Slow-Control System and Monitoring of the ATLAS Cosmic Ray Measurement Facility

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88 monitored drift tube (MDT) chambers of the ATLAS Muon Spectrometer, built in collaboration with the Max-Planck-Institute for Physics and the JINR Dubna, have to be commissioned and calibrated [1] in the ATLAS cosmic ray measurement facility of the Ludwig-Maximilians-University (LMU) Munich [2] until summer 2005.
The slow-control program [3], a stand-alone C++ program, controls different aspects of the measurement facility, monitors and records several operating parameters.

The program controls the mixing of the chamber gases (Argon and CO_2 for the MDT chambers and Argon, CO_2, Isobutane C_4H_{10} for streamer chambers) and its pressure. Furthermore, it monitors the chamber alignment, the temperature probes and operating voltages. Critical conditions or warnings are immediately notified via email and are logged to the slow-control web pages (see Fig. 1).

Fig. 1: Warnings on the Slow-Control web page due to empty gas bottle

About 25 slow-control web pages provide an on-line overview of the current status of the test chamber and reference chambers in the ATLAS cosmic ray measurement facility and their evolution over the past 24 hours.

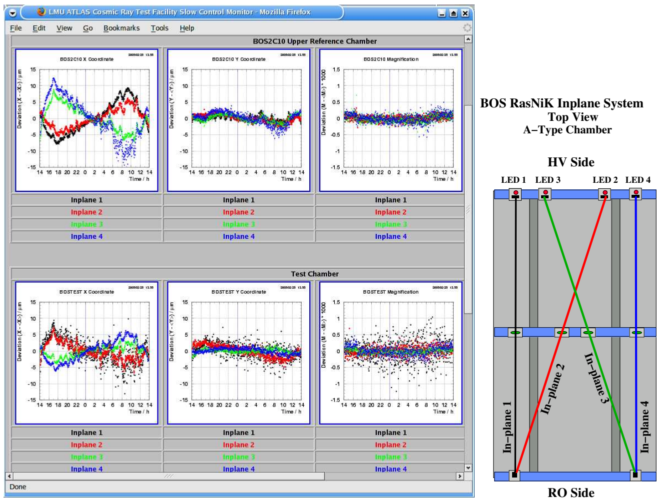

Fig. 2: On-line overview of the variations (in μm) of current RasNik data of the reference chamber and test chamber after mounting in the cosmic ray measurement facility exemplifying larger variations due to thermal stabilization after switching on the read-out electronics

This includes the alignment monitoring of the chambers in the cosmic ray measurement facility with the 8 RasNiK sensors [4], which measure the relative movement and the thermal deformation of the chambers in the measurement facility. The chamber embedded RasNiK sensors are sensitive to misalignments of less than 1 μm.

To reduce the data taking time, the correction of test chamber deformations and movements due to thermal variations in the air-conditioned hall during the calibration runs can now be done. Such periods of thermal changes (see Fig. 2) have previously been excluded from analysis.

The very sensitive RasNiK sensors allow a precise correction of any mechanical deformations. As example, Fig. 3 shows the correlation between the monitored temperature gradient ΔT along the drift tubes and the measured expansion parameter difference $\Delta x/x$ (applying the fit algorithm used in ASAP [5]). Thus thermally induced changes of the MDT chambers can be corrected to a precision of better than a few μm.

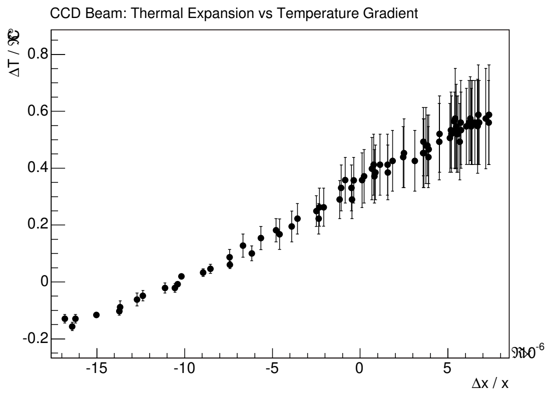

Fig. 3: Temperature gradient versus the difference of the thermal expansion parameter measured between the read-out front-side and the center of chamber BOS1C02

A simultaneous measurement of the temperatures and pressure is done for two of the four stacked chambers in the anteroom, which are in preparation for the comic ray measurement facility. This data of about 2-3 days is used for the determination of a temperature corrected average leak rate [6] which has to meet the ATLAS requirements. As the leak rate determination is time consuming and often dictates the measurement plan, for time saving, two more precise and temperature stabilized pressure gauges will be arranged in the anteroom and included in the slow-control monitoring for the simultaneous measurement of the pressure and determination of the leak rate of all possible four chambers in the anteroom.

References

[1] J. Dubbert *et al.*, Annual report 2003, p. 88
[2] T. Trefzger *et al.*, Annual report 1999, p. 106
[3] J. Dubbert *et al.*, Annual report 2002, p. 103
[4] J. Elmsheuser *et al.*, Annual report 2001, p. 90
[5] `http://florian.home.cern.ch/florian/Asap.htm`
[6] R. Hertenberger *et al.*, Annual report 2003, p. 89