GEM Report DarkLight

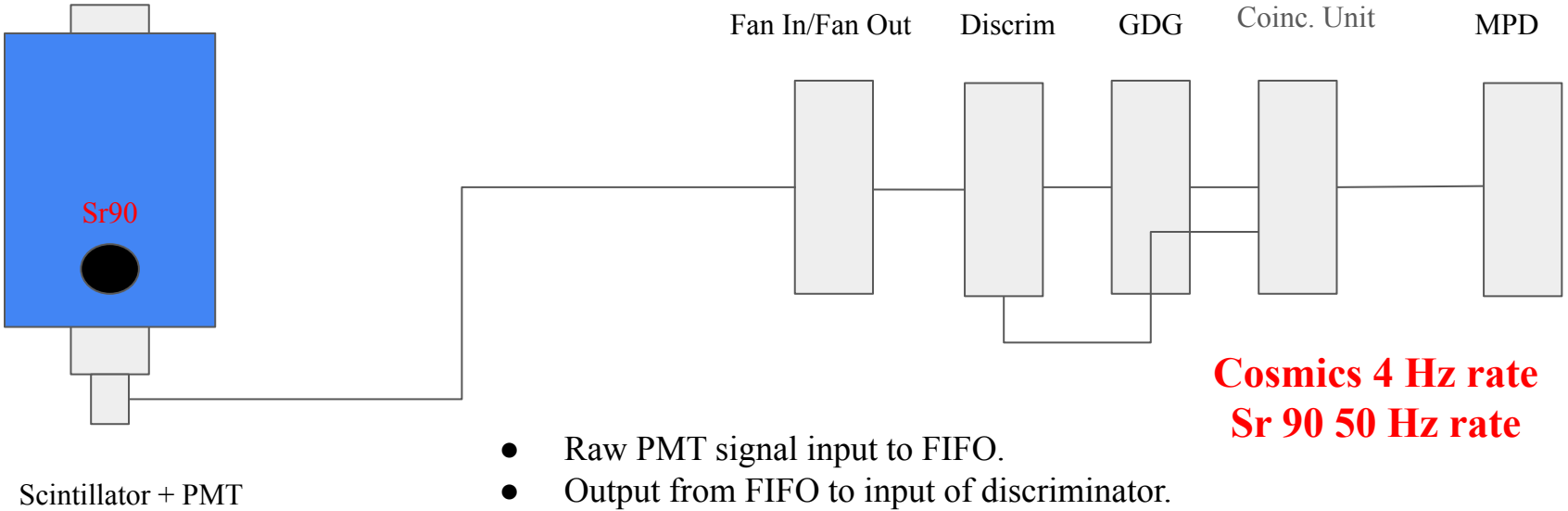
July 11, 2024

Outline

- Setup
- Latency/ADC threshold studies
- Mapping
- Identified Problems
- Two GEM stand
- Further Commission Tasks/Outlook

Setup

GEM active area 400 x 250 mm^2

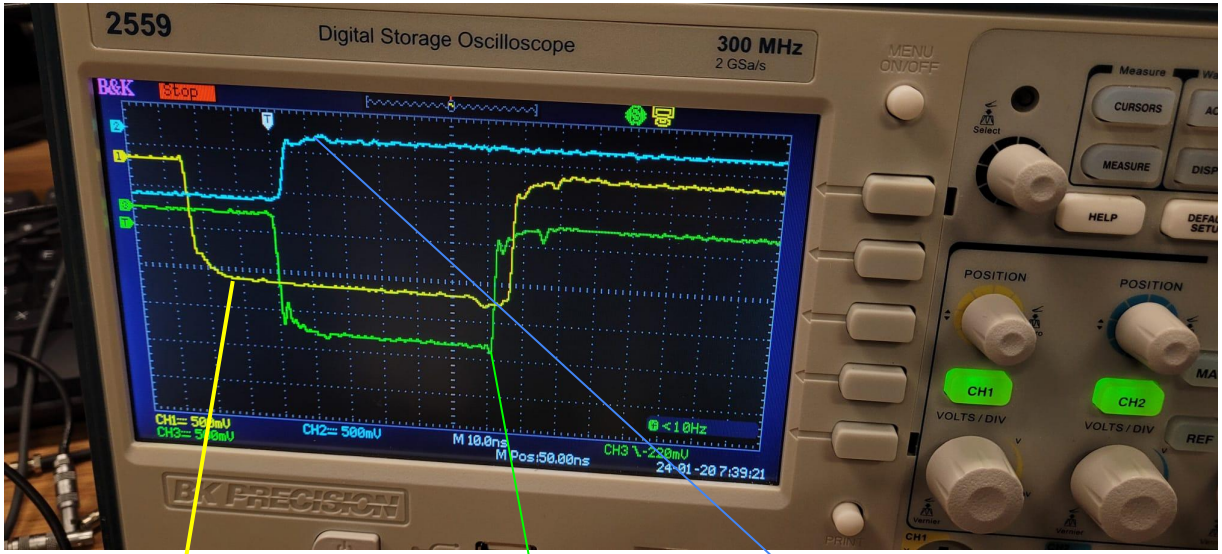


Scintillator + PMT

Cosmics 4 Hz rate
Sr 90 50 Hz rate

- Raw PMT signal input to FIFO.
- Output from FIFO to input of discriminator.
- One copy of the output from discriminator to input of gate/delay generator, which creates 2 ms latch output
- Take the NOT gate output from the GDG and other copy of discriminated signal as inputs to the coincidence module to form AND signal
- Output AND signal is sent to the MPD.

Trigger Timing



Discriminated signal

AND output

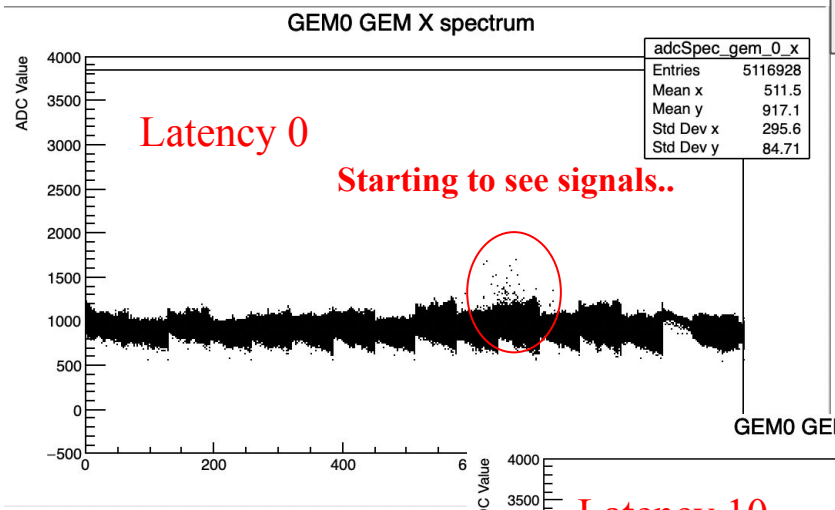
NOT Gate (Not BUSY signal)

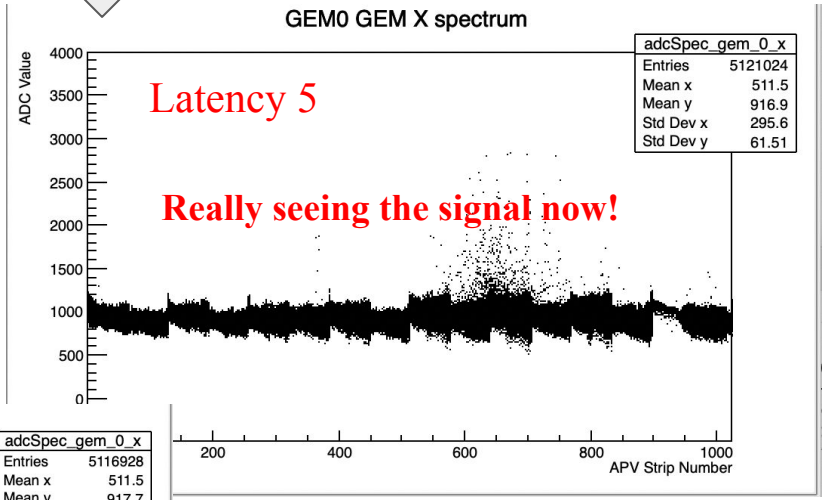
- Using the NOT gate output in coincidence with the discriminated output so that we can allow the first trigger to be sent to the MPD.
- The output from the gate/delay generator is produced roughly ~ 25 ns after the discriminated signal so that the first trigger can indeed pass through.
- The AND coincidence output has to be at least 25-50 ns long and be a negative NIM signal for the MPD to recognize it.

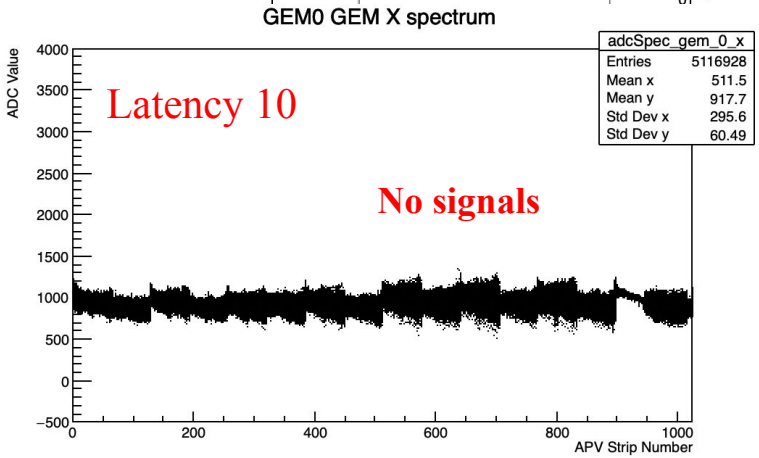
Latency and HV Scan

- The APVs have a 4 μs buffer. The latency refers to how far back one has to go in order to probe the buffer. If the trigger takes a long time to create, then the farther in time we must go back to probe.
- One latency unit is 25 ns, so 160 latency channels in the buffer.
- First started with finding the optimal latency (a parameter that is changed in a file) at fixed HV. Started with HV = 3700 V.
- Scanned the latency from 0 to 10 with this HV.
- After finding the optimal latency, scan at different HVs. We did from 3700-4000 V in steps of 50.

Finding the Latency (HV = 3700)

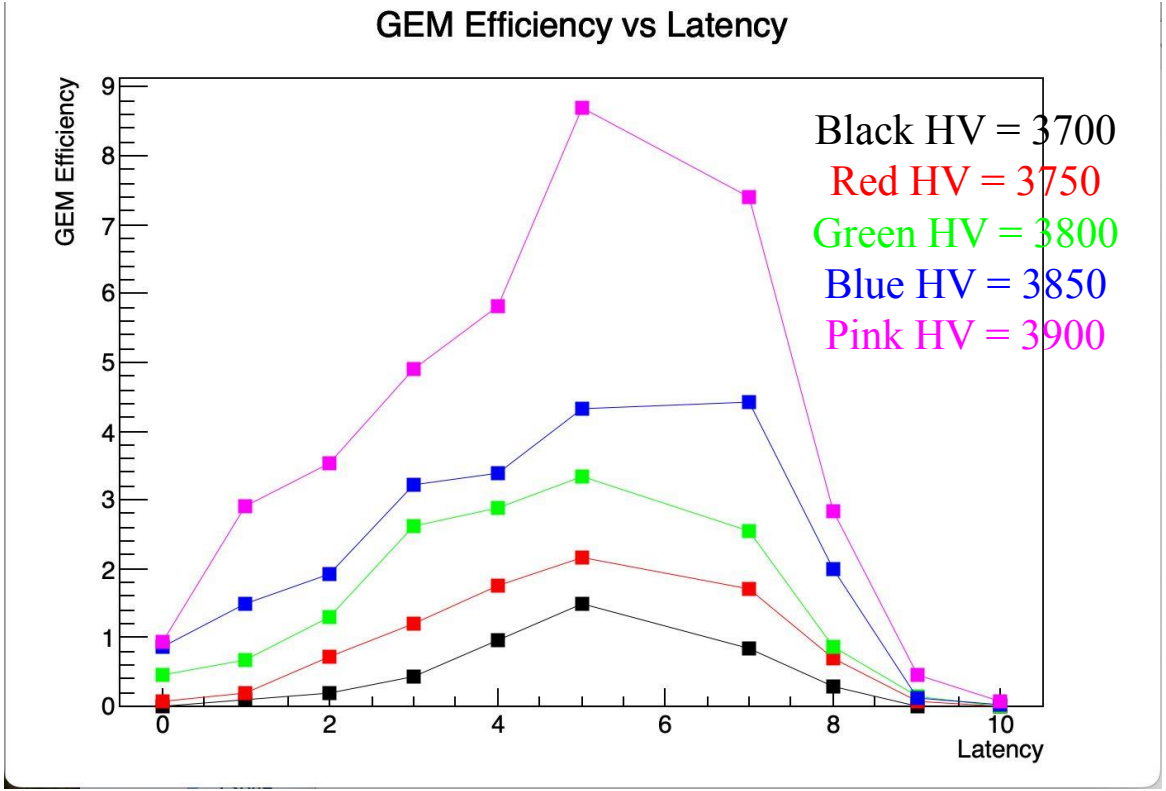






We chose latency 5 to be optimal…

GEM “Efficiency” vs Latency



Latency = 6 omitted…One problematic run…

- We initially defined the efficiency as the ratio of clusters found over the number of events. The number of events was renormalized to account for the fact the trigger had both Sr90 and cosmics.
- In the software, there is a minimum ADC threshold which is used to identify possible cluster candidates. This threshold was set to 500 for this plot. So, we now have another parameter to scan but this is software driven

GEM efficiency

- Take the latency 5 runs and look at the cluster multiplicities per event. Then the efficiency ε is then

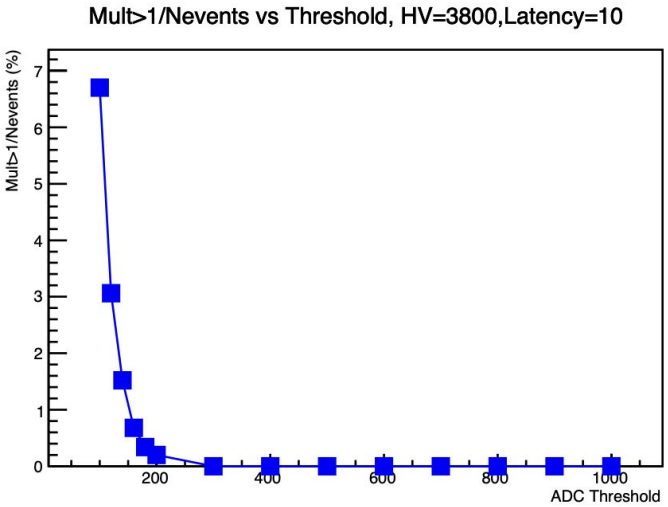
>1 multiplicity indicative of noise present. Should be 1 cluster/event for Sr90 (cosmics)

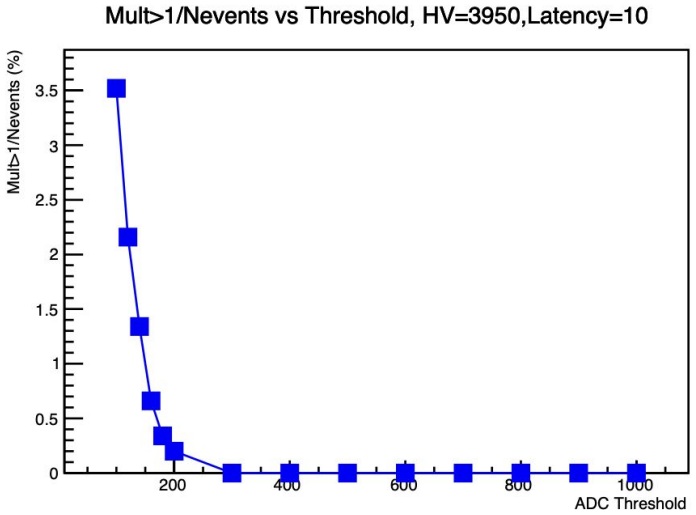
ε = # single cluster events/# of events

(1 - ε) = # no cluster events/# of events

- This works if S/N i.e., signal to noise ratio is big and noise is the same for all strips. We scan the peak finding threshold to suppress the multi cluster events. We can use the latency 10 data to probe the noise distribution and find the minimum peak threshold that suppresses the noise.

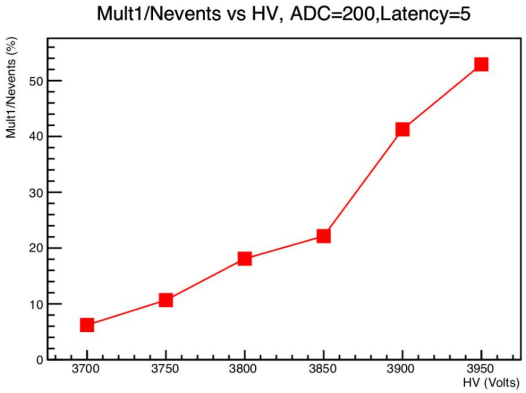
ADC Threshold Scan at Latency 10

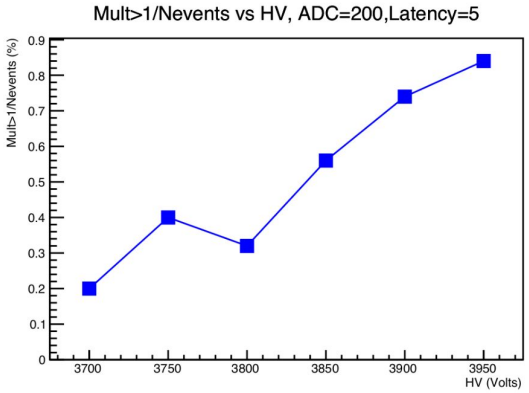


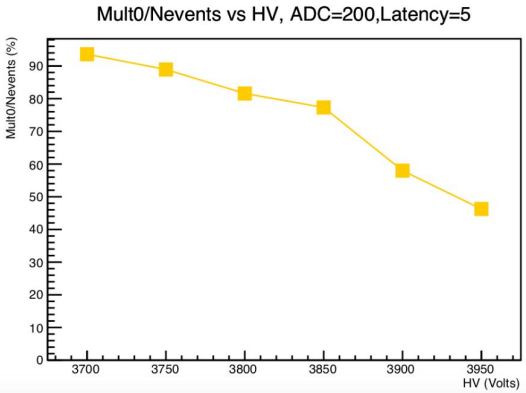


We do pick up more noise (i.e., multi-cluster events) with increasing HV, but < 0.5%, so we deduced that an ADC threshold of 200 is good enough to suppress this

GEM Efficiency vs HV (Latency 5)







- Multi-cluster events suppressed well suppressed (<1%) with this threshold.
- This is a global threshold but would like to move to a strip level threshold.

GEM Mapping

Strips: S0, S1, S2 …. (assume adjacent strips are connected to opposite pins in the panasonic connector, see table)

Panasonic Connector index
1=GND, 2, 3 … 129,
130=GND

APV physical inputs: IN0 … IN127

Electronics channel index (from MPD): e0, e1 … e127

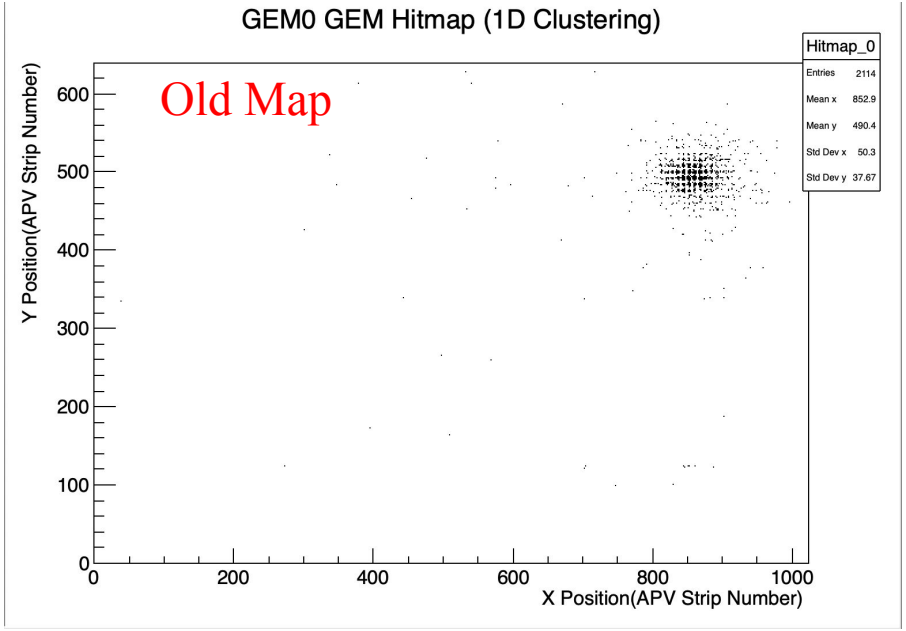
IN = 32 * (e MOD 4) + 8 * INT(e / 4) - 31 * INT(e / 16)
)

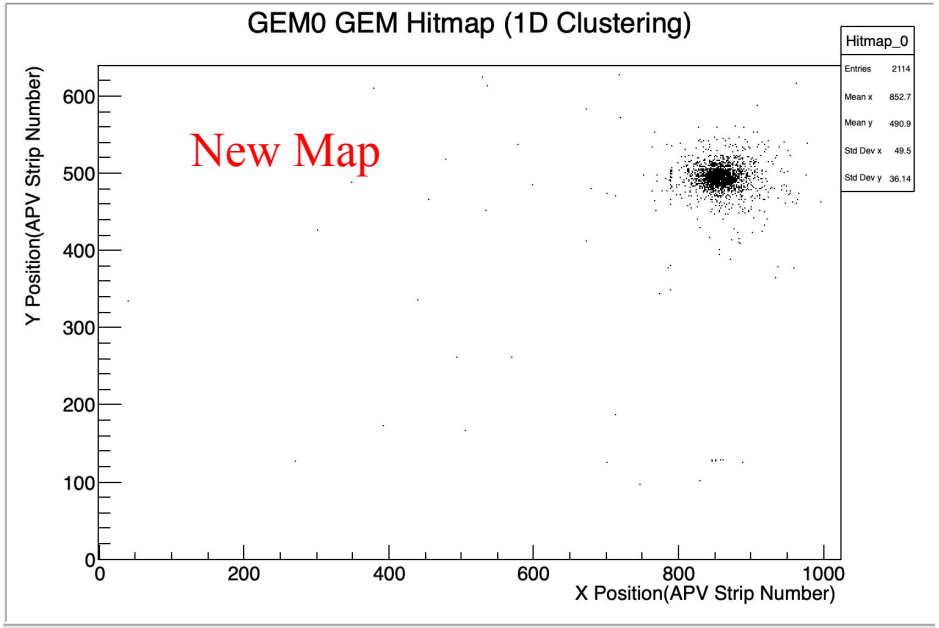
Strip (S)	0	1	2	3	4	5	6	7	8	9	10	11	12	…
Panasonic index	2	3	4	5	6	7	8	9	10	11	12	13	14	…
APV (IN)	4	0	5	1	6	2	7	3	12	8	13	9	14	…
Electronics index (e)	64	0	80	16	96	32	112	48	68	4	84	20	100	…

Slide from C. Ghosh

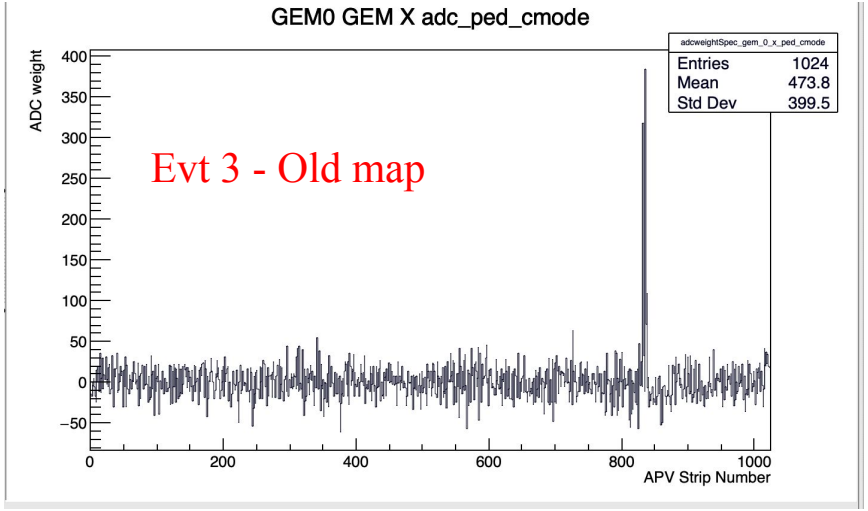
Mapping can also be inverted!

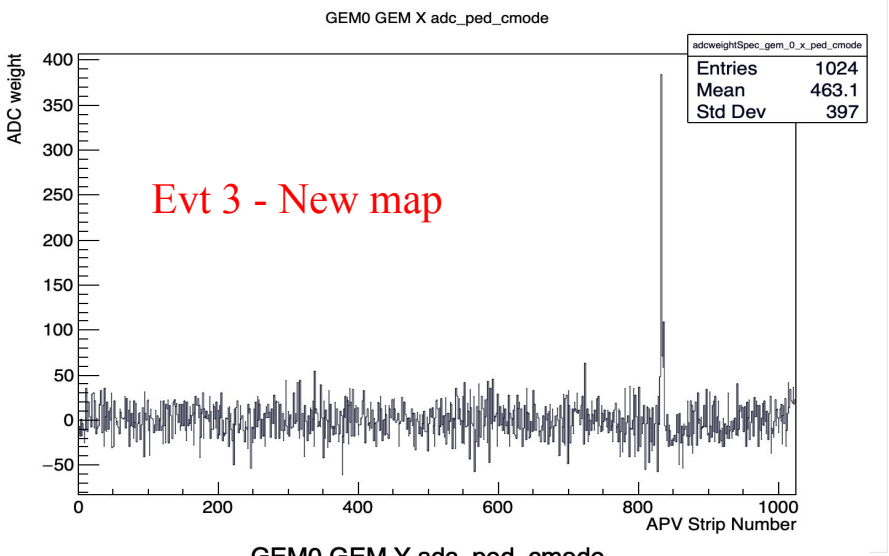
GEM Mapping

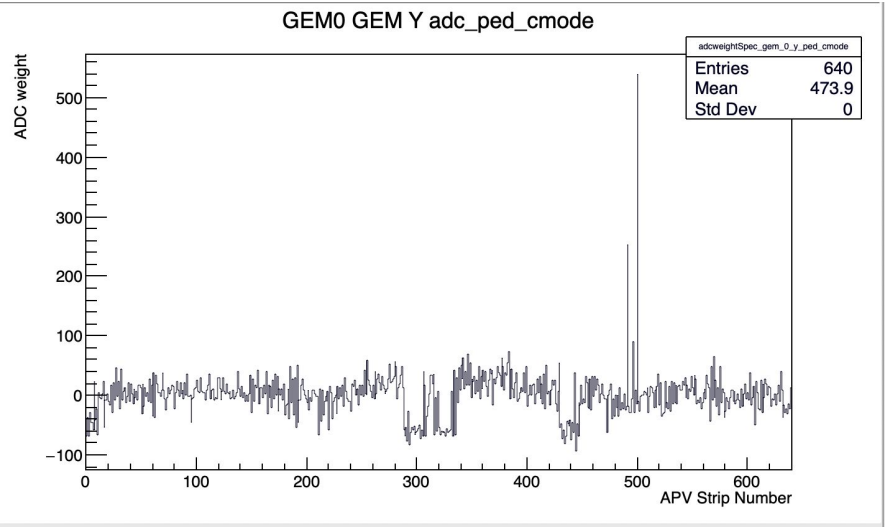


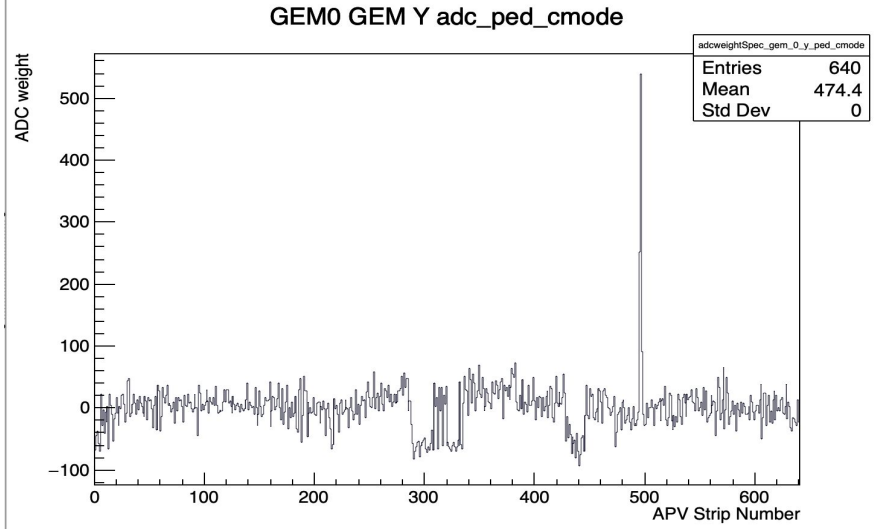


No fractured clusters…

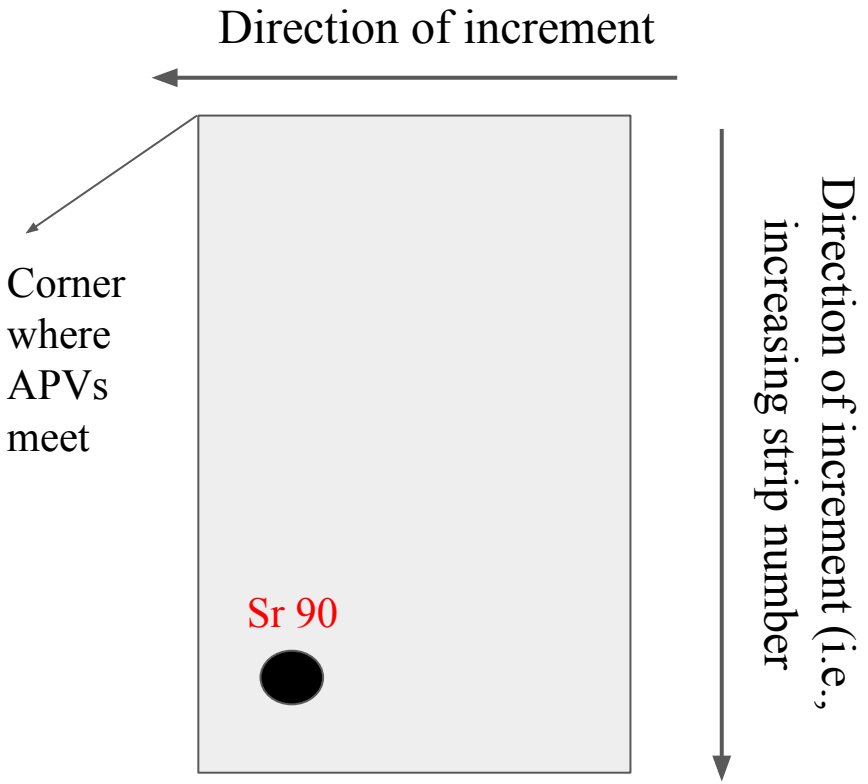

GEM0 GEM X adc_ped_cmode
adcweightSpec_gem_0_x_ped_cmode
Entries 1024
Mean 473.8
Std Dev 399.5
ADC weight
APV Strip Number
Evt 3 - Old map


GEM0 GEM X adc_ped_cmode
adcweightSpec_gem_0_x_ped_cmode
Entries 1024
Mean 463.1
Std Dev 397
ADC weight
APV Strip Number
Evt 3 - New map

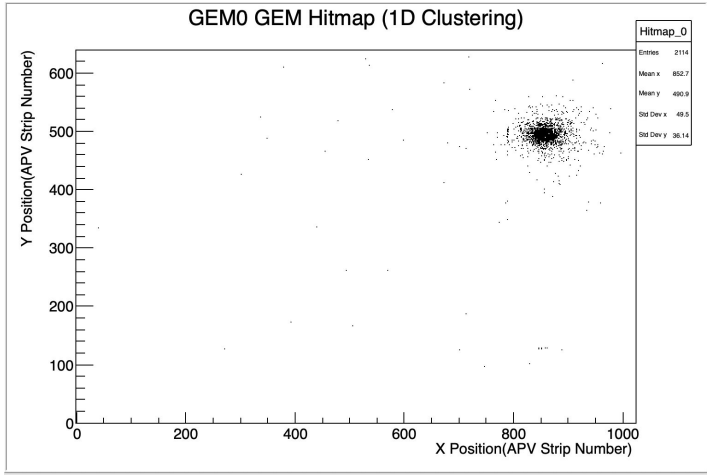

GEM0 GEM Y adc_ped_cmode
adcweightSpec_gem_0_y_ped_cmode
Entries 640
Mean 473.9
Std Dev 0
ADC weight
APV Strip Number


GEM0 GEM Y adc_ped_cmode
adcweightSpec_gem_0_y_ped_cmode
Entries 640
Mean 474.4
Std Dev 0
ADC weight
APV Strip Number

Local GEM Frame

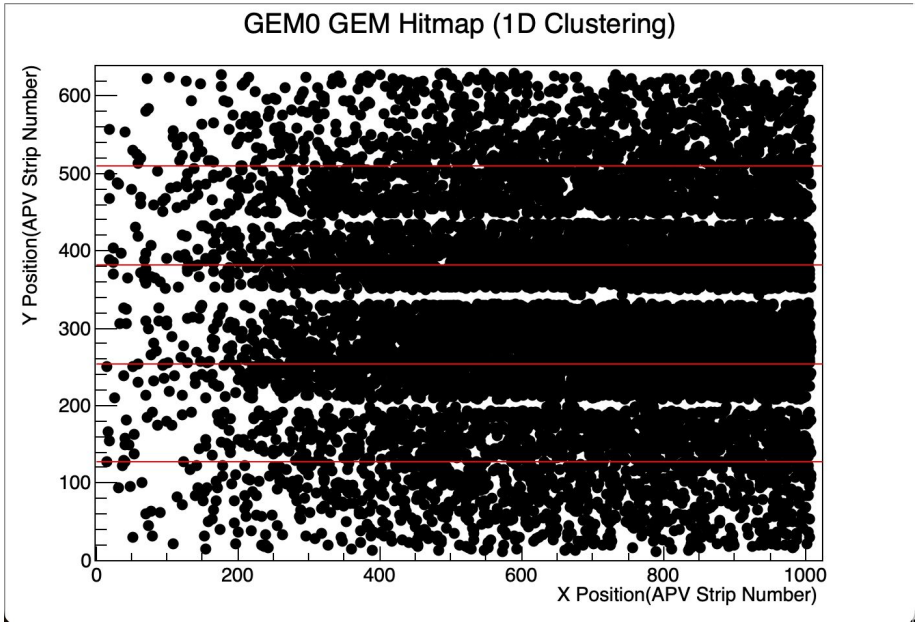


- Arrows indicating direction of increment along the GEM axes.
- Choice is up to you…

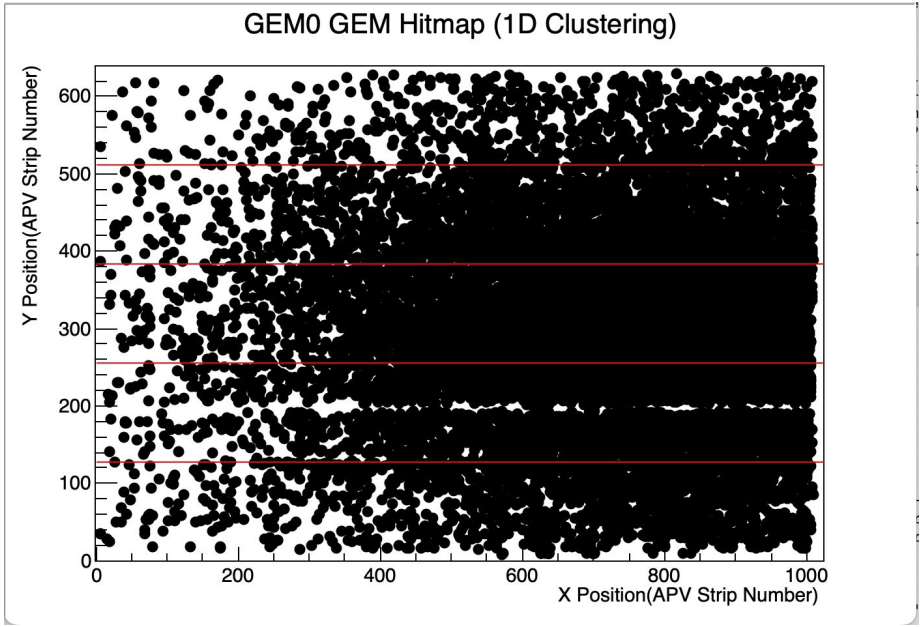


Cosmics For Different GEMs

GEM “Tanvi”

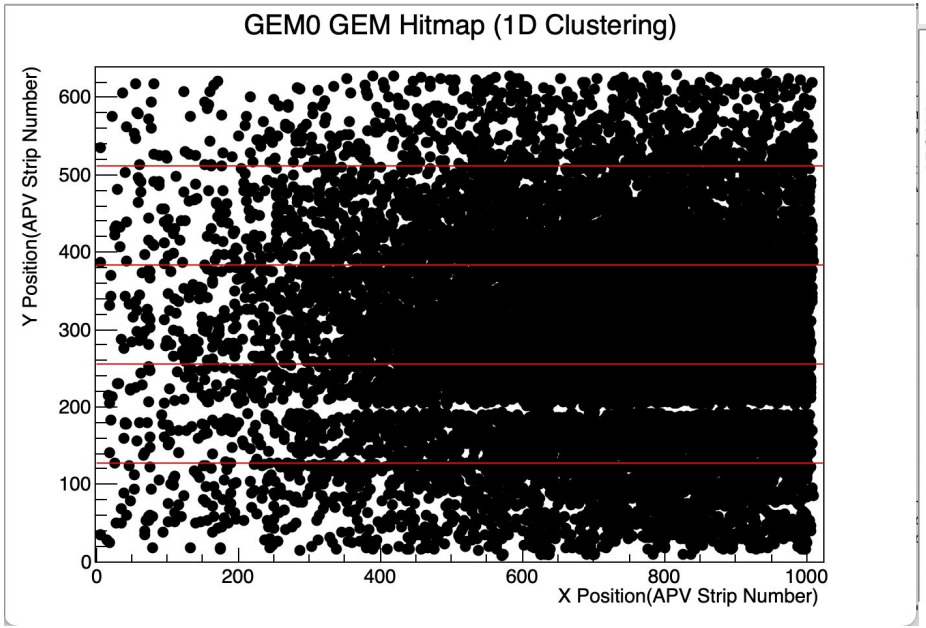


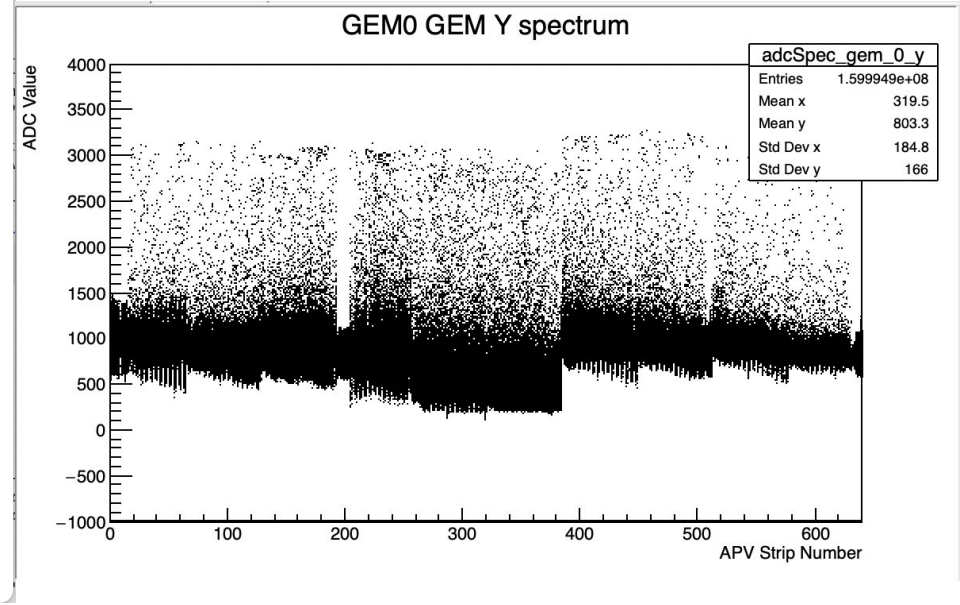
GEM “Jesmin”



Cosmics For Different GEMs

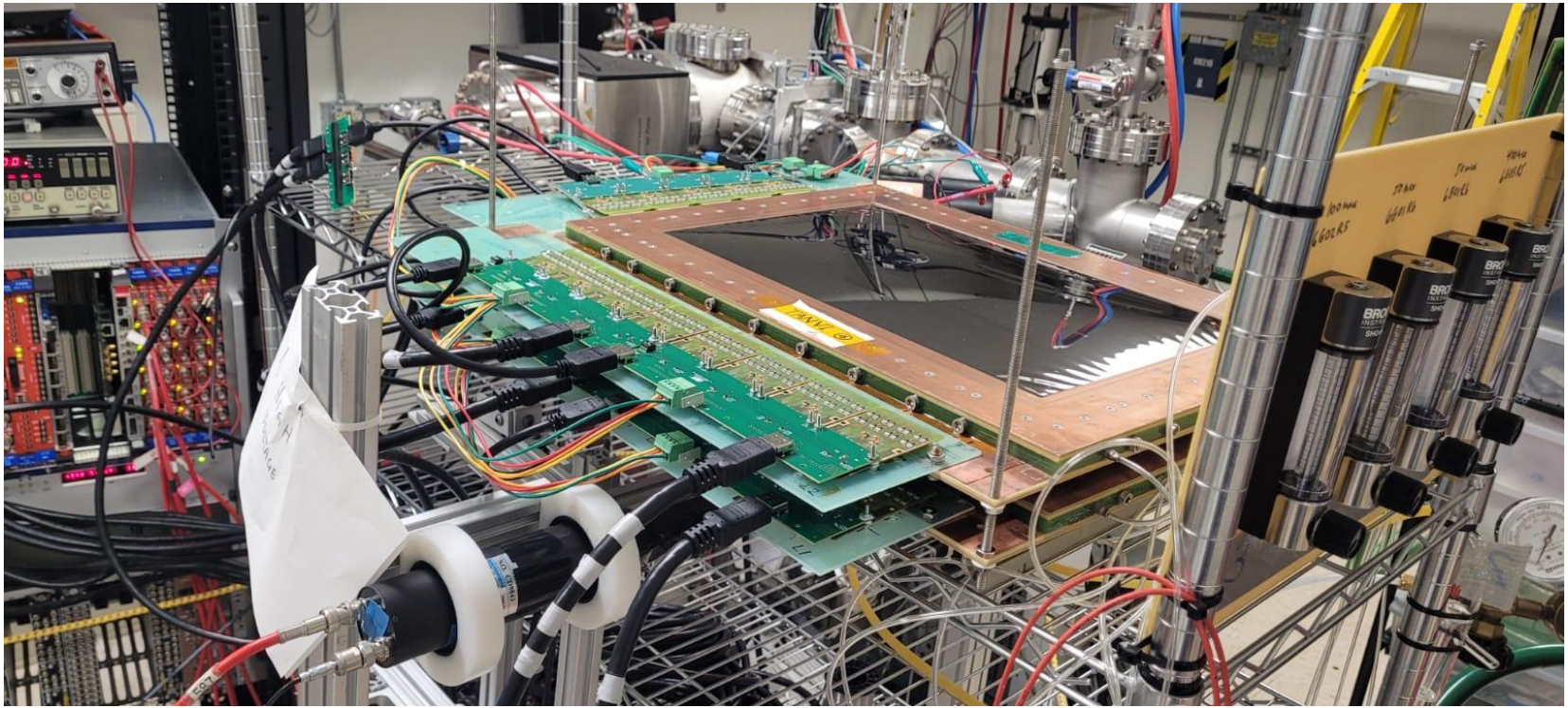
GEM “Jesmin”





Read the pedestals just fine, just no signal for those strips…

Two GEM Stand

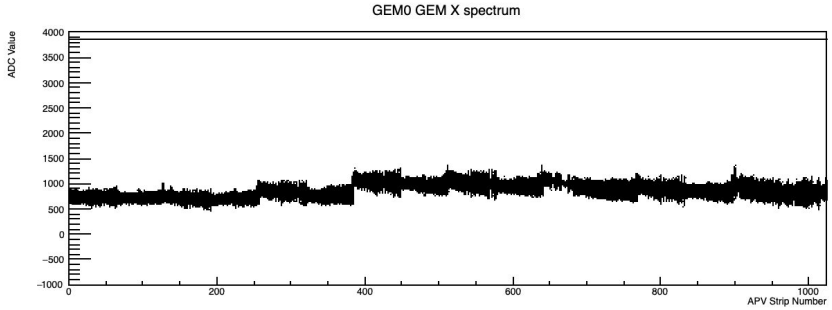


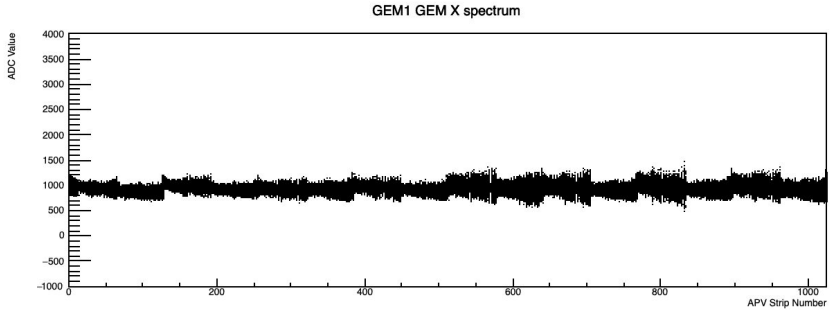
Three centimeter gap between the two GEMs. Top APV electronics - MPD Slot 3, Bottom - MPD Slot 4, Same trigger fed into both MPDs.

Photo from Manju

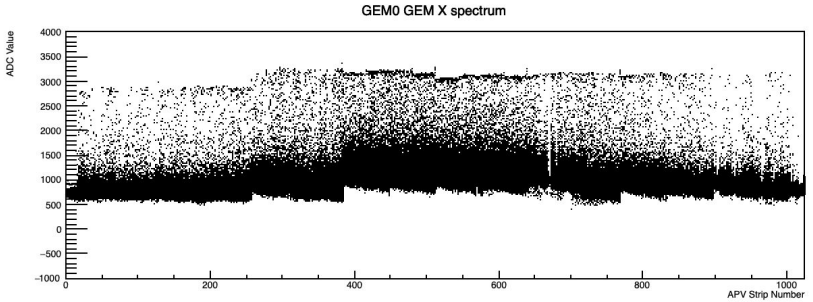
Two GEM stand

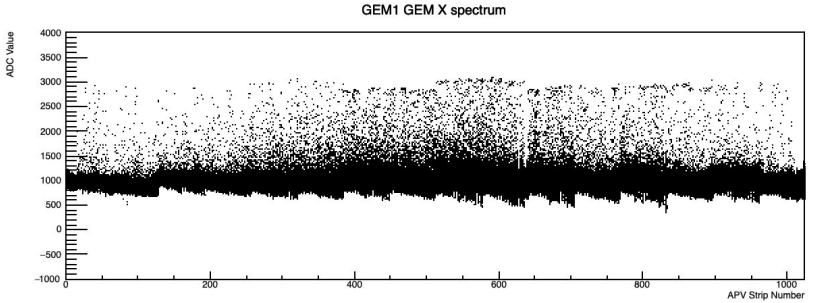
Pulser Mode (Raw ADC)





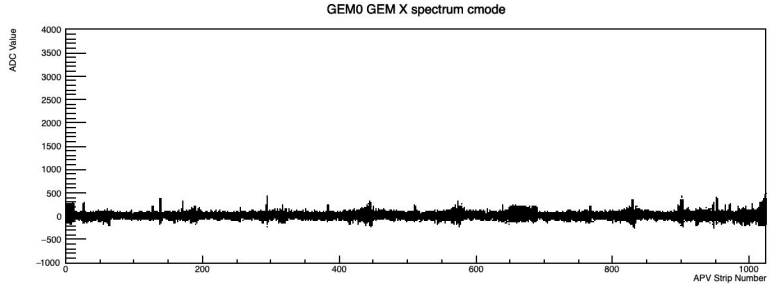
Trigger Mode (Raw ADC)



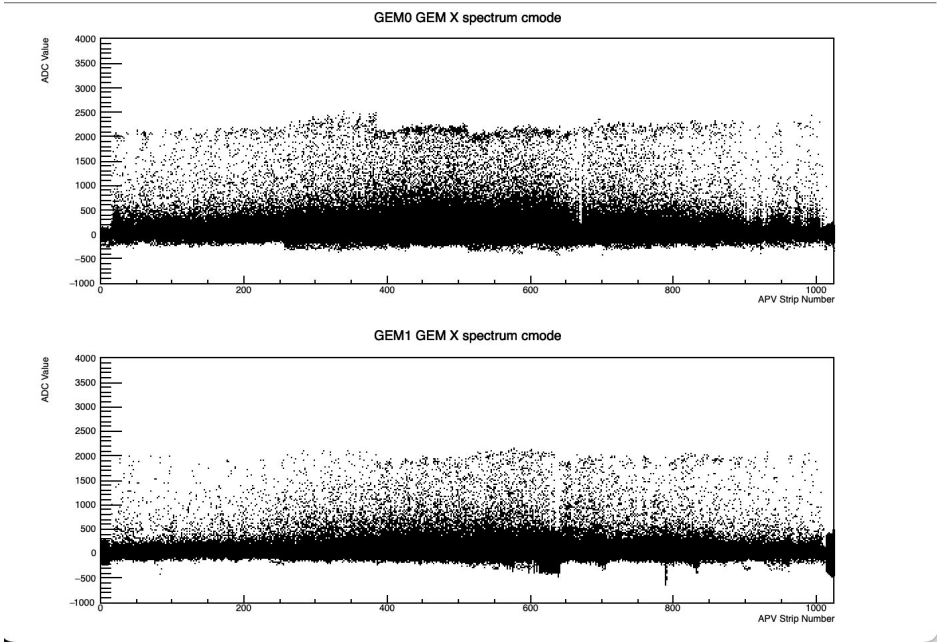


Two GEM stand

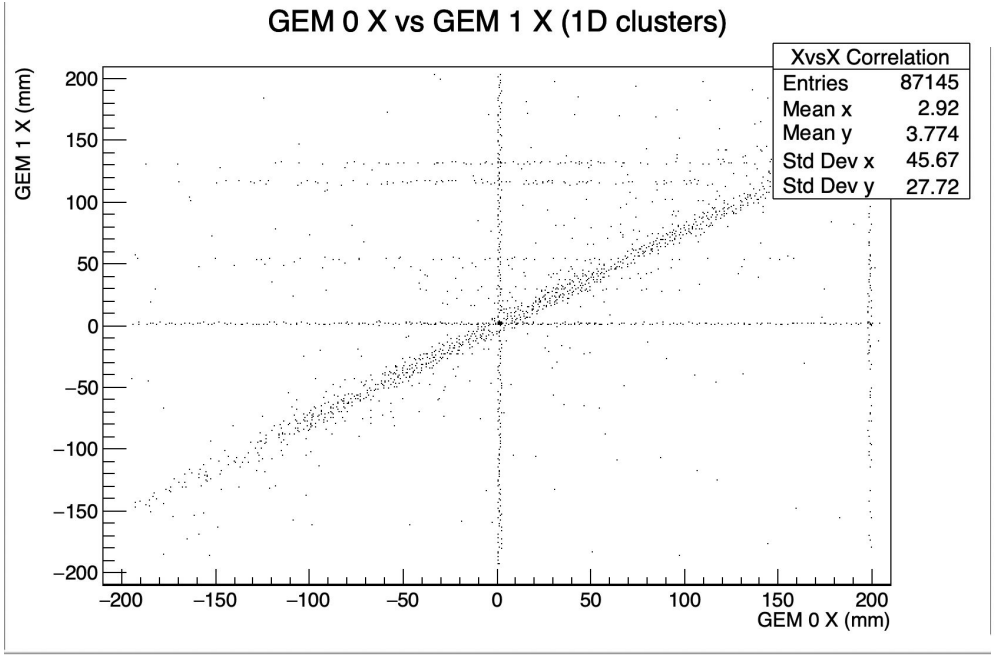
Pulser Mode (Ped+Cmode Subtracted)

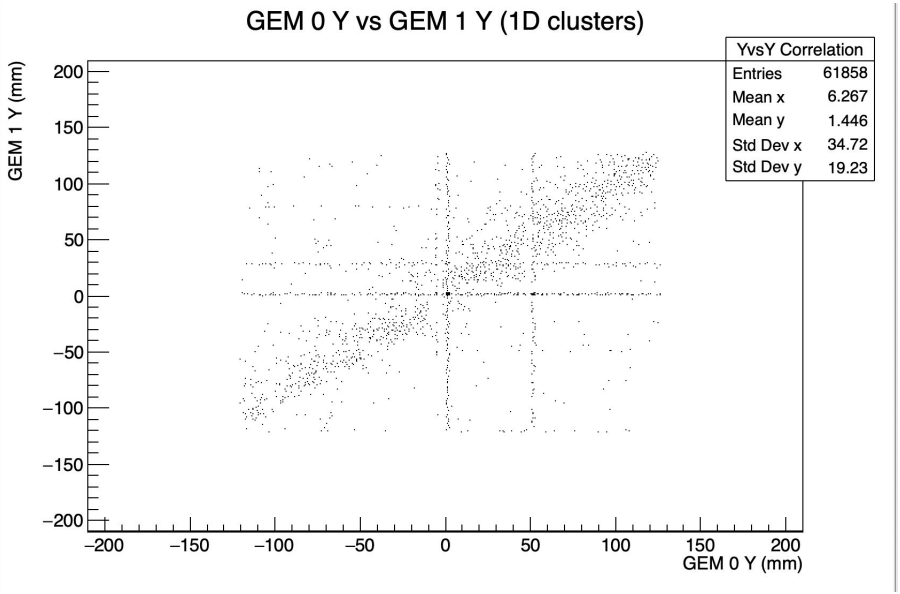


Trigger Mode (Ped+Cmode Subtracted)



Two GEM stand





Began working on exploring correlated GEM hits. The analysis is very preliminary

Further Commissioning Tasks/Outlook/Summary

- We fixed the mapping.
- Currently commissioning the GEMs as a rigid object. Exploring and developing the analysis to explore correlations and find the efficiency (Next few weeks)
- Vary the HV for one layer to probe how the efficiency changes with the HV. Data will be taken in the next few days/week
- Everything that has been presented, currently uses one sample. Need to modify the frontend, data structure and analysis to accommodate this. I see this as a fall project.
- Systematic studies on the flow rate. How does the gain, efficiency vary with the flow rate (Next few weeks).
- Fix the HV connection and mount an SHV socket on the side. Next few weeks?
- Investigate the dead sectors on the two GEMs. We can read the pedestals just fine. Investigate the pedestal widths (data exists).