Results from the ATLAS Cosmic-Ray Test-Facility

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1. Introduction

For the ATLAS muon-spectrometer 88 drift tube chambers are constructed in a collaboration of LMU and MPI. At the LMU a cosmic-ray test-facility has been set-up for the commissioning and calibration of these chambers. In summer 2002 a preproduction of chamber electronics became available allowing for the first time a complete check-out of the entire set-up.

In order to measure the geometry, i.e. the positions of the sense wires, the chamber is put in between two reference chambers, which were measured at an x-ray tomograph at CERN determining the position of the wires with a precision of 2 μm. The track of the muon is reconstructed with these reference chambers, extrapolated into the chamber which is investigated, and compared with the measurements in the tested chamber. The validity of the method has been checked by using as investigated chamber one of the few chambers which has also been mapped in the tomograph.

2. Homogeneity of the Behavior of the Tubes

The drift-time spectra of individual tubes are a very sensitive and quantitative probe for the functioning and homogeneity of the chamber. By fitting Fermi-functions to the leading and trailing edges of the spectrum , the maximum drift-time can be determined. In the tested chamber, the spread of this quantity did not exceed the statistical uncertainty of the fit (see figure 1), which shows, that all tubes had the same drift properties.

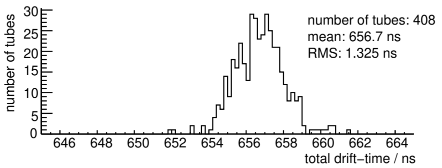

Fig. 1: Distribution of total drift times for one chamber

3. Determination of the Wire Position

Let δ_y be the displacement of the wire in the wire plane, and δ_z be the displacement perpendicular to this plane. The deviation of the drift-radius from the distance of the reference track to the assumed wire position is

$$r_{ref} - r_{drift} = \delta_y - m\delta_z \tag{1}$$

where m is the slope of the track.

By fitting a line to the distribution of $r_{ref} - r_{drift}$ versus m, δ_z can be determined from the slope of this line. In figure 2 the measurement of the cosmic-ray test is compared to a previous measurement at the x-ray tomograph at CERN, which located part of the wires with a precision of 2 μm. A clear correlation between these two measurements can be seen, and two production errors with extremely displaced wires were found with both measurements. The precision of the measurement for single wires of δ_z is 27 μm. By fitting a straight line to the tubes of one layer, the displacement of layers can be measured with a precision of 6 μm. As can be seen in the lower part of figure 2 the cosmic-ray measurement agrees with the measurement from the x-ray tomograph.

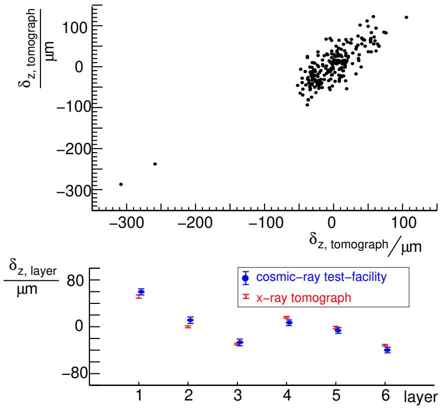

Fig. 2: Comparison between the measurement of δ_z with the cosmic-ray test and the x-ray tomograph

For the determination of δ_y the assumed wire position is corrected according to the measurement of δ_z for a single wire if $|\delta_z| > 150\mu m$, and for all other wires according to the measurement of the layer position. The average $\langle r_{ref} - r_{drift} \rangle$ is then δ_z. Figure 3 shows a comparison of this measurement with the measurement of the x-ray tomograph. The RMS of the difference of these two measurements is 7.8 μm

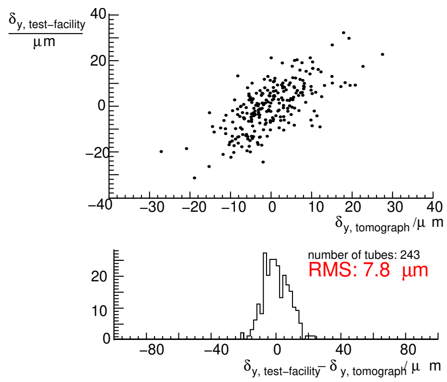

Fig. 3: Comparison of the measurement of δ_y between tomograph end cosmic-ray

References

[1] O. Kortner, Ph.D. thesis, LMU München, 2002 Schauerproduktion durch hochenergetische Myonen und Aufbau eines Höhenstrahlungsprüfstandes für hochauflösende ATLAS-Myonkammern