iCSA08 plan: Muon Alignment (HIP)

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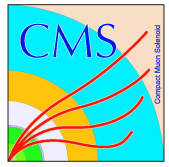
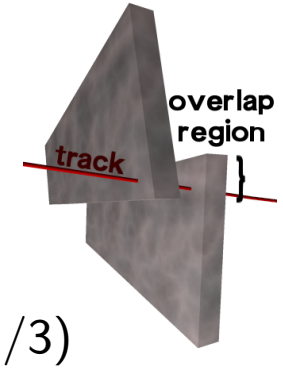
Outline



- Context of start-up alignment
- Workflows in iCSA08
- Monitoring and Validation
- Timeline

Overview of alignment procedures

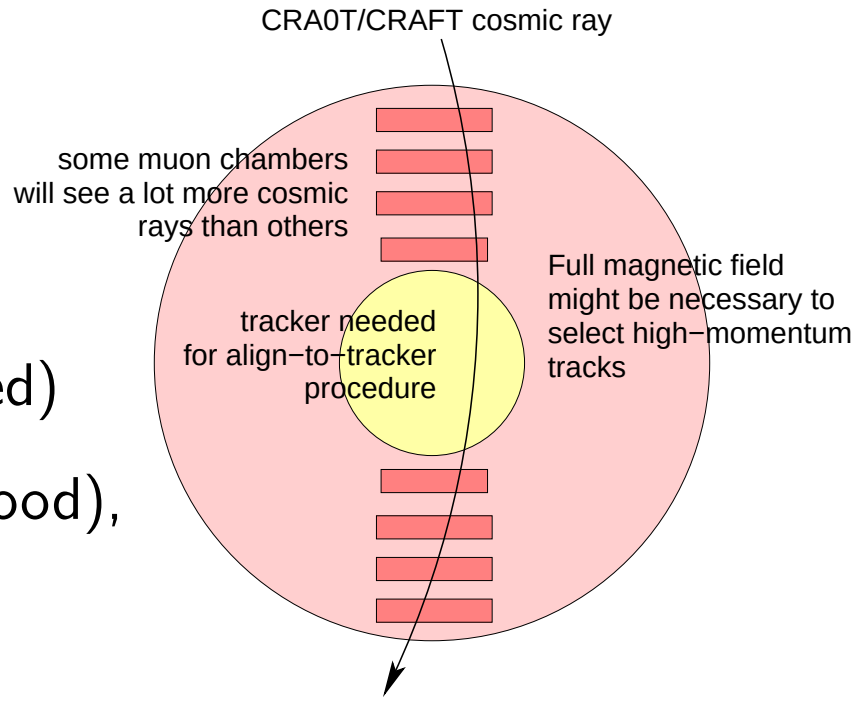
- Track-based alignment with HIP
  - "Baseline procedure" align each chamber (DTs and CSCs) to the tracker
    - uses tracker as an external reference
    - requires at least 10 pb^{-1}
    - well-studied procedure
  - Beam-halo alignment align CSCs to each other
    - uses CSC overlap regions (all endcap except ME1/3)
    - relative alignment within each CSC ring
    - internally-aligned rings can be easily aligned to the tracker
  - Layer alignment align CSC layers to layer 1 in each chamber
    - similar procedure, but not limited to overlap regions
    - also possible with beam-halo
  - Note that "beam-halo" and "layer" techniques can both be applied to beam-halo and I.P. muons
- Track-based alignment with MillePede
  - see Pablo's talk
- Hardware alignment
  - independent point of comparison, more relevant in real-data tests



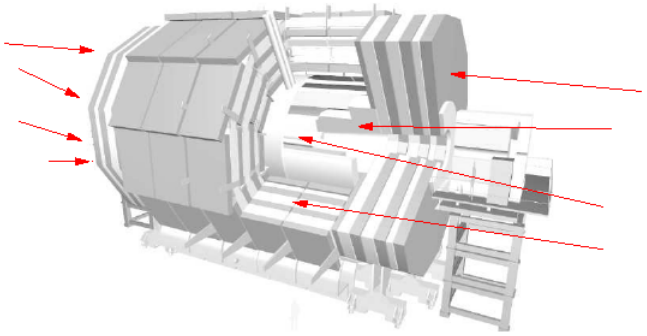
Baseline procedure

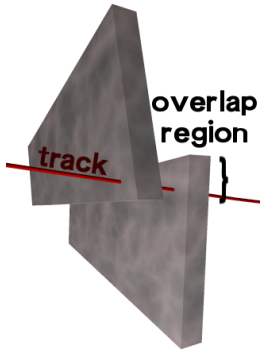
- Tracks are iteratively re-fit with varying hit-weights
  1. loose hit weights in the muon system: project tracks from tracker and align first station
  2. tight hit weights in first station: align second station
  3. etc.
- Each chamber is aligned independently of its neighbors

- Test with CRAFT: full tracker and high statistics for top and bottom chambers
- Maybe test with CRA0T: how essential is our p_T cut? (to be studied)
- Estimate 1 million muons in MB0 (good), 10k muons in ME1/3 (fair)



Beam-halo/layer alignment





- Beam-halo may be a good source of horizontal muons before first collisions
- Tracks passing through overlap region link pairs of chambers without uncertainty from multiple scattering
- Specially-configured HIP procedure aligns chambers to each other within CSC rings
- Small number of I.P. muons ($\sim$0.2 pb^{-1}) aligns rings to tracker

Beam-halo rate is very uncertain (simulation suggests we'll have enough muons, but uncertainty quoted as factor of 100)

Same technique can be applied to low-energy I.P. muons

Workflows in iCSA08

1. Baseline alignment with $W \rightarrow \mu\nu$ (10 pb^{-1})
2. Baseline alignment with realistic soup (10 pb^{-1})
3. CSC ring alignment with soup (1 or 10 pb^{-1}?)
4. CSC ring alignment with beam-halo ($\sim$1 million overlaps?)
5. CSC layer alignment with soup (1 or 10 pb^{-1}?)
6. CSC layer alignment with beam-halo ($\sim$1 million muons?)

(1) and (2) are minimal goals

Other workflows may be labeled "minimal goals" when their parameters are better understood

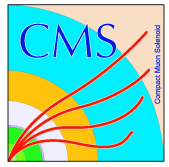
1&2. Baseline workflow

- $W \rightarrow \mu\nu$ or soup obtained via ALCARECOMuAlZMuMu stream
- Procedure takes about 10 hours on 50 CAF nodes
- Temporarily requires 18 GB on CAF mass storage
  1. Select non-scattering tracks from ALCARECOMuAlZMuMu stream, placing a filtered copy on CAF mass storage
  2. Align DT wheels and CSC rings
  3. Align all chambers in automated procedure

I'm debugging baseline-procedure scripts on the CAF right now (in 1_6_7 with back-ported 2_0_X features)

Will be tested in 1_8_X samples

3&4. CSC ring workflow

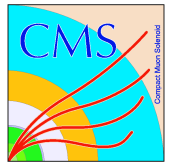


- Soup passed through ALCARECOMuAlOverlaps; beam-halo through ALCARECOMuAlBeamHaloOverlaps
- Also needs a temporary copy, split by station with the overlap event (8 subsamples)
- Procedure to be studied in detail this month: current estimate of needed resources:
  - 1 or 10 pb^{-1} ($\sim$5% of events with endcap muons have overlaps)
  - 10's of GB temporarily on CAF mass storage
  - approximately 250 CPU-hours
- ALCARECOMuAlOverlaps will be tested in 1_8_X samples, beam-halo needs to be tested independently

5&6. CSC layer workflow

- Similar to the above, but using ALCARECOMuAlZMuMu and ALCARECOMuAlBeamHalo streams
- No need to split sample or copy to CAF mass storage

Monitoring and validation



Three tools:

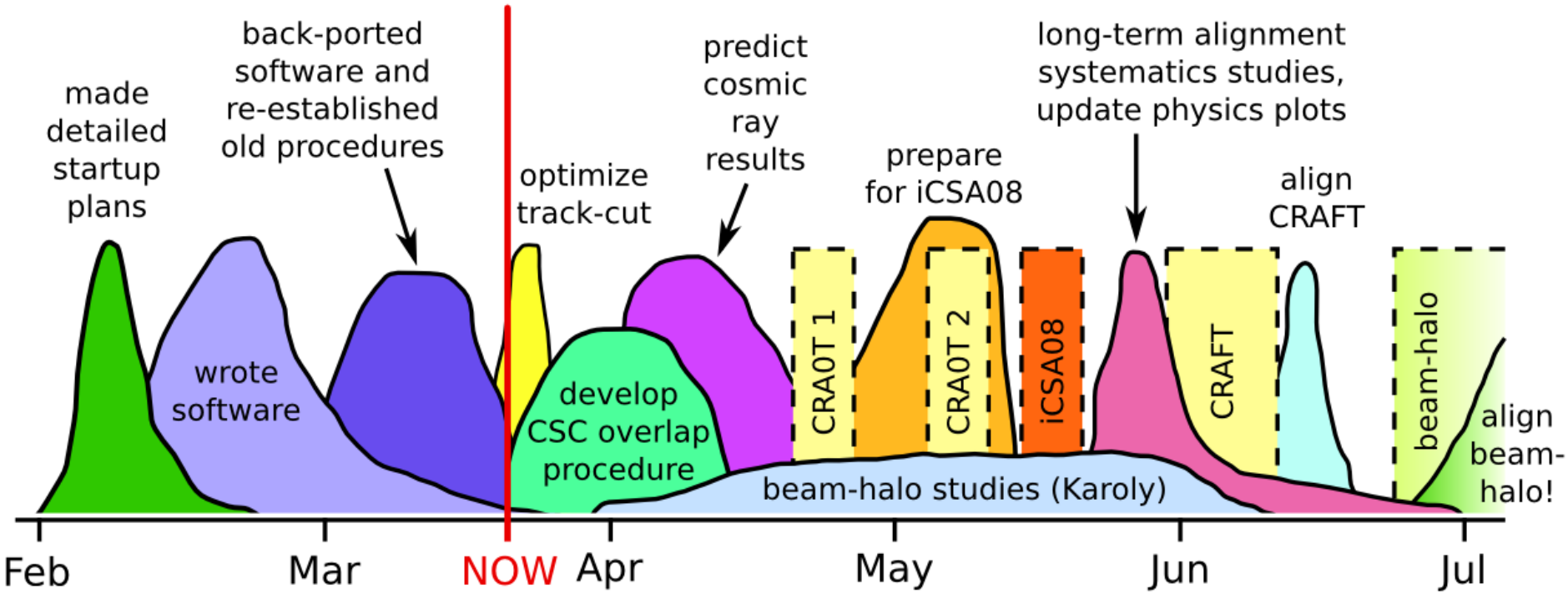
1. Full iteration-by-iteration, job-by-job residuals histograms for diagnostics if there's a mistake
2. Summary hit residuals plots and alignment positions relative to true (MC diagnostic)
3. MuonAlignmentAnalyzer: segment residuals and physics plots ($Z \to \mu\mu$)

Validate with MuonAlignmentAnalyzer before and after alignment

Watch hit residuals and alignment positions after each iteration, or at the end of the alignment

Run MuonAlignmentAnalyzer in re-reconstruction job to make sure that we uploaded the right constants!

Timeline (in blobs)



- April: time to develop the new start-up procedures (set up configuration files)
- May: prepare for iCSA08 (tests with 1_8_X samples)
- June: real-data test with CRAFT data (maybe CRA0T)
- July: real alignment with beam-halo

Conclusions

- Well-defined baseline workflow
- Developing workflows relevant for start-up
- Resource requests will clarify in the next month
- Everything to be tested before the iCSA08 event
- Good lead-in to real-data alignments