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

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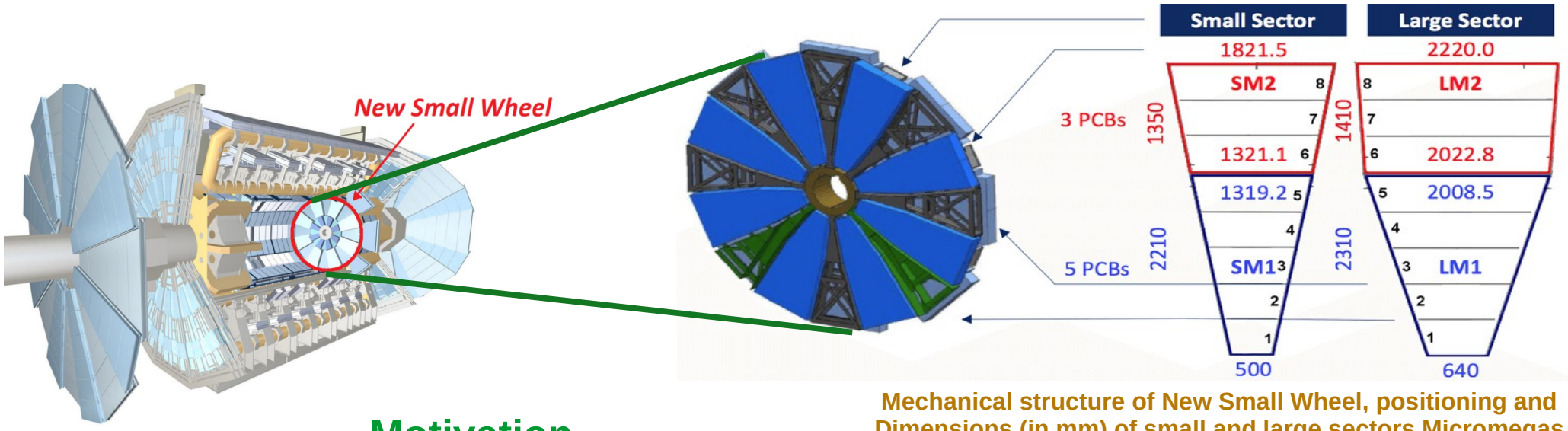
ATLAS New Small Wheel



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

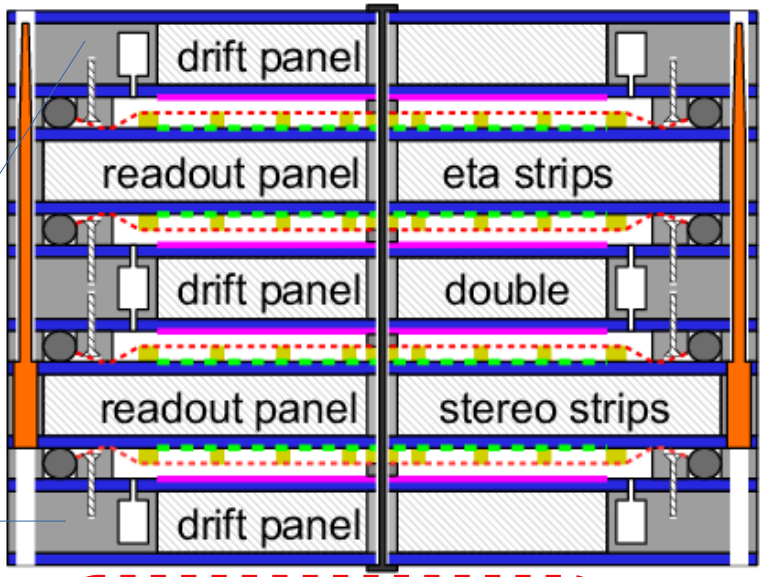
Motivation

- *Reduction of fake Level-1 muon triggers.*
- *Excellent tracking performance in terms of efficiency and resolution.*
- *Cover 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*

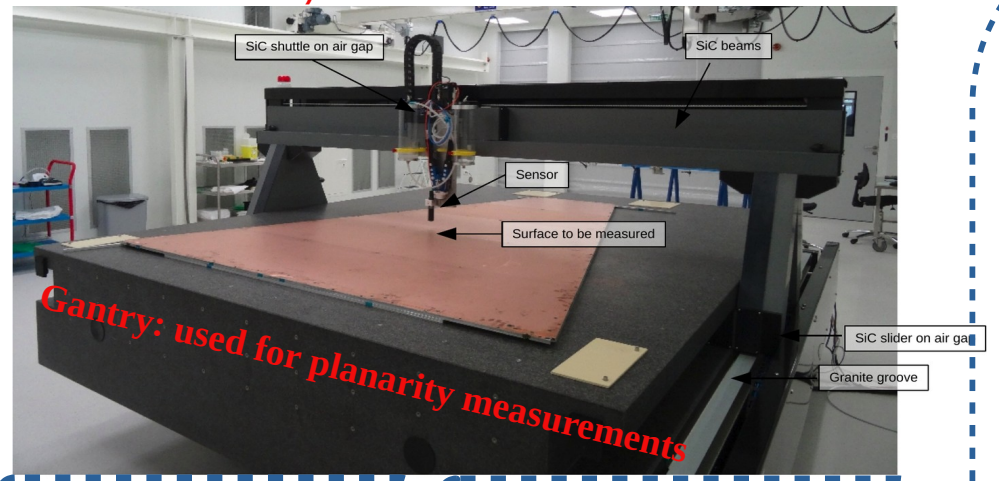
Schematic view of a Micromegas quadruplet



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

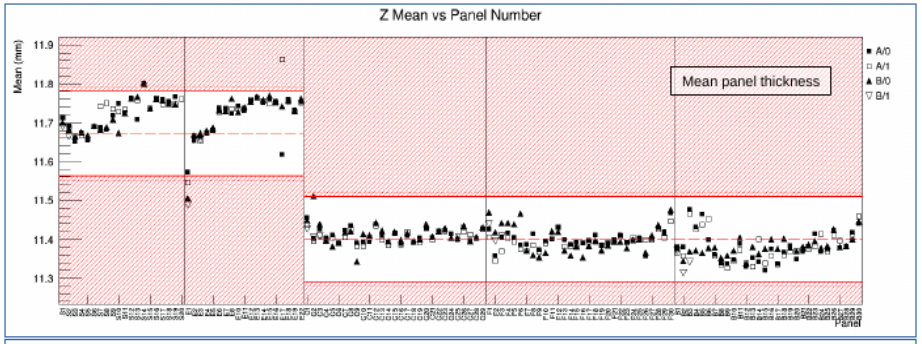
Planarity Measurements (panels and modules)

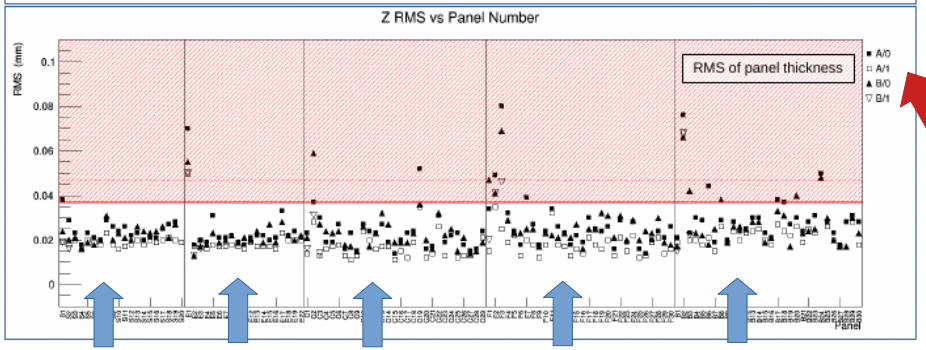
Total precision of gantry + optical tool (multi-wavelength achromatic sensor) ~10 micron



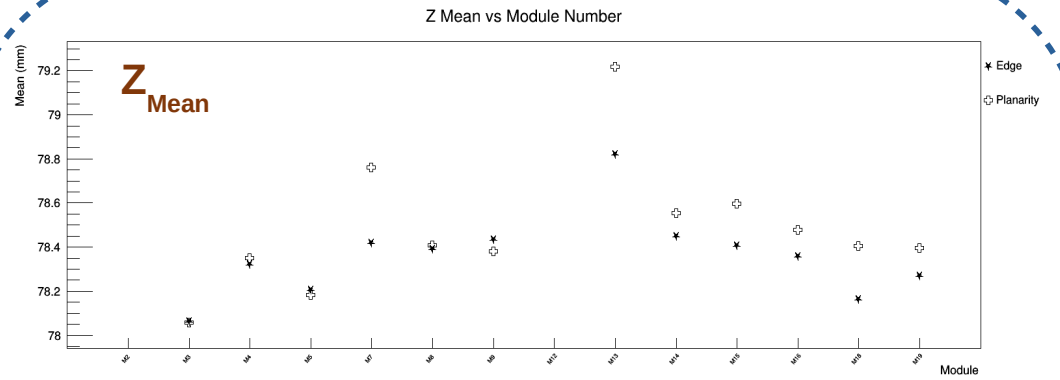
- From top to bottom:
- Z (Mean); Z is thickness
- Z (RMS)

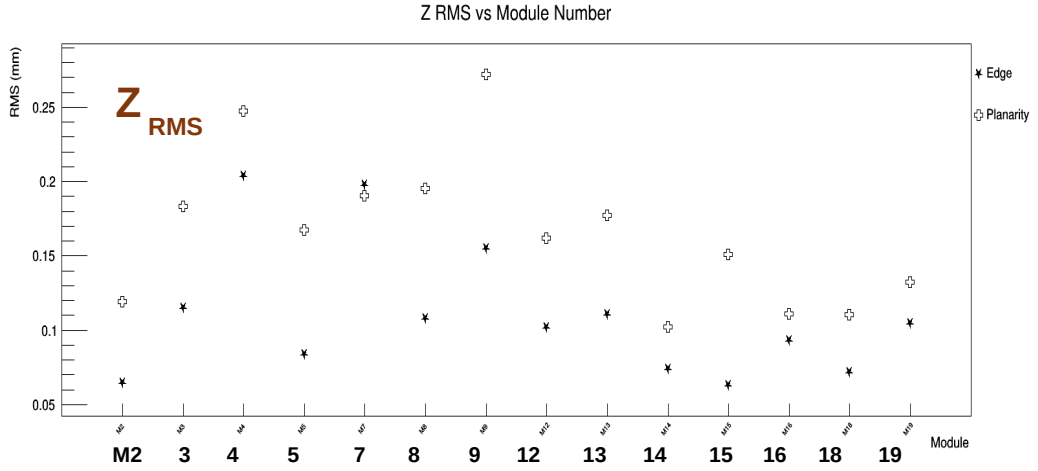
- A0, A1, B0, B1: Different configurations of RO faces (with & without vacuum)





Stereo RO, Eta RO, Central Drift, Front Drift, Back Drift



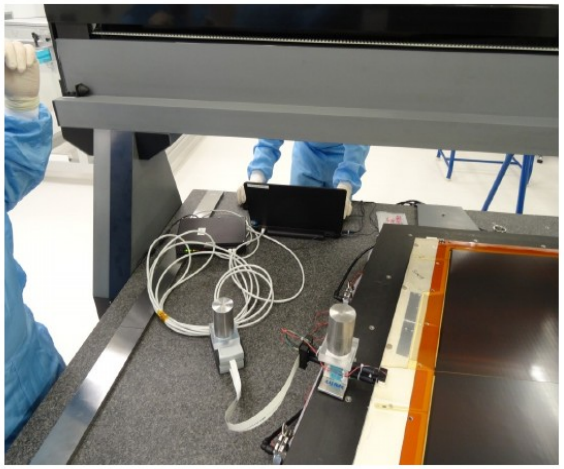


- ✔ **Average thickness of modules is ~ 78-79 mm.**
- ✔ **Z_{RMS} is caculated as a measure of flatness. Except few cases, there is consistency in the measured values for various modules.**

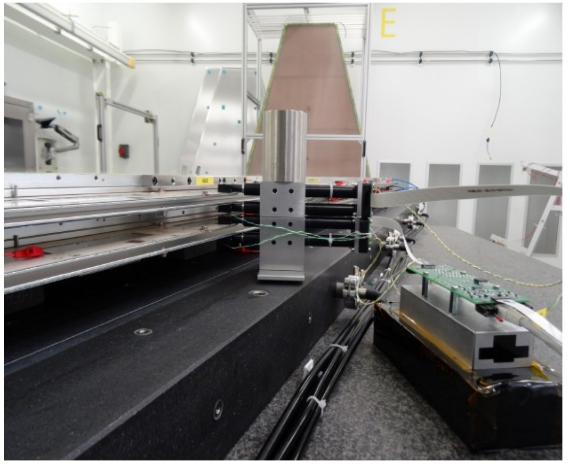
- ✔ **Average thickness of RO panels is ~ 11.8 mm and drift panels ~ 11.3 mm (observed from top plot).**
- ✔ **Z (RMS) values are measured to confirm that flatness of all the panels are in acceptable range. Except few cases, there are no bumps leading to deviations outside acceptable range.**

Measuring the PCB positions within a panel and within a module

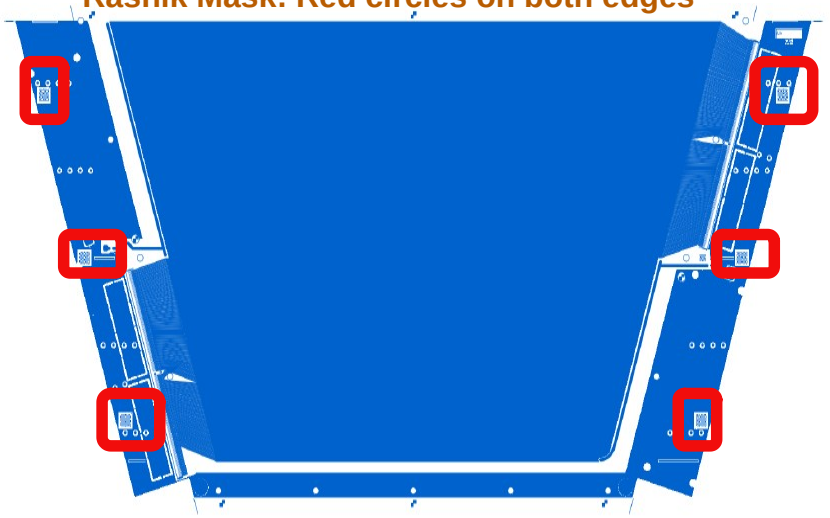
2 Channels Rasfork measurements for RO panels



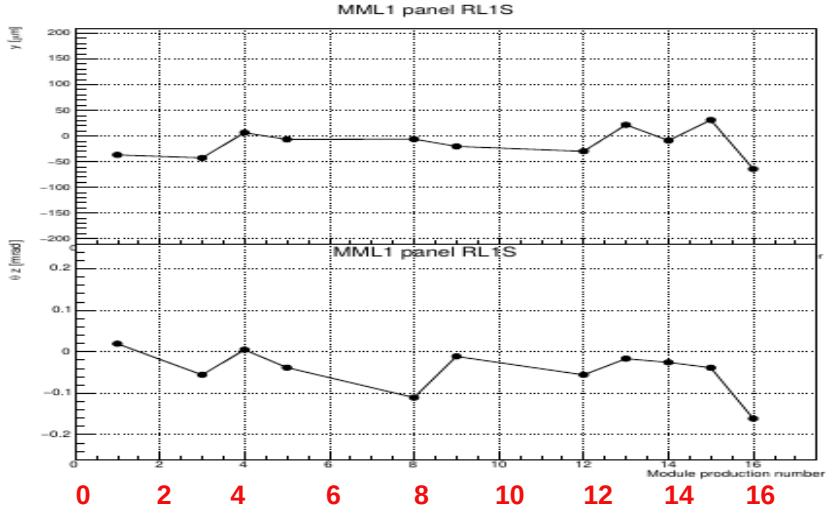
4 Channels Rasfork measurements for MM module



Rasnik Mask: Red circles on both edges

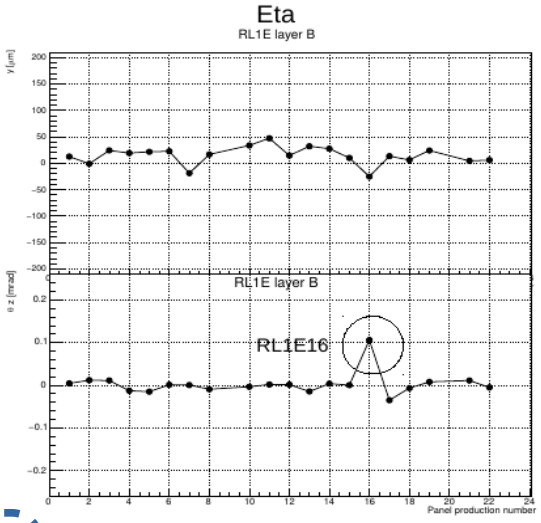


Panel-panel alignment measurements of LM1 module

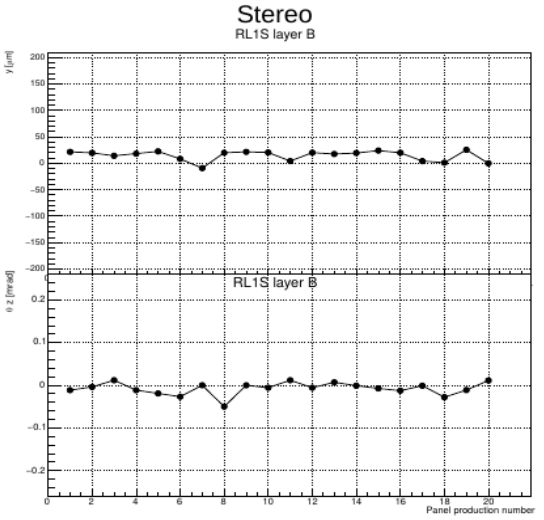


0 2 4 6 8 10 12 14 16

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



0 2 4 6 8 10 12 14 16 18 20 22 24



0 2 4 6 8 10 12 14 16 18 20

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

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