Alignment Status / Plans for 2019 dataset

PF

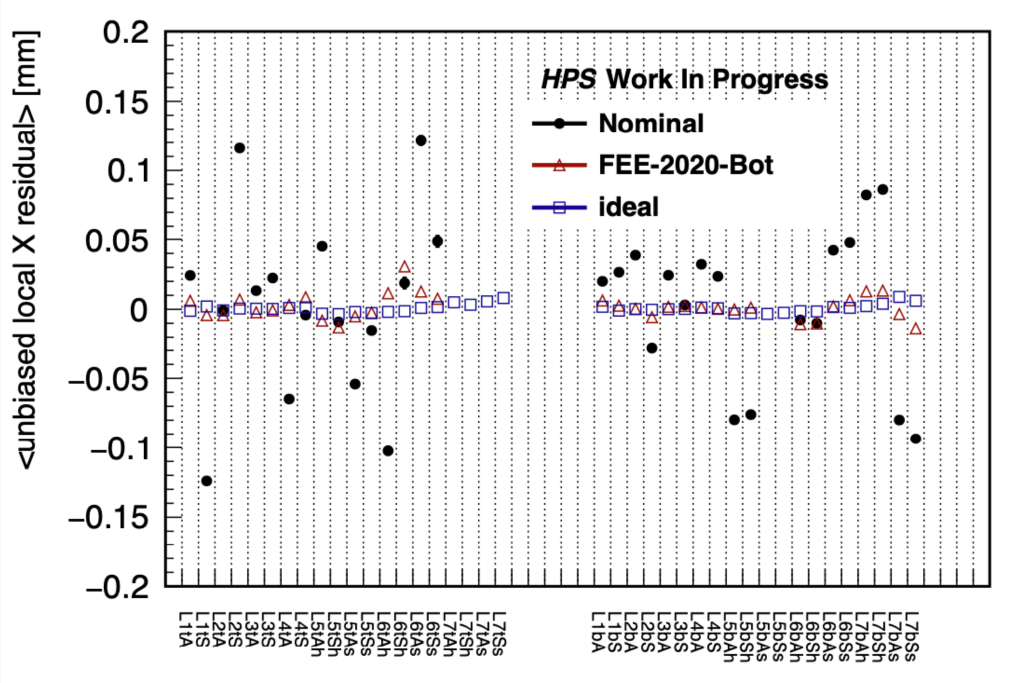
18/10/2022

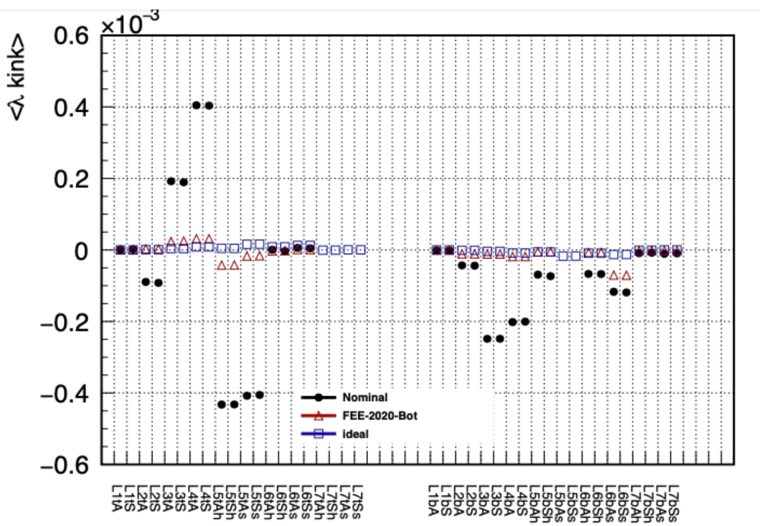
Introduction

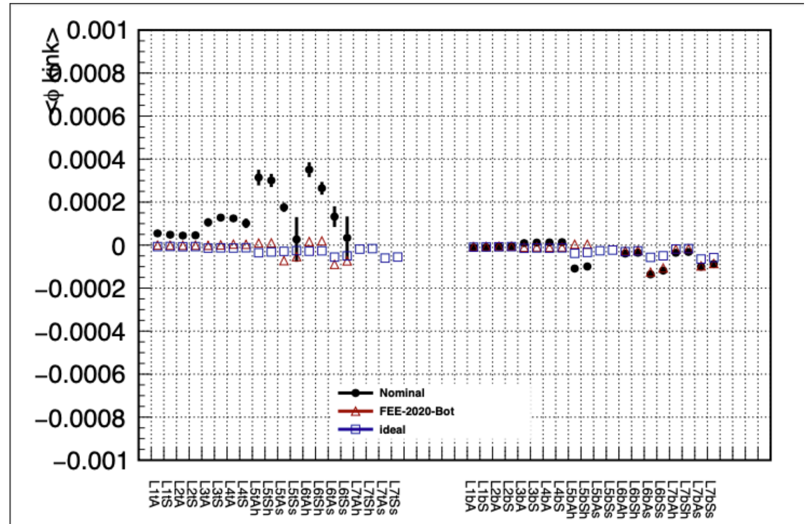
- Recap of the current alignment solution for 2019 based on FEEs
  - Starting point, procedure, results
  - What can we do to address some of the known problems
  - Priorities and next steps
- Inputs and requests

Current solution: Recap of starting point

- Restarted from 2020 alignment using FEEs
- Previous performance has been shown at the Alignment collaboration meeting and various workshops
- Here is a snapshot
- This alignment used FEEs, Momentum constraint and Beamspot constraint with 10um resolution in X-Y



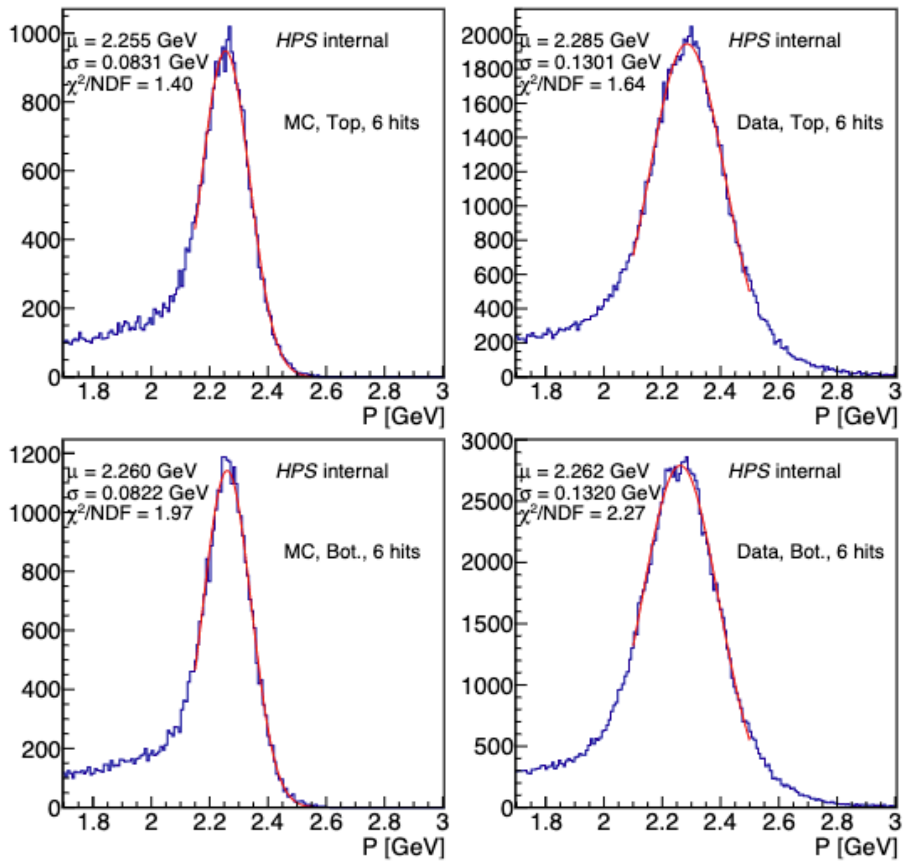


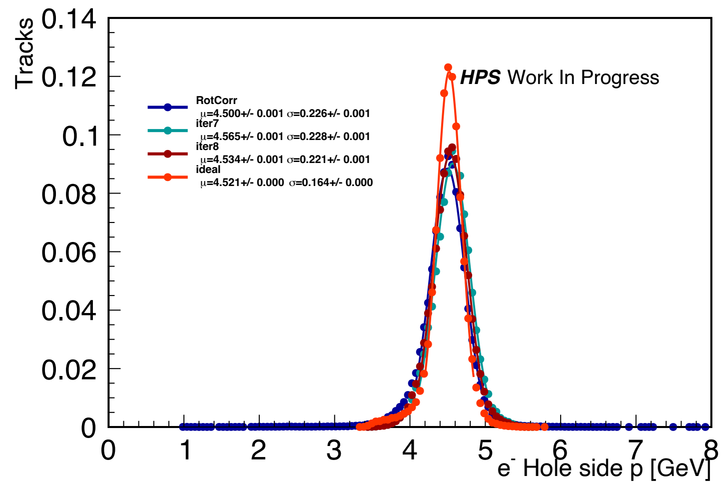


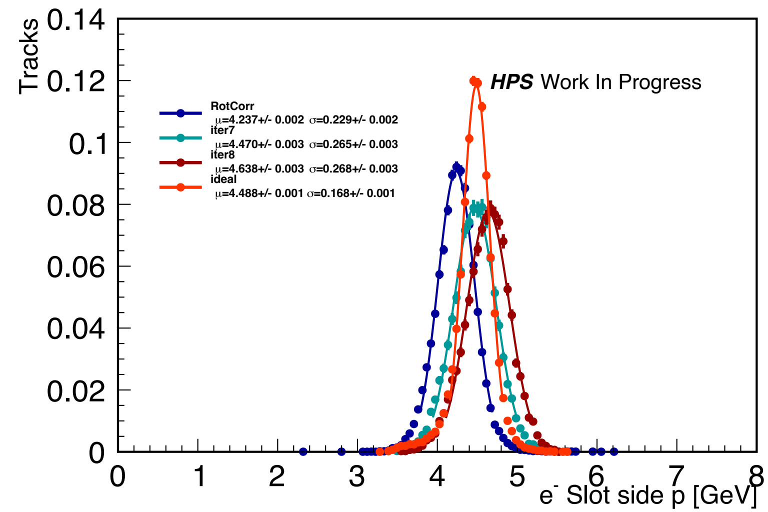
Targeting the momentum scale

- Next alignment iterations are targeting momentum scale in the back of the detector.
- Kept L1L2L3 mostly fixed and performed a series of iterations of the back of the detector pinning the momentum of the FEEs to 4.5 GeV
  - The various iterations subsequently used:
    - Full modules (4 sensors) structures alignment in Global Y
    - Hole-Slot double sensor structures (2 sensors) alignment in Global Y / RW separately for axial-stereo and rotations along Z
    - Single sensor alignment Tu / rW
- I moved to smaller structures when the larger structures were not moving anymore, i.e. the MPII computed corrections were 0

Targeting the momentum scale



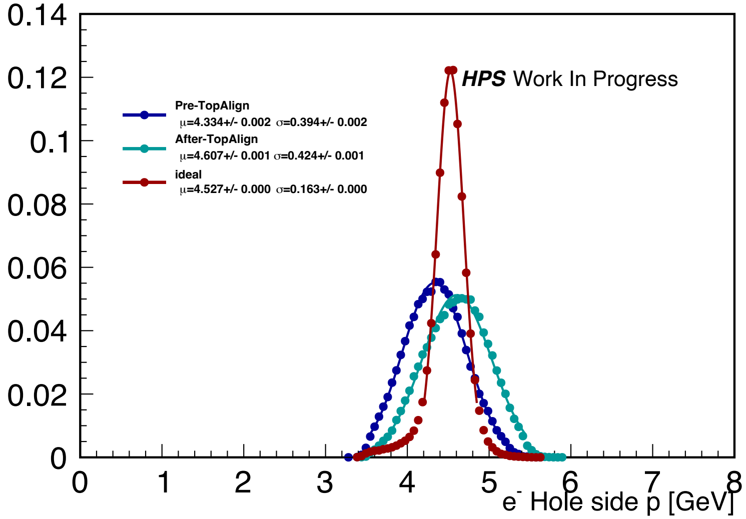


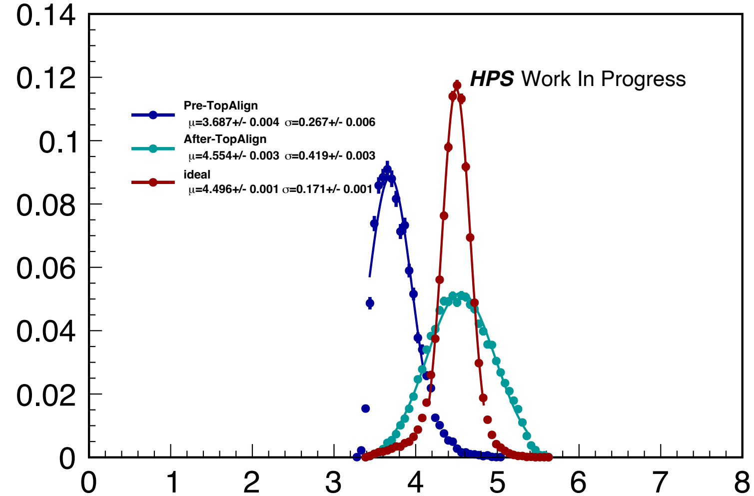


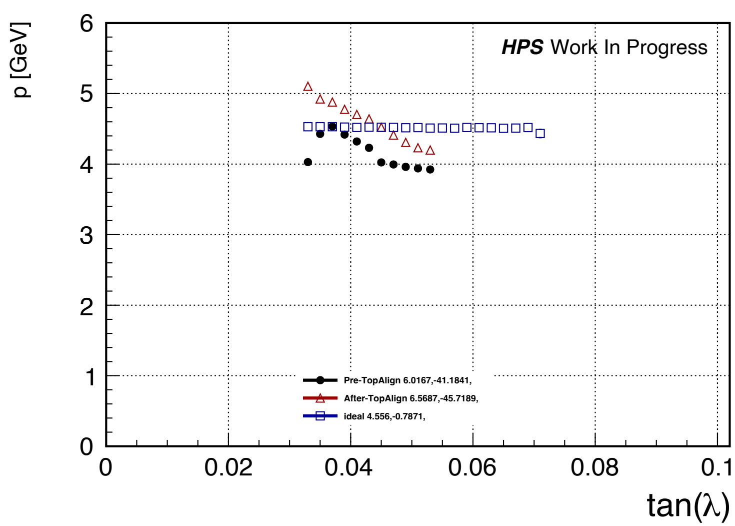
- When checking vs 2016, bottom p-resolution is better. (~30% vs 50% discrepancy with MC)

Targeting the momentum scale

- Followed same procedure outlined for BOTTOM for TOP volume as well







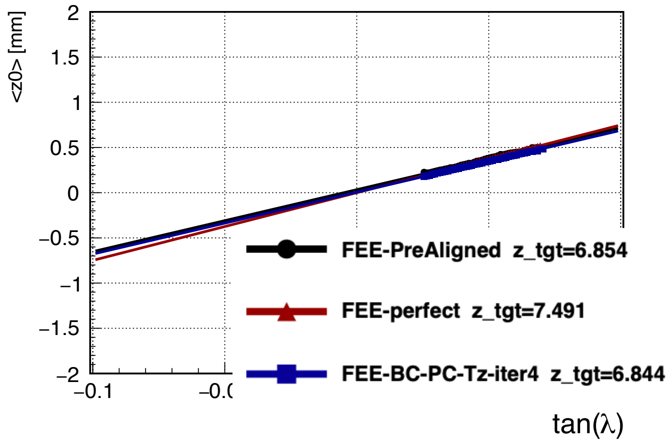
- For Top Volume there is a dependence of the momentum vs tanL that cannot be corrected with this alignment procedure.
- Momentum scale is OK
- P-resolution not optimal.
- Same issue is seen in 2021

Targeting the momentum scale - Take away message

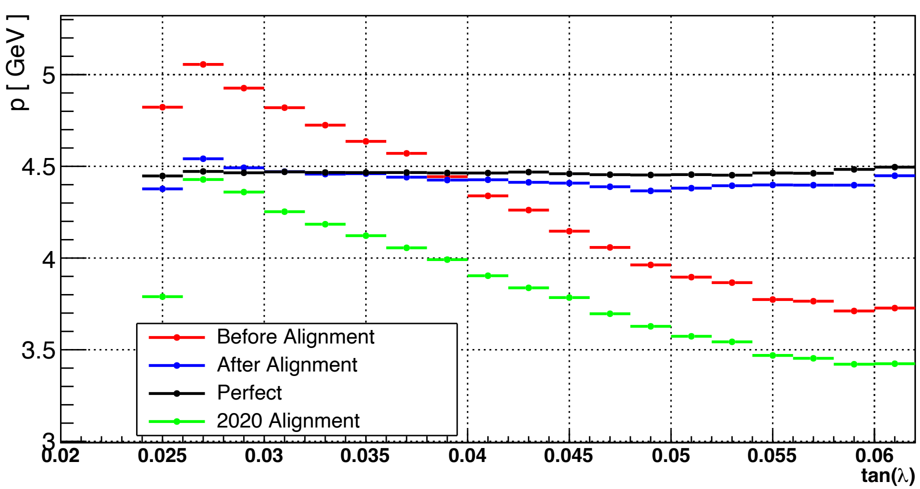
SLAC

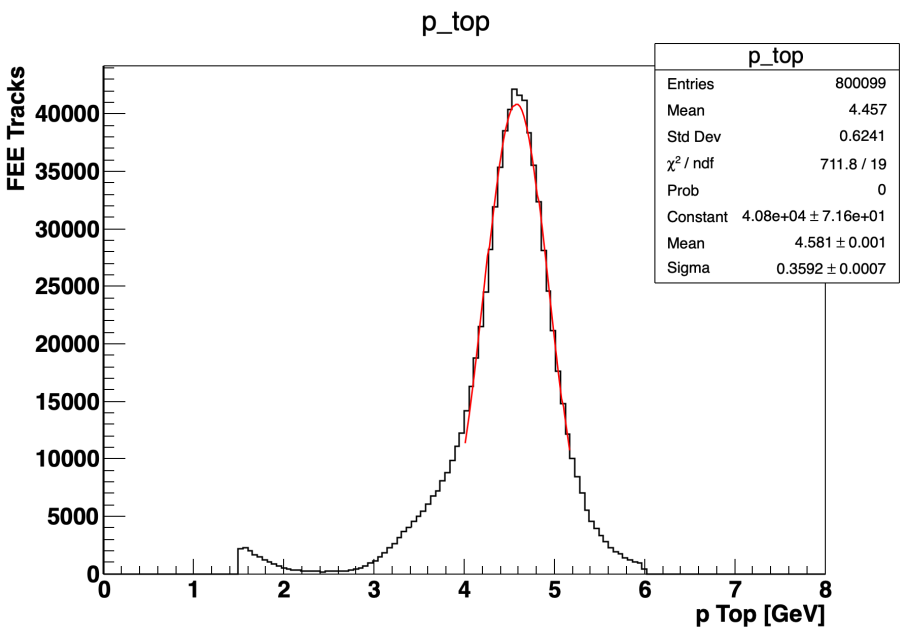
- The momentum resolution estimated from the width of the momentum distribution in FEEs skimmed sample is better than 2016 resolution for the BOTTOM volume when comparing against MC
  - Caveats:
    - The MC in 2019 doesn't reproduce the data condition (Cam will talk about this little bit more)
    - Top volume is quite off in terms of resolution wrt bottom and expected performance
- Dedicated plots should be produced to asses the reason of this problem
  - Cam will discuss some proposals of plots to add to the validation package, e.g. hit content distributions for tracks

SVT Performance TOP - Possible to improve via Tz ?

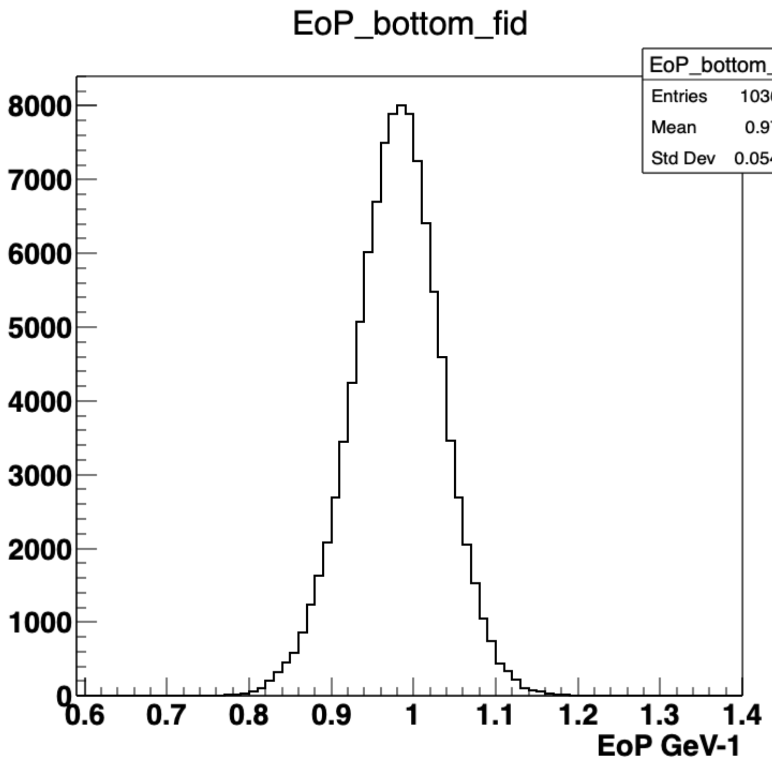


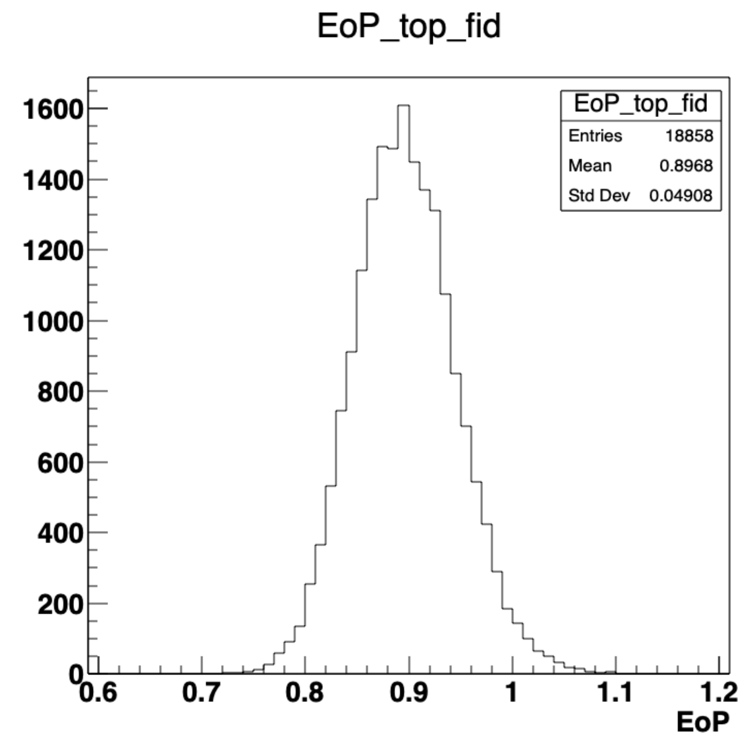
- This iteration
  - Fixes ures vs u/v dependence in large amount
  - Fixes PvsTanLambda
  - Keeps the BC at 0,0 in x/y with internal constraint at -6.9 mm
  - Fixes hole/slot dependence on momentum
  - Worth pursuing further? Combine with lower momenta tracks with more curvature?
  - Survey Z position of the modules in the U-Channels at jLab. Or ship it to SLAC?





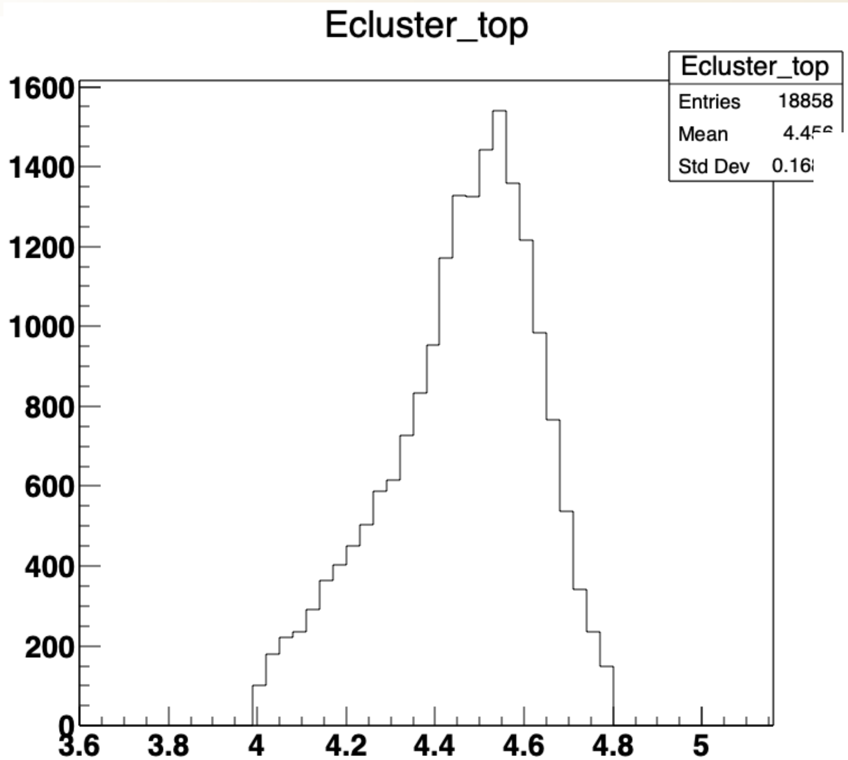
Track to Cluster association

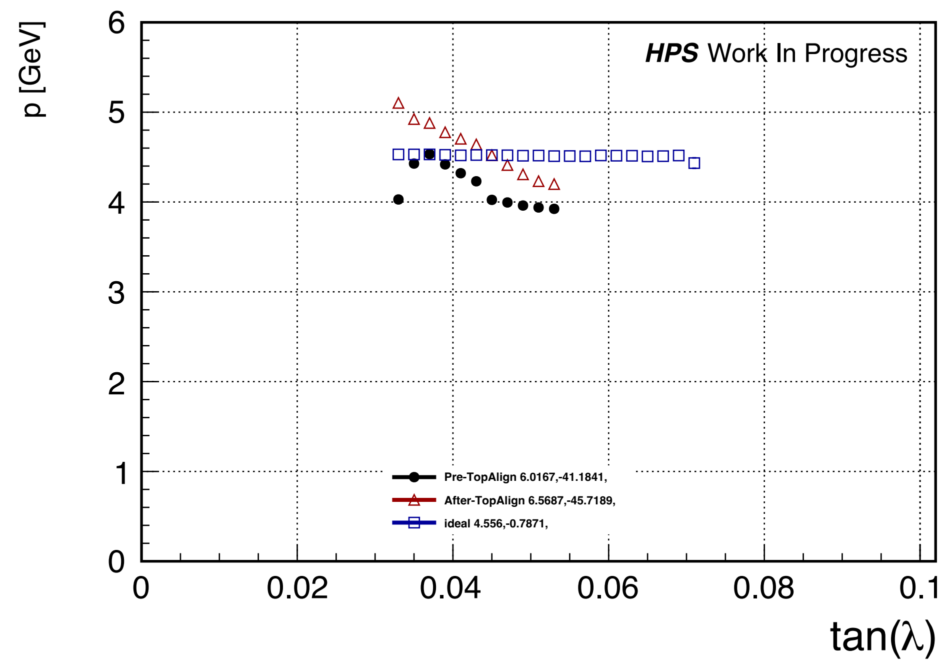




- When checking EoP seems like top Volume is at 90%, which indicated a larger momentum of tracks matched with clusters with respect to the one measured on the full track collection measured in the tracker
- I use Alic's latest TrackToCluster association
  - Run on FinalTrackParticles collection,
  - Extract the track and cluster
  - Plot the track/cluster quantities

Track to Cluster association



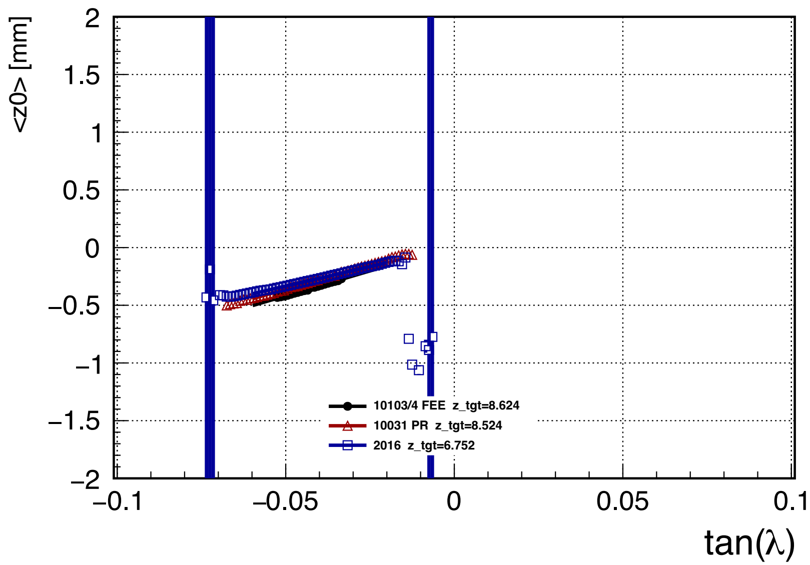


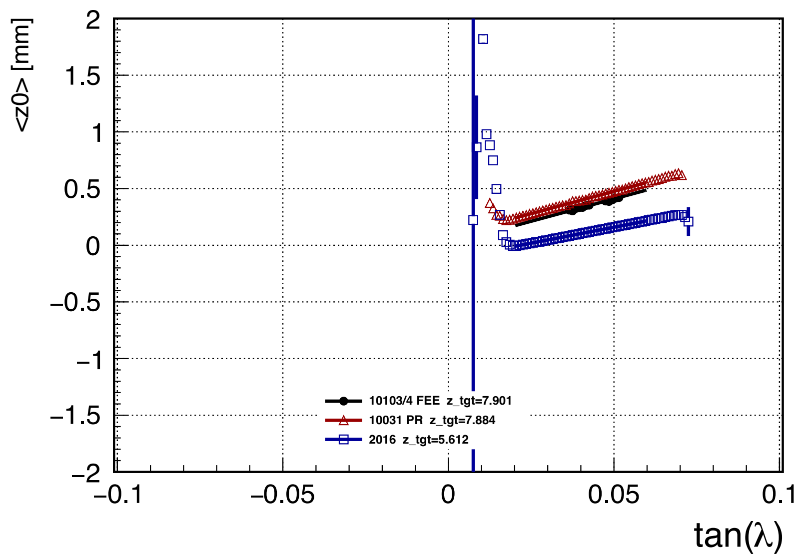
- The energy of the cluster seems correct.
- I did not have time to check if the tracks matched to clusters are at low tanL => given the p dep on tanL, this might explain the difference
- Also, number of matched clusters is much smaller of total tracks in the skims.

Track to Cluster association

- I think we should make a dedicated and structured effort to harmonize the track-cluster analysis
  - I’ve started looking at distributions vs tanLambda/phi and other quantities but we should check track-cluster time distributions, residual vs angles etc etc.
- Revisit how we use E/p as constraint in e+/e- sample, review the structure of the code I’ve implemented

Vertex Location and Beamspot

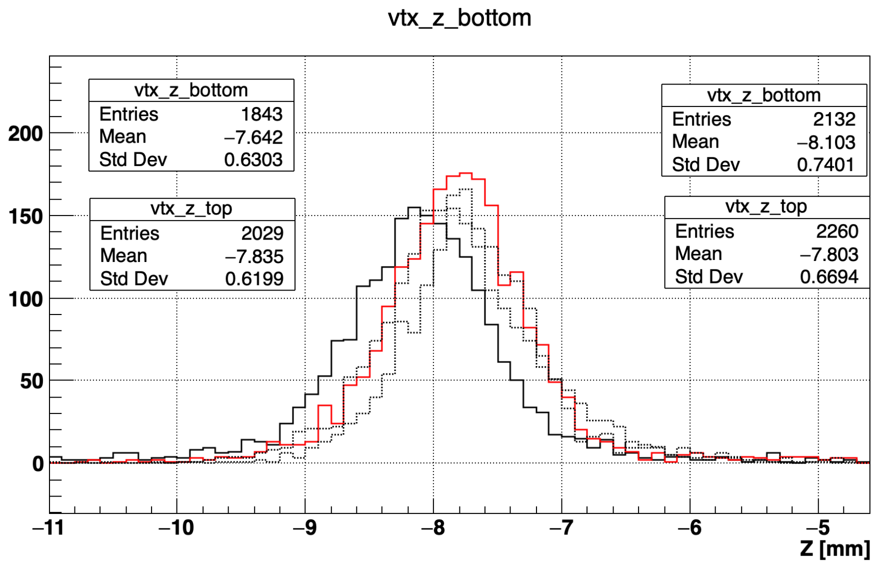


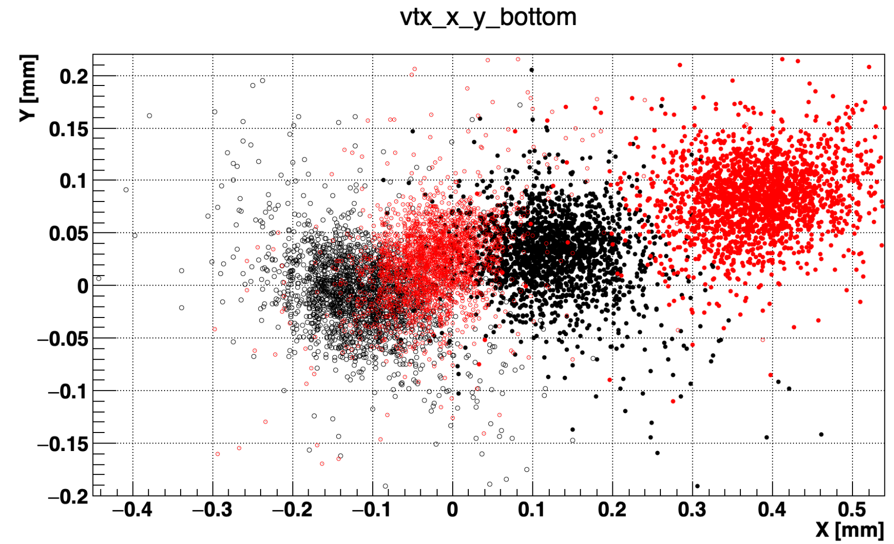


- Z0 vs TanL method shows a 1mm discrepancy between top and bottom volume
  - Consistent between FEE and PR runs:
  - no observation about why one dataset is better than the other
- How to approach this?

  - Relative movement of the two volumes in Z to have same slope?
  - Global rotation of the volumes to bring to same tanL slope?
  - Also present in 2016 (if not worse) -> live with it?

Vertex Location and Beamspot

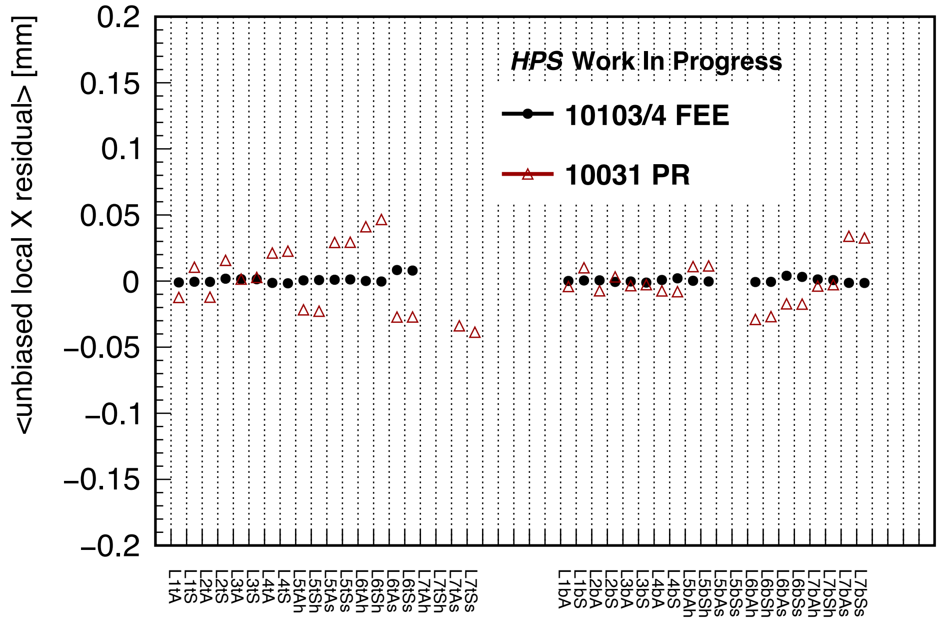




- Beamspot location X-Y consistent between FEE/PR runs.
  - Full points: FEE, Open points PR
  - Black: Bottom Red: Top
- 3D fit shows less discrepancy in the bottom vs top
  - Still bottom seems to resolve to more upstream target
  - Fix? Live with it? What to do?

How much room for improvement?

- Some of the physics quantities seem under control.
- I’m relatively happy with the Beamspot constraint, while less convinced with the momentum constraint:
  - I’m stubborn, but maybe the fact that u is along Y is a case against pinning momentum (in other experiments where E/p and momentum constraint provided successful have most sensitivity along r/phi)
- There is clear room for improvement with plain chi2 alignment of top volume modules using PR.
  - Worth doing it.



What I want to do now

- I've fixed few weeks ago the loading of the original survey constants
  - Review what's available
  - Review the Tz survey for 2019 that are available
- With the surveyed geometry:
  - Run 2016 alignment procedure as crosscheck
    - Needs to be adapted for 2019 as the layers are not the same but we can use the same concepts
    - Chi2 only, no constraints

- When that is completed:
  - If successful continue from that
  - If not, try a last pass on physics run to fix residuals