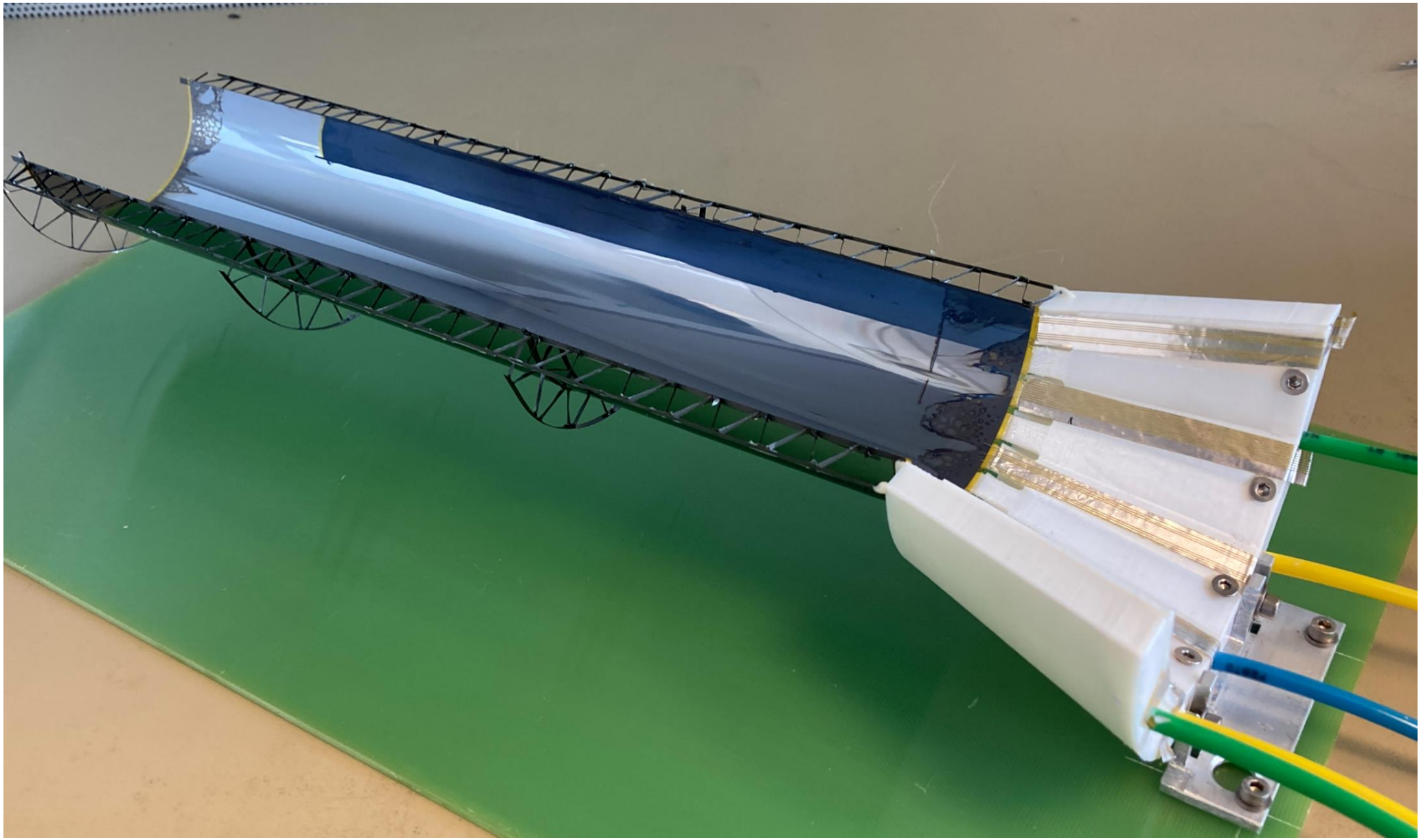
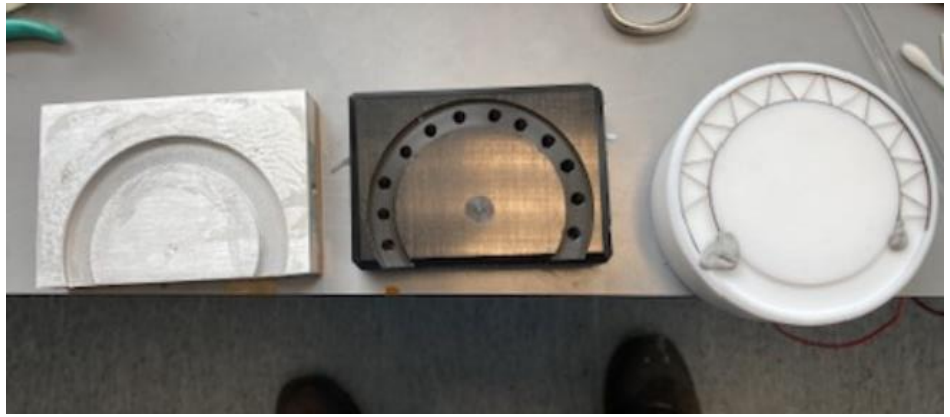
Part 1 Quick overview of Concave assembly option

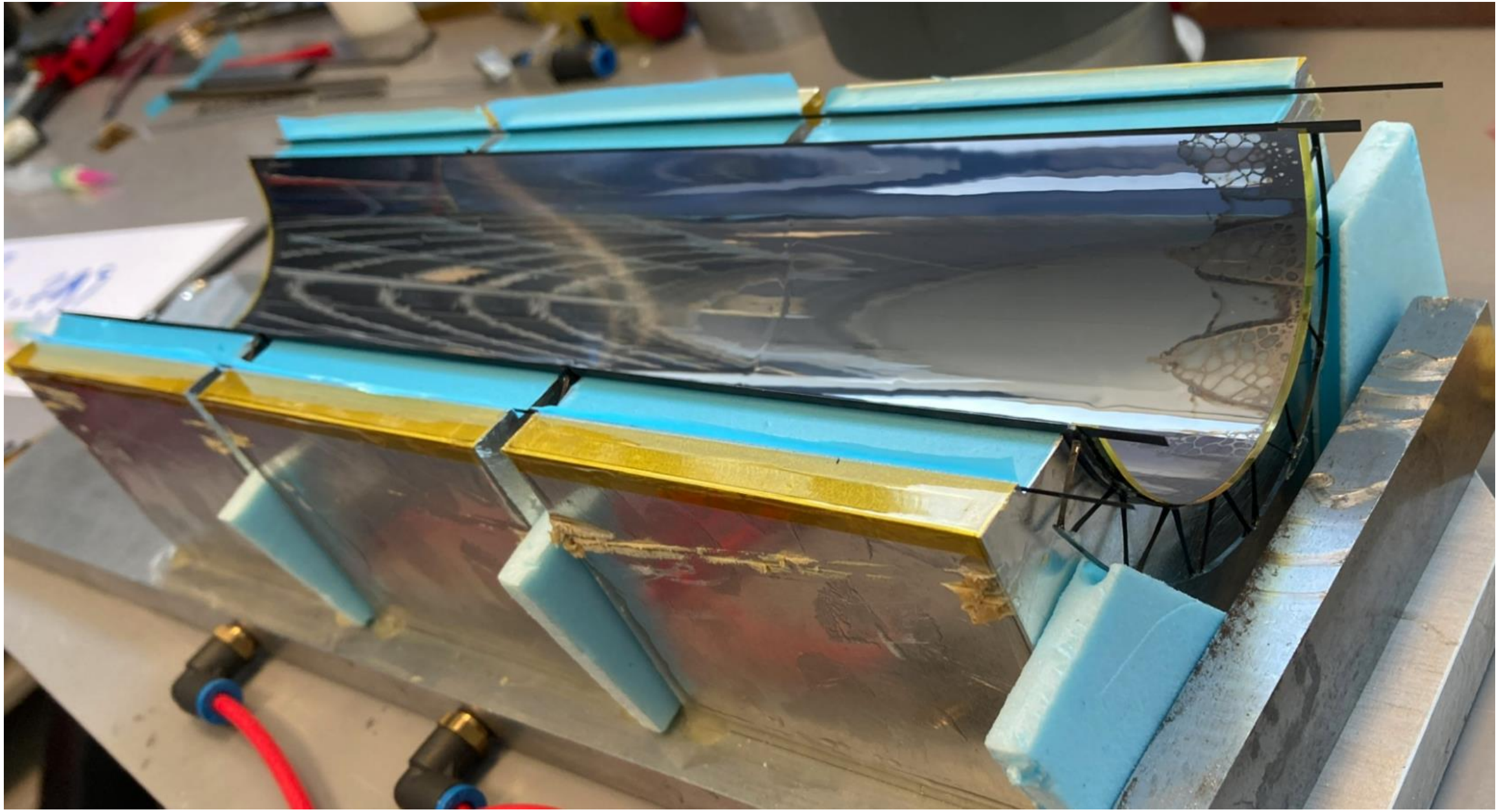
Part 2 Corrado kindly made a list of pro and con which I try to address

Wel thanks to marcel his question to bent silicon concave for the strain research and Grigory his suggestion to make slots in a concave mandrel to glue from the outside we have a optional vacuum assembly strategy .

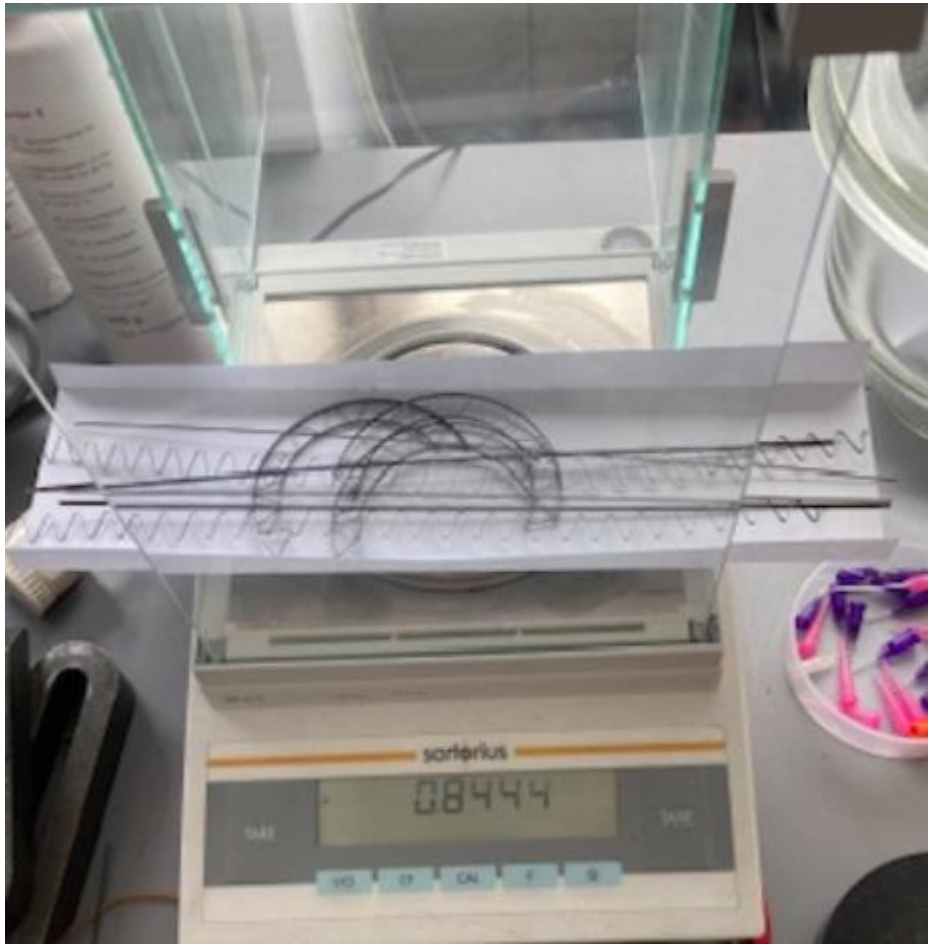


Tooling for first test made on conventional machines



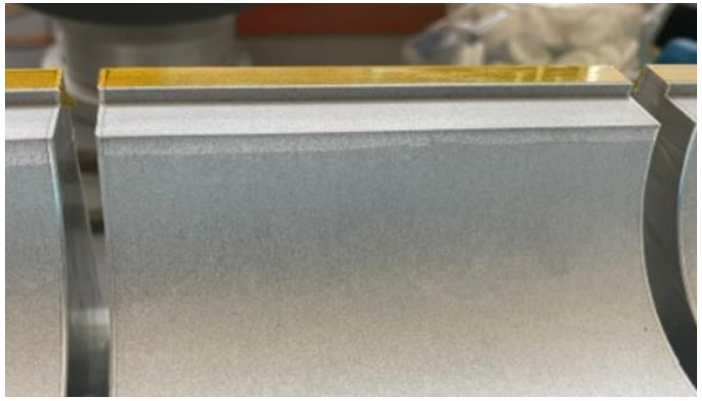


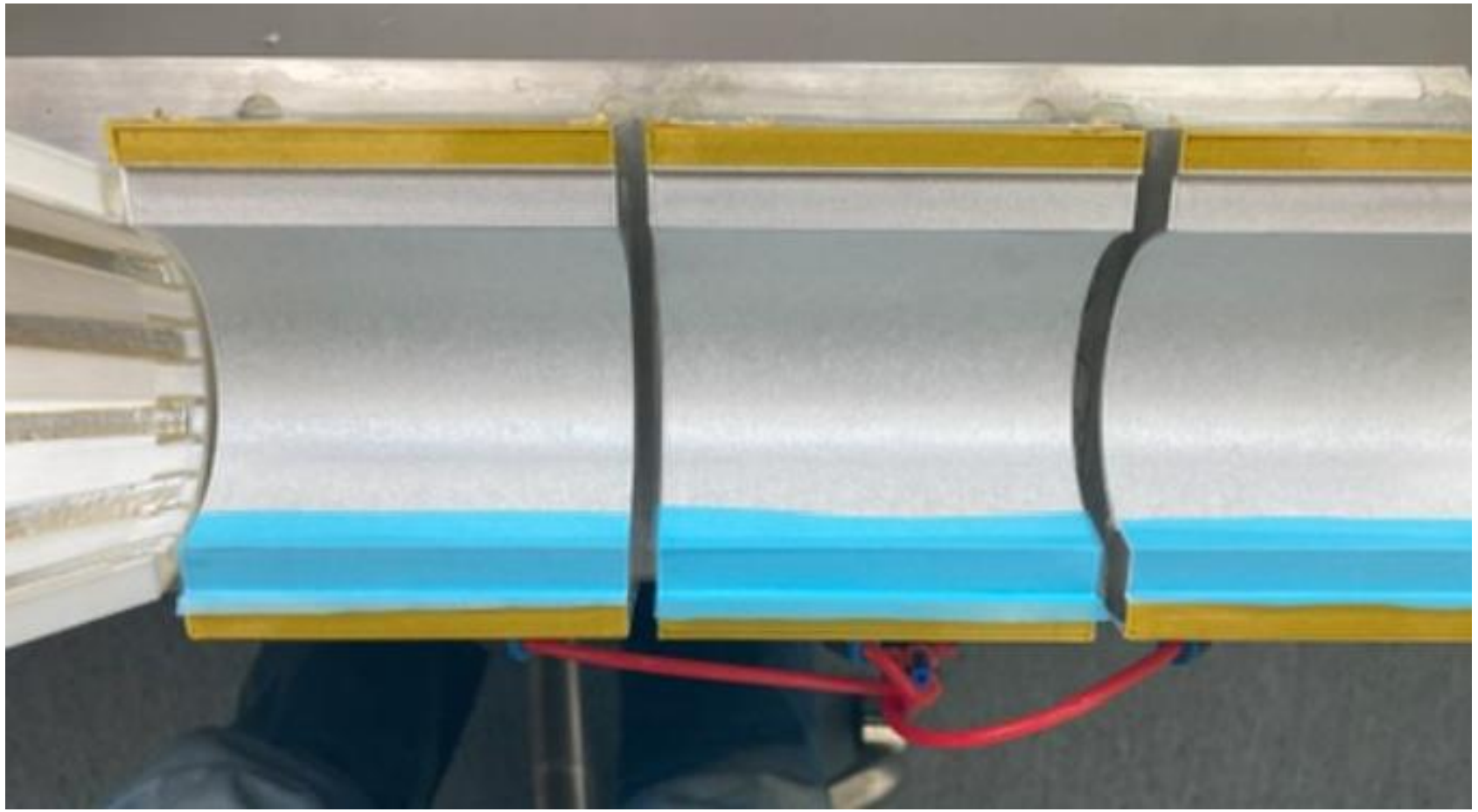
Assembly : push silicon in with rubber bar possible to position til you switch on vacum(slides on paper)



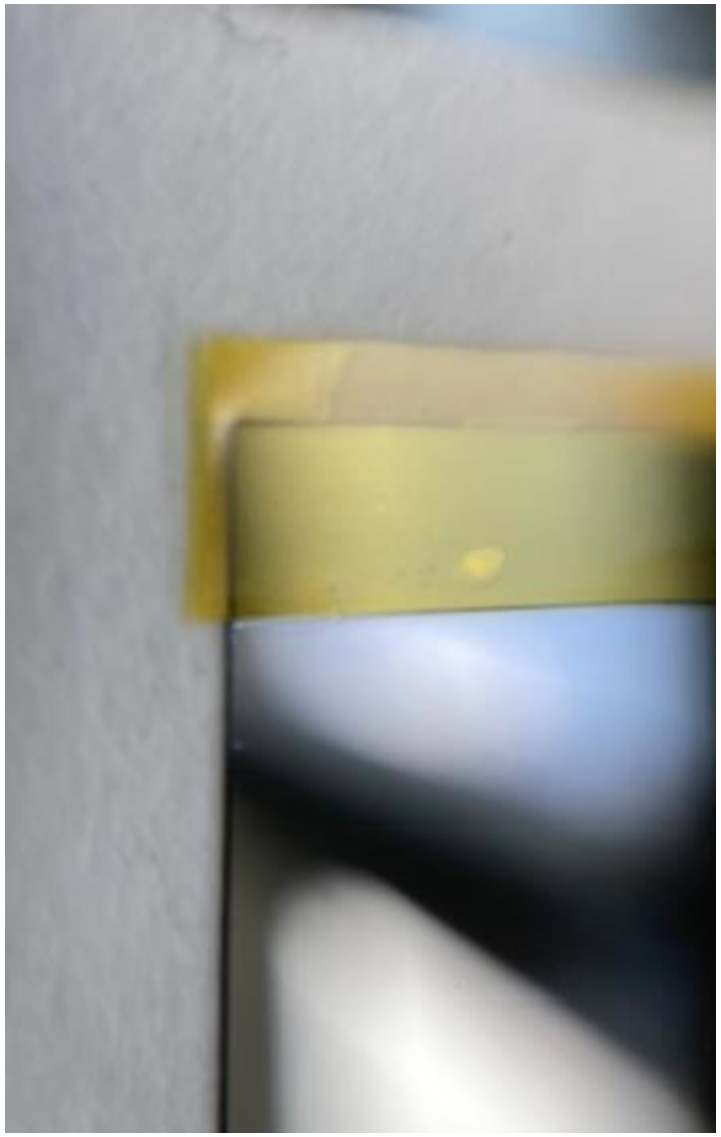
“Cheating part 1” current our cleanroom is not so clean and I suspect aluminum particles getting lose from the metaphor
Or left over from machining so I added a ca 30mu japanese tissue on the mandrel

After discussion with metaphor they advised light sanding with fine scotch bright cleaning ultrasonic and drying and
Possible finer structure metaphor (BF100-al) they don’t expect once cleaned that particles loosen





More cheating , as we saw already a lot broken silicon and this is last on at utrecht (2 set more at cern)
I added a 30 mu kapton strip on the silicon edge in the hope to move the neutral bending line in
to get a bit less tension in the silicon (need to do it different got glue stains on other side)
Once we understand the edge defects this might not be necessary



From the thorough comment of corrado, rene's comment in blue

Concave assembly

Pro:

It eliminates the need for Kapton at the chip side; however, Kapton solves of the electrical isolation issue. Kapton thickness can go down 25um. Therefore I do not consider the use of Kapton a big problem.

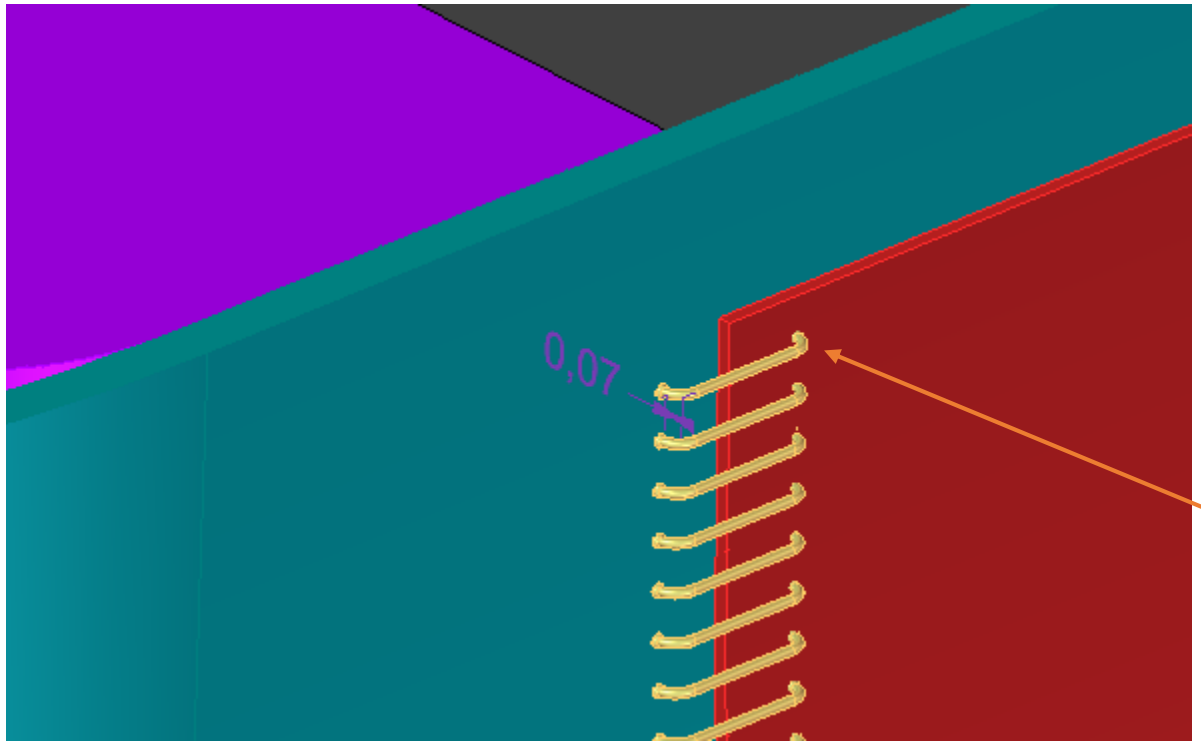
As of first test, method seems easy to use needs to be assessed by other people (yes Im probably biasd….)

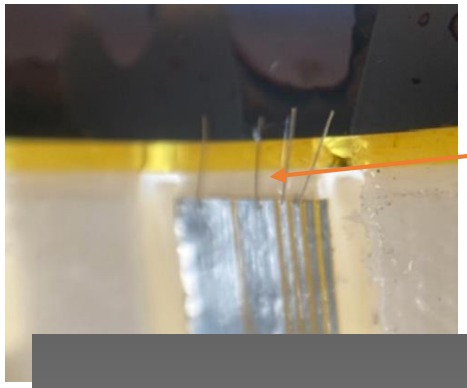
Concave assembly

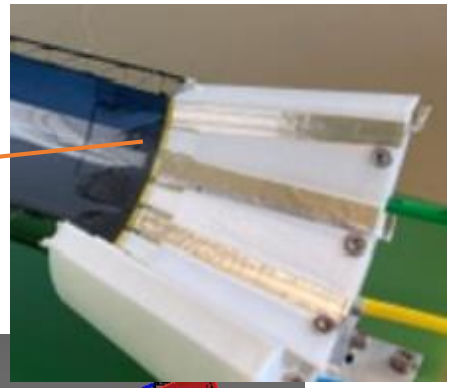
Contra:

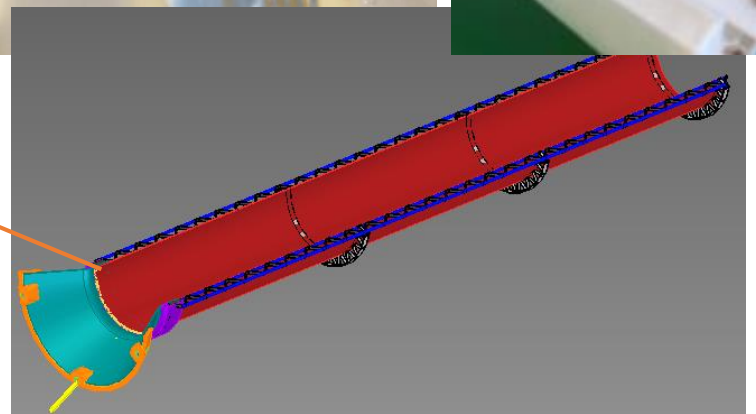
LO electrical *interconnection* issue. As you said, it creates a problem with the electrical interconnection that can be solved by tab bonding or reversing the chip for the wire bonding. Up to now, we cannot base the ITS3 development on tab bonding or another interconnection that differs from wire bonding (it must be demonstrated that you can bond 40um chips with them). Reversing the chips will complicate the assembly, but it could be feasible in principle.

As of now wire bonding seems the way to go , according to NIKHEF bonding specialist at a distance of 300-500 mu Bond hight can be around 80 mu bonding (NOTE 1 WE GOT 1 MM TO BEAMPIPE) (Note 2 we did measurements on a concave bended alpide (analisis wil be continued round september) effects seem low but needs to be validated (wp3?)









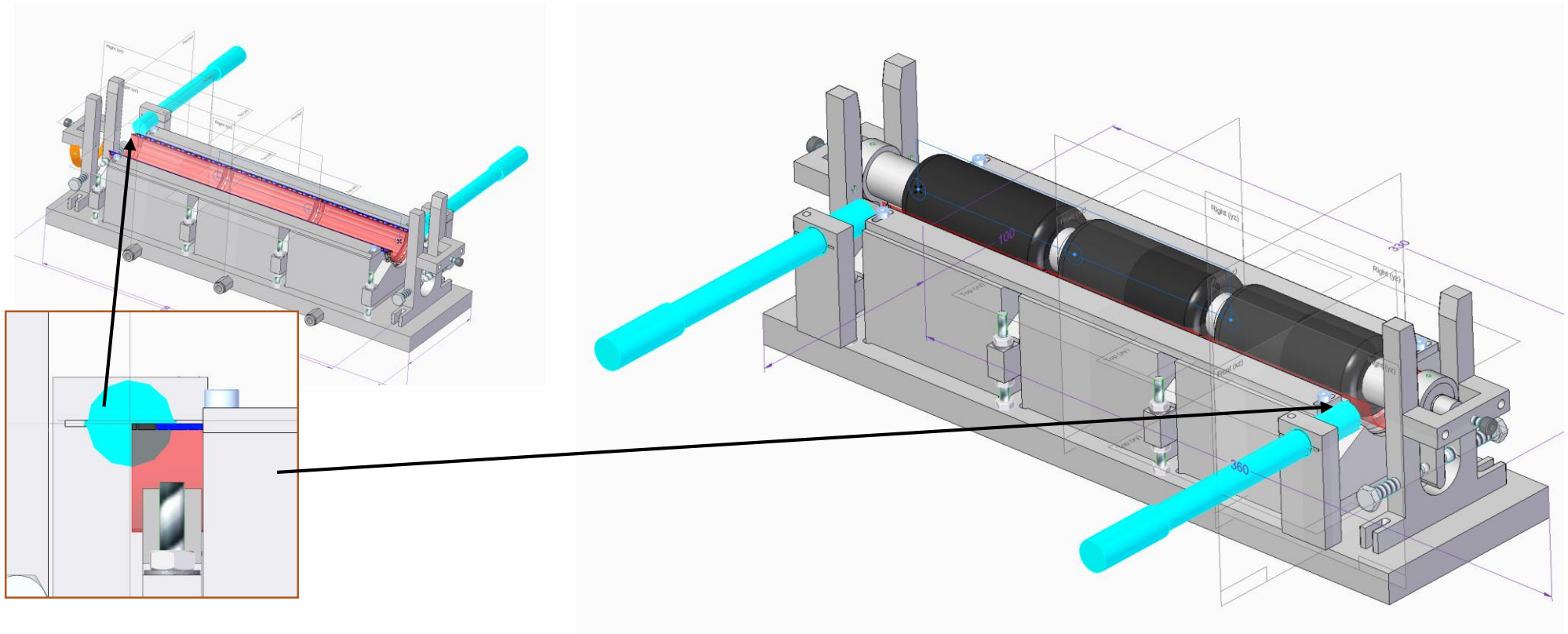
Extra note on interconnect ,Pending on final data bitrate (2-5Gbit ???) Marcel Rossewij expects 2-5 cm pcb/flex no problem longer (30cm e.g.) Has to be tested

So it could wel be that we need firefly like connectors at a couple cm from edge of silicon
This would be a consideration in material budget of support cone desing

Concave assembly
Contra:

Alignment control concerning the mechanics during bending/gluing. It is unclear how you can align the chip in the conclave mandrel.

I noticed that before applying vacuum the silicon slides well in the “Japanese tissue” we can aling to the edges Of the silicon with cameras and use some adjustmetscrews to move the pressing roll wich we divide in 3 independent rotating sections , concept desing ready try to build one (L0) for demo



Self-support configuration

Pro:

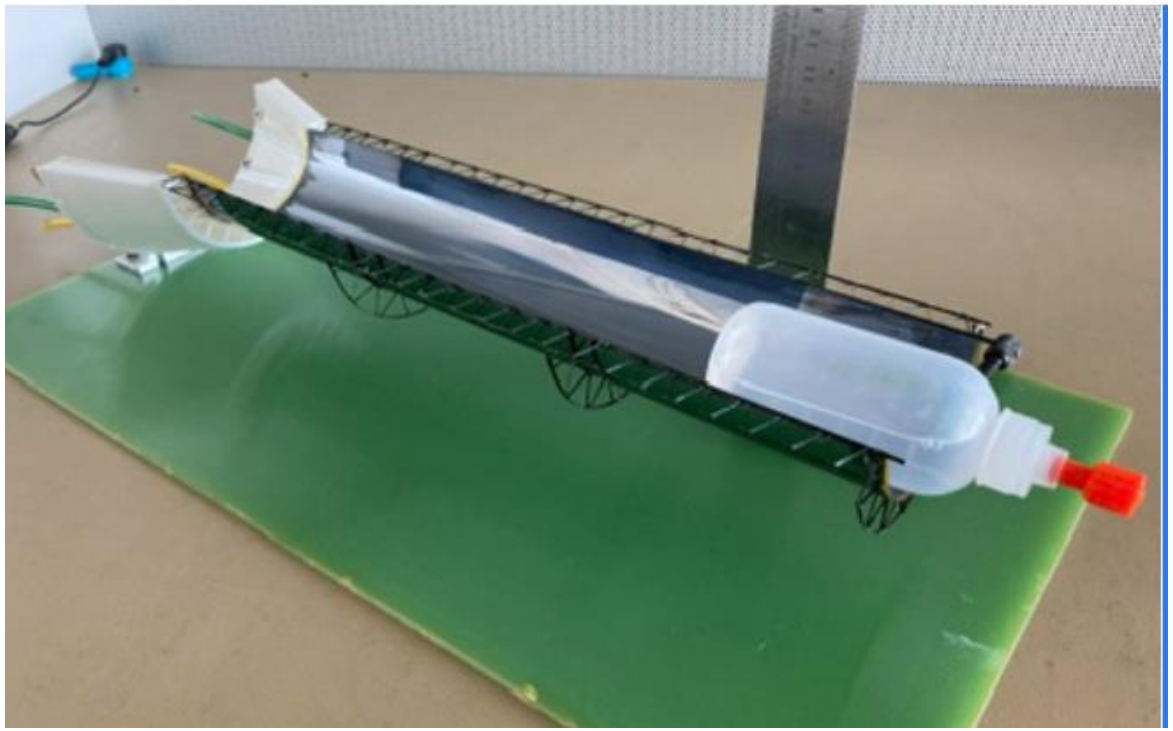
self supporting layer that can be reworked in case of problem without loosing the entire half barrel

Eliminates the carbon support barrel “nicer for L4-5-6- should check with physics”

Contra:

Self supporting layer requires that the supporting frame provide the right stiffness, the right shape and alignment features among layers. We considered the self-supporting concept, at the beginning, also for the carbon foam; and I discarded due to the complexity to fulfil these three requirements (stiffness, shape, alignment), based on the ITS2 experience. Nevertheless I am opened to reconsider.

Note, on concave mandrel assy it has to be self supporting it can be fixed to a final assembly in a later stage

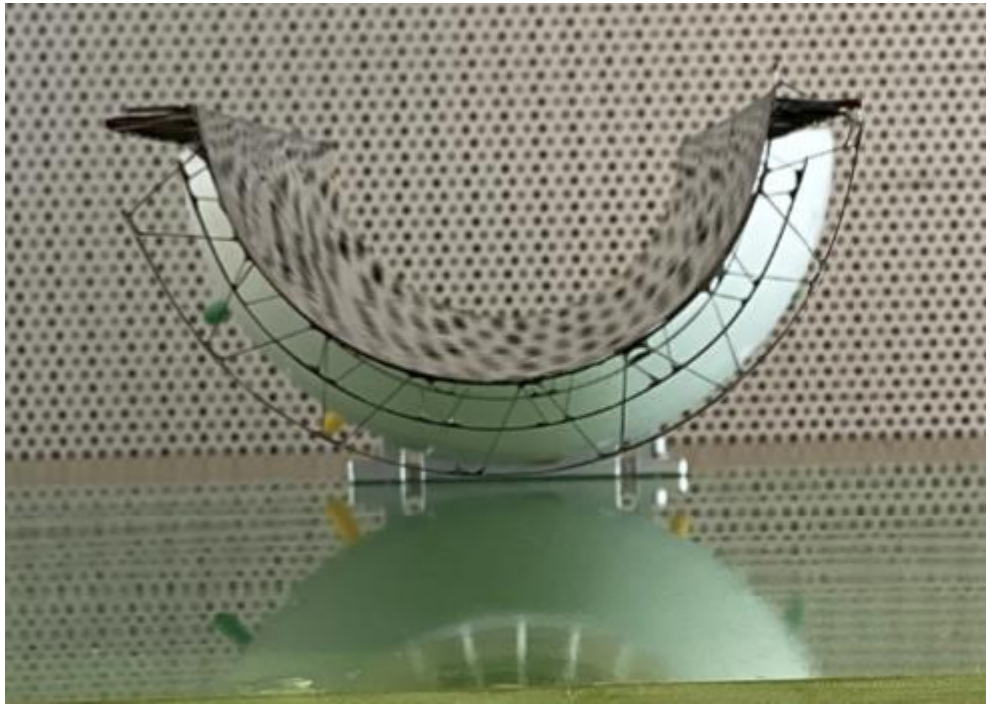


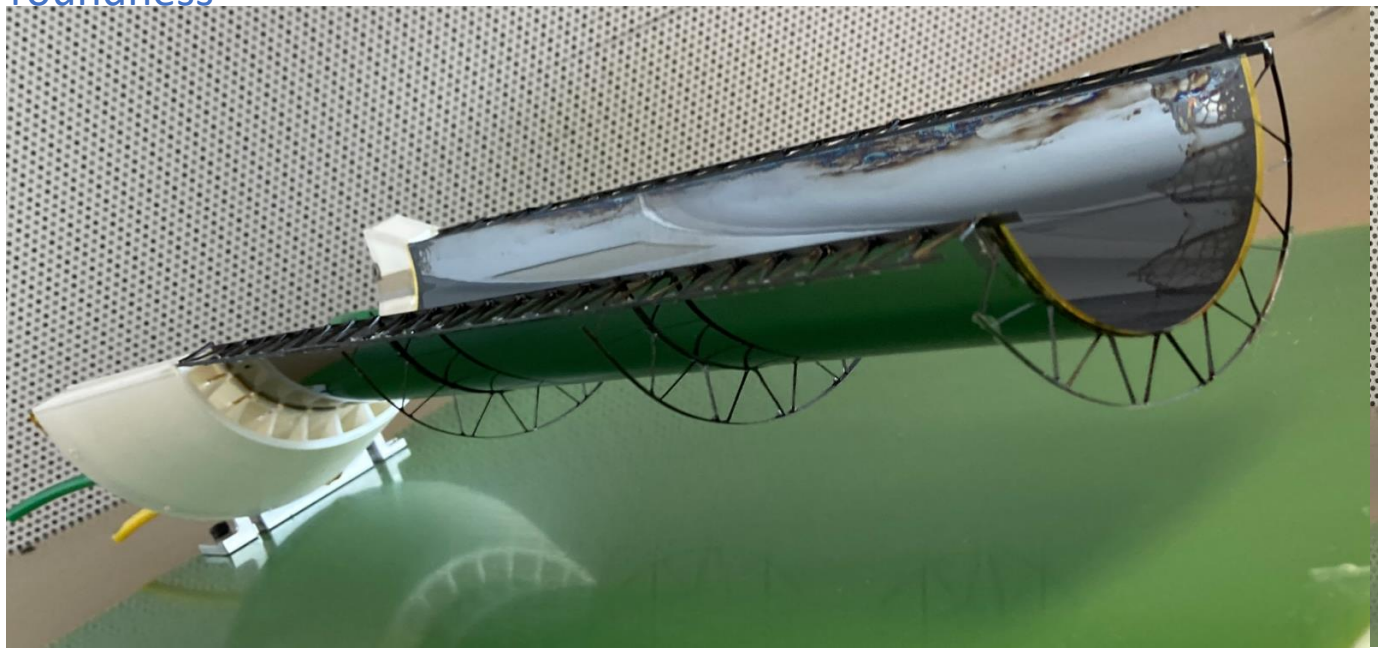
50 gram load at tip is no problem, note that silicon =aprox 3.3gr+1gram carbon. As far as I could see sag was mainly in printed Support and fixation.

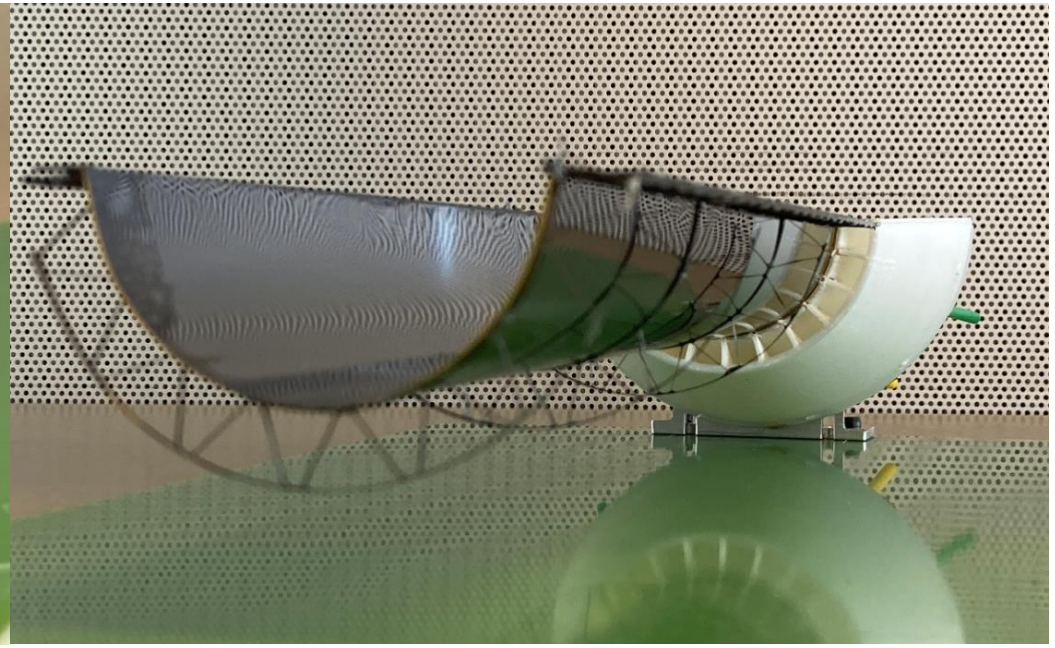
Yes support is critical as anny error is “amplified” by the length Of the silicon

On support rings I don’t think with only longeron support You wil get a circle, or the side support Needs to be so strong to hold the Bending moment
I could try one ring close to free end
Say 5 to 10 cm assuming other side is fixed by cooler/cone ???

We could compare the ct of engineering module a and
Ring support also check with physics wat is the real requirement of roundness







Carbon space frame structure

Pro:

Material budget? Less? Must be reassessed considering glue

Contra:

Non uniform material budget, One additional ring.

In principle the concave assembly can be done also with c-foam longerons as long as its self supporting

Note we should take care with realistic simulations !
I pealed off the fleece from a Longeron scratched of foam its including glue when forcing it In micrometer 0.3mm wheight is 0.007 gram for 1 cm long pice

The carbon fibre is aprox0.1mm thik And a cm weights 0.0026 gram current its Zigzag + 2 straight strips so aproc same weight as 1!! Side of fleece on longeron

So material weight is lower but less uniform this must be simulated .

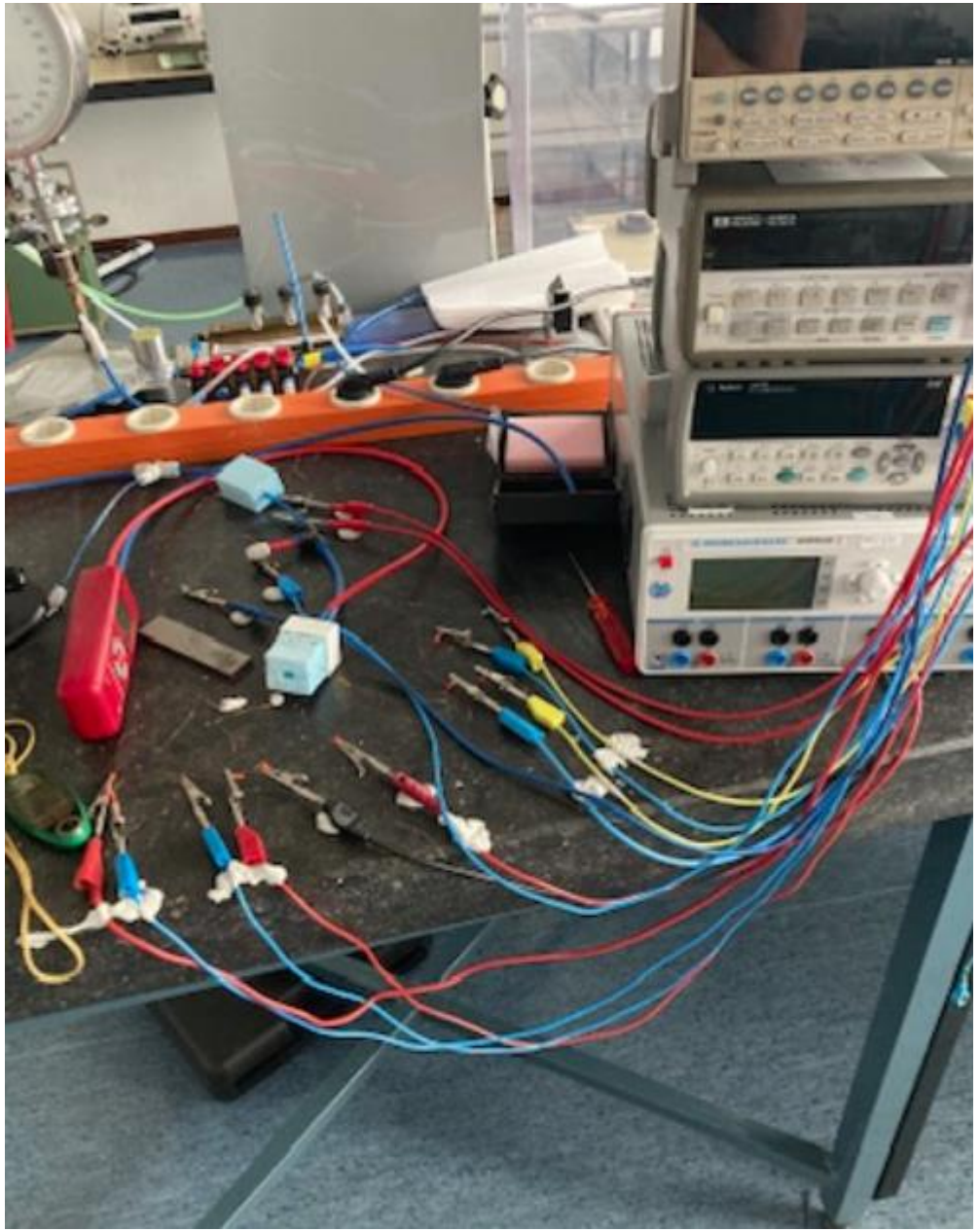
Who did the simulations now ? Current I have only preliminary L0 in CAD is that enough as a base for simulations ? E.g. scale it for L1-L0 ?
We did some test with GDML export (KeithSloan / **GDML** with freecad) that seem to work but needs some more time. (current I rather focus on demonstrating the mechanics)

Could somebody be available to do the simulations ?

Carbon space frame structure
Contra:
Lost the function of radiator at the periphery

So with latest carbon foam mini windtunnel tests ……

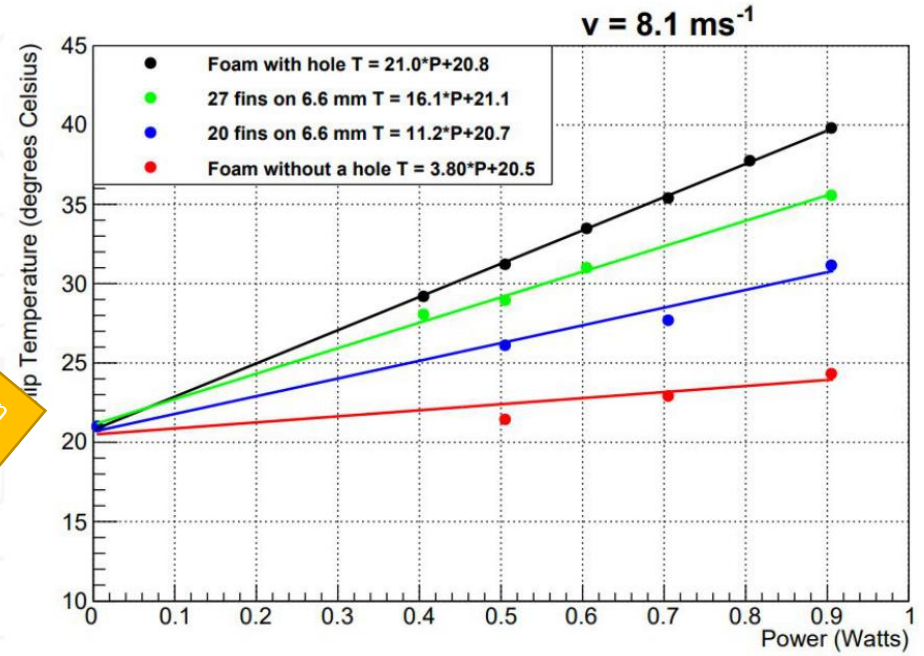
~~(spoiler carbon foam works fantastic as cooler~~
~~As lon as you don't have holes and a considerable~~
~~Pressure drop 0.1 bar)~~

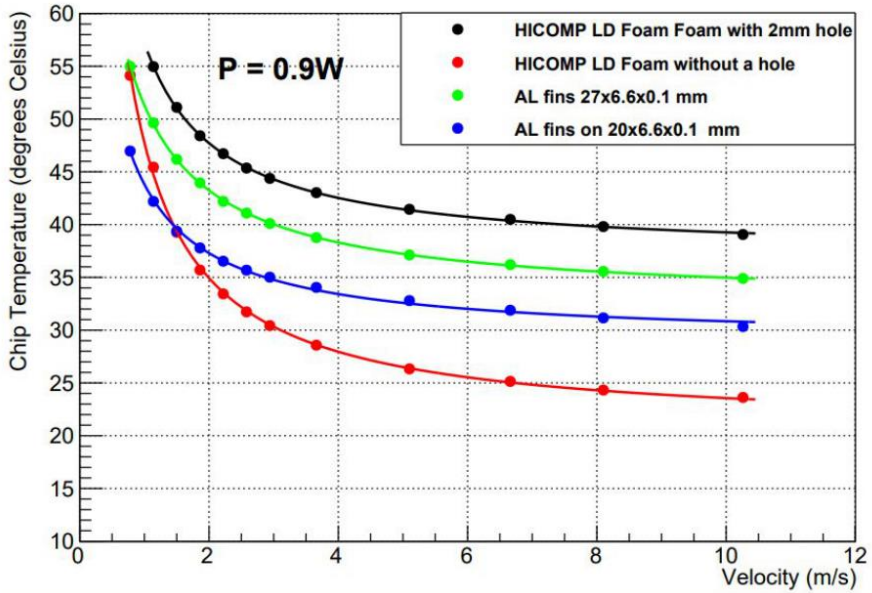


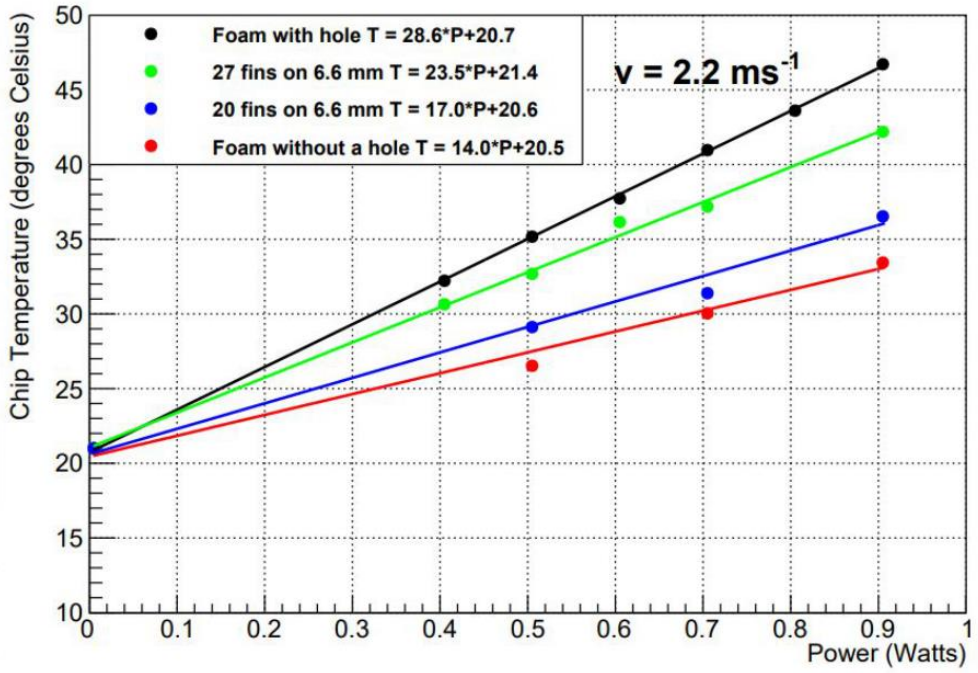
ALICE ITS3 R&D: Wind Tunnel Measurements

PRELIMINARY/IN PROGRESS will be continued in September by (interim)else + ???
Note pressure drop graph is being workd on some 0.1-0.2 bar at max flow

Haadi Mustapha Naqvi, Sem Bode, Eline Mels
Utrecht University

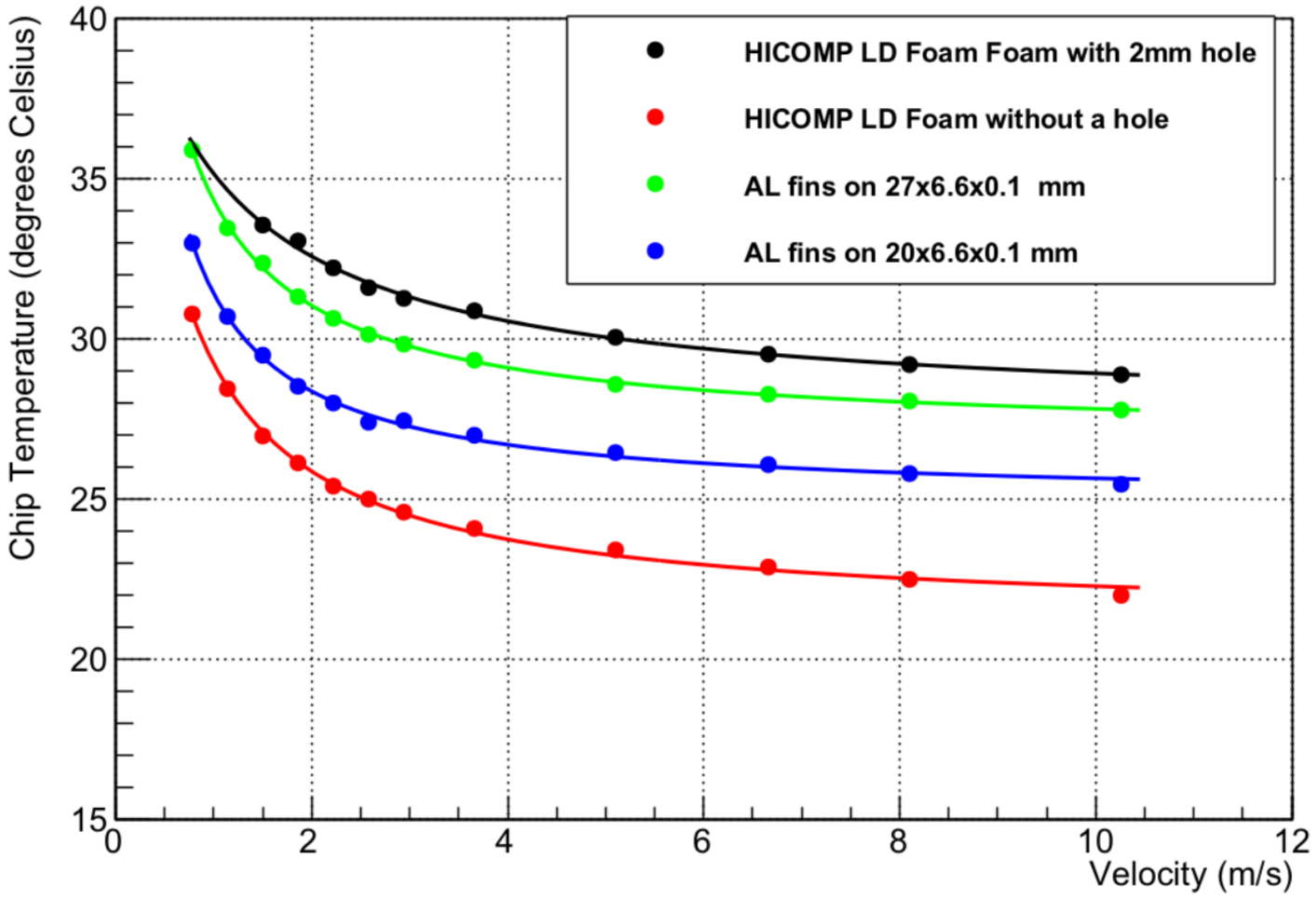




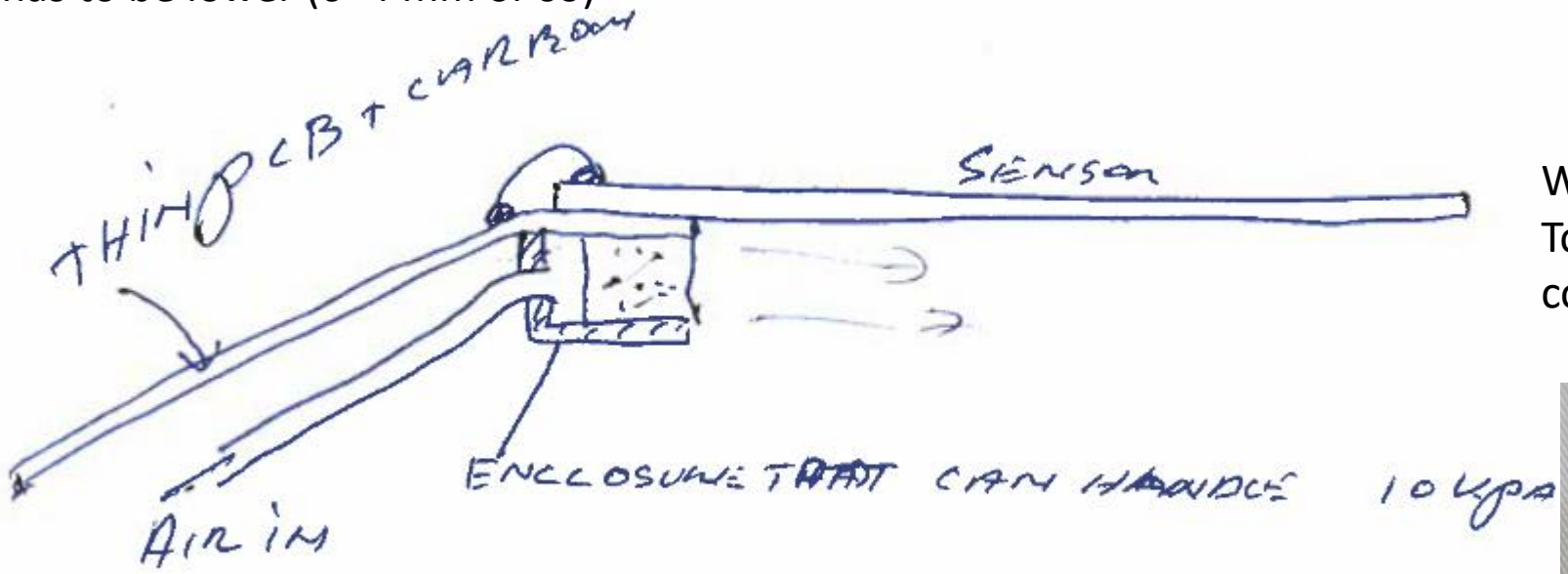


we are current testing a 3 mm high cooler preliminary looks good it seems most cooling happens near chip and there is not so much conduction through the foam

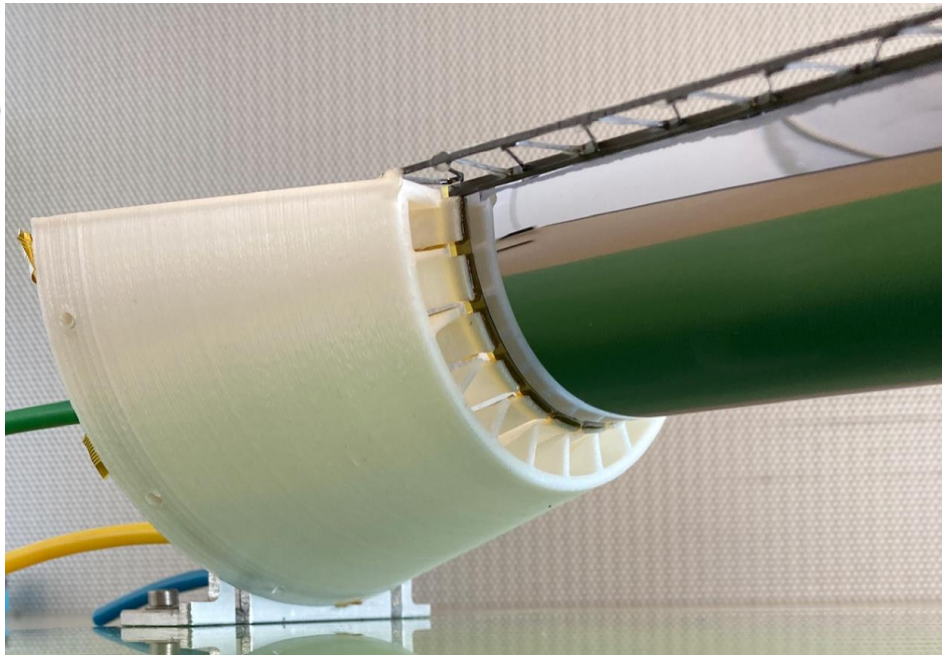
Graph is 0.4 watt and cooler is 3mm high 10 wide and 6 long (haadi is working on rest of analasis/data)

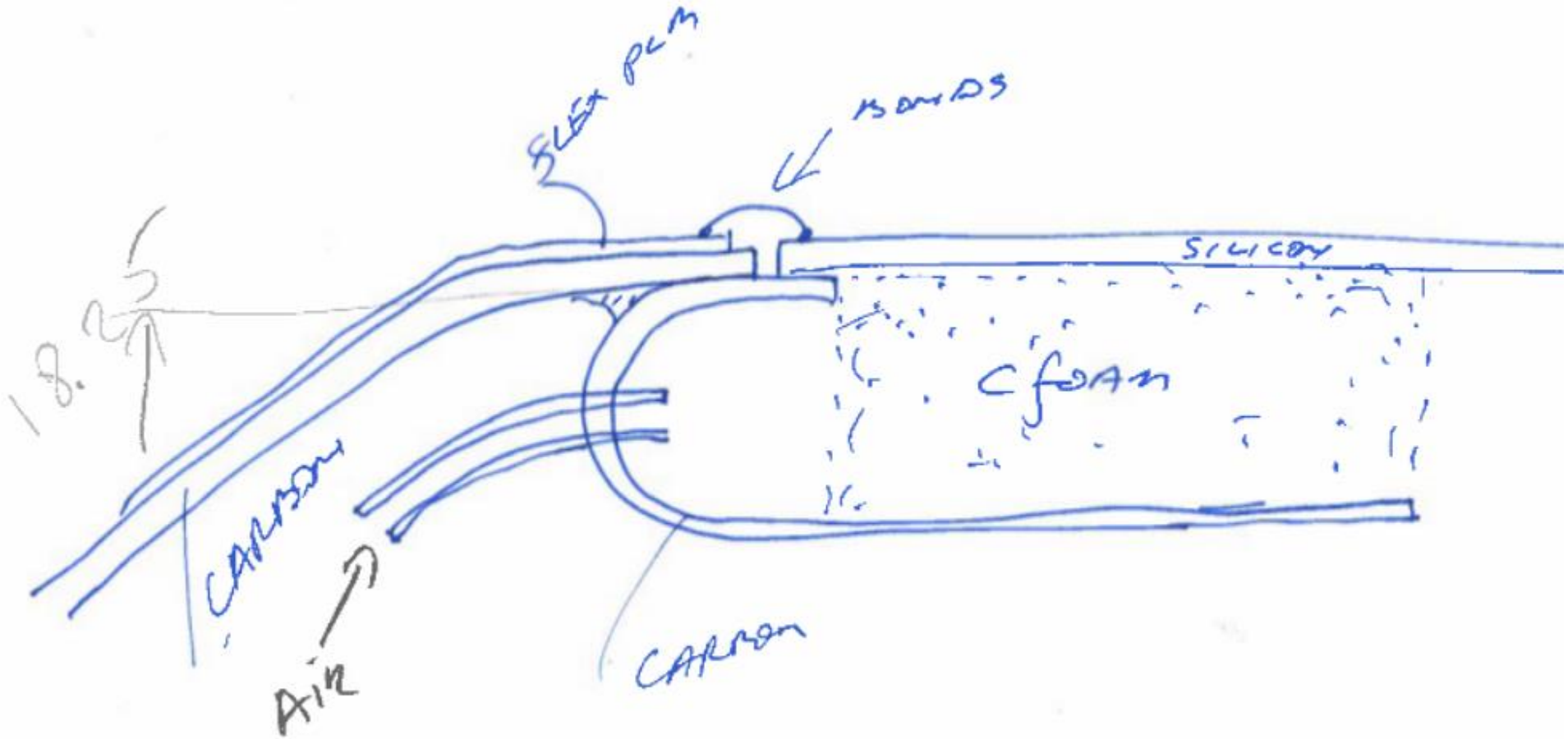


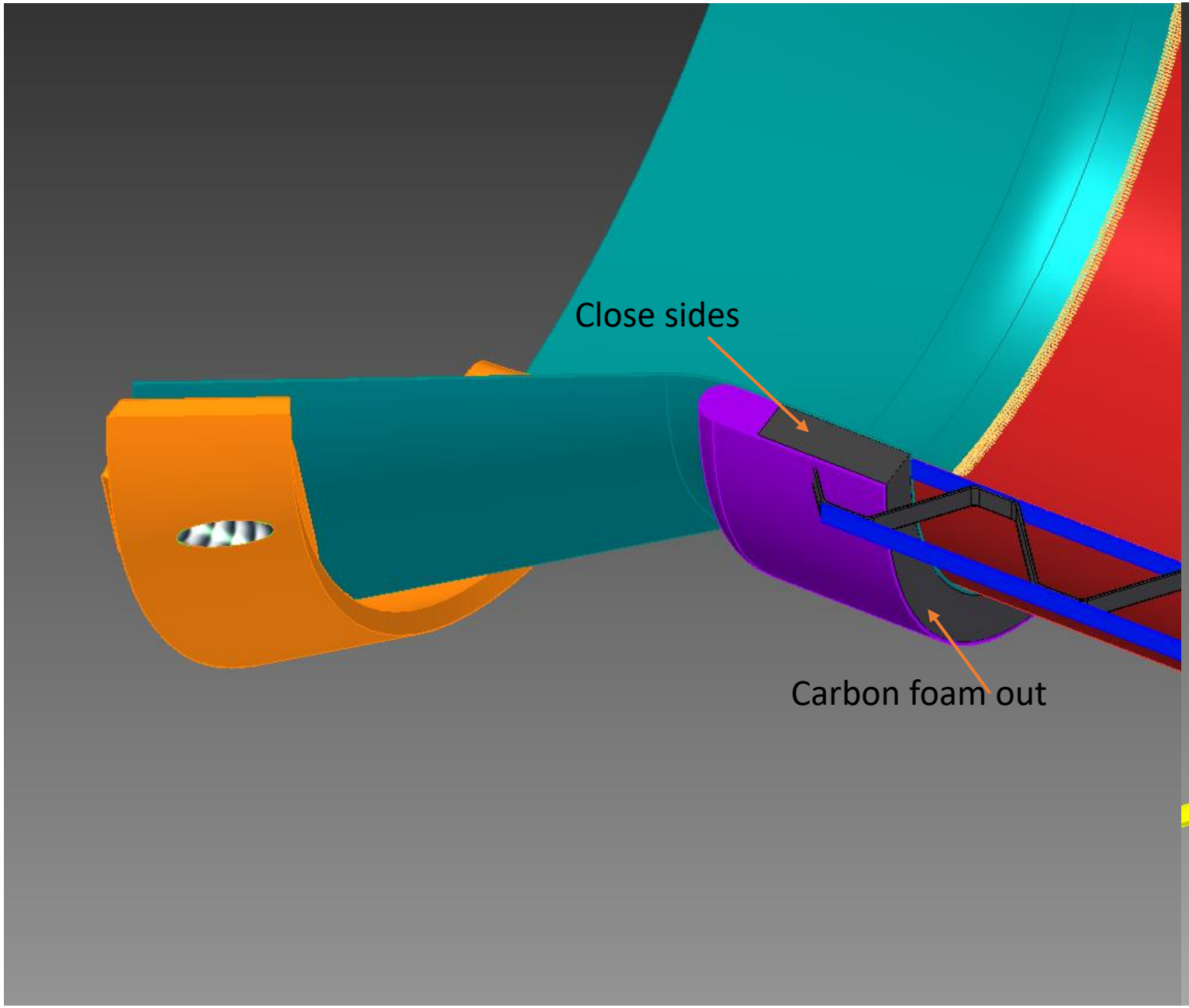
On cooling , so from sem,eline,haadi ther work it seems carbon foam works realy well to cool as long as you have a Considerable pressure drop of some 10Kpa (0.1bar) that's 1newton per cm2 so nothing you wana do to 40mu silicon But if you can constrain the forces to the foam and have a free flow out it should work. Also the flow coming out of a Restriction like a sieve or pourus medium is in general very laminar and smooth (principle used in gas lens for tig welding) So this could be beneficial for vibrations on silicon. Not that if a 3 separate layer construction is accepted by the cooler has to be lower (6>4 mm or so)

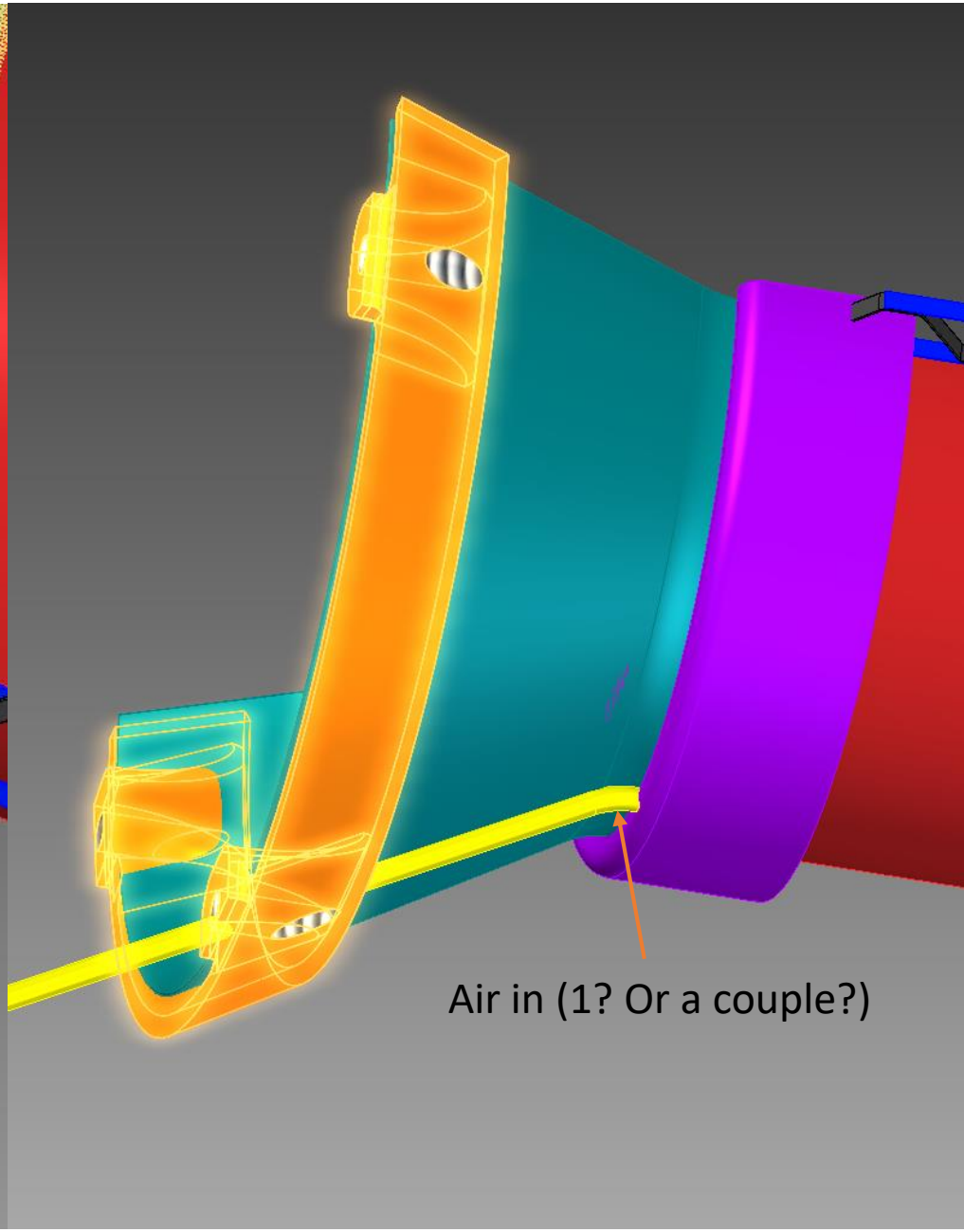


Want to make some small experiments
To se if carbon can hold the over pressure cooling of 3 mm high e.t.c



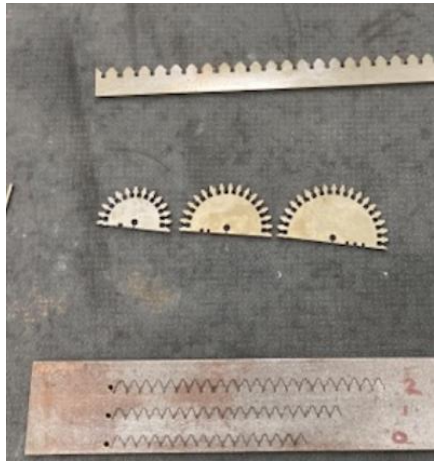

SILICON
BONDS
SILICON
CFOAM
CARBON
AIR
CARBON


Close sides
Carbon foam out


Air in (1? Or a couple?)

Next steps

* As discussed with corrado demo at cern after holliday season (who wants to join ?)
  coming month prepare L2 I have need to build l1-l0 got still enough metapor (not enough for big mistakes☹) build protop alingmnet with cameraas(probably only l0)
  There are stil 2 sets silicon at cern would be grate to use them for the demo
* Prepare carbon support 4 mm high improve tooling to make procedure better (new tooling mostly done)



* We stil have a set heated G10 layers test the no hole carbon cooler
  (probably L0 first)