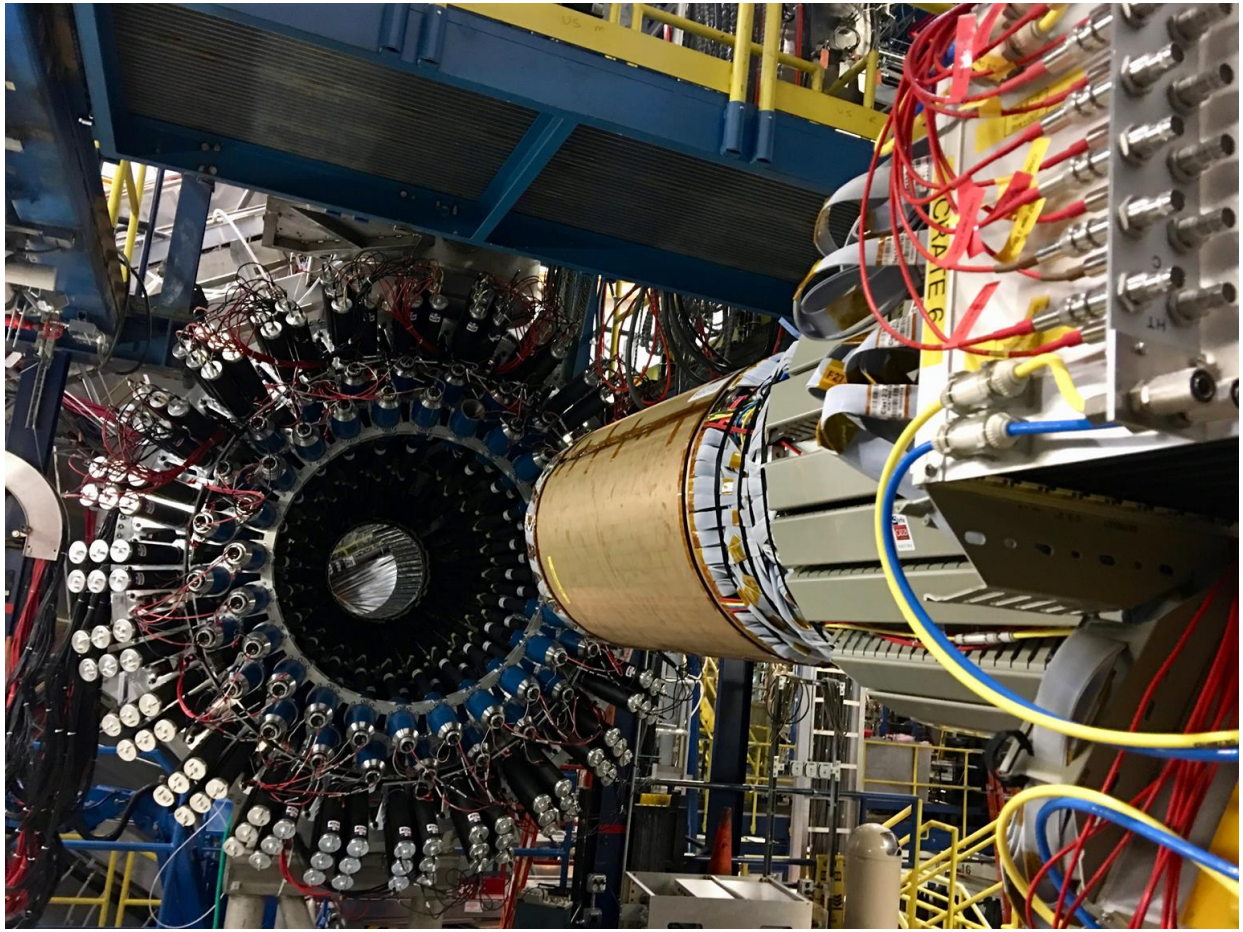
Micromegas Vertex Tracker

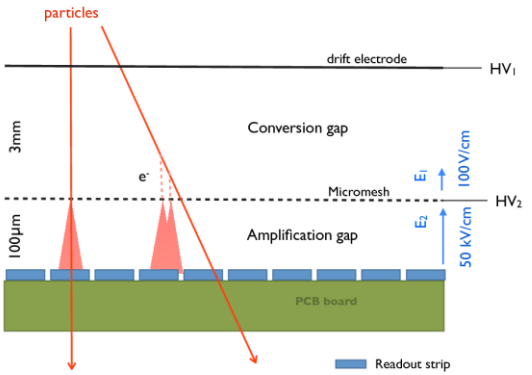


Quick reminder

- Micromegas are gaseous detectors.

- The MVT is made of:
  - a barrel of micromegas tiles
  (6 layers of three tiles)
  - a forward part made of 6 disks.

- 0.3% of radiation length for active zone of a tile in BMT.
  0.6% for active zone of one disk in FMT.

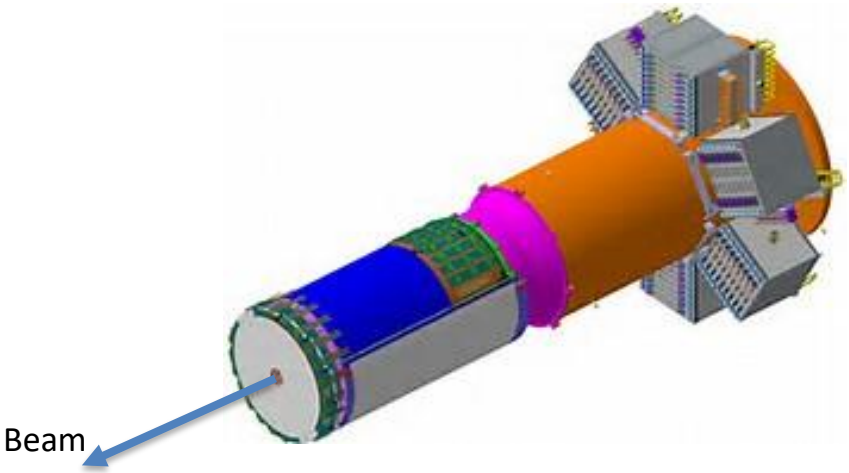


Z-detector because strips along Z-axis

C-detector because strips are curved

MVT - TECHNICAL PARAMETERS

PARAMETER	DESIGN VALUE	
Elements	Barrel	Forward
Micromegas technology	Bulk with resistive strips	
PCB thickness	200 µm	
Radiation length	0.33% / layer	
Electronic chip	DREAM	
Sampling frequency	20 MHz	
Cables	1.5-2 m coaxial from Hitachi, 50 pF/m	
Time resolution	10 ns	
Total active area	2.9 m²	0.6 m²
Number of readout elements	15,000	6,000
Angular coverage	35-125°	6-29°
Number of detectors	18	6
Gas mixture	Ar+10%iC_4H_{10}	Ne+10%C_2H_6+10%CF_4
Drift gap	3 mm	5 mm
Drift electric field	Z: 6 kV/cm; C: 5 kV/cm	1 kV/cm
Micro-mesh transparency	Z: 50%; C: 75%	~100%
Effective gain	5,000	3,000
Lorentz angle	20°	NA
Particle flux per layer	4 MHz	12-20 MHz
Strip Pitch	Z:540 µm; C:330-900 µm	500 µm



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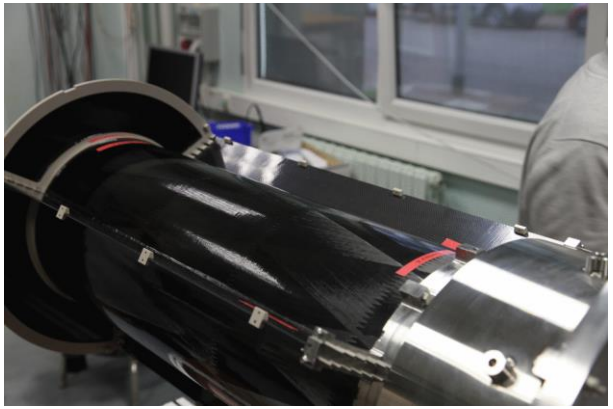
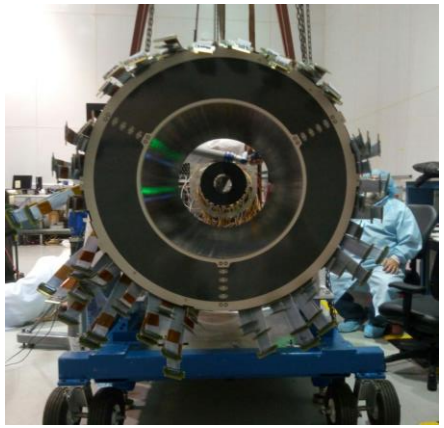
The MVT was delivered at Jlab in June.
10 French guys in the eel buiding for two weeks assembled the MVT in June.



6 layers of tiles per sector



MVT integrated with SVT in the clean room

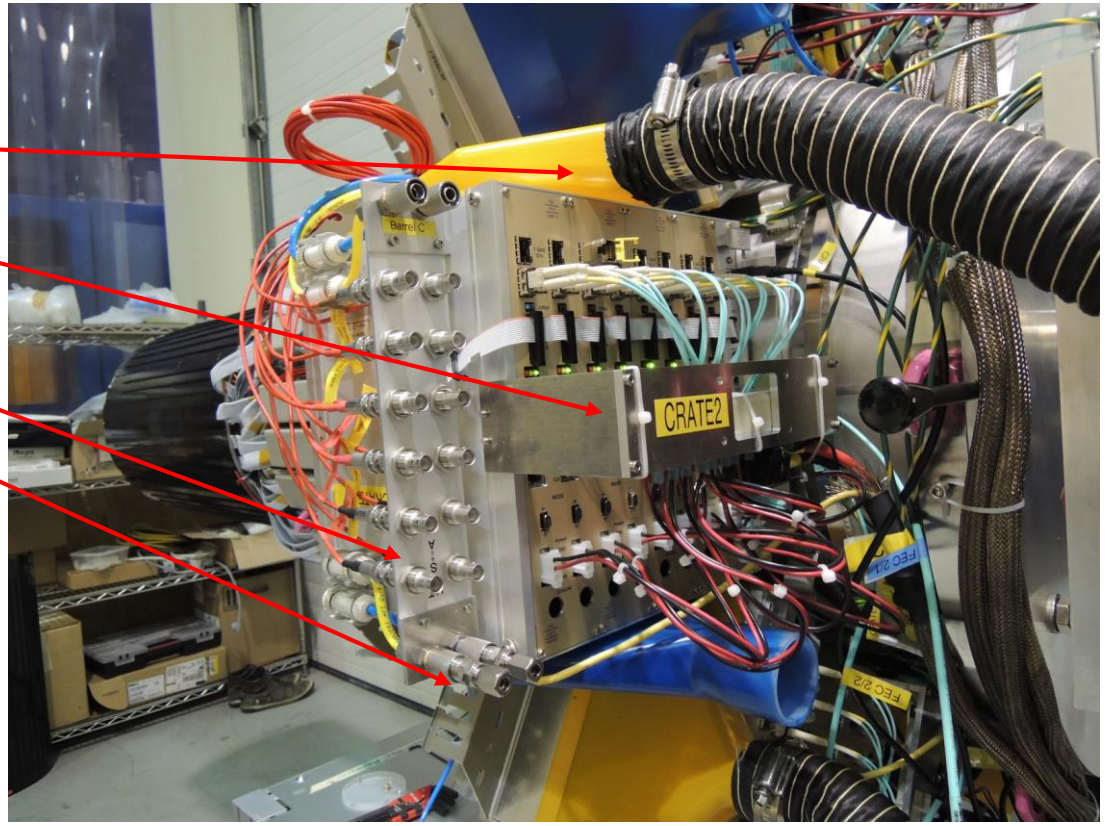
MVT assembled in the EEL by CEA Saclay

Thank you to Detector support group and electronics group for their help!

The DAQ system

Each of the 6 front crate is dismounted and refurbished:

- Filled with 8 Front End Unit
- Air cooling and air extraction
- LV connector mechanics
- HV connectors
- Gas connectors



Each front end unit is composed of 8 DREAM-ASICs. Each DREAM is connected to 64 strips.

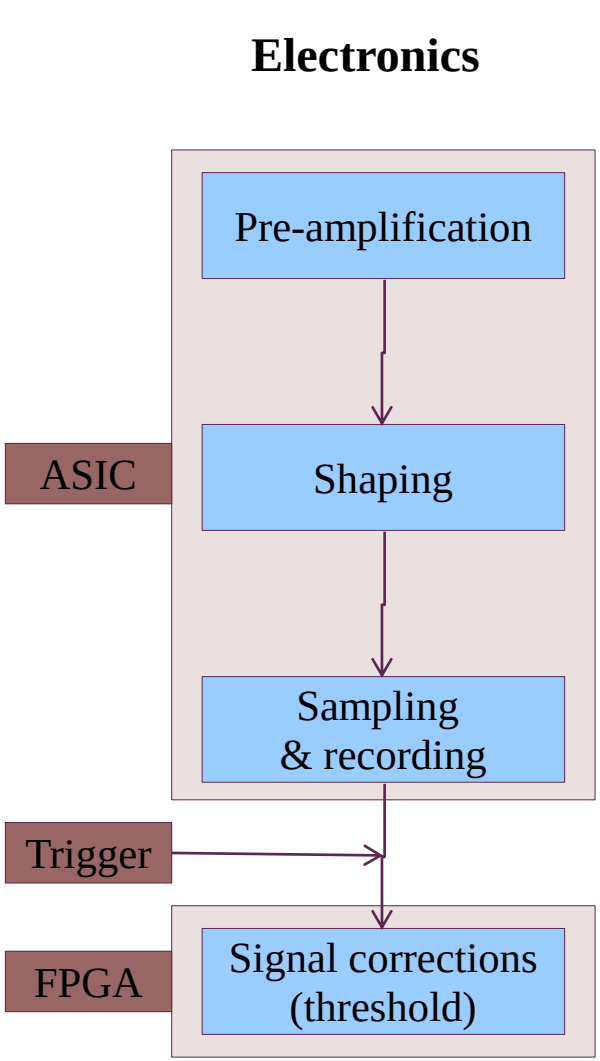
How to reduce the data?

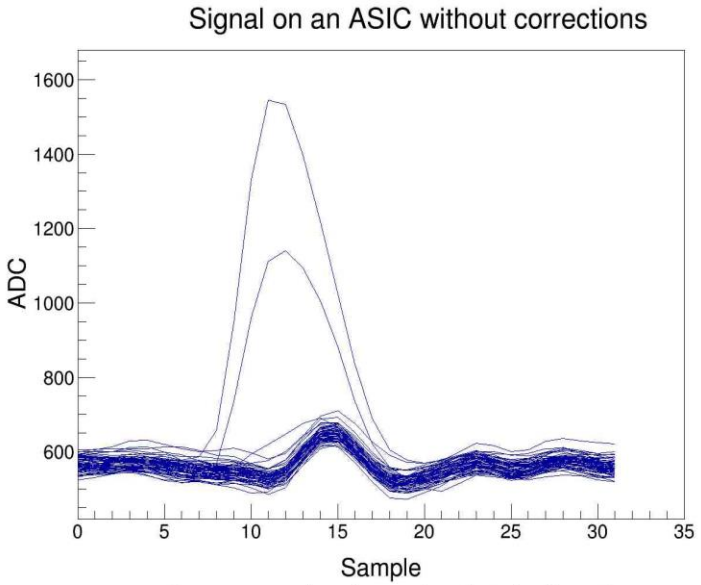
For each event, you cannot save 16 samples for all the 20000 channels.

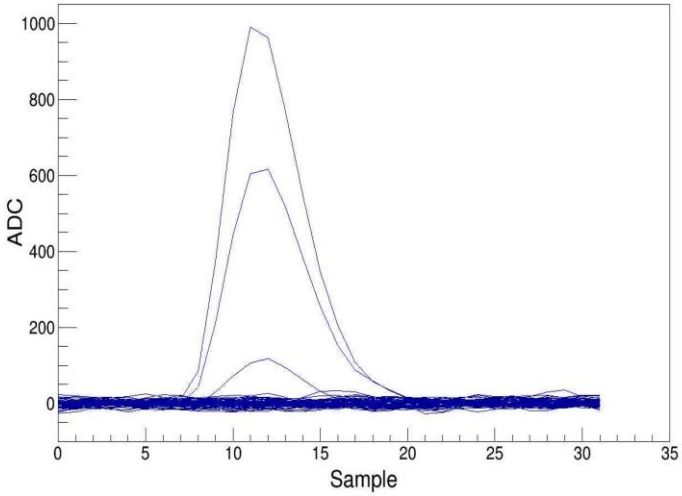
We use the zero suppression to save data for strips fired by a real hit.

Sampling time = 40 ns

Nb samples = 16

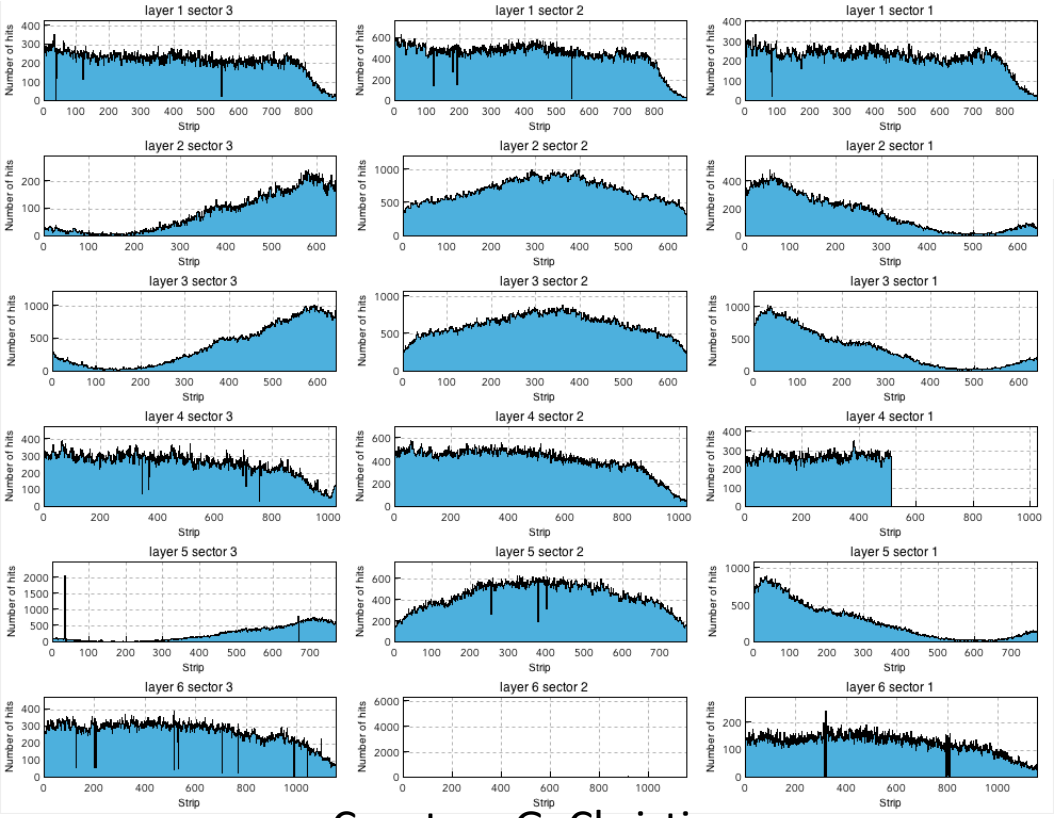




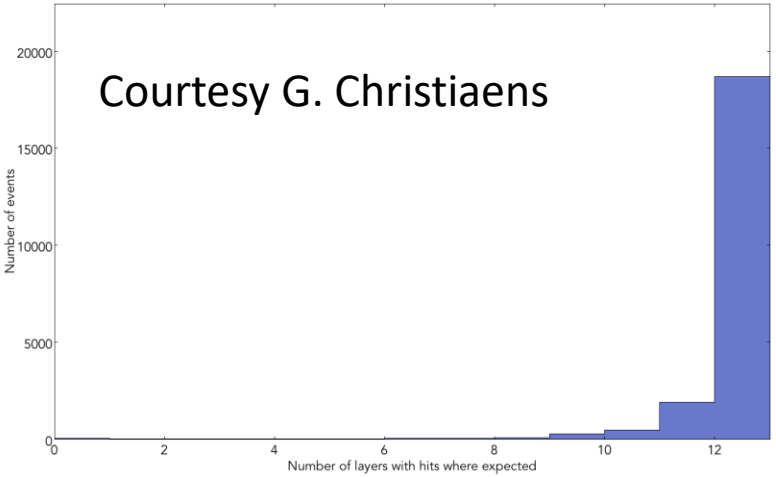


Taking cosmic in the eel

Cosmics have been collected in the eel until late October… but saving the premix gas.
=> Hit occupancies is the mirror of the SVT trigger.



Courtesy G. Christiaens



- Efficiency of each tile > 90%
- Alignement still needed, to have good resolutions

-Last layer has been changed in Fall 2017.

-1 FEU was replaced last summer

Installation in the Hall

- Once in the Hall, we checked noise level:
  - After common noise subtraction, equivalent noise level as in the eel.
  - Even with magnetic fields.

- We were supposed to use gas mixing system. But it was not ready. Since December, we are using premix gas. At some point, we had to save it.

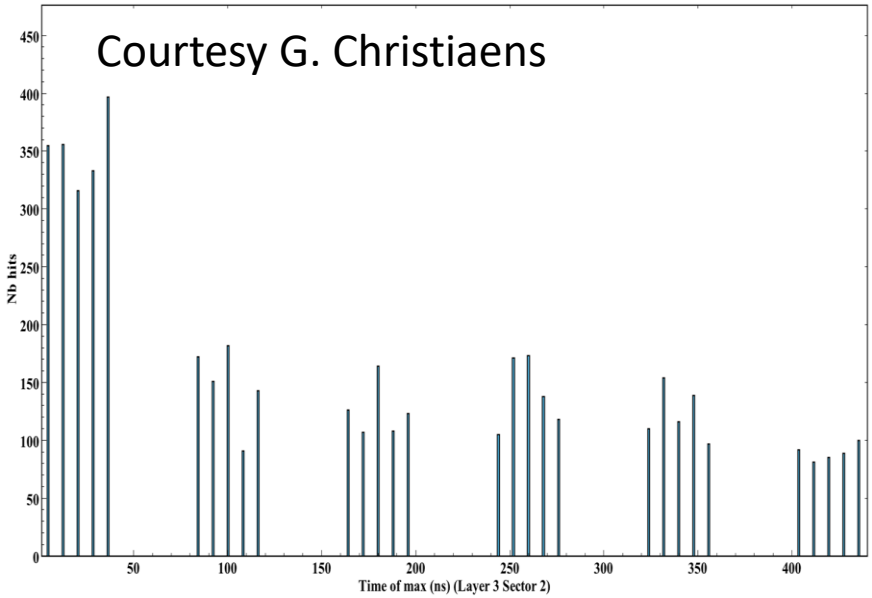
DAQ optimization

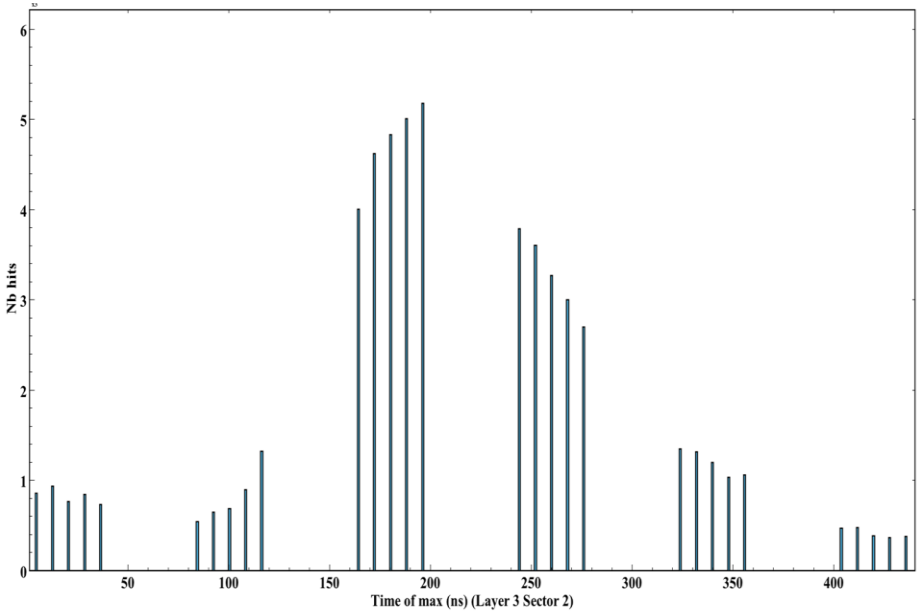
- For Cosmics in the eel, we took 16 samples with a sampling time of 40 ns.

- Several limitations appeared with beam:
  - Deadtime… Since you need to read and analyze 16 samples.
  - Large amount of data despite zero suppression (real hits/data).

- It was then decided to:
  - reduce the number of samples from 16 to 6.
  - read one sample over two… to reduce the amount of data but keep a wide time window.

Courtesy G. Christiaens





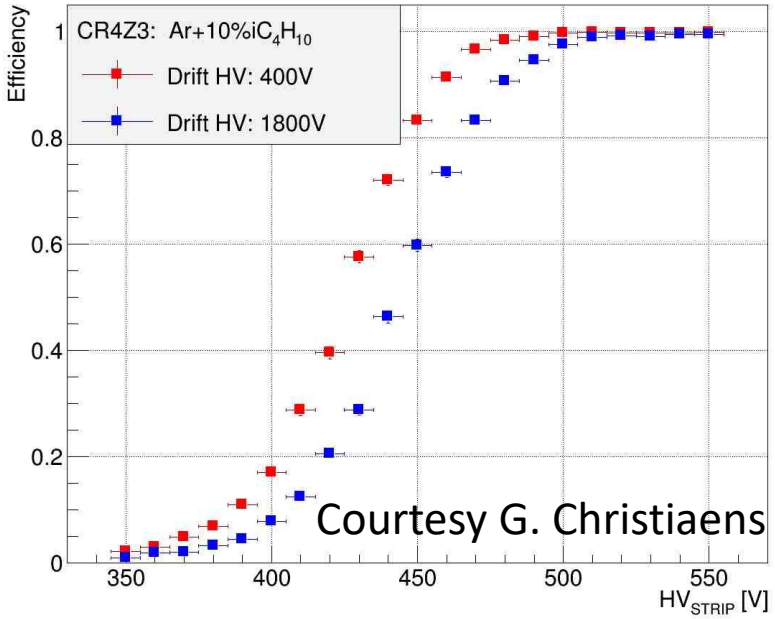
HV settings optimization

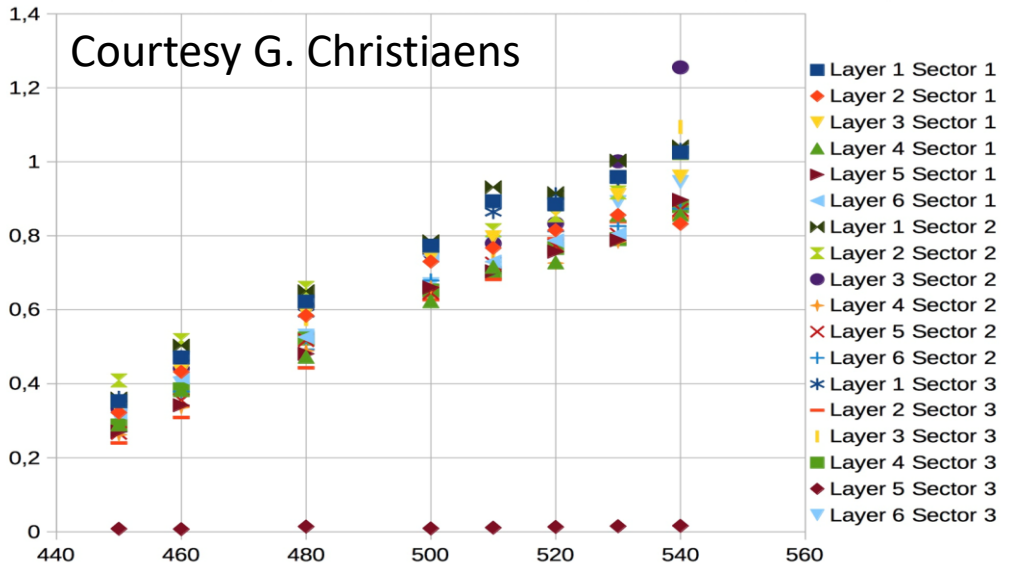
- HV strip choice driven by :

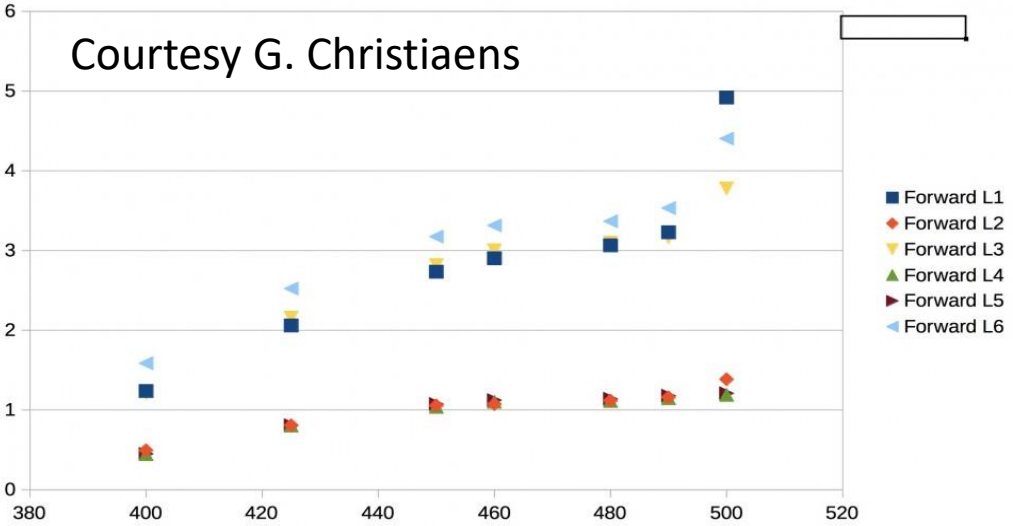
– **efficiency** (lower limit)

–**currents** and **safety** (upper limit)

- Efficiency computed with cosmics at Saclay
- Pseudo-efficiency computed with cluster number during Engineering run

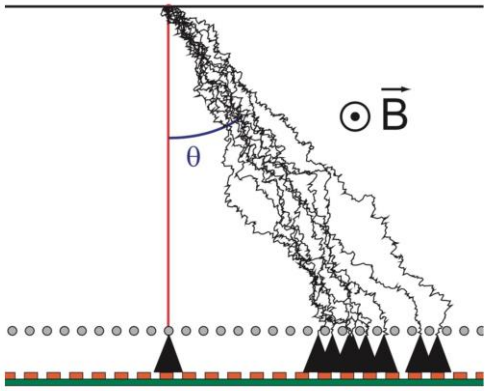






Lorentz angle measurement

- Taking a low beam current data, we can run the reconstruction and have enough statistics to study the Lorentz angle.
- Electrons will drift more or less along the track of negative-charged particle.
- When these particles makes an angle with the micromegas equal to the Lorentz Angle, the cluster size is minimal.
  (Only transverse diffusion contributes)
- We find 26 degrees, in agreement with computed values currently used in GEMC and reconstruction.



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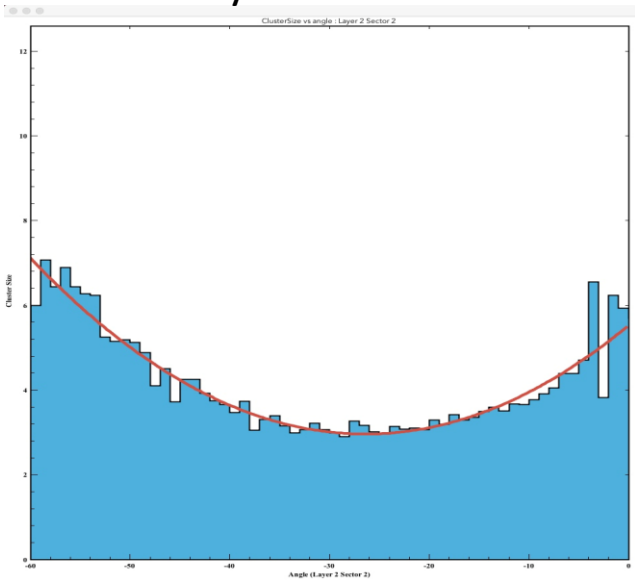
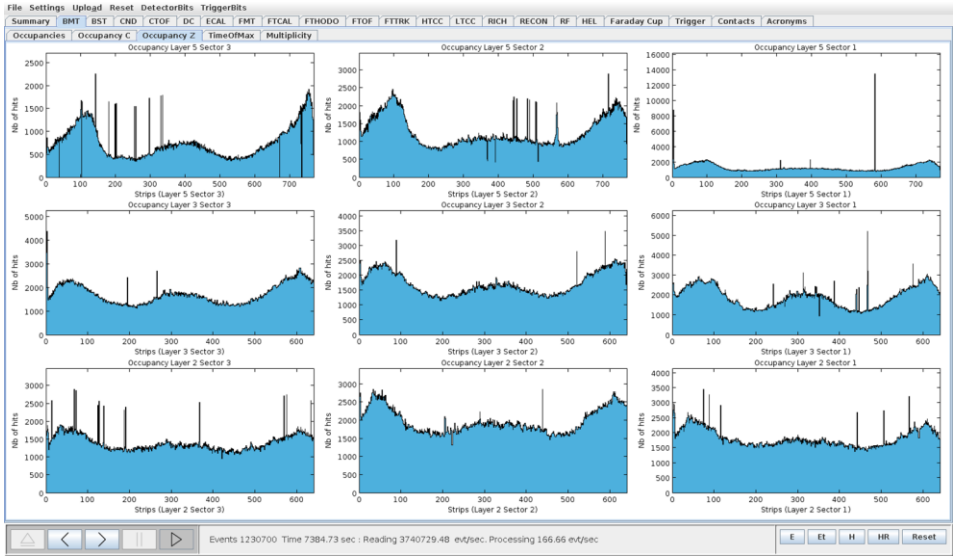


MVT status

- Until today we have lost an entire layer of micromegas (3 tiles of a same layer). The reason is still unknown today. But we are assuming a defect since it is a same layer.
  => Tiles will be shipped back to Saclay for investigation and to be fixed.

- Three out of the six FMT disks have half of their active zone which are in fact not active due to HV issue.
  => Two spare disks will be sent for Fall. The third one has just a loose HV connection.

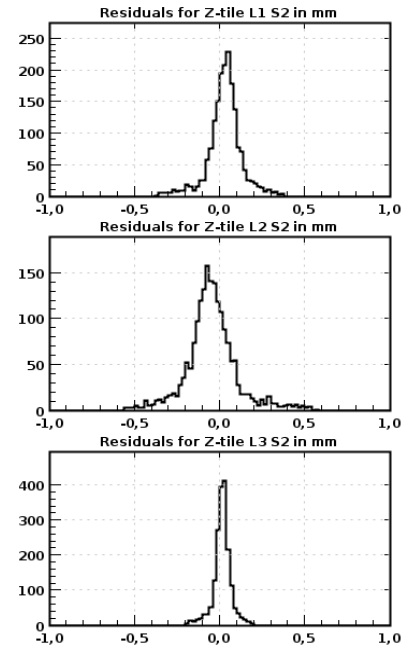
- Puzzle of the day:
  The occupancy in phi exhibits a weird pattern:
  - Drift space not homogeneous. (gas overpressure?)
  - Amplification gap not homogeneous? (Vibration during shipment of MVT)

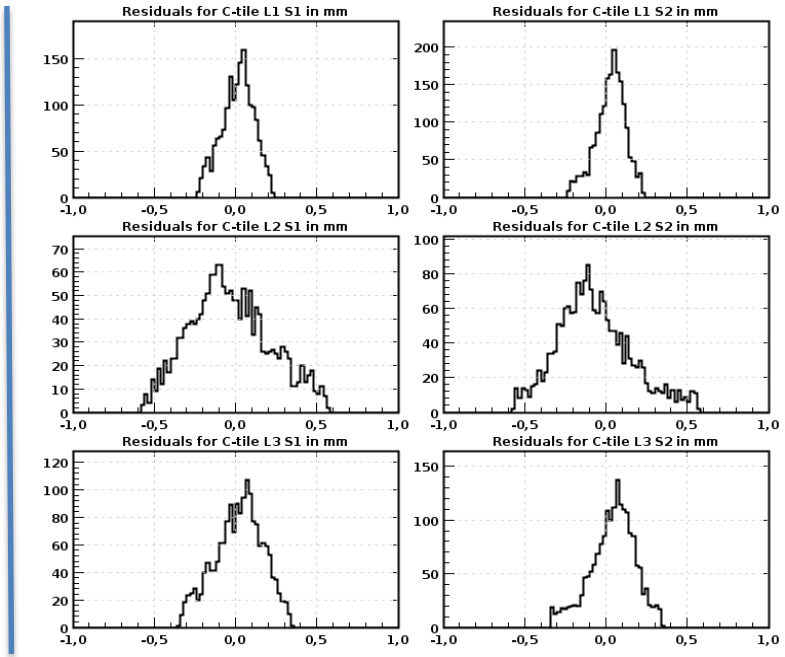


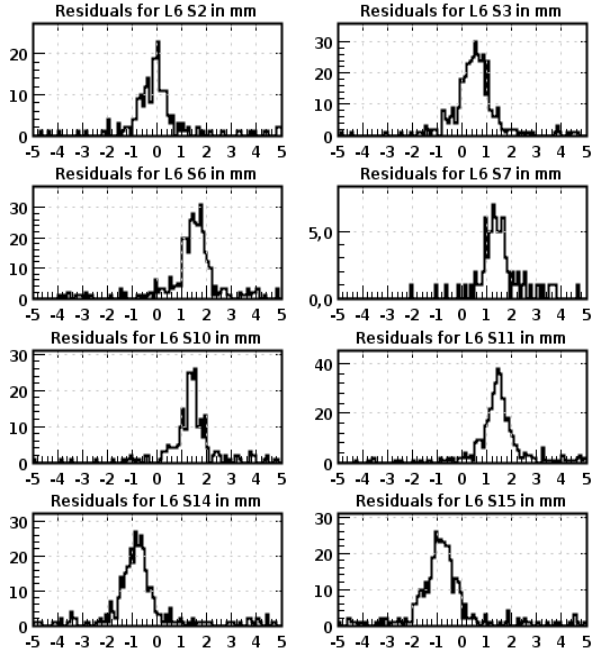
MVT roadmap

- It is tightly linked to the progress on central reconstruction, which is not efficient enough to study MVT when beam current is higher than 10nA. Veronique and Francesco Bossu (staff CEA Saclay) are working on this.

- A step done in parallel is the alignment. We took 0-field run. Developping a new algorithm for straight track using MVT only, we have obtained our first residuals for MVT only and MVT vs SVT.







THANK YOU!