CGEM Software update

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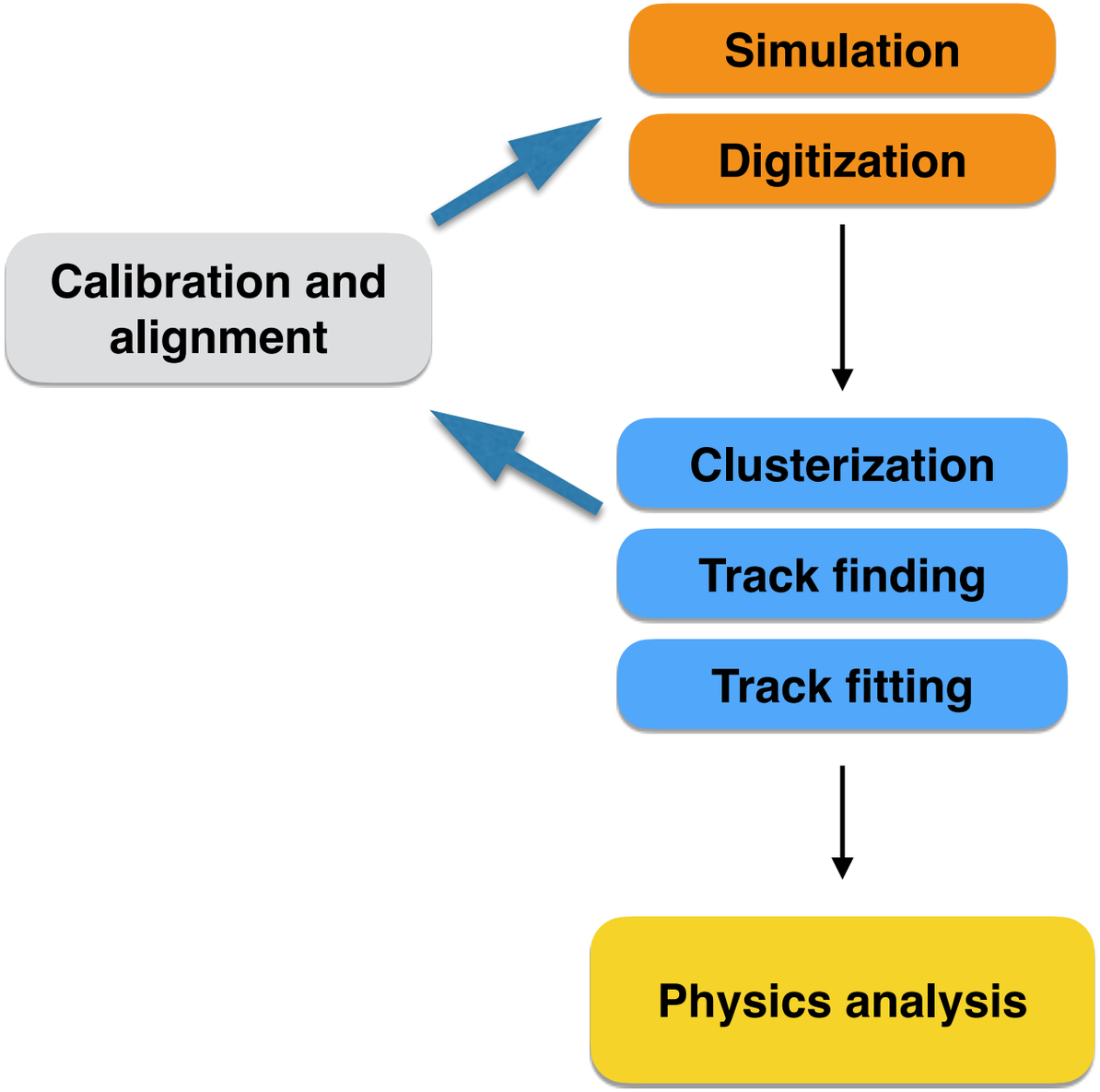
April 7, 2022

Software status and activities

Cgem BESIII Offline Software System (CgemBoss)

OFFICIAL RELEASE **CgemBoss665g**



Simulation

- More on full digitization tuning (Xiao-Ling Lu *et. al.*)

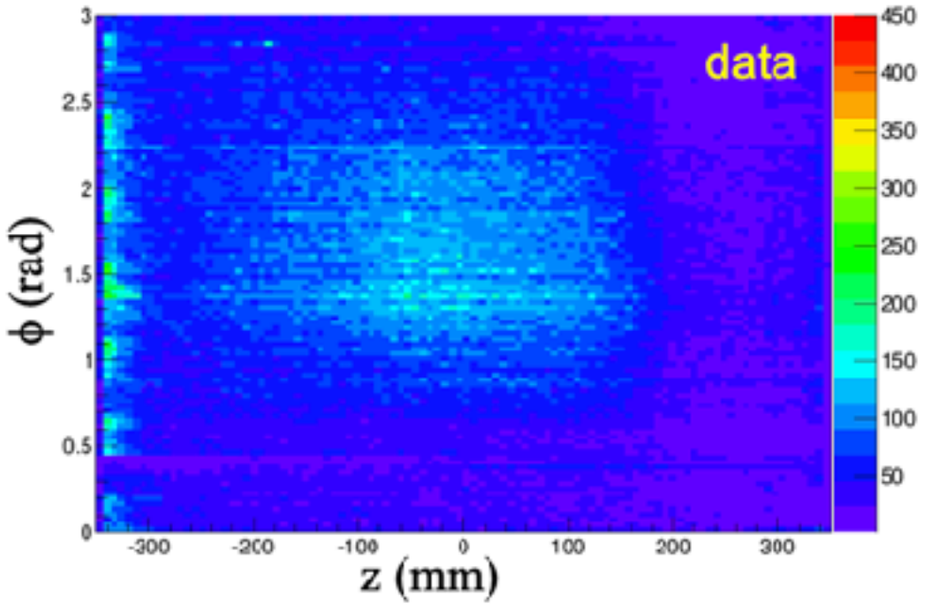
Reconstruction

- Check of K^- and p reconstruction (Liang-Liang Wang *et. al.*)

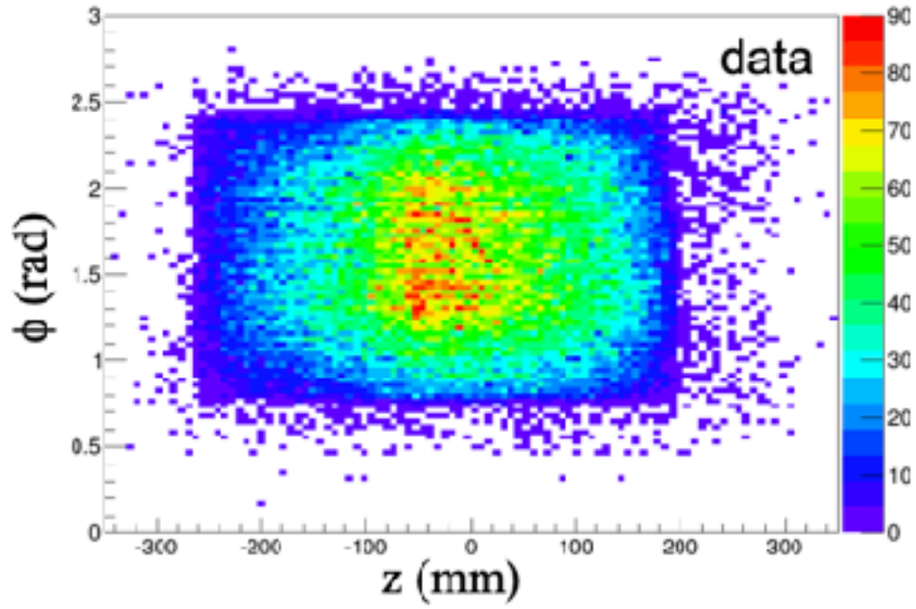
Software status and activities

Xiao-Lin Lu

- Idea:
  - Fix ionization & electronics models, tune gain, diffusion and so on
  - Compare MC and cosmic-ray data (charge, cluster size ...)
  - Match MC and data with a minimum number of tuning parameters in full digitization
- Sample: **cosmic-ray** data and MC passing straight-line fitting (χ^2<80)

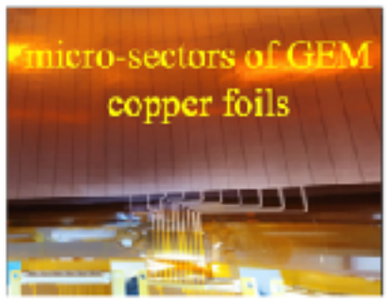


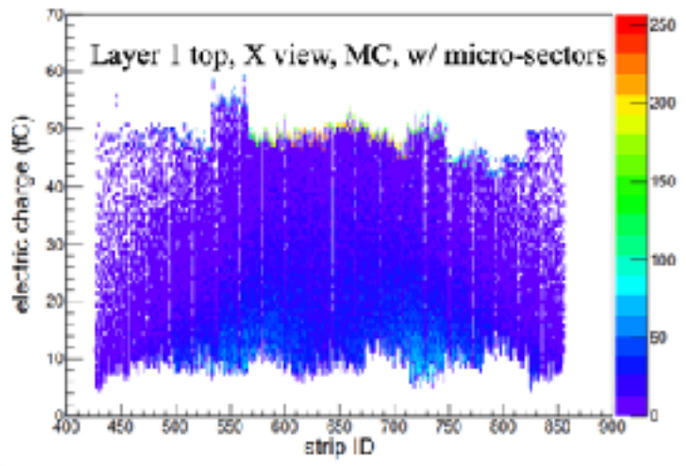
Cluster map (layer 2 top part) before straight-line fit



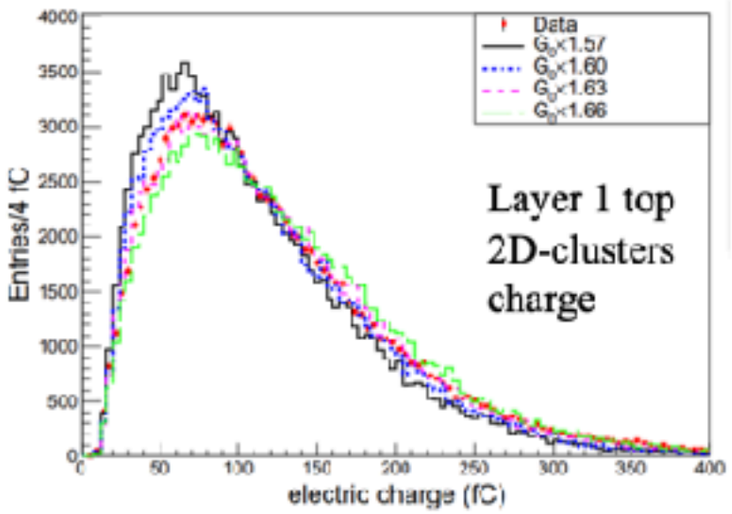
Cluster map (layer 2 top part) passing straight-line fit

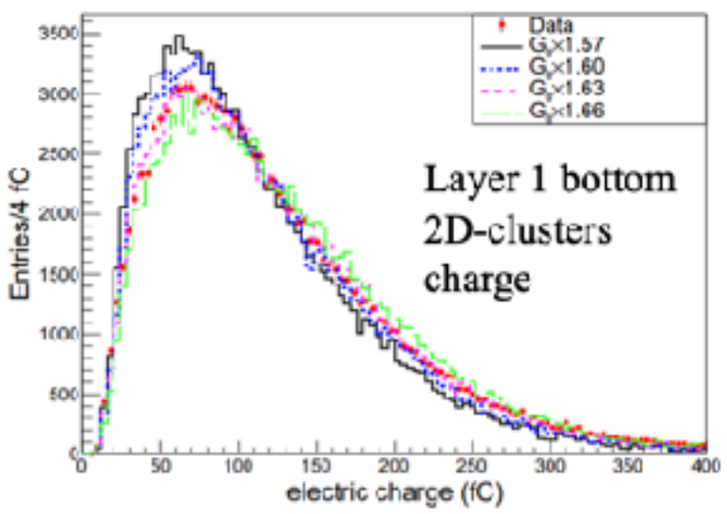
✓ Micro sector effects & dead channels simulation





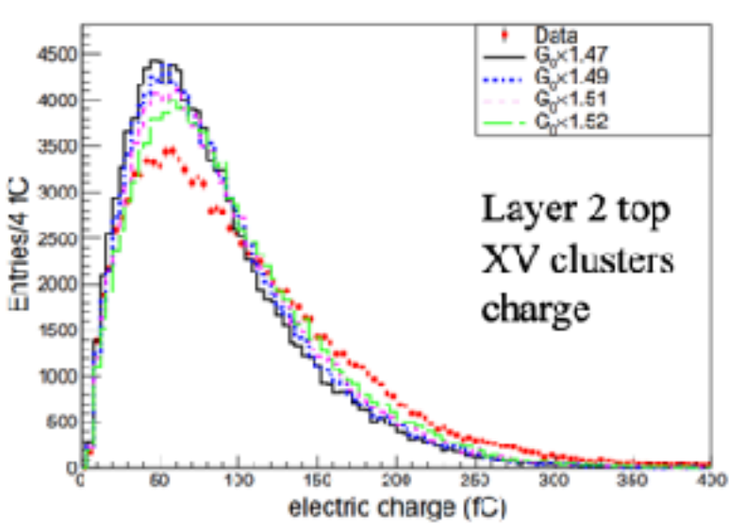
Gain tuning with 2D-cluster charge (total charge)

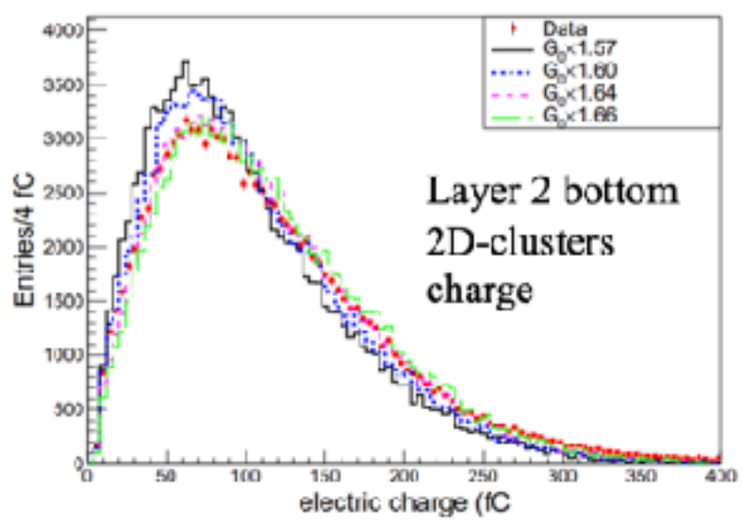




- Gain distribution for GEM described by Polya function (default parameters from Garfield++ simulation)

$$P(G) = C_0 \frac{(1+\theta)^{1+\theta}}{\Gamma(1+\theta)} \left(\frac{G}{G_0}\right)^{\theta} exp\left[-(1+\theta)\frac{G}{G_0}\right]$$



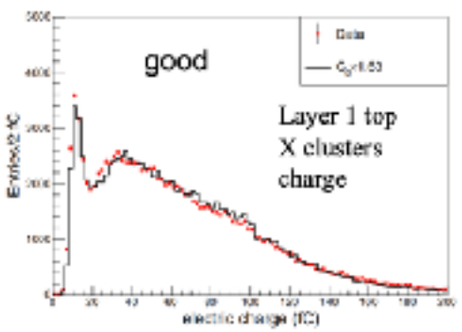


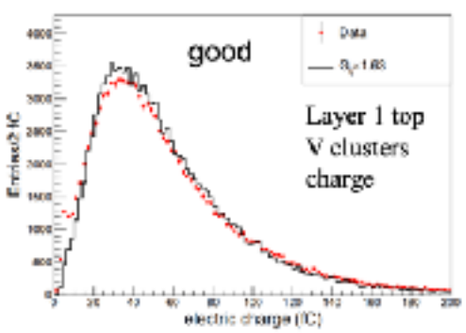
- A more reasonable approach: tune gain (G_0) to match the peak on 2D-cluster charge (Q_X+Q_V) (instead of match 1D-cluster charge Q_X or Q_V)
- The optimal G_0 scale factor for layer 2 top (~1.49) is very different from other parts (~1.63)

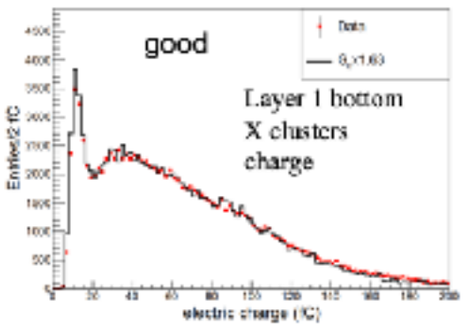
1D-cluster charge after gain tuning

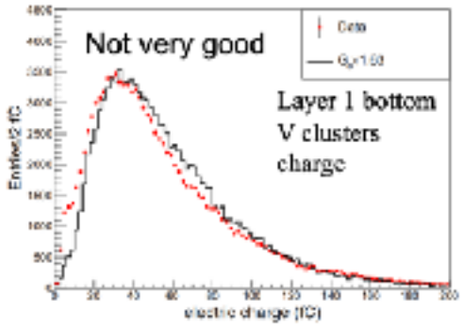
Xiao-Lin Lu

1D-cluster charge for layer 1 after gain tuning

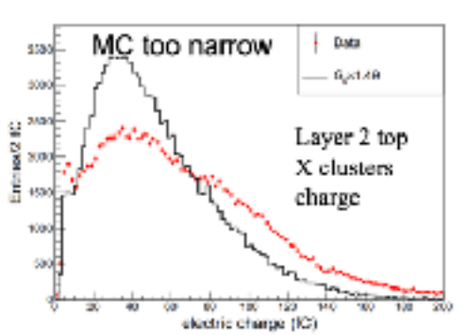


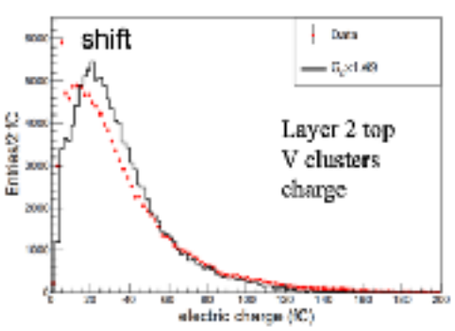


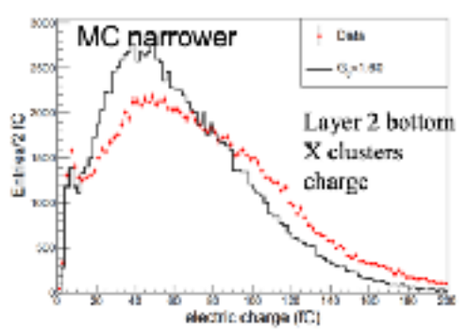


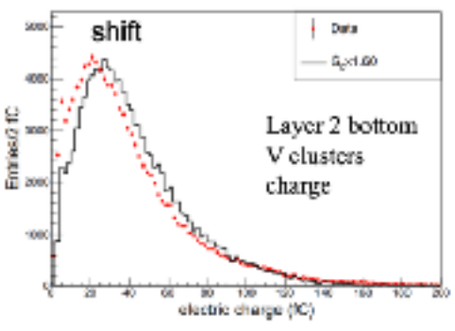


1D-cluster charge for layer 2 after gain tuning









1D-cluster charge after charge sharing tuning tuning

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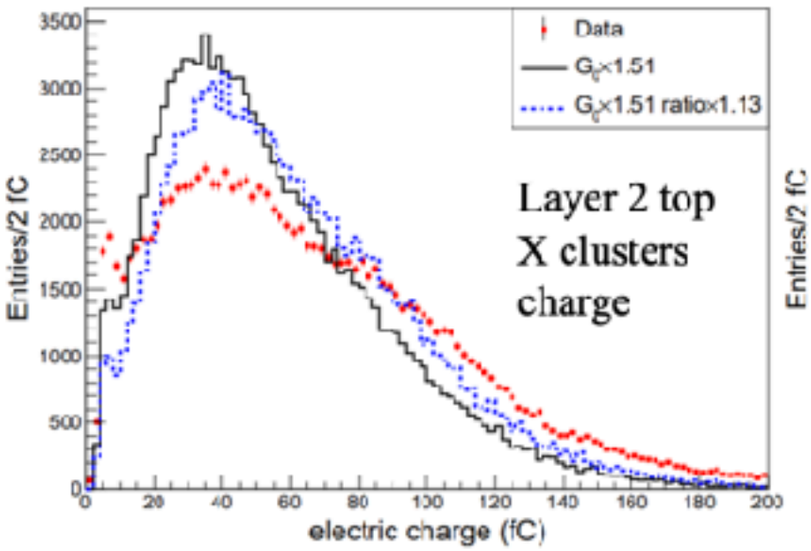
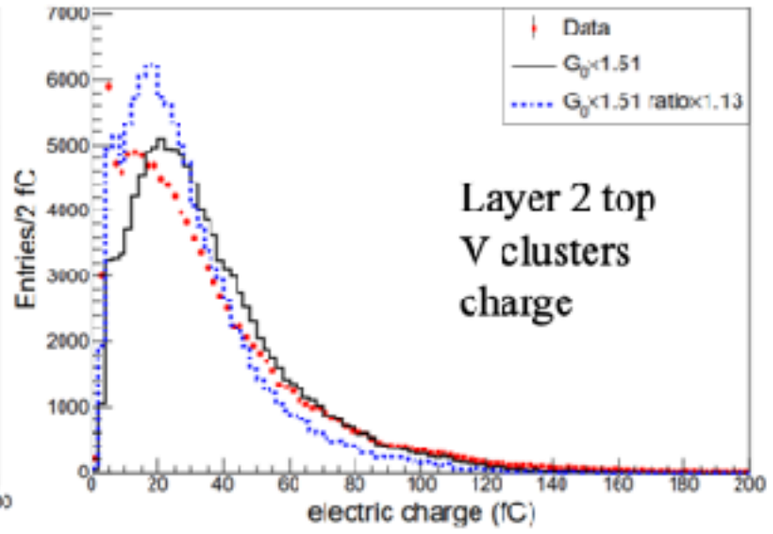
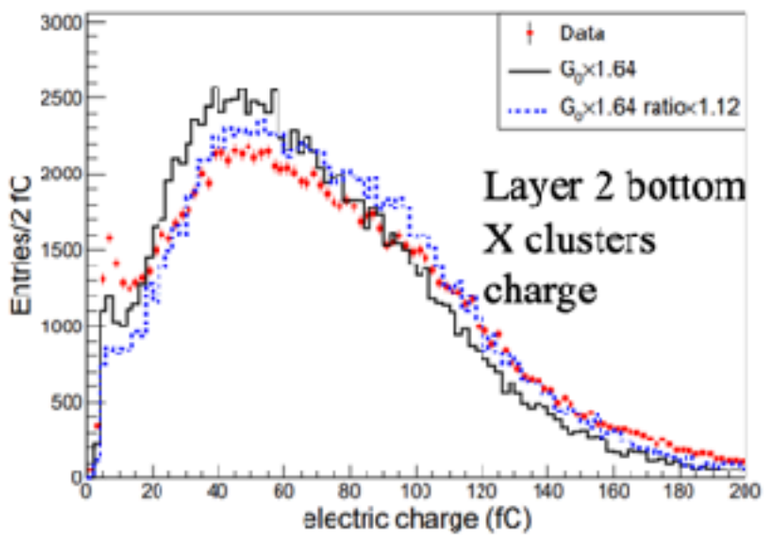
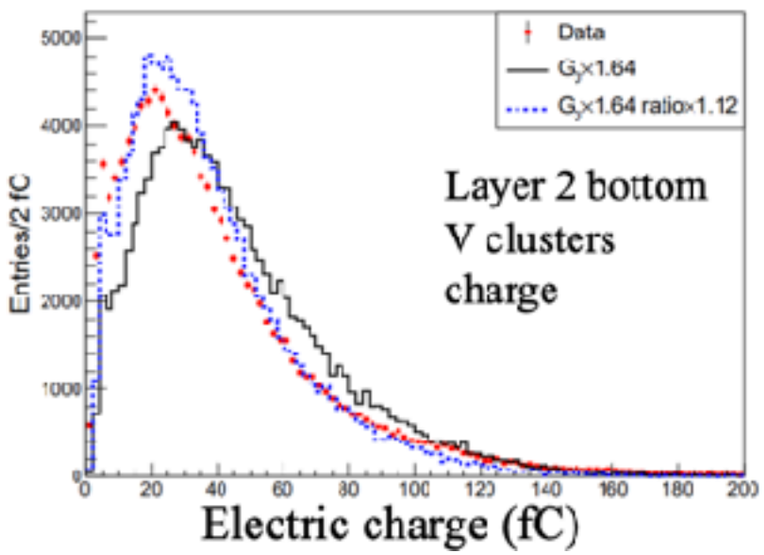
1D-cluster charge for layer 2 after charge-sharing tuning







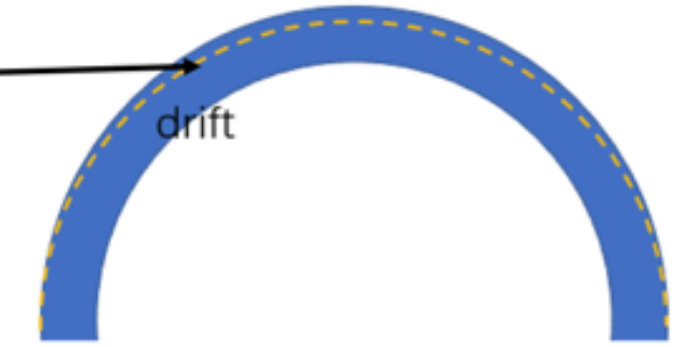


- Agreement improved after charge sharing ratio tuning
- But data is wider especially for layer 2 top part

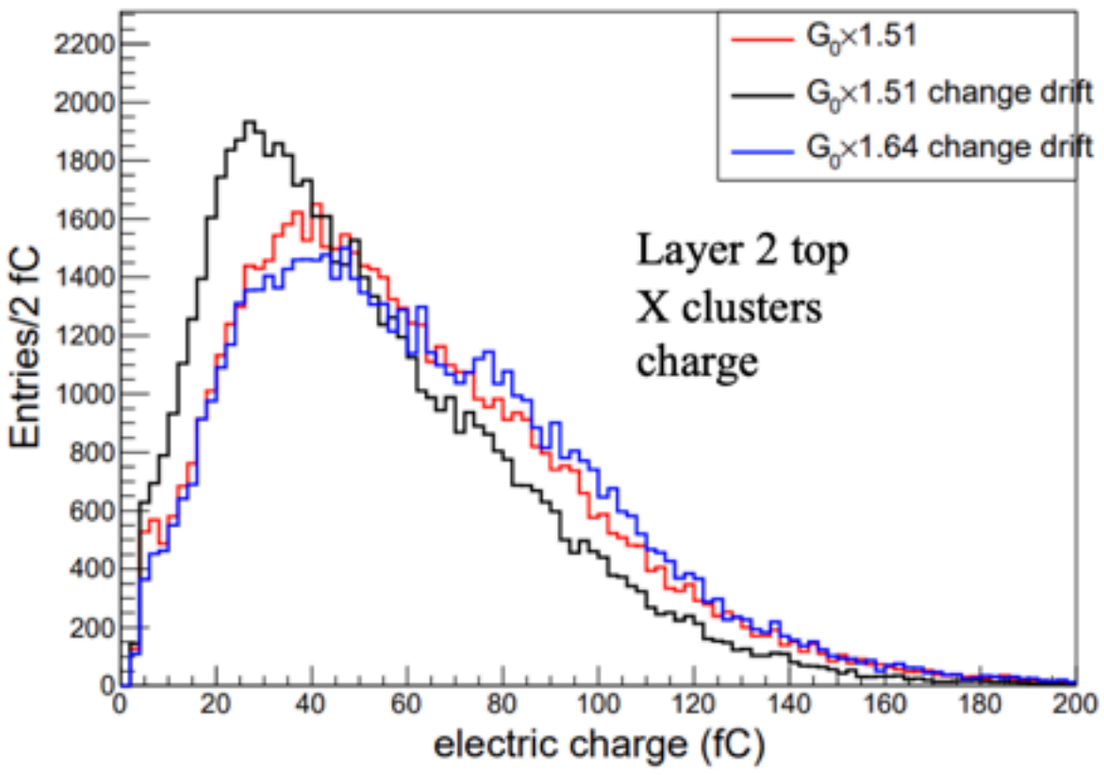
Different geometry from the nominal one? (different gap size?)

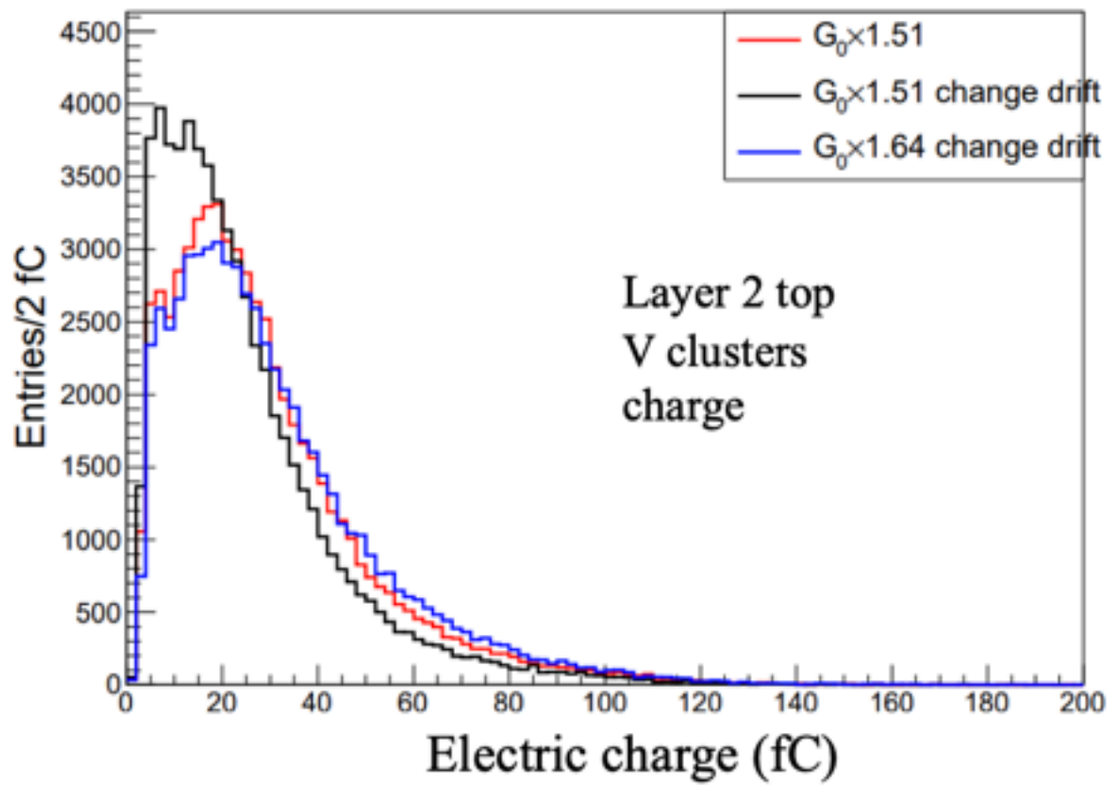
Variation of drift gap size in simulation

- A test: variation of drift gap size from 5 mm to 5-sinϕ mm



- After additional tuning of G_0 to reproduce the same peak position, a **wider** charge distribution does be found

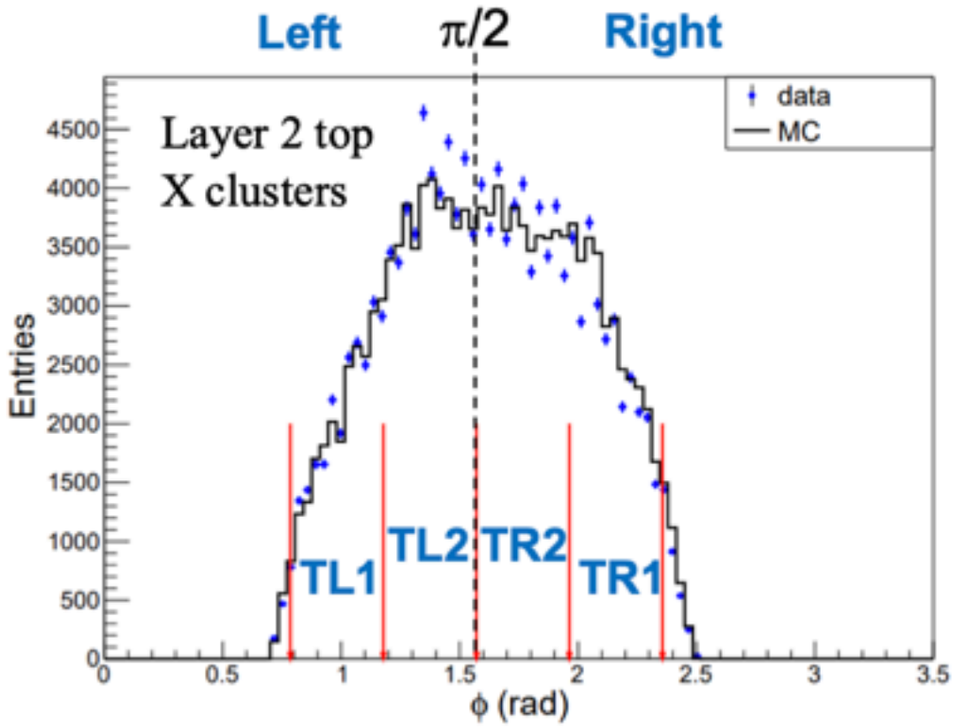




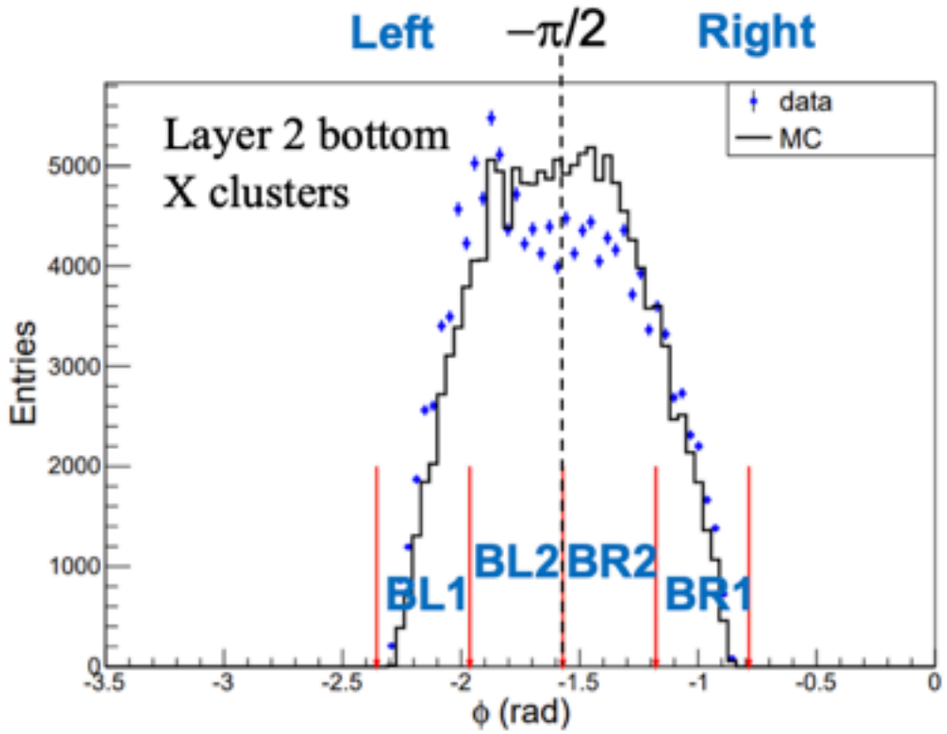
Just a test in simulation.
More direct investigation on layer 2 geometry distortion would help a lot!

Left-right symmetry checks

Xiao-Lin Lu



TL1: Top Left part 1
TR1: Top Right part 1



BL1: Bottom Left part 1
BR1: Bottom Right part 1

similar distributions for Left and Right expected

Left-right symmetry checks: LAYER 1

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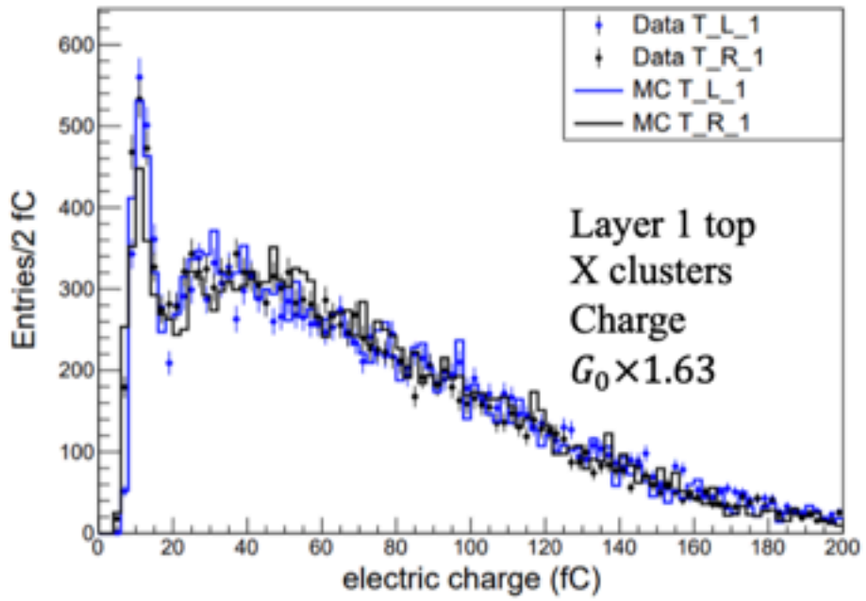
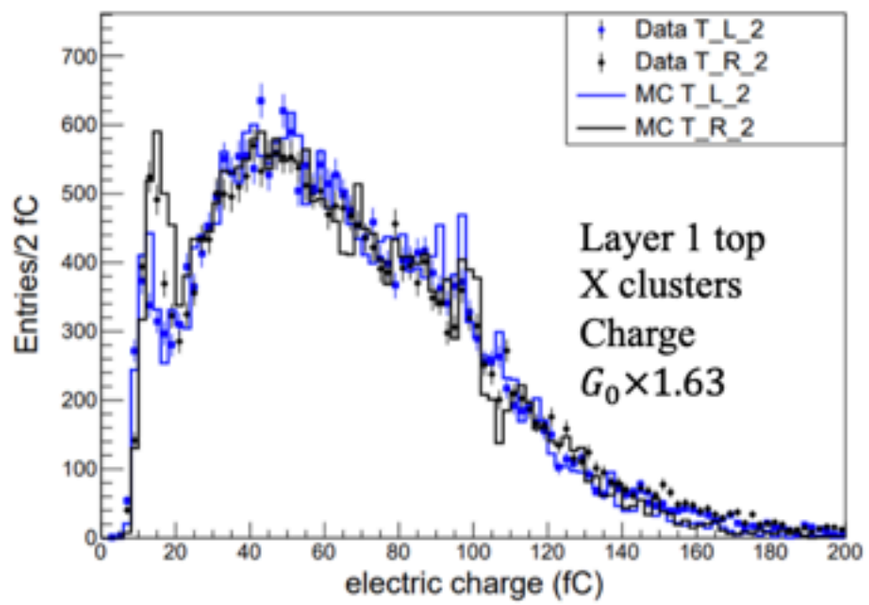
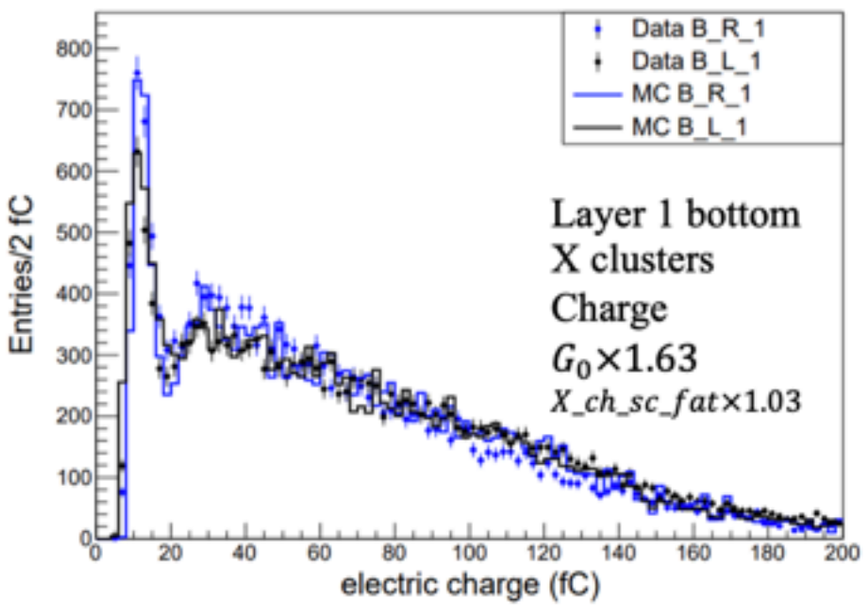
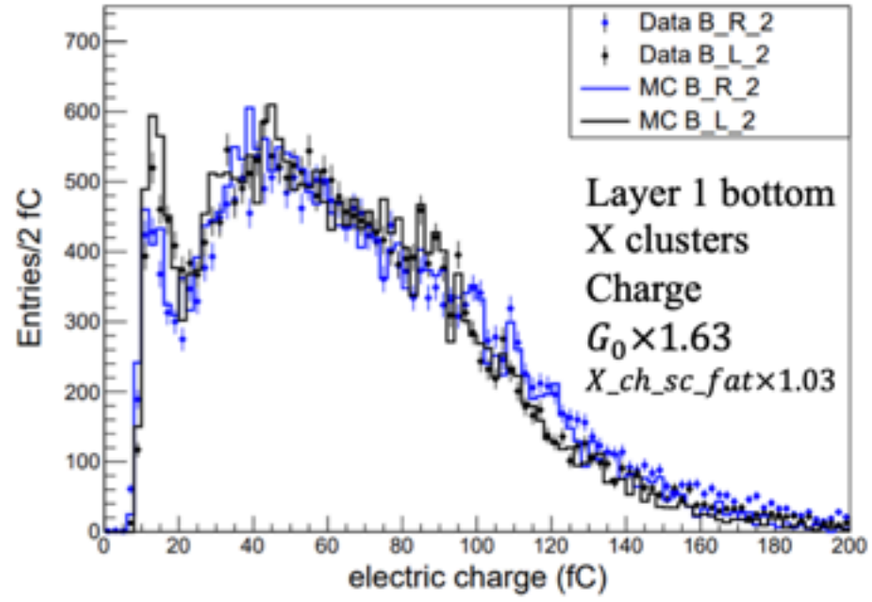




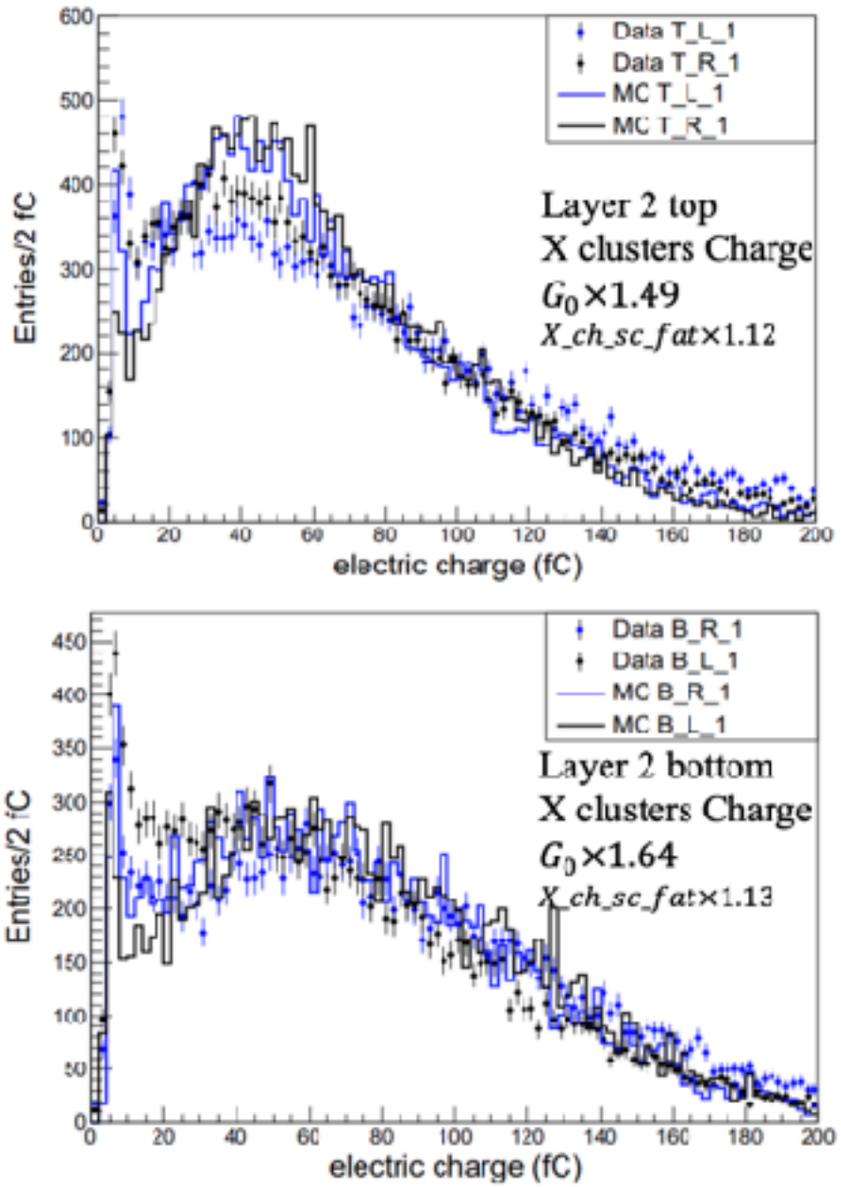


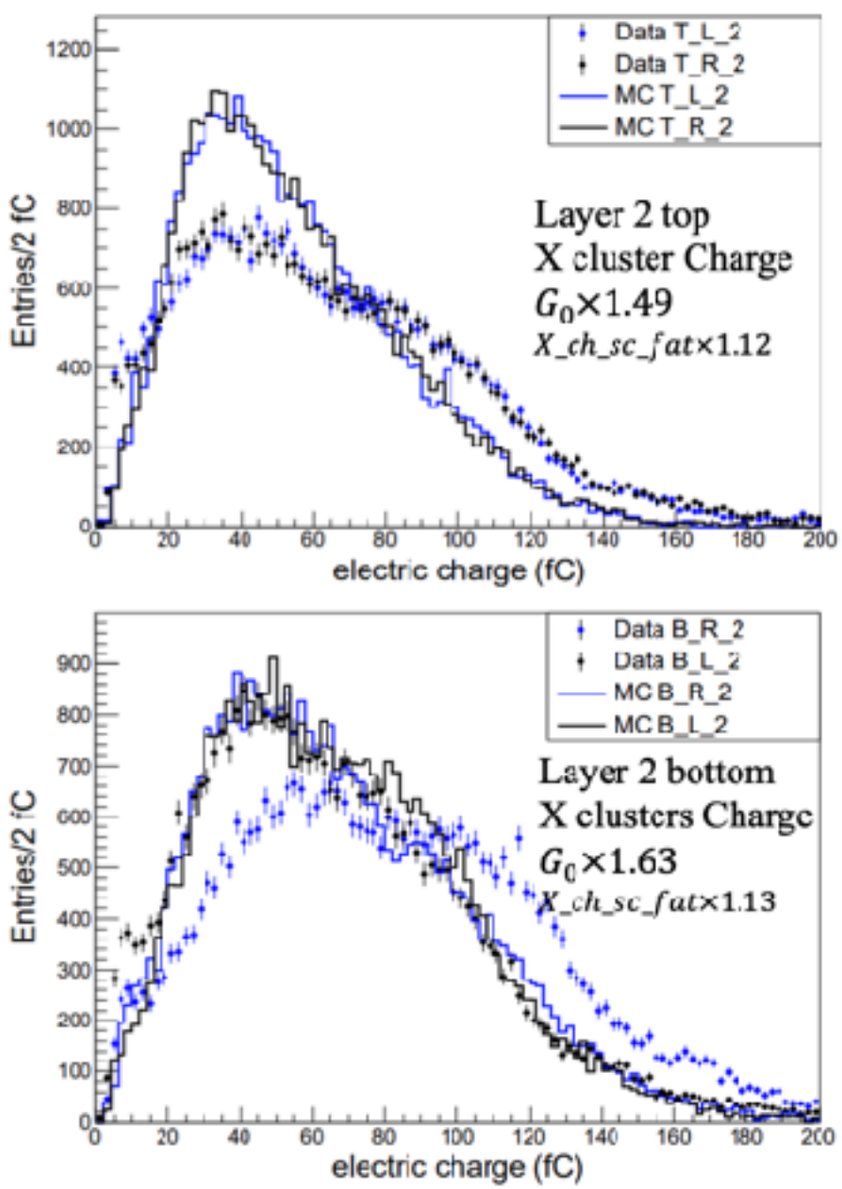


Good agreement between data and MC
Left-right symmetry as expected

Left-right symmetry checks: LAYER 2

Xiao-Lin Lu





Layer 2

For layer 2 top:
both data and MC
left-right symmetric

For layer 2 bottom:
MC left-right symmetric
But data not symmetric

geometry distortion
(left-right asymmetric),
HV, others... ?

CgemBoss6665g: K/p reconstruction

L.L.

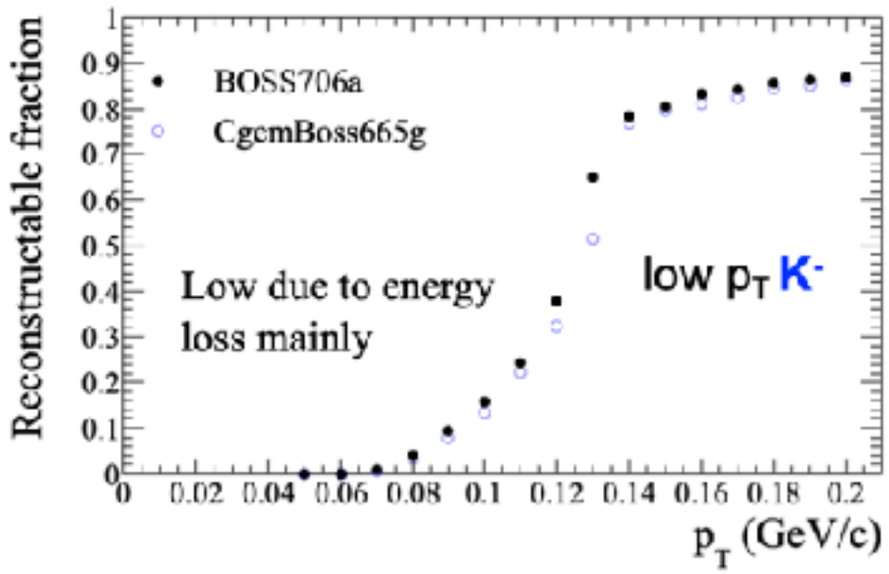
- **Sample: simulated single K-/p with |cos(θ)|<0.93**
  - CGEM: 100% efficiency and 130 μm resolution

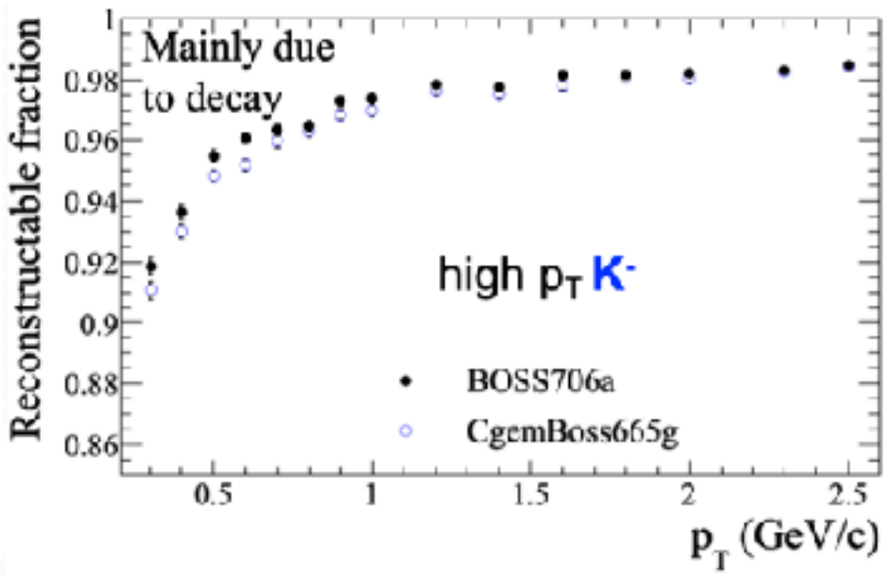
- **Ideal tracking**: find all CGEM clusters and MDC hits from K and p using MC truth information
  - Reconstructable K/p: kaons or pions with
    - V-view hits ≥ 2 or V-cluster ≥ 2
    - total number of MDC hits or CGEM clusters > 5 that must be from K/p
    - Reconstructable fraction is an indication of the tracking efficiency due to detector material and layer out only
    - **Reference tracks**: tracks passing the global track fitting

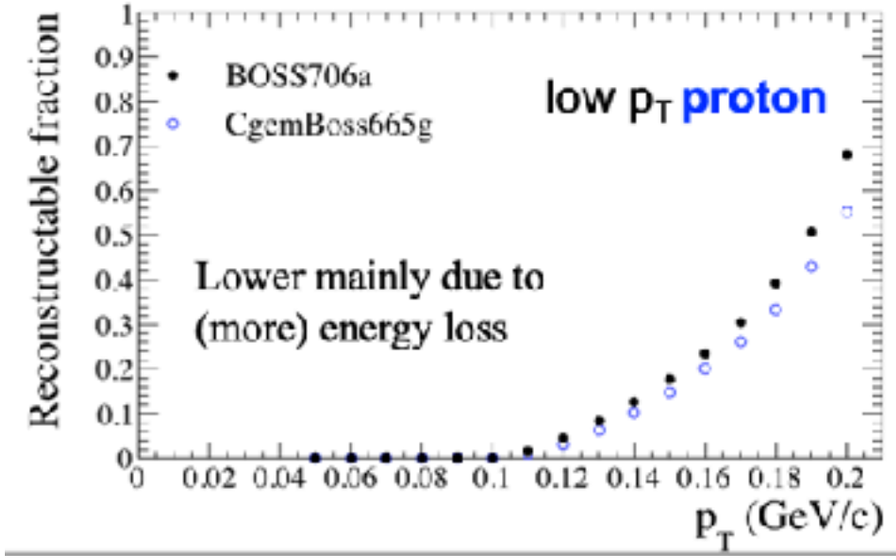
- **Comparison between reference tracks and tracks found by the tracking software** (global track finding with Hough transform)
  - If the fraction of common hits and clusters > 0.5, these tracks are considered as good reconstructed (Hough matched) ==> reasonably quantity to evaluate the efficiency with a tracking package

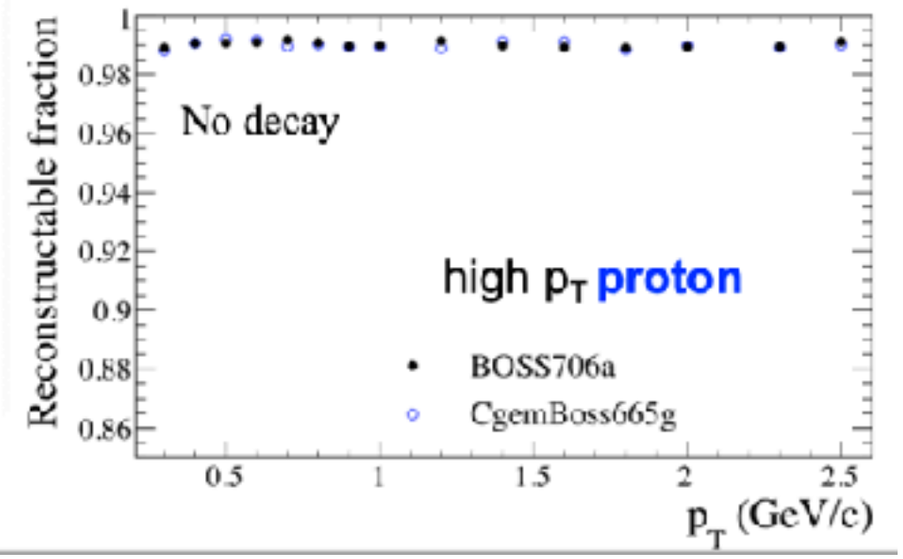
Left-right symmetry checks: LAYER 2

L.L.









- Lower fraction in CgemBoss due to the higher material budget
- K and proton: check tracking efficiency with the Hough transform track finding package => good in general

Conclusions

No update since the beginning of the year from the Italian side

To do

- Investigation of left-right symmetry problem for layer 2
- Optimization of global track reconstruction with CGEM+ODC
- Update of layer 3 geometry
- Time calibration: automatic procedure implemented in CgemBoss
- μTPC
- Others ….