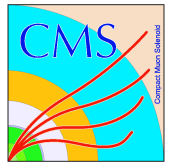

Status of Muon Alignment II

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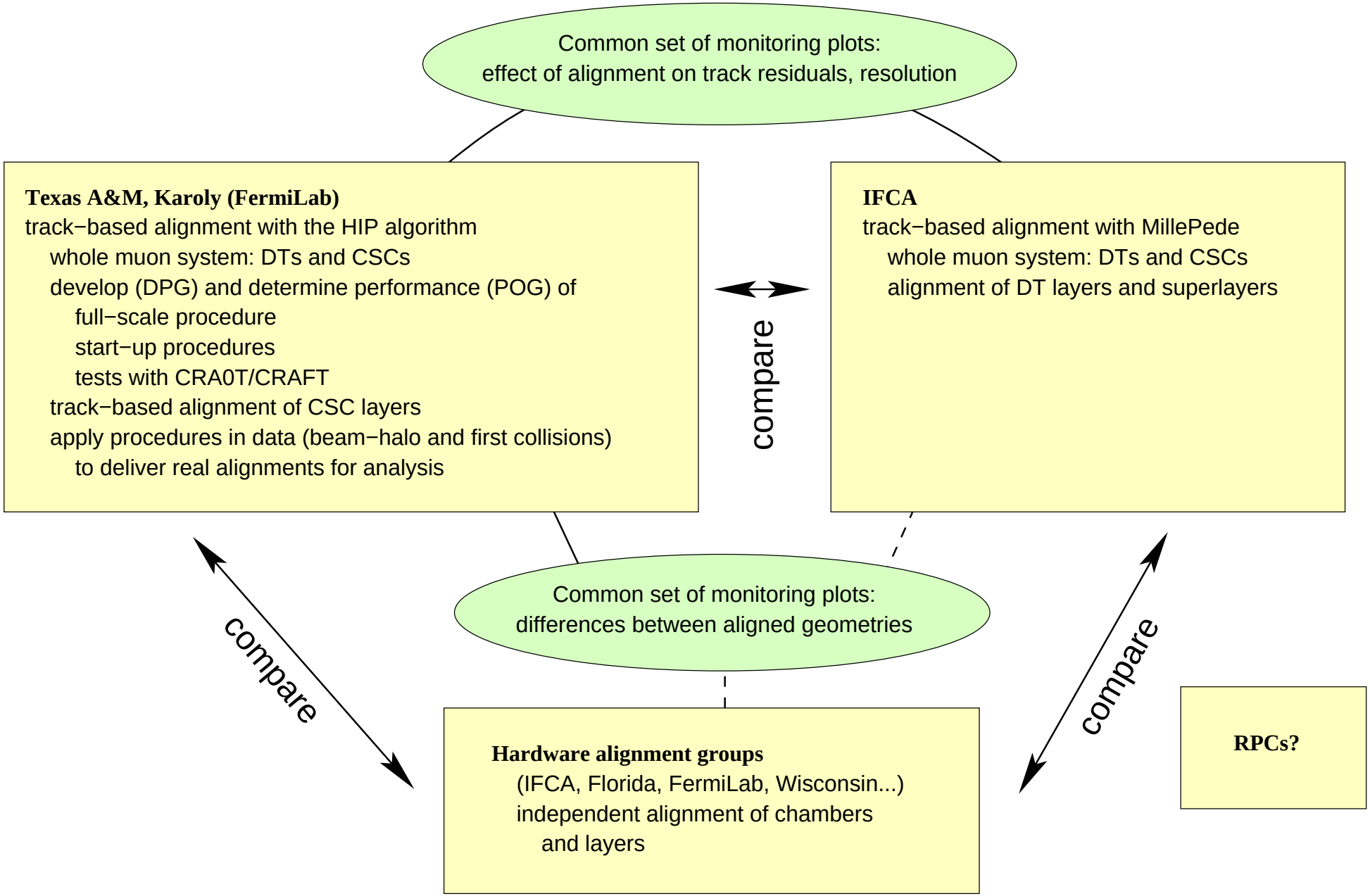
How we see subdivision of tasks



Status at a glance

Software development (C++ and algorithms):

- HIP is done and stable, MillePede is being ported to common framework
- Monitoring plots in progress
  - On-board monitoring during alignment iterations: done
  - After-alignment validation with events: Javier is porting to DQM
  - After-alignment comparison of geometries: infrastructure in place, but plots need to be defined

Procedure development (tuning parameters, improving performance):

- Current state of HIP: mm level alignment of chambers relative to tracker
- New track cut has been shown to improve this dramatically ($\longrightarrow$ 100's of μm)
- Needs to be fully incorporated, tested
- Studies can begin now in 1_6_7 with existing MC

Estimation of alignment performance:

- Performed full study, including systematic uncertainties, before improvements
  - We can repeat it with updated procedure
- Old study followed through to Z' resolution in Analysis Note 2007/038

Start-up plans:

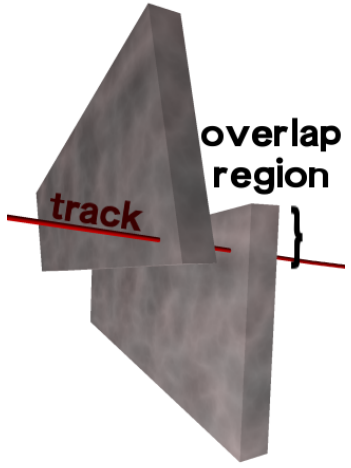
- Developed detailed plans for analyzing CRAFT, beam-halo, and first collisions
- Plan includes points of contact with hardware alignment
- Made sure all software in 2_0_X, including trigger paths for special data streams

1. Full-scale alignment of chambers to tracker (10 and 100 pb^{-1}, not startup)
   - Basic idea: tracker provides good tracks, we move muon chambers to minimize "track-minus-hit" residuals on average
   - Therefore alignment is automatically relative to tracker
   - Residuals distributions are wide due to multiple scattering
     - Gain precision by re-fitting tracks with different hit weights in tracker and in each muon station
     - We use muon Alignment Parameter Errors (APEs) to set these hit weights: APEs have been behaving as expected since last summer

$\longrightarrow$ test with selected chambers in CRAFT (CRA0T?)

$\longrightarrow$ measure all chambers "for real" when 10–100 pb^{-1} are available

2. Relative alignment of CSCs (low energy tracks and/or beam-halo)



- Locally fit tracks that pass through CSC overlap regions (again, by setting APEs)
- Align CSC chambers relative to their neighbors

→ test with horizontal cosmics in MTCC

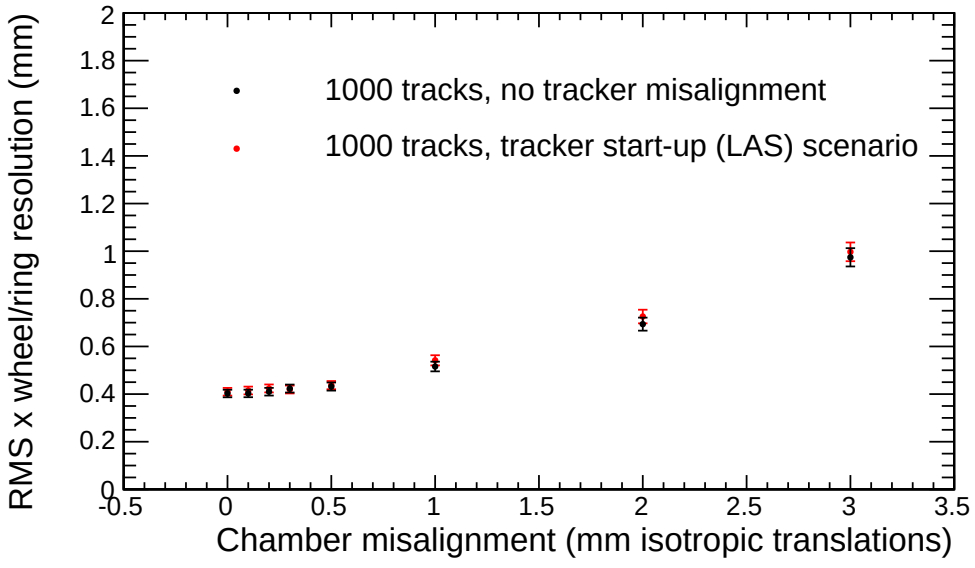
→ measure all applicable chambers "for real" when enough beam-halo and/or QCD muons are available

3. Relative alignment of CSC layers

- Same method as above, not restricted to overlap regions

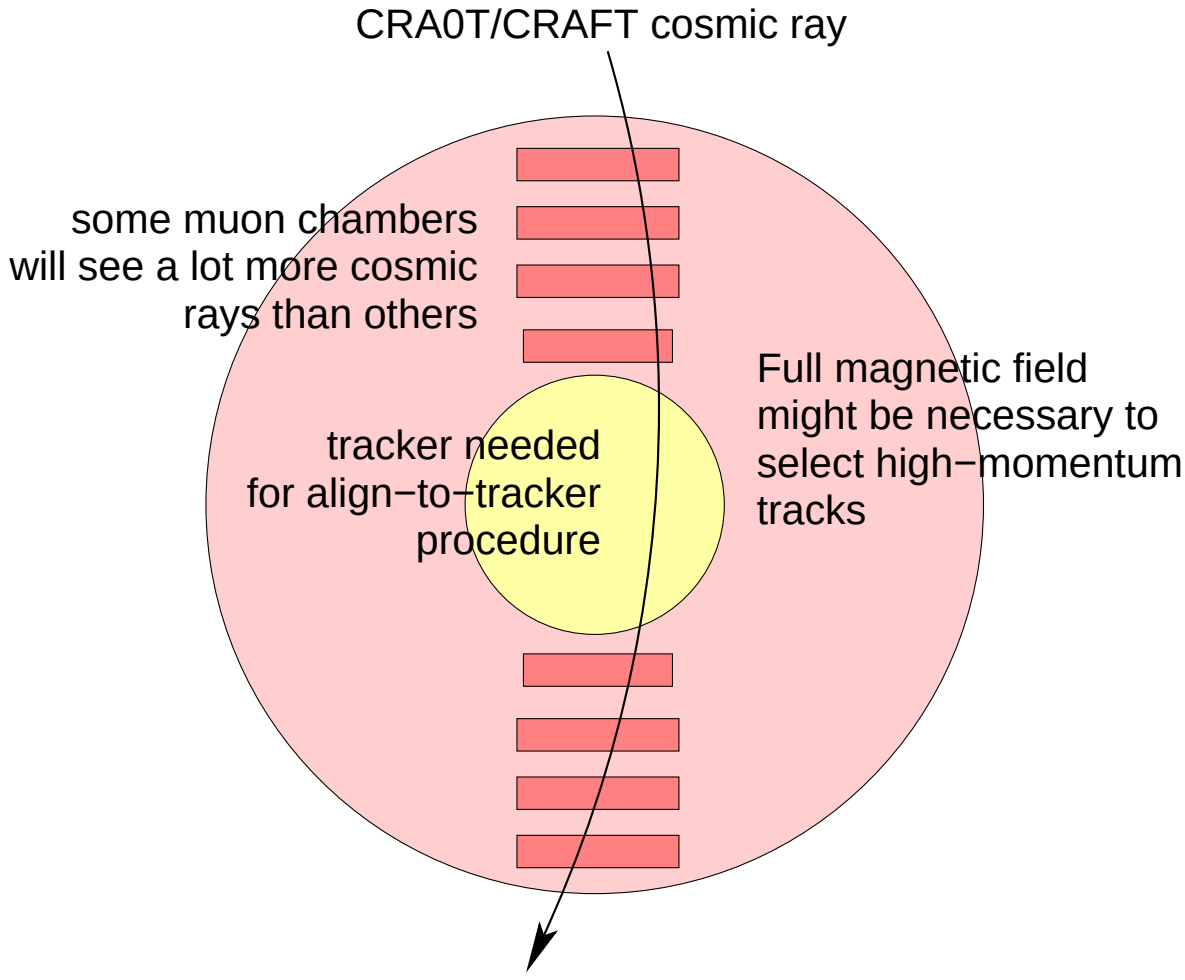
4. Alignment of large structures to tracker (first collisions)

- Treat large structures (barrel wheels and endcap rings) as individual alignable objects
- Compliments relative measurements in combined start-up program
- Very few tracks needed: 1000 muons (0.1 pb^{-1}) yields 400 μm global precision when chambers have 500 μm local precision



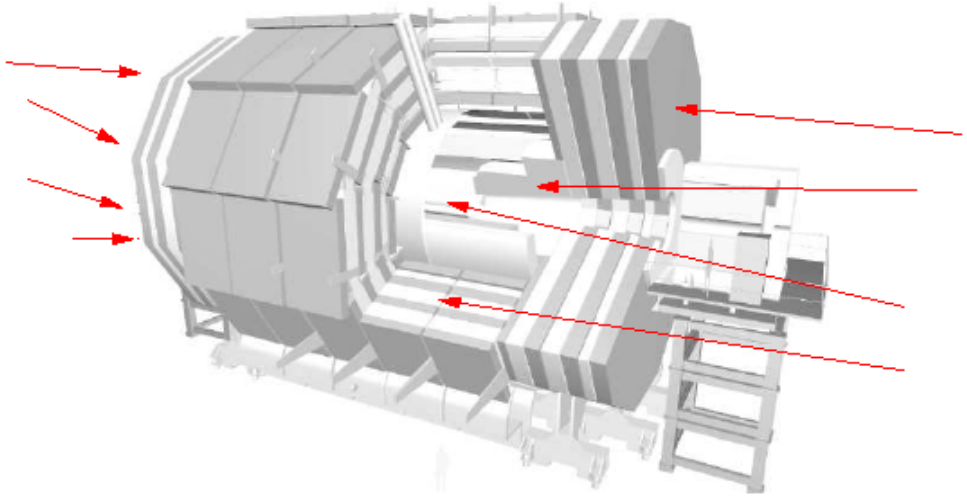
→ measure in the first week or two of collisions

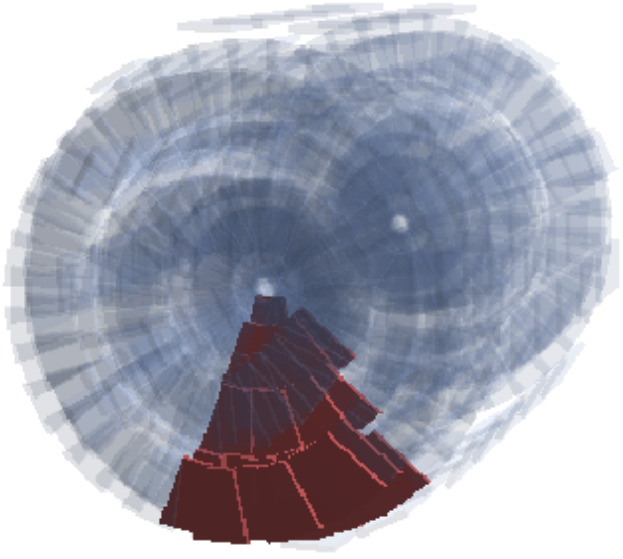
Real-data test for full procedure



- Test full-scale procedure on top and bottom chambers in muon barrel (1 million muons through tracker?), possibly as far as ME1/3 (10k muons?)
- Alignment output would be "real," usable for reconstruction, but this is primarily a test of the procedure

Real-data test for beam-halo





- Pre-collisions beam-halo muons are ideal for relative CSC alignment; procedures will be developed with these in mind
- We can test the procedure in MTCC as soon as we're ready

Readiness for real beam-halo data

- L1 trigger in progress
- HLT paths and event streams are ready

Comparisons with hardware

Opportunities for comparison with hardware alignment available in

- MTCC relative alignment of CSCs: hardware alignment already exists and compares favorably with photogrammetry
- Chambers selected for CRA0T/CRAFT alignment
- Relative alignment of CSCs during beam-halo period (June)
- Position of large structures relative to tracker in the first weeks of collisions

How would we do that comparison?

- Database comparison tool applied to alignment output in SQLite files (under development)

Combining track-based and hardware alignment data?

After verifying a mutually-measured direction, for example

- beam-halo and SLM lasers both measure CSC $r\phi$
- only SLM lasers measure CSC z: use it if $r\phi$ agrees

Timeline (POG-related steps in blue)

March:

1. Infrastructure for database comparison and manual update (done)
2. Back-port last HIP-related software updates to 1_6_7 to use existing MC samples
3. Implement first draft of CSC overlap-hit alignment procedure

April:

- Optimize large-dataset procedure with new track cut
- Determine expected performance with 0 T and 3.8 T cosmic rays
- Apply to CRA0T dataset if 0 T case is interesting
- Develop database comparison plots
- Study CSC overlap-hit procedure in beam-halo MC (Karoly)
  - Apply to horizontal MTCC muons as a test

May:

- Full systematics studies with all procedures
- Update physics studies
- Apply procedure to CRAFT dataset
  - Compare with hardware measurements, if available

June:

- Use beam-halo tracks to get a real alignment of endcap chambers/layers
  - Compare/combine with hardware measurements, if available/in agreement

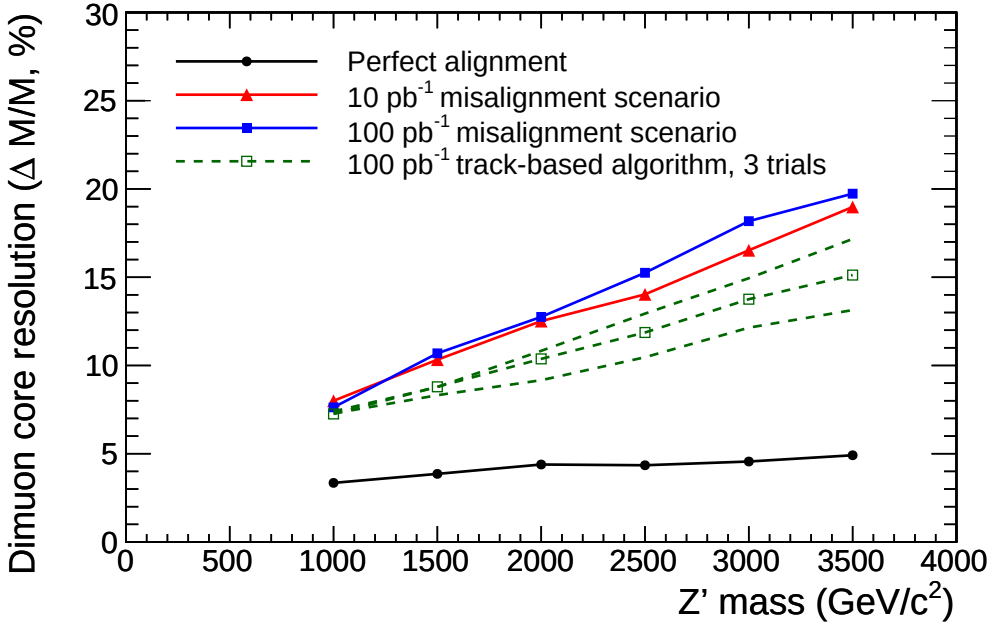
July:

- Align large structures with first 1000 muons
- Combine measurements where applicable (beam-halo, CRAFT, first 1000 muons, hardware measurements, etc. . .)

and beyond:

- Apply full-scale procedure

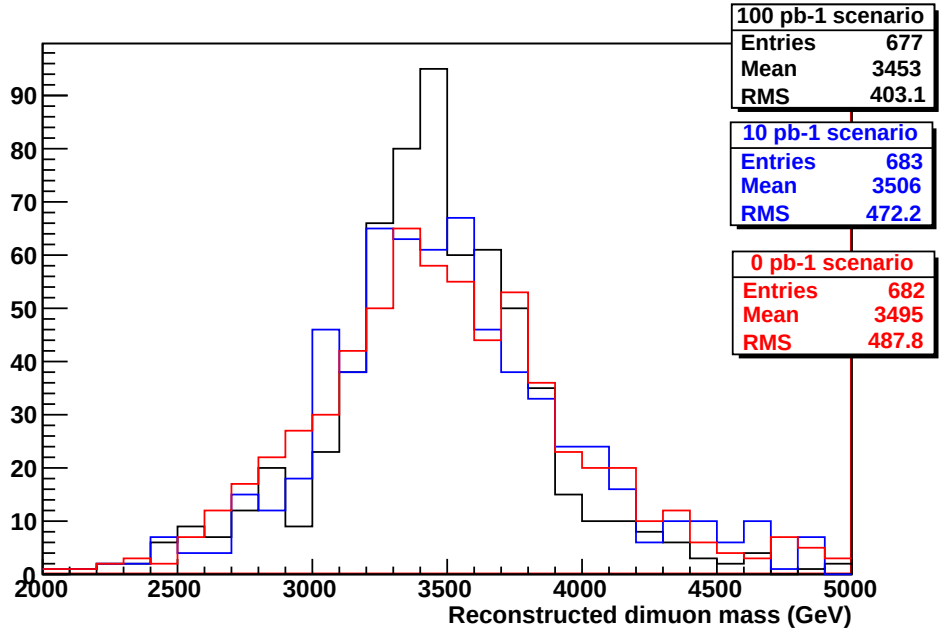
CSA08 alignment scenarios



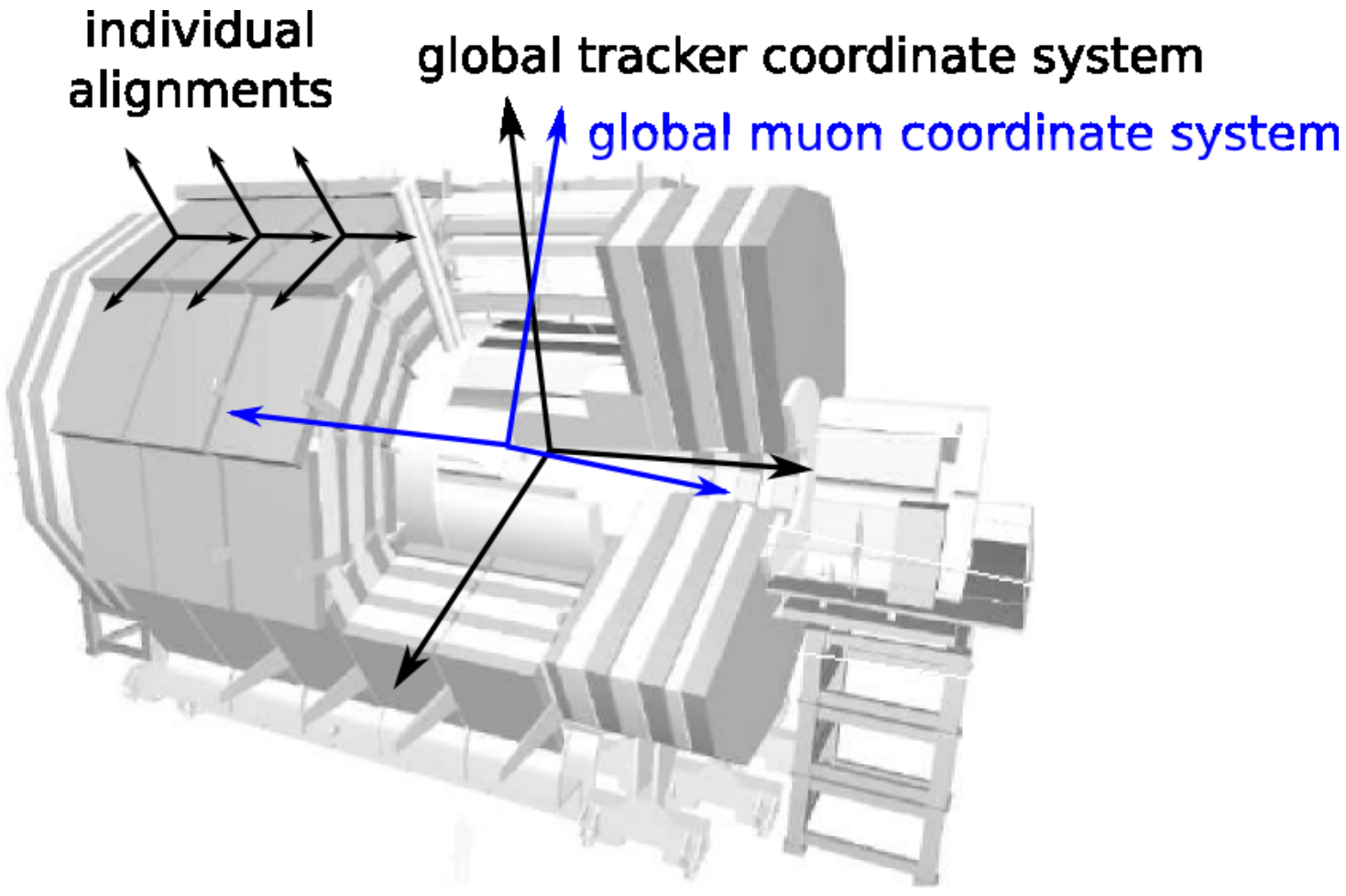
CSA07 10 and 100 pb^{-1} scenarios were generated under different assumptions, and effect on high dimuon masses didn't scale as expected

CSA08 0, 10, and 100 pb^{-1} scenarios do scale as expected for a 3.5 TeV (extreme) Z'

- Also incorporate new information from hardware and track-based alignments
- More detailed model of uncertainties



Global alignment constants



- Global coordinate system for (1) tracker, (2) muons, (3) ECAL, (4) HCAL
- Separate database record, so global shifts/rotations can be applied with more agility than individual alignment constants

Conclusions

- While still working on full-scale procedure, we are focusing on start-up
- All HIP-related software is done (in 2_0_X) except monitoring plots
- We're not waiting for MC: we can use existing samples
- We can test beam-halo procedure in MTCC as soon as we're ready
- With this timeline, we'll be ready for CRA0T/CRAFT data when it becomes available
- We'll also get as much information as we can from beam-halo before first collisions