

Analysis of dE/dx in Straw Tracker for Particle Identification

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Events generation


- SpdRoot
- Primary generator: Pythia8
- Minimum bias

```
P8gen->SetParameters("SoftQCD:nonDiffractive = on");
```

- Detector setup, etc.: as in SimuQs1Py8.C
- 10 000 events

Data to analyse

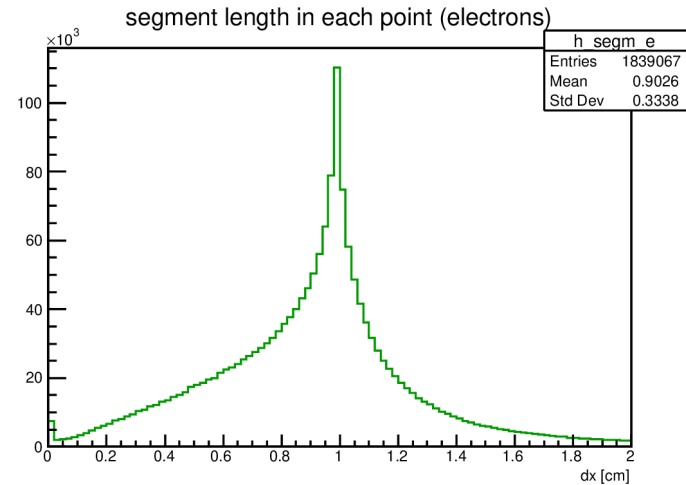
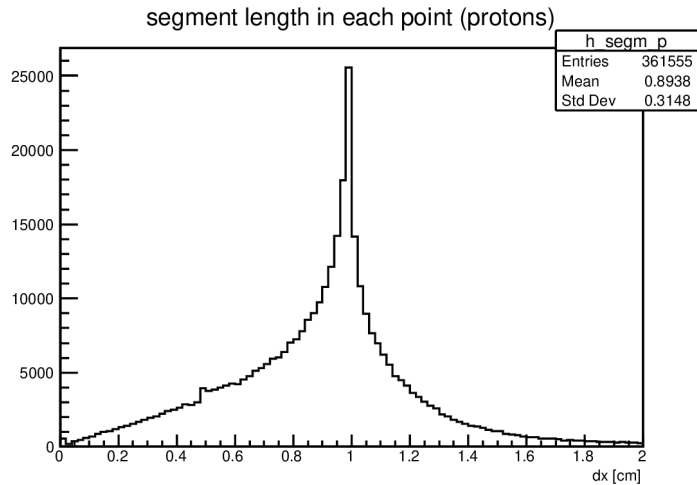
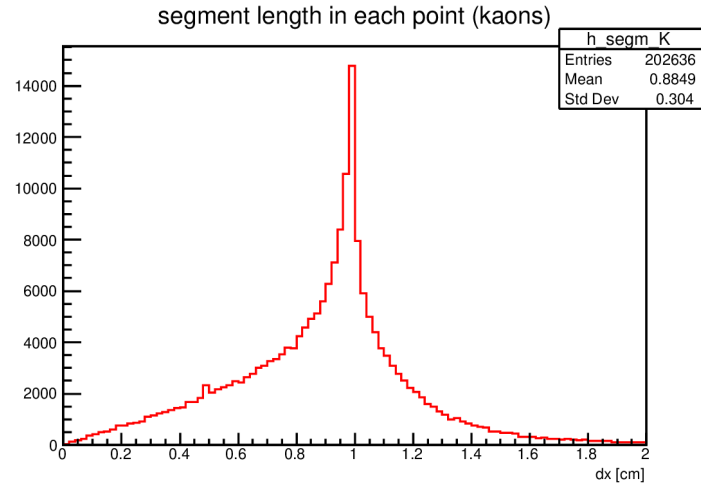
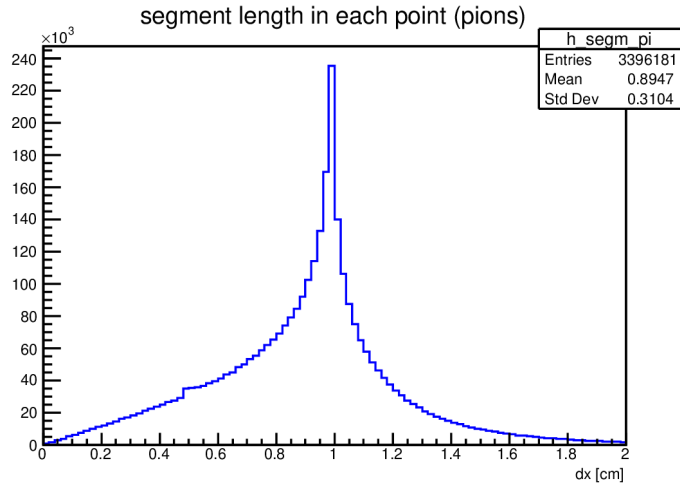
- SpdTsTBPoint

- GetEnergyLoss() → dE
 - GetSegmentLength() → dx
 - ...
- 
- A diagram consisting of two arrows pointing from the right towards a central point. The top arrow starts at the text 'dE' and the bottom arrow starts at the text 'dx'. Both arrows converge towards a larger text 'dE/dx' on the right.

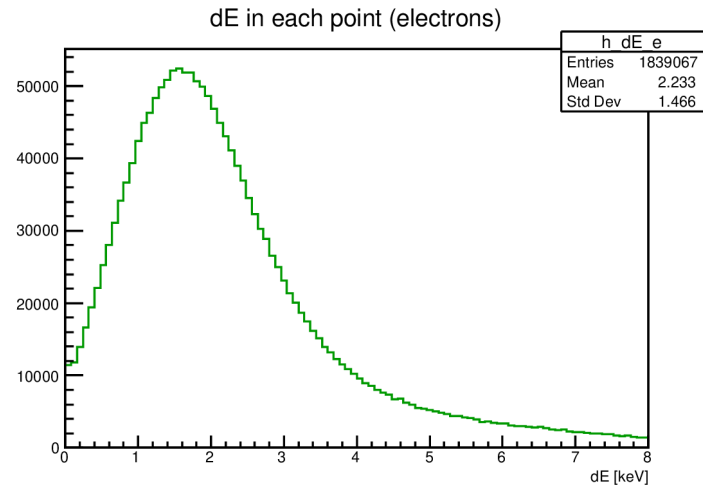
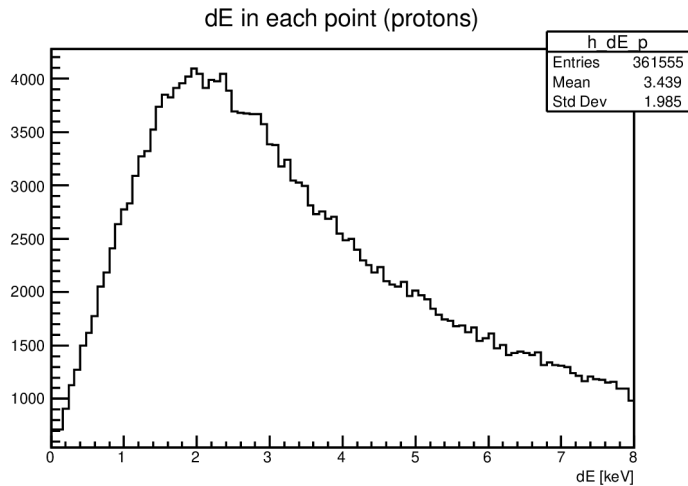
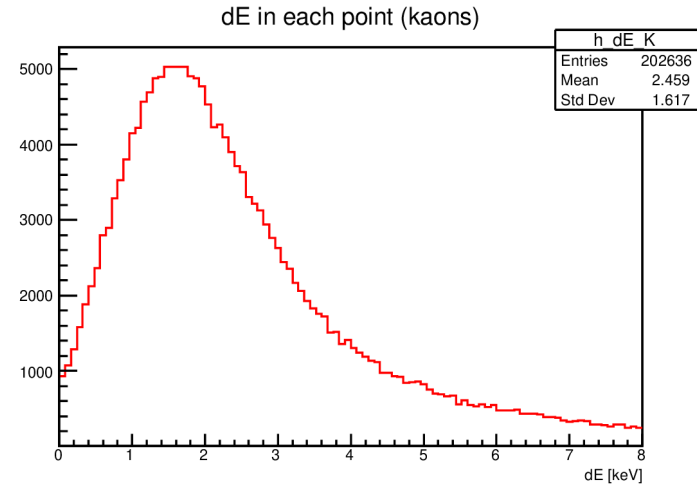
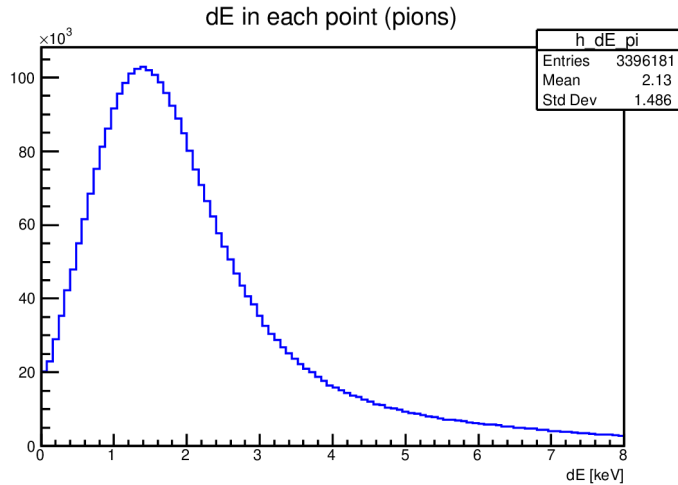
- SpdMCTrack

- GetP() → momentum
- GetPdgCode() → particle type
- ...

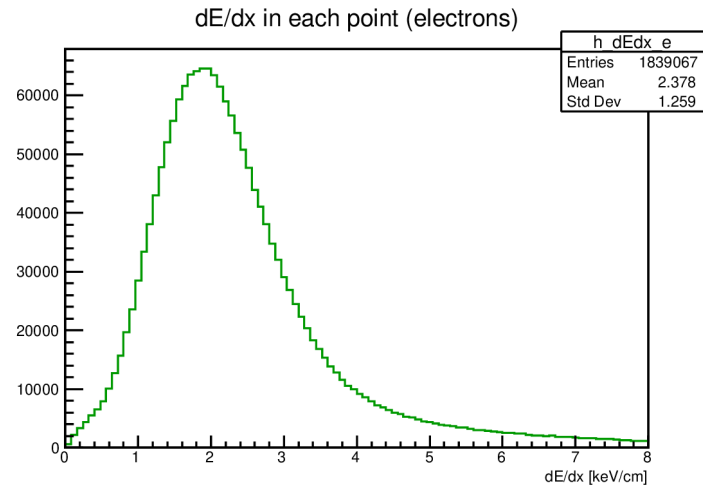
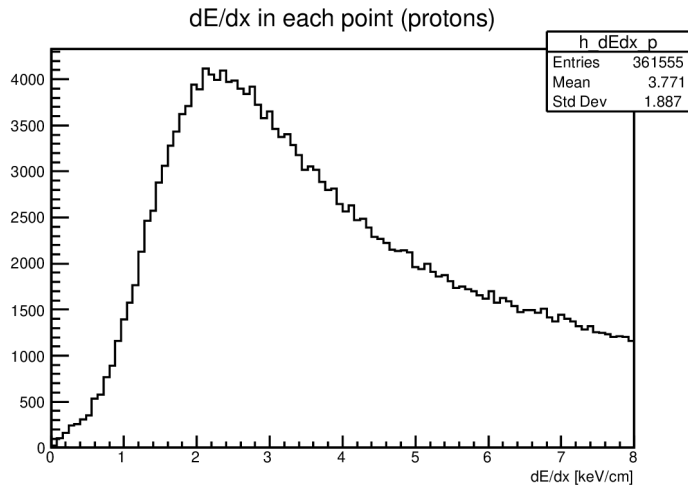
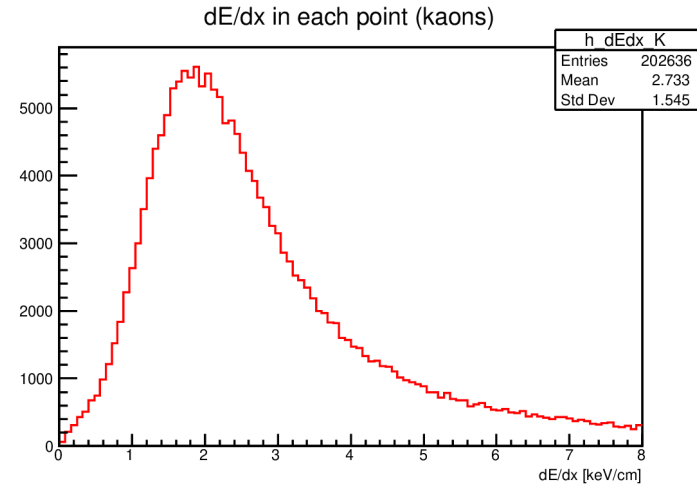
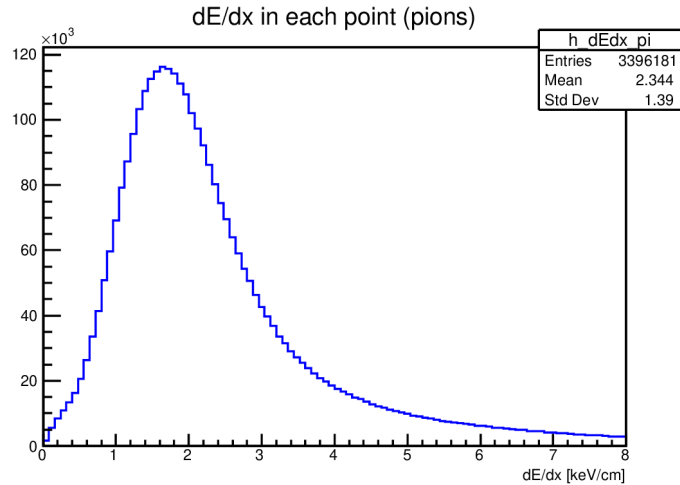
Distributions of segment lengths (dx)



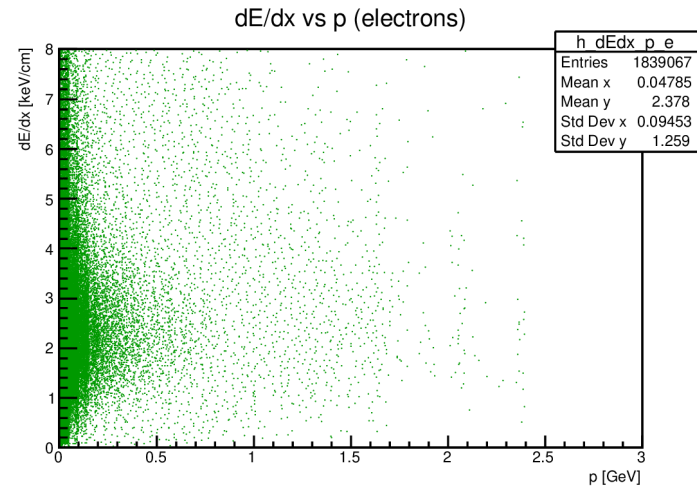
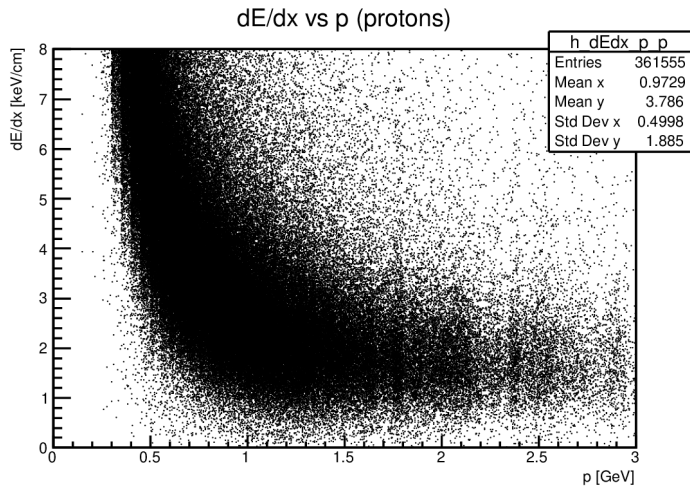
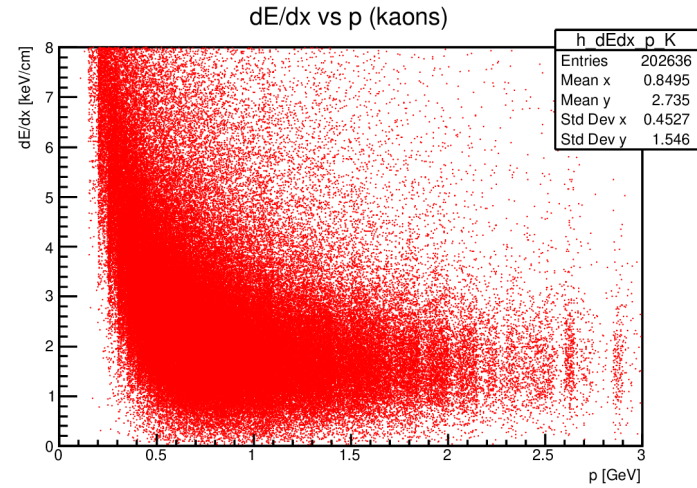
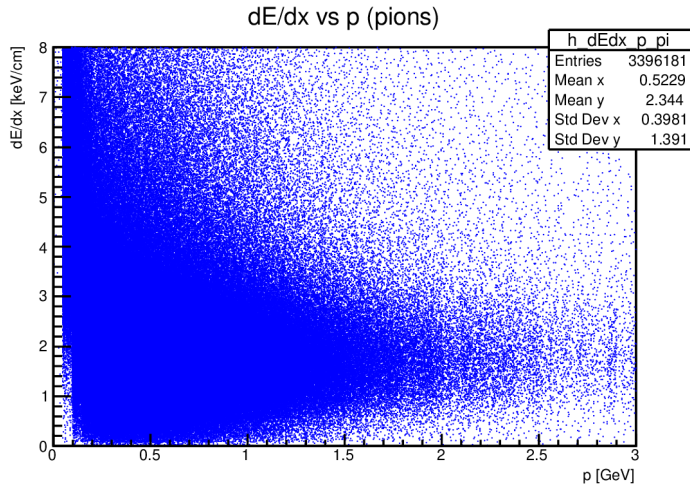
Distributions of energy losses (dE)



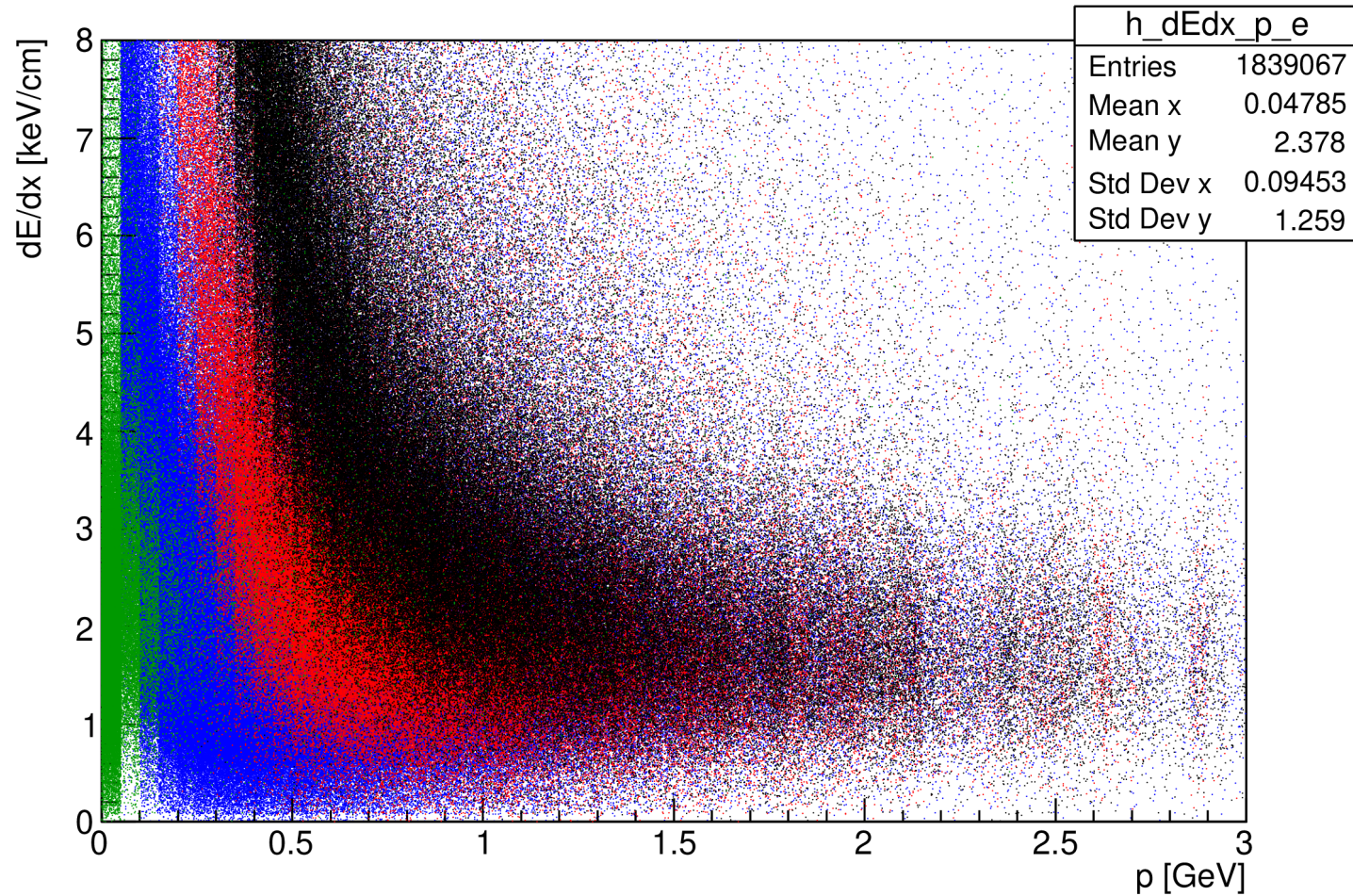
Distributions of dE/dx



dE/dx vs p



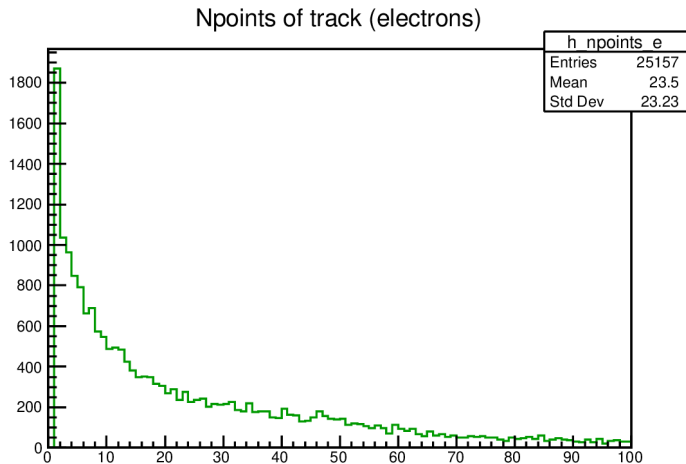
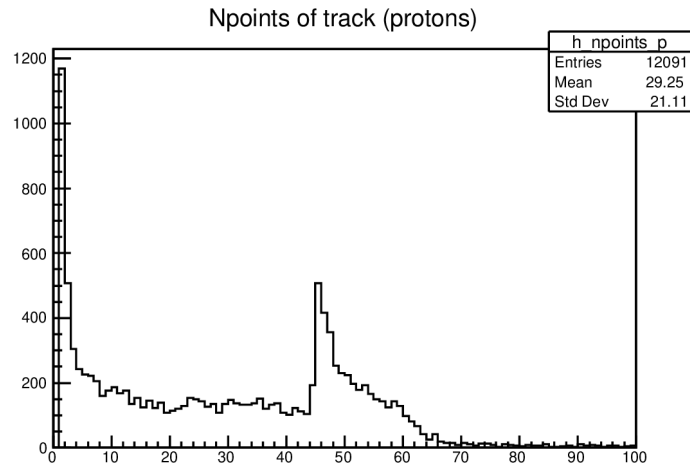
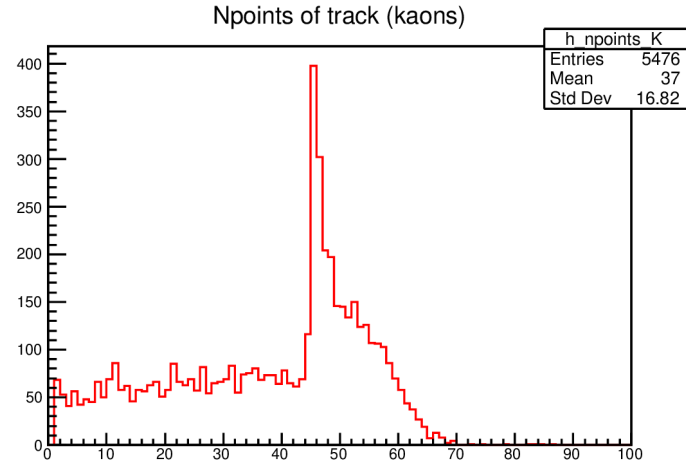
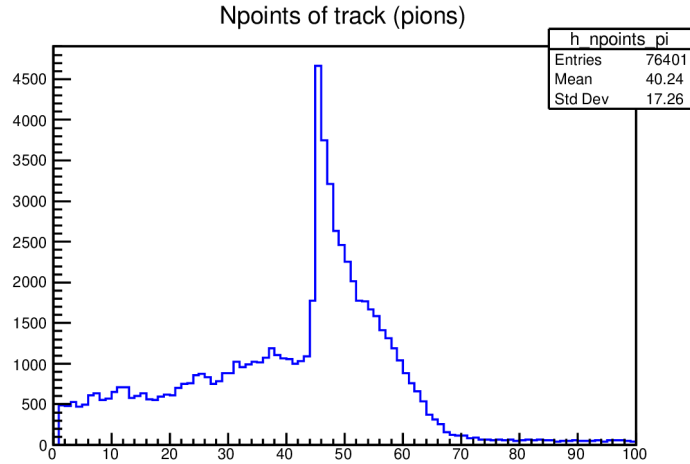
dE/dx vs p



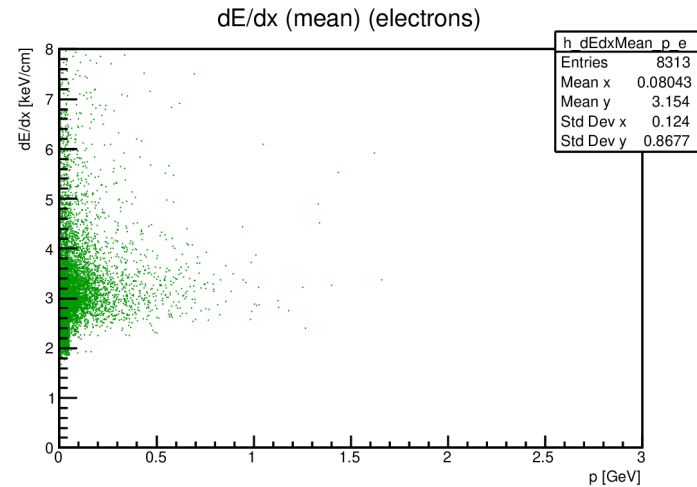
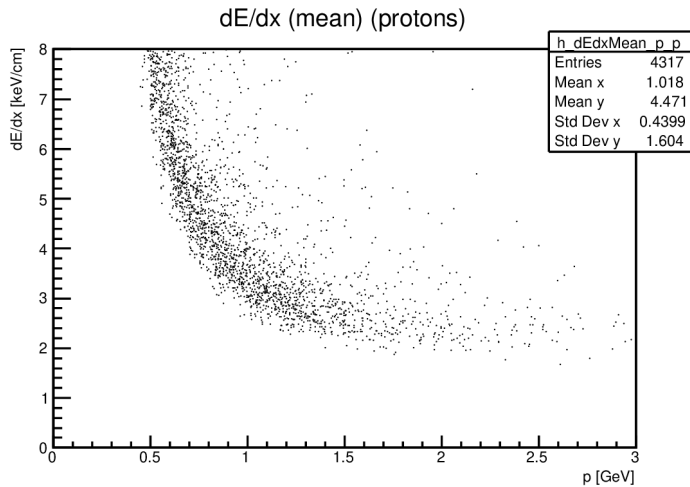
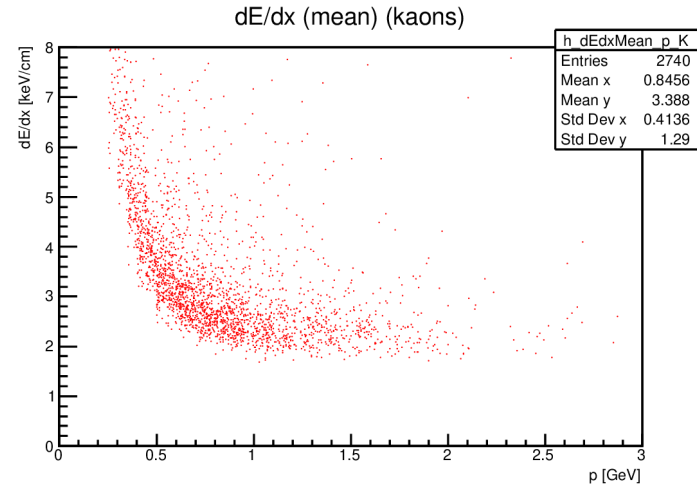
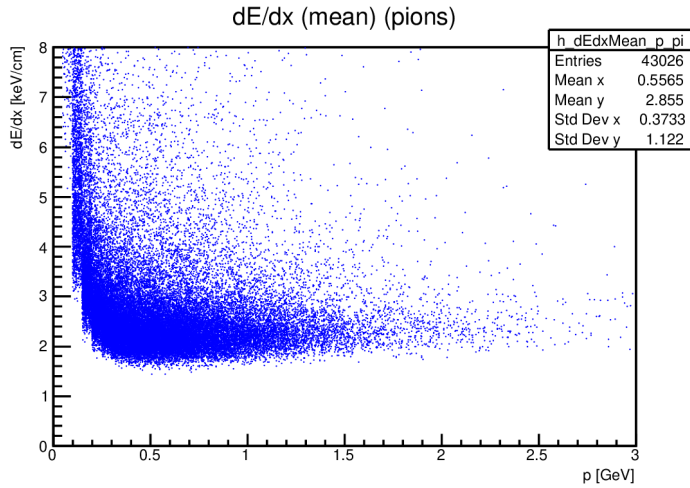
Track analysis

- Each track (usually) crosses several straw tubes.
- In simplest case, we calculate **mean** value of dE/dx for each track.
- To calculate the **truncated mean**, we discard certain percentage of points with highest values of dE/dx .

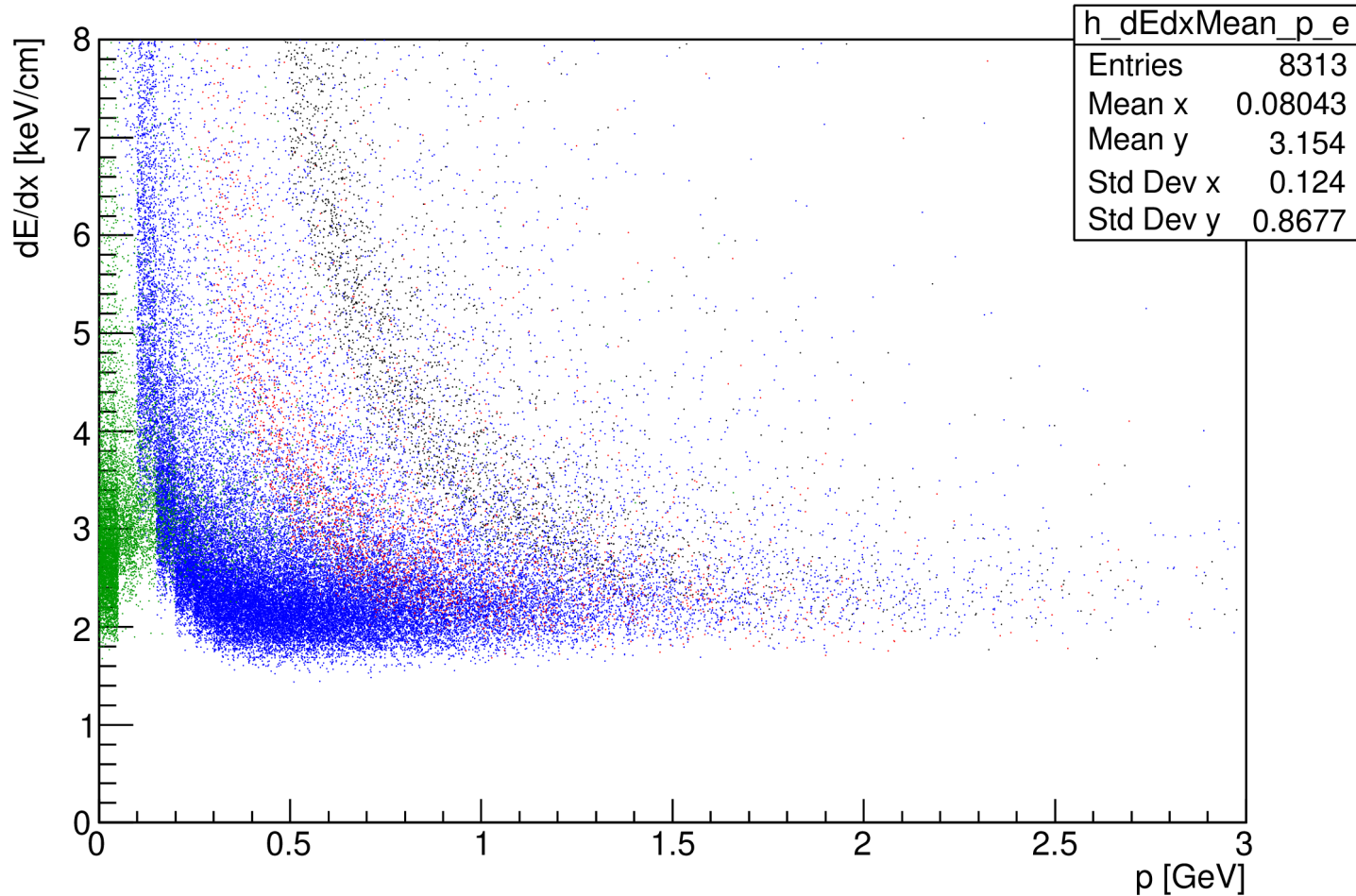
Number of tubes each track crosses



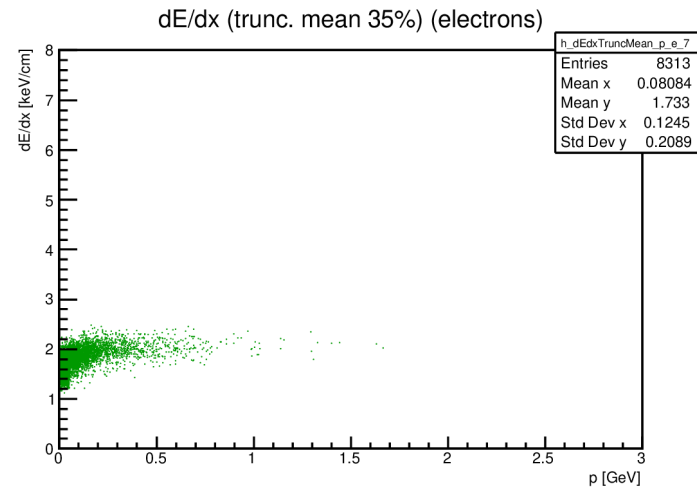
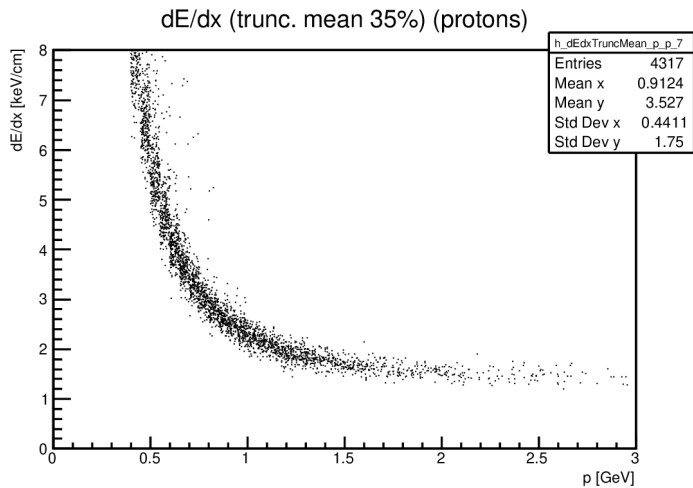
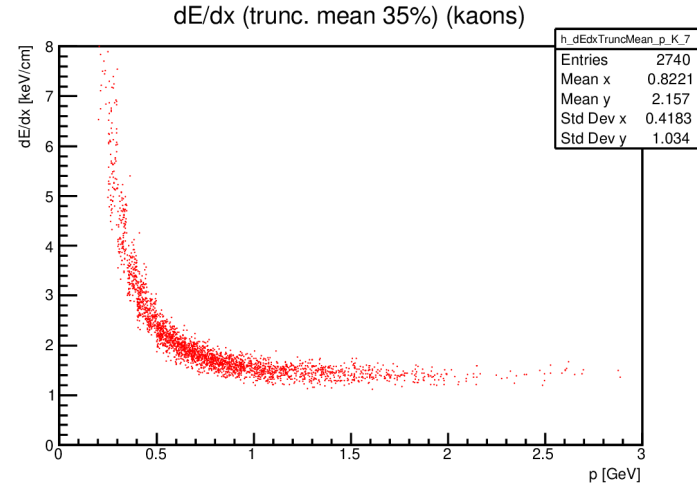
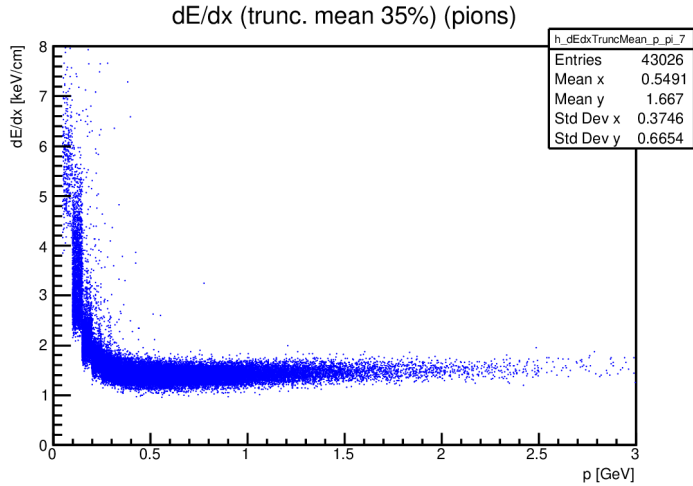
Mean dE/dx



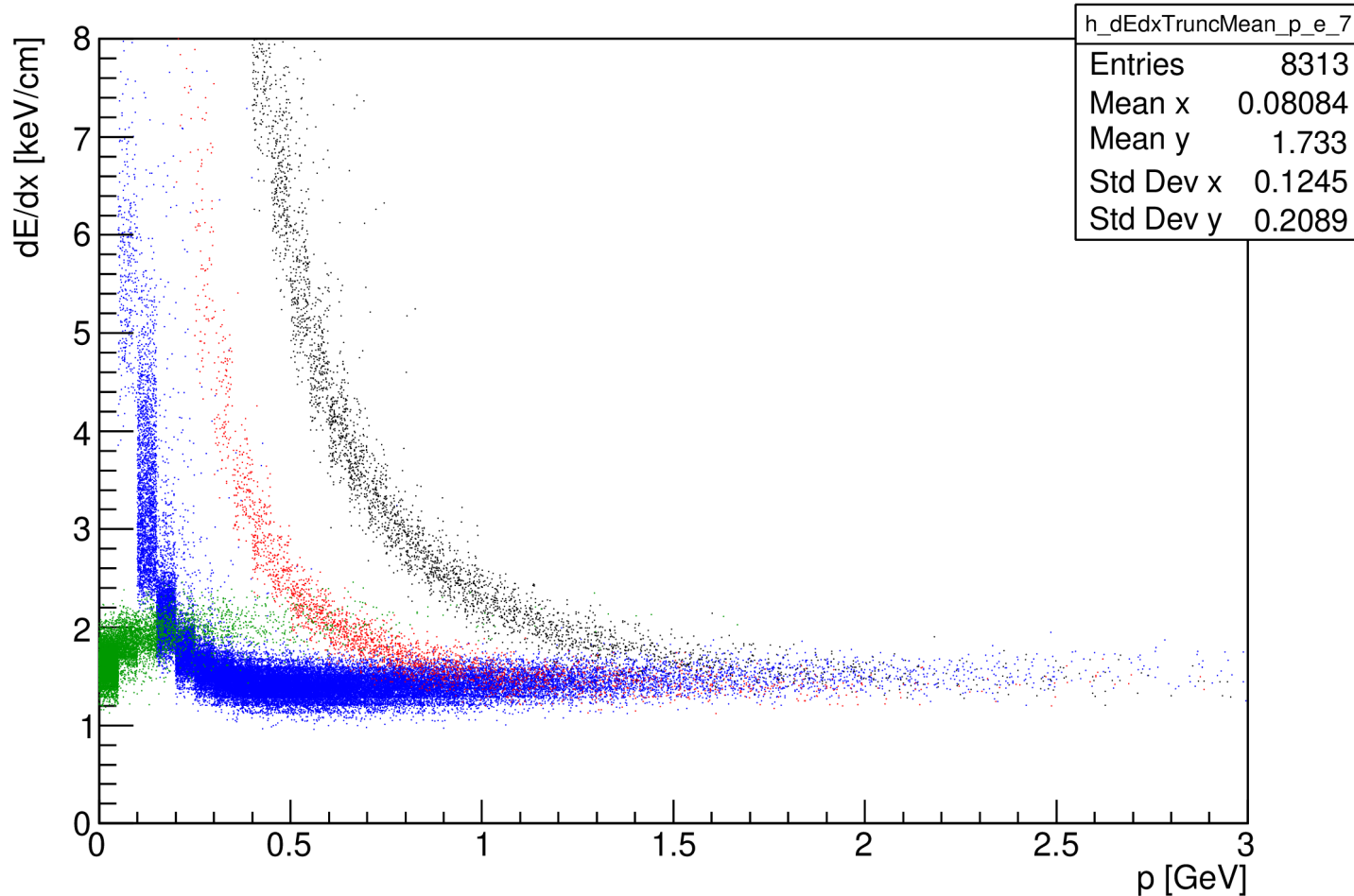
Mean dE/dx



Truncated mean dE/dx (35%)



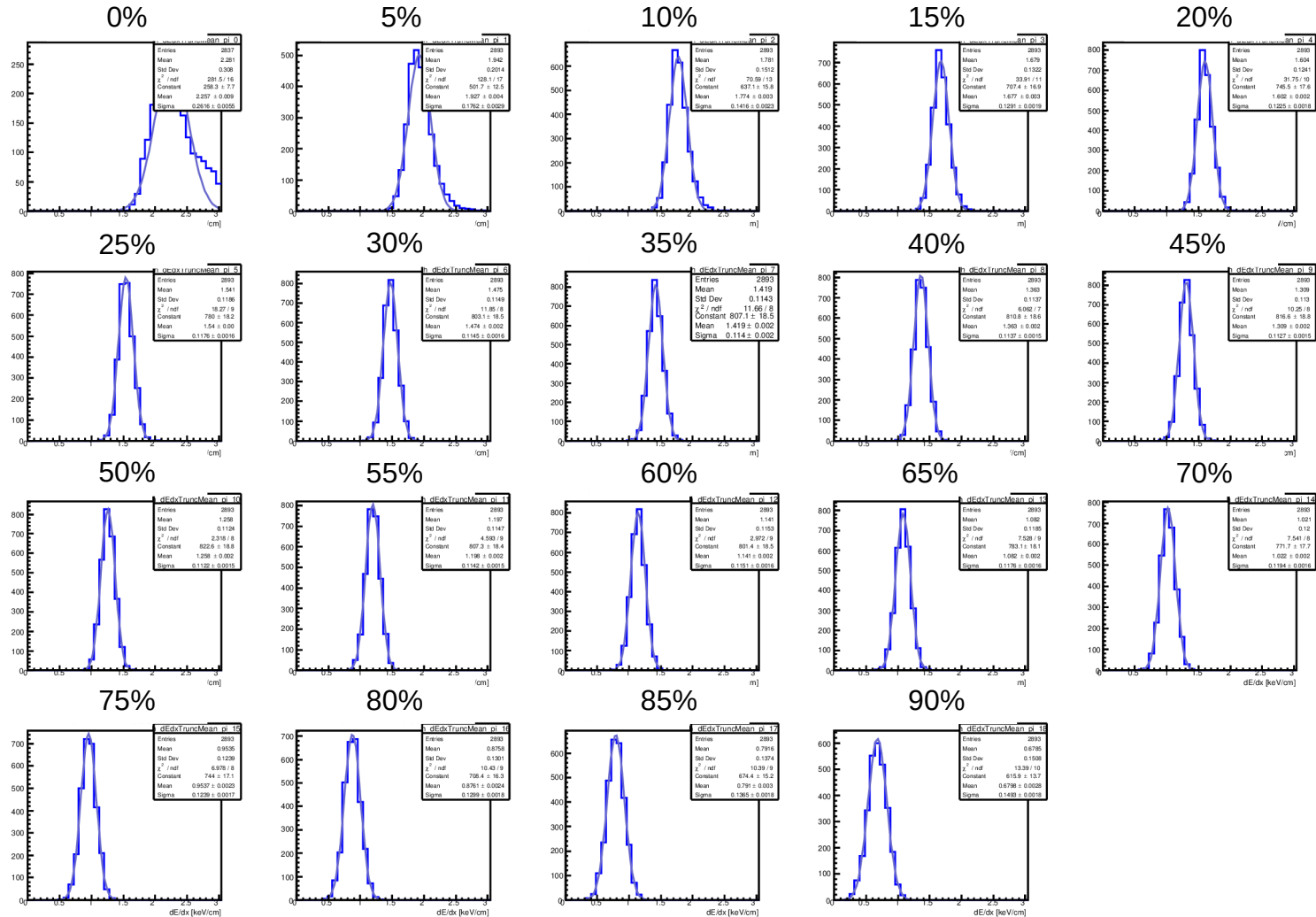
Truncated mean dE/dx (35%)



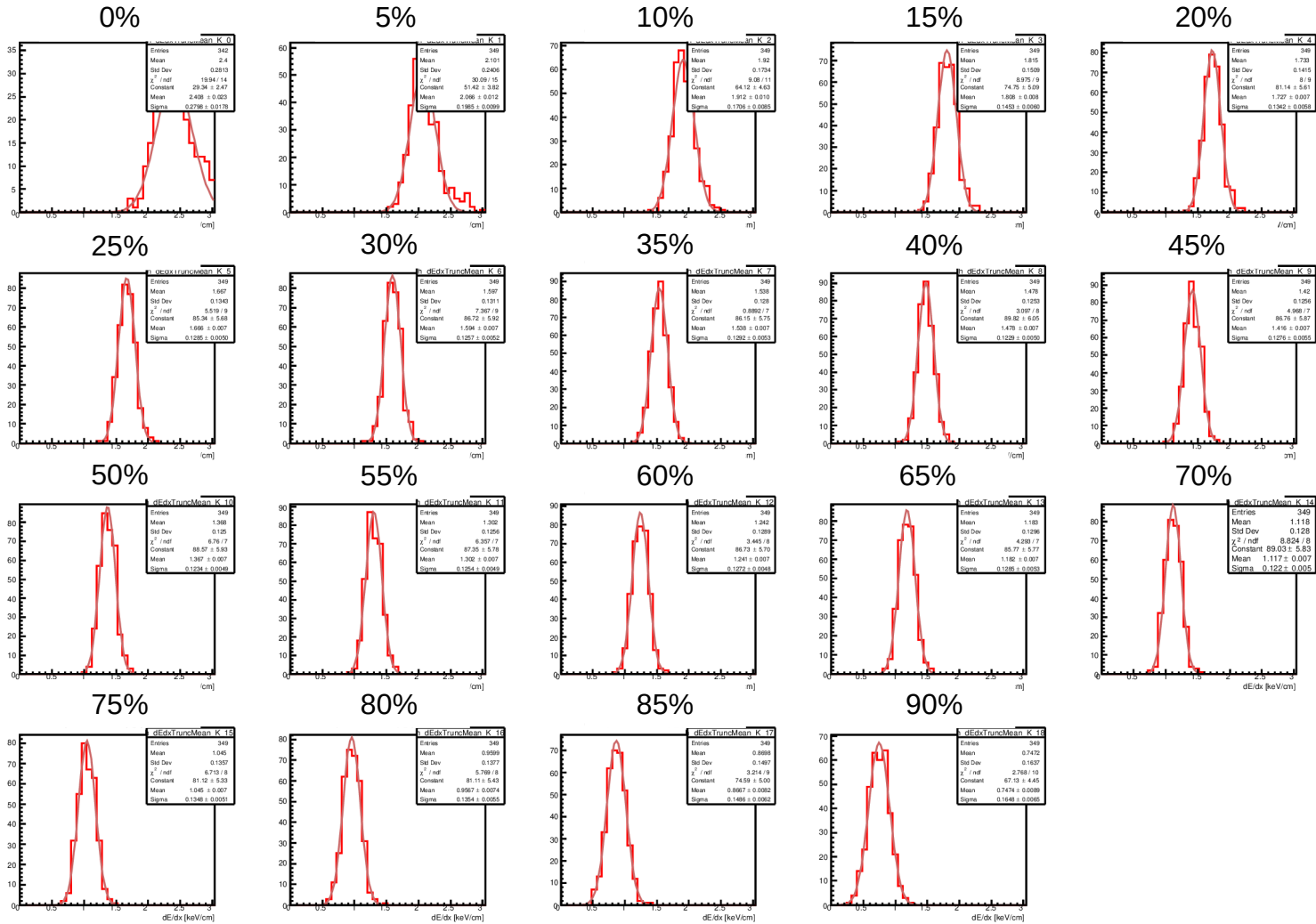
Finding optimal truncation parameter value

- Scan over truncation parameter value from 0% to 90% with step 5%.
- Get «slice» of truncated mean dE/dx distribution in momentum range 0.9 .. 1.1 GeV/c.
- Fit it with gaussian distribution.

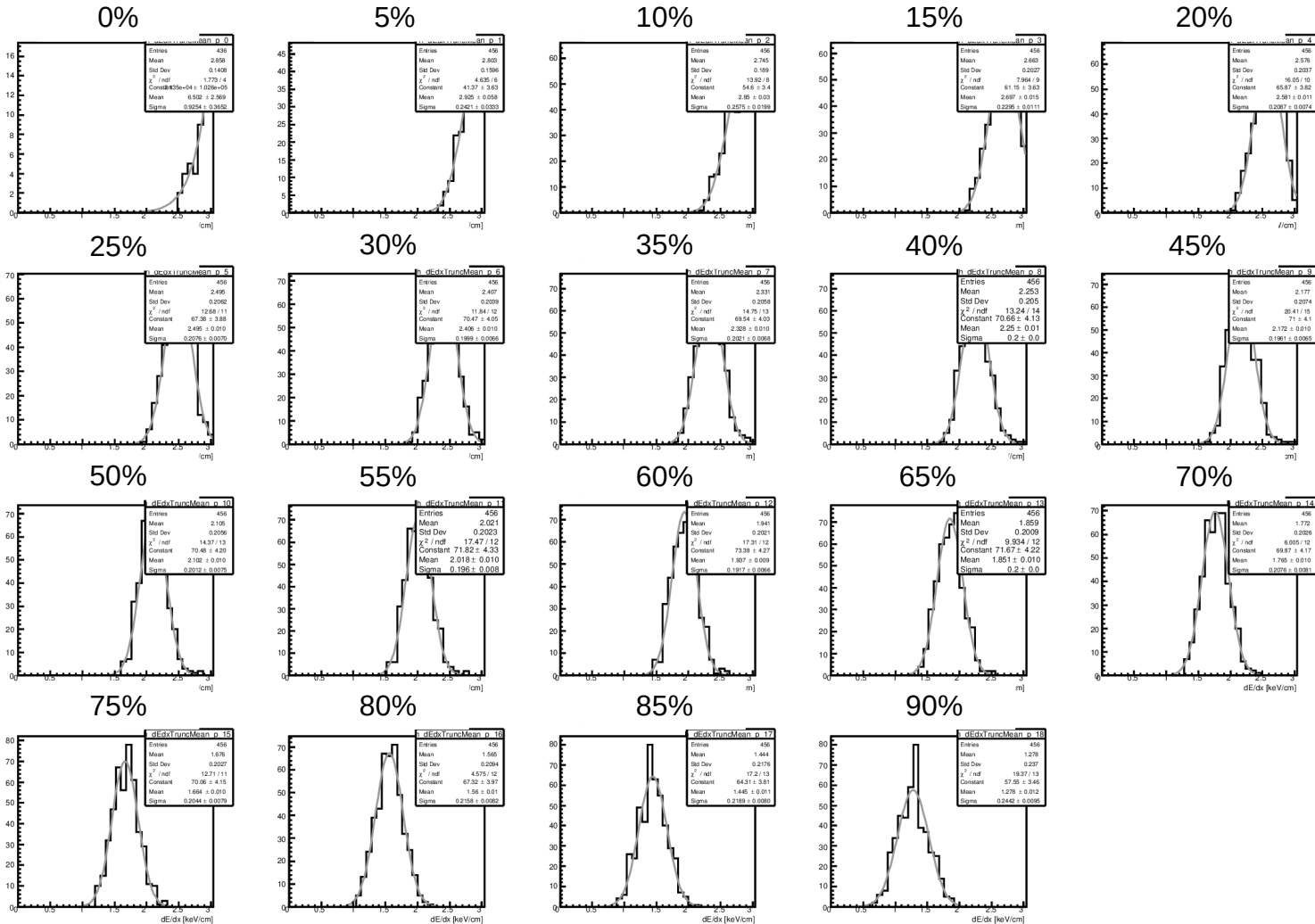
Truncated mean dE/dx at $p = 1 \pm 0.1$ GeV (pions)



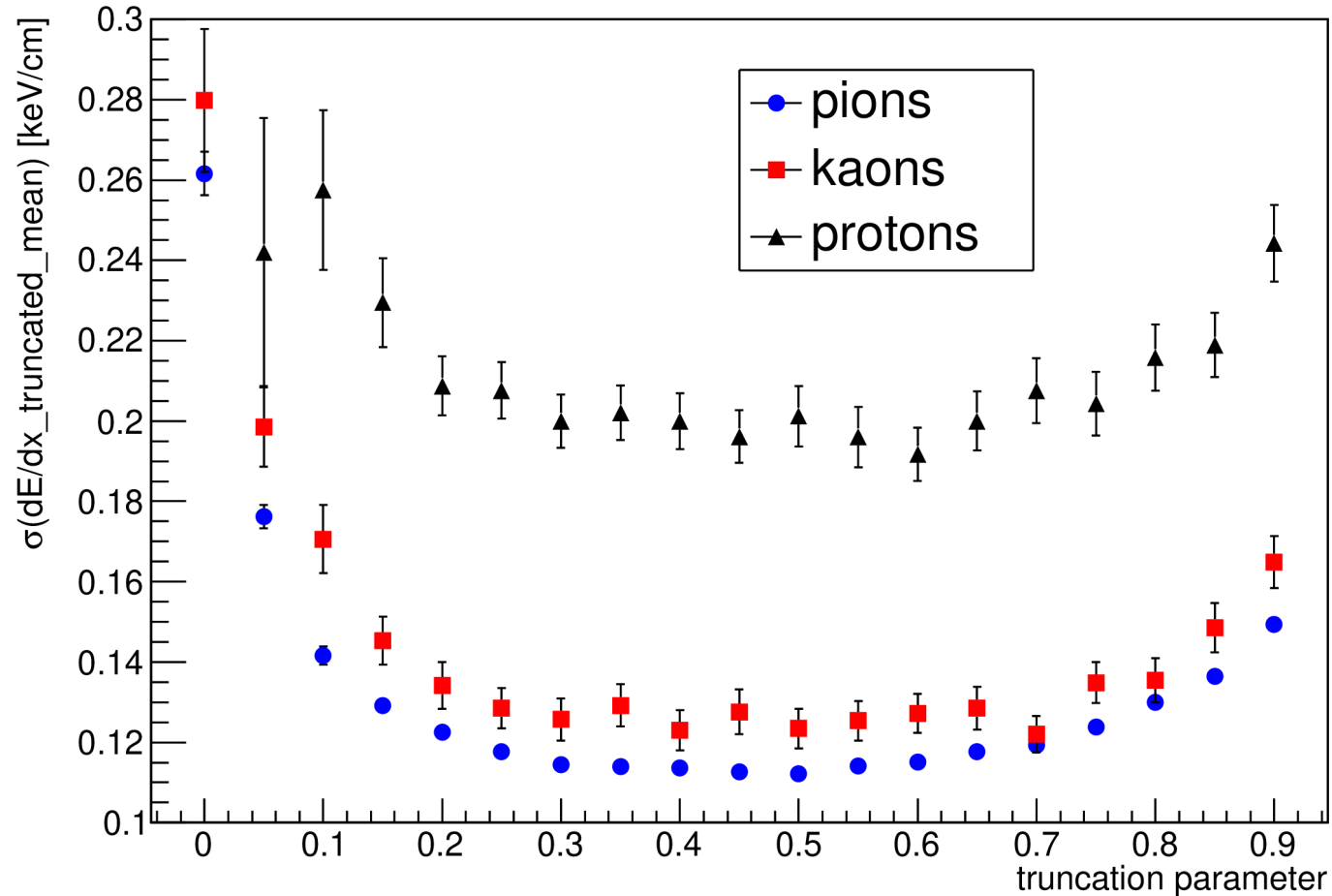
Truncated mean dE/dx at $p = 1 \pm 0.1$ GeV (kaons)



Truncated mean dE/dx at $p = 1 \pm 0.1$ GeV (protons)



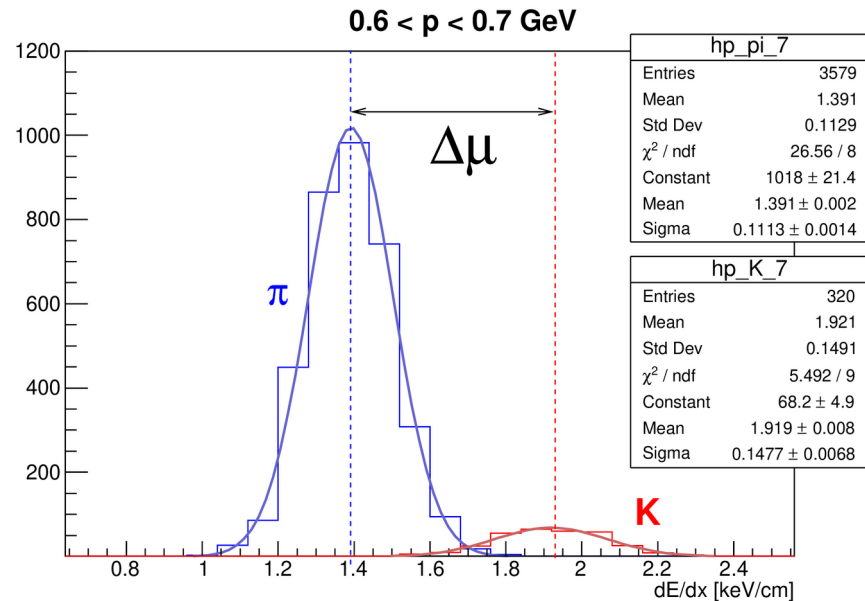
Truncated mean dE/dx distribution sigma



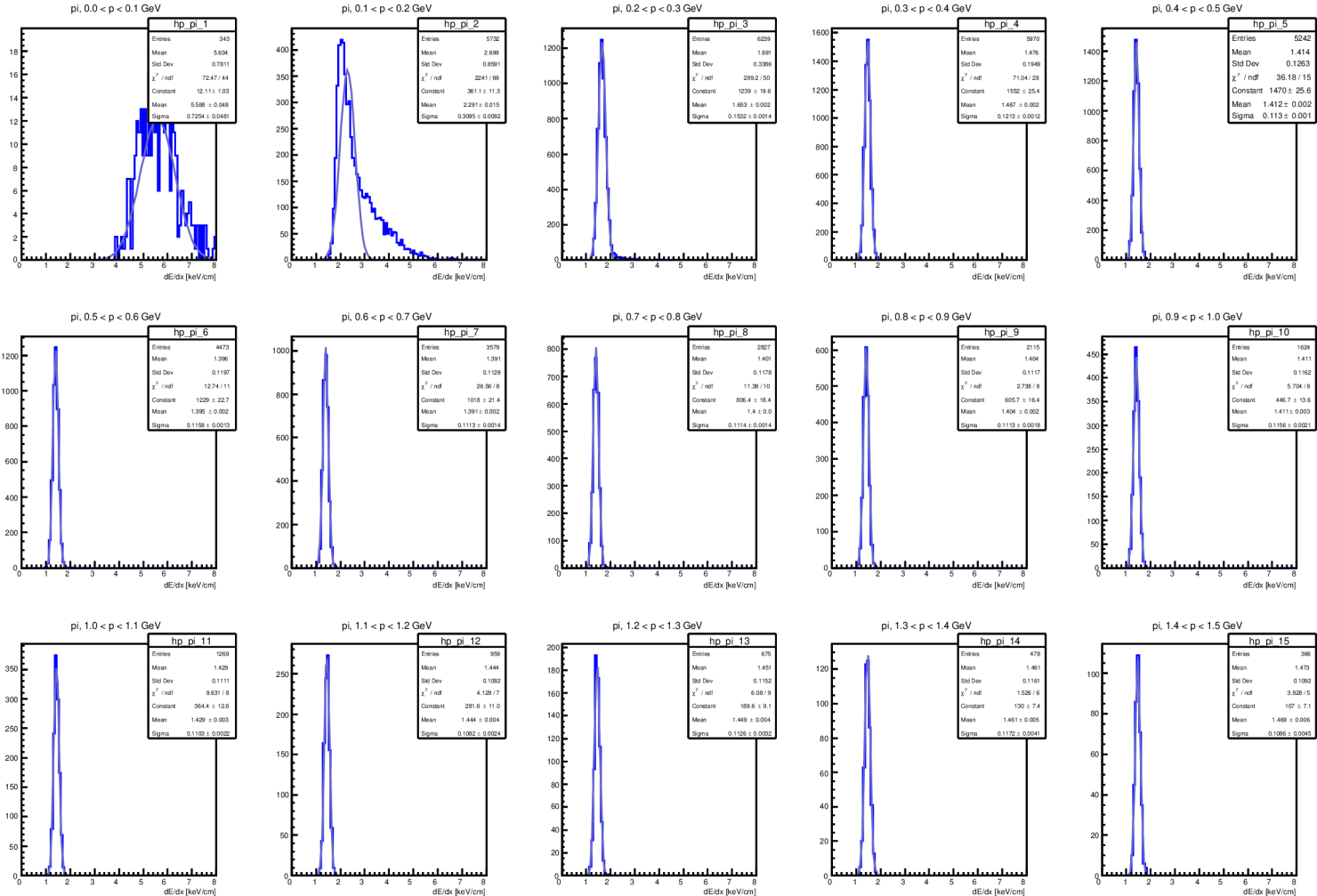
Particle resolution

- Truncation parameter = 35%
- For each bin in momentum and each particle type, make a fit of truncated mean dE/dx distribution.

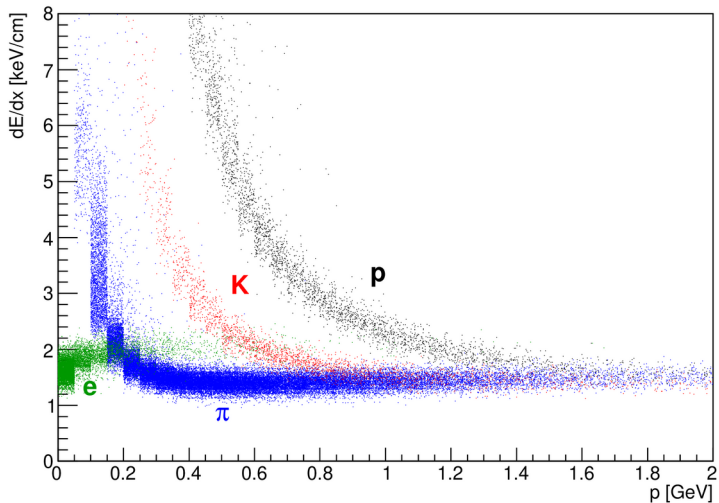
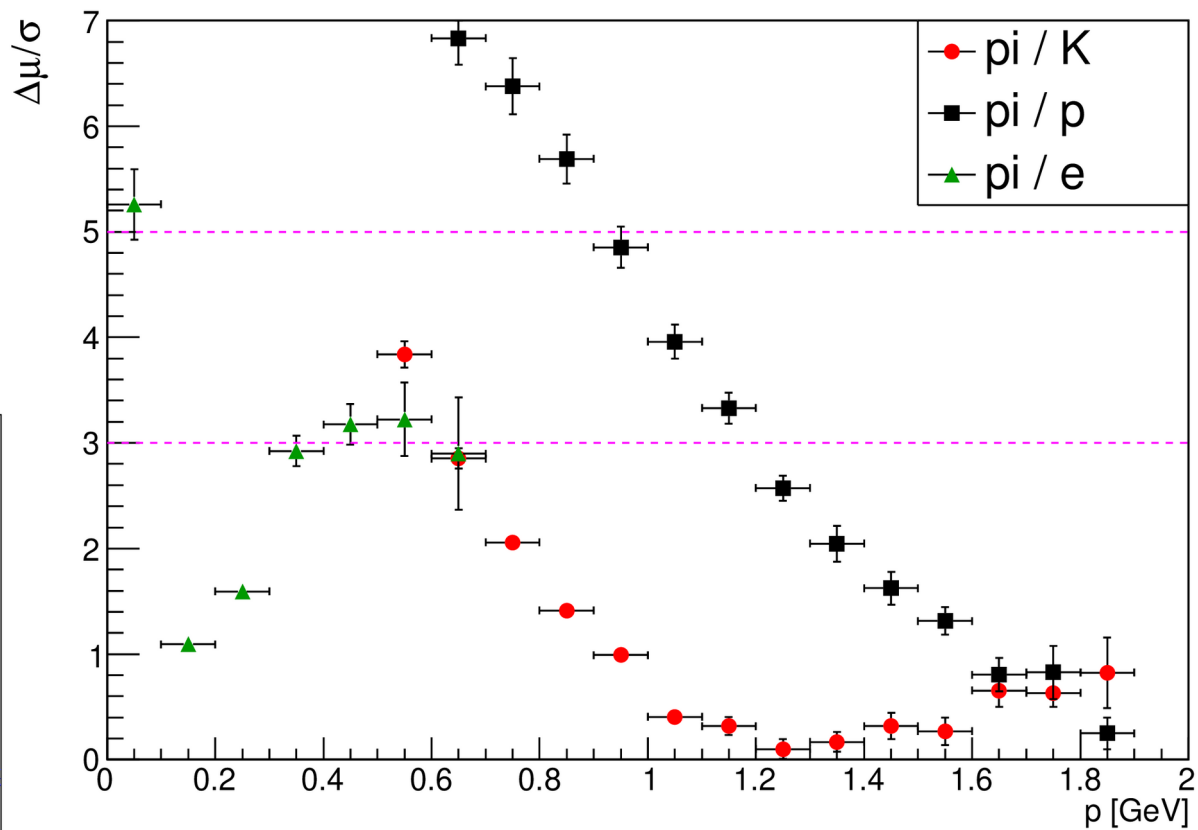
- Calculate
$$\frac{\Delta \mu}{\sigma} = \frac{|\mu_{\pi} - \mu_K|}{\sqrt{\sigma_{\pi}^2 + \sigma_K^2}}$$



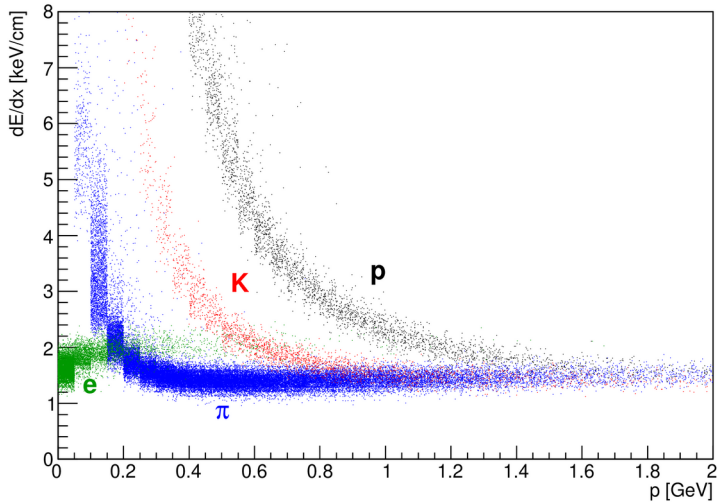
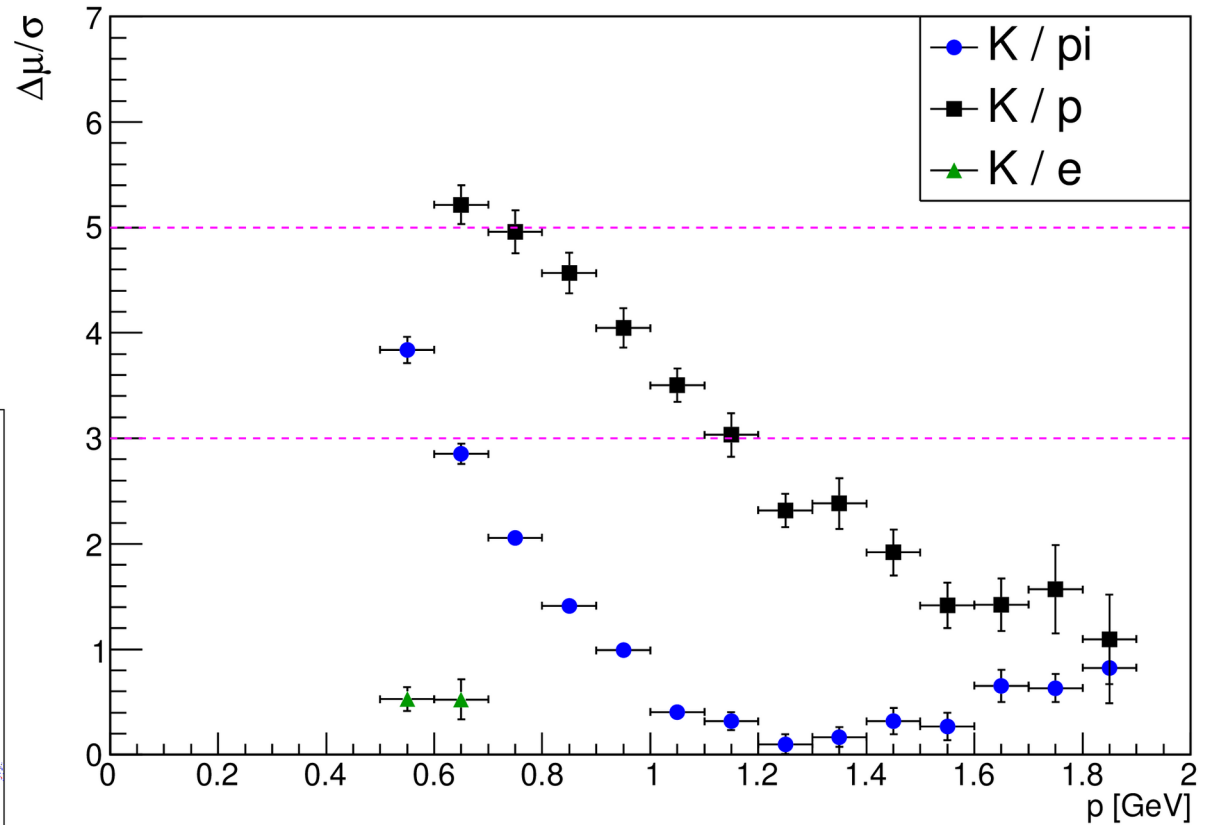
Distribution of truncated mean dE/dx (35%) for different momenta, pions



Pions resolution



Kaons resolution

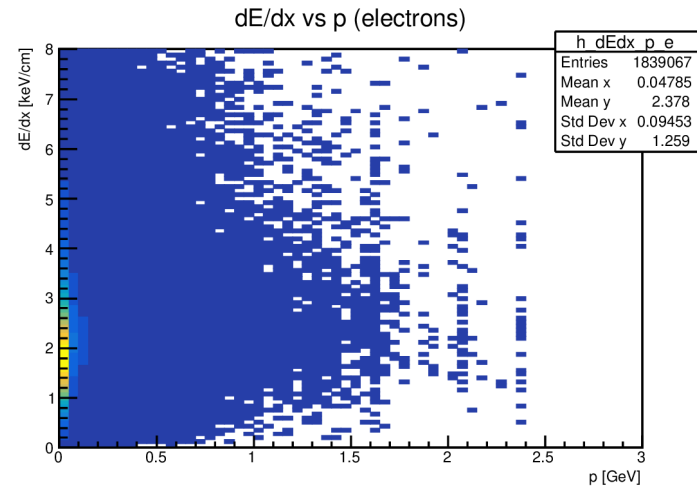
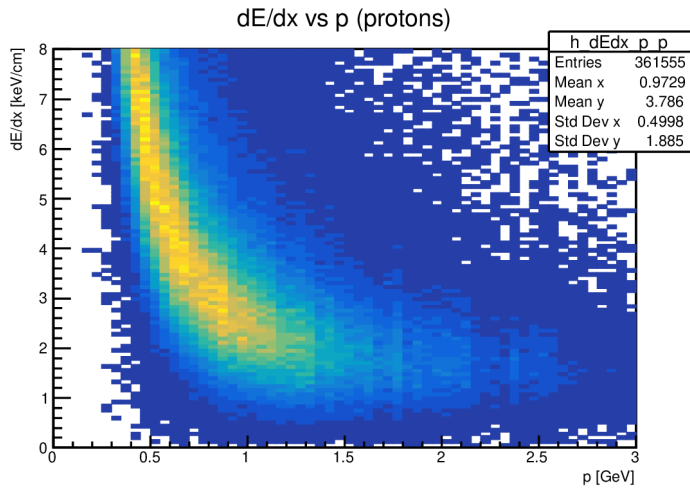
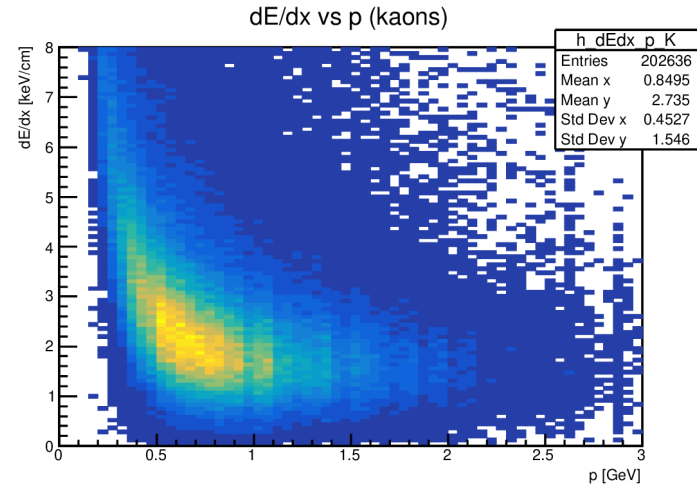
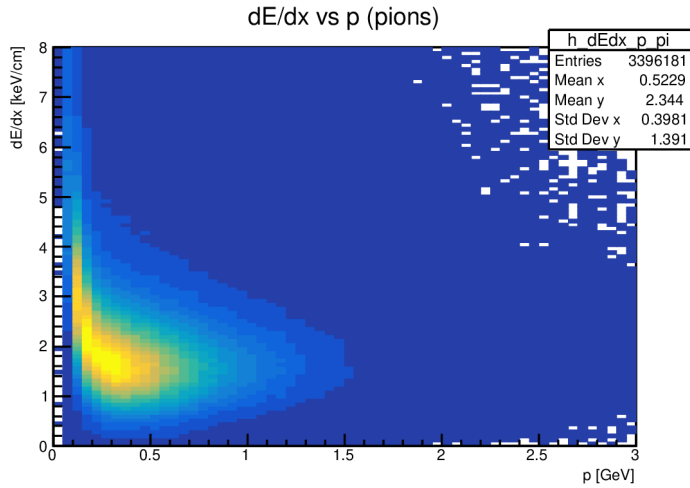


Conclusions

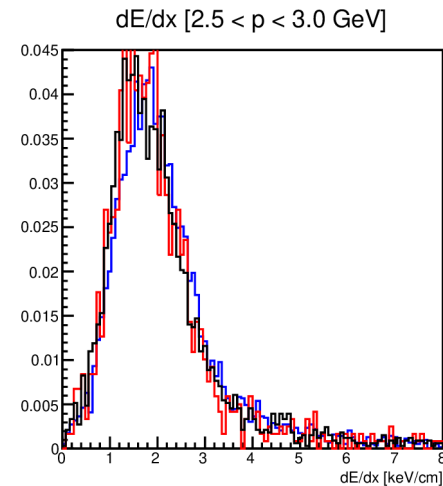
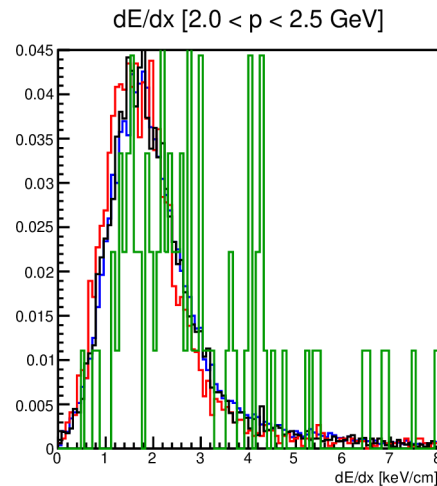
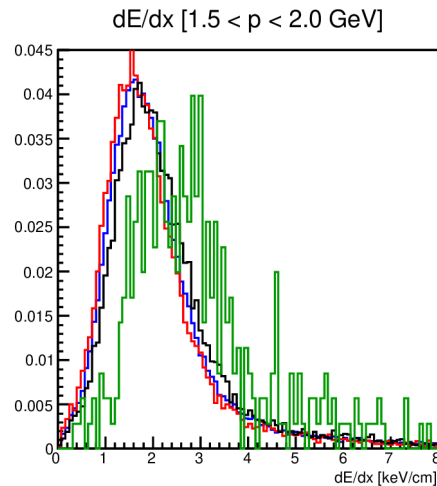
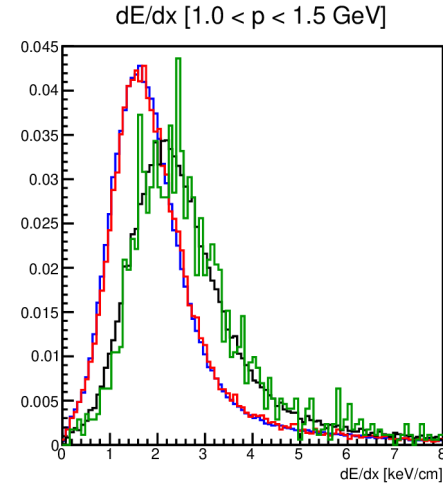
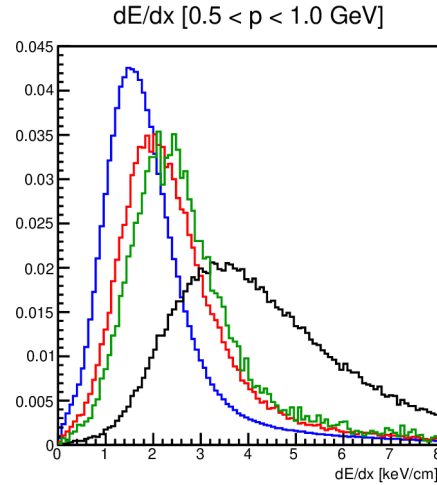
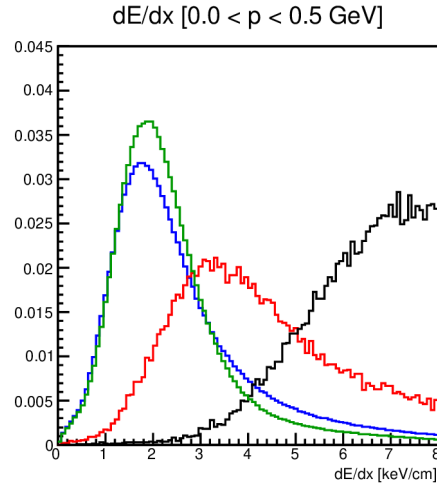
- Analysis of dE/dx in straw tracker of SPD for particle identification using «truncated mean» method was performed.
- Optimal value of truncation parameter is in the range **0.30 .. 0.55**.
- Pions can be separated from kaons up to **~ 0.7 GeV**, pions and kaons from protons up to **1.2 GeV**.

Backup slides

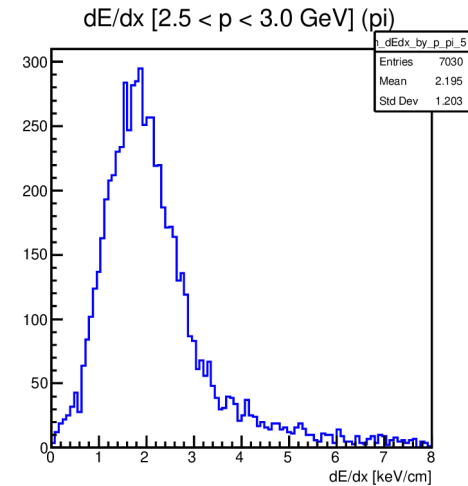
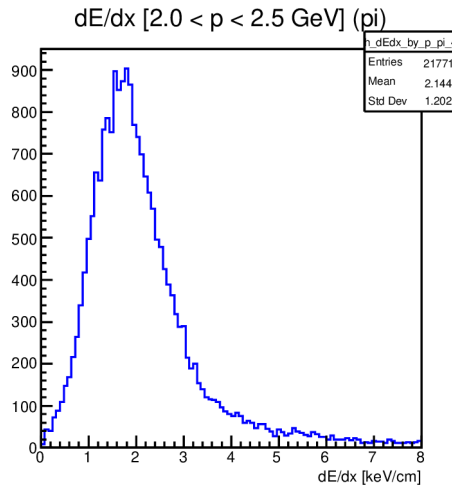
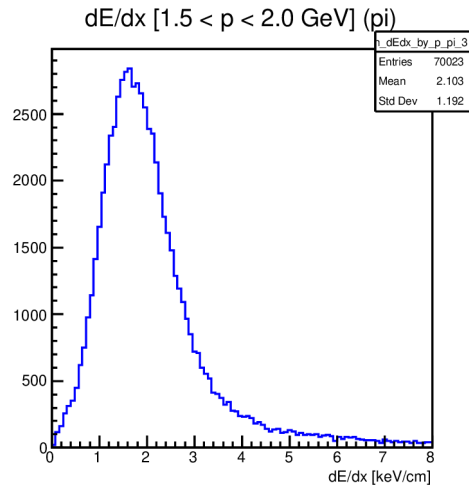
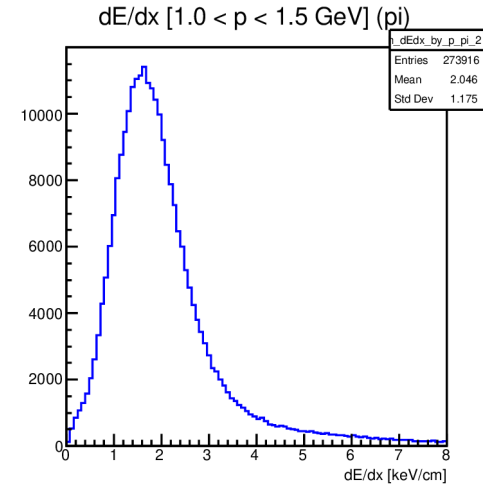
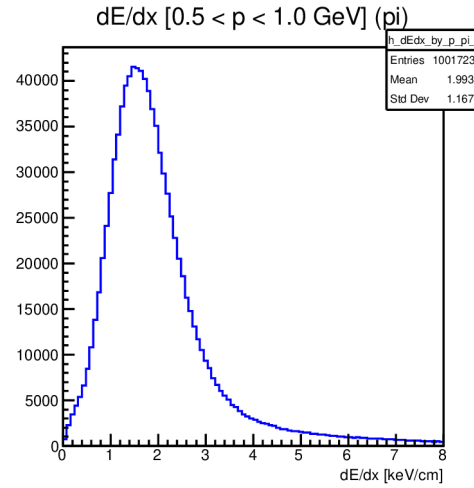
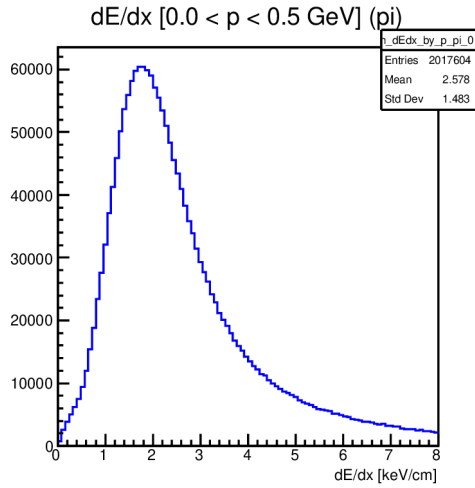
dE/dx vs p



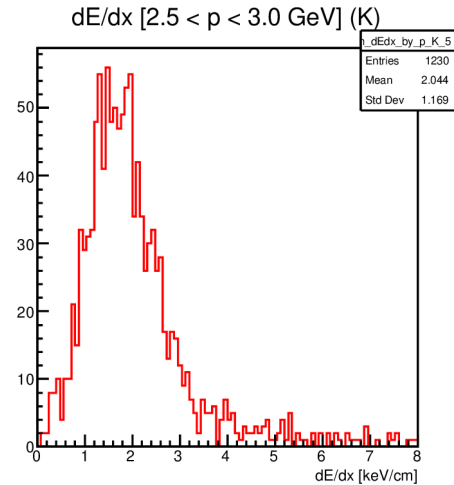
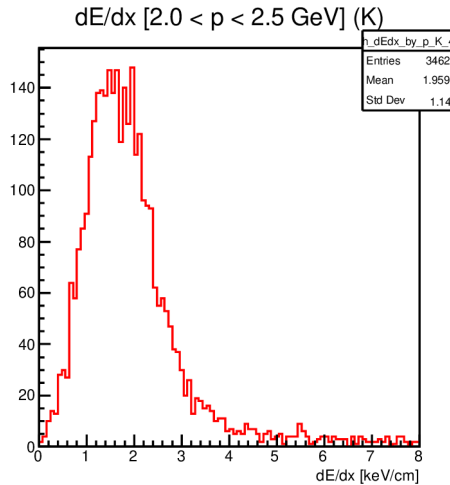
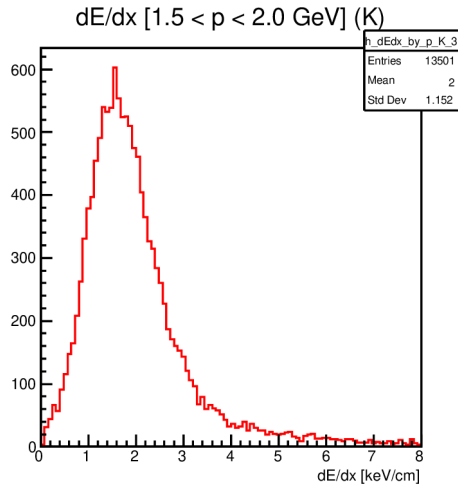
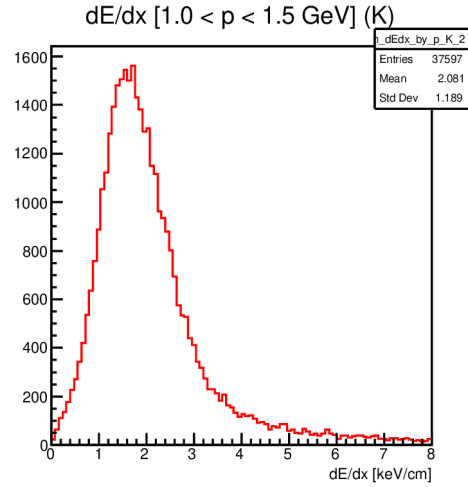
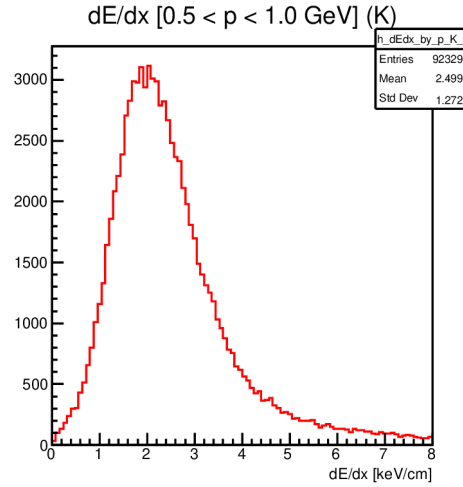
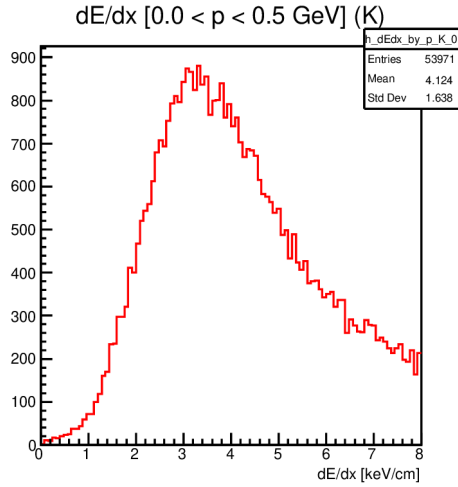
Distributions of dE/dx



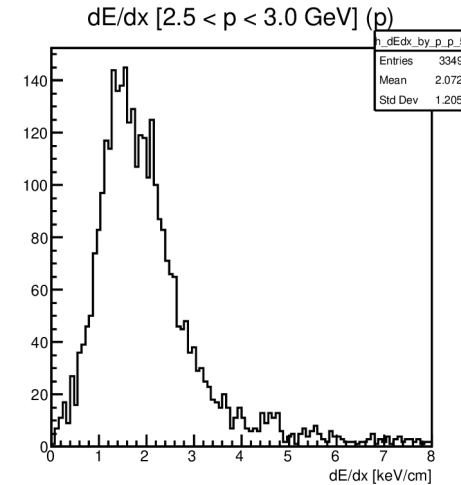
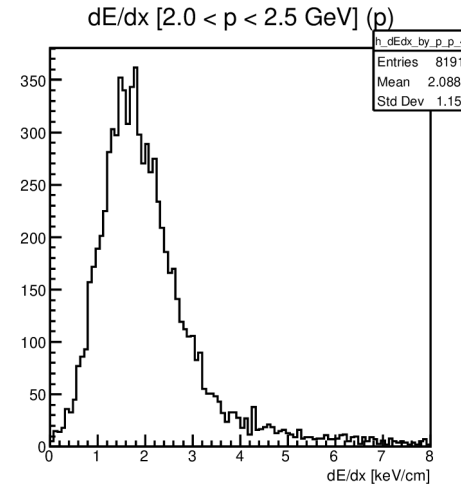
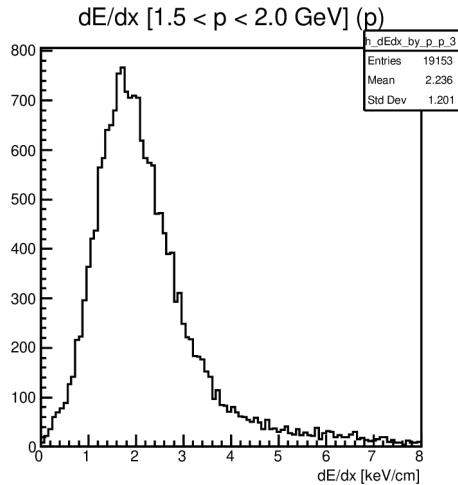
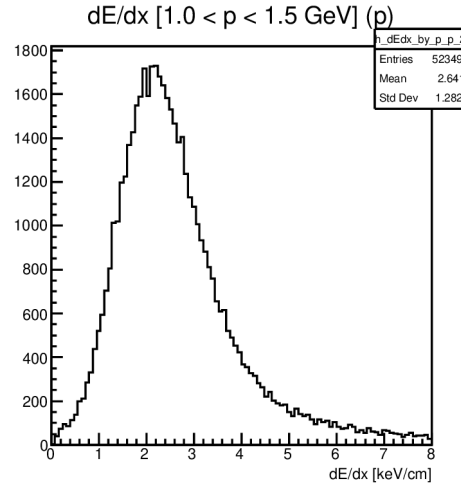
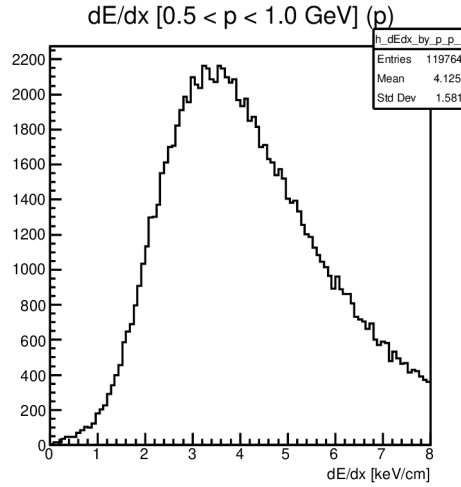
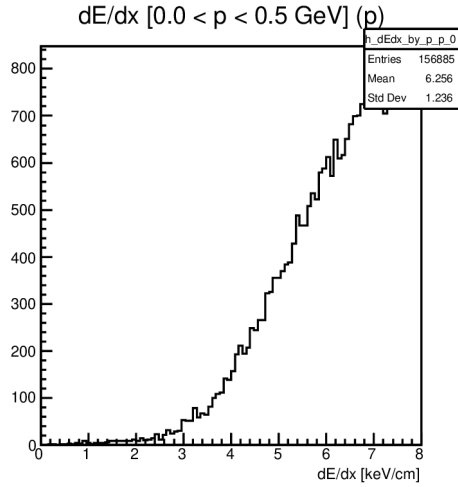
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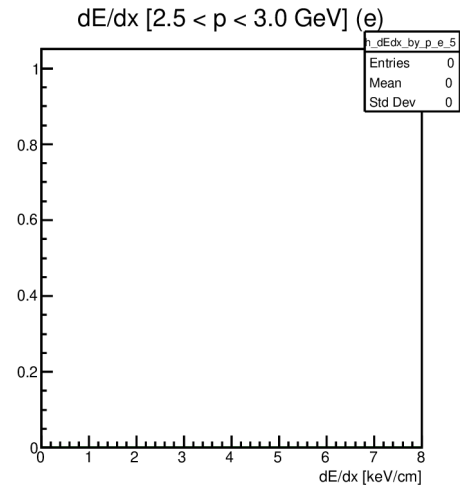
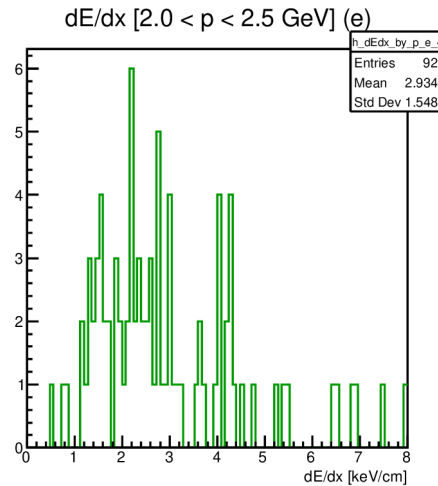
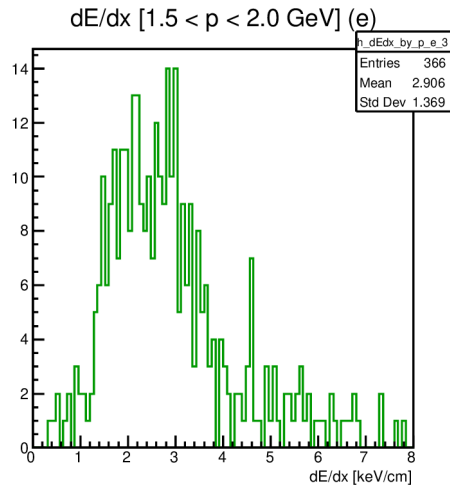
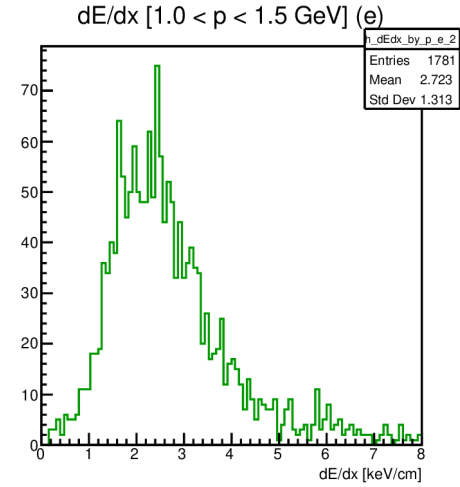
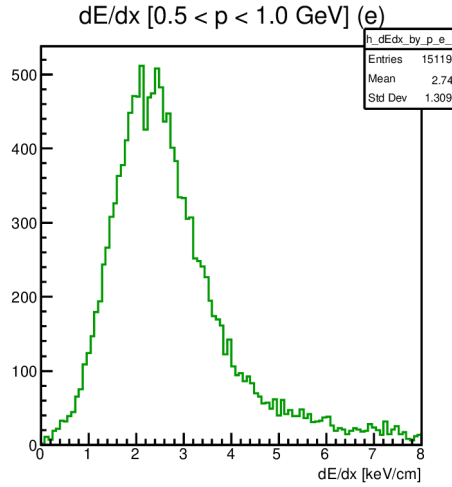
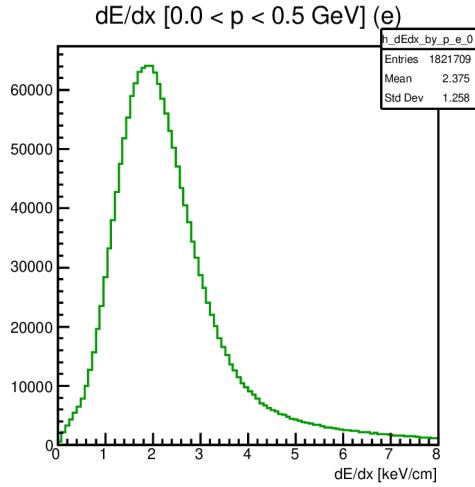
Distributions of dE/dx



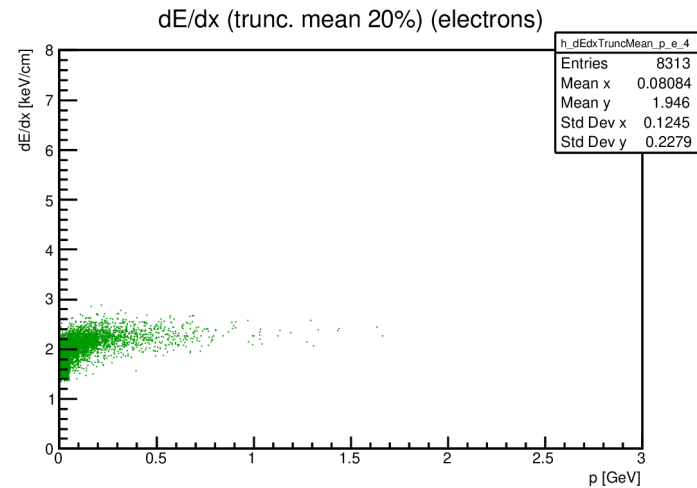
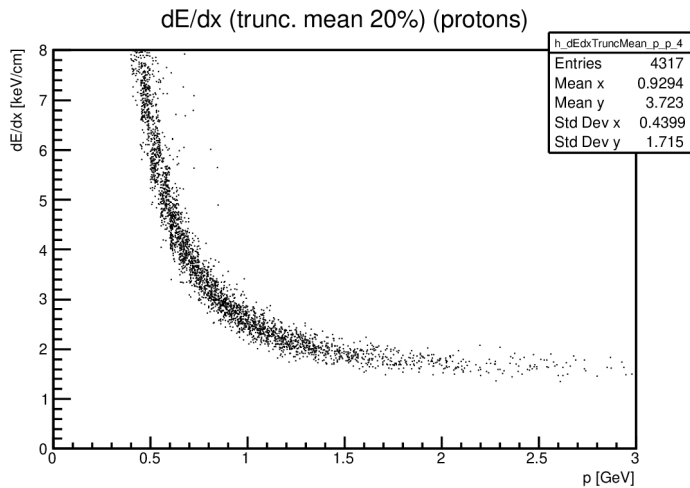
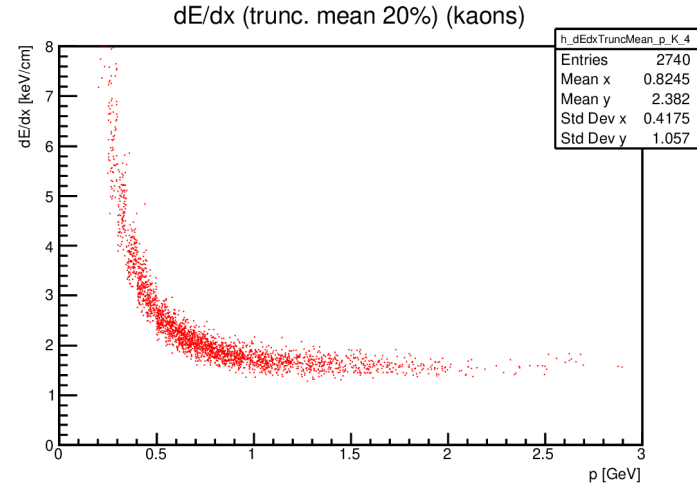
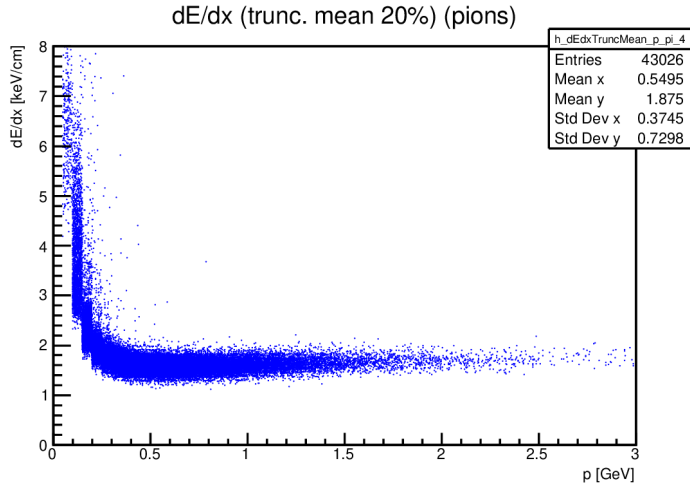
Distributions of dE/dx



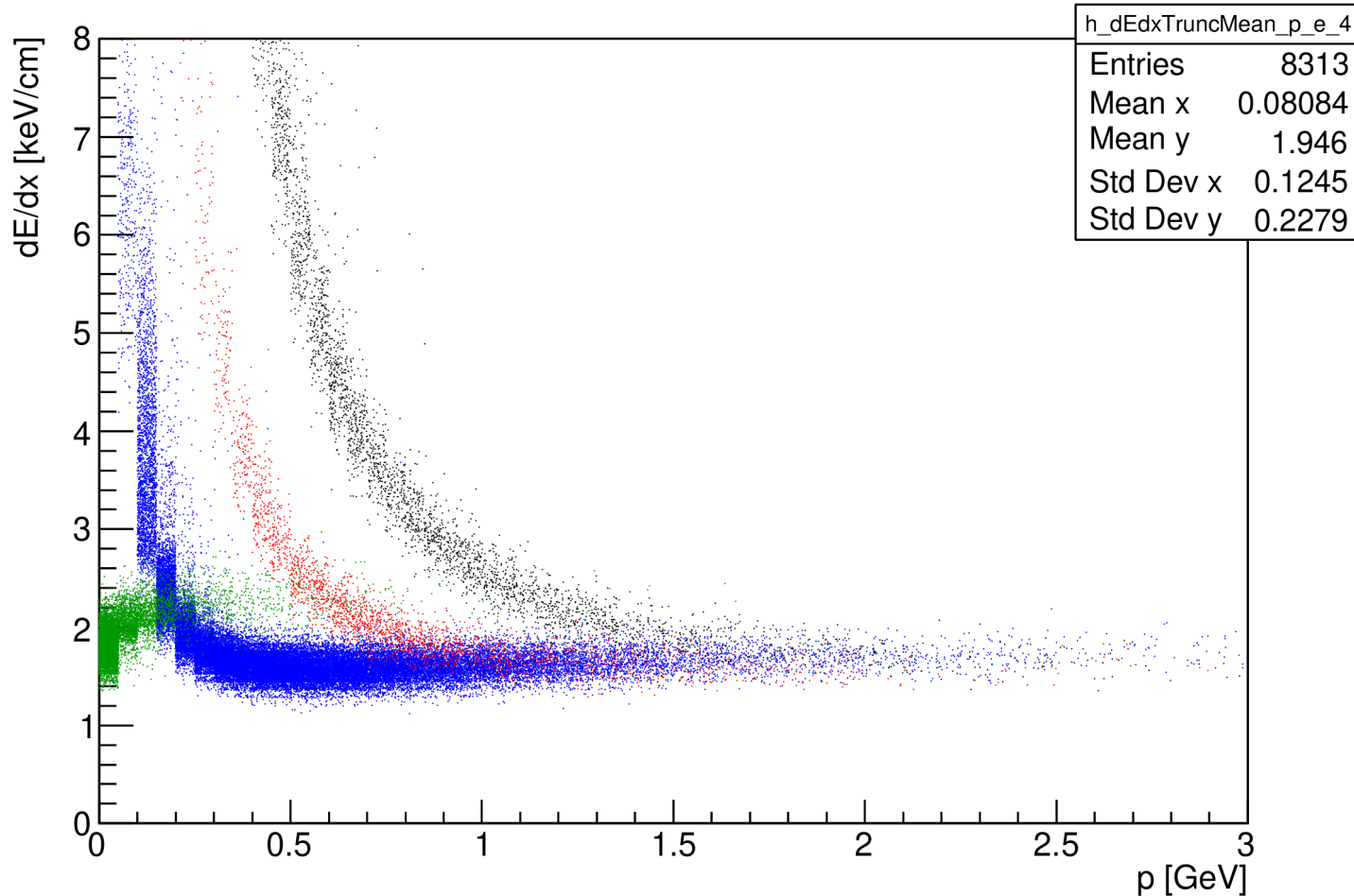
Distributions of dE/dx



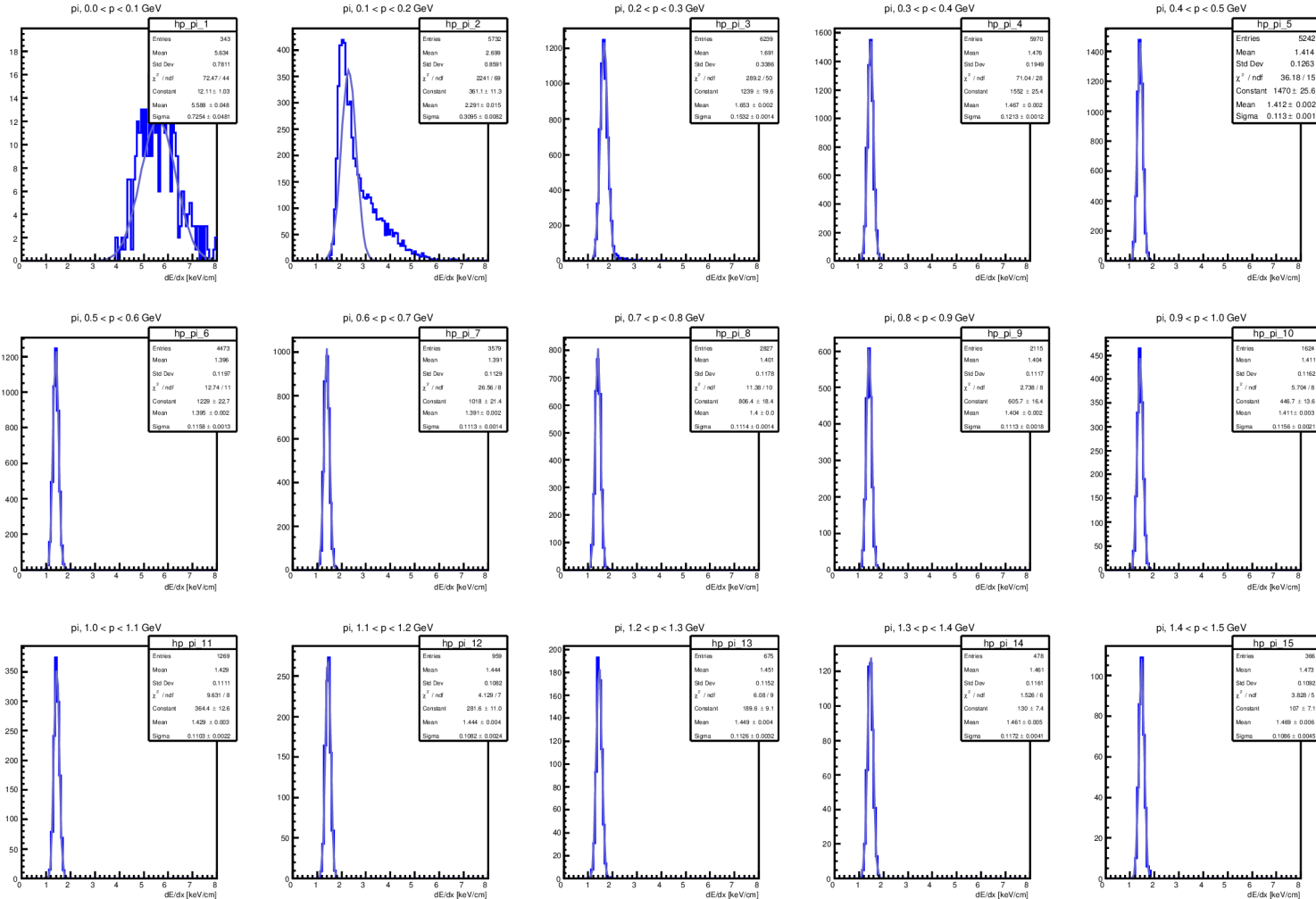
Truncated mean dE/dx (20%)



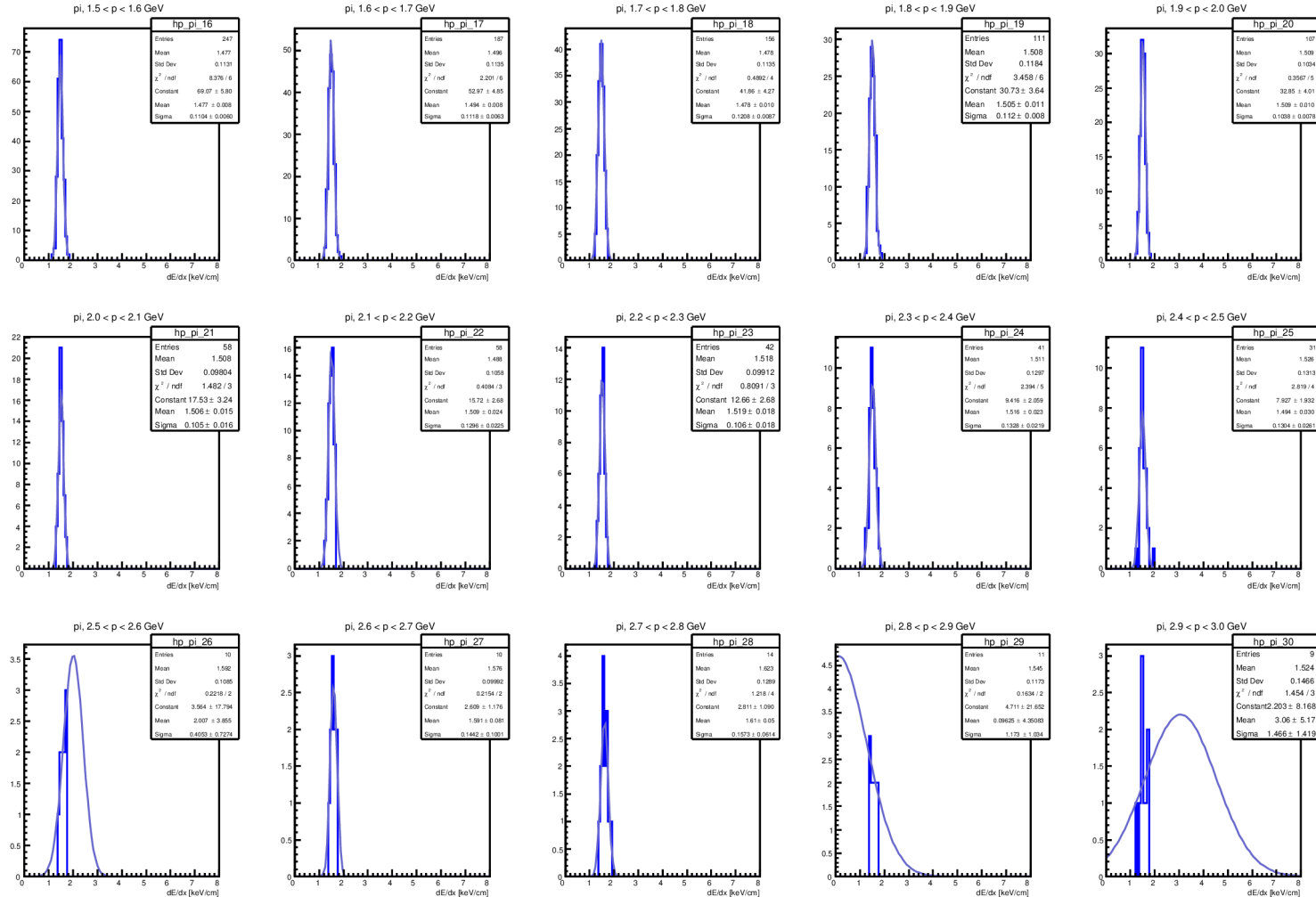
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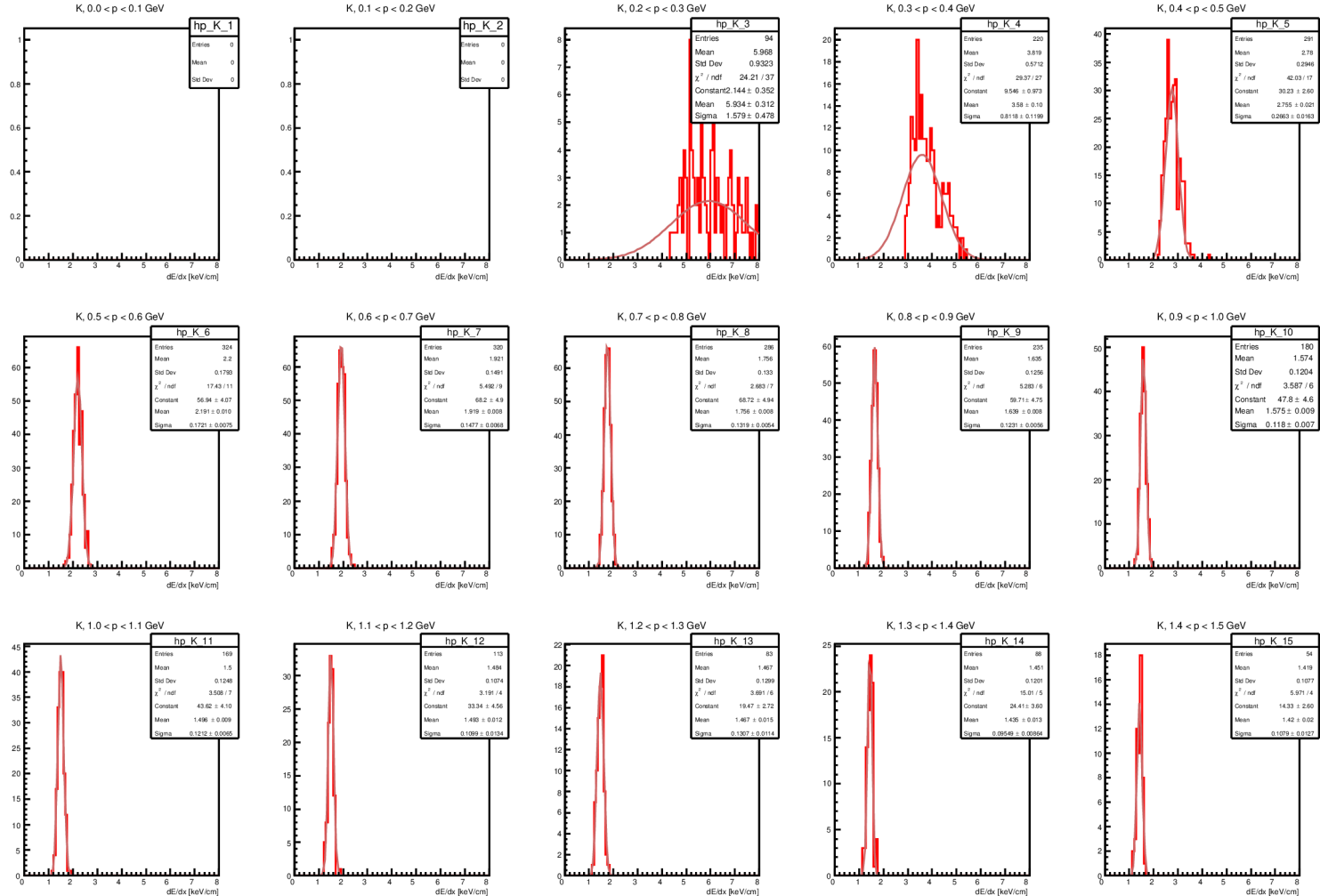
Distribution of truncated mean dE/dx (35%) for different momenta, pions



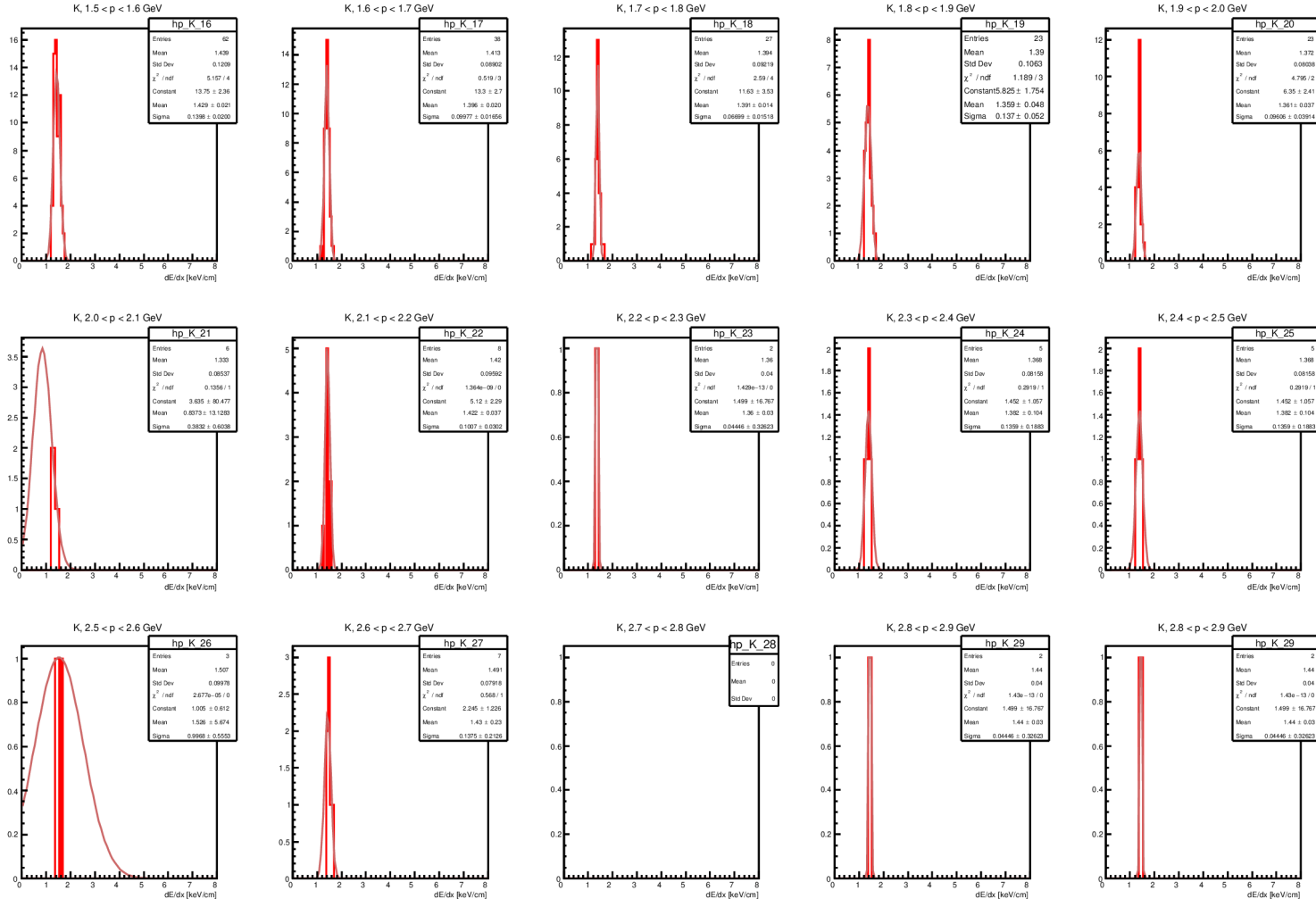
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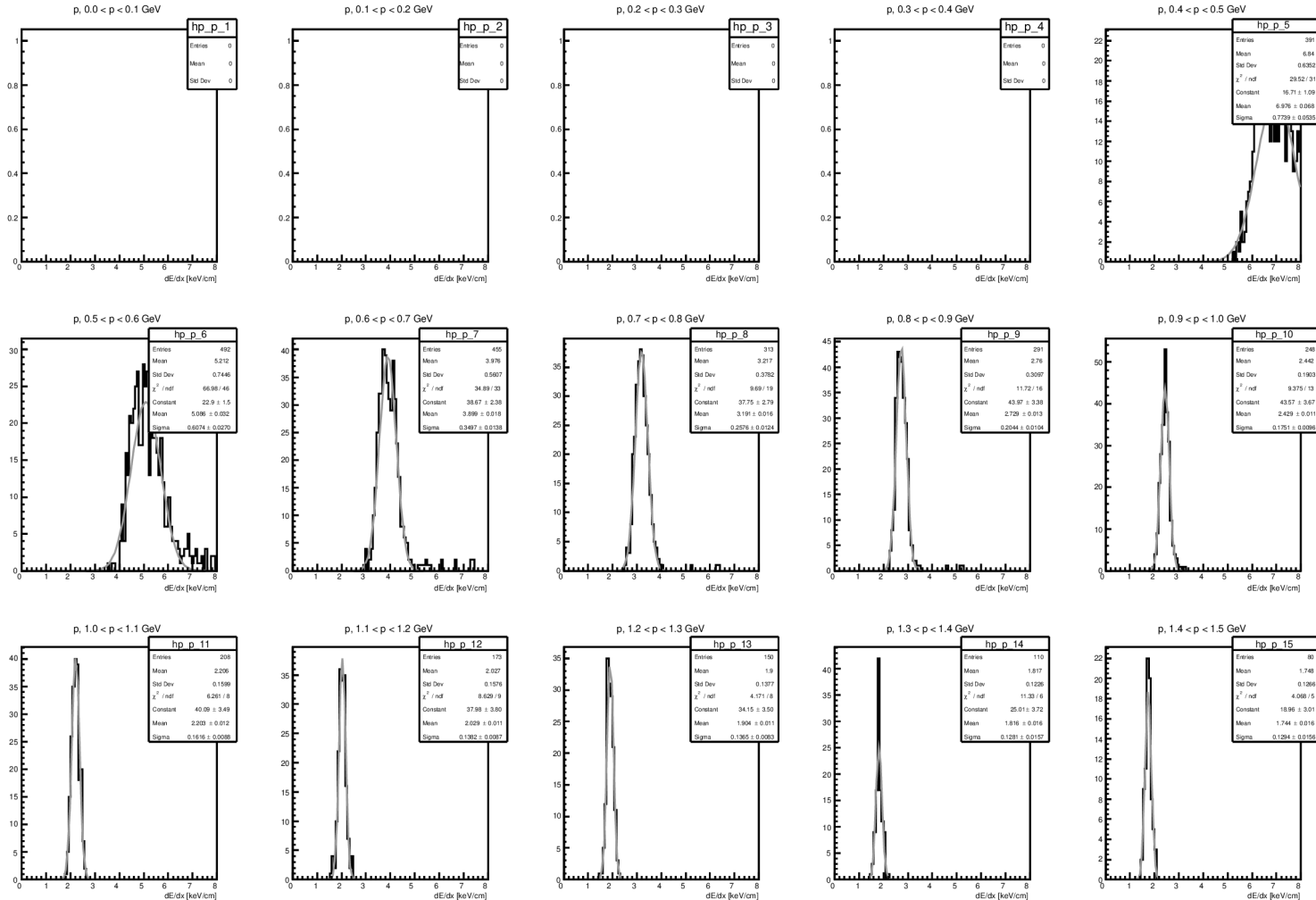
Distribution of truncated mean dE/dx (35%) for different momenta, kaons



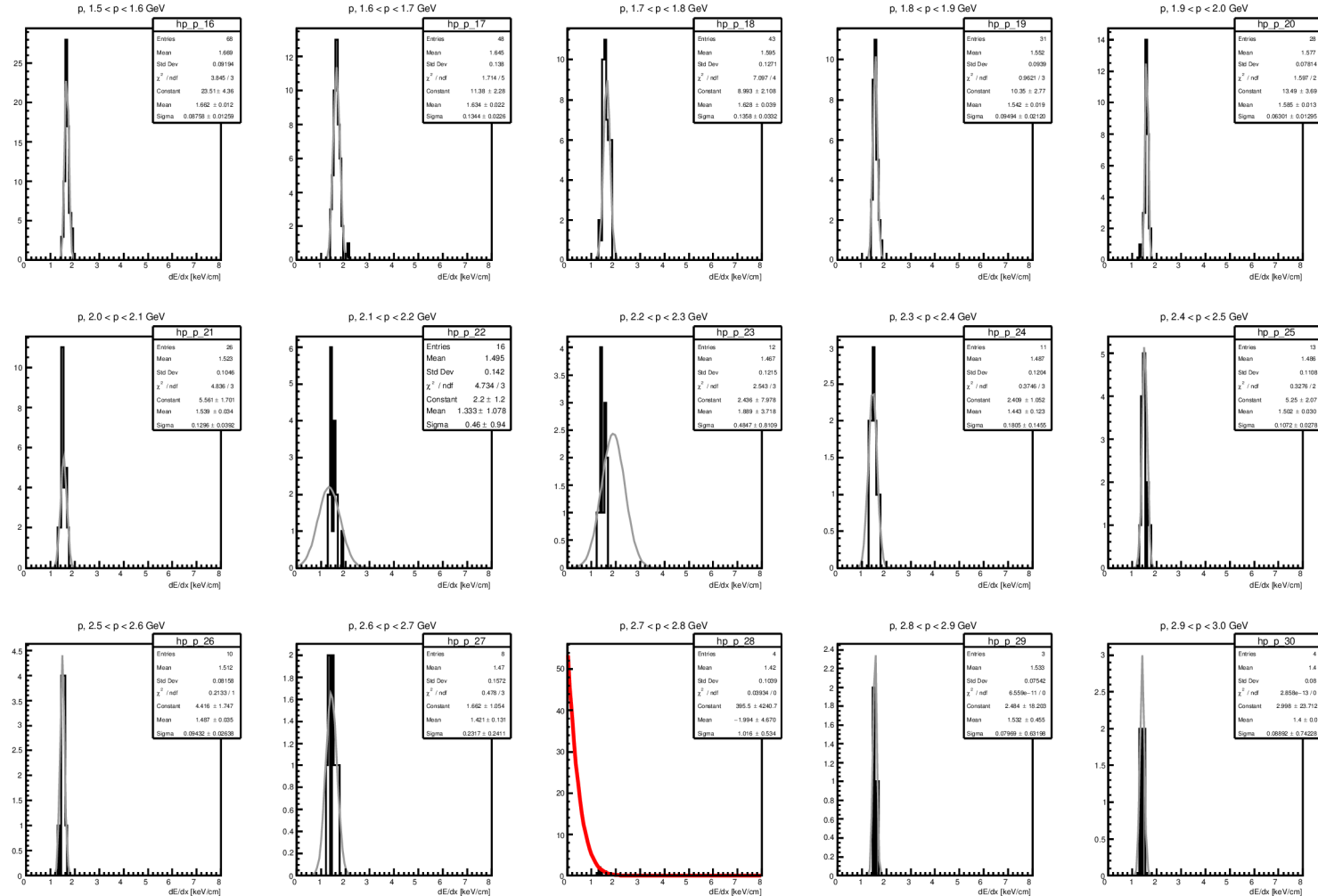
Distribution of truncated mean dE/dx (35%) for different momenta, kaons



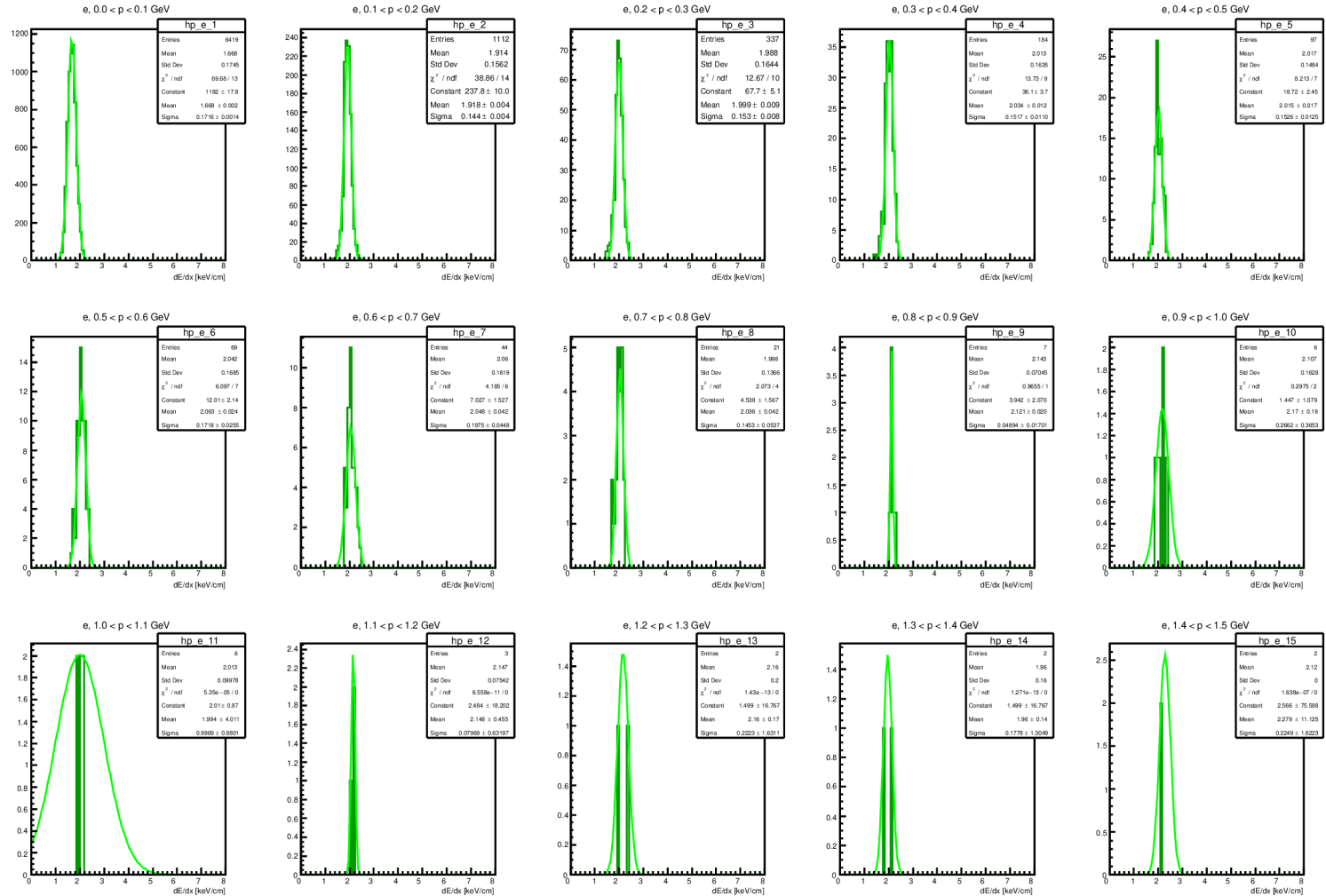
Distribution of truncated mean dE/dx (35%) for different momenta, protons



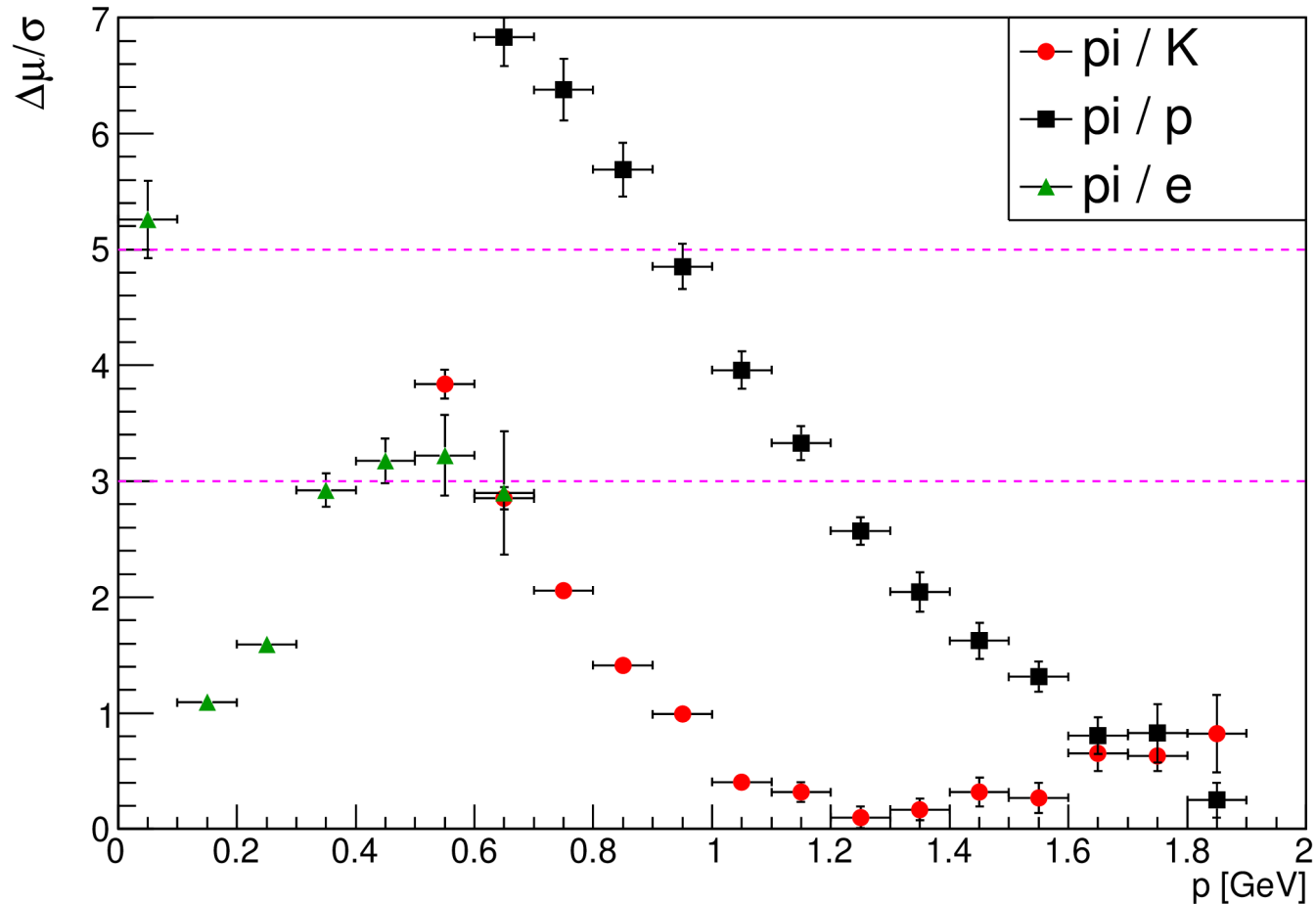
Distribution of truncated mean dE/dx (35%) for different momenta, protons



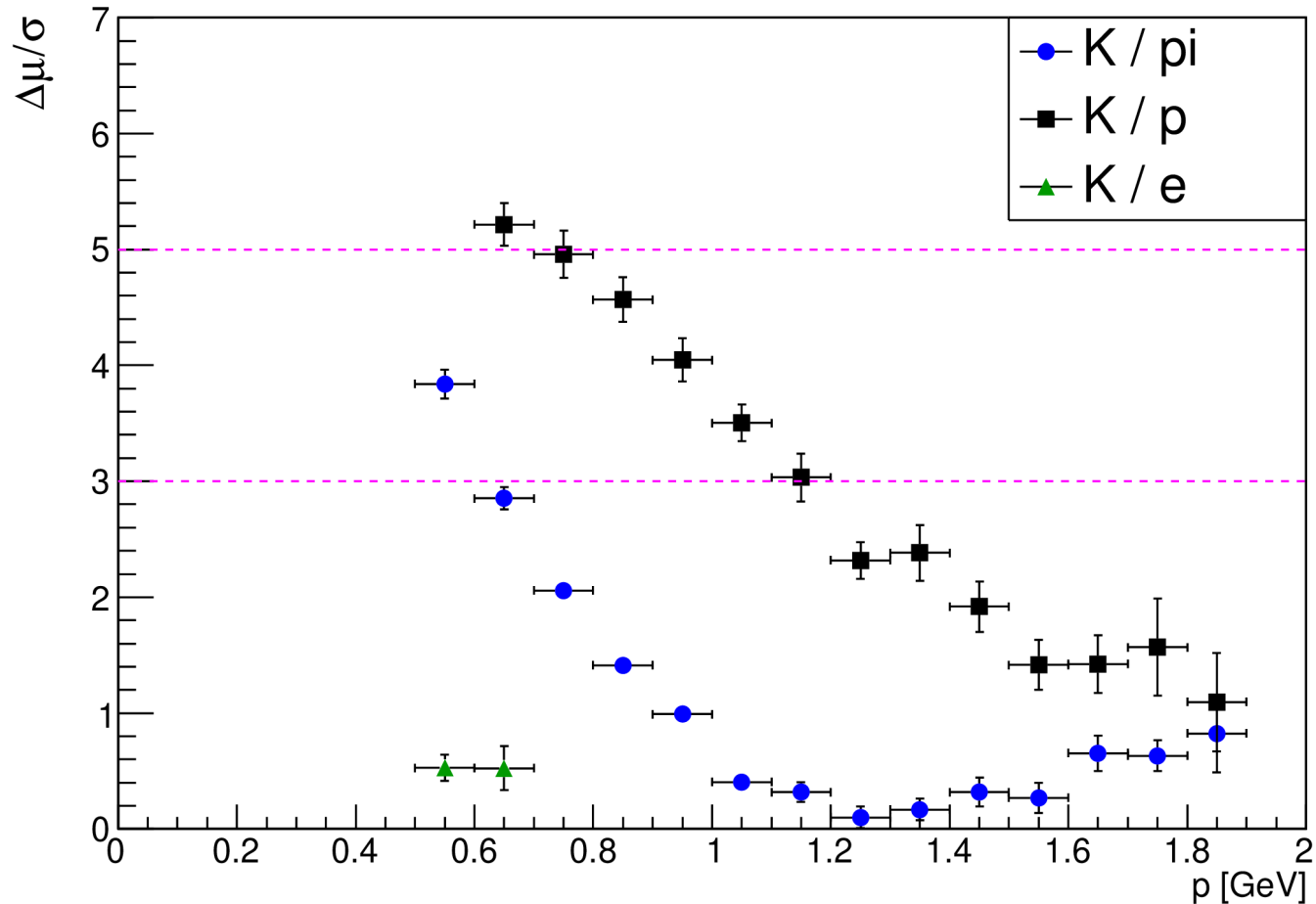
Distribution of truncated mean dE/dx (35%) for different momenta, electrons



Pions resolution



Kaons resolution



Truncated mean dE/dx (35%) at p = 1.8 GeV

1.7 < p < 1.8 GeV

