Calibration and Performance of the precision chambers of the ATLAS muon spectrometer

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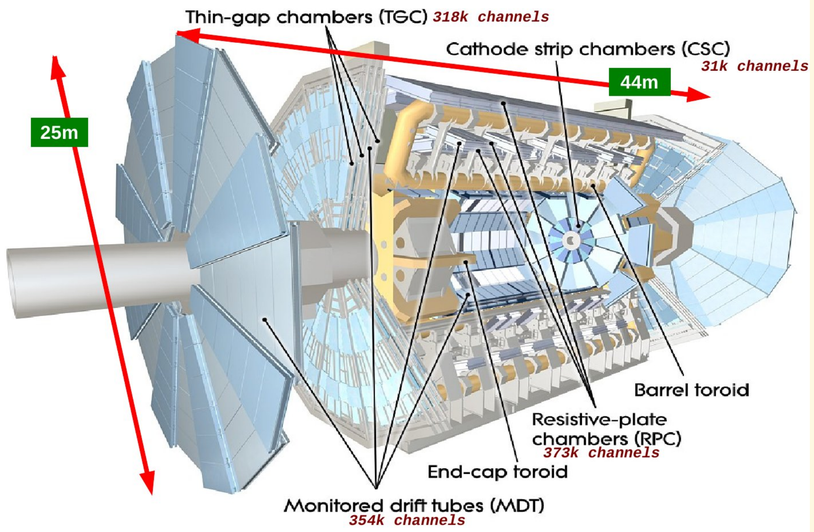
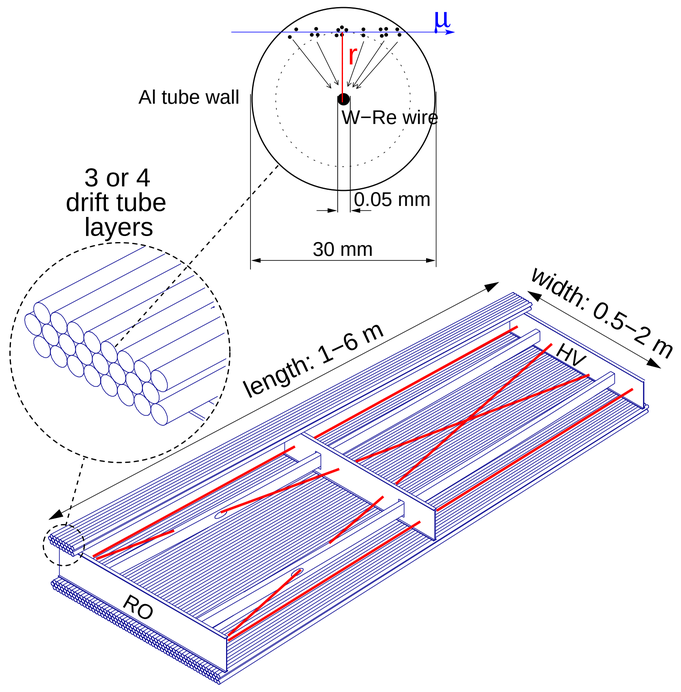
The ATLAS Muon Spectrometer



Standalone Spectrometry

- $\Delta p_T/p_T < 12\%$ up to 1 TeV
- Coverage: $|\eta| < 2.7 (|\theta| < 86°)$

Monitored Drift Tubes Chambers



Drift Tube

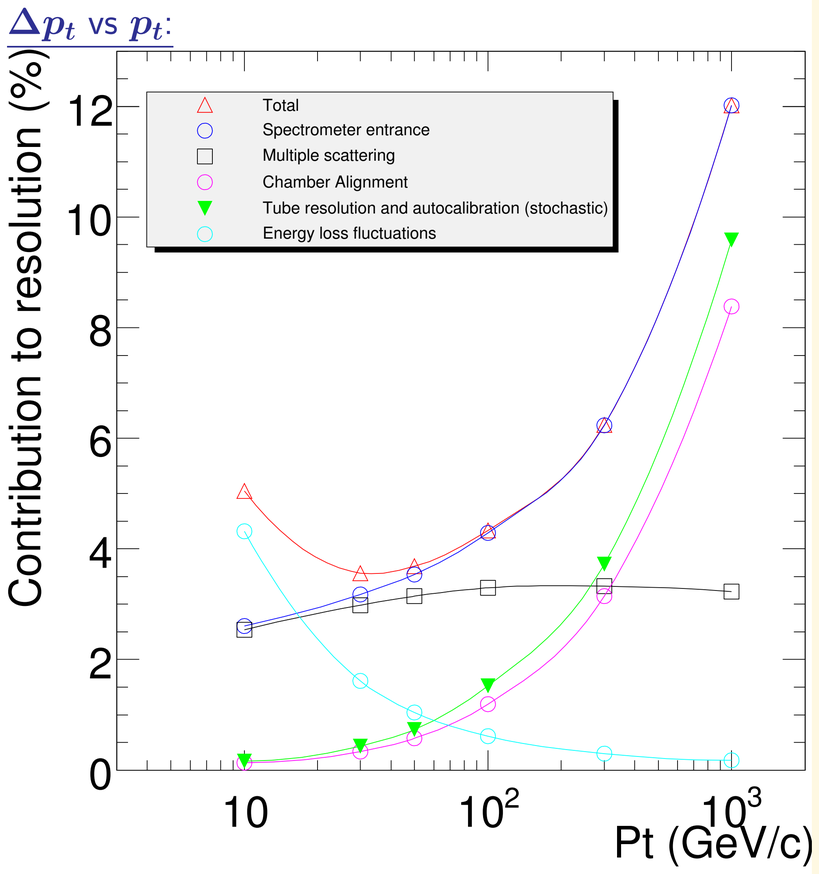
- Ar/CO_2 @ 3 bar absolute
- $\varnothing_{\text{Tube}} = 30\,mm$ $\varnothing_{\text{Wire}} = 50\,\mu m$
- HV$= 3080$ V
- Gas Gain: $2\ 10^4$

MDT-chamber

- 2 multi-layers with 3 or 4 layers.
- surface 0.5 - 11 m^2
- Monitoring of geometry, temperature, B-field.

Resolution Contributions

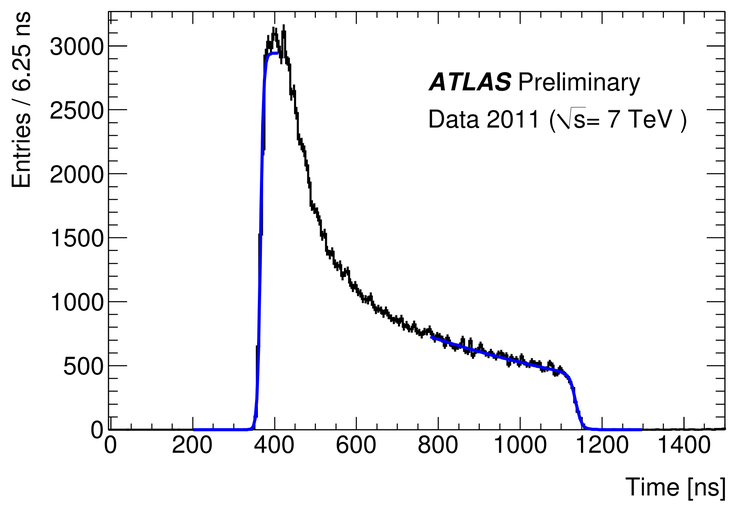
Δp_t vs p_t:



- Required chamber resolution: 50 μm
  → Drift time offset 0.5 ns
  → rt-precision: 20 μm

t_0-Fit

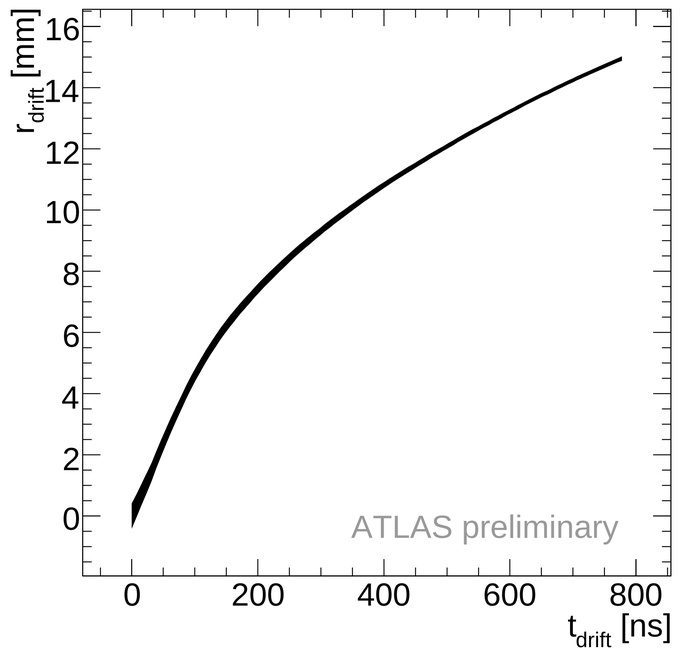
The drist-time spectrum with analytic functions fitted to the rising and falling edges:



- Automatic and reliable procedure
- t_0 Calibrated drift-time offset
- Other parameters (slope, t_{max}) enter data quality analysis

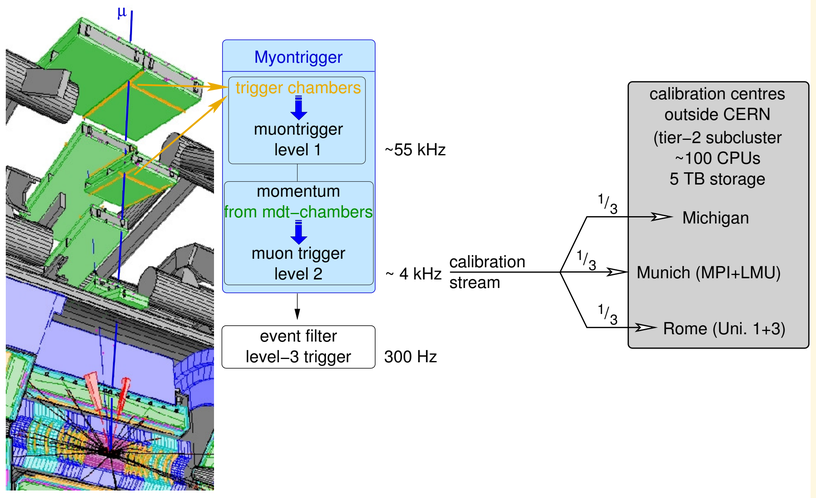
rt-calibration

Conversion function $t_{\text{drift}} \mapsto r_{\text{drift}}$:

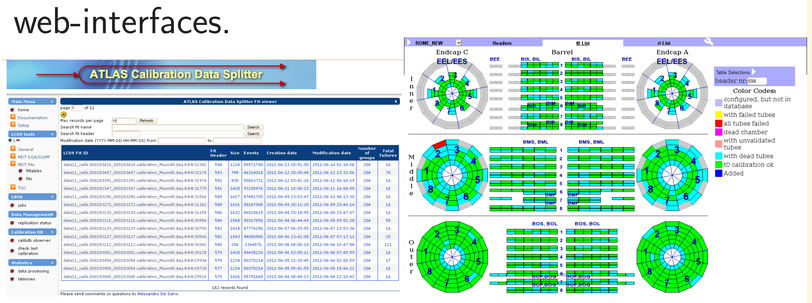


- Straight line segment fit in a chamber is overdetermined.
- r_{drift} (t_{drift}) and $\sigma(r_{\text{drift}})$ (t_{drift}) can be determined iteratively.
- One rt-relation per chamber is determined. Corrections (magnetic field) are applied.

Calibration Stream

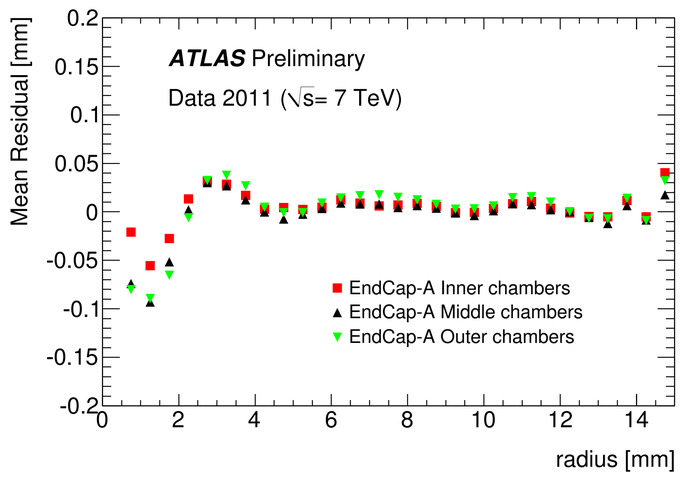


- muon spectrometer tracks are extracted by the level 2 trigger.
- Due to the processing power needed, the data is sent to three dedicated calibration sites. Like this the processing is finished in time for the start of the reconstruction (36 hours).
- Shifters control and monitor calibration via web-interfaces.



rt-Precision

The difference $r_{\text{segment}} - r_{\text{drift}}$ shows the precision of the rt-relation:



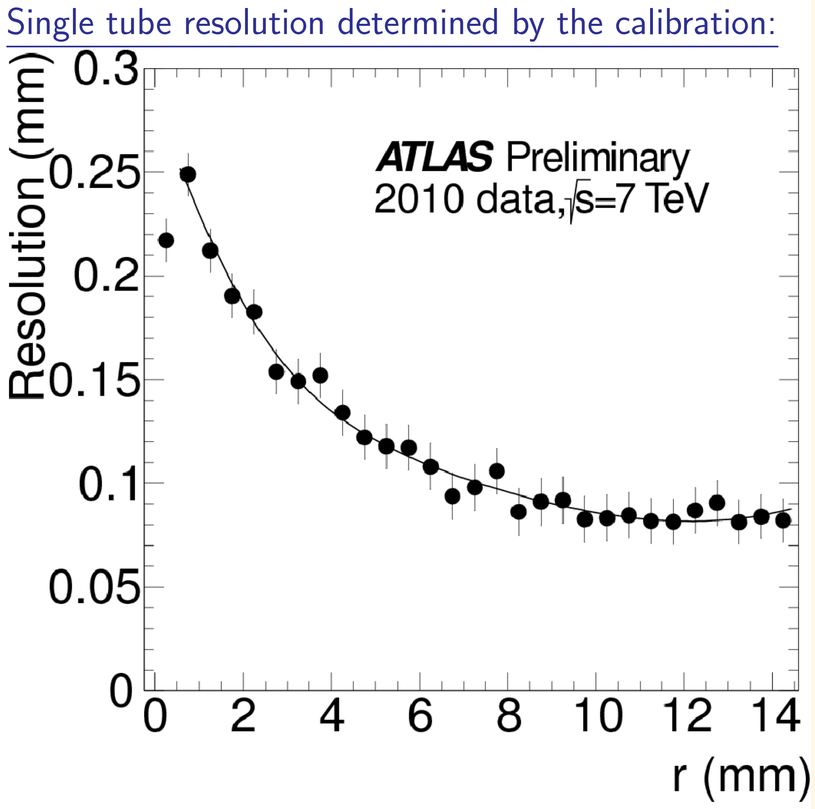
- Deviations at $r < 1mm$ and $r > 14mm$ are due to the limit $0 < r < 14.6mm$.
- Deviations at $1mm < r < 2mm$ hint at a small offset in the t_0-calibration. However, due to the high drift velocity in this range the resolution is worse in this region, and less affected by the rt-precision.
- For $r > 2mm$ the rt-precision is better than $20\mu m$.

Stability:

Drift properties are slowly changing due to their dependence on the gas-composition. Calibration is performed for each run with sufficient statistics, and applied if needed.

Tube Resolution

Single tube resolution determined by the calibration:



- Resolution goal is reached for 6 hits.
- Further improvements can be achieved by hit-level corrections according to magnetic field and pulse height.