

PRELIMINARY

VXD Alignment *from first collisions*

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Weekly Tracking Meeting, 4th May 2018

The Data Set

- Runs 521 – 532 (luminosity runs)
- Events with RecoTracks with > 3 VXD hits
 - Just anything charged going through VXD used
 - I suspect many tracks come from the hot-spots
 - Could be a good think, but...
 - No ideas about systematics, we do not have anything like this on MC :-)
 - Note: the sample is mostly IP tracks (I reused scripts for beam alignment) – but those usually go only through CDC – if no VXD hits, they do not contribute to the alignment
 - About 2k VXD tracks

Reconstruction

- Master branch
- Global Tag #332
- Standard reconstruction (VXDTF2)
 - SVDSpacePointCreator.MinClusterTime=-999
 - PXD + SVD + CDC, DAF
 - CDC is used as external reference
- Wanted to show also DQM plots with tracks, but scales are too small to see all features

Results

- U, V residuals from standard reconstruction
 - PXD + SVD + CDC, DAF
- Set of drawings/plots:
 - VXDAAlignment payload content
 - U residuals
 - V residuals
- First set using GCR2 alignment from cosmics
 - `/home/belle2/bilka/GCR2VXDAAlignment_init/database.txt`
- Second set using computed alignment from collisions

layer 6 ladder 1

$u = -32.34718 \text{ um}$	$u = -59.1628 \text{ um}$	$u = 122.47315 \text{ um}$	$u = 285.2872 \text{ um}$	$u = 611.89884 \text{ um}$
$v = 1201.0189 \text{ um}$	$v = 1379.0202 \text{ um}$	$v = 1381.2395 \text{ um}$	$v = 1373.405 \text{ um}$	$v = 1385.972 \text{ um}$
$w = 729.60785 \text{ um}$	$w = -91.62963 \text{ um}$	$w = -91.47742 \text{ um}$	$w = -275.07736 \text{ um}$	$w = -93.19213 \text{ um}$
$\alpha = -2.43835 \text{ mrad}$	$\alpha = 1.82428 \text{ mrad}$	$\alpha = -2.49197 \text{ mrad}$	$\alpha = -0.11543 \text{ mrad}$	$\alpha = 2.76449 \text{ mrad}$
$\beta = 6.94594 \text{ mrad}$	$\beta = 9.32705 \text{ mrad}$	$\beta = 3.78779 \text{ mrad}$	$\beta = -0.15664 \text{ mrad}$	$\beta = -5.18588 \text{ mrad}$
$\gamma = 2.61673 \text{ mrad}$	$\gamma = -1.25469 \text{ mrad}$	$\gamma = -1.47513 \text{ mrad}$	$\gamma = -1.33904 \text{ mrad}$	$\gamma = 0.0337 \text{ mrad}$

layer 5 ladder 1

$u = -210.22667 \text{ um}$	$u = -70.71388 \text{ um}$	$u = 231.51287 \text{ um}$	$u = 602.87982 \text{ um}$
$v = 1273.5856 \text{ um}$	$v = 1457.234 \text{ um}$	$v = 1476.556 \text{ um}$	$v = 1427.5199 \text{ um}$
$w = 497.5932 \text{ um}$	$w = -210.98747 \text{ um}$	$w = -377.42838 \text{ um}$	$w = -40.33378 \text{ um}$
$\alpha = -1.89397 \text{ mrad}$	$\alpha = -4.35395 \text{ mrad}$	$\alpha = 0.80789 \text{ mrad}$	$\alpha = 4.16214 \text{ mrad}$
$\beta = 7.34429 \text{ mrad}$	$\beta = 10.47483 \text{ mrad}$	$\beta = 5.38889 \text{ mrad}$	$\beta = 0.40486 \text{ mrad}$
$\gamma = 2.74029 \text{ mrad}$	$\gamma = -2.78208 \text{ mrad}$	$\gamma = -2.10782 \text{ mrad}$	$\gamma = -1.34366 \text{ mrad}$

layer 4 ladder 1

$u = 78.66829 \text{ um}$	$u = 471.52095 \text{ um}$	$u = 649.57118 \text{ um}$
$v = 1198.0864 \text{ um}$	$v = 1349.176 \text{ um}$	$v = 1289.788 \text{ um}$
$w = 697.3752 \text{ um}$	$w = 161.0224 \text{ um}$	$w = 293.98554 \text{ um}$
$\alpha = 1.67512 \text{ mrad}$	$\alpha = -2.96467 \text{ mrad}$	$\alpha = 2.64059 \text{ mrad}$
$\beta = 4.42185 \text{ mrad}$	$\beta = -1.51546 \text{ mrad}$	$\beta = -3.79422 \text{ mrad}$
$\gamma = 0.29257 \text{ mrad}$	$\gamma = -1.56181 \text{ mrad}$	$\gamma = -1.3923 \text{ mrad}$

layer 3 ladder 1

$u = 378.95534 \text{ um}$	$\alpha = -0.27123 \text{ mrad}$	$u = 643.58986 \text{ um}$	$\alpha = -0.11714 \text{ mrad}$
$v = 1479.756 \text{ um}$	$\beta = 4.4605 \text{ mrad}$	$v = 1471.9244 \text{ um}$	$\beta = -1.74195 \text{ mrad}$
$w = 113.21934 \text{ um}$	$\gamma = -1.85214 \text{ mrad}$	$w = 91.51538 \text{ um}$	$\gamma = -1.45636 \text{ mrad}$

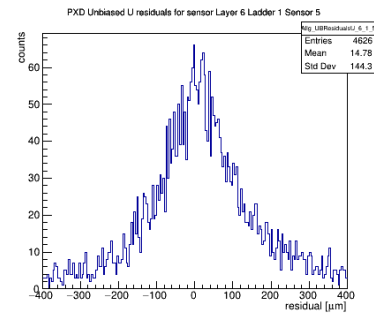
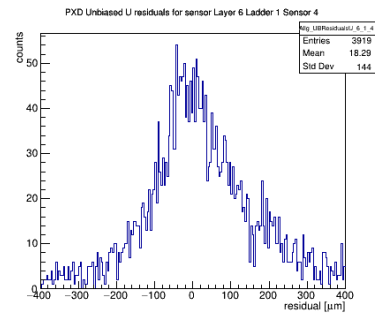
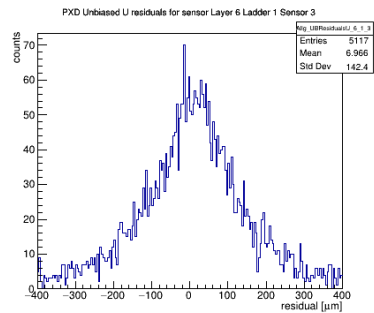
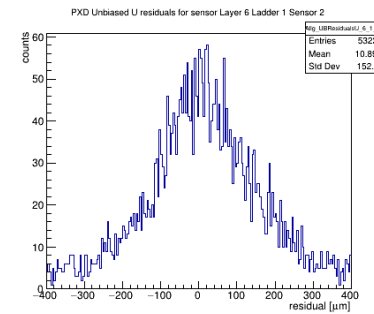
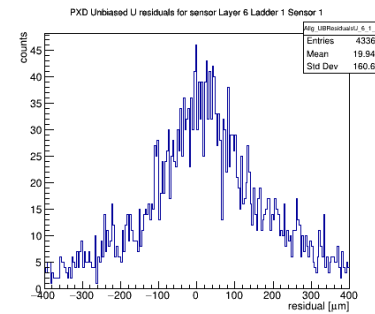
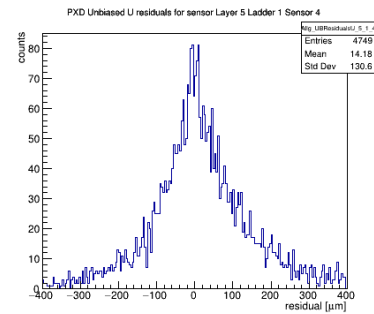
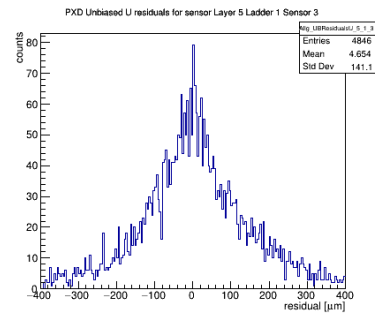
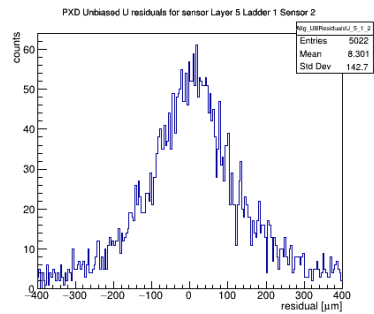
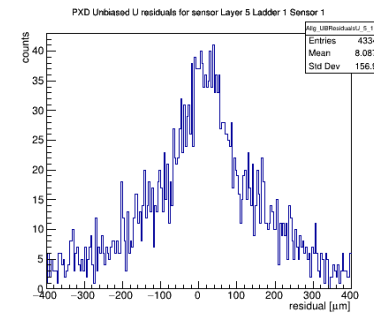
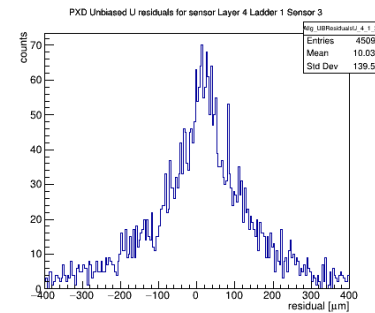
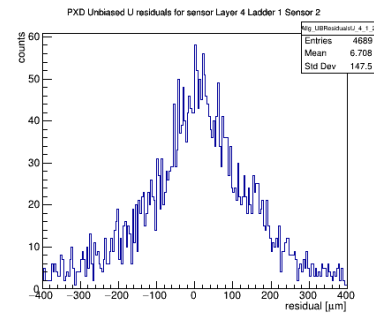
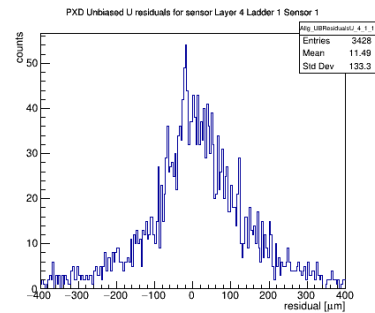
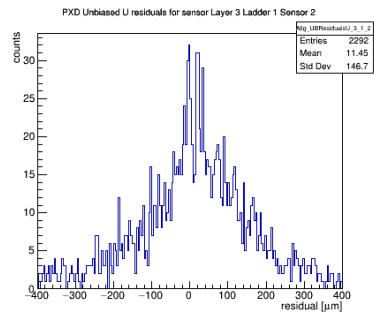
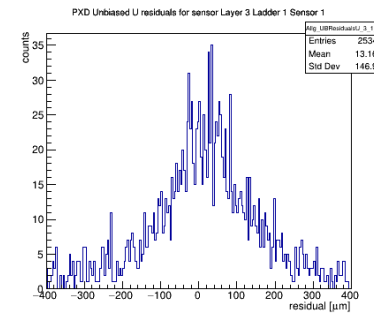
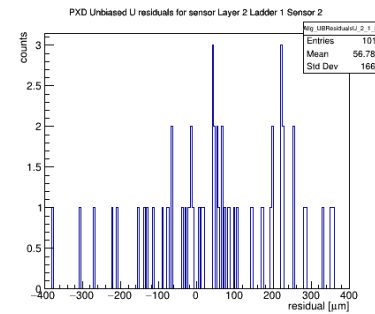
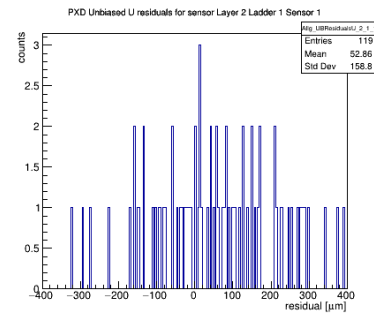
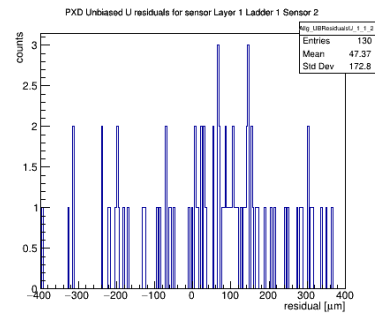
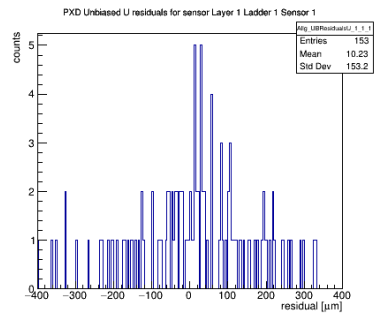
layer 2 ladder 1

$u = 1243.3604 \text{ um}$	$\alpha = 1.07289 \text{ mrad}$	$u = 1105.2434 \text{ um}$	$\alpha = 1.08852 \text{ mrad}$
$v = 2155.086 \text{ um}$	$\beta = -0.236 \text{ mrad}$	$v = 1816.409 \text{ um}$	$\beta = -8.24308 \text{ mrad}$
$w = -68.8197 \text{ um}$	$\gamma = -16.24299 \text{ mrad}$	$w = -80.1334 \text{ um}$	$\gamma = 10.35166 \text{ mrad}$

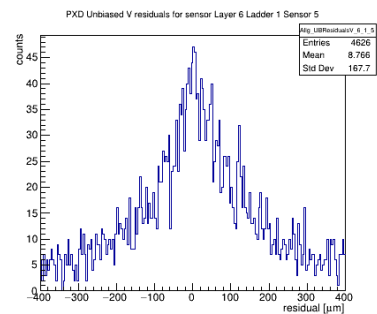
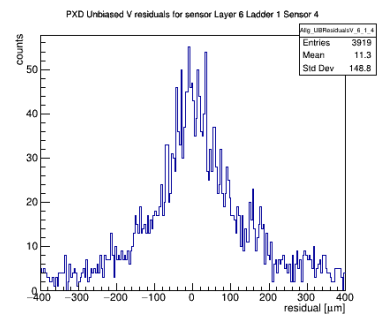
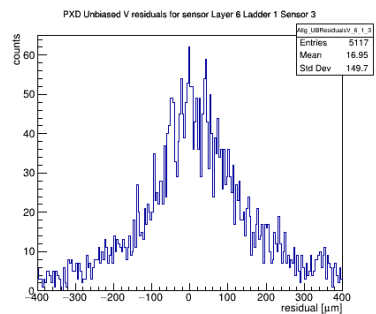
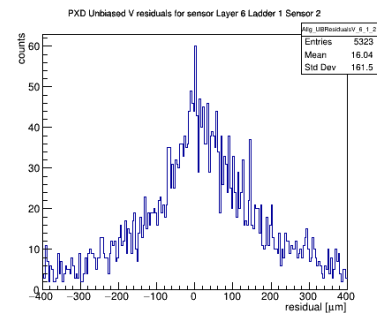
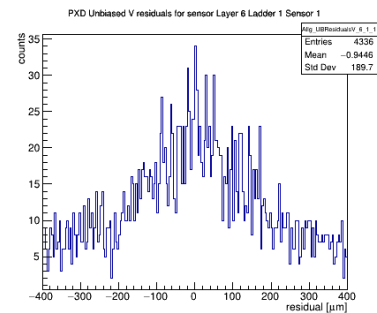
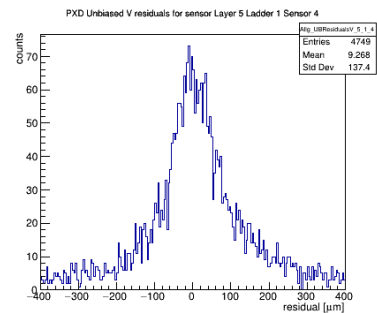
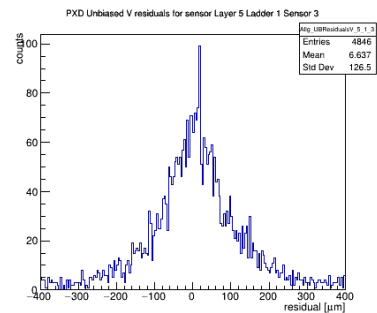
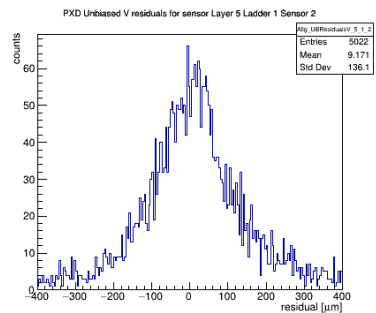
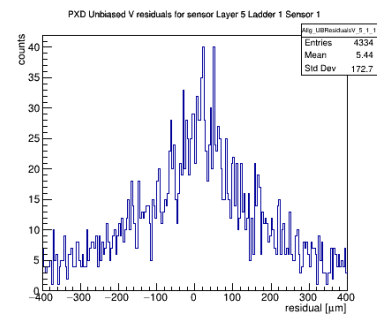
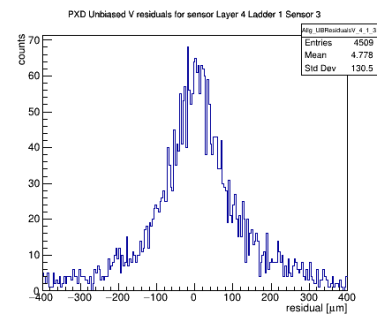
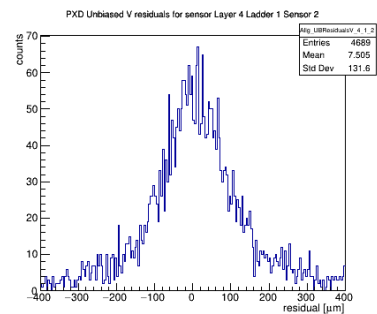
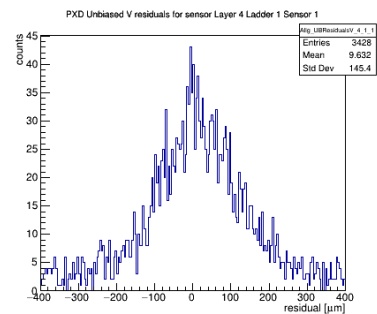
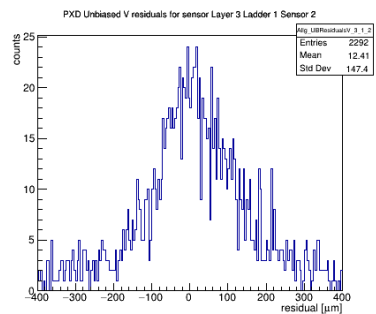
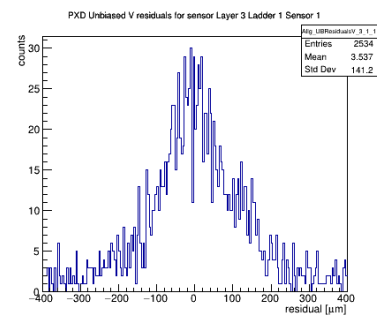
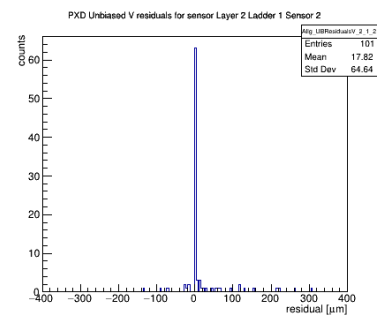
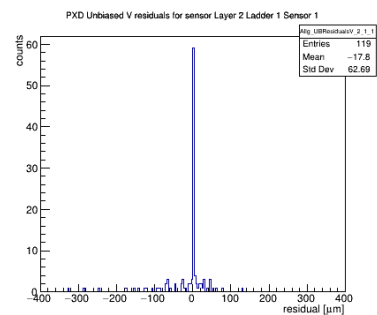
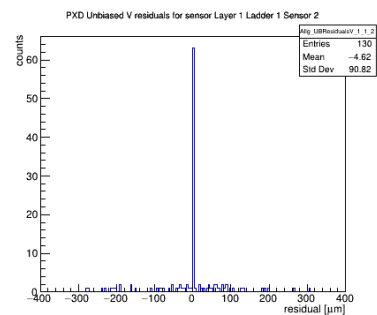
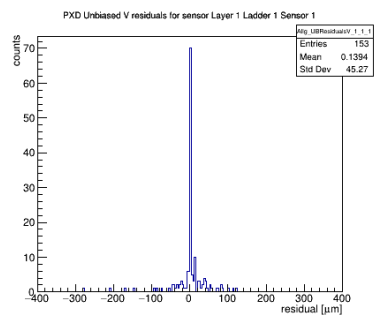
layer 1 ladder 1

$u = 545.906 \text{ um}$	$\alpha = -0.75709 \text{ mrad}$	$u = 588.1124 \text{ um}$	$\alpha = 5.65117 \text{ mrad}$
$v = 2515.094 \text{ um}$	$\beta = -2.3832 \text{ mrad}$	$v = 1808.45 \text{ um}$	$\beta = -9.35585 \text{ mrad}$
$w = -311.10136 \text{ um}$	$\gamma = -3.6102 \text{ mrad}$	$w = -402.67 \text{ um}$	$\gamma = -0.56437 \text{ mrad}$

GCR2 Alignment
Payload content



GCR2 Alignment
for collision data
U residuals



GCR2 Alignment
for collision data
V residuals

layer 6 ladder 1

$u = -4.34918 \text{ um}$	$u = -50.4268 \text{ um}$	$u = 136.42895 \text{ um}$	$u = 311.5788 \text{ um}$	$u = 654.37054 \text{ um}$
$v = 1046.9279 \text{ um}$	$v = 1659.6045 \text{ um}$	$v = 1431.0185 \text{ um}$	$v = 1387.232 \text{ um}$	$v = 1325.956 \text{ um}$
$w = 704.03985 \text{ um}$	$w = 246.77537 \text{ um}$	$w = 121.30378 \text{ um}$	$w = 89.32574 \text{ um}$	$w = 81.46937 \text{ um}$
$\alpha = -4.84061 \text{ mrad}$	$\alpha = 4.38908 \text{ mrad}$	$\alpha = -1.68932 \text{ mrad}$	$\alpha = -0.76658 \text{ mrad}$	$\alpha = -0.20989 \text{ mrad}$
$\beta = 2.42327 \text{ mrad}$	$\beta = 8.84796 \text{ mrad}$	$\beta = 8.64943 \text{ mrad}$	$\beta = 2.29149 \text{ mrad}$	$\beta = 0.74706 \text{ mrad}$
$\gamma = 2.85472 \text{ mrad}$	$\gamma = -0.99817 \text{ mrad}$	$\gamma = -1.38374 \text{ mrad}$	$\gamma = -1.49464 \text{ mrad}$	$\gamma = -0.16583 \text{ mrad}$

layer 5 ladder 1

$u = -172.99837 \text{ um}$	$u = -61.87318 \text{ um}$	$u = 259.11277 \text{ um}$	$u = 642.88932 \text{ um}$
$v = 1001.7106 \text{ um}$	$v = 1481.808 \text{ um}$	$v = 1511.667 \text{ um}$	$v = 1461.3939 \text{ um}$
$w = 490.4122 \text{ um}$	$w = -67.62527 \text{ um}$	$w = -68.37548 \text{ um}$	$w = 117.13722 \text{ um}$
$\alpha = -4.27649 \text{ mrad}$	$\alpha = -5.08138 \text{ mrad}$	$\alpha = 2.2043 \text{ mrad}$	$\alpha = 1.09933 \text{ mrad}$
$\beta = 6.96077 \text{ mrad}$	$\beta = 11.70694 \text{ mrad}$	$\beta = 5.77772 \text{ mrad}$	$\beta = 3.83877 \text{ mrad}$
$\gamma = 2.95413 \text{ mrad}$	$\gamma = -2.75858 \text{ mrad}$	$\gamma = -2.2851 \text{ mrad}$	$\gamma = -1.51593 \text{ mrad}$

layer 4 ladder 1

$u = 138.52709 \text{ um}$	$u = 506.07306 \text{ um}$	$u = 692.97678 \text{ um}$
$v = 1010.1974 \text{ um}$	$v = 1418.477 \text{ um}$	$v = 1361.044 \text{ um}$
$w = 742.675 \text{ um}$	$w = 385.0448 \text{ um}$	$w = 454.76654 \text{ um}$
$\alpha = 0.79538 \text{ mrad}$	$\alpha = -0.46819 \text{ mrad}$	$\alpha = 0.69029 \text{ mrad}$
$\beta = -1.19958 \text{ mrad}$	$\beta = -0.93372 \text{ mrad}$	$\beta = -1.64907 \text{ mrad}$
$\gamma = 0.72706 \text{ mrad}$	$\gamma = -1.61563 \text{ mrad}$	$\gamma = -1.31721 \text{ mrad}$

layer 3 ladder 1

$u = 442.36924 \text{ um}$	$\alpha = -0.83024 \text{ mrad}$	$u = 702.36336 \text{ um}$	$\alpha = -1.47463 \text{ mrad}$
$v = 1561.861 \text{ um}$	$\beta = 2.0391 \text{ mrad}$	$v = 1555.3394 \text{ um}$	$\beta = -2.65391 \text{ mrad}$
$w = 364.54434 \text{ um}$	$\gamma = -1.58169 \text{ mrad}$	$w = 366.49898 \text{ um}$	$\gamma = -1.87602 \text{ mrad}$

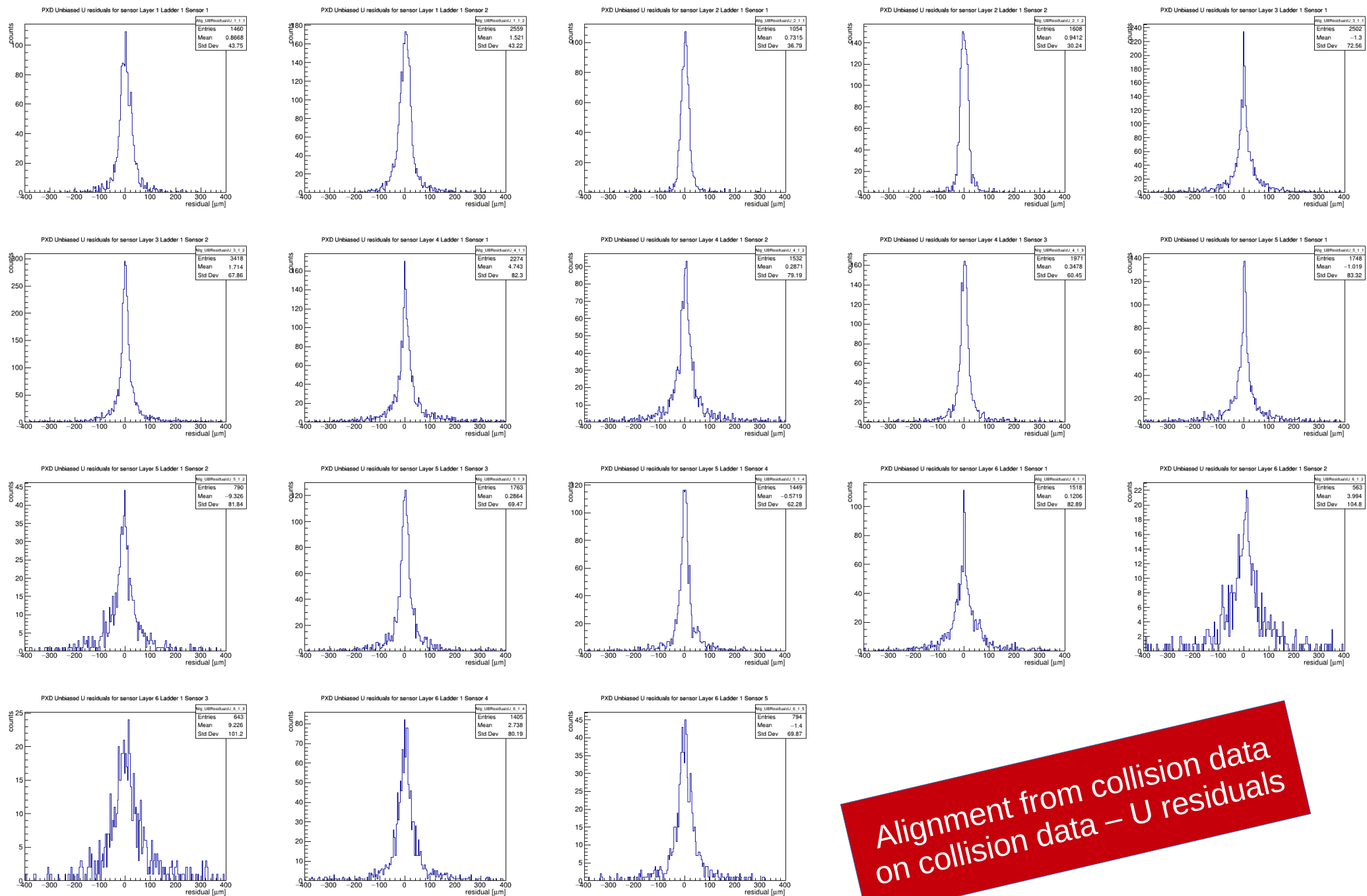
layer 2 ladder 1

$u = 1317.8714 \text{ um}$	$\alpha = 0.45302 \text{ mrad}$	$u = 1163.3531 \text{ um}$	$\alpha = 0.10156 \text{ mrad}$
$v = 2581.377 \text{ um}$	$\beta = -11.3945 \text{ mrad}$	$v = 2144.773 \text{ um}$	$\beta = -8.74658 \text{ mrad}$
$w = 113.1393 \text{ um}$	$\gamma = -15.43234 \text{ mrad}$	$w = 131.6313 \text{ um}$	$\gamma = 9.43878 \text{ mrad}$

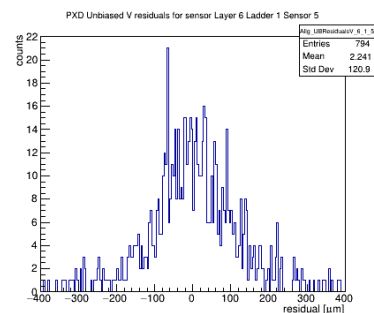
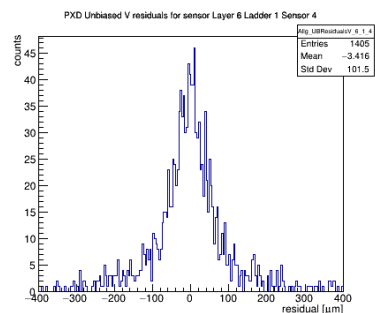
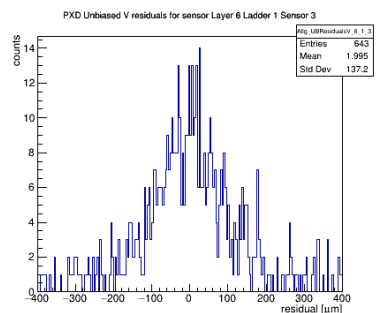
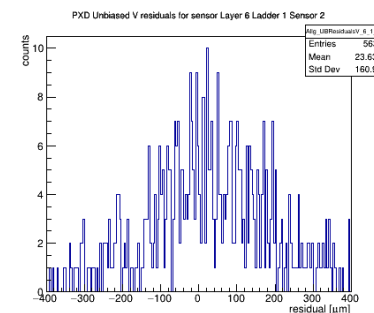
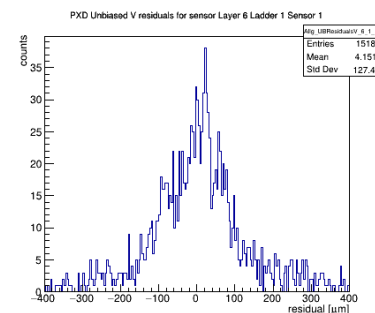
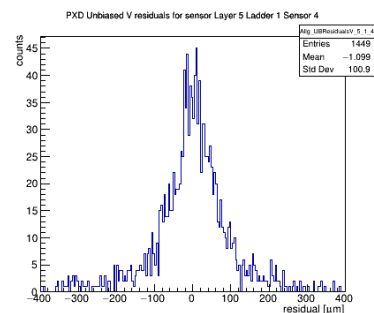
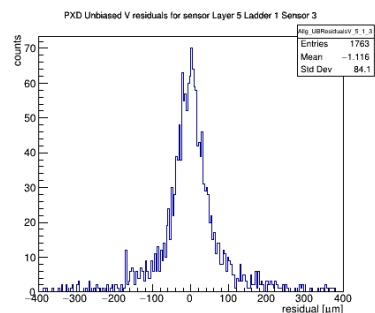
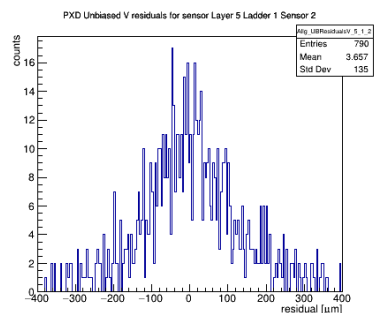
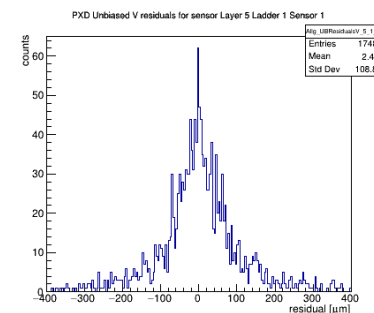
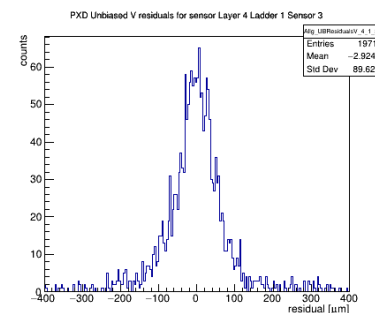
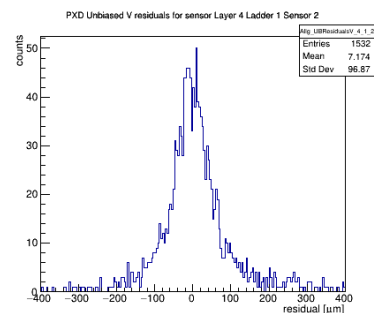
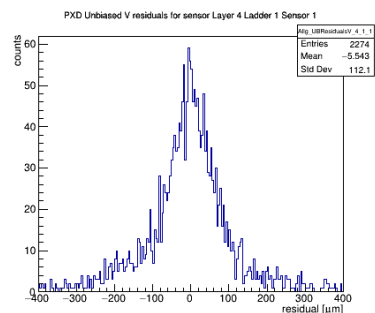
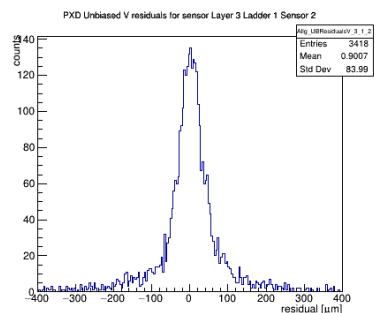
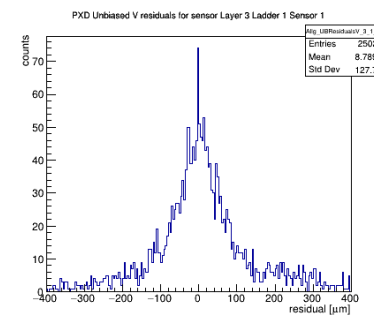
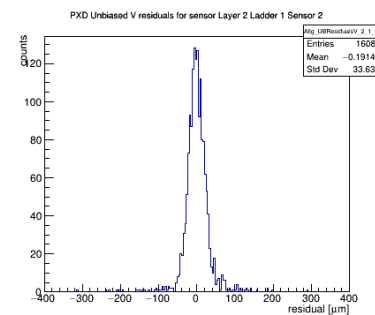
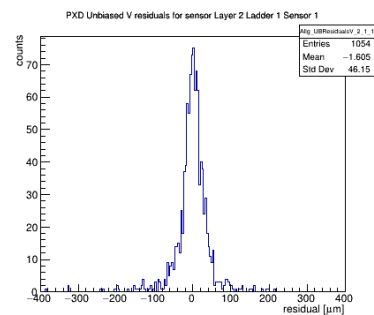
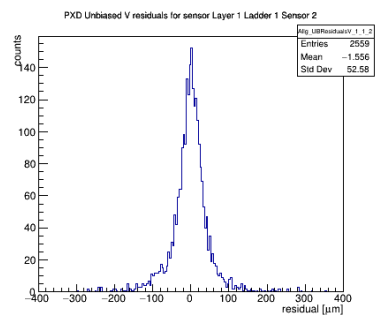
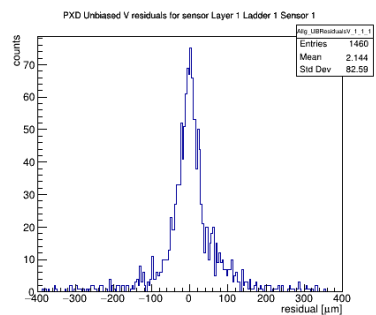
layer 1 ladder 1

$u = 605.435 \text{ um}$	$\alpha = -1.43431 \text{ mrad}$	$u = 650.1355 \text{ um}$	$\alpha = 4.67683 \text{ mrad}$
$v = 2576.434 \text{ um}$	$\beta = -10.1762 \text{ mrad}$	$v = 2092.916 \text{ um}$	$\beta = -11.42998 \text{ mrad}$
$w = -82.33036 \text{ um}$	$\gamma = -2.1086 \text{ mrad}$	$w = -164.10026 \text{ um}$	$\gamma = 0.69078 \text{ mrad}$

Collision Alignment
Payload content



Alignment from collision data
on collision data – U residuals



Alignment of Primary Beam Spot

- Runs 112 – 140
- Pre-selection of events
 - RecoTracks with
 - $\text{abs}(d0) < 0.2$ and $\text{abs}(pt * \text{math.sqrt}(1 + \tan\Lambda^2)) > 4.0$
- Reconstruct 2-track decays with beam+vertex constraint → Millepede
- Still using Phase 3 IP vertex covariance
- CDC-only
- 96 CAF iterations
 - Phase3 beam size limits the iteration step (~200um per each iteration)
- Results:
 - $x = -124 \text{ um} \pm 1 \text{ um}$
 - $y = 0.0 \pm 0.01 \text{ um}$
 - $z = 1.05 \text{ cm} \pm 0.002 \text{ cm}$

Summary / Conclusions / Plans

- We inherit systematics from CDC
 - Nothing can be done with that at this stage
- Some missing items
 - More collision data!
 - Checking the tracks sample
 - Try collision alignment on GCR2 cosmics data
 - Combine beam+cosmics data if consistency confirmed
- Upload to GT's
 - I think this alignment should be sufficient for all initial tracking studies
 - N.B. the alignment will be updated again and again, probably even years after the experiment will finish! (but not by me I hope)
- Jakub will step in to produce/validate the alignment regularly
- More improvements with more data, mu-pairs ...
- What about uploading IP alignment to GT's?
 - Displaced beam spot not such a big problem for tracking
 - But analysis could suffer a lot (any beam+vertex constrained reconstructions)
 - Covariance should be updated to Phase 2 parameters (M. Ritter?)