

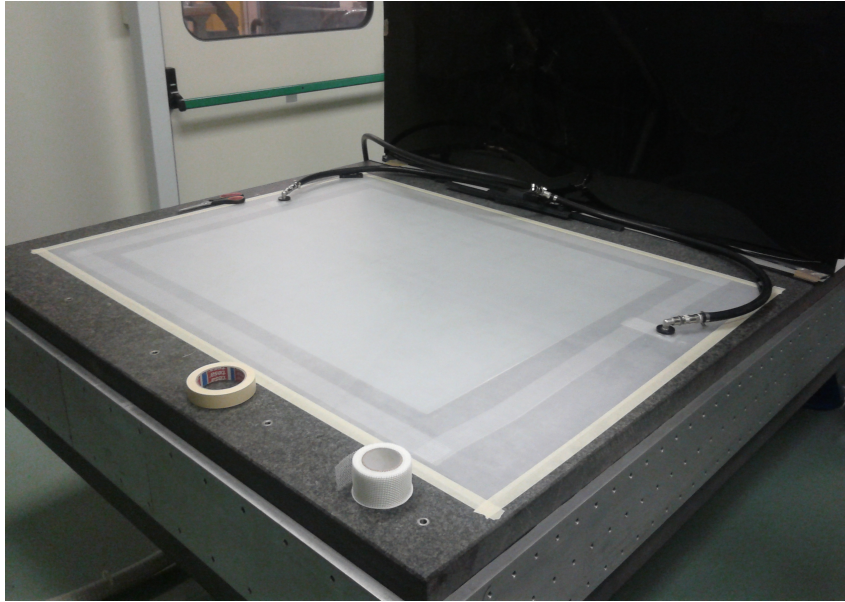
Mechanical Tests in Roma1 Status Report

MM Workshop
18-19 april 2013
Saclay

Outline

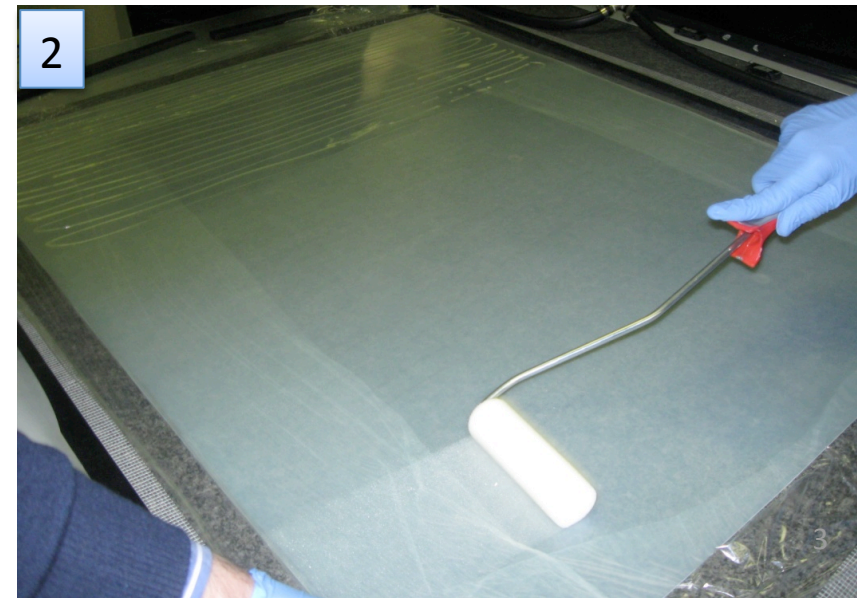
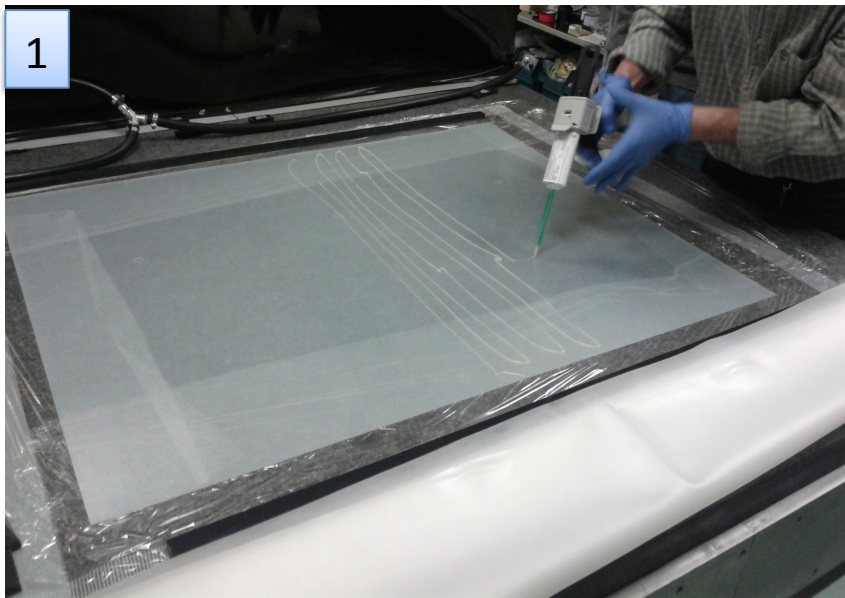
- We are testing a MM assembly scheme based on the vacuum bag technique:
 - we have started to build single test panels;
 - we plan to participate to the summer mechanical test.
- Outline
 - (1) Method of panel assembly;
 - (2) Results of the planarity and thickness measurements;
 - (3) Ideas concerning panel and quadruplet assembly and alignment.

(1) – Method of panel assembly



Marble table in a clean room.

1. The ***first PCB foil*** is put on the table;
2. The ***glue*** is rolled on the foil
→ uniform glue layer (≈0.1 mm thick)



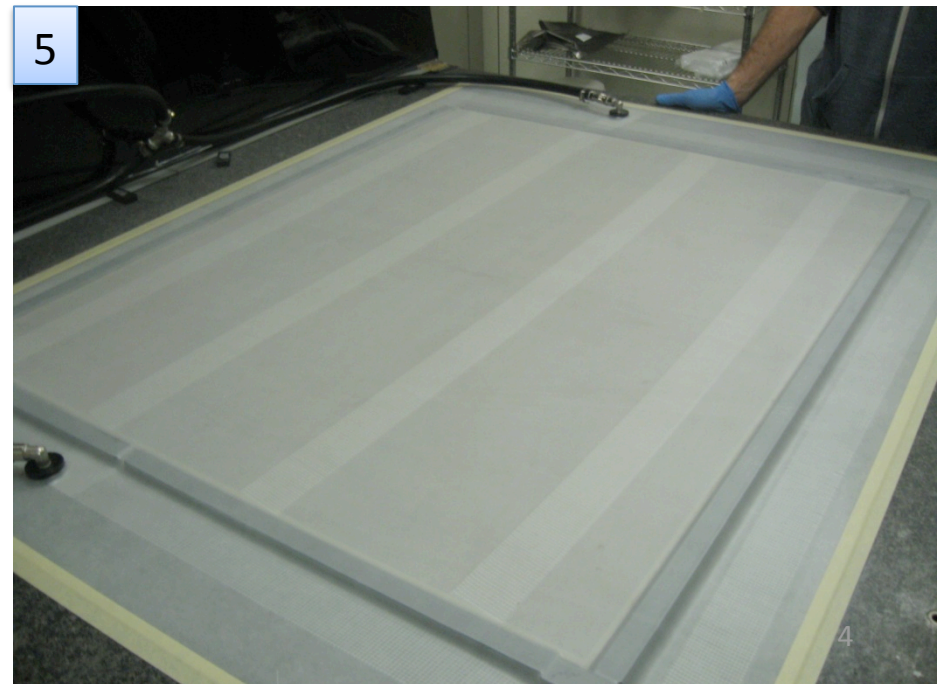
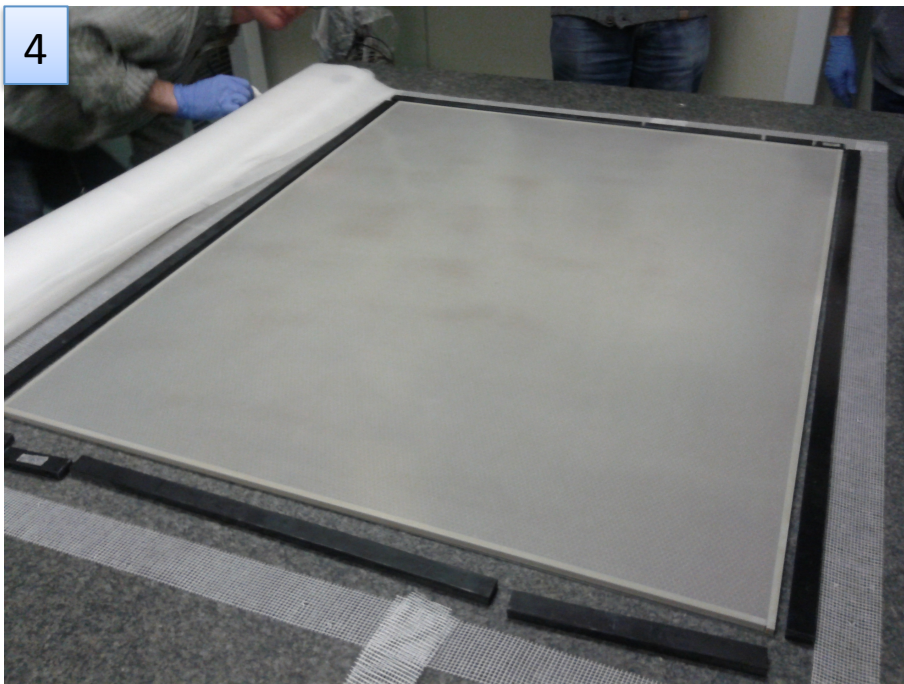


3. The **frame** and the **honeycomb** are put on the PCB foil.

4. The **second PCB foil** (with glue) is put on the structure.

5. The **vacuum bag** is started and held for ≈ 24 hrs.

N.B. *bottom side* and *top side* correspond to first and second PCB foils



Materials and operating conditions:

PCB foils: PCB 0.8 mm thick
G10 or FR4 0.5 mm thick

honeycomb: NOMEX (3.2 mm cells, 7.5 mm thick)
Al-honeycomb (6 mm cells, 9.2 mm thick)

frame and spacers: peek

glue: Araldite 2011, layer thickness \approx 0.1 mm

vacuum bag pressure: btw 50 and 800 mbar

	Dimensions (cm ²)	Honeycomb	Spacers	Pressure (mb)	Plates
Test-1	40x20	nomex	yes	800	PCB 0.8
Test-2	40x20	nomex	yes	50	PCB 0.8 G10 0.5
Test-3	40x20	nomex	no	50	G10 0.5
Test-4	40x20	Al-honeycomb	no	50	G10 0.5
Test-5	40x20	Al-honeycomb	no	600	G10 0.5
Test-6	80x100	nomex	no	300	FR4 0.5

(2) – Planarity Measurements

Two instruments are used (panel on the marble table):

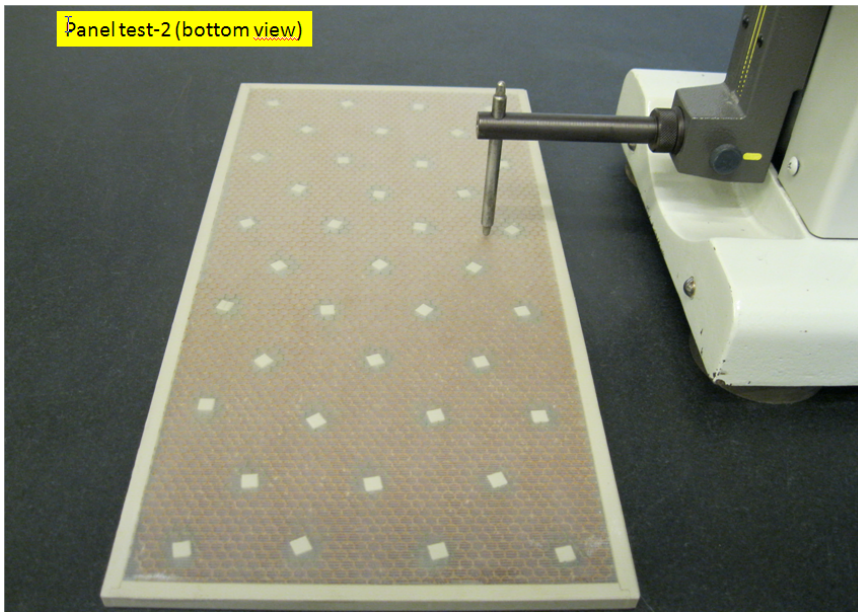
Mitutoyo (10 cm arm)

Poli Galaxy (50 × 50 cm)

Scans on both sides (steps of 1 ÷ 3 cm)

-- Distributions of *residuals* with respect to the *fitted best plane* are evaluated;

-- Estimate of the *absolute thickness*

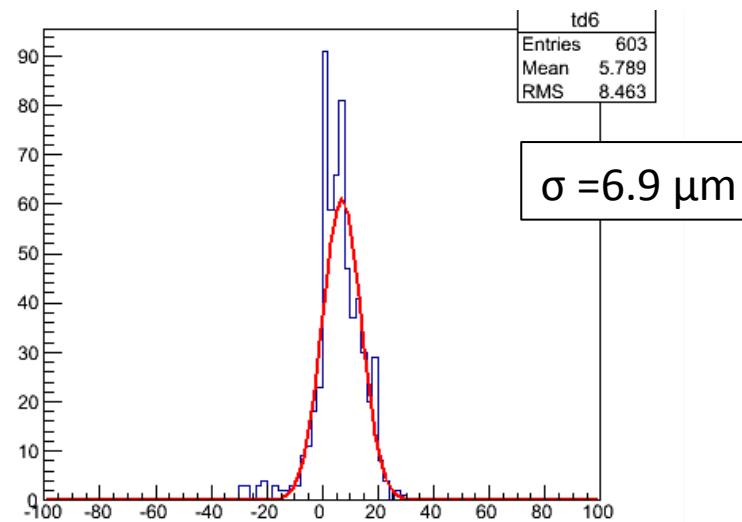


1 Proposta commerciale braccio 7 assi

Campo di misura	Ripetibilità nel punto	Precisione di lunghezza	Precisione con sistema di scansione SI	Peso
RA 75 20 - 2000 mm diametro sferico	± 0.023 mm	± 0.033 mm	± 0.058 mm	8,6 Kg

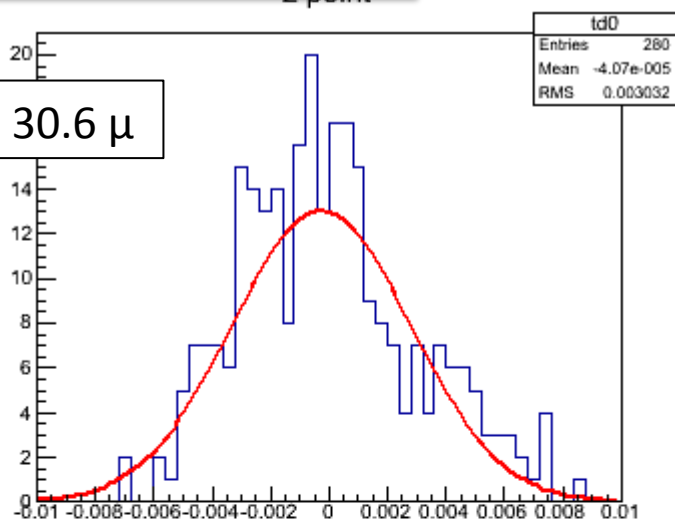


We have tested it by measuring a Johnson precision block and we got a $s = 7 \mu\text{m}$.
 We plan to use this instrument to measure our next panels



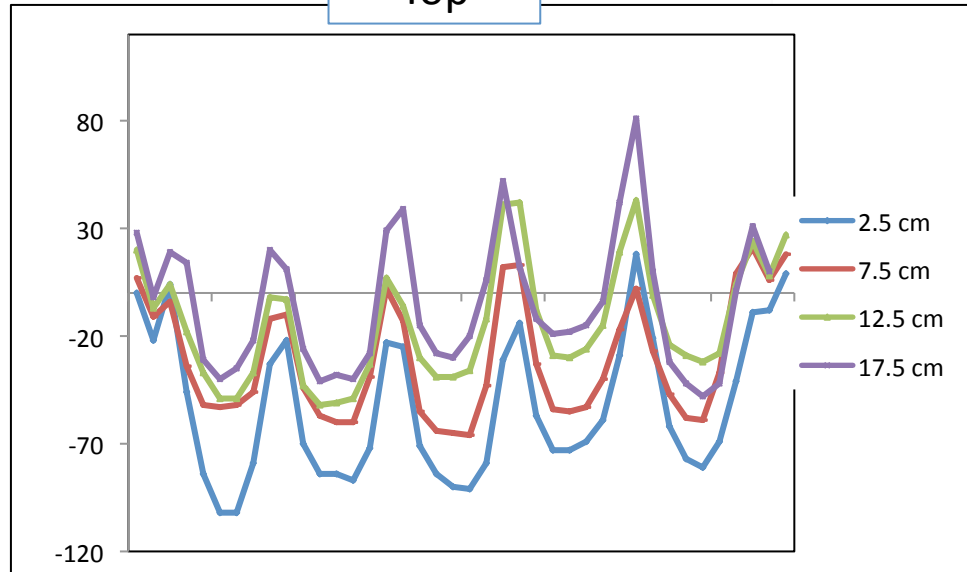
Example of measurement:
Test-1

$\sigma = 30.6 \mu$



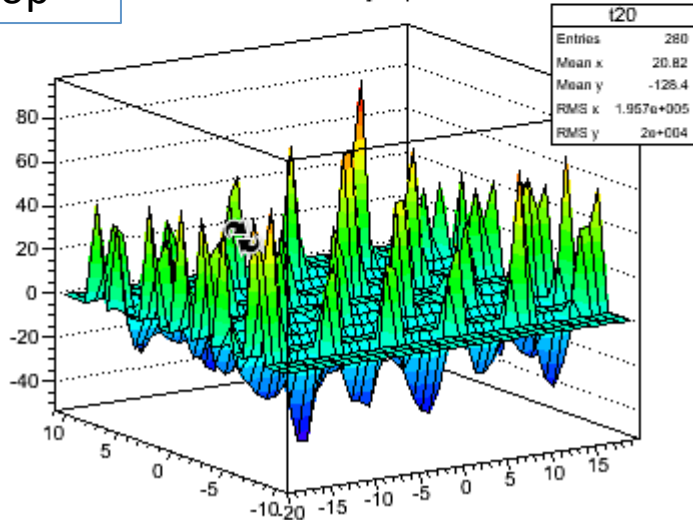
Test1-top-Mitutoyo

Top

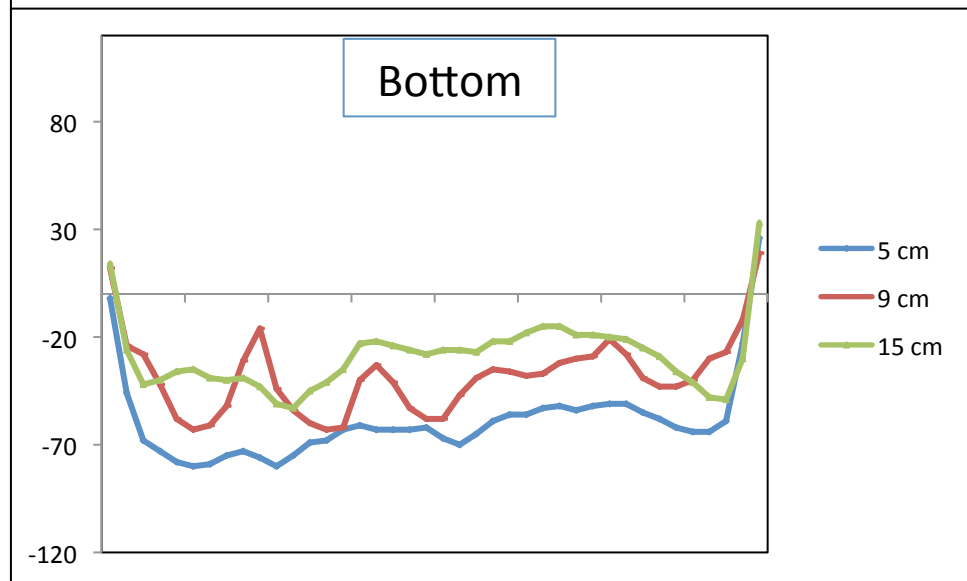


Top

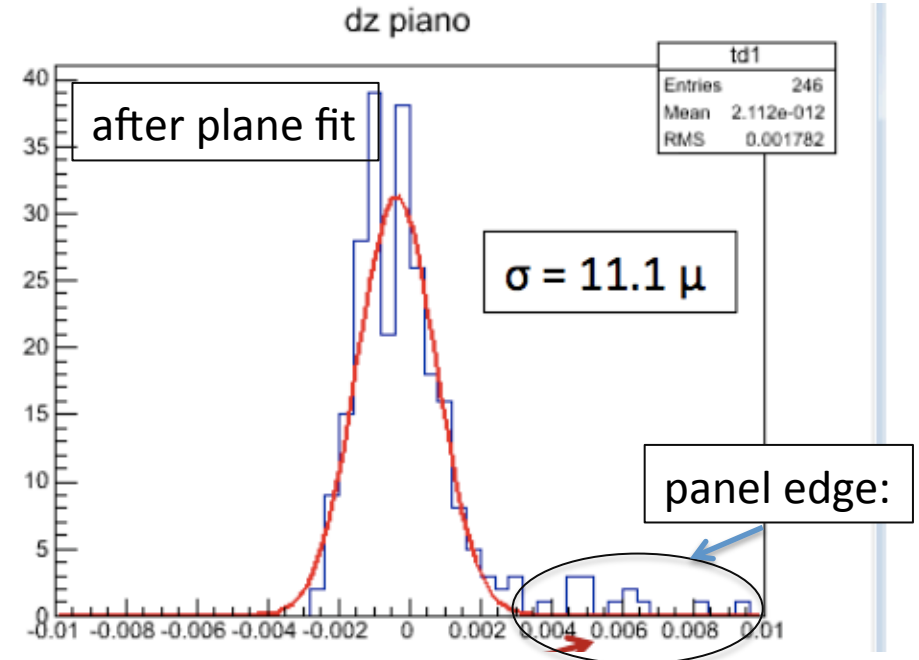
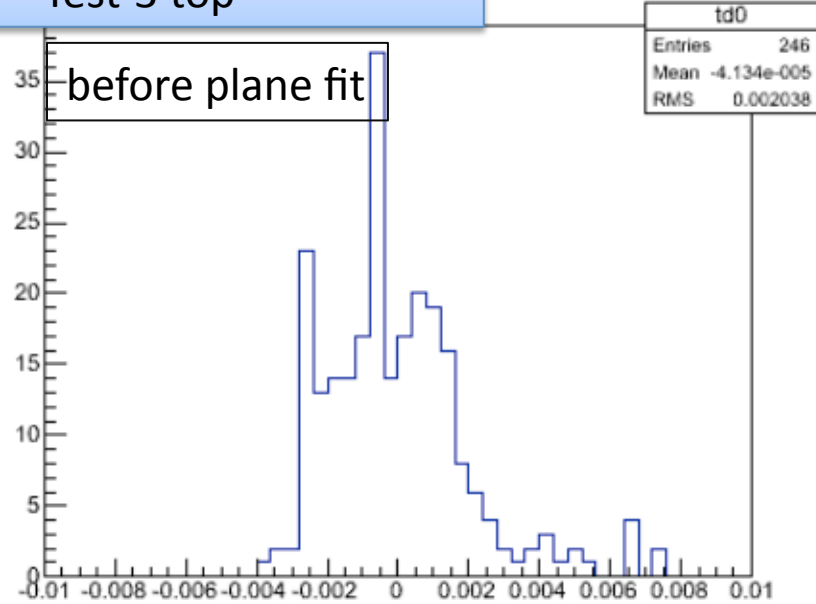
dz vs x y-up



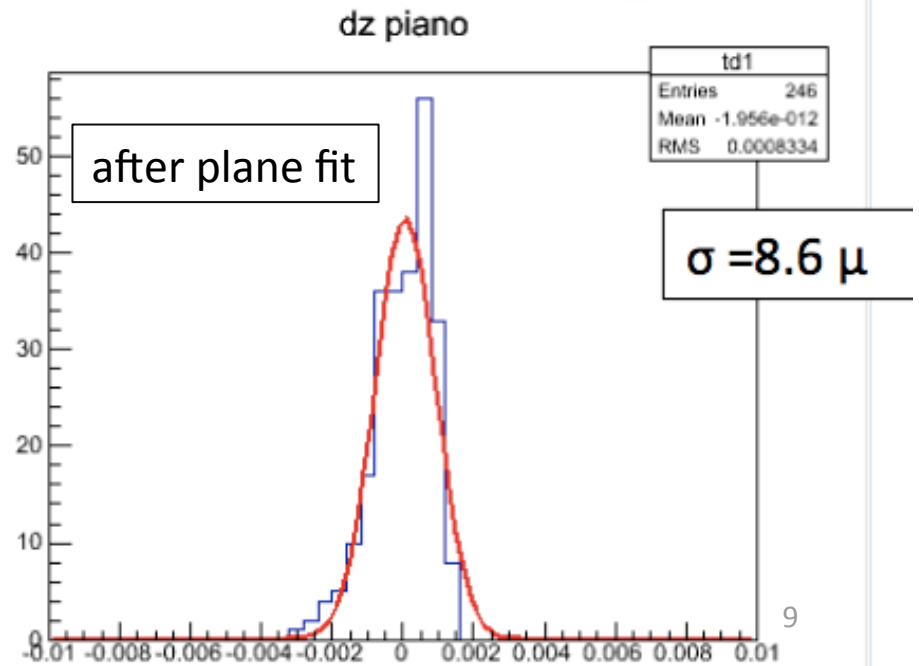
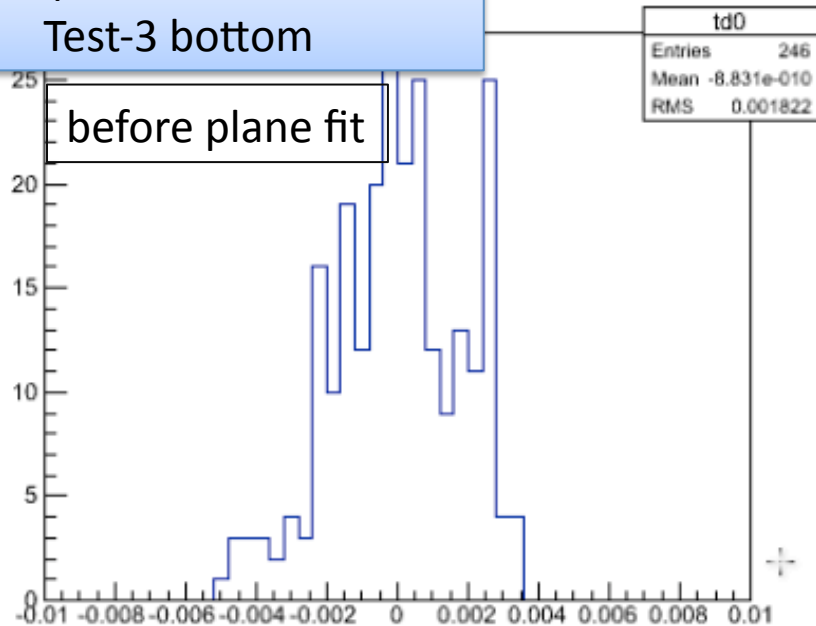
Bottom



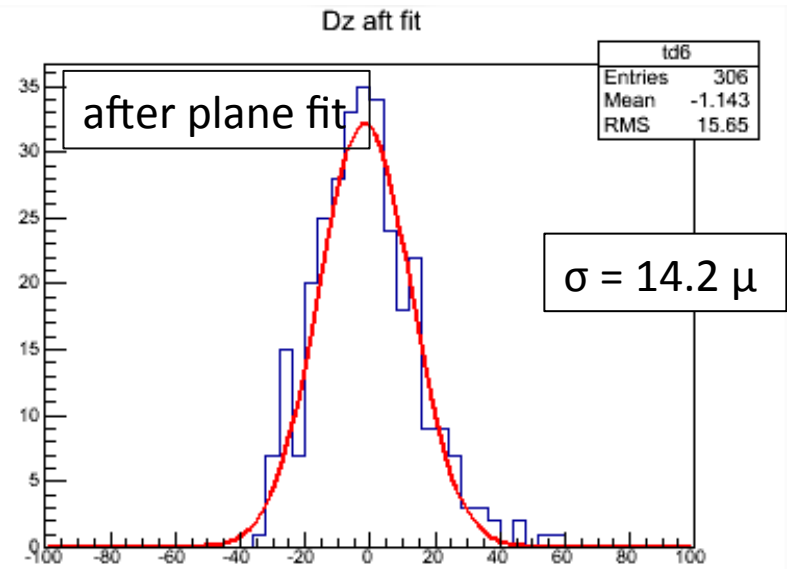
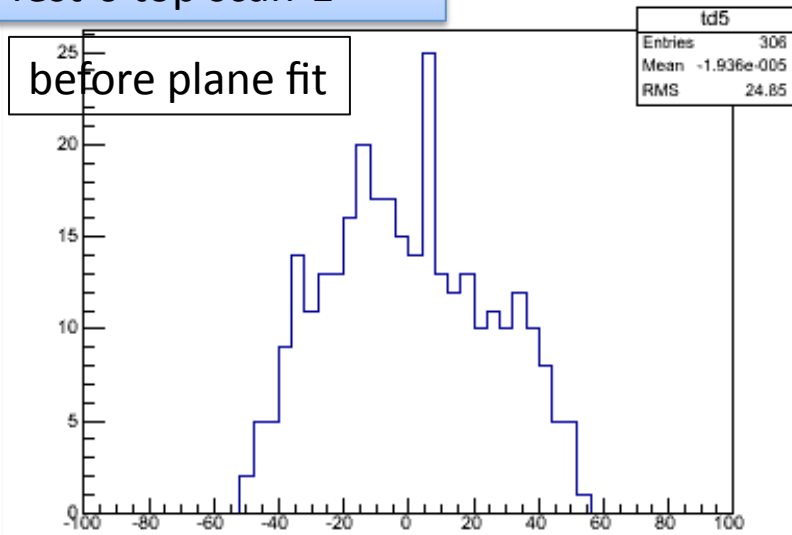
Example of measurement:
Test-3 top



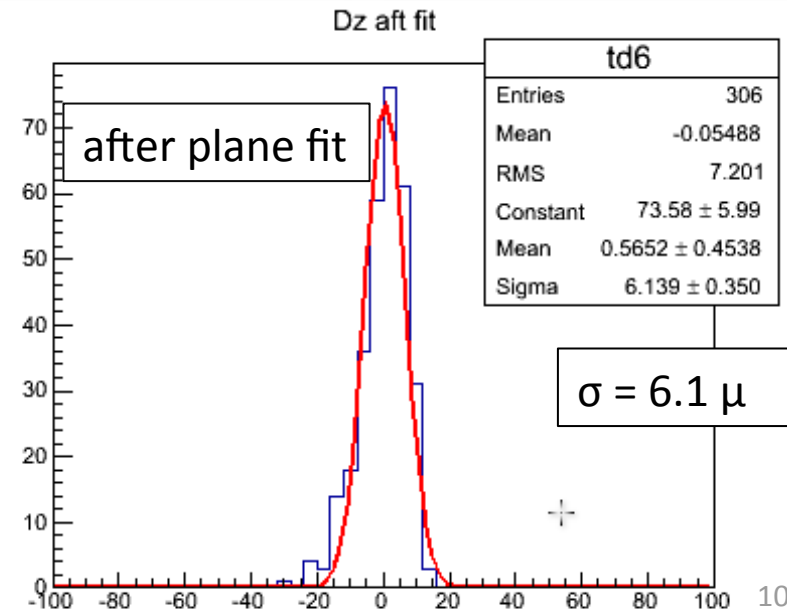
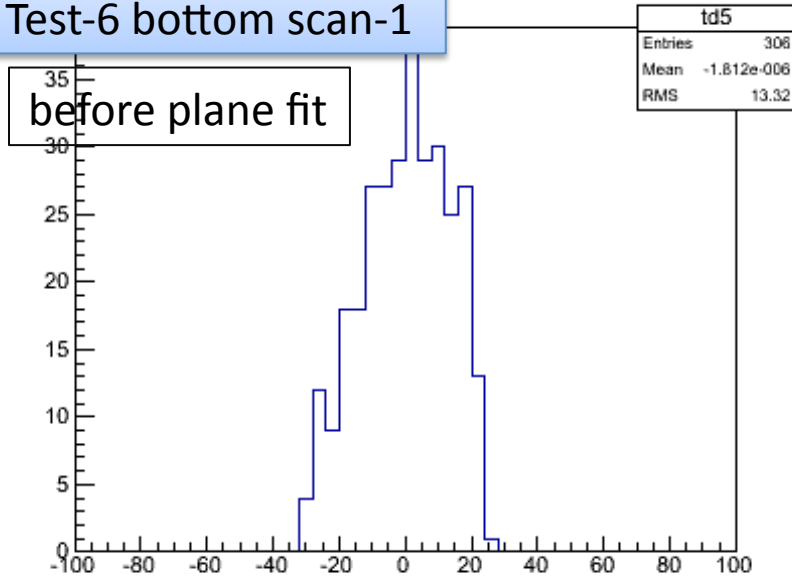
Example of measurement:
Test-3 bottom



Example of measurement:
Test-6 top scan-1



Example of measurement:
Test-6 bottom scan-1



Planarity measurements: summary table

	Dimensions (cm ²)	Honeycomb	Spacers	Pressure (mb)	Plates	σ_{top} (μm)	σ_{bottom} (μm)
Test-1	40x20	Nomex	yes	800	PCB 0.8	30.6	
Test-2	40x20	Nomex	yes	50	PCB 0.8 G10 0.5	14.7	11.4
Test-3	40x20	Nomex	no	50	G10 0.5	11.1	8.6
Test-4	40x20	Al- honeycomb	no	50	G10 0.5	18.2	8.4
Test-5	40x20	Al- honeycomb	no	600	G10 0.5	17.4	8.4
Test-6	80x100	Nomex	no	300	FR4 0.5	14.2 (10.9)	6.1 (11.2)

- Bottom plane planarity at 10 μm level for all tests;
- Top plane planarity below 20 μm for all tests (apart test-1)
- Spacers on the panel do not help planarity;
- Nomex honeycomb slightly better than Al honeycomb.

Absolute average thickness measurements:
 panel thickness is measured wrt to marble table 0
 expected thickness = honeycomb + 2 × PCB

	Honeycomb	Pressure (mb)	Measured thickness (mm)	Expected thickness (mm)	Measured – Expected (mm)
Test-3	Nomex	50	8.583	8.55	0.03
Test-6	Nomex	300	8.440	8.55	-0.11
Test-4	Al-honeycomb	50	10.384	10.20	0.18
Test-5	Al-honeycomb	600	10.308	10.20	0.11

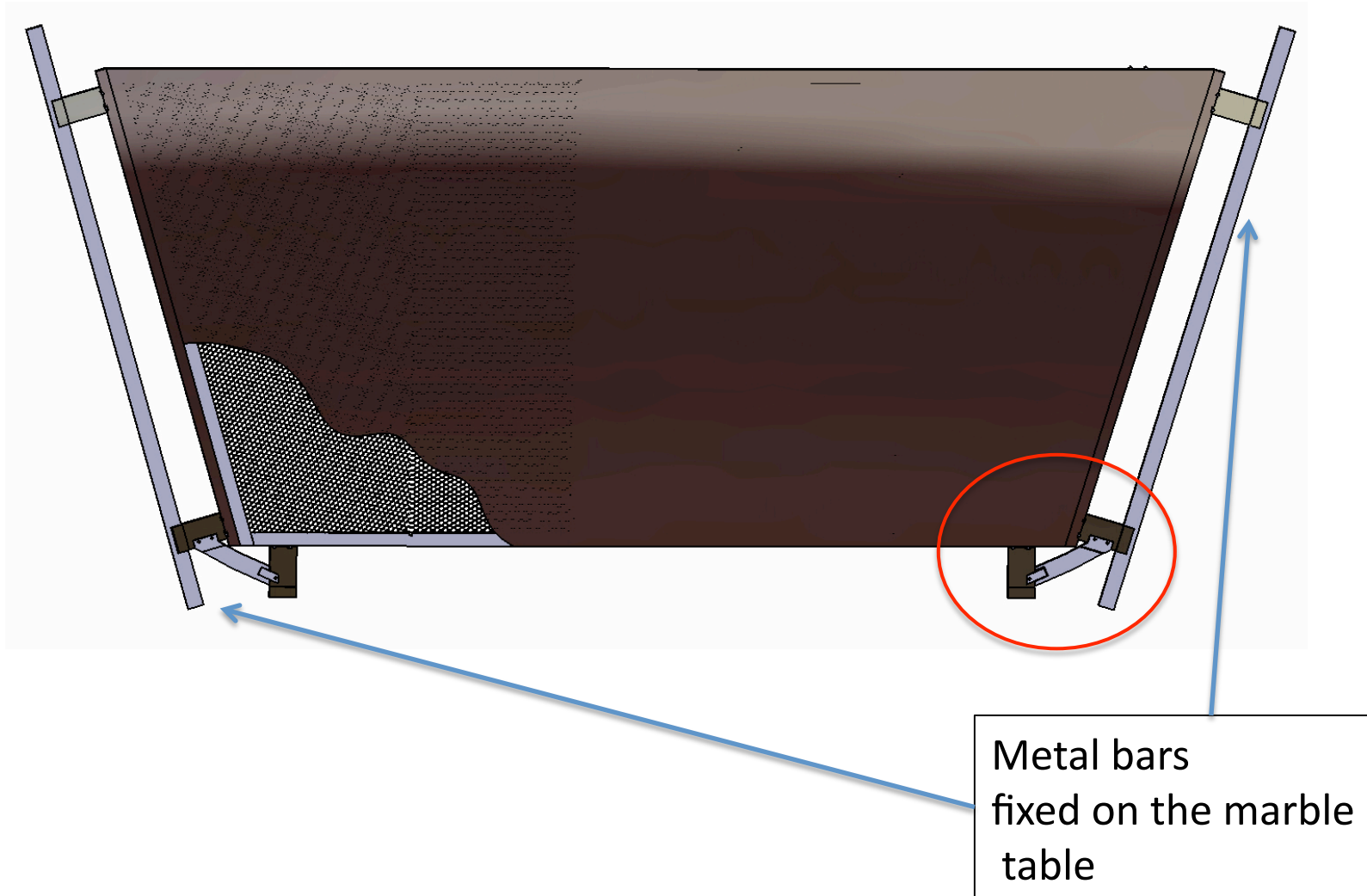
Clear effect of the pressure that reduces the panel thickness
 In case of nomex the effect is huge but doesn't affect the planarity properties.

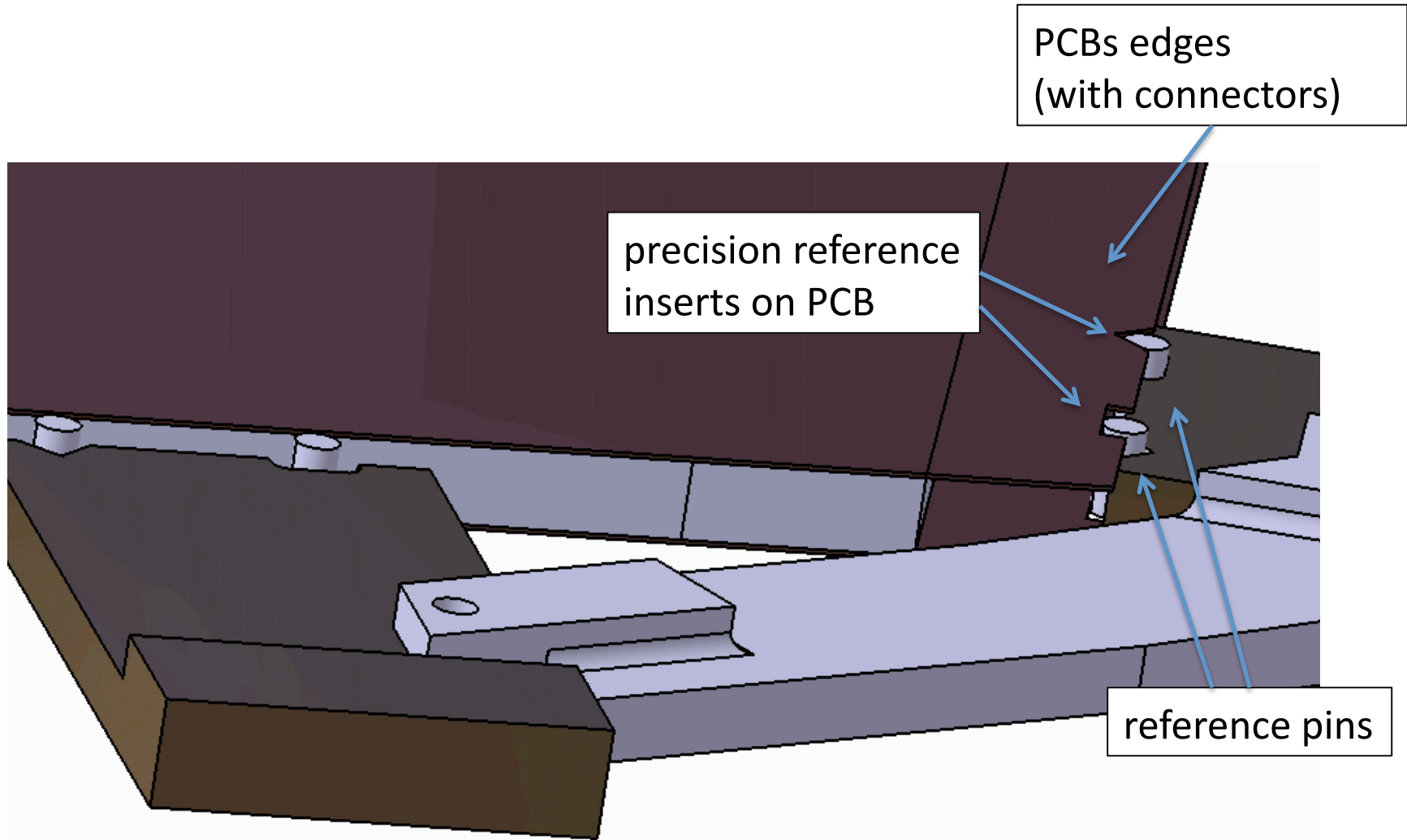
Next: **“calibration” of thickness vs. pressure to define the working point.**

(3) – Ideas concerning panel and quadruplet assembly and alignment

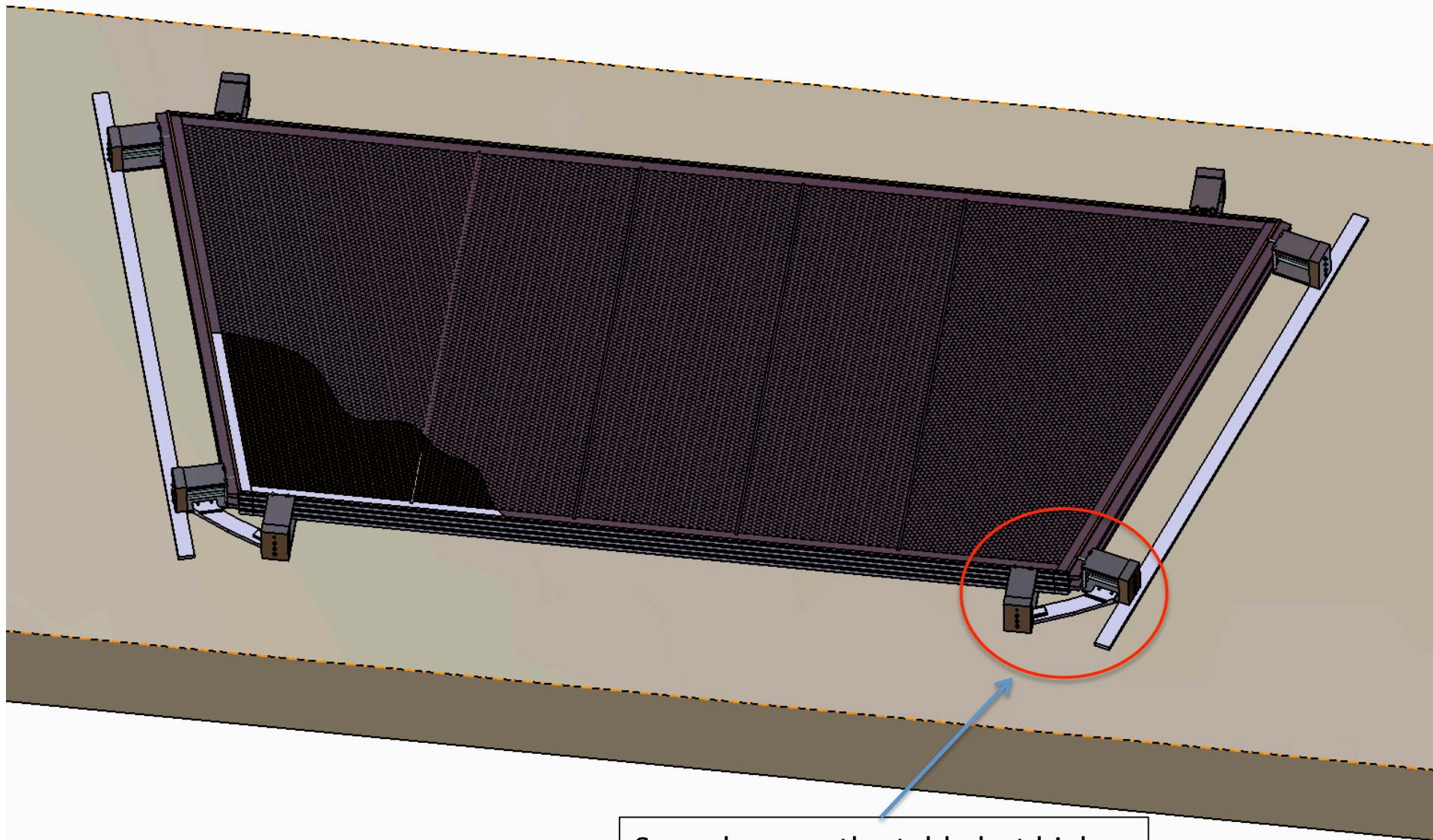
- Work in progress to define an assembly scheme (A.Zullo)
- Approach (preliminary, some aspects still are to be defined):
 - 1 single panel / day: panels 2 and 4 require a careful PCB alignment system, based on a “setpin system” (see next slides)
 - Quadruplet assembly in 1 or 2 days with a panel alignment system also based on a “setpin system”.

Assembly and alignment scheme for the gluing of panels 2 and 4

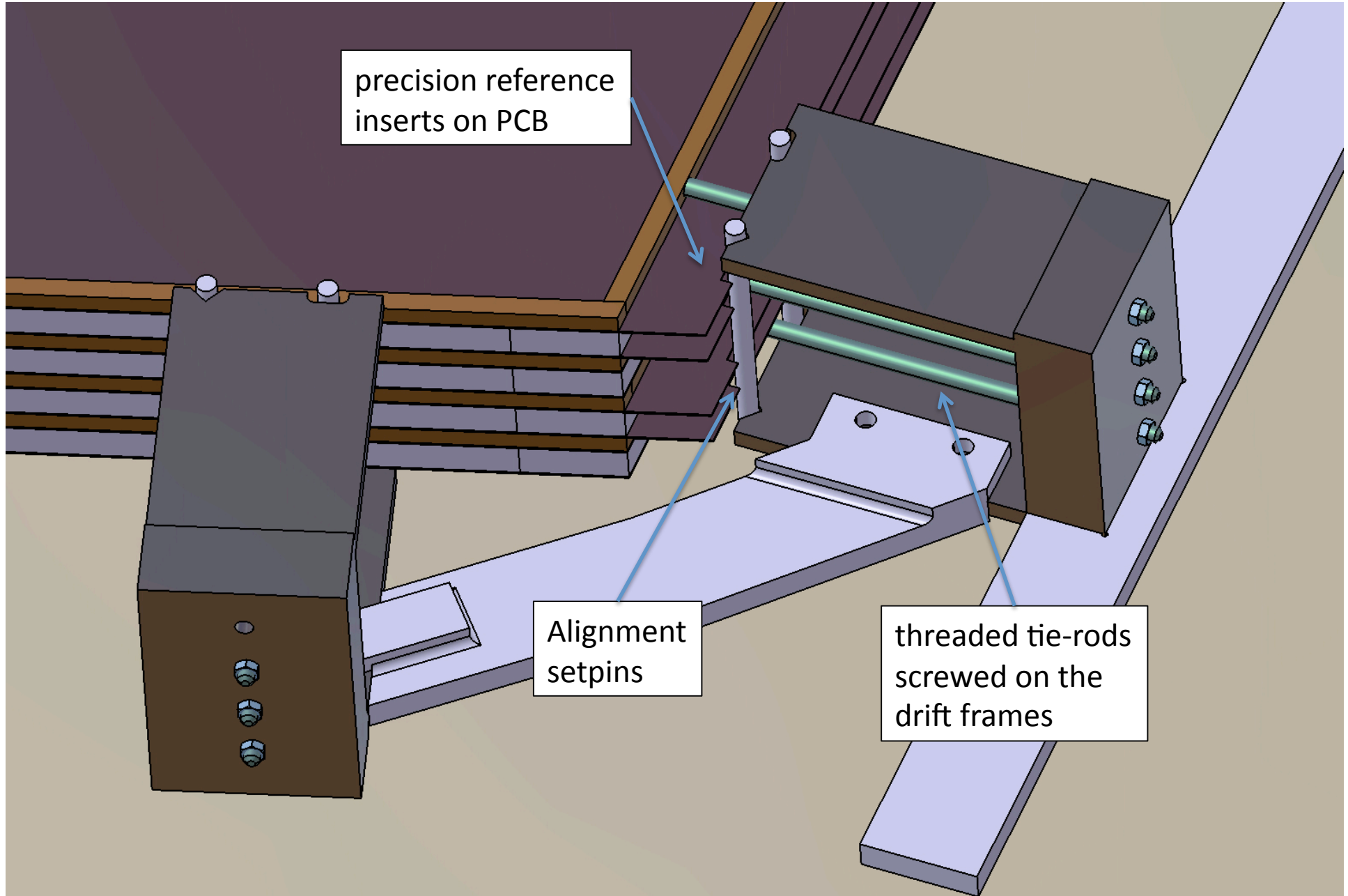




Quadruplet assembly and alignment scheme



Same bars on the table but higher towers and pins.



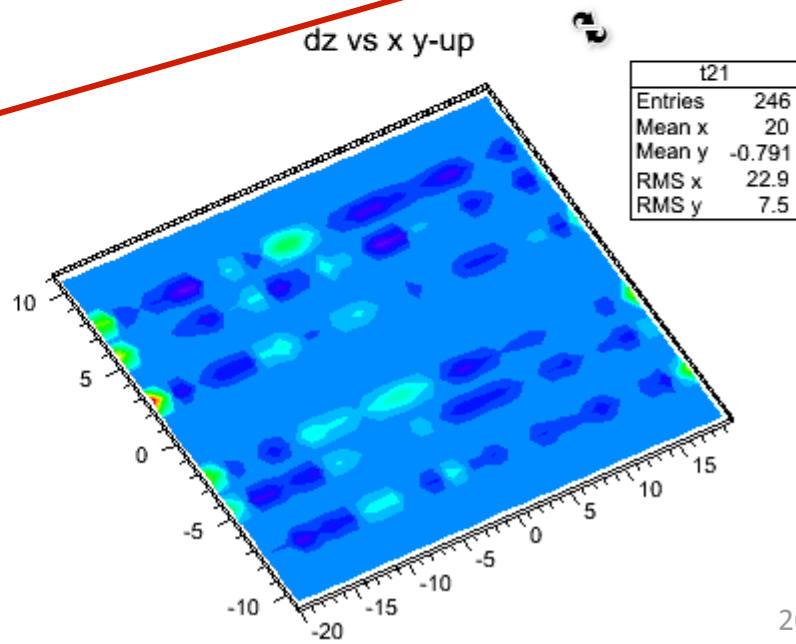
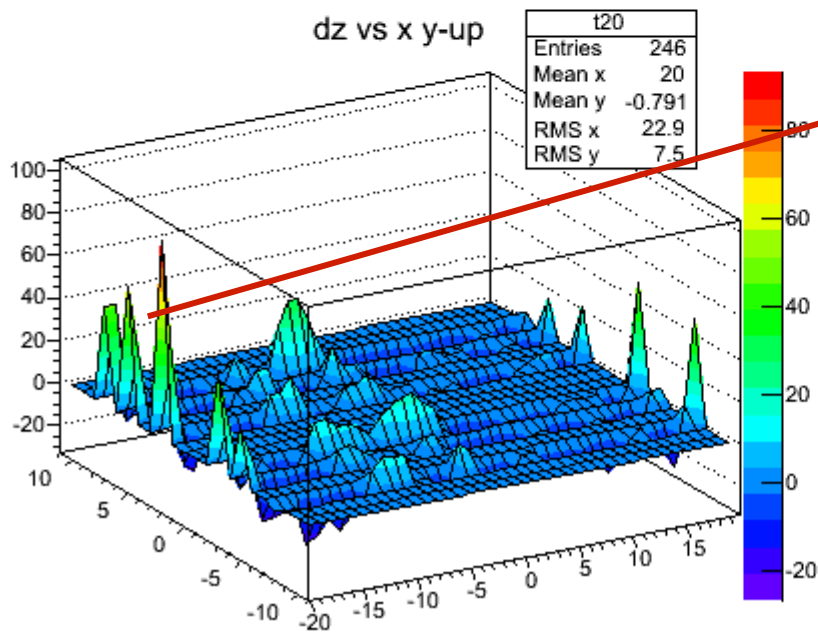
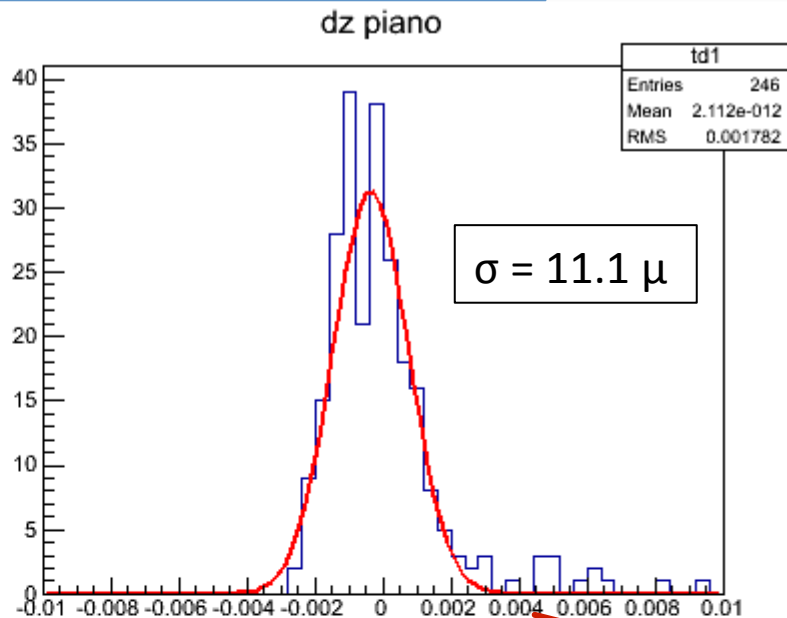
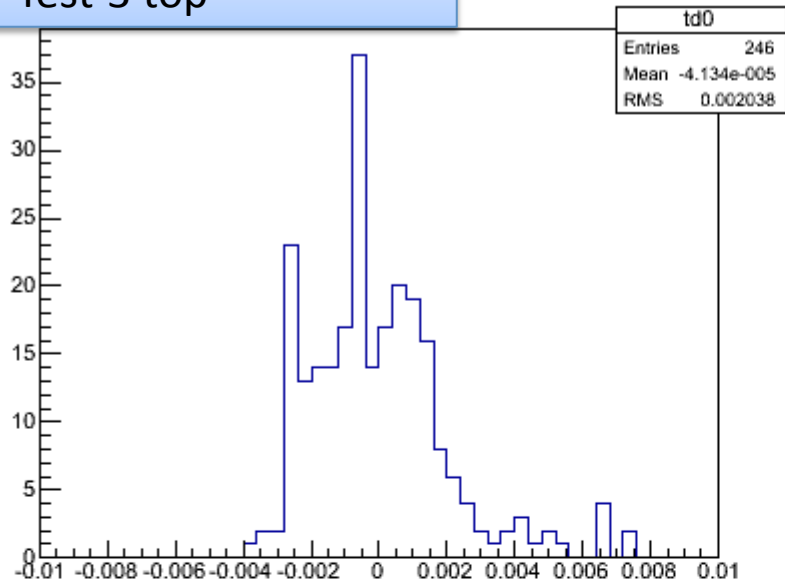
Summary and outlook

- The vacuum bag technique guarantees panels with good planarity up to 1 m dimensions based on PCB glued on honeycomb.
- NOMEX honeycomb is a good option, but pressure is to be optimized (measurements are in progress).
- Next tests:
 - tests with “expansion” glue;
 - gluing on PCB with pillars.
- A preliminary project of assembly has been presented, still to be finalized and tested.
- We are in conditions to build a mechanical test of a full quadruplet (M1, M2 or M3).

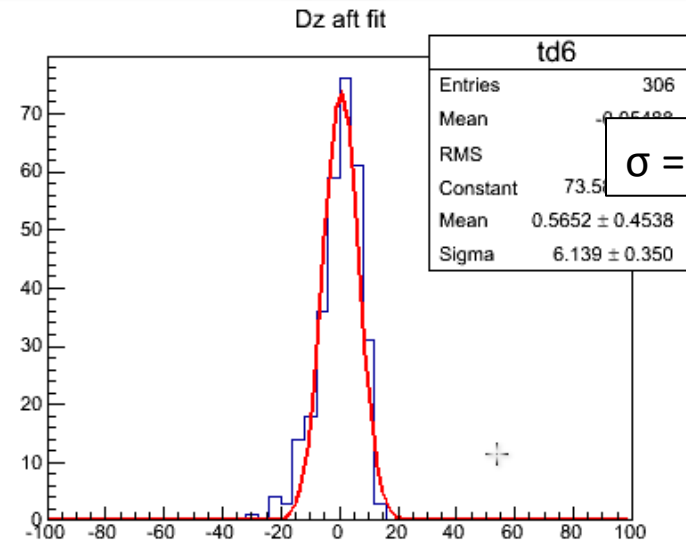
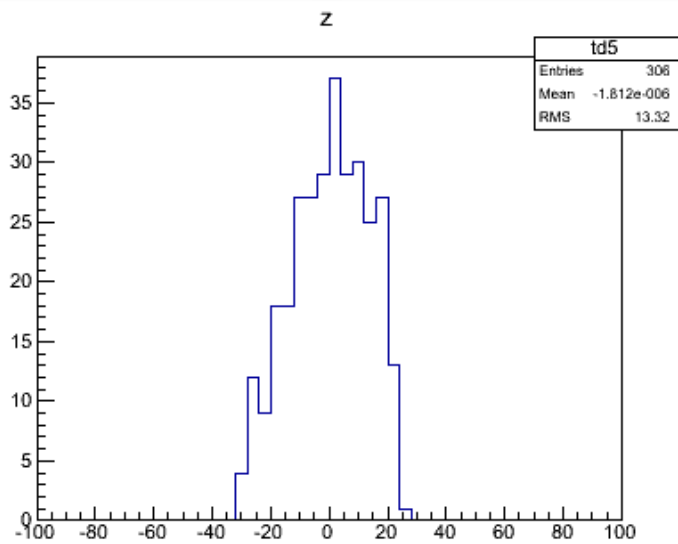
Backup slides

Example of measurement: Nomex-Dp=50 mb – No pillars-Top-Mitutoyo

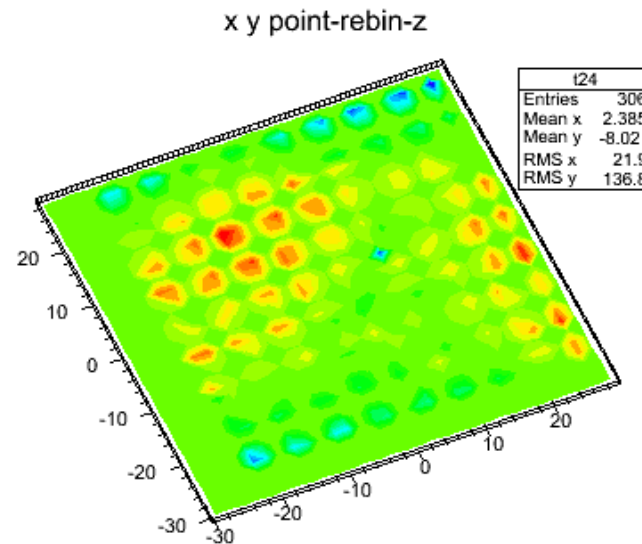
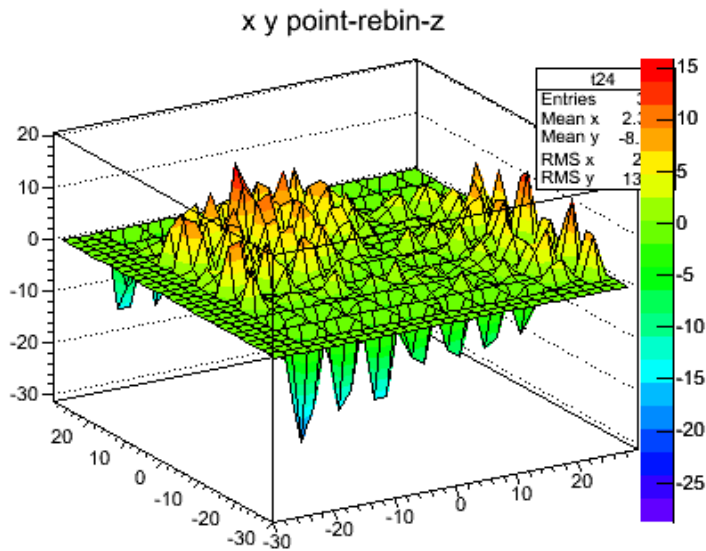
Test-3 top



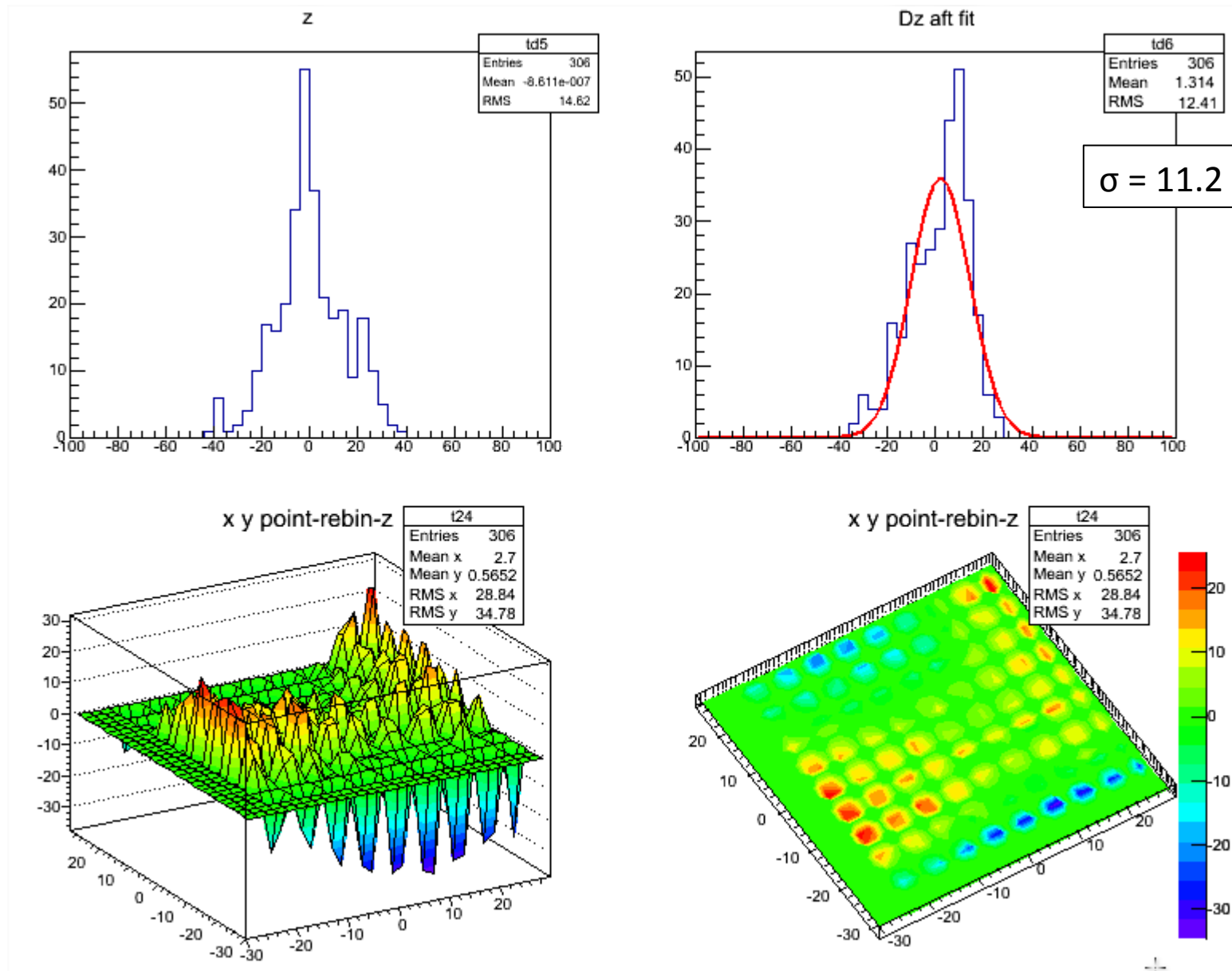
Test6-800 x 1000 mmNomex-Dp=300 mb – Bottom-Poli
Zone 1- 50 x 50 cm



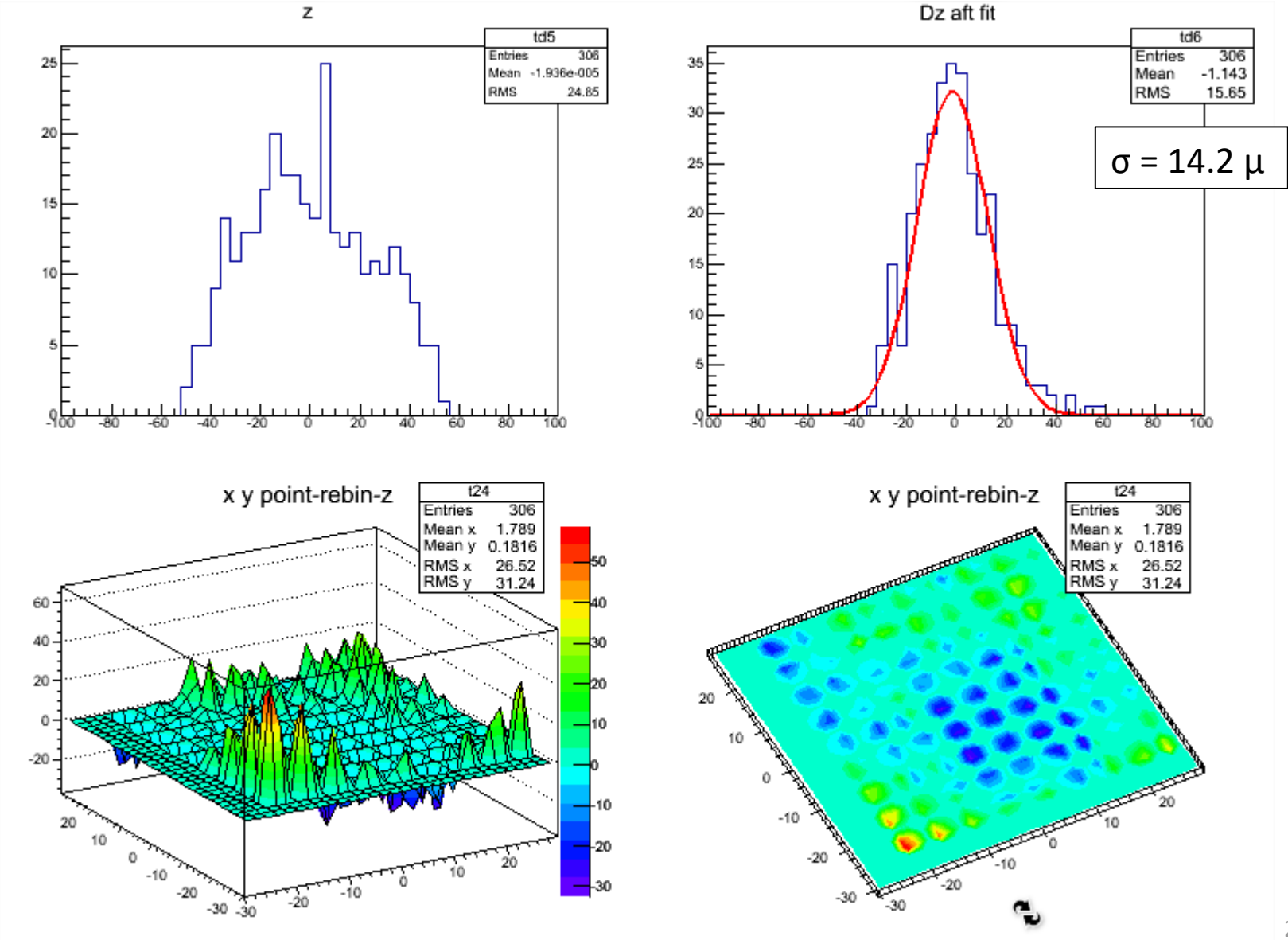
$\sigma = 6.1 \mu$



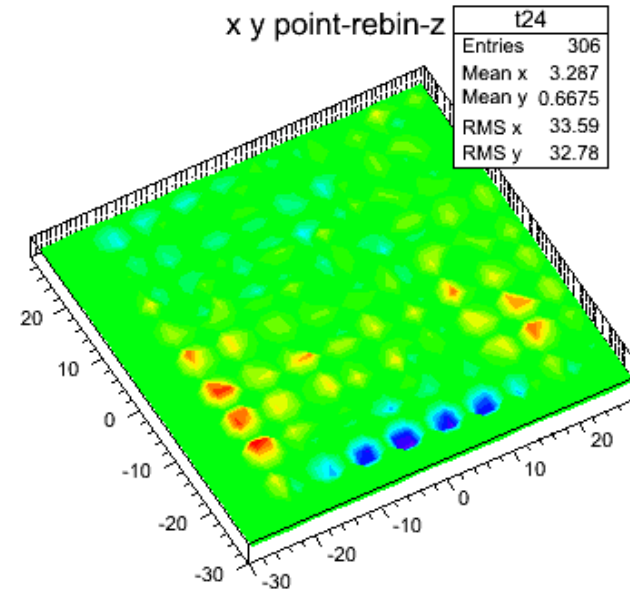
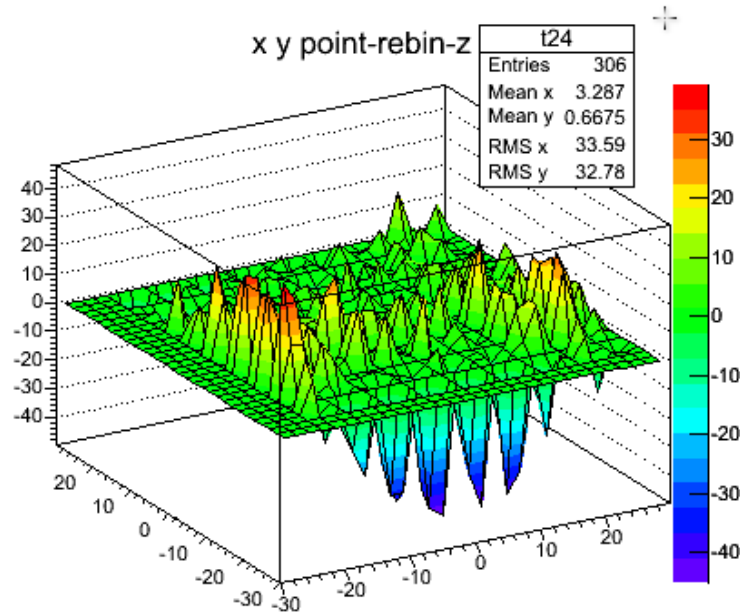
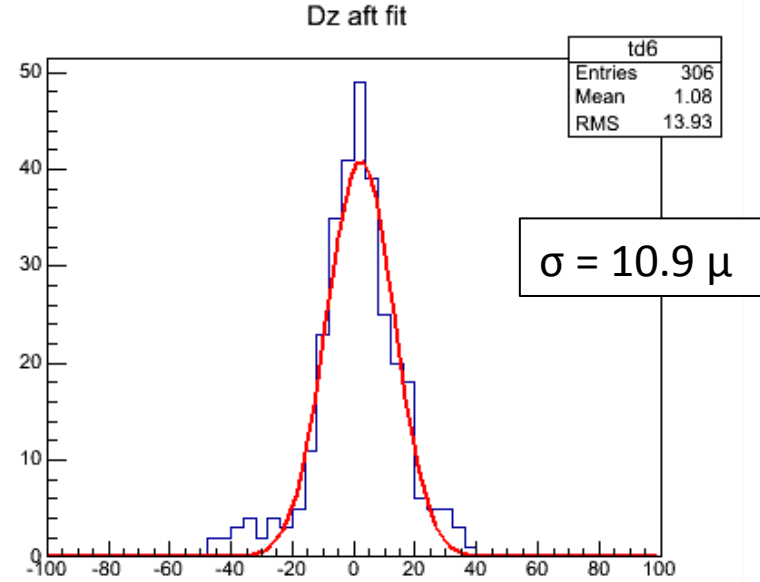
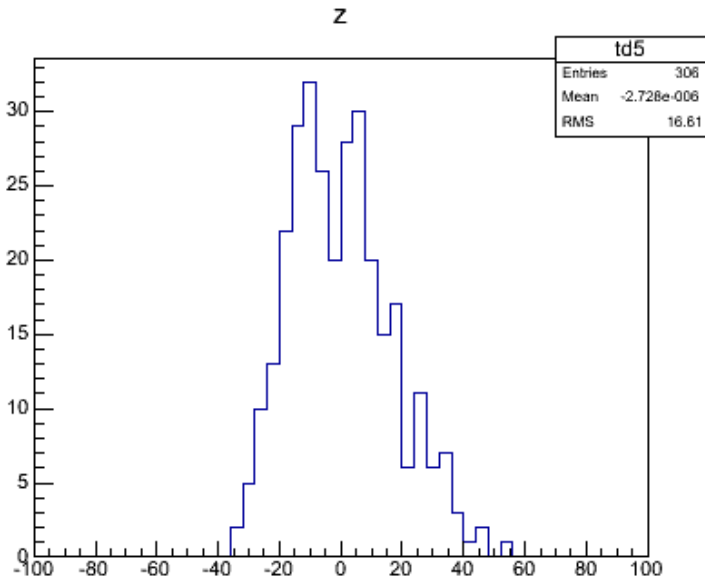
Test6-800 x 1000 mmNomex-Dp=300 mb – Bottom-Poli
Zone 2- 50 x 50 cm



Test6-800 x 1000 mmNomex-Dp=300 mb – Top-Poli
 Zone 1- 50 x 50 cm



Test6-800 x 1000 mmNomex-Dp=300 mb – Top-Poli
 Zone 2- 50 x 50 cm

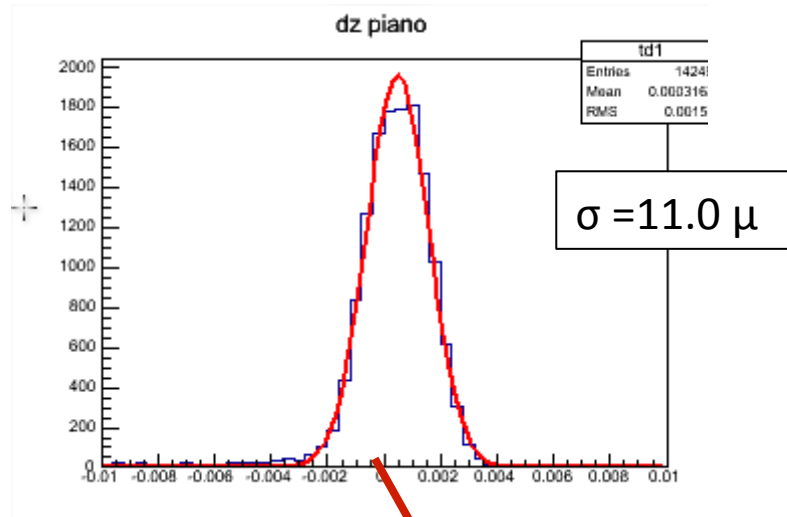


1 Proposta commerciale braccio 7 assi

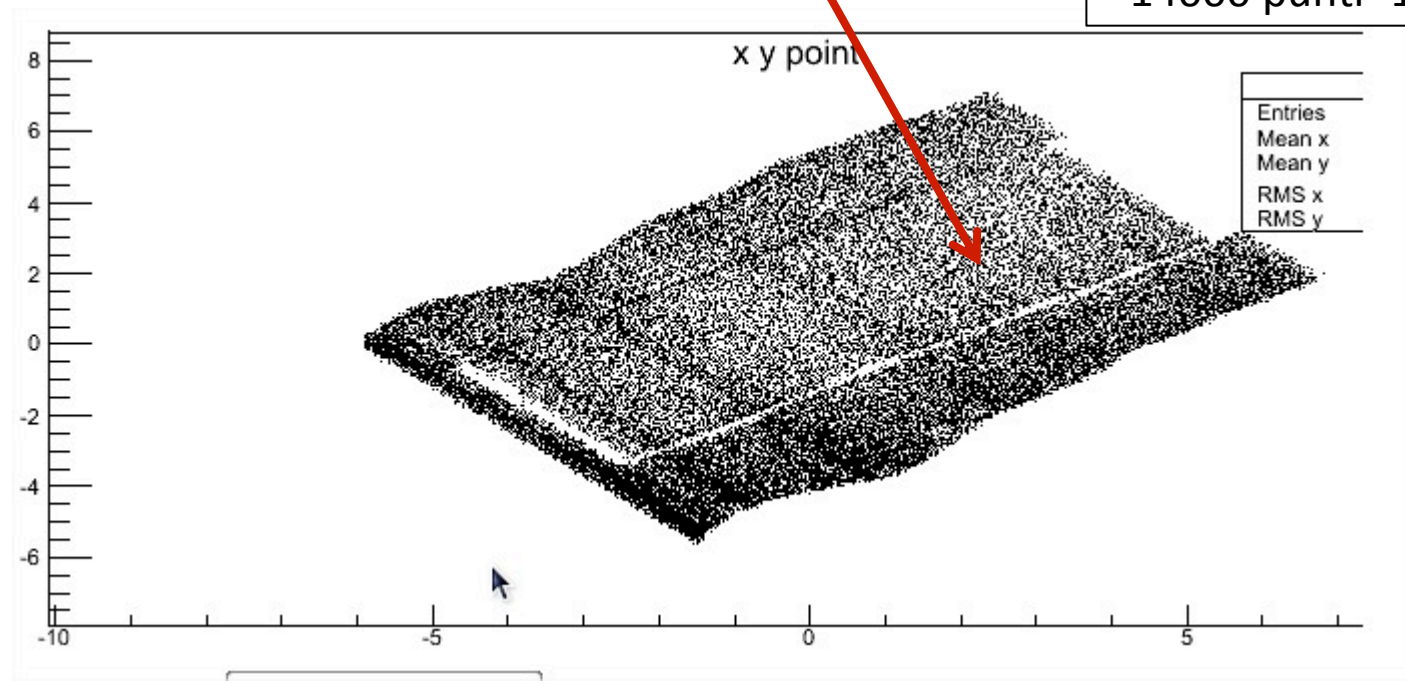
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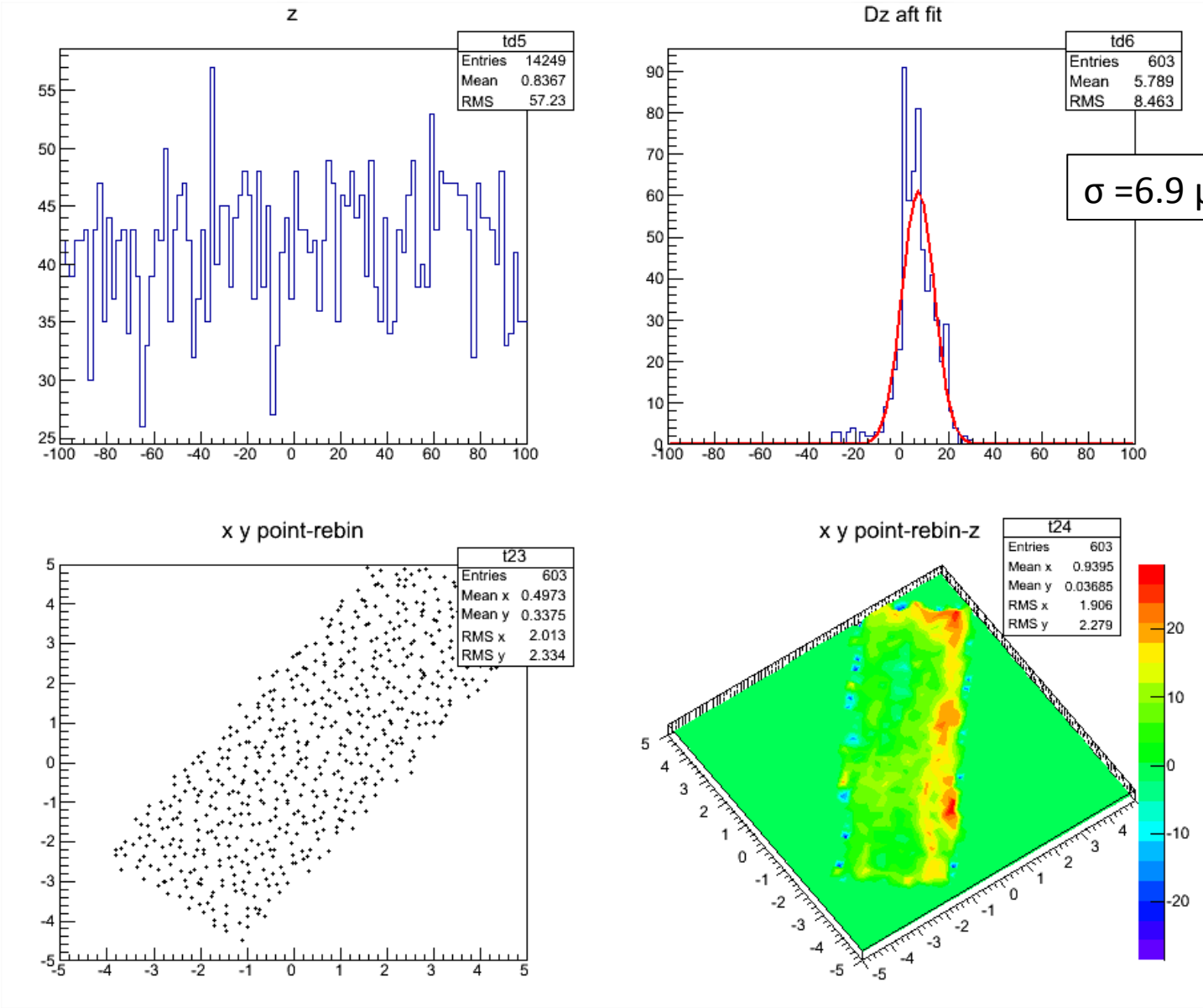
Blocchetto Johnson-Misura con Braccio Exagon

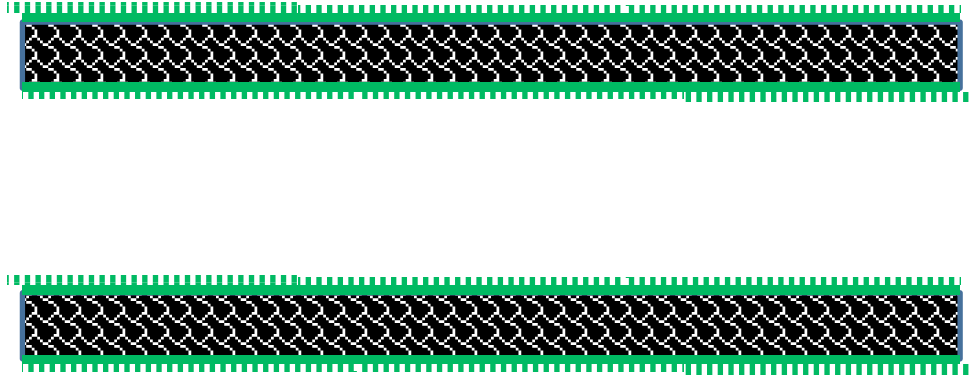
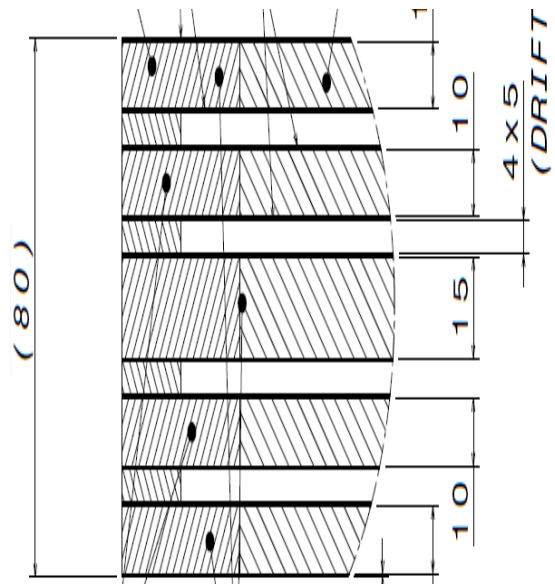


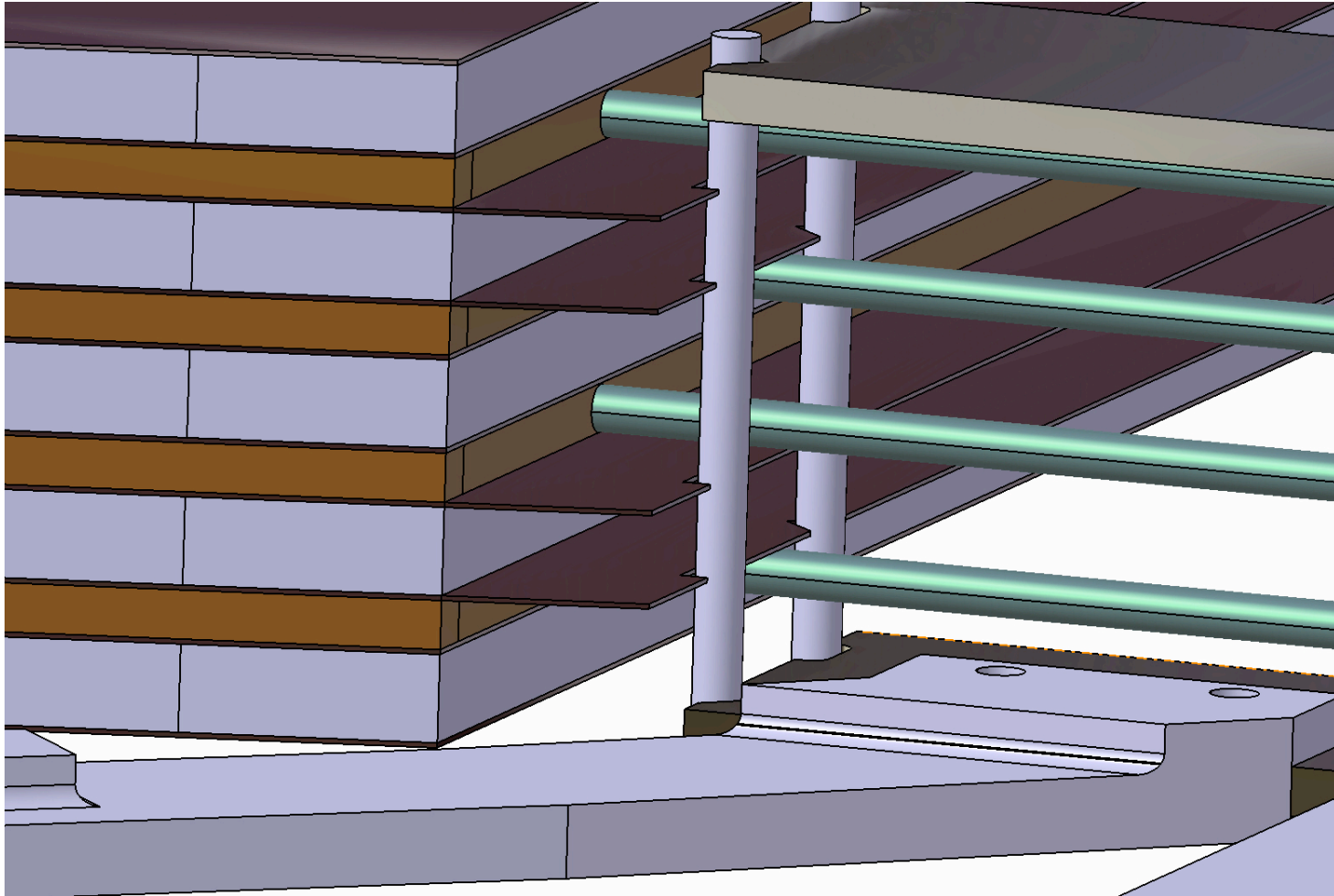
~14000 punti- 1 minuto!



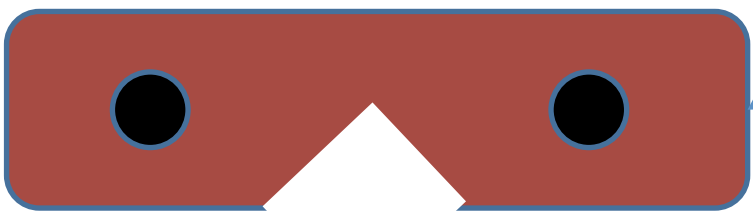
Blocchetto Johnson-Misura con Braccio Exagon-rebin



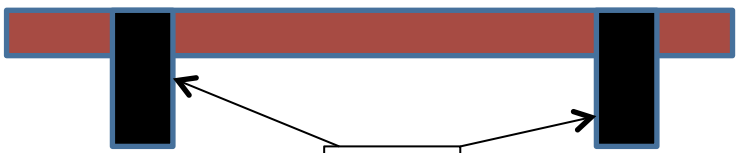




PCB



Brass



Pins

PCB

