Track Pulls Using PrimeVtx

Studies on Data

Daniel Sherman, João Guimarães, Kevin Burkett
Harvard University

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Tracking Meeting

- Method
- Primary Vertex Pulls and Resolution vs. Z Position
- Track Parameters vs. Z

Method

Using 4.9.1hpt1 PrimeVtx with default parameters

☞ Top Multijet Data:

- Four jets per Event
- Production 4.8.4
- Offline 4.9.1hpt1

1. No COT Only Tracks
2. Only OI, OIS, and OIZ track algorithms enabled
   - OI: ≥ 3 silicon hits
   - OIZ,OIS: $\geq 6, 5$ silicon hits, ≥ 3 $r - \phi$ hits, ≥ 2 stereo, ≥ 2 Z hits
3. Alignment table "ofotl_prd_read 100030 1 GOOD"

- good_run list from b-tag group
- z_0 seed $= z$ position of maximum $\sum P_T$ vertex in ZVertexColl

PrimeVtx Implementation

☞ PrimeVtxFit is a seeded algorithm.

- Requires an initial (x_0, y_0, z_0) guess
- Typical input:
  1. Beam line position
  2. Rough z_0 position (from ZVertex collection, high-pt track,...).

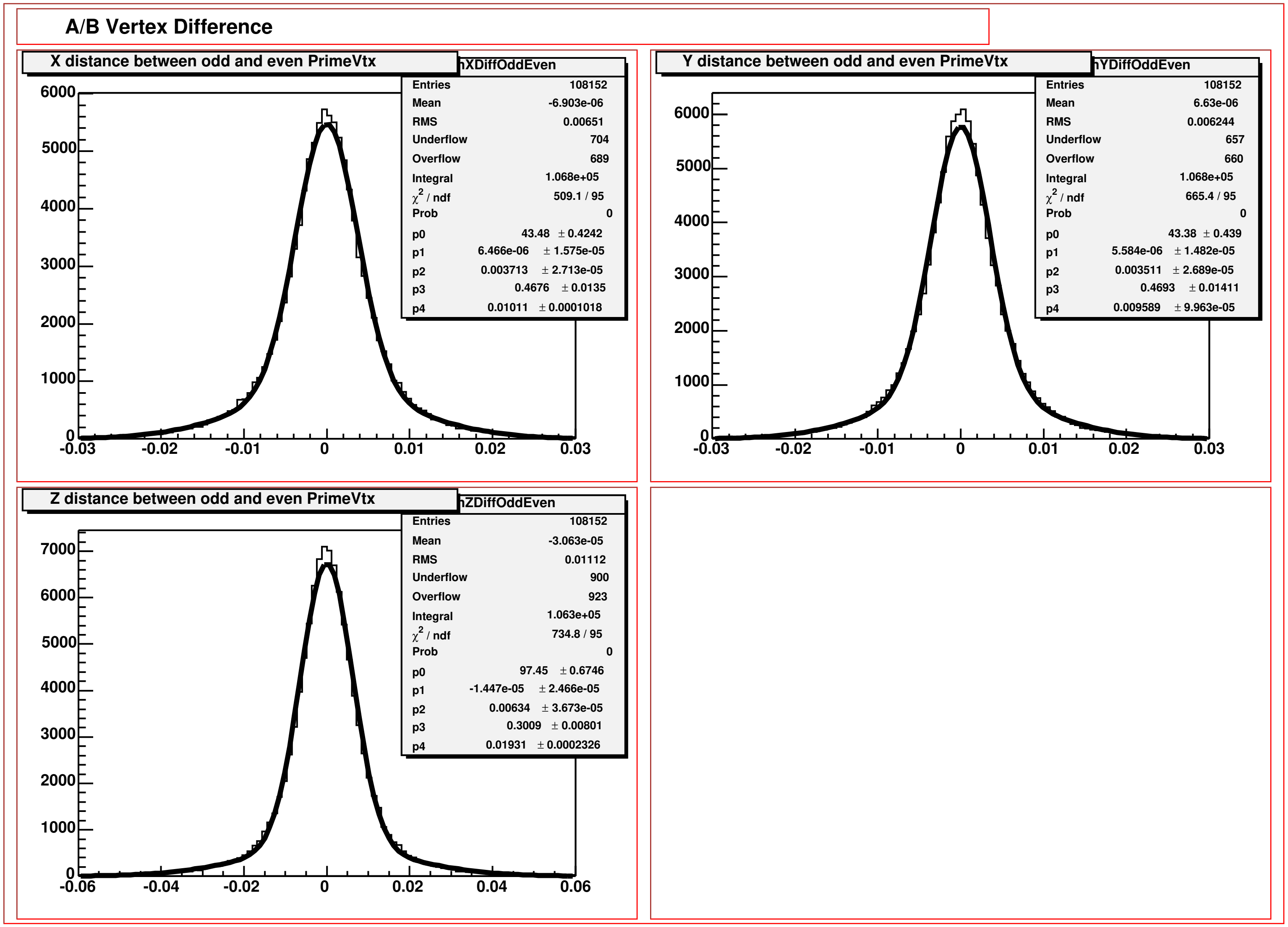
Current track selection

- Uses tracks in a window around the z_0 seed (default: ± 1 cm)
- P_T $\geq$ 0.5 GeV
- $|d_0|$ $\leq$ 1.0 cm (with respect to beamline)
- $|d_0|/\sigma$ $\leq$ 4.0 (with respect to beamline – beamline error not included)
- Track algorithms:
  - OI, OIS, OIZ
  - Using defTracks
  - No COT only tracks.
- COT quality cuts
  - 2 Axial and 2 Stereo Segments with $\geq$ 6 hits each
- Silicon quality cuts
  - OI: ≥ 3 silicon hits
  - OIZ,OIS: ≥ 5 silicon hits, ≥ 3 $r - \phi$ hits, ≥ 2 stereo, ≥ 2 Z hits

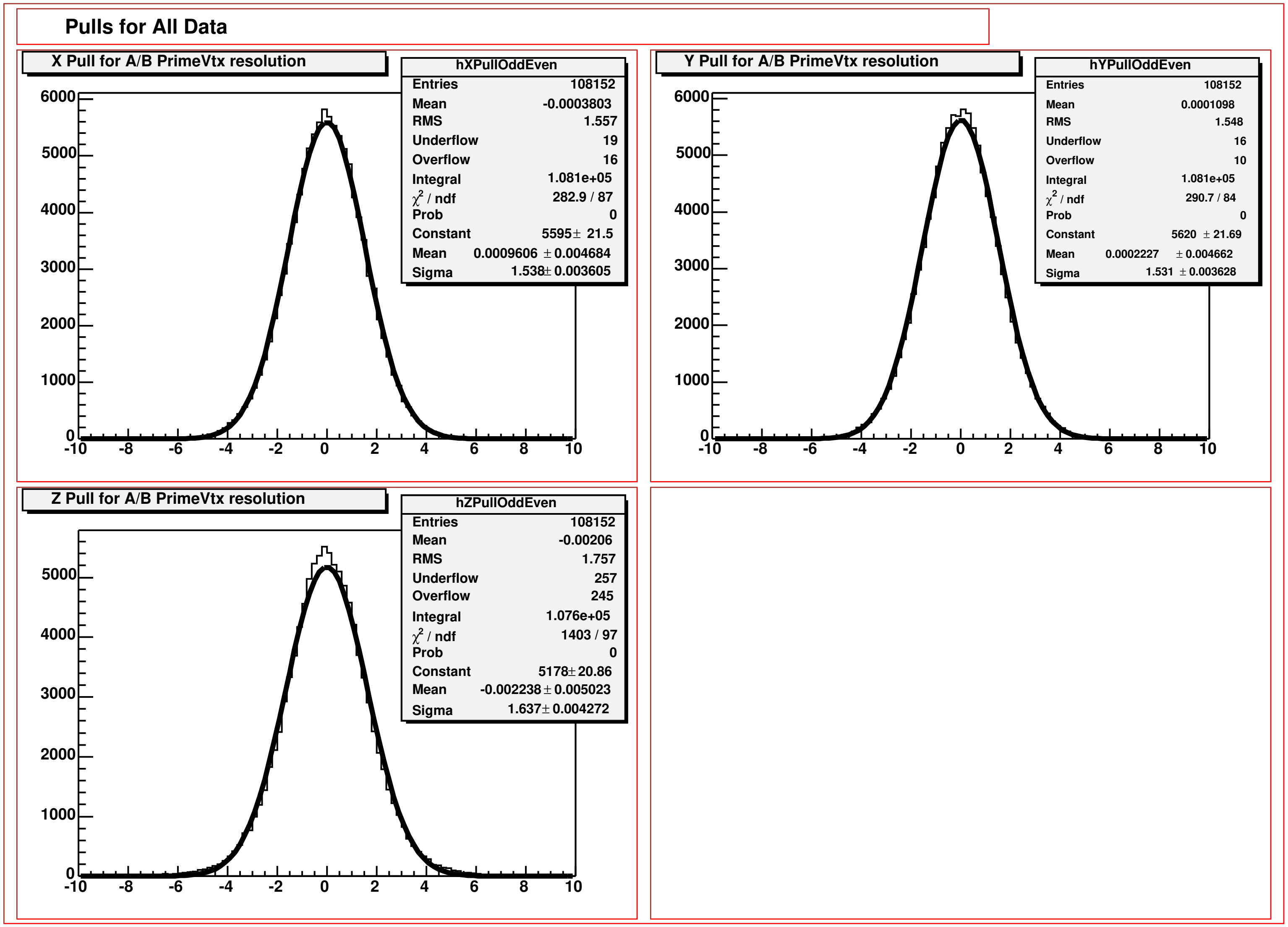
Resolution and Pulls on Data: Method

1. Divide tracks in two independent sets (A and B)
   - Select tracks as in standard PrimeVtx
   - For each pair of selected tracks randomly choose which track goes in which set (A or B)
2. Find vertex using the two independent track sets
3. Get x, y, z difference between the 2 vertices
4. Resolution:
   - Histogram $x_1 - x_2$
   - Fit gaussian
   - Divide sigma by $\sqrt{2}$
5. Pull:
   - $\frac{x_1 - x_2}{\sqrt{\epsilon_1^2 + \epsilon_2^2}}$
   - Fit gaussian and get sigma
6. Make study as function of z

A/B Resolution



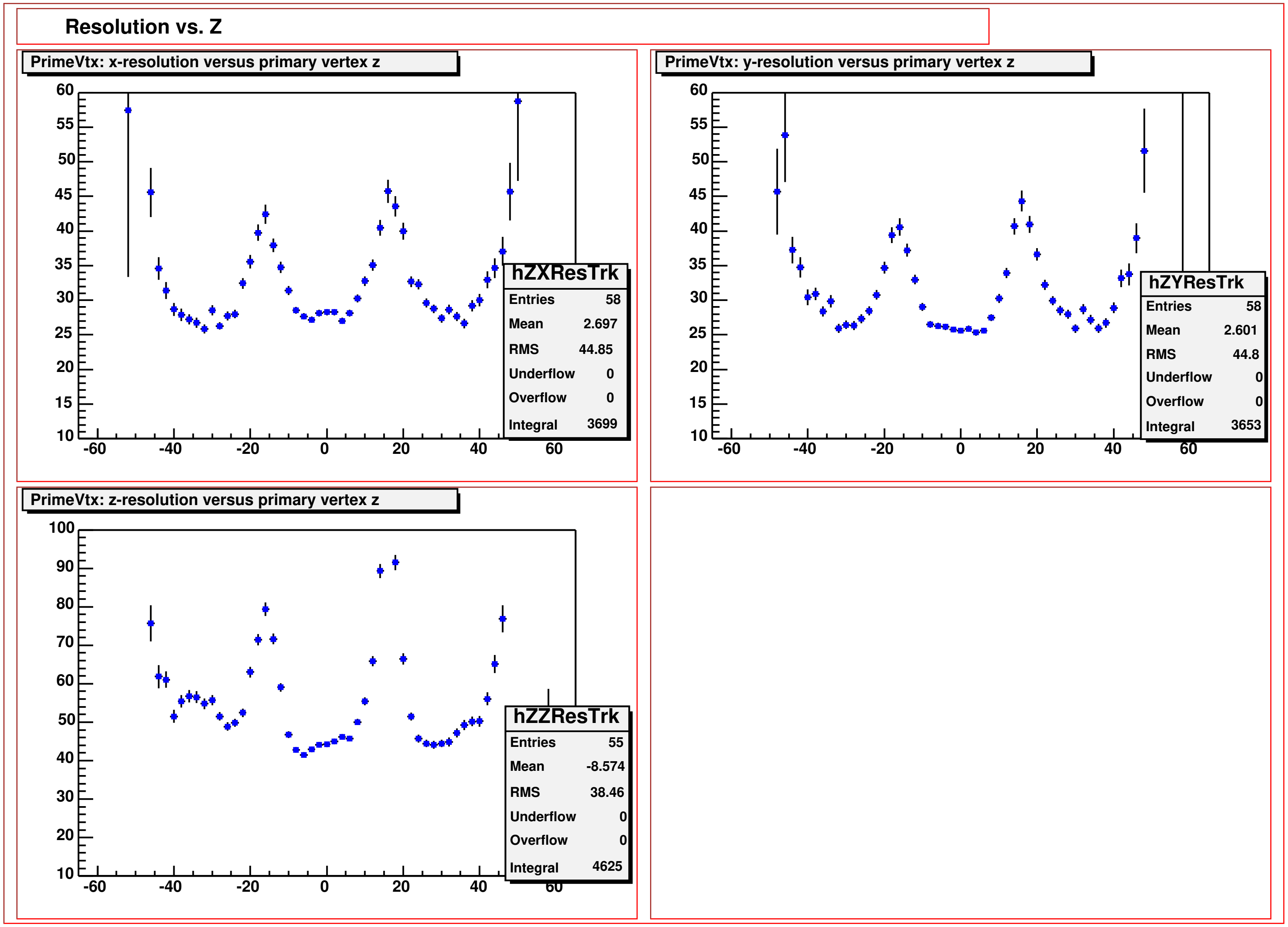
A/B Pulls



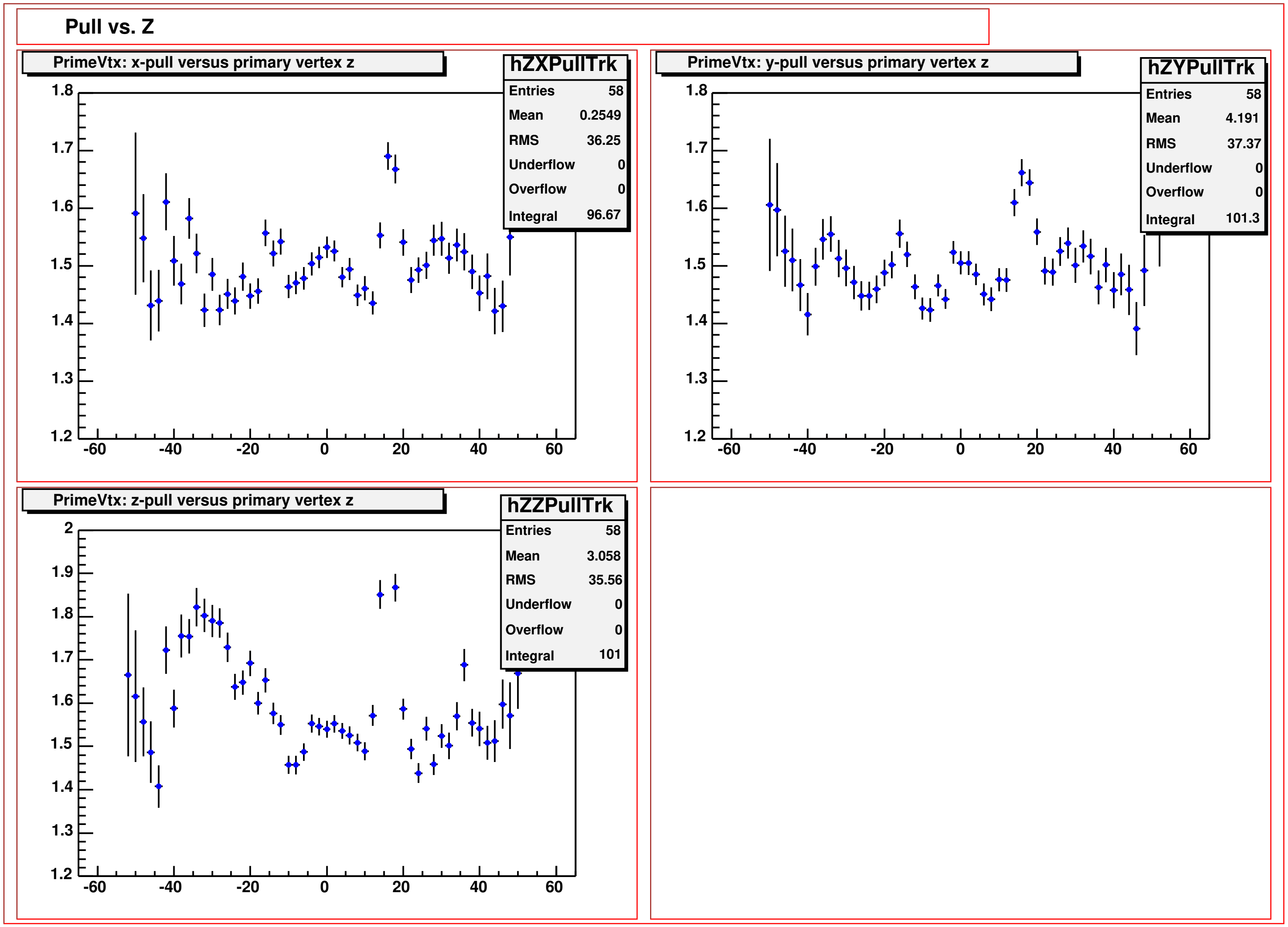
Pulls for All Data
X Pull for A/B PrimeVtx resolution
hXPullOddEven
Entries 108152
Mean -0.0003803
RMS 1.557
Underflow 19
Overflow 16
Integral 1.081e+05
χ² / ndf 282.9 / 87
Prob 0
Constant 5595 ± 21.5
Mean 0.0009606 ± 0.004684
Sigma 1.538 ± 0.003605
Y Pull for A/B PrimeVtx resolution
hYPullOddEven
Entries 108152
Mean 0.0001098
RMS 1.548
Underflow 16
Overflow 10
Integral 1.081e+05
χ² / ndf 290.7 / 84
Prob 0
Constant 5620 ± 21.69
Mean 0.0002227 ± 0.004662
Sigma 1.531 ± 0.003628
Z Pull for A/B PrimeVtx resolution
hZPullOddEven
Entries 108152
Mean -0.00206
RMS 1.757
Underflow 257
Overflow 245
Integral 1.076e+05
χ² / ndf 1403 / 97
Prob 0
Constant 5178 ± 20.86
Mean -0.002238 ± 0.005023
Sigma 1.637 ± 0.004272
0
1000
2000
3000
4000
5000
6000
-10
-8
-6
-4
-2
0
2
4
6
8
10

Resolution vs. Z

Repeat procedure on 2 cm bins in Z from -65 cm to 65 cm:



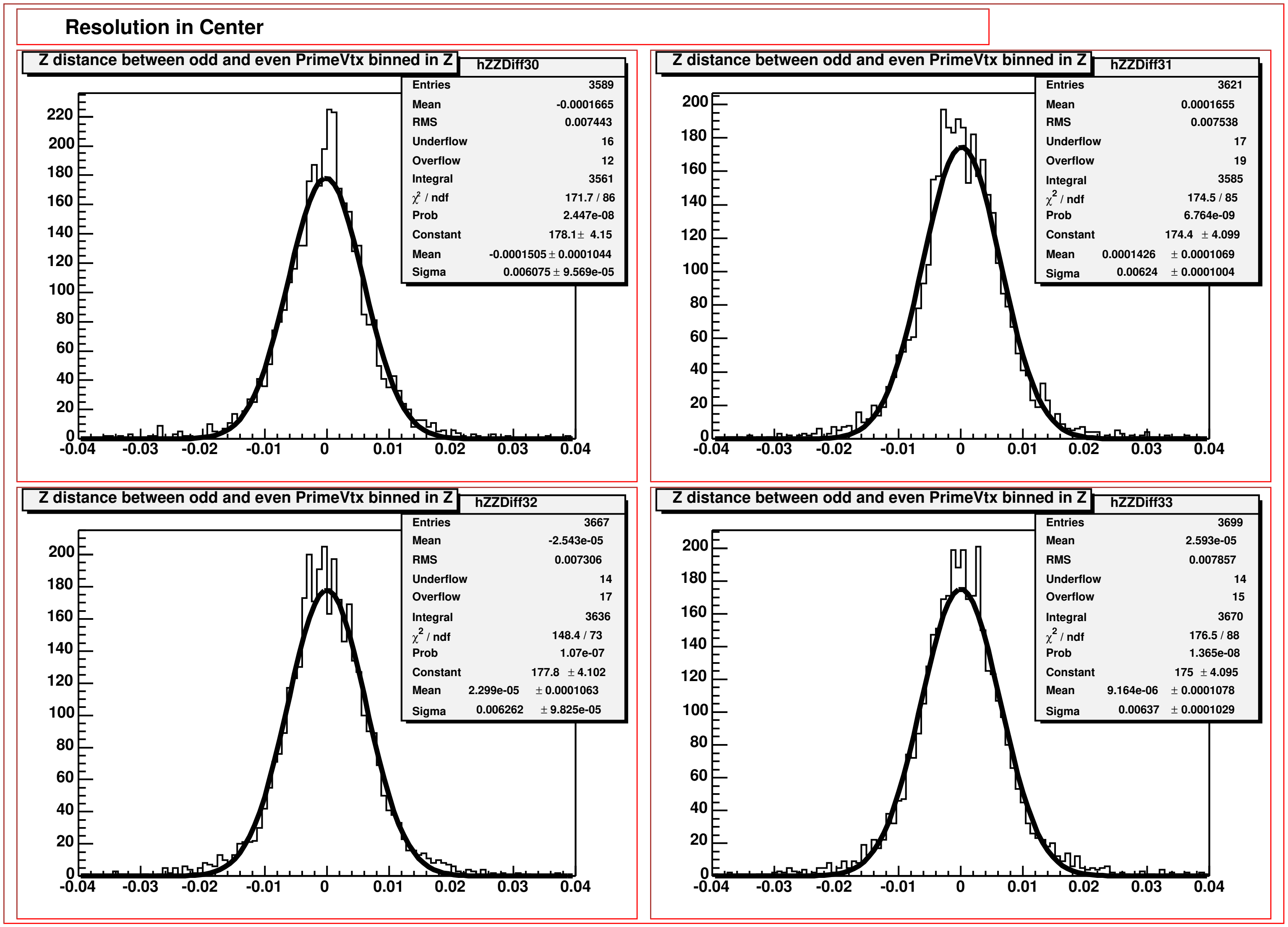
Pulls vs. Z



Pull vs. Z
PrimeVtx: x-pull versus primary vertex z
hZXPullTrk
Entries 58
Mean 0.2549
RMS 36.25
Underflow 0
Overflow 0
Integral 96.67
PrimeVtx: y-pull versus primary vertex z
hZYPullTrk
Entries 58
Mean 4.191
RMS 37.37
Underflow 0
Overflow 0
Integral 101.3
PrimeVtx: z-pull versus primary vertex z
hZZPullTrk
Entries 58
Mean 3.058
RMS 35.56
Underflow 0
Overflow 0
Integral 101

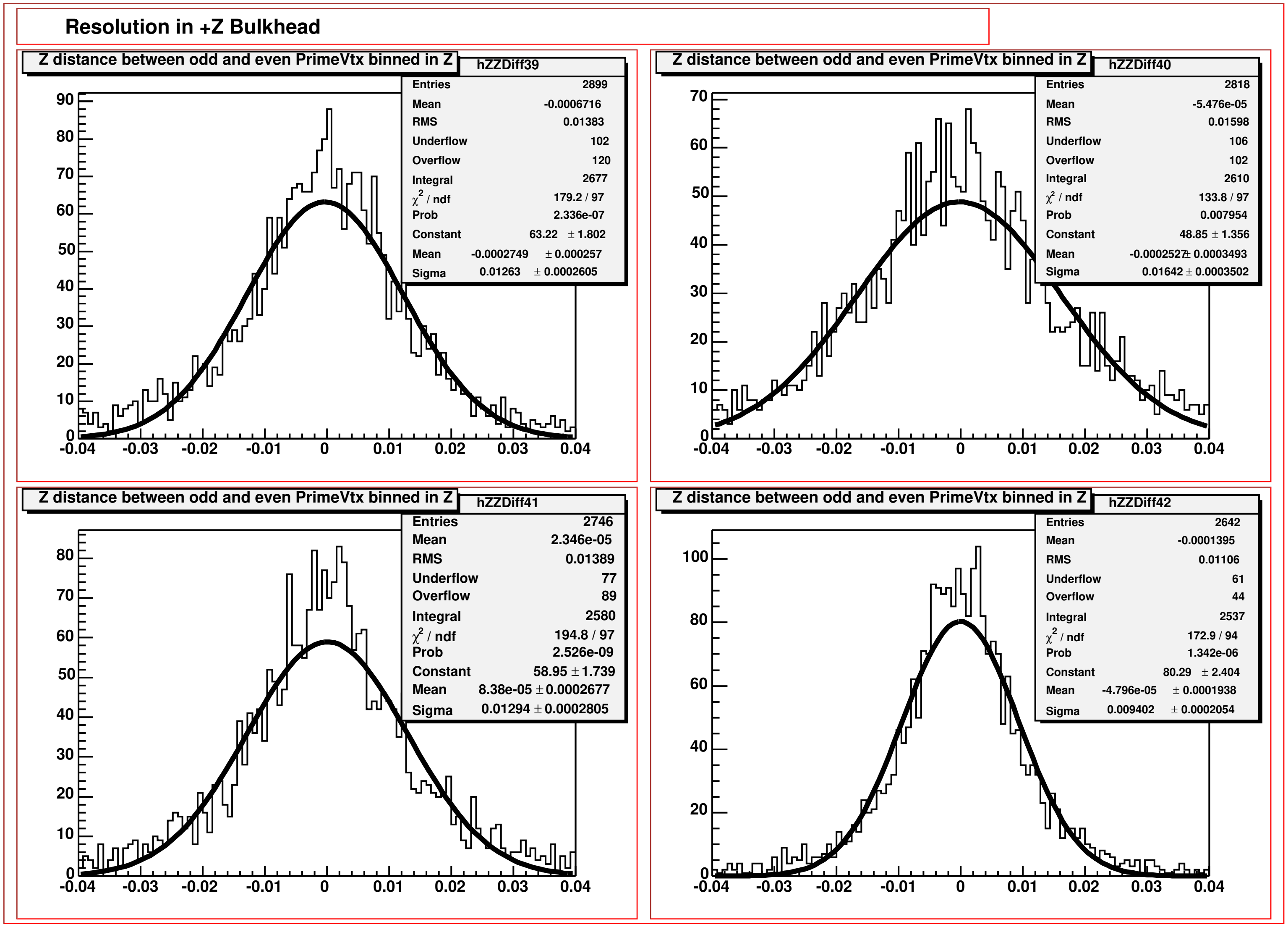
Z Resolution in Center (Barrel 1)

Individual bins near center of detector(-7 - 7 cm):

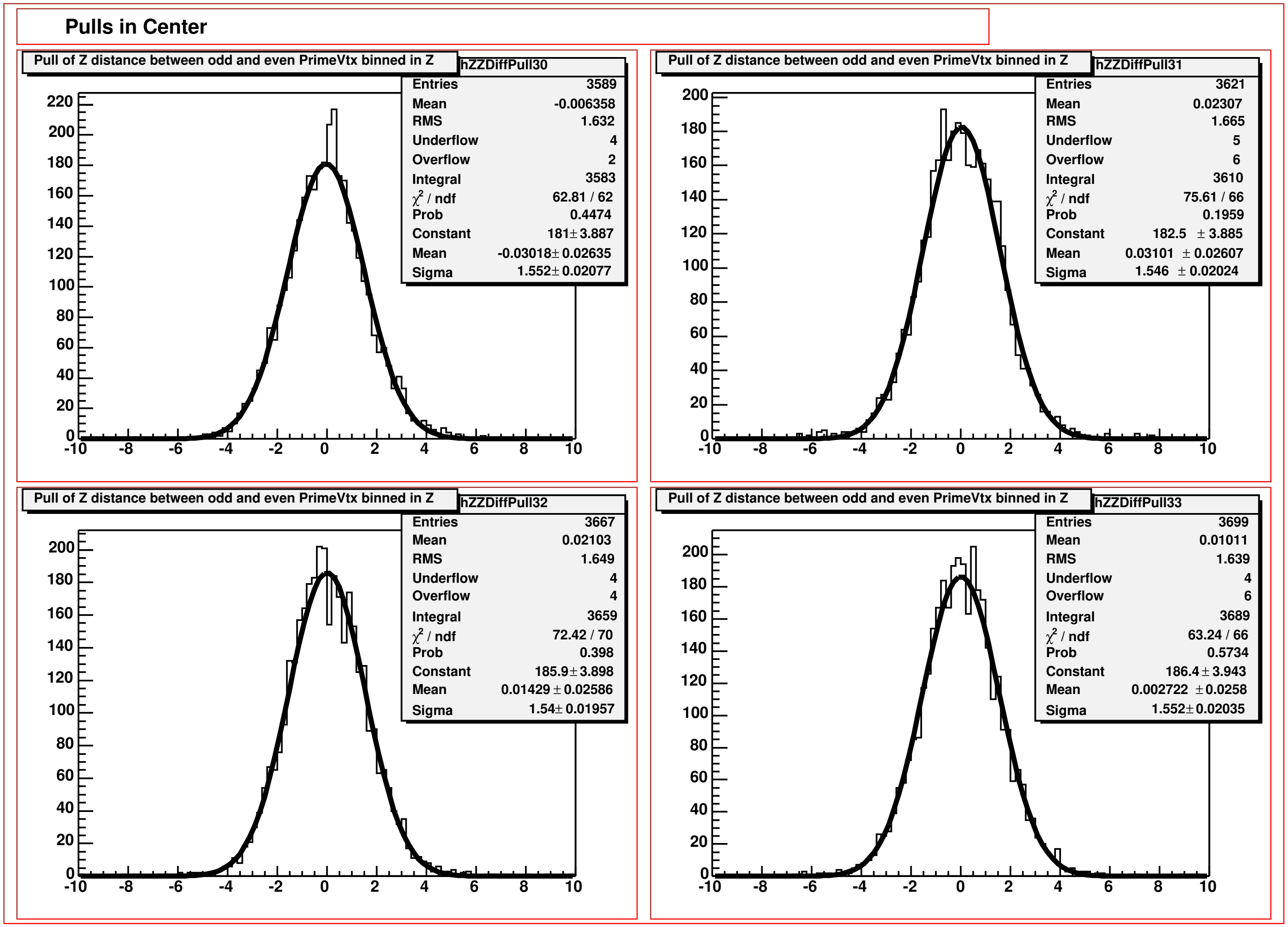


Z Resolution in Positive Bulkhead

Individual bins around positive bulkhead (13 - 21 cm):

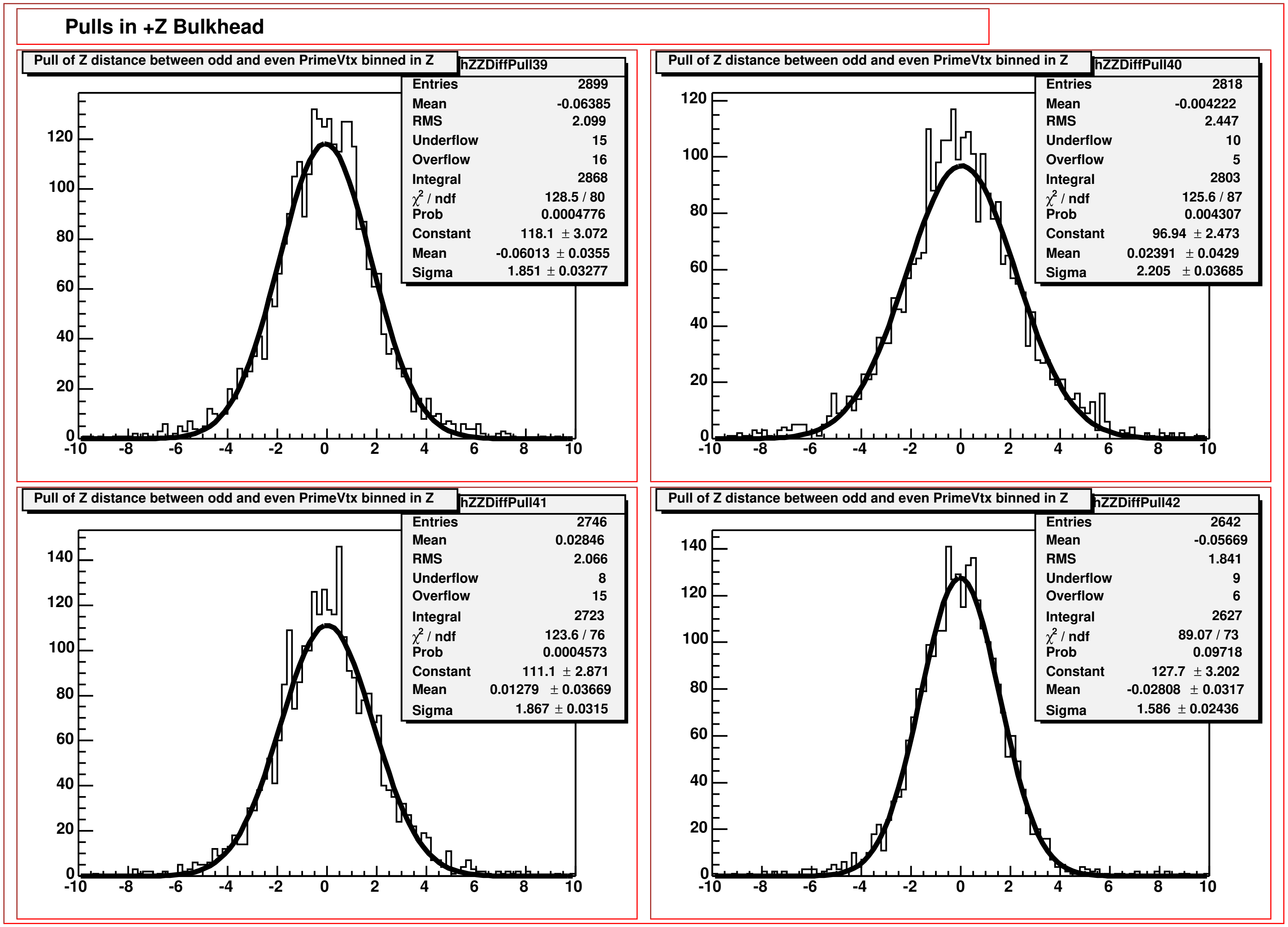


Z Pulls in Center (Barrel 1)



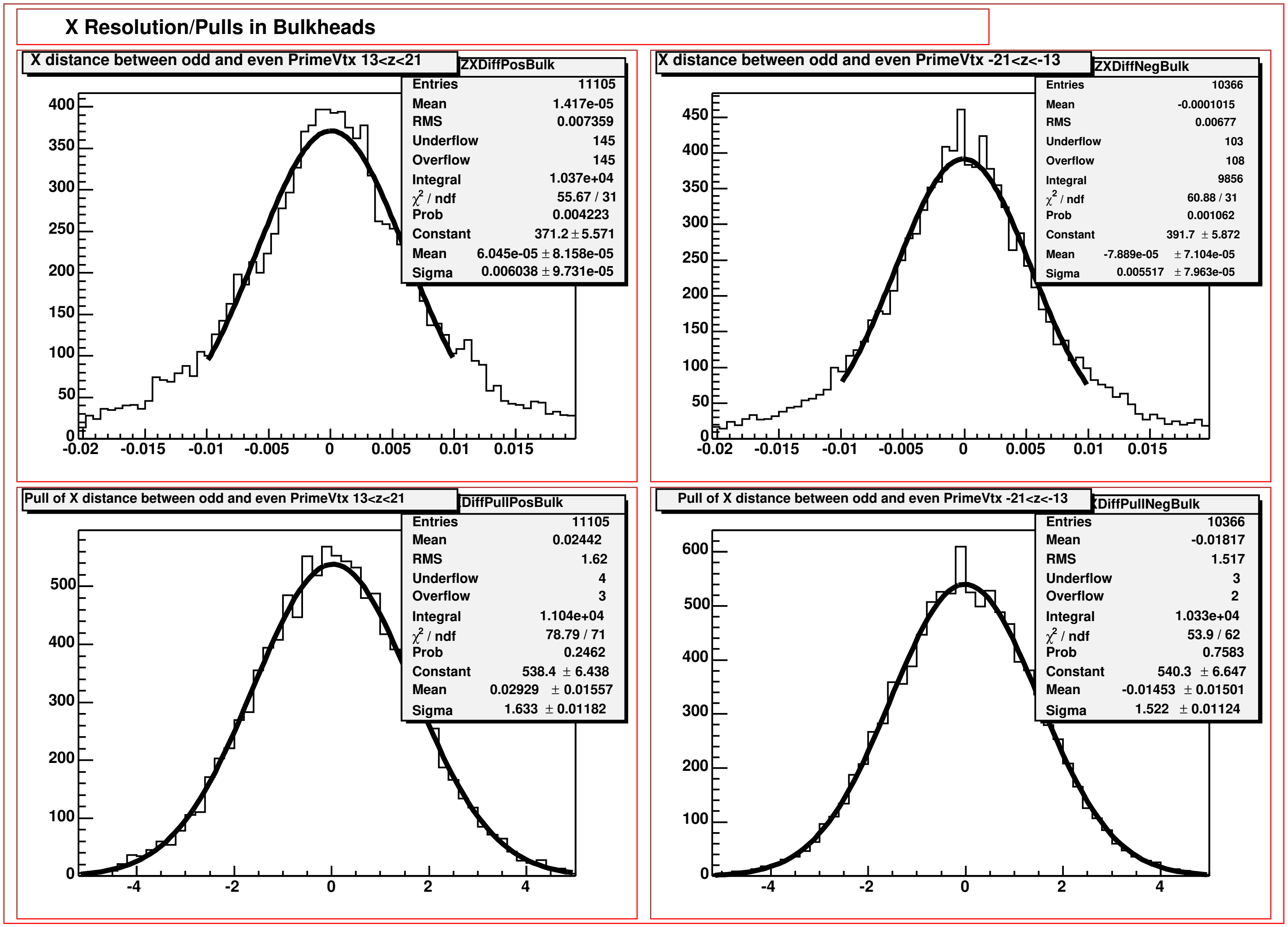
Z Pulls in Positive Bulkhead

Up to 37% higher than average



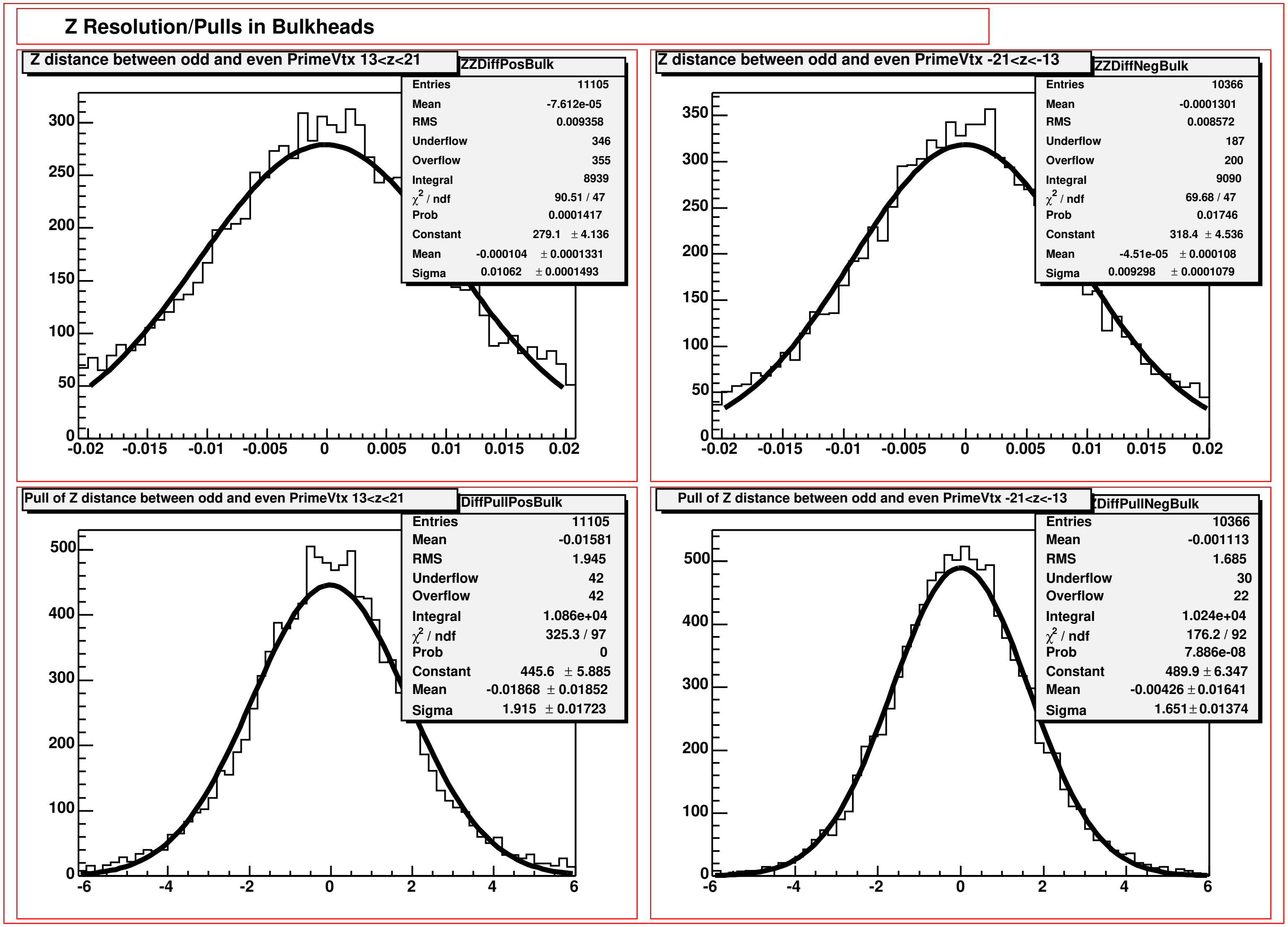
X Resolution/Pulls in Bulkheads

Resolution in X slightly worse in positive bulkhead (left plots):

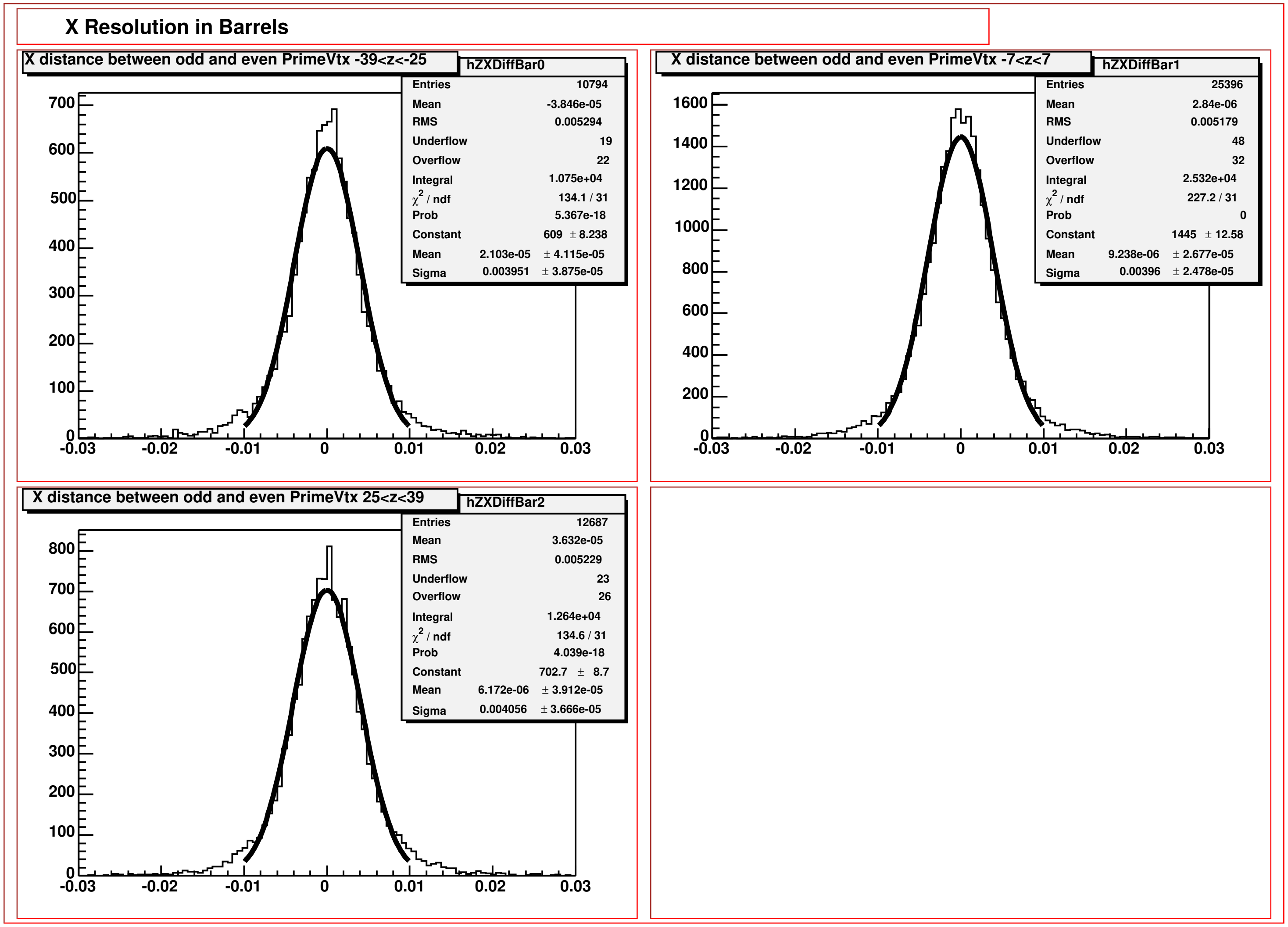


Z Resolution/Pulls in Bulkheads

Resolution in Z 15% worse in positive bulkhead (left plots):

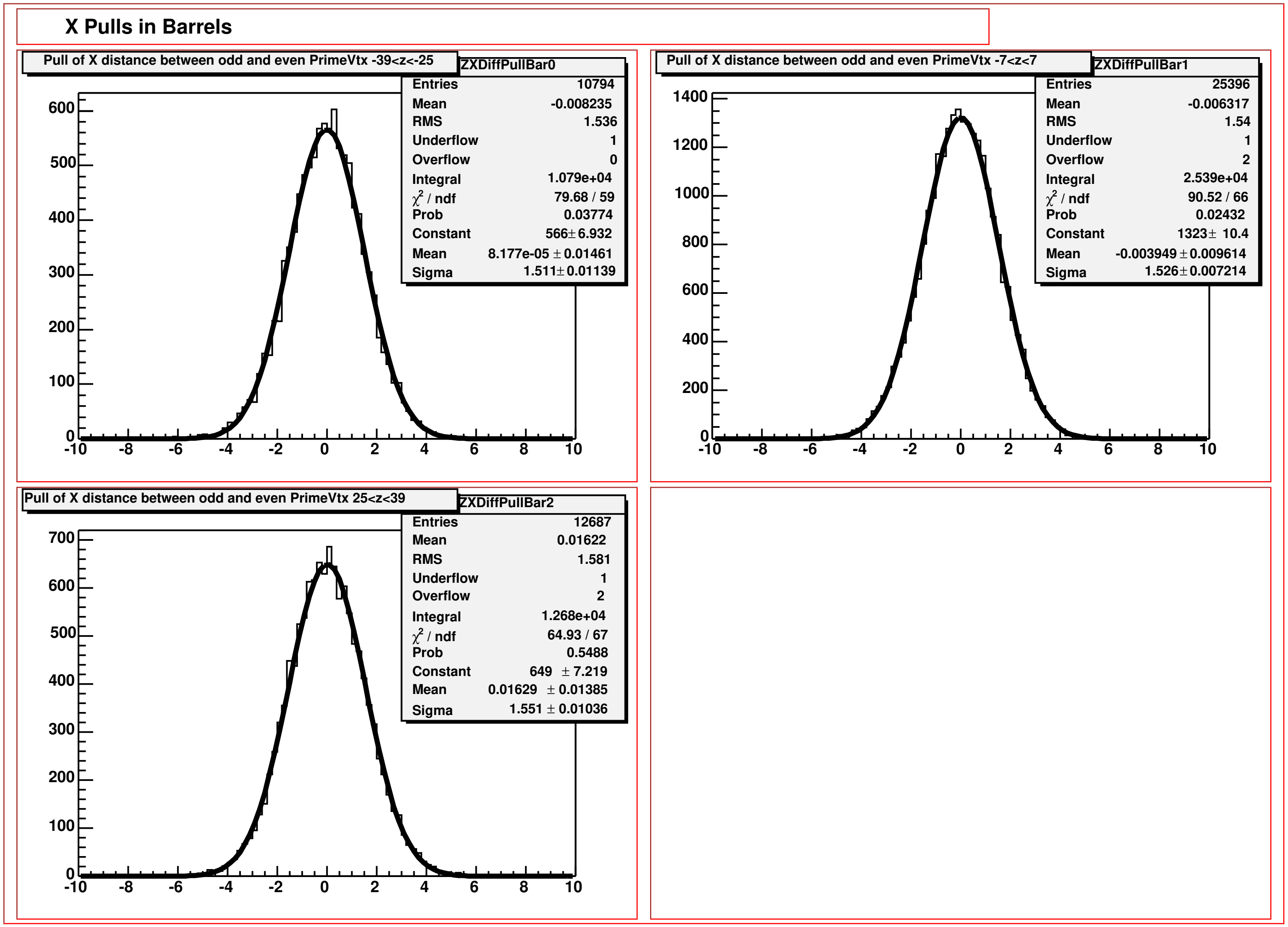


Check resolution/pulls in centers of three barrels:



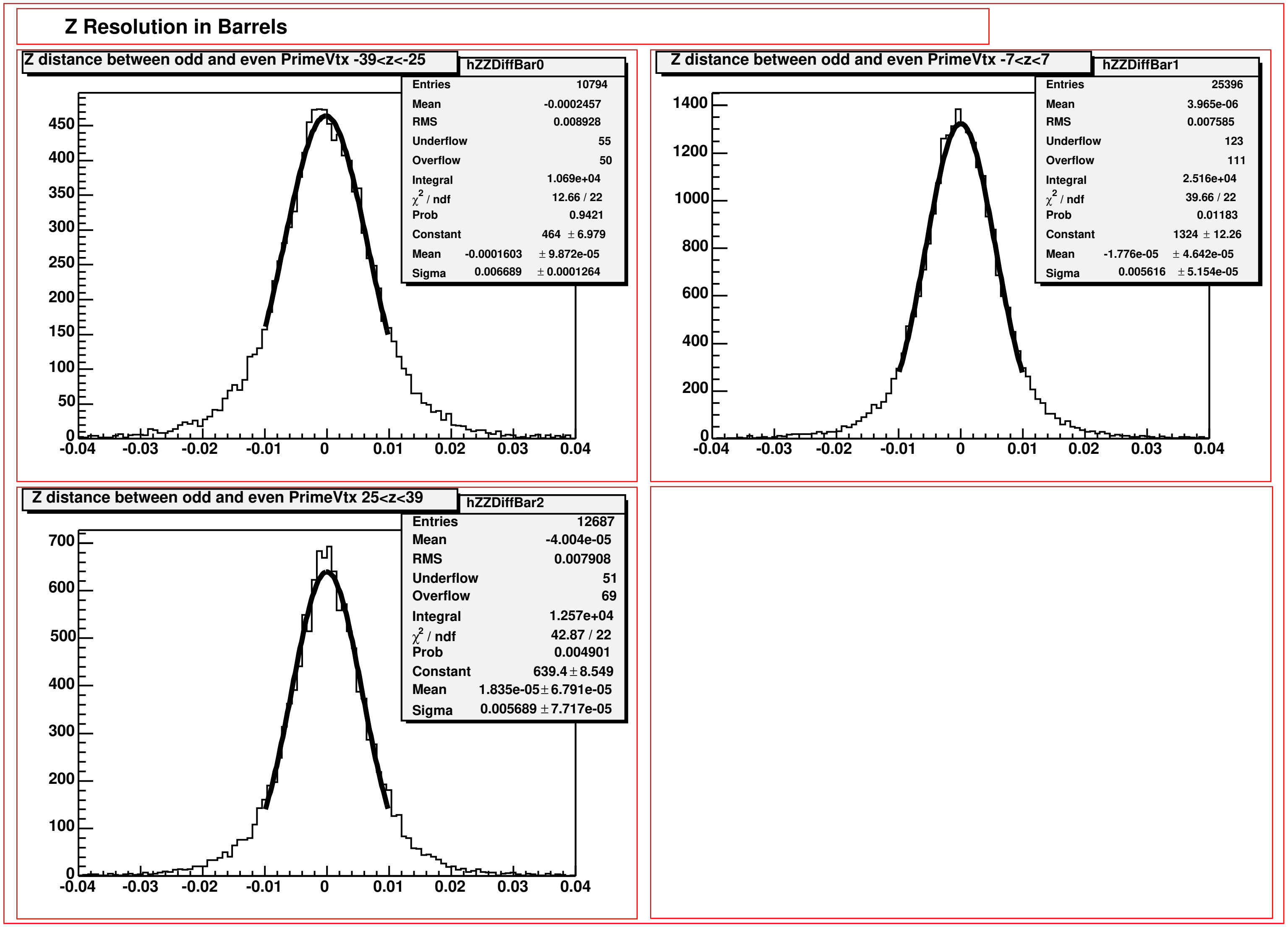
Similar plots in y

X Pulls in Barrels



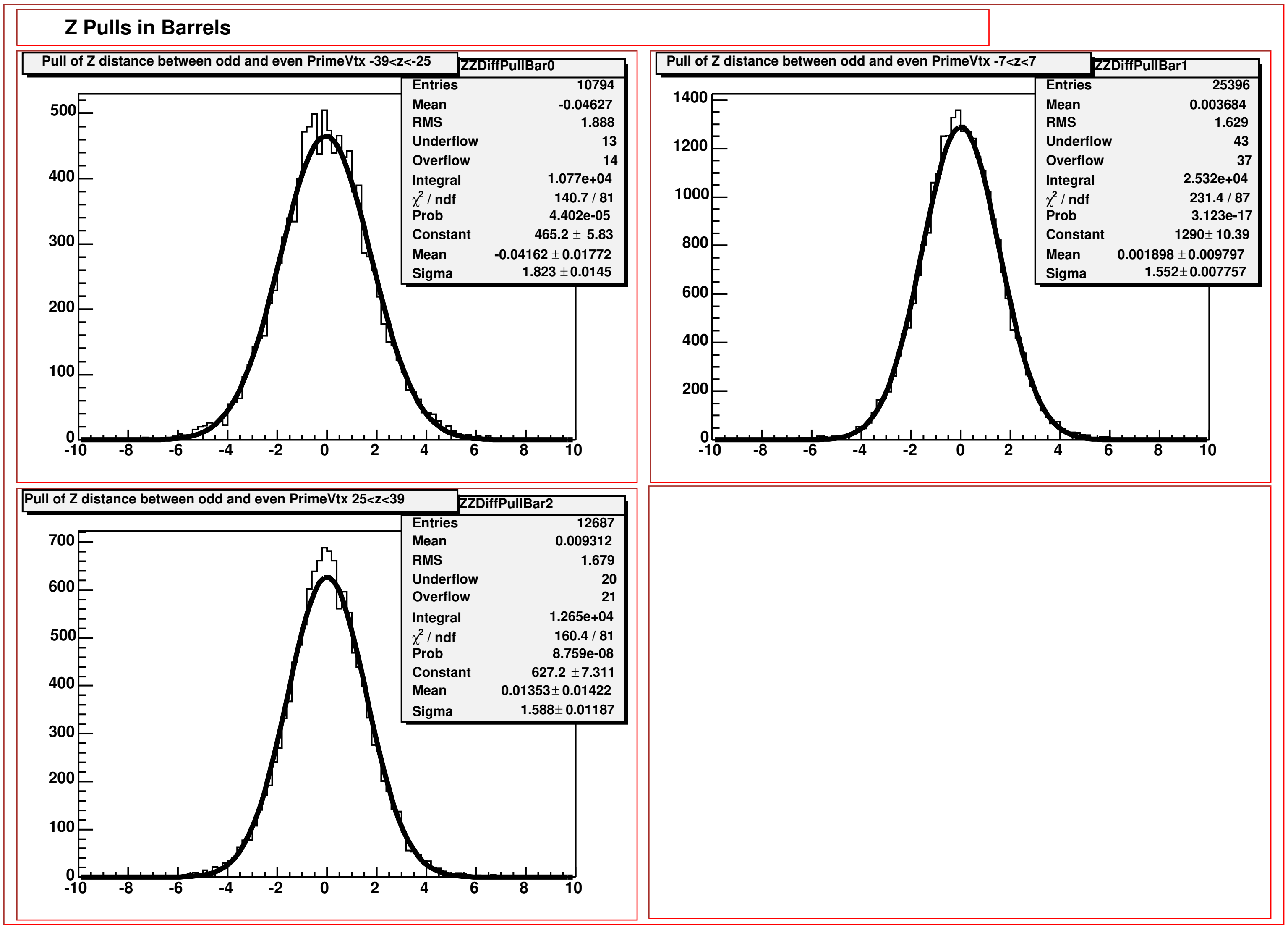
Z Resolution in Barrels

Barrel 0 has conspicuously poor resolution in Z (20%):



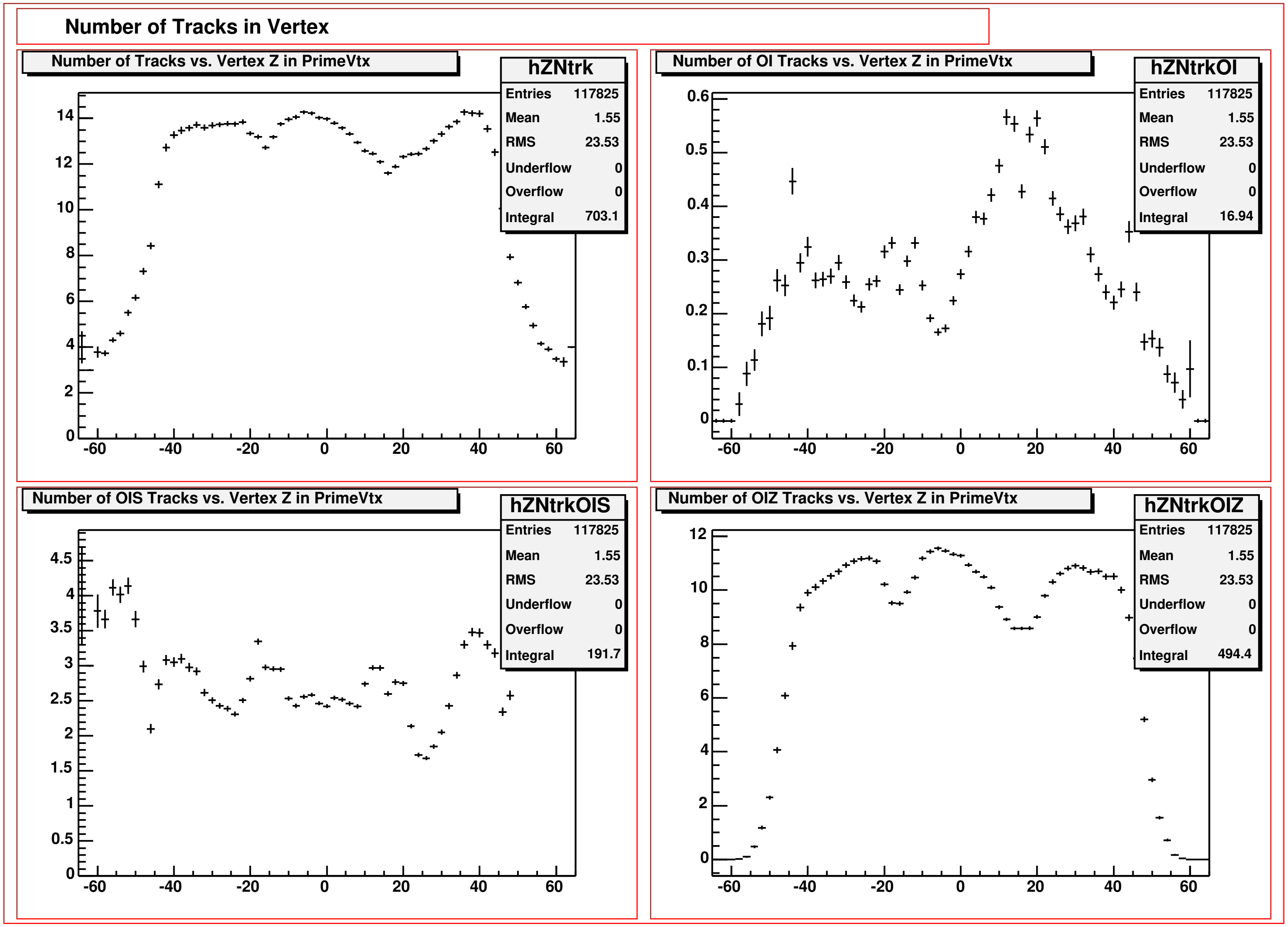
Z Pulls in Barrels

Barrel 0 pulls in Z also worse by 20%:

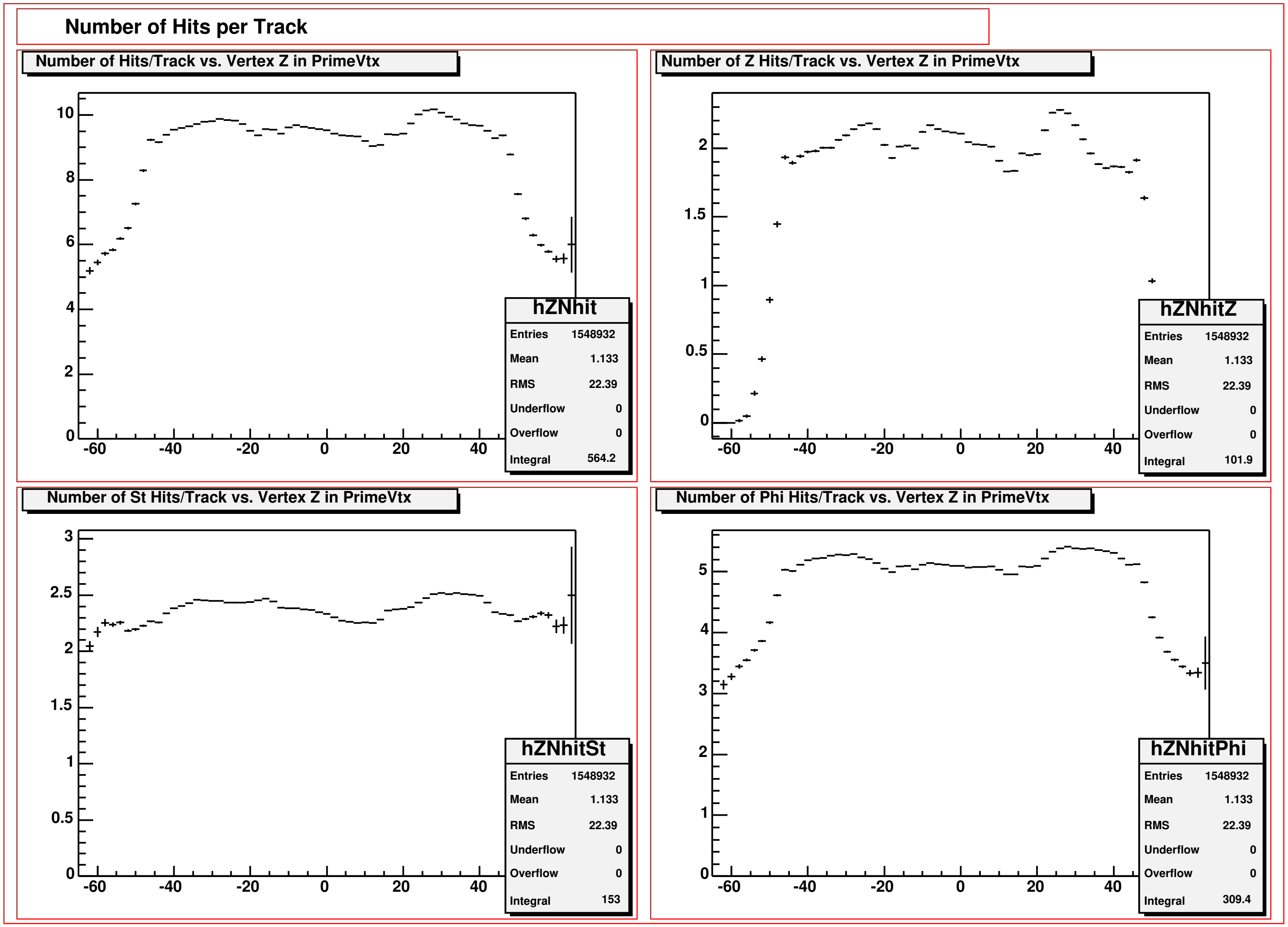


Number of Tracks vs. Vertex Z

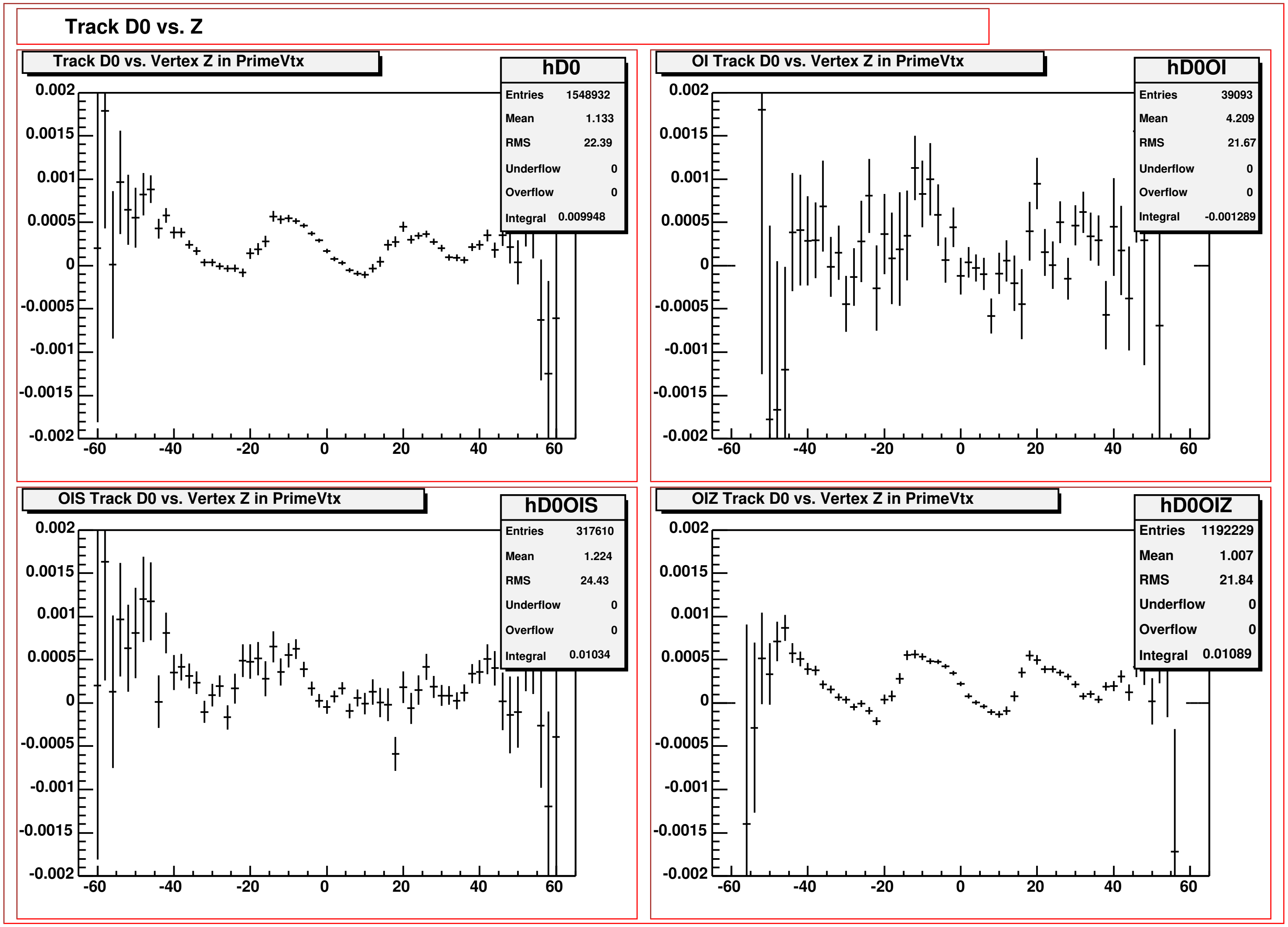
Some unexplained variation in vertex composition



Number of Hits/Track vs. Vertex Z

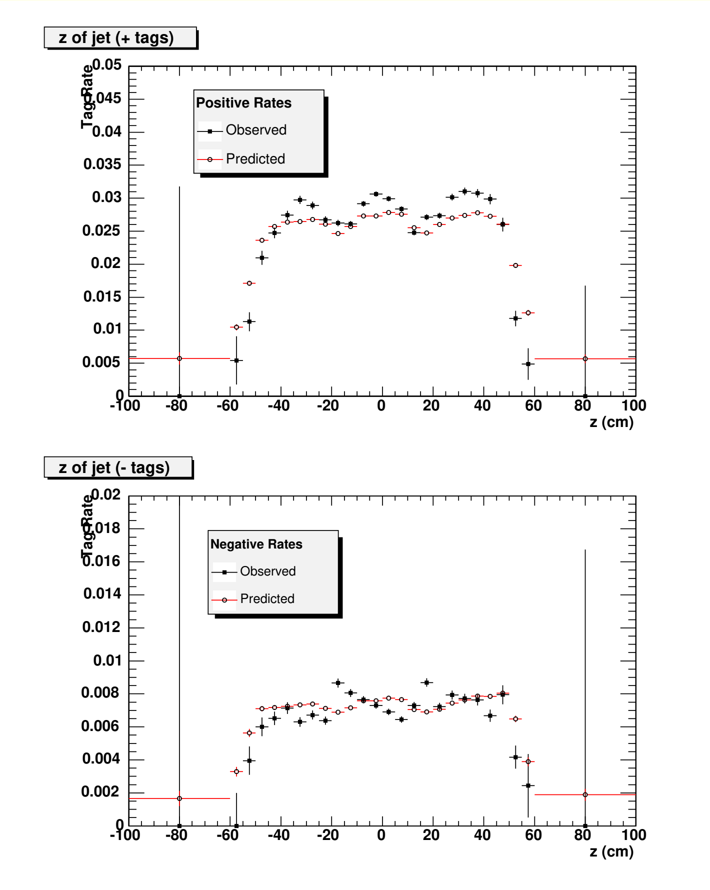


D0 shows asymmetric dependence on Z (present in all algorithms)



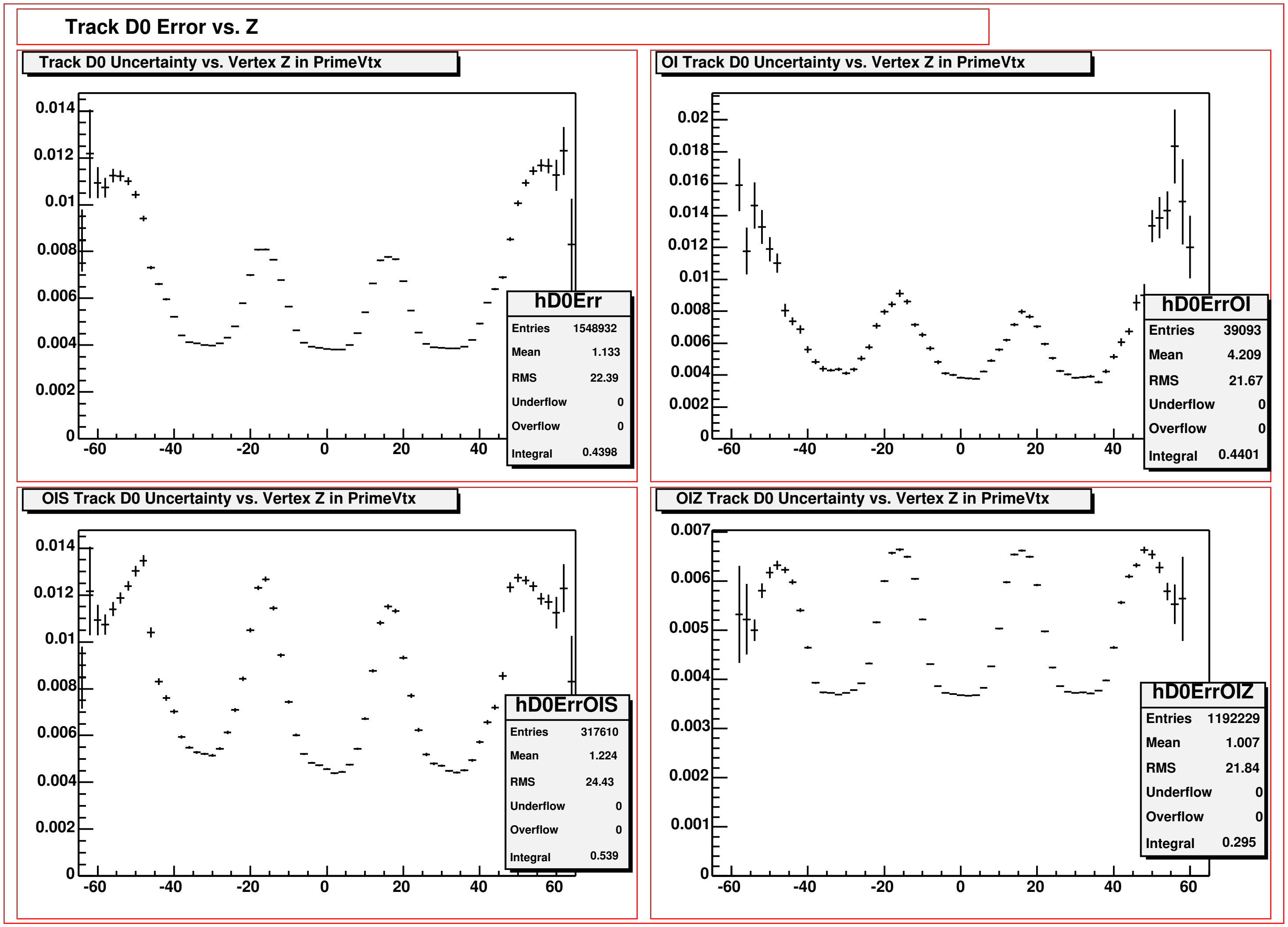
SecVTX Tagging Rate

Negative Tag Rate has Same Features as D0 Track Distributions



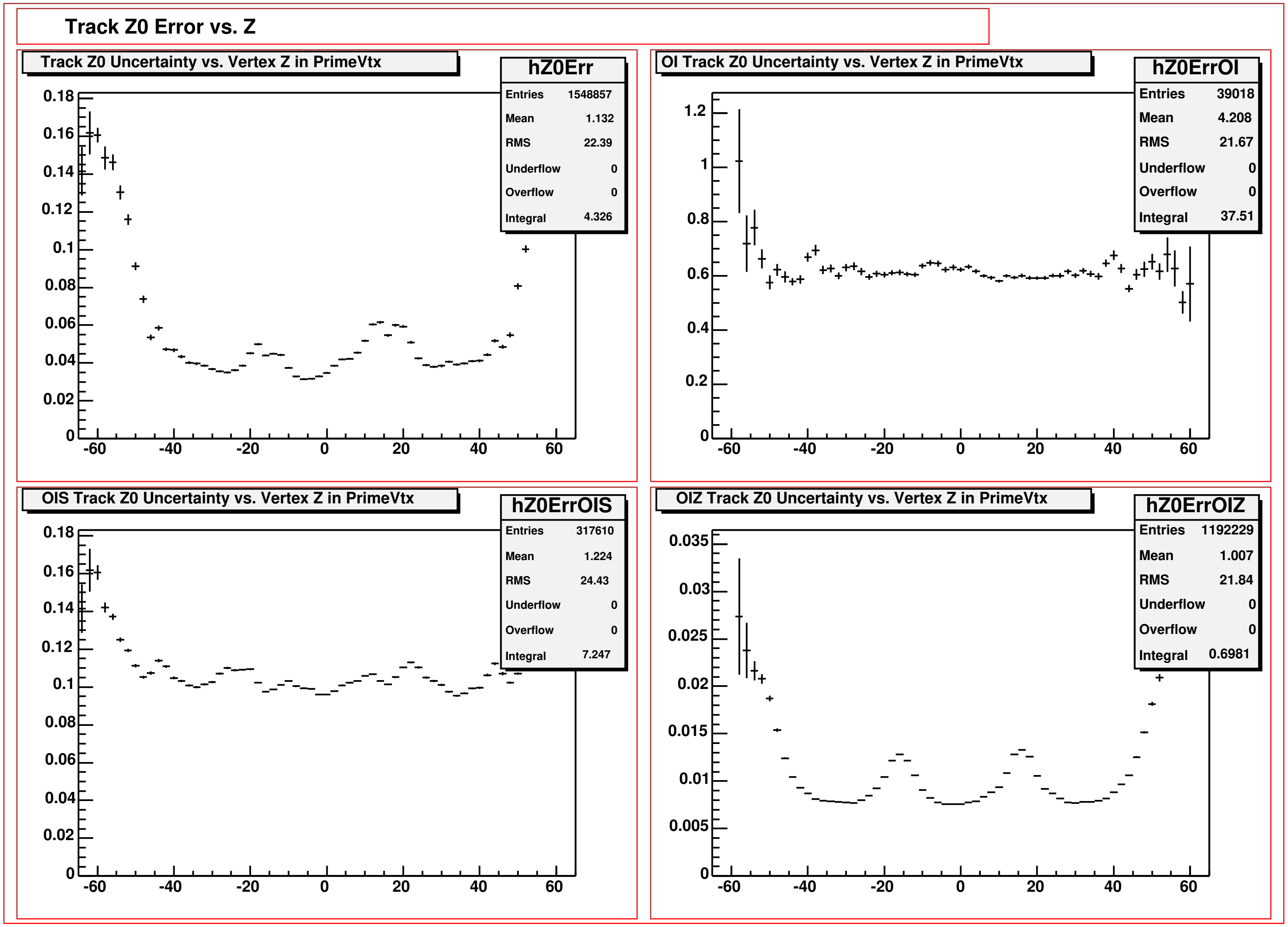
D0 Error vs. Z

Errors in negative bulkhead are larger for OI and OIS tracks
Symmetric for OIZ tracks (under-estimated in positive bulkhead?)

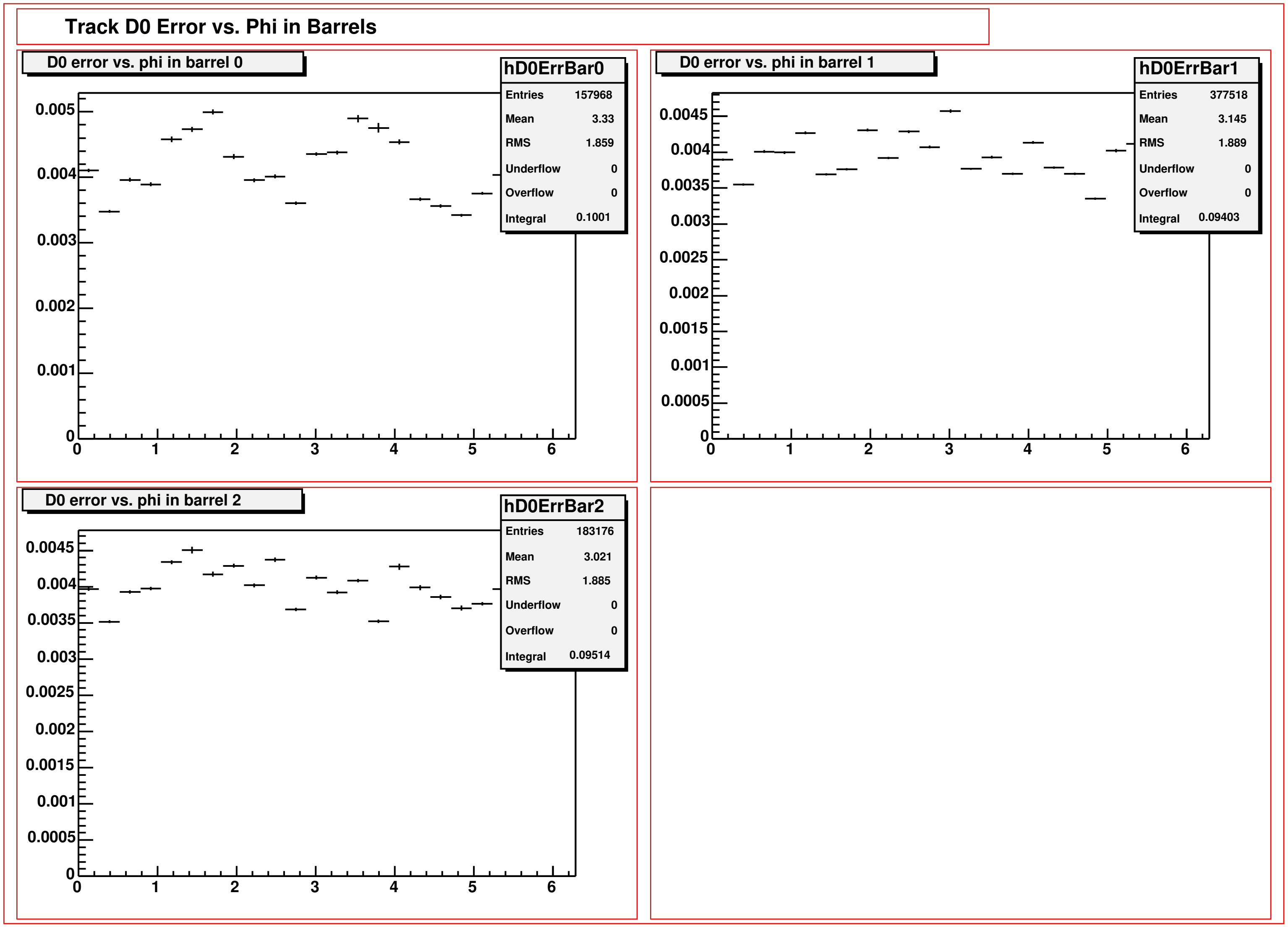


Z0 Error vs. Z

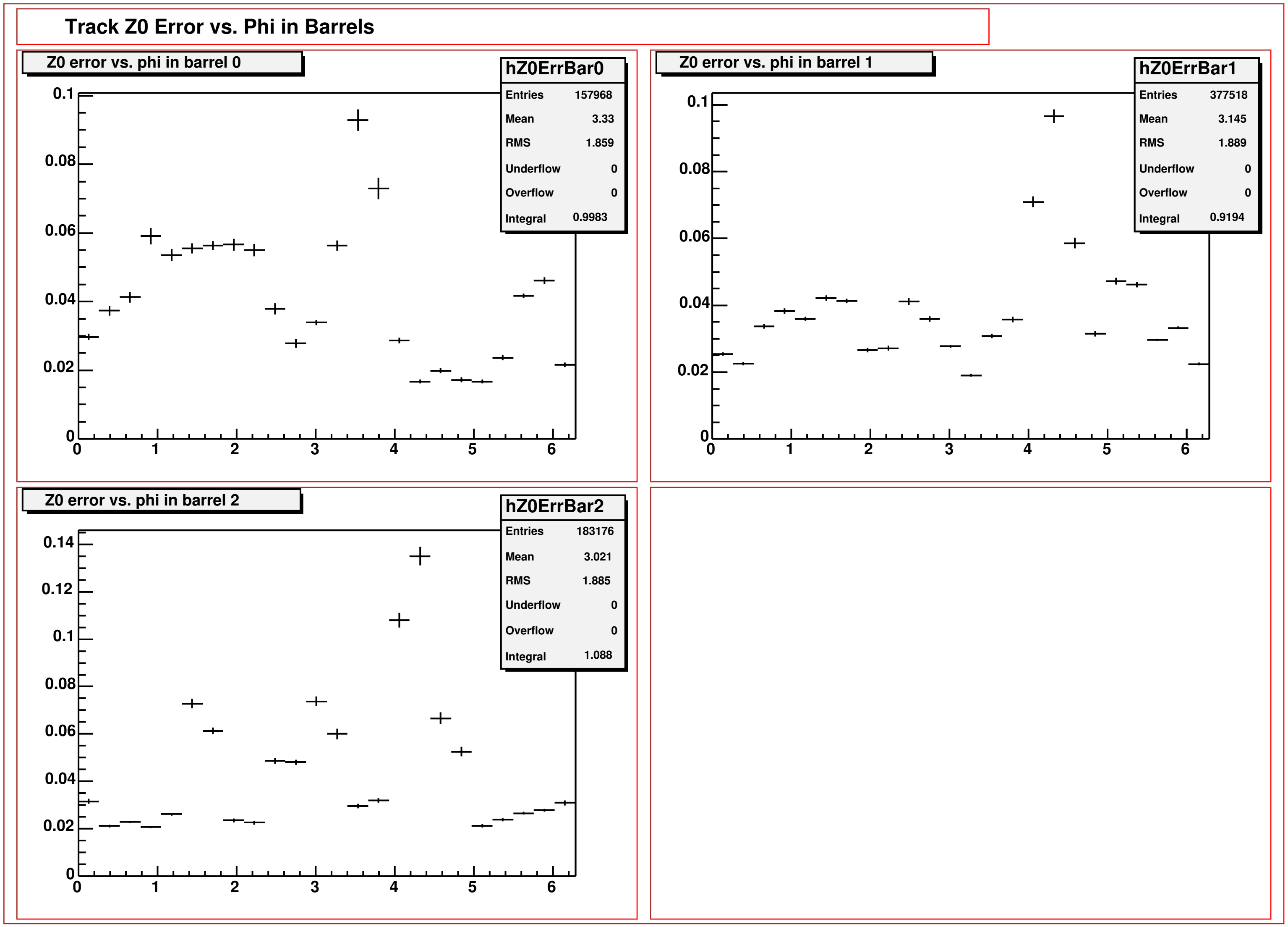
Z0 Errors also asymmetric near bulkheads



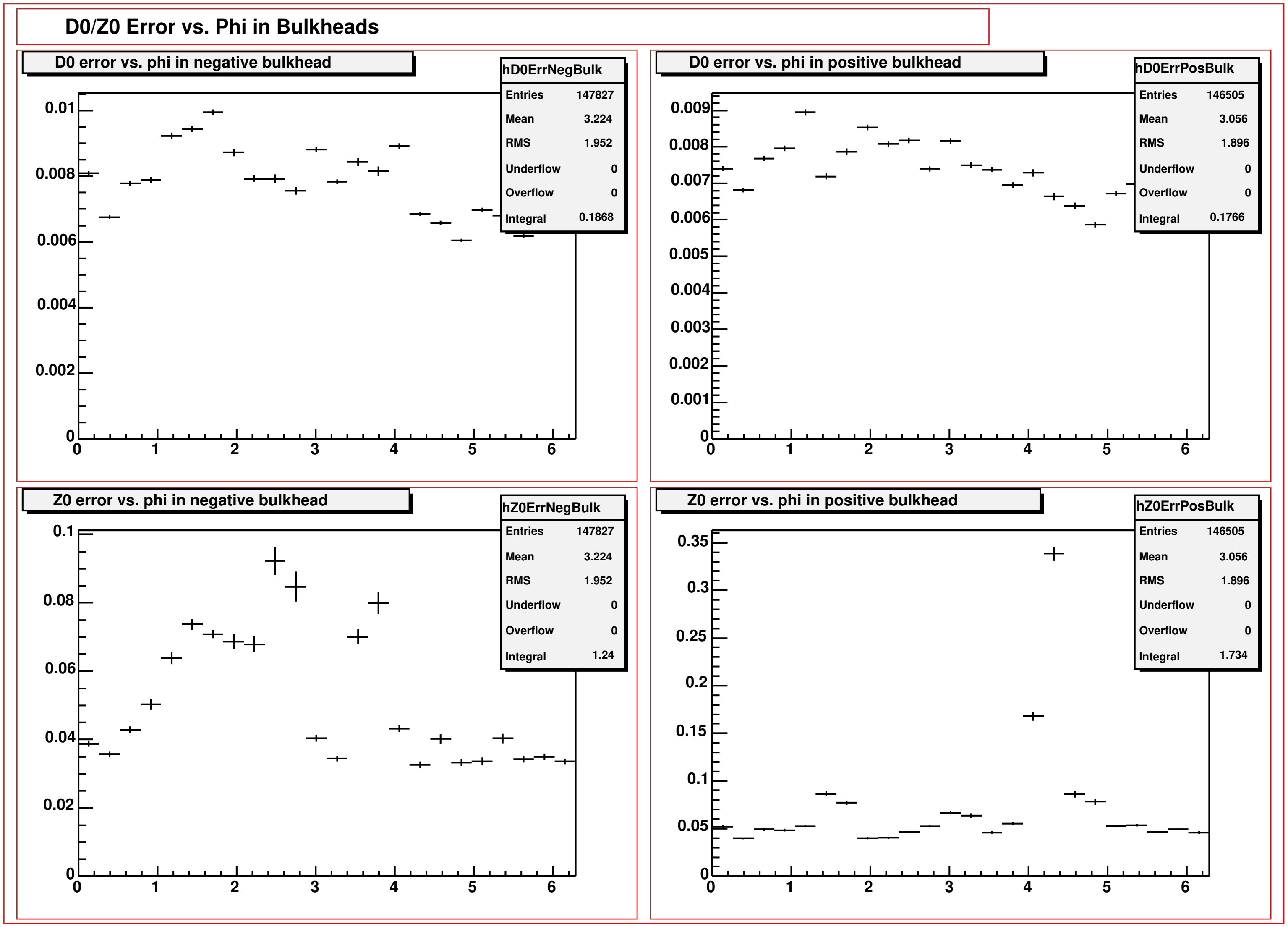
D0 Error vs. Phi in Barrels



Z0 Error vs. Phi in Barrels



D0 and Z0 Error vs. Phi in Bulkheads



Summary

Questions:

1. Primary Vertex Pulls Larger in Positive Bulkheads (max 37%)
2. Primary Vertex Pulls in Z Larger in Barrel 0 (max 20%)
3. Track D0 Asymmetric in Z
4. Track Z0 Errors Spiked in Phi

To Come:

- Understand and Correct Weird Features
- Repeat with Higher Statistics and Newest Alignment