Update on SBS GEM prototypes tests at FNAL (Oct. 2013) and JLab (March 2014)

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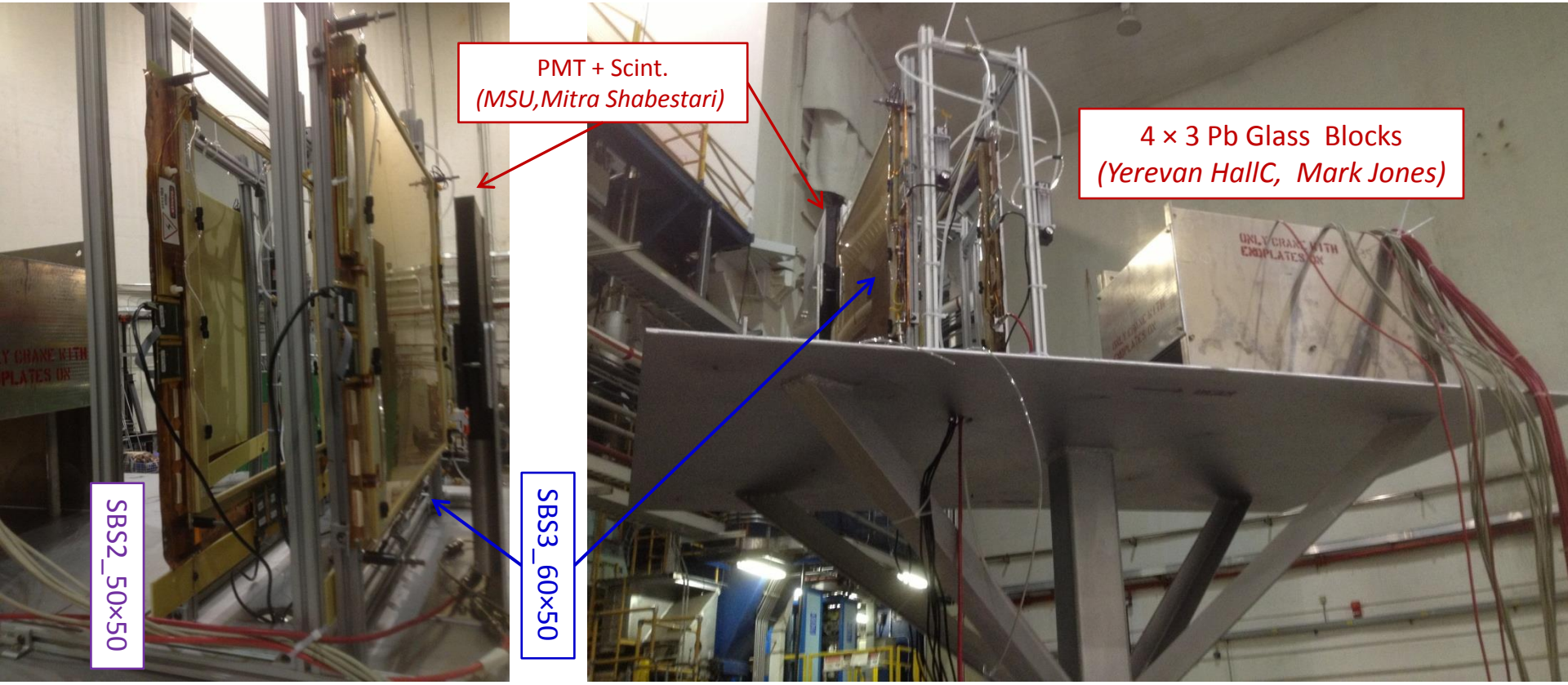
Outline

- Preliminary results from the GEM tests at JLab (March 2014)
  - Performances of the SBS GEM Modules
  - Preliminary results on APV25 electronics latency and timing
- Update on the GEM tests at FNAL Test Beam (October 2013)
  - Spatial resolution of SBS GEM
  - Efficiency of the SBS GEM modules

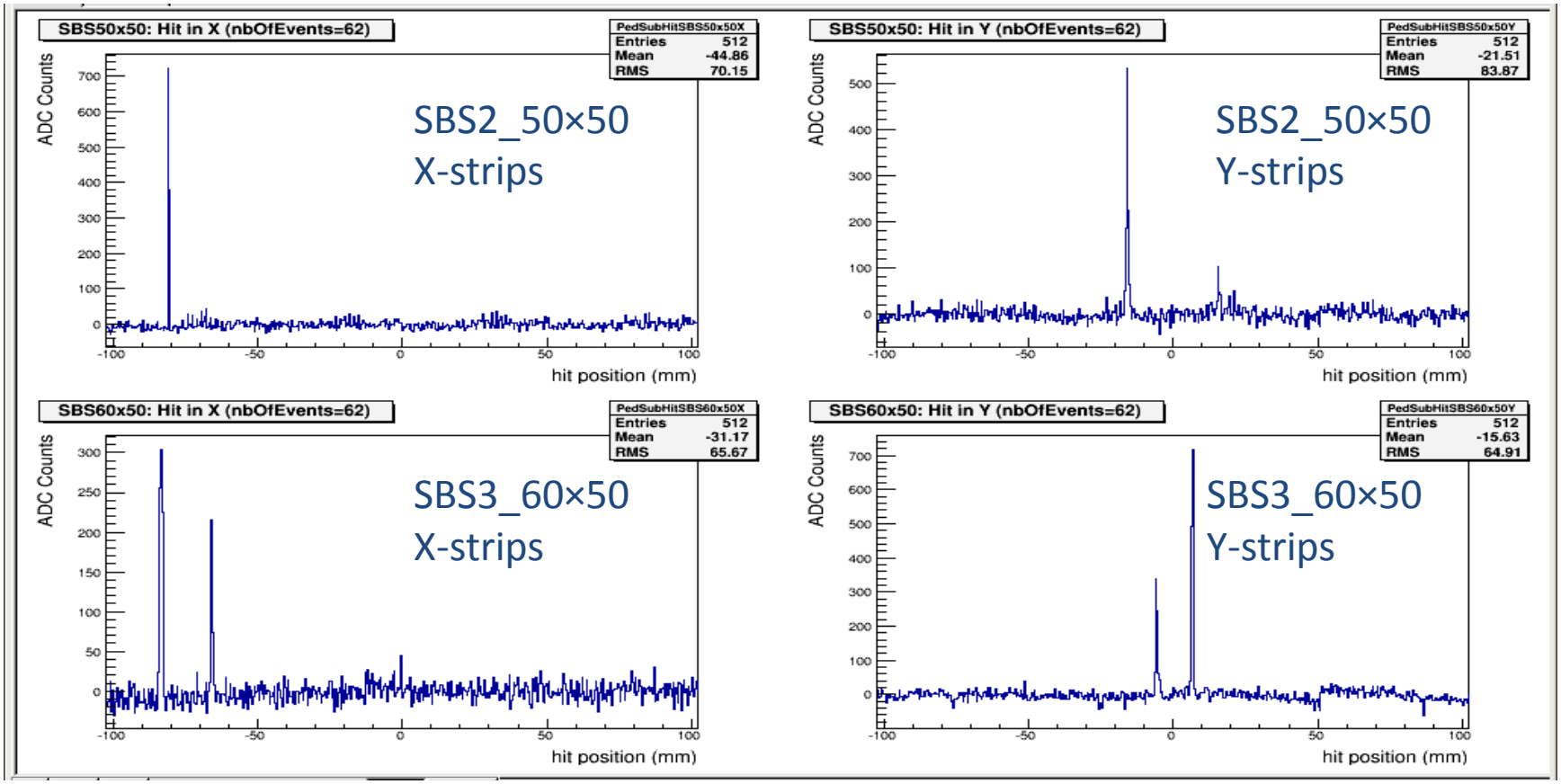
UVa GEMs @ JLab Test Beam (March 2014):

- Two SBS GEM Module: SBS2 (50×50 cm^2) and SBS3 (60×50 cm^2);
- 20×20 cm^2 read out during the test
- Trigger: Coincidence between PMT-Scintillators upstream and Lead Glass downstream
  - 2 Scint. Are 16×16 cm^2 side by side, and 4×3 cm^2 Lead glass blocks (10×10 cm^2)
- Readout System: APV25-SRS + DATE DAQ

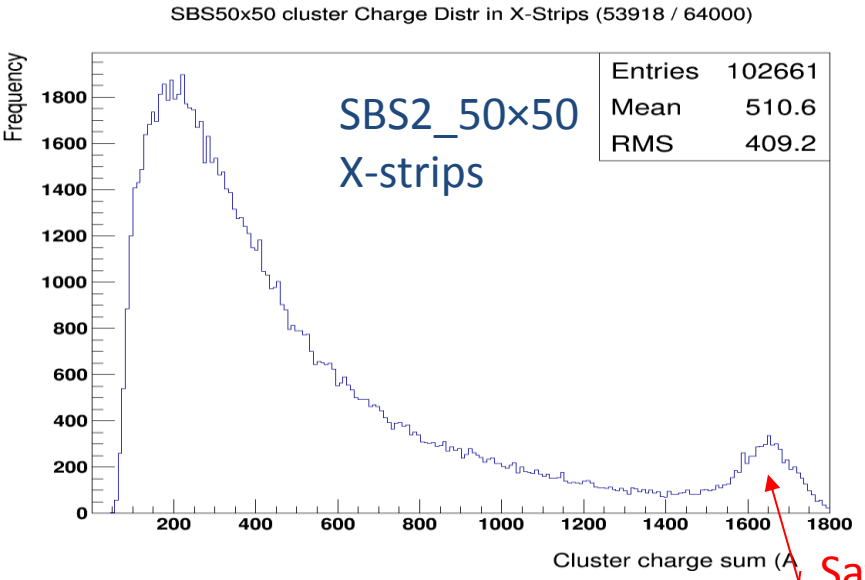


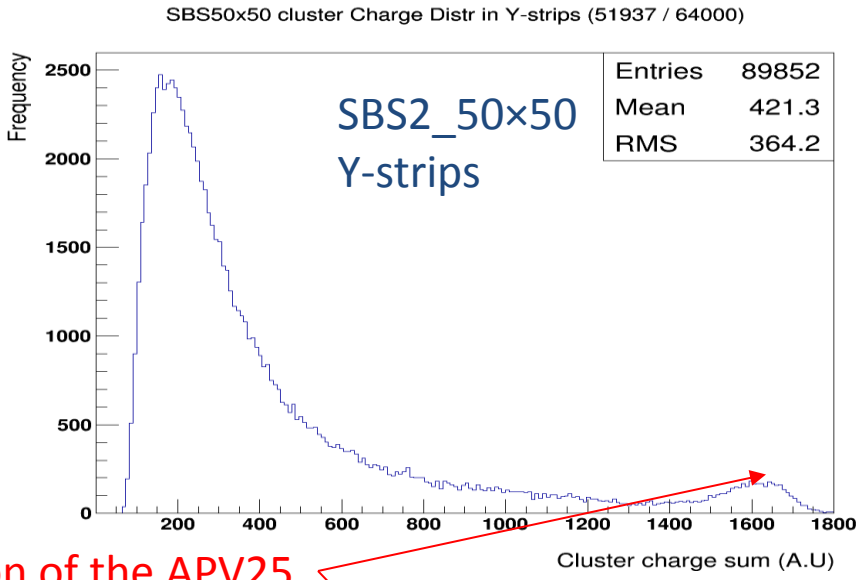
UVa GEMs @ JLab Test Beam: Typical event

- Data on April 02, 2014: Last day of the beam in Hall A
- CW beam with Carbon target: very low intensity ➔ low trigger rate
- Gas mixture ArCO2 (75/25) ➔ 3950 kV on the divider
- 64 K Events saved into raw data files with APV25-SRS ➔ with 6 apv25 time sample

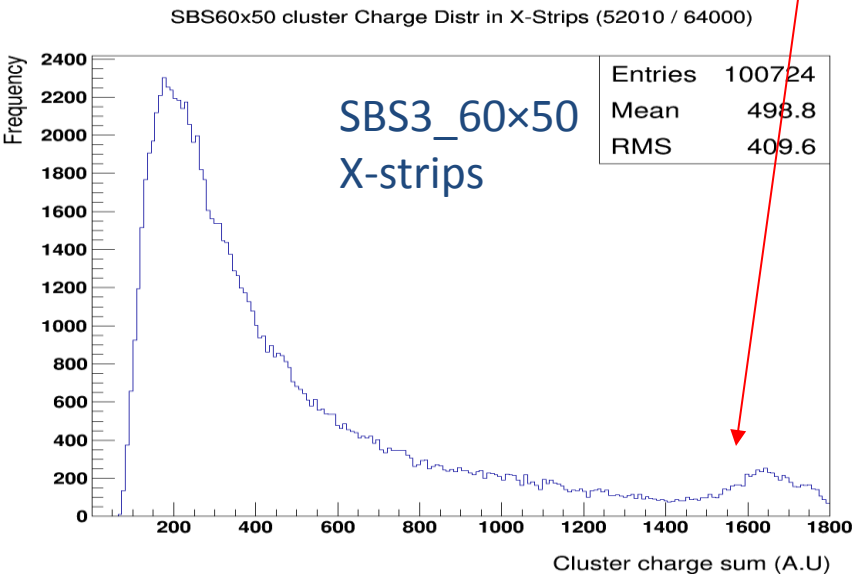


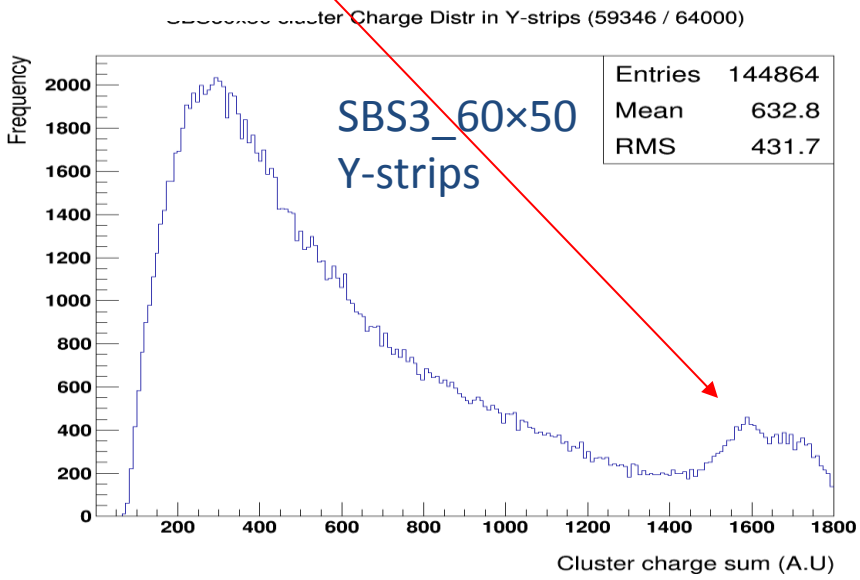
UVa GEMs @ JLab Test Beam: ADC distribution plots





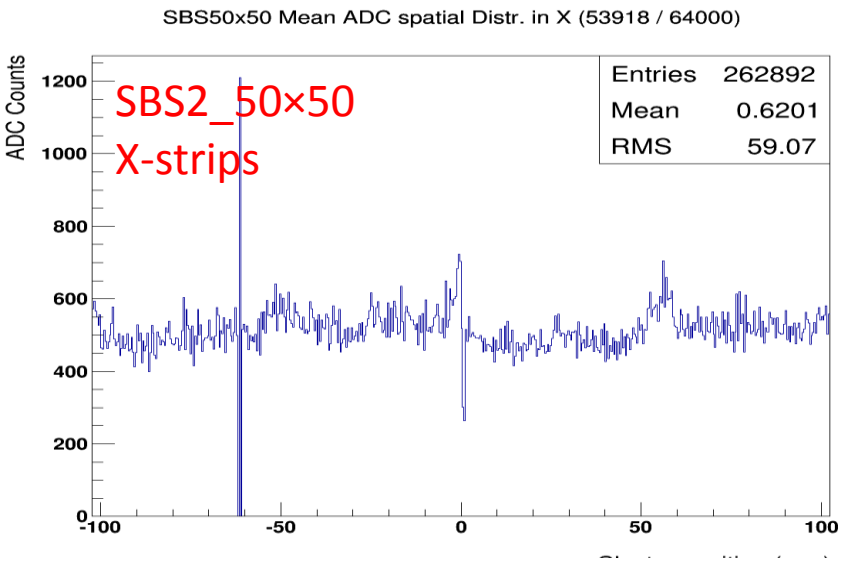
Saturation of the APV25

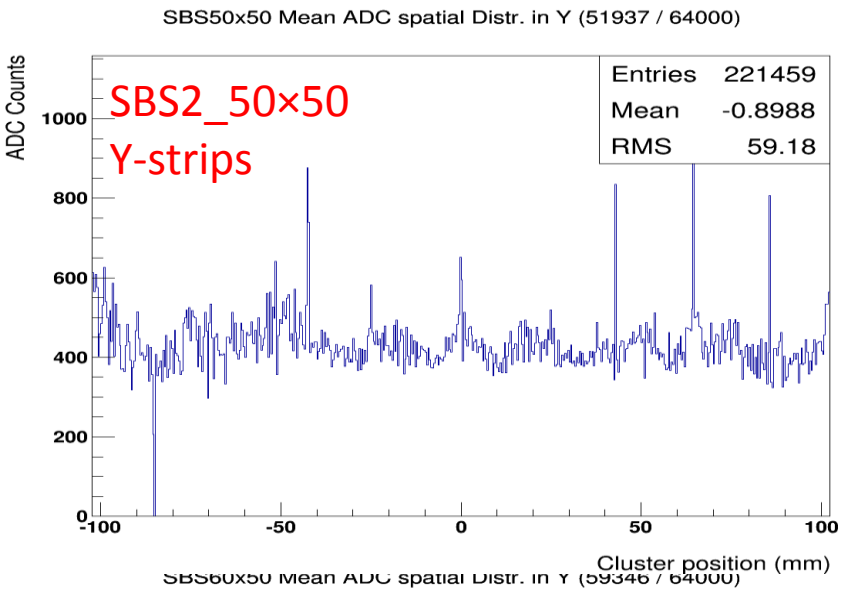


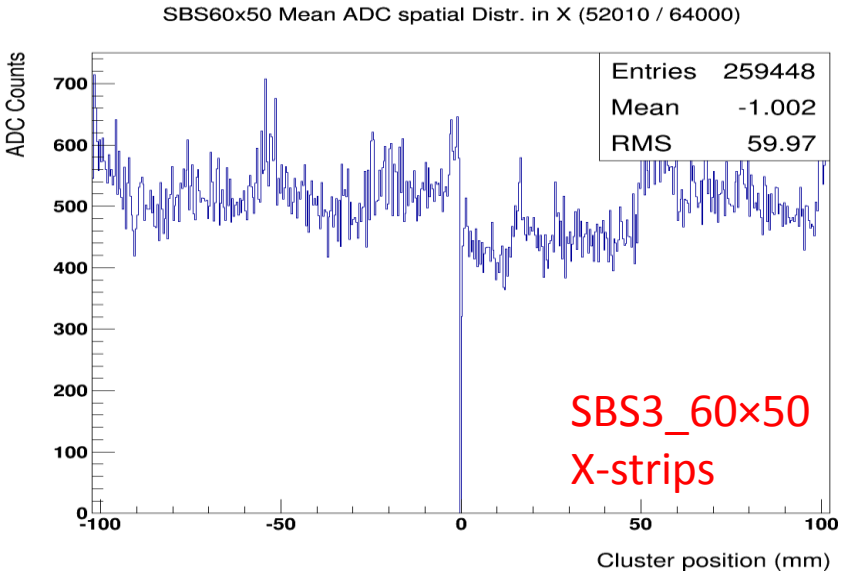


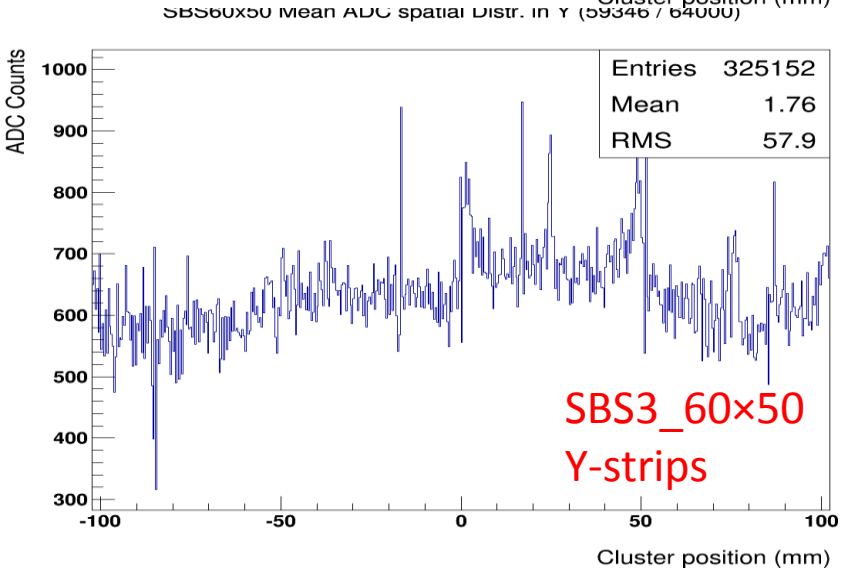
UVa GEMs @ JLab Test Beam: Average ADC distribution vs cluster position

Gain uniformity



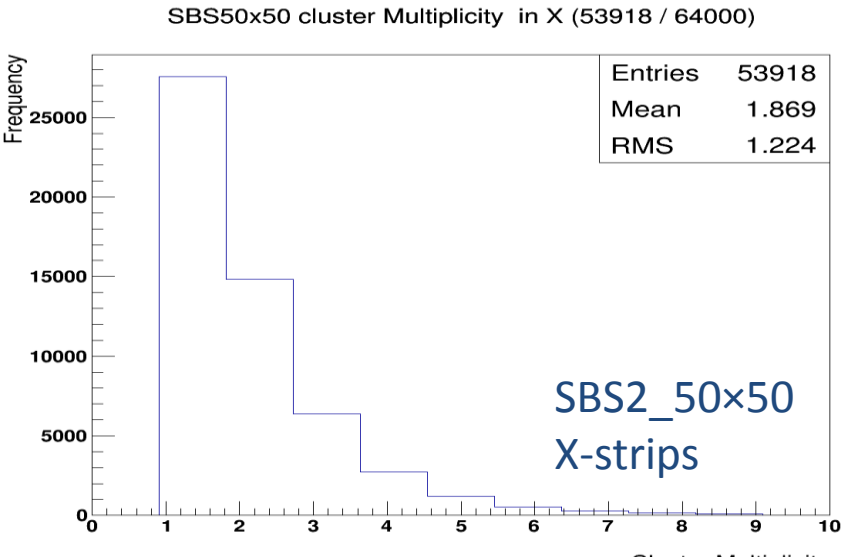


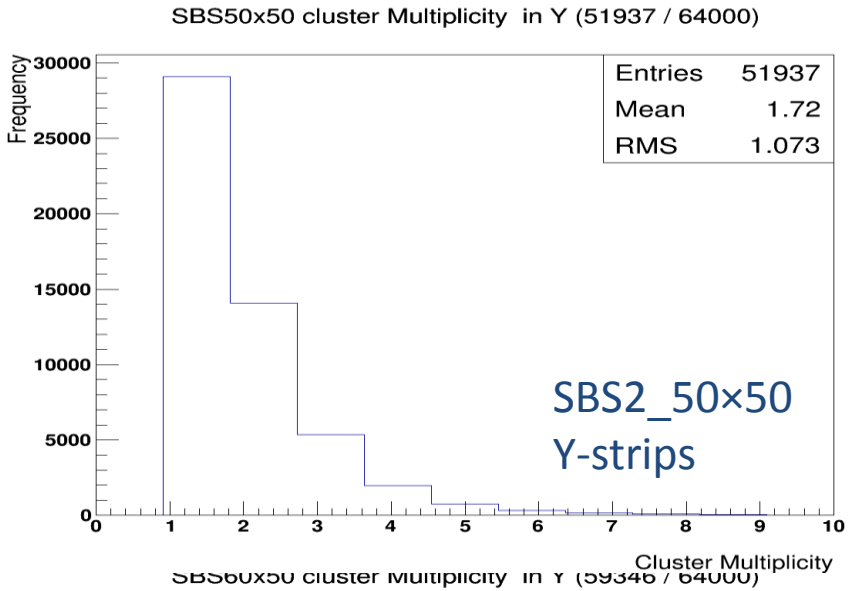


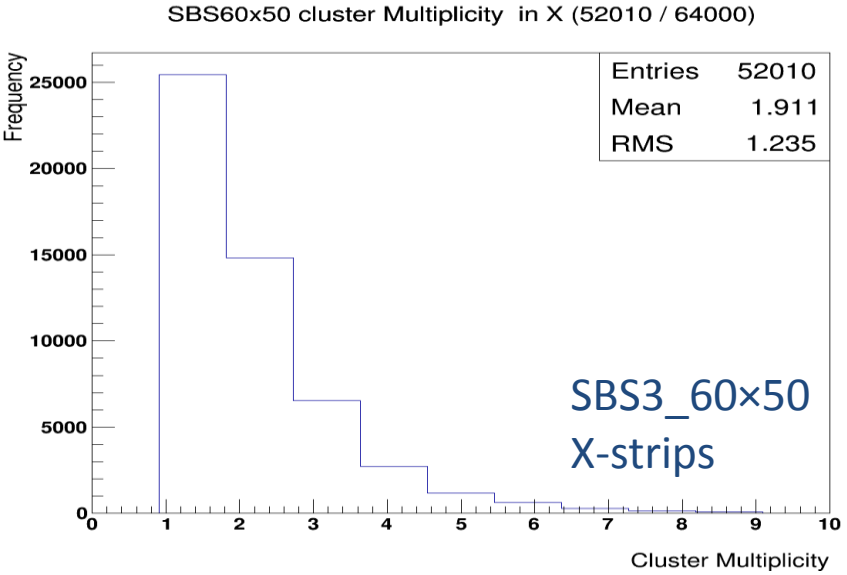


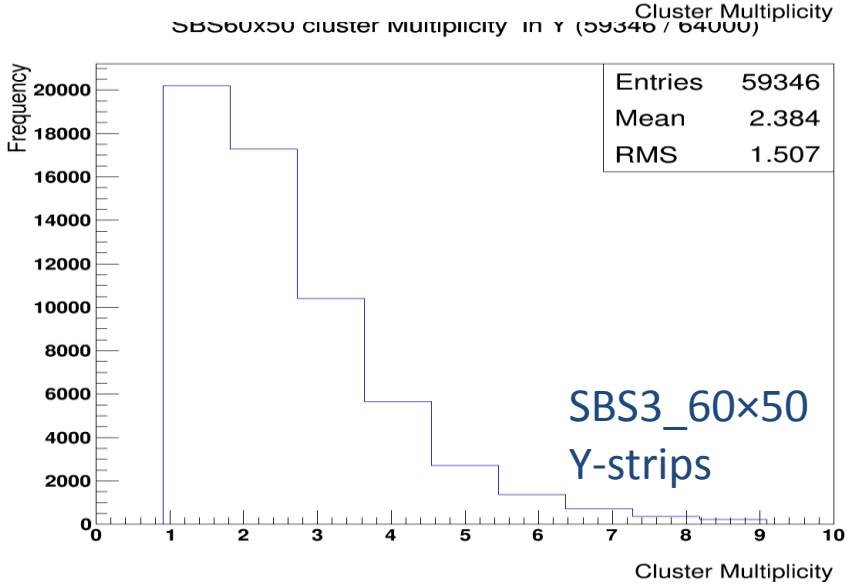
UVa GEMs @ JLab Test Beam: Cluster Multiplicity

Average number of cluster per event per detector plane



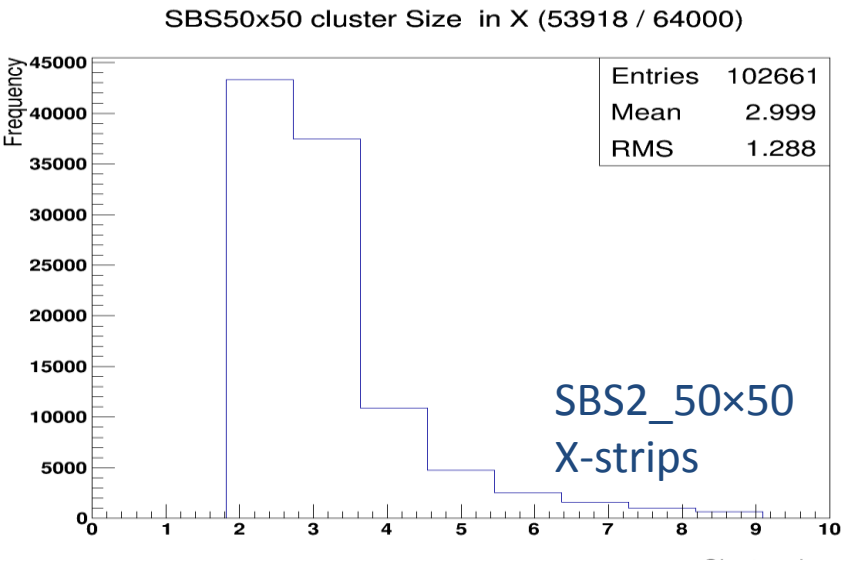


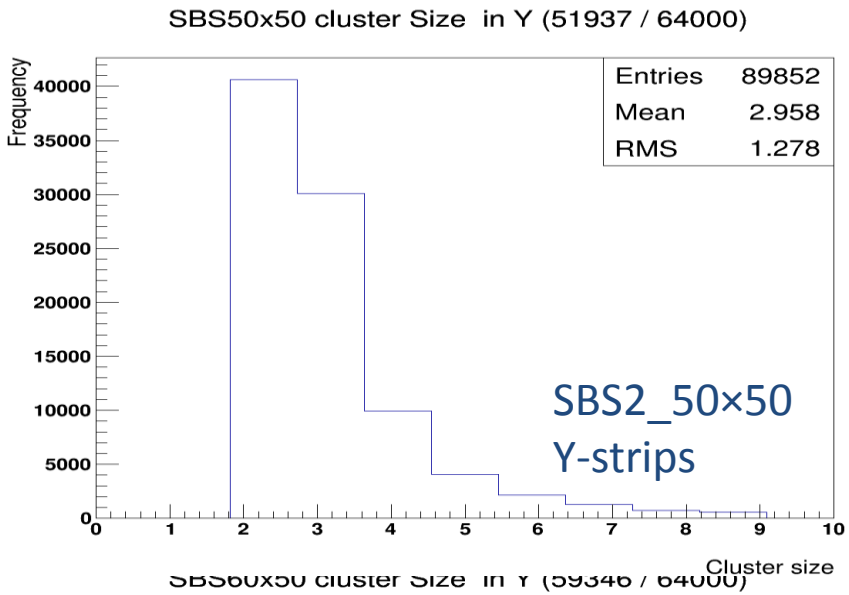


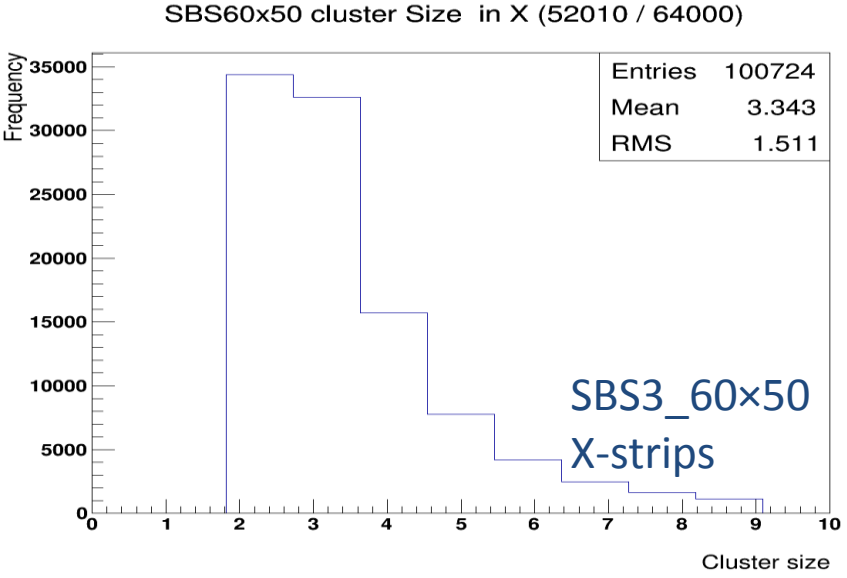


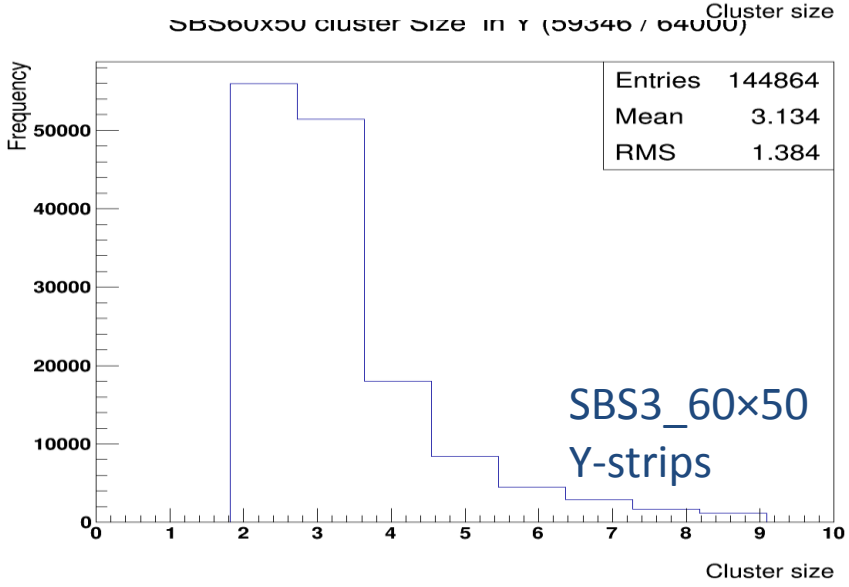
UVa GEMs @ JLab Test Beam: Cluster Size

Average number of hits per event cluster

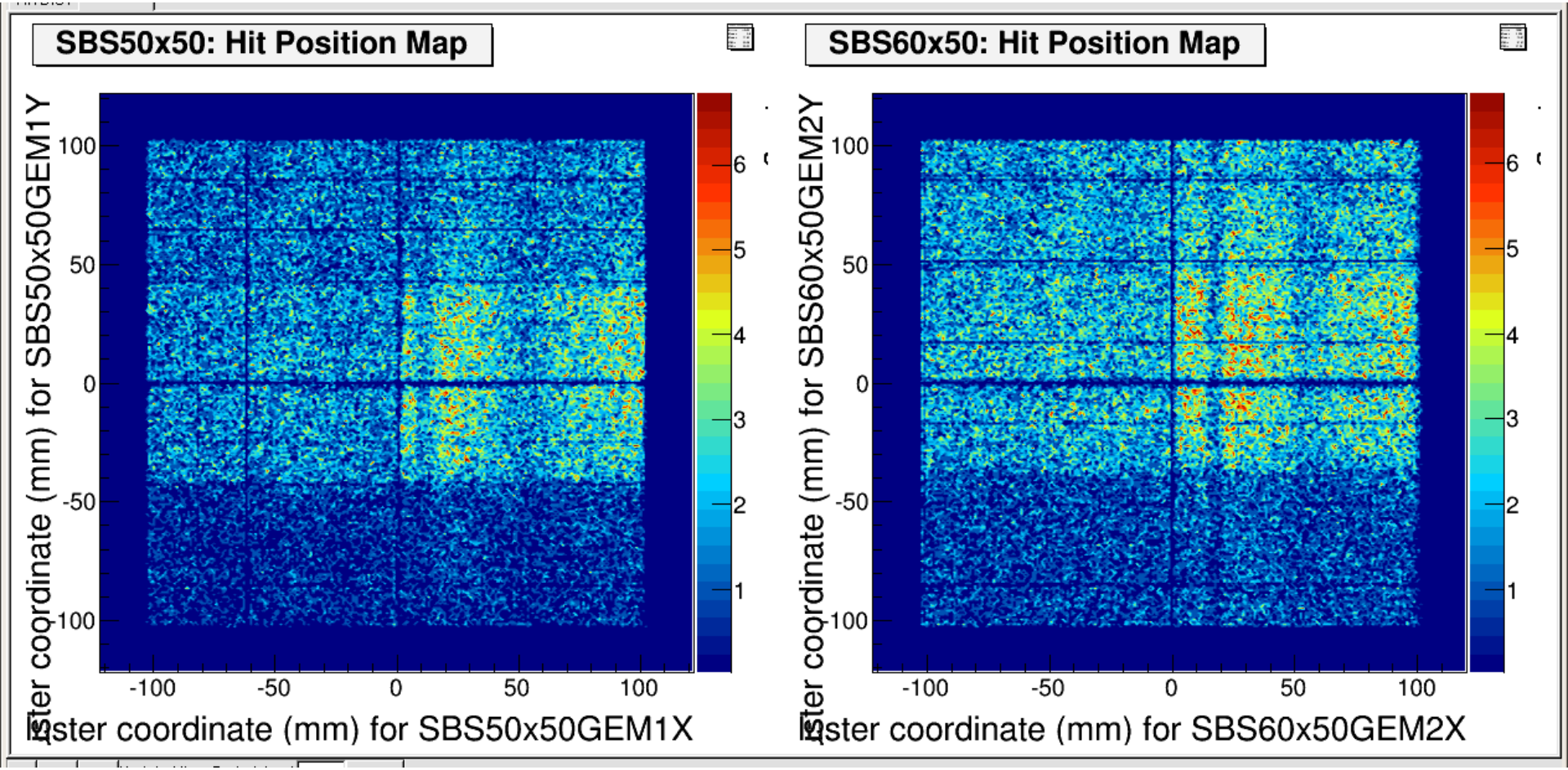








UVa GEMs @ JLab Test Beam: Cluster position map

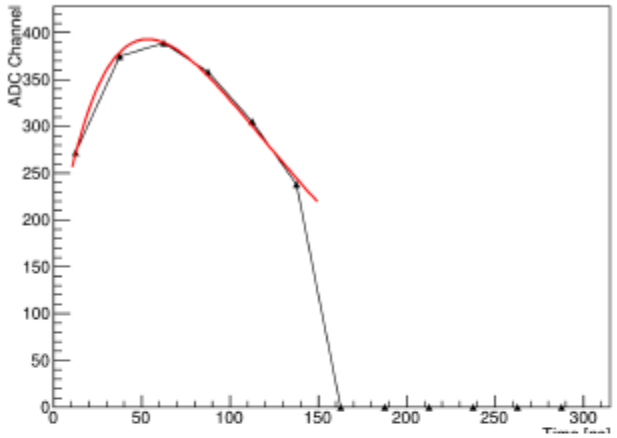


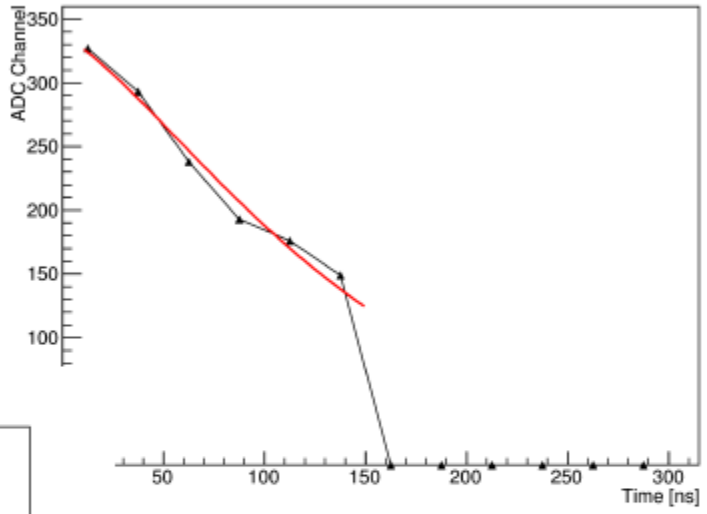
UVa GEMs @ JLab Test Beam: APV25 timing analysis

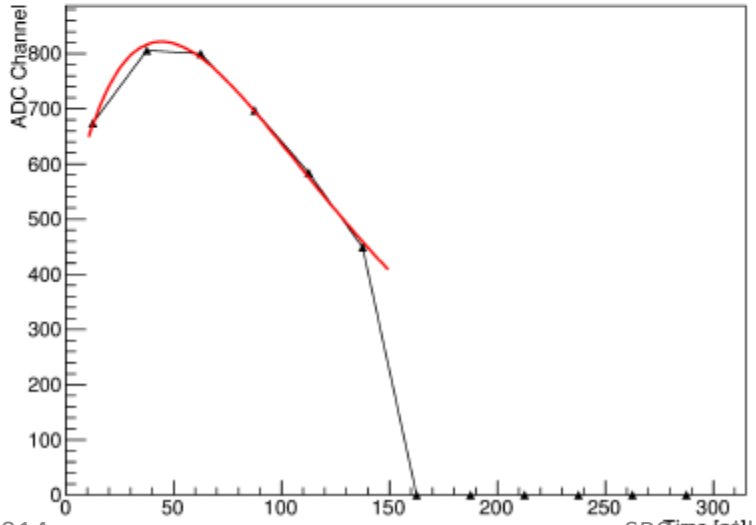
Very preliminary (Xinzhan Bai)

6TS JLab Data

Fitting of some Events in the Data







From the fit,we get the start data timing “apv latency” and the shaping time of the apv signal

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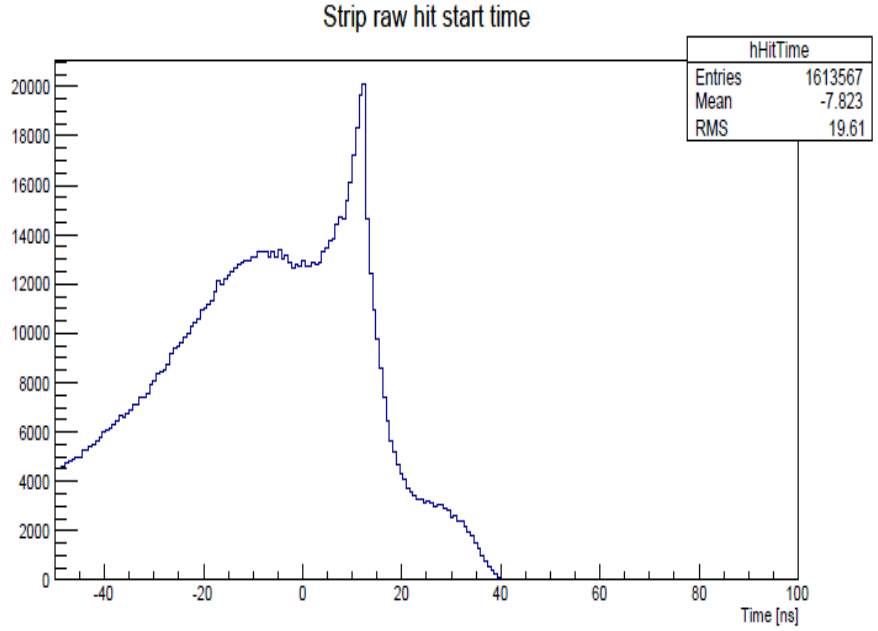
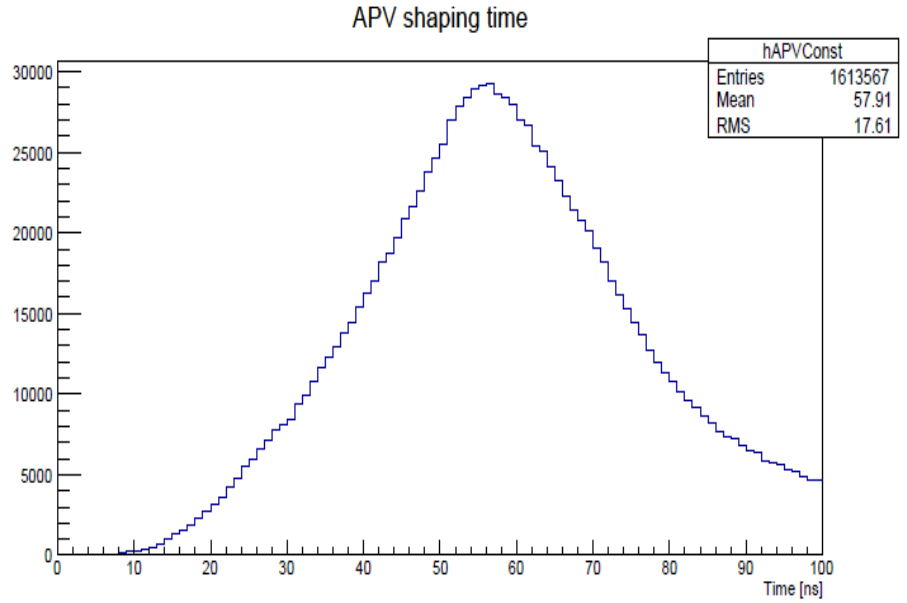
UVa GEMs @ JLab Test Beam: APV25 timing analysis

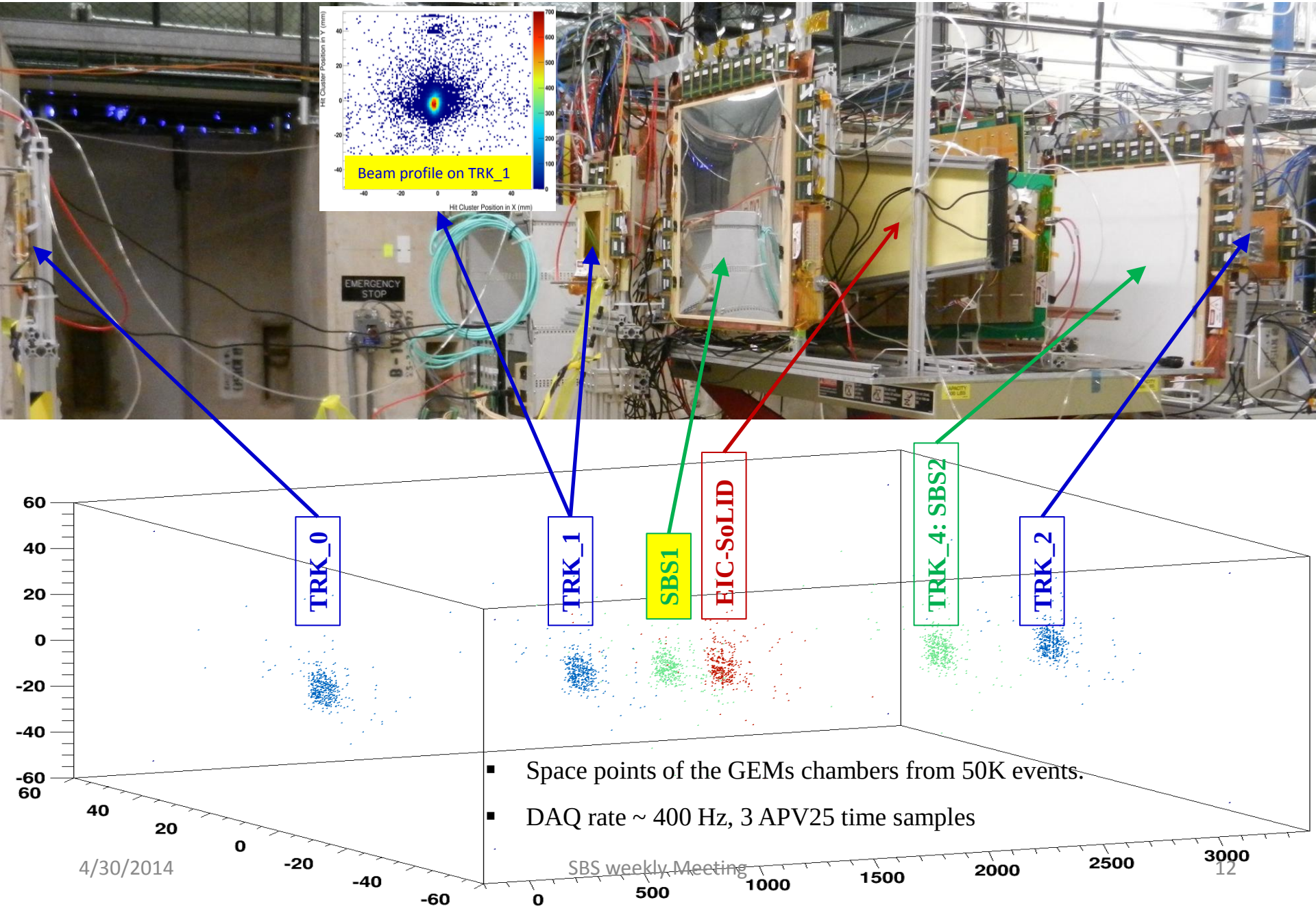
Very preliminary (Xinzhan Bai)

- Shaping time distribution over all apv25s: mean @ 57 ns (expected value is 50 ns)
- APV latency: delay between the apv trigger and the data ➔ Need to adjust this measured parameter with the apv latency set by initializing the SRS
- Triggered particles ???➔ The pic at 15 ns ➔ event synchronized with the trigger???
- Background: remaining of the distribution???





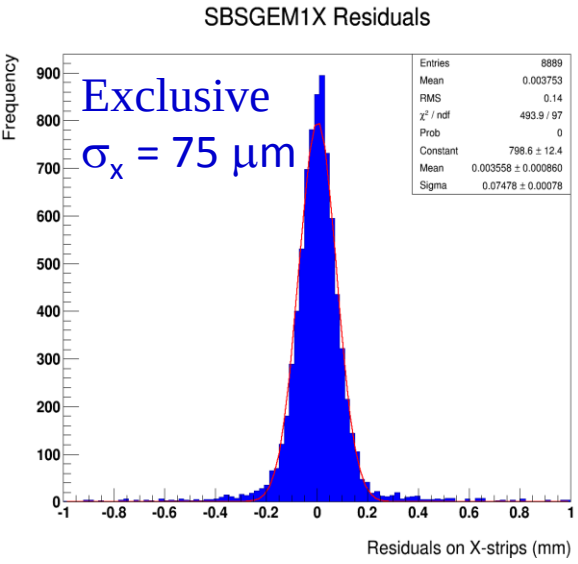
UVa GEMs @ FNAL Test Beam (Oct. 2013): 120 GeV Proton Beam

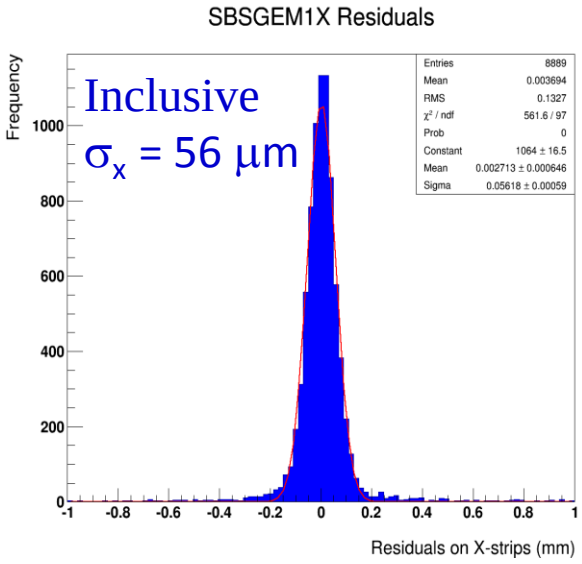


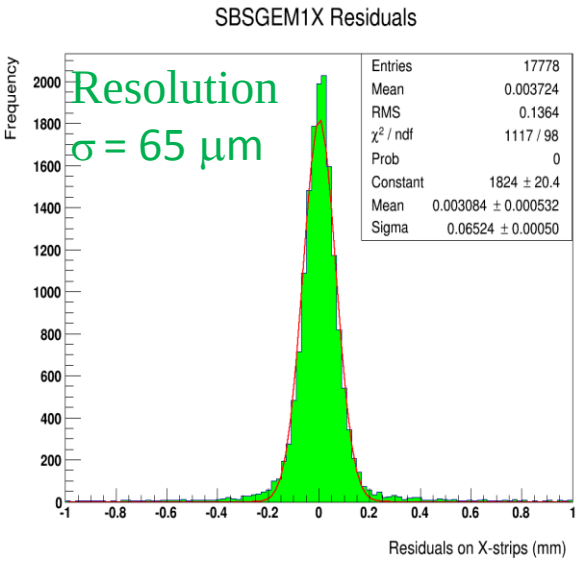
- Space points of the GEMs chambers from 50K events.
- DAQ rate ~ 400 Hz, 3 APV25 time samples

SBS1_50×50: Resolution studies from track fit residuals

- Tracking: Linear fit in X and Y using the single hit from the 3 small trackers
- Exclusive residual : SBS1 data point excluded from the track fit
- Inclusive residual : SBS1 data used for the track fitting
- Resolution: Width ($\sigma_{resolution}$) of the Gaussian fit to the combined exclusive and inclusive residual distribution: $\sigma_{resolution} = sqrt(\sigma_{exclusive} \times \sigma_{inclusive})$

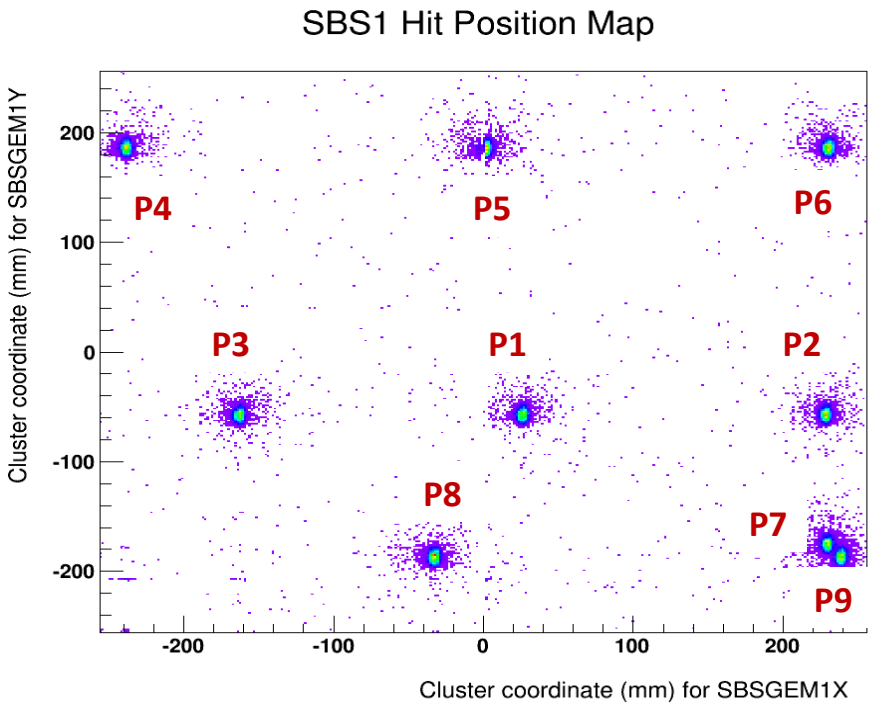


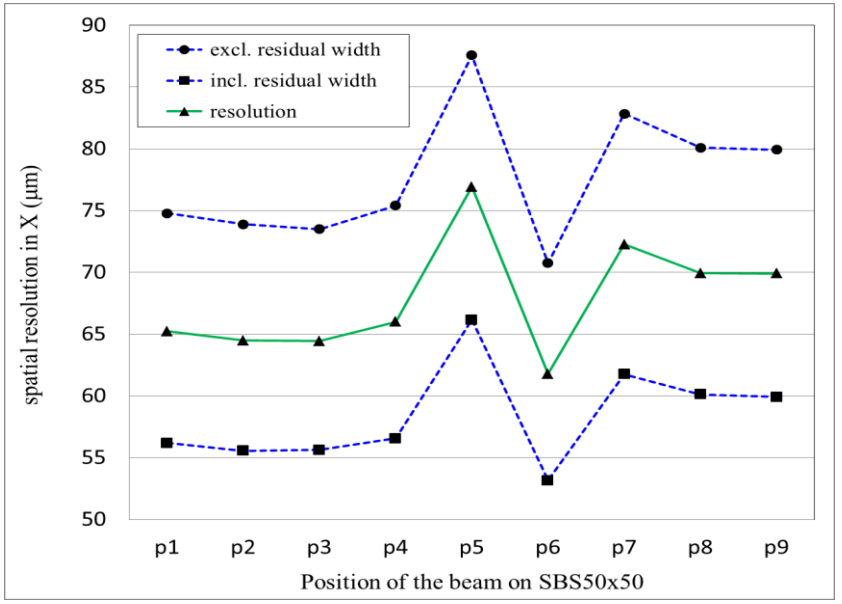


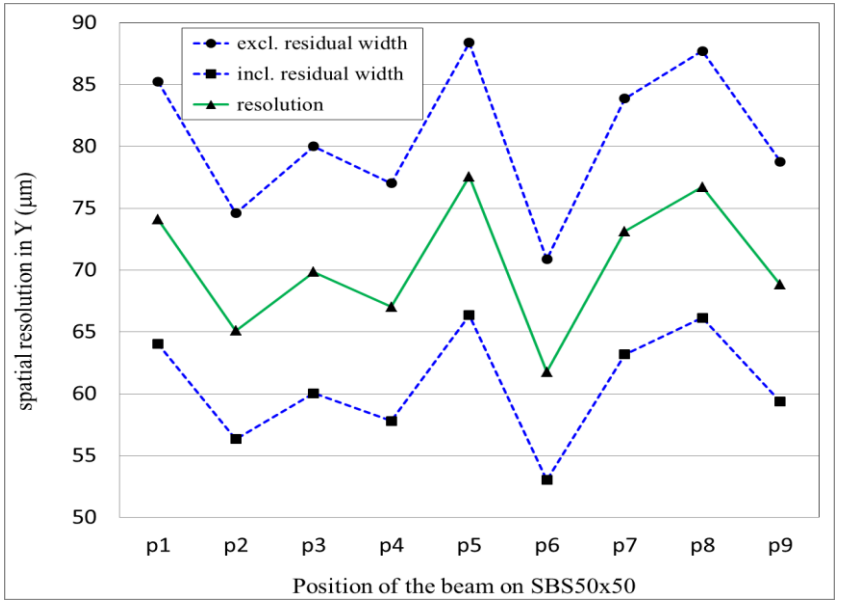


SBS1_50×50: Position scan & resolution

- Zero suppression: 5 × σ cut pedestal noise for each channel
- Clusterization: One or more hits per cluster
- HV: 4100 V on the voltage divider
- Uniform resolution over the 9 position scanned in X and Y
  - (75 μm average for X-strips and 75 μm for Y-strips)
- Pic on P5 ➔ beam close to the spacers inside the chamber
  - Degradation of the resolution

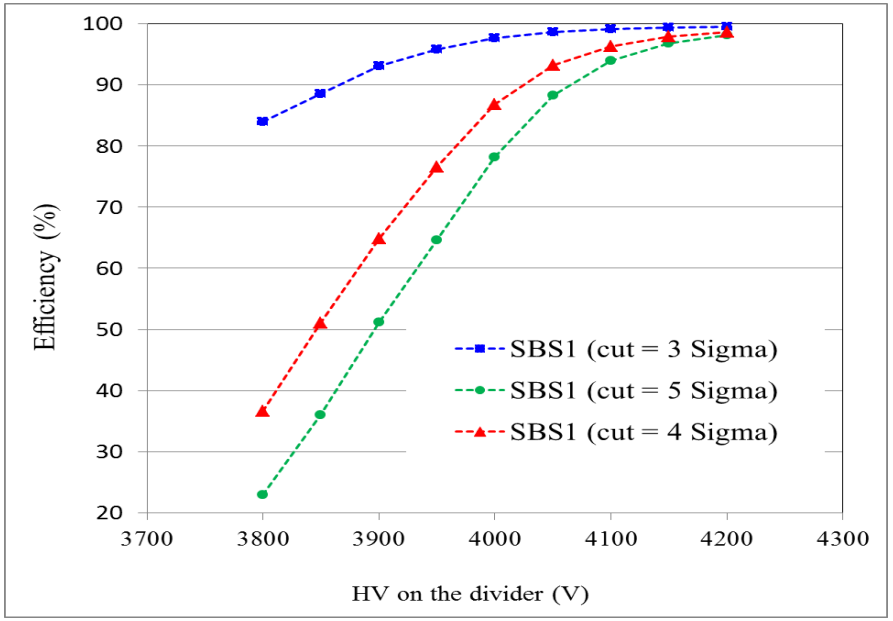


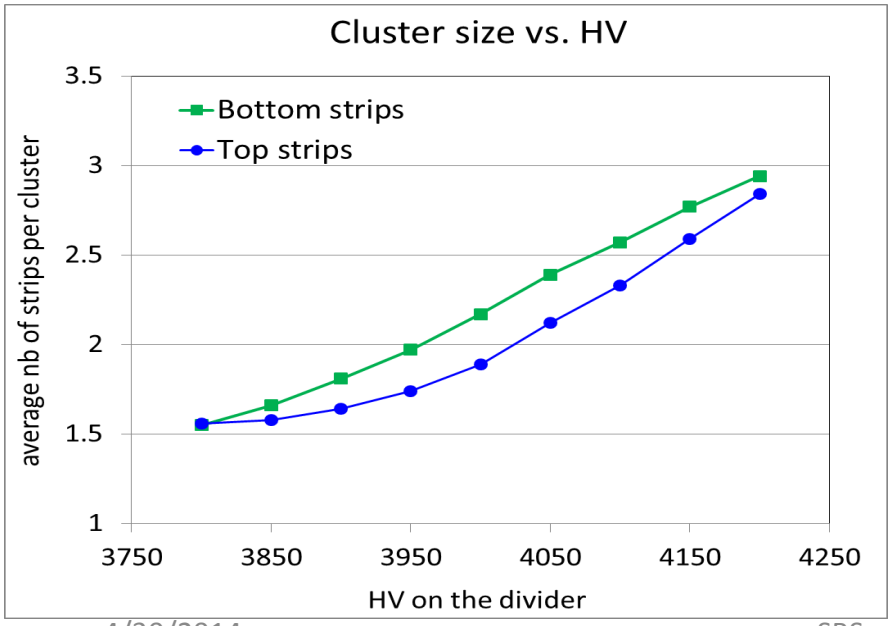


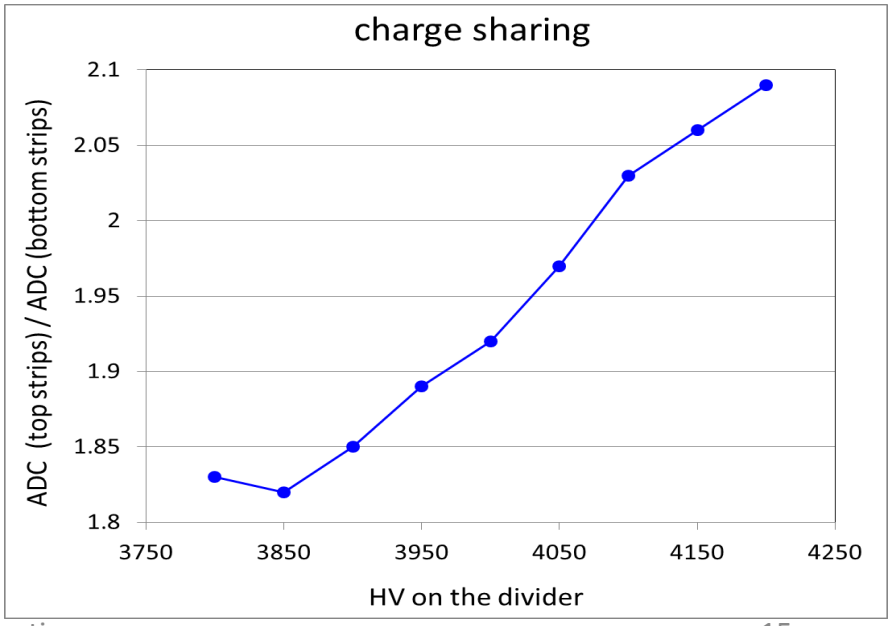


SBS1_50×50: HV scan

- Efficiency plateau around 4100 kV at 4 sigma cut
- Charge sharing slightly dependent of the HV ➔ from the same charging up effect of the readout board
- expected increase of cluster size with the HV in both X-strips and Y-Strips

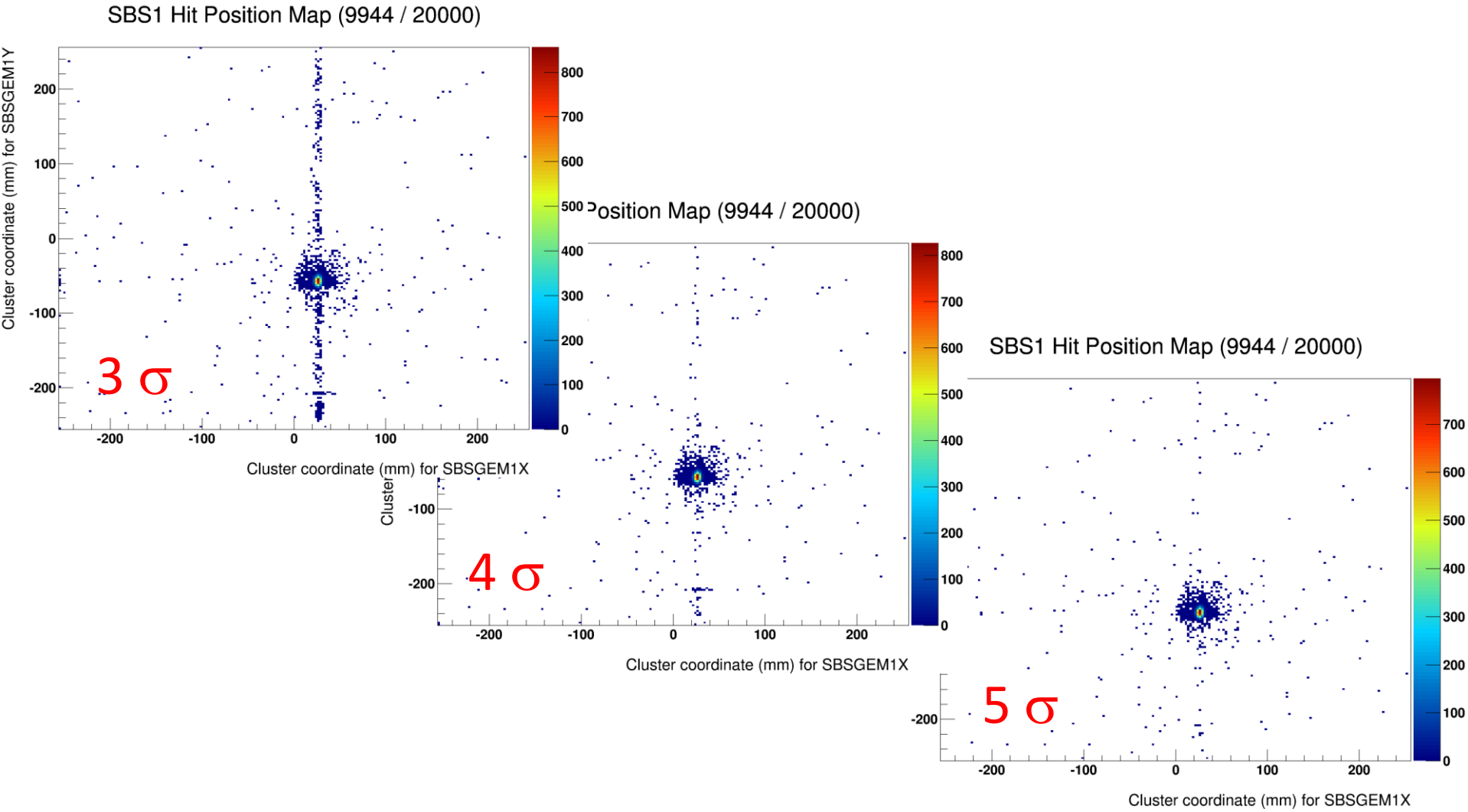






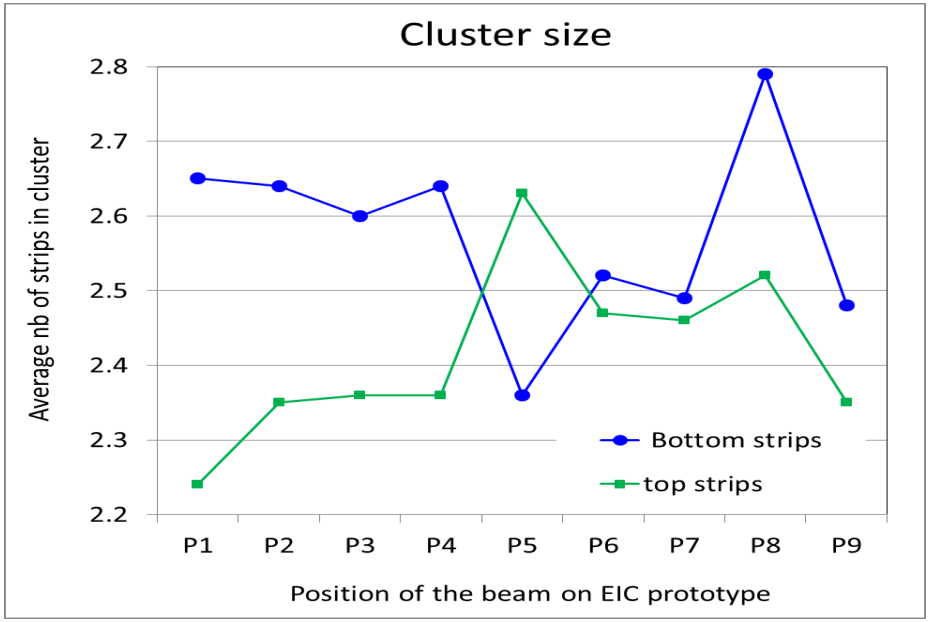
Choice of the zero suppression cut at 5 × σ of the strip pedestal noise

SBS1_50×50: 120 GeV proton beam



SBS1_50×50: Pos Scan

- Uniform efficiency over the beam positions scanned
- Drop in efficiency at P5 ➔ beam close to the spacers inside the chamber
- Relative good uniformity of the cluster size for both x-strips and y-strips
- Significant variation of the charge sharing ➔ need to investigate why?



Efficiency @ different cuts (zero suppression)