Laboratoire d'Annecy-le-Vieux
de Physique des Particules

WA-105

Anode Deck Structure
- design status -

WA105 Technical Board – 29th of June 2016

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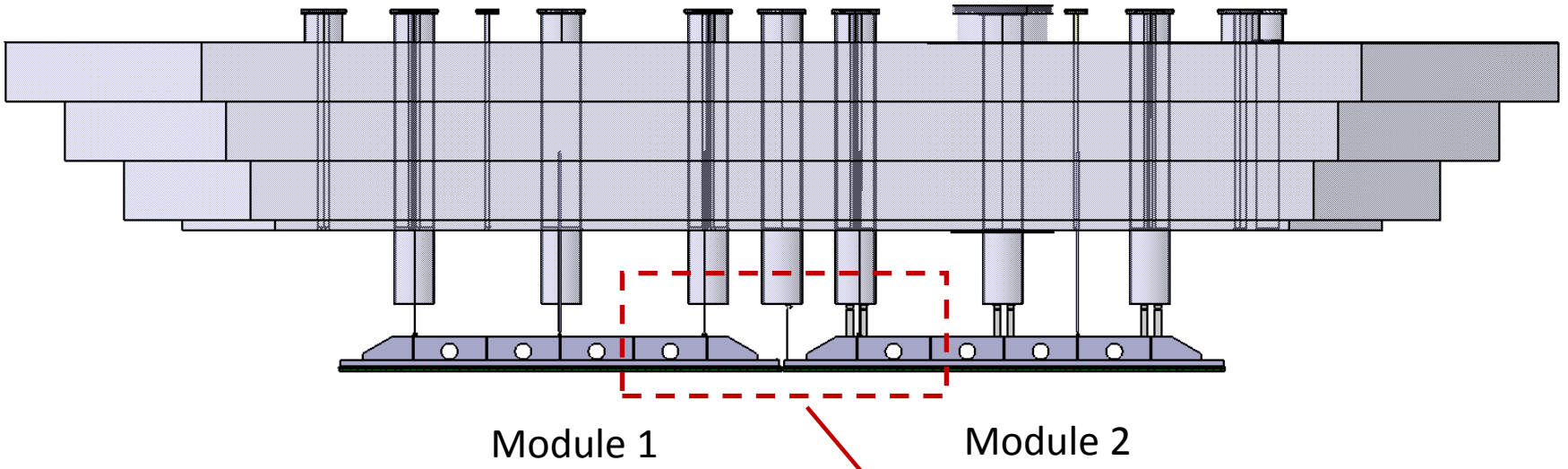
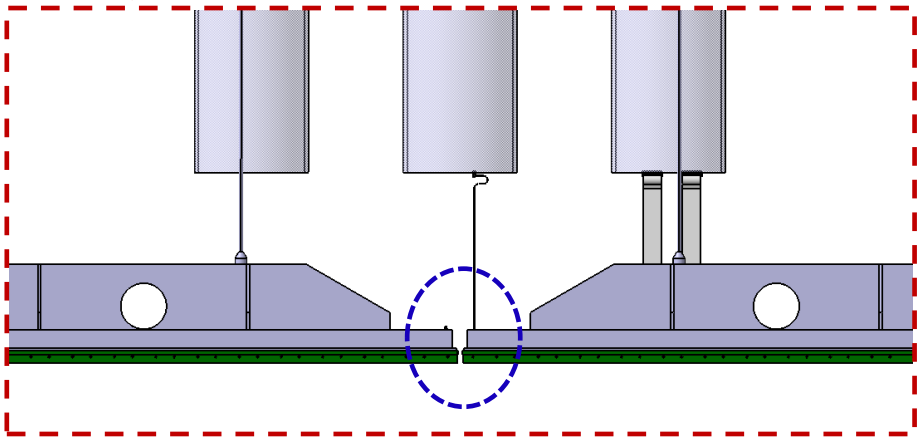
CNRS IN2P3 Les deux infinis

UNIVERSITÉ SAVOIE MONT BLANC

Modules positioning

Top of cryostat & crossing pipes just for illustration



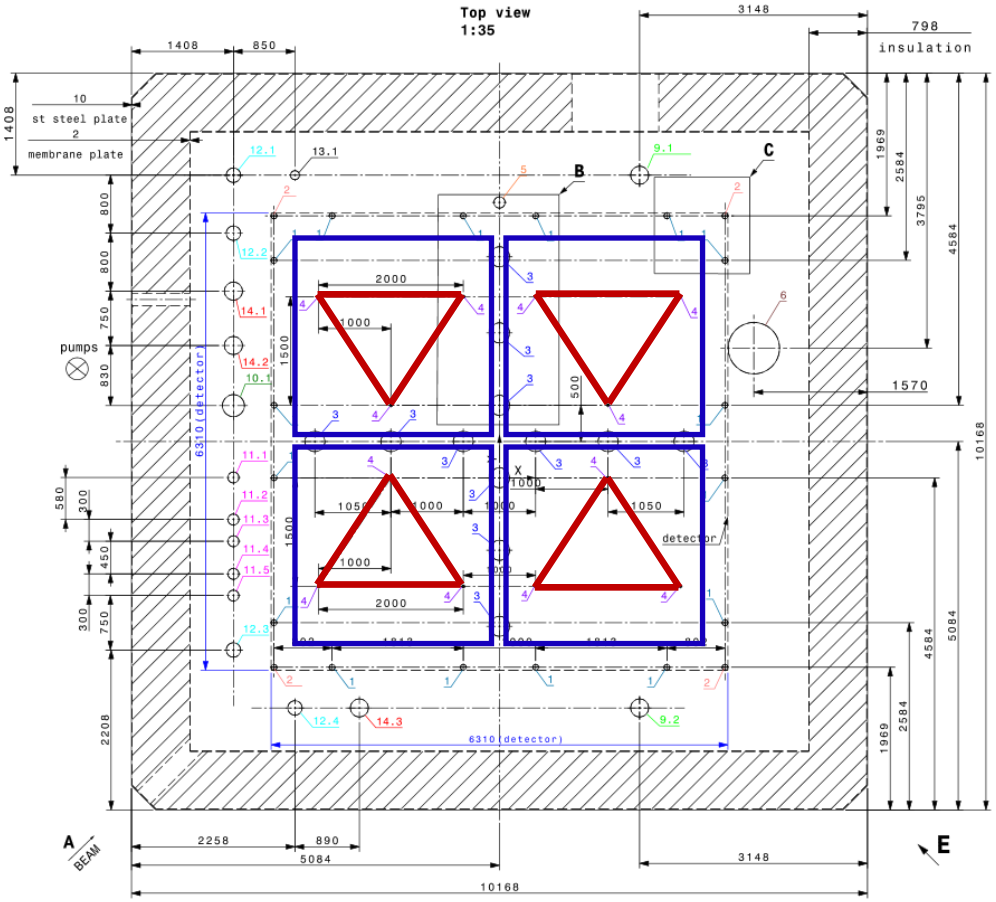


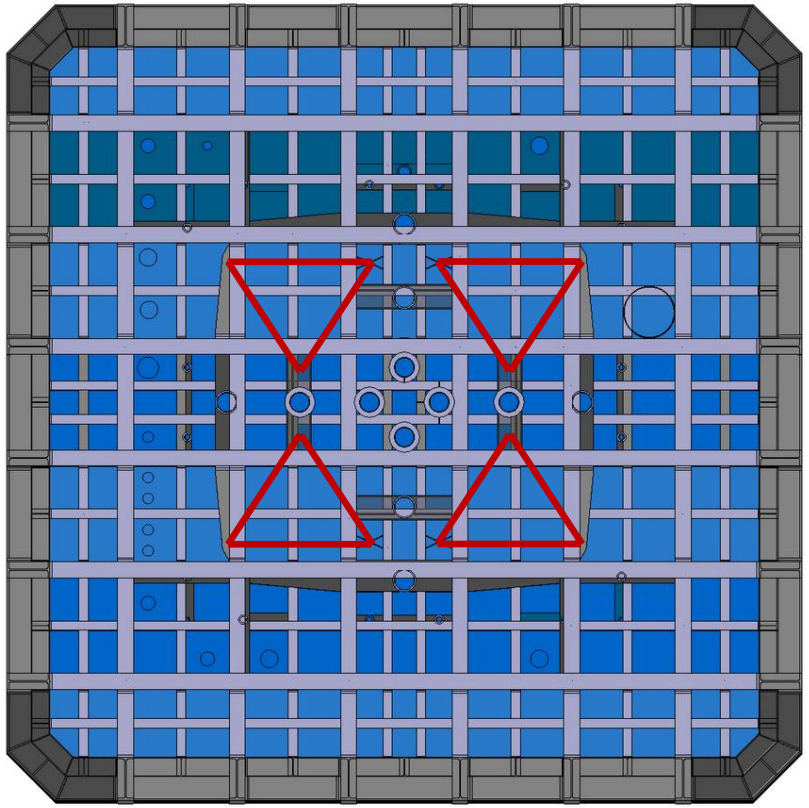
Position the modules as close as possible

to *minimize dead-space* for Physics

Modules positioning

Modules positions depend on ***SusPension FeedThrough (SPFT) positions***





- 3x3 Modules in blue
- suspension triangles in red

WA-105 penetrations:
https://edms.cern.ch/ui/#!master/navigator/document?D:1164910258:1164910258:subDocs

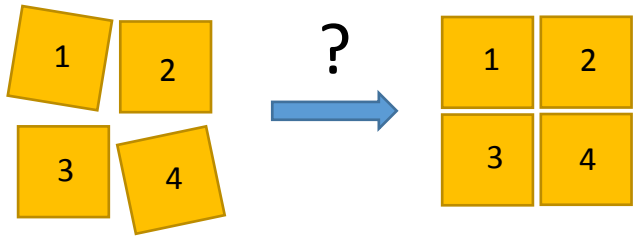
Modules positioning

Due to *fabrication processes* of such a big structure different things could happen:

- Crossing pipes *not at the proper location* (tolerances ?)
- Crossing pipes *not vertical* (tolerances ?)

In addition, positions and angles of crossing pipes can be affected by the deformation of the cryostat under:

- LAr + Gar pressure
- Thermal loads

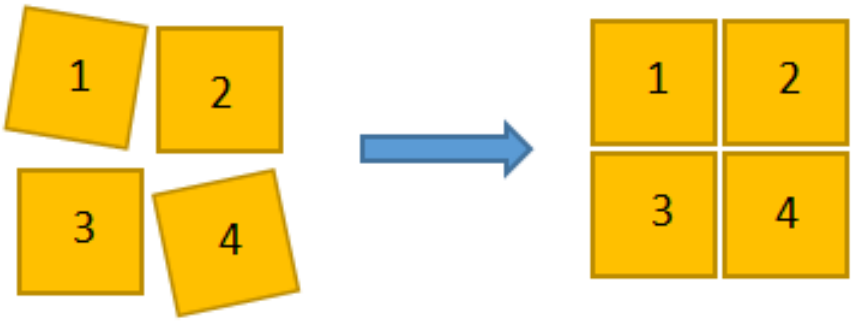


Modules positioning

Goal =

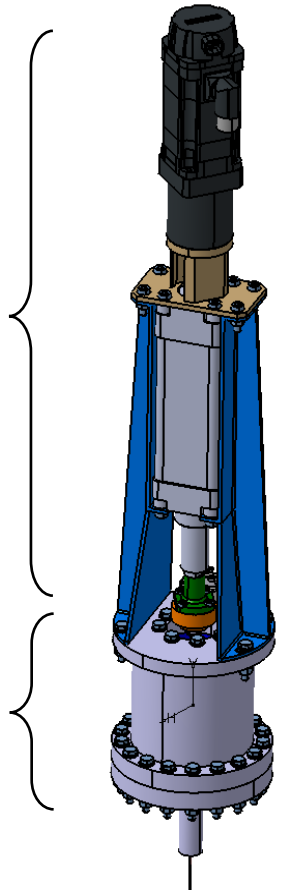
to be able to tune the modules relative position
in order to minimize the inter-space between modules (dead-space)

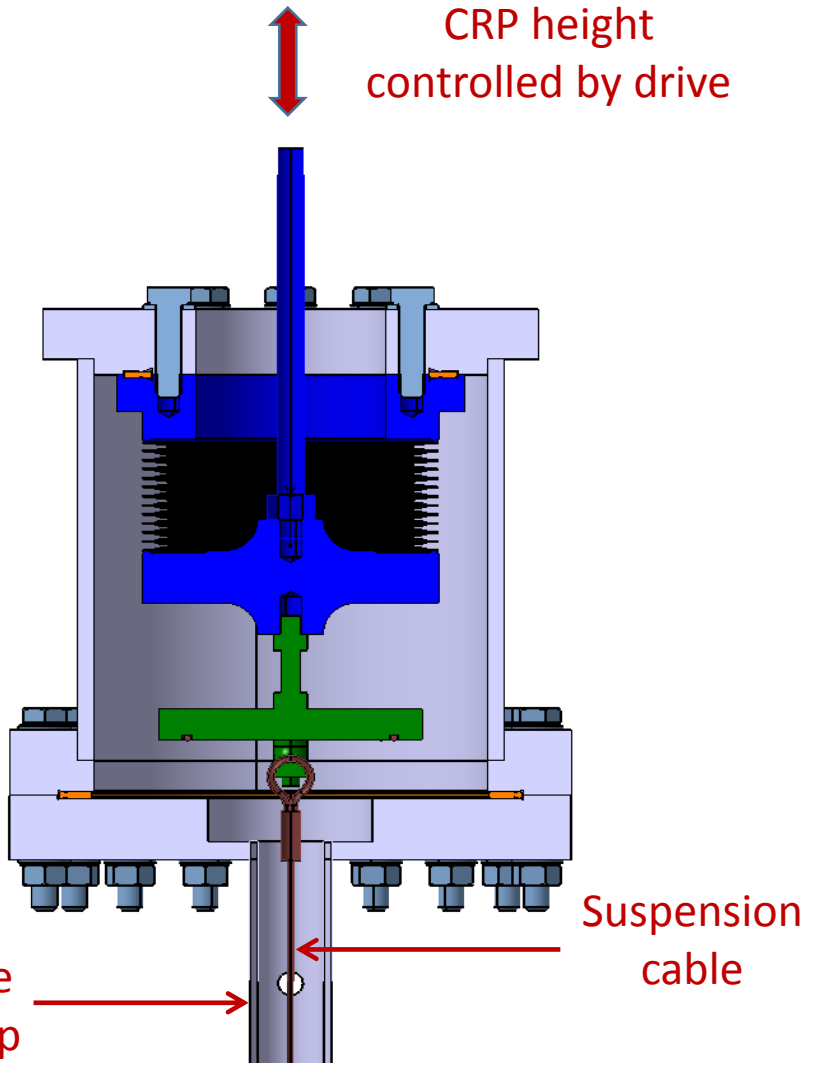
- Consider “strong” tolerances for production
- Increase pipes diameter: +20mm already validated, ie. from 40mm to 60mm (cf. Dario / Marzio)
- Translate top extremities of suspension wires
- (Translate bottom extremities of suspension wires)



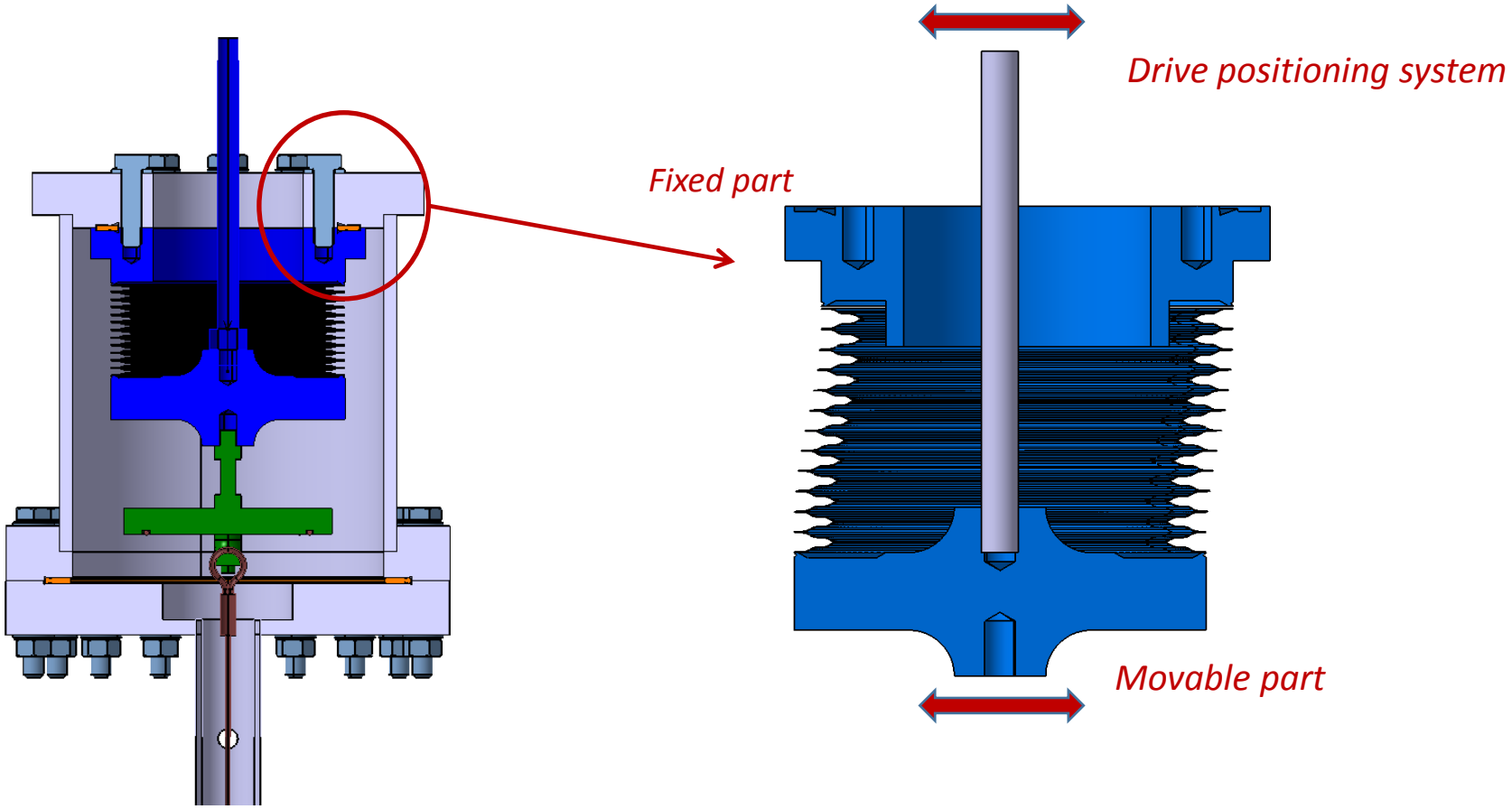
Modules positioning – Bellow lateral deformation

Example on 3x1 SPFT chimney

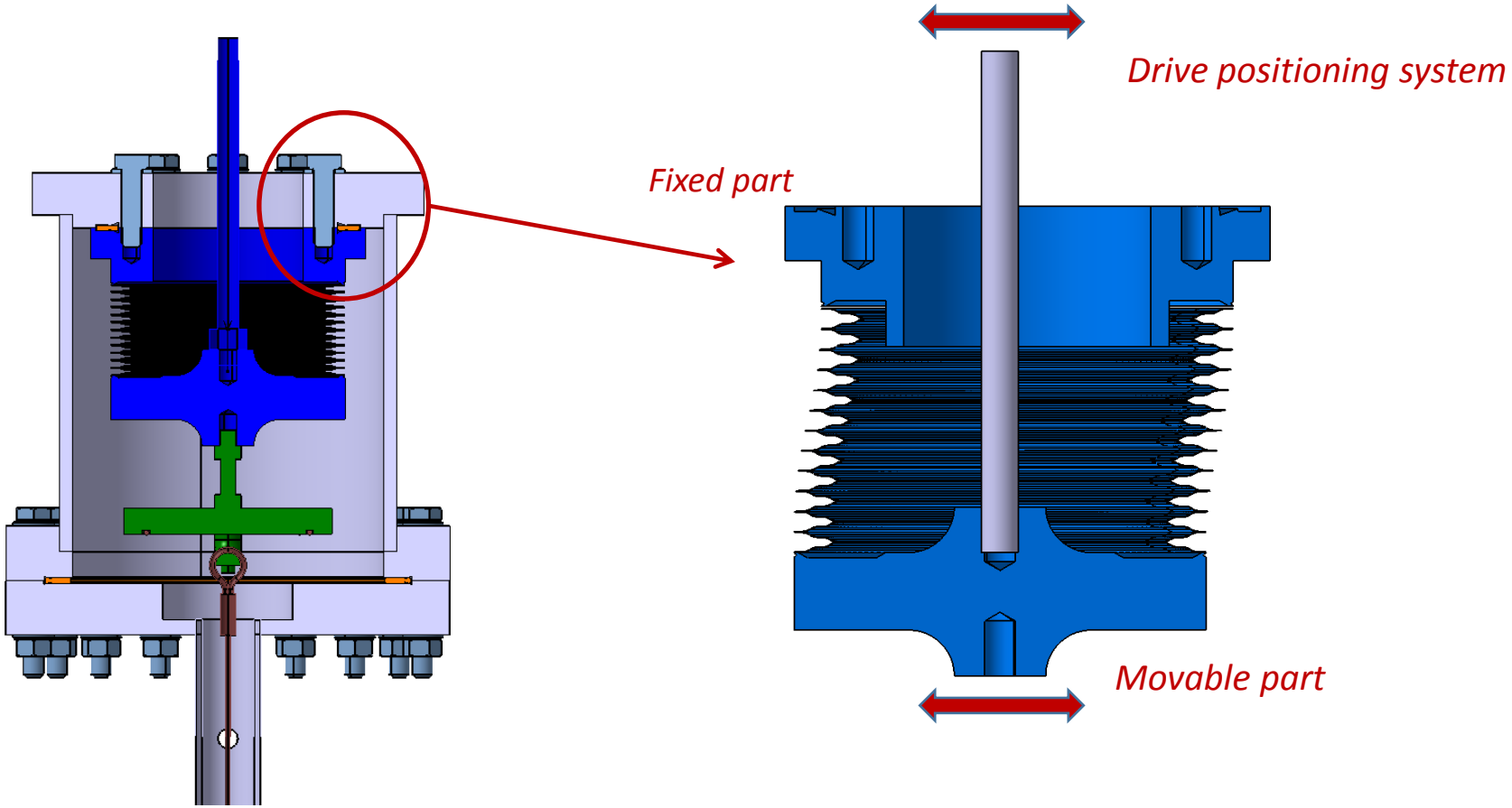




Modules positioning – Bellow lateral deformation

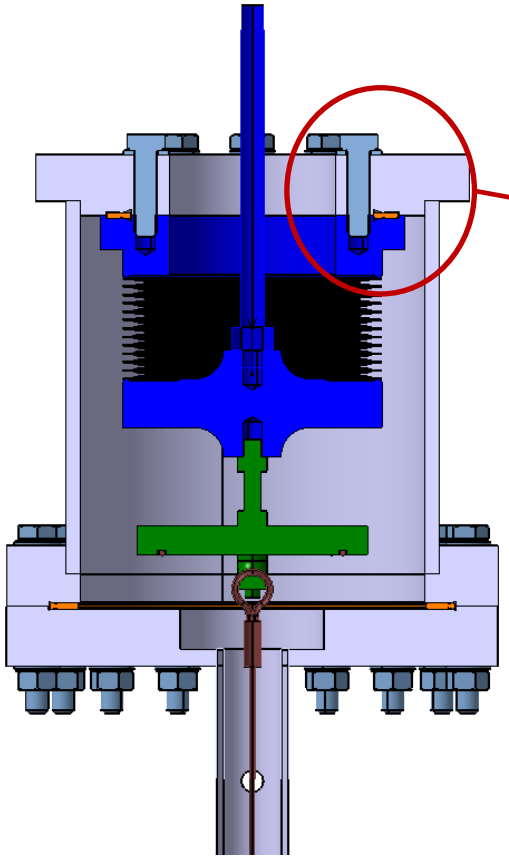


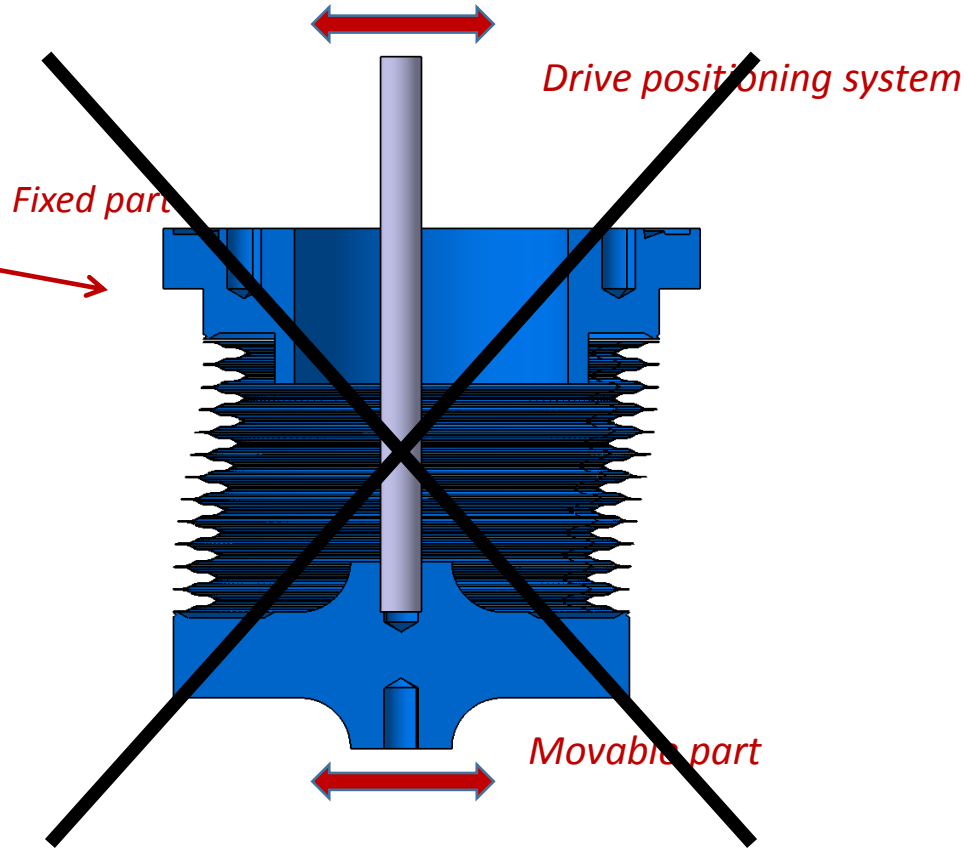
Modules positioning – Bellow lateral deformation



- Lateral deformation drastically decreases longitudinal stroke of bellow
- Need to increase the numbers of convolutions (length of bellow) to get allowable force to deform bellow
- Need very (very) long bellow

Modules positioning – Bellow lateral deformation





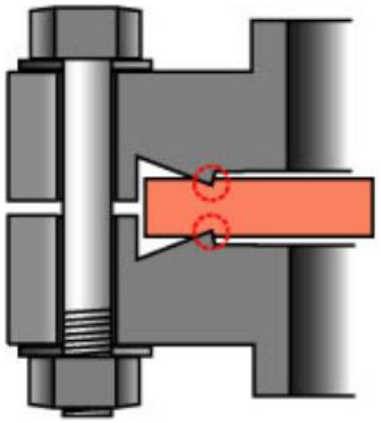
- Lateral deformation drastically decreases longitudinal stroke of bellow
- Need to increase the numbers of convolutions (length of bellow) to get allowable force to deform bellow
- Need very (very) long bellow

Find something else…

Modules positioning

CF flanges with copper ring
are designed to ensure UHV conditions

(10^{-9}mbar for some of them)



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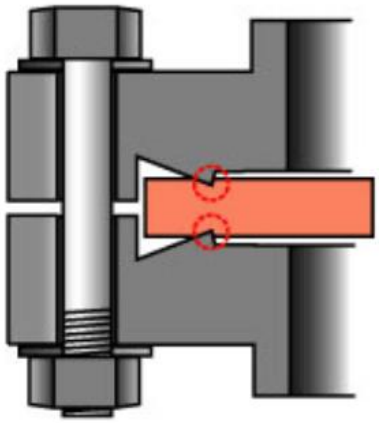

WA-105 will work at ***Pa + 40 mbar***

Modules positioning

CF flanges with copper ring
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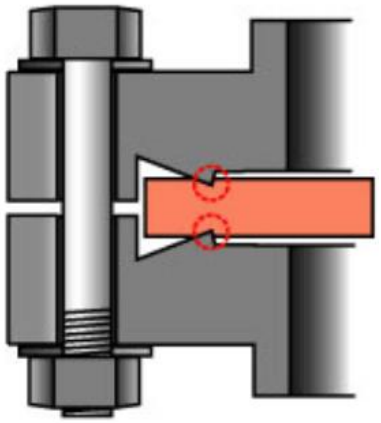


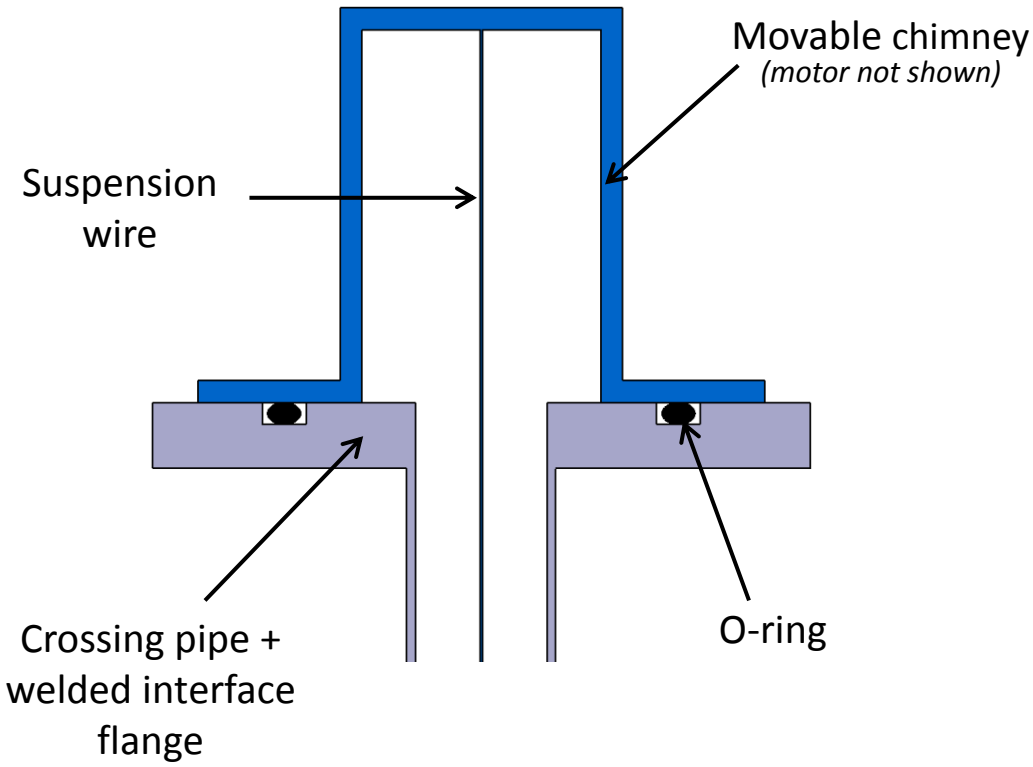
WA-105 will work at ***Pa + 40 mbar***

The use of an ***O-ring*** (elastomer/silicone) could offer us a great opportunity :

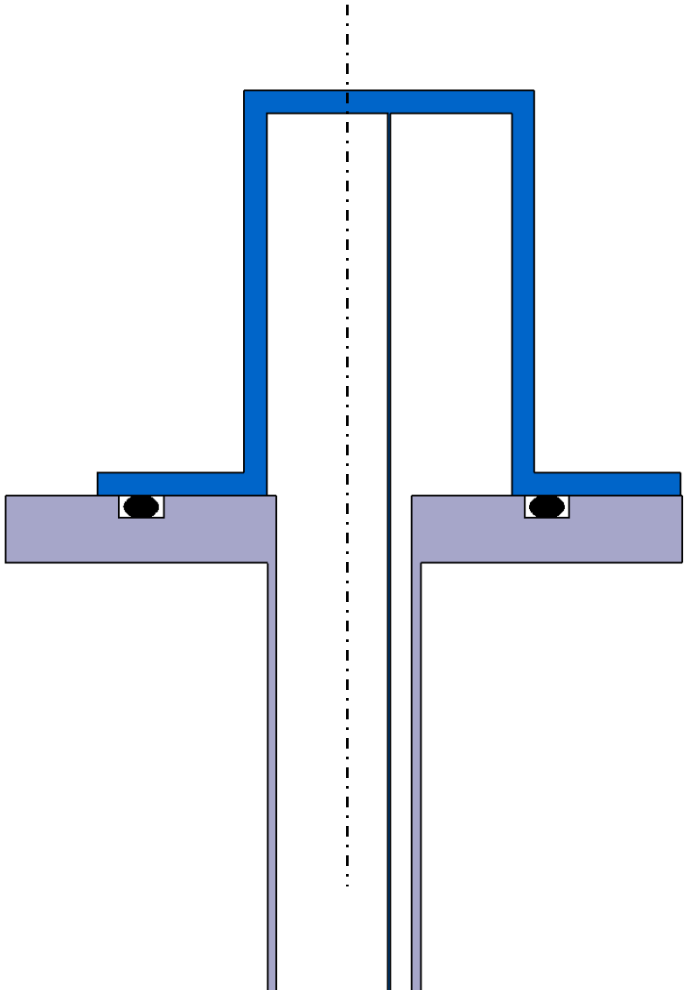
Translate the chimney and clamp at desired position !

Modules positioning – chimney translation

Centered position



Translated position



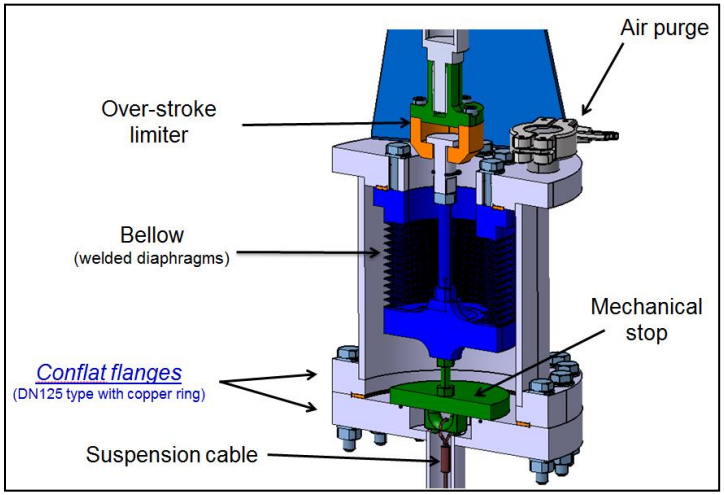
Modules positioning – O-ring

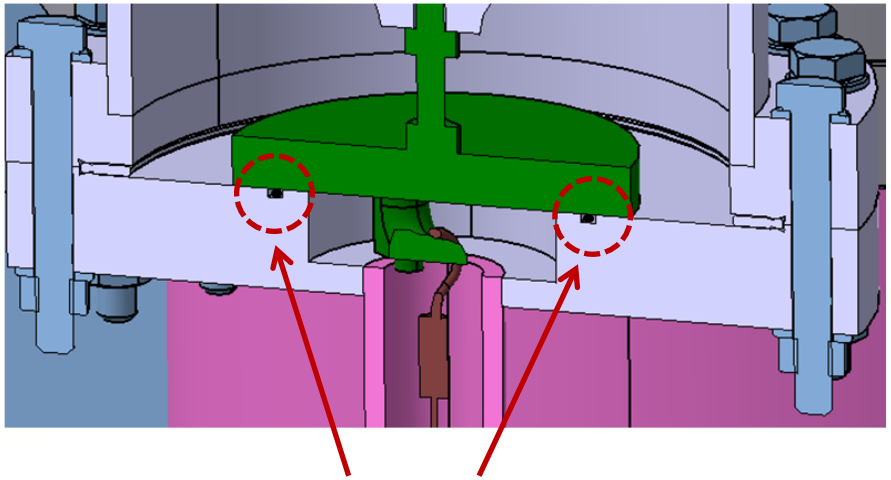
O-ring in elastomer/silicone is Ok for:

- WA-105 pressure conditions
- Temperature (-30°C mini assumed)

Eventually ***metallic O-ring***… not yet investigated, only discussions with elastomer/ silicone O-rings suppliers.

NB: it is the same principle we wanted to adapt on 3x1 chimneys. Not implemented because not always squeezed





O-ring to close the cryostat during bellow maintenance

Modules positioning - strategy

1. Position modules by translating the chimneys

2. If chimney translation is not sufficient, we could eventually play on bottom extremities wires (anchoring on 3x3 modules)

A margin must be kept to be able to translate them for step #3

Warm condition

Modules positioning - strategy

1. Position modules by translating the chimneys → A margin must be kept to be able to translate them for step #3
2. If chimney translation is not sufficient, we could eventually play on bottom extremities wires (anchoring on 3x3 modules)

Warm condition

3. Due to module shrinkage after cooling, re-position modules by translating the chimneys (action outside the cryostat only !)

Cold condition

Modules positioning - strategy

1. Position modules by translating the chimneys → A margin must be kept to be able to translate them for step #3

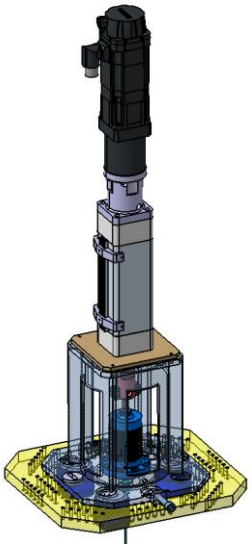
2. If chimney translation is not sufficient, we could eventually play on bottom extremities wires (anchoring on 3x3 modules)

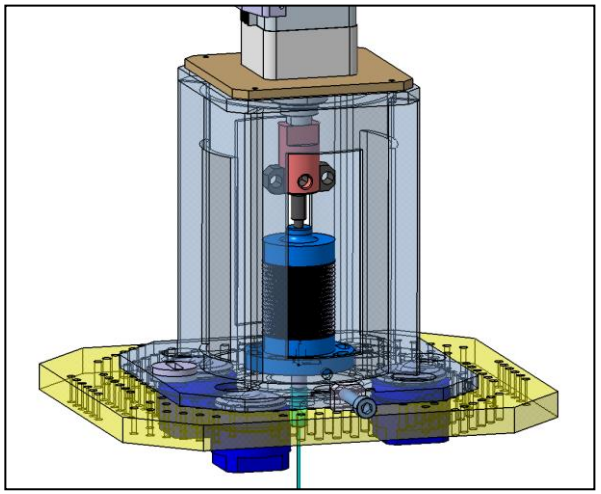
Warm condition

3. Due to module shrinkage after cooling, re-position modules by translating the chimneys

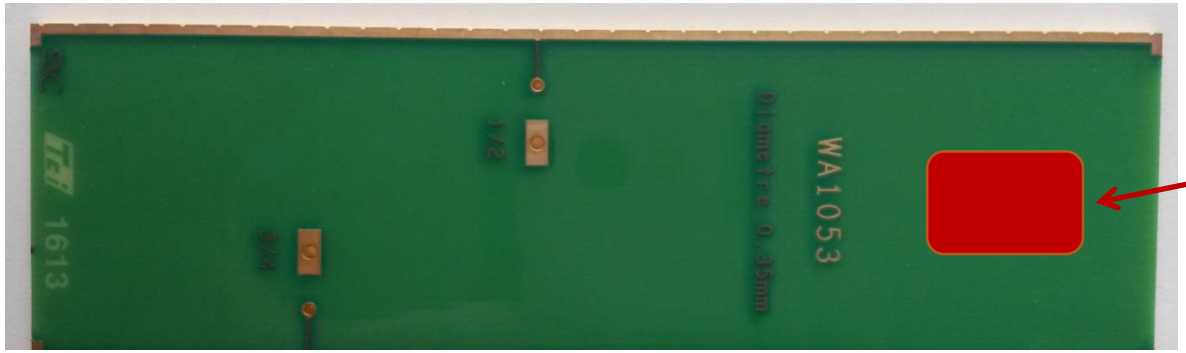
Cold condition

Ideas and first CAD model
but too preliminary for today's presentation

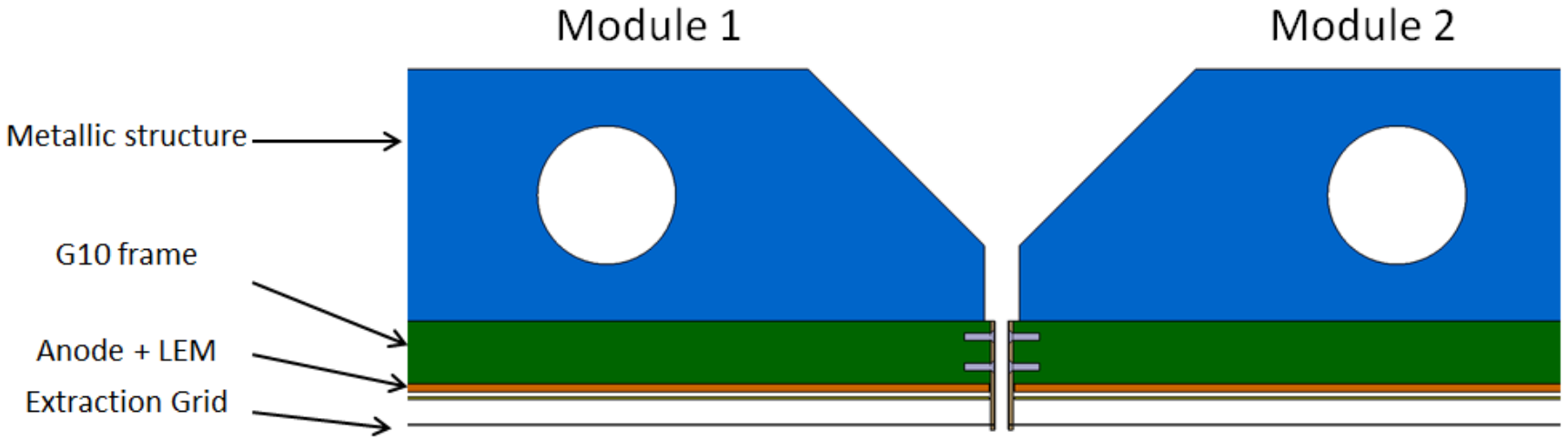




Modules positioning *measurement in cold conditions*

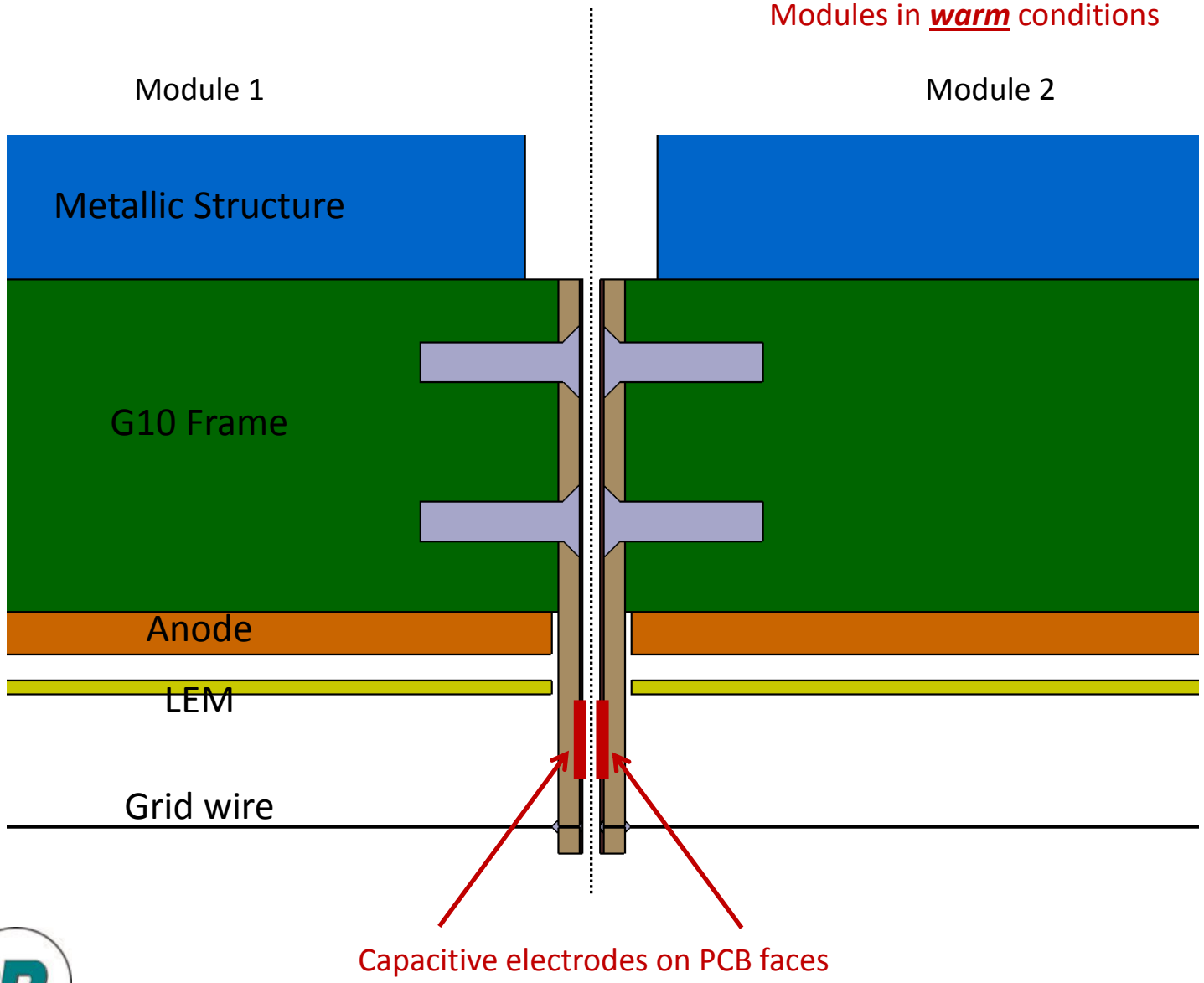


Capacitive electrode
to be designed for
future PCB production



Cross Section
- zoom in the interface region -

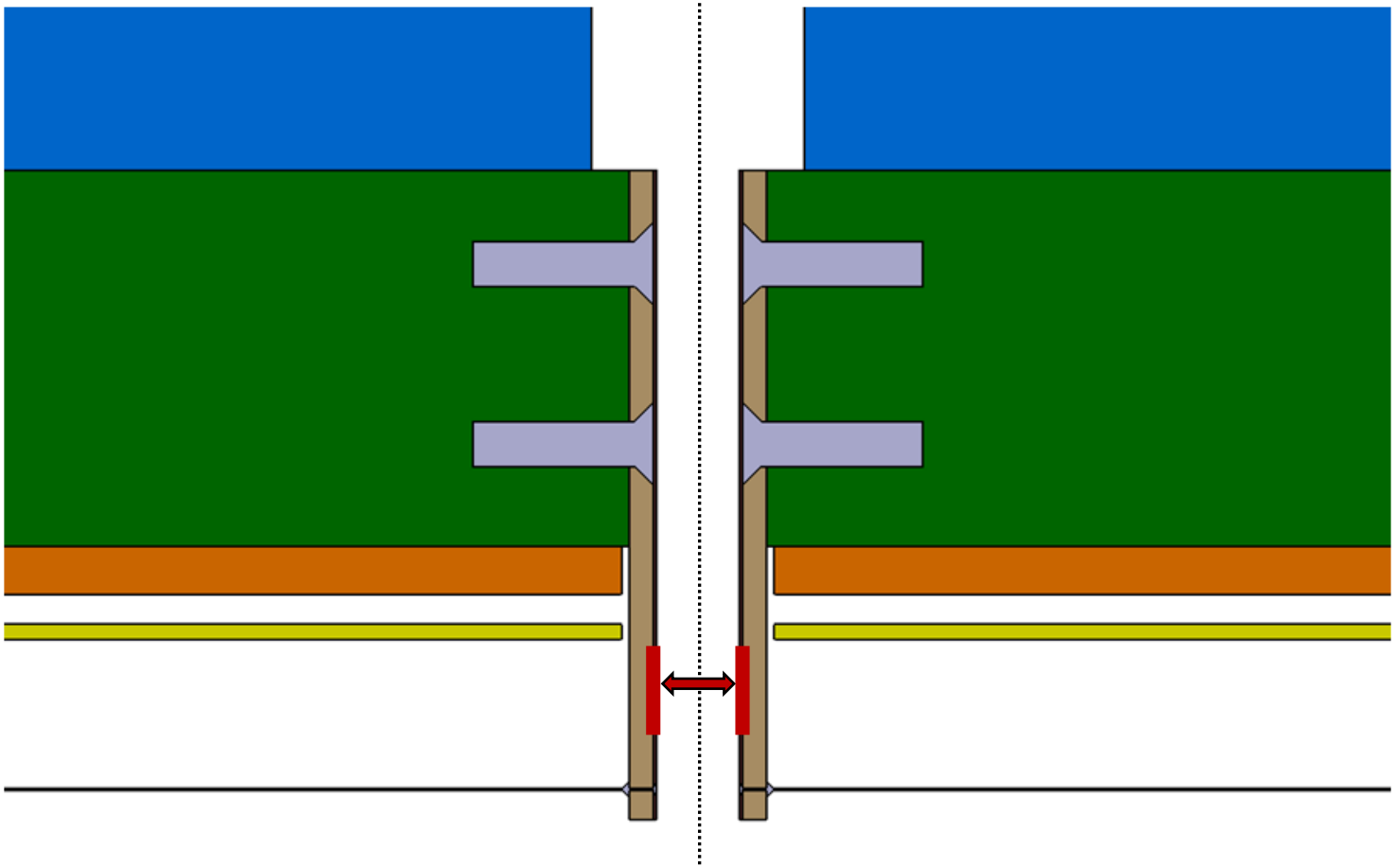
Modules positioning *foreseen scenario*



Modules positioning

foreseen scenario

Modules in ***cold*** conditions

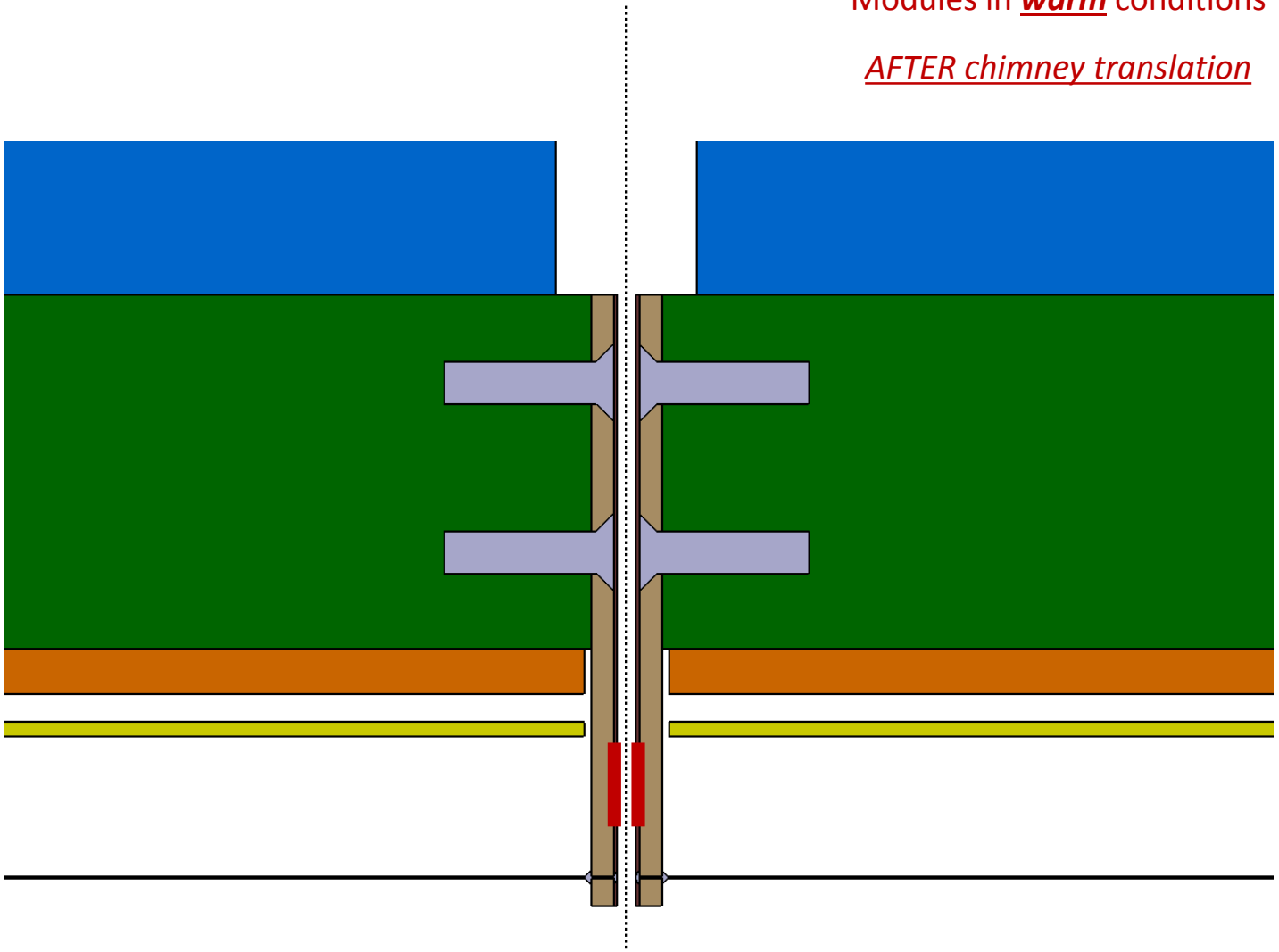


G10 shrinkage = need of translation
is given by capacitive electrodes

Modules positioning *foreseen scenario*

Modules in ***warm*** conditions

AFTER chimney translation

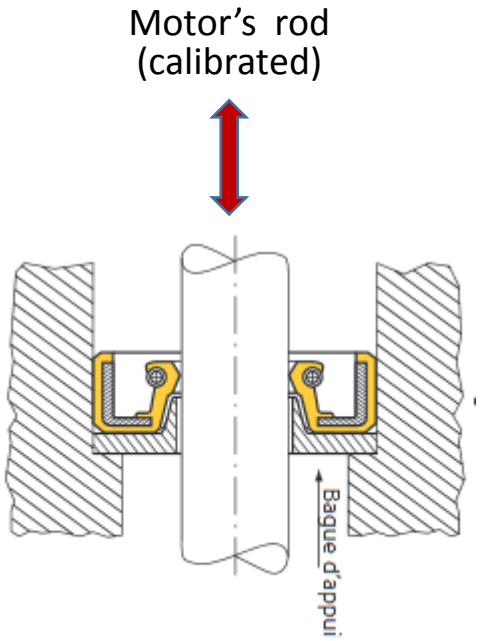


Modules positioning *others possibilities studied*

- ***Bellow made of Silicone*** : lateral + longitudinal deformation

- ***Scraper made of Silicone***

  - used for dynamic motions (few tens of m/sec)
  - and pressured vessels (up to 0,5bar)



Modules positioning *others possibilities studied*

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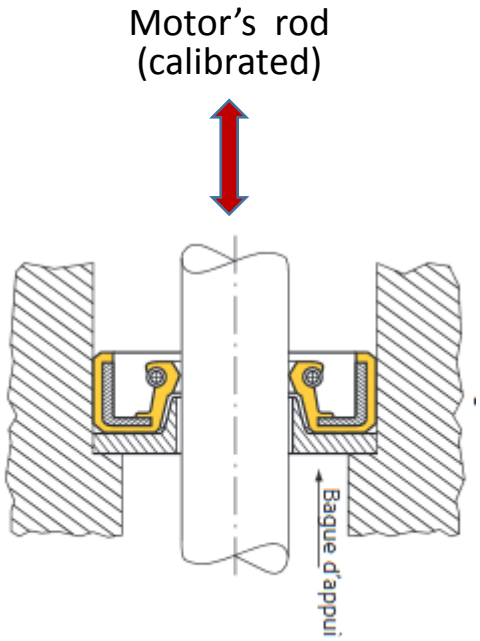


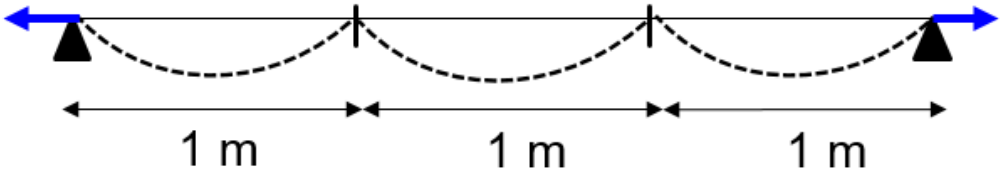
Not a lot of time to study these possible solutions…

Our favorite option remains O-ring + metallic bellow

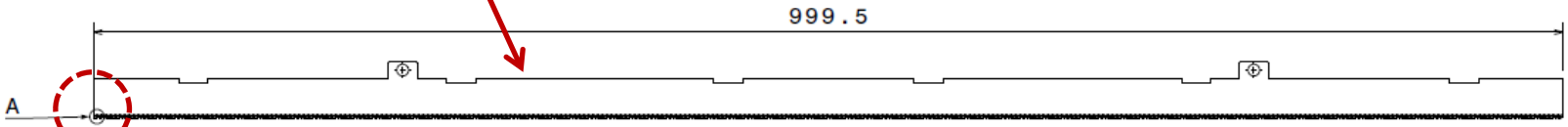
Extraction grid wires

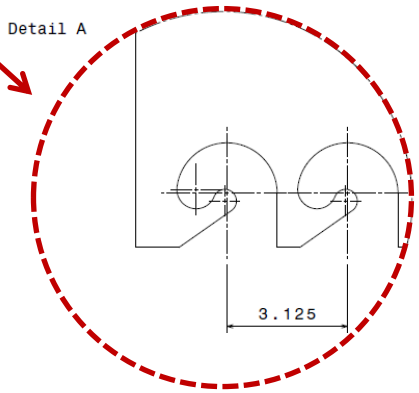
Sagging / tension

The use of combs every meter (to support wires)
helps a lot to decrease the sagging and the necessary tension



0,2mm Glass Fibers comb

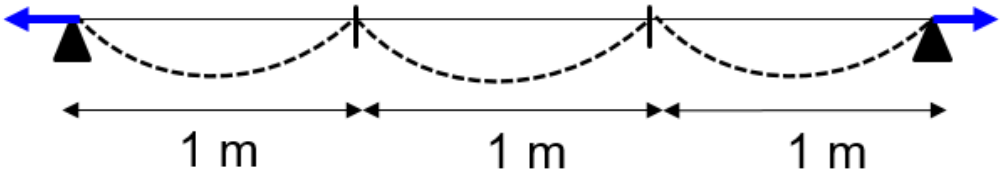




First prototype in production
(reception in 2weeks)

Extraction grid wires

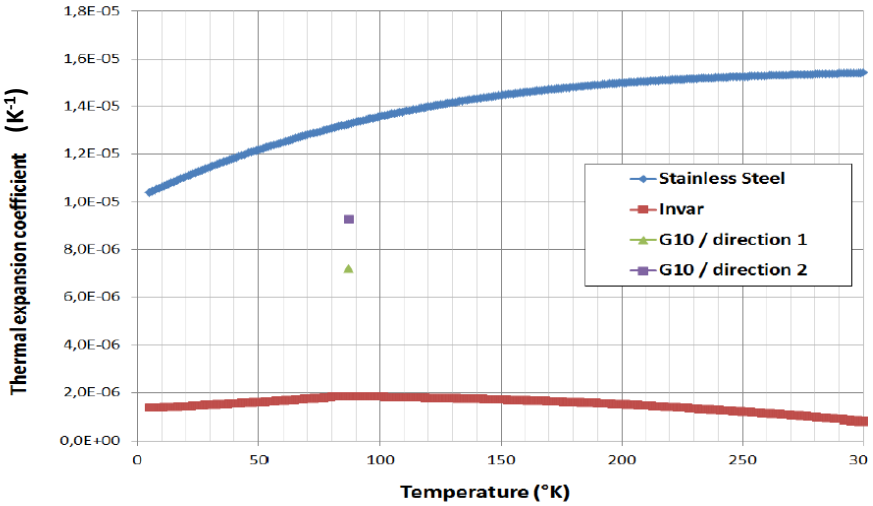
Sagging / tension



Former thermo-mechanical simulations presented during past TB
were considering assumed (wrong) thermal shrinkage coefficients for Stainless Steel and G10

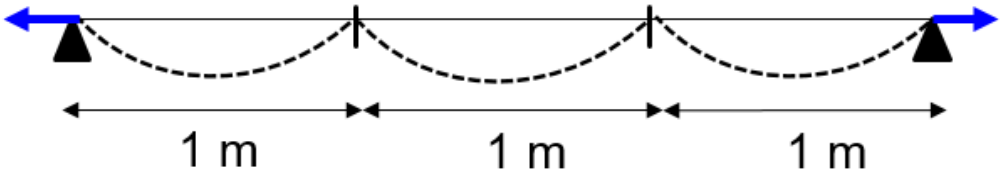
We have re-run simulations with accurate values
for thermal shrinkage coefficient (at 87°K):

- α_{SS} = 13,3 e-6 (NIST database)
- $\alpha_{1/G10}$ = 7,2 e-6 (CRYOLAB tests)
- $\alpha_{2/G10}$ = 9,3 e-6 (CRYOLAB tests)



Extraction grid wires

Sagging / tension



We are managing to get 0,1mm maximal sagging and allowable tension for wires (under gravity and cooling of wires and G10 frame)

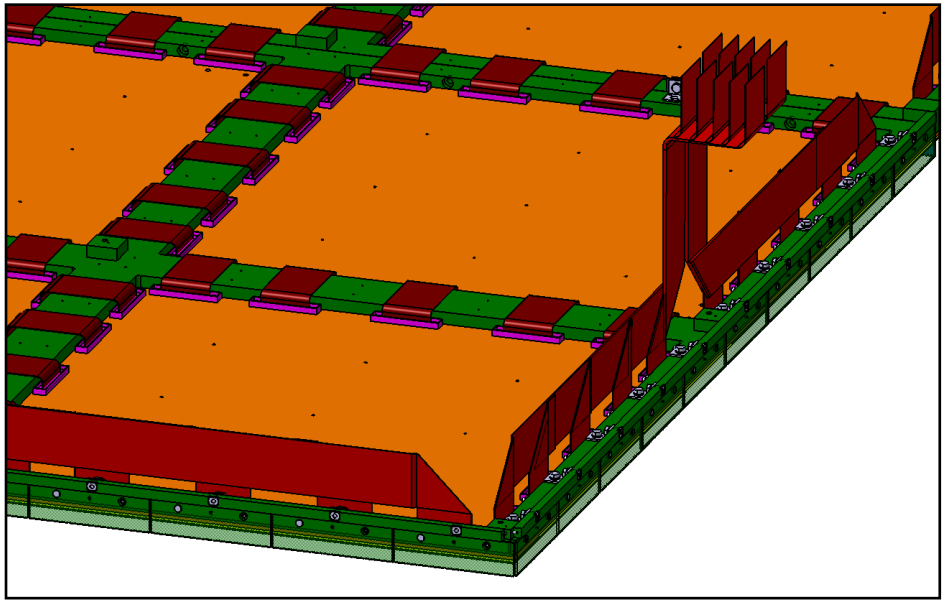
But the more *wire tension* we have the more *G10 frame deforms*.

We would like to ***decouple the behavior of the assembly*** to have more margin for pre-tension during mounting

Extraction grid wires

G10 Frame behavior

Zoom on a corner
(metallic structure hidden)



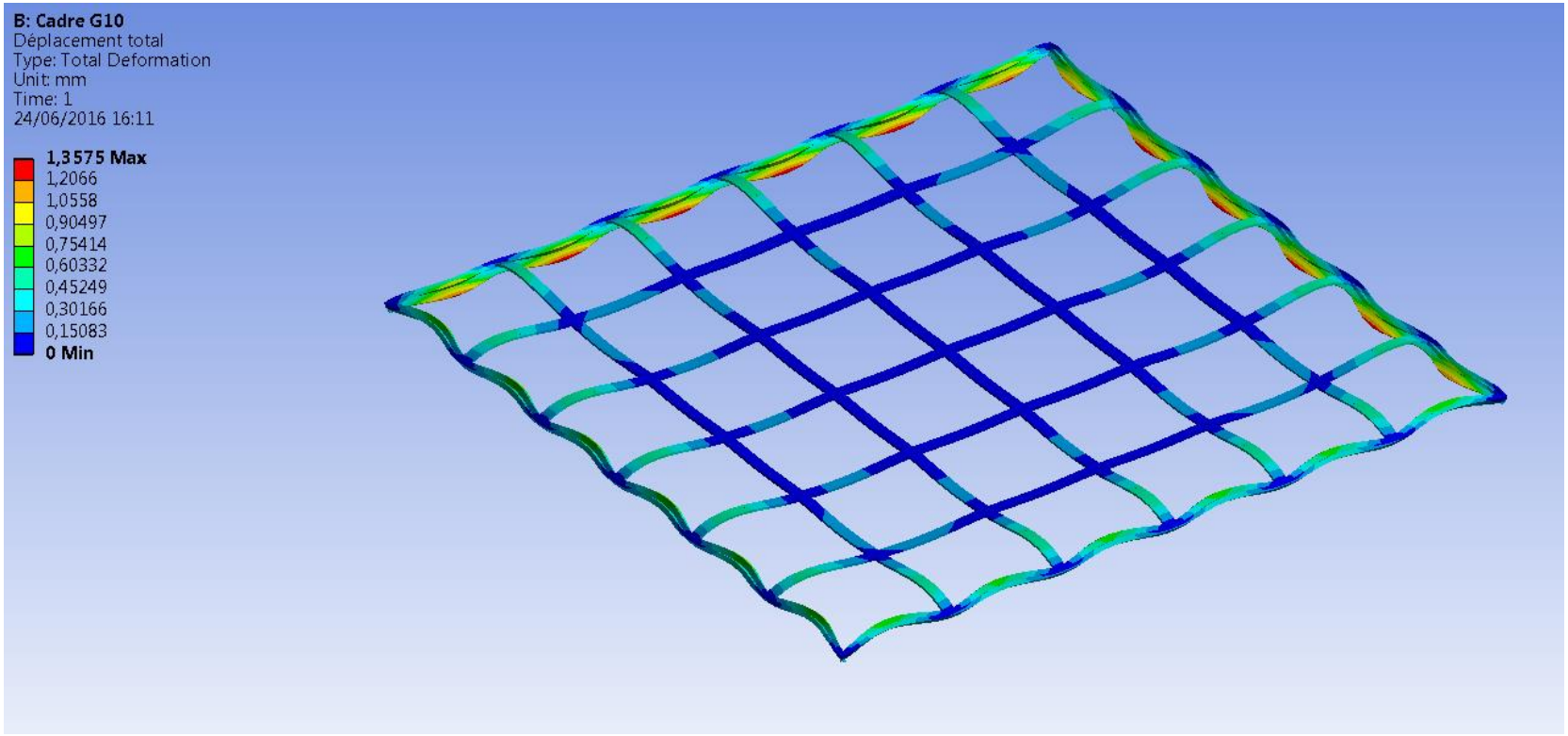
PCB wire holders are cantilevered
(10mm being the LEM to grid distance)

↓

Wires tensions induce a ***torque on G10 frame***

Extraction grid wires

G10 Frame behavior



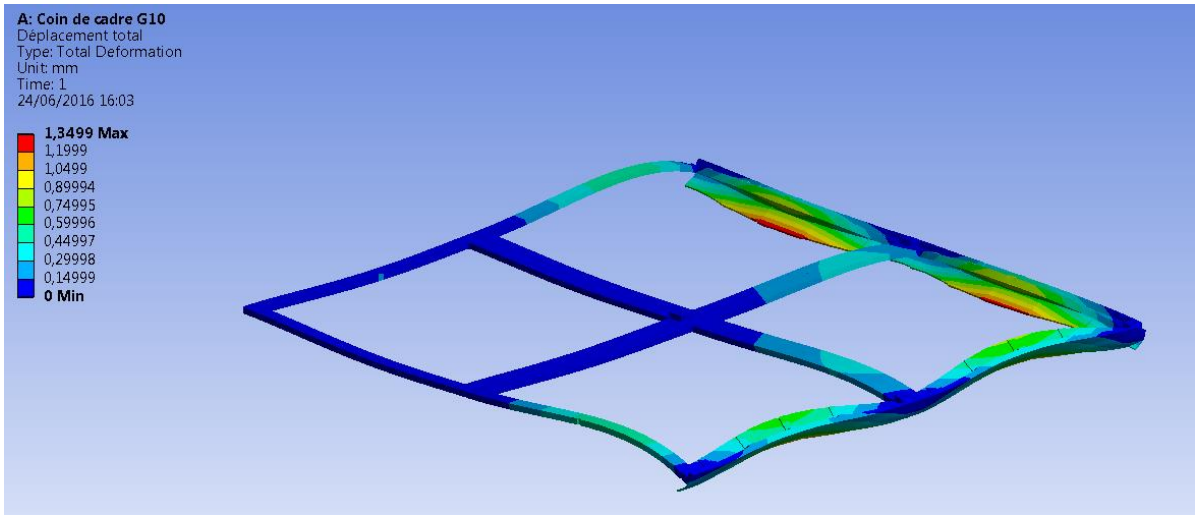
These displacement values have been obtained for 7N / wire, which is overestimated.
We plan (hope) 3N max, which correspond to 0,6mm max displacement (illustration not available).

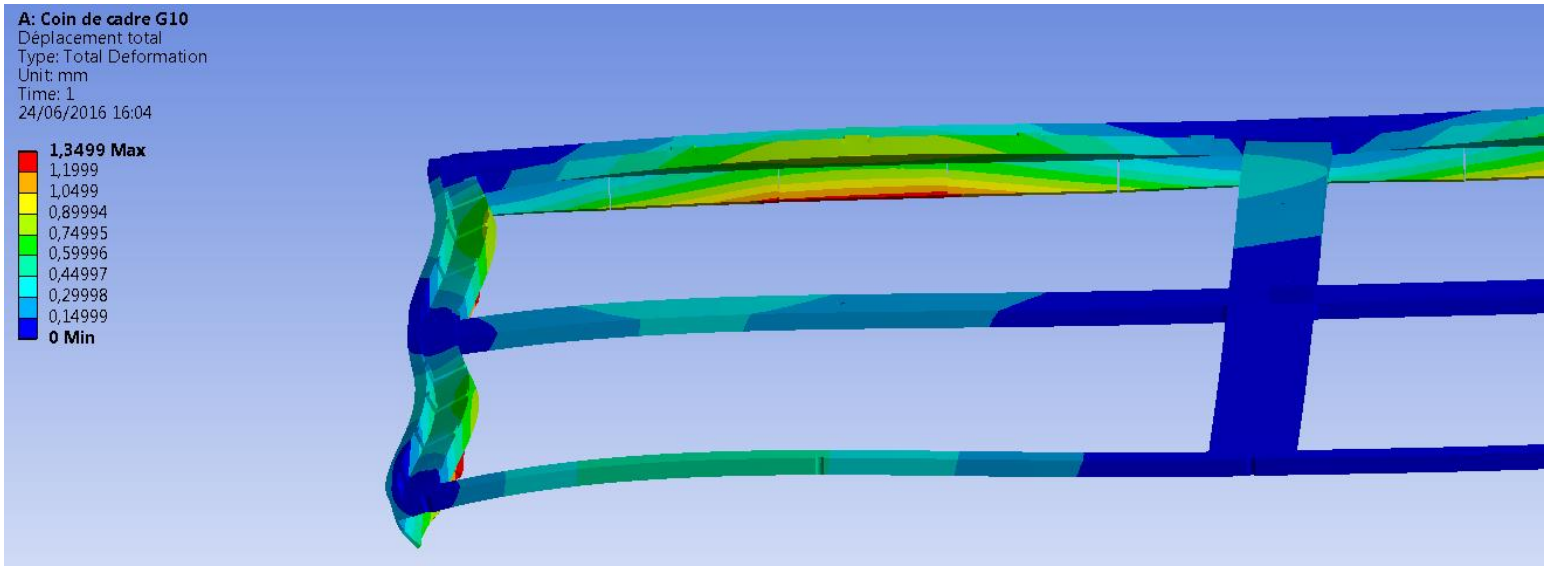
Note that G10 deformation induces a ***loose of tension in wire***
(ie. an increase of ***sagging*** too).

Extraction grid wires

G10 Frame behavior

Local model
on a G10 frame corner

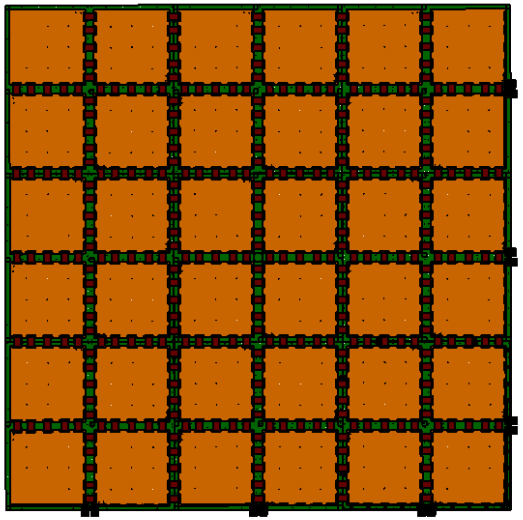


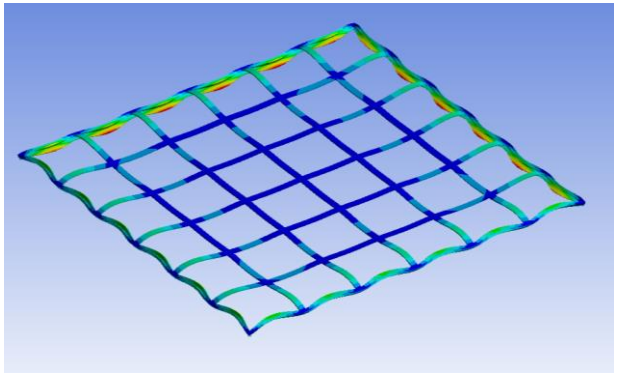


Stiffen the G10 frame would help
to decrease the deformation / to “uncouple” wires tension and G10 frame

Extraction grid wires

G10 design evolution



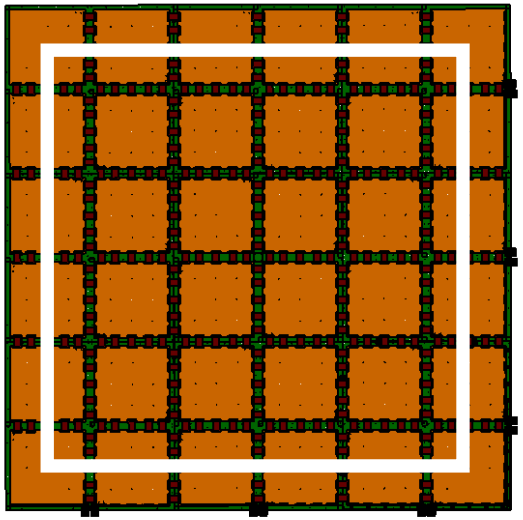


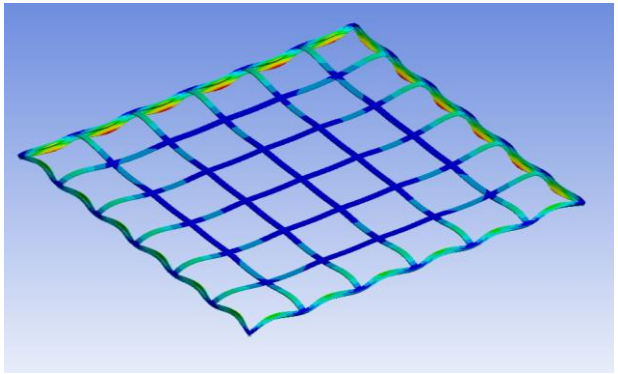
Stiffen the rim of G10 frame

- to avoid in-plane flexural deformation
- to limit torque effect

Extraction grid wires

G10 design evolution





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Extraction grid wires

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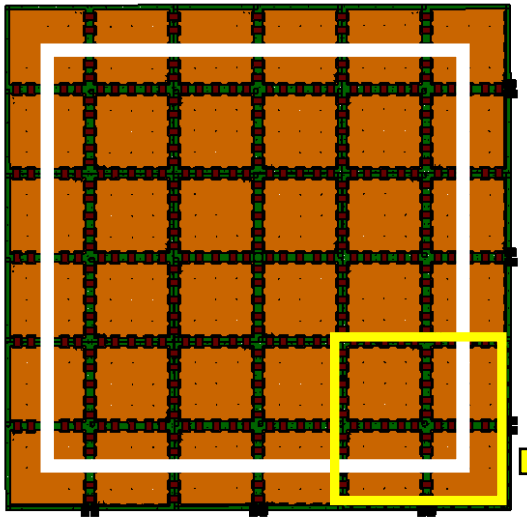

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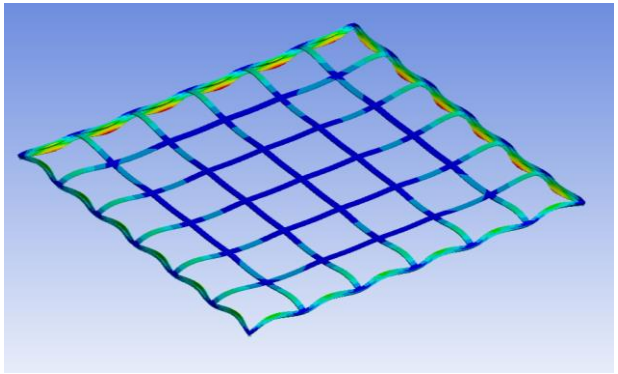
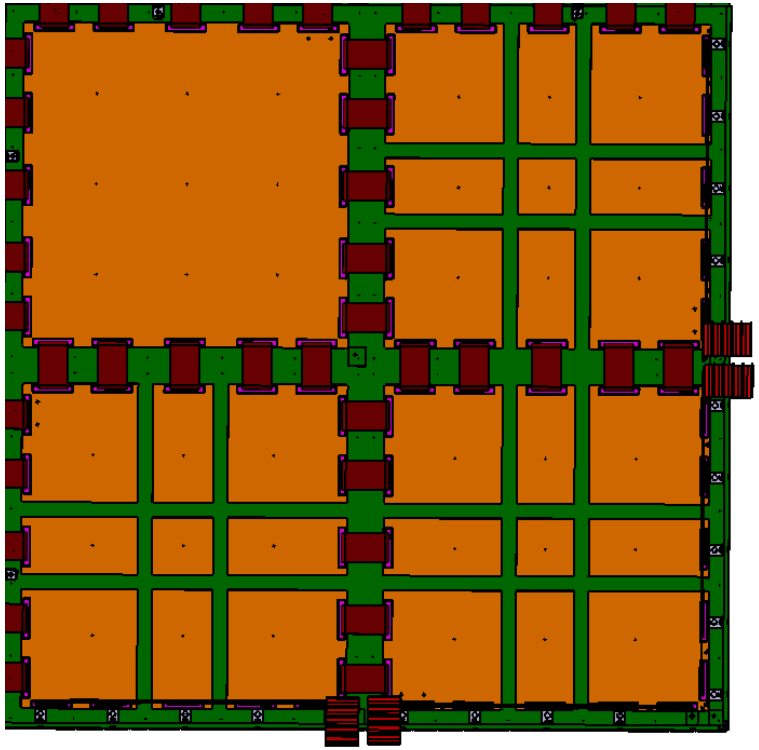
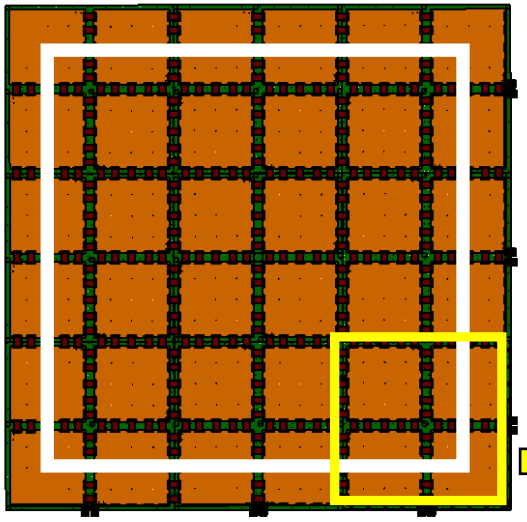




Extraction grid wires

G10 design evolution



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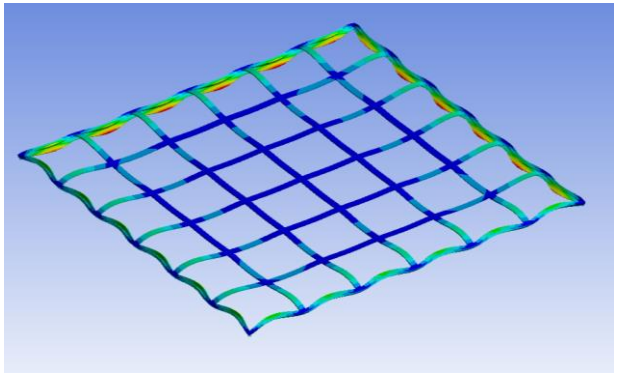
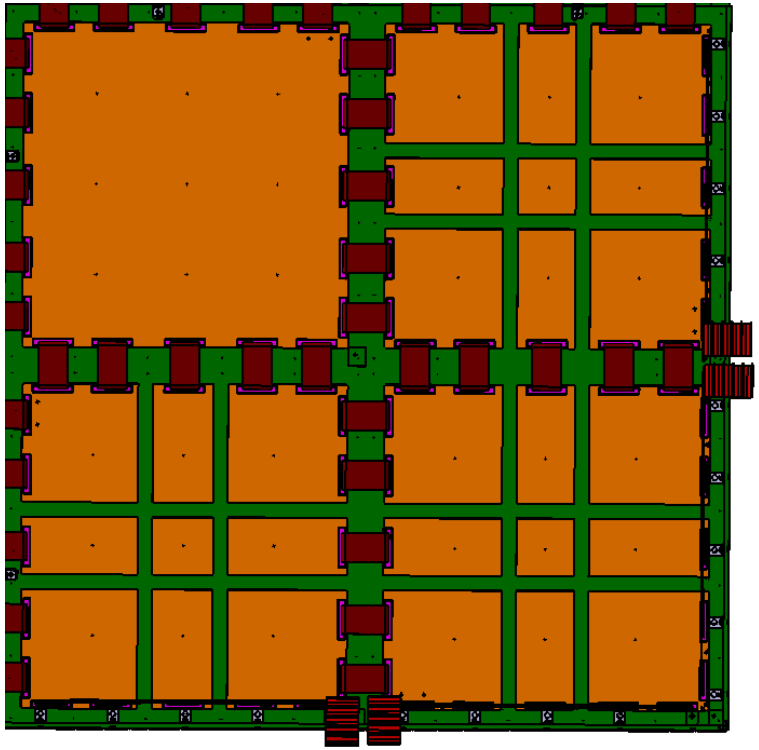
- to avoid in-plane flexural deformation
- to limit torque effect





This G10 plate design seems allowable for sandwich screws and bridges connectors.

We need to be 100% sure not to have interference with something !

Is there any anode with connectors to make measurements ?