

# Update on APV25-SRS Electronics

Kondo Gnanvo

# Outline

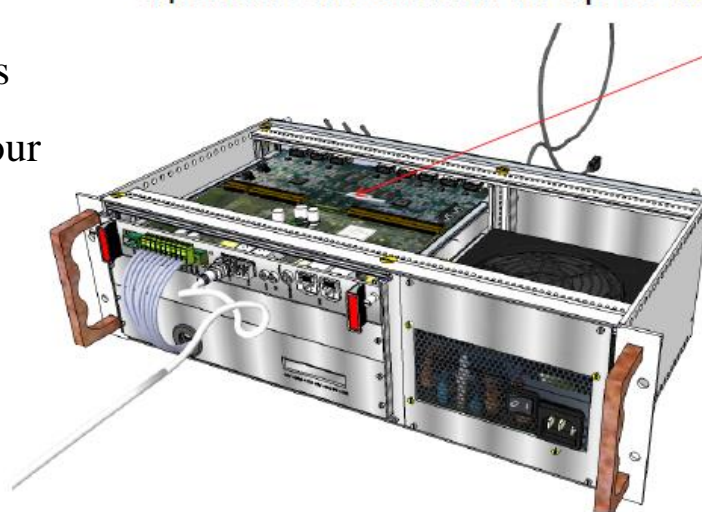
- Various SRS Electronics
- Status of the APV25-SRS Electronics @ UVa
- Test of the SRU with multiple FECs at CERN

# Small size Scalable Readout System (SRS)

- Most popular version of the SRS
- In use now in many detector R&D lab
- Very stable and and easy to operate
- Have been used in our lab at UVa for 2 years now for the test and the characterization all our SBS GEM prototype

## SRS Minicrate

a portable 5kG solution for up to 4k channels



1 x FEC -ADC card Combo

CERN store items  
SCEM 07.89.00.100.1 (FEC)  
SCEM 07.89.00.105.6 (ADC)

Minicrate  
CERN store SCEM 07.89.00.020.0

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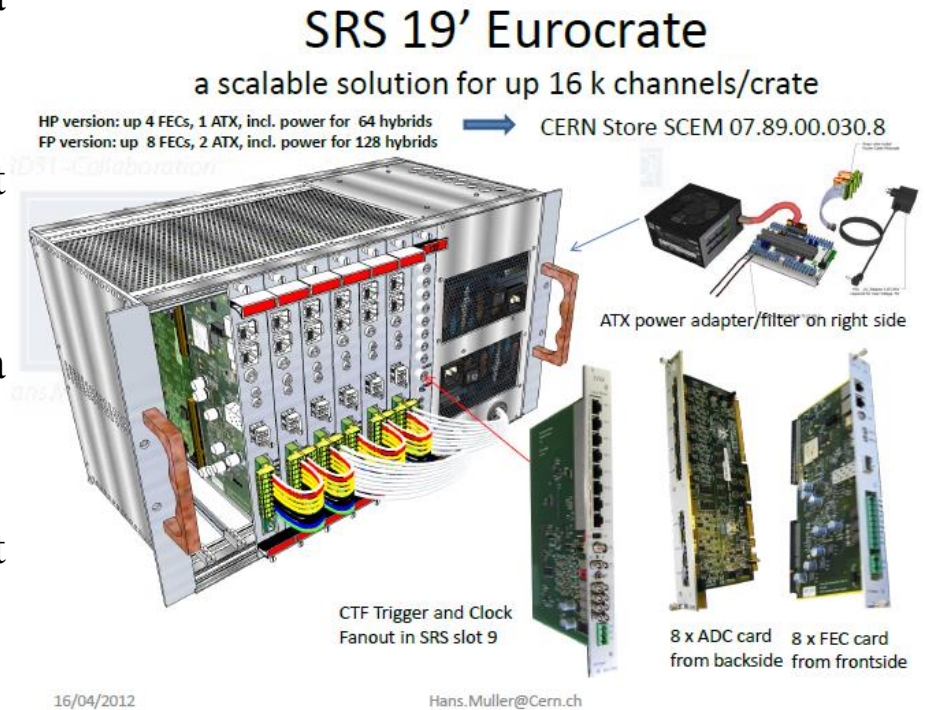
6/04/2012

## Available DAQ:

- DATE (ALICE Exp. @ CERN)
- mmDaq (ATLAS MAMMA Group @ CERN)
- rcDaq (PHENIX Daq @ BNL)
- LabView (RD51 GDD @ CERN)

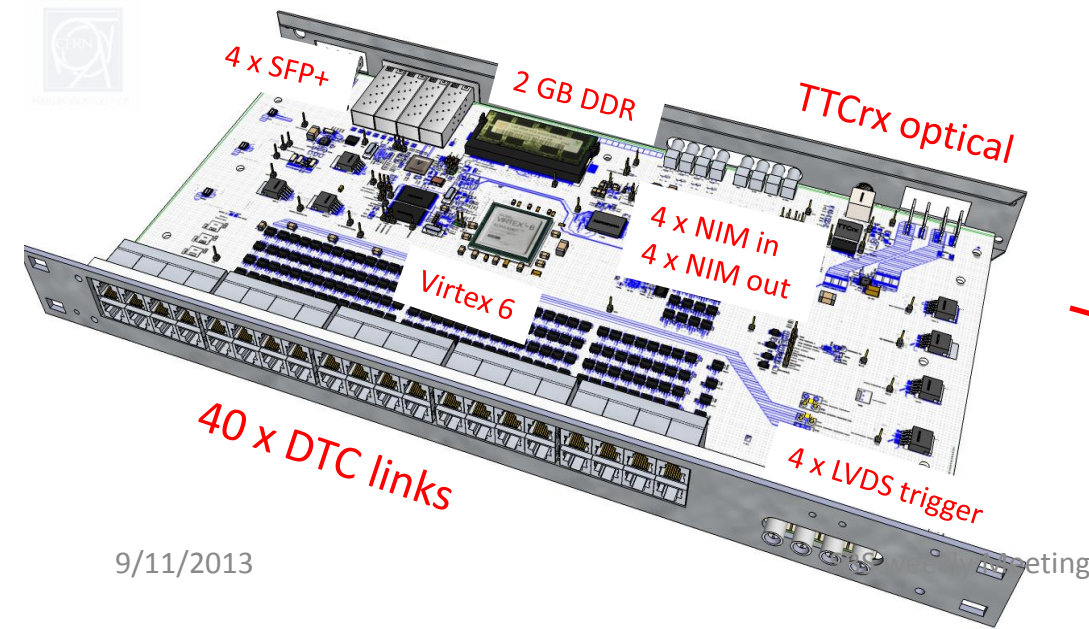
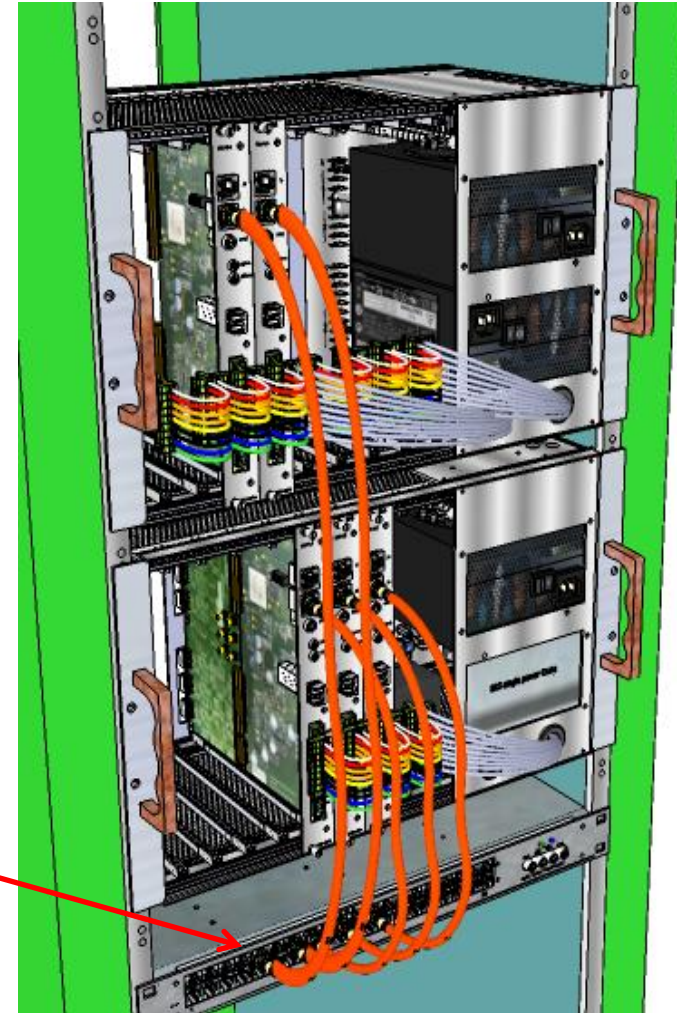
# Medium size SRS (up to 16k Channels)

- Run with a network switch for the data transfer to the DAQ PC
- Stable with up to 4 FECs on the switch but limited acquisition rate
- FEC trigger and clock synchronization via CTF card
- Medium size SRS in used for 3 years at Florida Tech



# Toward Large SRS with SRU module

- The Scalable Readout Unit (SRU) is needed to use the SRS for large size amount of channels ( $> 16$  K Ch)
- Event builder: collect events from up to 40 FECs and send to the DAQ PC via a 10 Gb optical link
- SRU distribute the trigger and clock signals via DTCC links to the FEC and APV25 hybrids
- Successful test of the SRU + multiple FECs in 08/2013 (see next slides)



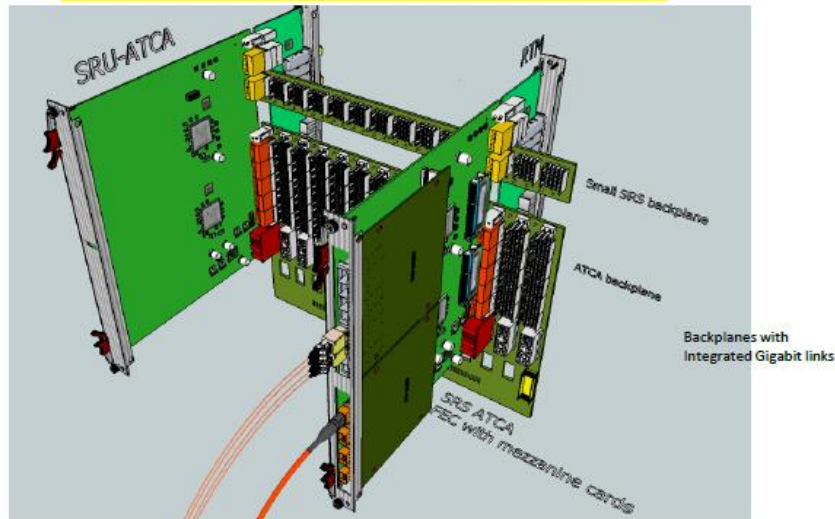
# Commercial SRS: ATCA-SRS by EicSys (Germany)

- Certified crate standard: ADC/FEC combo replaced by ATCA blades
- Higher channel integration => reduce cost/channel for large systems
- Replace DTCC cables by ATCA backplane
- First implementation uses the standard SRU → but later version with ATCA-SRU

## SRS ATCA\*

fully commercial SRS in certified Crates

Co-development RD51 with EicSys GmbH, Hamburg



## ATCA -14 slot crate

Ad interim: SRU-3 connected via rear RTMs (SRU-4 to become slot 1 card)

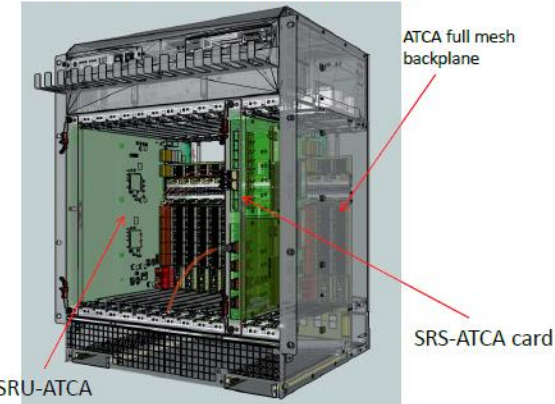


Full-mesh backplane: 4x 6 Gbit duplex links embedded in each backplane slot



each Blade can talk to each other:  
→ new possibilities to explore

12 SRS-ATCA blades ( 72k APV channels )



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\*AdvancedTCA ( Advanced Telecommunication Computing Architecture) an open industry standard developed by PICMG 3.0  
16/04/2012

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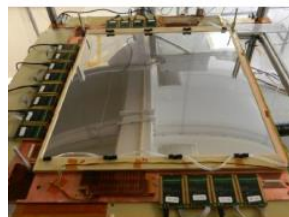
# Status of the APV25-SRS Electronics @ UVa

## Small size SRS (2 K channels)

- We have been running the small size SRS for about two years now
- Use for characterization of all SBS prototypes built at UVa
- Very good performance and stable system
- CERN ALICE DATE & AMORE use for the daq

### APV25-SRS Electronics

APV25-SRS FE cards on the GEM detector



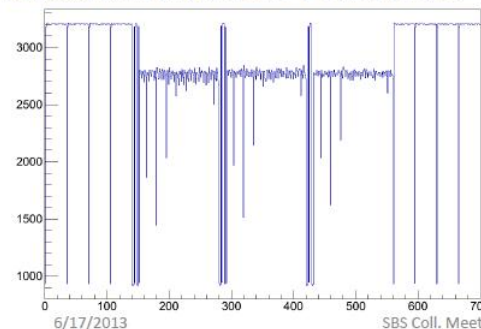
SRS small system 1 ADC/FEC combo



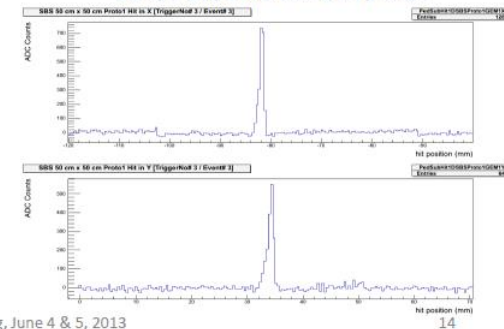
CERN ALICE DAQ (DATE/AMORE)



Raw data event on 1 APV25 FE → 3 time samples



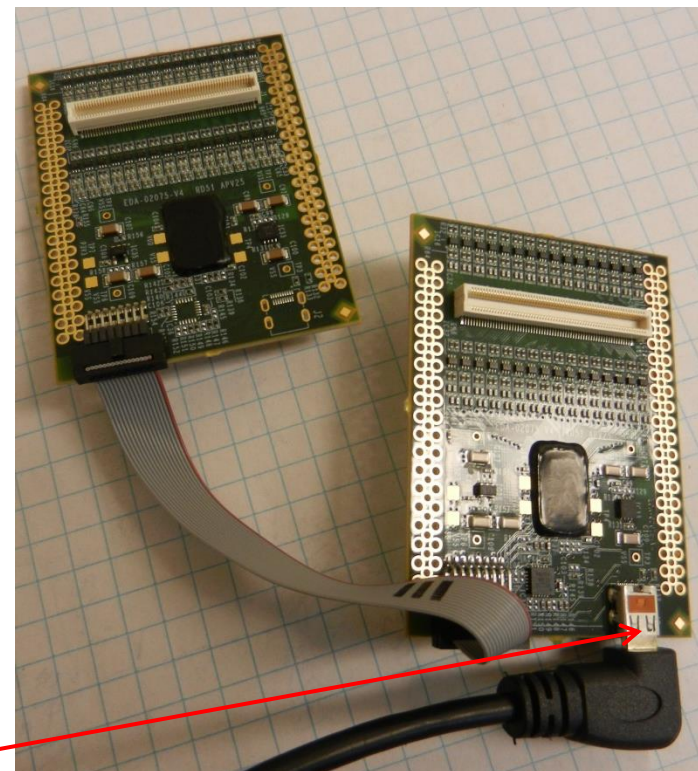
2D X/Y strips hits event on proto I



# Status of the APV25-SRS Electronics @ UVa

## Newly acquired medium size SRS system (10K channels)

- 80 APVs hybrids → tested OK
- 5 FEC cards V.6 (major upgrade of the current V.3) still prototype level
- 6 ADC cards → 3 already delivered and tested OK, we are still waiting for remaining 3
- 1 Full Power Euro crate → power up to 8 FECs
- One SRU module to read out up to 40 FECs → tested OK at CERN August 2013 (next slides)
- New: 90° angle HDMI cable for APV25 hybrids





# Status of the APV25-SRS Electronics @ UVa

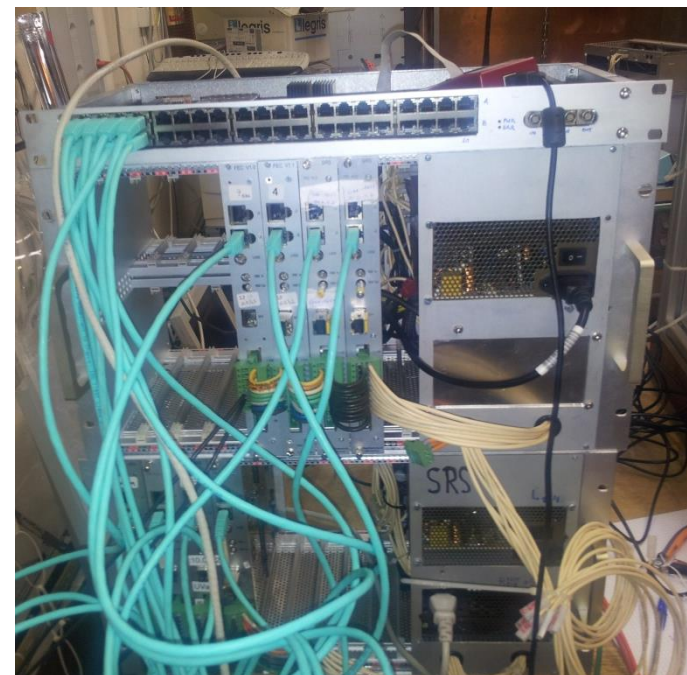
## Quote and Estimated cost for 73K channels AP25-SRS

- 14-slots ATCA-SRS crate @ \$128,372 → \$1.74 / ch (quote from EicSys)
- 576 APVs hybrids @ \$86,400 → \$1.18 / ch (current cost)
- 2 (to 4) SRU modules @ \$8,000 to \$16000 → \$ 0.11 (to \$0.22) / ch (current cost)
- 2 PCs + 10 Gb NIC @ \$6000 → \$0.08 / ch (Estimate)
- 288 HDM (A-D) cables 2m @ \$3200 → \$0.04 / ch (current cost)
- 288 HDMI (A-A) cables 5m (if needed ?) @ \$7200 → \$0.1 /ch (current cost)
- 288 HDM adapters @ \$2100 → \$0.025 /ch (current cost)
- 288 SAMTEC flat cable for master/slave connection @ \$2800 → \$0.03 /ch (current cost)
- 4304 SAMTEC Grounding connectors @ \$7000 → \$0.09 / ch (current cost)

**TOTAL: \$273 k → \$3.7 / ch**

# Test of the SRU with Multiple FECs

- First time SRU was been tested with more than one FEC card
- Test performed at CERN August, 15<sup>th</sup> – 30<sup>th</sup> 2013
- Many groups interested and involved in the test:
  - UVa (Kondo Gnanvo)
  - RD51 Electronics WG5 (Hans Muller & Alfonso Tarazona)
  - RD51 GDD lab at CERN (Eraldo Oliveri)
  - ATLAS MAMMA Group (Andre Zibel, Michele Bianco)
- SRS Material used for the test:
  - **UVa:** SRU + FP Euro crate + 1 FEC card + 4 ADCs cards + 40 apv25 hybrids
  - **Florida Tech:** 2 FEC/ADC combos
  - **MAMMA Group at CERN:** 2 FEC/ADC combos + Micromegas Tracker Telescope
  - **RD51 GDD:** 2 FEC/ADC combos + x-ray box and DATE PC



# Test of the SRU with Multiple FECs

## Firmware version that was tested

- SRU Firmware: SRU as a switch with the FEC send FEC IP
  - Final version: SRU build the event of all the FEC and send one fragment to the DAQ PC
- Data transmission to the PC via 1 Gb Ethernet copper cable
  - Final version: transmission through 10 Gb optical link
- External trigger to the SRU which distribute to the FEC/APVs through
- FEC firmware version without zero suppression
  - ATLAS MAMMA group also tested the zero suppression version

# SRU on X-ray box in GDD lab @ CERN

- SRS-SRU tested in RD51-GDD X-ray box
- 8 FECs card connected to the SRU
- 70 APV25 Hybrids, 4 APV25 connected to a small 10 x 10 GEM chamber
- Trigger from the bottom GEM foil
- Preliminary evaluation of the high rate capability of the system

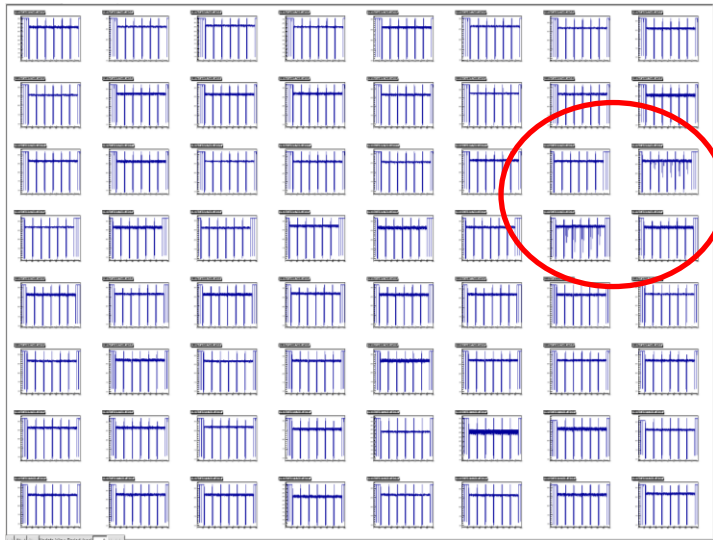


DATE Run Control Display

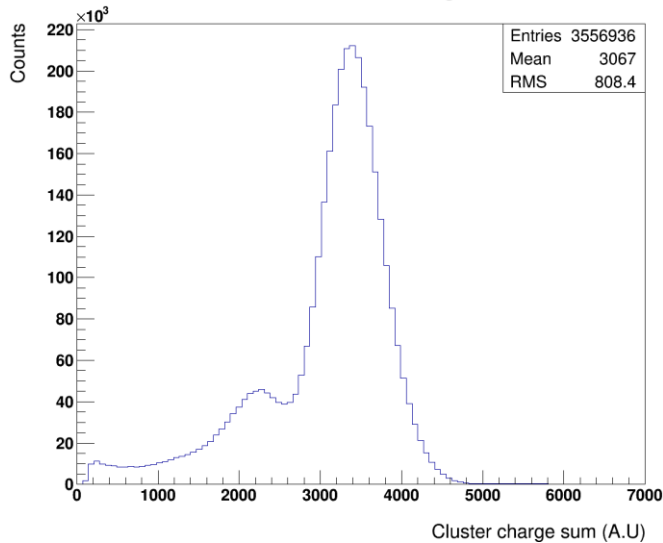
DAQ_TEST	
LDC status display	
LDC name	aloneldc
host	cmsrsr1
Number of equipments	8
Number of triggers	835296
Current Trigger rate	589.600
Average Trigger rate	585.351
Number of sub-events	835296
Sub-event rate	589
Sub-events recorded	835297
Sub-event recorded rate	589
Bytes injected	121278296976
Byte injected rate	85.605 MB/s
Bytes recorded	121278151784
Byte recorded rate	85.576 MB/s
Nb. evts w/o HLT decision	0
mem allocation failed	0
average time bmAllocate	12

# SRU on X-ray box in GDD lab @ CERN

## Some preliminary plots from the small GEM

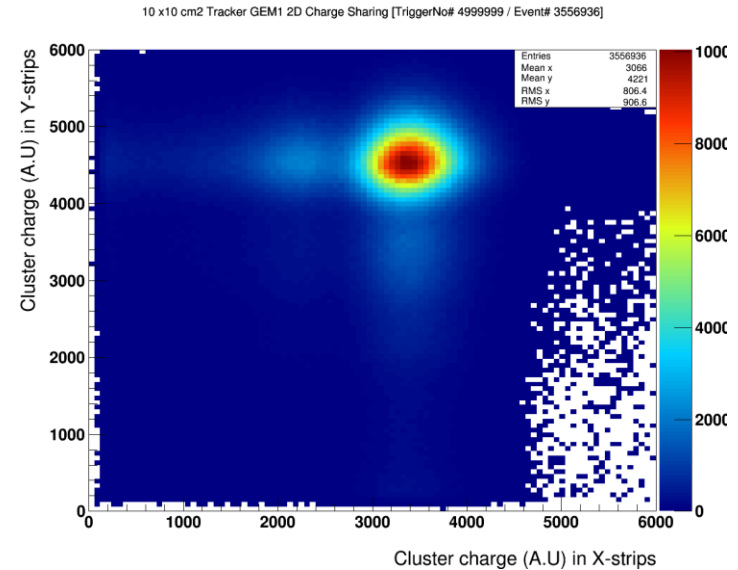


10 x 10 GEM cluster Charge Distr in X

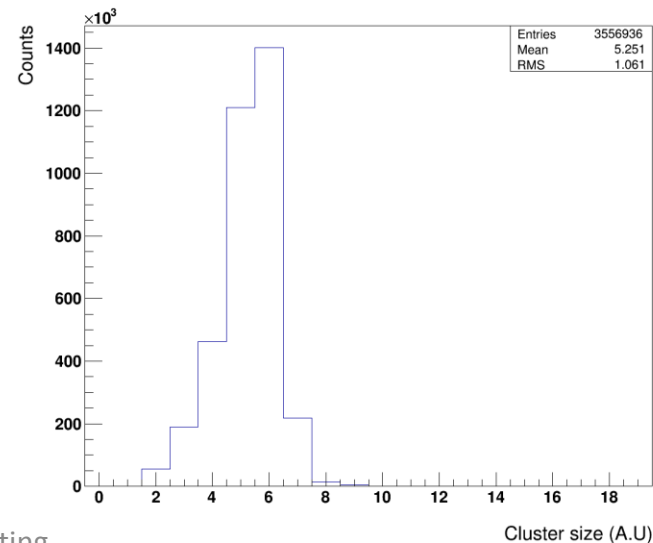


9/11/2013

SBS weekly Meeting



10 x 10 GEM X-axis Cluster Size



Cluster size (A.U.)

# Preparation for the Test beam at Fermilab October 2013

- The system we tested has been shipped to UVa expect it to be delivered today ...
- Setup the SRS-SRU with 4 FECs and 64 apvs here in the lab
  - Take data with our 2 SBS GEMs + SoLID GEM prototypes
- This setup at in the lab will be a rehearsal for the FNAL test beam we are going
- Expect to stress the APV25-SRS-SRU during that test beam

## Next step: Another travel to CERN in January 2014

- Status of the SBS GEM production
- New round of test of the SRS Electronics. The plan is to test with the developpers:
  - 10 Gb link data transmission to the DAQ PC
  - New FEC V.6 and Zero suppression firmware implementation in FEC FPGA
  - The prototype of the commercial ATCA-SRS crate