ILD Magnet & Calorimeters Integration

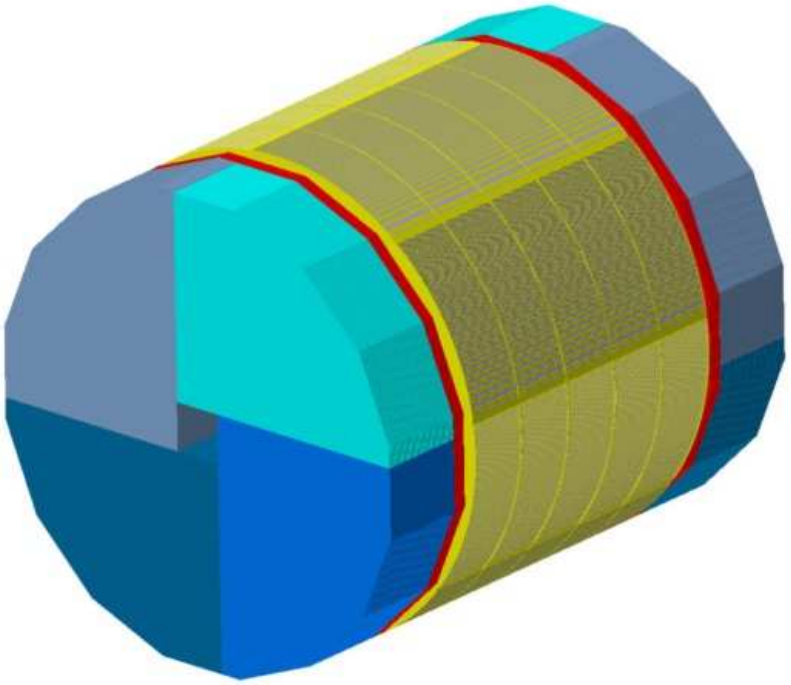
DHCAL Barrel and Endcaps

Design, Integration & Services

J.C Ianigro

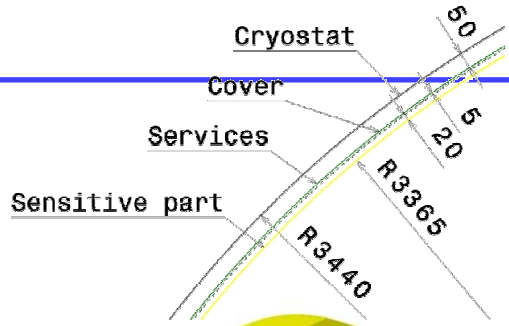
- IPN Lyon -

- Barrel design
- Endcaps design
- Services
- Perspectives



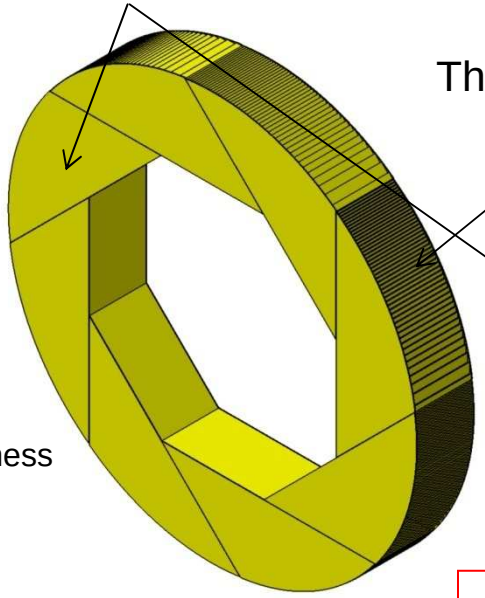
Barrel design

Ext. Diameter	6770 mm
Int. Diameter	4116 mm
Lenght	4700 mm

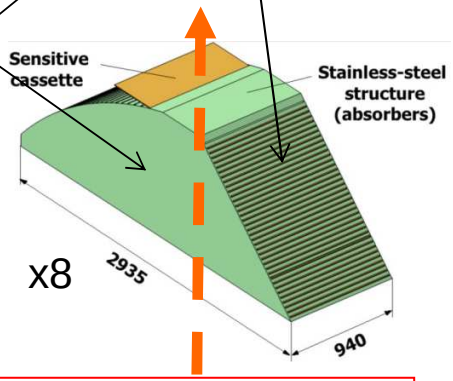


Thickness wheel face = 10 mm

Thickness absorbers= 15 mm

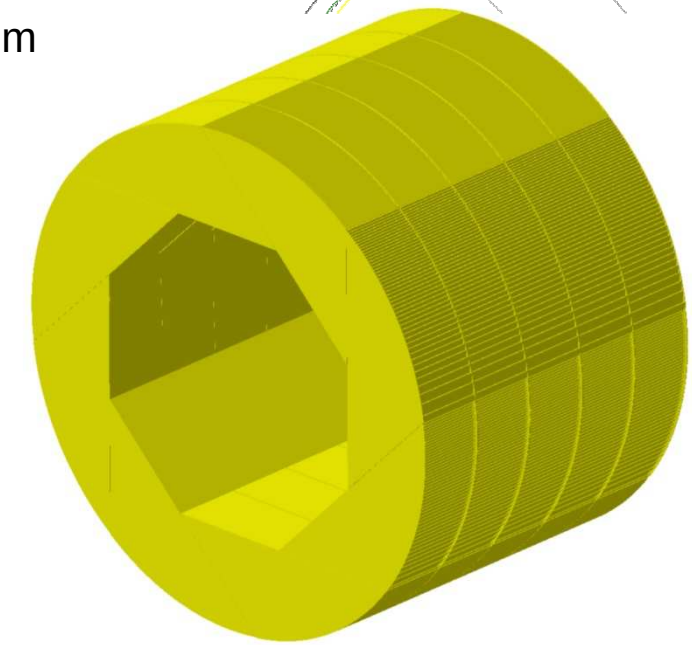


Wheel Thickness
940 mm



x8

46 sensitives layers

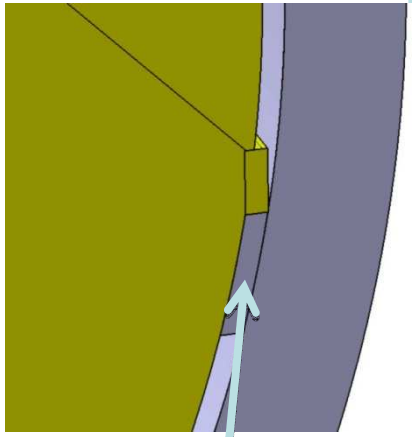


Stainless steel	1 wheel (8 mod.)	5 wheels
Weight (t):	88 t	440 t
Detectors W. (t):	36.8 t	184 t
Total Weight (t) :	124.8 t	**624 t**

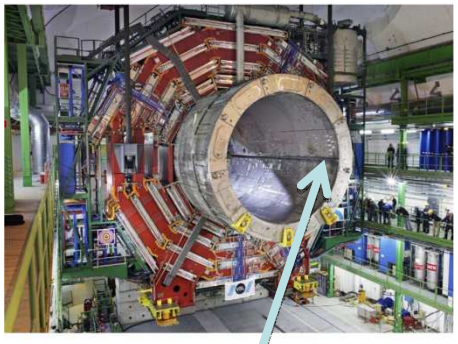
Barrel design

Barrel supports in the cryostat

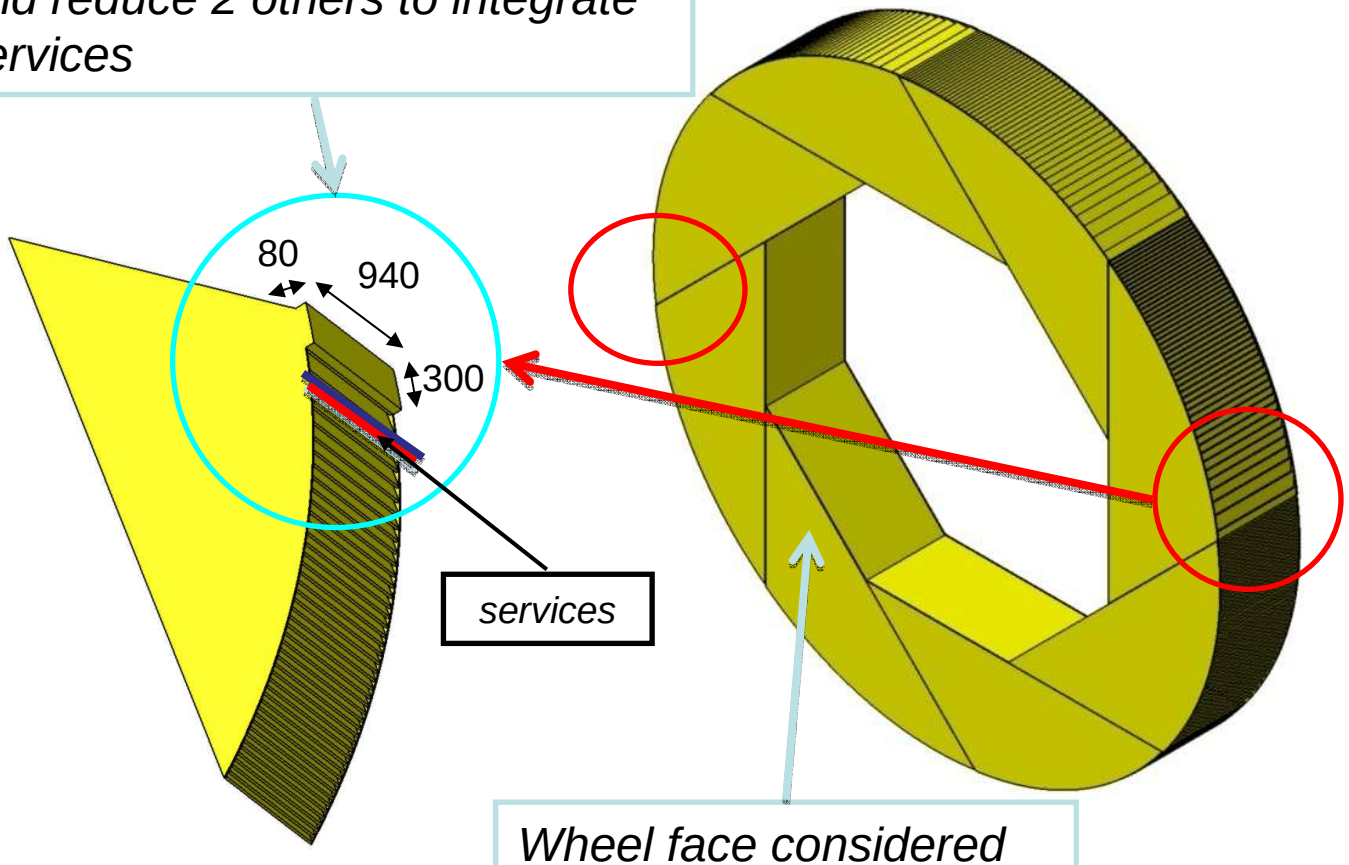
Need to get out 2 small cassettes and reduce 2 others to integrate services



Cryostat rails x 2



CMS Cryostat rails

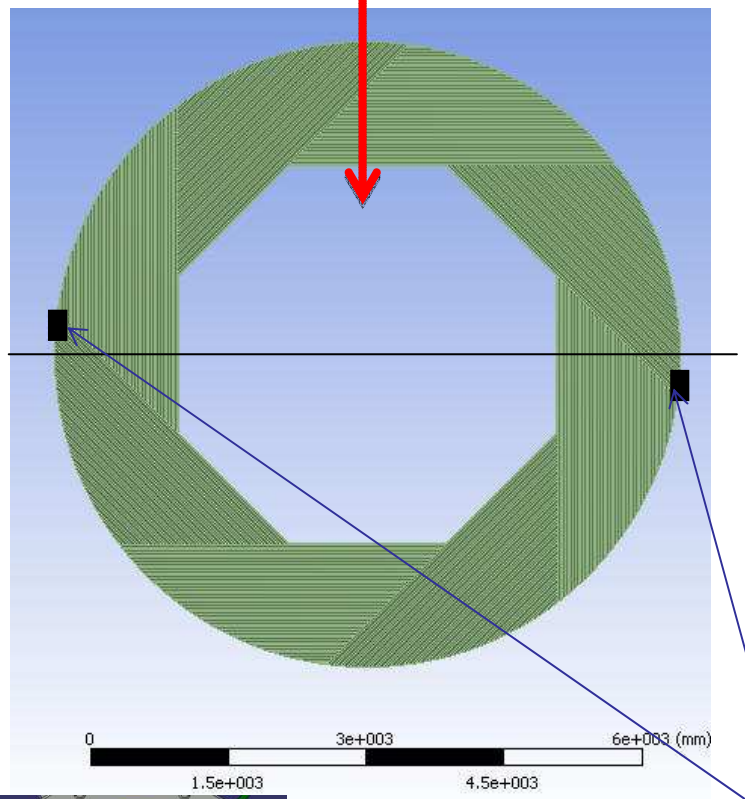


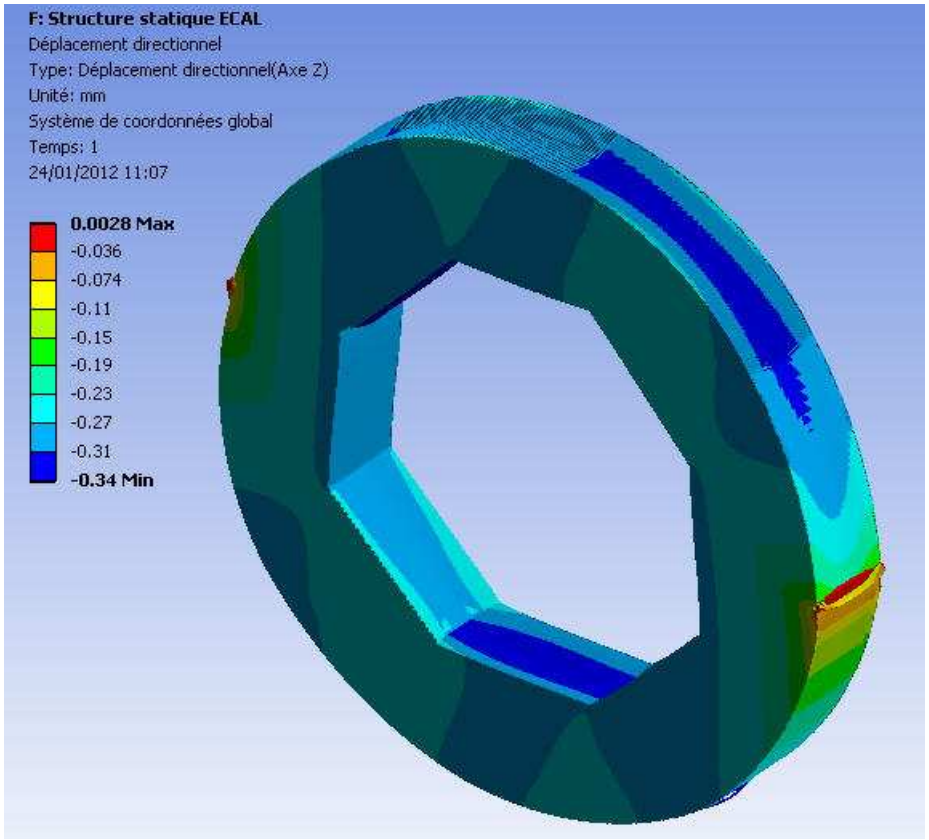
Wheel face considered as one disk 10 mm thick

Modification 2 modules to support on rails

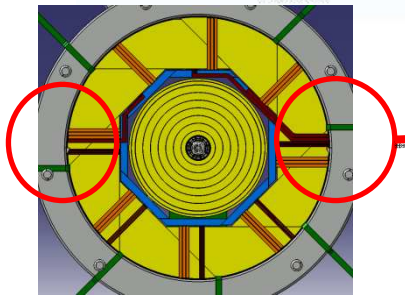
Barrel design – Support in cryostat

Gravity and Detectors mass





Directionnal deformation axis Z (// gravity) (mm)



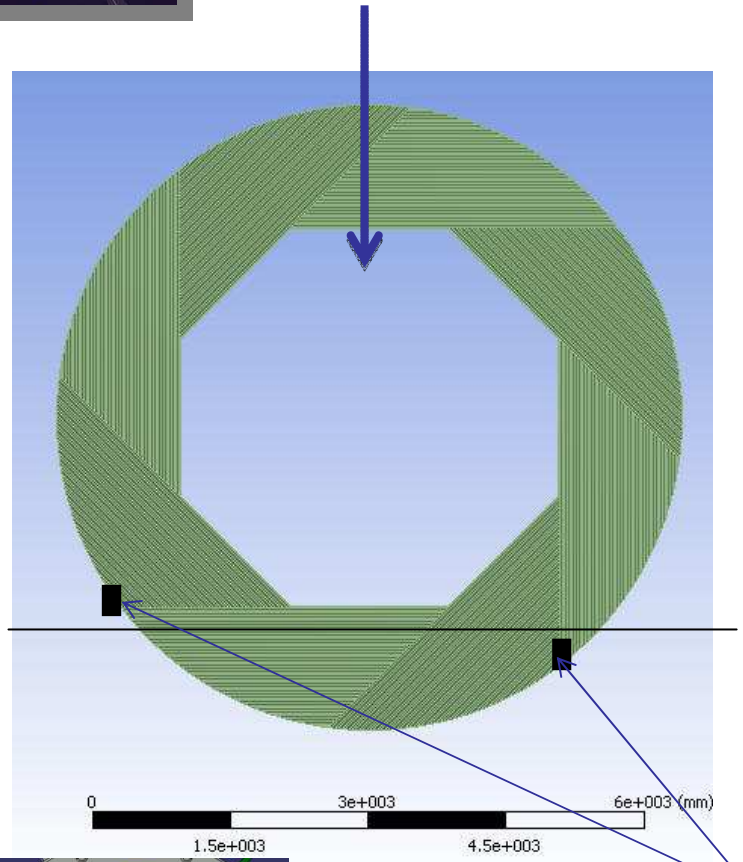
Disymmetrical supports 9-15 H

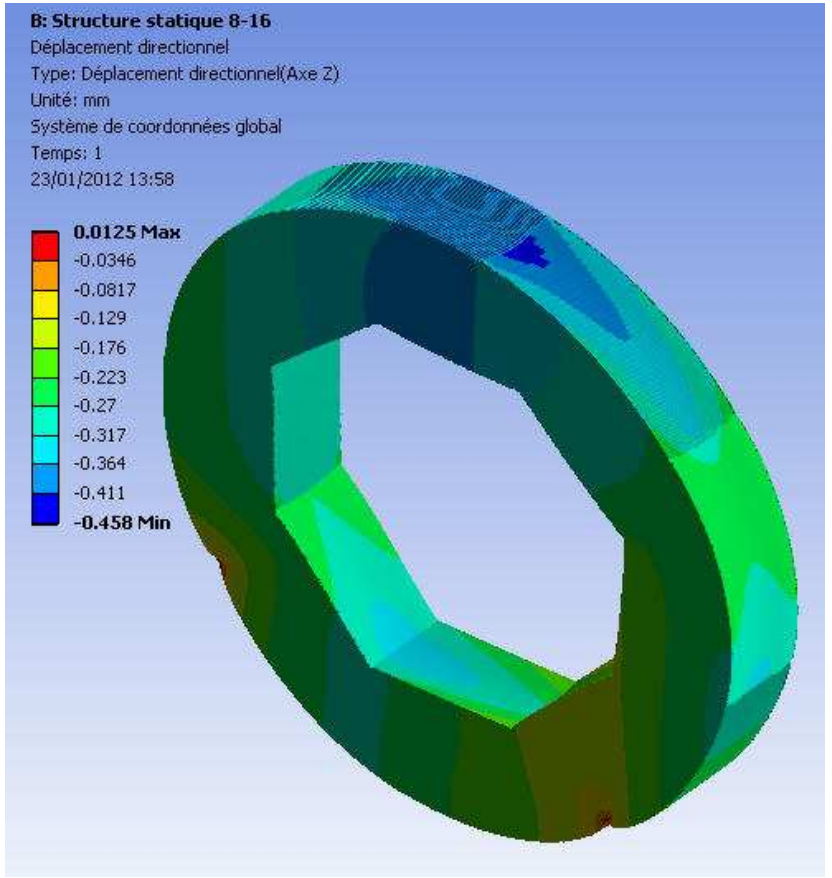
Von mises stress around 100 MPa near supports

Max deformation : 0.34 mm for position around 9-15H

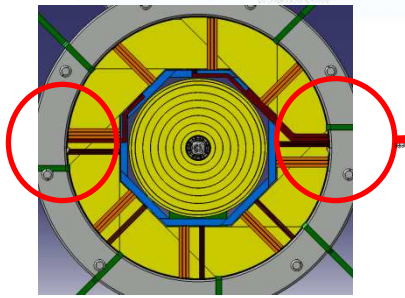
Barrel design - Support in cryostat

Gravity and Detectors mass





Directionnal deformation axis Z (// gravity) (mm)

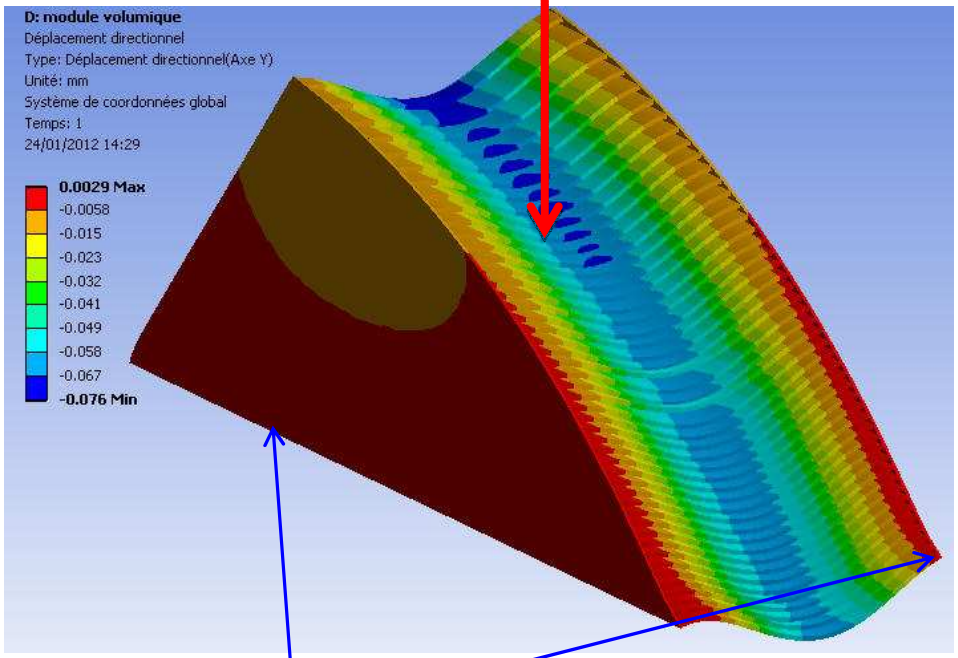


Disymmetrical supports 8-16H

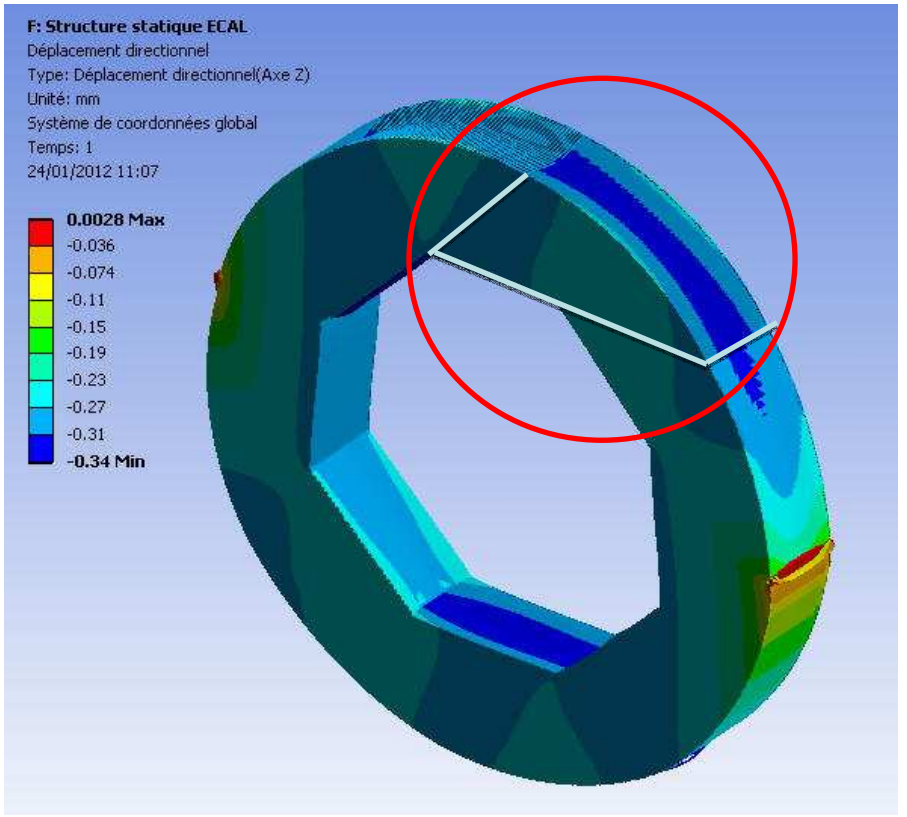
Max deformation : 0.45 mm for position around 8-16H

Barrel design – Absorbers deformation

Gravity and 46 Detectors mass



symmetrical supports



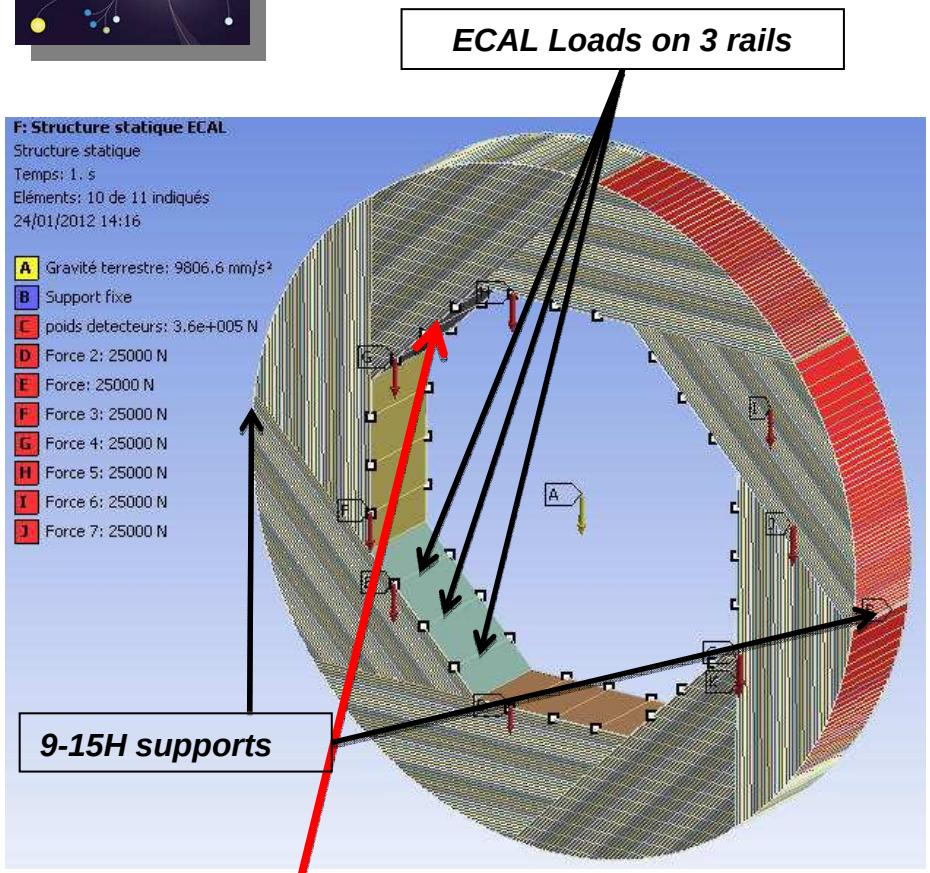
Directionnal deformation axis Z (// gravity) (mm)

Wheel Max deformation : 0.34 mm – 0.09 mm relative zone

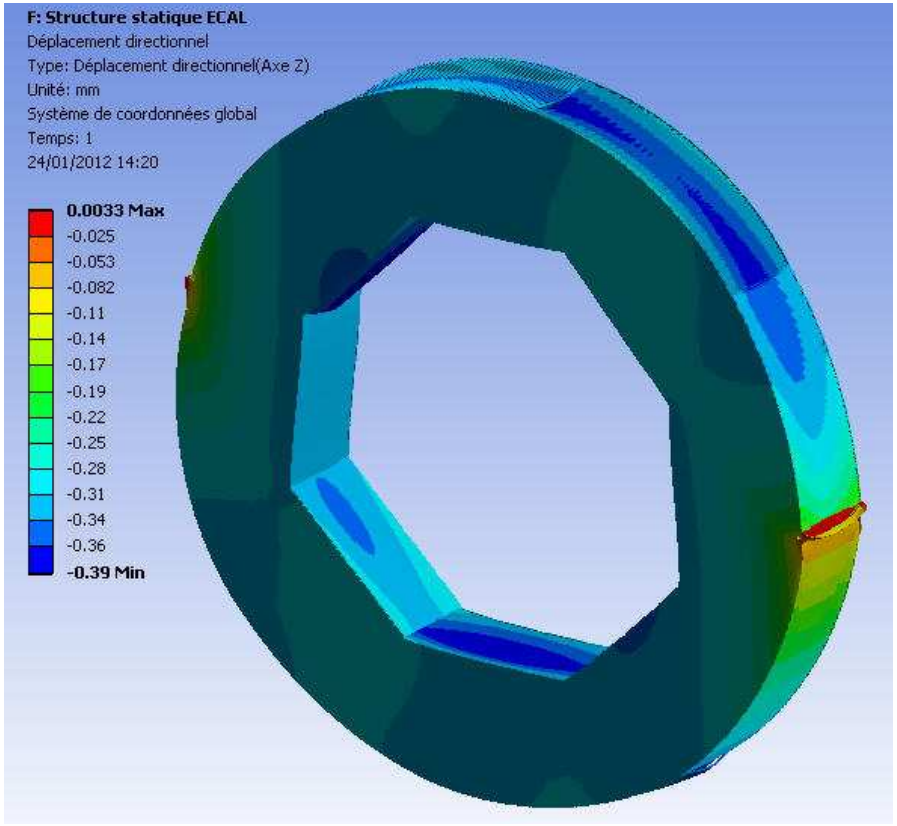
Module Max deformation : 0.07 mm

Vision of the influence of absorbers deformation

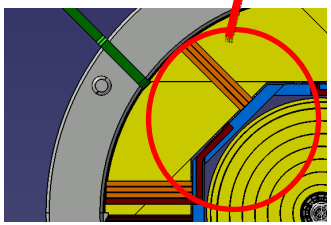
Barrel design ECAL impact



DHCAL with 8 x ECAL modules (8x2.5 t)

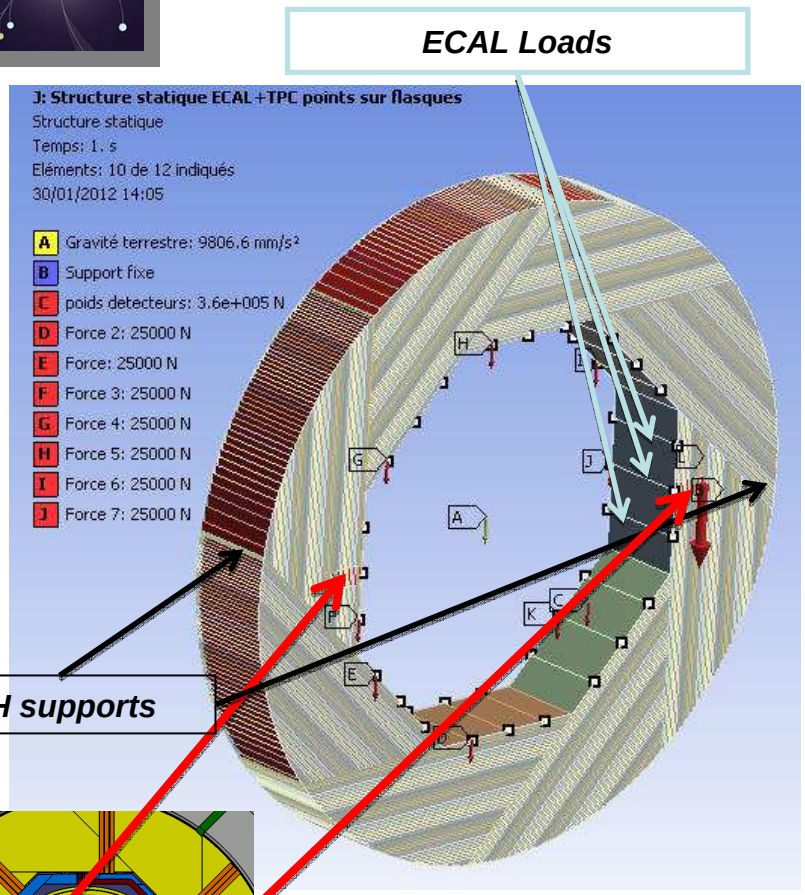


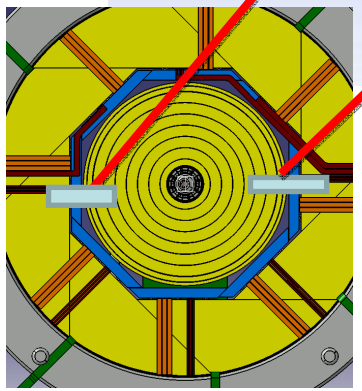
Directionnal deformation axis Z (// gravity) (mm)



Deformation DHCAL + ECAL : +0.05 mm % DHCAL alone

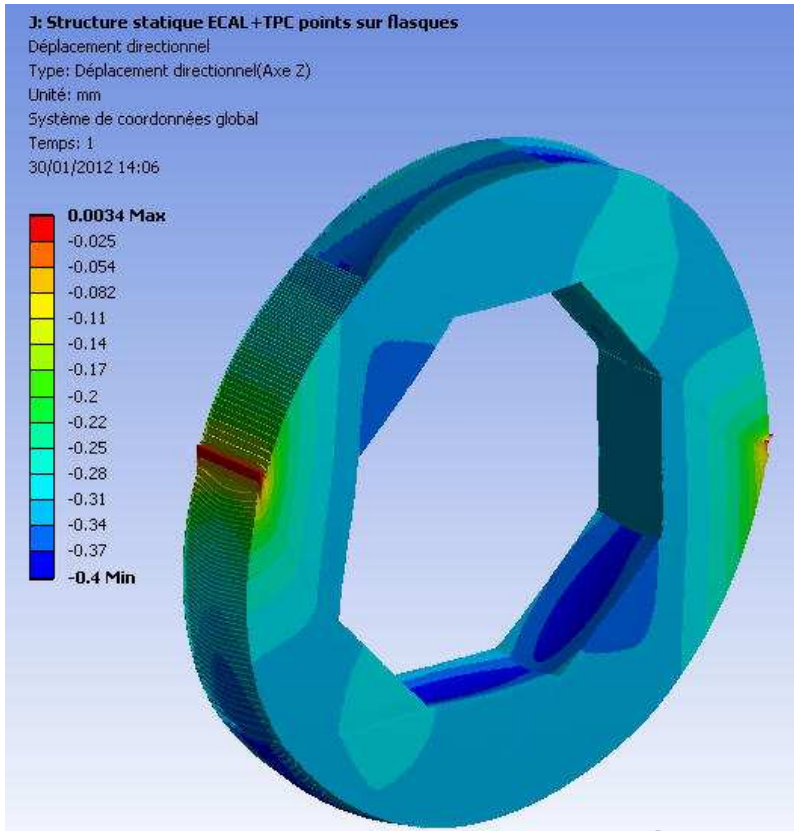
Barrel design ECAL + TPC impact





DHCAL with 8 x ECAL modules (8x2.5 t)

And TPC (4t)



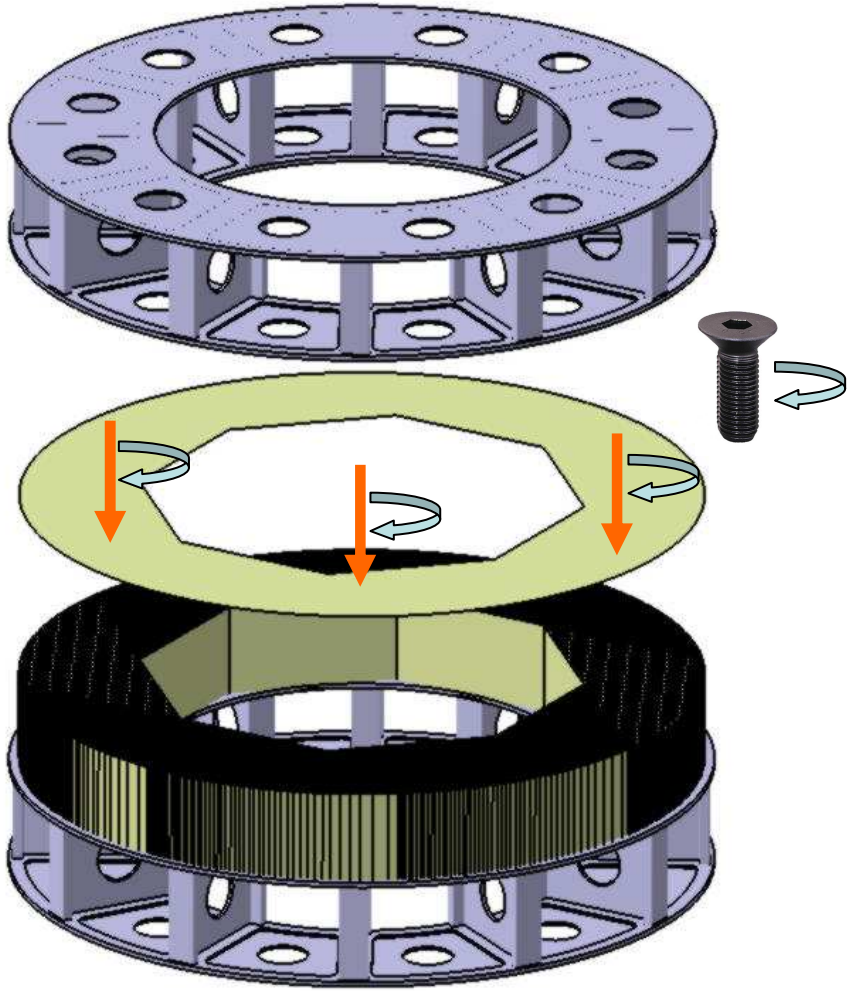
Directionnal deformation axis Z (// gravity) (mm)

Deformation DHCAL + ECAL + TPC: +0.06 mm % DHCAL alone

- Barrel Building: Wheel by wheel

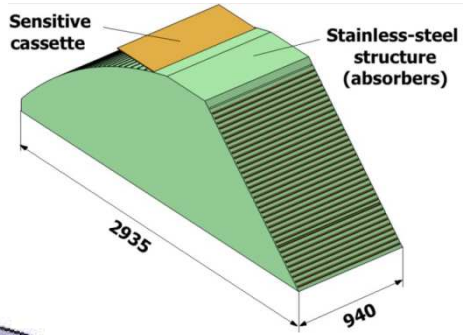
Scenario 1: Screwing method

- 1 wheel side put on a structure
- Screwing of absorbers as m3 prototype (Ciemat)
- 1 wheel screwed on the assembly



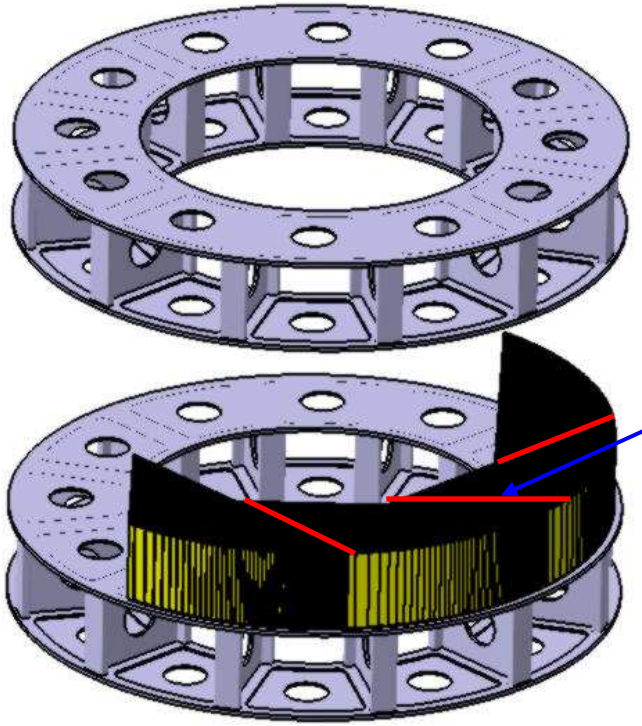
Barrel design : Building & detectors integration

- Barrel Building : wheel by wheel



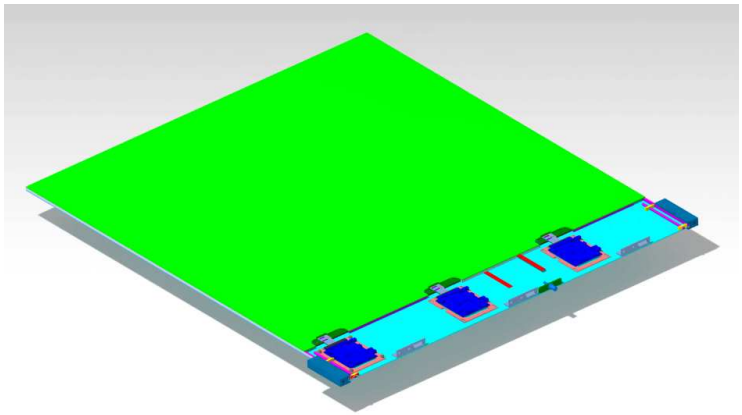
Scenario 2 : Welding Method

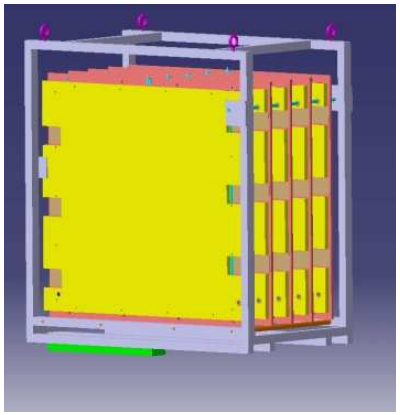
- 8 Modules assembling for making a wheel on specific structure
- Welding of one side to make a wheel
- Turning with tool to do the other side



Barrel design : sensitive layers integration

- Cassettes integration in the barrel





-Wheels put one by one on the structure

-Detectors come in specific structure

-Insertion vertically around barrel in the same line of every 5 wheels

-Rotation one step

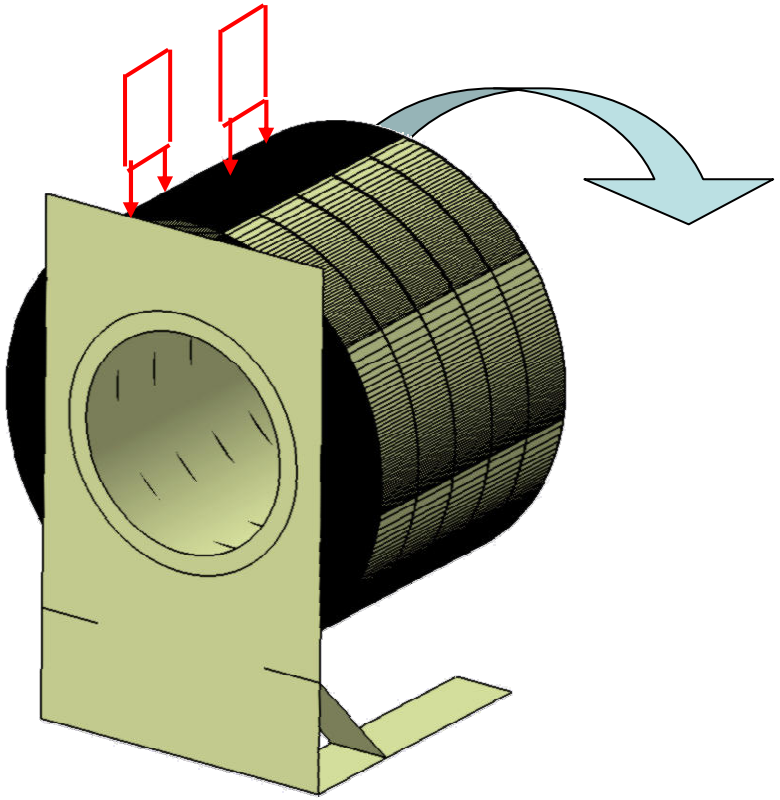
Size :

Lenght : from 150 to 3500 mm

Width : 940 mm

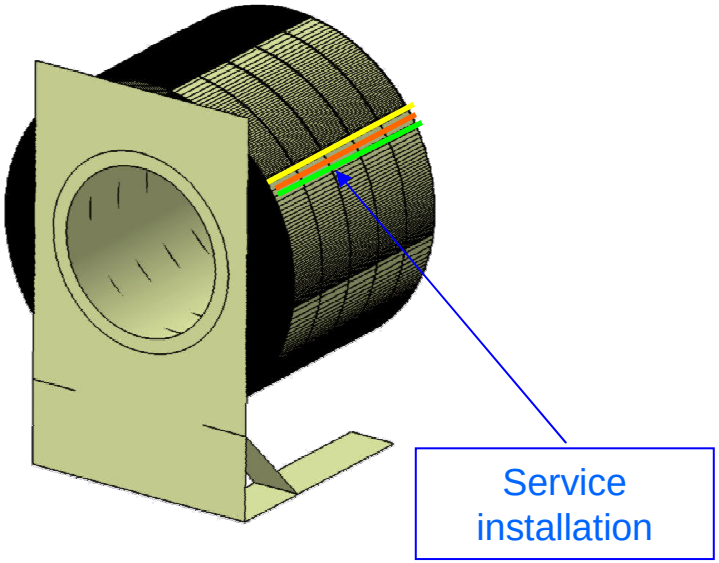
Thickness : 11 mm

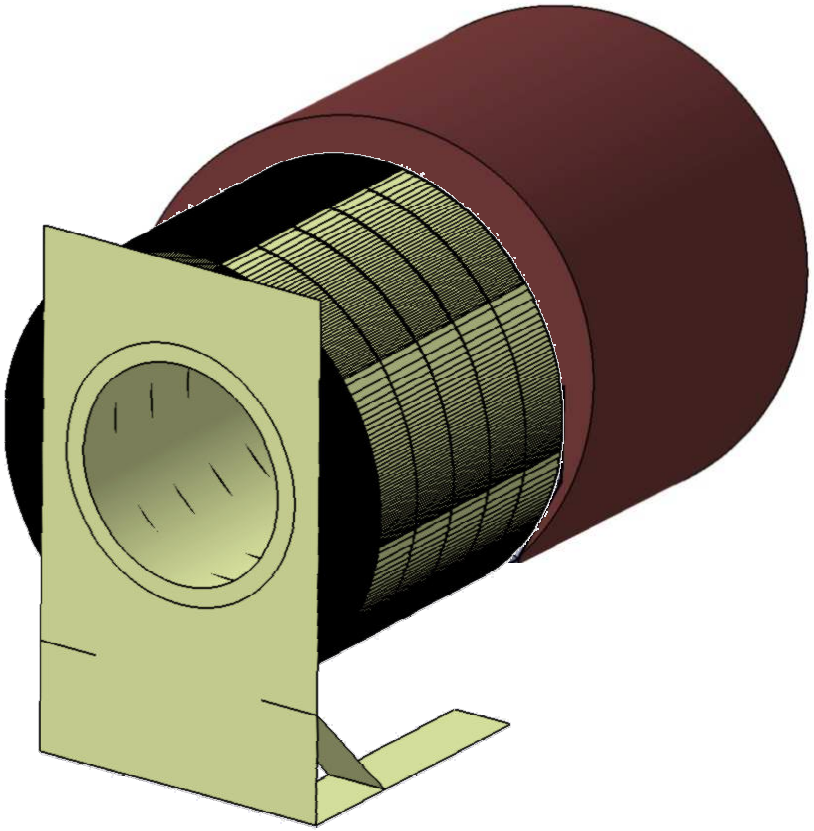
Weight : 55 kg for 1m2



Barrel design : ILD integration

- Barrel with 5 wheels into the ILD





-Wheels are linked together

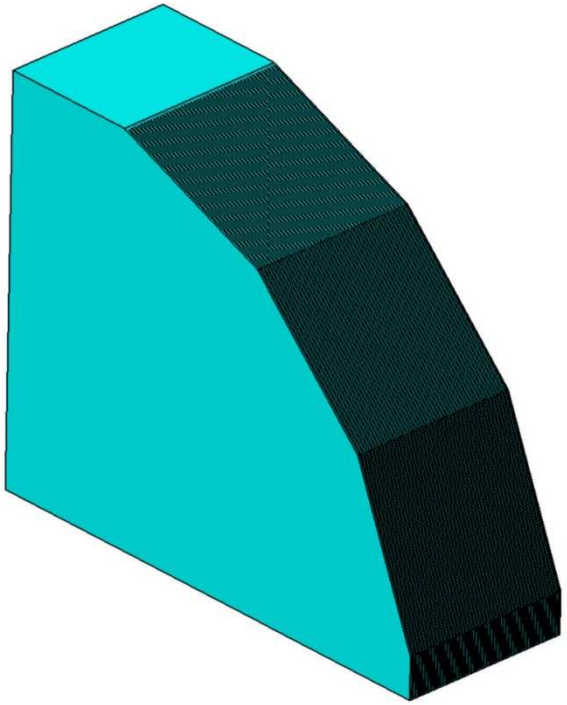
-Services installed then and connected between wheels

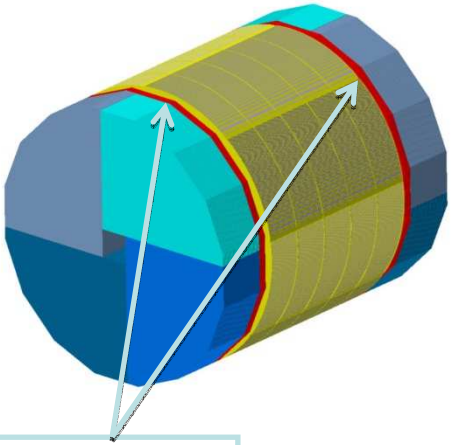
-Barrel ready to be connected put in front of the coil

-Insertion on the rails with tool

End caps design

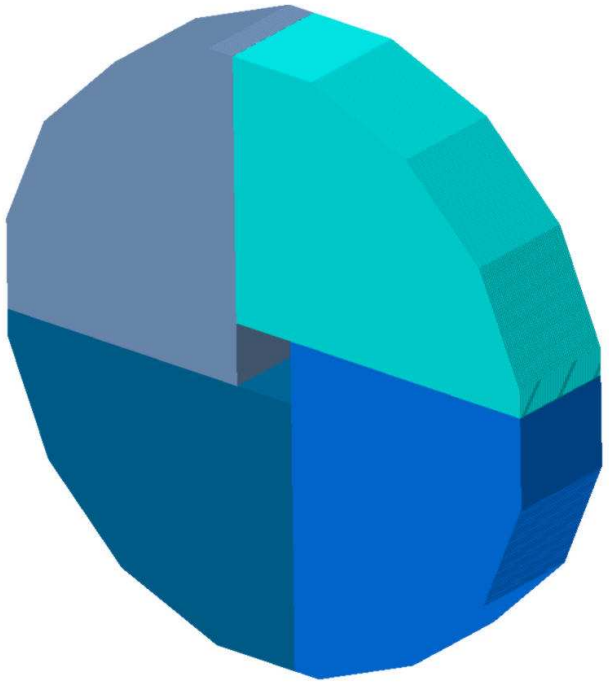
- Endcap





2 endcaps

Material : stainless steel



16 sides - 48 detectors

Screwing or welded assembly as barrel ?

One modulus

Module Weight : 50 t

Detectors weight : 22.5 t

Total weight : 72.5 t

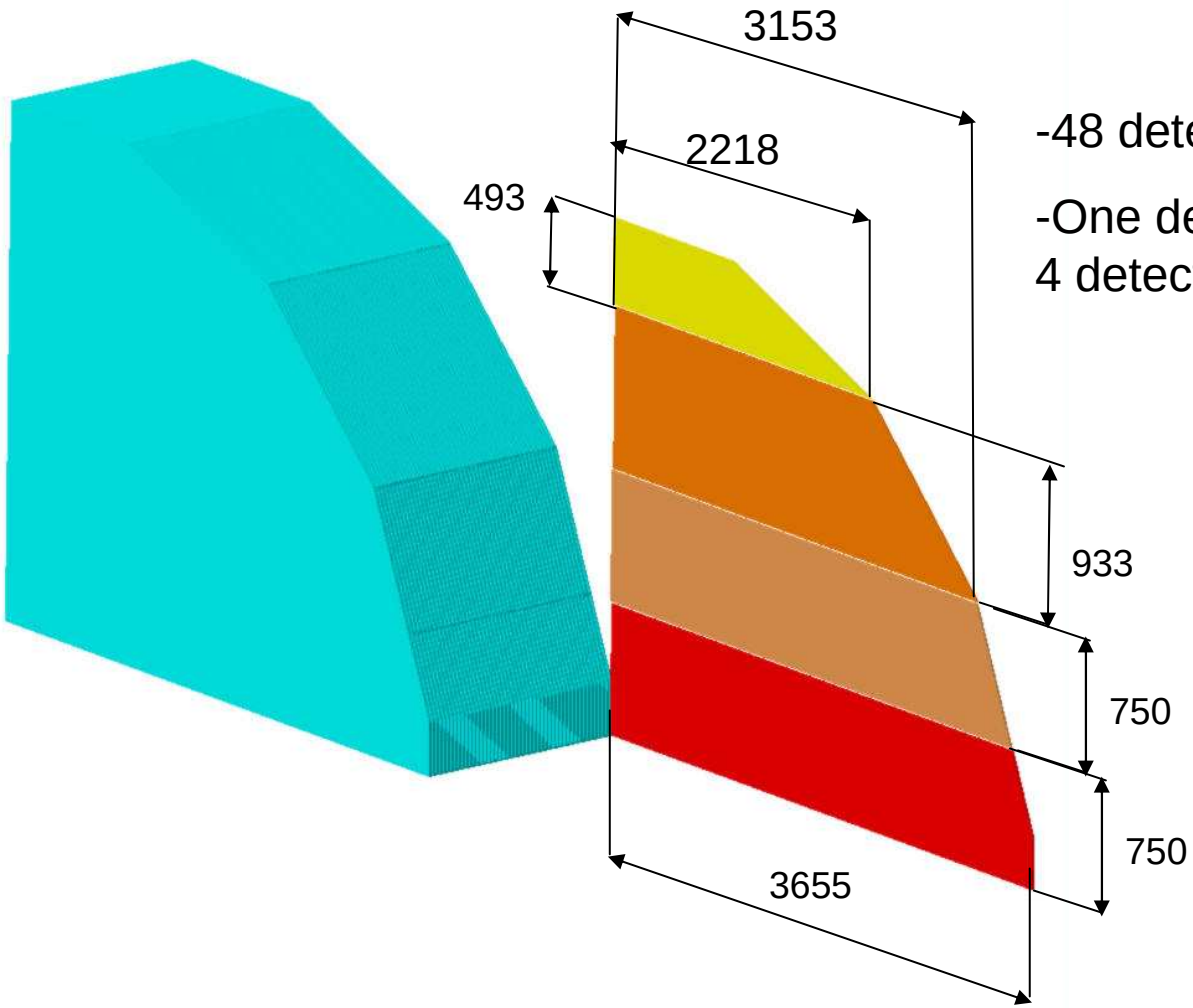
One endcap made of 4 modulus

Endcap Weight : 200 t

Detectors weight : 90 t

Total weight : 290 t

- One module composition



-48 detection planes

-One detection plane consisted of 4 detectors

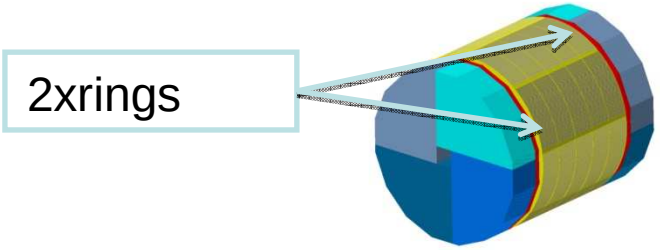
GRPC plane : S = 8.5 m²

192 detectors

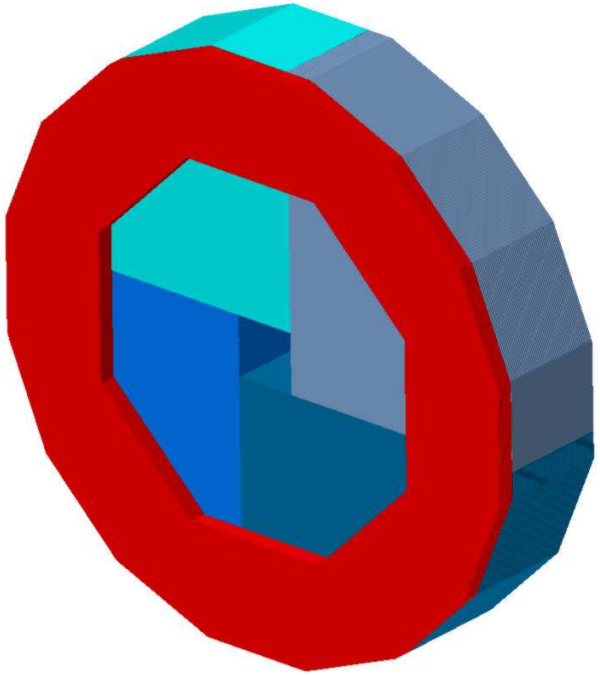
P = 467.5 Kg

P/module = 22.5 t

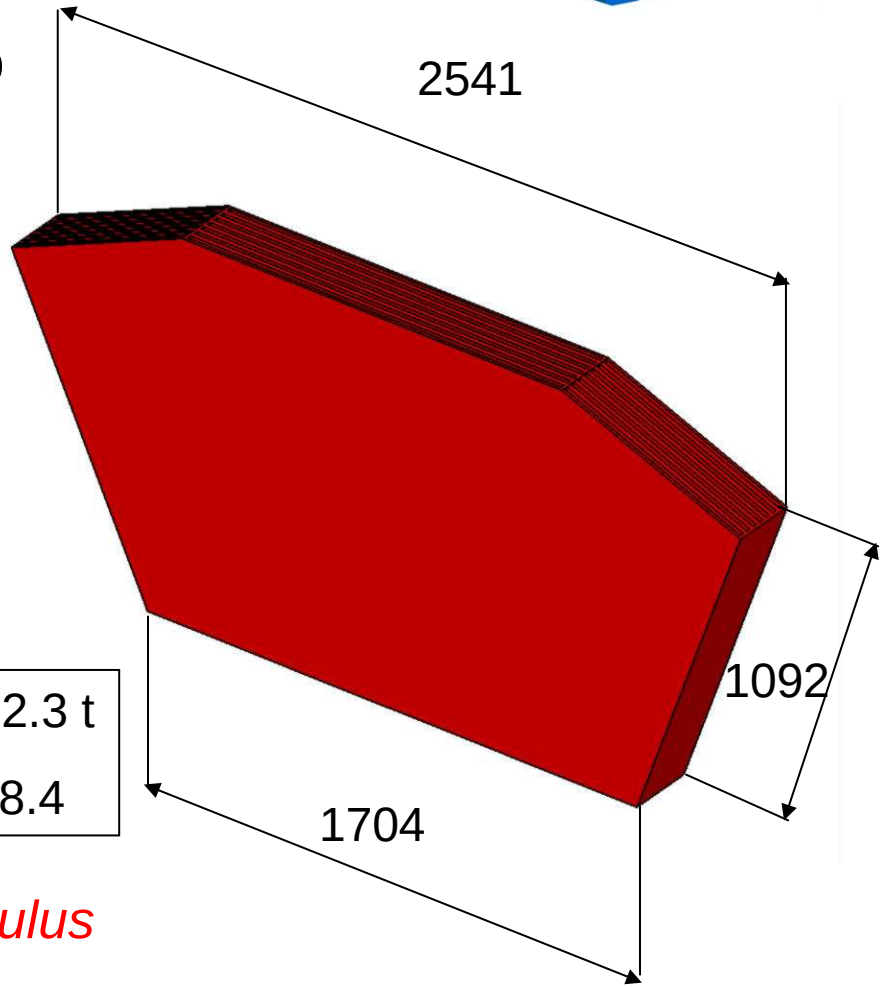
- Ring between barrel and endcap



  - Placed around the ECAL endcap



8 modulus

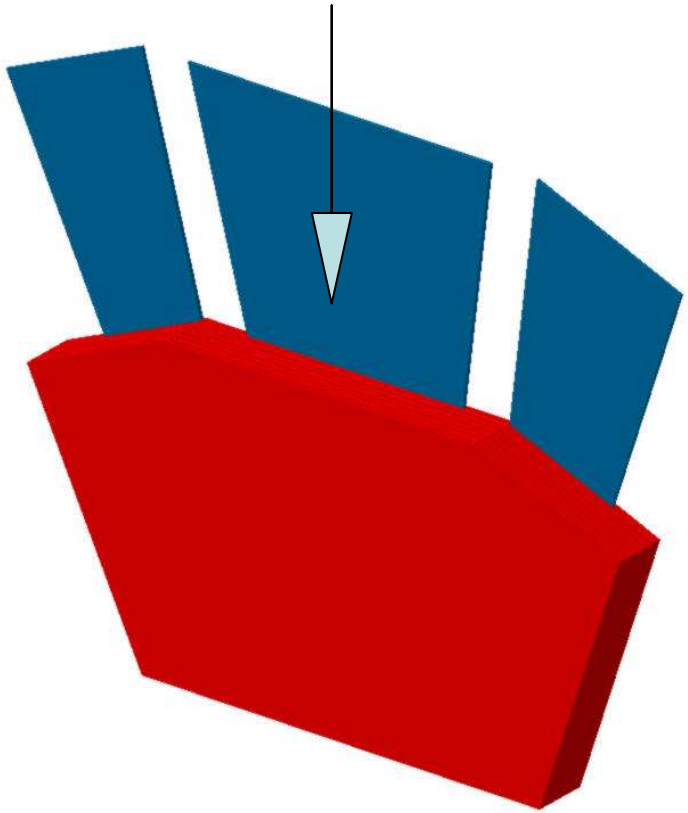


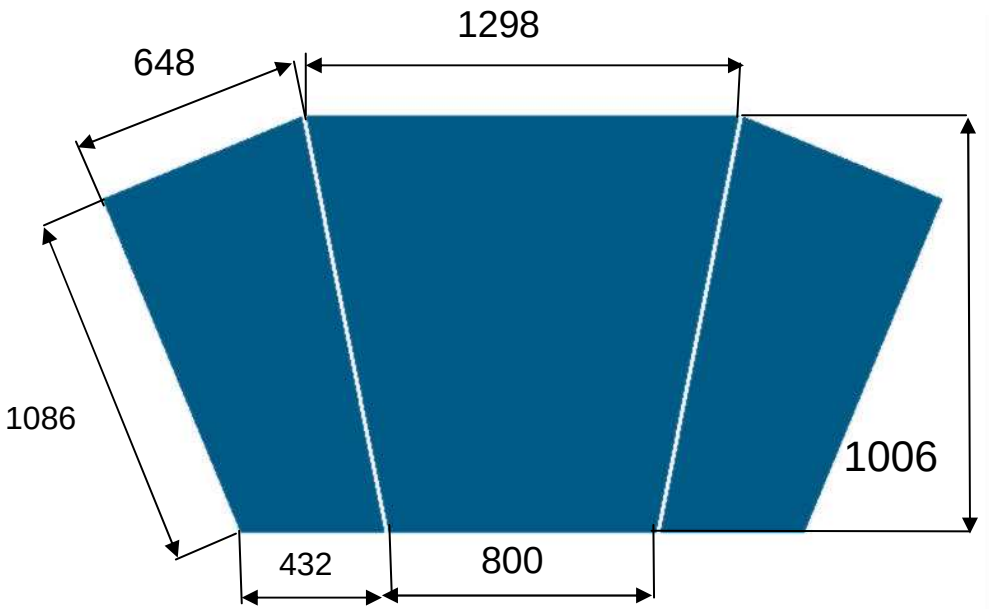
Module weight = 2.3 t

Ring weight = 18.4

Ring fixed on the endcap modulus by modulus

- Ring between barrel and endcap
  - 7 GRPC planes by modules ⇨ 21/modules ⇨ 168 /ring



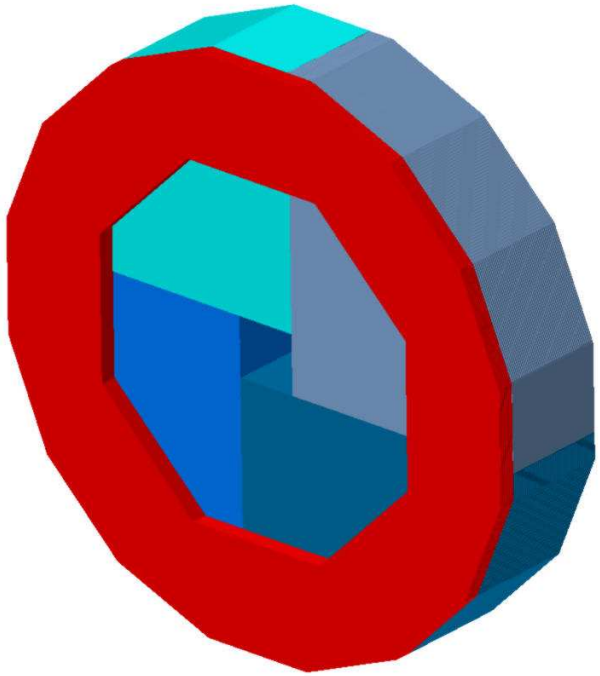


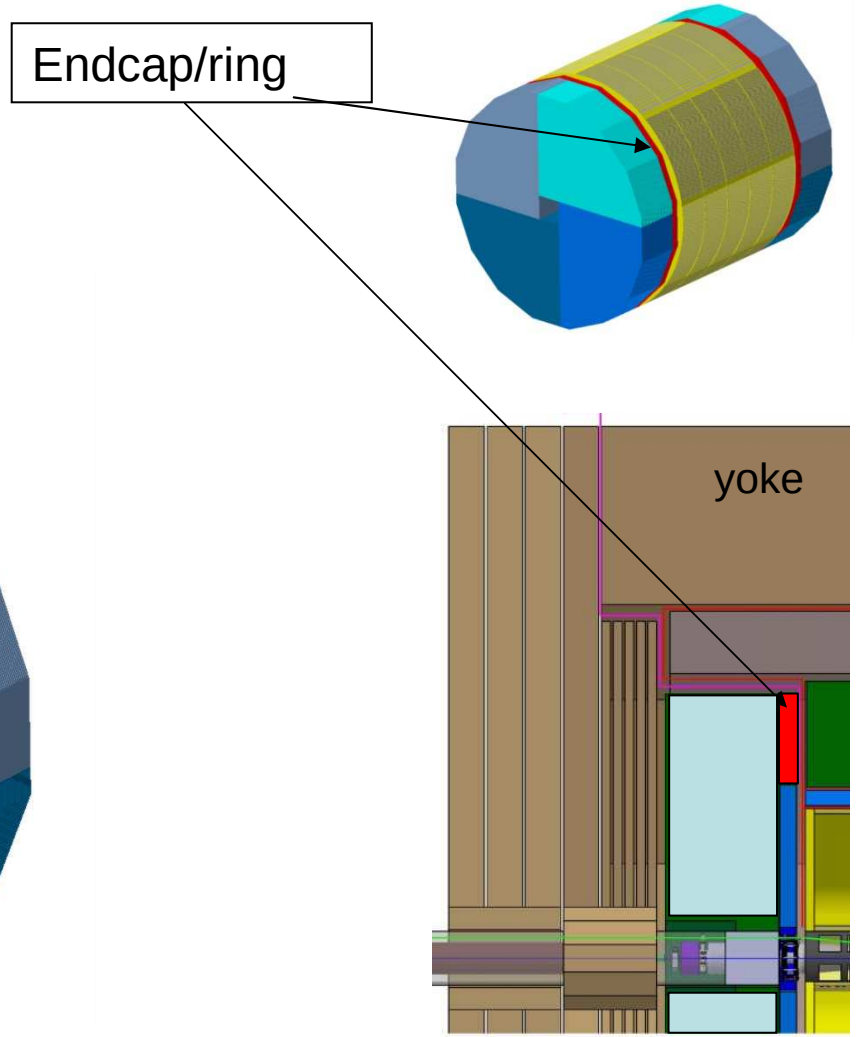
GRPC : S = 2.55 m² P = 140 Kg

P/module = 980 Kg

End caps design

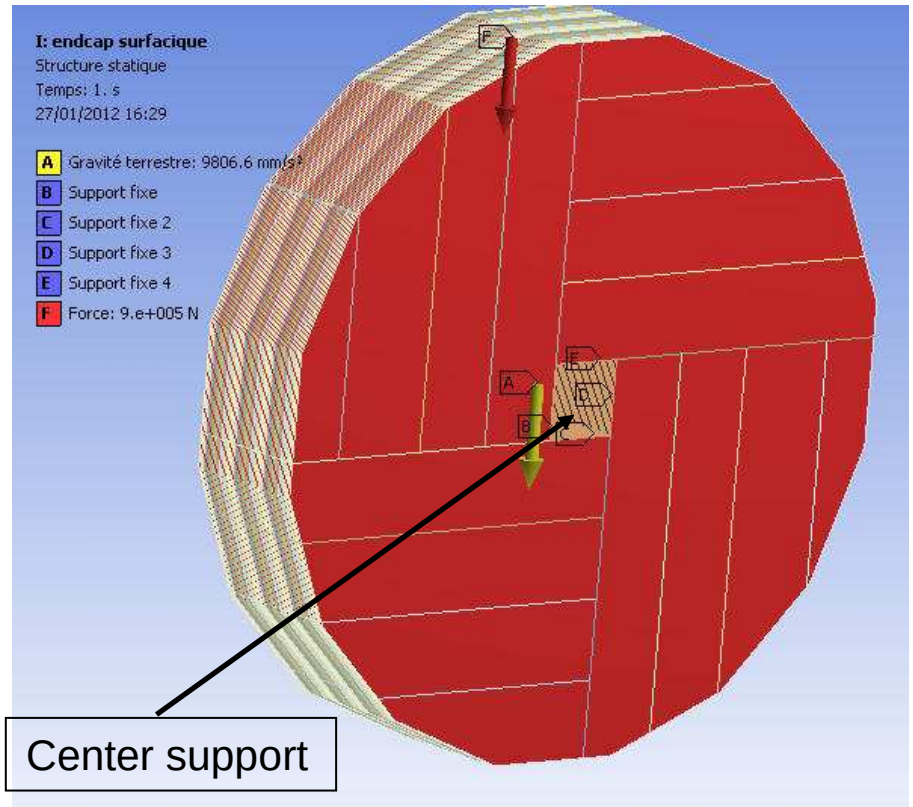
- Ring / Endcap linked
  - Endcap/Ring is linked to ?



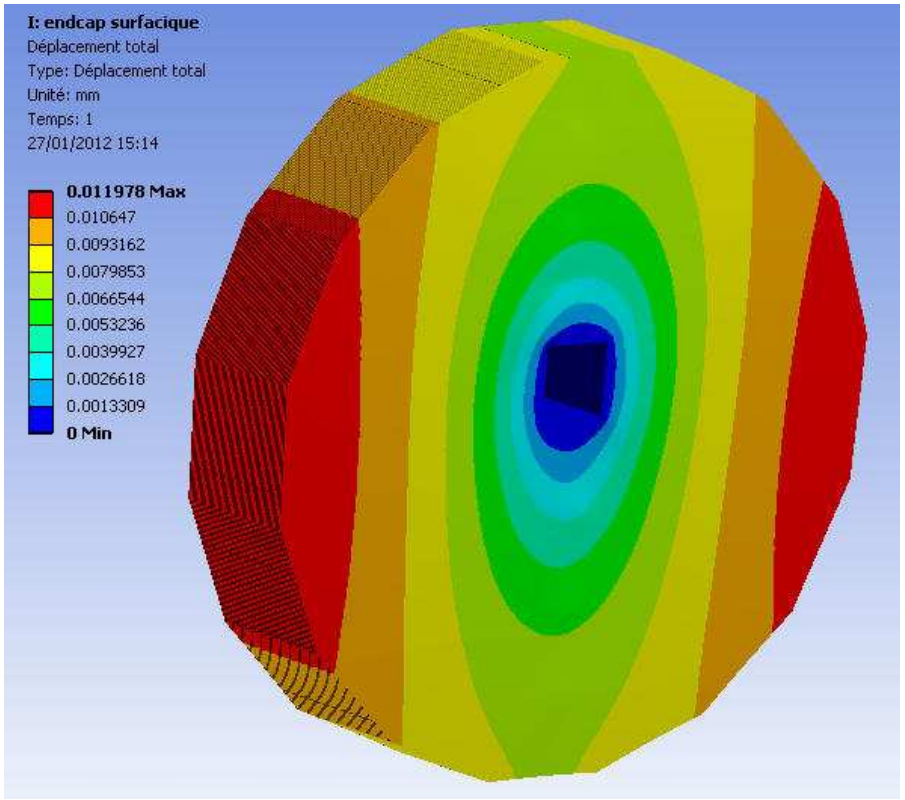


Ring (18.4 + 8) + Barrel endcap (290) = 316.4 t

- Endcap deformation
  - Fixed by center tube (no magnetic field)



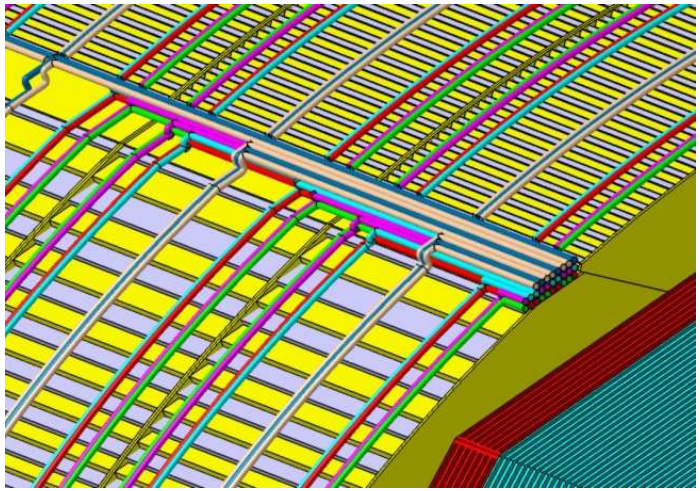
Gravity and Detectors mass

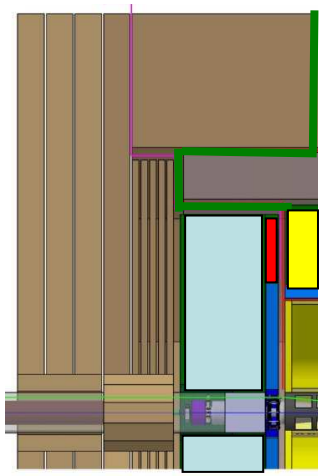


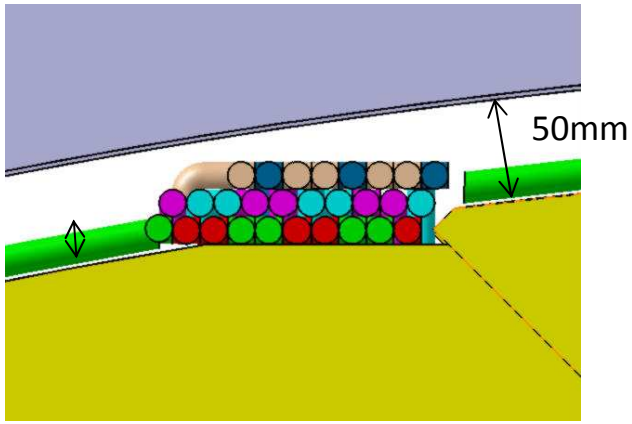
Max deformation : 0.01 mm

Barrel Services

Services : Barrel







- Cooling for Dif : Blue / Red

  2 loops by module
  Ø14 for principal
  Ø4 for distribution alternative

- Gaz For GRPC : green / pink

  2 loops by module
  Ø14 for principal
  Ø4 for distribution alternative

- High Tension : Brown

  Ø14 for supply

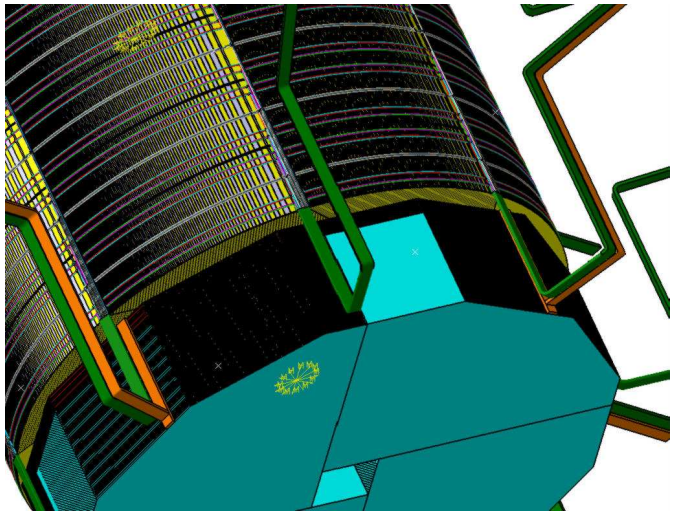
- Data acquisition : Beige

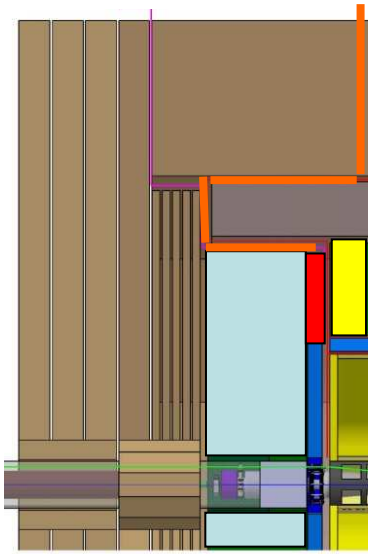
  Ø14 for collecting

Issues : 8 zones 170 x 50

Endcaps Services

- Services : Endcap+ring





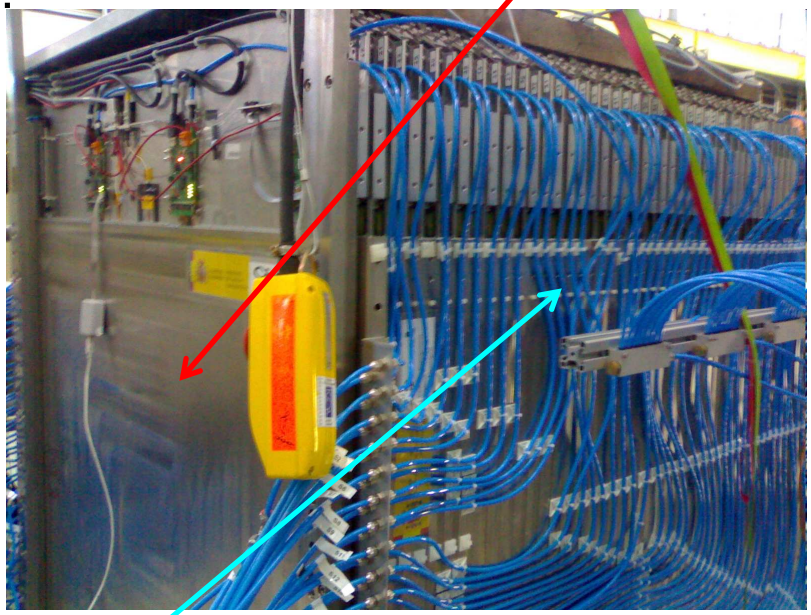
- Cooling for Dif :
  - 2 loops by GRPC
  - 14 for principal
  - Ø4 for distribution alternative
- Gaz For GRPC :
  - 2 loops by GRPC
  - Ø14 for principal
  - Ø4 for distribution alternative
- High Tension :
  - Ø14 for supply
- Data acquisition :
  - Ø14 for collecting

Issues : 4 tubes outing 150 x 50

ILD mechanical structure. Perspectives

- Simulations have to be done in this configuration
  - Endcaps deformation with magnetic field
  - Yoke deformation with DHCAL endcap weight
  - Coil deformation = AHCAL study ?
  - Support structure for introduction
  - Thermal studies

- Design evolution
  - Interfaces optimization
  - Mechanical tool for insertion
  - Services optimization
  - Modification after M³ tests



M3 prototype