Data Analysis for GEMs

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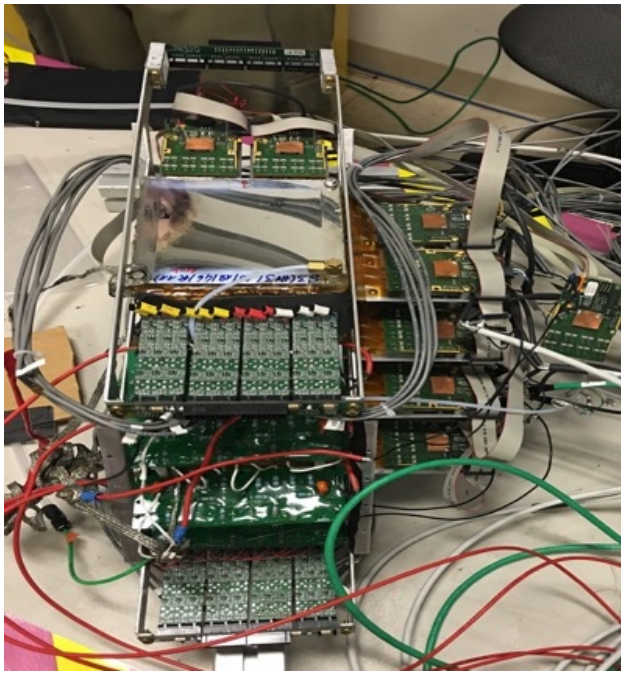
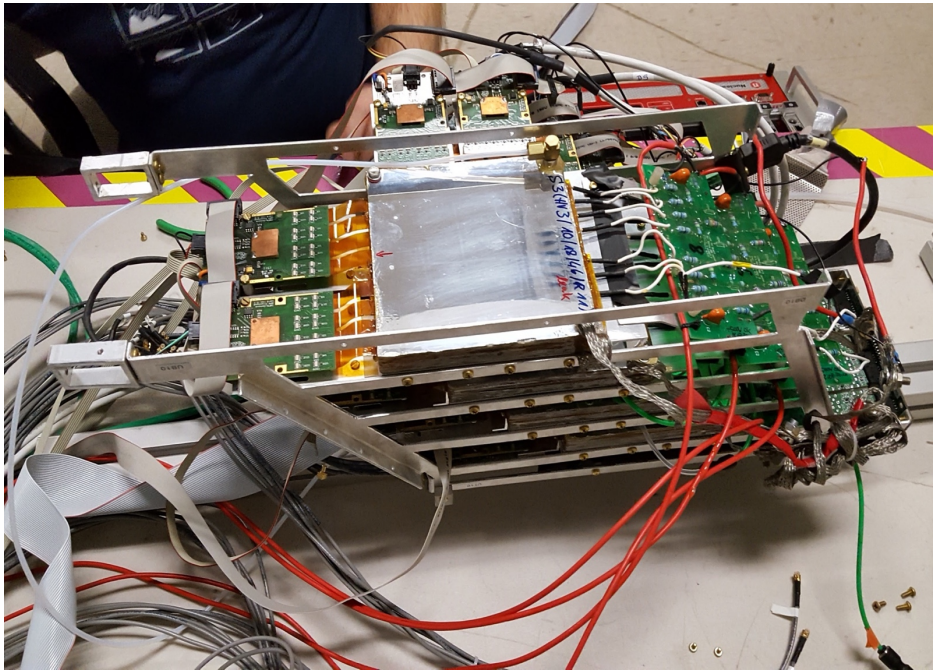
DarkLight Collaboration Meeting

March 18, 2017

GEM Detectors

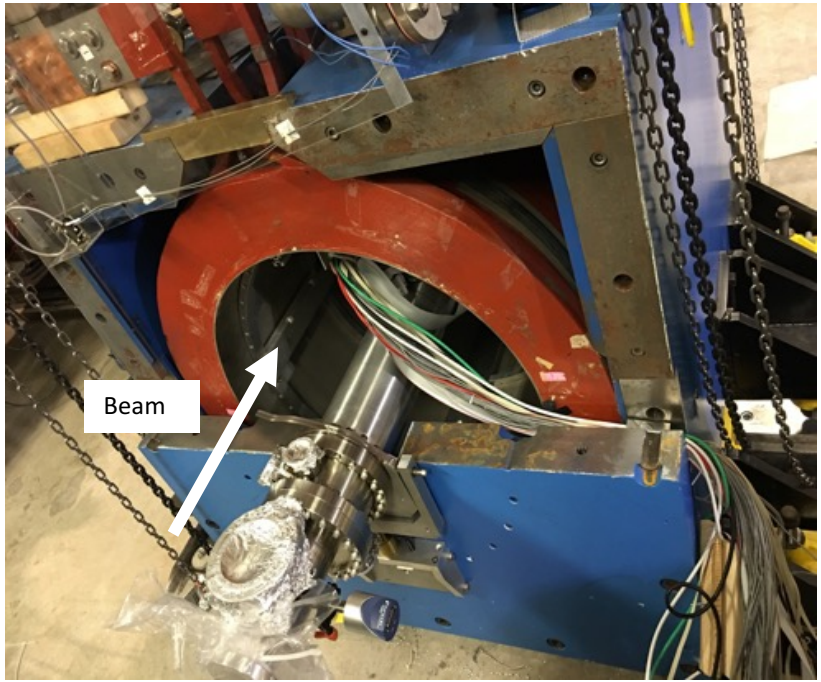
- 4 triple layer GEM chambers
- 2000 readout channels in total

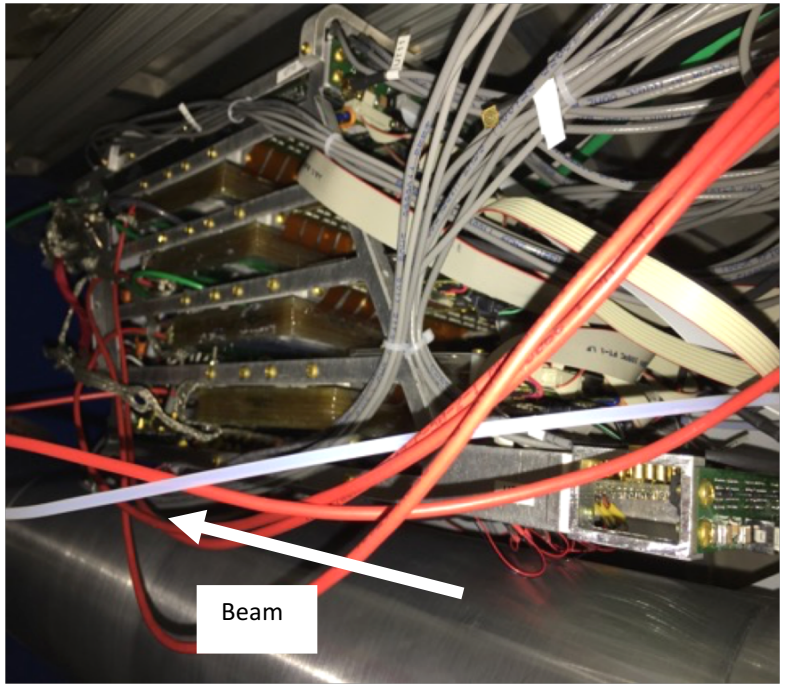




Installed GEM Detectors

- The GEM stack was installed inside the solenoid above the beam pipe





Engineering Run Aug-Sep 2016

- Initial study of target, beam and detector operation
- Successfully acquired several millions of events.
  - ✓Took multiple latency scans to time in GEMs

    Latency – time interval between the actual trigger and response from the electronics

    Found latency 12 to be the optimistic value.
  - ✓Recorded large samples without target gas.
  - ✓Recorded 1k events with target at 300 mTorr

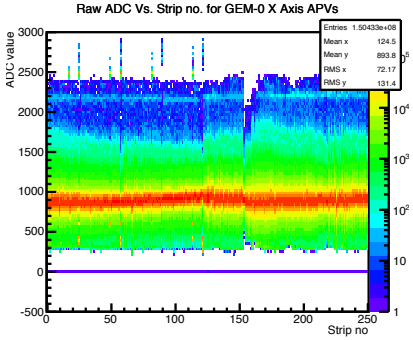
Data Analysis

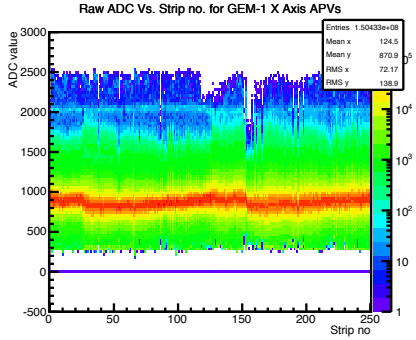
- Mapping to x and y coordinates still being validated. (Two different versions of APVs being used)
- Common mode noise subtraction and pedestal subtraction was applied on raw data to reduce background noise.
  - Common mode noise – Collective fluctuation of all channels from event to event
  - Pedestal - Average baseline to be subtracted, channel by channel

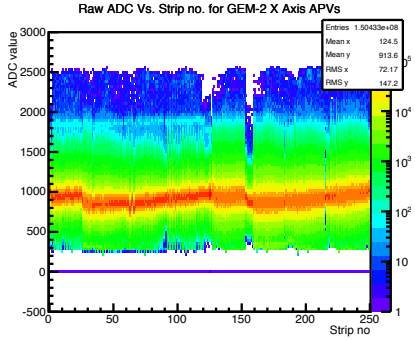
Raw ADC Spectra Vs. Strip number

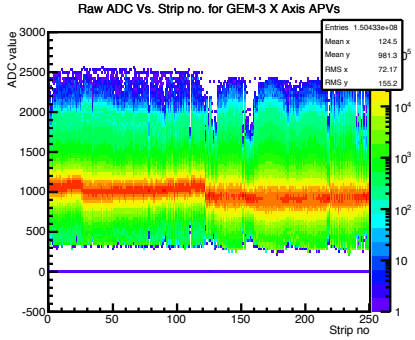
GEM 0 | GEM 1 | GEM 2 | GEM 3

X

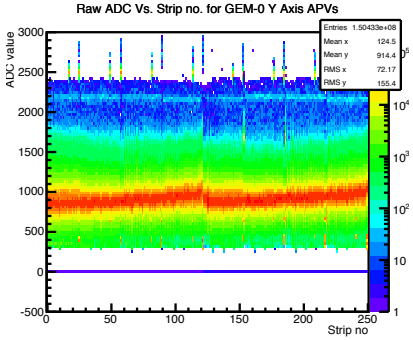


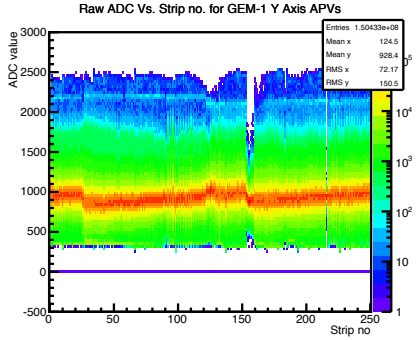


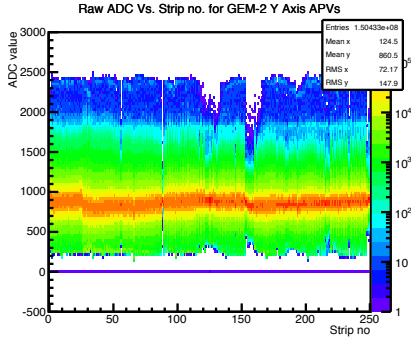


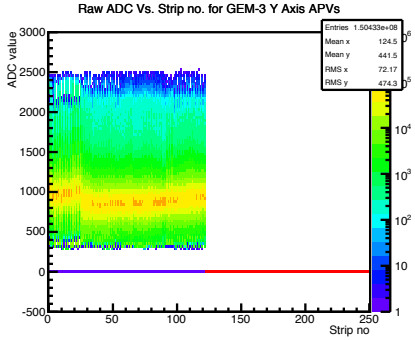


Y

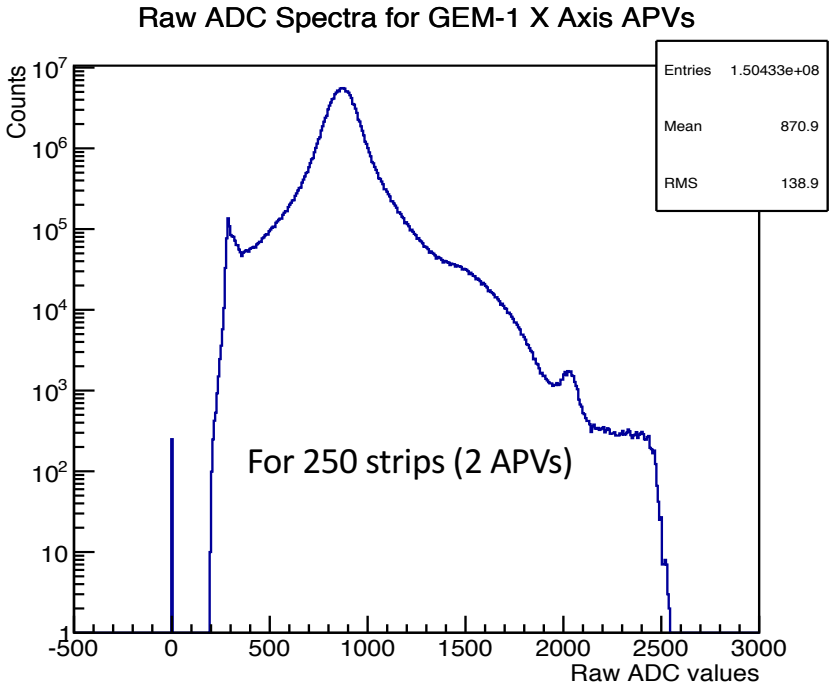


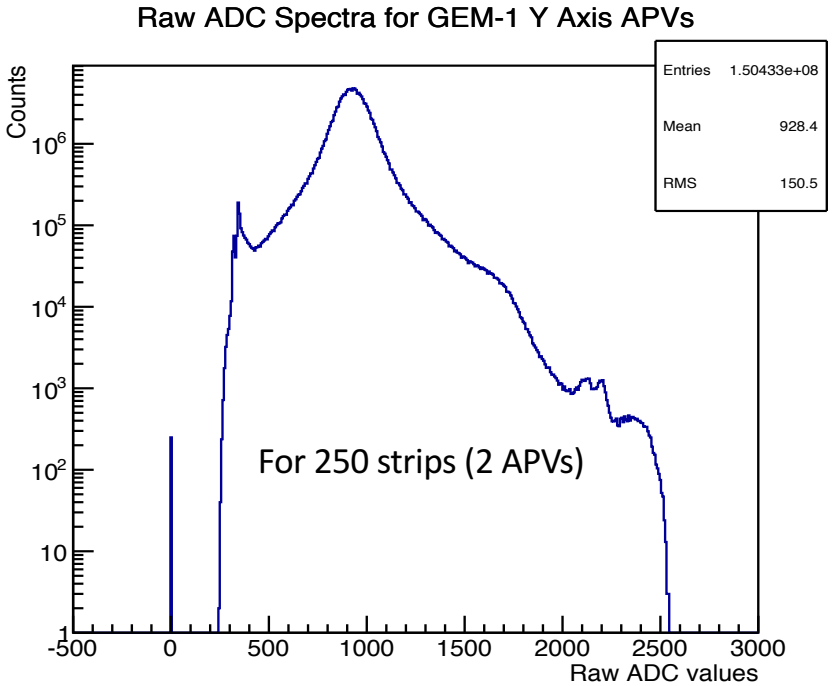




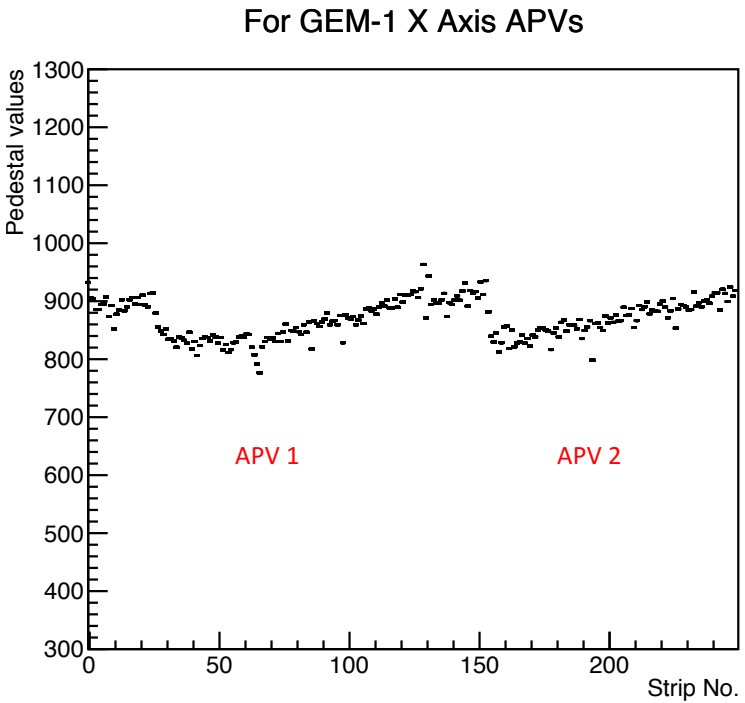


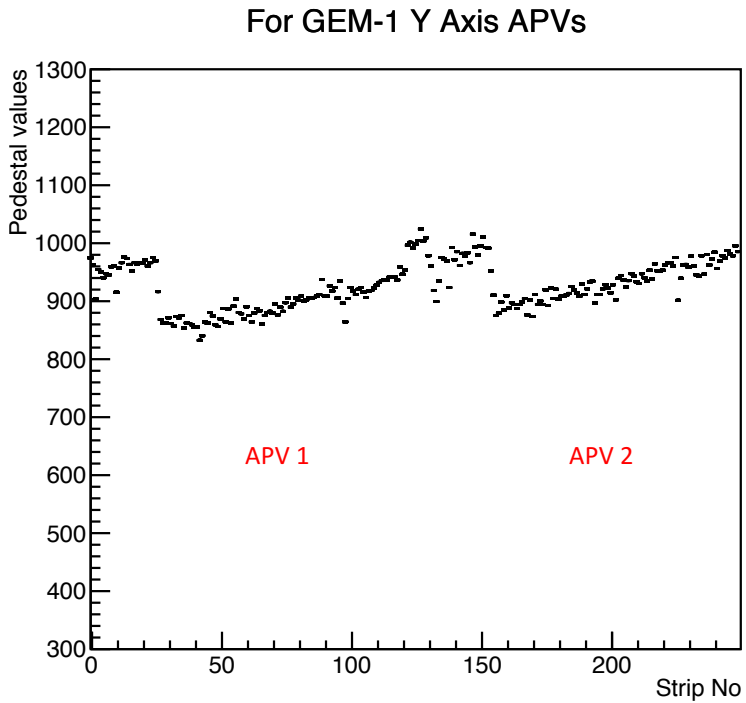
Raw ADC Spectra



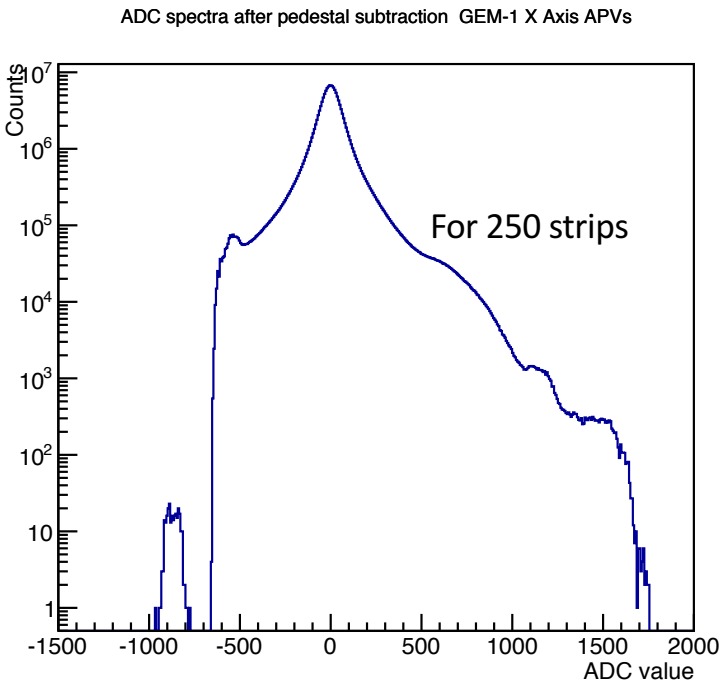


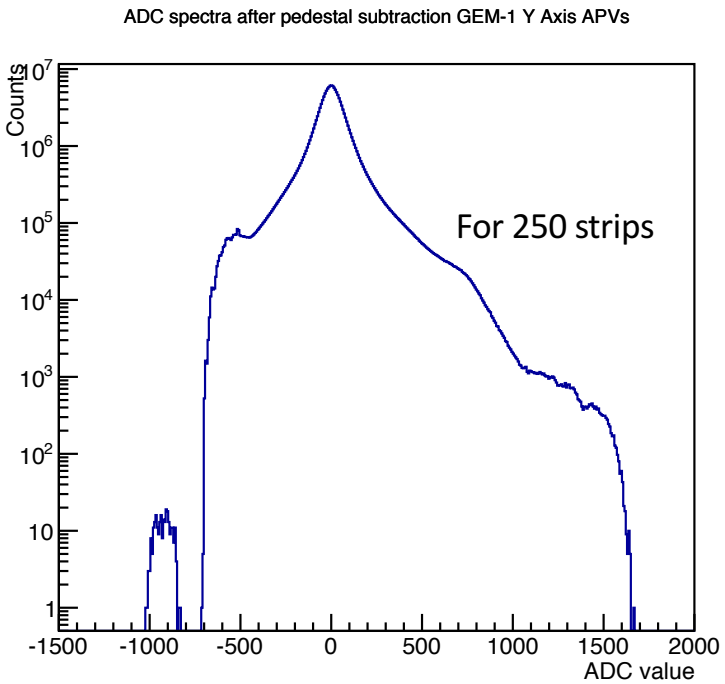
Peak location of ADC spectra Vs. Strip number



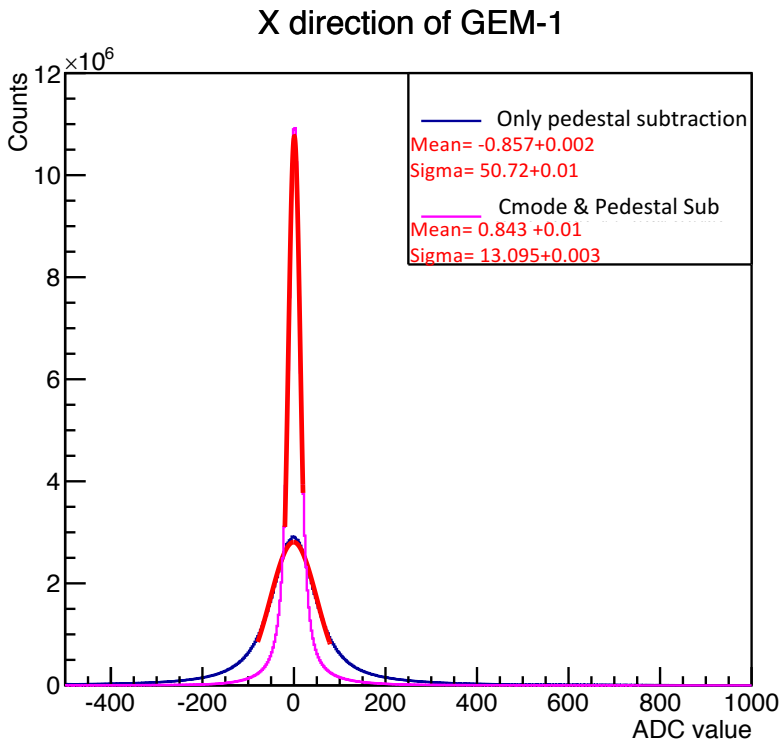


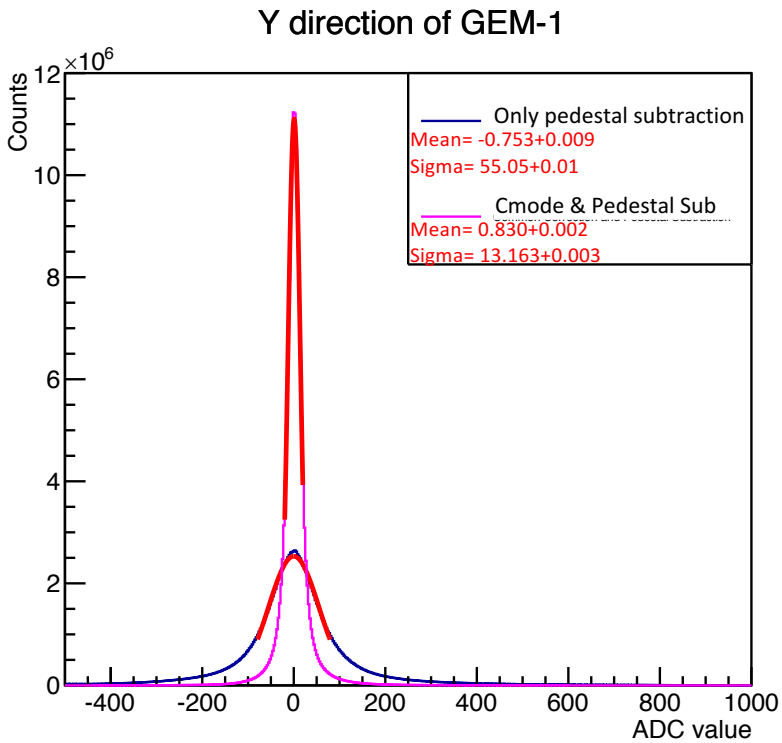
Pedestal Subtracted ADC Spectra



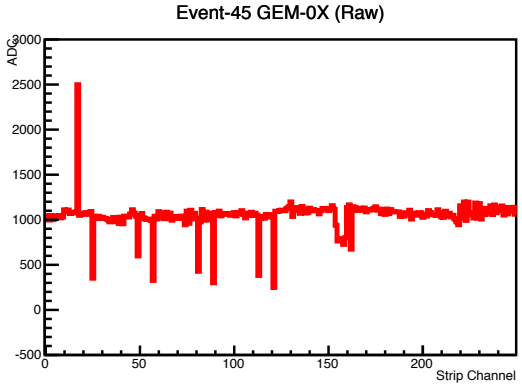


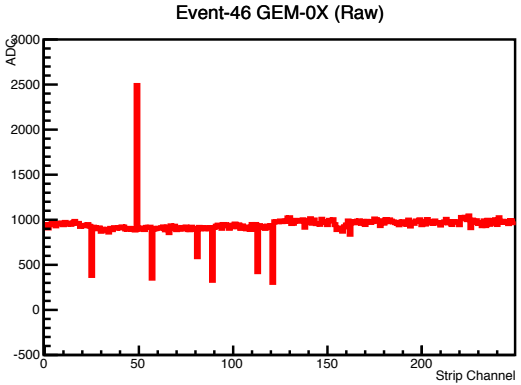
Before and After Common mode noise correction

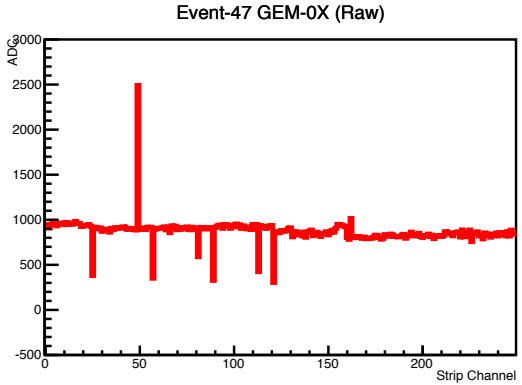


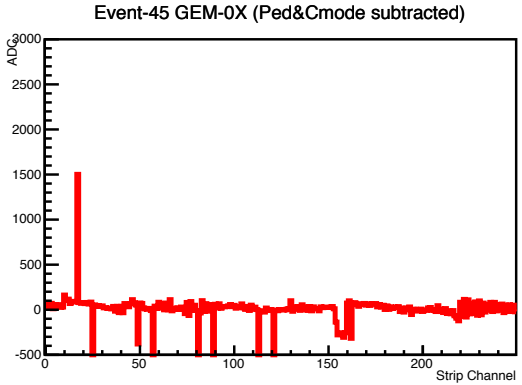


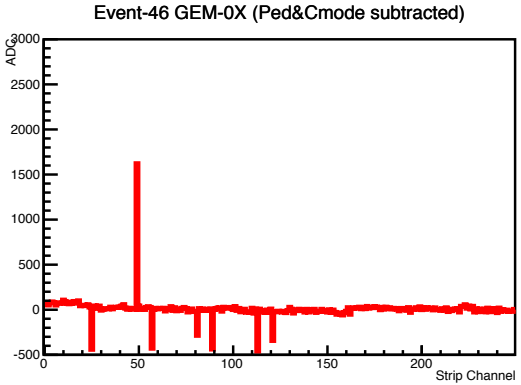
Event by event scan – DL data

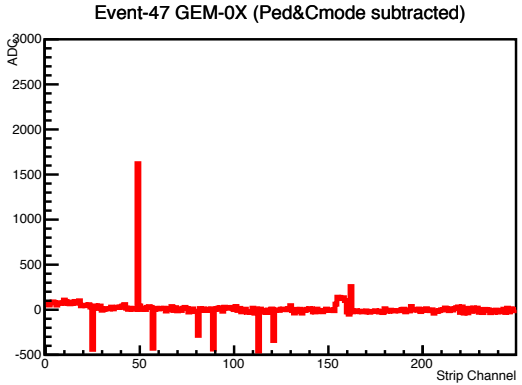




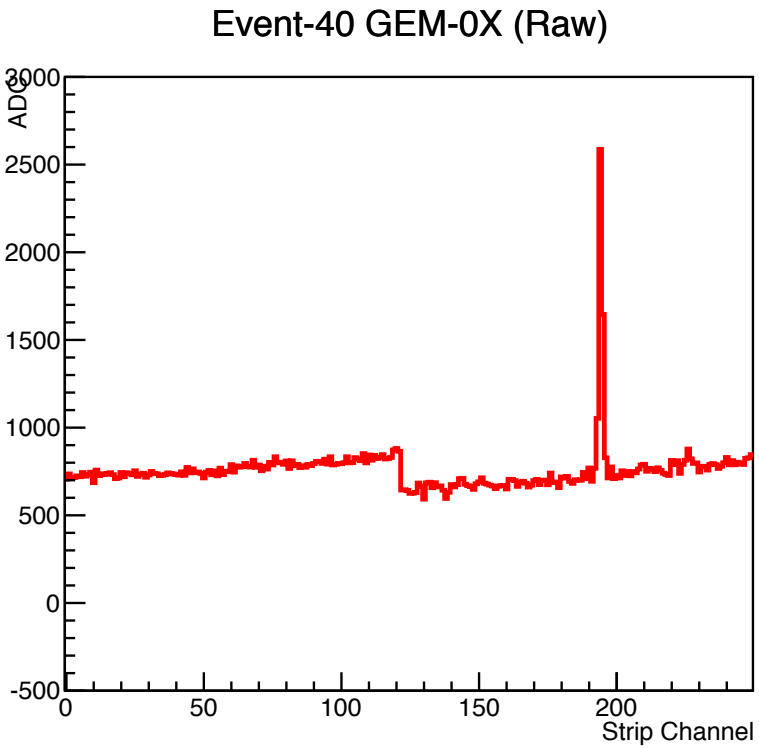


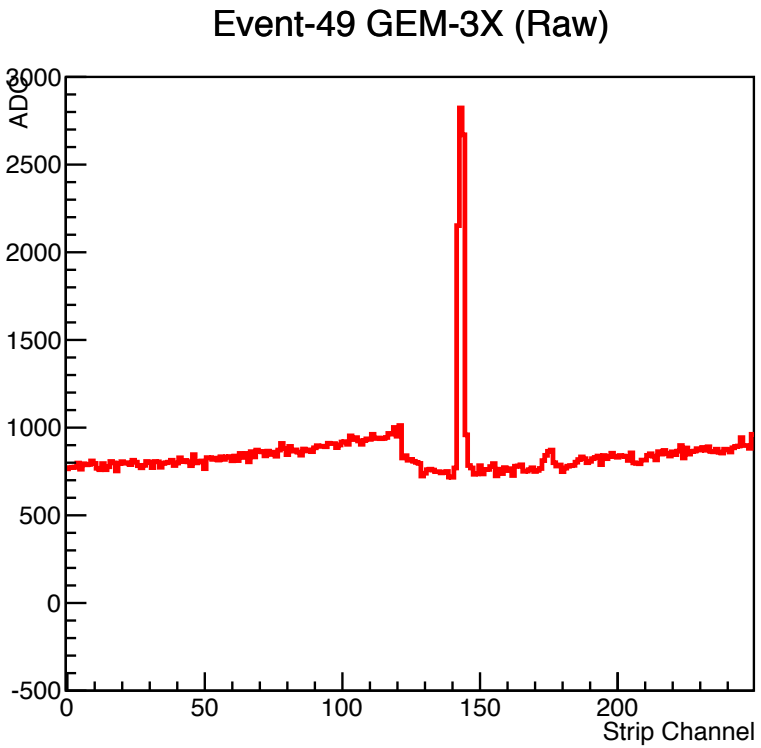






Event by event scan – Cosmic Rays



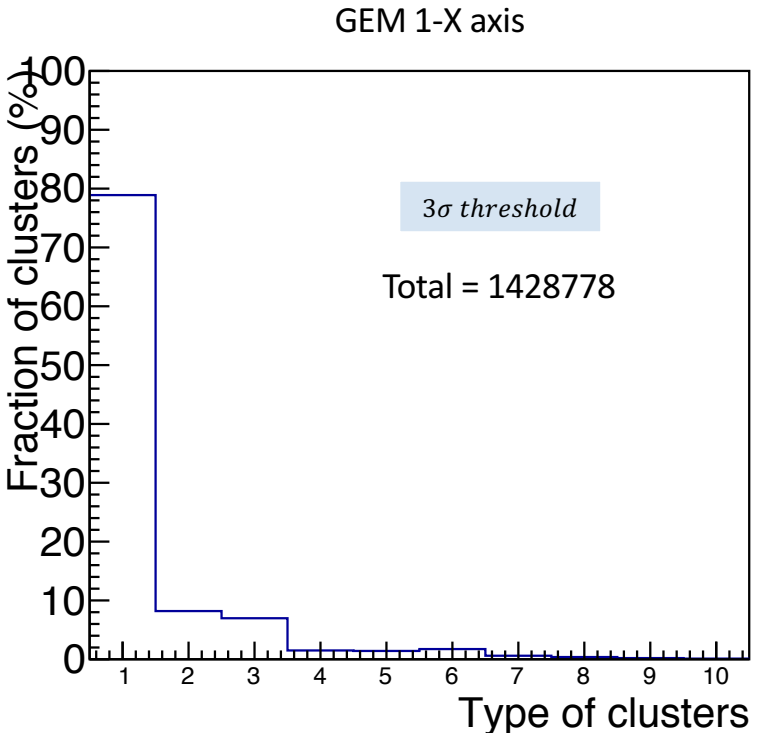


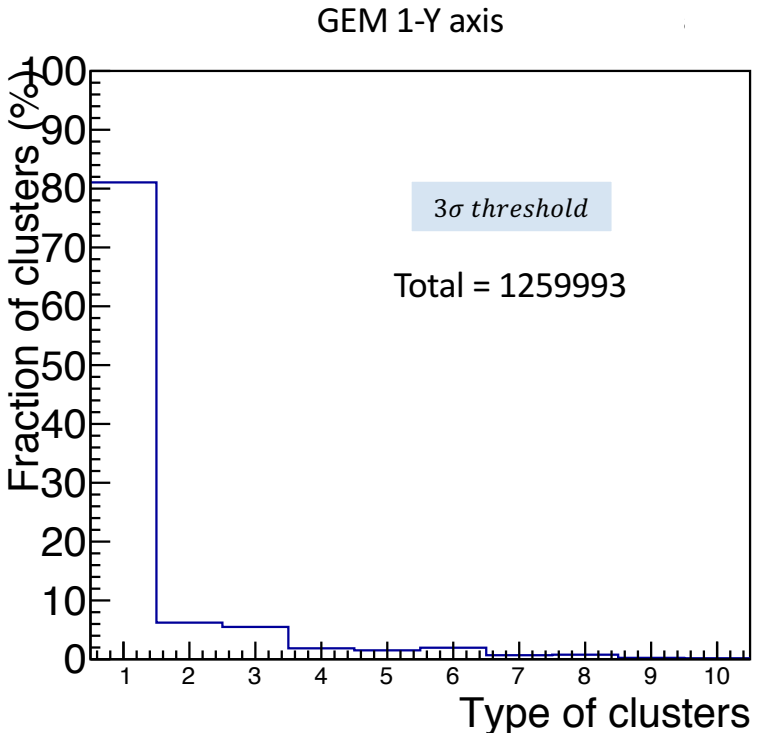
Cluster Analysis

Clusters

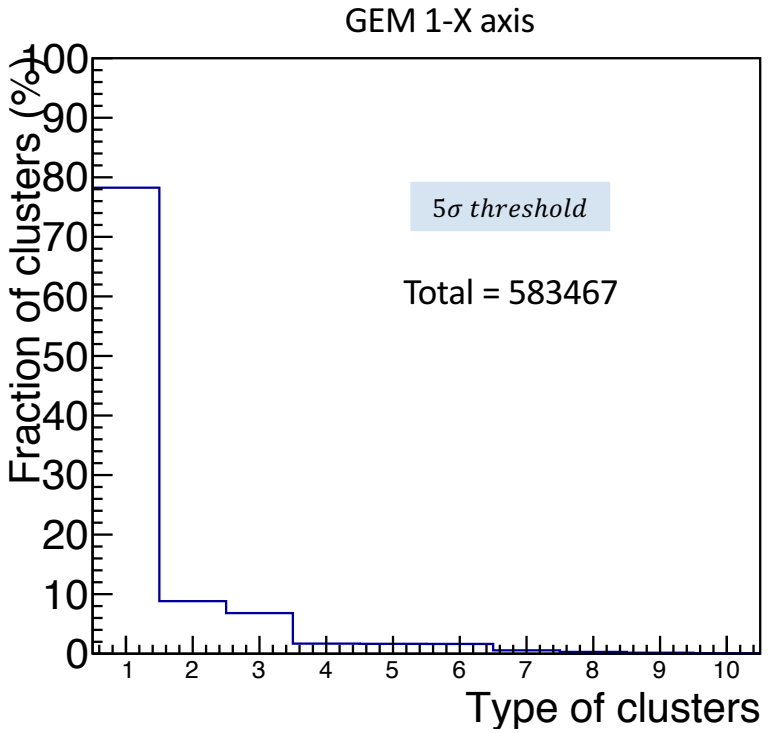
- The method used to find clusters was adapted from TREK MWPC analysis (written by Tongtong Cao).
  - An array of adjacent hits
  - Hit is an ADC value above imposed threshold
  - Categorized in to multiplets, such as singlets, doublets, triplets and so on.

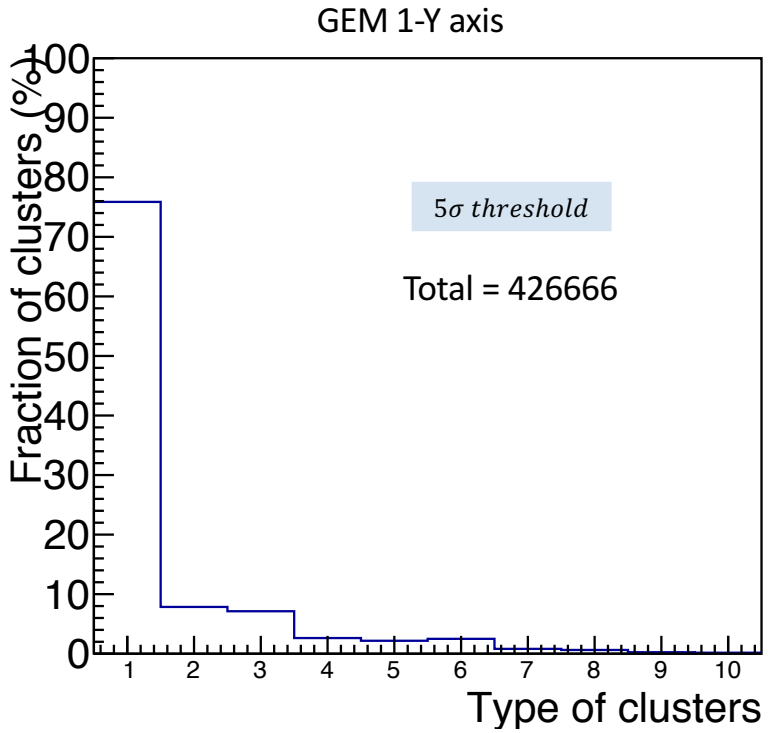
Hit multiplicity



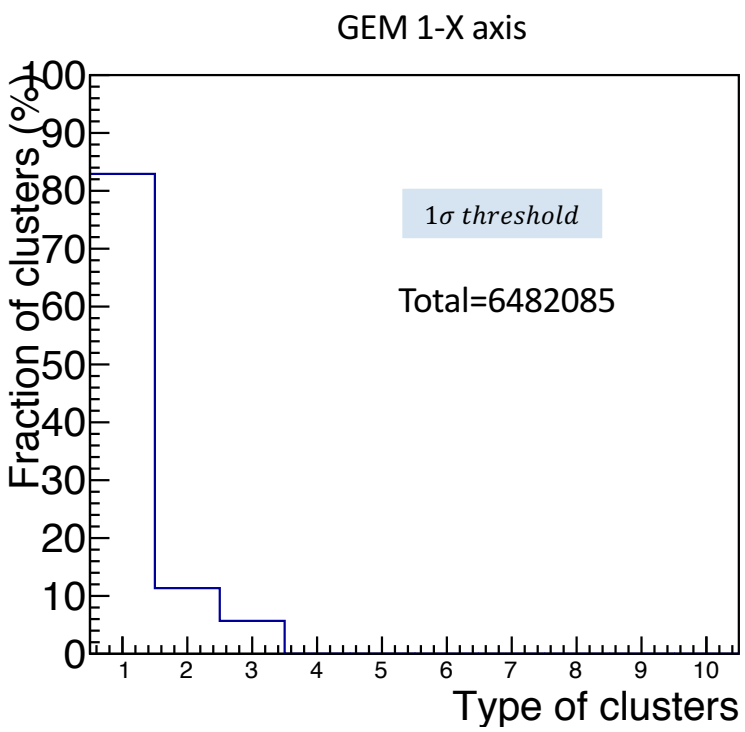


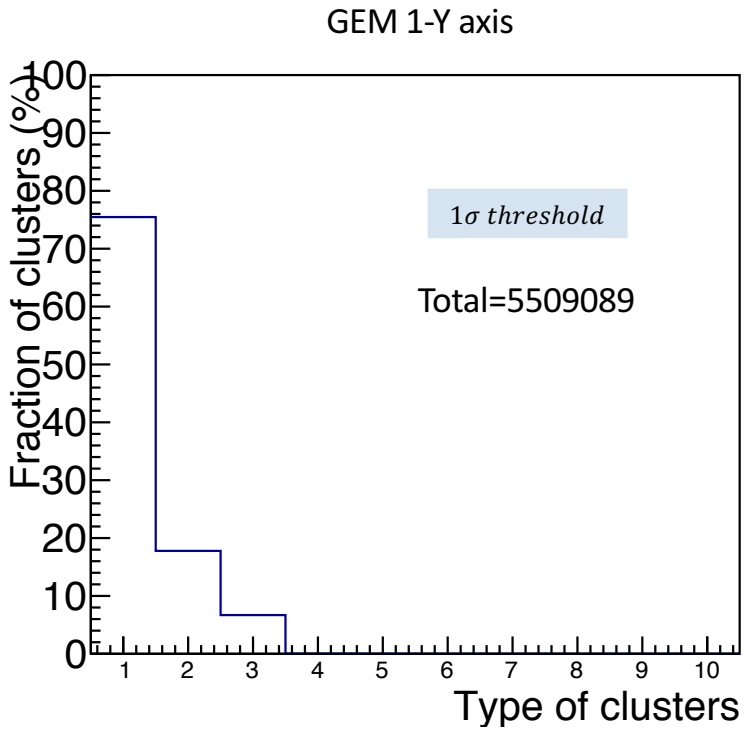
Hit multiplicity



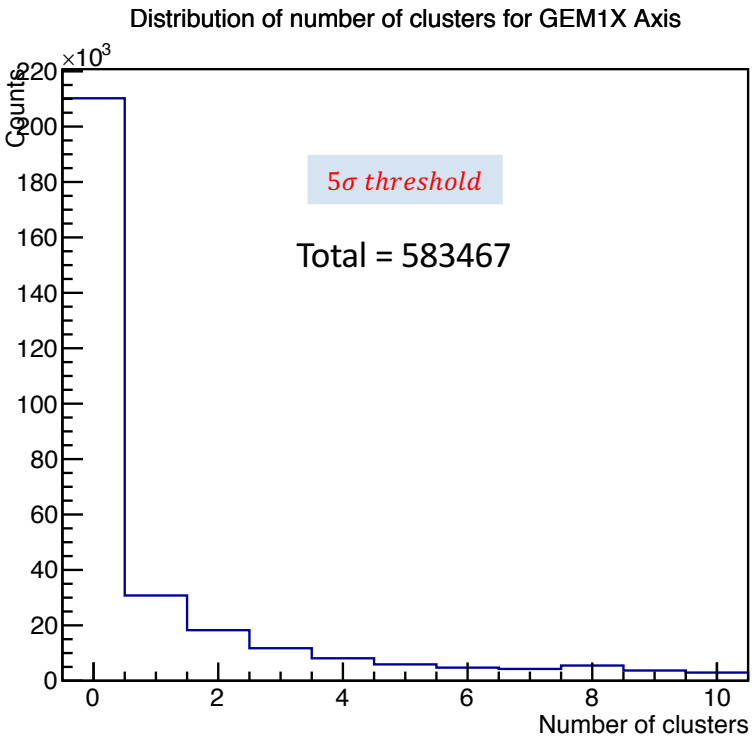


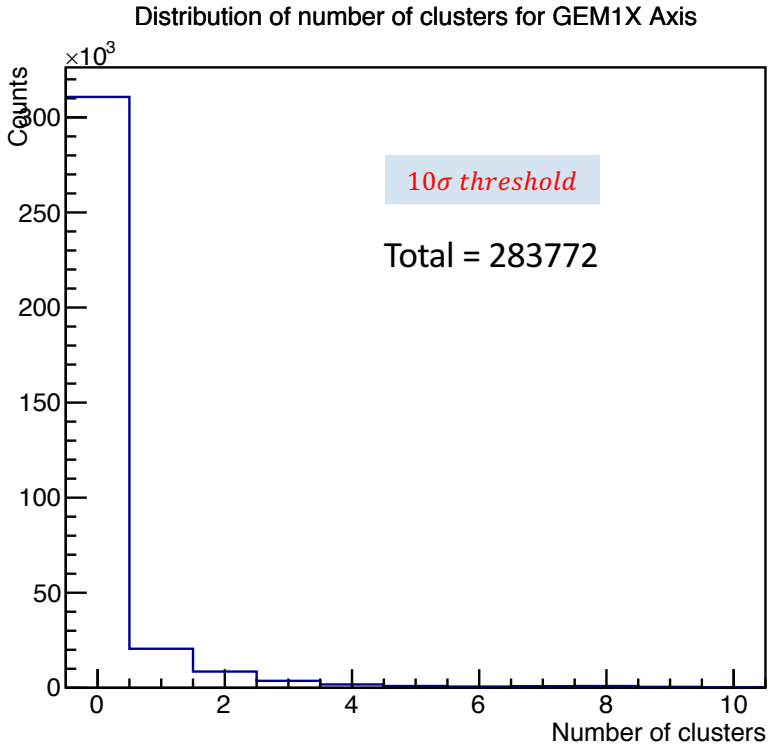
Hit multiplicity – Cosmic data



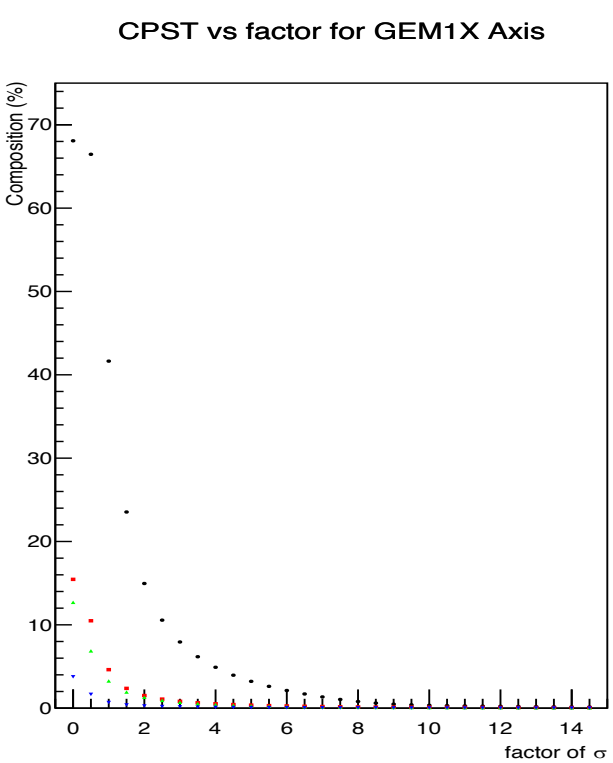


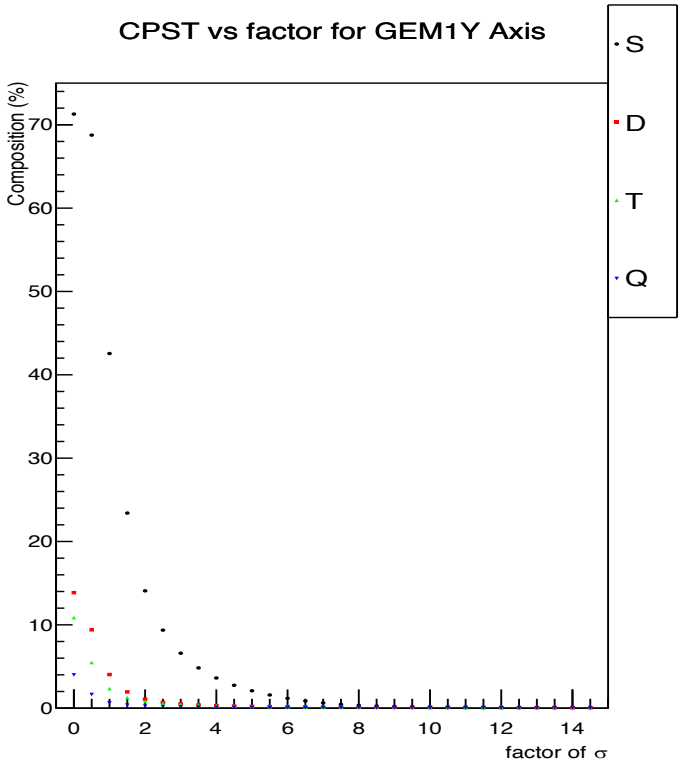
Distribution of number of Clusters per event





Distribution of clusters Vs. threshold





Summary

- Successful commissioning run
- Took several millions of events

Run number	Events	Run condition
158	122k	Empty target
165	600k	Empty target
200	1k	Target in

- Pedestal and common mode noise subtraction done
- Cluster analysis in progress

THANK YOU