dE/dx-Check for 250 GeV Test-Production 2

Looks good

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ILD Software and Analysis Meeting
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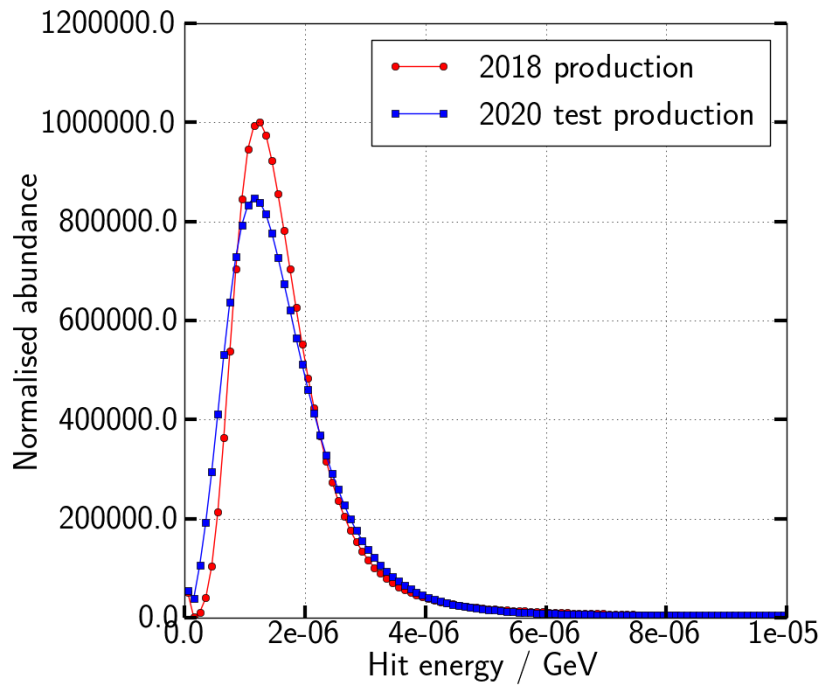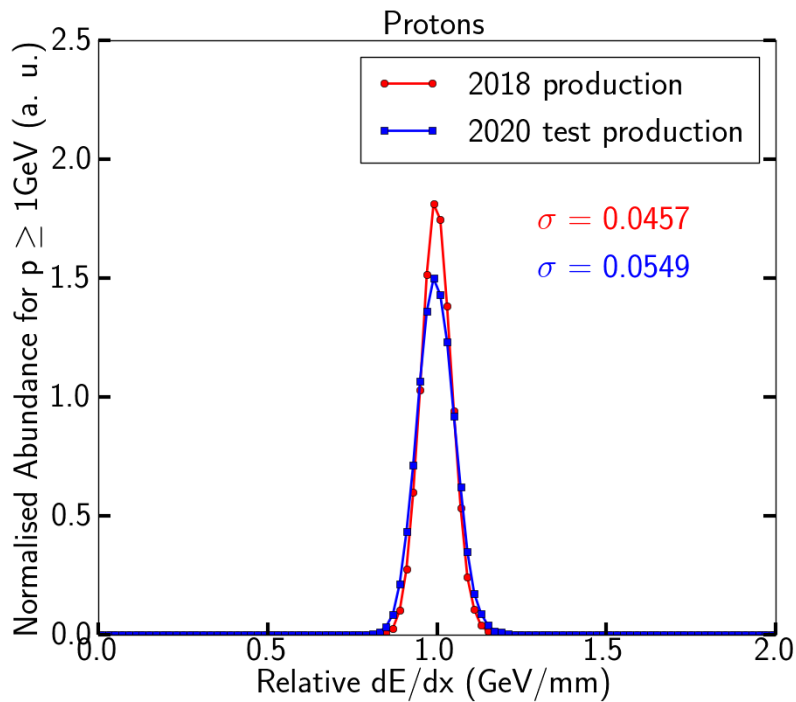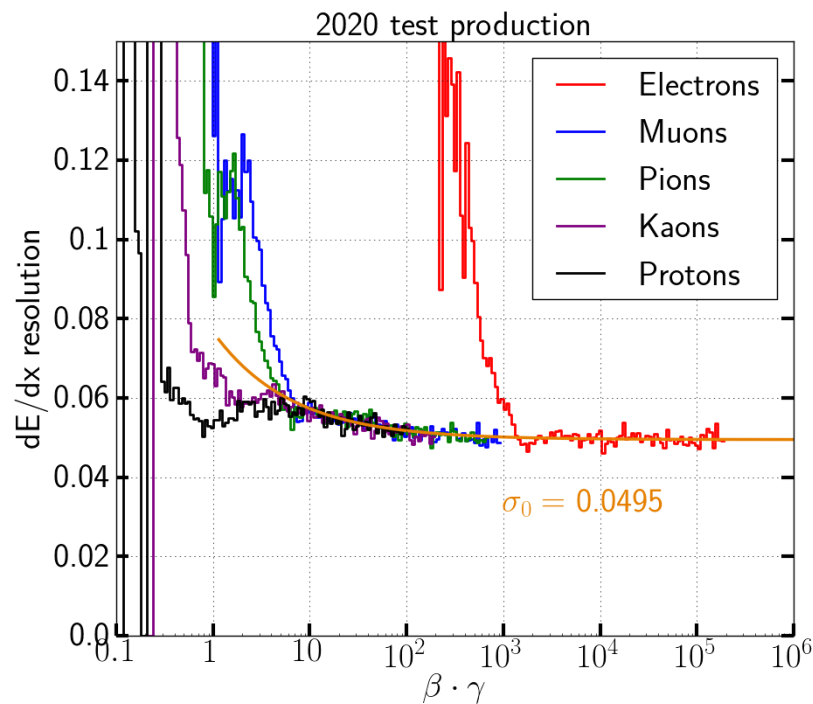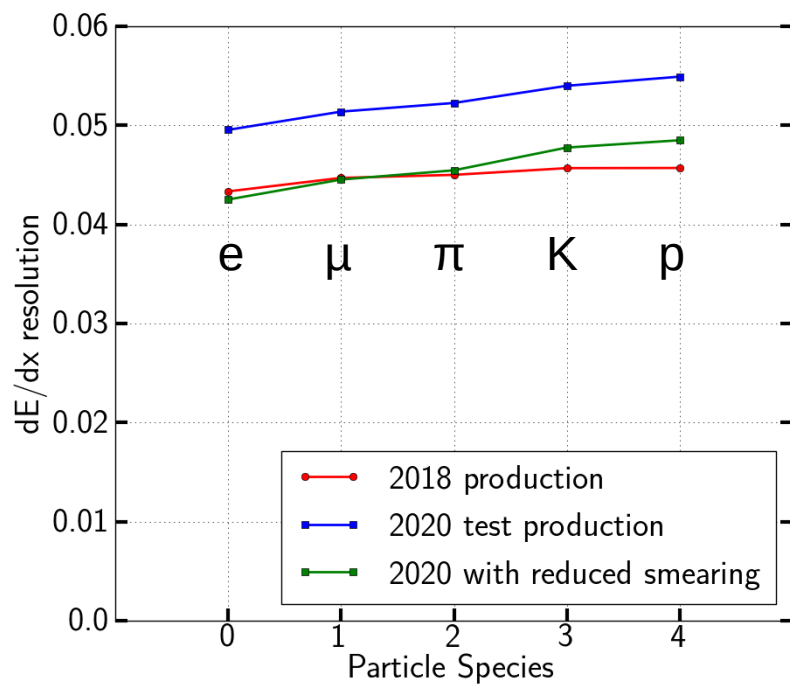
dE/dx Resolution Issue

Reminder: With default parameters, the dE/dx resolution in the new test production is worse than the 2018 production (and than test beam results)

The probable cause for this is a new geant version, which has a wider and slightly overall lower hit energy distribution.
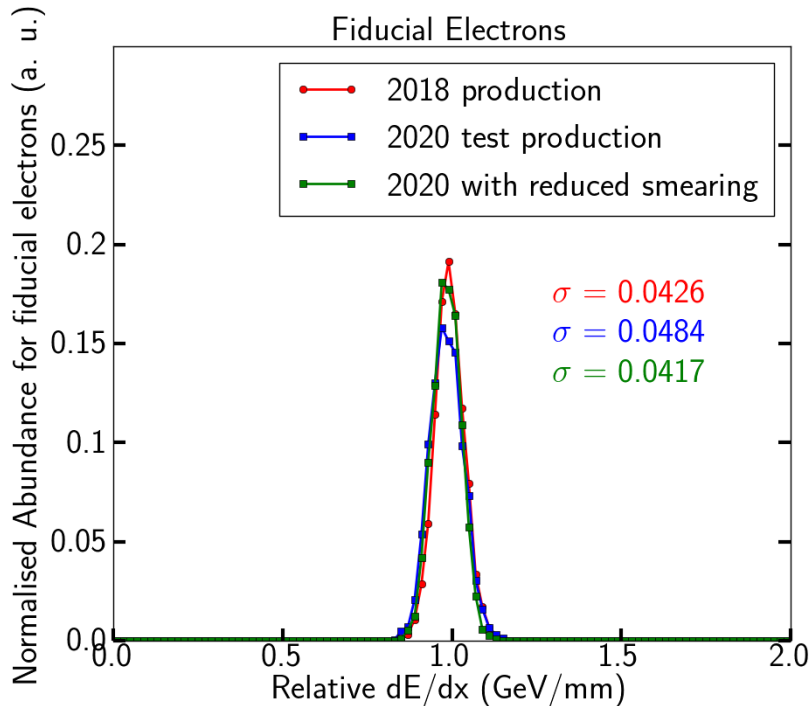
After correction by reducing the (democratic) smearing factor, the resolution returns to previous levels, but differences in resolution values of different species arising from looking at different areas of βɣ for each species are enhanced.

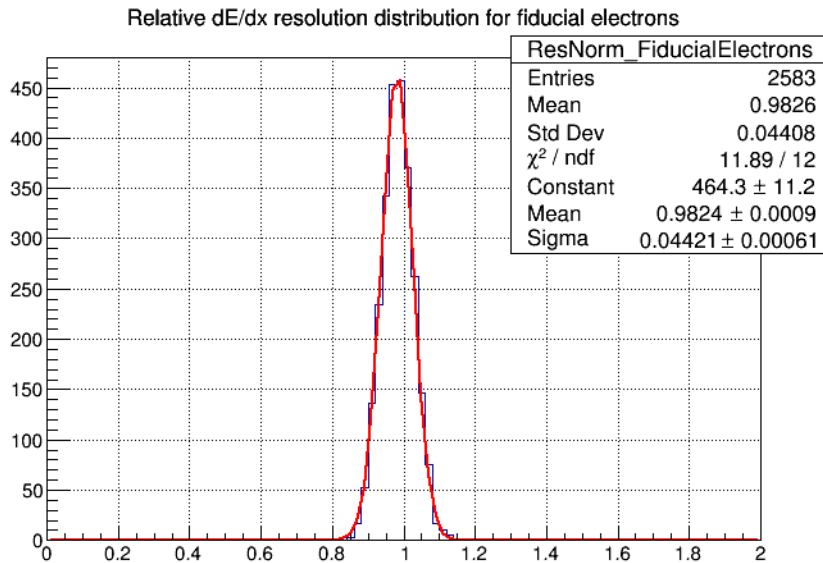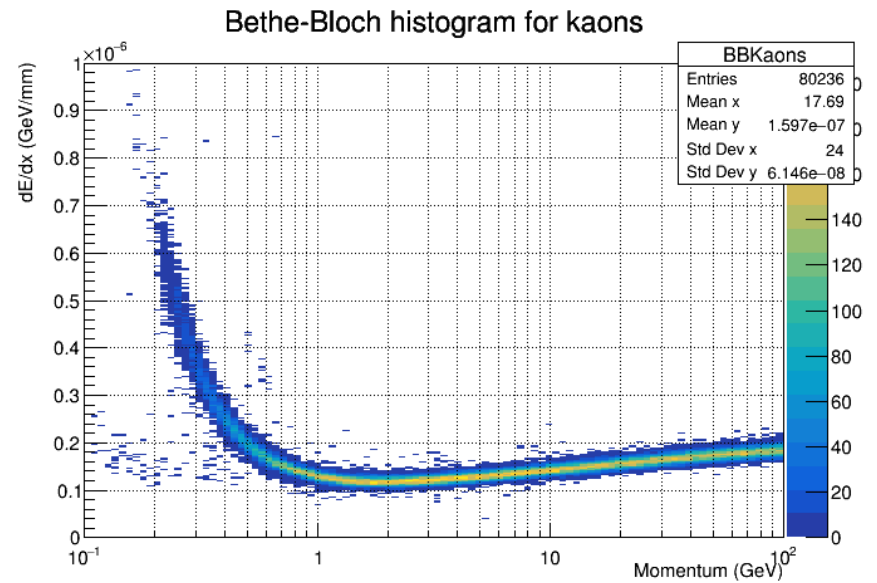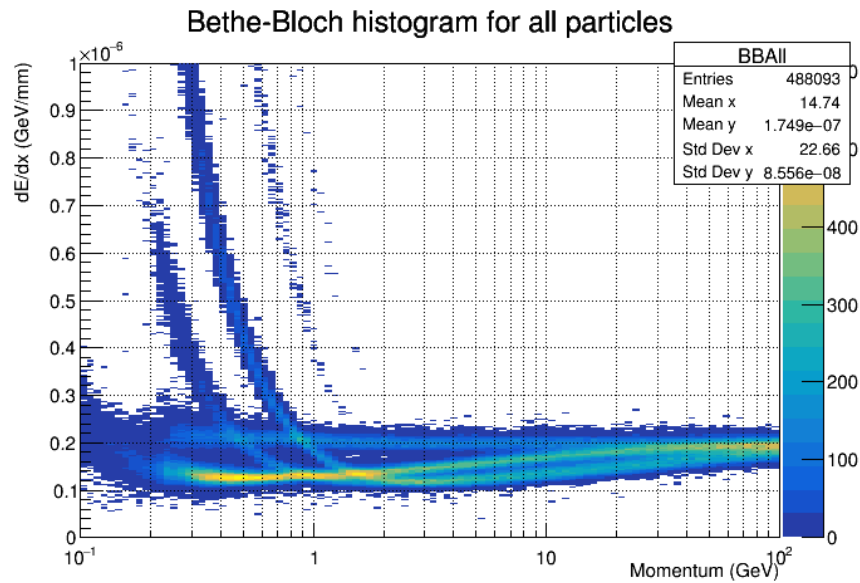- To compare resolution with test beam, define fiducial electrons:

  3 GeV < p < 10 GeV

  1° < | λ | < 10°

  #Hits > 200

- In the end, the smearing factor was chosen so that fiducial electrons have a dE/dx-resolution comparable to test beam results: 4.4%

Relative dE/dx resolution distribution for fiducial electrons

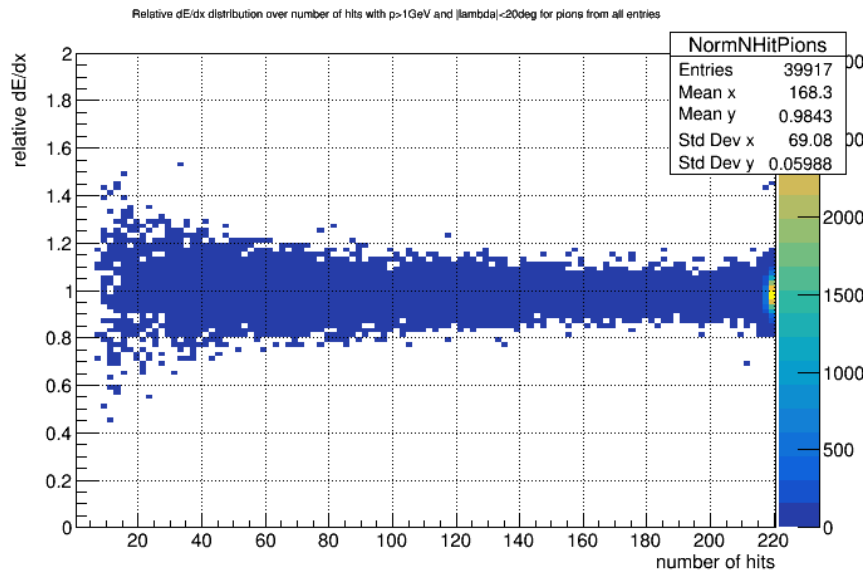| ResNorm_FiducialElectrons	
Entries	2583
Mean	0.9826
Std Dev	0.04408
χ^2 / ndf	11.89 / 12
Constant	464.3 ± 11.2
Mean	0.9824 ± 0.0009
Sigma	0.04421 ± 0.00061

- Fiducial electrons: 4.5%

- Other species: between 4.6% and 5.2%

- This is worse than in the 2018 production (all < 4.6%), but more realistic!

- Similarly, the estimated separation powers between species are slightly worse than 2018, but still comparable.

Test Production 2

Test Production 2 – Additional Dependencies

Relative dE/dx distribution over number of hits with p>1GeV and |lambda|<20deg for pions from all entries

NormNHitPions	
Entries	39917
Mean x	168.3
Mean y	0.9843
Std Dev x	69.08
Std Dev y	0.05988

dE/dx resolution for pions over number of hits from fit result

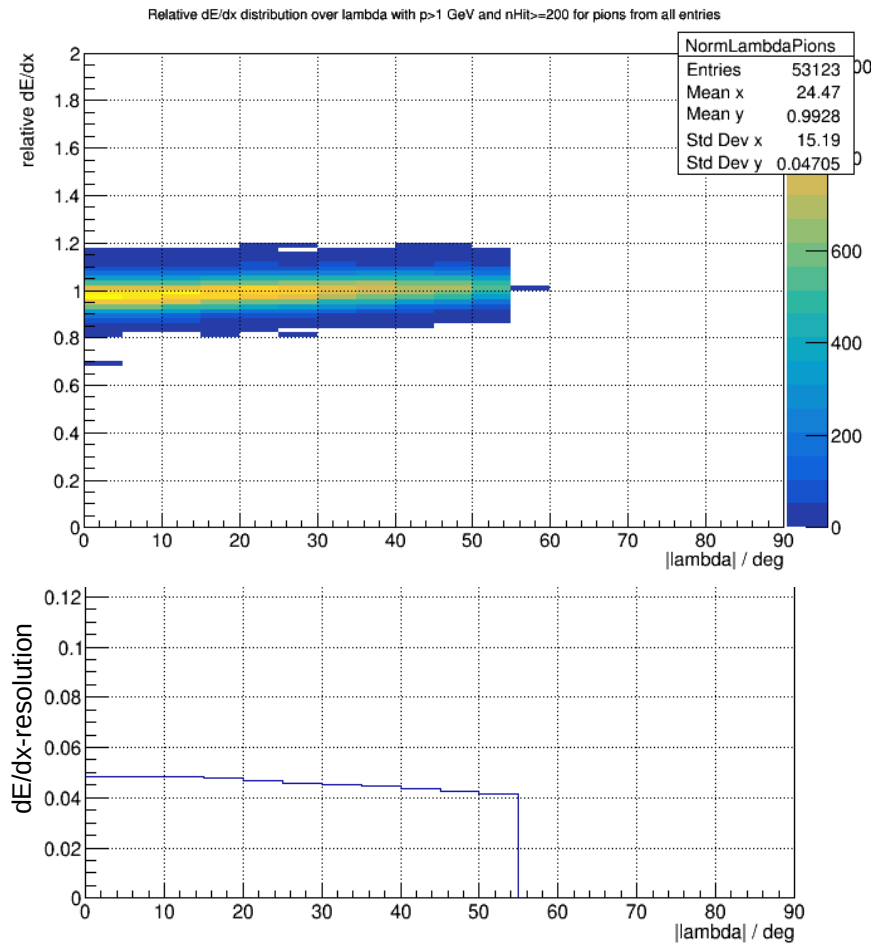| NormNHitPions_FitRes	
Entries	110
Mean	66.28
Std Dev	65.3

- Dependence of dE/dx-resolution on number of hits clearly visible.

- Expected behaviour:

$$\sigma \sim N^{-0.47}$$

Relative dE/dx distribution over lambda with p>1 GeV and nHit>=200 for pions from all entries

NormLambdaPions	
Entries	53123
Mean x	24.47
Mean y	0.9928
Std Dev x	15.19
Std Dev y	0.04705

- Dependence on angle lambda (or theta), related to track length in the TPC (or track length per hit).

- Expected behaviour:

  $$\sigma \sim L^{-0.35}$$

- Further studies and more data needed to investigate interplay and remaining impact of smearing factor.

Conclusion

- dE/dx-resolution was successfully investigated and recalibrated.

- Fiducial electrons have a resolution comparable to test beam results.

- With reduced impact of smearing factor additional expected dependencies become visible, need more time and data to fully assess.

- We're good to go!