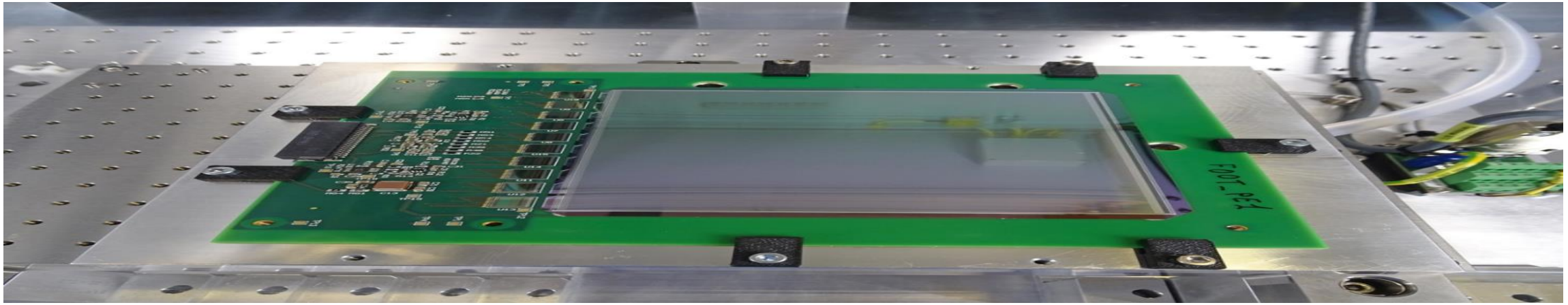


FOOT - Silicon Microstrip Detector

STATUS @INFN Perugia

G.Ambrosi, M. Barbanera, M. Caprai, Maria Ionica-Movileanu, K. Kanxheri, L. Servoli, G. Silvestre,

2021.07.07

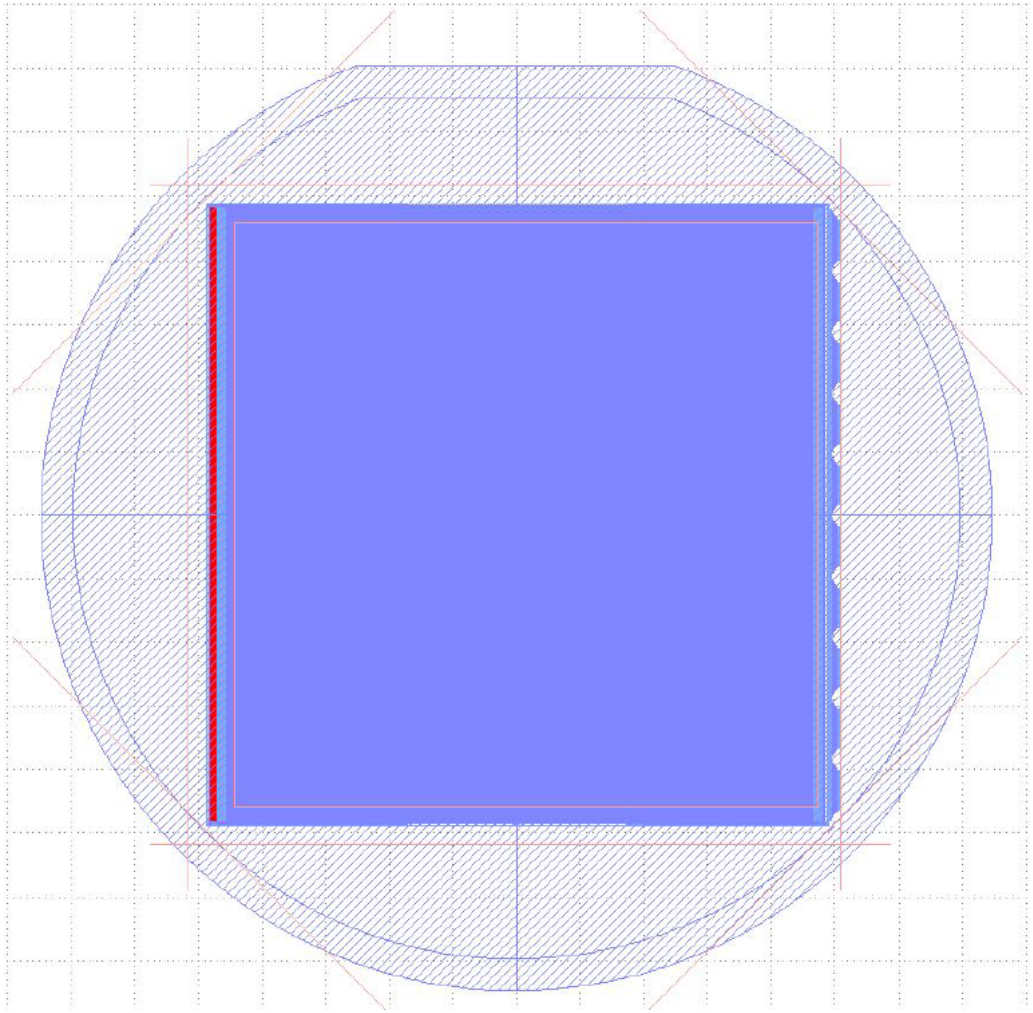
Summary

- Si sensors characteristic
- PCB design
- VA1140 design
- Module construction
  - Mechanical prototypes: PM01_300umFBK, PM02_150umHamamtsu
  - Electrical prototypes:PE01_TFHold, PE02_TFHnew
  - Final modules
- Plane Integration
- Beam Test

Silicon Microstrip Sensors

Requests:

- Silicon microstrip sensor with pitch adapter of reading ten VA directly on the silicon wafer -> less material on the particle path
- Backside metallization used as optical isolation for the plane inegration-> less material on the particle path

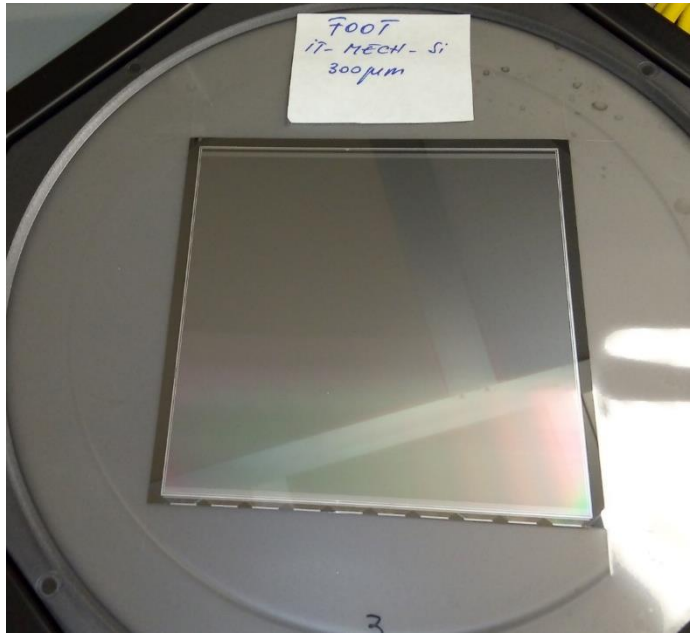


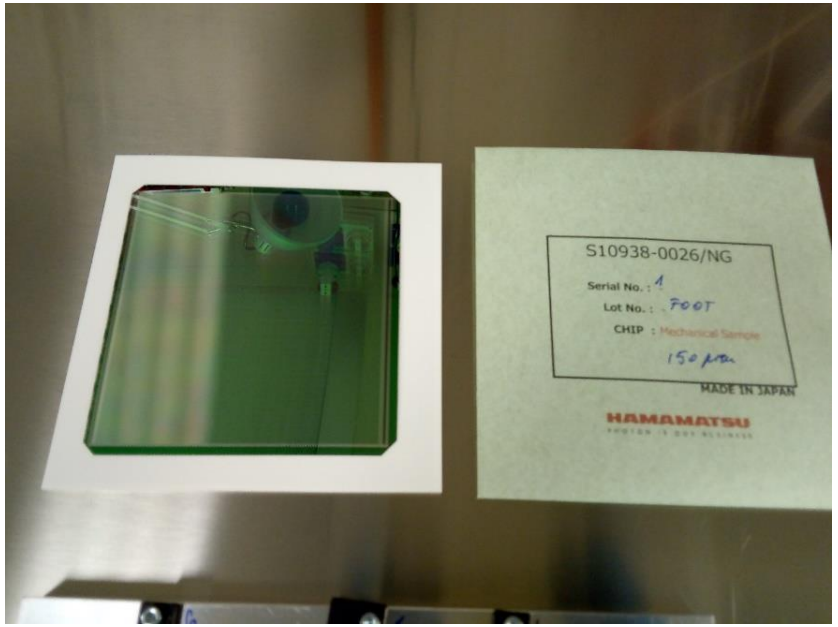
Thickness	150um
Overall dim	102.5mmx103.5mm
Active area	96mmx96mm
Strip pitch	50um
Readout pitch in Foot	150um
Number of readout strips	640
Mechanical edges width	2.5mm per side

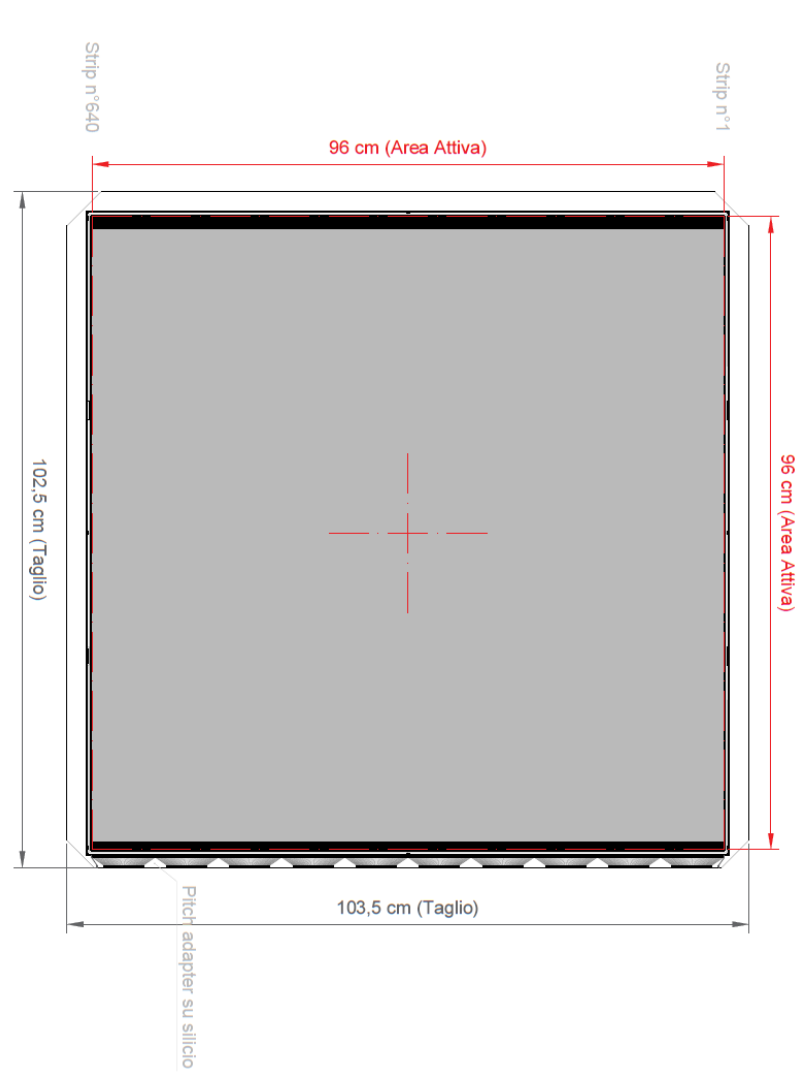
Silicon Microstrip Sensors

Sensors ordered for FOOT experiment:

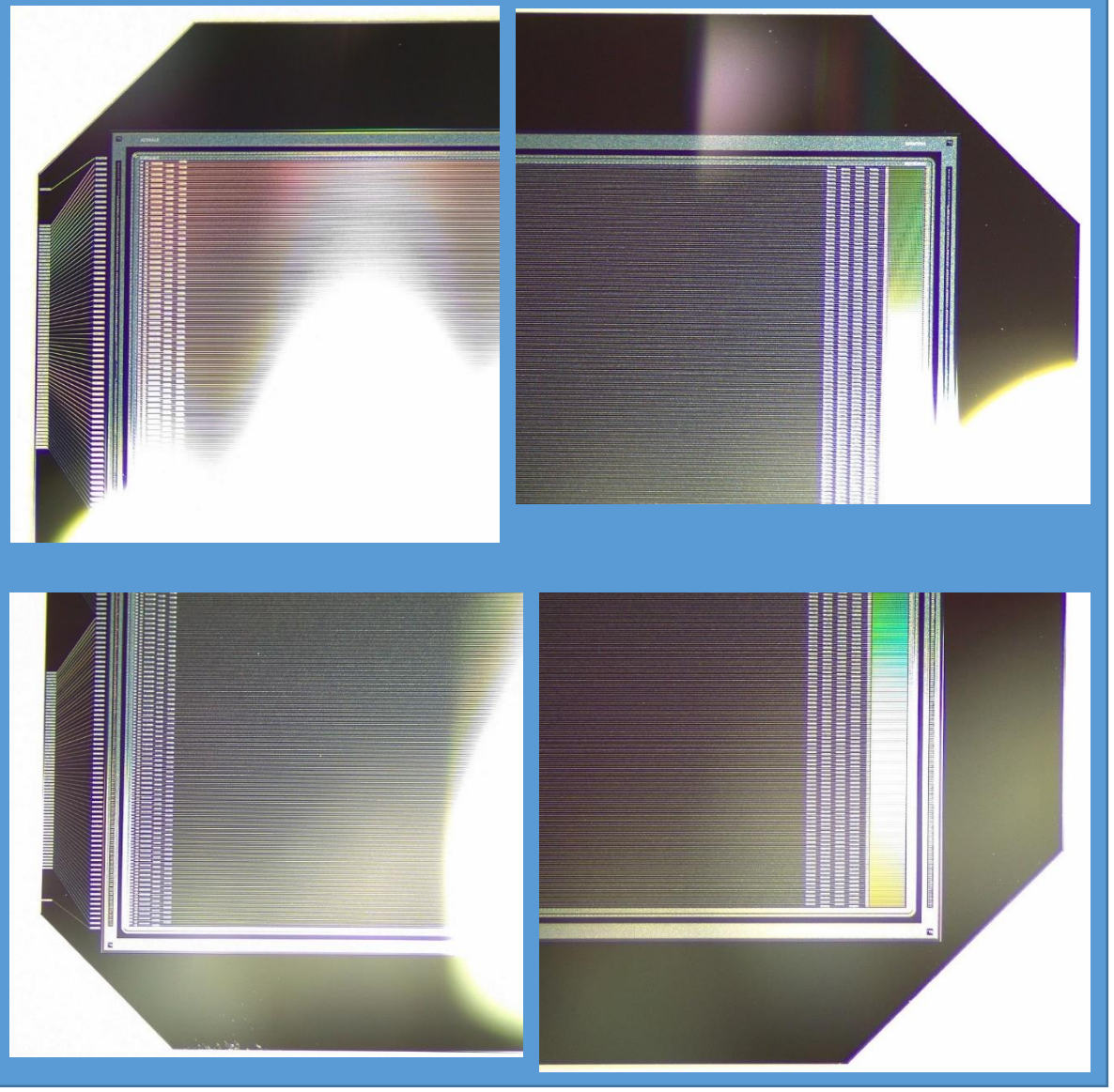
- Nr. 3 Mechanical sensors made in Italy FBK_spin-off on 300um silicon substrate
- Nr. 5 Mechanical sensors from Hamamatsu, 150um
- Nr. 15 GOOD (in two shipments 12 + 3 good si sensors)

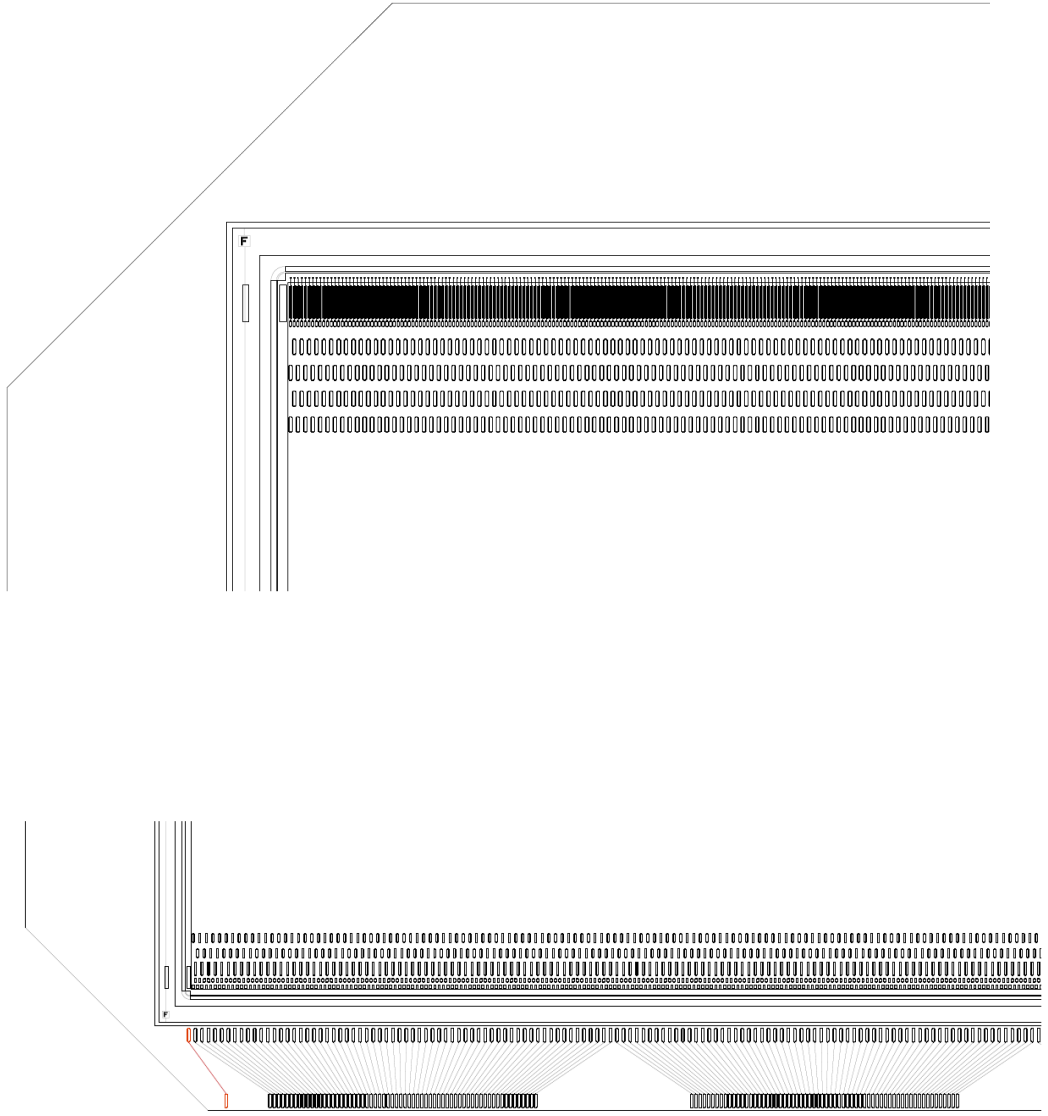






Silicon Microstrip Sensors



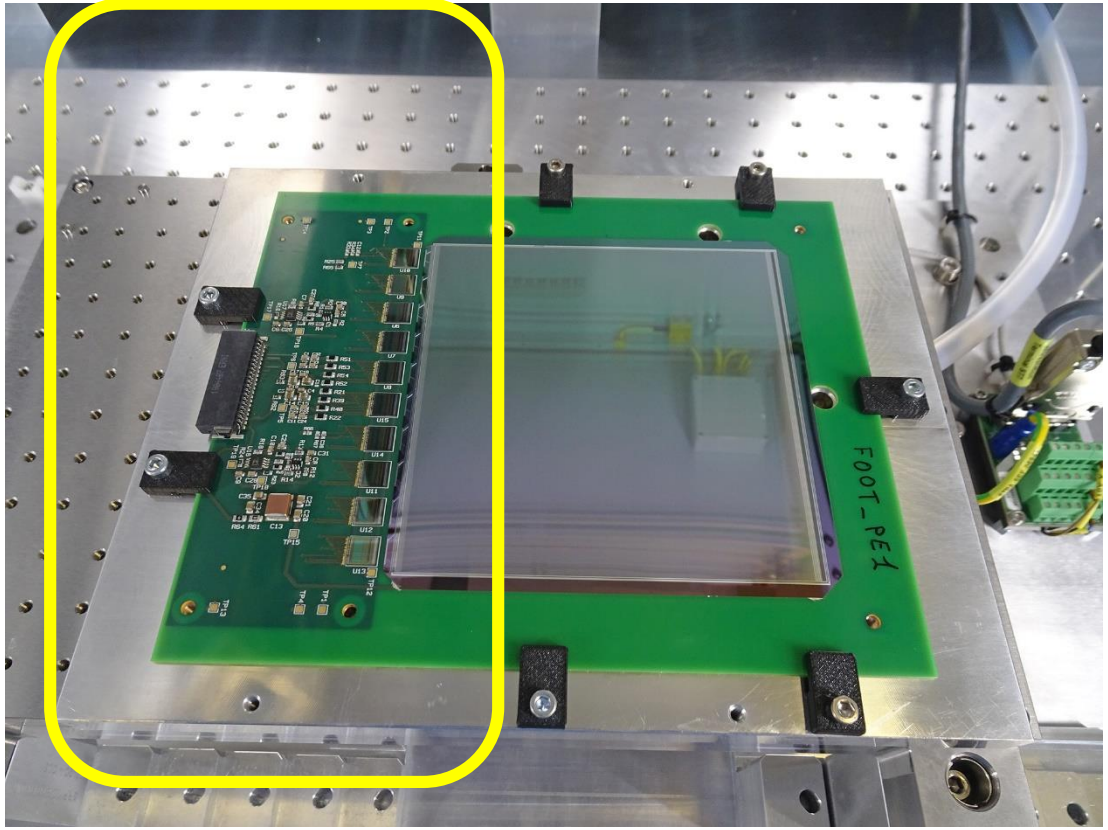


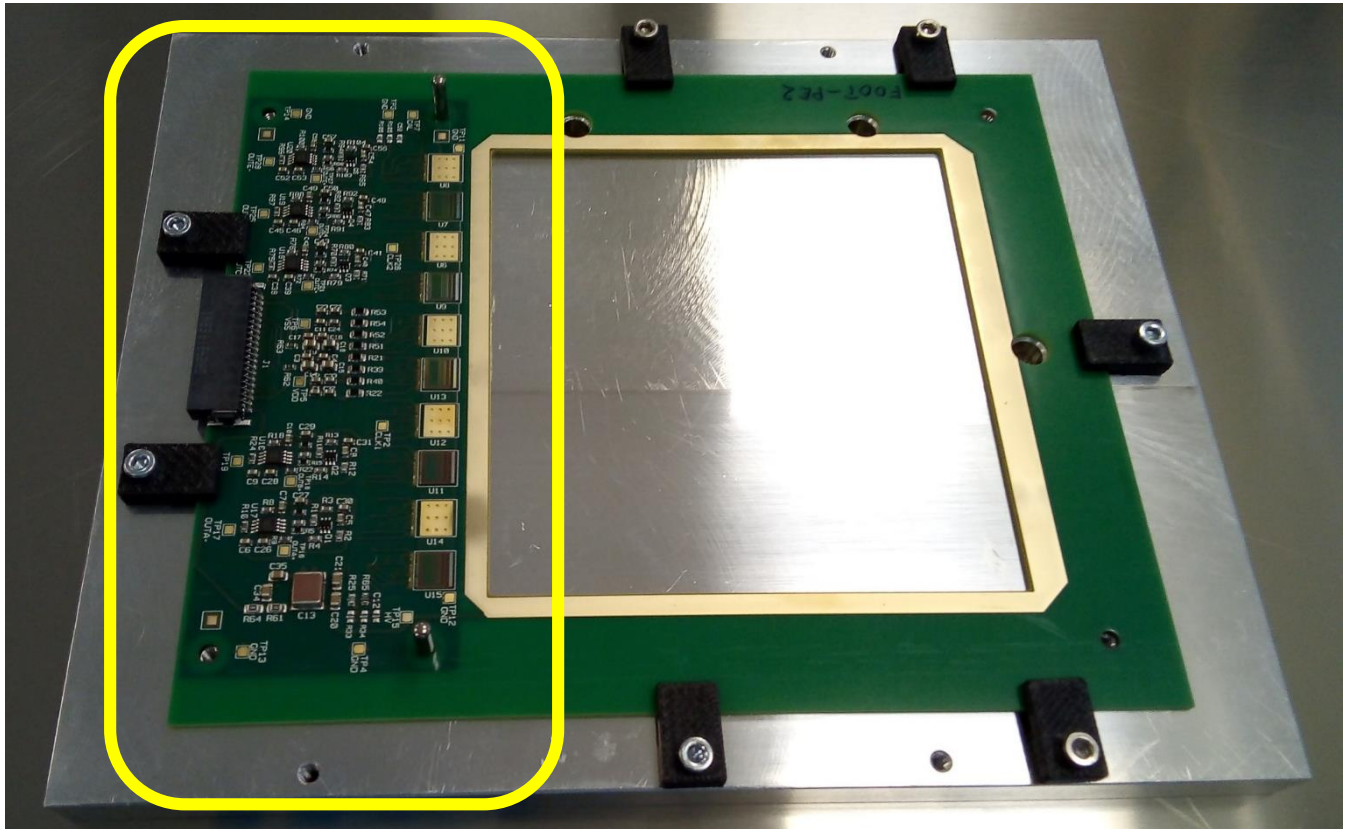
Front End Hybrid and VA140

made by Artel Italy:

- **4 mechanical** pieces old design without electronic components old design (readout of five VA140) now in Perugia
- **2 electrical** pieces old design (*reading two groups of five VAs*) @Artel for electronic components assembly. PP01 done with a good Silicon sensor from Hamamatsu. One prototype PP01

- **15 New TFH version** for readout out of pairs of two VA140: start to be used with PPE02





400pcs ordered from IDEAS Norway

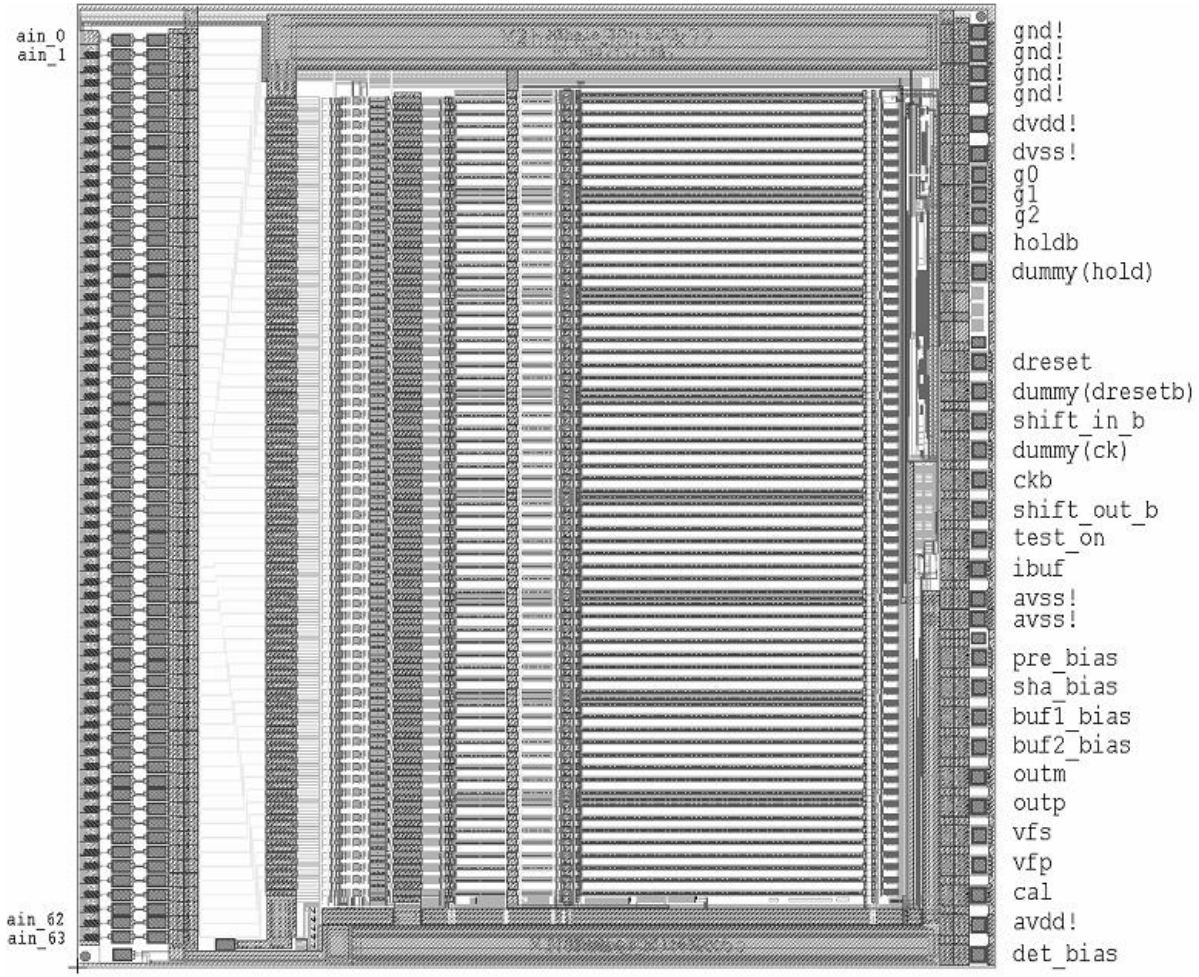


Table 5: Process, die size and pad pitch.

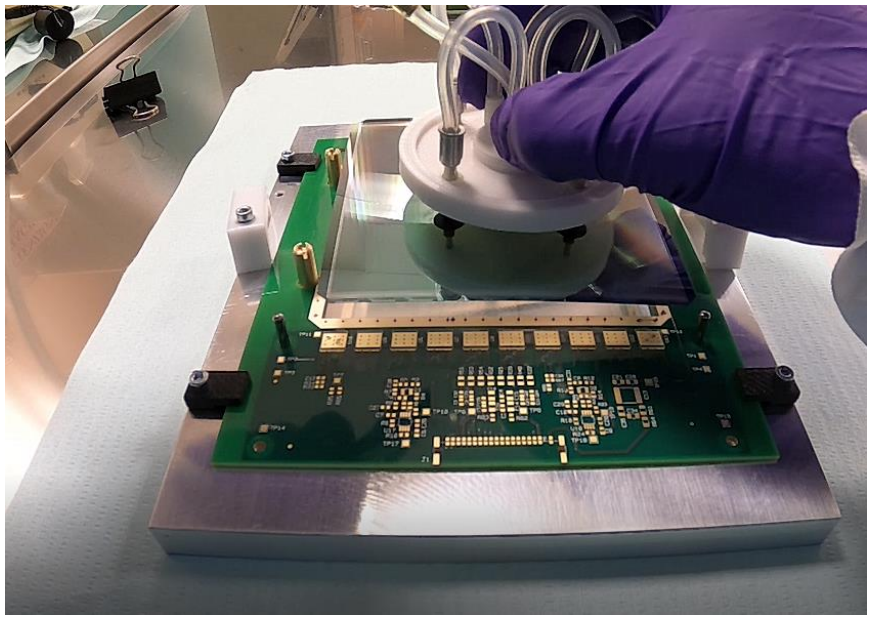
Process:	0.35 µm CMOS, epitaxial layer wafer	
Die size (Maximum):	6.2 mm x 6.5 mm. Add 100µm on each side for scribe edge.	
Input bonding pads:	Double row (see Figure 5) Pad size: Pad pitch:	 70 µm x 120 µm 96 µm

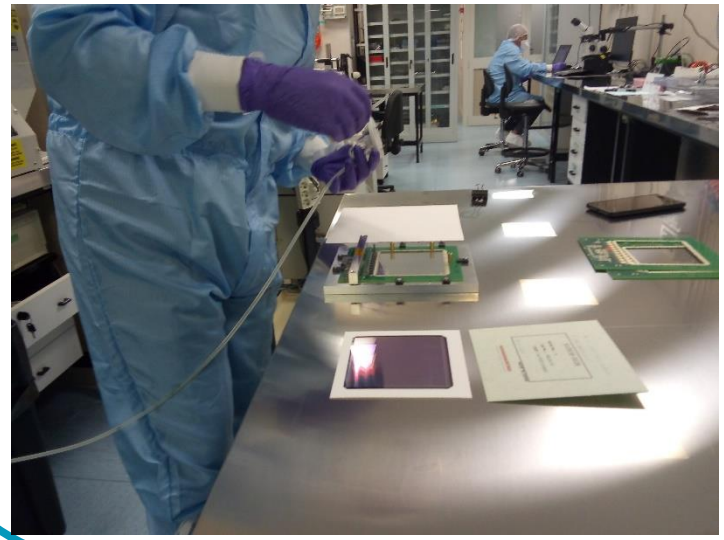
MSD assembly method

The alignment method consists :

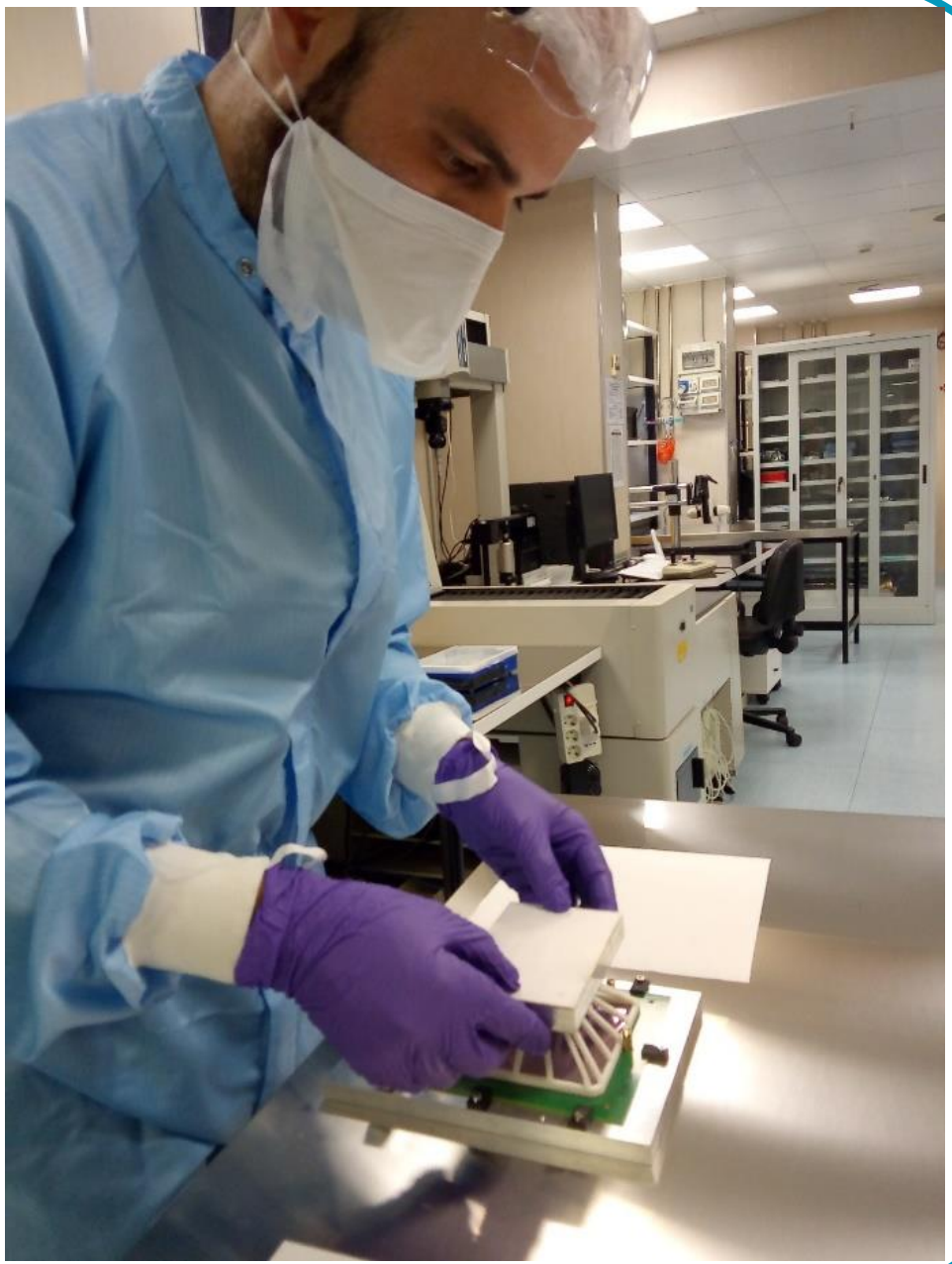
- Fix on the jig the two alignment pins for the Front End Hybrid fixation and three alignment pins for the Si Sensor
- Place the FEH and fix it with clamps
- Dispence the two kinds glues (electrical conductive glue EPOXYEJ2189 and the siliconic one DC3145 – grey on the metalic edge of FEH.
- Place carefully - with the custumized vacuum instrument - the sensor against the dedicated alignment pins
- Adjust the alignment under the microscope, pushing well the sensor against the pins
- Fix the silicon sensor carefully with two clamps and place an wight
- Curing time 24h
- Ultrasonic wire Wire Bonding with thin Alluminium wire (25um)
- Transfer the module on the test/storage/transport jig and test module
- Plane integration

Alignment and Gluing

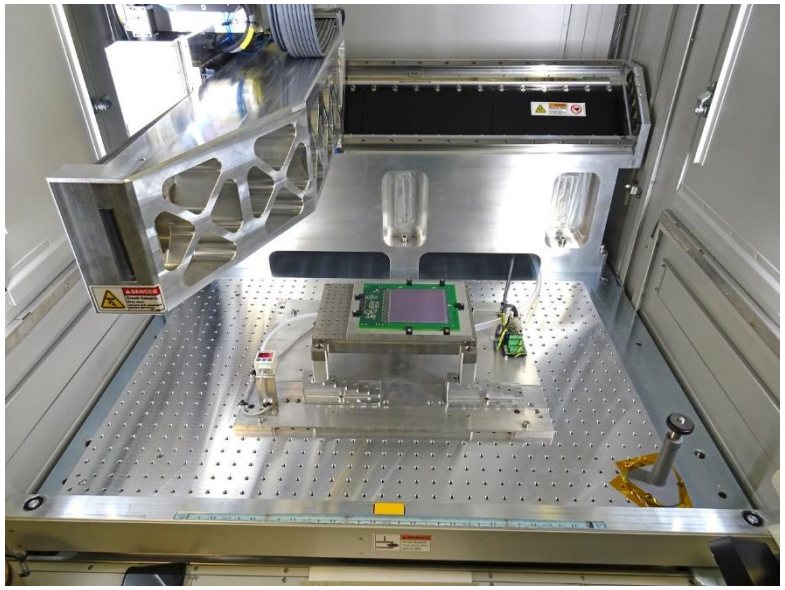


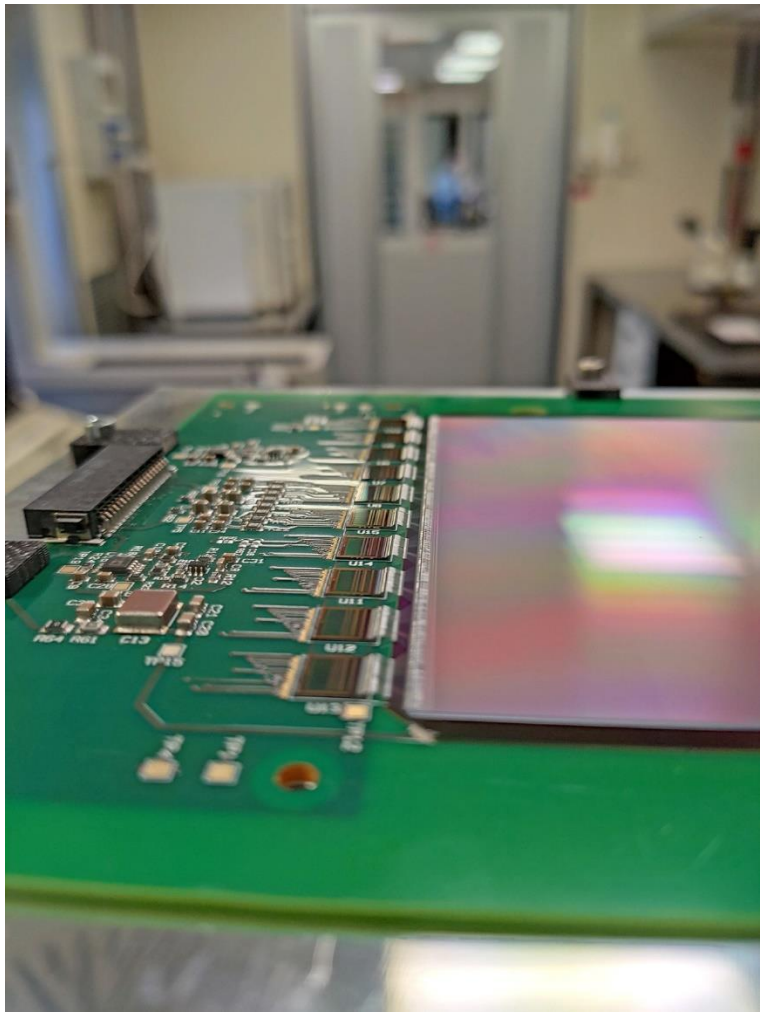


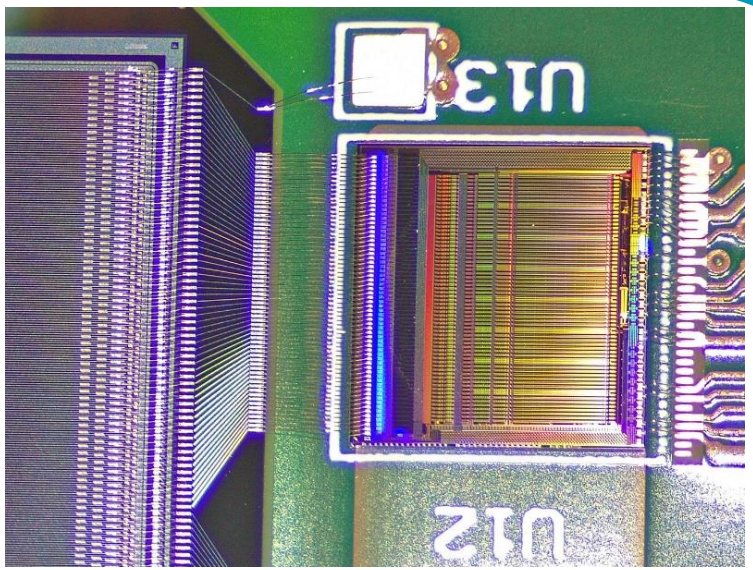
Assembly jig
Vacuum tool
weight support
Dispencer machine
Glue RTV3145 grey
RS silver-loaded

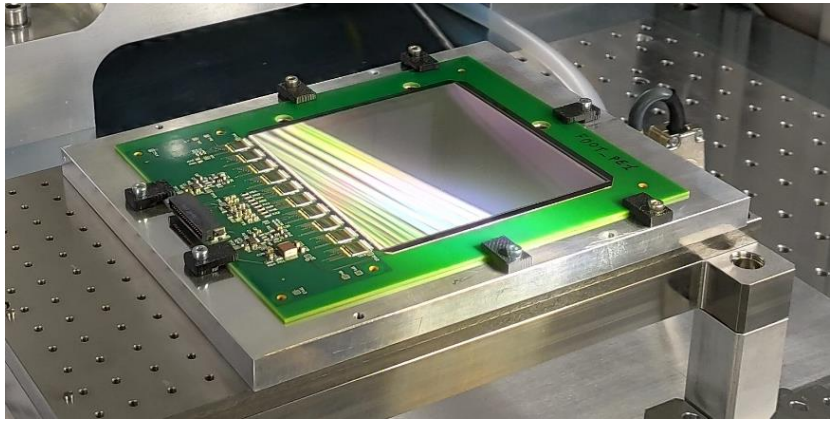


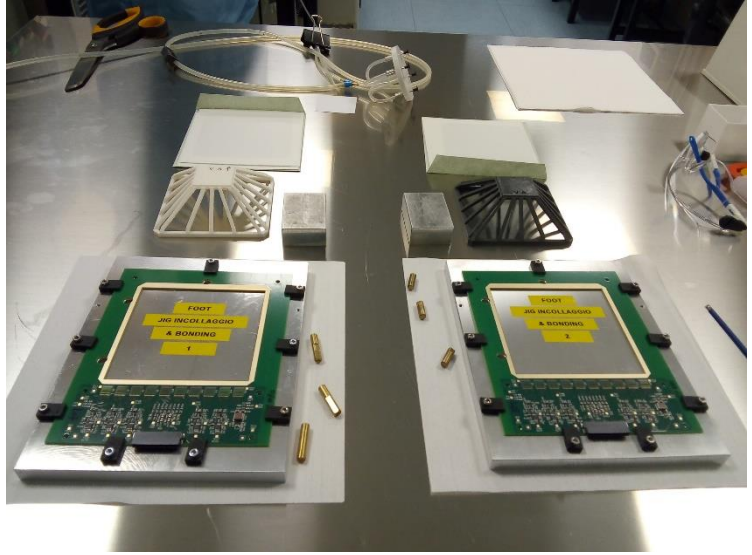
BONDING with the new M17L→ easy programming with PRU, short time, repeatibility
VA-FEH control wires , VA-Si pitch adapter, Si pitch adapter-Si strips





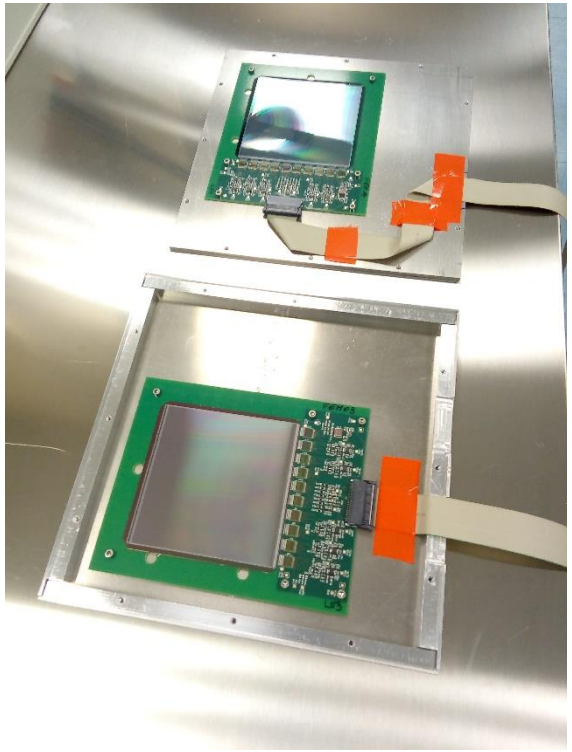


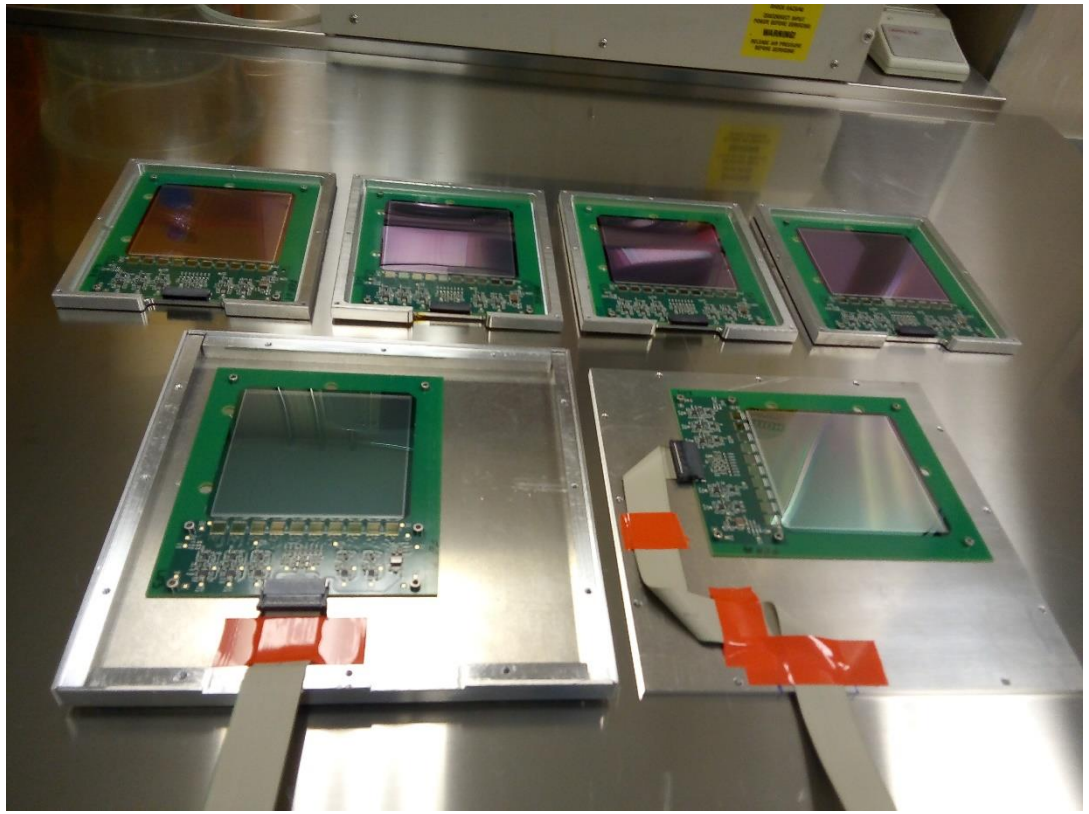


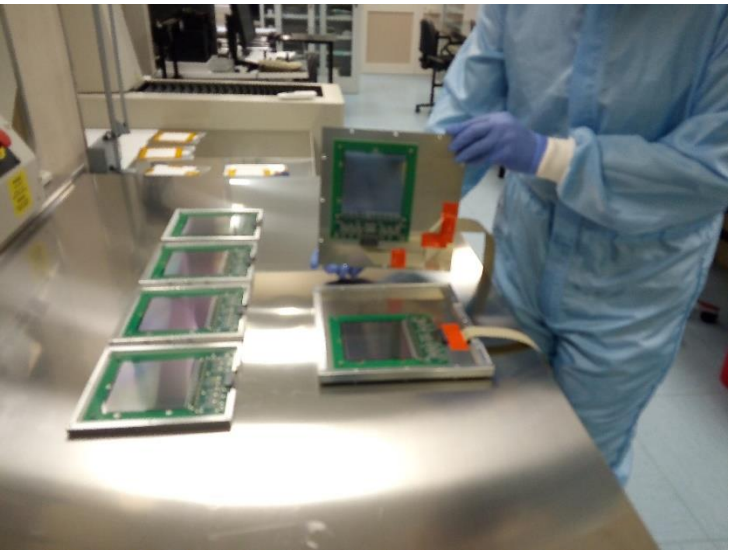

FOOT
JIG INCOLLAGGIO
& BONDING
1
FOOT
JIG INCOLLAGGIO
& BONDING
1

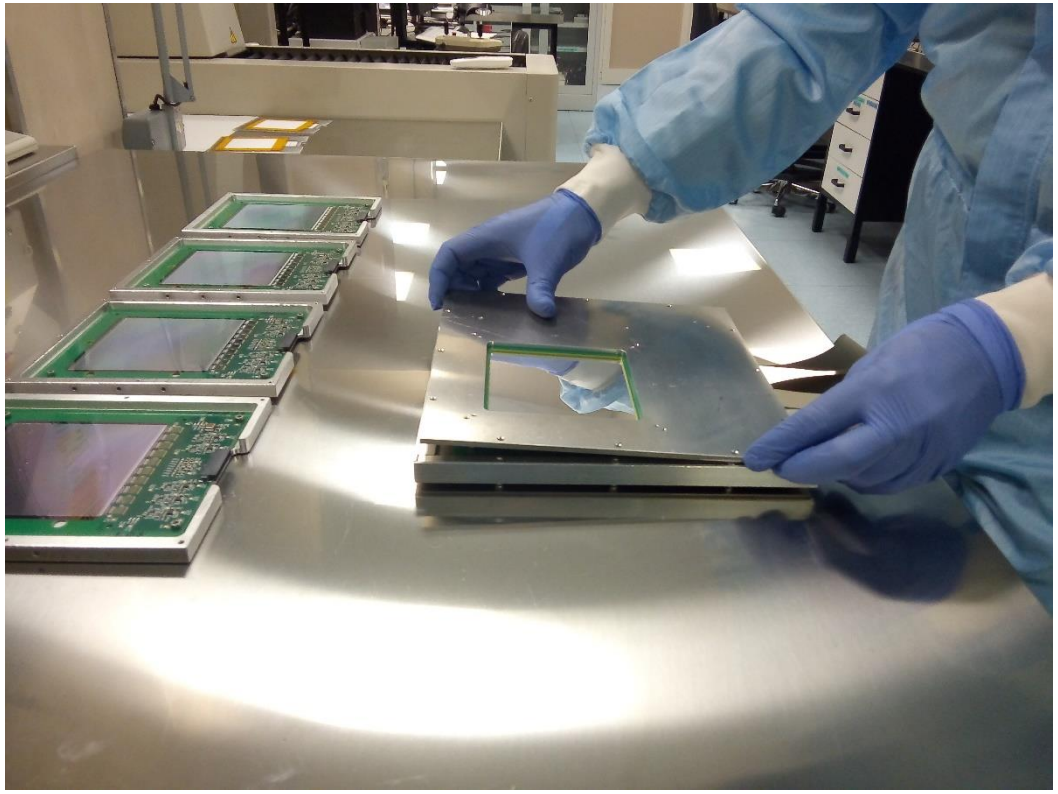

ESTINTORE

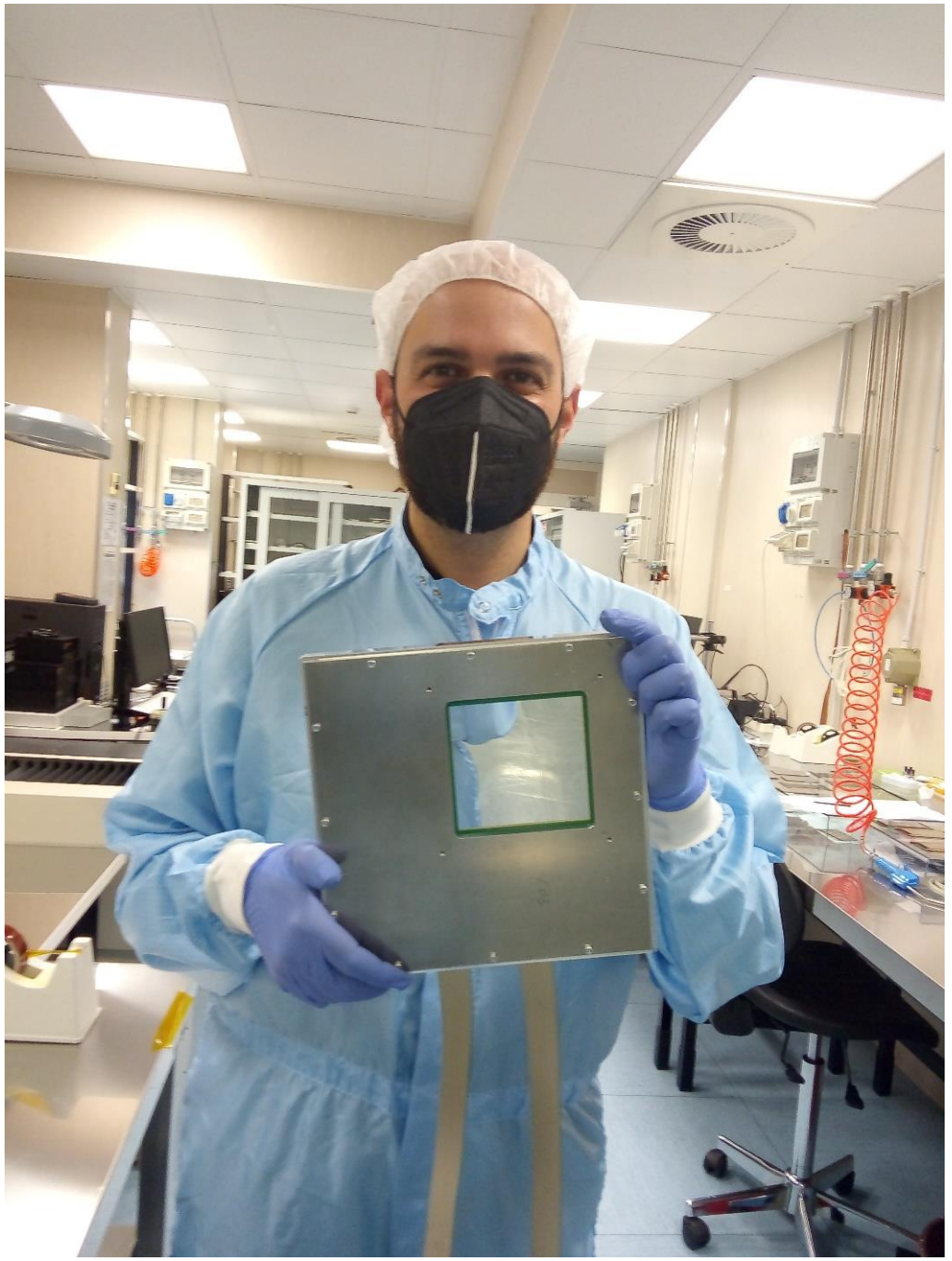

SPAZIO RISERVATO TEST FOOT



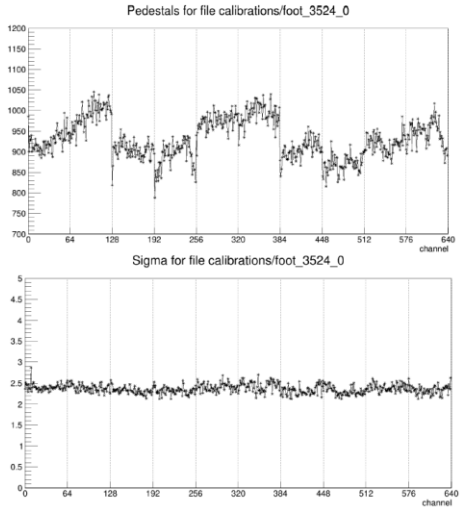




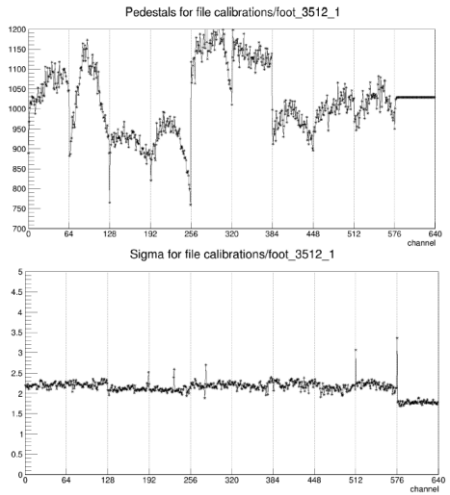




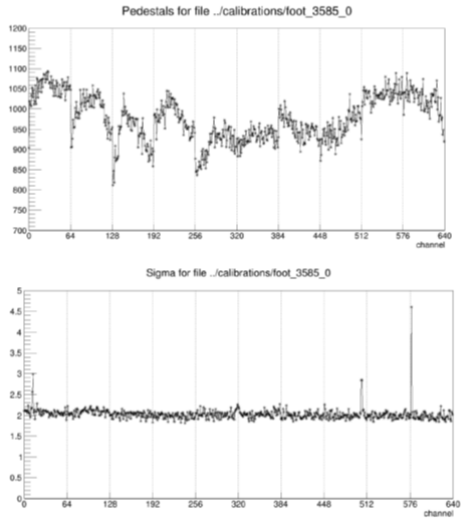
L01



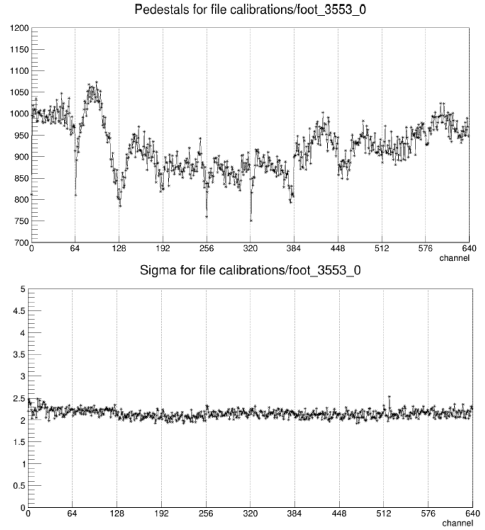
L02



L03



L04



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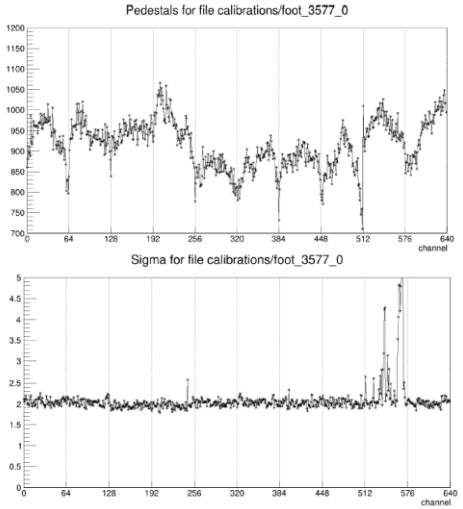
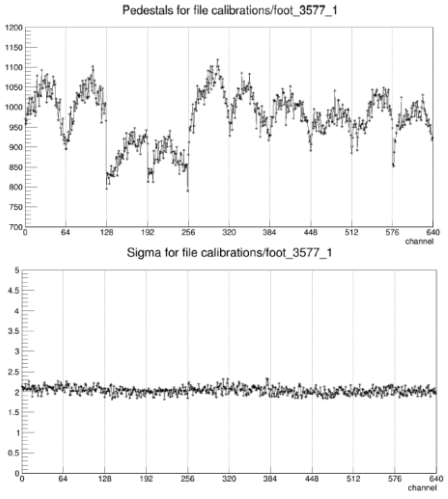
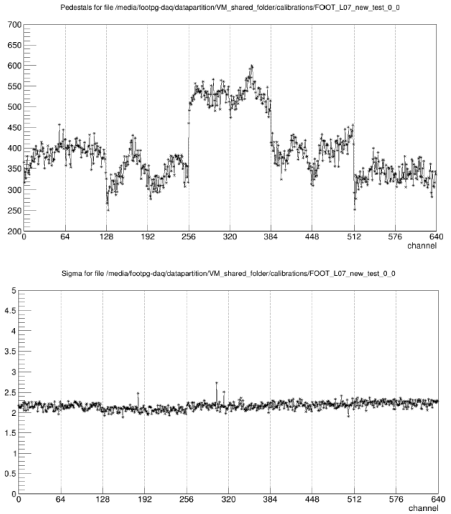


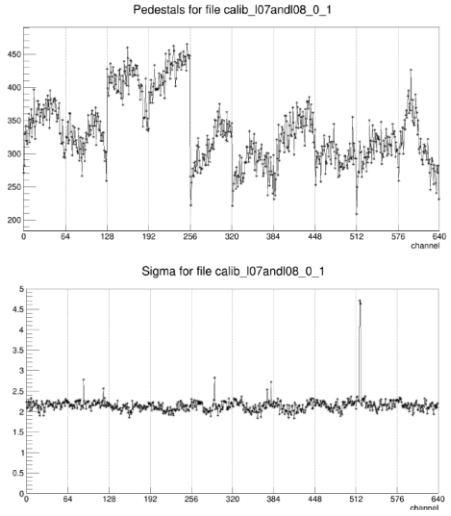
L06



L07

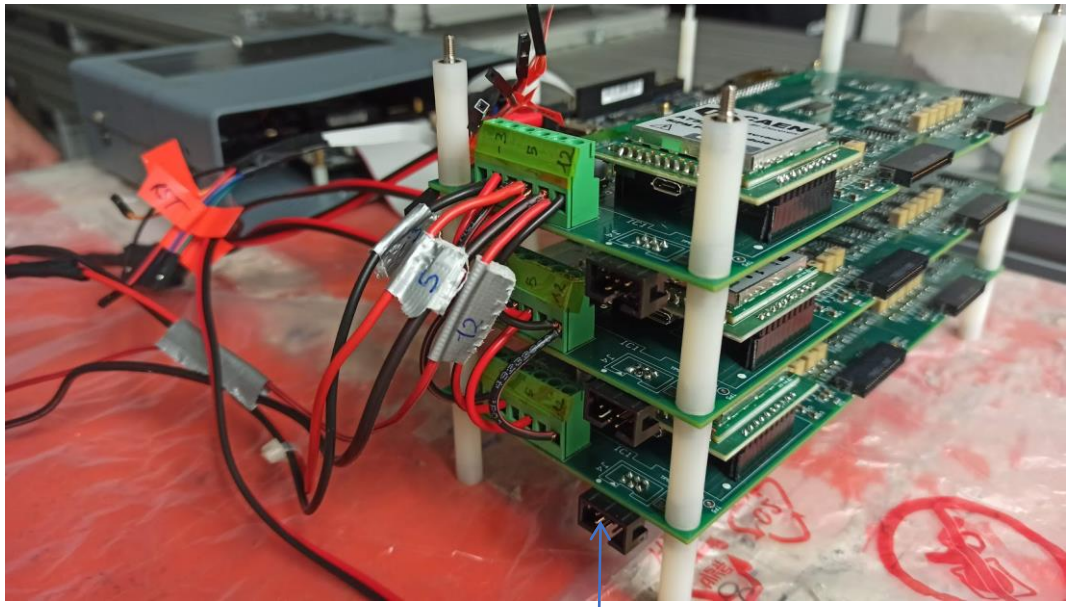


L08



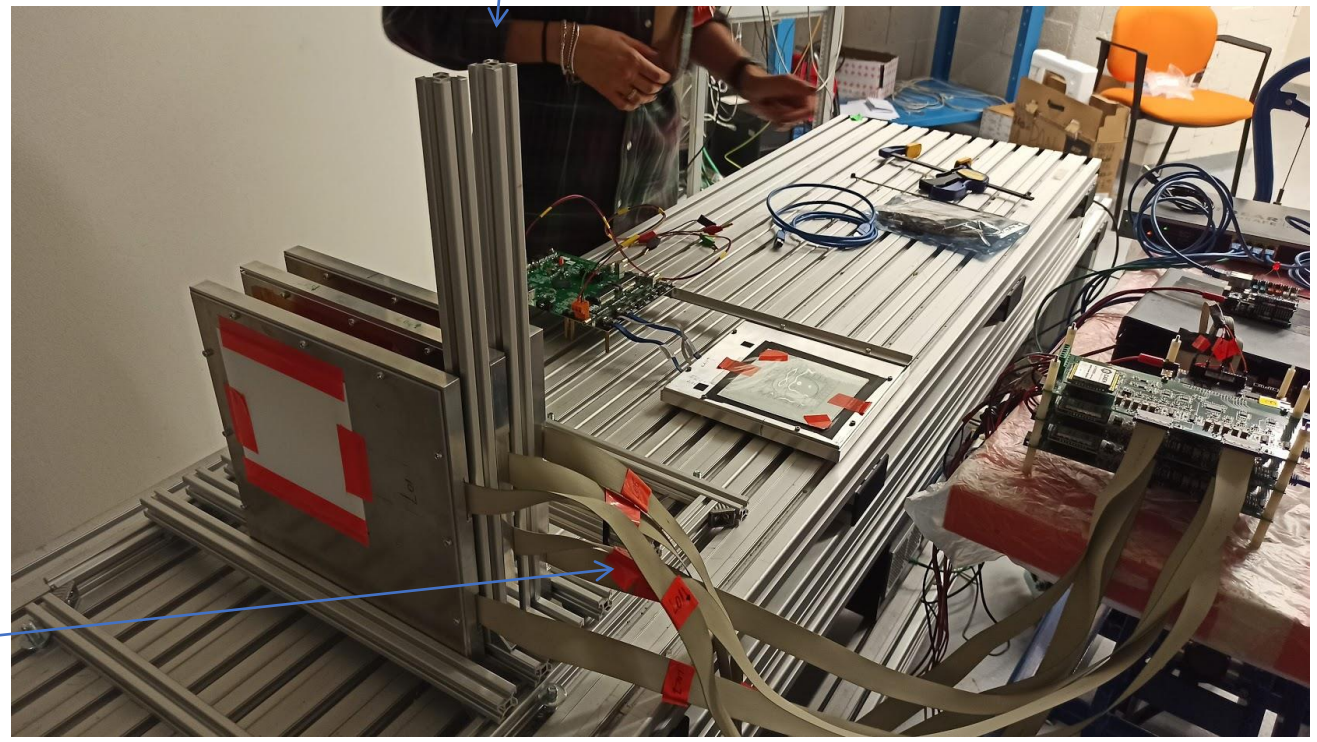
Test di calibrazione dopo l'assemblaggio del singolo modulo (Sigma = cca 2.6ADC). **Very good quality**!

Beam test @ Trento



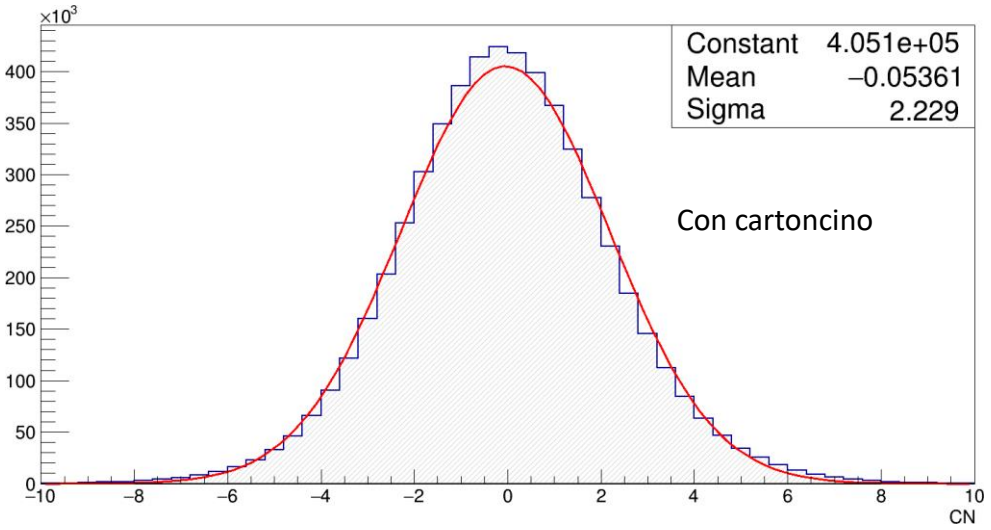
Stack elettronica senza scatola

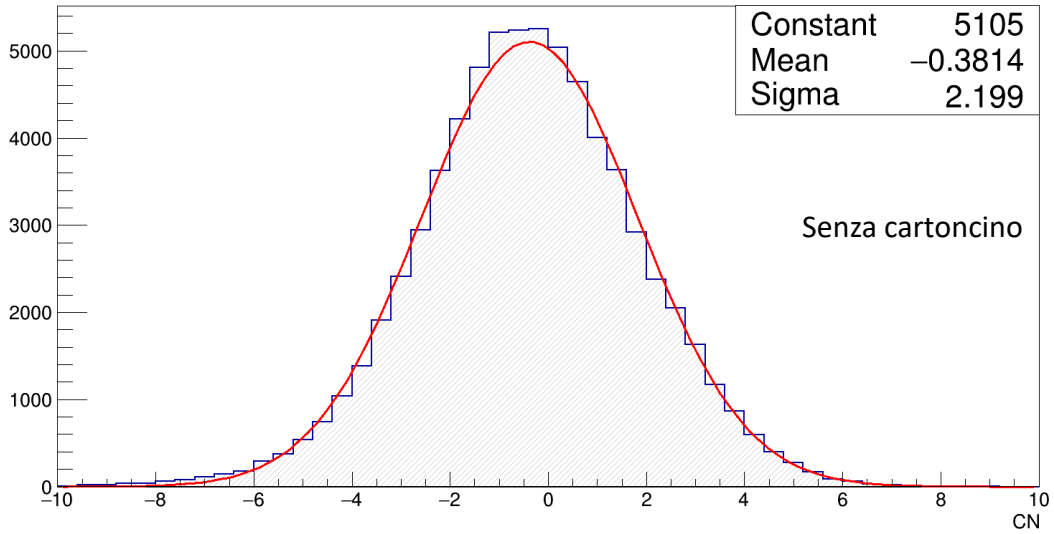
Versione preliminare della struttura meccanica



Cavi segnale

Isolamento ottico dei piani

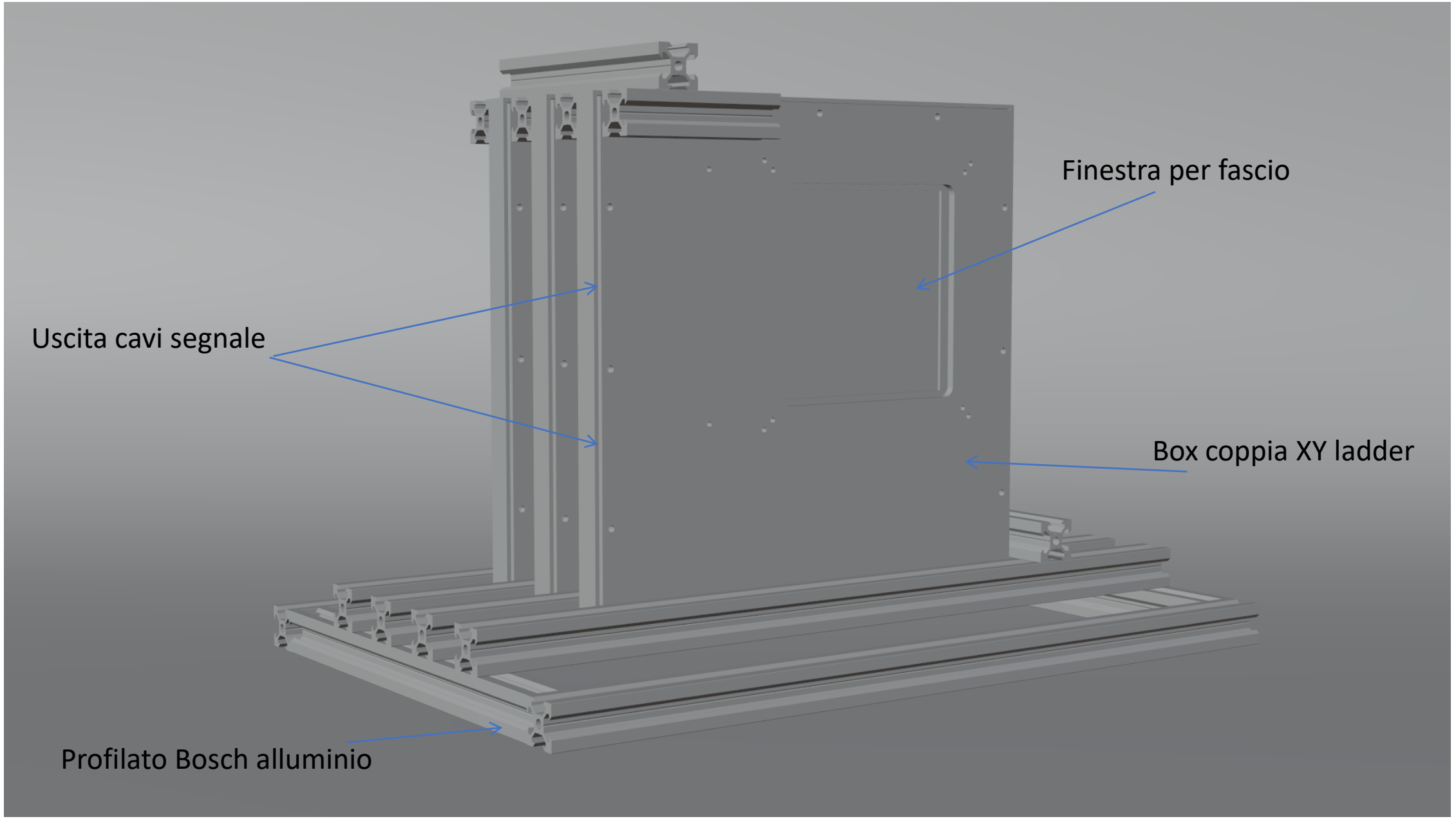




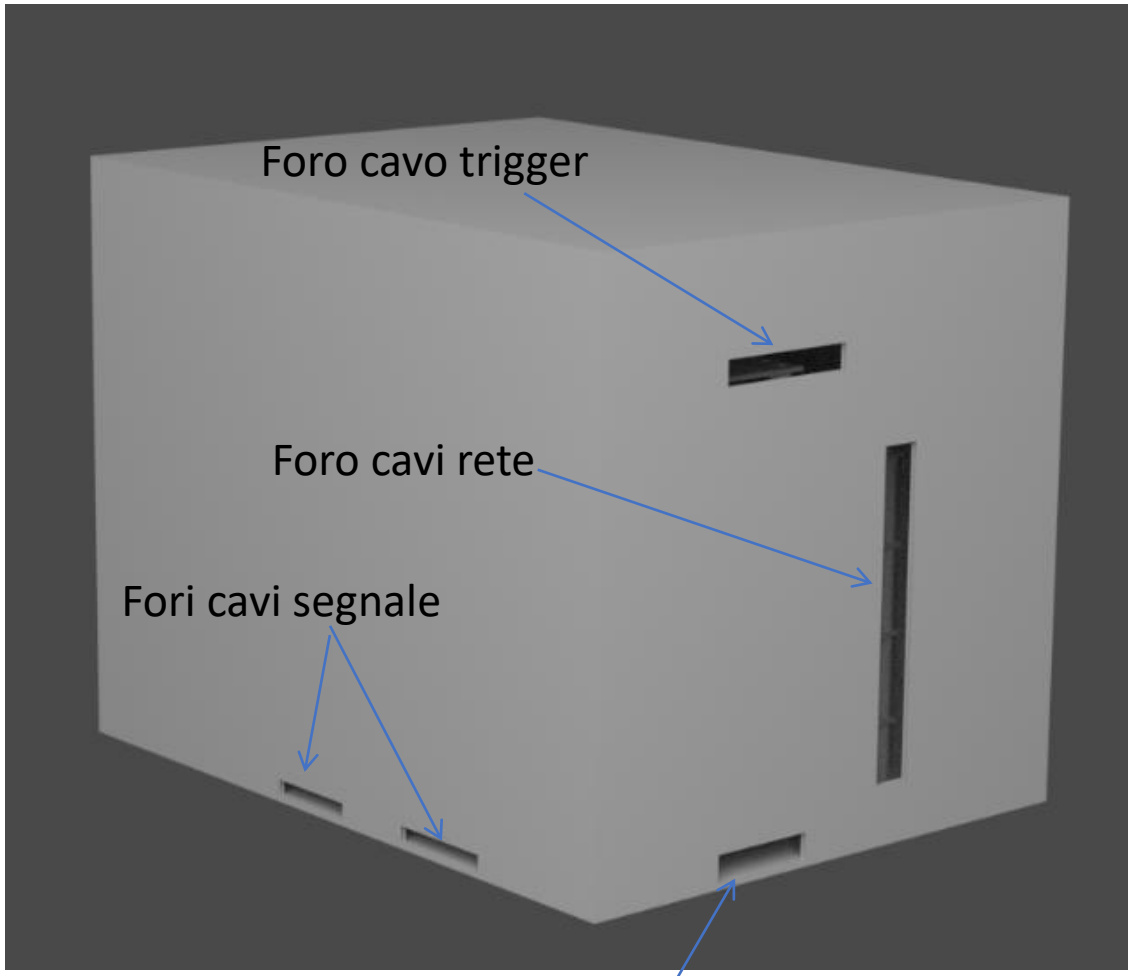
- Prova common noise su dati TB Trento
- Luci della sala sperimentale di Trento

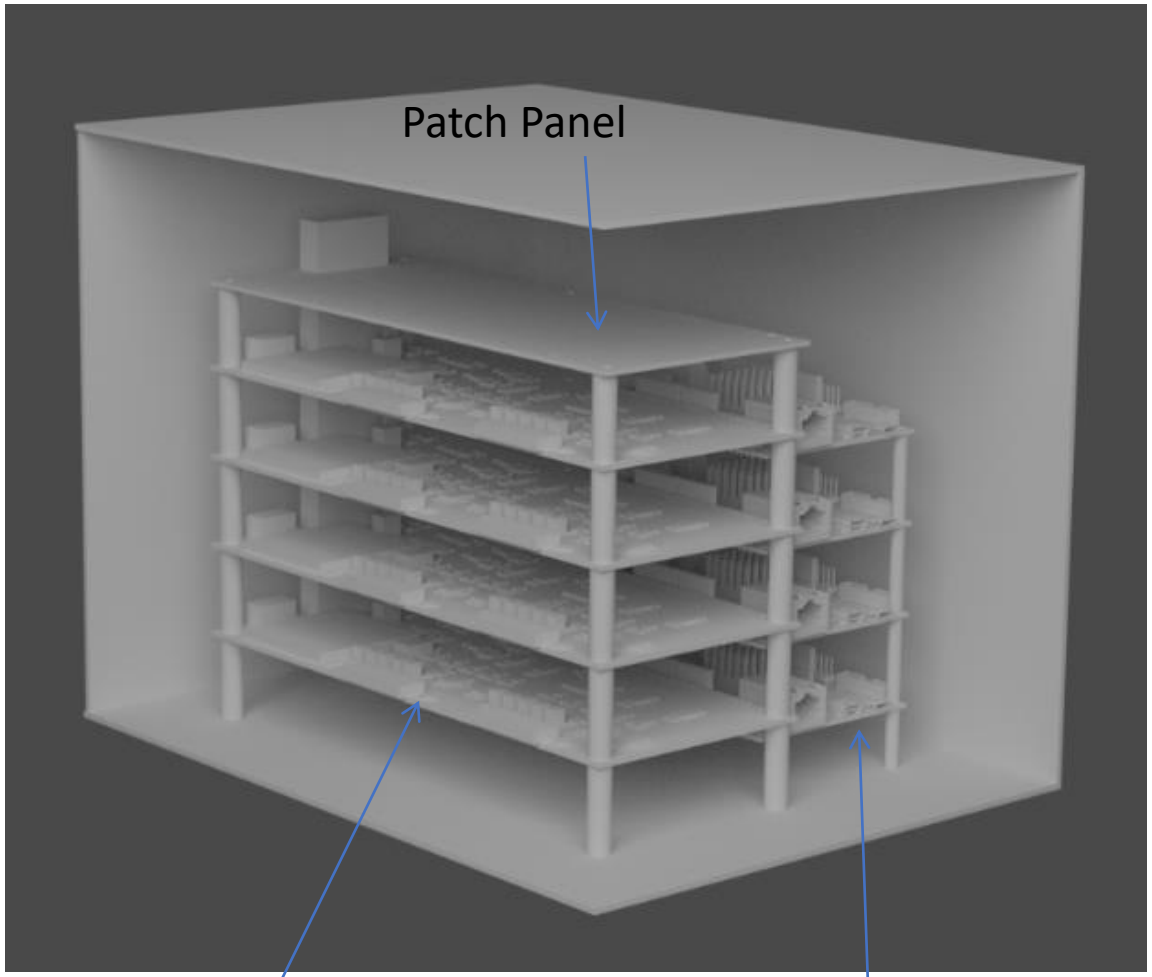
Piano X-Y (L03-L04) LAB test con luce; Alimentatore AMS (0.1uA precisione)	
Condizioni di test	I_leak, uA (ambi-ladder)
Piano chiuso+ black box	0.7
Piano chiuso+box aperta	1.4
Piano chiuso+box aperta+LED	1.7
Piano chiuso+box chiusa+LED	1.0
Piano chiuso+box aperta+LED+torcia su L03	2.8
Piano chiuso+box aperta+LED+torcia su L03 e L04	3.2

Setup meccanico GSI



Setup meccanico GSI





Setup meccanico GSI

- Scatola alluminio
  - 3 coppie XY con scheda ADC + DE10Nano
  - 1 coppia ADC + DE10Nano spare gia' inclusa nello stack dell'elettronica
  - Coppia XY sostituibile in caso di necessita' (basta sfilare la scatola dalla struttura)
- Fori chiusi con nastro alluminato
- Cavi rete schermati
- Cavi segnale schermati con nastro alluminato

Conclusioni

- 10 FOOT MSD Ladders done
- 3 piani X-Y assemblati e testati con fascio a Trento
- 2 piani X-Y pronti per essere integrati
- Meccanica per l’elettronica in fase di costruzione
- GSI Test luglio
- CERN Test agosto