MPI Contributions to the Calibration, Alignment, and Commissioning of the ATLAS Muon Spectrometer

Oliver Kortner

Max-Planck-Institut für Physik

ATLAS-Besprechung, 18.09.2006

Outline

1. MPI responsibilities for the software for the calibration of MDT chambers: status and plans
2. Alignment of the muon spectrometer with tracks.
   2.1 MPI responsibilities: status and plans.
   2.2 Alignment with curved muon tracks of low momentum.
3. MPI centre for calibration and alignment.
4. Commissioning of the muon spectrometer: status and plans.

Calibration of the MDT Chambers

The regular calibration tasks

- Weekly synchronization of all drift-tube channels.
- Daily determination of the r-t relationship of each chamber.
- Daily determination of the spatial resolution of each chamber.

Difficulty

- The operating conditions are not uniform over an entire MDT chamber in some regions of the spectrometers. $\rightarrow$ Non-uniformity of $r(t)$.
- Main sources of the non-uniformity:
    - non-uniformity of the magnetic field ($\lesssim 0.4$ T),
    - non-uniformity of the temperature (1-2 K),
    - non-concentricity of the anode wires in the end-cap chambers ($\lesssim 600$ μm).

Calibration of the MDT Chambers

Calibration strategy

Application of time corrections for the non-uniformity of the operating conditions in order to keep one $r\text{-}t$ relationship per chamber.

Responsibilities for the correction functions

MPI: Magnetic-field correction.
     Status: tested, ready for code submission.

Rome: Temperature correction.
      Status: pending.

Michigan: Wire-sag correction.
          Status: under development.

# Further Software Responsibilities of MPI

Old commitments

- Autocalibration of $r(t)$:
  - Part of ATHENA.
  - Excellent performance (see next slide).
- Determination of the spatial resolution:
  - Algorithm developed by S. Horvat (PhD thesis).
  - Algorithm will be implemented in ATHENA until beginning of November.

Recent commitment (since the last muon week)

- Interface between the calibration algorithms and the calibration database.
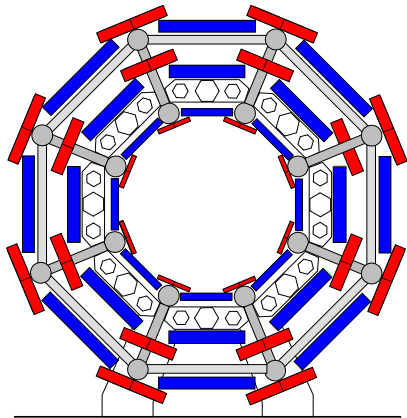- Work on the interface is about to start.

ATLAS Monte-Carlo study

Jörg von Loeben

required r–t accuracy
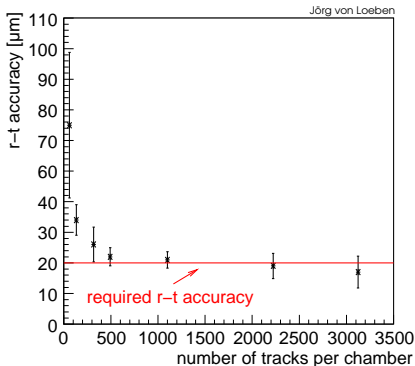
- Required r-t accuracy of 20 μm achieved with 2000 tracks per chamber.
- Calibration data stream: 5 Hz/chamber.
- $\rightarrow$ r-t calibration every 10 minutes possible.

- Relative alignment of large barrel chambers with optical system.
- Missing optical precision alignment for the small barrel chamber.
- Role of muon tracks:
  - Absolute alignment of large chambers.
  - Alignment of the small chambers with respect to the large chambers by means of overlap tracks.

Alignment with Tracks

Status

Overlap-tracks:

- First version ready.
- Problems with new tracking classes in ATHENA.

Absolute alignment:

- Alignment with straight tracks simple, but no algorithm in ATHENA yet.
- New approach with curved low-momentum tracks from the calibration stream.
  First studies by Jens Schmaler look promising.

MPI Centre for Calibration and Alignment

- The MDT calibration will be performed by 3 three calibration centres outside CERN: Michigan, Munich, Rome.
- The alignment with tracks will solely be performed at the Munich centre.
- Requirements by the beginning of next year:
  - 100 CPUs.
  - 2×5 TB disk storage.
- Status:
  - No CPUs.
  - 1 5 TB file server.
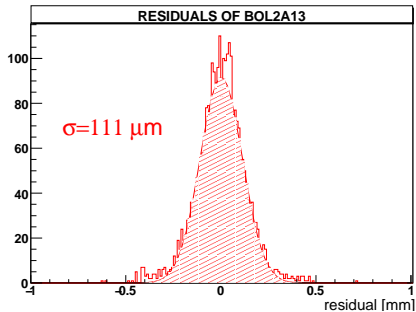- First tests in the context of the DC-3 end of October.

Measurement of the Noise Levels of the Chambers
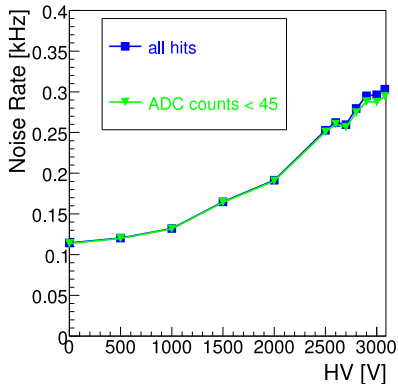
- Counting rate well below the limit of 5 kHz/tube.
- Additional hits have low ADC-Value (like noise).
- Increase of counting rate with the high voltage due to HV ripples.

Analysis of First Commissioning Data

Check of the Spatial Resolutions of the Chambers

- Residual distribution centres at 0.
- Width of the residuals compatible with the single-tube resolution of 100 μm plus muliple scattering.

Performance of the MDT chambers as expected.