Forward Alignment Update

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Testing No Misalignment

Original GEANT precision (16 bit)

Parameter	Input	Output	Error	Global Corr.
Δu (μm)	0.0	2.63	0.11	0.660
Δv (μm)	0.0	4.87	0.12	0.699
Δγ (mrad)	0.0	-0.0030	0.0005	0.798

Increased GEANT precision (bins = 0.00001)

Parameter	Input	Output	Error	Global Corr.
Δu (μm)	0.0	1.57	0.15	0.656
Δv (μm)	0.0	4.27	0.16	0.696
Δγ (mrad)	0.0	-0.0065	0.0007	0.795

Used roughly half the number of tracks.

Various Misalignments

Δu shift

Parameter	Input	Output	Error	Global Corr.
Δu (μm)	200	202.6	0.4	0.656
Δv (μm)	0.0	1.8	0.4	0.704
Δγ (mrad)	0.0	0.039	0.002	0.799

Δv shift

Parameter	Input	Output	Error	Global Corr.
Δu (μm)	0.0	0.9	0.4	0.663
Δv (μm)	200	196.7	0.4	0.691
Δγ (mrad)	0.0	-0.025	0.002	0.795

Δγ shift

Parameter	Input	Output	Error	Global Corr.
Δu (μm)	0.0	-13.6	0.4	0.649
Δv (μm)	0.0	29.4	0.4	0.685
Δγ (mrad)	2.0	1.875	0.002	0.788

Δu, Δv, and Δγ shifts

Parameter	Input	Output	Error	Global Corr.
Δu (μm)	200	191.3	0.4	0.660
Δv (μm)	200	215.2	0.4	0.699
Δγ (mrad)	2.0	1.904	0.002	0.798

Summary

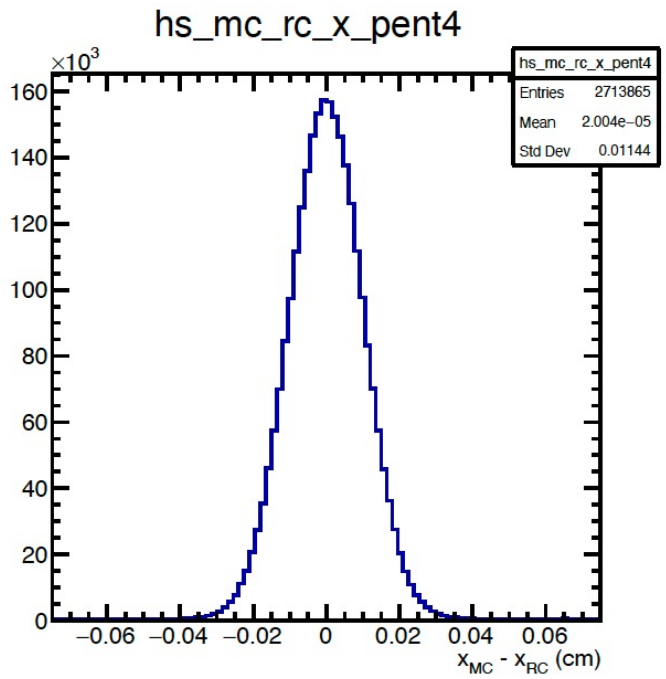
- Increasing precision in GEANT geometry did not improve the “no misalignment” results.
- Millepede does a decent job of recovering alignments from shifts in Δu and Δv.
- Poor performance for Δγ rotational shifts.
  - Maybe large size of detector causes points on the edge of detector to be highly sensitive to rotations, skewing the result?

BACKUP

Some additions and fixes to code

- Added an alignment Ttree, which contains the hit positions for each track which partakes in alignment.
  - volume id, MC, RC, Track positions.
  - Makes generating residual histograms easier and can be performed for every FST and sTGC module.
  - Also adds sTGC residuals which were not in place before.

- Found mistake in loading the sTGC hits, the covariance matrix was rewritten for the hits. Increased σ_x and σ_y by factor of 100.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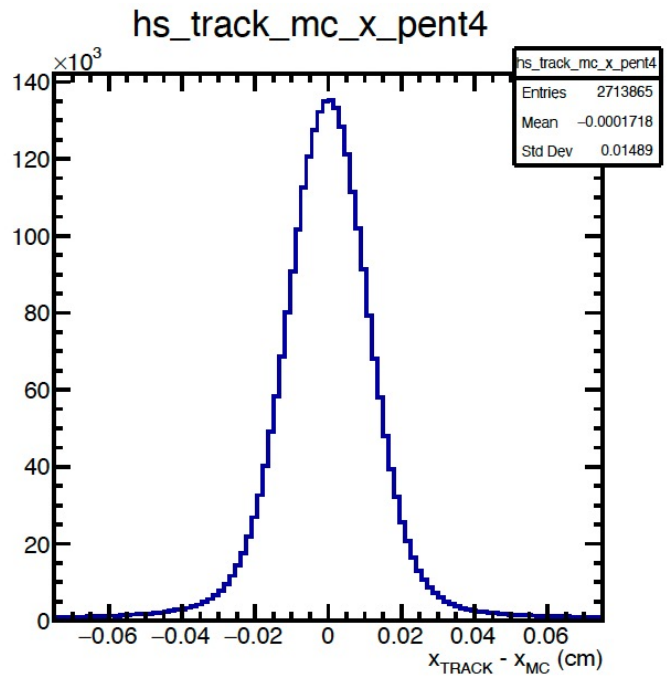
Entries 2713865
Mean 2.004e−05
Std Dev 0.01144
×10^3
x_MC - x_RC (cm)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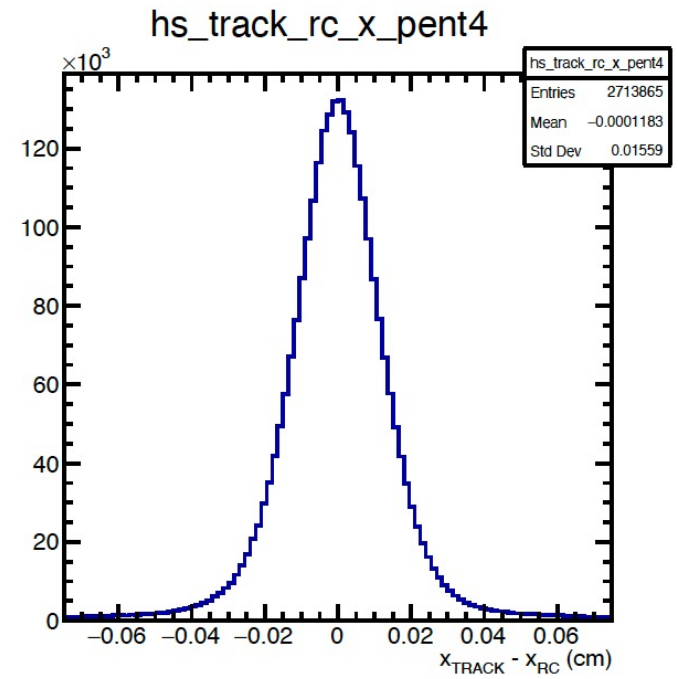
Std Dev 0.01489
×10^3
x_TRACK - x_MC (cm)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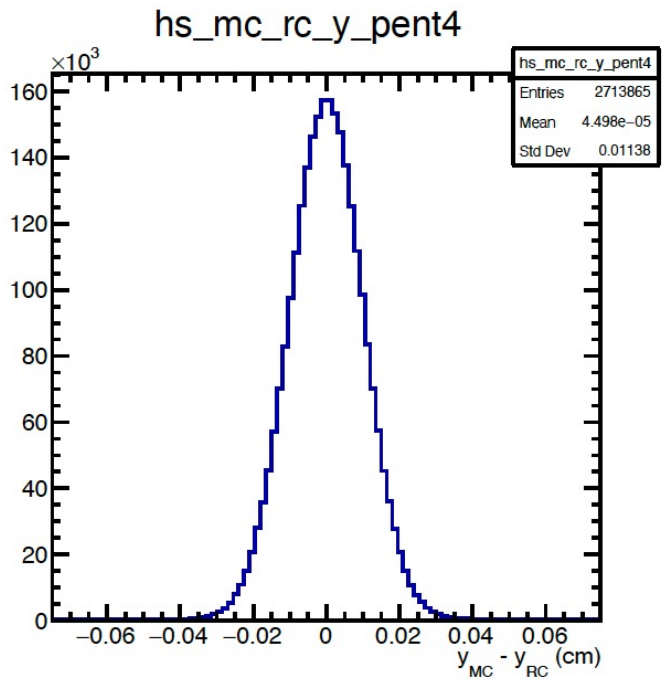
Entries 2713865
Mean −0.0001183
Std Dev 0.01559
×10^3
x_TRACK - x_RC (cm)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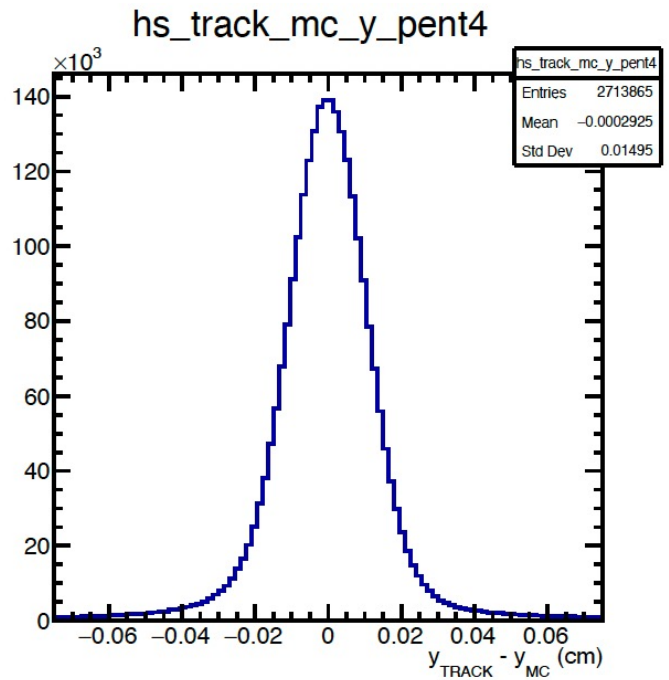
Std Dev 0.01138
×10^3
y_MC - y_RC (cm)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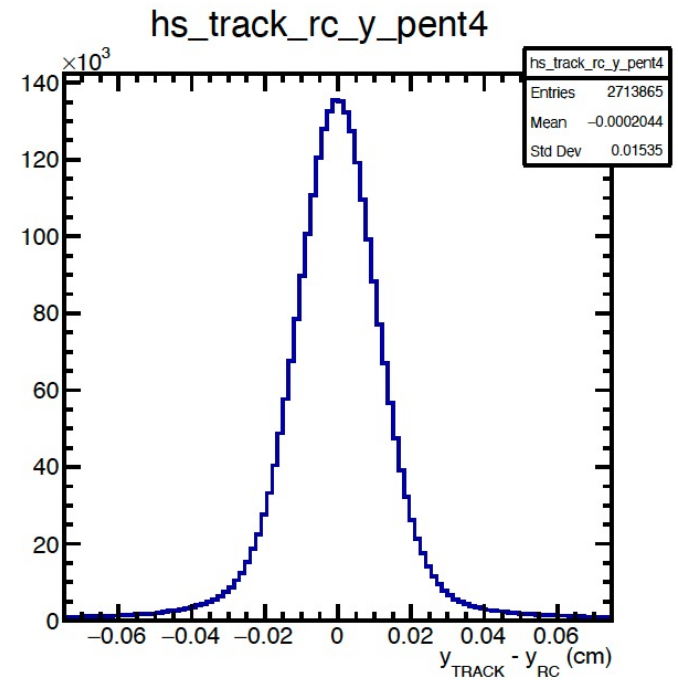
Entries 2713865
Mean −0.0002925
Std Dev 0.01495
×10^3
y_TRACK - y_MC (cm)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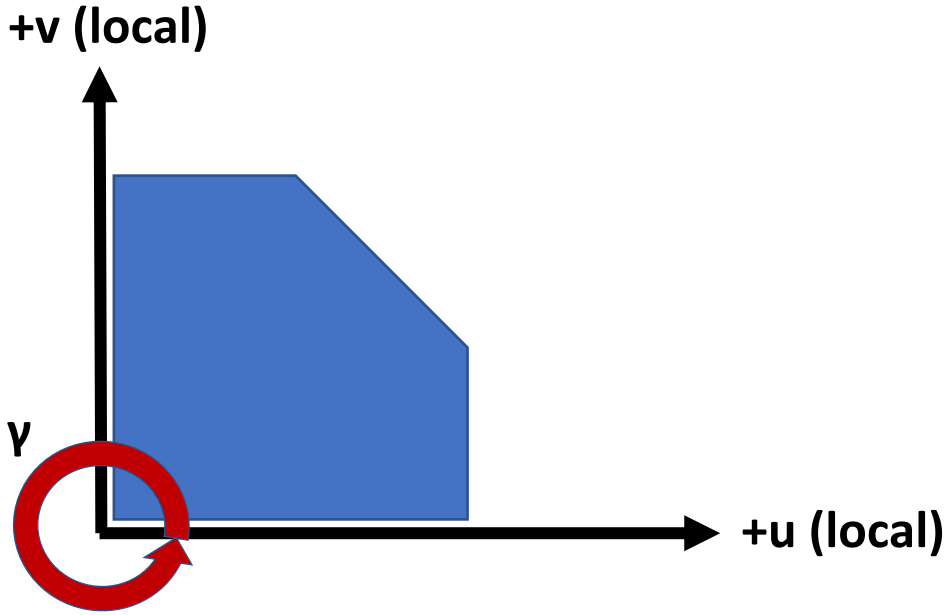
hs_track_rc_y_pent4
Entries 2713865
Mean −0.0002044
Std Dev 0.01535
×10^3
y_TRACK - y_RC (cm)

Alignment (global) Parameters

FTT (sTGC)

- 6 alignment parameters per pentagon (16 pentagons).
- 6 per plane (4 planes).
- 6 for sTGC.
- 126 alignment parameters.



Single Pentagon Alignment

- Misalign 1 Pentagon (4) in sTGC simulated geometry. Located in +x,+y quadrant on plane second closest to IP.
- Throw mu+ with particle gun with following settings*:*
  - $0.2 < p_T < 2.0$ GeV/c
  - $2.3 < \eta < 4.4$
  - $0.0 < \phi < 1.7$ rad
  - B = 0 T
- Require hits on all sTGC, at least 1 FST plane and pentagon module 4.
- Fit with GenFit Kalman filter and then refit with GenFit GBL.
- Output data to Mille.dat files. Mille.dat files are then fed to pede.
- Fix rotations about u-axis and v-axis, in addition to w translation all to 0.
- Matrix inversion used to solve for alignment parameters.

Testing No Misalignment

- Required on all 3 FST planes for this test.
- Before fix to covariance matrix.

~2.4M tracks

Parameter	Input	Output	Error	Global Corr.
Δu (μm)	0.0	-10.8	9.2	0.673
Δv (μm)	0.0	-34.9	9.9	0714
Δγ (mrad)	0.0	-0.063	0.047	0.816