ATLAS NEW SMALL WHEEL MICROMEGAS TESTBEAM RESULTS

Setup at H8

The beam test took place over summer 2018, the purpose was to study performance under high rate muons/pions and different types of gases, HV stability and definition of the operating HV point and Data Acquisition System based on MMFE8 Readout Scheme equipped with VMM3 .

Setup consists of:
- 4 Scintillators
- Tmm*/T* prototypes
- SM1-M1 Quadruplet

GIF++ irradiation

• 14 TBq Cs source giving high photon irradiation rate
• Scans of current vs. HV performed for different attenuations and gas flows
• Micromegas performance study under high radiation environment
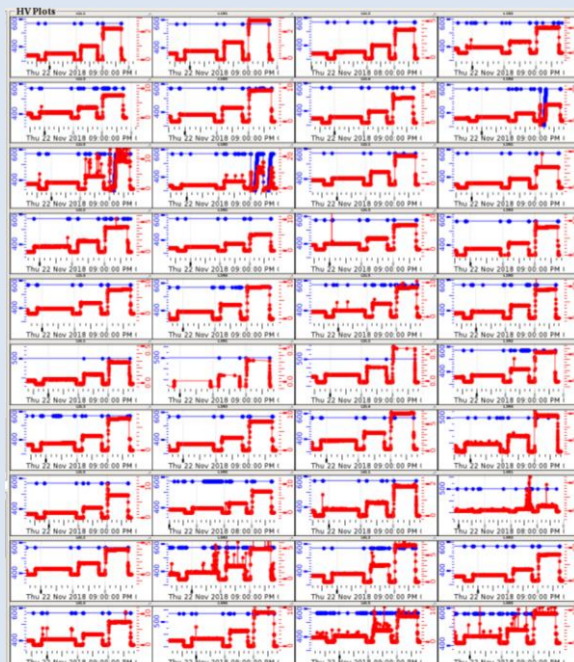
DCS panel, showing 34/40 HV sections of the SM1 module operating at 570V. Five section are at 500V for this test, but can go to 560V with partial discharge.

New Small Wheel

The ATLAS Phase-I flagship upgrade is the New Small Wheel (**NSW**), which consists of 2 disks of Muon Gas detectors. Technologies used are **Micromegas** (MM) and **sTGC**, providing a total of 16 layers of tracking and triggering.
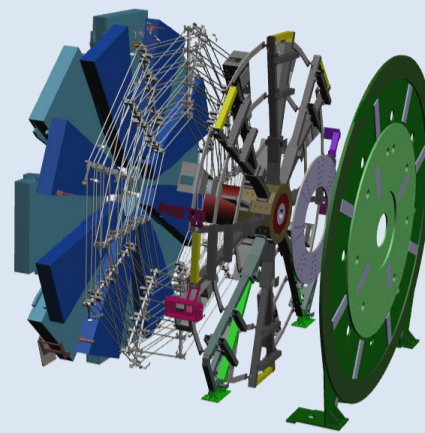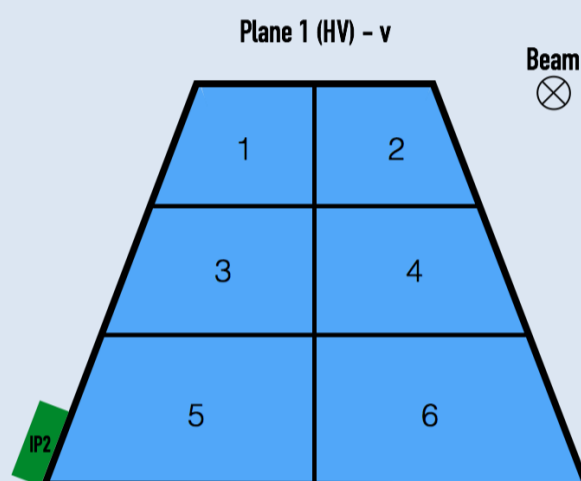
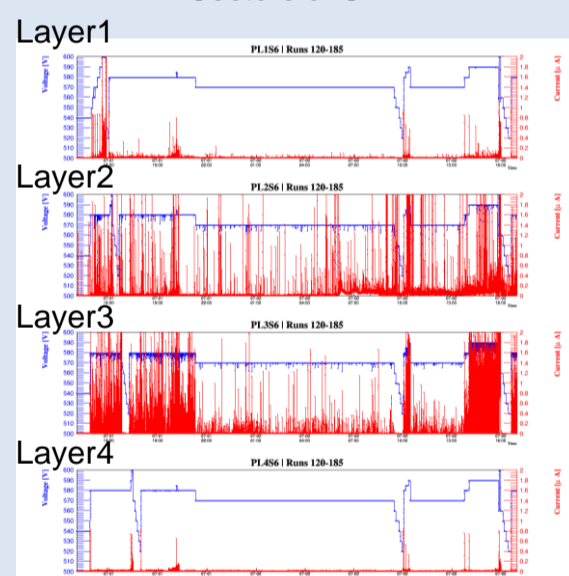Exploded view of the New Small Wheel
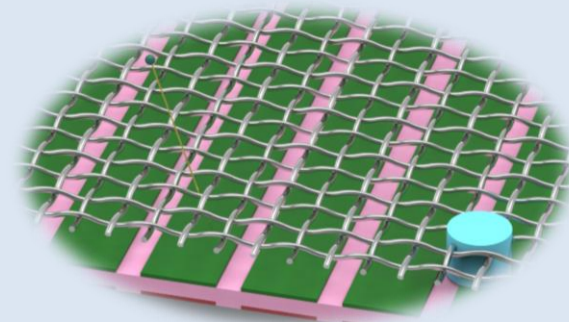
3D representation of the Micromegas geometry.

HV behaviour

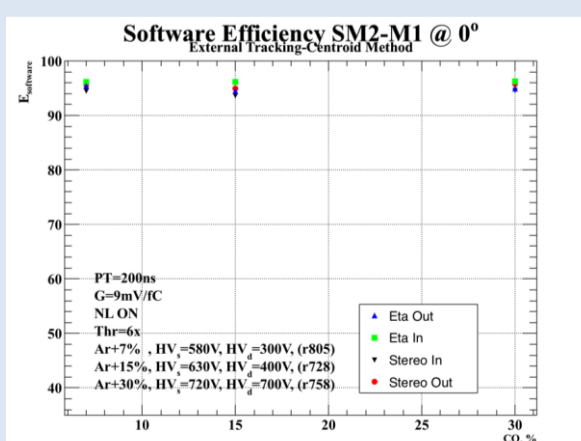HV scans performed to determine the performance of chamber's layers

Plane 1 (HV) - v

Beam ⊗

Sectors of SM2

Layer1
Layer2
Layer3
Layer4

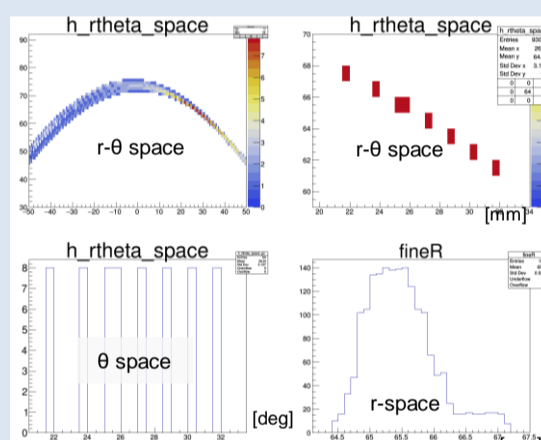HV behaviour of SM2-M1 in the summer. Situation improved much since.

Gas studies

Different CO_2 percentages are tried to optimise the detector behaviour. Software efficiency is not affected by the CO_2 content. Software efficiency: no cluster within 10σ of the extrapolated position.

Software Efficiency SM2-M1 @ 0°
External Tracking-Centroid Method

PT=200ns
G=9mV/fC
NL ON
Ar+7%, HV$_A$=580V, HV$_D$=300V, (r805)
Ar+15%, HV$_A$=630V, HV$_D$=400V, (r728)
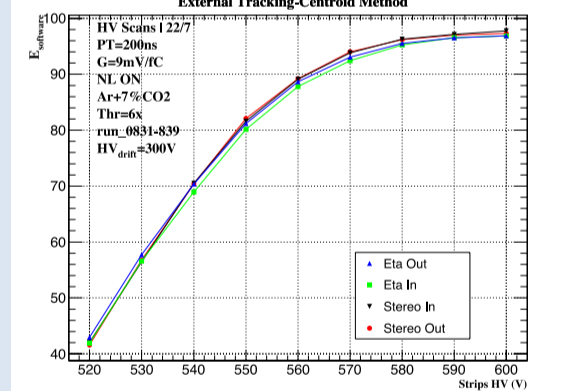Ar+30%, HV$_A$=720V, HV$_D$=700V, (r758)

Analysis - 30°

In the microTPC analysis, the hits are grouped into clusters. Then, each cluster passes through a Hough Transform filter, and finally the 2D position is reconstructed. The steps are described below.
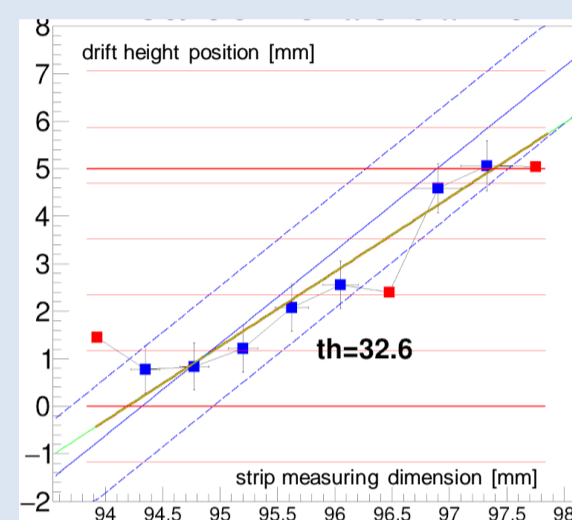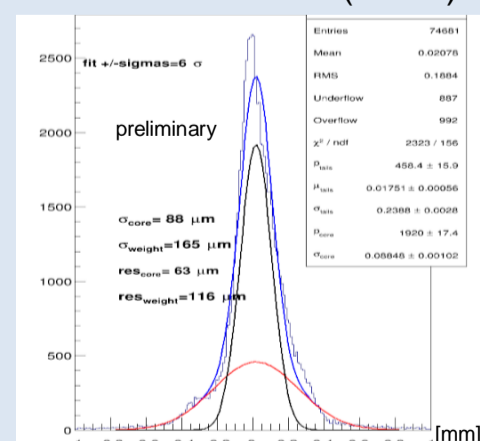
The Hough transform steps.

Software Efficiency HV Scan SM2-M1 @ 0° PCB7-S3
External Tracking-Centroid Method

HV Scans 12/7
PT=200ns
G=9mV/fC
NL ON
Ar+7%CO2
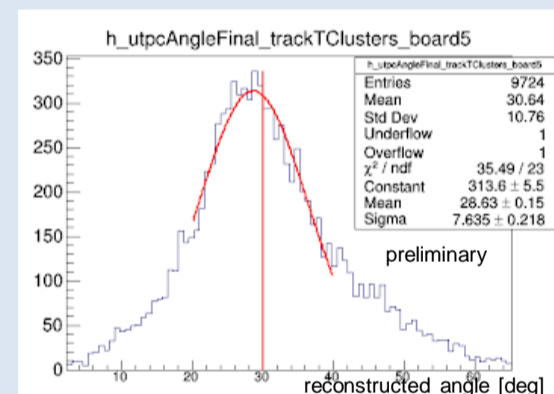Thr=6x
run_0831-839
HV$_{drift}$=300V

A HV scan, showing the efficiency of the chamber, which is shown to have the turning point at 570V.

Analysis - 0°

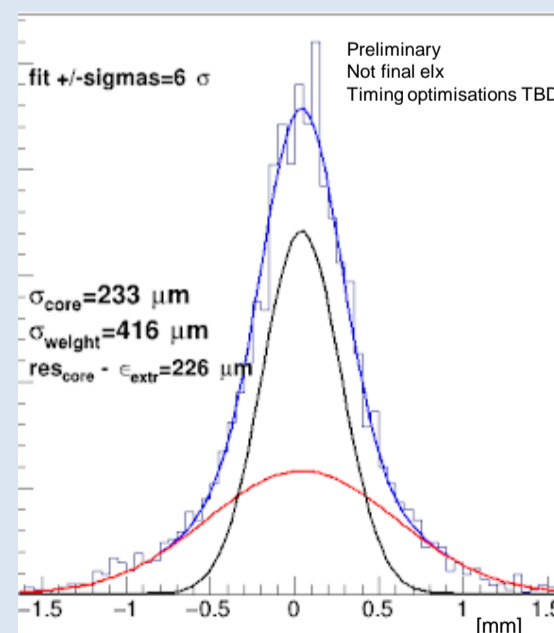The residual distribution of the two eta layers of SM2, which shows resolution of O(60um).

preliminary

σ_{core}= 88 μm
σ_{weight}=165 μm
res$_{core}$= 63 μm
res$_{weight}$=116 μm

drift height position [mm]

th=32.6

strip measuring dimension [mm]

Using the Hough transform, the x-y points are cleaned up. This allows to discard noisy strips, while fitting the remaining points to find a 2D track.

h_utpcAngleFinal_trackTClusters_board5

preliminary

reconstructed angle [deg]

The reconstructed angle distribution, peaking at the expected 28 degrees.

fit +/-sigmas=6 σ

Preliminary
Not final elx
Timing optimisations TBD

σ_{core}=233 μm
σ_{weight}=416 μm
res$_{core}$ - c$_{extr}$=226 μm

Distribution of residuals between the reconstructed position and the position from the tracking chambers. The difference of capacitance between the large detector and the smaller ones, greatly affected the resolution. However, the layer multiplicity of the NSW Micromegas allows the system to retain its performance.