Residuals in Track Fit

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  - global positions of clusters according to the hit pattern
  - Steps to calculate the global cluster position
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Ideal geometry loaded

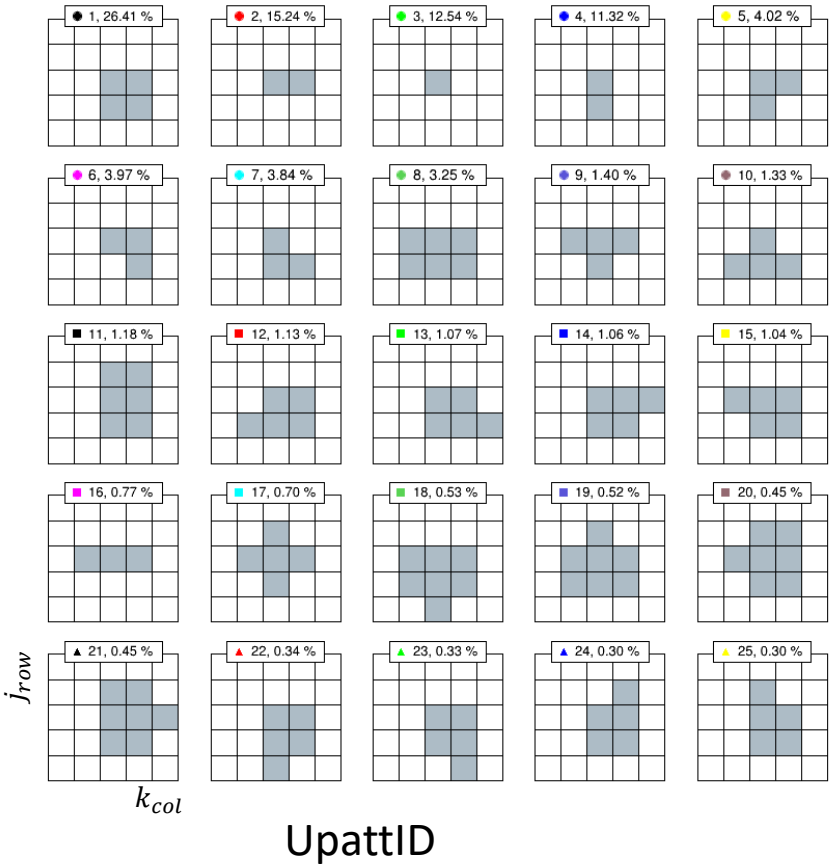
```
geomFileName="";    (o2sim_geometry.root)
applyMisalignment=true;
void GeometryManager::loadGeometry(std::string_view geomFileName, bool applyMisalignment)
{
   ///< load geometry from file
   std::string fname = o2::base::NameConf::getGeomFileName(geomFileName);
   LOG(info) << "Loading geometry from " << fname;
   TFile flGeom(fname.data());
   if (flGeom.IsZombie()) {
     LOG(fatal) << "Failed to open file " << fname;
   }
   // try under the standard CCDB name
   if (!flGeom.Get(std::string(o2::base::NameConf::CCDBOBJECT).c_str()) &&
       !flGeom.Get(std::string(o2::base::NameConf::GEOMOBJECTNAME_FAIR).c_str())) {
     LOG(fatal) << "Did not find geometry named " << o2::base::NameConf::CCDBOBJECT << " or " <<
o2::base::NameConf::GEOMOBJECTNAME_FAIR;
   }
   applyMisalignent(applyMisalignment);
}
```

mTimeStamp = 0 (=now()) -> **empty object**
→ **Ideal geometry is loaded**

We calculated global positions of clusters according to the hit pattern.

```
void CookedTracker::process(...) {
  ...
  auto clusters_in_frame = rof.getROFData(clusters);
  ...
  for(const auto& comp : clusters_in_frame) {
    ...
    o2::math_utils::Point3D<float> locC;
    auto row = comp.getRow();
    auto col = comp.getCol();
    auto chipID = comp.getSensorID();
    auto UpattID = comp.UpattID;
    ...
    temp_Cluster iCluster;
    TVector3 gloC_Group = iCluster.getClusterGroupedPosition(mGeom, row, col, chipID, UpattID);
    ...
  }
}
```

Steps to calculate the global cluster position




```
std::vector<TVector3> gPos;
for(int a=0; a<25; a++) {
  o2::math_utils::Point3D<float> locC;
  if((int)FiredPix[a]==(int)1 || (int)a==(int)24) {
    o2::itsmft::SegmentationAlpide::detectorToLocalUnchecked(j_row, k_col, locC);
    auto gloC = mGeom->getMatrixL2G(chipID) * locC;
    gPos.push_back(TVector3(gloC.X(),gloC.Y(),gloC.Z()));
  }
}
```

$(j_{row}, k_{col}) \rightarrow \vec{x}_i$

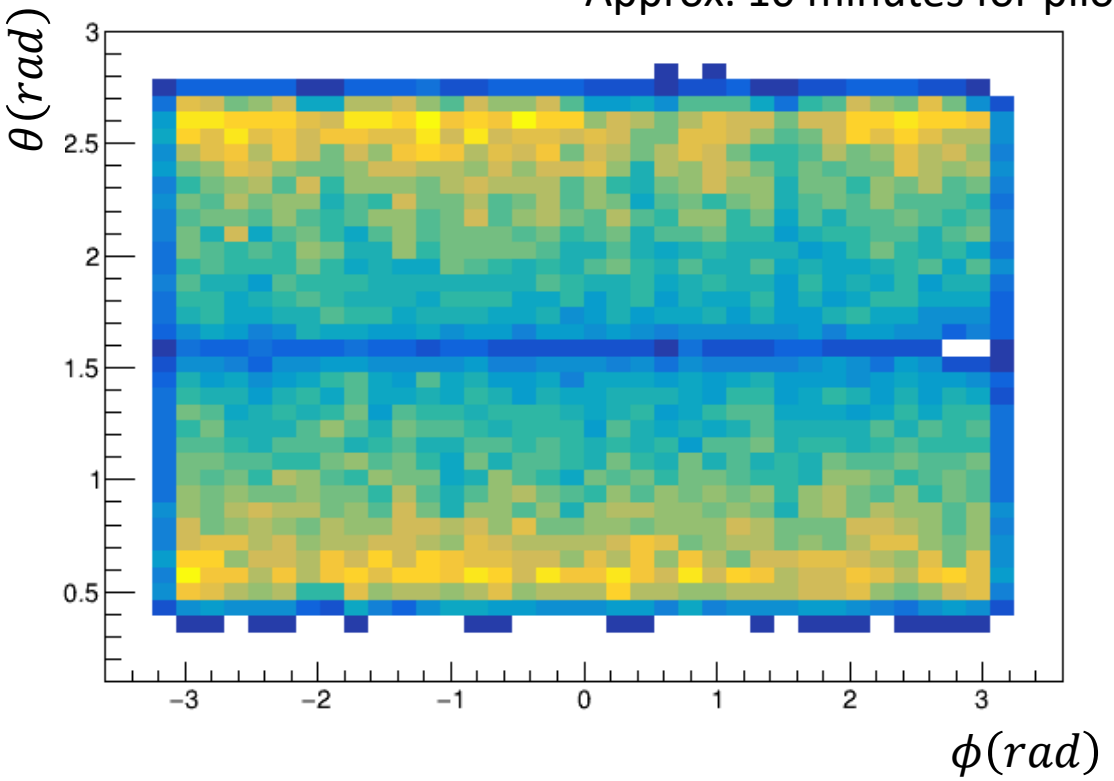
```
TVector3 gPos_mean(0,0,0);
for(int a=0; a<gPos.size();a++){
  gPos_mean.SetX(gPos_mean.X() + gPos[a].X()/gPos.size());
  gPos_mean.SetY(gPos_mean.Y() + gPos[a].Y()/gPos.size());
  gPos_mean.SetZ(gPos_mean.Z() + gPos[a].Z()/gPos.size());
}
```

$$\vec{x} = \frac{\sum_{i=1}^{N} \vec{x}_i}{N}$$

Crude Tracking Algorithm for alignment

RUN 505669 (~90%)

Approx. 10 minutes for pilot beam luminosity



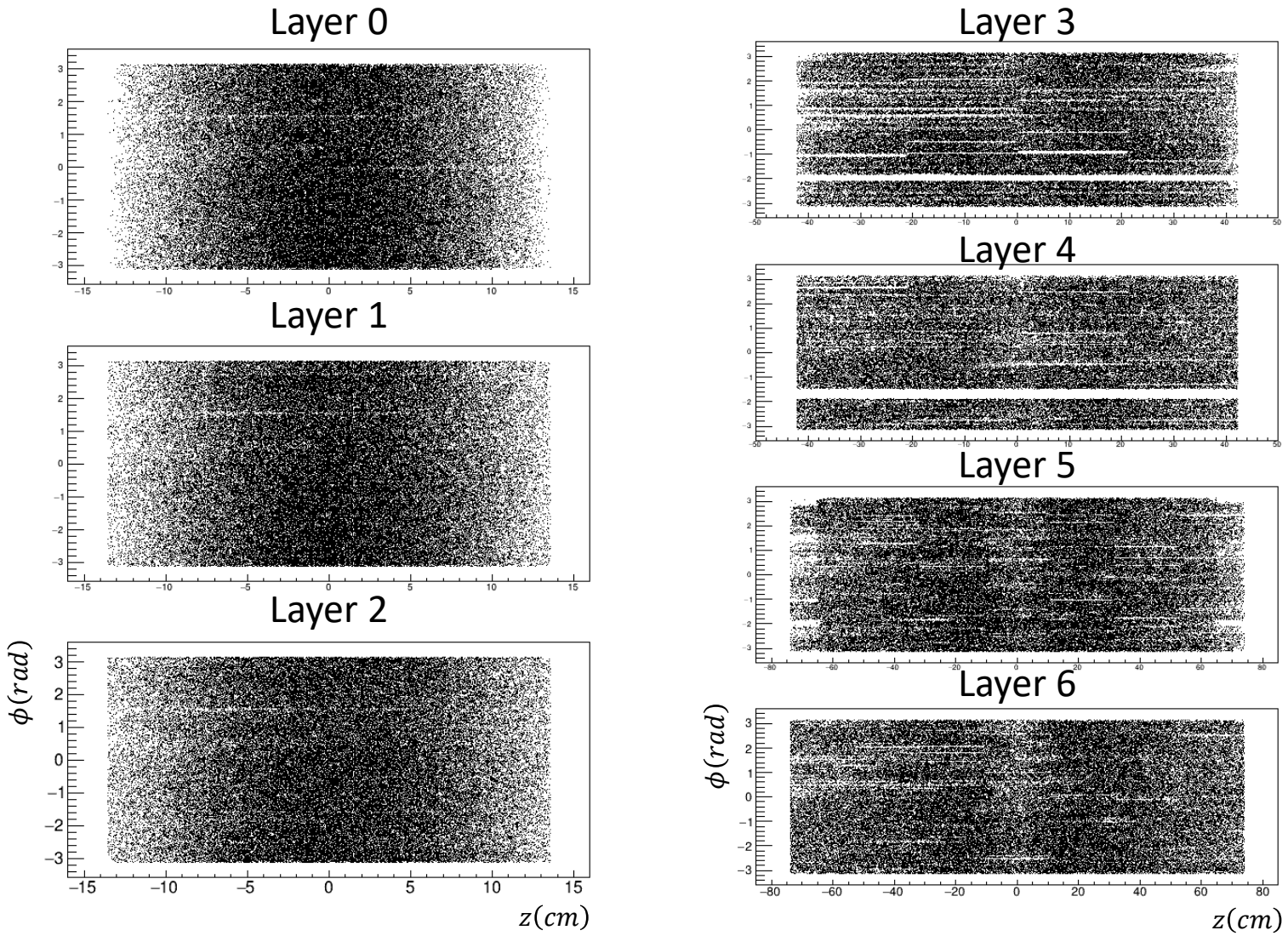
Angular Distribution estimated at collision location for reconstructed tracks

(To be presented by Taejun next week)

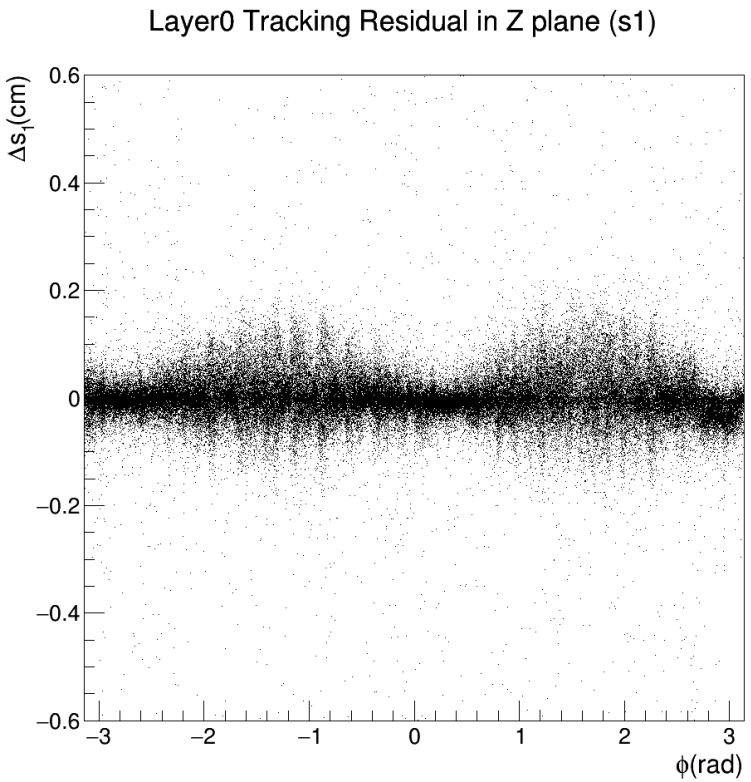
Event Selection for alignment, $N_{track} \geq 3$

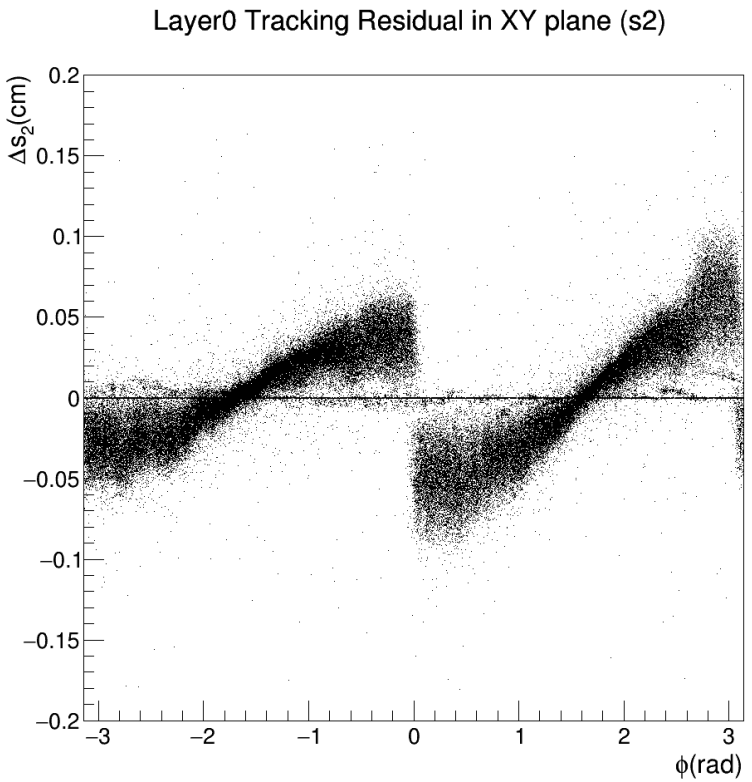
- Well-defined vertex & suppression of noisy events.
- Self-constraining vertex & extra information to track fit.
- Tracks are consistent to each other within proximity & suppression of ghost tracks.

Detector Images seen by tracks

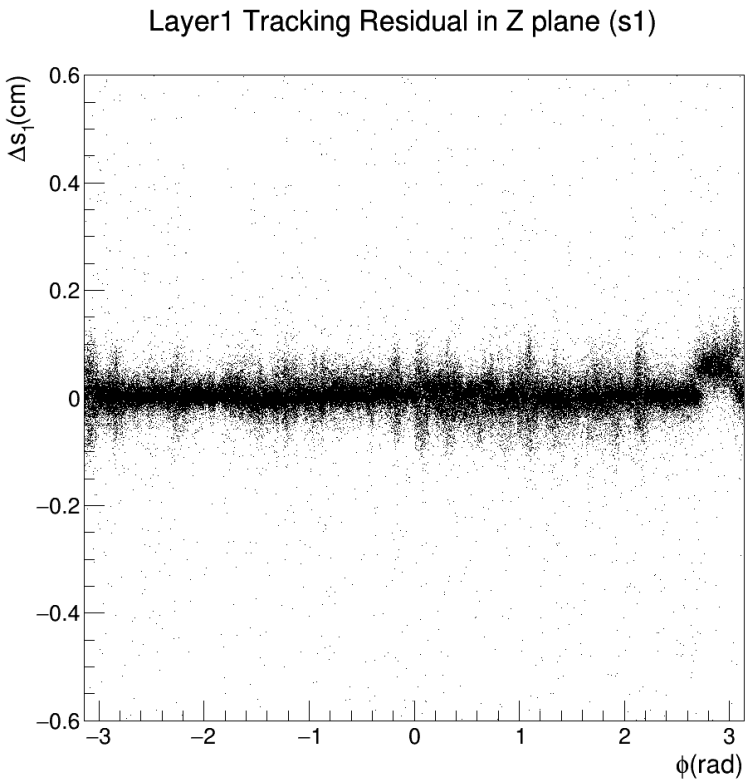


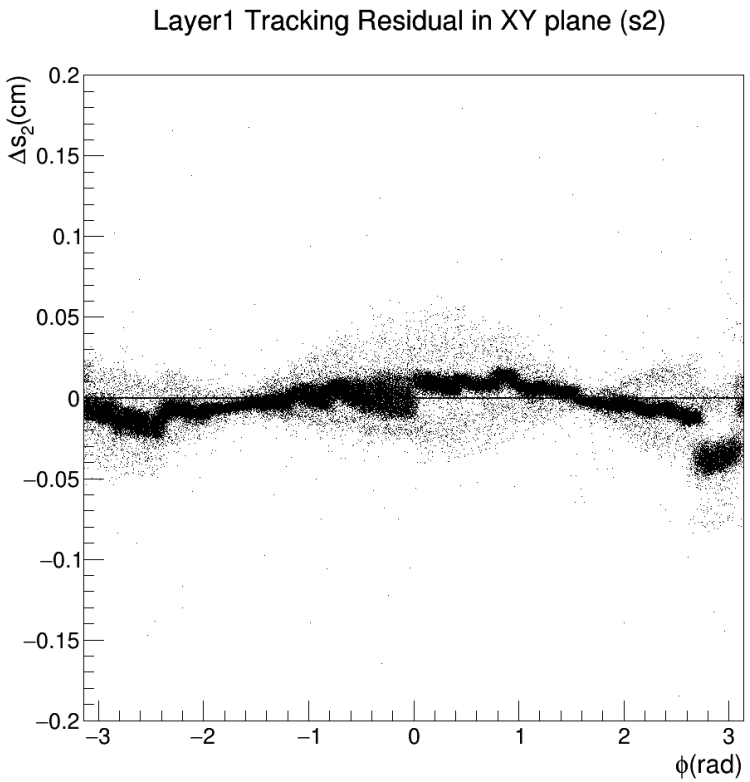
Layer 0


Layer0 Tracking Residual in Z plane (s1)
Δs_1(cm)
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−3
−2
−1
0
1
2
3
ϕ(rad)

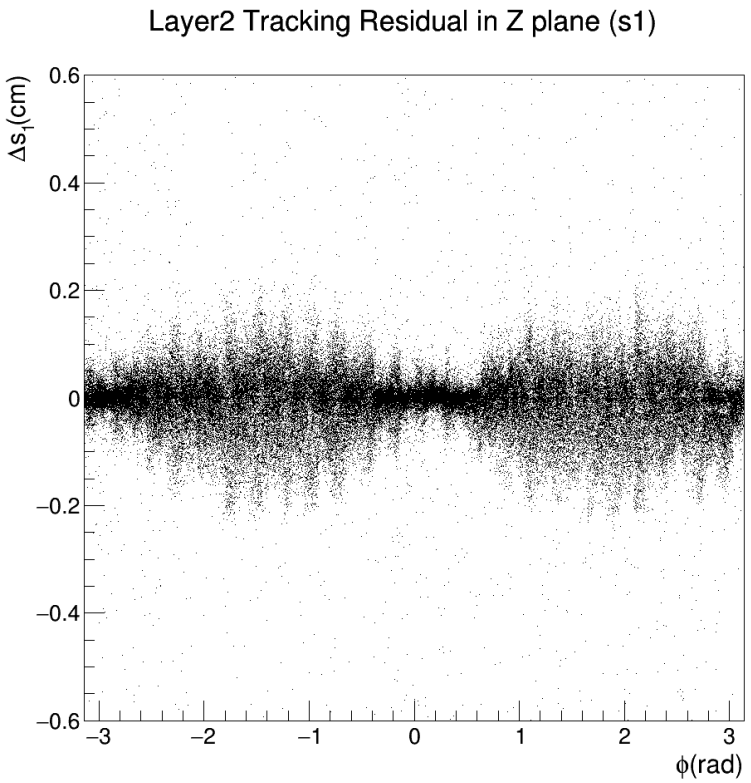

Layer0 Tracking Residual in XY plane (s2)
Δs_2(cm)
0.2
0.15
0.1
0.05
0
−0.05
−0.1
−0.15
−0.2
−3
−2
−1
0
1
2
3
ϕ(rad)

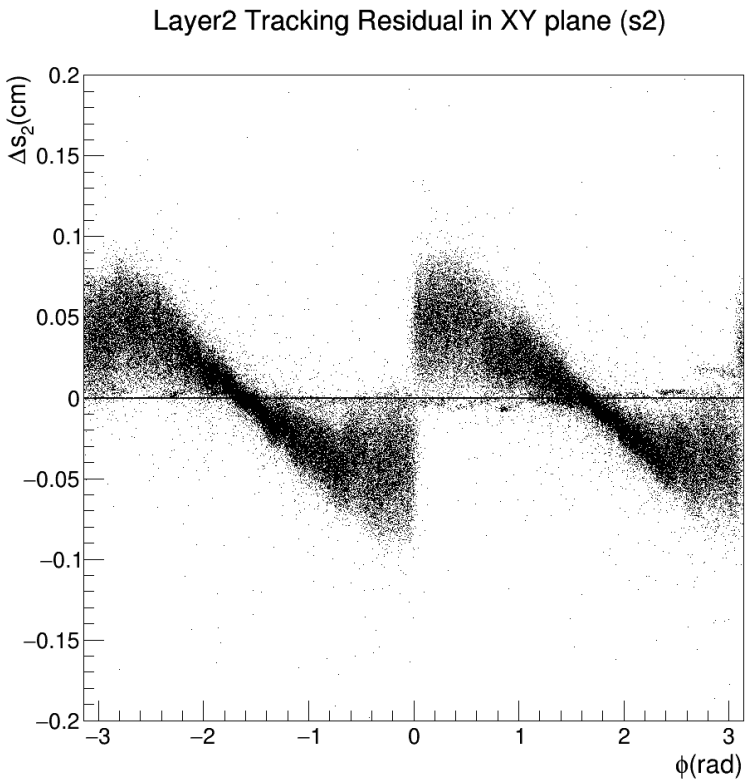
Layer 1


Layer1 Tracking Residual in Z plane (s1)
Δs_1(cm)
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−3
−2
−1
0
1
2
3
ϕ(rad)

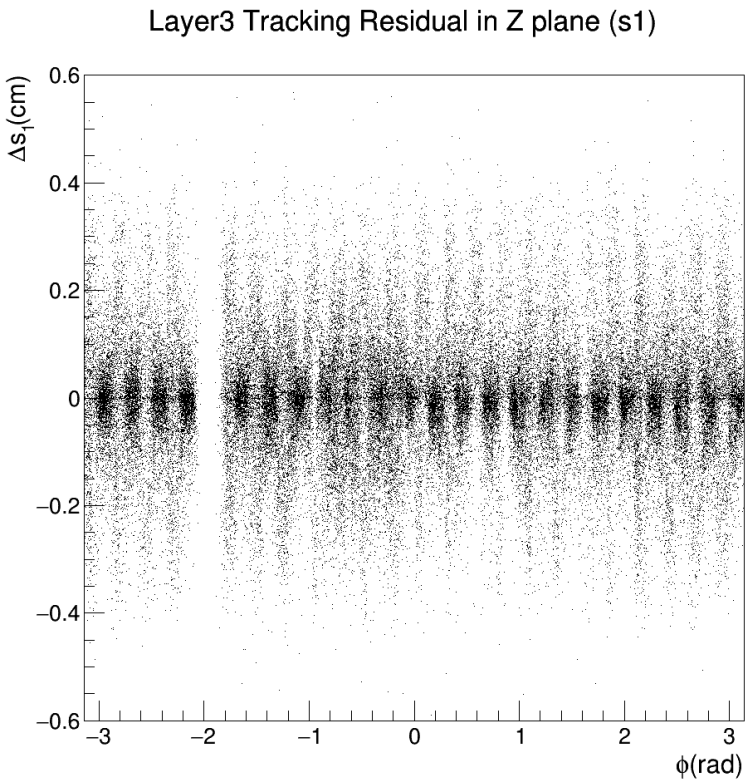

Layer1 Tracking Residual in XY plane (s2)
Δs_2(cm)
0.2
0.15
0.1
0.05
0
−0.05
−0.1
−0.15
−0.2
−3
−2
−1
0
1
2
3
ϕ(rad)

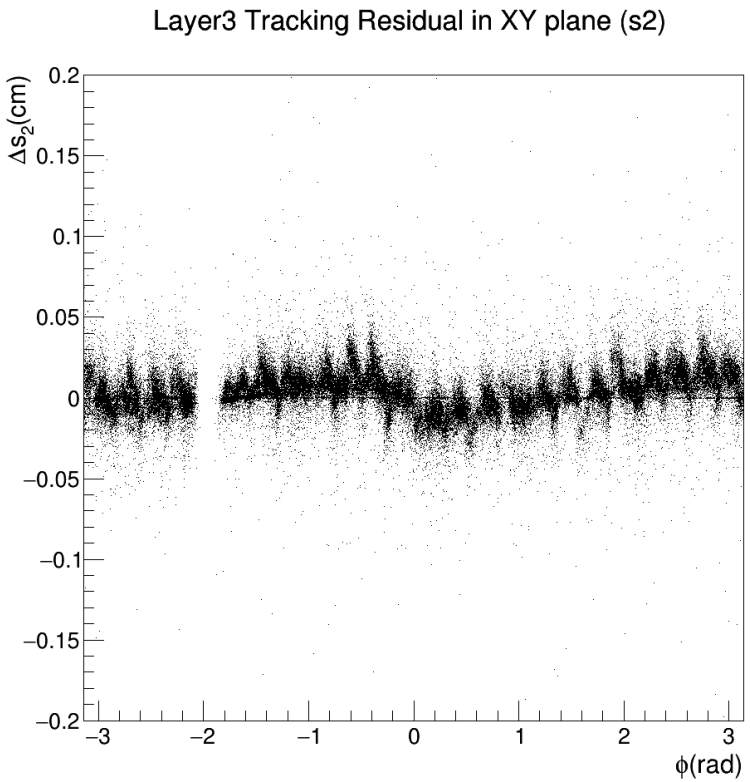
Layer 2


Layer2 Tracking Residual in Z plane (s1)
Δs_1(cm)
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−3
−2
−1
0
1
2
3
ϕ(rad)

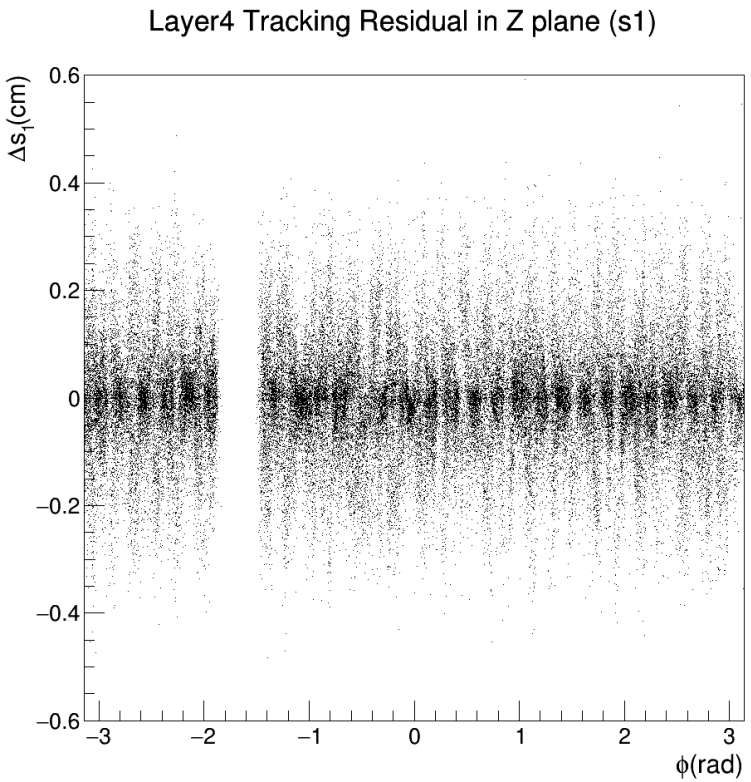

Layer2 Tracking Residual in XY plane (s2)
Δs_2(cm)
0.2
0.15
0.1
0.05
0
−0.05
−0.1
−0.15
−0.2
−3
−2
−1
0
1
2
3
ϕ(rad)

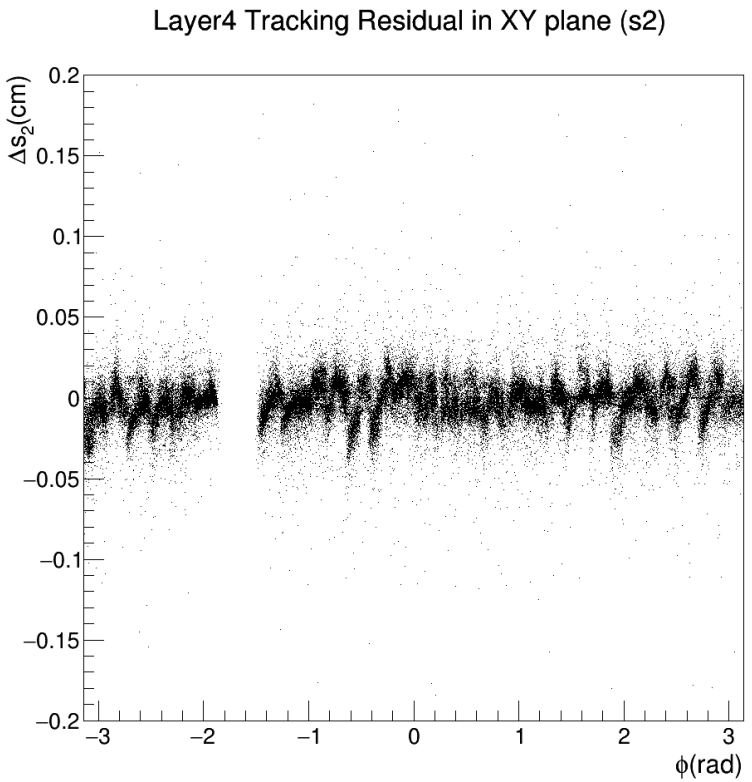
Layer 3


Layer3 Tracking Residual in Z plane (s1)
Δs_1(cm)
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−3
−2
−1
0
1
2
3
ϕ(rad)

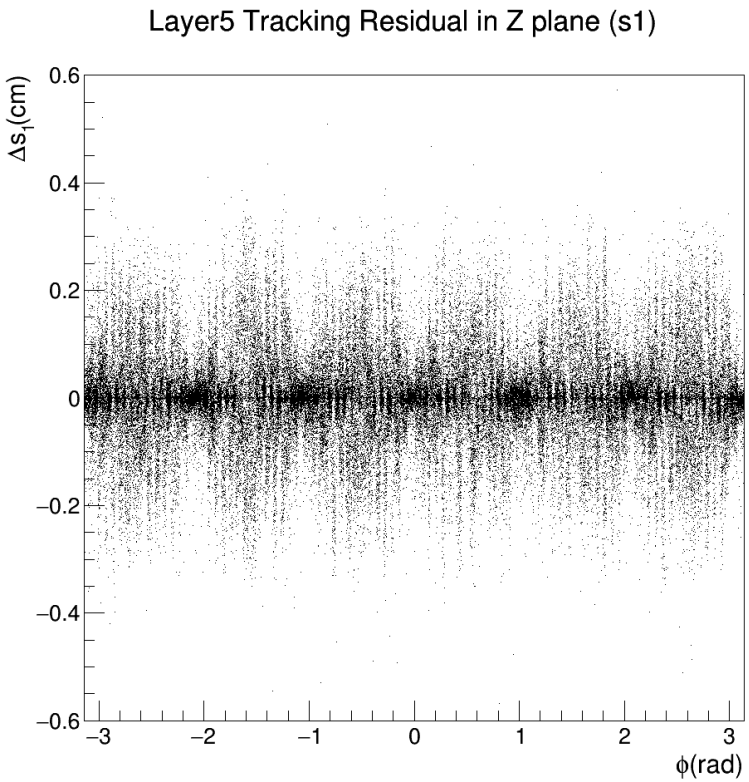

Layer3 Tracking Residual in XY plane (s2)
Δs_2(cm)
0.2
0.15
0.1
0.05
0
−0.05
−0.1
−0.15
−0.2
−3
−2
−1
0
1
2
3
ϕ(rad)

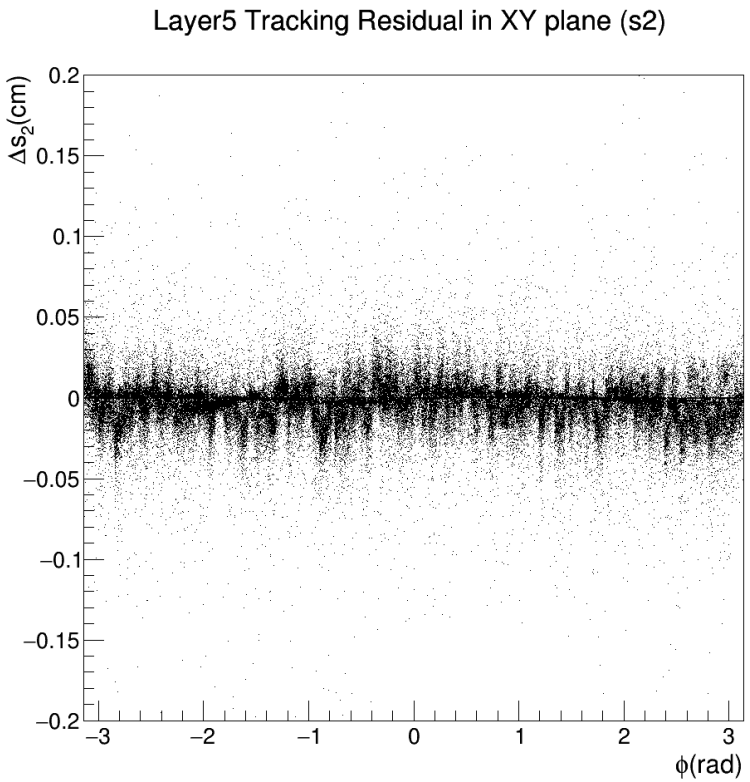
Layer 4


Layer4 Tracking Residual in Z plane (s1)
Δs1(cm)
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−3
−2
−1
0
1
2
3
ϕ(rad)

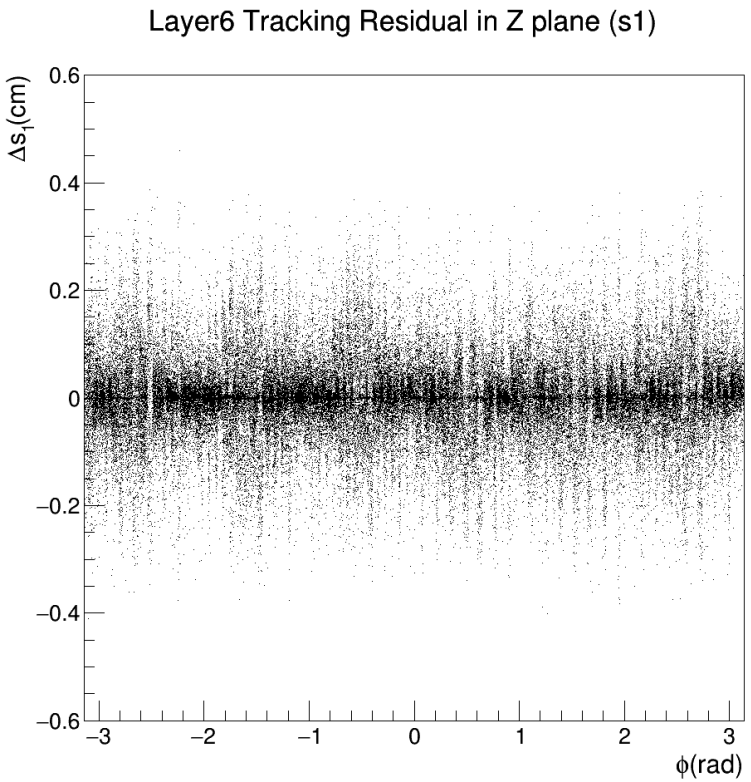

Layer4 Tracking Residual in XY plane (s2)
Δs2(cm)
0.2
0.15
0.1
0.05
0
−0.05
−0.1
−0.15
−0.2
−3
−2
−1
0
1
2
3
ϕ(rad)

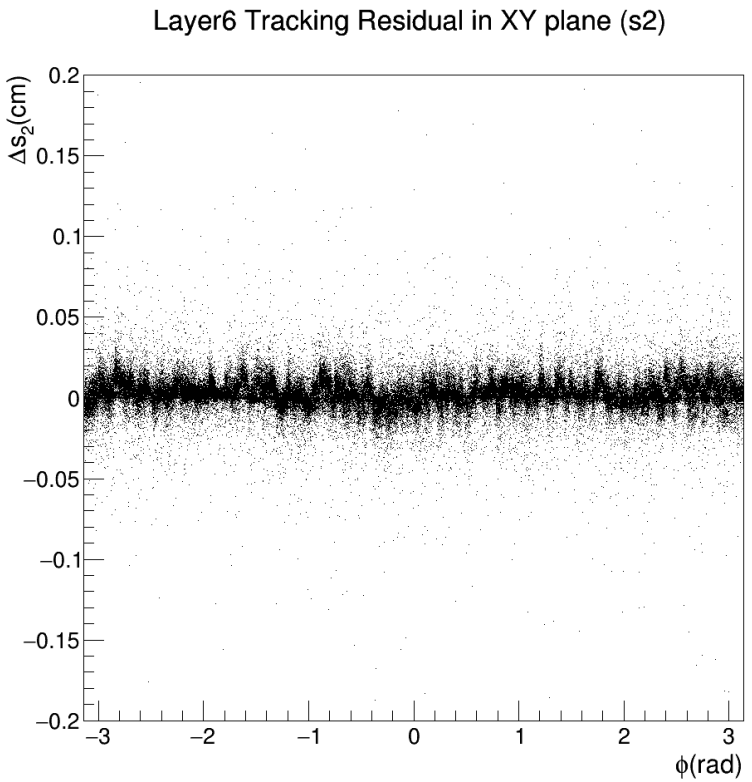
Layer 5

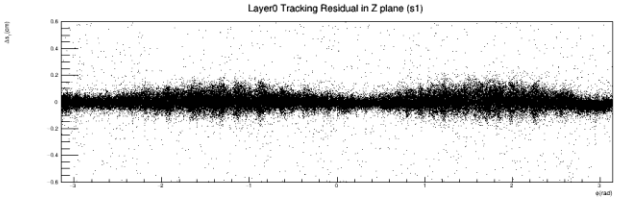

Layer5 Tracking Residual in Z plane (s1)
Δs_1(cm)
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−3
−2
−1
0
1
2
3
ϕ(rad)

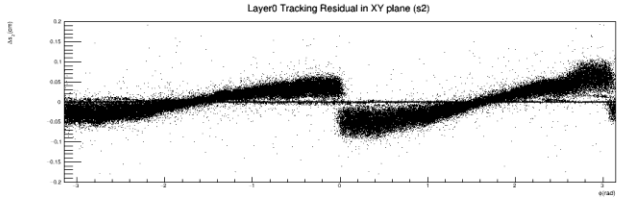

Layer5 Tracking Residual in XY plane (s2)
Δs_2(cm)
0.2
0.15
0.1
0.05
0
−0.05
−0.1
−0.15
−0.2
−3
−2
−1
0
1
2
3
ϕ(rad)

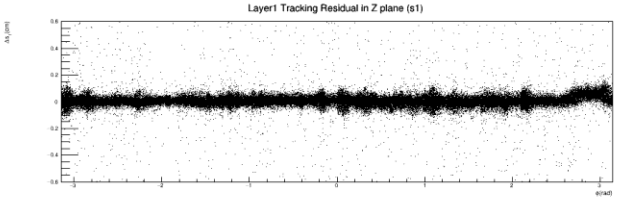
Layer 6

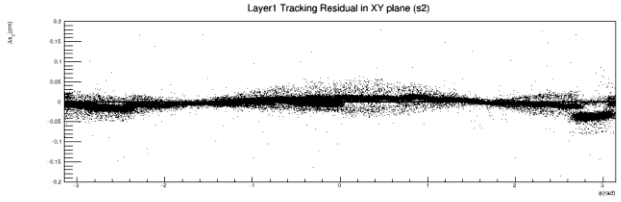

Layer6 Tracking Residual in Z plane (s1)
Δs1(cm)
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−3
−2
−1
0
1
2
3
ϕ(rad)

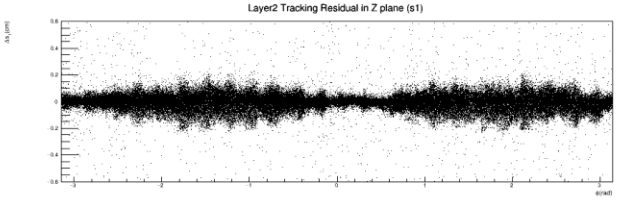

Layer6 Tracking Residual in XY plane (s2)
Δs2(cm)
0.2
0.15
0.1
0.05
0
−0.05
−0.1
−0.15
−0.2
−3
−2
−1
0
1
2
3
ϕ(rad)

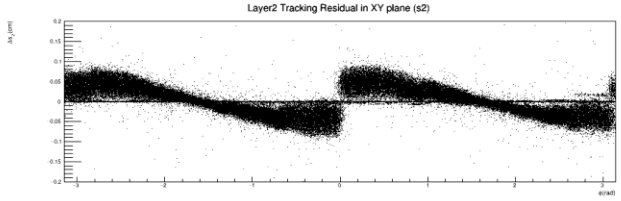

Layer0 Tracking Residual in Z plane (s1)

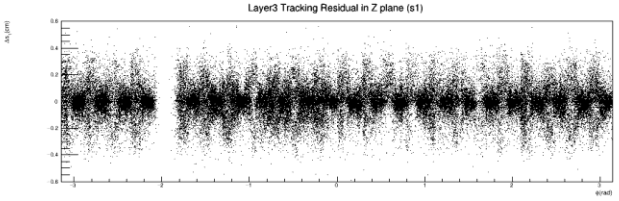

Layer0 Tracking Residual in XY plane (s2)

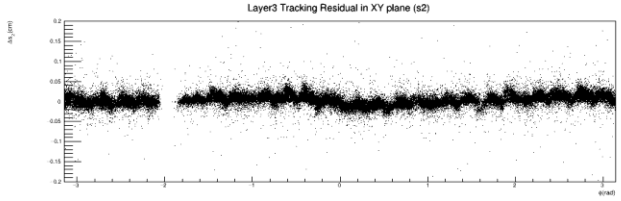

Layer1 Tracking Residual in Z plane (s1)

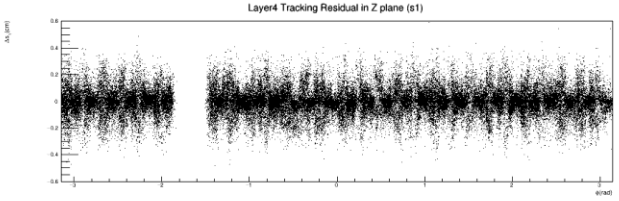

Layer1 Tracking Residual in XY plane (s2)

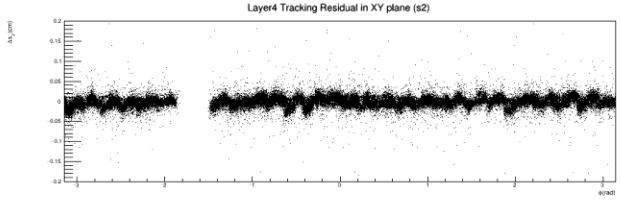

Layer2 Tracking Residual in Z plane (s1)

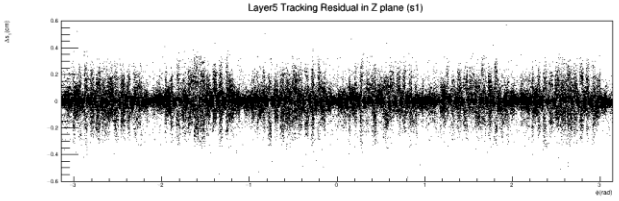

Layer2 Tracking Residual in XY plane (s2)

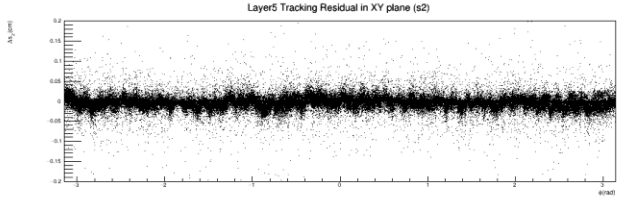

Layer3 Tracking Residual in Z plane (s1)

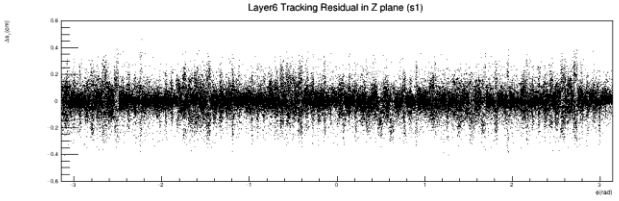

Layer3 Tracking Residual in XY plane (s2)

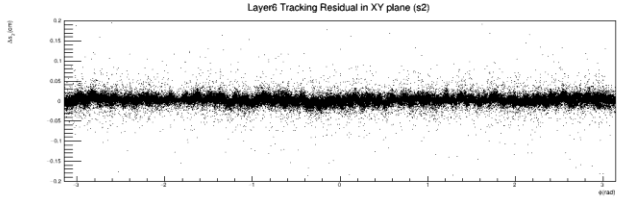

Layer4 Tracking Residual in Z plane (s1)


Layer4 Tracking Residual in XY plane (s2)


Layer5 Tracking Residual in Z plane (s1)


Layer5 Tracking Residual in XY plane (s2)


Layer6 Tracking Residual in Z plane (s1)


Layer6 Tracking Residual in XY plane (s2)

Summary

- Systematic offsets in z w.r.t. half-stave (specifically outer barrels, similar look for all layers)?
- Systematics depending on the half-barrel?
- A special issue with one stave in layer 1?
- Efforts to next two weeks: Seeking for remedy based on AI for the observed issues.