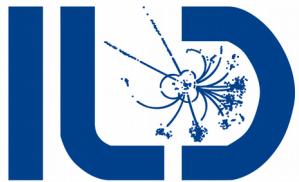


dE/dx-Check for new 250 GeV-Production

Follow-up

Uli Einhaus

ILD Software and Analysis Meeting
22.04.2020

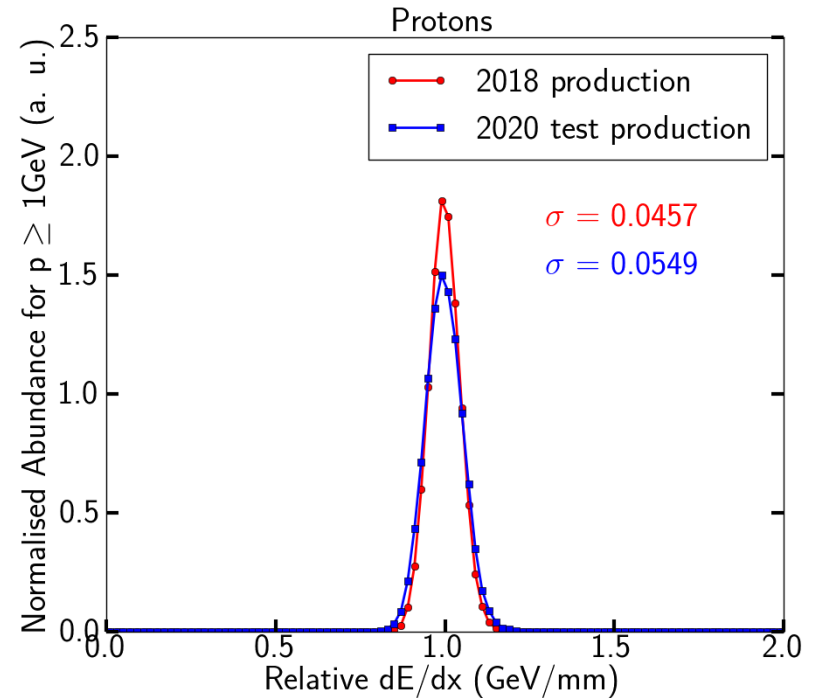
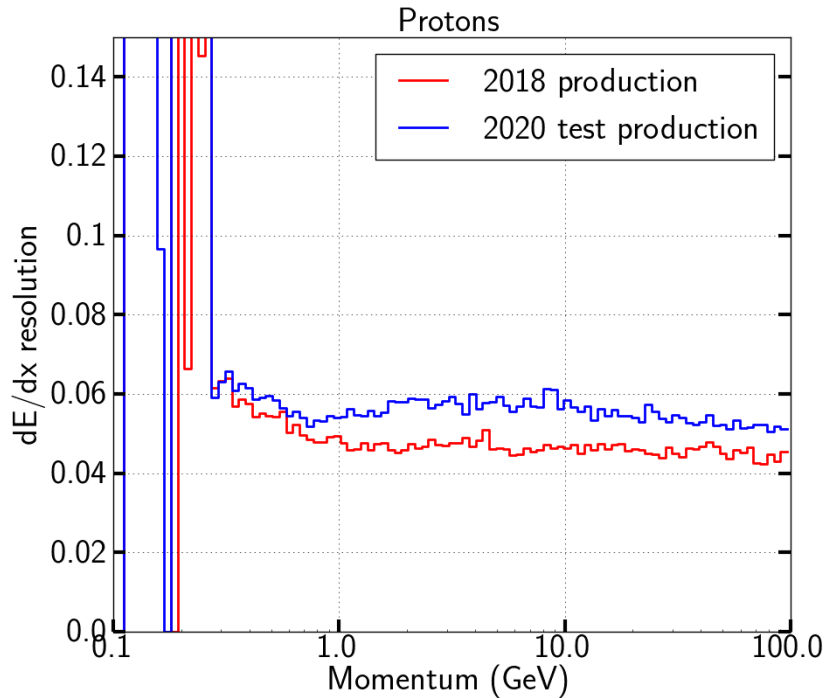


HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES



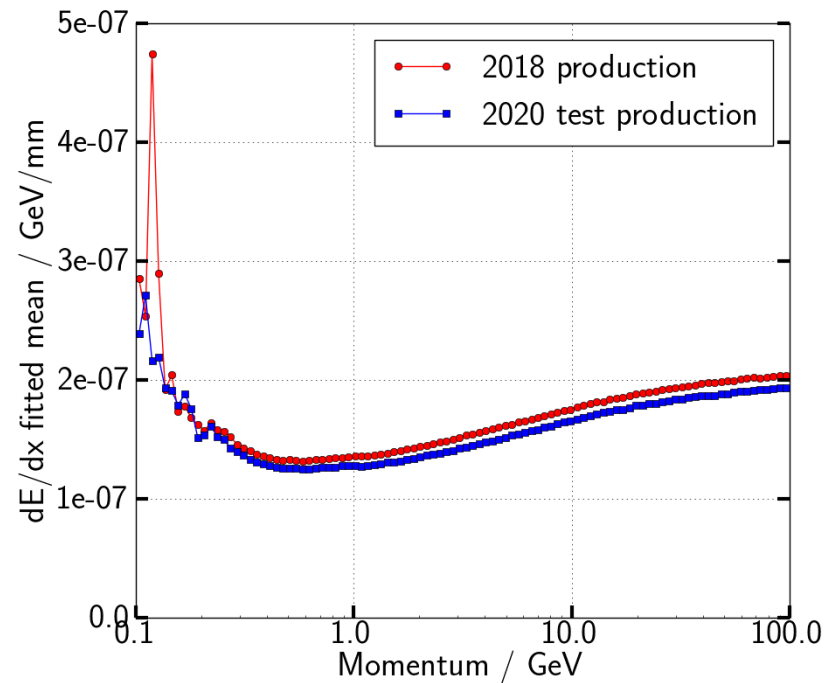
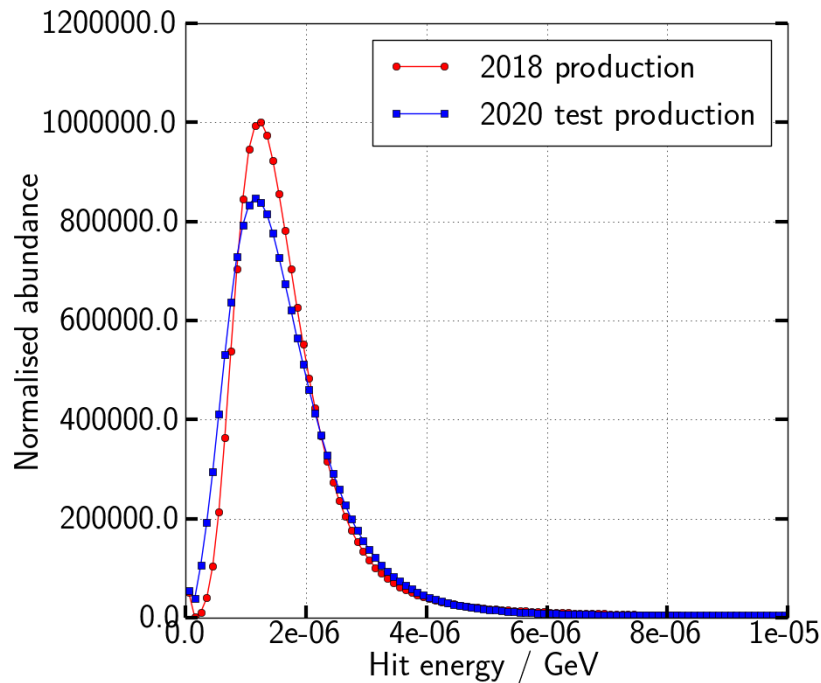
dE/dx Resolution Issue

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

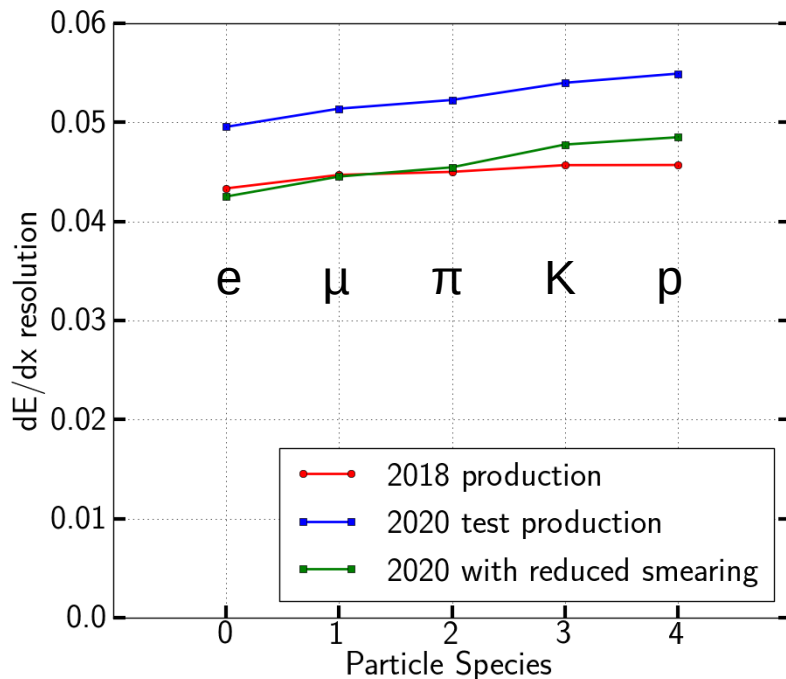


Probable Cause

The probable cause for this is a new geant version, which has a wider and slightly overall lower hit energy distribution.



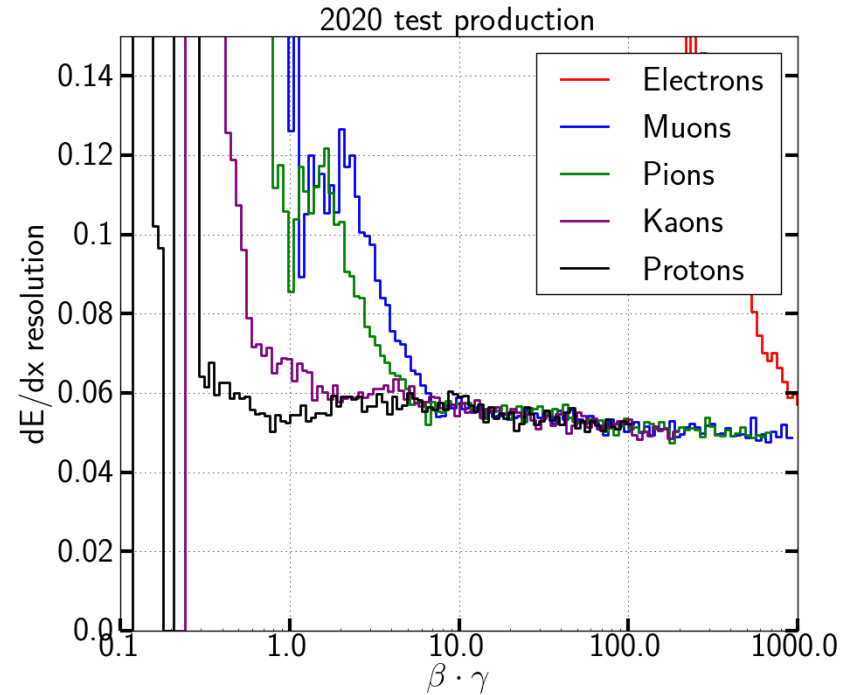
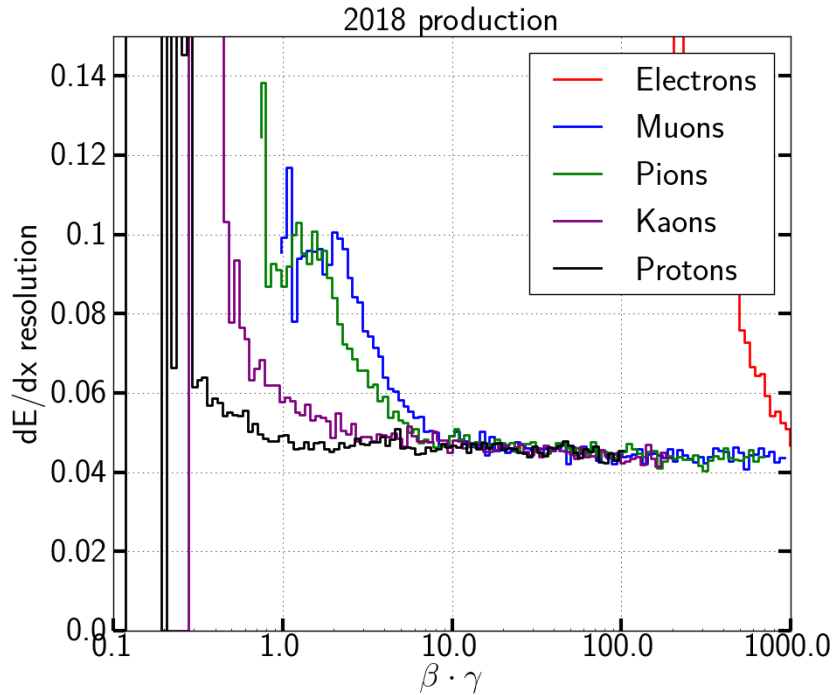
Difference between Species



- After correction by adjusting the smearing factor, the resolution returns to previous levels.
- But: difference in resolution values of different species (worse with growing mass) is enhanced.
- Why?
- → Bias through looking at different $\beta\gamma$ of each species. Resolution depends on $\beta\gamma$!

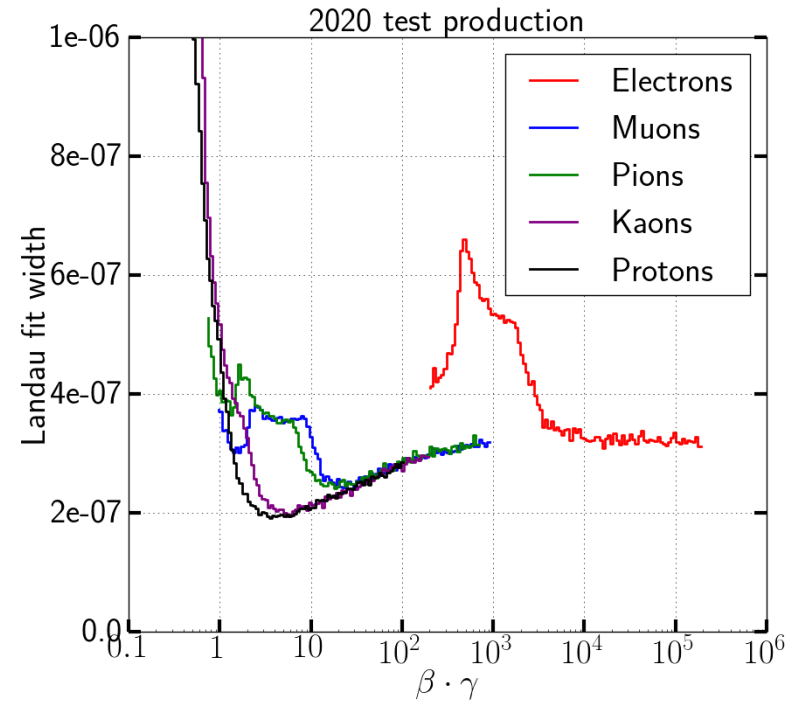
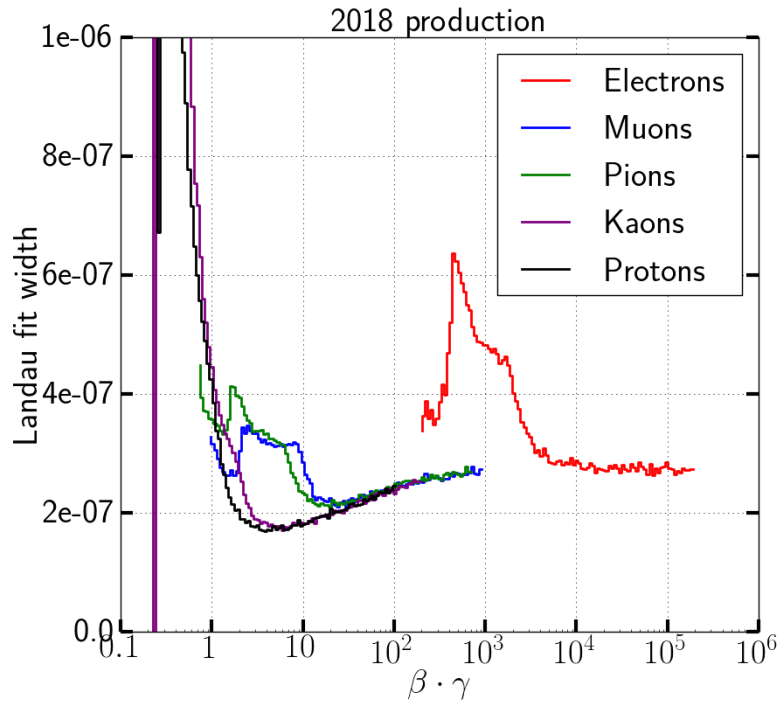
dE/dx Resolution over $\beta\gamma$

For previous resolution numbers, $p > 1$ GeV was required, so protons with $\beta\gamma > 1$ were accepted, but pions with $\beta\gamma > 10$.



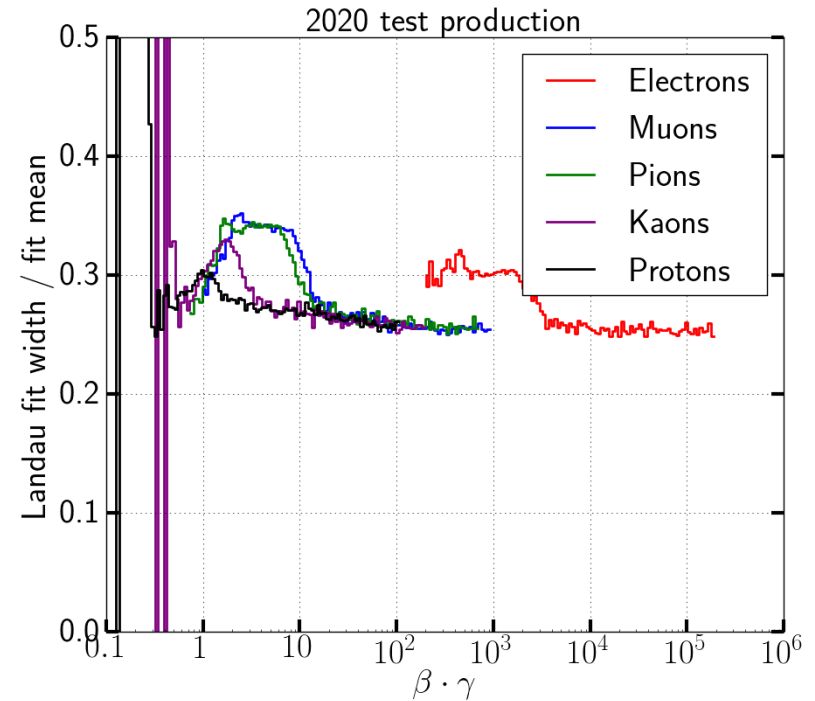
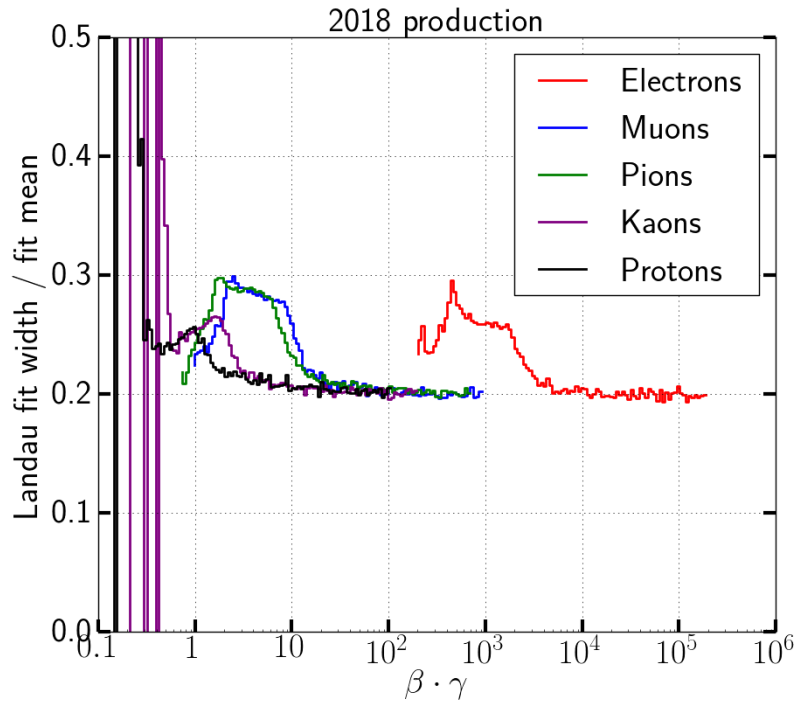
Width of Landau Fit of Hit Energy Distribution

The effect on the resolution stems from the underlying hit energy distribution.



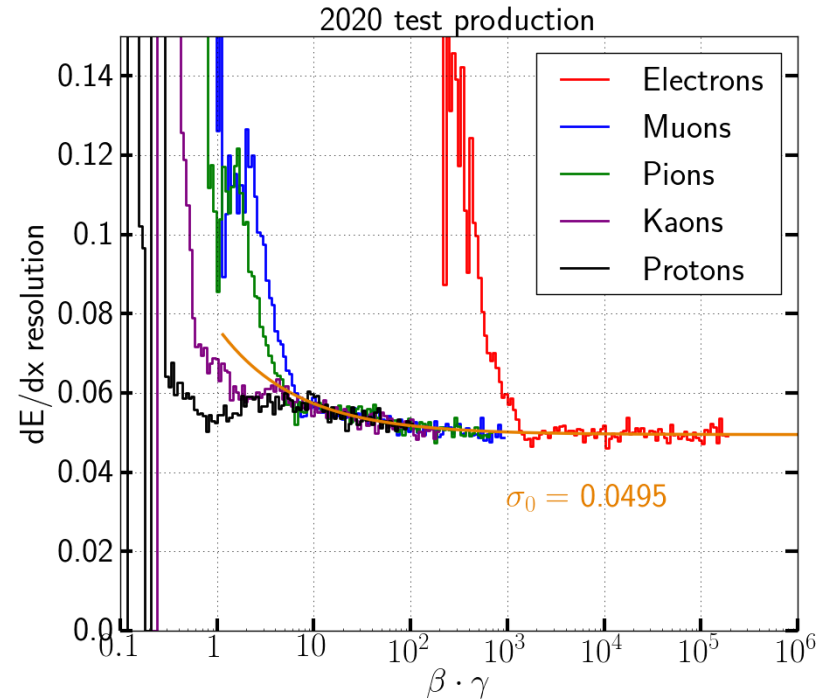
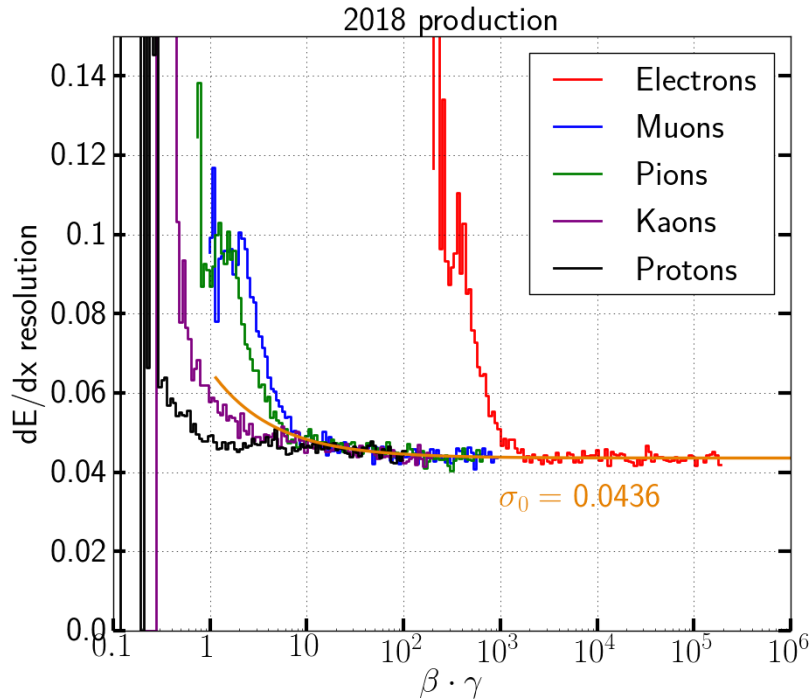
Width / Mean of Landau Fit of Hit Energy Distribution

The width / mean is falling with increasing $\beta\gamma$.

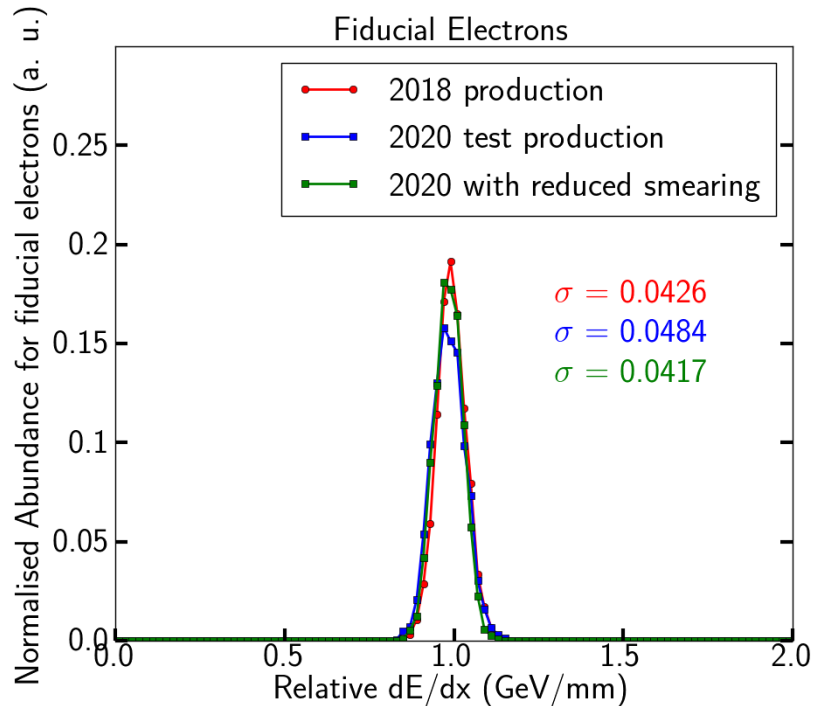


dE/dx Resolution over $\beta\gamma$, asymptotic Behavior

An exponential fit for $\beta\gamma > 2000$ (electrons) and $\beta\gamma > 10$ (others) gives an estimate for the asymptotic resolution. Still affected by angular distribution.

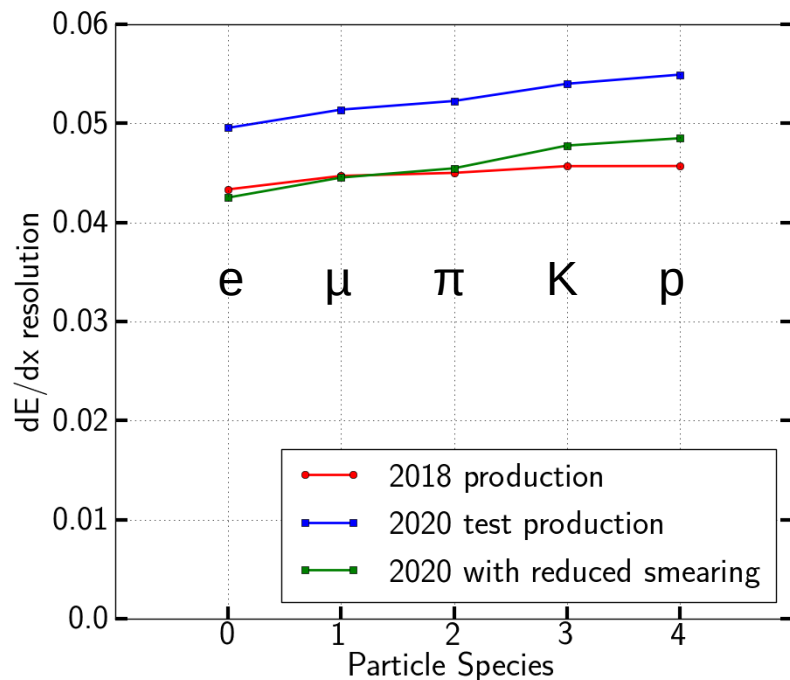


Fiducial Electrons



- To compare resolution with test beam, define fiducial electrons:
 $3 \text{ GeV} < p < 10 \text{ GeV}$
 $1^\circ < |\lambda| < 10^\circ$
 $\#\text{Hits} > 200$
- Fiducial cut out of 100k isotropic single particle electrons.
~ 2300 entries remaining.
- Suggestion: dedicated run with ~ 100k electrons of 6 GeV parallel to cathode and $.1\text{m} < |z| < .2\text{m}$.
- Should be most realistic comparison to test beam data.

Conclusion



- Differences between species seem resolved, the resolution is the same for all when looking at $\beta\gamma$.
- Use dedicated ‘fiducial electrons’ runs to have the best direct comparison to test beam data.
- Note: Even though we know now why the resolution is different for the different species, this feature still exists and causes the particles in the detector to still have different effective resolutions.
- In the 2018 production the resolution for heavier particles was over-estimated because of the dominating smearing factor.