# Muon-HIP Alignment Workflow

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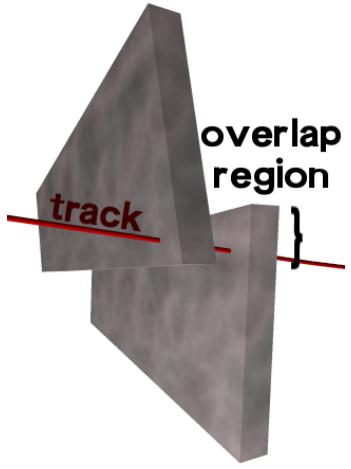
# Two projects



## Very early alignment of muon endcaps




- Align chambers and layers relative to each other with beam-halo (before first collisions) through CSC overlap hits
- Align whole rings relative to the tracker with several hundred I.P. muons
- Two opportunities to compare with hardware alignment
- Manually configured and operated by Károly Banicz and me

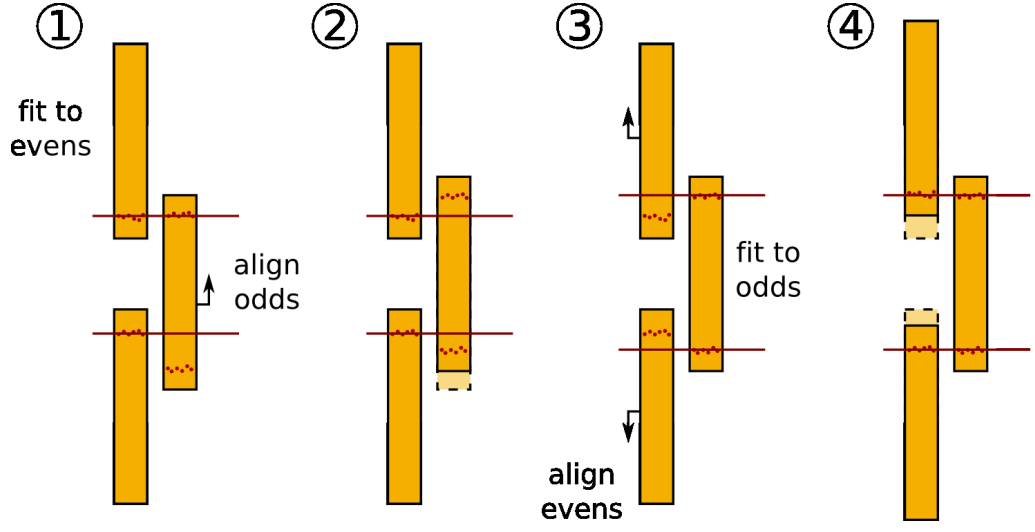
## 10 to 100 $\text{pb}^{-1}$ alignment of the whole muon system

- Align chambers relative to the tracker with tens of thousands through millions of I.P. muons
- Automated and parallelized, run on the CAF

# Very early alignment of endcaps



- See Károly's talk at yestday's CSC DPG
- Alternate between track-fitting even-numbered chambers, aligning odd, and fitting odd, aligning even




- Ring alignment step requires a new level in muon hierarchy

  $\ldots \longrightarrow$ CSCStations $\longrightarrow$ CSCRing $\longrightarrow$ CSCChamber $\longrightarrow \ldots$

- New item since last meeting
  - Hard to implement a structural change like this for 2_0_0?
  - I'd like to have that discussion offline

# Workflow for 10 and 100 pb$^{-1}$

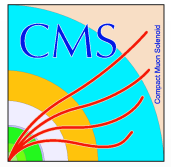
- 9 passes, the first having 15 iterations, the rest 5 (total of 55)
  - First align wheels and disks, slow convergence
  - Next align innermost muon stations
  - Then fix innermost and align next, etc.
  - Then allow everything to float when close to optimum
- Data selected by a $p_T$ cut and a new track cut that rejects highly-scattering tracks

# Resources for 100 pb$^{-1}$

- Assuming all $W + Z$ and no QCD: 714,000 events
- 54 CPUs + 1 control job
- 11 min/iter $\longrightarrow$ 10 hours wall time (ideally)
- 12 MB/iter output on *local* disk $\longrightarrow$ 660 MB
- Typical max memory: 300 MB, max swap: 700 MB
- CASTOR failed on 13 jobs (0.6%), each of which pauses the entire process— must be restarted by hand

# Implementation details (skip?)







- Single perl script creates all necessary directories and configuration files; easy to stop and restart a half-finished job
- One control job submits parallel sub-processes, waits for them to finish
  - This CPU spends most of its time sleeping
  - Waits forever if sub-job fails
- Muon geometry is passed from one iteration to the next via SQLite files: last one copied into database by hand
- Residuals monitoring through CommonAlignmentMonitor
- Alignment monitoring through MuonGeometryIntoNtuples
- For MC, combine datasets at the level of parameter matrices (individual subjobs run on pure samples)

# Work to be done



## Relative chamber alignment with beam-halo:

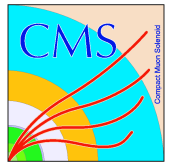
- Need HLT paths for beam-halo technical trigger
- CSC overlap hits need to be put on CosmicMuon tracks
- Need to submit code for setting APEs (through CommonAlignmentMonitor)
- Need to write and submit geometry-monitoring scripts
- Need to test survey constraints for muon system
- Develop procedure on MC (beam-halo rate is "factor-of-100" uncertain: level of feasibility will not be fully known)

## Ring alignment with globalMuon tracks:

- Need to add CSCRing level of hierarchy
- Need to submit track-scattering cut

# Work to be done






## 10 and 100 $pb^{-1}$ full alignments:

- Procedure runs, but with CASTOR problems (now rare, but still a problem)
- Same new code requirements
- Determine optimal cut and preferred parameters for AlCaReco (to be coordinated with MillePede muon alignment group)
- Systematics studies (in 1_6_7 with large data samples)
  - Still need to try several configurations (optimize new track cut)
  - Miscalibrations, misaligned tracker, wrong $\rho(\vec{x})$, $\vec{B}(\vec{x})$...
  - Generic event selection with $p_T$ cut, rather than $W$, $Z$
  - Layer alignment feasibility study
- CSA08: make sure the baseline procedure works and gives the same results in CMSSW_2_0_0
  - Need small 2_0_0 $Z \rightarrow \mu\mu$ sample: 54,000 events after AlCaRecoMu cuts

# Conclusions



## Requests:

- More reliable CASTOR access
- Occasional overnight use of 50 CPUs
- Larger non-CASTOR space? (several GB)

## Status:

- Baseline 100 $\text{pb}^{-1}$ procedure is almost in good shape: early tests show 300–800 $\mu$m, depending on station
- Finished 85% of a full walkthrough, with manual intervention
- A lot of new code to submit; most of it is written
  - We need to talk about new item: CSCRing

## CSA08:

- Extensive physics-tests of the procedure using 1_6_7 and existing CSA07 samples
- Check that software still works in 2_0_0 and beyond