MeChanICs Project meeting

Alignment and assembly of Rf structures

G. Riddone, 22/03/2011

Content

- Review of main assembly steps
- Recall of main technical issues
- From test structures to CLIC structures

Assembly of accelerating structures

T18 structures tested at SLAC/KEK showed excellent test results

consequent validation of design, machining and **assembly procedure**

NLC/JLC fabrication technology: validated to 100 MV/m (baseline for future CERN X-band accelerating structures)

Baseline procedure

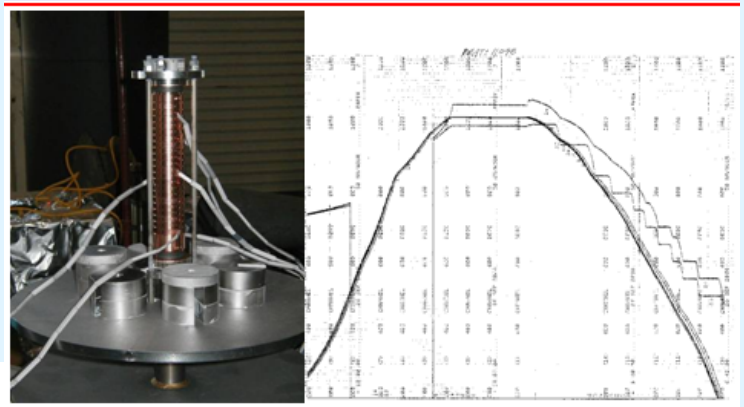
Diamond machining (sealed structures)

Cleaning with light etch

H2 diffusion bonding/brazing at ~ 1000 ˚C

Vacuum baking 650 ˚C > 10 days

Diffusion Bonding of T18_vg2.4_DISC



Pressure: 60 PSI (60 LB for this structure disks)
Holding for 1 hour at 1020° C

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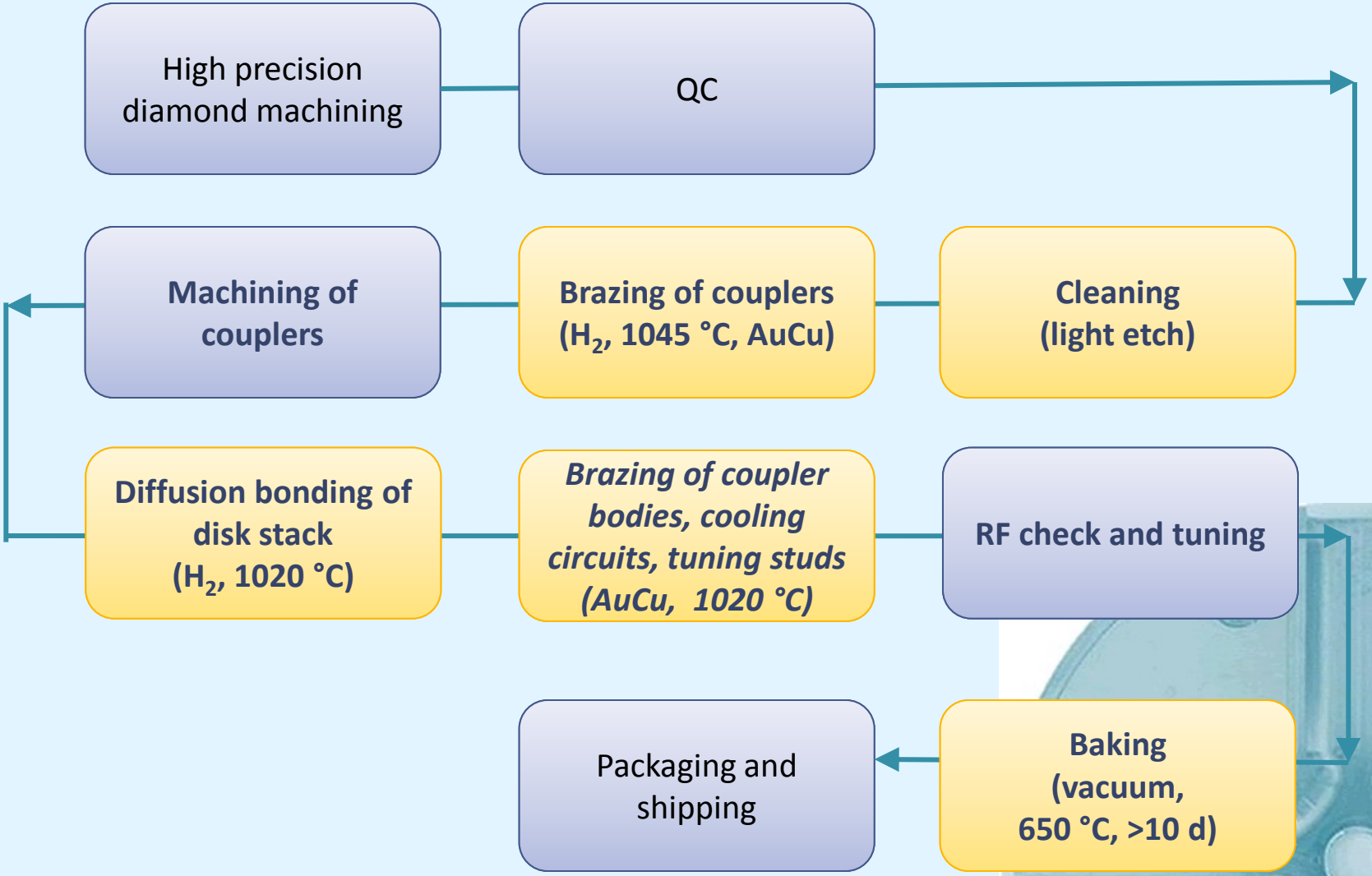
Vacuum Baking of T18_vg2.4_DISC

650° C
10 days

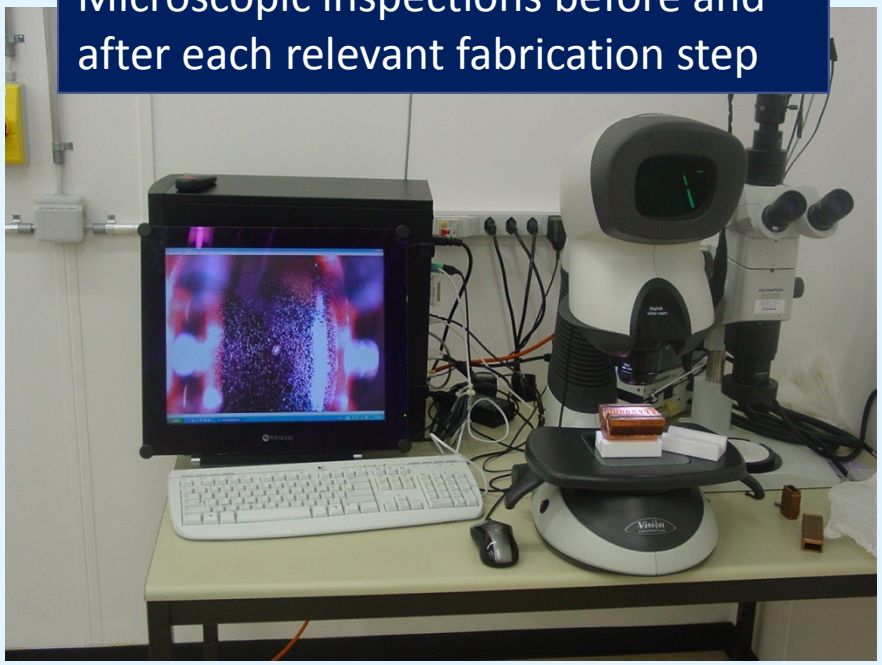
J. Wuang

Baseline manufacturing flow

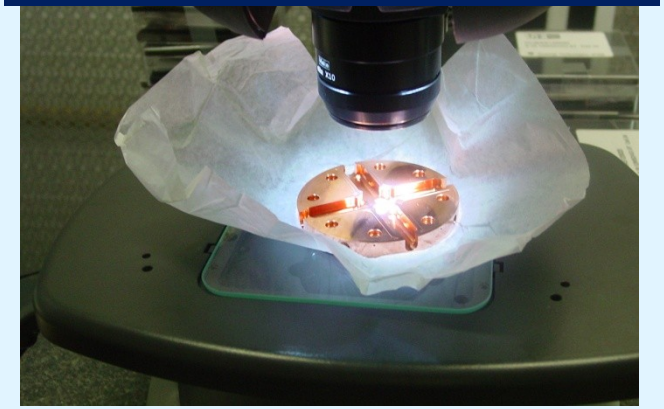


Inspections

Microscopic inspections before and after each relevant fabrication step



Microscopic inspection of disks before and after cleaning (on **witness pieces**)



Video inspections, SEM and microscopic inspections

T18 KEK/SLAC design

Cleaning

SLAC NATIONAL ACCELERATOR LABORATORY

Cleaning of Accelerator Parts

For accelerator structure parts with single diamond tuning surfaces:

1. Vapor degrease in 1,1,1 trichloroethane or equivalent degreaser for 5 minutes.
2. Alkaline soak clean in Enbond Q527 for 5 minutes at 180°F.
3. Cold tap water rinse for 2 minutes.
4. Immense in 50% hydrochloric acid at room temperature for 1 minutes.
5. Cold tap water rinse for 1 minute.
6. Immense in the following solution for maximum of 5 seconds depending on the surface finish required:

Phosphoric Acid, 75%	21 gallons
Nitric Acid, 42° Baume	7 gallons
Acetic Acid, Glacial	2 gallons
Hydrochloric Acid	12.6 fluid ounces
Temperature	Room

7. Cold tap water rinse for minimum of 2 minutes until the film on part disappears.
8. Ultrasonic in DI Water for 1 minute.
9. Ultrasonic in new, clean alcohol for 1 minute.
10. Final Rinse to be done in new, clean alcohol.
11. Hold in clean alcohol in stainless steel containers.
12. Dry in a clean room using filtered N2.

For accelerator structure parts with regular machining surfaces:

6. Immense in the following solution for maximum of 30-60 seconds depending on the surface finish required:

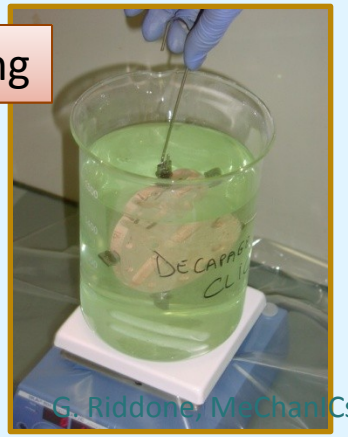
J. Wuang

SLAC cleaning procedure as a baseline

For **degreasing**
Trichloroethane ➔ at SLAC replaced by Perchloroethylene

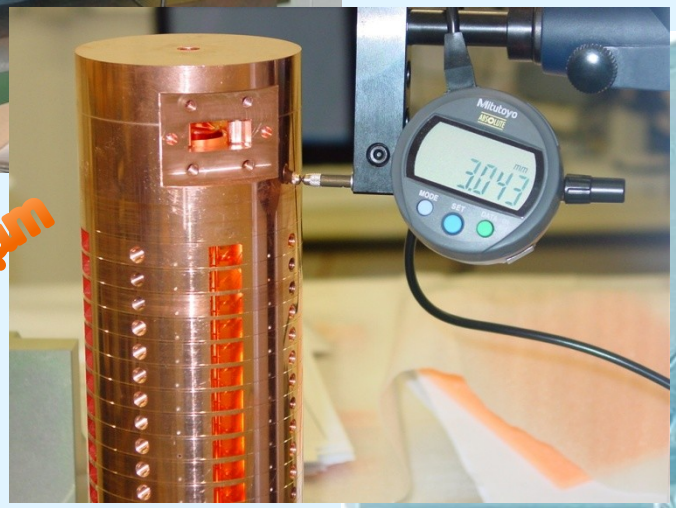
CERN procedure:
(Firm AVANTEC Performance Chemicals):
- TOPKLEAN MC 20A
- PROMOSOLV 71IPA

Etching



Tool for holding the disks

Alignment



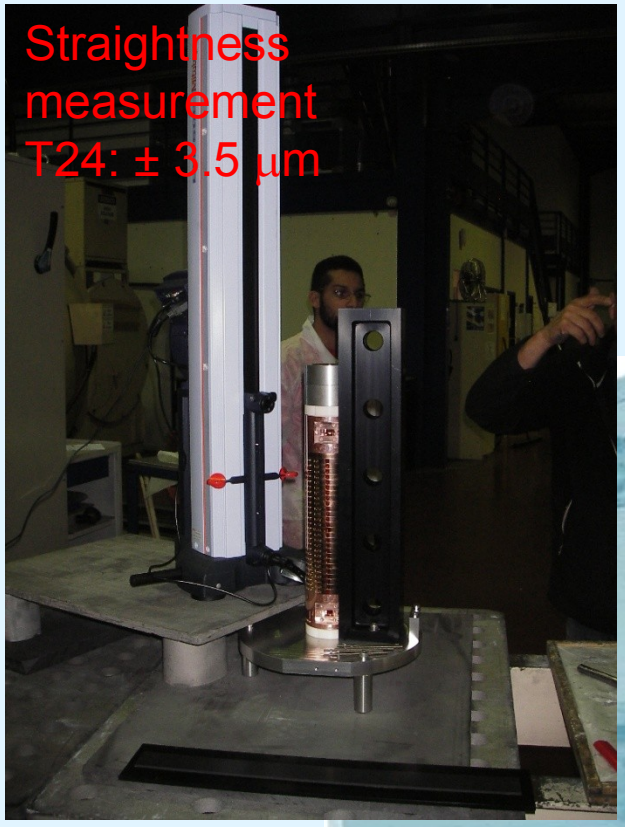
Assembly made on V-blocks
Verification of the assembly (before and after bonding) with a new measurement column: straightness and tilt

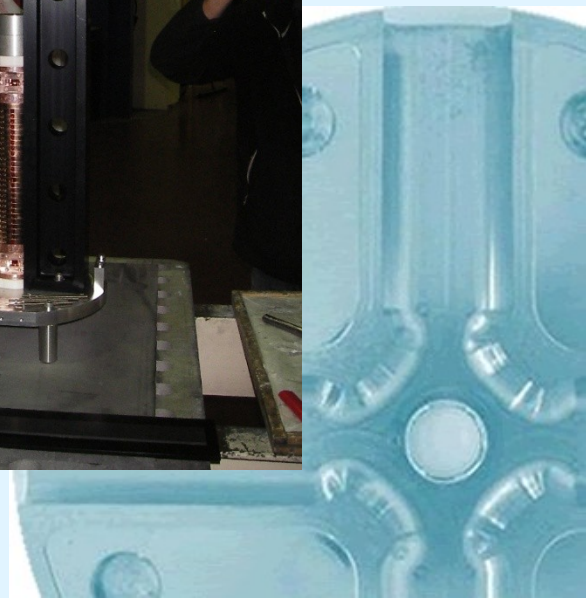
Straightness measurement ±2 µm

ALIGNMENT AND BONDING (T24@12 GHz)

Reference on the external diameter:
- tolerance on external diameter: ± 12.5 μm
- tolerance on the ref. line: ± 1 μm

Alignment done on a V-shape vertical support in granite (accuracy of ± 1.5 μm)

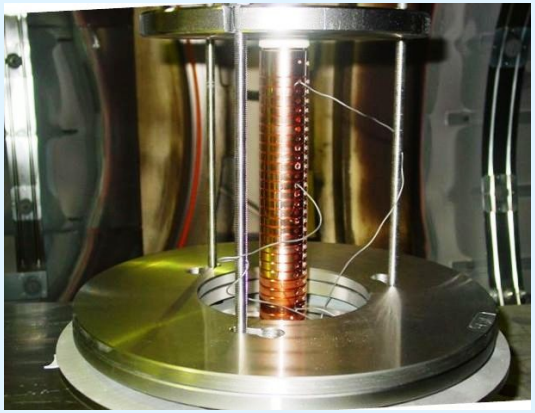


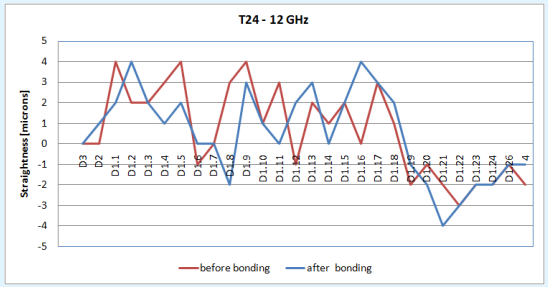


DIFFUSION BONDING PARAMETERS AND CYCLE

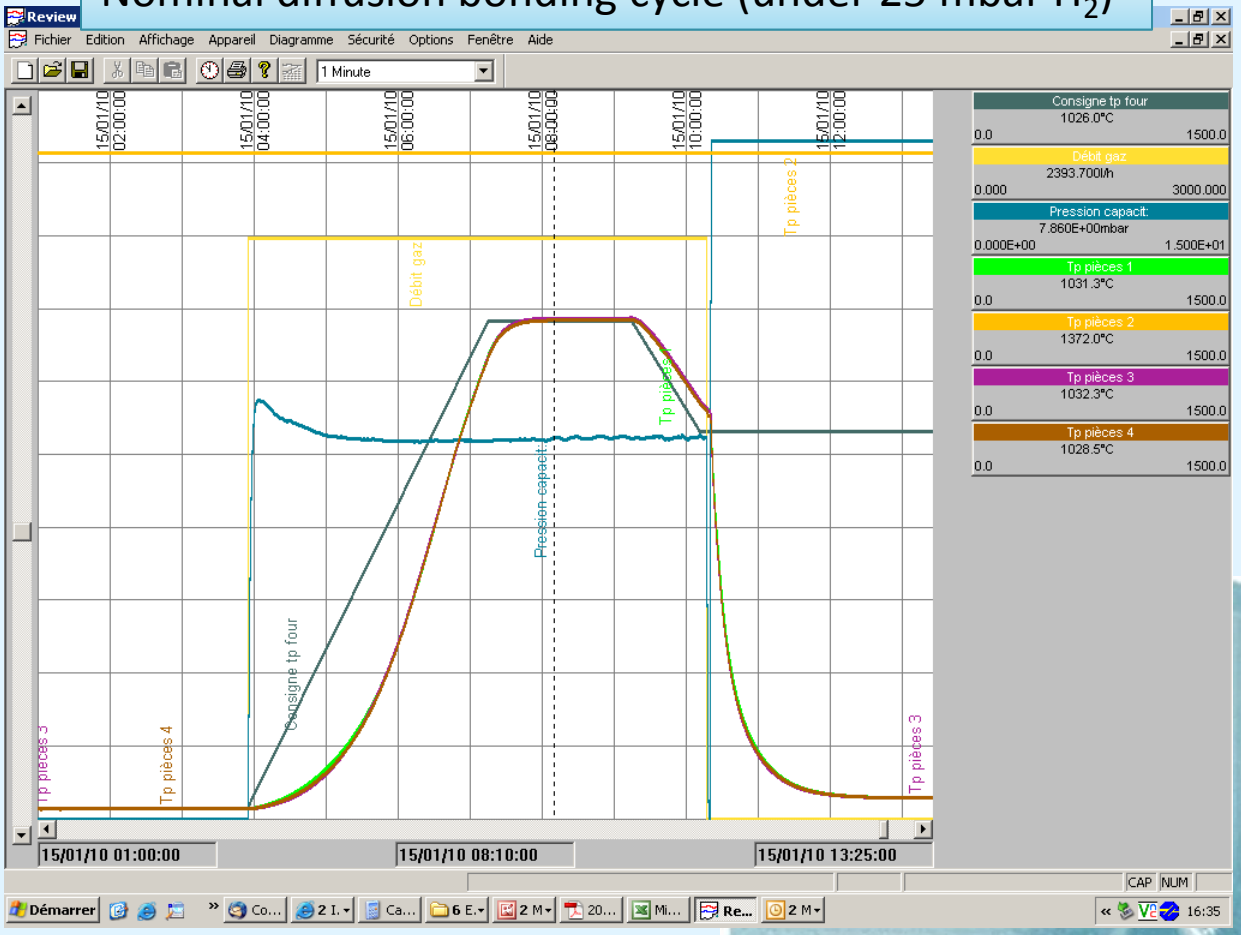
Temperature: up to 1040˚C
Pressure: 0.28 MPa
Holding time: 2 h

New infrastructure to guarantee uniform load



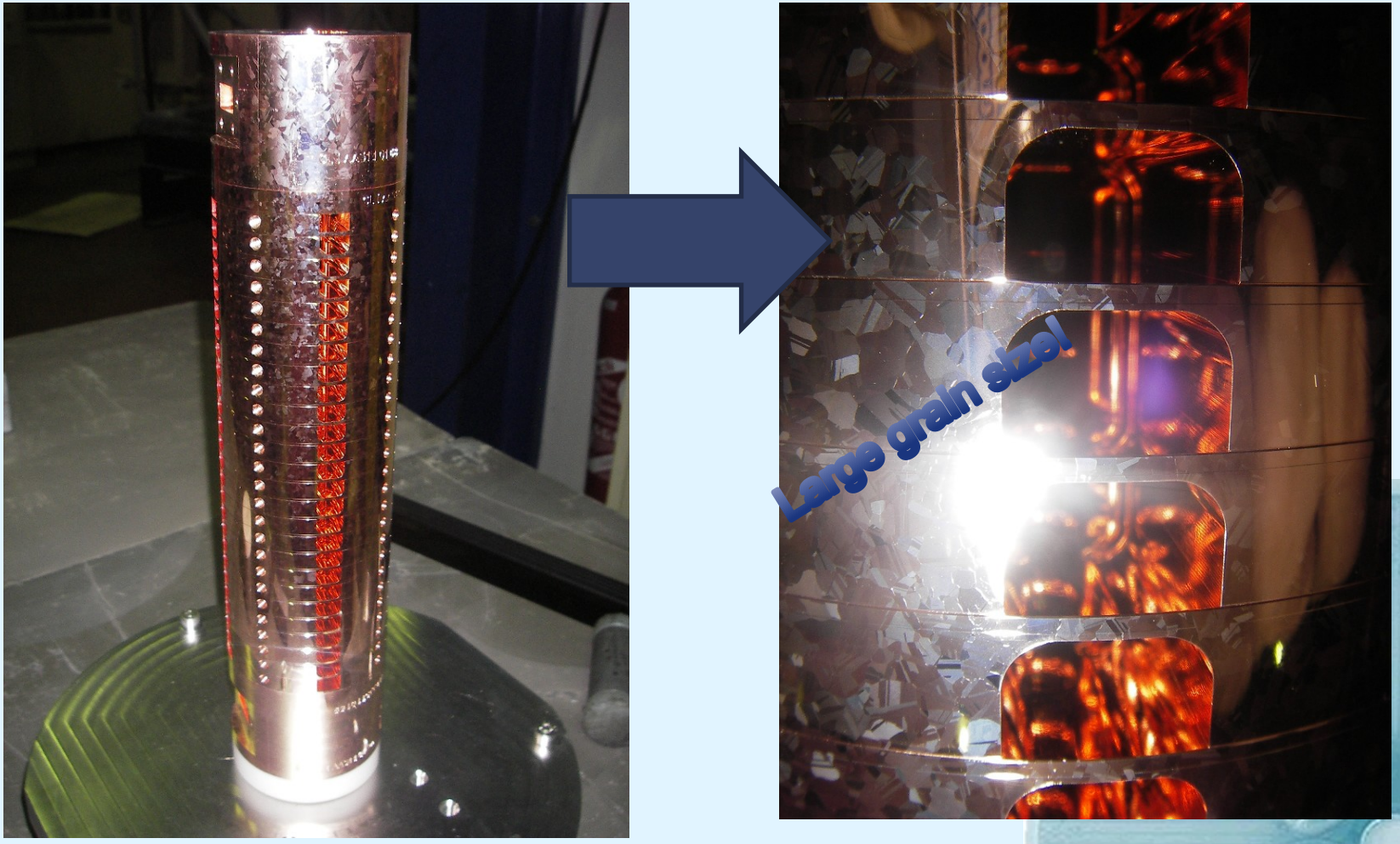


Nominal diffusion bonding cycle (under 25 mbar H_2)



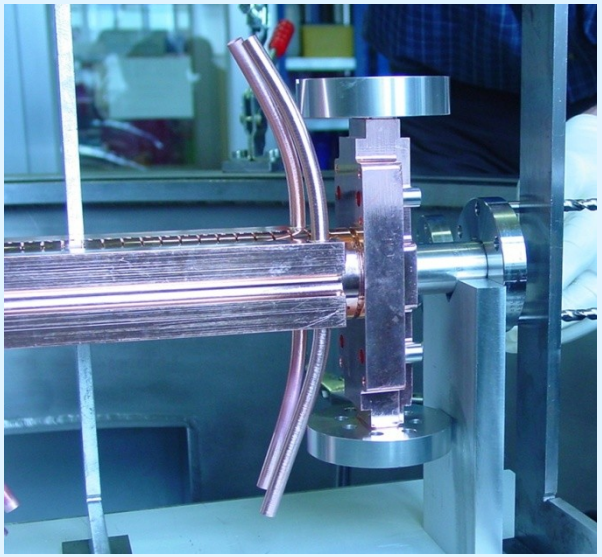
Straightness measurement after diffusion bonding: variation of 1 μm before and after bonding

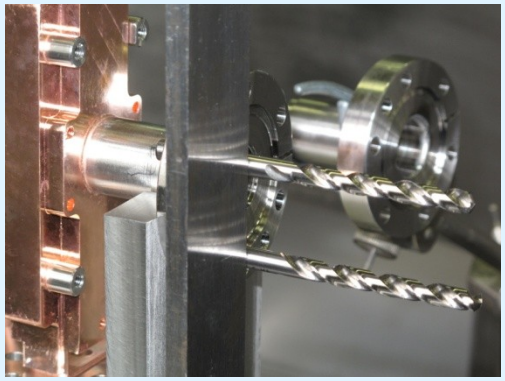
Accelerating structure TD24 after diffusion bonding under H_2

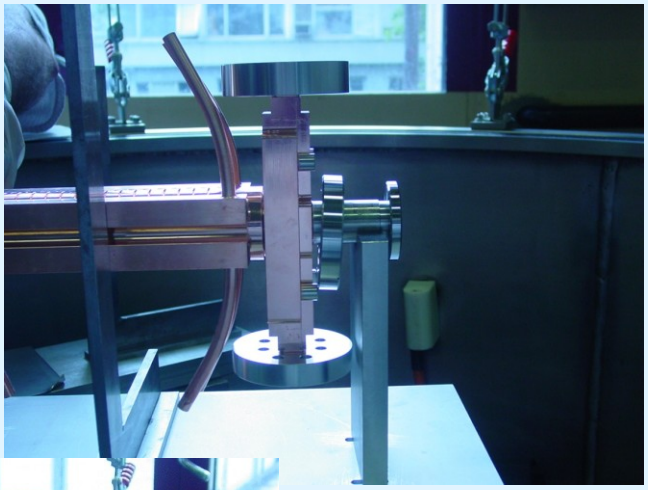


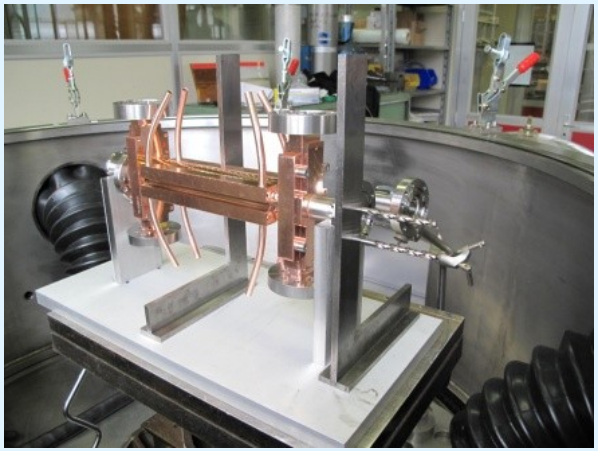
Welding of the vacuum flanges

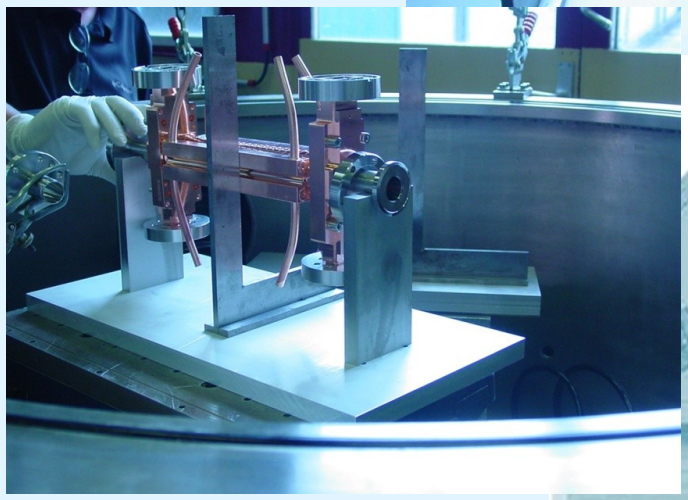
Under Argon 13 l/min in a glove box



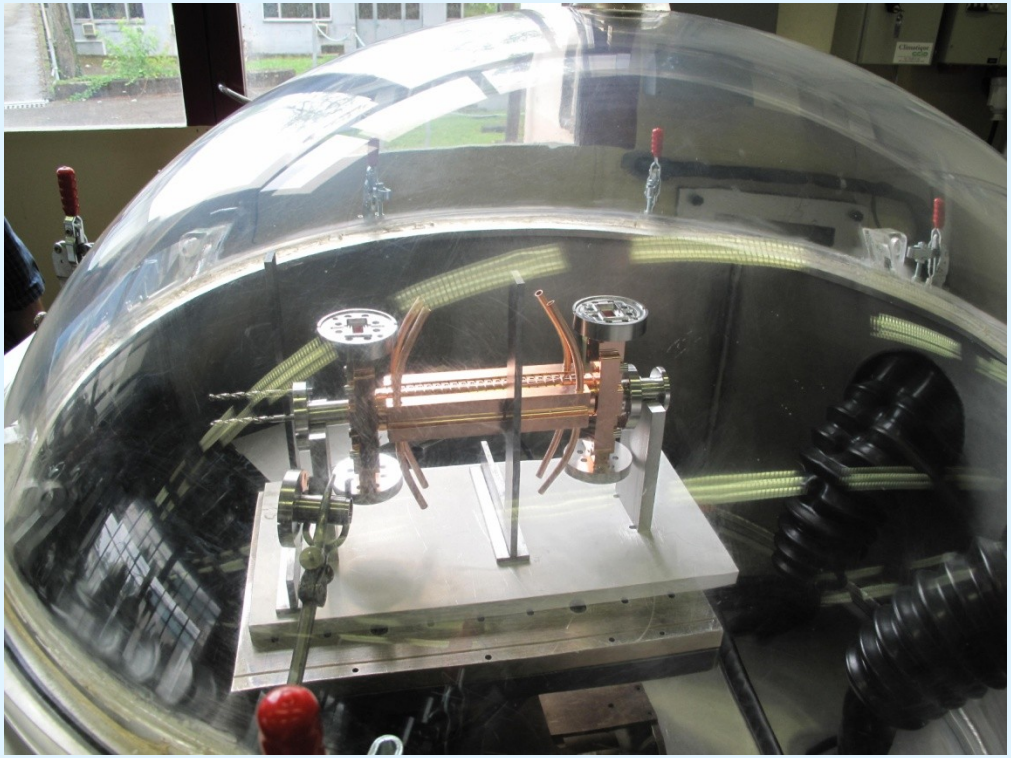


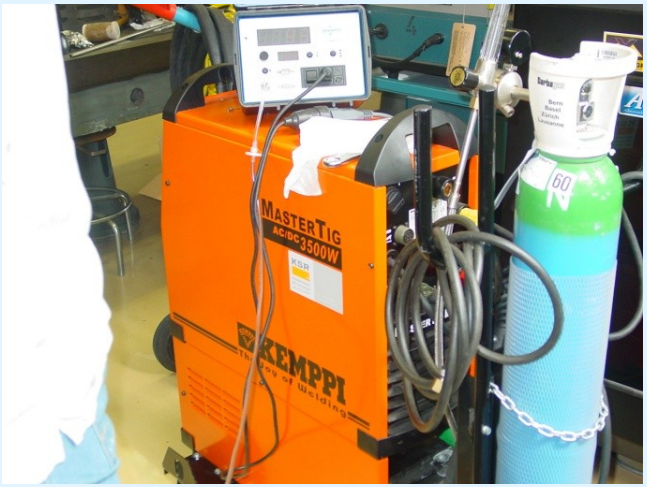






Welding of the vacuum flanges

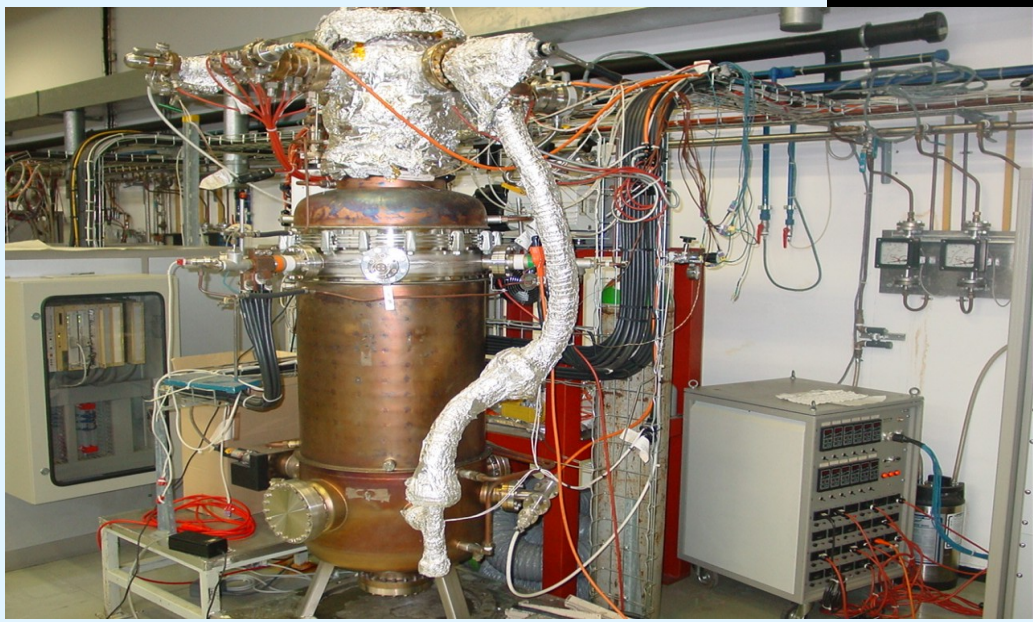


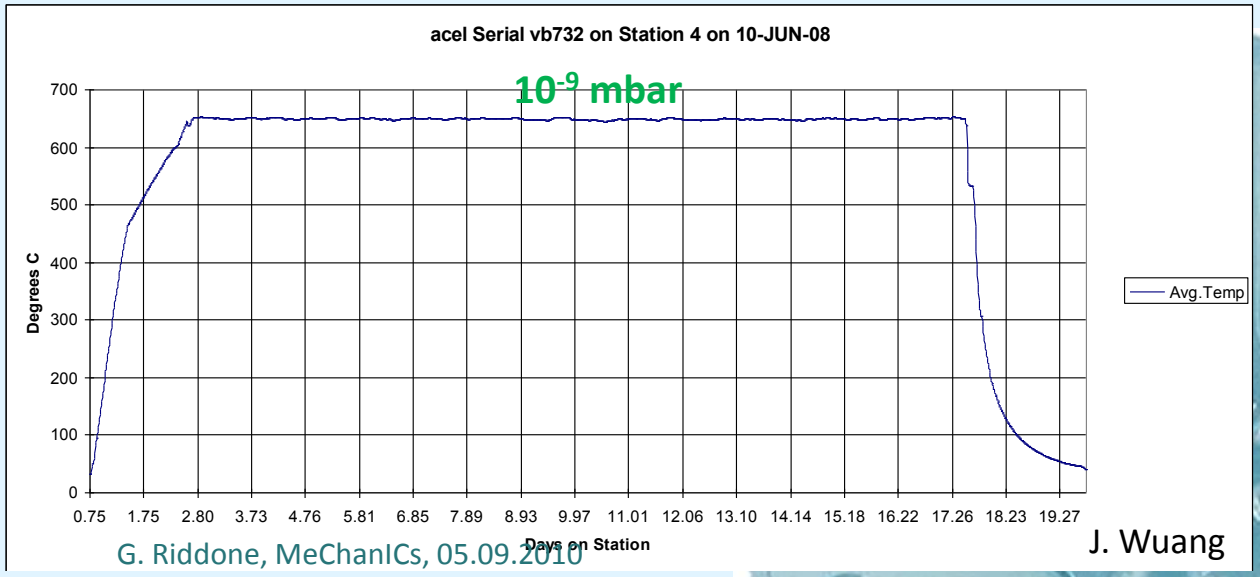


Vacuum baking

1st baking: TD24 for CLEX, two-beam test stand

CERN furnace ➔ several mechanical adaptations were needed





G. Riddone, MeChanICs, 05.09.2010

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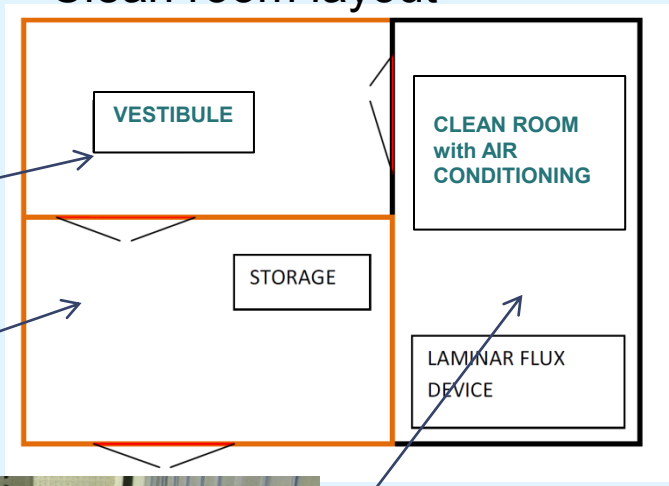
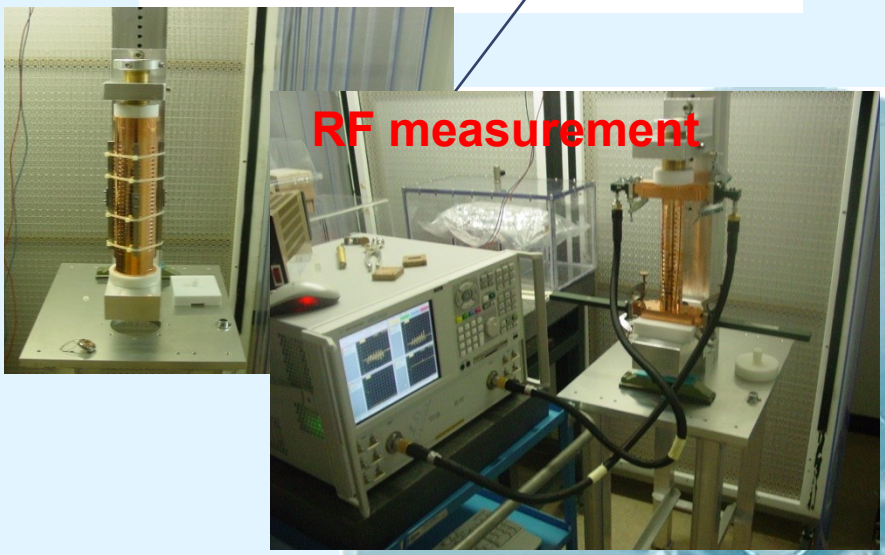
Clean room

S. Lebet, visit this afternoon

Clean room layout



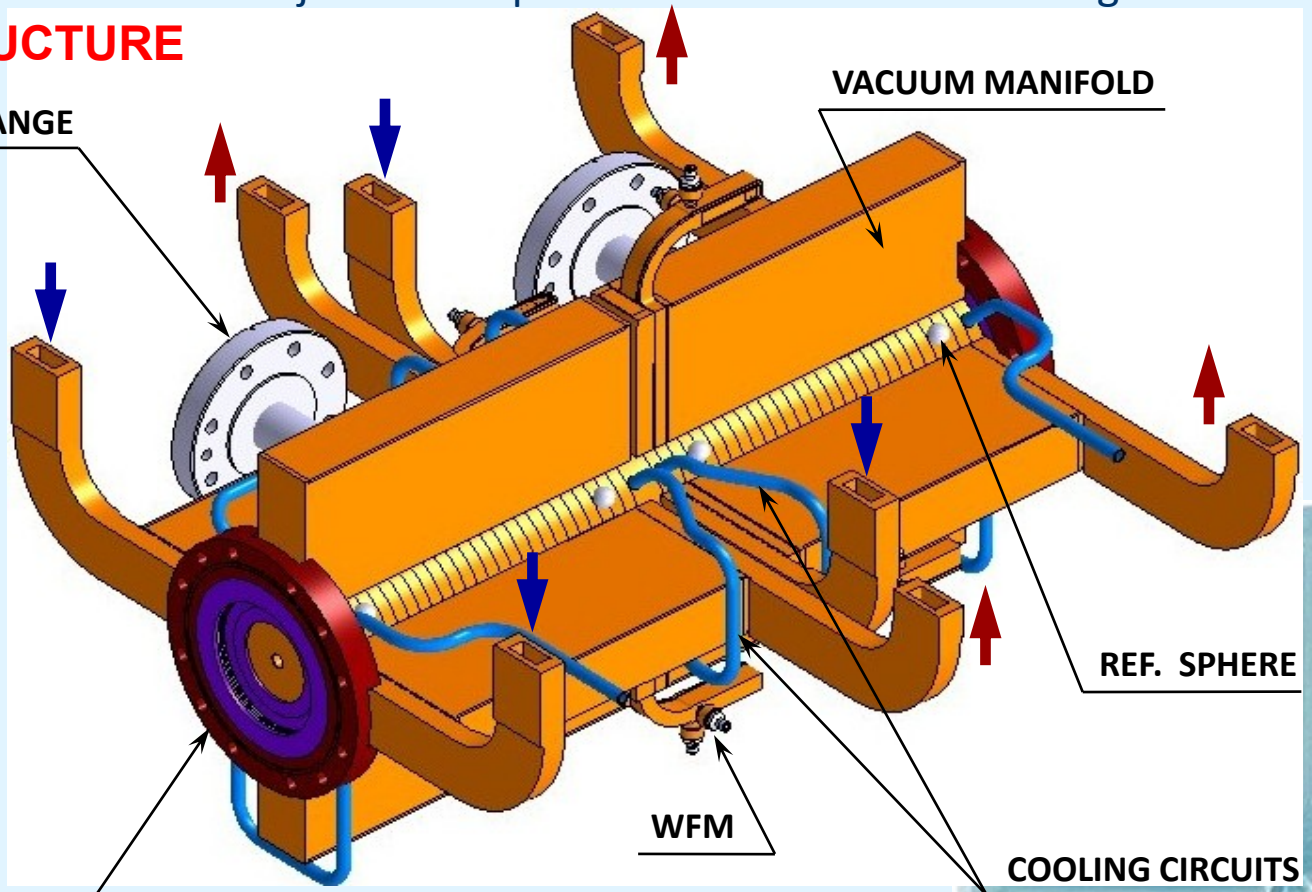


TOWARDS CLIC STRUCTURES

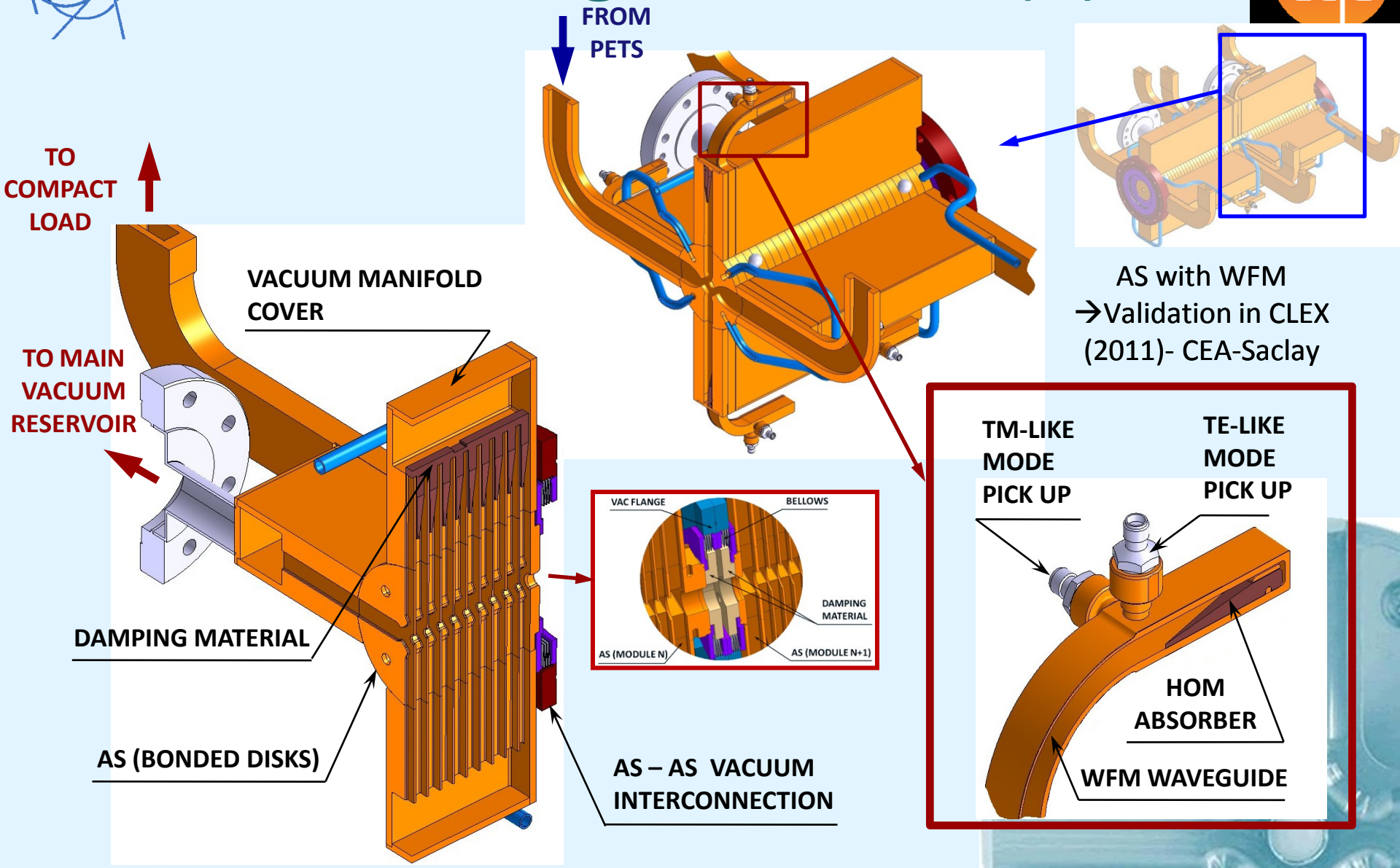
Accelerating structures (1)

- Shape accuracy ±2.5 µm - assembly accuracy is ±5 µm
- Integration of damping loads, WFM (*1 per Super-AS*), vacuum manifolds, cooling circuits, supports + interconnection to adjacent components and inter-beam waveguides

SUPERSTRUCTURE



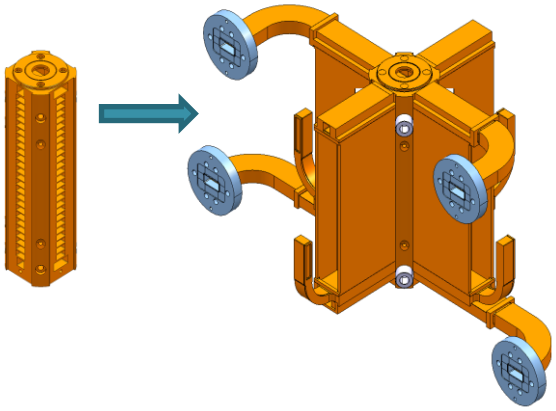
Accelerating structures (2)



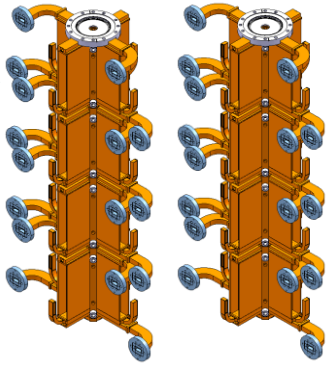
AS with WFM
→Validation in CLEX (2011)- CEA-Saclay

Accelerating structure mock-ups

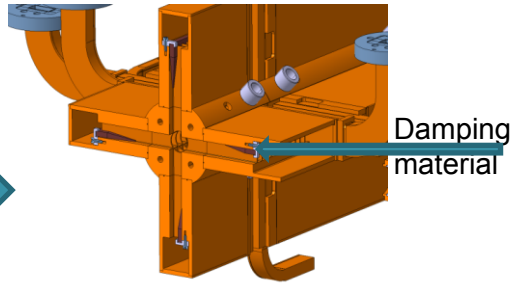
1. Brazing of manifolds; interface WGs; cooling adapter



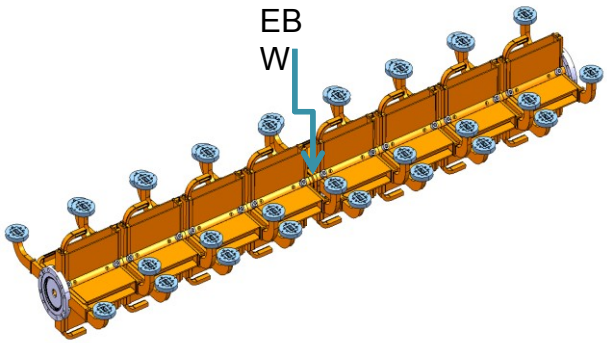
2. Brazing of 2 stacks 1005 mm long each:
Includes:
4 AS with manifolds;
Interconnection MB-MB;

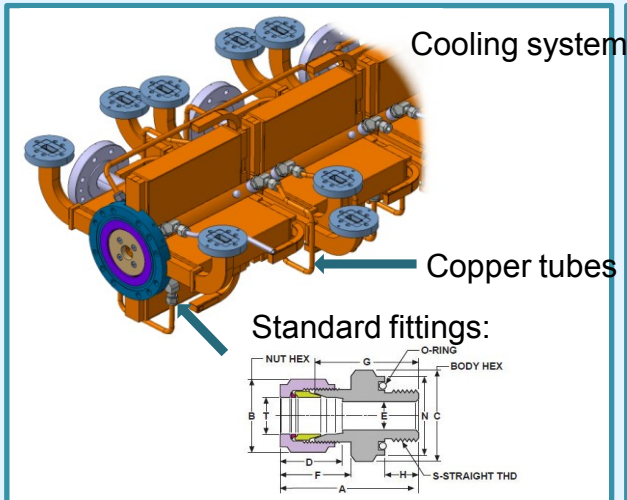


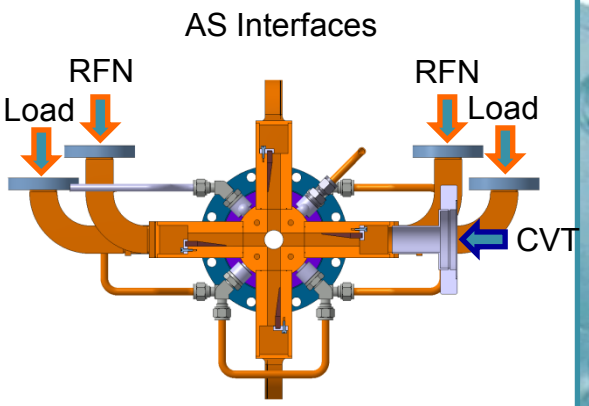
3. Installation of the damping material, welding of covers:



4. Welding (EBW) of two stacks together:







Conclusions

- Alignment and assembly very challenging ➔ several steps which have to preserve tolerances and cleanliness
- Development of new/industrialised assembly procedures is mandatory
  - Cost optimization!