Update on the GEn GEM Detectors Commissioning

SBS Weekly Meeting, Sept. 19, 2018

INFN: E. Cisbani, P. Musico, R. Perini, L. Re.
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
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 5th 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

**Layer J0 - Module 0**

**Layer J0 - Module 1**

**Layer J0 - Module 2**

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

- **Dead strips or issues with connectors?**
- **Low efficiency at the spacers locations**
Preliminary Cosmic Data: Layer J0

Cluster size - average nb of strips with hit / event

Cluster Size x module_0
- x-strips Module 0
- Cluster size = 2.99 strips

Cluster Size module_1
- x-strips Module 1
- Cluster size = 3.1 strips

Cluster Size x module_2
- x-strips Module 2
- Cluster size = 2.99 strips

Cluster Size y module_0
- y-strips Module 0
- Cluster size = 3.5 strips

Cluster Size y module_1
- y-strips Module 1
- Cluster size = 3.7 strips

Cluster Size y module_2
- y-strips Module 2
- Cluster size = 3.5 strips
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 but 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
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)
Sketch of the gas system for UVa GEM EEL Clean Room 124

- Premix of Ar-CO2 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

- 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
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 fixes

• 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)

**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…

---

**GUI for online monitoring of raw APV data**

**GUI for online monitoring hit in GEM modules**

---

9/19/2018
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 analsys 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
Preliminary Cosmic Data: Layer J0

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

- **X axis cluster charge_0**
  - x-strips Module 0
  - Entries: 60614
  - Mean: 729.9
  - Std Dev: 714.6

- **X axis cluster charge_1**
  - x-strips Module 1
  - Entries: 62143
  - Mean: 666.1
  - Std Dev: 591.9

- **X axis cluster charge_2**
  - x-strips Module 2
  - Entries: 52915
  - Mean: 741.7
  - Std Dev: 628.4

- **Y axis cluster charge_0**
  - y-strips Module 0
  - Entries: 59154
  - Mean: 728.9
  - Std Dev: 700.6

- **Y axis cluster charge_1**
  - y-strips Module 1
  - Entries: 67749
  - Mean: 653.6
  - Std Dev: 610.8

- **Y axis cluster charge_2**
  - y-strips Module 2
  - Entries: 45865
  - Mean: 767.9
  - Std Dev: 669.2
Preliminary Cosmic Data: Layer J0

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

Layer J0 - Module 0
Layer J0 - Module 1
Layer J0 - Module 2

9/19/2018