

Update On PRex/CRex GEM detector analysis

Siyu Jian

University of Virginia

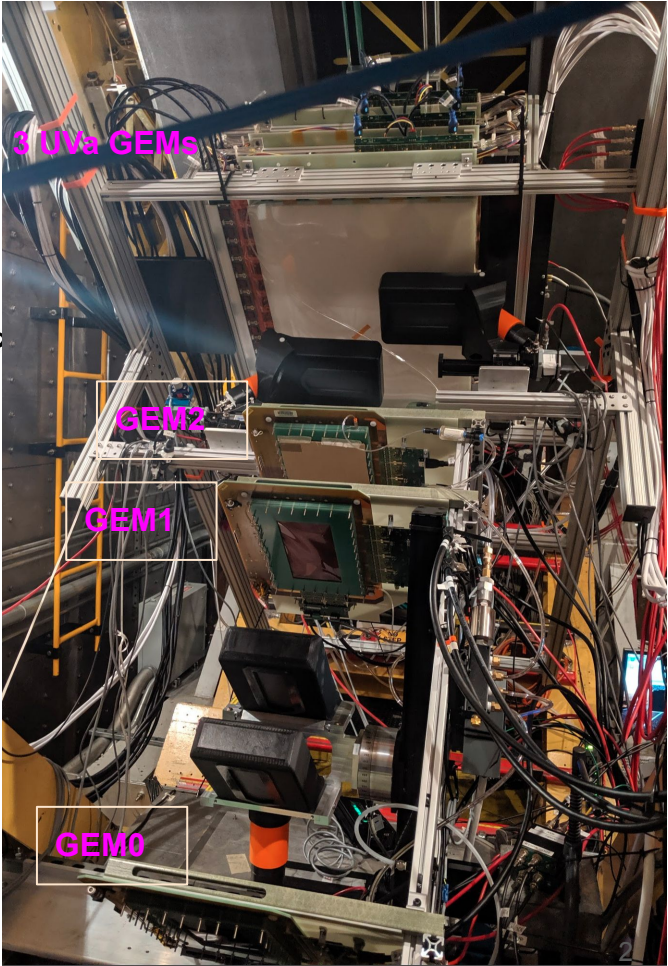
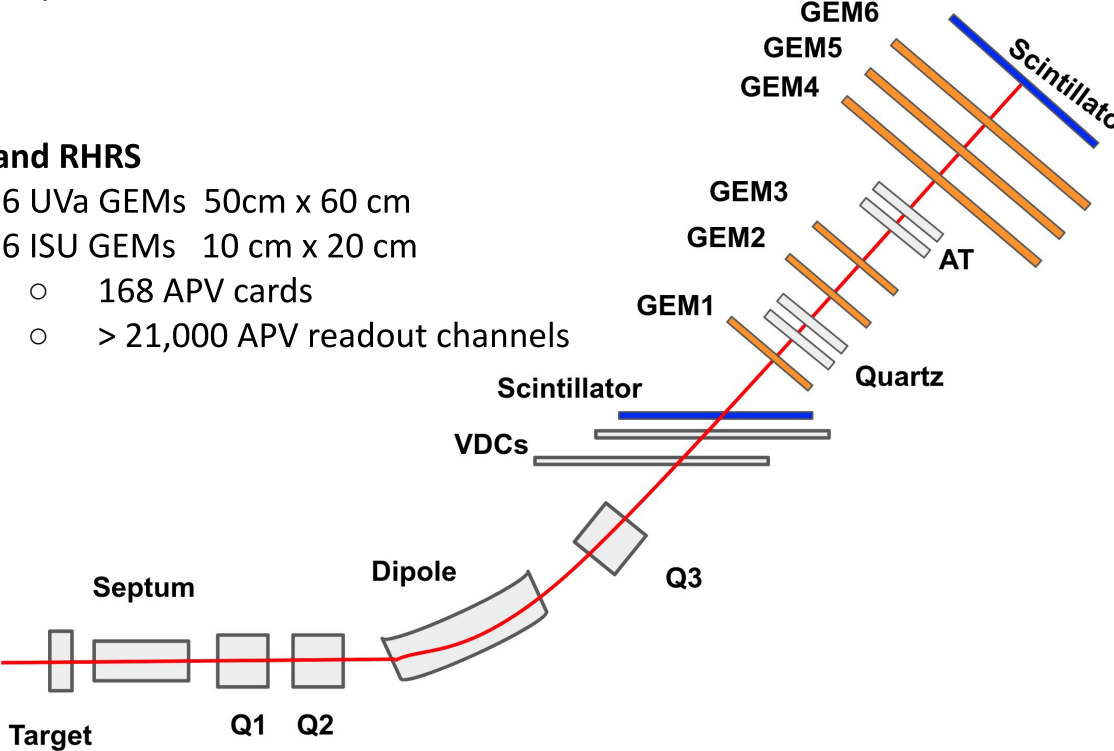


Layout of GEM detectors in PRex/CRex

- VDC efficiency drops when rate goes Higher
- Good Opportunity to test the SBS GEMs in real experiment

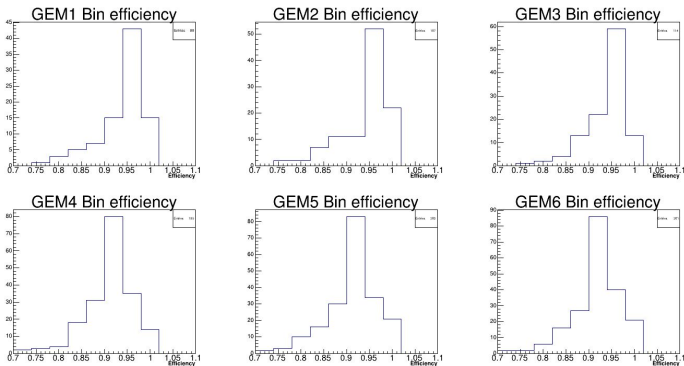
LHRS and RHRS

- 6 UVa GEMs 50cm x 60 cm
- 6 ISU GEMs 10 cm x 20 cm
 - 168 APV cards
 - > 21,000 APV readout channels



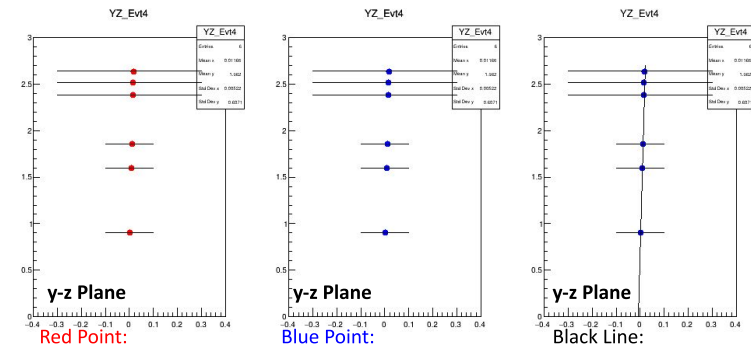
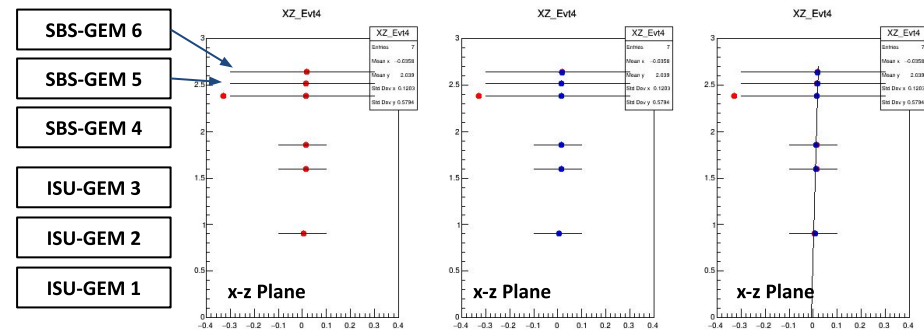
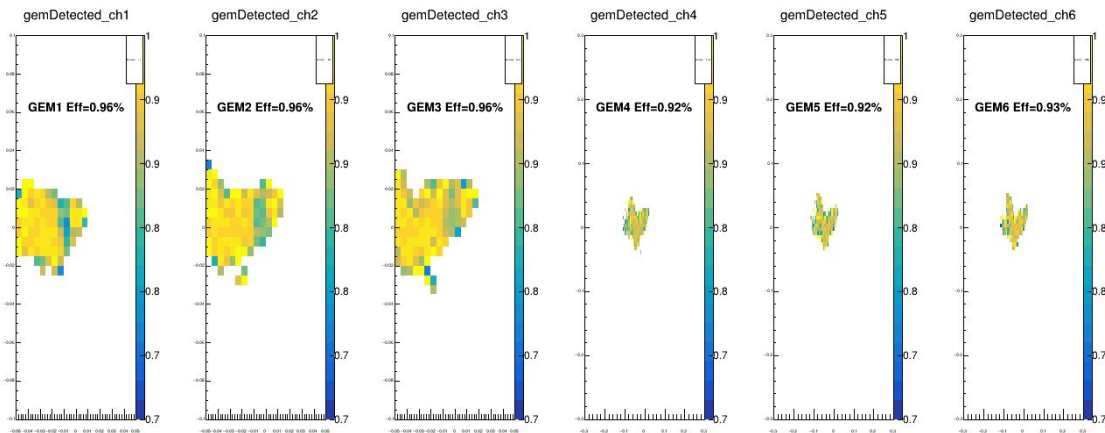
GEM efficiency relative to VDC

- Track Event Viewer
 - Hit on each GEM
 - Hit reconstructed from TreeSearch
 - track reconstructed from VDC



Efficiency distribution for 1cm x 1cm bin

RHRS 20862

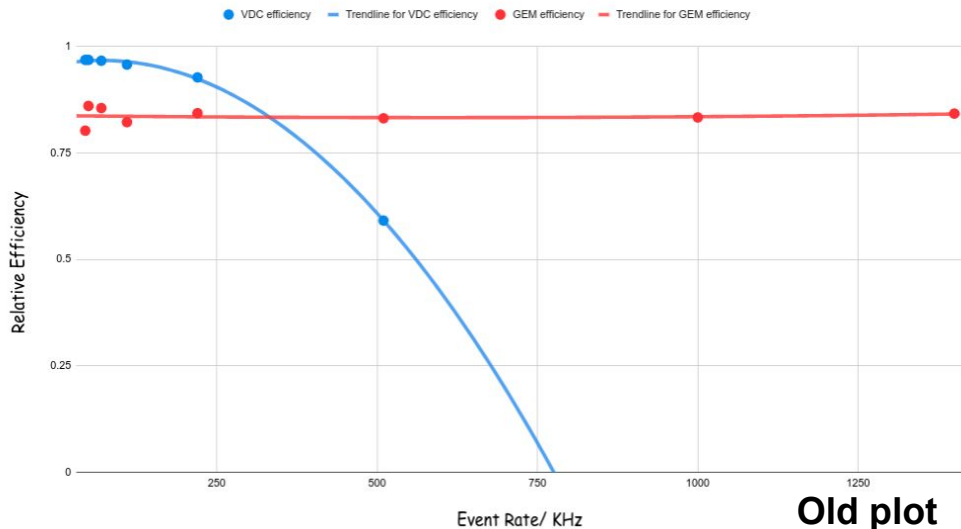


- Distribution of efficiency of each Bin
 - Cut bins > 30
 - Most if the bin efficiency > 90%

GEM Efficiency vs. Rate

- GEM efficiency is calculated based on GEM track. Independent of VDC
- For safety concern, the VDC are switched off when event rate larger than 500K
- VDC efficiency drop down when the event rate larger than 200k

VDC efficiency and GEM efficiency



Old plot

Event Rate (kHz)	RunID	VDC	GEM
45	21281	On	On
50	21291	On	On
70	21289	On	On
110	21282	On	On
220	21283	On	On
510	21284	On	On
1000	21285	OFF	On
1400	21286	OFF	On

Why GEM efficiency is low:

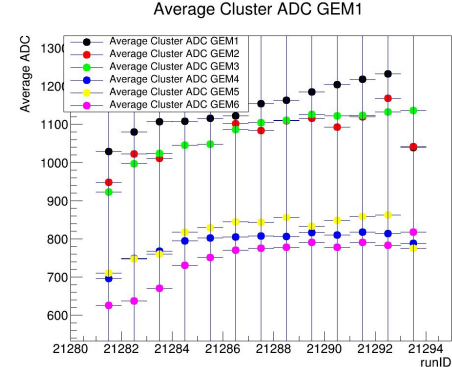
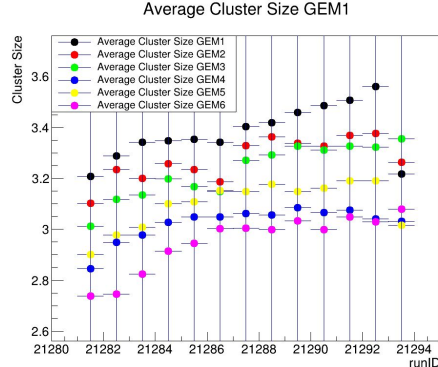
- Better alignment (PRex need to change GEM position)
- Track selection to avoid bias
 - Require all the rest of the GEM have track

VDC projected Efficiency(run 20862):

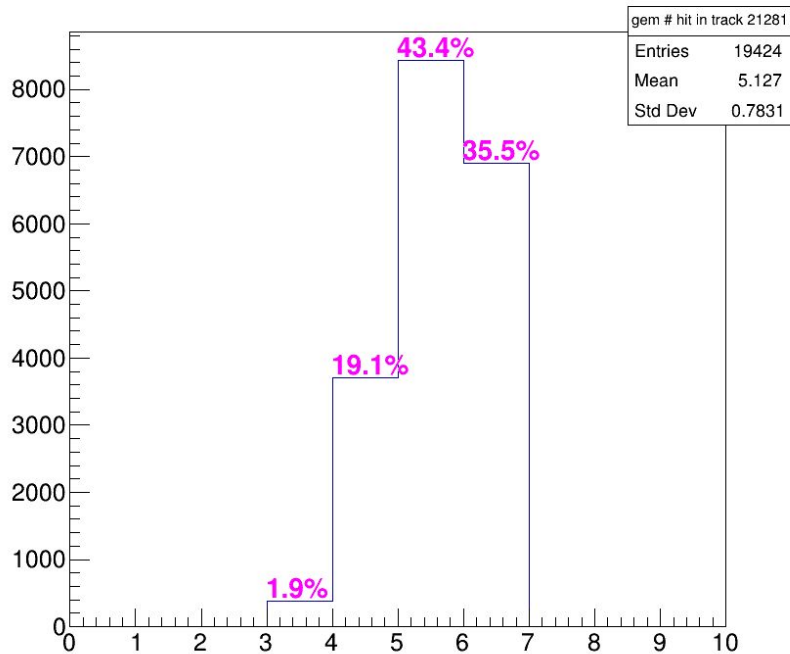
GEM1	GEM2	GEM3	GEM4	GEM5	GEM6
96%	96%	96%	92%	92%	92%

GEM Efficiency

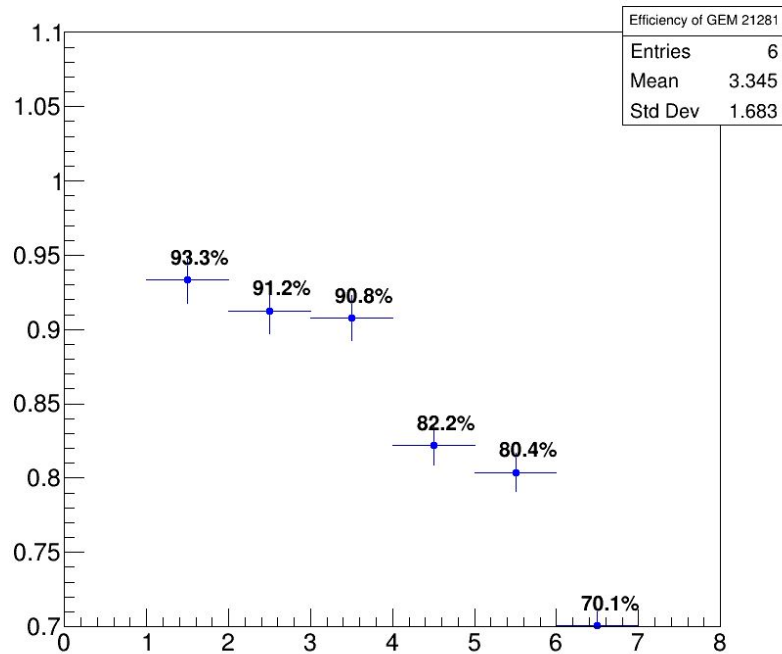
- Better alignment (PReX need to change GEM position)
- Track selection to avoid bias
 - Require all the rest of the GEM have track



gem # hit in track 21281



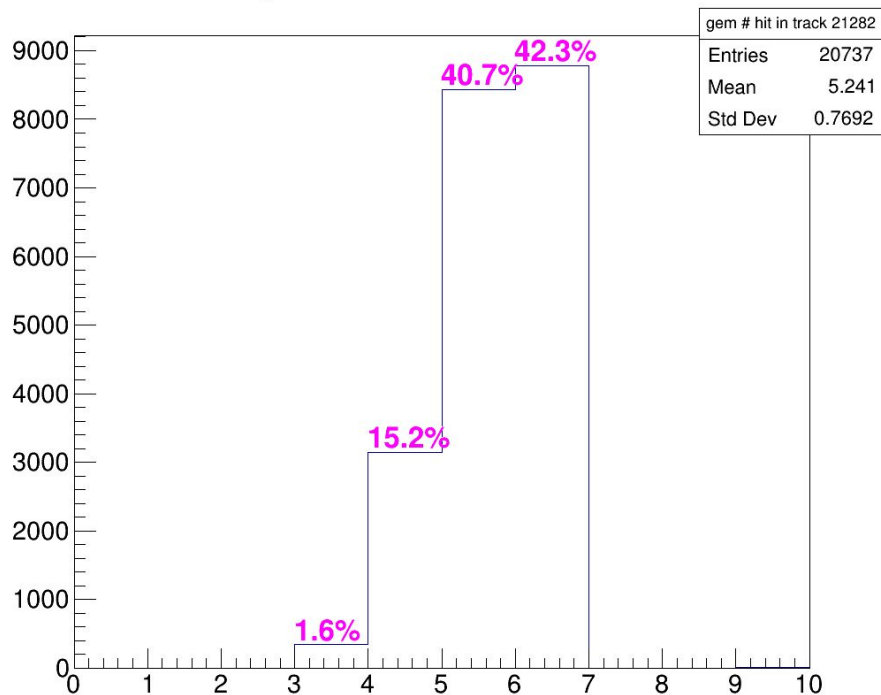
"Efficiency" of GEM 21281



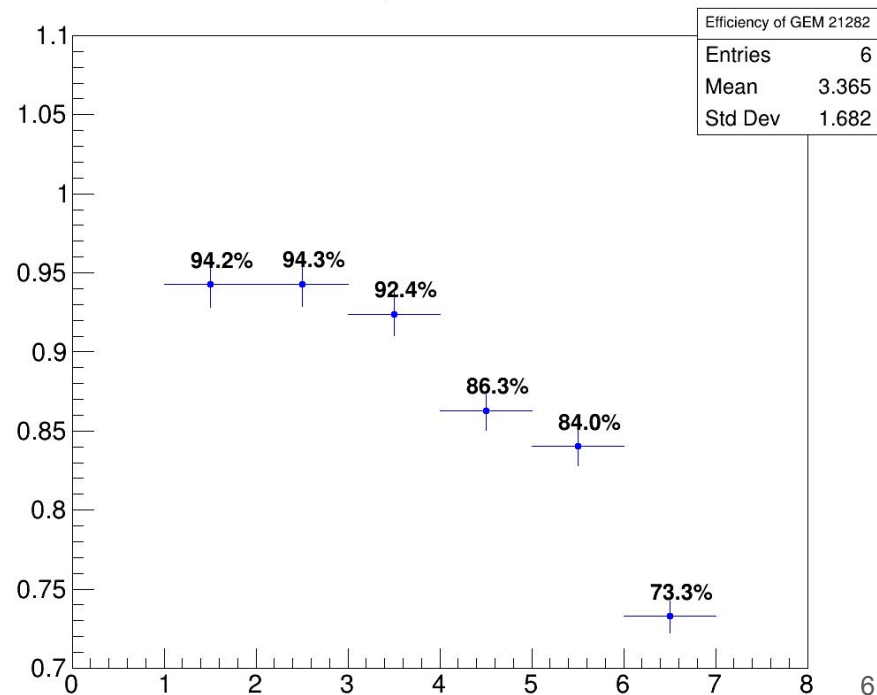
GEM Efficiency

- Better alignment (PReX need to change GEM position)
- Track selection to avoid bias
 - Require all the rest of the GEM have track

gem # hit in track 21282



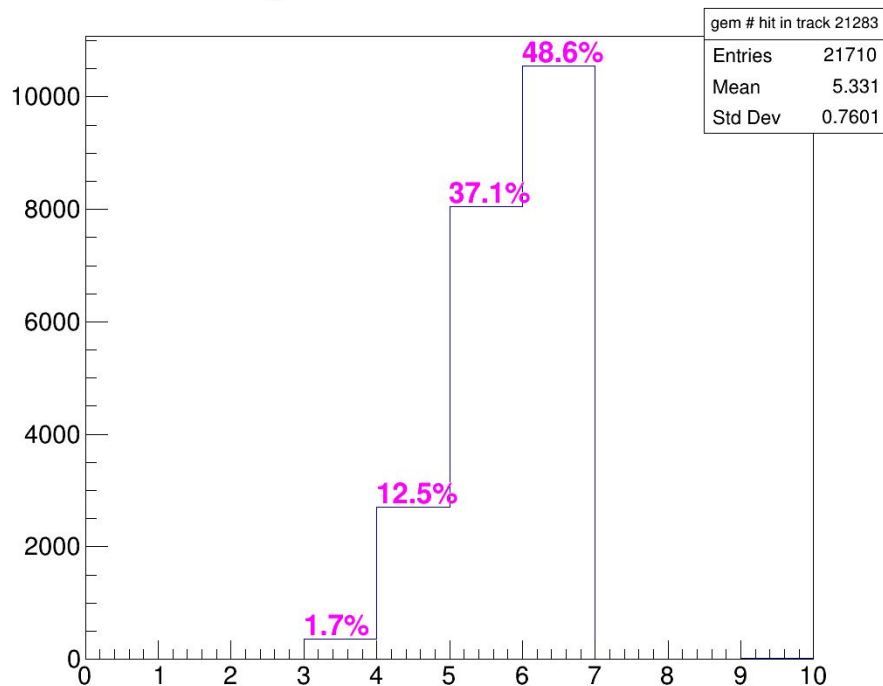
"Efficiency" of GEM 21282



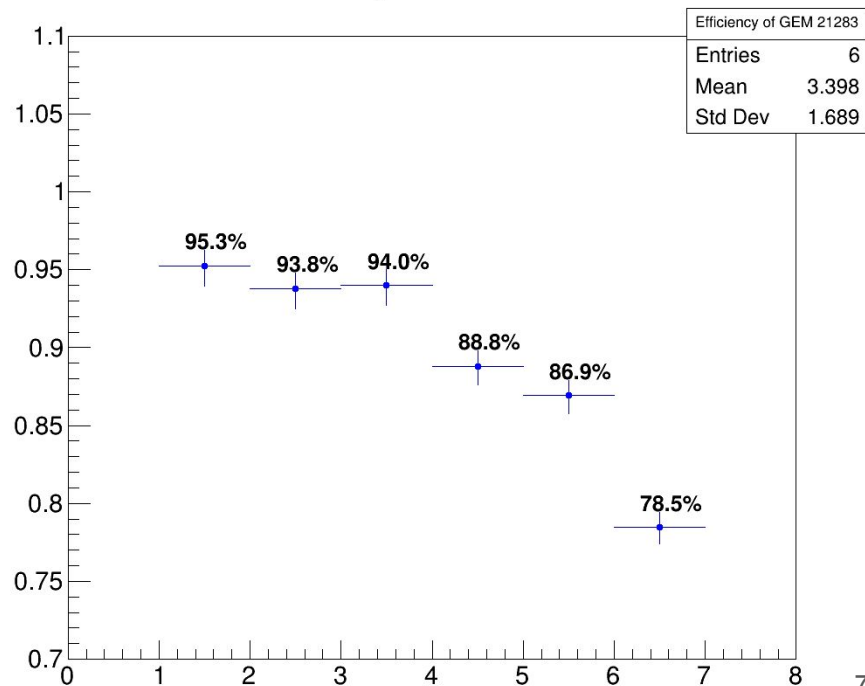
GEM Efficiency

- Better alignment (PReX need to change GEM position)
- Track selection to avoid bias
 - Require all the rest of the GEM have track

gem # hit in track 21283



"Efficiency" of GEM 21283



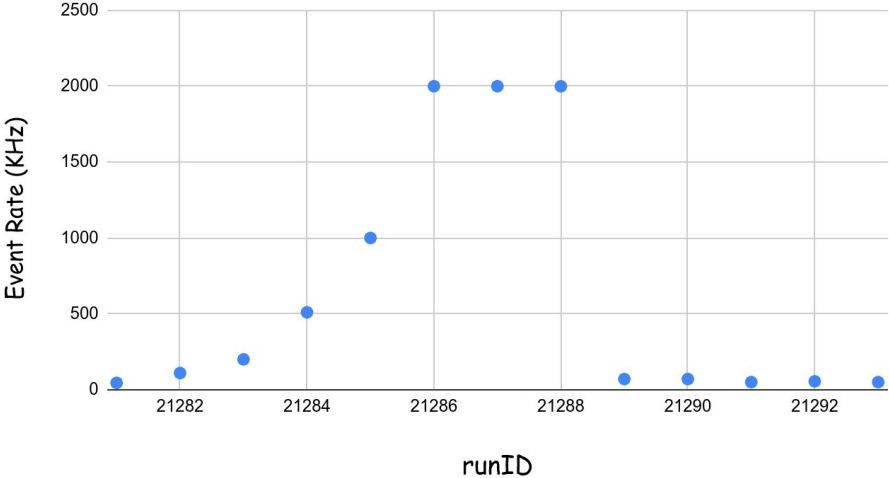
GEM Efficiency

- The GEM efficiency becomes better but not good
- The efficiency increase among those runs
 - T1 Rate 45kHz -> 200kHz
 - other

runID	Event Rate (KHz)
21281	45
21282	110
21283	200
21284	510
21285	1000
21286	2000
21287	2000
21288	2000
21289	70
21290	70
21291	50
21292	55
21293	50

GEM Runs on Aug-21-2019

Event Rate (KHz) vs. runID

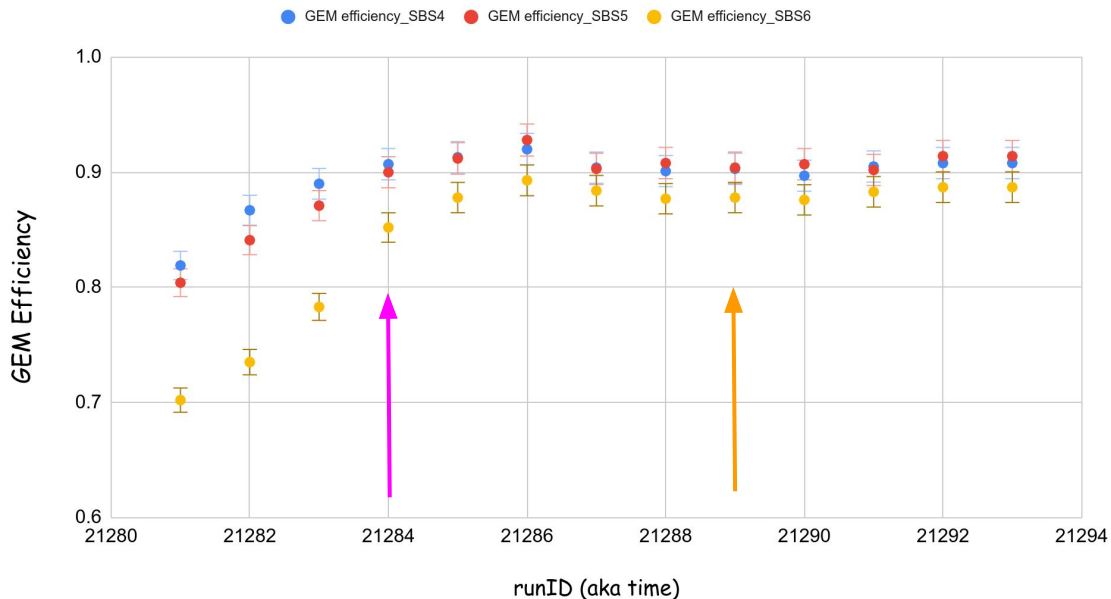


GEM Efficiency

- GEM efficiency is low for run 21280 21281 21282 21283
- After 21284, the efficiency reaches plateau

runID	Event Rate (KHz)
21281	45
21282	110
21283	200
21284	510
21285	1000
21286	2000
21287	2000
21288	2000
21289	70
21290	70
21291	50
21292	55
21293	50

GEM Efficiency vs runID (aka time)

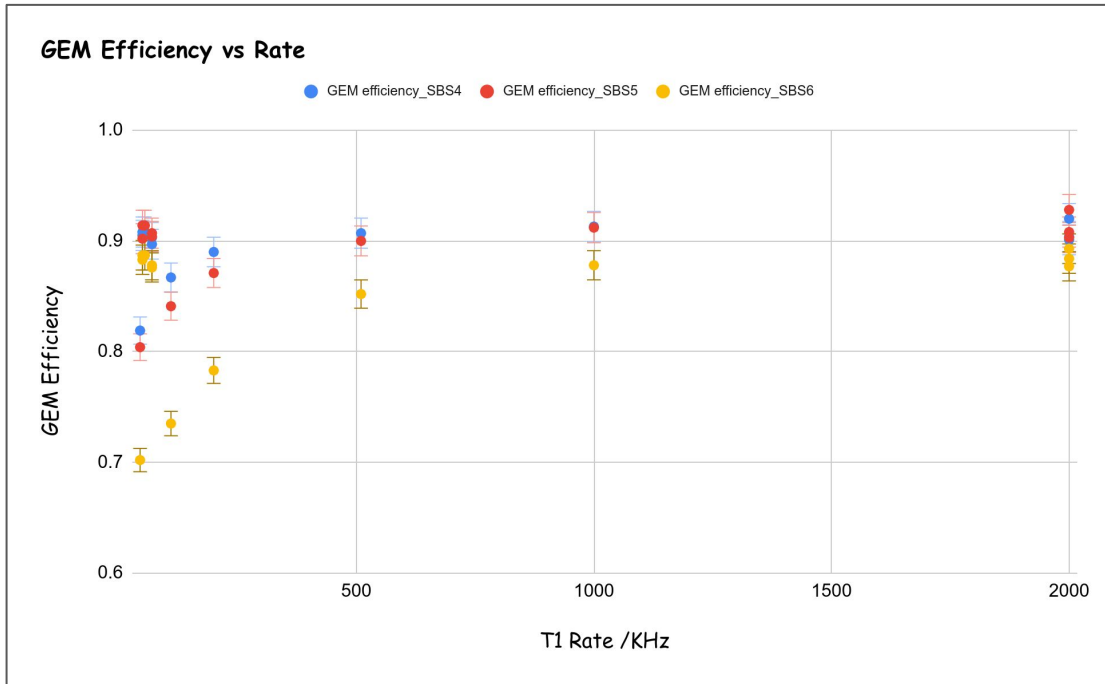


- 21281 -> 21288 T1 rate increase
- 21289 -> 21293 T1 rate 70kHz, 50kHz
- Everything beside the T1 rate are the same for all those runs.
- GEM efficiency increase and reaches stable

GEM Efficiency

- GEM efficiency is low for run 21280 21281 21282 21283
- After 21284, the efficiency reaches plateau

runID	Event Rate (KHz)
21281	45
21282	110
21283	200
21284	510
21285	1000
21286	2000
21287	2000
21288	2000
21289	70
21290	70
21291	50
21292	55
21293	50

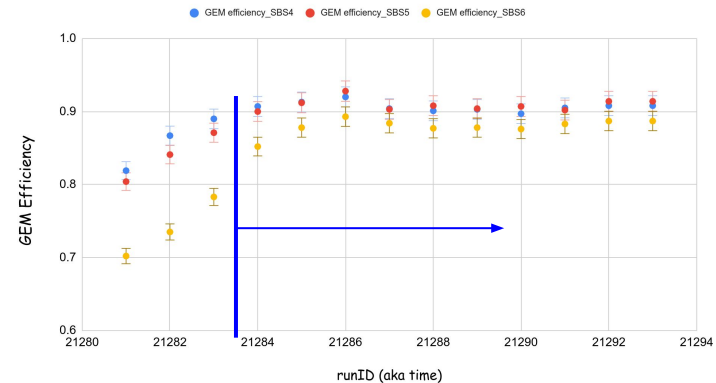


- 21281 -> 21288 T1 rate increase
- 21289 -> 21293 T1 rate 70kHz, 50kHz
- Everything beside the T1 rate are the same for all those runs.
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GEM Efficiency

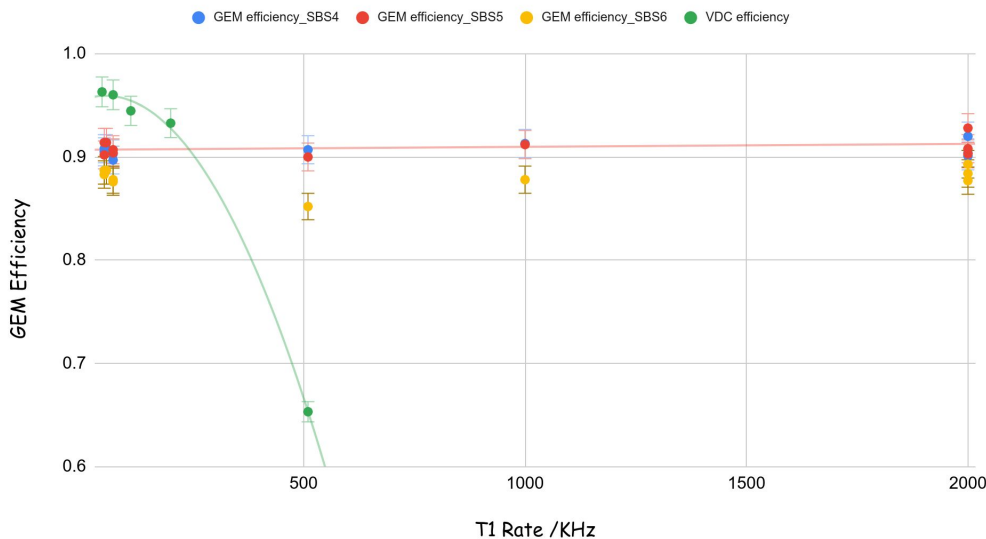
- GEM efficiency 21284 -> 21293
- The efficiency consistent among those runs ~90%

GEM Efficiency vs runID (aka time)



runID	Event Rate (KHz)
21281	45
21282	440
21283	200
21284	510
21285	1000
21286	2000
21287	2000
21288	2000
21289	70
21290	70
21291	50
21292	55
21293	50

GEM Efficiency vs Rate

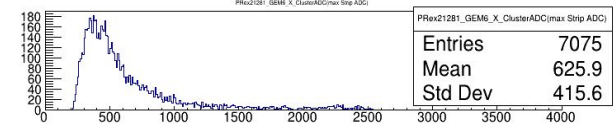
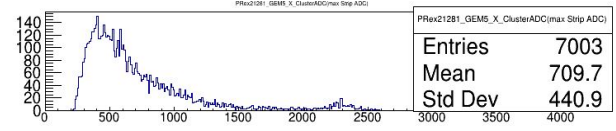
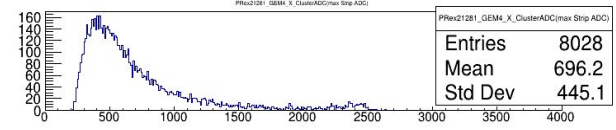
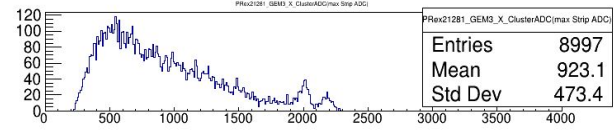
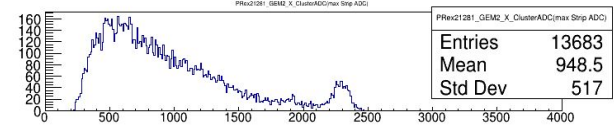
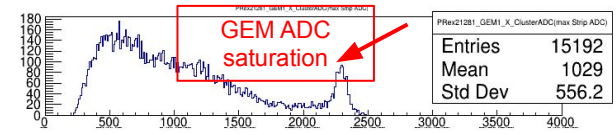
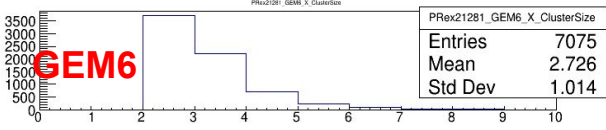
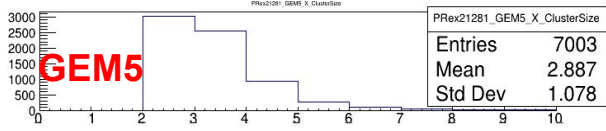
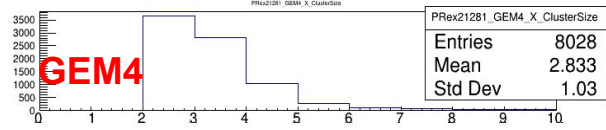
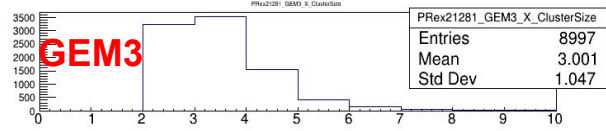
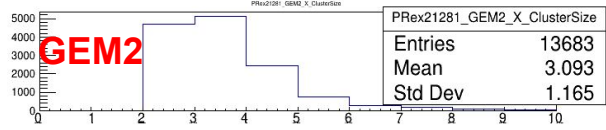
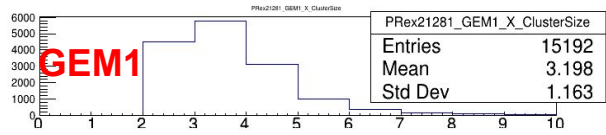


GEM Cluster

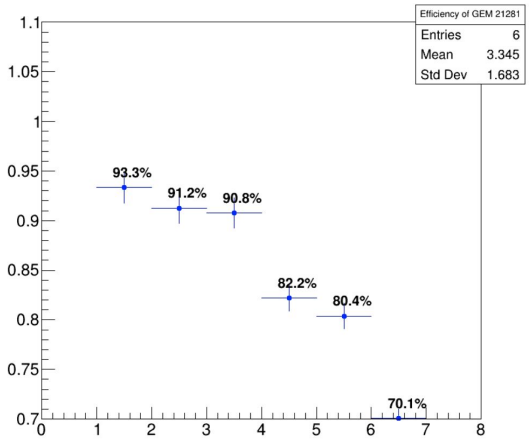
Cluster Size: number of strips in cluster

Cluster ADC: Maximum of strip ADC of cluster

- SBS GEM: mean of cluster ADC smaller
- Less saturation on the tail
- Efficiency lower



"Efficiency" of GEM 21281



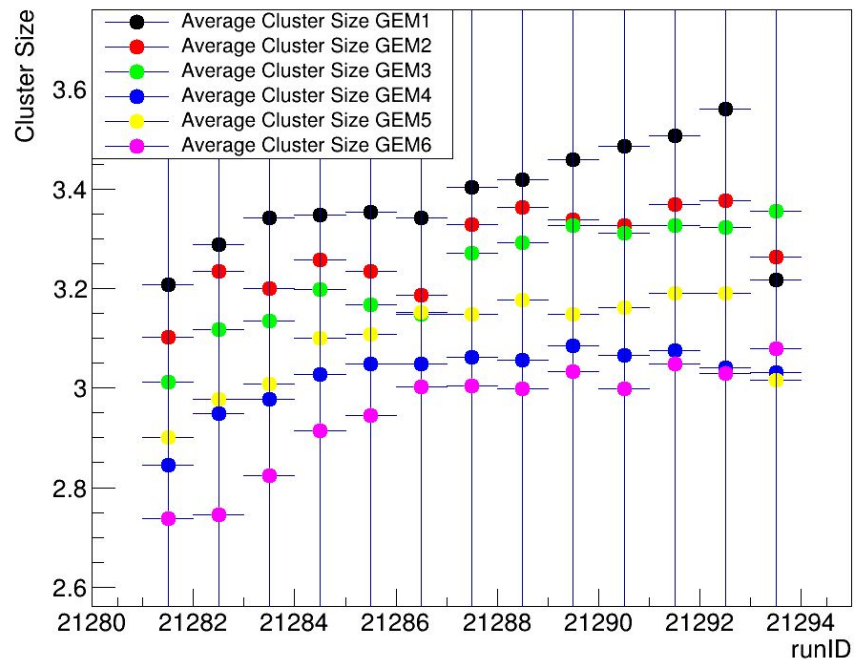
Cluster Size

Cluster ADC

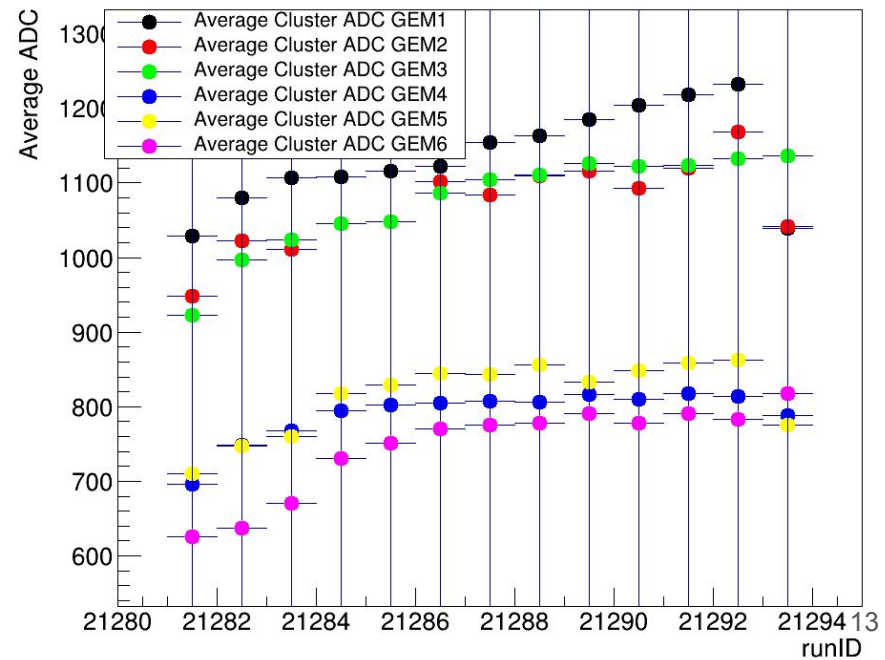
GEM Cluster ADC/Size vs. runID

- Before 21284, the average cluster size and cluster ADC increase
- Reaches saturation after 21284

Average Cluster Size



Average Cluster ADC



Summary:

- GEM have not reach stable working condition before 21283
 - GEM cluster ADC increase
 - GEM cluster size increase
- Why GEM efficiency is low at the beginning
 - Moisture ?
 - Gas flow ?
 - 70uA beam current during production, although the HV is off, but gas still will be ionized. Time to exchange gas in chamber after switch to counting? (~15 units gas flow rate)
 -

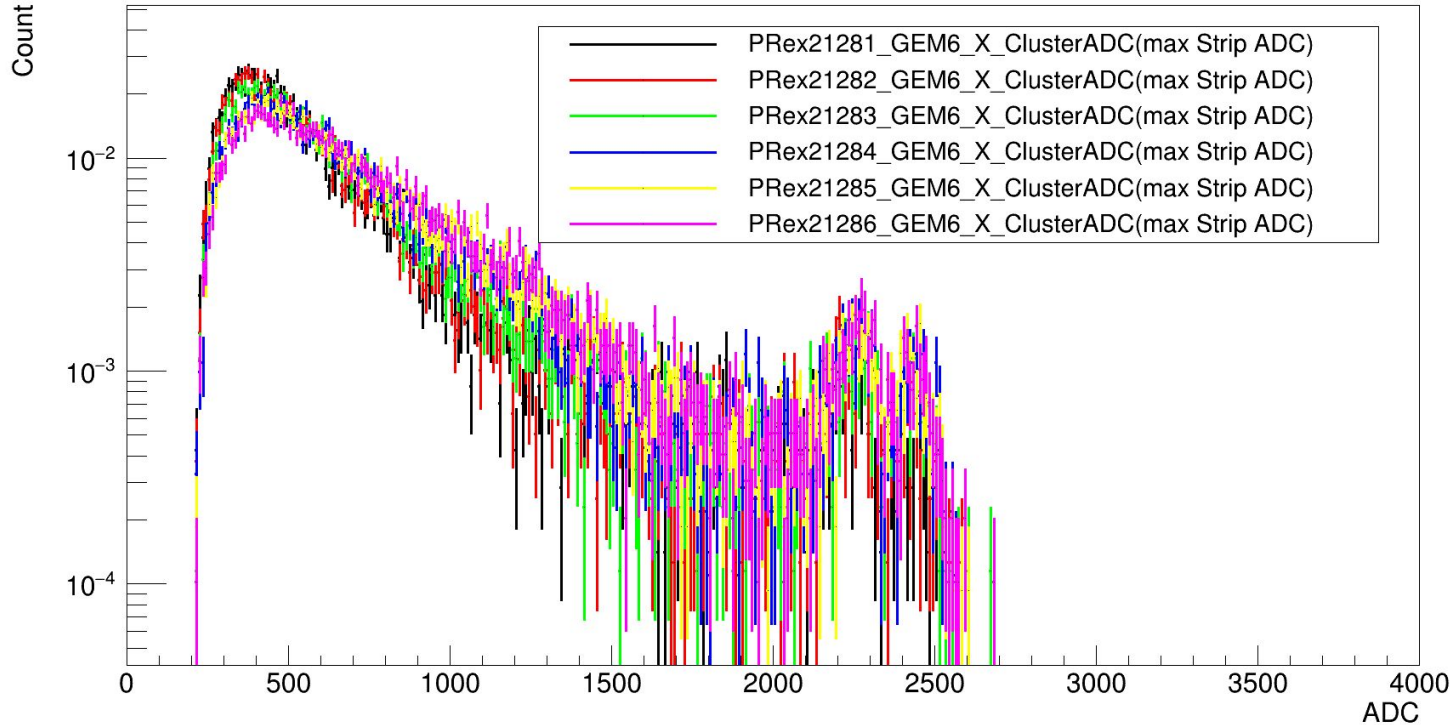
The End!
Thank you



GEM Cluster

- SBS6, Cluster ADC for different runs
- Around 500 ADC, 21281 -> 21286 count drops
- Around saturation tail: 21281 -> 21286 count increase

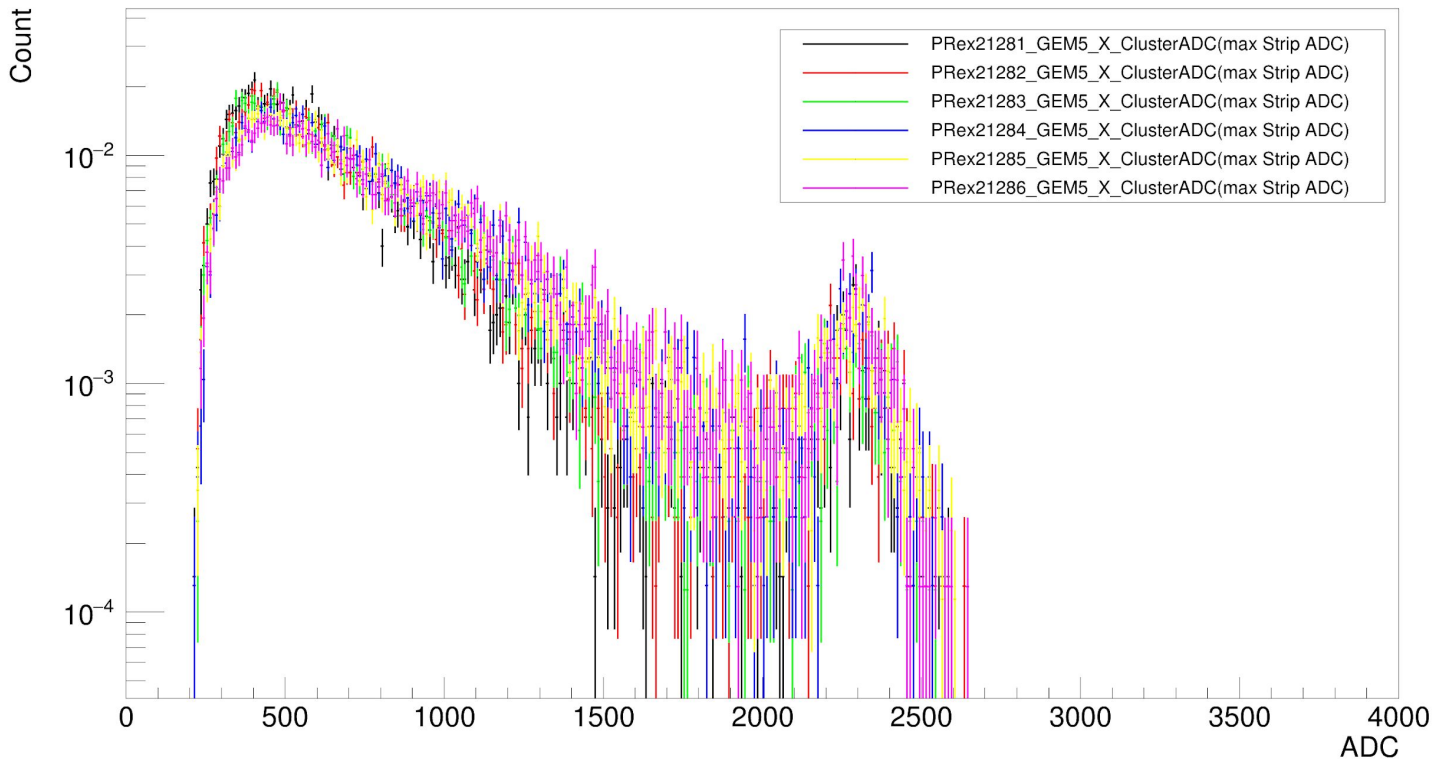
GEM6 Cluster ADC



GEM Cluster

- SBS6, Cluster ADC for different runs
- Around 500 ADC, 21281 -> 21286 count drops
- Around saturation tail: 21281 -> 21286 count increase

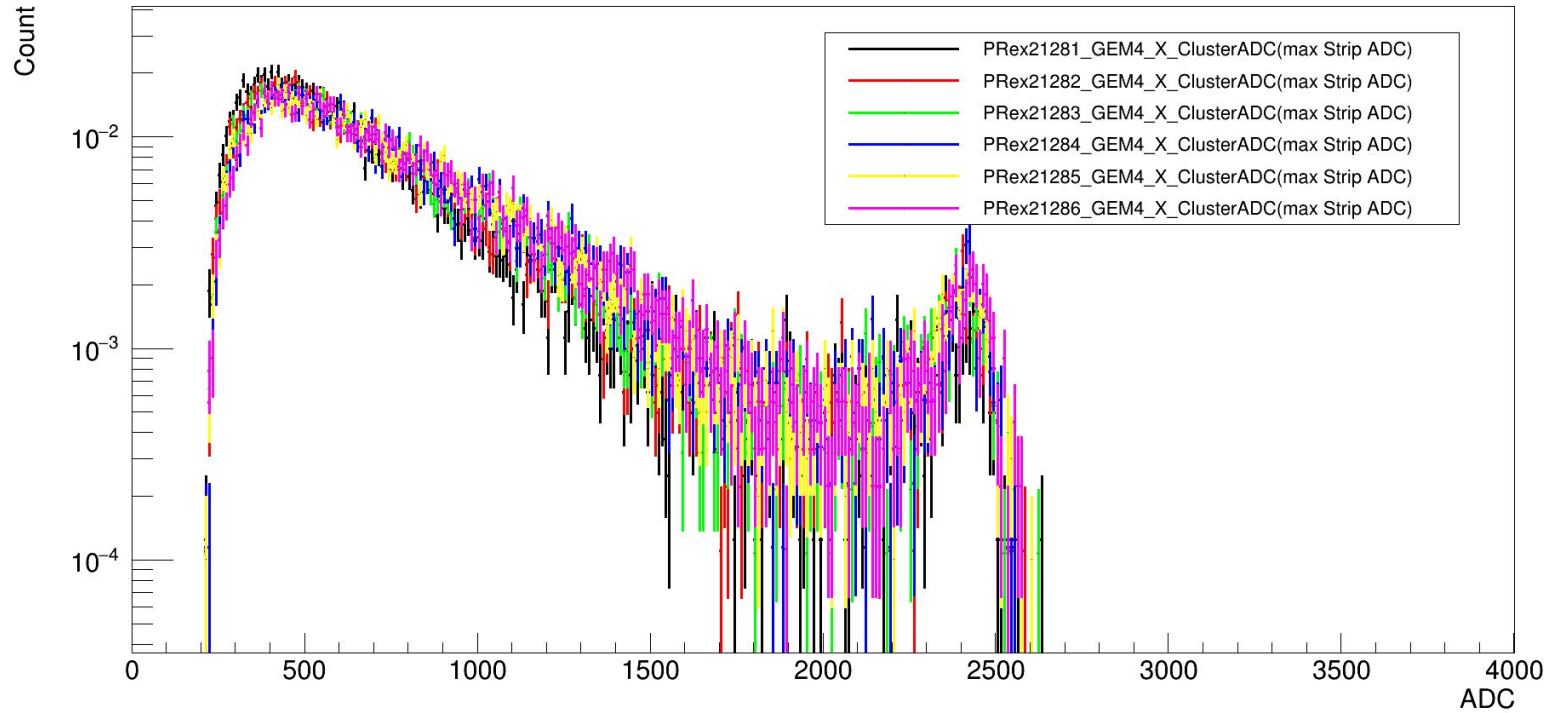
GEM5 Cluster ADC



GEM Cluster

- SBS6, Cluster ADC for different runs
- Around 500 ADC, 21281 -> 21286 count drops
- Around saturation tail: 21281 -> 21286 count increase

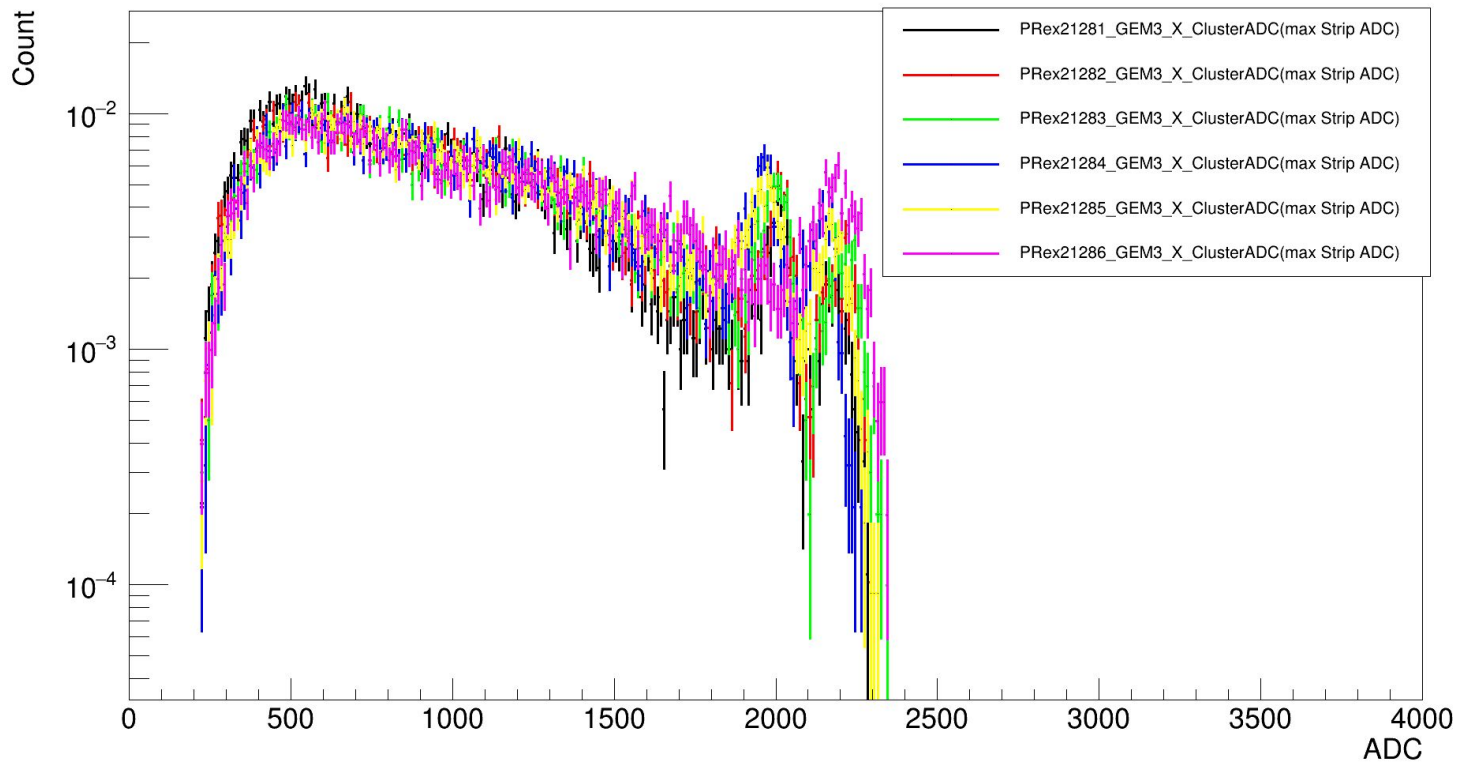
GEM4 Cluster ADC



GEM Cluster

- SBS6, Cluster ADC for different runs
- Around 500 ADC, 21281 -> 21286 count drops
- Around saturation tail: 21281 -> 21286 count increase

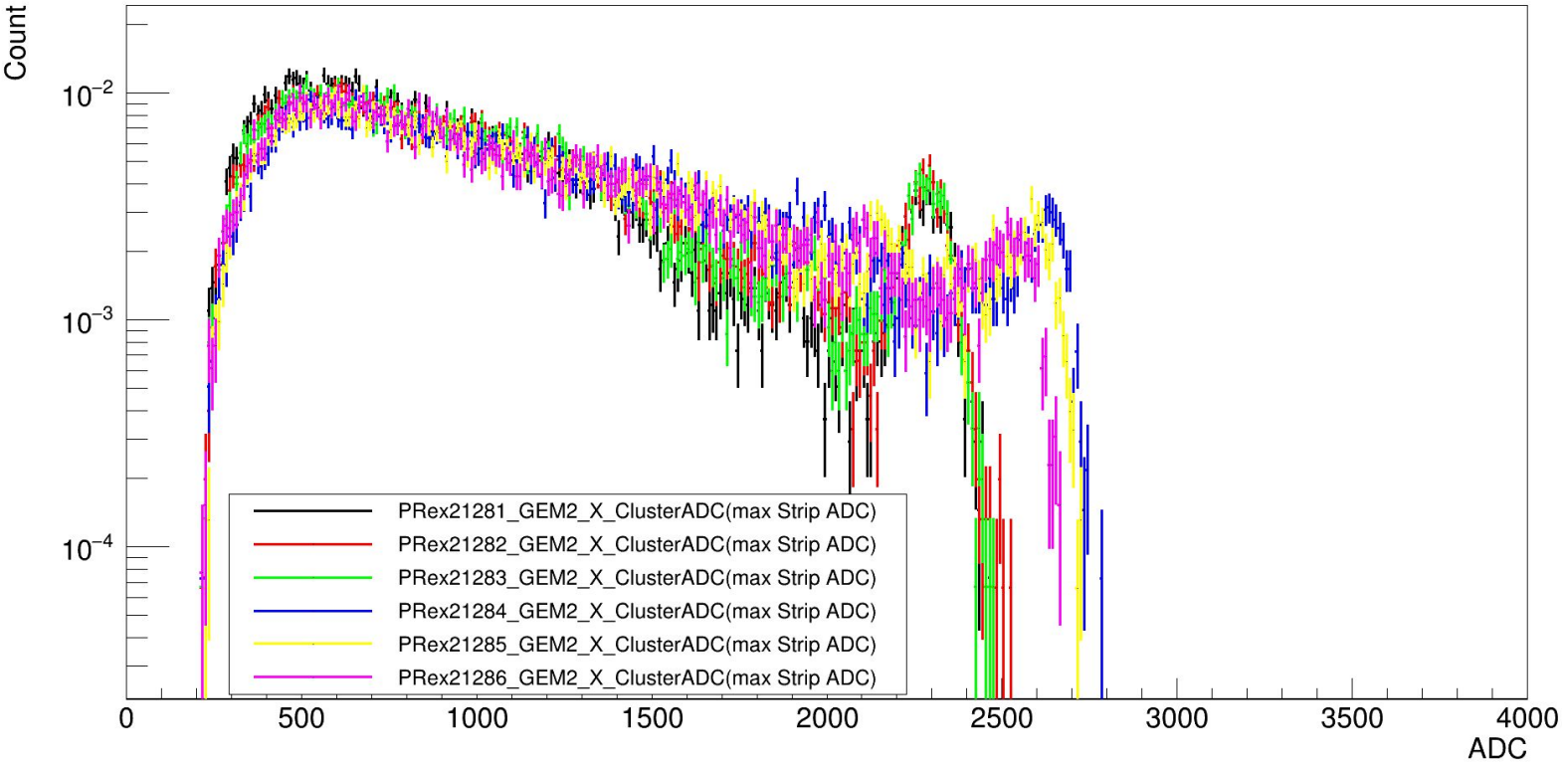
GEM3 Cluster ADC



GEM Cluster

- SBS6, Cluster ADC for different runs
- Around 500 ADC, 21281 -> 21286 count drops
- Around saturation tail: 21281 -> 21286 count increase

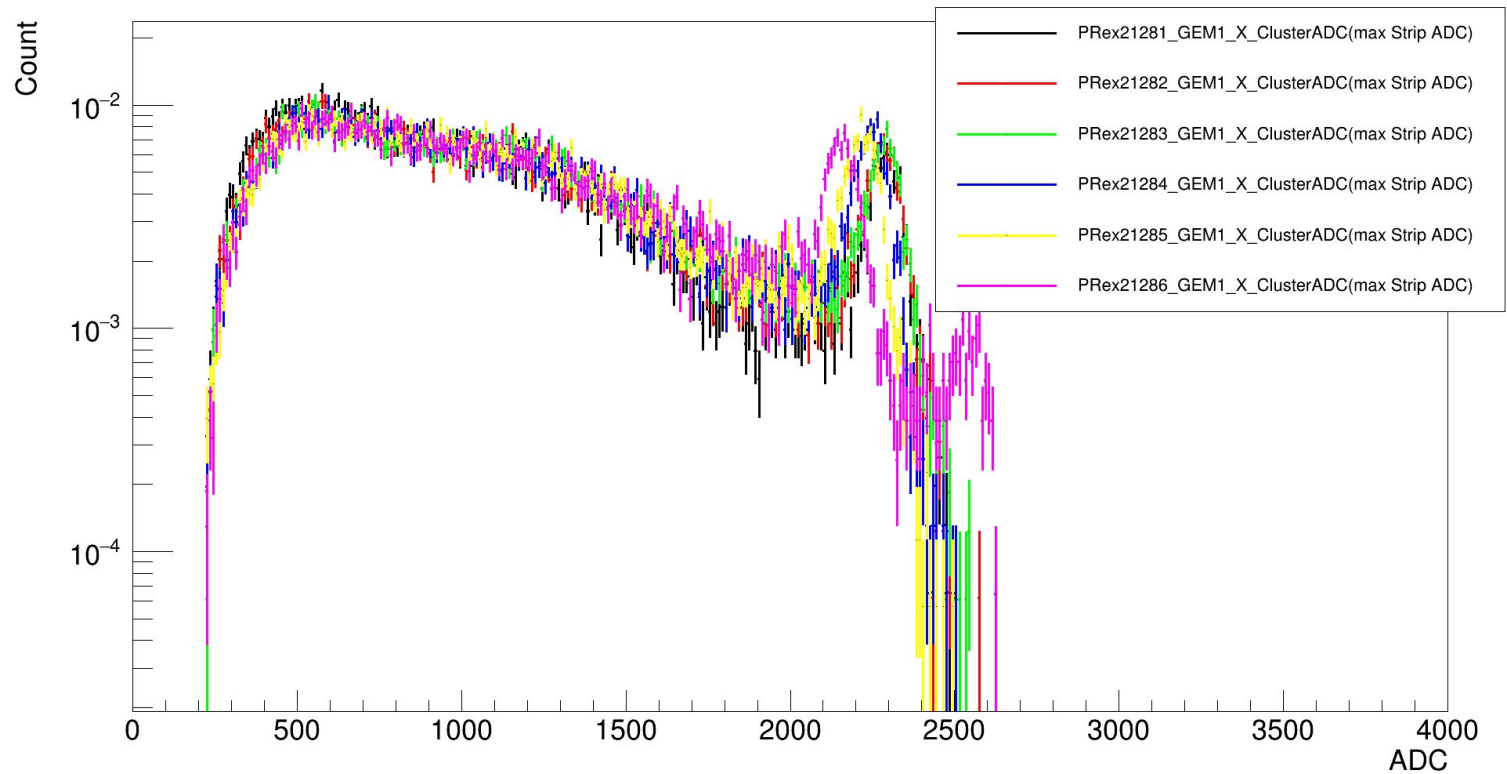
GEM2 Cluster ADC



GEM Cluster

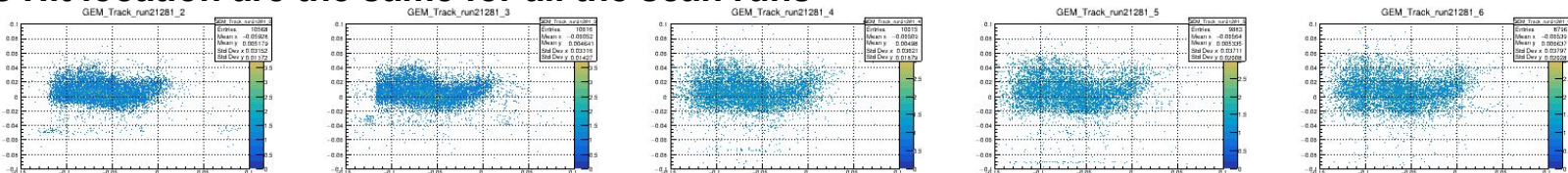
- SBS6, Cluster ADC for different runs
- Around 500 ADC, 21281 -> 21286 count drops
- Around saturation tail: 21281 -> 21286 count increase

GEM1 Cluster ADC

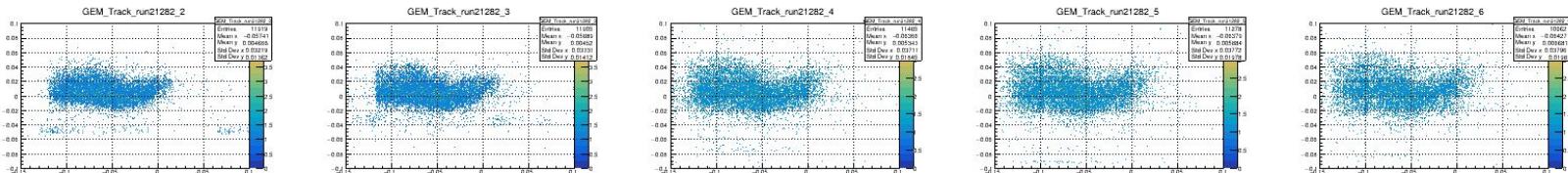


2D plot shows Hit location are the same for all the scan runs

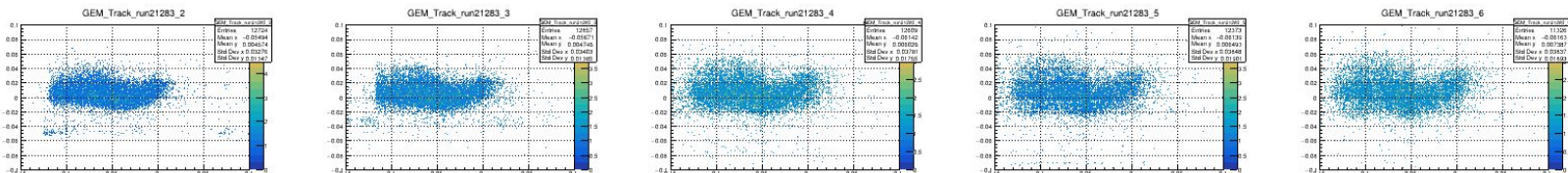
21281



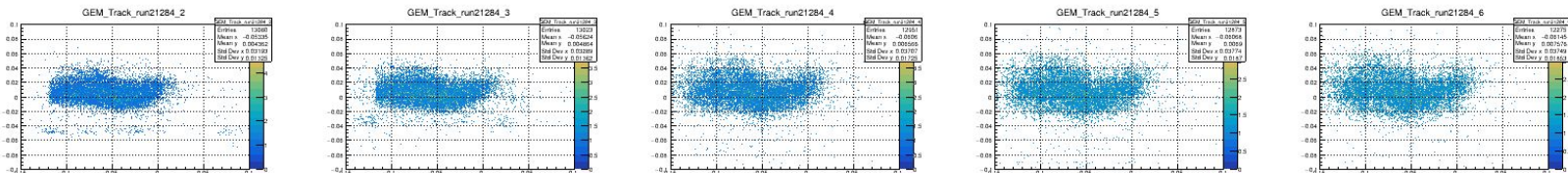
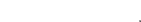
21282



21283



21284



21285

