Propagation of CSC Segments to GEM subsystem

GEM RecHit studies

GEM DPG Meeting

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Overview

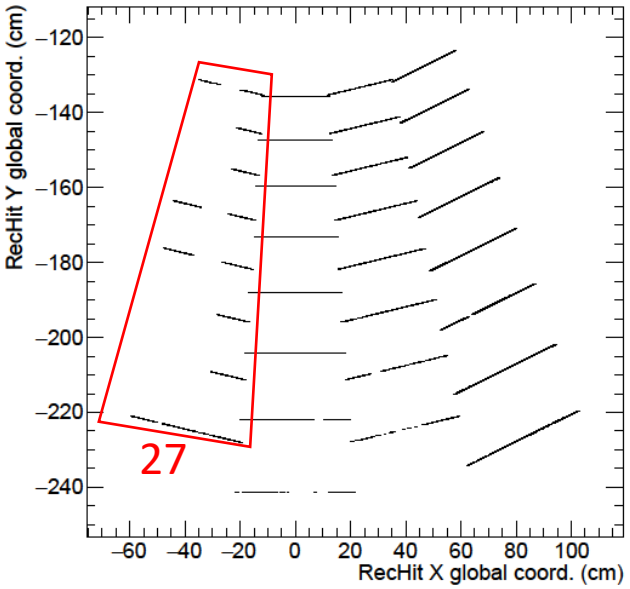
- GEM RecHit occupancy studies
- GEM RecHit cluster size studies
- Propagation from CSC to GEM
- Matching procedure
- Residuals

Occupancy of GEM RecHits

Analyzed runs SingleMuon_2018C: 319347, 319348

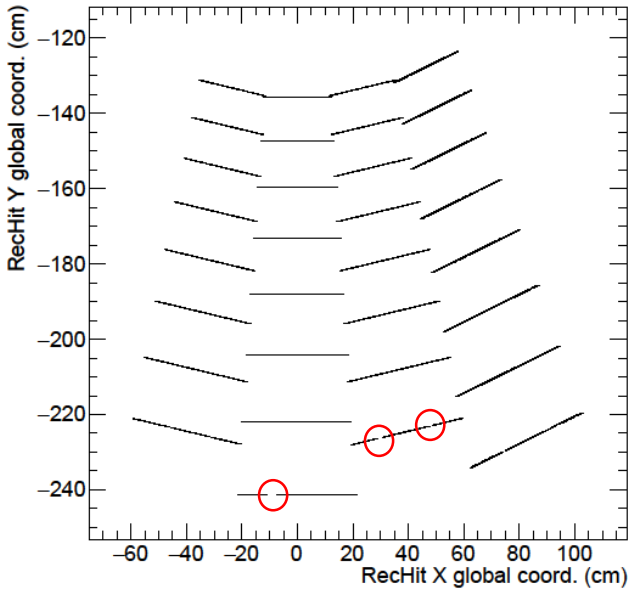
GEM chambers under study: 27, 28, 29, 30

GE -1/1 Layer 1



- A lot of silent strips and silent VFATs noticed, especially in chamber 27

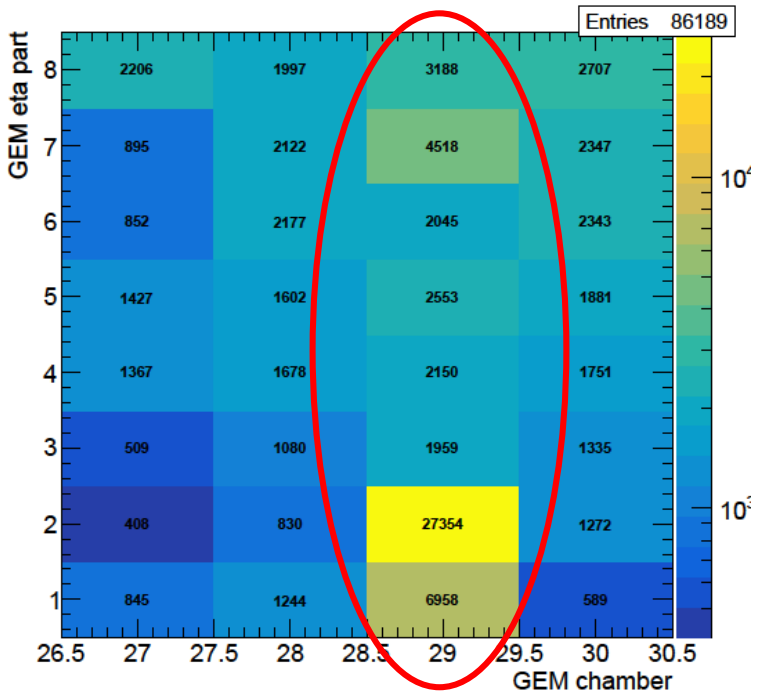
GE -1/1 Layer 2



- Occupancy more homogeneous but some silent strips are present

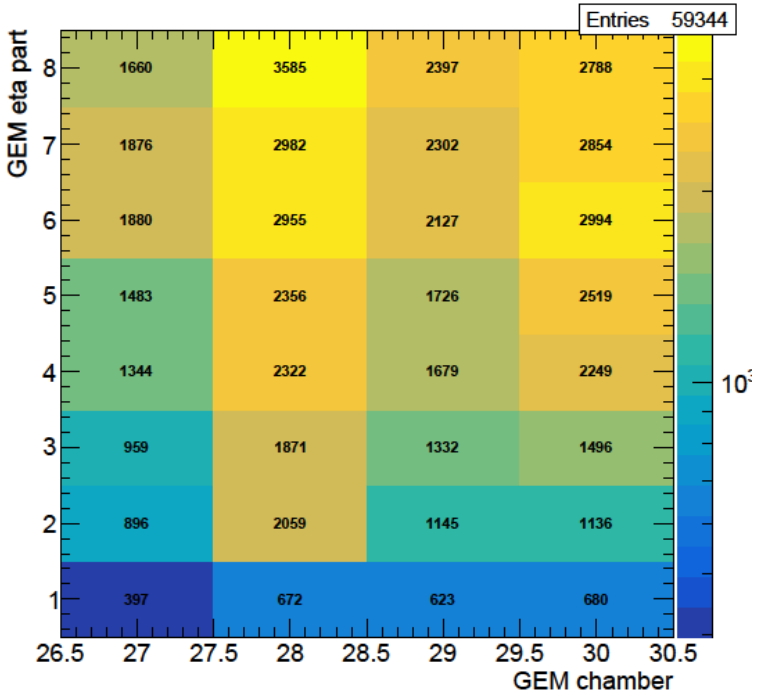
Occupancy per chamber vs eta part

GE -1/1 Layer 1



- Chamber 29 noisier than others.
- Chamber 29 eta 1-2 very noisy.

GE -1/1 Layer 2

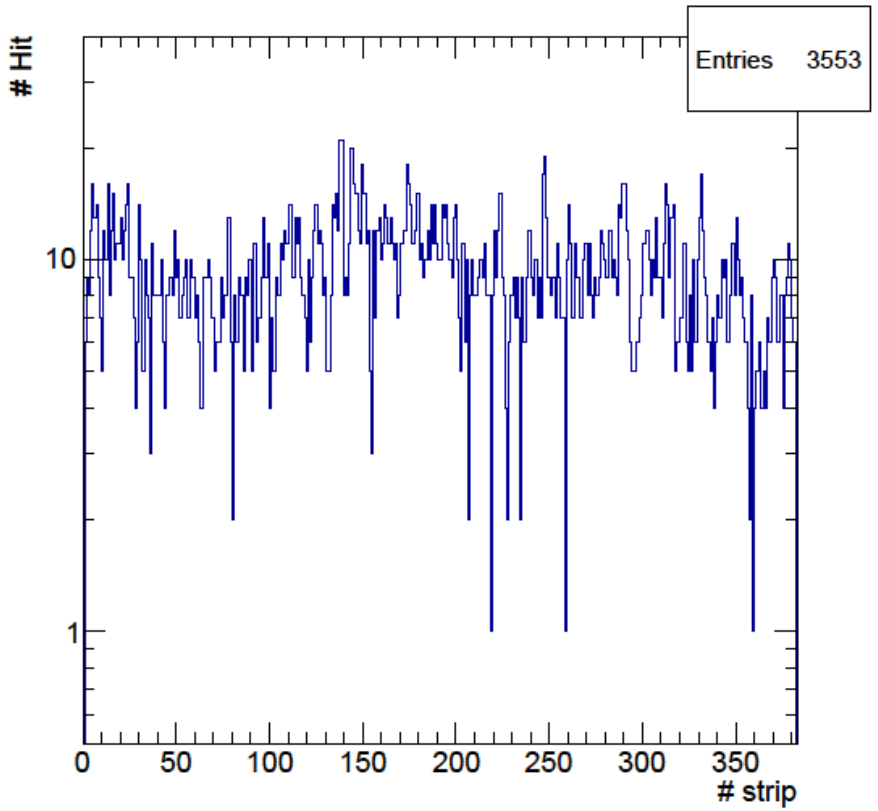


- Occupancy is rather homogeneous.

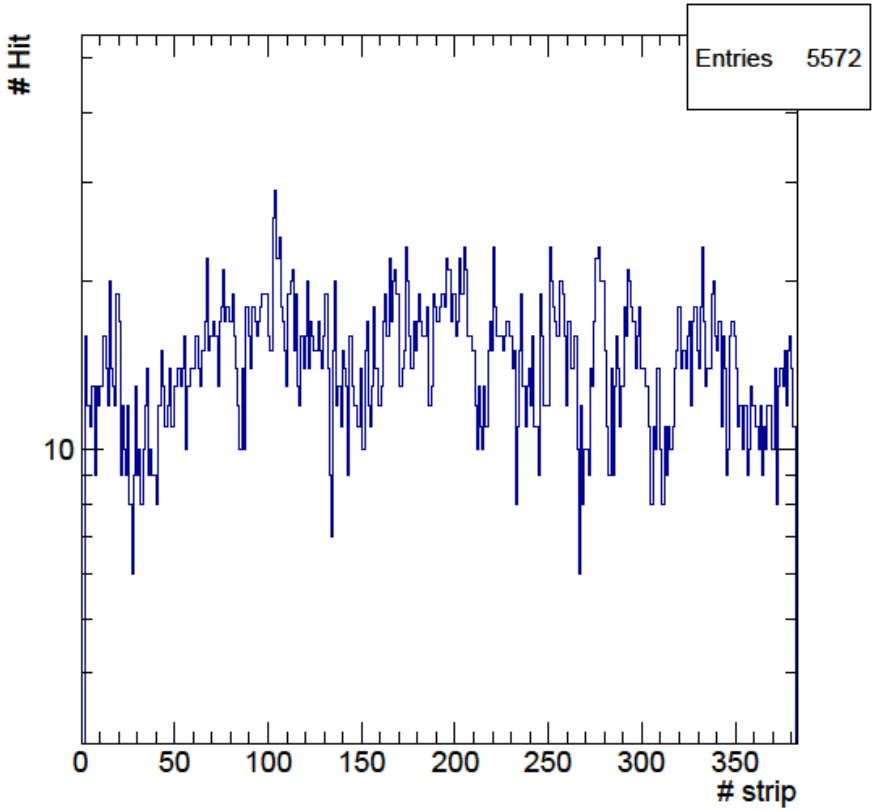
Examples of uniform strips occupancy

firststripcluster + *clustersize* distribution.

GE -1/1 Layer 1 chamb 30 eta 4

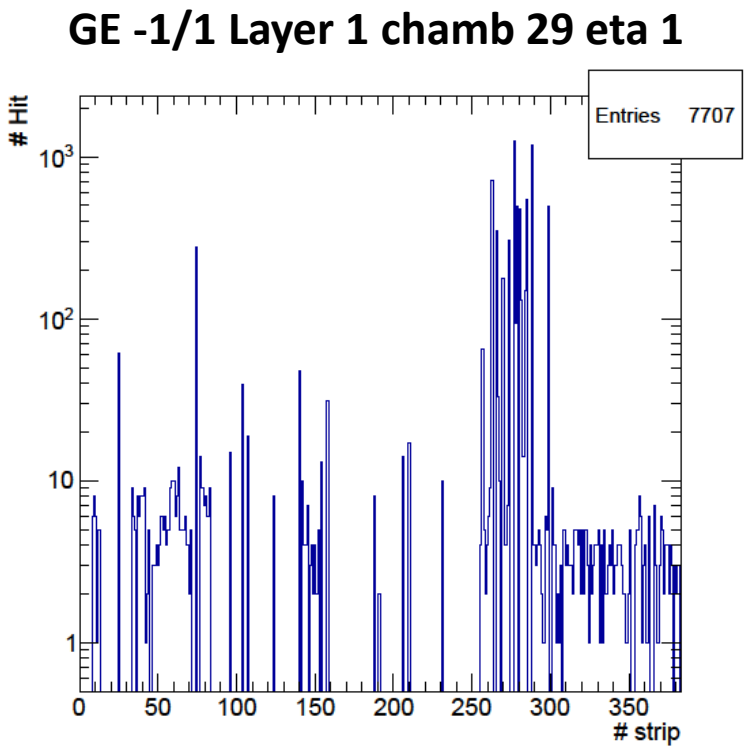


GE -1/1 Layer 2 chamb 28 eta 4

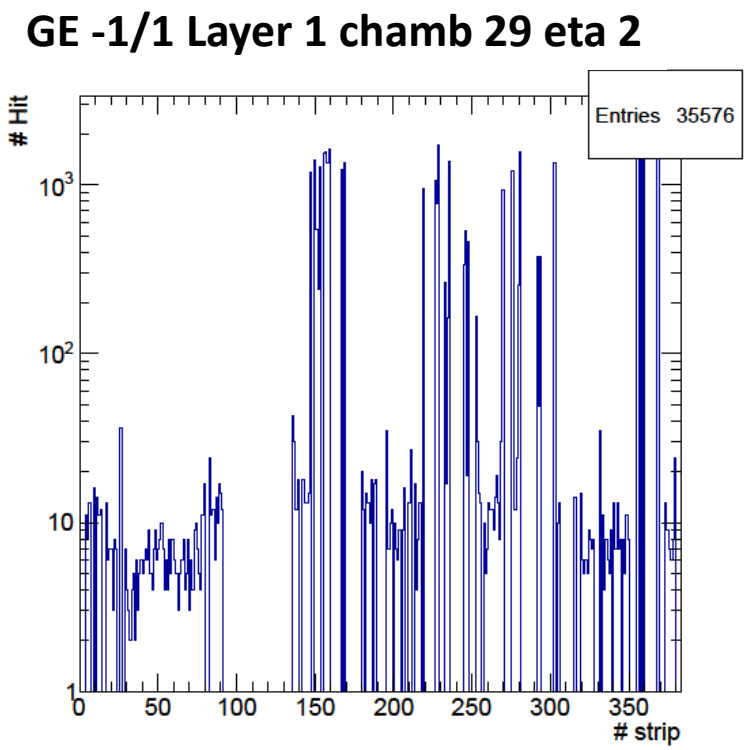


Examples of noisy strips

Chamber 29 eta 1-2 very noisy



- Noisy strips are in VFAT7 and VFAT23

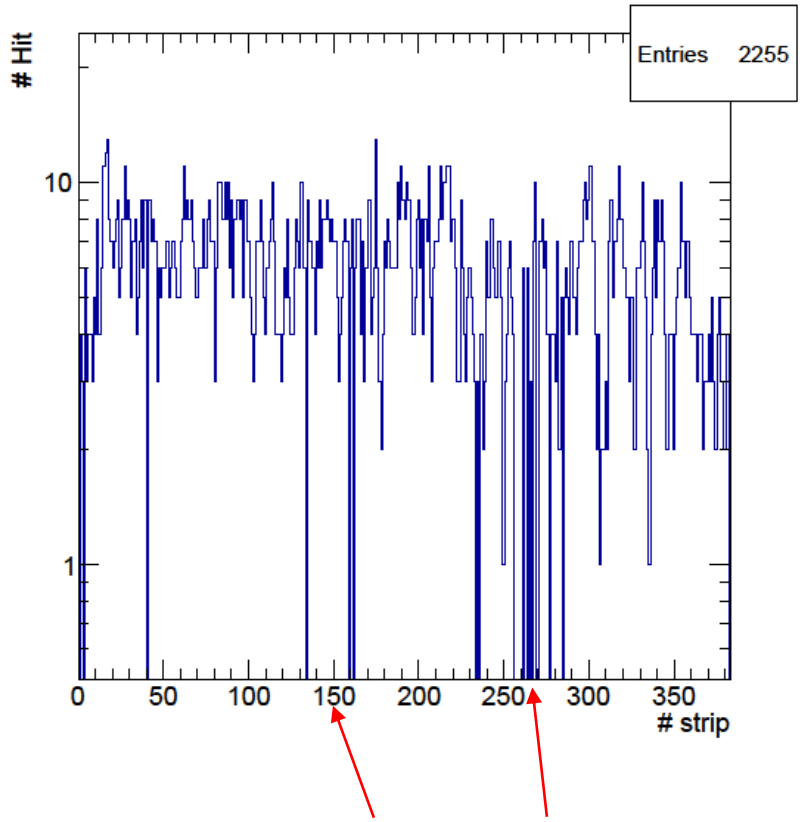


- Noisy strips are in VFAT14 and VFAT22

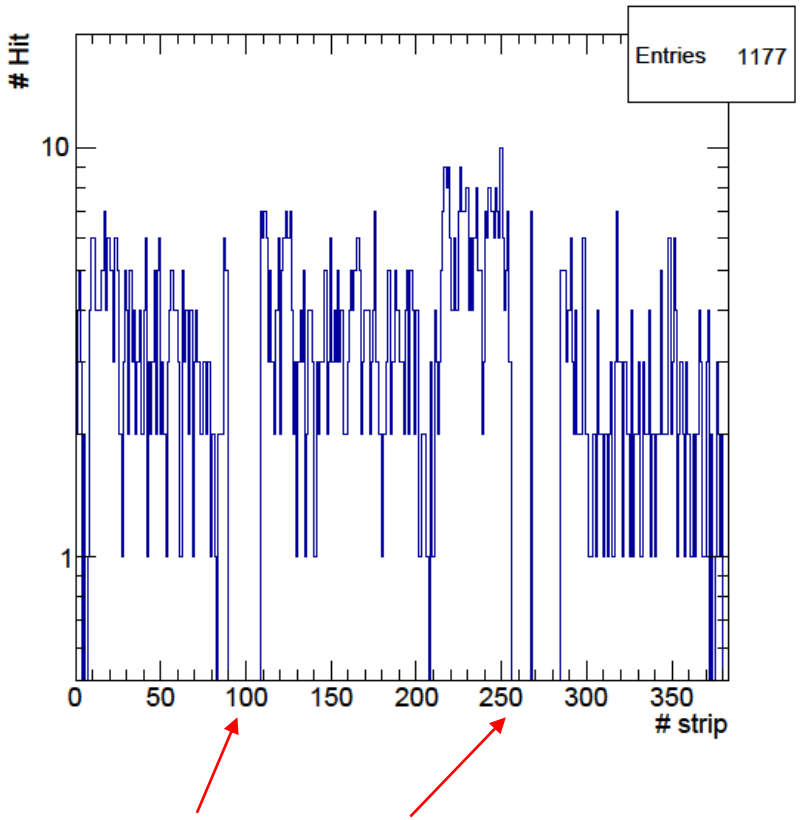
Examples of silent strips

Single or blocks of silent strips noticed.

GE -1/1 Layer 2 chamb 27 eta 3

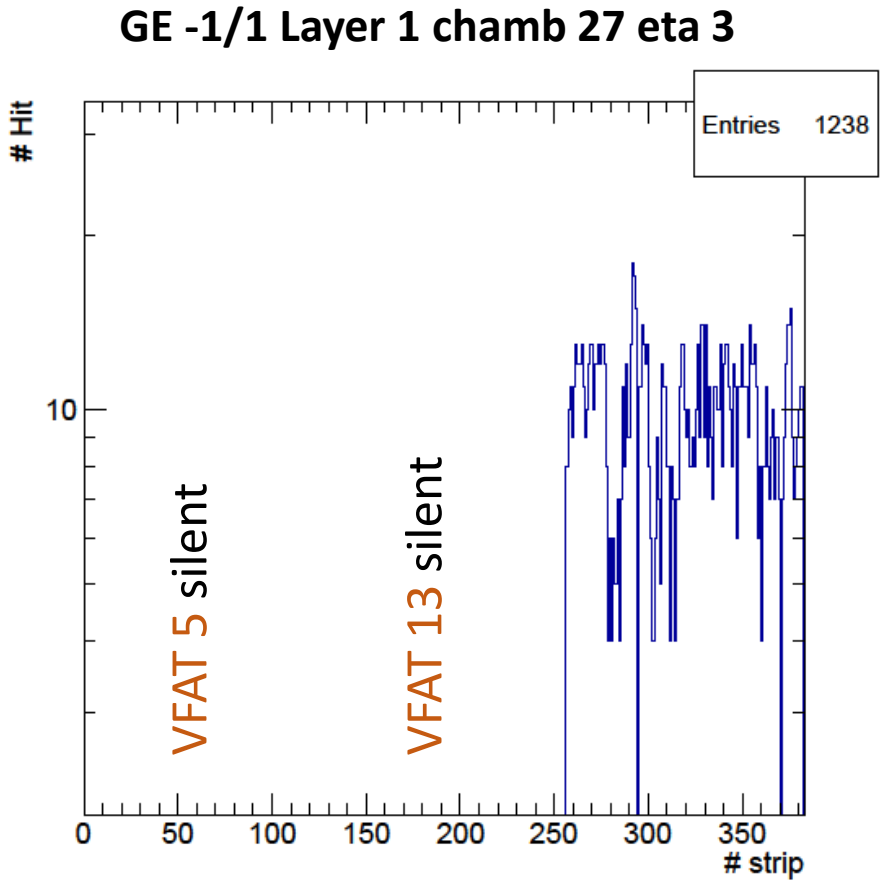


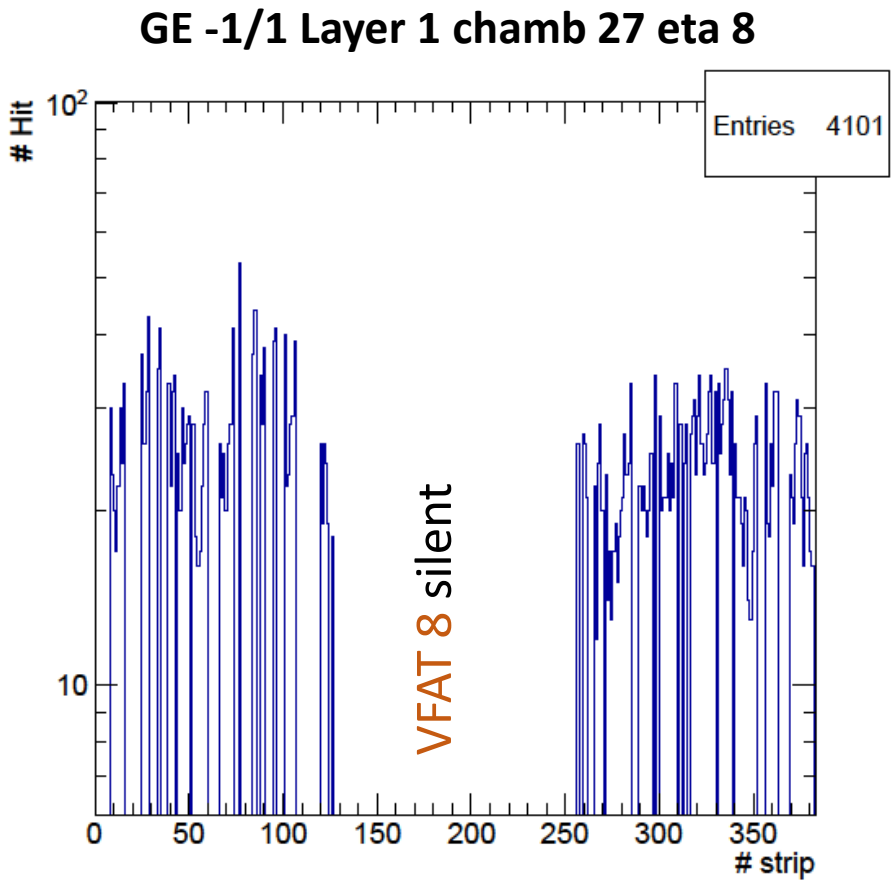
GE -1/1 Layer 2 chamb 29 eta 1



Effect of the poor statistics? To be investigated!

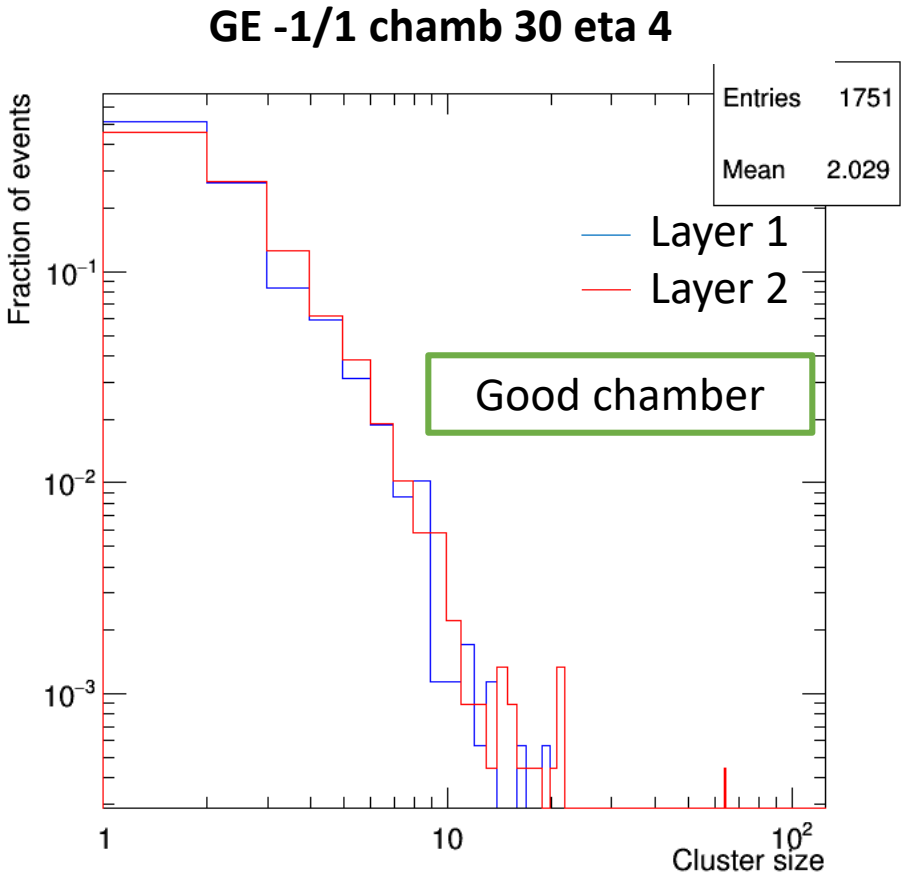
Examples of silent VFATs

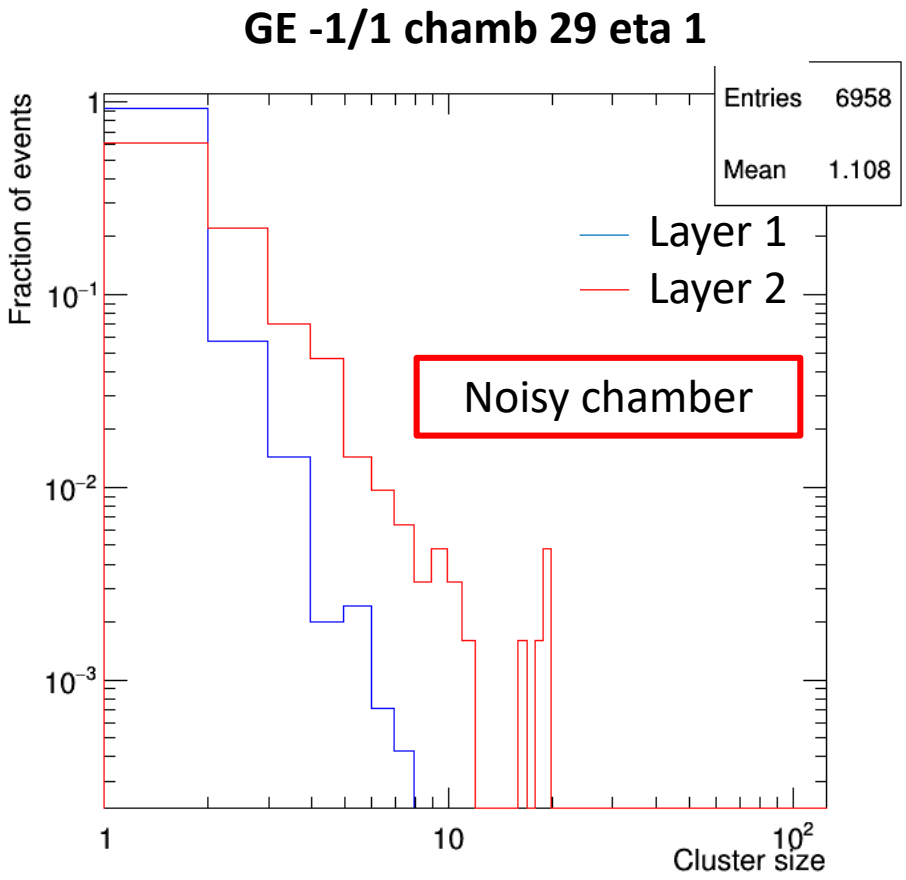




VFATs not correctly working?

Examples of GEM RecHit cluster size



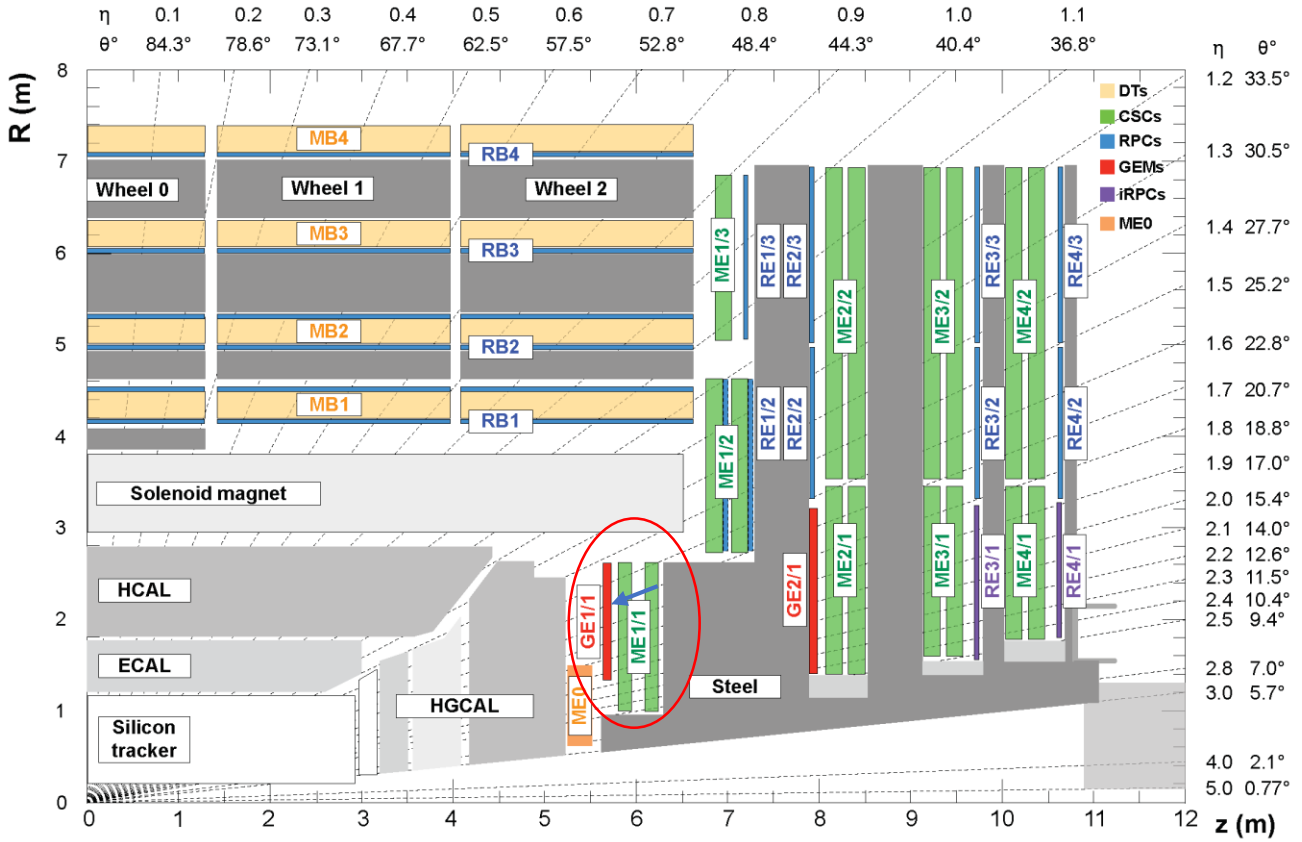


- Both layers look fine
- Typical cluster size within 1-3
- Good chambers show <cluster_size>~2

- Layer 1 noisy with 92% of cluster_size=1
- Further investigation needed.
- Layer 2 looks fine

Propagation of CSC Segments to GEM

The aim is to develop the code for the propagation of a CSC Segment from ME-1/1 on the surface of the GEM subsystem GE-1/1.



Propagation 1/2 (RPC-based)

CSC Segment

Characterized by a starting point $(x_0; y_0; z_0)$ and a direction $(dx; dy; dz)$.

Propagation

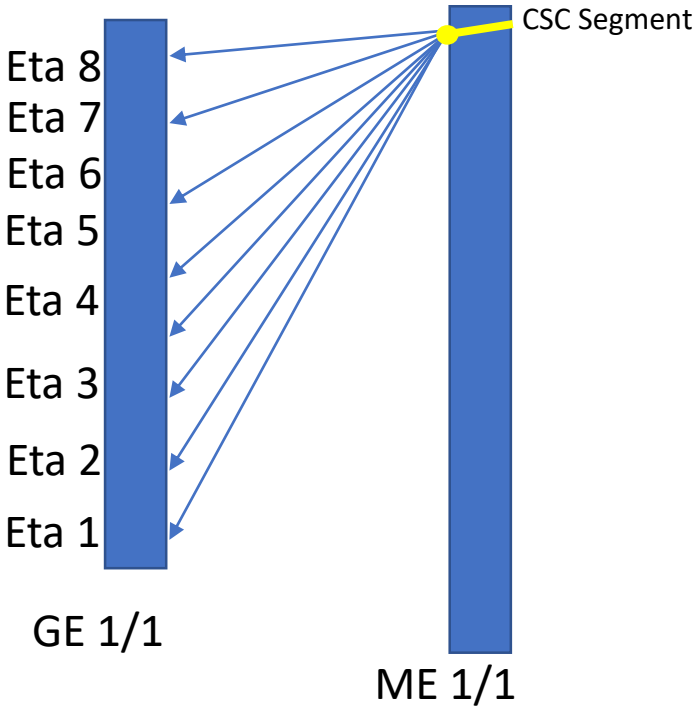
The point on the GEM chamber is find according to:

$$x = x_0 + \frac{dx}{dz} D \qquad y = y_0 + \frac{dy}{dz} D \qquad z = D$$

where D is the z-coordinate of the layer of the GEM chamber.

Propagation 2/2

GeometryTag GeometryExtended2015MuonGEMDev_cff used



Step for propagation:

1. Pairing the CSC Segment to the facing GEM (e.g. from CSC 28 to GEM 28, lay 1-2)
2. Projection of the CSC Segment on the plane(z=D) of each GEM layer
3. Searching for the hit eta partition for both GEM layers
4. Definition of propagated RecHit (x,y,D)

Improvement

We plan to perform the propagation also on the GEM chambers near in ϕ.

Matching to a GEM RecHit

Recipe:

- y coordinate → same eta partition for GEM RecHit and propagated RecHit

- x coordinate → two possibilities:
  1. By requiring distance to be less than a Δx_{thres} → residuals
  2. By requiring the strip distance to be less than n-strips (n t.b.d.)

Matching to a GEM RecHit

Recipe:

- y coordinate → same eta partition for GEM RecHit and propagated RecHit

- x coordinate → two possibilities:
  1. By requiring distance to be less than a Δx_{thres} → residuals

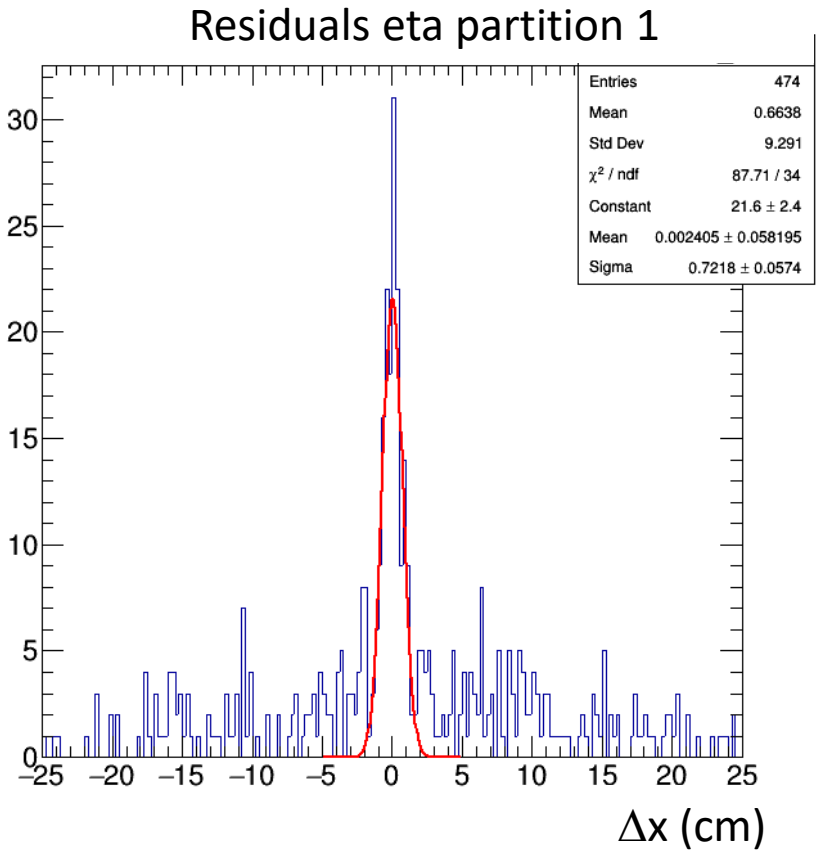
Residual:

$$\Delta x = \min(x_{prop} - x^{i}_{RecHit})$$

over all GEM RecHits of the same eta partition for each event

Residuals

Distribution of Δx of all chambers at the same eta partiton with <u>no quality requirements</u> on the GEM RecHits



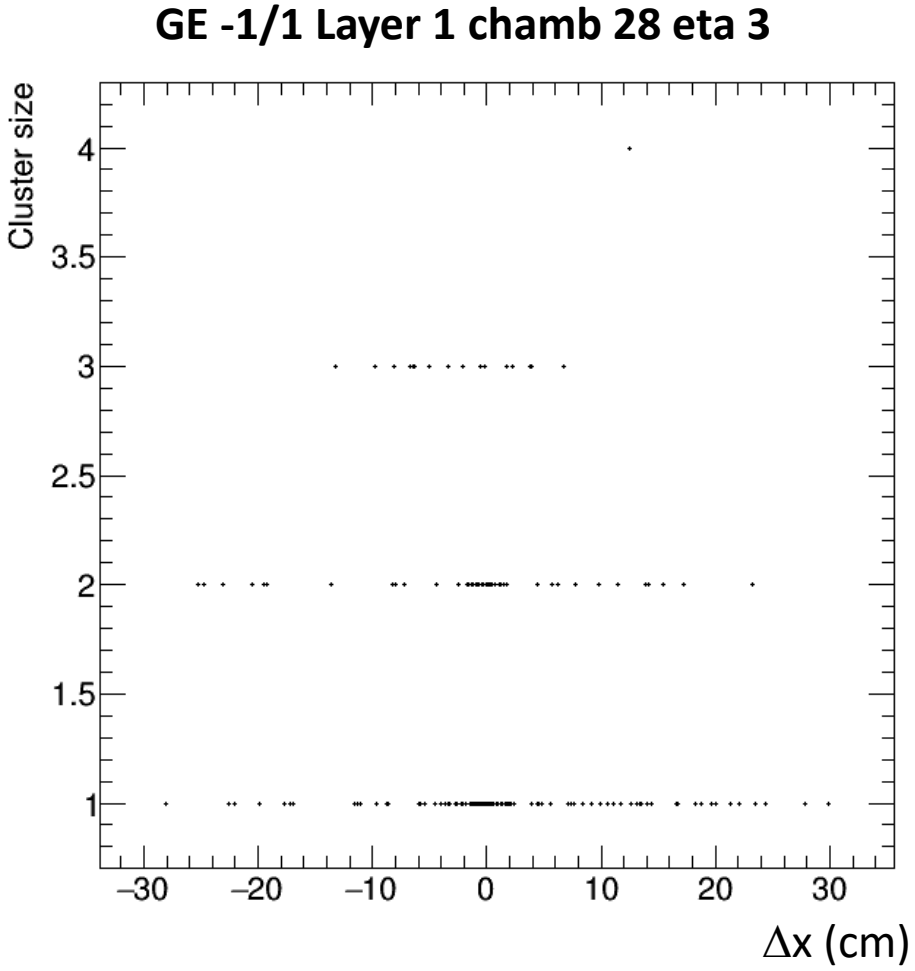
Distribution fitted in the range (-5, 5)

From the fit:

σ = 7,2 ± 0,6 mm

- Good result? To be further investigated

Residuals vs cluster size



Attempt to find a correlation between residuals and GEM RecHits cluster size.

No strong correlation observed from this study.

Conclusions

Current status

- Understood some features of GEM RecHits of the analyzed runs
- Propagation procedure set up
- First matching procedure defined
- Study of the residuals started

Next steps

- Improve the propagation procedure
- Improve and refine the matching procedure
- Introduce quality criteria on CSC Segments and GEM RecHits
- Increase the statistic with the full 2018C sample