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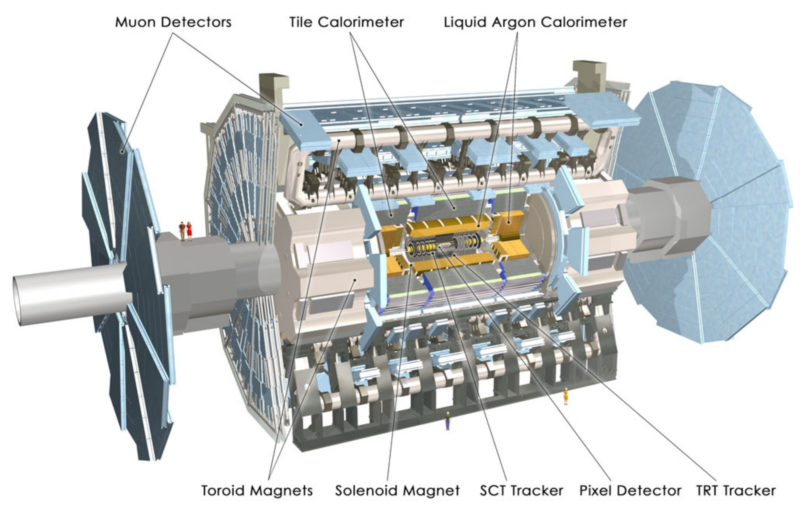
ATLAS NSW sTGC Quadruplet Test Beam Characterization

CERN GIF++ October 20th - November 2nd 2021

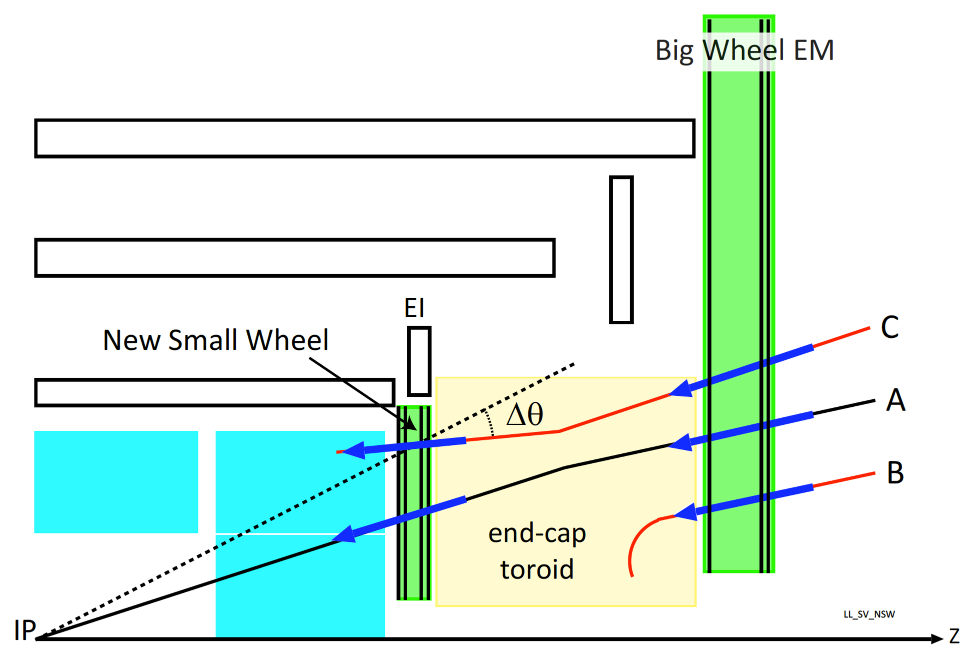
Leesa Brown for the ATLAS Muon Test Beam

New Small Wheel



ATLAS

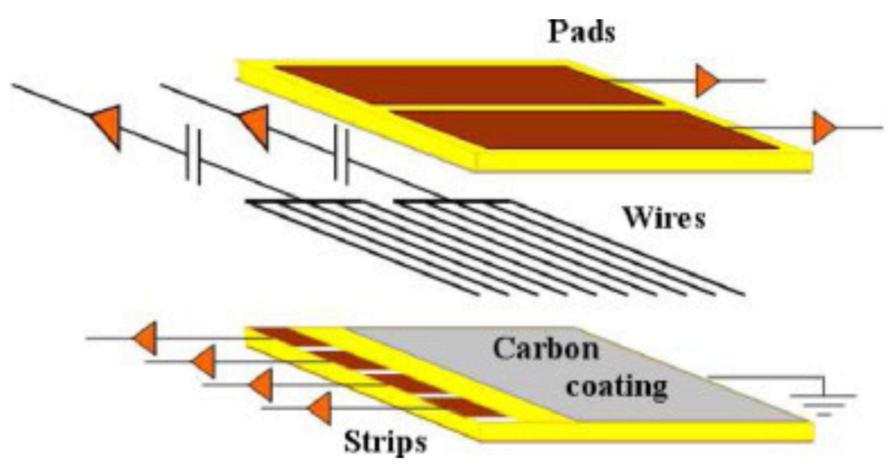
L1 muon trigger rate high in forward region.
Fake muons signals from charged particles due to endcap material activation are ~ 90% of current muon triggers.
Fake muon rate increases with luminosity
After LS2 LHC's instantaneous luminosity will be 2-3 x 10^{34} cm^{-2} s^{-1}.
New Small Wheel (NSW) will reduce fake muon trigger rate and reconstruct muon tracks with high precision.
NSW has 16 sectors, 8 small, 8 large overlapping to fully cover φ. Each sector contains two technologies: small-strip Thin Gap chambers (sTGC) and Micromegas detectors (MM)



NSW will veto fake muon candidates. Only track A is a real muon candidate originating from the interaction point.

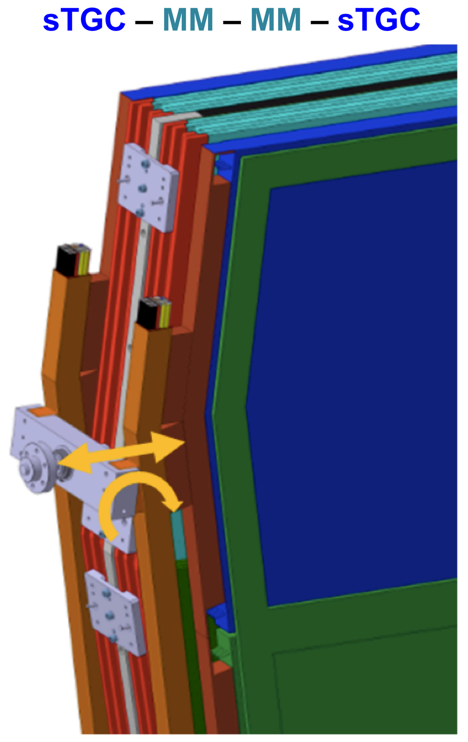
Small-strip Thin Gap Chambers

The small-strip Thin Gap Chambers are the successor to the TGC technology used in the ATLAS muon detectors.
The sTGCs are composed of thin wires centred between two cathodes planes.
One plane is composed of strips with a 3.2 mm strip pitch and the other has larger pads.

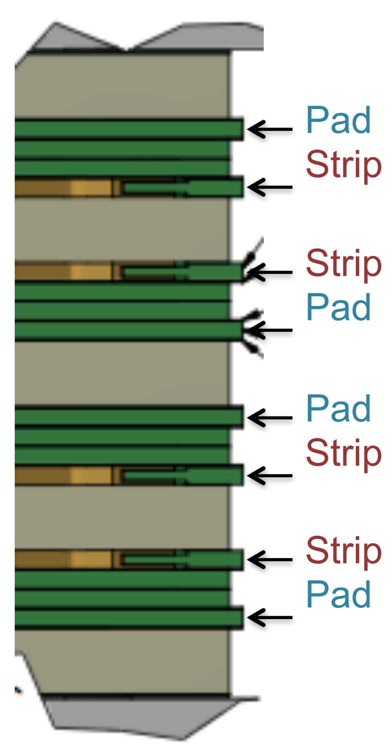


sTGC 50 μm gold-plated tungsten wires, between cathode planes coated with a resistive graphite-epoxy mixture.

Pads are used for triggering with 6 out of 8 pad coincidence required for a NSW level 1 trigger.



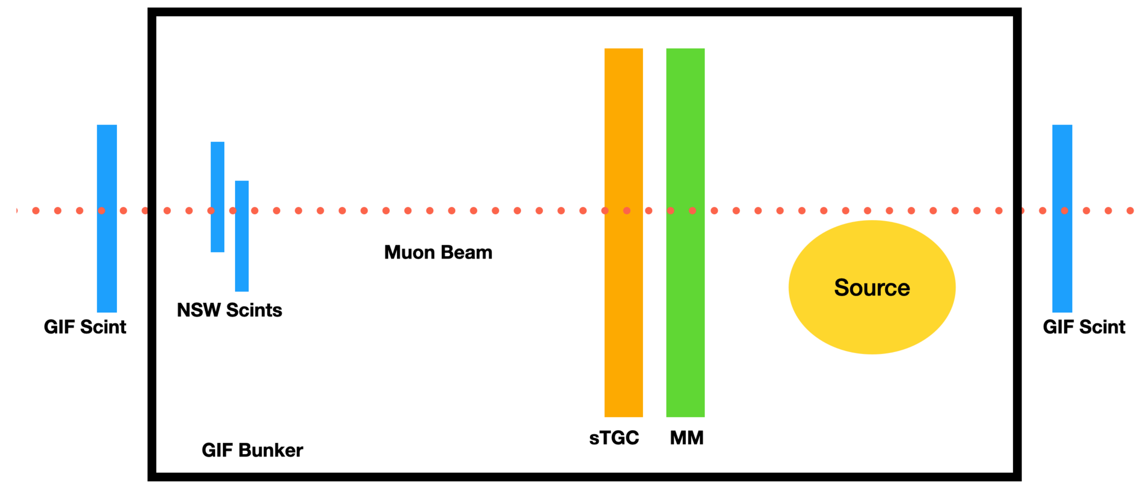
Layering of sTGC and MM quadruplets within a NSW sector



sTGC quadruplet cross-section. Each module is built with 4 gas gaps.

GIF++ Test beam

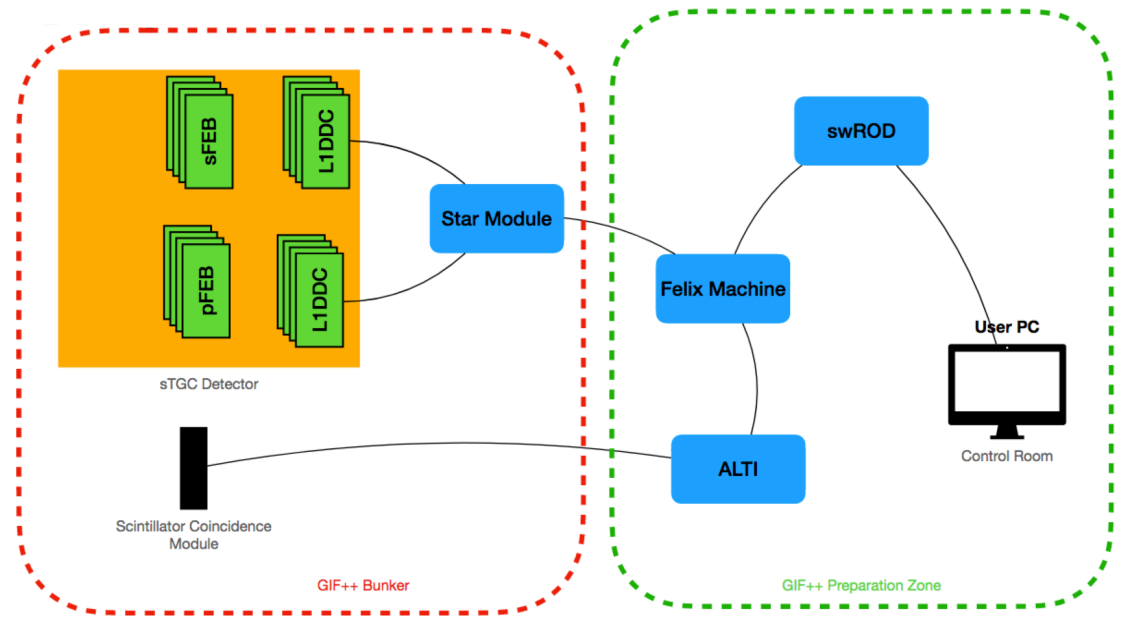
CERN Gamma Irradiation Facility: H4 beam line with 10 cm radius muon (or pion) beam of momentum up to 100 GeV/c and about 14k muons per spill and a 14 TBq^{137} Cesium gamma source (unattenuated rate on sTGC quadruplet 13 kHz/cm²).
Gamma source background adjusted by various filter/attenuation settings.



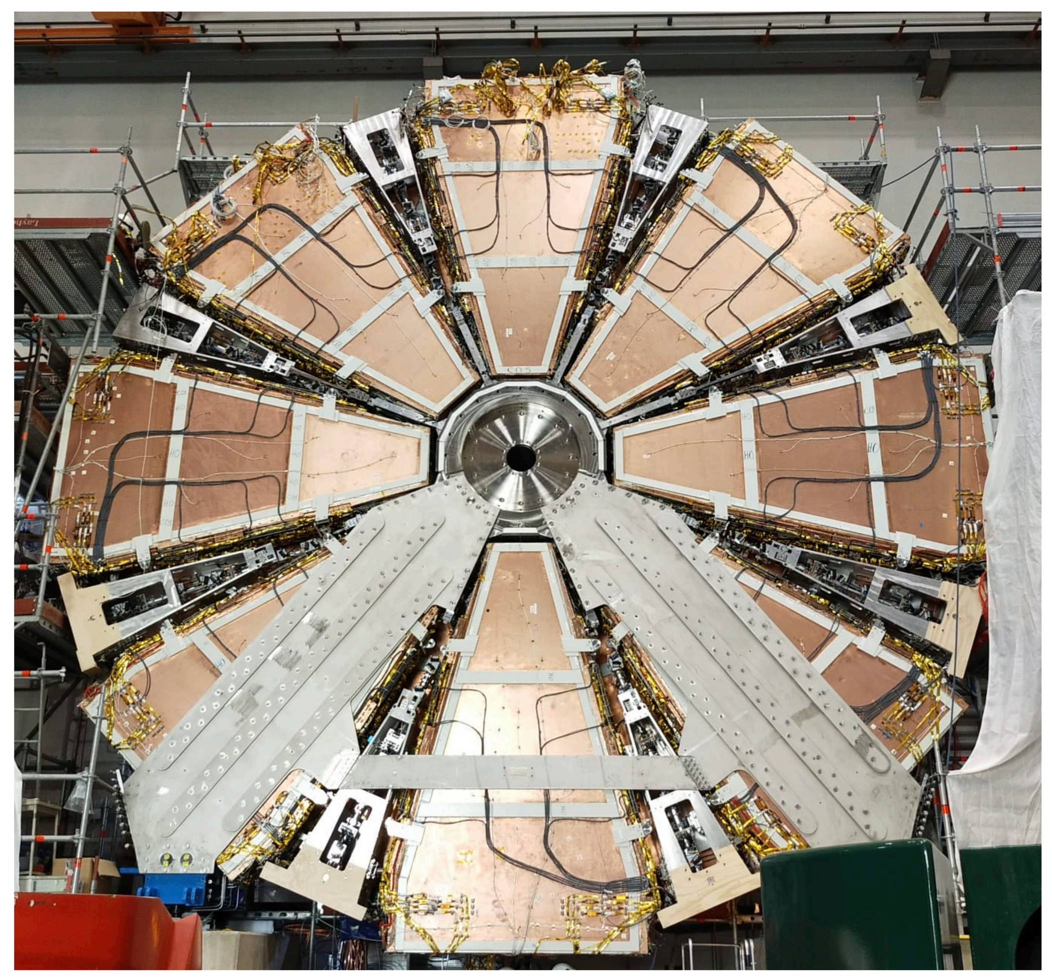
NSW test beam setup (not to scale): sTGC and MM modules, two scintillator pairs.

Data Collection

Triggers were scintillator coincidences.
Scintillator coincidence size: 20cmx20cm or 1cmx5cm.
sTGC filled with CO_2 n-pentane mixture.
Gamma source attenuation was changed on an hourly basis, allowing for sTGC testing with various photon backgrounds.
Different readout parameters were tested to inform final NSW decisions on timing and thresholds.
Support frame was tilted to a maximum of 20° to measure track resolution as a function of incidence angle.



sTGC readout setup: Electronic signals from detector are converted to optical signals and transmitted to PCs outside the GIF++ Bunker.



NSW C at the end of surface commissioning, September 2021.

MM and sTGC modules in GIF bunker. The support frame can tilted to change beam incidence

sTGC Collaboration

Israel (Weizmann Institute, Tel Aviv University, Technion); Canada (Carleton University, McGill University, Simon Fraser University, TRIUMF, University of Victoria); Chile (Universidad Técnica Federico Santa María, Pontifica Universidad Catolica de Chile); China (Shandong University); Russia (PNPI)

University of Victoria
ATLAS EXPERIMENT