Smartcell X-Band Normal Conducting Acc. Structure Prototype Fabrication

LCWS2024

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09/07/2024

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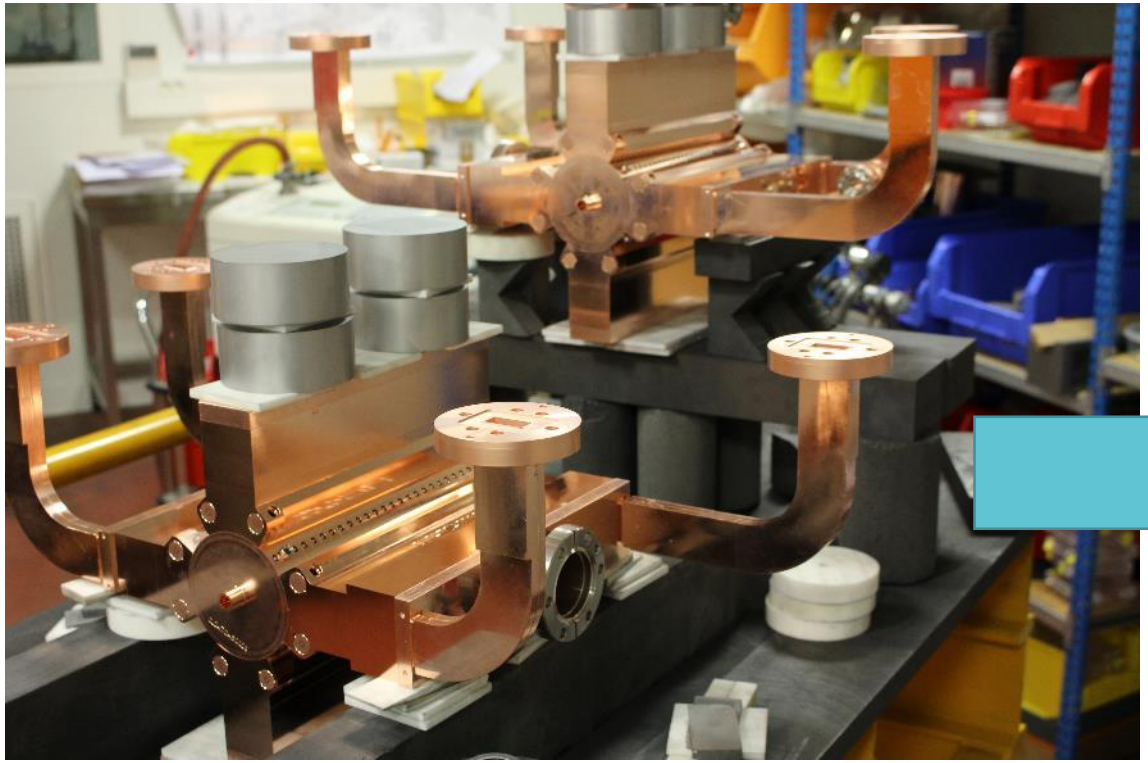
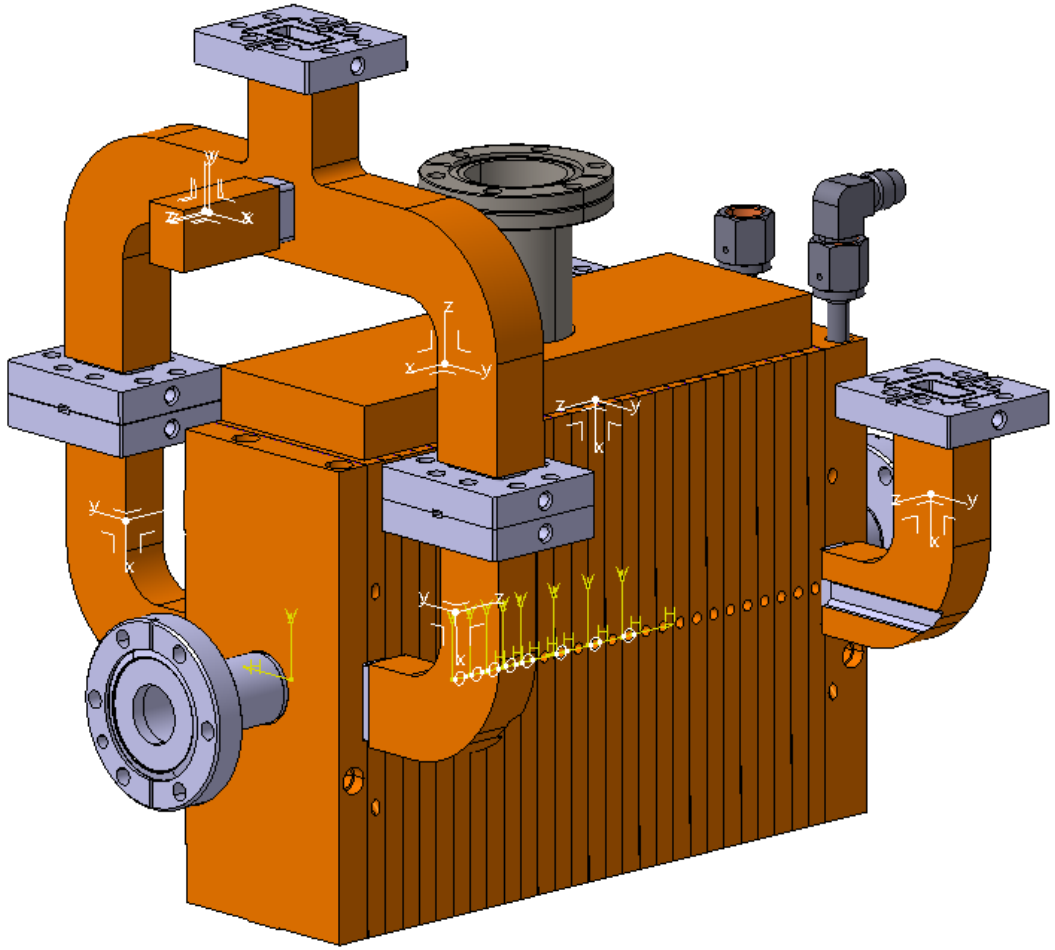
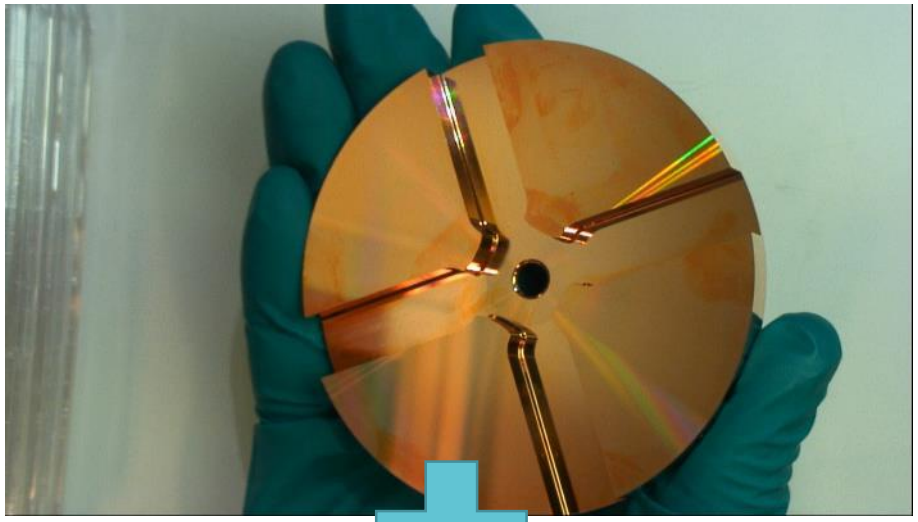
Structure design





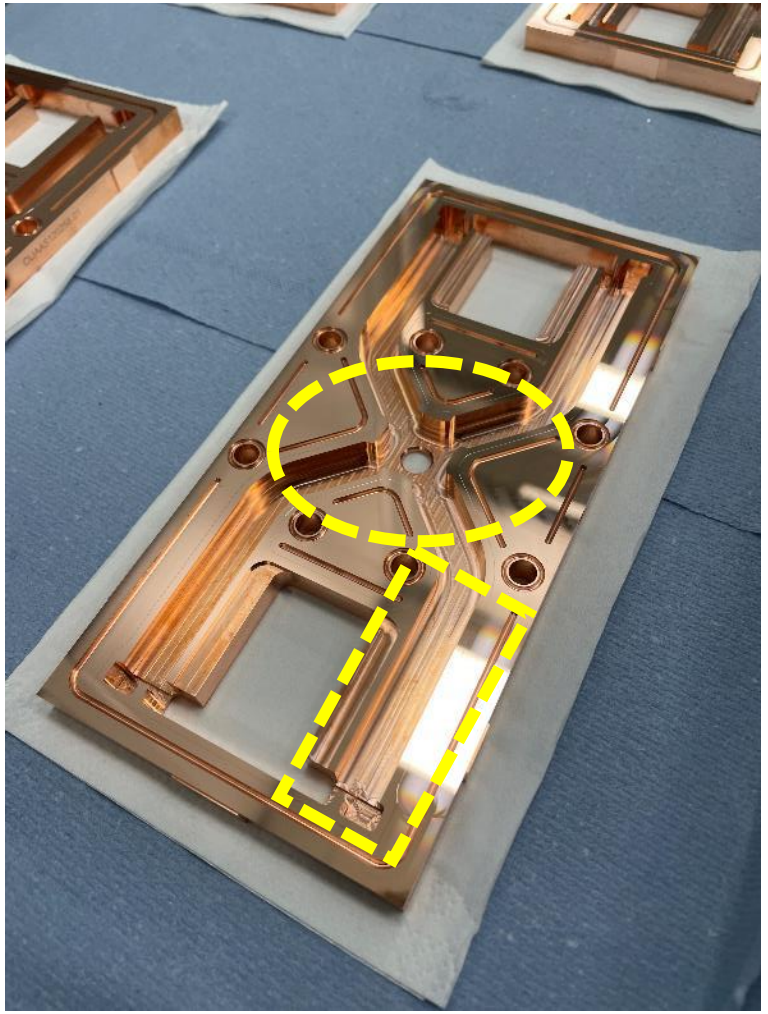
Prior to this new design of the Smartcell (rectangular), many steps on the production and assembly needed to be done producing a full structure

Structure design

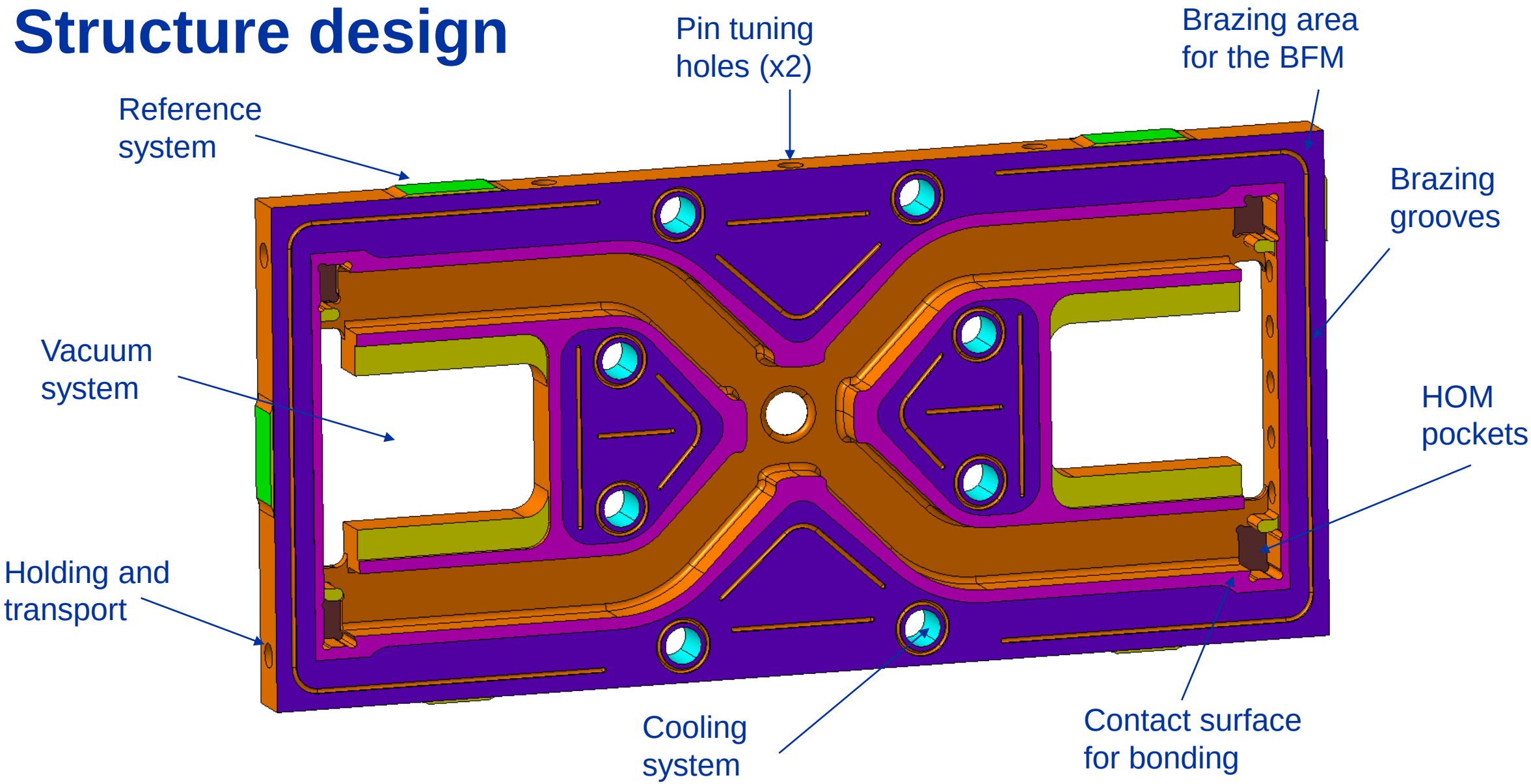


There are two main reasons for this redesign. The transition from bonding to bonding + brazing and avoiding many parts and steps to get the full structure

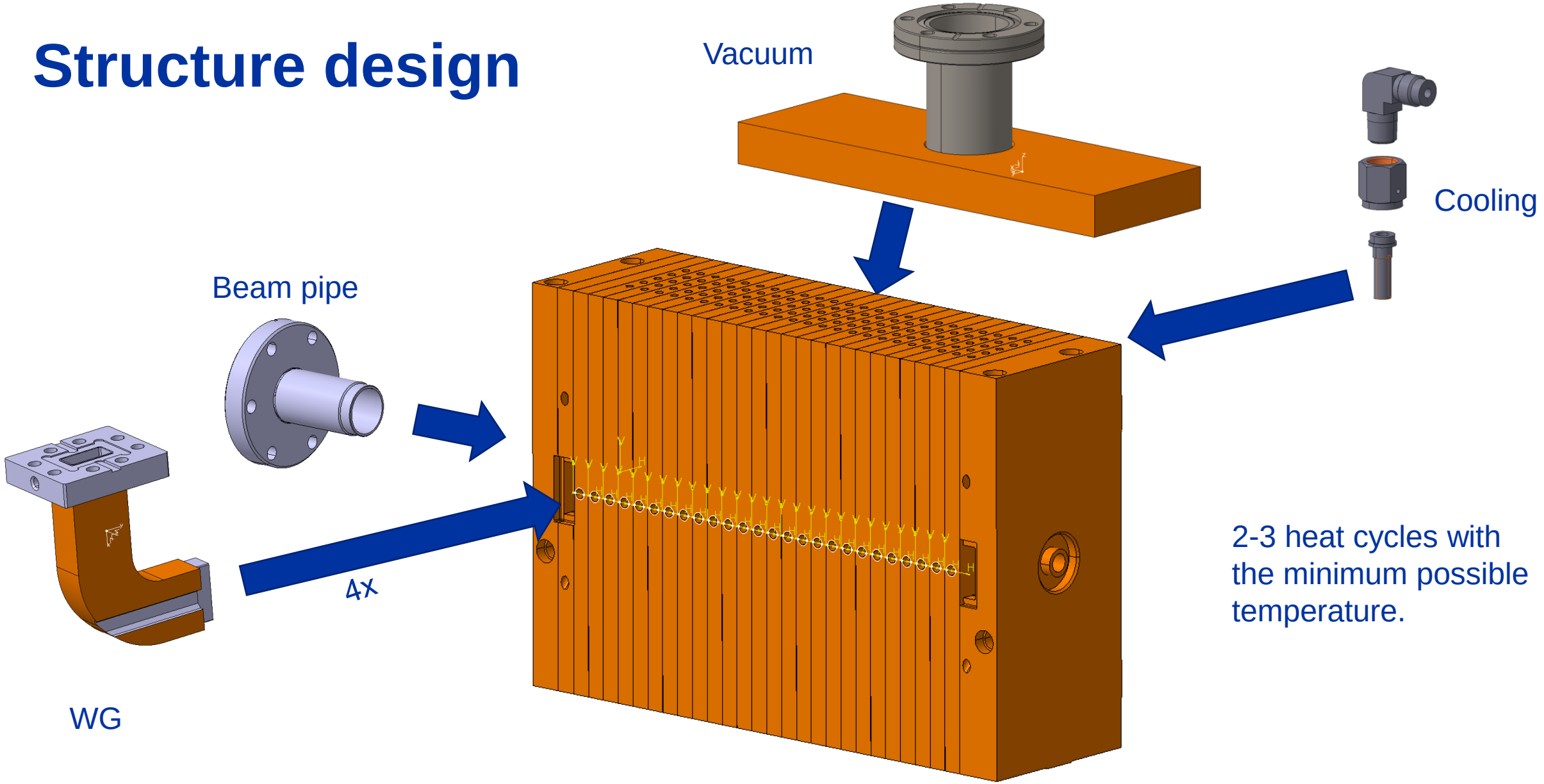
The new design integrates the RF area, cooling circuits, HOM loads and part of the vacuum system in one part



Structure design



Structure design

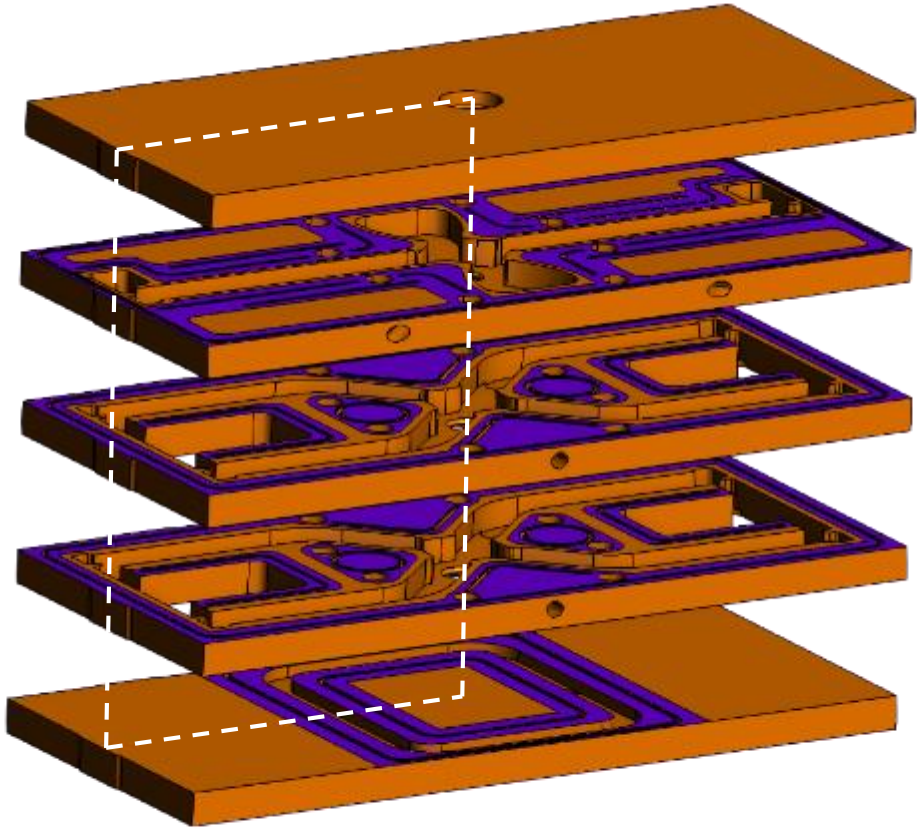


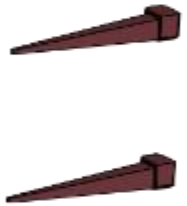
2-3 heat cycles with the minimum possible temperature.

Brazing Mock-up

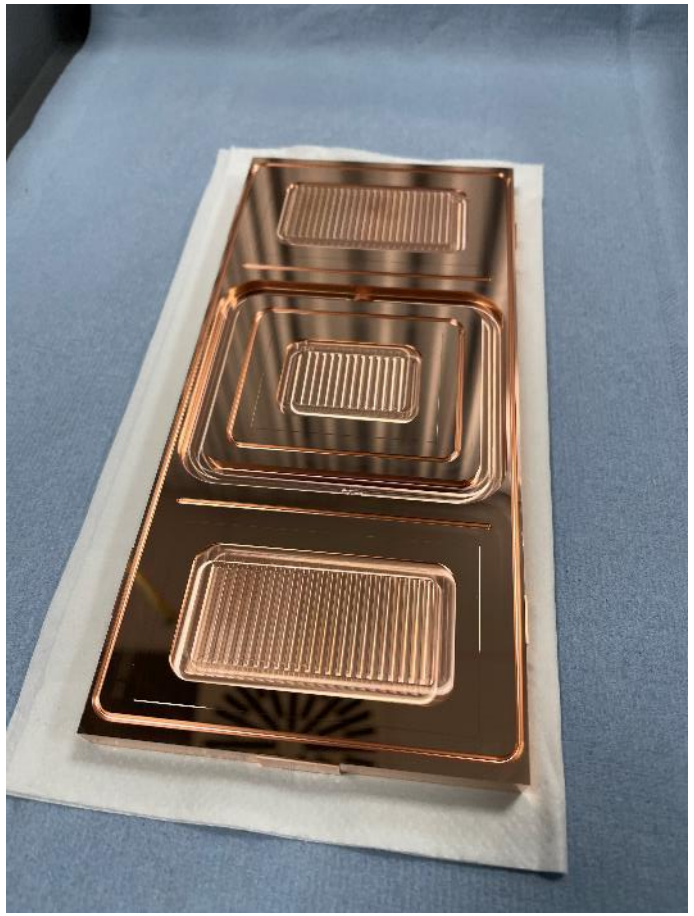
Previous to this, we already did a mock-up, using standard precision machining (not UP-Machining).
More details about it at this previous meeting: https://indi.to/zB6GH

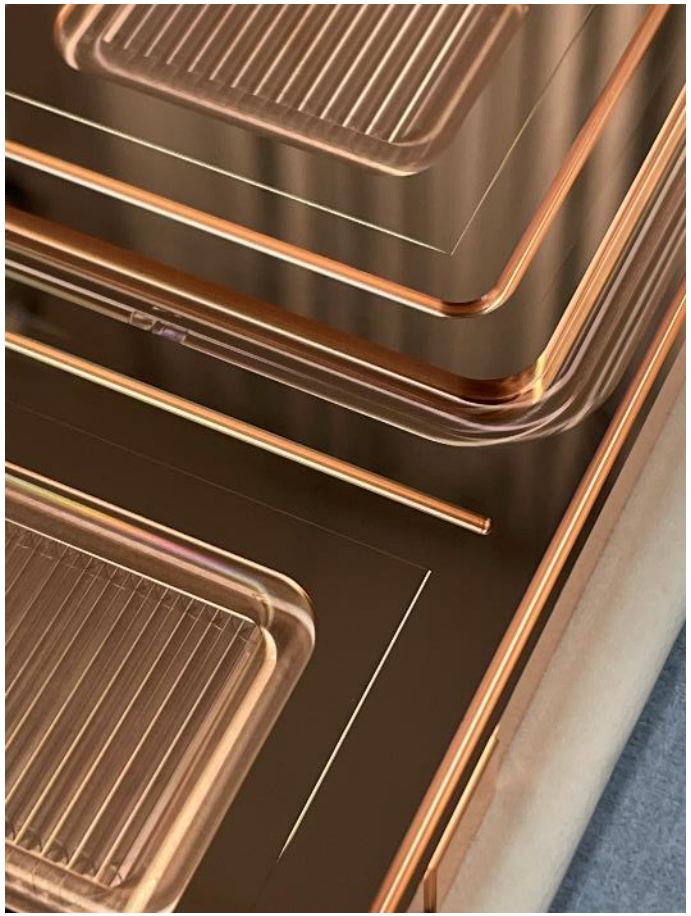
The last mock-ups trials have been produced by UP-Machining. With this production we aim to check the bonding starting at a very low temperature cycle, the layout of the brazing channels and the overall feasibility of the whole part.

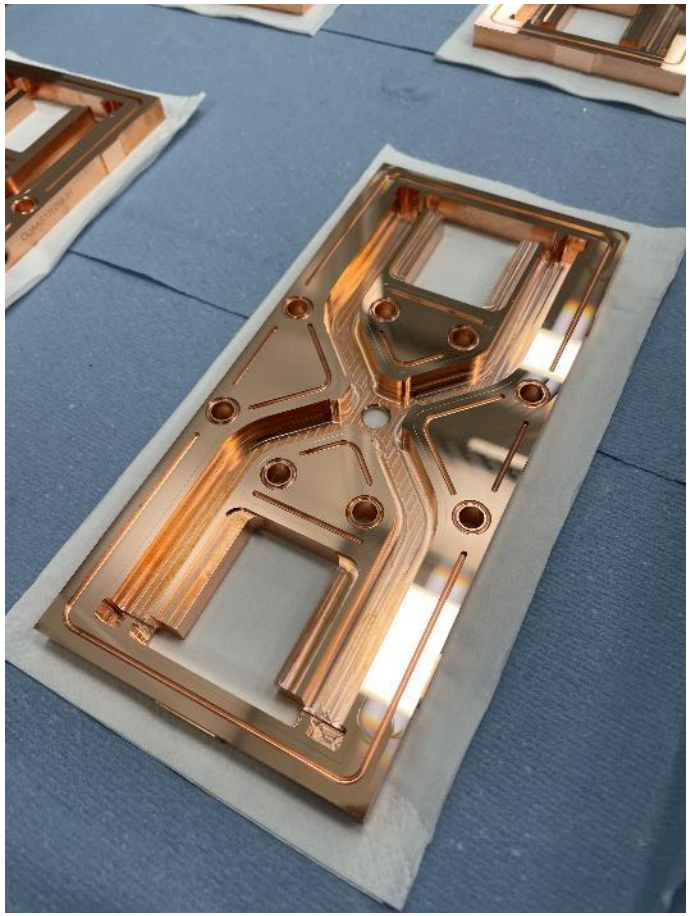




Brazing Mock-up





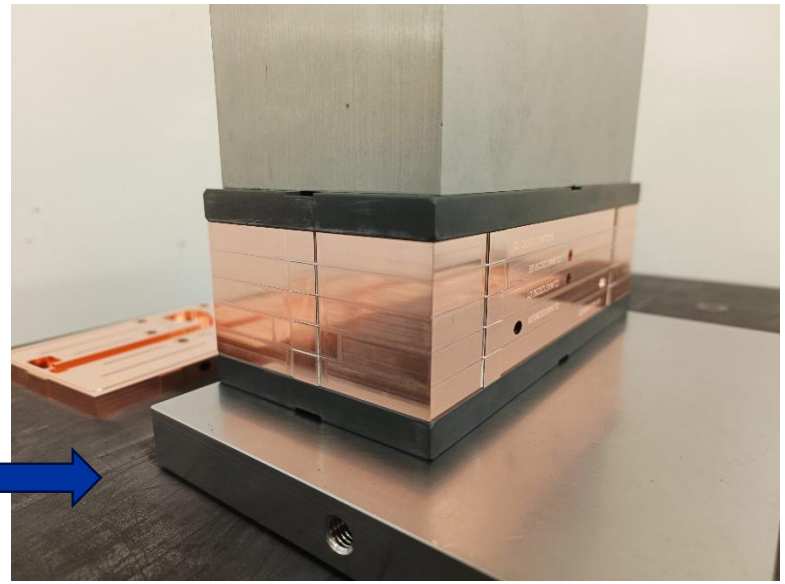


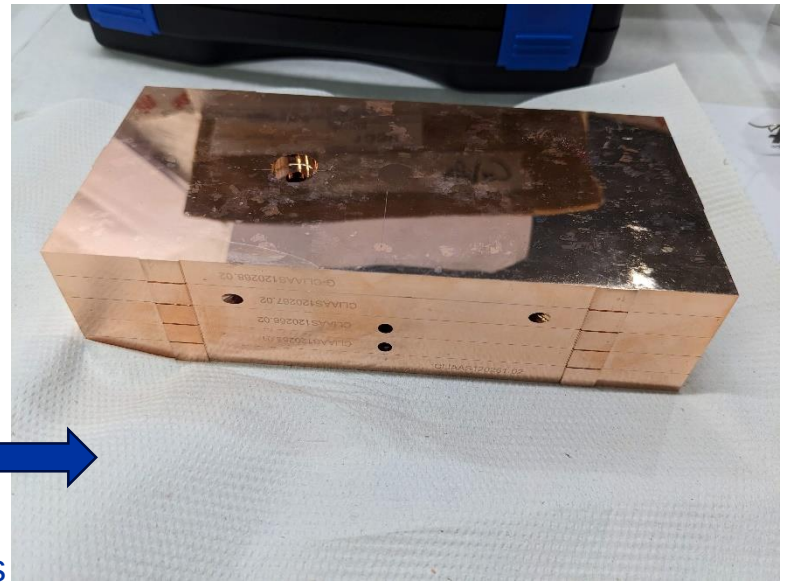
- Pre-machining done at CERN by MME, metrology OK.
- All cells with UP-Machining at external company.

Brazing Mock-up

4 different Brazing tests

- Silver base
  - In-house
  - External
- Gold base
  - In-house
  - External





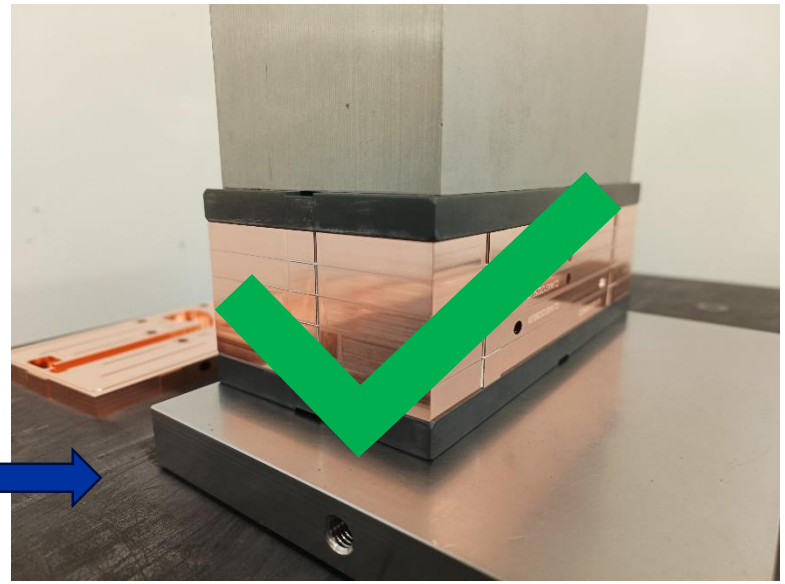
Thanks, Sergio Gonzalez for the tests and pictures

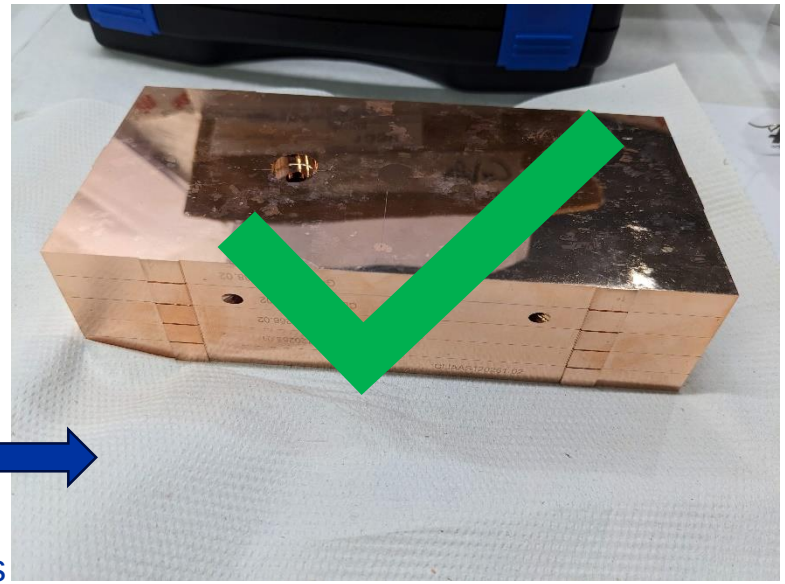
Brazing Mock-up

Leak check

4 different Brazing tests

- Silver base
  - In-house
  - External
- Gold base
  - In-house
  - External





Thanks, Sergio Gonzalez for the tests and pictures

Brazing Mock-up

Alignment

4 different tests

Silver base

Gold base

In-house

External

In-house

External

Pads covered in BFM

Alignment (um)	Before brazing	After brazing
Pad 1	3	5
Pad 2	1	-
Pad 3	2	5

Alignment (um)	Before brazing	After brazing
Pad 1	4	15
Pad 2	2	18
Pad 3	1	14

Alignment (um)	Before brazing	After brazing
Pad 1	4	9
Pad 2	3	5
Pad 3	3	7

Brazing Mock-up

Alignment

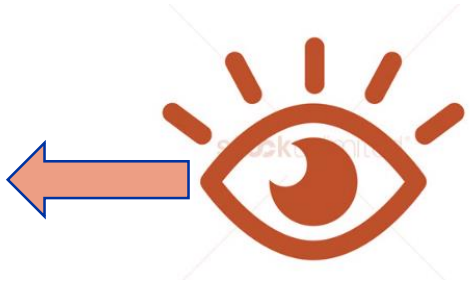
4 different tests

- Silver base 20Kg
  - In-house → 
    Pads covered in BFM
  - External →

Alignment (um)	Before brazing	After brazing
Pad 1	3	5
Pad 2	1	-
Pad 3	2	5

- Gold base 40Kg
  - In-house →

Alignment (um)	Before brazing	After brazing
Pad 1	4	15
Pad 2	2	18
Pad 3	1	14



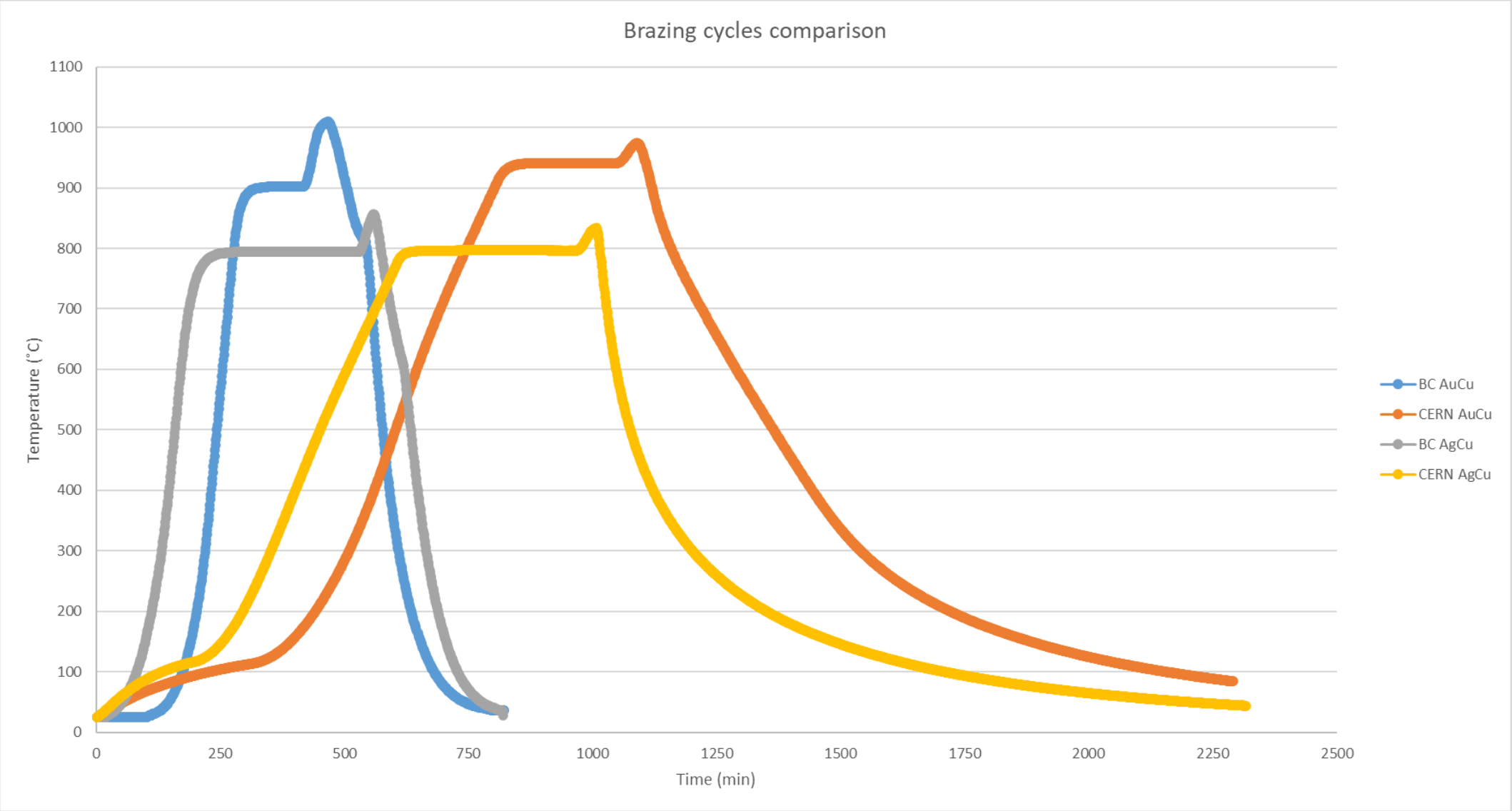
  - External →

Alignment (um)	Before brazing	After brazing
Pad 1	4	9
Pad 2	3	5
Pad 3	3	7

We will need to pay attention to the transport method.

Apparently, the misalignment is not related to the weight but the transportation.

Brazing Mock-up

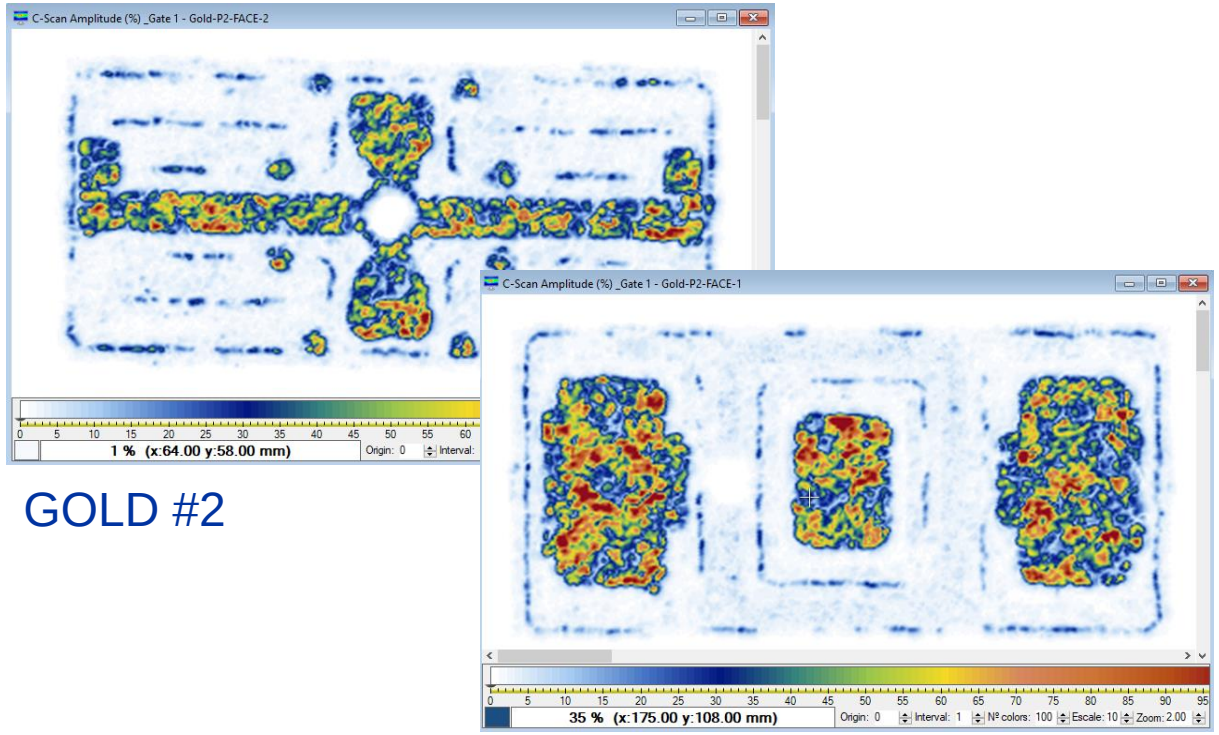


Brazing mock-up analysis

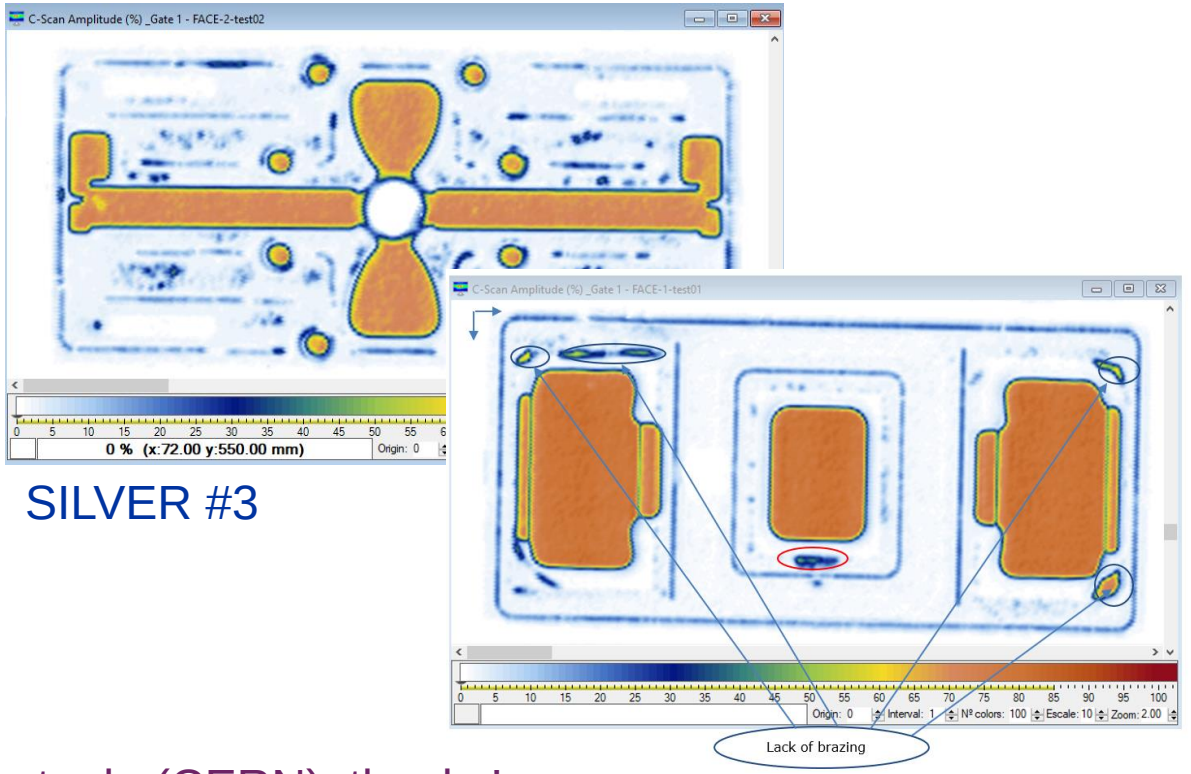
Samples: GOLD #1, GOLD #2, SILVER #3 and SILVER #4.

Procedure: Only top and bottom brazed interfaces are inspectable with this method.

Results: Both “GOLD” samples present sound interfaces while both “SILVER” samples presented indications in one of the inspected interfaces.



GOLD #2



SILVER #3

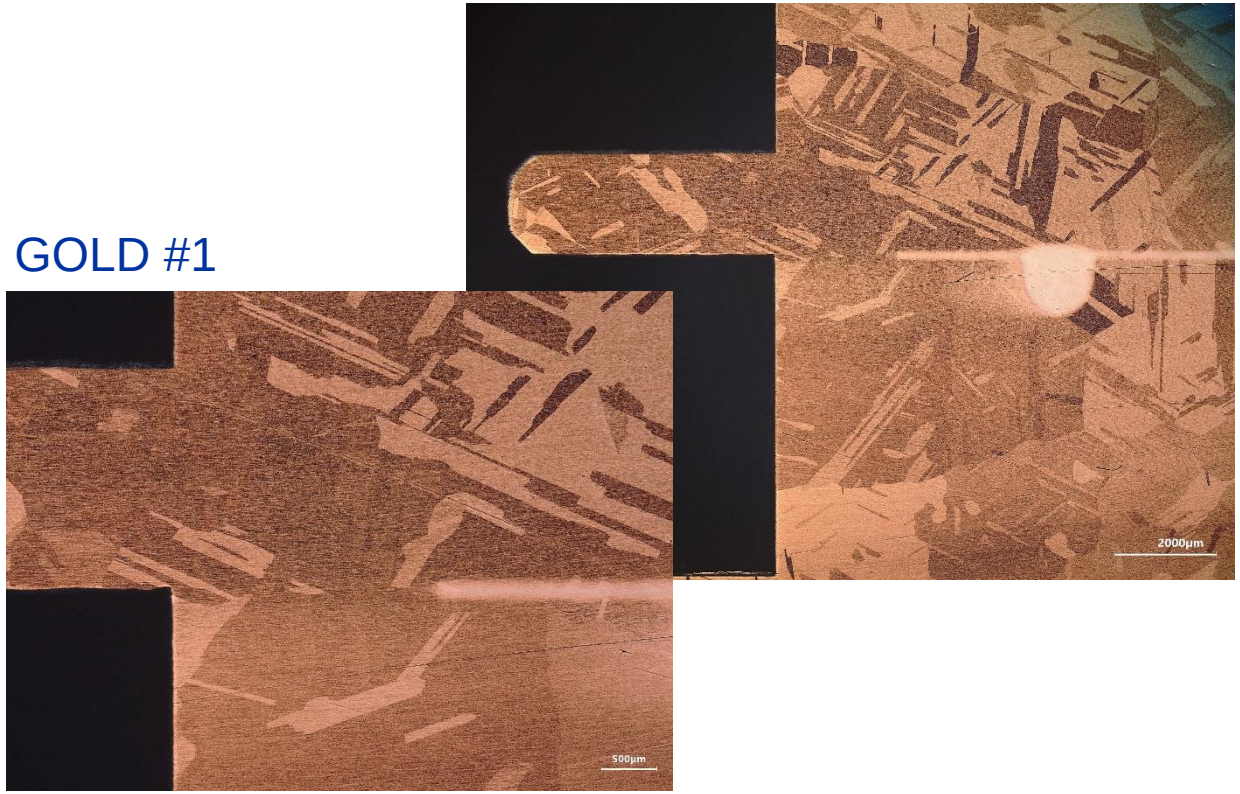
Indico slides from Alice Moros (CERN), Ana Teresa Perez Fontenla (CERN), thanks!

Brazing mock-up analysis

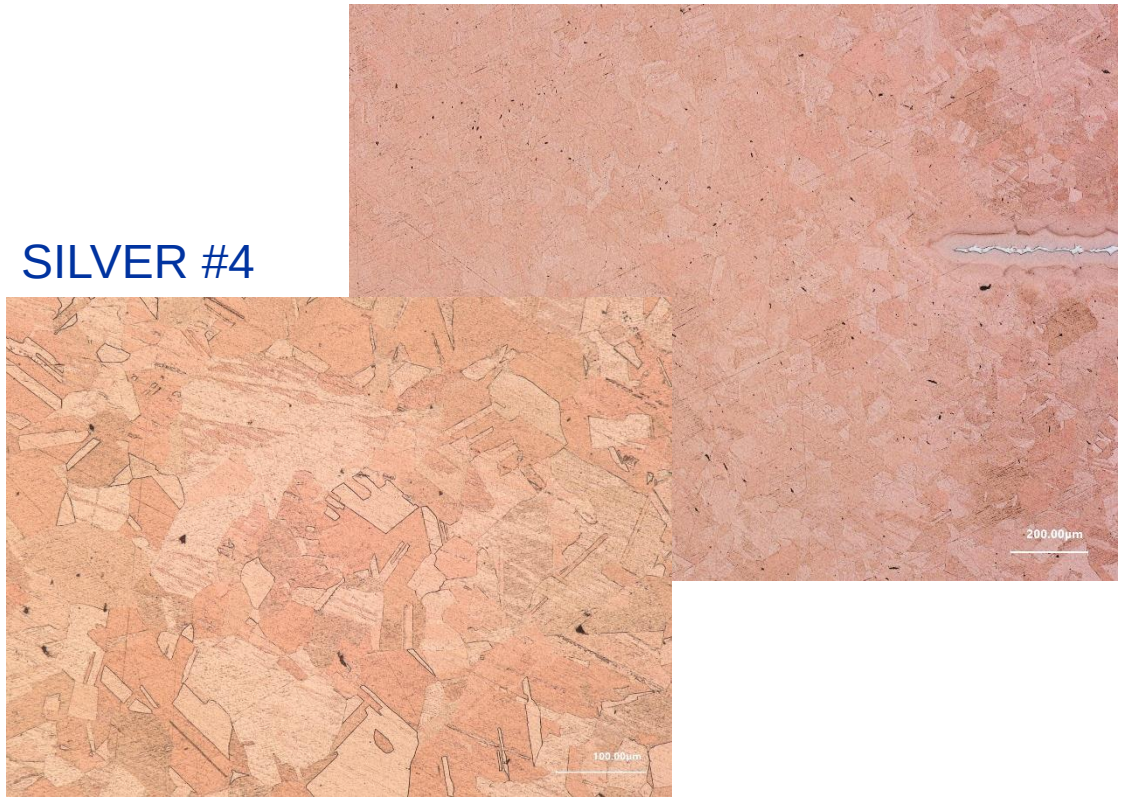
The cut surfaces were prepared by mechanical polishing and etching to reveal the Cu microstructure.

The components were subjected to different thermal cycles depending on the BFM being for the “GOLD” samples the maximum temperature ~1000 °C and for “SILVER” samples ~840 °C.

GOLD #1



SILVER #4



Indico slides from Alice Moros (CERN), Ana Teresa Perez Fontenla (CERN), thanks!

Brazing mock-up analysis

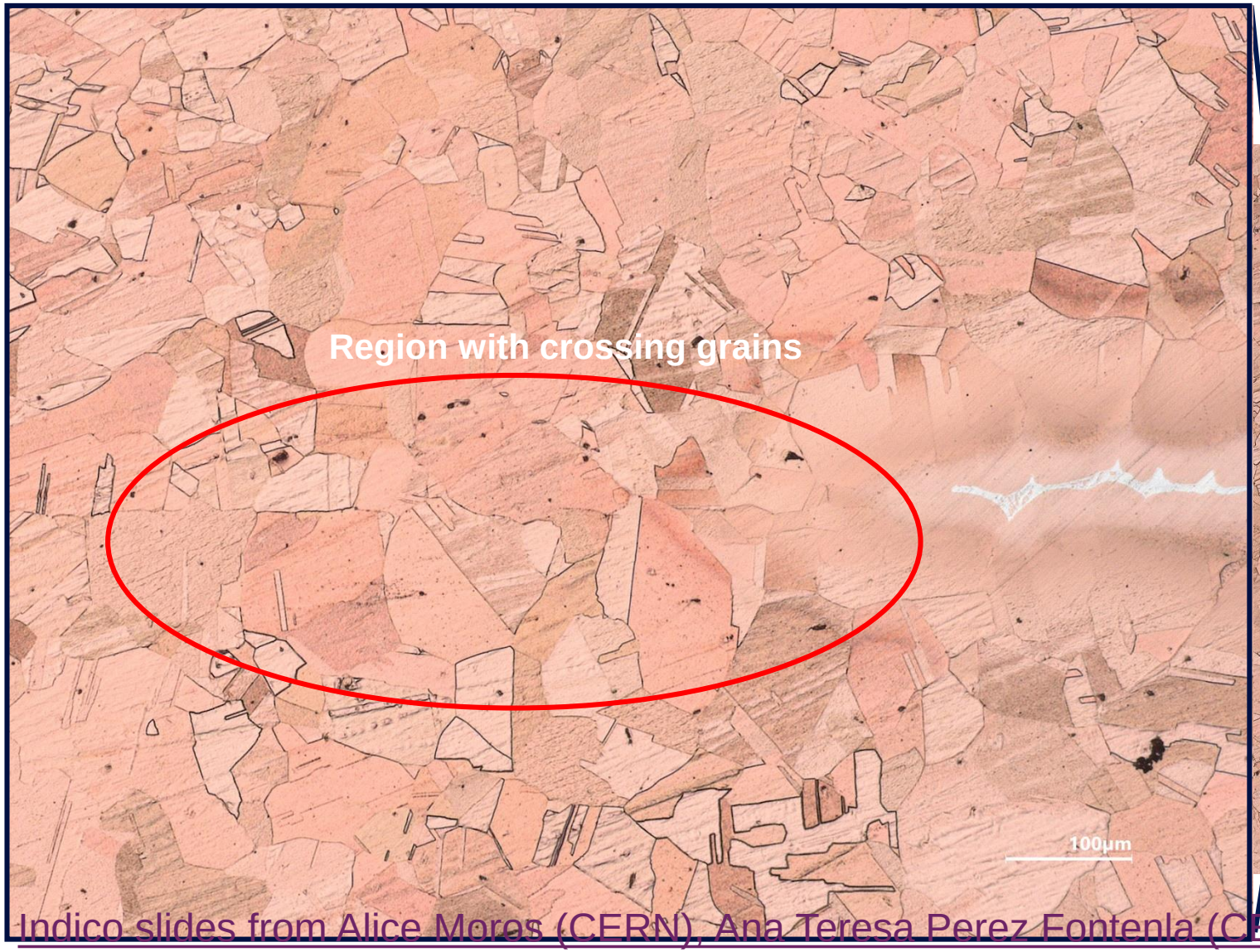
If we look to the Silver samples, we can see that the microstructure is formed with smaller grain sizes due to a lower temperature of the cycle. Even with this conditions, we manage to see crossing grains in the contact interface

SILVER #4 - IF1

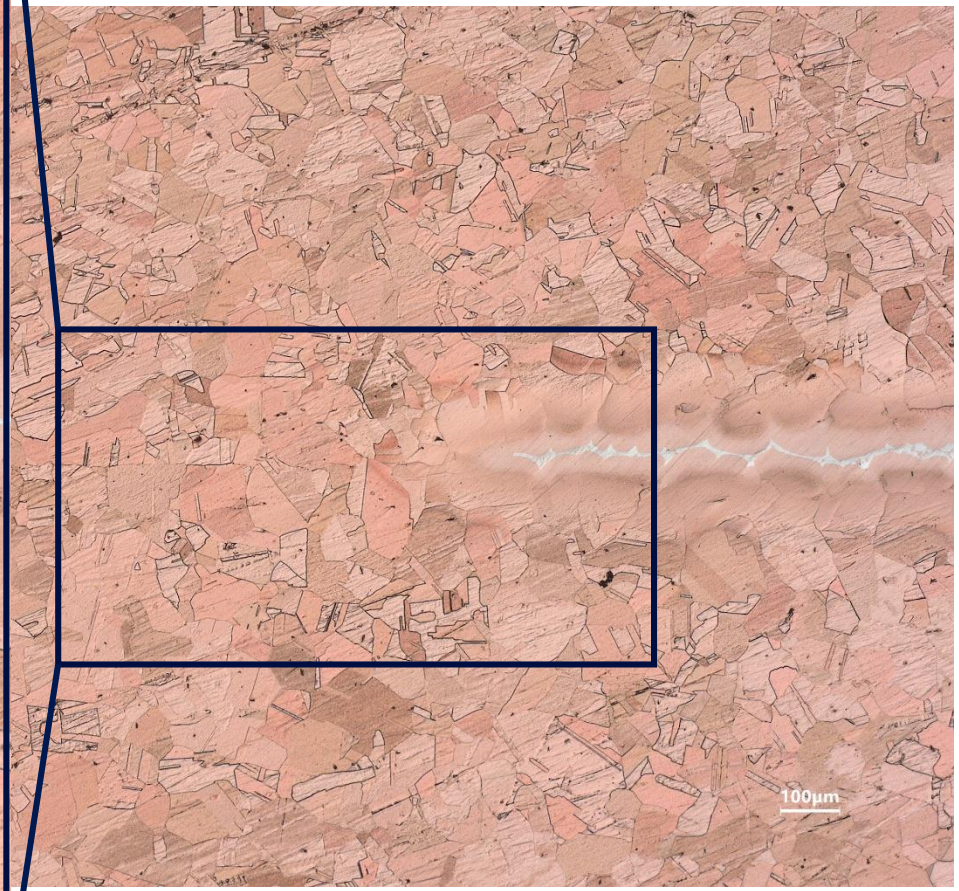
SILVER #3 - IF1

Indico slides from Alice Moros (CERN), Ana Teresa Perez Fontenla (CERN), thanks!

Brazing mock-up analysis



SILVER #3 - IF1



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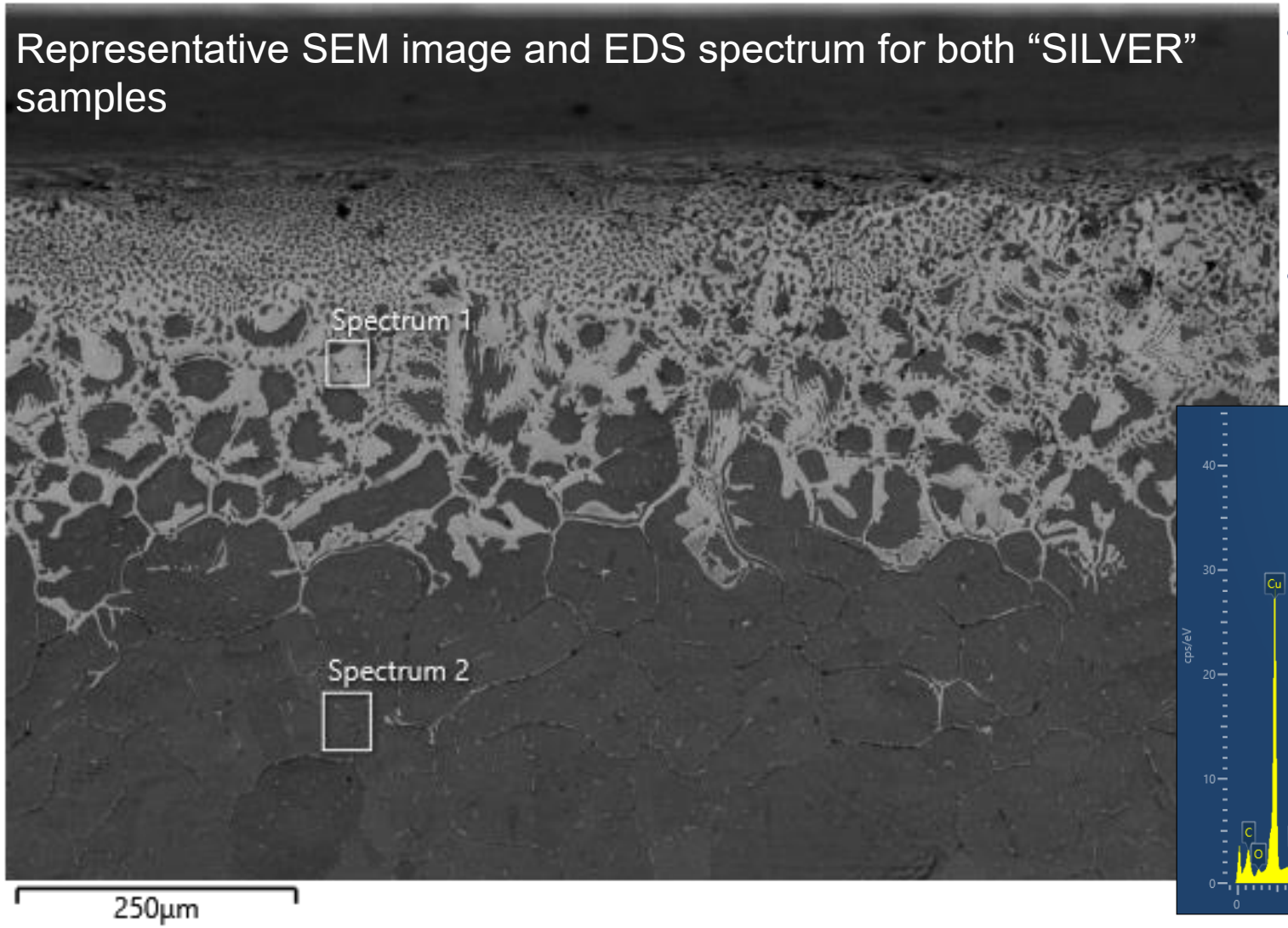
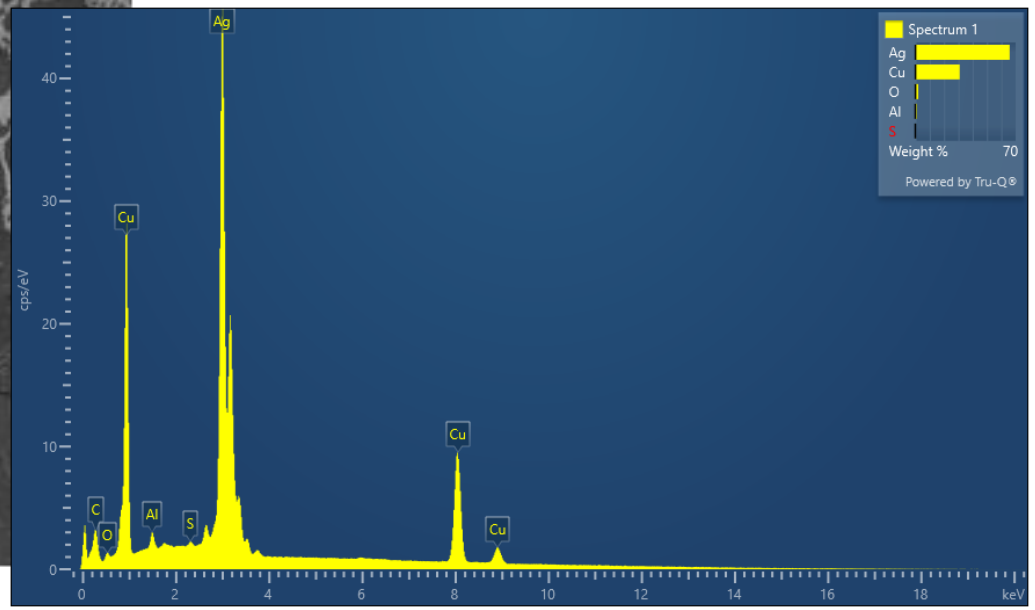
Brazing mock-up analysis



- **The visual inspection after cutting pointed out in the “SILVER” samples the presence of BFM in the RF volume as observed in other tests (EDMS-2937007).**
- **The silver-based FM diffusion was confirmed by EDS into the SEM but not on the gold-based one.**



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Conclusions

- The production of a full prototype is ongoing and will be launch for fabrication before the end of the year.
- A very deep analysis has been done about the brazing + bonding technique.
- After all those analysis, we are confident that the strategy chosen for the new prototype will succeed.
- The new tooling used for the rectangular shape was successfully tested and a similar approach will be used for the final assembly.

Band
Prototypes
Production

Thank you for your attention and do not hesitate to ask any question.

Thanks to Nuria Catalan Laseras and all the team for the help on the presentation and the pictures.