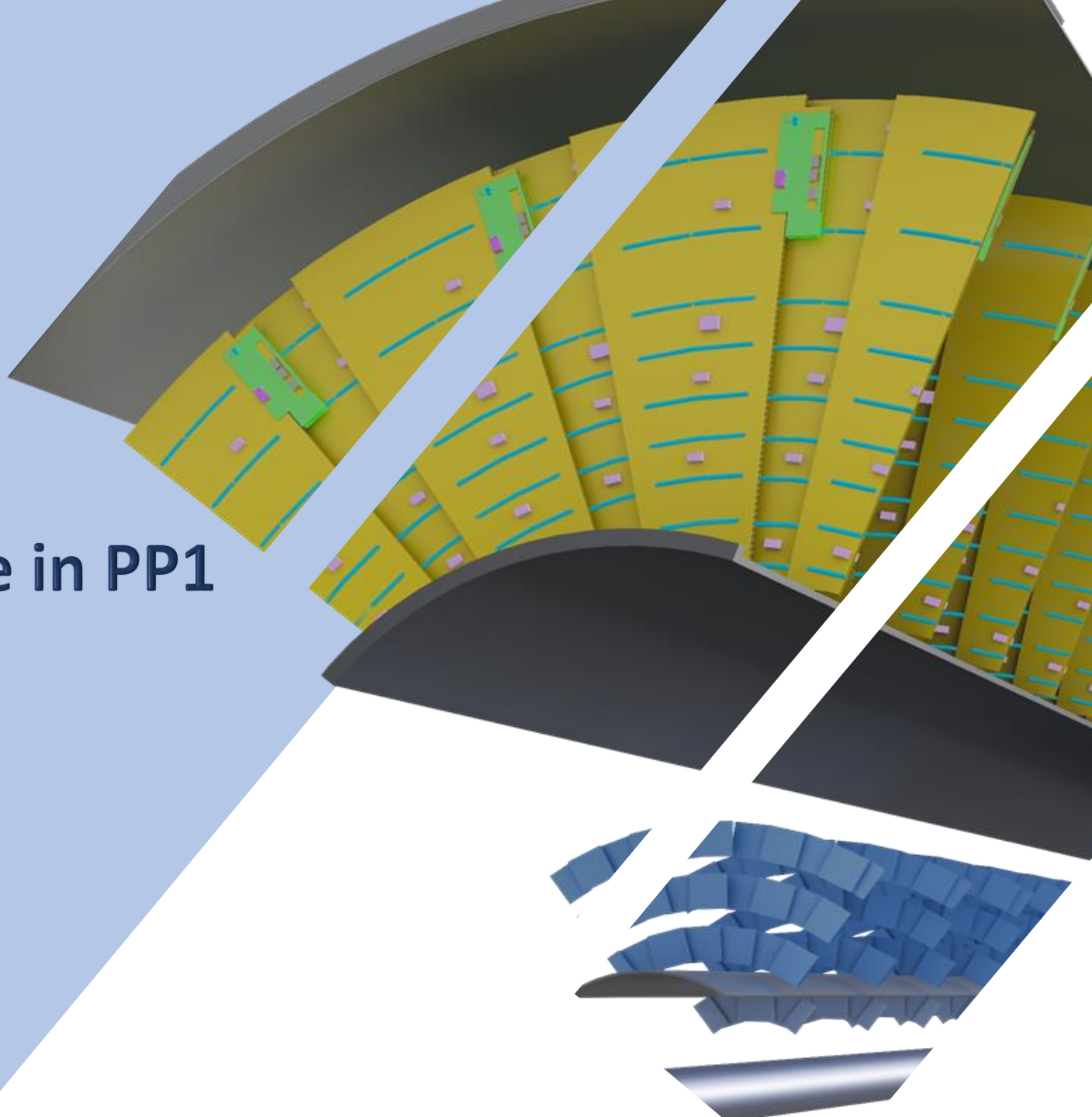
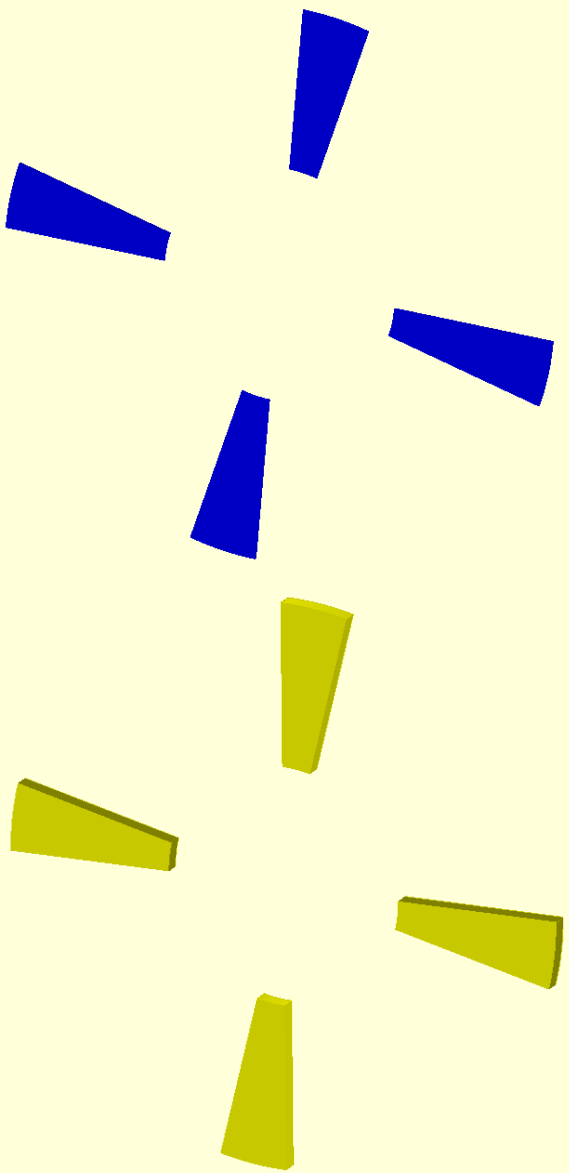
Investigation of Twin-ax Cable in PP1



Niko Tsutskiridze
Giorgi Mirziashvili
Georgian Technical University

Working Life Cycle



1. Compare Analyses (Weight) – Detailed CATIA Geometry vs. GMX Geometry

2. ~~Calculation of the Radiation Length (Xo) – Detailed CATIA Geometry vs. GMX Geometry~~

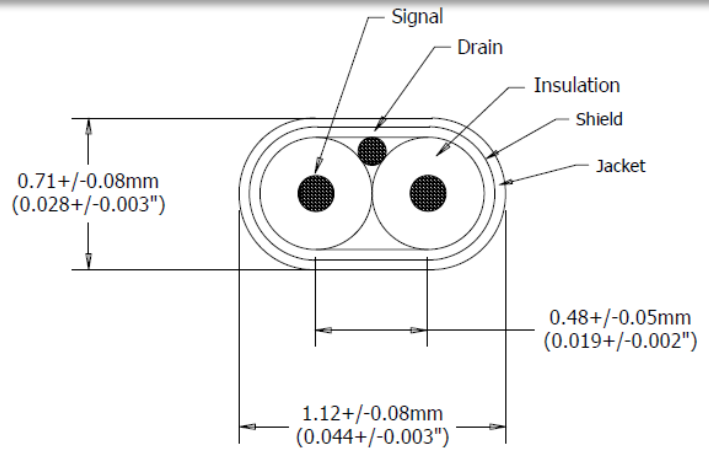
3. ~~Simplification of the Detailed CATIA Geometry~~
3. Creation of simplified CATIA Geometry

4. ~~Calculation of the Radiation Length (Xo) - Detailed CATIA Geometry vs. Simplified CATIA Geometry~~
4. Calculation of the Radiation Length (Xo) – ~~Detailed CATIA Geometry~~ simplified CATIA Geometry vs. GMX Geometry

5. Preparation of GMX Description

6. Integration Conflicts Checking

Compare Analyses (Weight) – gmx Description vs As-Built Geometry



NOTES

CONSTRUCTION
- Conductor: 34 AWG, 0.16MM (0.0063") Bare Copper
- Insulation: Polyolefin, 0.5mm (0.020") Diameter
- Drain Wire: 36 AWG, 0.13mm (0.005") Bare Copper
- Shield: Aluminum/Polyimide Foil, 0.023mm (0.0009") Thickness Ref.
- Jacket: Polyester, Heat Sealed, 0.018mm (0.0007") Thickness Ref.

ELECTRICAL CHARACTERISTICS
(Based on a 2m Length)
- Differential Impedance: 100+/-10 ohms
- Propagation Delay: 5.0ns/m Ref.
- Intra-Pair Skew: 20ps/2m Max.

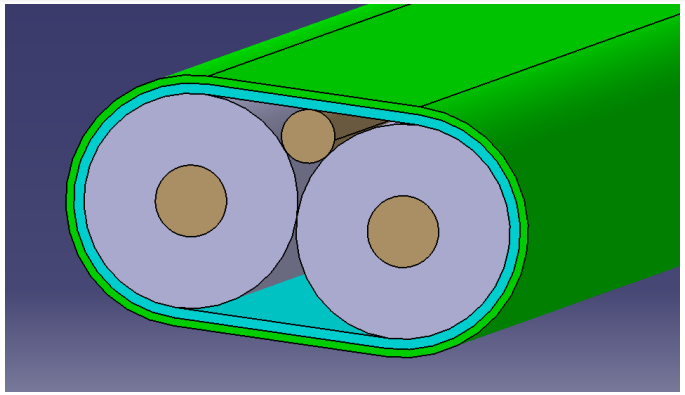
SCD21
- f < 20 GHz: 20 dB Min.

SCD21-SDD21
- 0.01 ≤ f < 12.89: 12 dB Min.
- 12.89 ≤ f < 15.7: (29-(29/22)f) dB Min.
- 15.7 ≤ f < 19: 8.3 dB Min.

GENERAL
- Weight: 1.1 kg/km (0.72 lb/kft)
- Min. Bend Radius: 5X OD - Minor Axis

Print Legend (Drain Wire Side): MOLEX TEMP-FLEX(R) <LOCATION CODE: US or PHL>
TWINMAX(TM) 34 AWG 1000680052 <LOT, DATE CODE>

Based on 2m Test Length		
	SDD21	
Freq (GHz)	Nom.	Max.
	dB	dB
0.64	3.6	4.0
1.28	5.2	5.7
2.50	7.3	8.0
5.00	10.8	11.9
7.50	13.9	15.3
10.00	17.5	19.3



1 kilometer Twinax cable		
Weight (kg)	Volume (m3)	Density (kg/m3)
1.1	0.00048	2291.666667

1 meter Twinax Cable			
name	Volume		%
Full	0.00000048		
Conductor - Copper	0.00000004		8.33
Insulation - Polyolefin	0.00000032		66.67
Drain Wire - Copper	1.30E-08		2.71
Sield - Aluminum/Polyimide Foil	0.000000058		12.08
Jacket - Polyester, heat Sealed	0.000000048		10.00
			100

General parameters			
Sectors	Twinax Cable in per sectors	Total Quantity of Twinax Cable	Total Length
4	3300	13200	7.656

Twinax Cables used in PP1 pixel		
Weight (kg)	Volume (m3)	Density (kg/m3)
8.4216	0.00367488	2291.666667

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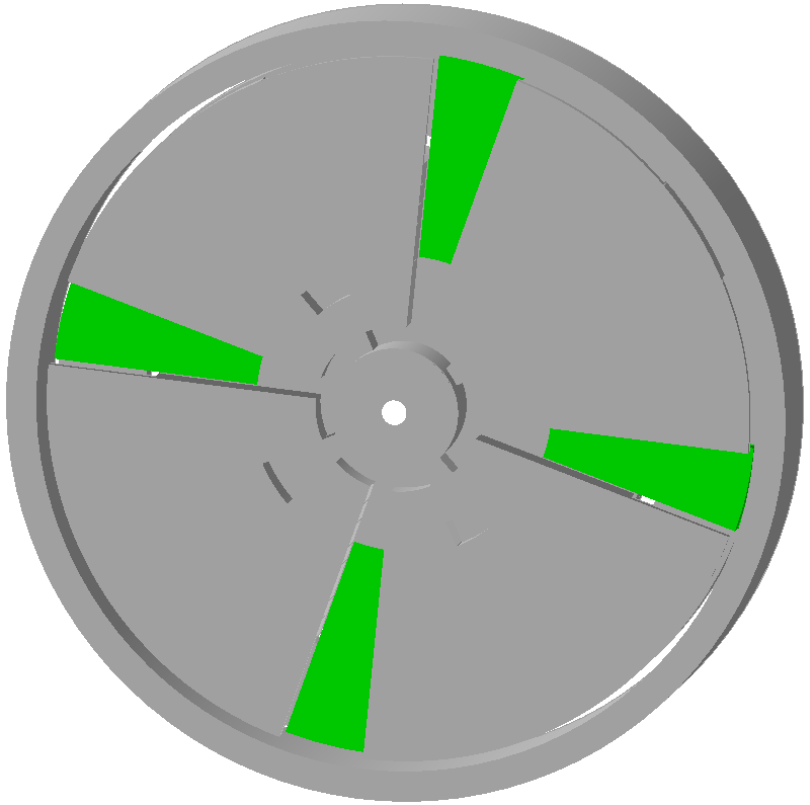
Compare Analyses (Weight) – gmx Description vs As-Built Geometry



```
<!--data readout-->
<!--to check; why this is named R700_R1000 when it only goes up to a smaller R (limited by EC_PP1)-->
<logvol name="pixSvc_PP1_T2_R700_R1000_Data" shape="shPixReadout1Q1" material="matPixReadout1"/>
<logvol name="pixSvc_PP1_T2_R347_R1000_Data" shape="shPixReadout2Q1" material="matPixReadout2"/>

<assembly name="PixReadout1Wheel">
  <multicopy name="AddPixRed1ToWheel" n="4" >
    <transformation name="PlacePixRed1ToWheel">
      <rotation zcos="1." angle="PI/2"/>
    </transformation>
    <logvolref ref="pixSvc_PP1_T2_R700_R1000_Data"/>
  </multicopy>
</assembly>

<assembly name="PixReadout2Wheel">
  <multicopy name="AddPixRed2ToWheel" n="4" >
    <transformation name="PlacePixRed2ToWheel">
      <rotation zcos="1." angle="PI/2"/>
    </transformation>
    <logvolref ref="pixSvc_PP1_T2_R347_R1000_Data"/>
  </multicopy>
</assembly>
```

```
<material name="matPixReadout2" density="0.124194654"> <!--readout-inner-->
   <materialref fraction="0.447786132" ref="CuMetal"/>
   <materialref fraction="0.139515455" ref="AlMetal"/>
   <materialref fraction="0.248955723" ref="PE"/>
   <materialref fraction="0.16374269" ref="PVC"/>
</material>
```

```
<material name="CuMetal" density="8.960">
  <elementref fraction="1.00000" ref="Copper"/>
</material>
```

```
<material name="AlMetal" density="2.700">
  <elementref fraction="1.00000" ref="Aluminium"/>
</material>
```

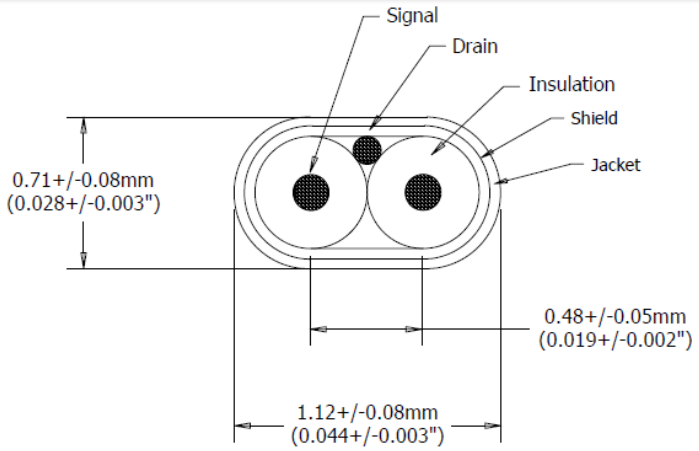
```
<material name="PE" density="0.935">
      <elementref fraction="0.86" ref="Carbon" />
      <elementref fraction="0.14" ref="Hydrogen"/>

</material>
```

```
<material name="PVC" density="1.38">
      <elementref fraction="0.384" ref="Carbon" />
      <elementref fraction="0.048" ref="Hydrogen"/>
      <elementref fraction="0.568" ref="Chlorine"/>
</material>
```

Volume (m3) (4x)	material	Density (kg/m3)	Weight (kg)
0.024145		124.2	3.00

Compare Analyses (Weight) – gmx Description vs As-Built Geometry



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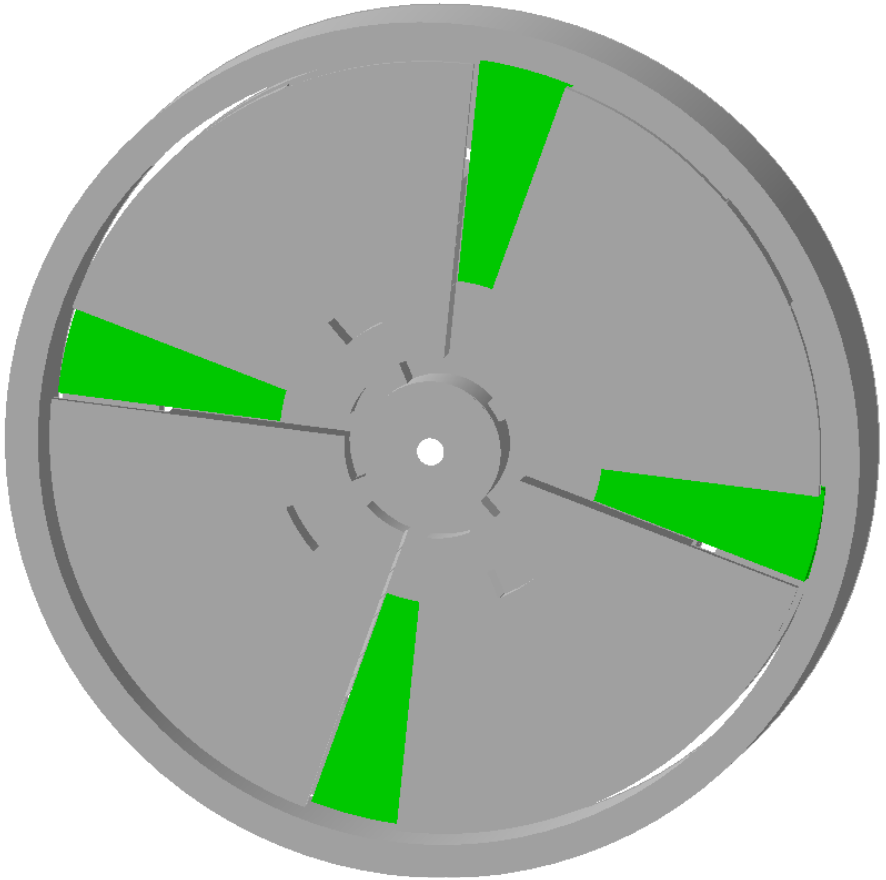
Min. Bend Radius: 5X OD - Minor Axis

Print Legend (Drain Wire Side): MOLEX TEMP-FLEX(F
TWINMAX(TM) 34 AWG 1000680052 <LOT, DATE C(

Based on 2m Test Length		
	SDD21	
Freq (GHz)	Nom. dB	Max. dB
0.64	3.6	4.0
1.28	5.2	5.7
2.50	7.3	8.0
5.00	10.8	11.9
7.50	13.9	15.3
10.00	17.5	19.3

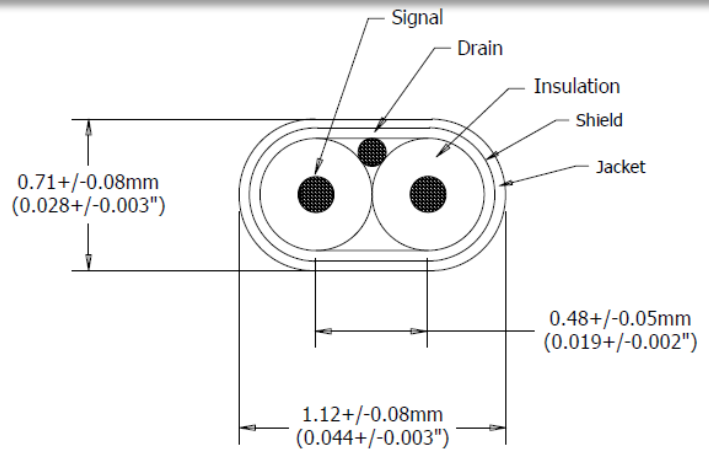


Volume (m3)-4x	Density (kg/m3)	Weight (kg)	Volume (m3)-4x	Density (kg/m3)	Weight (kg)
As-Built			GMX-Simulation		
0.00367488	2291.66	8.42	0.024145	124.2	3

64.3%
Diff: 5.42

Simplification

Simplification of Twin-ax Cables



NOTES

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TWINMAX(TM) 34 AWG 1000680052 <LOT, DATE CODE>

Based on 2m Test Length		
	SDD21	
Freq (GHz)	Nom. dB	Max. dB
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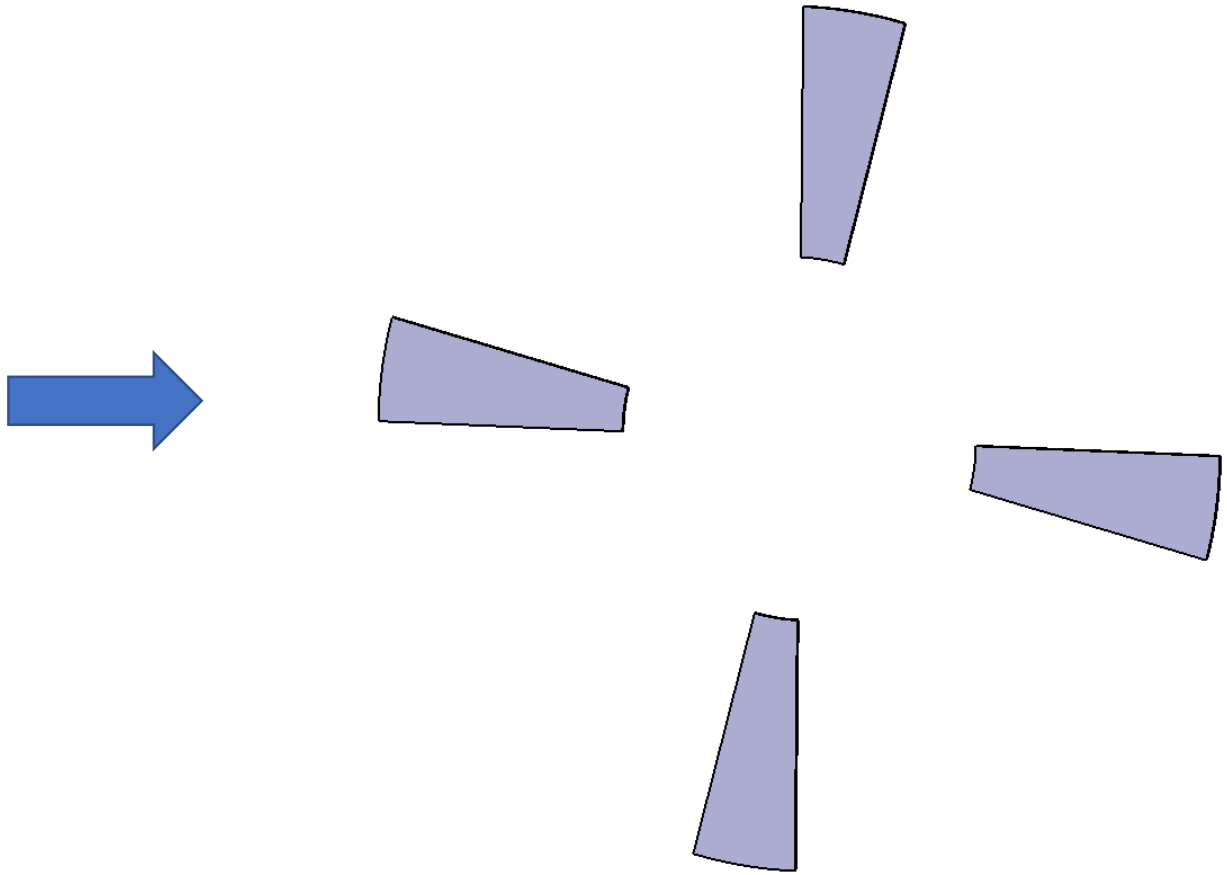
1.28	5.2	5.7
2.50	7.3	8.0
5.00	10.8	11.9
7.50	13.9	15.3
10.00	17.5	19.3

RoHS COMPLIANT

Simplified Model



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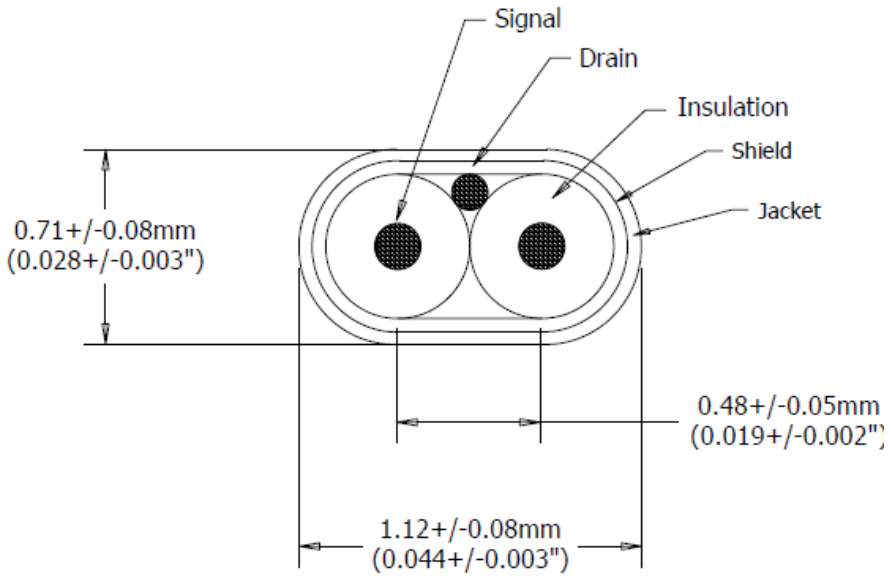
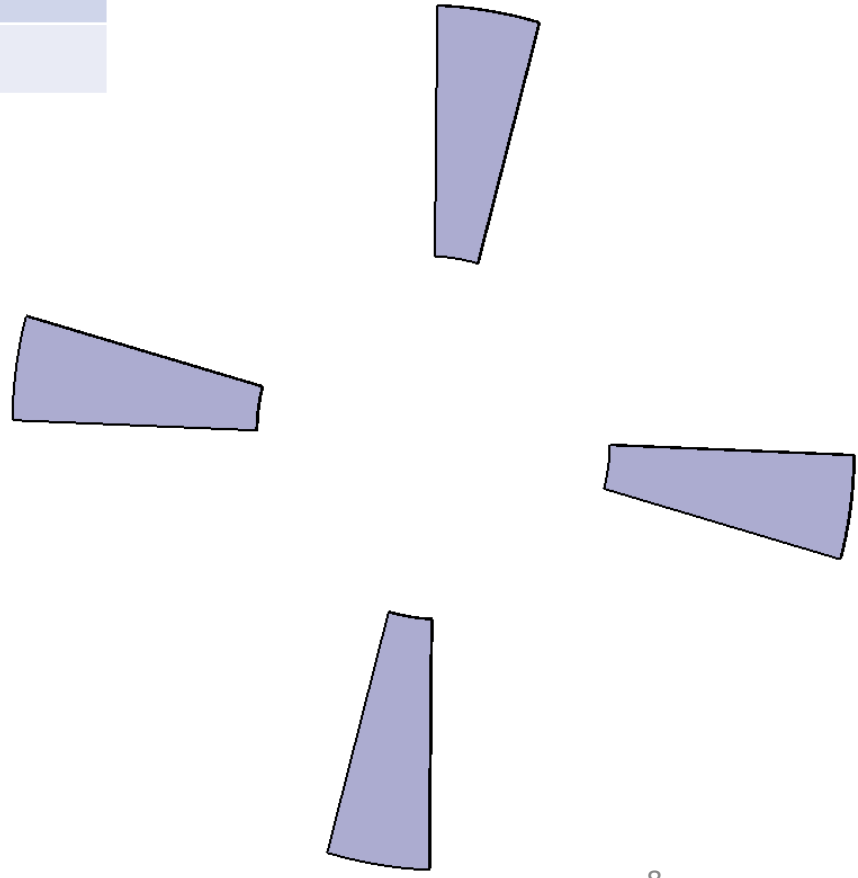
Simplification of Twin-ax Cables

		Detailed CATIA Geometry				Simplified CATIA Geometry
	Name	Volume (m3)	Material	Density (kg/m3)	Weight (kg)	Weight (kg)
1	Twin-ax Cables	0.00367488	Copper/Aluminum/ Polyolefin/polyester	2291.66	8.42	8.42
				Total:	**8.42**	**8.42**

Diff: 0

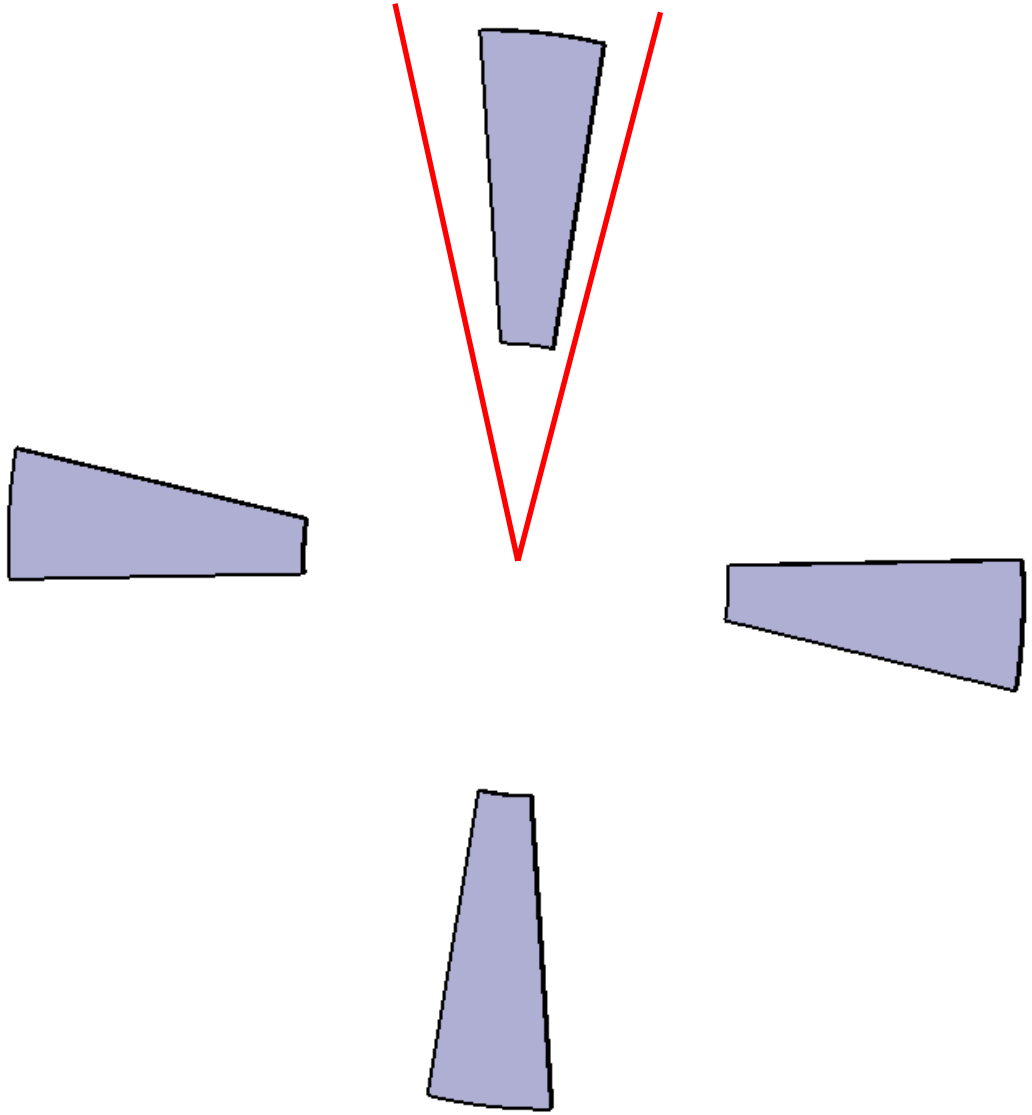


Simplified Model

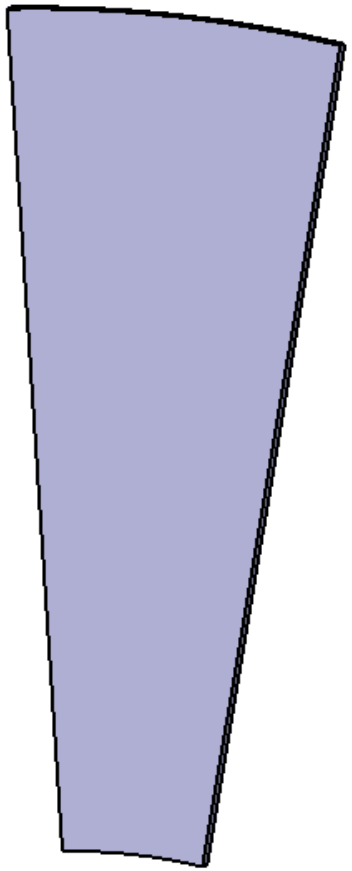


Calculation of Radiation Length (Xo)

Selection Area for calculation Radiation Length L(Xo)

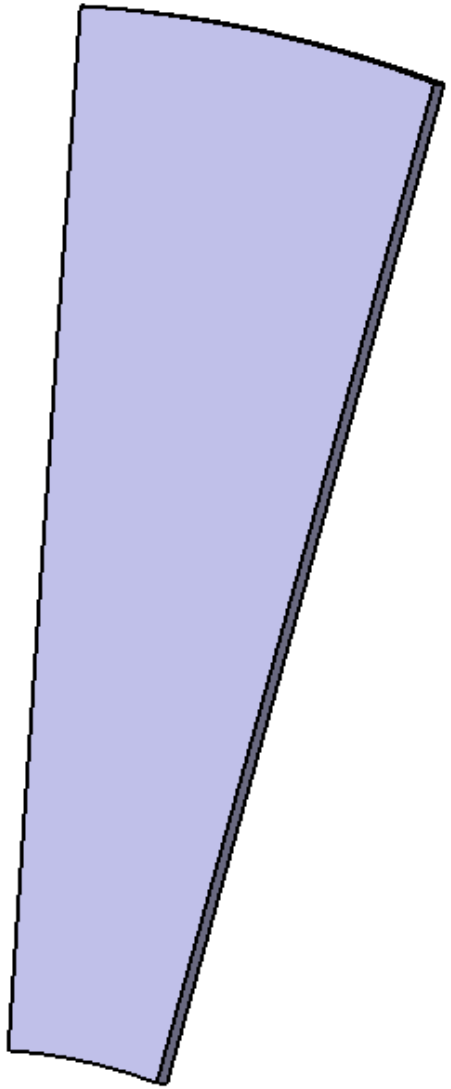


Because of geometries in each sectors are identical the **Radiation length** will be the same for all of them.
So, detailed calculation of the Radiation Length performed for the one sector



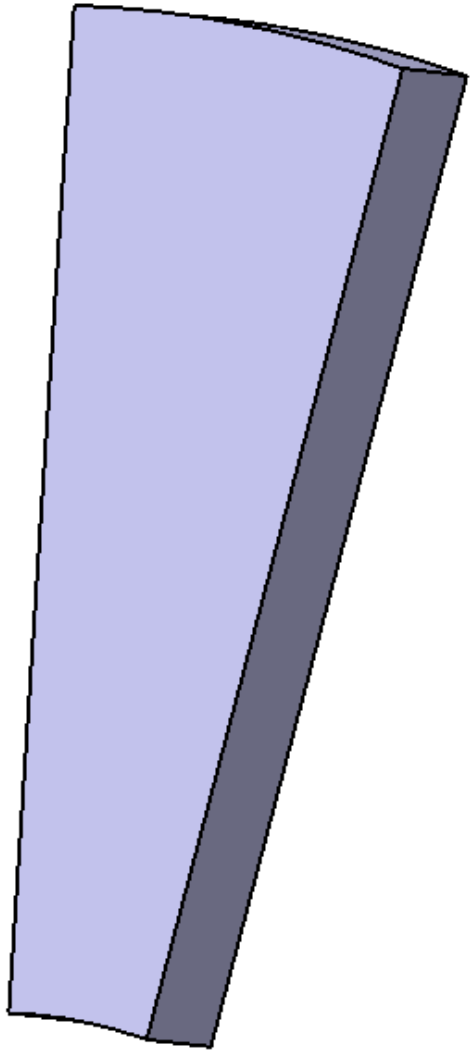
Selection Area for calculation Radiation Length L(Xo)

Simplified CAD Model

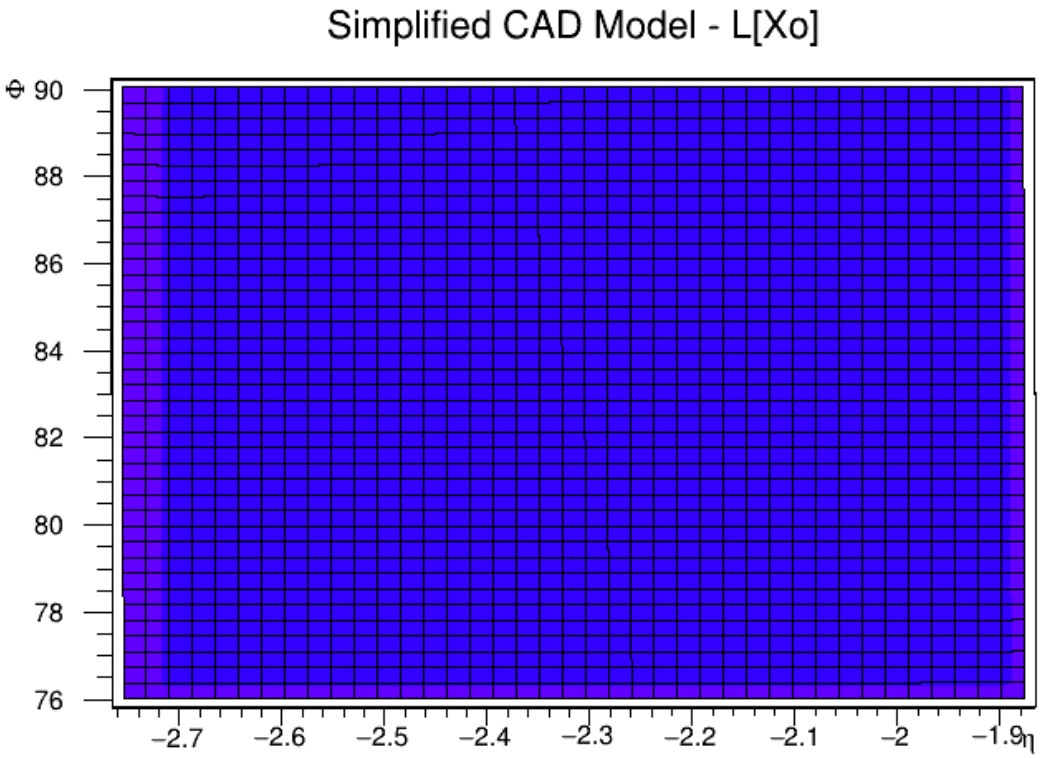


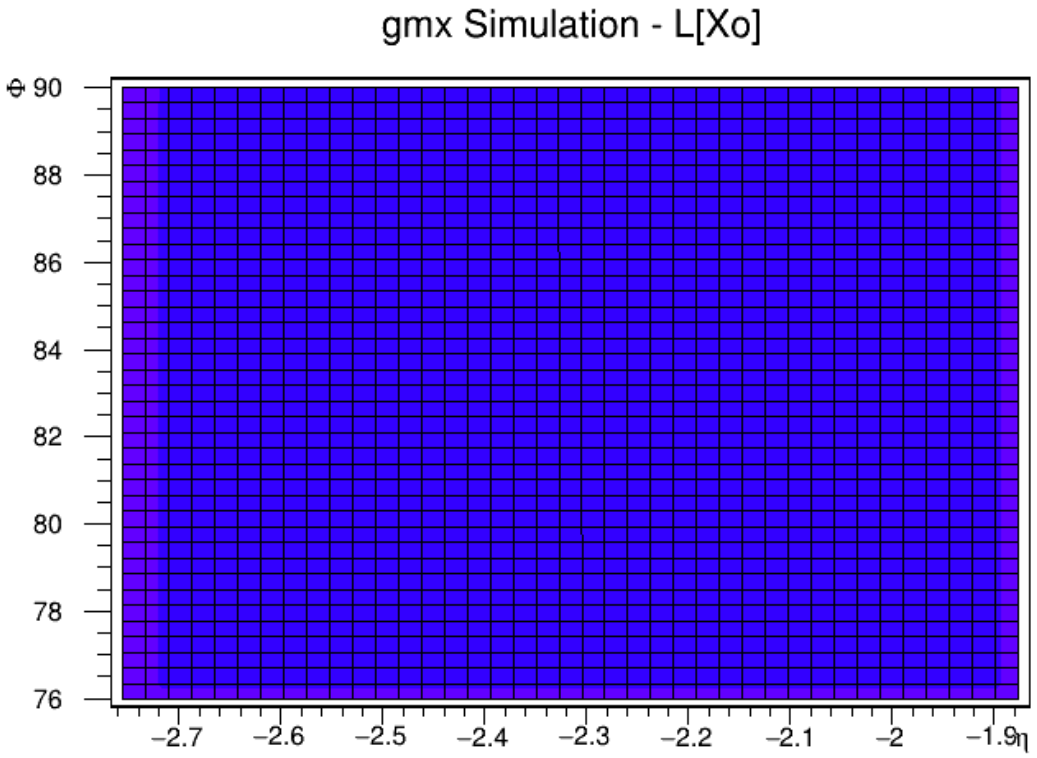
Vs.

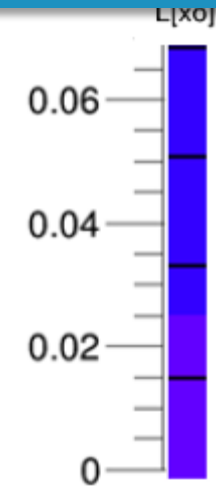
gmx - Simulation



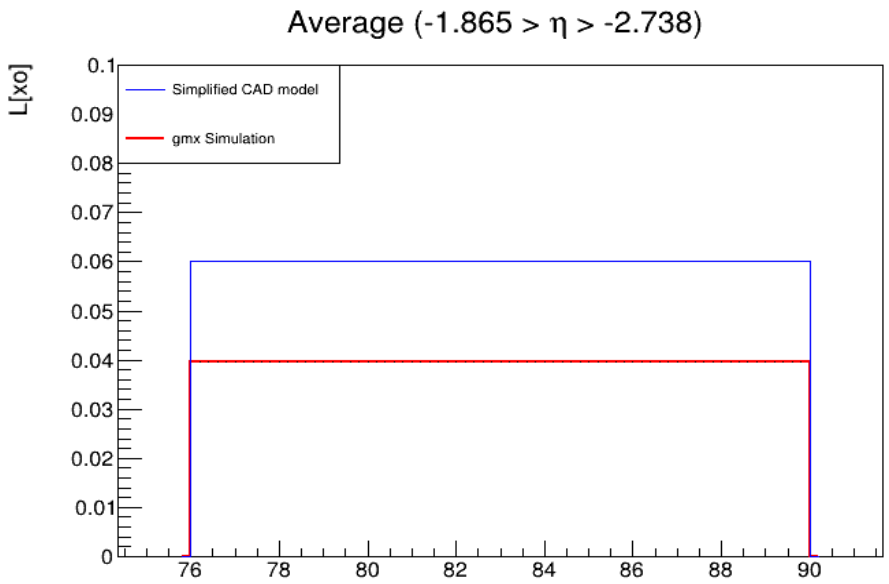
Compare Analyses – Radiation Length L(Xo)

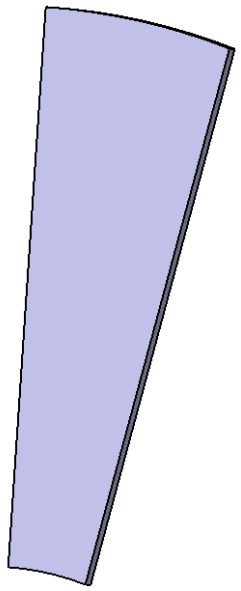


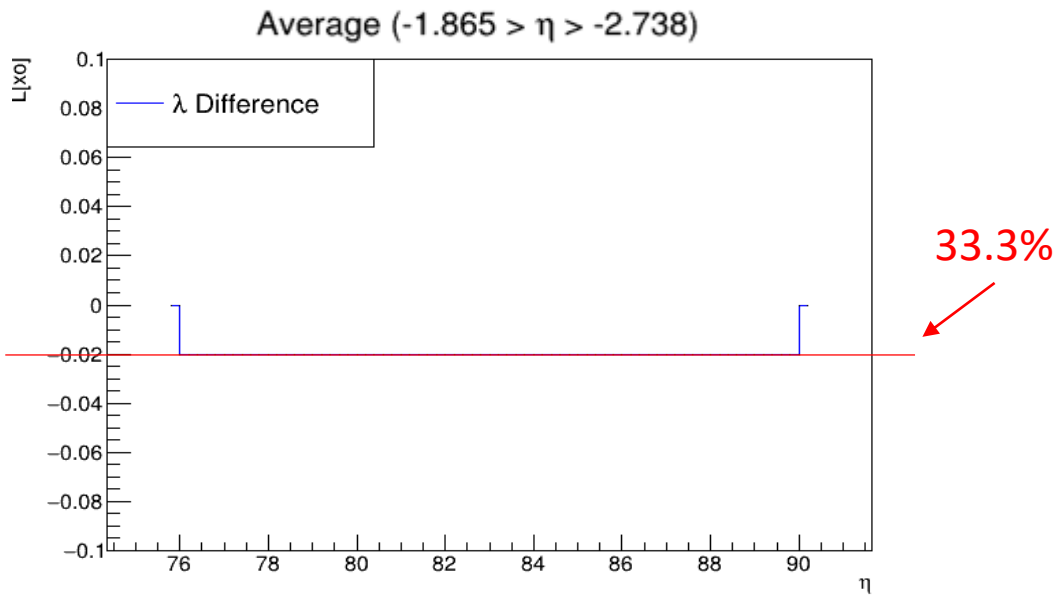




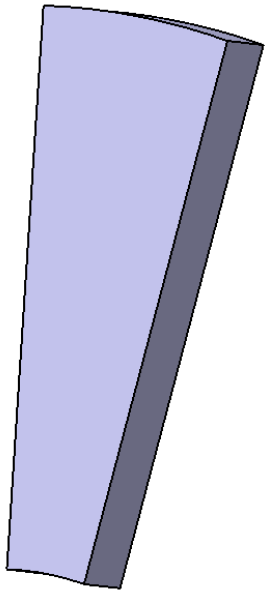
Compare Analyses – Radiation Length L(Xo)



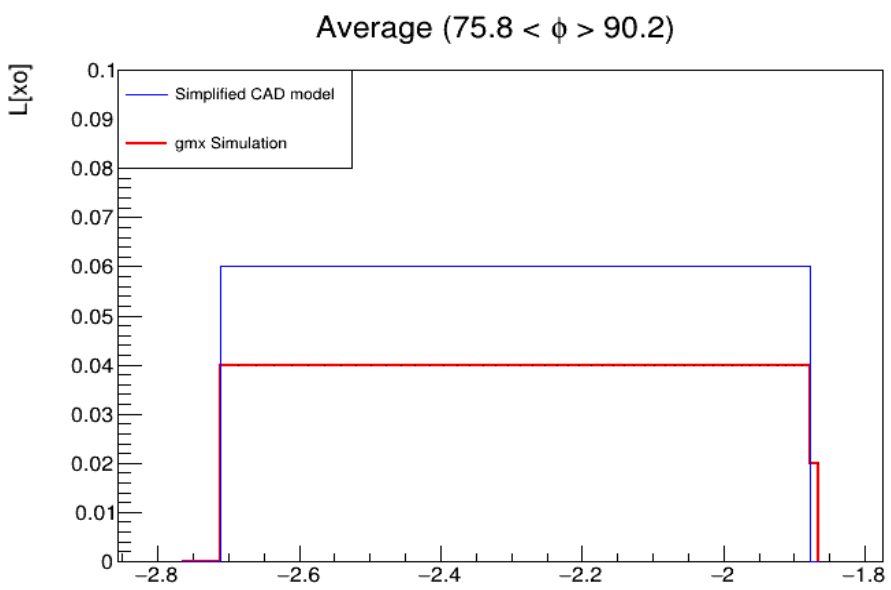


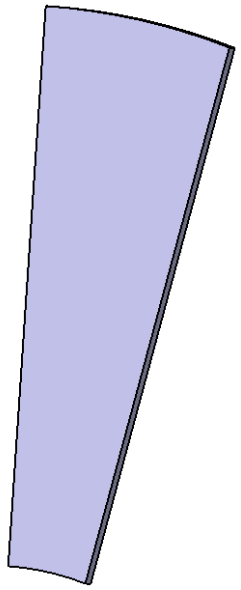


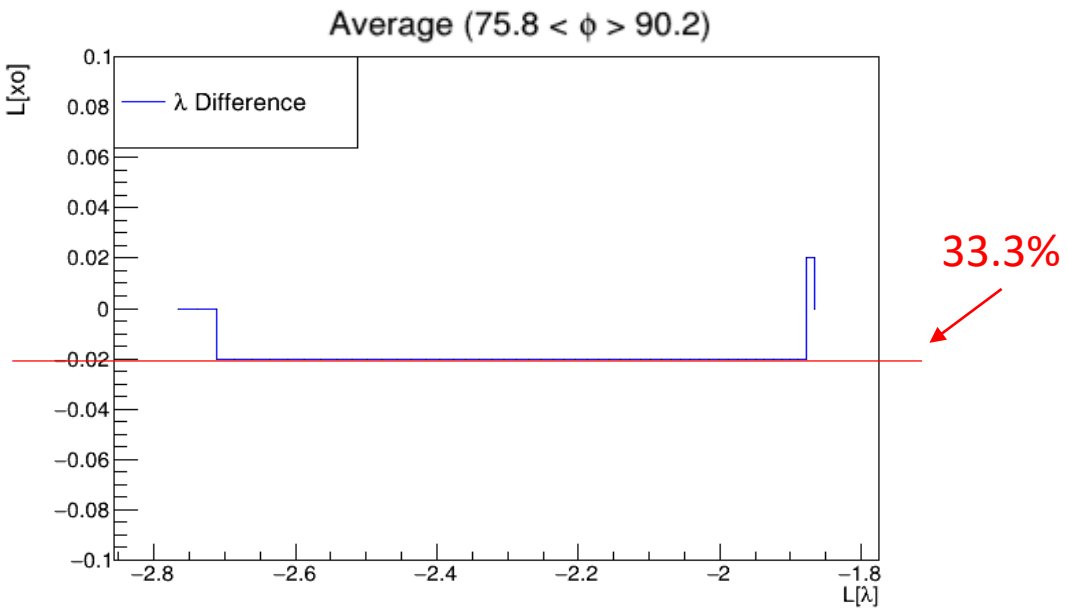
33.3%

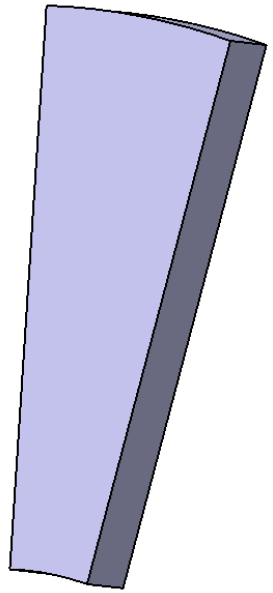


Compare Analyses – Radiation Length L(Xo)









Preparation of GMX Description Integration Conflicts Checking

Preparation of GMX Description

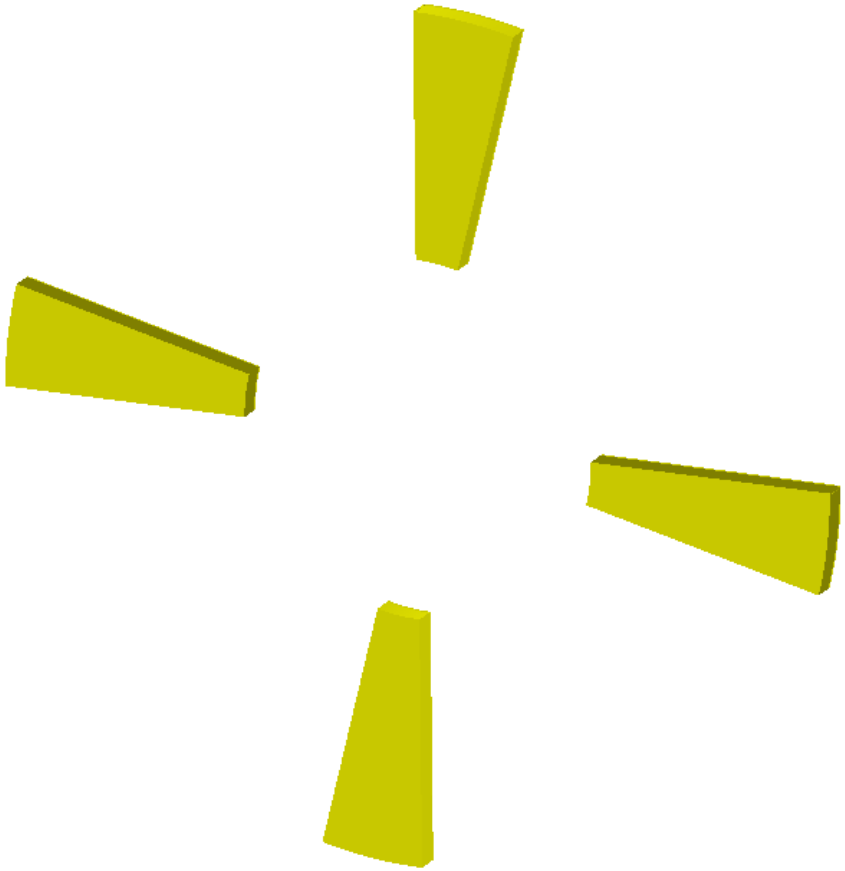
```
<materials>
  <material name="matPixReadout2_New" density="2.29167">
    <materialref fraction="0.1104" ref="CuMetal"/>
    <materialref fraction="0.1208" ref="AlMetal"/>
    <materialref fraction="0.6688" ref="PE"/>
    <materialref fraction="0.1" ref="PVC"/>
  </material>
</materials>
```

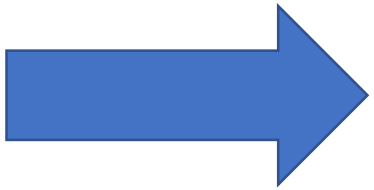
```
<defines>
 <var name="twin_ax_cable_main_rmin" value="420."/>
 <var name="twin_ax_cable_main_rmax" value="1000."/>
 <var name="twin_ax_cable_main_zhalflength" value="4.55"/>
 <var name="twin_ax_cable_main_dphi" value="0.2443"/>
 <var name="twin_ax_cable_ZPos" value="3195."/>
</defines>

<shapes>
<tubs name="twin_ax_cable_main" rmin="twin_ax_cable_main_rmin" rmax="twin_ax_cable_main_rmax"
zhalflength="twin_ax_cable_main_zhalflength" sphi="0" dphi="twin_ax_cable_main_dphi"/>
</shapes>

<!-- Logical Volumes -->
<logvol name="twin_ax_cable" shape="twin_ax_cable_main" material="matPixReadout2_New"/>
<!-- end Logical Volumes -->

<assembly name="twin_ax_cable_assem">
  <multicopy name="twin_ax_cable_assem_mult" n="4" >
    <transformation name="twin_ax_cable_assem_multrot">
      <rotation zcos="1." angle="PI/2"/>
    </transformation>
    <logvolref ref="twin_ax_cable"/>
  </multicopy>
</assembly>
```

44 Programing strings
1 Solids
0 Boolean Operations

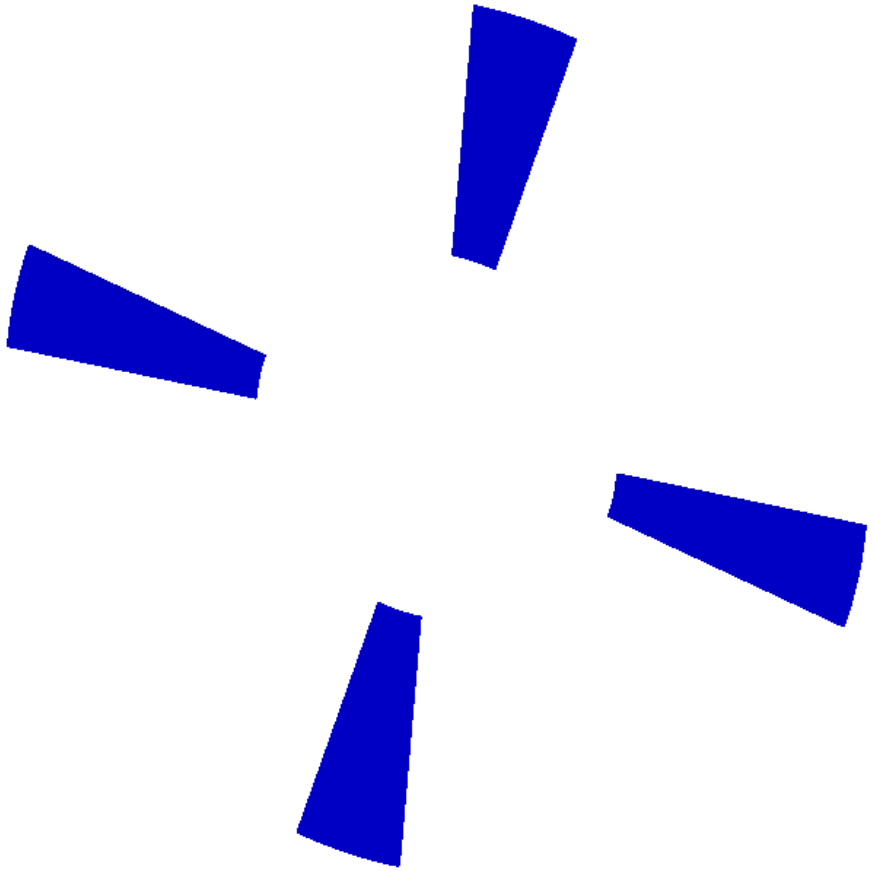
Integration conflicts checking - Replacement

GMX - Simulation

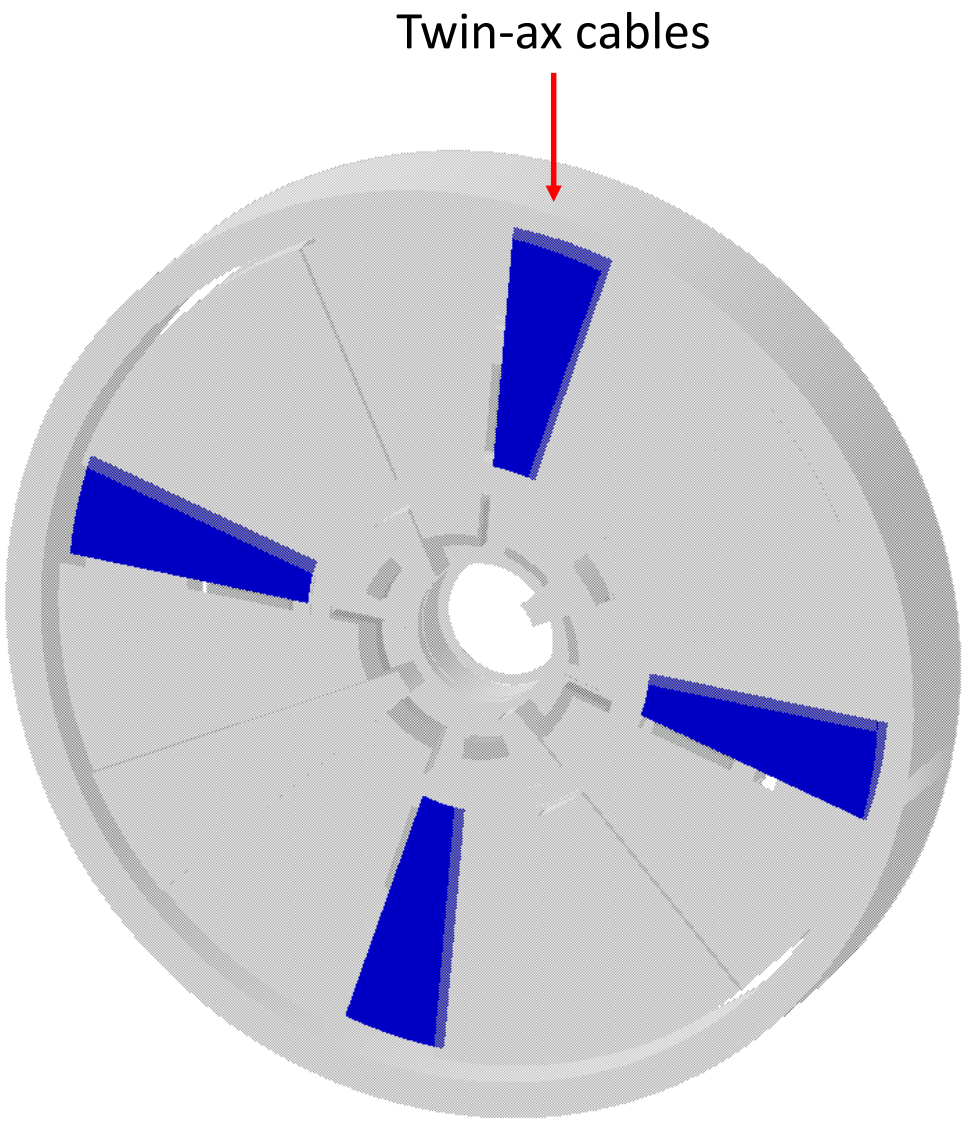




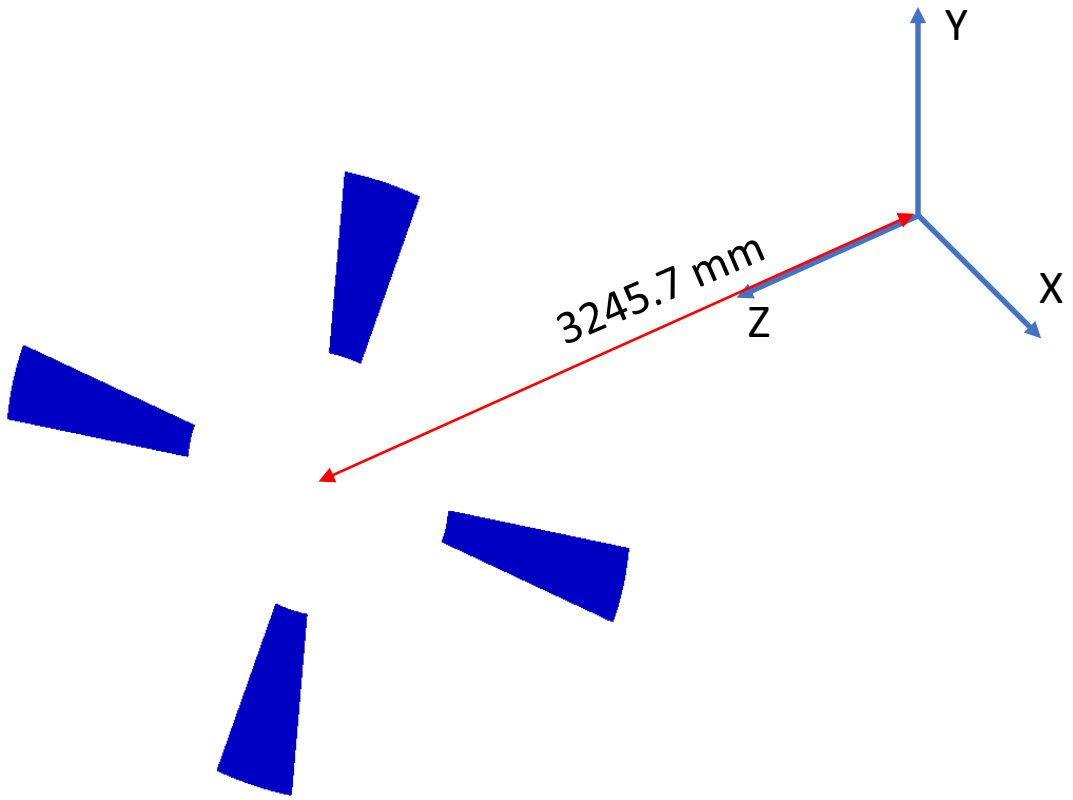
New Geometry



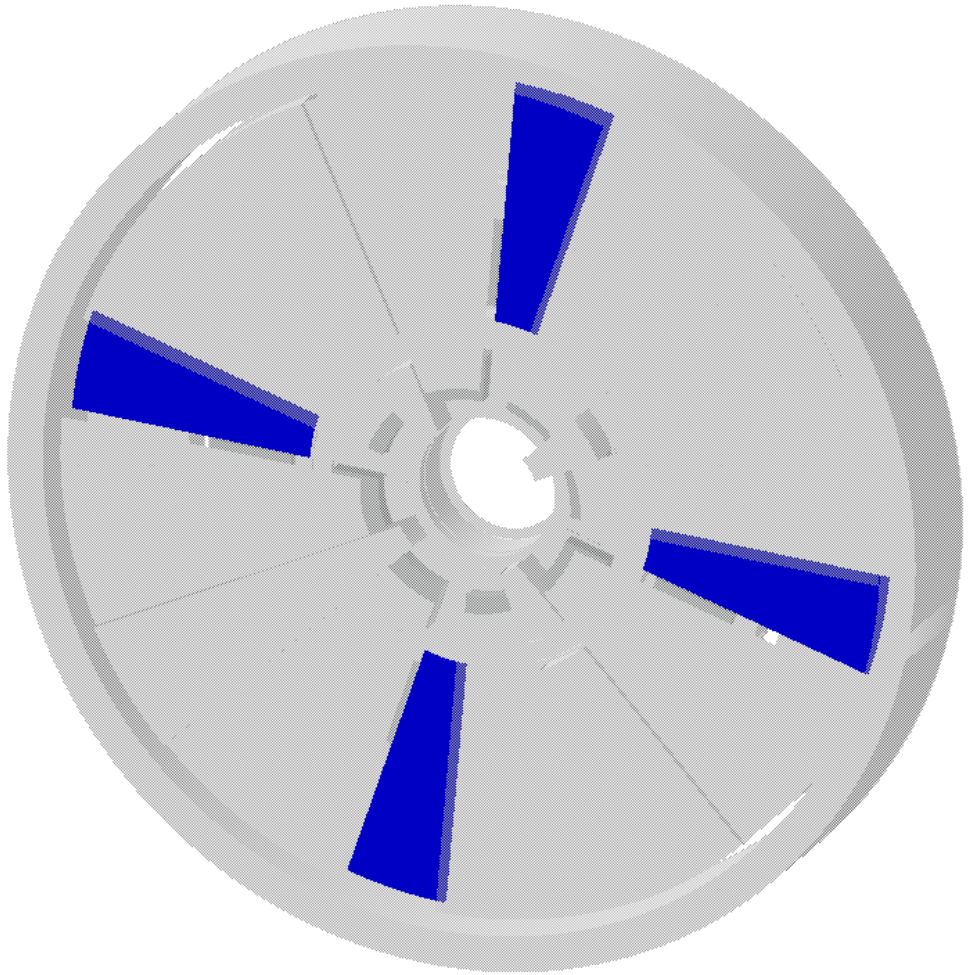
Integration conflicts checking

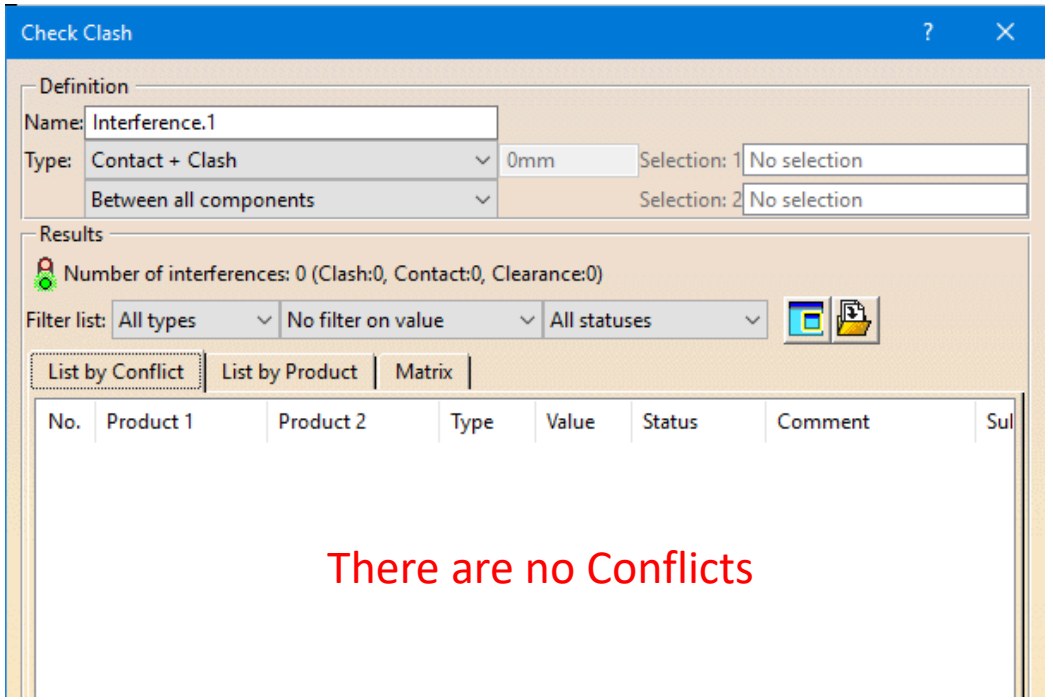


Twin-ax cables are located on the both side (Side A/C)



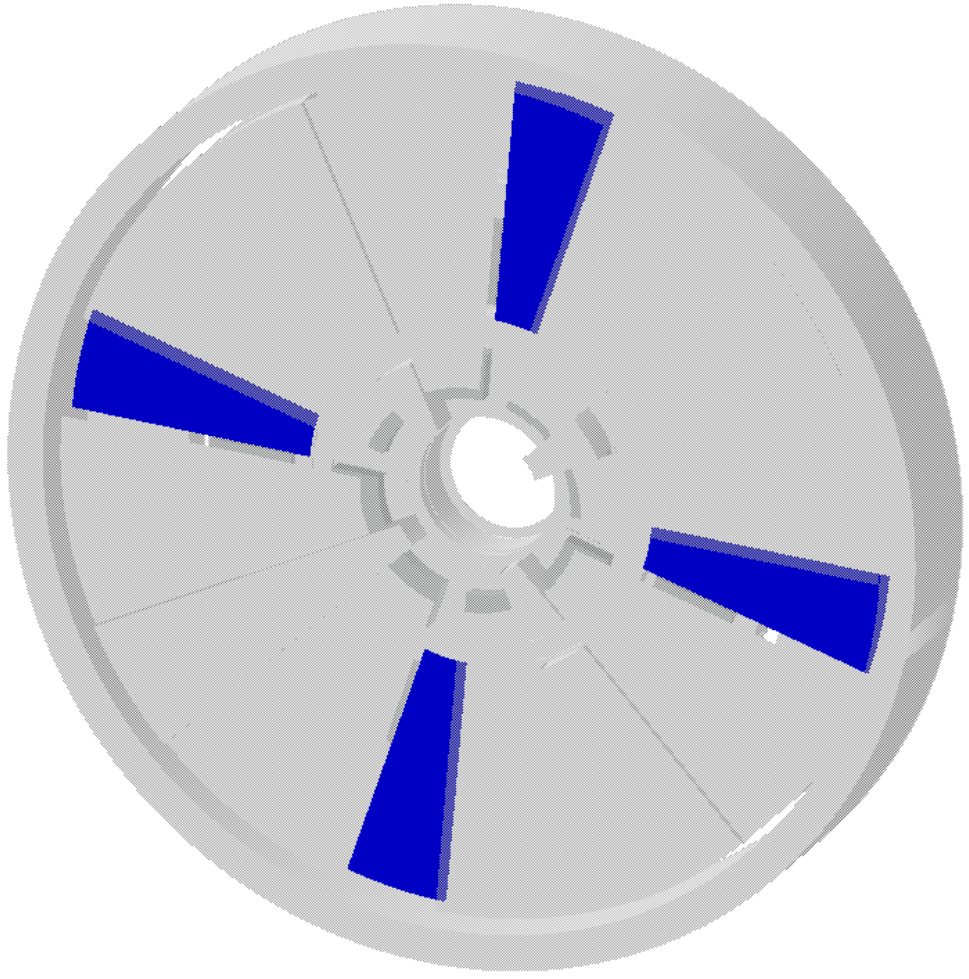
Integration conflicts checking - Using CATIA





Internal Conflict Checking – Using GMClash

New GMX Description



There are no internal conflicts between separate parts of New GMX Description

```
nika@nika-VirtualBox: ~/Packages/ITKLayouts-modified/ITKLayouts/data/Pixel

Building the detector from the GDML file: geometry.gdml
G4GDML: Reading 'geometry.gdml'...
G4GDML: Reading definitions...
G4GDML: Reading materials...
G4GDML: Reading solids...
G4GDML: Reading structure...
G4GDML: Reading setup...
G4GDML: Reading 'geometry.gdml' done!
Stripping off GDML names of materials, solids and volumes ...
Detector Construction from the GDML file geometry.gdml, done!
**** Real time elapsed   : 0.0590124
**** User time elapsed   : 0.02
**** System time elapsed : 0.01

 ==================  Starting Clashes Detection  ==================


**** Real time elapsed   : 0.145131
**** User time elapsed   : 0.12
**** System time elapsed : 0

**** Writing out the clashes report file: result.json

================== Recursive overlap check done! ==================
nika@nika-VirtualBox:~/Packages/ITKLayouts-modified/ITKLayouts/data/Pixel$
```

There are no conflicts

Clash_Report.json

```
Open   Clash_Report.json
       ~/packages/GMClash/install/bin   Save

1 {
2     "ClashesReport":
3 }
4
```

There are no conflicts

MR at GitLab

Draft: Integration/replacement of new Twin_ax_Cables

Open **Niko Tsutskiridze** requested to merge `PP1_Twinax_Cable` into `main` 2 days ago

Overview 4 | Commits 1 | Pipelines 2 | Changes 4

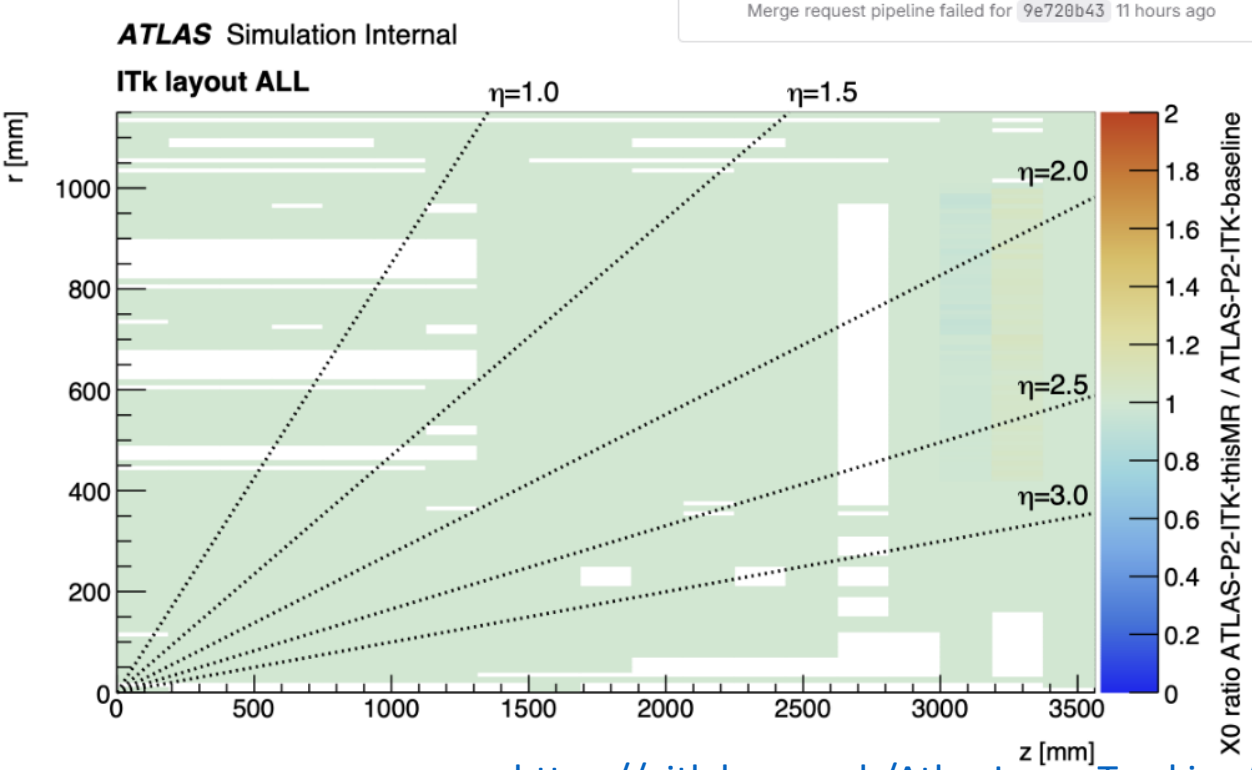
1. Modification of Cables_Connectors detailed/simplified switcher

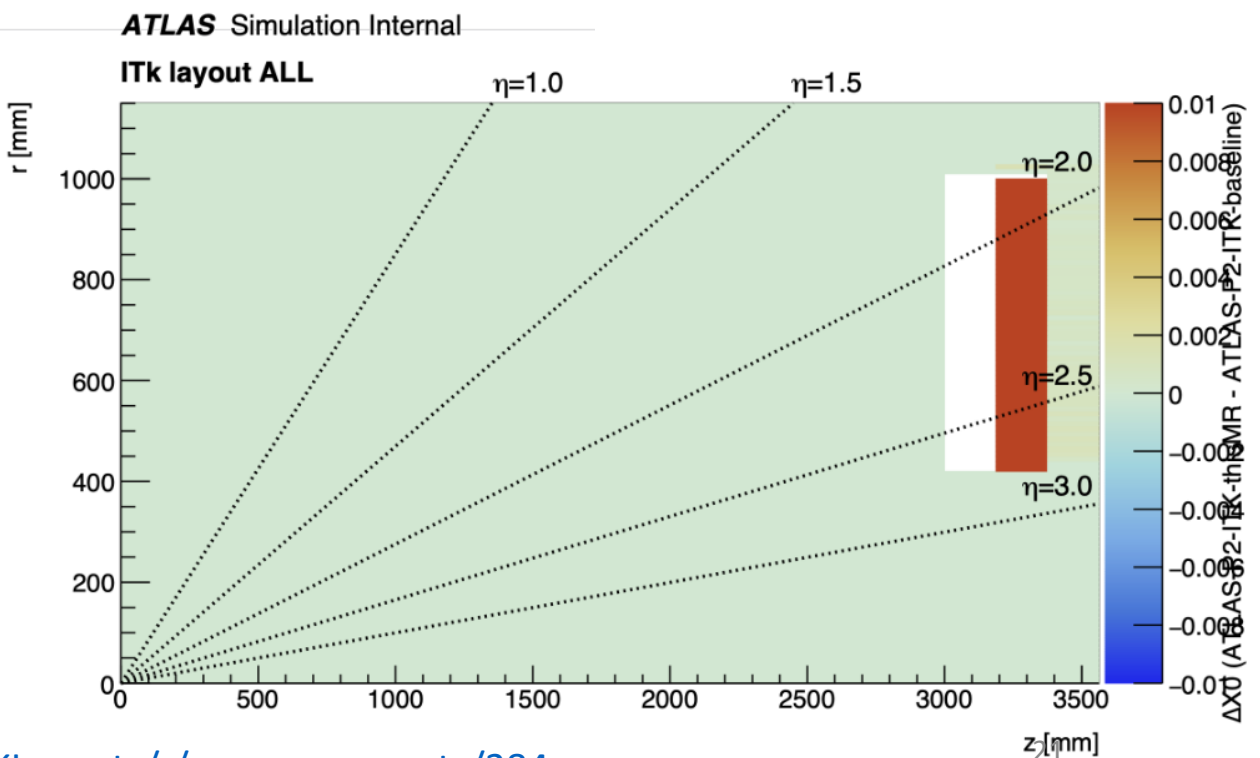
2. Integration/replacement of new Twin_ax_Cables description

0 0

Merge request pipeline #8235962 failed

Merge request pipeline failed for `9e720b43` 11 hours ago





https://gitlab.cern.ch/Atlas-Inner-Tracking/ITKLayouts/-/merge_requests/384

Technical reports at GitLab

master / itk_projects / Project N7 - Twin-ax Cable / + | Lock | History | Find file | Edit | Code

Upload New File
Niko Tsutskiridze authored 18 minutes ago

ac16687d

Code owners Assign users and groups as approvers for specific file changes. Learn more. | Manage branch rules

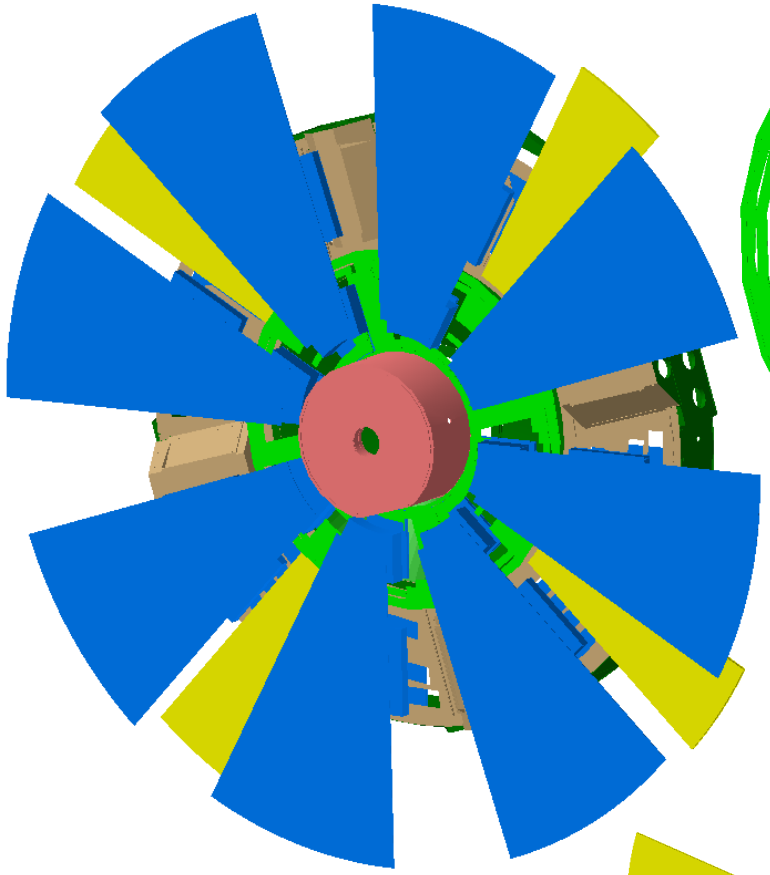
Name	Last commit	Last update
..		
.gitkeep	Add new directory	34 minutes ago
1._Mass_Analyses.pdf	Upload New File	22 minutes ago
2._SImplification.pdf	Upload New File	22 minutes ago
3._Calculation_of_Radiation_Length.pdf	Upload New File	22 minutes ago
4._Codding_and_Integration_Conflicts_Checking.pdf	Upload New File	22 minutes ago
Twin-ax.gmx	Upload New File	21 minutes ago
Twin_ax.wrl	Upload New File	18 minutes ago

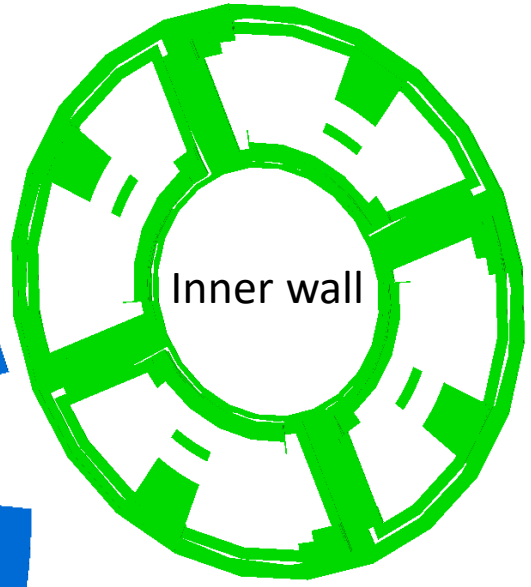
https://gitlab.cern.ch/ntsutski/itk_projects/-/tree/master/Project%20N7%20-%20Twin-ax%20Cable

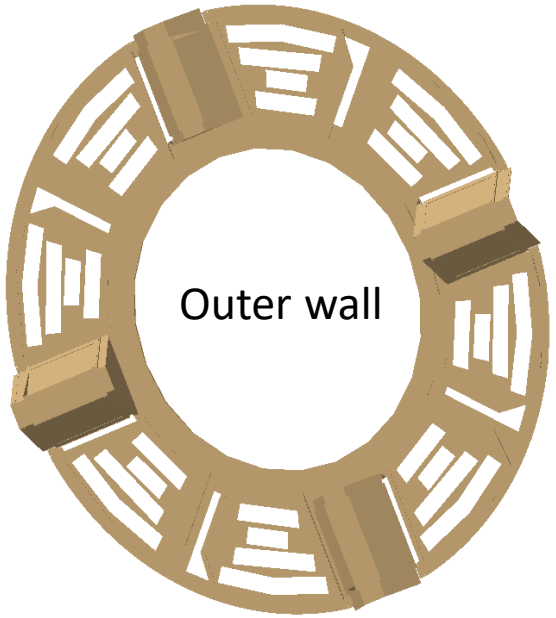
General Status of PP1 Region

List of completed projects

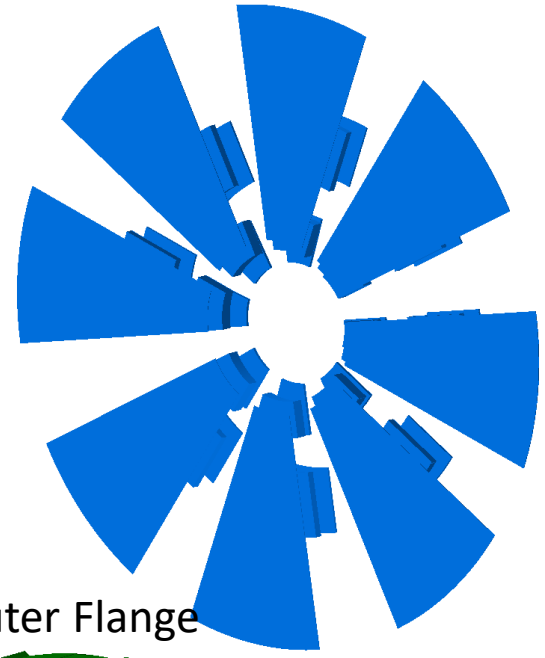
PP1 region

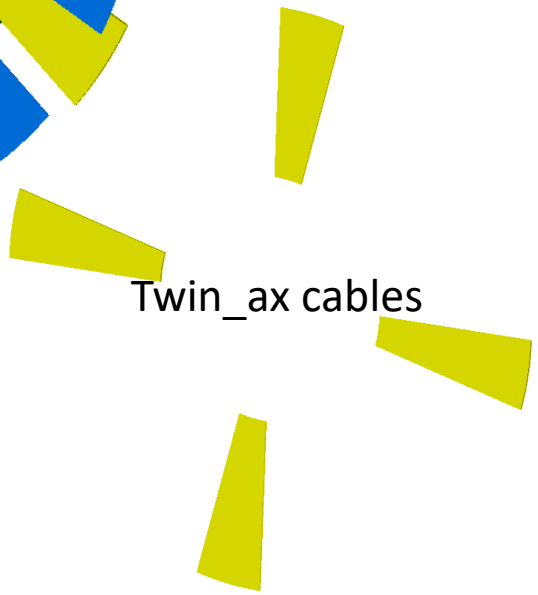




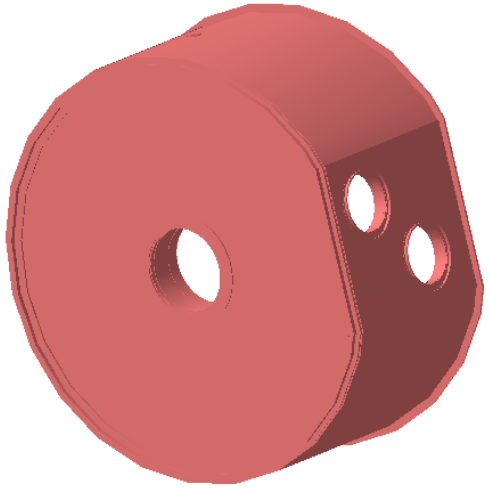


Cables and Connectors

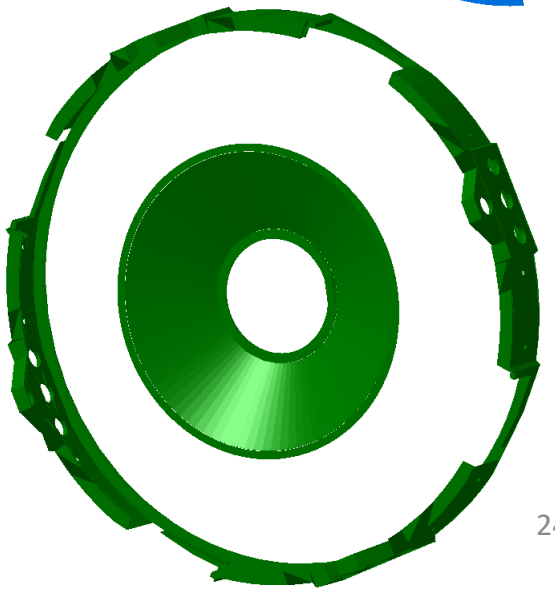




Inner Cylinder



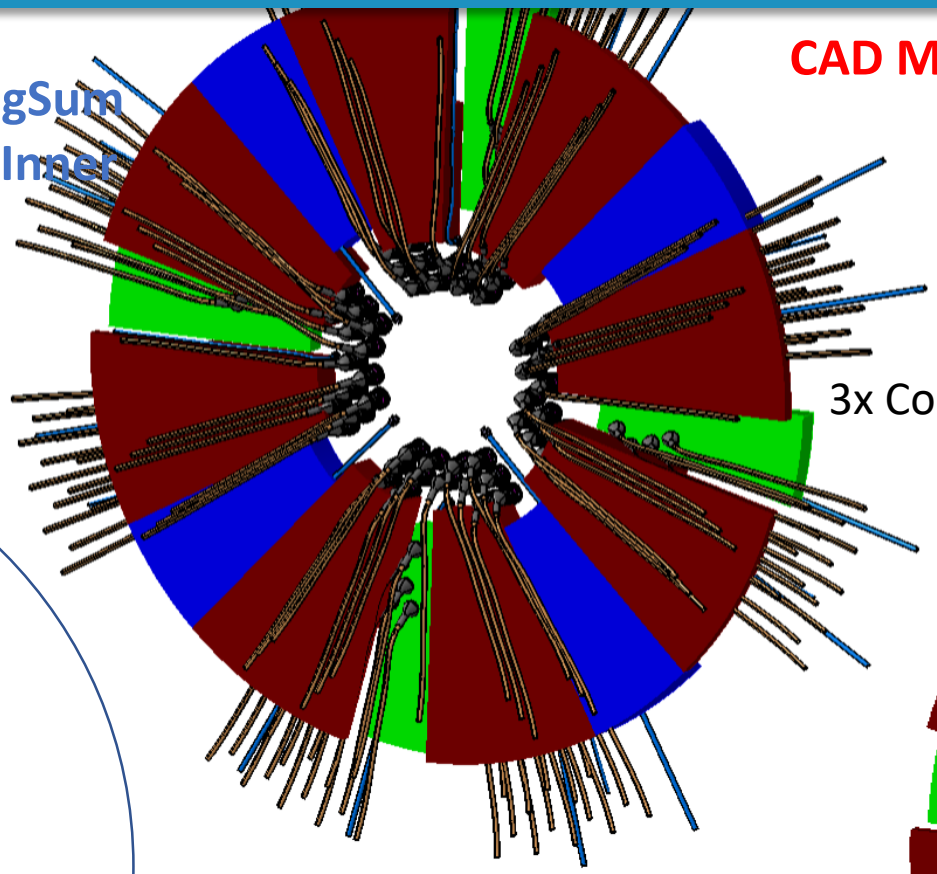
Outer Flange



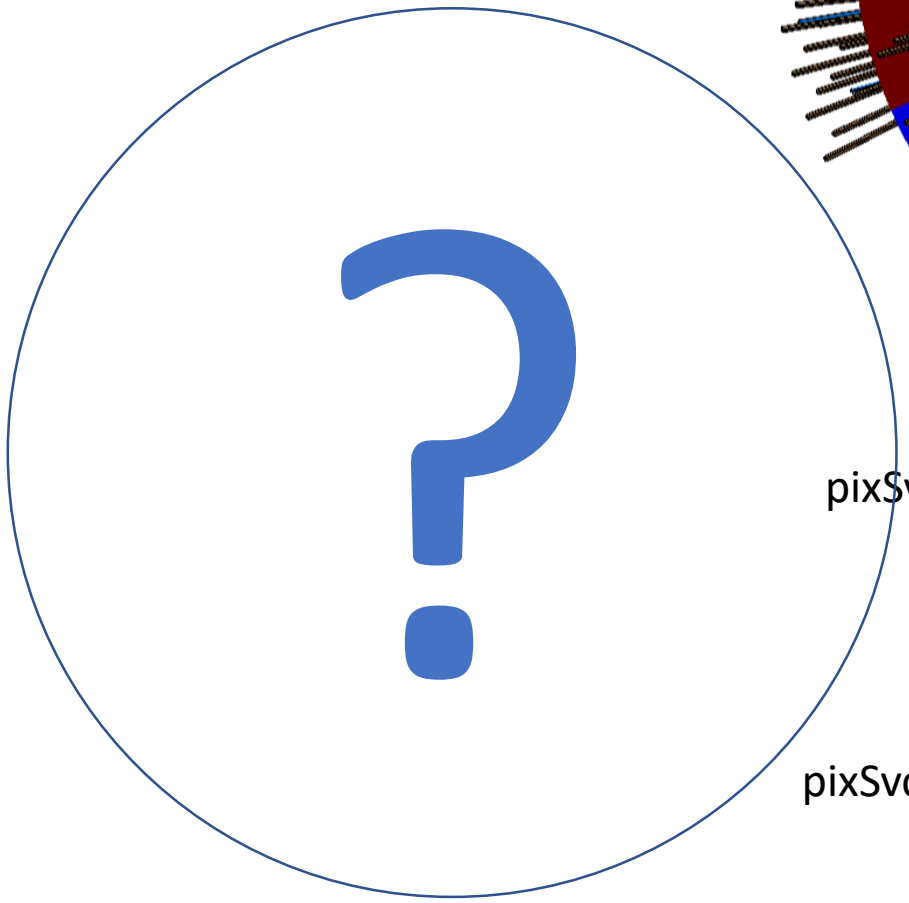
List of volumes that require investigation

CoolingOuterWheel
pixSvc_PP1_T2_R420_R1000_CoolingSum
pixSvc_PP1_T2_R347_R420_CoolingInner

CAD Model + gmx

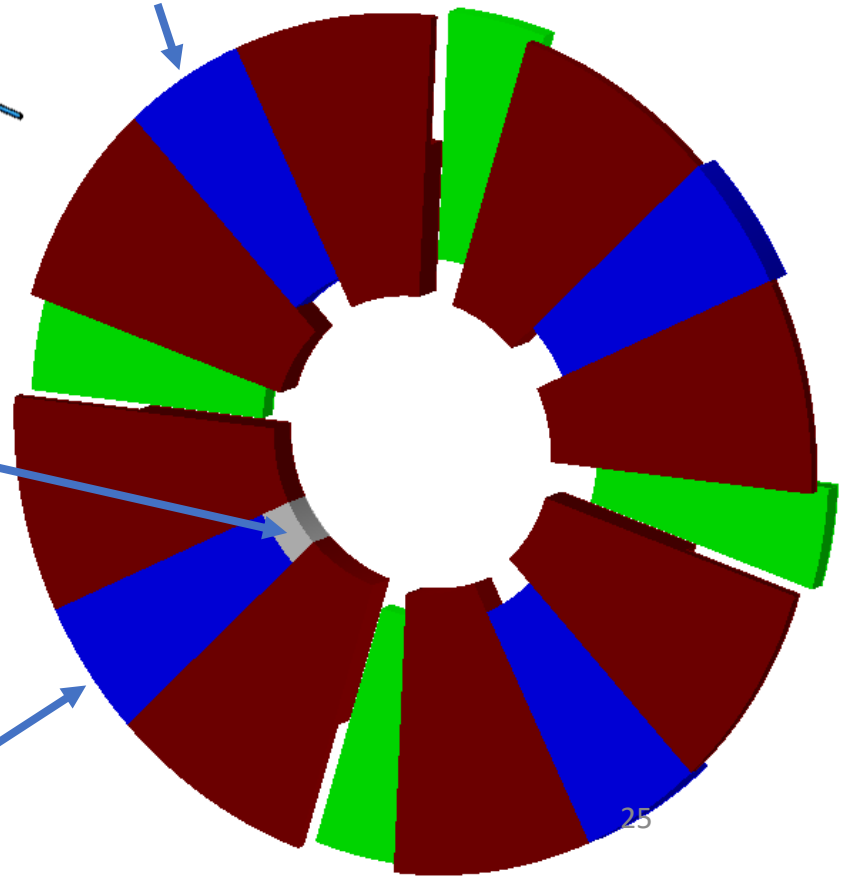


CAD Model



Simulation - gmx

3x CoolingOuterWheel



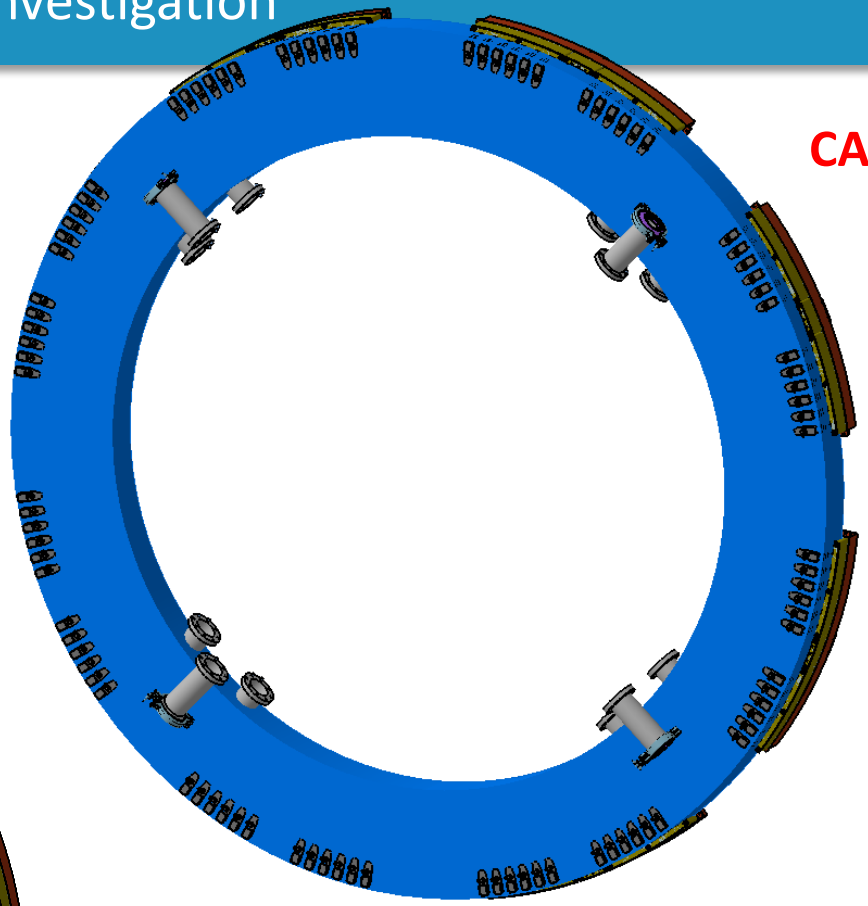
pixSvc_PP1_T2_R347_R420_CoolingInner

Vs.

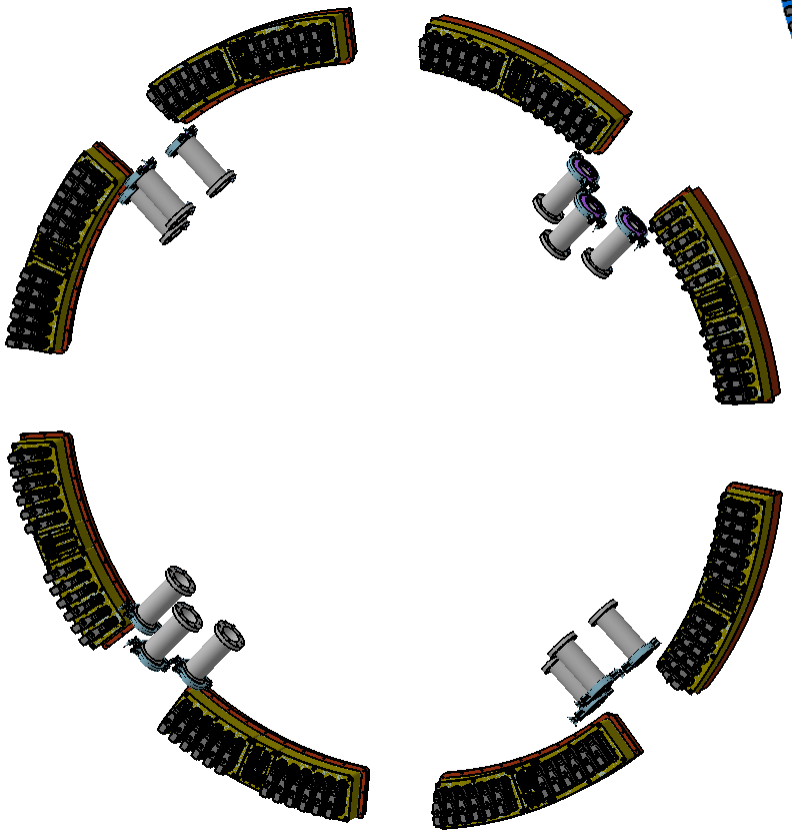
pixSvc_PP1_T2_R420_R1000_CoolingSum

StripEC_PP1

CAD Model + gmx

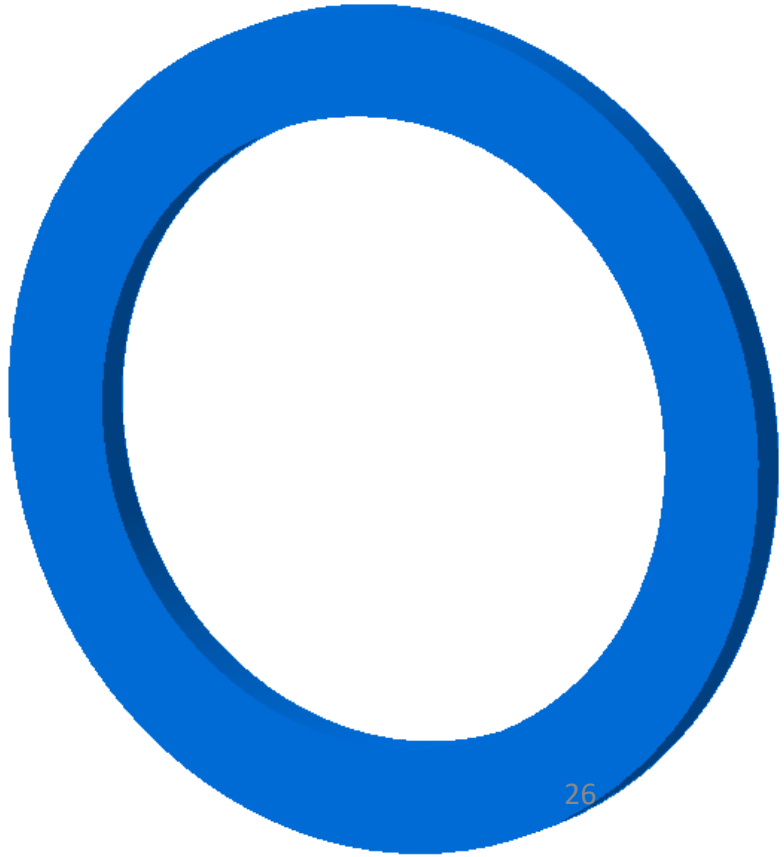


CAD Model



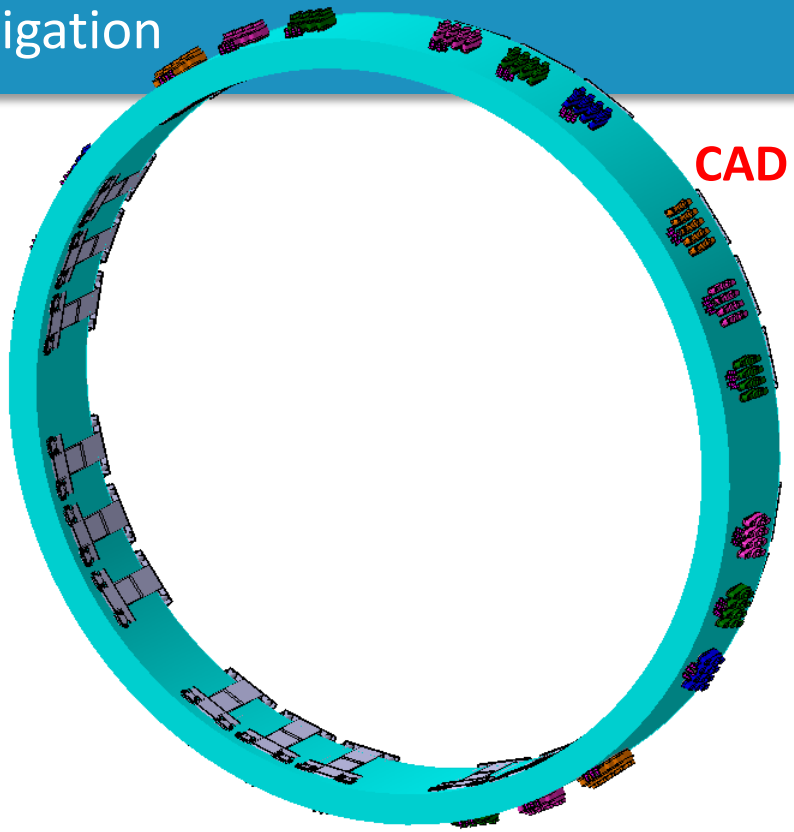
Vs.

Simulation - gmx

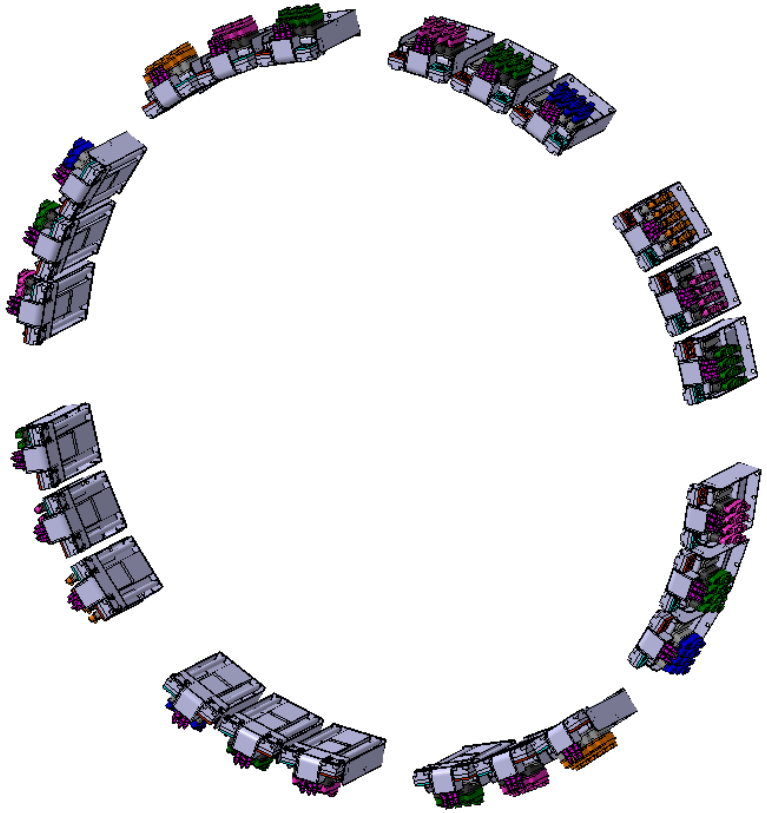


StripB_PP1

CAD Model + gmx

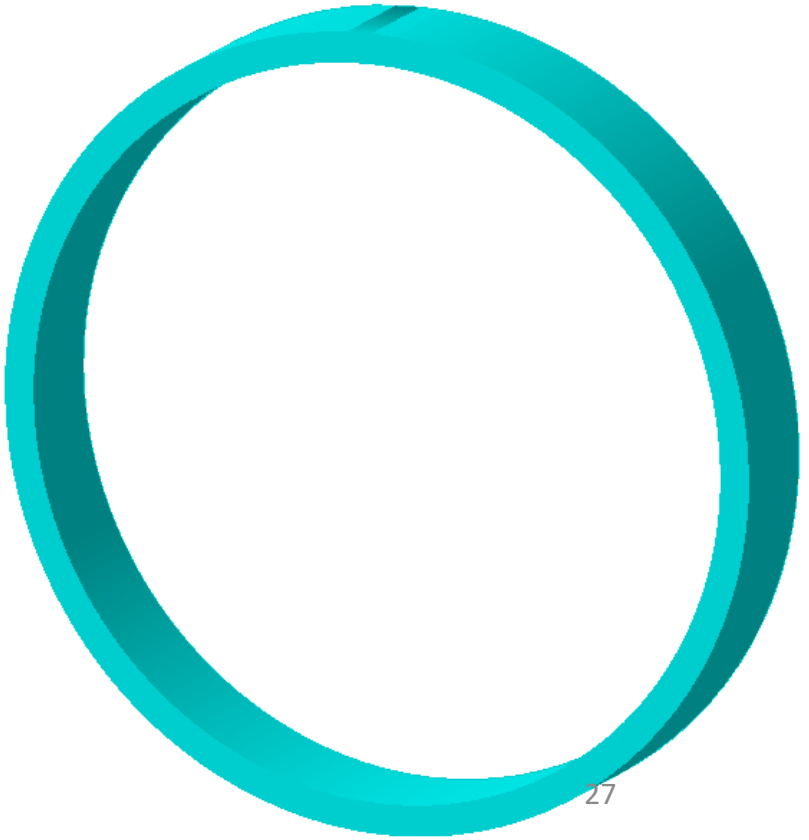


CAD Model



Vs.

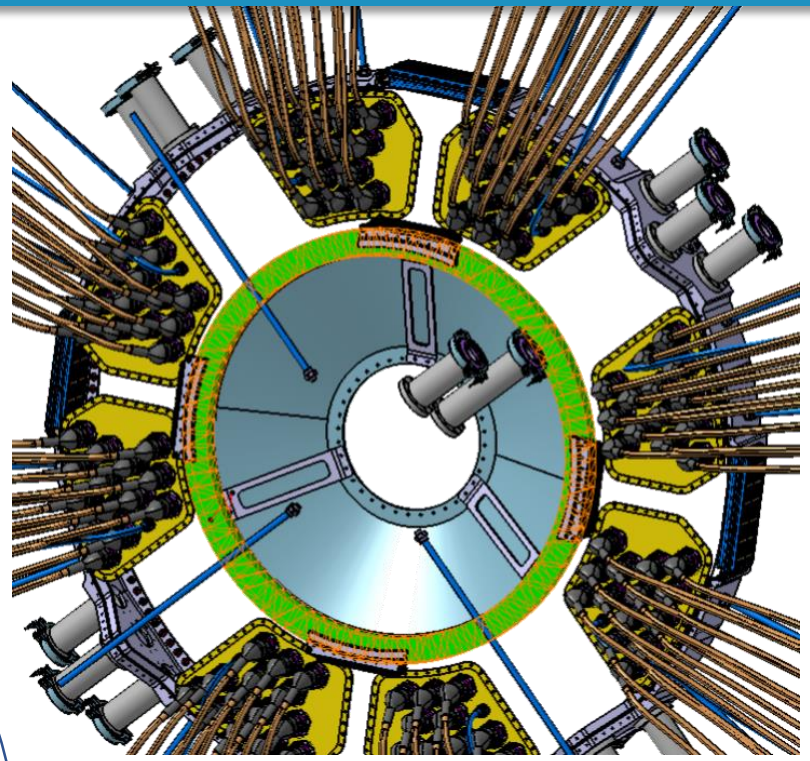
Simulation - gmx



List of volumes that are difficult to identify

Pix_PP1InnerServices

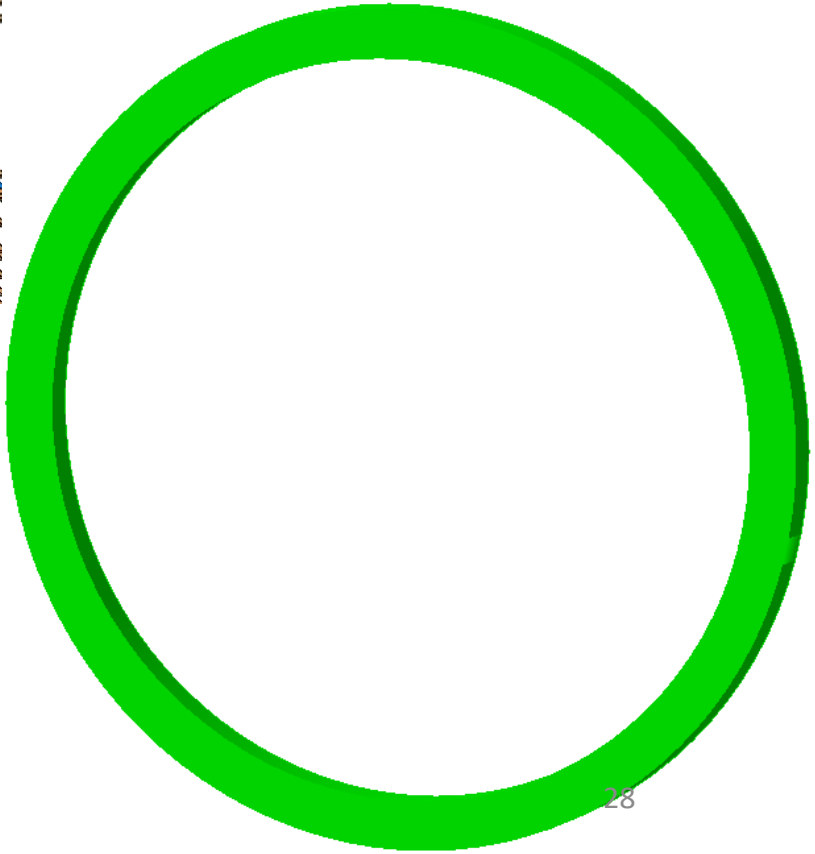
CAD Model



CAD Model + gmx

Vs.

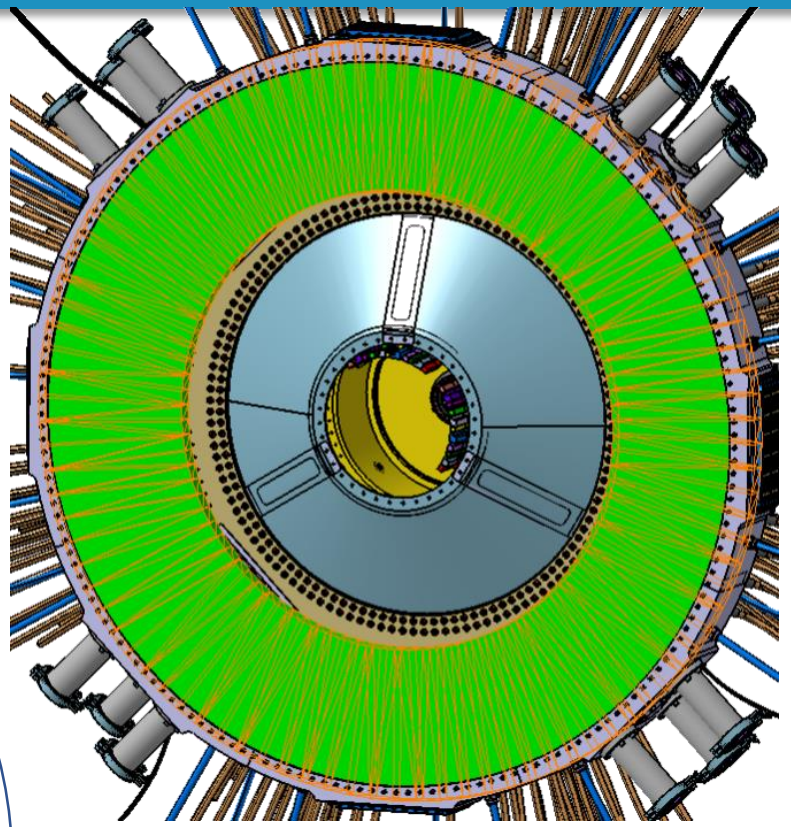
Simulation - gmx



List of volumes that are difficult to identify

Pix_PP1OuterServices

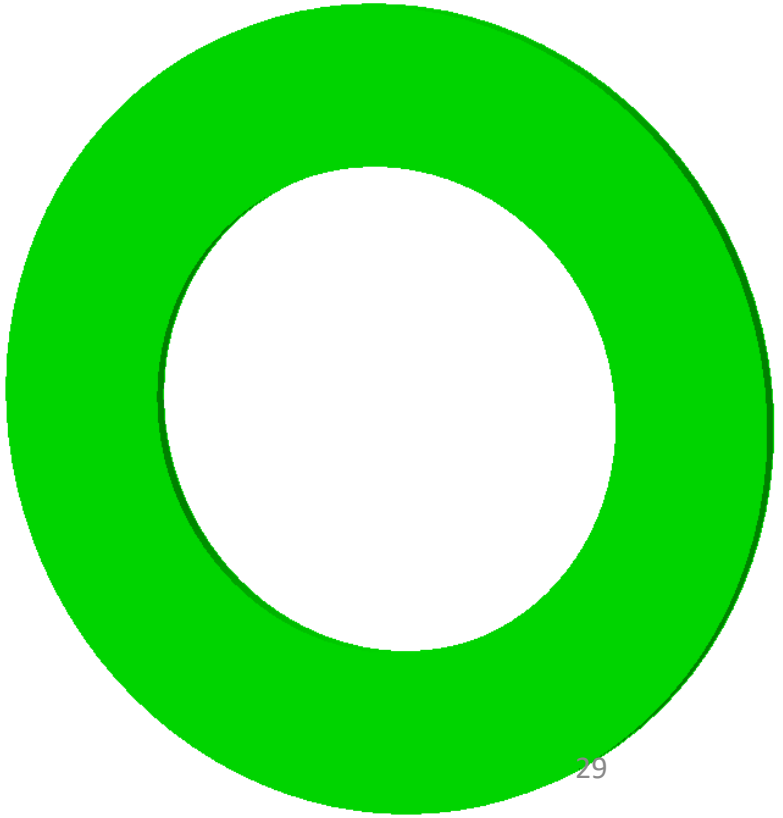
CAD Model



CAD Model + gmx

Vs.

Simulation - gmx

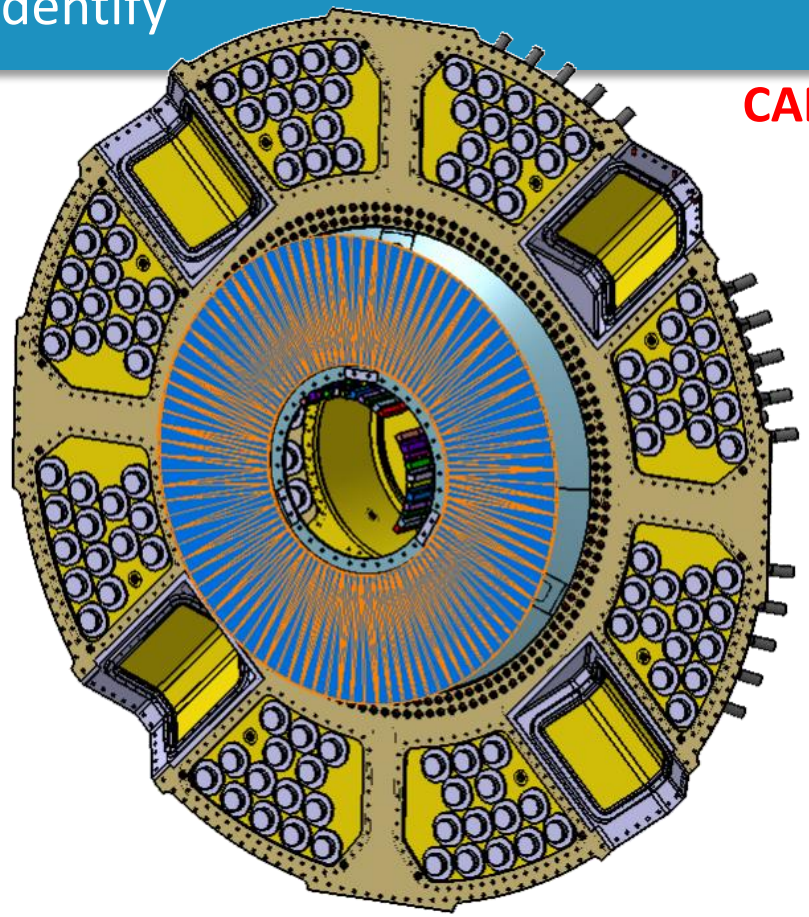


List of volumes that are difficult to identify

PP1_T1_outercylinder

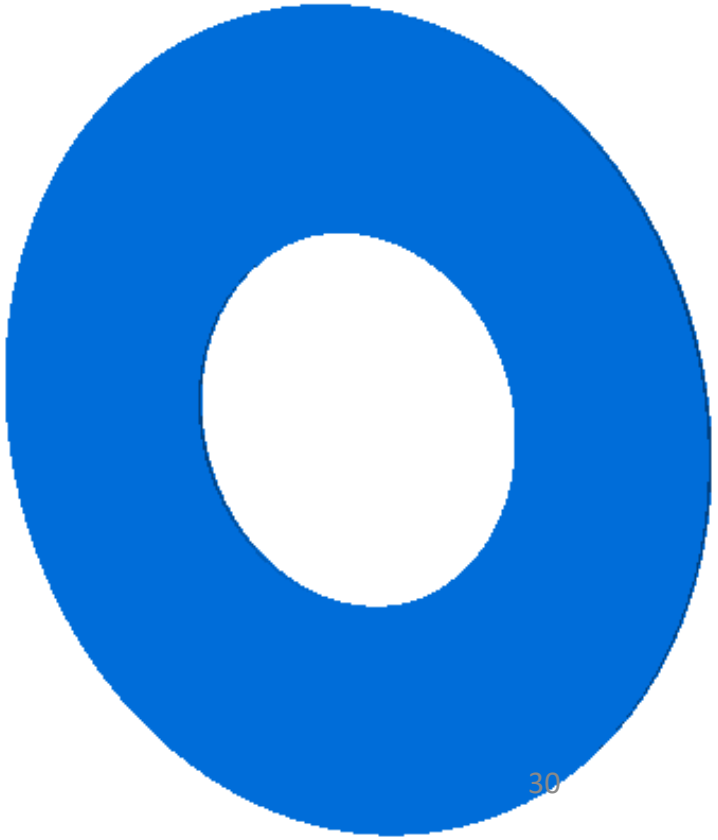
CAD Model

CAD Model + gmx



Vs.

Simulation - gmx



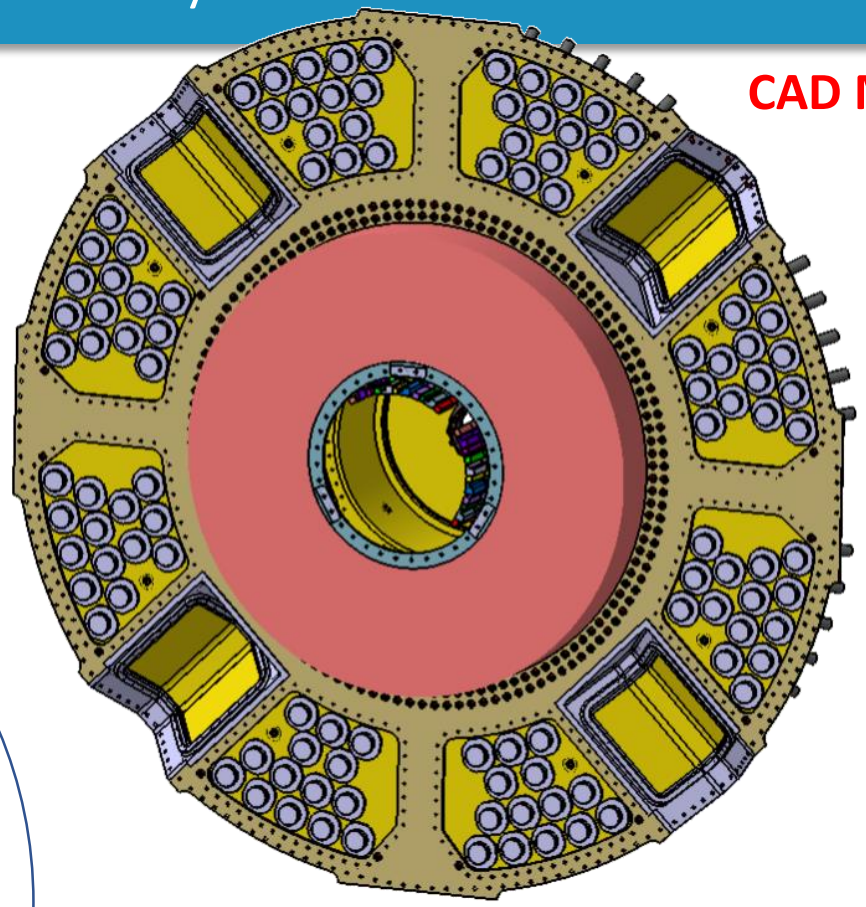
List of volumes that are difficult to identify

PP1_T1_outercone

CAD Model

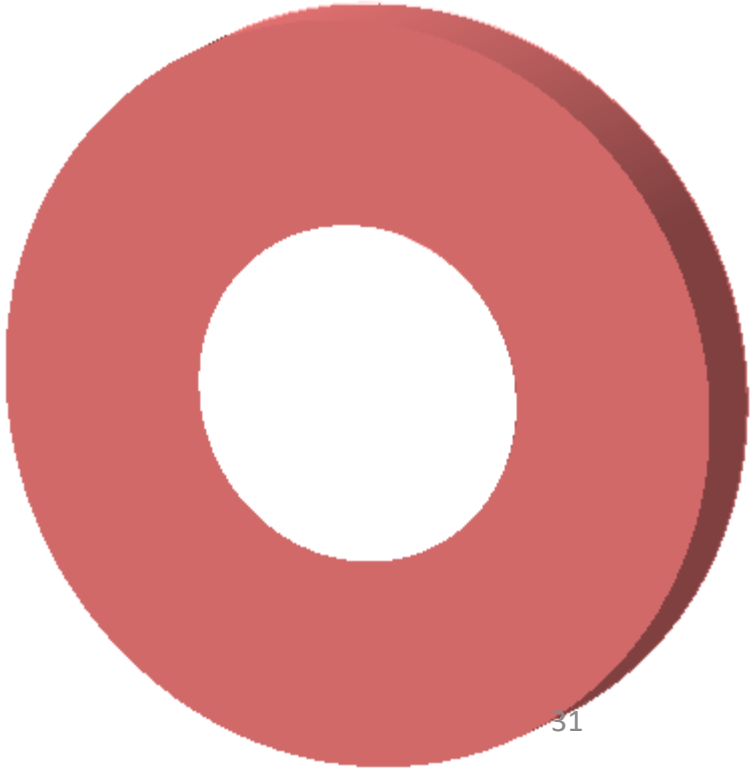
?

CAD Model + gmx



Vs.

Simulation - gmx

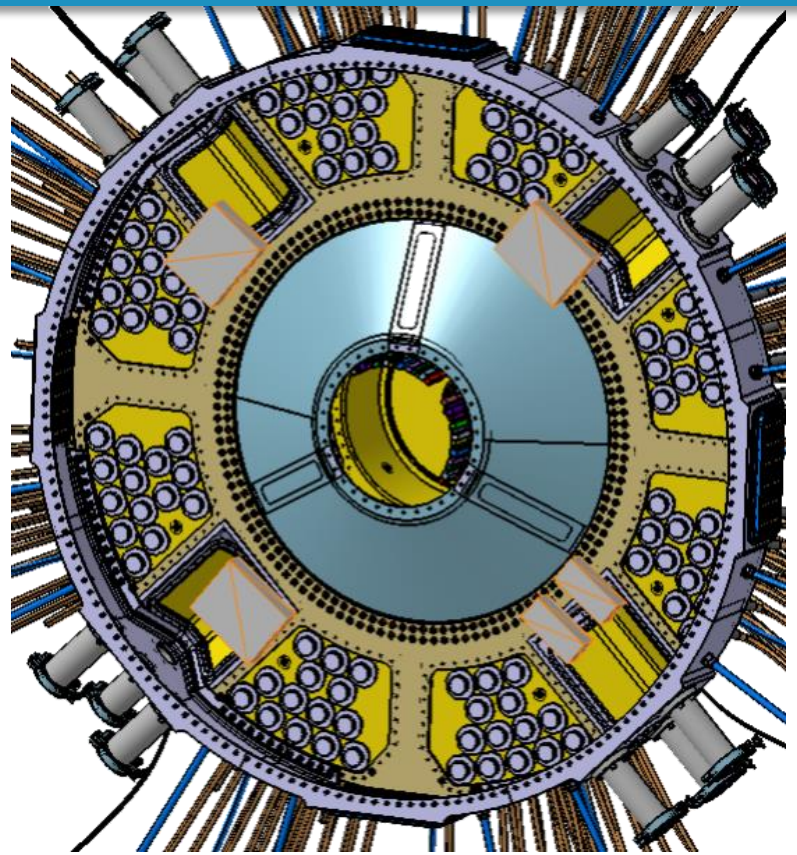


List of volumes that are difficult to identify

AddHeatExchangers
PlacedHeatExchanger_doublet

CAD Model

?



Vs.

CAD Model + gmx

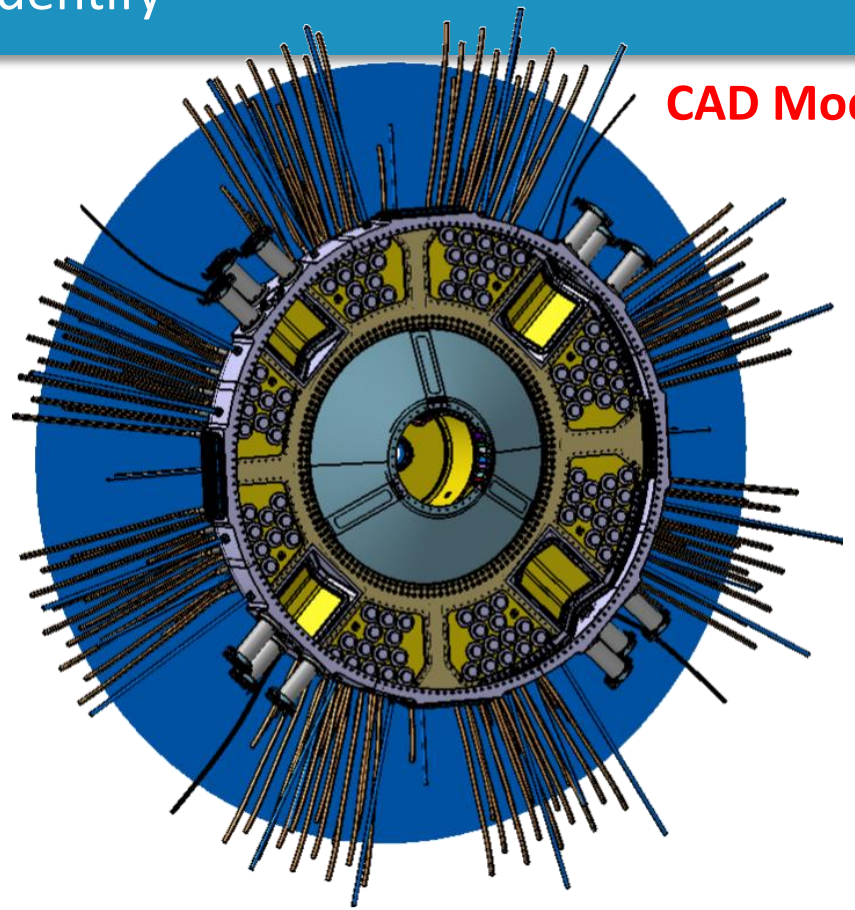
Simulation - gmx

List of volumes that are difficult to identify

SealPlate

CAD Model

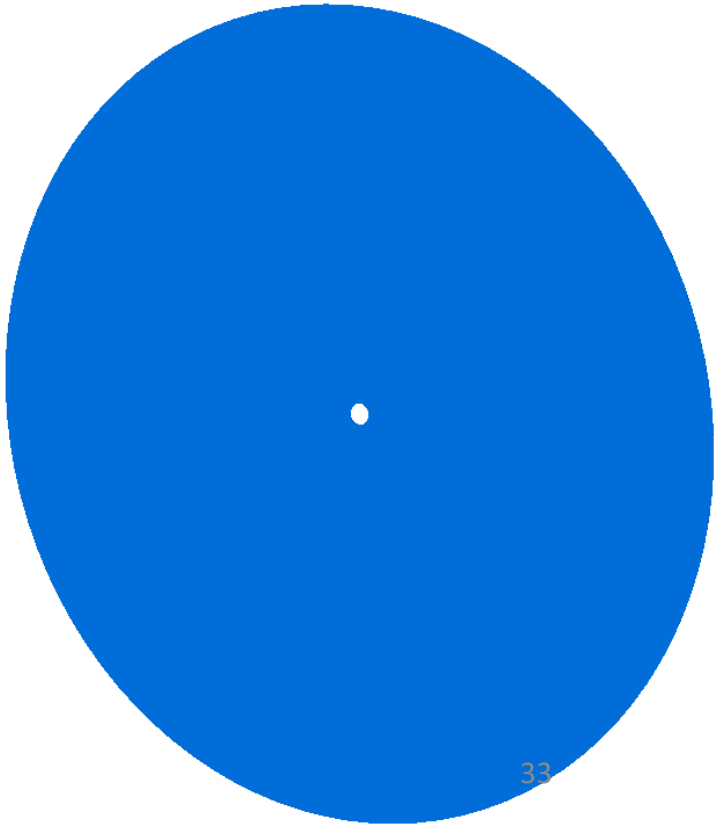
?



CAD Model + gmx

Vs.

Simulation - gmx



Thank you for your attention
მადლობა ყურადღებისათვის

Niko Tsutskiridze