

# Update on the GEn GEM Detectors Commissioning

**SBS Weekly Meeting, Sept. 19, 2018**

**UVa:** K. Gnanvo, S. Jian, J. Matter, N. Liyanage.

**INFN:** E. Cisbani, P. Musico, R. Perini, L. Re.

**JLab:** A. Camsonne, M. Jones, M. Long, B. Wojtsekhowski.

**H.U:** T. Cao, M. Kohl.

**Weekly meeting for the commissioning of the GEMs every Thursday at 9:00 am**

Wiki: [https://hallaweb.jlab.org/wiki/index.php/GMn\\_GEM\\_Commissioning\\_Meeting](https://hallaweb.jlab.org/wiki/index.php/GMn_GEM_Commissioning_Meeting)

# Status of the INFN GEMs Commissioning TestLab Clean Room

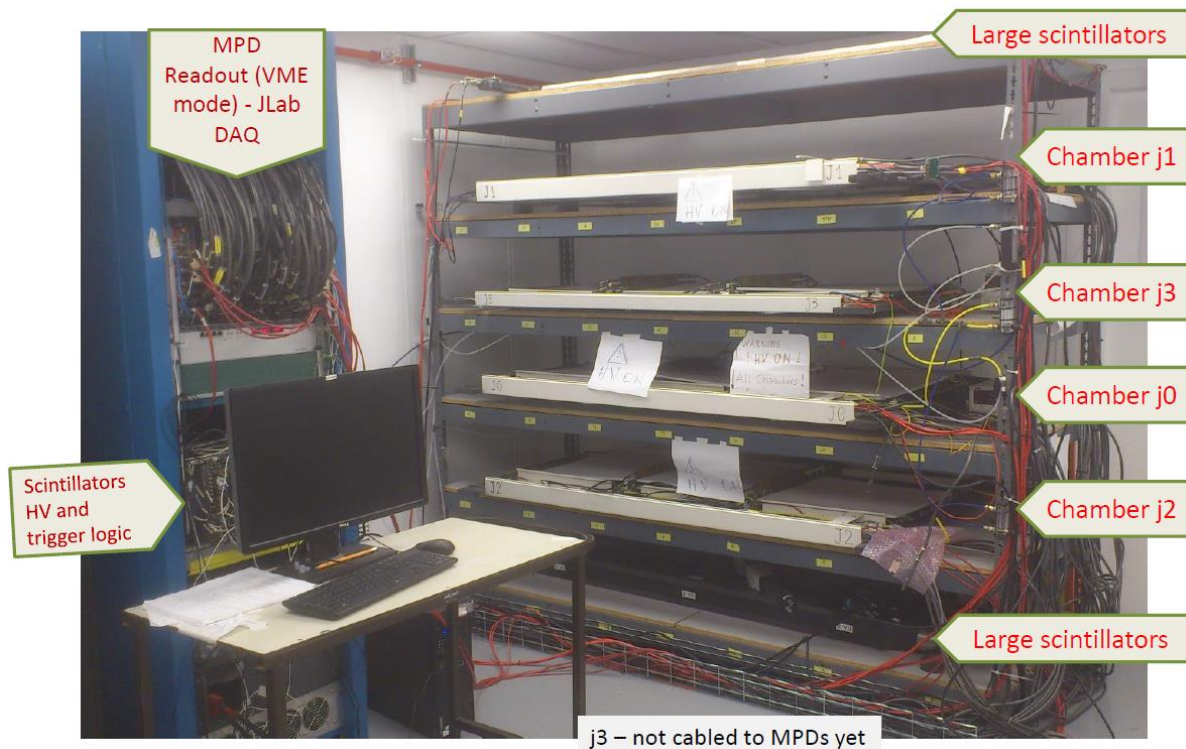
# INFN GEM Cosmic Stand Setup

- Integration of 4 INFN layers in Cosmic stand for commissioning (July 2018)
- 3 modules for 5<sup>th</sup> layers already at JLab (July 2018).
- Setup for individual module test with Sr90 available
- Ongoing commissioning with cosmic and preliminary results from analysis of data (next slides)
  - Lately we had a continuous 4 days run with 10M triggered event collected that we are currently analyzing

## Some major activities and fixes this summer

*(Alexandre, Bryan, Mark, Siyu, Leonard, Paolo, Roberto, Evaristo, Antonio, Maurizio, ...)*

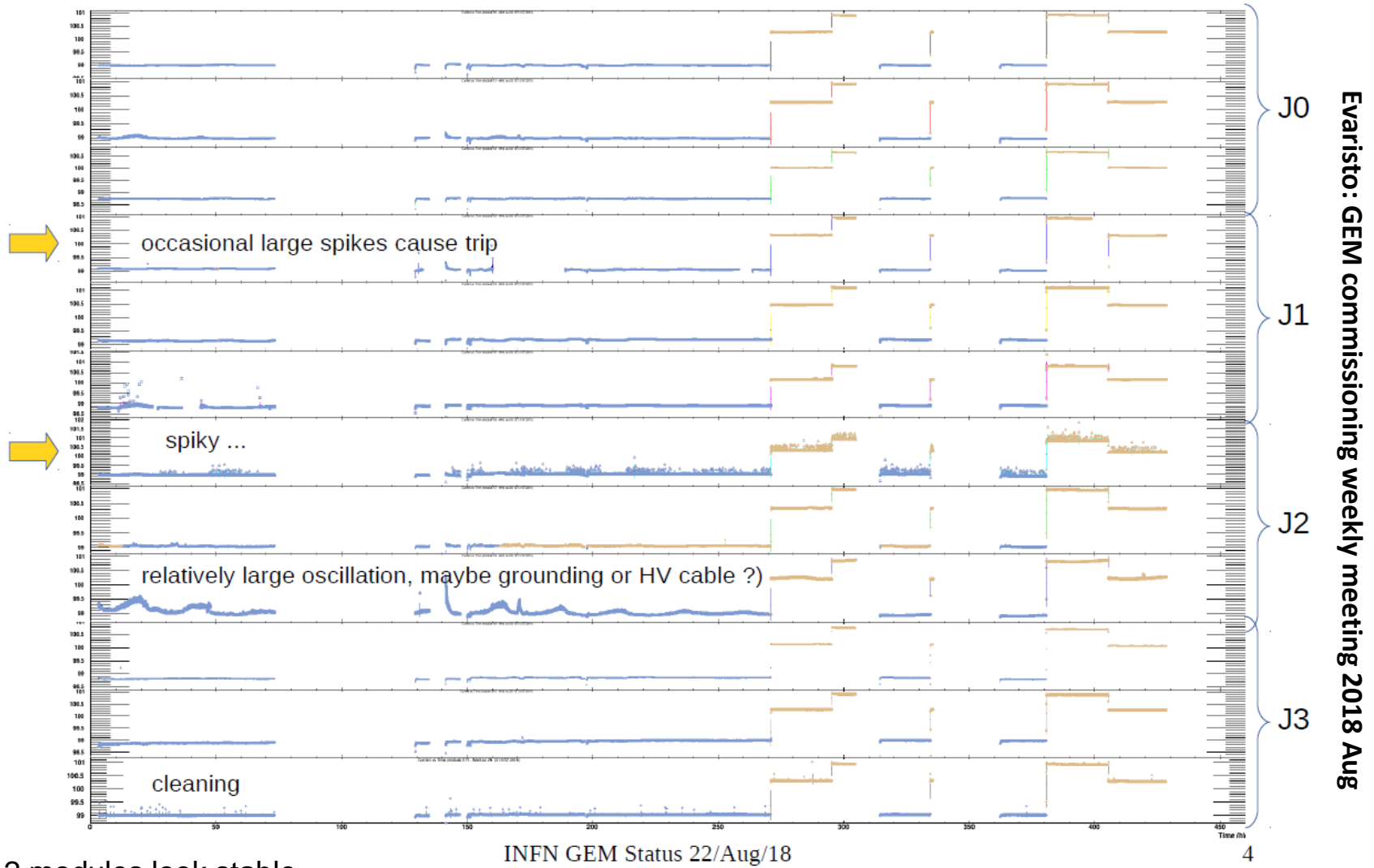
- MPD hardware problem (I2C chips) ⇒ fixed
- Improvement of DAQ/CODA (DMA buffer limitation and other)
- 3 & 20 m analog cables replaced by 2 & 10 m respectively
- All electronics re-tested during re-cabling and improvement of noise and grounding



**Evaristo's talk: SBS Summer Coll. Meeting 2018 July 22-23**

# Monitoring of the HV on the GEMs:

Over more than 20 days of running

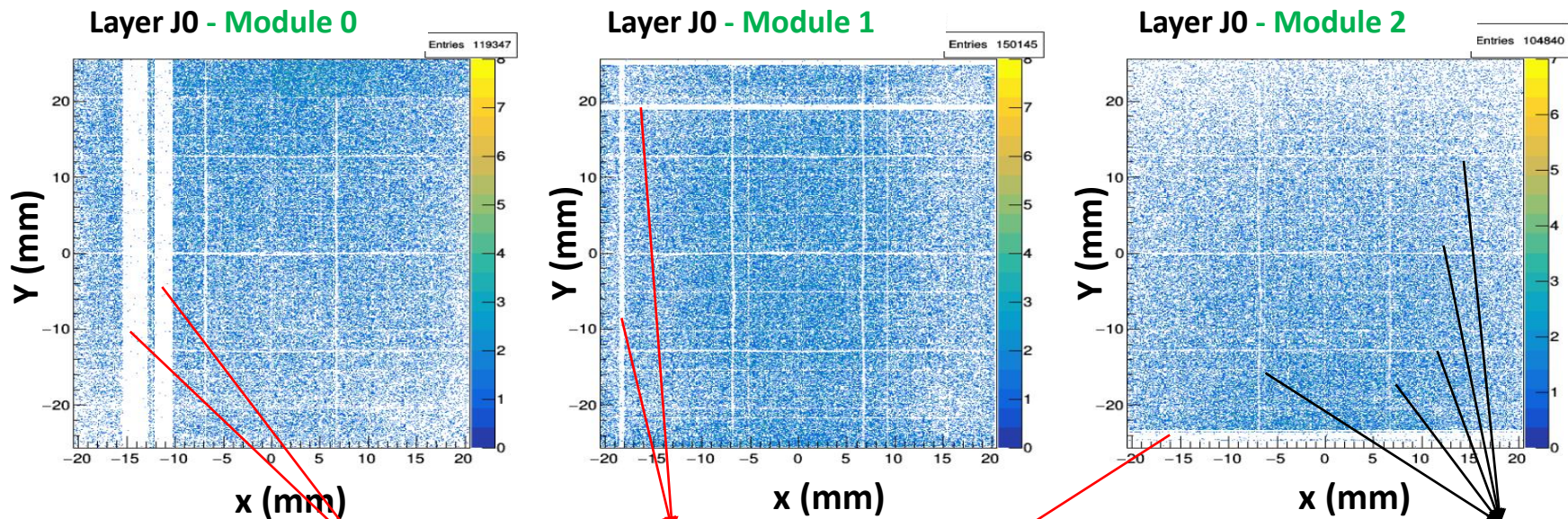


- All 12 modules look stable
- Two modules with some oscillation at the beginning but stabilized later



# Preliminary Cosmic Data: Layer J0

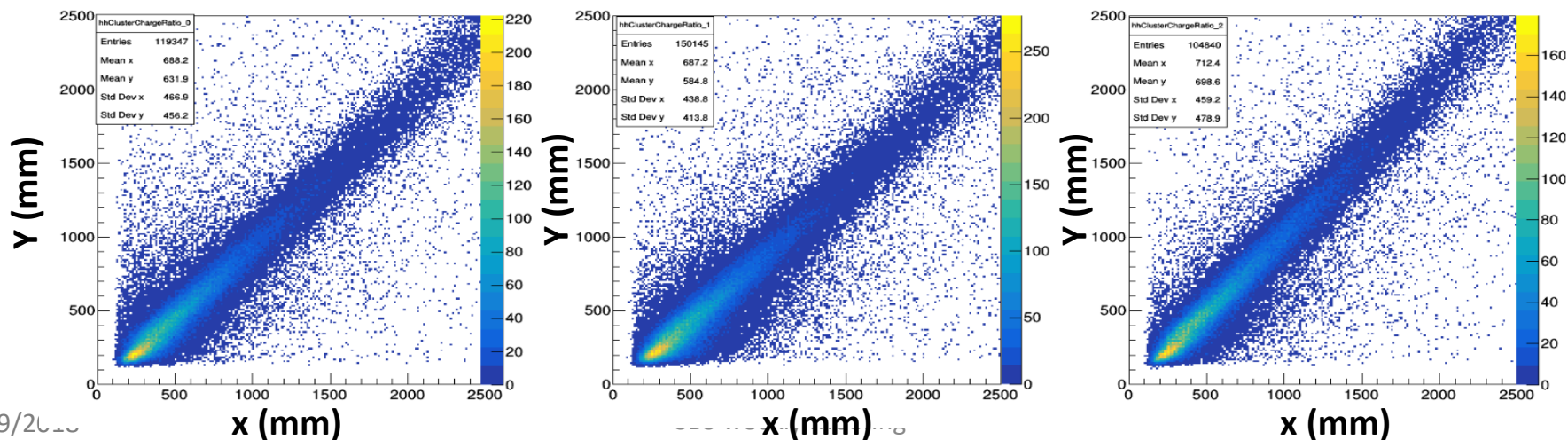
2D hit map: Distribution of X-Y cluster positions – Overall good response of the modules



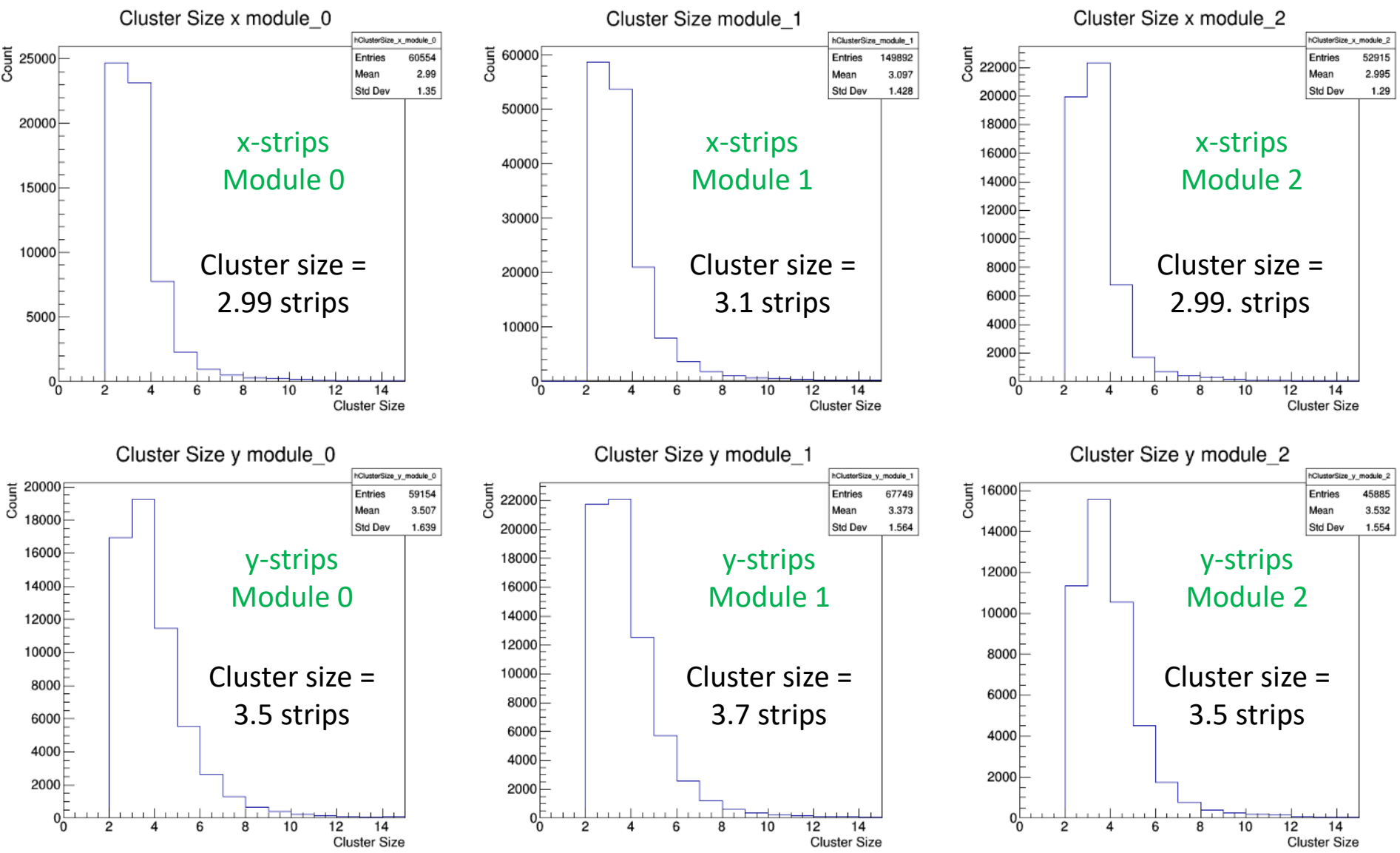
dead strips or issues with connectors?

Low efficiency at the spacers locations

Charge sharing X-strips vs. Y-strips (ADC units) – Quality of the 2D strip readout layer



## Cluster size - average nb of strips with hit / event

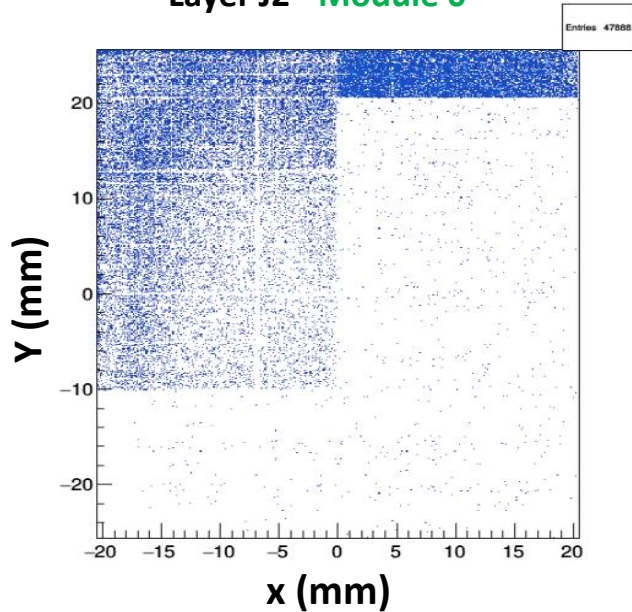




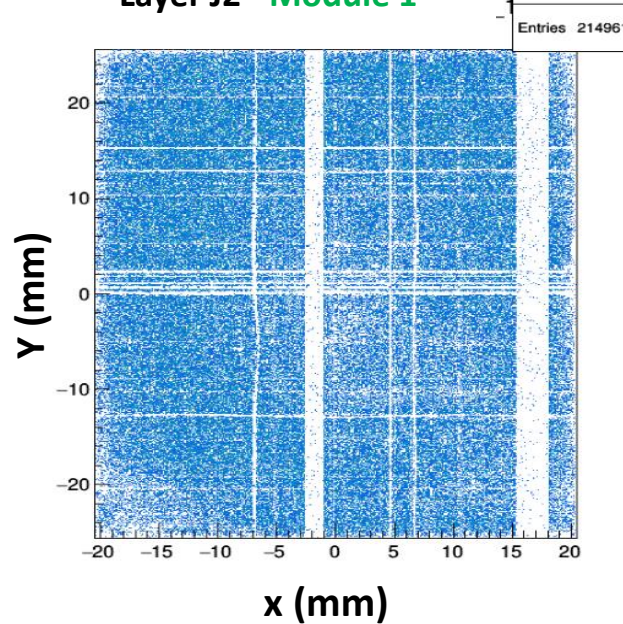
# Preliminary Cosmic Data: Layer J2

2D hit map: Distribution of X-Y cluster positions – Overall response of the module

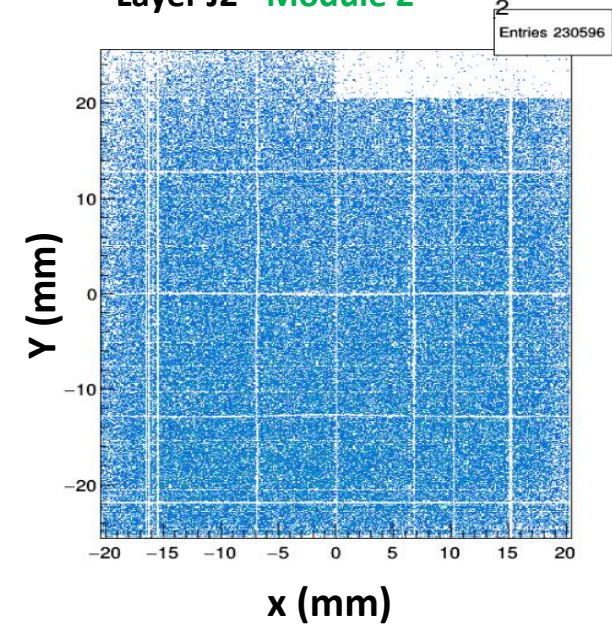
Layer J2 - Module 0



Layer J2 - Module 1

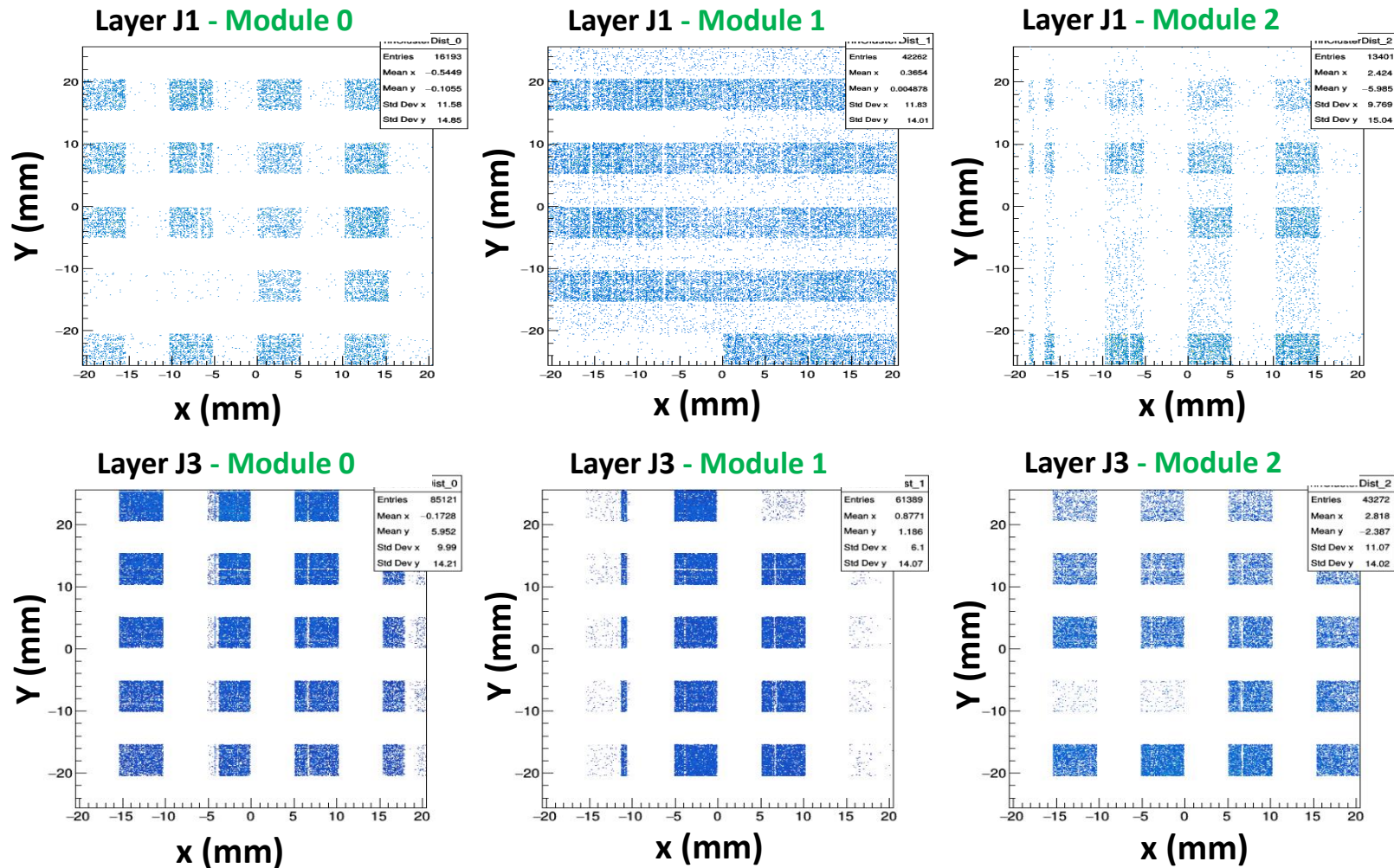


Layer J2 - Module 2



- Layer 2 - Module 1 has large area without data ⇒ looks like a problem with the HV supply line cut out
  - Known problem, was reported by Evaristo at last Coll. Meeting.
  - Seems a small issue ⇒ Evaristo expects to fix it in October or replace the module
- Layer 2 – Module 2 seems OK overall but a few dead strips specially in the vertical directions
- Layer 2 – Module 3 has one dead sector ut is overall good (with very few dead strips)

# Preliminary Cosmic Data: Layer J1 & J3



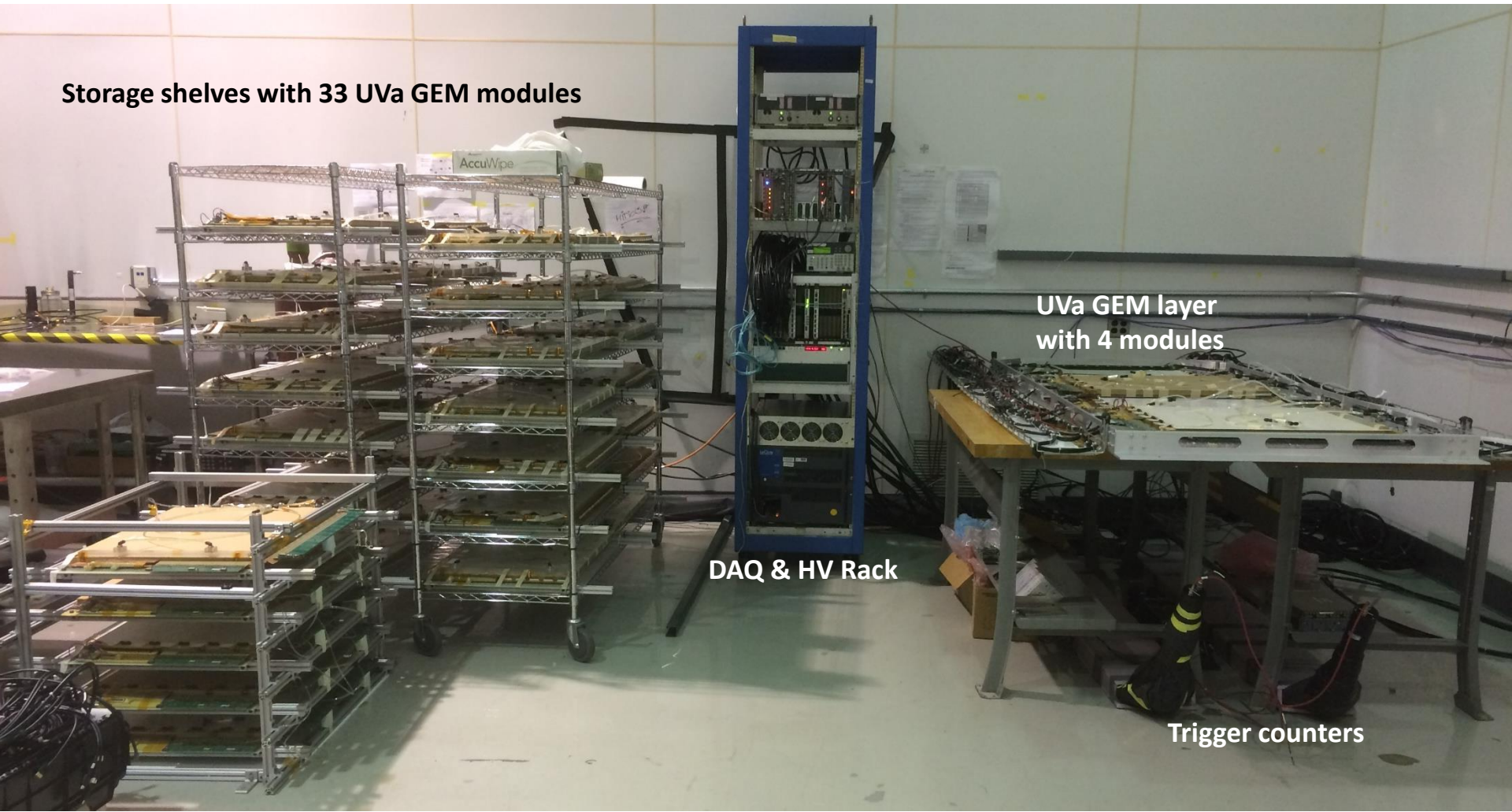
Some issues with layers J1 and J2 with pattern of areas with missing data ⇒ Not clear yet what the problem is

- Evaristo suggest a grounding problems of the APV25 backplanes
- Siyu suspect some MPDs are not working properly, we know of MPD7 has issues but quid MPD17 and 18?
- We are currently investigating the issues and communicating with Evaristo and Paolo



# Status of the UVa GEMs Commissioning EEL Clean Room 124

# Setup of UVa GEMs in the EEL Clean Room 124



Storage shelves with 33 UVa GEM modules

UVa GEM layer  
with 4 modules

DAQ & HV Rack

Trigger counters

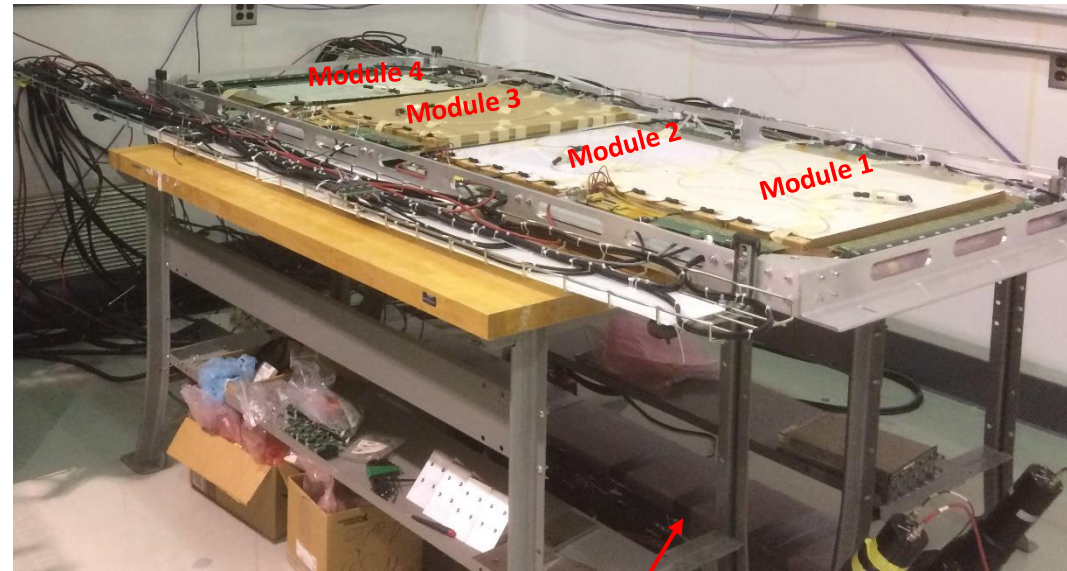
# Status of the Activities in the EEL Clean Room 124

## First UVa GEM layer is ready to go

- Fully cabled with APV25 electronics, HV and gas
- MPD DAQ is tested and pedestal data taken for the UVa GEM layer's modules.
- 4 channels CAEN HV N1470 for the GEMs
- Two scintillator / PMTs counters (2m x 25 cm) for cosmic trigger ⇒ **with Bogdan's help**
- Issues of the Raspberry Pi for LeCroy HV crate
  - ⇒ see with B. Michaels or the fix
- Gas system ready to go(completed yesterday)

## Little delay to get things started because:

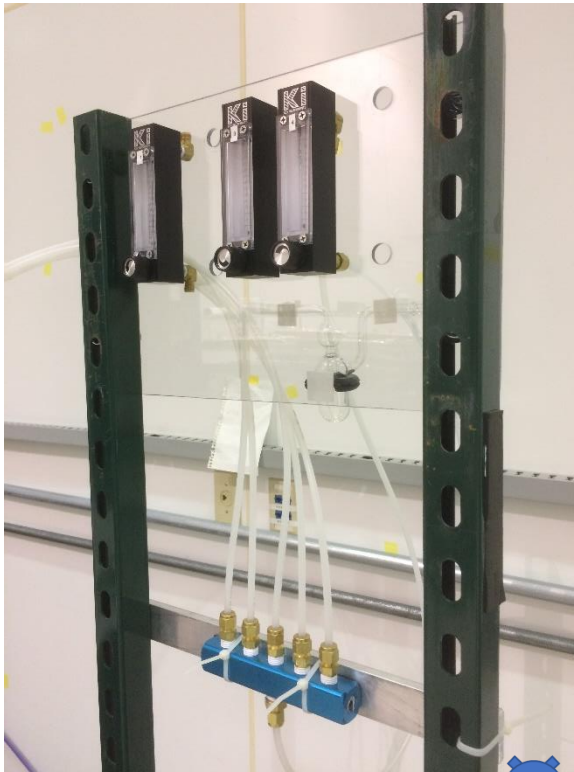
- **Need pressure systems design authority to approve the gas supply setup**
  - meeting with Whit Seay after the meeting for that (Expected to get green light)
- Produce a new ODH and Task list for the activities in the Clean Room (done)



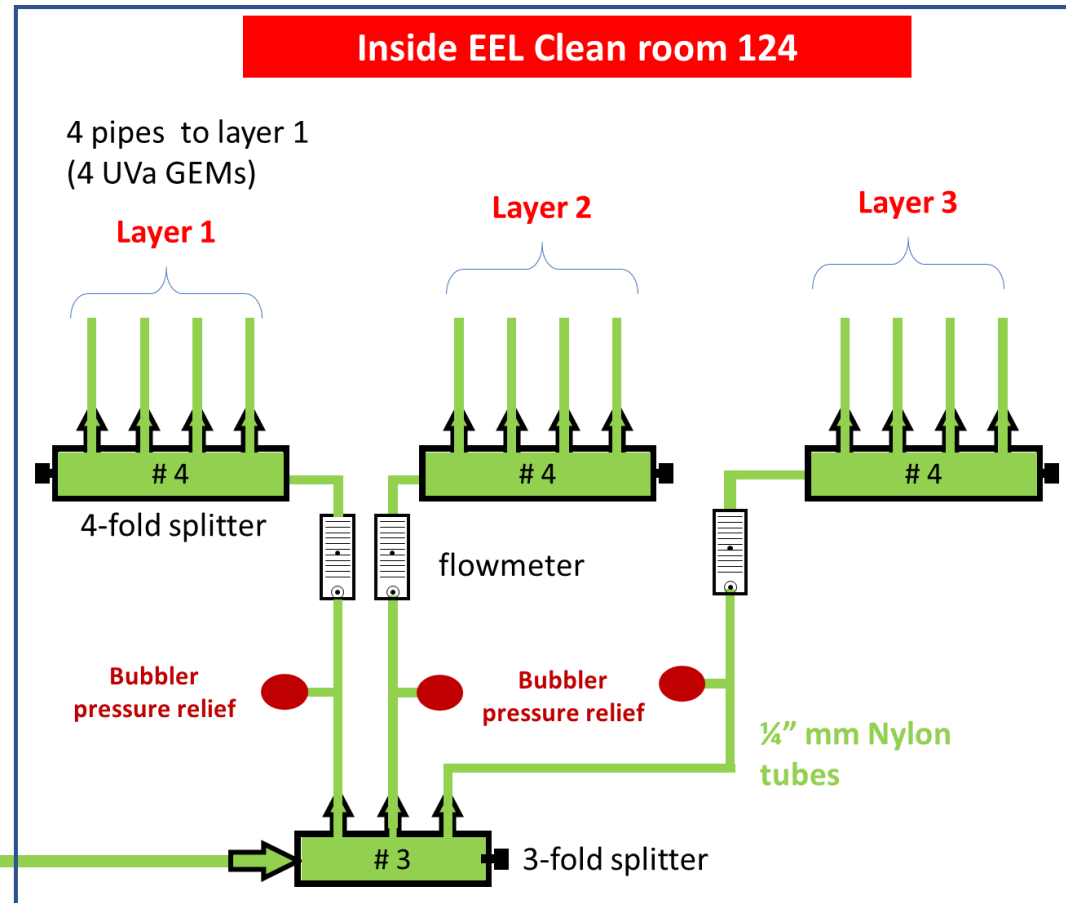
**Trigger counters**

# Sketch of the gas system for UVa GEM EEL Clean Room 124

Panel for gas system for 1 layer



Gas bottles outside in EEL room 125

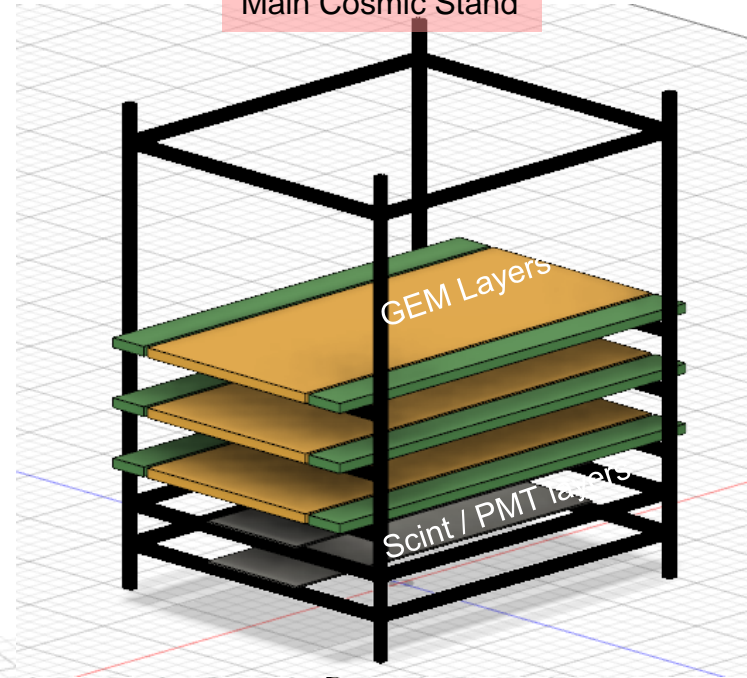


- Premix of Ar-CO<sub>2</sub> gas mixture ratio 70-30 (**non flammable and inert gas**)
- Running **2 gas bottles** simultaneously, One bottle for 3 UVa GEM layers (chambers ⇒ 12 UVa GEM modules)
- Up to 6 layers when fully operational (24 UVa GEMs)
- 4L per hour per module ⇒ a total ~100 L per hour (small capacity compared to the clean room size)
- Exhaust line at the output of each GEM module will be vented into the room



# Design of Cosmic Tests Stand

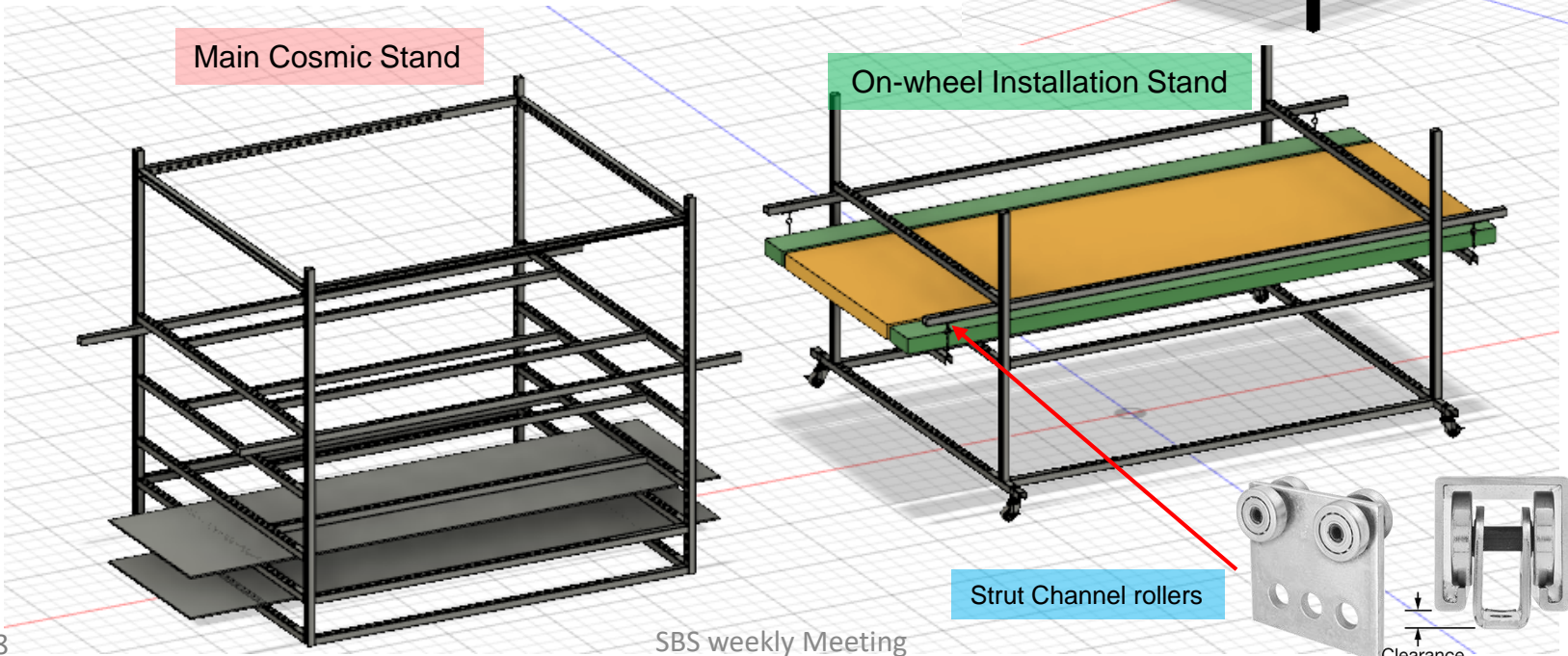
Main Cosmic Stand



- Design of the cosmic test stand for 6 layers almost completed
  - ⇒ **Main Cosmic stand:** For the commissioning of the UVa layers
  - ⇒ Will ultimately accommodate up to 6 UVa GEM layers
  - ⇒ **Additional lightweight on-wheel installation stand**
    - ⇒ to help install layer on main stand
    - ⇒ We are testing the principle at UVa
- Based on Unistrut / or Aluminum 80/20 hardware
  - ⇒ Optimize cost / simplicity / robustness of the structure
  - ⇒ **Once finalized, will be submitted to JLab safety for validation**
  - ⇒ We'll start the installation soon after

Main Cosmic Stand

On-wheel Installation Stand



Strut Channel rollers

Clearance

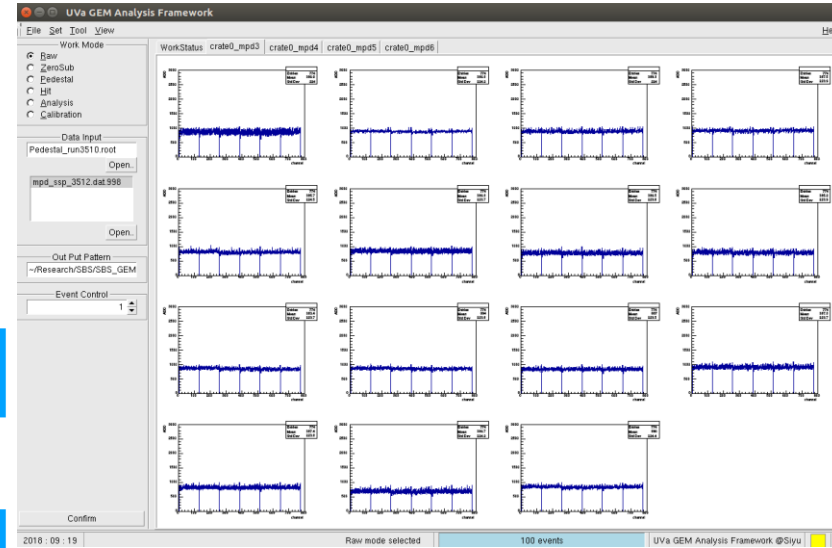
# Analysis software development for the GEM commissioning

## (Siyu Jian)

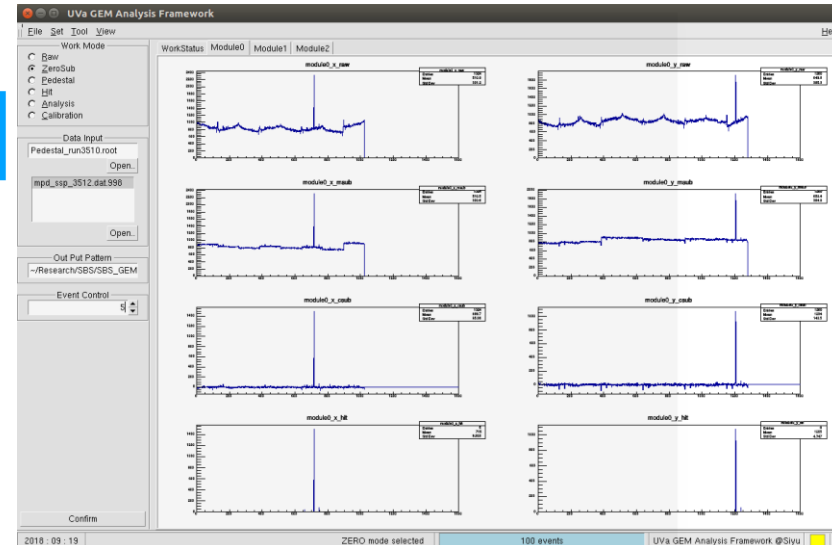
- Lots of progress on the development of the decoder / analysis tool for the GEM commissioning
  - Most of the tool needed for diagnostic and characterization of the GEM modules are already implemented
- Online monitoring with the implementation of:
  - Pedestal data, common mode suppression, pedestal offset subtraction and zero suppression
  - Display event by event of the hits in GEM modules and layers
  - Analysis of large data for 2D hit map, charge correlation etc ...available and successfully tested on 10M cosmic data for INFM GEMs
  - A few small glitches still need to be fixed
- **Tracking capability is the part missing?** (But Siyu working on this right now)
  - Need tracking to assess the GEM efficiency
  - We will benefit from the codes developed by Danning for the cosmic tests in 2016
  - We expect the tool to be ready in a few weeks from now

# Analysis software development for the GEM commissioning (Siyu Jian)

GUI for online monitoring of raw APV data



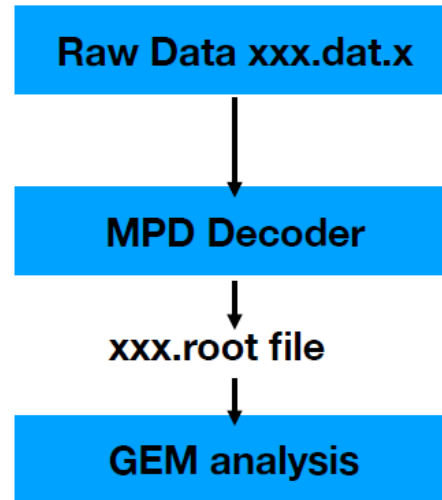
GUI for online monitoring hit in GEM modules



## Current data process procedure:

### MPD Decoder

- Parse GEM data from the raw data block
- Calculate Common mode, common mode subtraction
- Calculate Pedestal
- Zero subtraction( sigma cut on the strips)
- crosstalk check( nearby channels, ratio)
- re-order APV channels according to map
- Save as root file



### GEM Analysis

- Cluster searching, cluster matching
- detector analysis
  - Hit distribution
  - Cluster distribution
  - cluster ADC, cluster size distribution
  - Charge share ratio
  - hit time distribution
  - etc...

# Plans and Timeline for the October SBS review meeting

## INFN GEMs: Commissioning of the 4 layers for GEN

- Complete the analysis of the current cosmic data including the tracking for efficiency measurement
- Adjust parameters such as HV, gas flow etc ... to optimize the operating parameters of the modules
- Help Evaristo and his crew in October to fix the outstanding issues with some of the GEMs and DAQ

## UVa GEMs: Commissioning of One UVa GEM chamber (layer) for GEN

- Start cosmic test (later this week) with the current layer and produce with characteristic plots
- Optimization of the trigger counters setup (if necessary, more likely)
- Complete the design and production of the cosmic stand frames for up to 6 layers

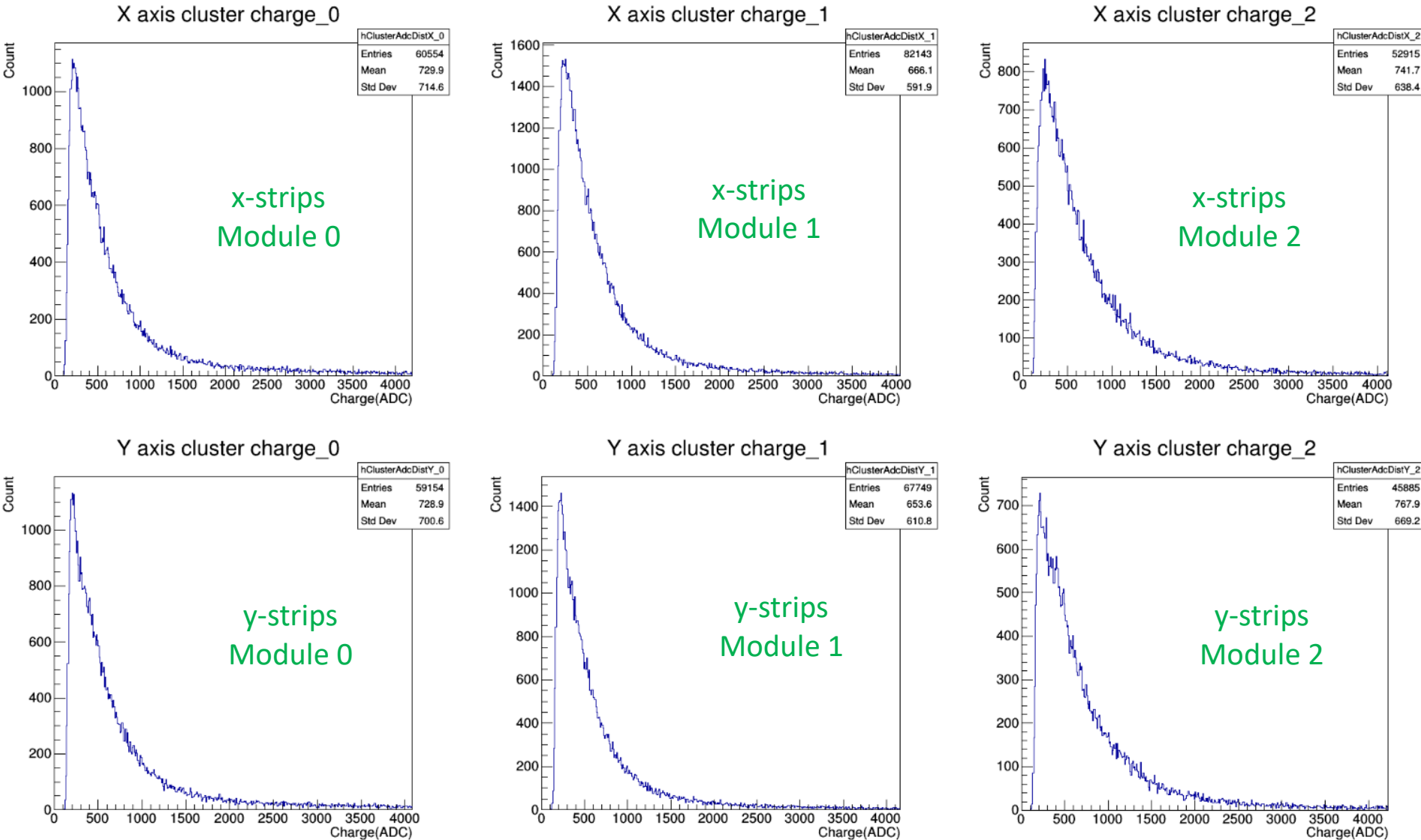
## Complete and validate the development of the analysis code for full commissioning of both INFN and UVa GEMs

- Implement the tracking code to perform efficiency analysis of the GEMs
- Validate the code with the accumulated cosmic data for in both INFN and UVa clean rooms



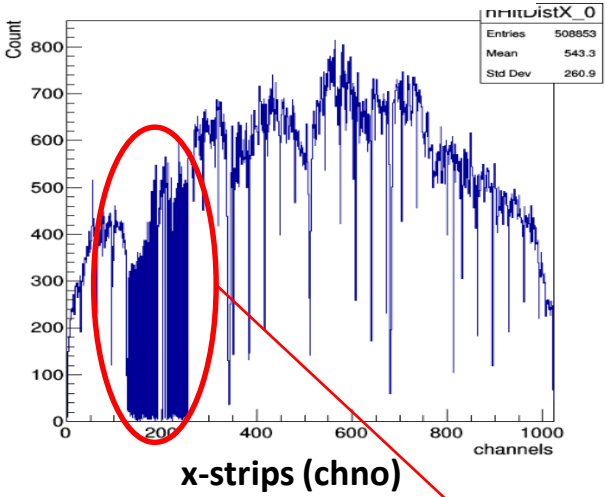
Back up

## ADC distribution - Sum of the ADC counts of all strips of a cluster / event

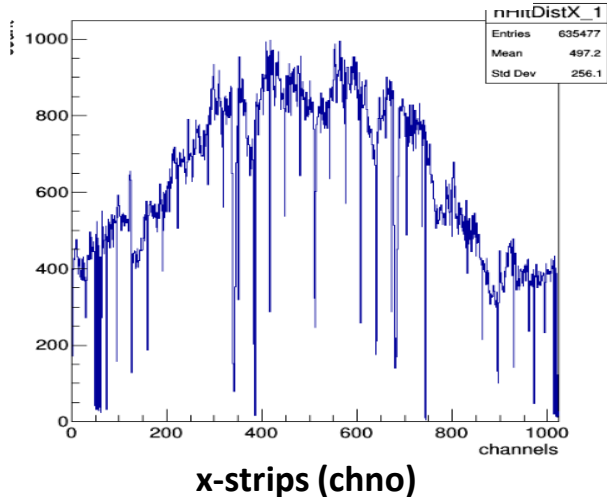


## Hit distribution on x-strips

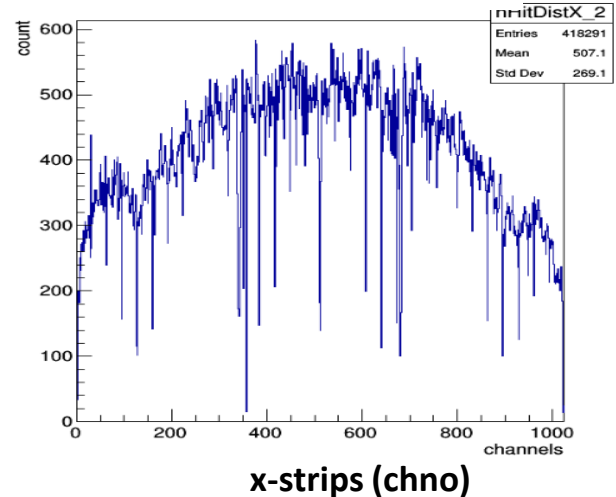
Layer J0 - Module 0



Layer J0 - Module 1



Layer J0 - Module 2



dead strips or issues with connectors?

## Hit distribution on y-strips

