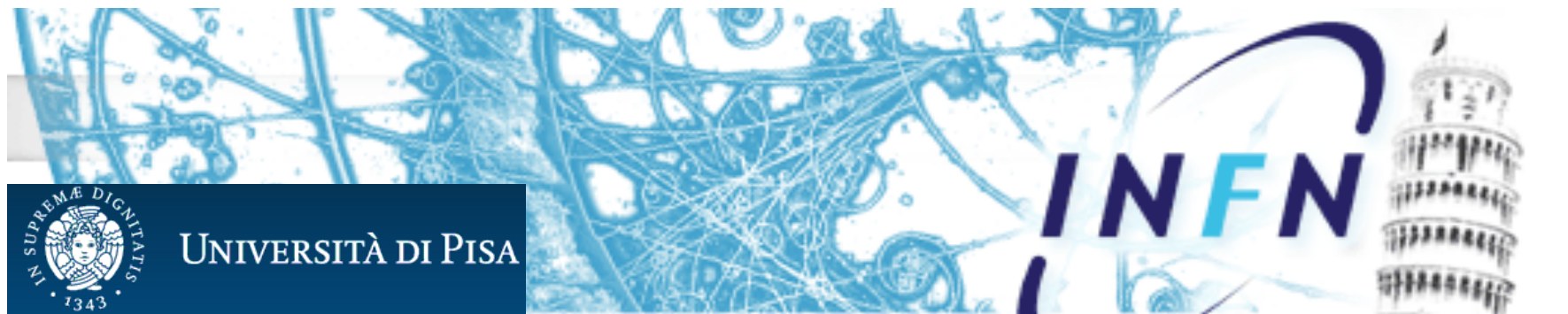


BW/FW assembly Status & Plans



S.Bettarini

On behalf the Pisa Belle2-SVD group

Outline

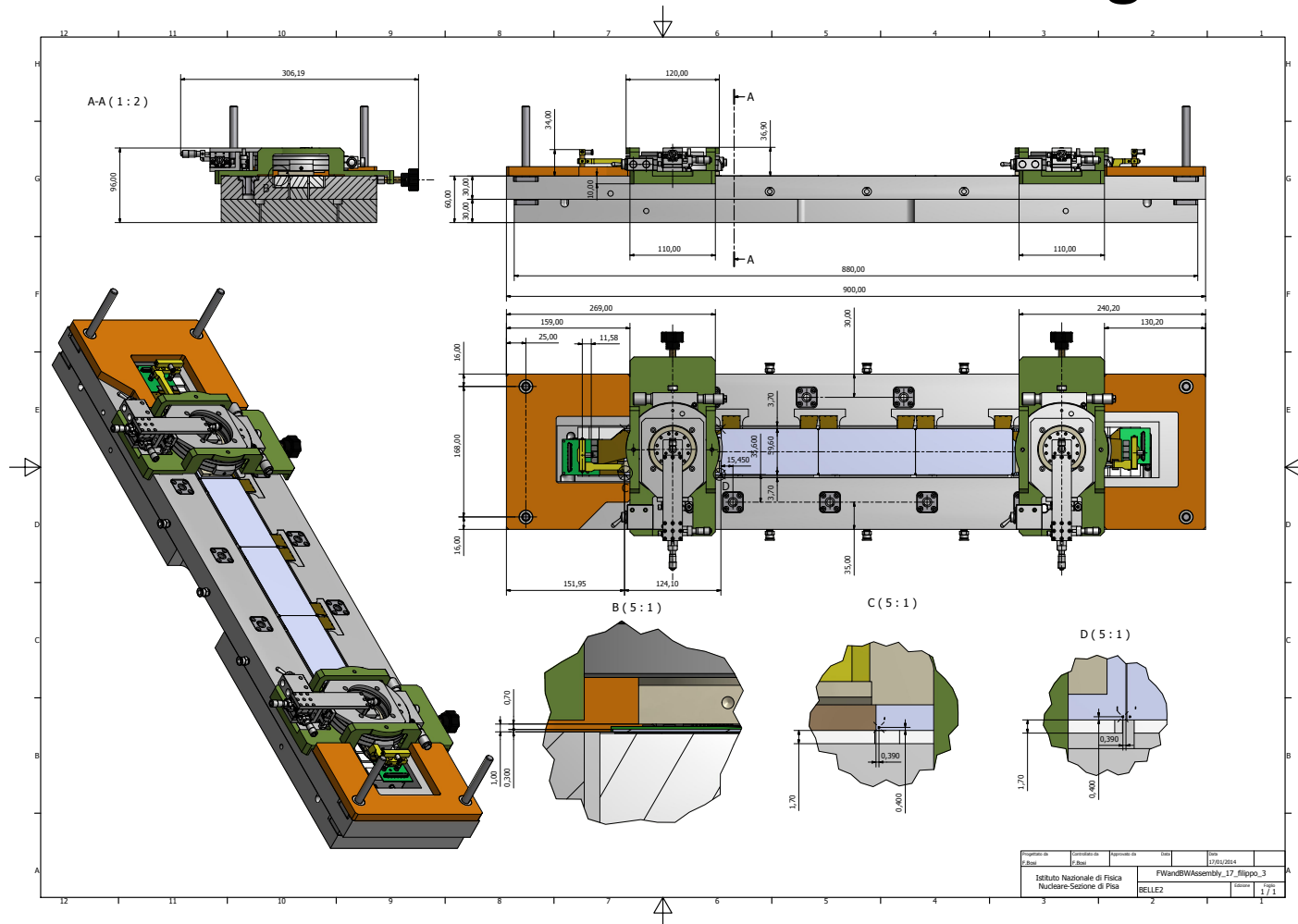
- Introduction
- Modified xyz- θ stage
- Multi-purpose jig
- Glue-stamping tests
- Work in progress on gluing chucks
- Conclusions

Introduction

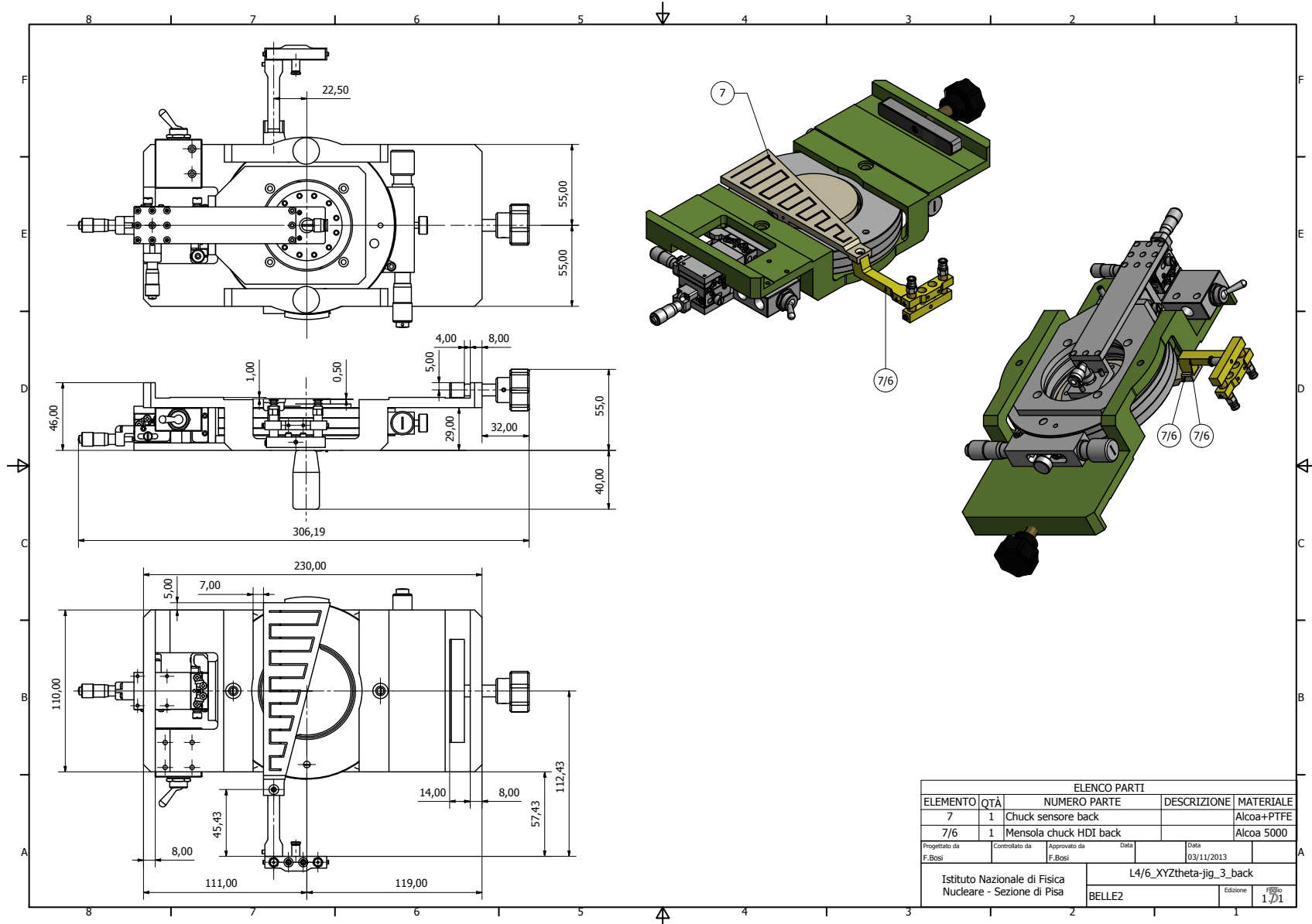
- The viability of the option “P” is based on:
 - build (i.e. glue the pitch adapters to det.’s and hybrids and u-bonding) the L4-5-6 backward and forward assembly
 - electrical characterization of the assemblies
 - safely shipment of BW/FW assemblies to the ladder production sites and sustain a proper production rate to feed them
 - align the BW/FW on the assembly bench(es) and go back in stream with the original procedures
- We started focusing on the last items, which requires tools to be produced in high multiplicity

Modified xyz- θ stage (3FW+3BW)

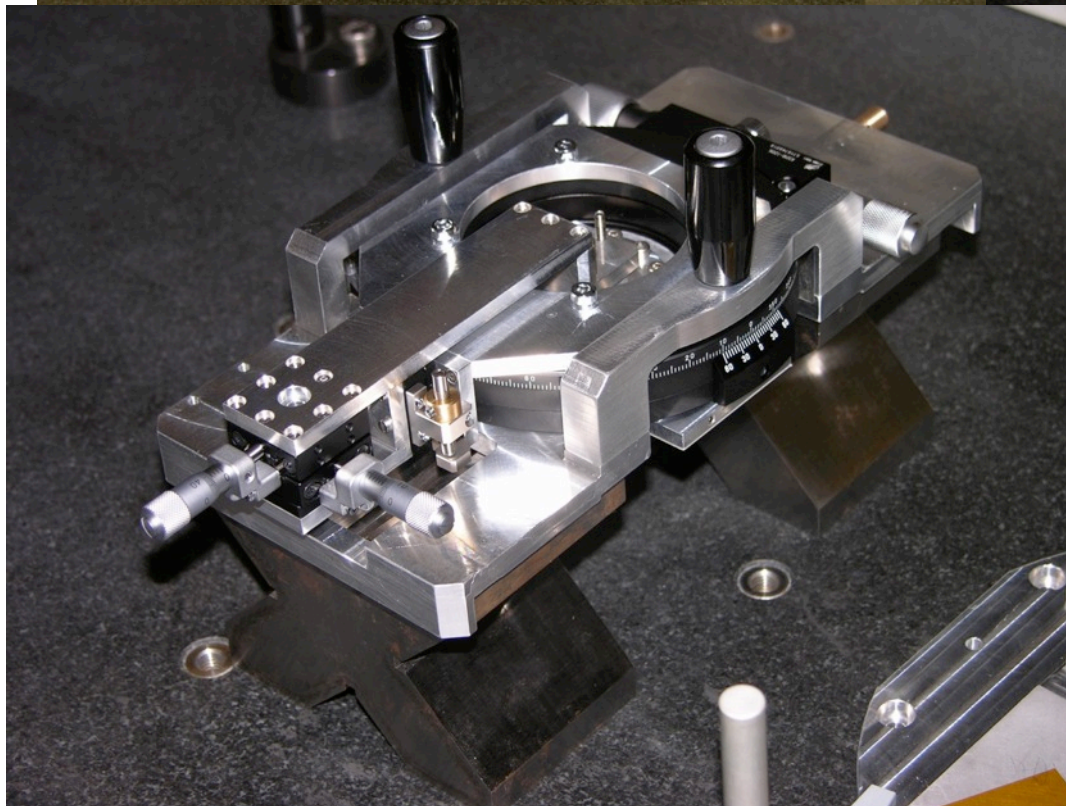
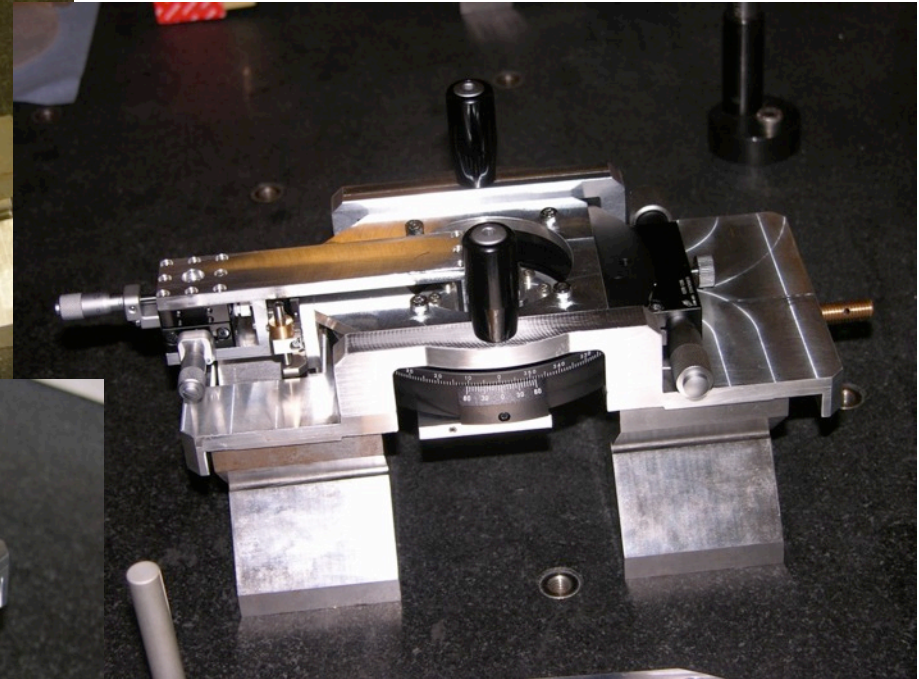
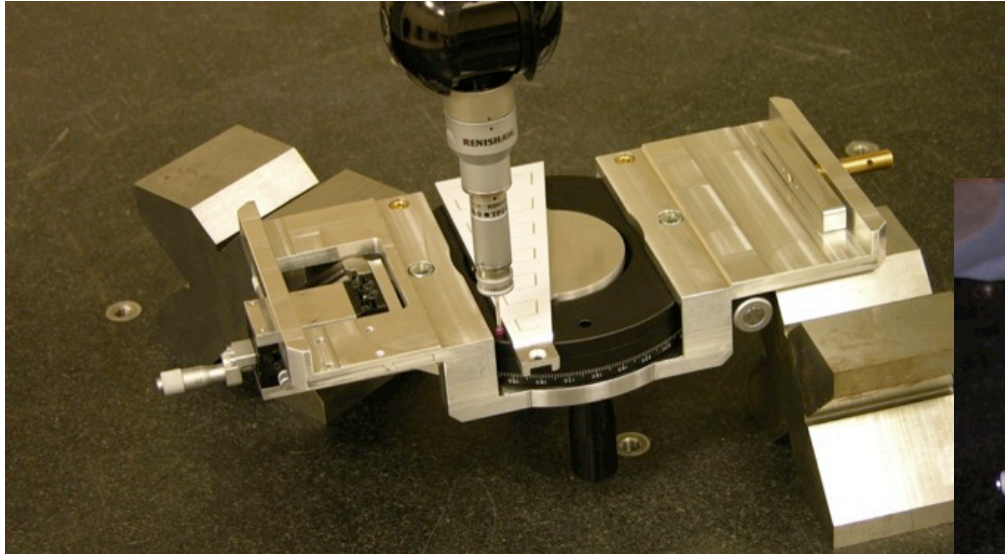
- The 1st prototype (BW) realized and inspected under the CMM after mounting the stages



Drawings (BW)



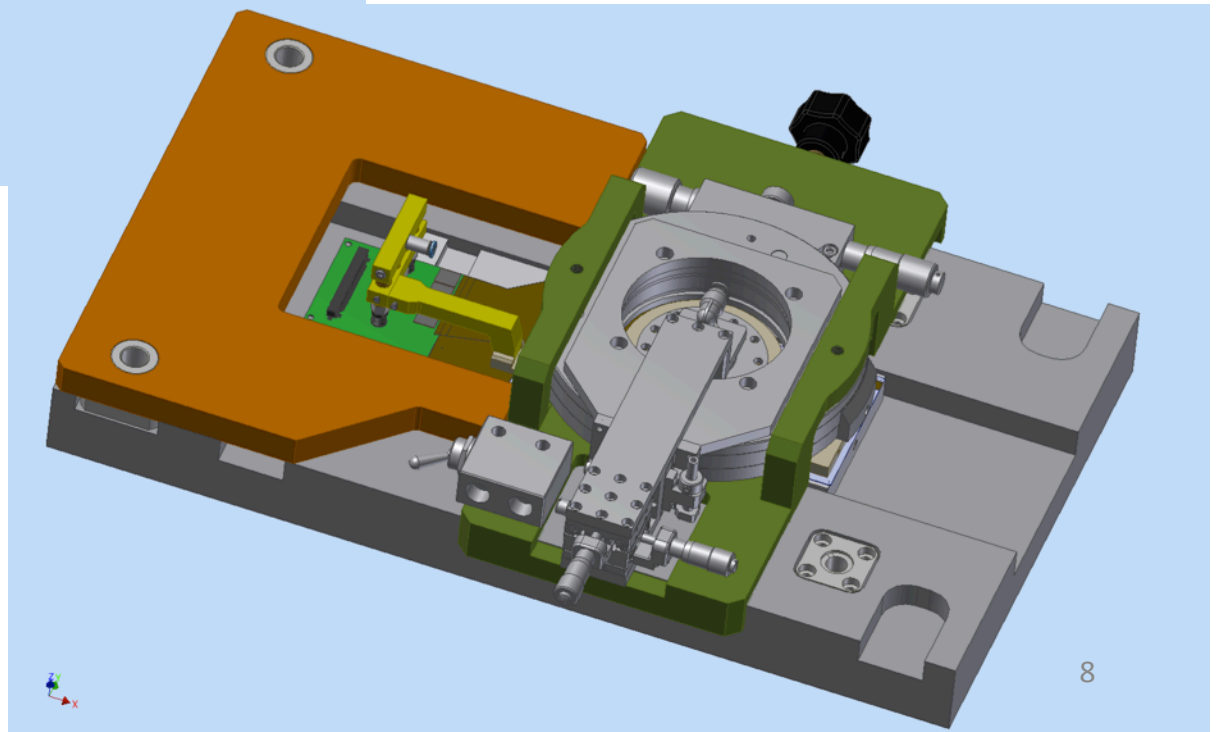
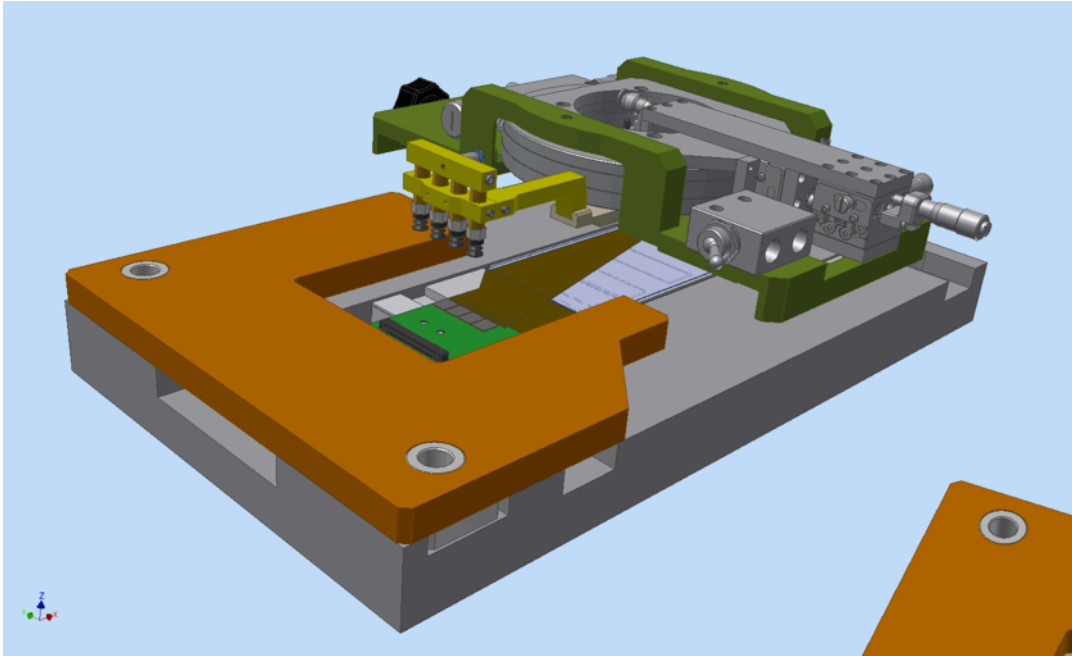
Current prototype measurements



Test at IPMU on Feb. the 4th

- (After mounting the θ stage) the teflon chuck planarity ~ 20 μm ; vacuum tested ok;
- Cup-spring + 3 screws to set the vacuum chuck parallel to the foothold plane (30 μm);
- Perform the test at IPMU with the mechanical BW assembly prototype already made in Pisa. Take the stage already properly set on a dummy bench-mask (a slab of aluminum with 3 reference planes, now in construction in Pisa):
 - Start with 700 μm gap between the chuck and the “detector”; decrease that to 100 μm ;
 - Take the hybrid with the suction cups and then switch on the upper vacuum and off the vacuum on the bench
 - Act on the rotating stage to align the ref. crosses (F)
 - Act on the x-y movement to place the detector in the nominal position
- The stage will be transported with a temporary shipment, we expect eventually some (minor) modifications.

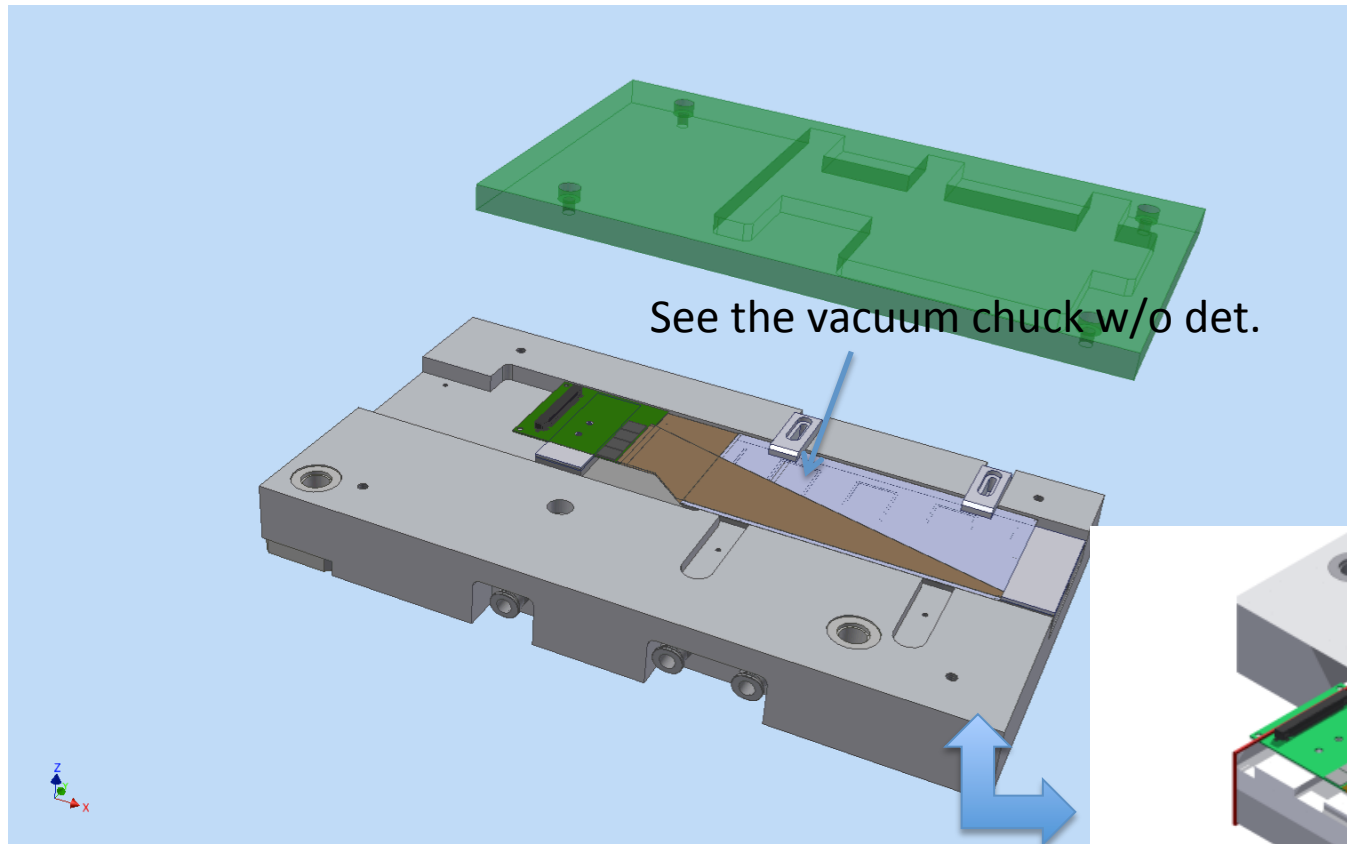
Test/Set the xyz- θ stage on the dummy bench mask



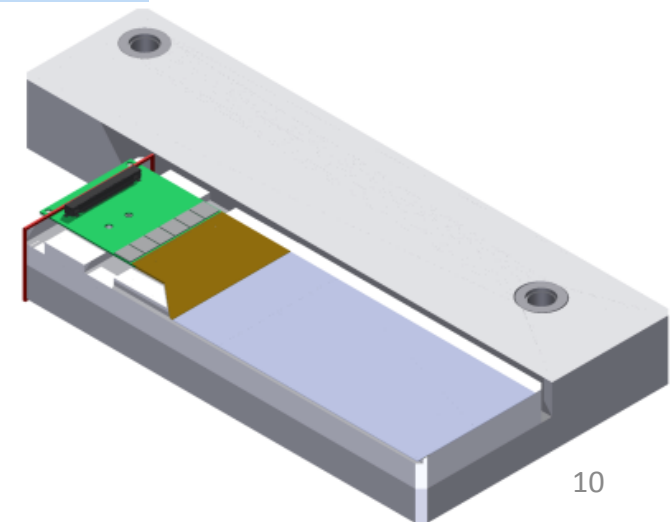
Multi Purpose chuck

- The MP chuck is needed to:
 - Provide the support for bonding (both sides)
 - In case of reworking, perform upside-down movement
 - Testing (on the APV test-stand)
 - Safe shipping
 - Match with the PB2 (PF2) chucks
- Status:
 - We designed a holder in which insert a teflon chuck for the detector z-side up (and a cover for the shipment). For the other operations the chuck can be both ϕ or z side up, with clamps and/or vacuum
 - After the tender, the order has been set: 1st prototype expected in mid-February, end of production and of March. (40BW + 40FW for shipping, 4BW + 4FW for bonding);

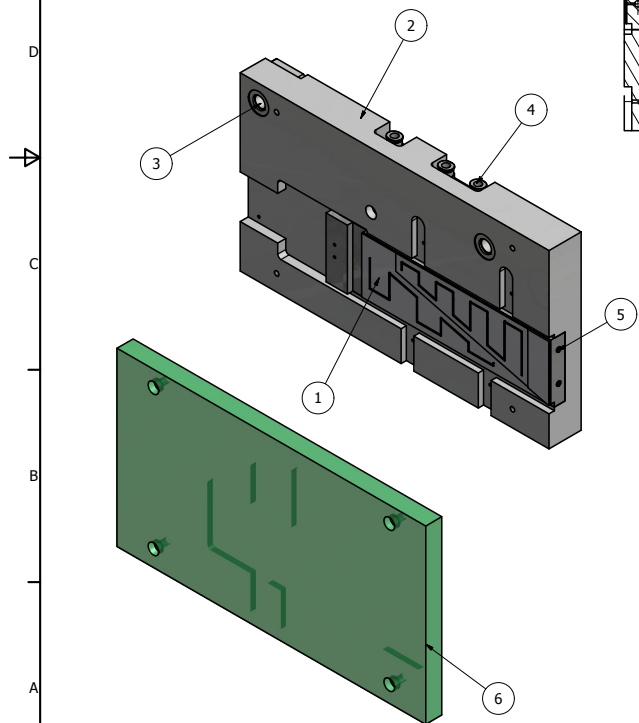
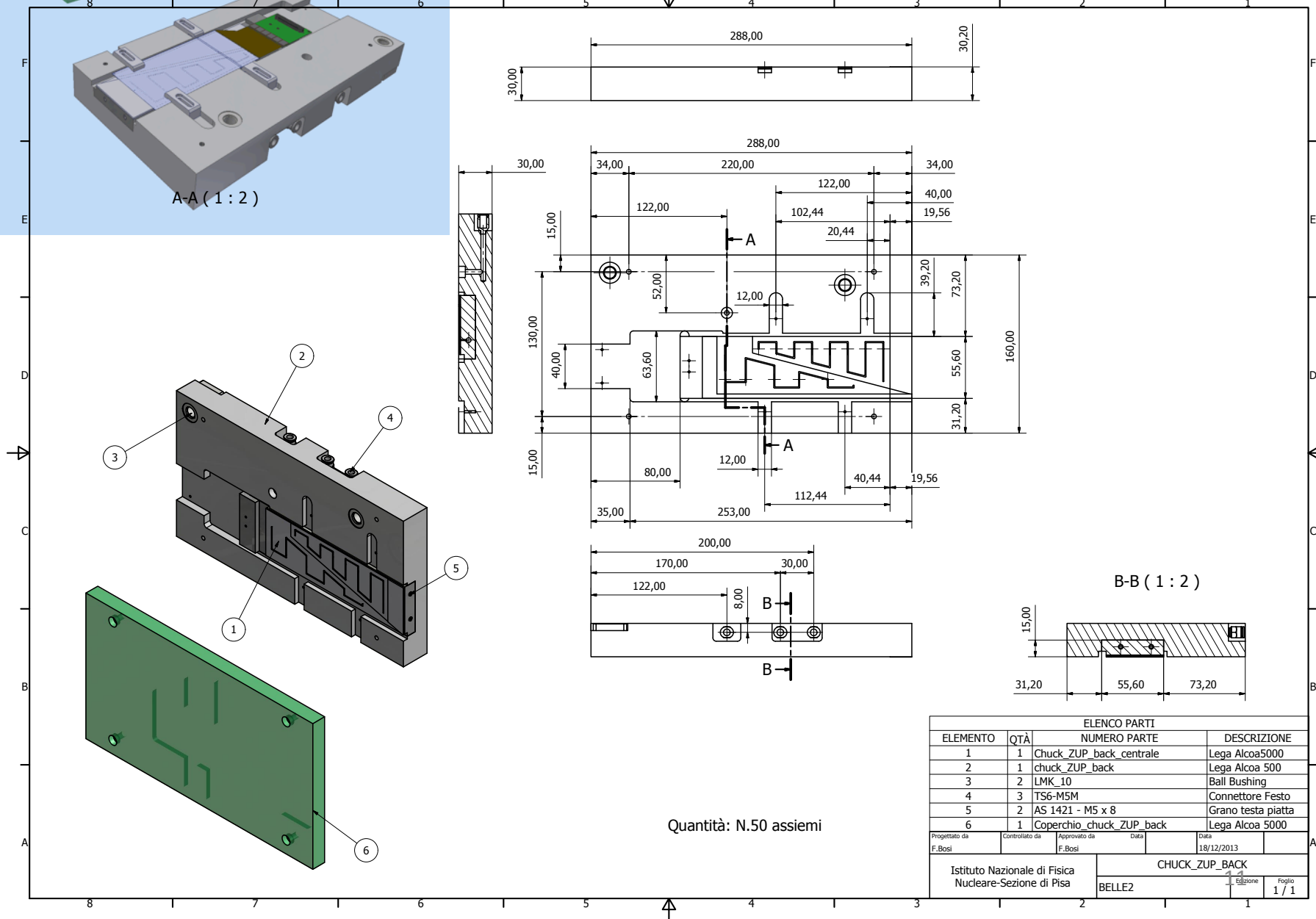
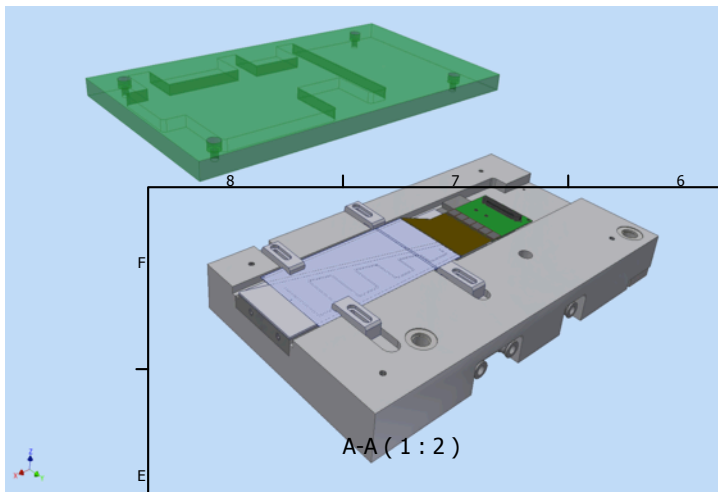
MP design: det. Z up



To be used with PB2
chuck to take the BW
assembly and place that on
the assembly bench



MP design: det. ϕ UP

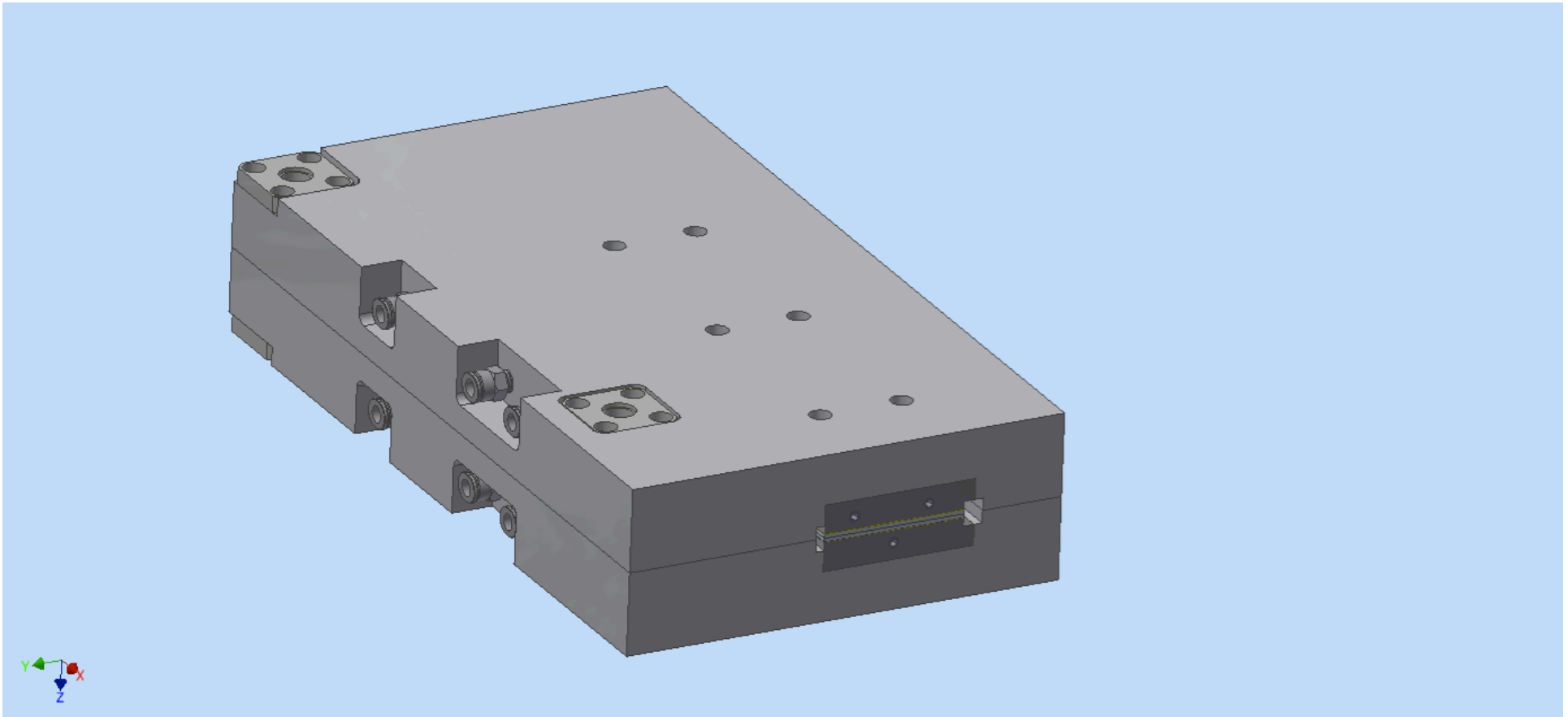


Quantità: N.50 assiami

ELENCO PARTI			
ELEMENTO	QTA	NUMERO PARTE	DESCRIZIONE
1	1	Chuck_ZUP_back centrale	Lega Alcoa5000
2	1	chuck_ZUP_back	Lega Alcoa 500
3	2	LMK_10	Ball Bushing
4	3	TS6-M5M	Connettore Festo
5	2	AS 1421 - M5 x 8	Grano testa piatta
6	1	Coperchio_chuck_ZUP_back	Lega Alcoa 5000

Progettato da F.Bosi	Controlato da F.Bosi	Approvato da F.Bosi	Data 18/12/2013
Istituto Nazionale di Fisica Nucleare-Sezione di Pisa		CHUCK_ZUP_BACK	
BELLE2		Edizione	Foglio 1 / 1

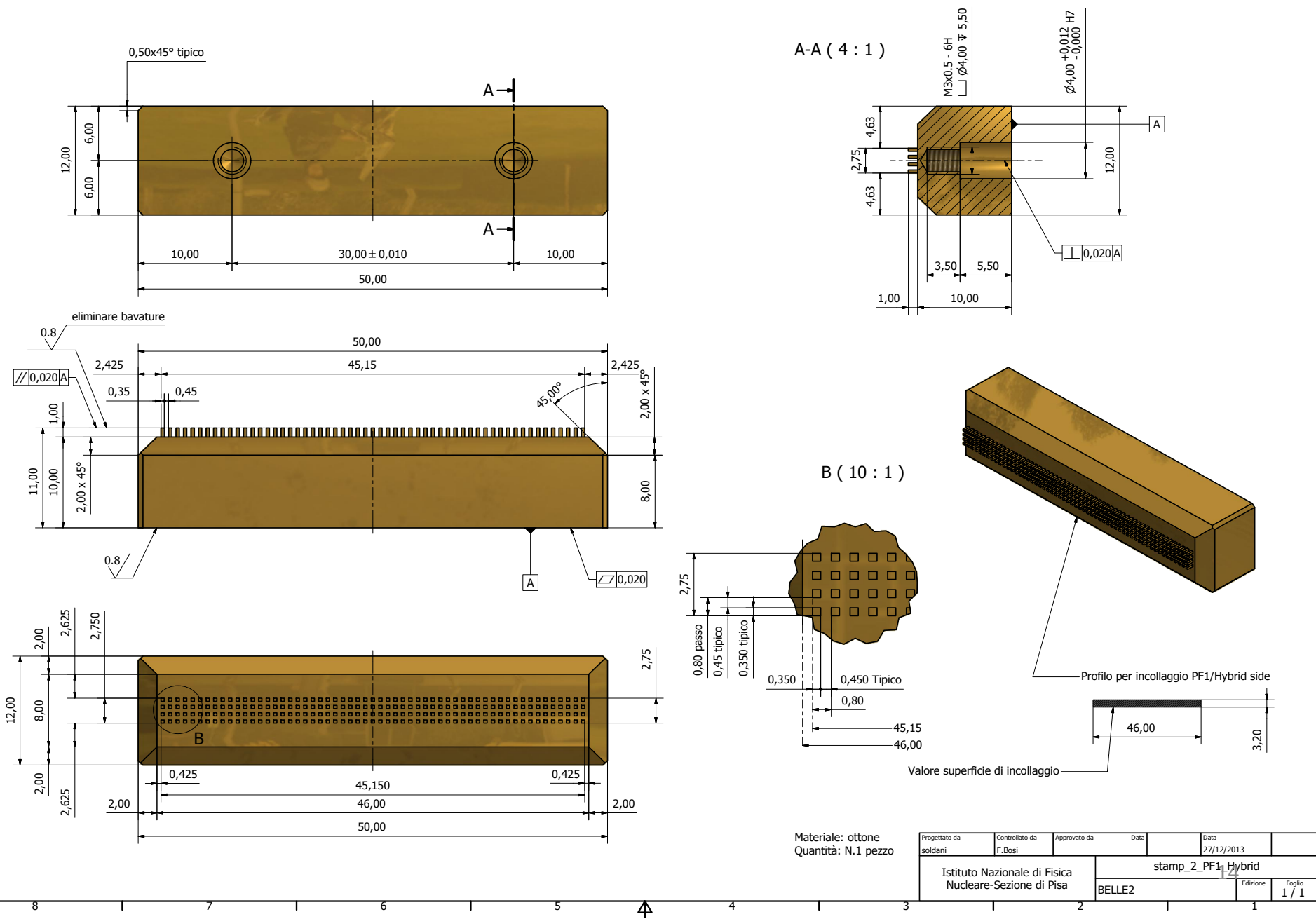
MP: chuck matching and upside-down



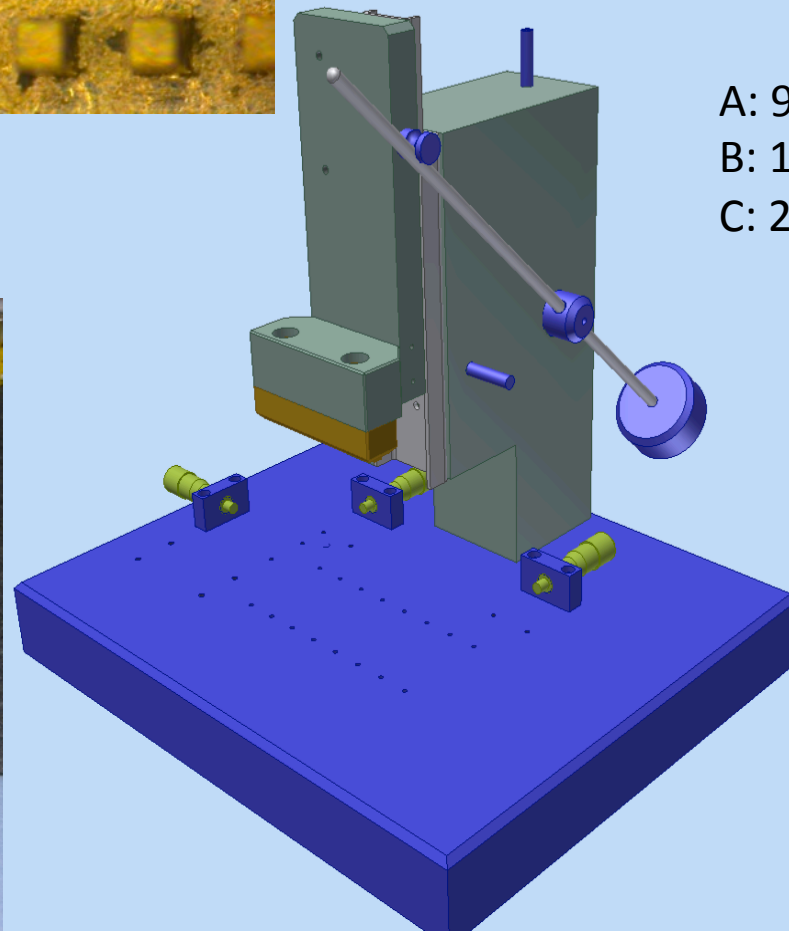
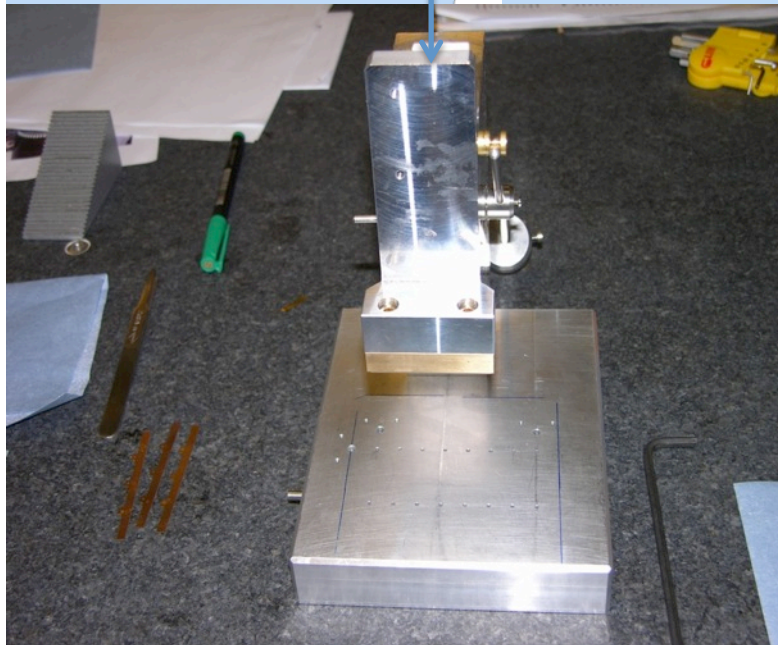
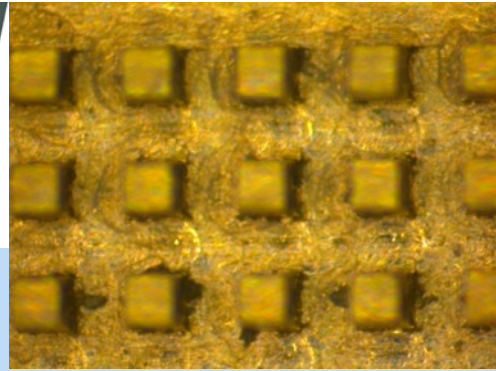
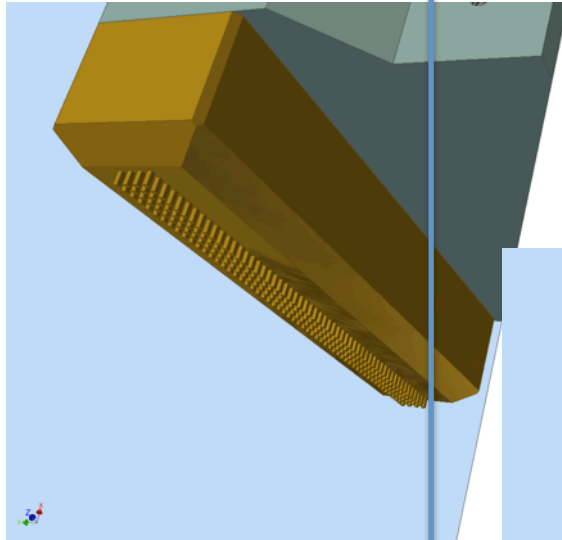
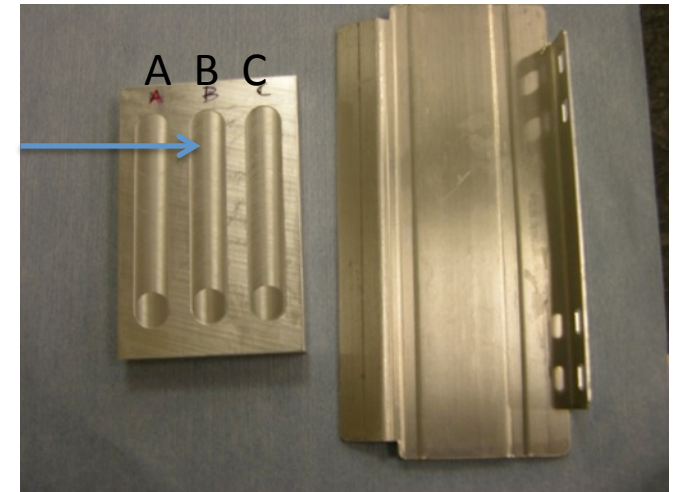
Glue-stamping tests

- Since November a lot of tests made. Key points:
 - Minimize the amount of glue (... and thickness);
 - Improve the reproducibility and the tunability of the glue spread w.r.t. stamped glue deposit.
- Real scale tests are deeply affected by using an inherited tool (chuck) to hold the PA originally not designed with the needed planarity
- The spread of the glue depends critically on the gap between PA and detector; typical distances 20→30 μm . The chuck holding the PA must be planar at the level of 10 μm over the entire length of the deposit.
- The gap between the PA and the det. must be set in the range ~20-30 μm with a precision of better than 10 μm .
- Only if the previous hypothesis are fulfilled, we can achieve a reliable gluing (i.e. with confidence on the glue-spread).

The stamping tools: PA to hybrids gluing



Printing jig and 3 gluing pots



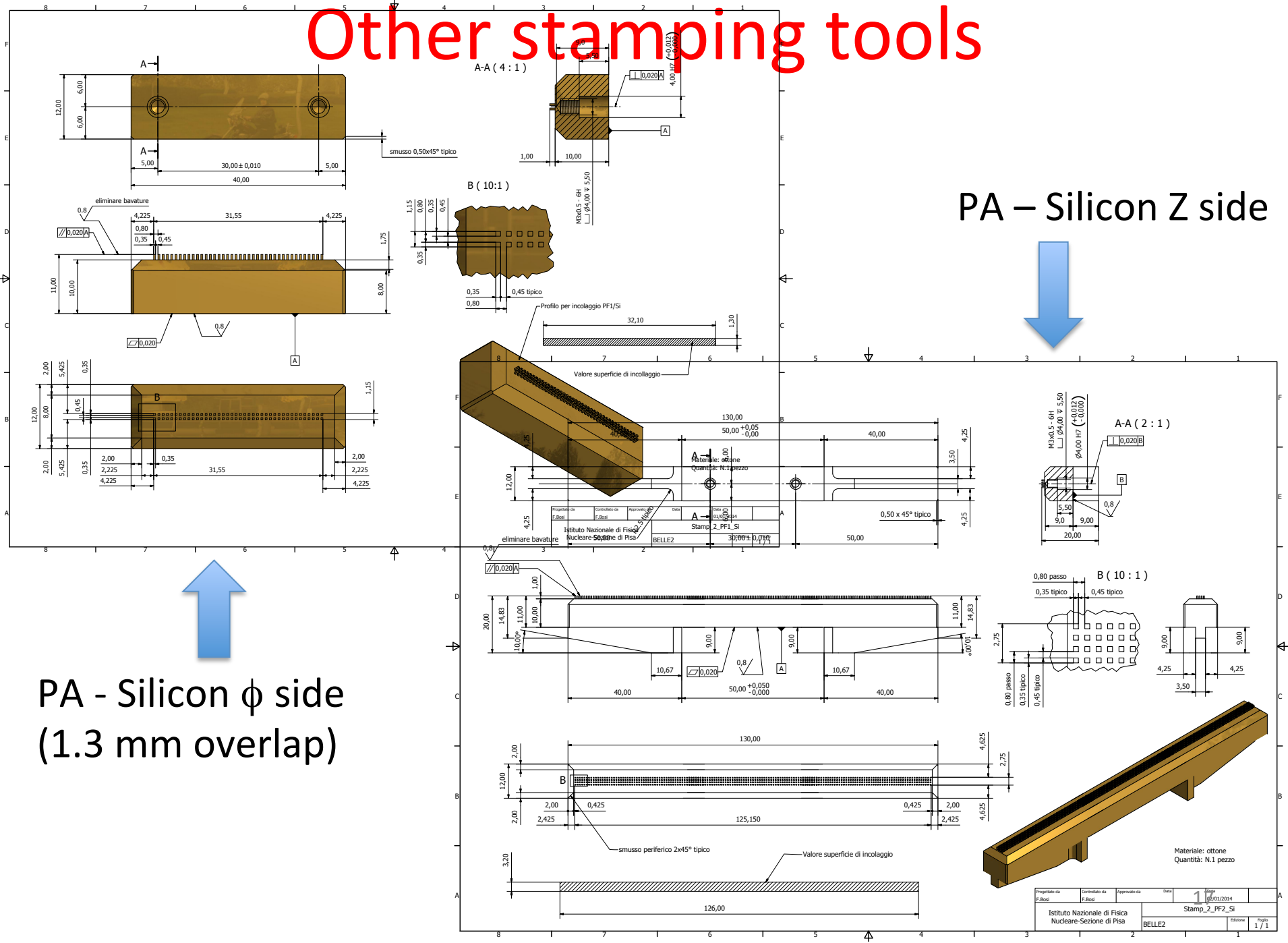
A: 90 um depth
B: 150 um
C: 200 um

Lesson we learnt: It is crucial to have a stamping tool designed to be easily cleaned otherwise ... random results are obtained!



Other stamping tools

PA – Silicon Z side

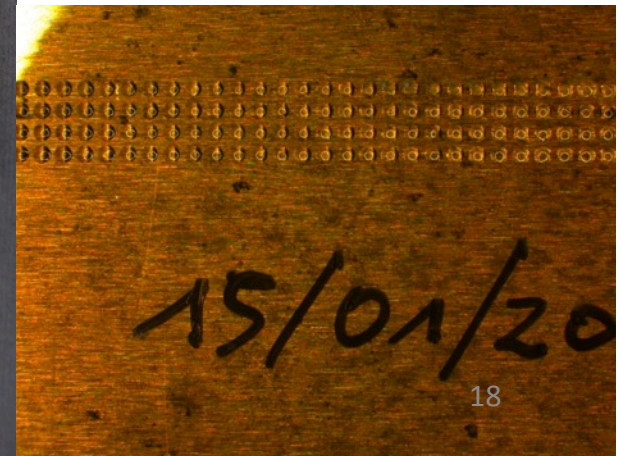
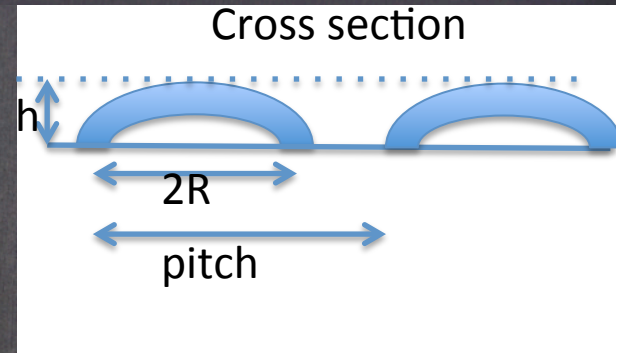
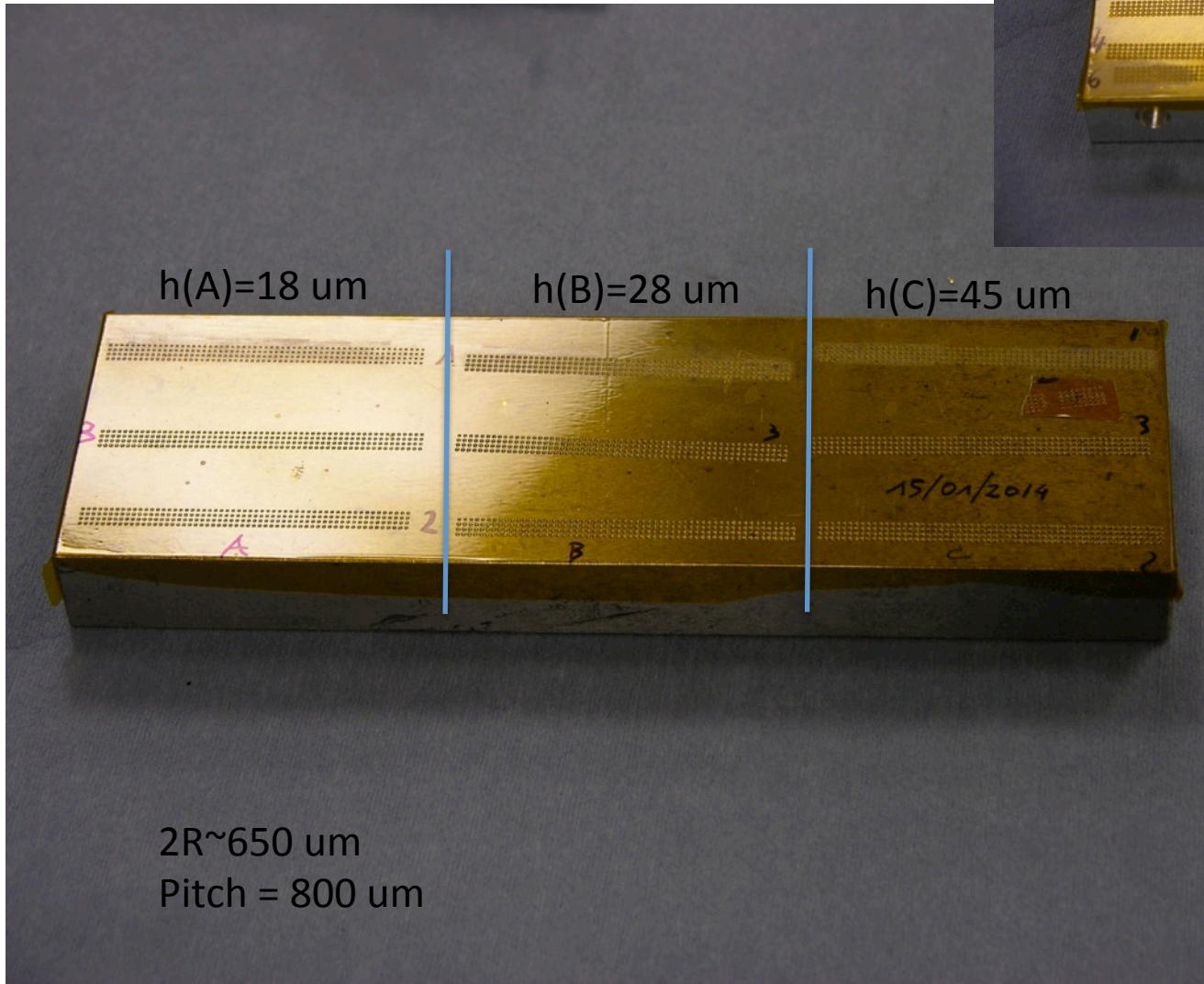
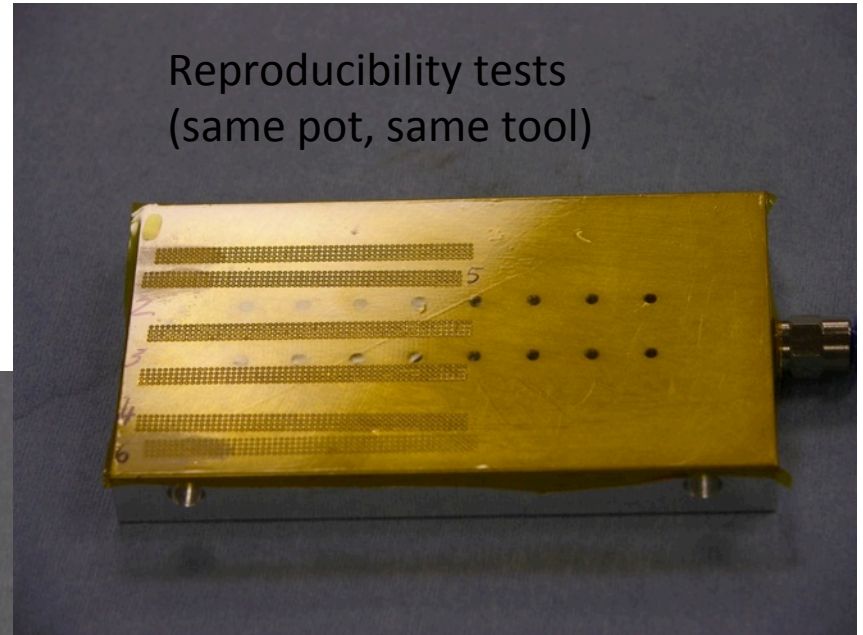


PA - Silicon φ side
(1.3 mm overlap)



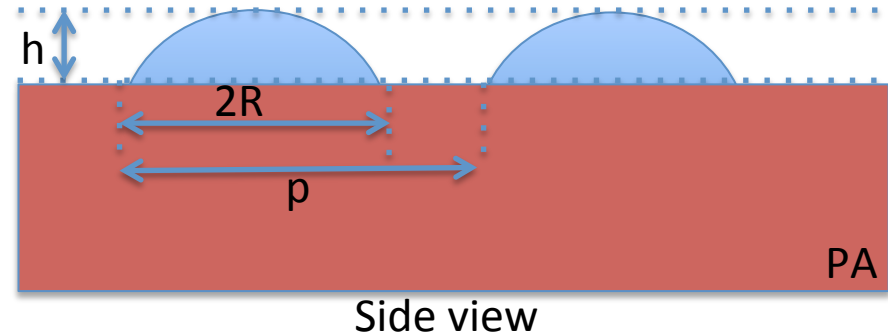
Stamping results (separated spherical caps)

Reproducibility tests
(same pot, same tool)



A naïve model

- The printed glue is a matrix
N x M of spherical cups
- $V_{sc} = \frac{1}{2} \pi h R^2$ ($h \ll R$)
- The pitch p is the pitch



of the tool, the quota h depends on the pot's depth

- Neglecting border effects ($N \ll M$) and conserving the glue-volume, the gap with the det's surface needed to completely fill the space is:

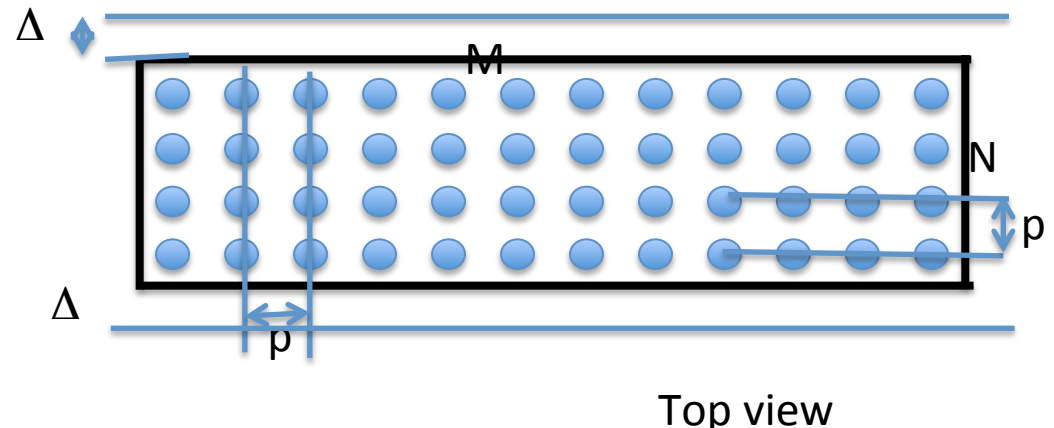
$$Z_f = V_{sc} / p^2$$

- pressing more, the glue "spreads" over the (N p) of the amount:

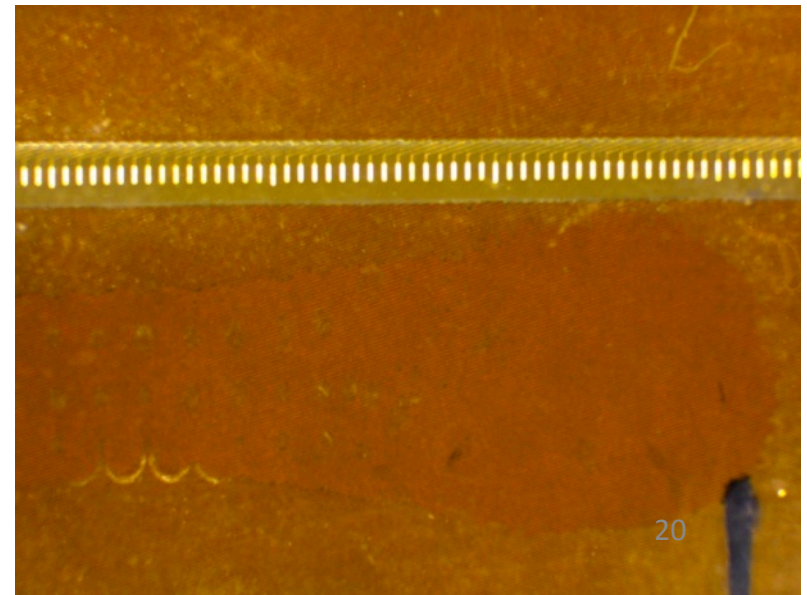
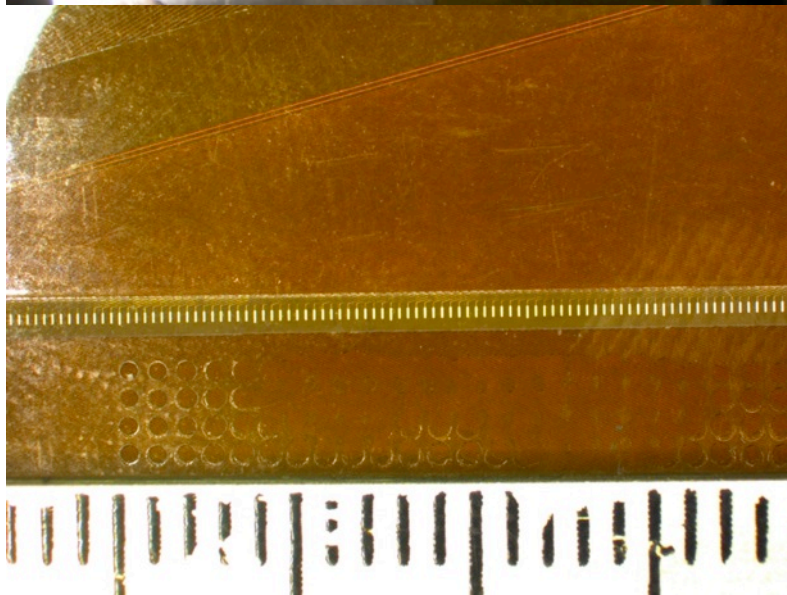
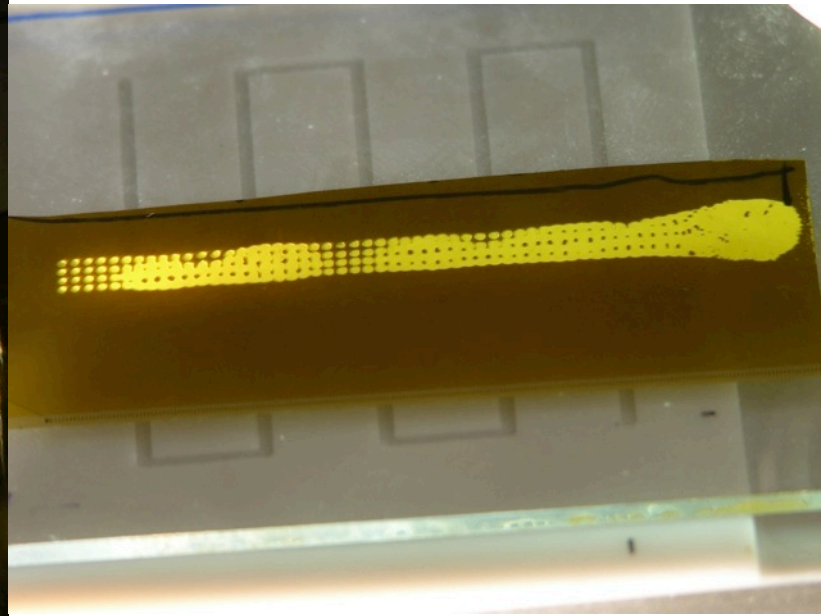
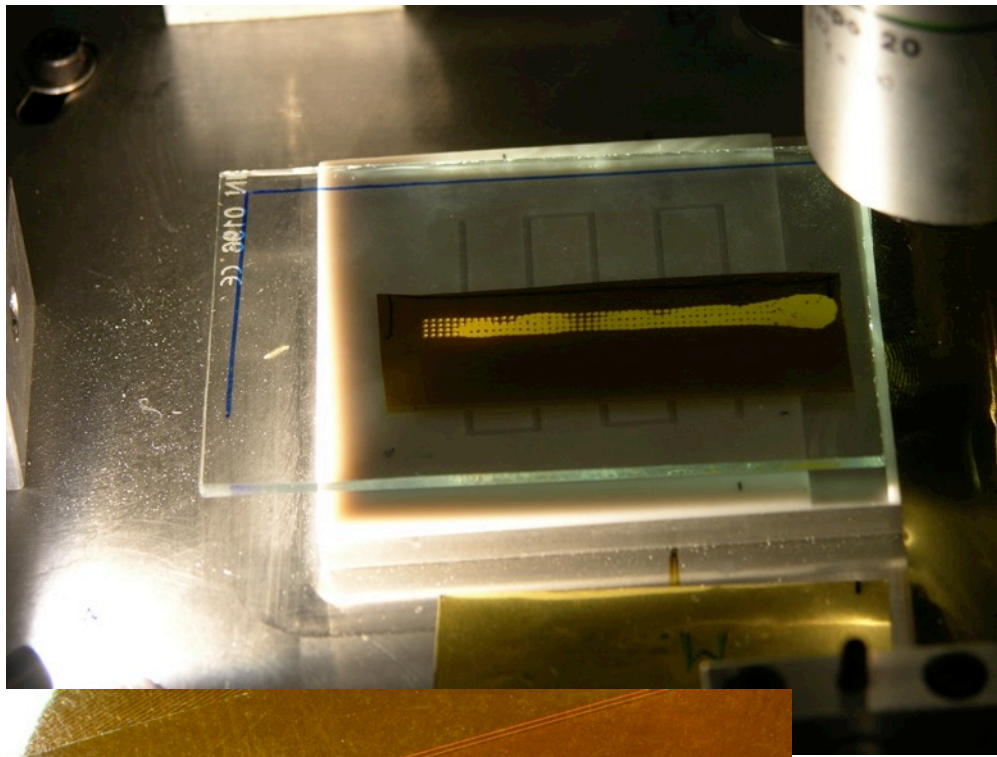
$$\Delta = NM(V - p^2 Z_f) / [2(N+M)p Z_f] \sim N(V - p^2 Z_f) / (2p Z_f)$$

- The control over the spread (critically!) depends on $(1/Z)^2$:

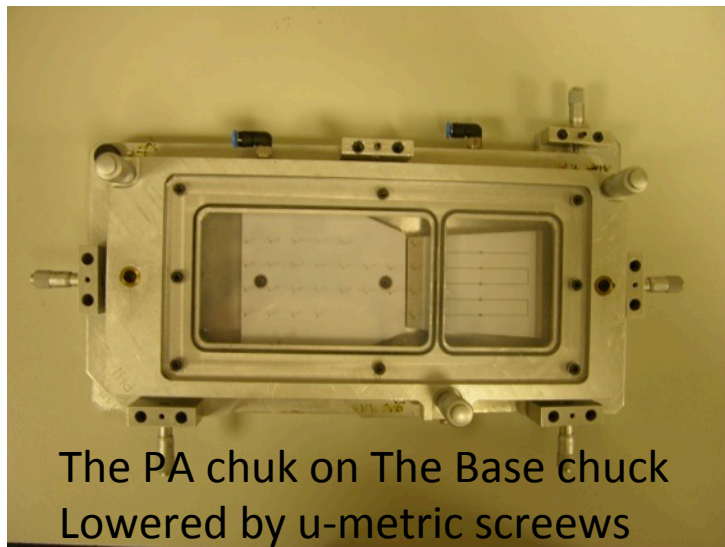
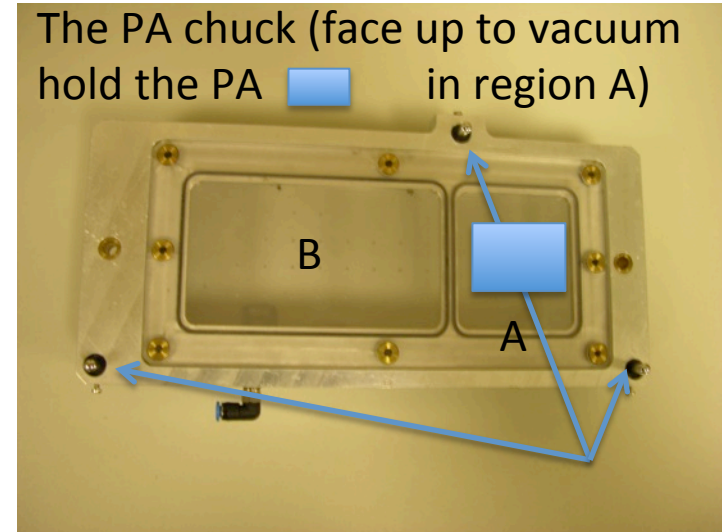
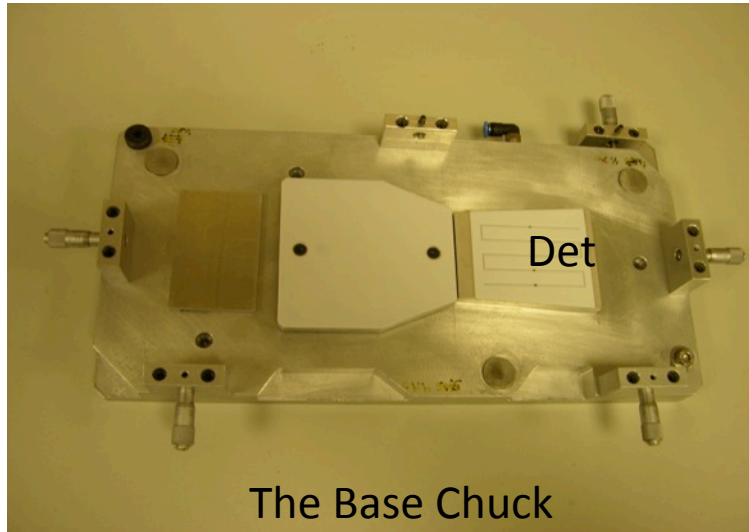
$$\sigma_{\Delta} = \left| \left(\frac{\partial \Delta}{\partial Z} \right)_{Z_f} \right| \sigma_{Z_f}$$



Gluing with a bad ($\sim 70 \mu\text{m}$) planarity chuck



OLD Detector and PA chucks



Two different vacuum lines for region A and B
Region A is submitted to mechanical survey:

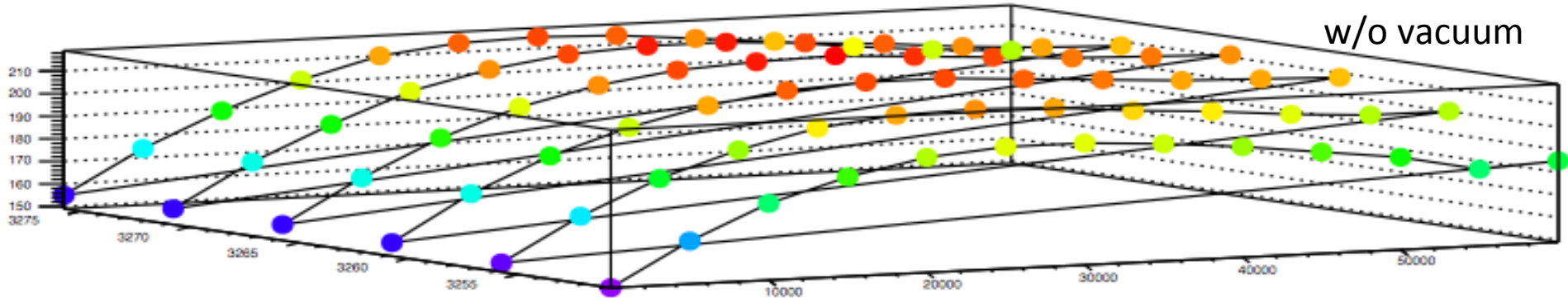
- w/o vacuum
- Vacuum on on A
- Vacuum on A and B

Vacuum modifies the profile of the plexi chuck!

PA chuck survey (same ref-frame)

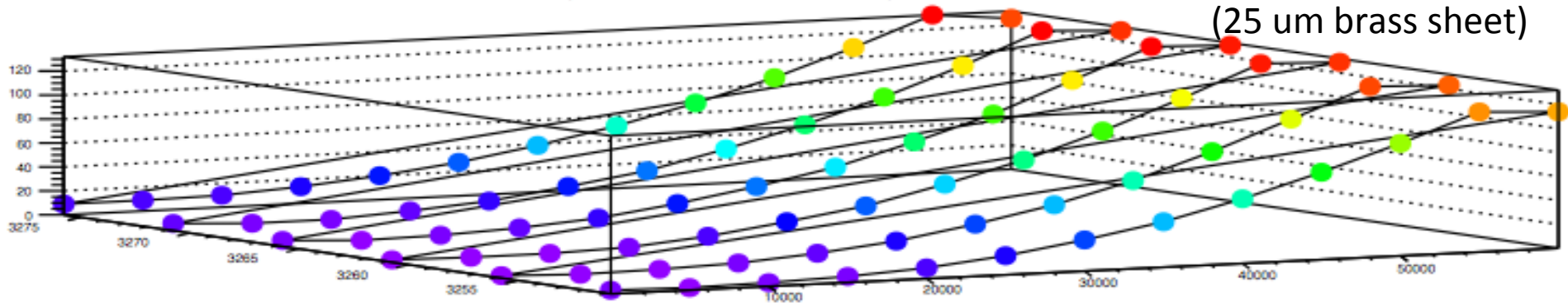
No vuoto su fo chuck absolute pos, zmean=199.192308 um

w/o vacuum



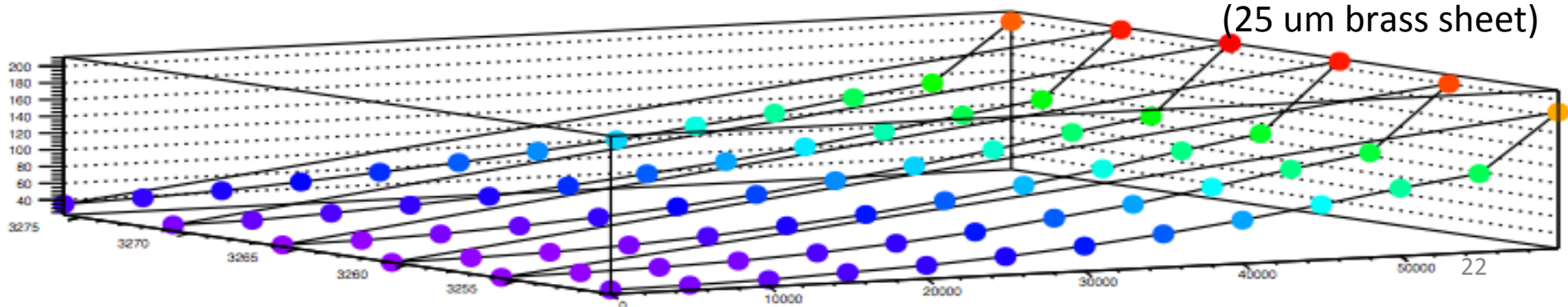
Vuoto su parte fo chuck +25 um absolute pos, zmean=47.679487 um

Vacuum on A
(25 um brass sheet)

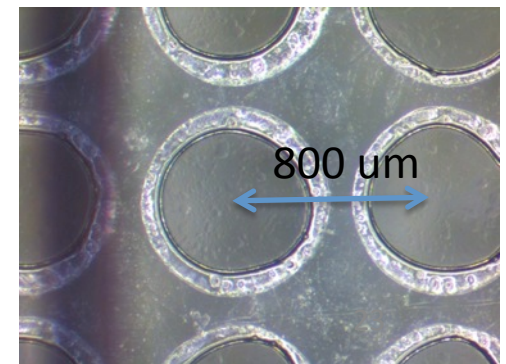
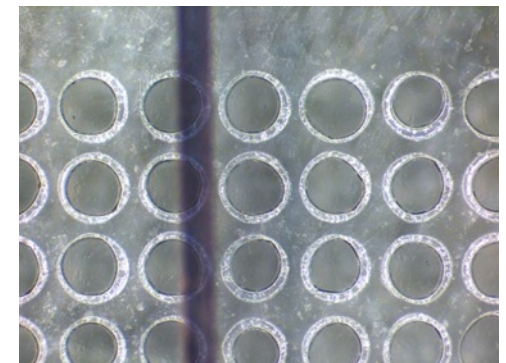
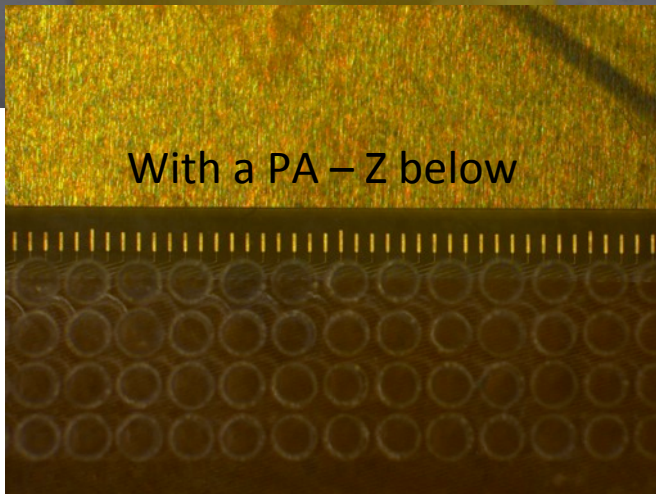
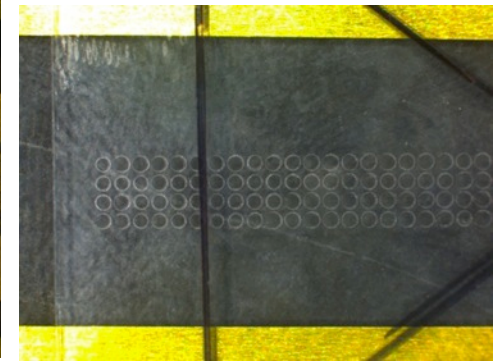
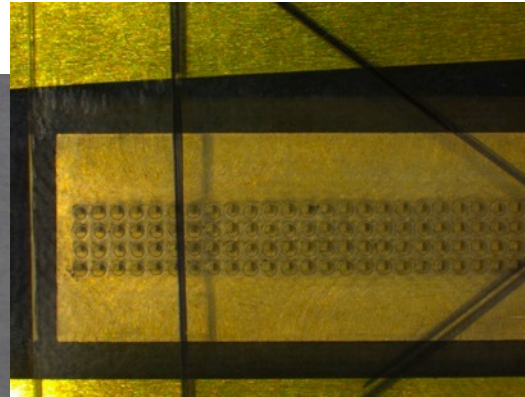
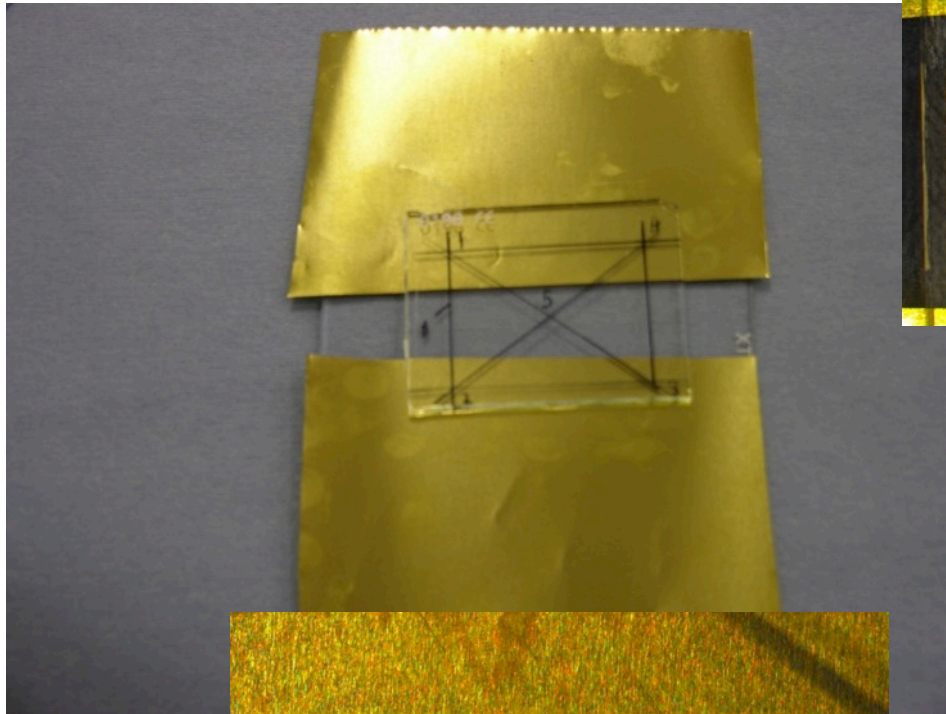


Vuoto su tutto fo chuck +25 um absolute pos, zmean=73.076923 um

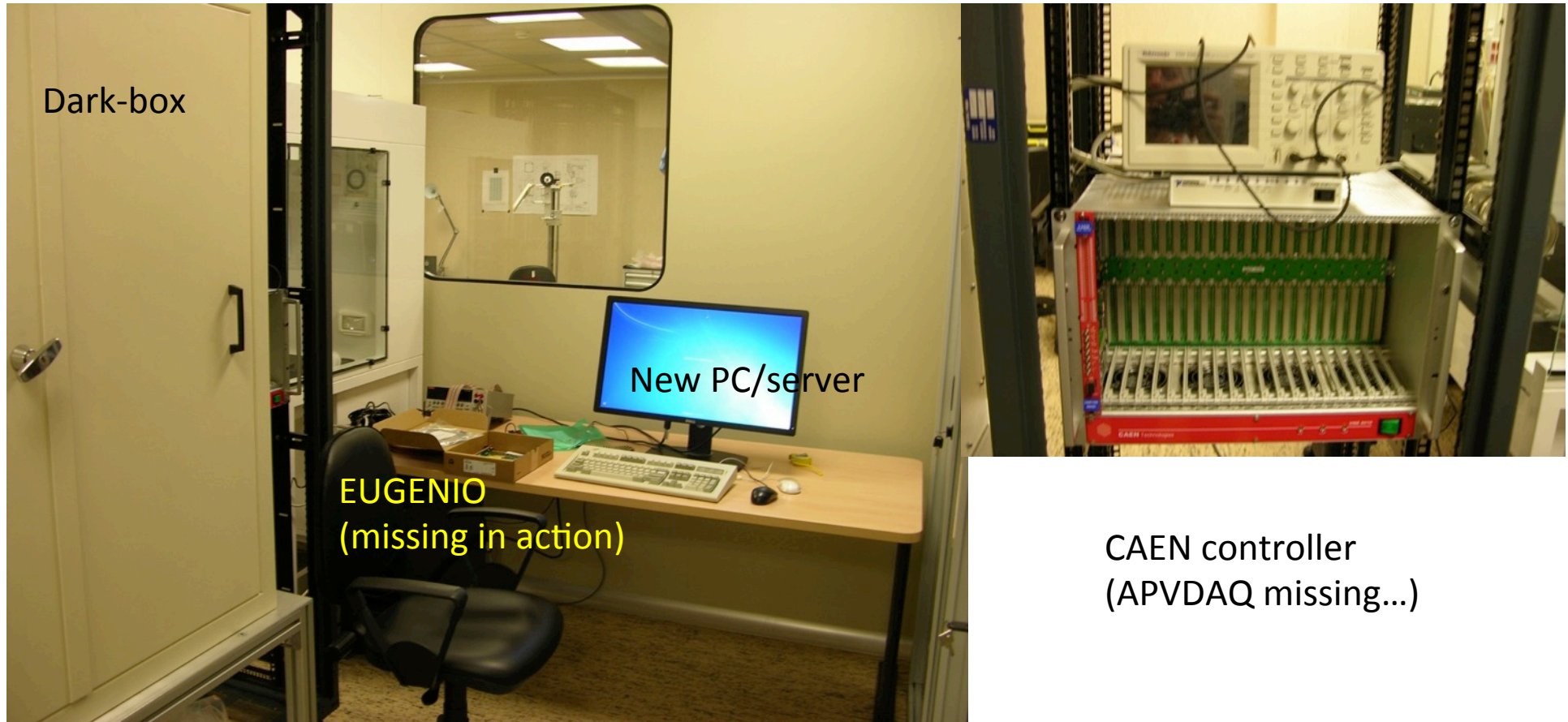
Vacuum on A and B
(25 um brass sheet)



Two pieces of glass with a calibrated distance in between (brass foil 25um thick)



Test-stand set-up



Hoping to fill the missing parts in mid February...

Work in progress on gluing chucks

- During these days (before the B2GM) the brainstorming and the artist's designs should be translated in the PA-Det-Hybrids gluing chuck CAD design.
- Many critical aspects arose in the past weeks just performing the gluing tests.
- Planarity, glue minimization, lower the PA with glue still on vacuum hold, possibility to calibrate z position and visual inspection during operations are the clear needs to match.
- To ensure the needed planarity and no chuck bowl under vacuum, the transparent/plexi-glass part of the chuck can be limited to the region of the glue (... and cross references).
- To set the detector and the hybrid on the same plane (for PA gluing) the quota of the detector chuck can be adjusted with a mechanism based on a screw and a wedge piece.

Conclusions

- The work in Pisa is covering many items, most on them are progressing.
- It's crucial to test the functionality of the modified xyz- θ stage @IPMU
- The stamping procedure didn't reach yet the optimization needed for the "production" phase. We want to work on that more, since we think it is promising (and we know it is still possible to revert to glue dispensing by robot).
- The problem of the glue-spread (in case of not perfectly planar PA) is unfortunately common to both techniques: stamping and dispensing.
- While following the production of the MP chucks, it is in highest priority the design and the realization of the prototypes of the gluing chucks.
- Some design progress expected before B2GM: the right moment to officially decide about the "P" option and to update the schedule.