

# Study of Misalignment Effects of on the PT-Resolution of the ATLAS-Muon-Spectrometer and the Z-Resonance

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## Study of the Vector-Boson-Production at the ATLAS-Experiment

- Primarily studying the process  $Z \rightarrow \mu\mu$

Study of the Sagitta Resolution of MDT-chambers with cosmic muons

- Analysis of the cosmic ray data at the LMU Cosmic Ray Measurement Facility (CRMF)
- Further Developments and Study of a full Geant4 simulation of the CRMF
- Study of different effects like Single Tube Resolution, Wire Positioning, ... on the Sagitta Resolution in ATLAS

To which precision can we expect to measure the cross-section / pT-Spectra, ... of  $Z \rightarrow \mu\mu$

- Pile-uped Background and Signal discrimination
- Study of Efficiencies / Resolution ...
- Using the Z resonance for Alignment and Calibration issues:

- **Impacts of Misalignment**

- Alignment-Algorithms

The  $Z \rightarrow \mu\mu$  process during low luminosity phase

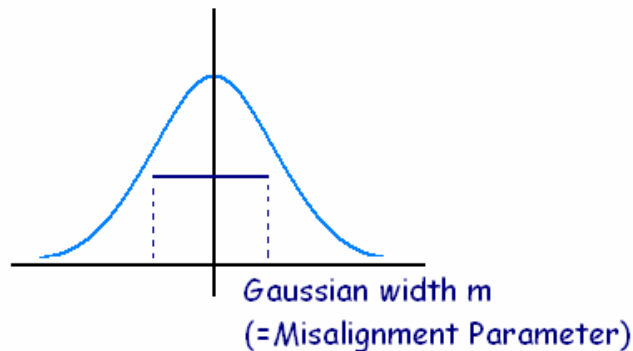
- Efficiencies, Resolution, ...
- Impacts of PDFs on the pT-Spectra of the Z-Boson
- Looking for new physics (like extra dimensions) in the Drell-Yang-Spectra of the Z-Boson

Service-Work

- Validation- / Clash-Buster-Team
- Some Installation-Services
- ...

## Basic Idea

- Shift and Rotate each MDT-chamber randomly by a certain amount, which is defined by one parameter  $m$

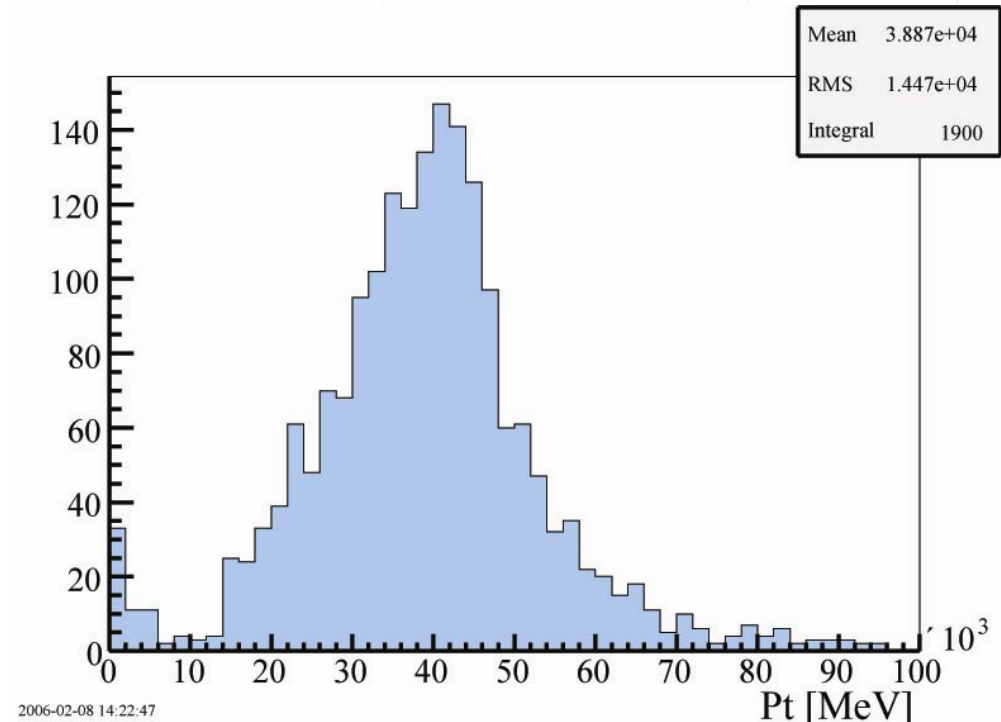


- Simulation & Digitization: This was done with the standard Q-Layout of the ATLAS Muon Spectrometer
  - Reconstruction: Here a misaligned Layout was used.
- ↓
- There should be a equivalence between a misaligned Detector during Simulation and standard Detector layout during Reconstruction and the other way round.
- ↓
- The equivalence was proven in the CRMF (but without effects of the magnetic field)
  - In principle this should be fine

# Which muons I have used for this study

## Alignment Study based on

- 5K  $Z \rightarrow \mu\mu$  (Generated with Jimmy)
- Simulated, Digitalized, Reconstructed with 11.0.2 (Muonboy)
- Q - Layout was used for the description of the Muon Spectrometer
- → Only PT-Effects between 20-60GeV were taken into account

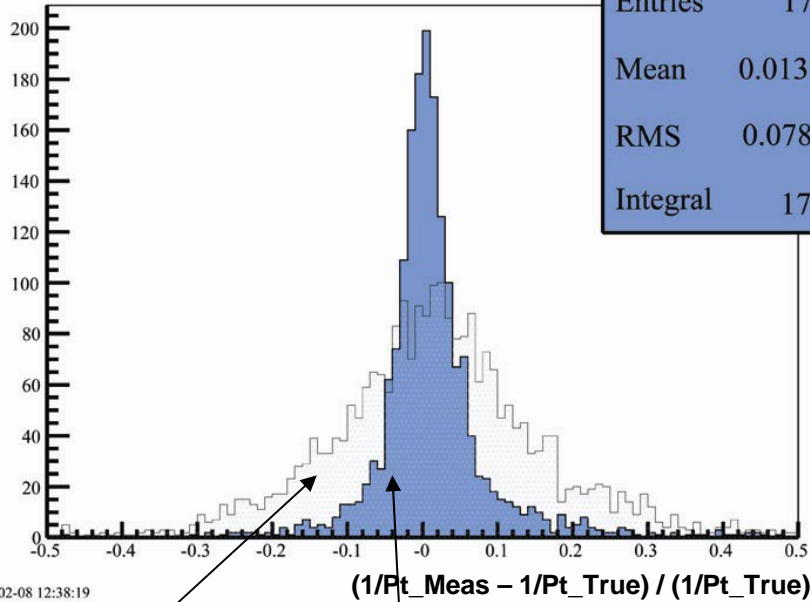


# PT-Resolution vs Misalignment for the Standard Layout

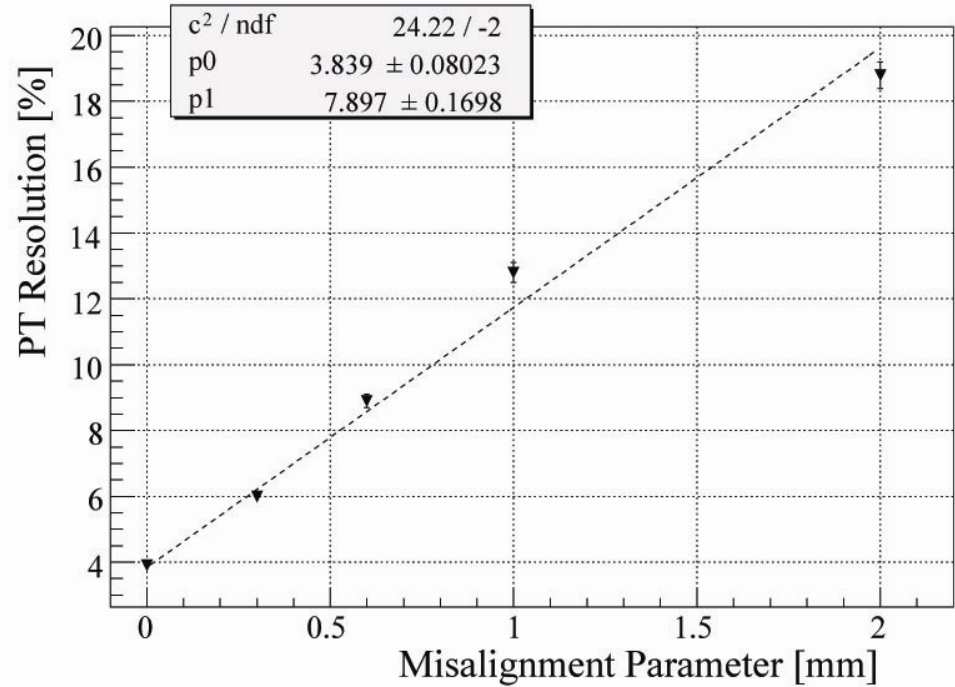
Pt-Resolution (total)

1 mm Misalignment

No Misalignment

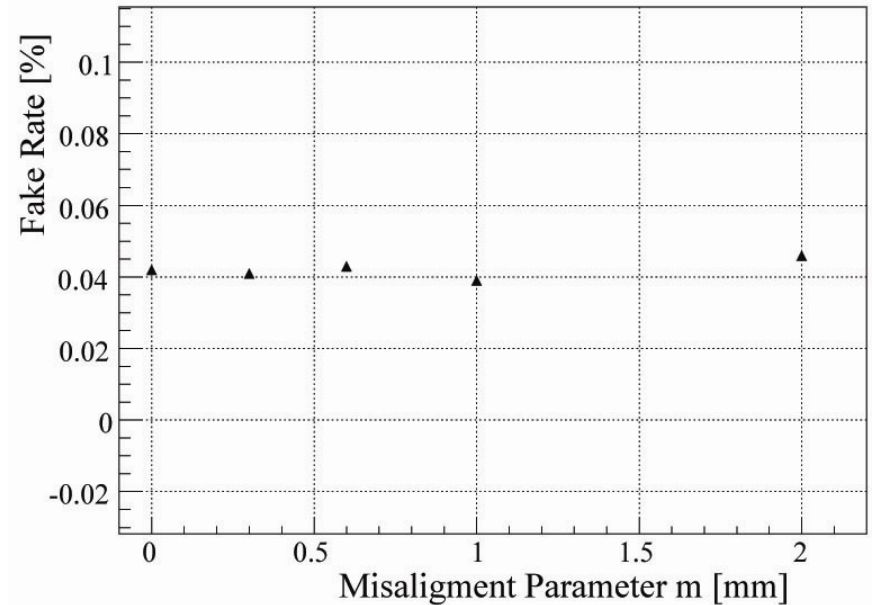
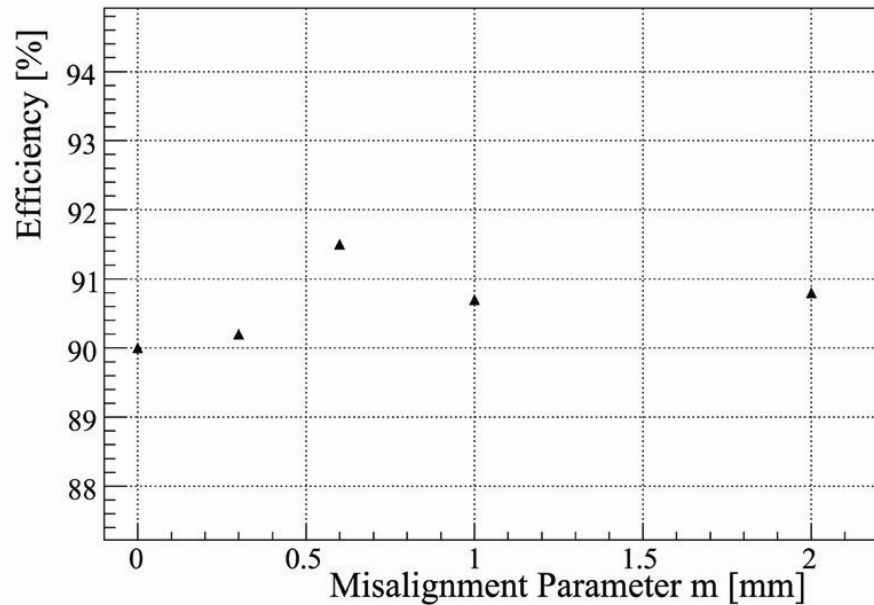


- 1mm Misalignment
- Perfect Layout



- We see a linear dependence between misalignment and PT-resolution

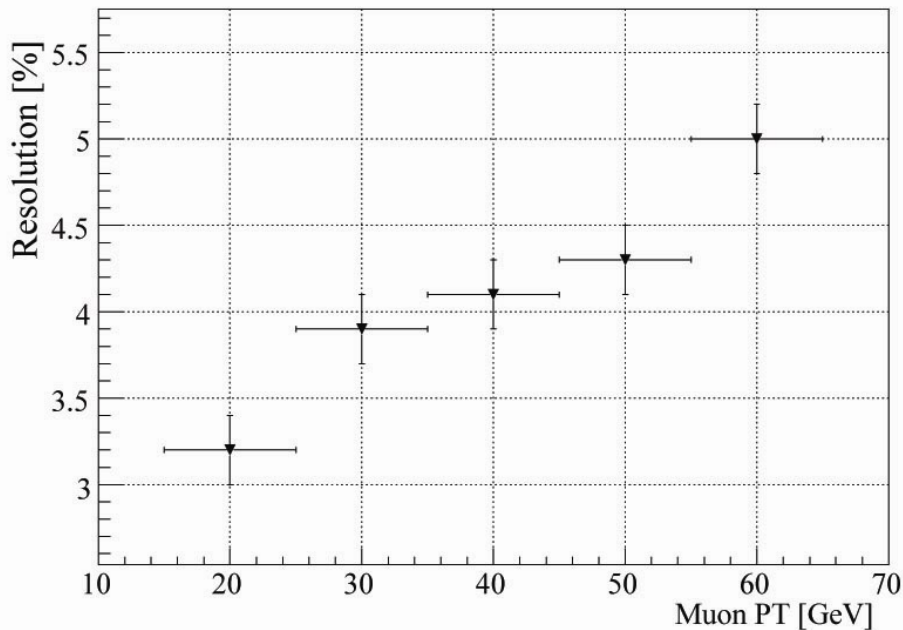
# Effects on Efficiency and Fake-Rate



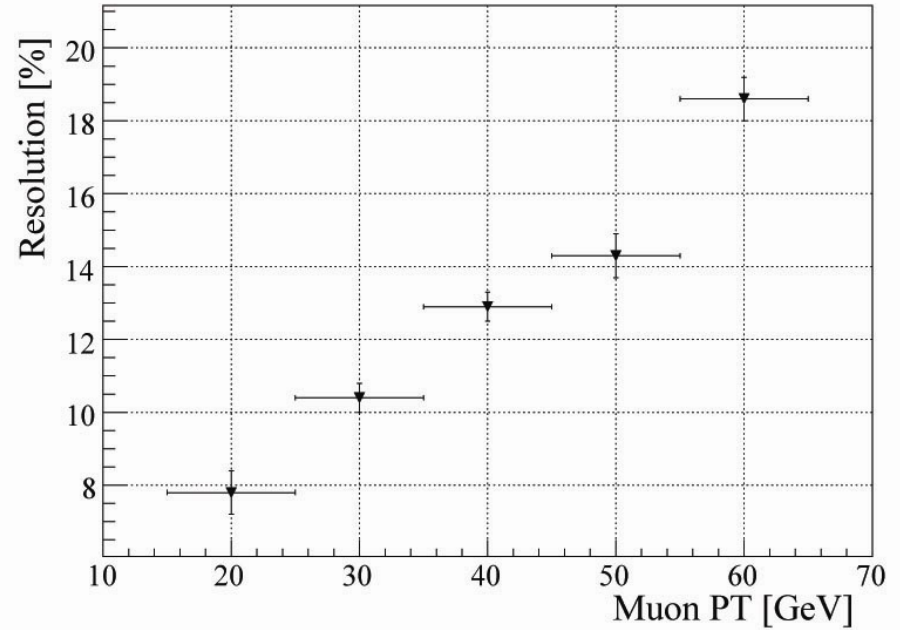
- Efficiency (Matched Truth and Reconstructed Muons)
- Done for Muon-PTs between 20-60GeV
- No visible effect on the efficiency is seen

- Fake Rate (Reconstructed Muons where no Truth Muon could be associated)
- Done for Muon-PTs between 20-60GeV
- No visible effect on the fake rate is seen

# PT-Dependence of Resolution for nominal Layout and 1mm Misalignment

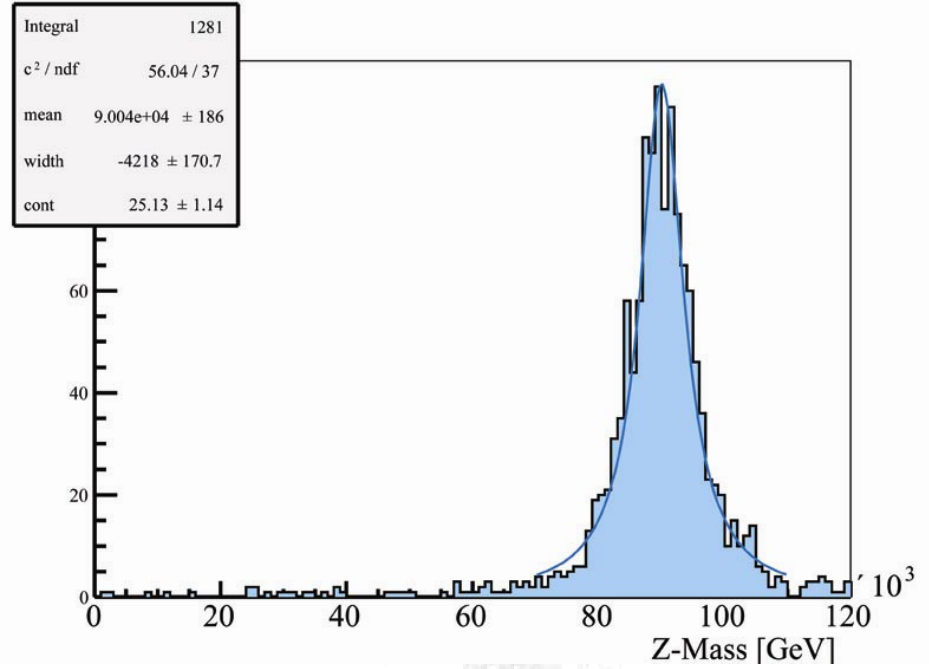
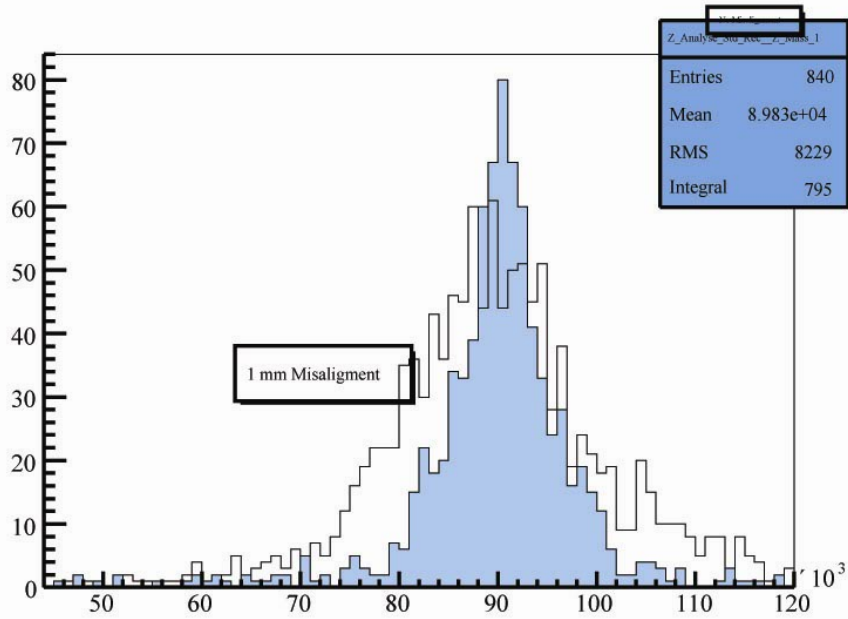


- PT-Dependence for the nominal Layout



- PT-Dependence for a misaligned Layout of 1mm

# Impact of Misalignment on the Z-Resonance

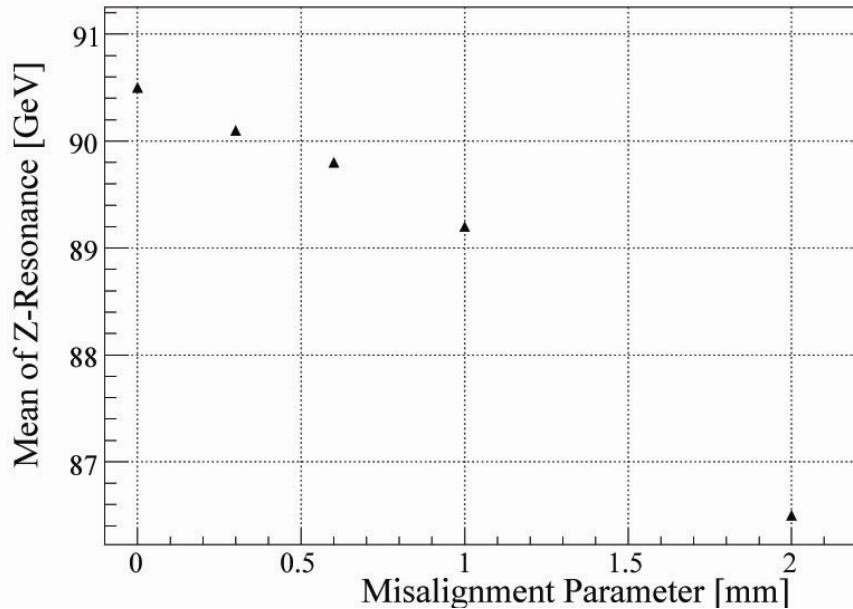


- The Z-Boson Resonance for Nominal Layout and 1mm Misalignment

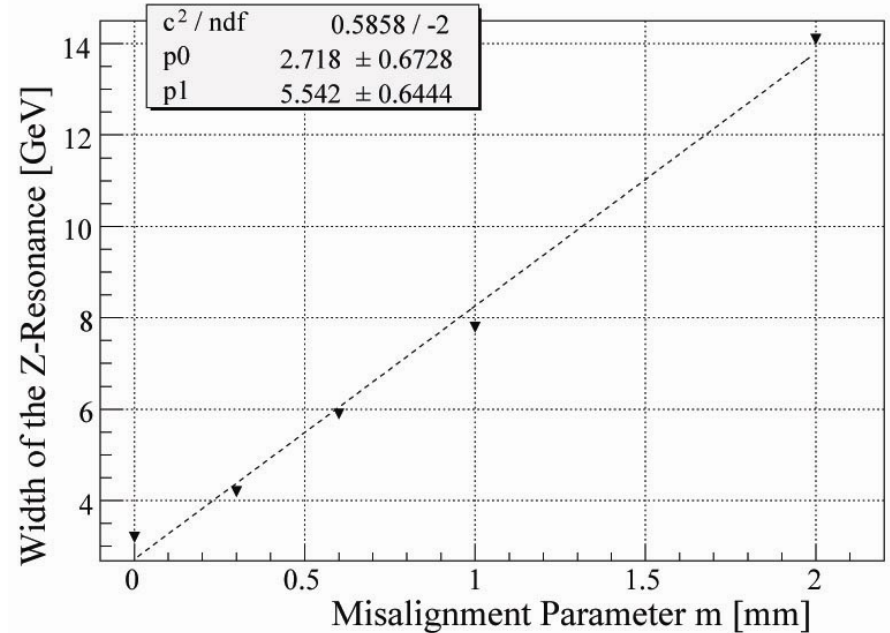
- The Z-Boson Resonance for 0.3mm Misalignment



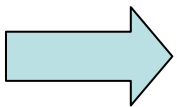
# A more systematic Study of the Z-Boson Resonance



- Effect of Misalignment on the mean of the reconstructed Z-Boson Resonance



- Effect of Misalignment of the width of the reconstructed Z-Boson Resonance



- Furthermore an impact on the Reconstruction and Cut-Efficiencies is seen

# Conclusion

## What has been done:

- We quantified the impact of misalignment effects on the  $p_T$ -Resolution of the ATLAS Muon Spectrometer
- We also quantified these effects for the reconstruction of the Z-Boson resonance
- We also studied (but this is not shown in this small presentation) the impacts of the Egg-Shape-Layout (R' and R'' Layout) and found a quite important bug, which should be fixed by now
- A more detailed presentation will be given during the upcoming ATLAS-week

## What will be done:

- Study of Alignment-Effects for sensitive and not-sensitive directions
- Study of the R' and R'' layout
- Study / Comparison between Magnetic-Field and Alignment Effects

## Special thanks

- Sacleby: For providing an insight to Muonboy and the good collaboration (Jean-F., Laurent)
- Nectarios: For his excellent supervision at CERN (although he is very busy...)