New ATLAS Muon Chambers for LHC Run-3

Installation of 32 new Resistive Plate (RPC) muon trigger chambers in combination with 16 new sMDT precision muon tracking detectors (“BIS 7 & 8”) on the toroid magnet coils at the ends of the barrel inner layer (red) in the Long Shutdown 2 of the LHC in 2019-2020.

Goal: Improvement of the trigger selectivity and fake trigger suppression in the region $1.0 < |\eta| < 1.3$ combined with the endcap trigger chambers for Phase-I and Phase-II.

Pilot project for the Phase-II upgrade of the barrel inner layer.

Integrated sMDT and Thin-Gap RPC Chambers

New RPC chambers require replacement of existing MDT chambers by sMDT chambers to provide sufficient radial space. Nevertheless tight spatial constraints on new detectors. Optical sensors for global alignment system on top and bottom of sMDT drift tube layers.

Thin-Gap Resistive Plate Chambers

Twice thinner gas gaps (1 mm) and thinner HPL electrodes

+ new highly sensitive amplifiers
- improve the time resolution from 1 ns to 0.4 ns,
- allow for operation at substantially lower voltage, 5.8 kV instead of 9.6 kV, and ~15 x lower gas gain and avalanche charge.

$\Rightarrow$ rate capability up to 10 kHz/cm$^2$ and lifetime well beyond 10 years at HL-LHC

sMDT-RPC Prototypes and Integration

Prototype thin-gap RPC triplet

sMDT-RPC Prototypes and Integration

Integrated BIS78 sMDT–RPC prototype chamber

RPC triplet in the light-weight but stiff support frame. Deformations below 2 mm.

sMDT Chamber Assembly Procedure

High-precision assembly jig
1. Glueing of bottom alignment sensors
2. Assembly of 6 drift tube layers, only two working days
3. Glueing of top alignment sensors
4. Mounting and calibration of optical chamber planarity monitoring system.
$\Rightarrow$ Wire positioning accuracy 10 µm rms

sMDT Chamber Construction 2018

Drift tube production and test (10k tubes). Class 1000 clean room.

Chamber assembly jiggling

Precision hole grid of the jig for drift tube insertion.

Automated glue dispenser needed for speed and precision

Assembled chamber with alignment sensors mounted

Mechanical measurement of sense wire and alignment sensor positions