Rootification of MuCh Software

&

mMuCh simulation @ mCBM

Omveer Singh (AMU, Aligarh, INDIA)

Partha Pratim Bhaduri (VECC, Kolkata, INDIA)

for CBM Collaboration

Acknowledgement:
Ms. Ekata Nandy (VECC)
Mr. Ajit Kumar (VECC)
Mr. Vikas Singhal (VECC)
Dr. A. K. Dubey (VECC)
Dr. S. Chattopadhyay (VECC)
Dr. N. Ahmad (AMU)
Dr. David Emschermann (GSI)
Dr. Volker Friese (GSI)
Dr. Florian Uhlig (GSI)

Outline

Much Software:

- Development of MuCh geometry in Root format.
- Modification of Geohandler classes.

mini-MuCh:

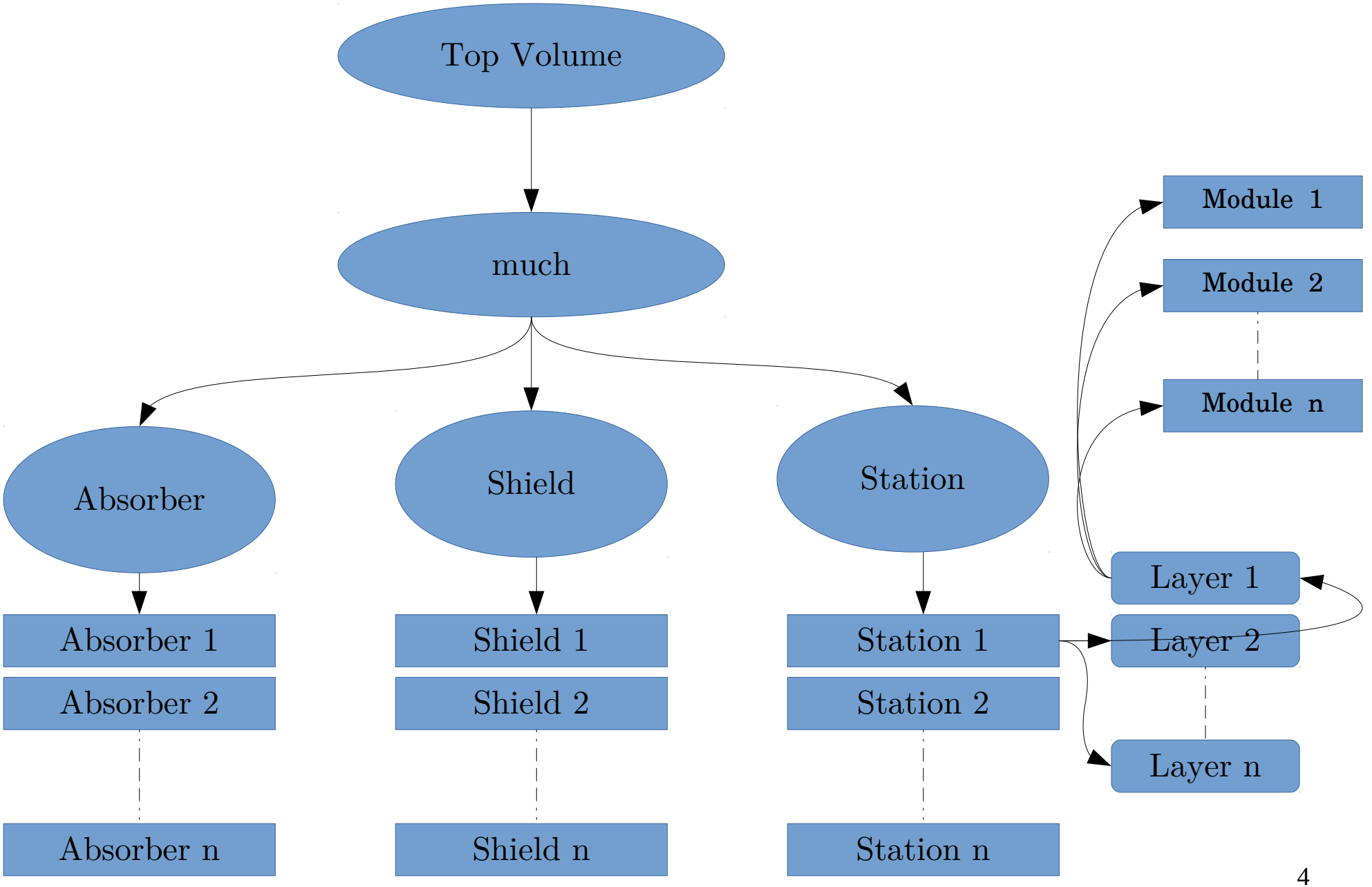
- Development of a mini-MuCh system for mini-CBM setup.
- Development of segmentation.
- Exploration of different geometry configurations.

- Earlier MuCh geometry specified via ASCII files.
- Seperate files for MuCh geometry and shielding geometry.

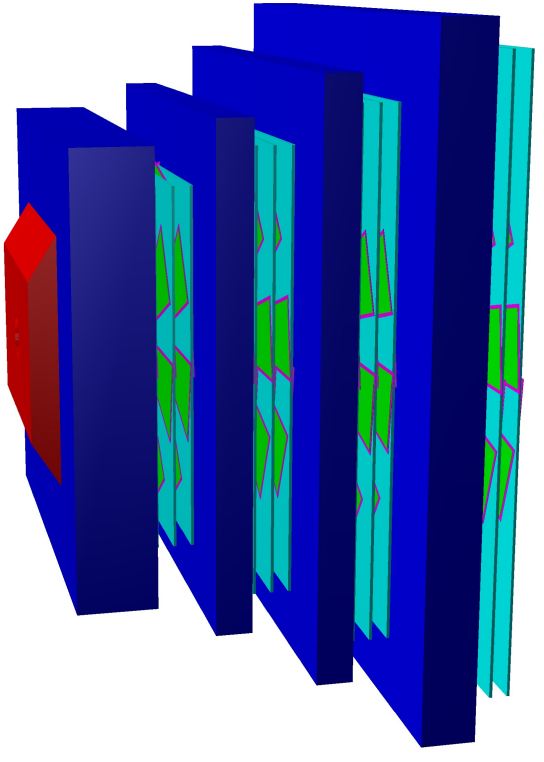
```
# General information
MuchCave Zin position [cm]  :     160
Acceptance tangent min      :     0.1
Acceptance tangent max      :   0.466
Number of absorbers         :       5
Number of stations          :       5

# Absorber specification
Absorber Zin position [cm]  :       0      55     105     155     215
Absorber thickness [cm]     :      25      20      20      30     100
Absorber material           :       C       I       I       I       I

# Station specification
Station Zceneter [cm]       :      40      90     140     200     330
Number of layers            :       3       3       3       3       3
Detector type               :       3       3       3       3       3
Distance between layers [cm]:      10      10      10      10      10
Support thickness [cm]      :     1.5     1.5     1.5     1.5     1.5
Use module design (0/1)     :       1       1       1       1       1

# GEM module specification (type 1)
Active volume lx [cm]       :    25.6
Active volume ly [cm]       :    25.6
Active volume lz [cm]       :     0.3
Spacer lx [cm]              :     0.5
Spacer ly [cm]              :       5
Overlap along y axis [cm]   :       2

# Straw module specification (type 2)
Straw thickness [cm]        :     0.4

# Sector-type GEM module specification (type 3)
Number of sectors/layer     :      15      19      23      27      37
Active volume lz [cm]       :     0.3
Spacer in r [cm]            :       2
Spacer in phi [cm]          :       2
Overlap in r [cm]           :       2
```

```
mantle0
cave
PCON
MUCHcarbon
2
0. 360.
1250  125  583
1490  149  695

0. 0. 0.
1.  0.  0.  0.  1.  0.  0.  0.  1

mantle1
cave
PCON
MUCHcarbon
2
0. 360.
1490  149  995
1600  160  1046

0. 0. 0.
1.  0.  0.  0.  1.  0.  0.  0.  1

mantle2
cave
PCON
MUCHiron
2
0. 360.
2150  129  214
2350  139  234

0. 0. 0.
1.  0.  0.  0.  1.  0.  0.  0.  1

mantle3
cave
PCON
MUCHiron
```

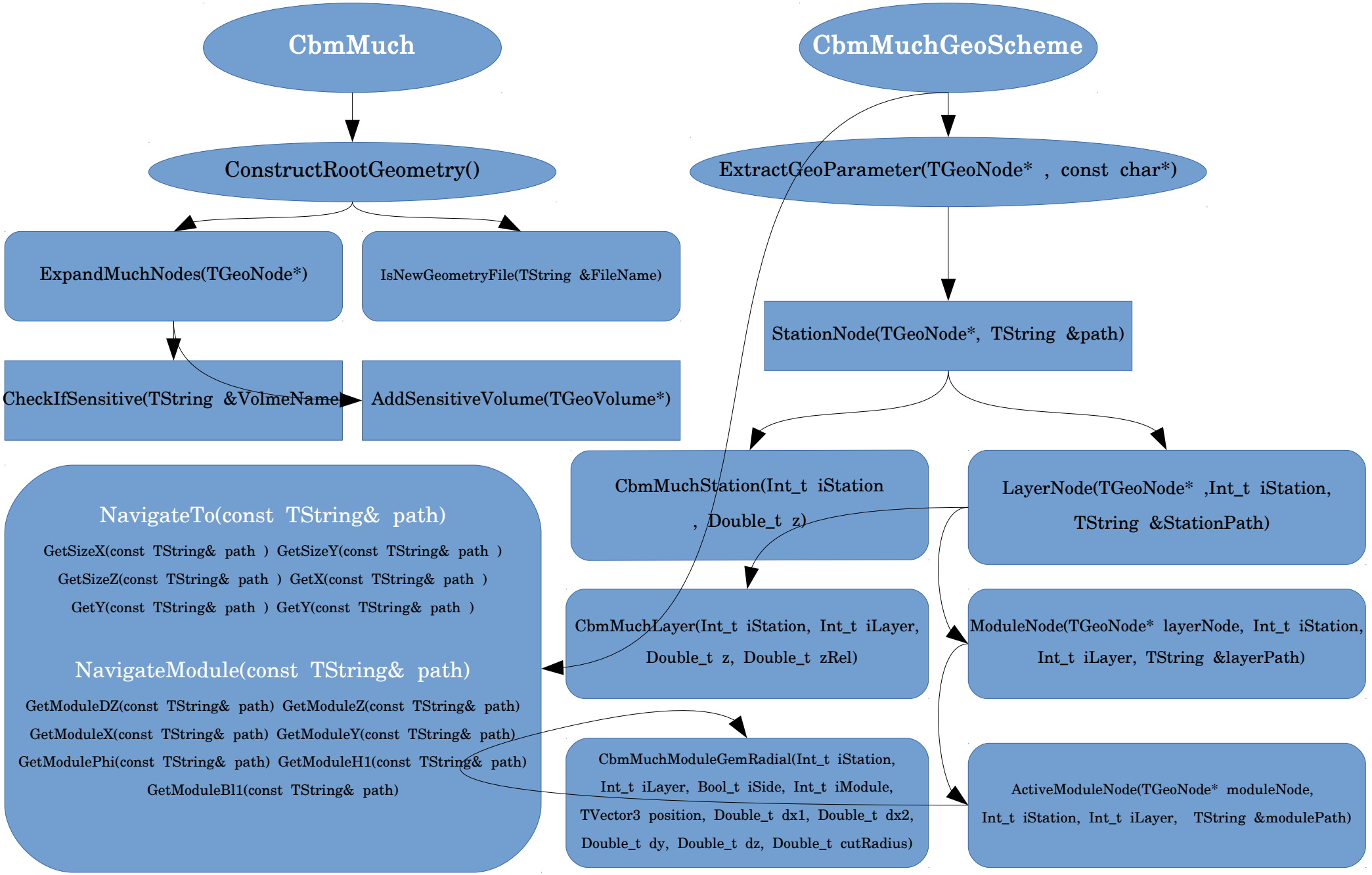
Layout of Rootified Geometry



Structure of geometry root file



Development of Geohandler classes (For adding modified geometry to transport)



Summary

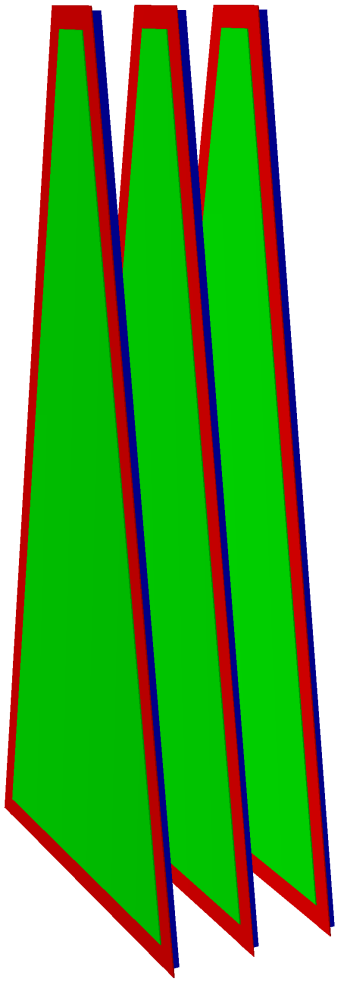
- MuCh geometry in Root format has been created with macro placed in repository (*/macro/much/geometry)*.
- Geohandler classes (CbmMuch & CbmMuchGeoScheme) have been developed for transport process using rootified geometry and added to repository (*/much/geo*).
- Full simulation chain (up to tracking) has been checked and working properly.

mMuCh simulation for mCbm

System: Central (Au + Au)
Beam Energy: 1.24 A GeV
Event Generator: UrQMD
Event Statistics: 10K

Target :

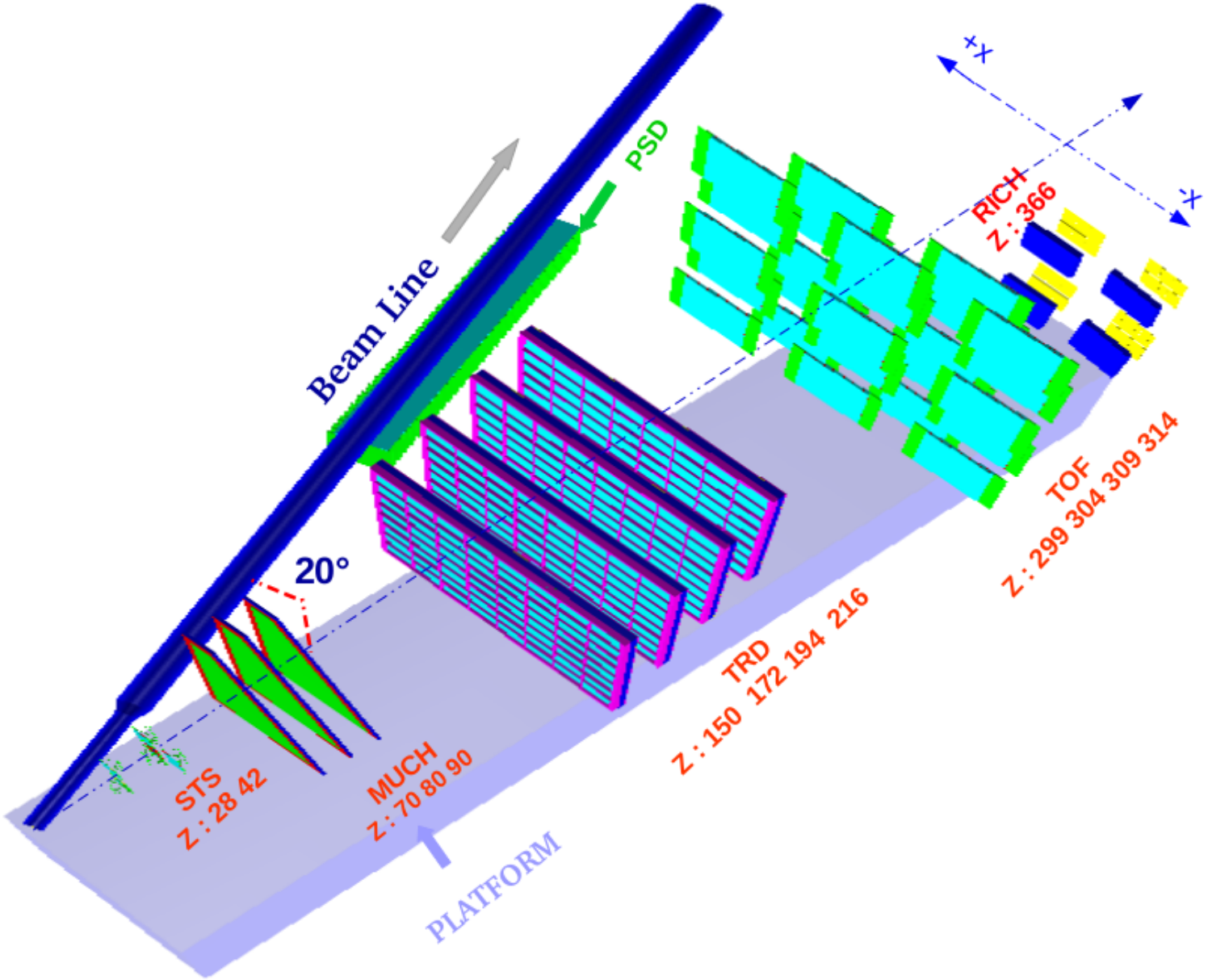
Element = Gold.
Thickness = 0.1 cm.
Diameter = 0.5 cm.
Position = (0,0,0).
RotY = 0 Deg.
BeamRotY = 20 Deg.



No Magnetic Field.

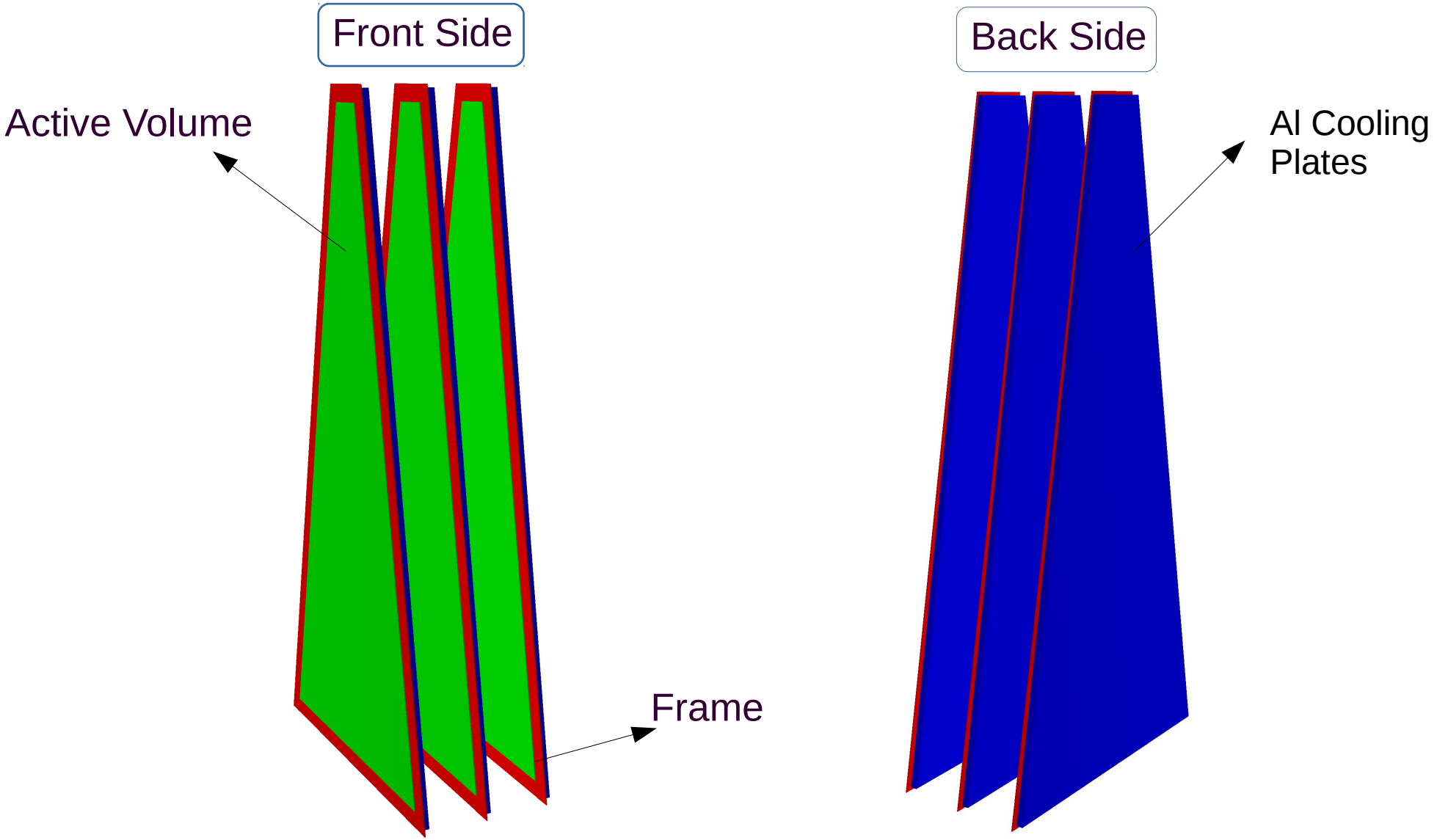
Transport: GEANT3.

Mcbm Setup



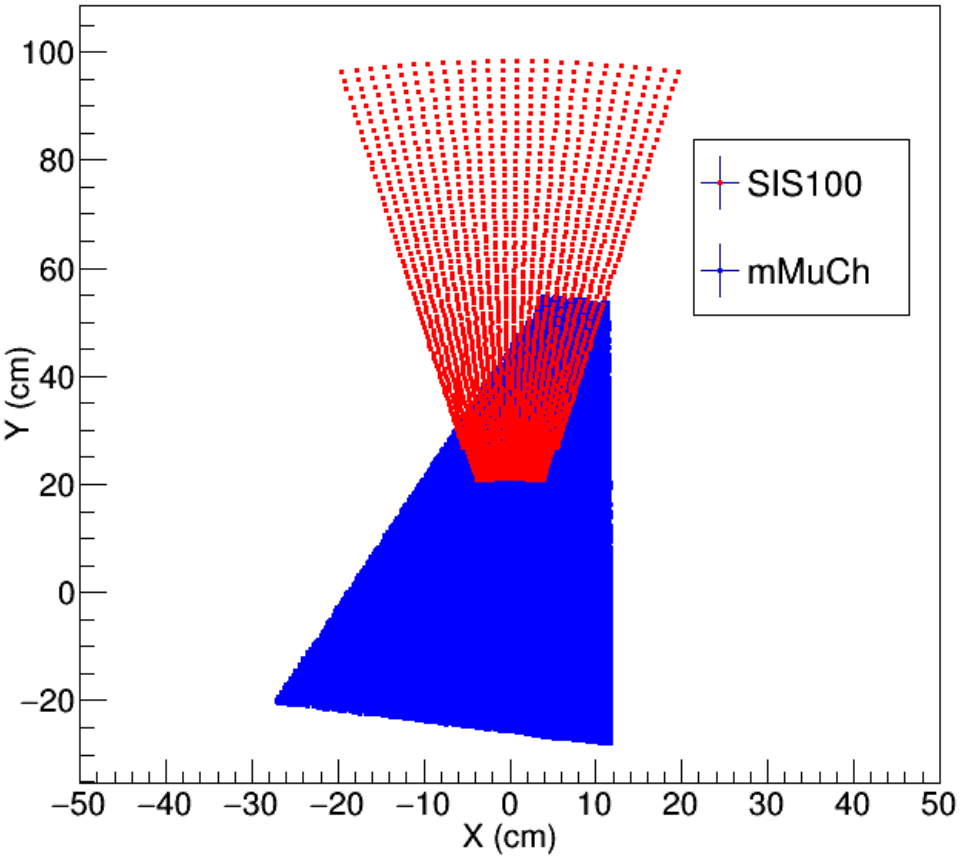
Courtesy: Ekata Nandy

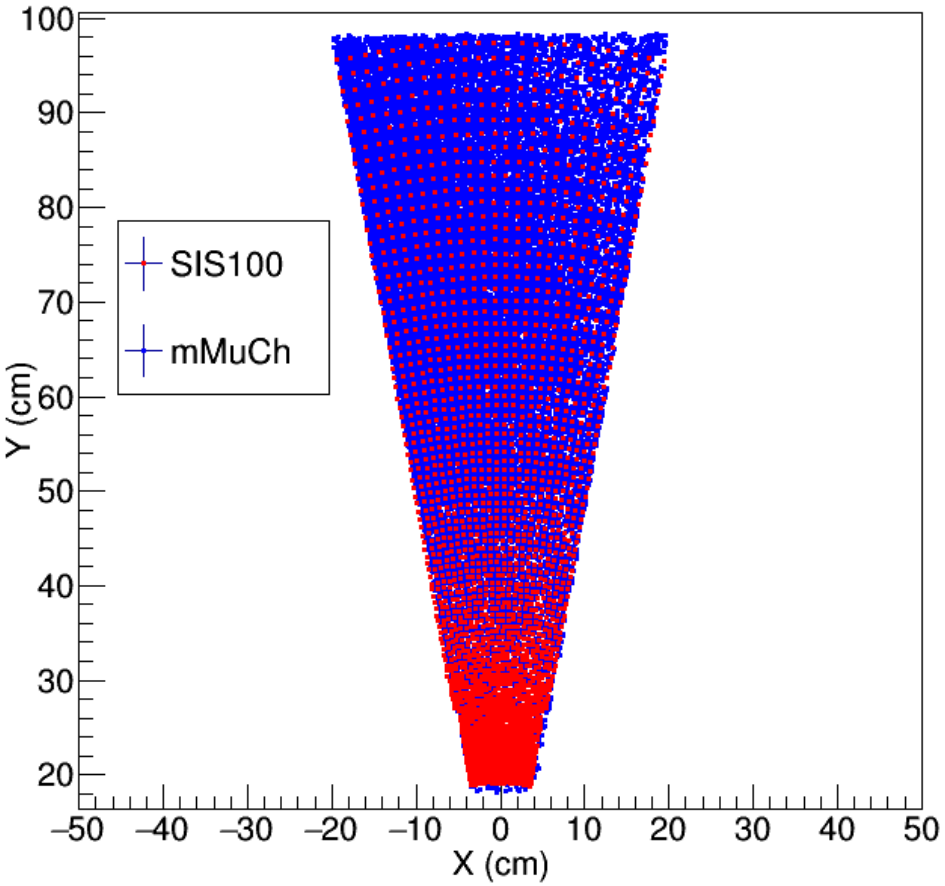
Mini-MuCh (Schematic View)



- 3 real size GEM modules have been placed at 70, 80 and 90 Cms respectively.

Segmentation in mMuCh



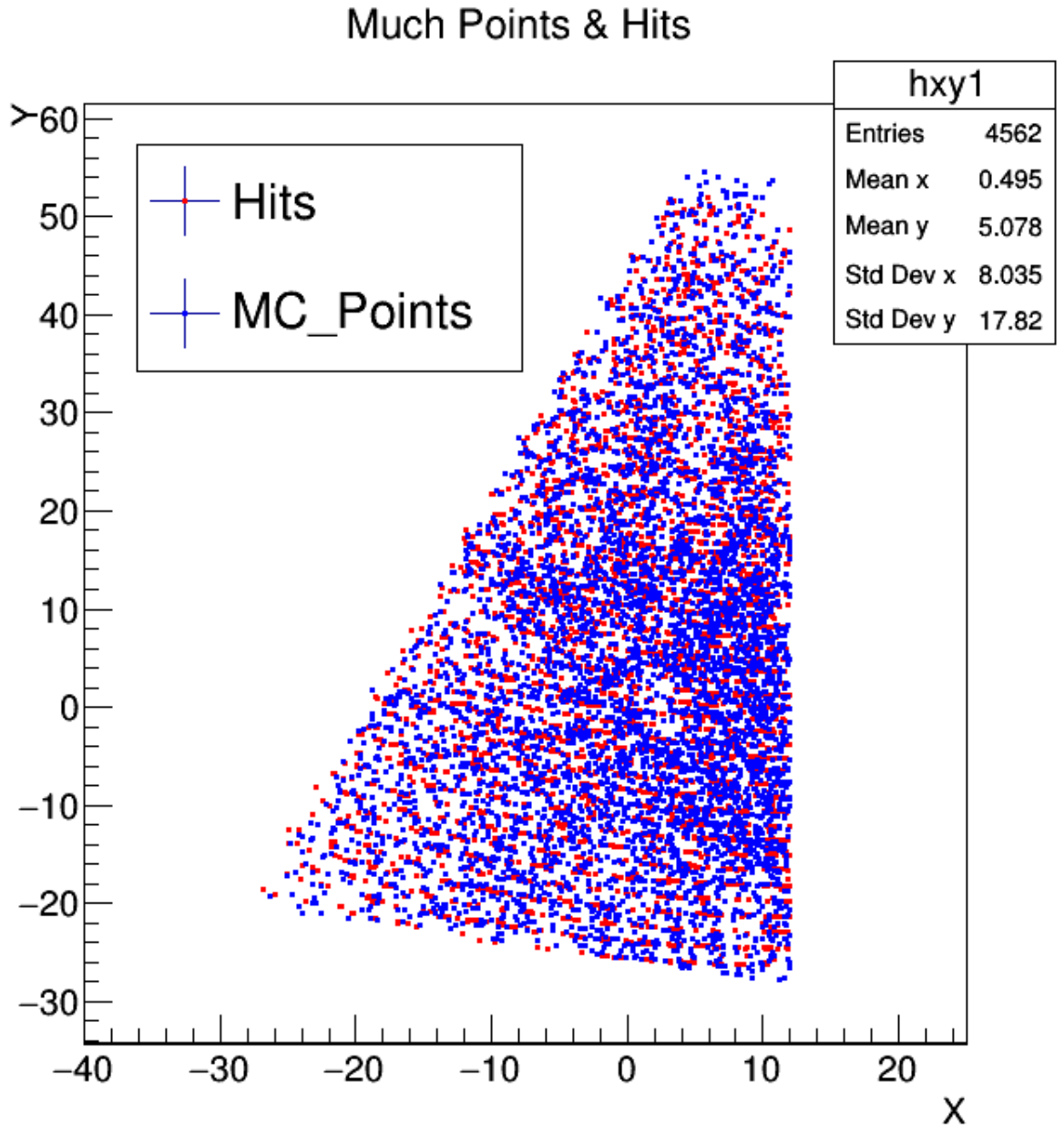


Transformation Equations:

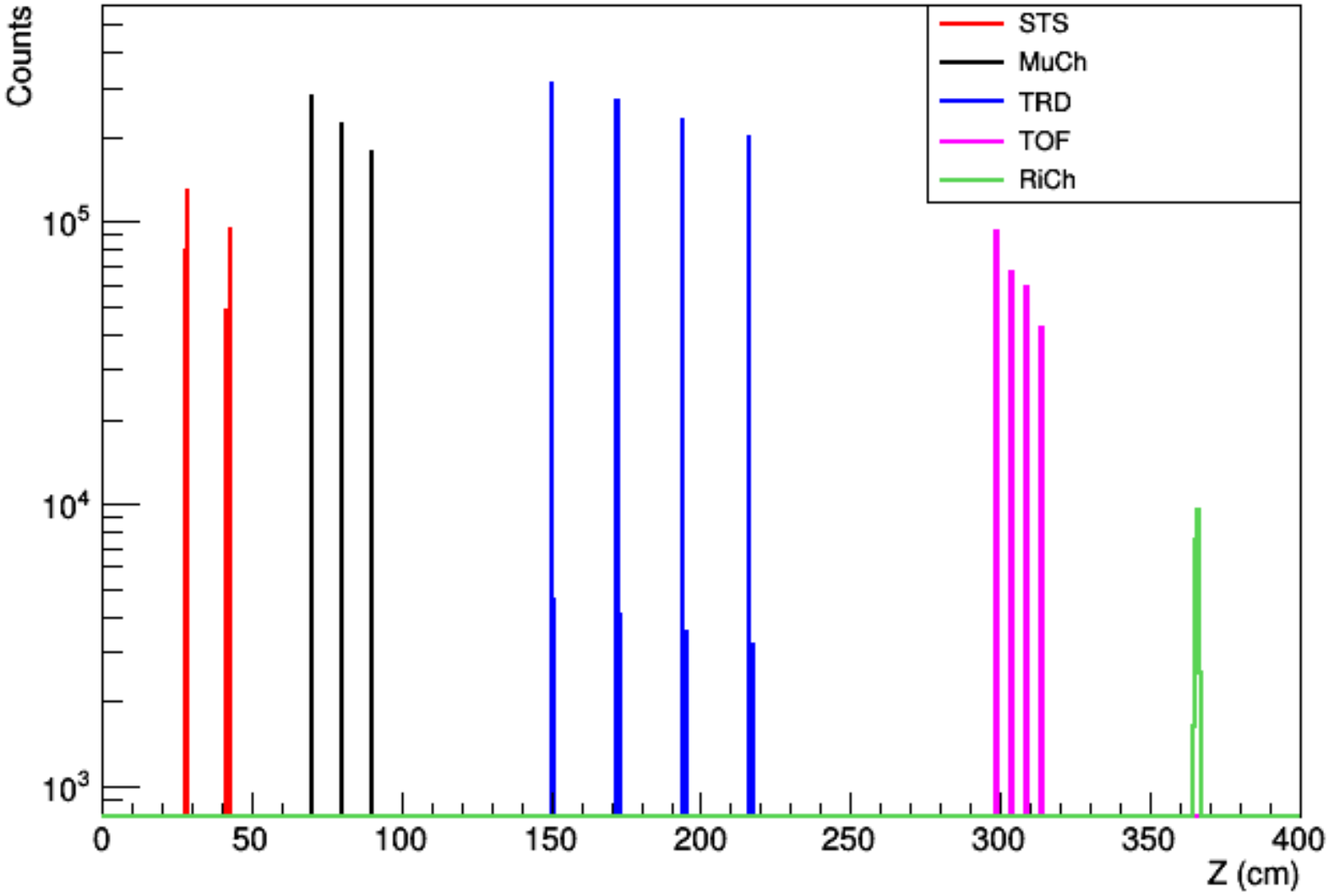
X' = (X-11.8) Cos(168.5°) +(Y-72.0) Sin(168.5°)

Y' = - (X-11.8) Sin(168.5°) +(Y-72.0) Cos(168.5°)

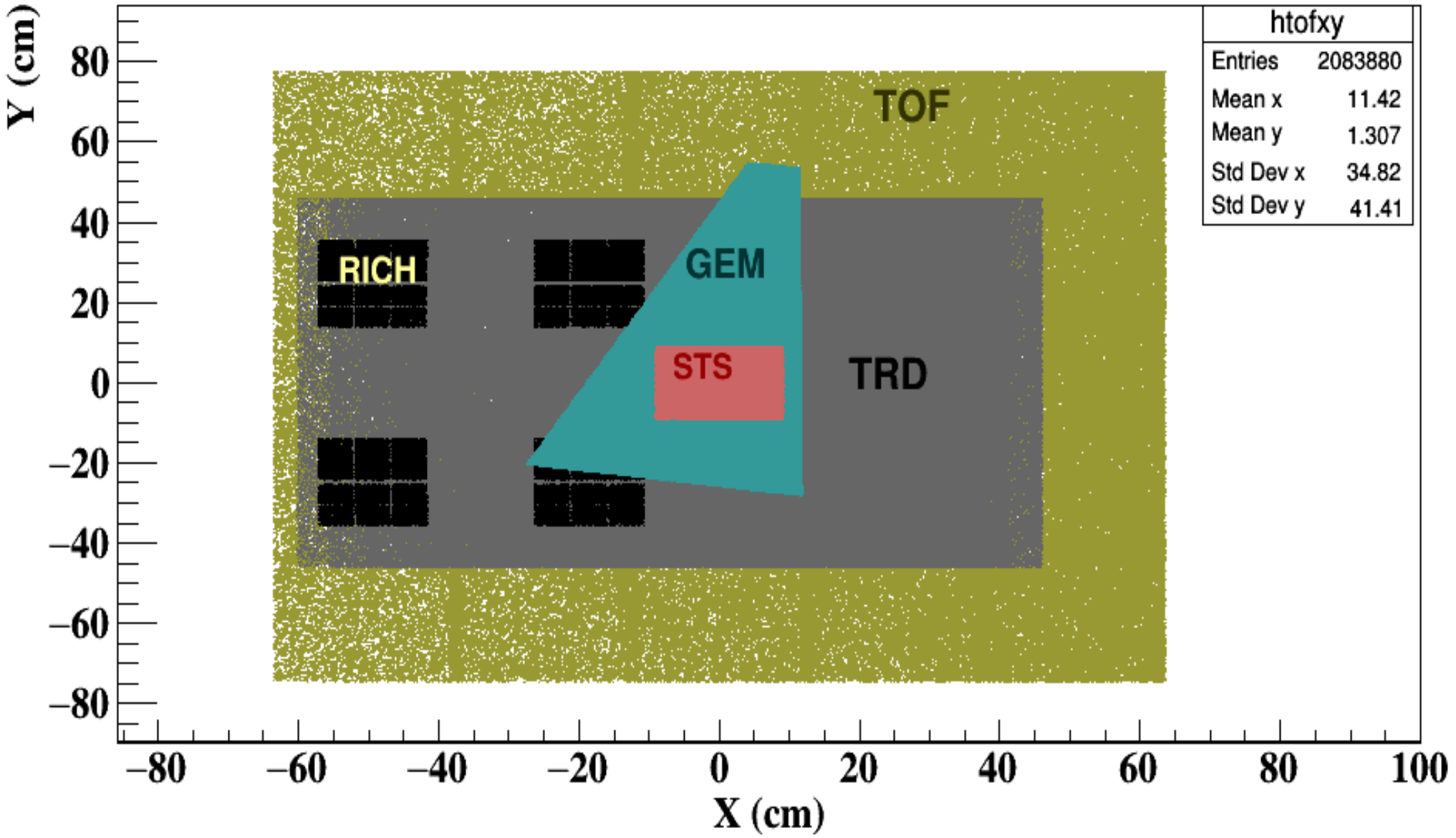
XY distribution of Much Points & Much Hits



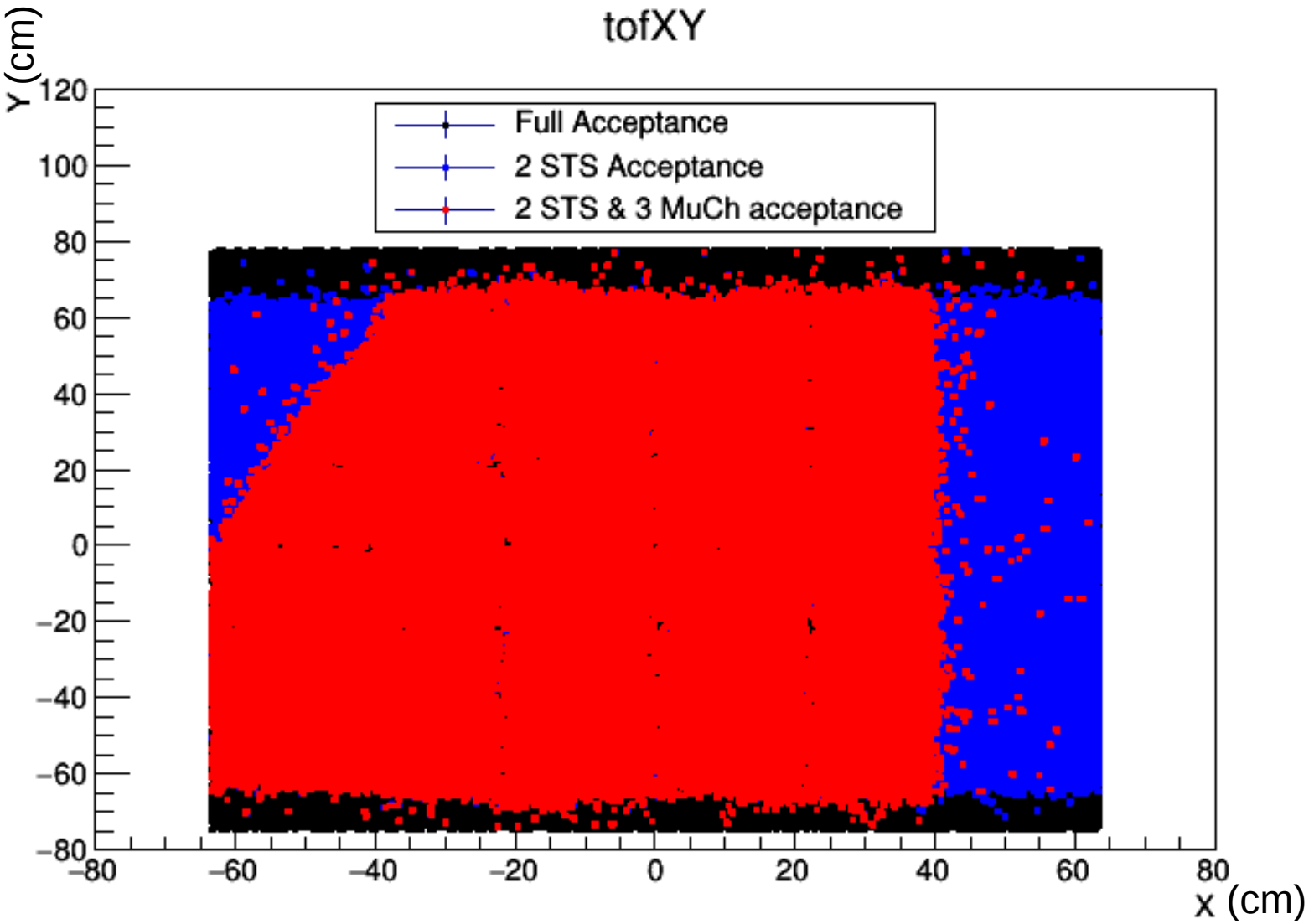
Position Distribution



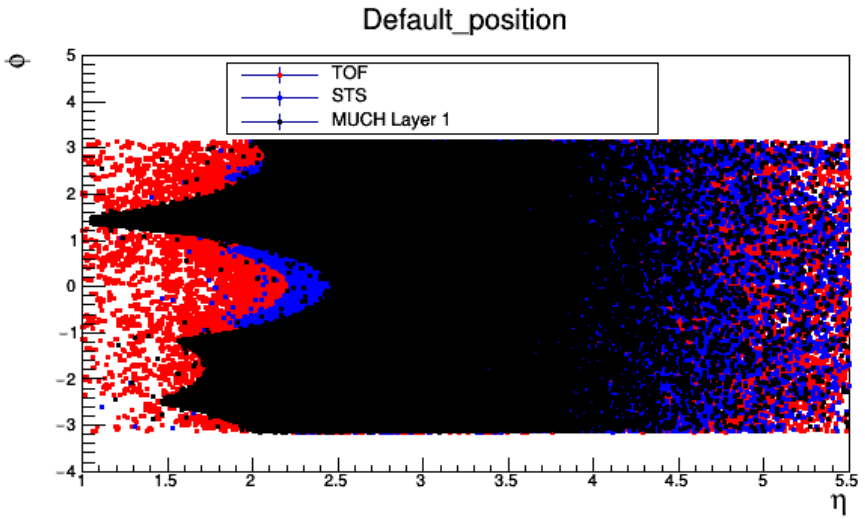
Position(X,Y) of each Setup

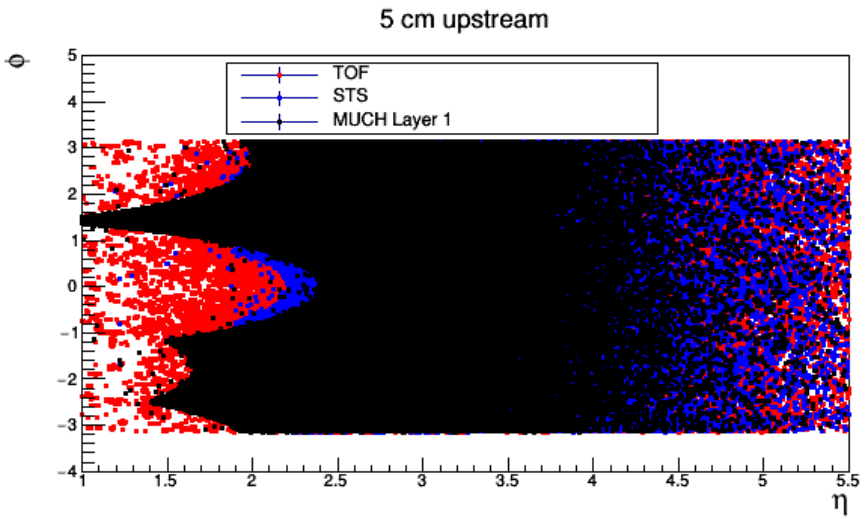


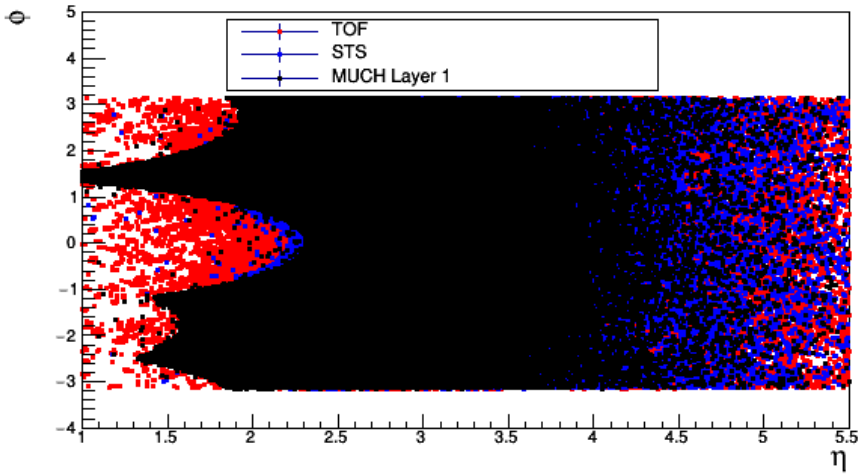
XY distribution of TOF points

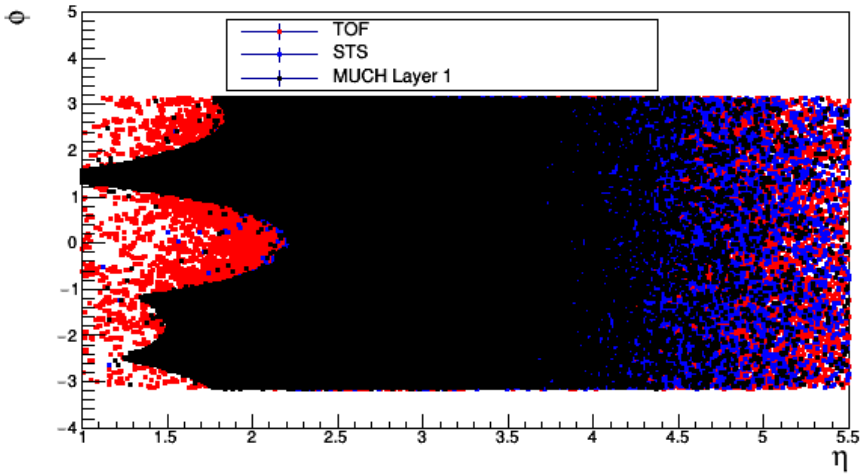


Eta Phi distribution(mMuCh Layer I)

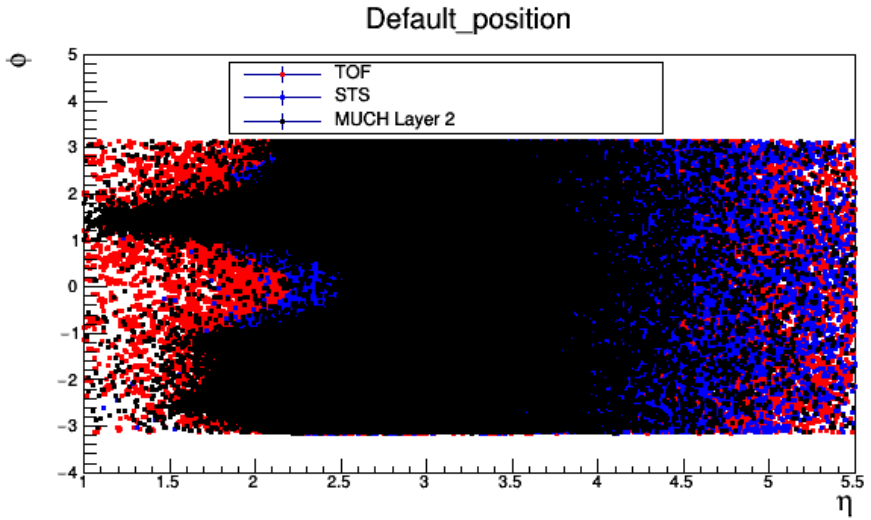


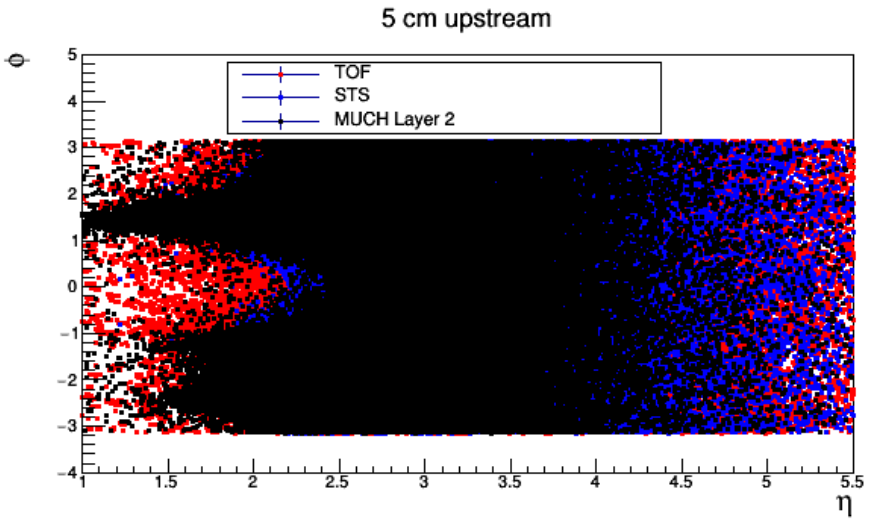


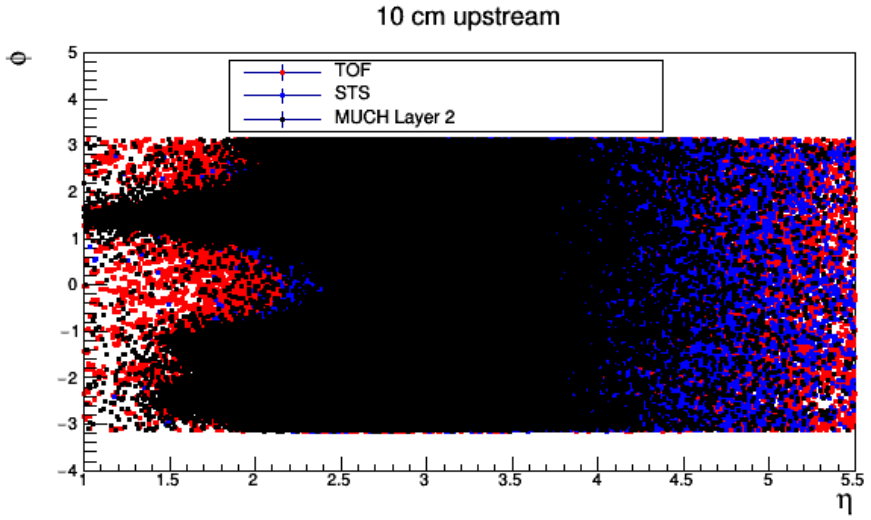


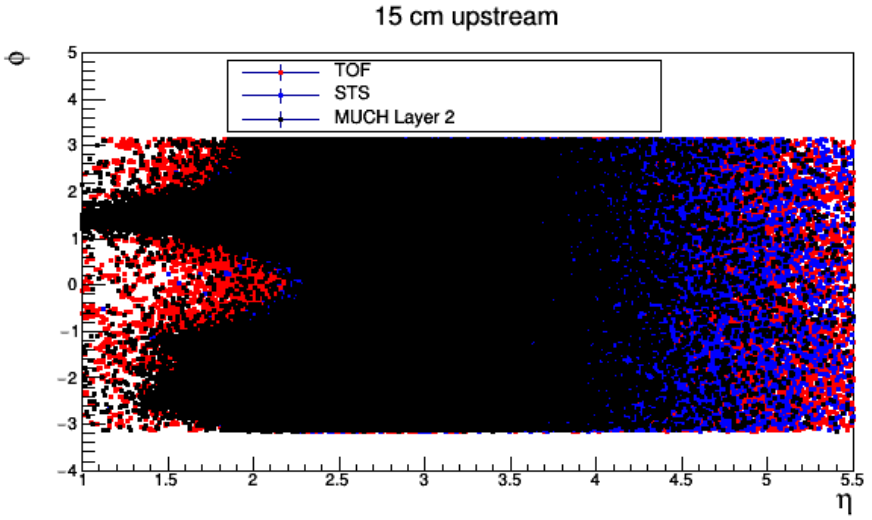


Eta Phi distribution(mMuCh Layer II)

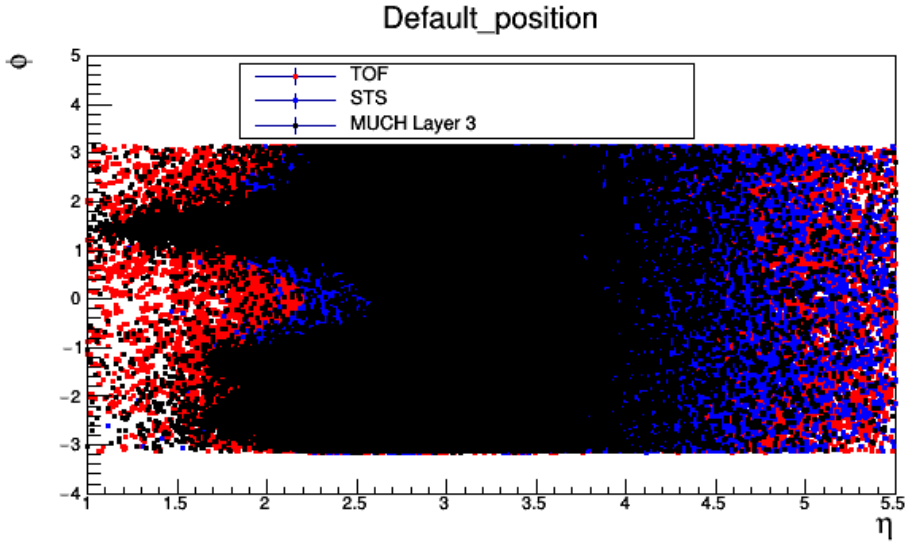


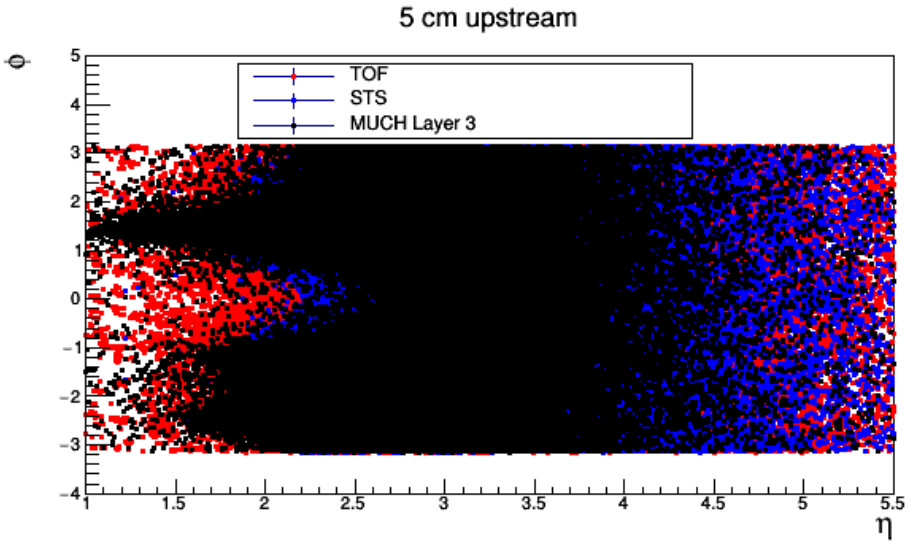


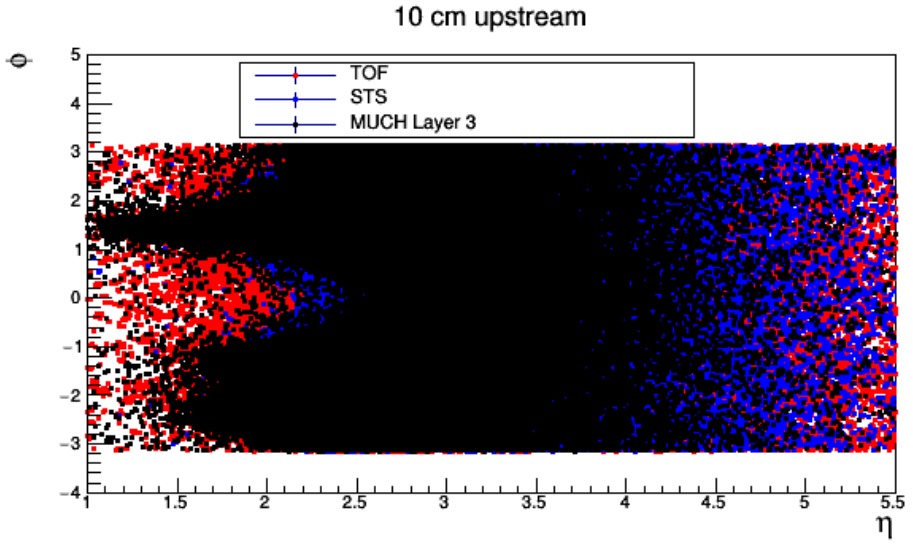


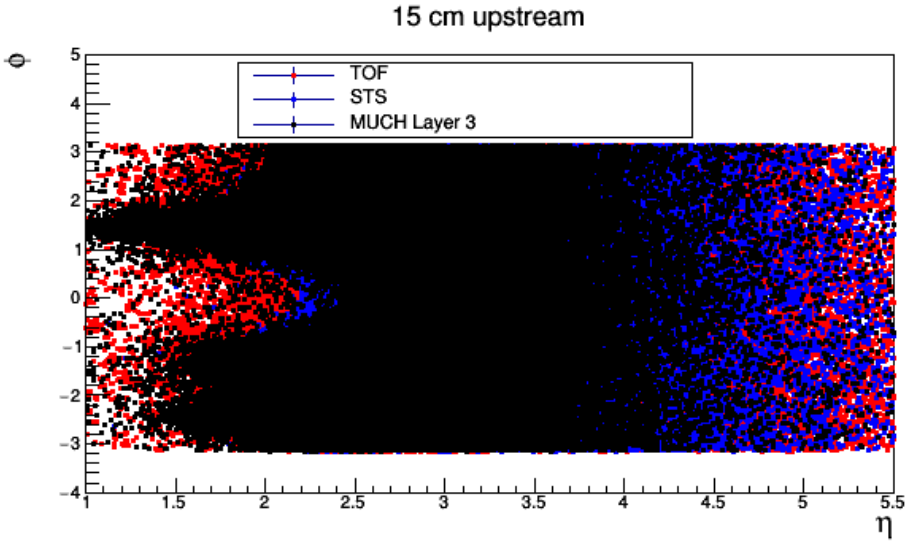


Eta Phi distribution(mMuCh Layer III)

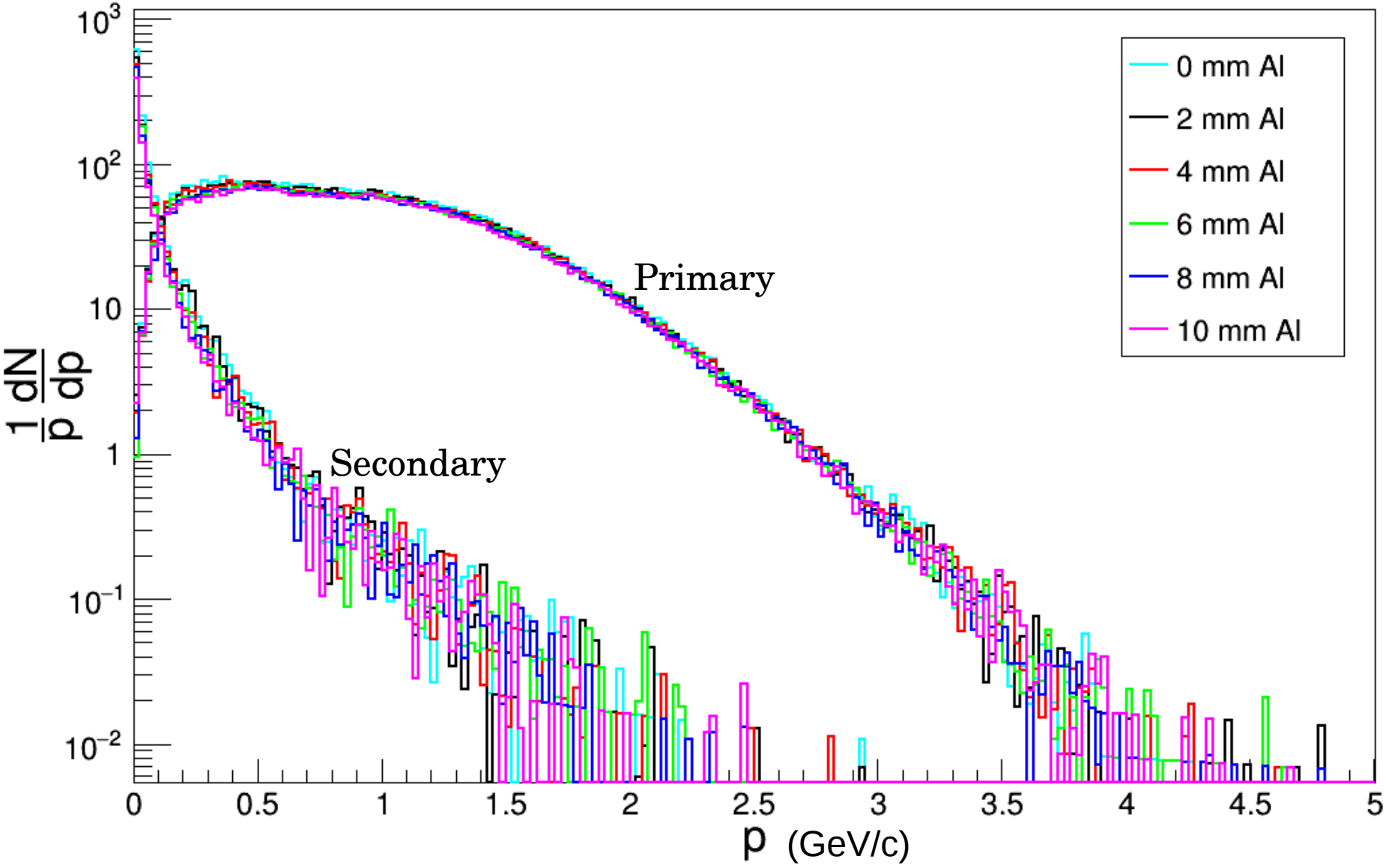




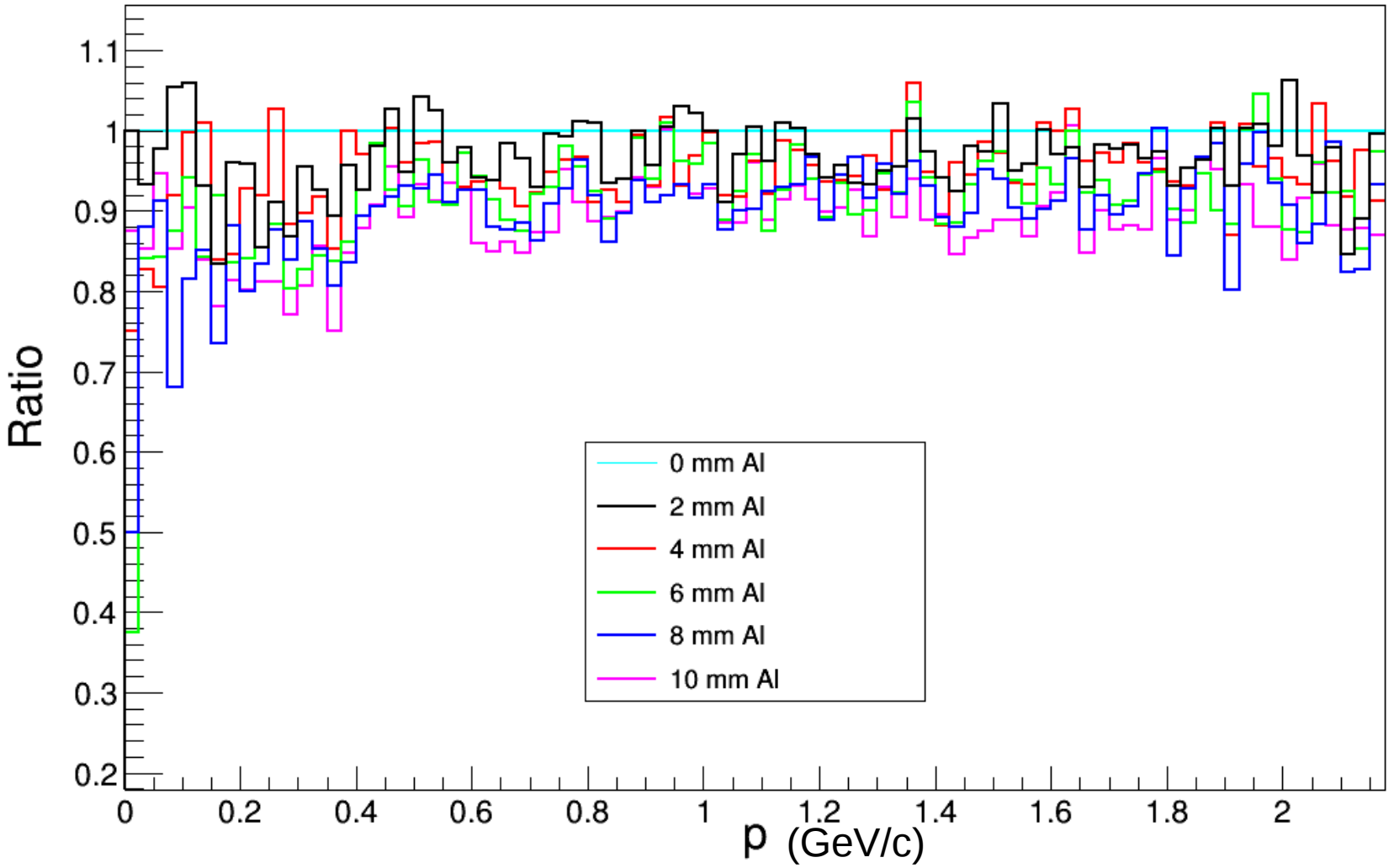




Momentum distribution of TOF points



Momentum Ratio



Summary

- Developement of segmentation (comptaible with mMuCh setup) has been done and added to repository.

- Investigation of additional material budget due to Aluminium cooling plates is in progress.

- Full track reconstruction and development of tracking QA classes are in progress in consultation with *Timur Ablyazimov*.


THANK YOU
FOR YOUR
TIME

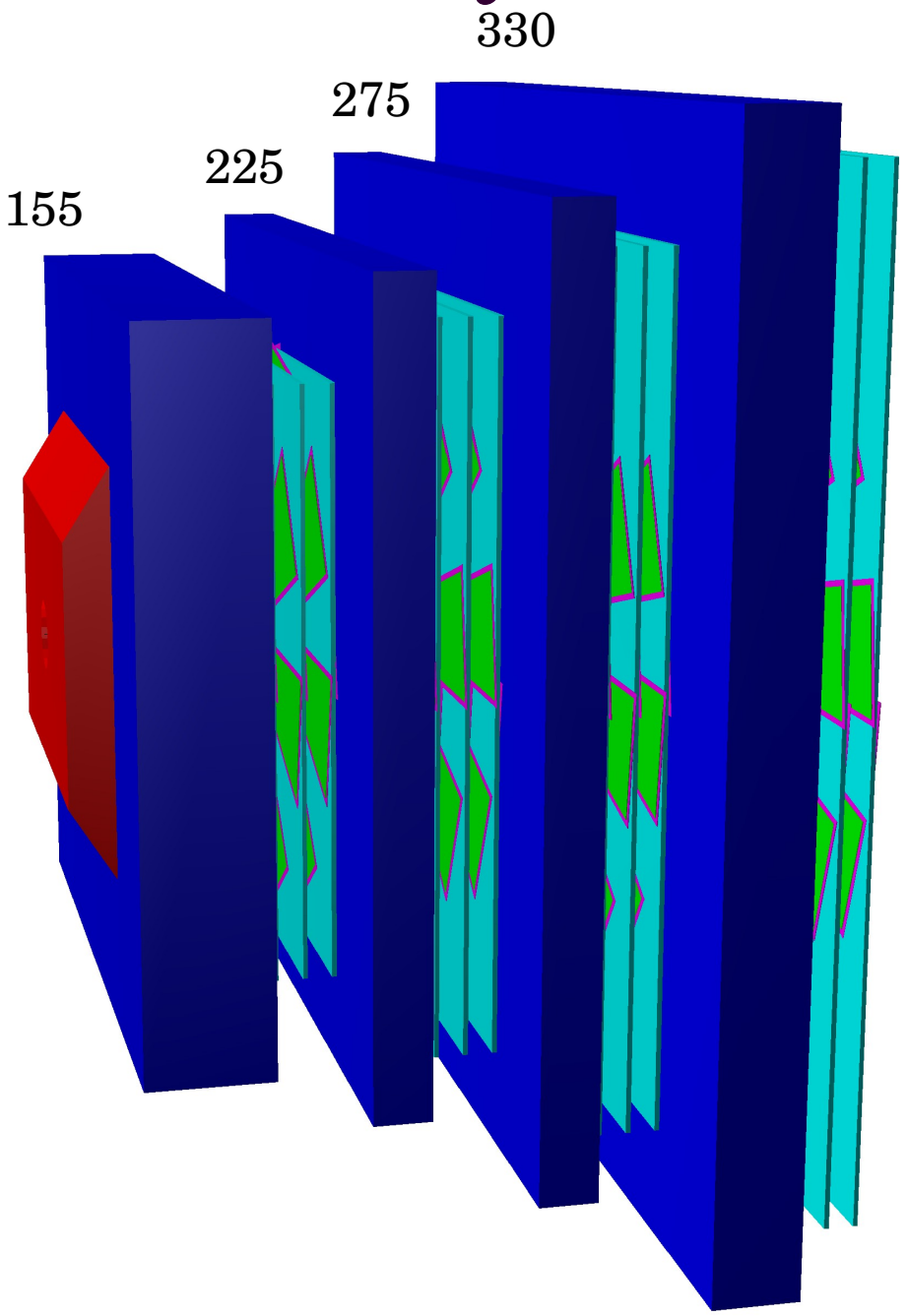
Rootified geometry created with a macro:

- Name of output file with geometry
- The materials which defined in the global media.geo file
- Universal input parameters (Muchcave position & acceptance)
- Input parameters for absorbers (No of absorbers, positions(cave reference frame), thickness, safetyradii)
- Input parameters for MUCH stations (No of stations, no of sectors per layer, active volume thickness, spacer width in R, spacer width in Phi, overlap in R direction, stations position, no of layers per station, detector type, Dz of the layer, support thickness of layer.
- Input parameters for beam pipe shielding (No of shield, shield position, shield size in Z, acceptance tangent min for shield, acceptance tangent max for shield)
- Create the top volume
- Create a much volume assembly and add to top volume as node
- Create a Absorber volume assembly and add to much as node
- Create a Shield volume assembly and add to much as node
- Create a Station volume assembly and add to much as node
- CreateShields(iShield)
- CreateAbsorbers(iAbsorber)
- CreateStations(iStation)
- CreateLayers(iStation, iLayer)

  Start adding the layersides (Front & Back)

  Start adding the modules

Latest MuCh Geometry @ SIS-100B



Much.cxx (New)	Much.cxx (Old)
ContructGeometry(): Decide whether geometry is in root format or not if yes then calls to ConstructRootGeometry() to read root geometry.	ContructGeometry(): Calls to the CbmMuchGeoScheme which reads .geo file.
ConstructRoot Geometry(): IsNewGeometryFile(): Volume Name & ClassName Import the geometry file Get Top Volume Expand all nodes() CheckIfSensitive() Whether node contains active volume. AddSensitiveVolume(Active Node)	Removed: Create Much Cave Create Absorbers Create Stations Create Layers Create Modules

CbmMuchGeoScheme.cxx (New)	CbmMuchGeoScheme.cxx (Old)
ExtractGeoParameter(TGeoNode* ncave, const char* volumeName): For extract the geometry parameters StationNode() Get Rmin, Rmax, TubeRmin, TubeRmax & Position of Stations. LayerNode() SupportDx, SupportDy, & SupportDz. ModuleNode() LayerGlobalZ (supportNode) ActiveModuleNode()pos, Dx1, Dx2, Dy, Dz, Nmodules NavigateTo(path) Find out the Box shape. GetSizeX(), GetSizeY(), GetSizeZ(), GetX(), GetY(), GetZ() NavigateModule(path) Find out the Trap shape. GetModuleDZ(), GetModuleX(), GetModuleY(), GetModuleZ(),, GetModulePhi(), GetModuleH1(), GetModuleTl1(), GetModuleBl1()	Removed: ReadGeoFile() Print() CreateMuchCave() CreateAbsorbers() CreateStations() CreateStationGem() CreateStationStraw()

	Station				Absorber			
	I	II	III	IV	I	II	III	IV
Z	200	250	300	360	155	225	275	330
shape					Trapezoid + Parallelepiped	Parallelepiped	Parallelepiped	Parallelepiped
dz					60	20	20	30
material					C	Fe	Fe	Fe

Latest MuCh Geometry @ SIS-100B