Geometrical precision alignment of the Micromegas detectors for the ATLAS New Small Wheel upgrade

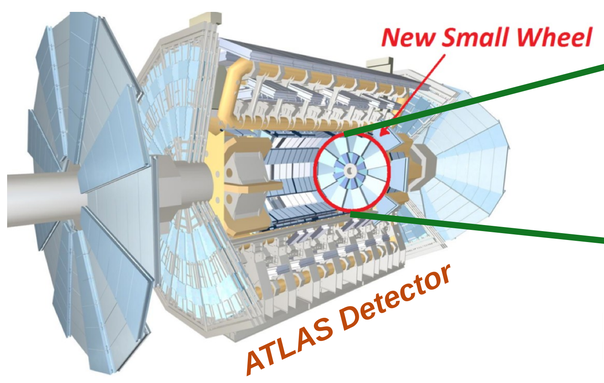
Manisha Lohan*

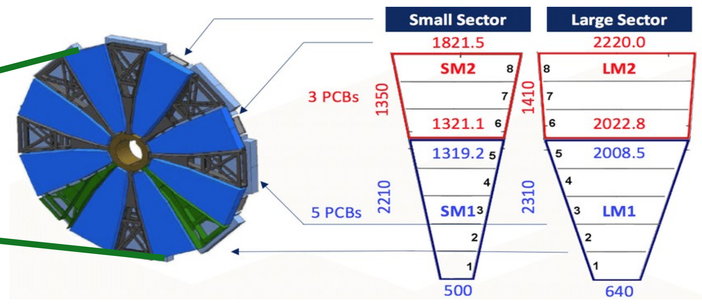
(on behalf of the ATLAS Muon Collaboration)

IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette 91191, France

**Electronic address: manisha.lohan@cern.ch*

New Small Wheel: A combination of excellent tracking and trigger detectors.





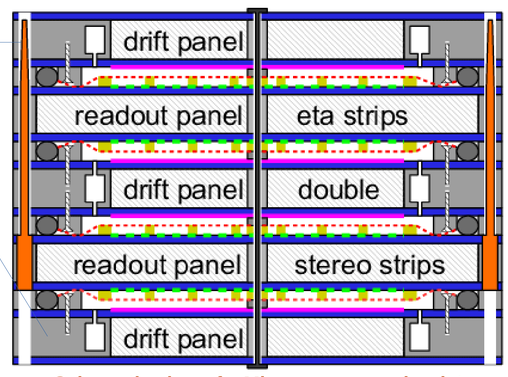
Mechanical structure of New Small Wheel, positioning and Dimensions (in mm) of small and large sectors Micromegas.

Motivation

- *Reduction of fake Level-1 muon triggers.*
- *Significant improvement in tracking resolution and efficiency.*
- *Covers the pseudo-rapidity region from 1.3 to 2.7*

Requirements

- *Detector planarity of the order of ~ 110 µm, having deformation in the acceptable range.*
- *All strip position within a detector (including both panels) of the order of ~ 60 µm.*
- *Precision to position one side of a RO w.r.t. other side of the order of ~ 40 µm.*

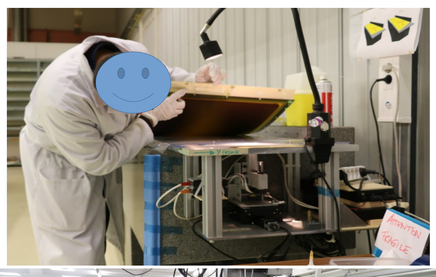


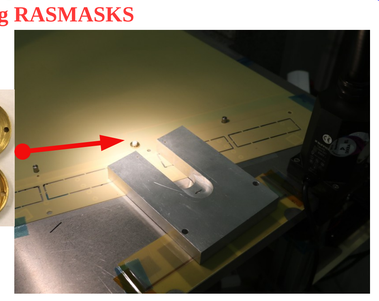
Schematic view of a Micromegas quadruplet

Red dotted line: Mesh; Purple: Drift electrode; Yellow: Pillars; Green: Readout strips

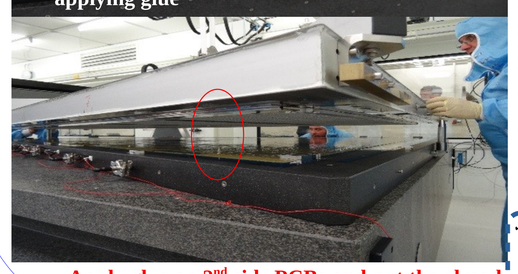
Panel Construction

Precision washer gluing using RASMASKS

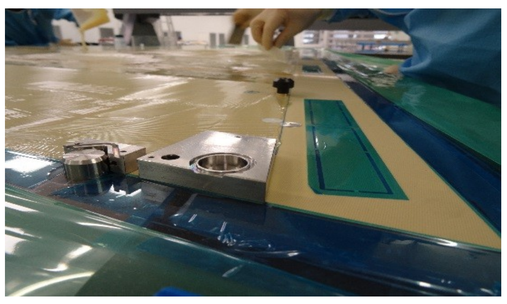




- Precision washers are glued with high accuracy on each PCB using an opto-mechanical tool and the Rasnik mask pairs; checked with Rasnik readings.



Apply glue on 2nd side PCBs and put the already extracted half panel on it using stiff-back.

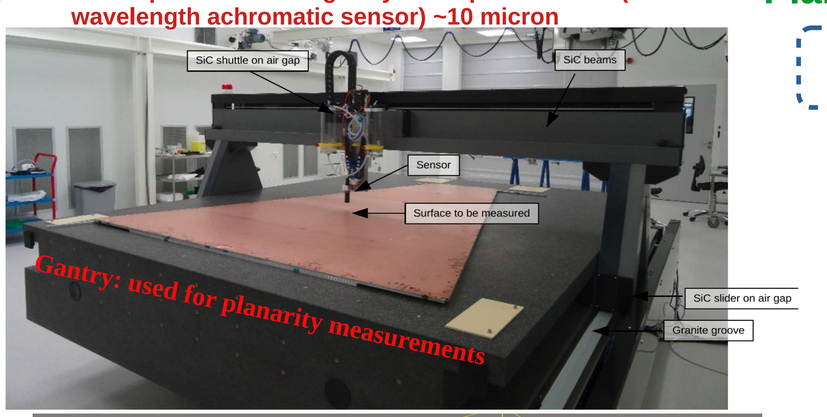


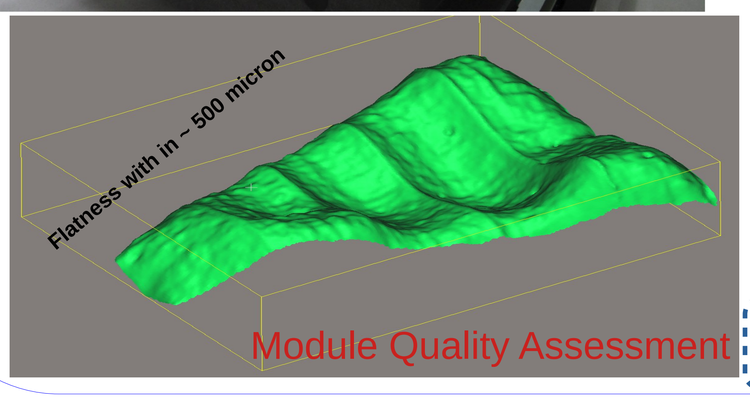
Position 2nd side PCBs on pins + V + flat. V and flat used for panel positioning in module

- After completion of readout (RO) panel construction, planarity and positioning measurements are done.

Planarity Measurements (panels and modules)

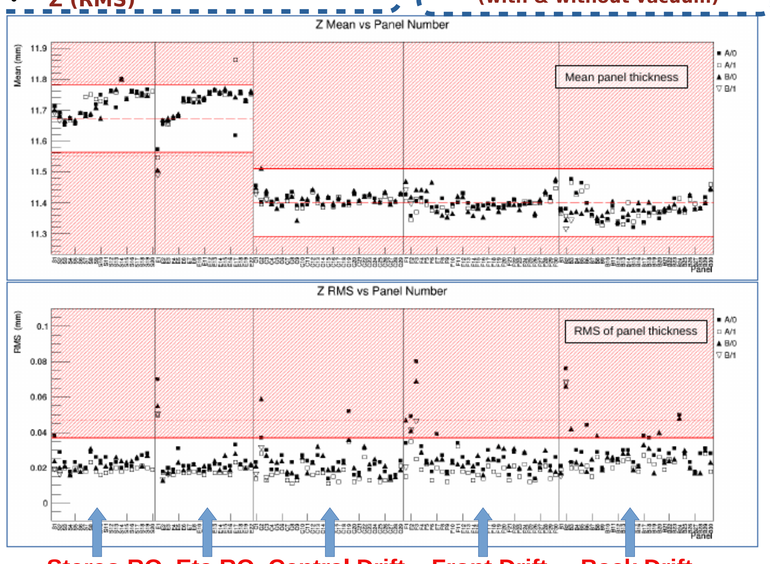
- Total precision of gantry + optical tool (multi-wavelength achromatic sensor) ~10 micron

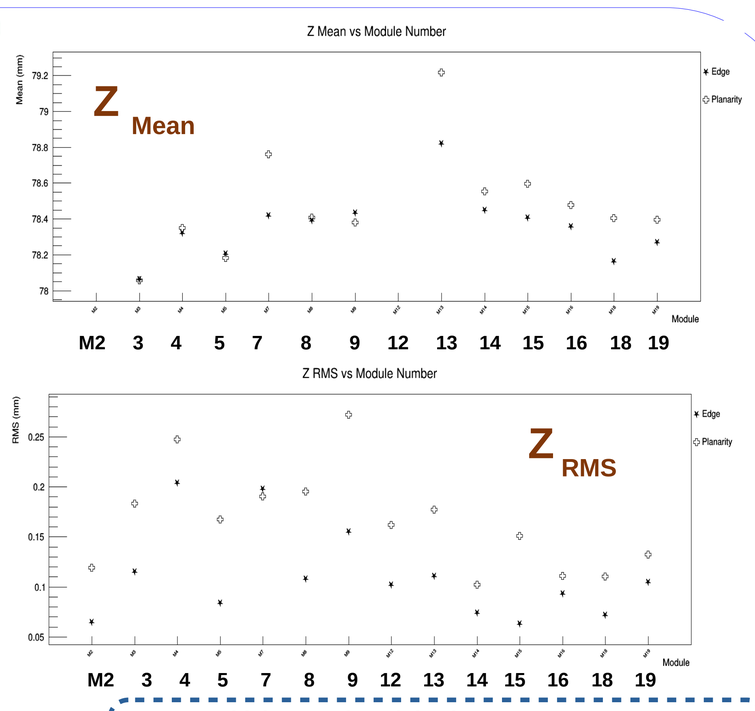




- From top to bottom:
- Z (Mean); Z is thickness
- Z (RMS)

- A0, A1, B0, B1: Different configurations of RO faces (with & without vacuum)



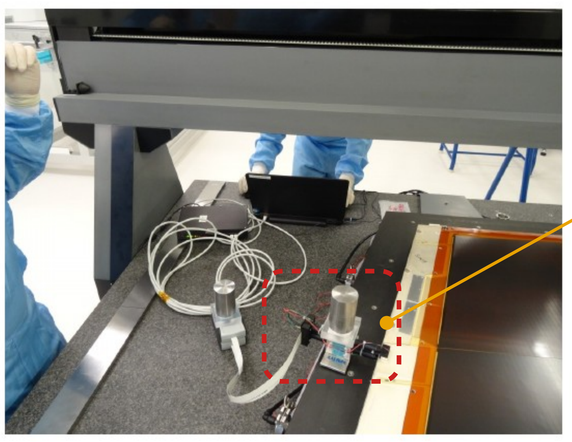


- Average thickness of RO panels is ~ 11.8 mm and drift panels ~ 11.3 mm (observed from top plot).
- Z (RMS) values are measured to confirm that flatness of all the panels are in acceptable range. Except few cases, there are no bumps leading to deviations outside acceptable range.

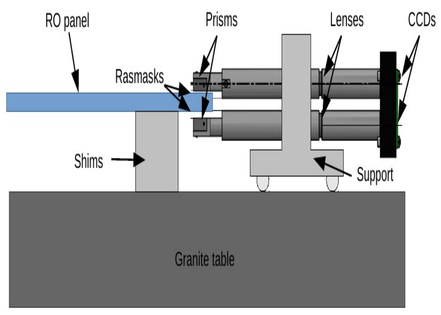
Average thickness of modules is ~ 78-79 mm. Z_{RMS} is caculated as a measure of flatness. Except few cases, there is consistency in the measured values for various modules.

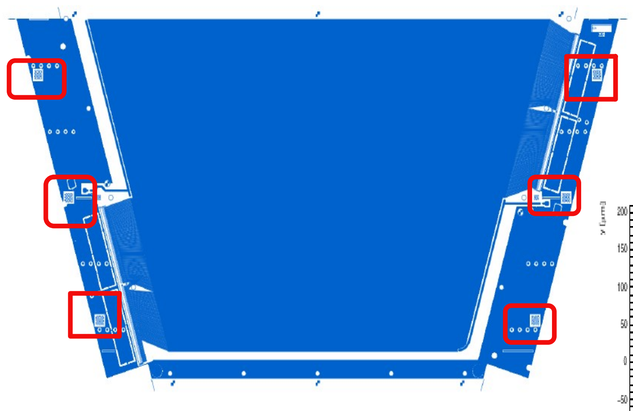
Measuring the PCB positions within a panel and within a module

2 Channels Rasfork measurements for RO panels



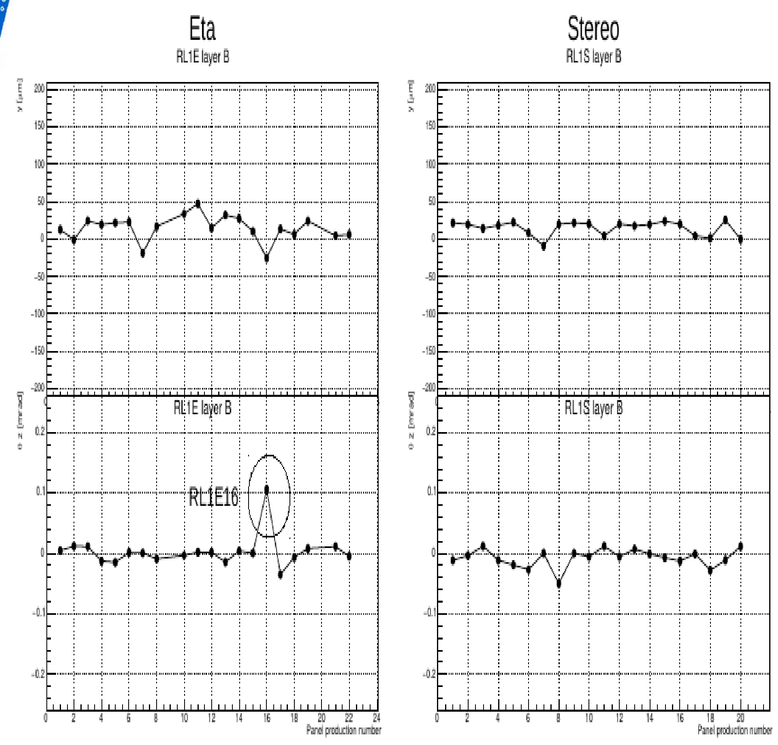
Schematic of Rasfork setup (meas. Precision ~few microns)



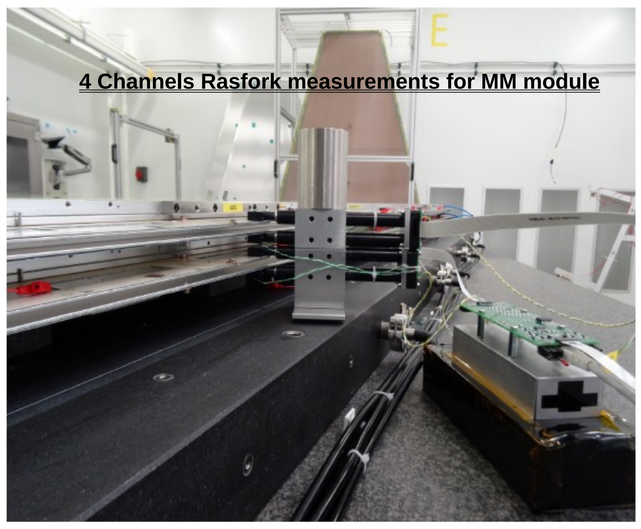


Rasnik Mask: Red circles on both edges

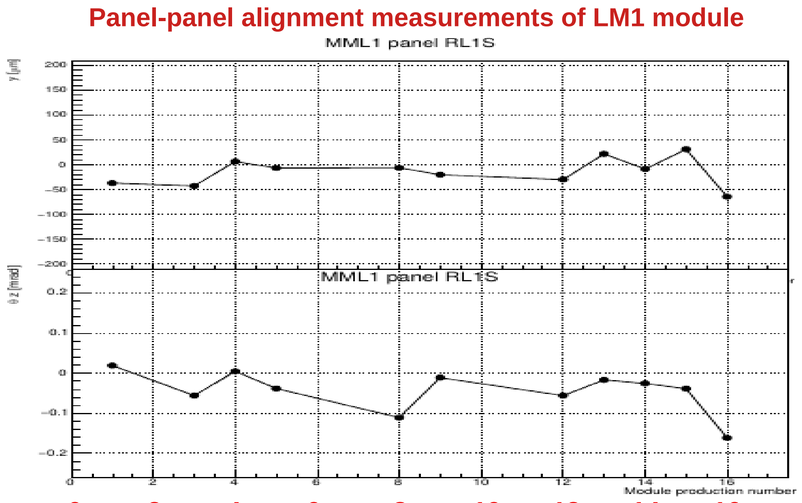
Layer-layer alignment measurements for Eta and Stereo RO panels (extent of misalignment between top and down PCBs)



4 Channels Rasfork measurements for MM module



Panel-panel alignment measurements of LM1 module



- *Two layers of RO panel (in general) have alignment < 30 µm and < 30 µrad.*

- *Two panels of a module (in general) have alignment < 50 µm and < 50 µrad.*

References

1. *M. Beker et al., The rasnik 3-point optical alignment system, Journal of Instrumentation 14 (08) (2019) P08010; https://iopscience.iop.org/article/10.1088/1748-0221/14/08/P08010*

40th International Conference on High Energy Physics 2020 (28 July – 6 August, 2020)