TEDD MECHANICAL SIMULATIONS

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CMS Tracker Upgrade France

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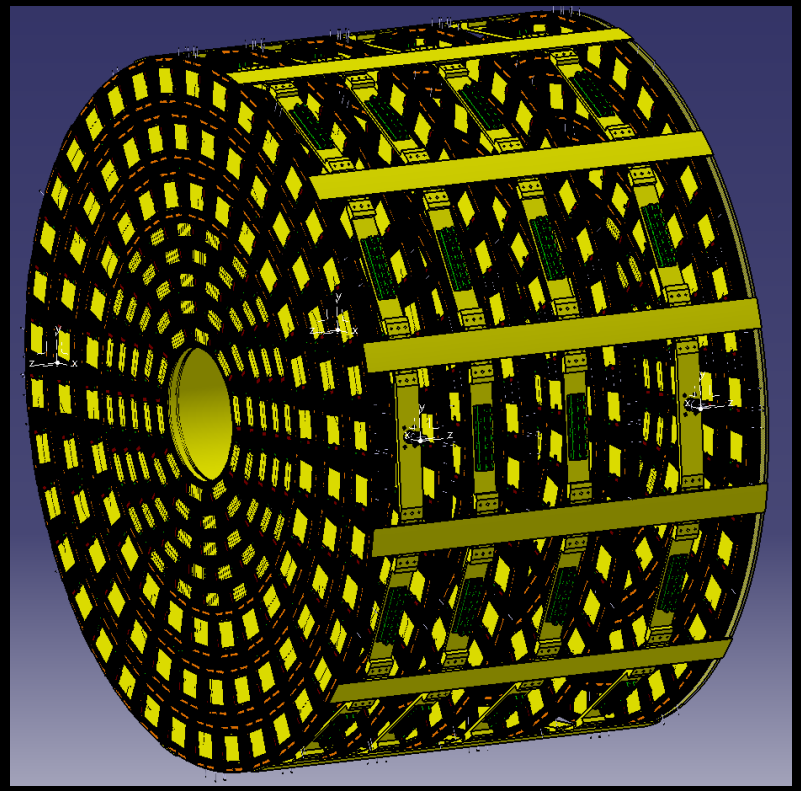
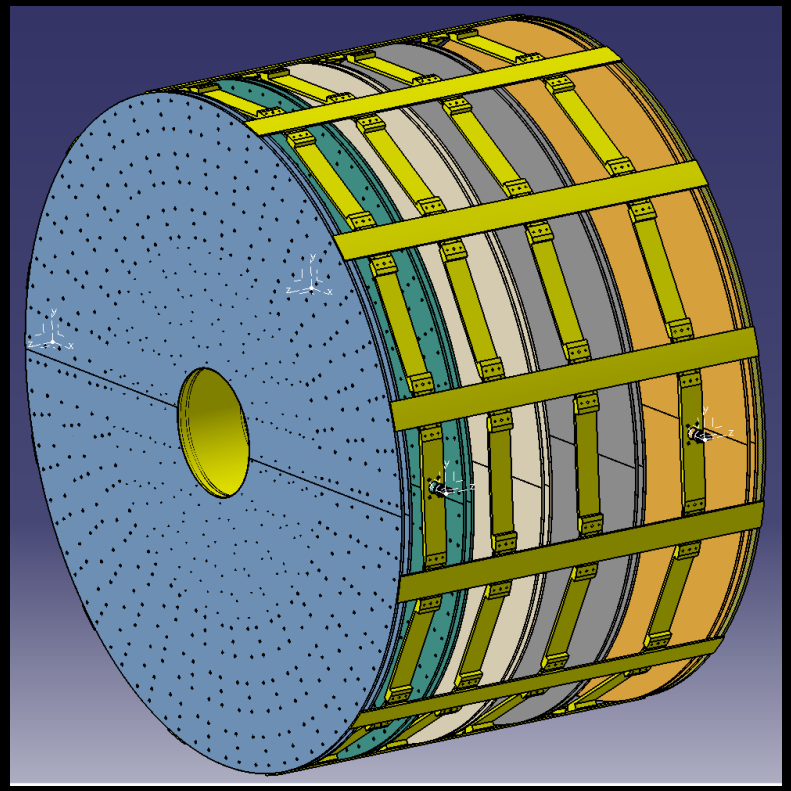
SUMMARY

- From CAD model to FE model
- Calculation hypothesis & Boundary conditions
- Calculation results
- From results to new geometry

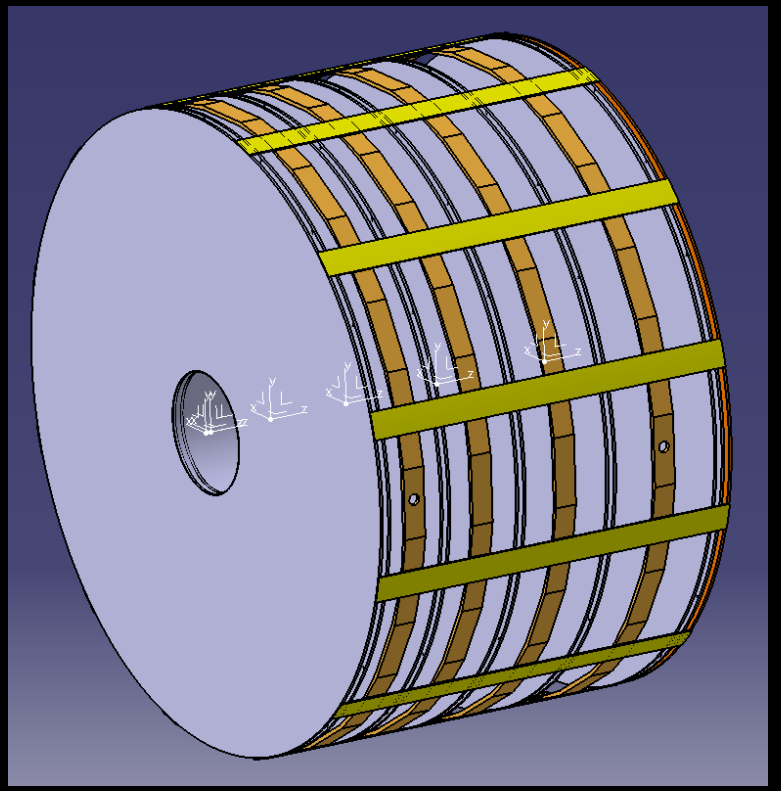
FROM CAD TO FE MODEL
3D SIMPLIFICATION



Initial complete 3D design

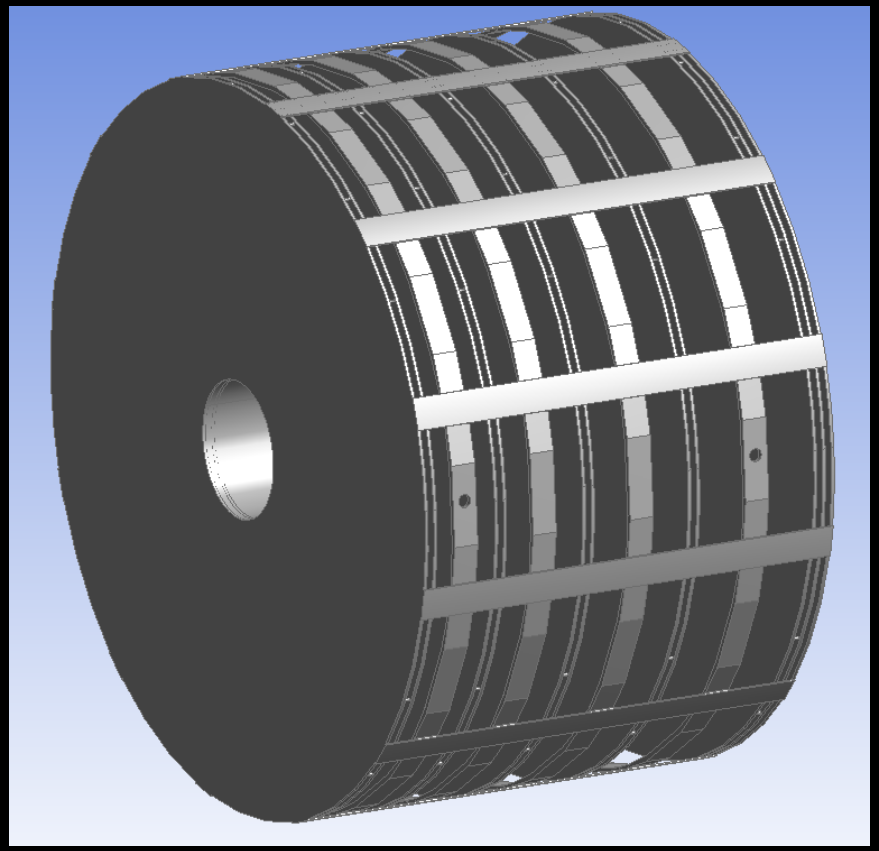


Remove useless parts
Filler / module / insert / cooling Electronics
Pins & screws

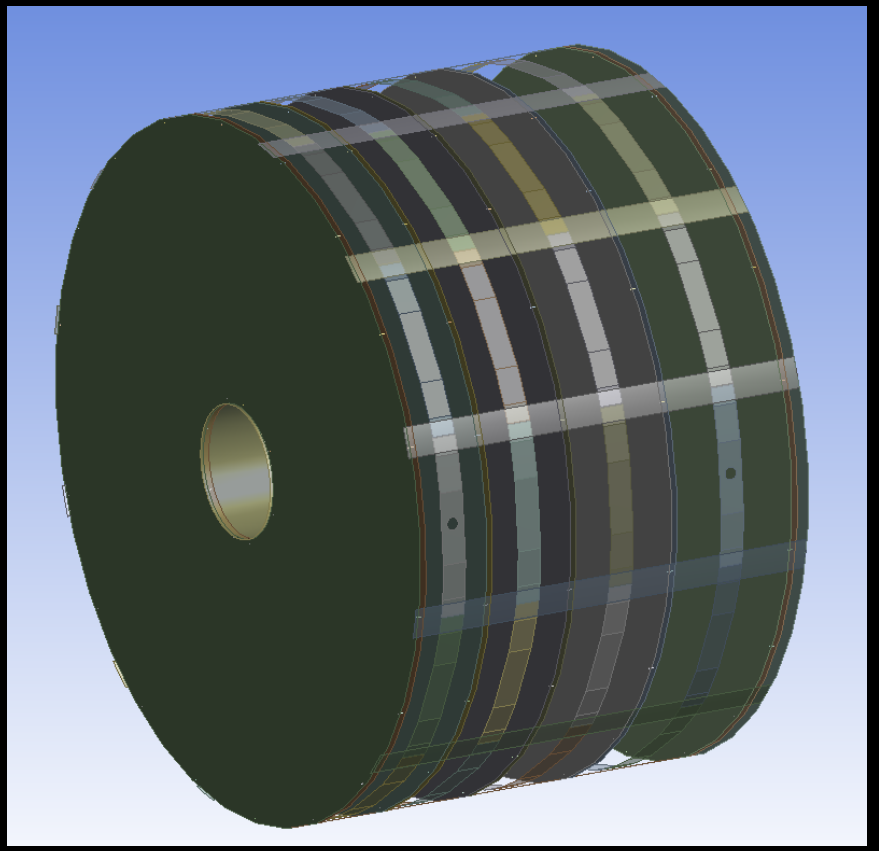


Simplify geometry
Non-regular Shape & Thickness
Holes / Chamfer / shoulder

FROM CAD TO FE MODEL
2D SIMPLIFICATION



3D face to 2D surface
3D spacer to 1D beam

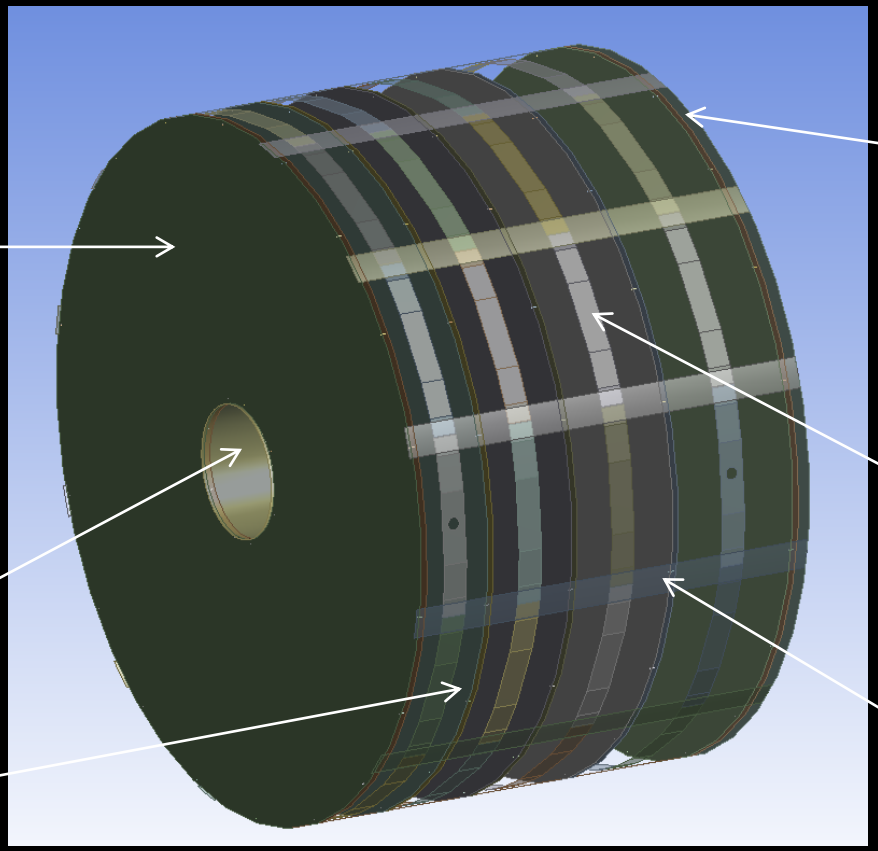


CALCULATION HYPOTHESIS
MATERIAL

Disk Sandwich [9,6mm]
6x CF UD 50µm 0/60/120°
9mm Airex Foam
6x CF UD 50µm 0/60/120

Inner Tube [2mm]
20x CF woven 100µm 0/45°

Spacer [Ø8mm]
Aluminium



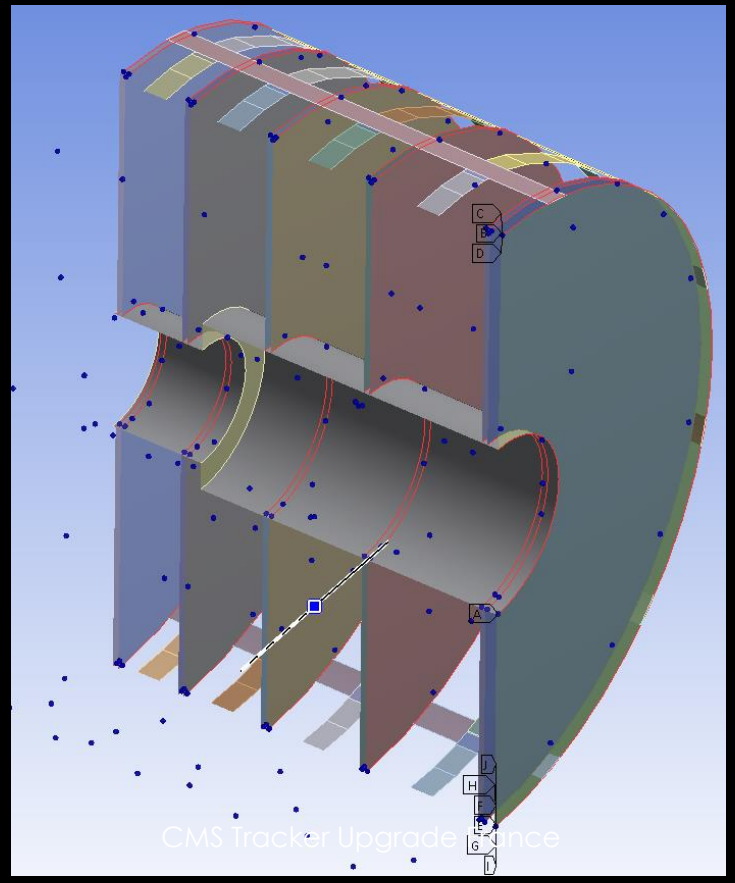
BackDisk Sandwich [10mm]
10x CF UD 50µm 0/60/120°
9mm Airex Foam
10x CF UD 50µm 0/60/120

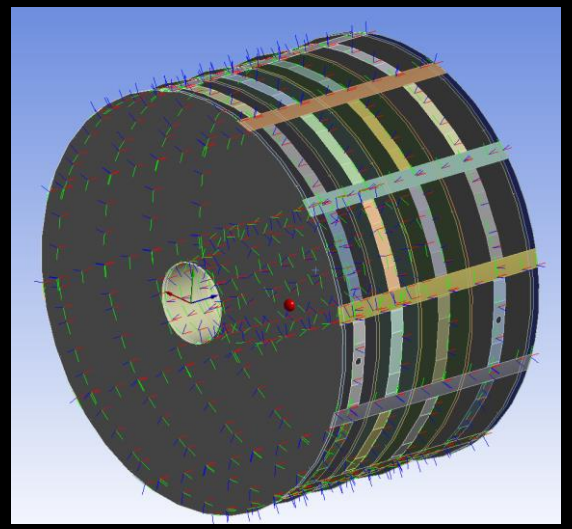
Strap [10mm]
Cabon isotropic

Beam [4mm]
20x CF woven 200µm 0/45°

CALCULATION HYPOTHESIS
CONTACT & MESHING

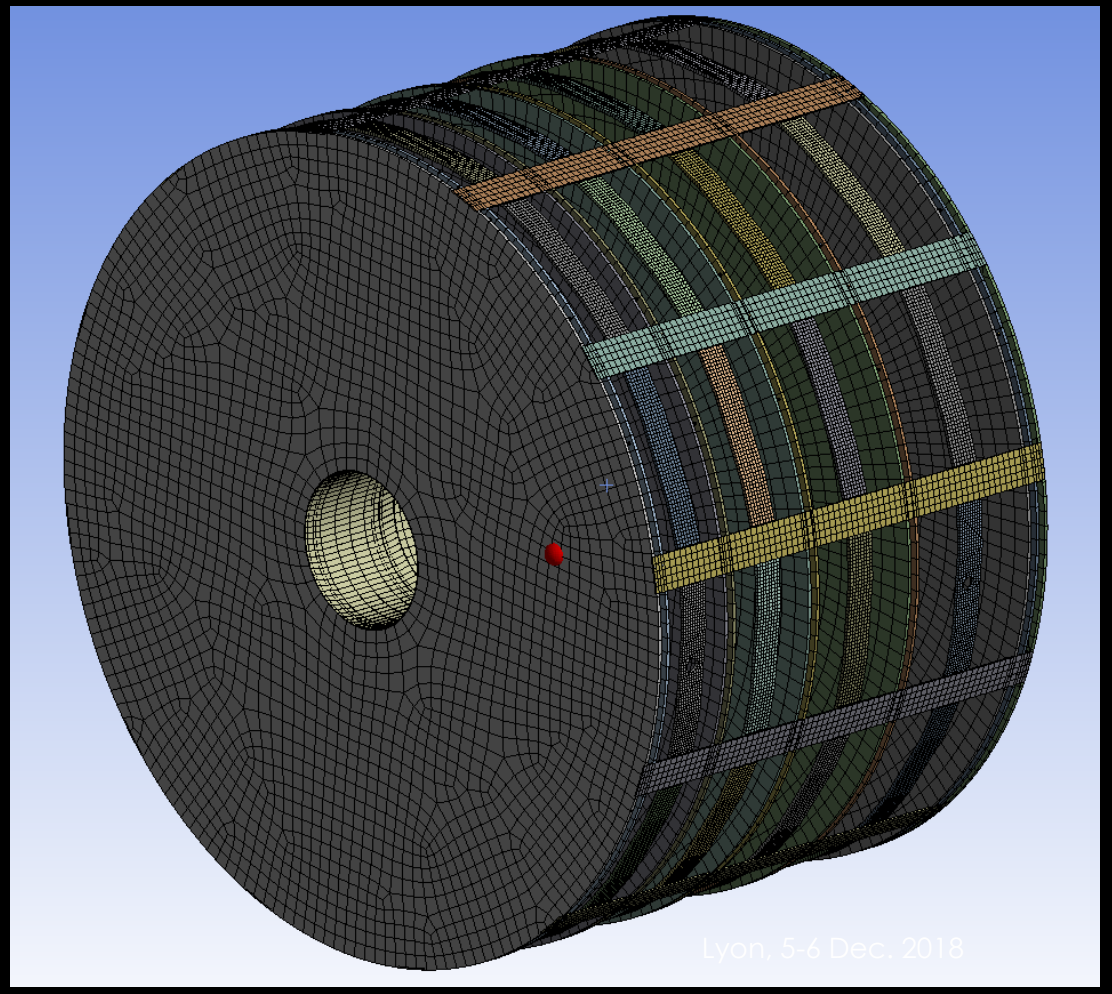
416 Contacts
Totally bounded

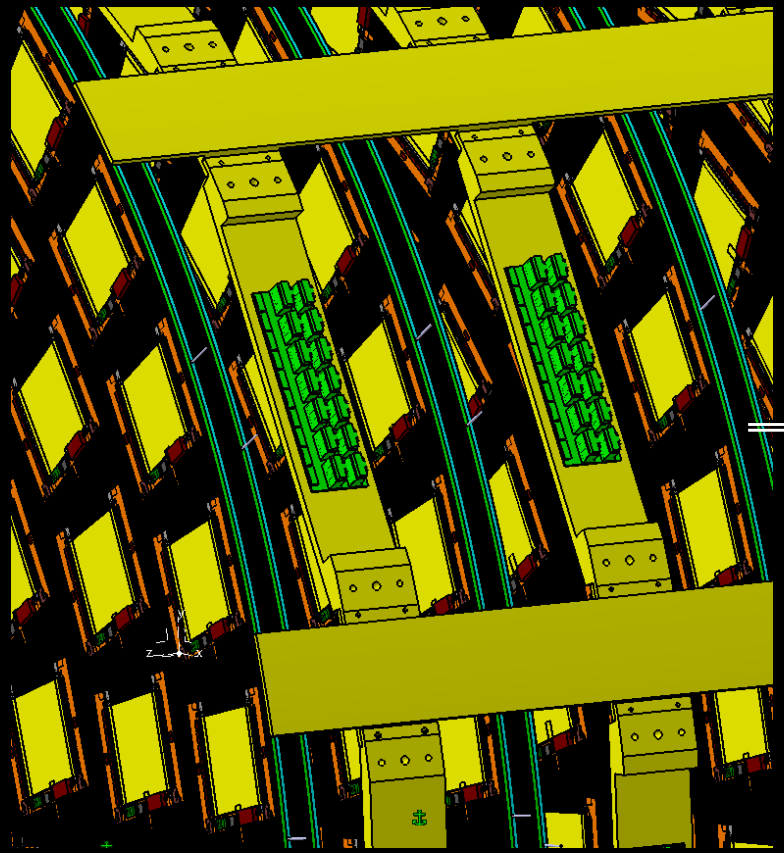


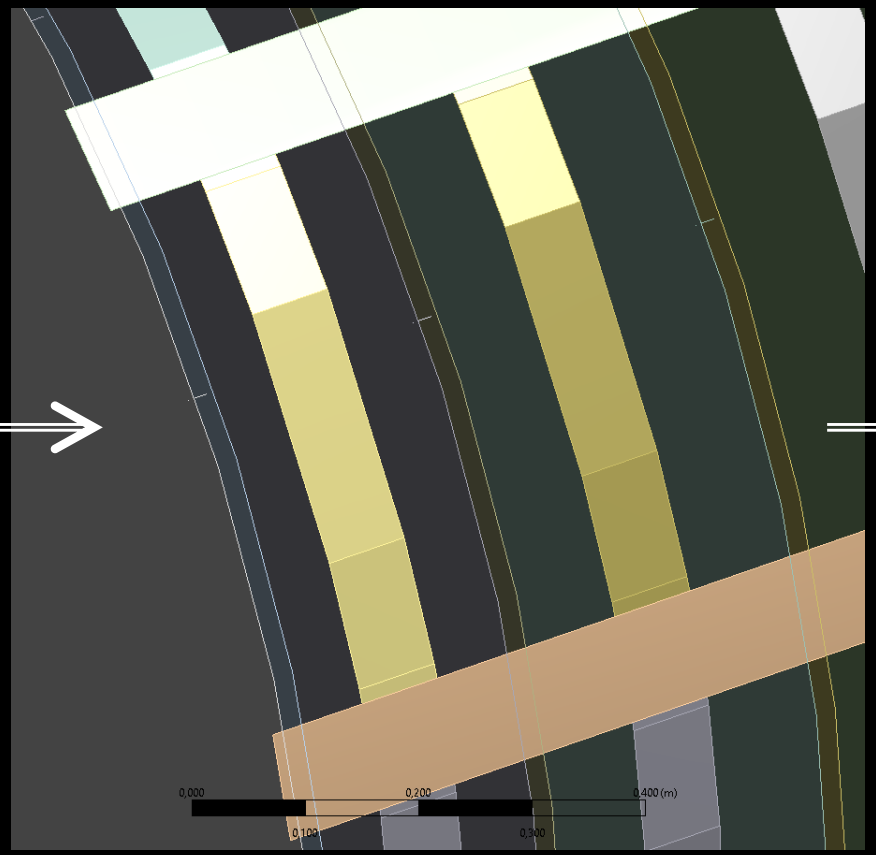


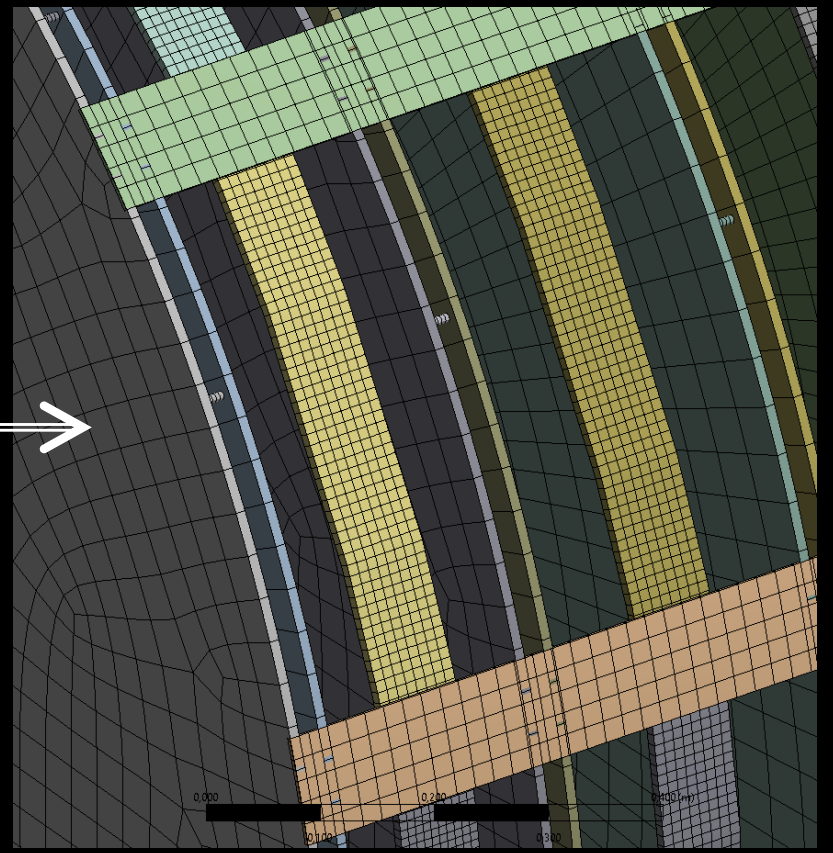
Elements orientation

Mesh
65000 nodes
Orthogonal quality > 0,996



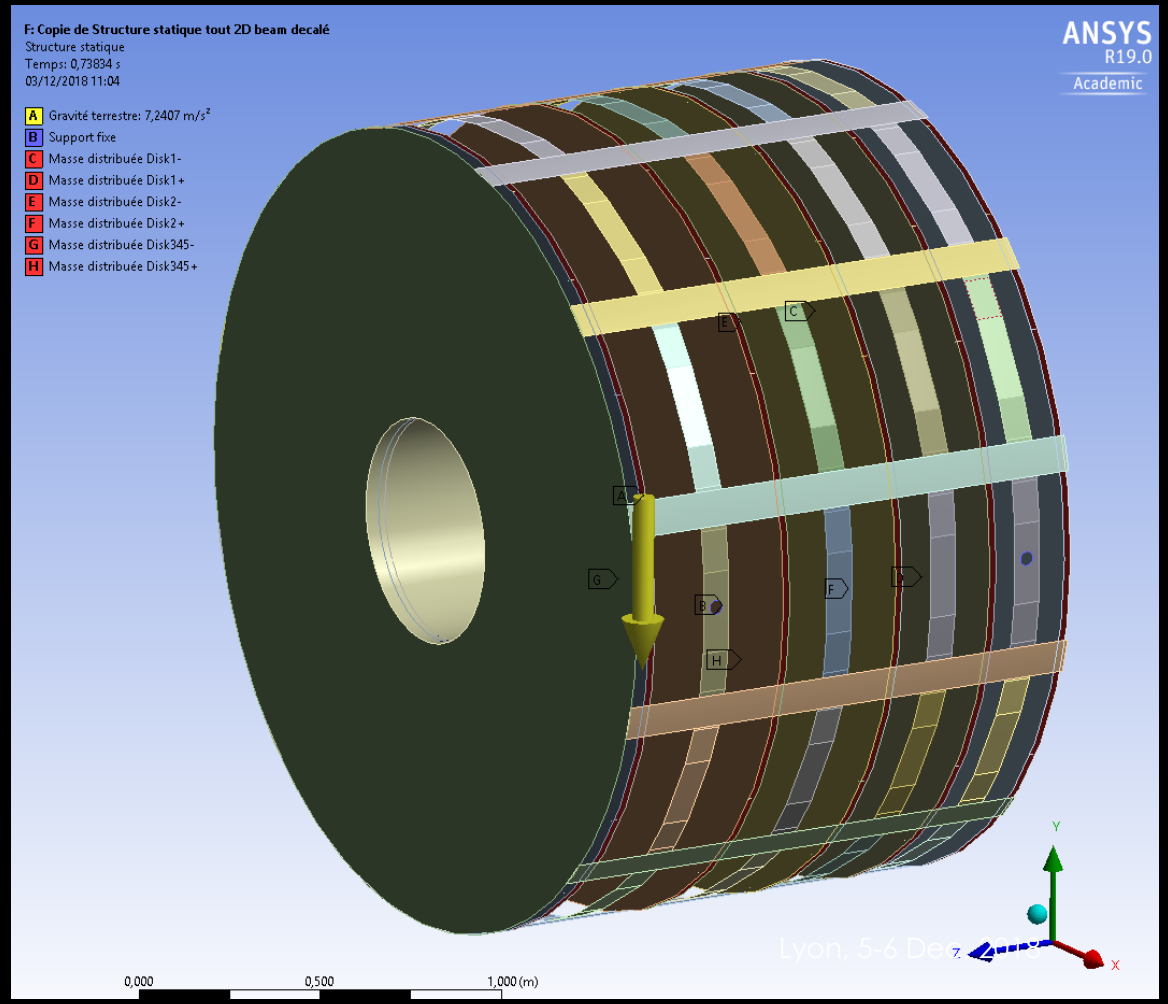



0,000
0,200
0,400 (m)
0,100
0,300


0,000
0,200
0,400 (m)
0,100
0,300

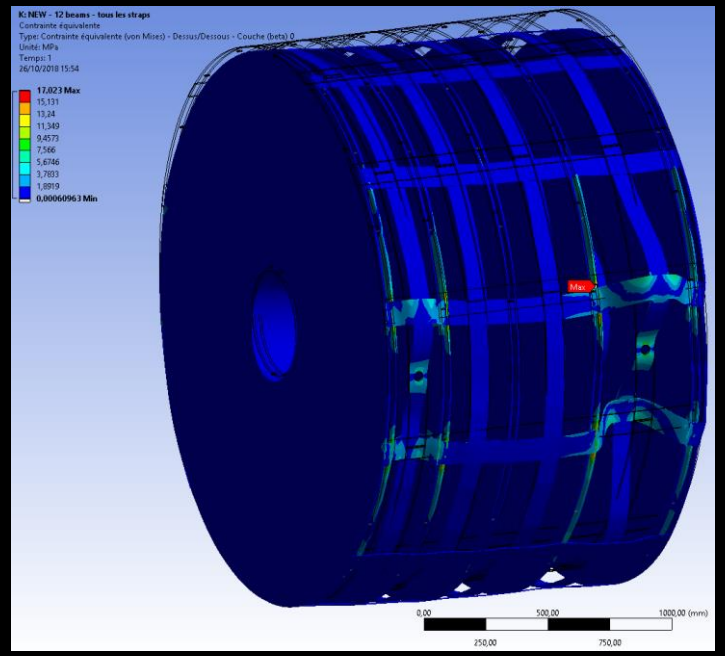
CALCULATION HYPOTHESIS
BOUNDARY CONDITIONS

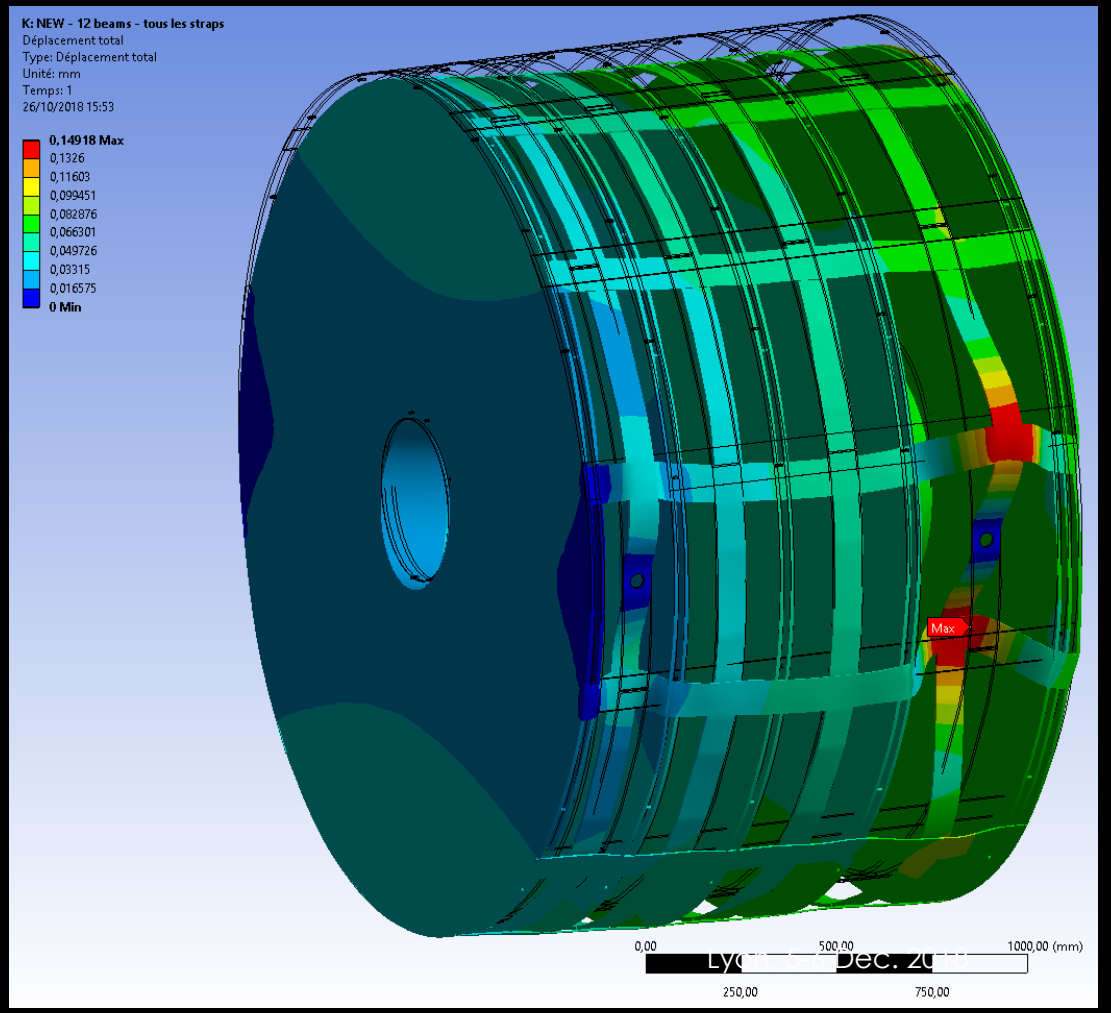
- Gravity
  - -Y
- Distributed mass on disks
  - modules & cooling equipment
  - 32 to 39 kg/disk
- Fixed support
  - 4 lateral wheels
- External services
  - Non uniform repartition
  - 150 kg cables
- No Patchpanel weight



CALCULATION RESULTS
INITIAL CASE

- 12 beams / all straps / no service
- Strain = 0,15 mm
- Stress = 17 MPa

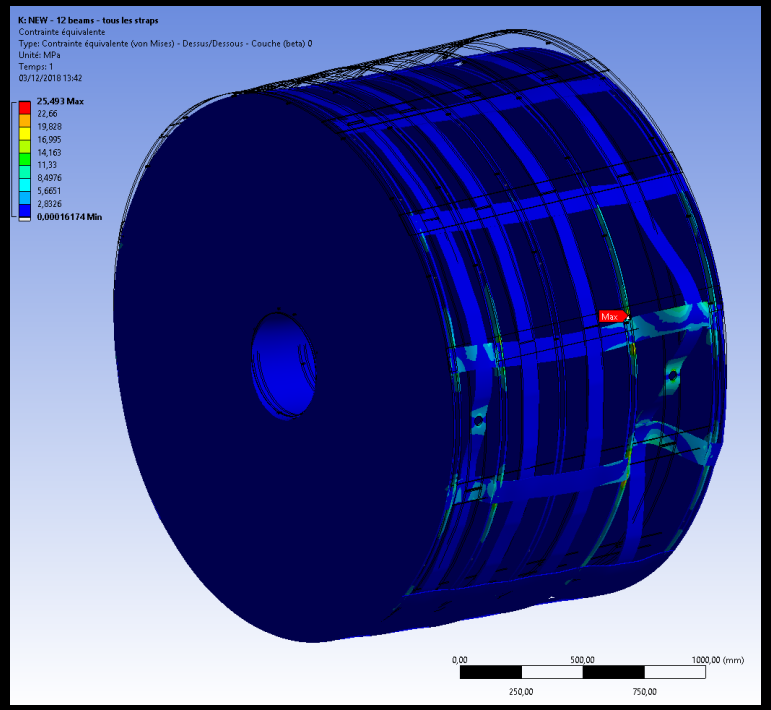


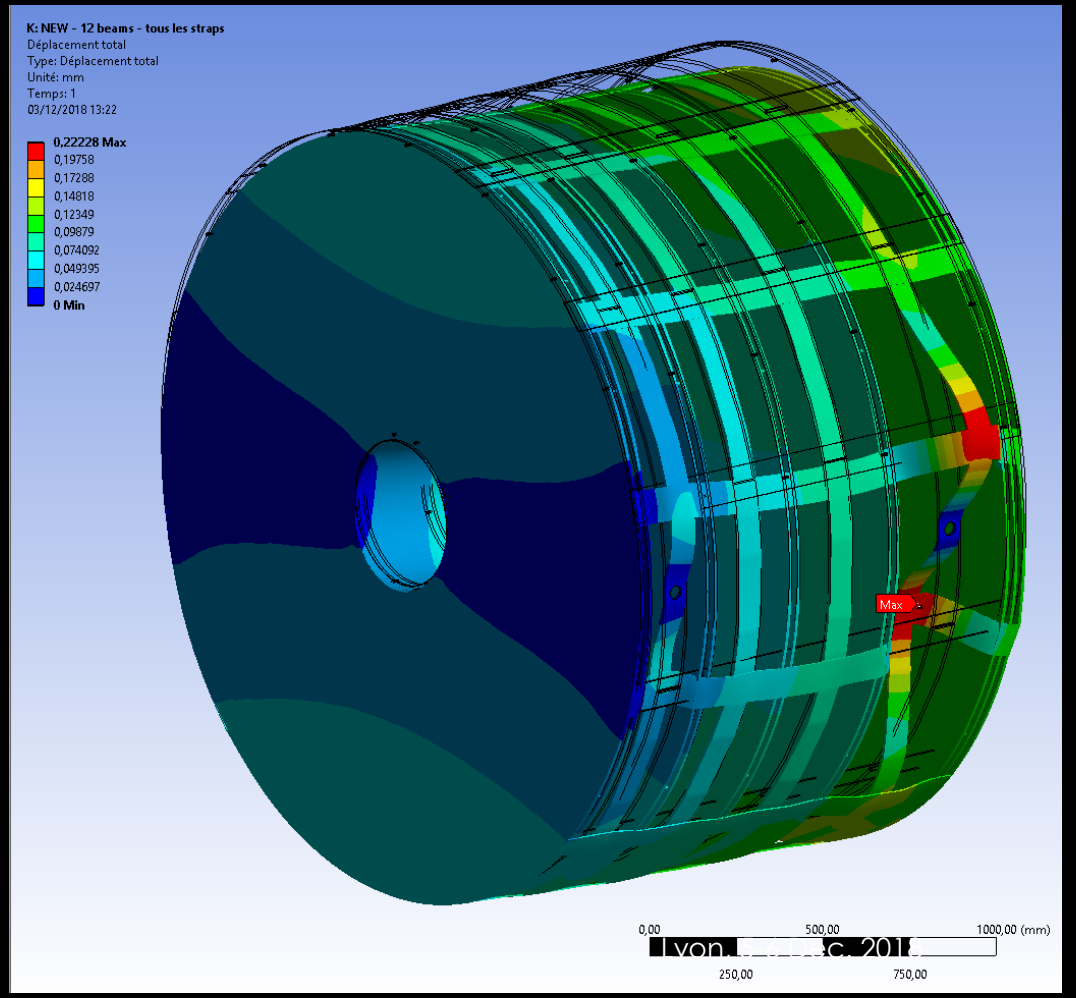


CALCULATION RESULTS
SERVICES INFLUENCE

- 12 beams / all straps / services
- Strain = 0,22 mm
- Stress = 25 Mpa

➔ +50%

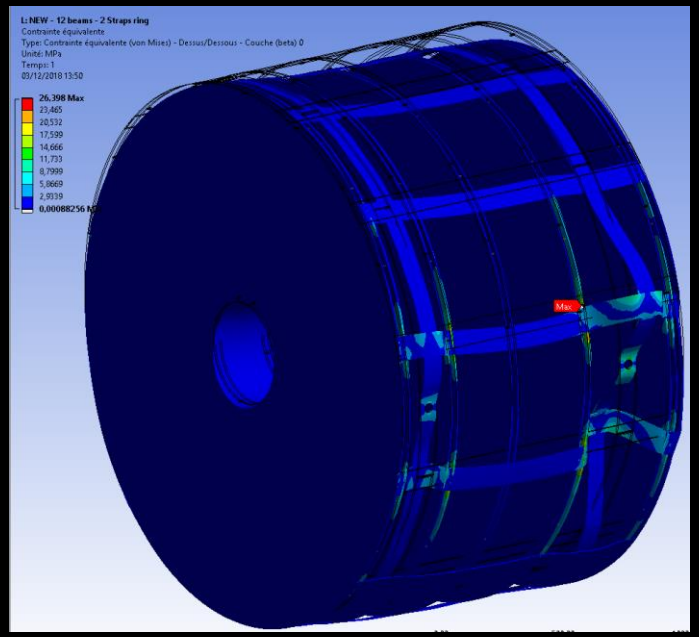


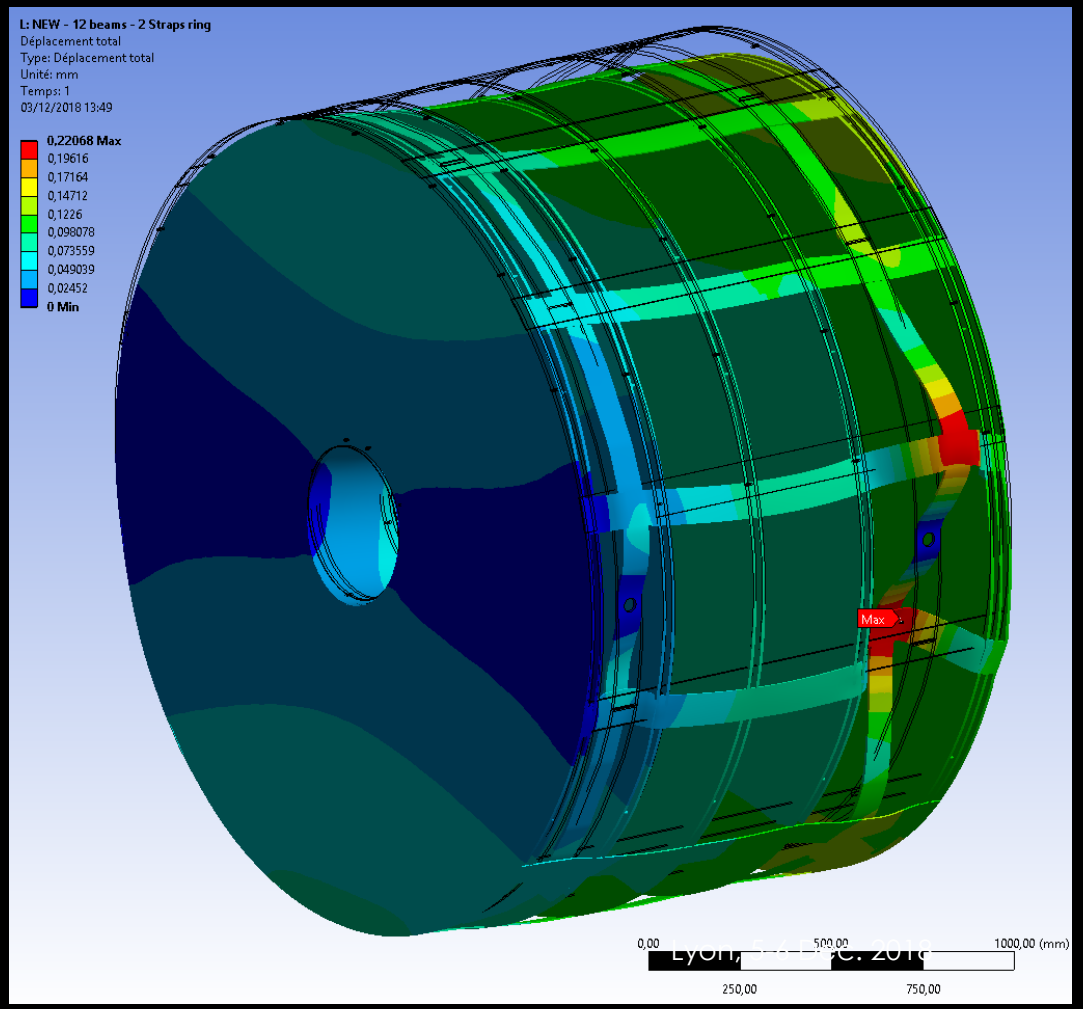


CALCULATION RESULTS
STRAPS INFLUENCE /1

- 12 beams / 2 strap rings / services
- Strain = 0,22 mm
- Stress = 26 Mpa

➔ 4 strap rings
⇔
2 strap rings

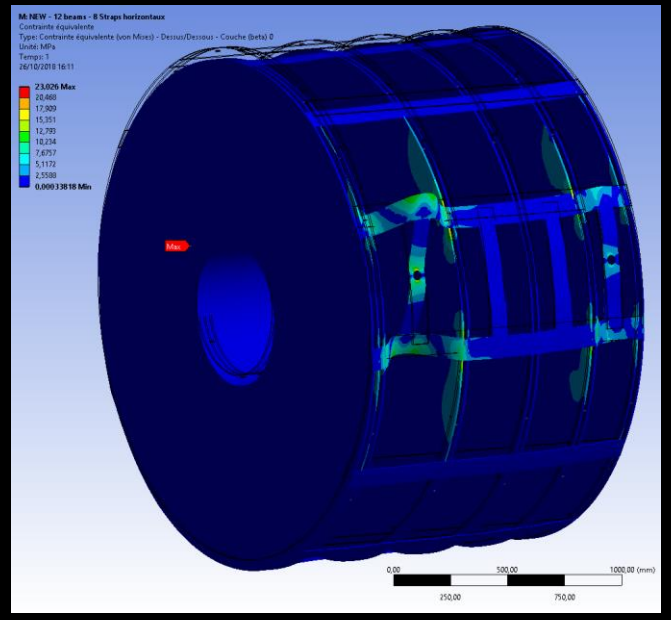


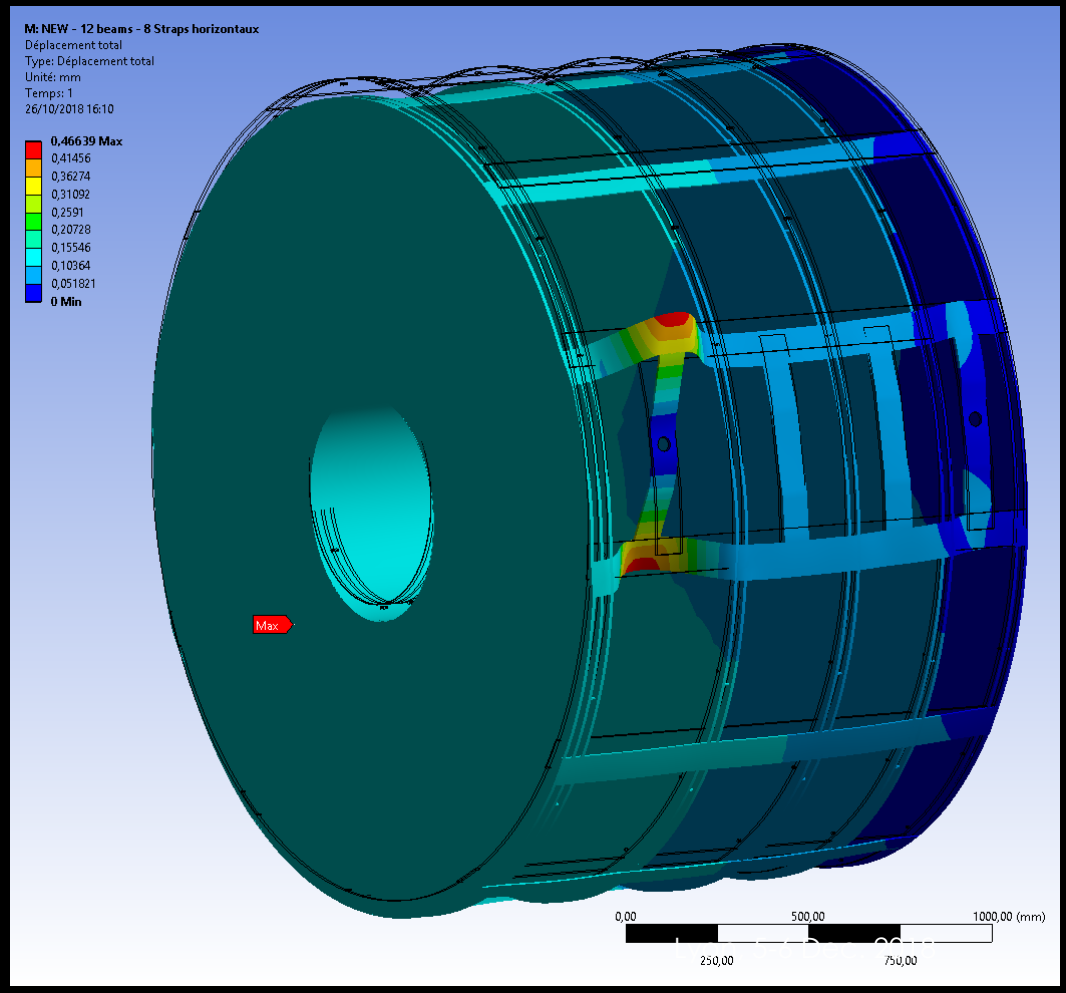


CALCULATION RESULTS
STRAPS INFLUENCE /2

- 12 beams / no strap / services
- Strain = 0,47 mm
- Stress = 24 Mpa

➔ +200%

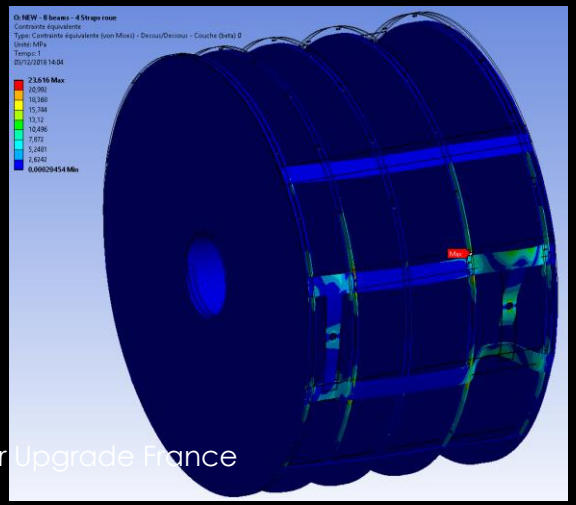


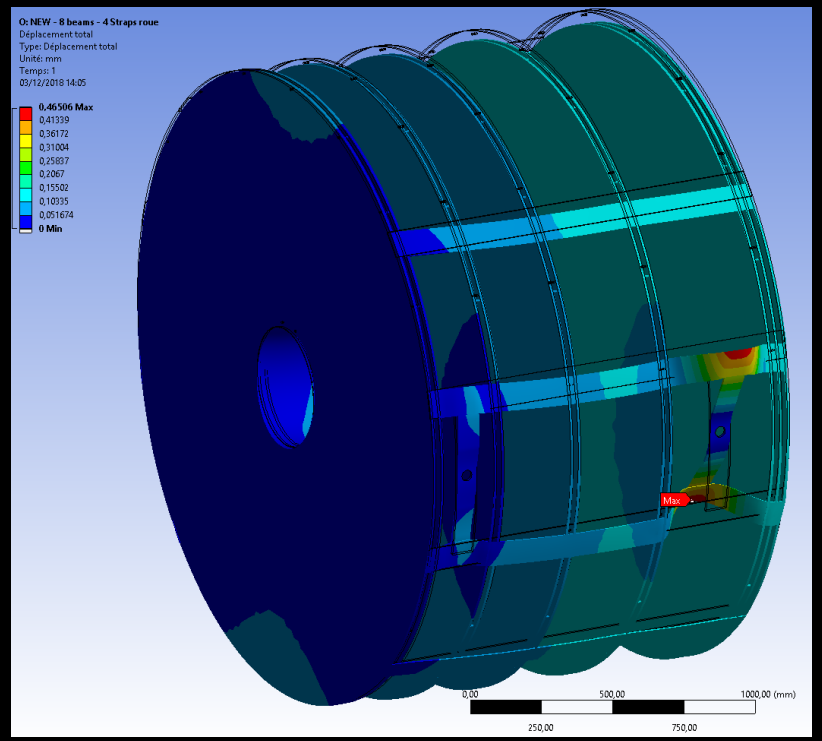


CALCULATION RESULTS
BEAMS INFLUENCE

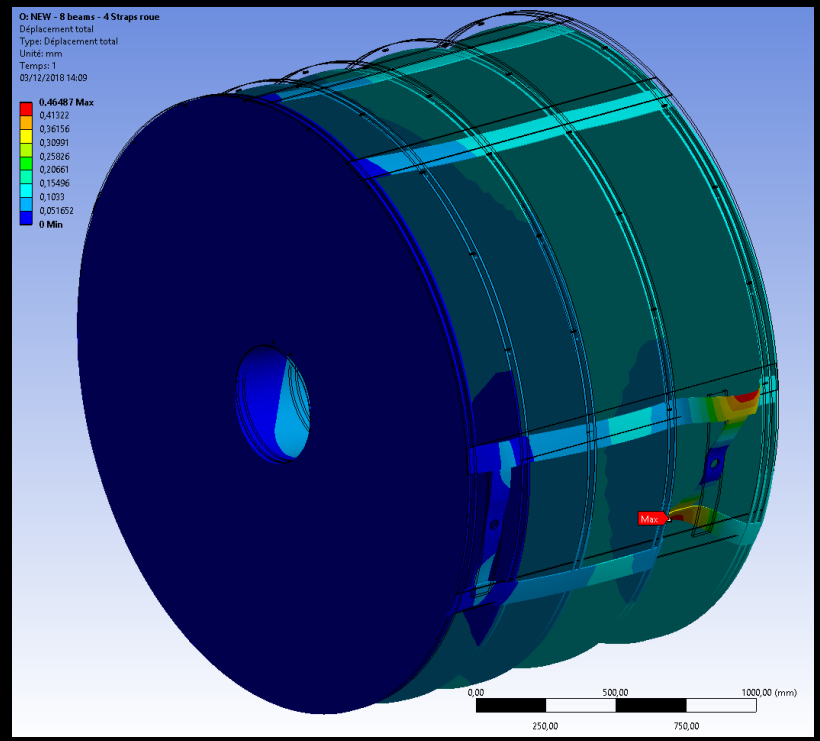
- 8 beams / no strap / services
- Strain 0,47 mm
- Stress 24 Mpa

➔12 beams ⇔ 8 beams





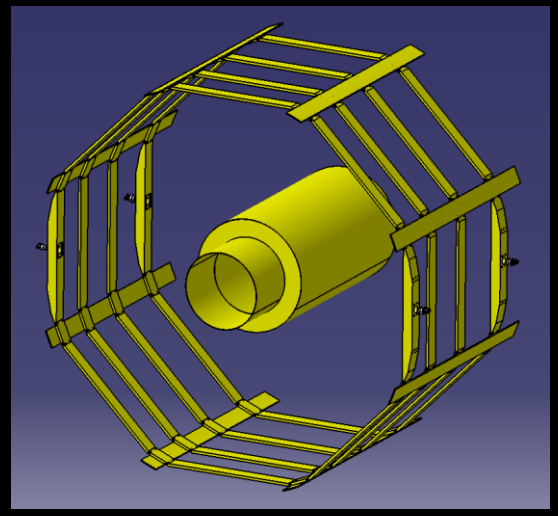
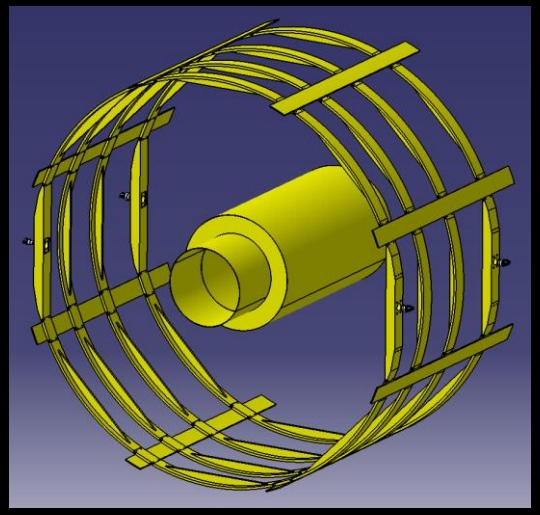
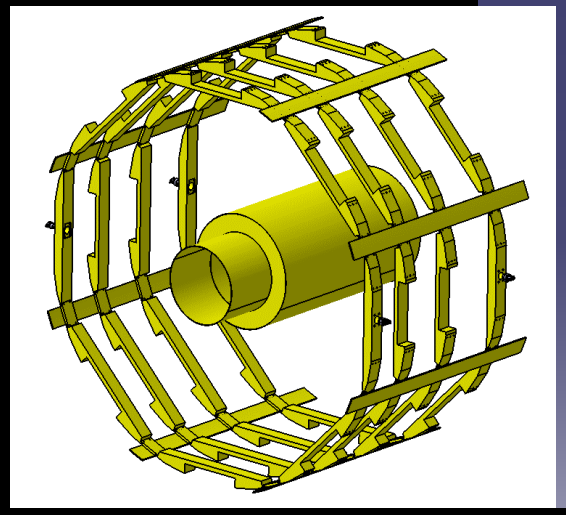
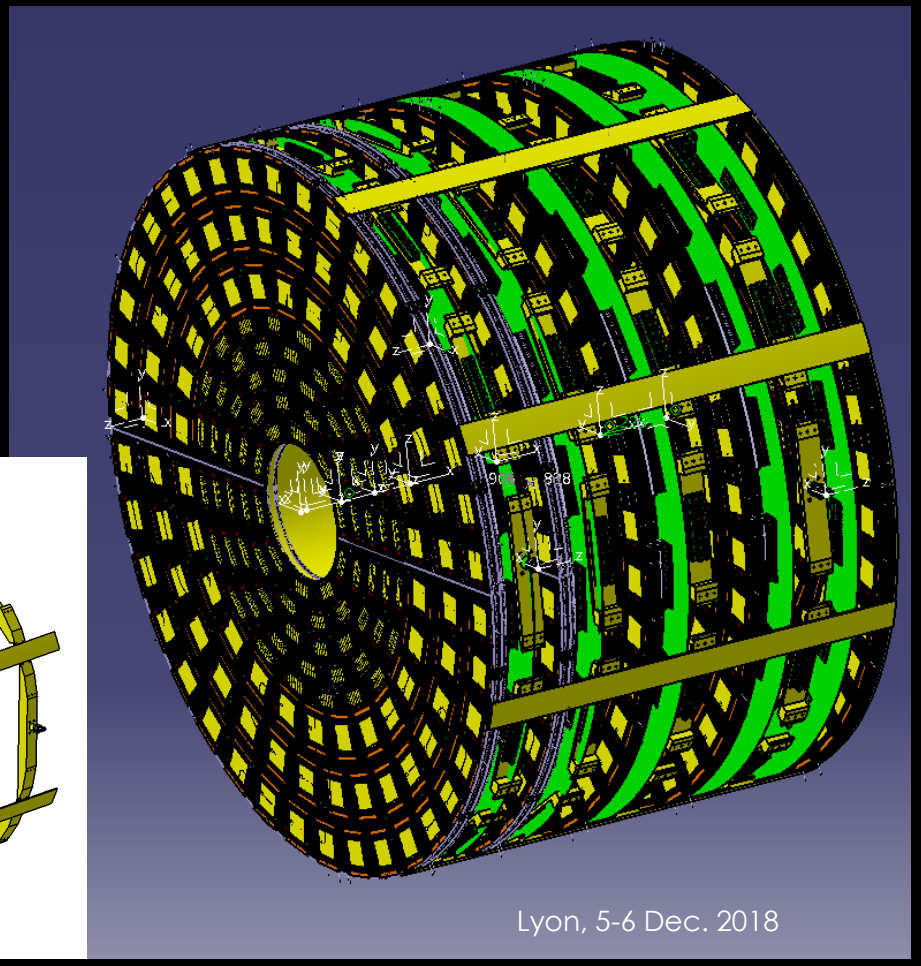
Lateral beams



Top & bottom beams

CONCLUSIONS
CALCULATION RESULTS

- Services influence
  - 150 kg non-uniform services : Δ_{max} & σ_{max} ↗ 50%
  - + 50kg patchpanel to take into account
- Straps influence
  - 4 complete strap rings ⇔ 2 complete strap rings
  - No strap rings : ↗ 200%
- Beams influence
  - 12 beams ⇔ 8 lateral beams ⇔ 8 top&bottom beams

CONCLUSIONS
TOWARD NEW DESIGN

- New design : work is on going
  - 4 strap rings
  - 8 beams at 45°
  - Inner tube thickness 3 mm
  - No backdisk
  - Patchpanel weight +50kg