Alignment Monitoring
Id Week

John Alison (University of Pennsylvania)
On behalf of many people

Outline:
Overview
Current Status
Longer term plans

What is Alignment Monitoring?

Goals

- Access the quality of the Inner Detector alignment, need for re-alignment, sign-off alignment constants/procedure
- Study systematic deformations/misalignments
- Easily compare/evaluate different alignment constants/algorithms
- Monitor the time dependence of the alignment

Strategy

-Monitor physical observables sensitive to misalignments.
(residuals, efficiencies, resonances, etc)
-Publish histograms to website
-Use DCube to preform automatic checks, which flag the quality of plots
-Currently DQA run on the express stream

What is Alignment Monitoring?

not so

Large amount of work, small number of people.

Ben Cooper (Queen Mary): residual code and overall release manager

John Alison (Penn): anything concerned with TRT

Juerg Beringer (LBNL): PV and beam spot related code

Jed Biesiada (LBNL): Kshort code

Kyle Stevenson (Queen Mary): high pT muon specific code (Z and W)

Sara Strandberg (UC Berkeley): electron specific code

Weina Ji (Lund): J/Psi and Upsilon code

- collaboration with B-physics experts / group:
  Vato Kartvelishvili, Andreas Korn, Darren Price, Maria Smizanska

Tobias Golling (LBNL): generic tracks, overall coordination, DQMF & RTT aspects

Beate Heinemann (UC Berkeley & LBNL): overall coordination

How it has worked

FDR

First full scale test of the Alignment Monitoring

- Provided testing ground for technical infrastructure (DQ browser/DQMF)
- Allowed us to access the sensitivity of plots (fill gaps/ missing links)

Overall Success

- Had shifter looking at plots via DQ web browser / implemented DQMF
- Participated in daily meeting to, sign-off on data bulk reconstruction
- Spotted problems, signed off on alignment (FDR & FDRII), rejected poor alignment constants (FDRII)
- Potential problem in alignment strategy (Si -> TRT -> Si ?)
- Successfully Implemented Trigger awareness / Beam spot monitoring

Lessons Learned

See Jurg's talks

- Defined plots as Shifter, Expert, Debug
- Width of resonances very sensitive to misalignments

How it has worked

Status & recent Improvements

FDR-1 Status

For collision data and MC:
- IDAlignMonGenericTracks
- IDAlignMonEfficiencies
- IDAlignMonResiduals
- IDAlignMonElectrons
-
- IDAlignMonJPsiUpsilon
- IDAlignMonZmumu
-
- Kshorts
- Vertex & beam line

For Cosmics data and MC:
- IDAlignMonCosmics

For MC only:
- IDAlignMonTruthComparison

FDR-2 Status/Plan

For collision data and MC:
- IDAlignMonGenericTracks
- IDAlignMonEfficiencies
- IDAlignMonResiduals + Overlap residuals
- IDAlignMonZee
- IDAlignMonWenu
- IDAlignMonJPsiUpsilon
- IDAlignMonZmumu
- IDAlignMonWmunu
- Kshorts
- Vertex & beam line
- Si vs. TRT tracks

For Cosmics data and MC:
- IDAlignMonCosmics

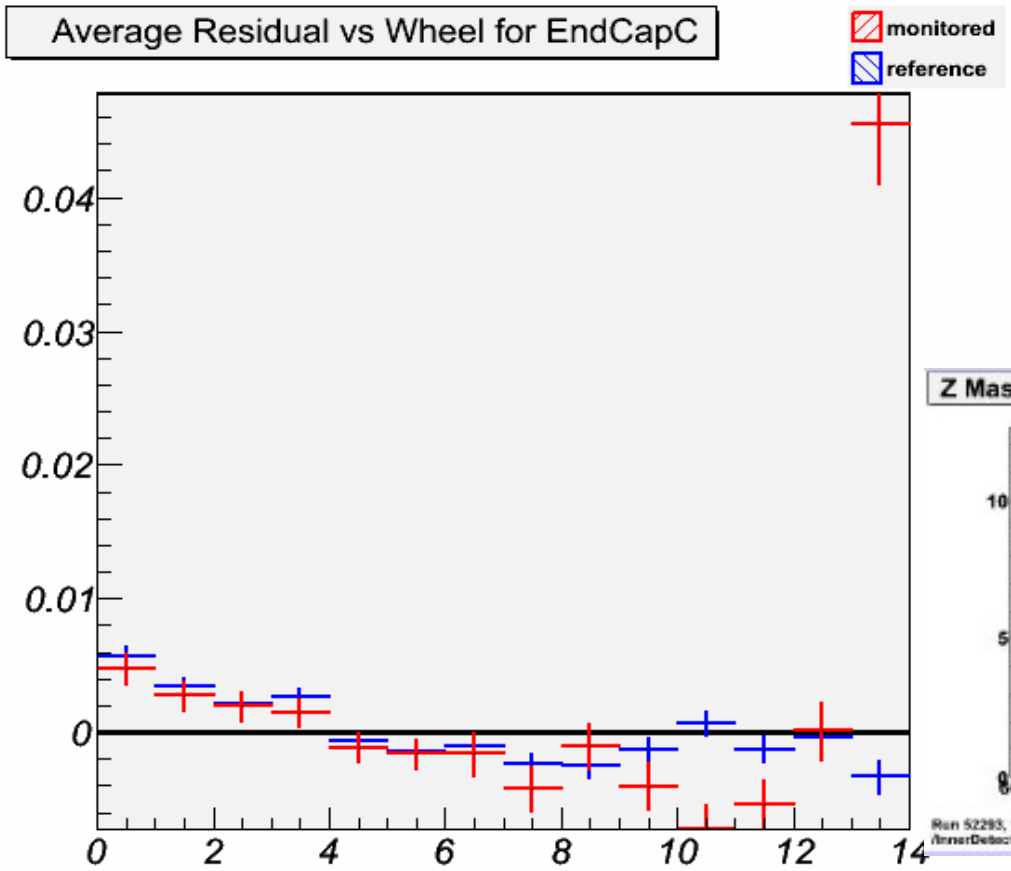
For MC only:
- IDAlignMonTruthComparison

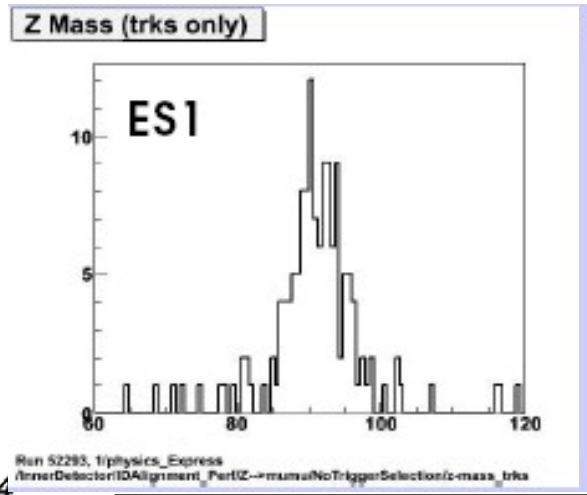
How it has worked

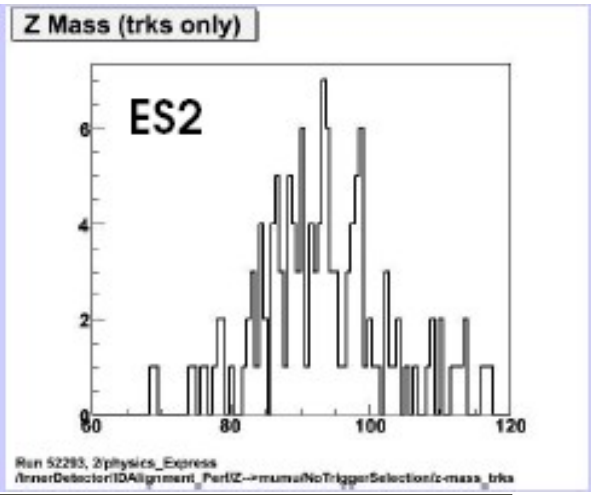
FDR

Found problem in TRT residuals (FDR, FDR II)

- TRT Residual mean in the last wheel of Endcap C off by~45 microns
- Explained by TRT mis-calibration (interplay calibration/alignment)
- Confirms sensitivity





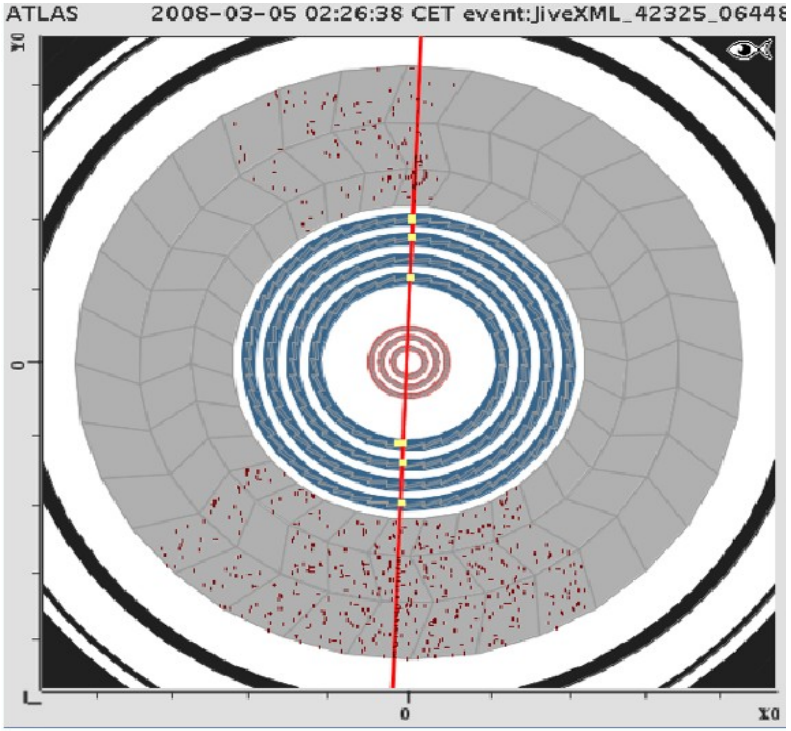


Perfect alignment, different TRT calibration

How it has worked

M6

First combined cosmic run with SCT and TRT since SR1. Over 12k events and 5000 tracks.



Alignment corrections were produced by

-Robust

-Global Chi2

-TRT Alignment

First test of alignment monitoring on real data. Misalignments seen suggest relative TRT/SCT misalignment smaller that in CSC

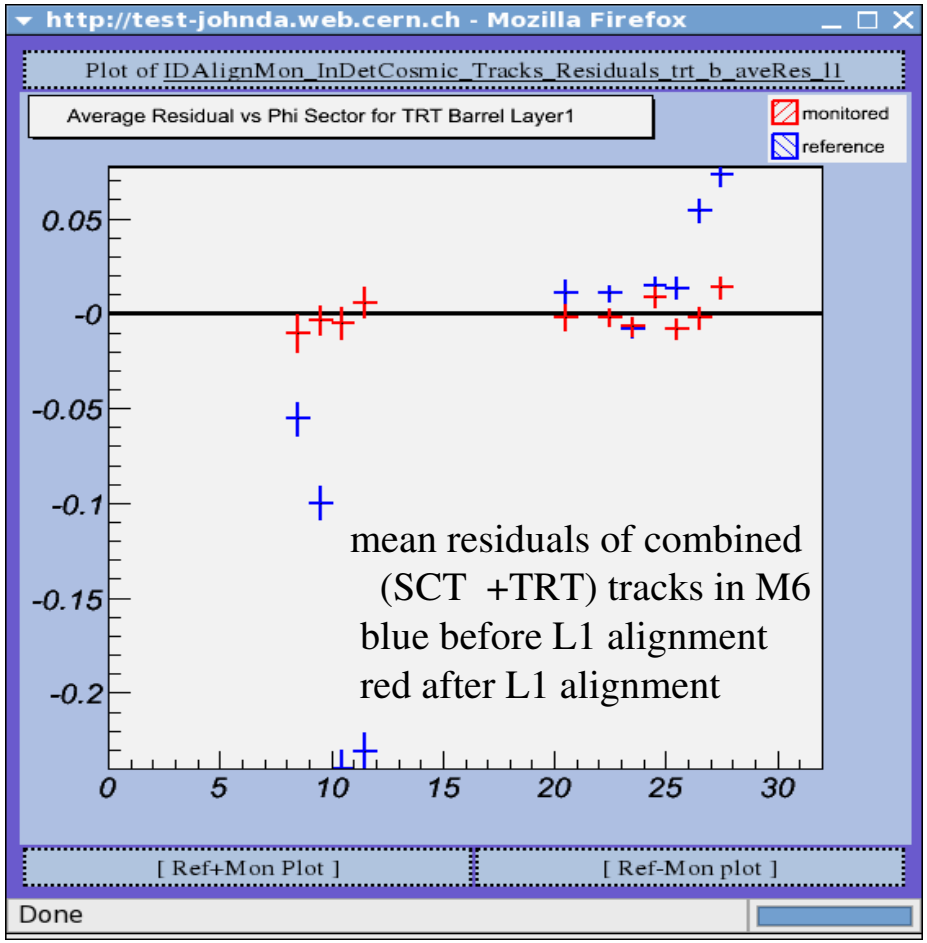
Provided direct feedback/input to the SCT/TRT relative alignment

Web display:
http://atlasdqm.web.cern.ch/atlasdqm/tier0/physics_HLT_Cosmics_MU3/run_43719/run/index.html

How it has worked

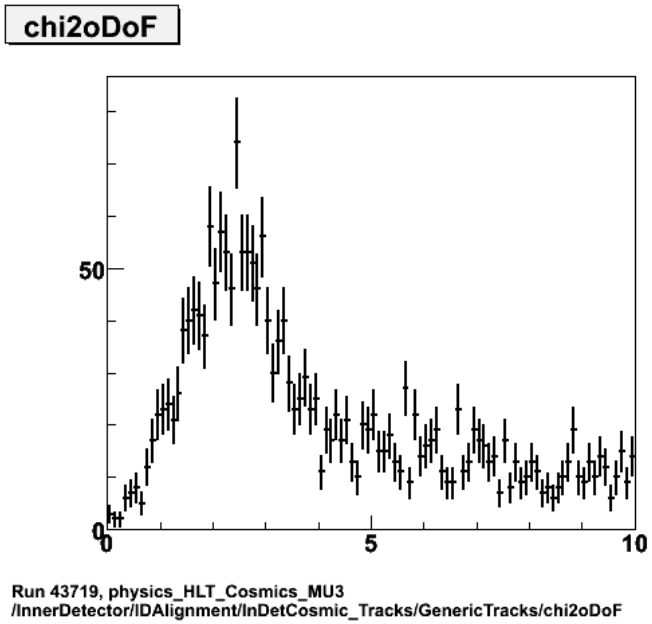
M6

Mean Residual vs Phi Sector for TRT Barrel modules in layer 1



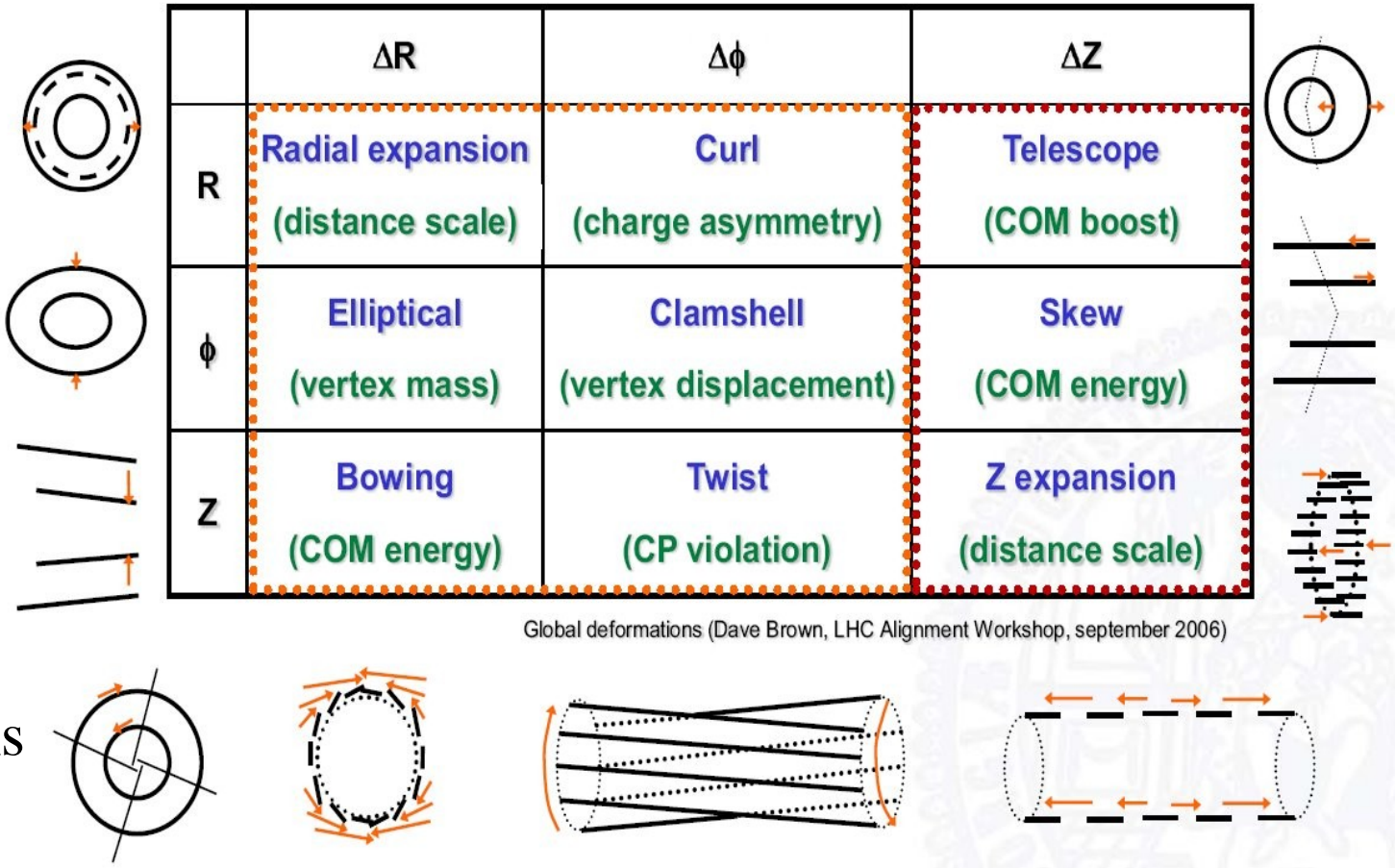
Ran Alignment Monitoring in cosmics mode

- hit efficiencies
- residuals
- generic track distributions



Weak Modes

- The "real" alignment problem
- The impact apparent in physical observables
- B/c of their nature, the alignment algorithms can be "unaware" of these types of problems



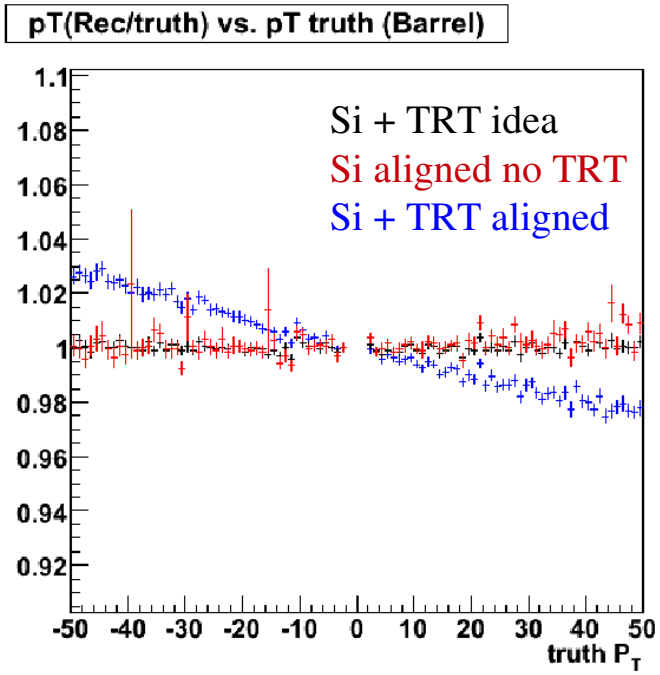
Global deformations (Dave Brown, LHC Alignment Workshop, september 2006)

(slide by Kathrin Störig)

- Important for the aligners to use alignment monitoring as a tool to detect these systematic misalignments

Weak Modes

Important for the alignment monitoring to identify which plots are sensitive to which weak modes (in a truth independent way)



Found the presence of a weak mode in the TRT alignment from CSC

Run alignment monitoring on the full 3x3 matrix, provide feedback to the alignment strategy (eg: identify which information could be used as an additional constraint)

Group has experience in running the alignment algorithms and plans to use the alignment monitoring to study the impact of using cosmics in the alignment on weak modes

Plans

- Systematic studies of mis-alignments and our sensitivity to them
  (particularly weak modes)

- Capitalize on commission data
  (MX, continuous running, beam halo, etc)

- Improving automatic tests, removing false alarms (always a challenge)

- Facilitate use as a tool for aligners debug/diagnose initial mis-alignments

- On-line running? (sub-set of modules: hit efficiencies/residuals etc)

- History of prototype histograms / statistical quantities
  (bean spot, resonance widths, ???)

Implemented already in FDR 2a