# Temperature Studies for ATLAS MDT BOS Chambers

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Gradients of temperature in the ATLAS detector influence the resolution of single MDT chambers. Due to heat from the inner part of the ATLAS detector and from the electronics of the muon spectrometer, temperature differences of about 3 to 5 Kelvins are expected.

To study the effect of temperature on driftgas properties and possible deformations of the chamber itself, a thermally isolated BOS MDT chamber was heated up with warm air. The measurements were performed at the cosmic-ray facility in Garching. The setup is shown in [1]. A set of three MDT chambers is enclosed by layers of scintillation counters on the top and bottom to trigger for cosmic muons.

The MDT chambers were operated at the ATLAS muon spectrometer conditions: 3080 V for the drift field and a gas mixture of 93 % $Ar$ and 7 % $CO_2$ at 3 bar absolute pressure. If temperature changes, also the pressure must change. Using an electronically controlled outlet valve, stable pressure conditions were guaranteed.

The maximum drift time $t_{max}$ is defined as the difference between leading and trailing edge of the drift time spectrum [1].

Fig. 1 shows that $t_{max}$ changes linearly with the temperature by 2.21 ± 0.08 $\frac{ns}{K}$. It changes similarly if pressure is reduced to get the same gas density as for a temperature change. Both variations show the same influence on the drift time. So everything can be reduced to density effects. The gas gain showed an increase of 2.1 % per Kelvin with temperature increase.

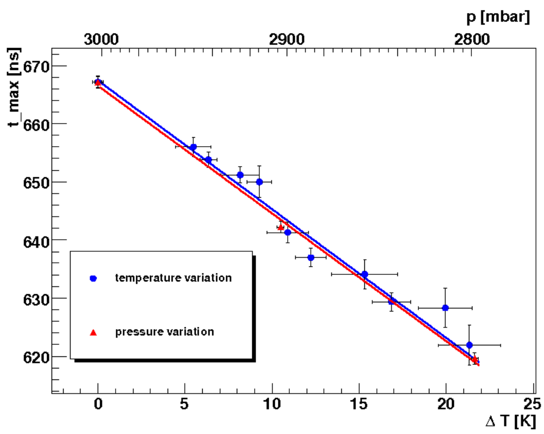


Fig. 1: Change of max. drift time with temperature and pressure

Another issue was the thermal expansion of the BOS chamber. On every chamber a monitoring system, consisting of 4 RasNik devices [2], is installed to measure changes in the geometry of a chamber. An optical mask on the high voltage side (HV) of the BOS chamber is illuminated by LEDs. Its image is projected by lenses in the middle of the chamber (MI) onto a CCD sensor at the readout side (RO). Deviations of about 2 $\mu m$ can be measured by this system. It is possible to distinguish between expansions of RO-, HV- and MI-crossplate. The shift of a single crossplate can also be observed.

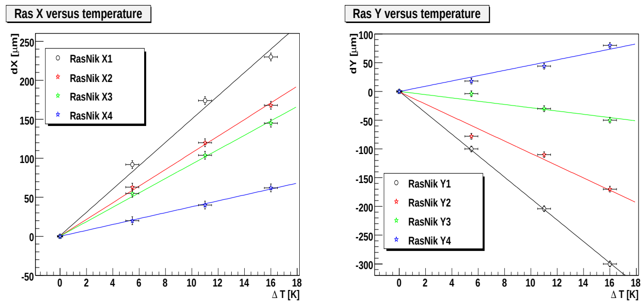


Fig. 2: X (left) and Y (right) deviations of the 4 RasNik systems in the chamber

With increasing temperature all measured RasNik deviations show linear behaviour (Fig. 2), so the thermally caused deformation stays the same in this temperature range. Considering the X values, one can see that all deviations are positive but have different amplitudes. These values indicate the shift of the MI-crossplate superimposed by different thermal expansion of the three crossplates. The measured deviations in Y direction correspond to a rotation of the MI-crossplate with respect to RO and HV sides. Another way to determine the expansion of RO- and HV-crossplate was the measurement of the wire positions [1]. The tracks of the reference chambers are compared to those of the test chamber. The transformations needed to overlay the track segments yield the chamber deformation. This analysis confirmed the results of the RasNik analysis.

The observed deformation corresponds to a banana-like bended chamber (Fig. 3), where the middle of the chamber is shifted and rotated.

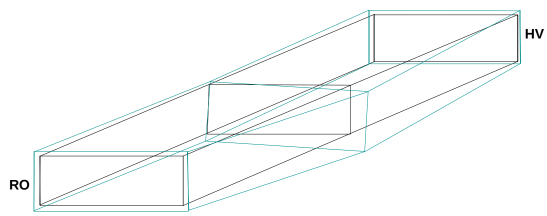


Fig. 3: Sketch of observed banana-like deformation.

## References

[1] F. Rauscher, Ph.D. thesis, LMU München, 2005
[2] http://www.nikhef.nl