Goals of the Muon Detector Upgrade for High-Luminosity LHC

1. Increase of the 1st level muon trigger selectivity and $p_T$ resolution by factor 10 by implementing a fast track trigger based on the Monitored Drift Tube (MDT) precision tracking chambers. Requires replacement of the MDT frontend electronics.

2. Installation of 276 new thin-gap RPC trigger chambers with longer lifetime at HL-LHC in the barrel inner layer BI, combined with 96 new small-diameter muon drift tube (sMDT) chambers in the small azimuthal (BIS) sectors. 16 BIS 78 chambers already for LHC Run 3.

New Thin-Gap Resistive Plate Chambers

- Reduction of gap thickness from 2 mm to 1 mm and new highly sensitive preamplifiers allow for operation at 5.8 kV instead of 9.6 kV and 15 times lower gas gain.
- Increased rate capability of > 10 kHz/cm² and lifetime 2.5 times requirement for HL-LHC.

BIS sMDT and RPC Chambers for Run 3 and HL-LHC

- Integrated BIS7 sMDT chambers mounted in mechanical support
- Integrated BIS78 sMDT and RPC chamber
- 14 sMDT chambers operated in ATLAS in run 2. 5 µm wire positioning accuracy achieved.

New Small-Diameter Muon Drift Tube (sMDT) Chambers

- Reduction of drift tube diameter from 30 mm to 15 mm and otherwise unchanged operating conditions increases the rate capability to > 30 kHz/cm².
- 14 sMDT chambers operated in ATLAS in run 2. 5 µm wire positioning accuracy achieved.

New TDC ASIC Functionality and Performance

The TDC chip combines the new continuous readout mode for HL-LHC operation with the legacy triggered mode needed for chamber testing. Full prototype chip in TSMC 130 nm CMOS technology successfully tested. Engineering run planned for 2020.