

Effect of Magnetic Field Calculation on Tracking

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(Doris Y Kim speaking on behalf of Mr. Cheon)

September 29, 2014

F2F Tracking Meeting in Pisa

Outline

- Geant4 Options on B Field Calculation
- Simulation Condition
- Results: Tracking Validation Plots
- Summary

Geant4 Options on B Field Calculation

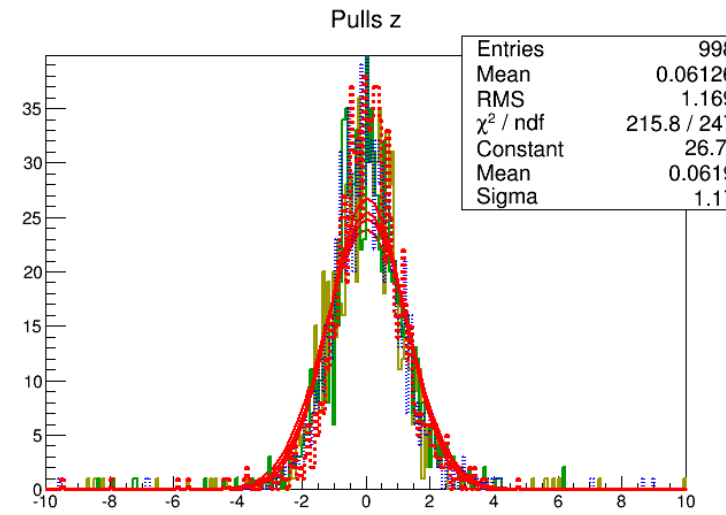
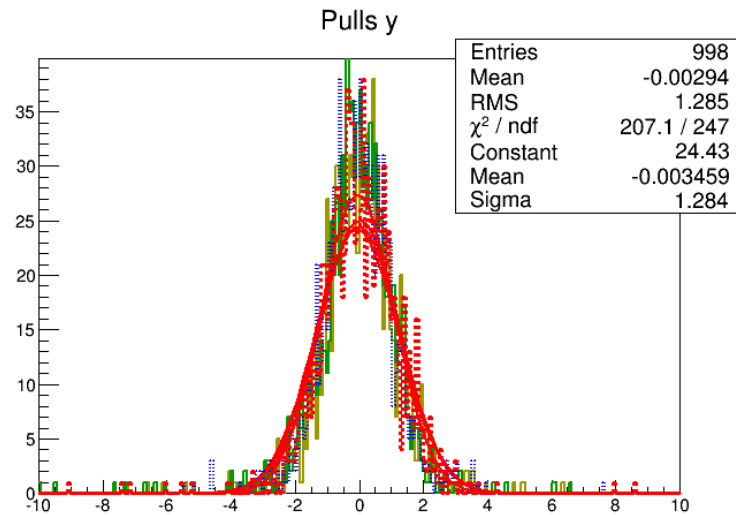
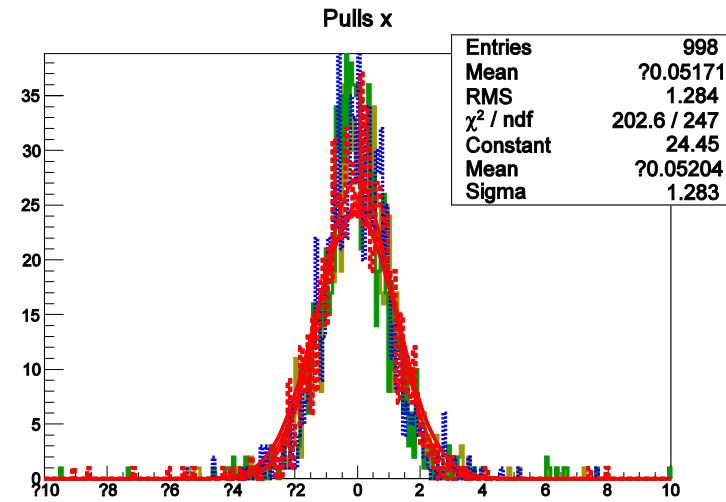
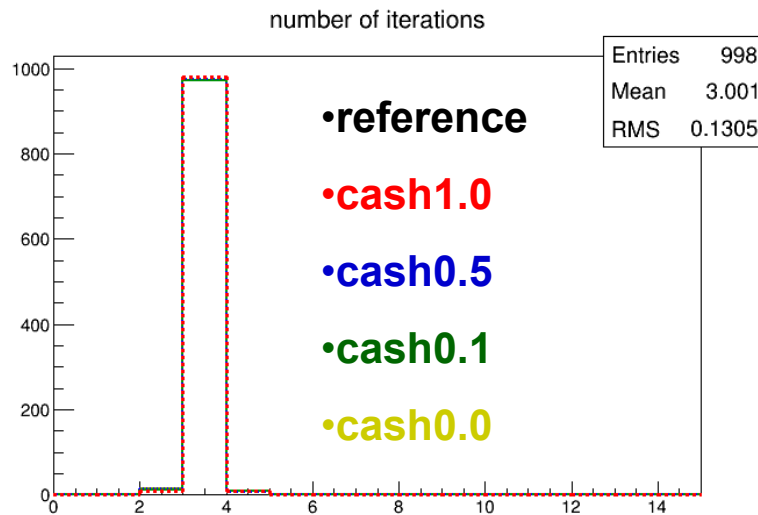
- Extrapolation method:
basf2 simulation option "magneticField" such as default, nystrom, expliciteuler, simplerunge
 - Checked these options a long time ago. Didn't see much difference in the CPU time consumed.
 - May have to revisit this again in future, since the basf2 on tracking has been changed.
- Cache Method:
Keep the previous calculated B Field until the certain distance threshold is met.
basf2 simulation option "magneticCacheDistance"

Simulation Condition

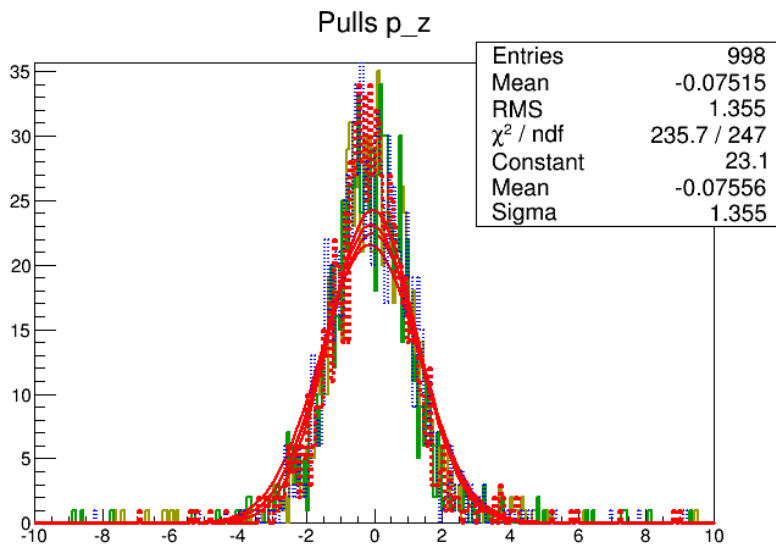
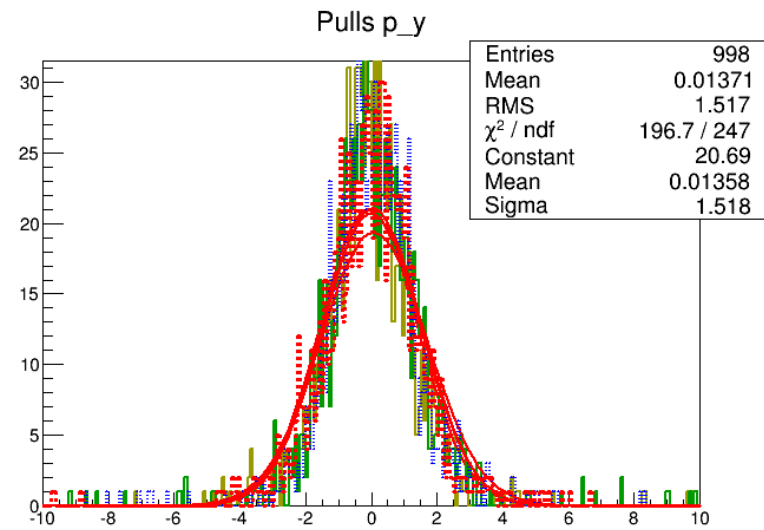
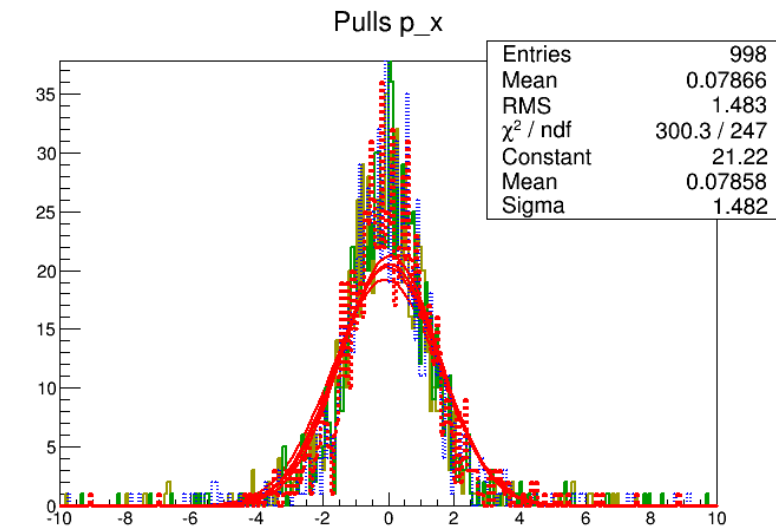
- Belle 2 Library version: build-2014-08-01
- Tracking Validation version: r 12959. Fri Sep 19, 2014
- Belle 2 Magnetic Field: 2D. Not the constant one.
- Cache distance option:
 - default (designated as 0.0)
 - 0.1 cm
 - 0.5 cm
 - 1.0 cm
- Sub-Detectors simulated: PXD, SVD and CDC

Results: Tracking Validation Plots

TrackFitCheckerPlots_pxdsvdcdc_Kalman

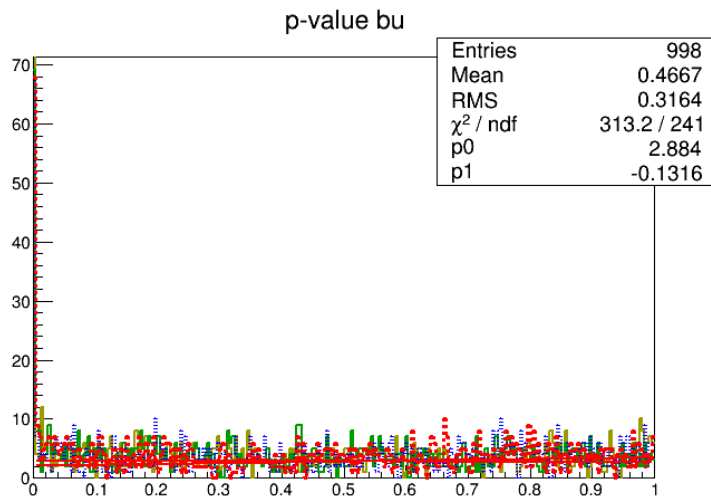
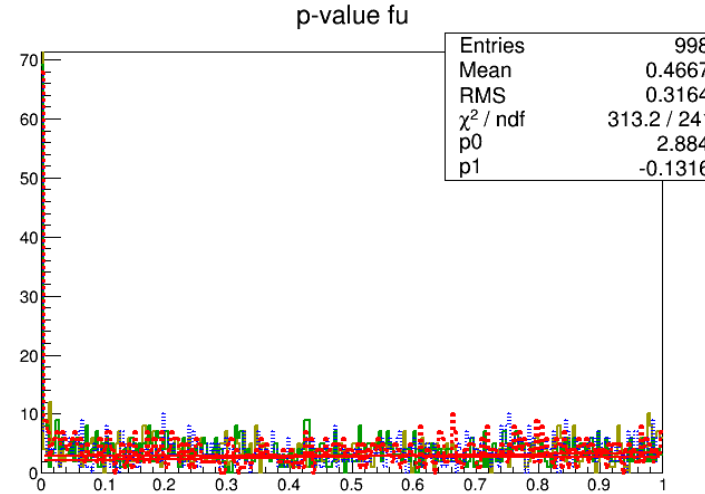
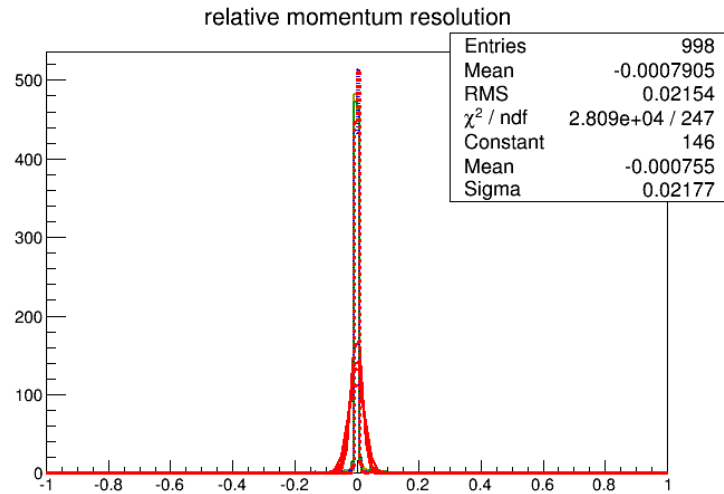


TrackFitCheckerPlots_pxdsvdcdc_Kalman



- reference
- cash1.0
- cash0.5
- cash0.1
- cash0.0

TrackFitCheckerPlots_pxdsvdcdc_Kalman



<nt_FittedConverged number>

•reference n/a

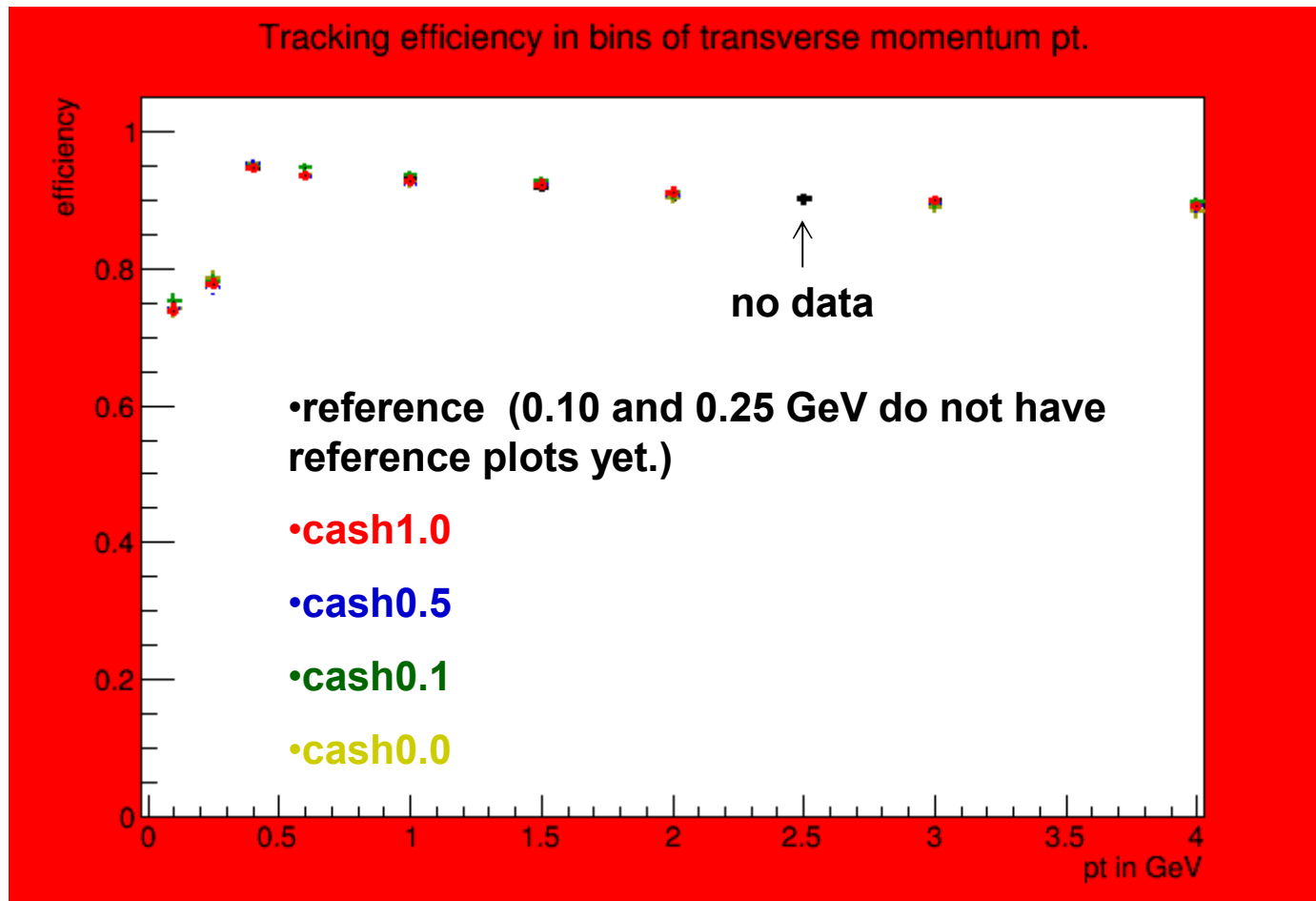
•cash1.0 0.965932

•cash0.5 0.966934

•cash0.1 0.962851

•cash0.0 0.953908

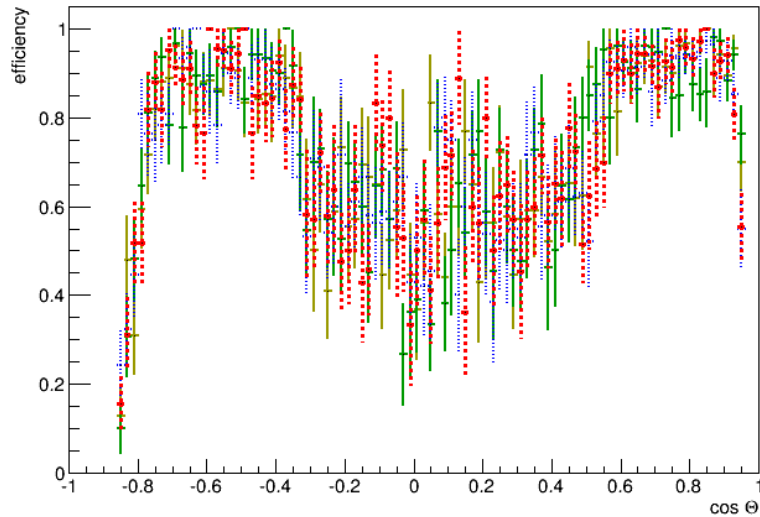
Tracking Validation: Efficiency vs Pt



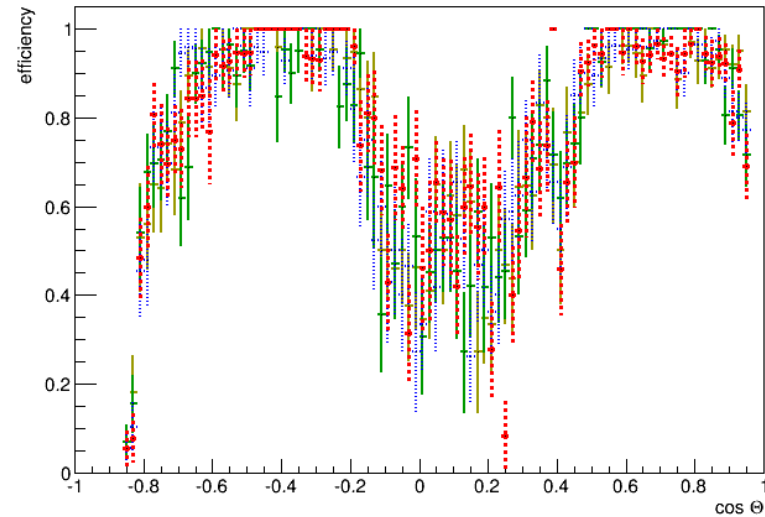
Events with 10 muon tracks with fixed transverse momentum are generated using the ParticleGun (500 events for each pt value). The events are reconstructed with VXDTF+Trasan+MCTrackCandCombiner. This plot shows the single track reconstruction efficiency over the transverse momentum. (Contact: michael.ziegler2@kit.edu)

Tracking Validation: Effi - Pt versus Cos Theta – up to 0.40 GeV

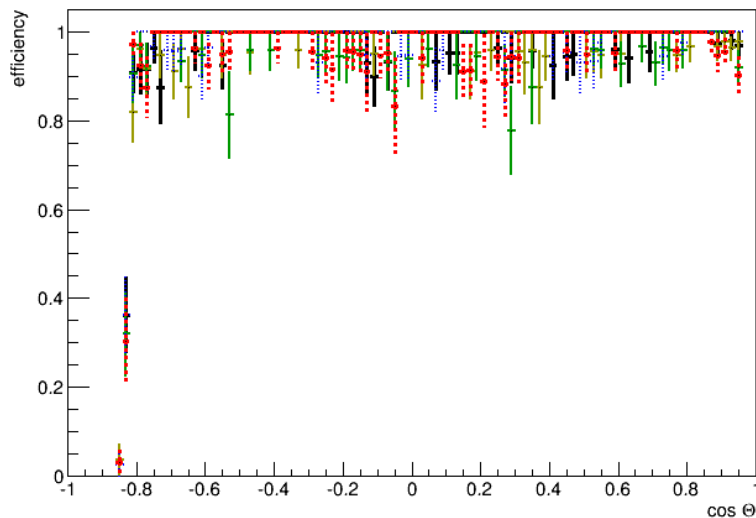
Tracks with pt = 0.10 GeV



Tracks with pt = 0.25 GeV



Tracks with pt = 0.40 GeV



•reference (0.10 and 0.25 GeV do not have reference plots yet.)

•cash1.0

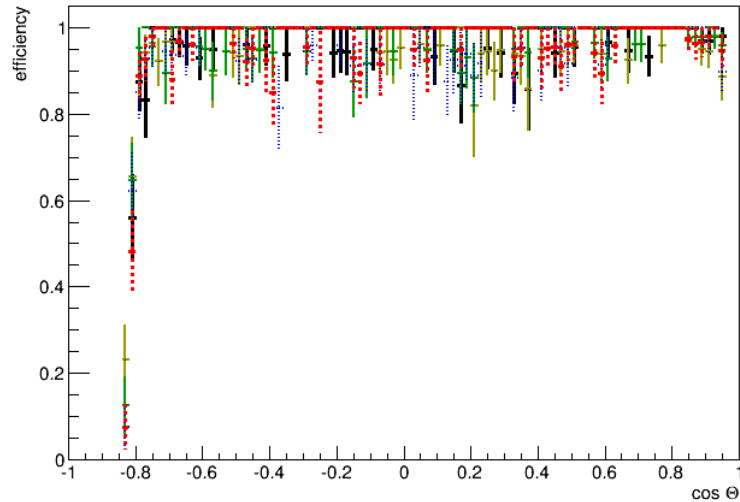
•cash0.5

•cash0.1

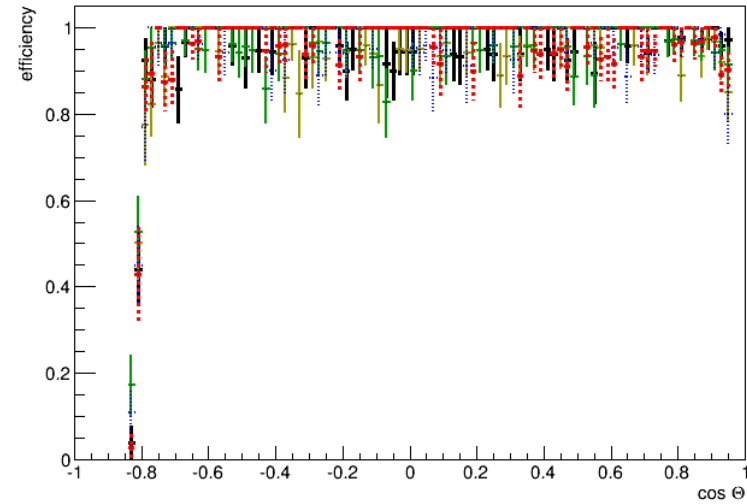
•cash0.0

Tracking Validation: Effi - Pt versus Cos Theta – up to 1.5 GeV

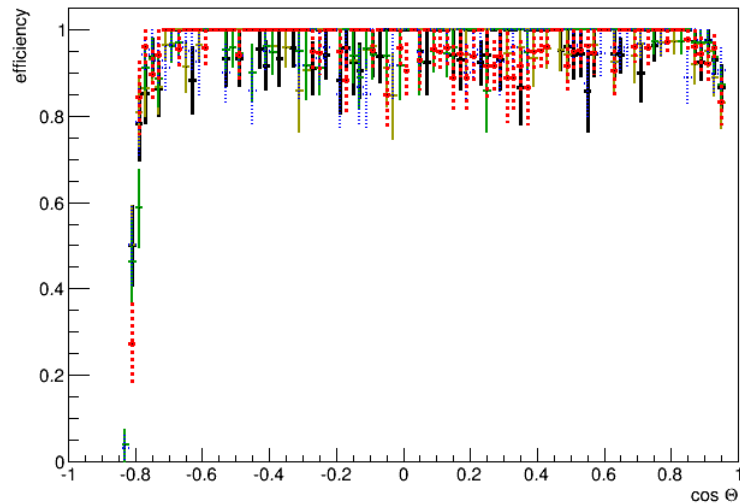
Tracks with pt = 0.60 GeV



Tracks with pt = 1.00 GeV



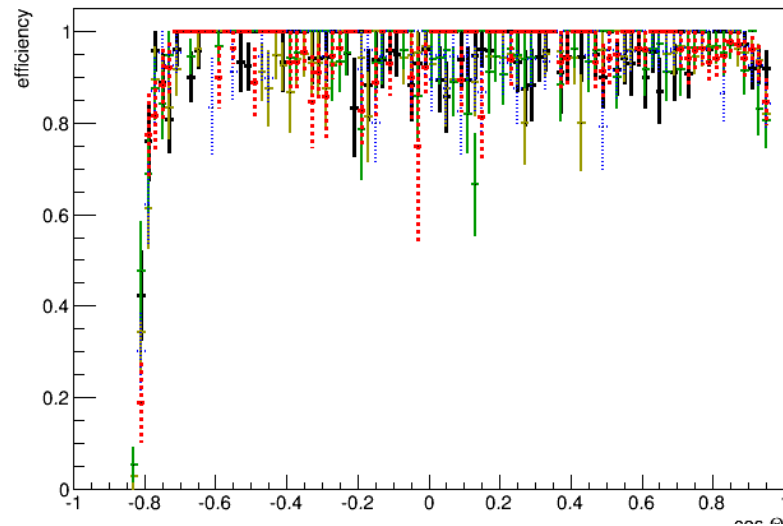
Tracks with pt = 1.50 GeV



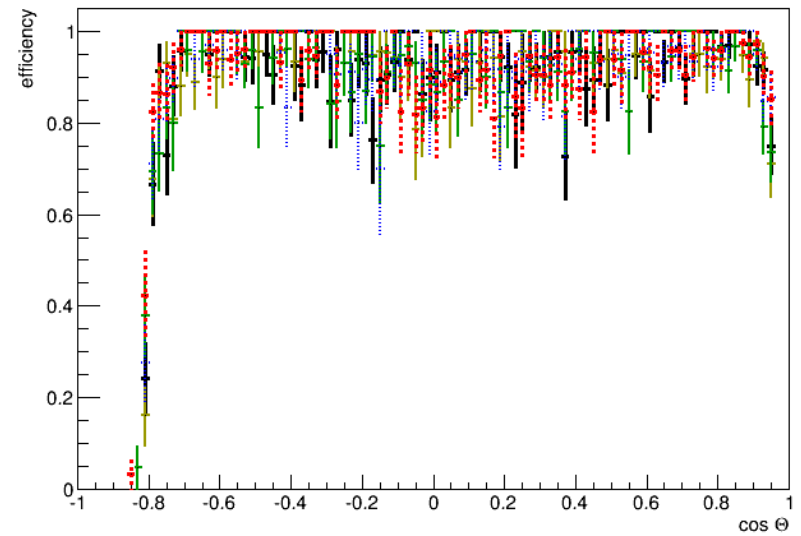
- reference
- cash1.0
- cash0.5
- cash0.1
- cash0.0

Tracking Validation: Effi - Pt versus Cos Theta – up to 4.0 GeV

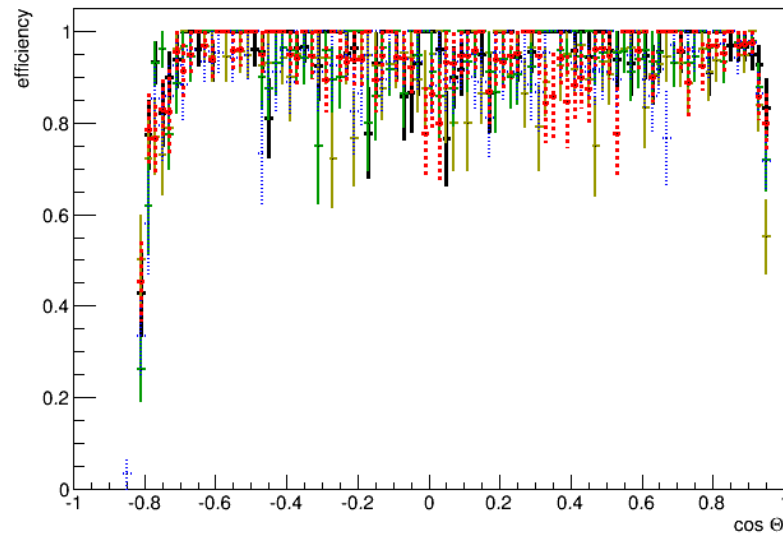
Tracks with pt = 2.00 GeV



Tracks with pt = 3.00 GeV

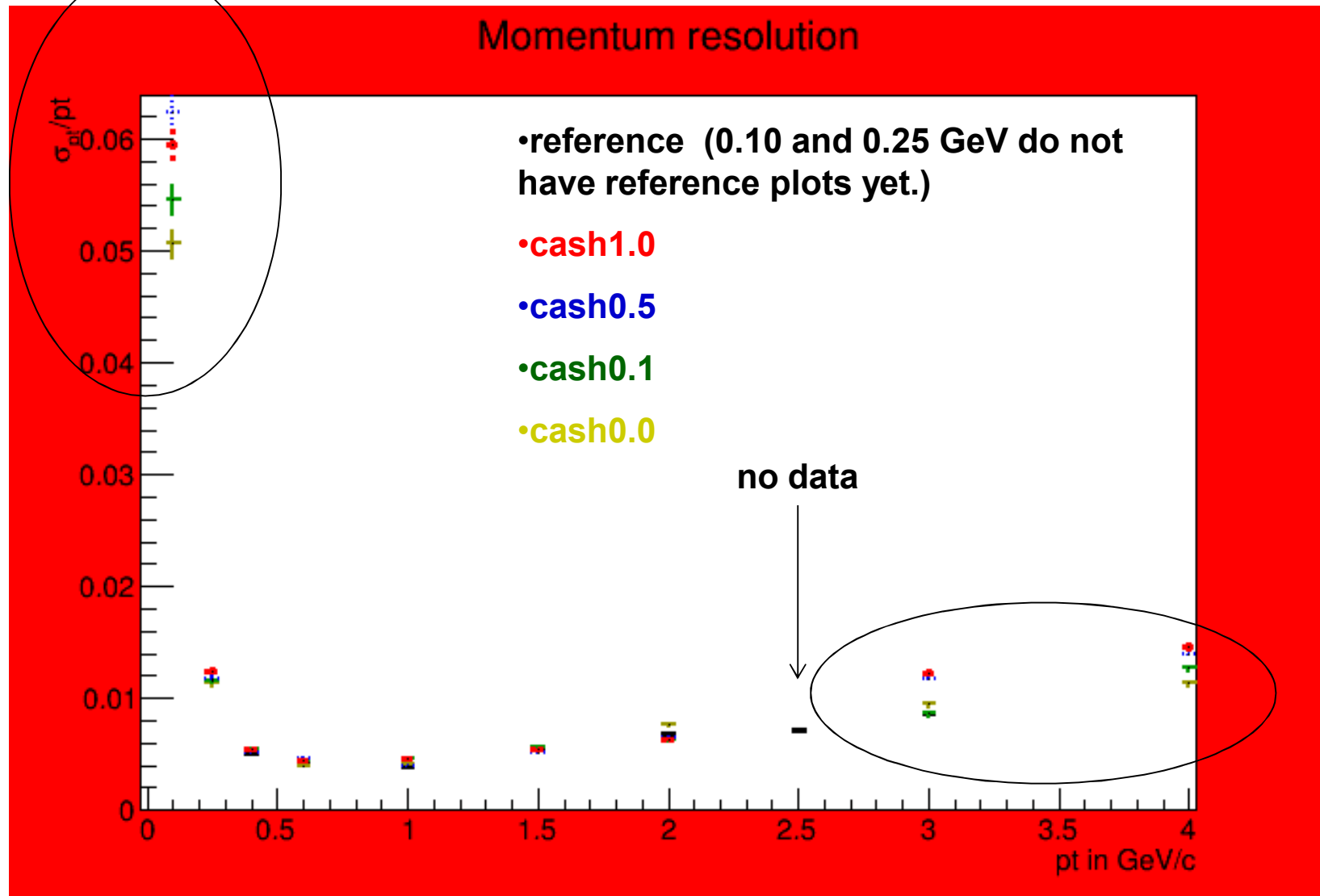


Tracks with pt = 4.00 GeV

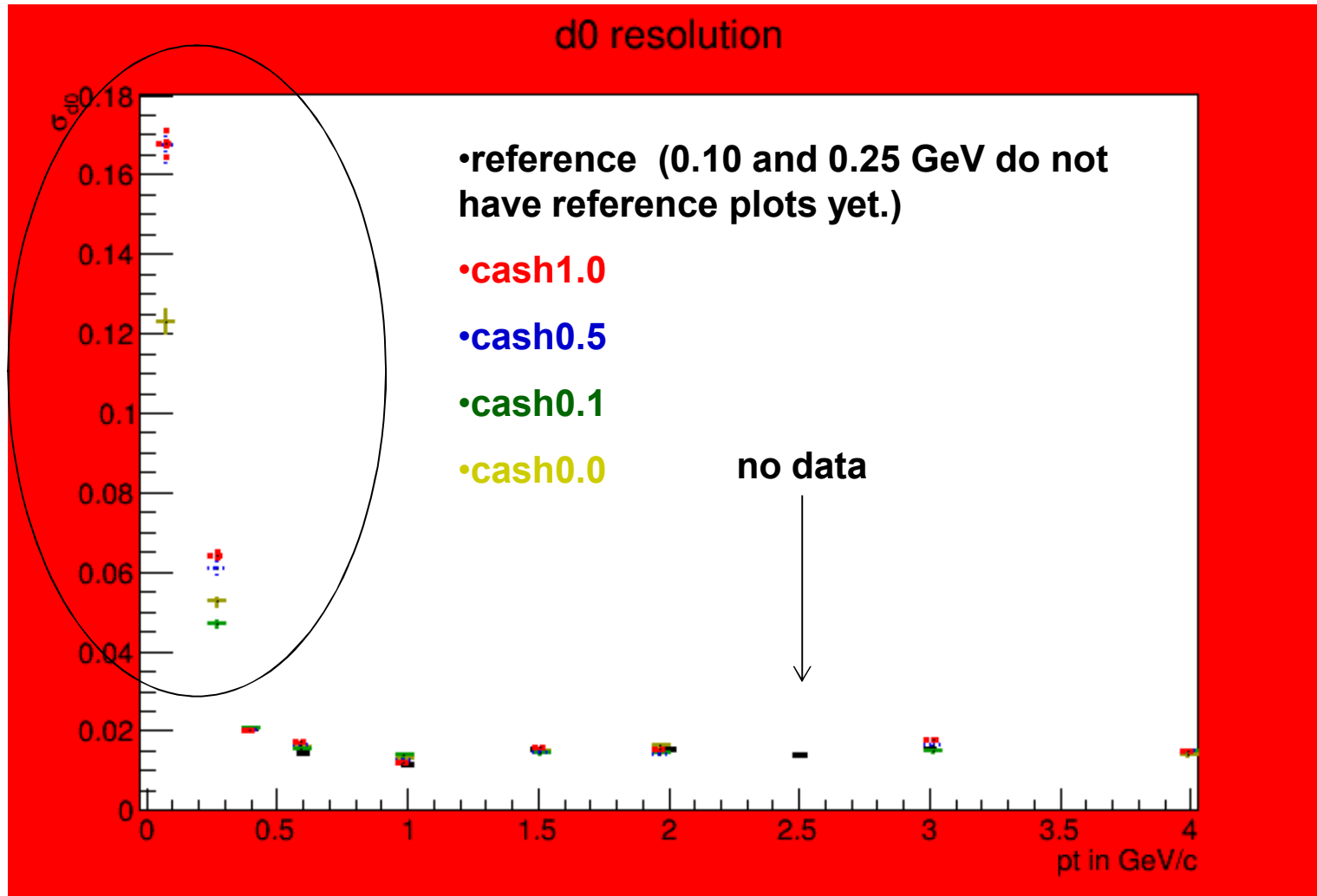


- reference
- cash1.0
- cash0.5
- cash0.1
- cash0.0

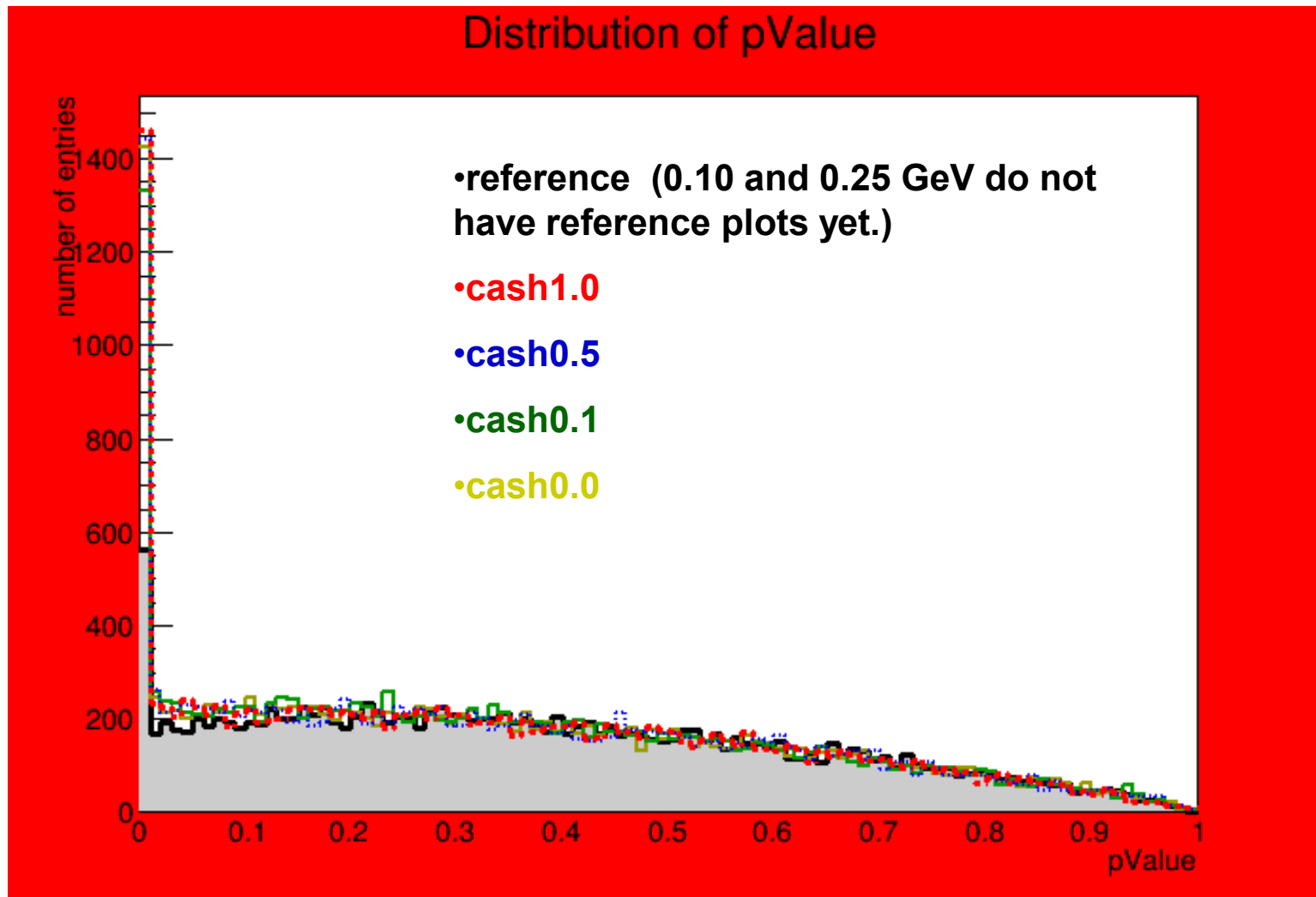
Tracking Validation: Pt Resolution



Tracking Validation: d0 Resolution

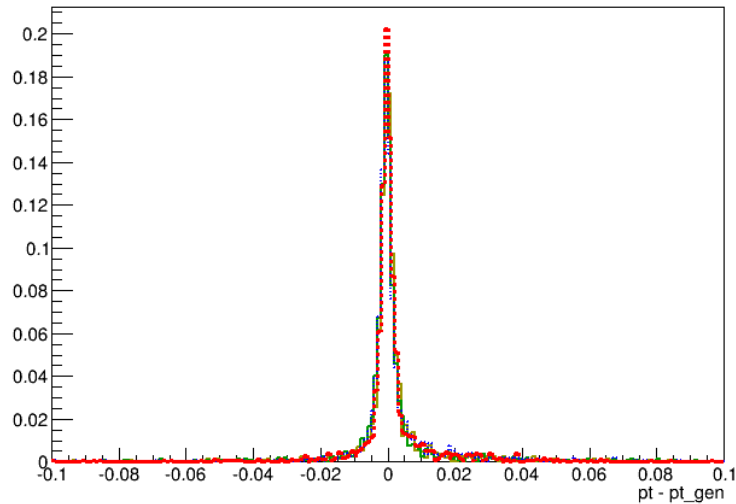


Tracking Validation

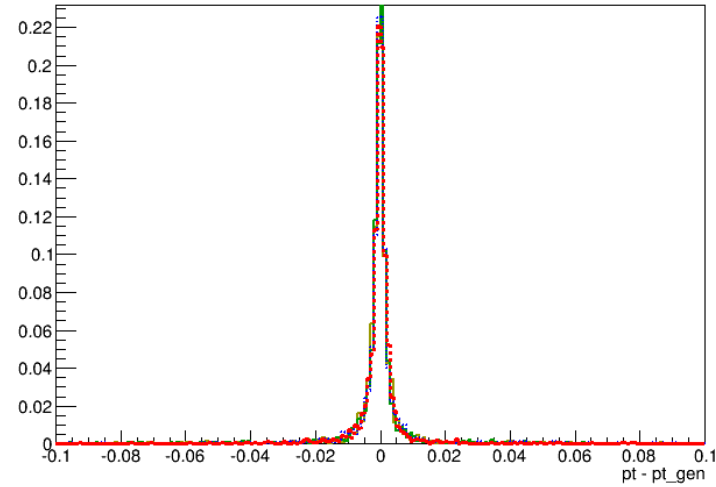


Tracking Validation: Pt Residuum up to 0.40 GeV

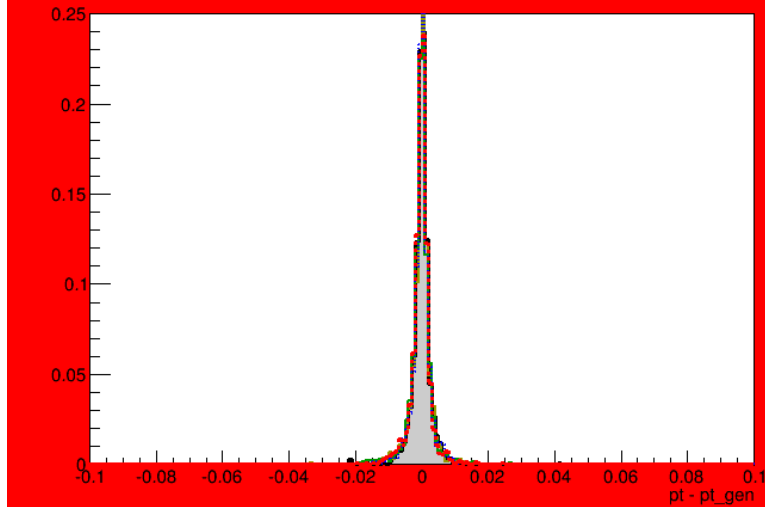
hptResiduum_0.10GeV



hptResiduum_0.25GeV



hptResiduum_0.40GeV



•reference (0.10 and 0.25 GeV do not have reference plots yet.)

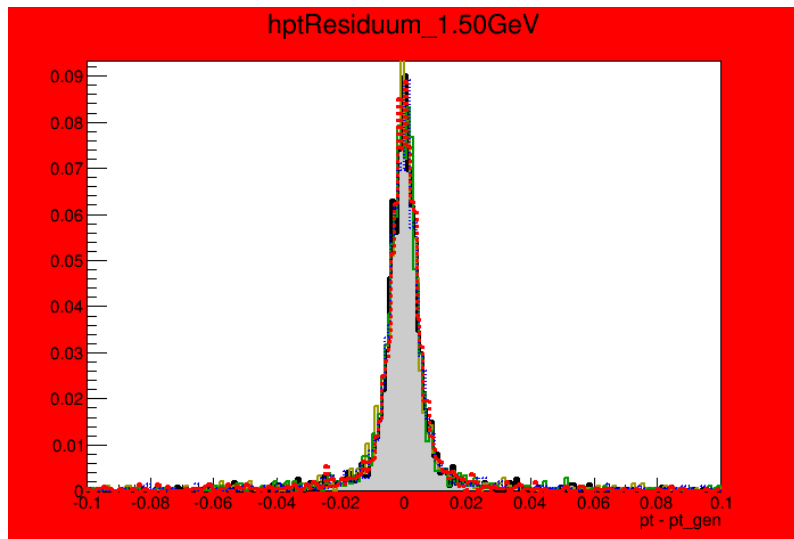
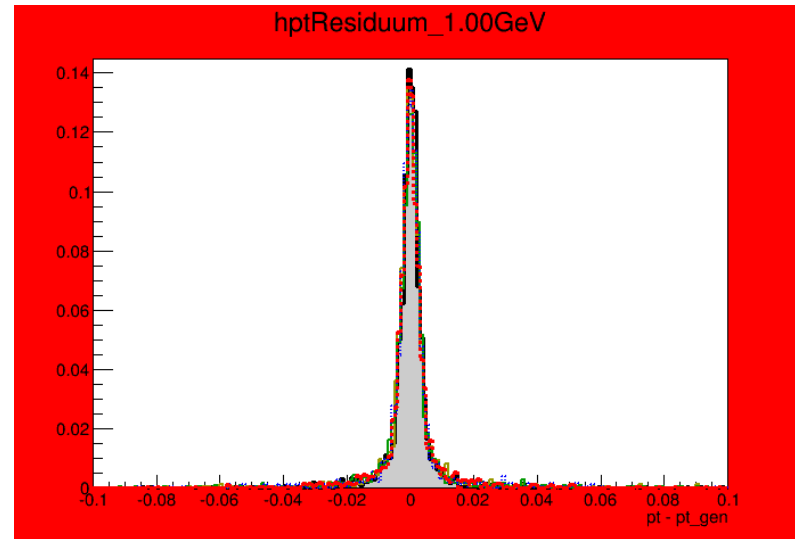
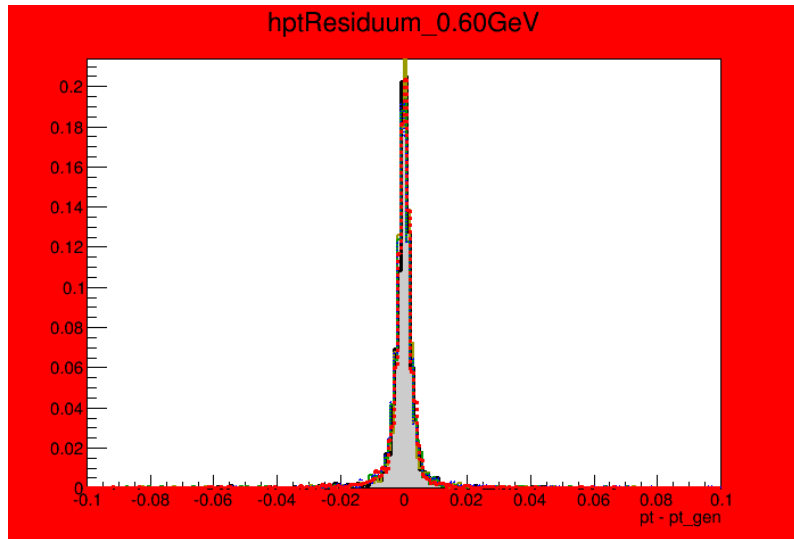
•cash1.0

•cash0.5

•cash0.1

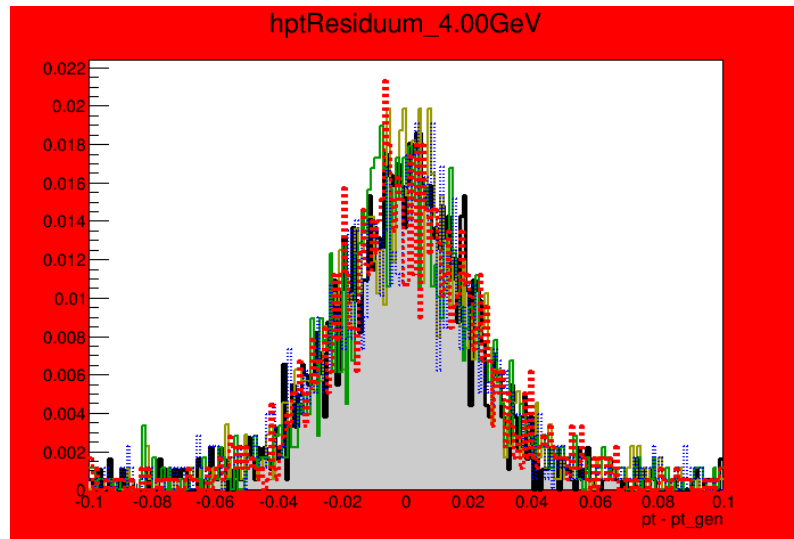
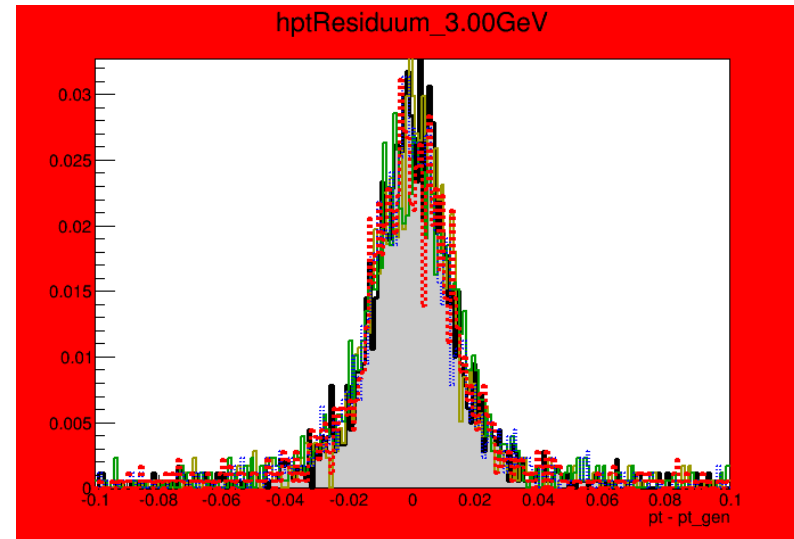
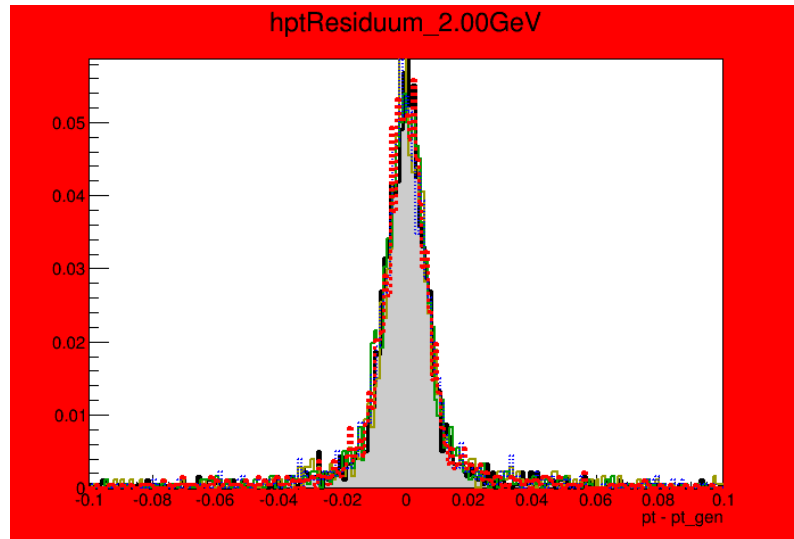
•cash0.0

Tracking Validation: Pt Residuum up to 1.50 GeV



- reference
- cash1.0
- cash0.5
- cash0.1
- cash0.0

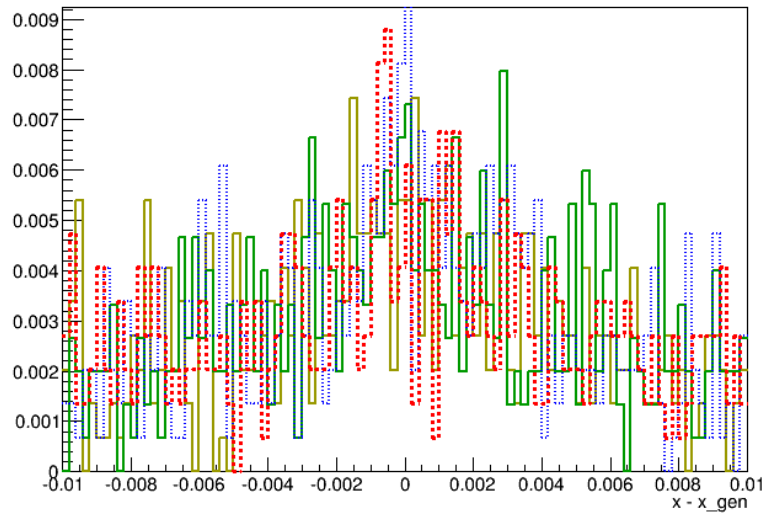
Tracking Validation: Pt Residuum up to 4.0 GeV



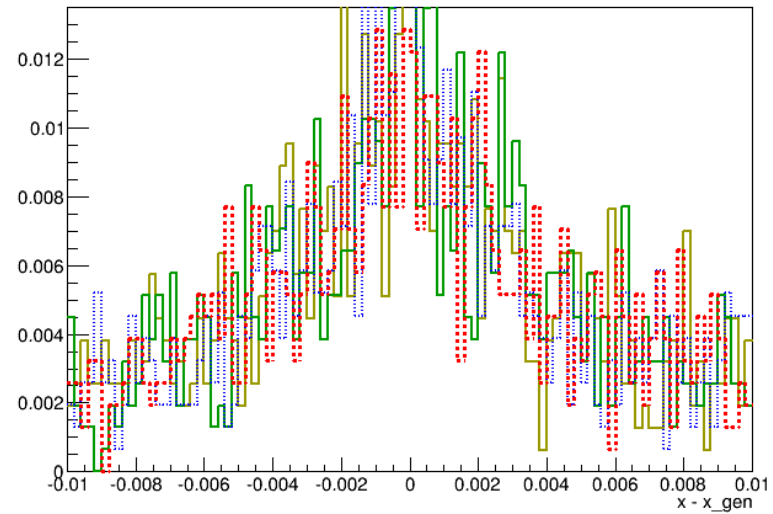
- reference
- cash1.0
- cash0.5
- cash0.1
- cash0.0

Tracking Validation: x Residuum up to 0.40 GeV

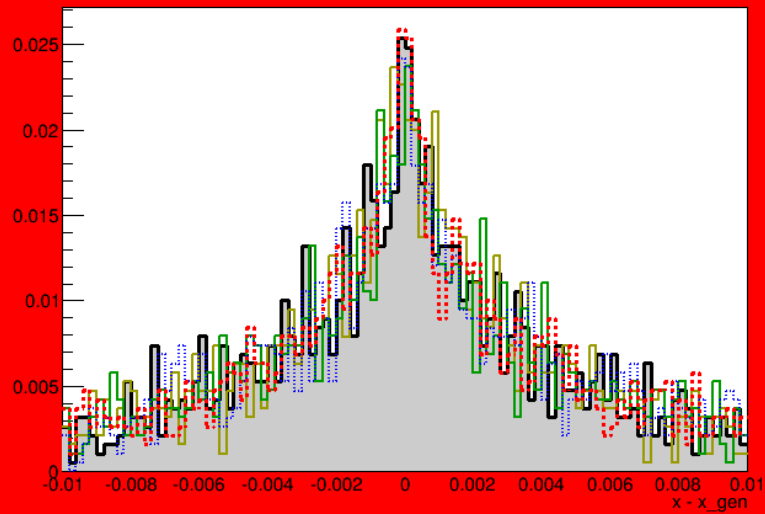
hxResiduum_0.10GeV



hxResiduum_0.25GeV



hxResiduum_0.40GeV



•reference (0.10 and 0.25 GeV do not have reference plots yet.)

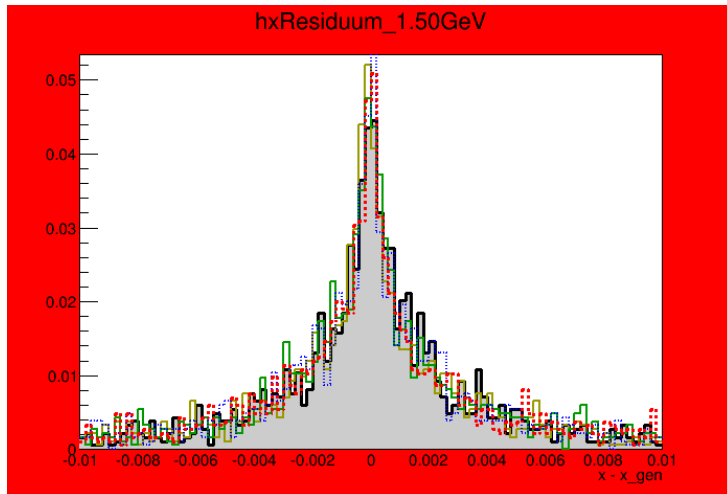
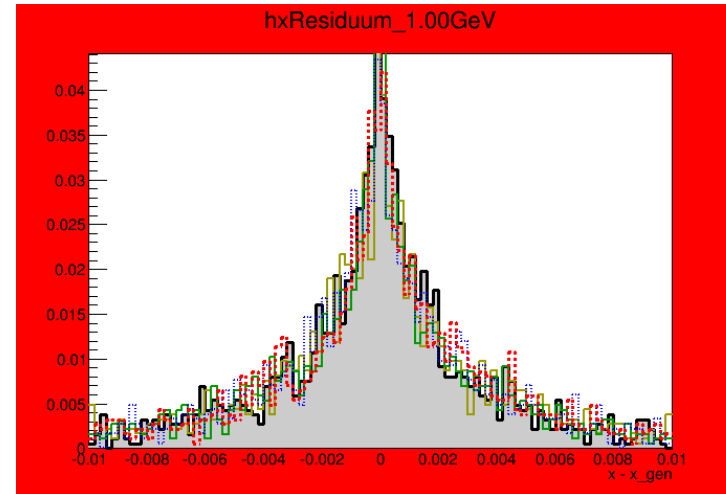
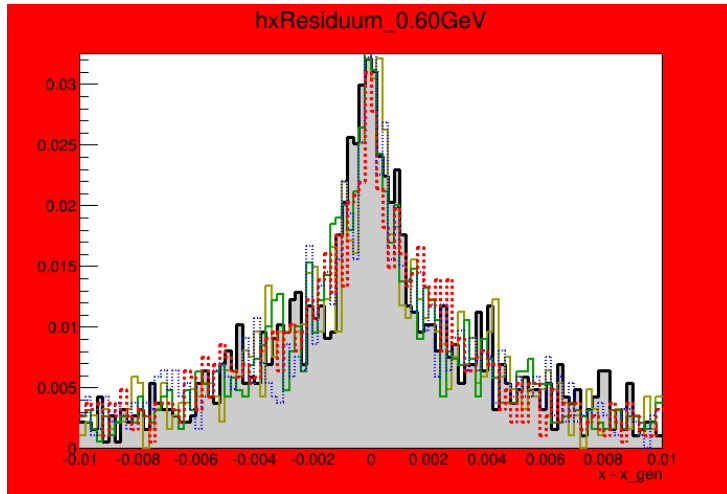
•cash1.0

•cash0.5

•cash0.1

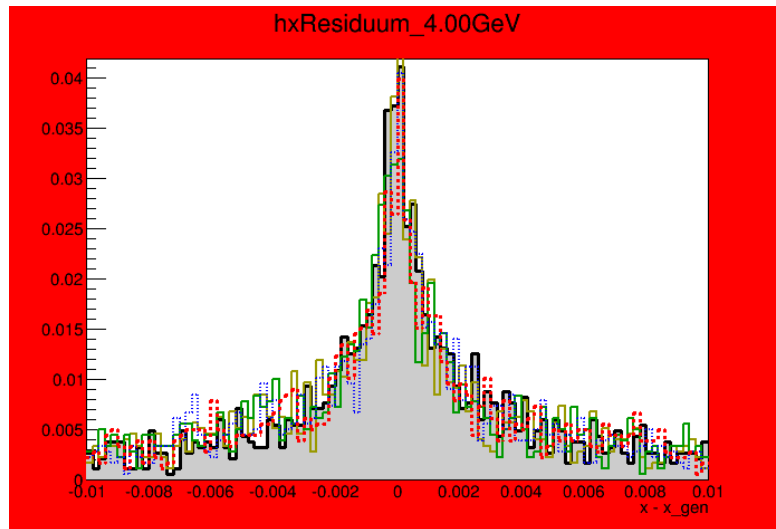
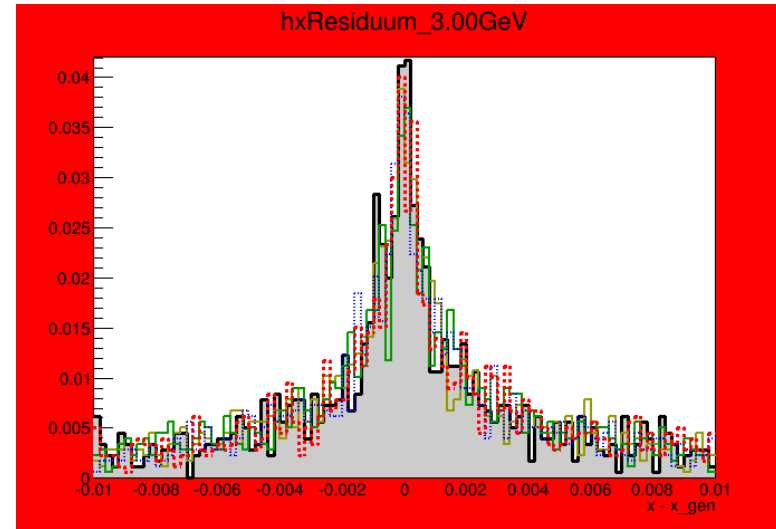
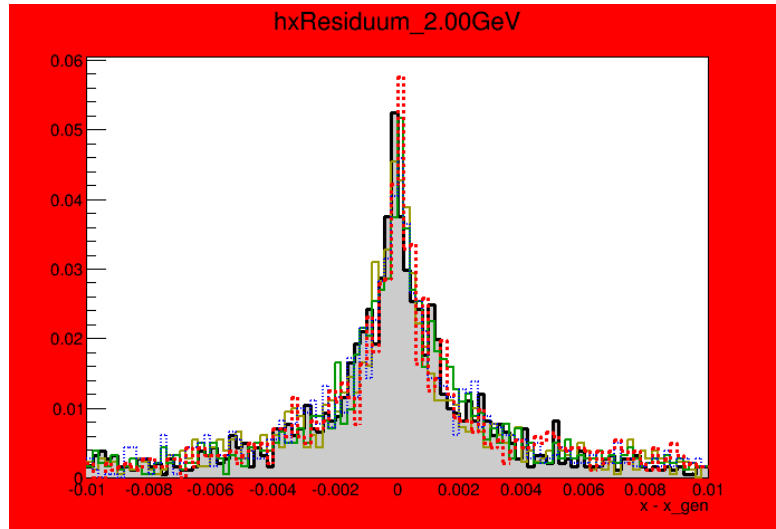
•cash0.0

Tracking Validation: x Residuum up to 1.50 GeV



- reference
- cash1.0
- cash0.5
- cash0.1
- cash0.0

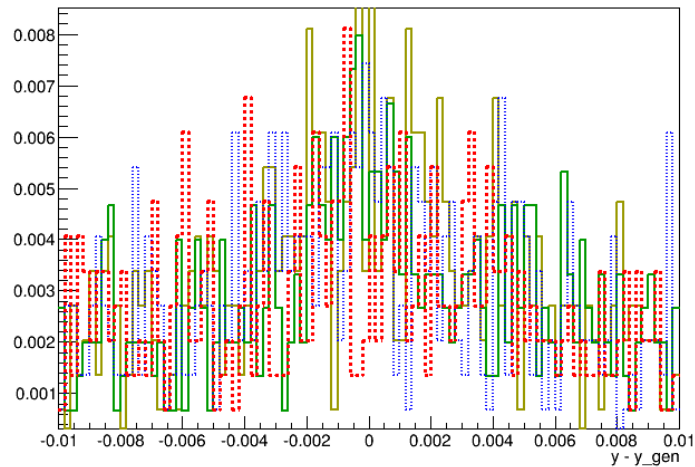
Tracking Validation: x Residuum up to 4.0 GeV



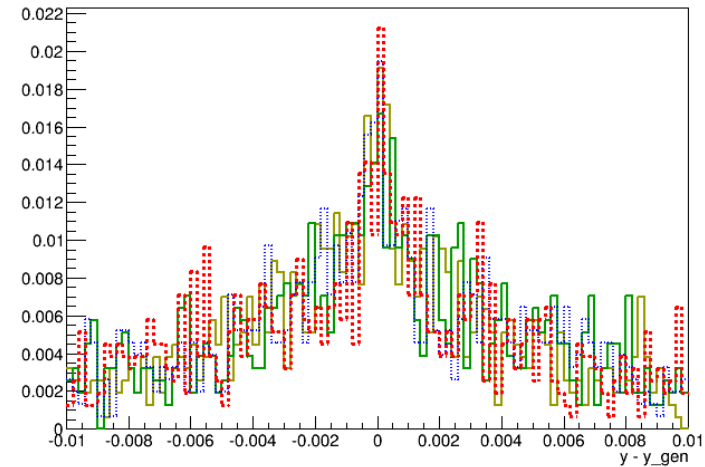
- reference
- cash1.0
- cash0.5
- cash0.1
- cash0.0

Tracking Validation: y Residuum up to 0.40 GeV

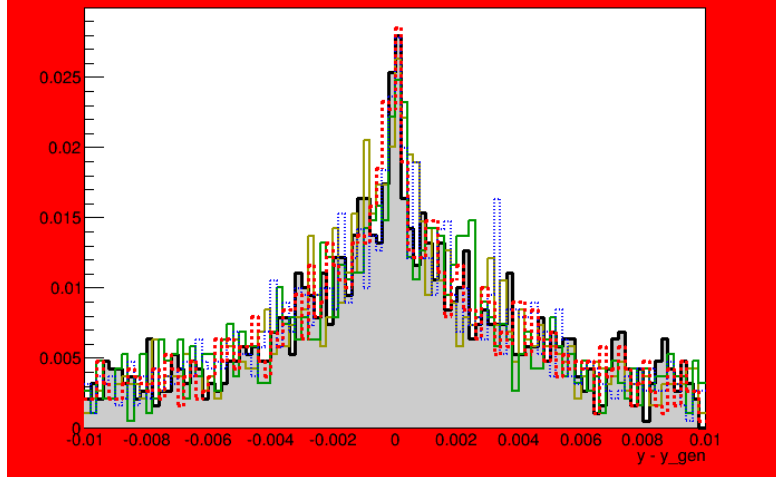
hyResiduum_0.10GeV



hyResiduum_0.25GeV



hyResiduum_0.40GeV



•reference (0.10 and 0.25 GeV do not have reference plots yet.)

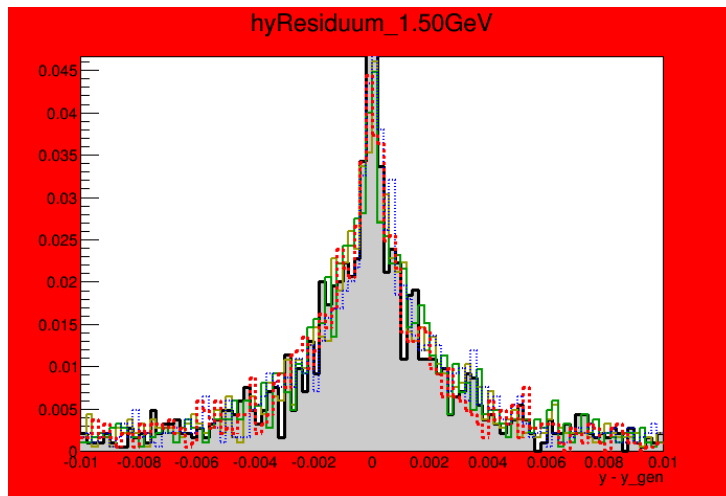
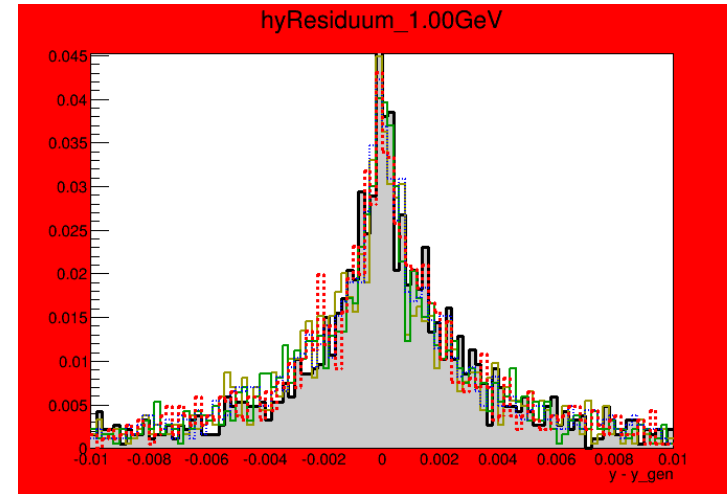
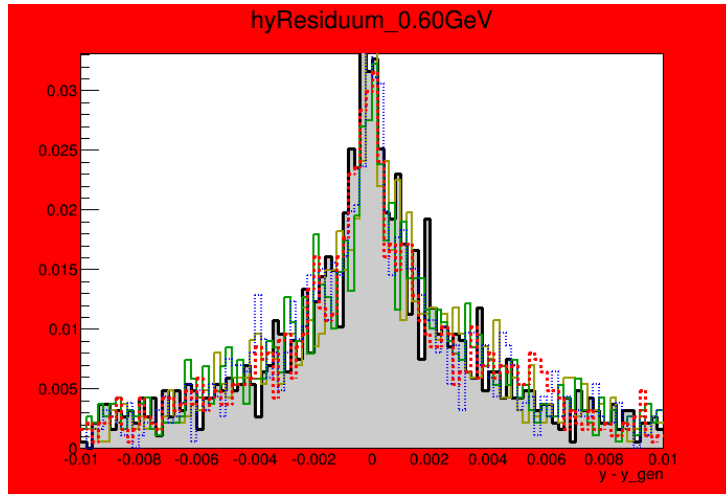
•cash1.0

•cash0.5

•cash0.1

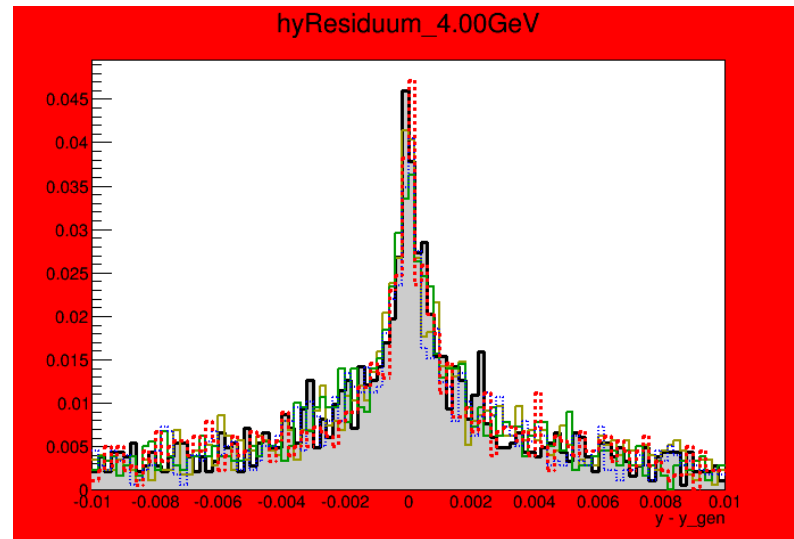
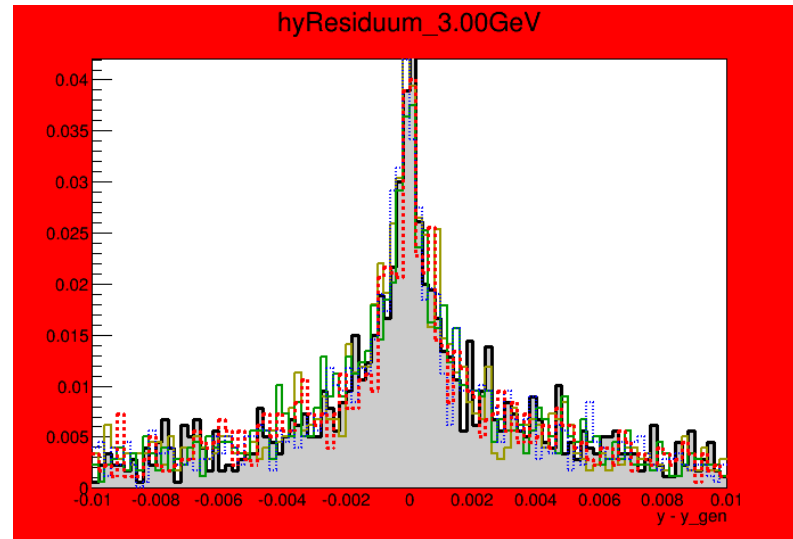
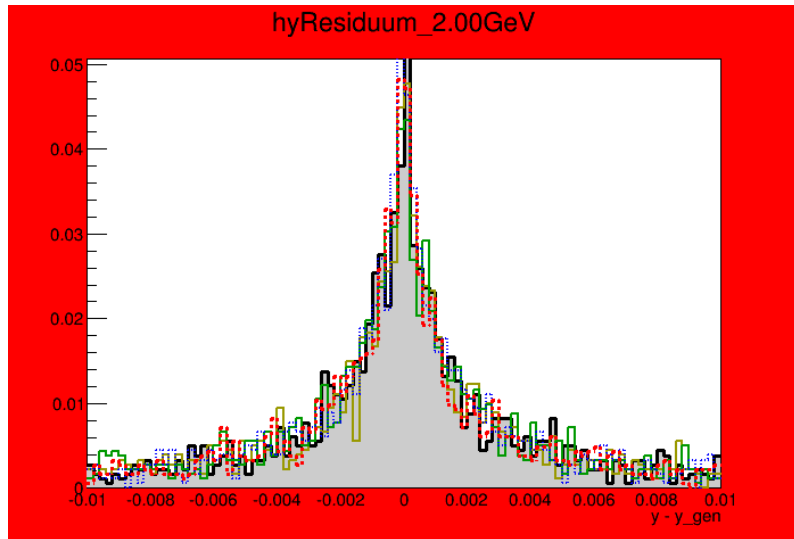
•cash0.0

Tracking Validation: y Residuum up to 1.50 GeV



- reference
- cash1.0
- cash0.5
- cash0.1
- cash0.0

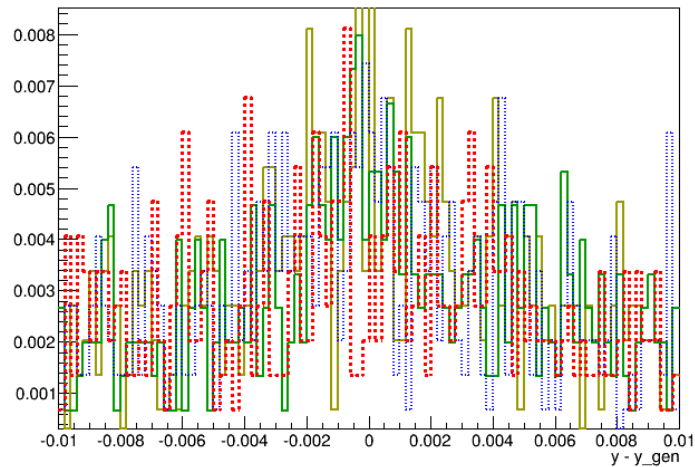
Tracking Validation: y Residuum up to 4.0 GeV



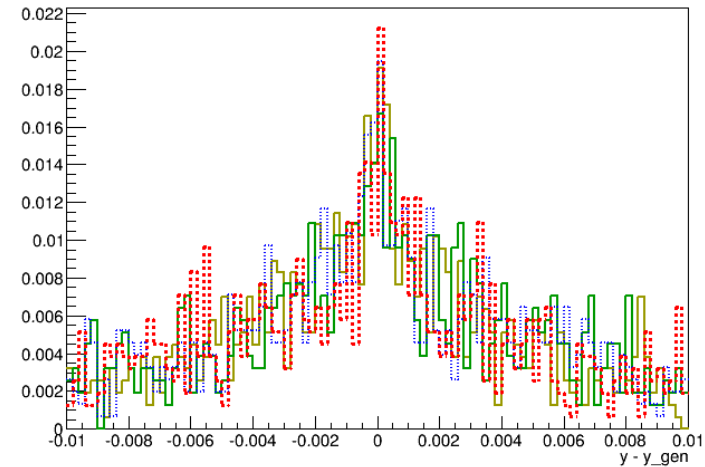
- reference
- cash1.0
- cash0.5
- cash0.1
- cash0.0

Tracking Validation: y Residuum up to 0.40 GeV

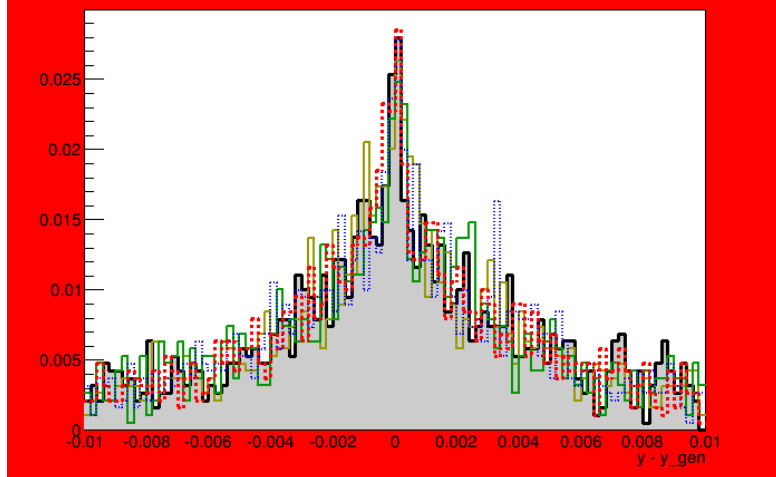
hyResiduum_0.10GeV



hyResiduum_0.25GeV



hyResiduum_0.40GeV



•reference (0.10 and 0.25 GeV do not have reference plots yet.)

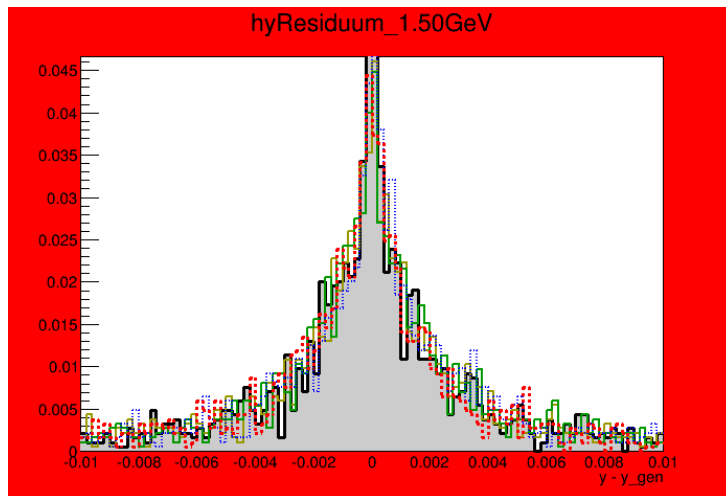
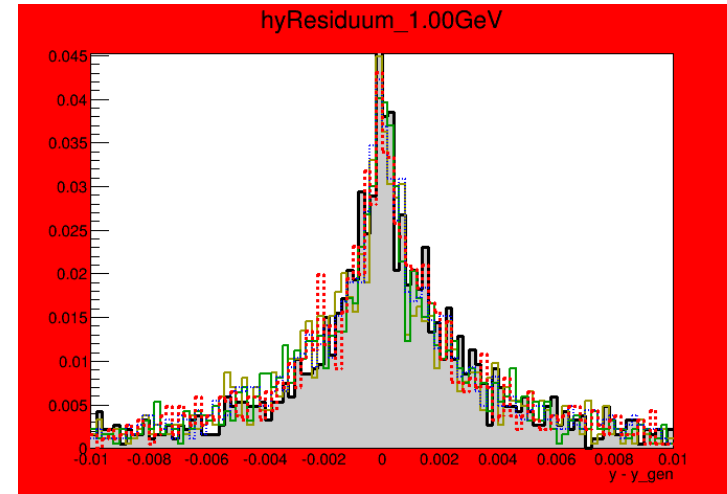
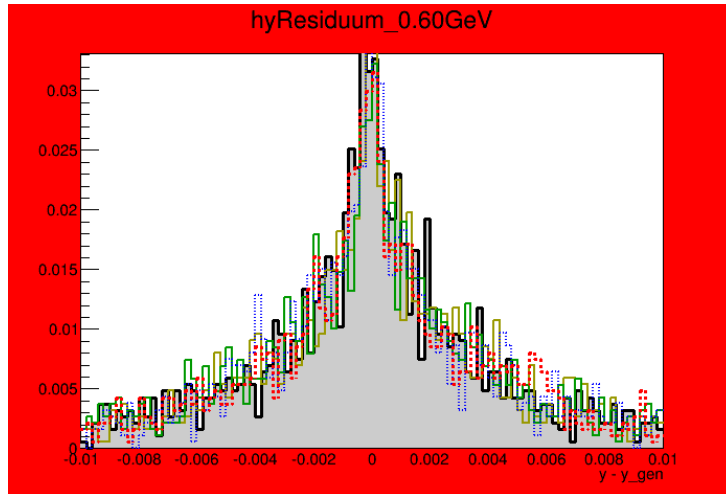
•cash1.0

•cash0.5

•cash0.1

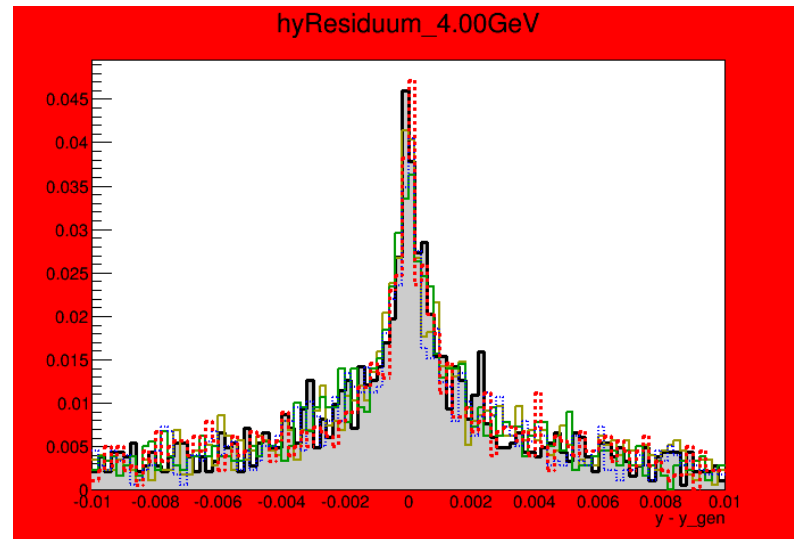
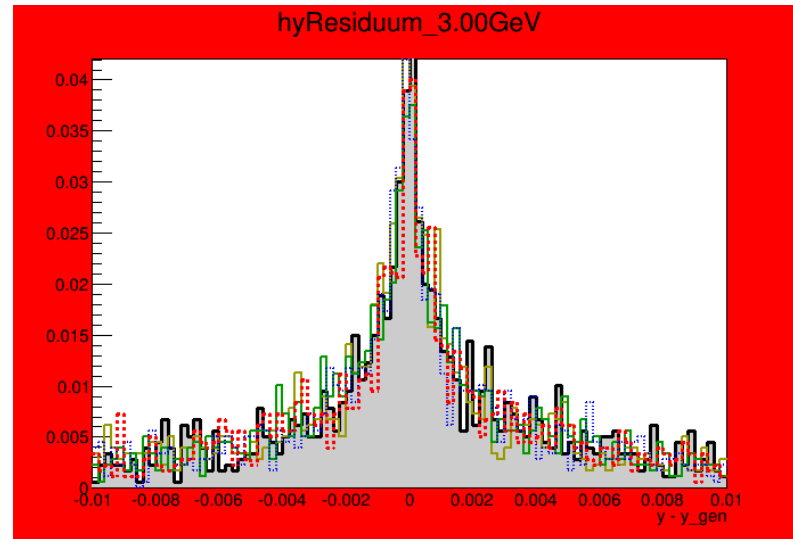
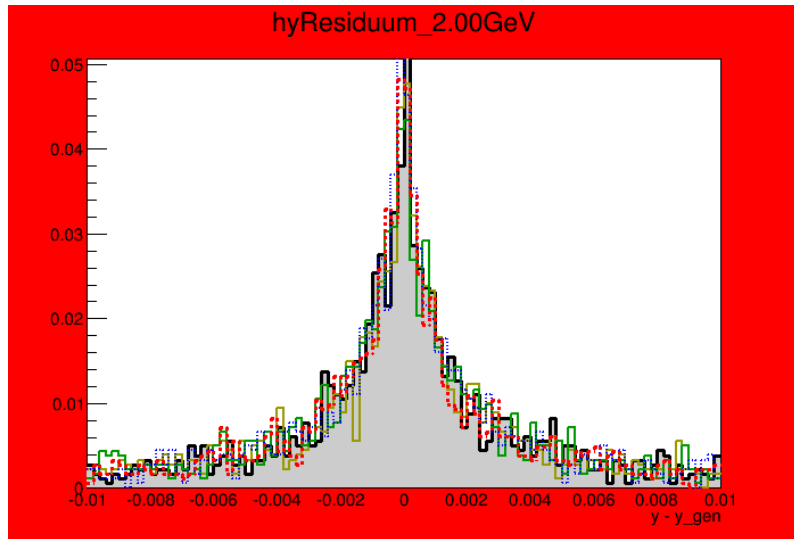
•cash0.0

Tracking Validation: y Residuum up to 1.50 GeV



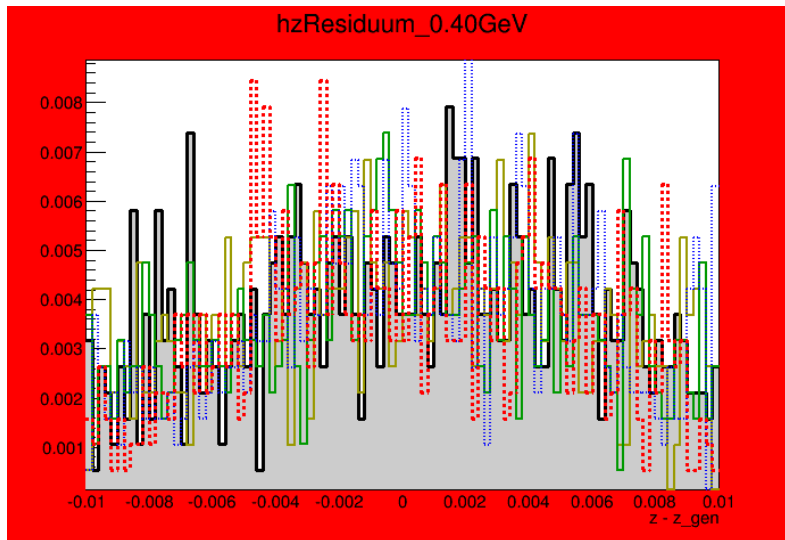
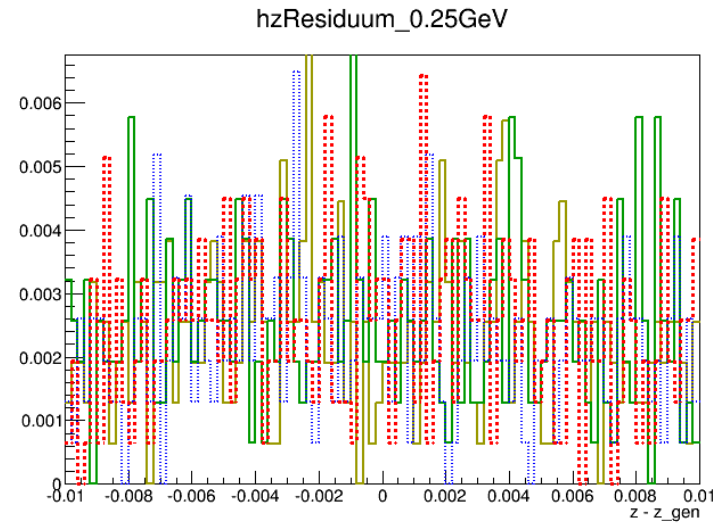
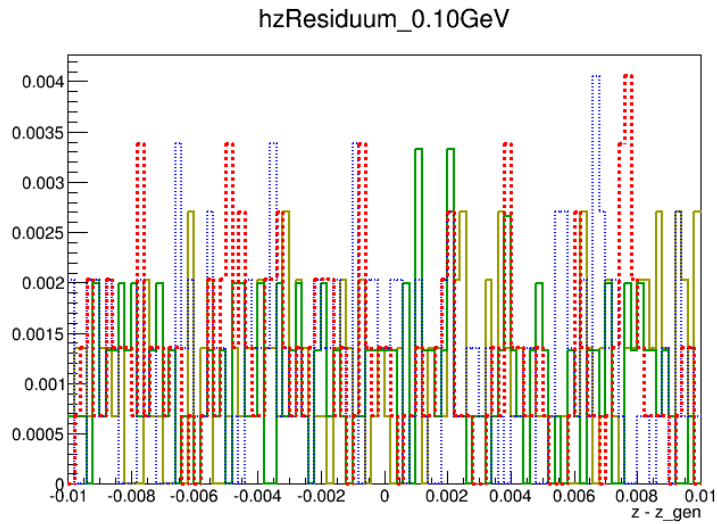
- reference
- cash1.0
- cash0.5
- cash0.1
- cash0.0

Tracking Validation: y Residuum up to 4.0 GeV



- reference
- cash1.0
- cash0.5
- cash0.1
- cash0.0

Tracking Validation: z Residuum up to 0.40 GeV



•reference (0.10 and 0.25 GeV do not have reference plots yet.)

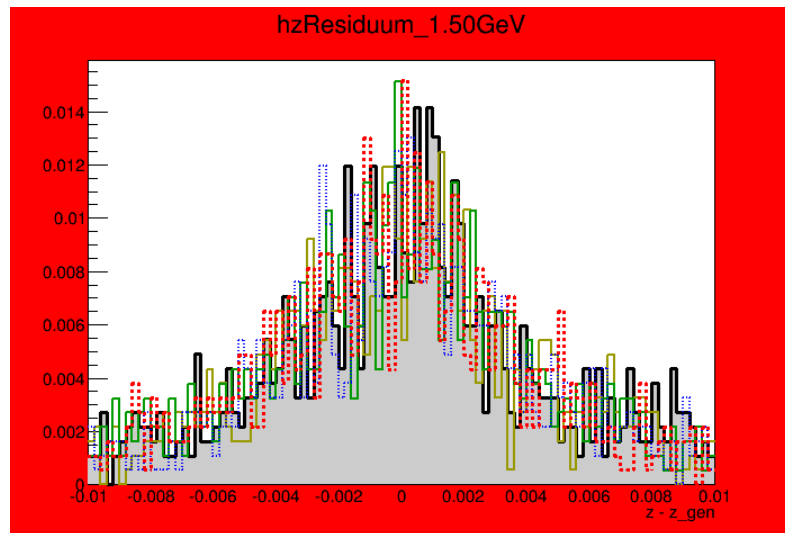
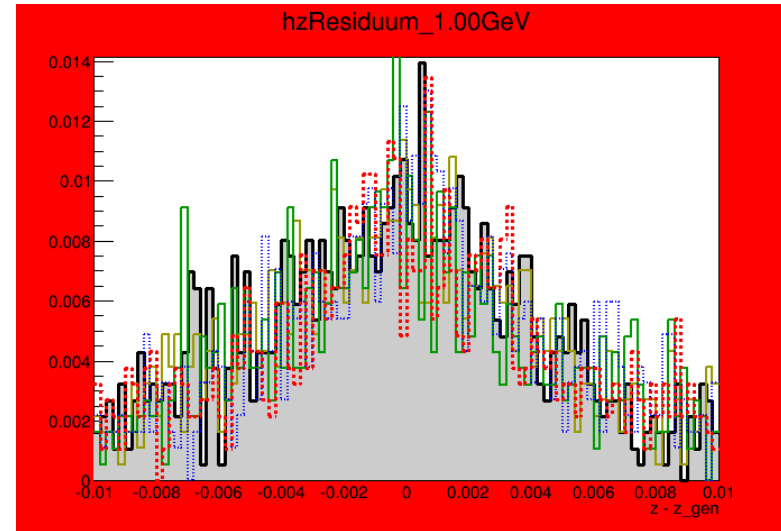
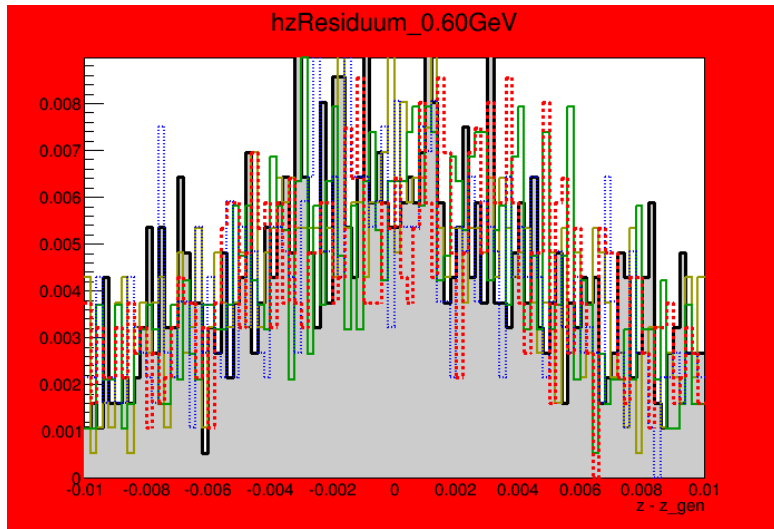
•cash1.0

•cash0.5

•cash0.1

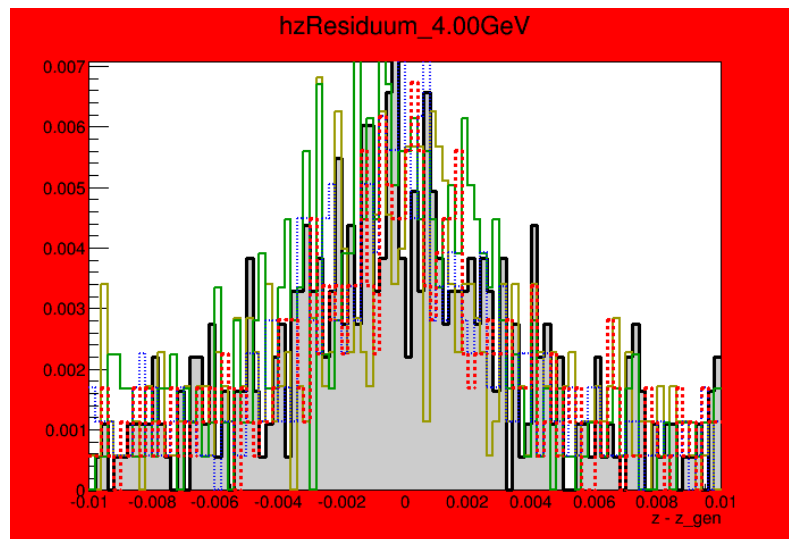
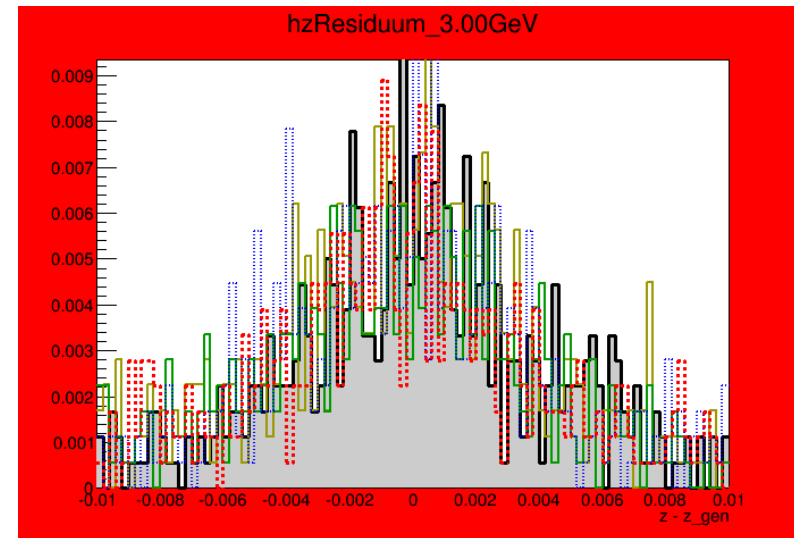
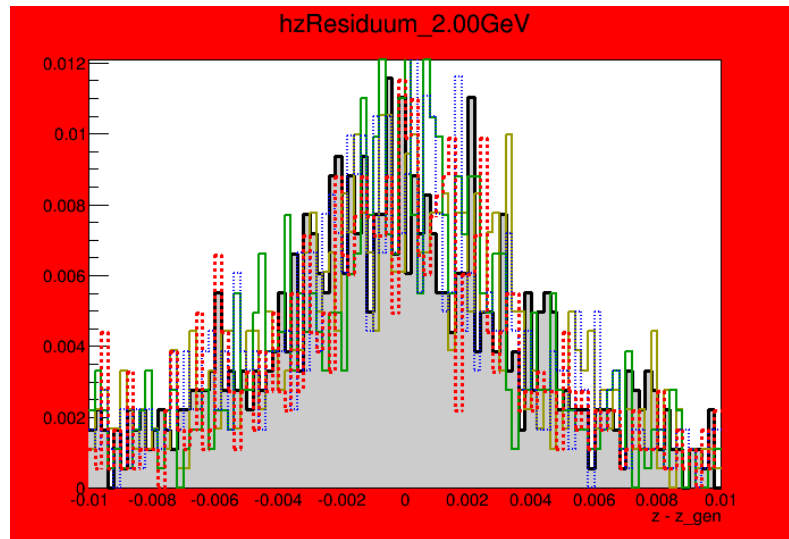
•cash0.0

Tracking Validation: z Residuum up to 1.50 GeV



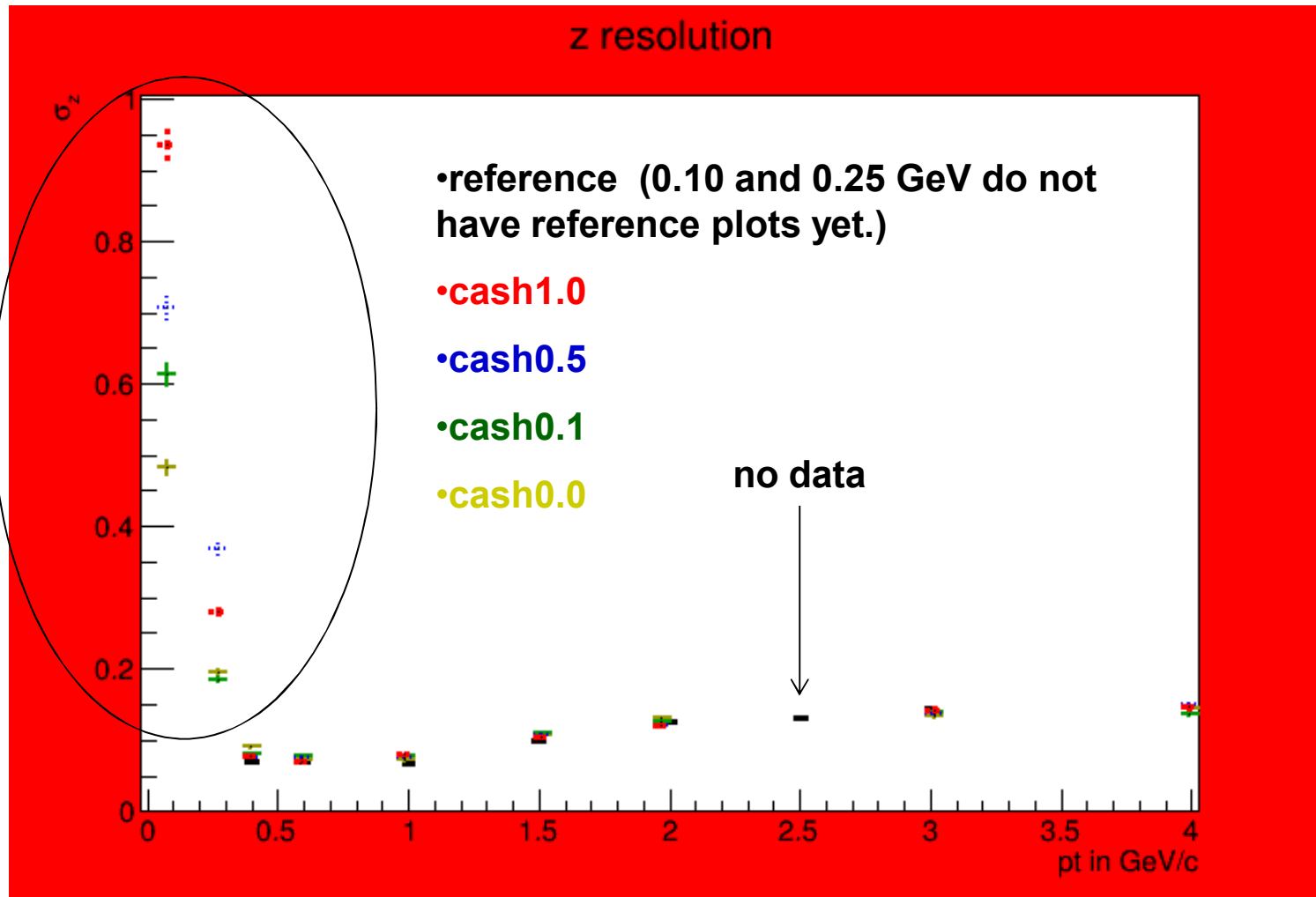
- reference
- cash1.0
- cash0.5
- cash0.1
- cash0.0

Tracking Validation: z Residuum up to 4.0 GeV



- reference
- cash1.0
- cash0.5
- cash0.1
- cash0.0

Tracking Validation: z Resolution



Resource Usage

genfit_pxdsvdcdc_Kalman.log

time consumed per call (ms)

	Default	0.1cm	0.5cm	1.0cm
FullSim	33.57 ± 31.00	24.30 ± 23.01	25.06 ± 28.36	21.87 ± 14.75
1,000 call				
Total	103.07 ± 34.84	94.49 ± 84.90	99.77 ± 32.55	92.24 ± 18.84
1,001 call				

Resource Usage 2

trackingEfficiency_pt_0.10GeV.log
time consumed per call (ms)

	Default	0.1cm	0.5cm	1.0cm
FullSim	401.80 ± 93.94	306.28 ± 63.21	288.53 ± 56.52	265.92 ± 48.95
200 call				
Total	530.55 ± 109.14	437.91 ± 82.42	427.58 ± 76.76	396.96 ± 69.96
200 call				

Summary

- The cache distance for the B field is varied:
Default, 0.1 cm, 0.5 cm, 1.0 cm
(Based on 2-D Belle2 B field map.)
- Not much difference seen in the tracking validation plots except
 - **Resolution of $P_t \geq 3.0$ GeV**
 - **Some responses when $P_t \leq 0.25$ GeV**
- The computing time consumed is slightly decreasing while the cash distance is increased.
- Plan to use the plots in Mr. Cheon's thesis.