Status of Muon Endcap Alignment

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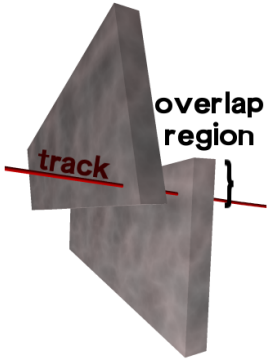
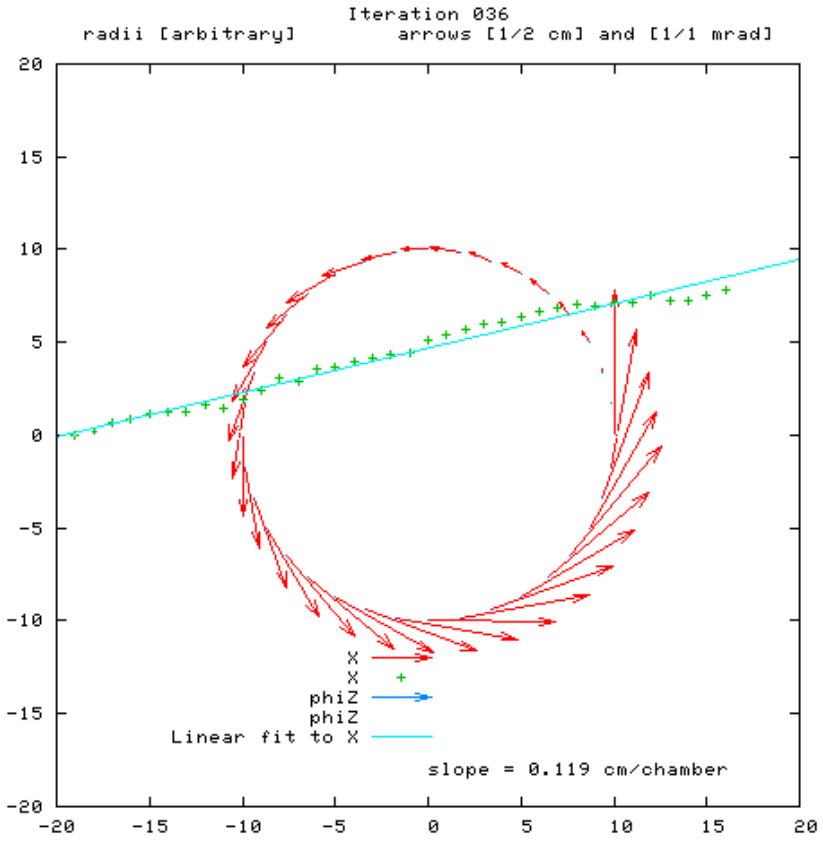
Outline



- Update on CSC-Overlaps procedure
- Alignment of endcap disks in CRUZETs 1&2
- Discovery and correction of ideal-geometry mistake
- New AlCaReco streams for CRUZET-4/CRAFT

Update on CSC-Overlaps

ME+2/2 in CRUZET-1: red arrows and green points are both the x alignment

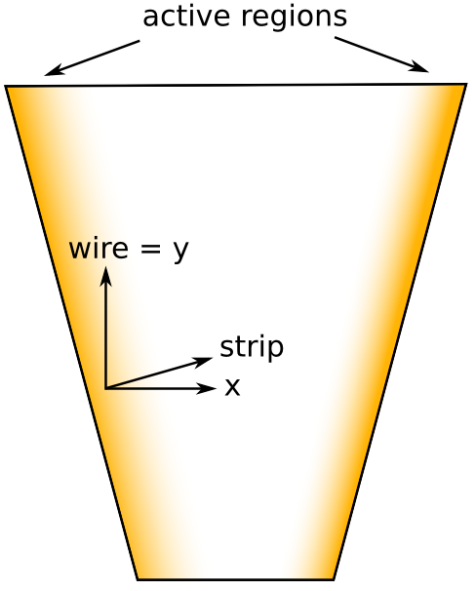


- converges: residuals become centered and alignment slows to a stop
- ring overcloses by 4 cm due to 1.2 mm systematic error per chamber
- same pattern in CRUZET-2, fit other direction, fit both x and ϕ_z...

Sources of systematics

All information is local: very little averaging over instrumental effects

1. Last strip is unique: no charge-sharing without a neighbor
2. Local x is not a good measurement near the edges



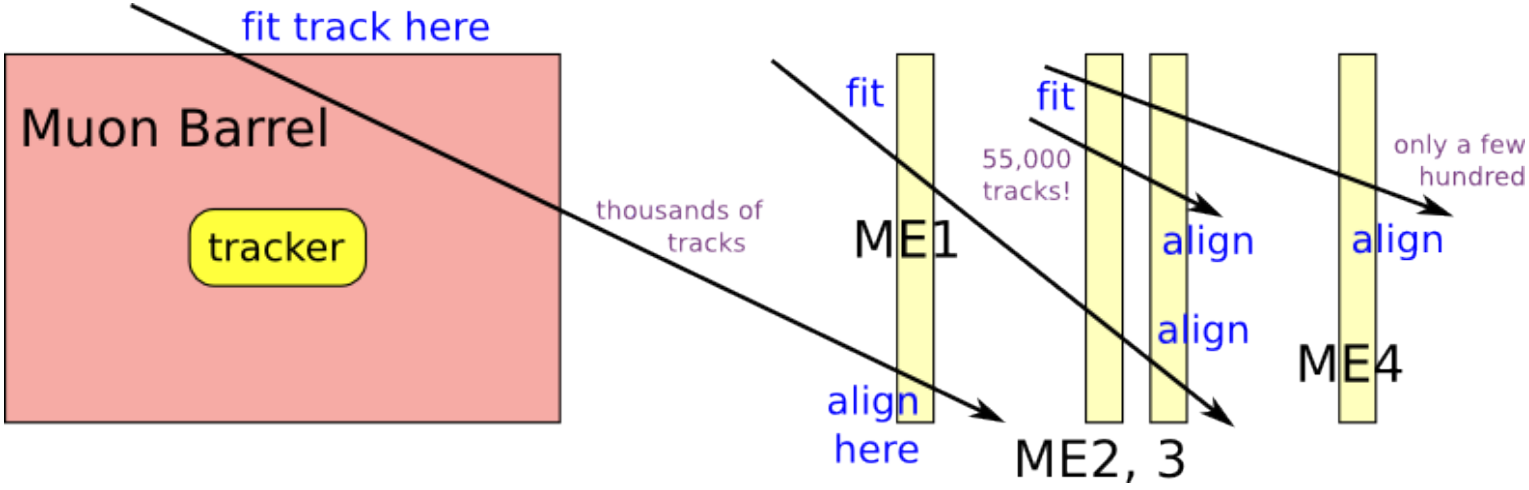
#2 in more detail:

- Local x has a large component from wire measurement near the edges
- Wires are ganged into 5 cm tall groups, position is taken to be the center of the group
- Hit position has a discrete component, fit from neighboring chamber has a discrete component, the two are offset (and angled)
- Can bias x residuals by $\mathcal{O}$(mm) with the observed pattern

Modifying procedure to use pure strip measurements, rather than local x

Alignment of endcap disks

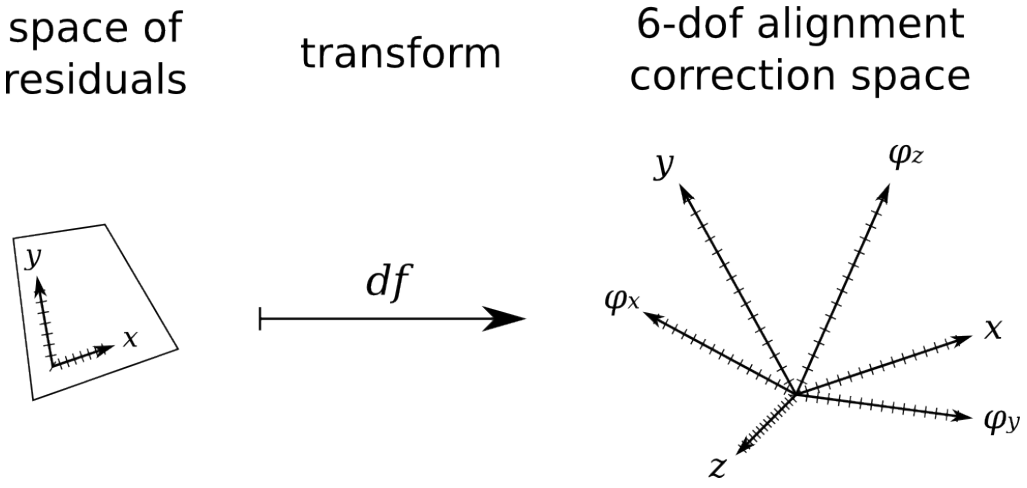
- Completed for CRUZETs 1&2, awaiting re-reco of CRUZET-3
- Modification of MuonHIP procedure to use StandAloneMuons

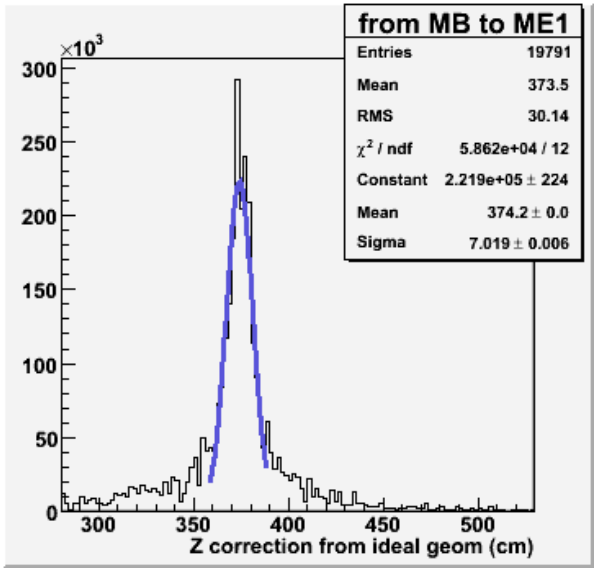


- Muon barrel is the reference (aligned by Pablo)
- Internal cross-checks by comparing direct MB→ME2 against MB→ME1 + ME1→ME2 (etc.)
- Whole disks are the alignables, "misalignments" are huge because the detector is open

Deconstructed alignment

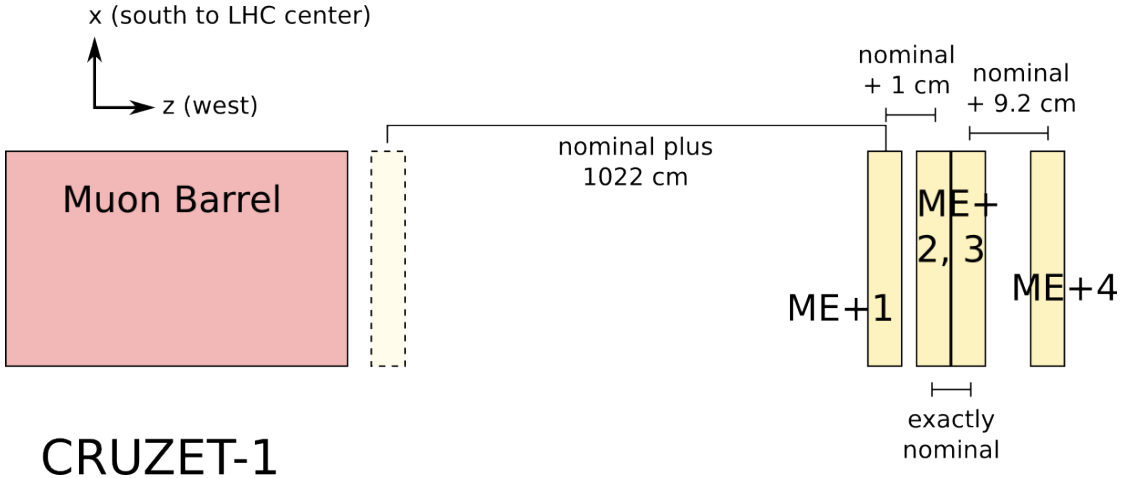
- Tools designed for many alignables and small misalignments
- We have 4 alignables, misaligned by *meters*
- Start with a pedestrian approach: hit-by-hit ntuple



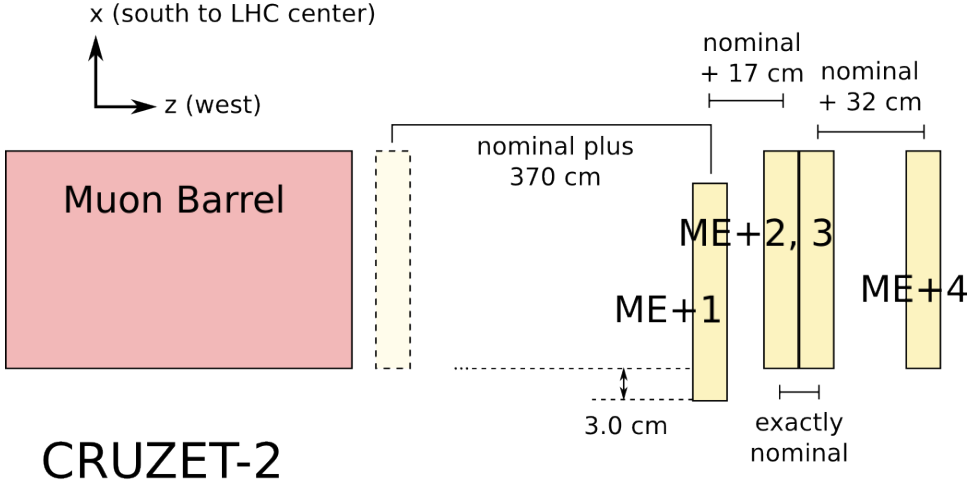


- Normal HIP: weighted mean of residuals in correction space
- Ntuple: "every hit tells us where it thinks the disk is"
- Without $\vec{B}$, we can't eliminate bad low-$\vec{p}$ tracks
- Use weighted *mode* instead (best tracks agree and pile up)

Results for CRUZETs 1&2



CRUZET-1



CRUZET-2

Observed all parameters, corrected and iterated $xyz(\phi_z)$

Few significant deviations from zero

Significance defined by consistency of independent fits: 8 mm in x-y, 3 cm in z, few mrad angles

Tags for CSCAlignmentRcds:

`CRUZET1-CSCStation-xyz-2mmRadialFix_v1`

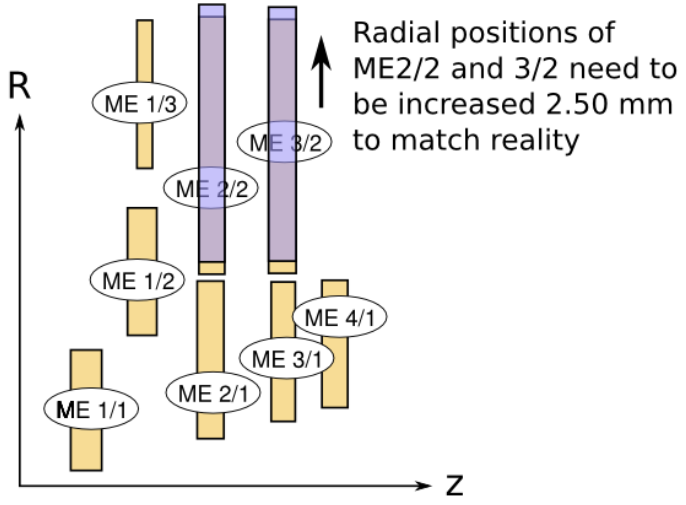
`CRUZET2-CSCStation-xyzphiz-2mmRadialFix_v2`

Appropriate IOVs applied (thanks, Pablo!)

Details (soon): https://twiki.cern.ch/twiki/bin/view/CMS/MuonAlignment

Correction of ME2/2 and 3/2

Investigating the closure problems in CSC-Overlaps, we found a mistake in the ideal CSCGeometry



- Discrepancy between drawings and DDD description of active volumes
- Correction included in CRUZET alignments ("`2mmRadialFix`")
- DDD fix in the 2_1_1 release, which means that 2_1_X MC will be generated at the right positions

- Created new ideal CSCAlignmentRcd for reconstructing MC: `CSCIdealGeometry211_mc`

  Generated misalignment scenarios centered on corrected positions: `CSC1InversepbScenario211v1_mc`, `CSC10InversepbScenario211v1_mc`, etc.
- Included in global tags `IDEAL_V6` and the `STARTUP_V5` for the 2_1_X MC production

New AlCaReco streams

To automate the procedure in CRUZET-4/CRAFT, we need cosmic ray AlCaRecos:

- ALCARECOMuAlStandAloneCosmics
- ALCARECOMuAlGlobalCosmics

} CommonAlignmentProducer V00-30-06

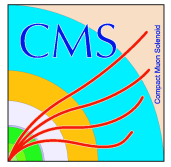
- ALCARECOMuAlZeroFieldGlobalCosmics } already published

Reasons:

- no minimum p_T cut: essential for zero-field data
- looser η constraints ($\pm$100 instead of 2.4)
- standard ALCARECOMuAlCalIsolatedMu is GlobalMuon-only: tracks that don't point into the tracker are also useful
- special ZeroFieldGlobalCosmics because there are sometimes problems with tracker-to-muon matching in $\vec{B} = 0$

Limited testing (4000 CRUZET-3 events in 2_0_12)

Summary/Conclusions



- Still making progress on CSC-Overlaps procedure (it's subtle)
- Corrected largest part of CSC misalignment: positions of disks relative to barrel (by a different method than Riccardo's) and positions of disks relative to one another (new, and large)
- Will repeat barrel-to-endcap alignment in CRUZET-3 and add tracker-to-muon system (higher resolution and a different statistical distribution, perhaps alignment of some individual chambers)
- Found an error in ideal geometry; added correction to CRUZET constants, fixed code for 2_1_1, updated MC ideal/misaligned geometries to match
- New AlCaRecos needed for CRUZET-4/CRAFT