Optimizing Support Structure for Inner Tracker in GLD Detector

SUNGKYUN PARK*, HYUNCHEONG HA, JIHOON CHOI, EUNIL WON
Korea University.

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- The Lorentz angle in GLD Detector
- Overlap between BIT sensors
- Elementary of Barrel Inner Tracker
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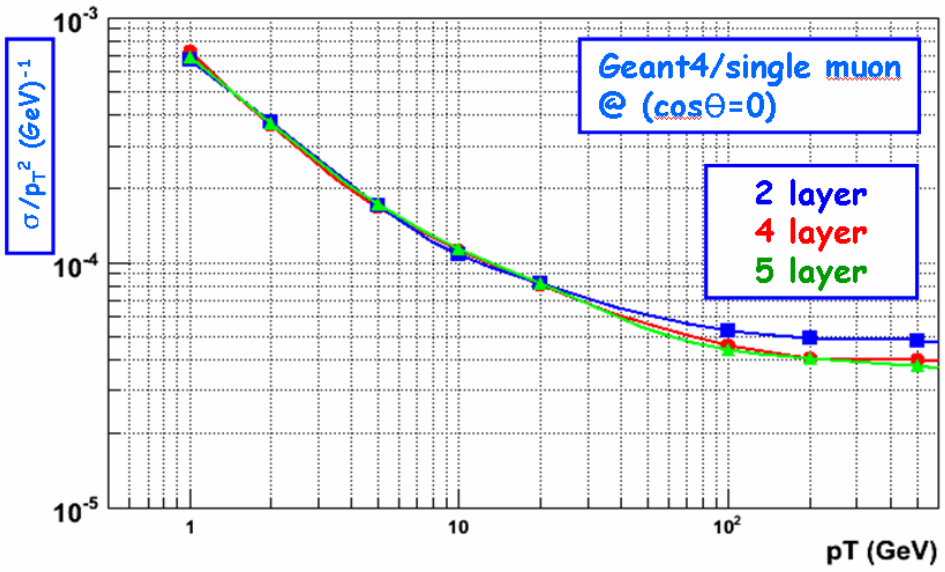
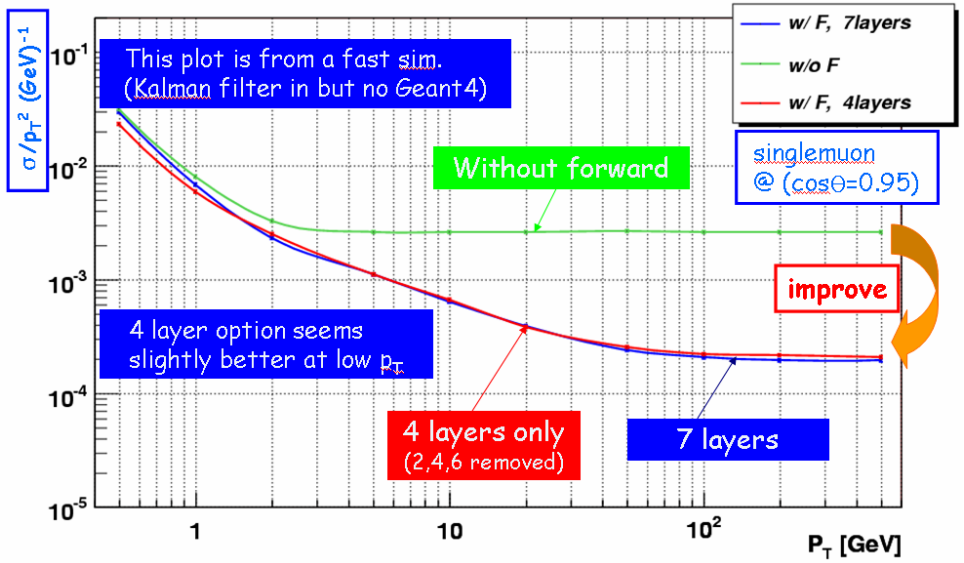
- Radiation length of Umbrella Frame Structure
- Next Work

The number of layer vs. Momentum resolution





Barrel Inner Tracker (BIT)

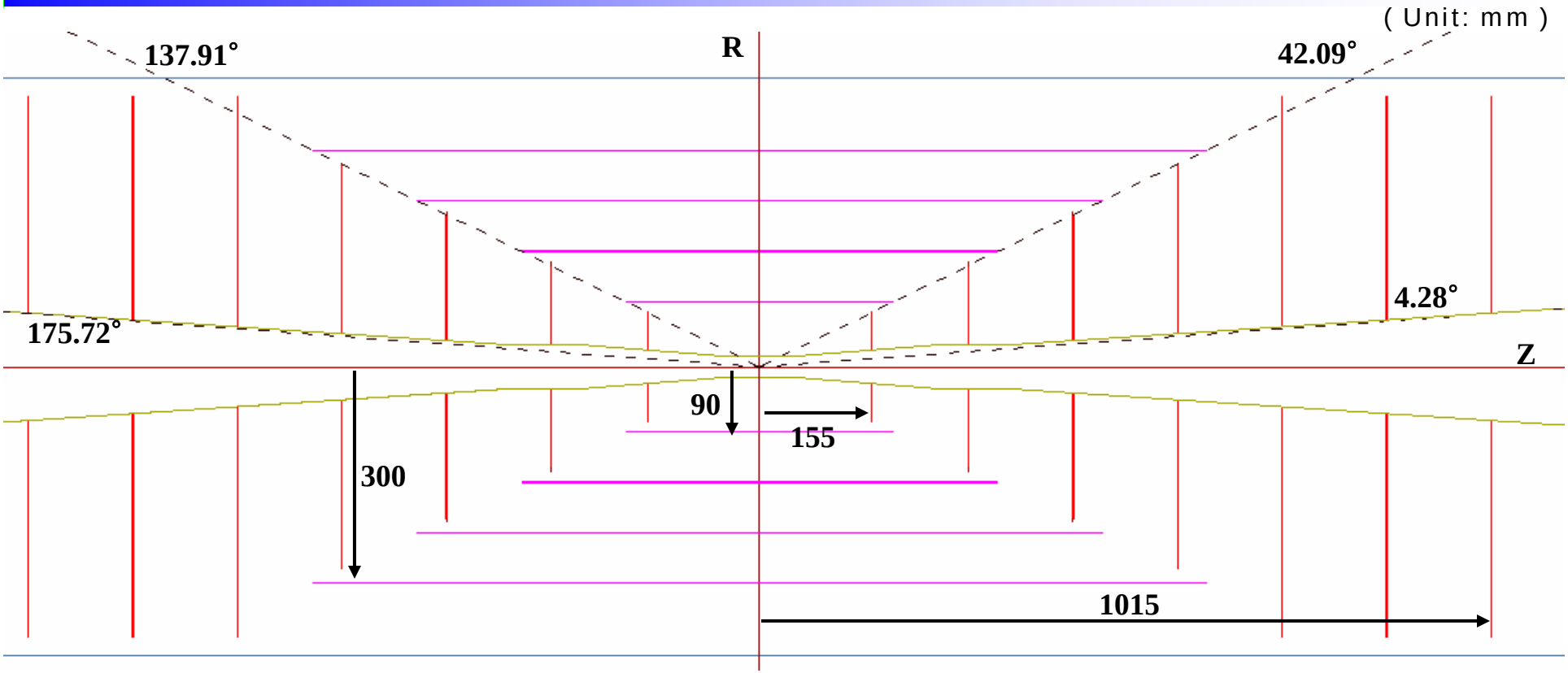
BIT layer	Z	R	Thickness
4th	1240	300	0.3
3rd	950	230	0.3
2nd	660	160	0.3
1st	370	90	0.3

Forward Inner Tracker (FIT)

module	z	r min	r max
layer 1	155	24	76
layer 2	290	32	140
layer 3	435	37	210
layer 4	580	47	280
layer 5	725	57	380
layer 6	870	66	380
layer 7	1015	76	380

(Unit: mm)

Inner Tracker Coverage



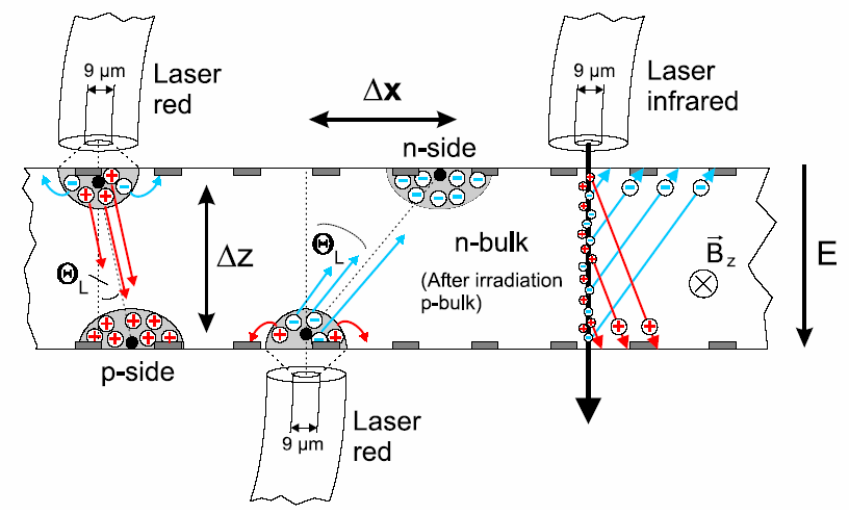
Forward Inner Tracker (FIT)

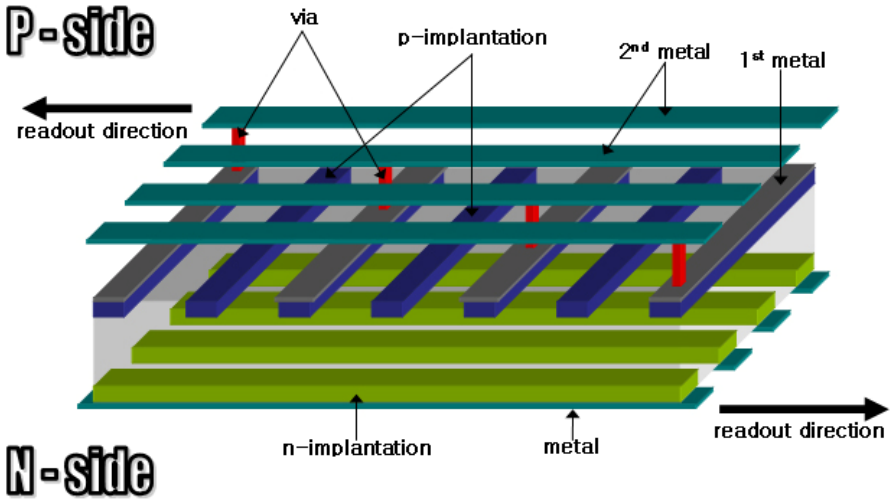
- Maximum active radius : 380
- Minimum active radius : 24
- Maximum Z (active) : 1015
- Minimum Z (active) : 155
- Coverable angle : 4.28° ~ 42.09°, 137.91 ° ~ 175.72°

Barrel Inner Tracker (BIT)

- Maximum active radius : 300
- Minimum active radius : 90
- Maximum Z (active) : 1240
- Minimum Z (active) : 370
- Coverable angle : 42.09 ° ~ 137.91 °

The Lorentz angle in the GLD Detector



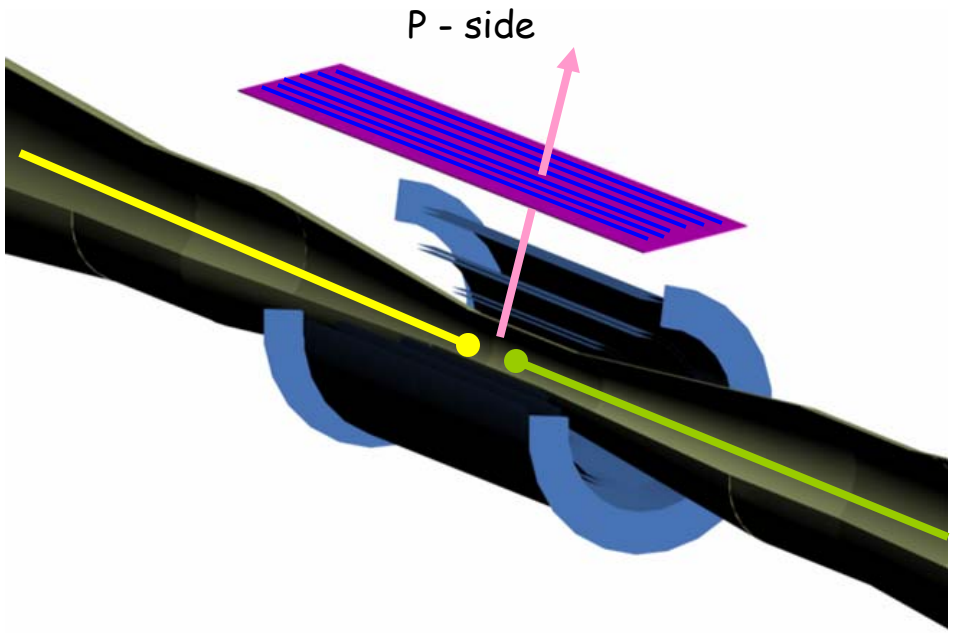


Silicon Strip sensor configuration

- **The Lorentz angle in GLD Detector (B=3T/T=300K)**

θ_L **for electron : 24.97°**

θ_L **for hole : 5.76°**

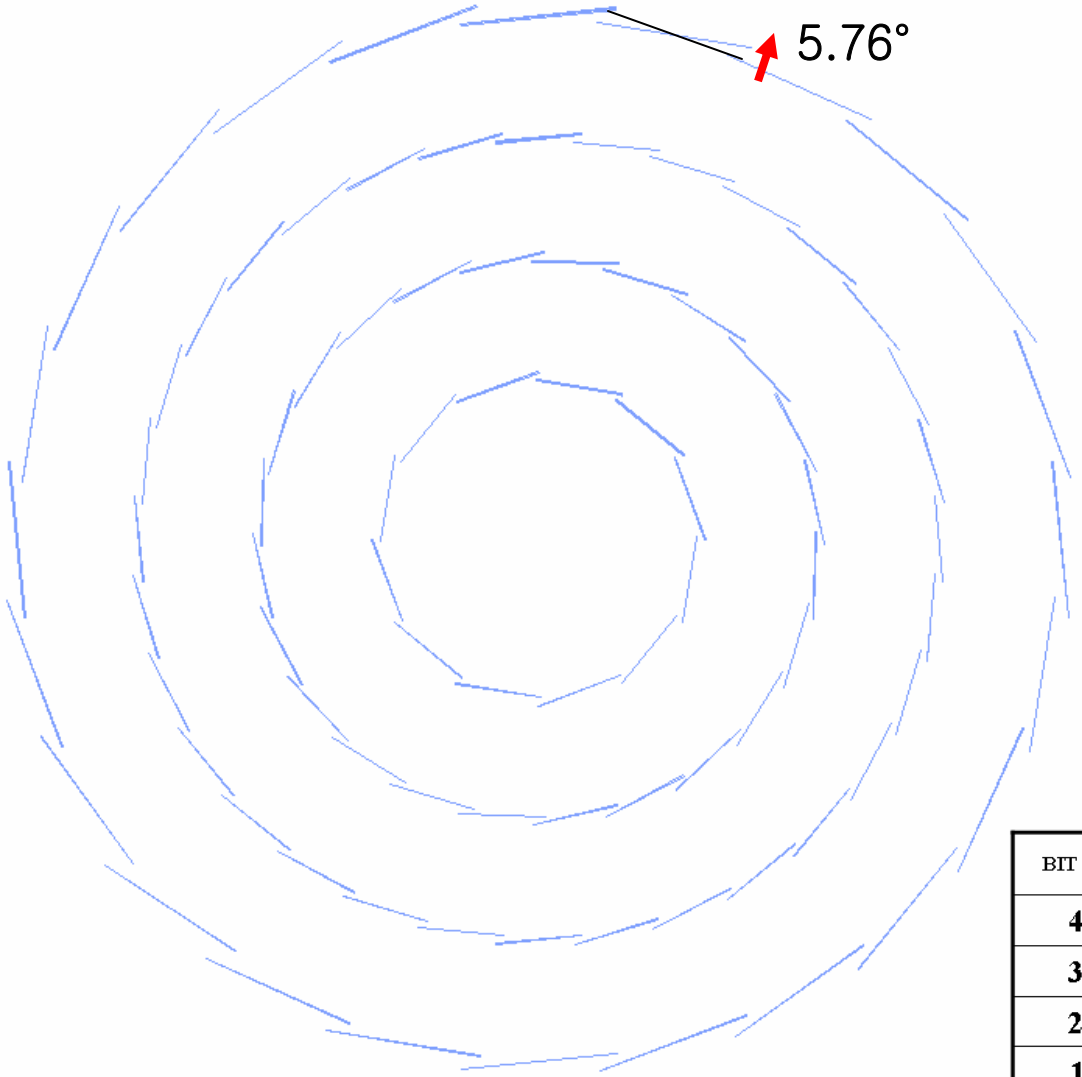


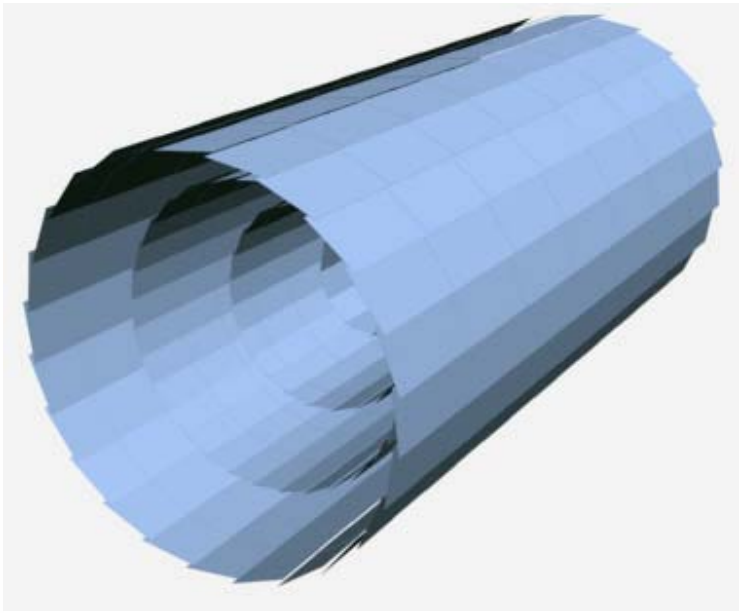
- **The lorentz angle which we have to consider in GLD detector is**

θ_L **for hole : 5.76°**

BIT arrangement reflecting the Lorentz angle

(Unit: mm)





BIT layer	Z	R	sensor Type	sensor # of module	module # of layer	sensor # of layer
4th	1240	300	90x90	14	24	336
3rd	950	230	50x50	20	32	640
2nd	660	160	50x50	14	24	336
1st	370	90	50x50	8	12	96

Overlap between BIT sensors

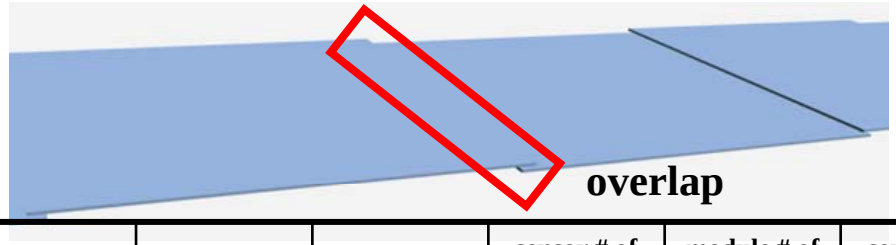
50 x 50 Sensor Type

n	o 1	o 1.2	o1.4	o 1.6	o 1.8	o 2.0
5	246	245.2	244.4	243.6	242.8	242
6	295	294	293	292	291	290
7	344	342.8	341.6	340.4	339.2	338
8	393	391.6	390.2	388.8	387.4	386
9	442	440.4	438.8	437.2	435.6	434
10	491	489.2	487.4	485.6	483.8	482
11	540	538	536	534	532	530
12	589	586.8	584.6	582.4	580.2	578
13	638	635.6	633.2	630.8	628.4	626
14	687	684.4	681.8	679.2	676.6	674
15	736	733.2	730.4	727.6	724.8	722
16	785	782	779	776	773	770
17	834	830.8	827.6	824.4	821.2	818
18	883	879.6	876.2	872.8	869.4	866
19	932	928.4	924.8	921.2	917.6	914
20	981	977.2	973.4	969.6	965.8	962
21	1030	1026	1022	1018	1014	1010
22	1079	1074.8	1070.6	1066.4	1062.2	1058

90 x 90 Sensor Type

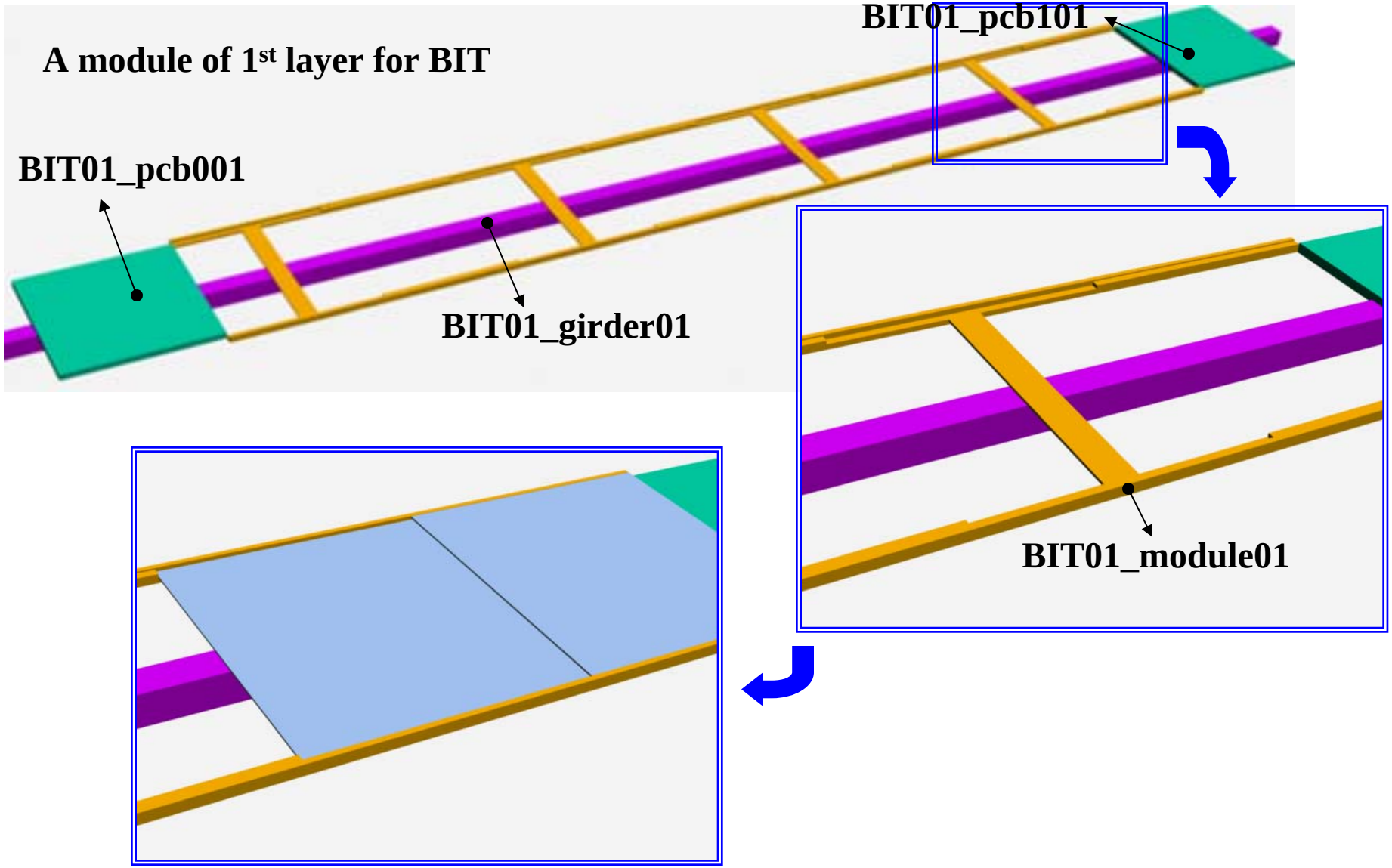
(Unit: mm)

n	o 1	o 1.2	o 1.4	o 1.6	o 1.8	o 2.0
10	891	889.2	887.4	885.6	883.8	882
11	980	978	976	974	972	970
12	1069	1066.8	1064.6	1062.4	1060.2	1058
13	1158	1155.6	1153.2	1150.8	1148.4	1146
14	1247	1244.4	1241.8	1239.2	1236.6	1234
15	1336	1333.2	1330.4	1327.6	1324.8	1322
16	1425	1422	1419	1416	1413	1410
17	1514	1510.8	1507.6	1504.4	1501.2	1498
18	1603	1599.6	1596.2	1592.8	1589.4	1586
19	1692	1688.4	1684.8	1681.2	1677.6	1674
20	1781	1777.2	1773.4	1769.6	1765.8	1762

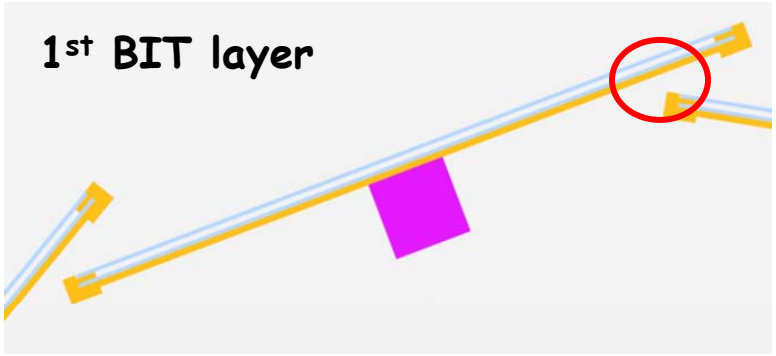


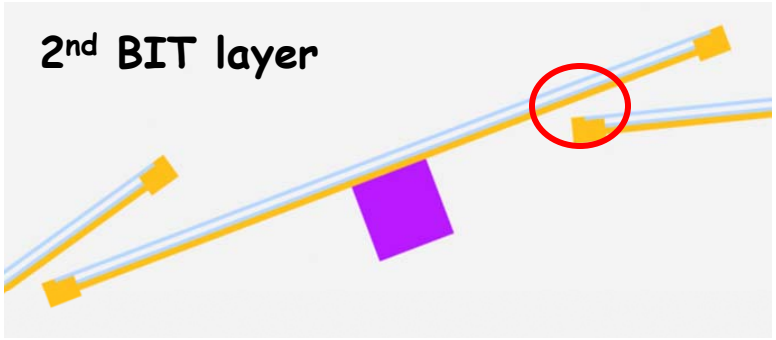
BIT layer	Z	R	Thickness	Real Z	overlap	sensor Type	sensor # of module	module # of layer	sensor # of layer
4th	1240	300	0.3	1241.8	1.4	90X90	14	24	336
3rd	950	230	0. 3	969.6	1.6	50X50	20	32	640
2nd	660	160	0.3	679.2	1.6	50X50	14	24	336
1st	370	90	0.3	388.8	1.6	50X50	8	12	96

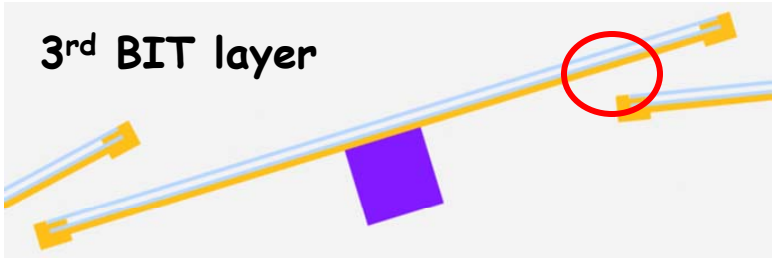
Barrel Inner Tracker module

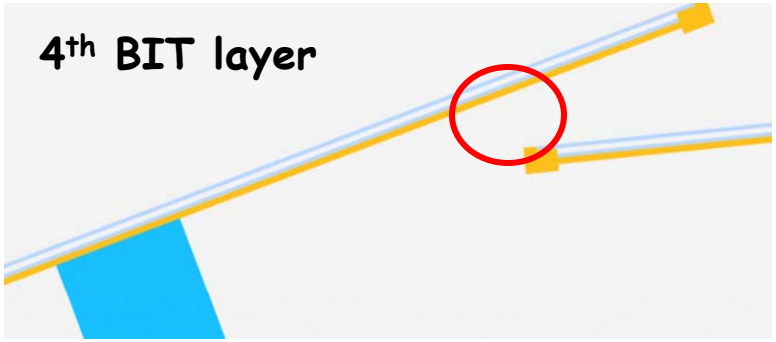


Distance between modules





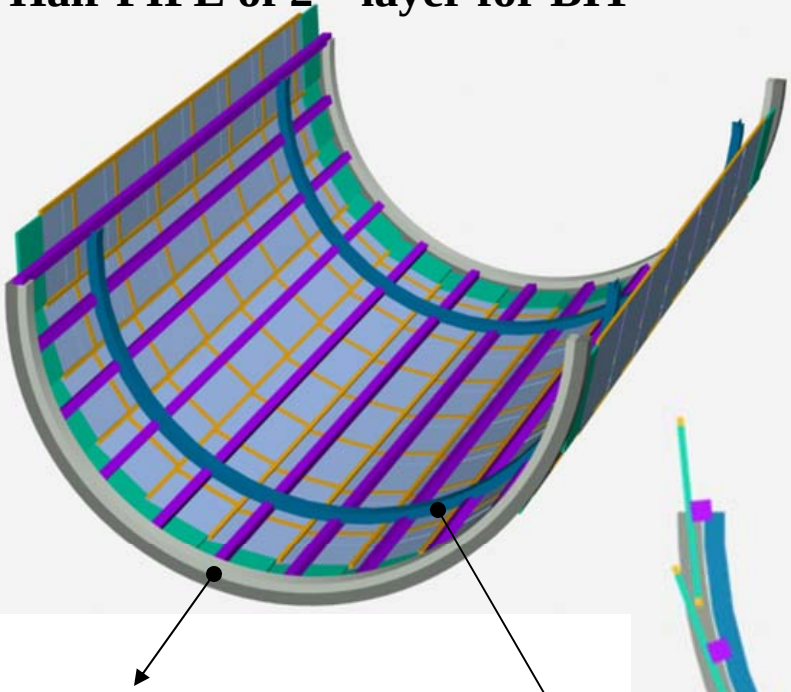




	Distance btw sensor (mm)	Distance btw modules (mm)
4th BIT	5.98	4.21
3rd BIT	3.67	2.05
2nd BIT	2.82	1.00
1st BIT	3.93	1.38

A Half-PIPE for Barrel Inner Tracker

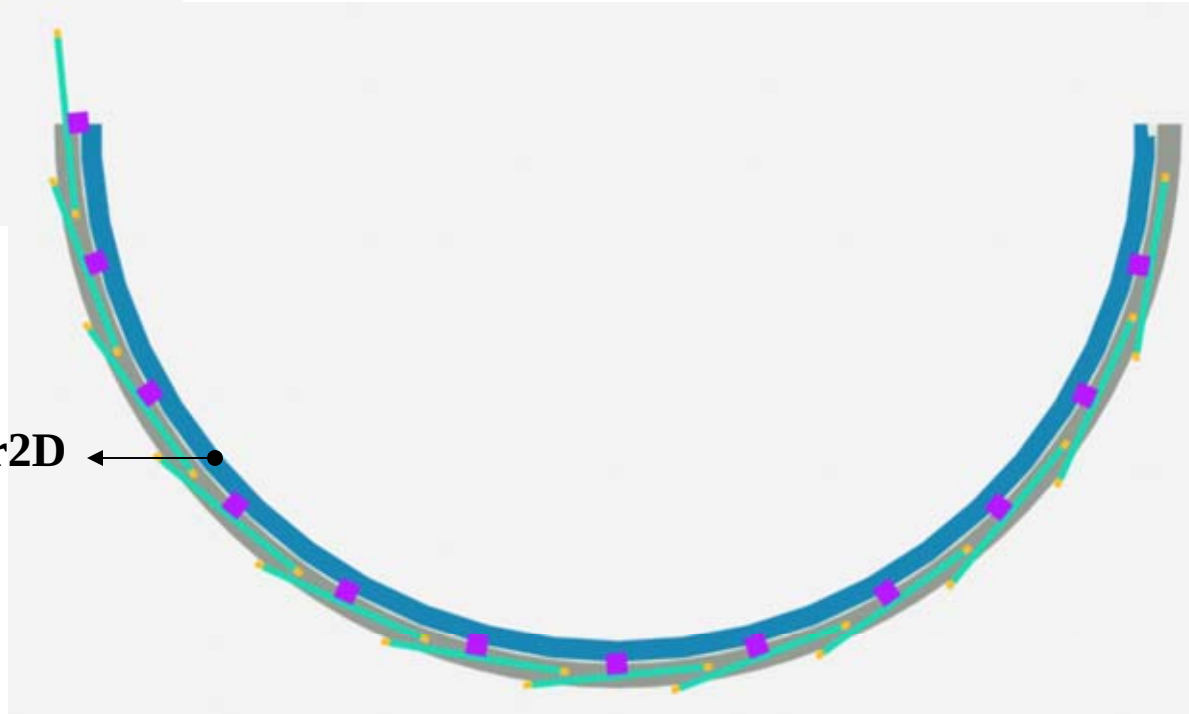
A Half-PIPE of 2nd layer for BIT



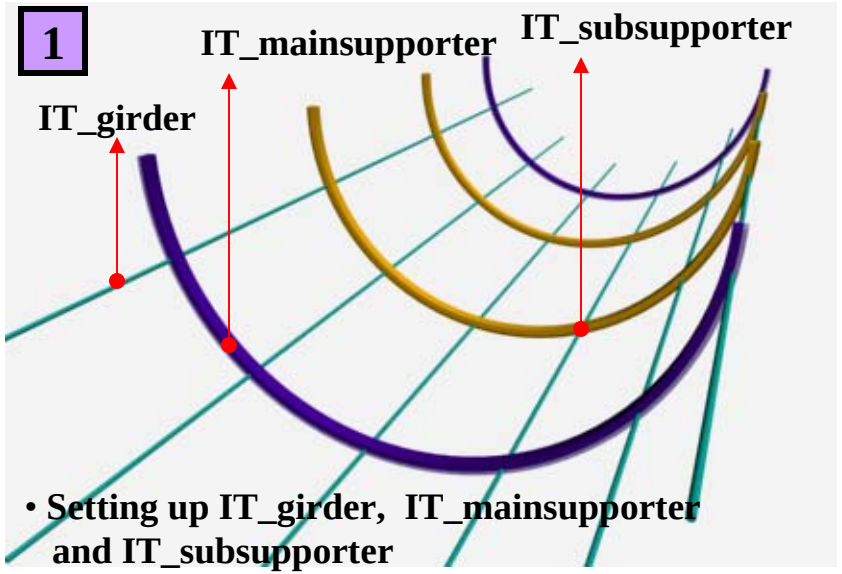
BIT02_mainsupporter0D

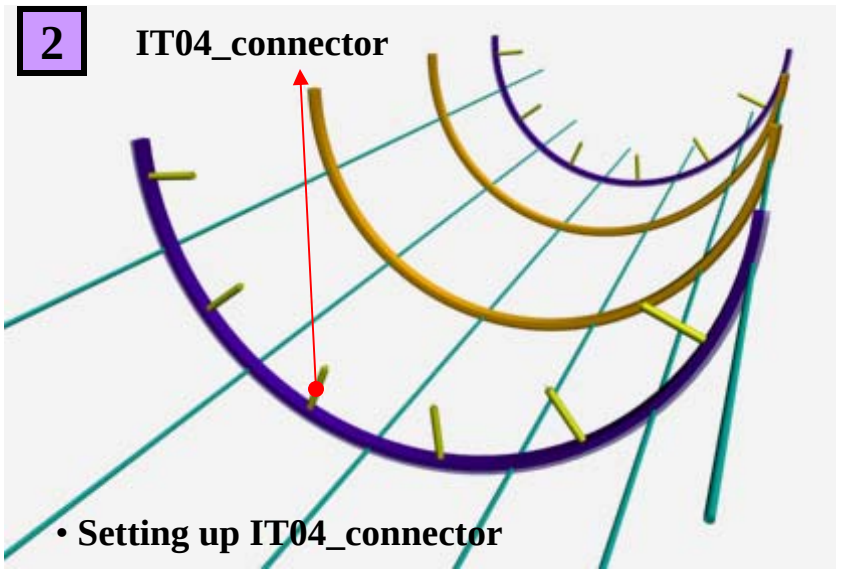
BIT02_subsupporter2D

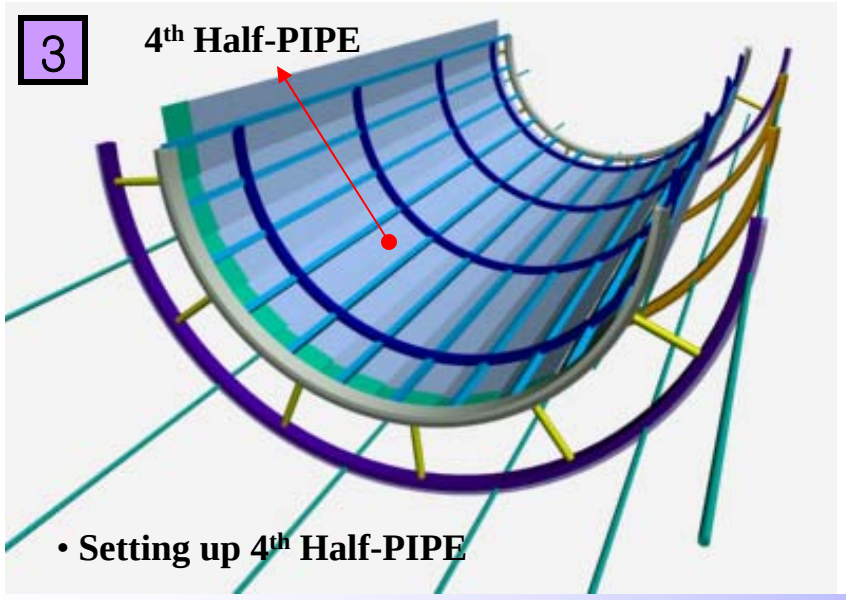
- **Each layer has two Half-PIPE. So there is eight Half-PIPE in BIT.**
- **BIT02_mainsupporter0D maintain the form of the Half-PIPE and IT_connector is set up on BIT_mainsupporter.**
- **BIT02_subsupporter2D support the Half-PIPE and connect FIT with BIT.**

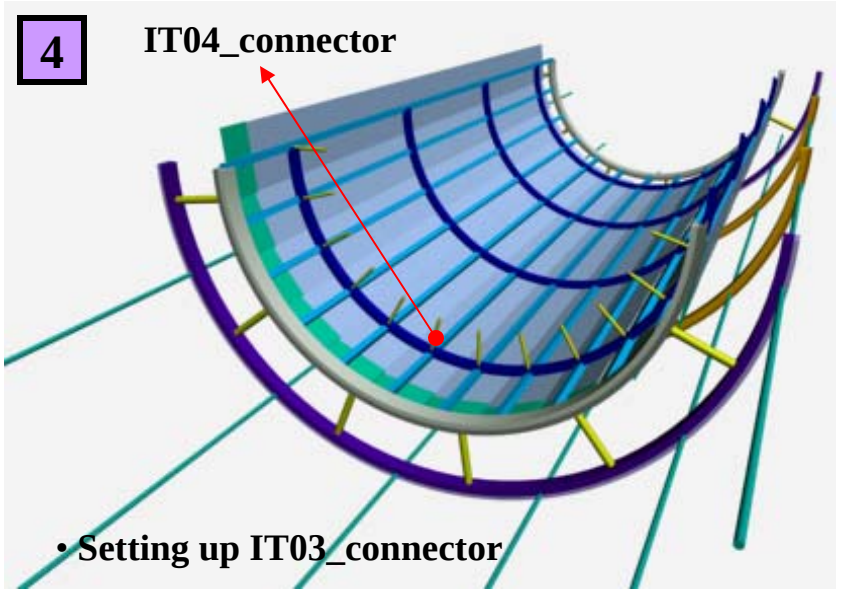


How to assemble Umbrella Frame Structure



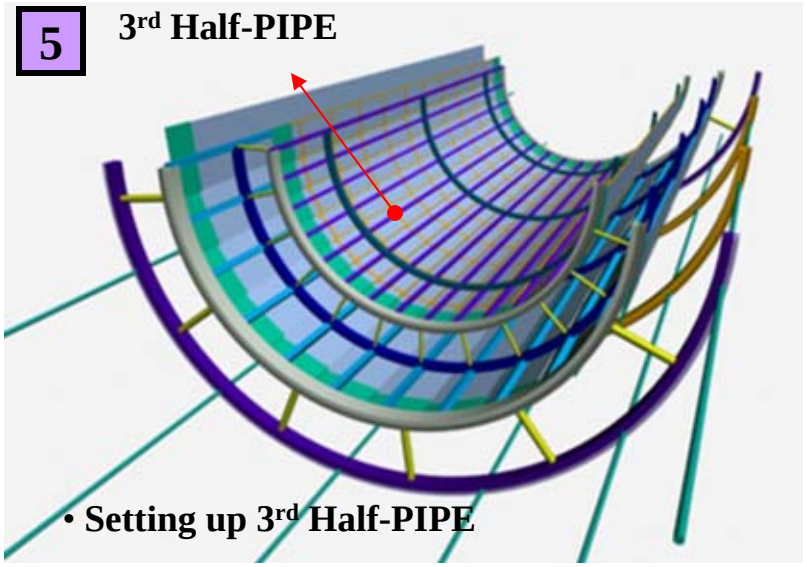






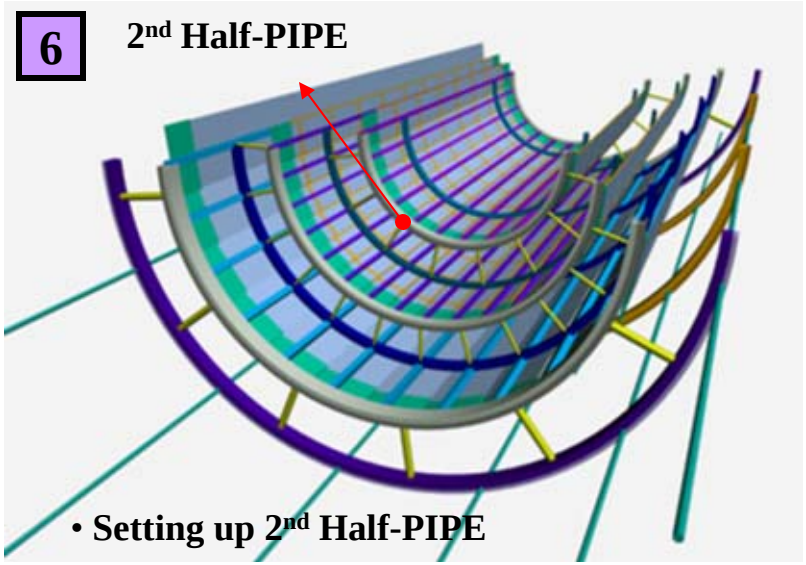
How to assemble Umbrella Frame Structure

5 3rd Half-PIPE



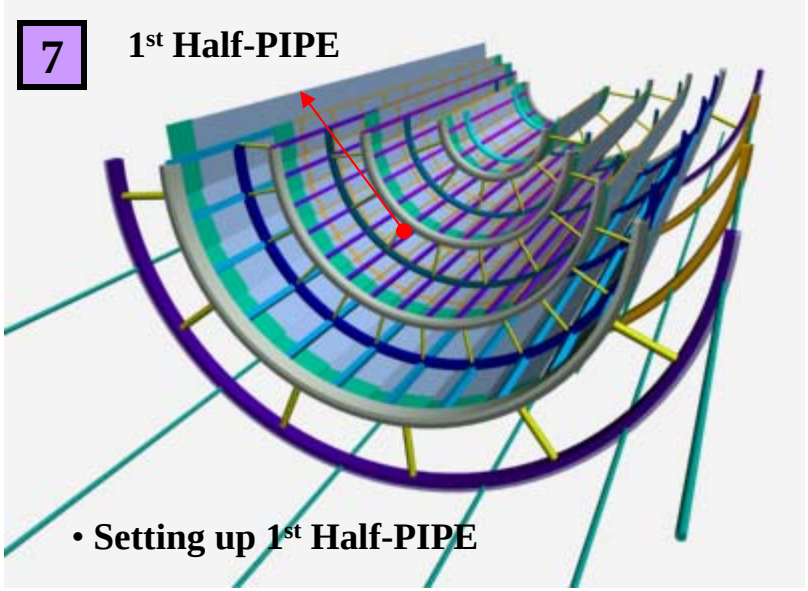
• Setting up 3rd Half-PIPE

6 2nd Half-PIPE



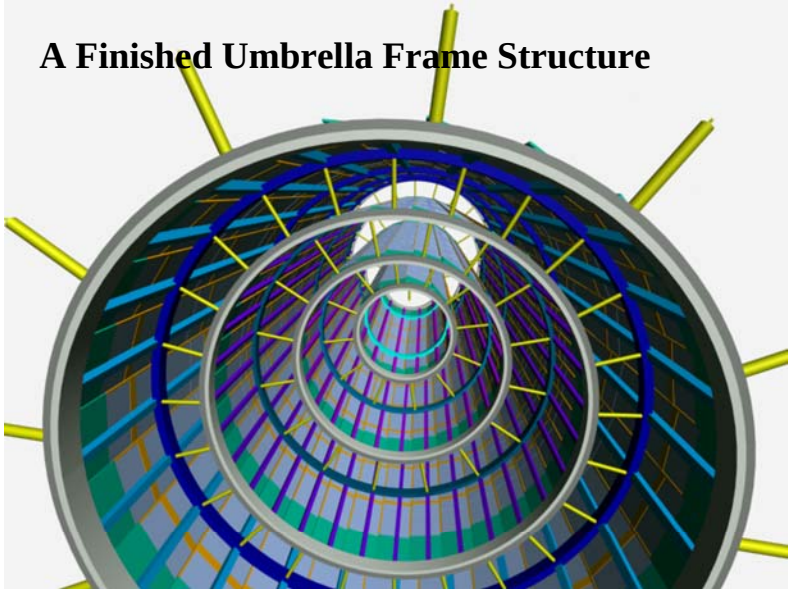
• Setting up 2nd Half-PIPE

7 1st Half-PIPE

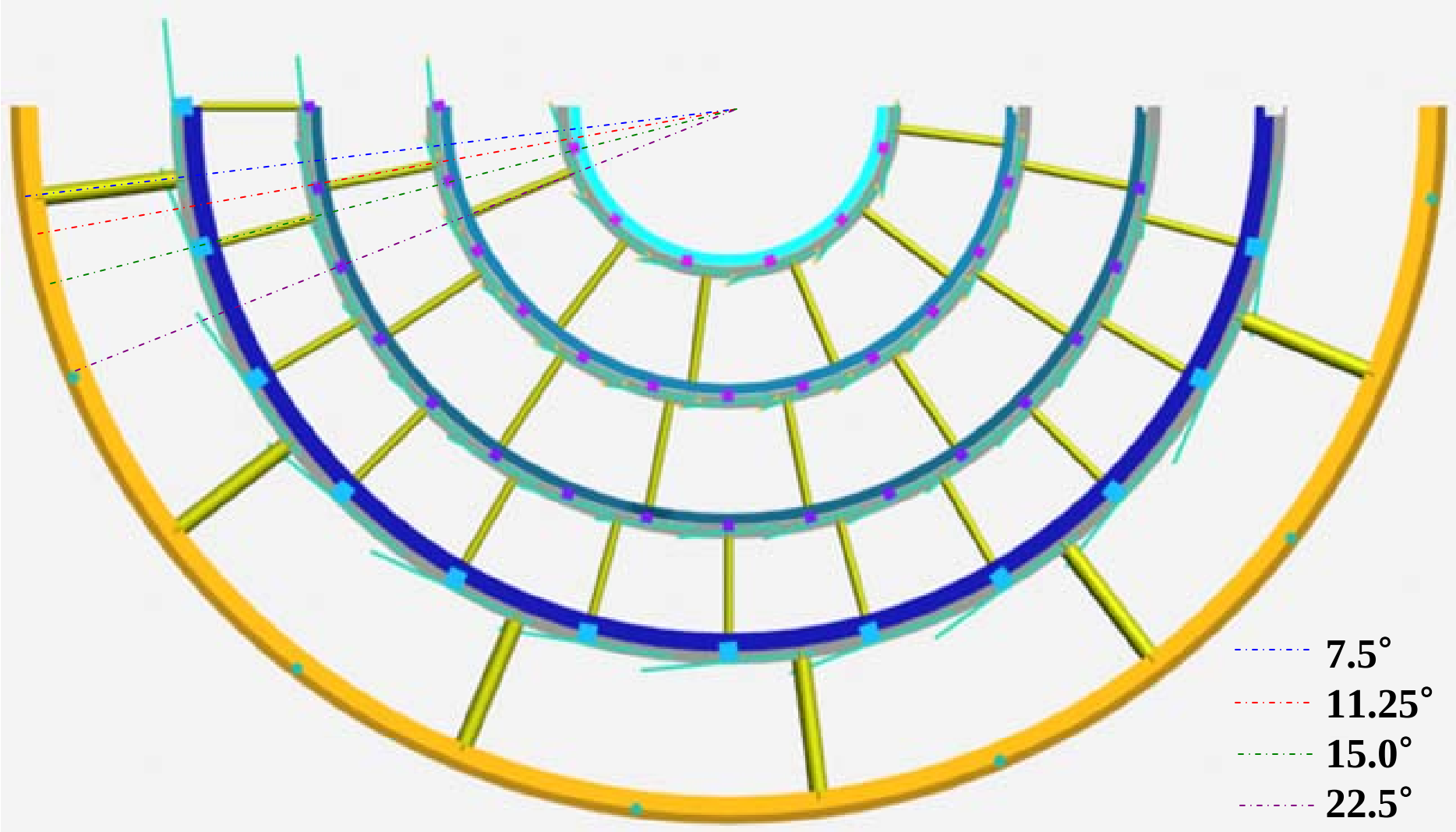


• Setting up 1st Half-PIPE

A Finished Umbrella Frame Structure



A cross Section of Umbrella Frame Structure

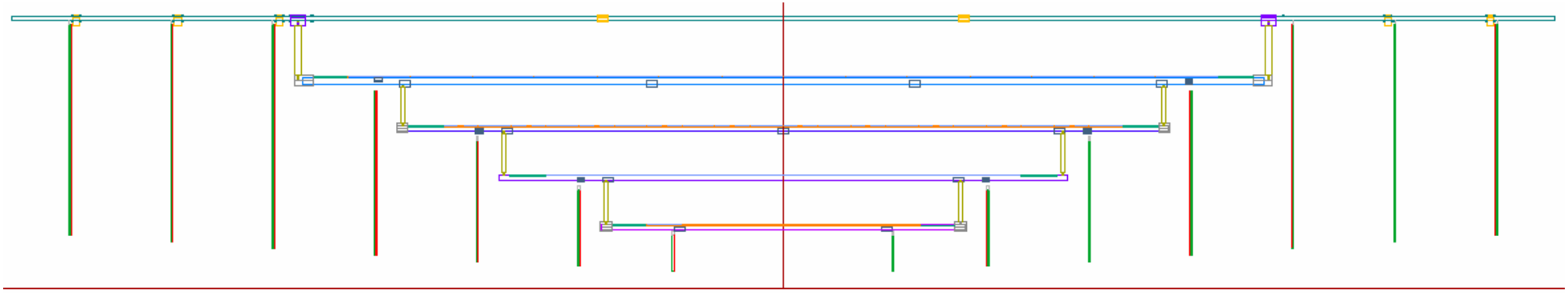


- **Ø angle Symmetry**
- **Proper arrangement of materials for low X/X_0**

Radiation length of Umbrella Frame Structure

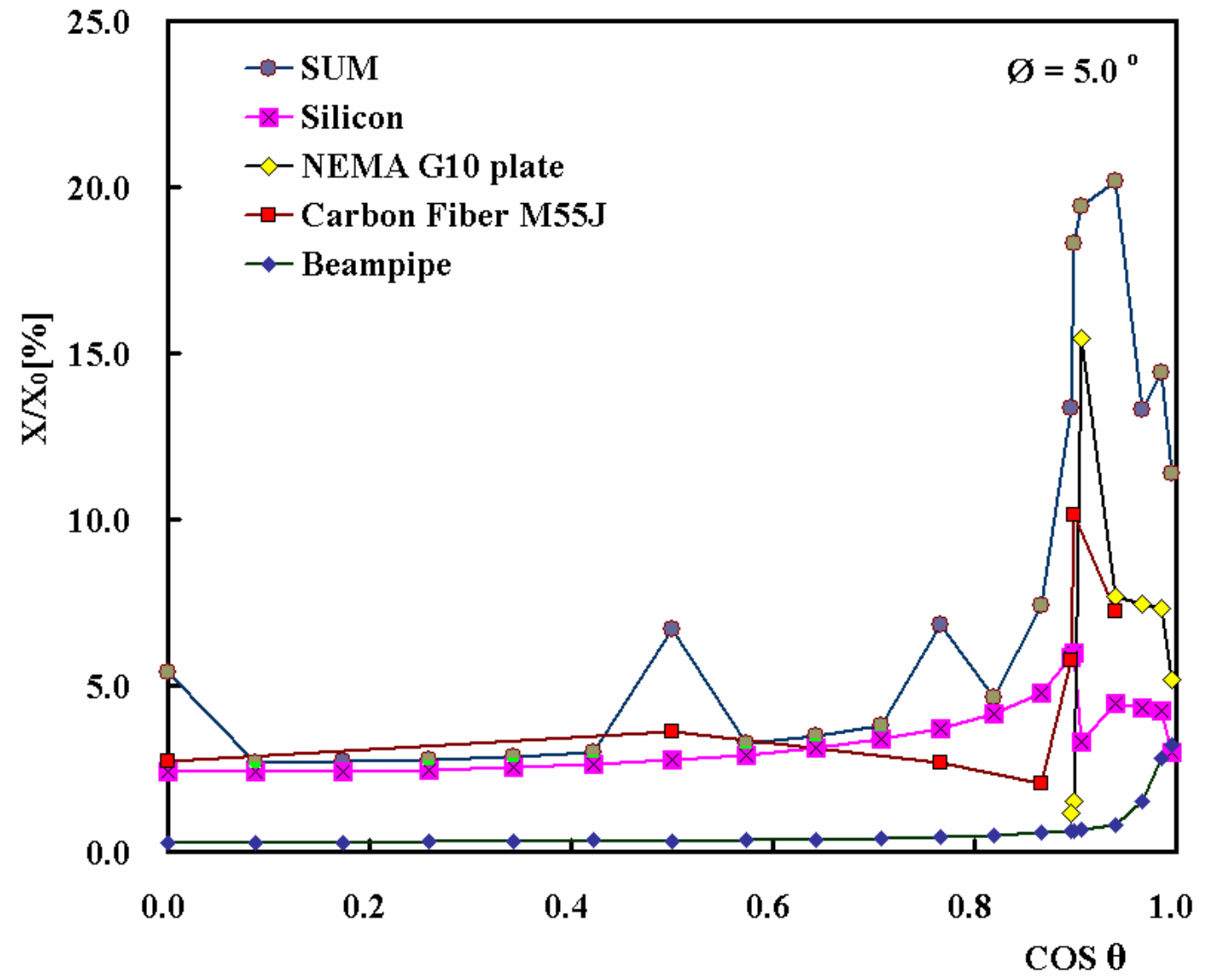
	Density (g/cm^3)	X0 (g/cm^2)	X0 (cm)	X0 (mm)
Carbon Fiber M55J	1.93	42.7	22.124	221.24
Silicon	2.33	21.82	9.37	93.7
Aluminum	2.699	24.01	8.9	89.0
NEMA G10 plate	1.7	33.0	19.4	194

- Reference homepage: http://pdg.lbl.gov/AtomicNuclearProperties/
- PHYSICAL REVIEW D : P 126,127

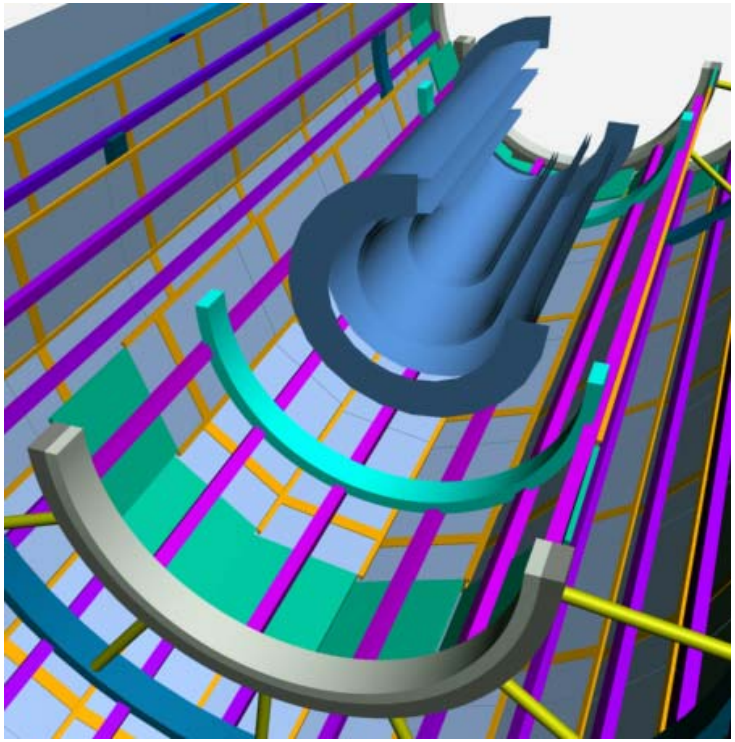


- **Beam PIPE : Aluminium**
- **PCB : NEMA G10 plate**
- **FIT and BIT sensor: Silicon**
- **IT_girder, IT_mainsupporter, IT_subsupporter and BIT_girder, BIT_mainsupporter, BIT_subsupporter : Carbon Fiber**

Material Budget for ø=5.0°



Next Work



- **Design Mechanic Structure for Vertex Detector**
- **Propose real arrangement of FIT sensors**
- **Product a mock-up of Umbrella Frame Structure**