

Construction of new small-diameter Monitored Drift Tube (sMDT) chambers for the HL-LHC upgrade of the ATLAS Muonspectrometer



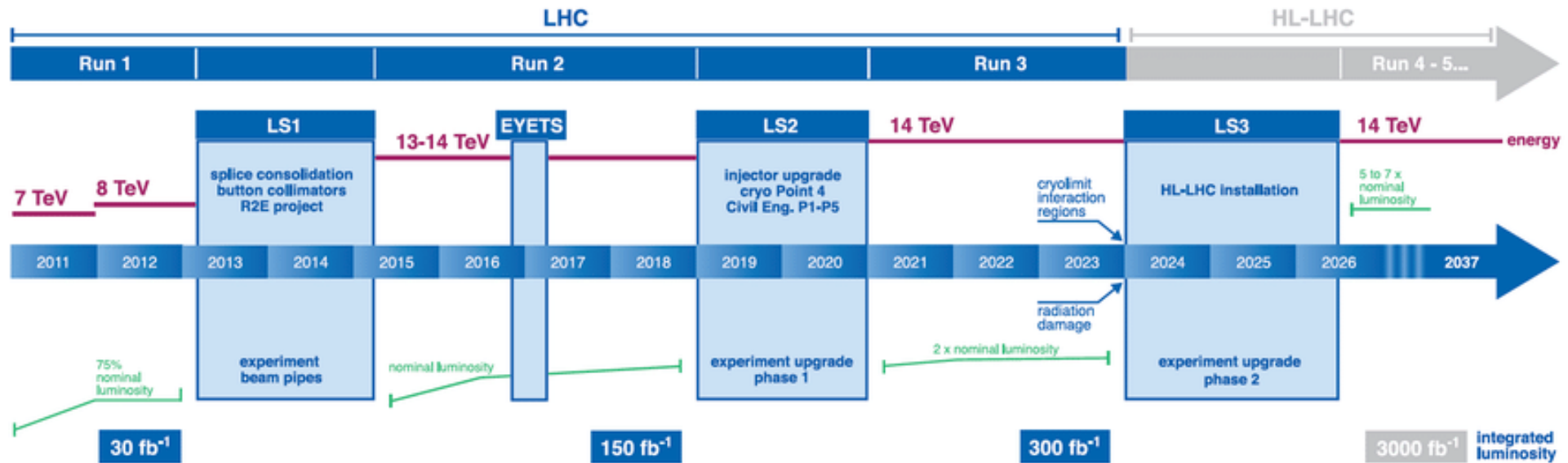
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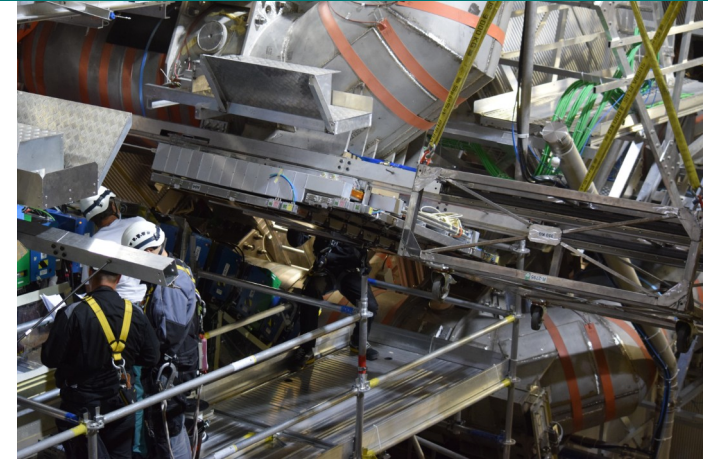
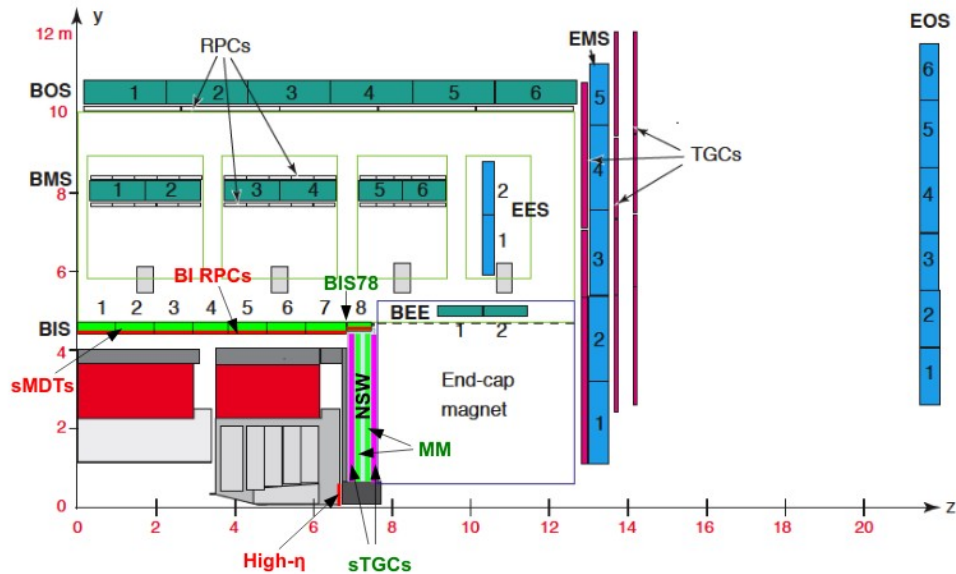
Thursday 18th March, 2021



MAX-PLANCK-GESELLSCHAFT



- Upgrade of the LHC to the high luminosity LHC (HL-LHC) to increase the luminosity by a factor of 5-7
- Increase in background rate and trigger rate requires an upgrade of the ATLAS muonspectrometer



Pilot project BIS78: new sMDTs+RPCs were installed in 2020 (Elena's talk)

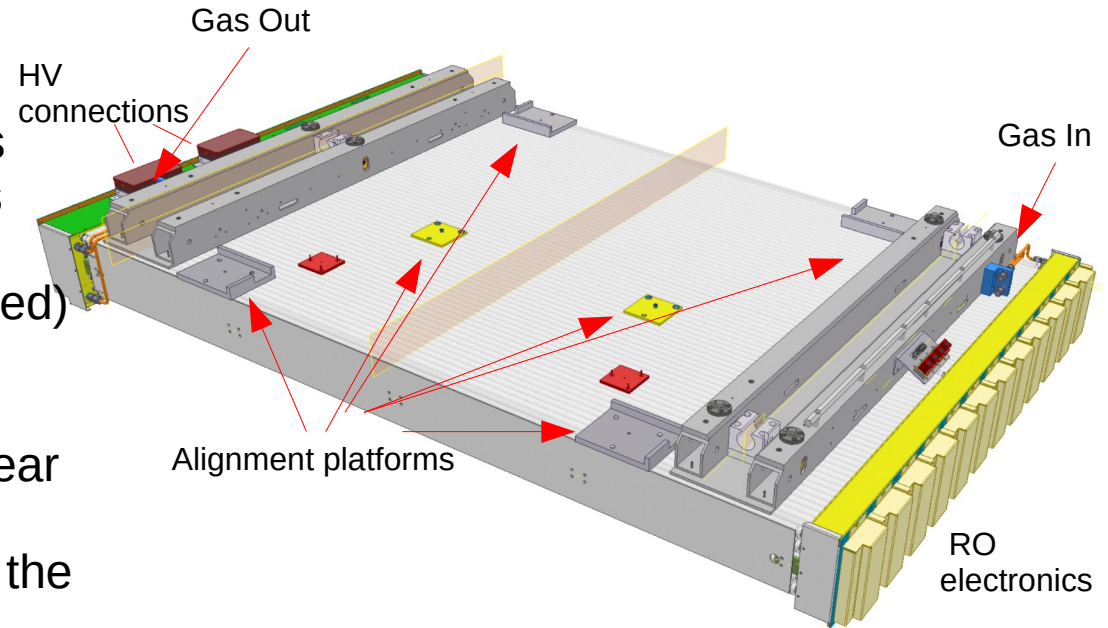
- For the HL-LHC, the monitored drift tube chambers (MDT) in the small sectors of the inner layer of the barrel of the ATLAS spectrometer will be replaced with small-diameter monitored drift tube chambers (sMDT) and new thin-gap resistive plate chambers (RPC), in order to increase the trigger acceptance and trigger efficiency
- This talk: Assembling of the sMDT
- Next talk by Verena Walbrecht: Measurements of the new sMDTs

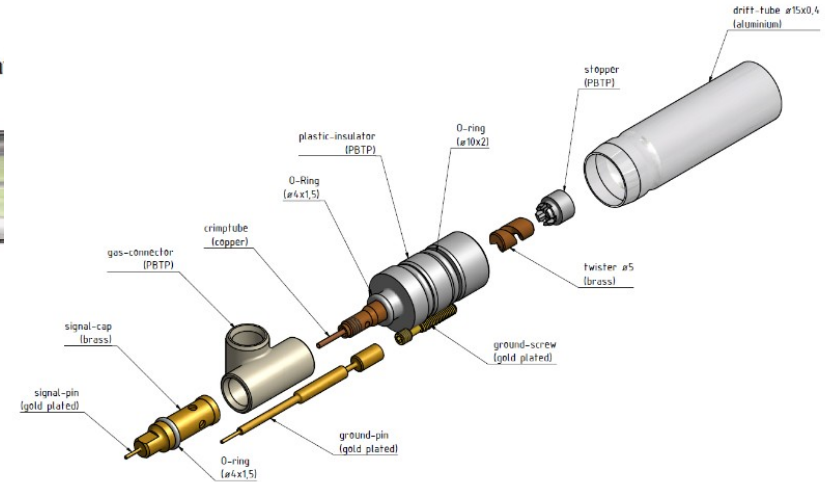
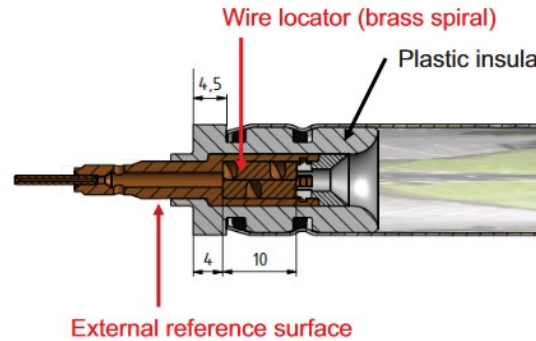
- MDT: 30mm tube diameter
- sMDT: 15mm tube diameter
- Same operation parameters

- Background reduced by a factor of 2
- Drift time reduced by a factor of 4
 - Occupancy reduced by a factor of 8



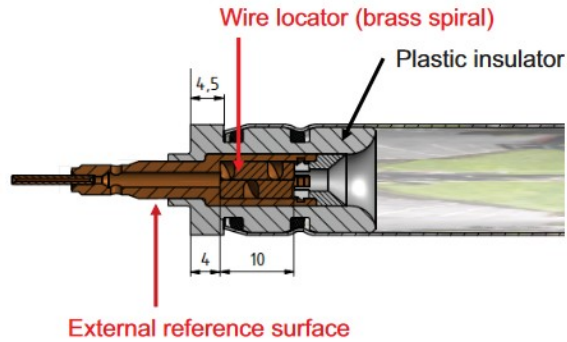
- Each sMDT consists of 560/464 tubes arranged in 2 multilayers with 4 layers each
- 16 BIS78 sMDT already built (8 installed)
96 BIS1-6 sMDT in production (48 in Munich)
- Seriesproduction started end of last year
- An optical alignment system monitors the chamber position relative to other chambers
- Deformations of the chamber are monitored with an in-plane alignment system
- 20 μ m accuracy on tube position needed





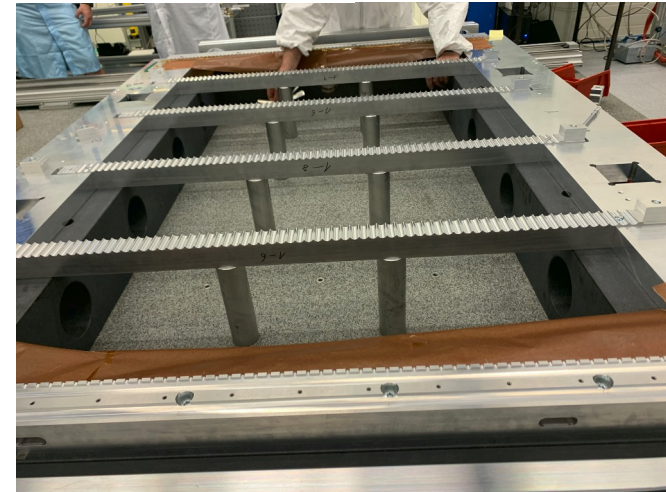
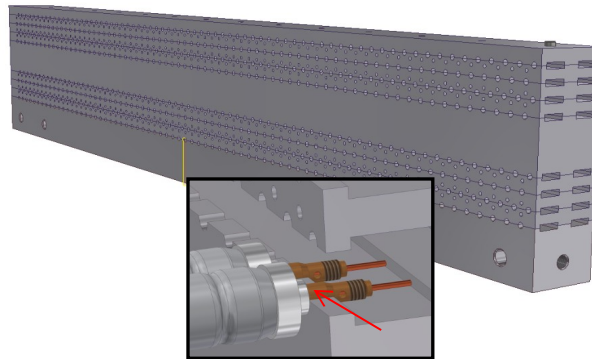
- Production of drift tubes is performed in a clean room
- Endplug defines the wire position with a precision of $1\mu\text{m}$
- Each tube is tested for wire tension, dark current and gas leakage

- Position of each tube endplug is fixed by the assembling comb
- Endplug defines precisely the wire position
- 10μm position accuracy achieved

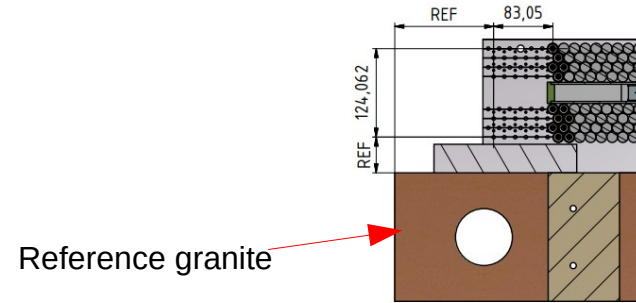


Tube endplug

Precision comb



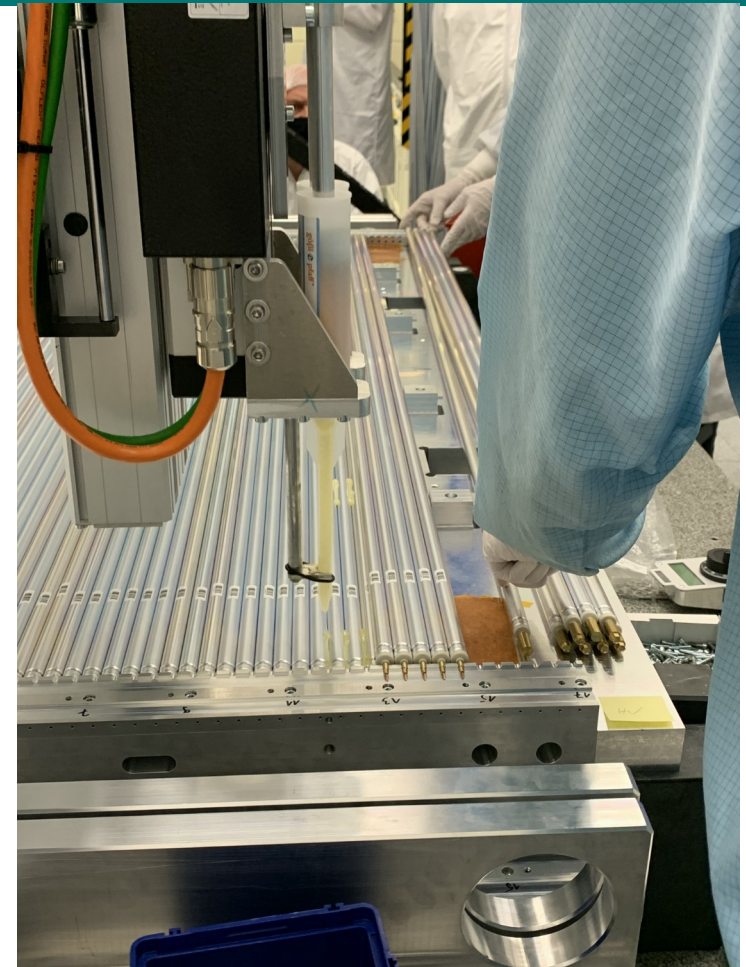
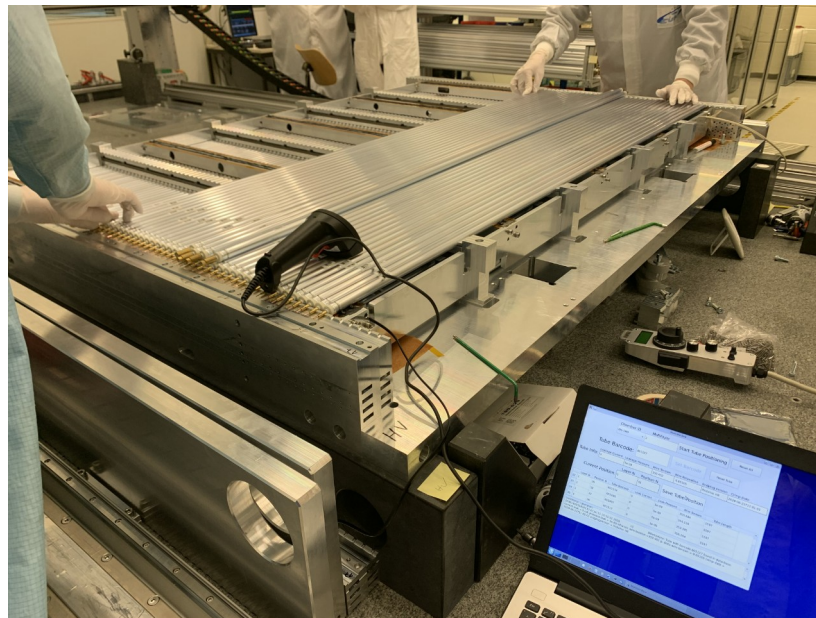
Assembling setup



sMDDT Assembly



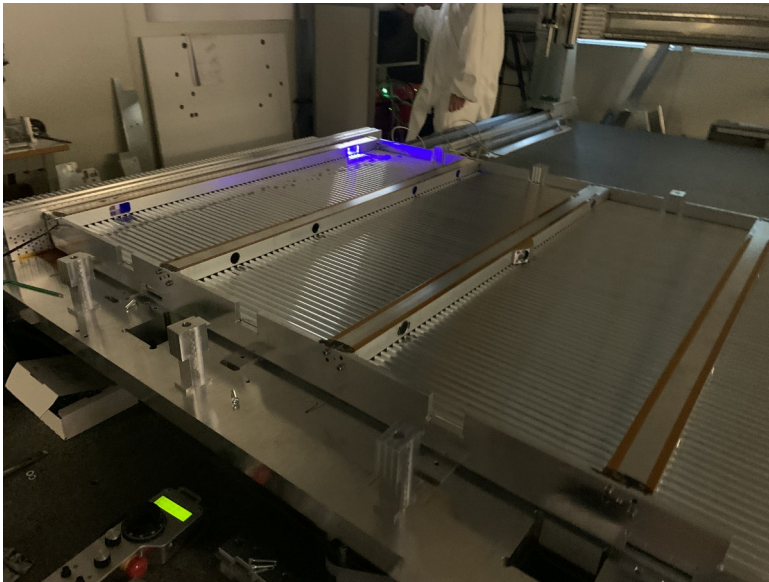
- Each layer consists of 70 tubes
- Gluing one layer per day (7 days in total)



Spacer and In-plane Alignment System

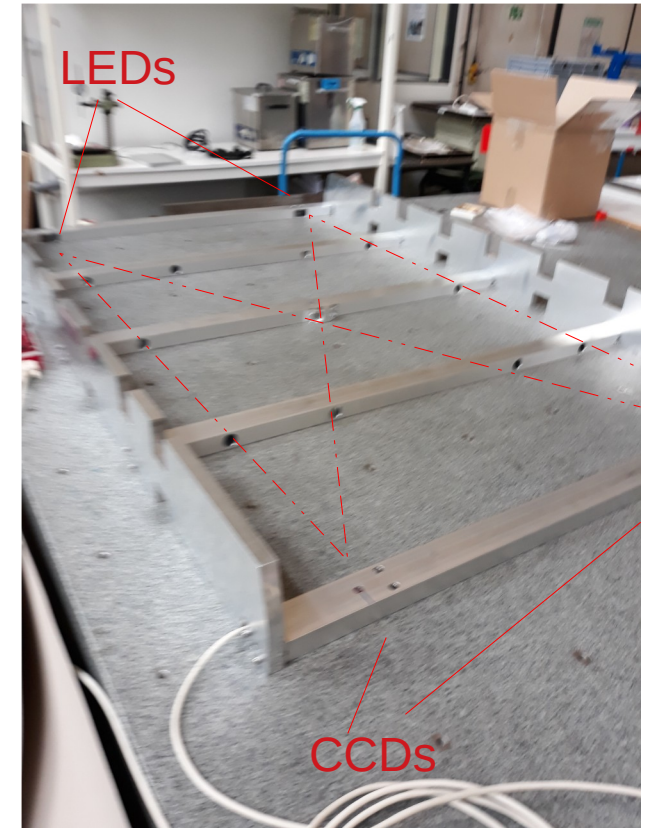


- The spacer between the 2 multilayers houses the in-plane alignment system to measure the deformation of the chamber
- In-plane alignment system measures torsion around tube axis



Test of the inplane alignment system

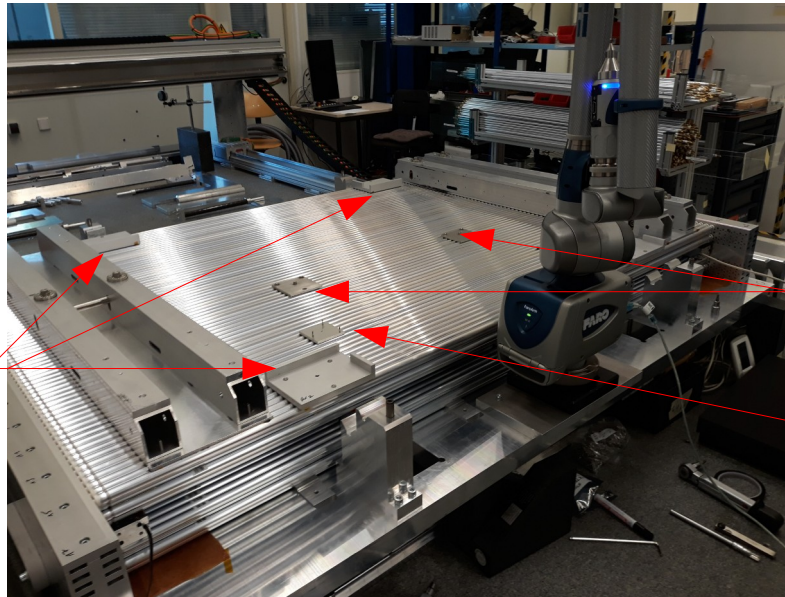
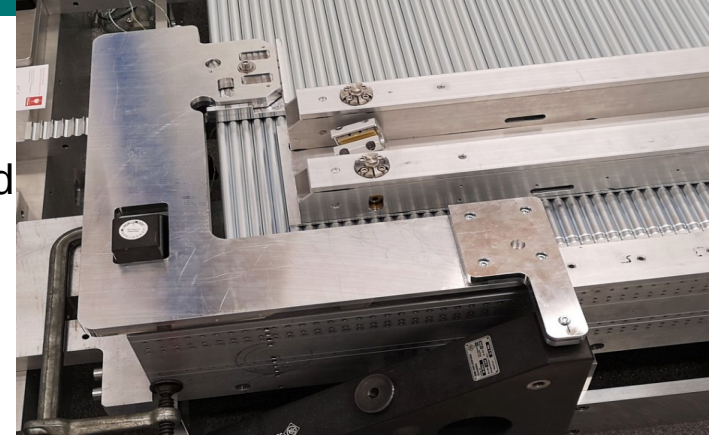
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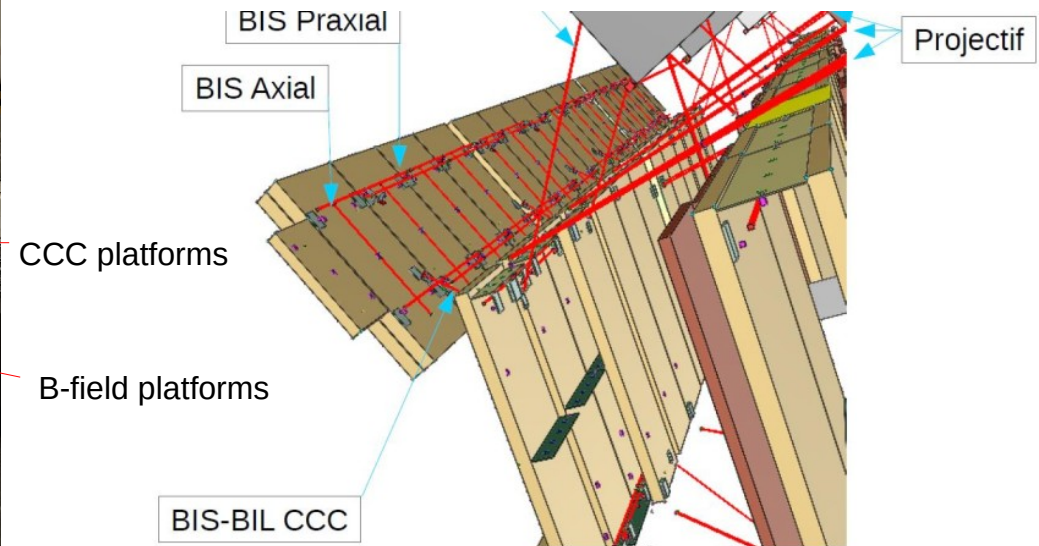
Assembled Spacer

Alignment Platforms

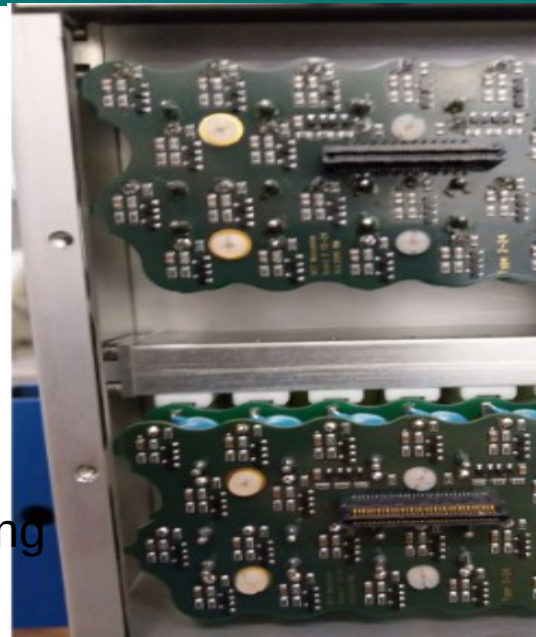
- The position of the SMDT chamber relative to the other chambers is constantly monitored by an optical alignment system
- The optical components will be mounted on platforms that are glued on top of the 8th layer of the chamber
- The position of these platforms have to be precisely measured with 10 μ m accuracy



Axial-Praxial platforms



Gas Distribution System and Electronics



- Getting the chamber gas-tight is challenging
- ~4000 O-rings per chamber
- Required gasleakage: $< 1 \cdot 10^{-8} \frac{\text{bar} \cdot \text{l}}{\text{s} \cdot N_{\text{Endplugs}}}$
- After installation of electronics: full test of the chamber using cosmic muons

- Serial production of sMDTs ongoing
- One chamber finished every two weeks
- Finished end of next year
- Chamber will be then integrated to RPCs at CERN

Chamber	Gluing	Gas supply	Electronics
Module 1	✓	✓	✓
Module 2	✓	✓	✓
Module 3	✓	✓	ongoing
Module 4	✓	✓	ongoing
Module 5	✓	✓	
Module 6	✓	ongoing	
Module 7	ongoing		