ECAL-P mechanics: tungsten plates CMM measurements

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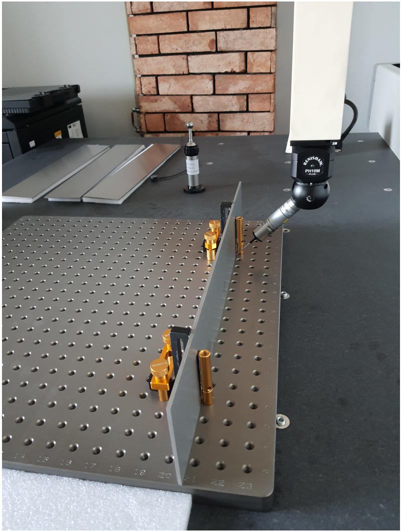
ECAL-P mechanics: 2x3 pilot tungsten plates

- 3 tungsten plates from Xiamen (purchased by TAU)
  - X1
  - X2
  - X3
- 3 tungsten plates from Beijing (ATM/ATAS) (purchased by UW)
  - B1
  - B2
  - B3

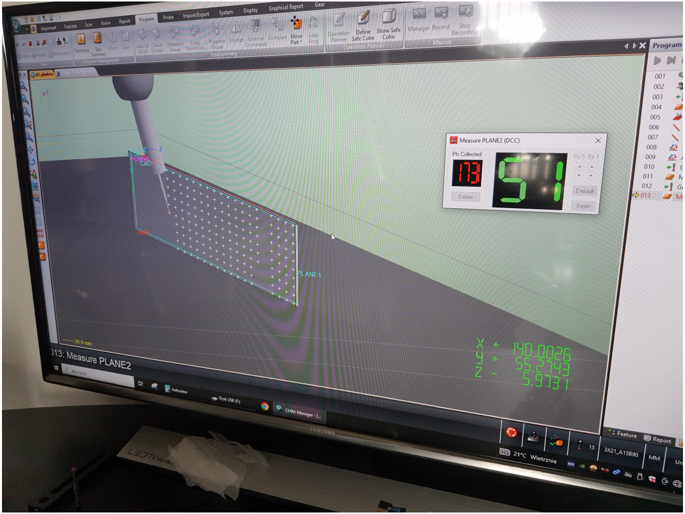
CMM: table and calibration

- CMM self calibration wrt the reference sphere
- CMM XYZ precision $\sim 1 - 2\ \mu$m



- measurement performed in vertical configuration (as in ECALp)
- some dead ares around the support pillars (mainly one side on "plane 2")

CMM: grid



- $\sim 250 = 10 \times 25$ XY points on each side, starting 2.5mm from the edge
- some dead ares around the support pillars (mainly one side on “plane 2”)

CMM: global dimensions XYZ

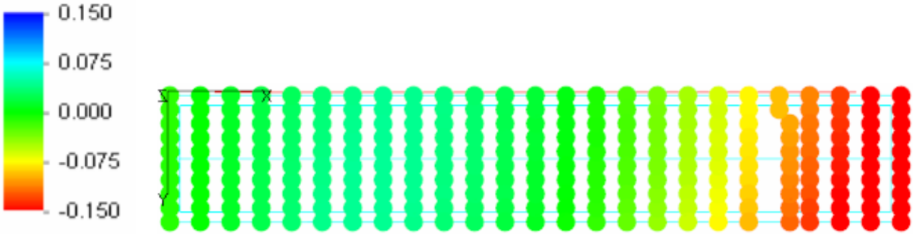
XYZ dimensions (mm)			
Plate	X	Y	Z
X1	555.1039	100.0907	3.5593
X2	555.1047	100.0864	3.5429
X3	555.1388	100.0964	3.5407
B1	555.0785	100.0640	3.5451
B2	555.0654	100.0458	3.5547
B3	555.0637	100.0366	3.5701
Nom	555.00$\pm$0.20	100.00$\pm$0.20	3.50$\pm$0.05

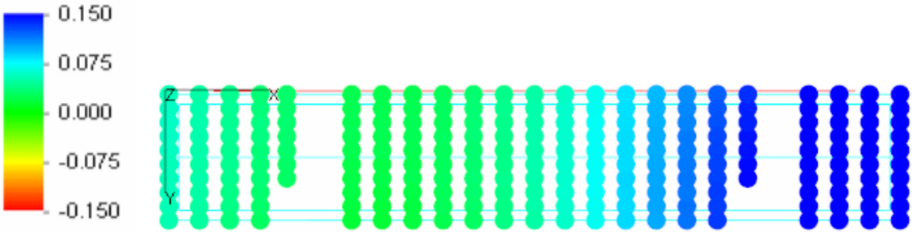
- XYZ: average ? max dev. ? (XY measured “flat on the table”)
- Beijing a bit better in XY precision, both within spec.
- in Z both similar, oversized by $\sim 50\ \mu$m, out of spec.

CMM: flatness

- on next pages plotted are deviations (residua) in local Z-direction from the nominal/ideal 555 $\times$ 100 $\times$ 3.5 mm^3 shape fitted as a rigid body (rotation and translation only) to the set of 3D CMM measurements points (“cloud of points”)
- the (0,0,0) point is in upper left corner on plane 2
- first points on the circumference are 2.5 mm from the edge (to ensure thickness measurement within the comb/rib area)

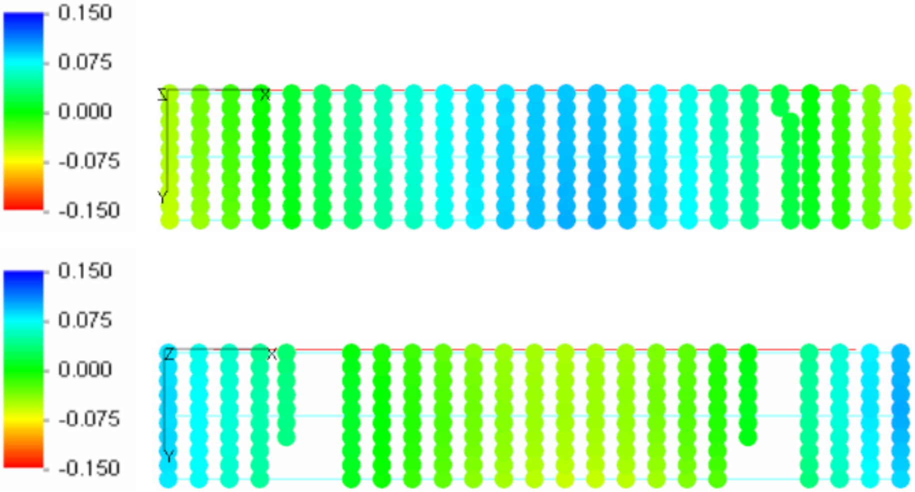
CMM: X1 plate: plane 1, 2





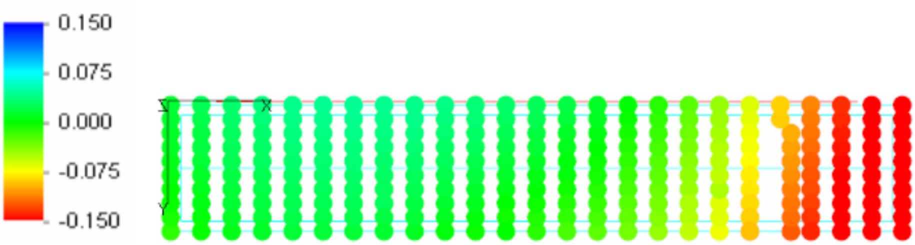
- bending for large X values, $\sim 150\ \mu$m, correlated
- 25% of the length affected

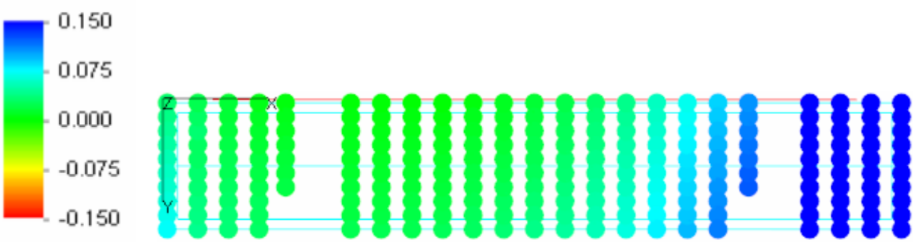
CMM: X2 plate: plane 1, 2



- little “wave” visible, hills and valleys correlated, $\sim$ 75 μm depth
- relatively good plate, best from Xiamen, close to spec.

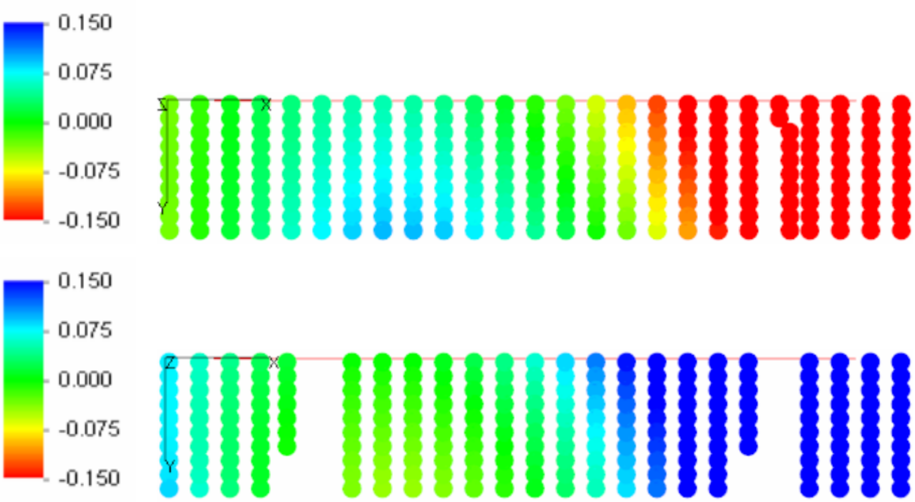
CMM: X3 plate: plane 1, 2





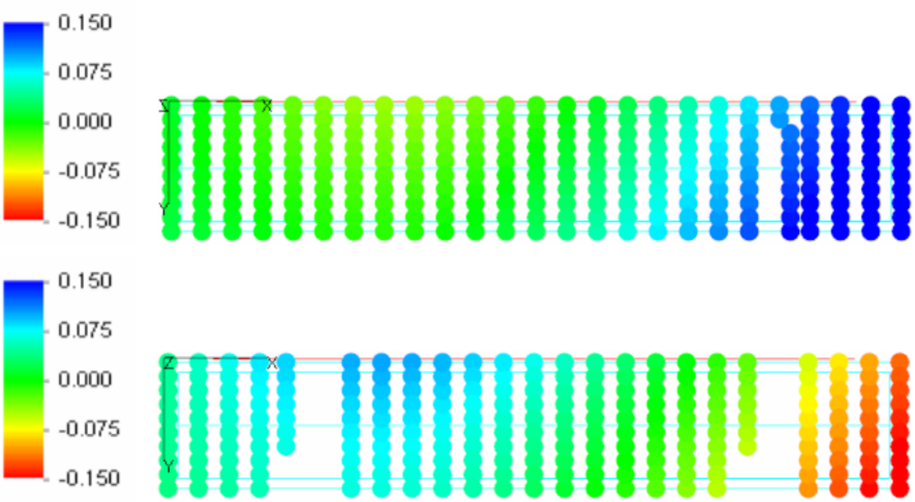
- similar to X1, $> 150\ \mu$m bending for large X

CMM: B1 plate: plane 1, 2



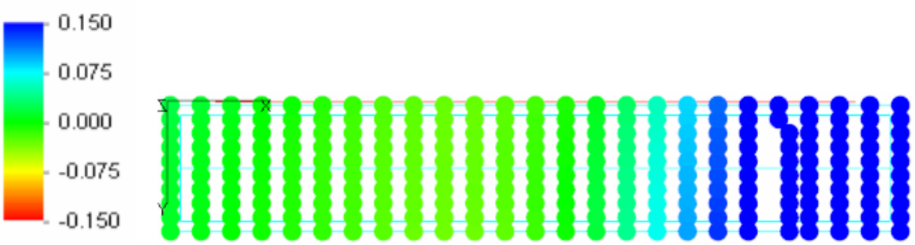
- big bending, $> 150\ \mu$m, for large X plus some “wave” in the middle, ,$\sim 75\ \mu$m
- 33% of the length affected

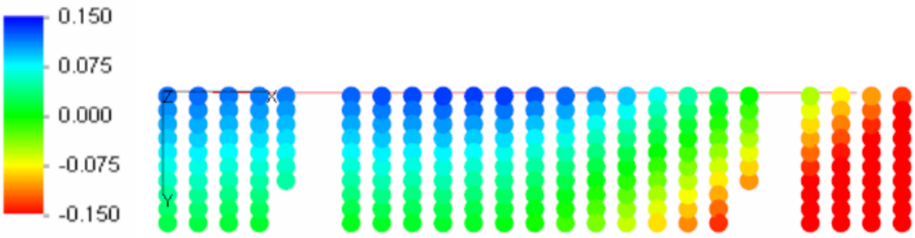
CMM: B2 plate: plane 1, 2



- bending $> 150\ \mu$m, for large X plus some “wave” in the middle ,$\sim 75\ \mu$m
- only 20% of the length affected, best plate from Beijing

CMM: B3 plate: plane 1, 2





- the worst plate, planes not parallel, edge cutting due to non uniform grinding ?
- deviations $> 150\ \mu$m

Summary

- XY dimensions OK for both vendors
- Z (thickness) on the edge of spec ($\gtrsim$50 μm bigger for all plates)
- flatness/planarity: $>$ 150 μ for majority of plates, see X1-3, B1-3
- usually it is due to the bending (good news ?)
- consumed are more than 200 μm from the safe margin of our tolerances (50 μm thickness + $>$ 150 μm bending)
- **anticipated big problems during Si+CF+kaptons+glue sandwich insertion !** The "sandwich" is thicker than 800 μm !
- for 2025 TB and few sensors under test we can hopefully survive (finding best slots/position along X) and by "shuffling" the tungsten plates
- **what for full ECALp prototype ? 1.2 mm gaps !?**
- any other ideas ?

- *BTW: the flatness $<$ 50 μm claimed by both manufactures were measured probably in position "flat on the table", not in vertical position, we did not specified this...*
- *so: maybe, if the tension is not very big we can compensate the bending (even partially) in the combs/ribs ?*