

2018 Overlay Geometry Issue

Xiaoning Wang

University of Illinois-Urbana Champaign

April 22, 2020

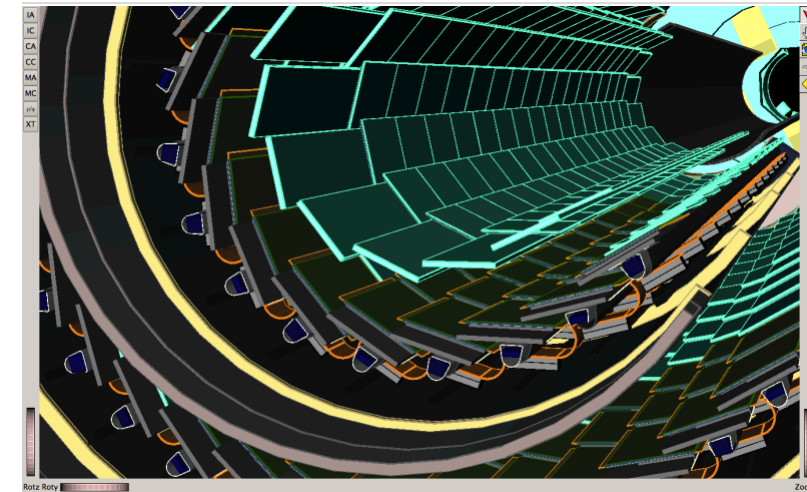
Tracking Geometry Ascii Files

```
Trk::TrackingVolume 'InDet::Detectors::Pixel::Barrel'
  - transform      : Translation : (0.000000, 0.000000, 0.000000)
                    Rotation    : (1.00000000, 0.00000000, 0.00000000)
                               (0.00000000, 1.00000000, 0.00000000)
                               (0.00000000, 0.00000000, 1.00000000)
  - listing Trk::BoundarySurface objects :
Trk::Surface object of type 2
  - transform      : Translation : (0.000000, 0.000000, -447.774440)
                    Rotation    : (1.00000000, 0.00000000, 0.00000000)
                               (0.00000000, 1.00000000, 0.00000000)
                               (0.00000000, 0.00000000, 1.00000000)
```

TrackingVolume: Which detector::which part. E.g.: Pixel::Barrel

Tracking::Surface: type (shape), location and rotation of modules. E.g.: a module of IBL

```
Trk::Layer with LayerIndex 16
  - writing surface representation :
    Trk::Surface object of type 1
      - transform      : Translation : (0.000000, 0.000000, 0.000000)
                        Rotation    : (1.00000000, 0.00000000, 0.00000000)
                               (0.00000000, 1.00000000, 0.00000000)
                               (0.00000000, 0.00000000, 1.00000000)
  - contains 280 confined Trk::Surface objects.
  - listing Trk::Surface objects :
    Trk::Surface object of type 4
      - transform      : Translation : (-31.151655, -13.418575, -323.939896)
                        Rotation    : (0.11046642, -0.00076359, -0.99387956)
                               (-0.99387647, 0.00252575, -0.11046801)
                               (0.00259464, 0.99999652, -0.00047990)
```



Issues: difference in simulation and reconstruction

Geometry dumps - Last time

Example for InDet::Detectors::Pixel::Barrel Trk::Layer with LayerIndex 16 (IBL) first module in the list

Overlay with **2018 PbPb data** - simulation step:

```
Trk::Surface object of type 4
transform      : Translation : (-31.151995, -13.417471, -323.944905)
                  Rotation   : (0.11046642, -0.00076189, -0.99387956)
                              (-0.99387646, 0.00252785, -0.11046802)
                              (0.00259655, 0.99999651, -0.00047798)
```

Overlay with **2018 PbPb data** - reconstruction step:

```
Trk::Surface object of type 4
transform      : Translation : (-31.151655, -13.418575, -323.939896)
                  Rotation   : (0.11046642, -0.00076359, -0.99387956)
                              (-0.99387647, 0.00252575, -0.11046801)
                              (0.00259464, 0.99999652, -0.00047990)
```

<https://indico.cern.ch/event/908155/>

Diff:

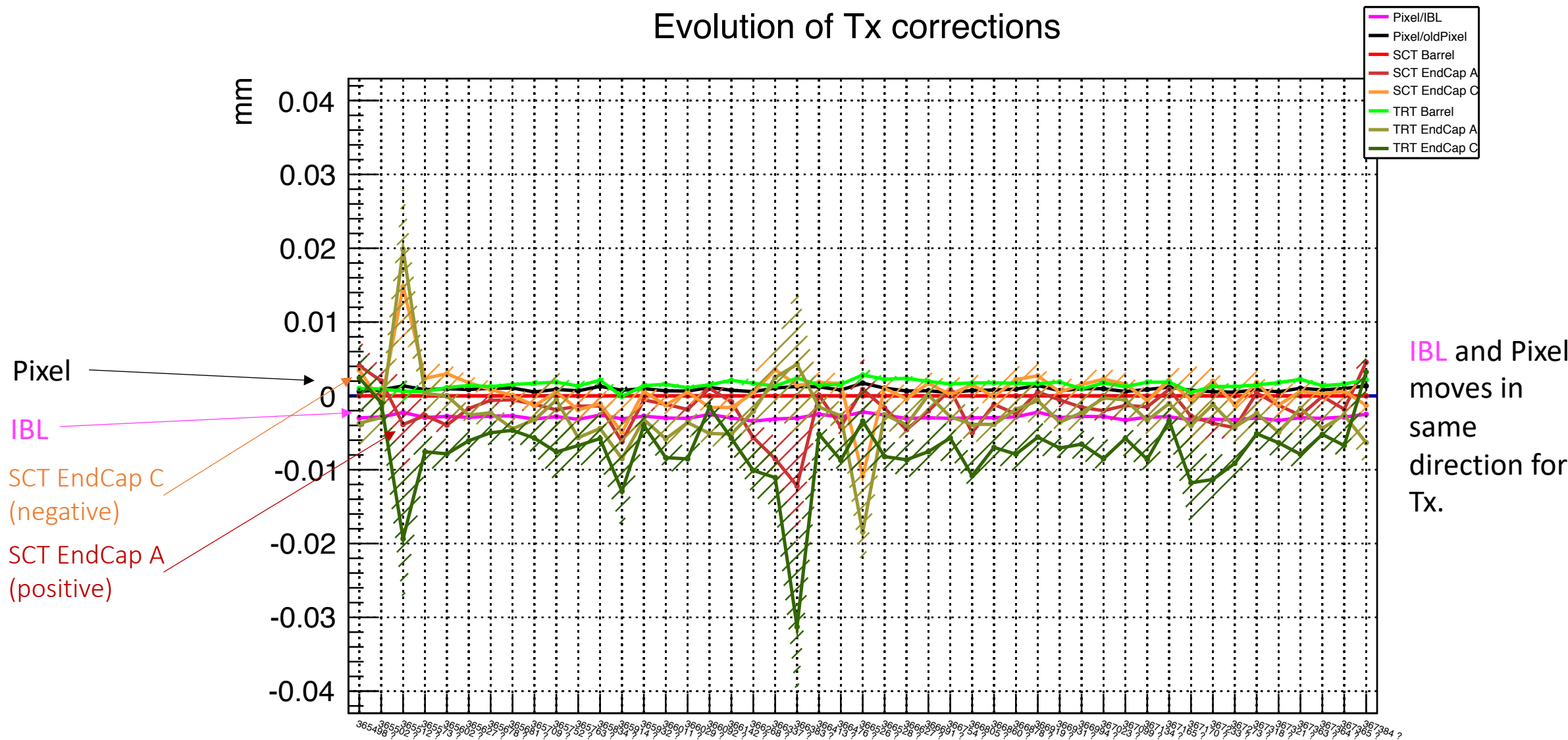
```
transform      : Translation : (-0.00034 , 0.001104, -0.005009)
                  Rotation   : (0.0 , -0.0000017, 0.0 )
                              (0.00000001, 0.0000021, -0.00000001)
                              (0.00000191, -0.00000001, -0.00000192)
```

Sizable difference in x,y,z
coordinates and in small
difference in the angle!

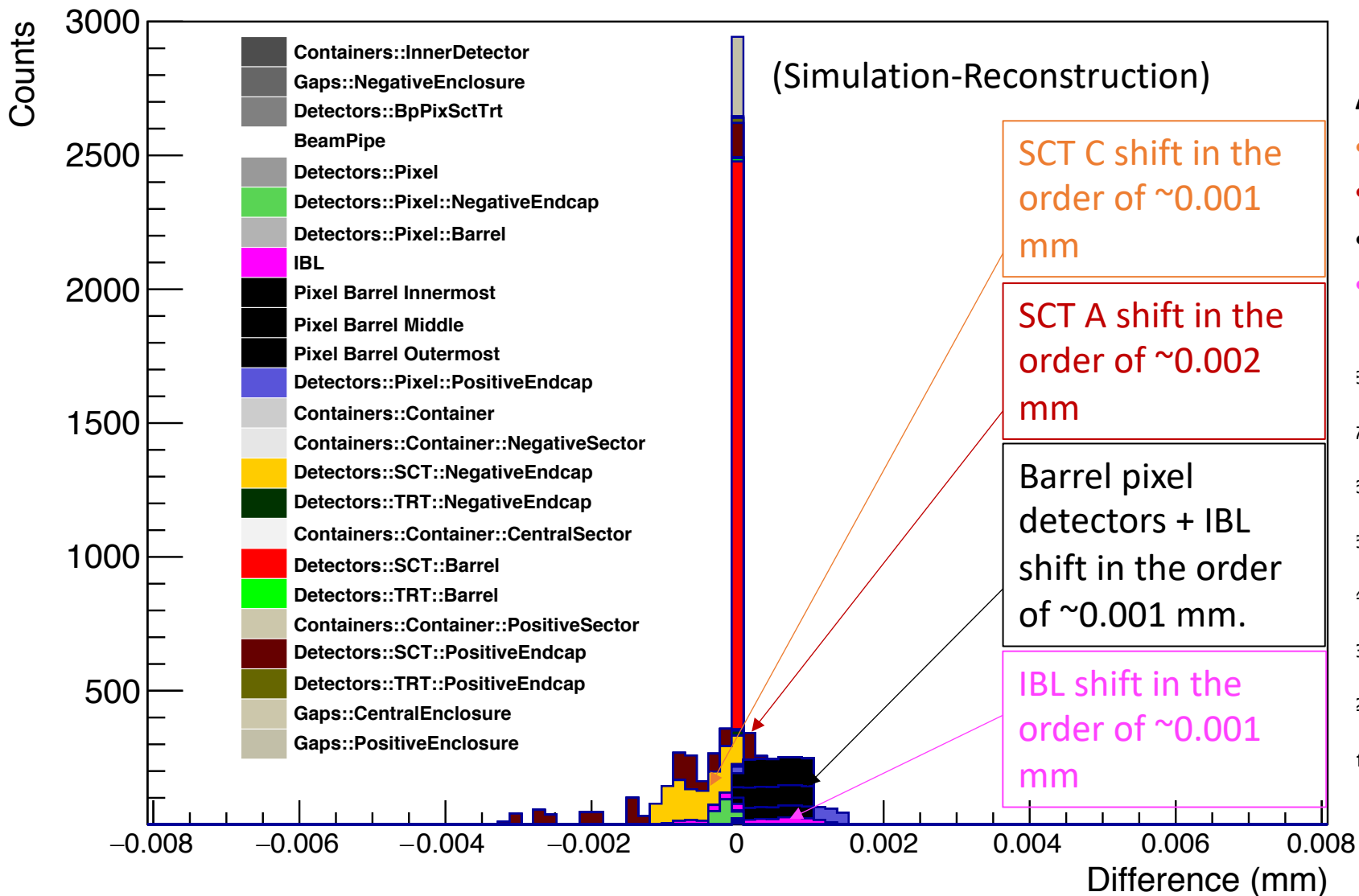
- Compared x, y, z translation in 2018 overlay geometry files for run=366691 and lbn=296
 - With 2015 overlay geometry files
 - With alignments translation constants
- Shown plots are made with simulation coordinate – reconstruction coordinate.

Change of Alignment Constants over Time for 2018 runs

Evolution of Tx corrections

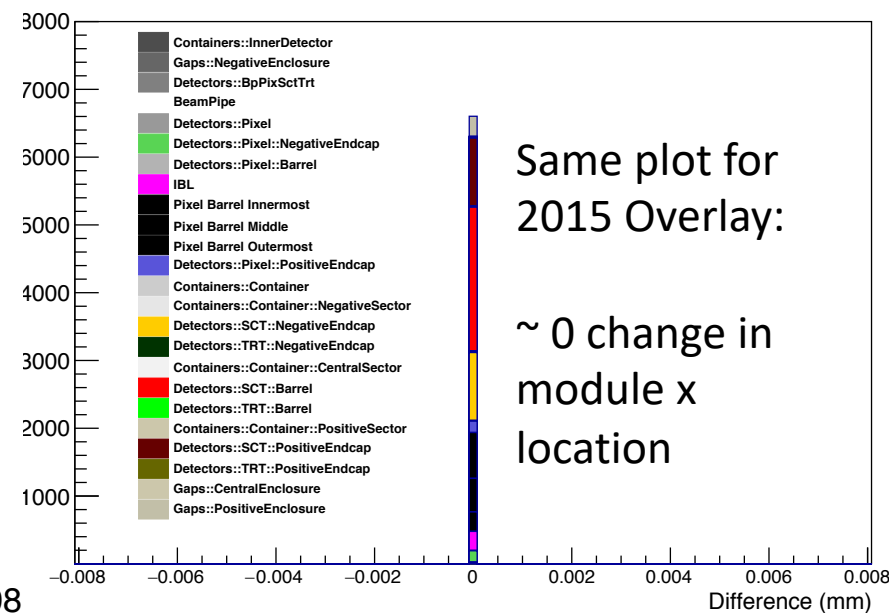


x for Comparing coordinates of modules from Simulation to Reconstruction in 2018



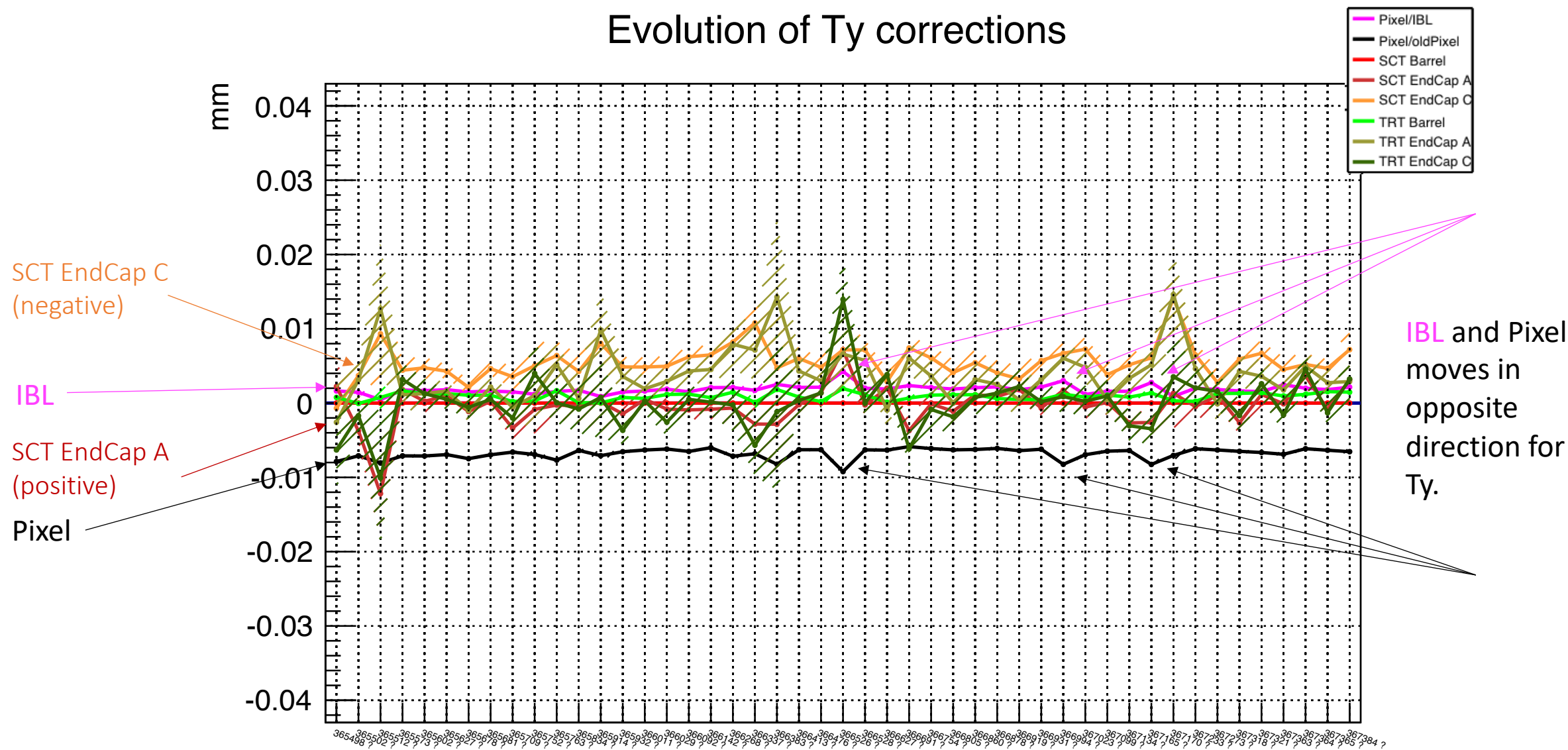
Alignment constants fluctuation:

- SCT EndCap C: ~ 0.002 mm
- SCT EndCap A: ~ 0.005 mm
- Pixel: ~ 0.001 mm
- IBL: ~ 0.001 mm

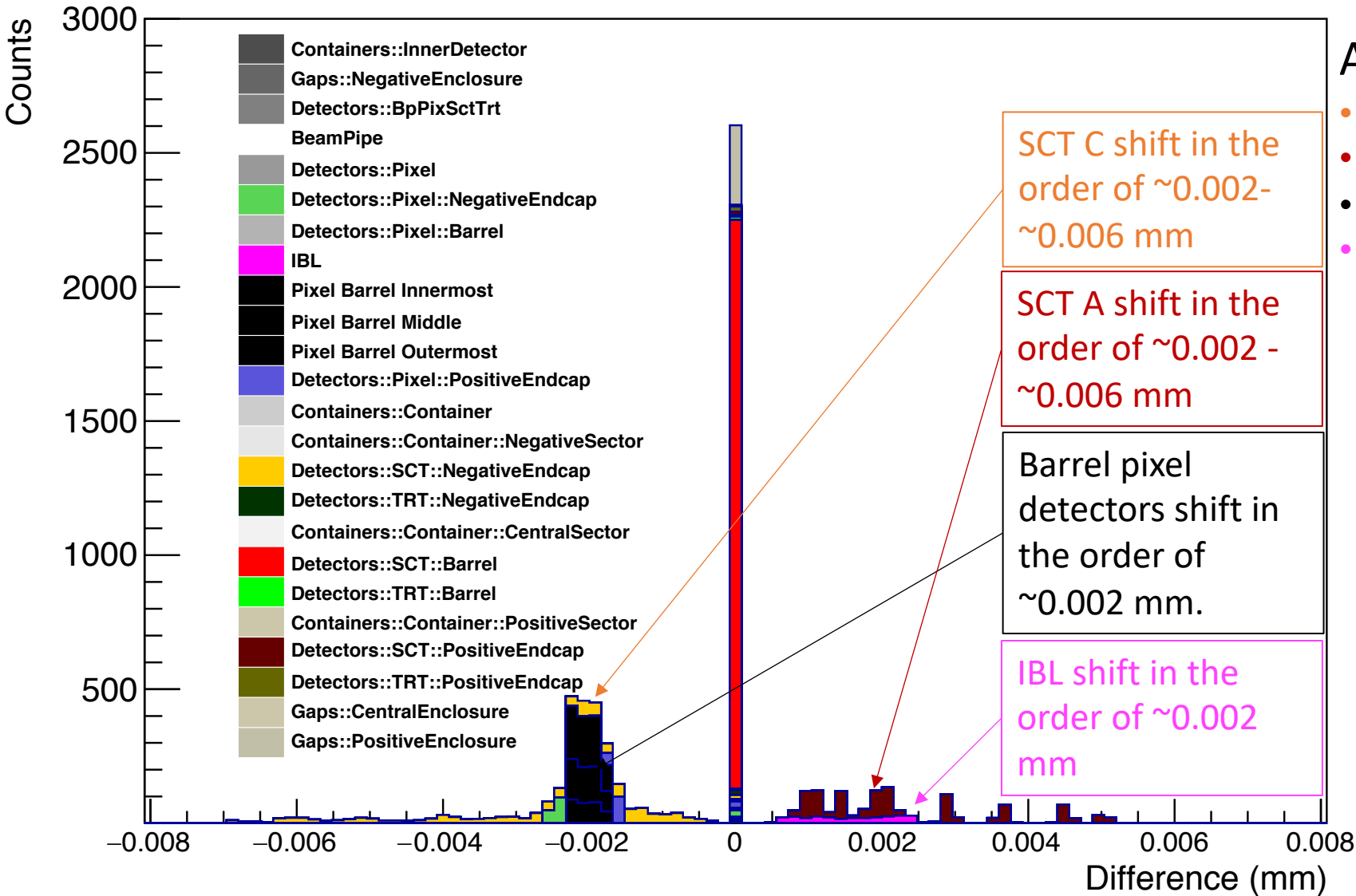


Change of Alignment Constants over Time for 2018 runs

Evolution of Ty corrections

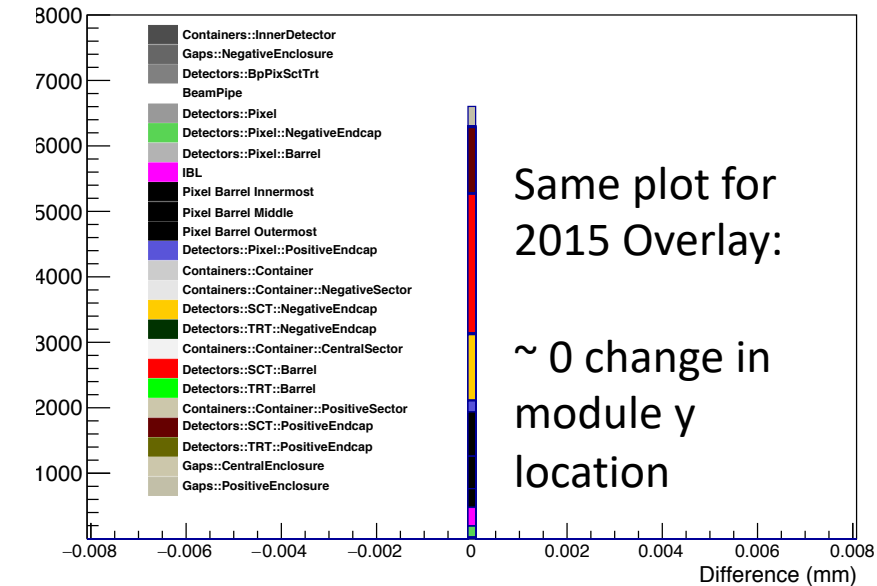


y for Comparing coordinates of modules from Simulation to Reconstruction in 2018

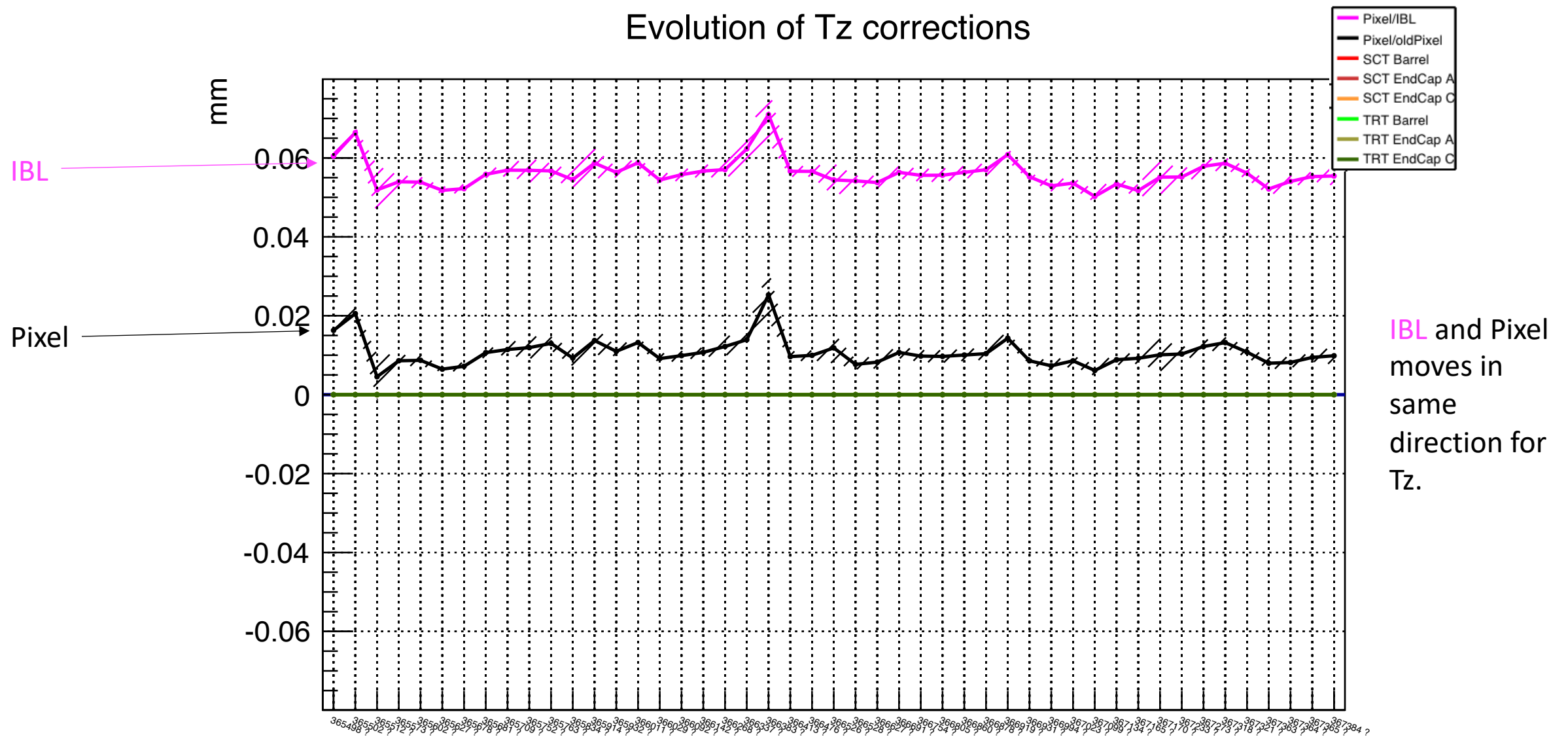


Alignment constants fluctuation:

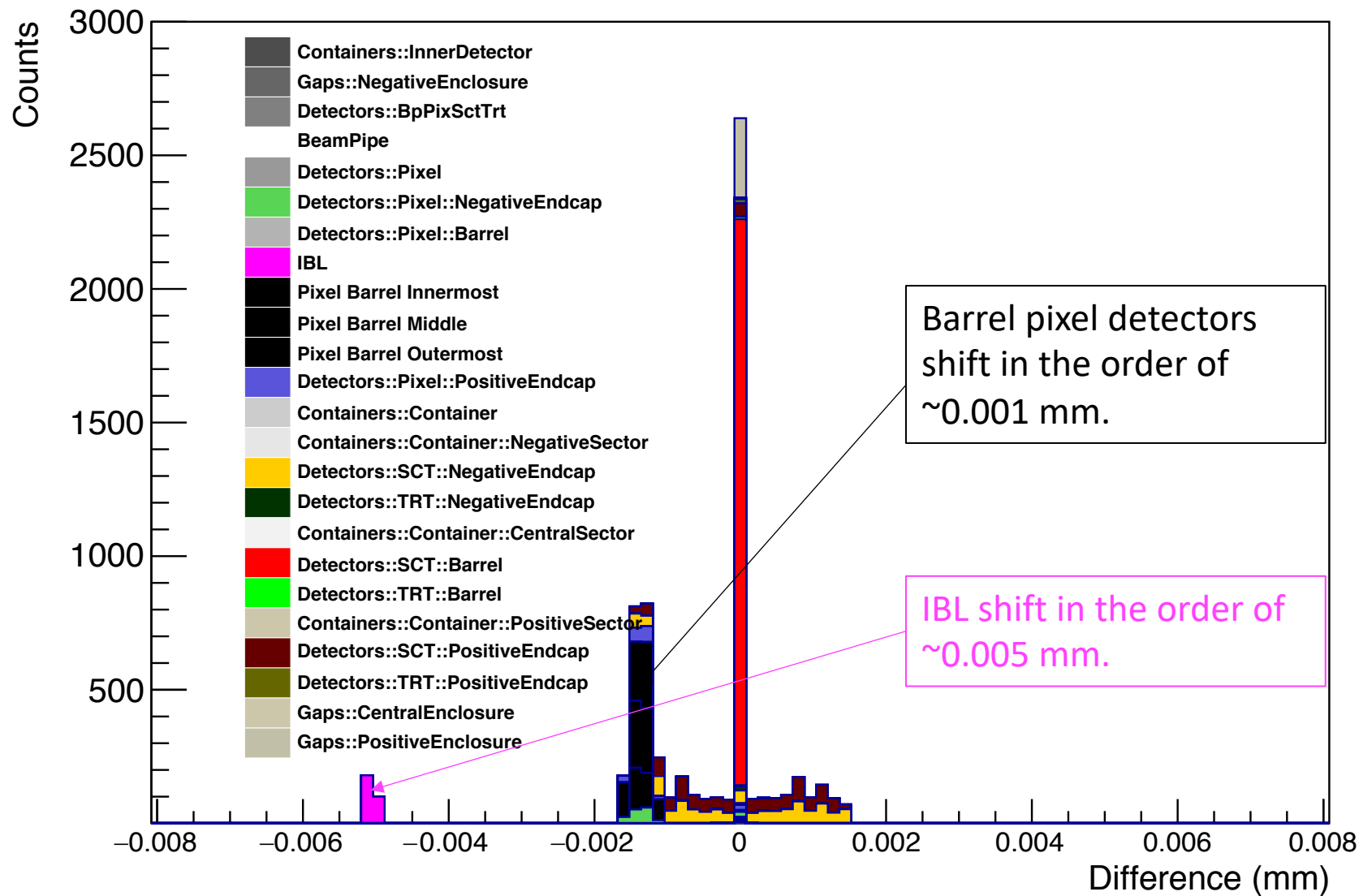
- SCT EndCap C: 0.004 mm
- SCT EndCap A: 0.002 mm
- Pixel: ~ 0.001 - ~ 0.002 mm
- IBL: ~ 0.001 mm



Change of Alignment Constants over Time for 2018 runs

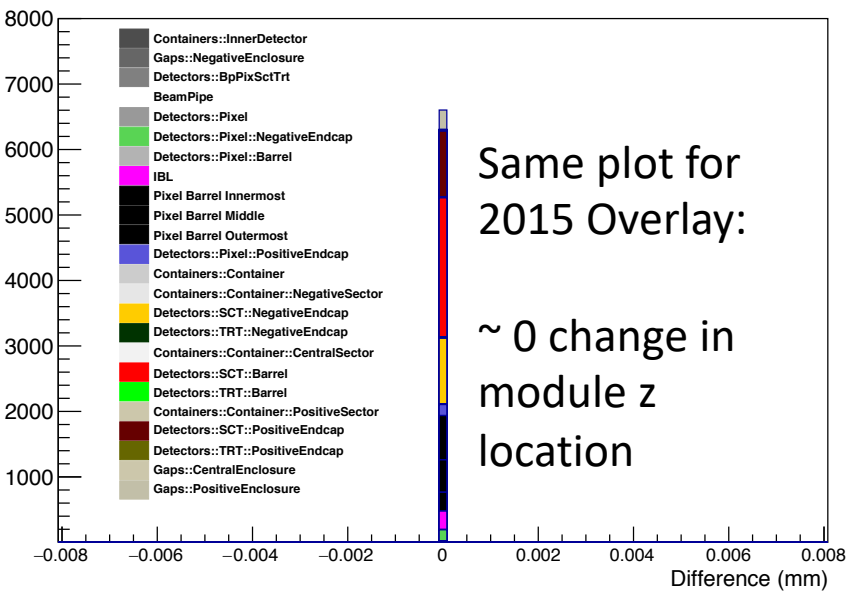


z for Comparing coordinates of modules from Simulation to Reconstruction in 2018



Alignment constants fluctuation:

- Pixel: ~0.005mm
- IBL: ~0.005 mm



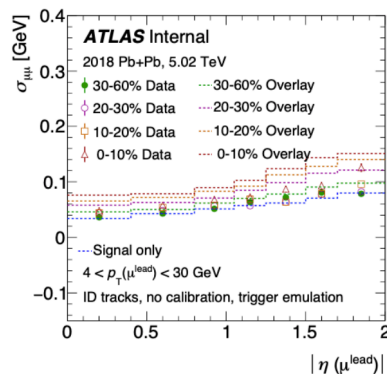
Summary

- X,Y,Z shifts are approximately on the same scale with alignment constants' fluctuation, and the direction of moving is consistent with alignment constants' curves.
 - It might come from using wrong alignment constant.
 - Question: why would IBL in z for this event has a much larger shift in comparison to other Barrel Pixel detector modules?

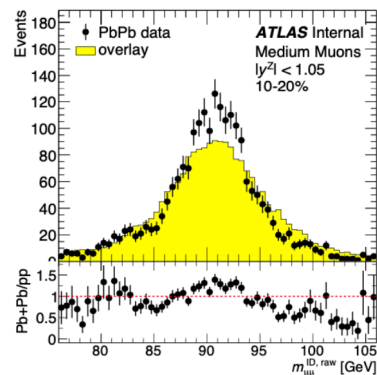
Back up

The problem (from [ATLHI-299](#))

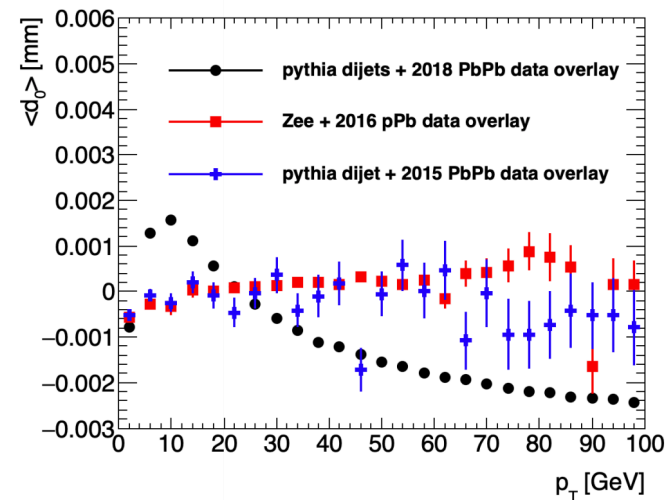
Samples with 2018 data overlay



J/ ψ - $\mu\mu$ invariant mass resolution in data and Overlay using ID momentum



Z- $\mu\mu$ invariant mass resolution in data and Overlay using ID momentum



Looks like only 2018 data overlay samples are affected