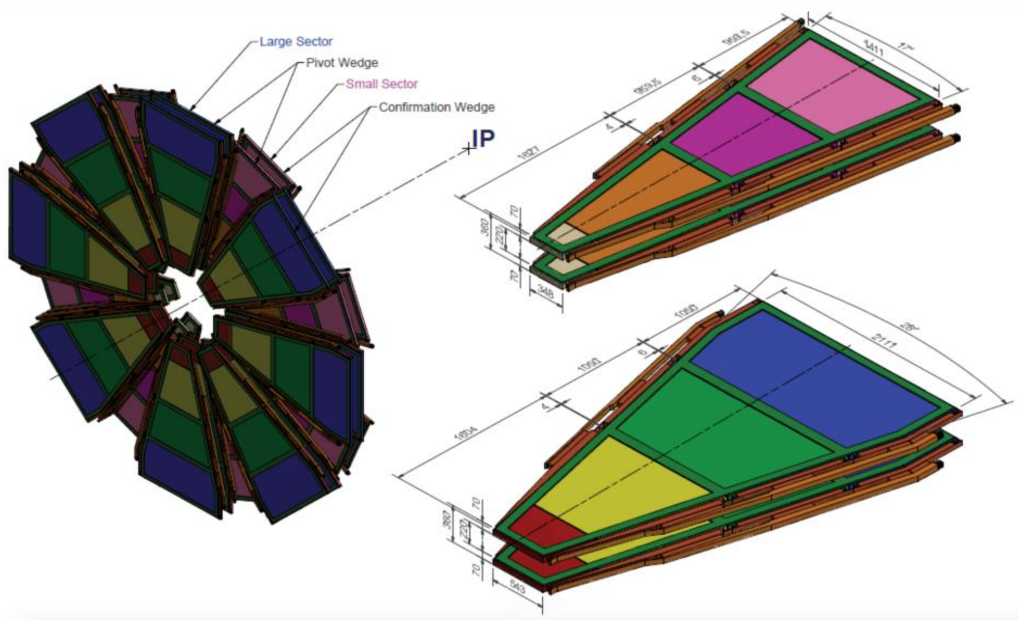
STGC ASSEMBLING AND TESTING IN CHILE FOR THE ATLAS MUON SPECTROMETER

LHCC 2019, CERN, Switzerland, 27th February 2019

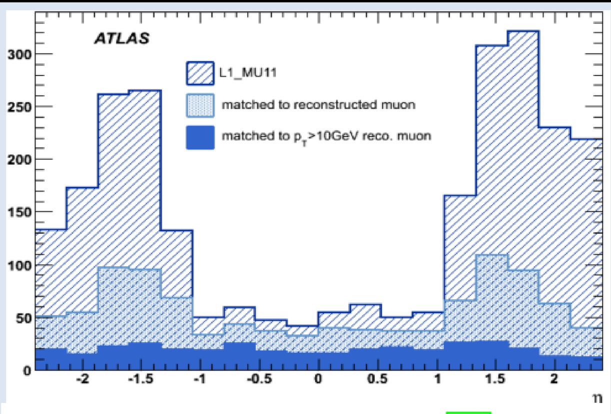
Introduction

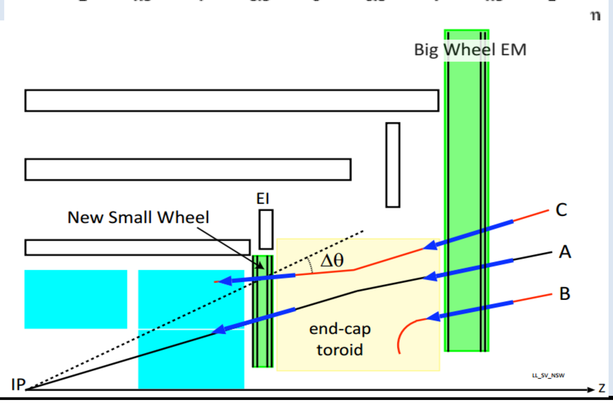
The forthcoming luminosity upgrade of LHC will increase the expected background rate in the forward region of the ATLAS Muon Spectrometer. The New Small Wheel (NSW) will be installed during the LHC long shutdown in 2019/2020. A small-strip Thin Gap Chamber (sTGC) was developed to provide fast trigger and high precision muon tracking under high luminosity LHC condition. Construction of sTGC modules is performed by five countries: Canada, Chile, China, Israel, and Russia. Construction of sTGC wedges is performed at CERN in a collaborative effort.



Why do we need a NSW?

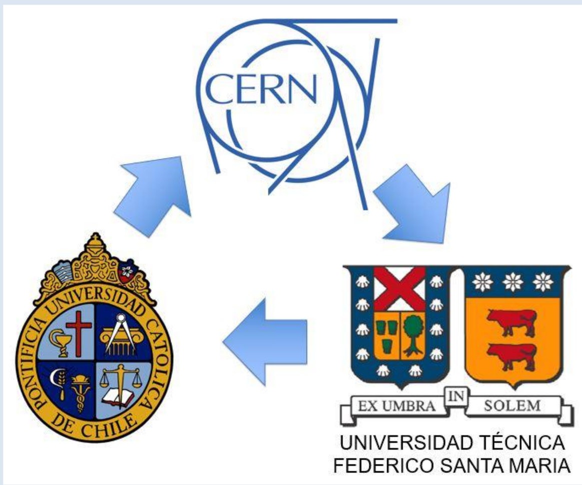
- Precise position measurement in front of the end-cap magnet is crucial for the momentum determination of the muon.
- Low energy particles produce fake segments by hitting the end-cap trigger chambers at an angle similar to that of real high pT muons. An analysis of 2012 data demonstrates that approximately 90% of the muon triggers in the end-caps are fake. Thus on-line reconstruction of muons is necessary to keep trigger rate at acceptable levels.





CERN/UTFSM/PUC Working Plan

Chilean team has committed to assembly 36 sTGC quadruplet detectors. Most of the relevant parts are ordered trough CERN, and from CERN shipped to UTFSM and some others parts are machined at CCTVal/UTFSM Machine shop. sTGC quadruplet are assembled at UTFSM, tested and then send to PUC to solder adapter boards and make validation using cosmic muons. After validation detectors are sent in bunches to CERN by air.



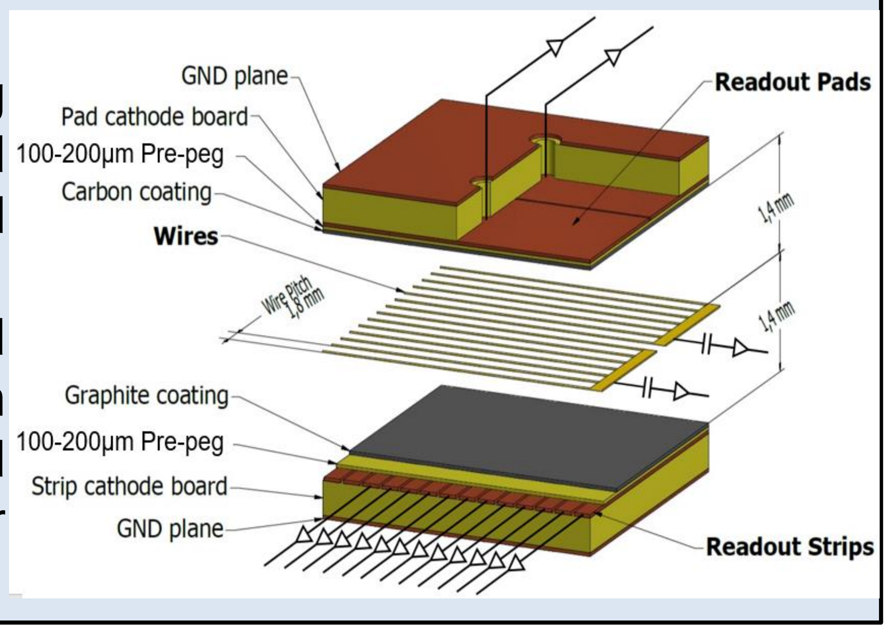
sTGC technology

The concept of Thin Gap Chambers (TGC) was developed in 1983 and then used at the OPAL experiment and for the ATLAS end-cap muon trigger system. The basic sTGC consists of an array of 50um diameter gold plated tungsten wires held at a potential of 2.9 kV, with a 1.8 mm pitch, sandwiched between two cathode planes located at a distance of 1.4 mm from the wire plane. The cathode planes are made of a graphite epoxy mixture with a typical surface resistivity of 100/200 kohm/sq sprayed on a 100/200um thick G-10 plane.

The precision cathode plane has strips with 3.2mm pitch for precision readout relative to a precision brass insert outside the chamber, and the cathode plane on the other side has pads which determine, using a 3 out of 4 coincidence logic, the timing of the collision and group of strips to be used for trigger.

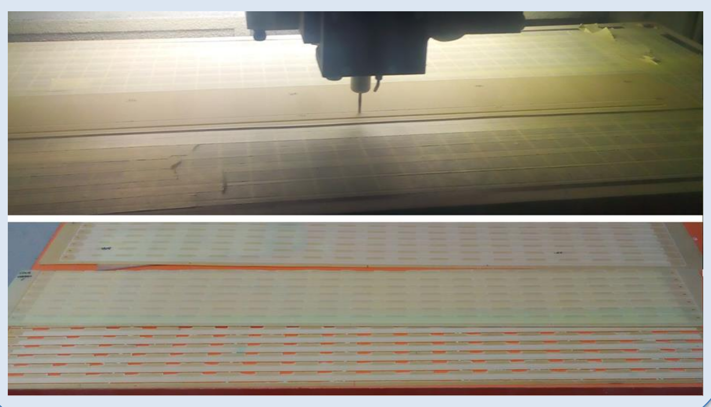
The gap is provided using precision frames machined and sanded to 1.4mm ±20μm and glued to the cathode boards.

The Muon trigger is performed with 1mrad angular resolution measurement in the NSW and in coincidence with the outer detectors (Big Wheel)

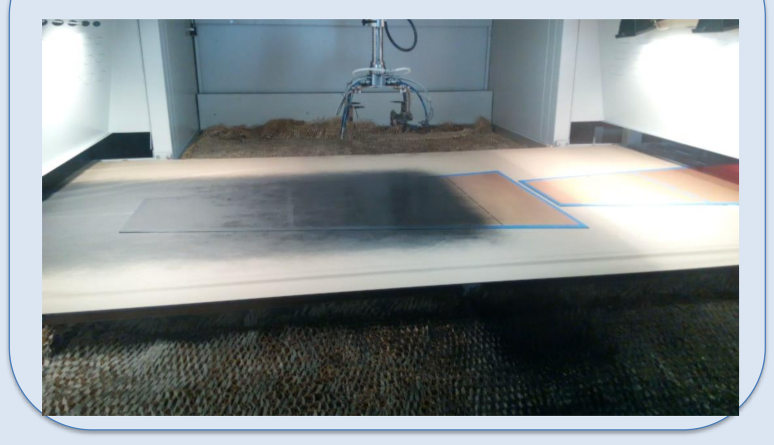


at UTFSM

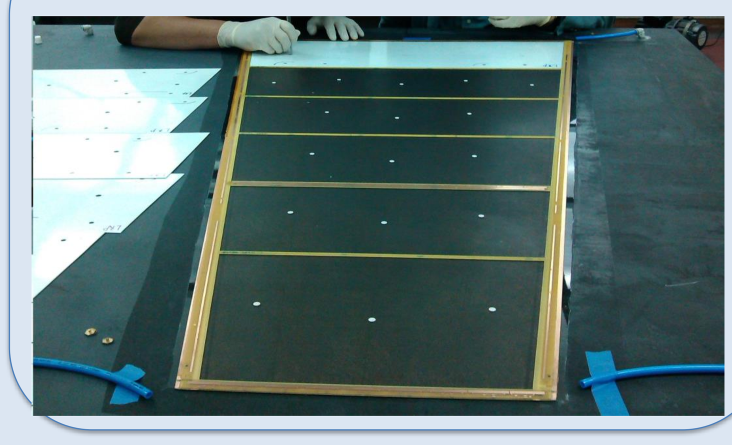
Parts machining



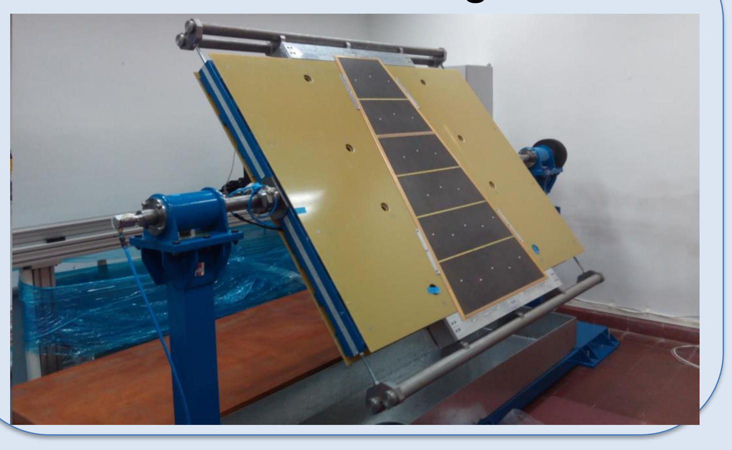
Graphite spraying



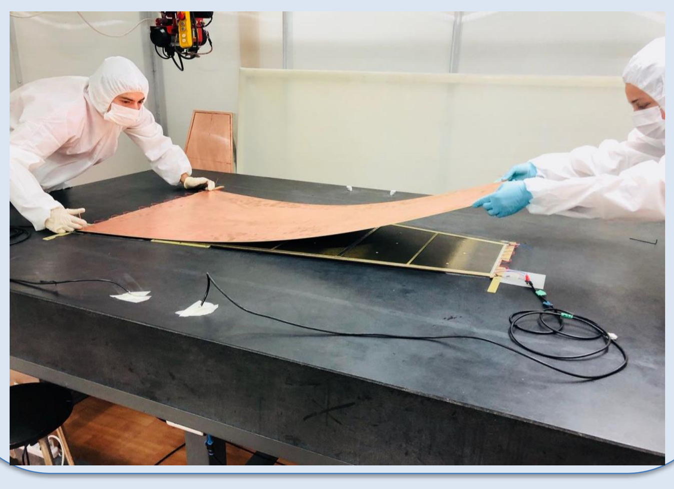
Frame gluing



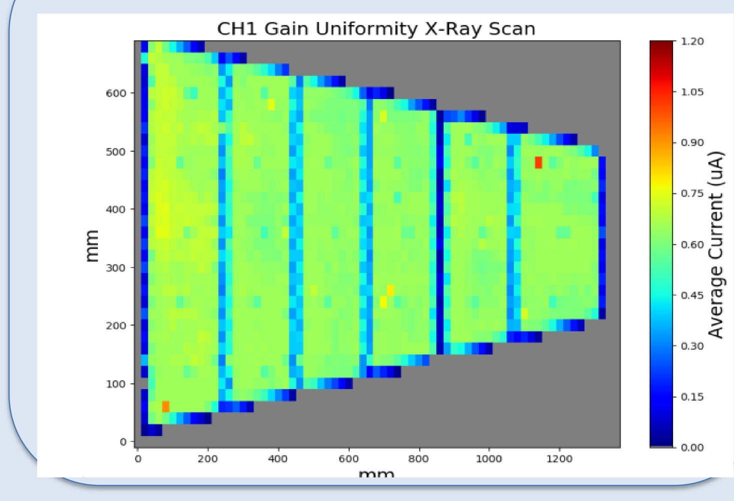
Wire winding



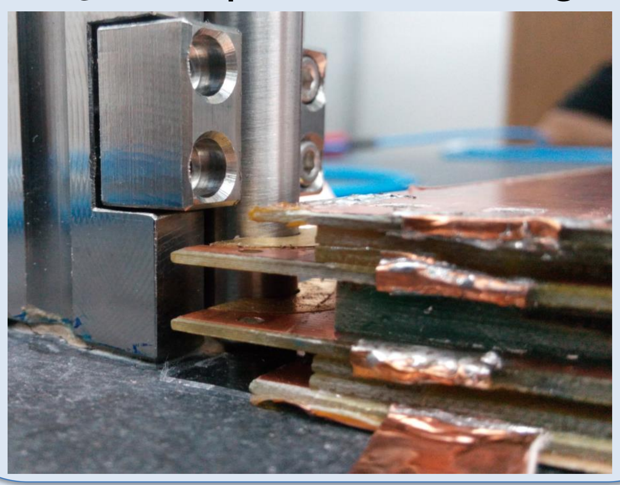
Single chamber construction



Single chamber x-ray



Quadruplet assembling



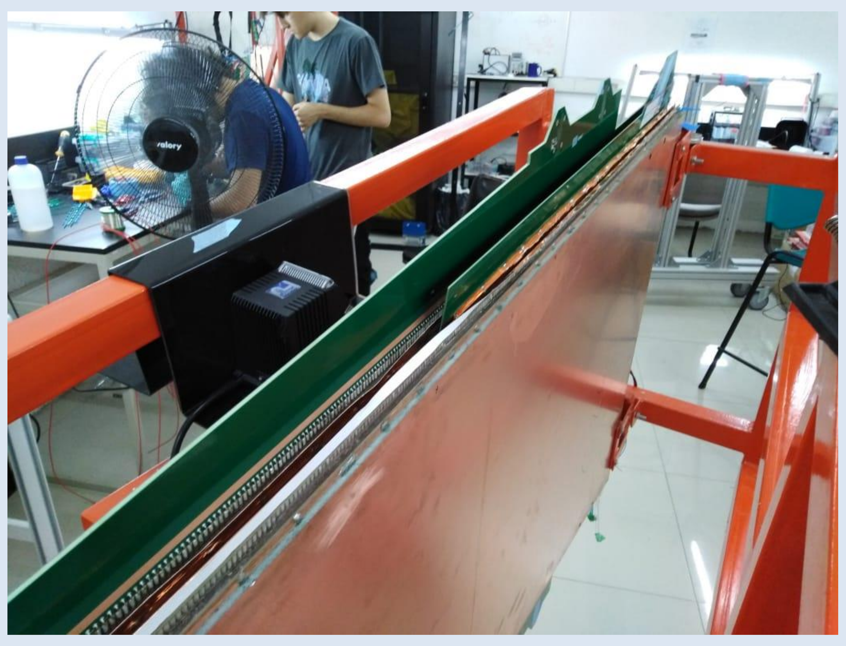
Chilean current status

So far 2 fully equipped production modules have been sent to CERN for wedge assembly.

Production of detectors is ramping up to 2 quadruplets per month.

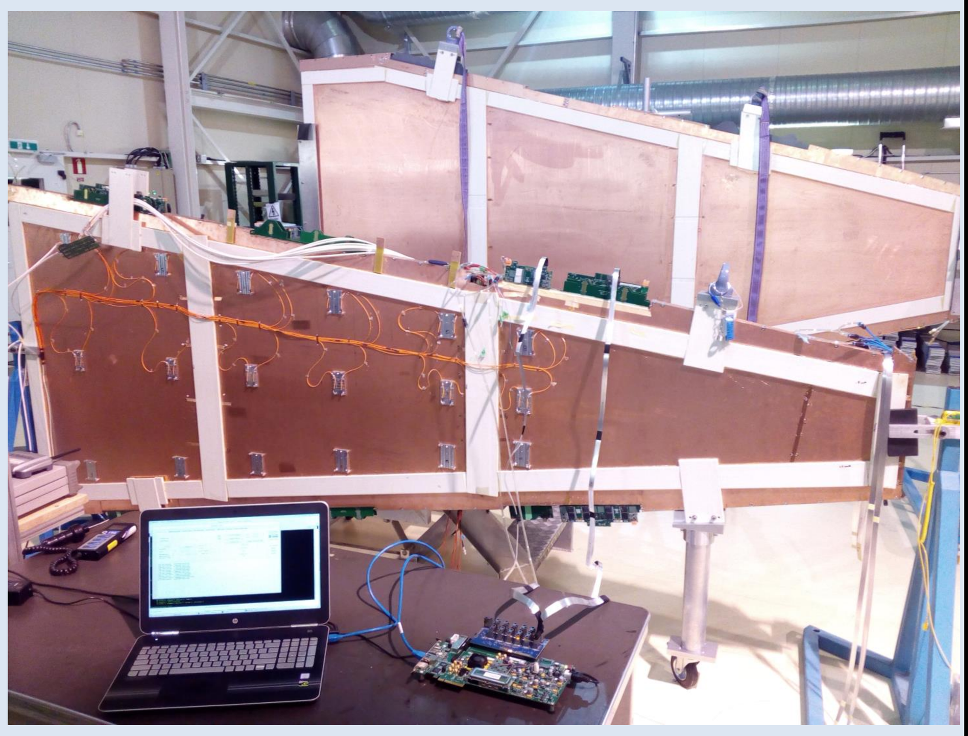
at PUC

- Installation of pad, strip & wires adapter board and grounding is done.
- Noise measurement and cosmic muons efficiency map are generated for every quadruplet using special setup and semifinal electronics.



at CERN

- Chileans helped to assemble the first small test wedge made of production ready quadruplets which are fully instrumented.
- Used as test-bed for services installation and definition of wedge assembly protocol.
- Part of the Chilean team also participated in test beam for electronics tests.



- Two production wedges have been successfully produced and tested.

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ATLAS EXPERIMENT