



STT Updates

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10th Feb., 2016 ND-WG Meeting



Outline

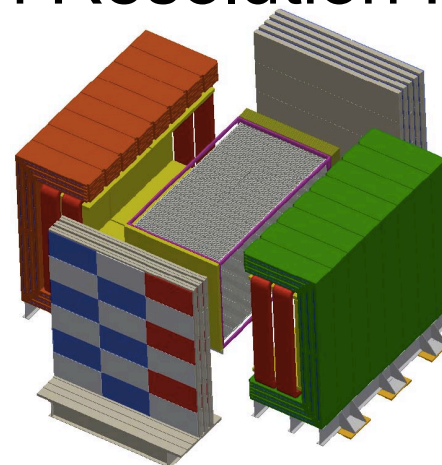


- Procurement of Raw material for the **Developmental Prototype**
- Straw tube Prototype Detector Simulation using **Geant4**
- On-going activities (FEA Techniques)
- Future Plans



Reference Design - High Resolution FGT

- $\sim 3.5 \text{ m} \times 3.5 \text{ m} \times 6.5 \text{ m}$ STT ($\rho \simeq 0.1 \text{ g/cm}^3$)
- 4π ECAL in a dipole magnetic field ($B = 0.4 \text{ T}$)
- 4π MuID (RPC) in dipole and up/downstream
- Pressurized ^{40}Ar target $\simeq \times 10$ FD statistics and ^{40}Ca target



- Transition Radiation : e^\pm
- dE/dx : π^\pm , K^\pm and proton
- Magnet : + .vs. -
- MuID : μ
 \Rightarrow Absolute flux measurement

Radiator (Target) Mass	5.2 tons
Other Nuclear Target Mass	1.9 tons
Vertex Resolution	0.1 mm
Angular Resolution	2 mrad
E_e Resolution	$6\%/\sqrt{E}$ (4% at 3 GeV)
E_μ Resolution	3.5%
$\nu_\mu/\bar{\nu}_\mu$ ID	Yes
$\nu_e/\bar{\nu}_e$ ID	Yes
π^- .vs. π^+ ID	Yes
π^+ .vs. <i>proton</i> .vs. K^+	Yes
NC π^0 /CCe Rejection	0.1%
NC γ /CCe Rejection	0.2%
CC μ /CCe Rejection	0.01%



Developmental Prototype

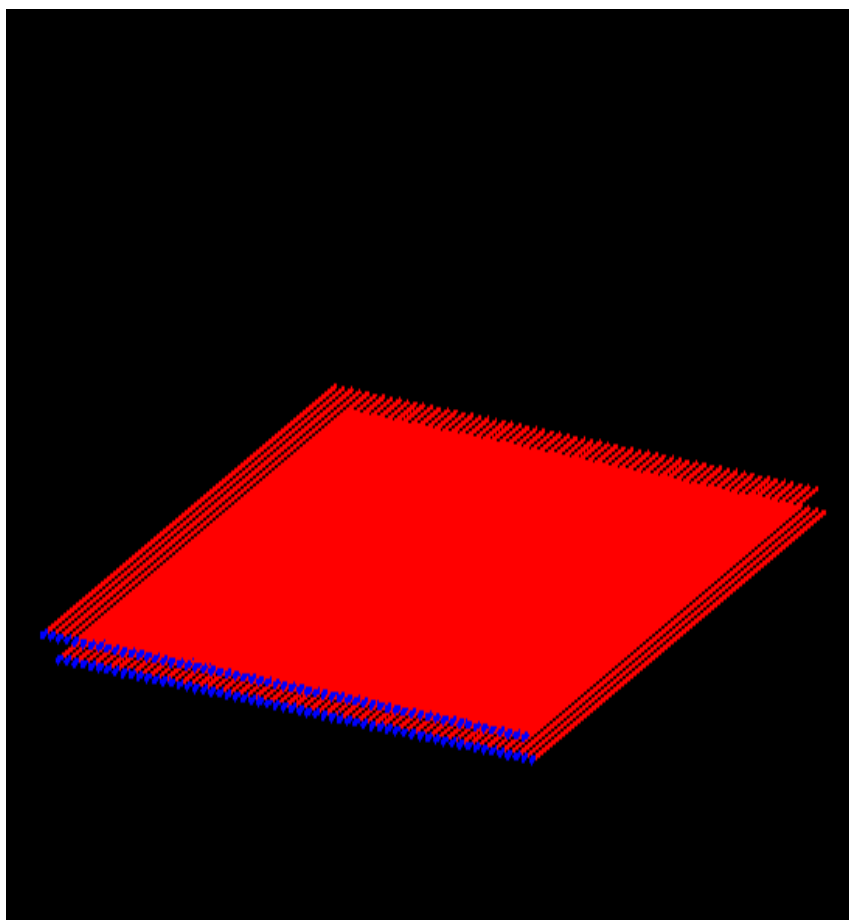


- Total **125 straws** (from **LAMINA**) sufficient for making the first prototype
 - 2 layer 1.8mt X 0.6mt
- **Mechanical inspection** of straws already done
- Already have (20 & 30 micron) anode wire (gold plated tungsten)
- Procurement of endplugs, spacers, crimping pins, spring connectors has been done
- Plan to start fabrication by Feb/Mar, 2016 (?)

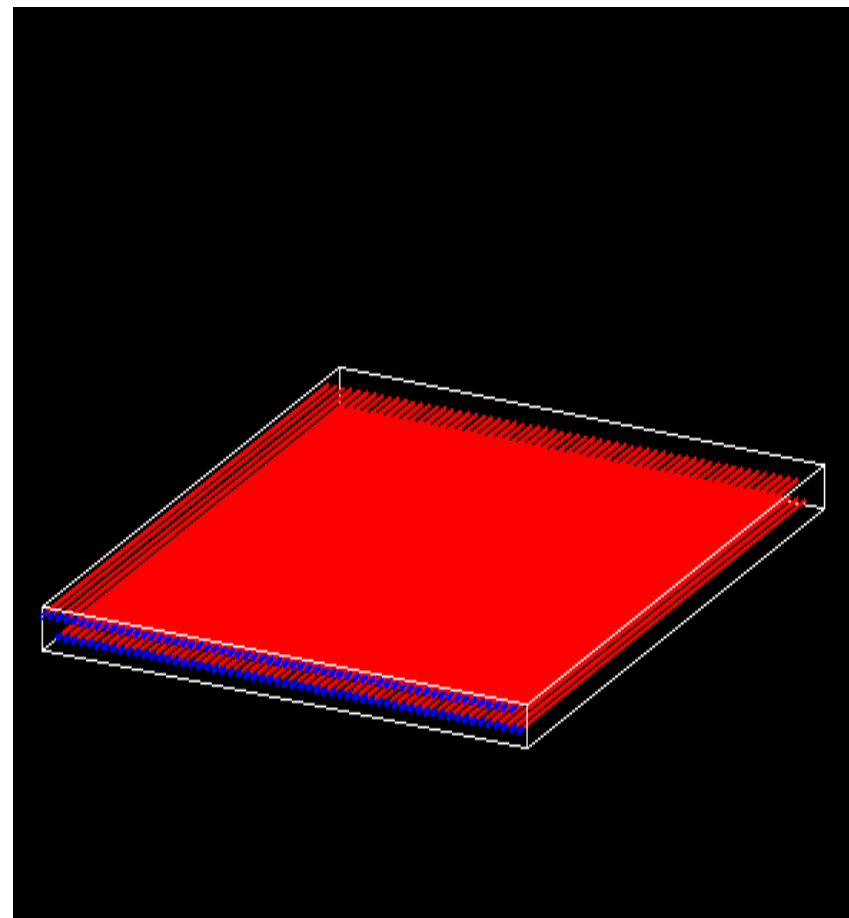
Vendors identified and Procurement Chain tested



Prototype Detector Geom using Standalone G4



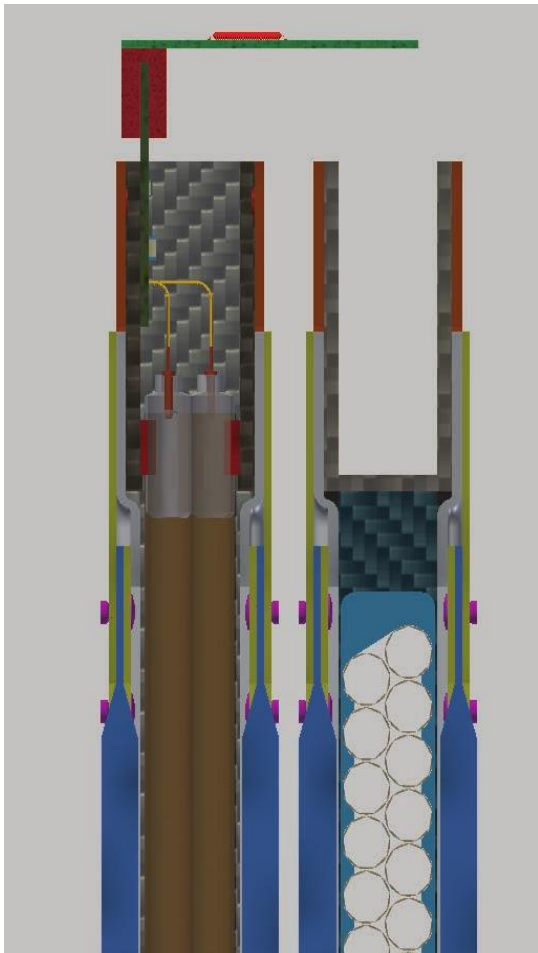
Without frame



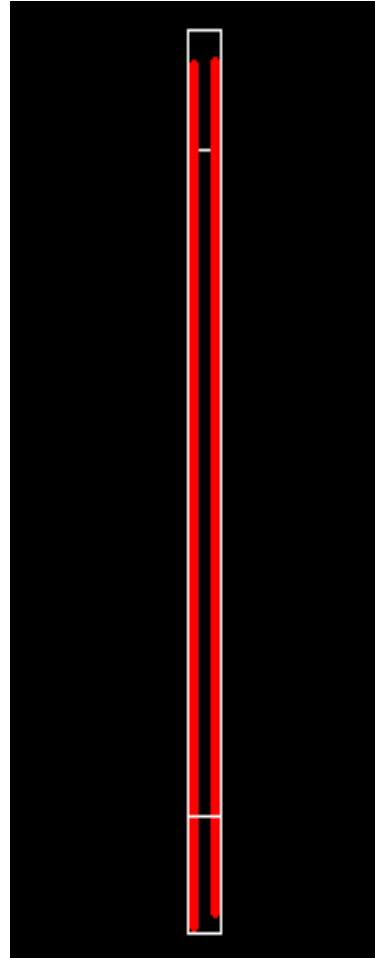
With frame (material
not fixed)



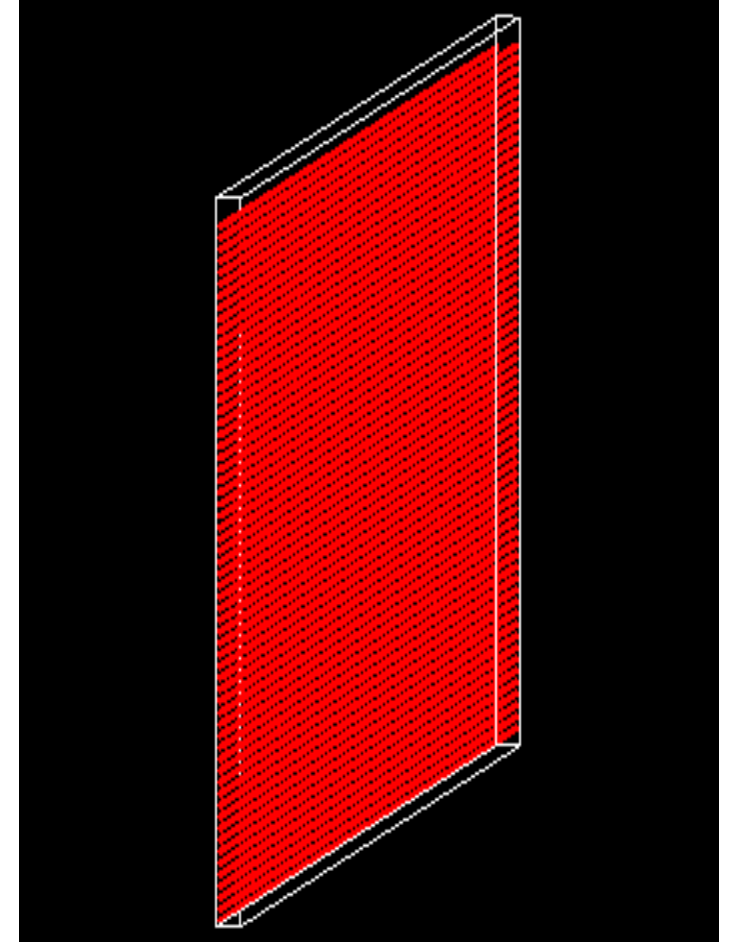
Submodule Geometry in G4



STT Module-4 layers



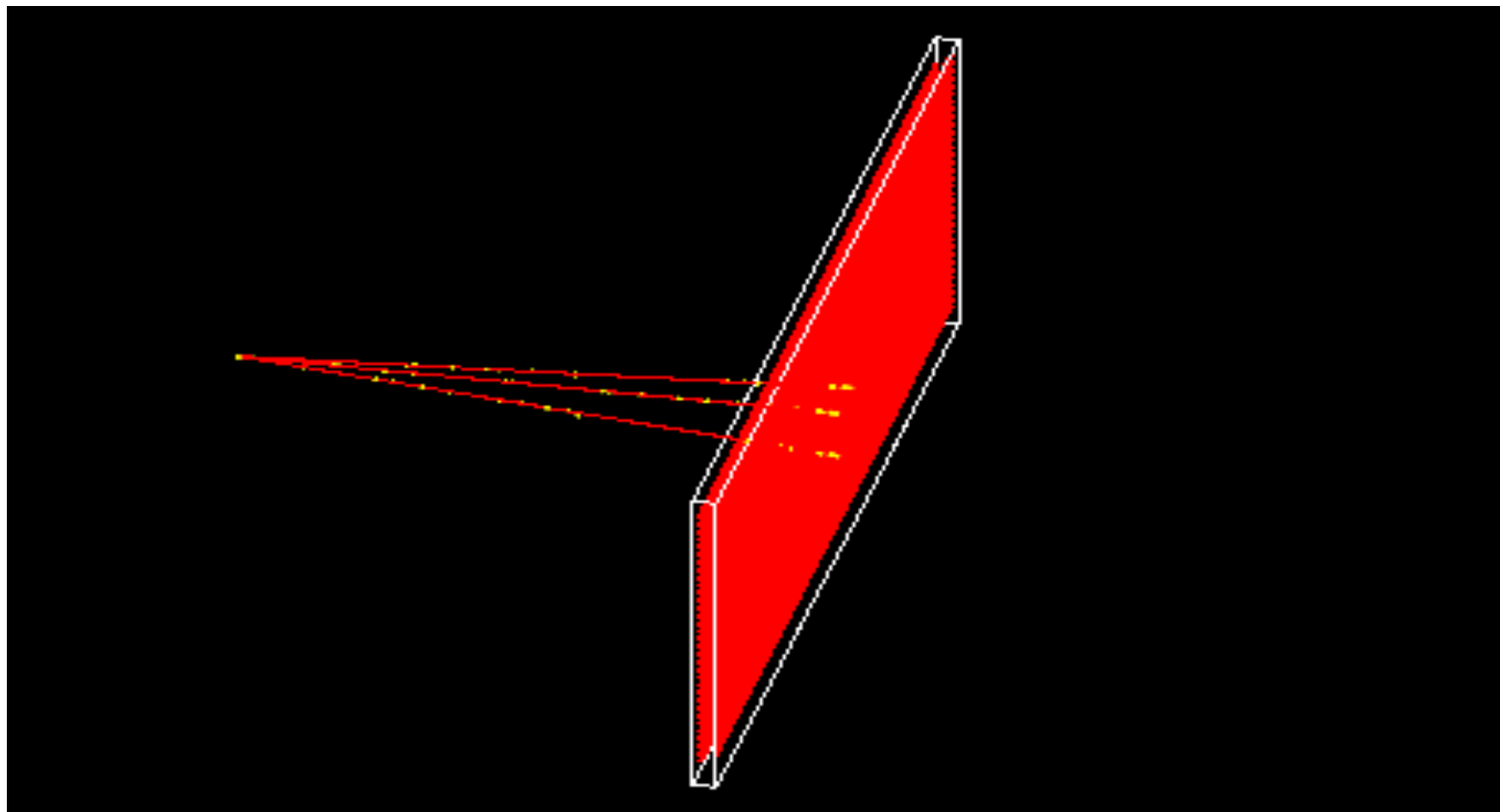
2 Layers



2 Layers Module+ Frame



G4 Simulation 2 GeV muons



2 Layer Developmental Prototype with 2 GeV muons



FEM Techniques for the Mechanical Structure



- **FEA – Finite Element Analysis**

Dimension of frame required for holding staggered layers of tubes of various material (Al, C composite) and tension of anode wire, is determined using FEA

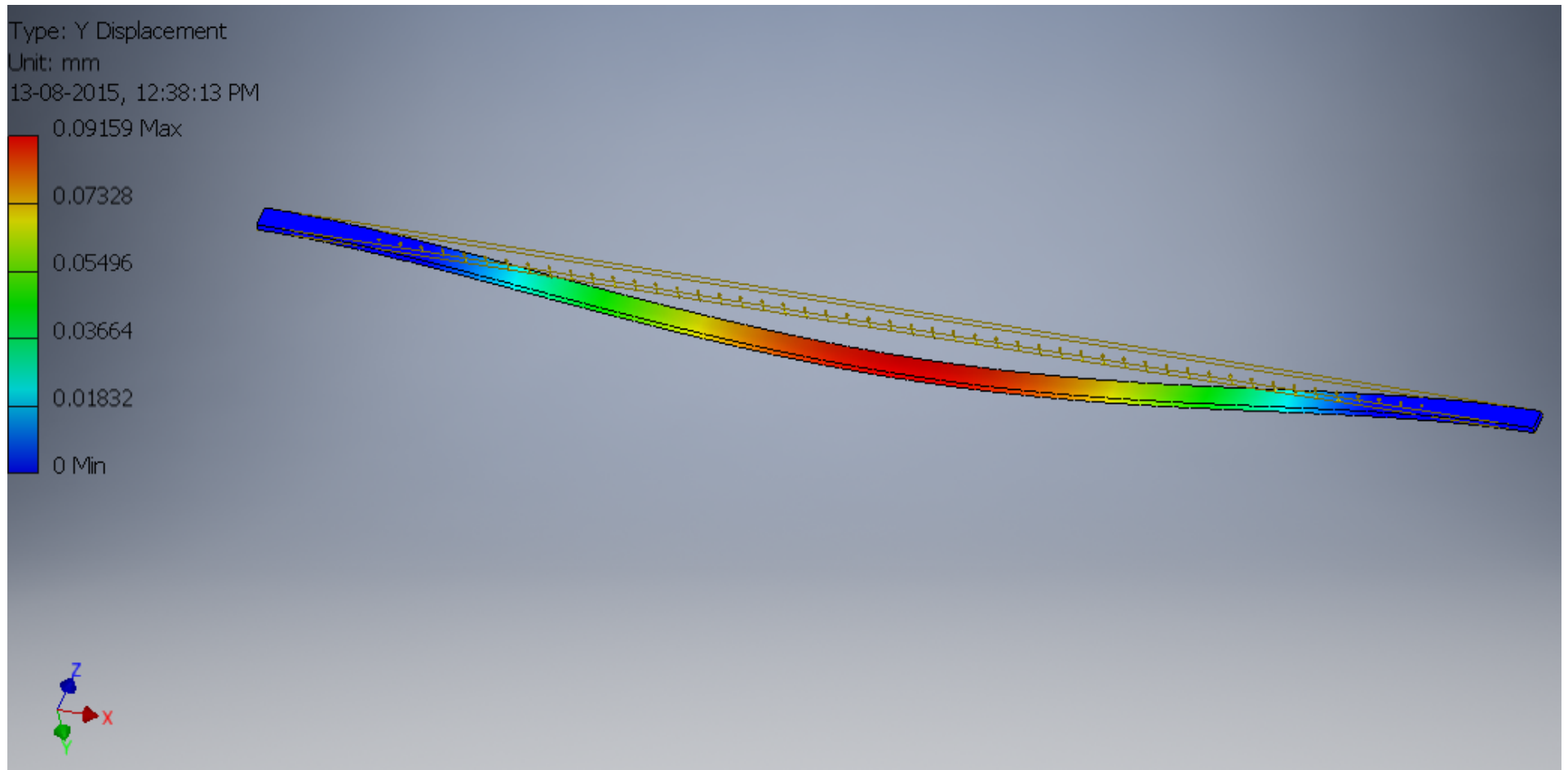
- **3D Modelling**

3D models of detector assembly is made using 3D CAD software (Autodesk Inventor®) for Digital Prototyping and Geant4 simulations

- 3D GDML geometry needs to be generated for GEANT4



Visual Results





Tabulated Results



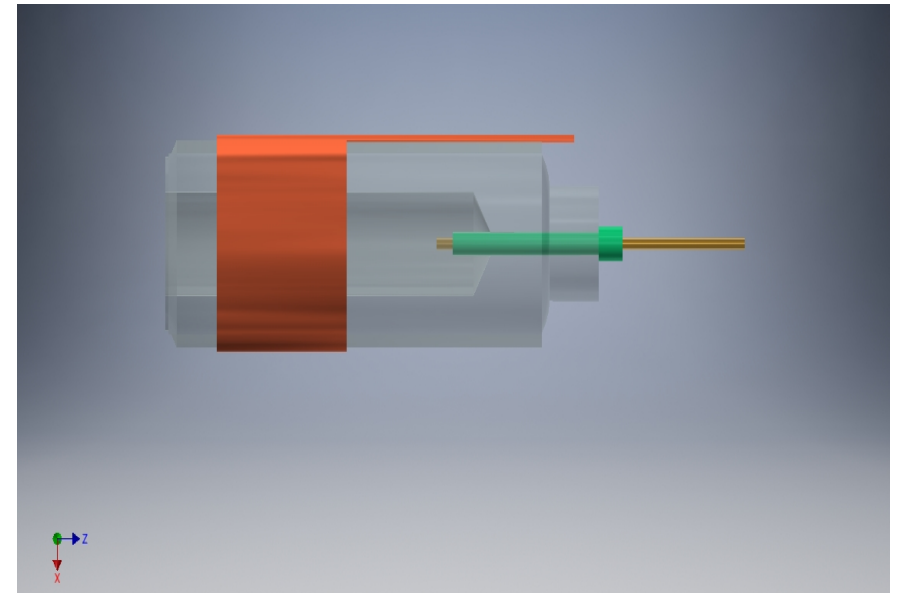
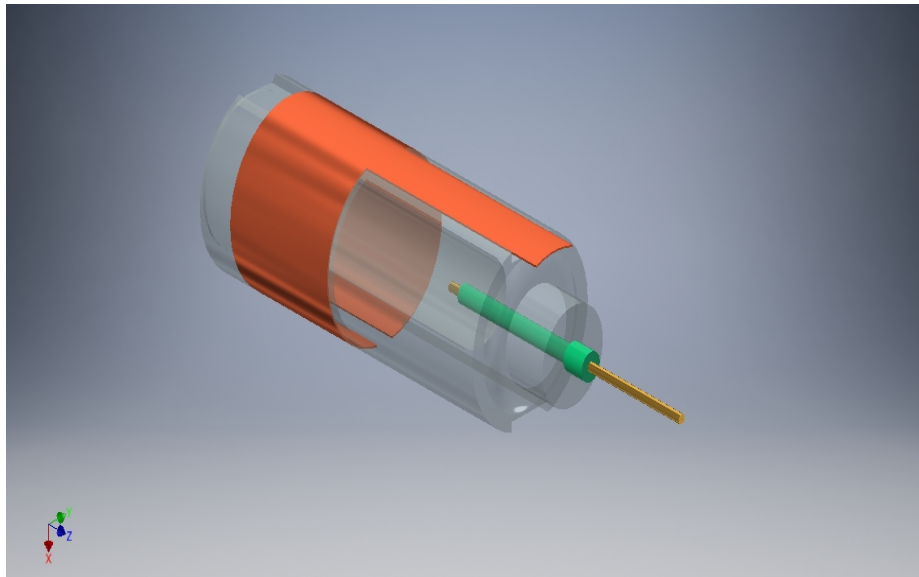
Thickness (mm) of Frame	Displacement in Y (mm)							
	60 cm, 1Row		60 cm, 2Row		1.8 m, 1Row		3.6 m, 1Row	
	CFRP	Al	CFRP	Al	CFRP	Al	CFRP	Al
1	2.555	4.70292	1.225	2.381	85.71	134.4	357.9	2418
2	0.31	0.59046	0.1553	0.3011	8.389	16.02	69.01	133.8
3	0.09159	0.17579	0.04587	0.08889	2.48	4.789	19.86	38.48
4	0.03869	0.07427	0.01935	0.0375	1.049	2.027	8.38	16.2
5	0.01967	0.03808	0.00995	0.01927	0.5347	1.033	4.298	8.3
5.5							3.225	
6							2.484	4.796

CFRP: Carbon Composite Frame

1Row: Single Layer or StrawTubes, 2Rows: Double Layer of StrawTubes



End caps



Endcaps are designed using 3D CAD Autodesk Inventor



Ongoing & Future plan



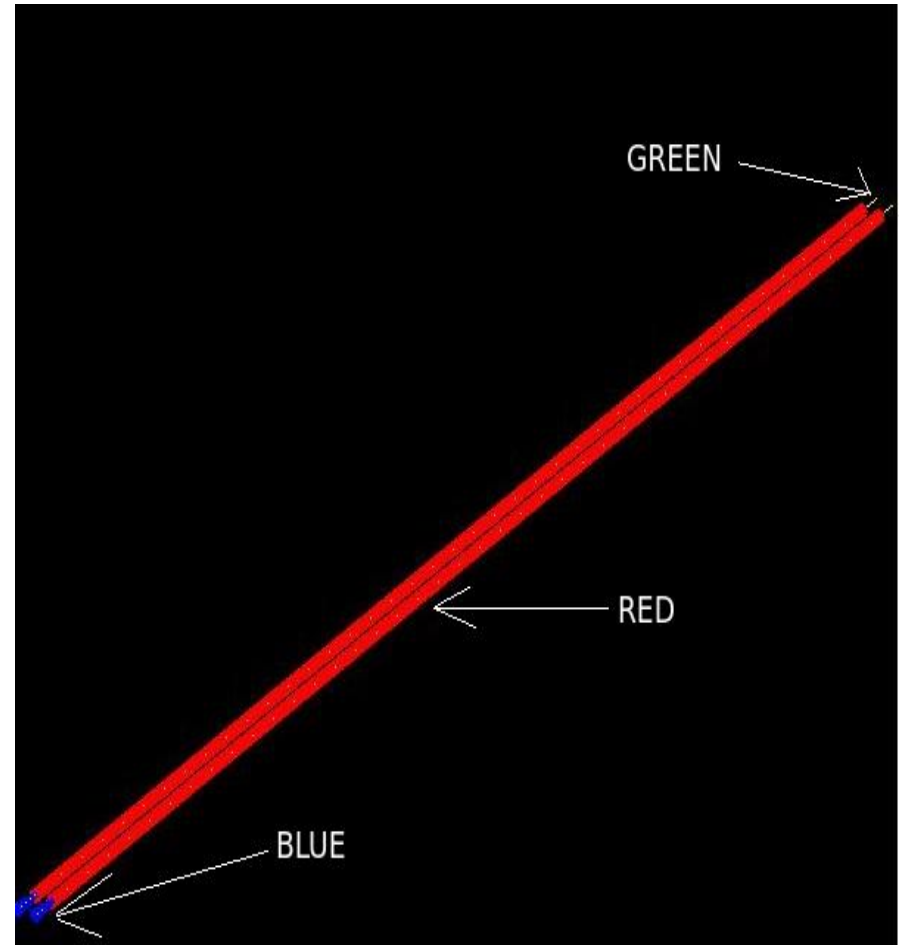
- Next plan is to trigger the particle gun of different particles at different energies
- Dump the result of simulation produced by G4 in **root file**
- Replicate the prototype geometry for the full scale STT
- Working on **HiSoft** with **FGT Simulation & Reconstruction Group (DUNE-ND simulation group in Fermilab)**
 - Implement STT geometry in the Framework
- Visit of Phd student Full time (initially for 6 months) to Fermilab is requested to speed up the ongoing efforts
- Carbon composite frame vendor identified (AI for protoDet)

Thank you

backup

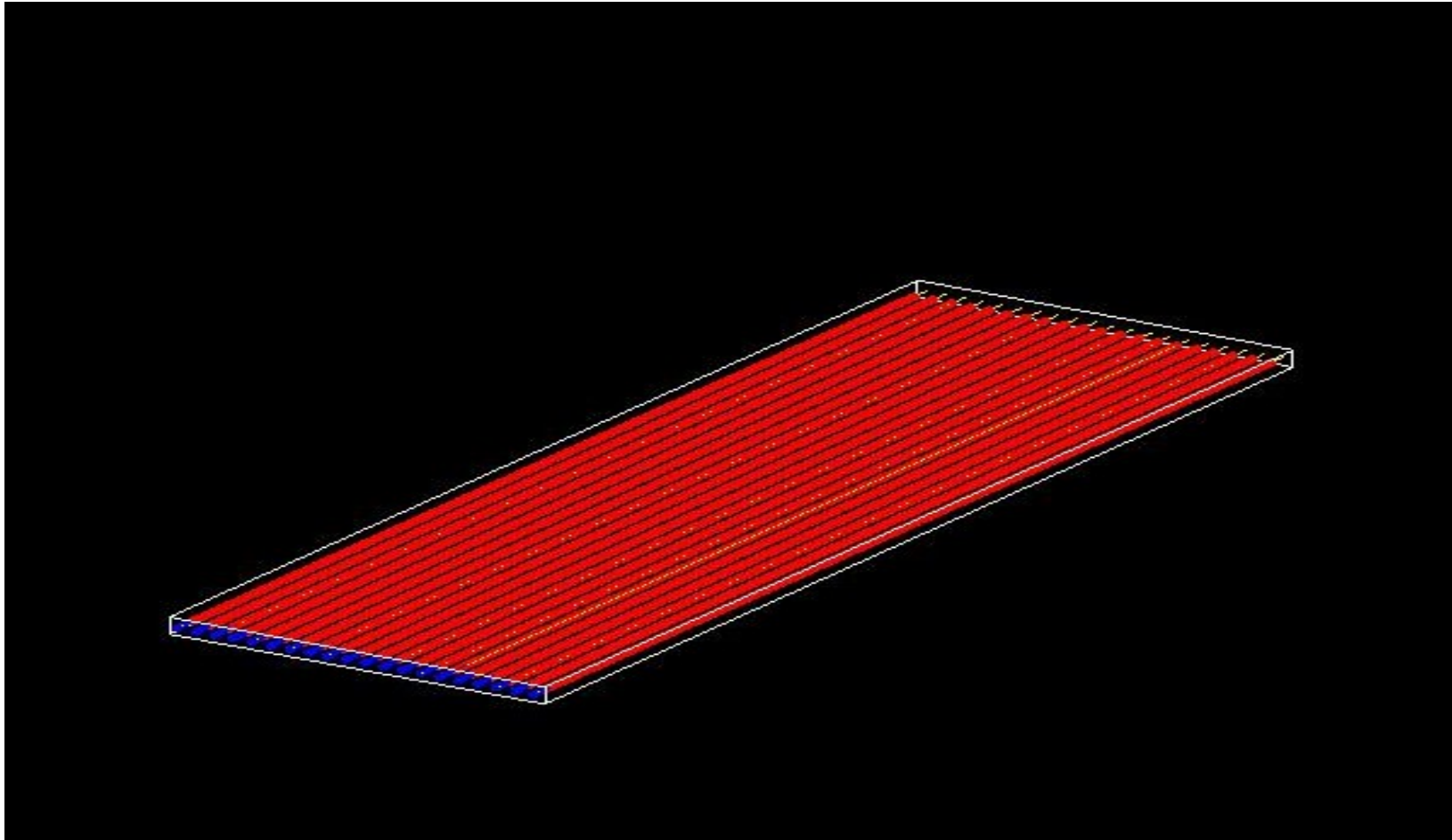
Straw Tube Construction using Geant4

- | Outer RED colored tube-
- | cathode (Kapton)
- | Inside GREEN colored wire-
- | anode (tungsten)
- | BLUE colored endcaps
- | (thermoplastic)



Single Layer Detector Geometry

Straw tube Prototype Detector Geometry



Single Layer of Prototype Detector Geometry