Engineering of the power prototype of the ESRF HOM damped cavity*

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Summary

- Introduction
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  Objectives
- Aluminum prototype
  Design optimization
  Experimental validation
- Copper power prototype
  Design aspects
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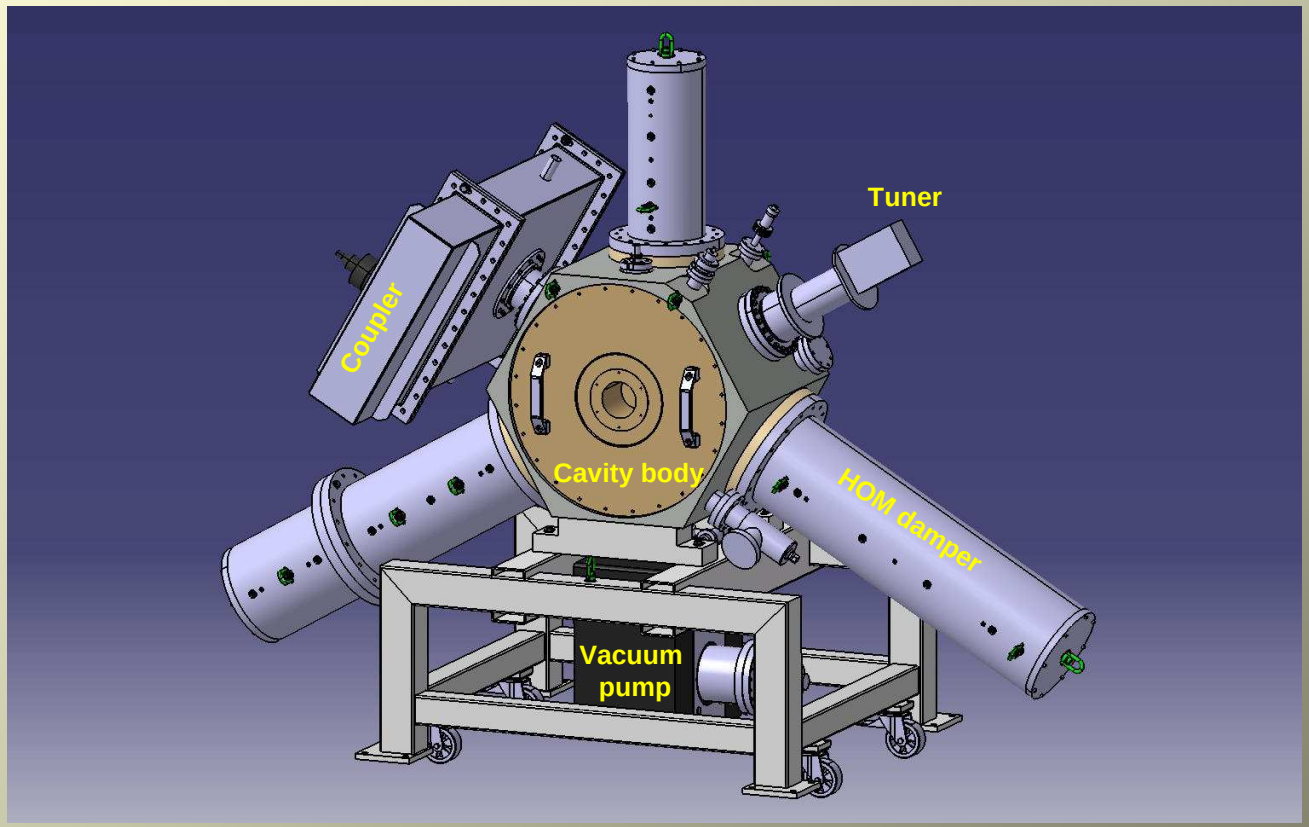
- Perspectives and future work

Introduction

The development of the new **352 MHz** cavity for the ESRF is based on the 500 MHz European HOM damped normal conducting cavity.



Introduction

- **New ESRF cavities objectives :**

  - 300 mA of beam current :

  - Design margin in terms of power per coupler window : 500 mA of stored beam.

  - Design margin in terms of HOM damping : 1A of bunch instability threshold to anticipate possible discrepancies between numerical and experimental data.

  - 9 MV of accelerating voltage :

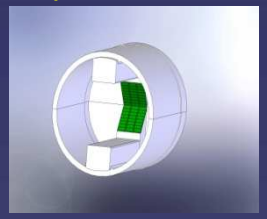
  - Installation of 18 new single-cell cavities.

  - The system should be operational with 12 cavities.

Aluminum prototype

- **Design optimization :**

Length before C48 ferrites = 840 mm
Dissipated power @ 352 MHz < 100 Watt



1 damper
for the remaining
HOMs : f_c = 1.05 GHz
d = 160 mm

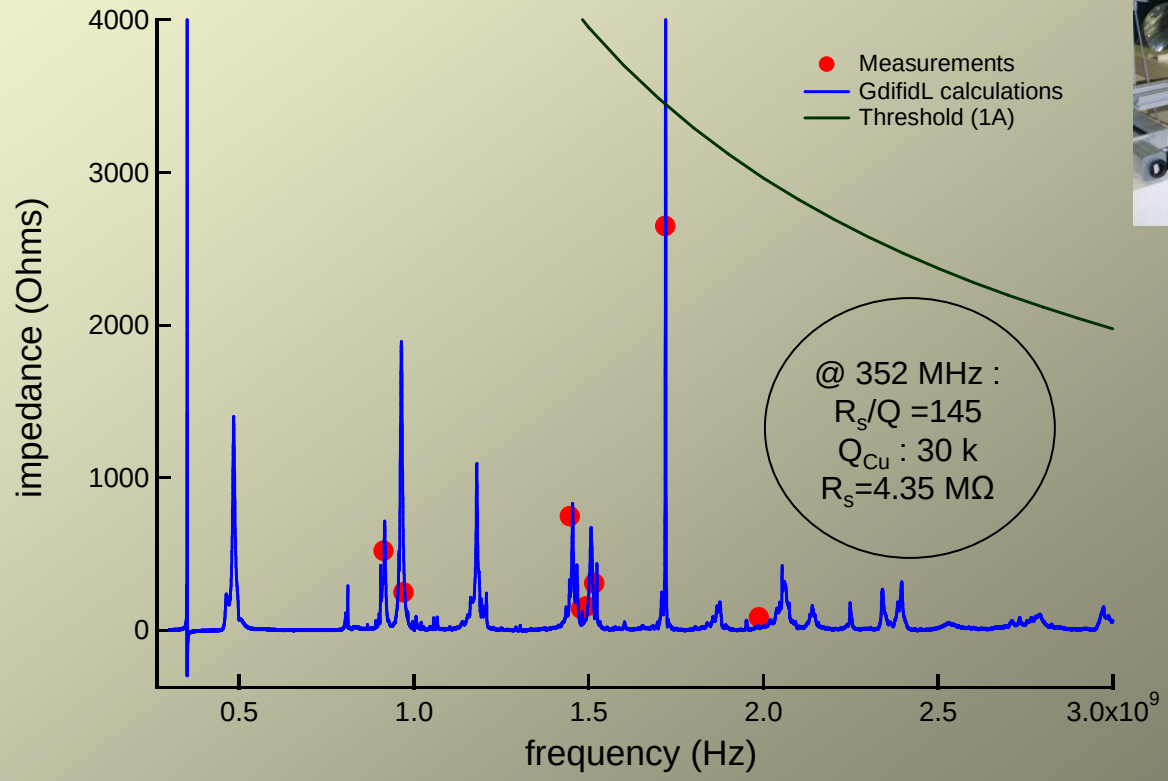
2 dampers not in the same plane :
to avoid the high impedance
758 MHz mode measured
on the previous prototype

2 dampers
for the lowest
HOMs : f_c = 452 MHz
d = 230 mm

The vacuum pump port
is not degrading the quality factor

Aluminum prototype

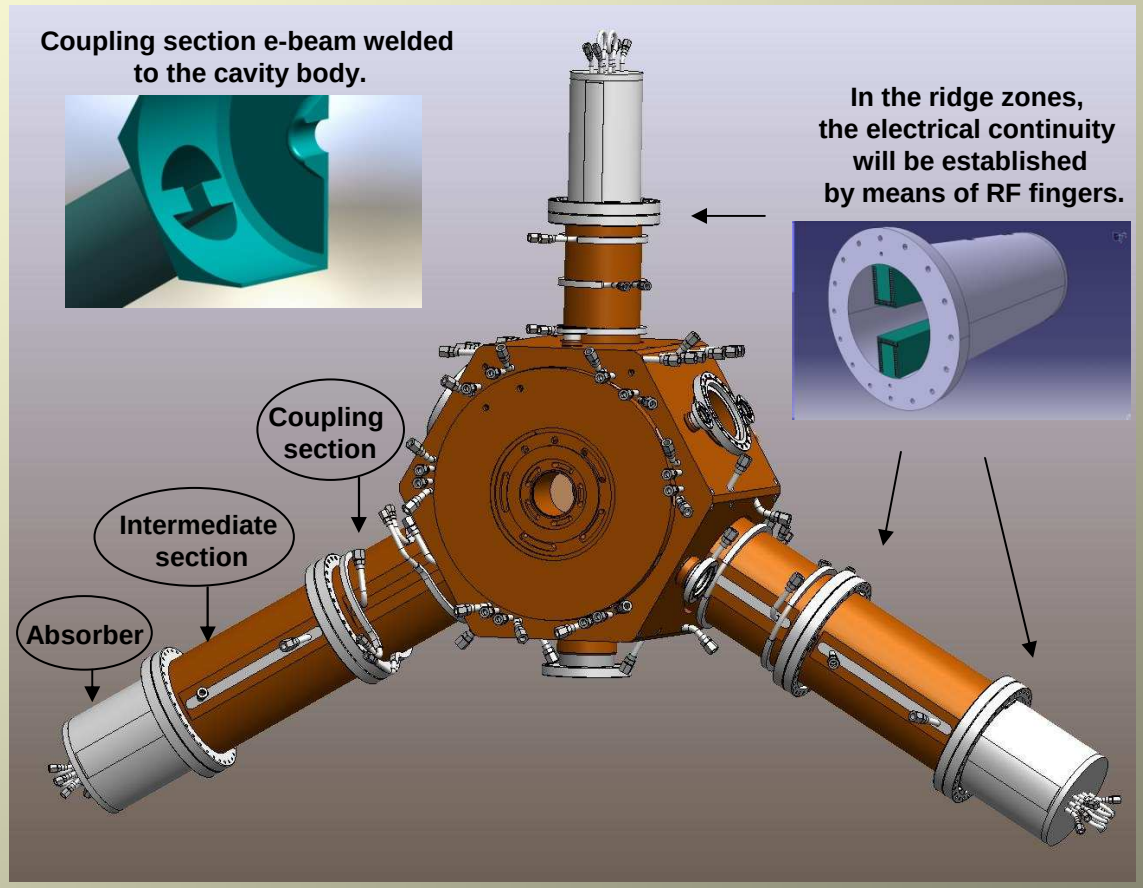
- **Validation of the numerical model :**
  - Good correlation between measured and calculated data.
  - All the measured impedances of the HOMs are lower than the L.C.B.I.



Copper prototype

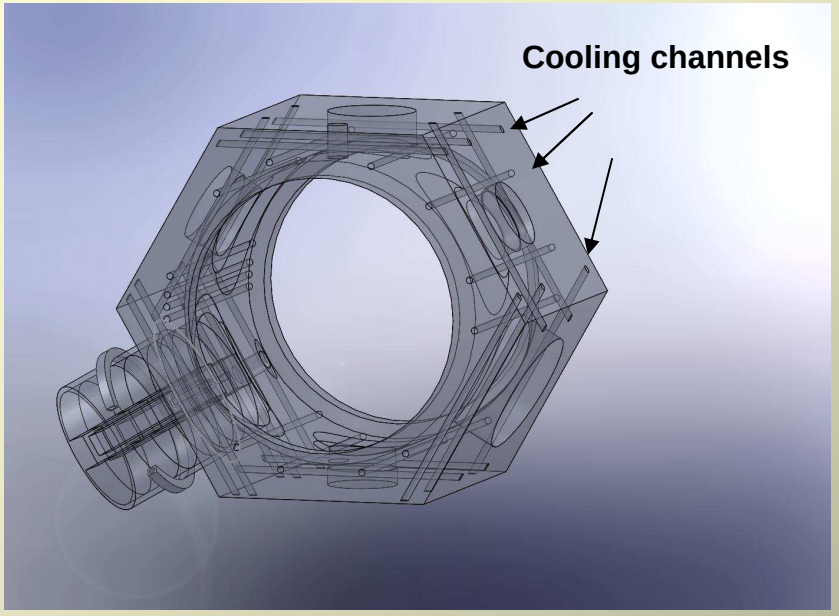
❑ Design aspects

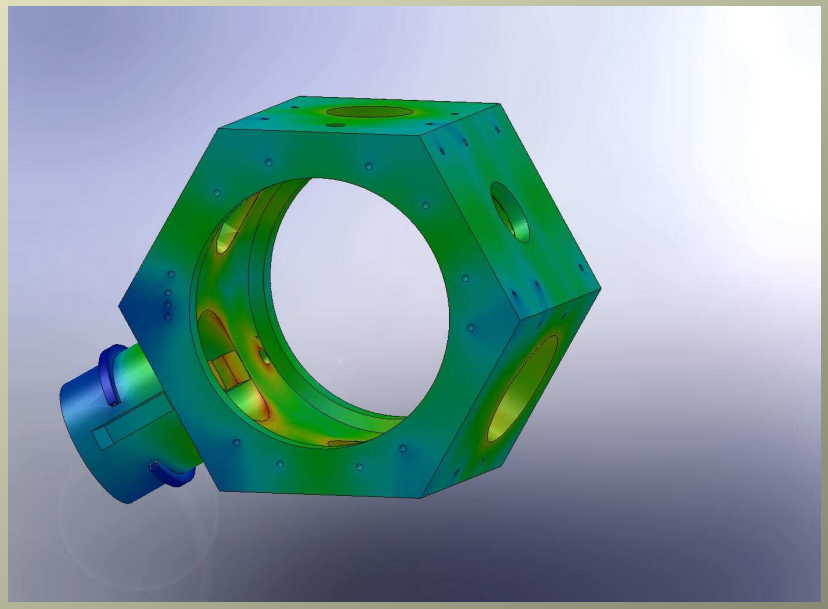
- The gap problems between the ridges and the cavity body are eliminated by splitting the HOM dampers in three parts.



Copper prototype

- **Design aspects**
  - In house design of the cooling system.





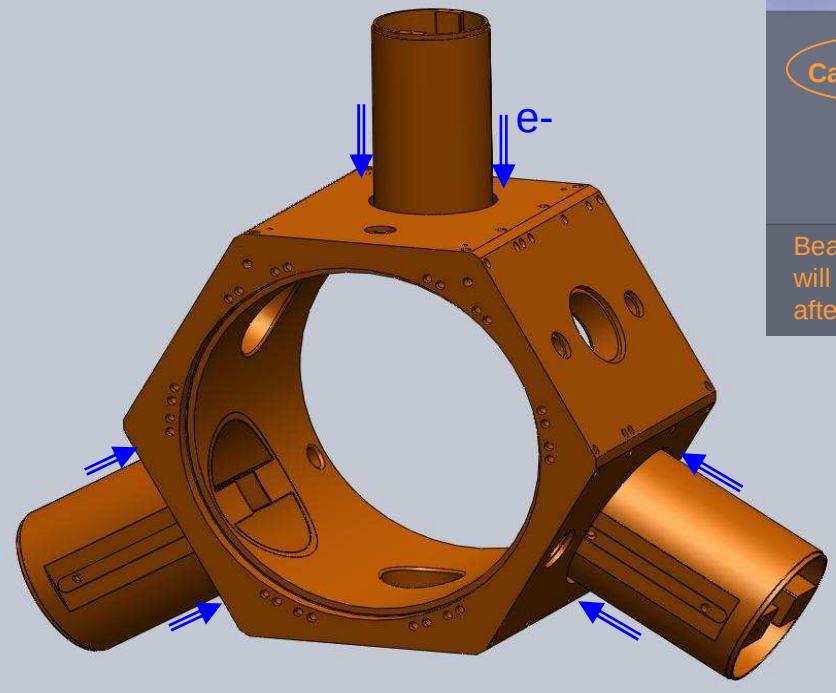
Heat flux computed for the degraded operation 9MV with 12 cavities :

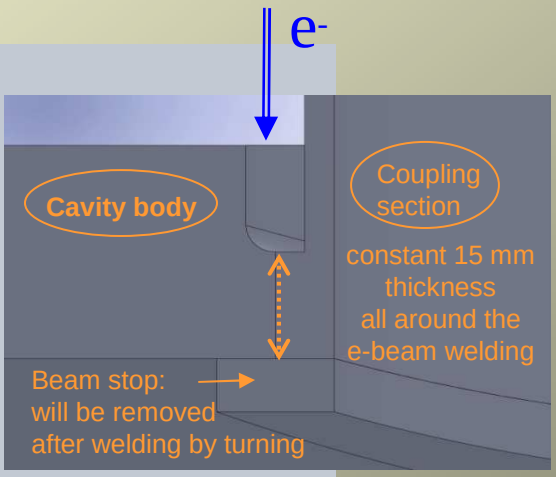
⇨ **Maximum temperature : 56°C**

***Thanks to Lin Zhang for his advice in thermal computations**

Copper prototype

- **Establishment of technological process (1/3)**

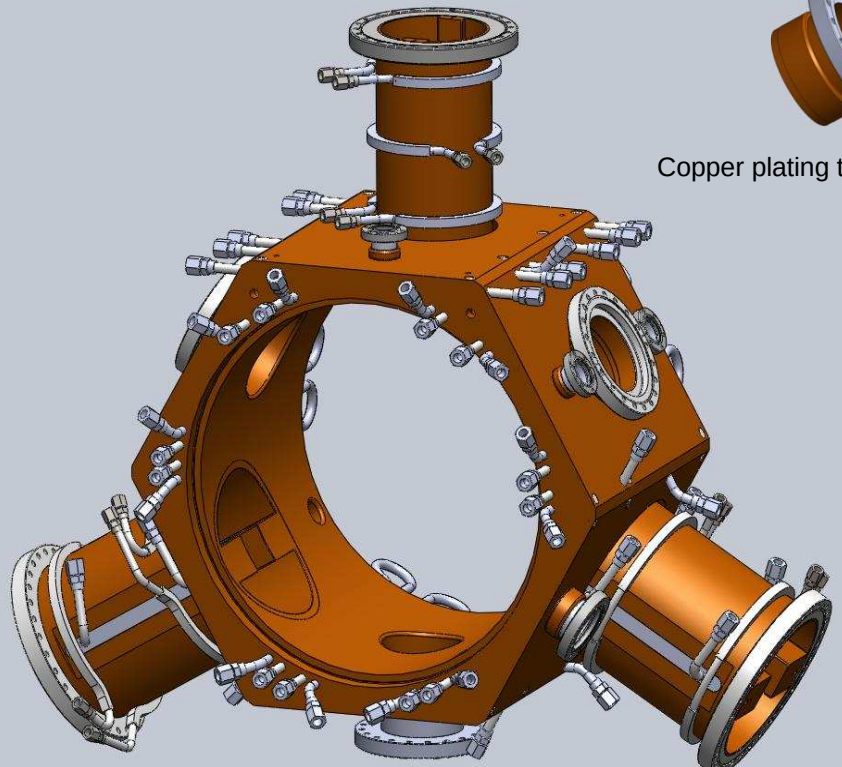




2.The gap is avoided by splitting the dampers in three parts. The first part is e- beam welded to the body.

Copper prototype

- **Establishment of technological process (2/3)**

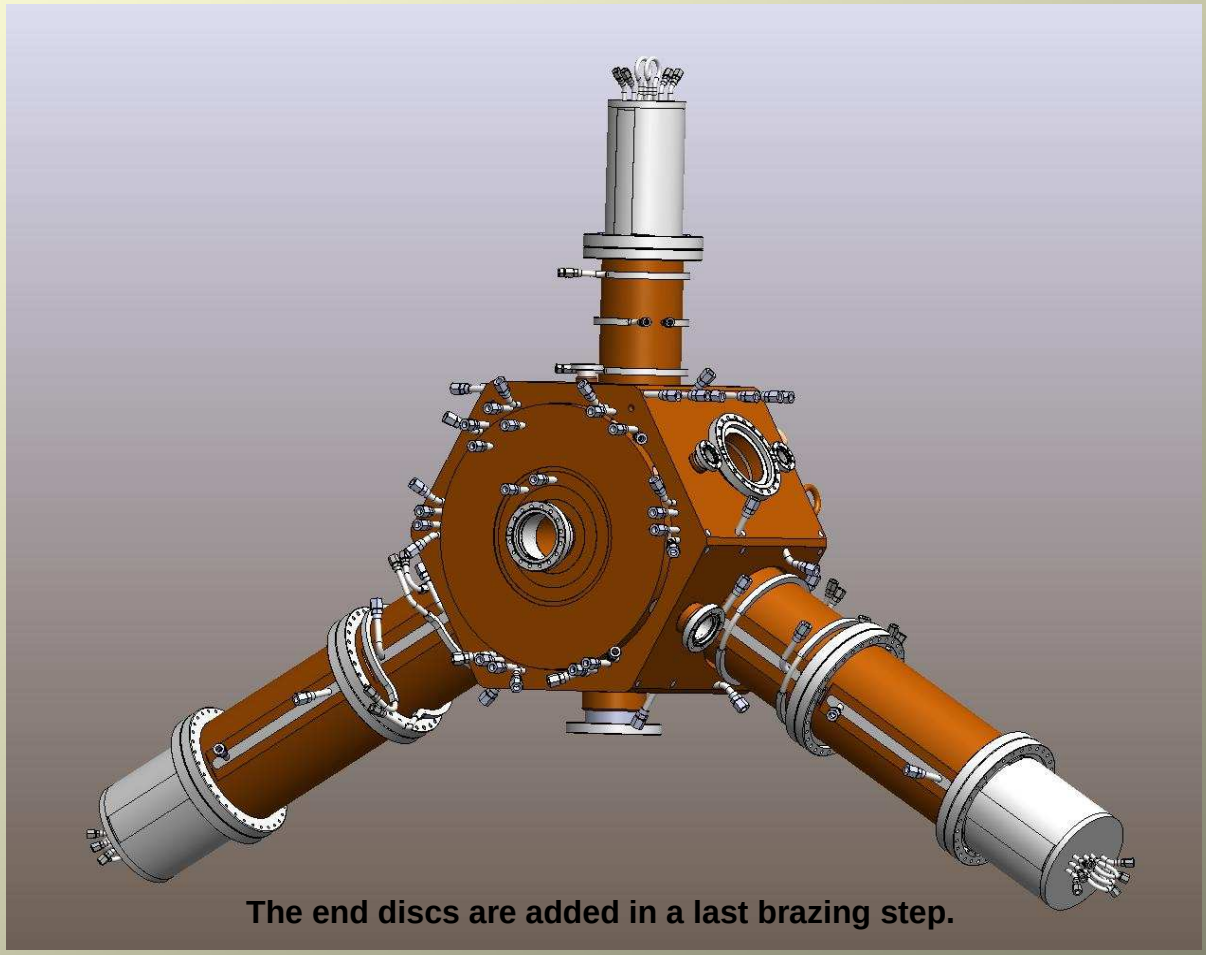


Copper plating the SS surface

3.The vacuum flanges, outlets and pipes are brazed in a single step

Copper prototype

- **Establishment of technological process (3/3)**

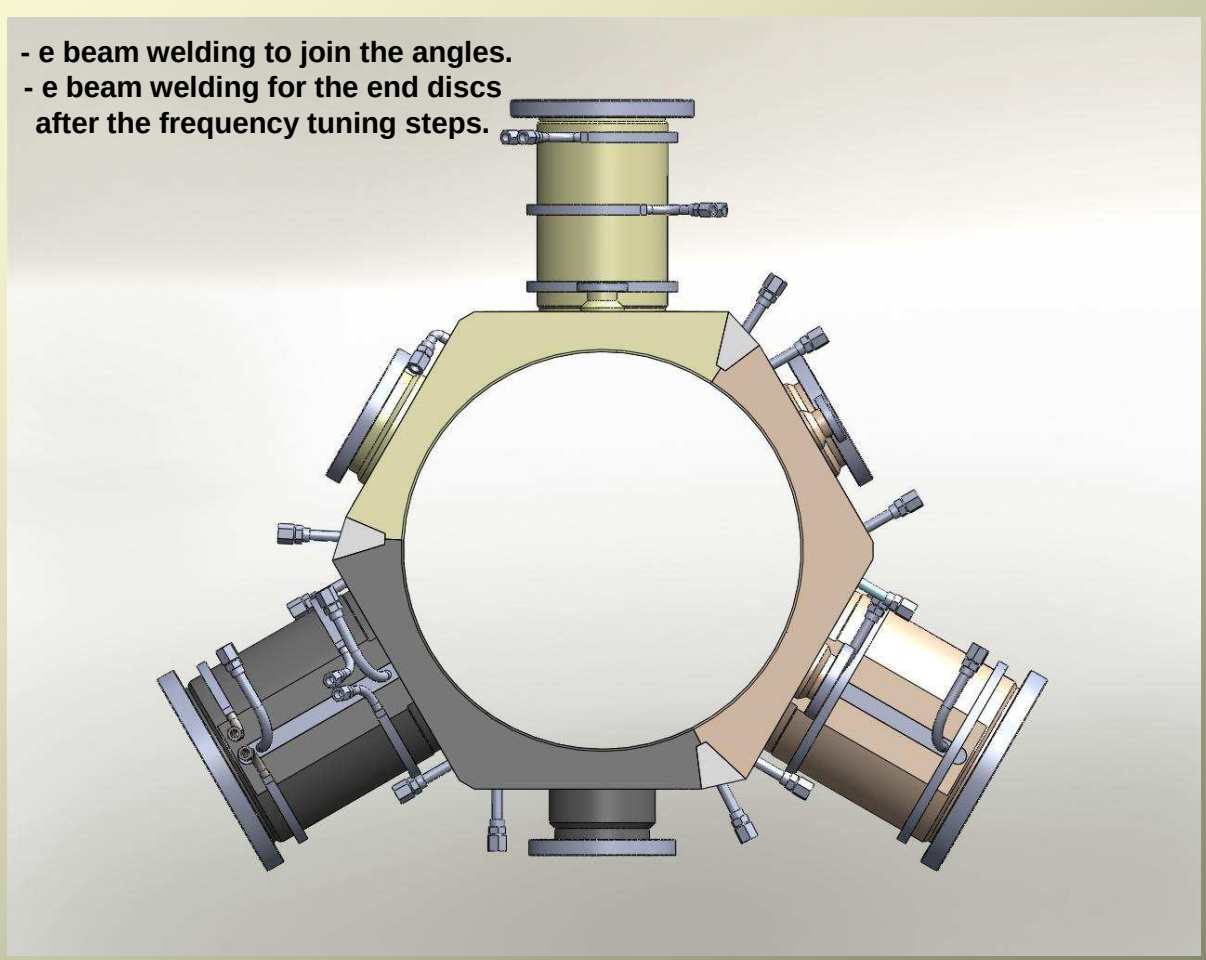


The end discs are added in a last brazing step.

Copper prototype

- **Alternative Fabrication process**

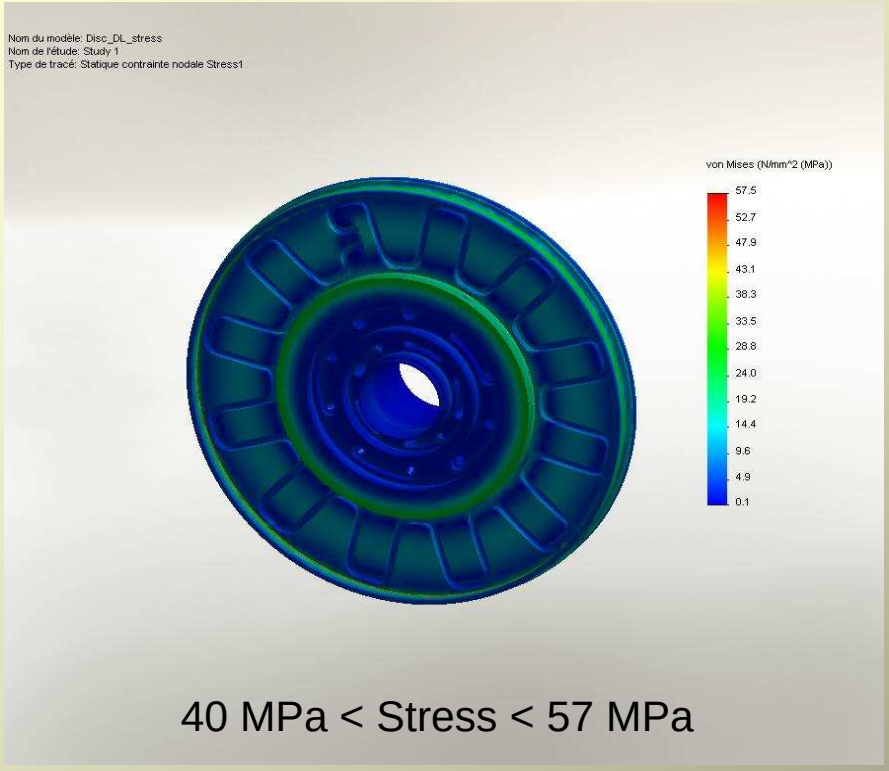
- e beam welding to join the angles.
- e beam welding for the end discs after the frequency tuning steps.



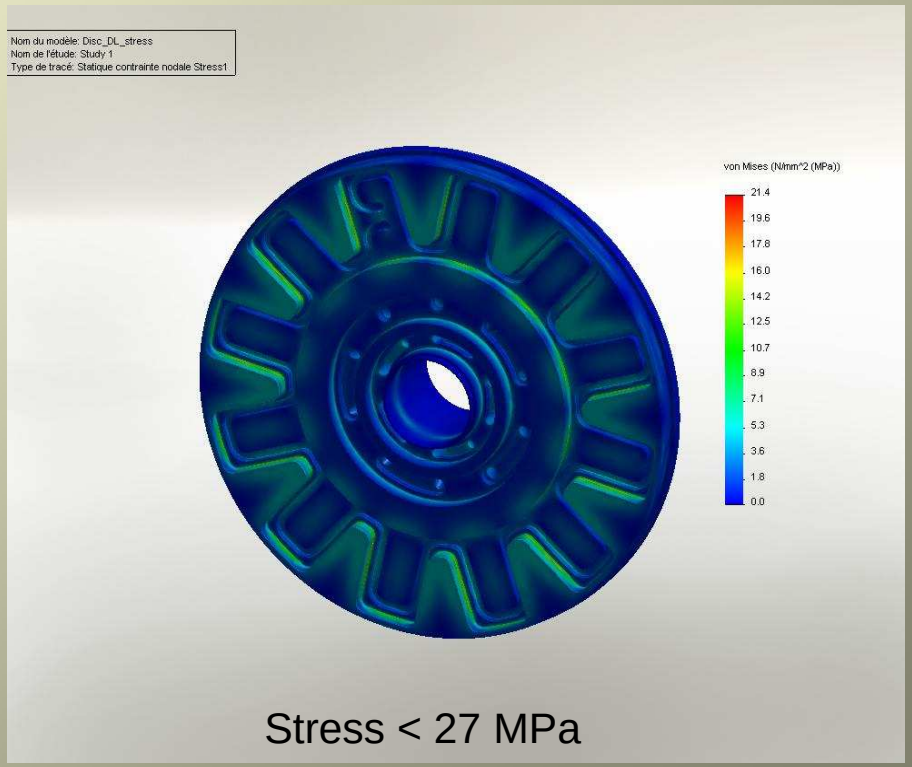
Copper prototype

- **Stress calculation :**

  - max water pressure = 15 Bars



40 MPa < Stress < 57 MPa



Stress < 27 MPa

⇨ The Maximum stress computed in the e beam weld area is reduced by increasing the e beam welding surface.

Conclusions and Perspectives

- ✓ Validation of the simulation model by an aluminum prototype.
- ✓ Two different fabrication processes for the power prototype.
- ✓ Ferrite infra red test bench under development.
- ✓ Delivery of three prototypes expected by the end of 2010 followed by tests.