

LUXE ECAL activities and plans in Valencia

Melissa Almanza, César Blanch, Adrián Irles

****AITANA group at IFIC – CSIC/UV***



▷ ECAL-e CALICE activities (snapshot)

▷ ECAL-p activities

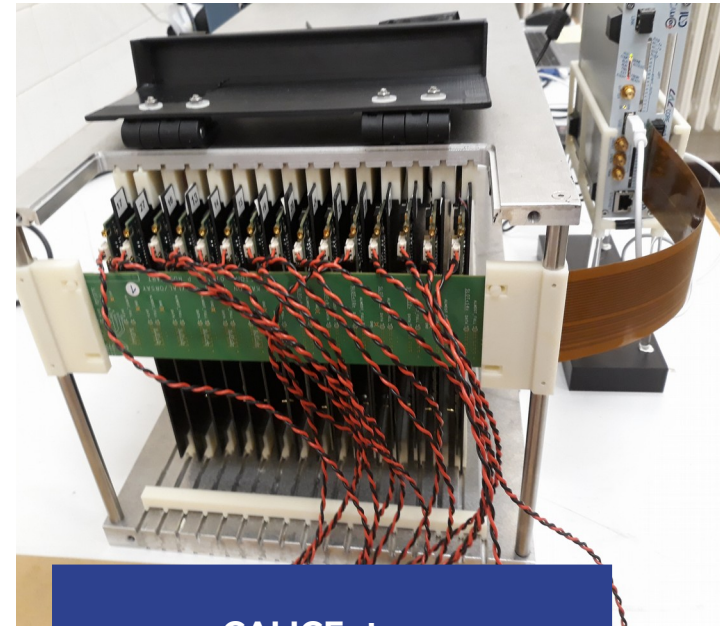
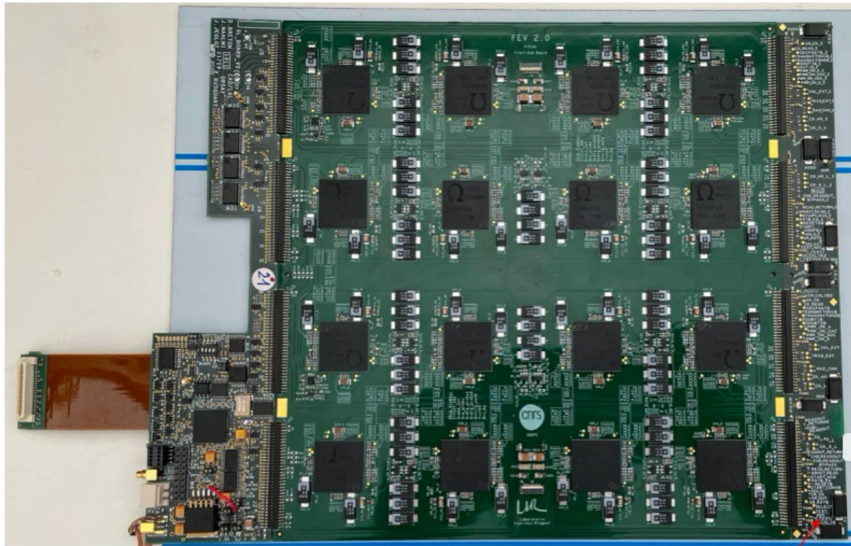
- Carbon Frames
- Metrologis
- Glue thickness studies

▷ Plans 2024



▷ Open **challenge**

- Delamination of wafers observed... $\frac{3}{4}$ of the latest prototype modules are not usable.
- Very busy-dense PCBs → uncontrollable(?) mechanical properties



CALICE -type
calorimeter

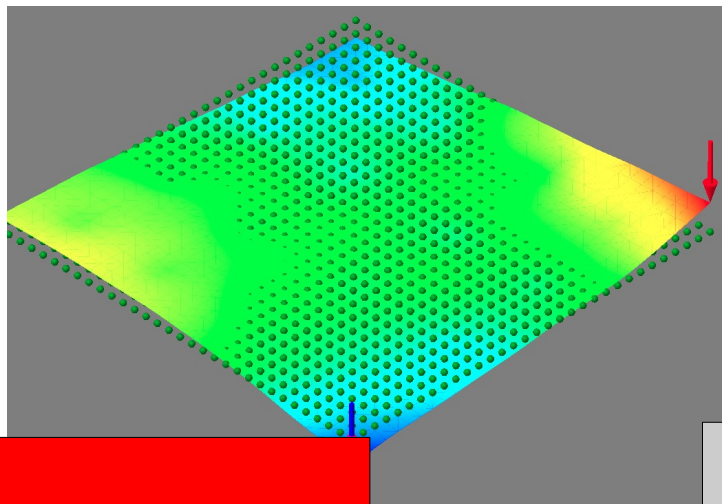
ECAL-e: sensor delamination

Gluing procedure?

Glue choice,
Mixing,
curing process...

Glue degradation?

Chemical oxidation
(silver vs aluminum),
Lifetime of glue...



Mechanical deformation of the PCBs
Complex PCBs with “intense” thermal processes
for the assembly of the components

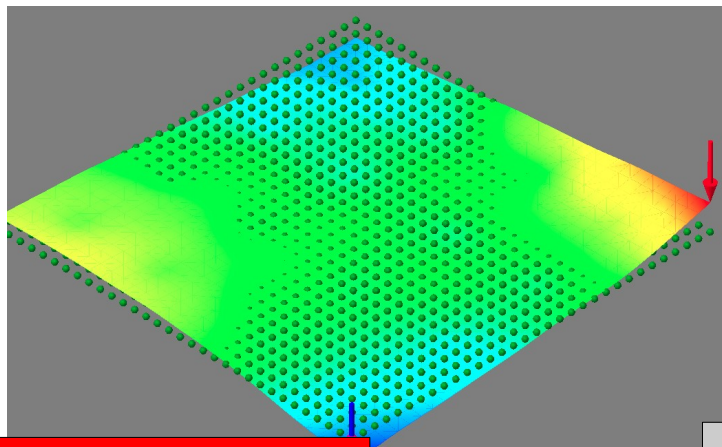
Storage and manipulations

Lots of traveling
Commissioning procedure
etc

ECAL-e: sensor delamination

Gluing procedure?

Glue choice,
Mixing,
curing process...



Glue degradation?

Chemical oxidation
(silver vs aluminum),
Lifetime of glue...

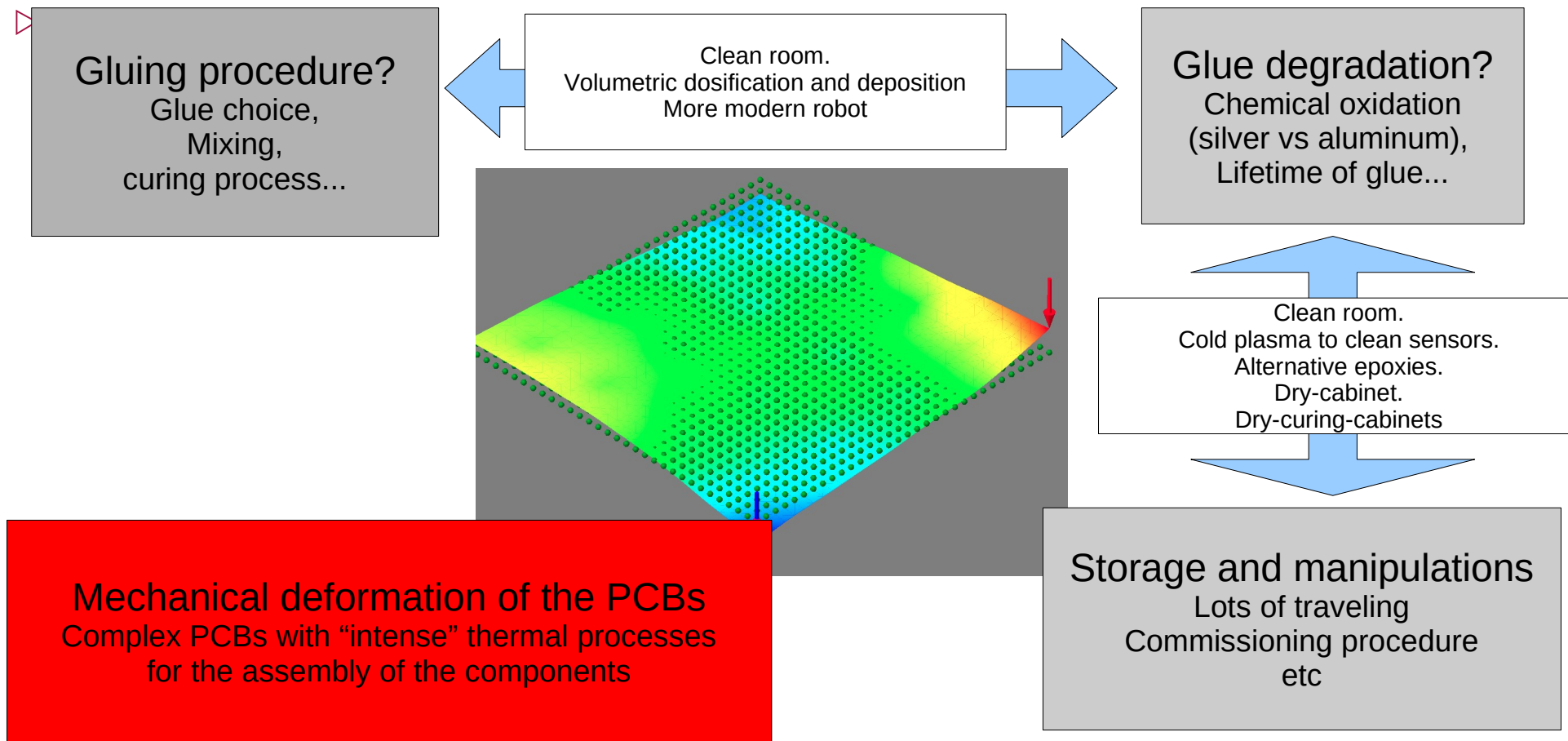
Clean room.
Cold plasma to clean sensors.
Alternative epoxies.
Dry-cabinet.
Dry-curing-cabinets

Storage and manipulations

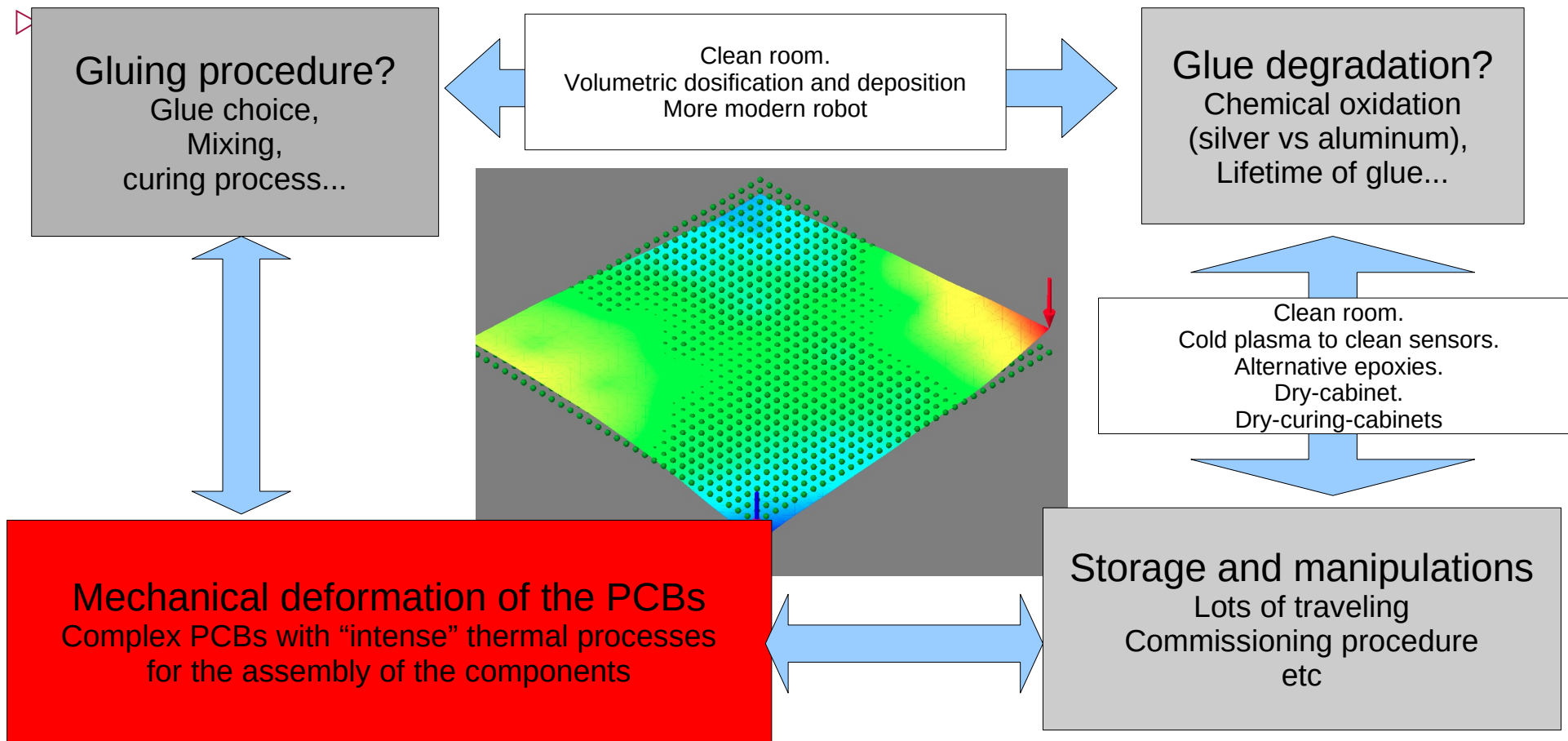
Lots of traveling
Commissioning procedure
etc

Mechanical deformation of the PCBs
Complex PCBs with “intense” thermal processes
for the assembly of the components

ECAL-e: sensor delamination

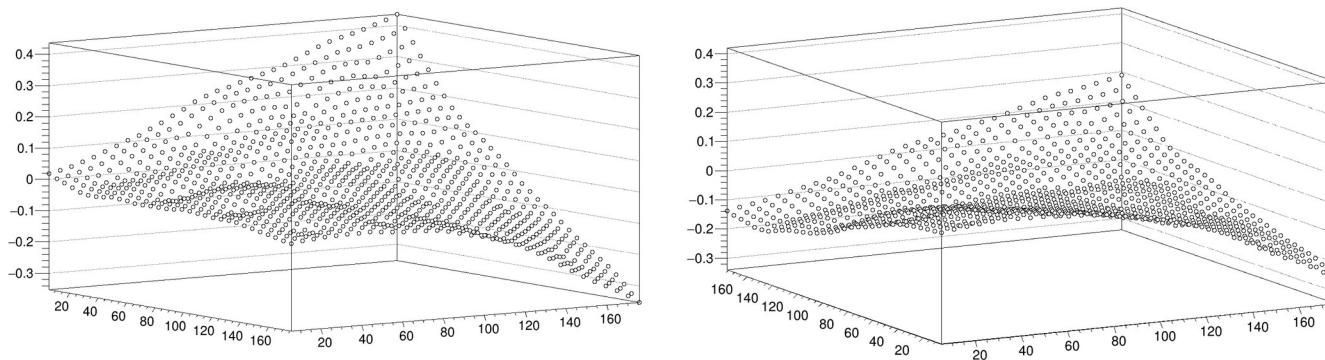


ECAL-e: sensor delamination



▷ PCB metrology at IFIC

- First time this is systematically done in the project with this precision



▷ First results are surprising(?) ! **To be understood**

- **Left:** the metrology of a equipped PCB after receival from IJCLab → up to ~800um deformation
- **Right:** same PCB after being carefully “dried-out” → deformation reduced to ~450um

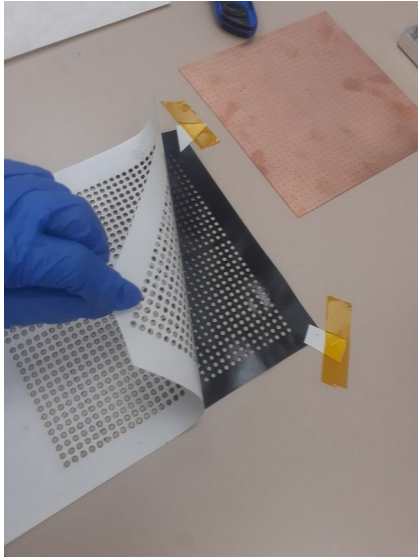
▷ **Systematic study to be conducted during early 2024 in collab with IJCLab**

- Using naked PCBs, following different heat treatments and drying processes

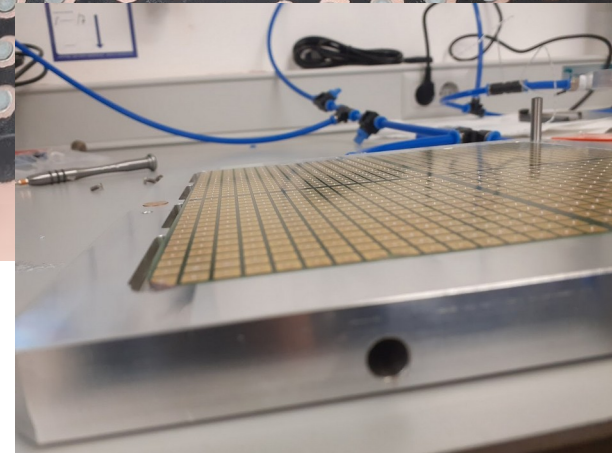
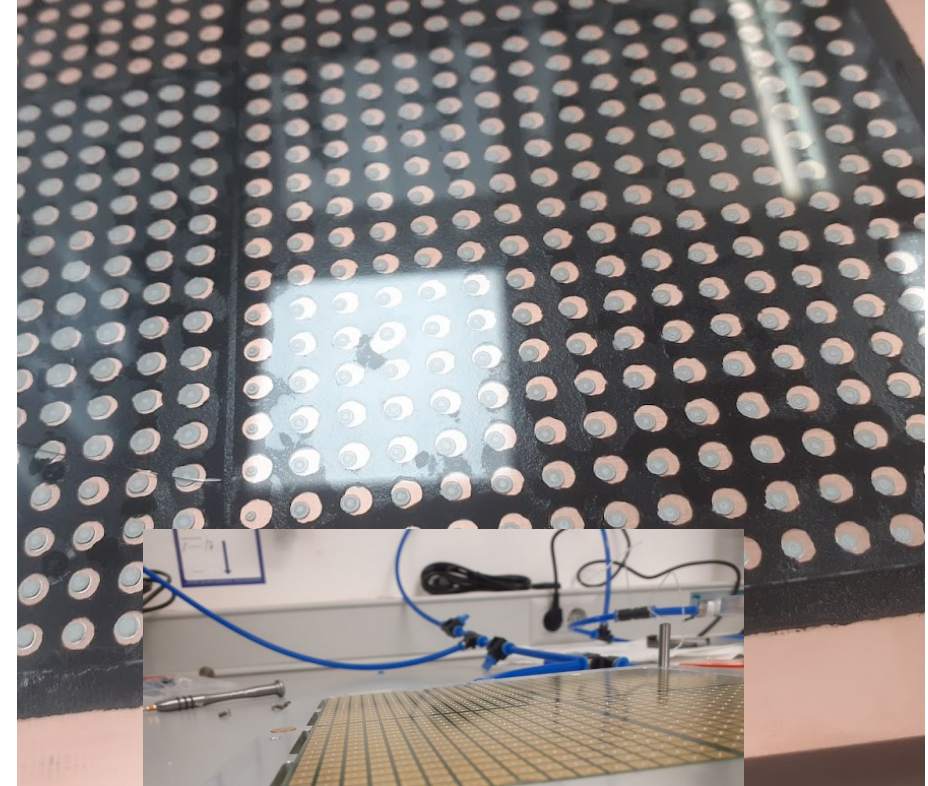
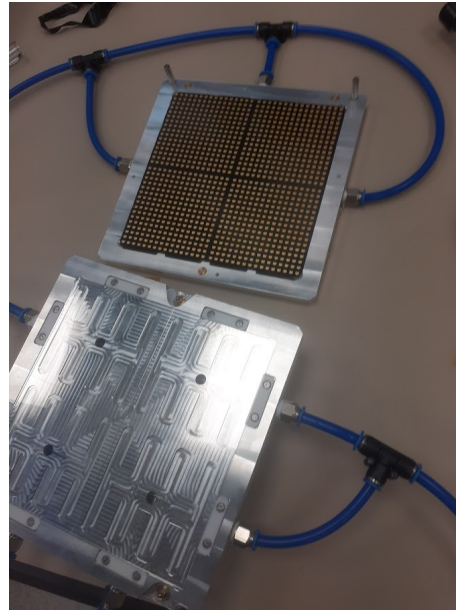
ECAL -e: tape+glue solution for hybridization

▷ Mixed solution:

- **Perforated stencil** of thin (250um) double tape VHB 5907F **for adherence**
- **Silver Epoxy dots** for electrical conductivity



Stencil made at IFIC (laser drill)



ECAL -e: summary & plans

▷ Metrology studies will take 1 month (probably more)

- IJCLab+IFIC

▷ Establishment of the procedure for using the tape+glue hybridization solution

- Tooling + training ongoing
- A particular challenge is the perforation of the 3M tape in a semi-automatized way. Currently using laser drill... 1st try was perfect, the 2nd one not so much

▷ June: TB at DESY

- 1-2 modules glued at IFIC... wip
- Commissioning etc would depend on person power.

(alternative solutions with underfill-glue are investigated at IJCLab)

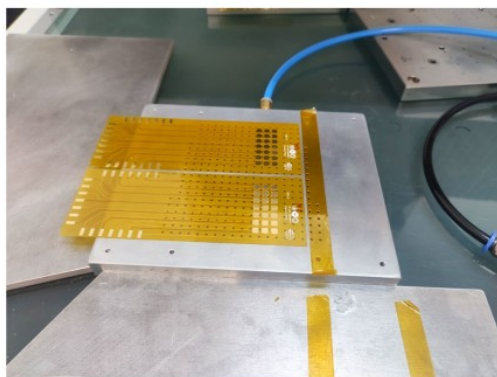
- ▷ Gluing procedure being established
 - Experience on the robot acquired during the ECALE tests
 - Design and manufacturing of tools for gluing (see <https://indico.desy.de/event/42289/>)

- ▷ Challenge to be addressed in the coming weeks: are the 50um for glue dots realistic ?
 - After several “manual tests”: t seems so...
 - More systematic studies ongoing.

- ▷ We found a company that produces thin Carbon Frames.
 - 10CF acquired
 - Metrology studies ongoing

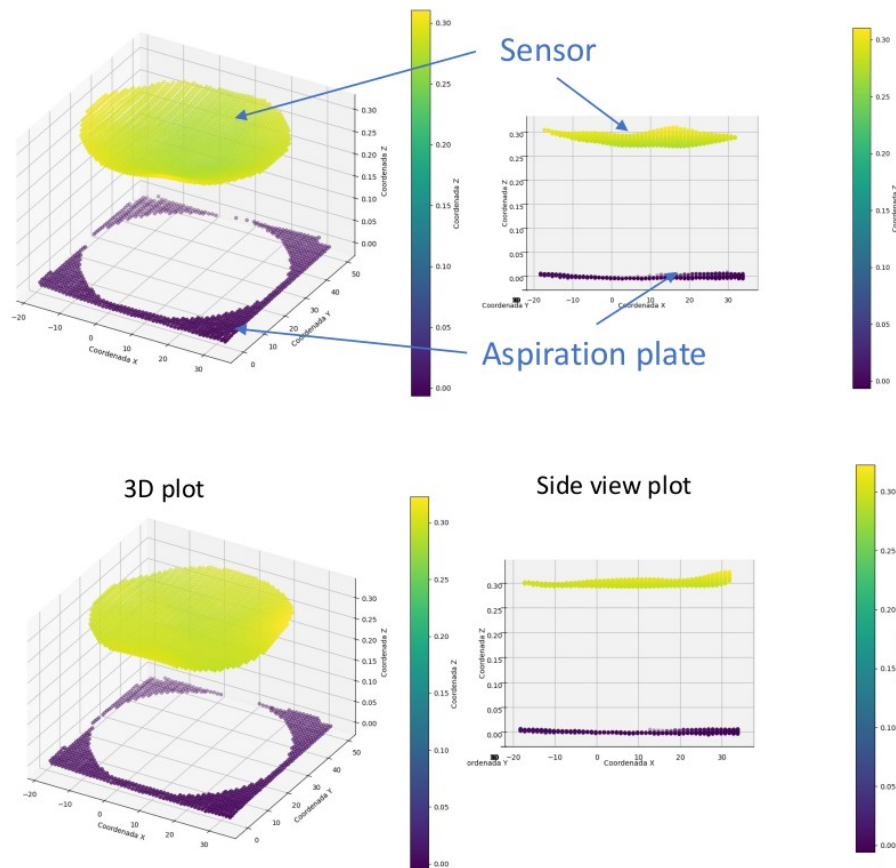
Sensors glueing metrology

- The goal is to measure the glue thickness after glueing process.
- Vision measurement machine
- Vacuum aspirated to ensure the position
 1. Flex PCB thickness measurements
 2. Sensor thickness measurements
 3. To glue the PCB to the sensor
 4. Final thickness measurements PCB+glue+sensor



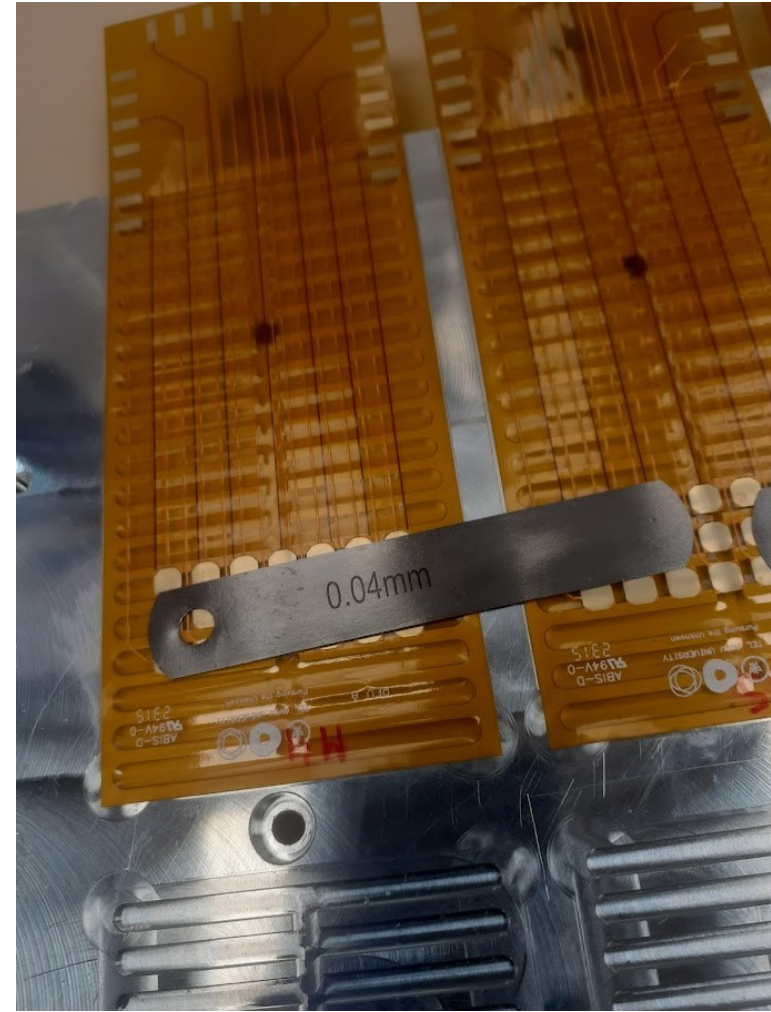
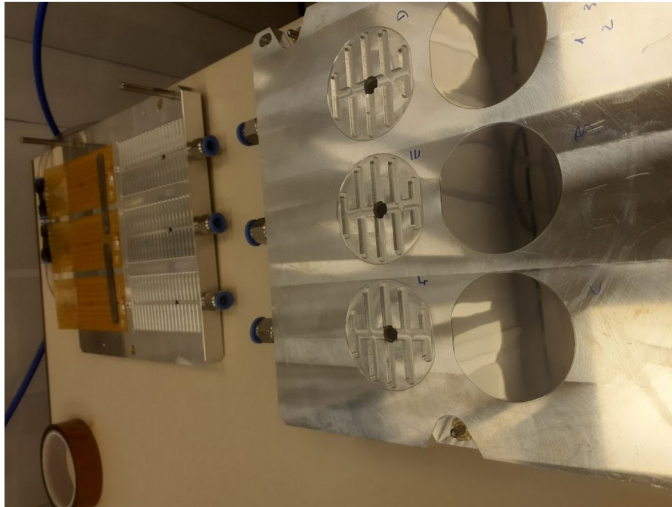
Sensors glueing metrology

- 6 fake Si sensors already measured
 - Still the data needs to be analysed
 - The aspiration plate is not completely plane so it seems that it induces an error in the thickness measurement.
 - So the aspiration plate will be measured and subtracted to the sensor measurement to compensate the error.
- PCB measurements in progress (expected to be finished by the end of this week)
- Then we will glue the sensor to the PCB and will measure again the pack



Gluing tests for glue thickness measurements

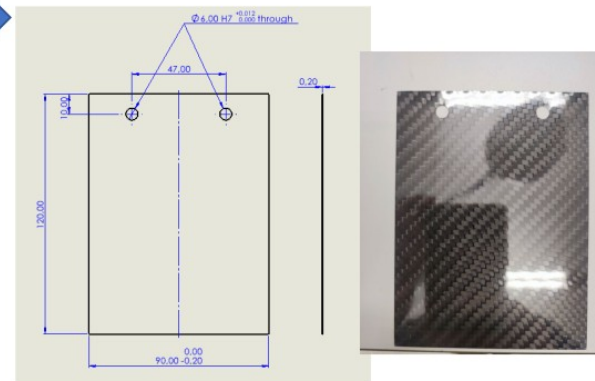
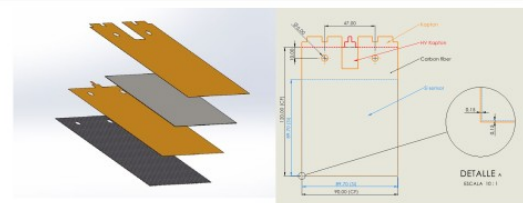
- ▷ Starting this friday
- ▷ Using the robot and procedure defined and tested with the ECALe modules
- ▷ Play with different approaches to define thickness:
 - Feeler gauges, glue dots size, etc
- ▷ Perform metrology after the gluing.



Carbon frame metrology

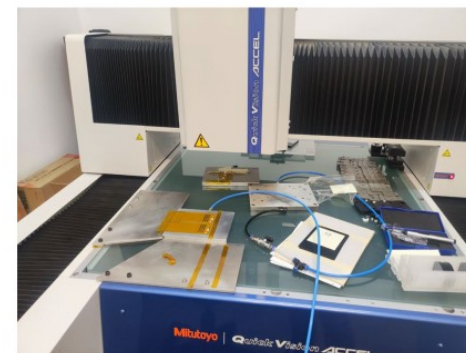
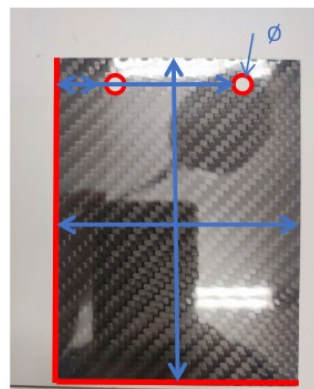
➤ 10 CF samples received manufactured according to the drawing ➔

- Dimensions: 90x120x0,2mm
- 2 holes $\varnothing 6$ mm for positioning pins



➤ Metrology in progress

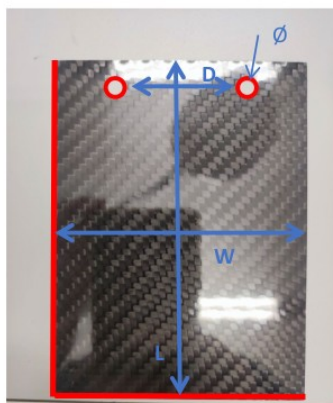
- Vision measurement machine
 - 2 measurement methods:
 - Focus by vision (slower but seems more accurate)
 - Focus by laser (faster but seems less accurate)
- Measure dimensions, thickness, and alignment holes position
- Vacuum aspirated to ensure the position
 - Need to measure the aspiration tooling (for thickness measurements)



Carbon frame metrology

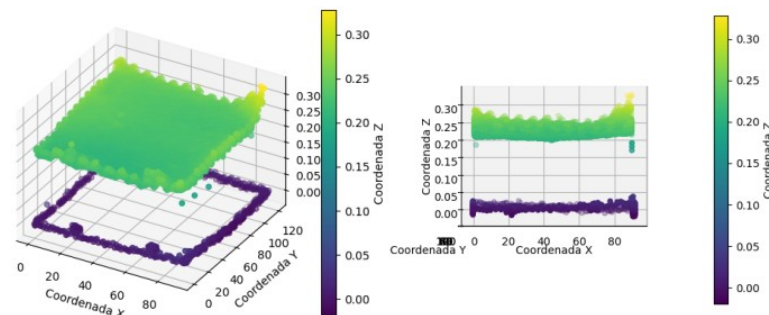
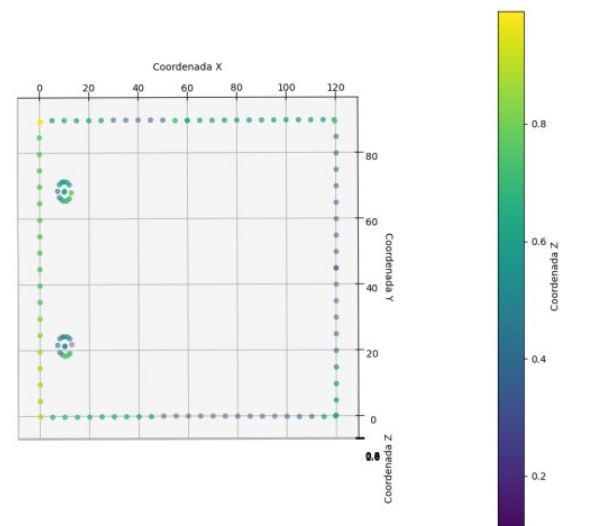
➤ Vision machine measurements

- Measurements with focus by laser method in progress
- XY measurements to determine dimensions.
- Z measurements to determine thickness



➤ Some results for sample 1:

- W= 89,93mm
- L= 119,89mm
- D= 46,98mm
- \varnothing = 5,94mm
- Z= 0,215mm (average plane)
- Z values increase on the edges of the CF, probably due to the lack of aspiration on that place



Carbon frame metrology

- Manual measurements with external micrometer
 - Thickness measurement at 6 points



Nº Sample	Measure point						AVG
	1	2	3	4	5	6	
1	208	213	237	236	246	242	230.33
2	207	216	220	237	229	238	224.50
3	215	206	220	214	219	206	213.33
4	220	233	222	240	226	230	228.50
5	215	214	224	207	217	207	214.00
6	229	231	242	244	235	233	235.67
7	219	214	241	242	245	246	234.50
8	213	215	234	238	242	247	231.50
9	227	227	238	239	226	227	230.67
10	233	229	236	239	228	226	231.83

- Measures between 207 and 247 μm
- $\sim 225 \mu\text{m}$ average thickness
- To crosscheck with the vision measurement machine

▷ Mechanics division at IFIC is being rearranged

- Less person power available from February until... ? (also an issue for ECALp...)

▷ February

- Study of all the metrology data we have
- Finalizing material and equipment of the clean-room.
- Probe station is taking longer than hoped: the switch card is still missing and part of the laboratory benches needed.

▷ Medium Term (2024):

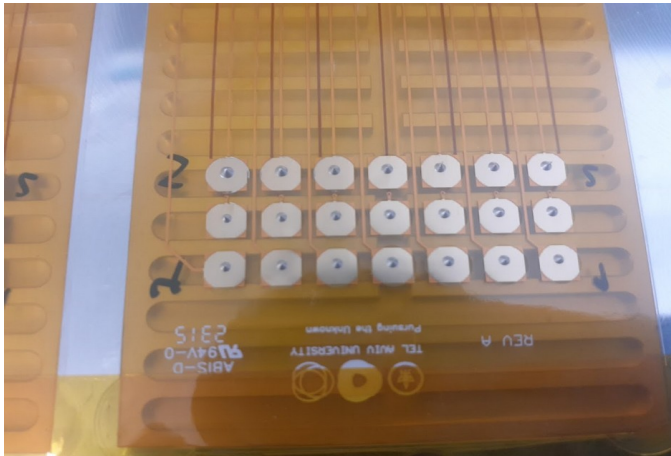
- Independently of the plans for full ECAL building, I advocate for having a handful of sensors glued and ready to test this year.
- To gain experience and get statistics on aging, quality assurance, etc...



ECAL-p: manual gluing tests

▷ Several “manual” tests during 2023

- Learning curve for epoxy / robot usage
- Learning curve for mechanic tooling design / construction / usage



1	15
2	6
3	13
4	22
5	16
av	14.4
stdev	5.8

