Status of the CMS/GEM Detector during the November 2012 Test Beam

RD51 mini week (22-24 April 2013)

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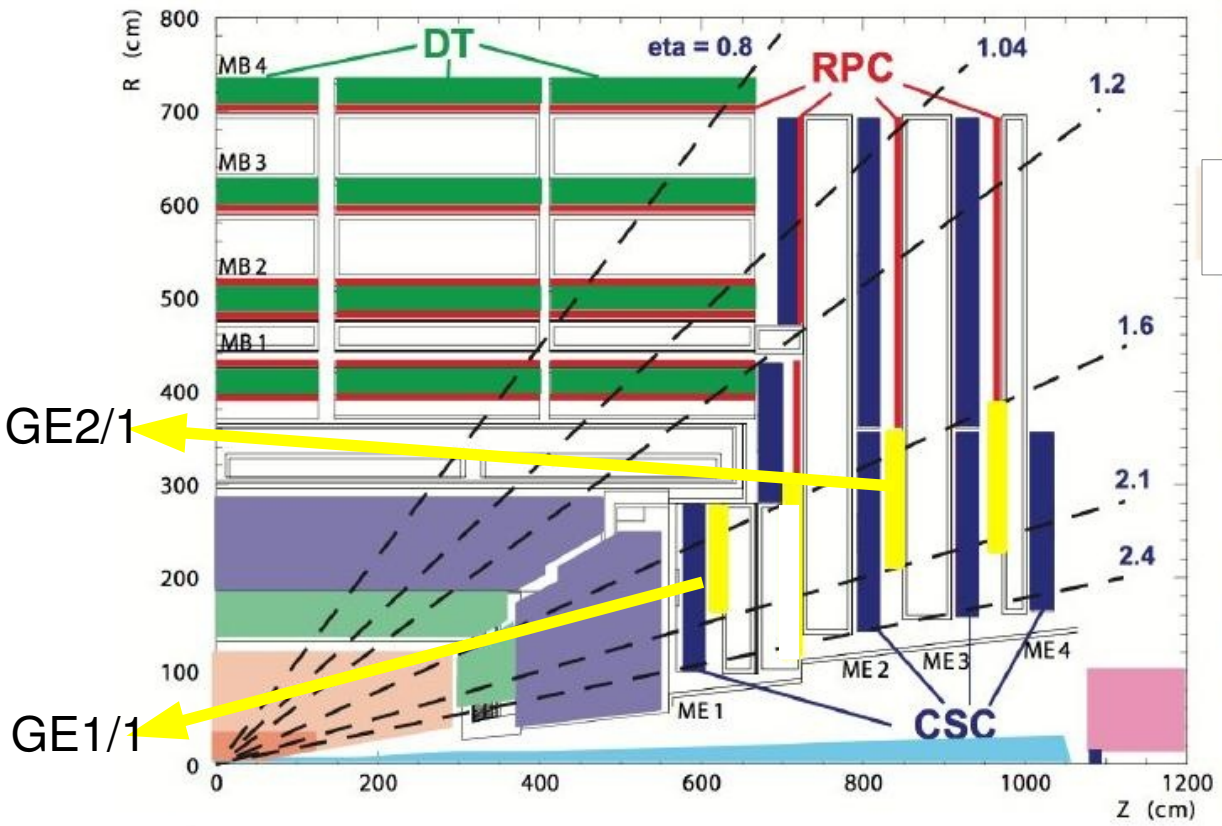
on behalf of
GEM Collaboration(GEMs for CMS)

Outline

- GEMs for CMS
- GE1/1 detector in the test beam
- Test-beam setup
- VFAT Analysis software
- Preliminary Results
- Conclusion

GEMs for CMS



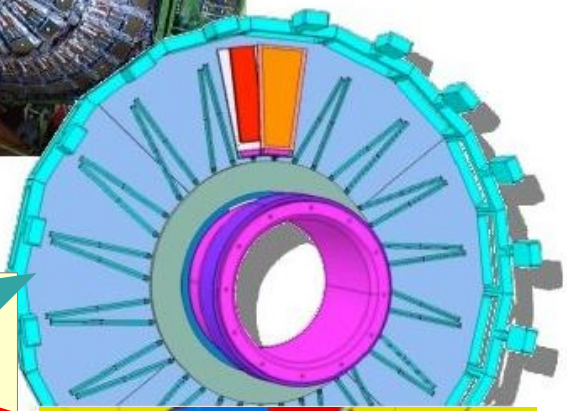
GE2/1

GE1/1

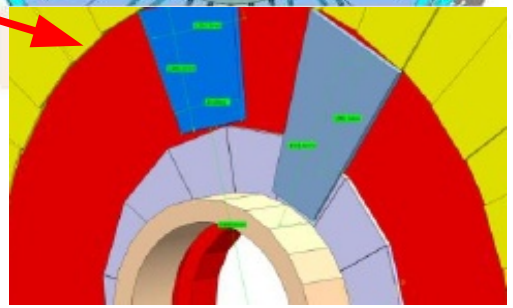
STATION 2

MISSING HIGH ETA

STATION 1



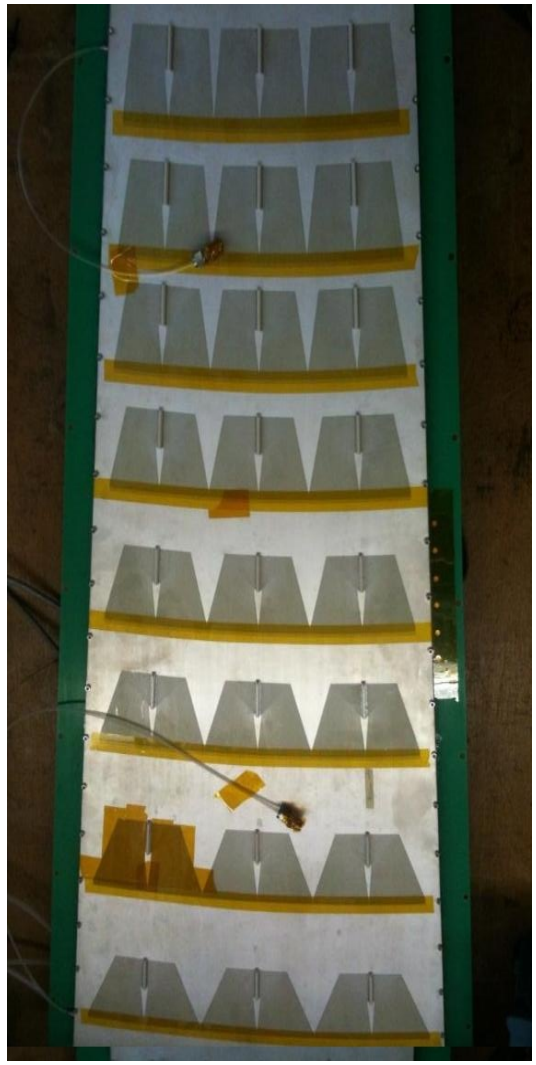
- CMS GE1/1
- CMS GE2/1

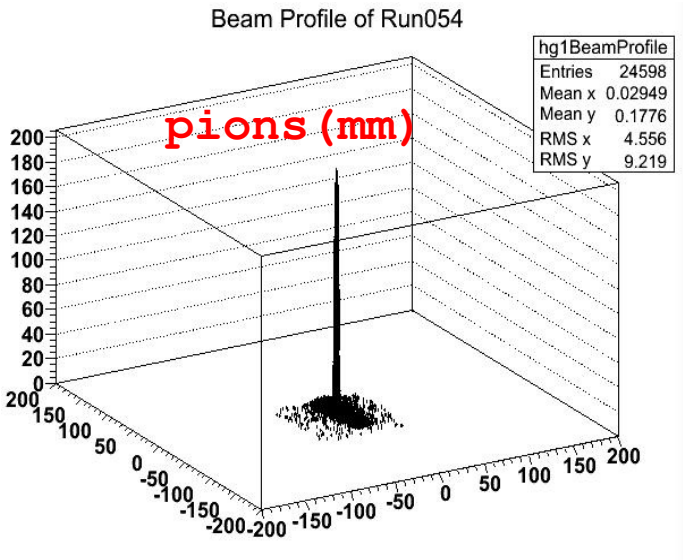


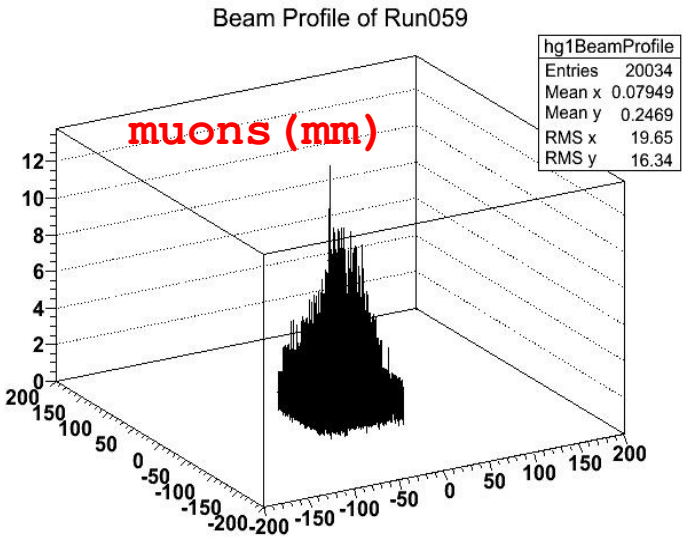
- New detector technology for uninstrumented High-η RPC region of Muon Endcaps

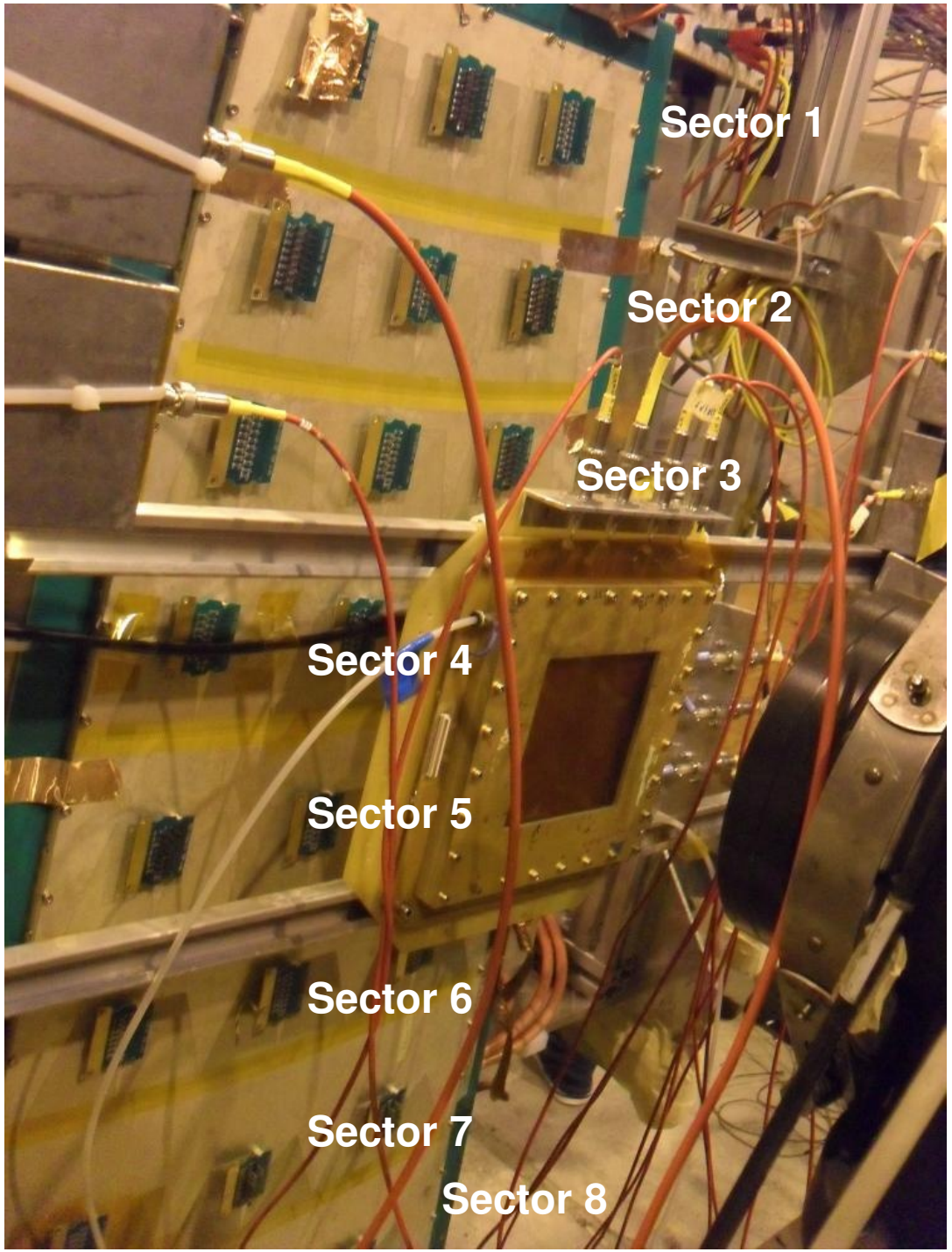
GEMs for CMS: **GE1/1**

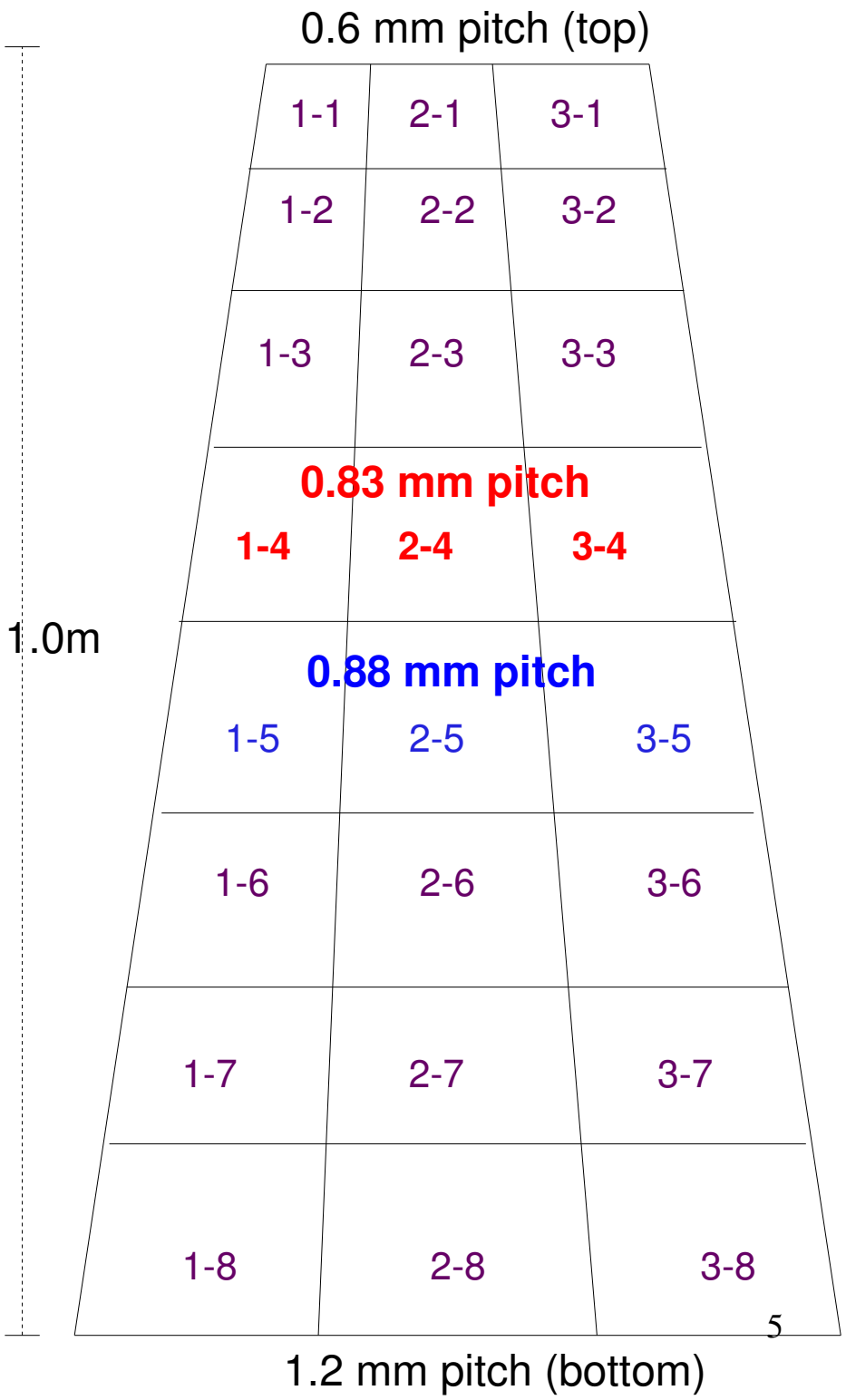
- 2 Large Chambers with NS2 method/no glue
- No spacers in the active area (990 x 220 x 445 mm)
- Gap configuration: 3-1-2-1 mm
- 2 different sectors tested
- Data taken with VFAT and SRS system
- Runs with both Pions & Muons @150GeV



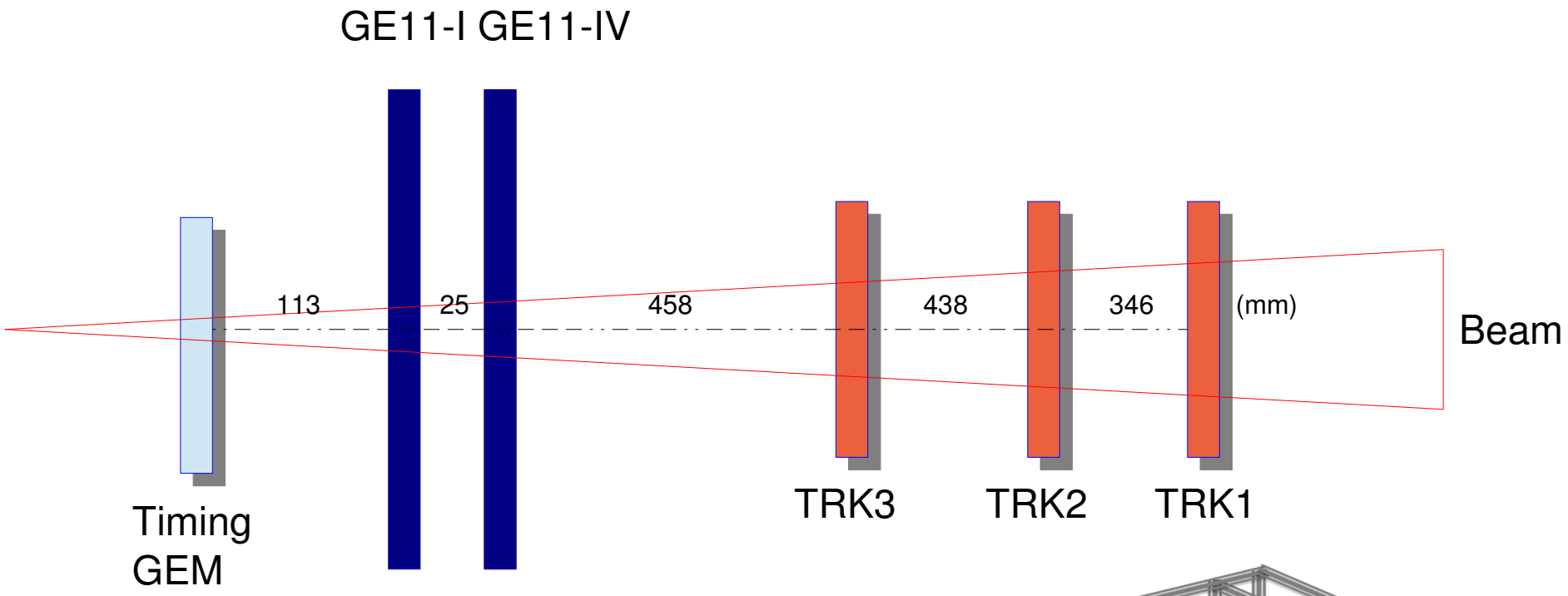




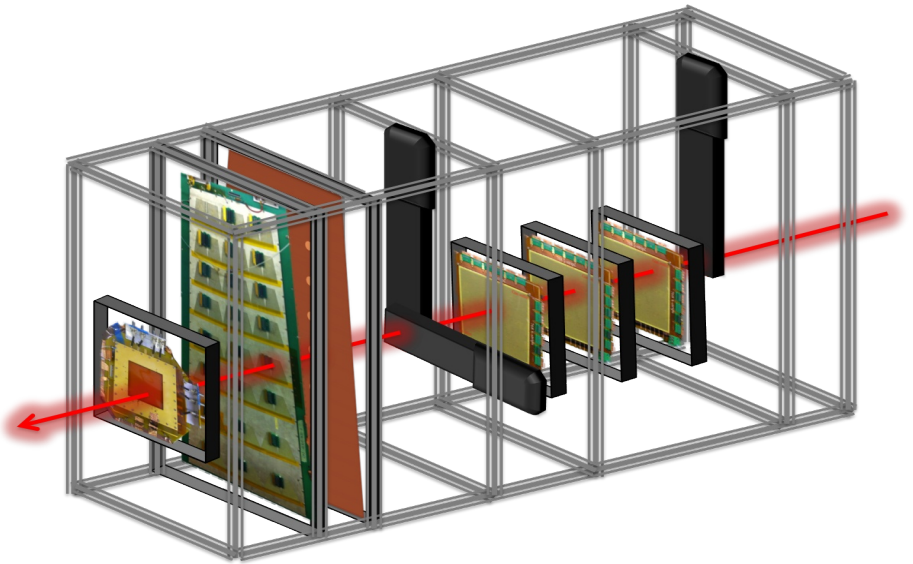

Sector 1
Sector 2
Sector 3
Sector 4
Sector 5
Sector 6
Sector 7
Sector 8


0.6 mm pitch (top)
1-1
2-1
3-1
1-2
2-2
3-2
1-3
2-3
3-3
0.83 mm pitch
1-4
2-4
3-4
0.88 mm pitch
1-5
2-5
3-5
1-6
2-6
3-6
1-7
2-7
3-7
1-8
2-8
3-8
1.0m
1.2 mm pitch (bottom)

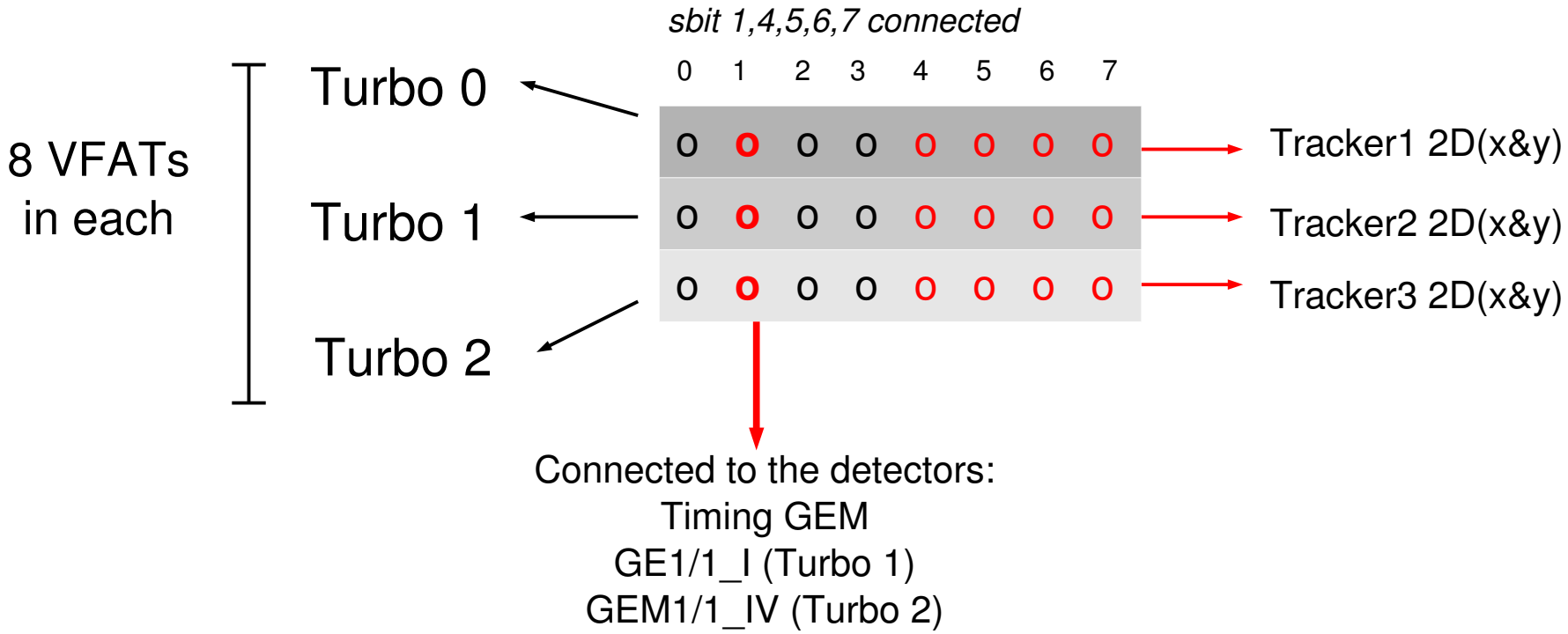
Test Beam Setup (November 2012)



- 3 Trackers (10x10triple GEMs)
- 1 Timing GEM
- GE11-I (sCMSNS2LC1)
- GE11-IV (sCMSNS2LC2)
- 3 Scintillators for Trigger
- DAQ with VFAT&SRS and different ntuples created



TURBO and VFAT



*Readout with VFAT electronics, a digital chip with 128 channels
*Programmable fast OR function of the input channels for triggering
*Adjustable threshold and latency

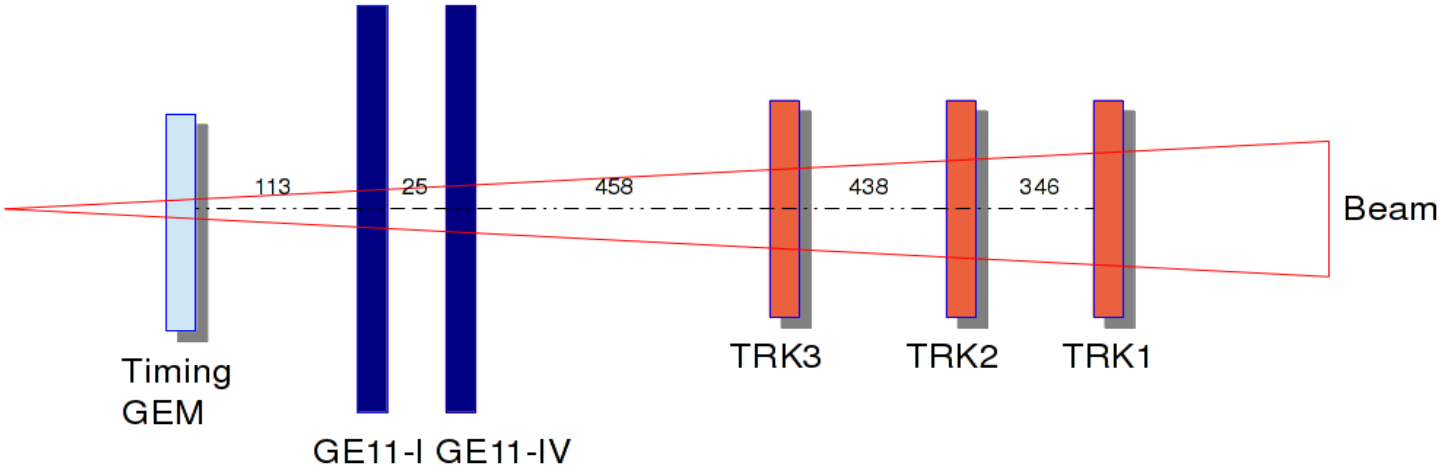
VFAT Analysis Software

Analysis Software in 3 steps

- Event Builder : converted channel hits into the cluster with spatial coordinates
- Track Finder : extracted tracks
- Analyzer : with output of tracks, calculation of efficiency, cluster size, etc.

Configuration Files

- Offset Flip Event Builder VFAT : all detector names, x and y offsets
- Offset Tracker : trackers and z offset of 3 trackers
- Offset And Coverage : timing GEM and 2 detectors



Residual X calculation

Residual X = position of the Detector cluster – Projected X

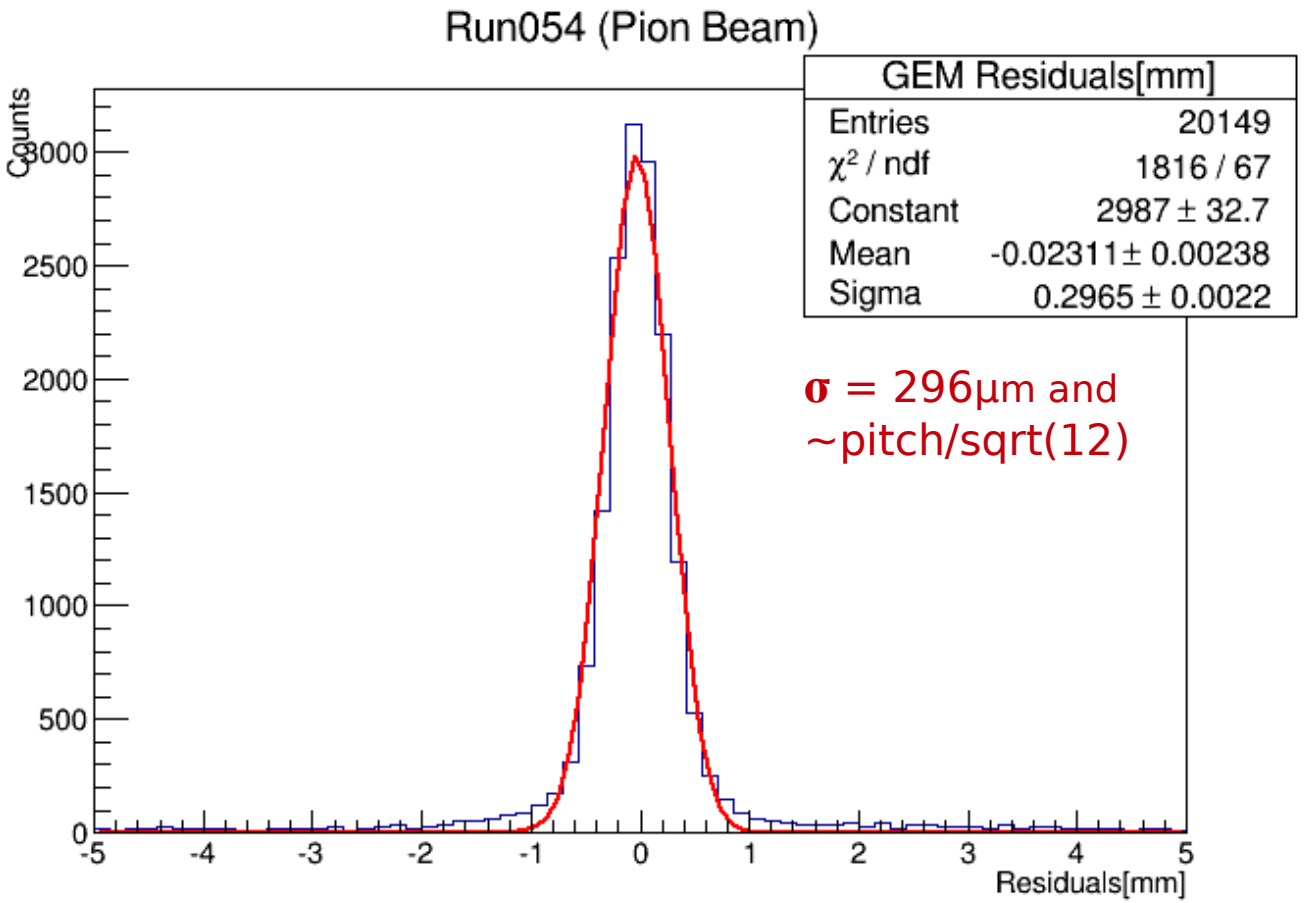
Projected X = position extrapolated from Trackers

- Acceptance radius : Distance between the track projection and the hit on the GEM detector
- Distance < Efficiency Radius

Cuts for track selection: nTracks ==1
Track chi2 < 2
Track residual < 0.2

Space Resolution

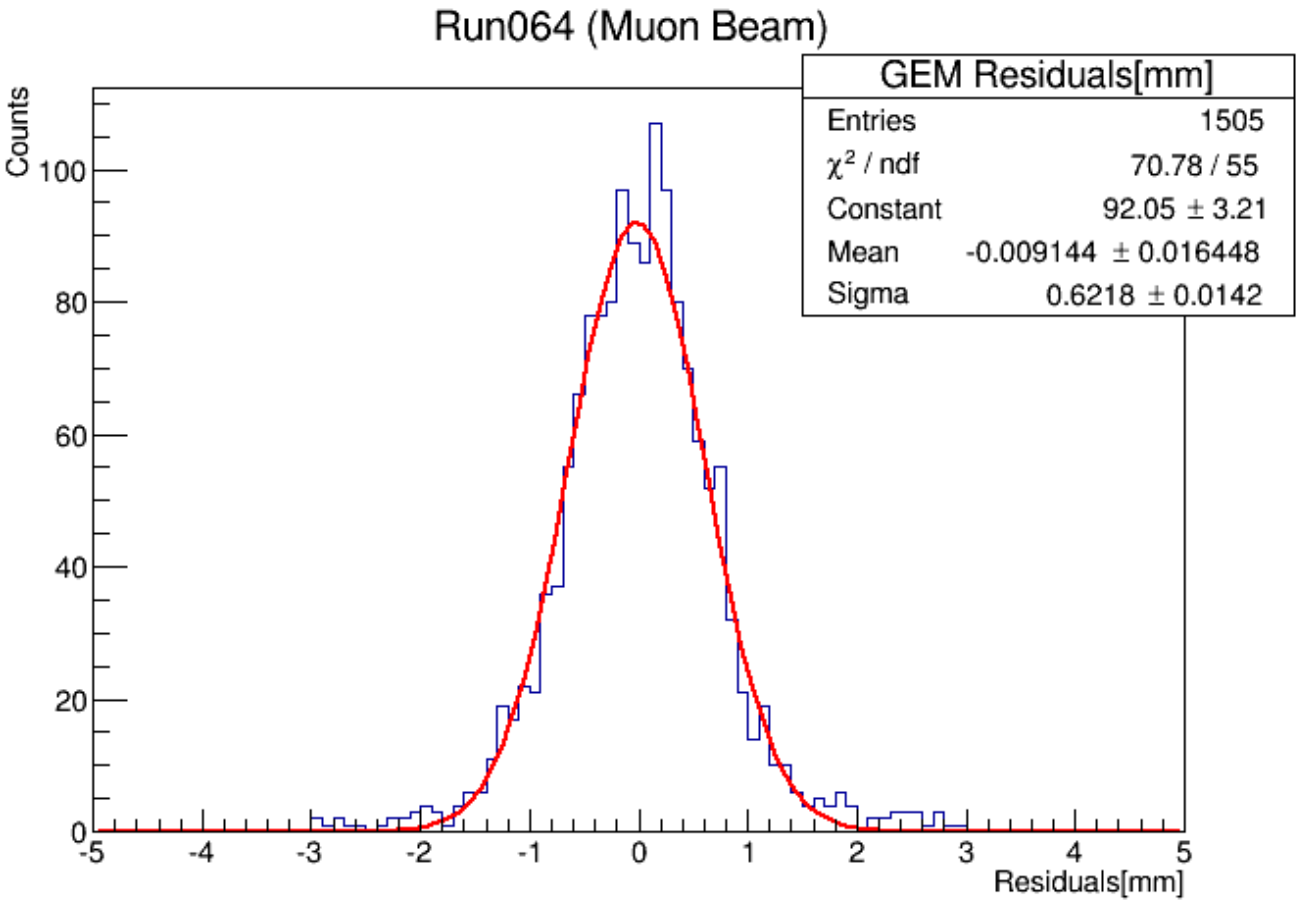
- name of the chamber → GE11-IV (sCMSNS2LC2)



GE11-IV
Thr=12 vfat units
Icomp=100
Gas Mix: Ar/CO2/CF4-45/15/40

Space Resolution

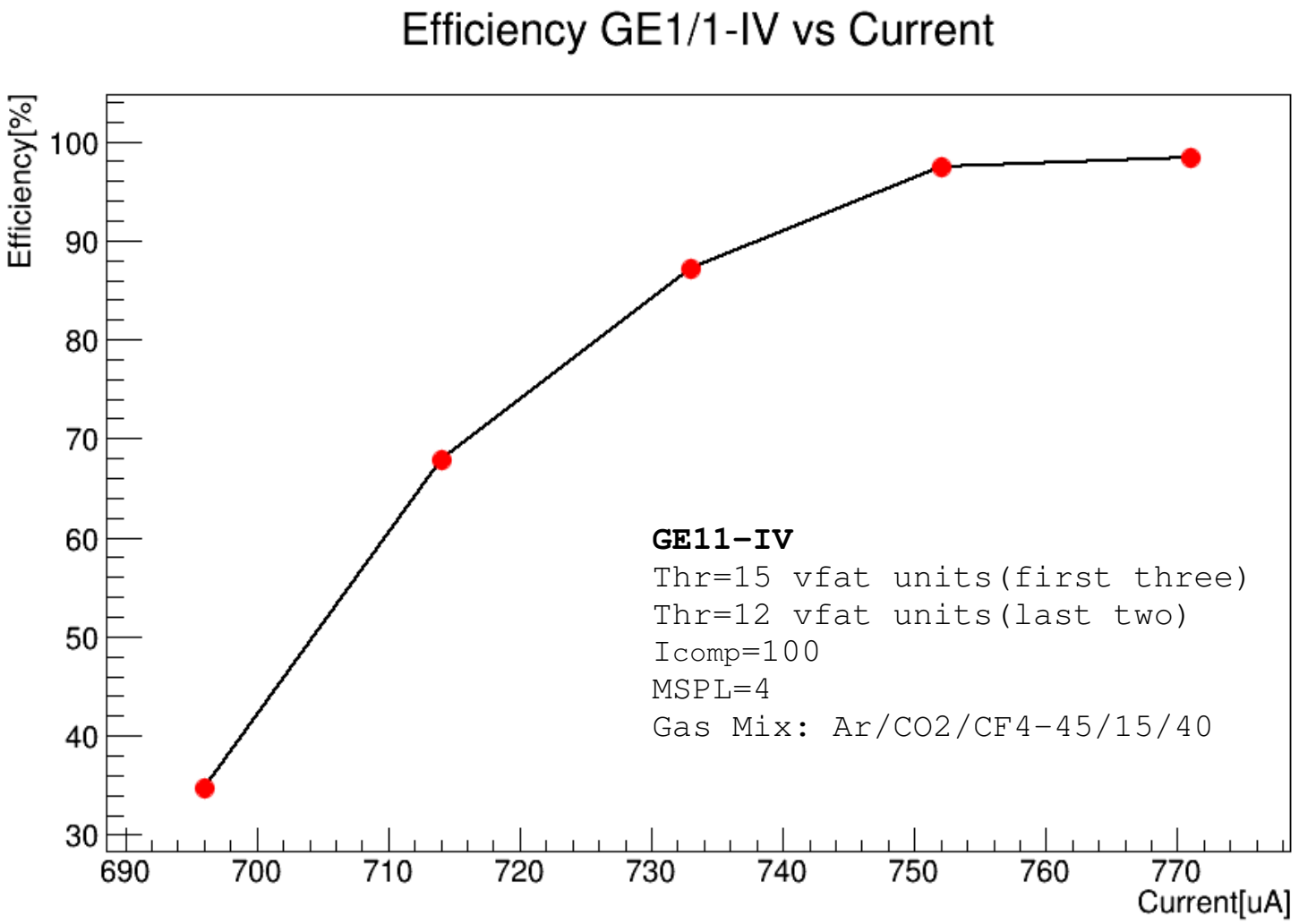
Preliminary Result



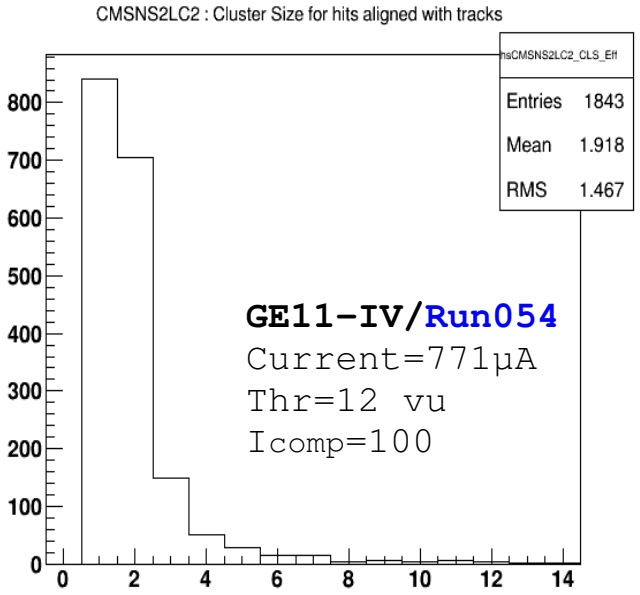
GE11-IV
Thr=15 vfat units
Icomp=100
Gas Mix: Ar/CO2/CF4-45/15/40

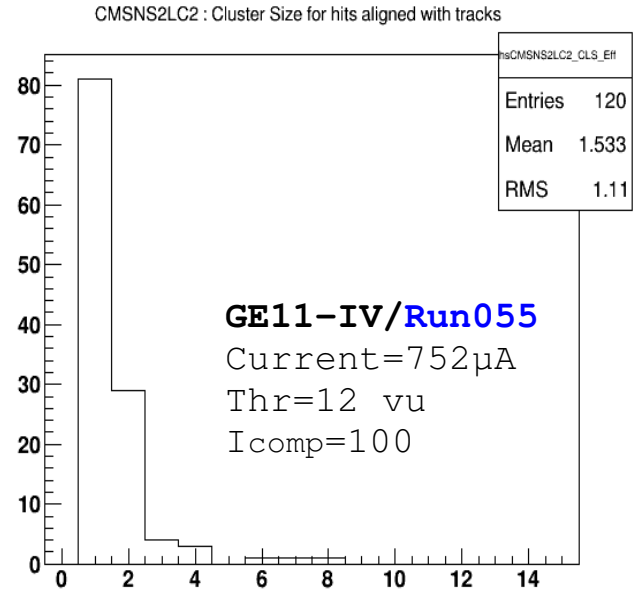
Efficiencies

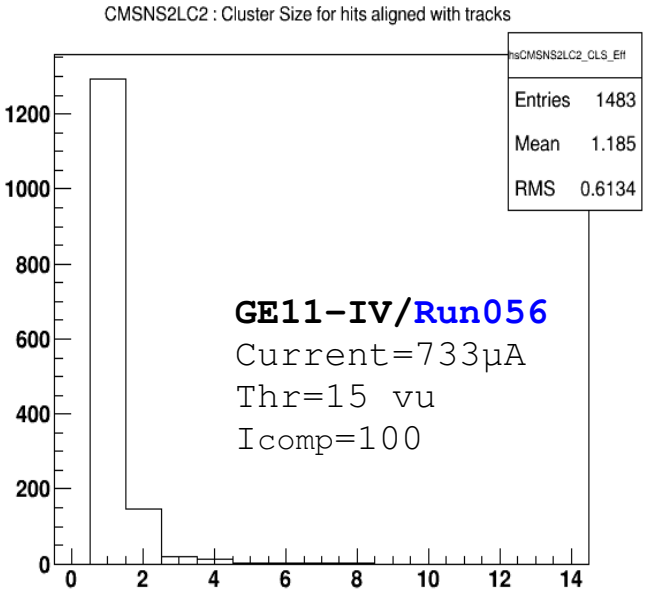
Runs : 054->058
HV : 4250-> 3850

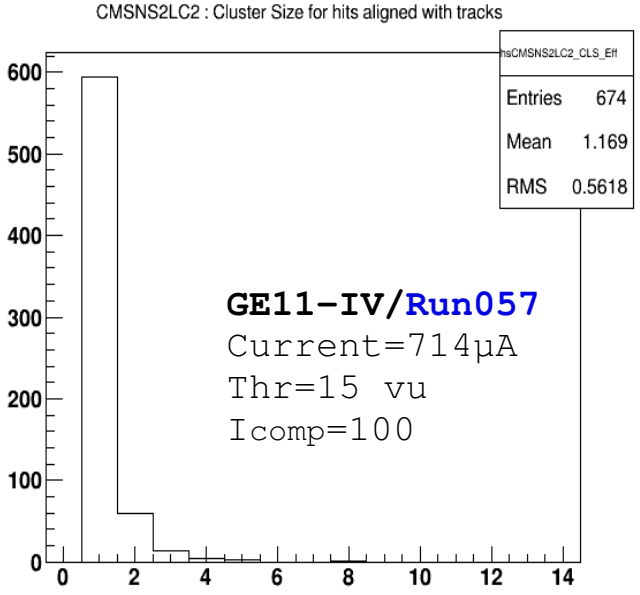


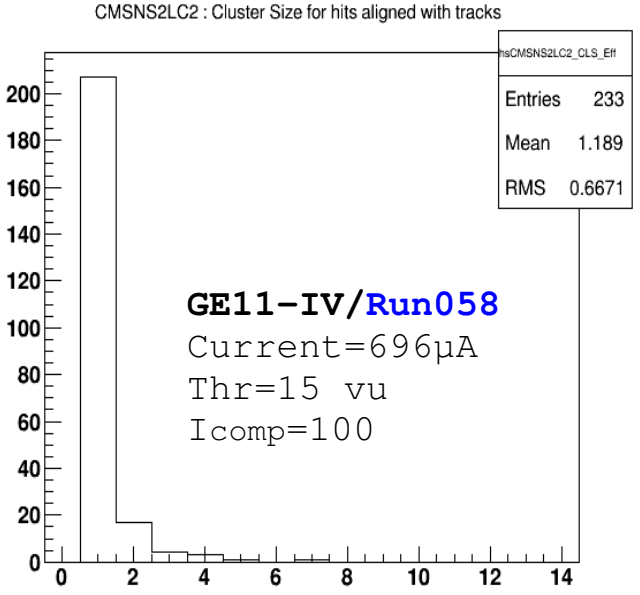
Cluster Size Distribution (pion beam)





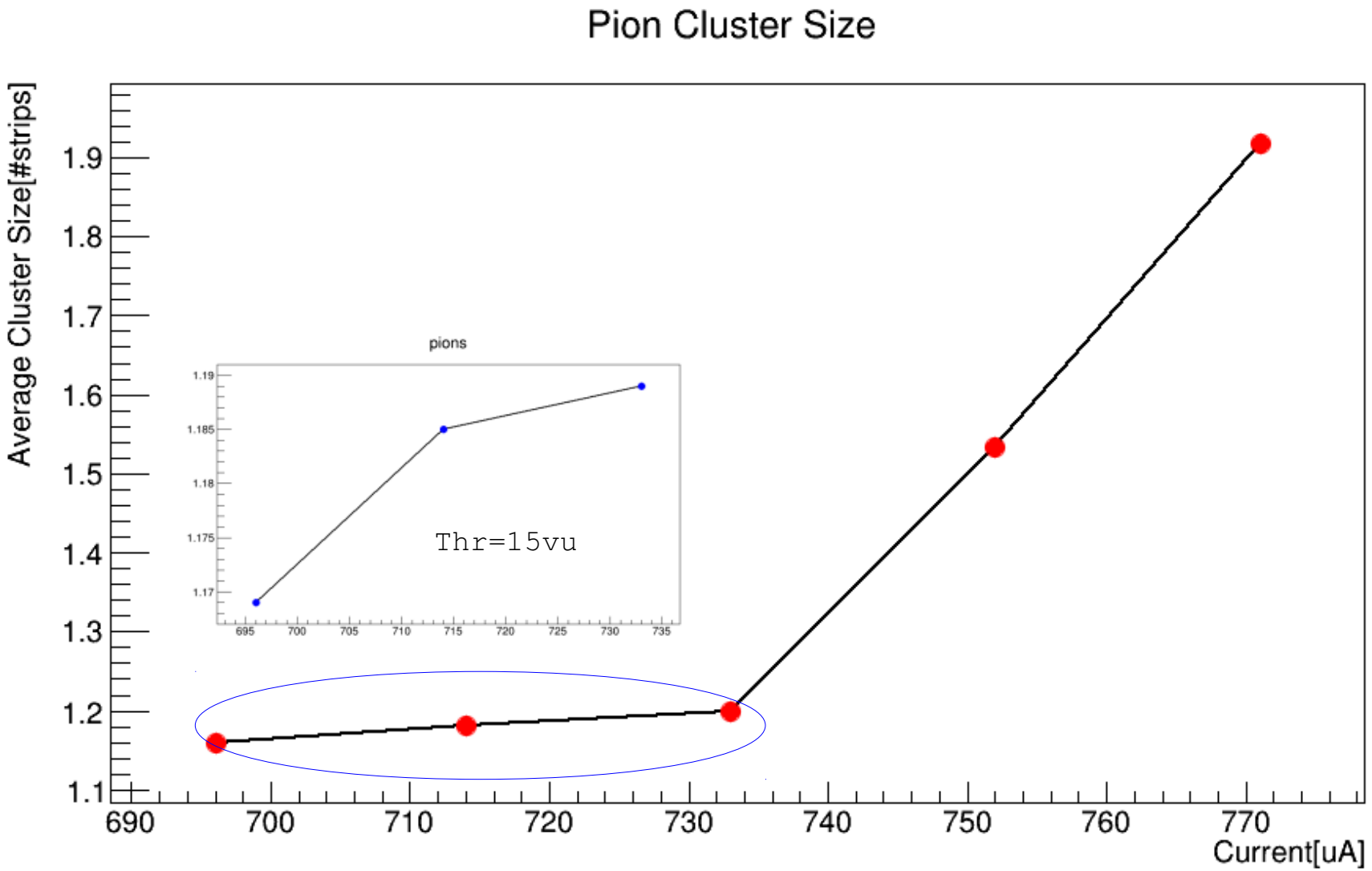




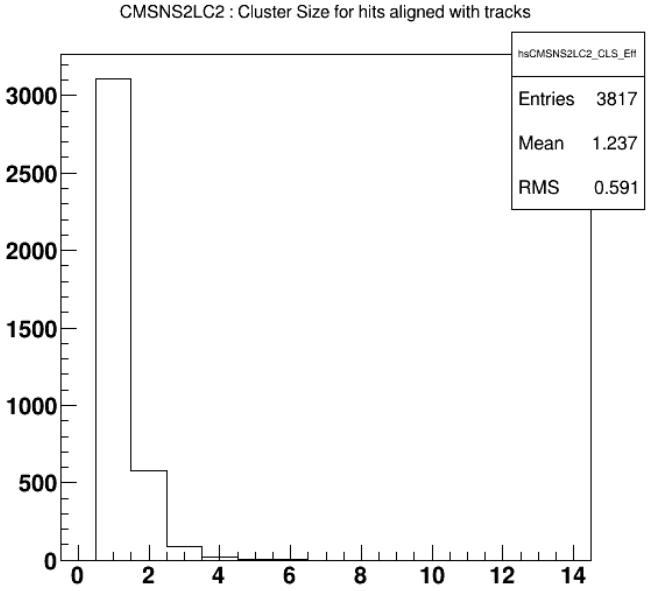


Cluster Size

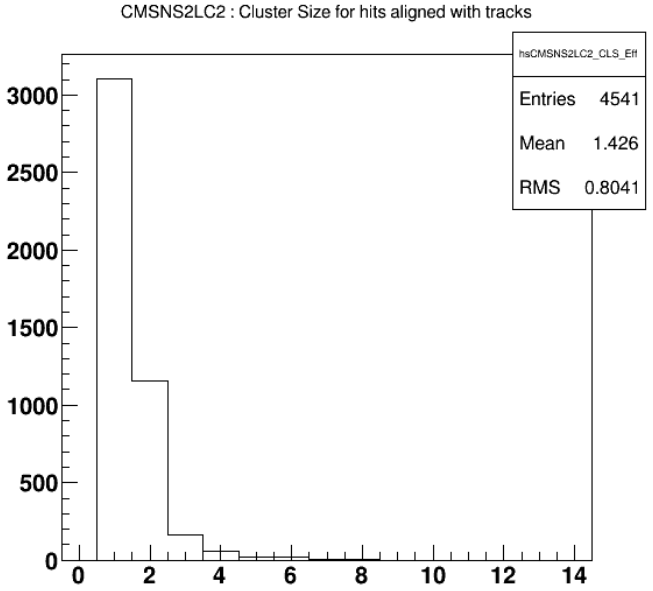
Runs : 054->058



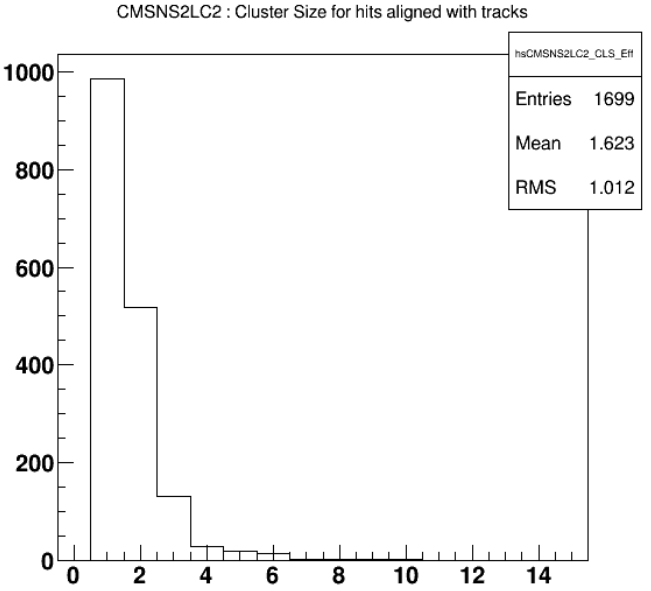
Cluster Size Distribution (muon beam)



GE11-IV/Run064
Current=752µA
Thr=15 vu
MSPL=1
Icomp=100



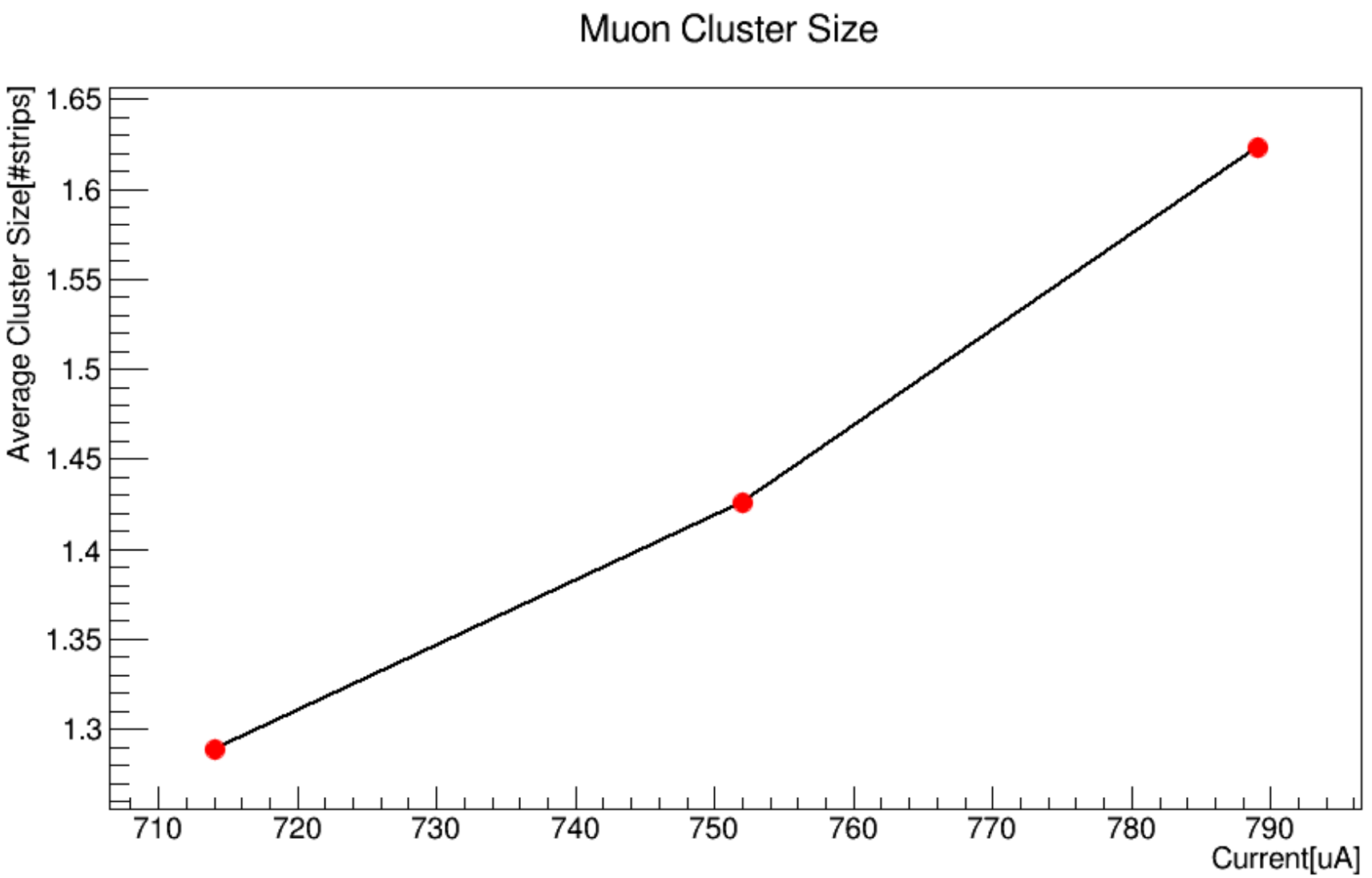
GE11-IV/Run065
Current=771µA
Thr=15 vu
MSPL=1
Icomp=100



GE11-IV/Run066
Current=789µA
Thr=15 vu
MSPL=1
Icomp=100

Cluster Size

Runs : 064->066



Conclusion

- GEM 1/1 chambers put in the Test-beam and tested with Pion&Muon beams
- New detectors added to the analysis software and new detector configurations used
- Maxiumum obtained efficiency is around 98.5%
- Space resolution is compatible with theoretical value and pitch
- Average cluster size is less than 2 in number of strips (0.9 mm strip pitch)
- Operated up to high gains of order 10^4