

# Geometry Description for Cavern Background

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**SCSWT'2010**

**South Caucasus Software / Computing Workshop & Tutorial**

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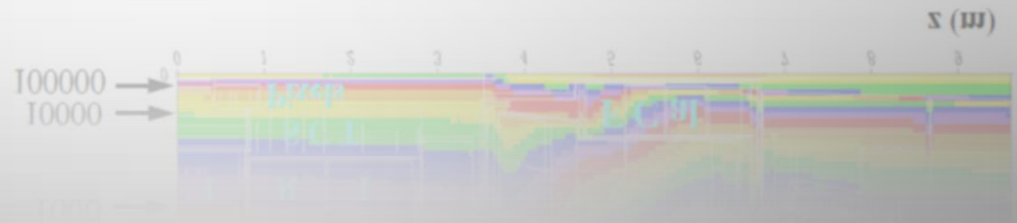
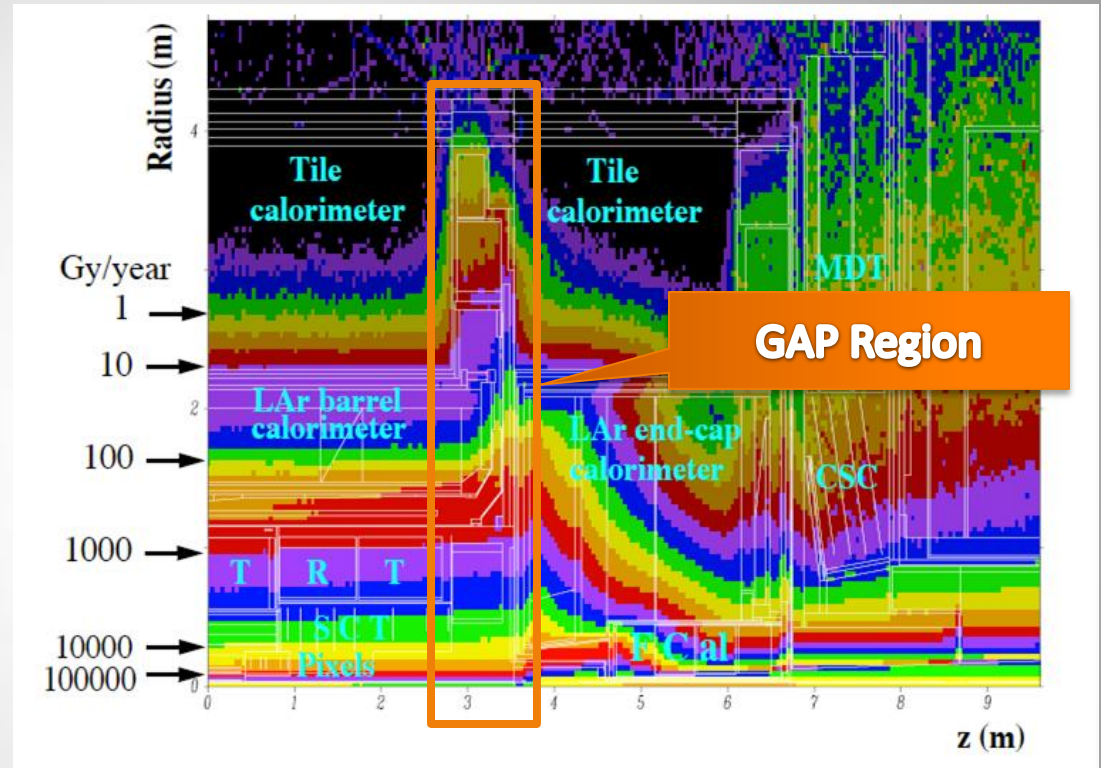
# Outline

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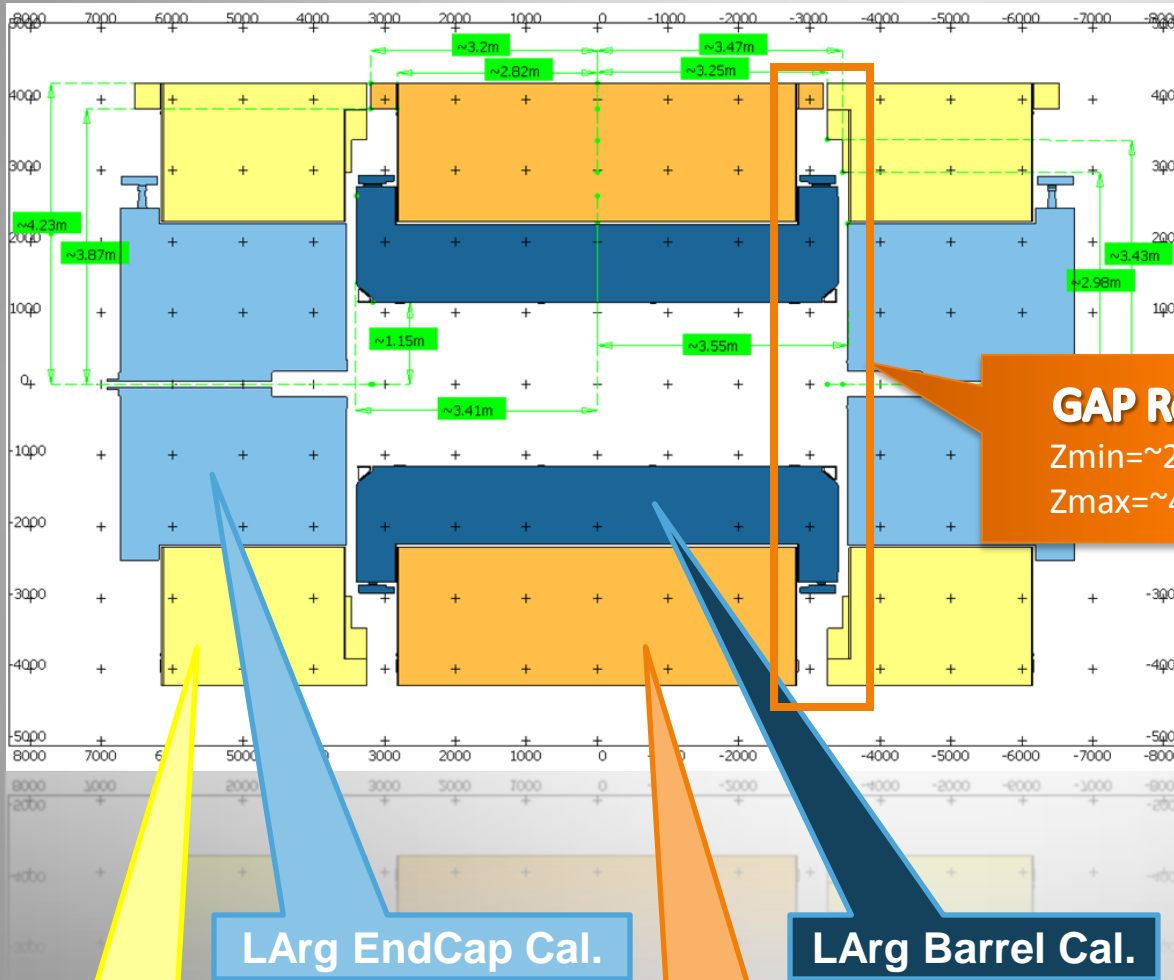
- **ATLAS Detector Simulation**
- **GAP Region between Barrel and Endcap**
- **Models from Local and SmarTeam database for GAP Region**
- **Modification of CATIA V5 models**
- **Integration of geometry from CATIA V5 model to Geant4 code**
- **Compare Atlas CATIA geometry and CavernBkg Geant4 geometry**

# ATLAS Detector Simulation

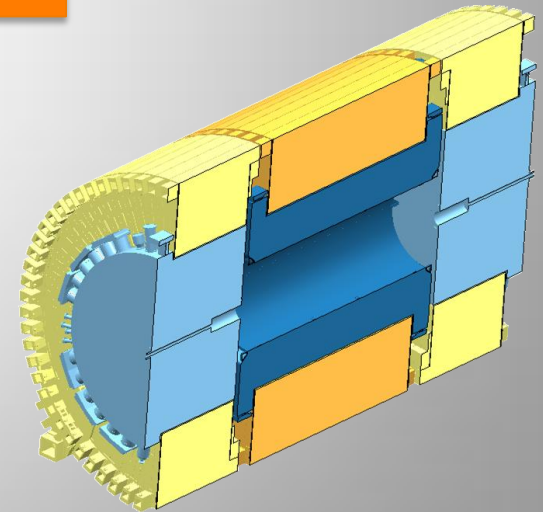
Low-energy neutrons and photons have come out and hit the barrel muon chambers



# GAP Region Layout

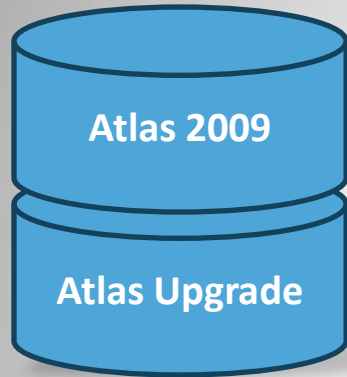


There was fixed Gap region size and shape between Barrel and Endcap

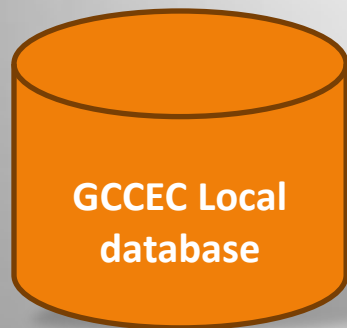


# Local and SmarTeam database

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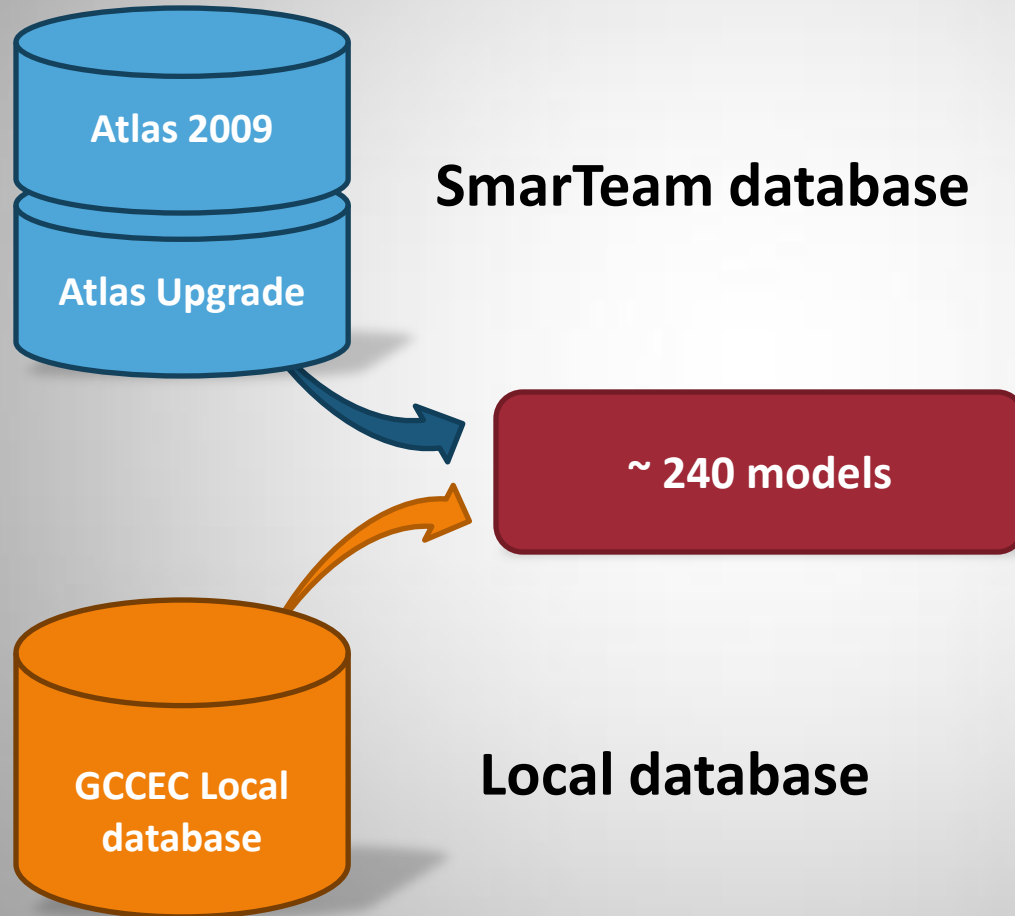
**SmarTeam database**



**Local database**

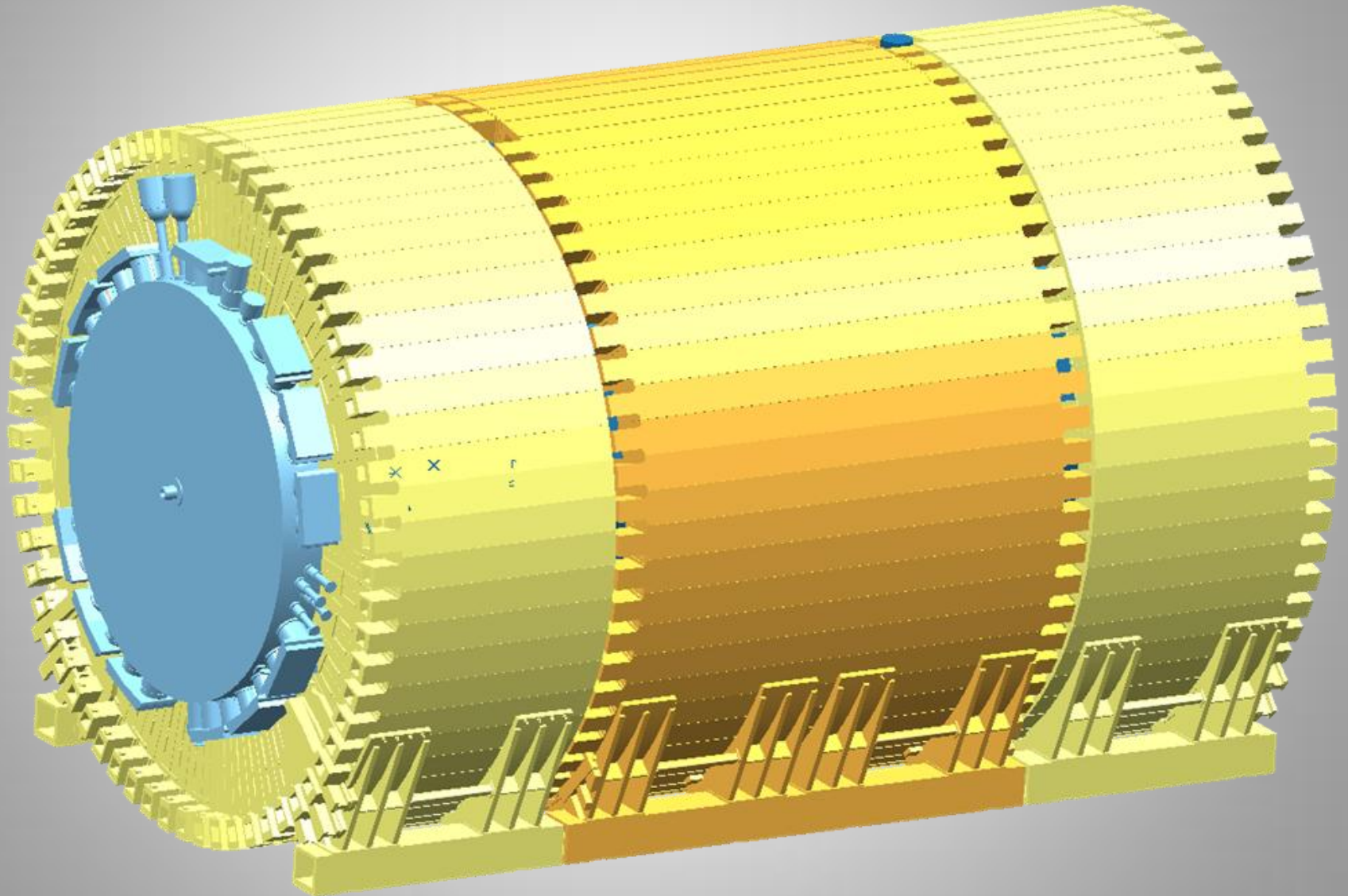
# Local and SmarTeam database

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# Calorimeter Layout

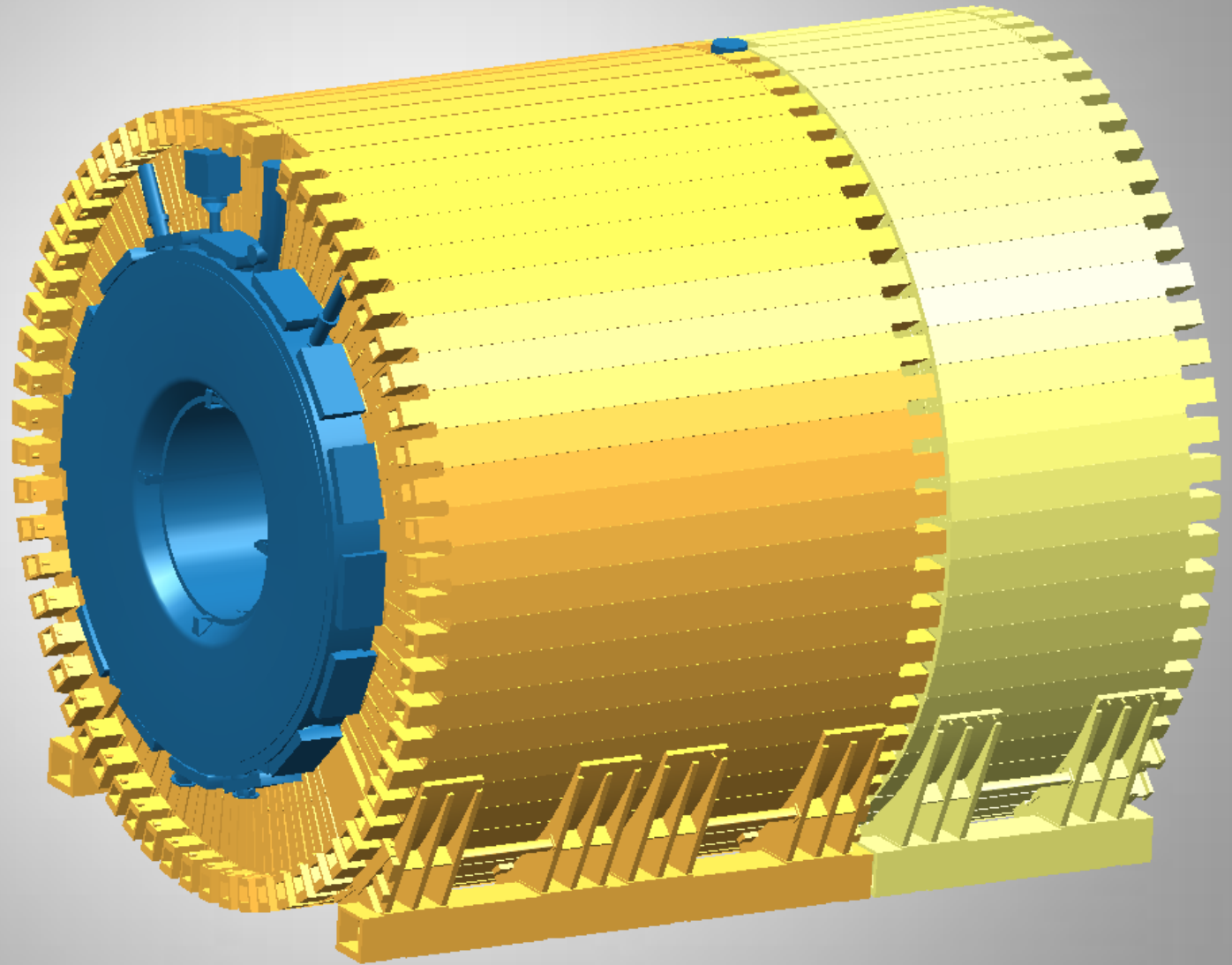
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# Calorimeter Layout

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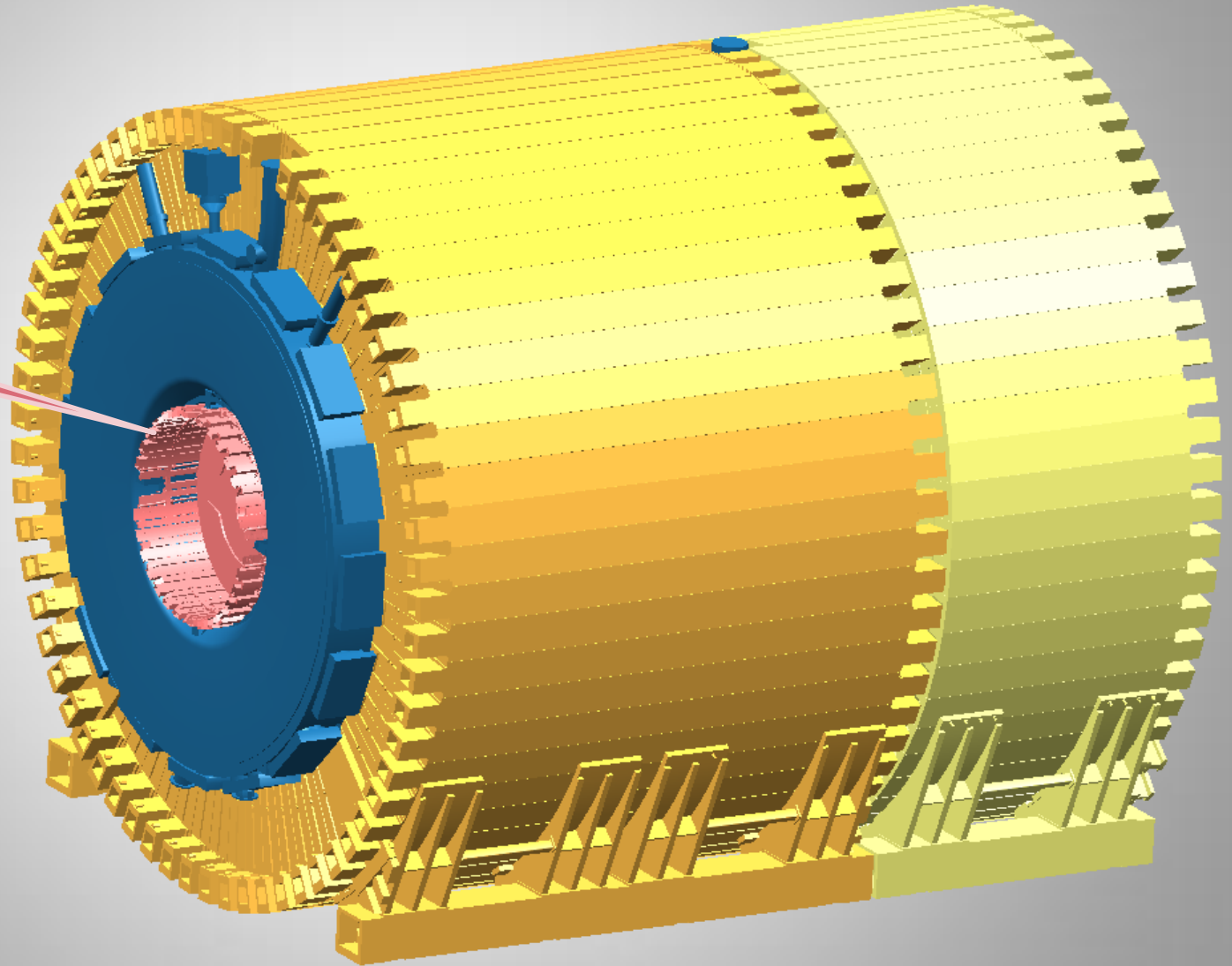




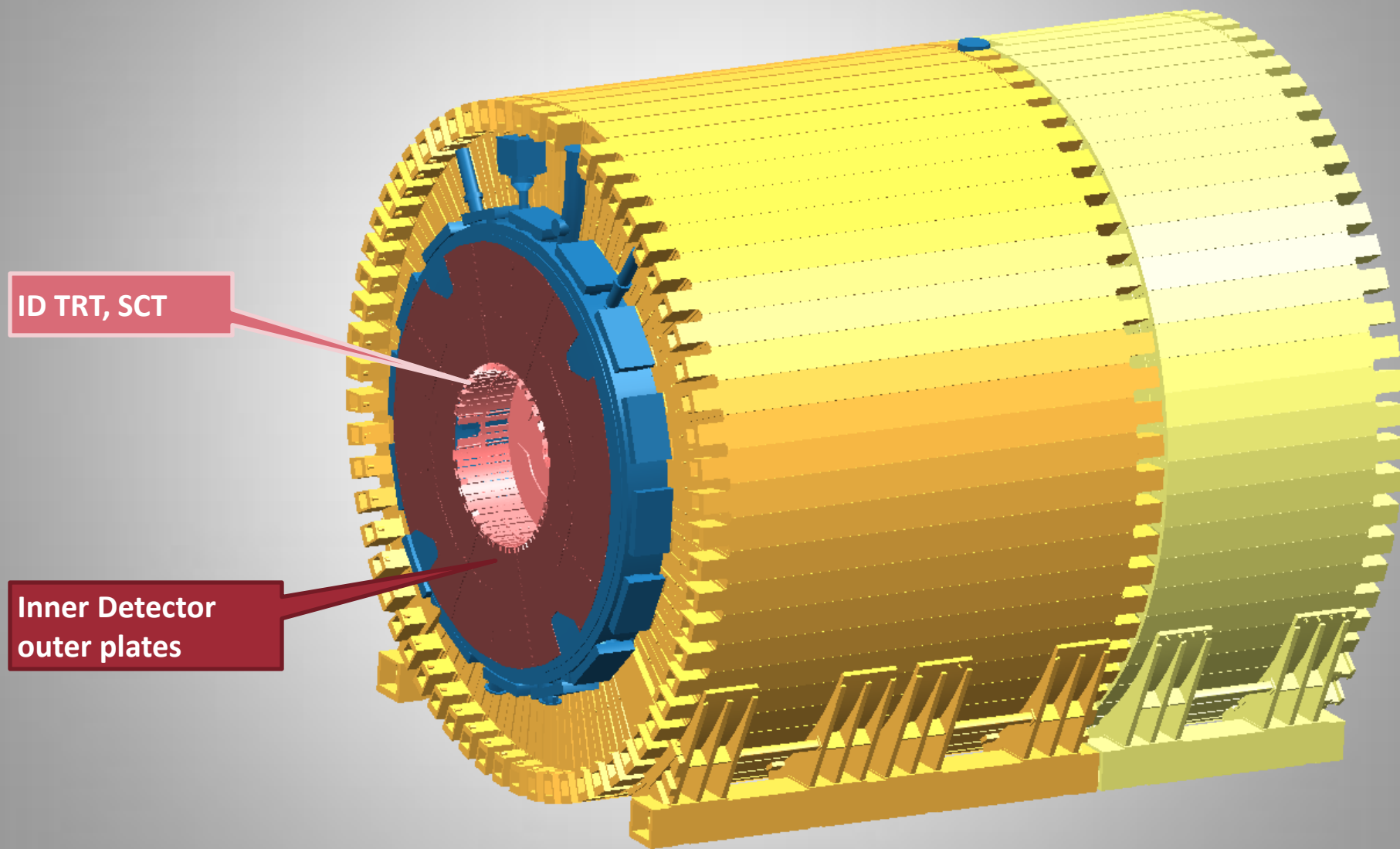
# Detector Components in GAP Region

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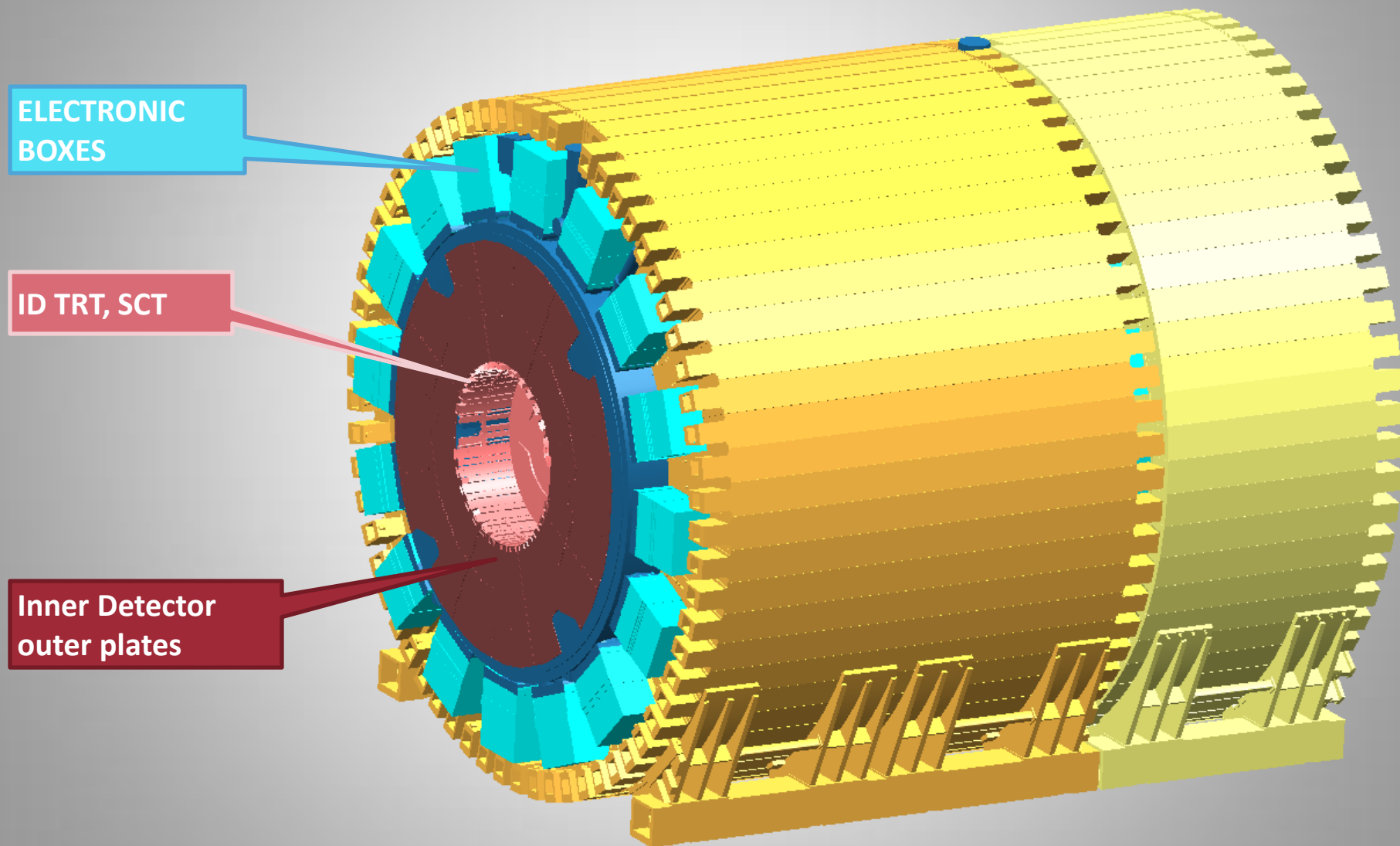
ID TRT, SCT



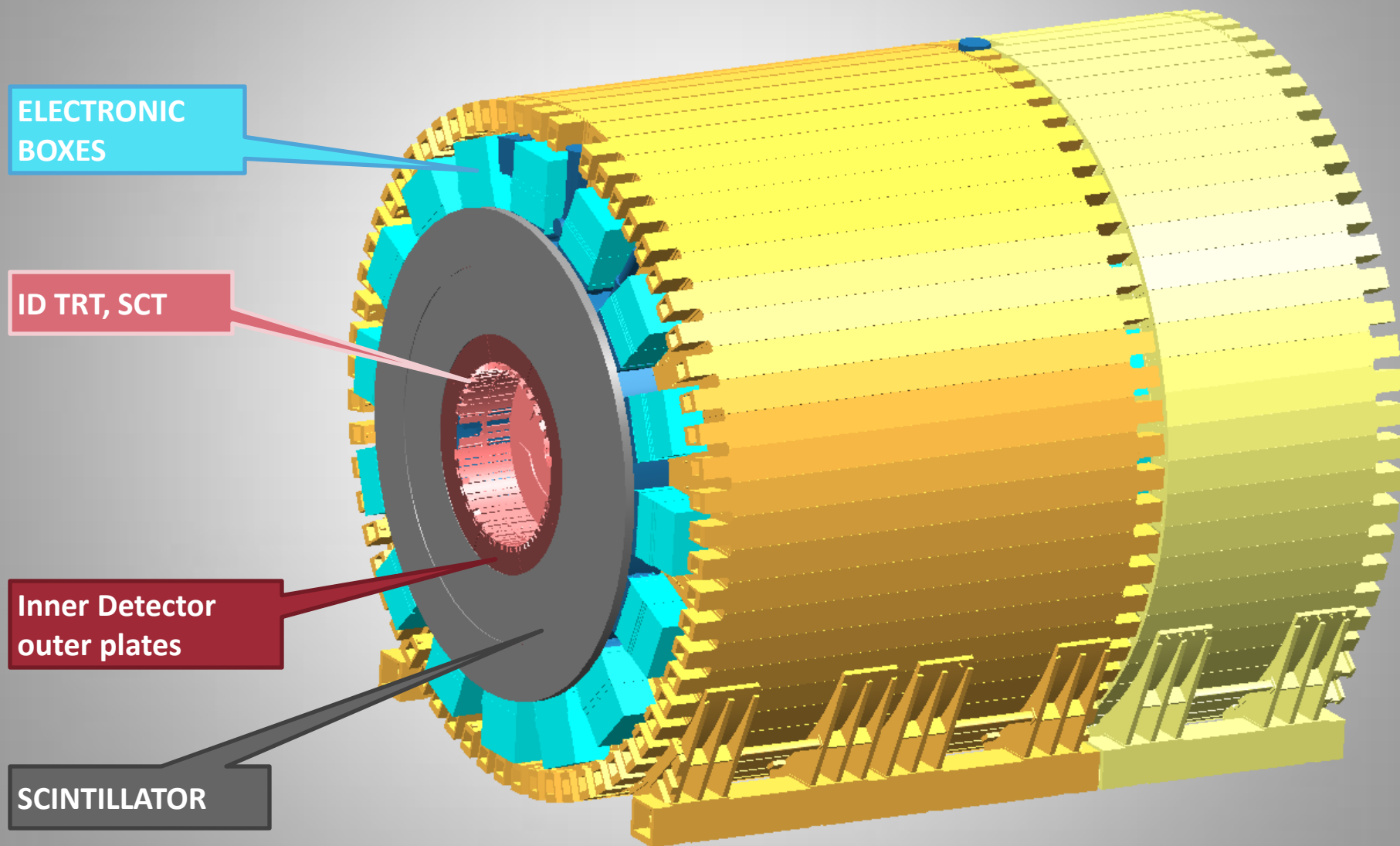
# Detector Components in GAP Region



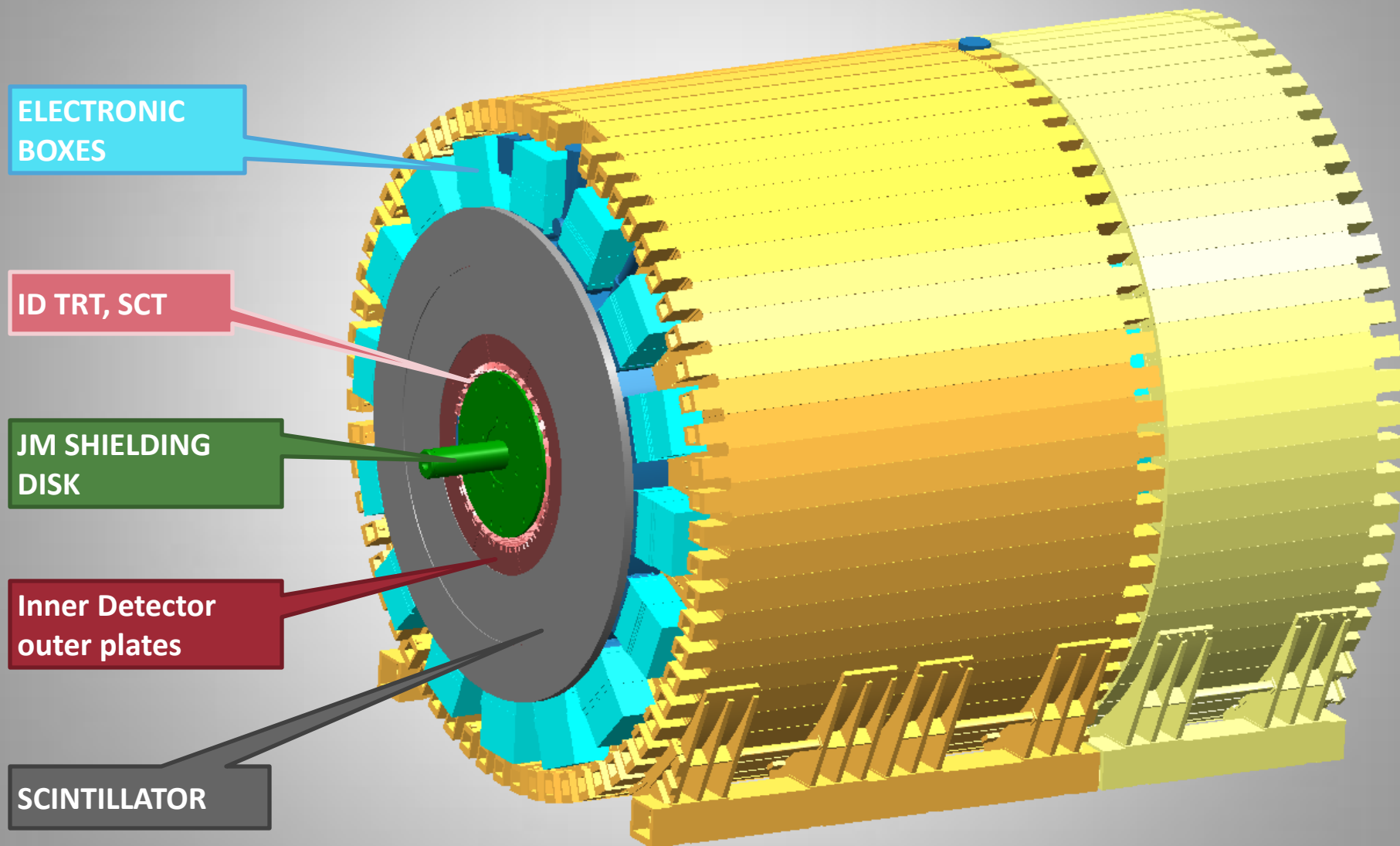
# Detector Components in GAP Region



# Detector Components in GAP Region

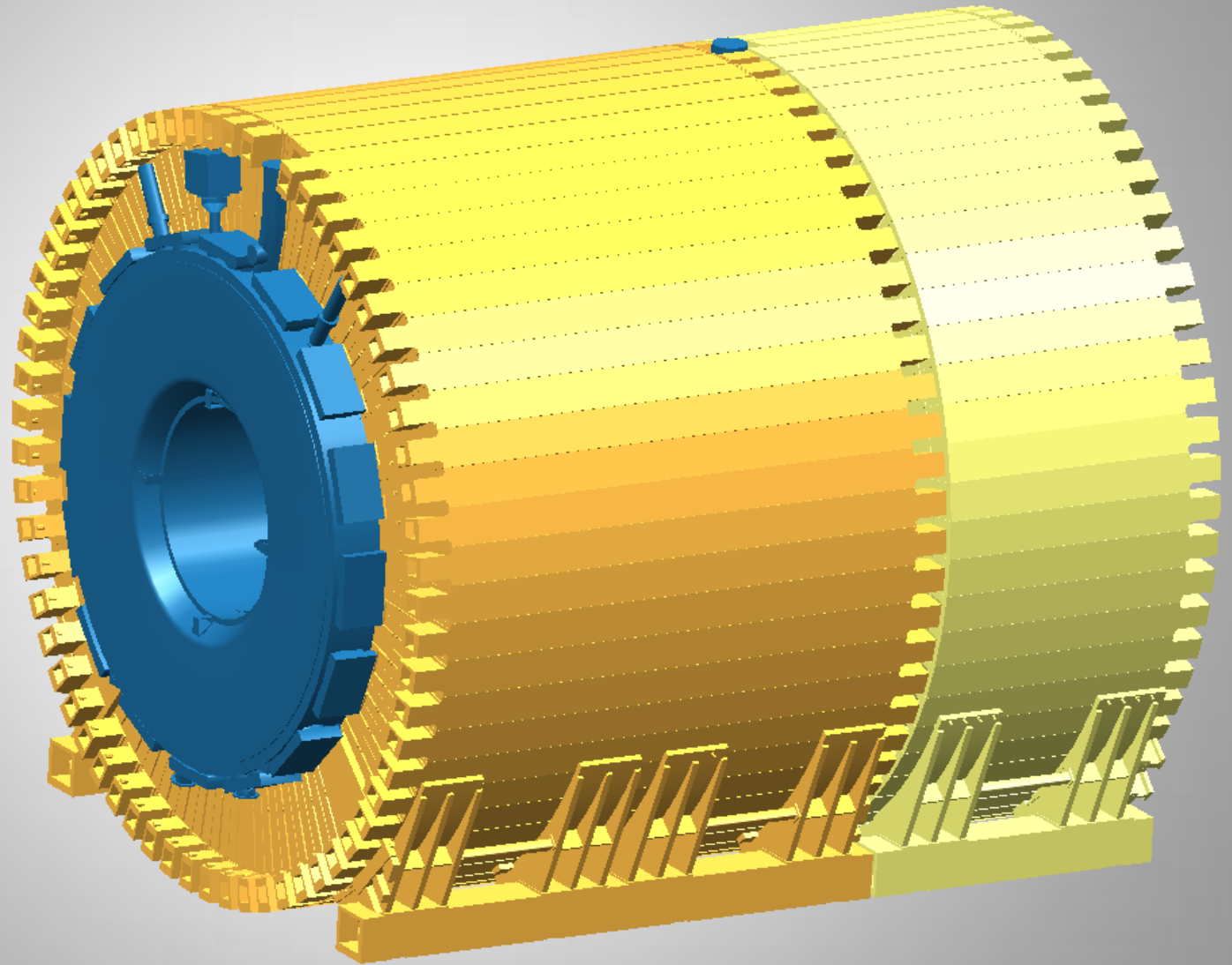


# Detector Components in GAP Region



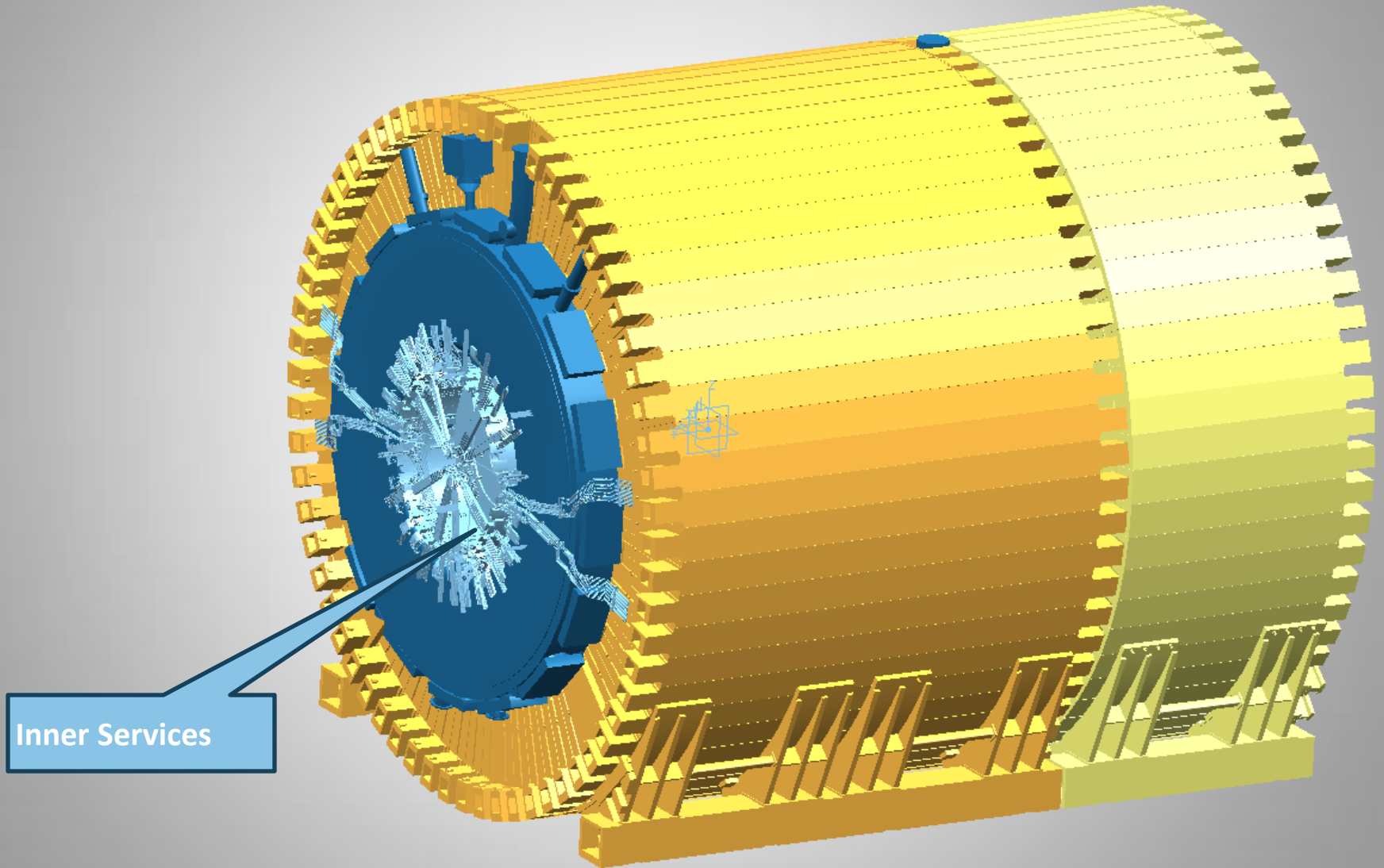
# Services in GAP Region

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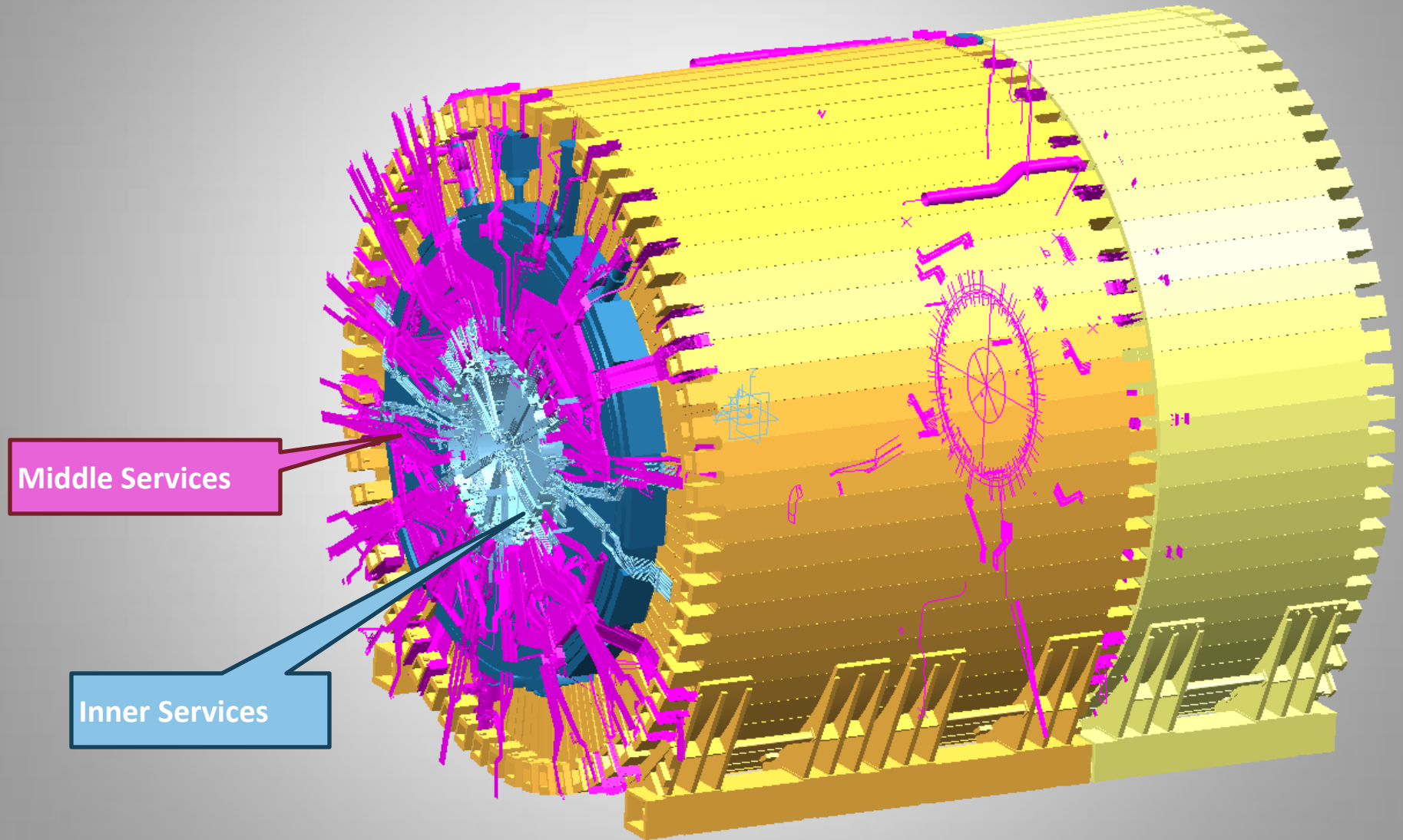
# Services in GAP Region

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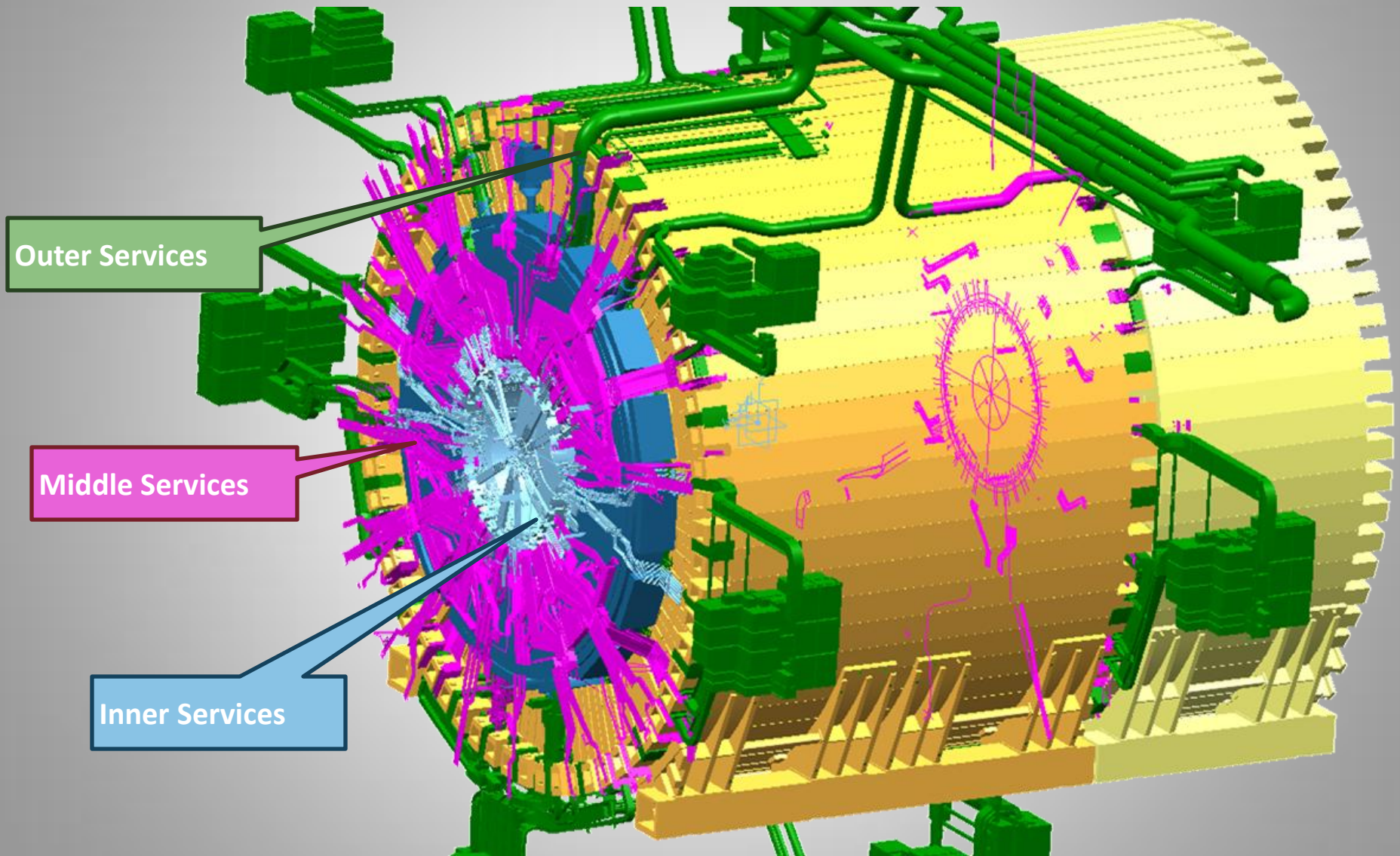




# Services in GAP Region



# Services in GAP Region

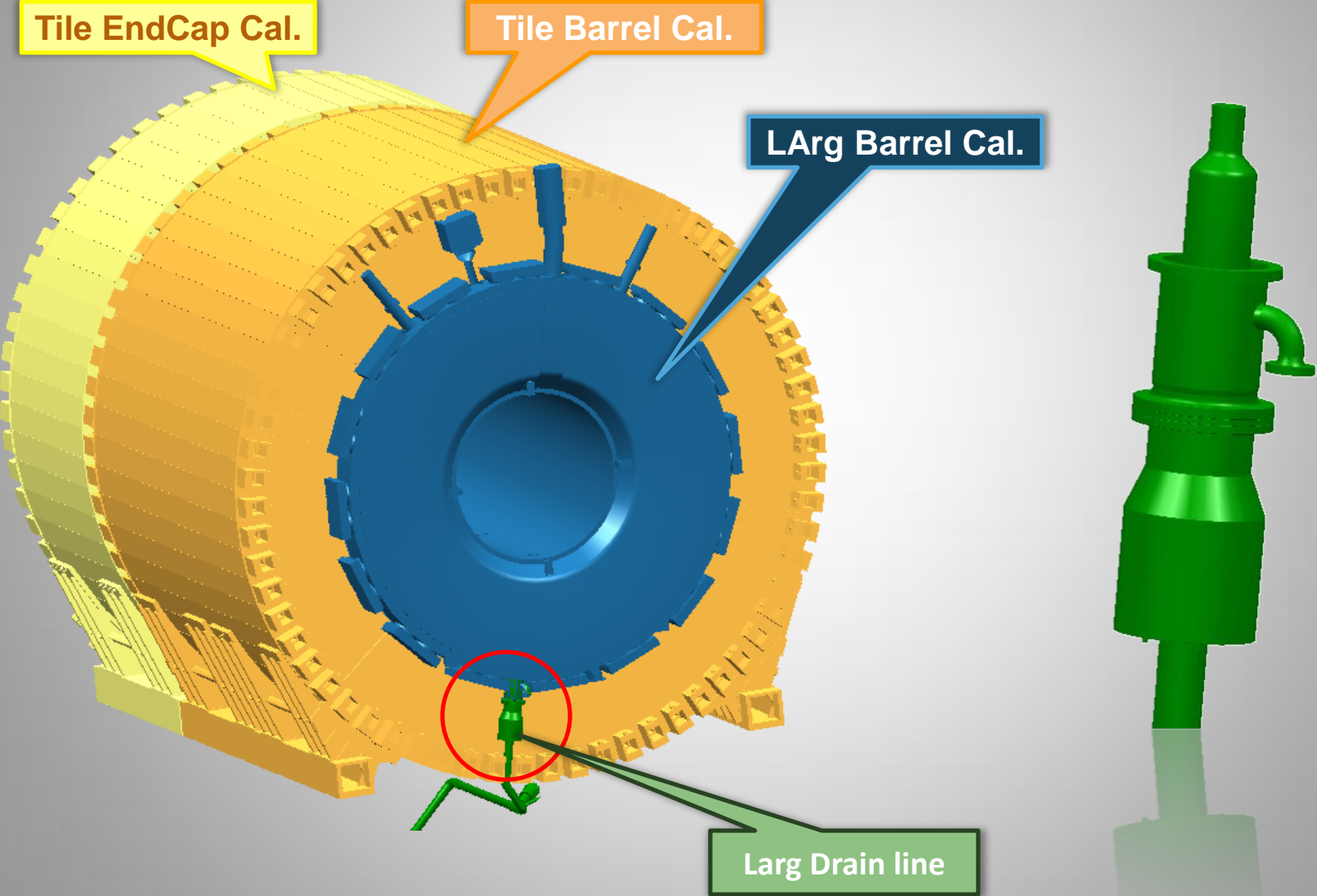


# Modification of CATIA V5 models

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- **Search of Detailed information**
- **Creation detail model**
- **Calculation of geometry Volume**
- **Simplified of geometry**

# Larg Drain Line

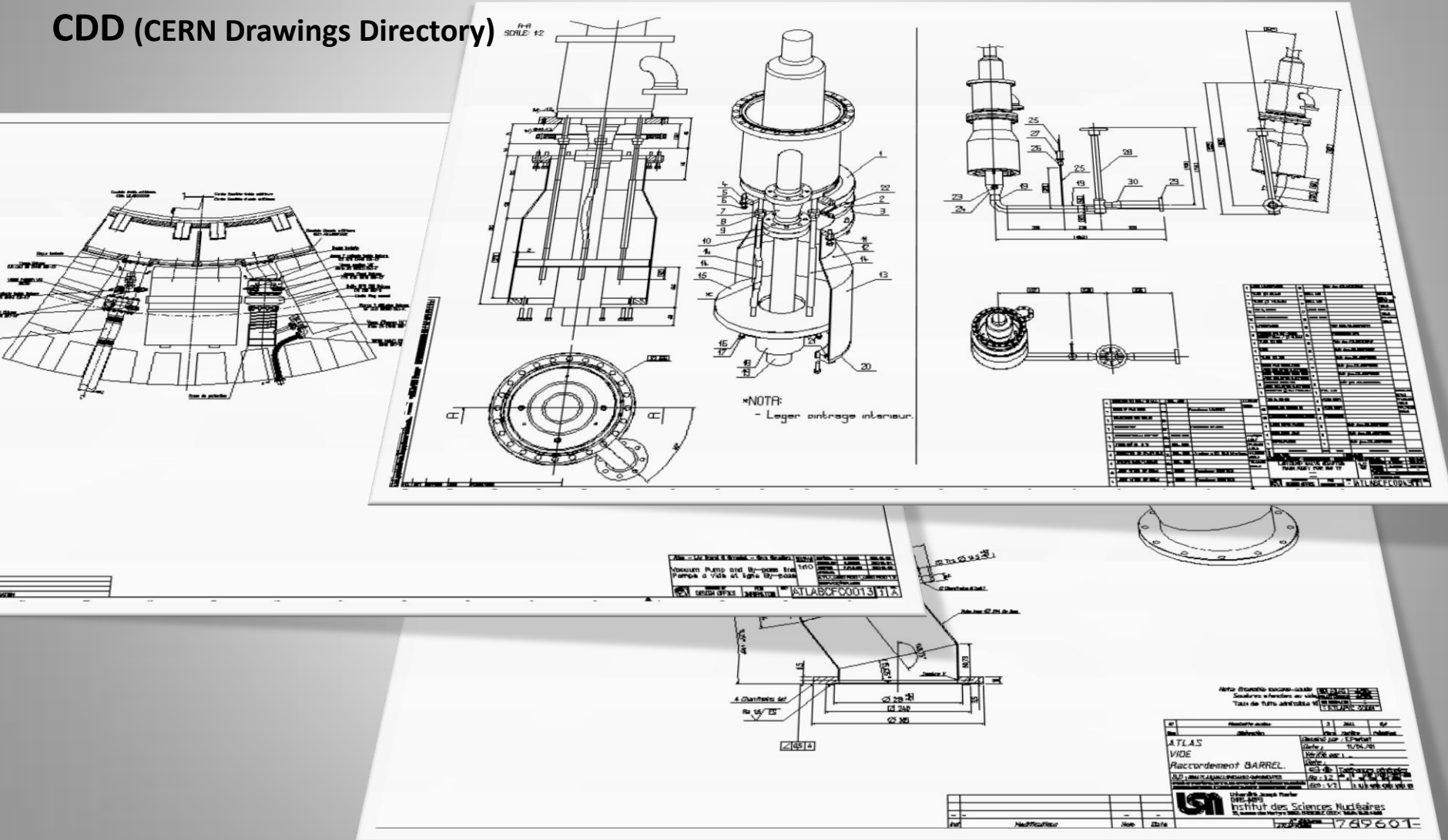




# Modification of CATIA V5 models

## ↳ Search of Detailed information

### CDD (CERN Drawings Directory)



# Modification of CATIA V5 models

## ↳ Search of Detailed information

### Catalogs



#### Vatterfly valve

VAT Series 20

#### Series 203 / 204

Pneumatic actuator,  
with rotary feedthrough

For contaminating and aggressive  
applications, mechanism in the actuator  
Compact alternative to gate valves



#### Components and feedthroughs



Flange components and feedthroughs  
for all vacuum applications

#### Ordering numbers

##### Series 203 with standard body

aluminum	stainless steel	
	ISO-F	CF-F
20338-PA14	20338-PE14	20338-CE14
20340-PA14	20340-PE14	20340-CE14
20344-PA14	20344-PE14	20344-CE14
20346-PA14	20346-PE14	20346-CE14

without solenoid: 203 . . . . . 24  
 r, with solenoid: 203 . . . . . 24 (specify control voltage)  
 rth solenoid: 203 . . . . . 24 (specify control voltage)

#### Ordering numbers

##### Series 204 with extended body

aluminum	stainless steel	
	ISO-F	CF-F
20436-PA14	20436-PE14	20436-CE14
20438-PA14	20438-PE14	20438-CE14
20440-PA14	20440-PE14	20440-CE14
20444-PA14	20444-PE14	20444-CE14
20446-PA14	20446-PE14	20446-CE14

without solenoid: 204 . . . . . 24  
 r, with solenoid: 204 . . . . . 24 (specify control voltage)  
 rth solenoid: 204 . . . . . 24 (specify control voltage)

ISO-F: ISO-F . . . . . F (through control voltage)  
 r: r . . . . . r (through control voltage)  
 rth: rth . . . . . rth (through control voltage)

ISO-F	CF-F	CF-F
20436-PA14	20436-PE14	20436-CE14
20438-PA14	20438-PE14	20438-CE14
20440-PA14	20440-PE14	20440-CE14
20444-PA14	20444-PE14	20444-CE14
20446-PA14	20446-PE14	20446-CE14

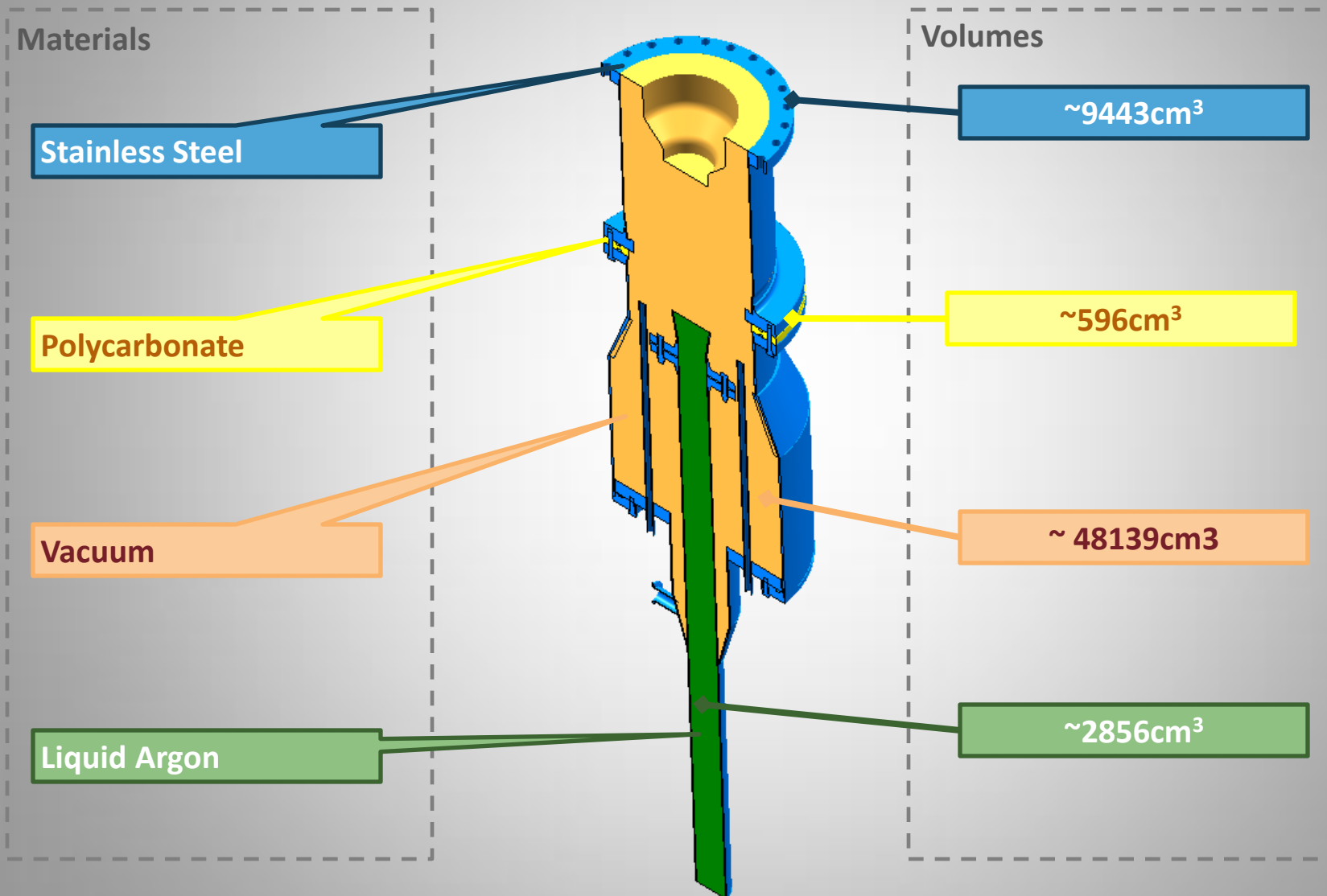
for all vacuum applications  
 Flange components and feedthroughs





# Modification of CATIA V5 models

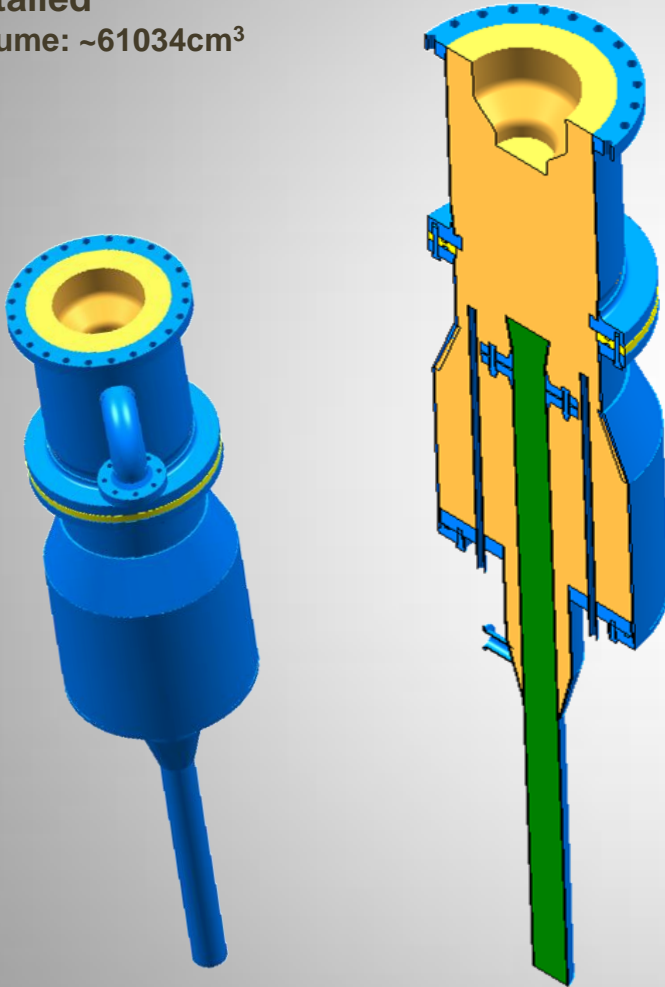
## ↳ Calculation of geometry Volume



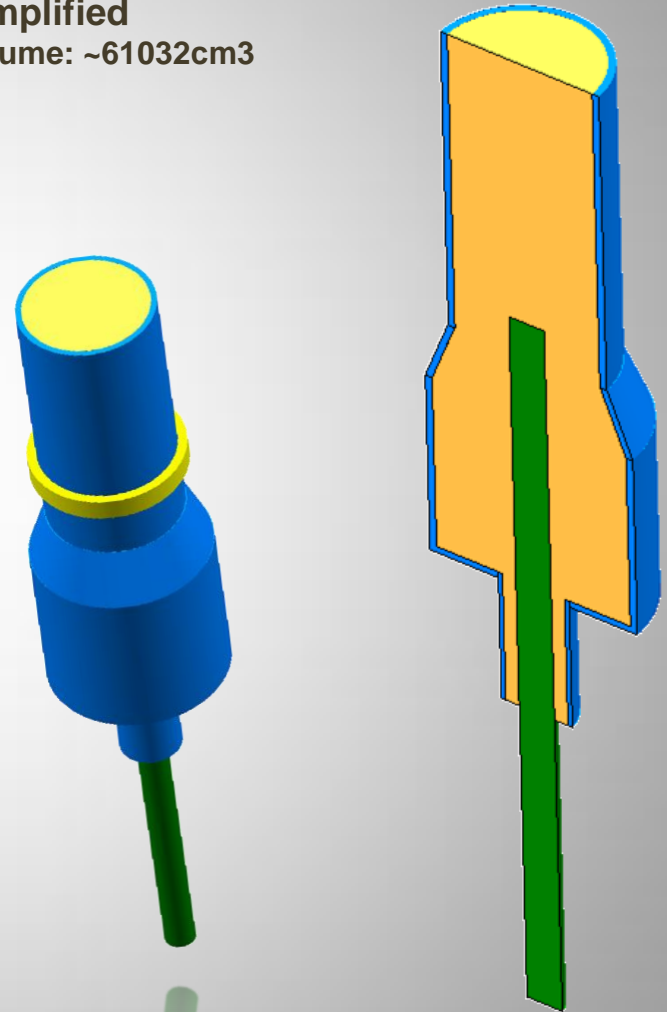
# Modification of CATIA V5 models

## ↳ Simplified of geometry

Detailed  
Volume:  $\sim 61034\text{cm}^3$



Simplified  
Volume:  $\sim 61032\text{cm}^3$



# Integration of geometry from CATIA V5 model to Geant4 code

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- **Geant4 code**
- **Clash checking Geant4 geometries**
- **Compare checking CATIA V5 and Geant4 geometries**

# Integration of geometry from CATIA V5 model to Geant4 code

## ↳ Geant4 code of DrainLine

### Geant4 code of DrainLine body

```
// DrainLine Solid
r_inner = 119*mm;
r_outer = 127*mm;
z_half = 243.75*mm;
G4Tubs* DrainLineBody1 = new G4Tubs("DrainLineBody1",r_inner, r_outer, z_half, phi0, dphi);
r_inner = 158*mm;
r_outer = 169*mm;
r_inner2 = 119*mm;
r_outer2 = 130*mm;
z_half = 50*mm;
G4Cons* DrainLineBody2 = new G4Cons("DrainLineBody2",r_inner, r_outer, r_inner2, r_outer2, z_half, phi0, dphi);
r_inner = 158*mm;
r_outer = 169*mm;
z_half = 145*mm;
G4Tubs* DrainLineBody3 = new G4Tubs("DrainLineBody3",r_inner, r_outer, z_half, phi0, dphi);
r_inner = 58*mm;
r_outer = 169*mm;
z_half = 4*mm;
G4Tubs* DrainLineBody4 = new G4Tubs("DrainLineBody4",r_inner, r_outer, z_half, phi0, dphi);
r_inner = 52*mm;
r_outer = 58*mm;
z_half = 100*mm;
G4Tubs* DrainLineBody5 = new G4Tubs("DrainLineBody5",r_inner, r_outer, z_half, phi0, dphi);

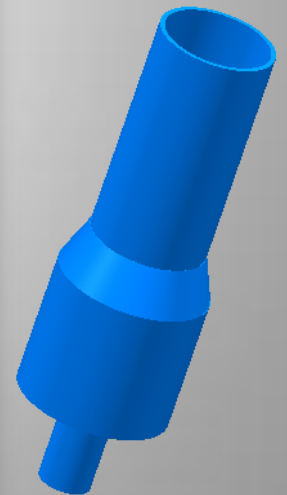
G4VSolid* DrainLineBody_Union1= new G4UnionSolid("DrainLineBody_Union1", DrainLineBody1, DrainLineBody2,
                                                0, G4ThreeVector(0, 0, -293.75*mm));
G4VSolid* DrainLineBody_Union2= new G4UnionSolid("DrainLineBody_Union2", DrainLineBody_Union1, DrainLineBody3,
                                                0,G4ThreeVector(0, 0, -488.75*mm));
G4VSolid* DrainLineBody_Union3= new G4UnionSolid("DrainLineBody_Union3", DrainLineBody_Union2, DrainLineBody4,
                                                0,G4ThreeVector(0, 0, -637.75*mm));
G4VSolid* DrainLineBody_Union4= new G4UnionSolid("DrainLineBody_Union4", DrainLineBody_Union3, DrainLineBody5,
                                                0,G4ThreeVector(0, 0, -737.75*mm));

G4LogicalVolume* DrainLineBody_log = new G4LogicalVolume(DrainLineBody_Union4,
                                                         GCalorMaterials::GetMat("SSTEEL"),
                                                         "DL_log", 0, 0, 0);

DrainLineBody_log->SetVisAttributes(SSVisAtt);

new G4PVPlacement(0, G4ThreeVector(0, 0, 243.75*mm), DrainLineBody_log, "DL_phys",
                 SpaceLDL_log, true, 0);
```

DrainLine body



# Integration of geometry from CATIA V5 model to Geant4 code

## ↳ Geant4 code of DrainLine

### Geant4 code of LiquidArgon

```
// LiquidArgon Volume
r_inner = 0.;
r_outer = 28.36*mm;
z_half = 565*mm;
G4Tubs* Liquidargon = new G4Tubs("Liquidargon",r_inner, r_outer, z_half, phi0, dphi);

G4LogicalVolume* Liquidargon_log = new G4LogicalVolume(Liquidargon,
    GCalorMaterials::GetMat("LIQ_ARGON"),
    "LA_log1", 0, 0, 0);

Liquidargon_log->SetVisAttributes(LiqAVisAtt);
new G4PVPlacement(0,G4ThreeVector(0,0,-519*mm), Liquidargon_log, "LA_phys1",
    SpaceLDL_log, false, 0);
```

### Geant4 code of Insulation Washer

```
// Insulation Washer
//-----material Polycarbonate

r_inner = 132*mm;
r_outer = 148.88*mm;
z_half = 20*mm;
G4Tubs* InsulationWasher = new G4Tubs("InsulationWasher",r_inner, r_outer, z_half, phi0, dphi);
G4LogicalVolume* InsulationWasher_log = new G4LogicalVolume(InsulationWasher,
    POLYCARBONATE,
    "IW_log1", 0, 0, 0);
InsulationWasher_log->SetVisAttributes(PolyVisAtt);

new G4PVPlacement(0, G4ThreeVector(0,0,120*mm), InsulationWasher_log, "IW_phys1",
    SpaceLDL_log, true, 0);
```

Liquid Argon



Insulation Washer



# Integration of geometry from CATIA V5 model to Geant4 code

## ↳ Geant4 code of DrainLine

### Geant4 code of Vacuum

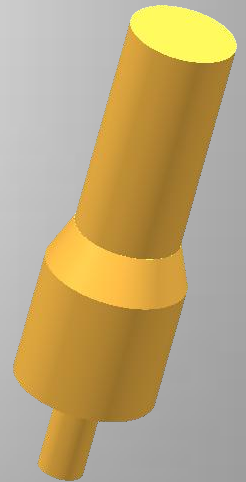
```
// Vacuum Volume
r_inner = 0*mm;
r_outer = 117*mm;
z_half = 243.75*mm;
G4Tubs* Vacuum1= new G4Tubs("Vacuum1", r_inner, r_outer, z_half, phi0, dphi);
r_inner = 0*mm;
r_outer = 156*mm;
r_inner2 = 0*mm;
r_outer2 = 117*mm;
z_half = 50*mm;
G4Cons* Vacuum2=new G4Cons("Vacuum2", r_inner, r_outer, r_inner2, r_outer2, z_half, phi0, dphi);
r_inner = 0*mm;
r_outer = 156*mm;
z_half = 140*mm;
G4Tubs* Vacuum3= new G4Tubs("Vacuum3", r_inner, r_outer, z_half, phi0, dphi);
r_inner = 0*mm;
r_outer = 50*mm;
z_half = 105*mm;
G4Tubs* Vacuum4= new G4Tubs("Vacuum4", r_inner, r_outer, z_half, phi0, dphi);
r_inner = 0*mm;
r_outer = 30*mm;
z_half = 330*mm;
G4Tubs* Vacuum5= new G4Tubs("Vacuum5", r_inner, r_outer, z_half, phi0, dphi);

G4VSolid* Vacuum_Union1= new G4UnionSolid("Vacuum_Union1", Vacuum1, Vacuum2,
    0, G4ThreeVector(0, 0, -293.75*mm));
G4VSolid* Vacuum_Union2= new G4UnionSolid("Vacuum_Union2", Vacuum_Union1, Vacuum3,
    0, G4ThreeVector(0, 0, -483.75*mm));
G4VSolid* Vacuum_Union3= new G4UnionSolid("Vacuum_Union3", Vacuum_Union2, Vacuum4,
    0, G4ThreeVector(0, 0, -728.75*mm));
G4VSolid* Vacuum_Subtraction1= new G4SubtractionSolid("Vacuum_Subtraction1", Vacuum_Union3, Vacuum5,
    0, G4ThreeVector(0, 0, -526.5*mm));

G4LogicalVolume* Vacuum_log = new G4LogicalVolume(Vacuum_Subtraction1,
    GCalorMaterials::GetMat("VACUUM"),
    "VA_log1", 0, 0, 0);
Vacuum_log->SetVisAttributes(VacuVisAtt);

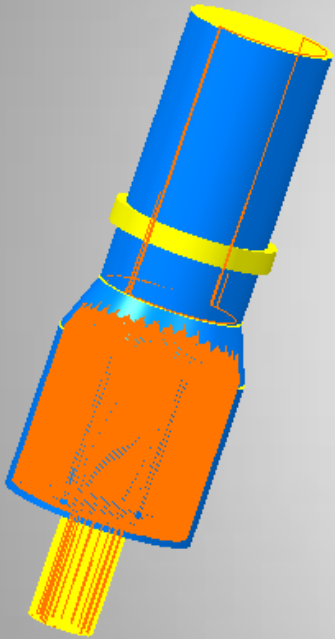
new G4PVPlacement(0, G4ThreeVector( 0, 0, 243.75*mm), Vacuum_log, "VA_phys1",
    SpaceLDL_log, false, 0);
```

Vacuum

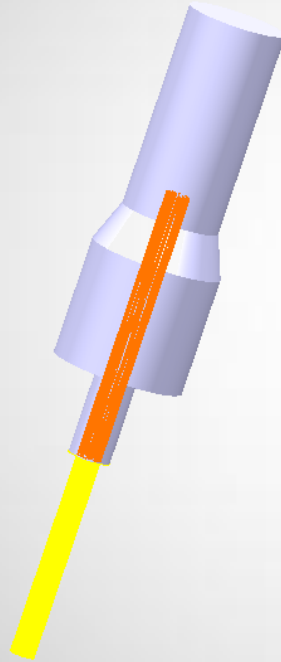


## ↳ Clash checking Geant4 geometries

1 Contact



2 Contact



**Check Clash**

Definition

Name: Interference.1

Type: Contact + Clash 0mm Selection: 1 No selection

Between all components Selection: 2 No selection

Results

Number of interferences: 2 (Clash:0, Contact:2, Clearance:0)

Filter list: All types No filter on value All statuses

List by Conflict | List by Product | Matrix

No.	Product 1	Product 2	Type	Value	Status
1	Drain Line Body (10041...	Vacuum (48135cm3)	Contact	0	Relevant
2	Vacuum (48135cm3)	Liquid Argon (2855c...	Contact	0	Relevant

Deselect More >>

OK Apply Cancel

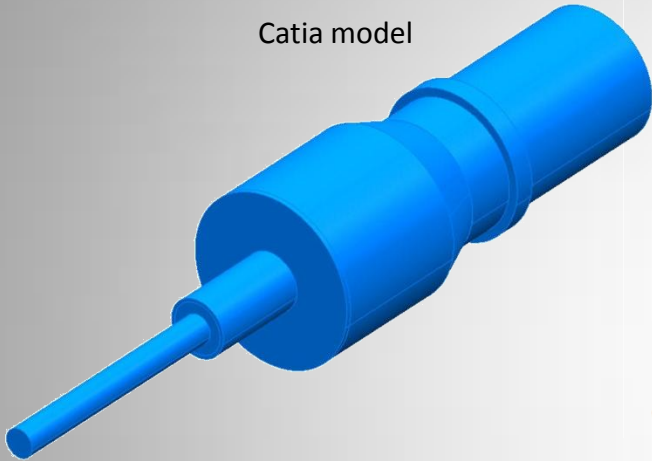
We have only contacts. Clash didn't fixed



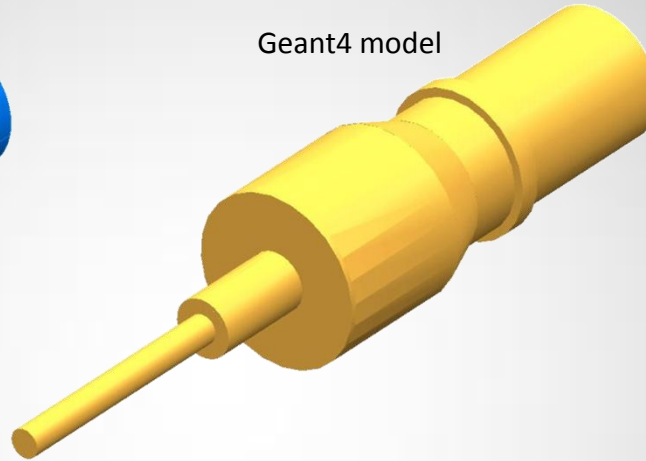
# Integration of geometry from CATIA V5 model to Geant4 code

## ↳ Compare checking CATIA V5 and Geant4 geometries

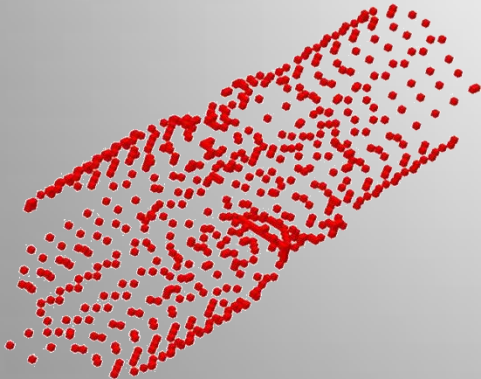
Catia model



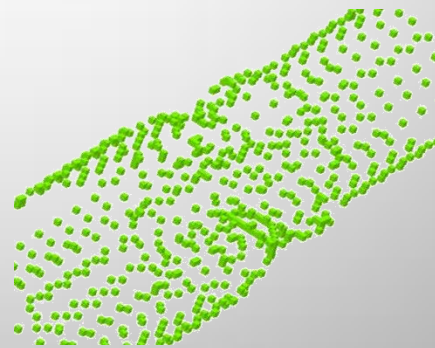
Geant4 model



AddedMaterial = Catia + Geant4



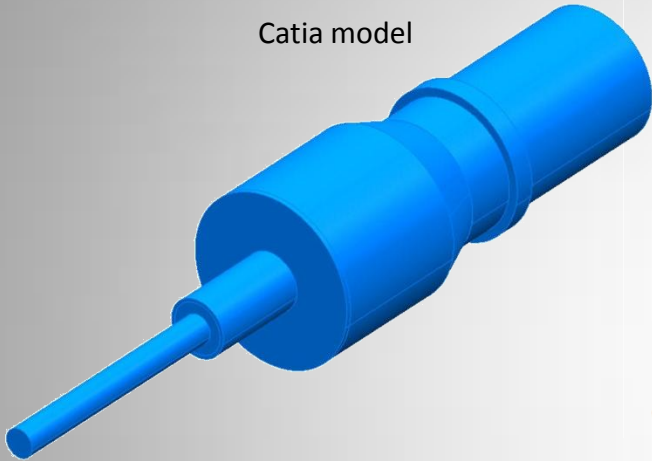
RemovedMaterial = Catia - Geant4



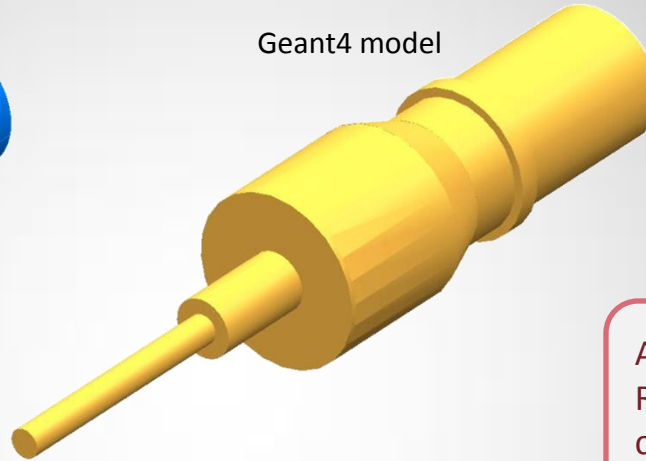
# Integration of geometry from CATIA V5 model to Geant4 code

## ↳ Compare checking CATIA V5 and Geant4 geometries

Catia model

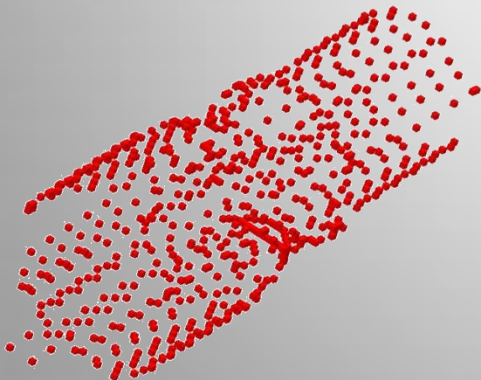


Geant4 model

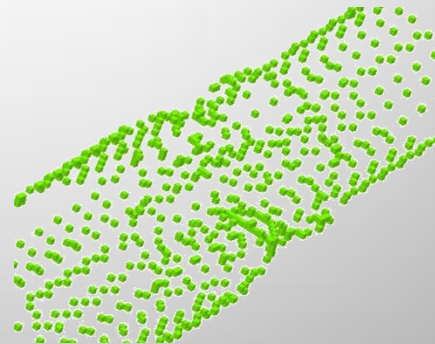


AddedMaterial and  
RemovedMaterial are due to  
computational inaccuracy

AddedMaterial = Catia + Geant4

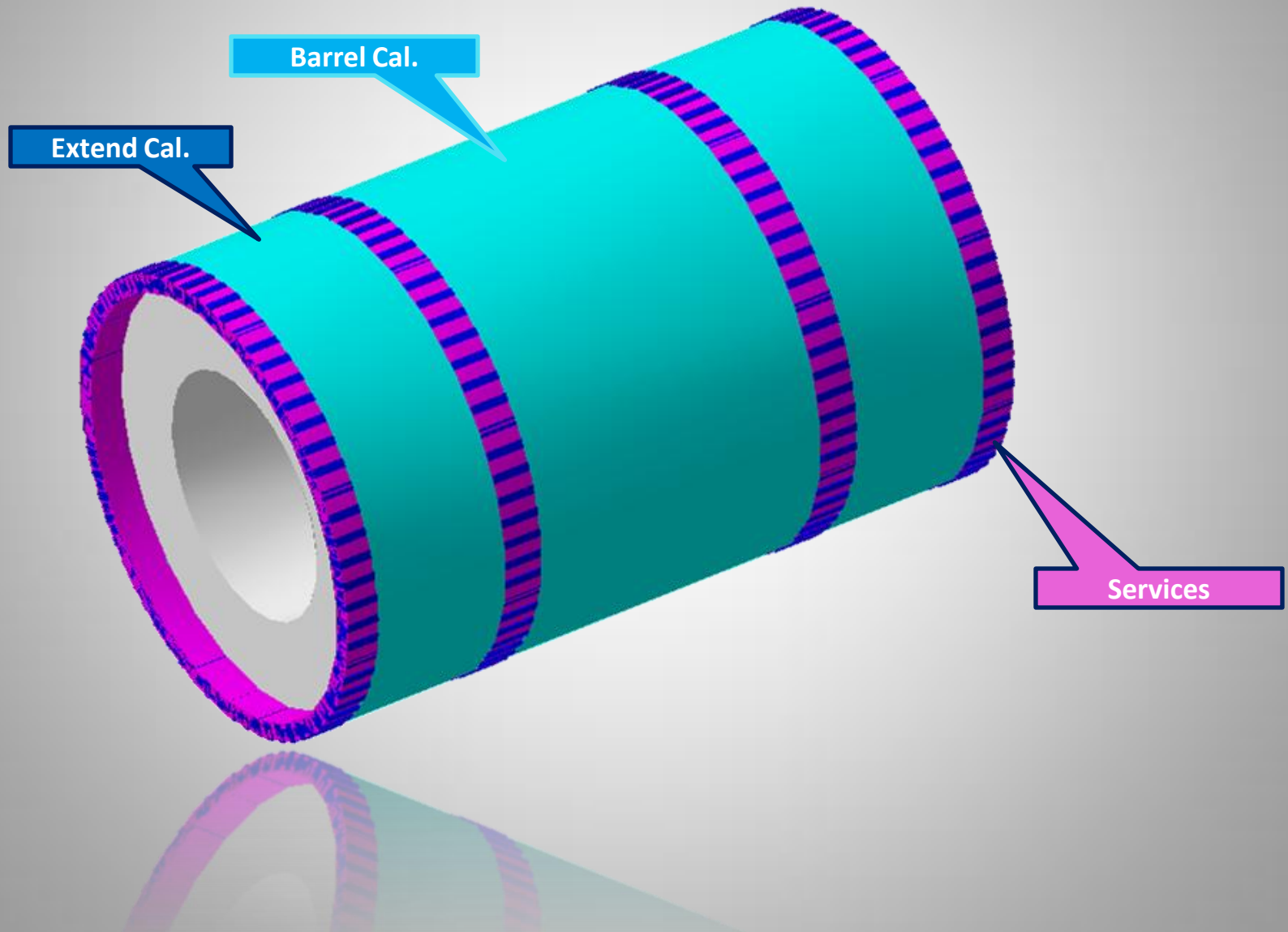


RemovedMaterial = Catia - Geant4



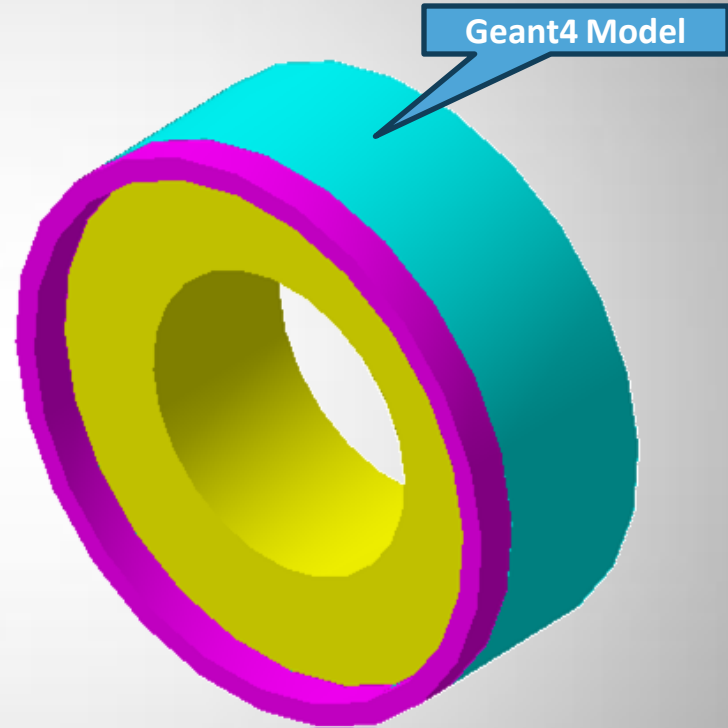
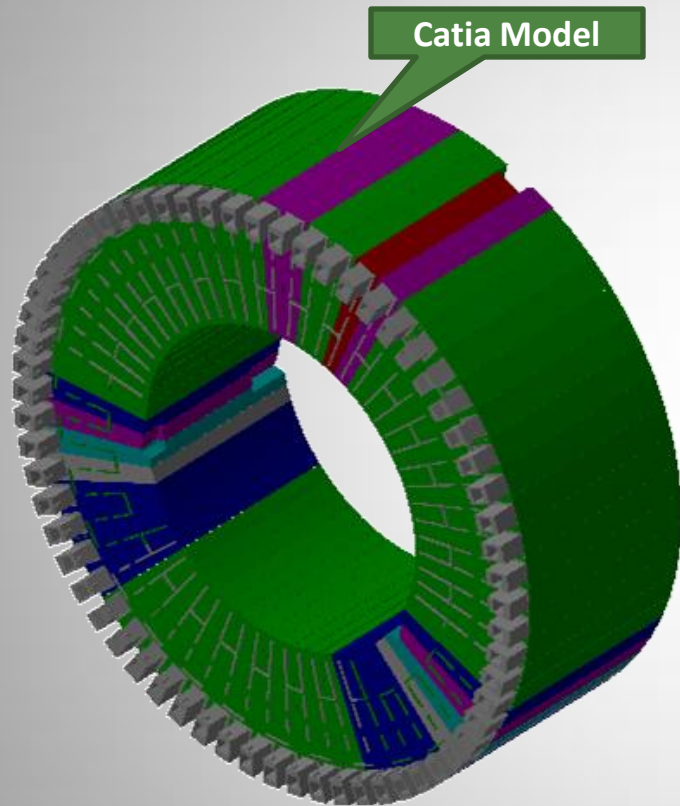
# Compare Atlas CATIA geometry and CavernBkg Geant4 geometry (Extend Tile Calorimeter)

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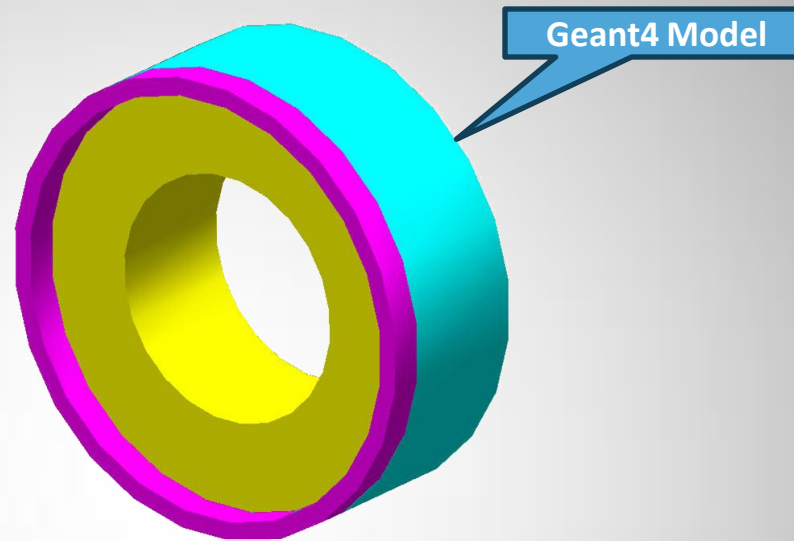
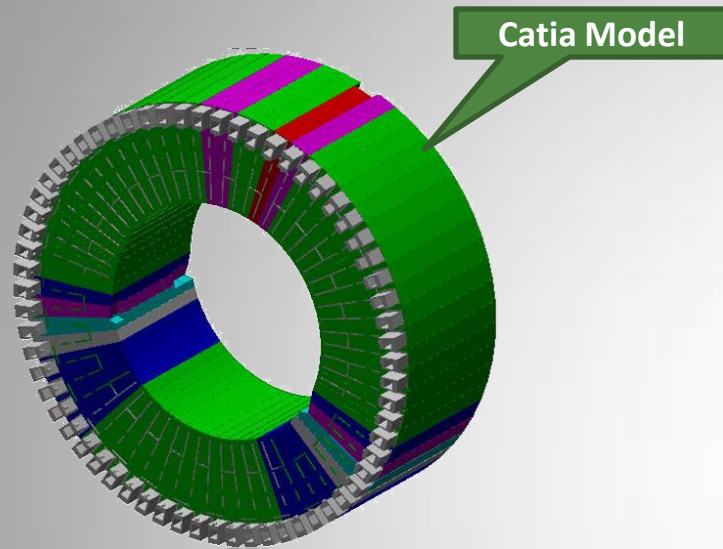
# Compare Atlas CATIA geometry and CavernBkg Geant4 geometry (Extend Tile Calorimeter)

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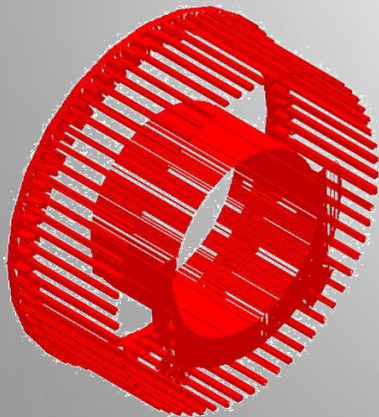


# Compare Atlas CATIA geometry and CavernBkg

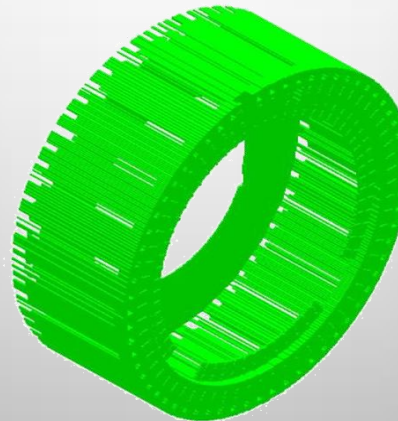
## Geant4 geometry (Extend Tile Calorimeter)



AddedMaterial = Catia + Geant4



RemovedMaterial = Catia - Geant4



### Volume:

Catia model - 104.432m<sup>3</sup>

Geant4 model - 99.303m<sup>3</sup>

**Difference - 5.129 m<sup>3</sup>**

### Mass:

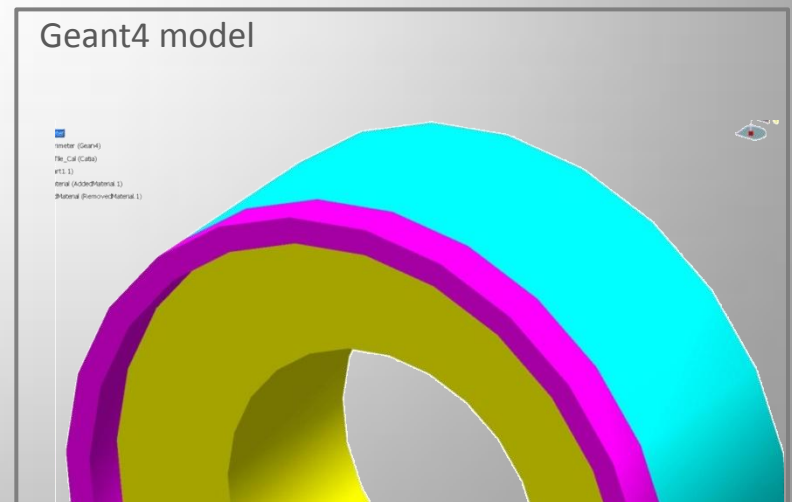
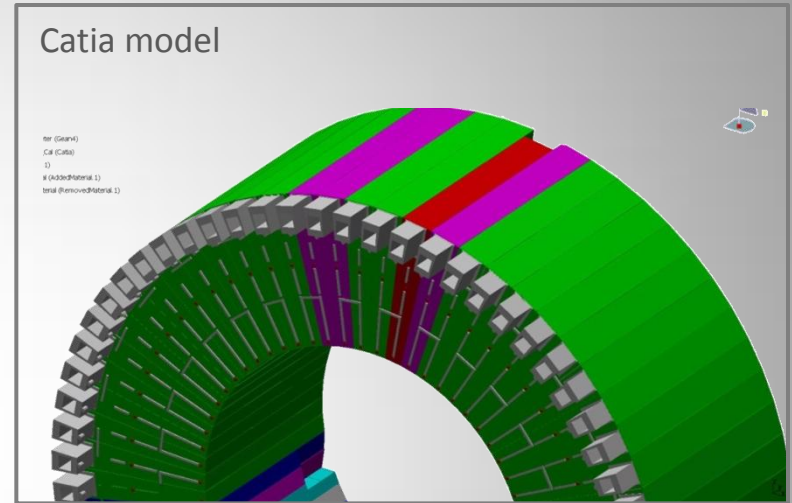
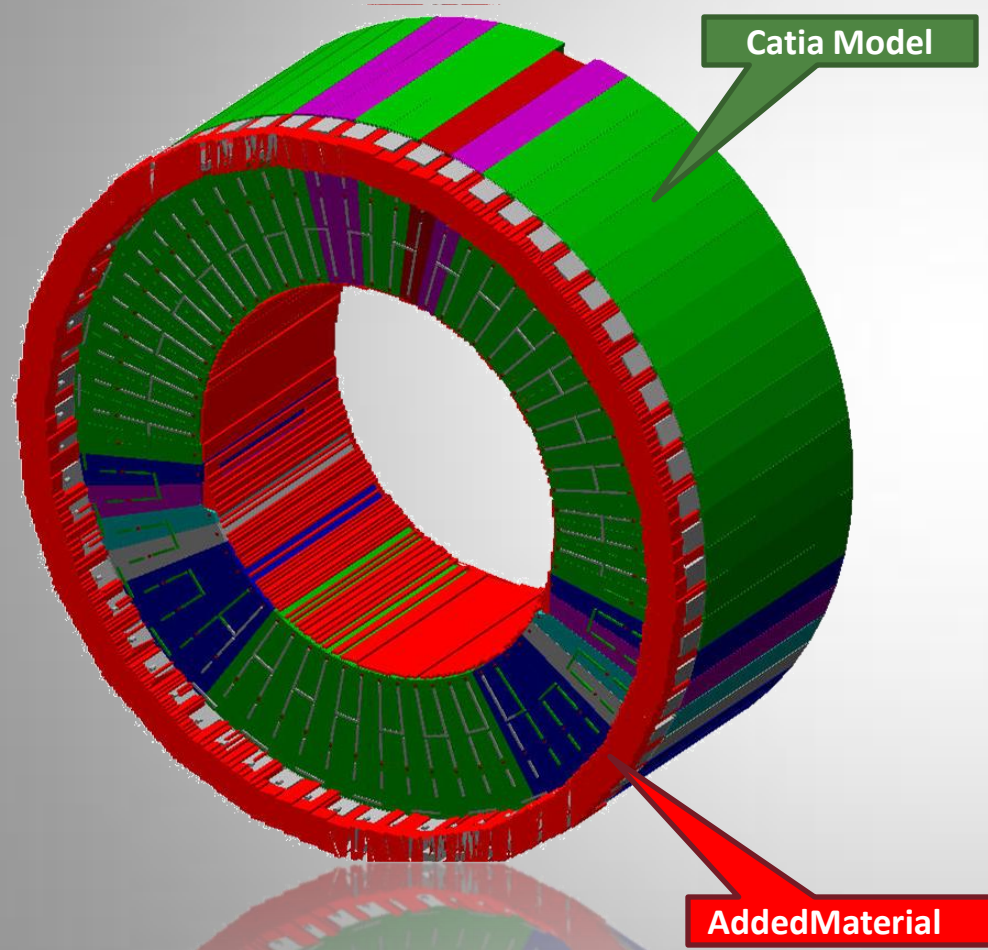
Catia model - 820.837T

Geant4 model - 780.519T

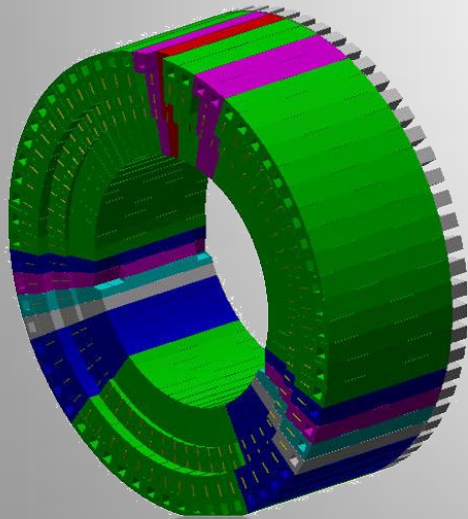
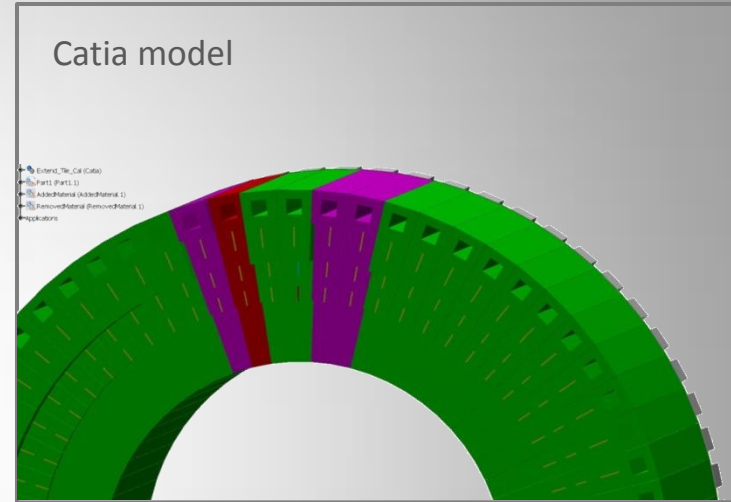
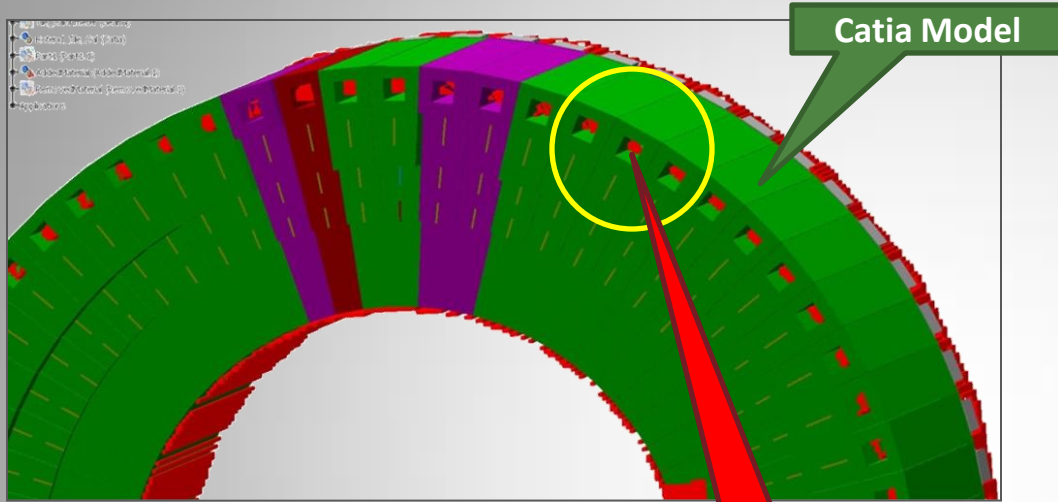
**Difference - 40.318T**



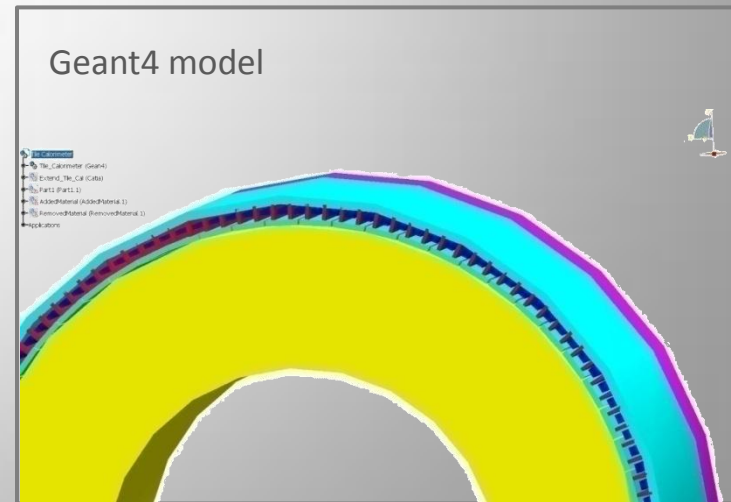
# Compare Atlas CATIA geometry and CavernBkg Geant4 geometry (Extend Tile Calorimeter)



# Compare Atlas CATIA geometry and CavernBkg Geant4 geometry (Extend Tile Calorimeter)

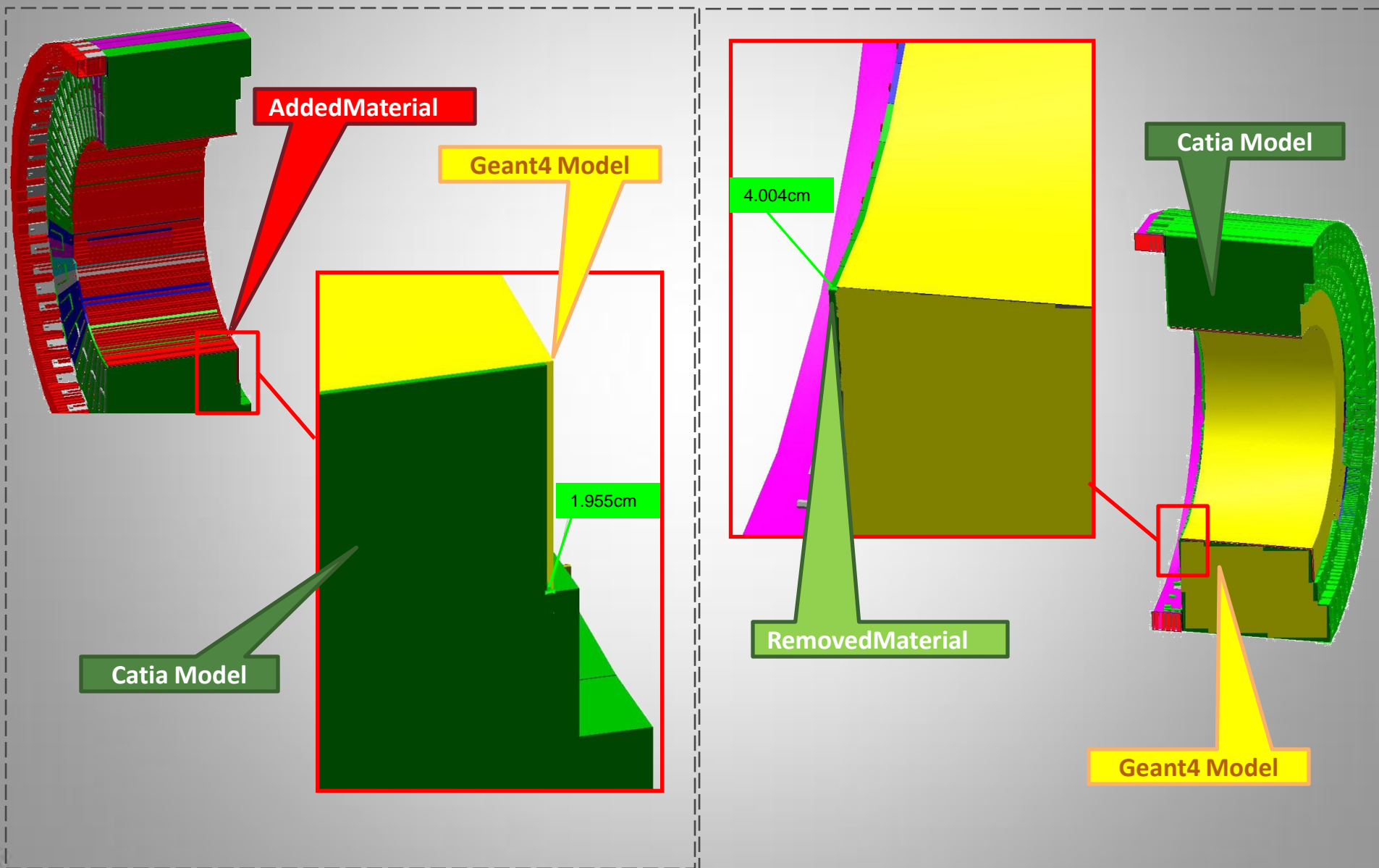


**AddedMaterial**

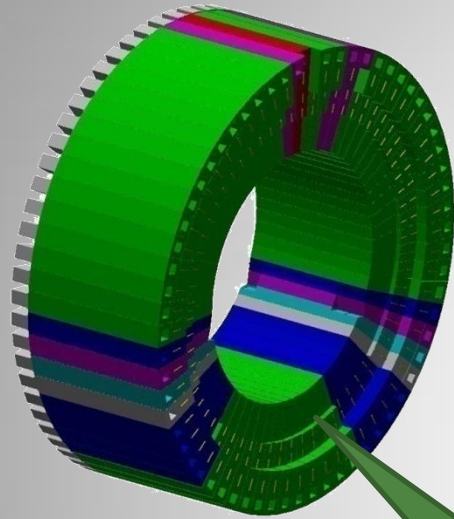




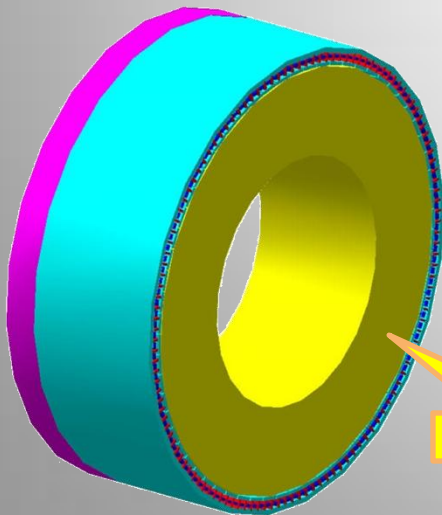
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Catia Model



Geant4 Model

