Cosmic Ray Tests for the ATLAS Muon Chambers ◇

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Cosmic ray teststand

The parameters of tracks in the ATLAS Muon Spectrometer will be determined by approx. 1200 precision muon chambers (MDT chambers, monitored drift tube chambers) of different geometries. In order to achieve the expected momentum resolution of $\Delta p_T/p_T^2 \approx 10^{-4}$ GeV^{-1} above the multiscattering limit of $\Delta p_T/p_T \approx 2\%$ stringent requirements for the accuracy of construction and the survey of systematic effects during operation have to be fulfilled.

The LMU Munich and the MPI für Physik in Munich work in close collaboration on parts of these chambers (90 in total). The initial geometry survey and the study of calibration procedures to reduce the systematic effects of operation will be performed in a detector laboratory in Garching. For these studies a cosmic-ray teststand as shown in fig. 1 will be built. The tracks are triggered by a fast hodoscope and two layers of streamer chambers. The coordinates of the track will be determined by two reference chambers which are below and above the tested chamber. The reference chambers are also MDT chambers which prior to installation will have been surveyed by test beam measurements and an x-ray tomograph at CERN. The chambers will be aligned using optical chains consisting of a mask illuminated with a diode, a lens and a CCD. The coordinate perpendicular to the wire will be measured with streamer tubes. The wire positions in the test chamber can then be determined by comparing the track position interpolated from the two reference chambers with the position measured in the test chamber.

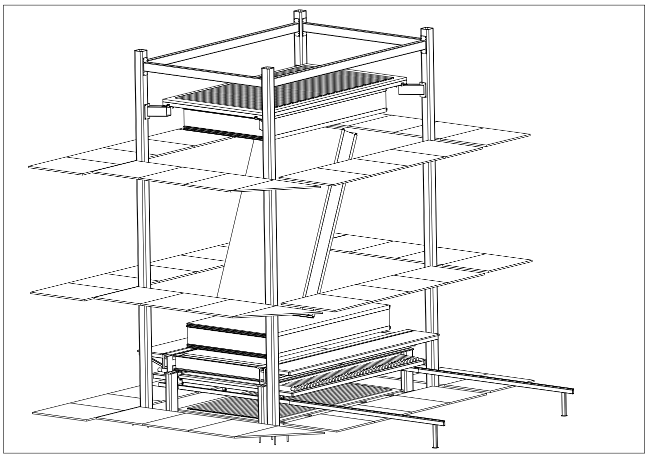

Fig. 1: Schematic of the cosmic ray teststand.

In order to reduce the effects from multiple scattering only muons that pass an iron absorber of 34 cm thickness are triggered. This corresponds to a cut in the muon momentum of approx. 380 MeV. In order to further harden the muon spectrum, events with multiple scattering angles larger than 0.7^o in the iron absorber (perpendicular to the wire direction) are rejected. The multiple scattering angle is estimated by comparing the extrapolation of the track from the reference chambers with the measurement by the streamer tubes 80 cm below the iron absorber. Events with multiple scattering in the measured chamber can be further reduced by requiring that a straight line fit through the top and bottom reference chamber give a reasonable χ^2. After these cuts one expects for a data taking period of 20 hours about 1000 events per meter tube length, each giving an estimate of the wire position with 150 μm RMS. This yields a statistical precision of 5 μm for the measurement of the wire position in four 1m long sections along the wire. It is also foreseen to test rotated chambers in their nominal positions of 22.5^o and 67.5^o which they will have in the ATLAS experiment.

Prototype of teststand

A prototype of the teststand (see fig. 2), which includes two sets of 5 drift tubes, a 10 cm lead absorber and a layer of streamer tubes 82 cm below the absorber, has been successfully operated [1]. A change of 200 μm in position of a tube between the two sets of 5 drift tubes has been reproduced with a systematic accuracy of better than 10 μm.

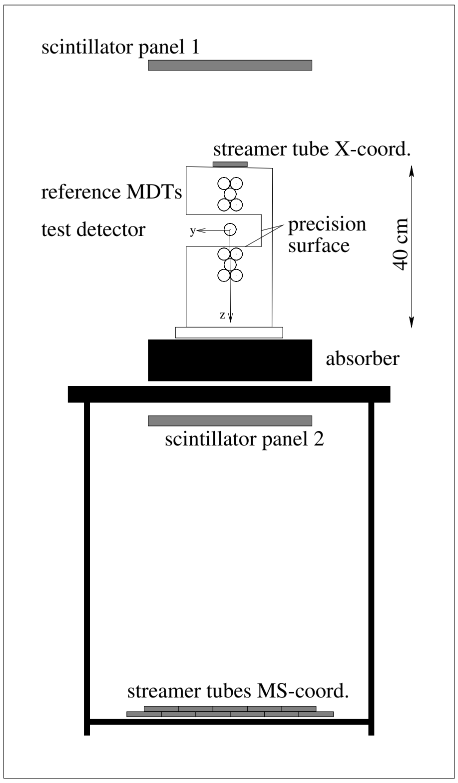

Fig. 2: Schematic of the prototype teststand

References

[1] M. Böhm, diploma thesis, LMU München, 1999

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