Spatial Resolution Study of Double GEM Modules

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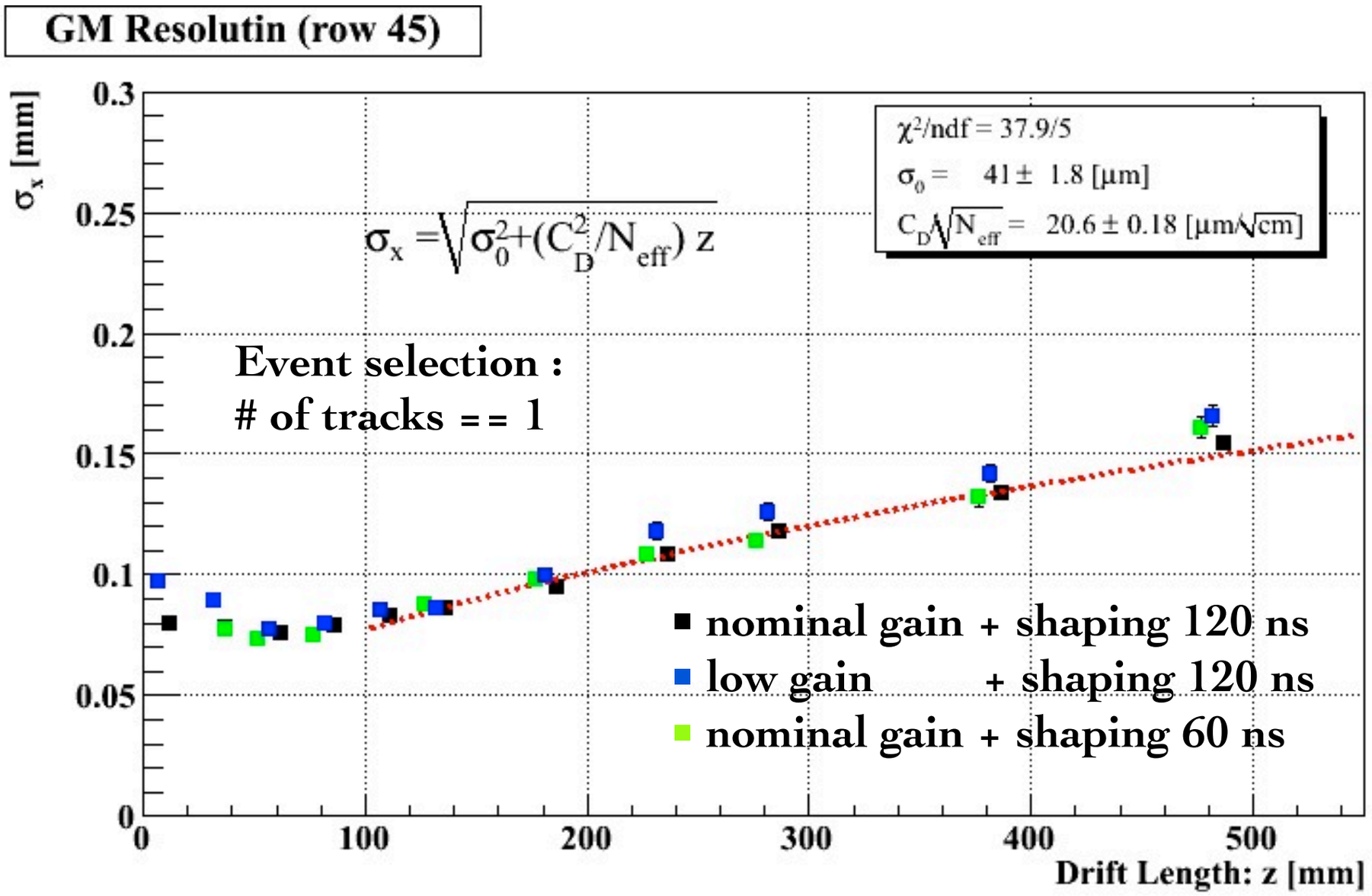
Point resolution (2012 data)

Gain and Shaping Time



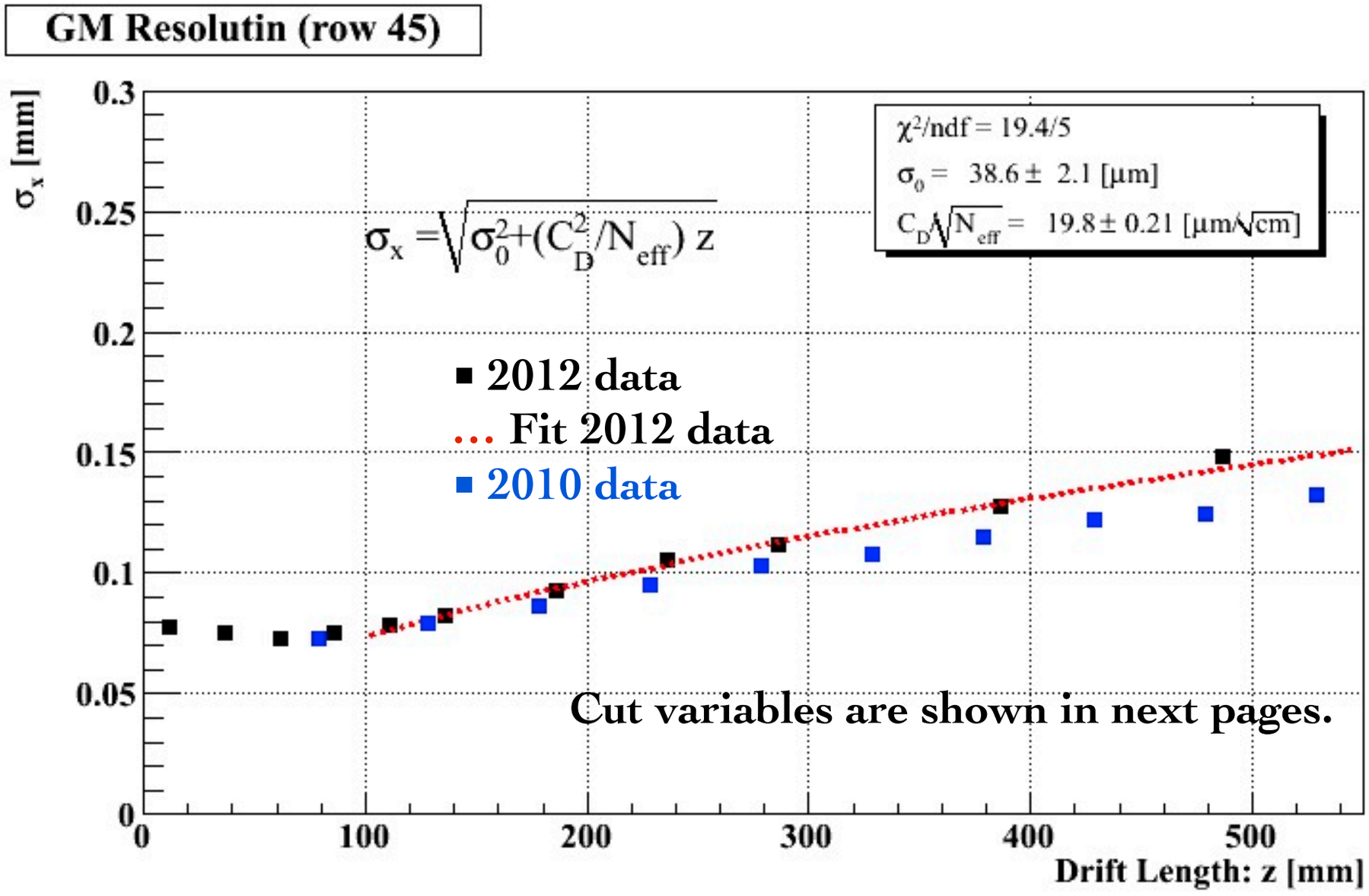
nominal : VGEM : 340V, 355V

low gain : VGEM : 330V, 340V
(+ slightly lower E-field in transfer region)

Comparing in gain, nominal (higher) condition is slightly better at long drift distance. --> threshold effect ?
Comparing in shaping time, they are almost same.

Point resolution (2010 & 2012)

I re-analyzed 2010 data with same condition (steering file, gear file, marlin processors) as 2012 analysis.

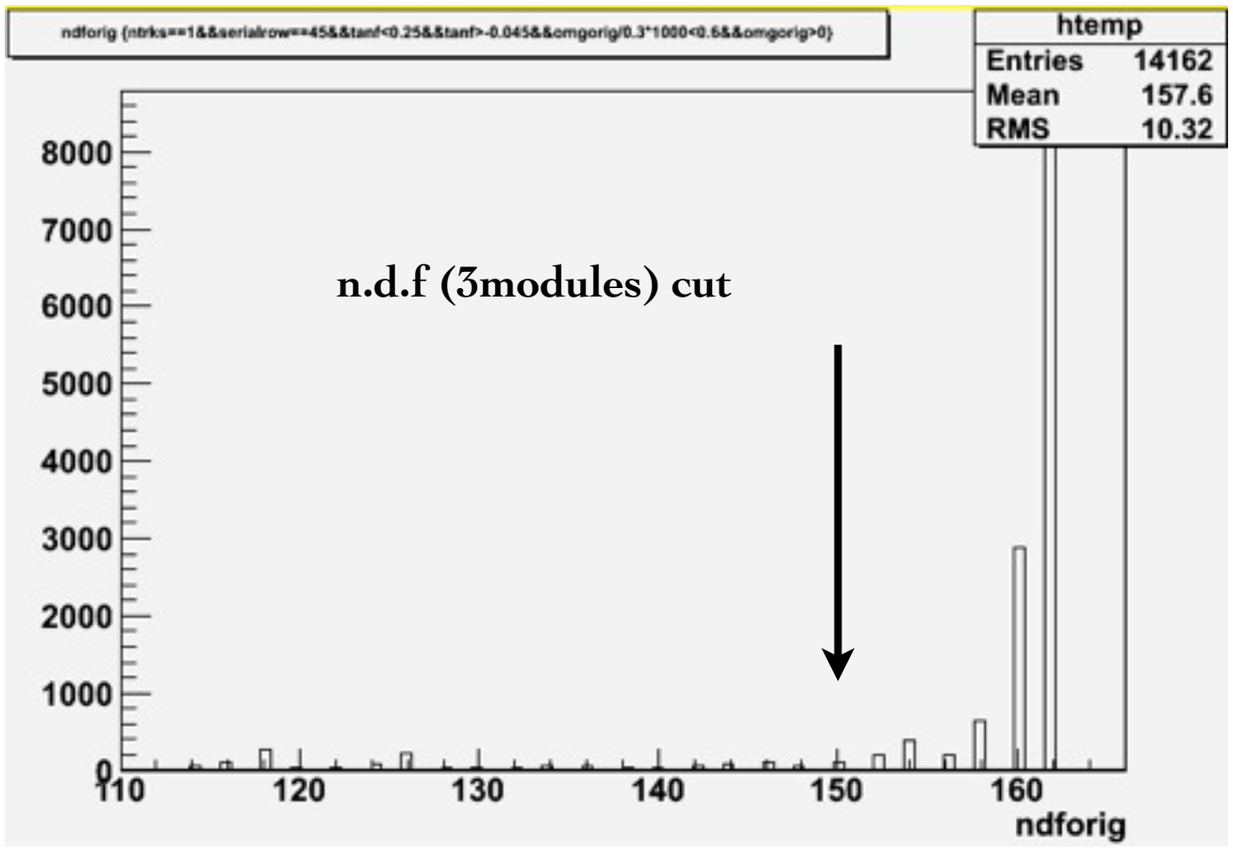


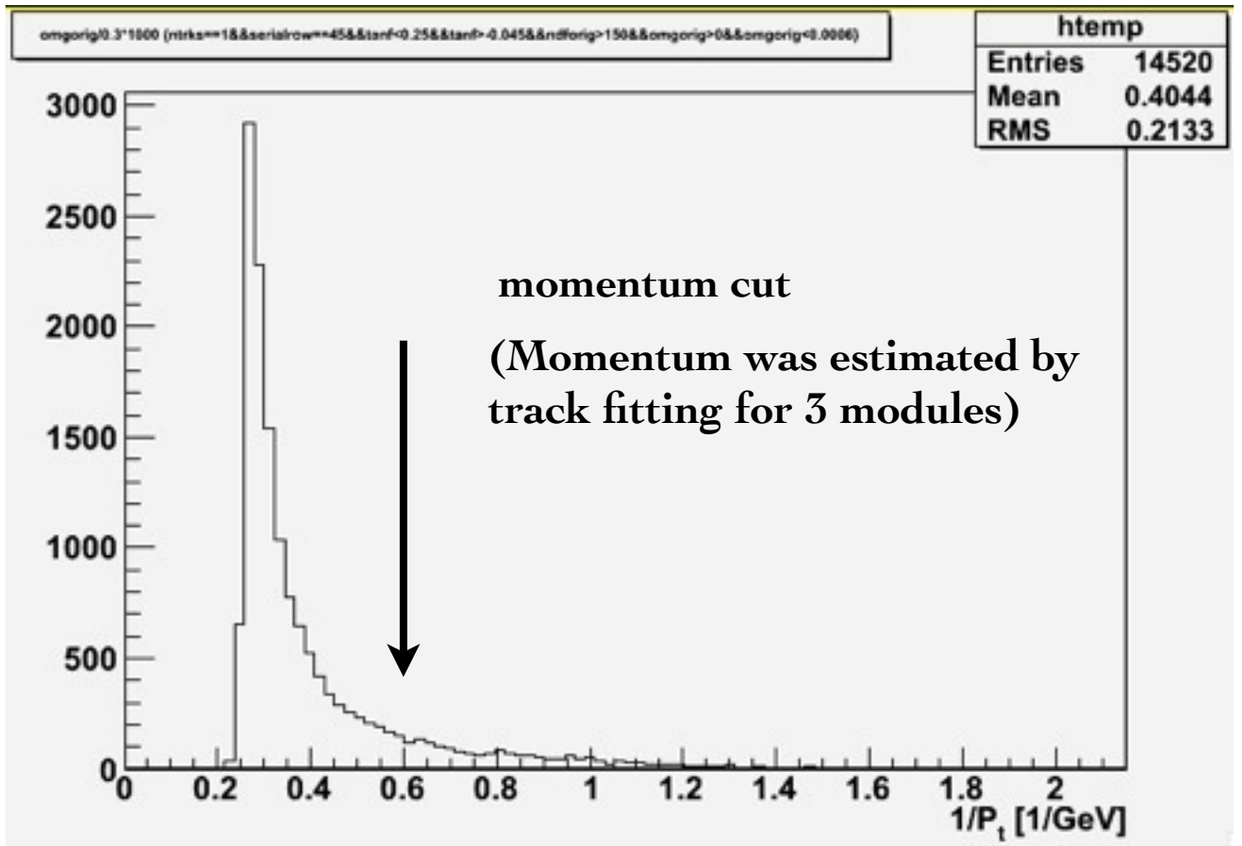
2012 data : Neff ~ 21

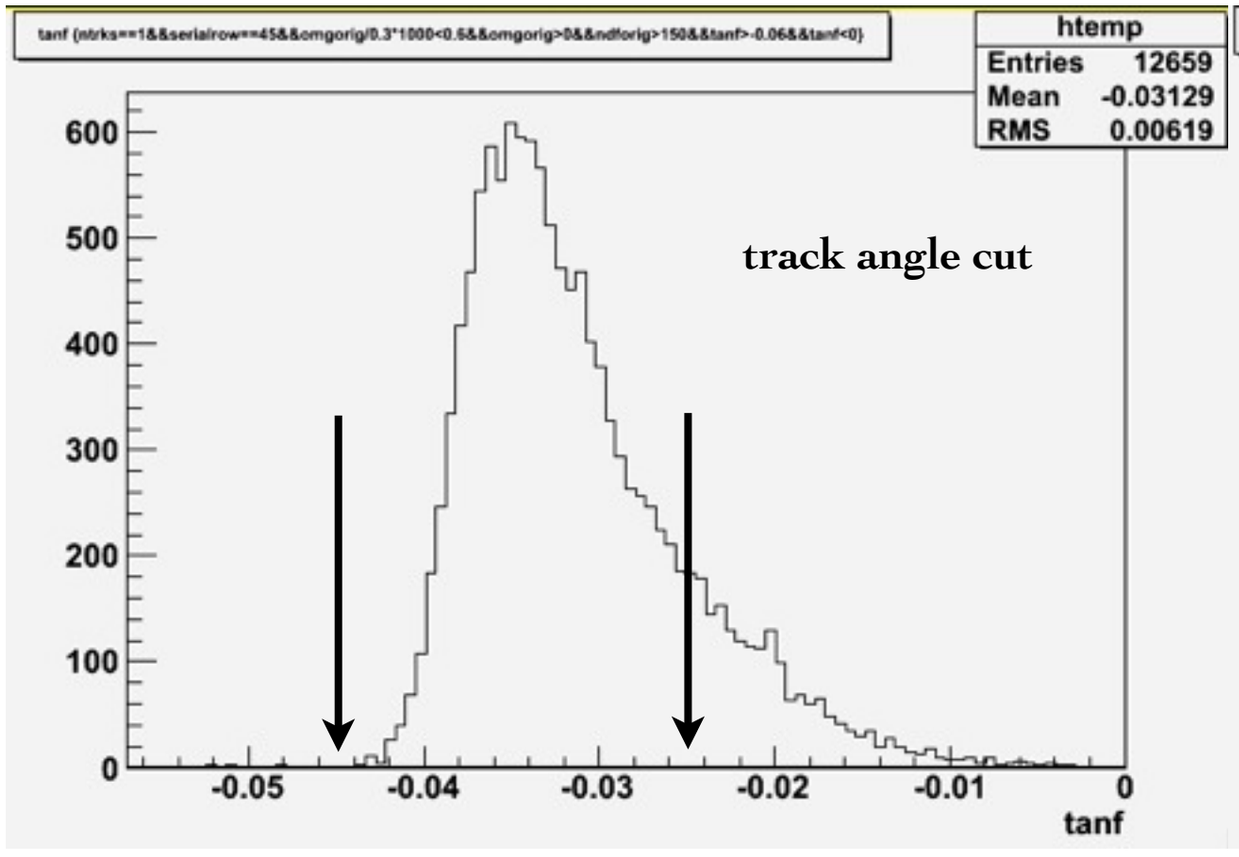
2010 data : Neff ~ 30

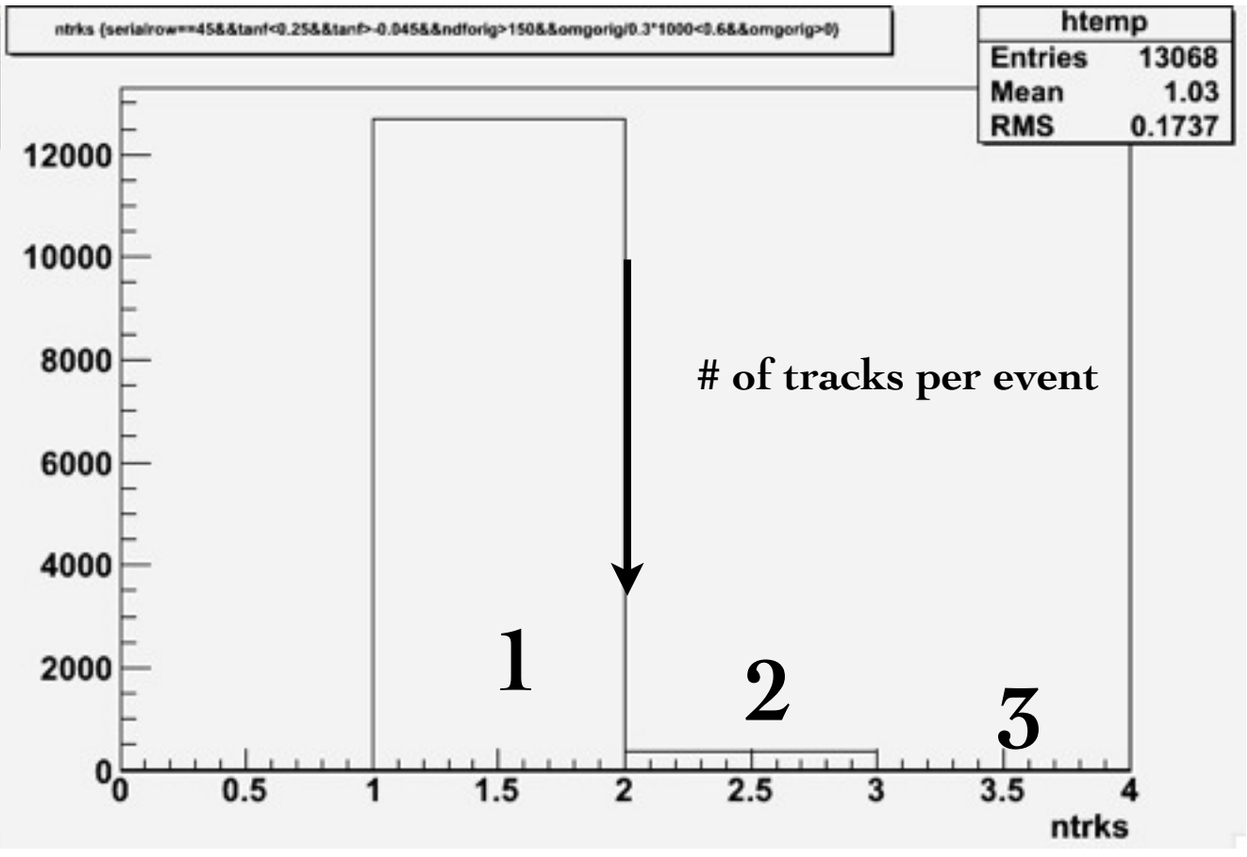
Cut Variables (2010)

Z = 7.9 cm



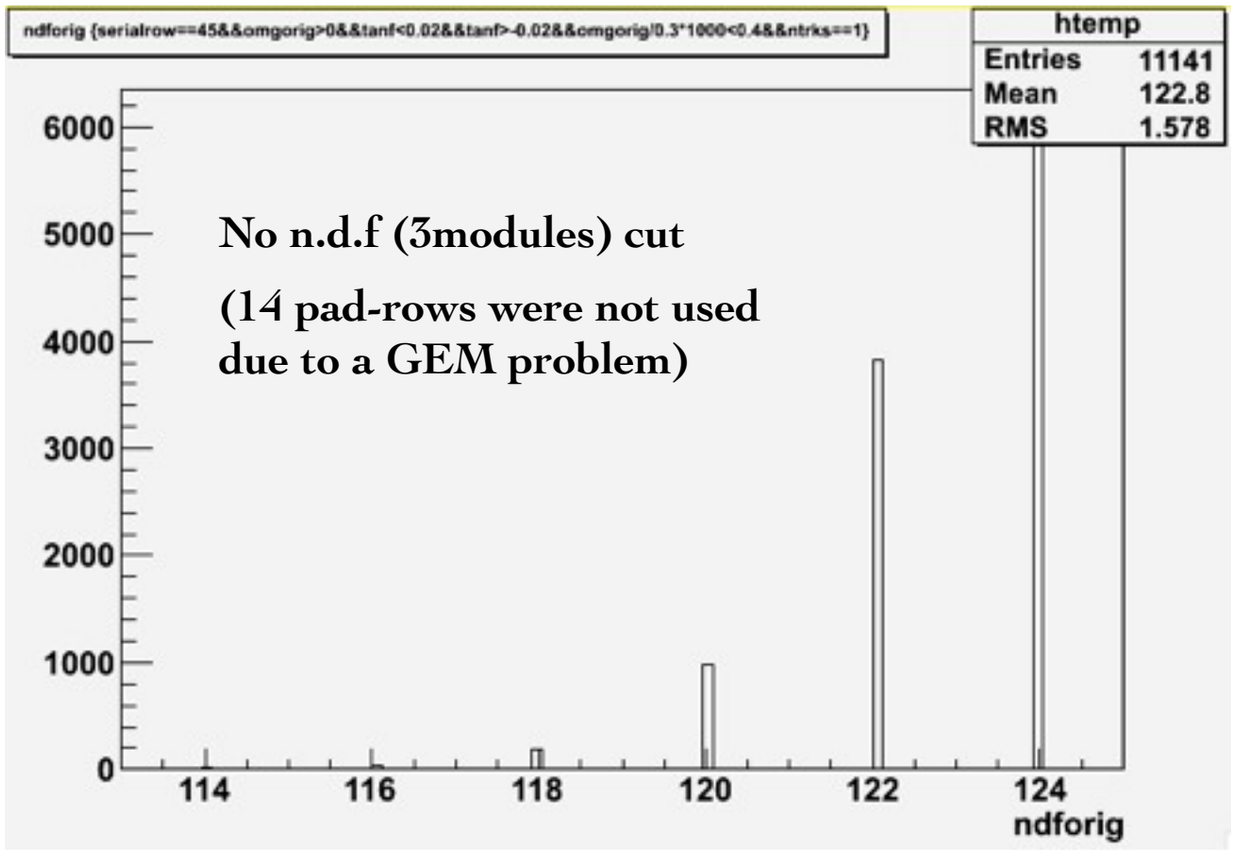


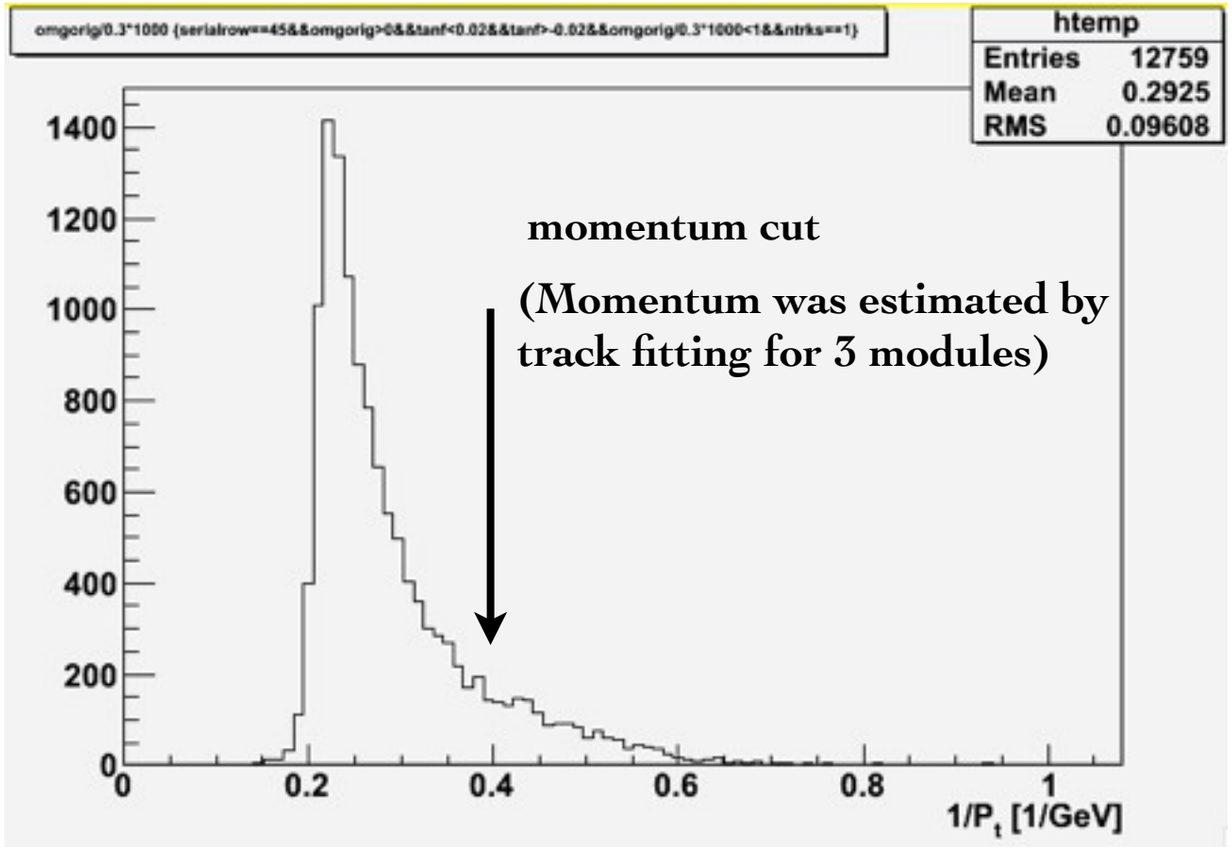


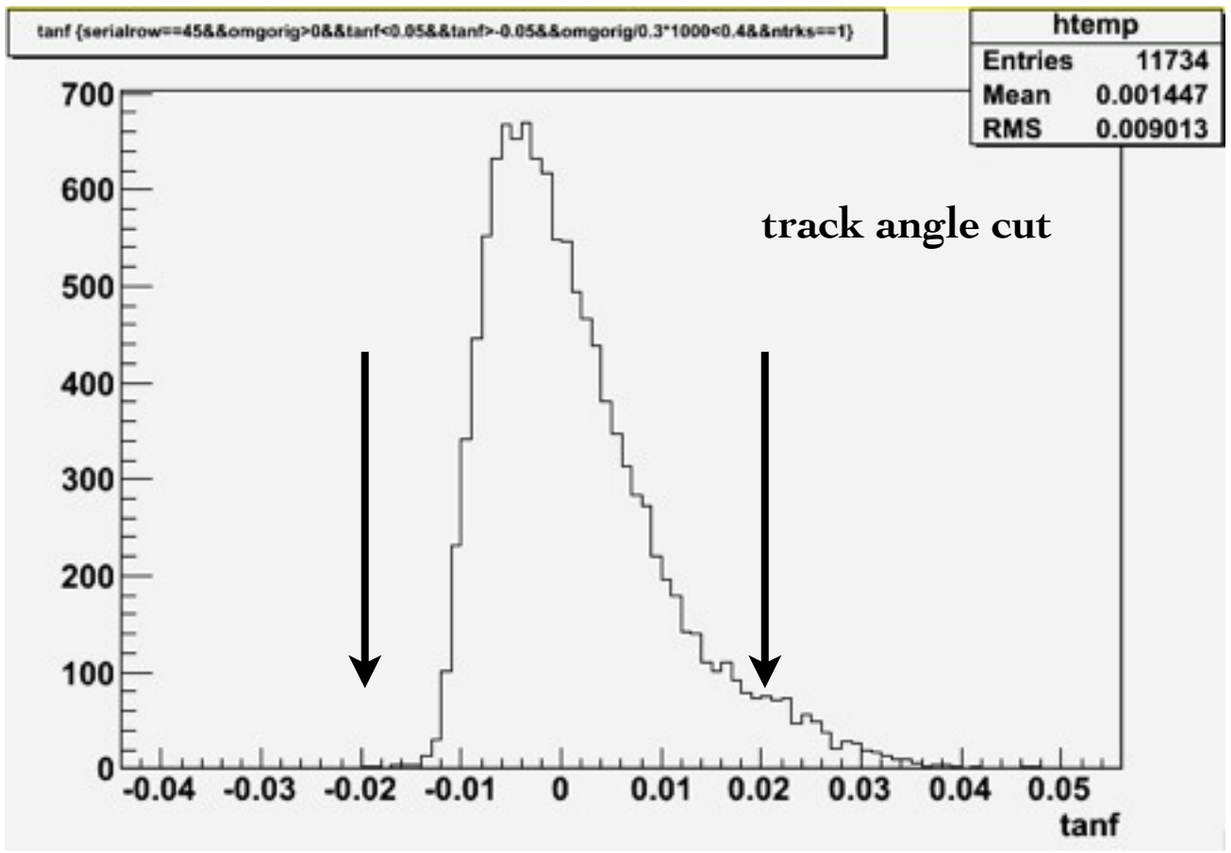


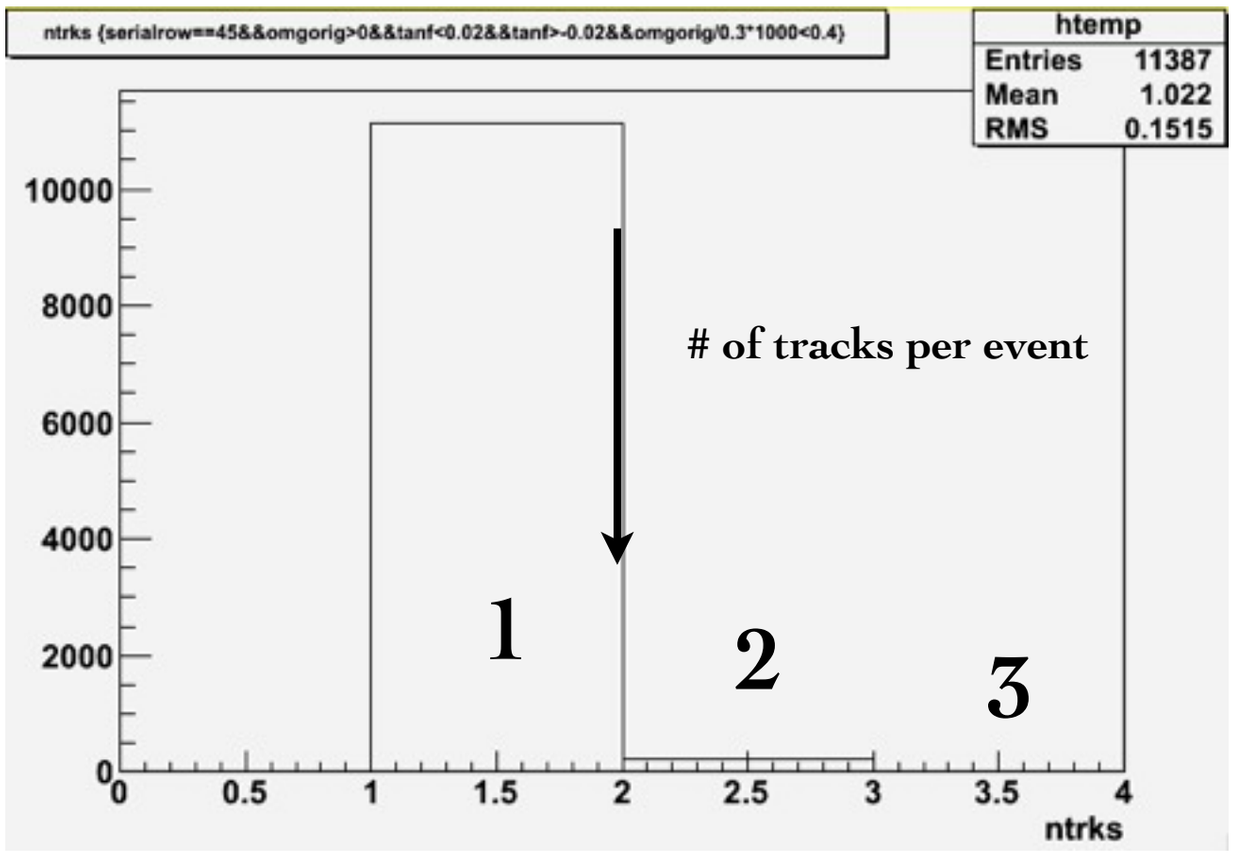
Cut Variables (2012)

Z = 2.5 cm



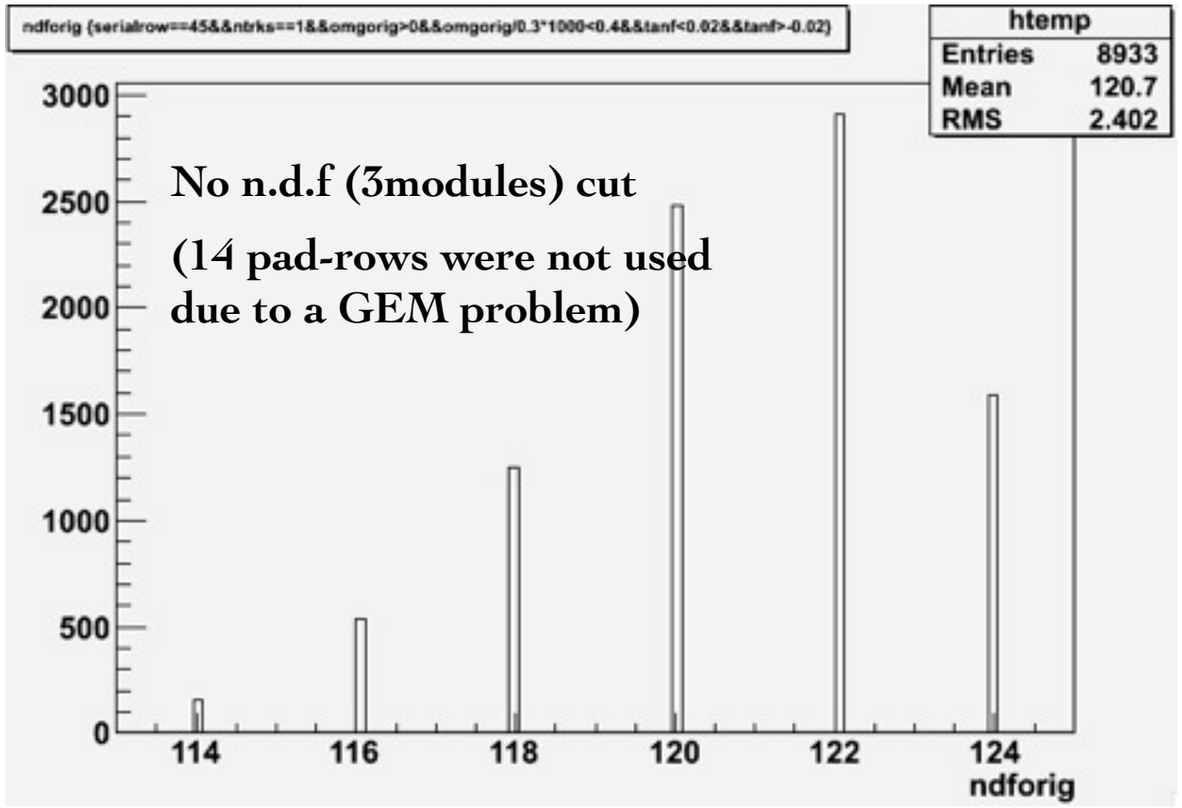


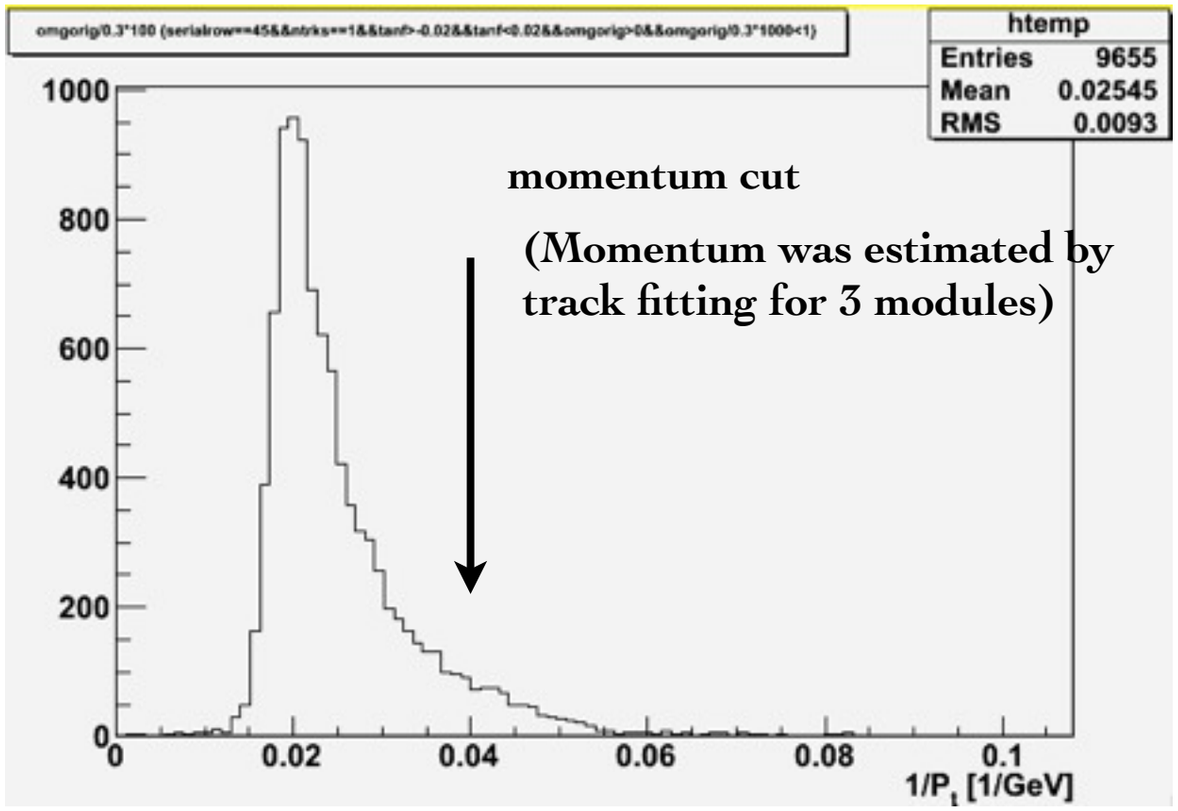


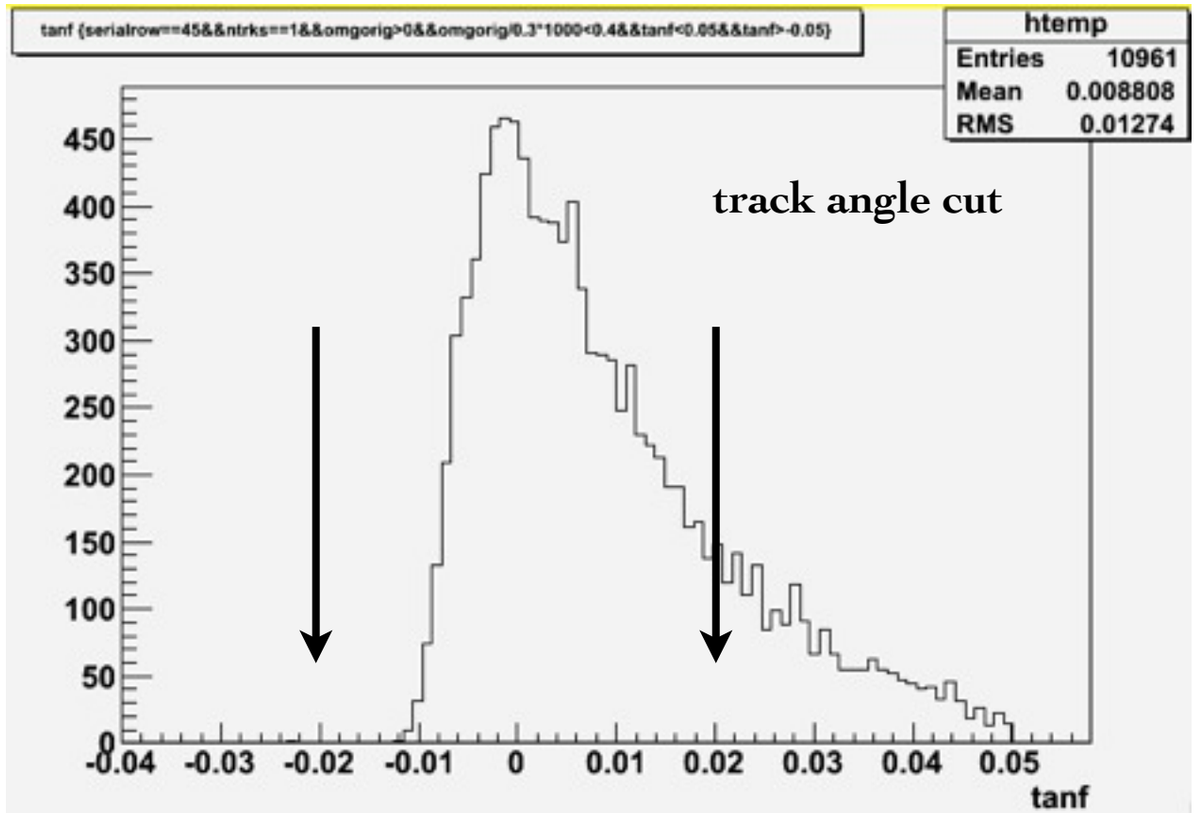


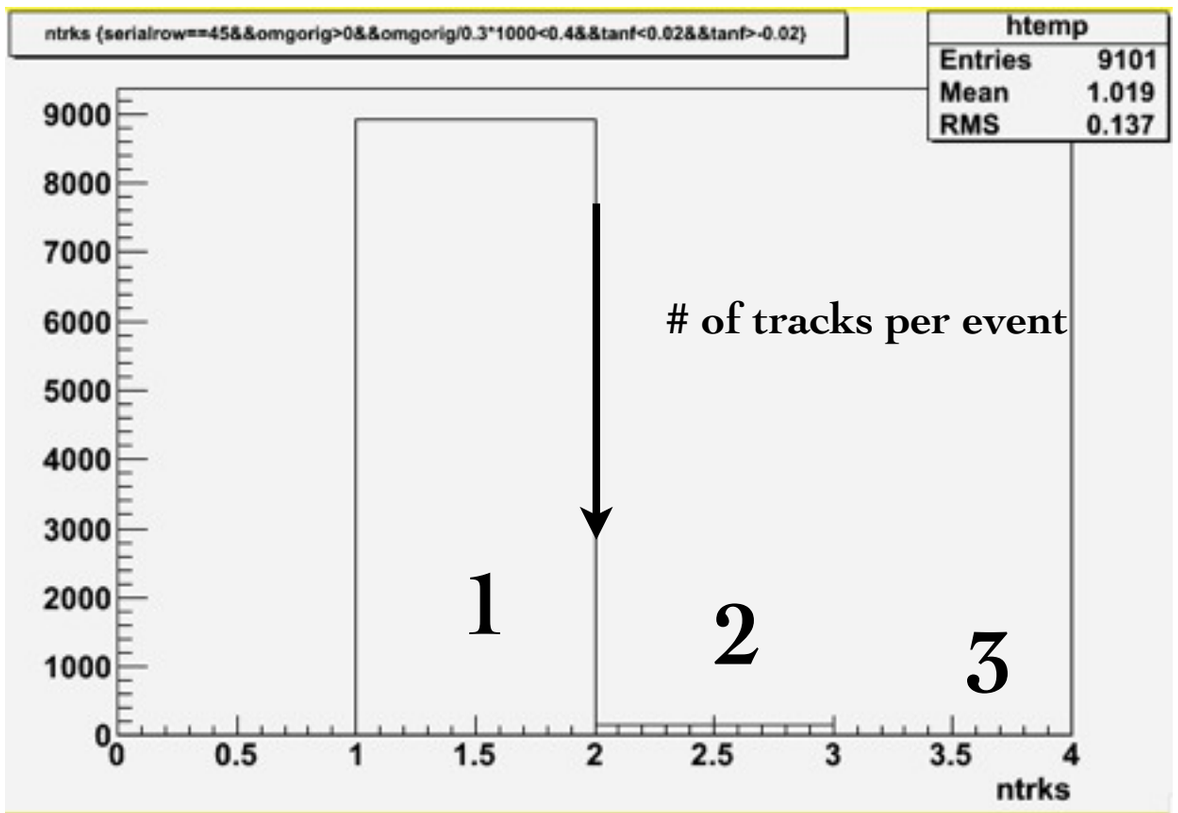
Cut Variables (2012)

Z = 50cm







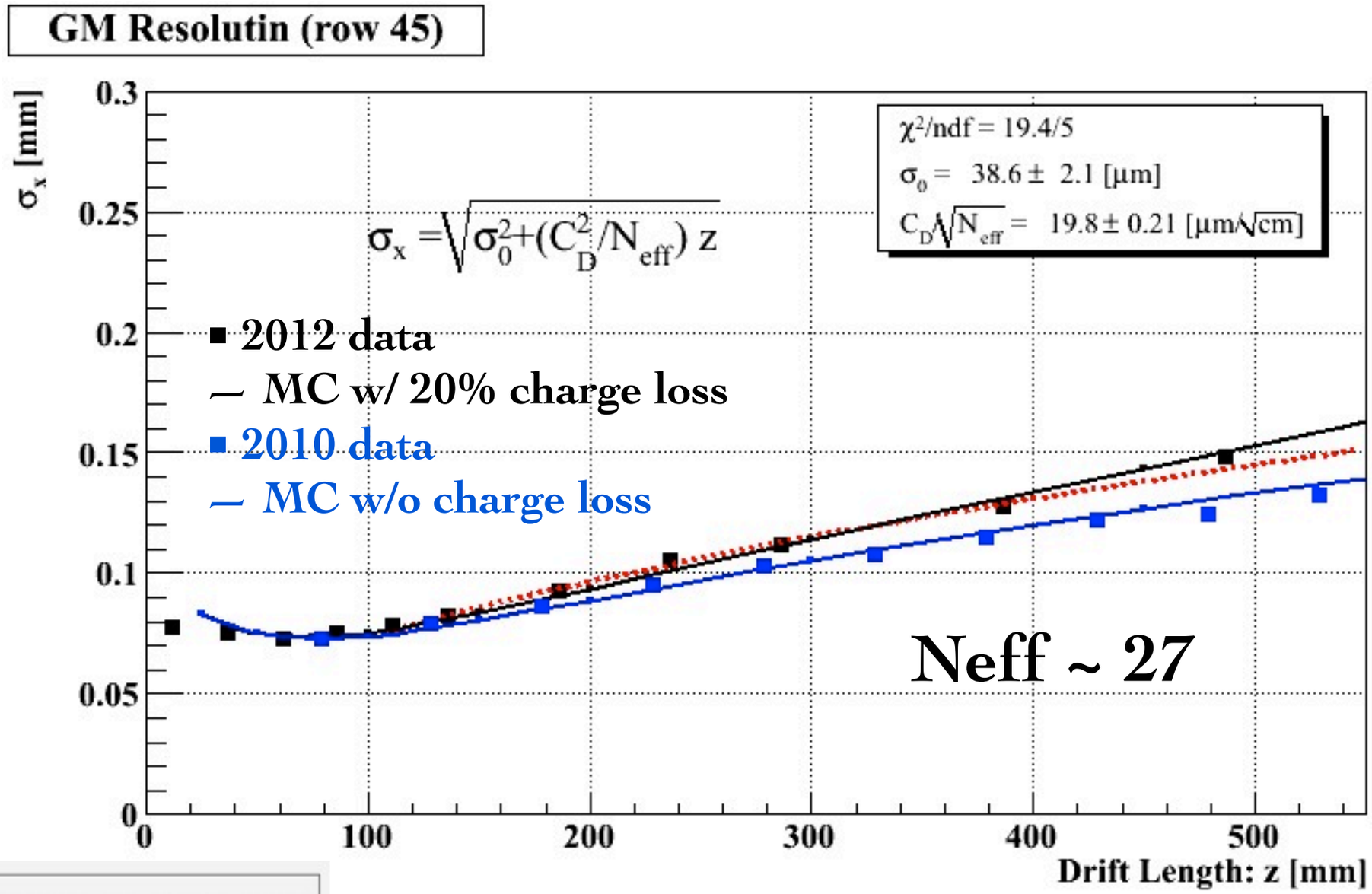


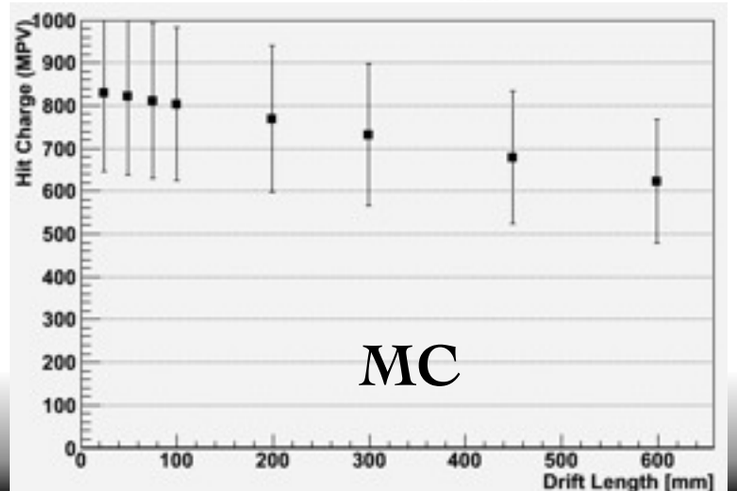
Does the apparent charge loss affect resolution ?

I checked by MC how a resolution plot looks if we really lose signal charges.

The MC was originally developed in order to check an analytic formula, and it is not based on Marlin. I considered ionization statistics, diffusion, gas gain fluctuation, and pad response function.
I added gamma4 function as signal shapes, threshold, noise and cross talk (10%).

W/ artificial charge loss





charge loss : assumed -20% at 550 mm drift
to be consistent with our measured data.

This theory seems not bad ...

Conclusion

I showed that the spatial resolution of 2012 data was consistent with 2010 data, but it seems that I used too tight cuts, especially for 2012 data. With looser cuts, the spatial resolutions of 2012 data are worse than 2010 data.

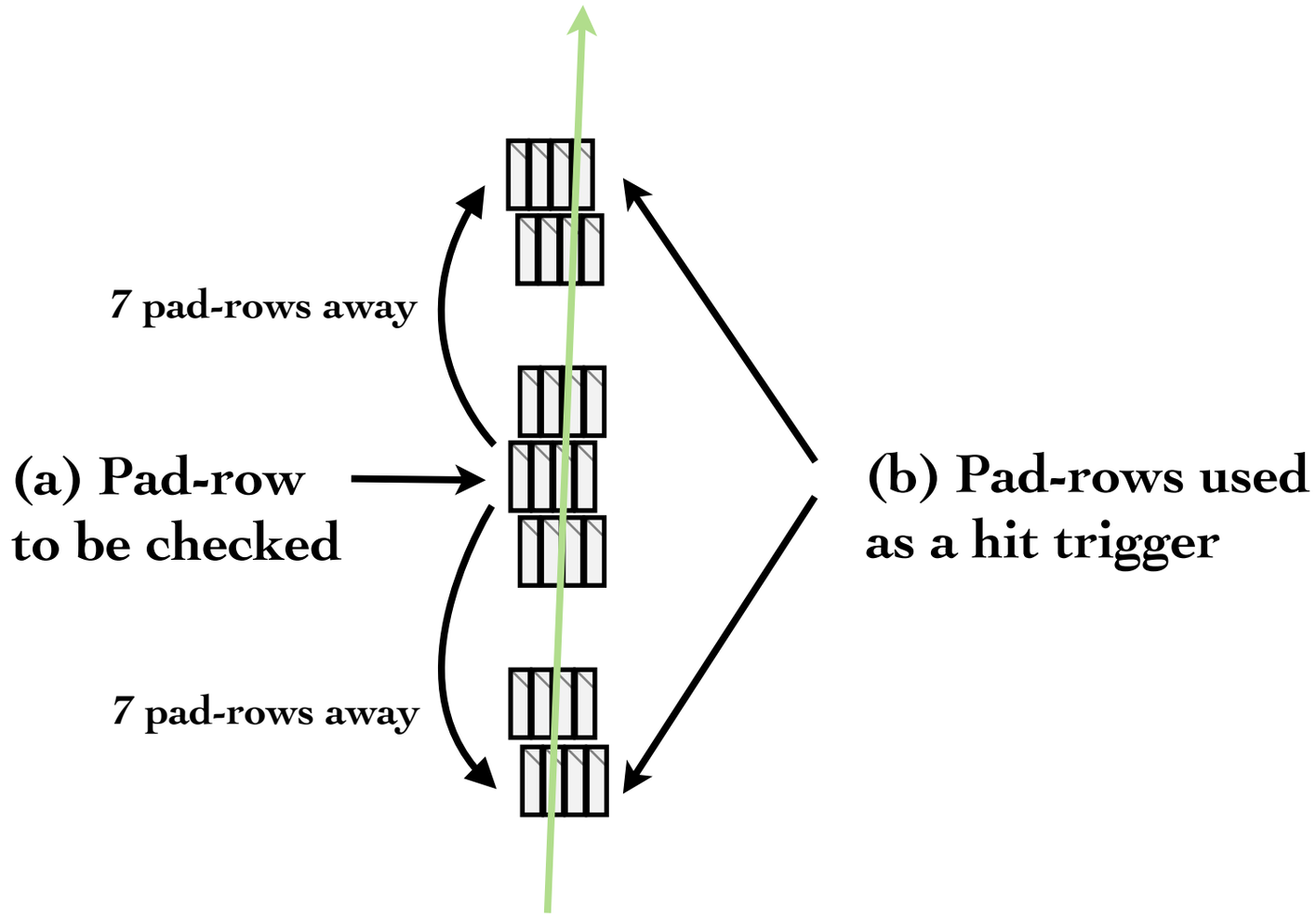
Unfortunately I can not exclude a "signal charge loss" theory from resolution behavior at this moment.

I have not yet understood the cause of apparent charge loss as a function of drift length in 2012 data.

Backup

Hit Efficiency

As a trigger,
I used the pad-rows of 7 pad-rows away from the pad to be checked (See right figure).



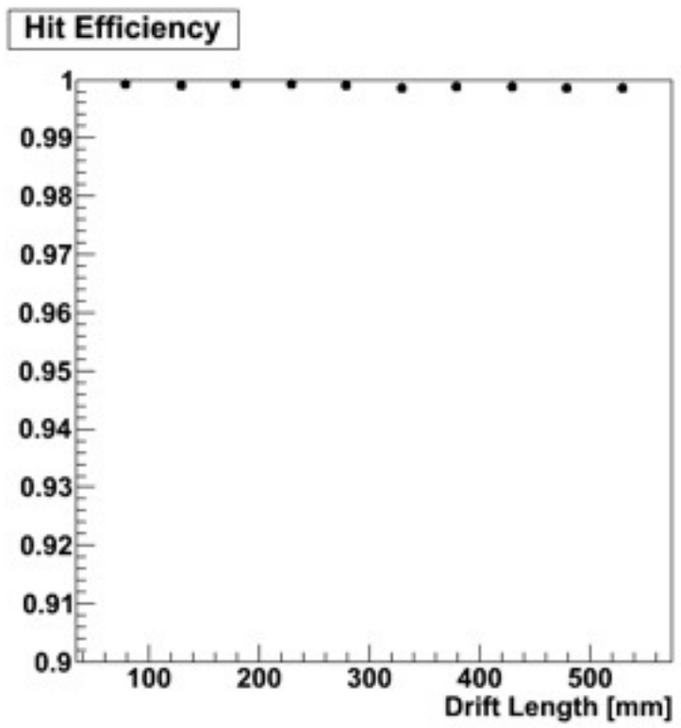
To remove the noise hits, I used only track-associated hits.

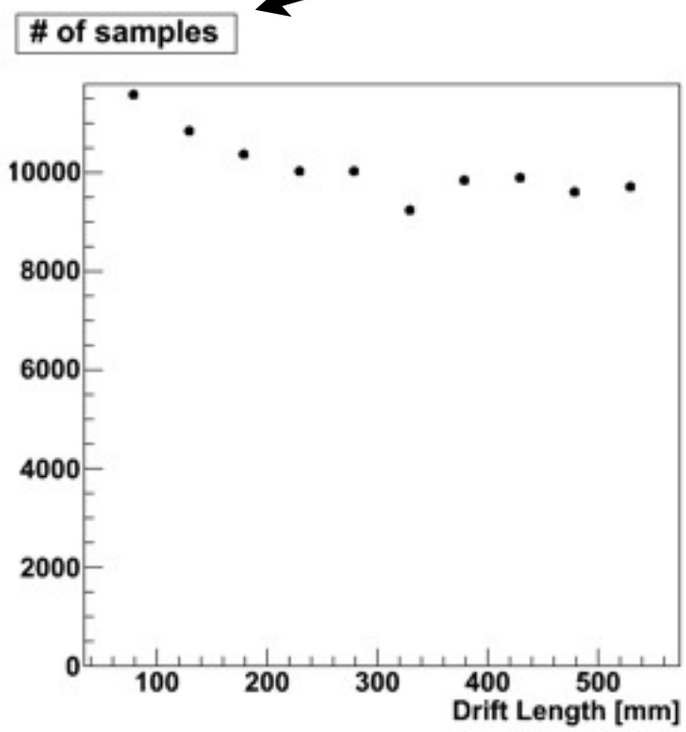
I defined hit efficiency by :

$$\text{hit efficiency} = \frac{\#\text{ of } ((a) \cap (b))}{\#\text{ of (b)}}$$

2010 data

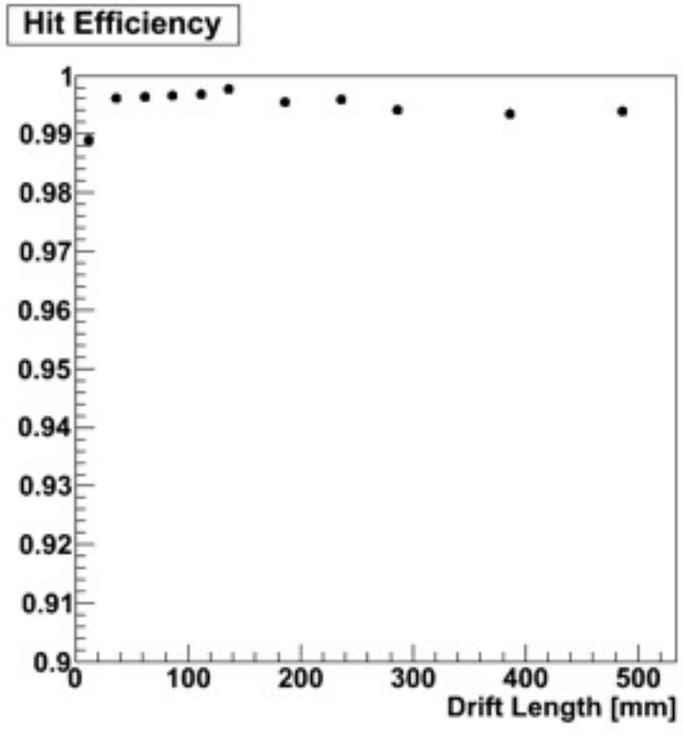
All cuts were applied except for ndf cut.

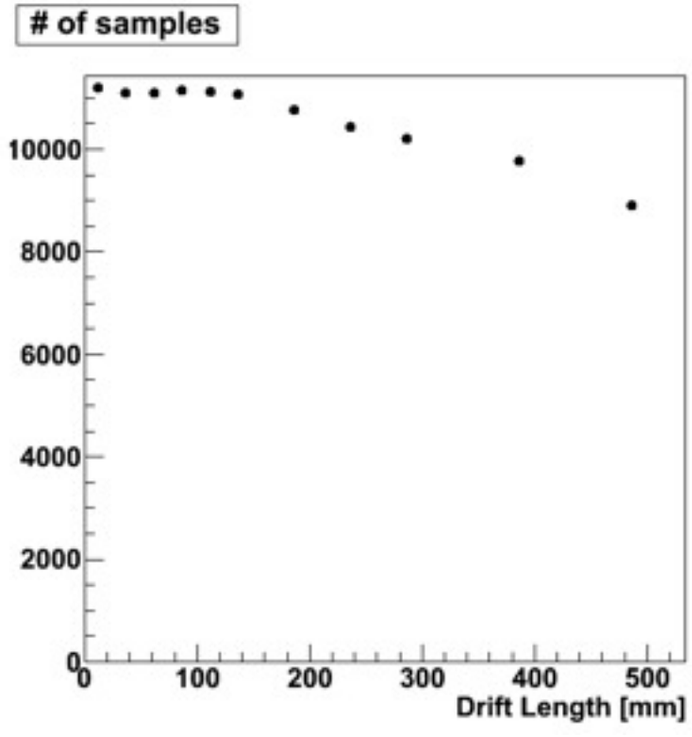




2012 data

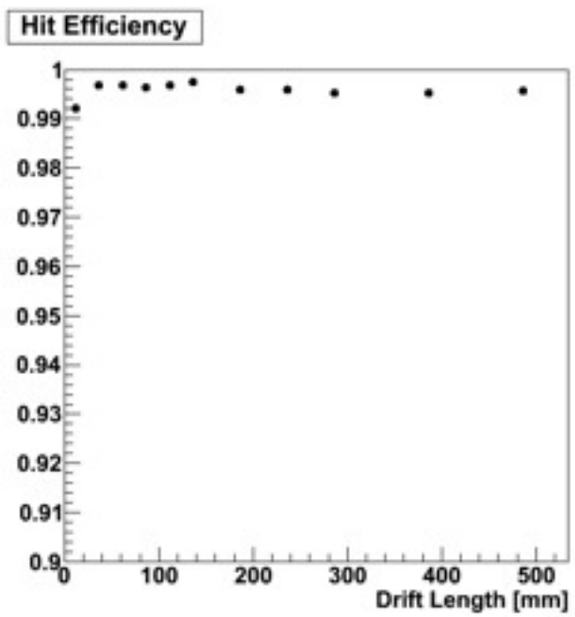
All cuts were applied except for ndf cut.

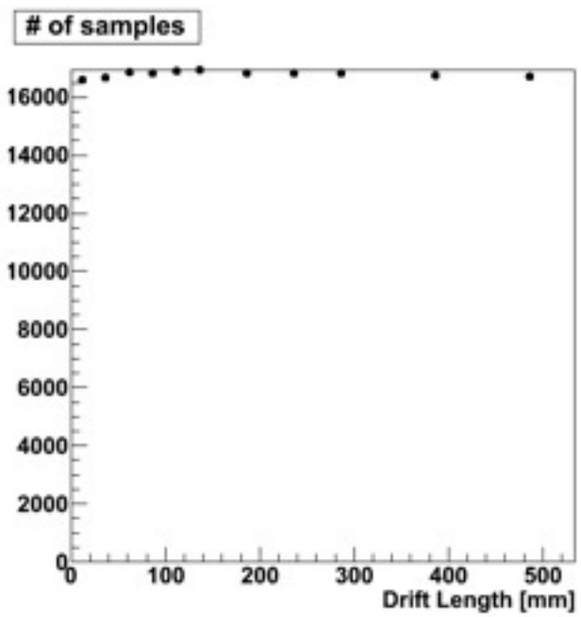




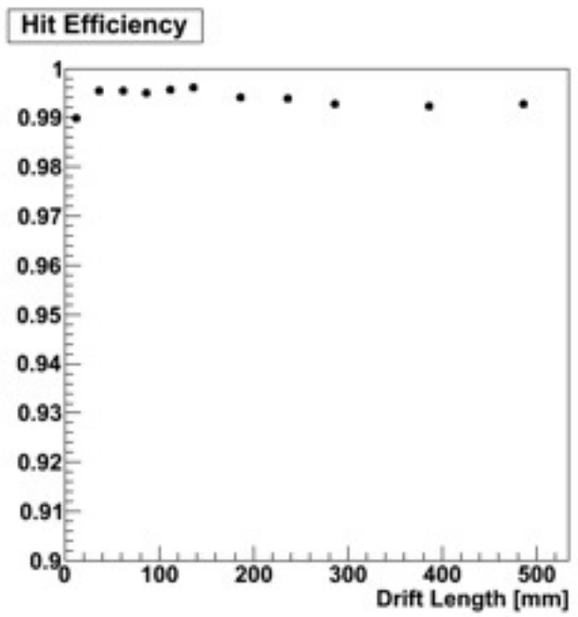
W/ different cuts for comparison (2012 data)

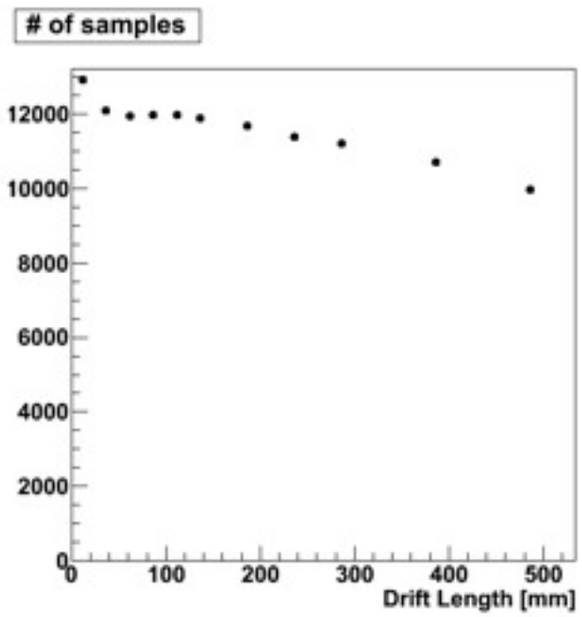
Only requirement of N-tracks=1 was applied.





All cuts were applied except for ndf cut and momentum cut
==> angle cut effect





All cuts were applied except for ndf cut and angle cut
==> momentum cut effect