dE/dx resolution with gating GEM

LCTPC WP meeting

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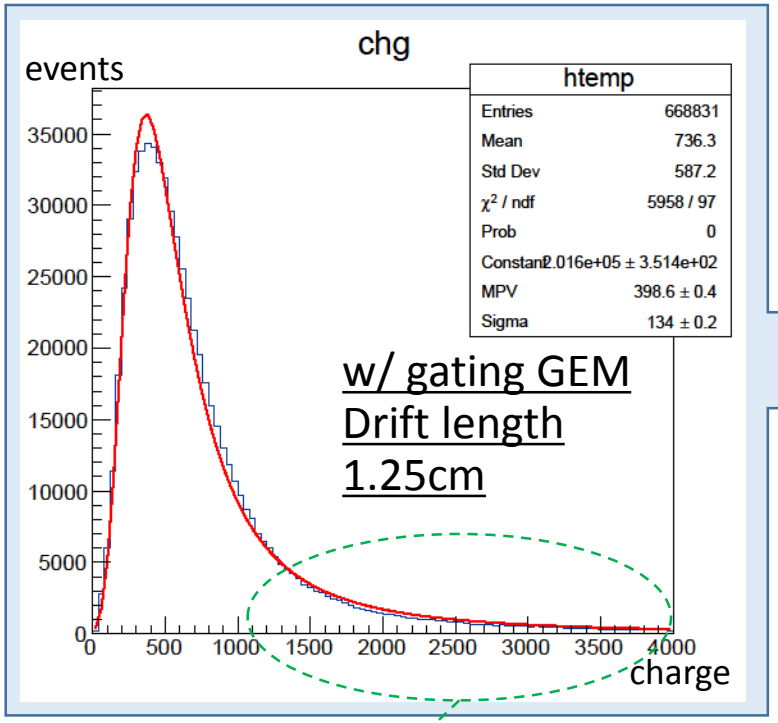
on behalf of the LC-TPC group

Calculation of dE/dx resolution

- Calculate the dE/dx resolution from the signal charge data of the beam test.

Example of charge distribution

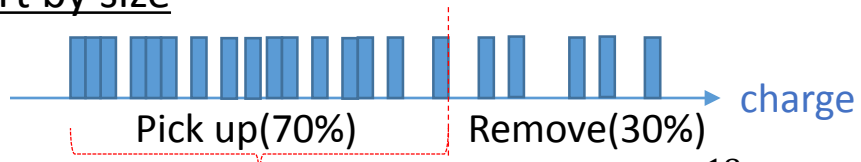


Calculating the dE/dx resolution including this part is undesirable because it causes fluctuation

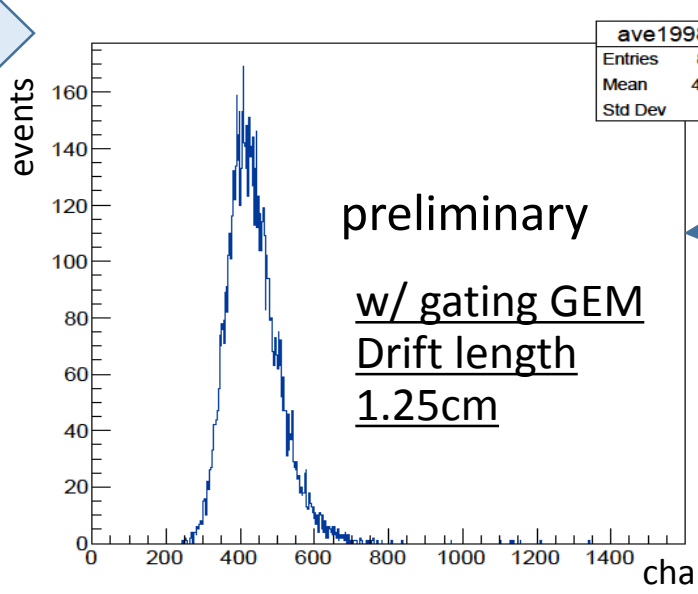
Truncated Mean Method

One event (charge of 26 measurement points)

Sort by size



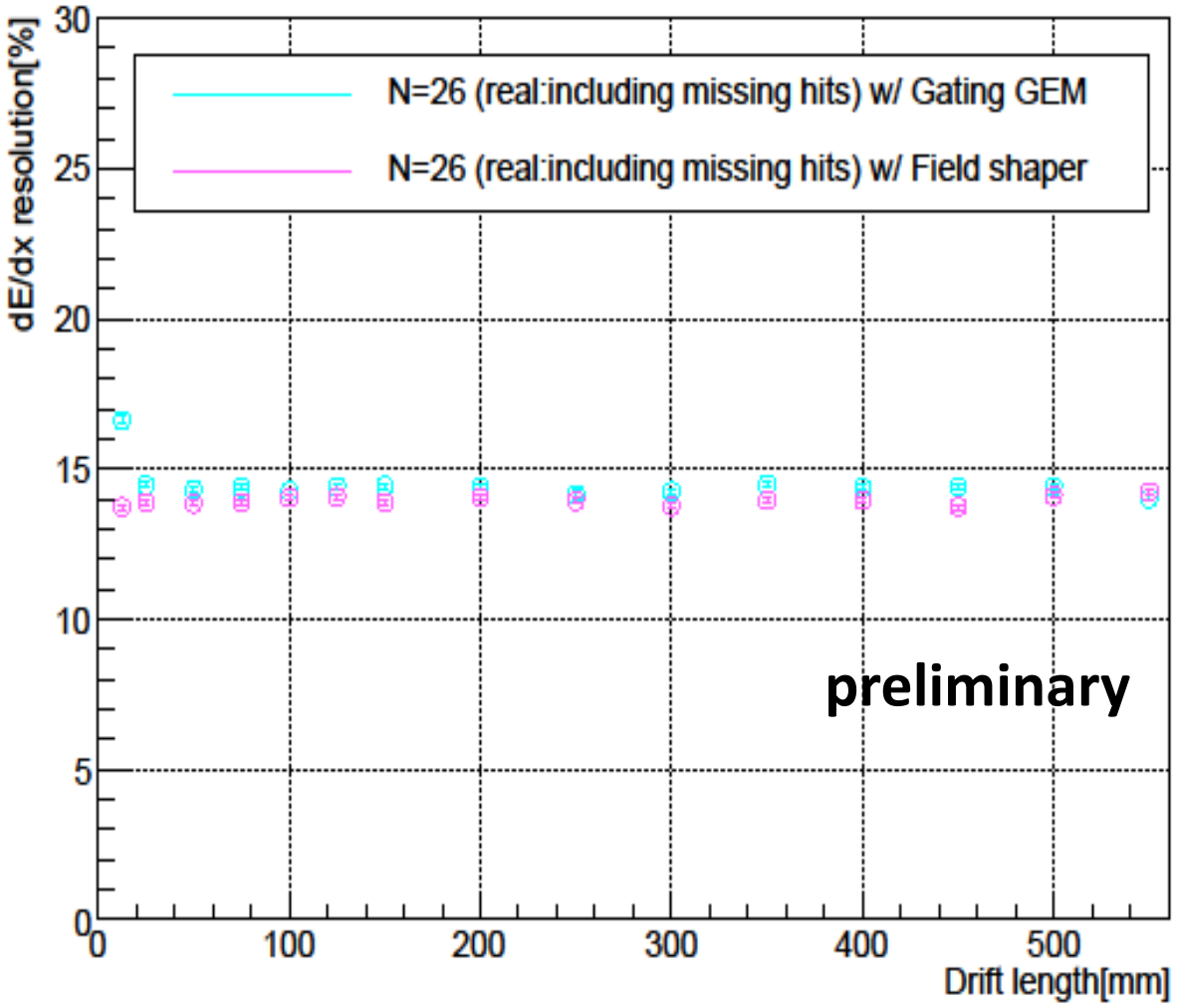
$26 \times 0.7 \fallingdotseq 18$ ⋯> Average $\bar{Q} = \frac{1}{18}\sum_{i=1}^{18} Qi$



Plots

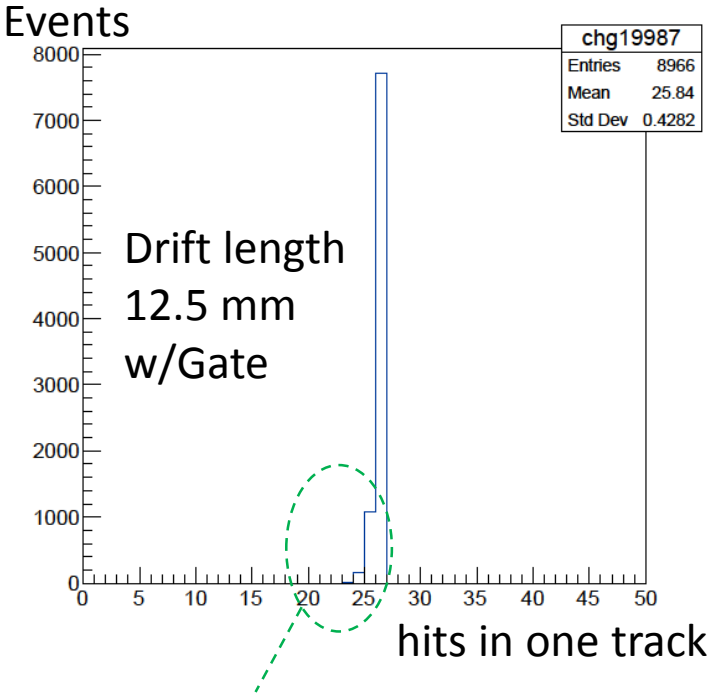
$$\text{dE/dx resolution} = \frac{Std\ Dev}{Mean}$$

dE/dx resolution (fraction = 70%)



N: measurement points

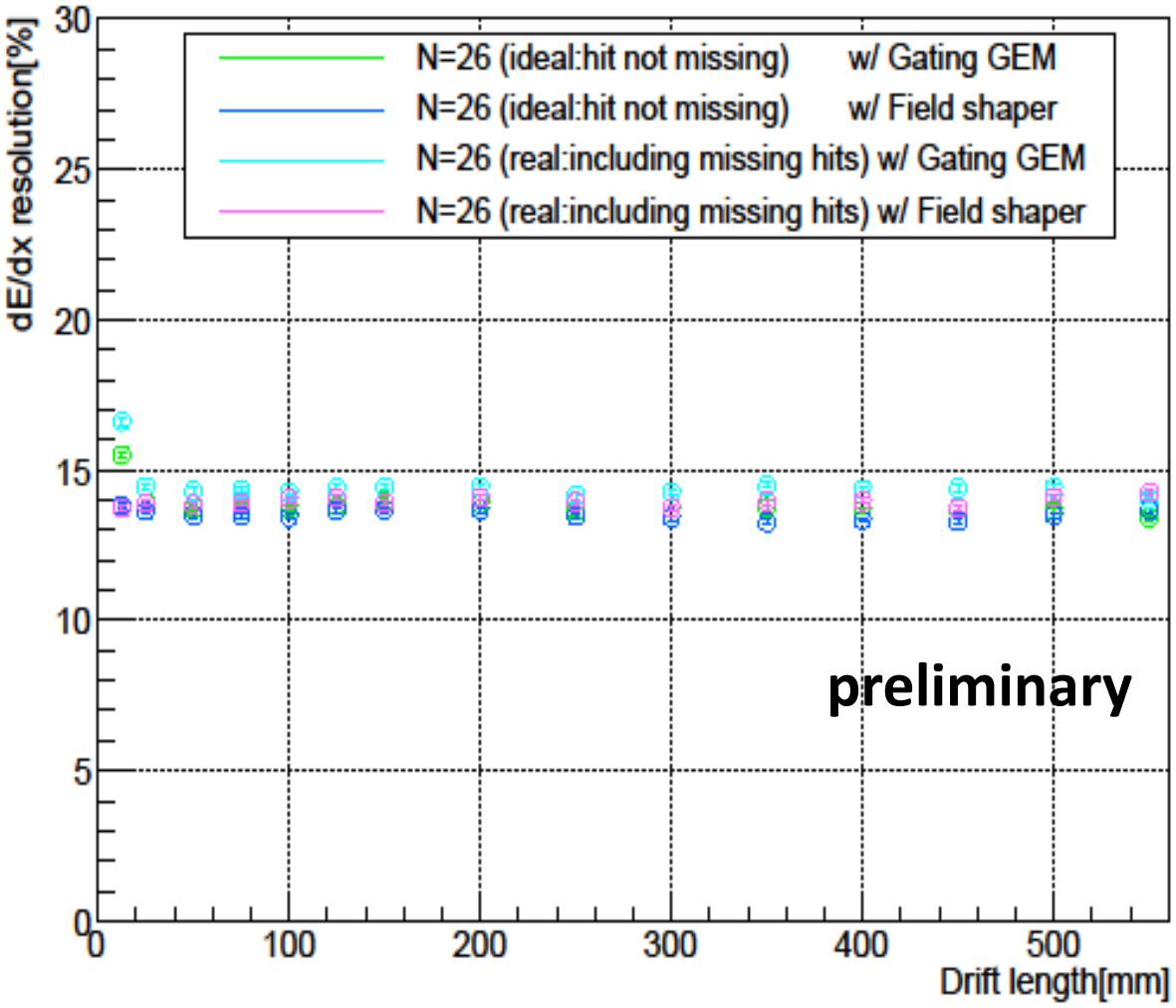
Number of hits in one track



Missing hits
It should contain
all 26 hits in one track.

- Average of dE/dx resolution with gating GEM is 14.4±0.03%
- Average of dE/dx resolution without gating GEM(with field shaper) is 13.9±0.02%
- There are 26 measurement points, but some measurement points are not operating.

dE/dx resolution(ideal value: TPC prototype)

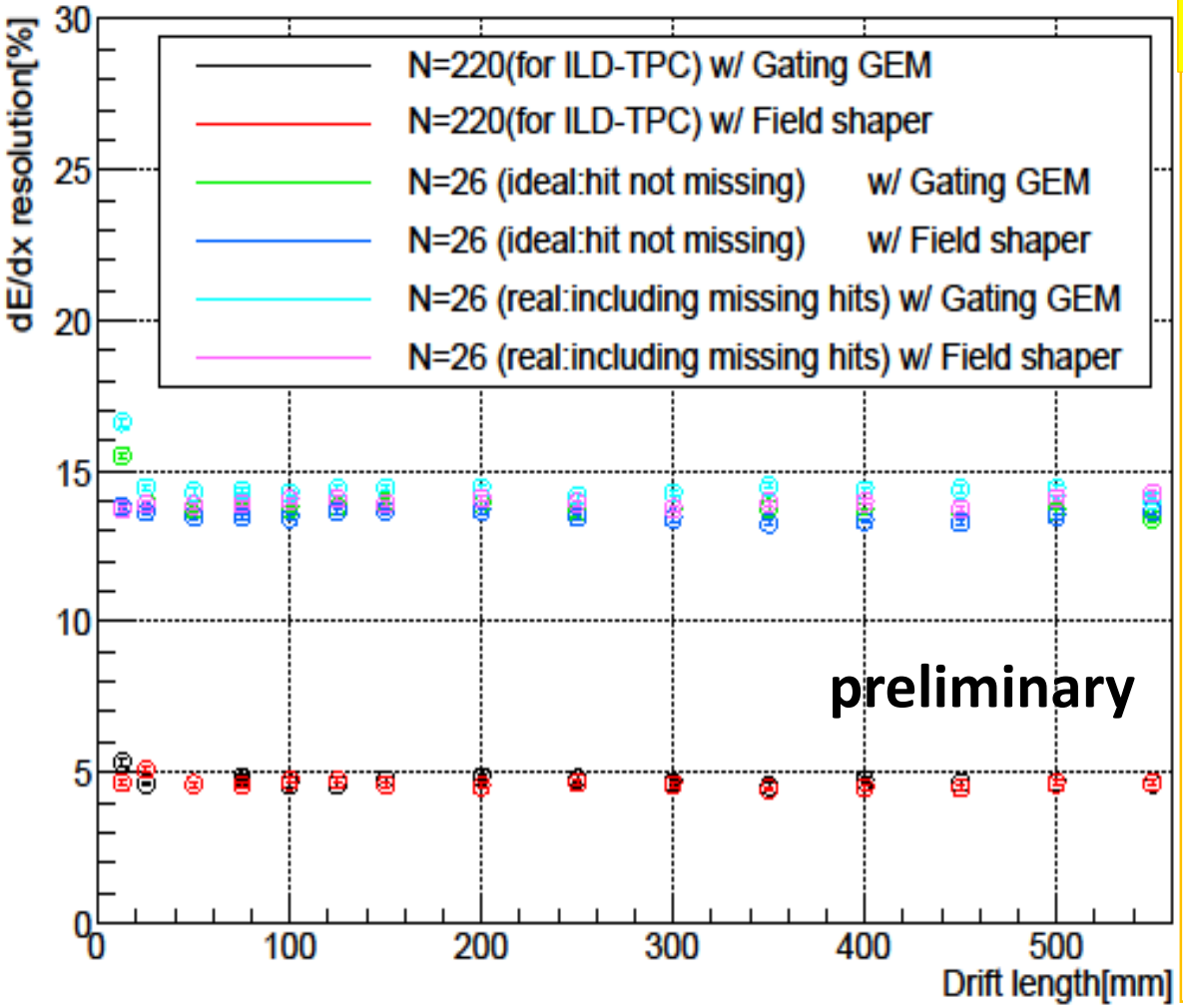


Average of dE/dx resolution

Real: including missing hits	
Gating GEM	14.4±0.03%
Field Shaper	13.9±0.02%
Ideal: not missing hits	
Gating GEM	13.83±0.02%
Field Shaper	13.52±0.02%

- The dE/dx resolution was calculated without including missing hits.
- By this calculation, dE/dx resolution with gating GEM improved by about 0.6 %, dE/dx resolution with field shaper improved by about 0.4 %.

dE/dx resolution (estimation for ILD-TPC)

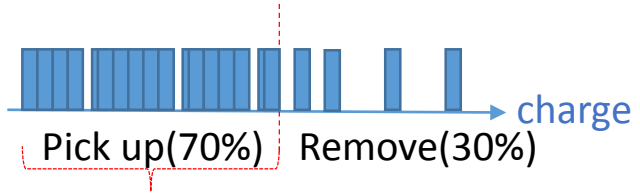


Truncated Mean Method

One event
(charge of 26 measurement points)

× about 8 ⇒ 220 points

Sort by size



220 × 0.7 ＝154

Average

$$\bar{Q} = \frac{1}{154}\sum_{i=1}^{154} Qi$$ ⋯> Plots

- Average of dE/dx resolution with gating GEM is 4.70±0.02%
- Average of dE/dx resolution without gating GEM(with field shaper) is 4.61±0.02%

Summary

➢ I calculated the dE/dx resolution from the signal charge data of the beam test.

- I estimated the dE/dx resolution for ILD-TPC using beam test data of TPC large prototype with gating GEM.
- The dE/dx resolution for ILD-TPC is calculated at fraction 70 % and number of measurement points is 220 :
- Average of dE/dx resolution with gating GEM is 4.70±0.02%

Future plan

- Obtain dE/dx resolution for other beam incident angle
- Continue to analyze dE/dx in detail