Alignment

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Alignment status/plans/...

Testbeam alignment

Alignment monitoring

VXD/CDC/Phase2 alignment

(VXD) Alignment Status/Future/...

- What are the missing features/future improvements (when needed to be ready?)
  - Mostly minor improvements (more hierarchy levels – for Phase 3)
  - Kinematic constraints (for Phase2)
  - Different time dependence for different sets of constants (during Phase 2)
  - Sensor deformations (for Phase 3)
  - Implementation of survey measurements (during Phase 2, for Phase 3)
  - Monitoring (VXD – for Phase 2 basics, full for Phase 3)
  - CDC alignment and calibration constants (interfaces ready but signifacnt effort needed to tune all signs, derivatives and test with MC/data
  - Missing mostly real workflow examples (I use CAF regularly, but still manuall intervention often needed – e.g. to combine magnet ON/OFF data at collection stage)

- What is the status of the documentation
  - Very poor except doxygen :-(
  - Internal note and more documentation on code organization planned (some skeleton already exists, but does not say anything about actuall implementation)
- Status of stress tests of the code on the last test beam data
  - Issues related to consistency with geometry reference system (e.g. best results fixing 1st PXD and last SVD, but 1st PXD is missing sometimes)
  - Want to reprocess with VXDTF2 – more found tracks, better looking residuals
- Workforce:
  Tadeas Bilka (all), Jakub Kandra (VXD, CDC?), Dong Thanh (CDC), Kirill Chilikin (EKLM), Yinghui Guan (BKLM), David Dossett (CAF)

Working with testbeam data

Pages / VXD beam test analysis / Combined Beam Test DESY 2017

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Condition Database (Alignment) (2017)

Tadeas Bilka posted on 27. Jun. 2017 14:10h - last edited by Tadeas Bilka on 27. Jun. 2017 14:36h

On this page, you will find out, how to use condition data (now only alignment) uploaded to central PNNL database for your analysis.

Different "versions" of database can exist and are stored under a global tag with unique name which identifies a set of payloads (alignments) and their assignment to intervals of validity.

How to use central DB in analysis

Custom scripts

At the beginning of your python script, you should do:

```python
#!/usr/bin/env python3
# -*- coding: utf-8 -*-
from basf2 import *

globalTag = 'teddy_test_8'

reset_database()
use_database_chain()
use_local_database(Belle2.FileSystem.findFile("data/framework/database.txt"), "", True)
use_central_database(globalTag, LogLevel.DEBUG)
```

where **globalTag** is a string identifier of the global tag you want to use (see below).

Default scripts

The 2017_reconstruct.py script has an command line option --global-tag which you can use to specify global tag for your analysis. Please note that this script includes a "DAQ DB" located in

testbeam/daq/data/database_v1/

which contains preliminary alignment used during data taking (in HLT) and this is included in the database chain. You might need to replace it either by using the --global-tag option or by specifying
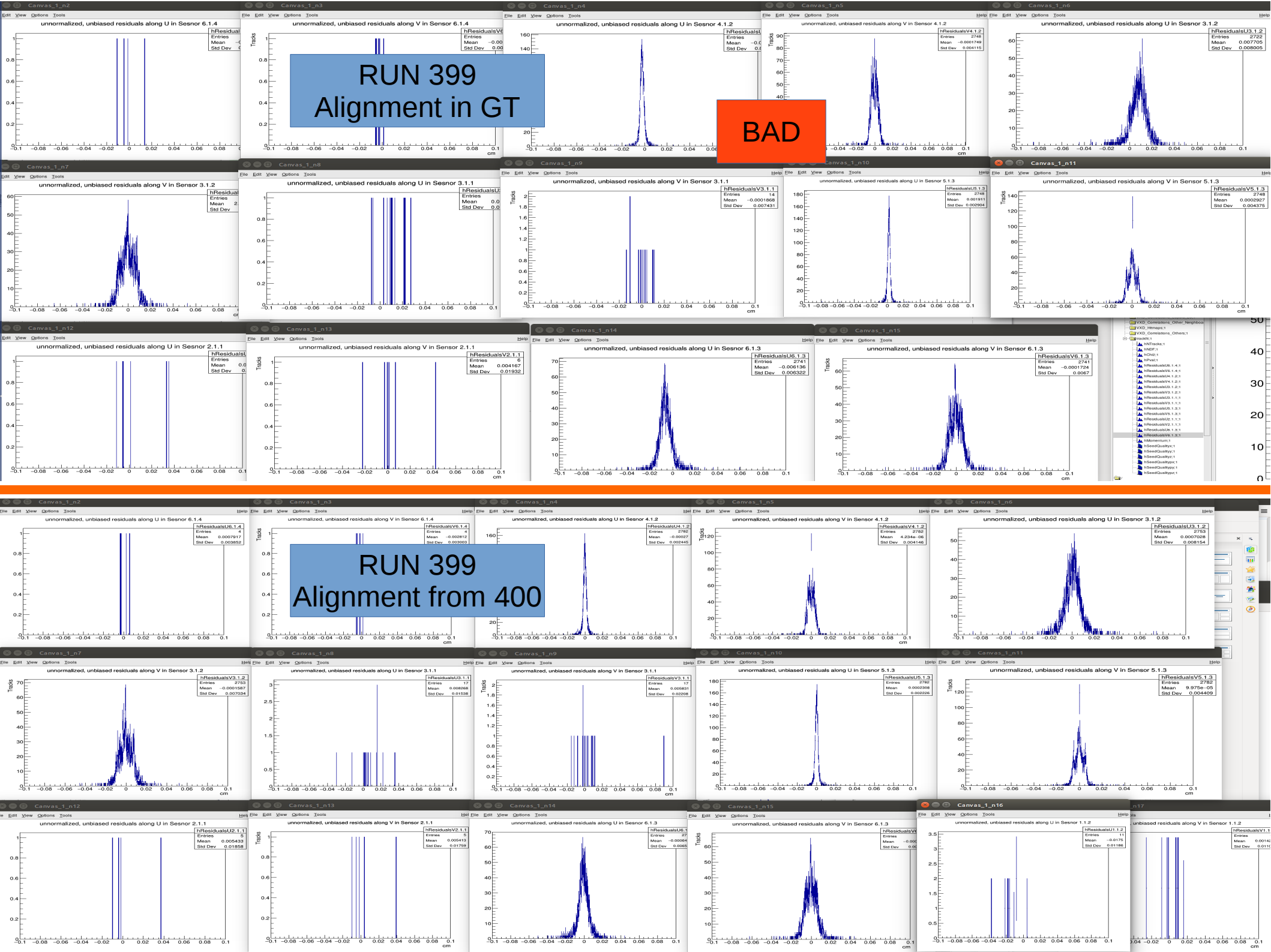
a local database as replacement (option --local-db DB_FILENAME)
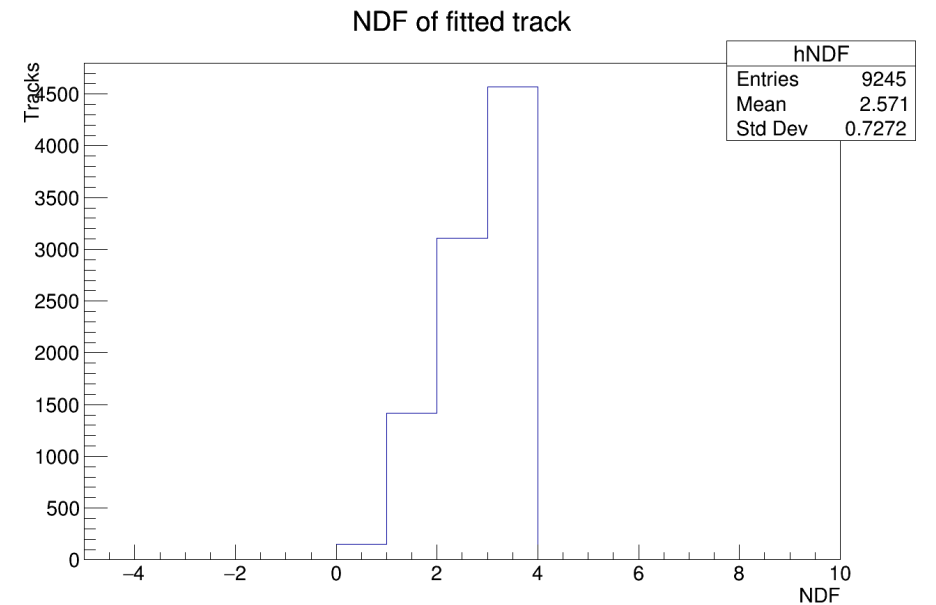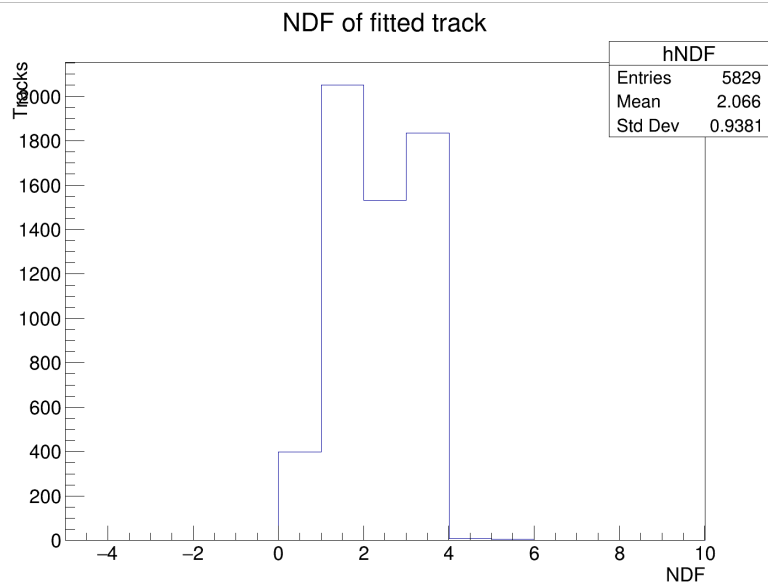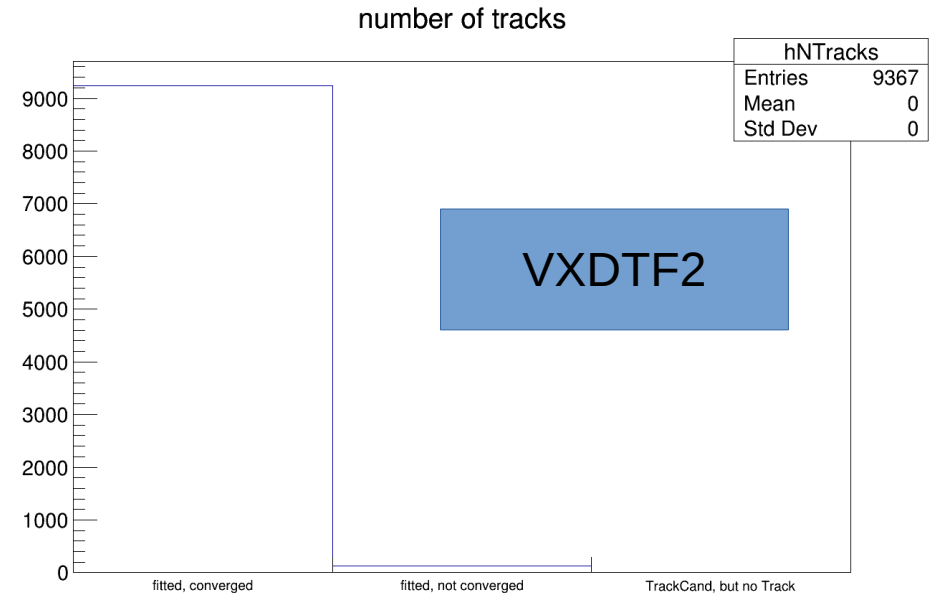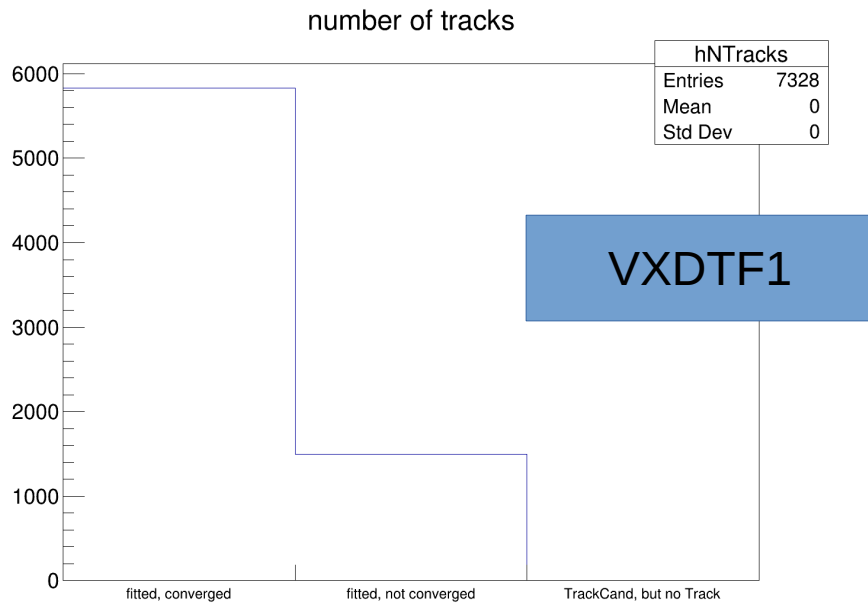
List of global tags in central PNNL database

Here is a list of global tags usable for analysis with comments about how they are created and their quality.

Feel free to add comments as you do further analysis with those global tags - e.g. for which runs the alignment is too bad.

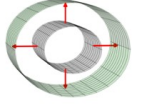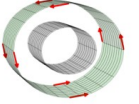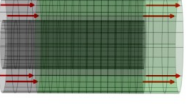| Global Tag	Comments	Usability
beamtest_vxd_april2017_rev1	Default tag for analysis. Produced using combined data from runs before and after addition of two more PXD modules. Then run-by-run alignment using requested list of analysis runs (111, 144, 176, 195, 236, 250, 276, 366, 399, 400). The precision is on level of 10 um.	Problems even for some sensors in some runs directly used for alignment, but mostly acceptable for non-resolution studies. Please check usability e.g. from DQM plots before use.

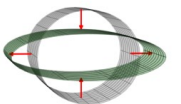PAGE TREE
- Combined Beam Test DESY 2016
- Combined Beam Test DESY 2017
  - Condition Database (Alignment) (20
  - Description of runs
- Getting started
- Meeting notes
- SeeVogh meeting minutes
- Troubleshooting articles

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RUN 399
Alignment in GT

BAD

RUN 399
Alignment from 400
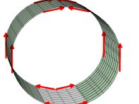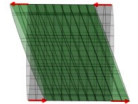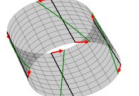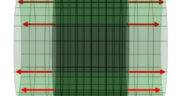
Try VXDTF2!

Alignment monitoring

- From Millepede (final Chi2, condition number of global matrix) – can detect severe problems
- From tracks (refit a control sample with new constants)
  - Use standard tracking (not GBL) and analysis tools
  - Low level – residuals, overlap residuals, residuals for cosmics at IP
  - Physics level – observables in specific channels - invariant mass, vertex residuals...
- External
  - Initially Survey measurements
  - From other detectors (CDC vs. VXD)
  - Laser/... measurements at reference points (z-expansion!)

Weak modes in alignment

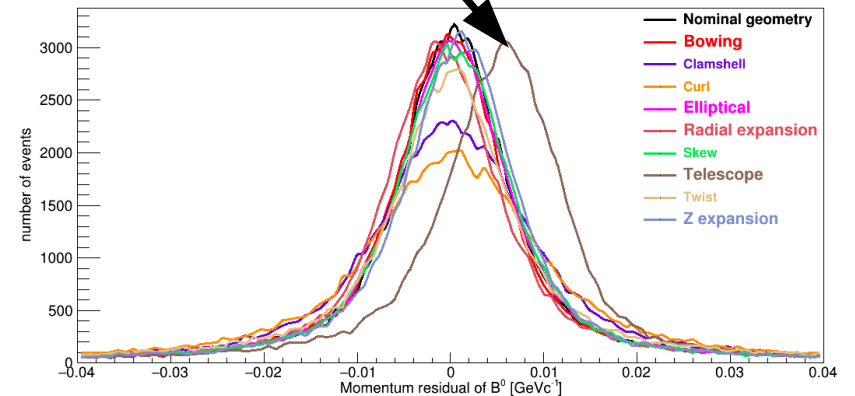|	Δr	$r\Delta\phi$	Δz
r	**Radial expansion** $\Delta r = c_{scale} \cdot r$	**Curl** $r\Delta\phi = c_{scale} \cdot r + c_0$	**Telescope** $\Delta z = c_{scale} \cdot r$
ϕ	**Elliptical expansion** $\Delta r = c_{scale} \cdot \cos(2\phi) \cdot r$	**Clamshell** $\Delta\phi = c_{scale} \cdot \cos(\phi)$	**Skew** $\Delta z = c_{scale} \cdot \cos(\phi)$
z	**Bowing** $\Delta r = c_{scale} \cdot |z|$	**Twist** $r\Delta\phi = c_{scale} \cdot z$	**Z expansion** $\Delta z = c_{scale} \cdot z$

Quantity	Radial	Elliptical	Bowing	Curl	Clamshell	Twist	Telescope	Skew	Z exp.
B_Z^0 residual				StD		StD		StD	Shift
B_ρ^0 residual				StD		StD			
J/Ψ_Z residual				StD		StD		StD	Shift
J/Ψ_ρ residual				StD		StD			
K_{SZ}^0 residual							Shift	StD	Shift
$K_{S\rho}^0$ residual	Shift	StD							
B^0 mass				StD	StD	StD	Shift		
B_P^0 residual				StD	StD	StD	Shift		
$B_{P_T}^0$ residual	StD			StD	StD	StD			
$B_{P_Z}^0$ residual	StD			StD	StD	StD	Shift		
J/Ψ mass				StD	StD	StD	Shift		
J/Ψ_P residual				StD	StD	StD	Shift		
J/Ψ_{P_T} residual	StD			StD	StD	StD			
J/Ψ_{P_Z} residual				StD	StD	StD	Shift	StD	
$K_{S\,P}^0$ residual				StD	StD	StD			
$K_{S\,P_T}^0$ residual				StD	StD				
$K_{S\,P_Z}^0$ residual				StD			Shift	StD	
$\mu_P^\pm$ residual				Shift	StD	Shift			
$\mu_{P_T}^\pm$ residual	StD			Shift	StD	Shift			
$\mu_{P_Z}^\pm$ residual	StD			StD	StD		Shift	StD	
$\pi_P^\pm$ residual				Shift	StD	StD			
$\pi_{P_T}^\pm$ residual				Shift	StD				
$\pi_{P_Z}^\pm$ residual				StD			Shift	StD	
Δt residual									Shift

$\Upsilon(4S)$

B_{tag}

ℓ^+

K^+

π^-

e^- e^+

B_{phys} J/ψ

μ^+

π^-

$K_S^{\cdot 0}$

π^+

μ^-

$\Delta t = \dfrac{\Delta z}{\beta\gamma c}$

Δz

Alignment almost insensitive for basic set of tracks coming from (near) IP – Chi2 measure invariant → track parameters biased

Momentum residual of B^0 [GeVc^{-1}] — histogram with legend: Nominal geometry, Bowing, Clamshell, Curl, Elliptical, Radial expansion, Skew, Telescope, Twist, Z expansion
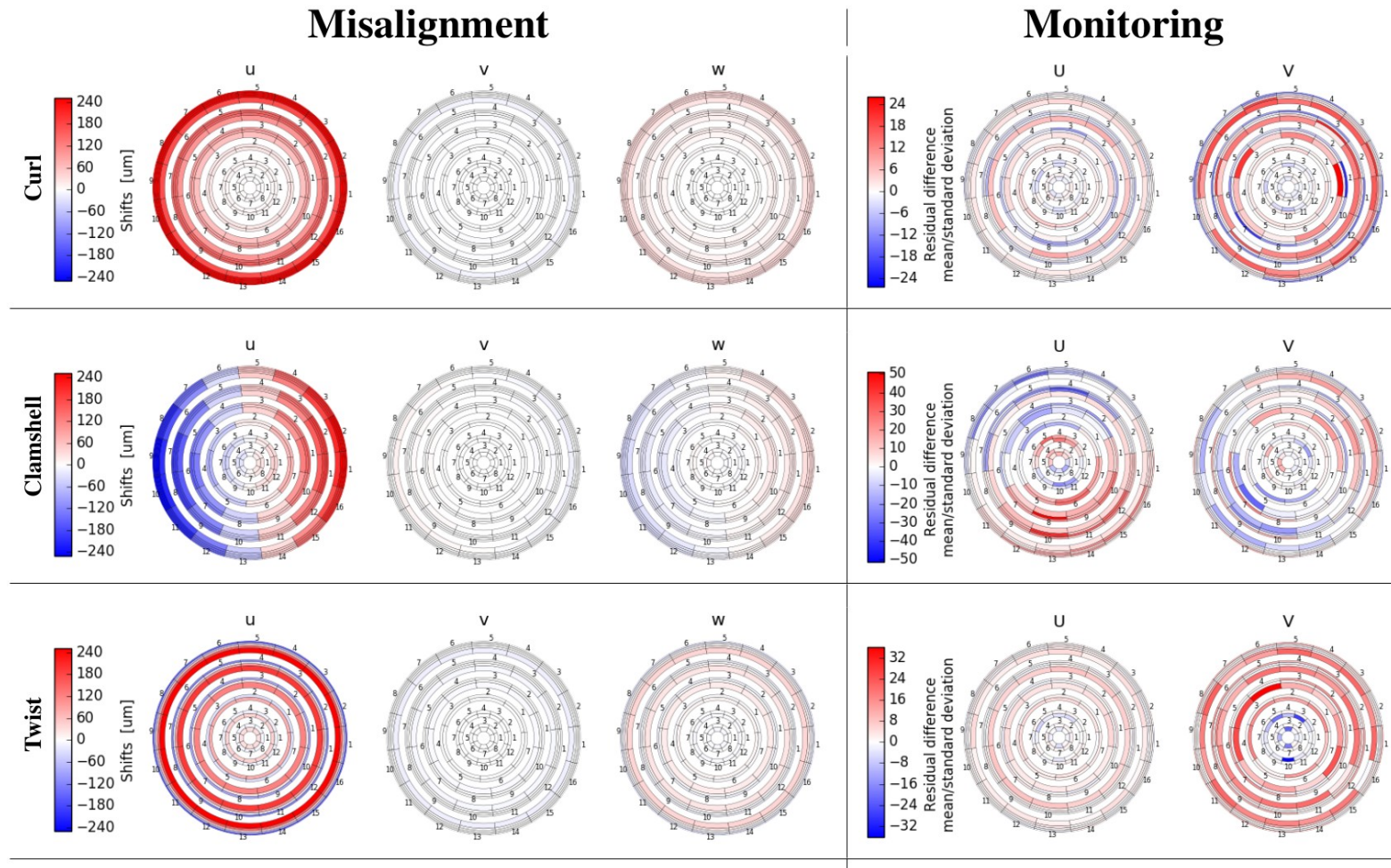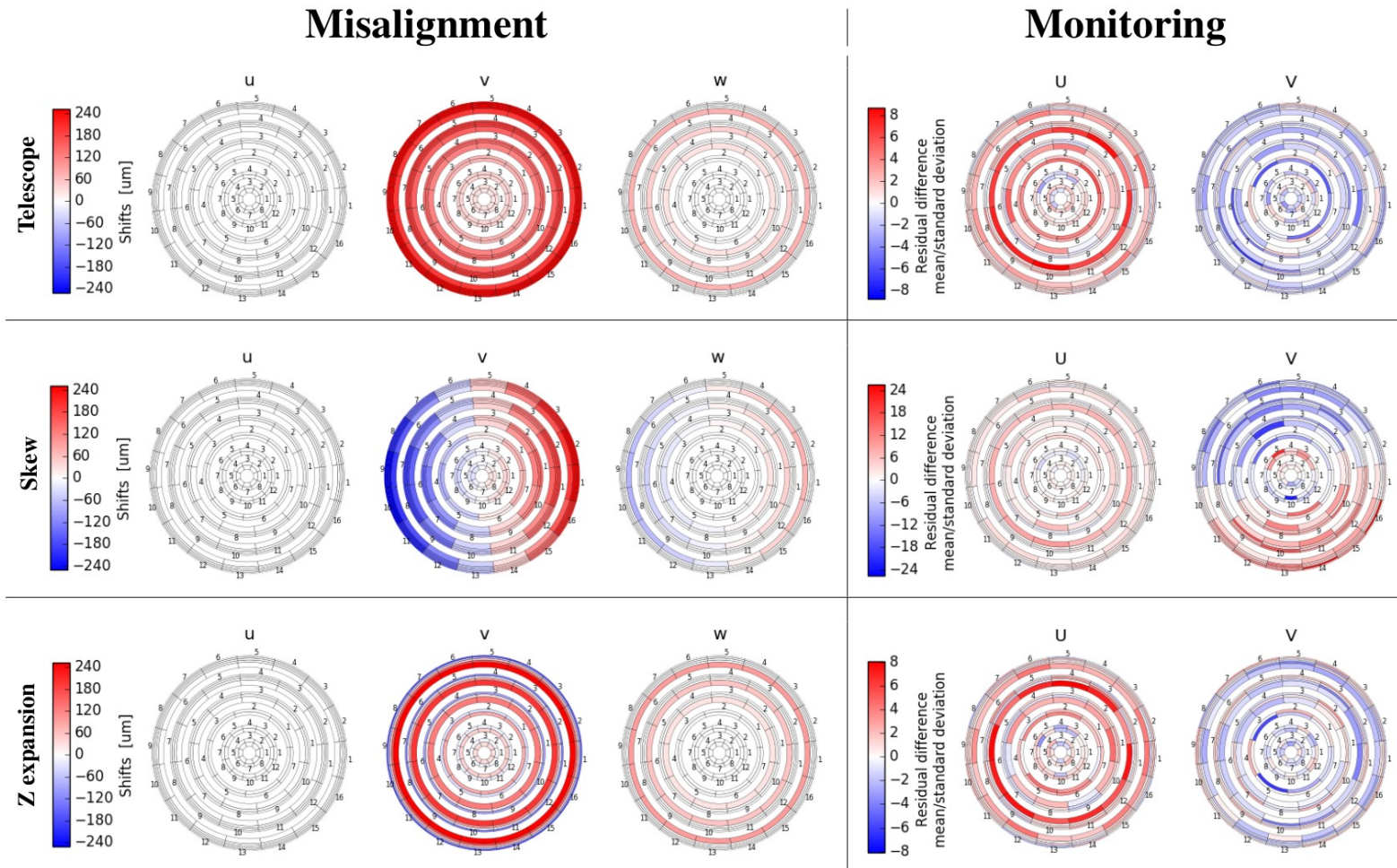
Issues with slanted SVD sensors

- New possible source of alignment issues with slanted SVDs found:

  – Predicted track position on slanted SVDs neglects the changing pitch size along sensor (needs track position estimation for precise reconstruction)
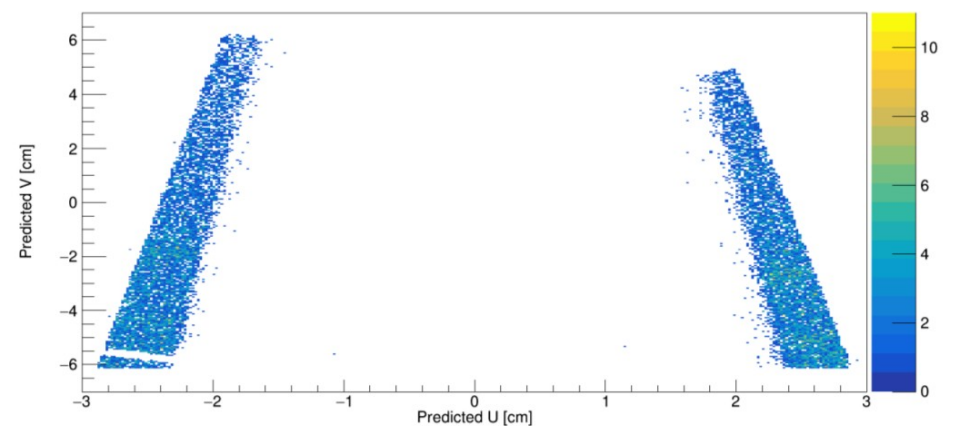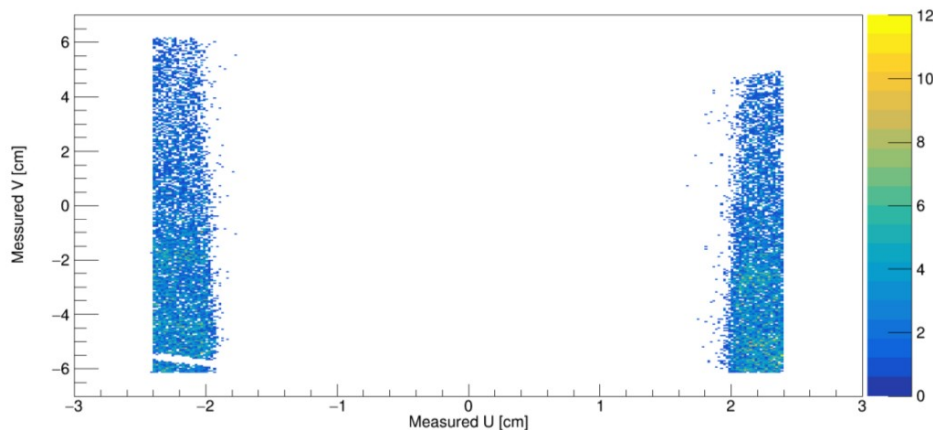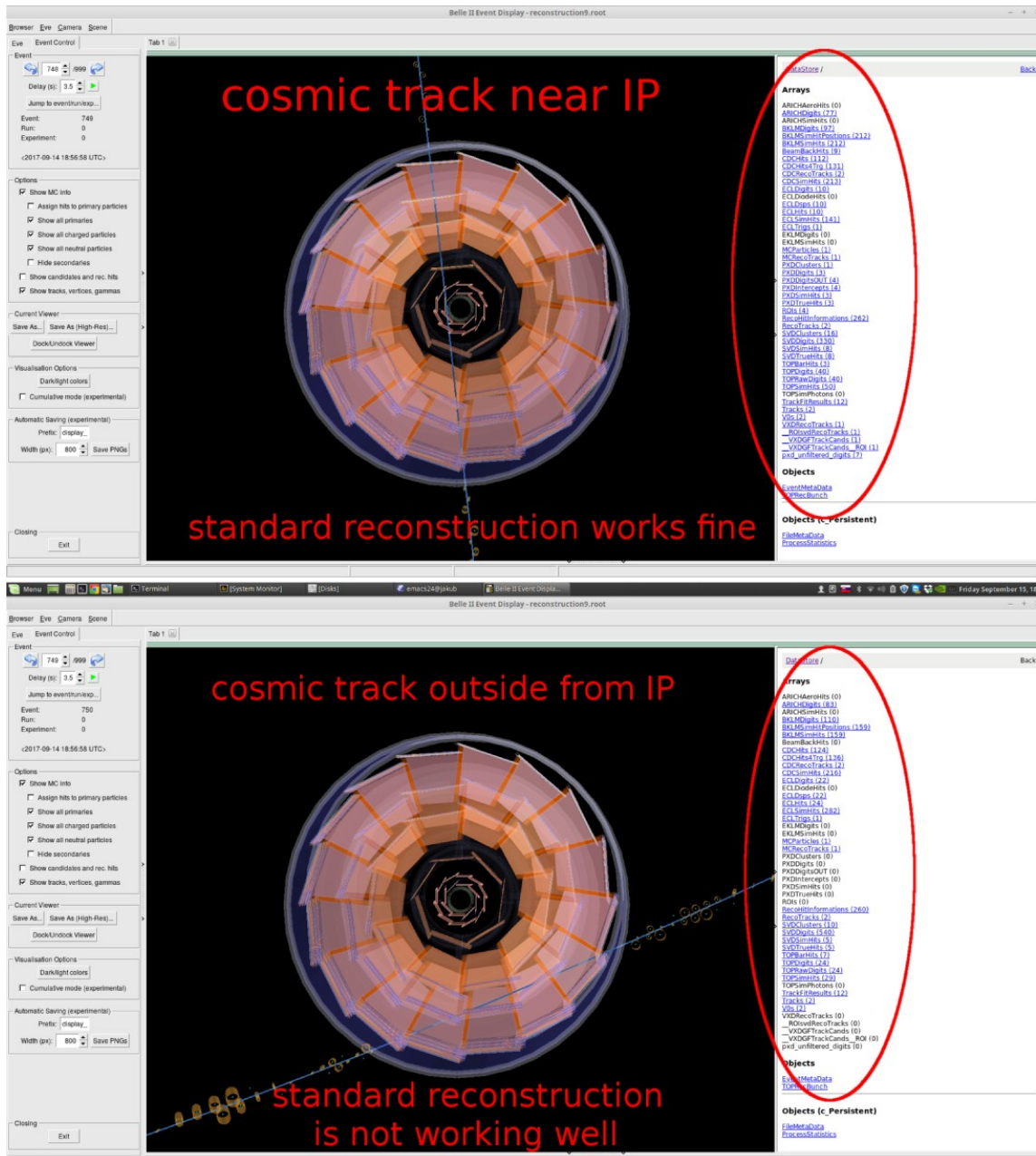
Overlaps for alignment monitoring

Overlaps for alignment monitoring

Issues with cosmic rays track finding

cosmic track near IP

standard reconstruction works fine

cosmic track outside from IP

standard reconstruction is not working well

How to?
- Extrapolate from CDC?
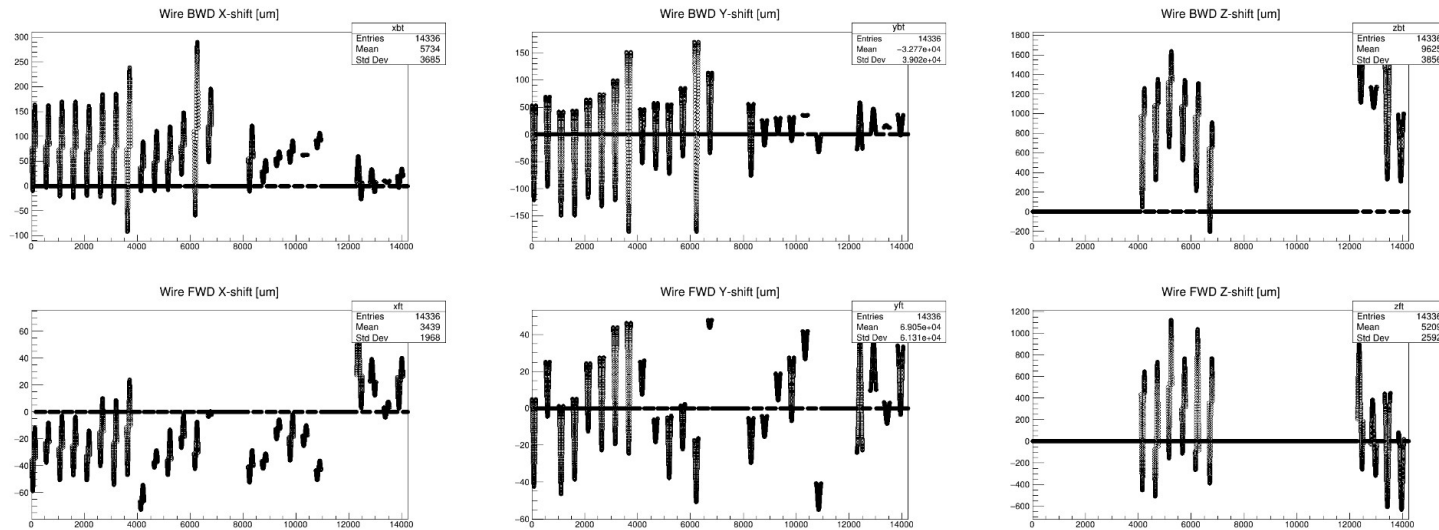- Low combinatorics for cosmic events

Benefits:

Off IP tracks vital for monitoring and reducing weak modes
- e.g. events from beam halo, beam-gas interactions...
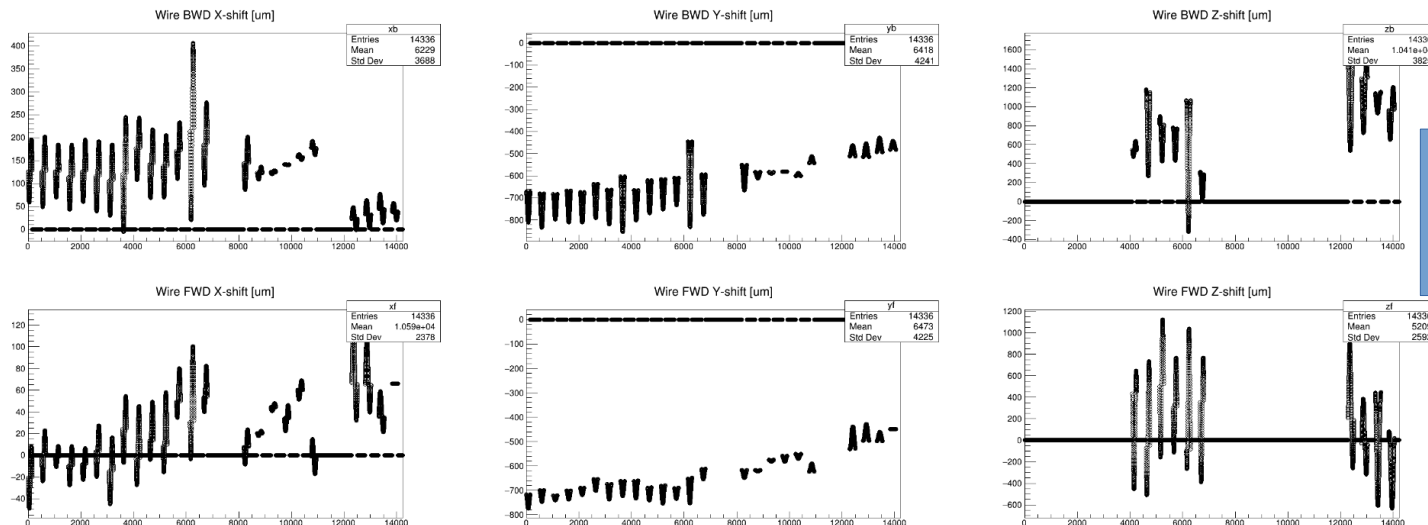
Important already for Phase 2

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CDC Alignment: consistency issues

Thanh's alignment

BWD x,y,z
FWD x,y,z

Combined alignment Issues

Millepede:
ΔBWD=ΔFWD
x,y only

CDC Alignment

- I will try to make the two approaches consistent,

  but best would be CDC reparametrization

  - Then no need to find out current wire positions (that is, construct the geometry etc.) when storing corrections in DB after alignment

  - I still do not understand how Thanh can align x,y,z for both backward and forward end-plate in each layer (reference in middle od CDC?)

- Karim prepares Phase 2 samples

  - Studies for Beast II + CDC + ?

  - Issues: Cosmics finding in VXD, low efficiency for VXD, off IP tracks

Thank you for your attention!