Geometry Description for Cavern Background

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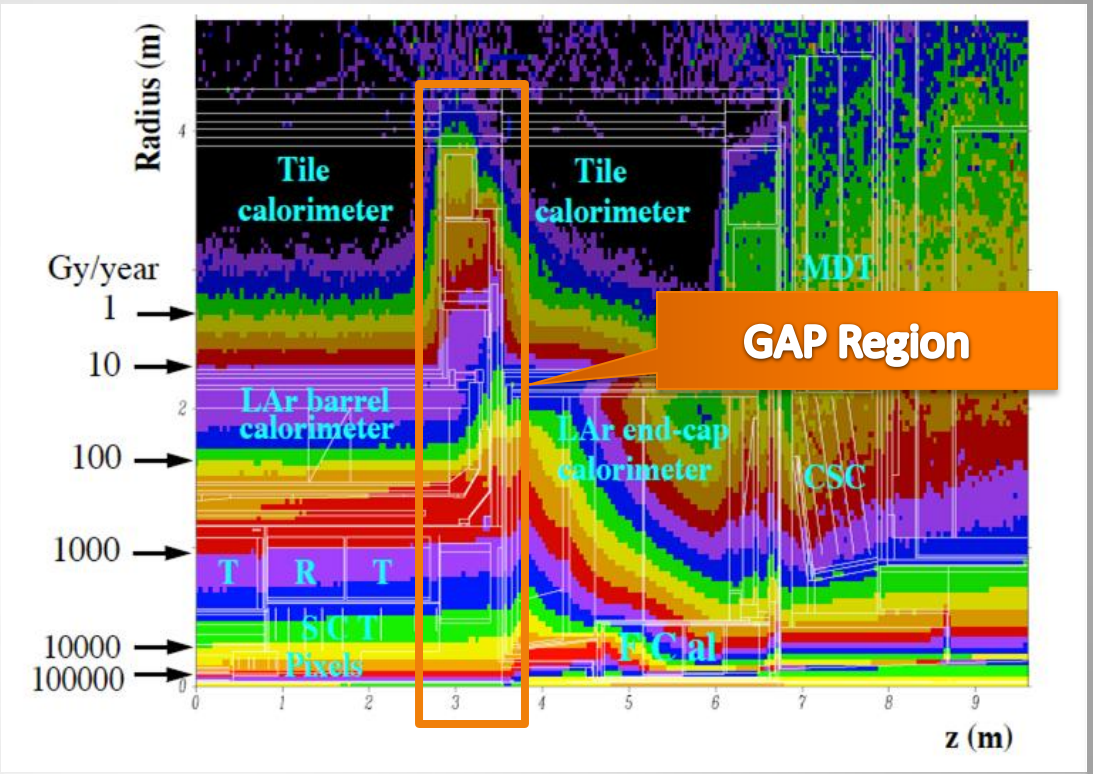
Outline

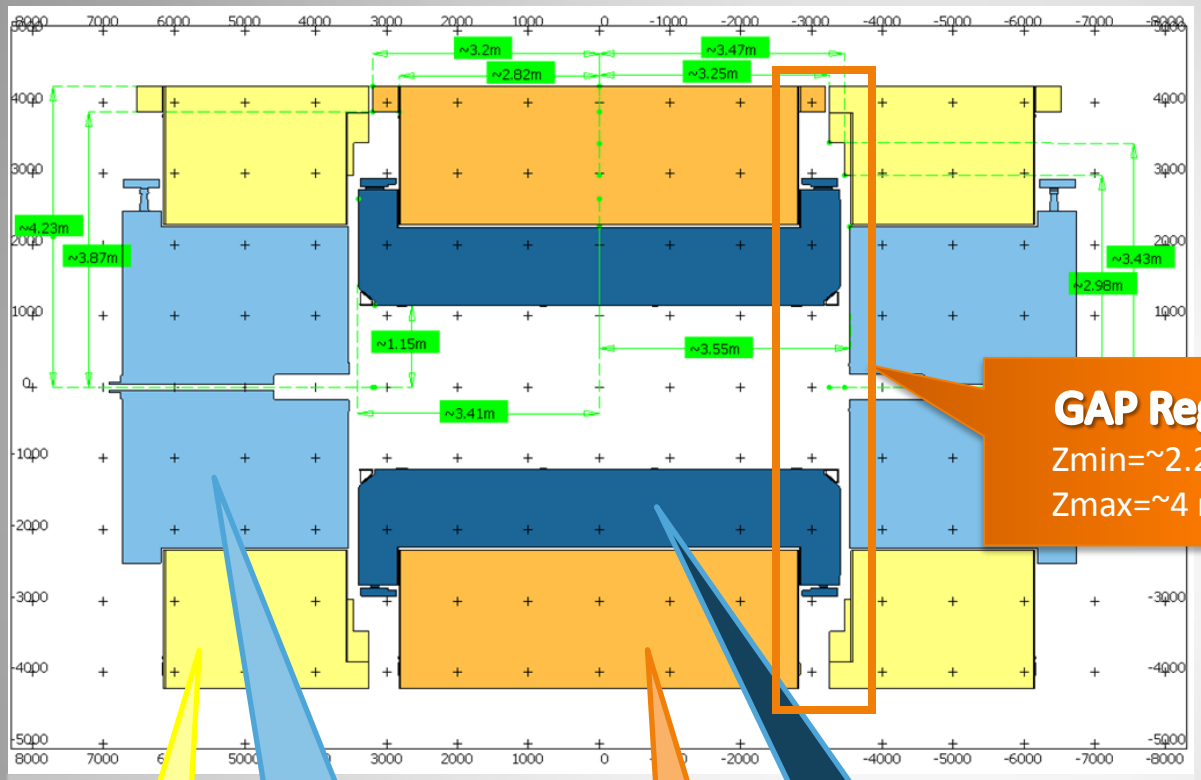
- ATLAS Detector Simulation
- GAP Region between Barrel and Endcap
- Models from Local and SmarTeam database for GAP Region
- Modification of CATIA V5 models
- Integration of geometry from CATIA V5 model to Geant4 code
- Compare Atlas CATIA geometry and CavernBkg Geant4 geometry

ATLAS Detector Simulation

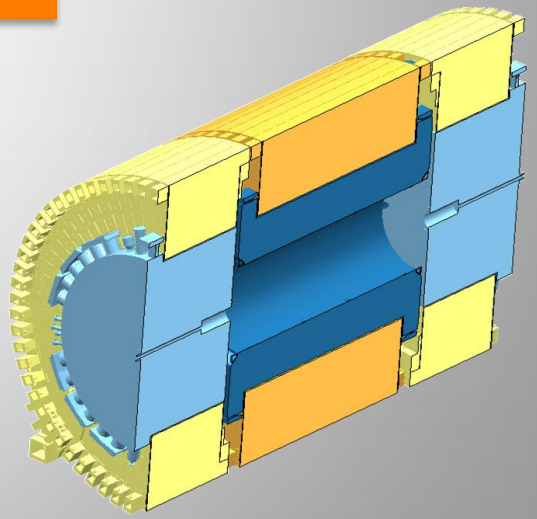
Low-energy neutrons and photons have come out and hit the barrel muon chambers



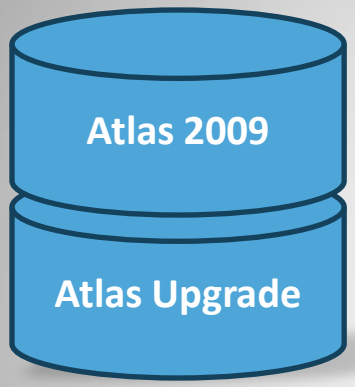
GAP Region Layout



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



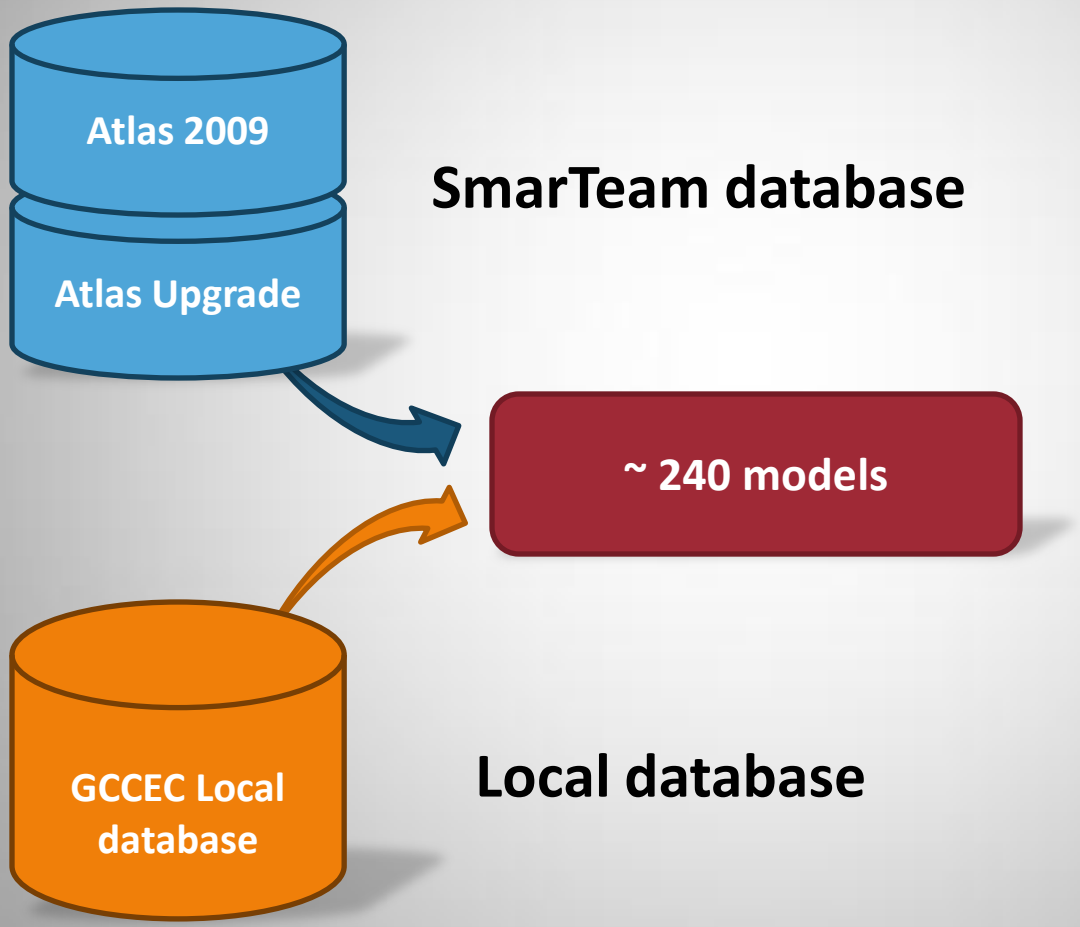
Local and SmarTeam database



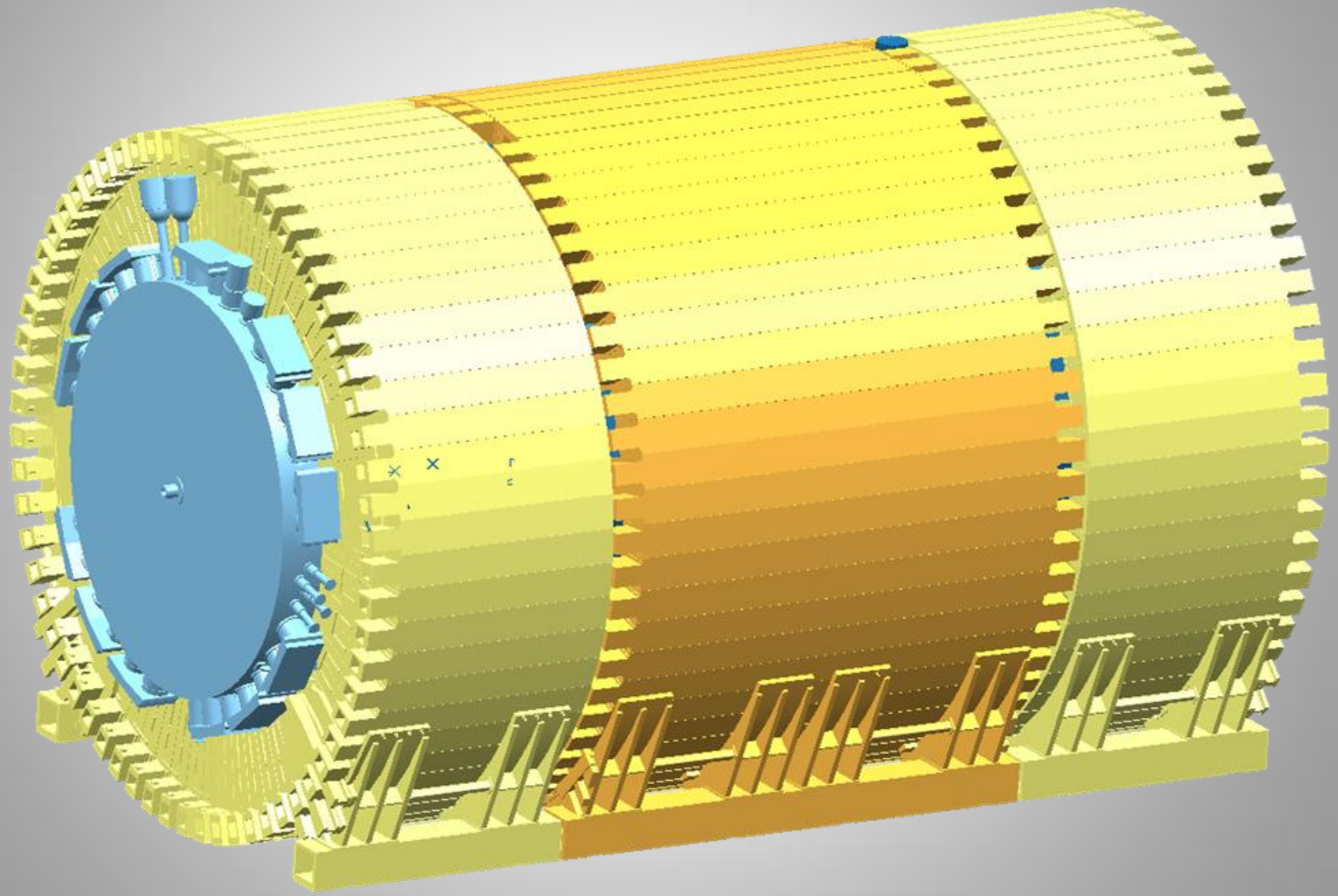
SmarTeam database

Local database

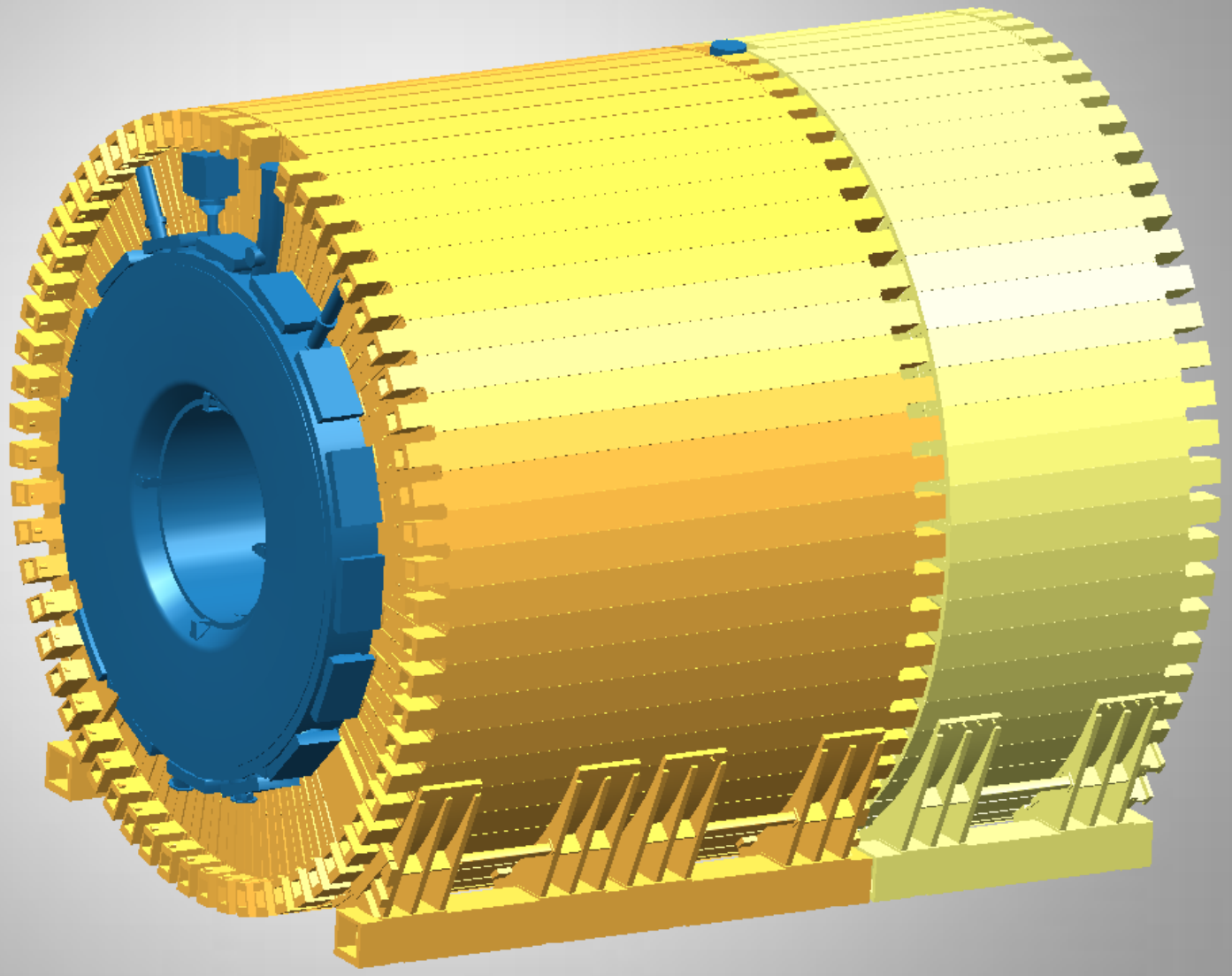
Local and SmarTeam database



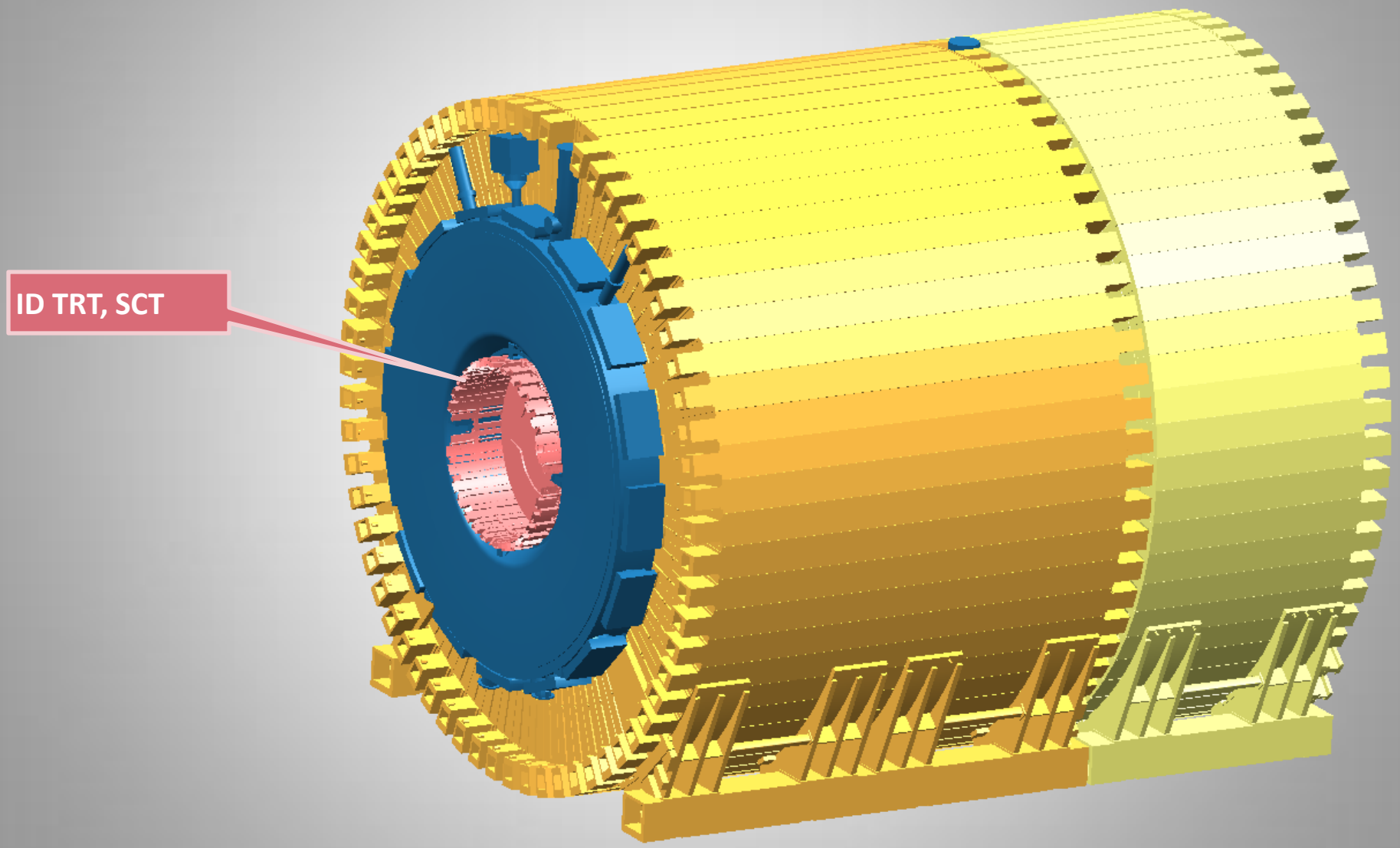
Calorimeter Layout



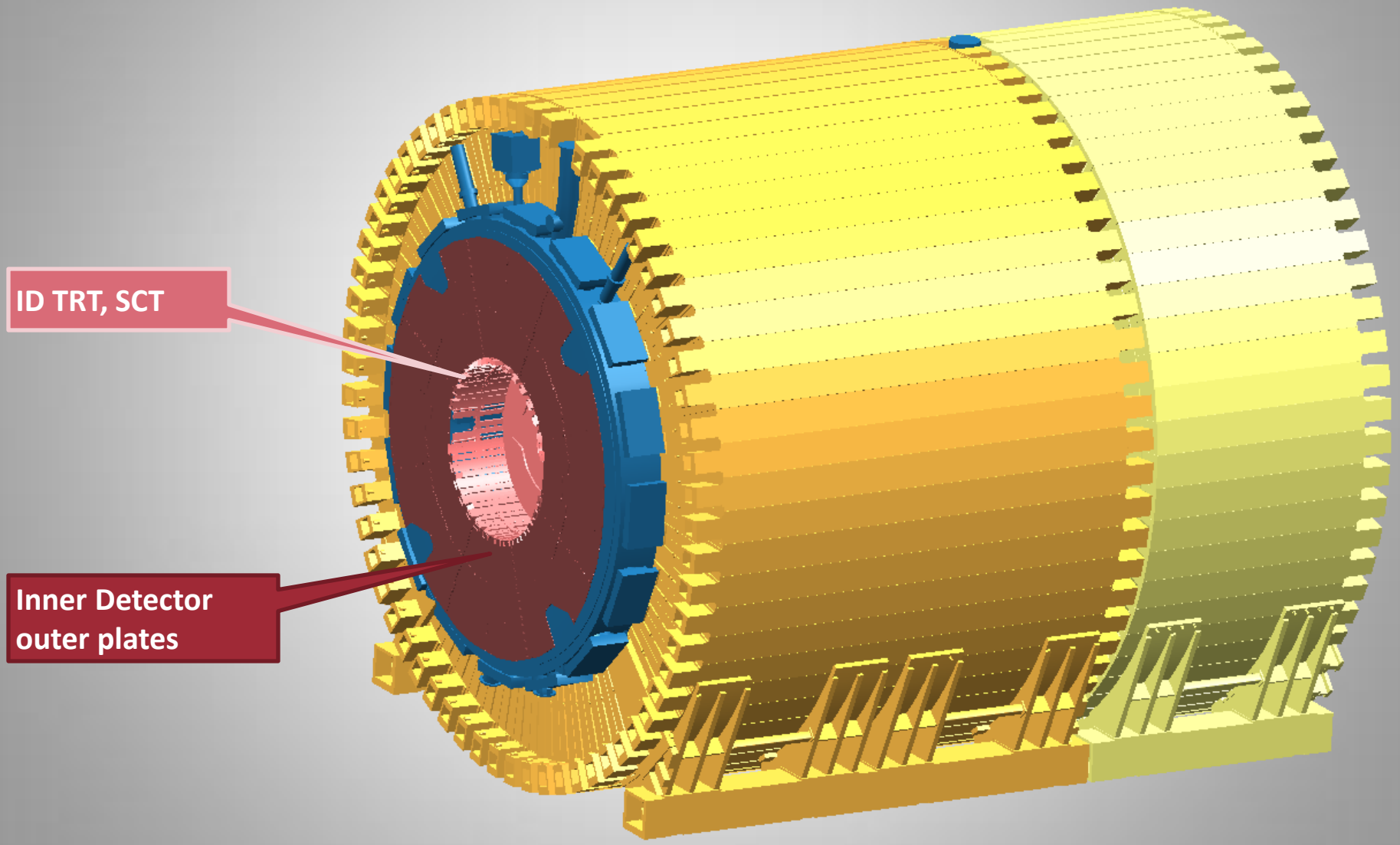
Calorimeter Layout



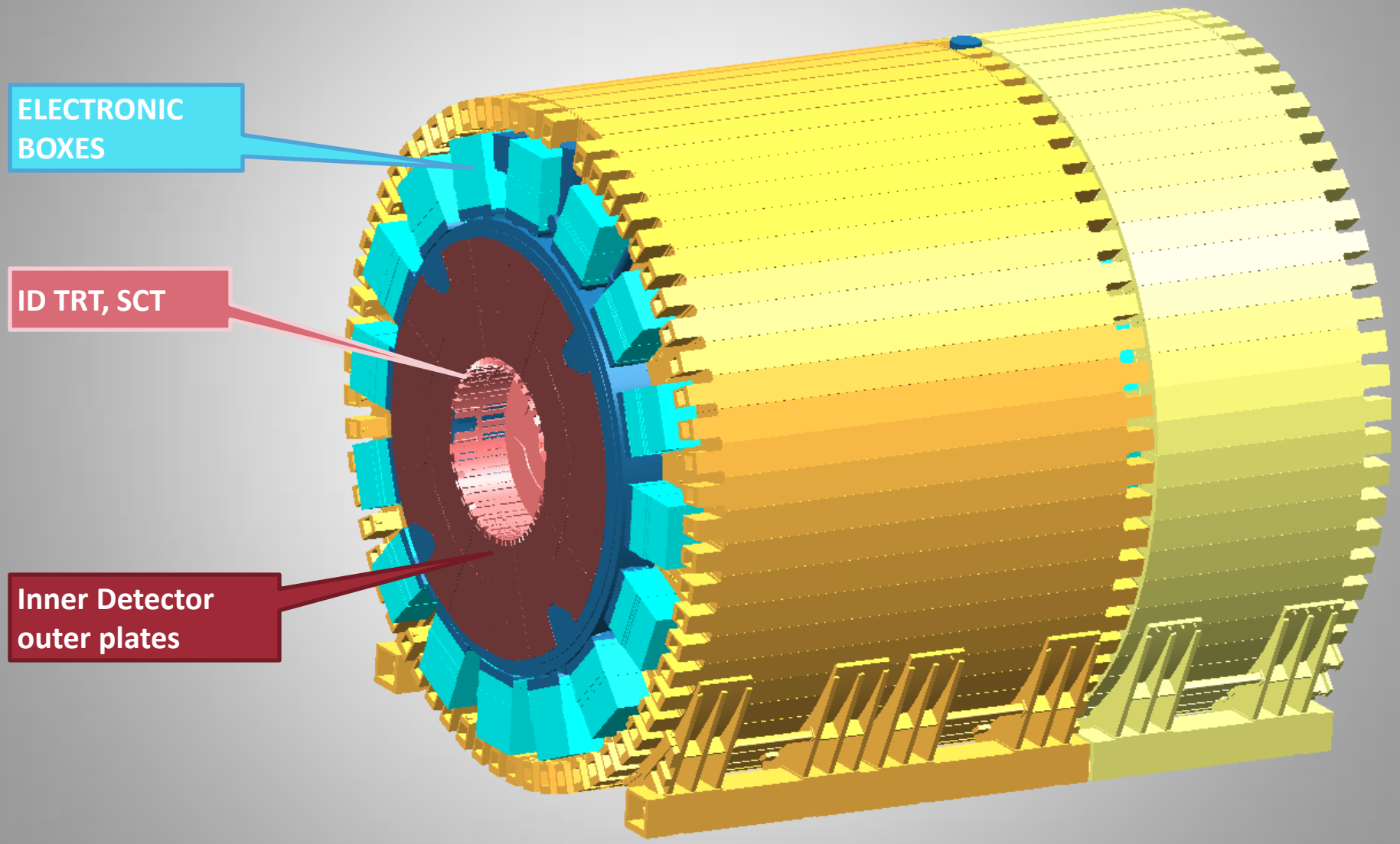
Detector Components in GAP Region



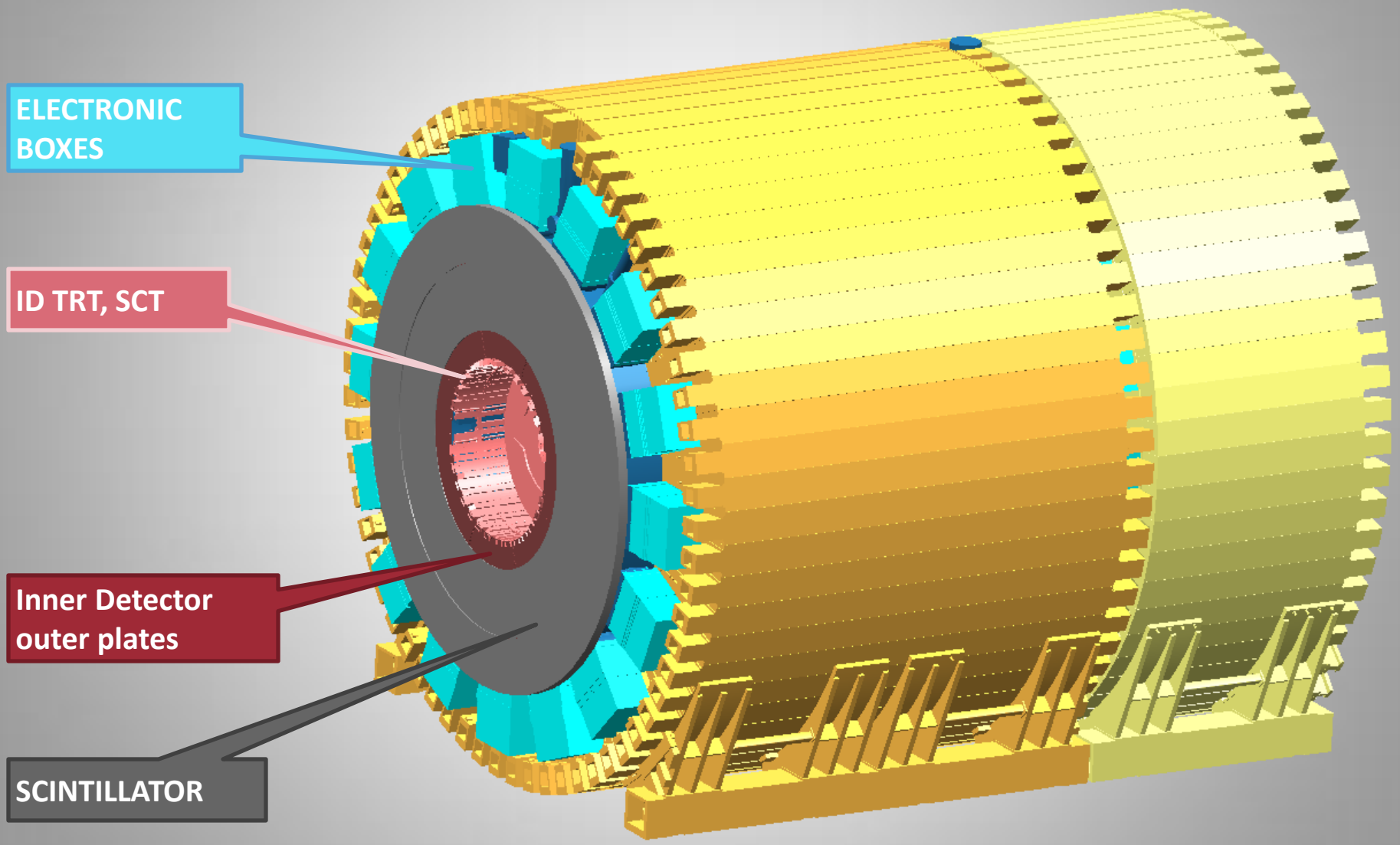
Detector Components in GAP Region



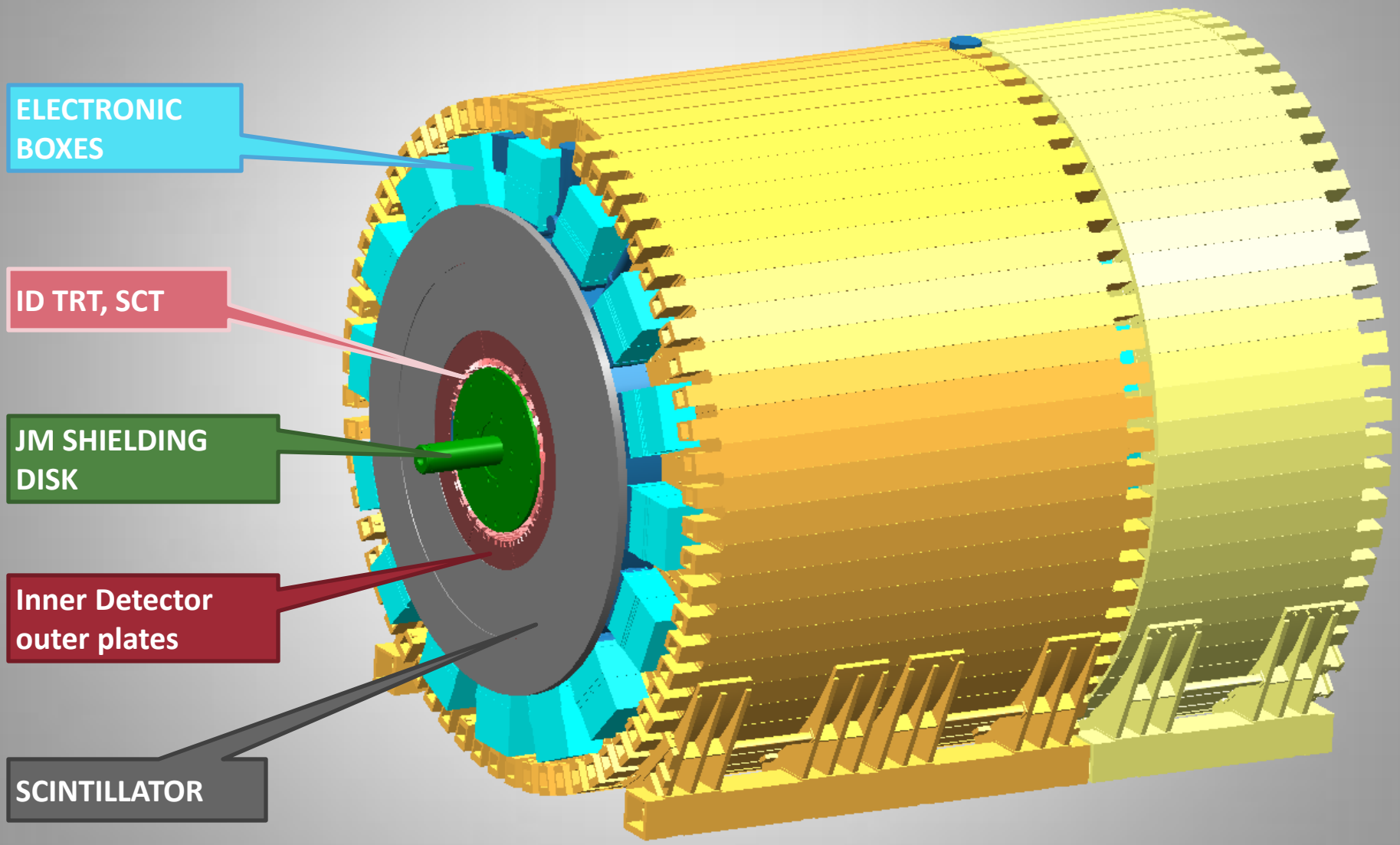
Detector Components in GAP Region



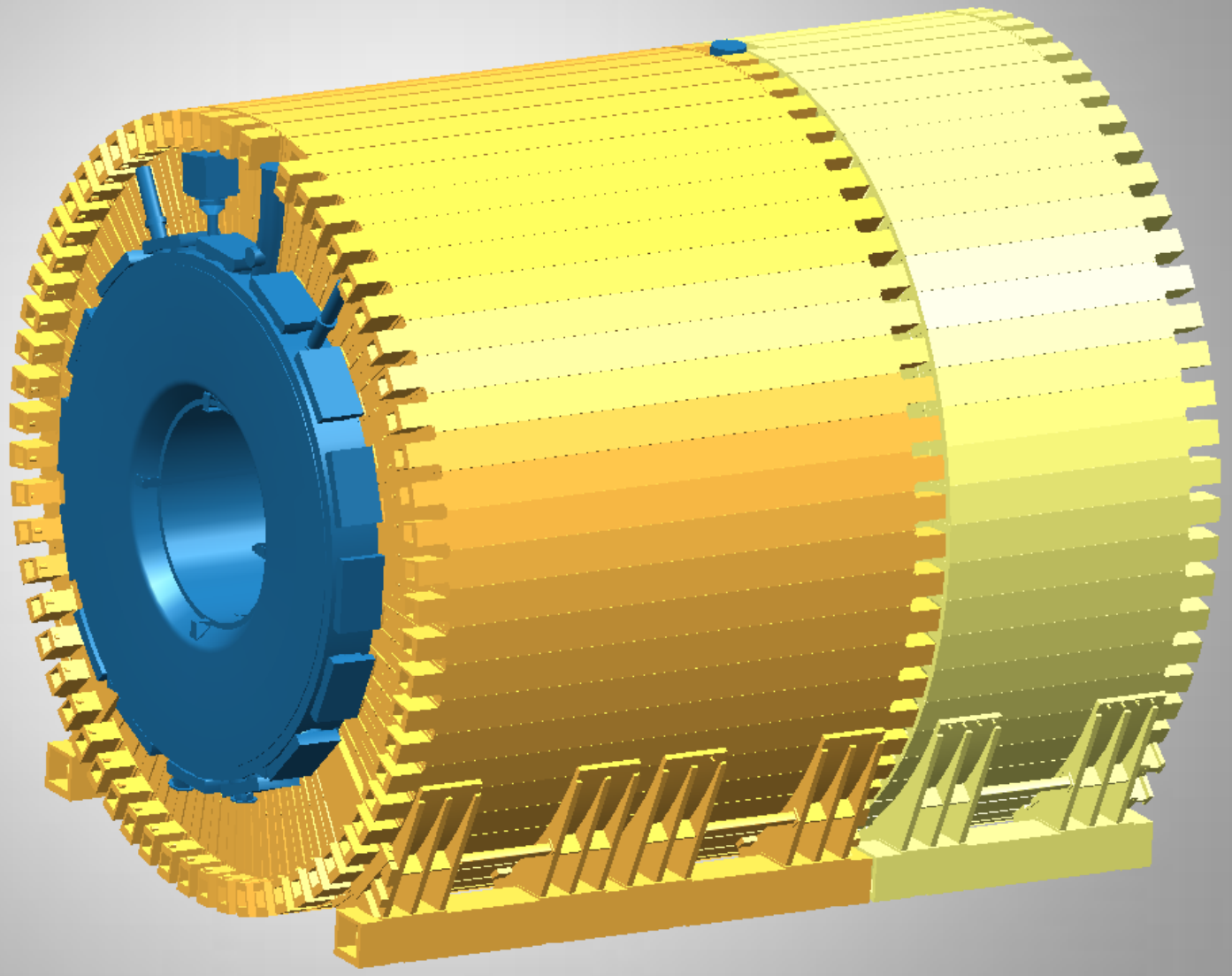
Detector Components in GAP Region



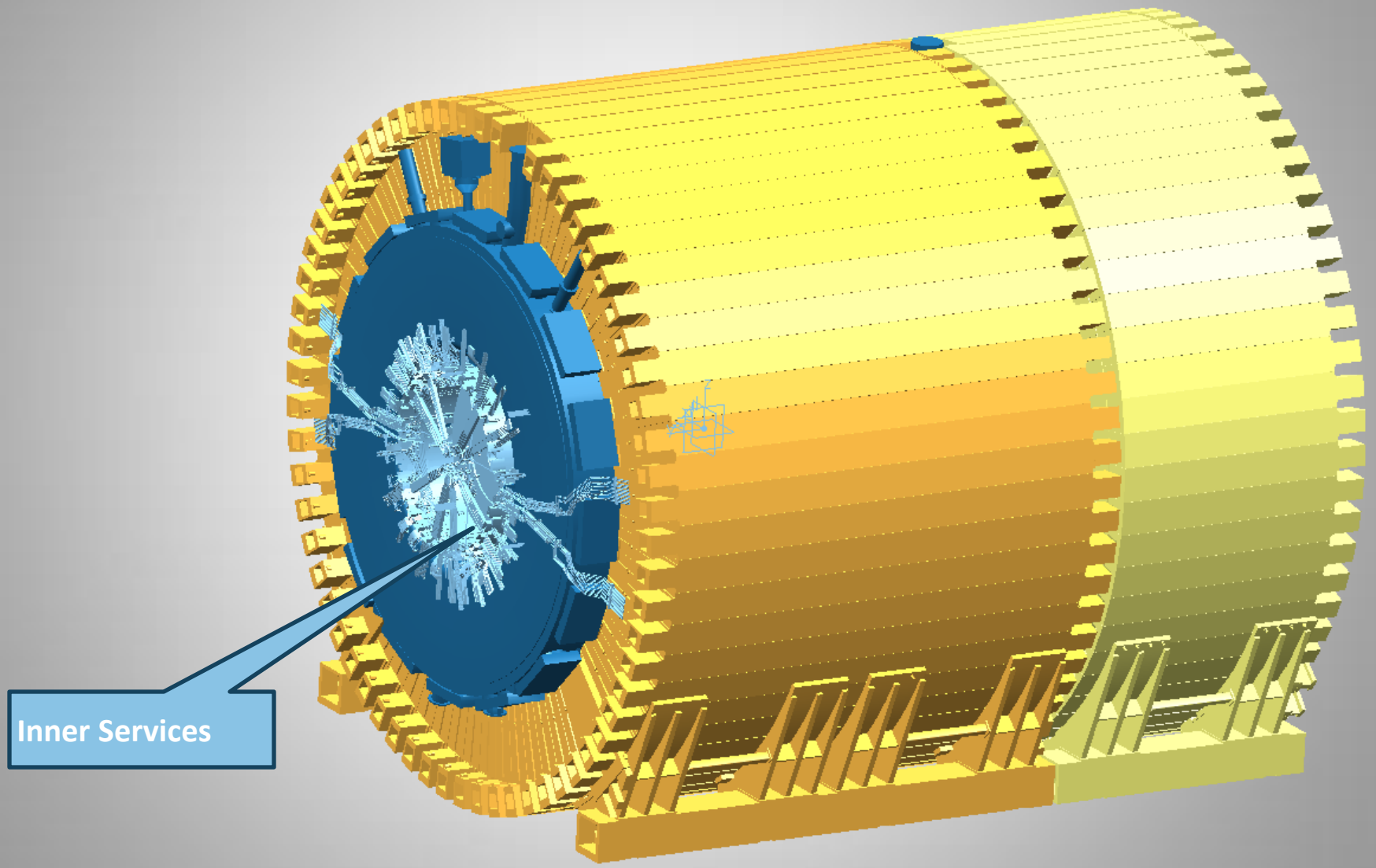
Detector Components in GAP Region



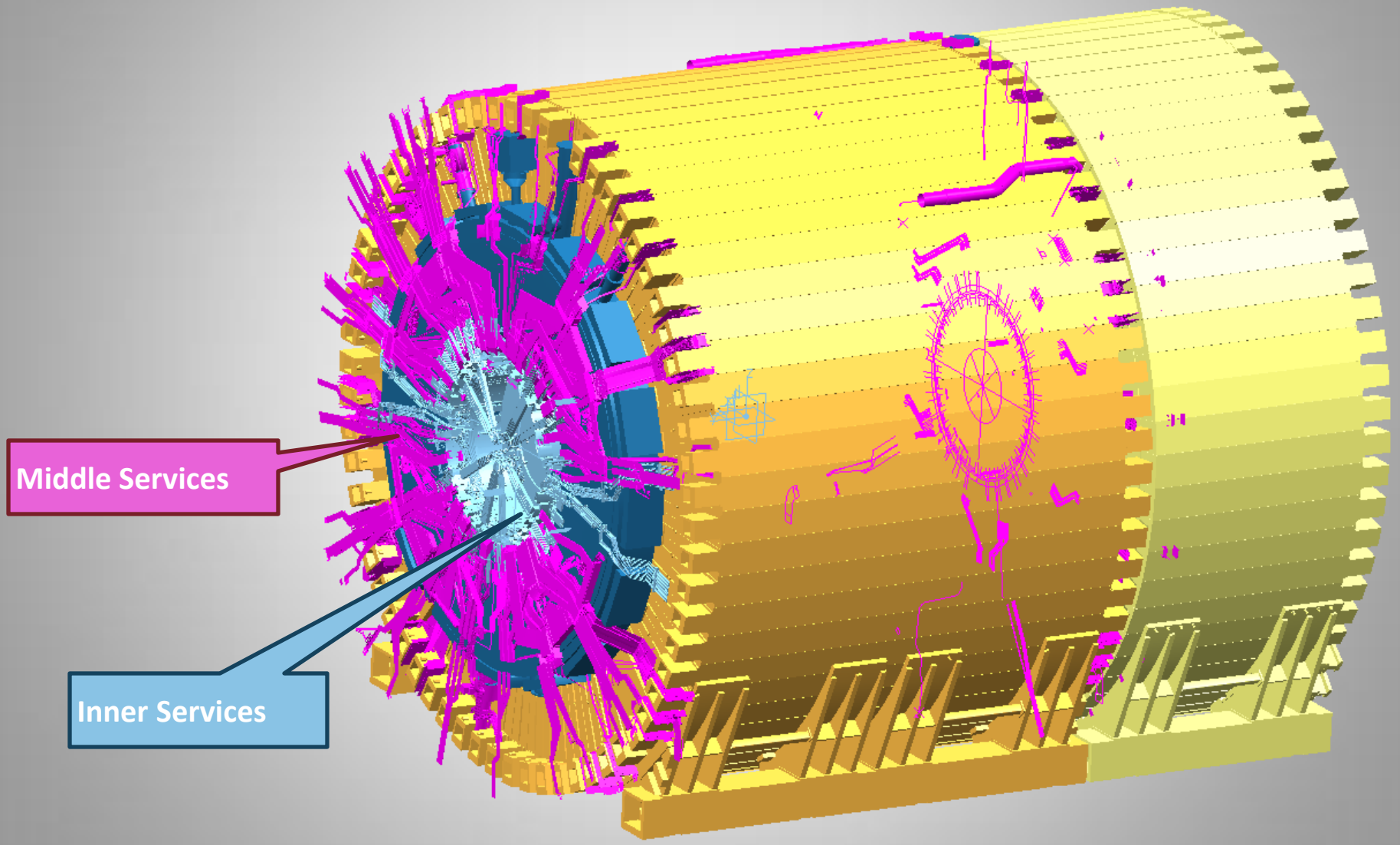
Services in GAP Region



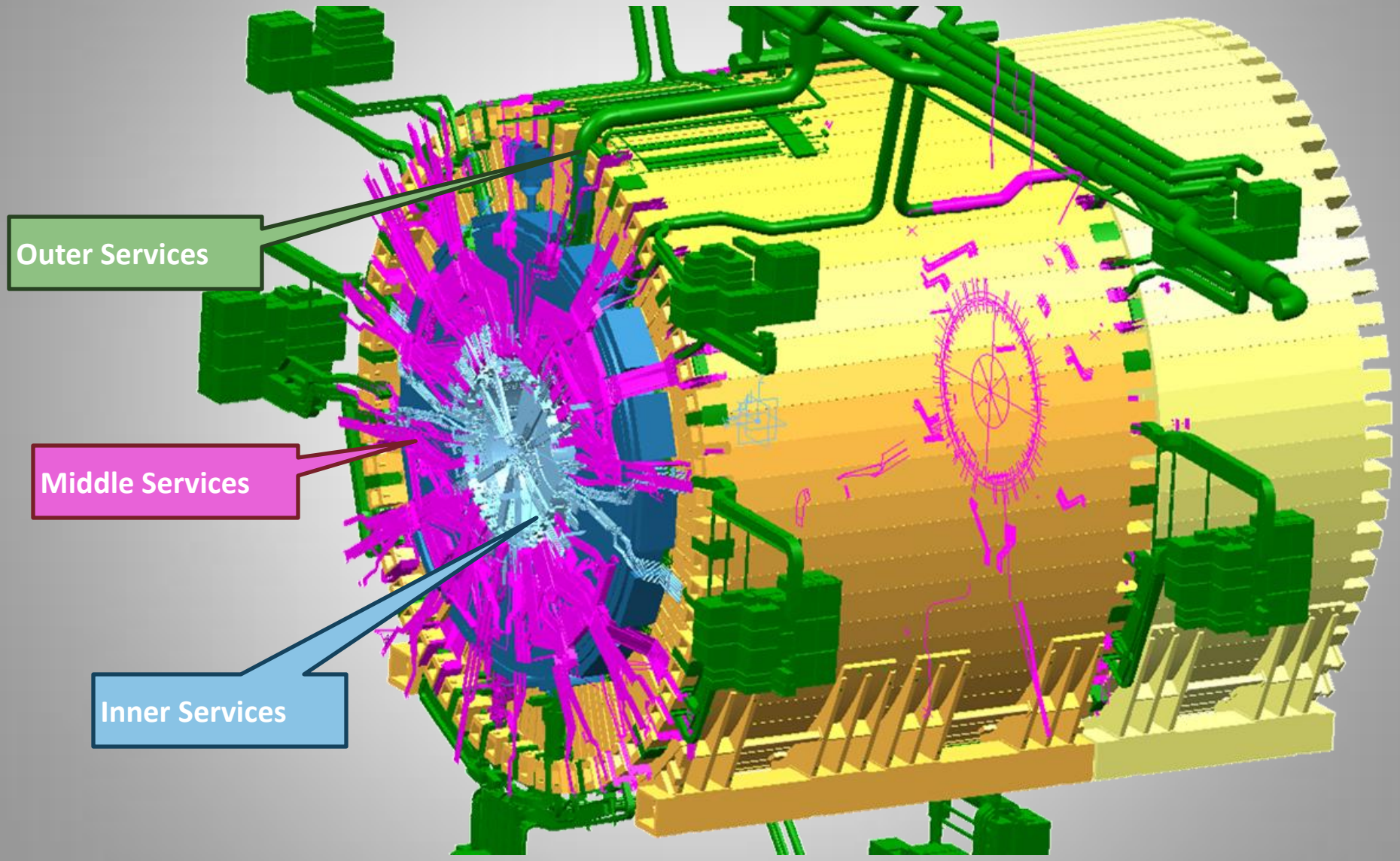
Services in GAP Region



Services in GAP Region



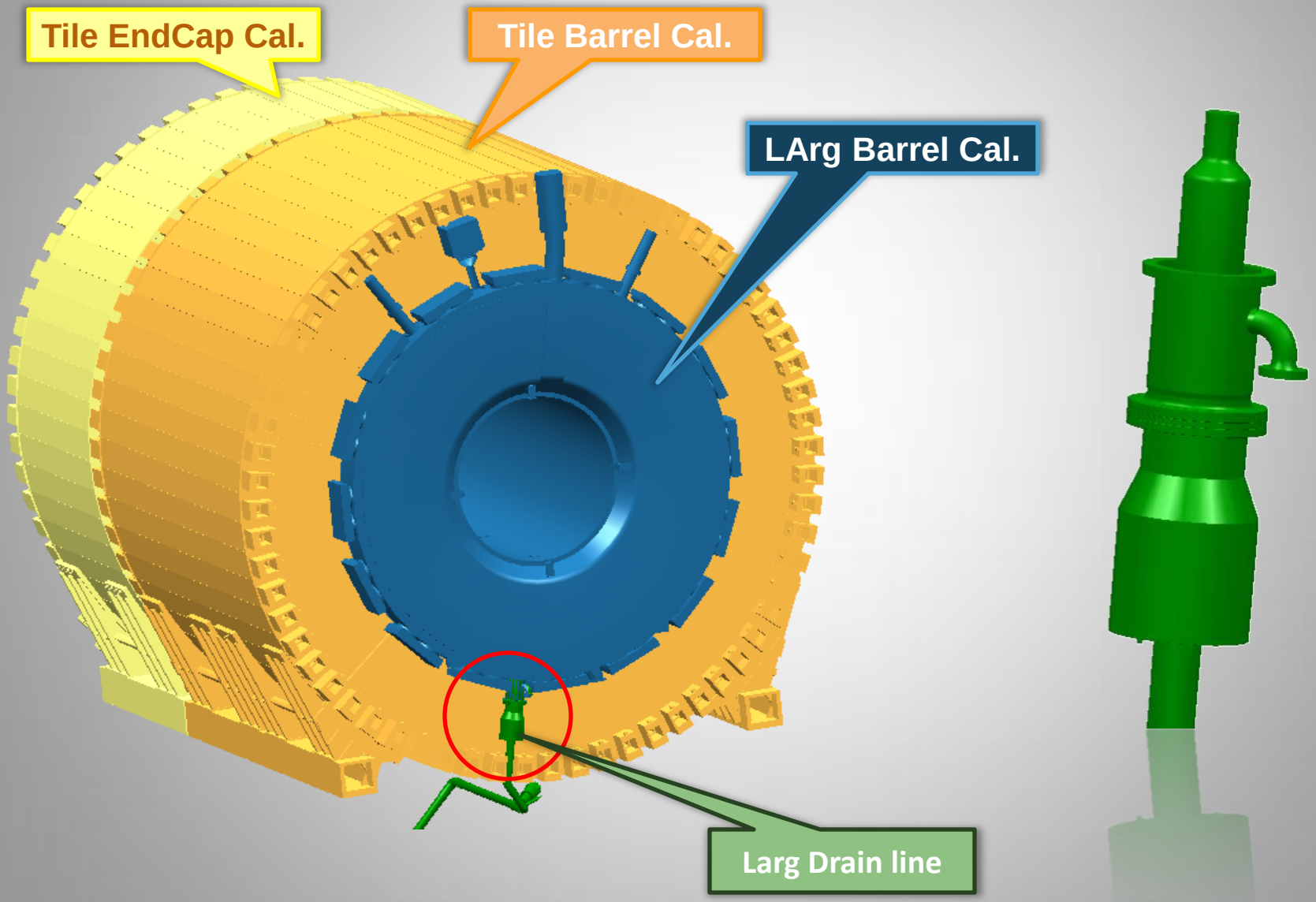
Services in GAP Region



Modification of CATIA V5 models

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

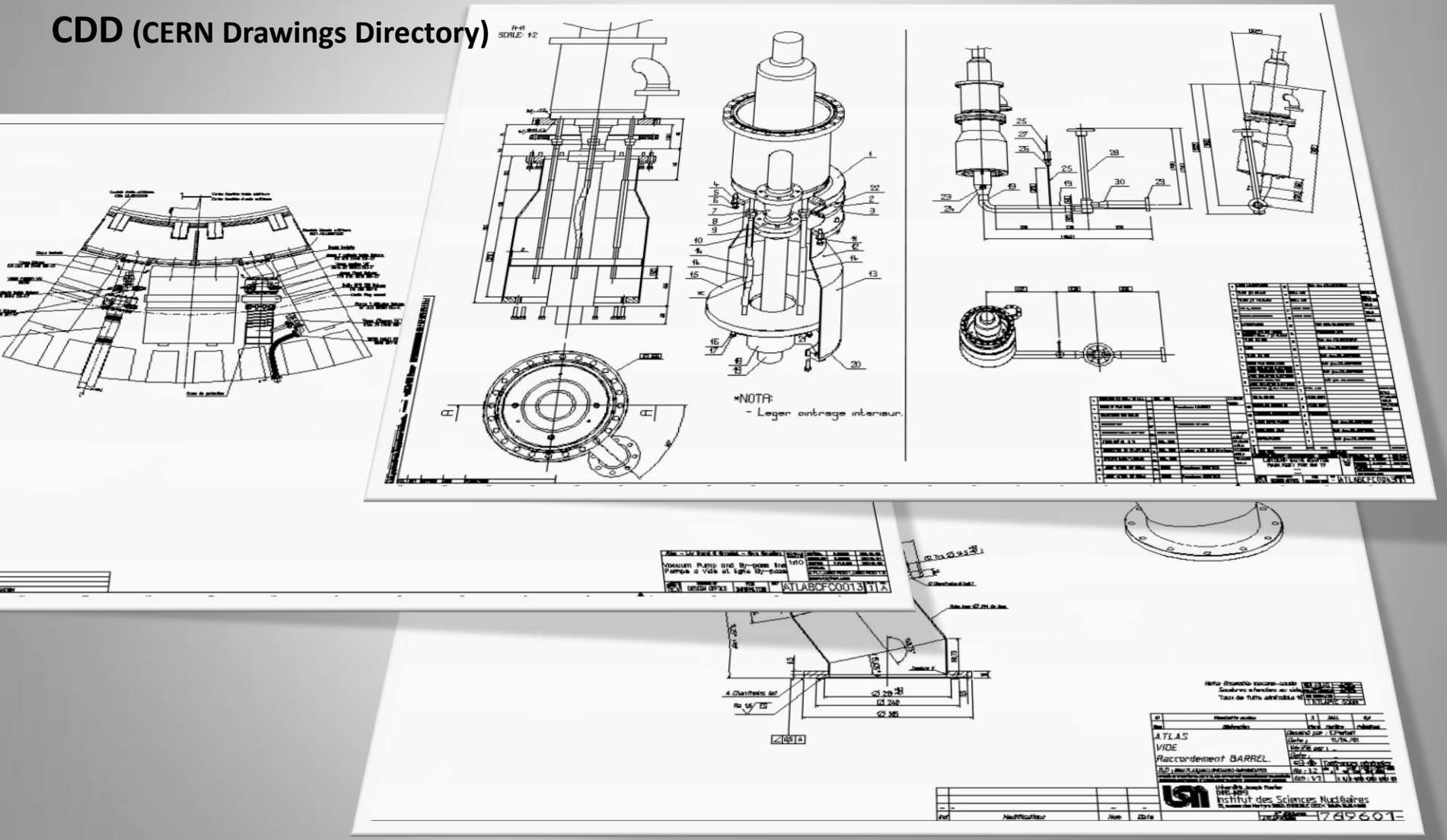
Larg Drain Line



Modification of CATIA V5 models

↳ Search of Detailed information

CDD (CERN Drawings Directory)



Modification of CATIA V5 models

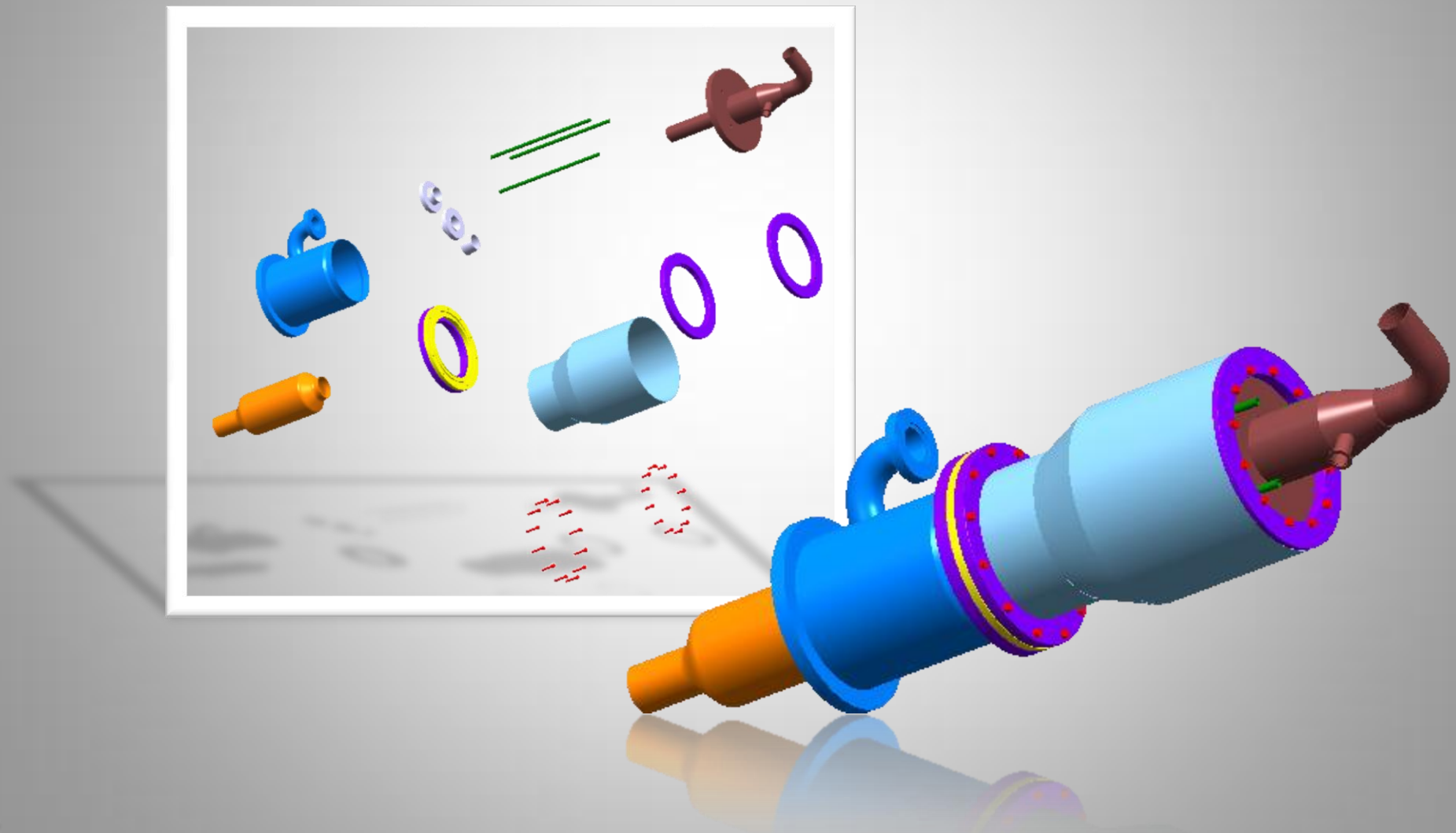
↳Search of Detailed information

Catalogs

Modification of CATIA V5 models

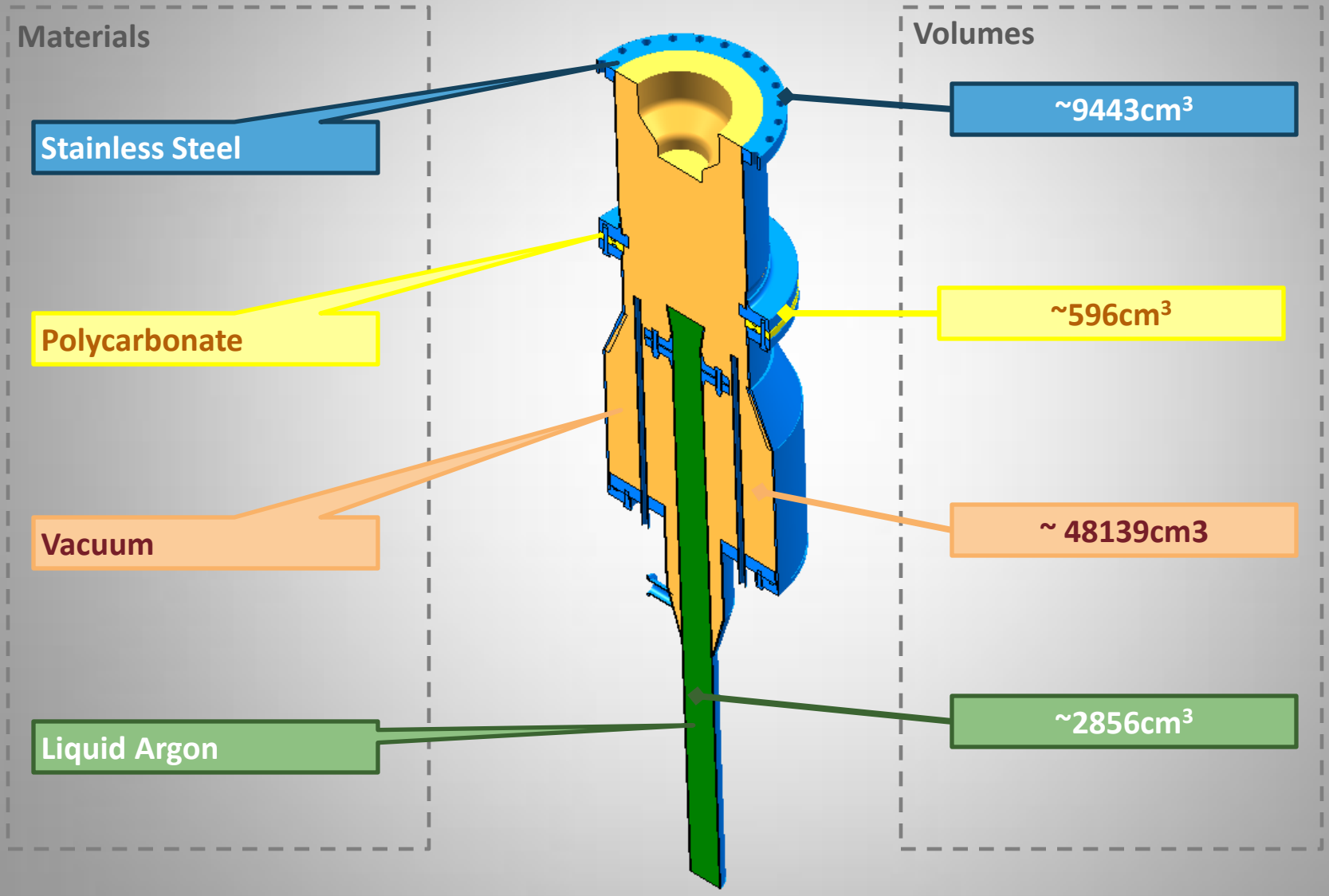
Creation detail model in CATIA V5

Larg Drainline Assemby



Modification of CATIA V5 models

Calculation of geometry Volume

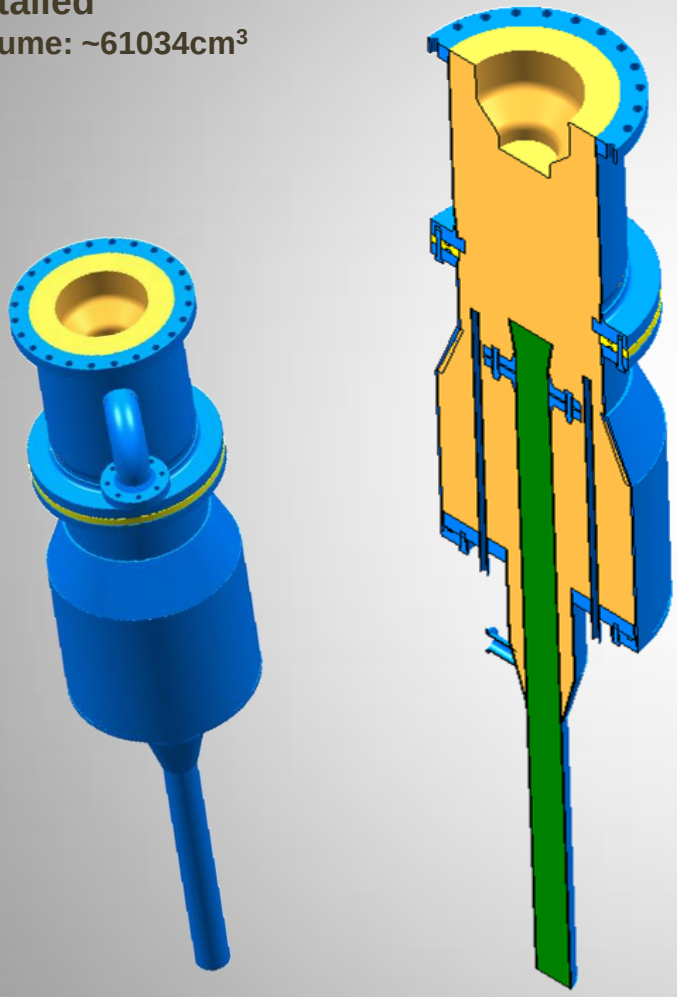


Modification of CATIA V5 models

↳ Simplified of geometry

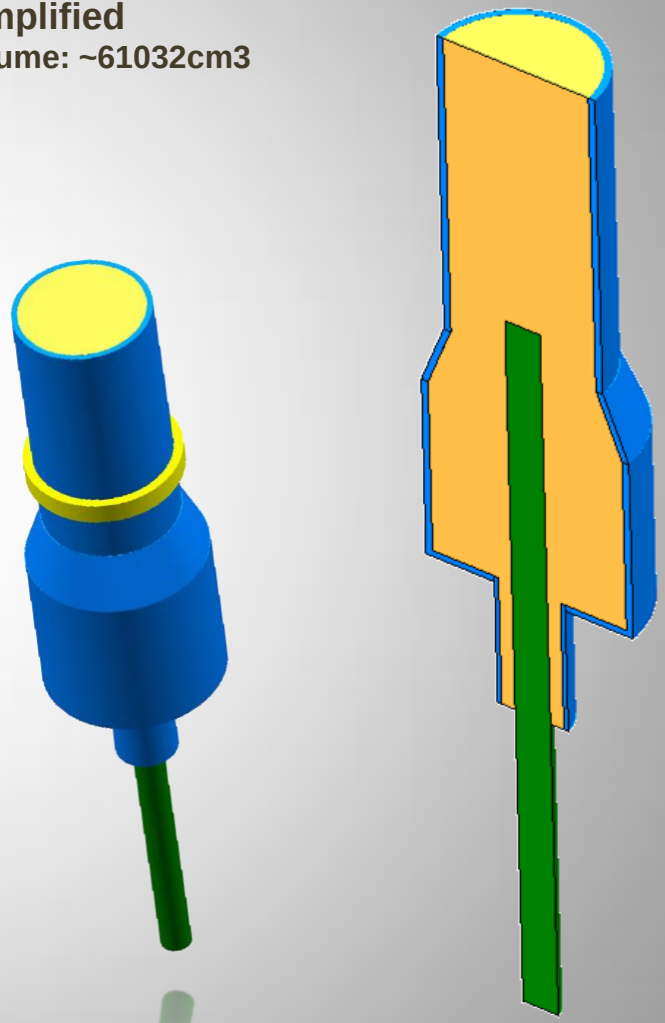
Detailed

Volume: ~61034cm³



Simplified

Volume: ~61032cm3



Integration of geometry from CATIA V5 model to Geant4 code

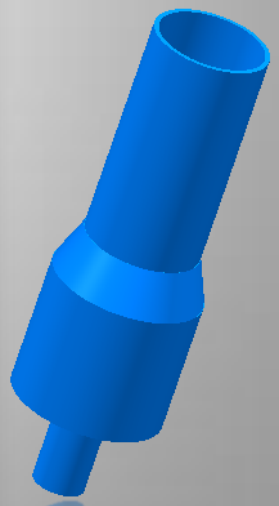
- Geant4 code
- Clash checking Geant4 geometries
- Compare checking CATIA V5 and Geant4 geometries

↳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

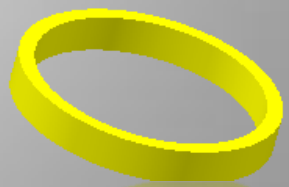
```
// LiquidArgon Volume
 r_inner = 0.;
 r_outer = 28.36*mm;
 z_half = 565*mm;
 G4Tubs* Liquidargon = new G4Tubs("Liquidargon",r_inner, r_outer, z_half, phi0, dphi);

 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);
```

Liquid Argon

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);
```

Insulation Washer



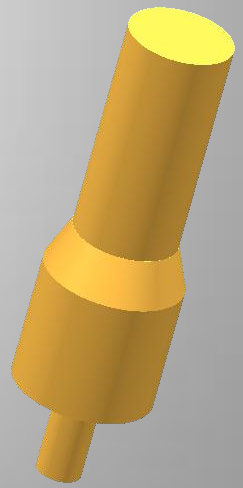
Integration of geometry from CATIA V5 model to Geant4 code

↳ Geant4 code of DrainLine

Geant4 code of Vacuum

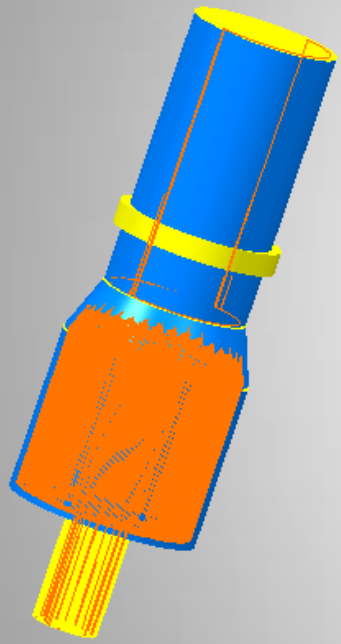
```
// Vacuum Volume
 r_inner = 0*mm;
 r_outer = 117*mm;
 z_half = 243.75*mm;
 G4Tubs* Vacuum1 = new G4Tubs("Vacuum1", r_inner, r_outer, z_half, phi0, dphi);
 r_inner = 0*mm;
 r_outer = 156*mm;
 r_inner2 = 0*mm;
 r_outer2 = 117*mm;
 z_half = 50*mm;
 G4Cons* Vacuum2=new G4Cons("Vacuum2", r_inner, r_outer,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

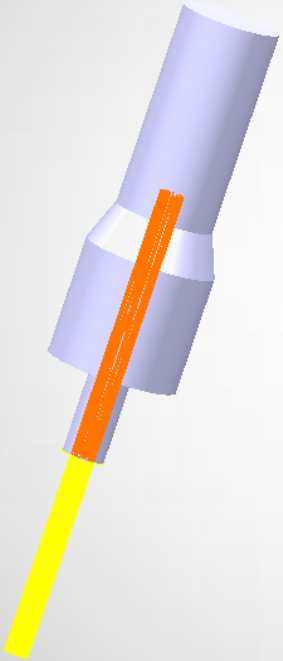


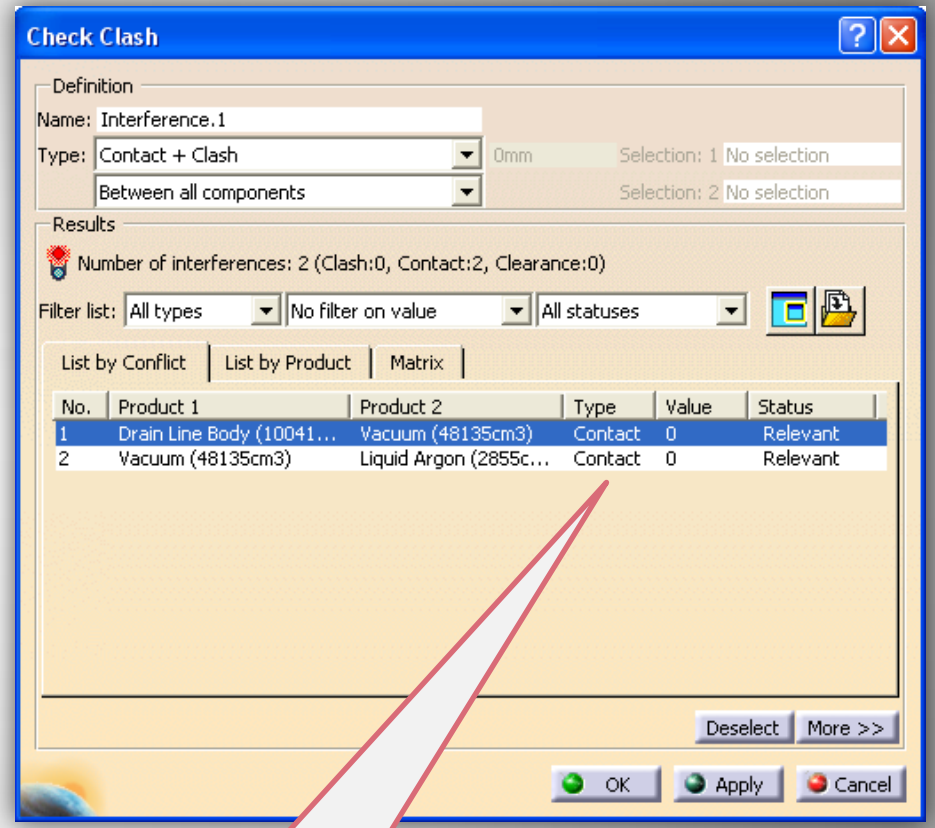
Clash checking Geant4 geometries

1 Contact



2 Contact

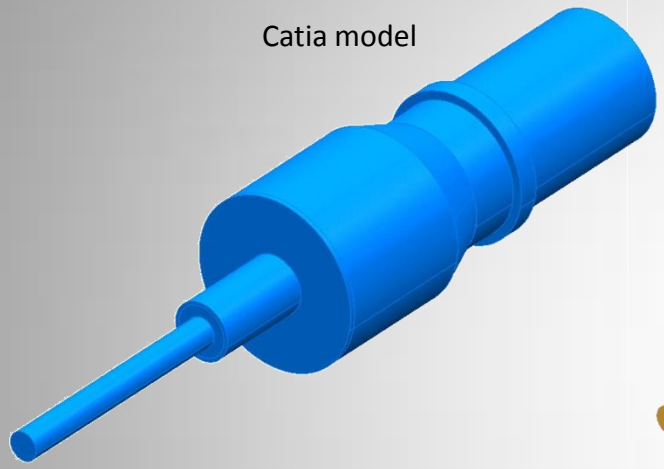




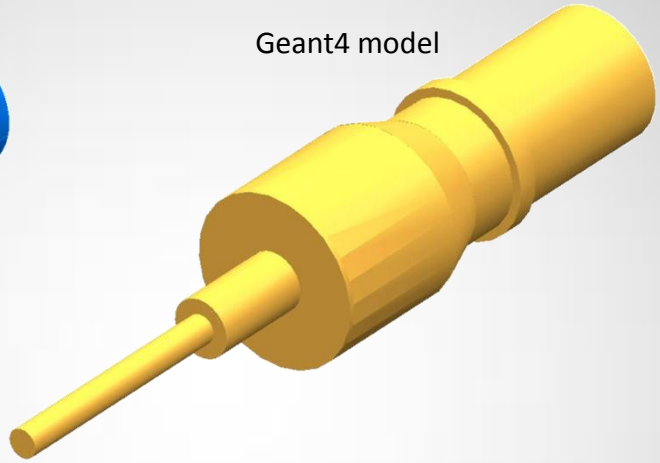
We have only contacts. Clash didn't fixed

Compare checking CATIA V5 and Geant4 geometries

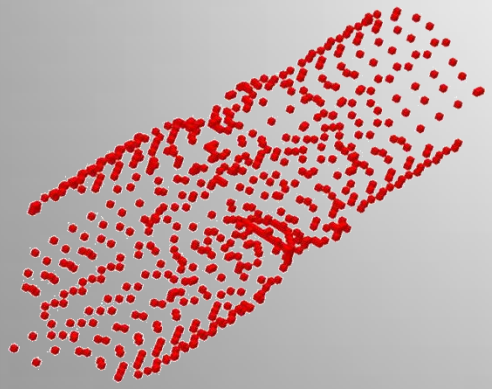
Catia model



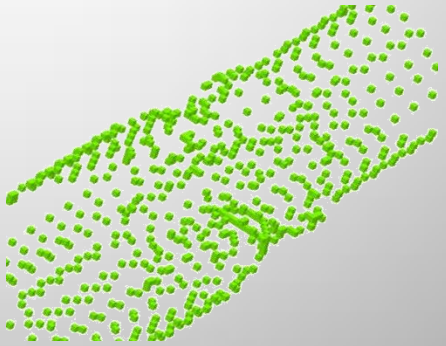
Geant4 model



AddedMaterial = Catia + Geant4

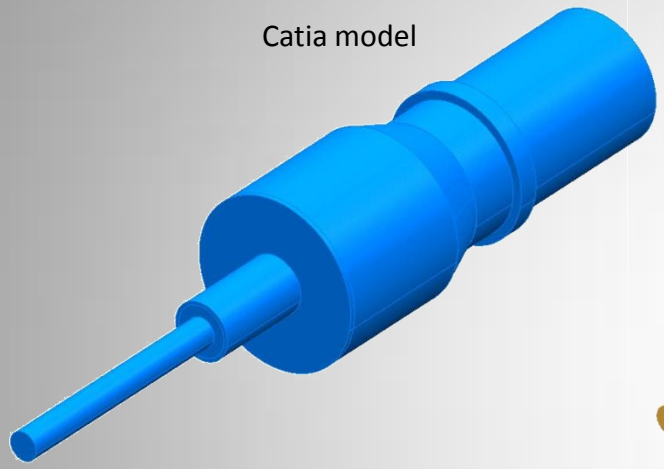


RemovedMaterial = Catia - Geant4

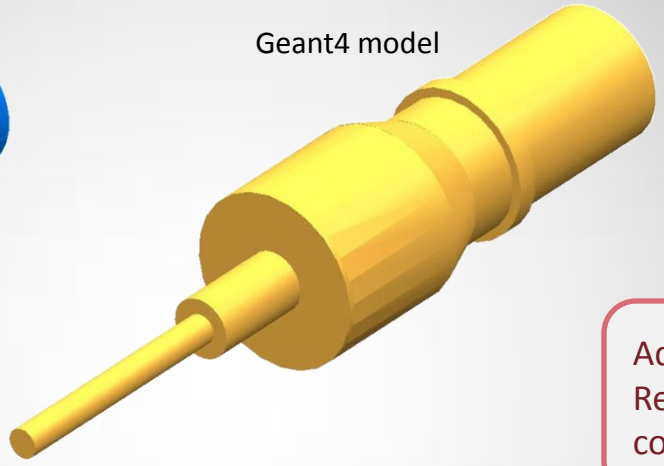


Compare checking CATIA V5 and Geant4 geometries

Catia model

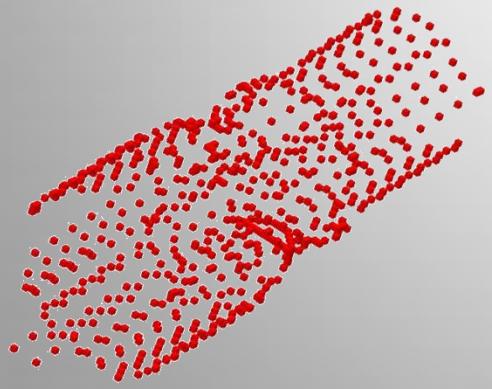


Geant4 model

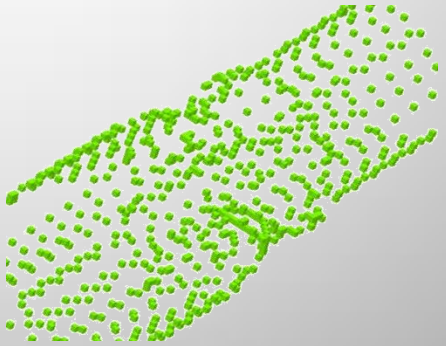


AddedMaterial and RemovedMaterial are due to computational inaccuracy

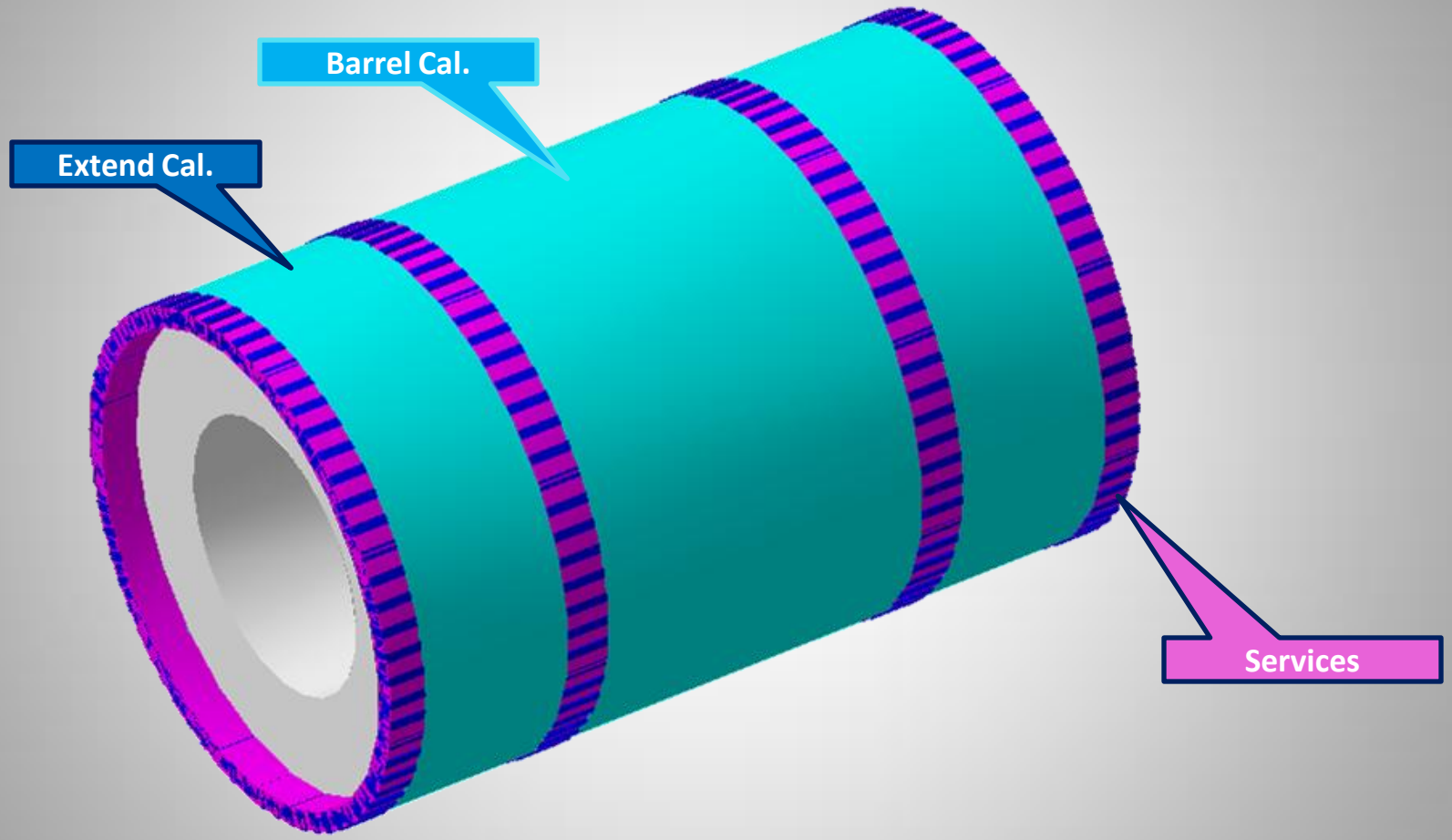
AddedMaterial = Catia + Geant4



RemovedMaterial = Catia - Geant4



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



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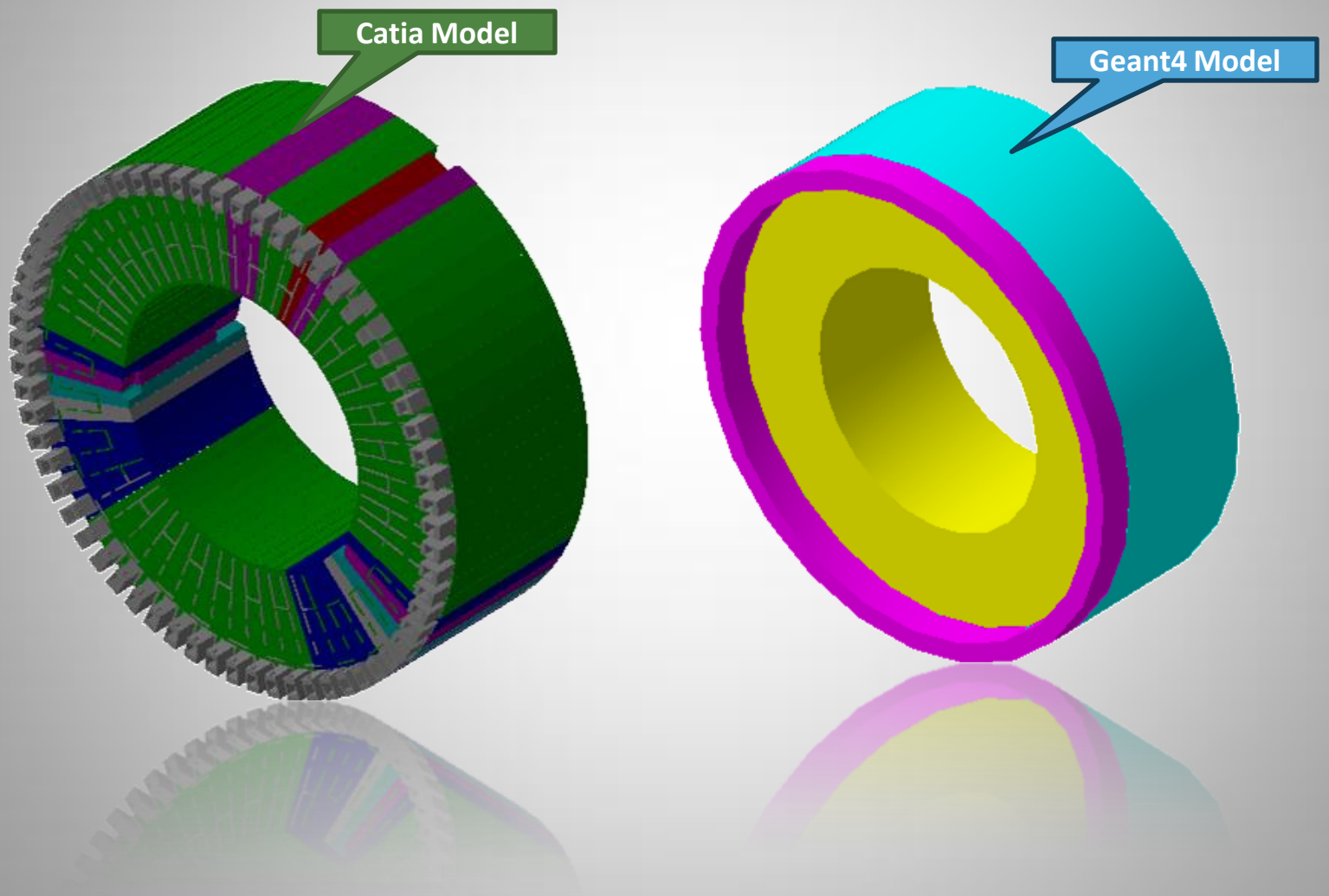

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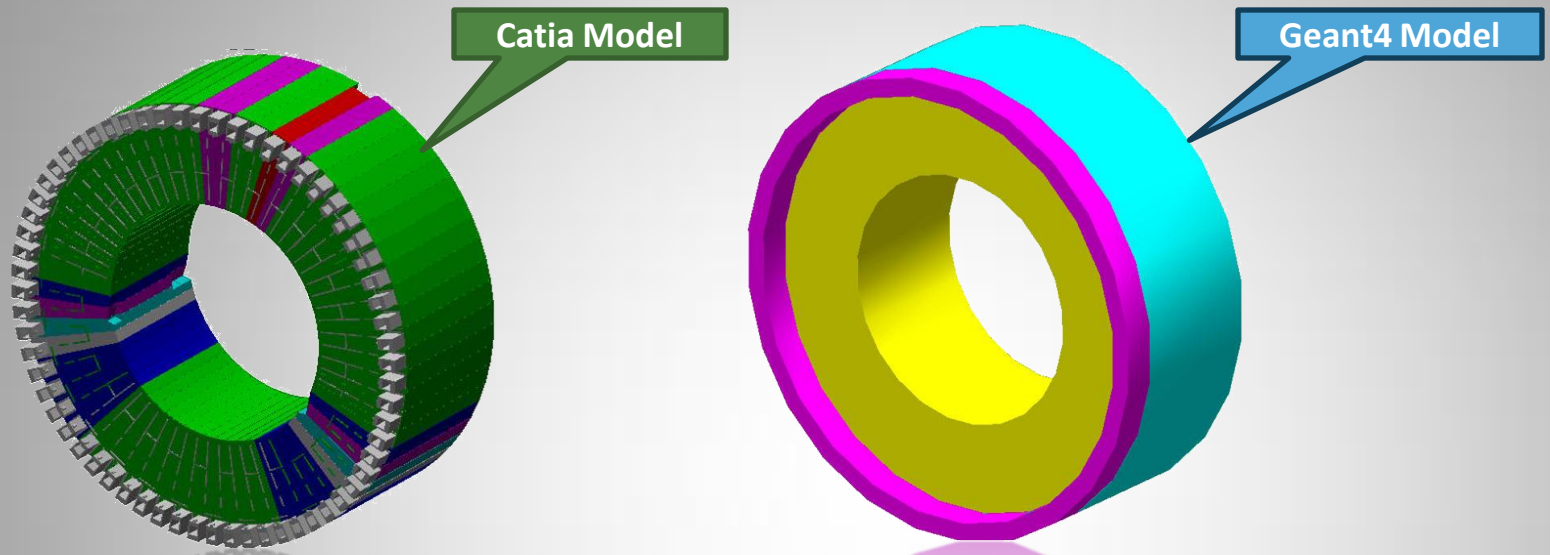
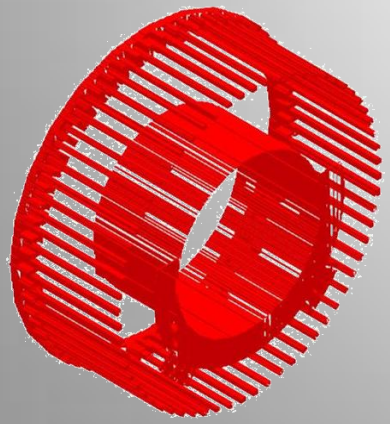
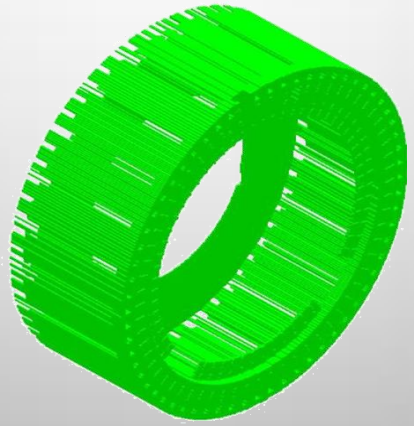


AddedMaterial = Catia + Geant4



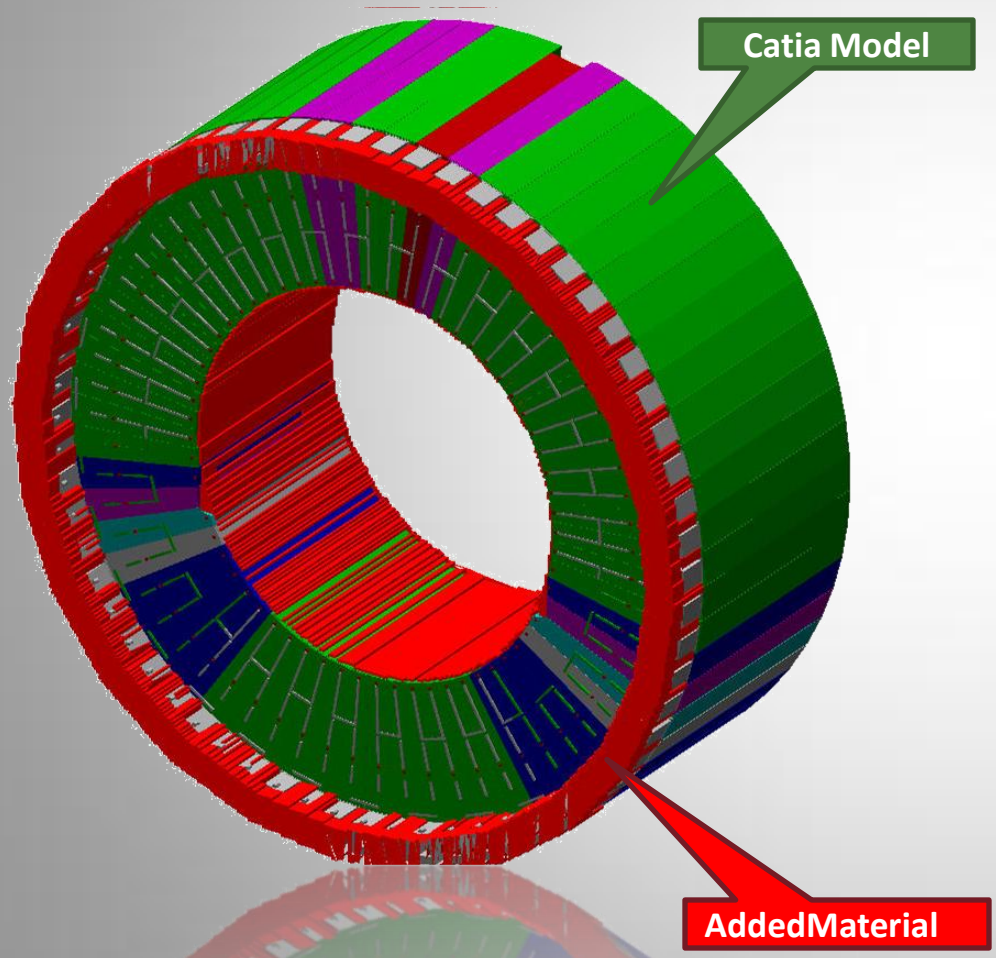
RemovedMaterial = Catia - Geant4

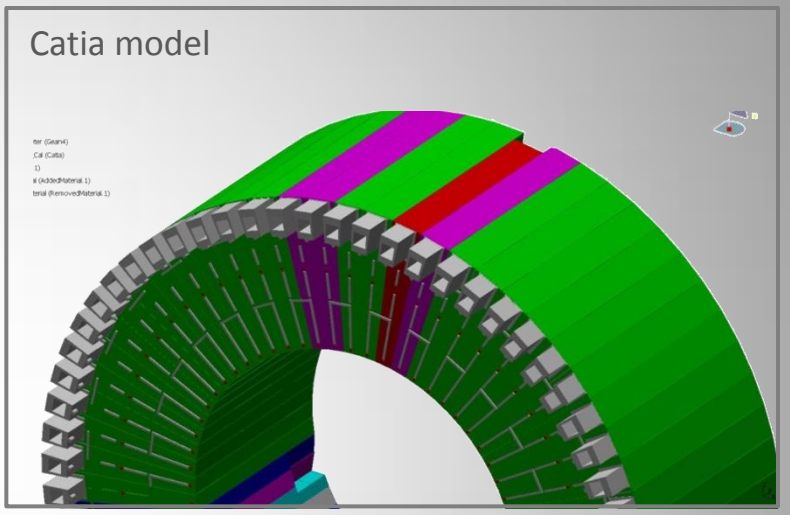


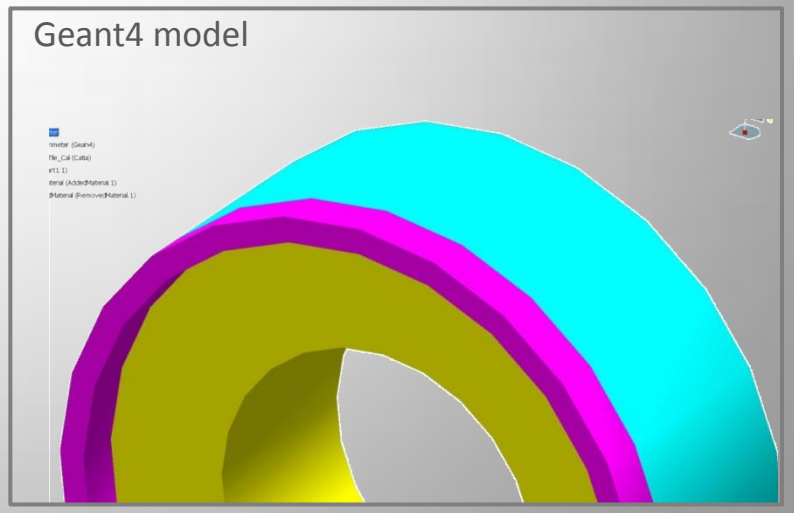
Volume:
Catia model -104.432m3
Geant4 model - 99.303m3
Difference - 5.129 m3

Mass:
Catia model - 820.837T
Geant4 model - 780.519T
Difference - 40.318T

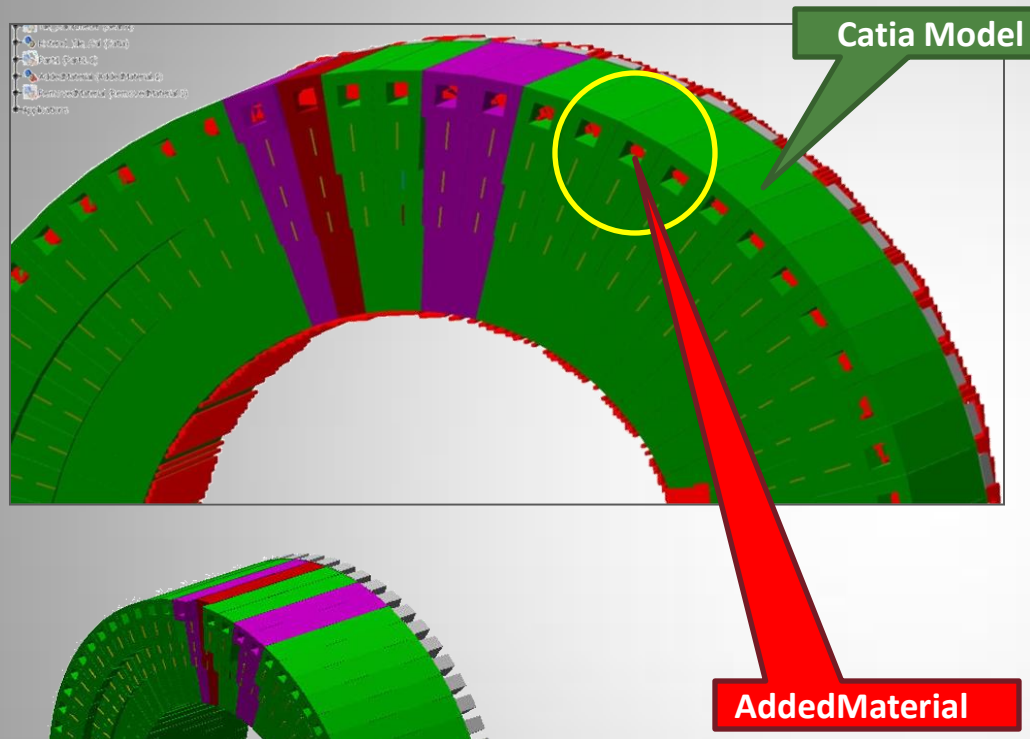
Compare Atlas CATIA geometry and CavernBkg Geant4 geometry (Extend Tile Calorimeter)

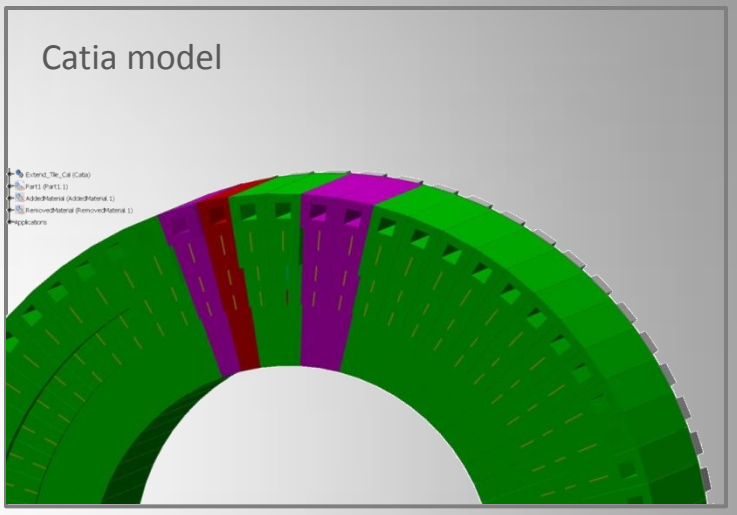


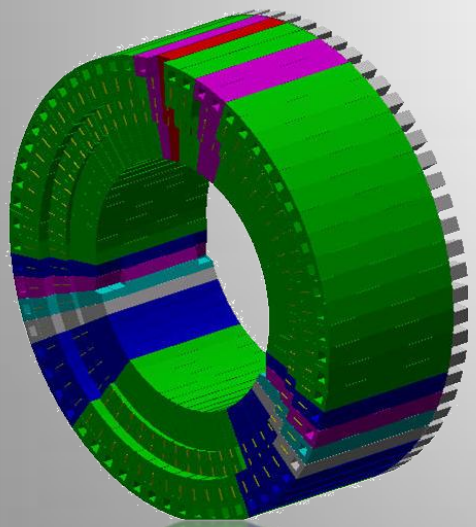


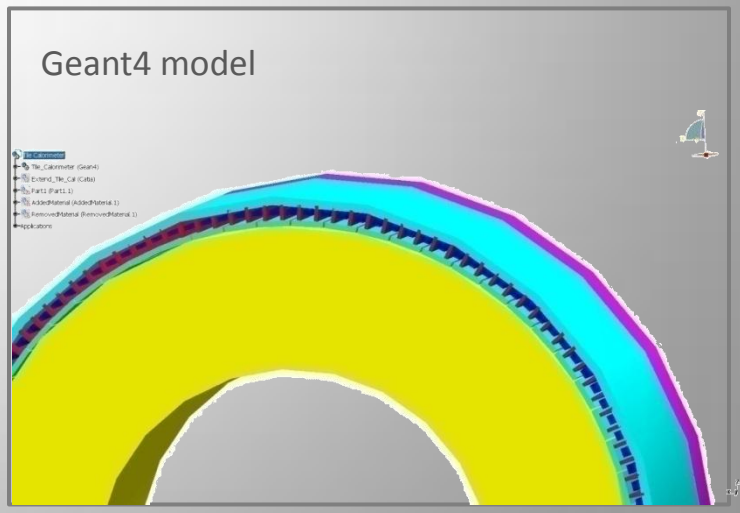


Compare Atlas CATIA geometry and CavernBkg Geant4 geometry (Extend Tile Calorimeter)

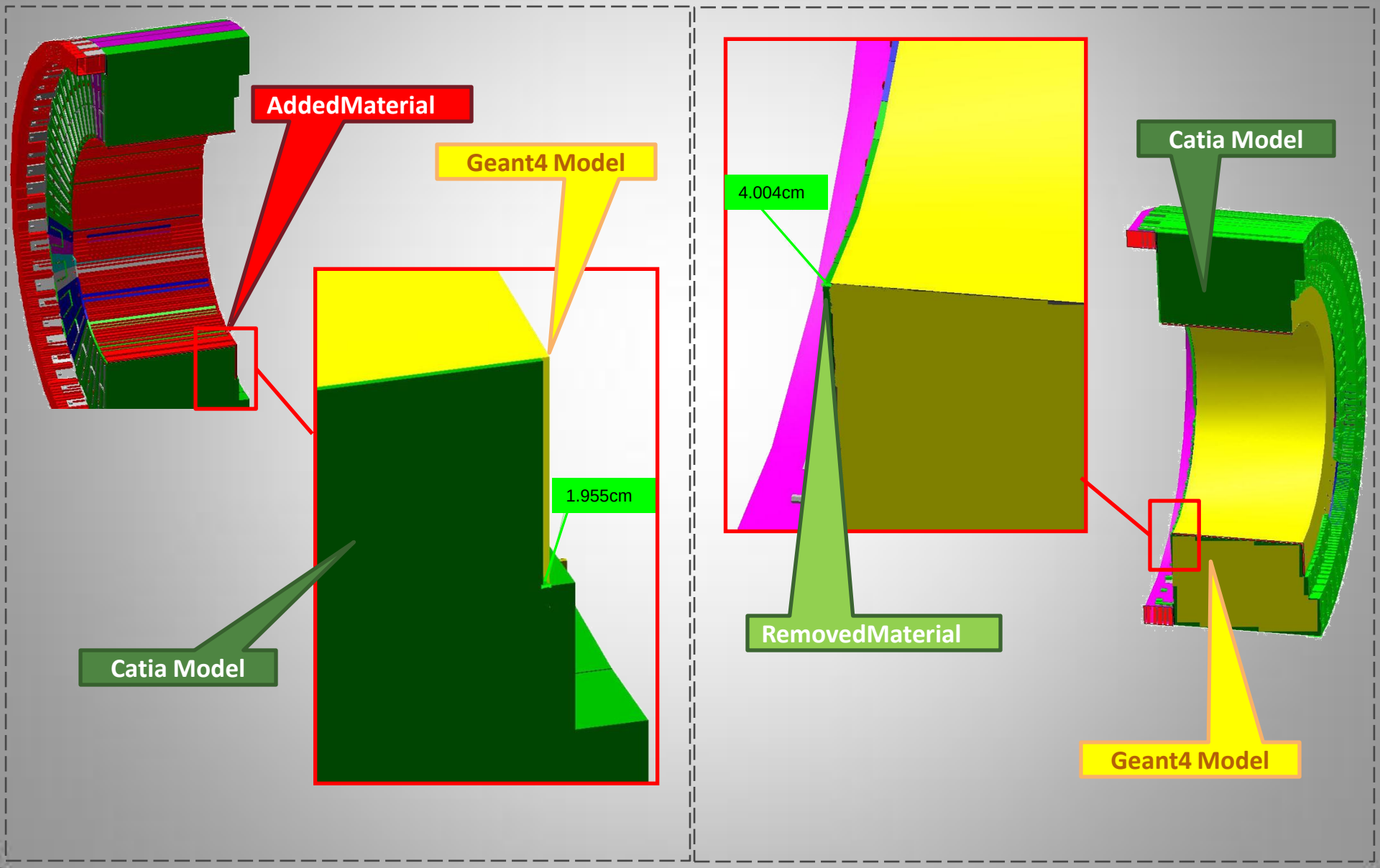




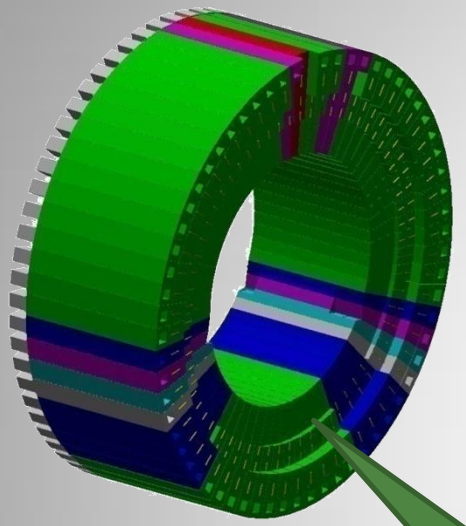




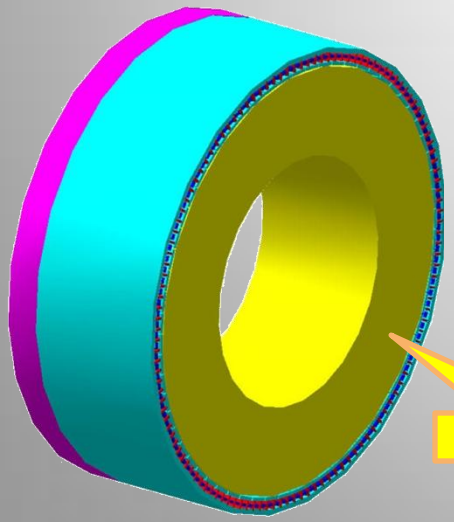
Compare Atlas CATIA geometry and CavernBkg Geant4 geometry (Extend Tile Calorimeter)



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



Catia Model



Geant4 Model