

Munich Muon Spectrometer Calibration and Alignment Centre

Oliver Kortner

Max-Planck-Institut für Physik

ATLAS-Besprechung am 18.06.2007 am MPI

Calibration tasks

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.

Calibration data-stream and calibration centres

- Calibration data stream: level-2 muons in region of interests at a rate of 2 kHz.
- Calibration data stream allows for quasi-online calibration of the muon spectrometer (1 day delay).
- Calibration centres: computing clusters of 100 CPUs each in Michigan, Munich, and Rome receiving the data stream and performing the calibration.

Status of the MDT calibration

- The calibration framework and the calibration algorithms are ready.
- A prototype version for the extraction of muon calibration stream at the end of the level-2 trigger is available.
- The automatic processing of the stream at all calibration centres is being tested within the calibration data challenge.
- The streaming of the single-muon data from CERN to all calibration centres should take place in June.

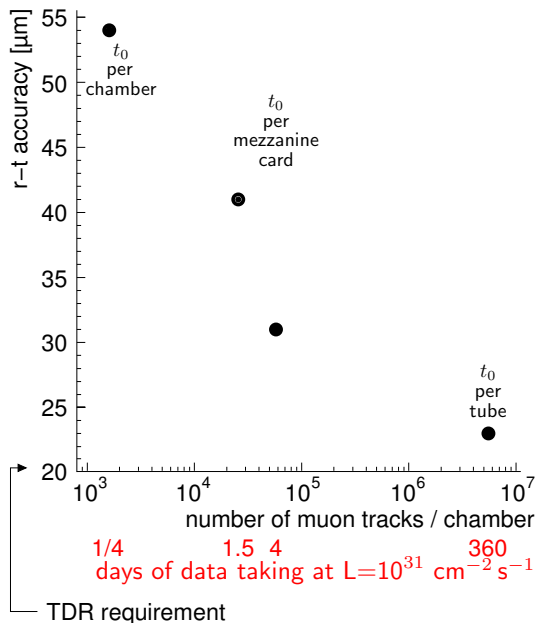
Problem at MPI: Tier-2 not yet ATLAS compliant, not yet in the list of ATLAS tiers.

→ Problem at MPI main reason for delay of streaming test.

- Start of conditions and muon calibration Oracle database replication planned for September.

MDT chamber calibration with the first pp data

$r-t$ accuracy after time synchronization and autocalibration



Assumptions:

- $L = 10^{31} \text{ cm}^{-2} \text{ s}^{-1}$
- Calibration stream at a rate of 100 Hz, i.e. 0.25 Hz/chamber.

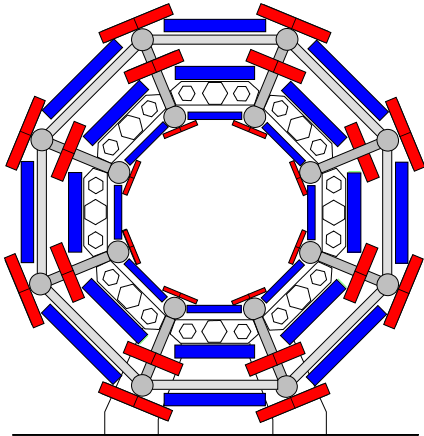
Conclusions:

- Reasonable $r-t$ accuracy already after 1 days of data taking.
- 30 μm $r-t$ accuracy close to TDR requirement after 1 week of data taking!
- TDR requirement of 20 μm unreachable due to missing statistics for a tube-by-tube synchronization.

Alignment of the muon spectrometer

End caps

- Calibrated optical alignment system.
- Absolute alignment accuracy $\sim 100 \mu\text{m}$.



Barrel

- Absolute optical alignment $\sim 100 \mu\text{m}$ in most areas of the barrel.
- Absolute optical alignment $>500 \mu\text{m}$ in some areas where platform positions are not known with sufficient accuracy.
- Relative alignment of large barrel towers with optical sensors.
- Missing optical precision measurements for small chambers.
- Role of muon tracks:
 - Absolute alignment of large towers.
 - Alignment of small towers with respect to large towers with overlap tracks.

Status of the alignment with tracks

- Alignment with tracks based on the calibration stream.
Stream extraction for overlap region still missing!
- Algorithms for the alignment with straight and curved tracks have been developed.

Remarks on the baseline scenario for the initial alignment

- Baseline scenario: Run with no toroid field → absolute alignment from straight tracks.
- Strategy for the baseline scenario at $L=10^{31} \text{ cm}^{-2} \text{ s}^{-1}$
Alignment on the calibration stream
 - No p_t^μ cut possible in the level-1/2 muon trigger in absence of the field.
→ Calibration stream dominated by low- p_T muons ($\sim 1 \text{ GeV}/c$ as for cosmics), but with a rate of $\sim 1 \text{ kHz}$.
 - Alignment accuracy $100 \mu\text{m}$ for 1 day of data taking with the stream at a rate of $\sim 1 \text{ kHz}$.

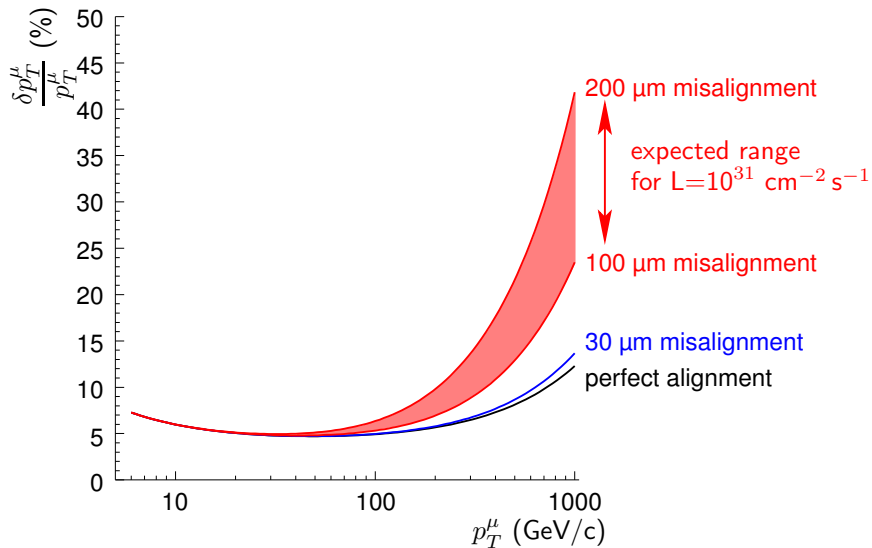
Alignment with high-level data

- Use the momentum measurement from the inner detector to select 20 GeV muons.
- Alignment accuracy $\sim 100 \mu\text{m}$ for 5 days of data taking.

Complementary approaches. → Cross check of the alignment parameters.

Stand-alone momentum resolution with first data

p_T^μ resolution for muon spectrometer alone



- $p_T^\mu \lesssim 100 \text{ GeV}/c$: Momentum resolution close to ideal.
- $p_T^\mu > 100 \text{ GeV}/c$: Significant deterioration of the momentum resolution.

Alignment data challenge

- Halted. Waiting for the appropriate data stream.
- Team: S. Kotov supported by O. Kortner.

Calibration data challenge

- CDC is done by the experts for the calibration framework and calibration algorithms.
- Team: O. Kortner (MPI), F. Rauscher (LMU).

Calibration of commissioning data

- The calibration centres share the production of calibration constants for the commissioning data starting with the M3 data.
- Team:
 - O. Kortner (coordination).
 - F. Rauscher (trigger-time calibration and event time calculation).
 - J. v. Loeben (MDT chamber calibration, expert for $r-t$ calibration).
 - S. Kaiser (MDT chamber calibration, expert for efficiency and fake-rate determination).
 - G. Dedes, Th. Ehrich (MDT chamber calibration).

Manpower requirements after the LHC start-up

- Coordination:**
- 1 person for the overall coordination of the calibration and alignment centre.
 - 1 contact person at LMU.
 - 1 contact person for the calibration part.
 - 1 contact person for the alignment part.
- Operation:**
- Team of shifters: 4 persons.
 - 1 person for the calibration database, data transfer, data storage, and job submission infrastructure.

A refined table will be made after the calibration data challenge based on the experience of the CDC.