Temperature Monitoring of ATLAS MDT Chambers

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The ATLAS muon spectrometer contains more than 1200 Monitored Drift Tube (MDT) precision chambers. About 3 - 28 temperature sensors are mounted on each of these chambers (the quantity depends on the chamber type) and are read out via the Detector Control System (DCS). The positions of the sensors were collected for each chamber type and transformed into a common local coordinate system (defined in the Technical Design Report (TDR)). These coordinates were written into an ORACLE database for each temperature sensor. The database provides the global position of all 12200 sensors in the ATLAS detector (Fig.1) using the stored rotation matrix, the global position of each chamber and the local coordinates of each temperature sensor.

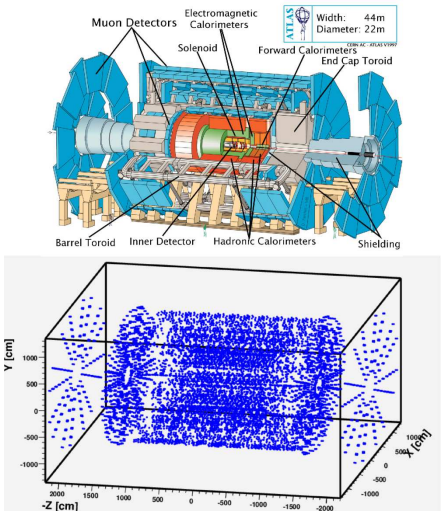

Fig. 1: Positions of the temperature sensors on all MDT chambers in the ATLAS detector

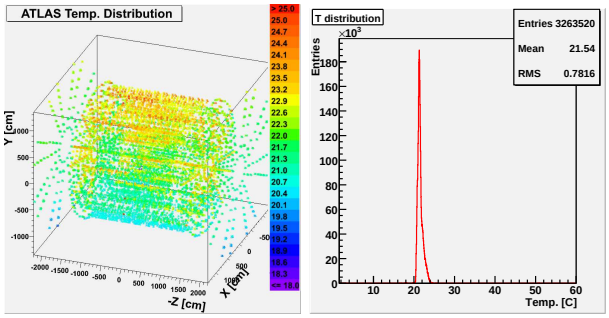

Fig. 2: Temperatures of the running ATLAS muon spectrometer

The temperature measurements are used to monitor the 3D temperature distribution in the muon spectrometer for MDT calibration, alignment, data quality and safety, e.g. protection of electronics. In the ATLAS control room certain panels for the online temperature monitoring are implemented. Outside the control room, the temperatures are accessible offline via a website which currently shows a summary of the last hours (Fig.2) and temperature variations in time of each MDT chamber (Fig.3). In an upcoming version the user can use this tool to trace and debug a posteriori any temperature and B-field problems.

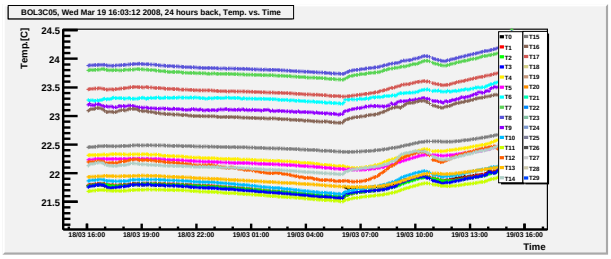

Fig. 3: 24h temperature measurements on a selected MDT chamber (BOL3C05, 18 temp. sensors)

Temperature variations change the properties of the drift gas ($Ar:CO_2$) in the MDT chambers and therefore the relation between the measured drift time t (of a muon hit) and the drift radius r of the muon track in the tube (r-t relation). Temperature gradients along the drift tubes develop (up to 0.5K/m) during normal operation e.g. due to the read-out electronics on one end of the drift tubes and other heat sources in the detector. Therefore, the temperature measurements of each chamber are used to fit the temperature profile along the drift tubes. The profile will be used in the muon track reconstruction to adjust the r-t relation to changing temperature (Fig.4).

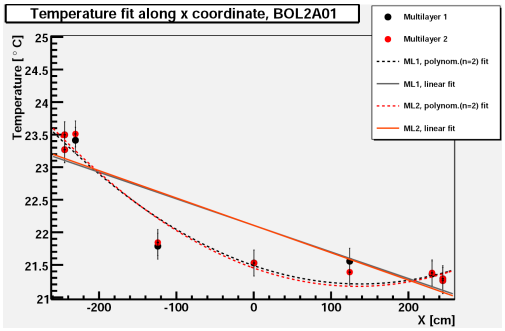

Fig. 4: Fitted temperature gradient along the drift tubes

For the track reconstruction during calibration [1], the temperature corrected r-t relation is applied. A global r-t relation for each MDT chamber is then determined which is used later for the muon momentum reconstruction.

Monitoring the temperature distribution in the ATLAS detector is also important for the alignment since deformations of the MDT chambers correlated to temperature changes [2] have to be taken into account as well.

References

[1] F. Rauscher *et al.*, 98
[2] A. Engl *et al.*, 81