On dE/dx simulation in straw

Ruslan Akhunzyanov

LHEP JINR

SPD Physics & MC Meeting
Feb 21, 2024

Introduction

- Currently MC value of dx (track segment length) is used in dE/dx calculations.

- In this report I show how results will change if instead dx is calculated from track fit information.

- To this end storing of intermediate states of the track should be enabled in the reco script (by default only the first and the last states of the track are saved).
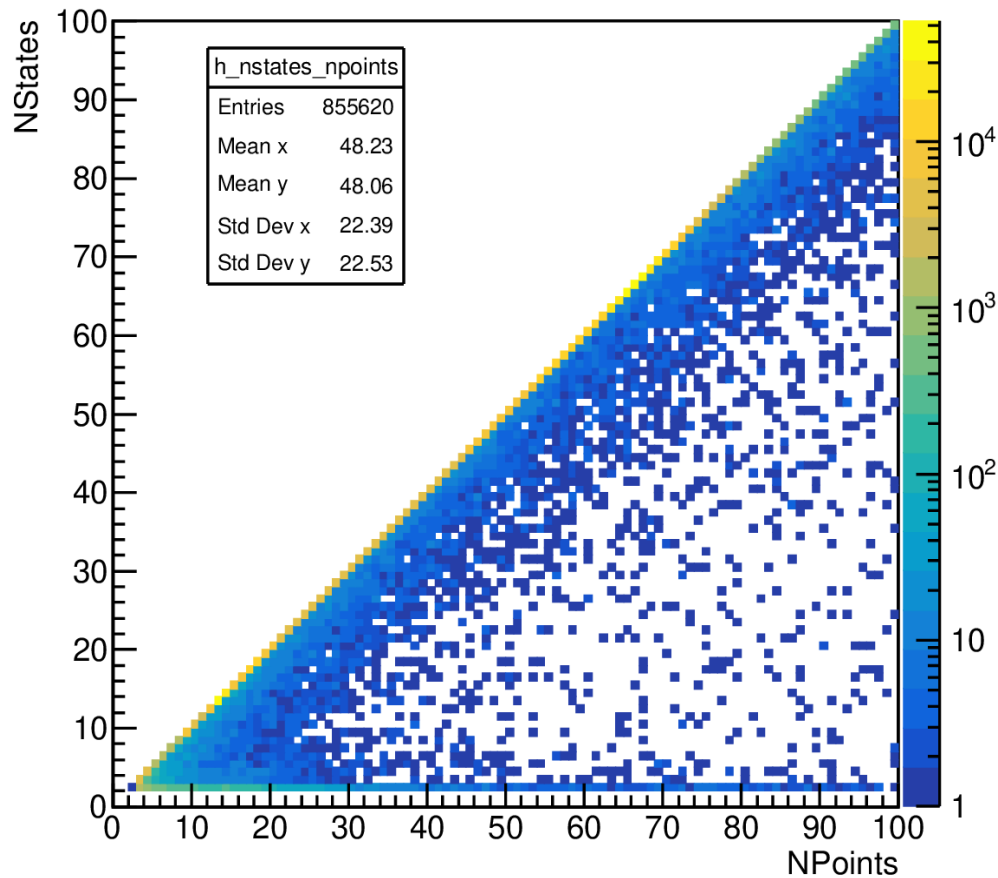
RecoEventFull.cc

```
...

SpdTrackFitterGF* track_fitter = track_finder→Fitter();

...

track_fitter->StoreImPoints(true);       // default: false
track_fitter->StoreImMomentum(true);     // default: true
track_fitter->StoreImPosition(true);     // default: false
//track_fitter->StoreImCovariance(true); // default: false

…
```

- This possibility was introduced in December 2021.

- However, jobs sometimes crashed due to uncatched genfit exception.

- Bugfix was commited recently to development branch of SpdRoot.

RecoEventFull.cc

```
...

SpdTrackFitterGF* track_fitter = track_finder→Fitter();

...

track_fitter->StoreImPoints(true);      // default: false
track_fitter->StoreImMomentum(true);    // default: true
track_fitter->StoreImPosition(true);    // default: false
//track_fitter->StoreImCovariance(true); // default: false

…
```

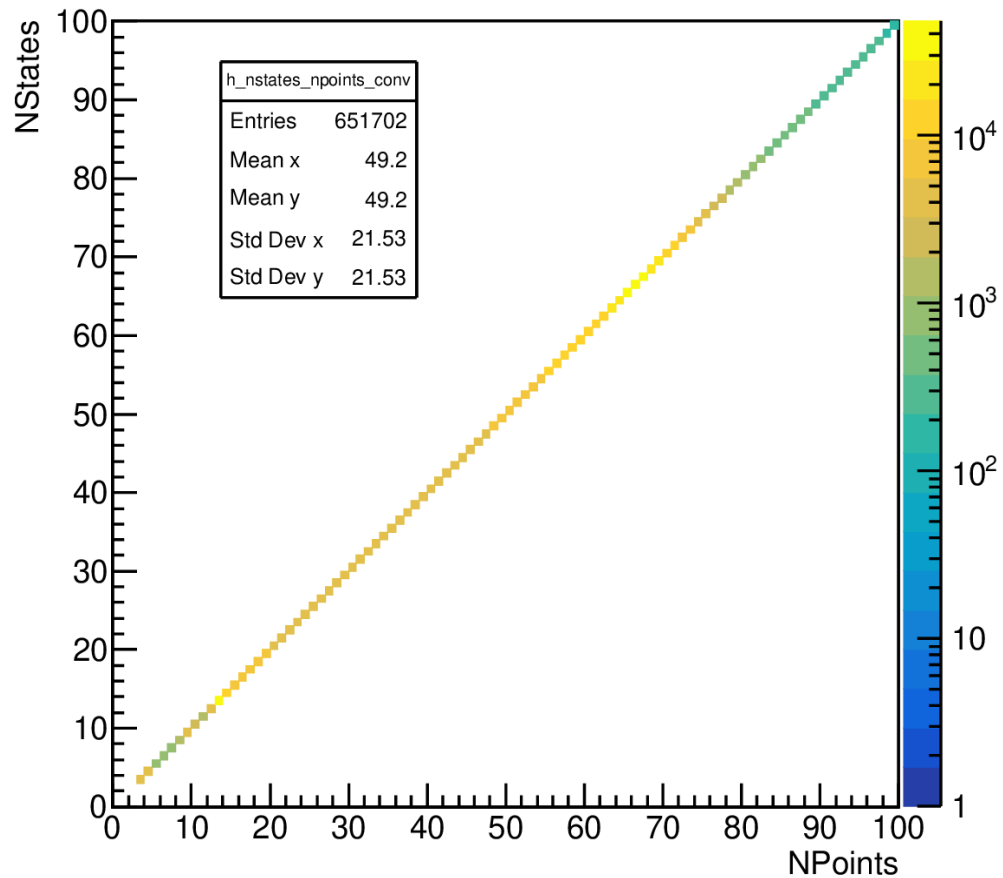- The average size of the produced file `reco_full.root` is increased by ≈ **7%**

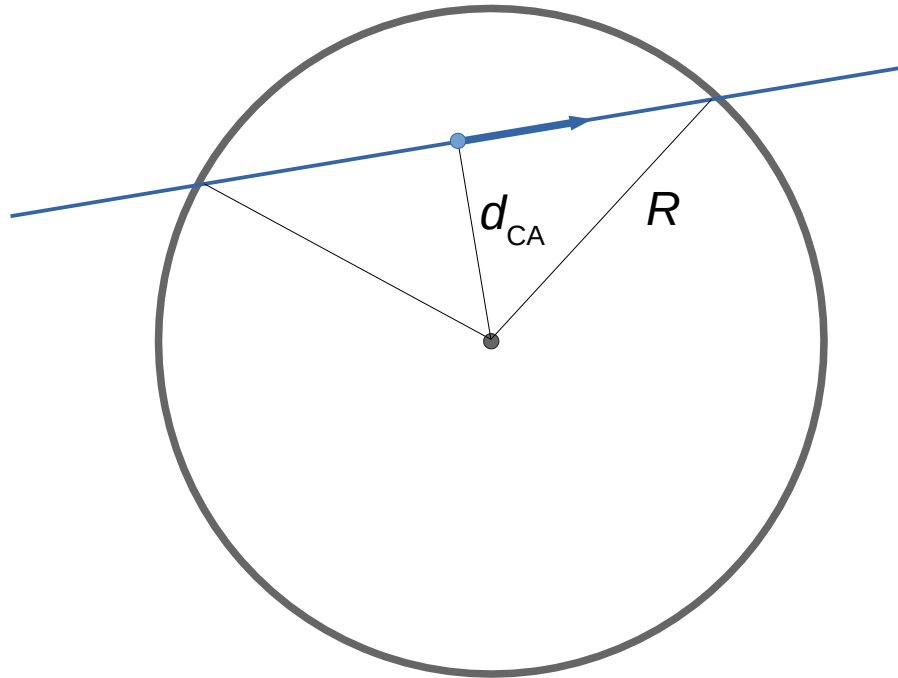 (for file with 1000 events from 507 MB to 540 MB).

NStates vs NPoints

NStates vs NPoints (convergency=1)

h_nstates_npoints	
Entries	855620
Mean x	48.23
Mean y	48.06
Std Dev x	22.39
Std Dev y	22.53

h_nstates_npoints_conv	
Entries	651702
Mean x	49.2
Mean y	49.2
Std Dev x	21.53
Std Dev y	21.53

?

Further I select only tracks with convergency = 1 and χ^2/ndf < 4.

5

Calculation of dx

$$\Delta x = \frac{2\sqrt{R^2 - d_{CA}^2}}{\sin \alpha}$$

$$R = (0.5 - 0.0036)\, cm$$

α - the angle between track direction and tube axis

dx_{reco} vs dx_{MC}

hits throgh
the wire

h_dxmc_dxrc		
Entries		2.896679e+07
Mean x		1.057
Mean y		1.064
0	23754	226532
0	2.861611e+07	3716
0	96672	4

dx_{reco}/dx_{MC} vs dx_{MC}

h_dxmc_dxratio		
Entries		2.896679e+07
Mean x		1.06
Mean y		1.01
0	59344	0
0	2.858052e+07	230248
0	96672	4

Profile   (width/2 = std.dev.)

dx_{reco}/dx_{MC} vs dx_{MC}

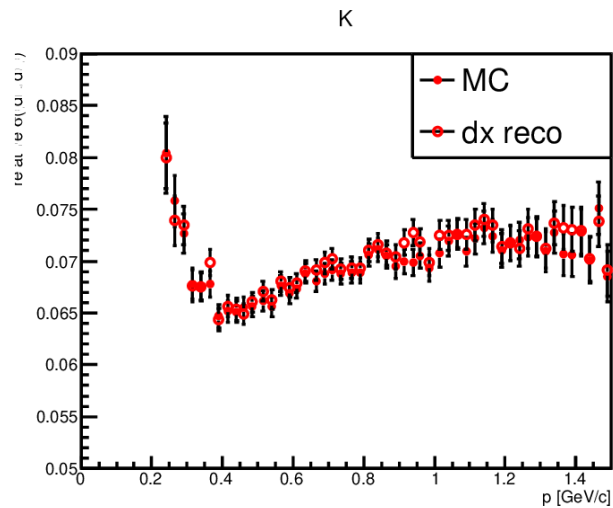| p2	
Entries	2.841298e+07
Mean	1.063
Mean y	1.003
Std Dev	0.4615
Std Dev y	0.06868

2%

at dx=0.3 error ≈ 20%
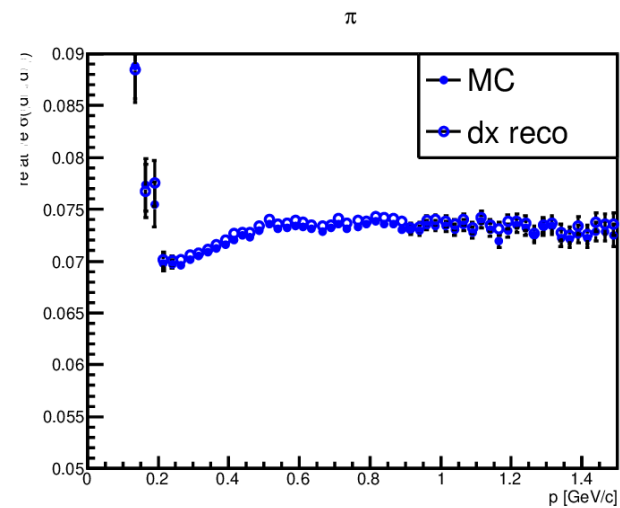
8
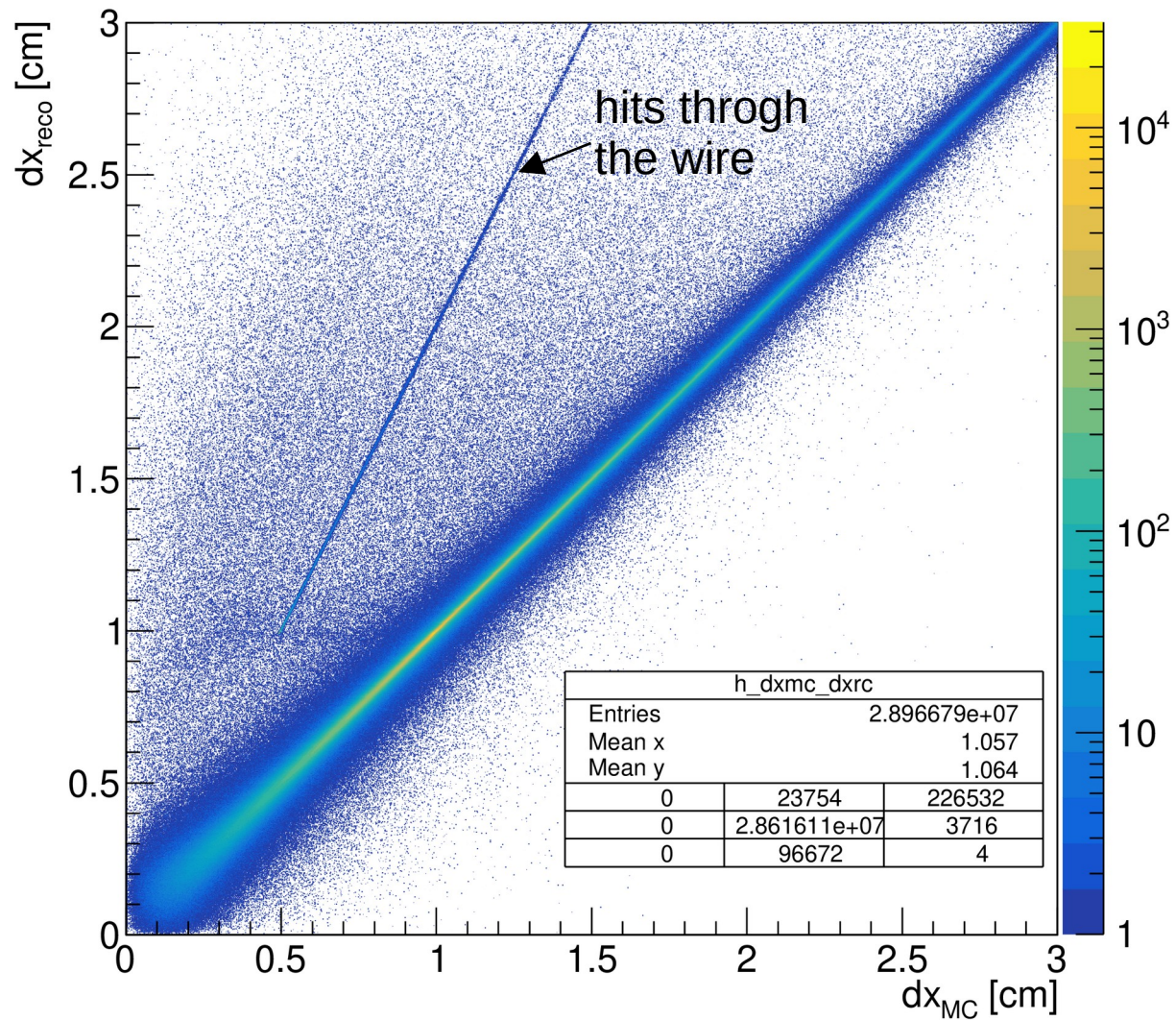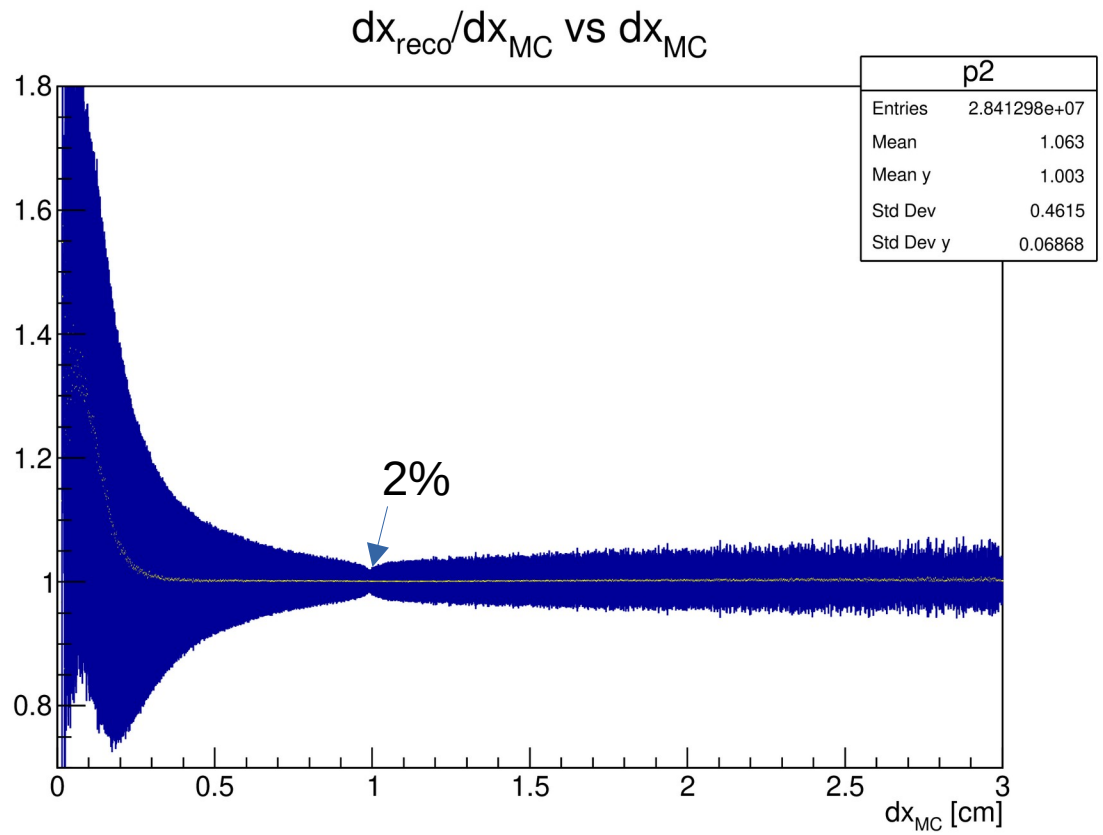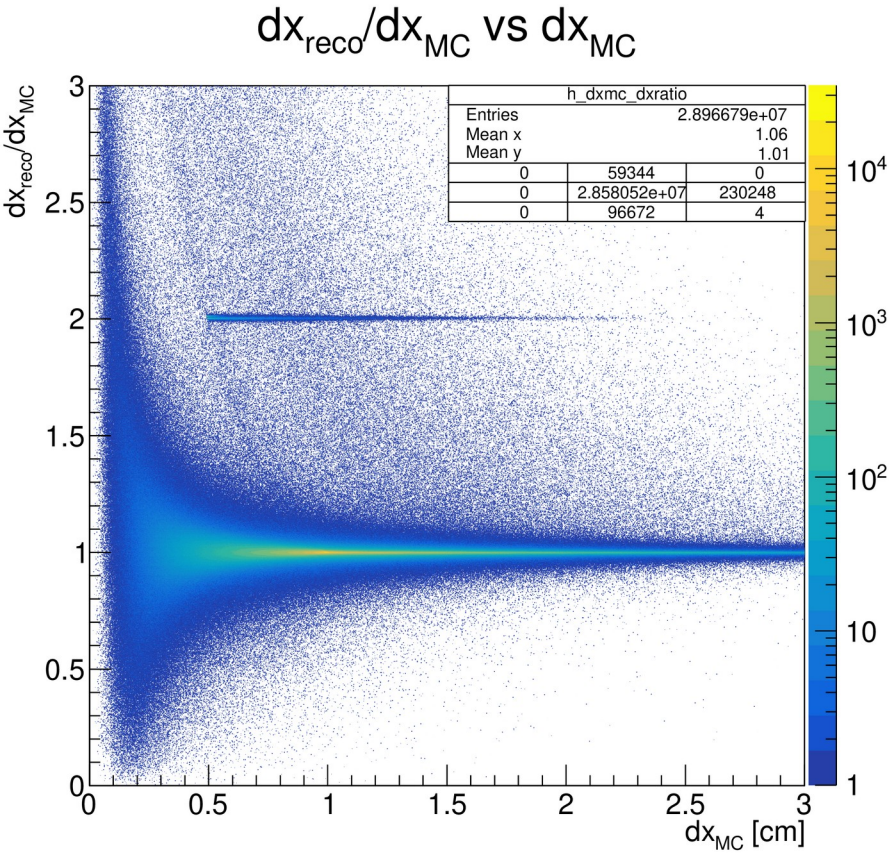
Truncated mean dE/dx distribution
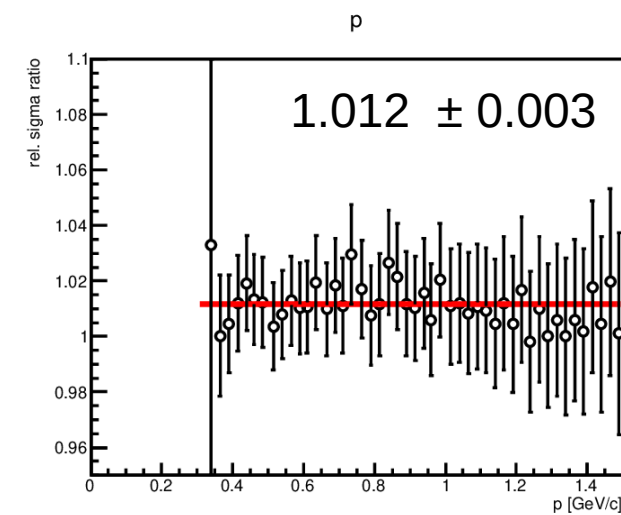

Trunc. mean dE/dx [MC] [NhitsB=62±3, NhitsEC=0]
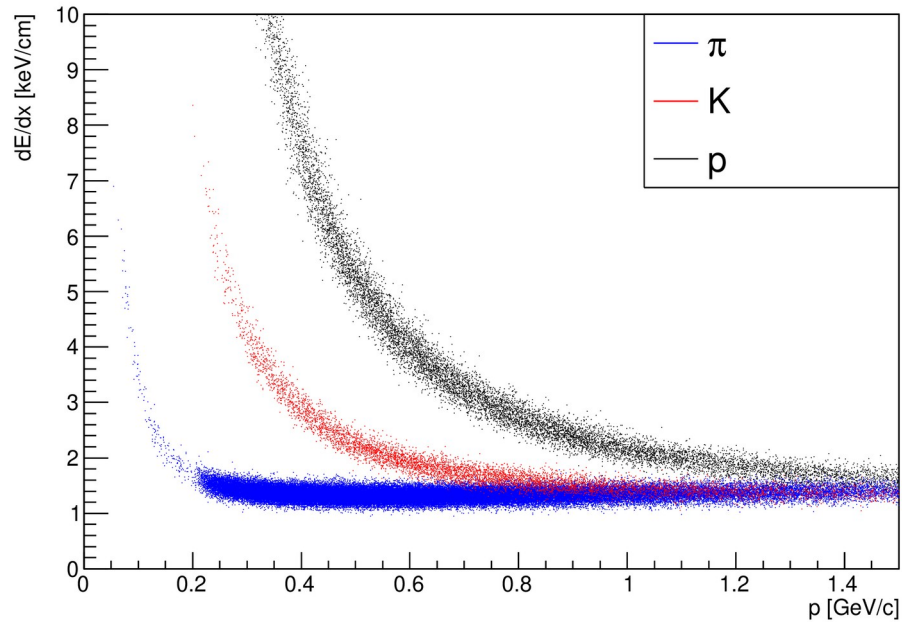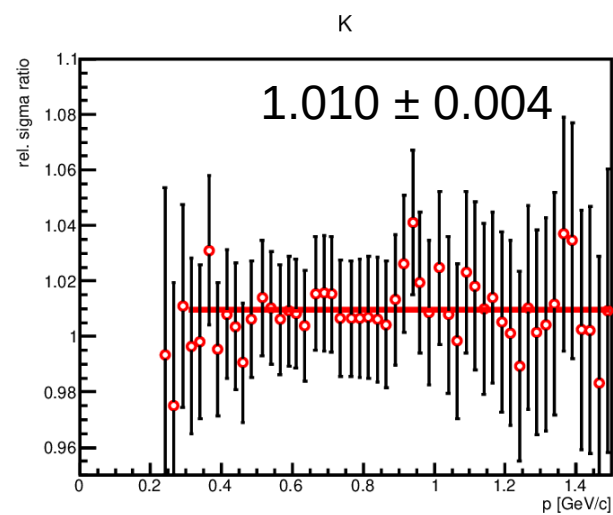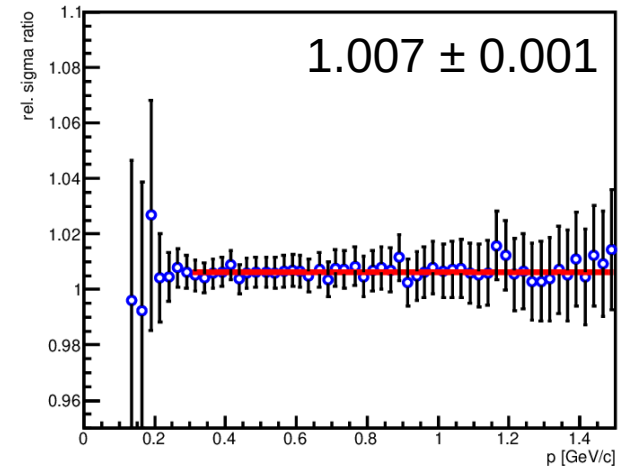
Trunc. mean dE/dx [reco] [NhitsB=62±3, NhitsEC=0]
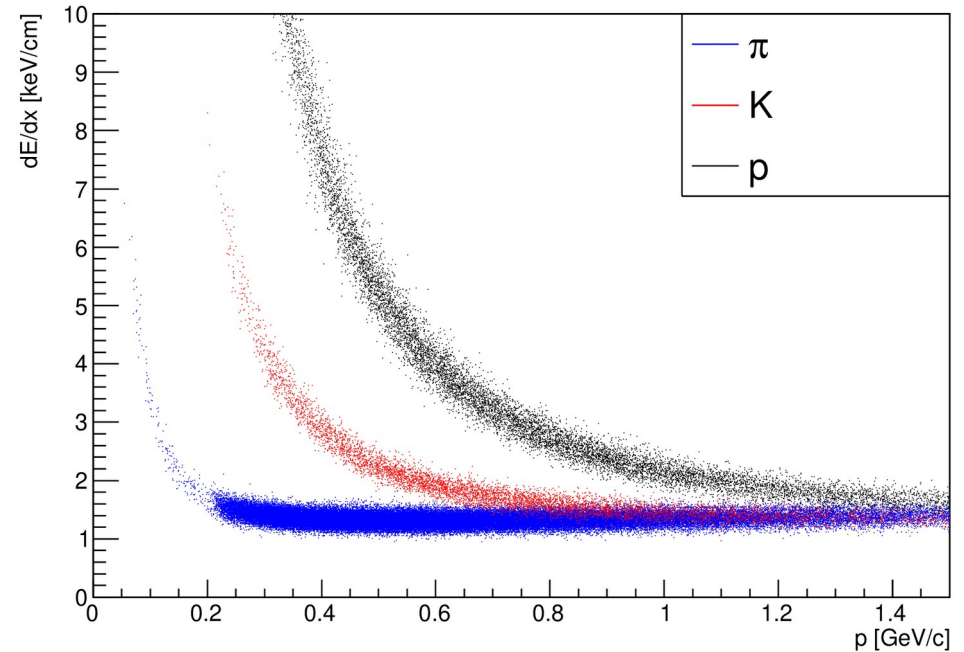
σ/μ of truncated mean dE/dx distribution
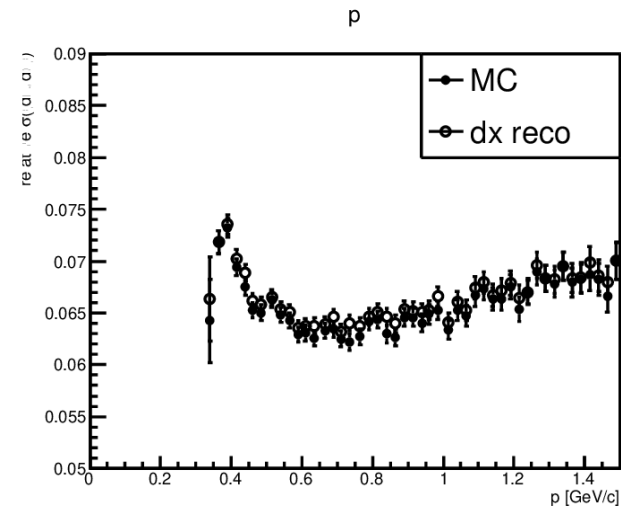
Conclusions

- Reconstructed values of dx can be used in SpdRoot now.

- Error of individual values of dx can be very large for small dx.

- However the impact on resolution in truncated mean dE/dx of the track is small — increase is about 1.01 times.