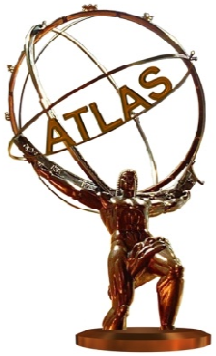
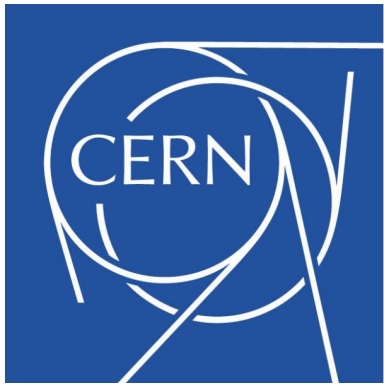


M. Bianco

On behalf of the ATLAS Collaboration



Development of large size Micromegas detectors for the upgrade of the ATLAS experiment

Outline

- ATLAS upgrade for the s-LHC
- MicroMegas (MM)Technology for the ATLAS New Small Whell (NSW) Upgrade
- The large MM chamber (1x2.4 m^2) construction
- First large chamber characterization
- Conclusions

ATLAS upgrade for the s-LHC

LHC upgrade to happen in three phases:

$L_{phase\ 0}$ ~ $1x10^{34}$ cm^{-2} s^{-1} (~2015)

$L_{phase\ 1}$ ~ $2\text{-}3\ x10^{34}$ cm^{-2} s^{-1} (~2018)

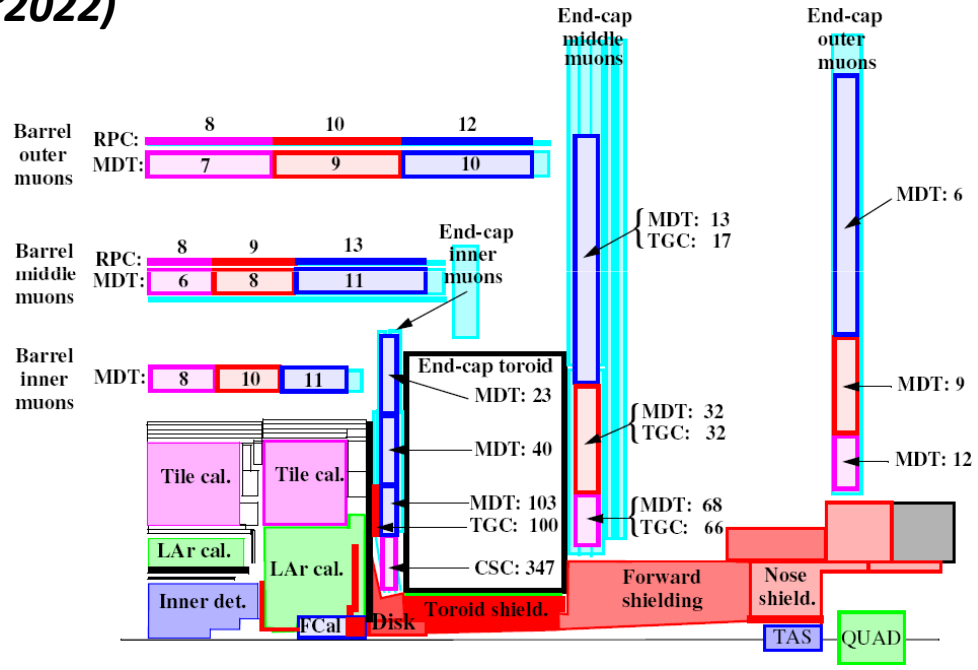
$L_{phase\ 2}$ ~ $5x10^{34}$ cm^{-2} s^{-1} (*with luminosity leveling* ~2022)

Muon Spectrometer affected regions :

- **End-Cap Inner (CSC,MDT,TGC)**

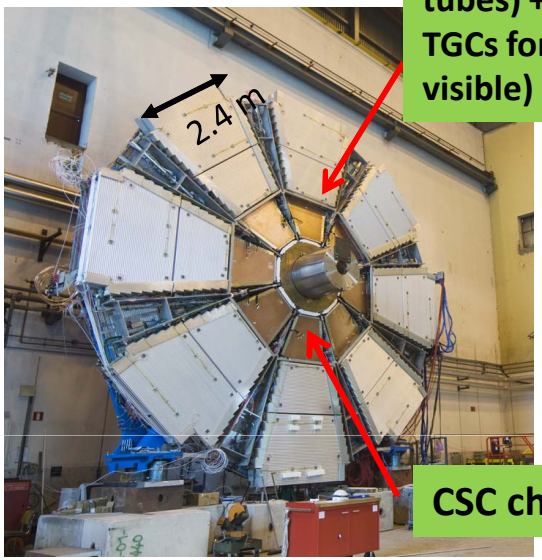
  Total area ~150 m2

Micromegas have been chosen as precision measurement detectors (but also trigger) of the New Small Wheel of ATLAS



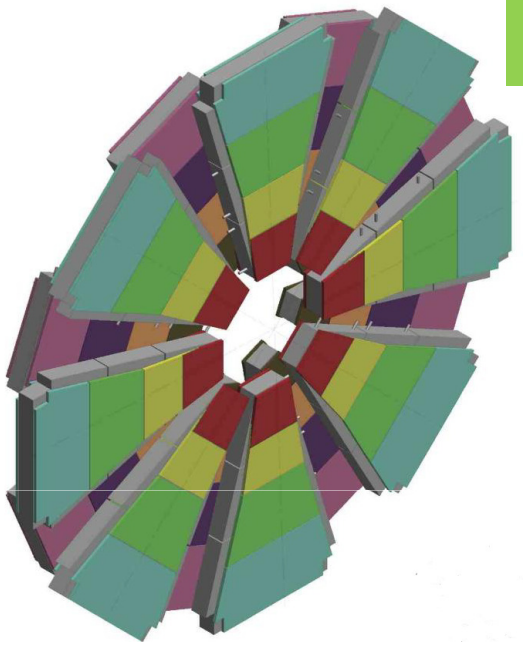
Average single plane counting rate (Hz/cm^2) at the 10^{34} nominal LHC luminosity (CERN-ATL-GEN-2005-001)

ATLAS Small Wheel upgrade project



Today: MDT chambers (drift tubes) +
TGCs for 2nd coordinate (not visible)

CSC chambers



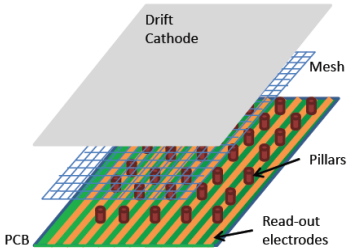
New Small Wheel Layout

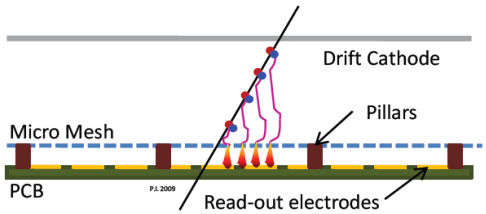
Equip the New Small Wheels with sTGC and MicroMegas (MM) detectors

MM parameters:

- ✓Detector dimensions: 1.5–2.5 m^2 per detector.
- ✓Combine precision and 2nd coord. measurement as well as trigger functionality in a single device
- ✓Each detector technology comprises eight active layers, arranged in two multilayers
- ✓MM 2nd coord will be achieved by using ± 1.5° stereo strips in half of the planes.
  - 2M readout channels
  - A total of about 1200 m^2 of detection layers

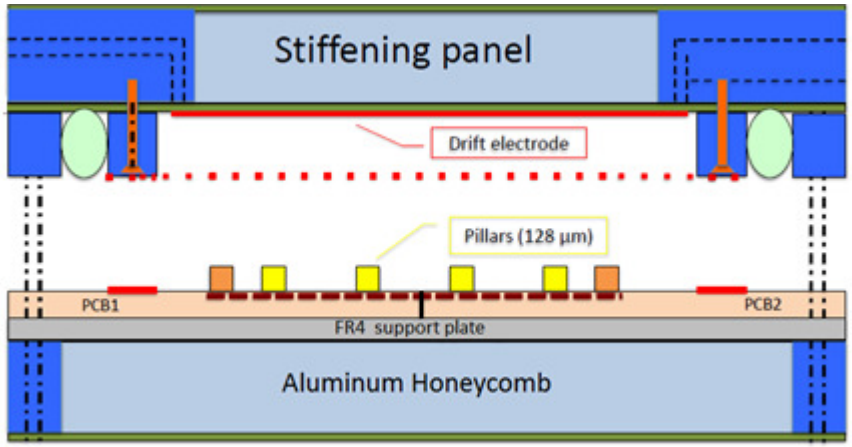
MicroMegas Technology for the ATLAS NSW Upgrade

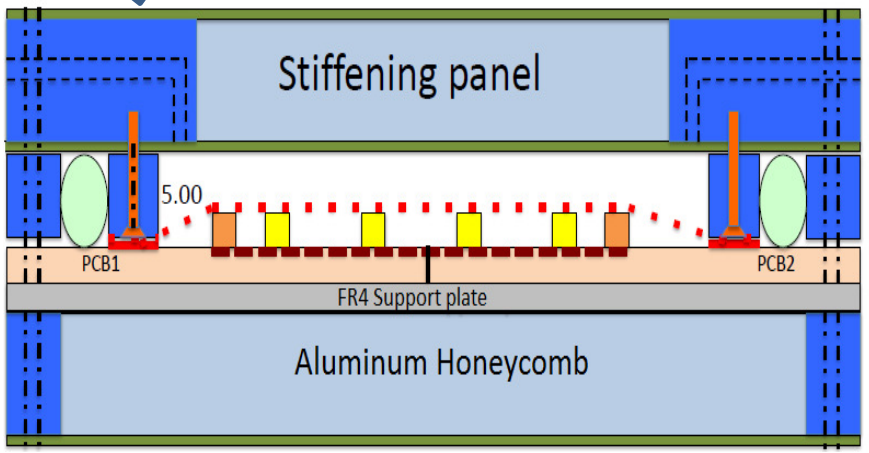




- **Micromegas (I. Giomataris et al., NIM A 376 (1996) 29)**
  are parallel-plate chambers where the amplification takes place in a thin gap, separated from the conversion region by a fine metallic mesh.

We opted for a non-bulk technique (**floating mesh**) that uses also pillars to keep the mesh at a defined distance from the board, the mesh is integrated with the drift-electrode panel and placed on the pillars when the chamber is closed. This allows us to build very large chambers using standard printed circuit boards (PCB) .

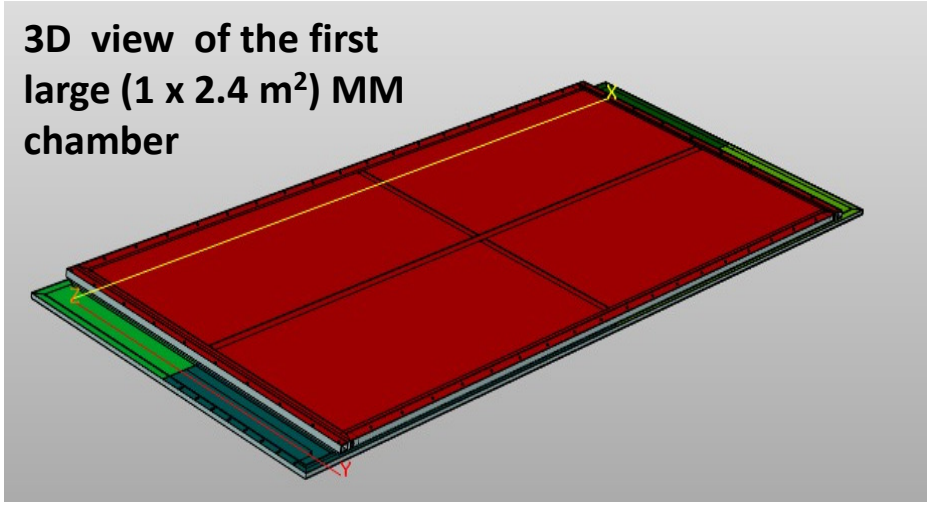




The 1 x 2.4 m^2 chamber

- **Parameters:**
  - Chamber dimensions: 1 x 2.4 m^2
  - 2 x 2048 strips separated in the middle
  - Four PCBs (0.5 x 1.2 m^2, thickness 0.5 mm) glued to a 10 mm thick stiffening panel
  - Floating mesh, integrated into drift-electrode panel (15 mm thick)
  - PCBs made at CERN, resistive strips have been printed in industry using screen printing technique

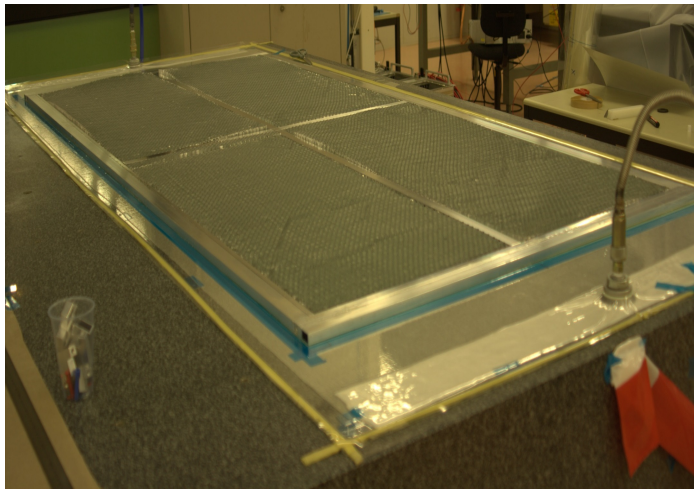
3D view of the first large (1 x 2.4 m^2) MM chamber

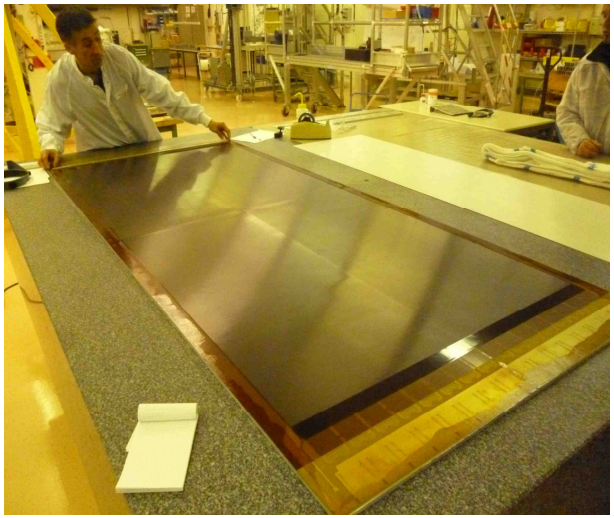


Construction procedure

- **On the granite table a vacuum sucking system was installed using a thin plastic mesh covered by a thin perforated plastic foil**
- **The FR4 sheets and the MM PCBs were then placed on the table, aligned, and sucked to the table to create a flat surface.**

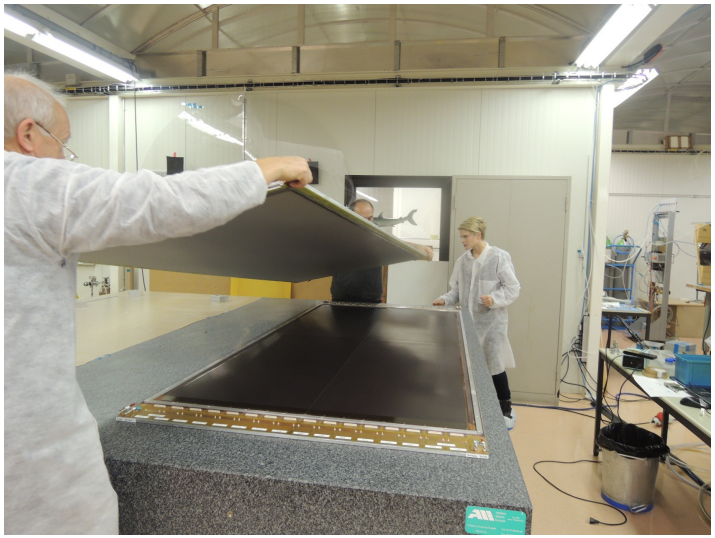
1) Honeycomb and aluminium frame gluing on the FR4 sheets, on the second face the PCB (drift or r/o) will be glued





2) Read out panel completed

3) Chamber assembly



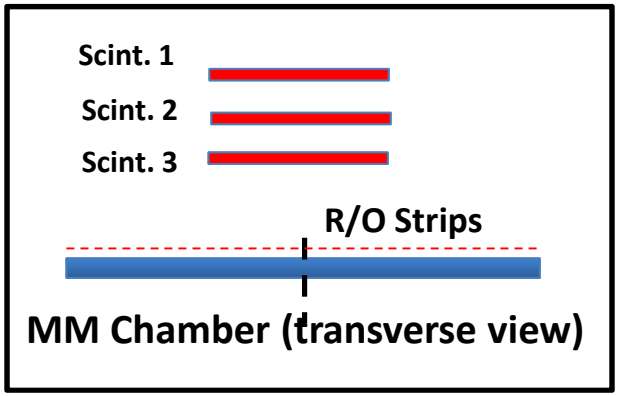
Large chamber, first results

Chamber parameters:

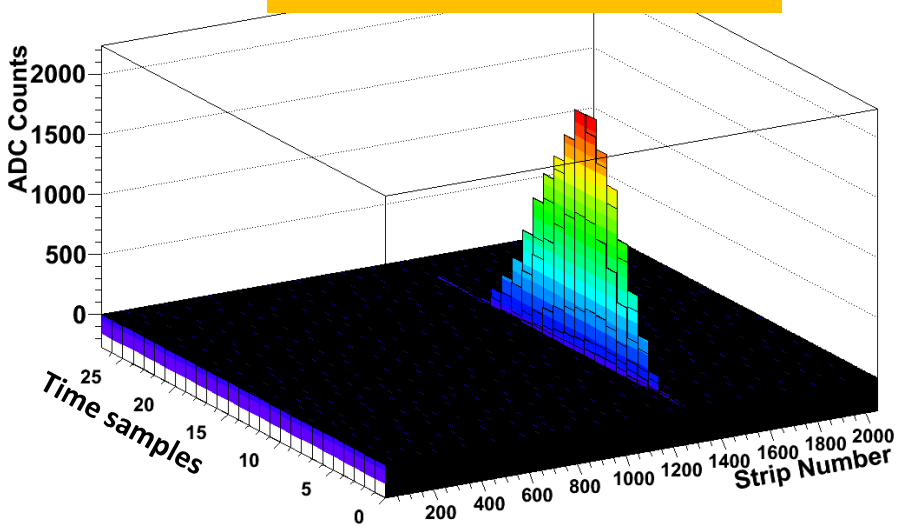
- 4096 r/o channels, 0.45 mm strip pitch
- 0.92 x 2.12 m^2 active area
- 5 mm drift space
- 128 µm amplification gap
- Gas mixture Ar:CO_2 93:7

Operating parameters:

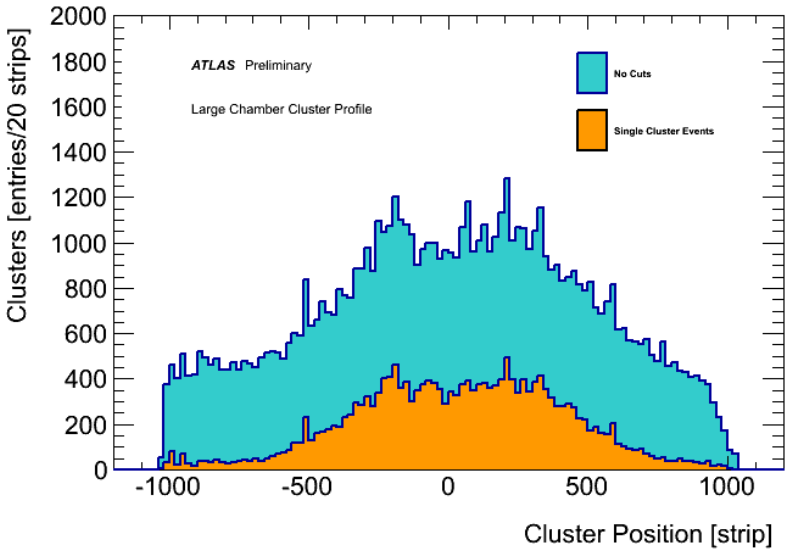
- HV Drift: 300 V
- HV Resistive Strips : 540-580 V



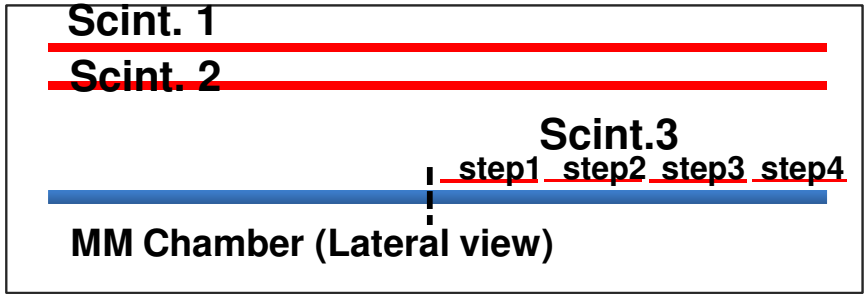
Signal from cosmic event in the Large MM chamber

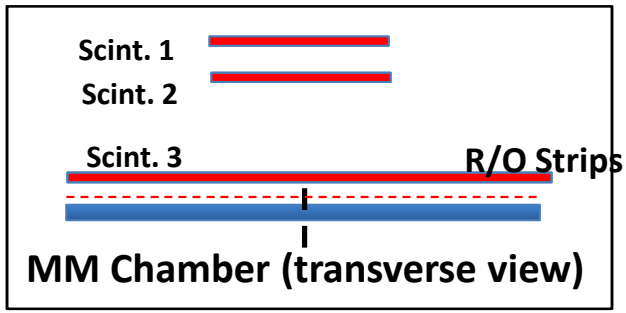


Number of clusters vs strip position



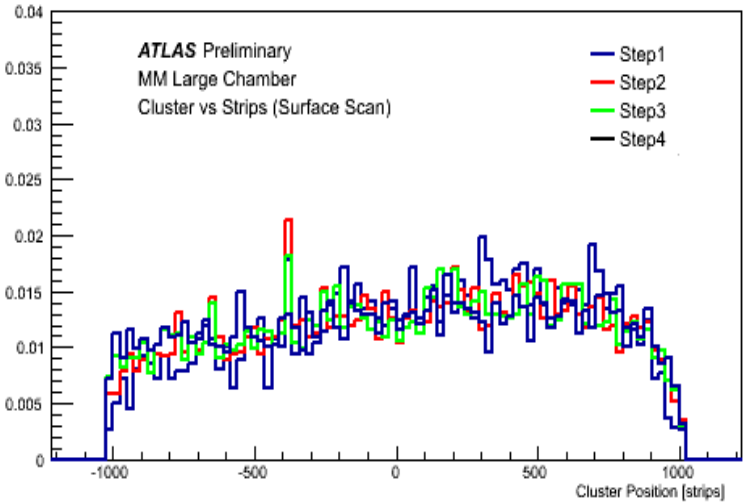
Large chamber, first results



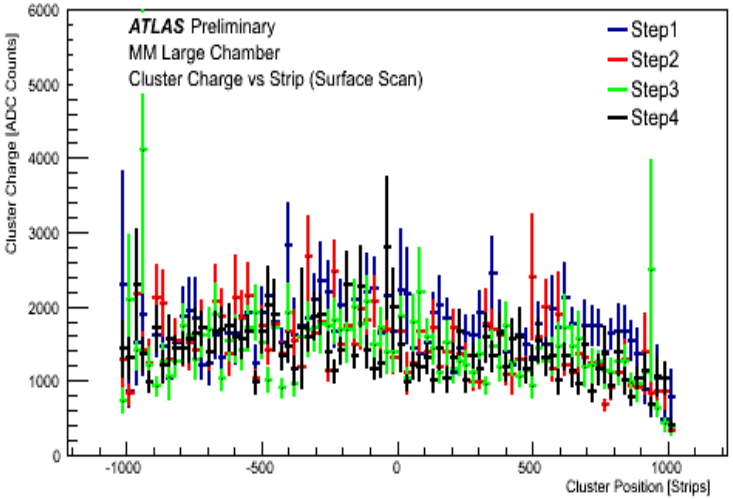


Number of clusters vs strip position as a function of distance from front-end

Cluster charge response uniformity across the chamber

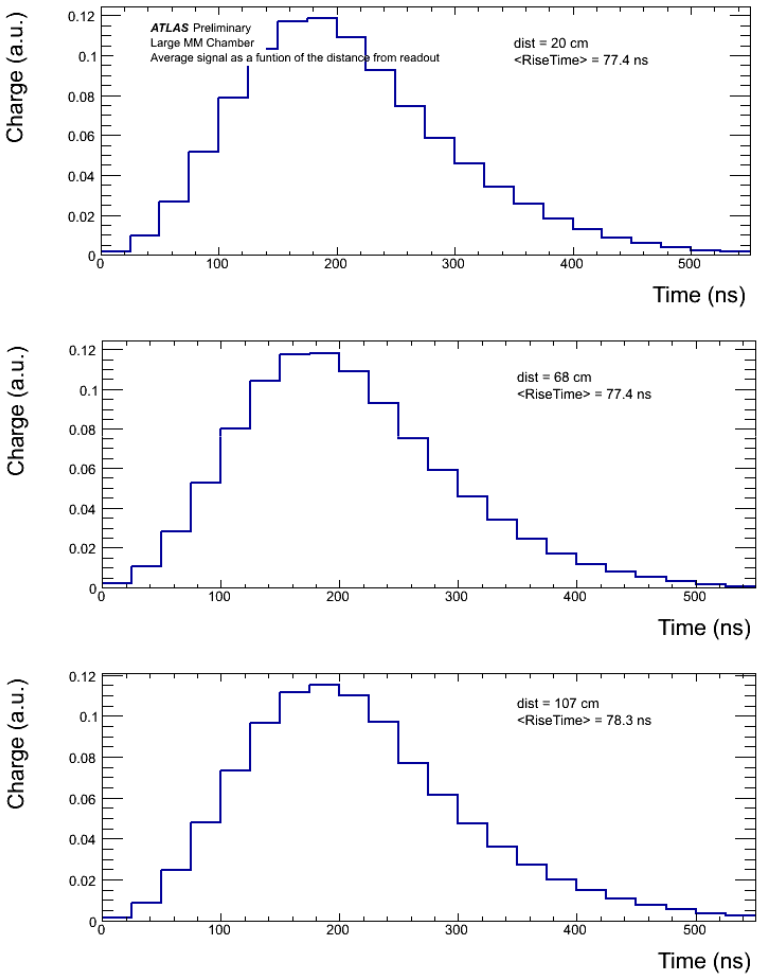


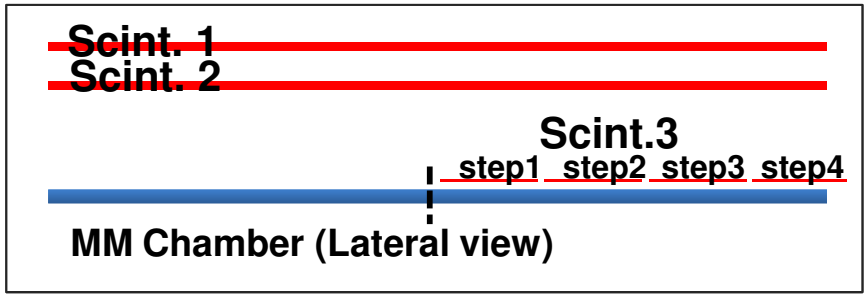
Transverse view

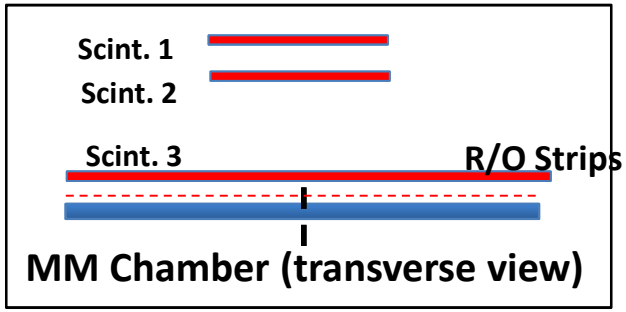


Transverse view

Large chamber, first results







The signal shape and the rise time are uniform and constant along the full strip length.

Summary

- We have constructed a 1 x 2.4 m2 Micromegas chamber with 0.45 mm strip pitch and 4096 r/o channels, the worldwide largest MM so far.
- It is made from four PCBs glued to a stiffener without dead space and a separate single mesh covering the full area.
- The chamber is working smoothly and shows a reasonably uniform response over the full detector area.
- No signal reduction over the 1m strip length has been observed.
- A second 1 x 2.4 m^2 MM has been constructed (where a few of the shortcomings of the first one have been fixed); it is working smoothly as well and is now under study.
- The technology here presented is fully suitable for the upgrade of the ATLAS NSW.

Thanks for your attention