The ATLAS New Small Wheel new Muon Stations Ready for LHC Run3

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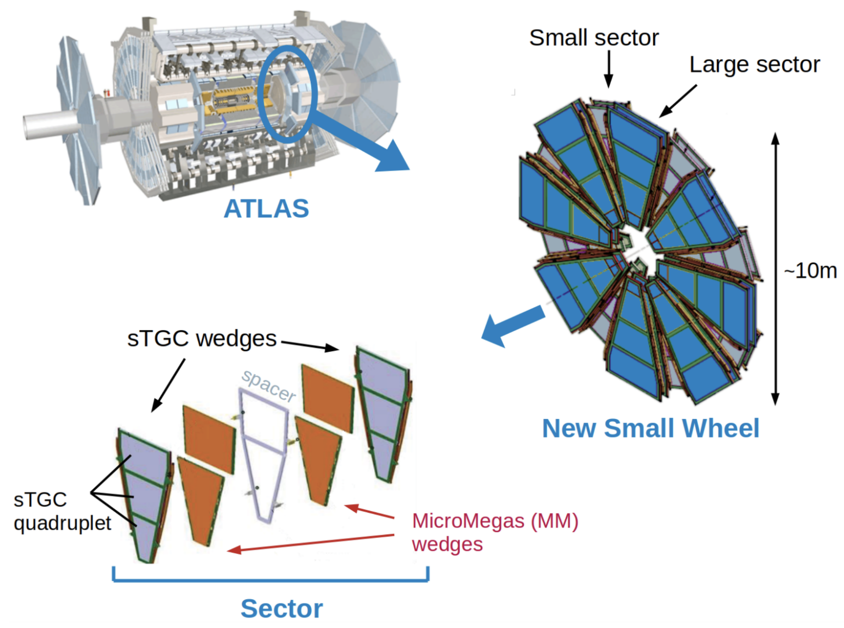
Introduction

The Luminosity of the LHC in the High Luminosity LHC era is expected to increase by a factor 5-7 with respect to the original design. In order to cope with the increase of background rates, still maintaining the high efficiency for tracking and trigger, the actual Small Wheel at the end-caps must be replaced with two New Small Wheel (NSW side-A and side-C). The following requirement must to be satisfied:

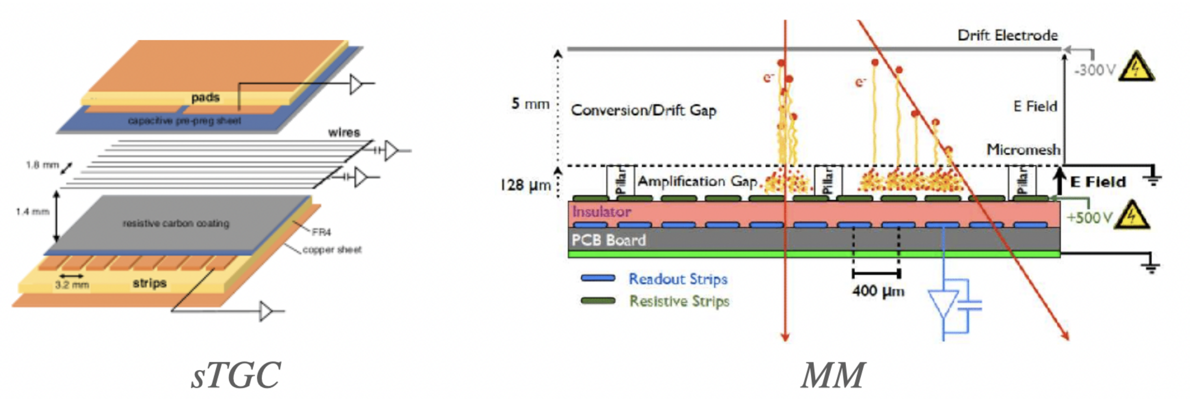
- Up to 1 mrad angular resolution for the trigger.
- 50 μm super-point position resolution ($\approx 100 - 150$ μm per layer).
- Alignment of readout elements better than 30 μm.



sTGC and MM operational description

Two different detector technologies are used for the NSW:

- Small Strips Thin Gap (sTGC): Two cathode boards with a gas gap that contain Gold-Tungsten wires between the cathodes boards filled with CO_2+n-Penthane.
- Micromegas (MM): It consists of a planar electrode structure with a thin metal micromesh electrically dividing the gas volume in two parts: a conversion/drift gap (5 mm) and a very thin amplification gap 120 μm thick. The gas finally selected is a ternary mixture (non-flamable) of Ar/CO2/Isobutane (93/5/2).

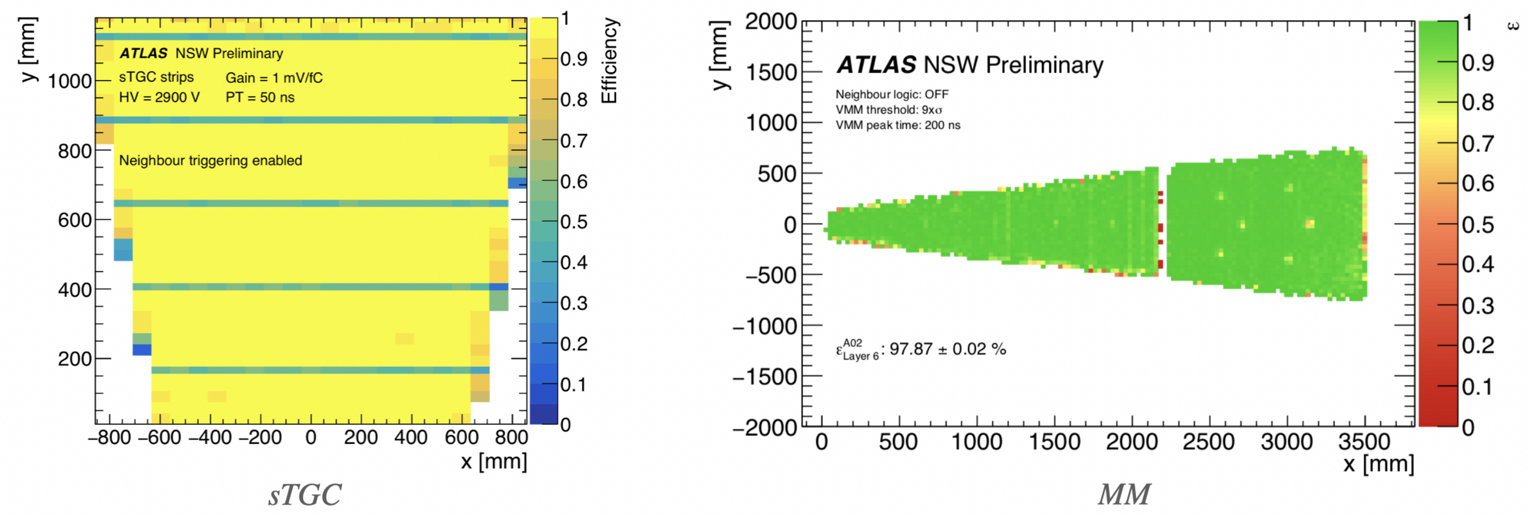


sTGC *MM*

Construction and Cosmic rays test

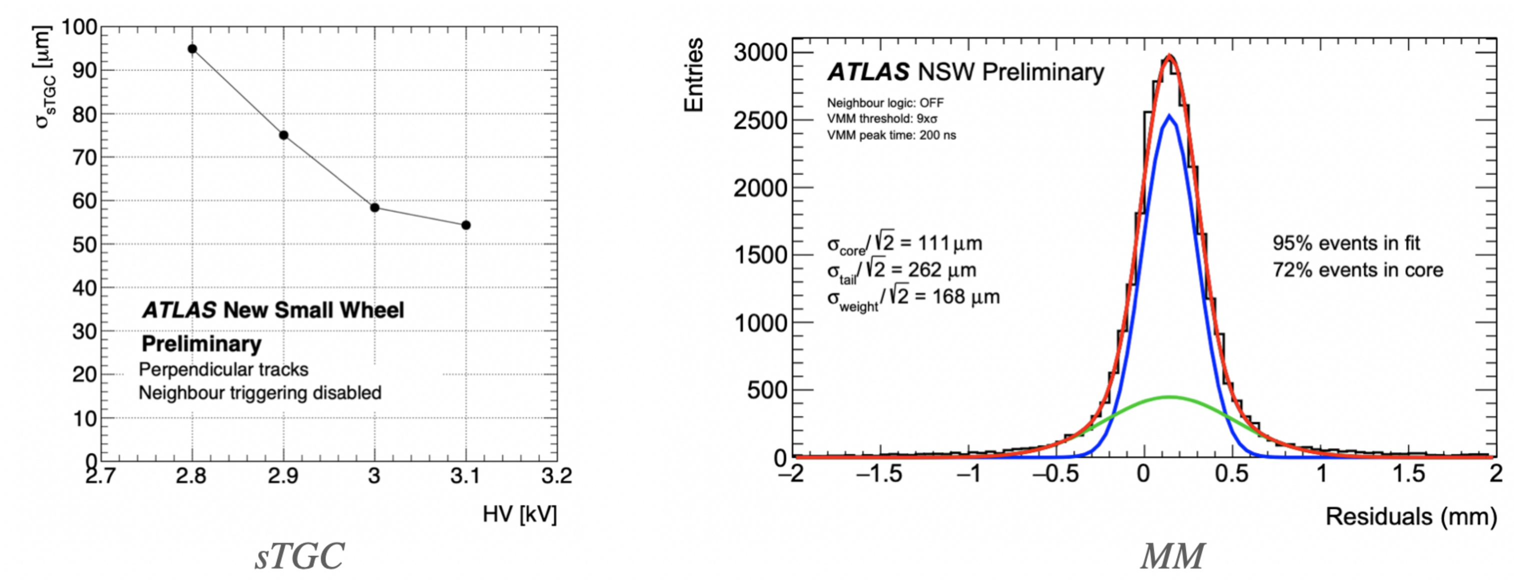
Countries involved in the construction of sTGC and MM: France, Germany, Italy, Canada, Chile, China, Greece, Israel, Russia.

During the integration phase of MM and sTGC separately, cosmic ray tests were performed on the detectors in order to control their performance and efficiency. The final step was the integration of sTGC and MM to form a sector. Later assembled on the wheel.



sTGC *MM*

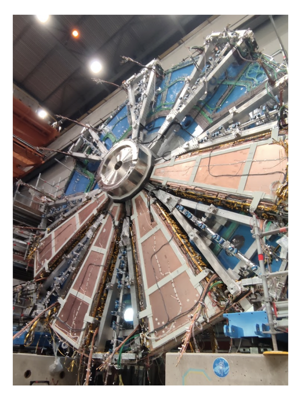
Efficiencies (from cosmic rays) and resolution (from beam tests) measurements was performed on MM and sTGC, satisfying the requirements before its installation on the NSW.



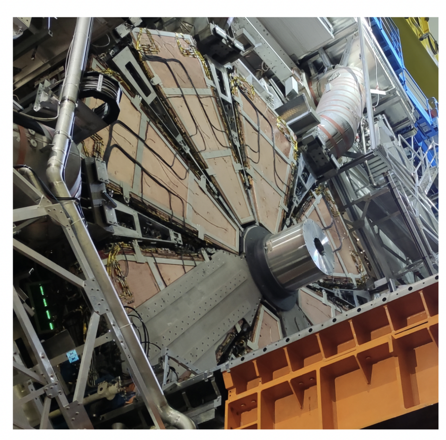
sTGC *MM*

Commissioning, Installation and First results.

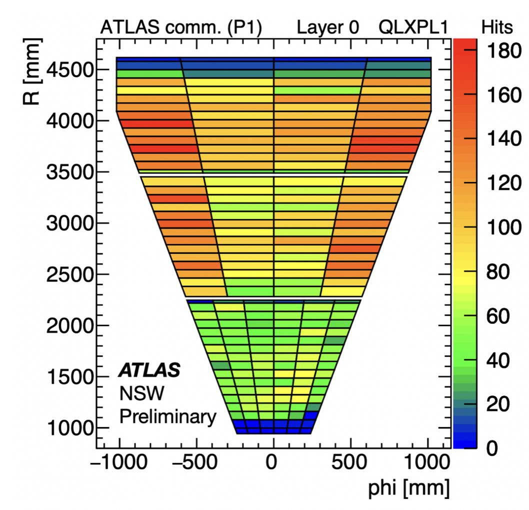
After a sector is installed on the NSW, several tests take place: readout, sensors, cooling, voltage, trigger, etc.



During 2021 NSW-A and NSW-C were successfully installed at the ATLAS experiment.



NSW-C in ATLAS



Muon candidates on sTGC during splashes

In October 2021 NSW received first splashes of particles when proton beams were circulated in the LHC ring and made to hit the closed collimators in front of the experiments (beam splash).

Conclusions

In the course of the project there were many challenges such as fabrication issues, noise, HV stability, etc. Both NSW are now installed in
ATLAS and in the final route for Run 3 data taking period.