Muon Geometry for CRAFT: HIP Group's Perspective

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Status of muon alignment

- HIP group produced a track-based alignment procedure of barrel wheels and endcap disks and a first set of constants in time for CRAFT reprocessing (November 9)
  - including sanity checks of internal issues, like residuals $\longrightarrow 0$, run-by-run stability, etc.
  - rough agreement with MillePede's wheel measurements
- Of course, that's not enough: we must be sure that the constants accord with reality
- Muon hardware alignment system provides a powerful cross-check
- We were told that our results were inconsistent with established hardware measurements/constraints
  - If so, it *could* point to χ^2-invariant global deformations of the tracker, in which case the role of track-based alignment could be reversed to constrain tracker
  - *But* we have recieved very little and very late input as to what the exact values of those established results are
- As a group (track-based and hardware alignments), we'll need to improve our internal communication and decision-making

Status of constants (1)

- CRAFT_V3P::All (old constants) contains
  - alignment of DT chambers within wheels from pre-CRAFT tracks and survey
  - no wheel-to-wheel or disk-to-disk corrections (large error)
  - no endcap disk-bulging
- Track-based alignment of wheel and disk positions is cast into doubt because of possible global deformations of the tracker, so we will not provide updates
- Laser alignment of endcap disk-bulging was well-studied, but not in a usable format
  - I converted ME$\pm$2, 3, 4 from Excel to CSCAlignmentRcd by hand
  - Couldn't find ME$\pm$1, so I *guessed* approximate values
  - Formatting should be done by hardware alignment group!

`/afs/cern.ch/cms/CAF/CMSALCA/ALCA_MUONALIGN/SWAlignment/CRAFTwheeldisk/CurvedEndcapsOnly.db`

`/afs/cern.ch/cms/CAF/CMSALCA/ALCA_MUONALIGN/SWAlignment/CRAFTwheeldisk/CurvedEndcapsOnly.xml`

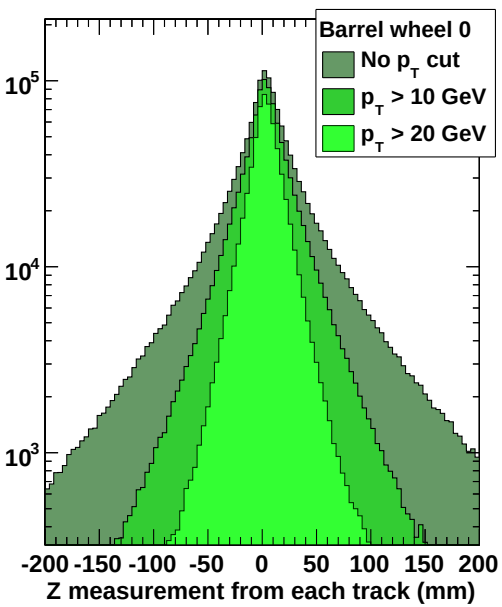
Status of constants (2)

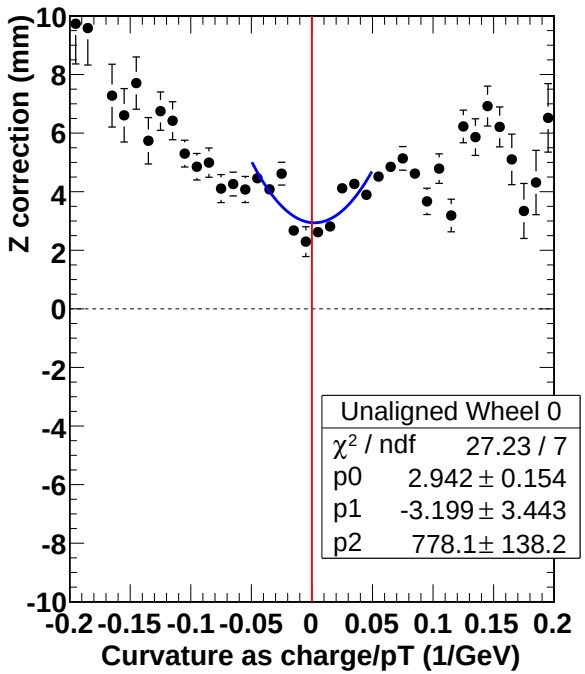
- We should also set the relative position of the tracker and muon system with tracks
  - tracker position is not defined in terms of a physical landmark
  - relative alignment is *defined* by globalMuon consistency
  - translating entire muon system cannot affect standAloneMuons
- −3.8 mm correction in Tracker entry of GlobalPositionRcd:

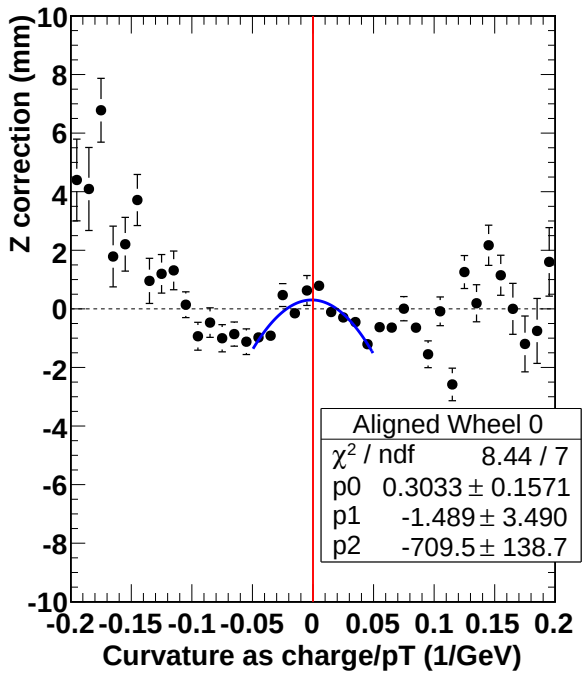
  `/afs/cern.ch/cms/CAF/CMSALCA/ALCA_MUONALIGN/SWAlignment/CRAFTwheeldisk/CRAFT_GlobalPositionRcd.db`
- From track-based alignment of wheel 0 with full CRAFT dataset (details on next page)
- Doesn't affect any new DT updates and doesn't change the coordinates of anything in the muon system

Details of global z measurement

- Every globalMuon track measures tracker-muon displacement, but low-momentum tracks are dominated by multiple scattering (tails)
  - want to take a mean of the highest-momentum tracks
  - plot alignment correction versus curvature (q/p_T)
  - Taylor-expand around infinite momentum ($q/p_T = 0$)
  - Quadratic fit: p_0 is misalignment (constant), p_1 is $\vec{B}$ error (antisymmetric with q), p_2 is multiple scattering (symmetric with q)
- Wheel 0 measurement is most reliable above ~40 GeV ($|q/p_T| < 0.025$)







Conclusions

- Recommended endcap and global position corrections (tags are named "CSCAlignmentRcd" and "GlobalPositionRcd"):

  `/afs/cern.ch/cms/CAF/CMSALCA/ALCA_MUONALIGN/SWAlignment/CRAFTwheeldisk/CurvedEndcapsOnly.db`

  `/afs/cern.ch/cms/CAF/CMSALCA/ALCA_MUONALIGN/SWAlignment/CRAFTwheeldisk/CRAFT_GlobalPositionRcd.db`

  - Relative disk positions remain uncorrected

- I am unfamiliar with new constants proposed for the barrel

- While the muon alignment group as a whole needs to communicate better and have a more formal decision-making process, we'd like to emphasize that our HIP group's objective is just track-based alignment
  - I should not be spending time trying to interpret and translate hardware results
  - About a year ago, we all agreed that hardware alignment would be provided as alignment records, to be a starting point for track-based alignment
  - We need to get back to that model