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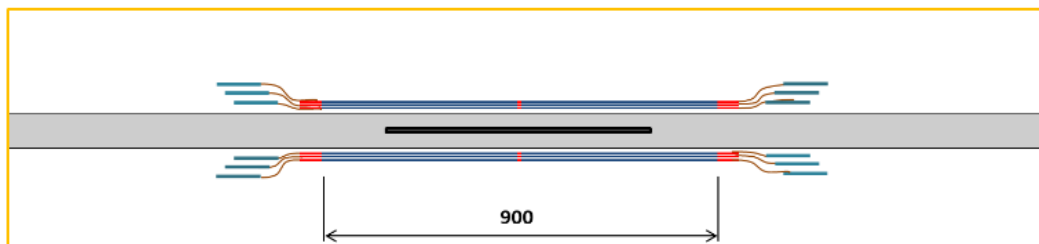
## Influence of FE modules on MVD detector performance

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# Front-end electronics for MVD | TDR

- Micromegas-based Central Tracker\* - is closest to beam pipe SPD subsystem;
- The readout boards are located 10 cm from the detector Z 60 cm + as close to the beam pipe;
- MVD Length: **900** mm (TDR) vs **800** mm (SpdRoot);  
See CustomMvd(3) in </cvmfs/spd.jinr.ru/production/MC/minbias-P8-spdroot417-dev.10GeV.V01/simu.C>
- A realistic detector model should contain FE modules;



**Detector Layout**

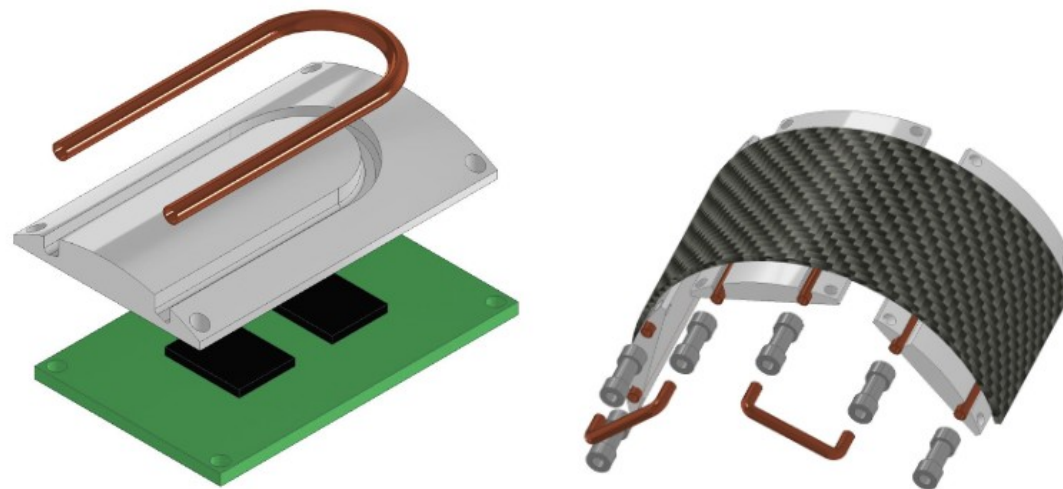


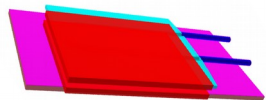
Figure 12.12: (a) Exploded-view diagram of a single cooling plate with the FE board. (b) Schematic view of the carbon fiber support structure with cooling plates fixed to it.

\*In SpdRoot source code it is referred by the Mvd (Micromegas vertex detector)

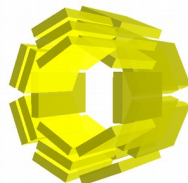
# Implementation in SpdRoot source code

Git repository with SpdMvdElectronics class: <https://git.jinr.ru/avasyukov/spdroot/-/tree/passiveElectronicMicromegas>

Module

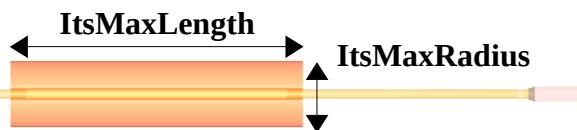


ElTube



?

Positioning the ElTubes inside the cave volume will cause **overlaps** with MVD



? = «MvdBarrel\_1»

From SpdCommonGeoMapper:

ItsMaxLength = 200 cm

ItsMaxRadius = 26.5 cm

No place for MVD Electronics

Temporary solution:

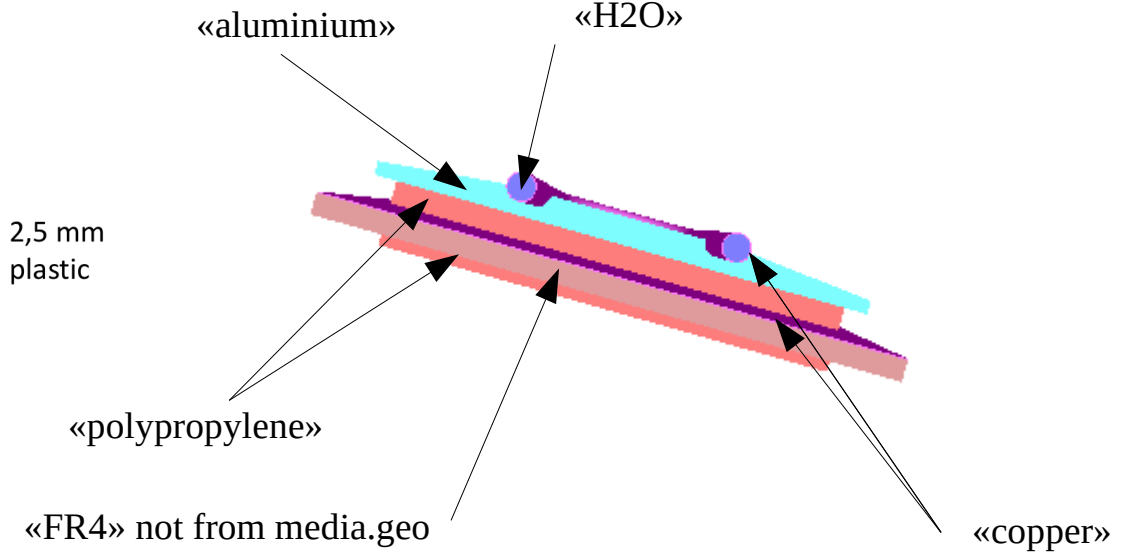
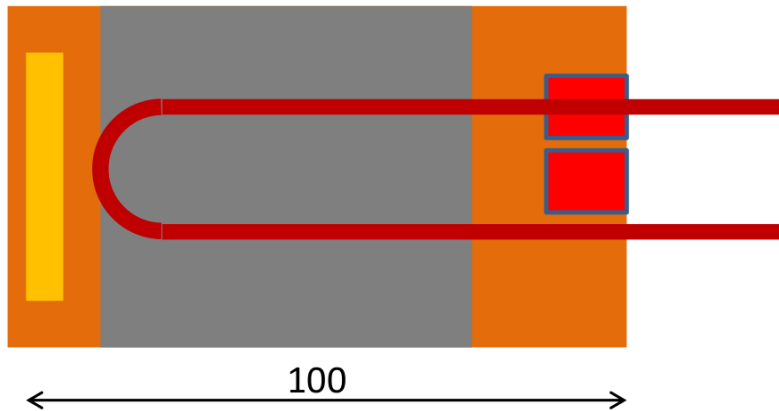
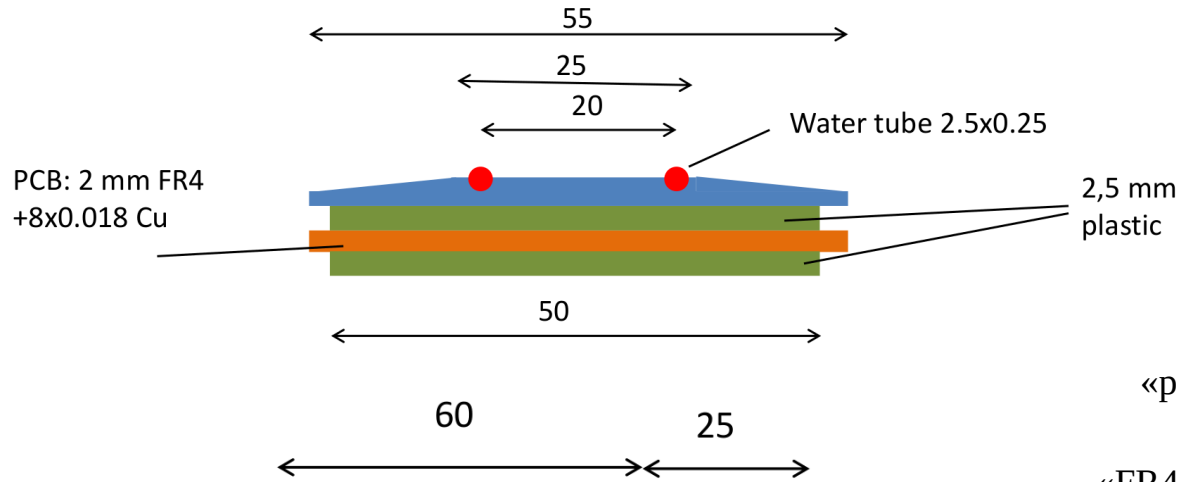
// Check that master volume contains MVD barrel

```
if (!fMasterVolume->GetNode("MvdBarrel_1"))
{ cout << "-E- <SpdMvdElectrics::ConstructGeometry> No Mvd Barrel " << endl; return; }
TGeoVolume *mvd_barrel = fMasterVolume->FindNode("MvdBarrel_1")->GetVolume();
```

// Put electrics module into MVD barrel

```
mvd_barrel->AddNode(fElTube, 1, new TGeoTranslation(0., 0., -fZshift));
mvd_barrel->AddNode(fElTube, 2, new TGeoCombiTrans(0., 0., fZshift, new TGeoRotation("fElTubeRot", 0., 180., 0.)));
```

# MvdElectronics | Module

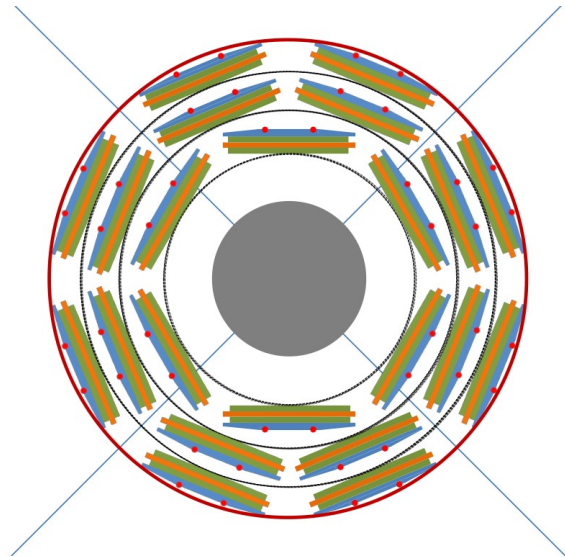
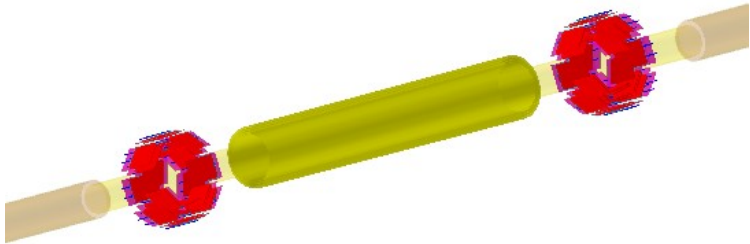


```

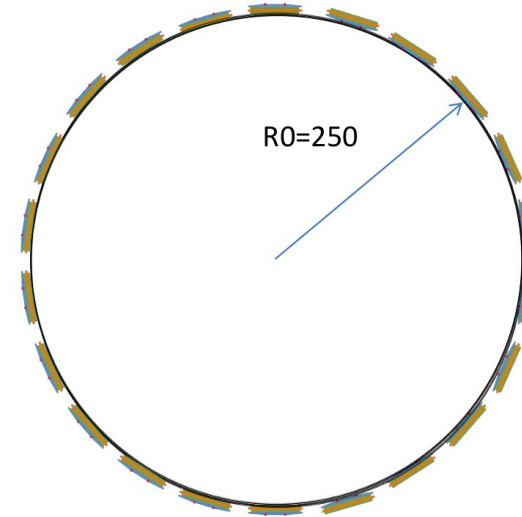
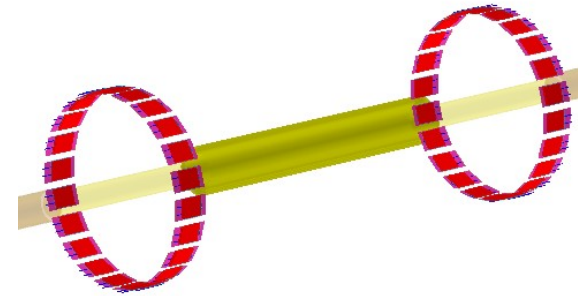
TGeoMixture* mEpoxy = new TGeoMixture("Epoxy", 2, 1.2);
mEpoxy->AddElement(elH, 2);
mEpoxy->AddElement(elC, 2);
TGeoMixture* mSiO2 = new TGeoMixture("mSiO2", 2, 2.200);
mSiO2->AddElement(elSi, 1);
mSiO2->AddElement(elO, 2);
TGeoMixture* mFR4 = new TGeoMixture("mFR4", 2, 1.86);
mFR4->AddElement(mEpoxy, 0.472);
mFR4->AddElement(mSiO2, 0.528);
TGeoMedium *PCBFR4Medium = new TGeoMedium("PCBFR4Medium",
18032025, mFR4);
    
```

# Types of FE modules layout

```
SpdMvdElectronics* mvdEl = new SpdMvdElectronics();  
mvdEl->SetGeometryType(1);
```



```
SpdMvdElectronics* mvdEl = new SpdMvdElectronics();  
mvdEl->SetGeometryType(2);
```



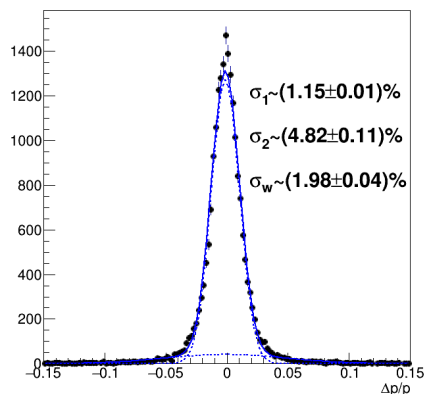
# Performance tests | GeoType = 1

Mvd customize geometry: CustomMvd(3);

```
primGen->SetBeam(0., 0., 0.1, 0.1);
primGen->SmearGausVertexXY(kTRUE);
primGen->SetTarget(0., 30.);
primGen->SmearGausVertexZ(kTRUE);
```

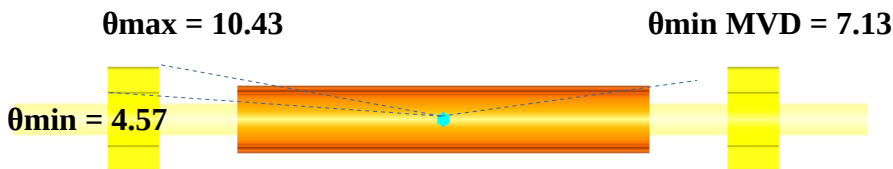
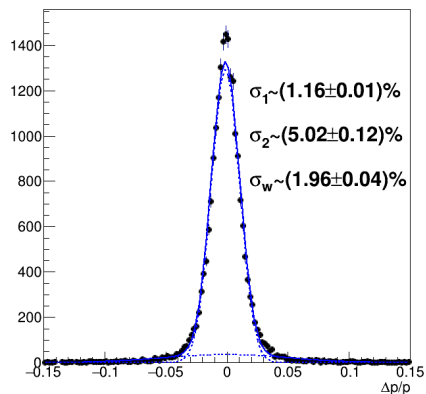
Resolution

Without FE Modules

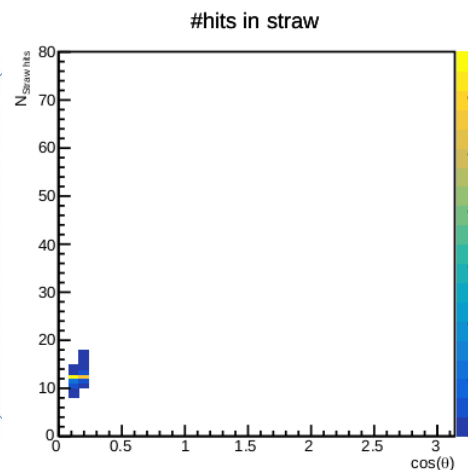
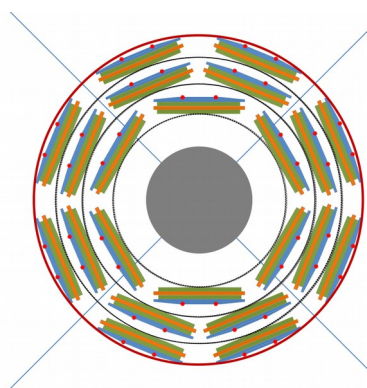


Resolution

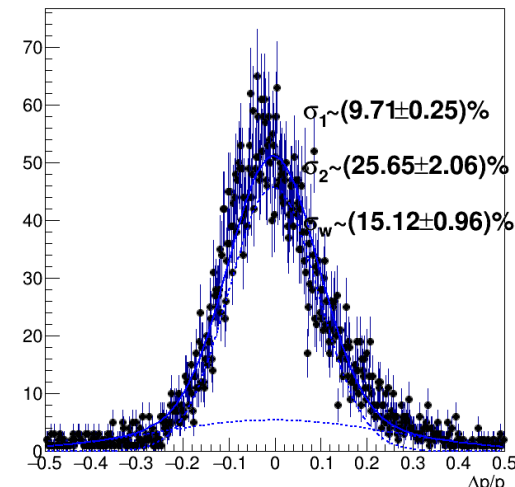
With FE Modules



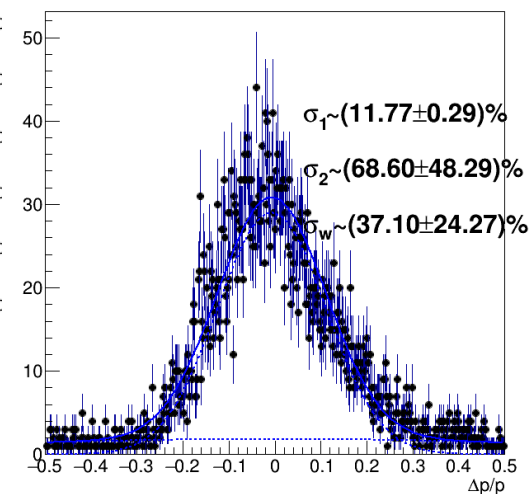
```
IGen->SetSpherical(4.5739213, 10.426010, 0., 360.);
primGen->SetBeam(0., 0., 0., 0.);
primGen->SetTarget(0., 0.);
```



Resolution Without FE



Resolution With FE



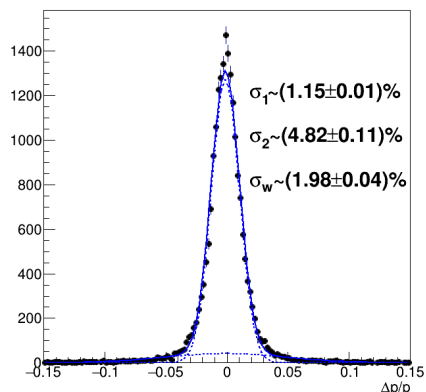
# Performance tests | GeoType = 2

Mvd customize geometry: CustomMvd(3);

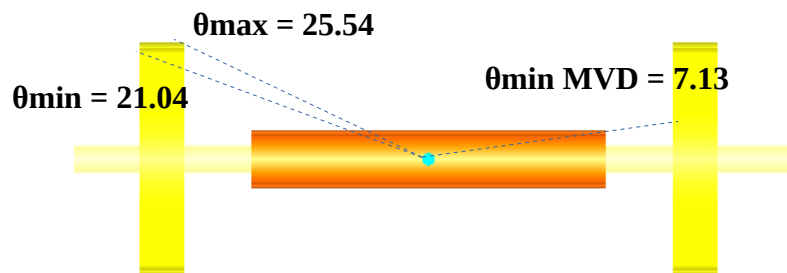
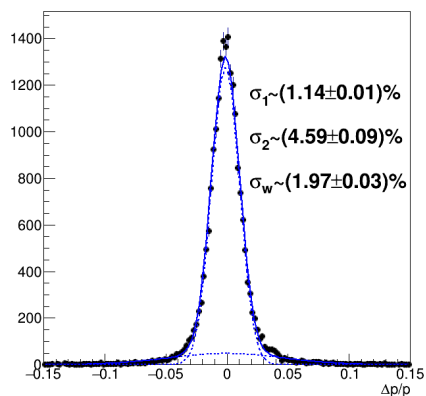
```
primGen->SetBeam(0., 0., 0.1, 0.1);
primGen->SmearGausVertexXY(kTRUE);
primGen->SetTarget(0., 30.);
primGen->SmearGausVertexZ(kTRUE);
```

Resolution

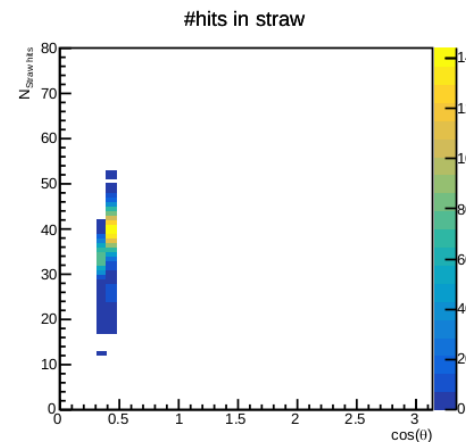
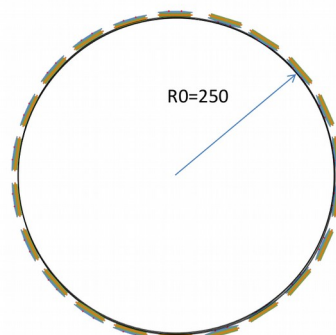
Without FE Modules



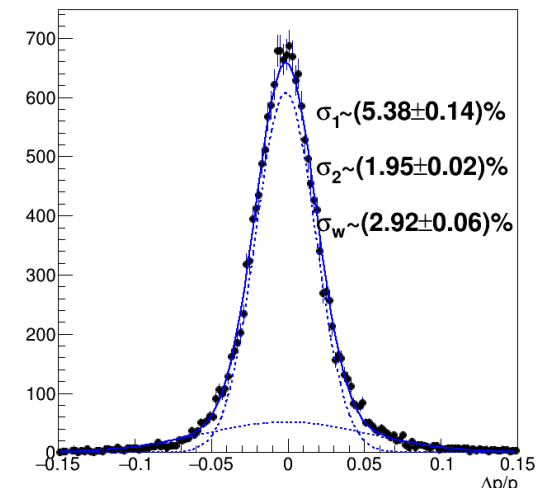
With FE Modules



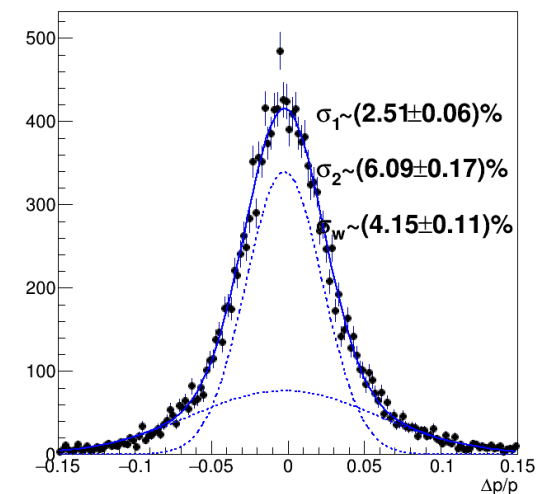
```
IGen->SetSpherical(21.037511, 25.542457, 0., 360.);
primGen->SetBeam(0., 0., 0., 0.);
primGen->SetTarget(0., 0.);
```



Resolution Without FE



Resolution With FE



# Conclusion

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- FE modules for Micromegas-based Central Tracker are implemented in SpdRoot source code;
- Electronics modules do not make a significant contribution to overall performance;
- FE layout version corresponding to the GeoType = 1 seems to be preferable, but it can significantly ruin the resolution for analyses requiring tracks from large pseudorapidity region;

## **ToDo**

- If necessary, the code is ready to be pushed to the common SpdRoot repository;
- Finalizing FE modules parameters (layout, materials);
- Vertex position resolution study;