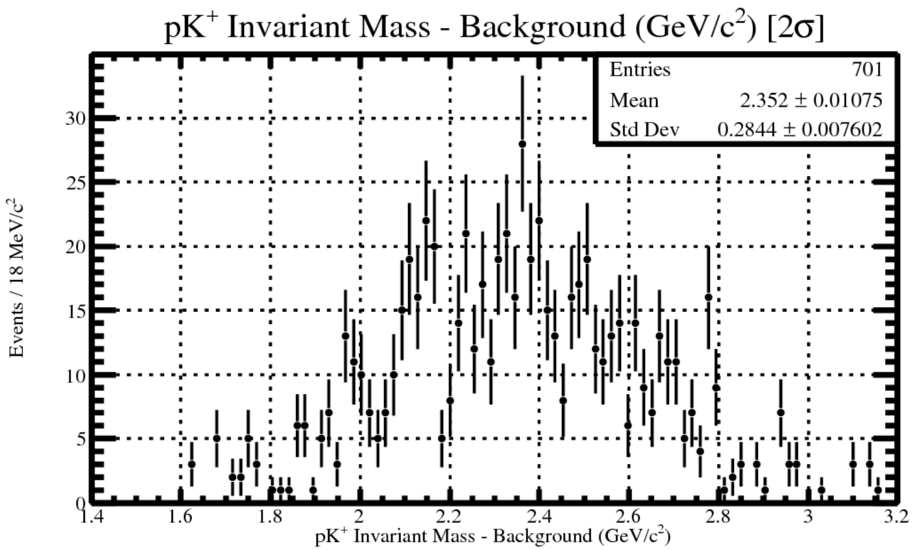
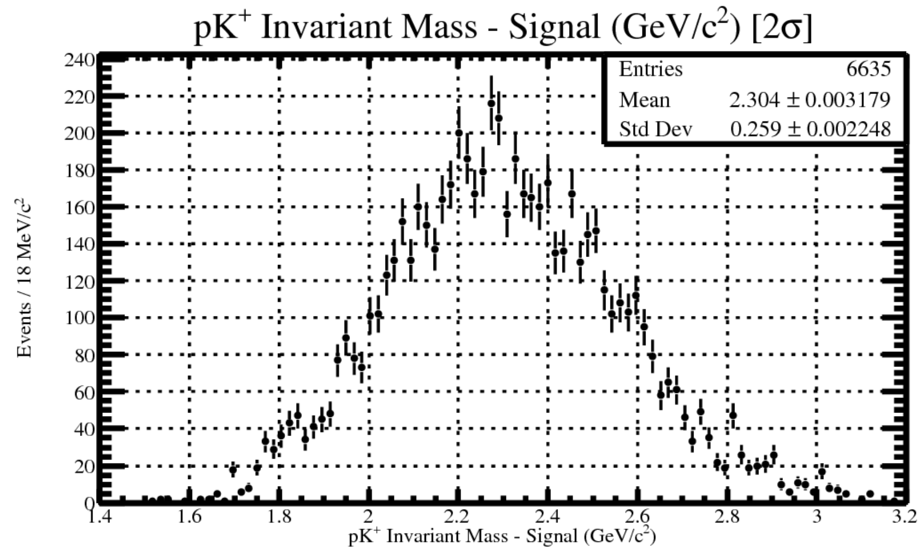
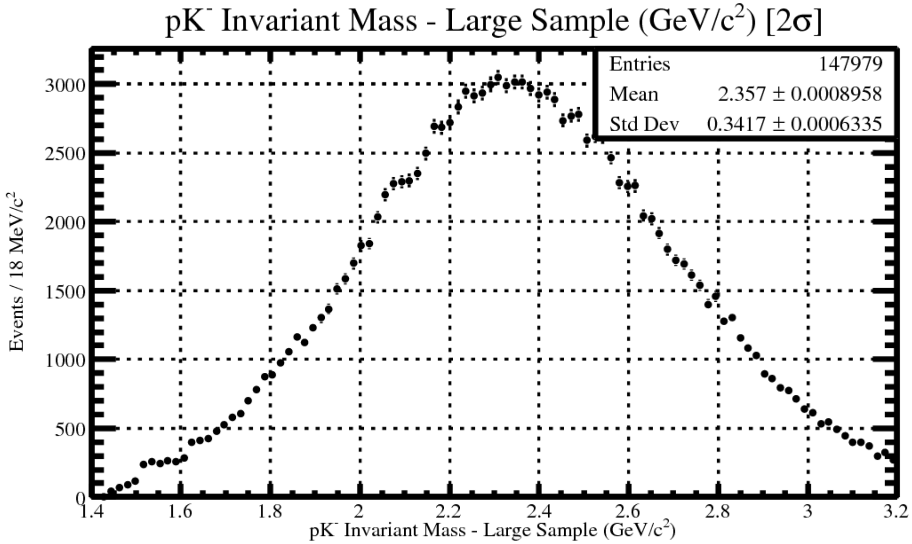


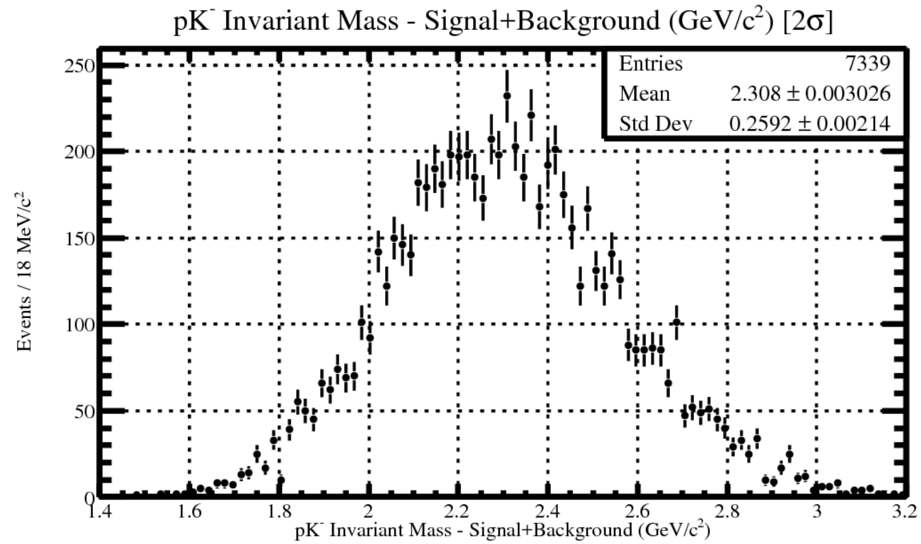


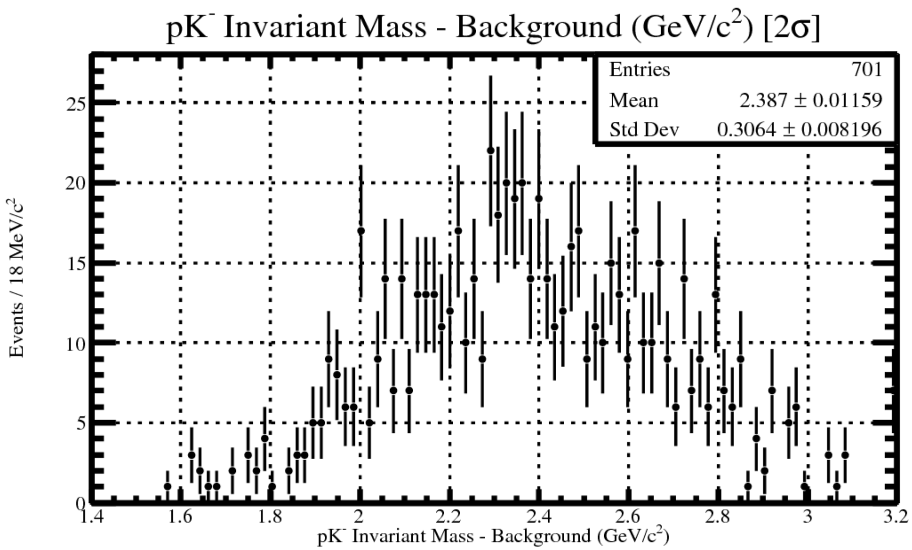


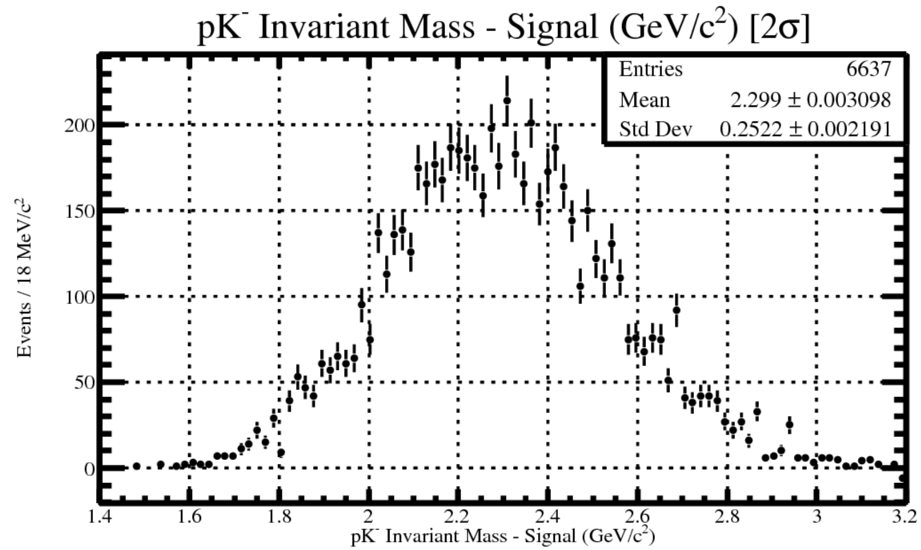


Results for All Data, All Cuts

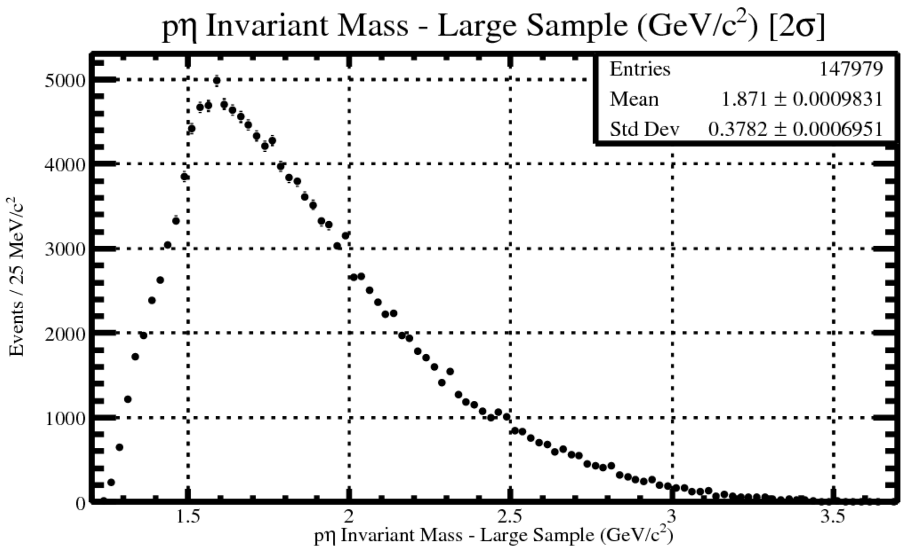


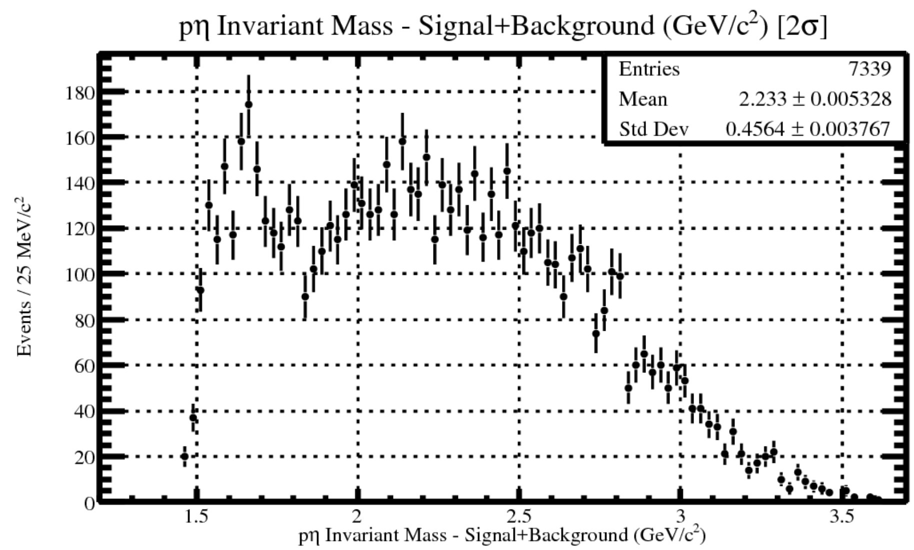


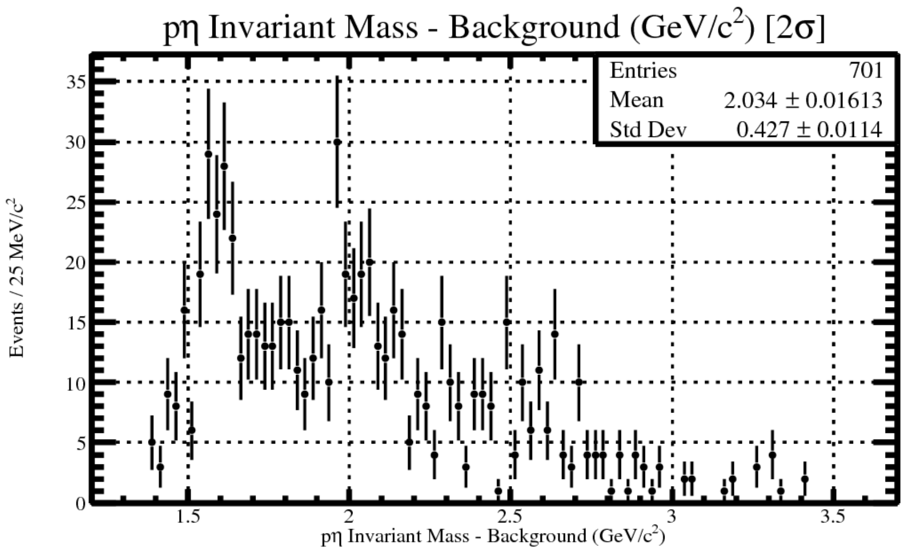


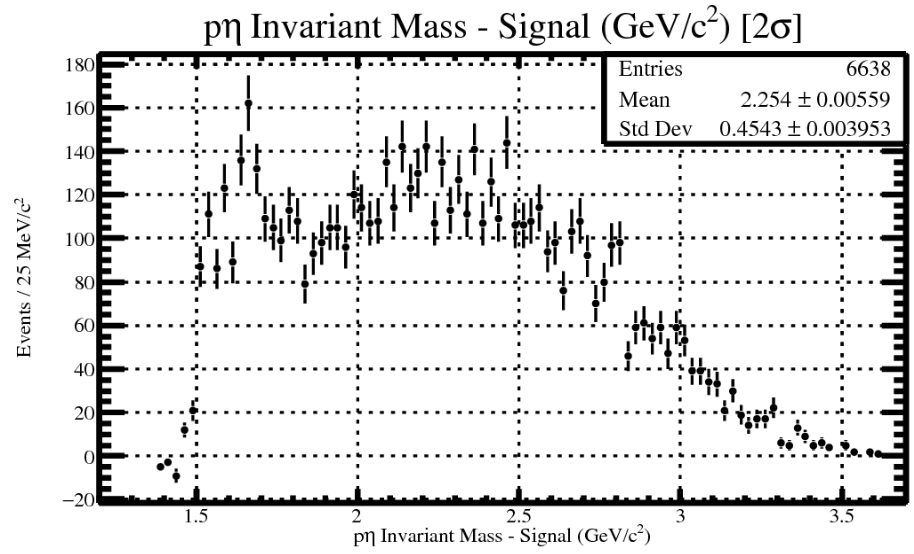


Results for All Data, All Cuts

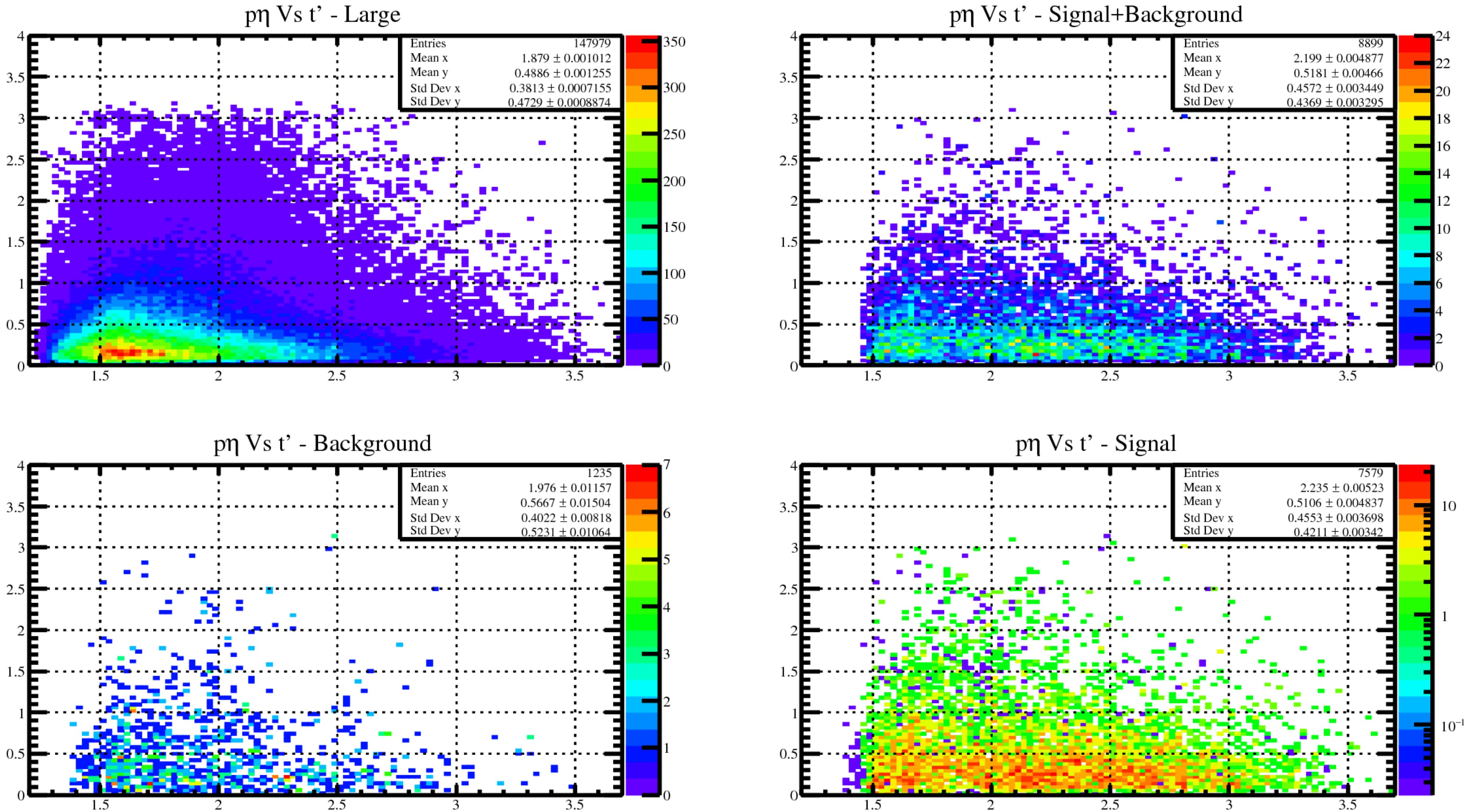








Results for All Data, All Cuts



Results for All Data, All Cuts