HIGHLY COMPACT CALORIMETER, ELECTROMAGNETIC FORWARD SECTION

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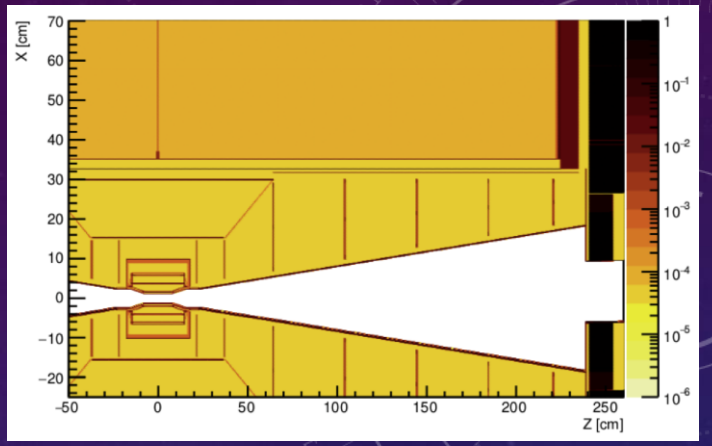
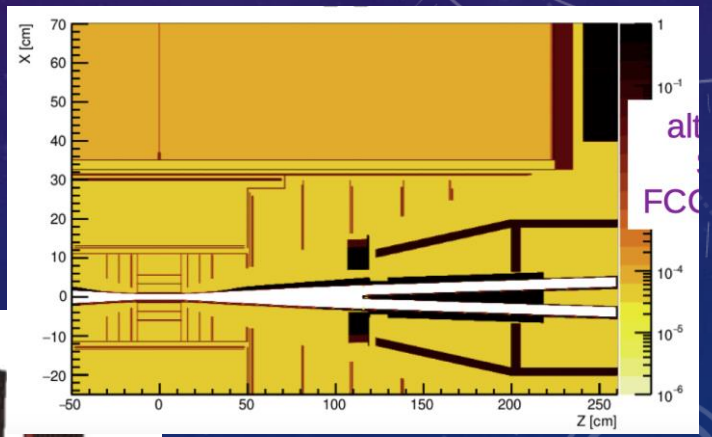
DRD6 COLLABORATION MEETING

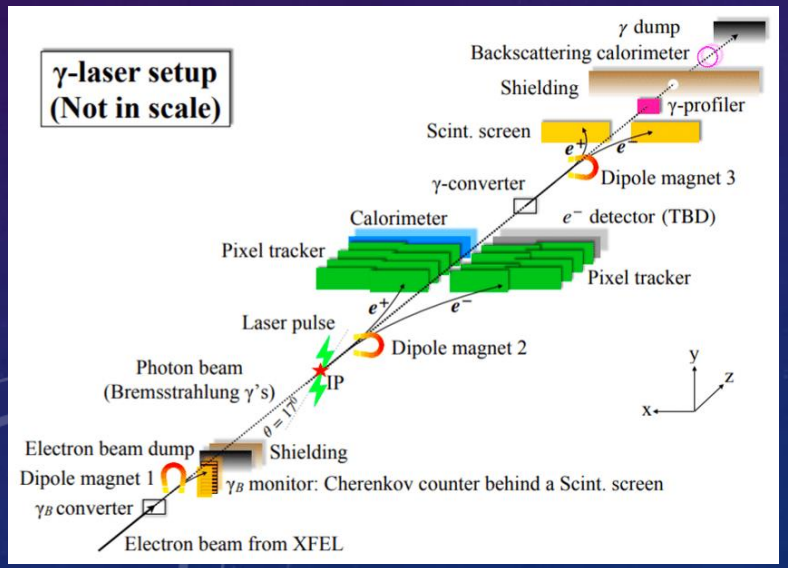
NEED FOR COMPACT CALORIMETER

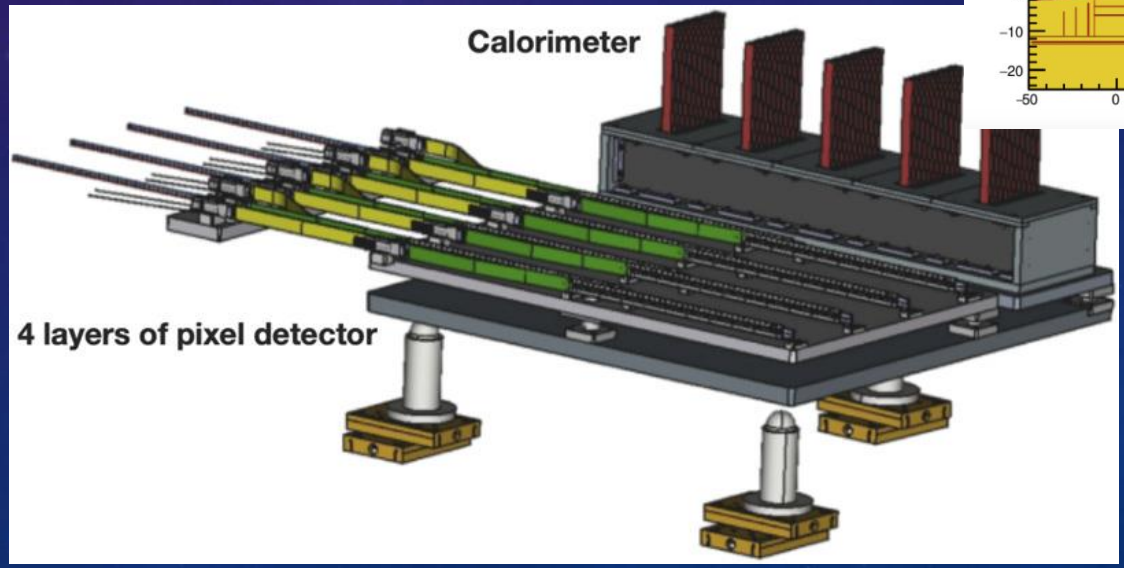
1 mm between W layers

- Compact calorimeter is interesting in :
  - Linear/circular/asymetric collider to measure the luminosity
  - In LUXE, to measure the number of positrons and their energy spectrum in the e- laser interaction





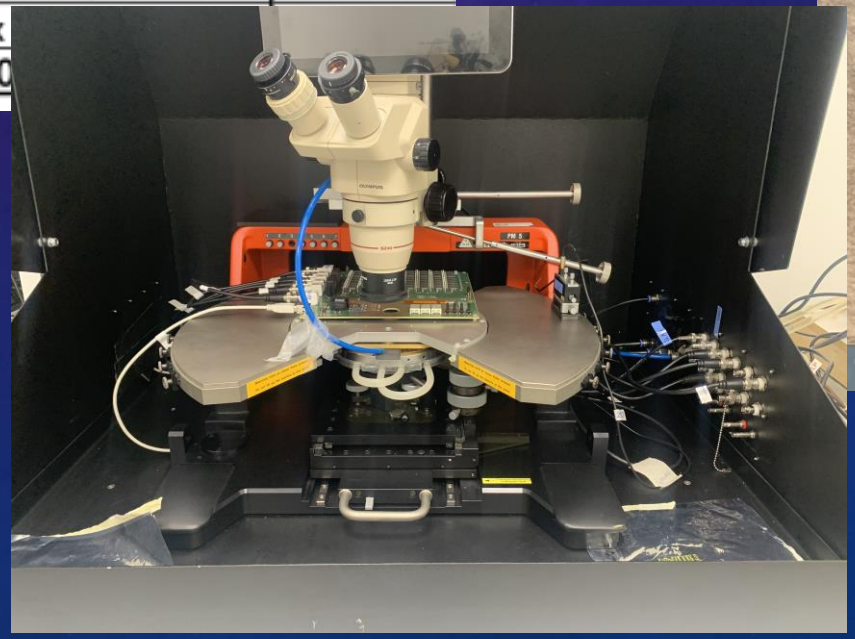


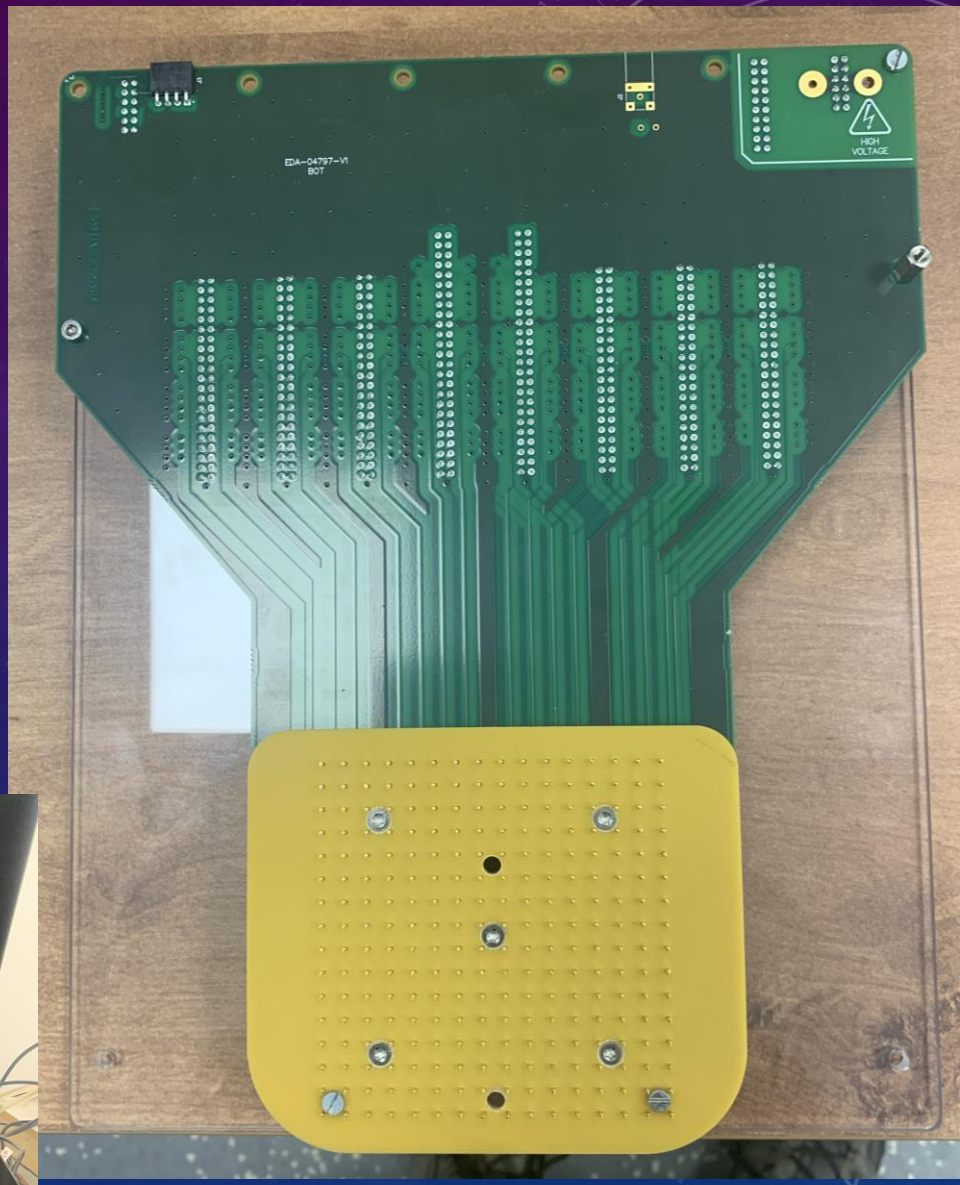


SENSORS AND PROBE STATION

- 90 CALICE sensors received from Hamamatsu.
  320 um thickness, 16x16 pads (5.5x5.5 mm2)
- Labeled and stored in dry cabinet with
  membrane boxes

Parameter	Rating	Unit
Device type	P+ PIXEL on N substrate	
Chip size	89700 ± 40 x 89700 ± 40	μm
Active area	88480 x 88480	μm
Chip thickness	320±15	μm
Number of PIXELs	256(16 x 16)	ch
PIXEL pitch	5530 x	
PIXEL GAP	10	



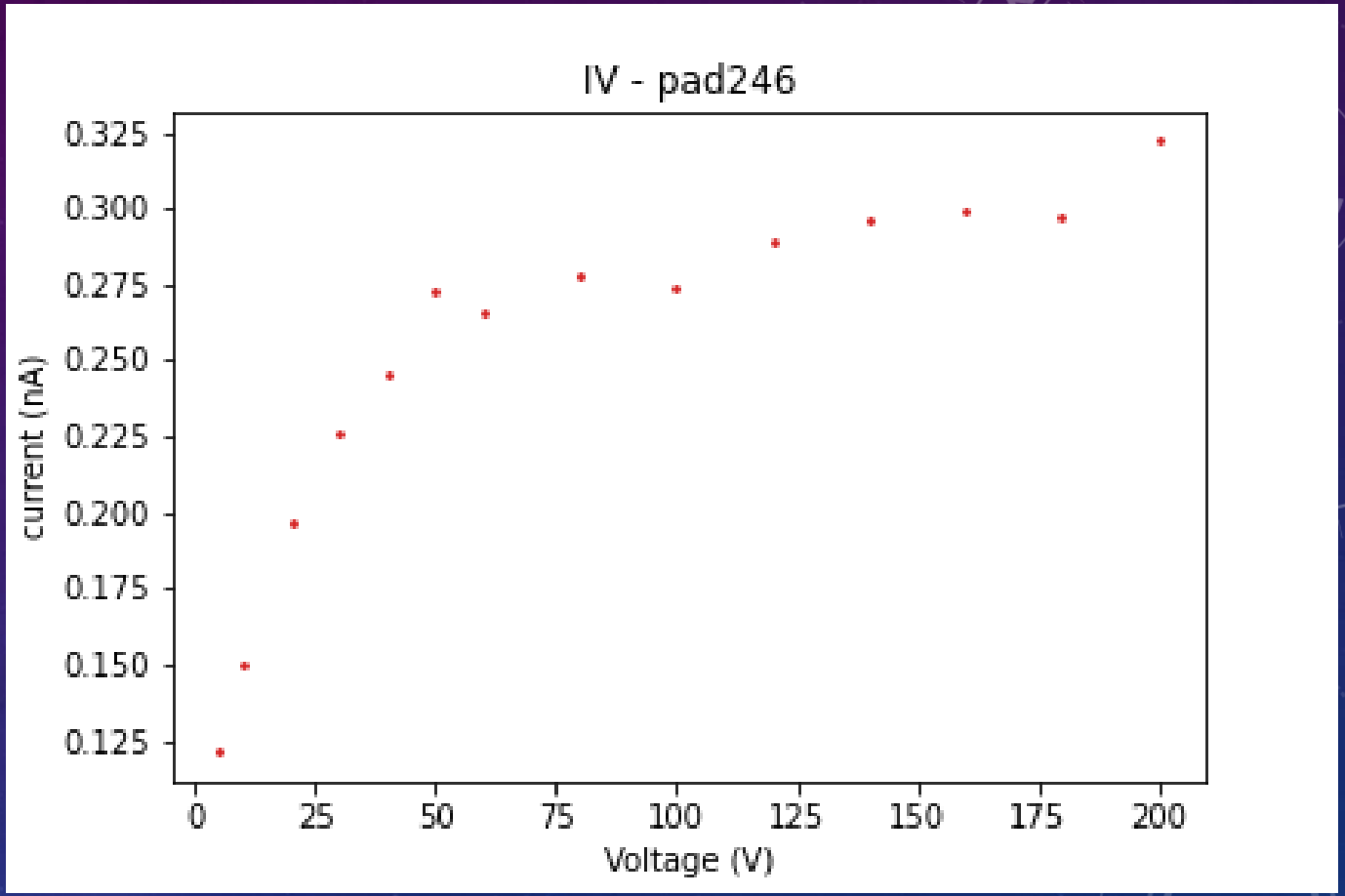


IV MEASUREMENT

Checked the influence of different parameters: delay between measurements, delay between voltage change,…

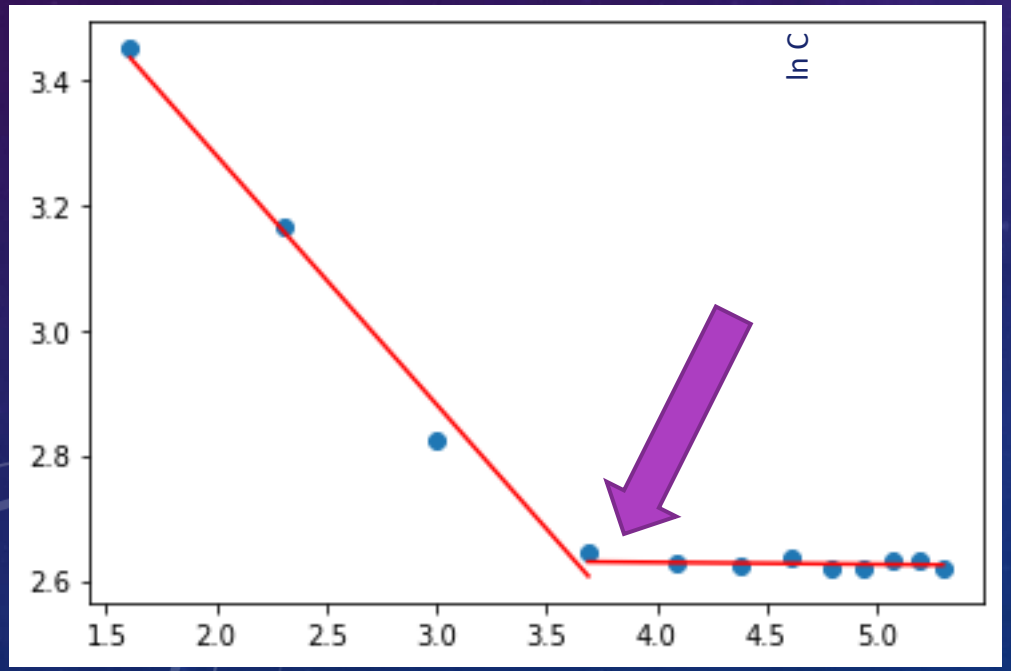
System tuned

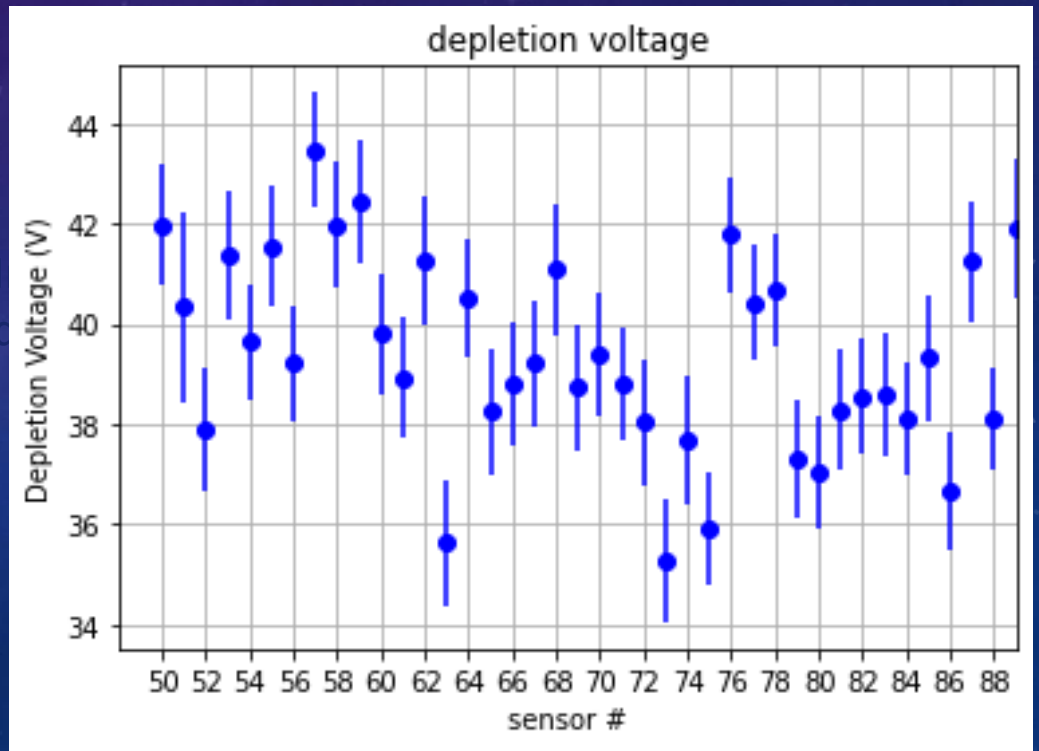
Up to now, 45 x 256 pads measured with current plateau



CV MEASUREMENT - DEPLETION VOLTAGE

- It is possible to extract the depletion voltage from the CV measurement; the capacitance can be modelized by:
- $C_g = A\frac{\varepsilon_{Si}\varepsilon_0}{w} = \begin{cases} A\sqrt{\frac{\varepsilon_{Si}\varepsilon_0 e N_d}{2V}} \; for\; V < V_d, A: pad\; area\; Nd: number\; of\; donor, V\; bias\; voltage \\ A\frac{\varepsilon_{Si}\varepsilon_0}{w_m} \; for\; V > Vd, w_m\; max. depletion\; width \end{cases}$
- So if we take the log of Cg, we should obtain two lines. The intersection of these lines is giving the depletion voltage



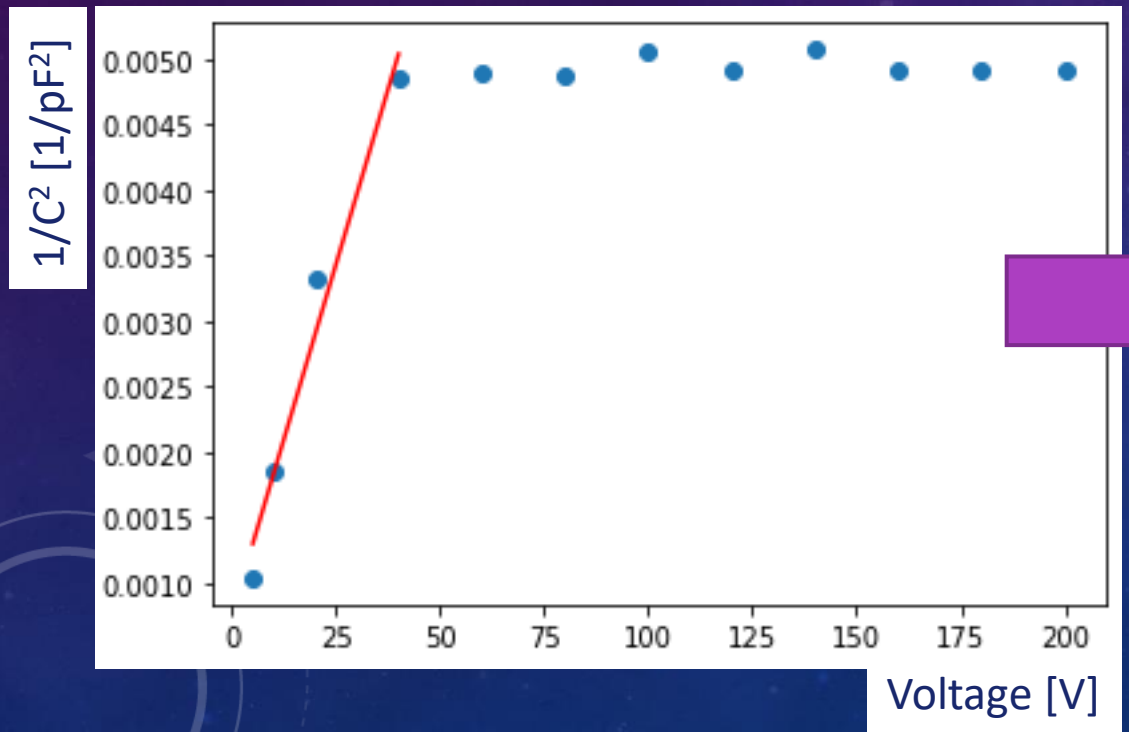


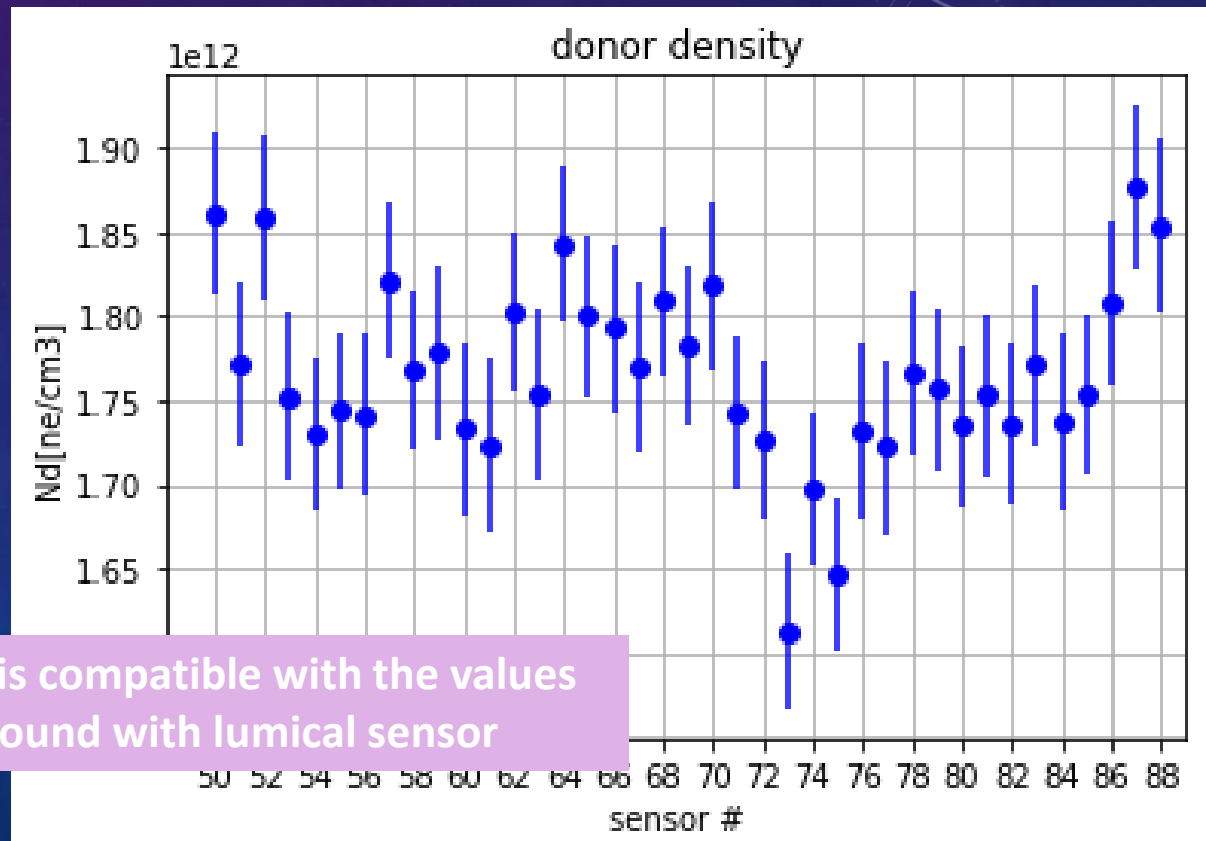
DONOR DENSITY

- It is possible to determine the donor density using the formula :

$$\frac{1}{C^2} = \frac{2}{\varepsilon e N_d A^2} V$$

Where N_d is the donor density and A is the pad area



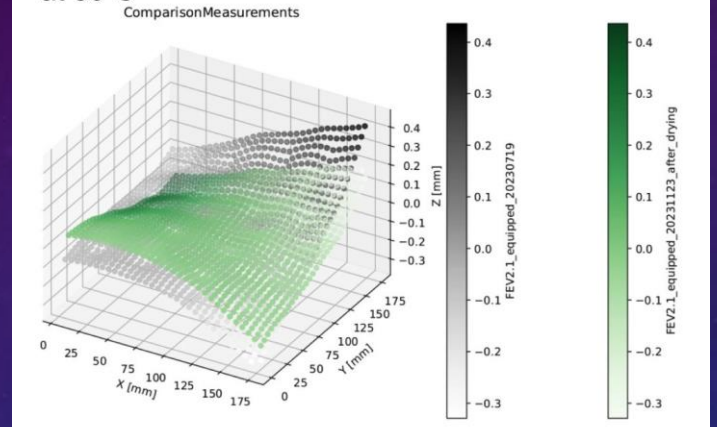


This is compatible with the values found with lumical sensor

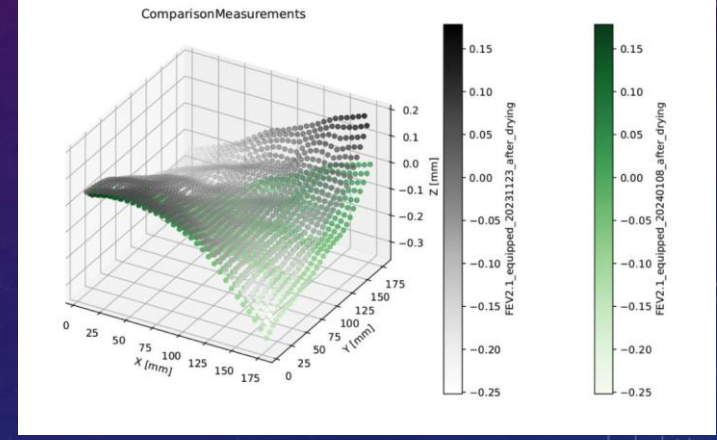
IFIC

- All the sensors will be sent to IFIC to be glued to a flexible PCB
- Several challenges in conductive gluing/hybridization procedure are shared between SiWECAL and the highly compact calo
- IFIC is leading the R&D studies on gluing/hybridization
  - R&D on rigid PCB hybridization in collaboration with IJCLab

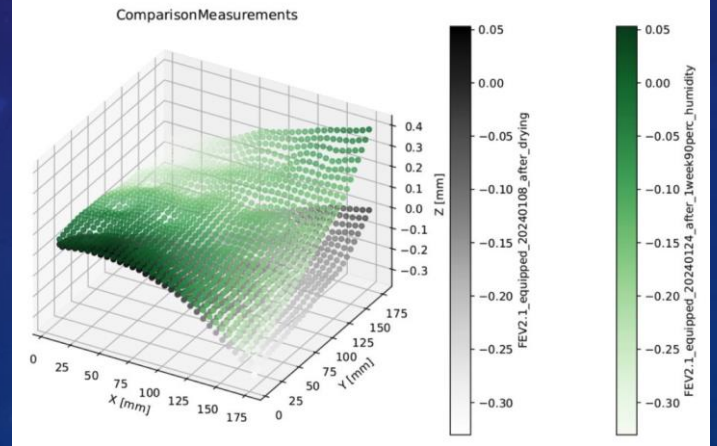
Deformation upon reception and after drying
for 10 days in dry cabinet and heating for 24 hours at 50°C



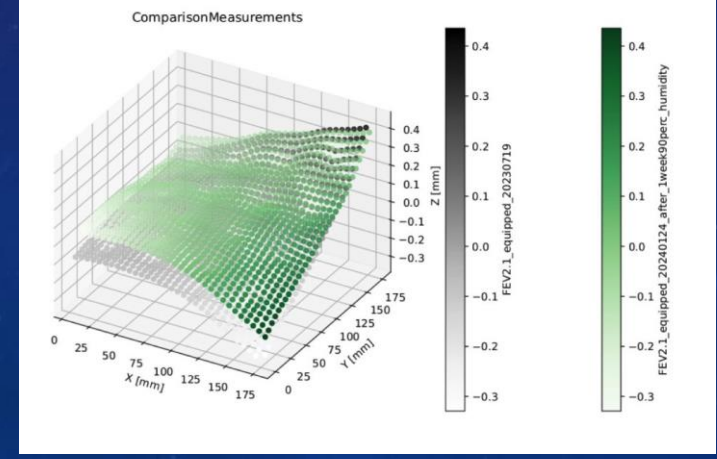
Immediately after drying and
after drying + 1day



Additional drying and humidity cycles
3x72 cycles during nine days at 90% and 30°C



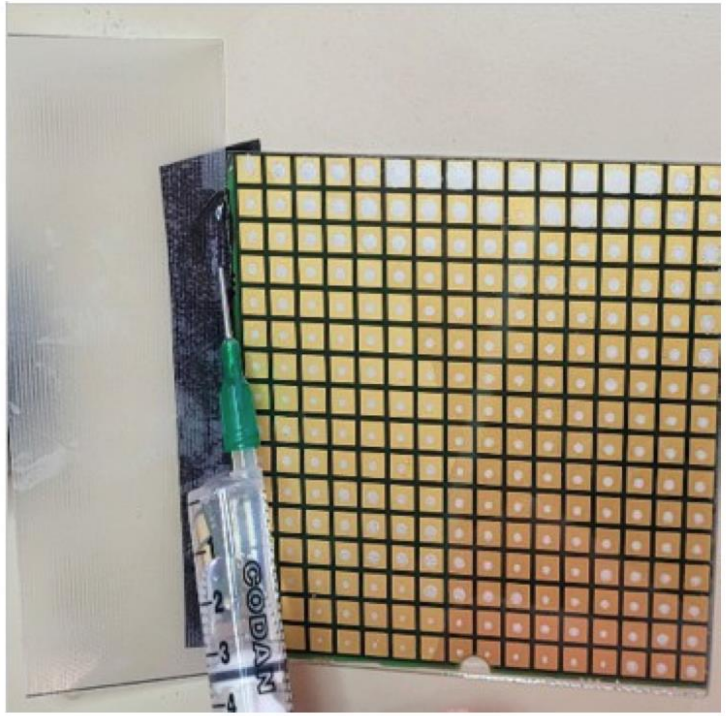
Humidity cycles and PCB upon reception



HYBRIDISATION - UNDERFILL

EPO-TEK® 301-2

Injection of underfill



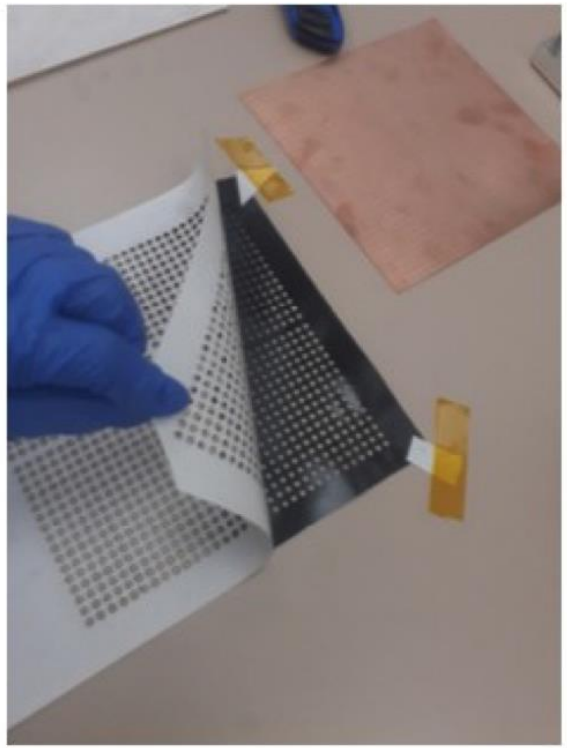
Requieres re-curing at 80 C

... but remains flexible after curing

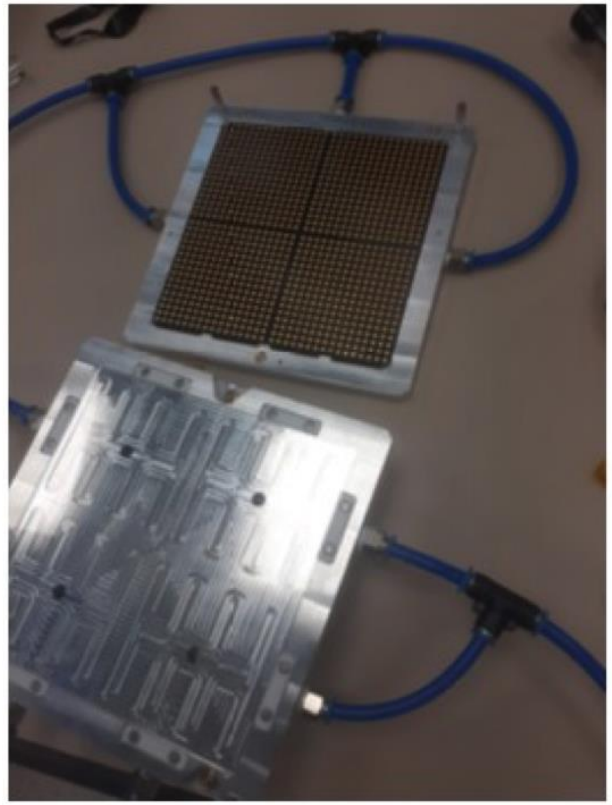
A. Thiebault, A. Gallas+ Mechanics Department of IJCLab

HYBRIDISATION: DOUBLE SIDE TAPE

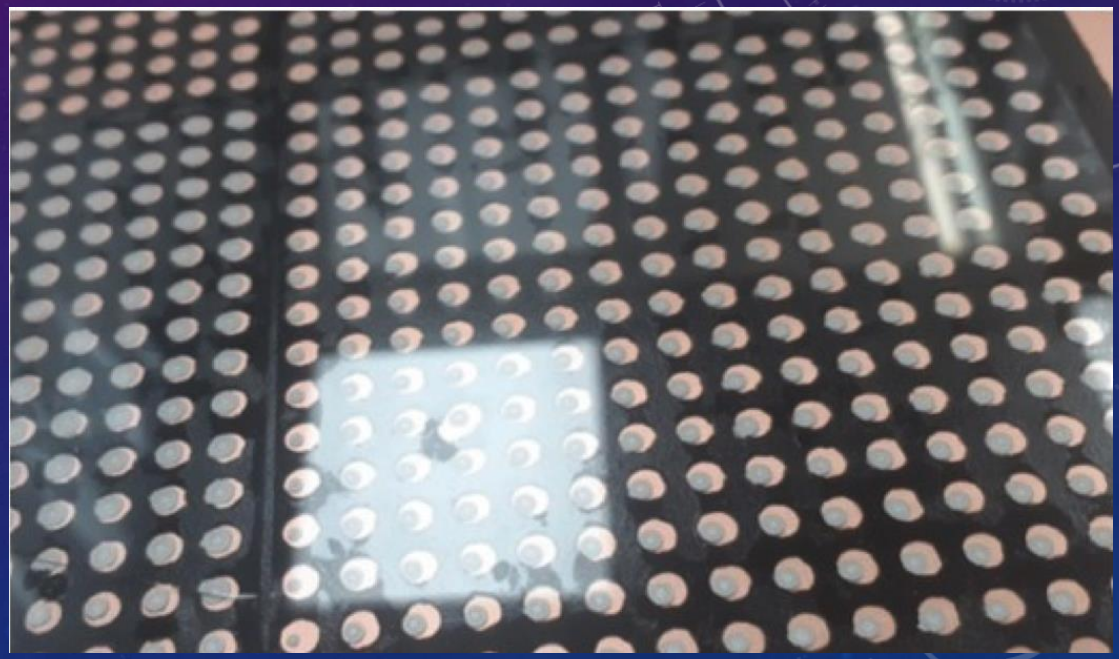
Perforated stencil of thin 250um double tape 3M VHB 5907F



Stencil made at IFIC (laser drill)



One 18x18cm^2 model completed at IFIC



CONCLUSION

- TAU :
  - We have a working setup to characterize silicon sensors, including analysis and storage : we can test two sensors a day
  - All the pads of the tested sensors have a plateau in the IV plot
  - Using the CV measurement, it is possible to extract the depletion voltage and the donor density. These extracted values are compatible with expectations
  - Design of flexible PCB
- IFIC :
  - R&D on rigid PCB deformation
  - Study of different technologies to glue the sensor to the PCB
  - Creation of a IV-CV measurement facility (probe station)

Good synergy between the two institutes to optimize the testing and gluing of the sensors to the PCB

THANKS