Updates in Muon Alignment

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Since July. . .

- ▶ Alignment procedure ported to $1\_5\_X/1\_6\_X$, fully documented

- ▶ Alignment projects split by task, not by detector

  - ▶ Karoly: investigating beam halo MC for beam halo alignment

  - ▶ Alexey: investigating cosmics MC for MTCC alignment
    (all stations, not only ME1/1)

  - ▶ Jim: systematics studies for disk-by-disk (and wheel-by-wheel)
    alignment, preparing for CSA07

- ▶ Using the same software; meeting weekly

▶ One-beam generator-level study: 2000 Hz?
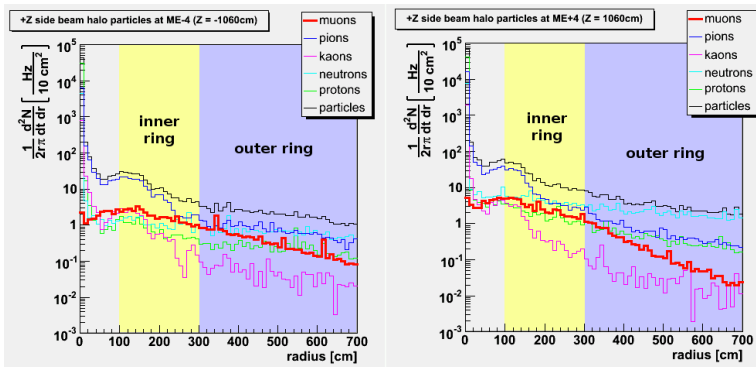
▶ Generated 10,000 events, found 1,600 standalone muons (CosmicMuonProducer), some events have 2 muons

▶ Tested full alignment path!

▶ Just started, working through the documentation...

▶ Will need cosmic ray MC, re-reconstructed MTCC

- Pessimistic internal misalignments (chambers and layers)
  - CSC Layers $\Delta x = 191\ \mu$m, $\Delta y = 335\ \mu$m, $\Delta\phi_z = 40\ \mu$rad

  - All Chambers $\Delta x = \Delta y = \Delta z = 3$ mm,
    $\Delta\phi_x = \Delta\phi_y = \Delta\phi_z = 1$ mrad

  - Disks/wheels $\Delta x = \Delta y = \Delta z = 1$ cm,
    $\Delta\phi_x = \Delta\phi_y = \Delta\phi_z = 1$ mrad

  - Tracker 10 pb^{-1} scenario

- Align muon system to tracker with globalMuons: x, y, ϕ_z
  - Check dependence on tracker alignment

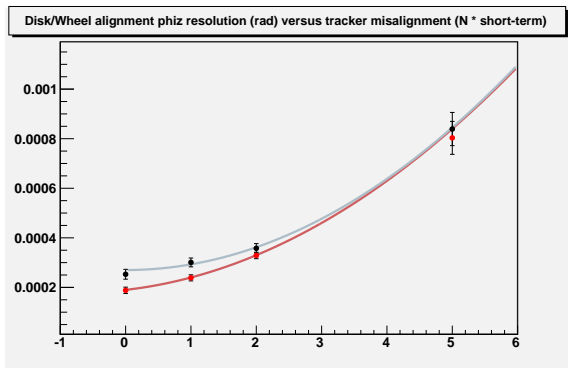- Nominally 2000 $Z \to \mu\mu$ (0.36 pb^{-1})
  - Check dependence on statistics
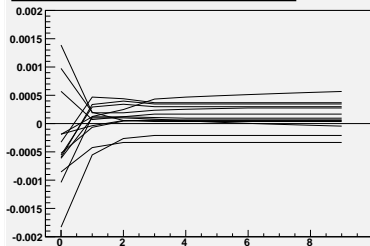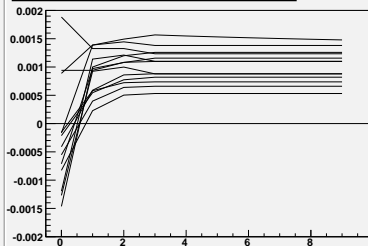
- 0.3 mrad resolution in ϕ_z, 800 μm in x, y
- Large numbers of tracks are unnecessary: reaches final precision with a few hundred muons
- Sensitive to tracker alignment: rotate tracker by 1 mrad (sanity check)
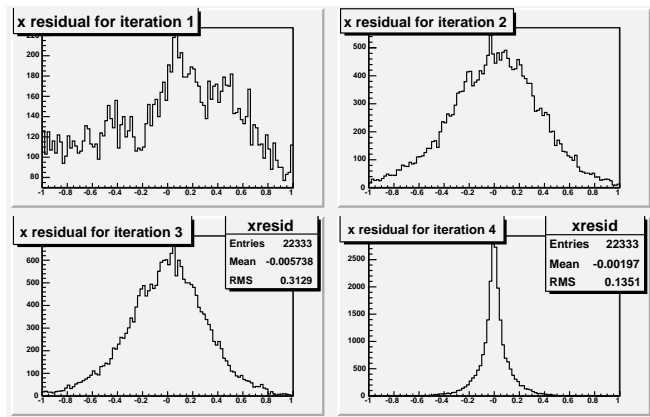
Sensitivity to tracker misalignment

black: with internal misalignments   red: ideal chambers, layers

- ▶ 13 disks+wheels is not enough to measure precision: 10 trials
- ▶ Tracker can be 2–3 times worse than short-term scenario

Varying Alignment Parameter Errors versus iteration

- ▶ Iterations 1–3: APEs $\gg$ intrinsic errors
- ▶ Iterations 4–10: APEs $\ll$ intrinsic errors; alignments stable

- ▶ CAF alignment farm is ready and working

- ▶ Discovered that RPC hits bias alignments toward ideal geometry: making sure they are excluded from alignment fits

- ▶ Pre-CSA test with 1 million $Z \to \mu\mu$, 1 million $W \to \mu\nu$
  - ▶ Ideal, 10 pb^{-1} miscal/misalign, 100 pb^{-1} miscal/misalign
  - ▶ Can we align with miscalibrations?

- ▶ Pre-pre-CSA test with 75,000 single-muons
  - ▶ Chamber-by-chamber dependence on tracker misalignment
  - ▶ Study momentum dependence (10 GeV and 100 GeV)

▶ Beam-halo alignments: we have a simulation, a small dataset, and are beginning alignment studies

▶ Cosmic ray alignments: just beginning— we'll need MC, re-reconstructed MTCC

▶ Collision-data alignments: finished tracker-dependence studies for disk-by-disk, moving on to chamber-by-chamber studies