

# Study of the Sagitta of Muon Tracks in the Cosmic Ray Measurement Facility for ATLAS Muon Chambers in Garching

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The cosmic ray measurement facility in Garching is used to calibrate Monitored Drift Tube Chambers (MDT) for the ATLAS muon spectrometer. It provides a good environment to study the agreement of a Geant4 simulation of the MDT-chambers with real cosmic data. The sagitta resolution of the muon track reconstructed with the three MDT-chambers of this setup allows a meaningful test of this agreement. The precision of the reconstruction of the sagitta of tracks in a magnetic field is directly related to the accuracy of the momentum measurement. Since there is no magnetic field applied and the studied cosmic muons are high energetic ( $\geq 600 \text{ MeV}$ ), a small sagitta in comparison with the arc length is expected. In this limit the circle can be approximated by a parabola (Figure 1).

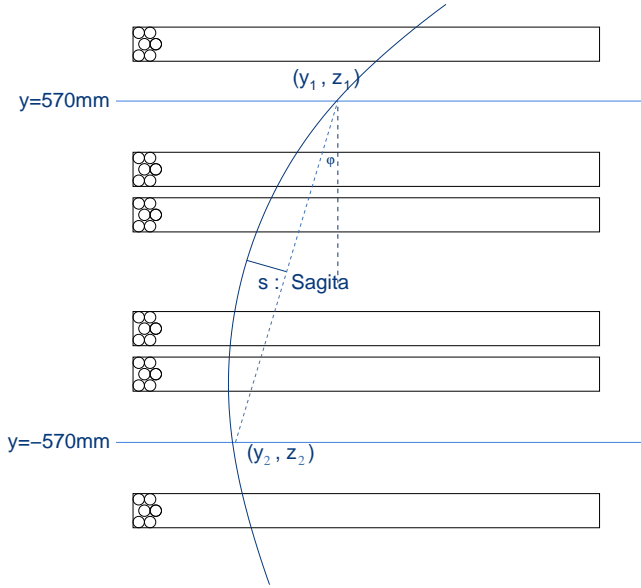


Fig. 1: Definition of Sagitta at the cosmic ray measurement facility

The corresponding simulation of the cosmic ray measurement facility (CMF-Simulation) is based on Geant4 and was fully implemented within the Athena-Framework [1], [2]. The distribution in Figure 2 shows the measured sagitta for about 100,000 events that have been measured at the cosmic ray measurement facility. The width of this measured distribution and the width of the Monte-Carlo distribution agree within 5%. This is a strong hint that various physical effects like multiple scattering are simulated correctly.

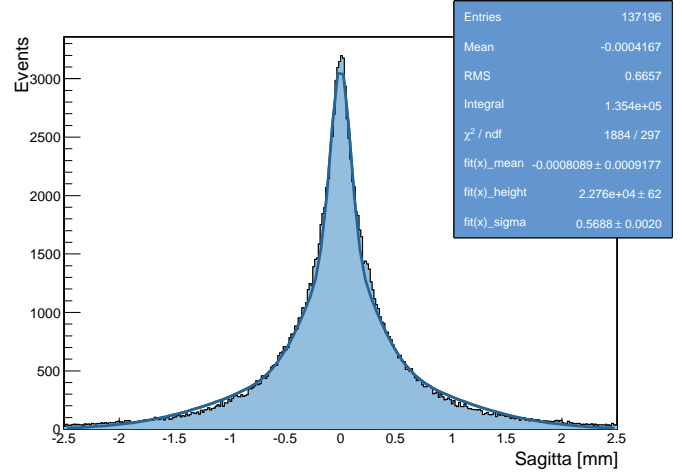


Fig. 2: Measured sagitta distribution of the cosmic ray measurement facility

It is a useful exercise to use the CMF-simulation validated by the cosmic ray measurement facility and extrapolate it to the setup at ATLAS [3]. To modify the CMF-Simulation according to the ATLAS geometry the distances of the chambers were chosen to be 2580 mm and 3550 mm. Multiple scattering effects due to the Resistive Plate Chambers (RPC), which are used as trigger chambers in the ATLAS Muonspectrometer, could not be neglected. Therefore passive blocks consisting of the same material and dimensions as the RPCs have been included in the simulation.

The high energy regime provides a possibility to compare the single tube resolution since this is the dominating effect at these energies. For 1 TeV a momentum resolution of 8.8% is expected in the ATLAS detector. The simulation in this study predicts a momentum resolution of 8.7% for muon energies of 1 TeV, which is a very good agreement, given the differences in the details of simulation, digitization and magnetic field between the CMF-simulation and the Technical Design Report studies for ATLAS [4].

## References

- [1] A. Brandt *et al.*, Annual report 2003, p. 84
- [2] M. Obermaier *et al.*, Annual report 2004, p. 96
- [3] M. Schott, G. Duckeck and M. Obermaier, ATL-COM-MUON-2006-004, Geneva, (2006)
- [4] Technical Design Report of the ATLAS Muon Spectrometer, Geneva, (2002)