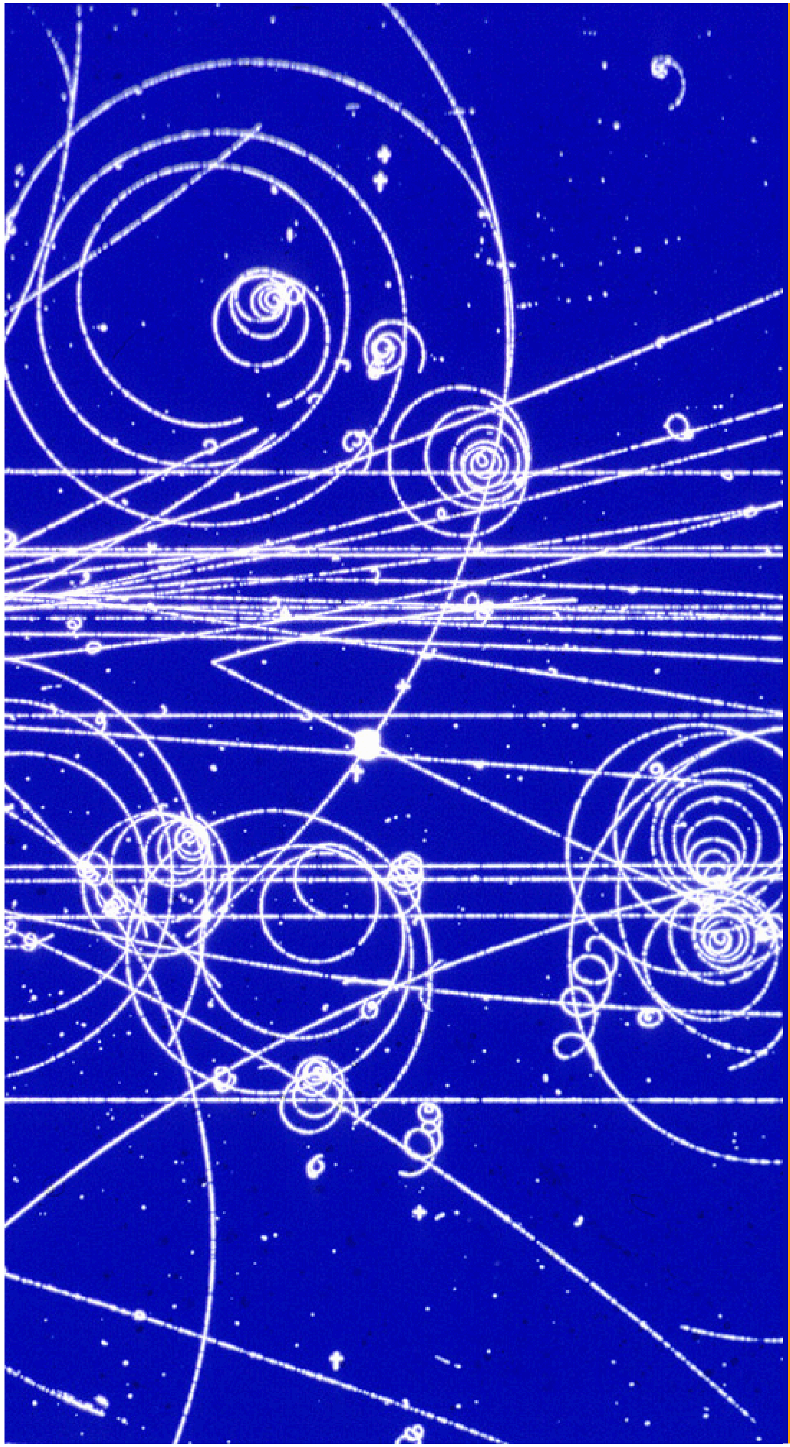

Modelling Chamber Deformations in ATLAS Muon Spectrometer

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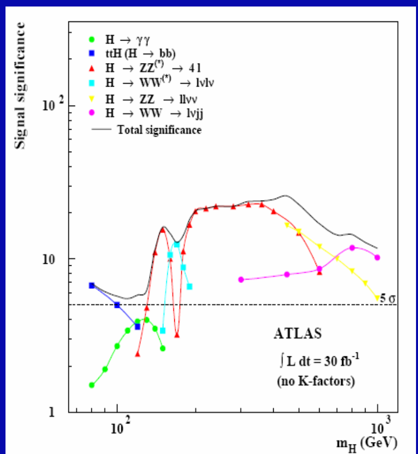
LHC : The largest collider ever is being built at CERN…

…to search for new physics and perform precise measurements

Probably the most famous search is the search for the higgs boson.

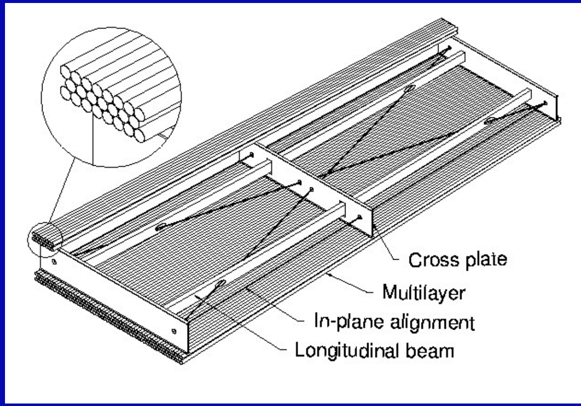
Muons are expected to provide clean signatures for a wide range of physics processes …



… because they are the only particles to escape the Calorimeters

For example H->ZZ->4μ

ATLAS Muon Spectrometer

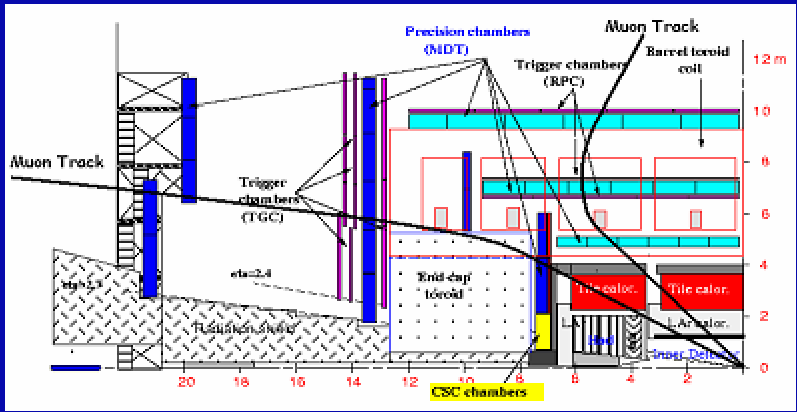


The main ingredient of the ATLAS Muon Spectrometer is the Drift Tubes, which are organised in Muon Chambers.

The Muon Chambers are organised in stations (layers).
The Muon Spectrometer has 3 such stations

Bear in mind that ATLAS is a HUGE detector of 44 m Length and 14 m Radius!

Measuring the muons



In order to measure the momentum of the muons, magnetic deflection is used.

Accuracy goal of Muon Spec. : Standalone reconstruction with P_T resolution of about 10% @ 1 TeV

1 Tev muon track will have a sagitta of 400 - 700 µm. (depending on its path)
Ultimate sagitta resolution (constrained by multiple scattering) is 50 µm.

Therefore, errors due to misalignments should be smaller(around 30 µm).

The accuracy goal cannot be reached and maintained mechanically!

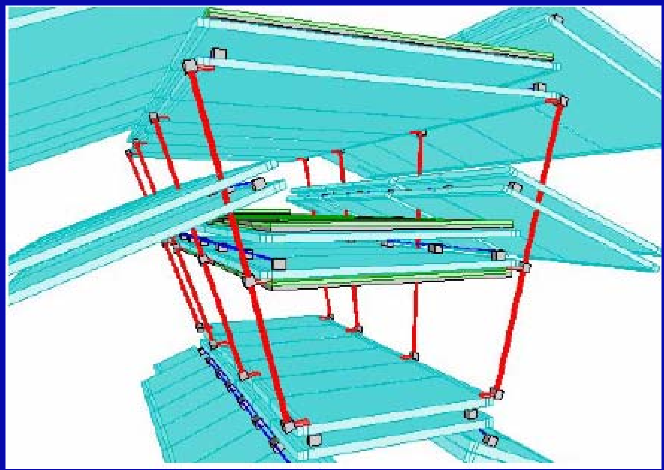
Measuring the muons is a difficult task

The geometry of the Muon Spectrometer must be continuously and accurately monitored.

Solution :

Sophisticated optical alignment systems and temperature probes are going to be installed on the Muon Spectrometer

Monitoring the Alingment



The Alignment of the Muon Spectrometer is mainly monitored by

•Praxial System

Provides Proximity and Axial measurements to unite a layer of chambers to form a single rigid layer

•Projective alignment system

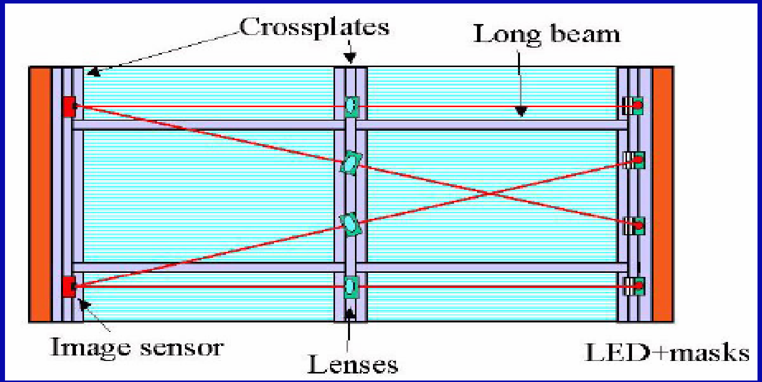
Relative alignment of different stations

•Reference System of absolute positioning (Not shown)

Monitoring the absolute positioning of the Muon Spectrometer

Monitoring the shape of the Chambers

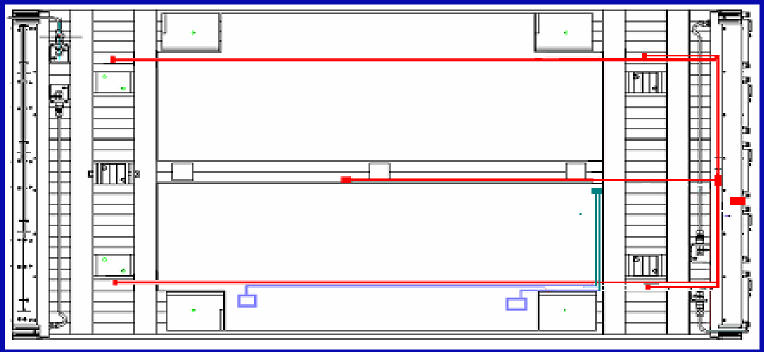
In – plane Alignment System



Monitor and correct for the Muon Chamber deformations

The Chambers are up to 6 m long! They are subject to gravity and inhomogenious heating on the two sides (effect of around 10 μm/K)

Temperature Probes



Monitor and correct for global changes in temperature

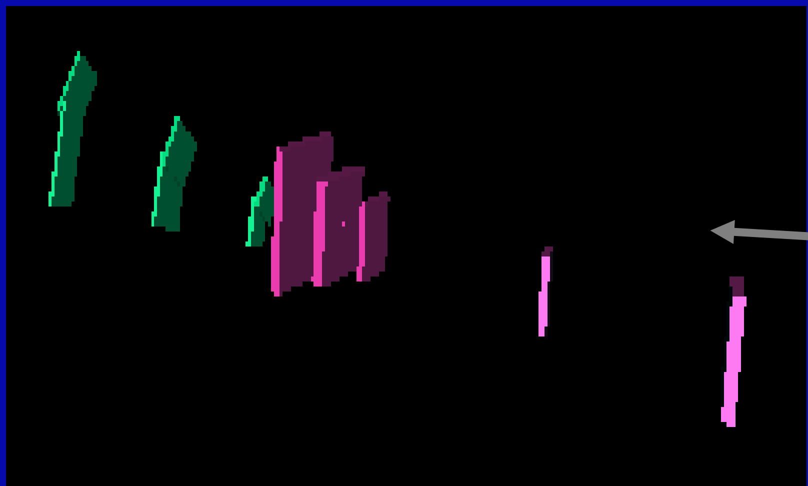
An important factor for such changes is the toroidal magnet

ATLAS Test Beam Area

Photo: A. Schricker

2004 Test beam is the last opportunity for testing in “real” conditions the alignment systems

Actual Test Beam set - up



Model Test Beam set - up

Good use of the information is needed

In order for the alignment systems to be useful, we should use the information inside the reconstruction algorithms. Presently 1 (out of 2) muon geometry packages and 1 (out of 2) reconstruction packages DO NOT take into account this deformations at all

Must model the deformations of the chambers

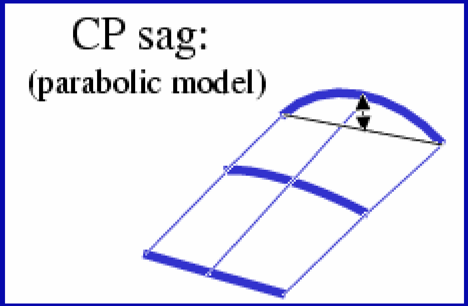
Modelling based on the kind of informations supplied by the alignment systems

Only deformations important for tracking being modelled

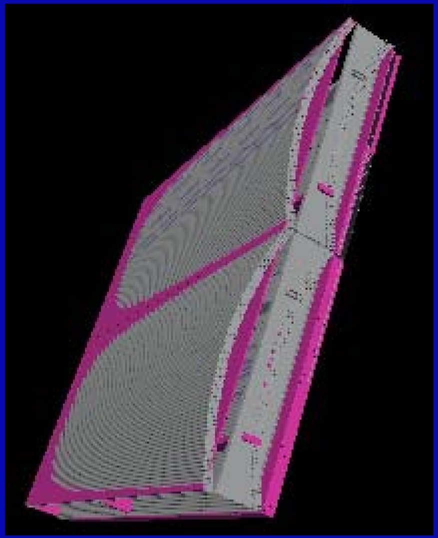
Cross Plate Sag

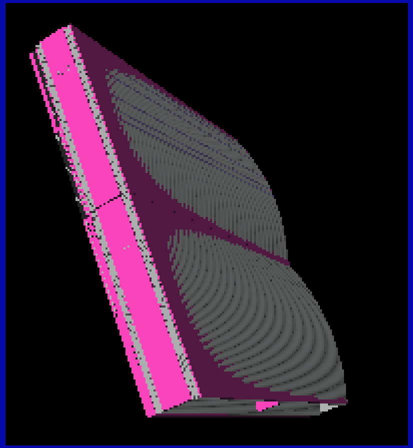
May occur due to problems in the kinematic mounting

The model



The implementation into MuonGeoModel geometry package





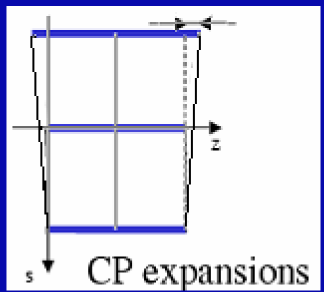
1 CP Sag at each side x 2 sides

Visualization using HEPvis
Effect enhanced for better visualization

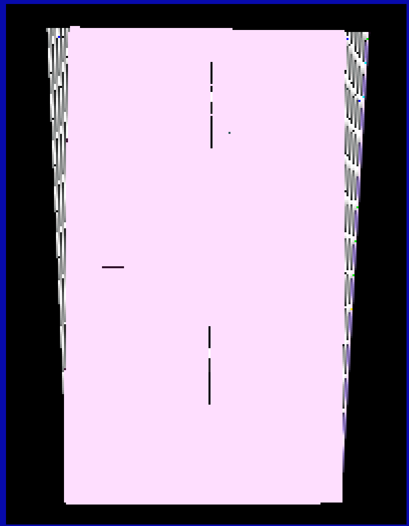
Cross Plate Expansion

May occur due to temperature gradients along the tubes

The model



The implementation into MuonGeoModel geometry package

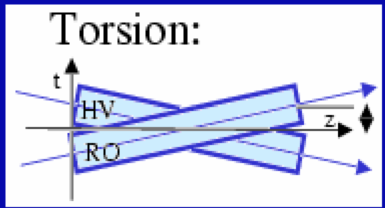


1 CP Expansion at each side x 2 sides

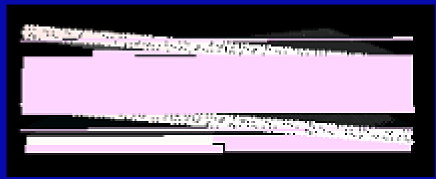
Torsion

May occur due to problems with the mounting bars

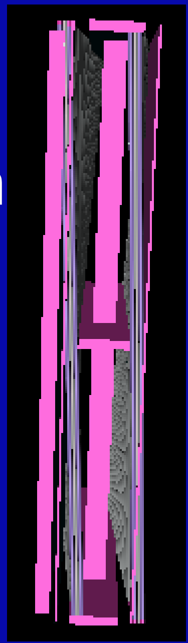
The model

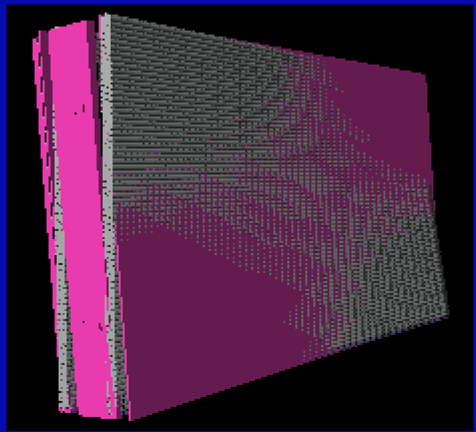


i.e. cross-plates twisting in opposite directions



The implementation into MuonGeoModel geometry package





Global Thermal Expansion

Global Thermal Expansion is difficult to visualize.

In order to have a view of the expansion, temperature must be really really high!

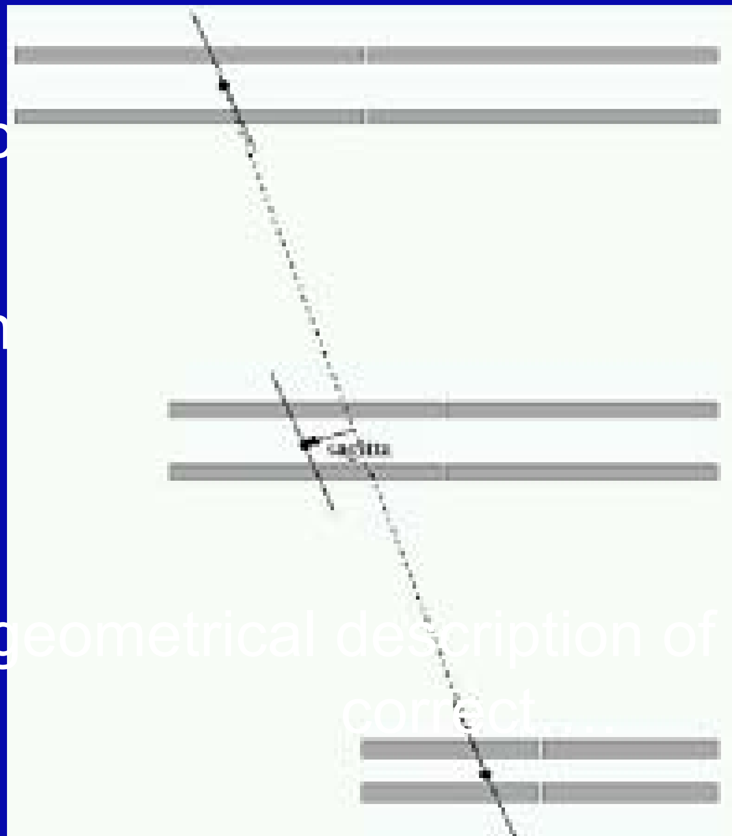
But remember that the tubes are made from aluminum

i.e. they are expanding fairly enough!!!

Measuring the effect

In the test b… agnetic field among
…rs

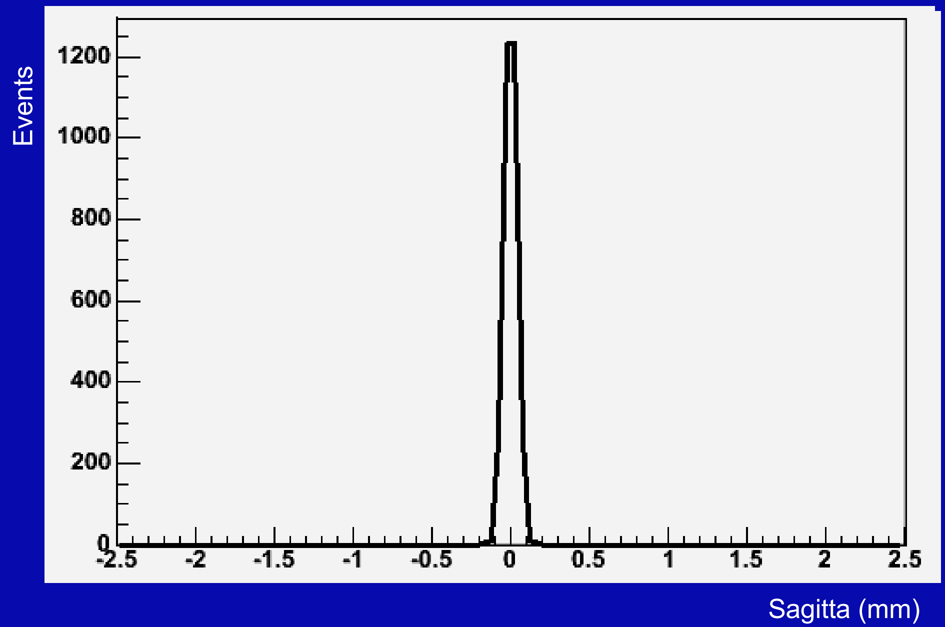
Thus on… e reconstructed



But if the geometrical description of the detector is not correct…

Analysis of the Test Beam data

The results of the test beam data without any corrections



The corrections are not fully implemented (1 more month of work for that) but we think that hopefully the new analysis should give results like…

Thank you very much…

… as a last word I would like to thank Dr Isabel Trigger and Dr Stefano Rosati for their help…

…any questions?