New ESRF cavities – bit by bit*

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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.

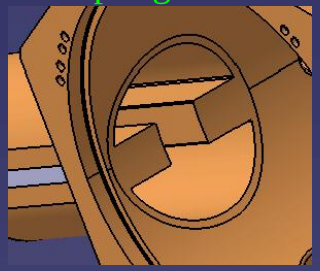
- The system should be operational with 12 cavities.

From simulations to copper prototype ….

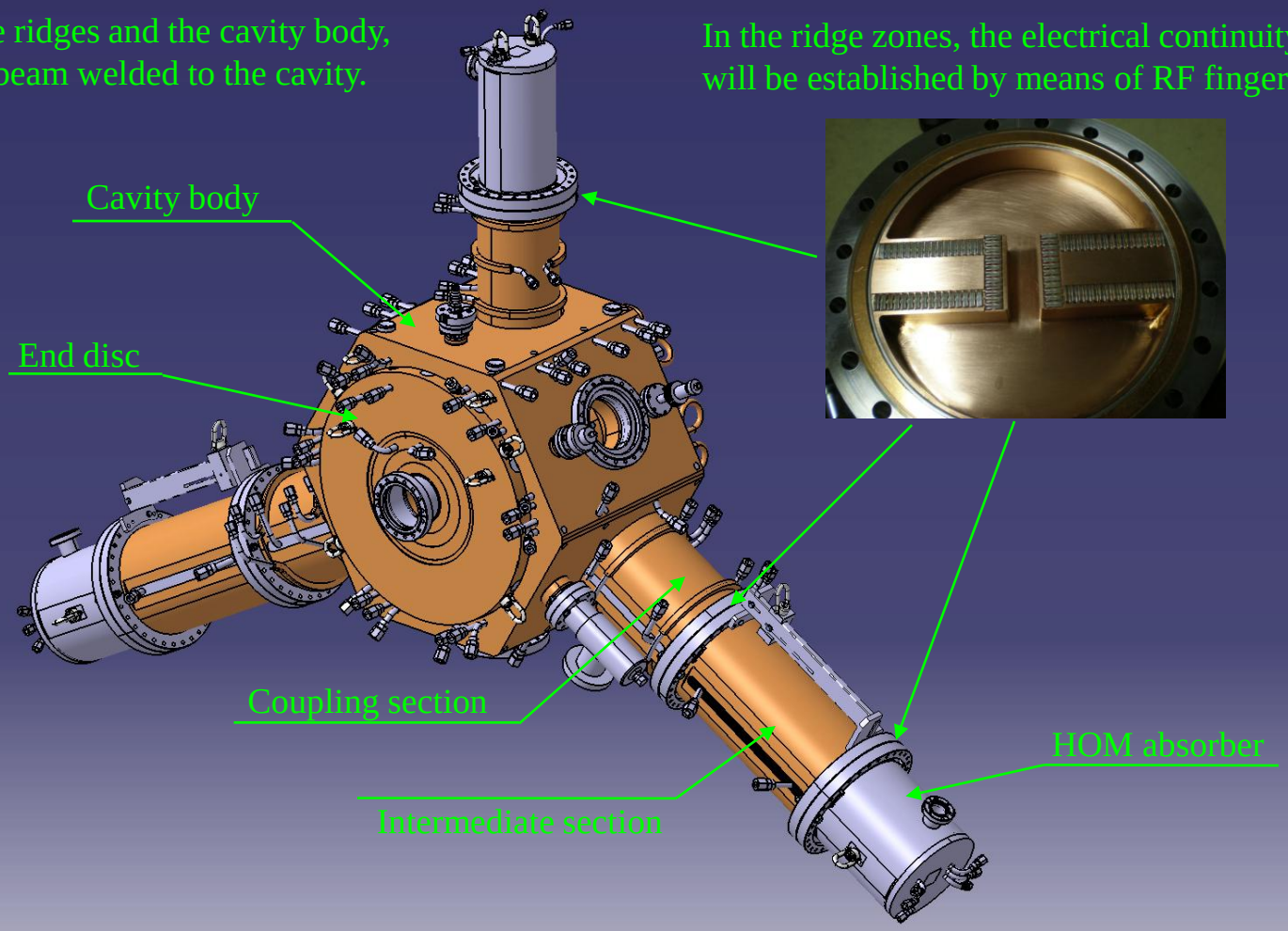
- Validation of the RF design on aluminium prototype: all HOM below threshold of 1 A
- Assembly design done in collaboration with external companies
- Mechanical design of cooling circuit made in house
- March 2009: Pre-qualification exercise (29 companies)
- May 2009: Call for tender (4 pre-qualified companies)
- July 2009: 3 technically conforming offers received
  - 1st Prototype ordered from RI - Research Instruments (D) in July 09
  - 2nd Prototype: deviating proposal from SDMS (F), with an interesting alternative technical approach
    - → fully new design carried out mainly by ESRF design team
    - → order of 2nd prototype from SDMS in November 09
  - 3rd Prototype: ordered from CINEL, who evaluated both approaches and selected the alternative design
  - ☞ Maximizing the chances of success
  - ☞ Having a market for the fabrication of remaining 16 or 17 cavities

Copper prototype – design aspect

- No gap bewteen the ridges and the cavity body,
- coupling section e-beam welded to the cavity.

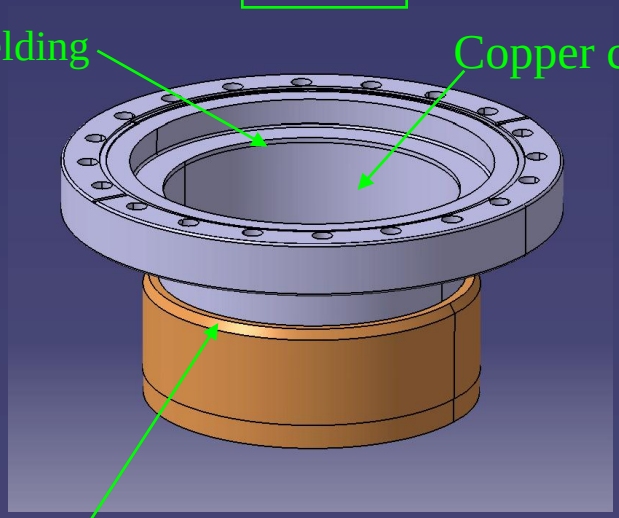


In the ridge zones, the electrical continuity will be established by means of RF fingers.

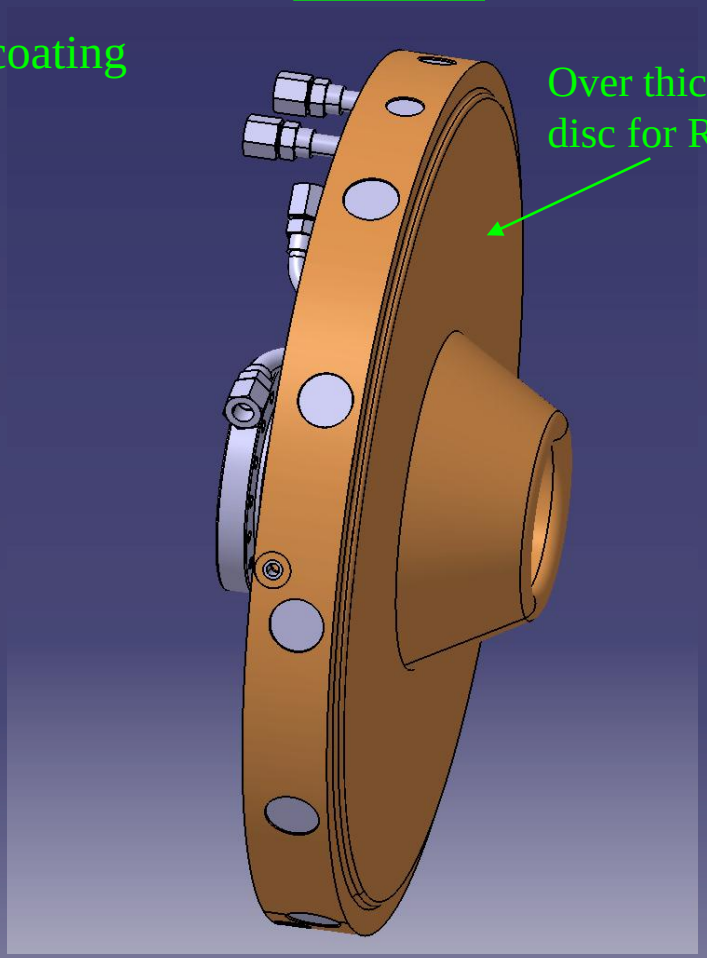


Copper prototype – Mechanical design

Outlets



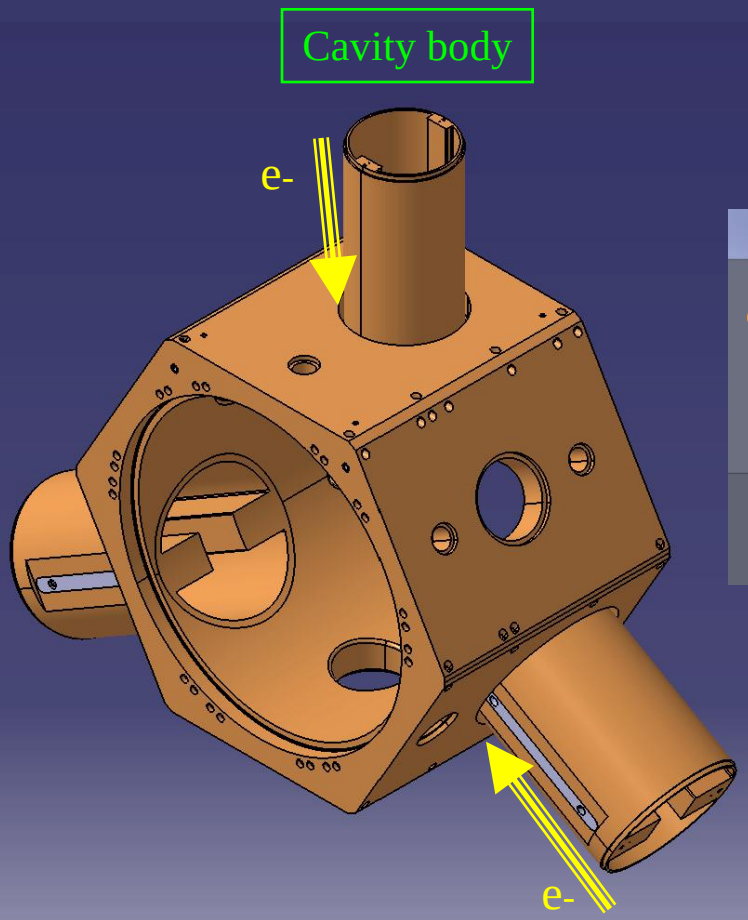
End disc

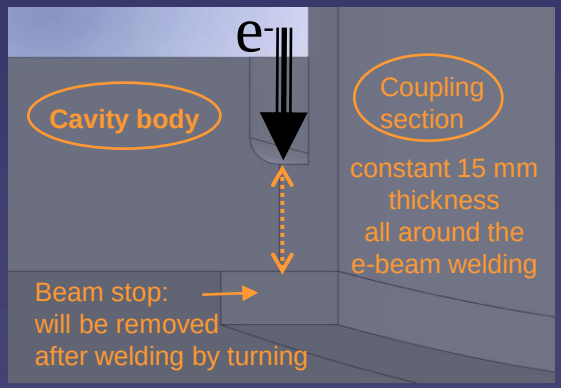


Outlet and cooling circuits are brazed in one step.

Copper prototype – Mechanical design

The coupling sections are e-beam welded from ouside on a constant 15 mm thickness.

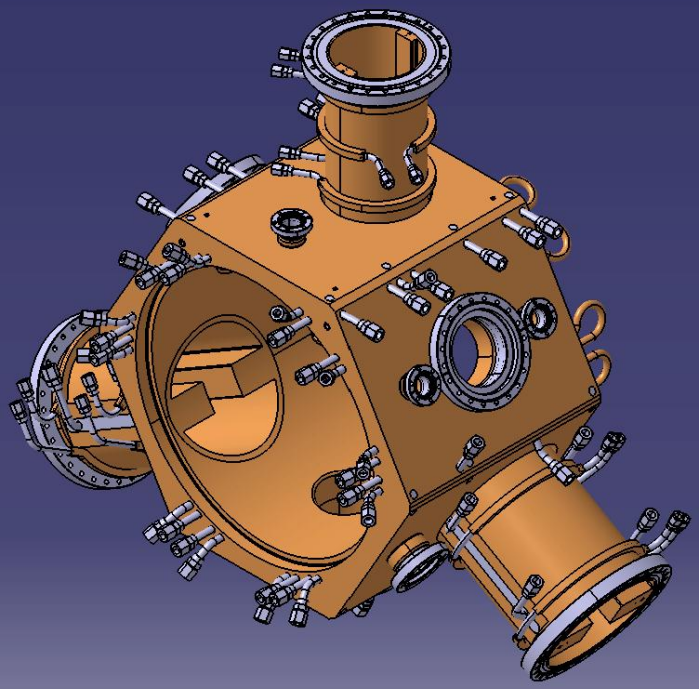




Copper prototype – Mechanical design

Cavity body

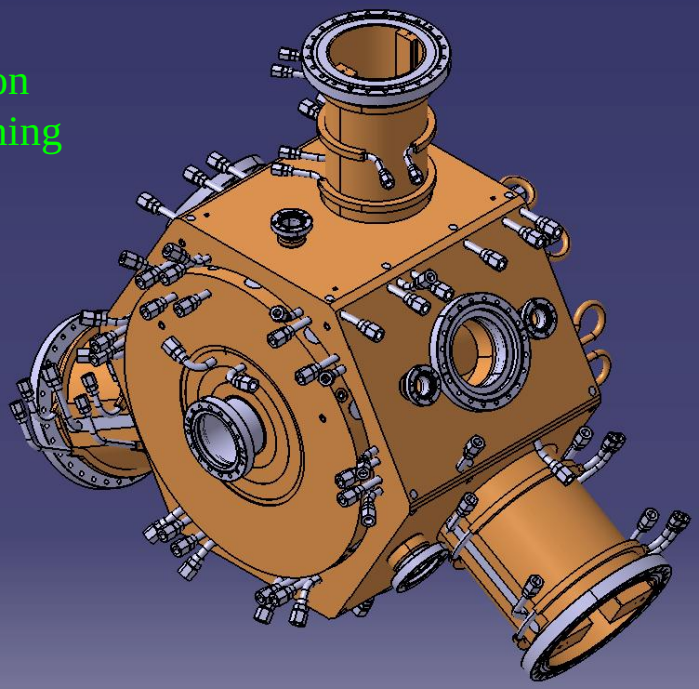
Vacuum flanges, outlets and cooling circuit are brazed in one step.



Copper prototype – Mechanical design

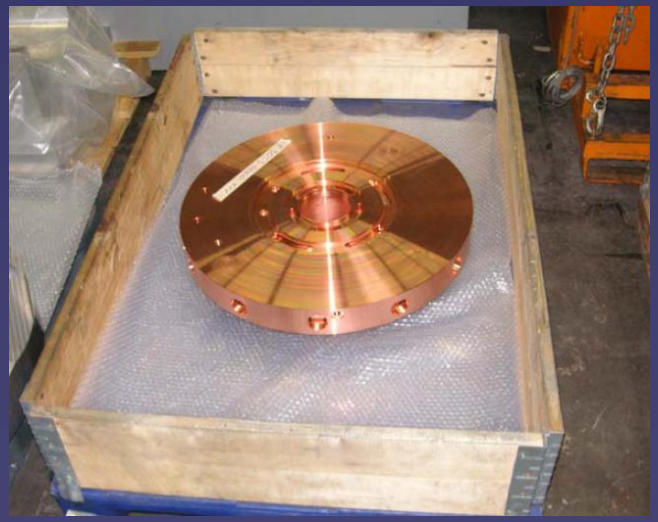
Cavity body

End discs are brazed on cavity body after RF tuning on one disc.



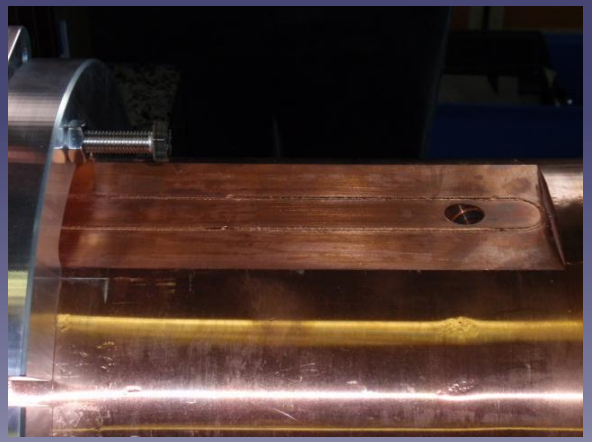
RI research instrument cavity

End disc



Outlets

E-beam welding of the water box on coupling section



[Photos: courtesy of RI research intruments]

RI research instrument cavity

Cavity before e-beam welding

Beam stop: -5 mm on the radius

[Photos: courtesy of RI research intruments]

RI research instrument cavity

Cavity after e-beam welding & before machining of the beam stop

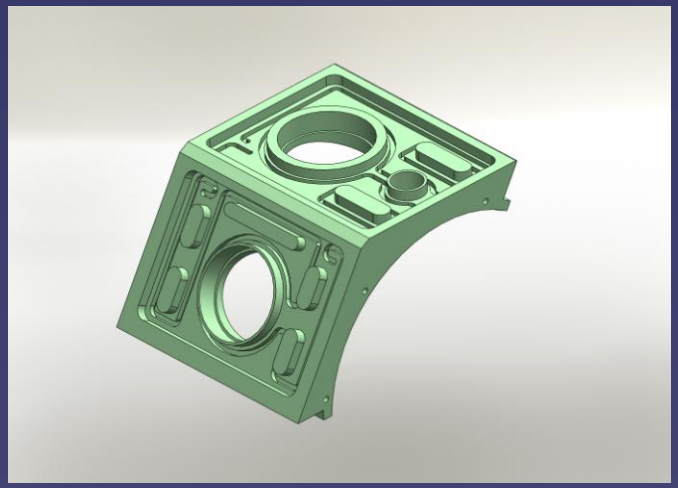
[Photos: courtesy of RI research intruments]

RI research instrument cavity

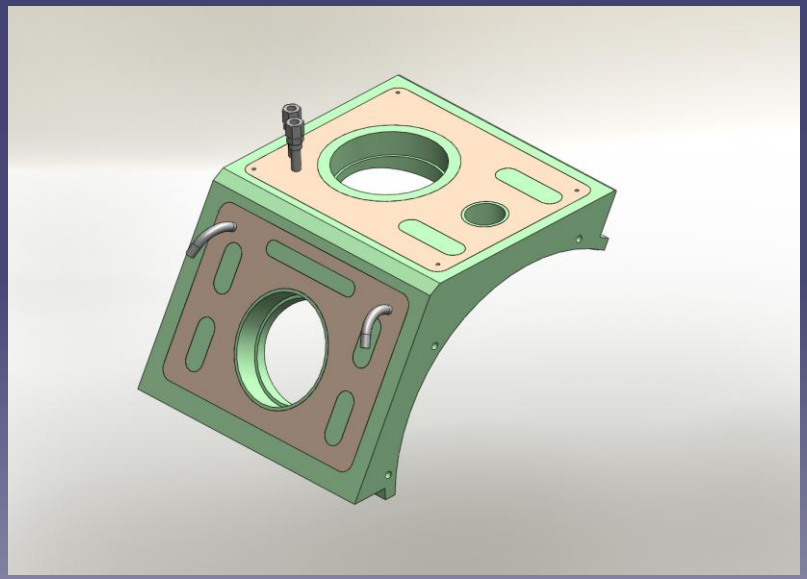
- In the coming months:

  - brazing of the end discs
  - brazing of the cavity body
  - RF tuning
  - brazing of the end discs on the cavity body
  - FAT & delivery at the ESRF before the end of the year

Copper prototype – Alternative mechanical design

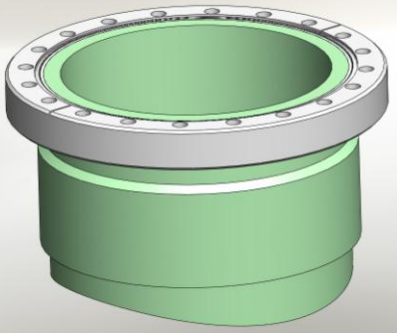


e-beam welding for assembly



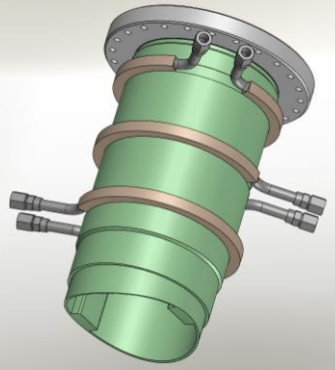
Copper prototype – Alternative mechanical design

Brazing Cu/Stainless steel

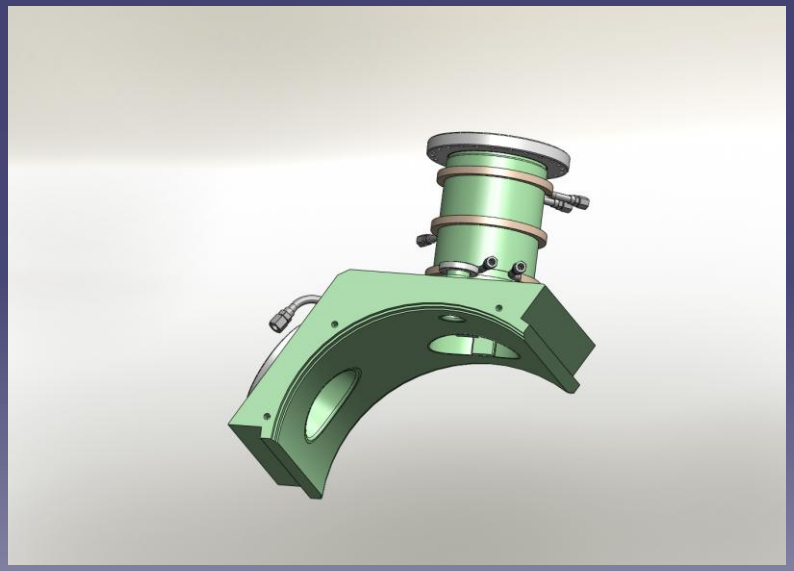


No copper coating

Brazing Cu/Stainless steel



Outlets and coupling sections e-beam welded from inside

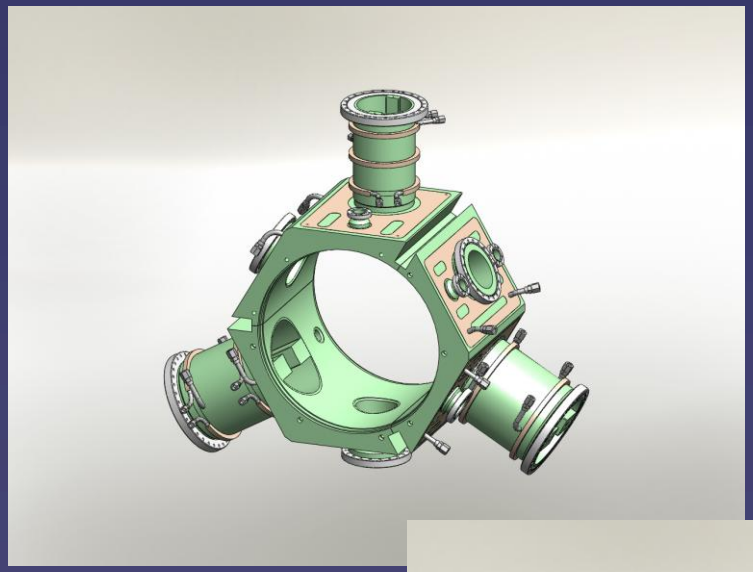


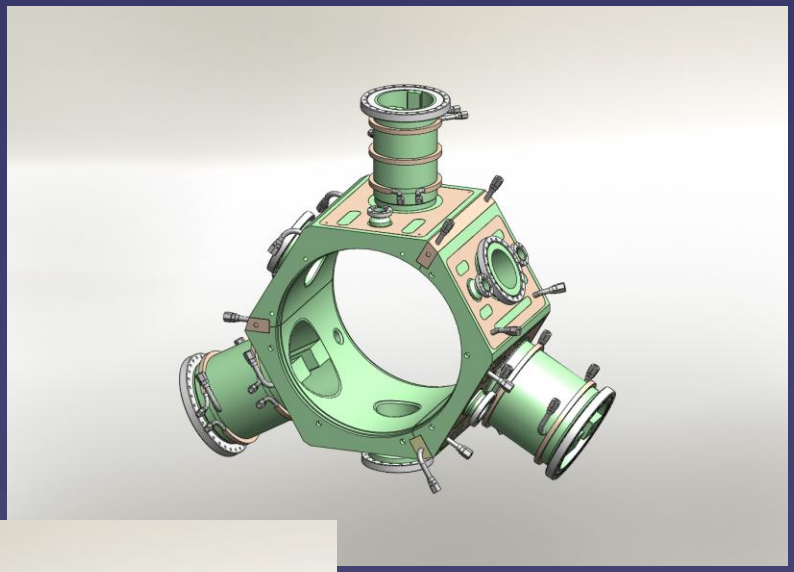
Copper prototype – Alternative mechanical design

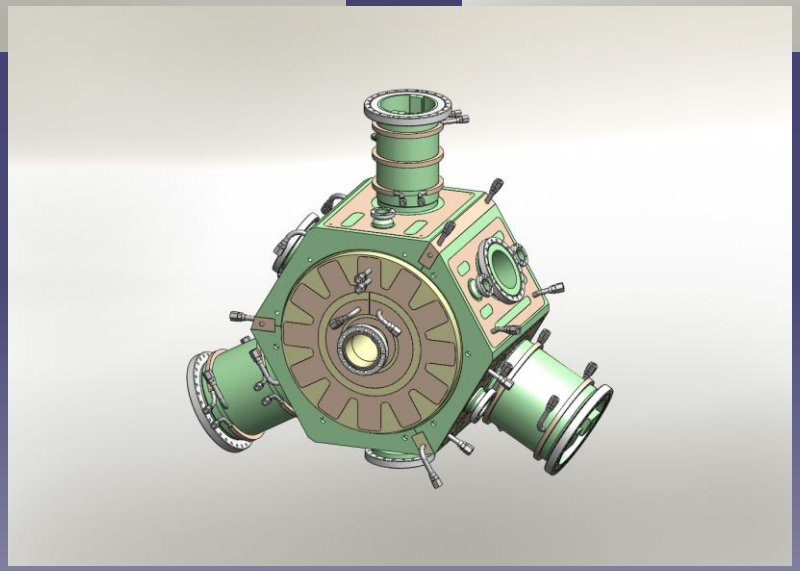
Brazing Cu/Stainless steel

Outlets and covers of cooling system e-beam welded

Copper prototype – Alternative mechanical design



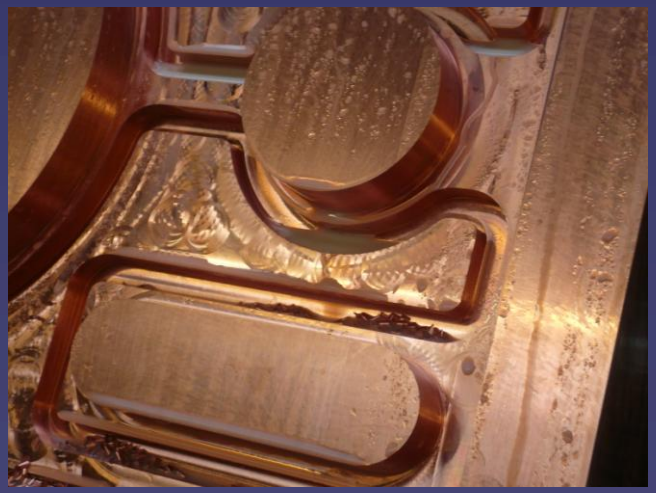




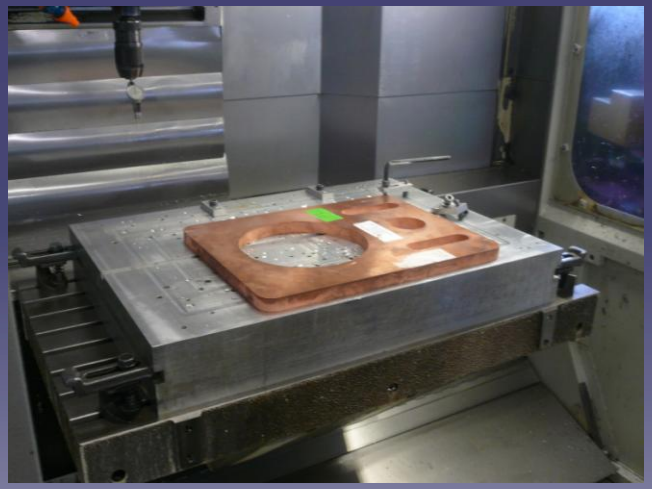
Only e-beam welding for assembly

SDMS cavity

Machining of the cooling circuit of the cavity body …

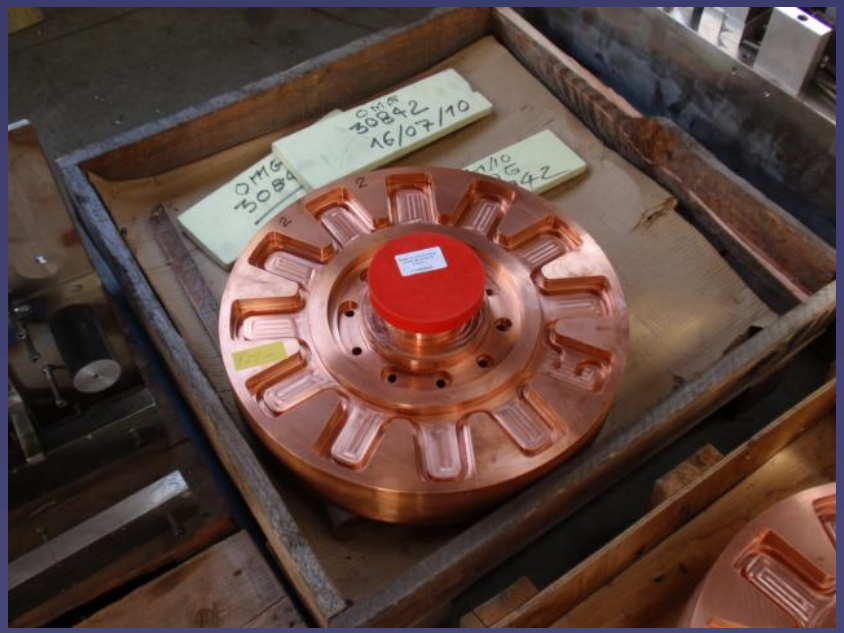


… and the cover.



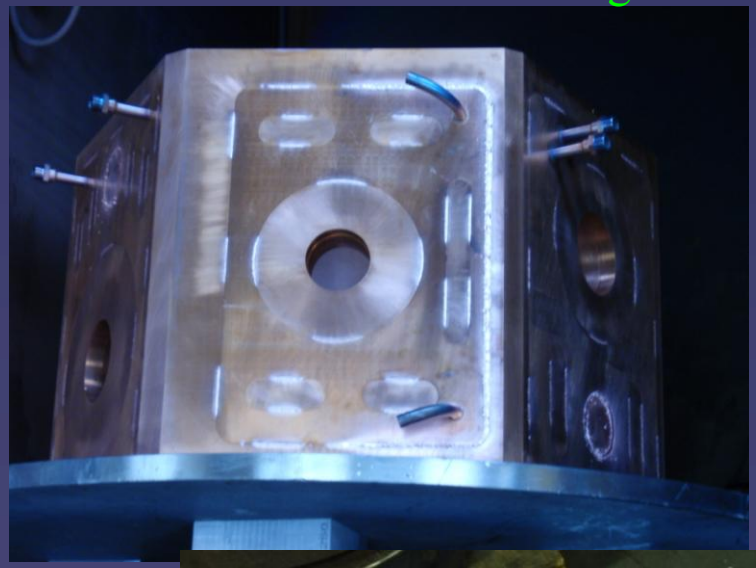
SDMS cavity

The end disc “marguerite” before e-beam welding

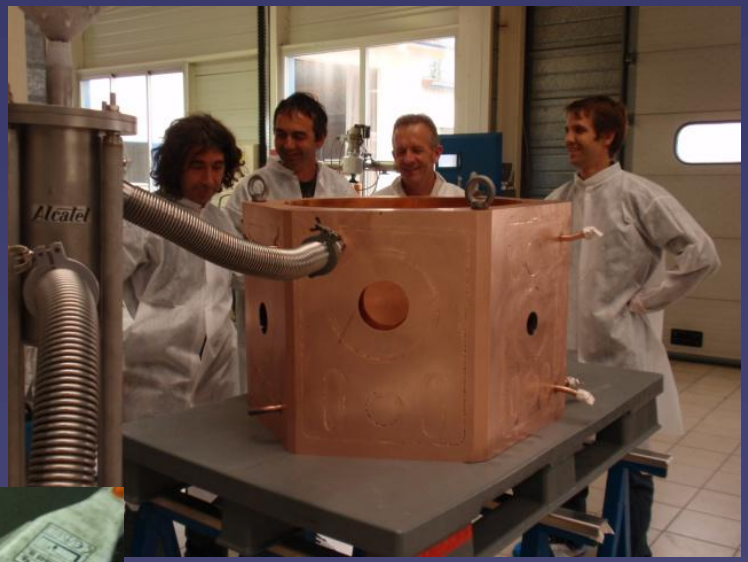


SDMS cavity

Start of the e-beam welding ….



… helium leak detection & water cooling circuit test.



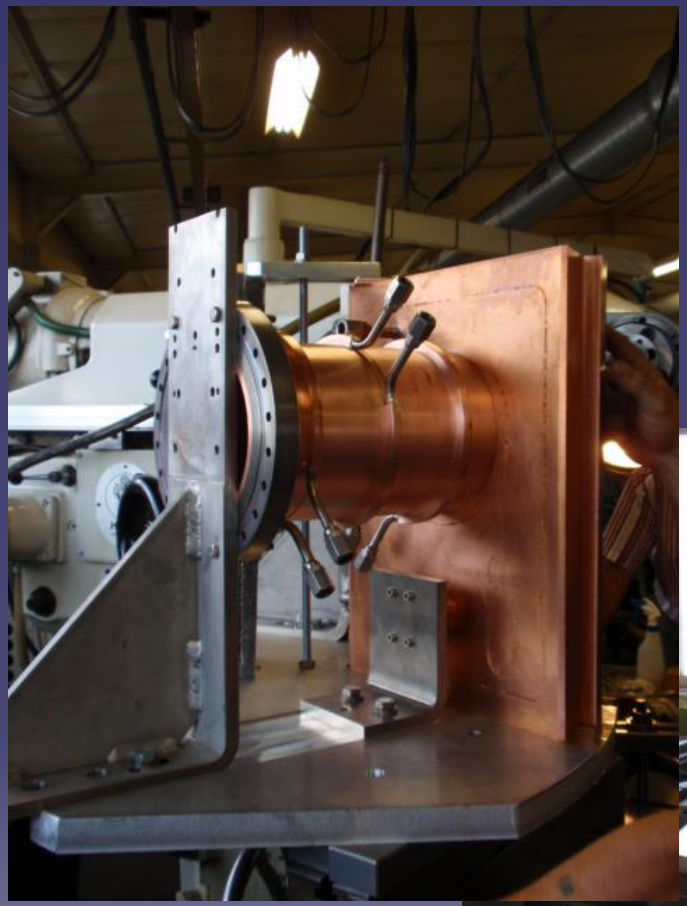
The cavity body and the end discs are water tight !!!

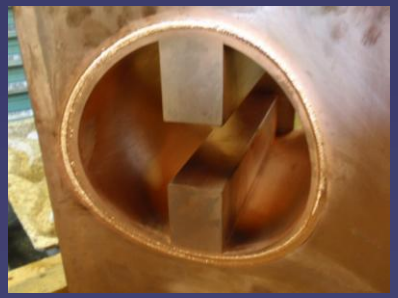
SDMS cavity

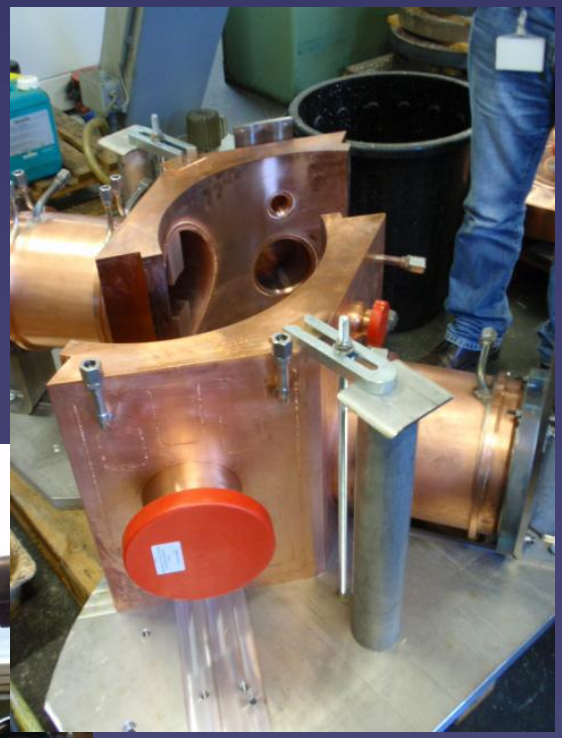
Then the cavity body is cut in three parts.

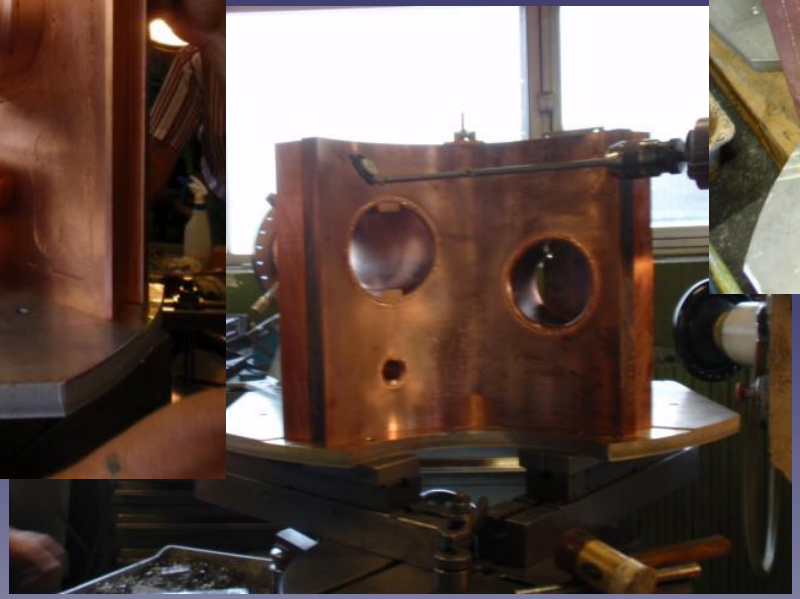
SDMS cavity

E-beam welding of coupling section and outlets from inside.









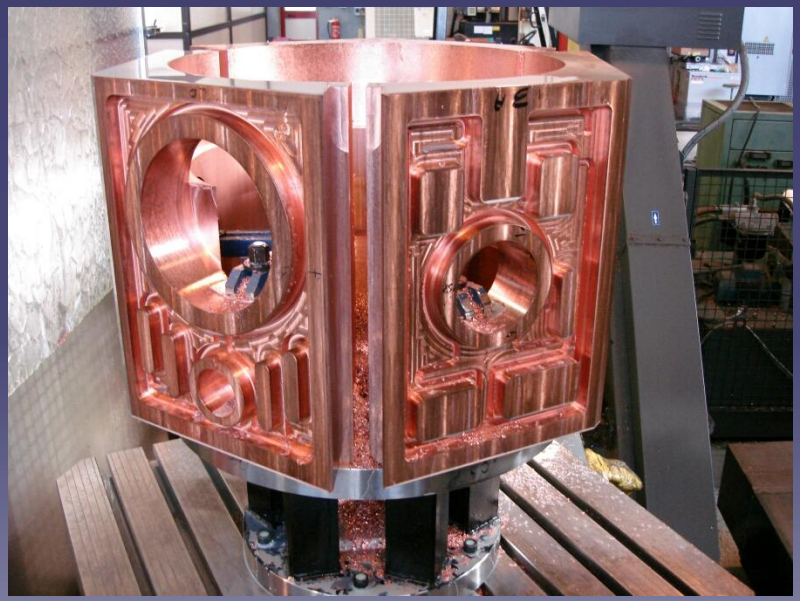
SDMS cavity

- In the coming months:

  - e-beam welding of the three sectors
  - machining of inner diameter to final dimension
  - e-beam welding of the additional cooling wedges
  - RF tuning procedure & e-beam welding of end discs
  - FAT & delivery at the ESRF before the end of the year

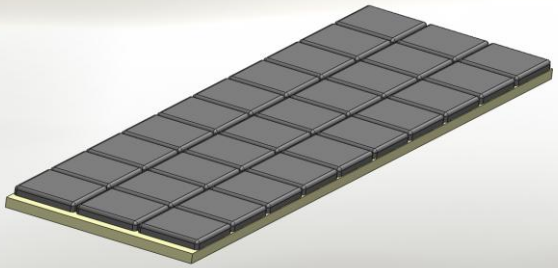
CINEL cavity

- CINEL has already machine all the part of the cavity
- Assembly by e-beam welding will start in October
- FAT & delivery at the ESRF expected for March 2011

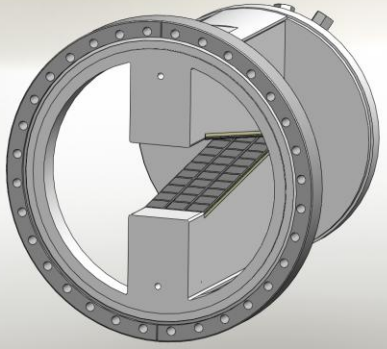


HOM dampers

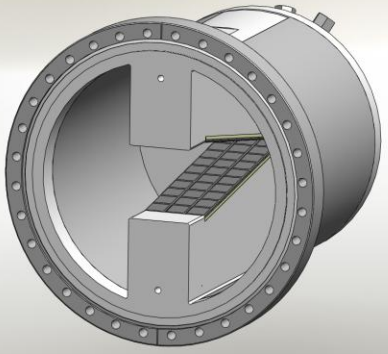
Ferrite brazed on copper plate



Copper plate brazed on stainless steel



Cover TIG welded

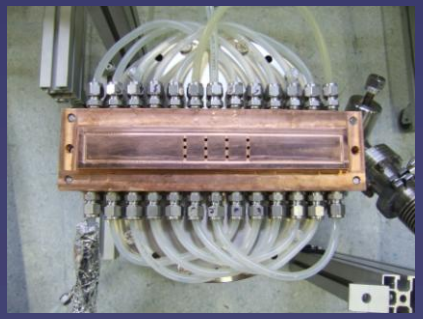


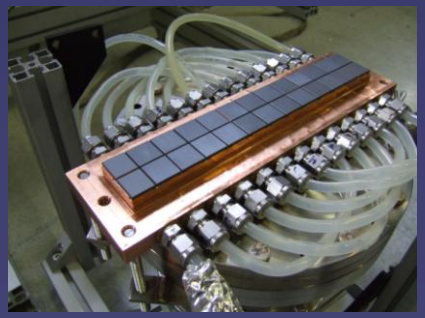
- RI and CINEL follow the initial design,
- SDMS prefers to braze the ferrite directly on stainless steel.

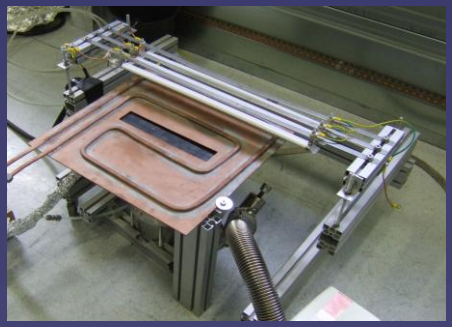
IR tests

- Experimental set up for the RI and CINEL copper brazed ferrites :

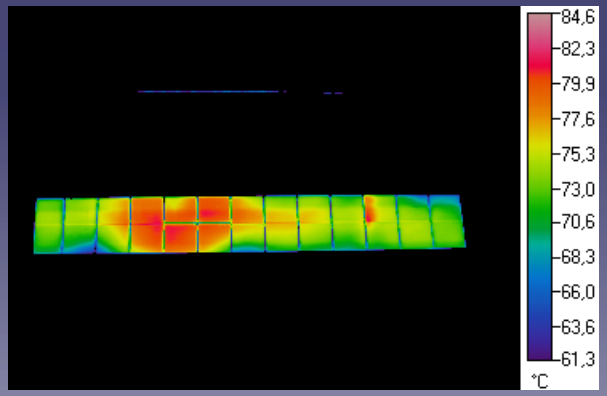
  - IR radiators provide the power estimated equal to 5W/cm^2.



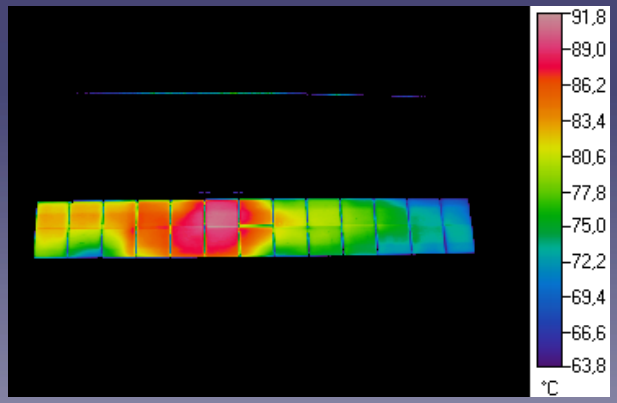




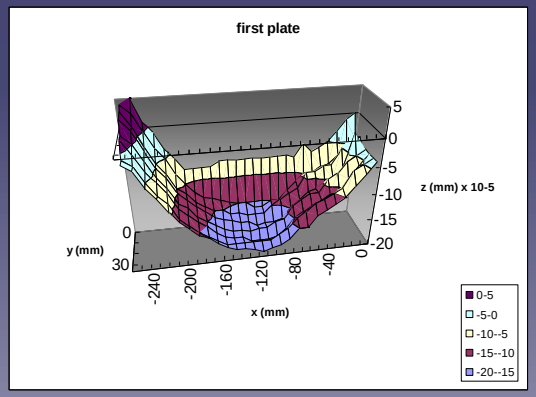
- Results for RI plates:



180º rotation



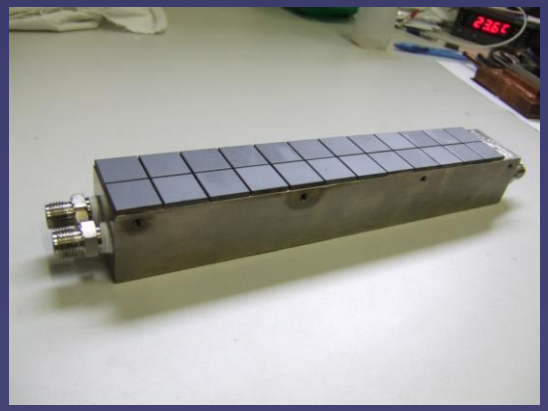
planarity measurement

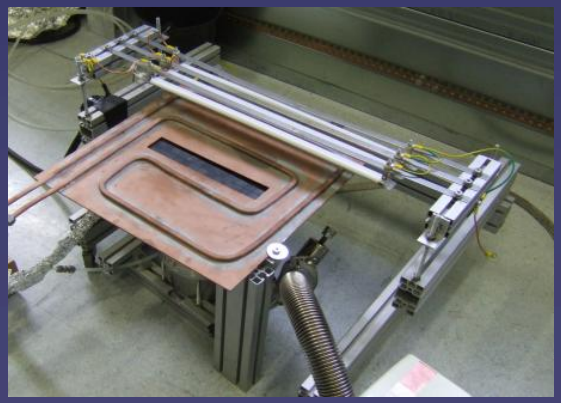


IR tests

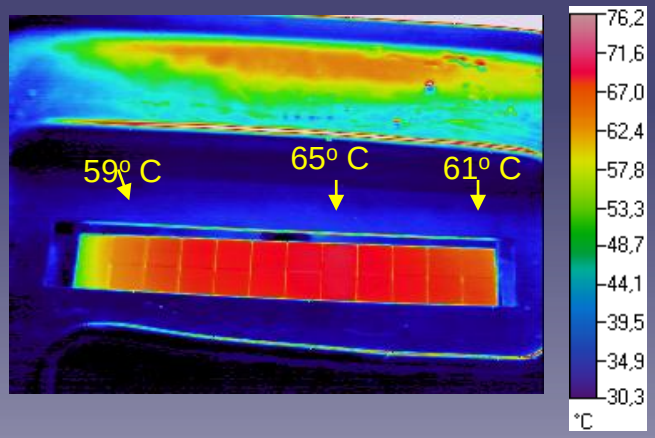
- Experimental set up for the SDMS stainless steel brazed ferrites :

  - The cooling system is drilled on the stainless steel base.
  - The ferrites are brazed on the stainless steel.

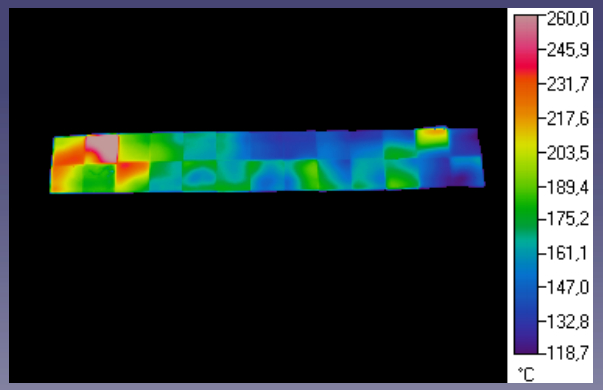




- Results :



Reference image for bad quality brazing



Conclusions

- The fabrication of the three prototypes progresses well
- Expected delivery time for cavity + intermediate sections + HOM dampers
  - RI research intruments: November 2010
  - SDMS: November 2010
  - CINEL: March 2010
- Followed by RF conditioning in the test stand
- Beam conditioning in place of cavity 5 on the storage ring
- More good news next year ……