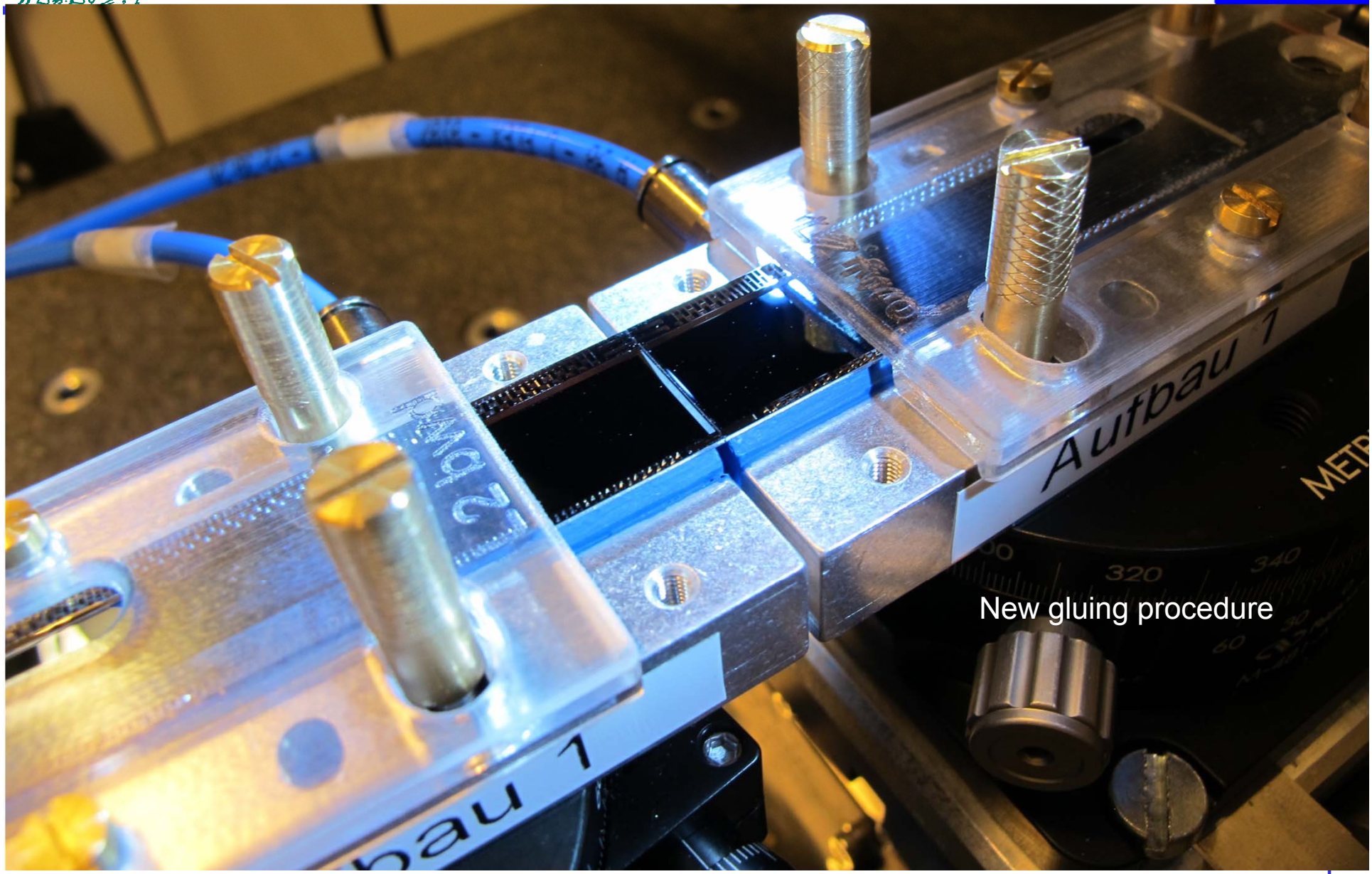
Ladder Assembly



Statistics

Ladder ID	L	bwd	fwd	
9	2	28OB2	28OF2	
10	2	31OB1	30OF1	
11	1	dummy	dummy	
12	1	37IB	31IF	
13	1	38IB	40IF	dead, PS malfunction
14	1	01IB	45IF	
15	1	02IB	47IF	
16	1	47IB	44IF	cracked when mounting, particle (few drains)
17	1	44IB	32IF	
18	1	41IB	41IF	
19	1	43IB	03IF	
20	1	45IB	42IF	
21	1	32IB	46IF	dead, high wire bonds
22	2	06OB1	11OF2	broken, step in aligment jig
23	2	dummy	dummy	
24	2	44OB1	12OF1	dead, particles (both modules)
25	1	dummy	dummy	
26	1	10IB	38IF	
27	1	33IB	31IF	
28	1	03IB	02IF	
29	2	09OB2	32OF1	
30	1	09IB	09IF	dead, screwdrive, particle in one module
31	1			abandoned
32	2	dummy	dummy	
33	2	dummy	dummy	
34	2	12OB2	41OF1	
35	1	04IB	04IF	dead, unknown (switcher area?)
36	1	13IB	13IF	
37	1	42IB	05IF	spare

18 ‘hot’ ladders glued
11 working ladders (10 in Phase III)

1: PS malfunction
1: jig misaligned
1: hit by screwdriver
1: particle
1: high wire bonds
1: cracked when mounting
1: unknown

Damage by particles
- Some drain lines in 1 module
- 2 dead modules (in one ladder)
- unknown (hidden by screwdriver acc).

$\Rightarrow$ ~ 4 occasions

With nylon mesh

Problems

Particles pressed by into module surface (sensitive) leading to shorts:

- dead drain lines
- complete failure of the module

Measures:

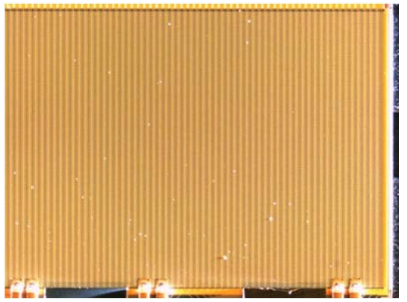
- strict inspection and cleaning of modules and jigs
- nylon mesh

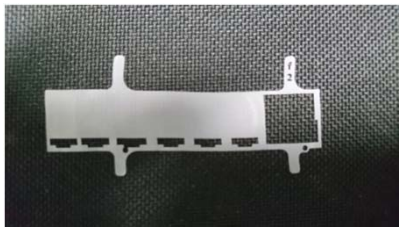
No such failures any more but:

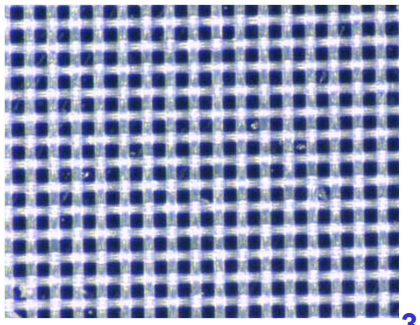
- small statistics
- no absolute guarantee that all particles can be removed
- time consuming (45 min -> 4h)

⇒ Modify assembly procedure such that the module surface is not touched

⇒ Keep steps which are proven to work

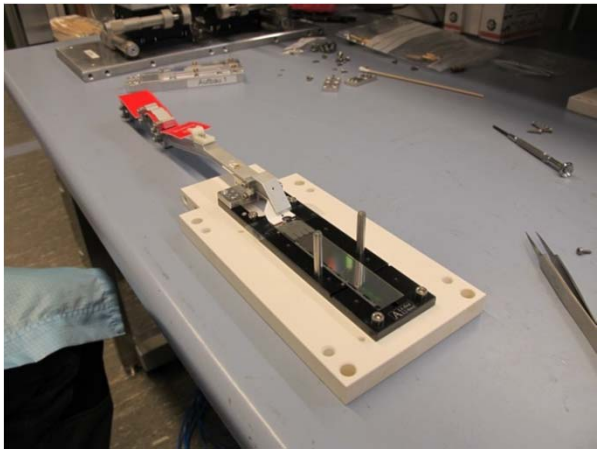


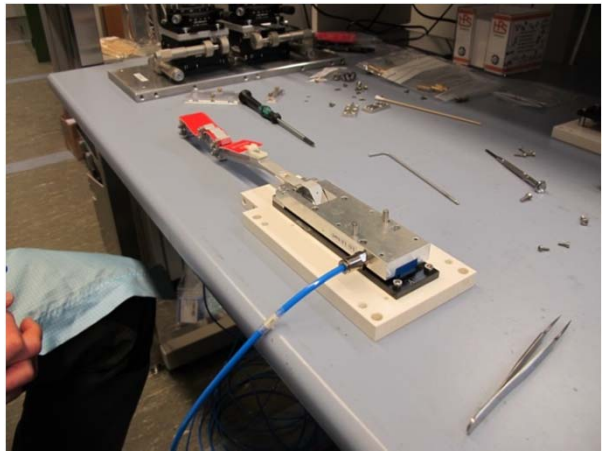




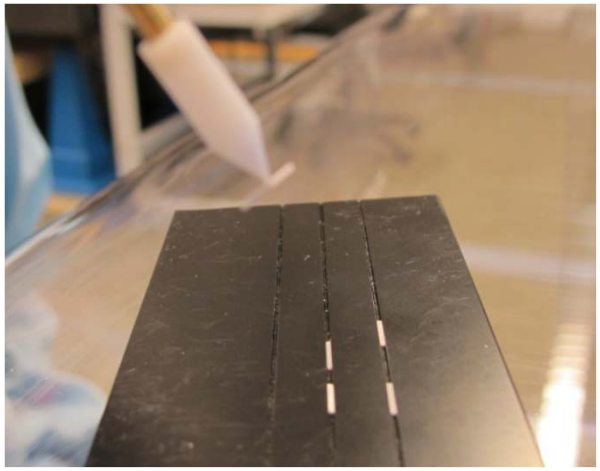
Old procedure

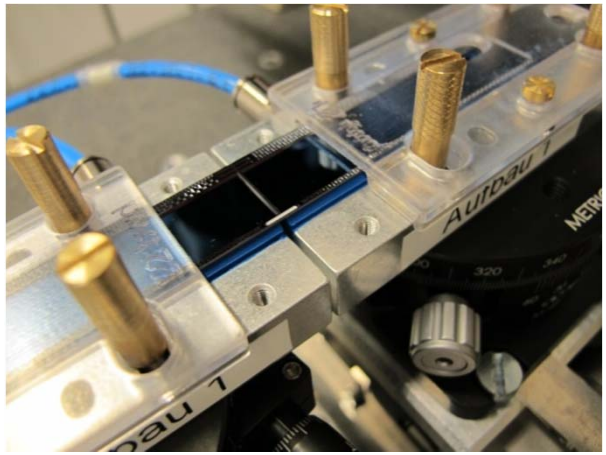
Module face up on jig
Transfer too put on top
Module fixed on transfer tool by vacuum





Flip and put on alignment stage
Groves on top
Glue and ceramic stiffeners are inserted by hand



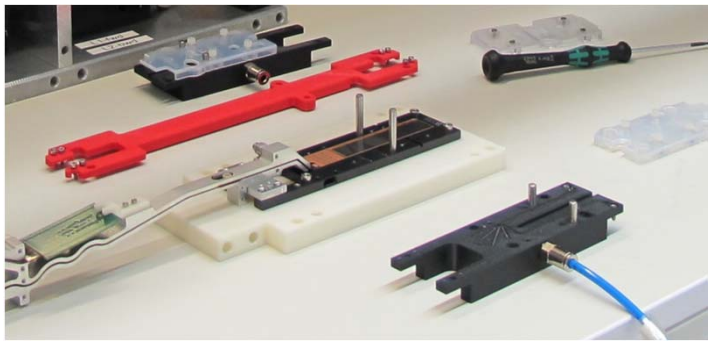


Modules were glued face down, to get ceramic stiffeners into the grooves on the backside.
Can these stiffeners be inserted from below?

New Method:

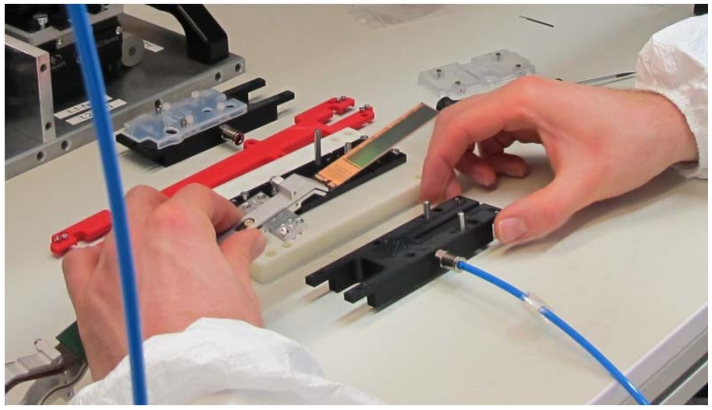
Tscharlie Ackermann, Enrico Töpper:

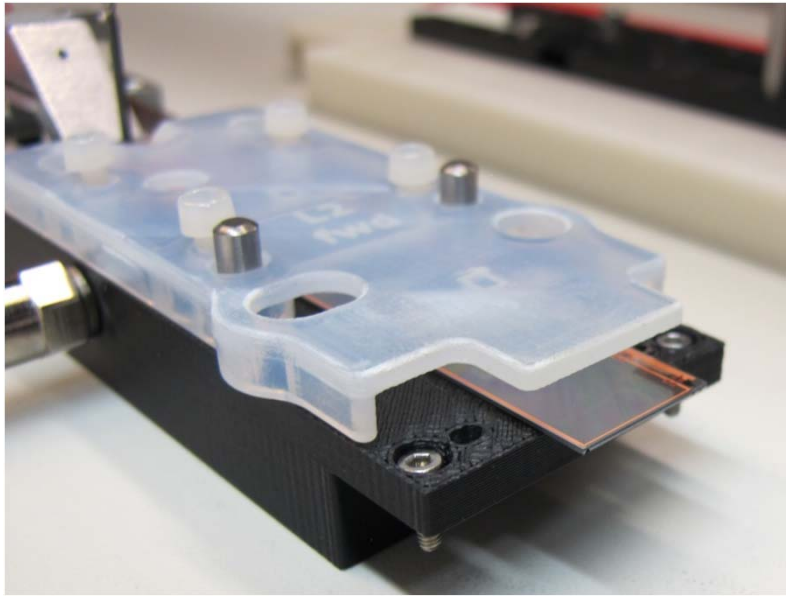
1) Module on transport & test jig



2) Take off and put on glue jig

Glue jig almost identical with test jig, just shorter
Held by vacuum (balcony and EOS)
Similar procedure as after Kapton soldering





3) Cover with protective cover & clamp

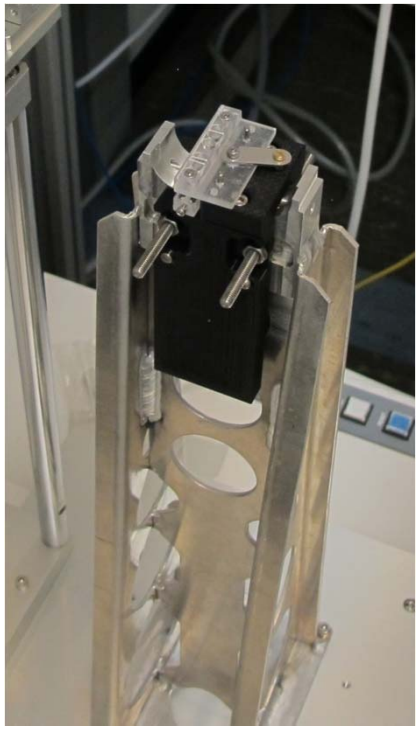
Repeat with 2nd module

Glue Dispensing

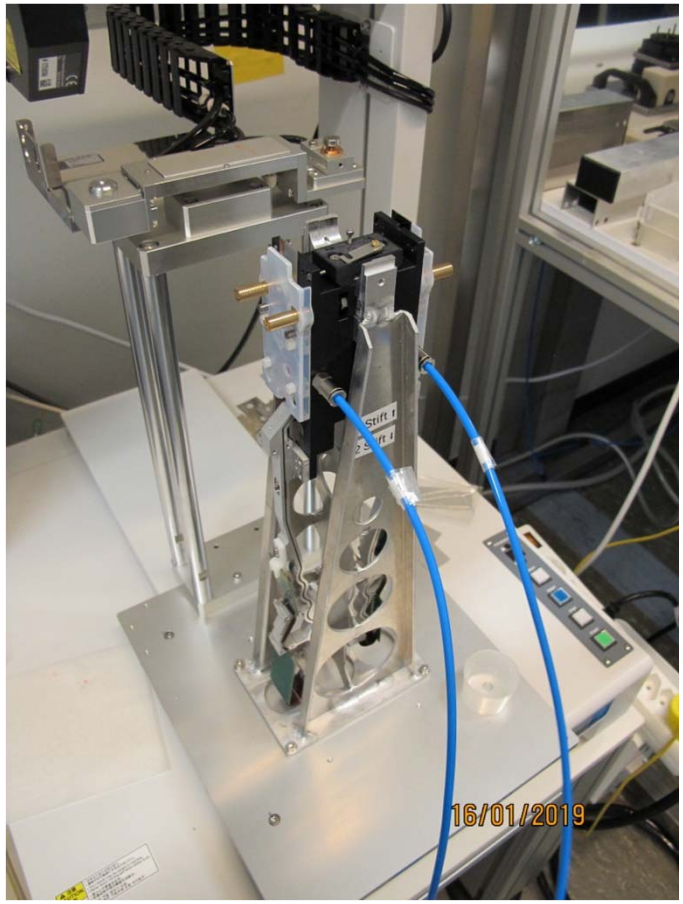
4) Place ceramic stiffeners in slots in a tray

5) Musashi dispenser applies glue on the stiffeners

(this was already tested with glue)

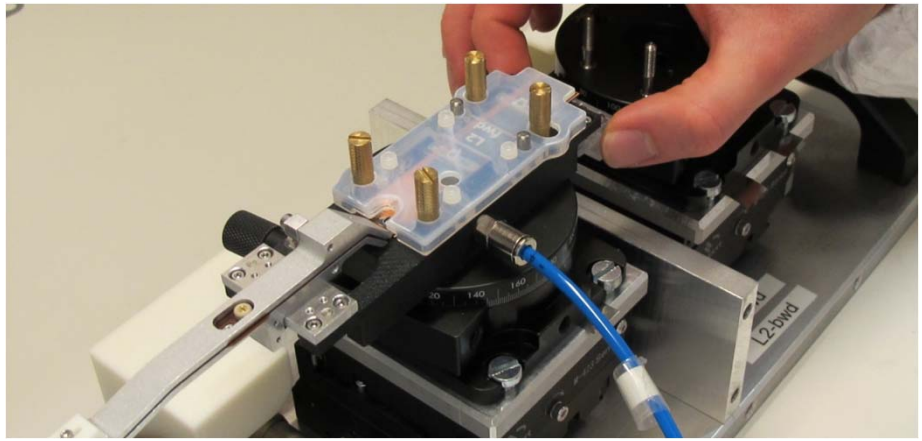


6) Afterwards modules mounted at the Musashi and glue is dispensed

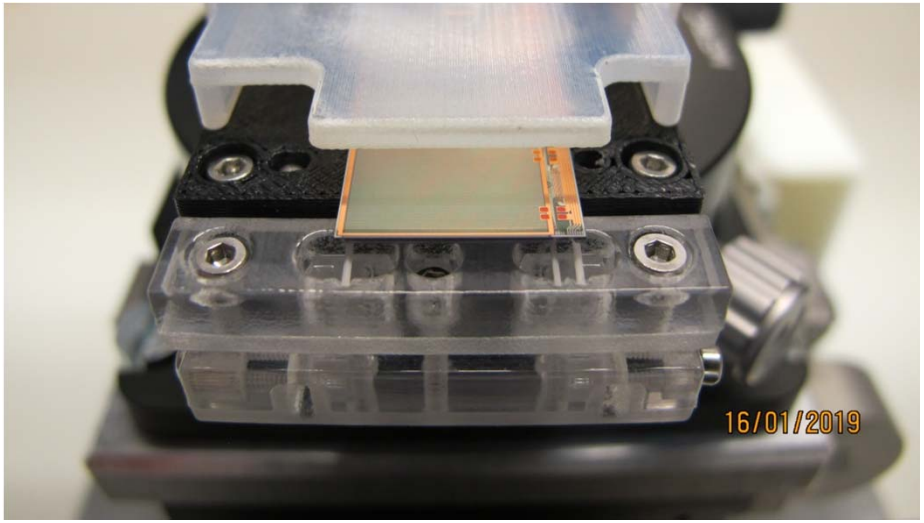


Mounting on alignment stage

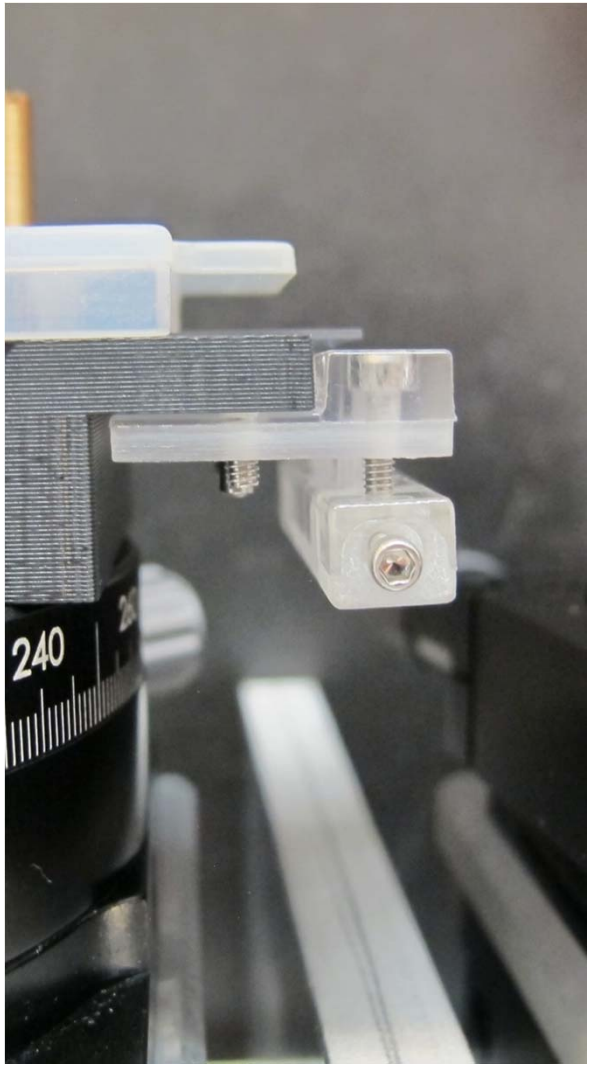
7) Place on alignment stage and add table with stiffeners



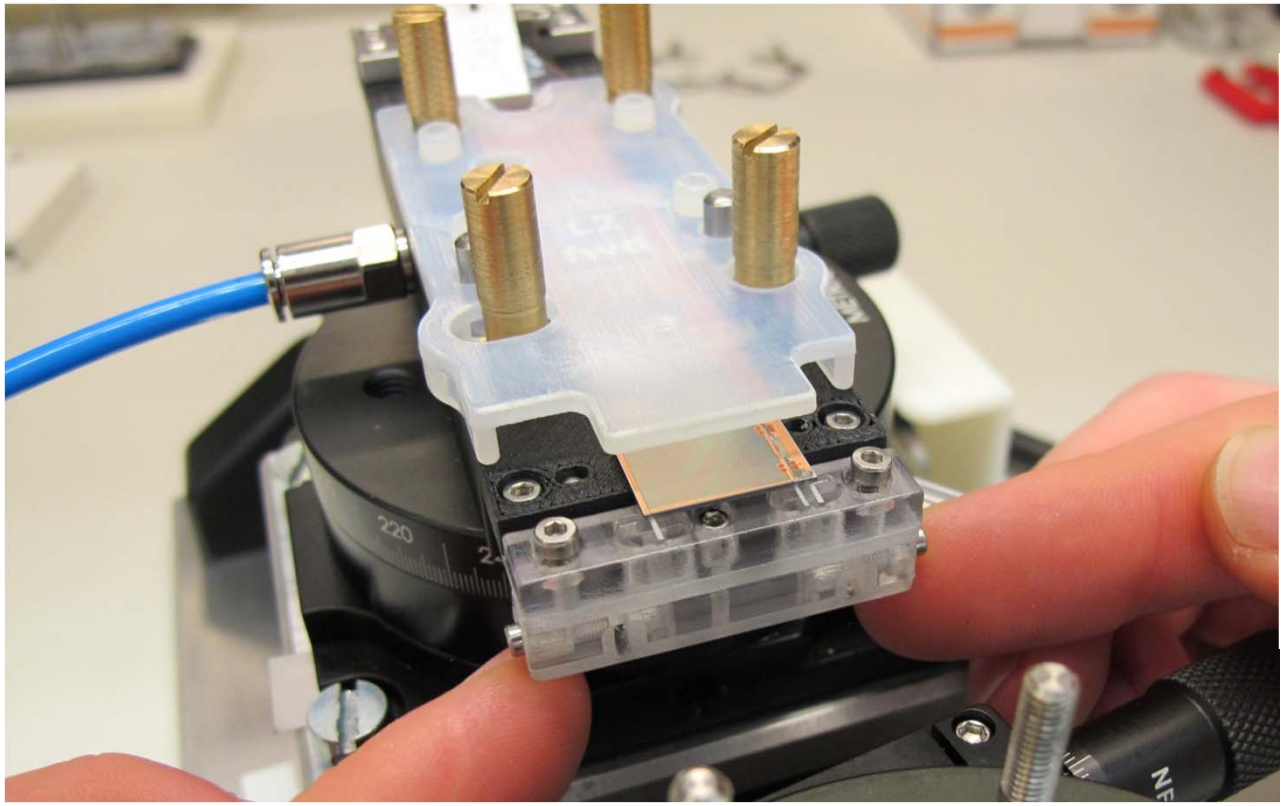
During mounting the lifter is blocked

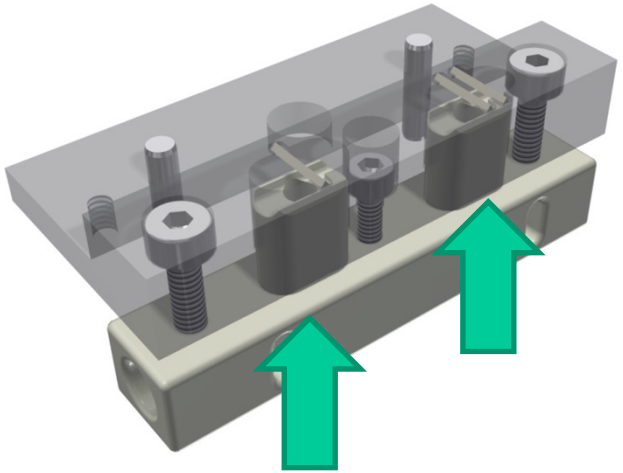


Side view of tray mounted



Lifting procedure



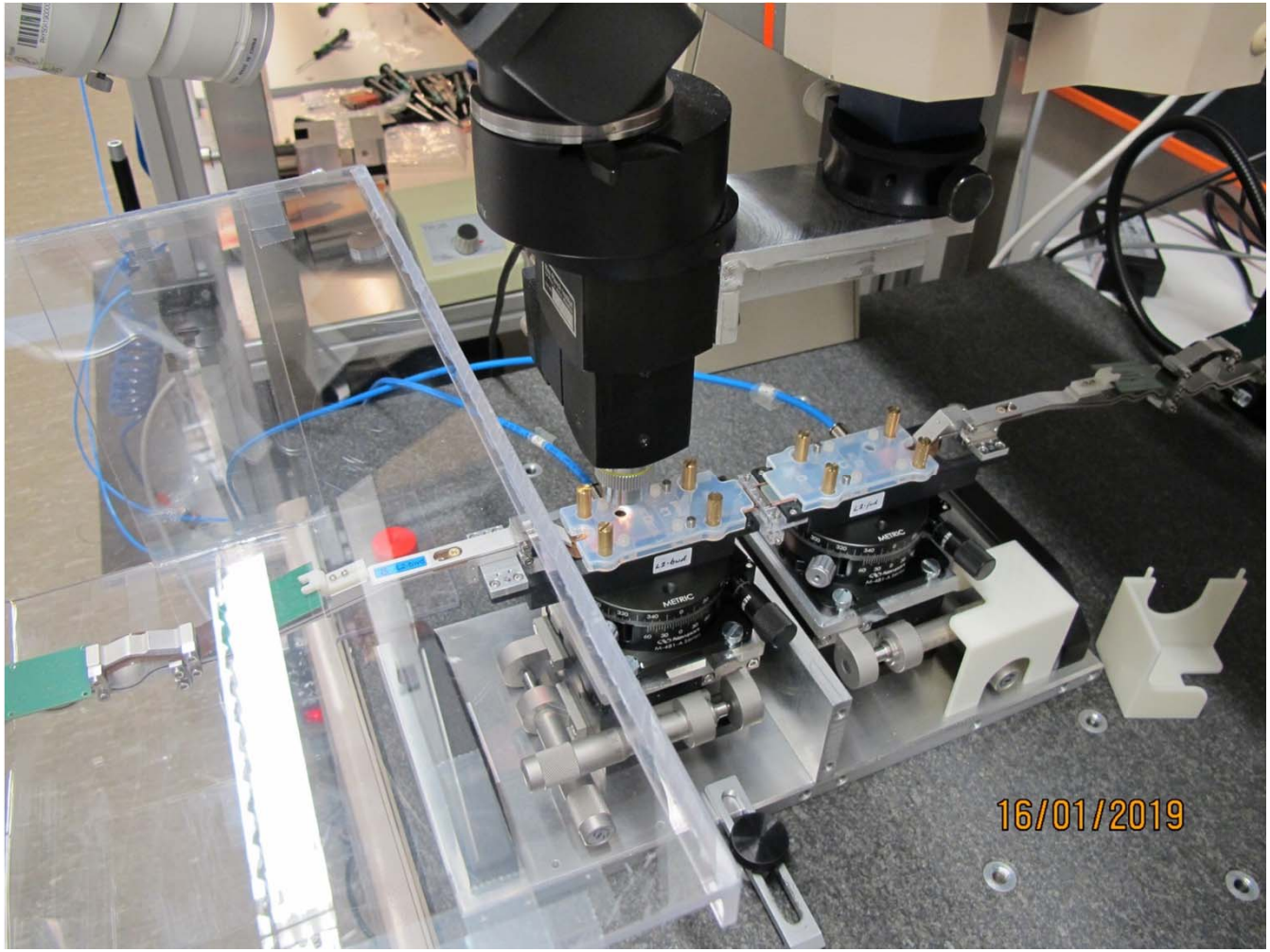


Fingers in the tray lift the stiffeners so that they are inserted in the grooves of the module
Overtravel is blocked, to avoid breakage of module

Just for demonstration, this is not done at this stage

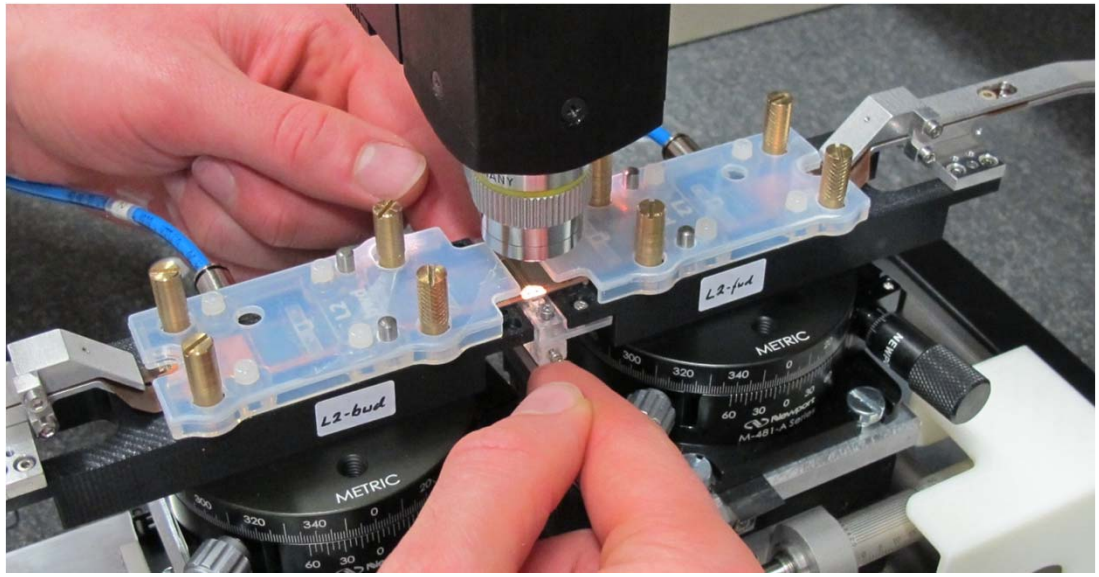
Alignment

8) 2nd module is mounted and both are aligned using a Mitotoyo CMM

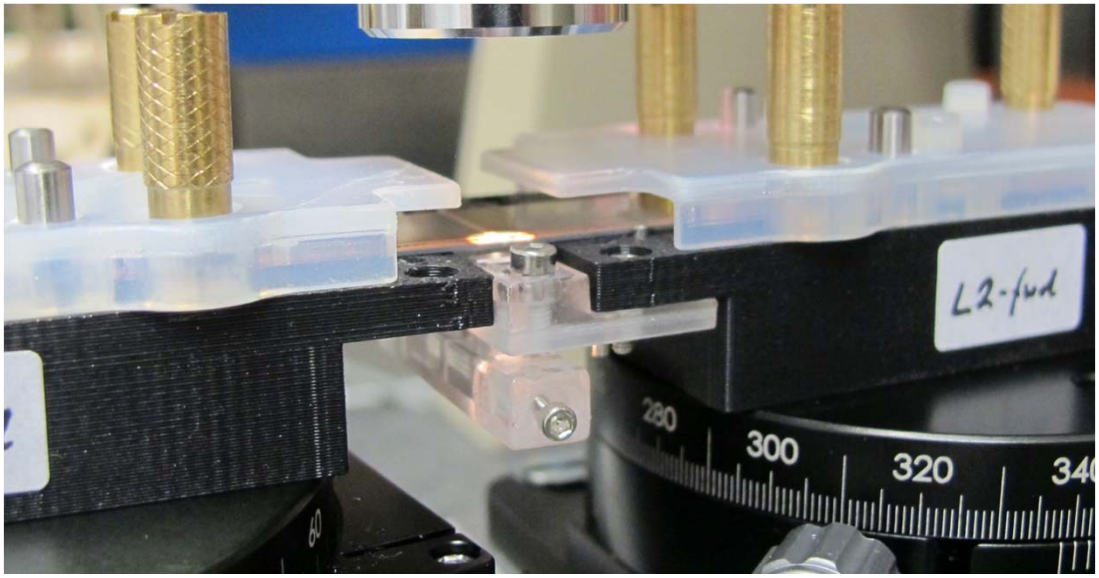


Insertion of Stiffeners

9) As shown before stiffeners are inserted in module grooves lifting up the support fingers

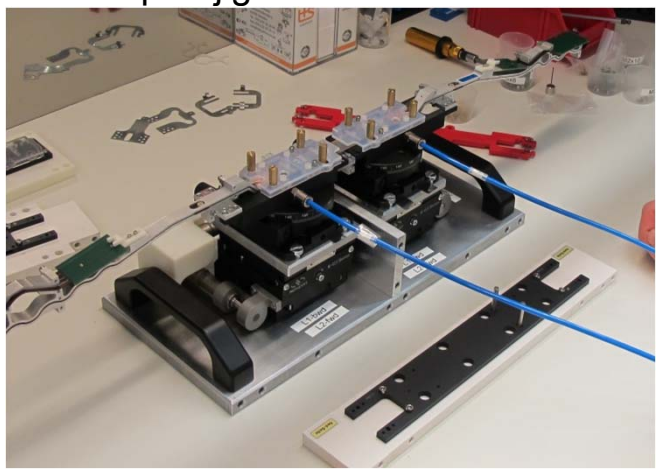


10) The assembly rests for 48h for curing

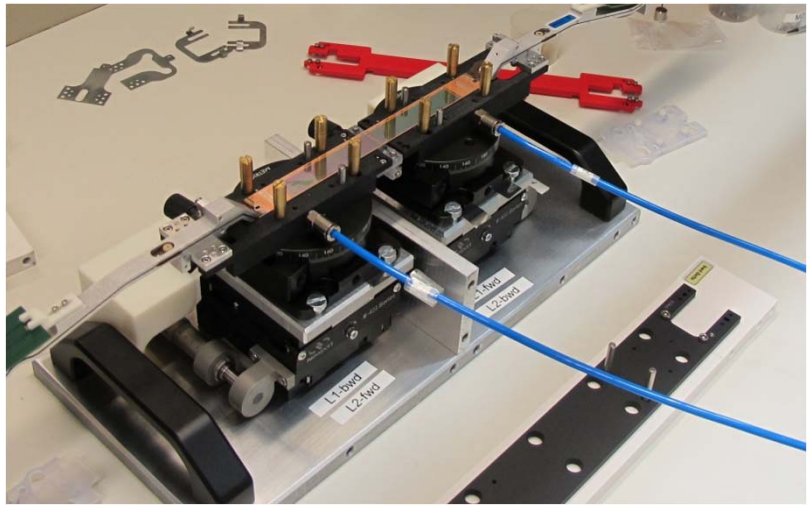


Lifting off

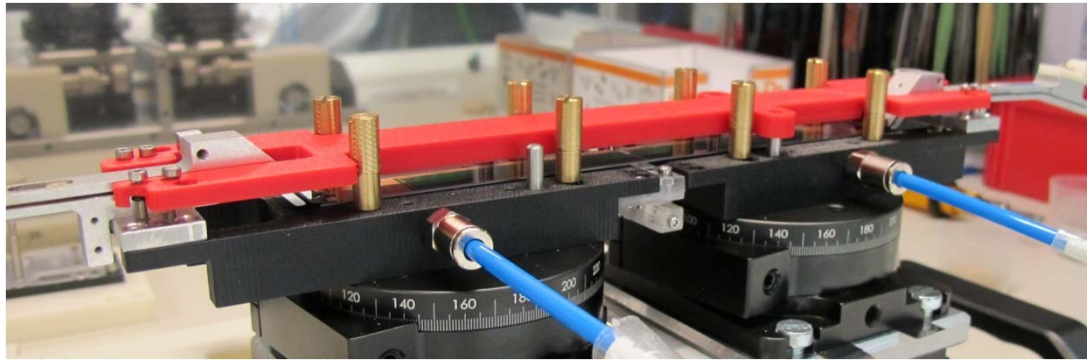
11) After curing the ladder needs to be taken off the alignment stage and put on the transport jig



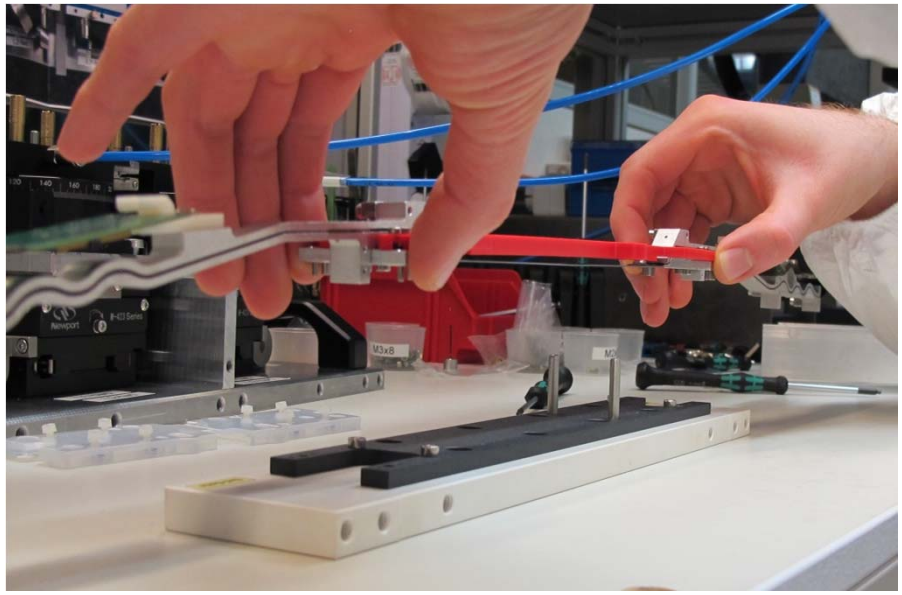
12) Covers are removed



13) Lift tool ('Knochen') is put on ladder and Kapton extensions are screwed to it



14) Ladder is lifted off and placed on the transport jig

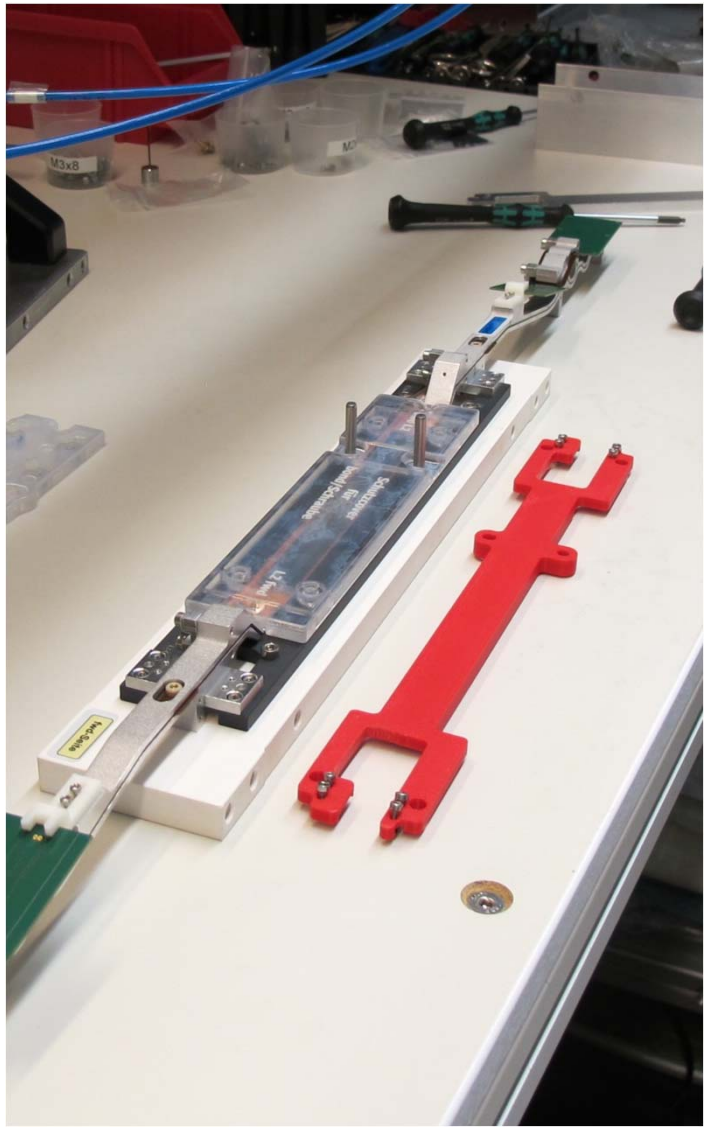


Finished

15) Kapton extensions are screwed to transport jig and lift off tool is removed

Lift off procedure and tool is a copy of the procedure used to mount the ladders on the cooling blocks. Well tested

(Real one is made of metal)



Tests

Dry assemblies (no gluing) worked
Procedure even simpler than old one

- no turn-over (was critical)
- automatic glue dispensing on stiffeners (better reproducibility)
- less manual steps

Next step: gluing of dummy ladders

- Test glue dispensing on ceramics
- Does self alignment work?
- Can the stiffener jam?
- Need to stop over-travel, don't apply too much force which can break module

3 pairs of modules available

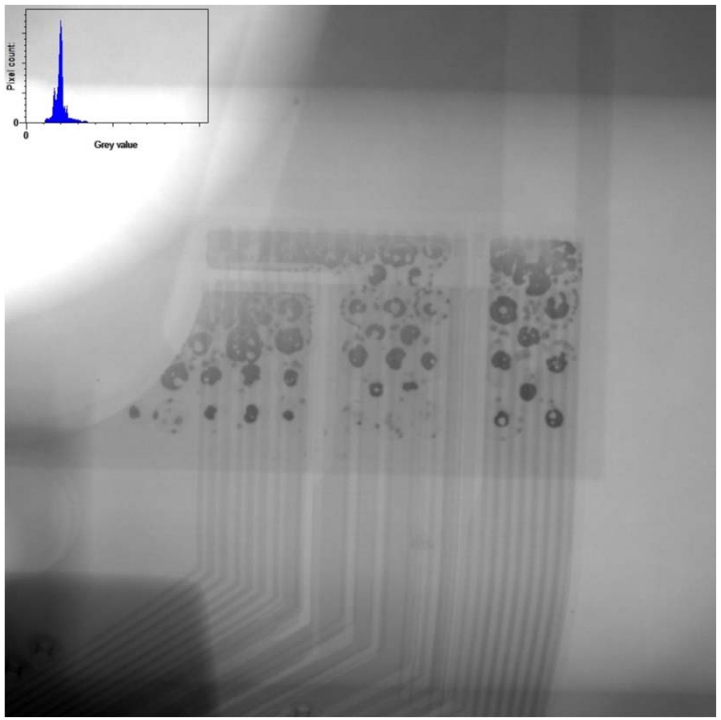
Jigs produced
(waiting for tray)

Week 5: glue dispensing tests
Week 6,7: dry assembly with final tools, adjustments
Week 8: dummy gluing
Week 9: dummy gluing, review

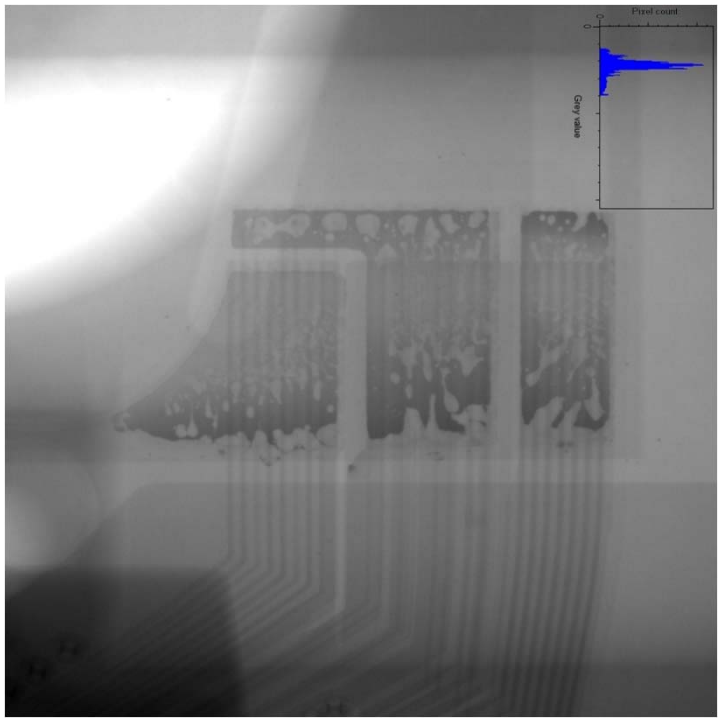
Kapton Soldering

With the old setup the coverage of the solder pads was often not satisfactory (though no failure was observed)
A new clamp equalizes the pressure during soldering and leads to a better coverage
Electrically ok, no shorts observed
More tests under way (adjust amount of solder to avoid spilling out ad module edge)

Old setup



New setup

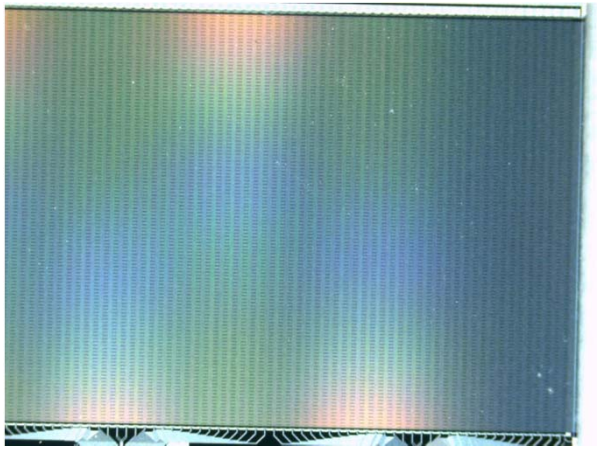


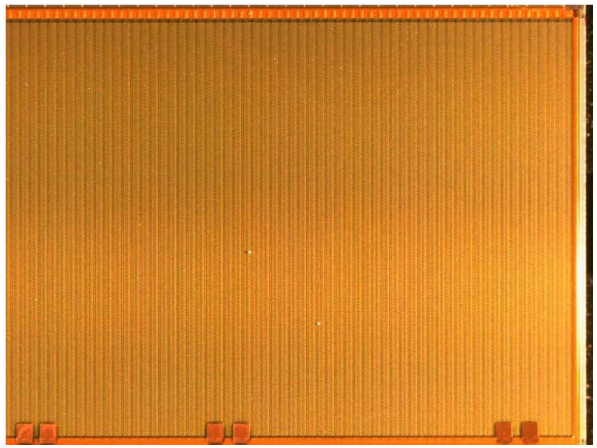
Module Inspection

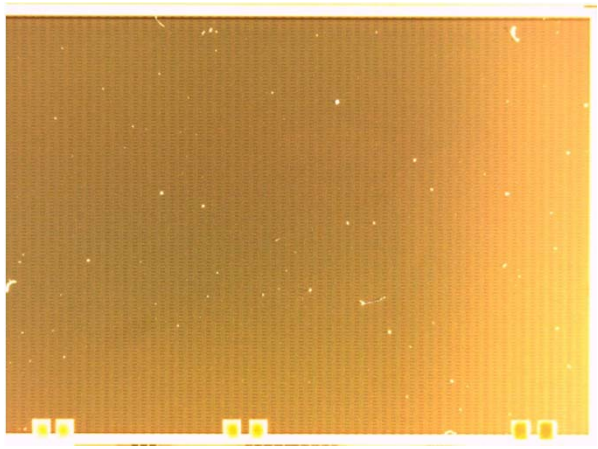
Fresh from gel pack

After Kapton attachment
1 day in storage box

> 1 month in storage box







Storage box: 3-D printed, perhaps residuals of support material or 3D powder itself
Was cleaned in ultrasonic bath