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

Kondo Gnanvo

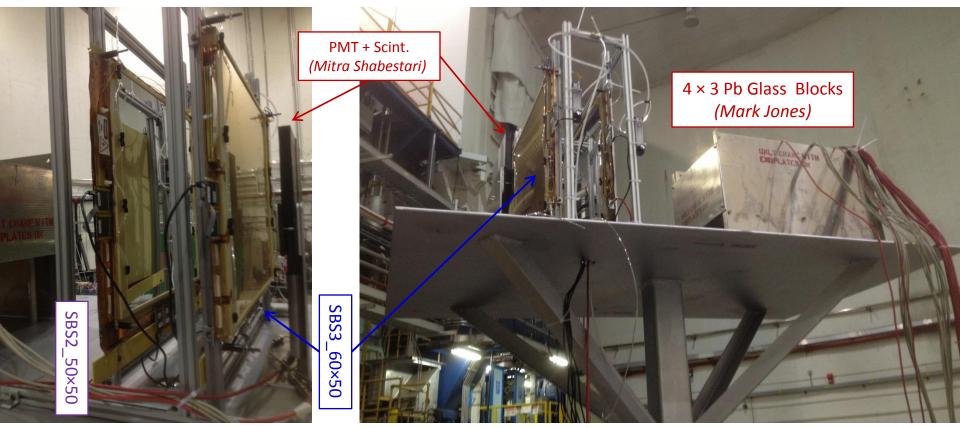
Outline

- 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

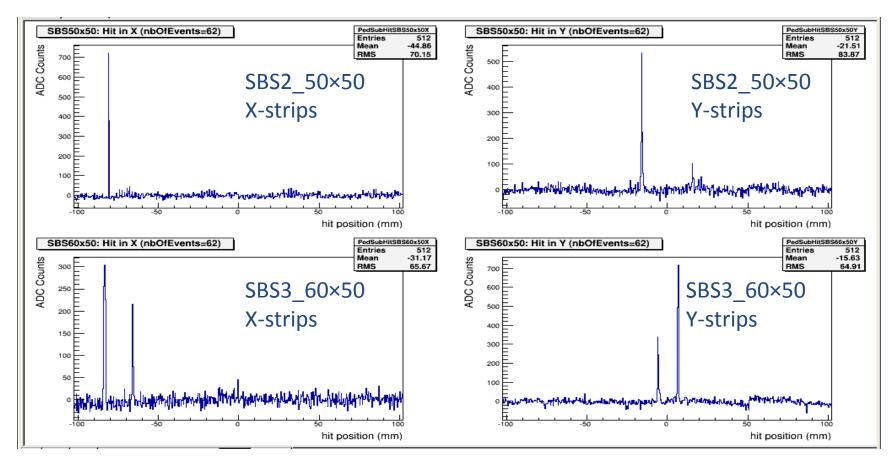
UVa GEMs @ JLab Test Beam (March 2014):

- Two SBS GEM Module: SBS2 ($50 \times 50 \text{ cm}^2$) and SBS3 ($60 \times 50 \text{ cm}^2$);
- 20×20 cm² read out during the test
- Trigger: Coincidence between PMT-Scintillators upstream and Lead Glass downstream
- 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) \rightarrow 3950 kV on the divider
- 64 K Events saved into raw data files with APV25-SRS \rightarrow with 6 apv25 time sample



UVa GEMs @ JLab Test Beam: ADC distribution plots

SBS50x50 cluster Charge Distr in X-Strips (53918 / 64000) SBS50x50 cluster Charge Distr in Y-strips (51937 / 64000) Frequency Frequency Entries Entries SBS2_50×50 Mean 510.6 SBS2_50×50 Mean 421.3 RMS RMS 409.2 364.2 **X-strips Y-strips** Cluster charge sum (A Cluster charge sum (A.U) Saturation of the APV25 SBS60x50 cluster Charge Distr in X-Strips (52010 / 64000) ter Charge Distr in Y-strips (59346 / 64000) Frequency Frequency Entries Entries SBS3_60×50 498.8 SBS3 60×50 632.8 Mean Mean RMS RMS 409.6 431.7 Y-strips **X-strips** Cluster charge sum (A.U) Cluster charge sum (A.U)

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



ADC Counts

SBS50x50 Mean ADC spatial Distr. in X (53918 / 64000)

SBS60x50 Mean ADC spatial Distr. in X (52010 / 64000)

Entries

Mean

RMS

50

Entries

Mean

RMS

262892

0.6201

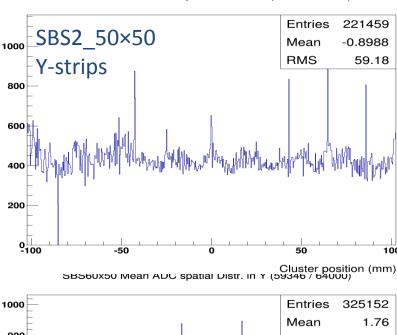
59.07

100

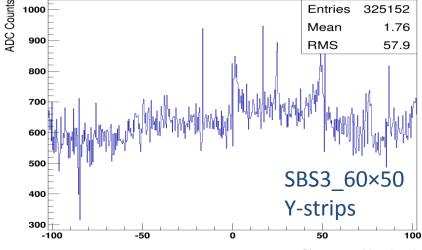
259448

-1.002

59.97



SBS50x50 Mean ADC spatial Distr. in Y (51937 / 64000)





X-strips 0 50

Cluster position (mm)

100

SBS3 60×50

4/23/2014

ADC Counts

1200

1000

800

600

400

200

700

600

500

400

300

200

100

0<u>100</u>

ADC Counts

0<u>100</u>

SBS2 50×50

-50

-50

X-strips

100

UVa GEMs @ JLab Test Beam: Cluster Multiplicity

Average number of cluster per event per detector plane

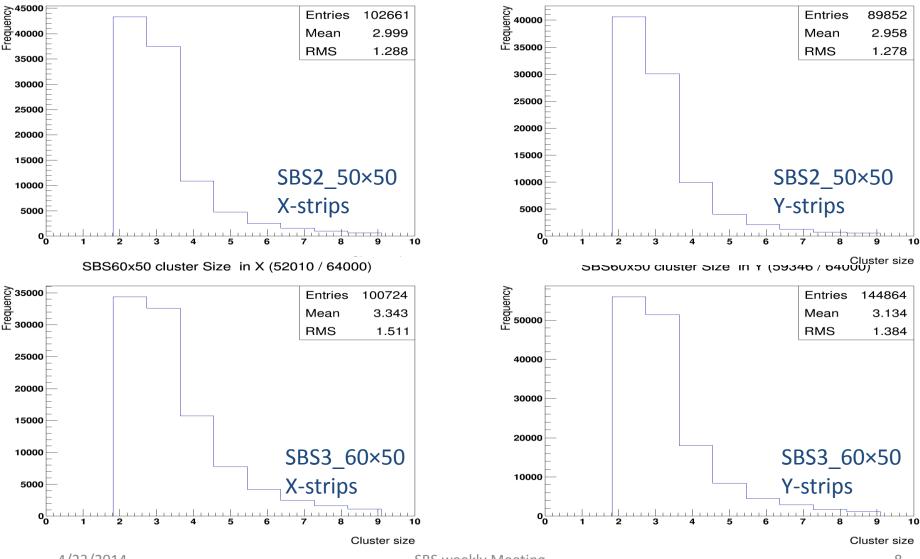
Erequency 52000 52000 Acedneuch 25000 53918 Entries Entries 51937 1.869 Mean Mean 1.72 RMS 1.224 RMS 1.073 20000 20000 15000 15000 10000 10000 SBS2_50×50 SBS2_50×50 5000 5000 X-strips **Y-strips** 9 10 0 0 0 Cluster Multiplicity SBS60x50 cluster Multiplicity in X (52010 / 64000) Lredneucy Leedneucy 18000 Entries 52010 Entries 59346 1.911 2.384 Mean Mean RMS 1.235 RMS 1.507 16000 20000 14000 12000 15000 10000 10000 8000 6000 SBS3_60×50 SBS3_60×50 5000 4000 X-strips **Y-strips** 2000 0 0 1 2 3 4 5 6 7 89 10 9 10 Cluster Multiplicity Cluster Multiplicity 4/23/2014 7

SBS50x50 cluster Multiplicity in Y (51937 / 64000)

SBS50x50 cluster Multiplicity in X (53918 / 64000)

UVa GEMs @ JLab Test Beam: Cluster Size

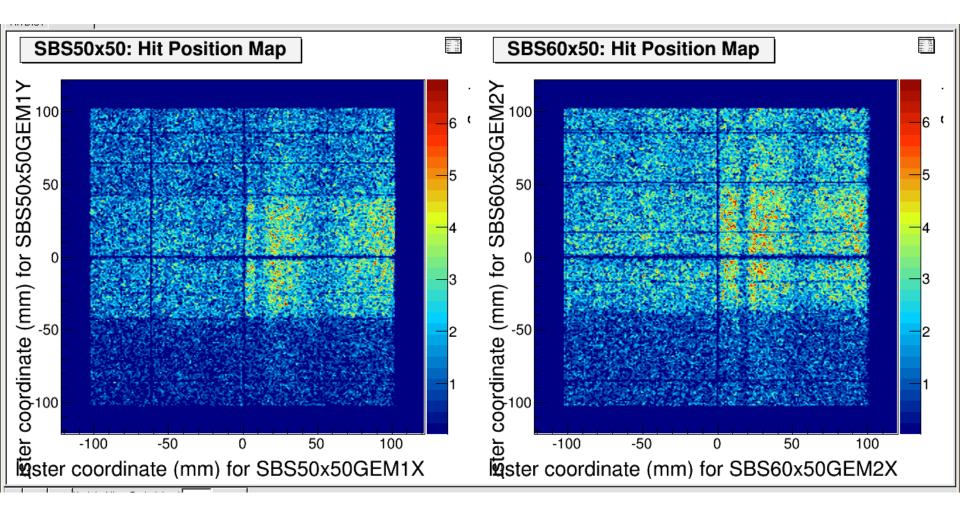
Average number of hits per event cluster



SBS50x50 cluster Size in Y (51937 / 64000)

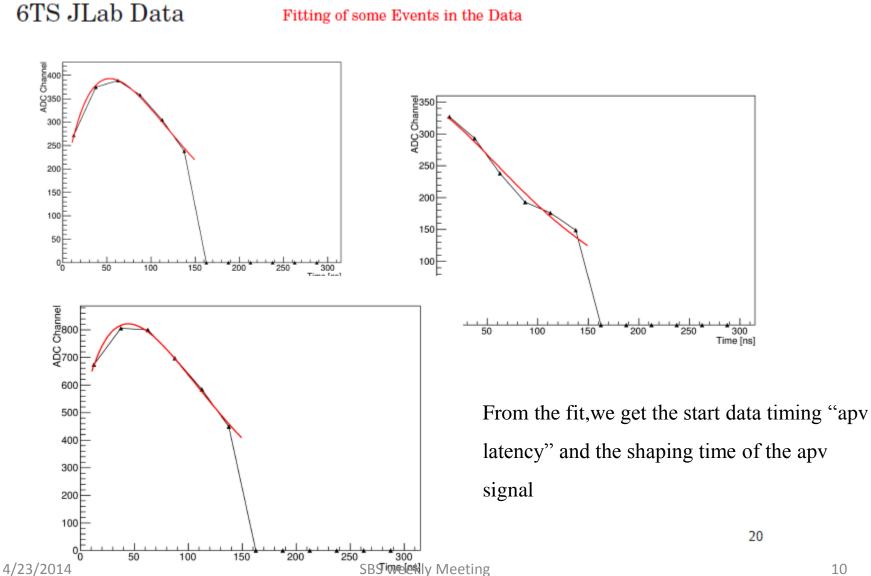
SBS weekly Meeting

SBS50x50 cluster Size in X (53918 / 64000)



UVa GEMs @ JLab Test Beam: APV25 timing analysis

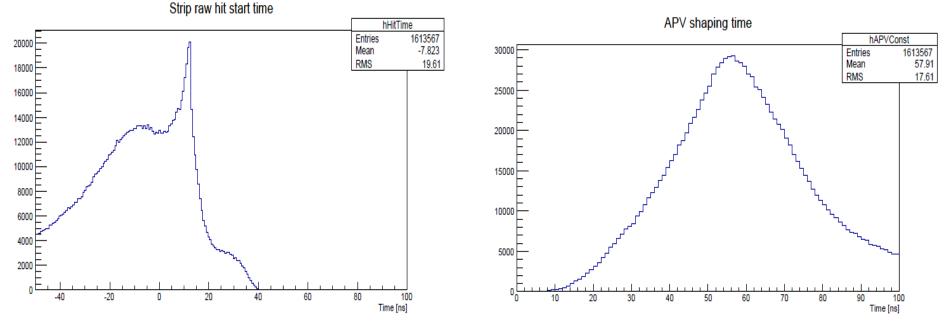
Very preliminary (Xinzhan Bai)



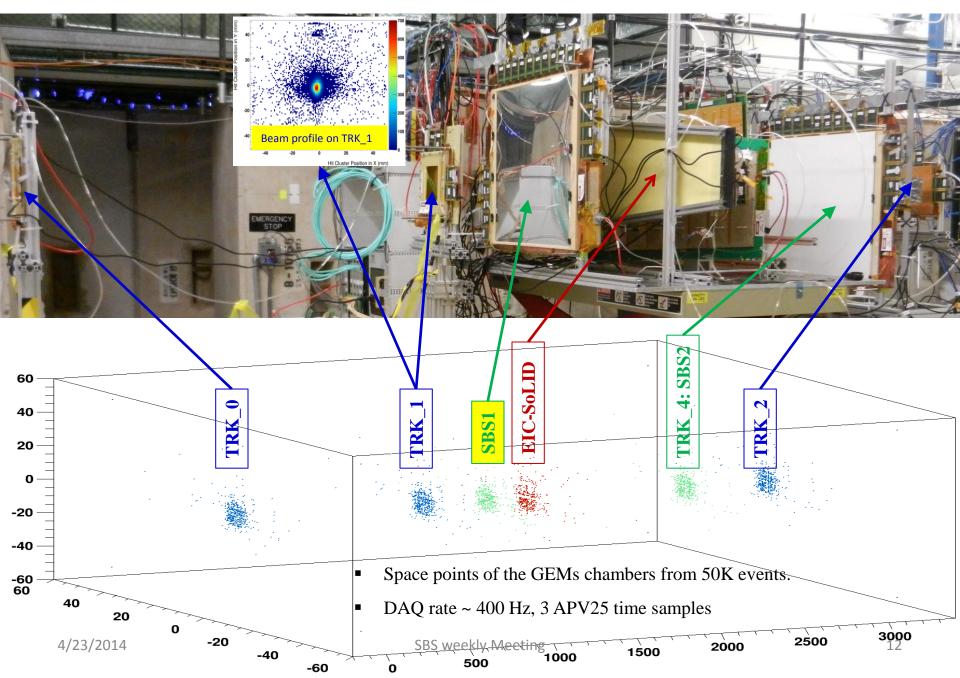
UVa GEMs @ JLab Test Beam: APV25 timing analysis

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 \rightarrow The pic at 15 ns \rightarrow event synchronized with the trigger
- Background: remaining of the distribution

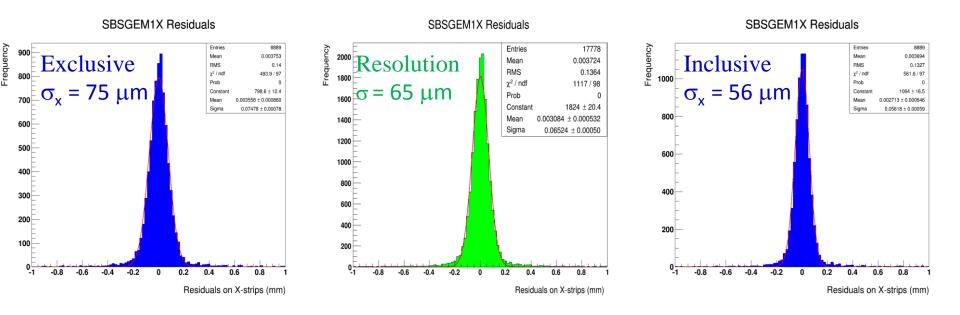


UVa GEMs @ FNAL Test Beam (Oct. 2013): 120 GeV Proton Beam



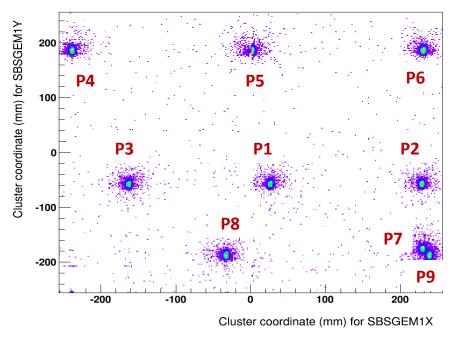
SBS1_50×50: Resolution studies from track fit residuals

- 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: $\sigma_{resolution} = \operatorname{sqrt} (\sigma_{exclusive} \times \sigma_{inclusive})$

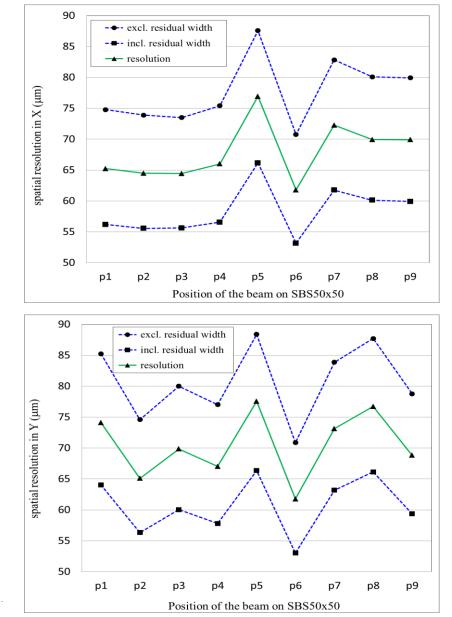


SBS1_50×50: Position scan & resolution

- Zero suppression: $5 \times \sigma$ 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 \rightarrow beam close to the spacers inside the chamber
 - Degradation of the resolution

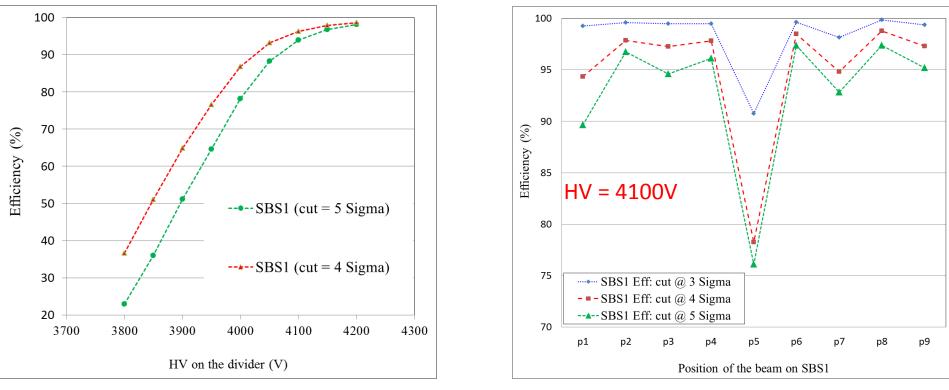


SBS1 Hit Position Map



SBS1_50×50: Efficiency

- Uniform efficiency over the beam positions scanned
- Efficiency plateau around 4100 kV at 4 sigma cut
- Drop in efficiency at P5 \rightarrow beam close to the spacers inside the chamber

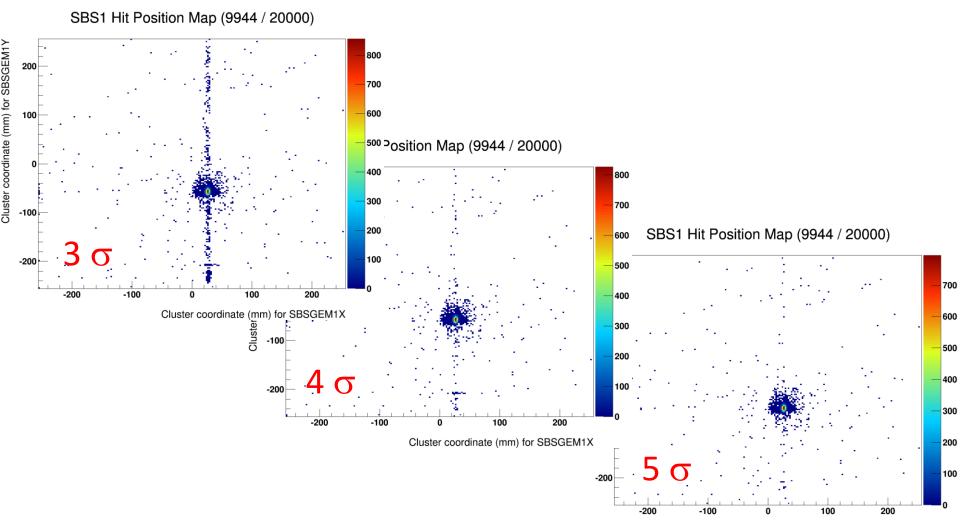


Efficiency vs. HV on the divider

Efficiency @ different cuts (zero suppression)

Choice of the zero suppression cut at $5 \times \sigma$ of the strip pedestal noise

SBS1_50×50: 120 GeV proton beam



Cluster coordinate (mm) for SBSGEM1X