dE/dx PID Study

Abdennacer Hamdi

GlueX Collaboration Meeting

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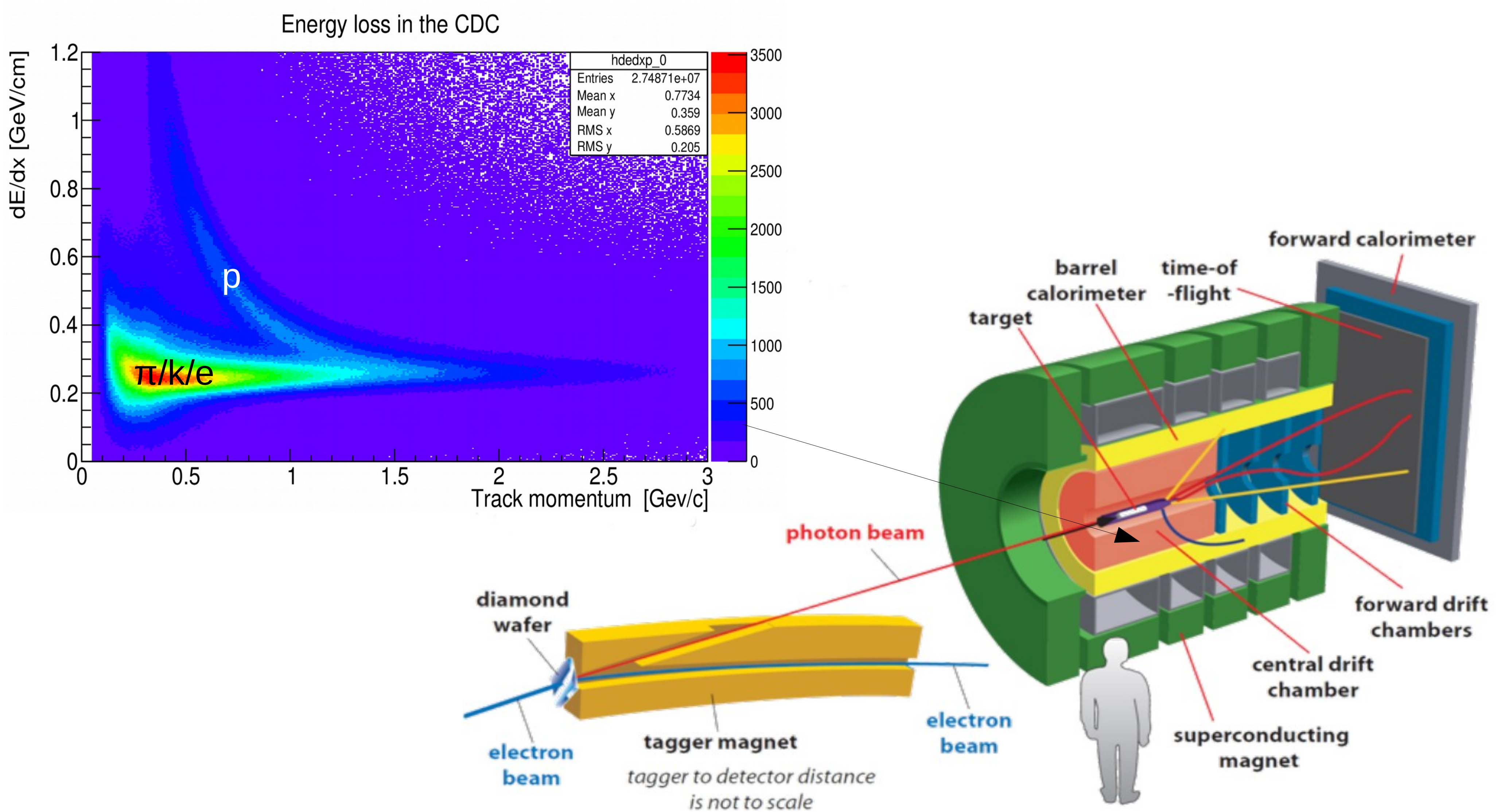
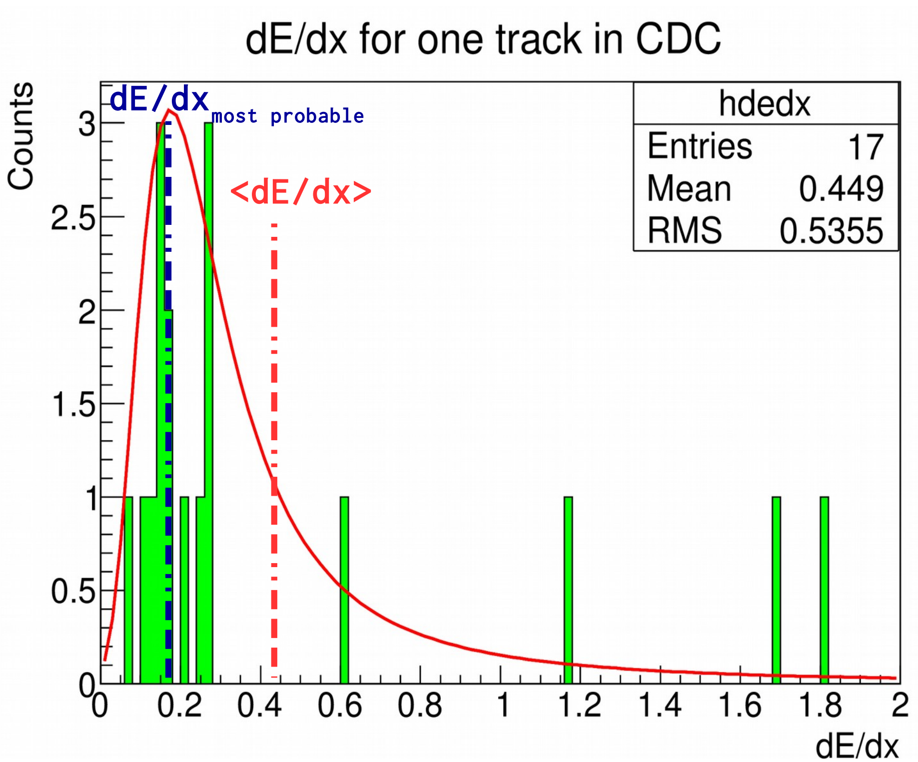
Introduction

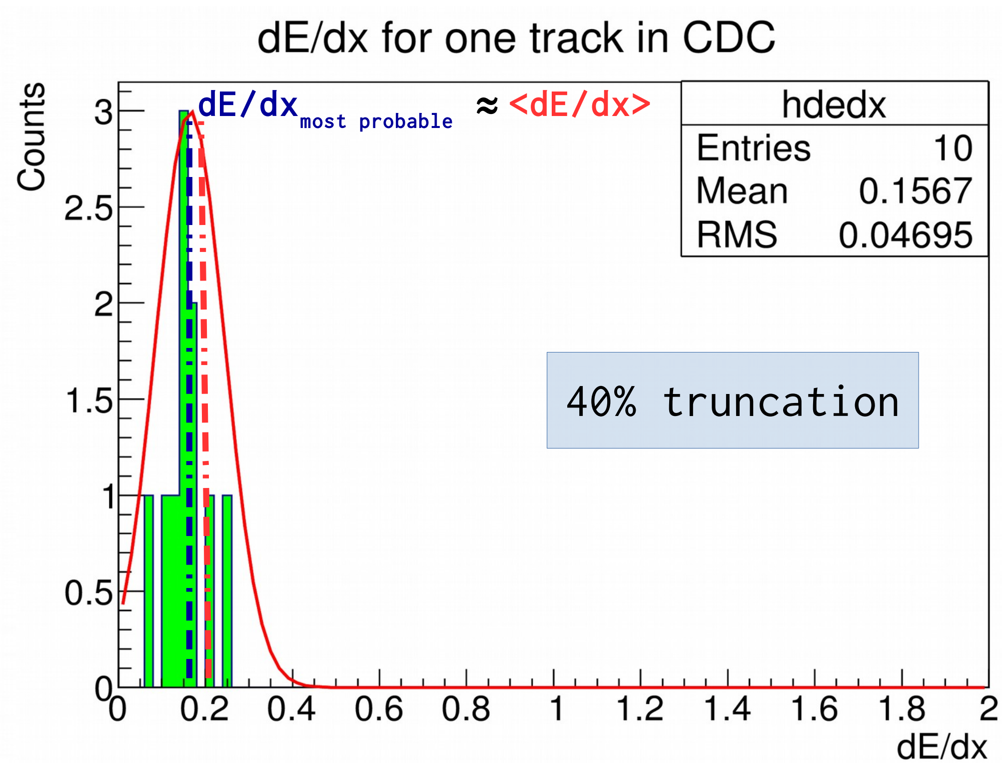
- Forward Drift Chambers: Cathode strip chambers, $\sigma_{x,y}$ ~ 200, $\sigma(\delta p/p)$ ~ 1-5%
- Measure dE/dx for particle ID => identify recoiled protons.



Motivation

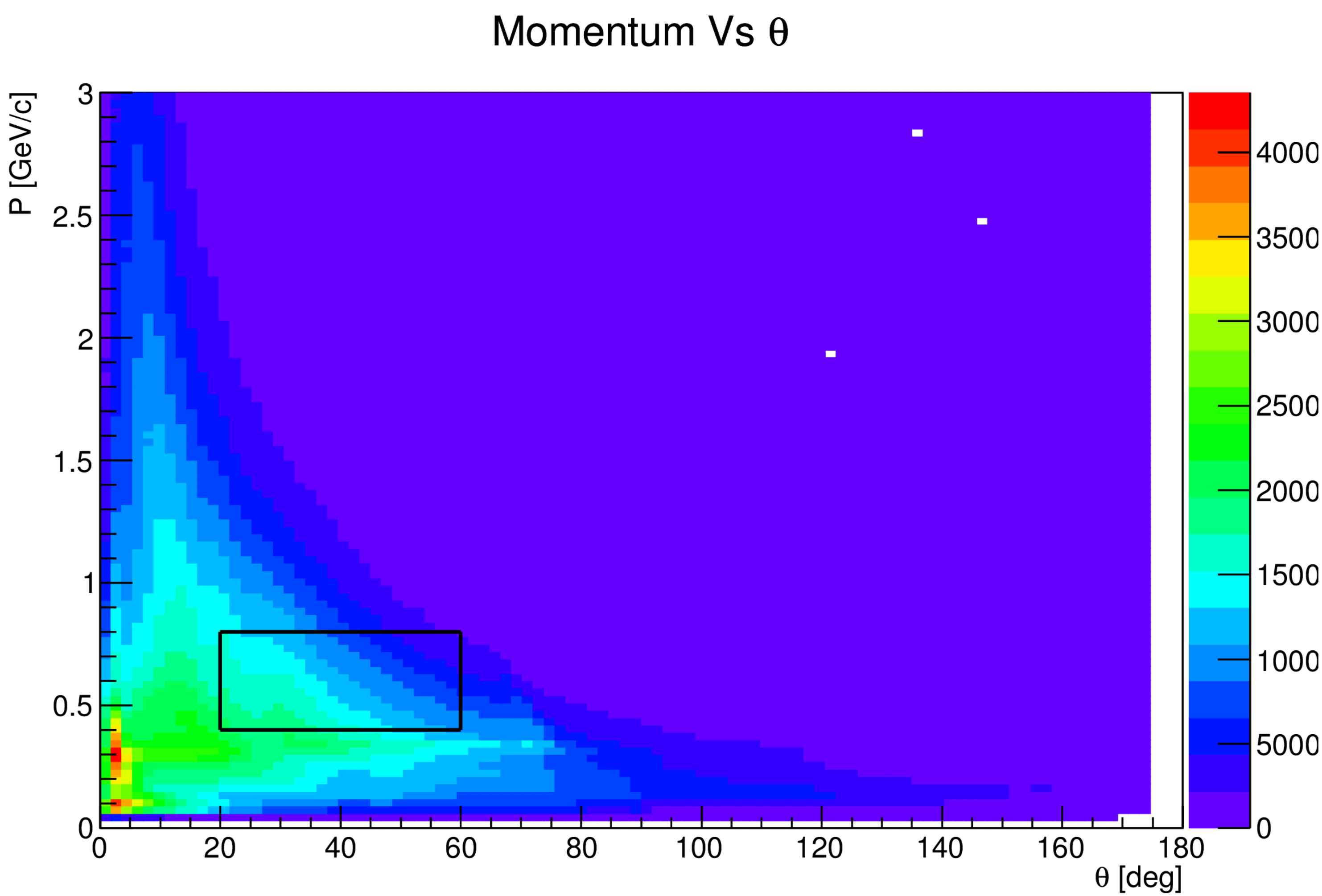
- Goal: Achieve the optimal separation of different particle types using dE/dx
  - Estimate dE/dx mean value and eventually the width.
- Method: Truncated mean
  - Drop some hits with largest dE/dx values from the track
  - Optimize truncation by:
    - 1^{st} method: best resolution.
    - 2^{nd} method: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





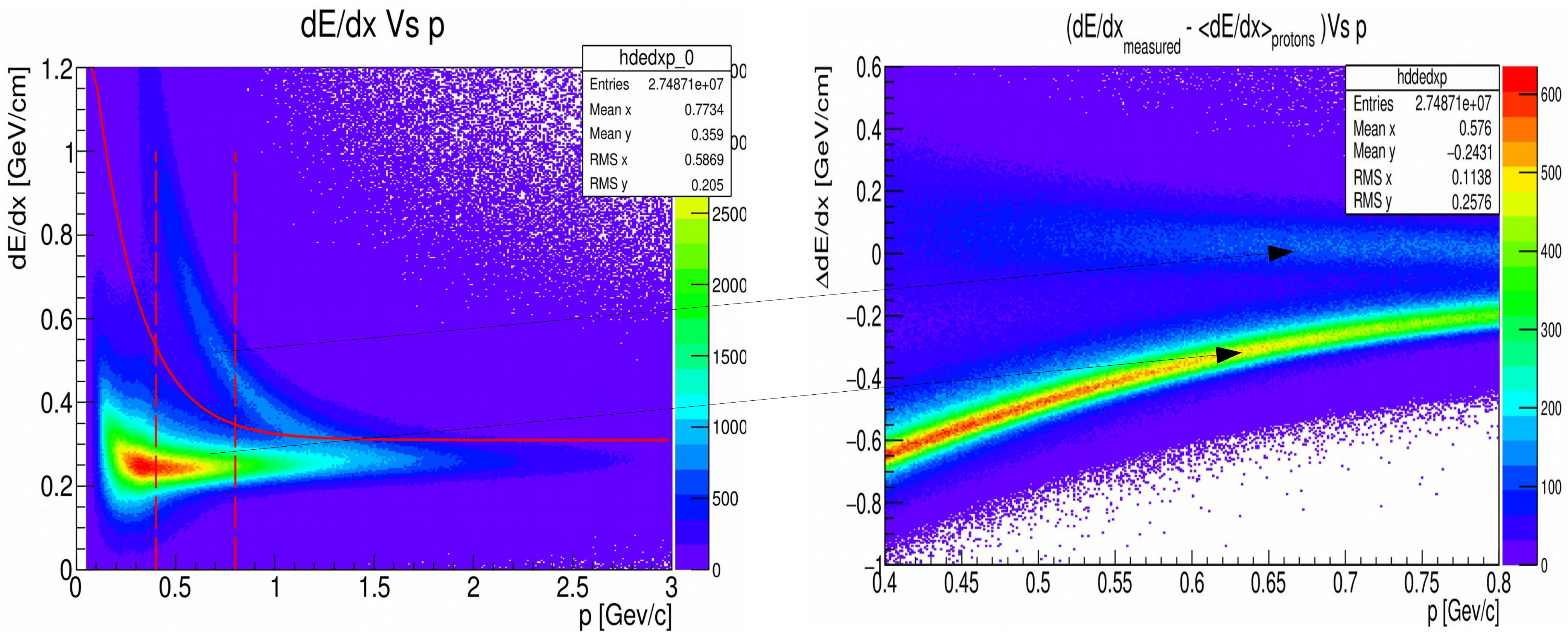
Procedure

- Spring 2016 data, runs: 011529_001 - 011529_010.
- All the tracks in the CDC
- Truncation dependence on P (0.4 - 0.8 GeV/c) & θ (20° - 60°)

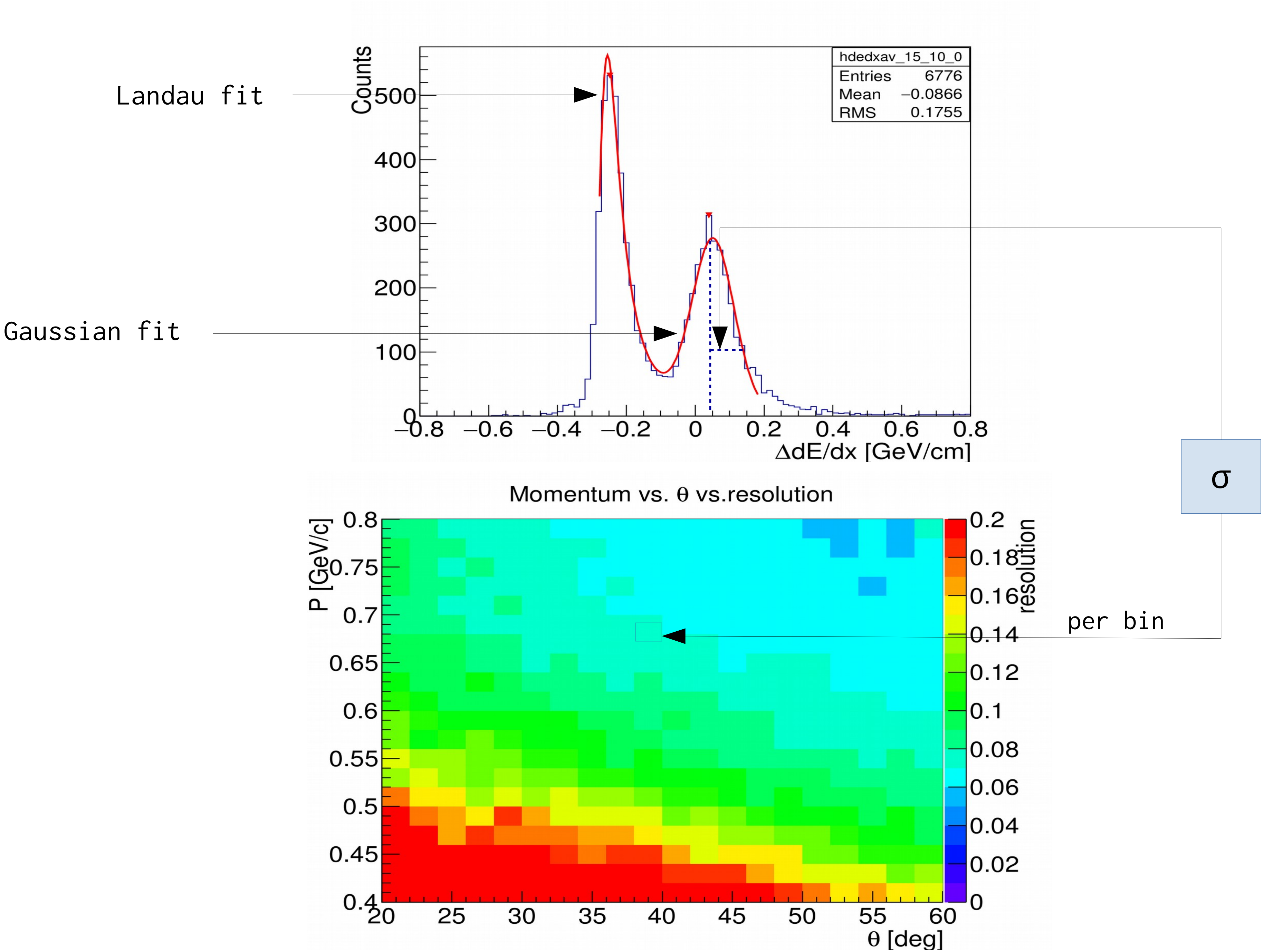


Procedure

- 1st Step: Select the protons.

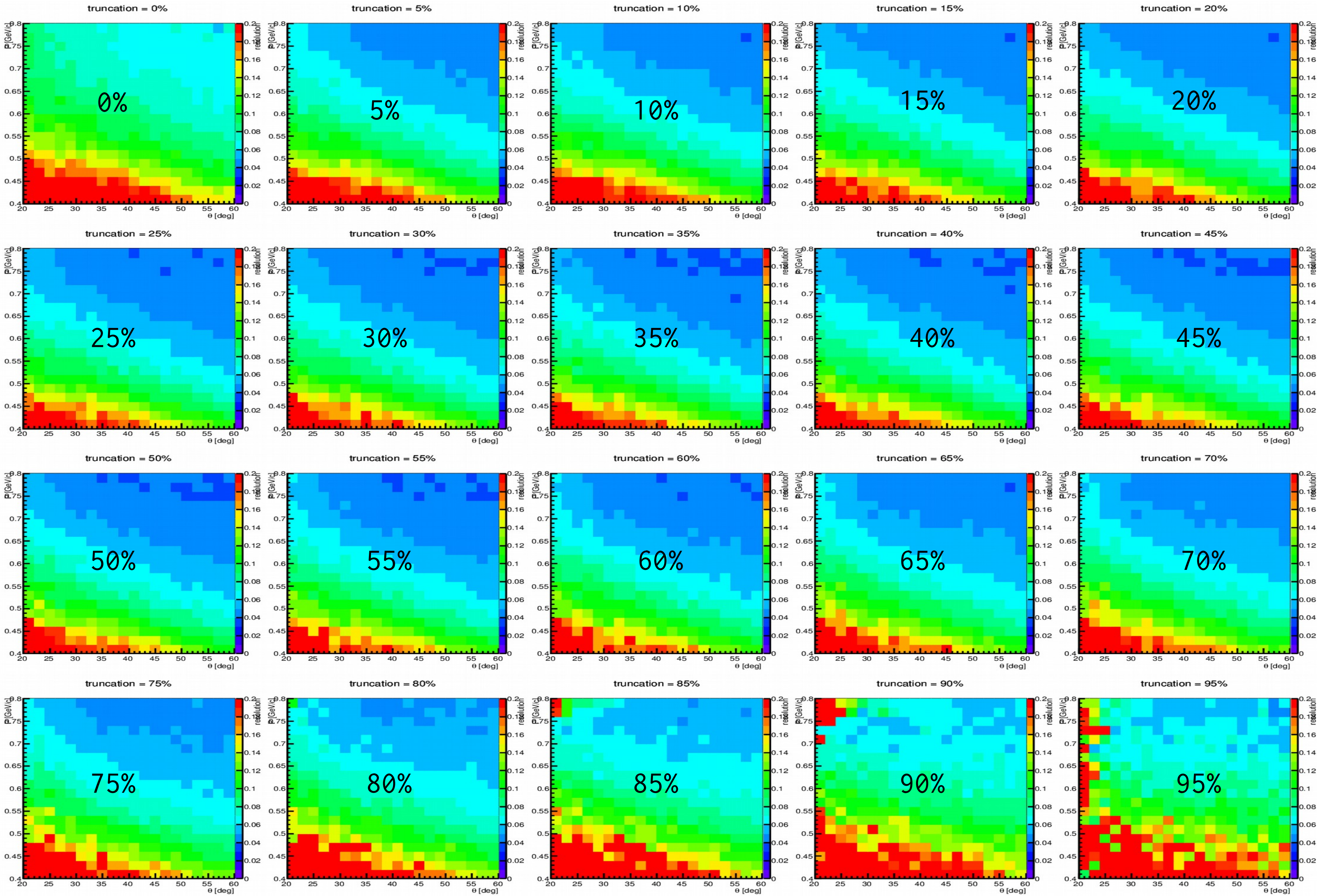


- 1st method: best resolution => optimal truncation.



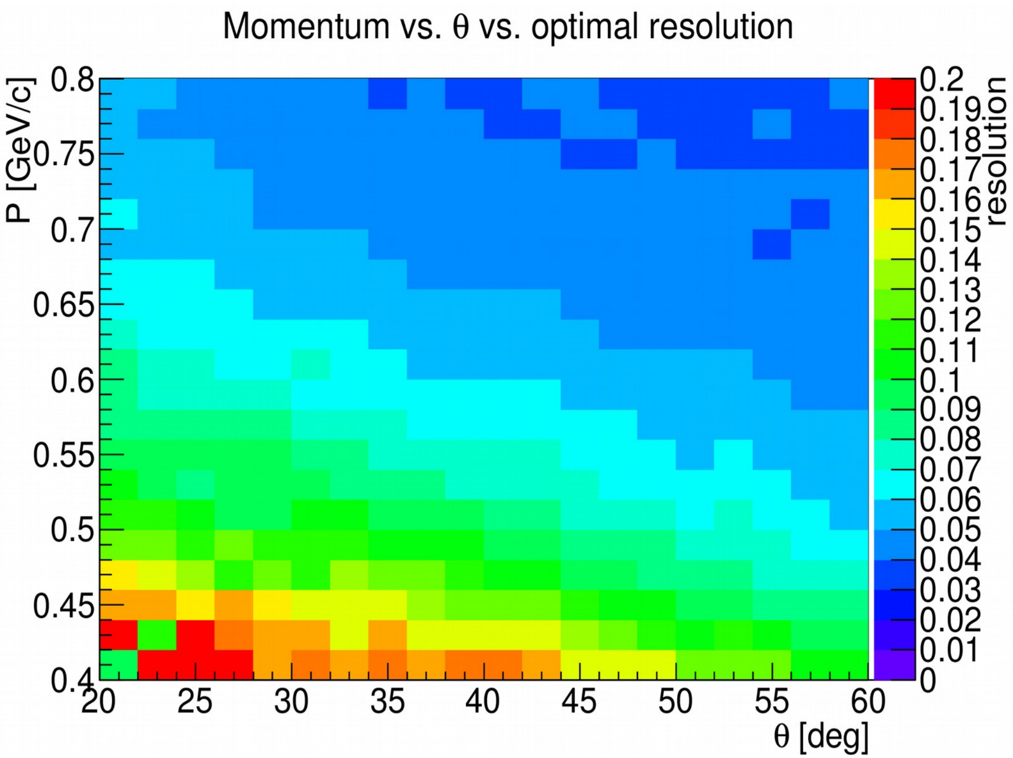
Resolution

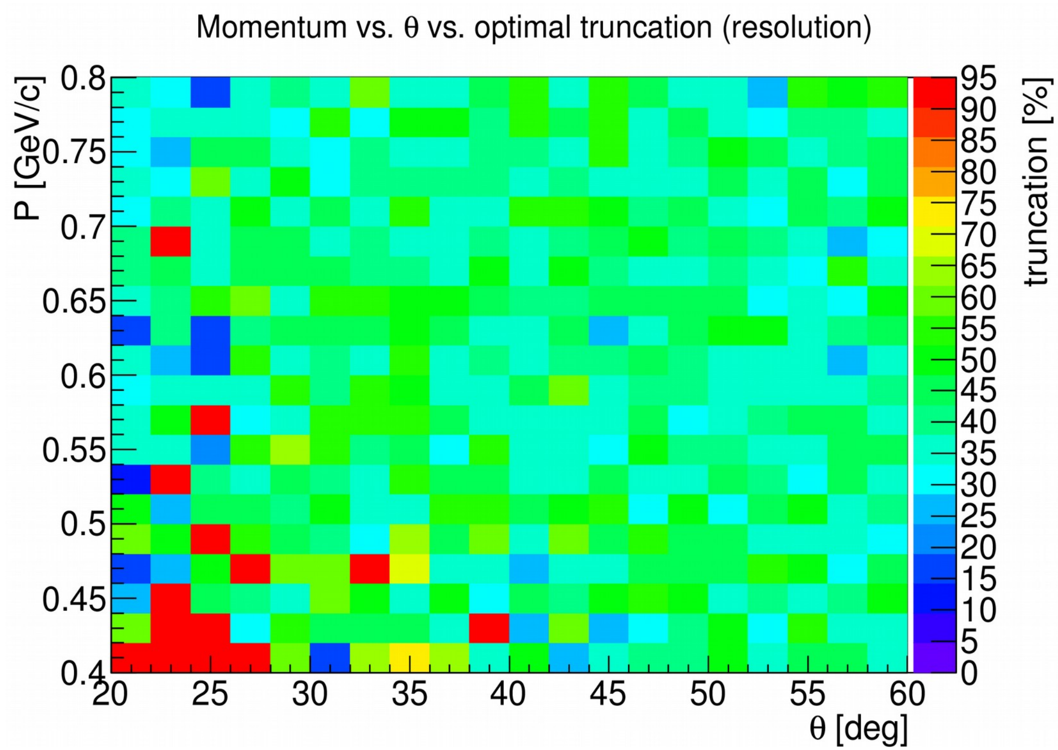
- 1st method: best resolution => optimal truncation.

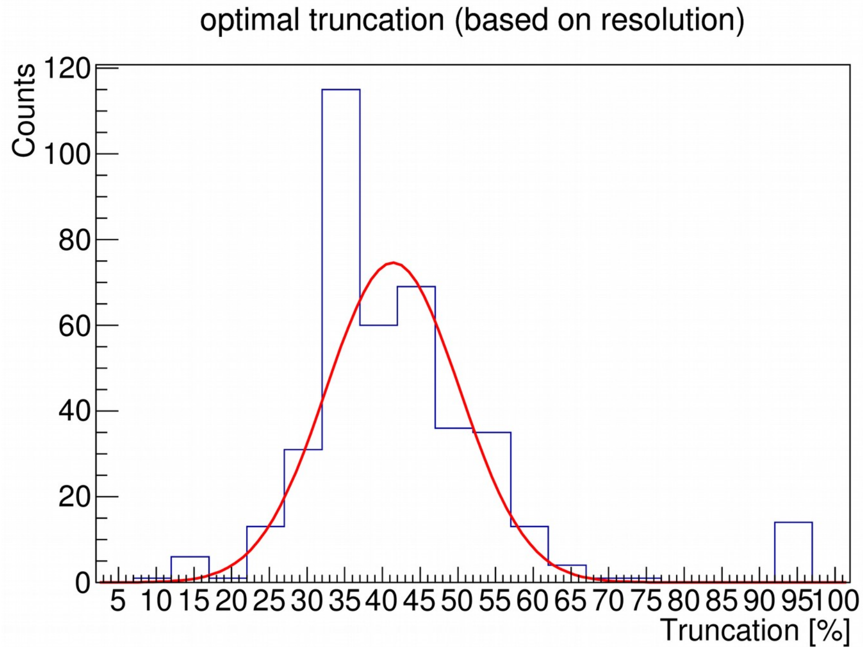


Resolution

- 1st method: optimal truncation ~35%





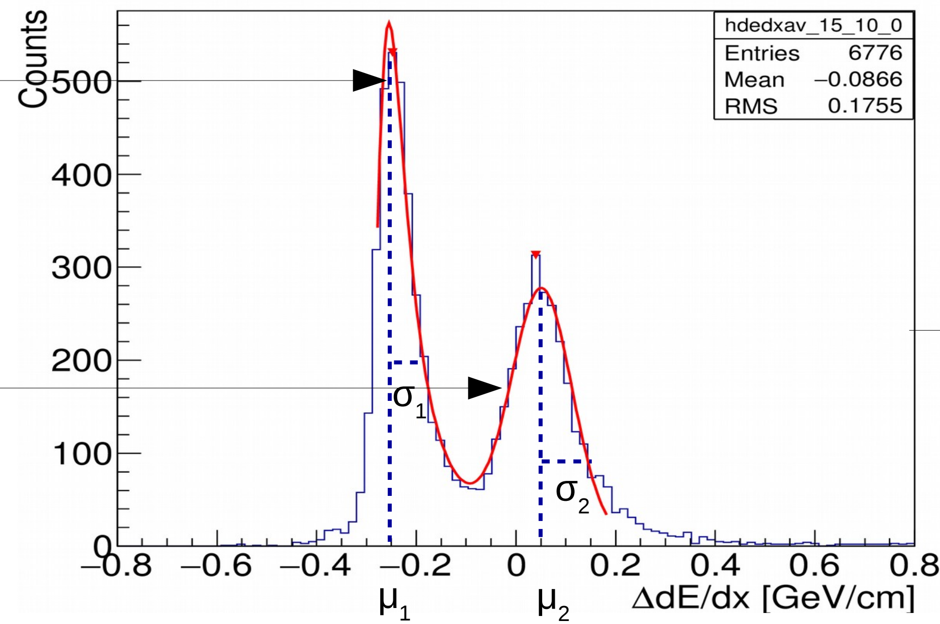


Separation Power

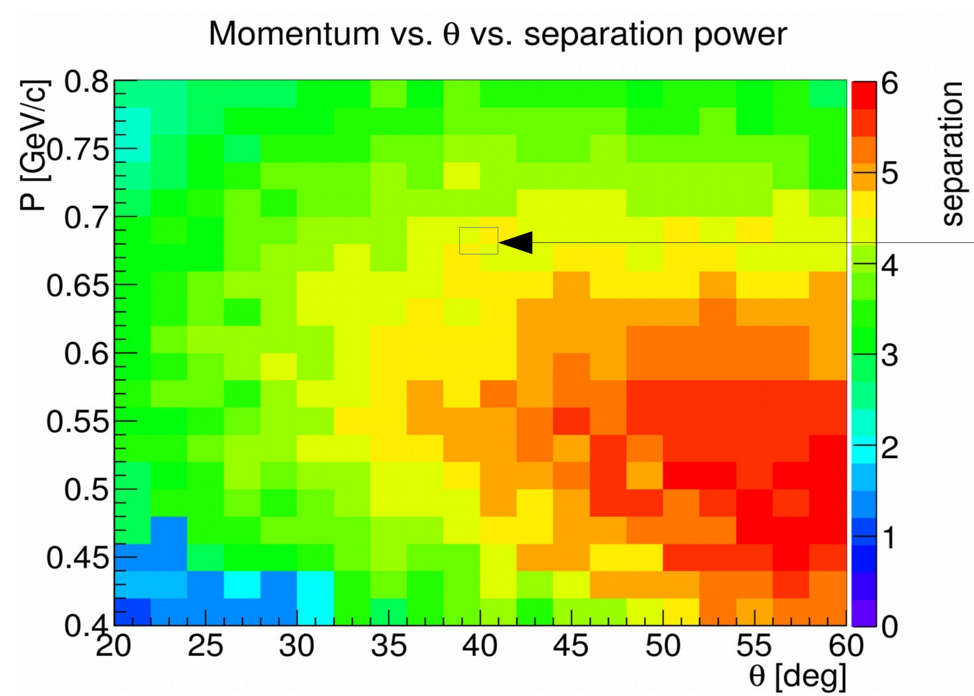
- 2nd method: strongest separation power => optimal truncation.

Landau fit

Gaussian fit



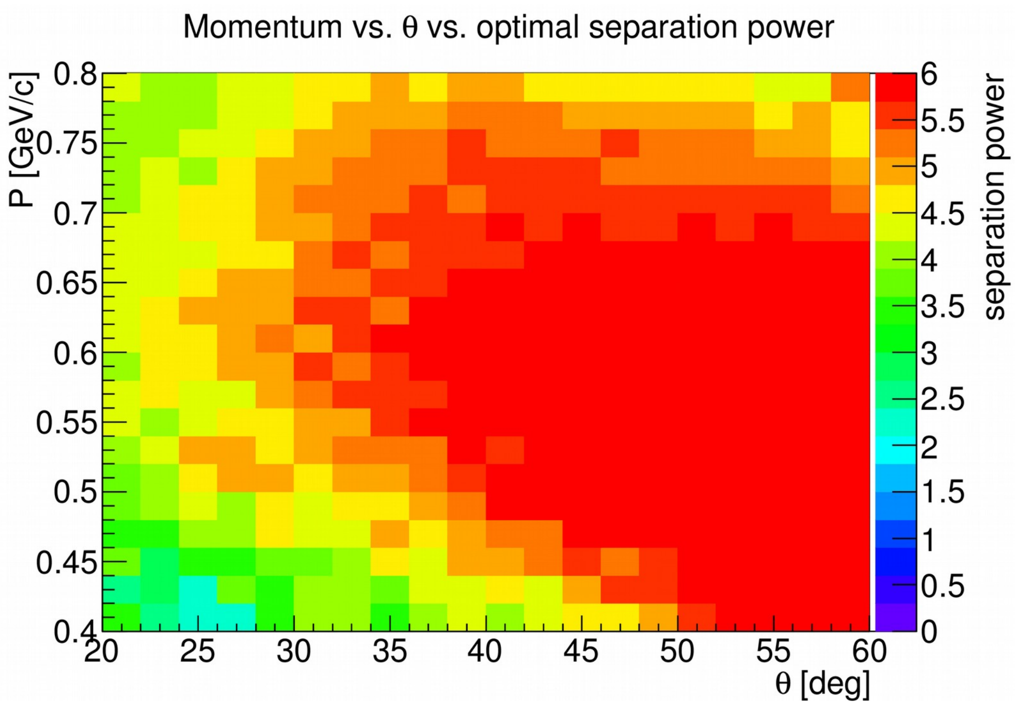
$$S = \frac{\mu_1 - \mu_2}{\sqrt{\sigma_1^2 + \sigma_2^2}}$$

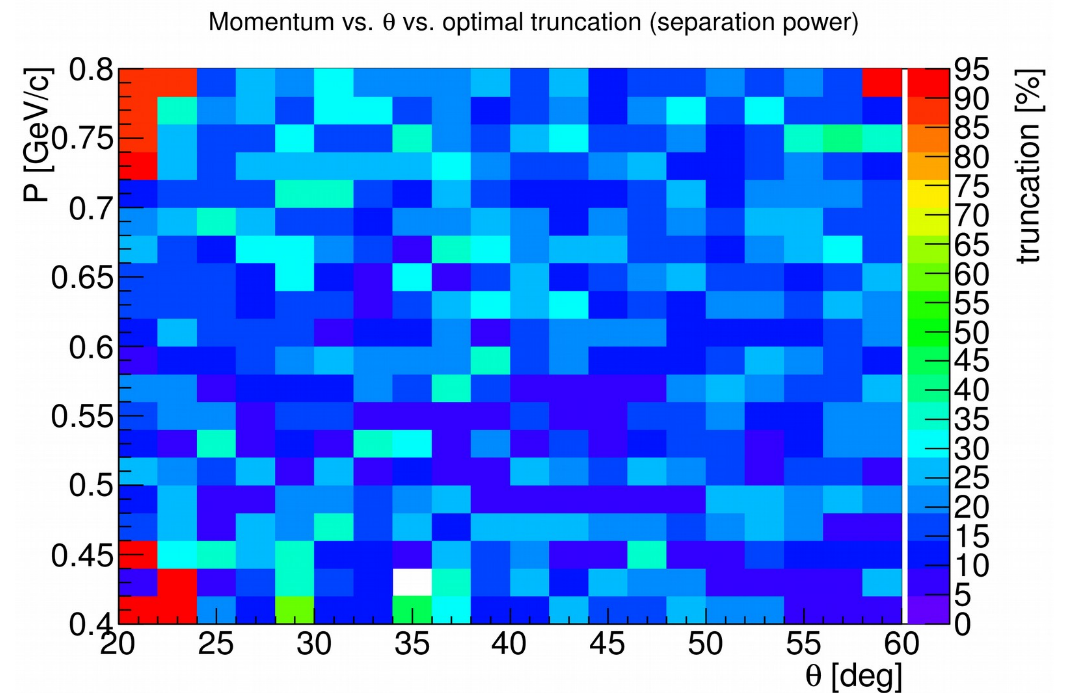


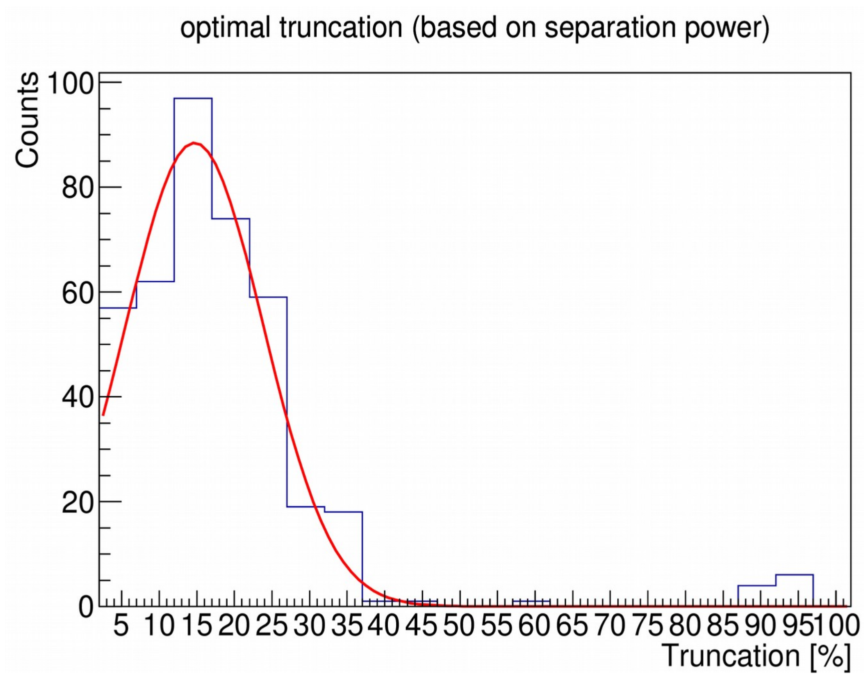
per bin

Separation Power

- 2^{nd} method: optimal truncation ~15%

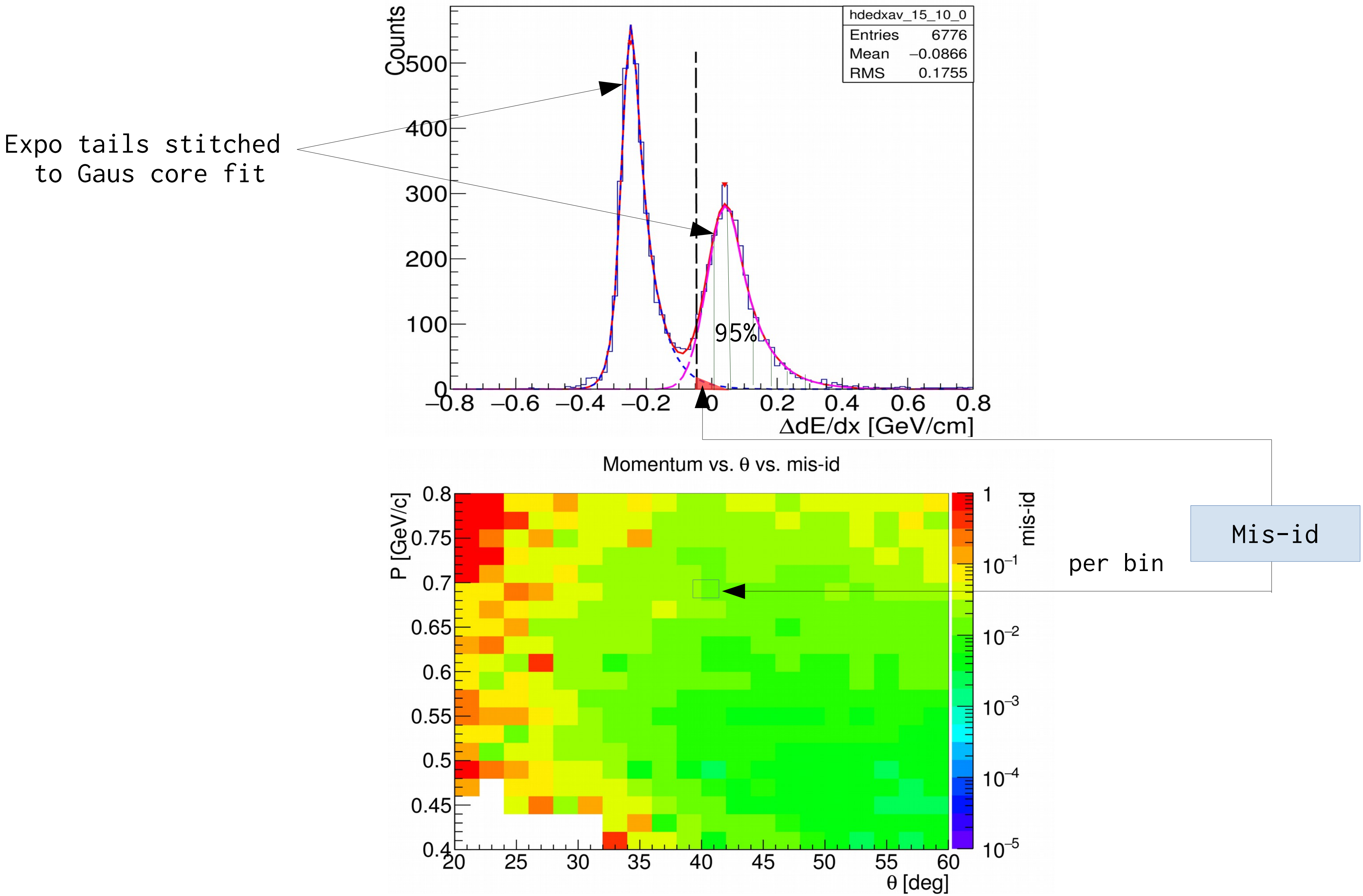




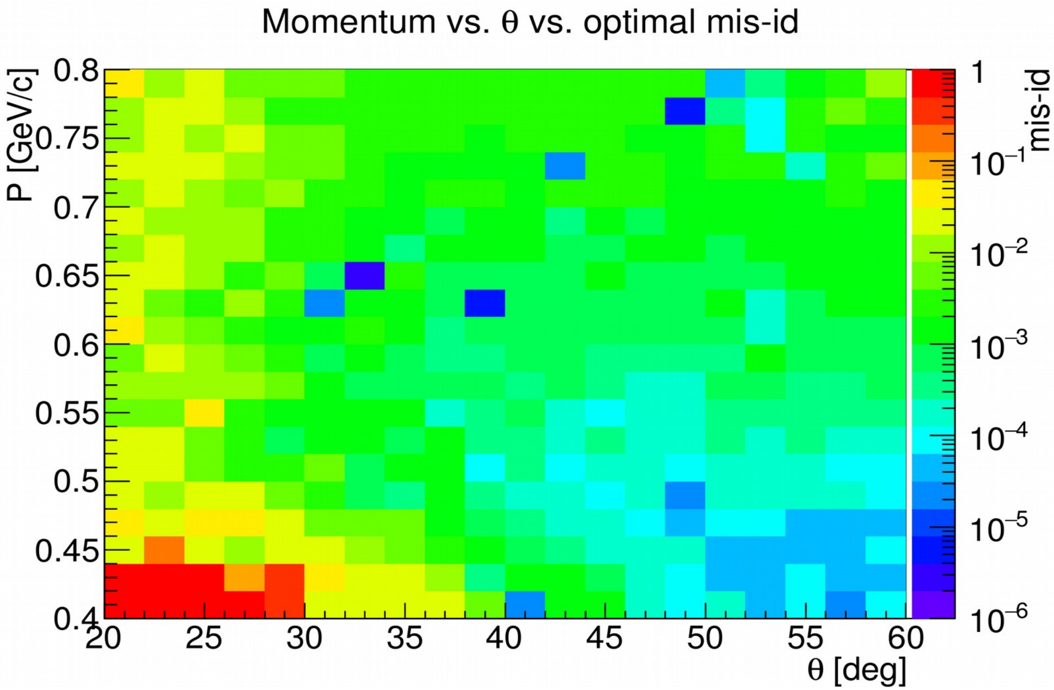


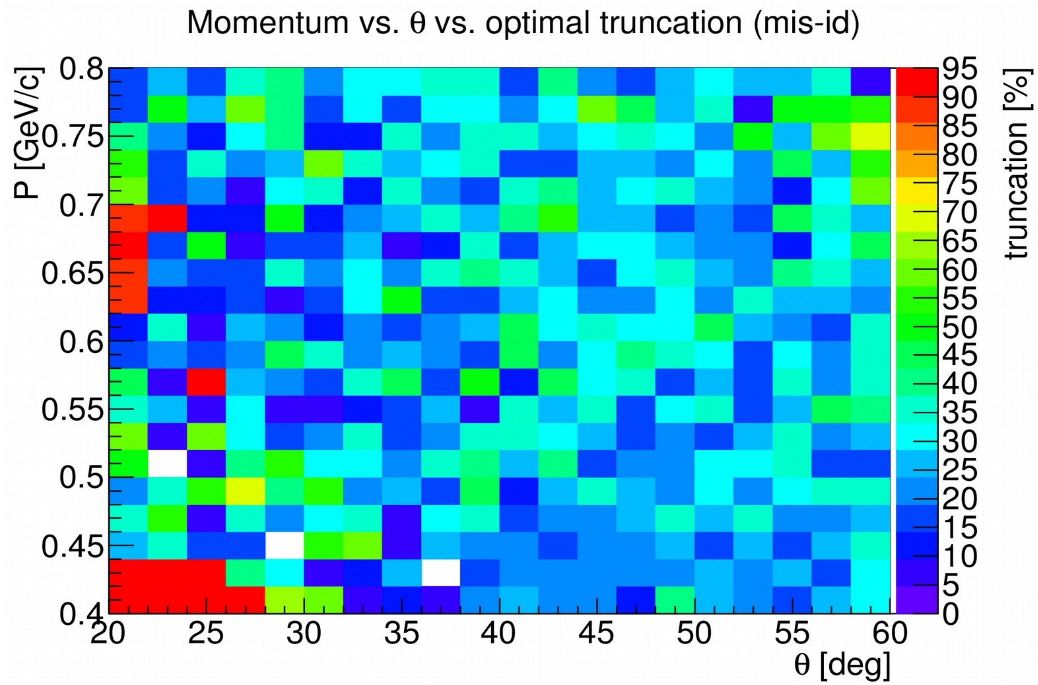
Mis-id

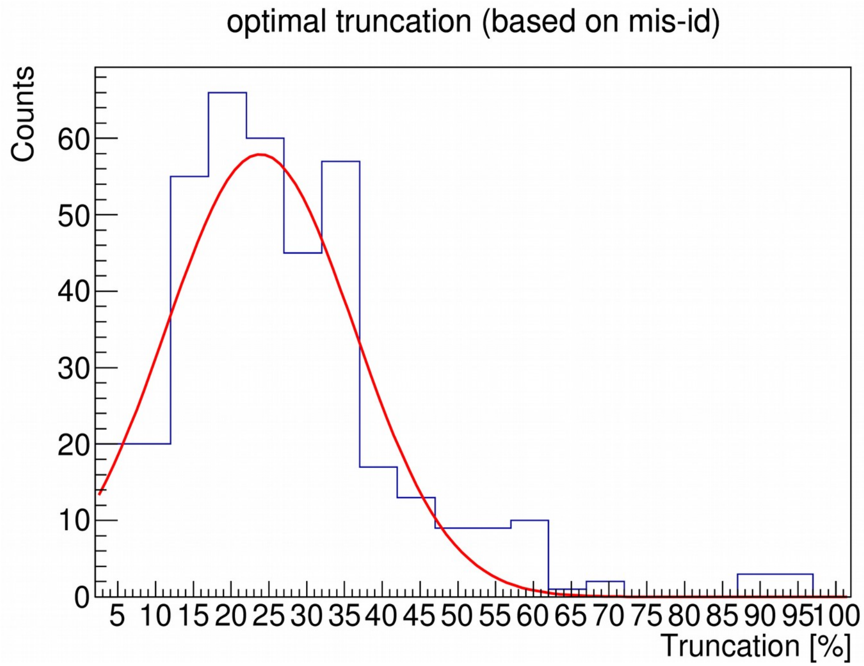
- 3rd method: lowest mis-id => optimal truncation.



- 3rd method: optimal truncation ~25%

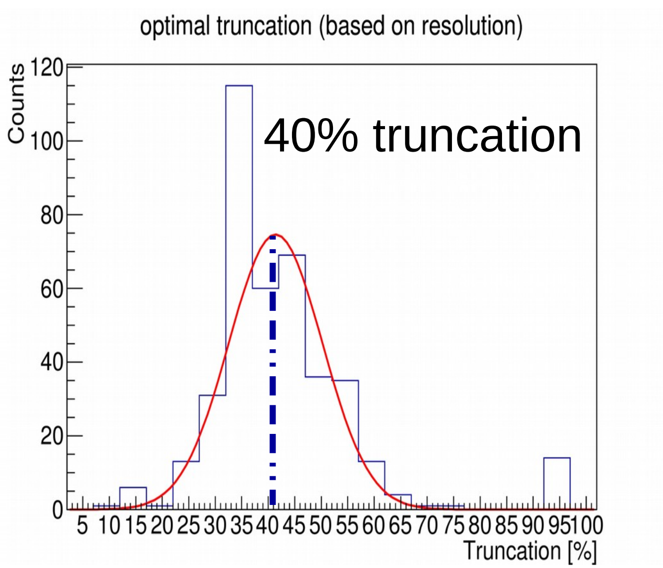


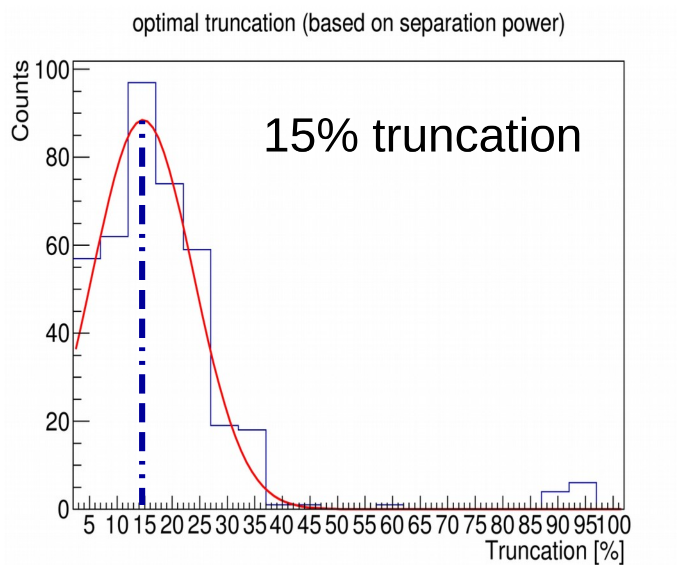


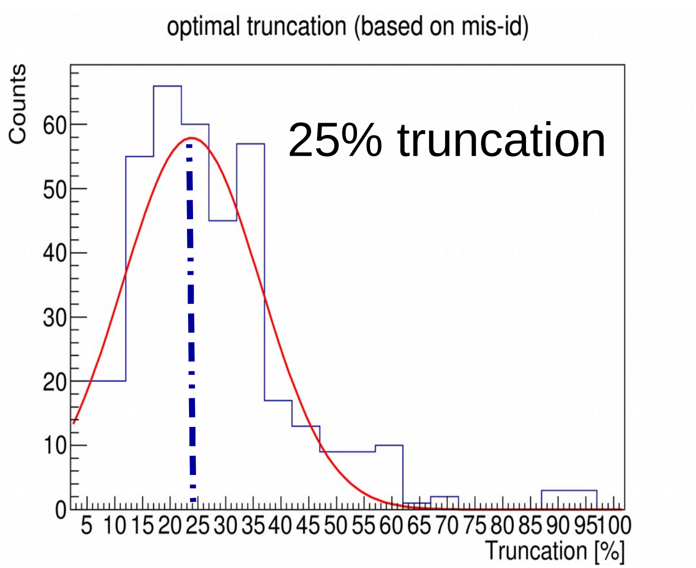


Results & perspectives

- 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>:

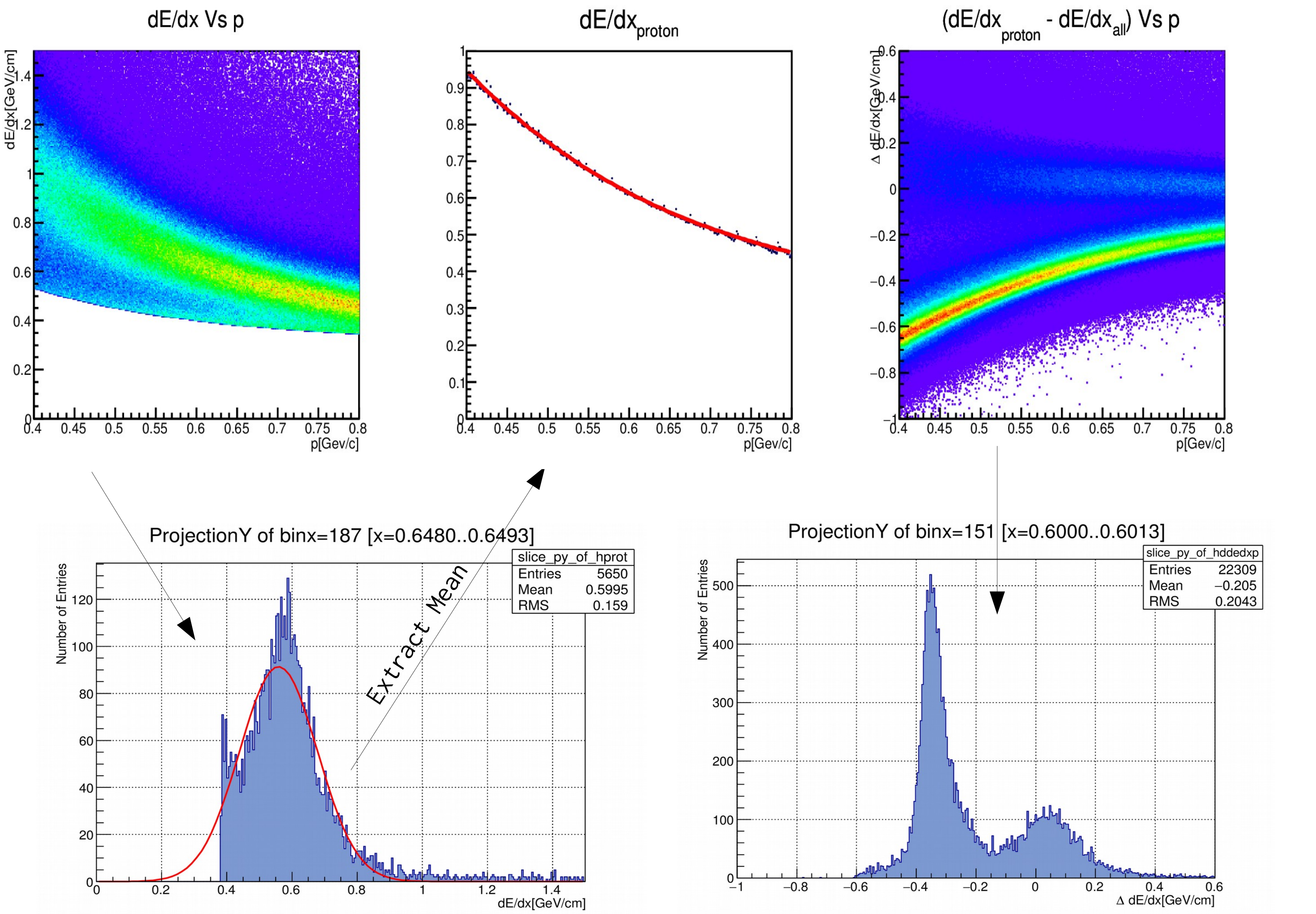
- Study the optimal truncation in exclusive channels:
  - Clean samples of different particles to improve separation power.
- Study the potential of a double truncated mean method.
- Study other possible calibration that might be needed (e.g.: entrance angle & space-charge effect).
- Determine dE/dx resolution for different momenta and particle types.

Thank you for your attention

Backup

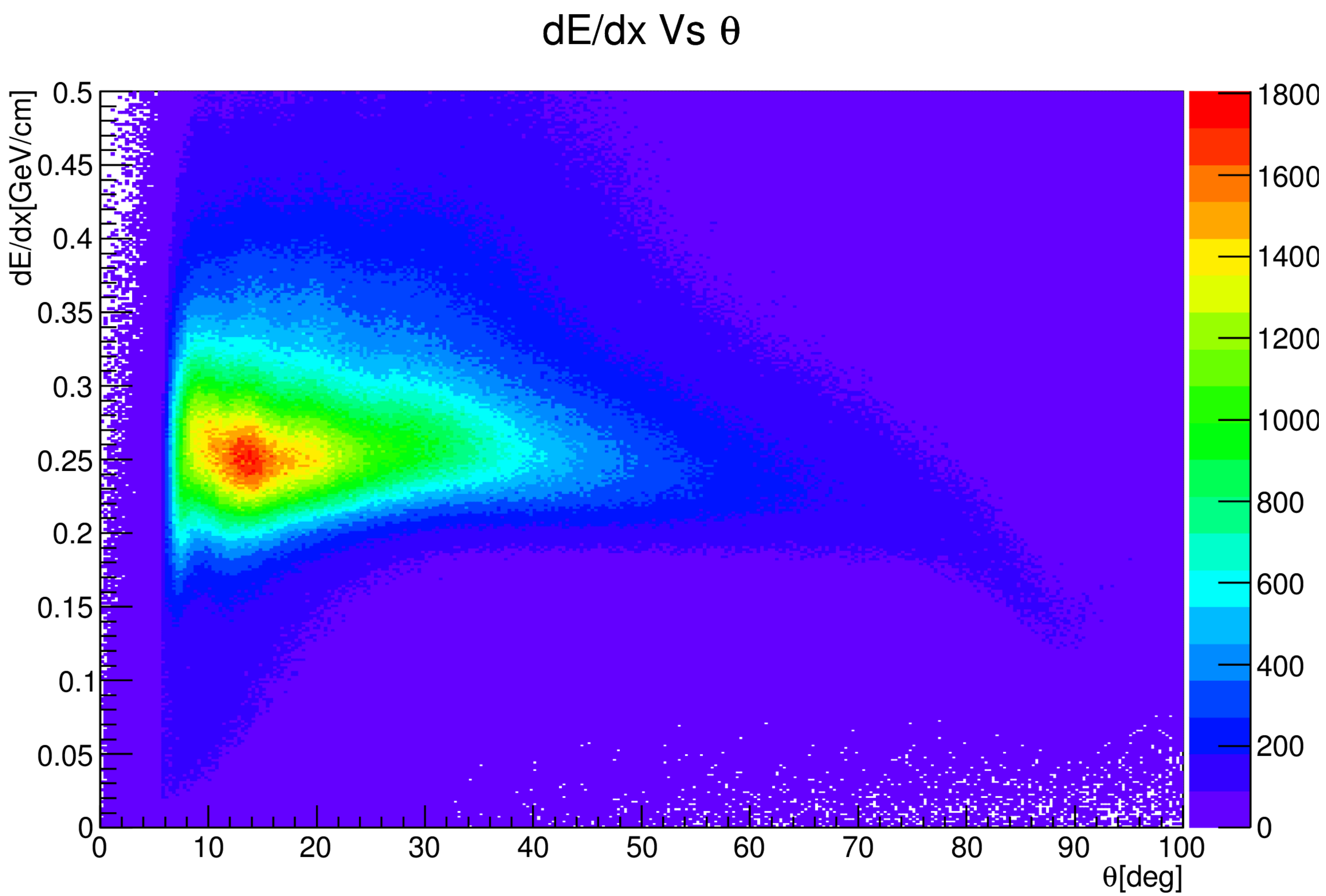
Procedure

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



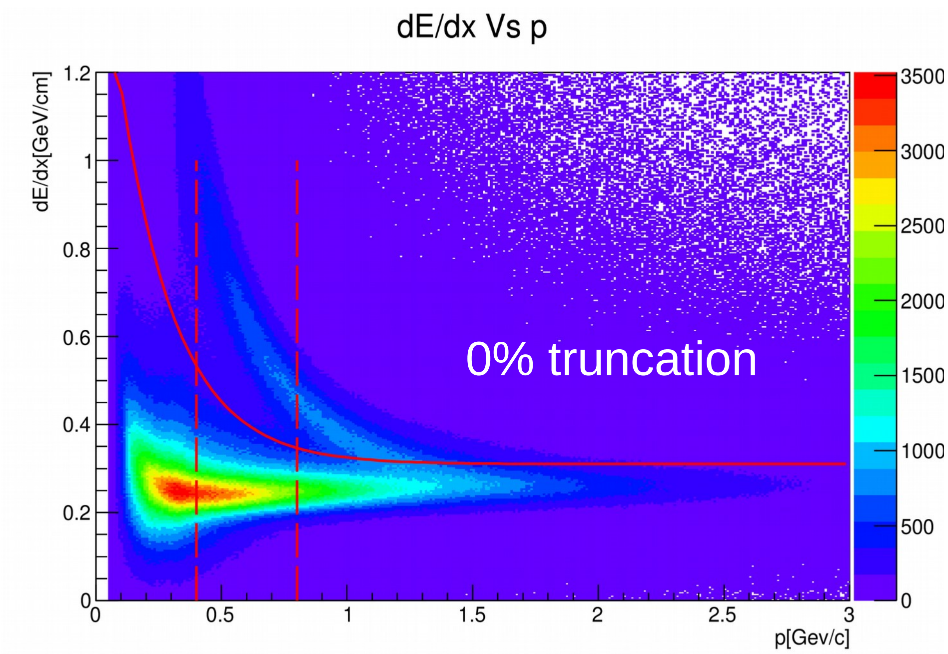
Procedure

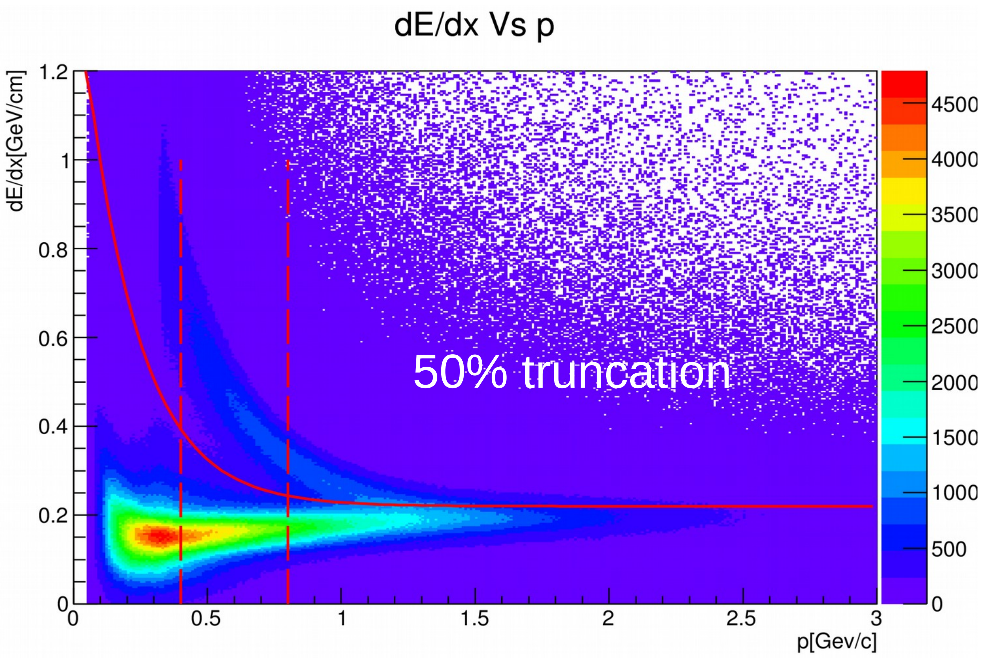
- dE/dx vs. θ

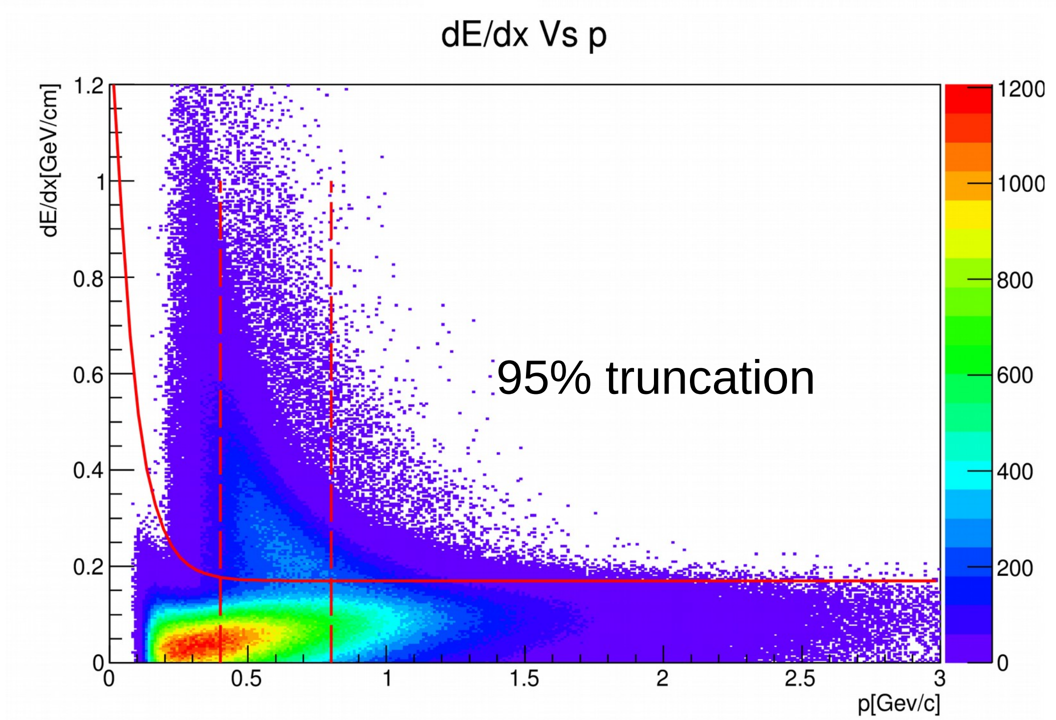


Procedure

- dE/dx dependance of truncation (different cuts)

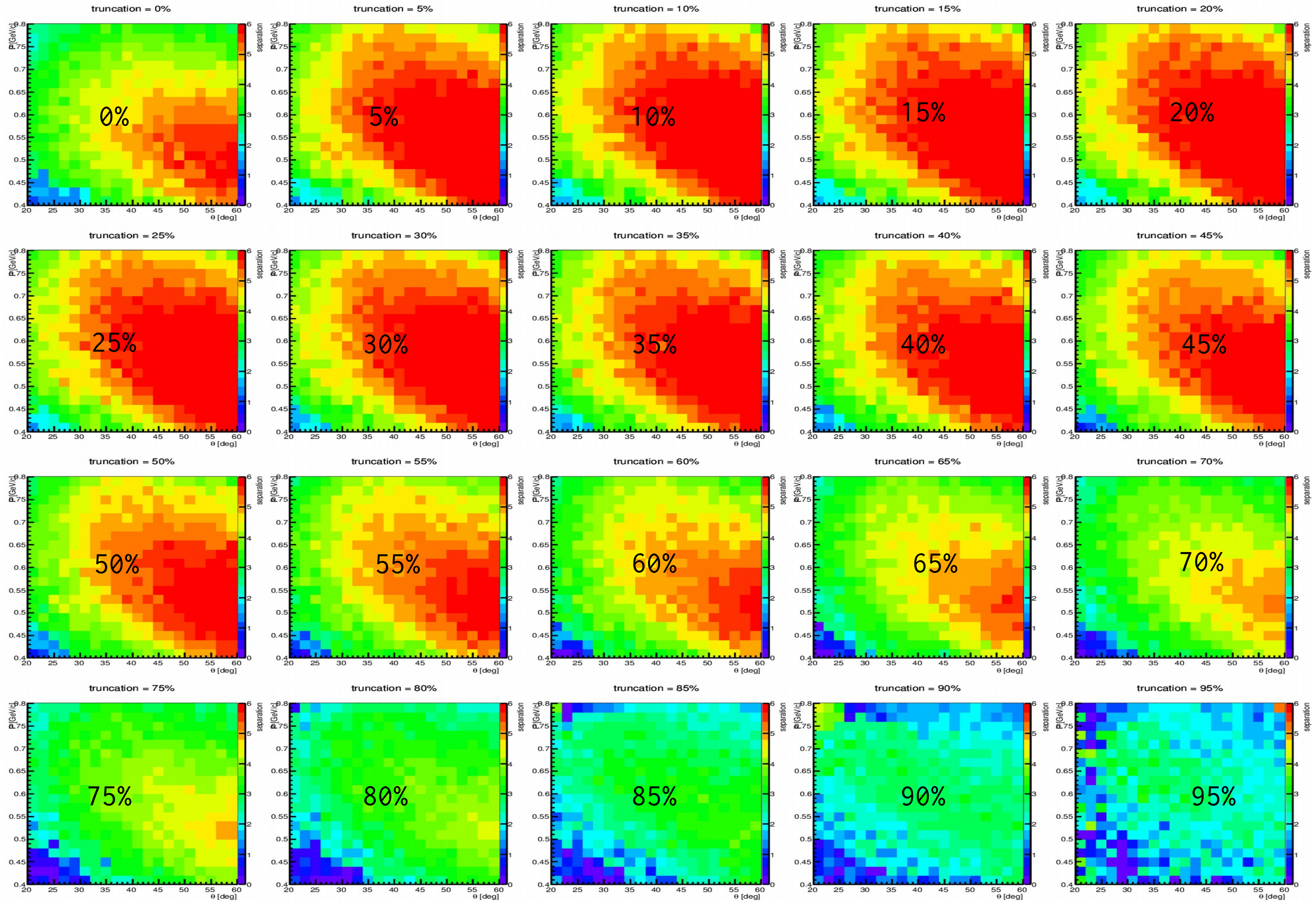






Separation Power

- 2^{nd} method: strongest separation power => optimal truncation.



Mis-id

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