CLIC Workshop 2014 (3-7 February 2014)

Experience assembling structures with damping manifolds

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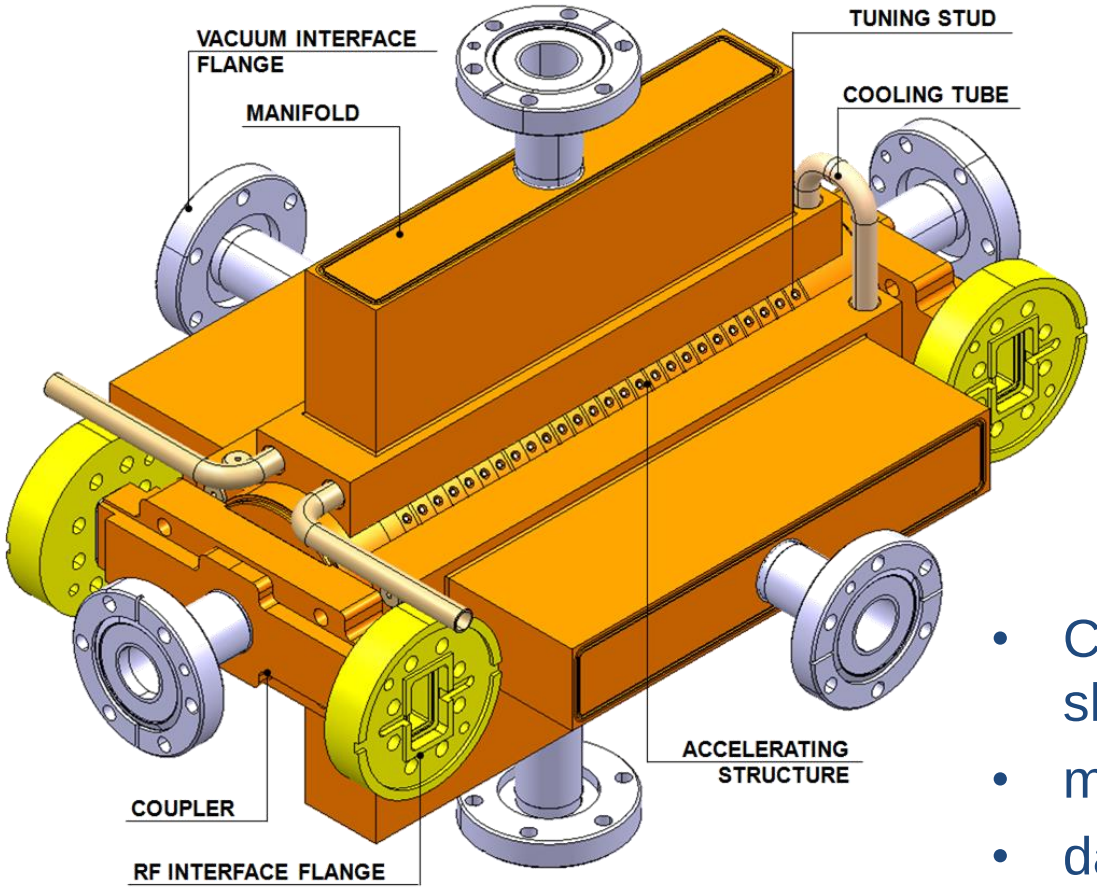
Aknowledgements to the x-band production team

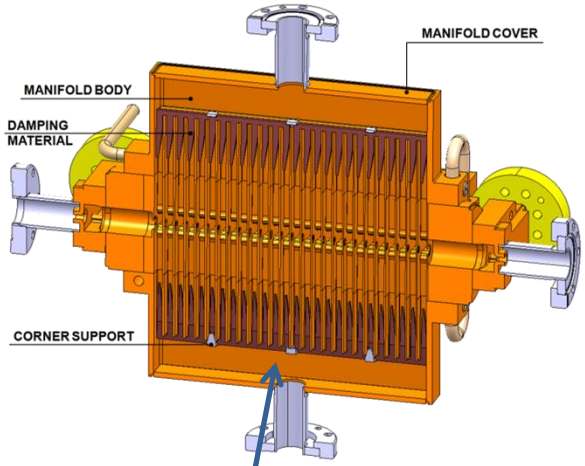
5 February 2014

Content

- Introduction
- Technical requirements, design and main components
  - TD24 R05 SiC
  - TBM LAB mock-ups
  - TBM CLEX TD26 (superstructure)
- Assembly procedure: from machining to installation
- Conclusions and next steps

Design and main components: **TD24 R05 SiC**

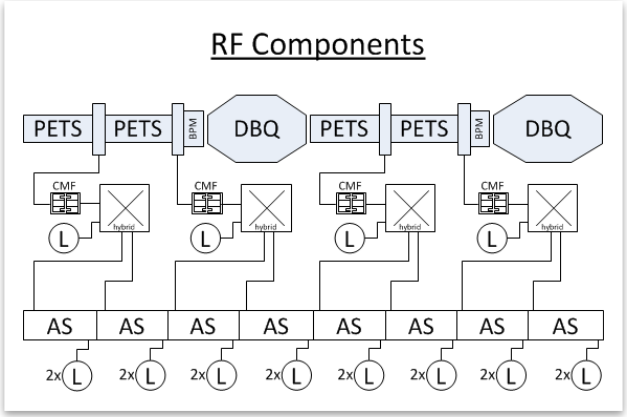


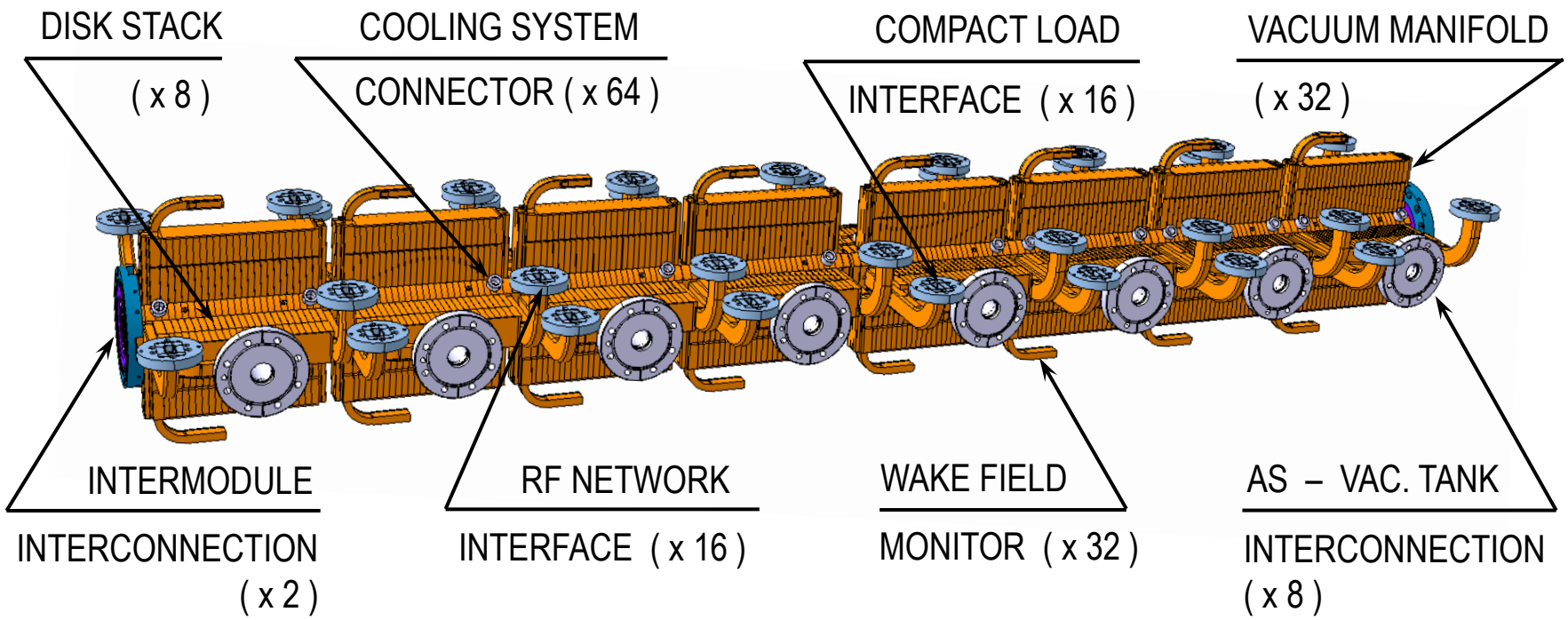


- Cu disk:
  shape accuracy ±2.5 μm
- mode launcher coupler
- damping loads
- brazed vacuum manifolds
- optimization of cooling circuit

Design and main components: **LAB mock-ups**

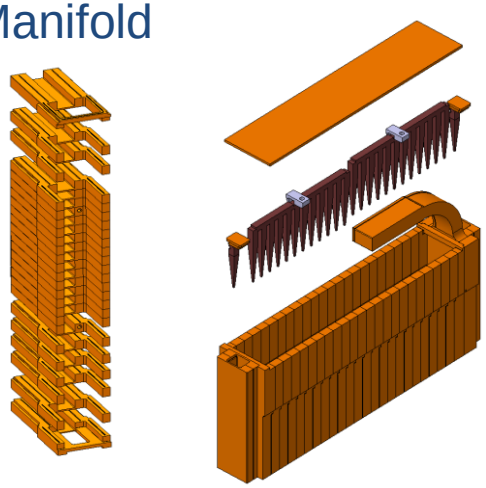
- Overall length 2010 mm (502.5 mm for CLIC module)
- Simplified parts = reduced cost
- Mechanical interfaces are equal to real AS
- Internal surface area is equal to real AS
- Cooling system is equal to real AS



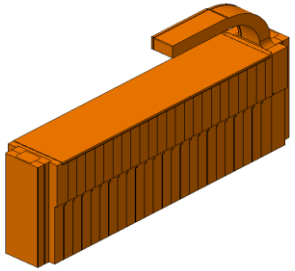


Design and main components: **LAB mock-up**

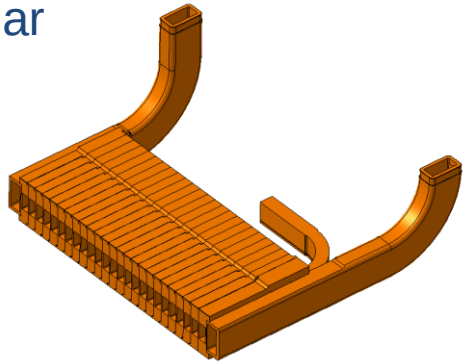
Manifold



Assembly learning process important for future structures (hundreds pieces)

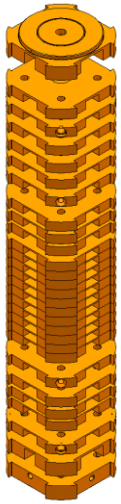


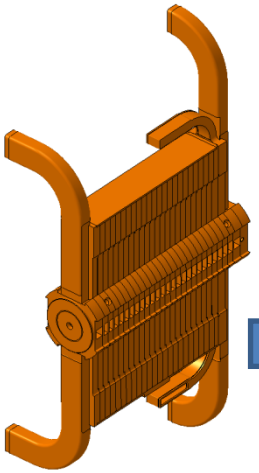
Assembly sequence for other types of manifolds is similar



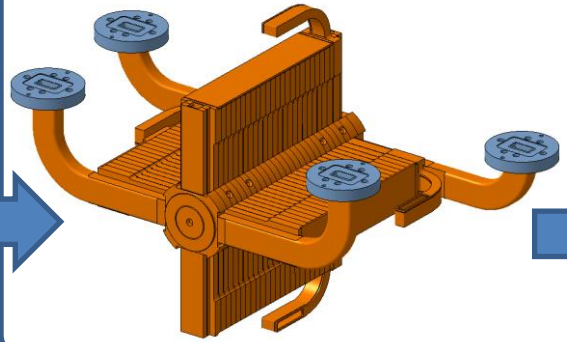
Assembly of the Super-AS

Disk stack (simplified disks)

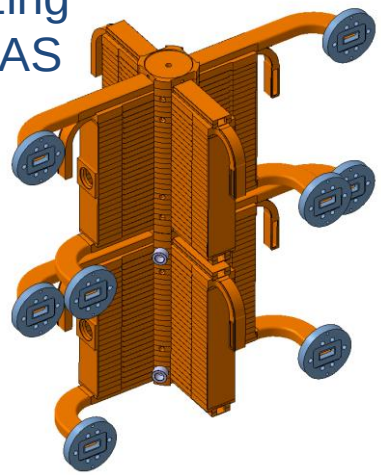




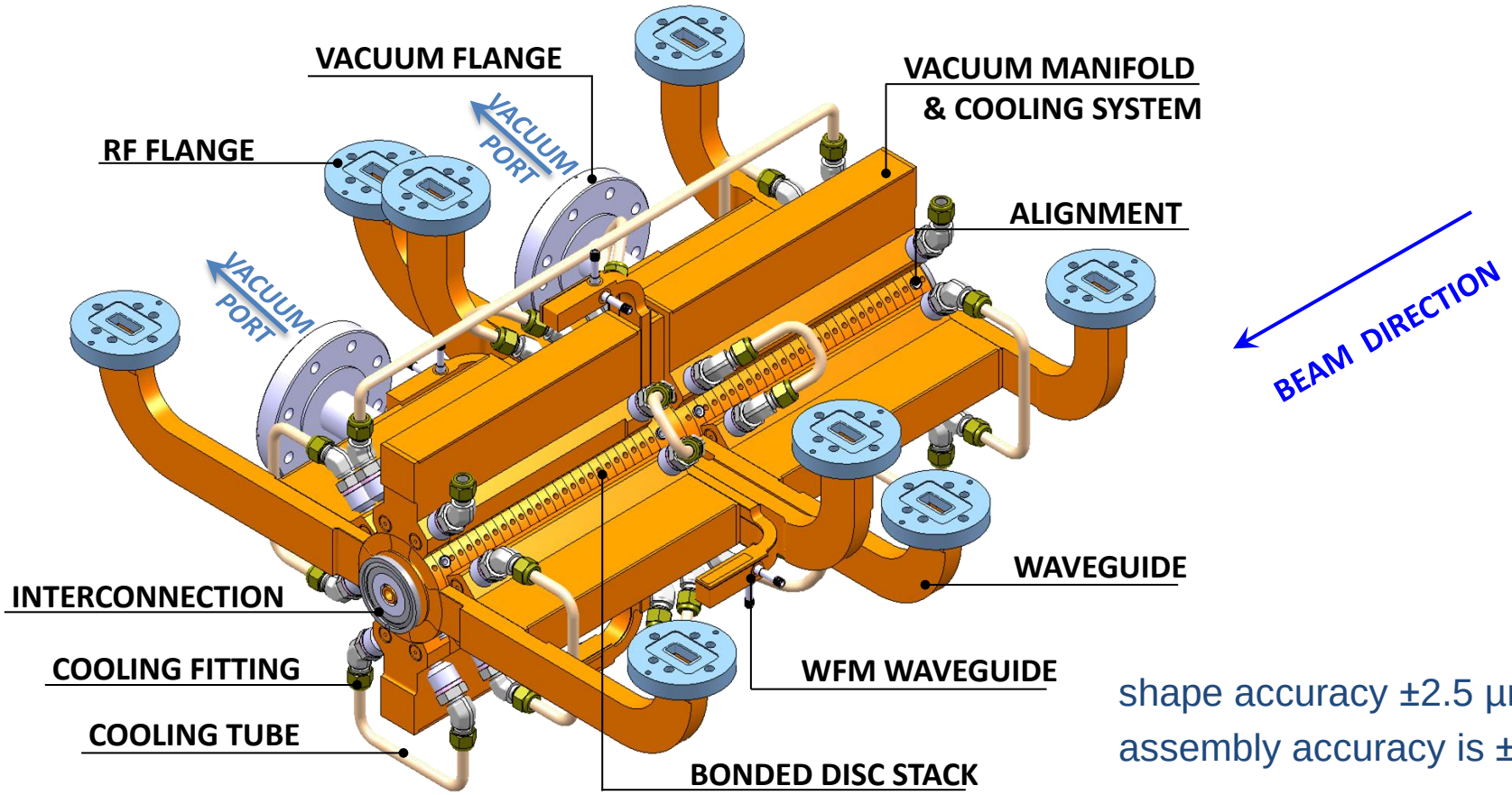
Brazing of manifolds



Brazing of 2 AS



Design and main components: TD26 CLEX



shape accuracy ±2.5 µm
assembly accuracy is ±5 µm

- Compact coupler design
- Cu discs joint by diffusion bonding at 1040 °C;
- 4 vacuum manifolds and 2 Wakefield Monitor (WFM) waveguides;
- Cooling system is integrated into the vacuum manifolds (compact technical solution).
- **Assembly of two AS to form a SuperAS**

Manufacturing flow, main steps

RF DESIGN

ENGINEERING DESIGN (3D models & drawings)

ULTRA PRECISION MACHINING

QUALITY CONTROL AT FACTORY

NON CONFORM

CONFORM

QUALITY CONTROL AT CERN

CLEANING (LIGHT ETCHING)

ASSEMBLY OF Waveguides

PRELIMINARY RF CHECK

DIFFUSION BONDING OF DISK STACK

BRAZING OF SAS (see next slides)

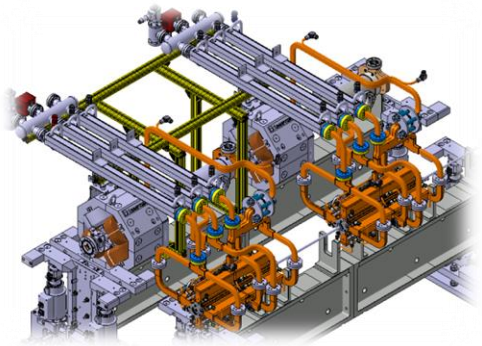
LEAK TIGHTNESS TEST

RF CHECK AND TUNING

BAKING (vacuum 650 °C, 10 days)

READY FOR INSTALLATION

TBM in CLEX



Cleaning

SLAC cleaning procedure as a baseline.

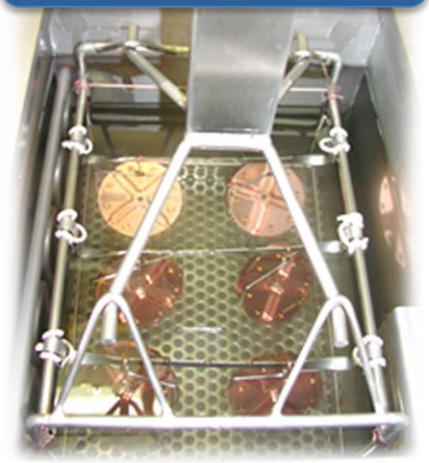
1. Unpacking, visual inspection, fixing of the support clip and mounting of the disk in the special basket.
2. Degreasing with solvents Topklean MC 20A and Promosolv 71IPA.
   This treatment is repeated twice if there are more than two blind holes. After the first degreasing the piece is removed from the basket and it put onto tissue paper. The support clip is removed and is then inserted into the other holes. The disk is placed in the basket and is degreased for the second time. See appendix n° 1 for the sequence of work.
3. Removal of the support clip, drying the blind holes with nitrogen, packaging with tissue paper and placing in the plastic boxes for transport to a different area.
4. Unpacking and fixing of the support clip.
5. Degreasing with detergent NGL 17.40 spec. ALU III and ultrasound.
   - Concentration: 10 g/l.
   - Temperature: 50 °C.
   - Time: 10 – 15 minutes.
6. Rising with water jet and by immersion.
7. Pickling (deoxidation) with hydrochloric acid.
   - Concentration: 50 %.
   - Temperature: room.
   - Time: ~ 1 minute.
8. Rising with water jet and by immersion.
9. Etching with SLAC solution.
   - Concentration:
     Phosphoric acid 70 %
     Nitric acid 23.3 %
     Acetic glacial acid 6.6 %
     Hydrochloric acid 0.49 %
   - Temperature: room.
   - Time: 30 seconds (etching of about 1.7 µm).
10. Rising with water jet.
11. Immersion in demineralised water, removal of the support clip, rinsing of the holes using a syringe and fixing of the support clip.
12. Final rinsing with demineralised water and ultrasound, followed by rinsing with ethylic alcohol and ultrasound.
    - Temperature: 30 °C. Time: ~ 1 minute.
13. Drying with nitrogen.
14. Drying in an oven.
    - Temperature: 60 °C. Time: ~ 5 minutes.
15. Mounting of the disk in the special basket. Degreasing with solvents Topklean MC 20A and Promosolv 71IPA. This step ensures the final deoxidation and the neutralisation of the SLAC solution.
16. Removal of the support clip, drying the blind holes with nitrogen, packaging with tissue paper and placing the disks in the plastic boxes.

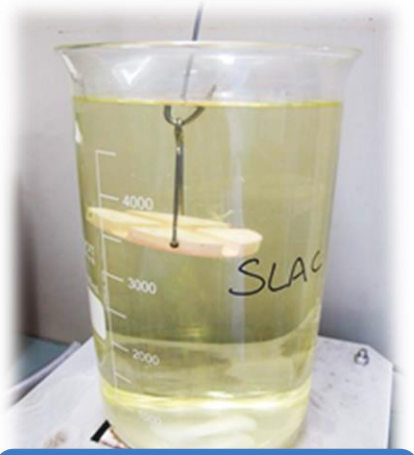
2. **Degreasing with solvents** Topklean MC 20A and Promosolv 71IPA. This treatment is repeated twice if there are more than two blind holes ➔ **manifold**

9. **Etching with SLAC solution.**
- Concentration:
Phosphoric acid 70 %
Nitric acid 23.3 %
Acetic glacial acid 6.6 %
Hydrochloric acid 0.49 %
- Temperature: room.
- Time: 30 seconds (etching of about 0.7 µm) ➔ **disks, couplers**

CERN – TE/VSC/SCC

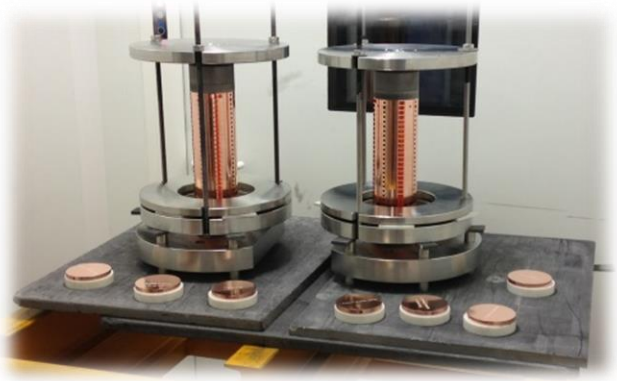
Degreasing solvents

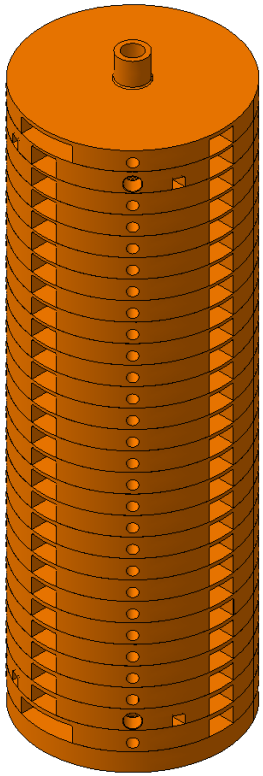




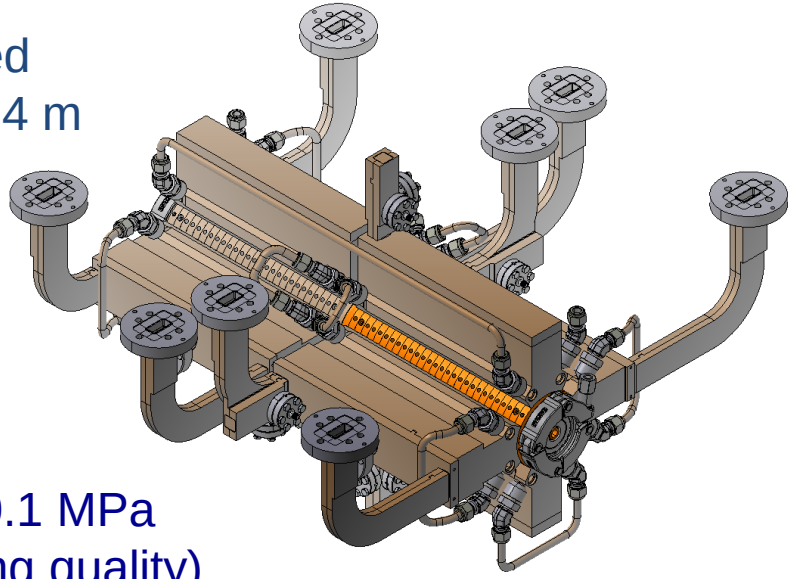
SLAC etching

SAS Assembly. Bonding of disk stack

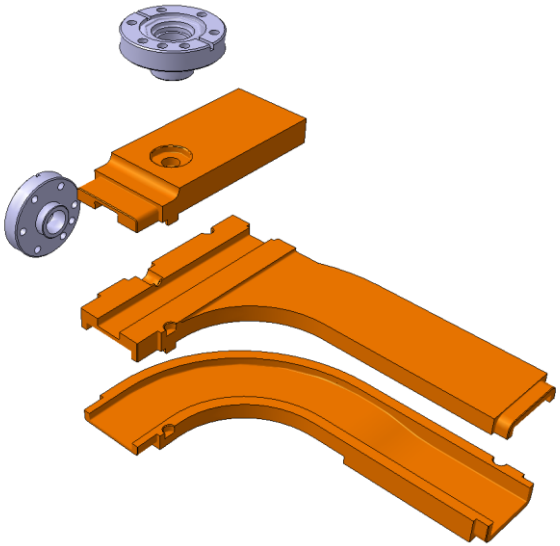


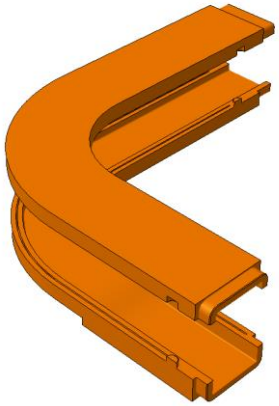


- Disks dimensional control at factory (shape accuracy, flatness and Ra)
- Alignment on dedicated V-shaped supports: tolerance 2 μm over 0.4 m
- Straightness measured on external diameters:
  - ±3 μm (before bonding)
  - ±5 μm (after bonding)
- T=1025 °C, holding time 1.5 h, 0.1 MPa (optimisation deformation/bonding quality)

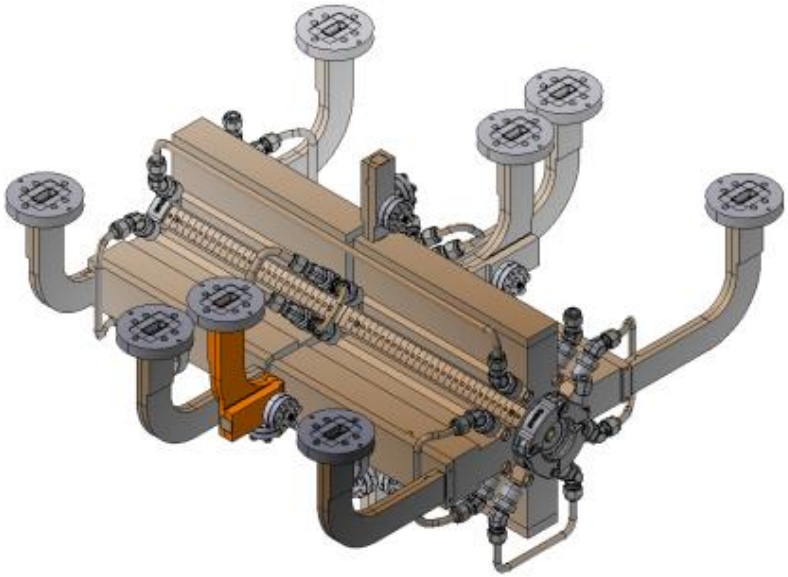


SAS Assembly. Brazing (Input + WFM)

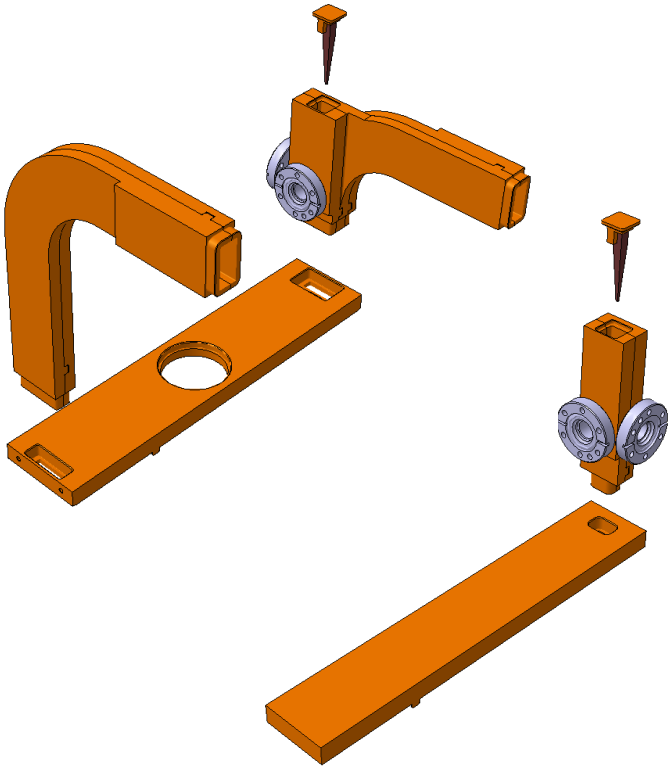


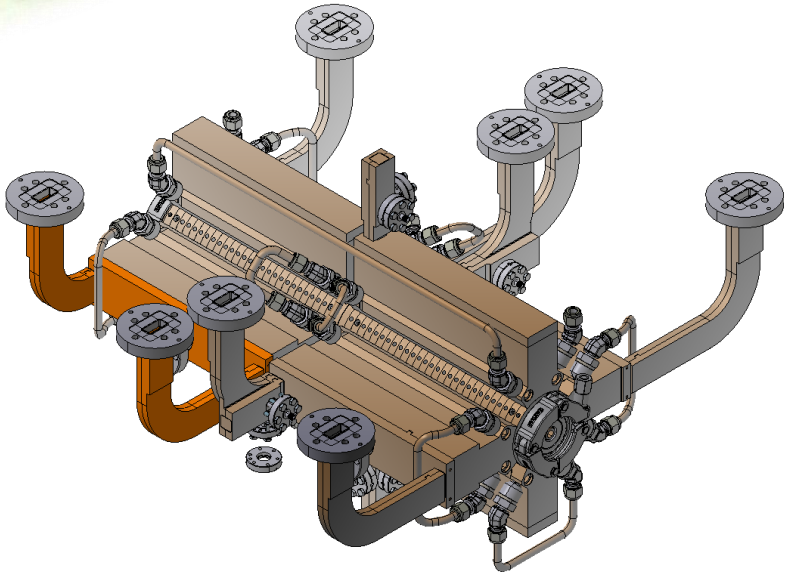


- Waveguide integrating WFM with 2 antennae
- Two AuCu brazing cycles needed.
- Dedicated tooling developed to align and hold pieces.
- No re-machining after brazing: result OK



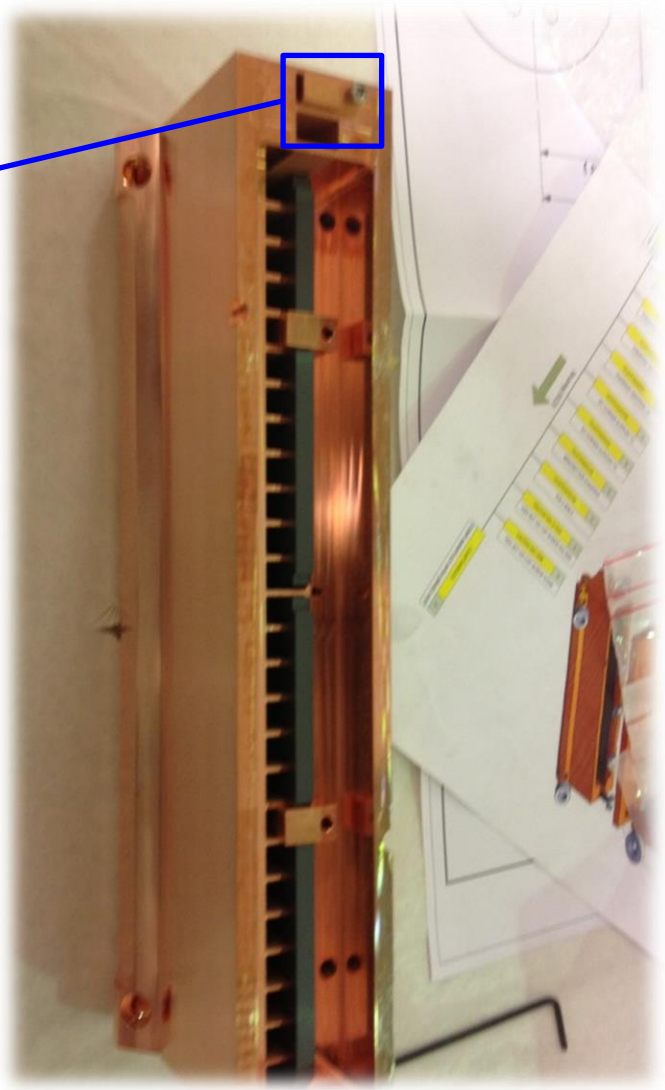
SAS Assembly. Brazing (cover + input/output)





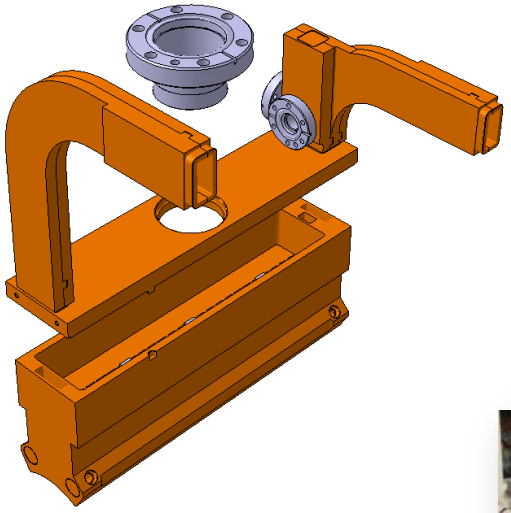
- Cover integrating input and WFM WG as well as output WG.
- In addition connection to vacuum tank
- Few brazing cycles (AuCu)
- Solved issues of flatness between covers and manifold
- Pressing and holding tooling

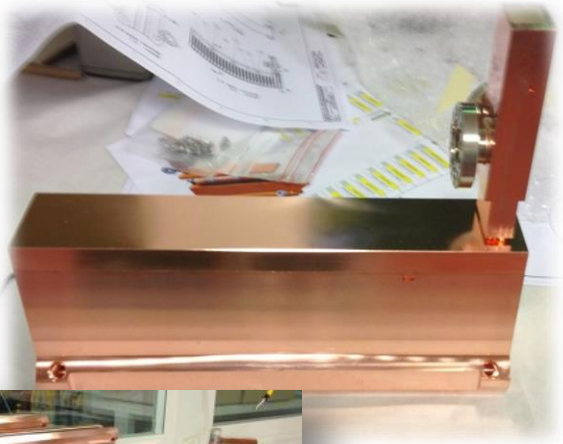
SAS Assembly. Fixation of SiC loads

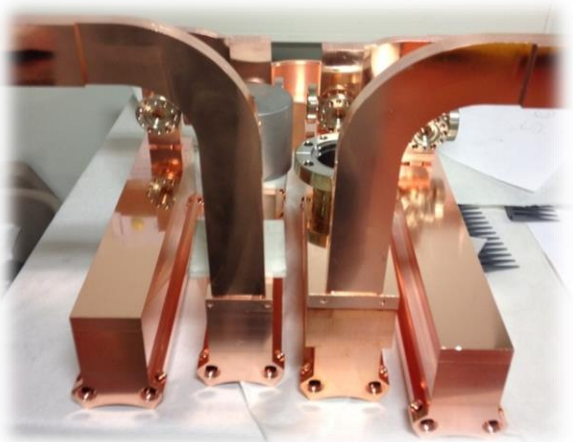


SiC damping load fired at about 1040 °C (T profile validated, cooldown very slow > 48 h)

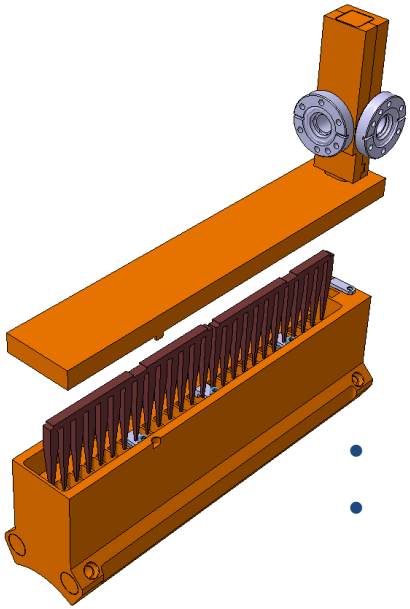
SAS Assembly. Brazing (to manifold)

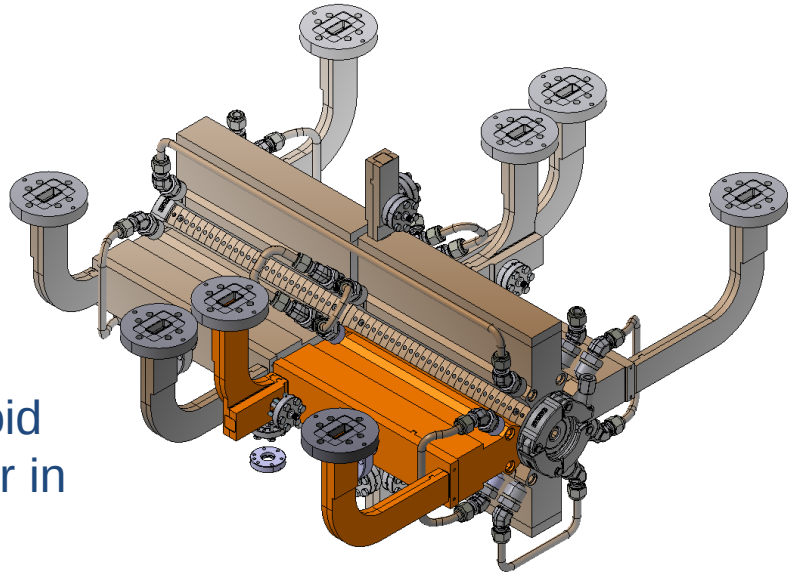






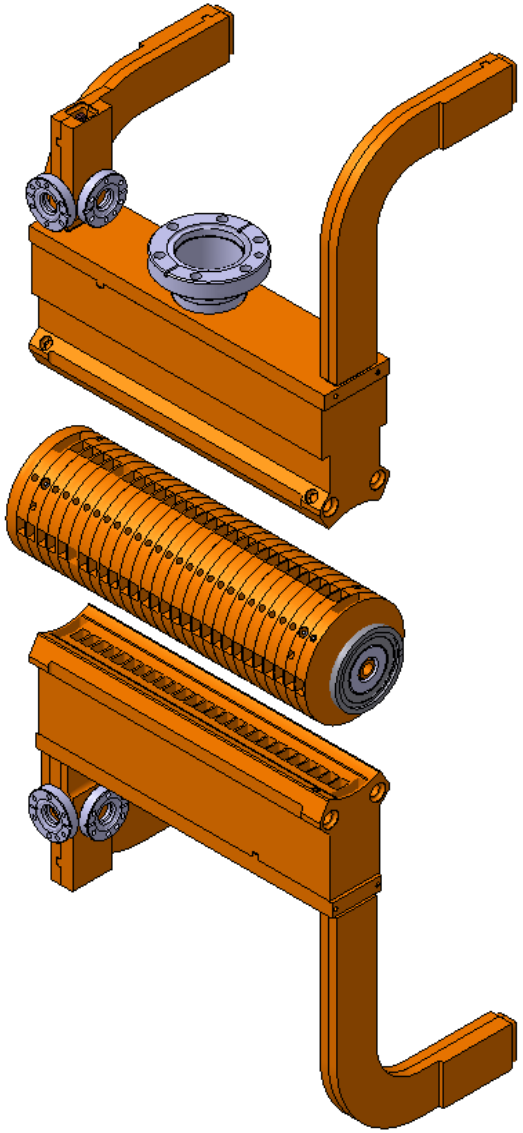
Mo spring to hold manifold & cover

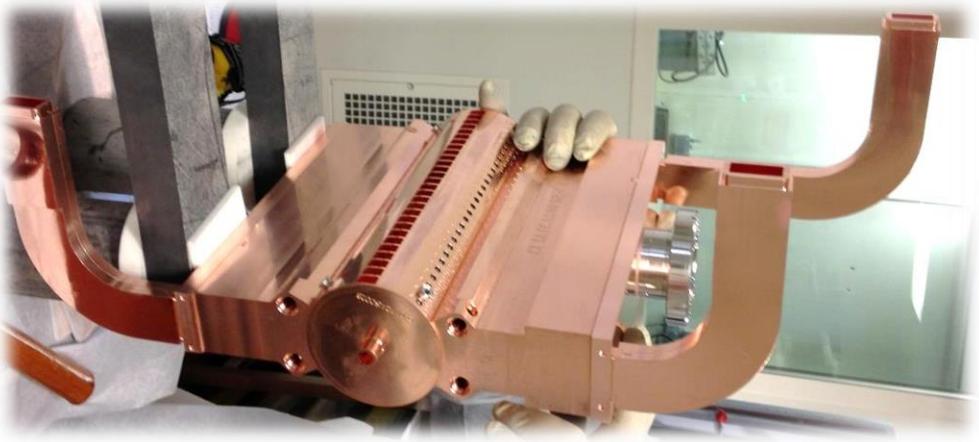




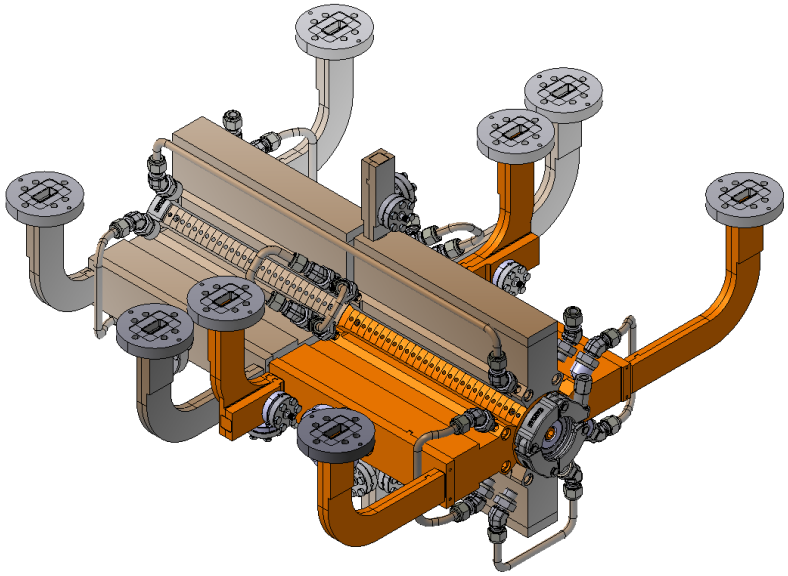
- AuCu brazing cycle
- Brazing upside down to avoid deformation on the diameter in contact with the disk stack

SAS Assembly. Brazing (to disk stack)



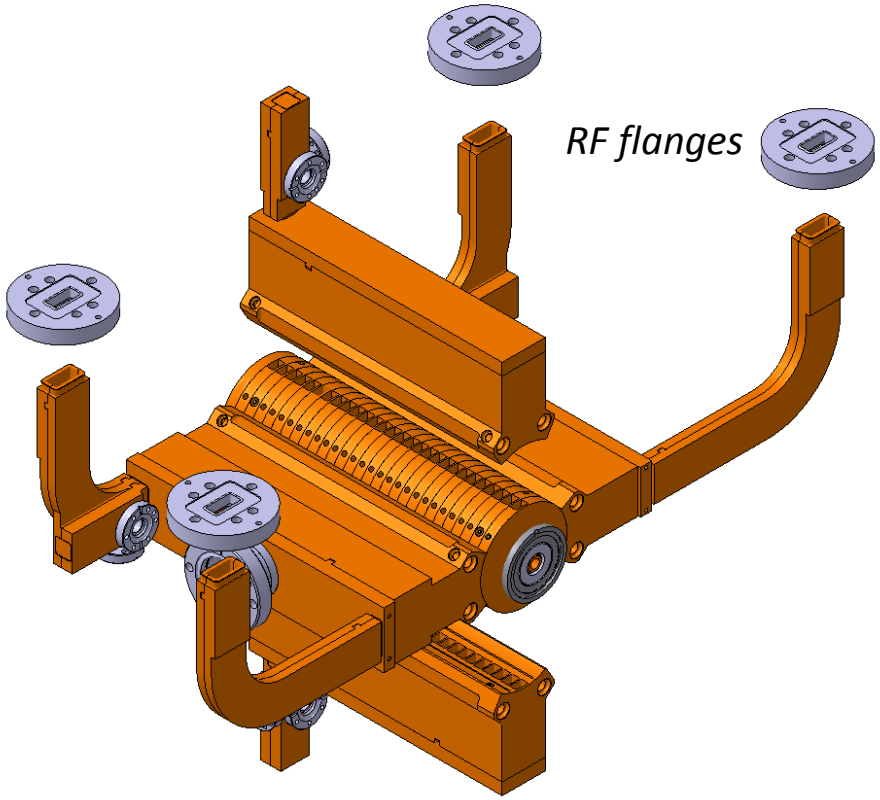


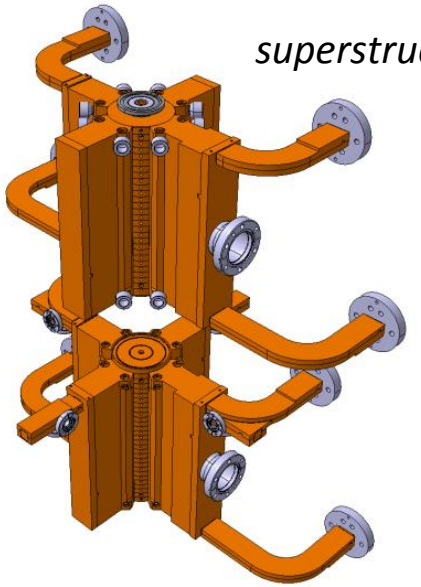
- 2 brazing cycles (2 manifolds each)
- Dedicated development: after several tests, wire Ø1 mm (AuCu 50/50)ß

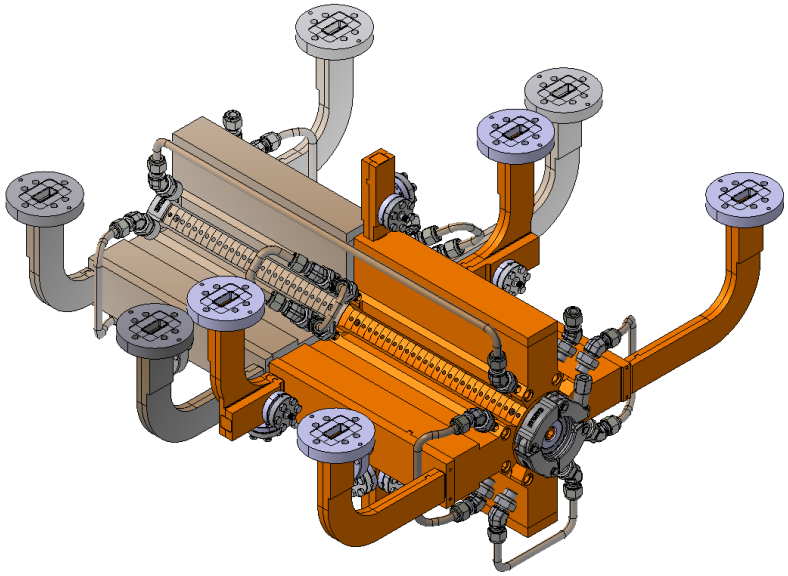


SAS Assembly. Brazing (RF flanges)

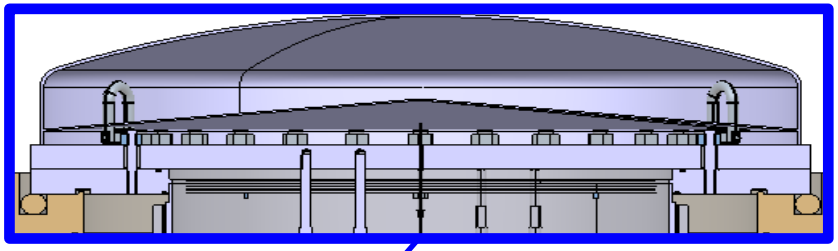
- Scheduled next week
- Brazing of RF flanges
- Brazing of two AS by interlocking



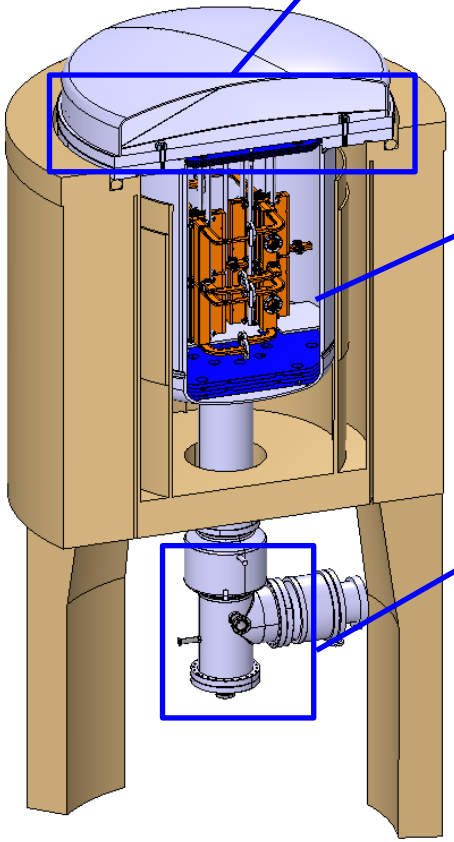


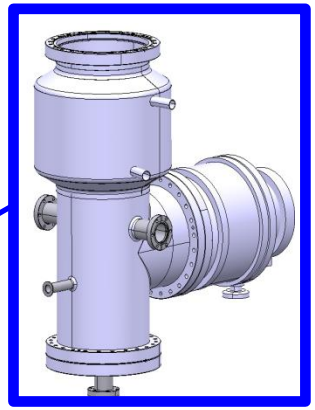


SAS Baking. Furnace

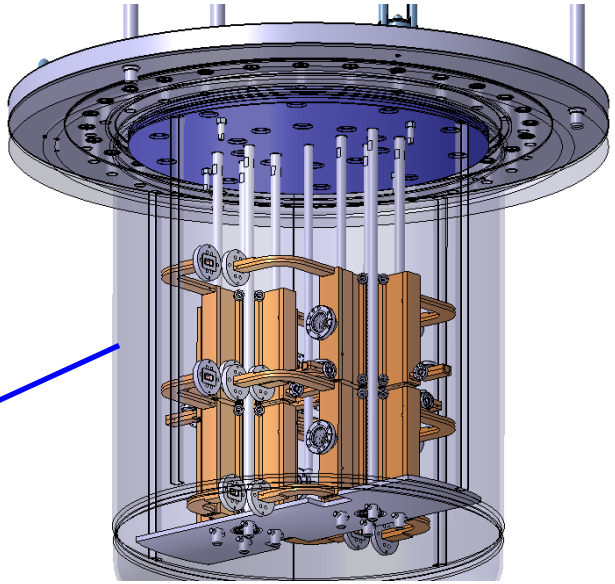


Cover modification





Vacuum interface chamber (with cooling system integrated)



Can housing two SAS

- Furnace: dedicated development in collaboration with Bodycote and TE/VSC, EN/MME
- Possibility to bake 2 SAS in parallel.

Conclusions and next steps

- Superstructures: several pieces and assembly steps, manifolds and covers pre-assembled before brazing to disks (aim of limiting brazing cycles for disk stacks)
- Dedicated tooling and procedures developed for each step
- Assembly of mock-ups: essential learning process before application on real structures (mounted in module In B169)
- Developed baking furnace for two superstructures in parallel
- 1st superstructure for CLEX module ready in the coming week
- Launched the study of integrated disk (➔integrate several functions as one piece to reduce number fo brazing cycles).