





dE/dx PID Study

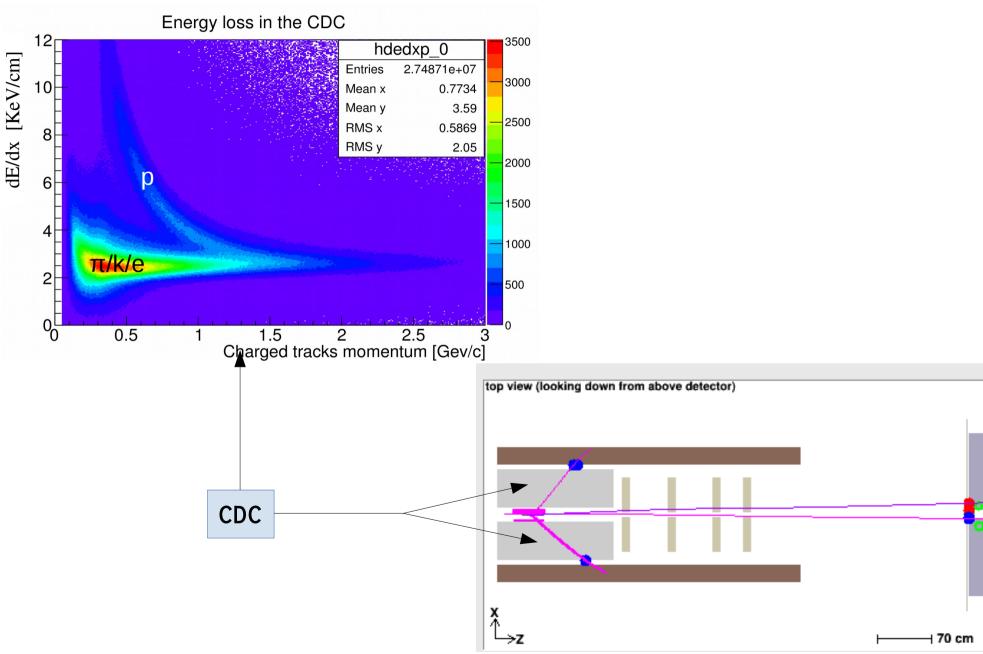
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GlueX Collaboration Meeting

May 16, 2017

Introduction

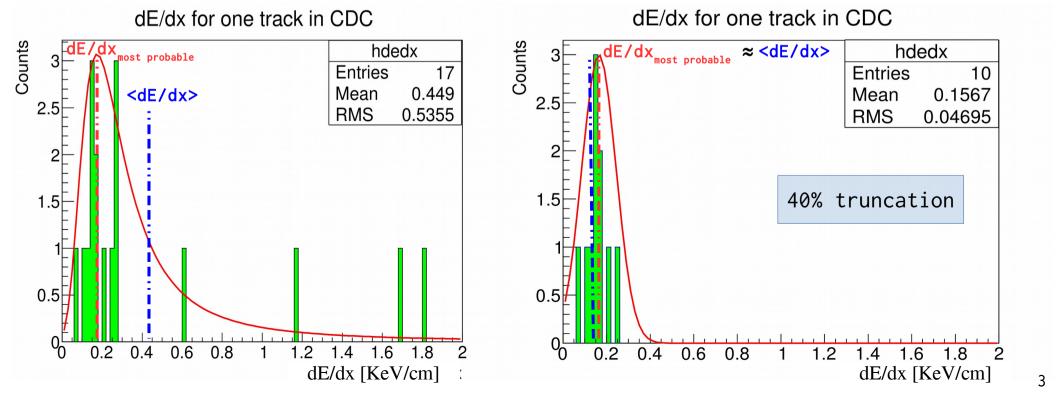
- Low Momentum charged particles and most of recoiled protons will not reach outer detectors.
- dE/dx measured in CDC will be the primary source for particle ID in this case



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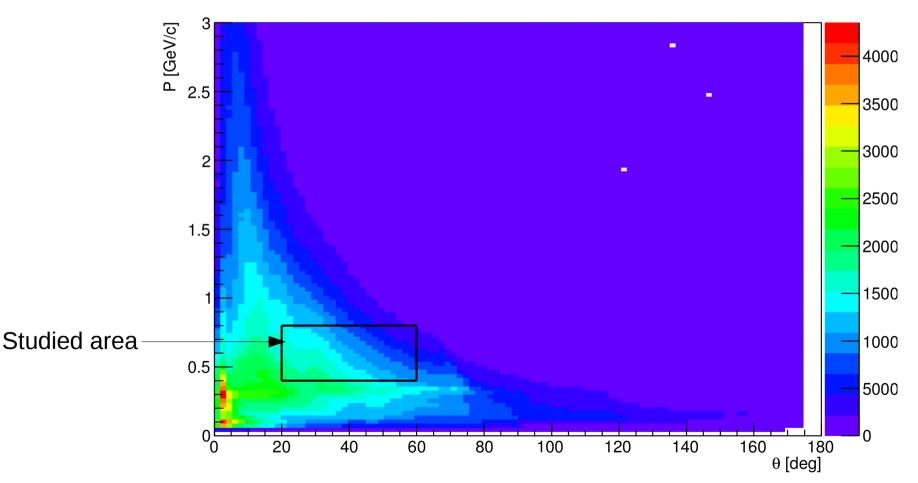
Motivation

- Goal: Achieve the optimal separation of different particle types using dE/dx
 - > Estimate dE/dx mean value and eventually the width.
- Method: Truncated mean
 - Drop some hits with largest dE/dx values from the track
 - Optimize truncation to achieve:
 - 1st method: best resolution.
 - 2nd method: Strongest separation power
 - 3rd method: lowest mis-id



Procedure

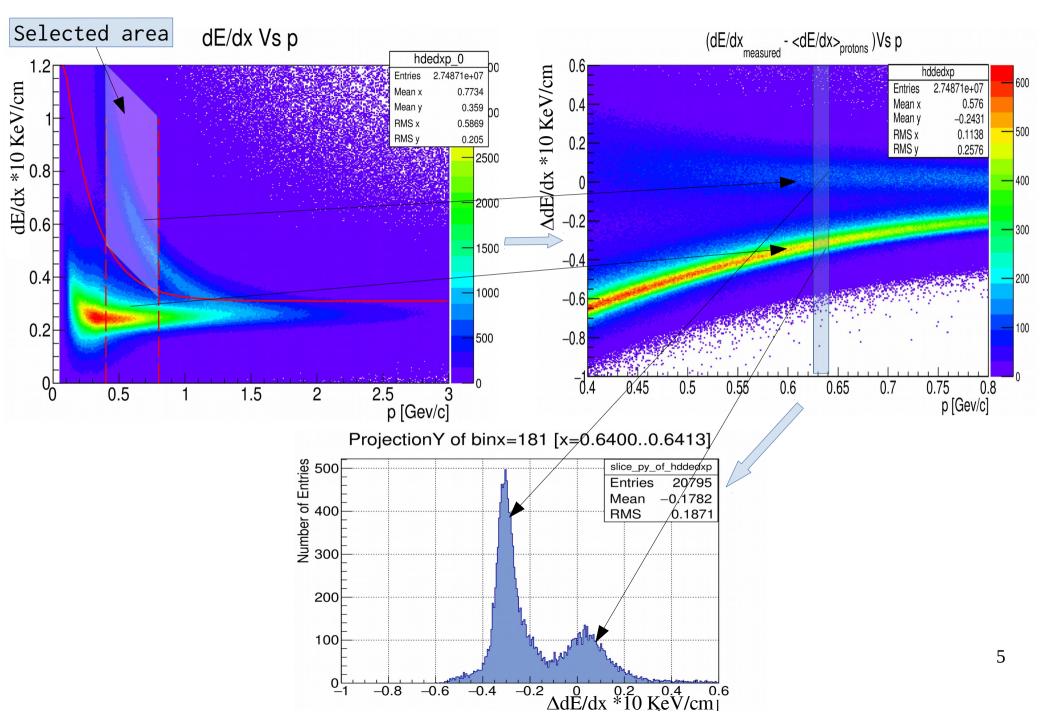
- Spring 2016 data, < 1%.
- All the tracks in the CDC
- Truncation dependence on P(0.4 0.8 GeV/c) & θ (20° 60°)



Momentum Vs θ

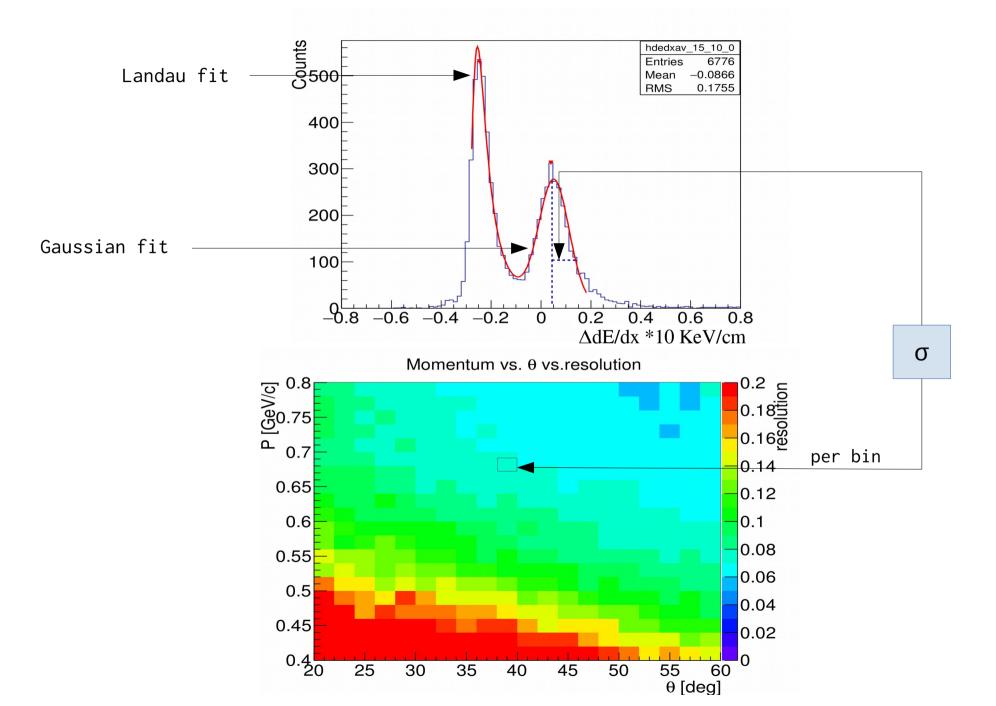
Procedure

• 1st Step: Select the protons.



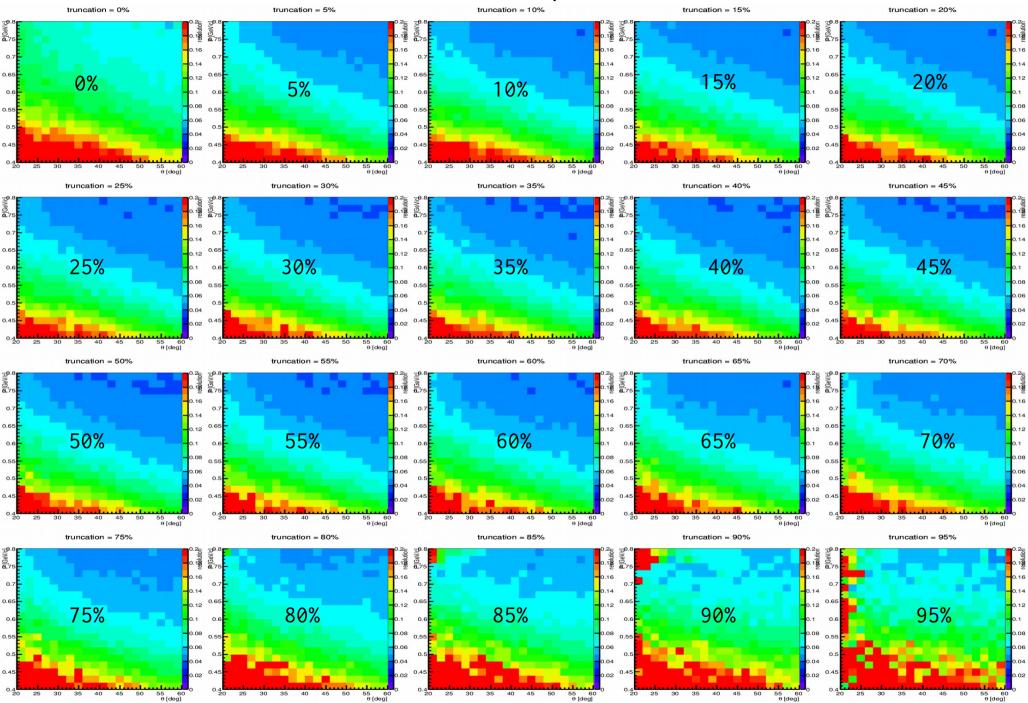
Resolution

• 1st method: best resolution => optimal truncation.



Resolution

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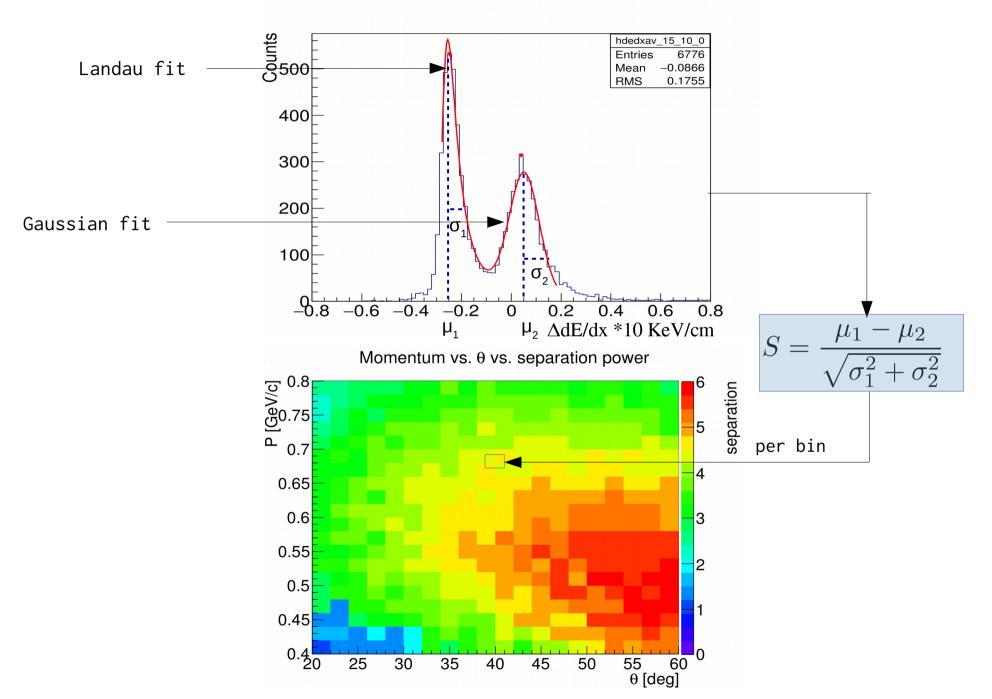


Resolution

- 1st method: optimal truncation ~40% •
- Momentum vs. θ vs. optimal resolution Momentum vs. θ vs. optimal truncation (resolution) 0.8 0.75 0.75 0.2 0.19.0 0.180 0.1760 0.160 [0.8 [0/0 [0.75] [0.7] 0.8 9988057660550540502211050 truncation [%] 0.7 0.15 0.14 0.7 0.13 0.65 0.65 0.12 0.11 0.6 0.6 0.1 0.09 0.08 0.55 0.55 0.07 0.07 0.06 0.05 0.04 0.03 0.02 0.01 0.5 0.5 0.45 0.45 0.4 0.4<mark></mark> 20 0 25 30 35 45 50 55 60 40 30 35 40 45 50 55 60 25 θ [deg] θ [deg] optimal truncation (based on resolution) 001 Conuts 001 C 80 60 40 20 0 ահահամա 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95100 Truncation [%]

Separation Power

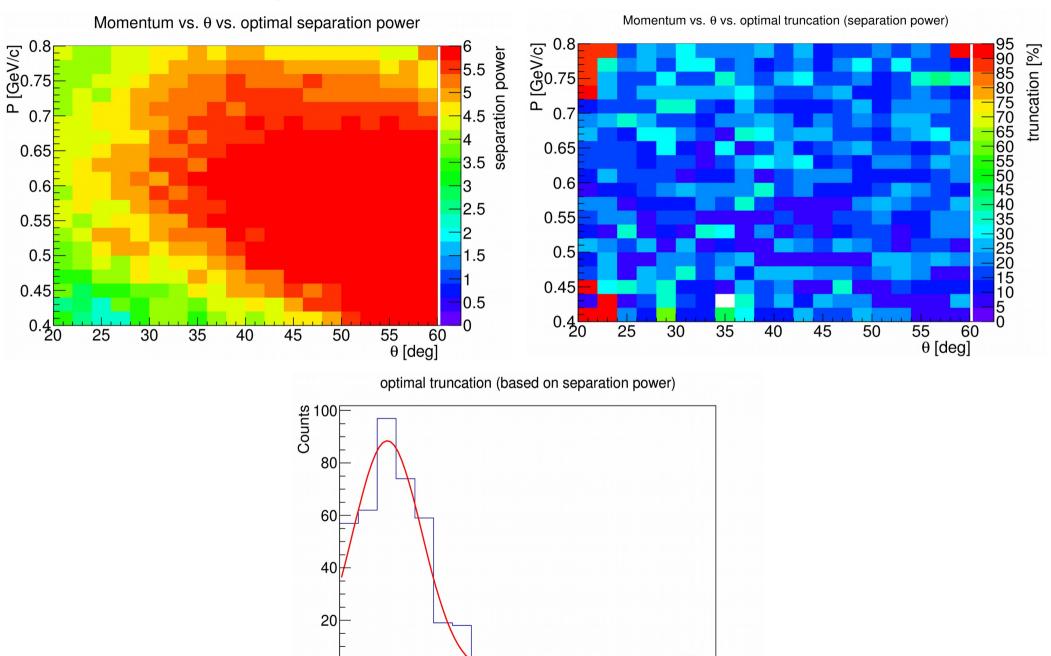
• 2nd method: strongest separation power => optimal truncation.



Separation Power

• 2nd method: optimal truncation ~15%

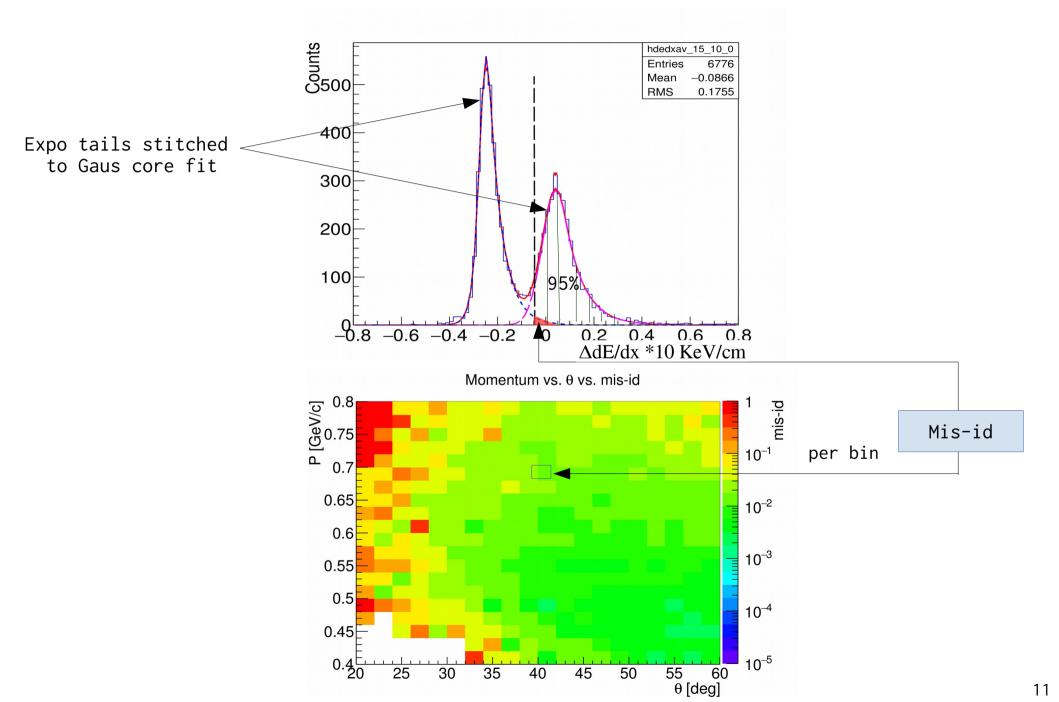
0



Truncation [%]

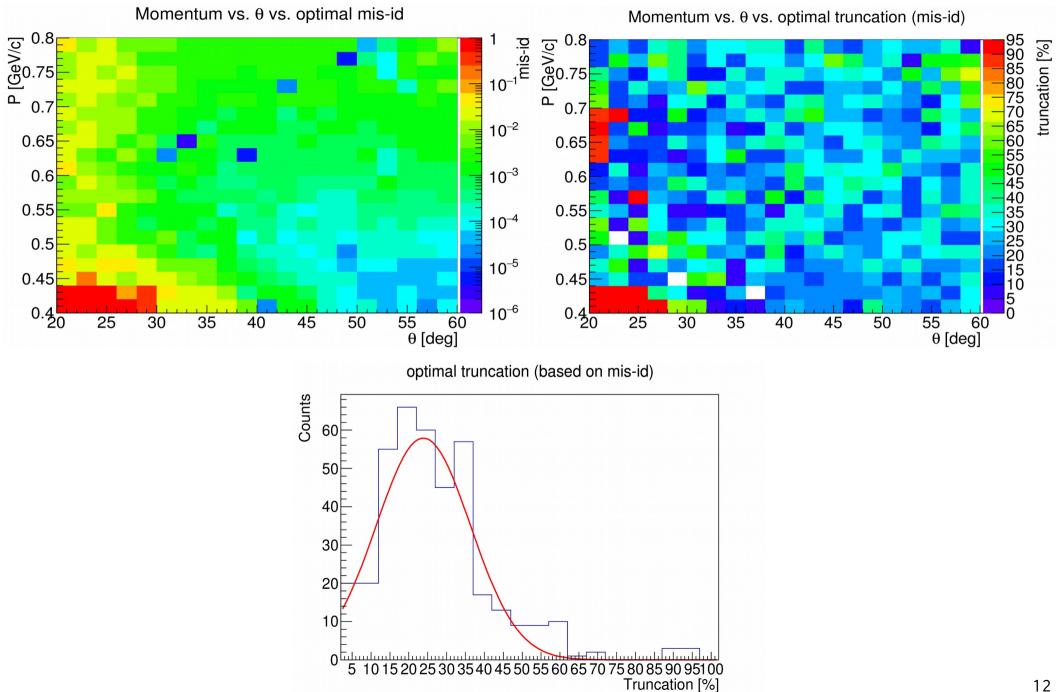
Mis-id

• 3rd method: lowest mis-id => optimal truncation.



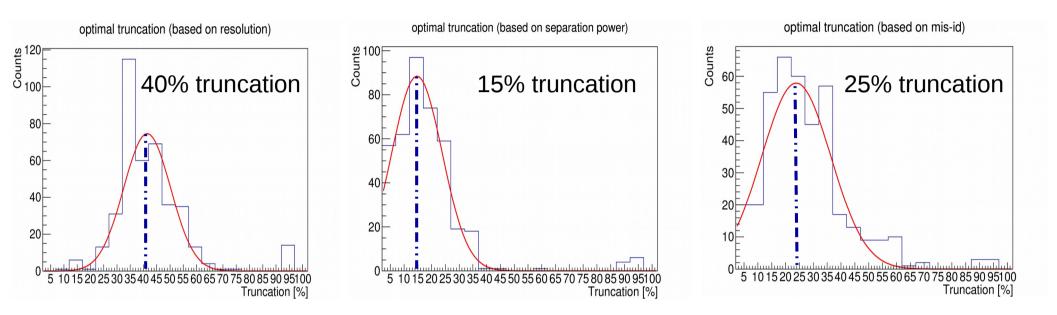
Mis-id

3rd method: optimal truncation ~25% •



Results & perspectives

- The dE/dx optimal truncations found are different from the currently used one (50%).
- The dE/dx optimal truncation is different for each classifier.



<u>Next</u>:

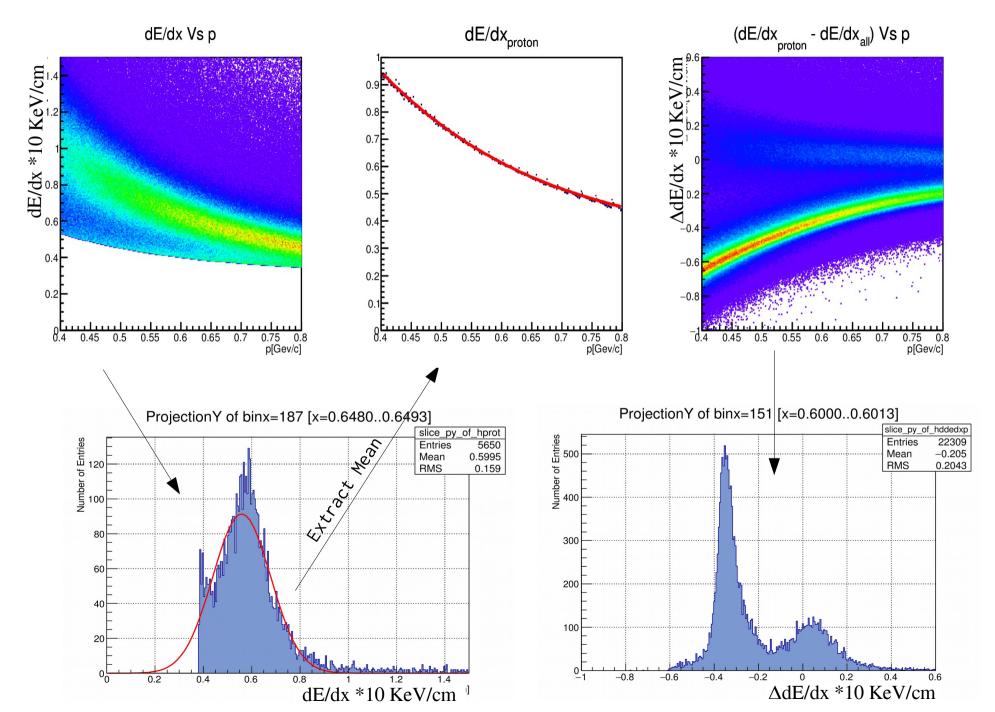
- Study the optimal truncation in exclusive channels and increase the statistics:
 - > Clean samples of different particles to improve separation power.
 - > extend the range in (p, θ) .
- Study the potential of a double truncated mean method.
- Study other possible effects on dE/dx calibration (e.g.: entrance angle & spacecharge effect).

Thank you for your attention

Backup

Procedure

• 2^{nd} step: extract the expected dE/dx for protons



$dE/dx vs \theta$

dE/dx Vs θ

Momentum Vs θ (Protons)

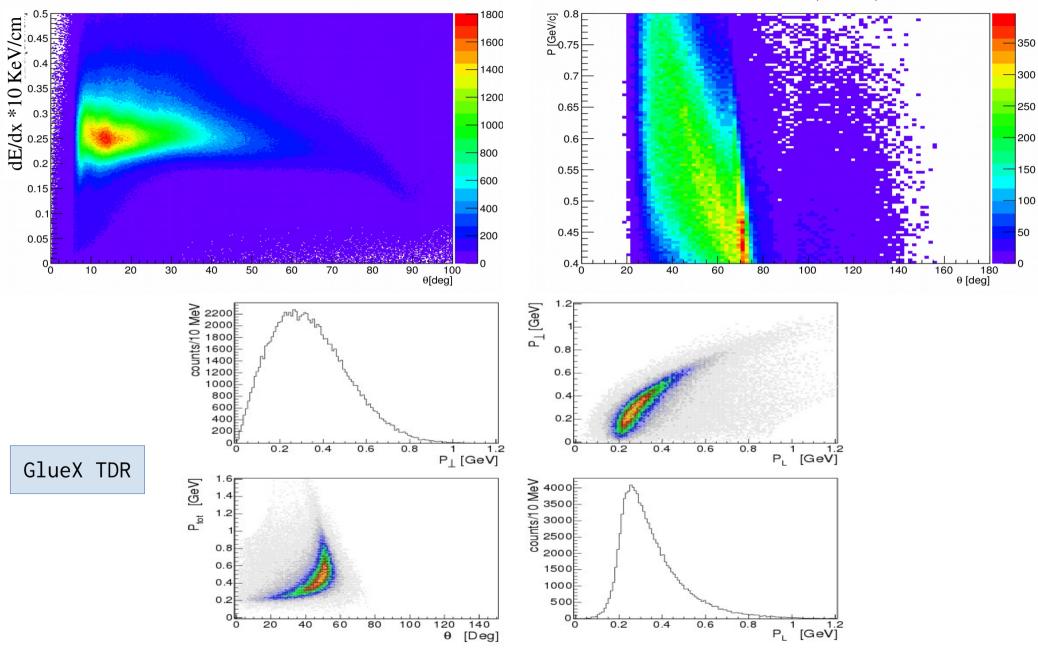


Figure 4.39: The momentum distribution of protons from the reaction $\gamma p \rightarrow \eta_1(1800)p \rightarrow 2\pi^+ 2\pi^- p$. The upper left-hand figure shows the momentum perpendicular to the beam direction. The upper right-hand figure shows the perpendicular versus the longitudinal momentum. The lower left-hand figure shows the total momentum versus the polar angle θ and the lower right-hand figure shows the momentum along the beam direction.

dE/dx vs θ

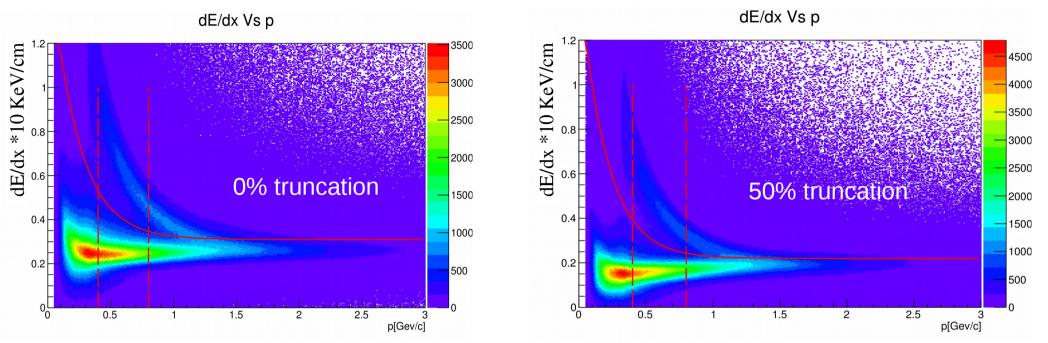
GlueX TDR

 $\gamma p \rightarrow K^* K^* p \rightarrow K^+ K^- \pi^+ \pi^- p$ 0 10 20 30 40 50 60 NO PID fraction (%) CDC proton CDC BCAL pion kaon CKOV CDC CKOV CDC BCAL CKOV TOF CKOV CDC CKOV TOF BCAL CDC CKOV TOF 10 30 40 50 0 20 60

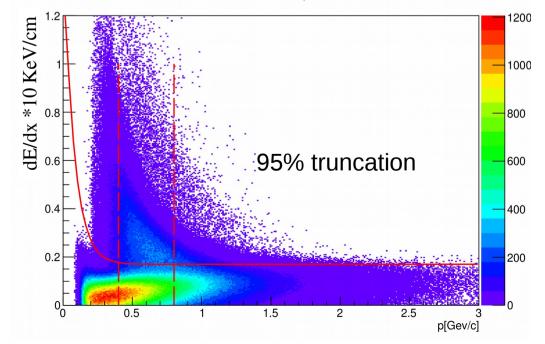
Figure 4.61: The fraction of tracks from the reaction $\gamma p \rightarrow K^* \bar{K}^* p$ detected by different combinations of particle identification elements.

Procedure

• dE/dx dependance of truncation (different cuts)

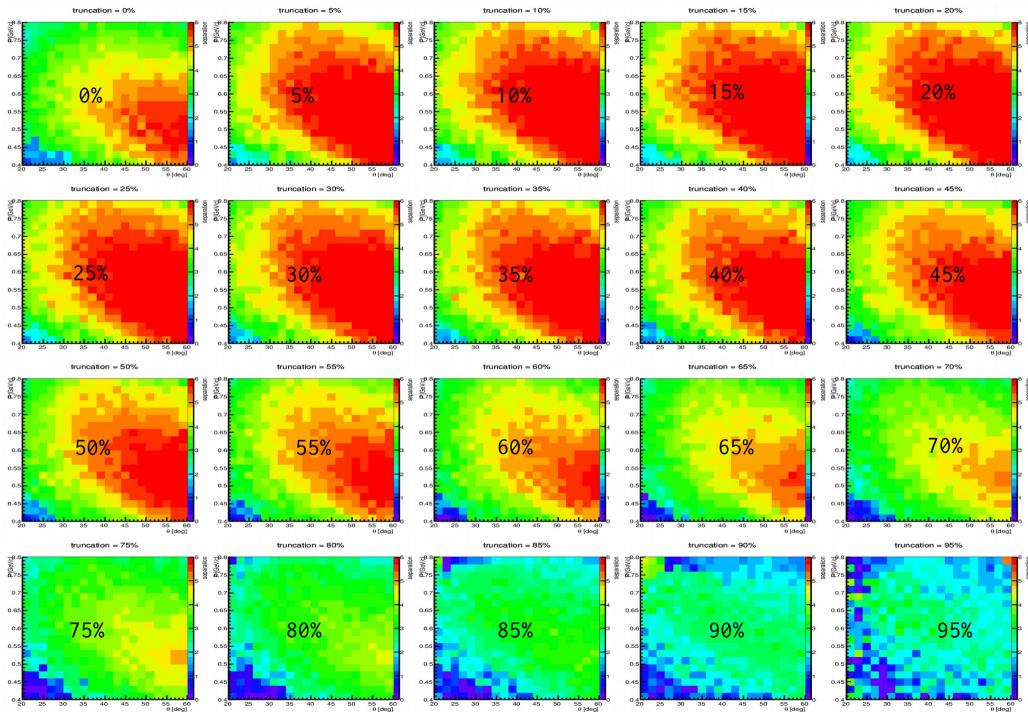


dE/dx Vs p



Separation Power

• 2nd method: strongest separation power => optimal truncation.



55 60 θ [deg]

Mis-id

• 3rd method: lowest mis-id => optimal truncation.

