THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

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

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KLONG FACILITY

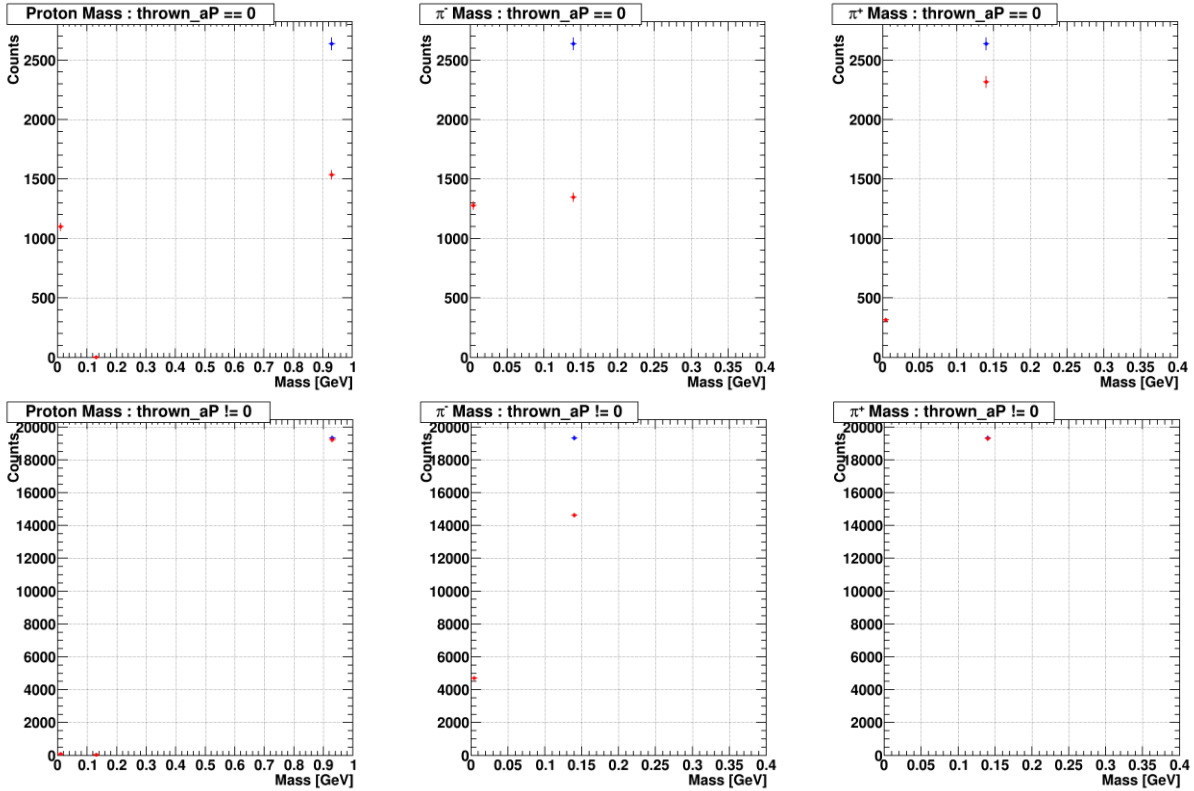
Jefferson Lab

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

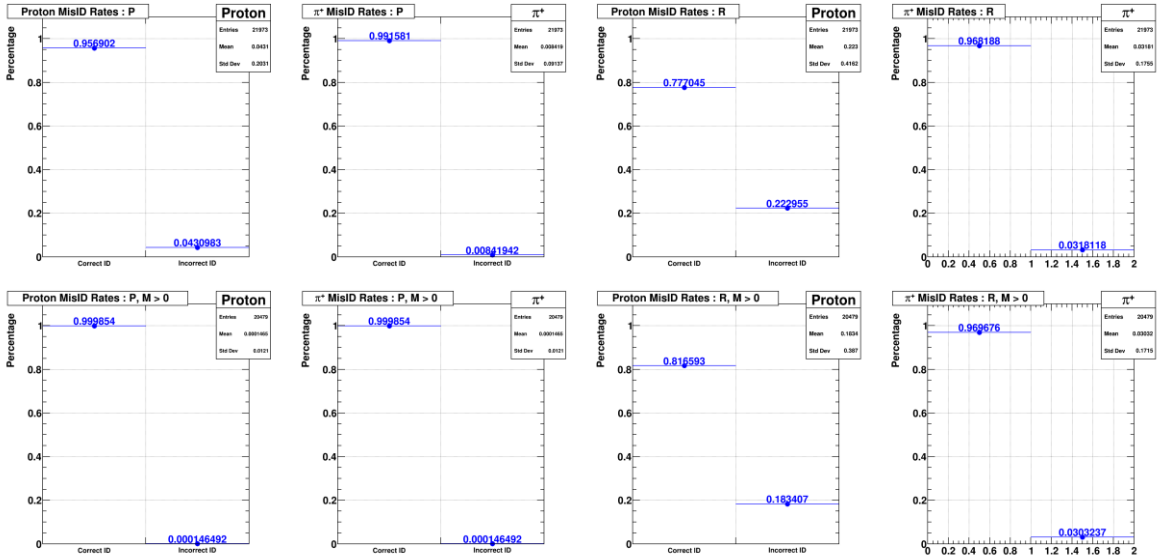
Zero Mass

- There are some thrown pi-s that have zero mass even when aP != 0.
- About a third of events have a pi- mass of zero.
- For all studies after this one the M > 0 applies to protons and pi+.



Misidentification Rates

- For the purposes of the following studies, I am using identification as the reconstructed vector closest to the true vector.
- Momentum and position were used as variables.
- Using momentum most of the events have a good match.
- Using position, ~20% have a bad match.
- The M > 0 cut on all thrown particles decreases this rate.

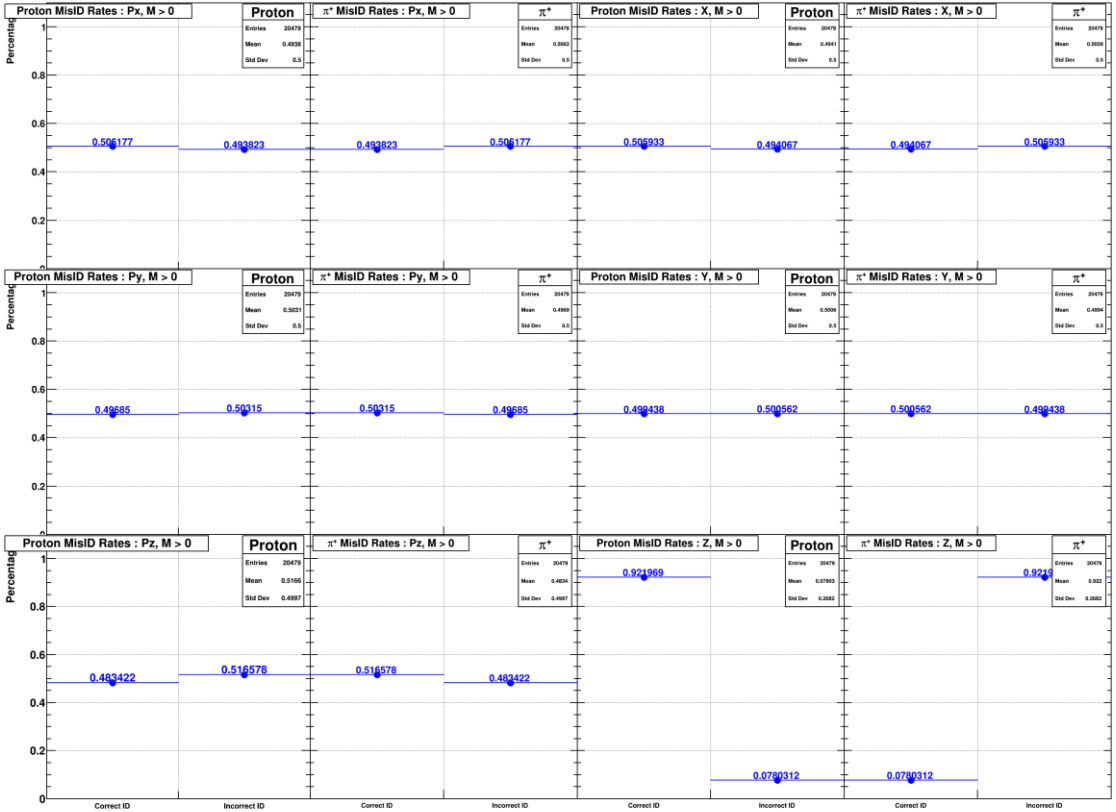


$$\Delta_{true,rec} = |p_{true} - p_{rec}|$$

$$\Delta_{tp,rp} < \Delta_{tp,r\pi} \rightarrow Good\ match$$

MisID : Momenta components

- For the x and y components, the misID rate is about 50%.
- However the misID rate for the Z position of the pion is ~93%.



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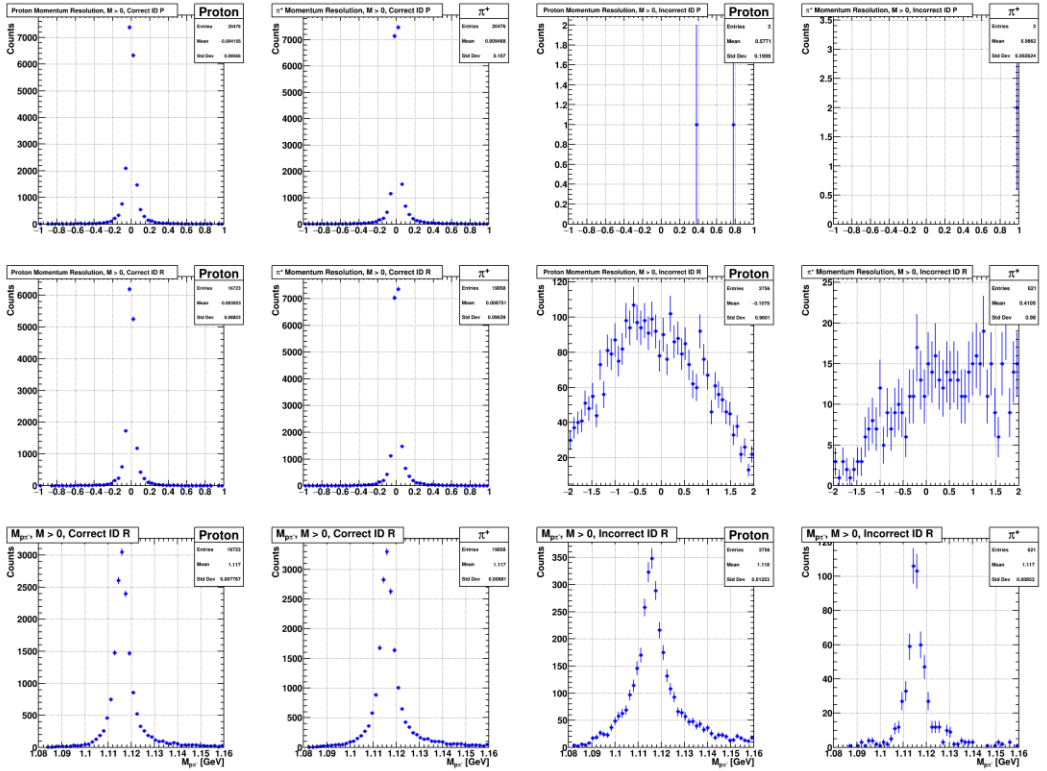
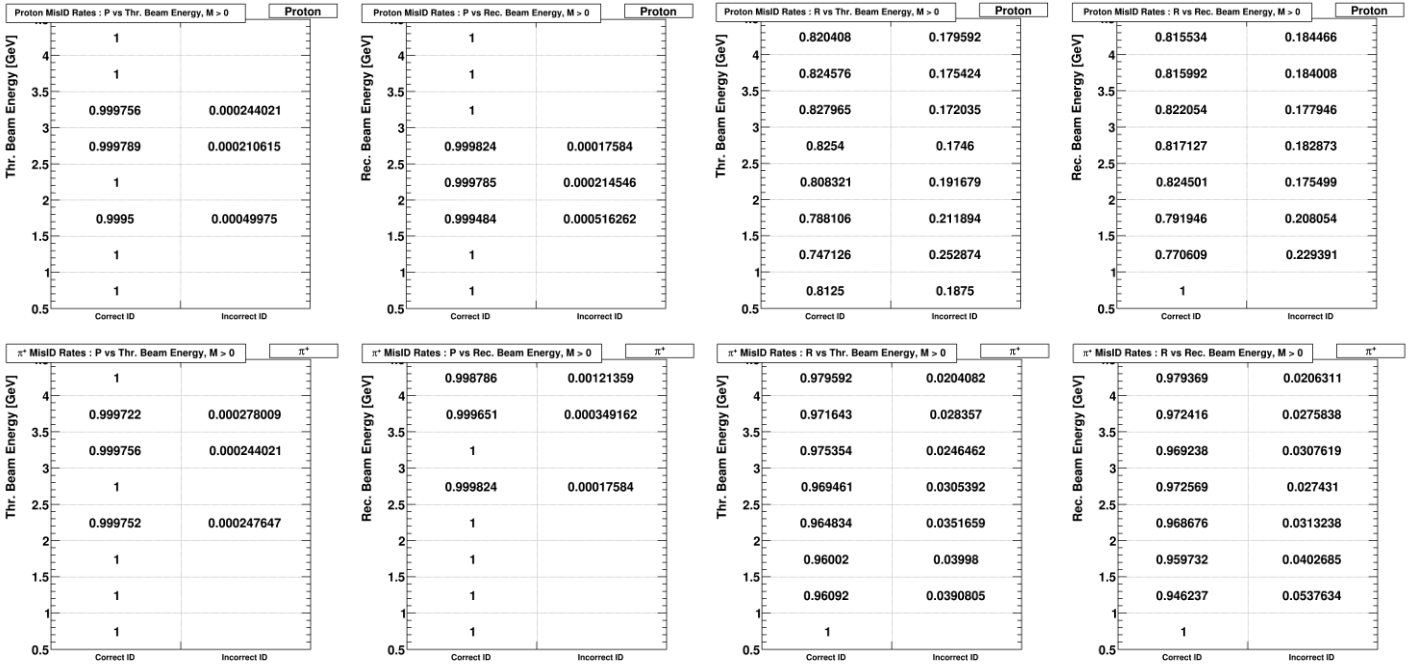
MisID : Resolution

- Looking at the resolution, it becomes clear that the pi+ and proton have poor resolution for events that are misIDed using position.
- The lambda mass distributions are slightly modified.
- The bottom row with mass fits are in the backup slides.
  - In short the position misidentified events have a slightly larger width.



MisID : Energy Dependence

- No strong energy dependence seen.



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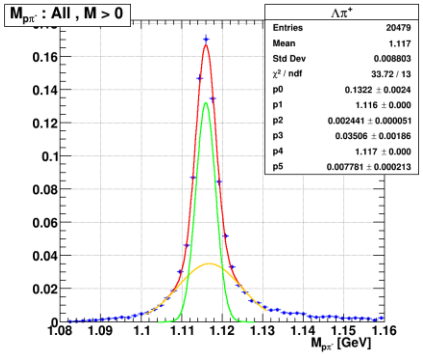
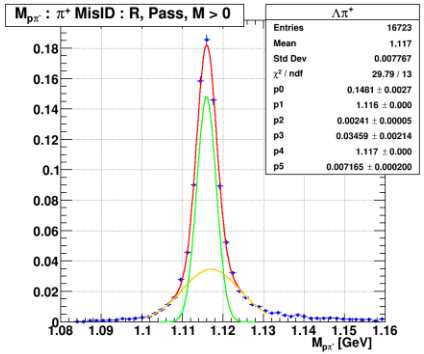
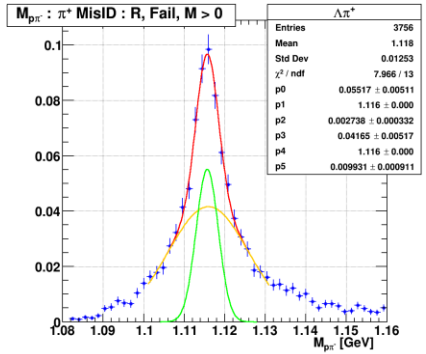
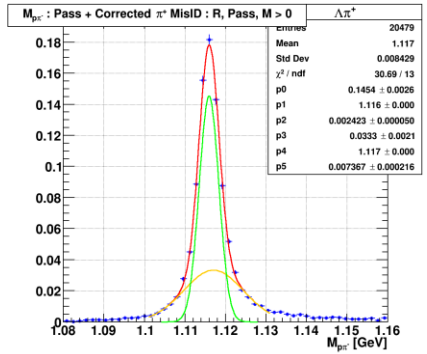
MisID : Mass distributions

- Below are plots of the lambda mass distribution as a function of cuts.
- The last plot shows the mass distribution with all misidentified protons swapped with pi+s.



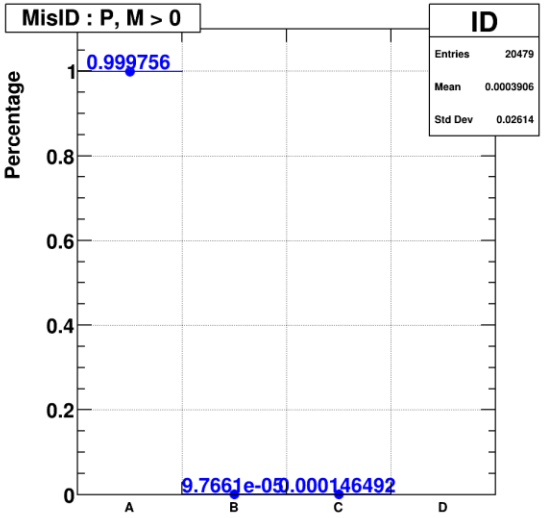


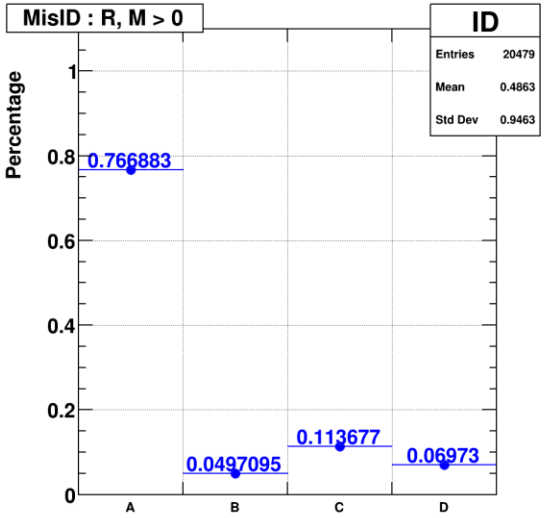




MisID : Combinations

- The plot shows the different possible cases
  - A : Good Proton, Good pi+
  - B : Good Proton, Bad pi+
  - C : Bad Proton, Good pi+
  - D : Bad Proton, Bad pi+
- The position variables again have higher misID rates than the momentum.
- Also there are a significant fraction of events with a Bad proton and a Good pi+.





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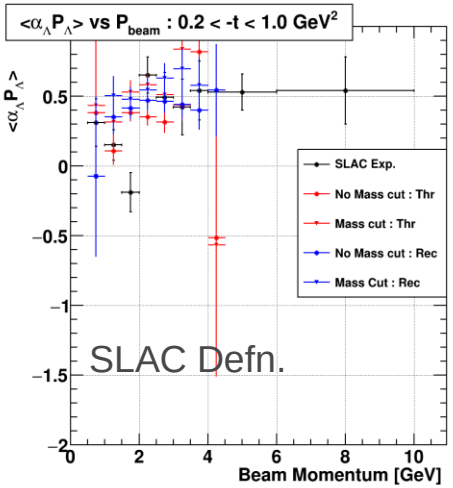
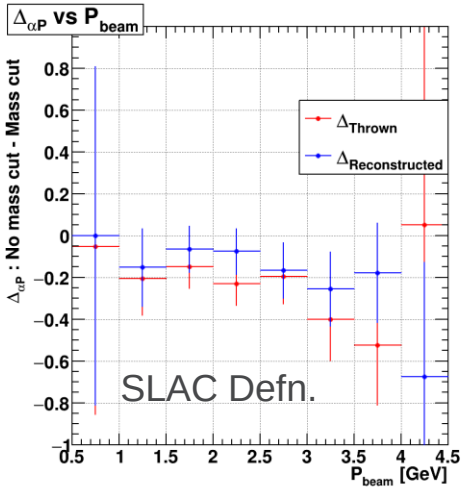
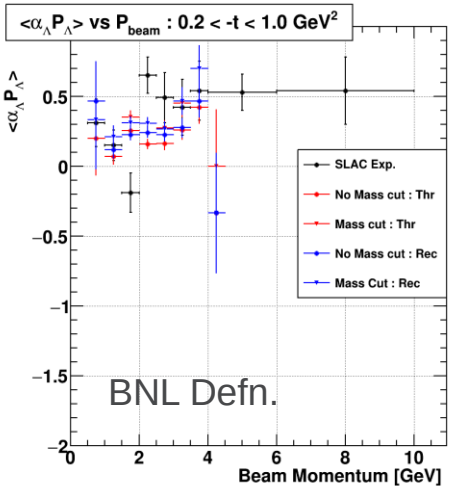
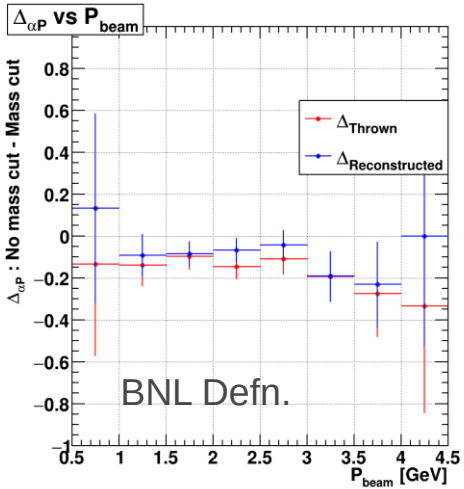
αP : MASS CUT DEPENDENCE

- Plots to the right show the extracted αP for the Λ with and without the mass cut (p, π^+, and π^- masses > 0).
- Across the board, the mass cut increases the polarization, but the difference is consistent with zero.









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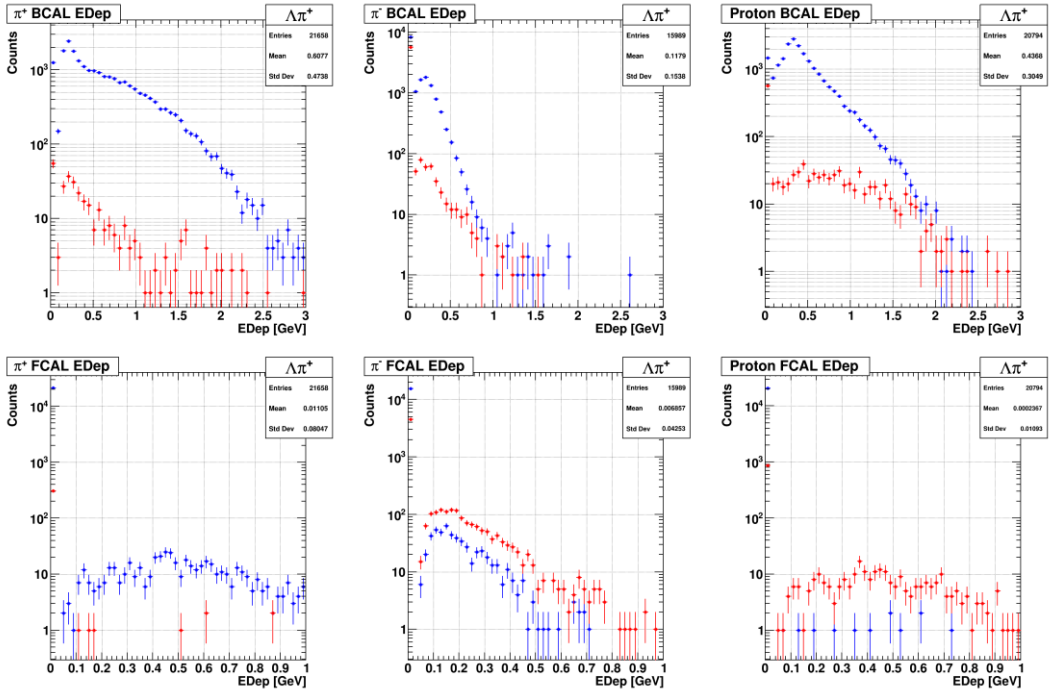
Backup Slides

Energy Deposit

- No real trend



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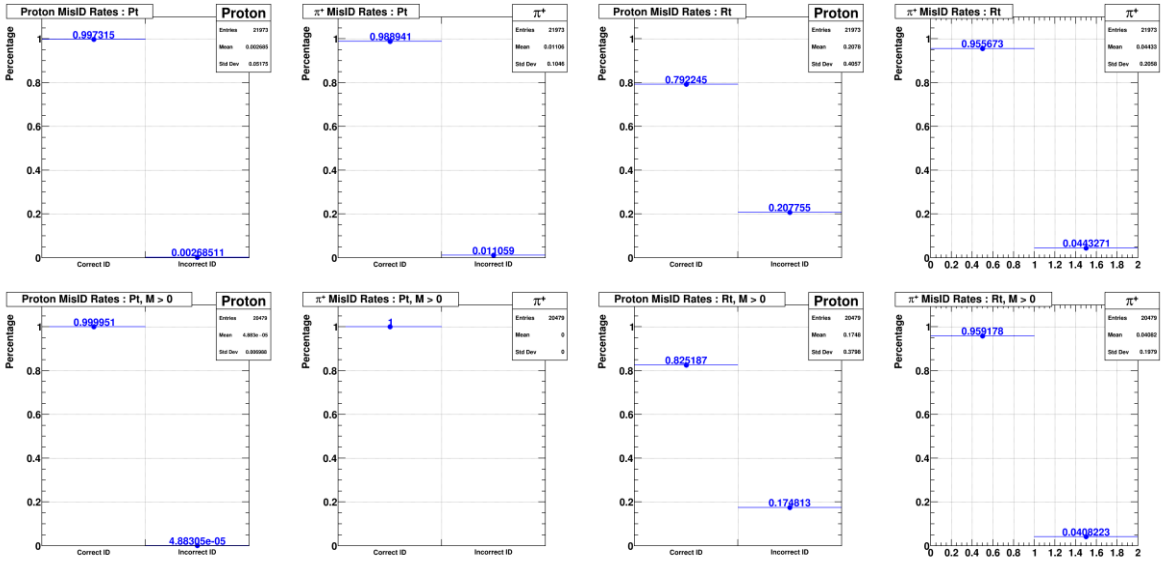
MisID : Transverse Variables

- The transverse momenta and position mirror the results on the previous slide



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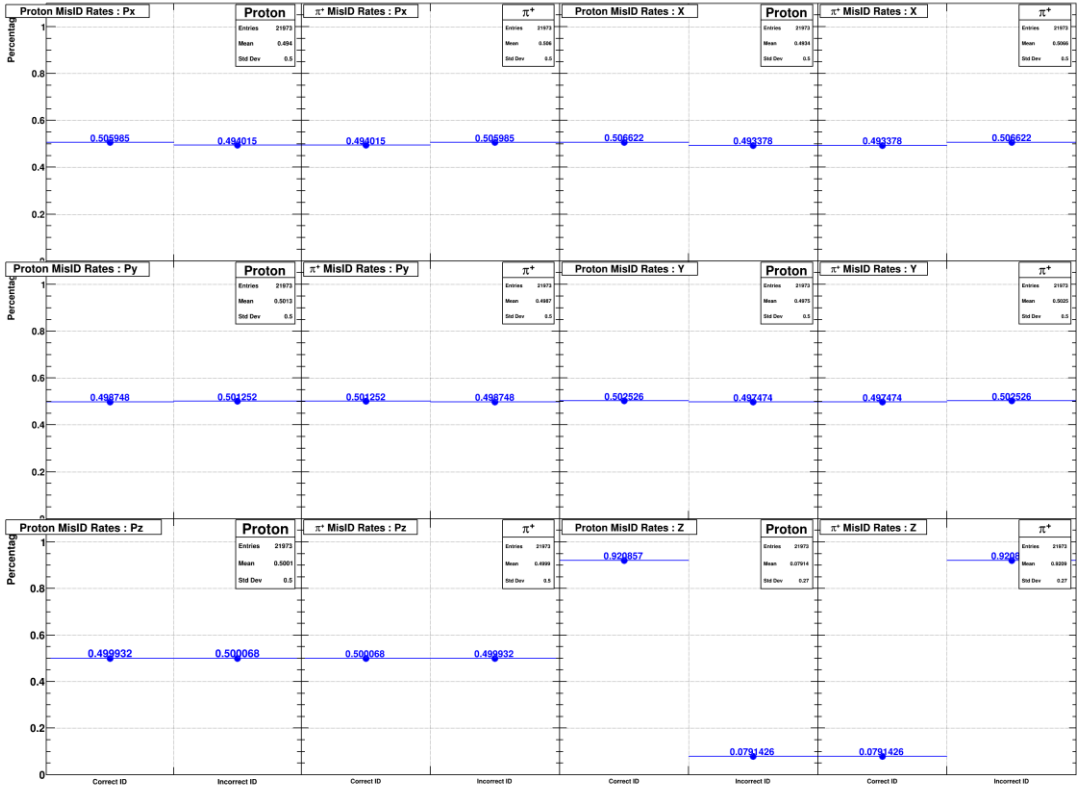

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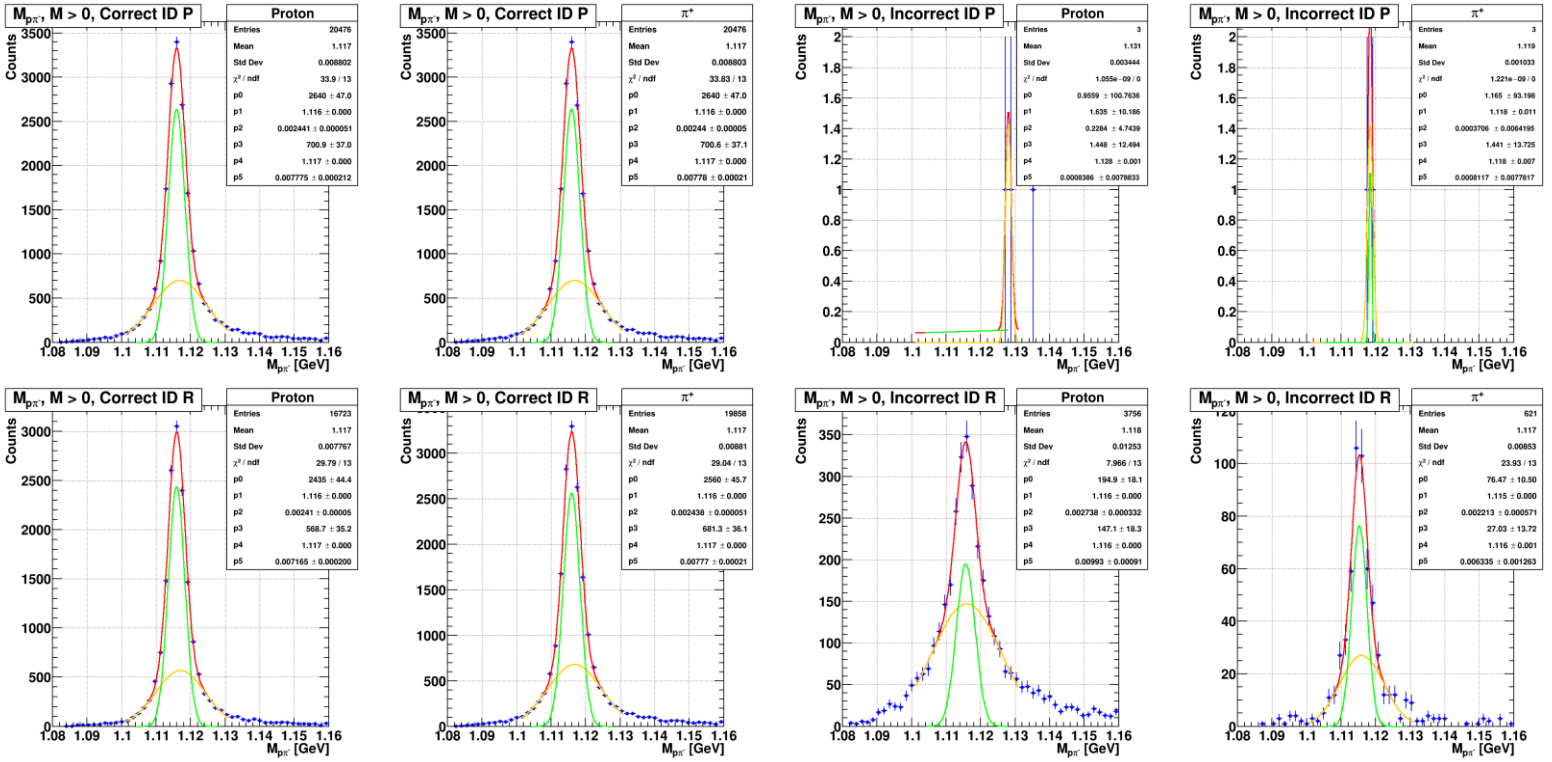
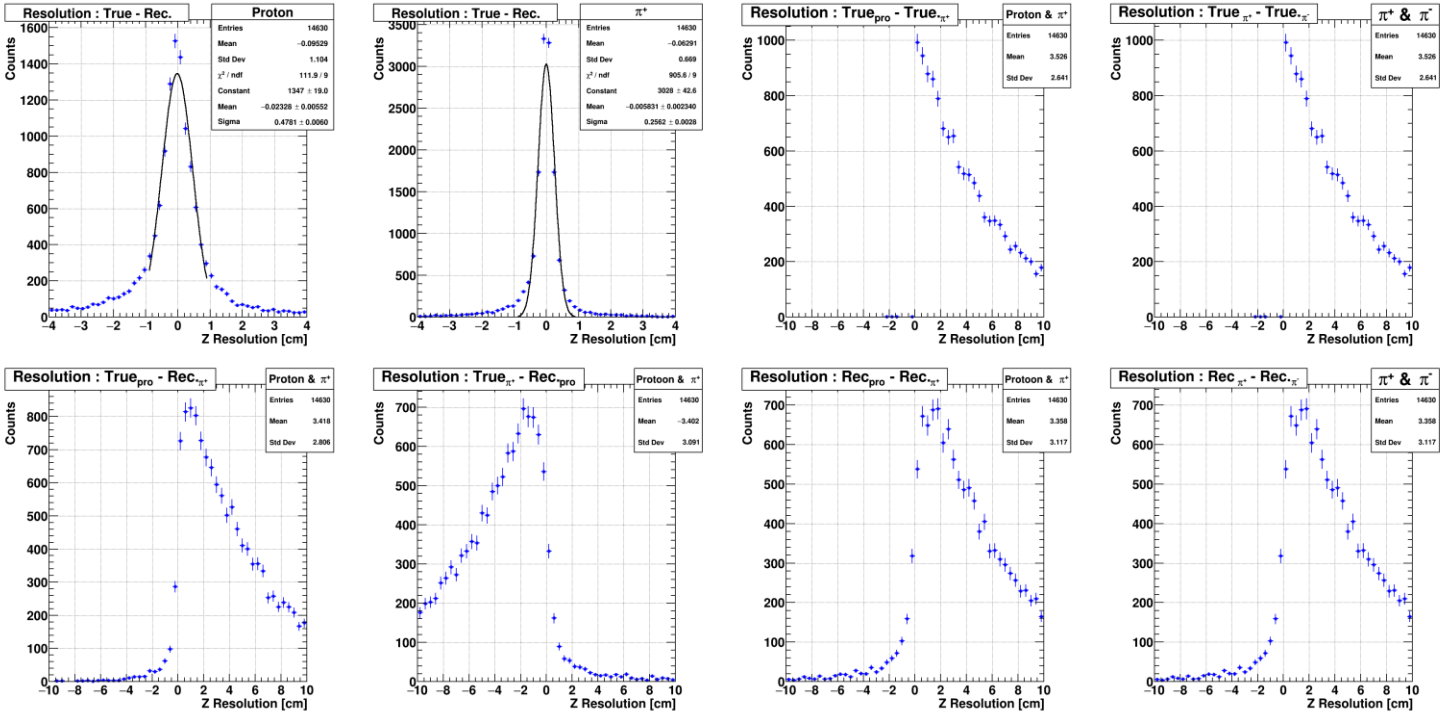
MisID : Fitted Lambda mass distributions



LAMBDA Z RESOLUTIONS



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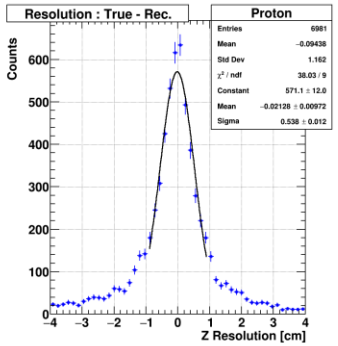
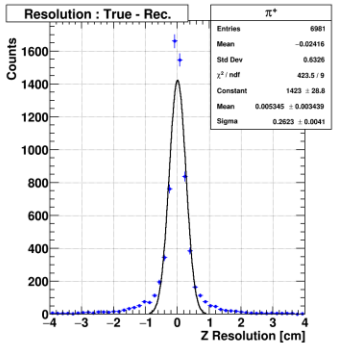
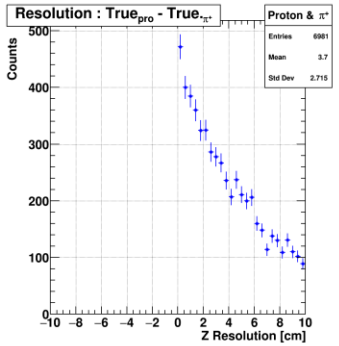
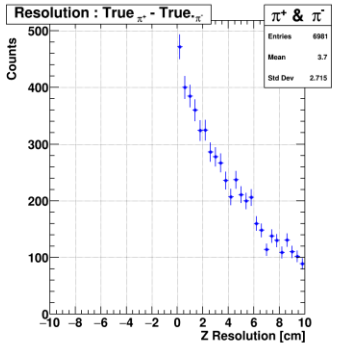
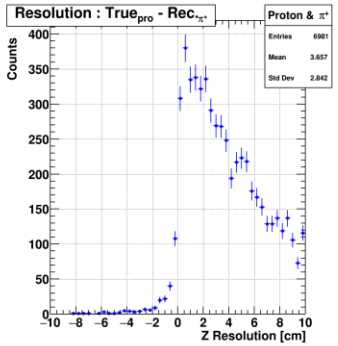
Sigma Z Resolutions

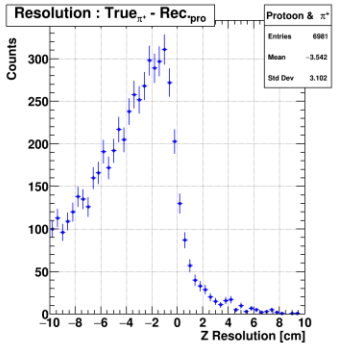


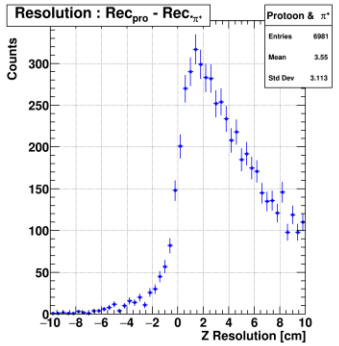


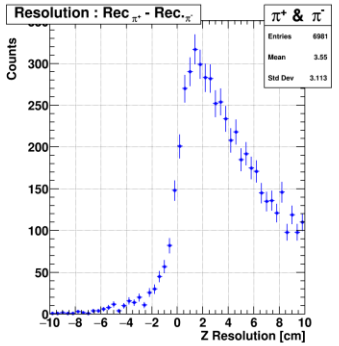






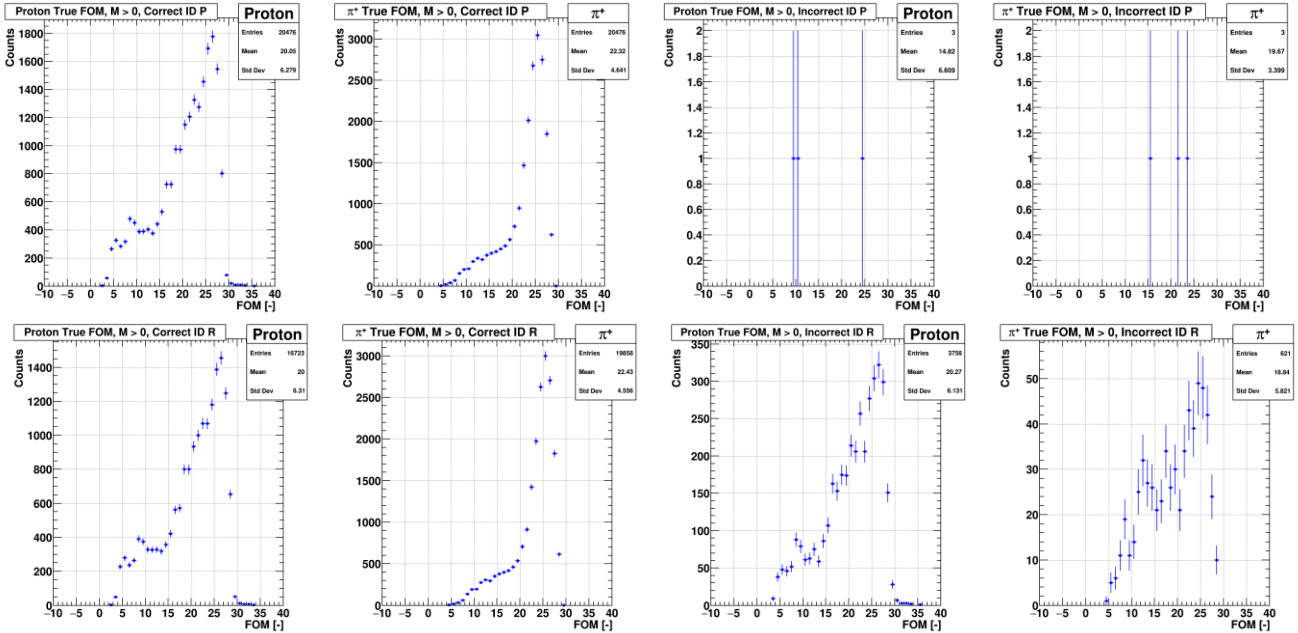






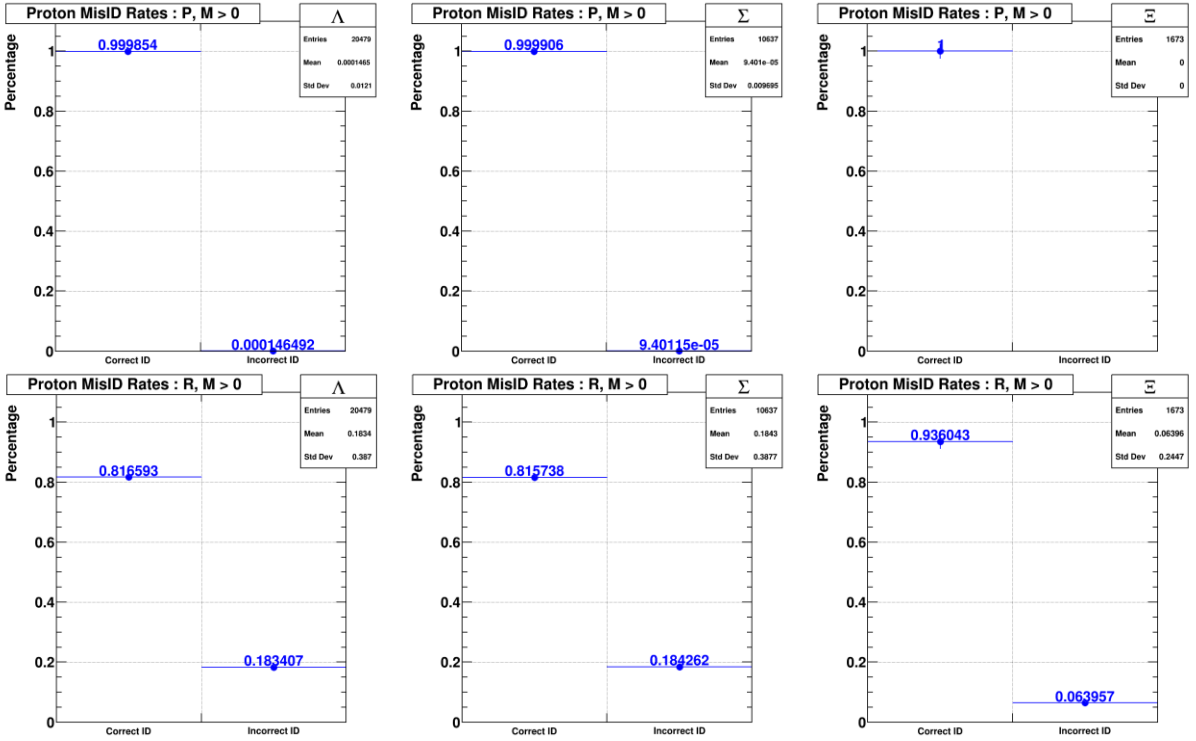
MisID FOM

- No strong dependence



MisID : Channels

- No real differences in misID rates across all channels
- Remember pi+ is really k+ for xi0.



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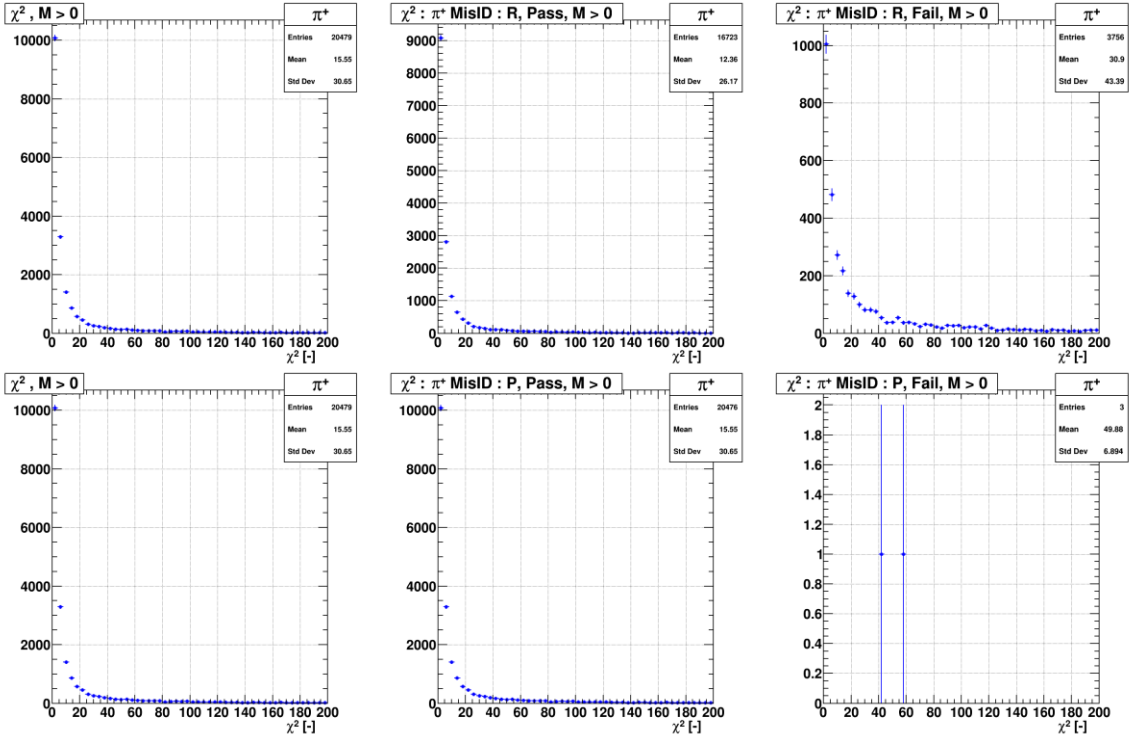
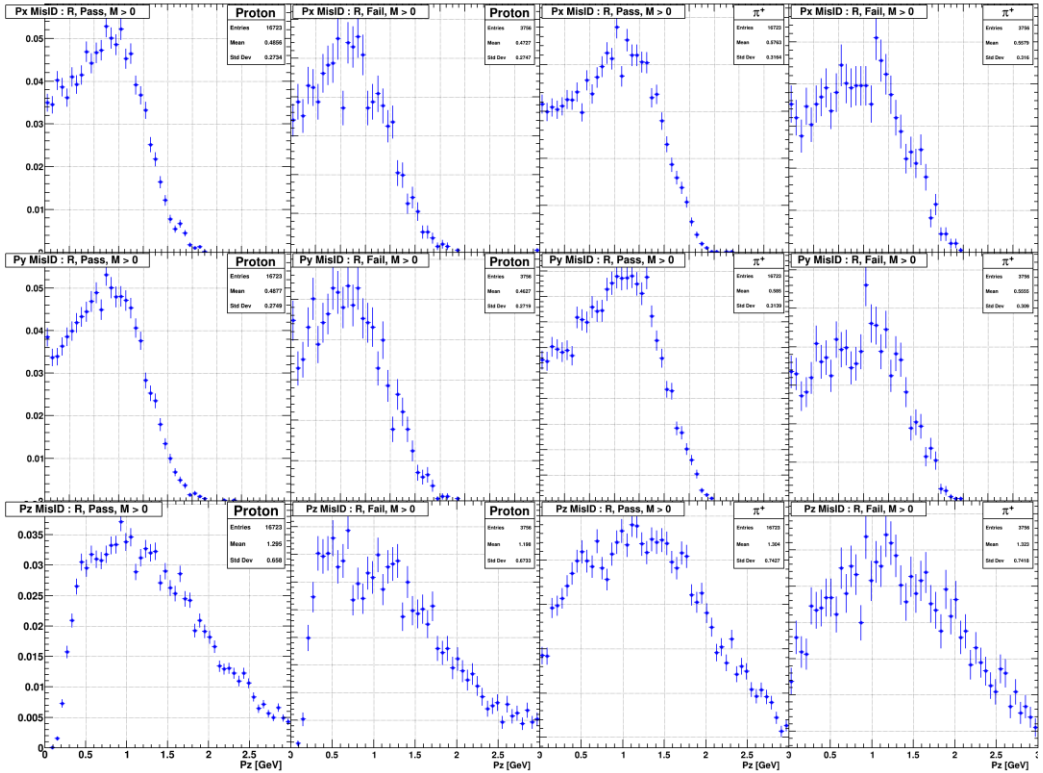
MisID : Chi^2

- No strong chi^2 distribution differences.



MisID : Momenta distributions

- No effect



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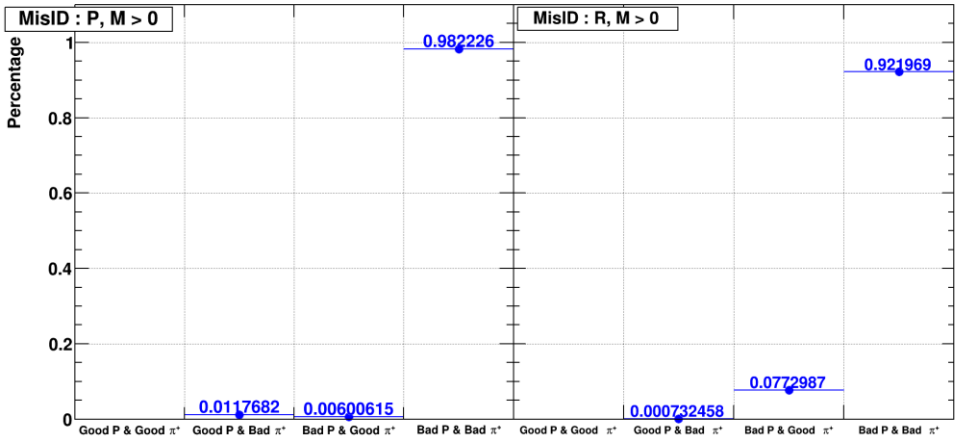
ADVANCED MISID

- Expanding the notion of identification to be that the distance between the true and recon. vector must be the smallest distance between the 3 possible distances shows that no particles are a “perfect” id match.



$$Good\ Proton : \Delta_{tprp} < \Delta_{tpr\pi}\ \&\ \Delta_{tprp} < \Delta_{t\pi rp}$$

$$Good\ \pi^{+} : \Delta_{t\pi r\pi} < \Delta_{t\pi rp}\ \&\ \Delta_{t\pi r\pi} < \Delta_{tpr\pi}$$

Lambda mass with and without Mass Cuts

- The removal of events where one of the true masses is zero changes the width of the mass distribution slightly.