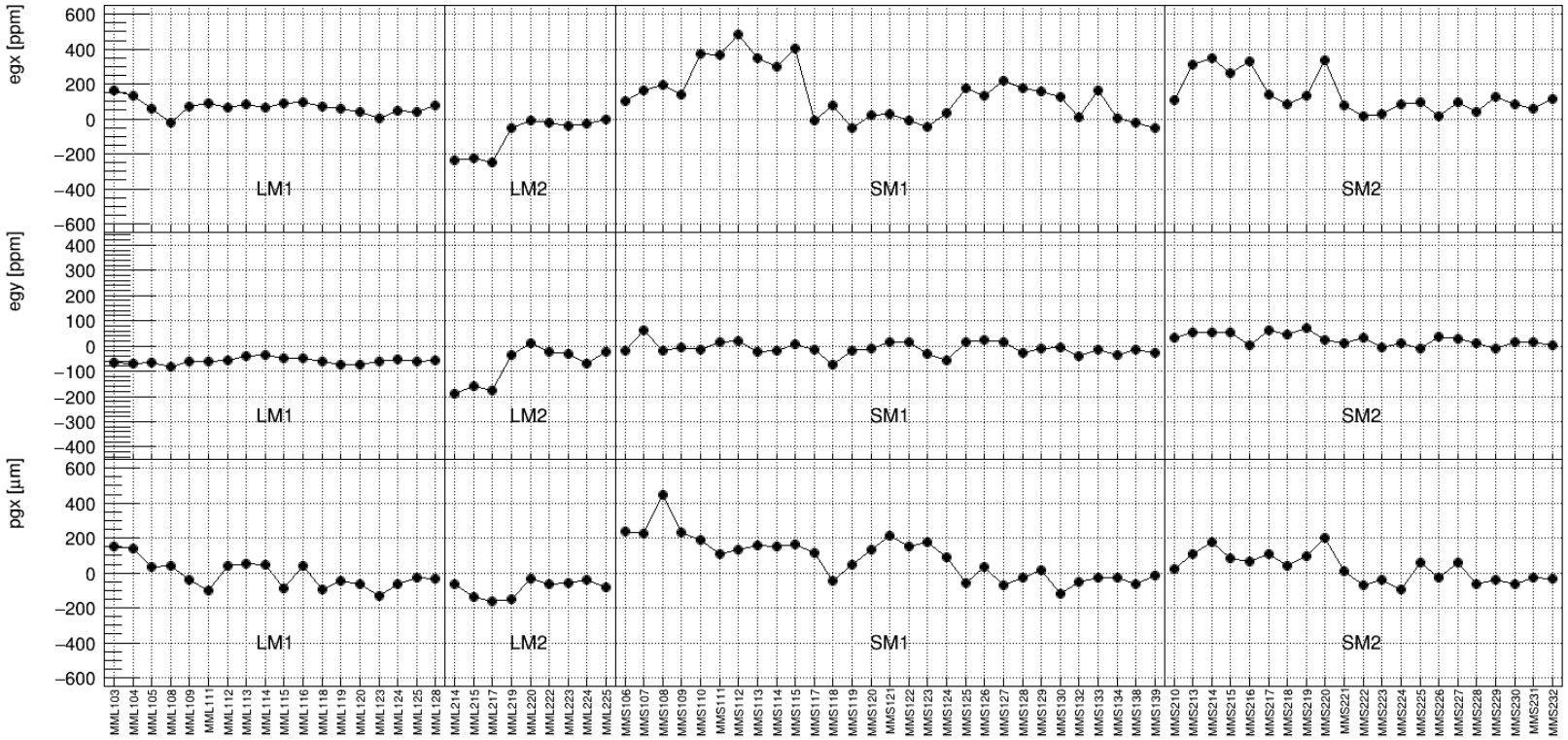
Investigating pgx

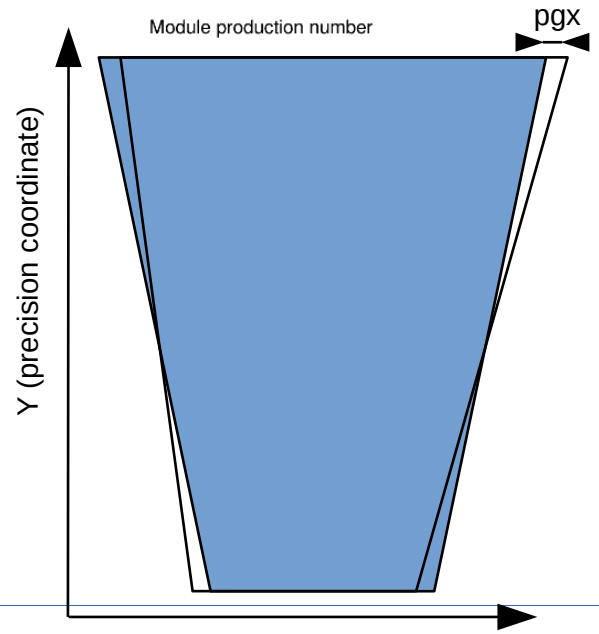


Plot above shown last week: elongations and deformations of top module layer seen by BB5 jig with respect to the measurements at construction sites.

My main concern: validity of elongation parameters

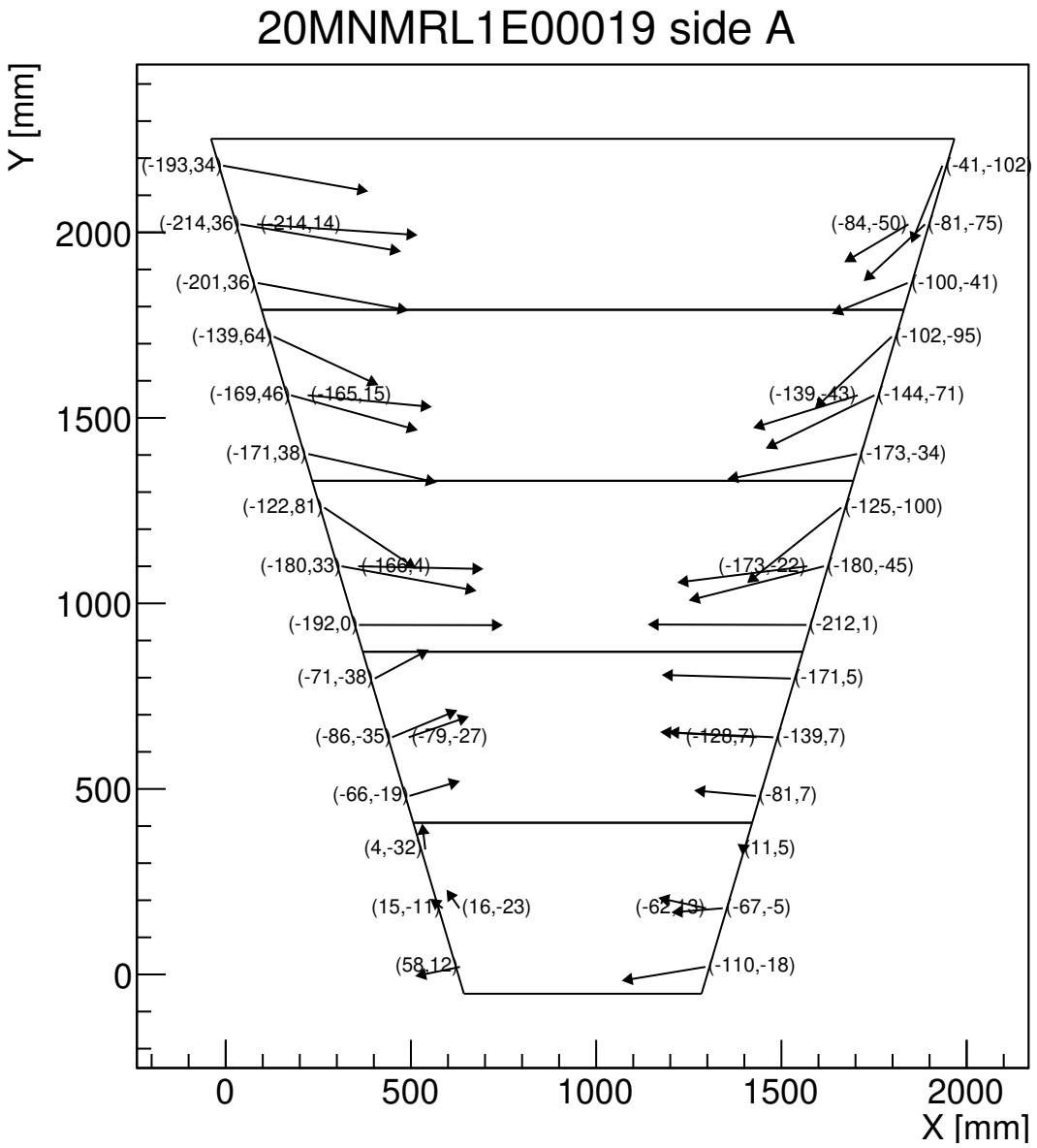
But for now: investigate the validity of parameter pgx
Two checks:

1) For LM1: measurement at construction site performed on assembled module, compare to BB5 jig value
2) Look for pgx using the rasfork data



LM1: measurement of assembled modules

LM1: measurement of assembled modules



Starting point: gantry CMM measurement of panel layer measured just after panel gluing

Each arrow corresponds to one rasmask and shows the observed deviation to nominal

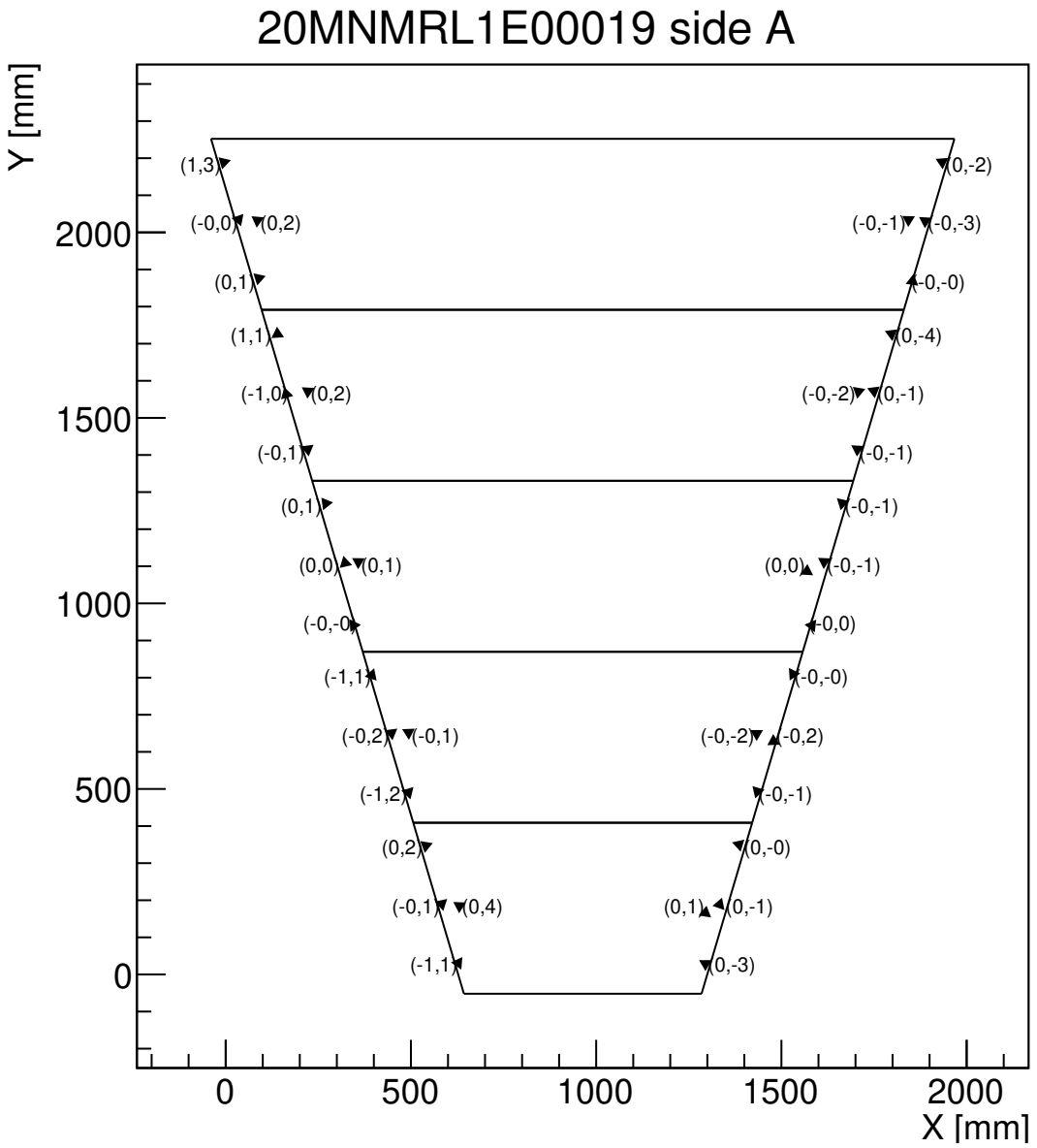
Frame (X,Y,THZ) is chosen such that

- Vertical measurements of bottom masks of PCB 3 are nominal (Fixes Y and THZ)
- Horizontal measurements of all masks are balanced (Fixes X)

What we see on this plot:

- Initial elongations and deformations of the PCBs
- Precision of positioning of the boards during panel assembly

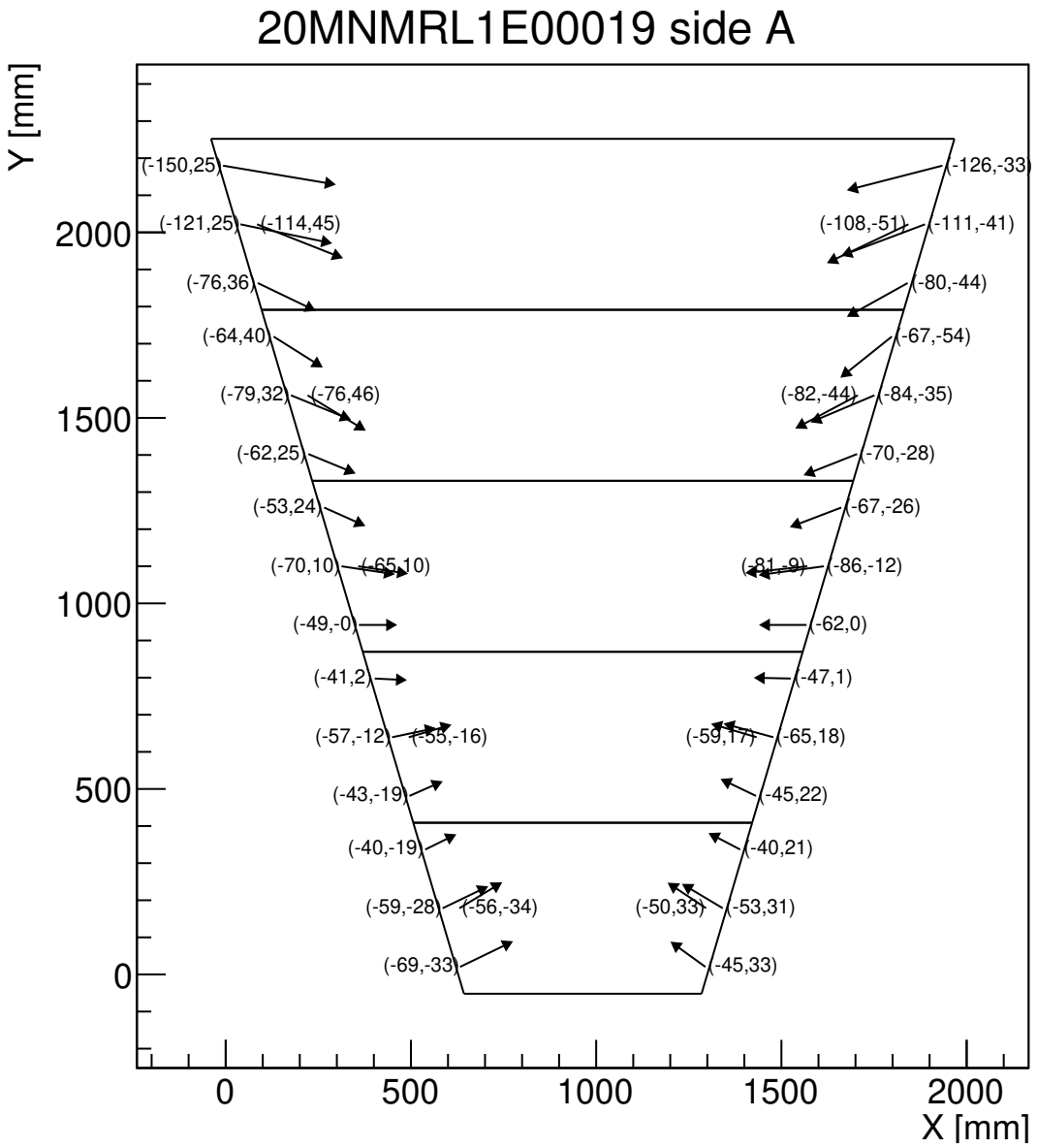
LM1: measurement of assembled modules



Step 1: offset each mask to its measured value
This offset is always applied in the following

In other words: use the panel measured after gluing as a reference, and show relative displacements with respect to this reference in the following

LM1: measurement of assembled modules



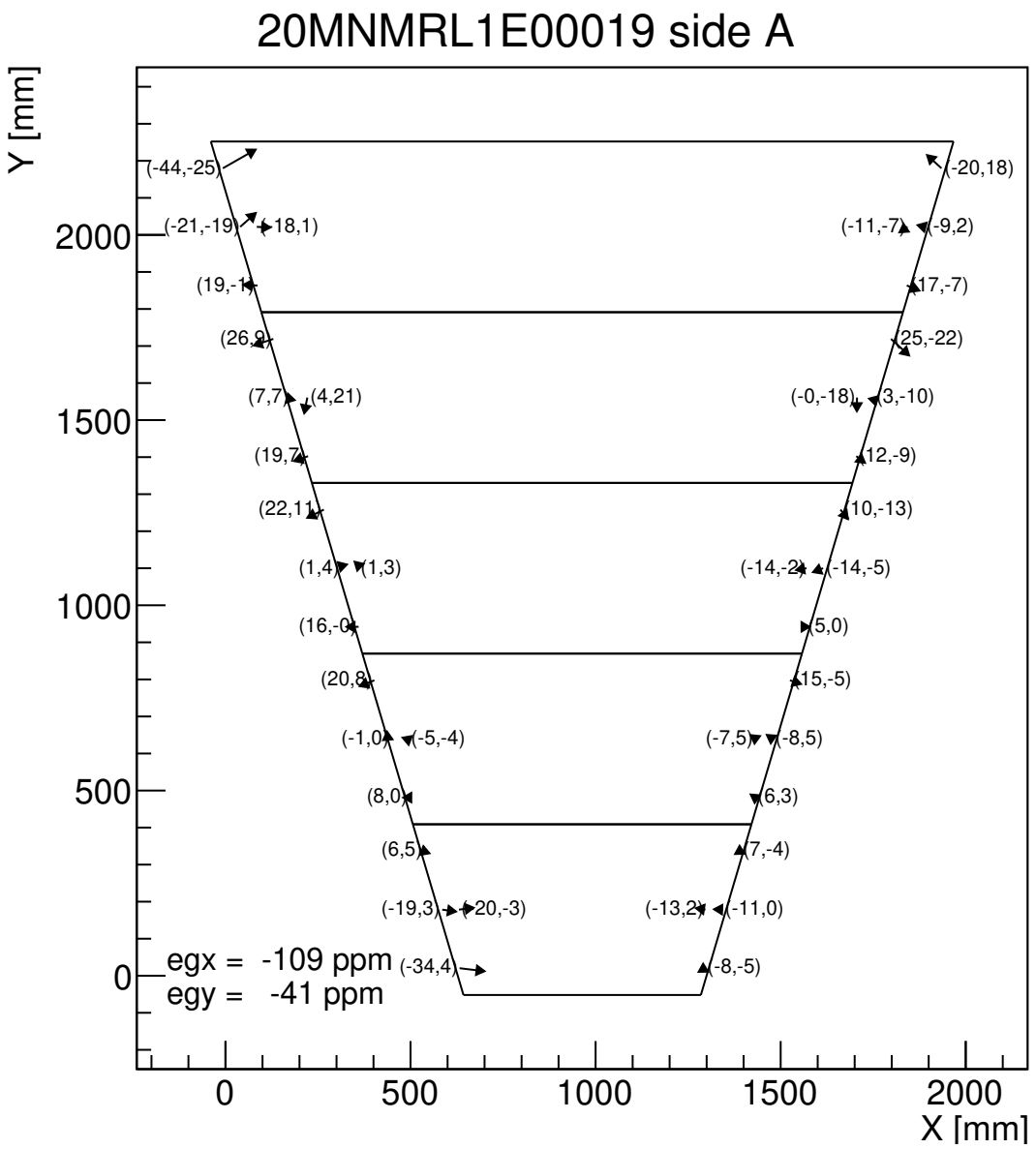
Gantry CMM measurement after panel drying and module assembly

(Offset is applied to masks using the reference measurement at panel gluing)

What we see here:

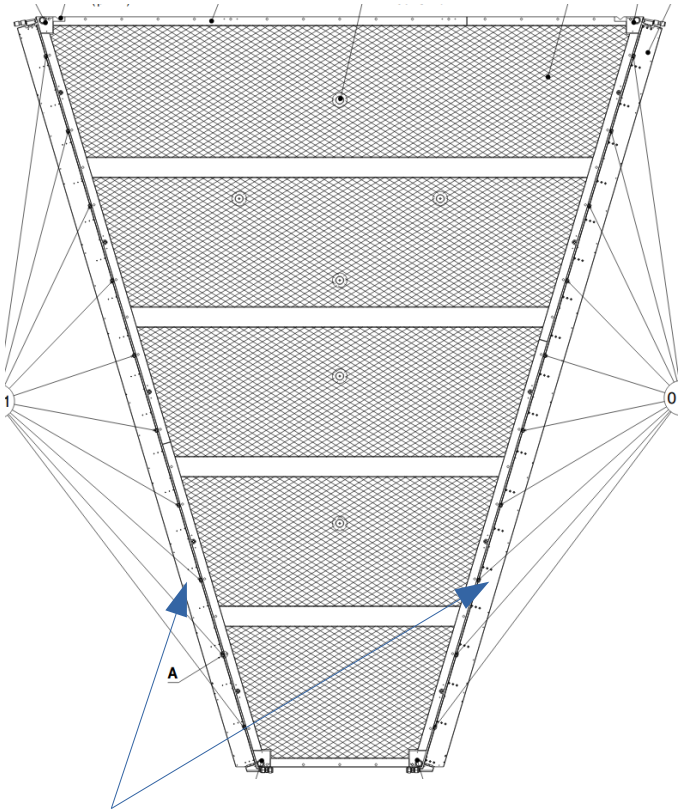
- Overall elongation of the panel, consequence of the drying
- The center of the panel also deforms, but this is invisible here: cannot measure the strips on assembled module

LM1: measurement of assembled modules



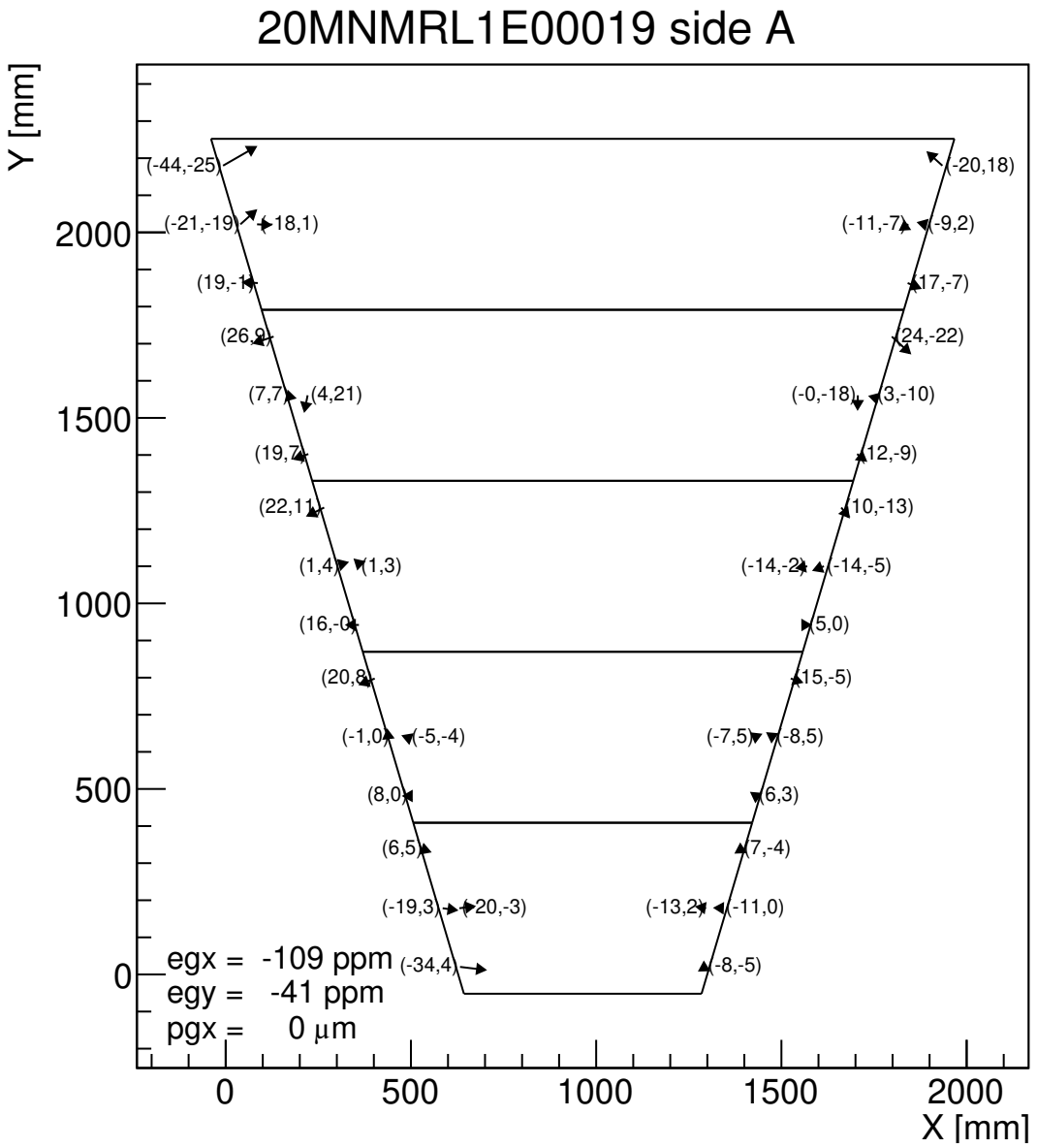
Gantry CMM measurement after panel drying and module assembly: fit parameters egx and egy

Note: egx shrinks more than egy because of internal structure of panel



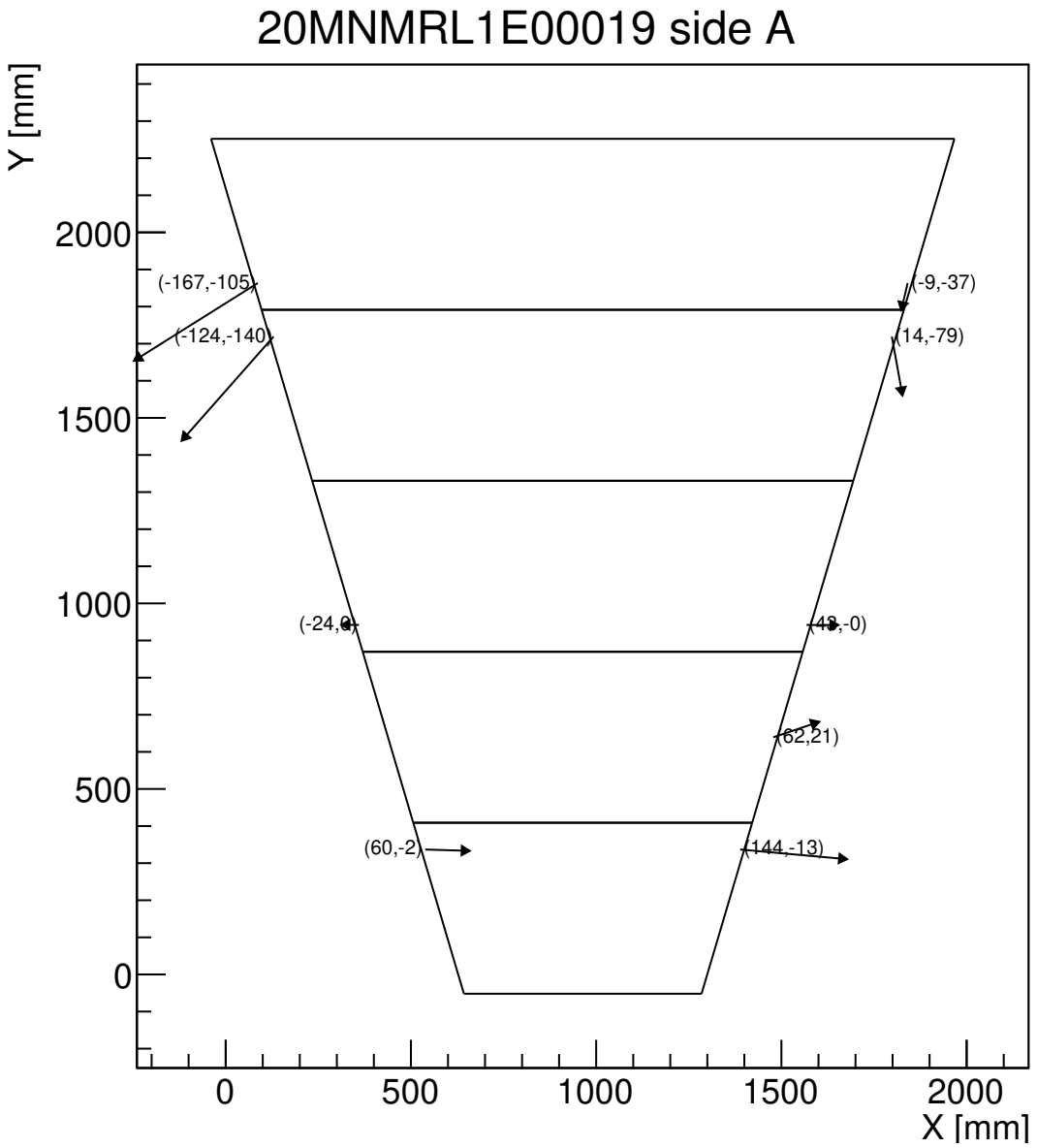
Cooling bars: stiff

LM1: measurement of assembled modules



Gantry CMM measurement after panel drying and module assembly: fit parameters egx, egy and pgx (here: 0)

LM1: measurement of assembled modules

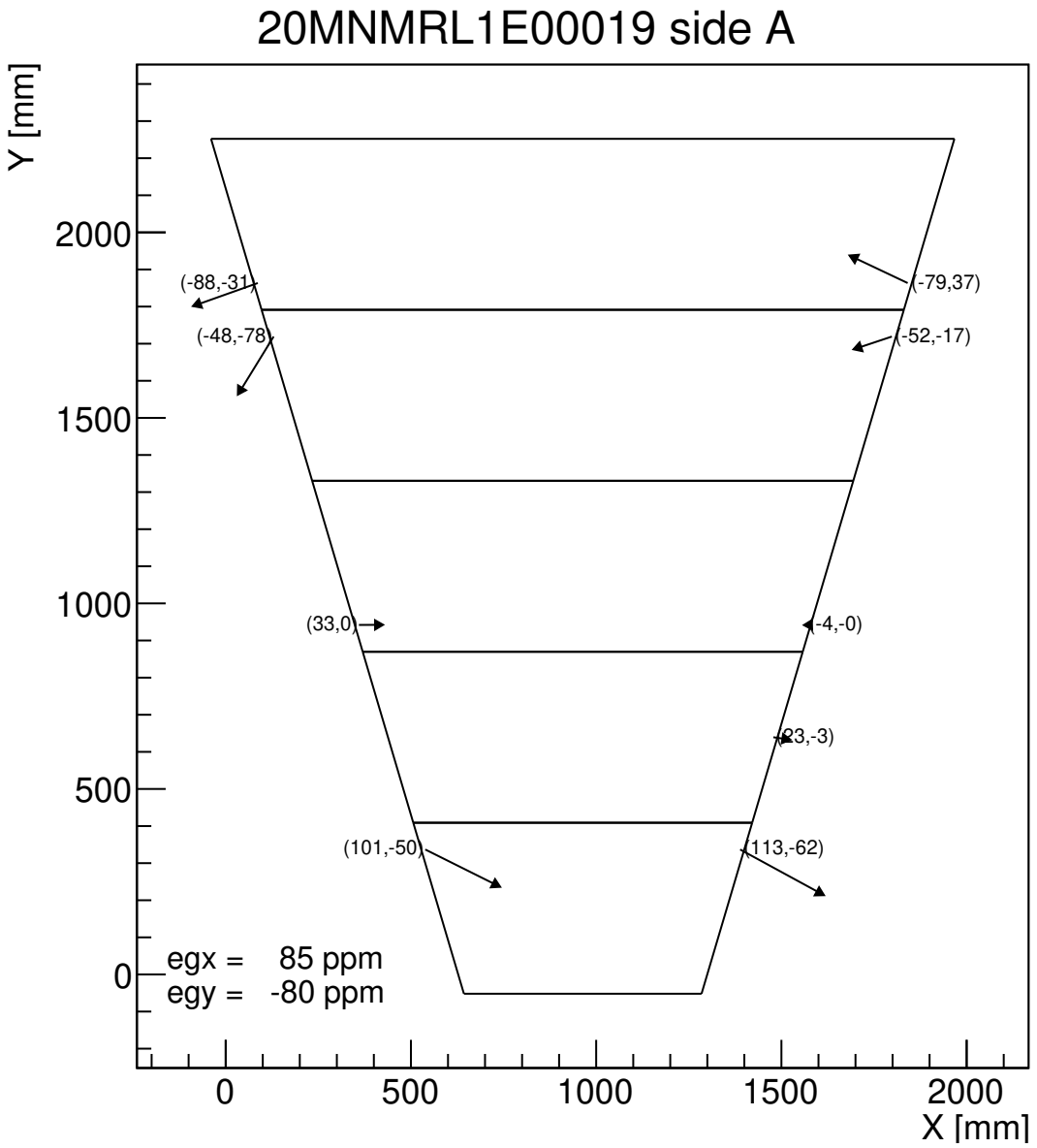


BB5 jig measurement of the same panel layer

(Offset is applied to masks using the reference measurement at panel gluing)

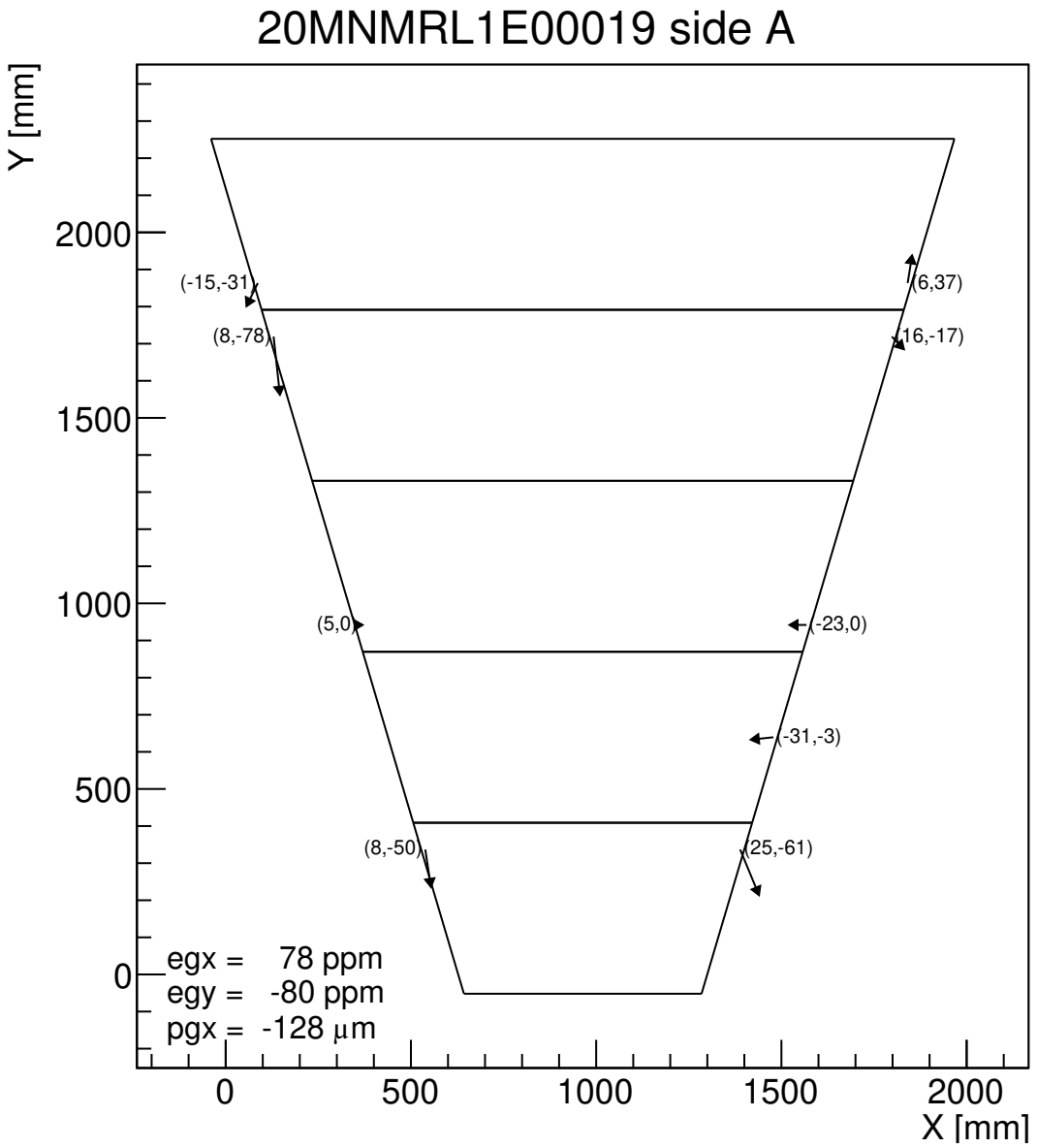
10 masks are measured for LM1.
Here: 1 faulty measurement on PCB 2

LM1: measurement of assembled modules



BB5 jig measurement: fit parameters egx and egy

LM1: measurement of assembled modules



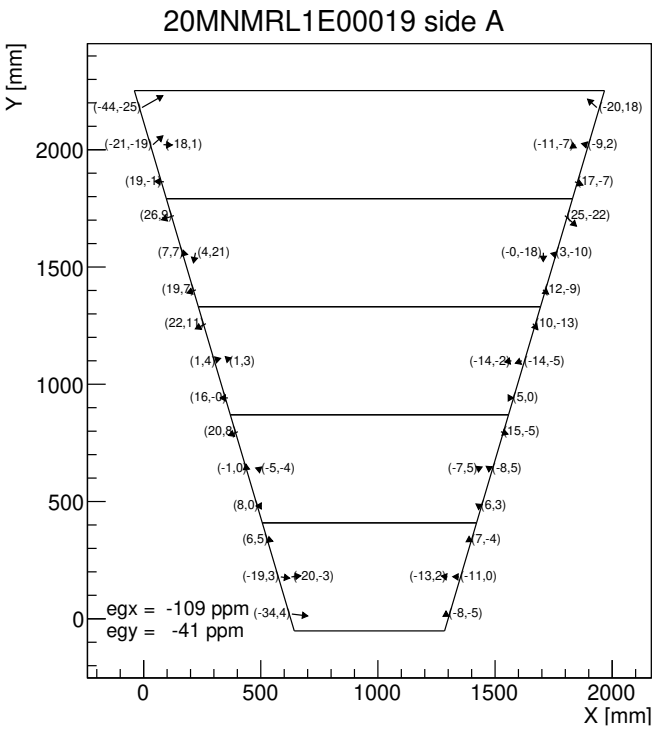
BB5 jig measurement: fit parameters egx, egy and pgx

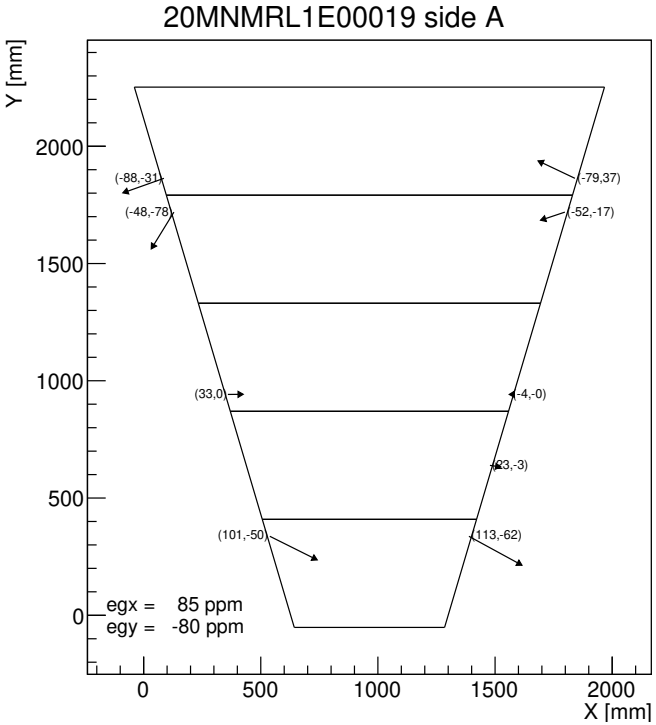
RL1E019

Saclay

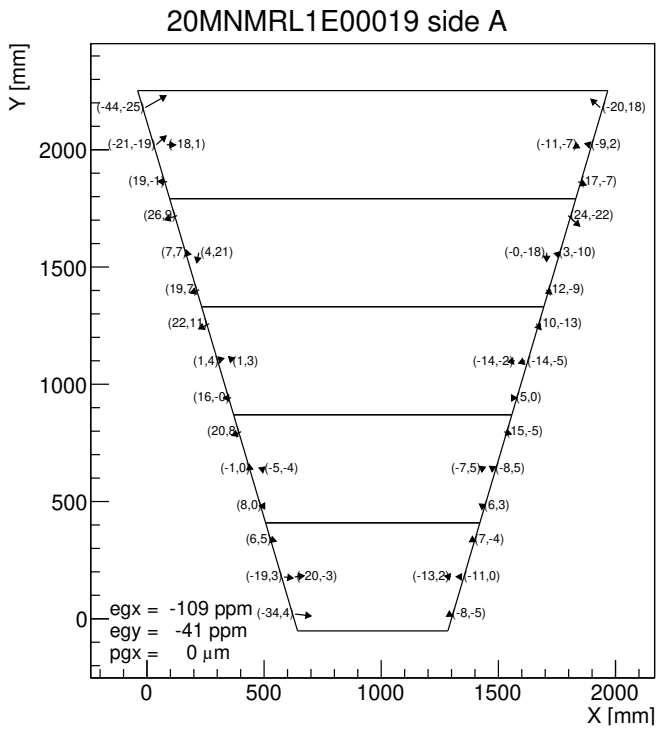
BB5

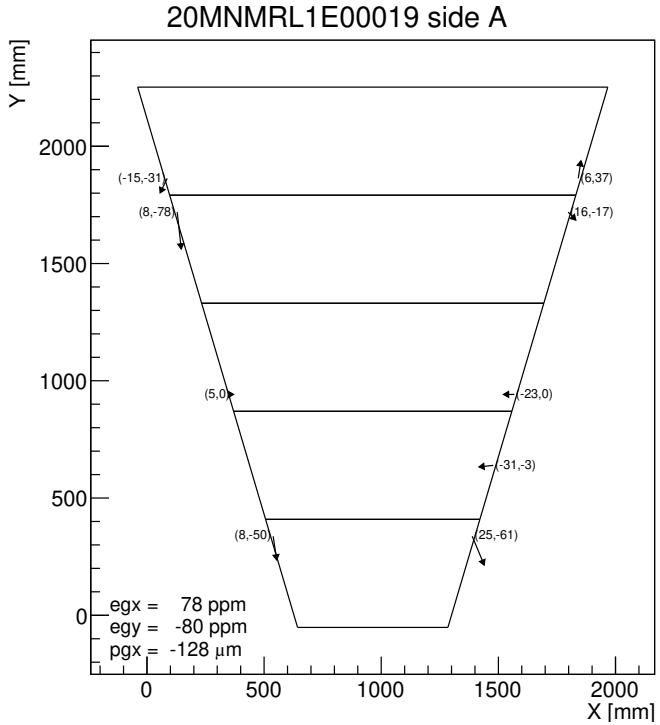
egx and egy





egx, egy and pgx





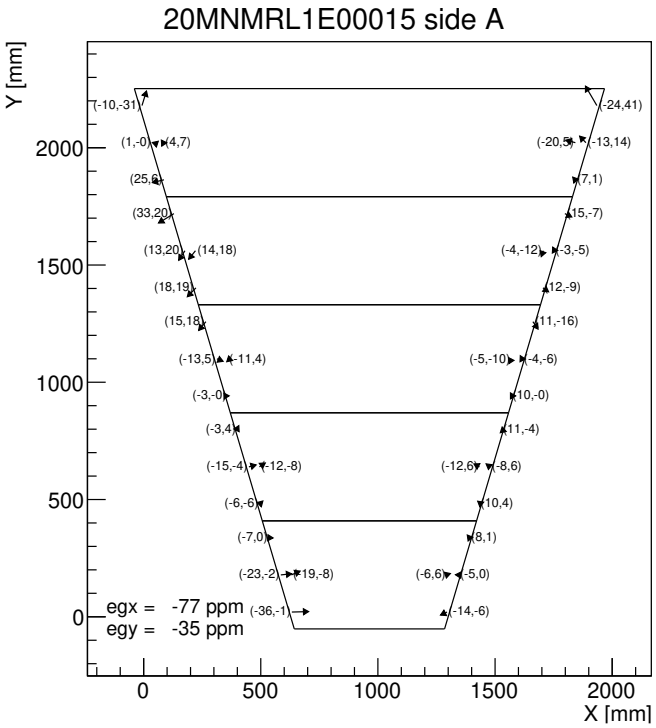
RL1E015

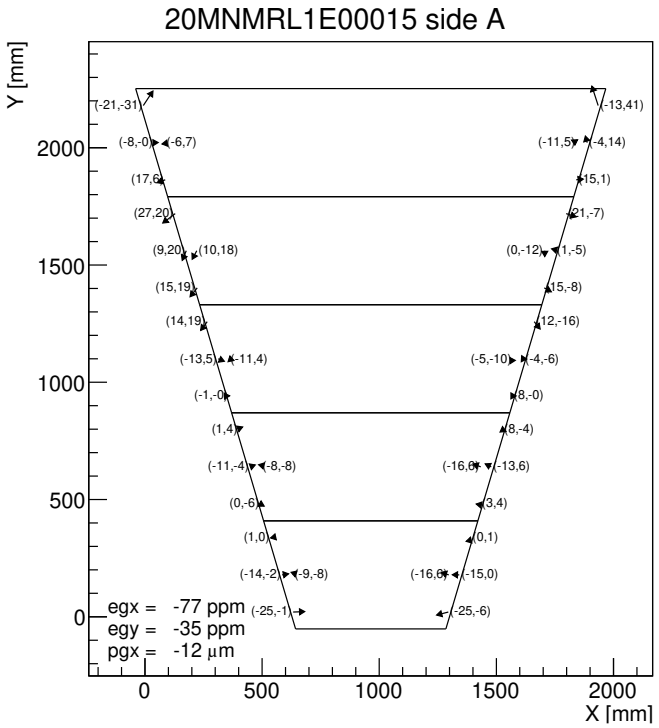
egx and egy

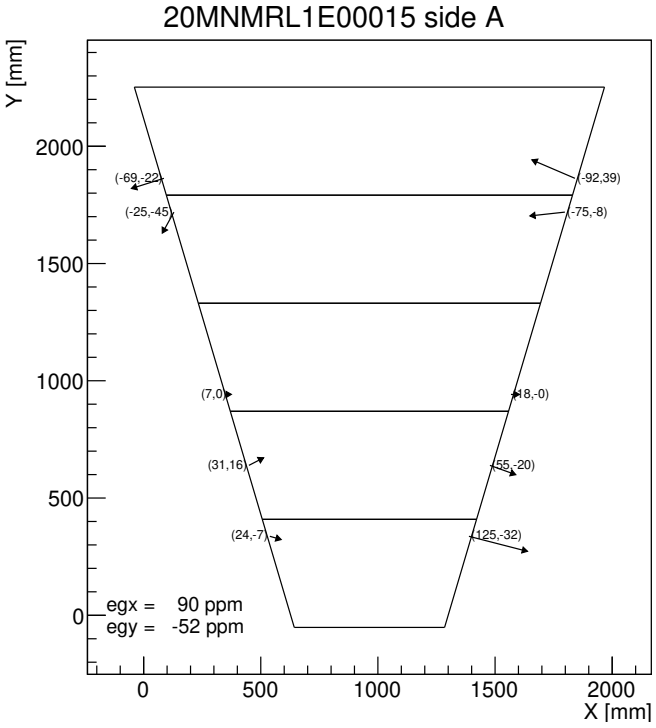
egx, egy and pgx

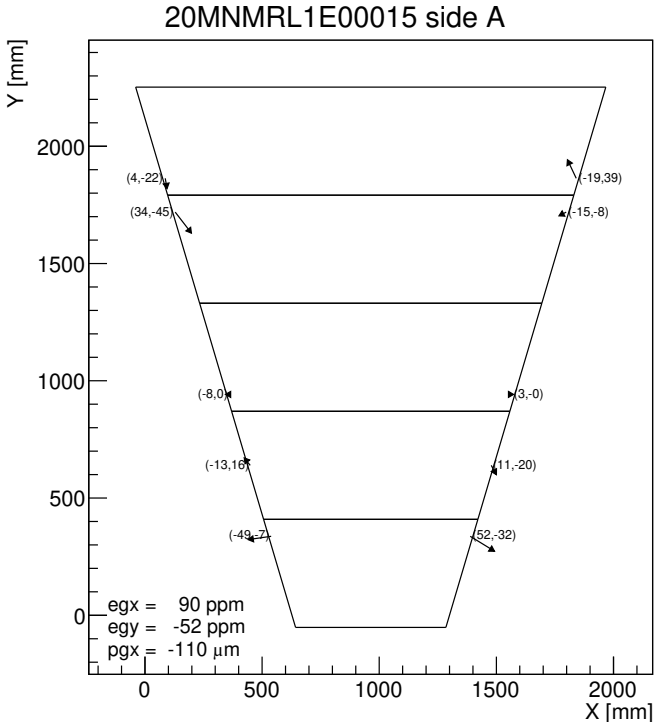
Saclay

BB5







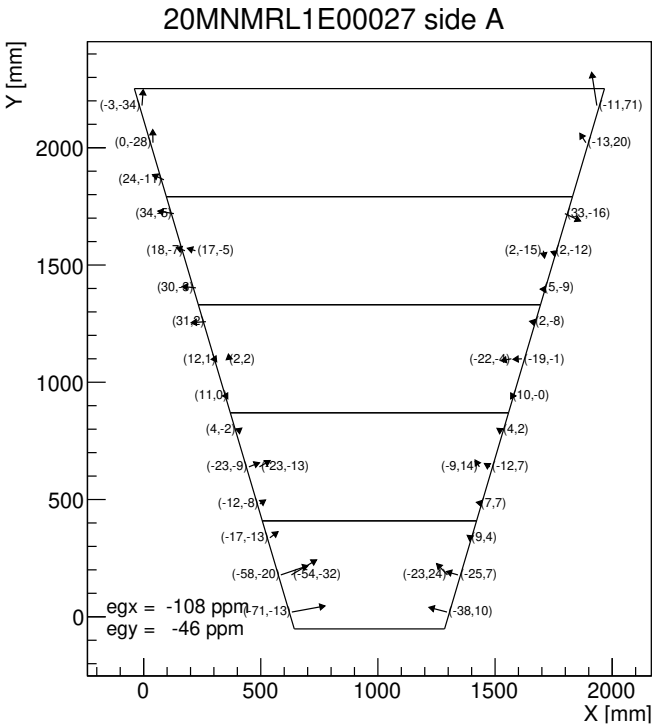


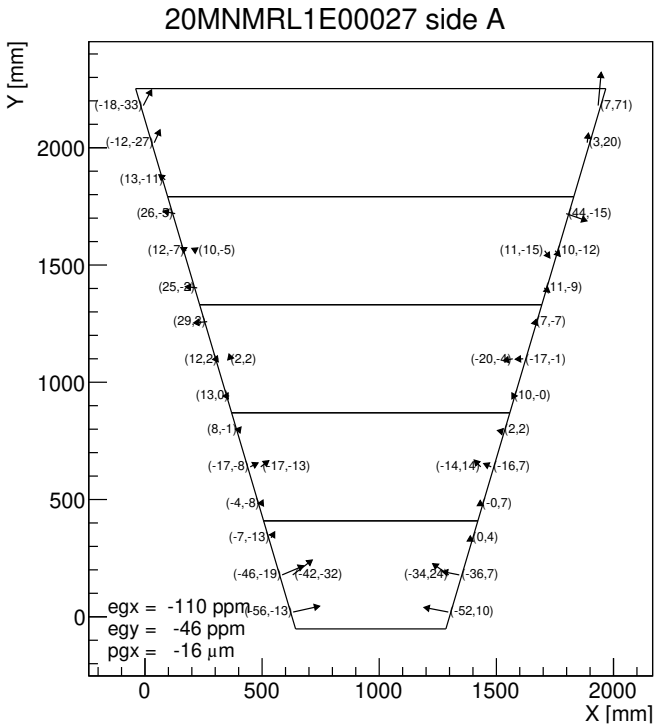
RL1E027

egx and egy

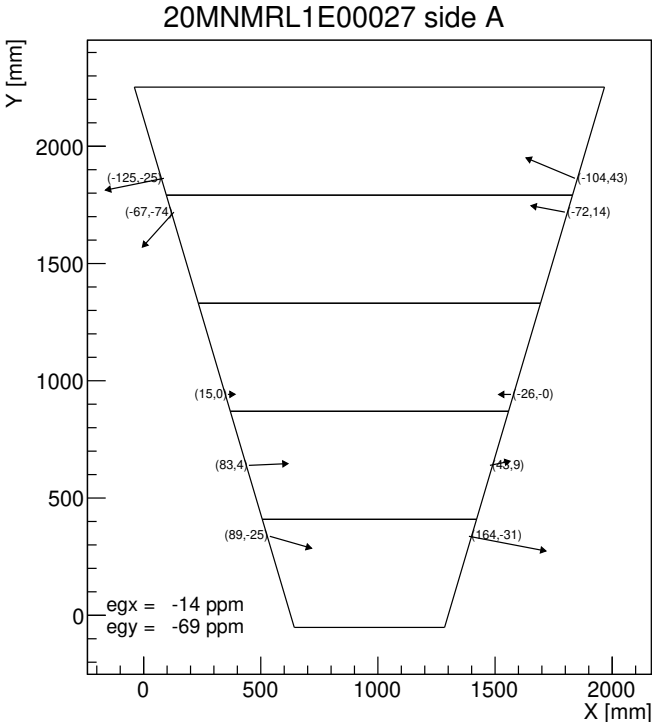
egx, egy and pgx

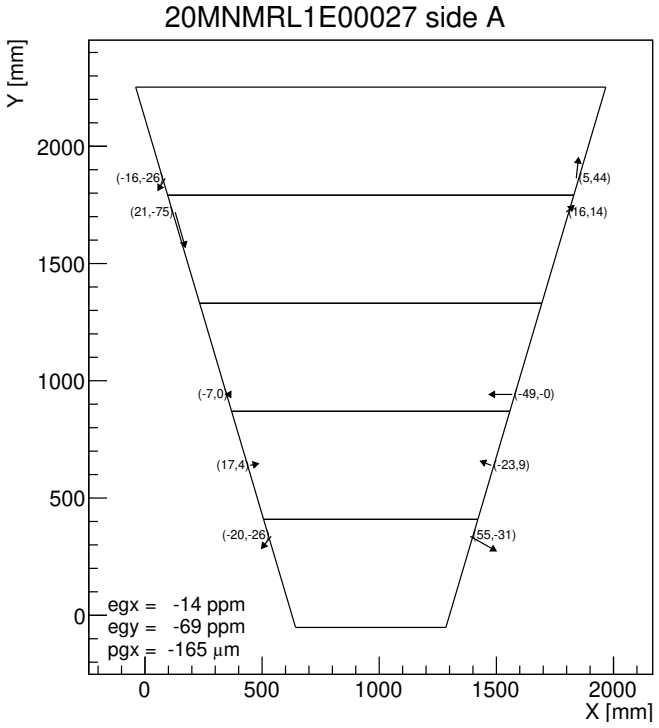
Saclay



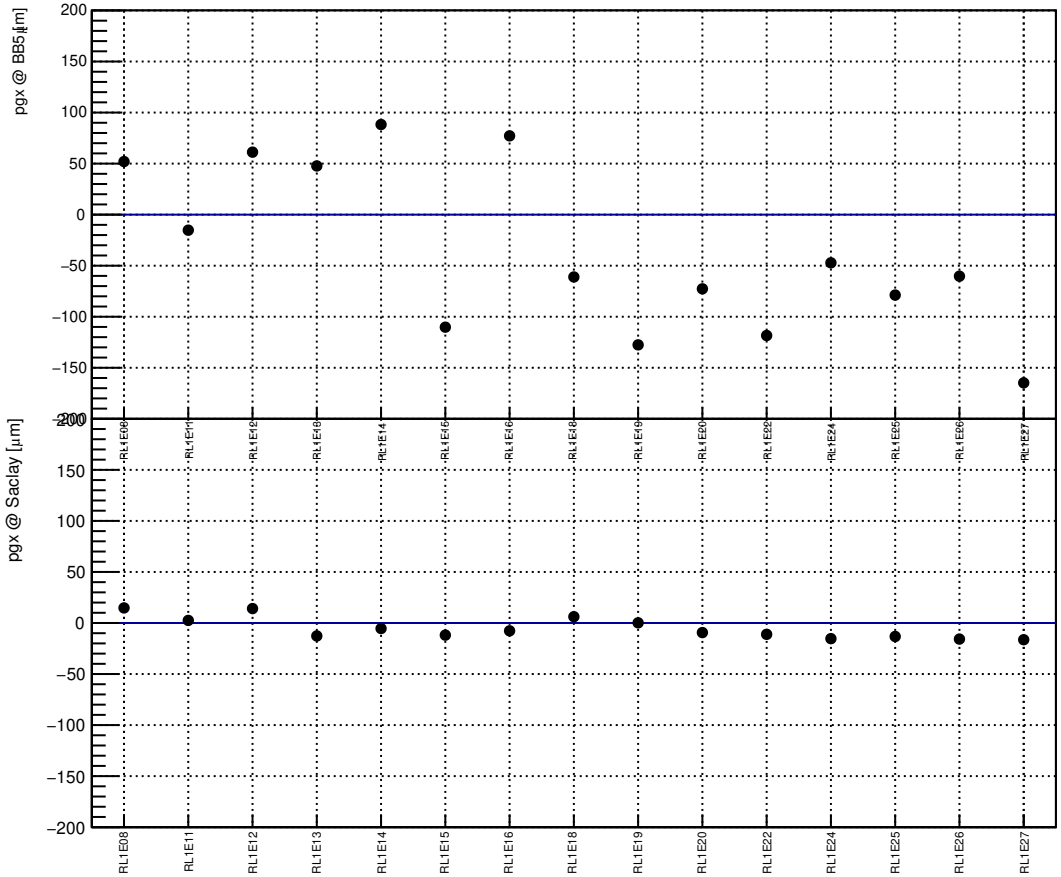


BB5





Summary of LM1 measurements of assembled modules

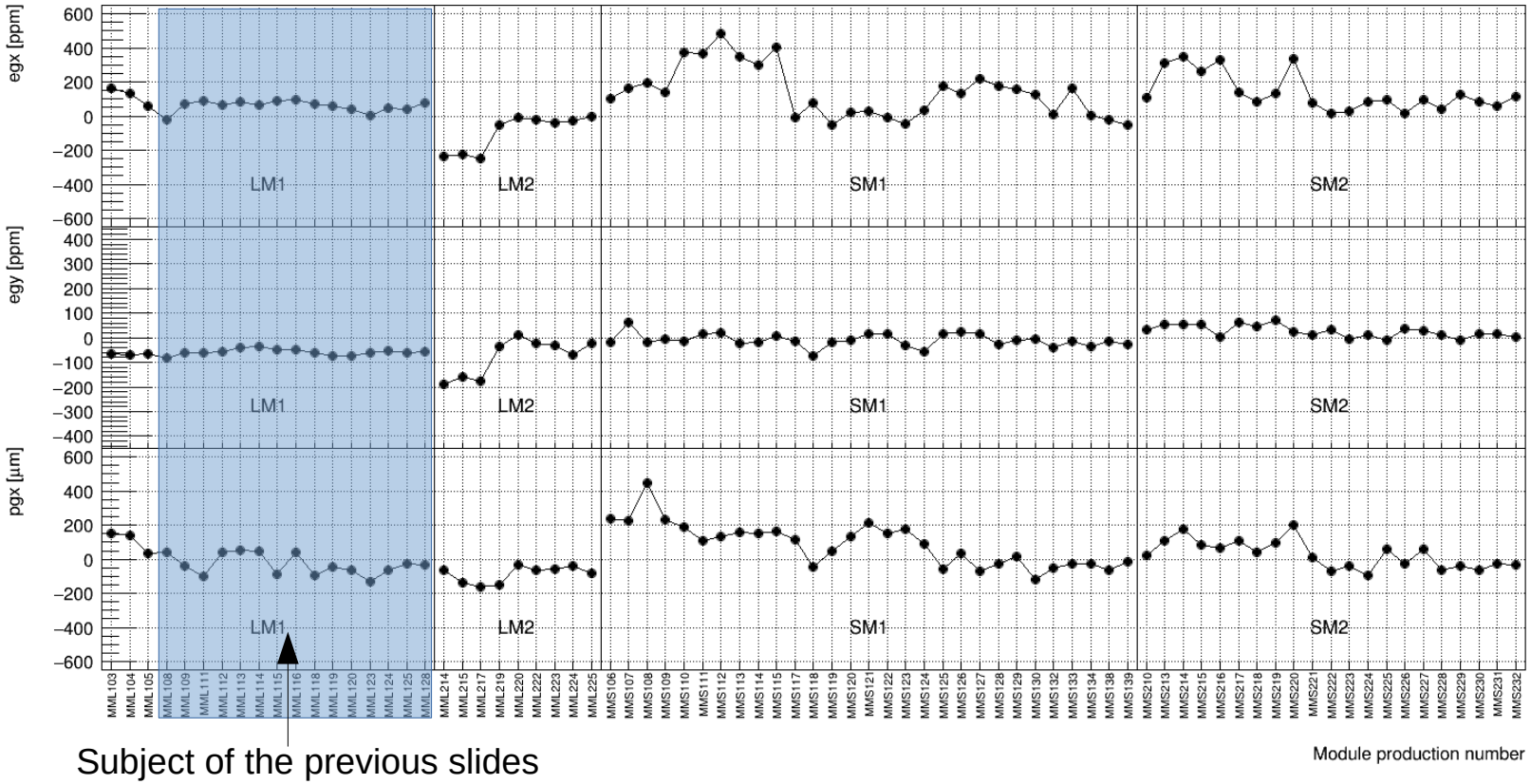


Larger pgx value is observed in the BB5 measurement

Probably at the limit of the precision of the BB5 jig

Look for pgx with help of rasfork data

Investigating pgx

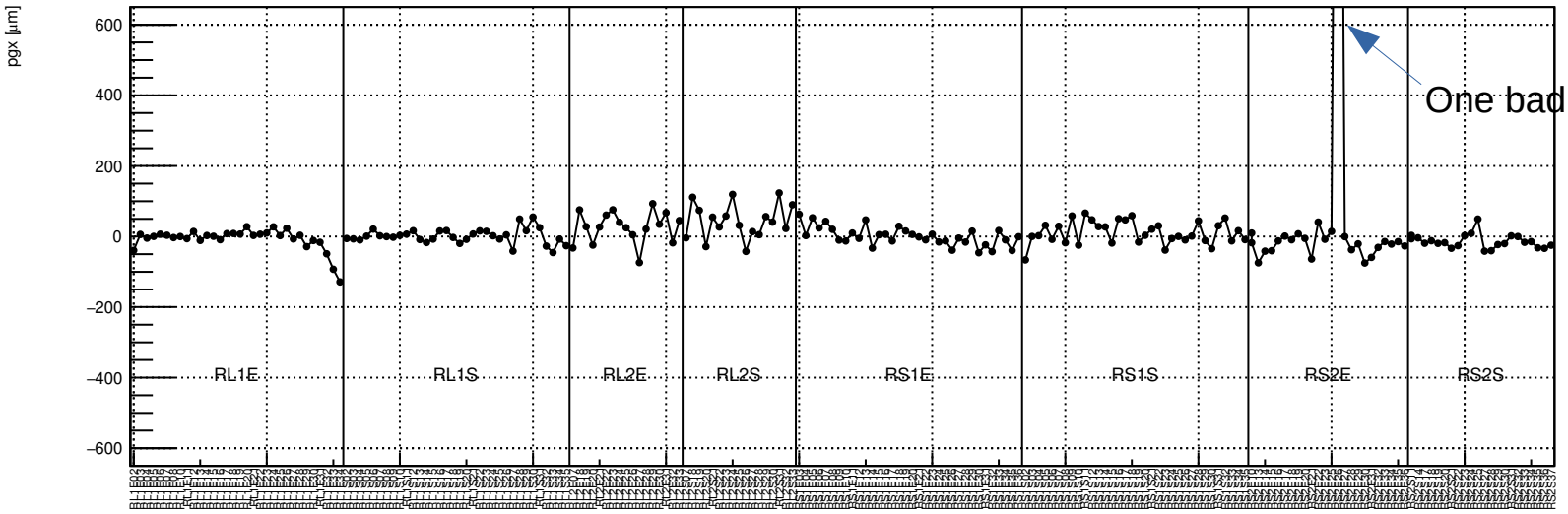


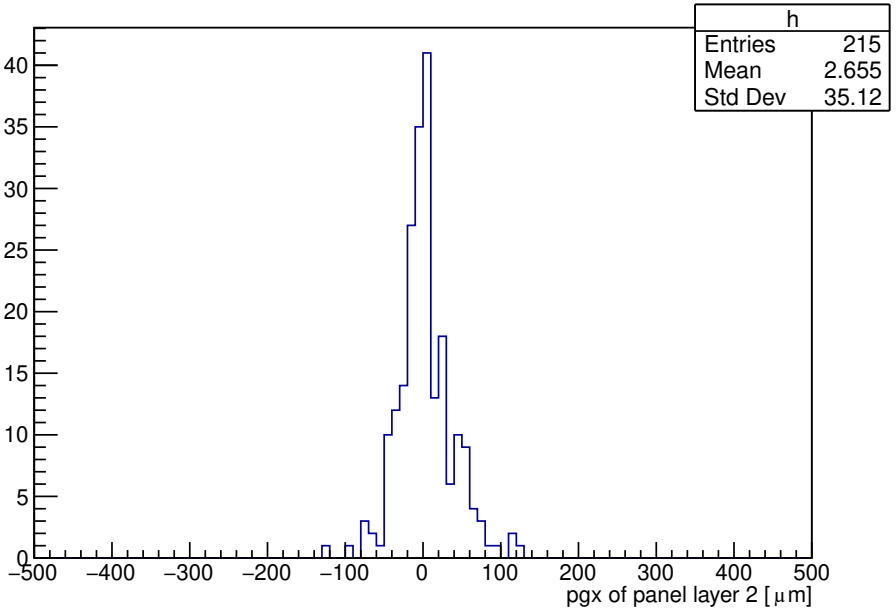
Subject of the previous slides

What about the rest of the production?
Three possibilities:
1) Observed pgx is real
2) BB5 measurement is biased or imprecise
3) Measurements at construction sites are biased or imprecise

Example gantry CMM measurement at construction site
- Possible systematic bias: angle between the X and Y axes
- Both panel sides are measured in CMM
- A pgx systematics would be visible when comparing with the rasfork measurements

Fit pgx in panel measurements





Perform full metrology fit for panels:

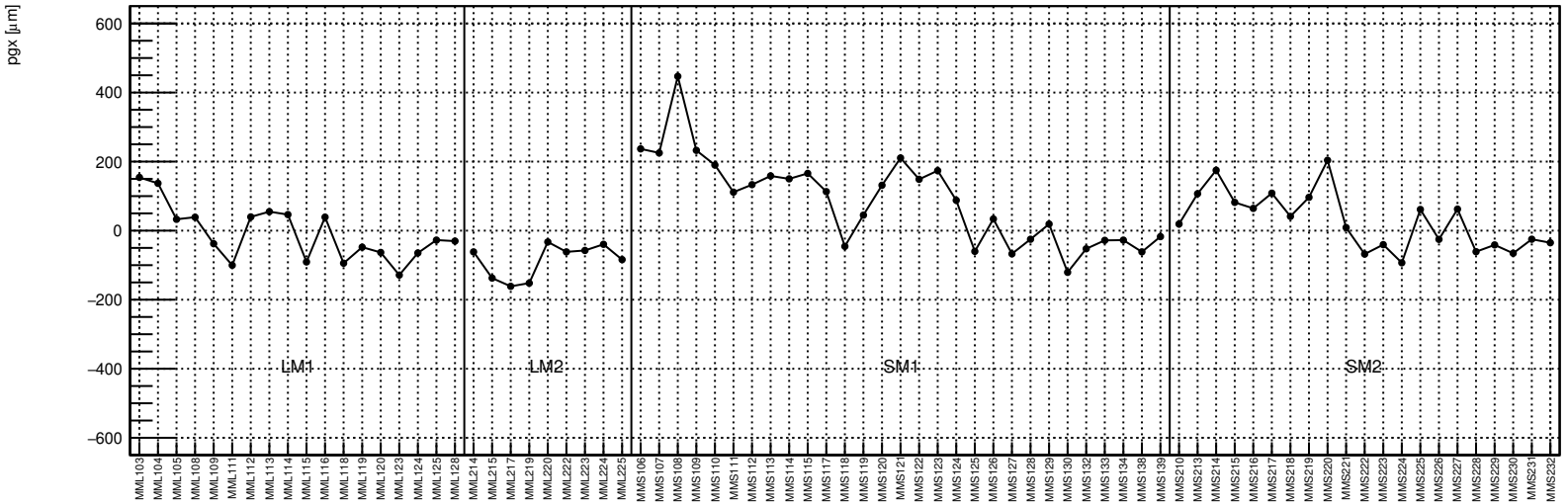
- Gantry CMM or contact-CCD table
- 2-rasfork
- CERN QAQC PCB measurements

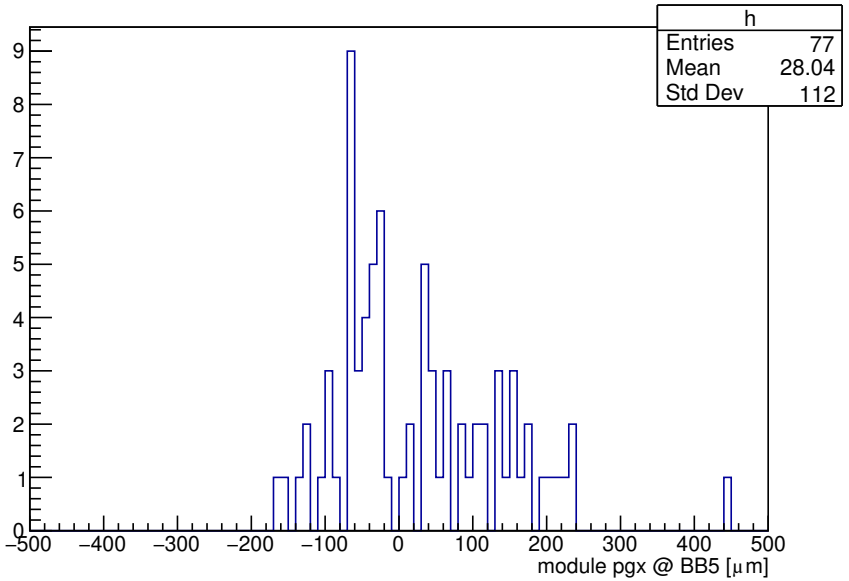
With additional parameter: pgx for one of the two panel sides

If bad of gantry: expect to see on BB5 jig measurement

- Factor 2 smaller values if systematic constant angle bias of the layer measurement
- Factor √2 smaller values if stochastic error (reproducibility)

Reminder of the BB5 result





Conclusion can be one of two things:

1) Effect is real
2) Systematic bias in BB5 measurement