Geometric considerations in Z→μμ decay simulation and reconstruction

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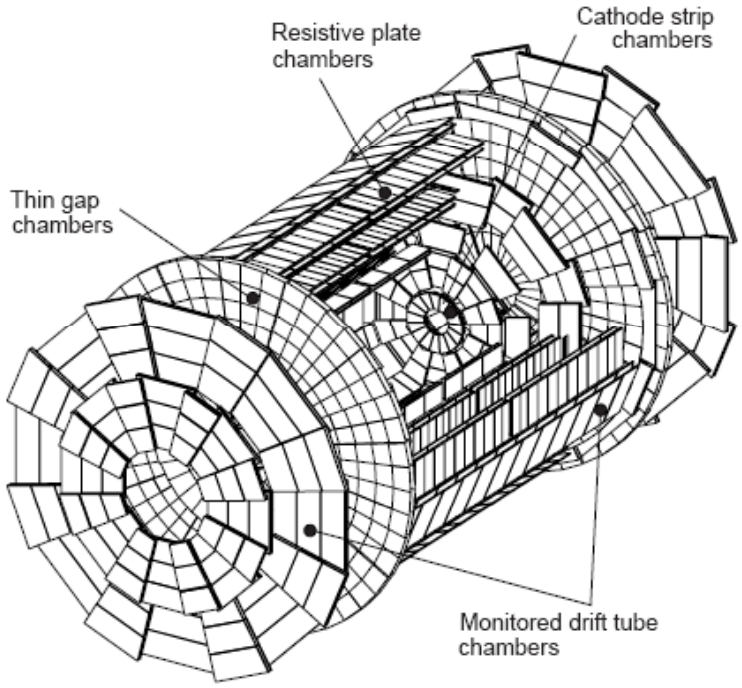
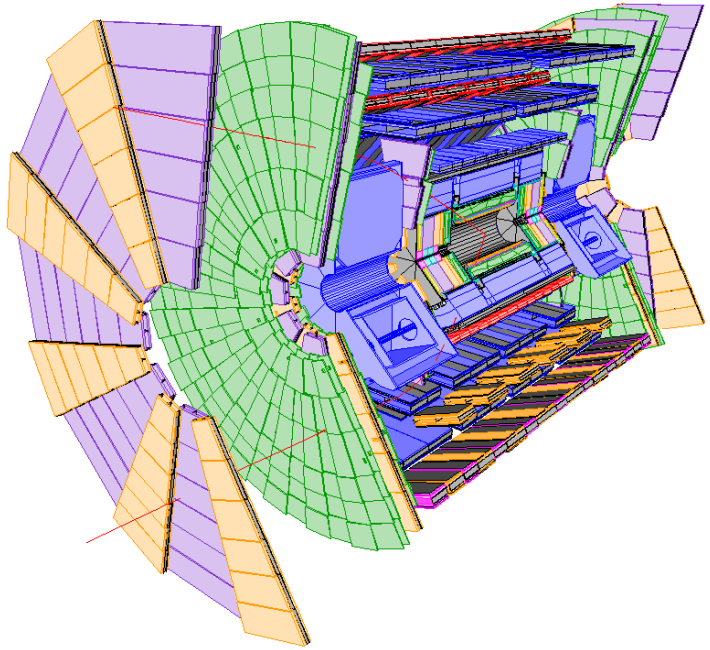
ATLAS

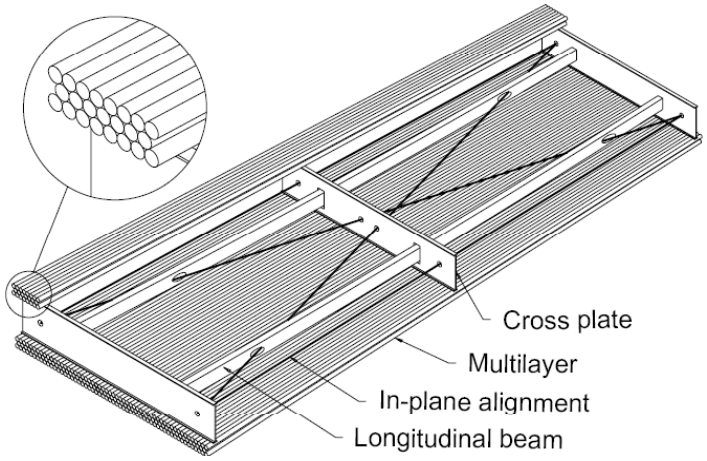
- Muon Detectors
  - Monitored drift tube chambers
  - Thin gap chambers
  - Resistive plate chambers
  - Cathode strip chambers

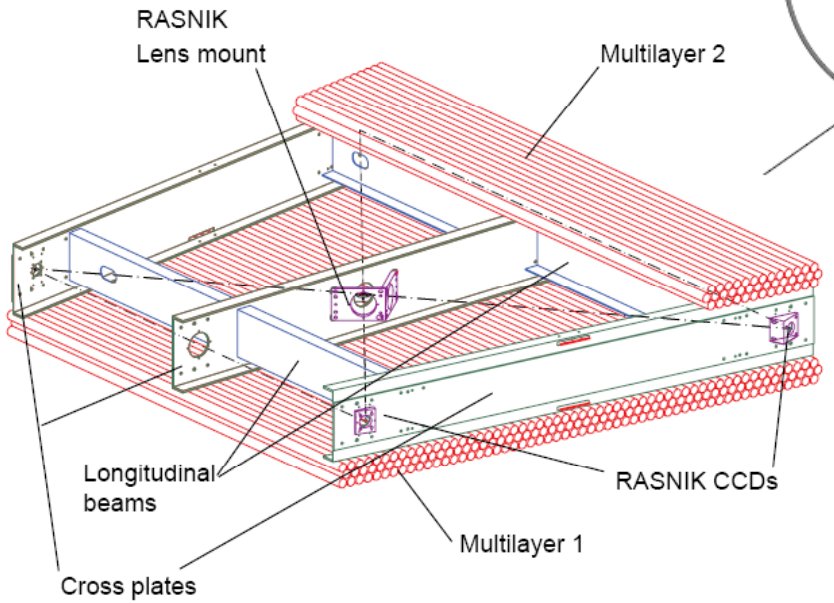


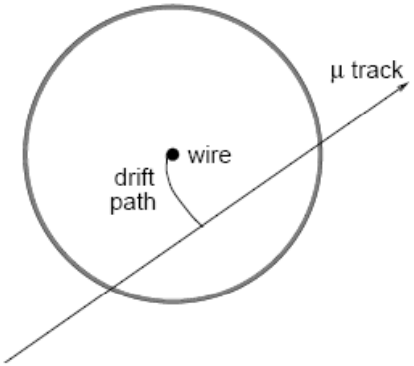


Monitored Drift Tube chambers

- 6 parallel layers
- Ionization electron drift time registration
- 6 coordinates
- Deformations monitored



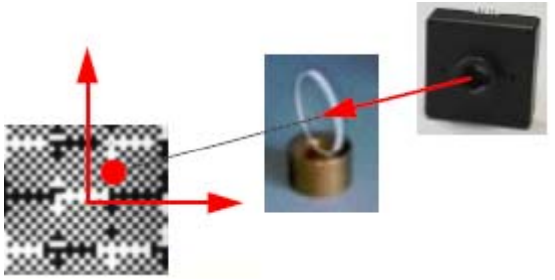




Alignment: importance

- Incorrect measurements
  - Especially at higher momenta
- Background more likely to be confused with event tracks
- Single MDT chamber spatial resolution ~40μm
  - Chambers must be aligned to 30μm accuracy (to provide desired momentum resolution)

Alignment: technique



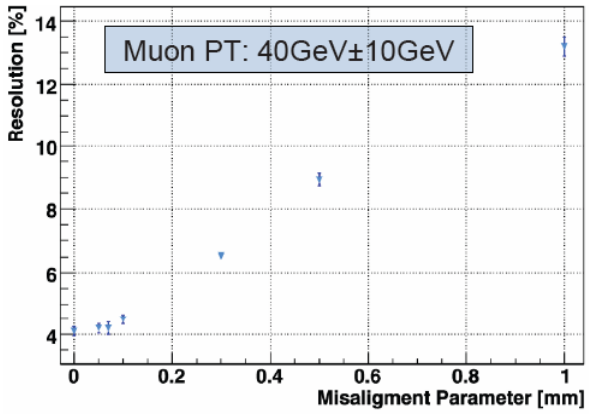
- RASNIK optical monitoring
  - Allows relative chamber displacements to be measured
  - Finds displacement of “mask” along the optical axis
- A-lines
  - Corrections to nominal chamber position
- B-lines
  - Chamber deformations and expansion

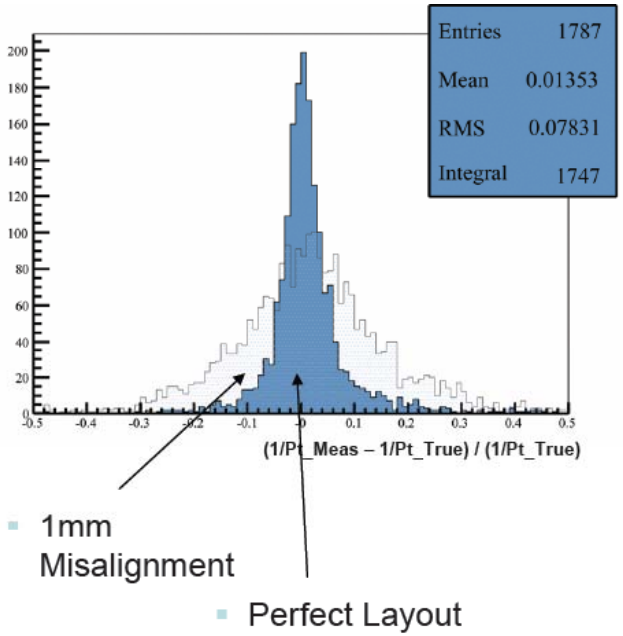
Why Z→μμ?

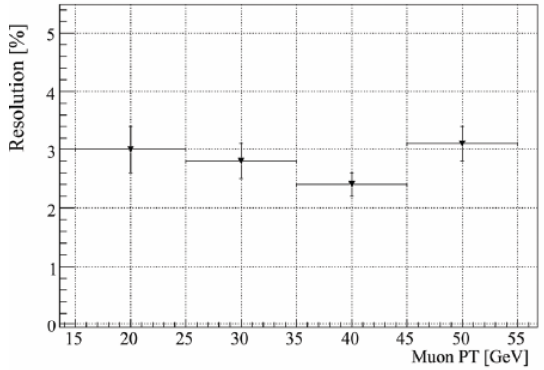
- Observation of misalignment effects
  - Momentum resolution
  - Will not know "simulated" (real) momentum with real data
  - Effects on simulated Z→μμ decay data can be studied for comparison to real decay data
- The Reconstructed Z mass
  - Well-known shape
  - Width comparisons

Previous alignment studies

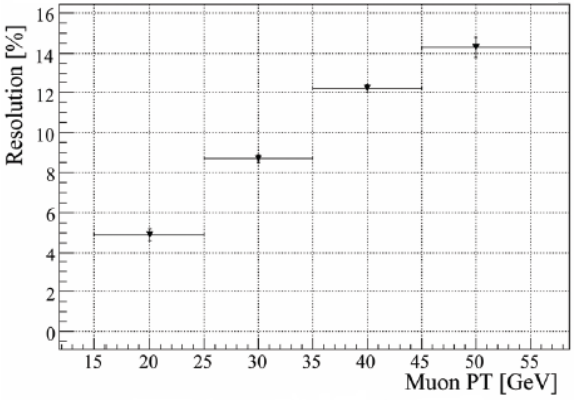
- Simulation and reconstruction using randomly generated, ~1mm displacements
- Study performed by Matthias Schott







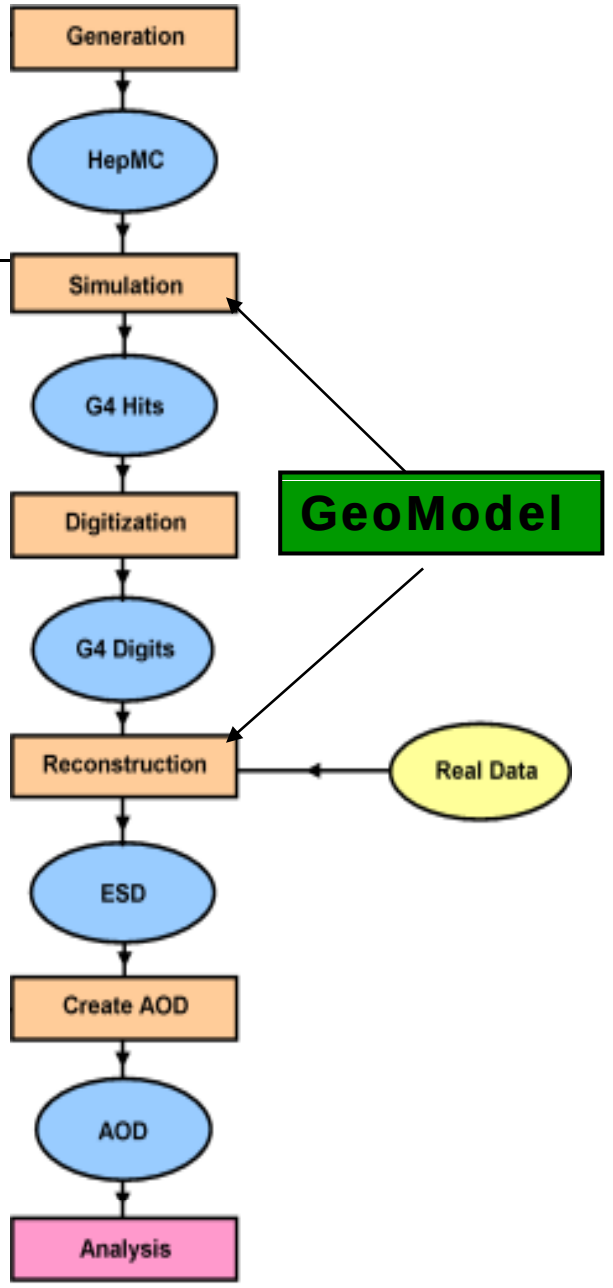
Measured Values for nominal Layout



1mm Misalignment

Running the full chain

- Generation scripts (10K)
- Simulation scripts (10K)
  - Perfect geometry used
  - Time-consuming
- Digitization scripts (10K)
- Reconstruction scripts
  - Perfect geometry (10K)
  - Real geometry (10K)
- NTuple Production

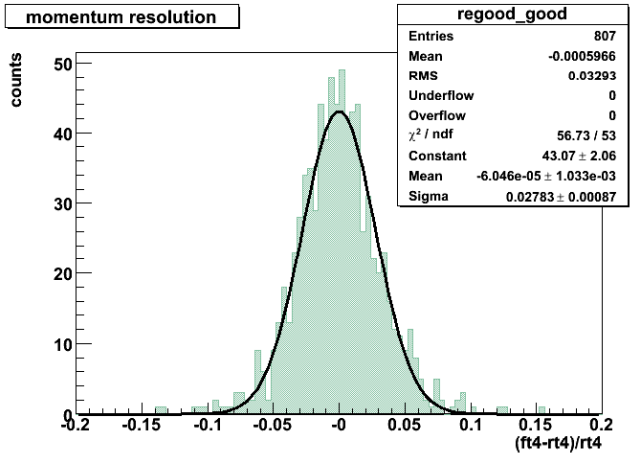


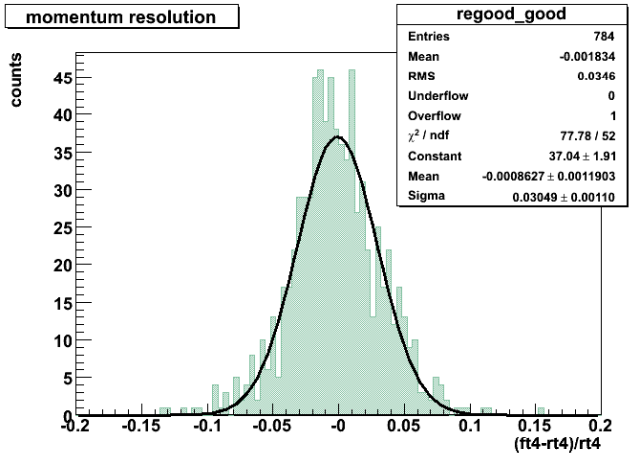
Results (Pending)

Perfect Geometry

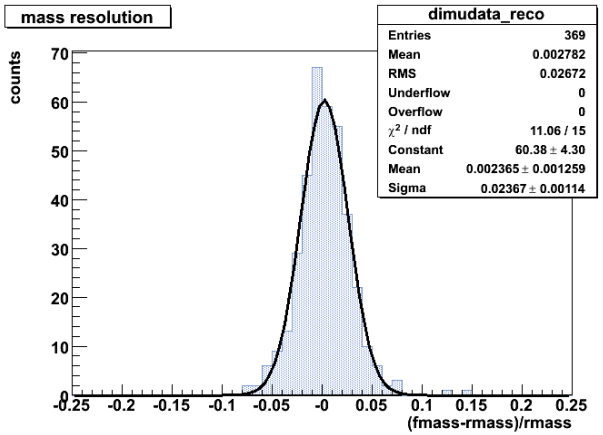
Real Geometry

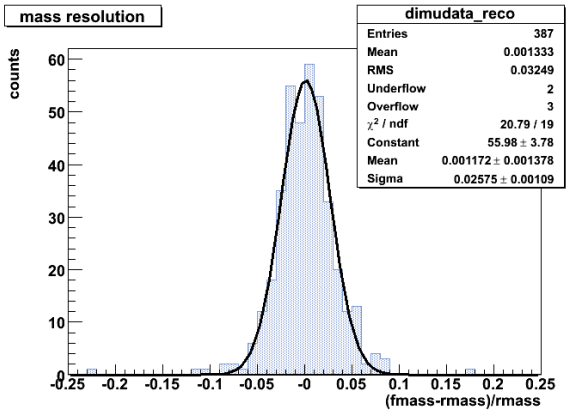
Single muon momentum resolution





Reconstructed Z mass





Conclusions

- Reconstructed Z mass width will most likely be useful in determining degree of alignment
- Real alignment effects should be much larger than random 1mm displacements
- Accurate alignment data (and its correct usage) is vital to data analysis

Future study

- Successful reconstruction using alignment data
- *Simulation* using the misaligned geometry
- Reconstruction with perfect and misaligned geometry
- Simulate corrections from alignment sensors (some uncertainty)
- Find how close one can get to a perfect measurement

Acknowledgments

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