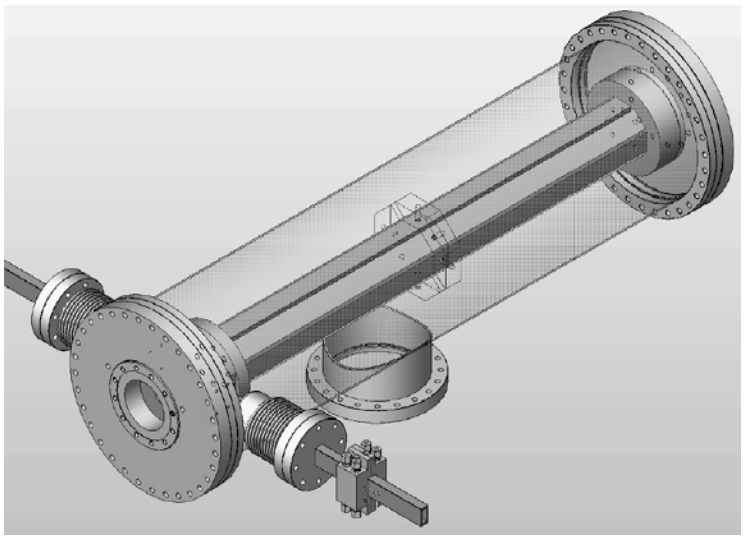
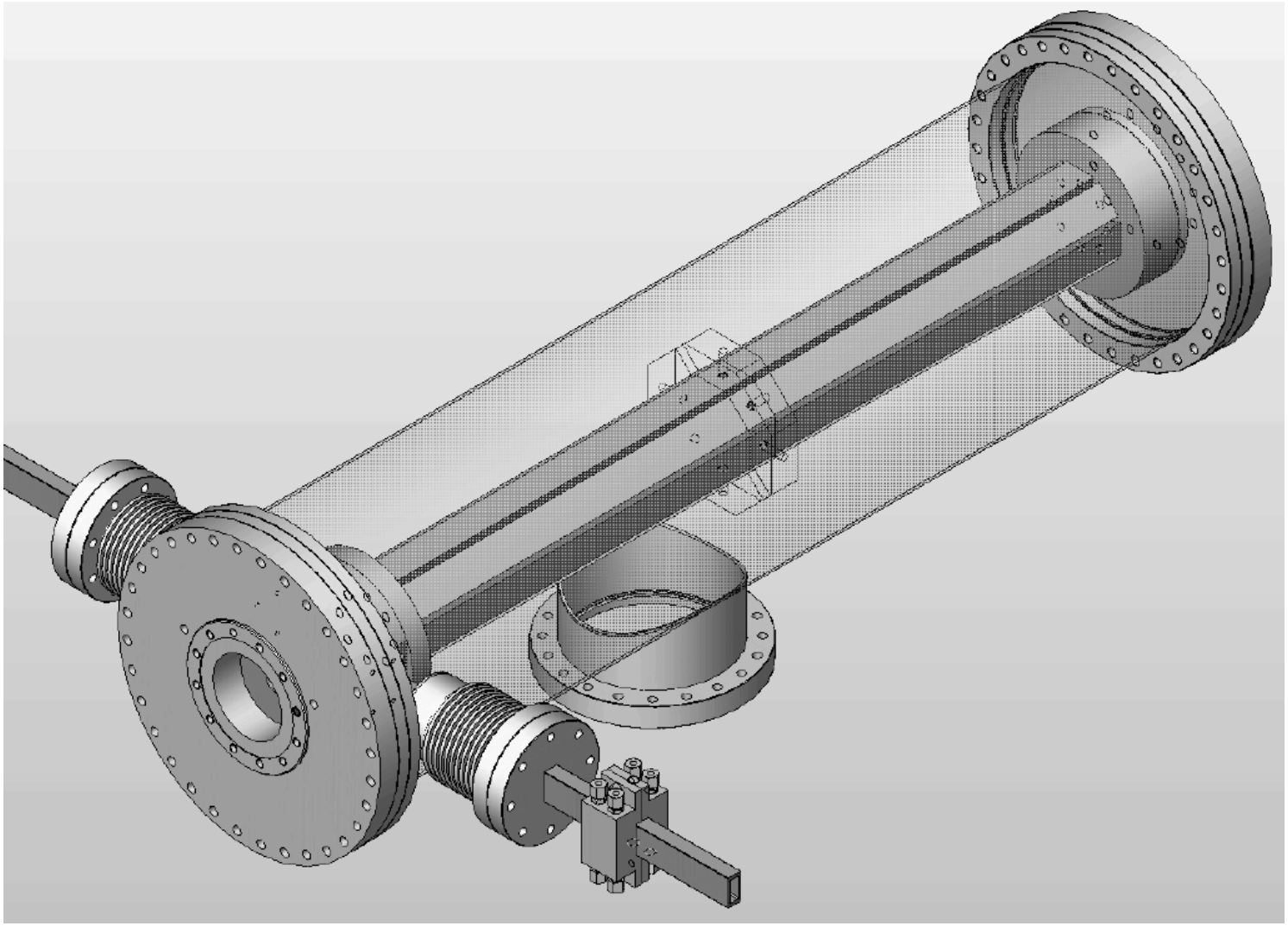
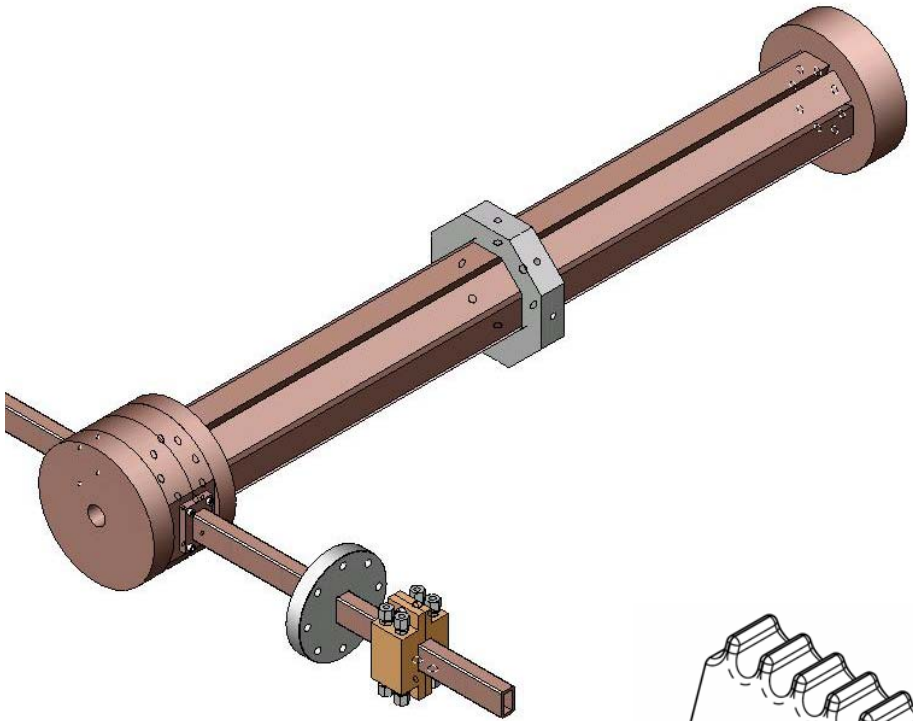
PETS tank conceptual design

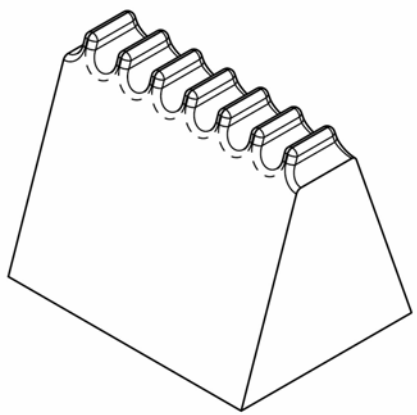


General layout



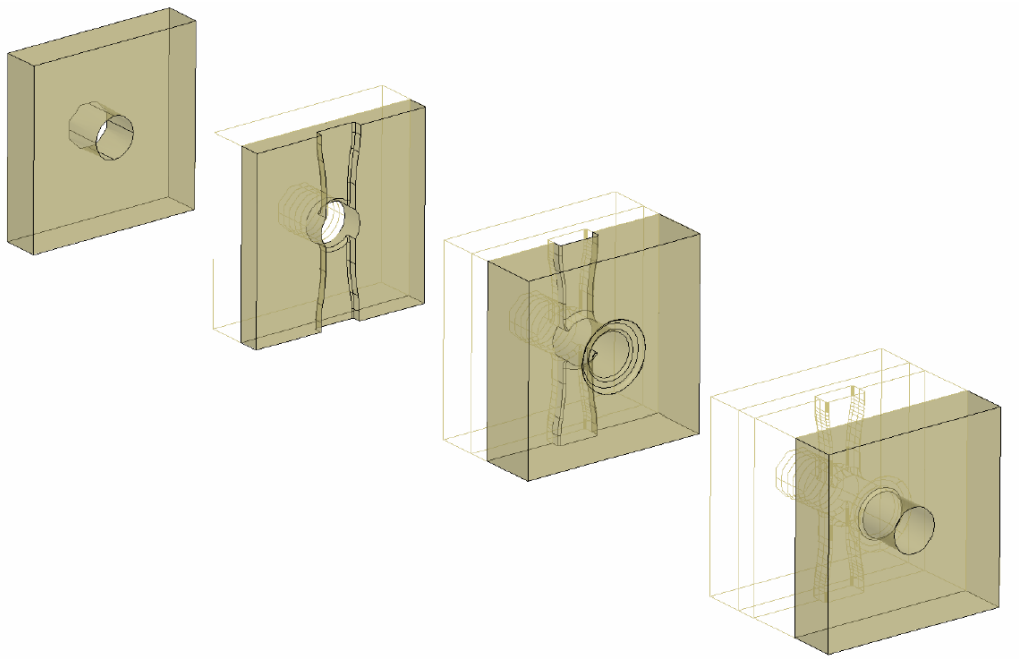
Copper rods





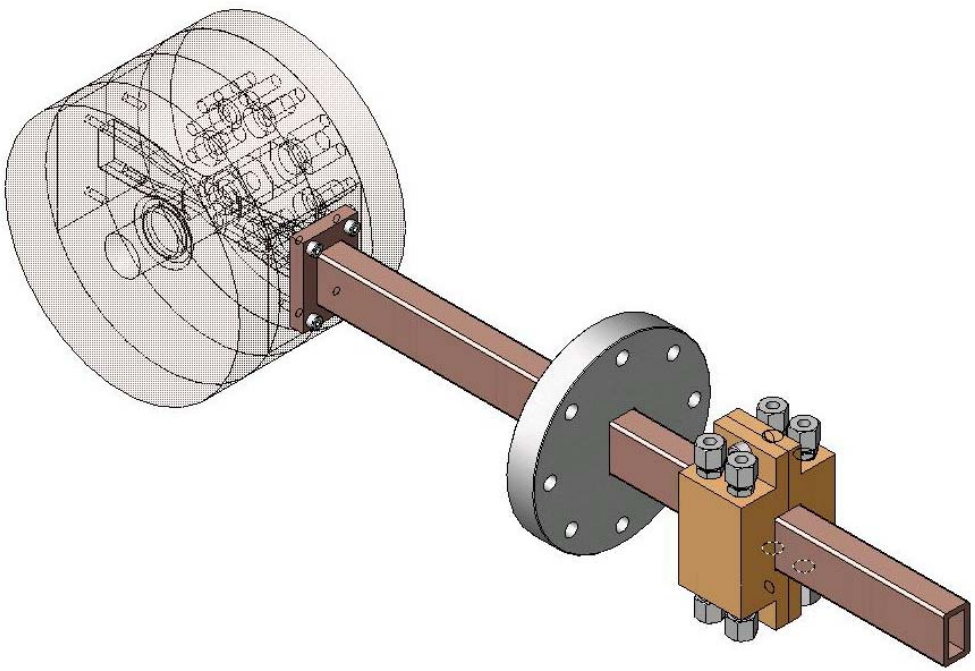
- End rings for reference: two pins on each rod.
- Enhanced thermal contact: all the rods have exactly the same length and contact pressure is made by bolts.
- Intermediate St. steel ring: the assembly is stiffer and the sag (up to 22 micron for a free rod) is eliminated.
- Several short probes (40 mm) machined at different Spanish firms.

Power extractor



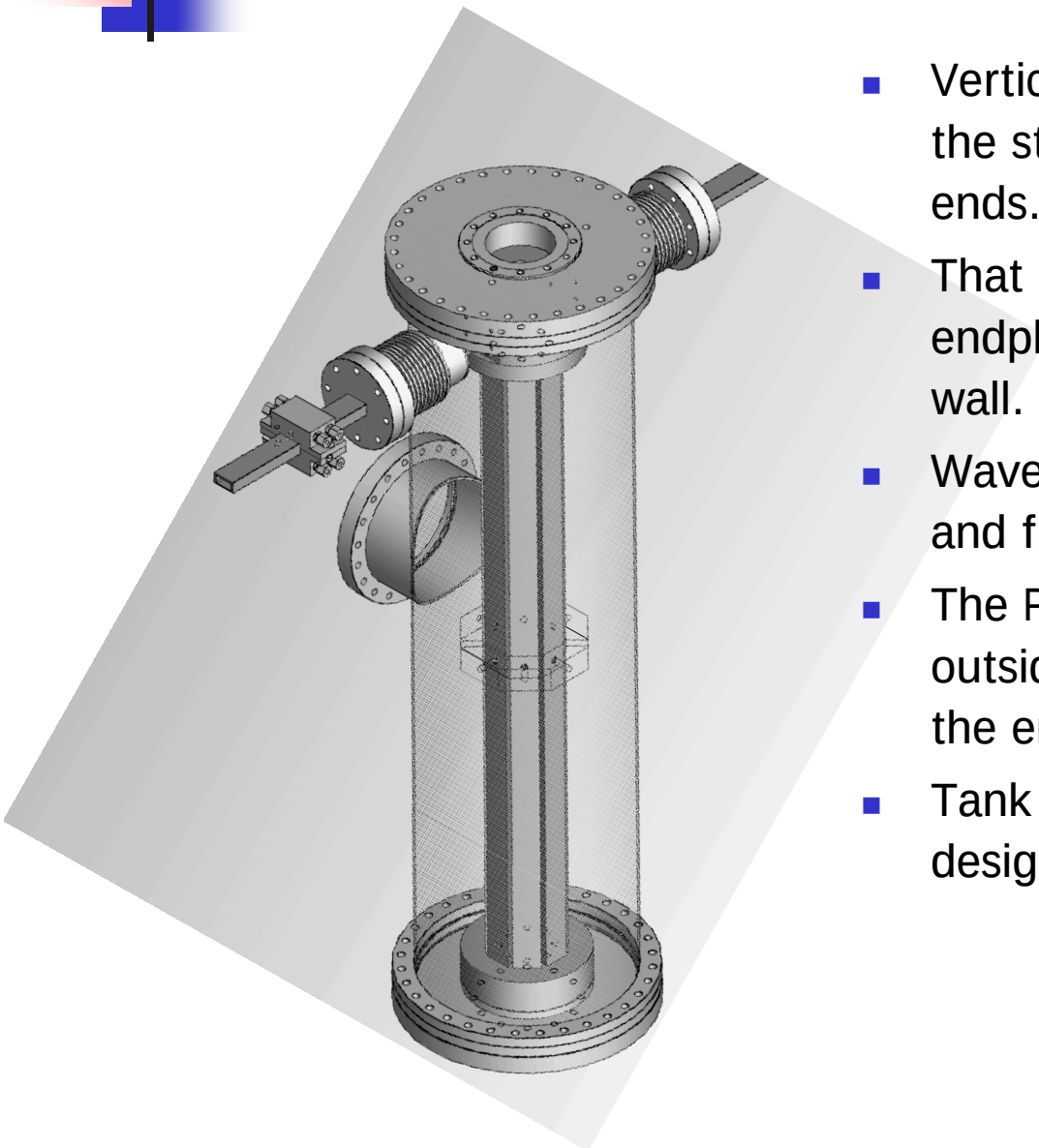
- Machined in four parts with pins for reference.
- Brazing to avoid virtual leaks and to enhance electric contact. It is important to avoid migration of brazing alloy into waveguide.
- We prefer round pieces to free some space for manipulation inside the tank during assembly.

Waveguides



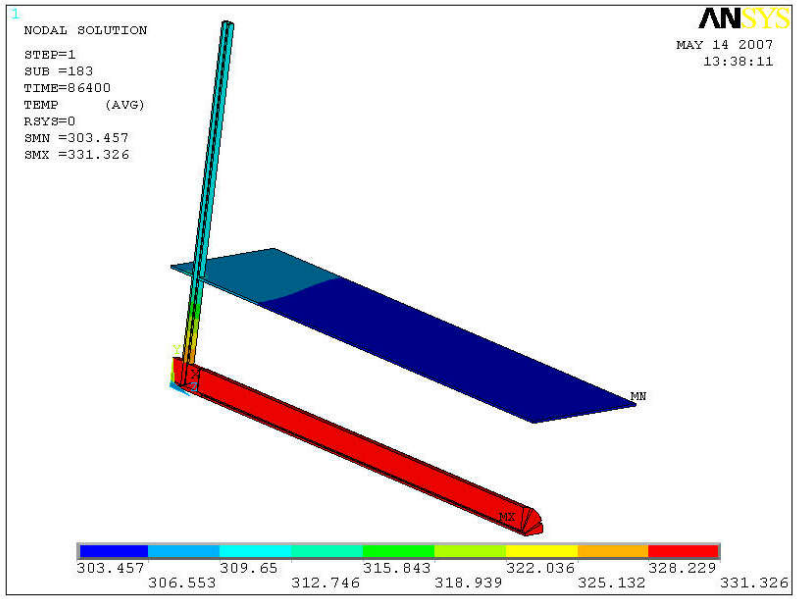
- Thick wall WR90 waveguides: 3.17mm.
- RF flange on the power extractor not defined yet. Large contact surface will decrease thermal resistance. It should be fixed once the copper set is inside the tank!
- A stainless steel vacuum flange should be brazed to the waveguide to close the tank. Bellows will allow for misalignment.
- An additional copper flange will provide additional cooling if necessary.

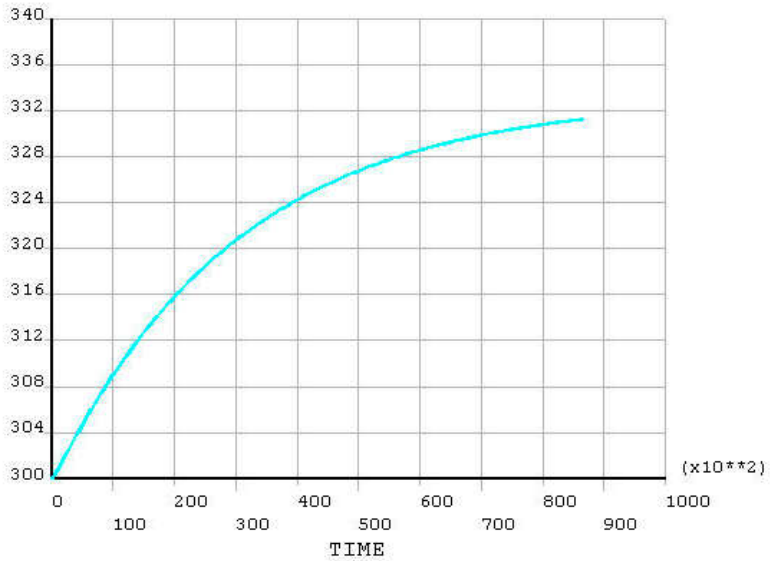
Assembly



- Vertical assembly of the copper rods, the stiffening ring and the two copper ends.
- That block is placed on top of the tank endplate, and surrounded by the tank wall.
- Waveguides will be fixed afterwards, and finally, the tank will be closed.
- The PETS axis reference is transferred outside by means of two pins drilled on the endplates.
- Tank interface with the girder is still not designed. Neither alignment system.

Thermal calculations (I)



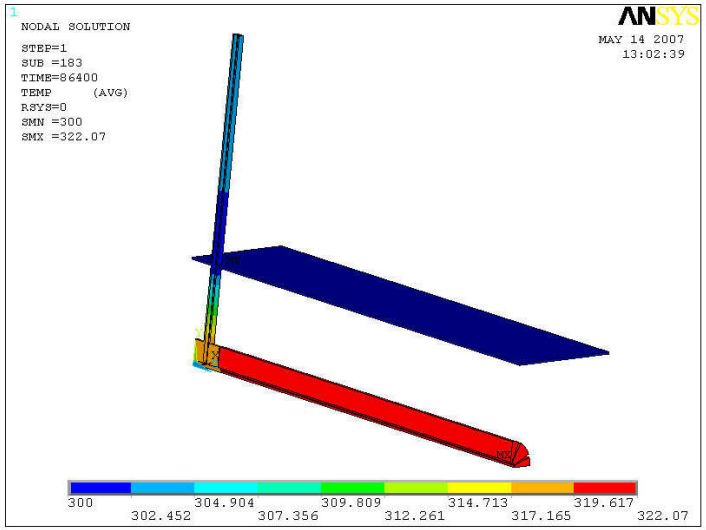


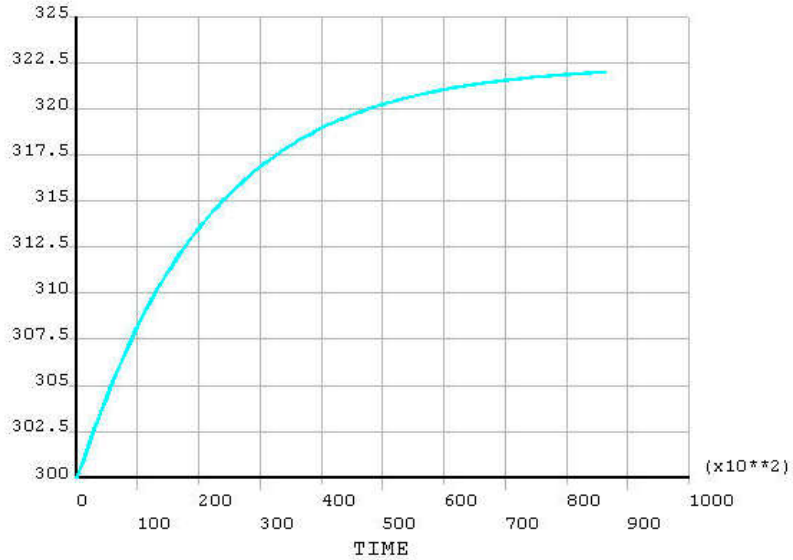
- Steady state FEM: only conduction and natural convection.
- Heating due to RF losses (imported from HFSS and averaged) and beam losses:

$$P_{beam\_losses} = 0.1 \times 150MeV \times 30A \times 140ns \times 5 = 315W$$

- Thermal contact resistances are modelled.
- After 24 hours of continuous operation, maximum temperature increase about 32ºC.

Thermal calculations (II)

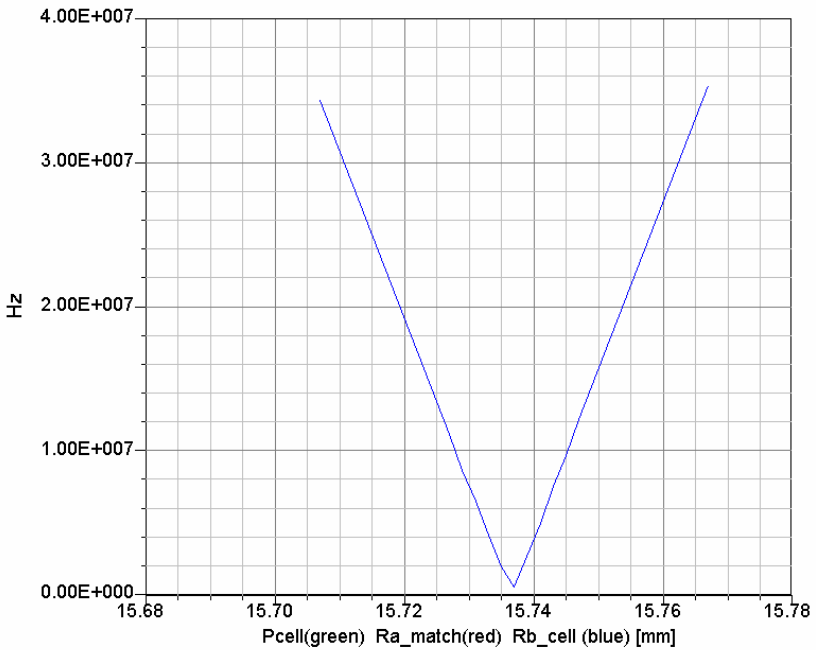


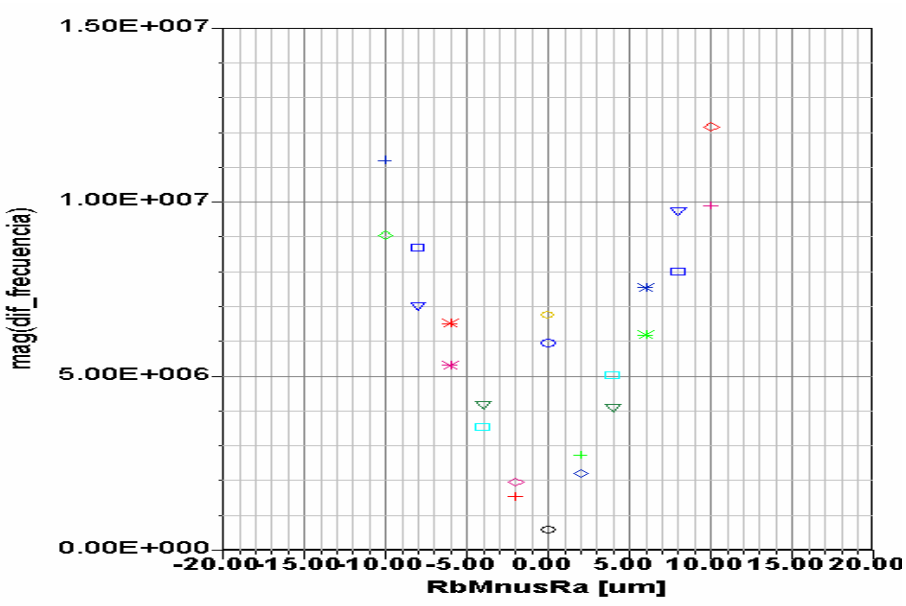


- If waveguide is cooled at the flange, temperature increase is about 10ºC lower.

Thermal calculations (III)

- A temperature increase of 30ºC means a unitary elongation of $5*10^{-4}$, that is, about 8 micron for the PETS radius.
- RF sensitivity analysis shows a variation of few MHz.





Courtesy of David Carrillo

Conclusions

- Conceptual design of PETS tank has just started. It is open for discussion.
- The main challenge is the machining of the copper rods.
- CERN experience is more than welcome, and interaction with TBTS PETS design team could be very profitable.