

Silicon sensor gluing for the SiW ECAL

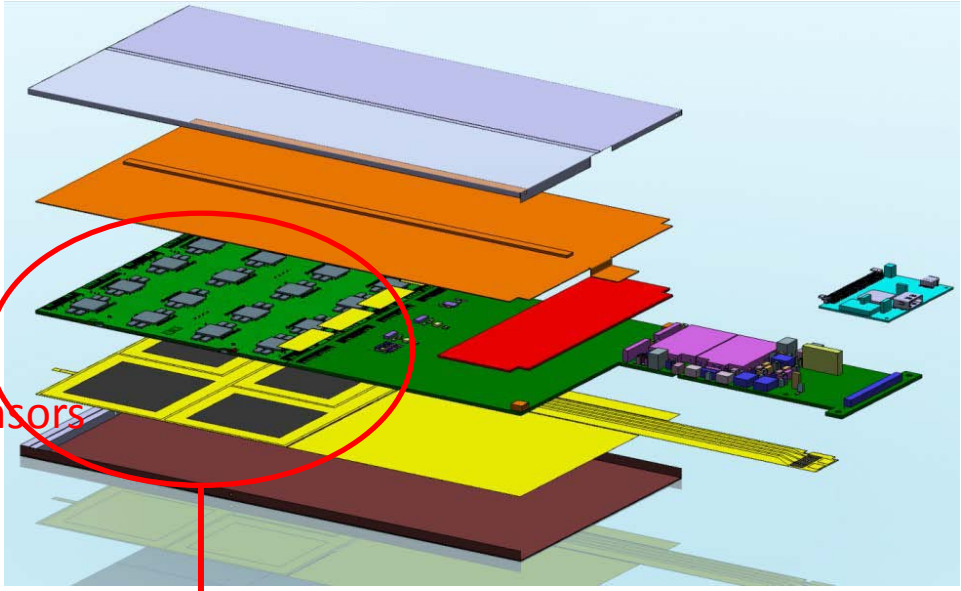
R&D status at LPNHE

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Brief reminder

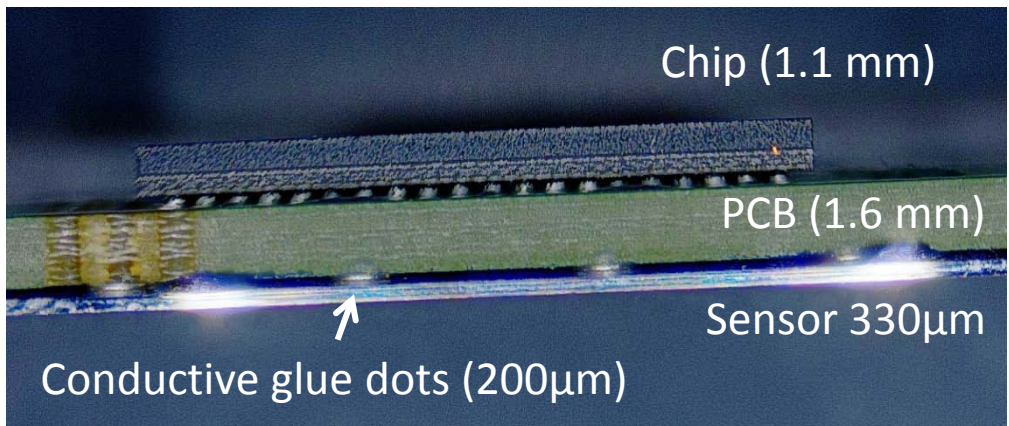
- The objectives
 - Develop a fully automated process to position, align and glue 4 sensors on a FEV board → active sensor unit (ASU)
 - Apply this process to mass production
- The different steps of the R&D at LPNHE
 - Develop gluing techniques (robot and glue)
 - Glue one silicon sensor on a PCB (FEV8 type)
 - Develop and assemble robots for the final process
 - Glue 4 sensors on a PCB (FEV9-10-11 type)
 - Follow the traceability of operations, controls and tests

Short slab



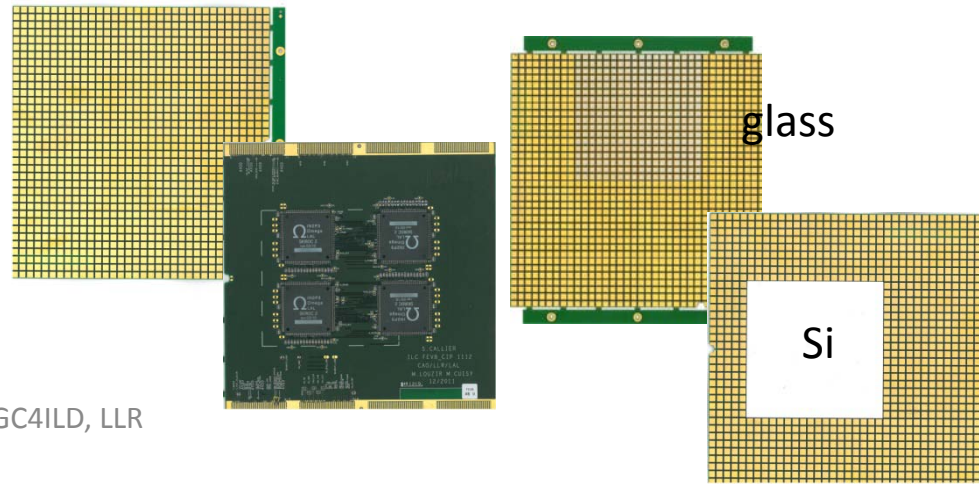
PCB
+
Si sensors

Thanks to Rémi, Michael



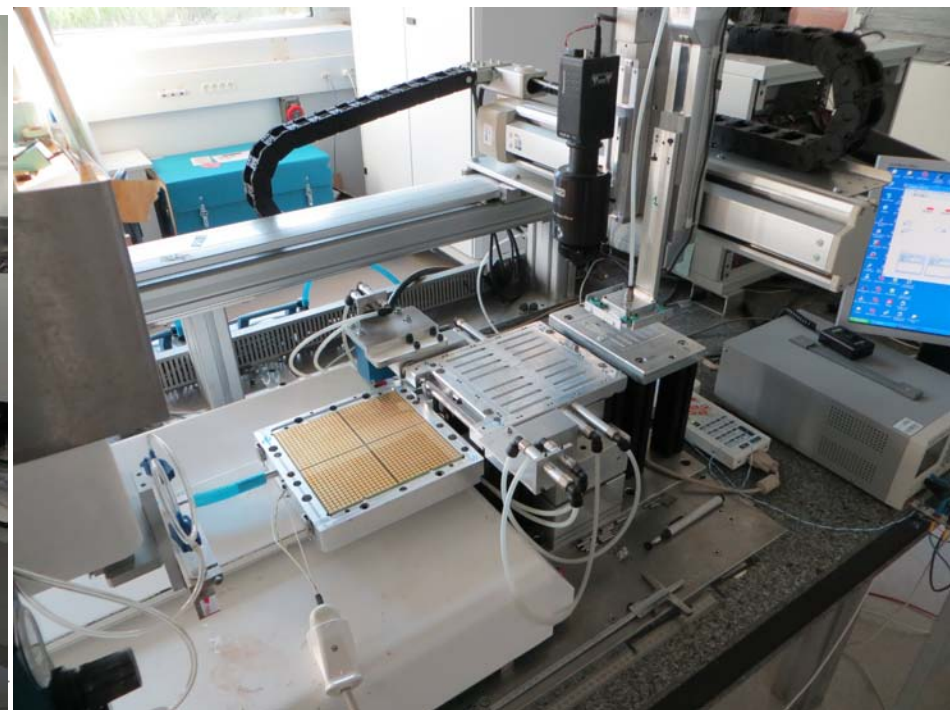
Gluing techniques

- Optimize the parameters of the gluing robot : duration of glue deposit and syringe displacement, syringe pressure,...
- Control the quality of the glue dots: thickness, resistivity, strength after polymerisation,...
- Develop the tools to position the silicon wafer on the PCB, to hold the PCB and the wafer during the whole process.
- Glue one wafer (glass then Hamamatsu sensor) on FEV8 board
→ validation of several ASU on test beam.



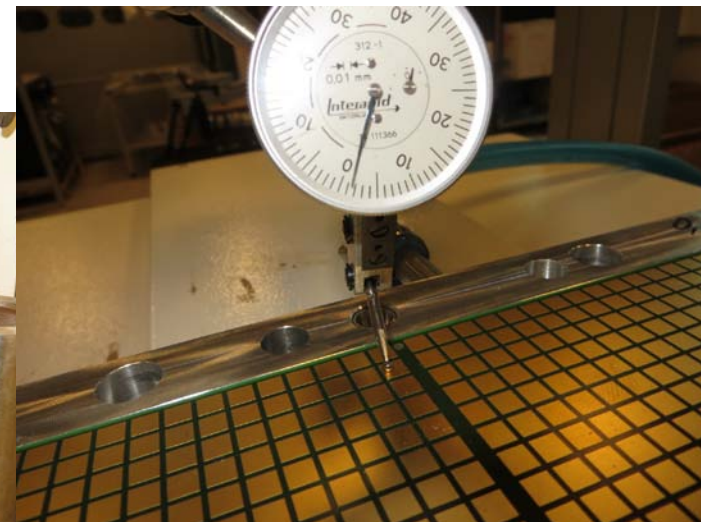
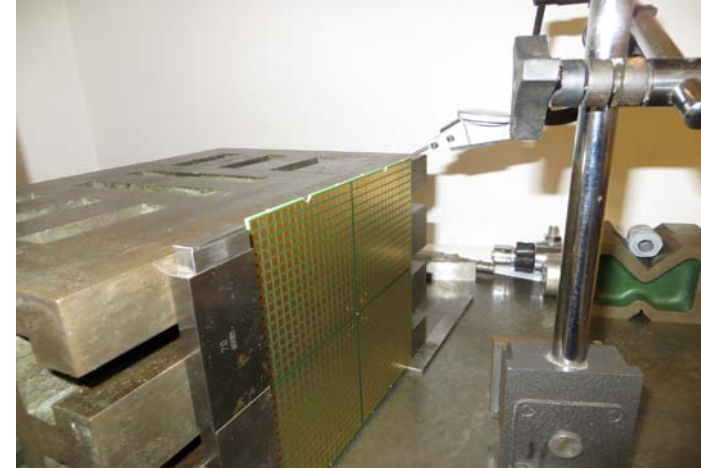
A dedicated robot

- Develop a new robot with labview driver to handle, position and glue 4 wafers on a PCB
- Assemble this robot and the gluing robot to manage the different steps of gluing process in a single sequence



PCB metrology

- Before cabling
 - Squaring
 - Parallelism
 - Dimensions
 - Thickness (flatness under pressure)
 - Flatness
- After cabling
 - Flatness
 - Thickness



Metrology sheets

N° FEV-11	Planéité (Δ_{max}) Tol. = 0,40	Epaisseur min - max Tol. = 1,60 à 1,70		Parallélisme entre face wafers et face composants (Δ_{max}) Tol. = 0,10	Géométrie/dimensions H - L Tol. = 180,20 à 180,30		Equerrage (Δ_{max}) Tol. = 0,05	Parallélisme entre bords extérieurs (Δ_{max}) Tol. = 0,05
31	0,30	1,55	1,64	0,09	180,42	180,39	0,02	0,02
32	0,30	1,55	1,64	0,09	180,40	180,45	0,02	0,02
33	0,30	1,55	1,64	0,09	180,35	180,35	0,02	0,03
34	0,30	1,58	1,68	0,10	180,30	180,30	0,02	0,02
35	0,20	1,55	1,64	0,09	180,42	180,36	0,01	0,05
36	0,15	1,52	1,62	0,10	180,43	180,41	0,02	0,02
37	0,20	1,54	1,65	0,11	180,46	180,46	0,02	0,02
38	0,20	1,55	1,65	0,10	180,40	180,30	0,02	0,08
39	0,20	1,56	1,68	0,12	180,45	180,45	0,02	0,03
40	0,30	1,60	1,70	0,10	180,45	180,45	0,03	0,02
<i>Moyenne des PCB</i>	<i>0,25</i>	<i>1,56</i>	<i>1,65</i>	<i>0,10</i>	<i>180,41</i>	<i>180,39</i>	<i>0,02</i>	<i>0,03</i>

N° FEV-9	Planéité (Δ_{max}) Tol. = 0,40	Epaisseur min - max Tol. = 1,60 à 1,70		Parallélisme entre face wafers et face composants (Δ_{max}) Tol. = 0,10	Géométrie/dimensions H - L Tol. = 180,20 à 180,30		Equerrage (Δ_{max}) Tol. = 0,05	Parallélisme entre bords extérieurs (Δ_{max}) Tol. = 0,05
11	0,30	NC	NC	0,15	180,21	180,31	0,10	0,06
12	0,30	1,59	1,64	0,05	180,21	180,28	0,12	0,08
13	0,30	1,58	1,65	0,07	180,23	180,27	0,07	0,07
14	0,30	1,58	1,65	0,07	180,21	180,30	0,10	0,02
15	0,30	1,59	1,64	0,05	180,21	180,28	0,09	0,03
16	0,30	1,58	1,70	0,12	180,22	180,28	0,07	0,07
17	0,30	1,60	1,70	0,10	180,25	180,30	0,08	0,05
18	0,30	1,58	1,70	0,12	180,22	180,32	0,08	0,05
19	0,30	1,60	1,68	0,08	180,20	180,27	0,10	0,02
20	0,30	NC	NC	NC (dépression impossible)	180,25	180,29	0,08	0,01
<i>Moyenne des PCB</i>	<i>0,30</i>	<i>1,59</i>	<i>1,67</i>	<i>0,09</i>	<i>180,22</i>	<i>180,29</i>	<i>0,09</i>	<i>0,05</i>

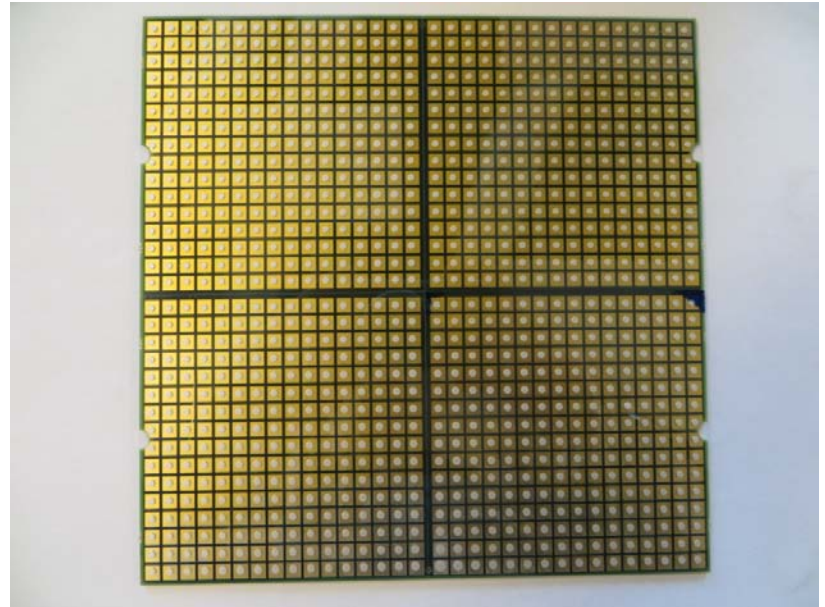
Toutes les mesures sont en mm

NC = mesure non réalisée

mesures en dehors des tolérances fixées à ce jour

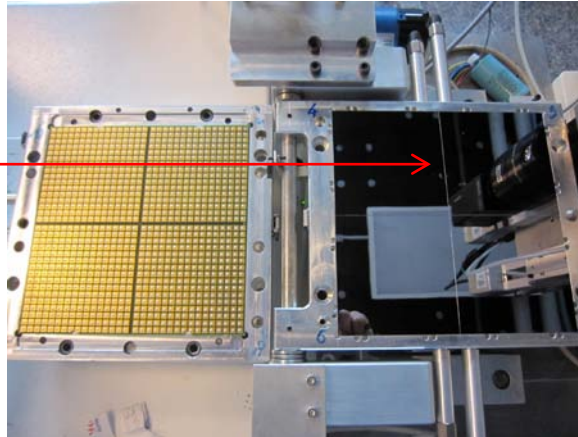
The gluing tests with 4 wafers

- Start with glass wafers
- Glue 4 Si unprocessed wafers
- 89.7*89.7 mm

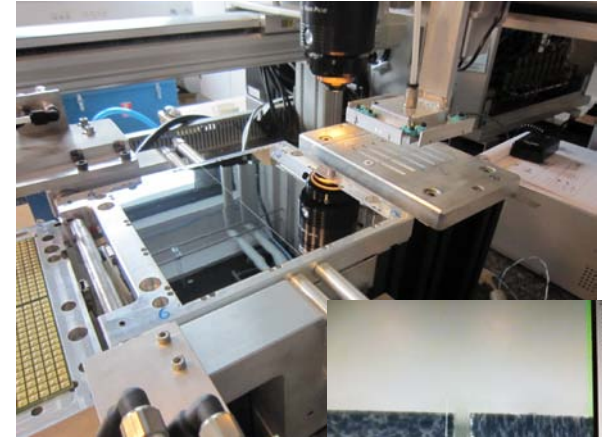


The first prototype with 4 wafers

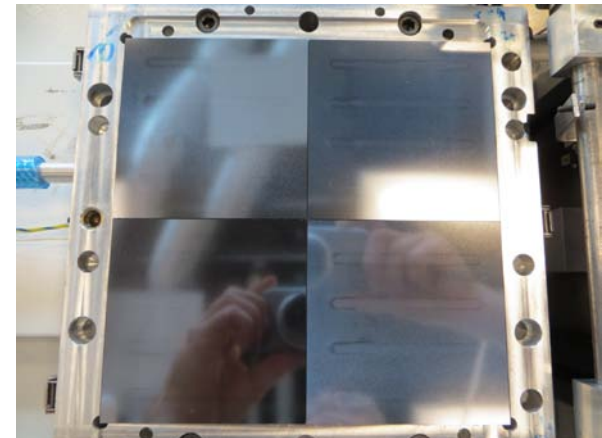
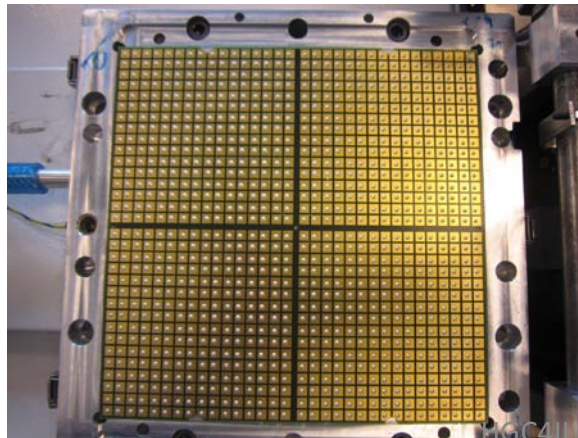
4 Si wafers are carefully aligned on the plate



The position is controlled. Fit the PCB geometry



Glue dots (1024) are deposited using 2 syringes (total time : 30 minutes)



February 2-3, 2015

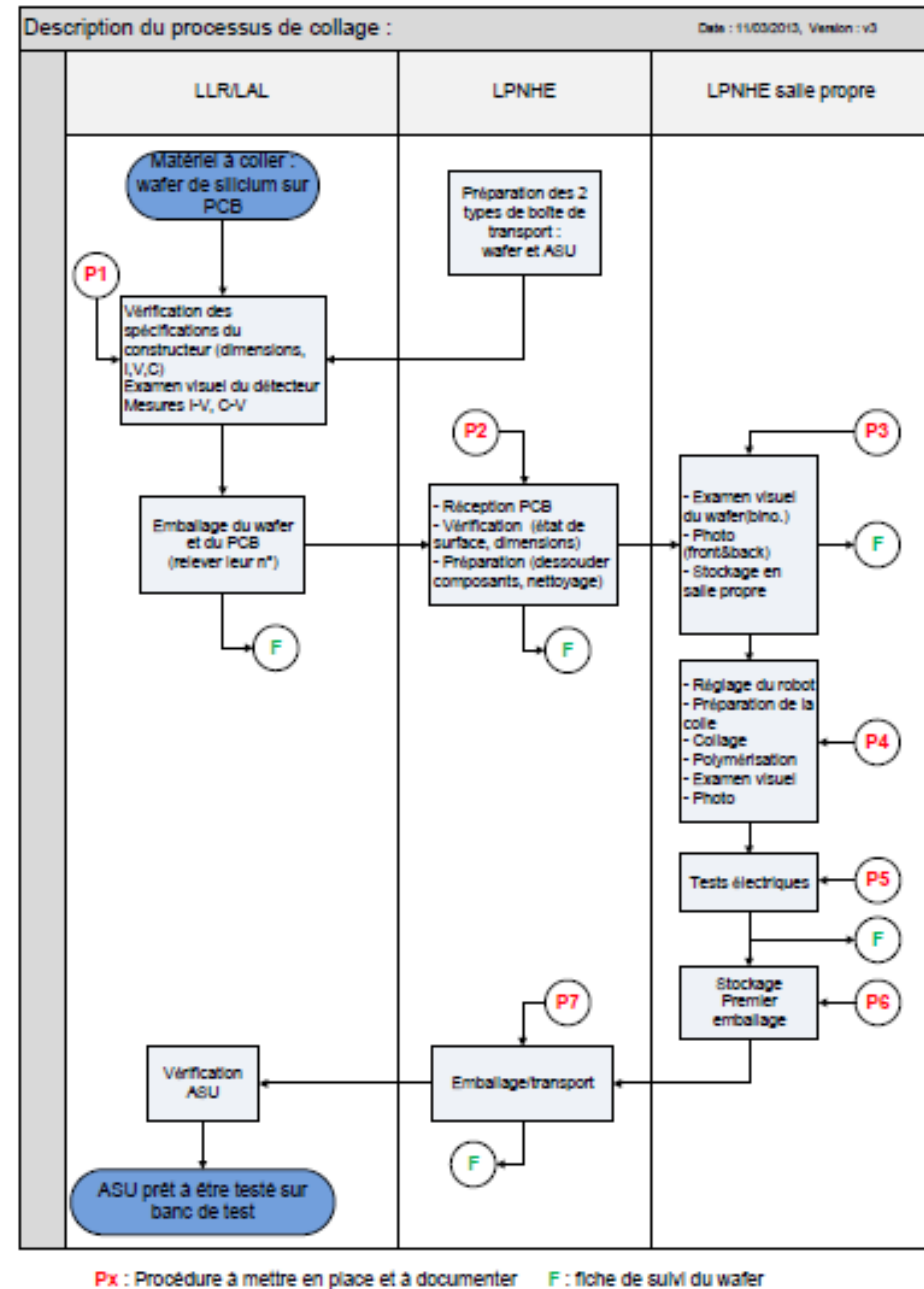
NGC4ILD, LLR

Before gluing the 4 Si sensors

- Hamamatsu sensors are larger : 90*90 mm
- Repeat the process with larger glass wafers and Si unprocessed wafers.
- Boards already used on assembly benches have been re-used for gluing tests → we encountered difficulties related to
 - The PCB geometry (not less than 180,2*180,2 mm)
 - The extra thickness on the cabling side of the board.

Quality insurance

- Task flow have been already presented
- Reception and gluing procedures for 1 and 4 silicon sensors are written
- each operation on PCB is monitored (follow up)
- Each gluing test is registered



Summary and perspectives

- The semi-automated gluing and positioning process is now functional for 4 sensors
- We are ready to glue 4 Hamamatsu sensors on FEV10 board.
- We have to check carefully the PCB geometry before any gluing operation
- We prepare the test bench for I-V measurements after gluing
- The quality insurance approach must be continued and improved (data base?).

Thank you

