Production and test of Micromegas boards for the ATLAS New Small Wheel project

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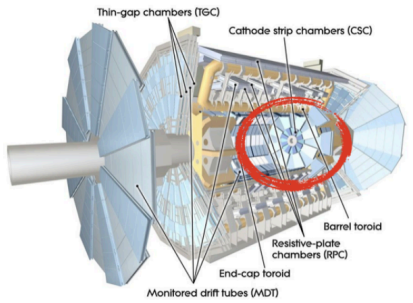
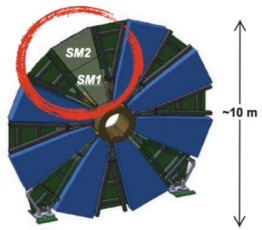
Micromegas for the ATLAS New Small Wheel

New Small Wheel (NSW) project: ATLAS Small Wheel upgrade with Micromegas (MM) and small-strip Thin Gap Chamber (sTGC) technologies

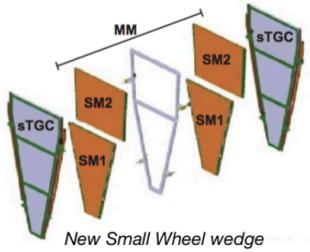
MM detectors cover 1280 m^2 being the largest system based on Micro Pattern Gaseous Detector (MPGD)



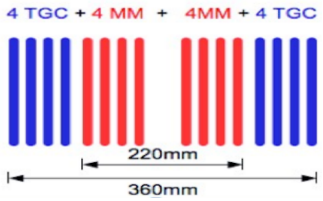
ATLAS experiment

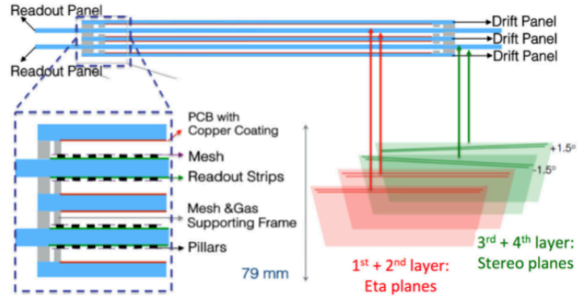


New Small Wheel



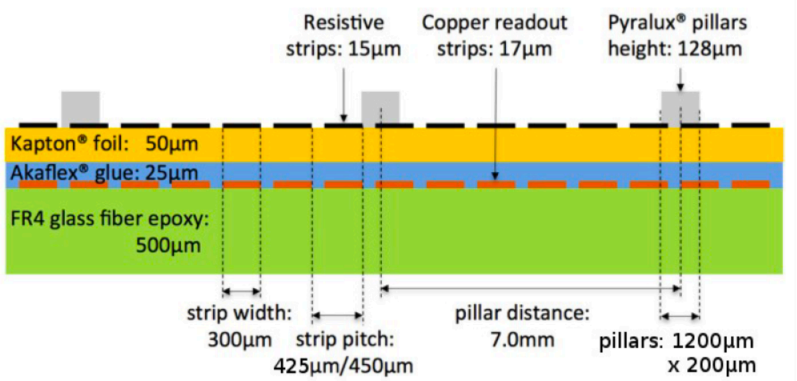
New Small Wheel wedge



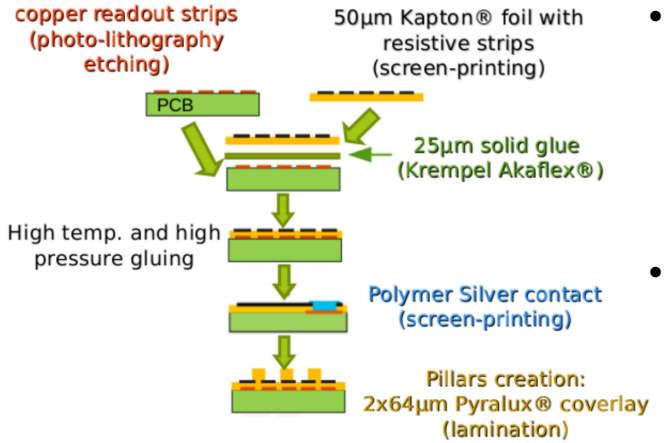


Structure of a quadruplet

Micromegas readout (RO) anode boards



Micromegas anode boards production

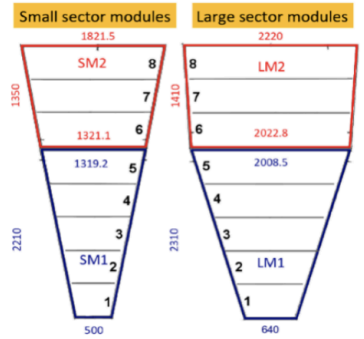


- Resistive protection layer produced in Japan (Matsuda-Screen Inc.). Quality control at Kobe university.
- Readout boards are manufactured in PCB industry:
  - ELTOS (IT),
  - ELVIA (FR).

Technology transfer & quality control

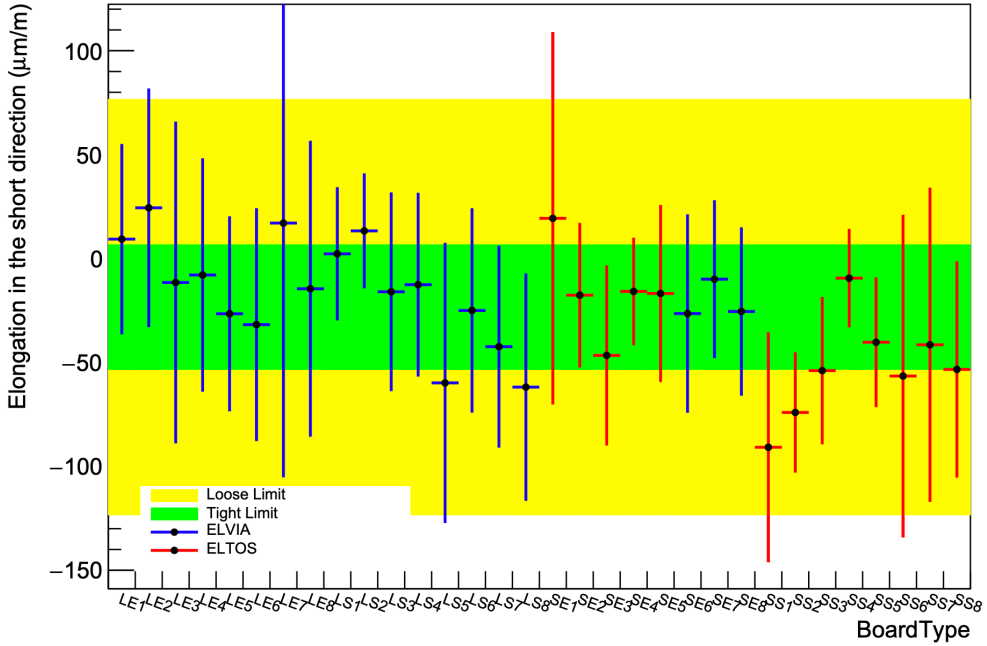
PCB industry is limited to 600 mm wide PCBs → PCB size kept in one dimension below 600 mm with no constraint on the other one:

- 32 types of PCB to fit the large (L) and small (S) modules dimensions and to produce eta (E) and stereo (S) layers (i.e. SE1: Small sector, Eta layer, PCB 1);
- total production of about 3000 boards;
- the boards undergo Quality Assurance and Quality Control (QA/QC) tests at CERN
  - visual inspection, electrical tests;
  - allignment and rotation between resistive pattern and copper strips;
  - cutting and milling accuracy.



Board dimension foundamental for precise tracking. FR4 material is subject to expansion for moisture uptake:

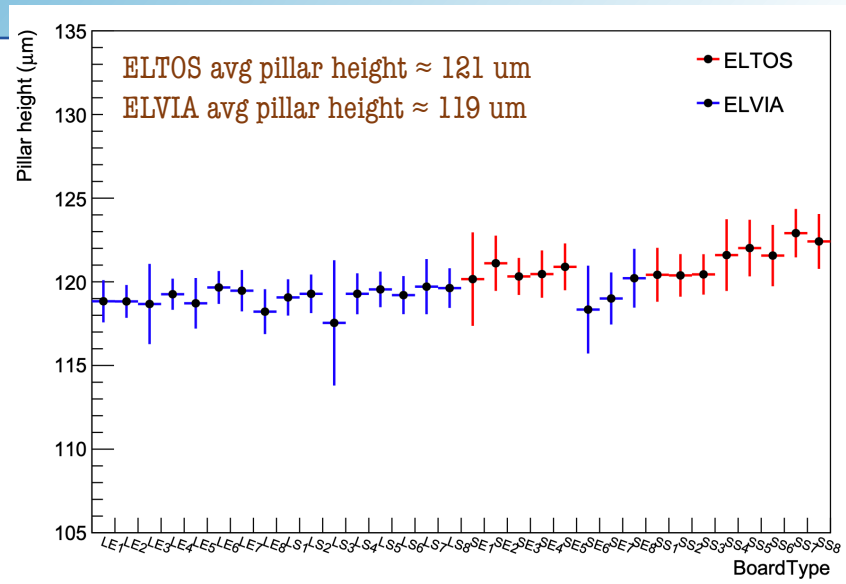
- expansion of about 400um/m;
- rescaling the dimensions for the board production;
- waiting a 4 weeks period at the companies to let the boards expand before final cutting/drilling;
- dimensions measurement performed at CERN to track the possible elongation with respect to the nominal dimensions.

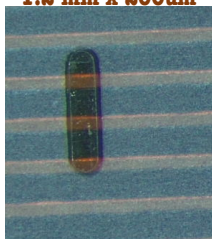


Technology transfer & quality control

Lack of pillars and/or differences in their height create inhomogeneity in the electric field and consequently difference in the detector performance:

- dedicated surface treatments for having a rougher surface which ensures good pillar adhesion;
- replacement of the missing pillars;
- 2D pillars height map to evaluate a possible shift in the pillar height (tolerance of 5um).





The resistance of the boards plays a crucial role for the high-voltage stability of the detector:

- resistance/sq (resistivity) can change during the boards production because of the pressing applied during the gluing step, the surface treatments or problems in foils production;
- temperature and pressure during the gluing step are tuned to have a final resistivity within the specifications (ex. average resistivity between 0.28 and 2.6 MΩ/sq);
- resistivity before and after the gluing procedure is measured on all the foils and boards respectively.