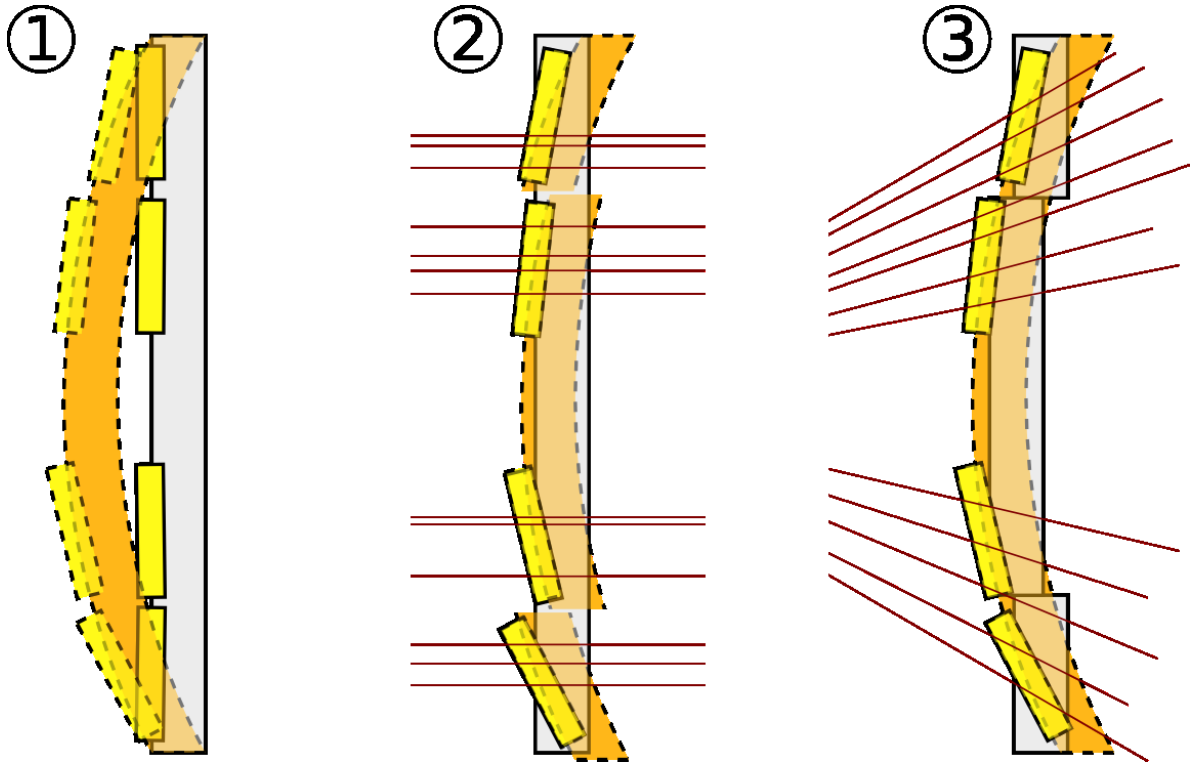
Very Early Alignment Plans

Jim Pivarski, Alexei Safonov, Károly Banicz*

Texas A&M University, *FermiLab

5 Feb, 2008

Overview



1. Chambers start misaligned relative to ideal positions on each ring, partly due to disk bending, and disk is misaligned relative to its ideal position
2. Align chambers relative to one another on each ring using beam-halo tracks in the CSC overlap regions
3. Align rings as large rigid bodies relative to the tracker using first collision events

Beam-halo goals

Goal 1: Relative alignment of all chambers within each ring using beam-halo tracks through CSC overlap regions

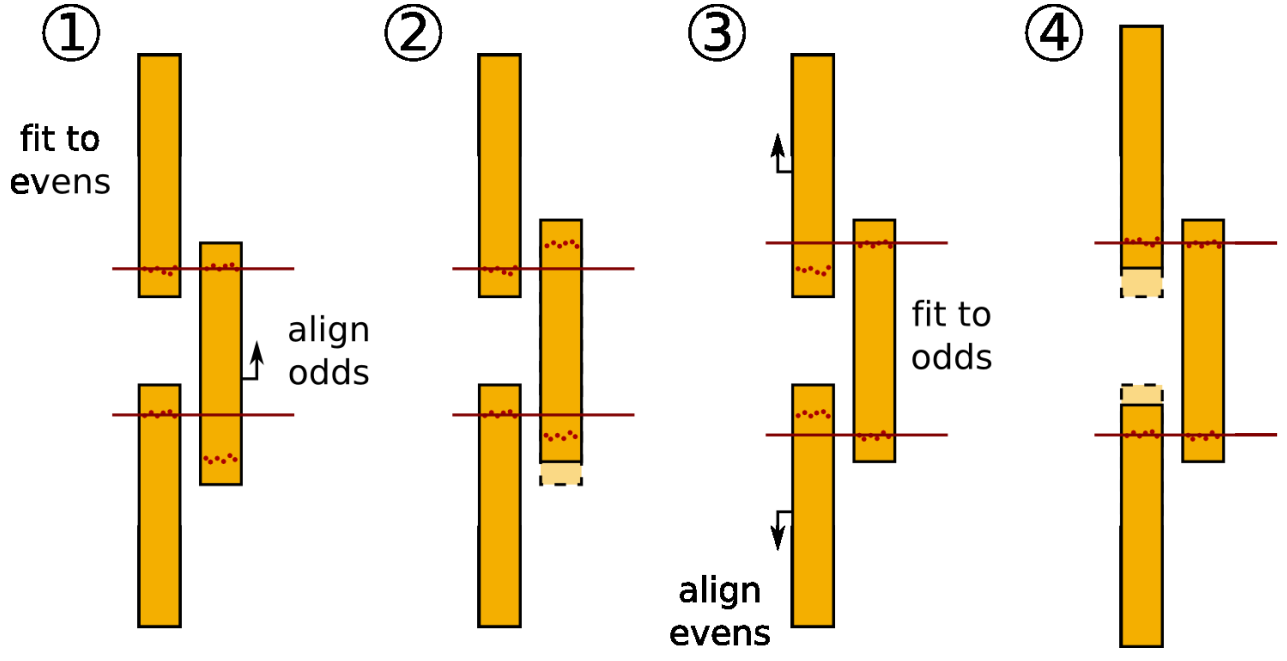
- Global position of whole ring (relative to other rings) is unconstrained by this procedure
- Only adjacent chambers in the same ring overlap
- Can't do ME1/3: no overlap regions and far from beam
- Before collisions, wide-open trigger to collect all beam-halo
- After collisions, use specialized beam-halo trigger

Goal 2: Relative alignment of all CSC layers within each ring using the same tracks

- Same technique, but let individual layers float
- Since chamber alignment is applied first, "chamber positions" will be the average of the layer positions (the real detectors)

Beam-halo procedure

- Even-numbered chambers always overlap odd-numbered
- Fit each beam-halo track to only one chamber, align partner
  - APEs $= 0$ for half of disk of interest, APEs $= \infty$ elsewhere
- Alternate between fitting to evens, aligning odds (1&2) and fitting to odds, aligning evens (3&4)

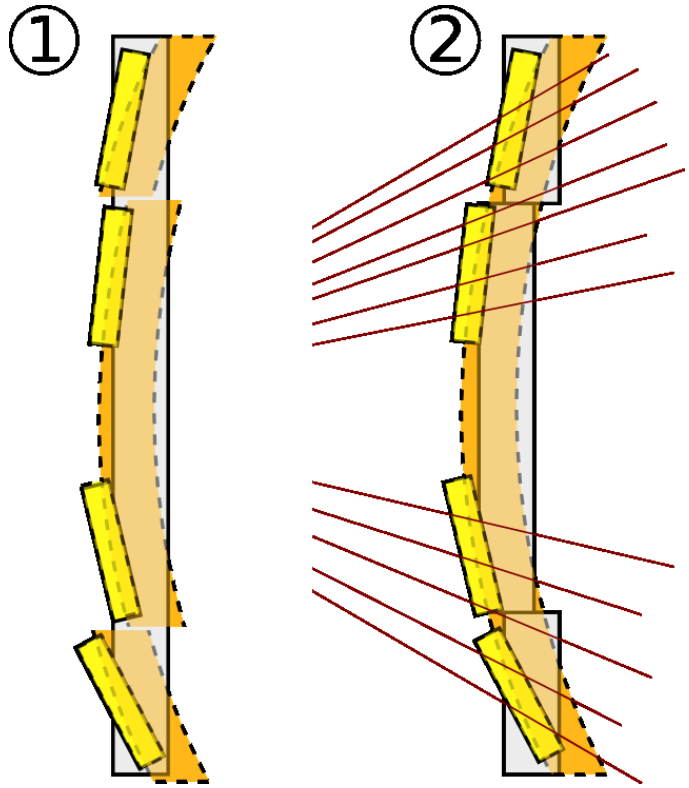


Ring/Disk alignment procedure

- Disks (CSCStations) can be aligned as rigid bodies with only several hundred tracks
- Beam-halo alignment procedure internally aligns rings, not disks

  Disks: ME1, ME2, ME3, ME4
  Rings: 1/1a, 1/1b, 1/2, 1/3, 2/1, 2/2, 3/1, 3/2, 4/1

- Software issue:
  - CSCRing not implemented in hierarchy (between CSCStation and CSCChamber)
  - Unrealistic to implement before CMSSW_2_0_0
  - Work in checked-out code?



Opportunities to compare with hardware alignment (1)

- We can use "survey constraints" mechanism to constrain at different levels of hierarchy, e.g. disk only
- Technique to *compare* beam-halo and hardware by applying constraints:
  1. In beam-halo alignment, constrain disks' x, y, z, ϕ_z to hardware measurement
  2. Compare beam-halo and hardware measurements of local x positions of chambers (which is global $r\phi$)
- #1 does not interfere with beam-halo procedure, since that procedure doesn't measure disk positions anyway
- Puts beam-halo chamber positions in the same coordinate system as Straight Line Monitors: *comparison is meaningful*
- Bonus: stabilizes beam-halo alignment

Opportunities to compare with hardware alignment (2)

- One more comparison, starting from disk (hardware) and chamber (beam-halo) alignment
  3. Align rings using standard technique: fitting tracks to tracker only (muon APEs $= \infty$)
- Fixing tracks to tracker makes track-based ring alignment independent of starting positions of muon disks
- Track-based result minus hardware result is change in alignment parameters (small numbers)
- Full 4-D test (x, y, z, ϕ_z) of Transfer Lines, Link System, all the way from muon endcap to tracker
- If there is a difference, we have ways to diagnose (residuals at chamber level, inner ring vs. outer ring, etc.)