Latest news on MFT from CERN

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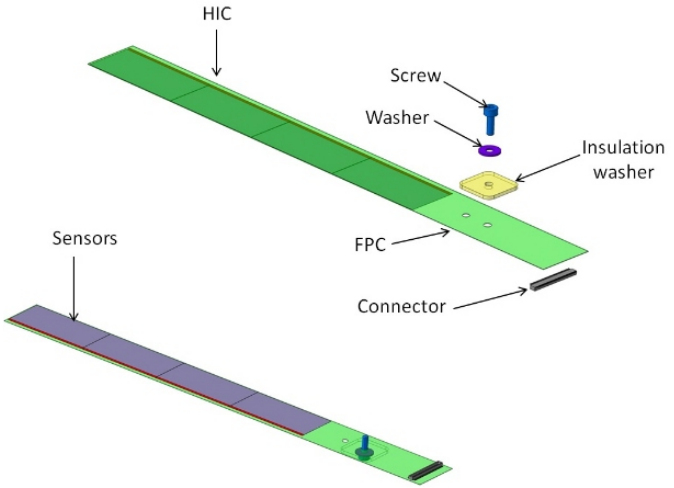
UPC Decin
26/09/2019

Workshop supported by grant SVK30/19/F4

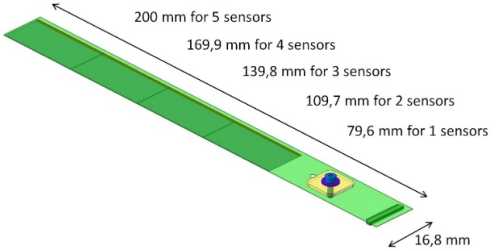
Outline

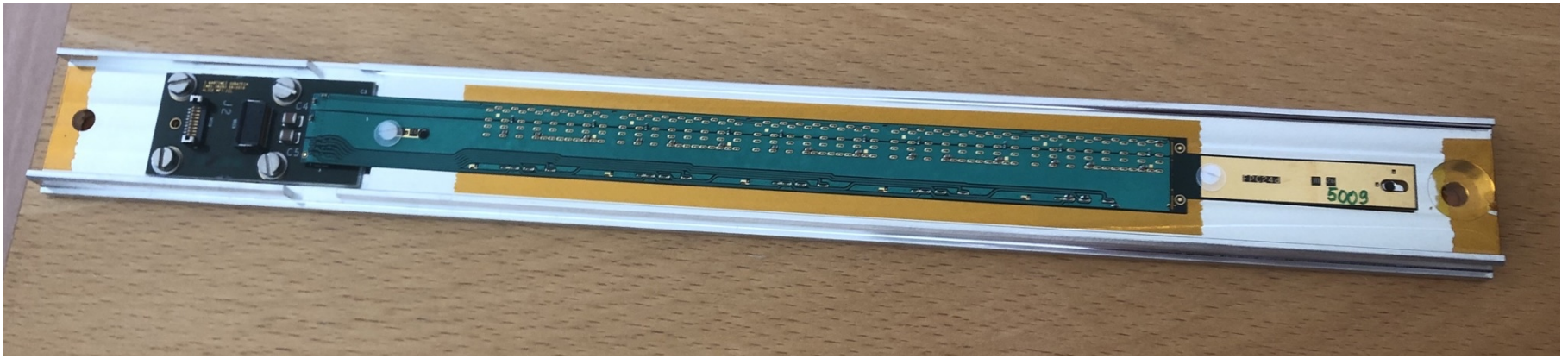
- Ladders
- Ladder design
- Ladder assembly
- Ladder qualification

Ladder design

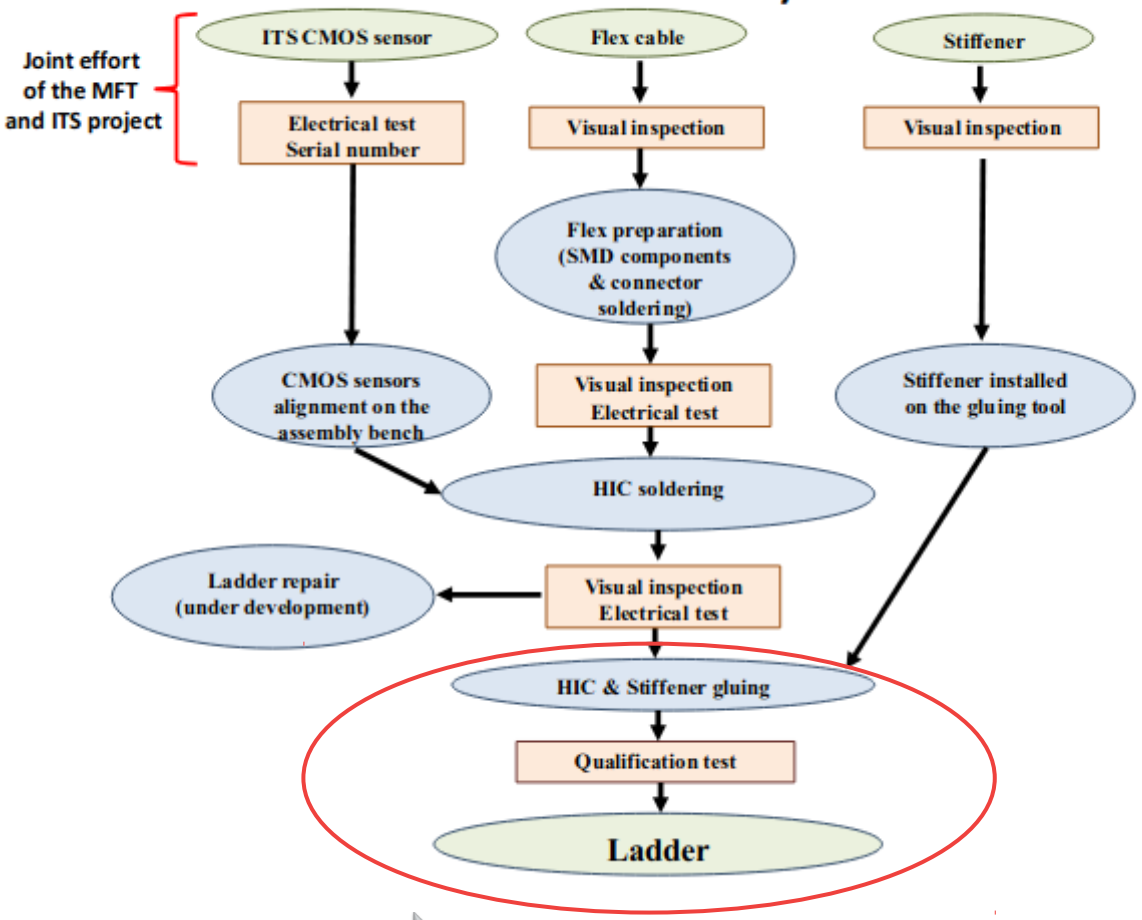


- the stiffener
- the silicon pixel sensors
- the Flexible Printed Circuit (FPC)
-
- HIC (Hybrid Integrated Circuit) – sensors laser-soldered to the FPC with a gap of 100 /mu m between sensors
- FPC precisely positioned during assembly

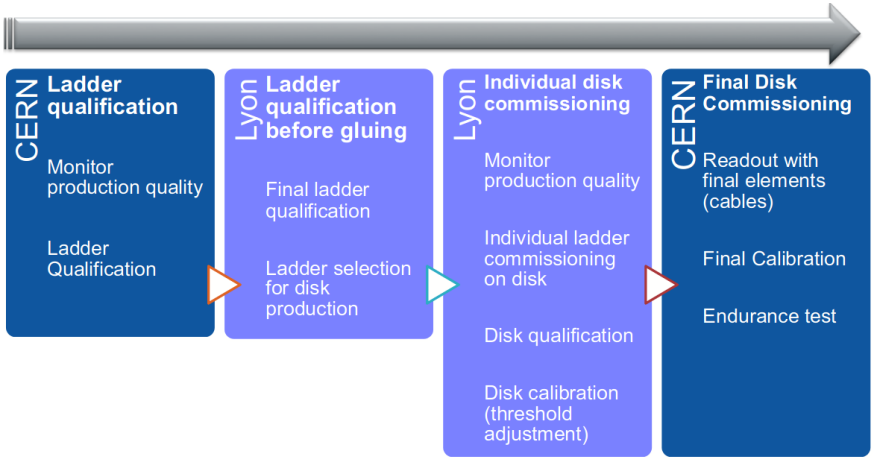




MFT ladder assembly scenario



Commissioning:

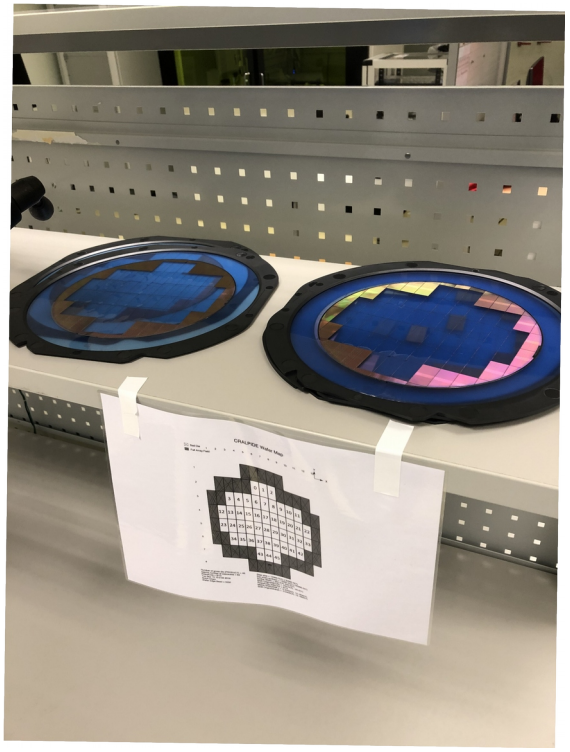


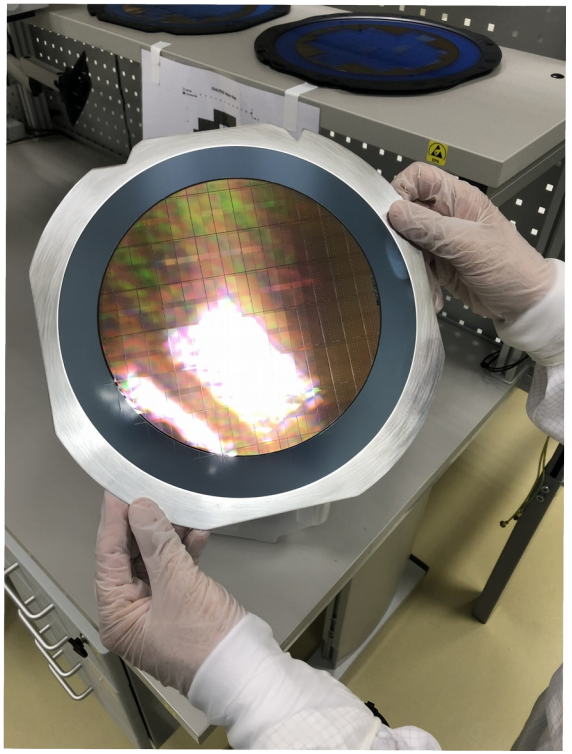
Ladder assembly

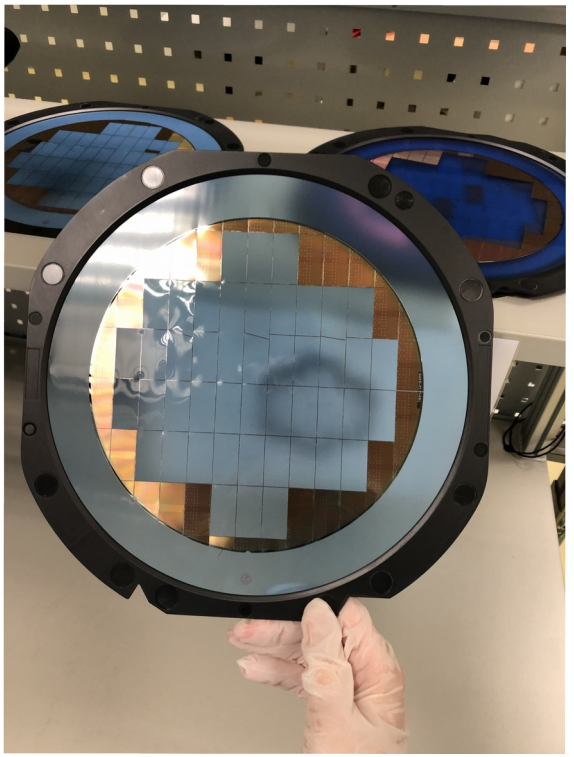
- FPC placed on top of sensors
- Placing soldering grid on top, soldering of each connection
- HIC removed from vacuum table
- Stiffener is placed in the gluing tool – glue is applied
- HIC placed on top of stiffener
- Quality tests of ladders

Ladder assembly ~wafers

- wafer production, thinning, dicing and qualification – procedure defined by ITS
- 100 wafer allocated for MFT (3 half-MFT + spares + prod. yield)



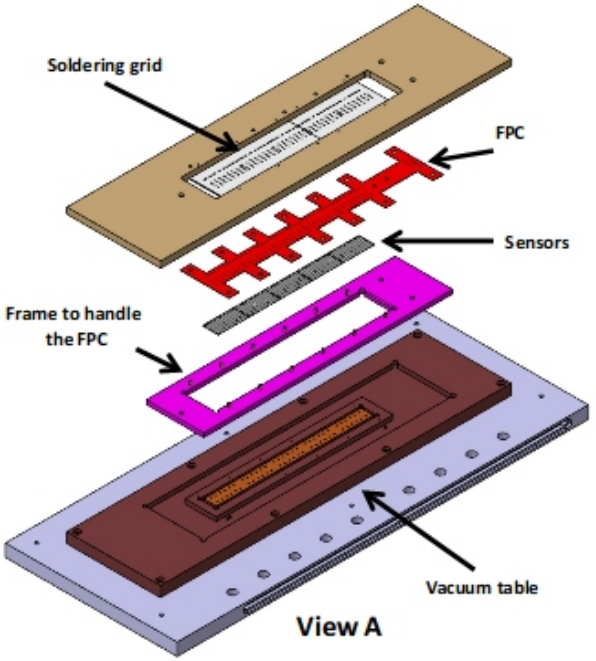


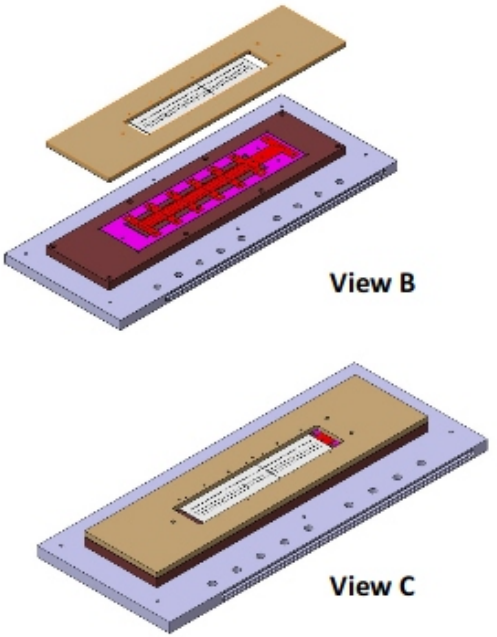


Chip cleaning

Positioning FPC

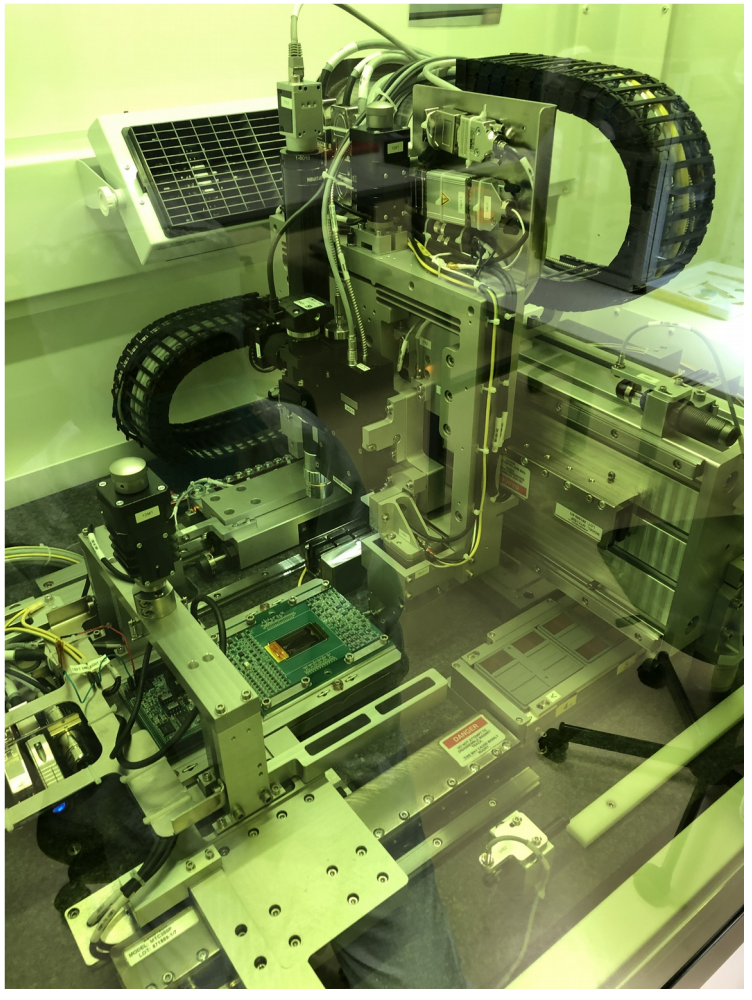
Ladder assembly

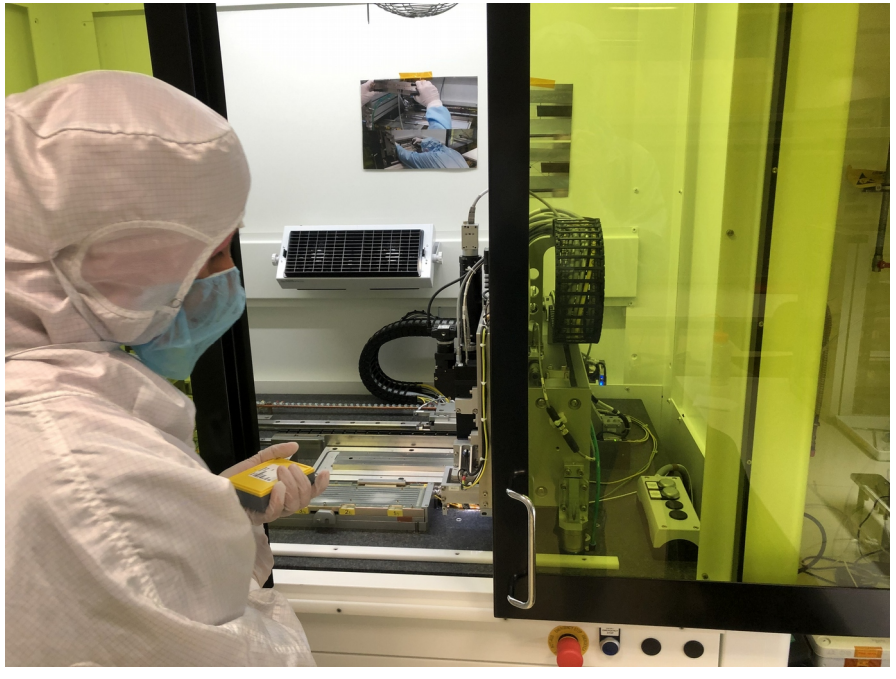




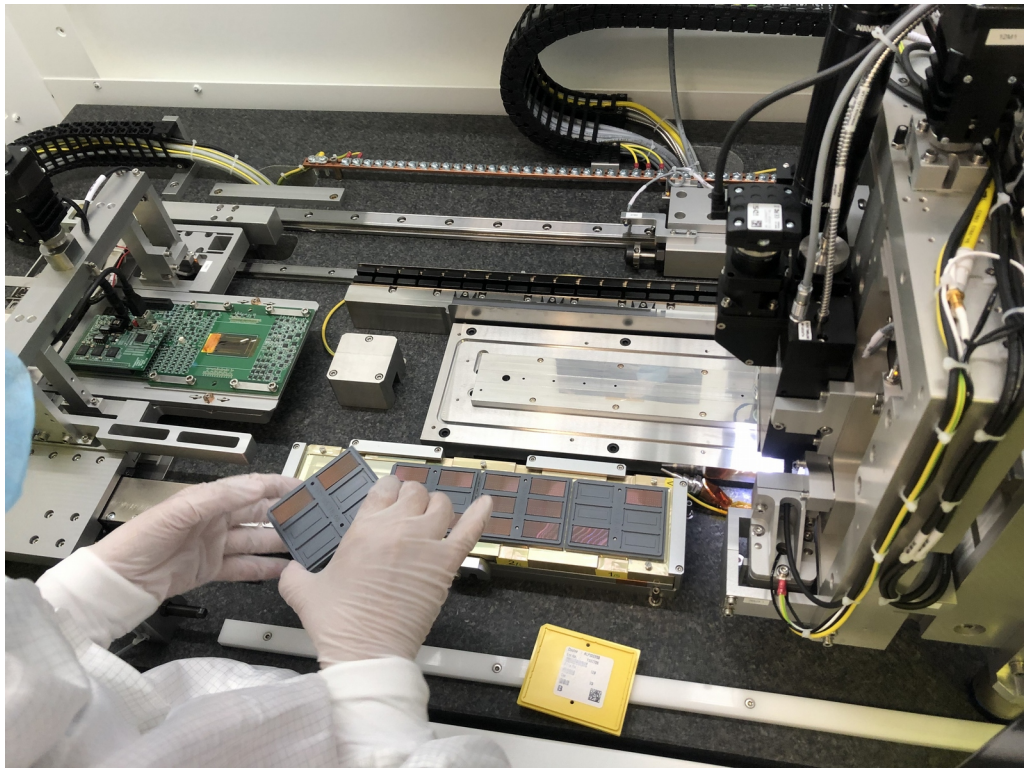
Ladder assembly ~ALICIA

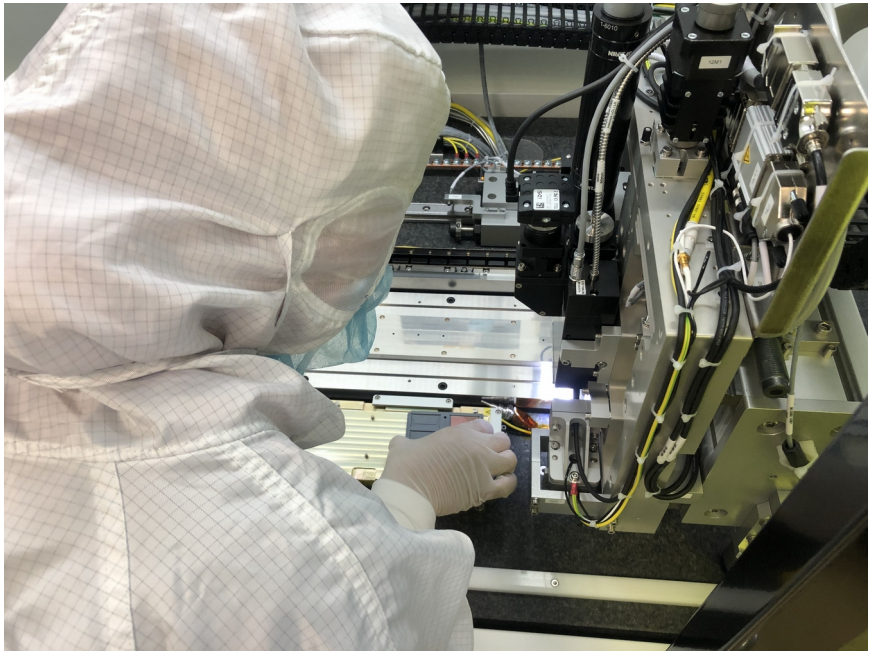
- automatic assembly system ALICIA
- ALICIA picks up each fragile chip from a supply tray and places it on the frame and solder all interconnects
- high-accuracy image system (< 0.1 µm) to measure markers
- final assembly accuracy of < 5 µm over full array of chips





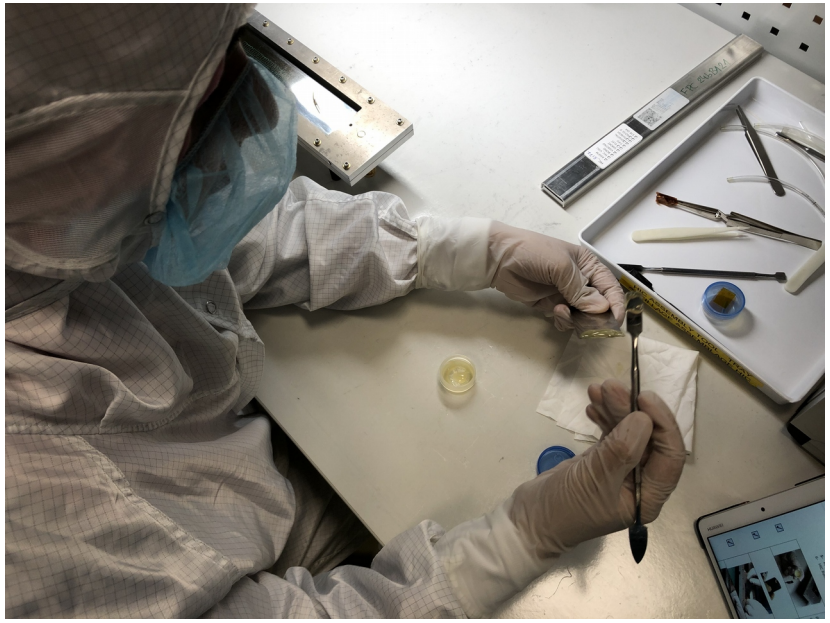
Ladder assembly
~ALICIA chips positiniong

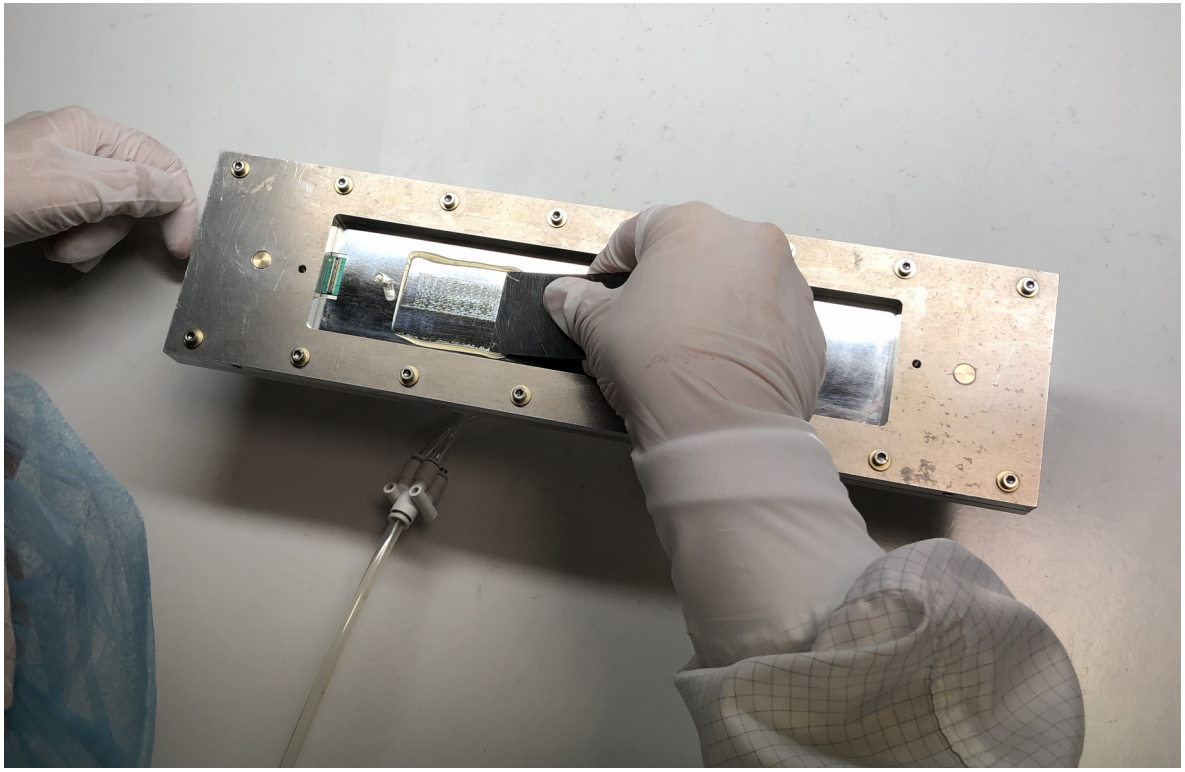




Ladder assembly ~gluing

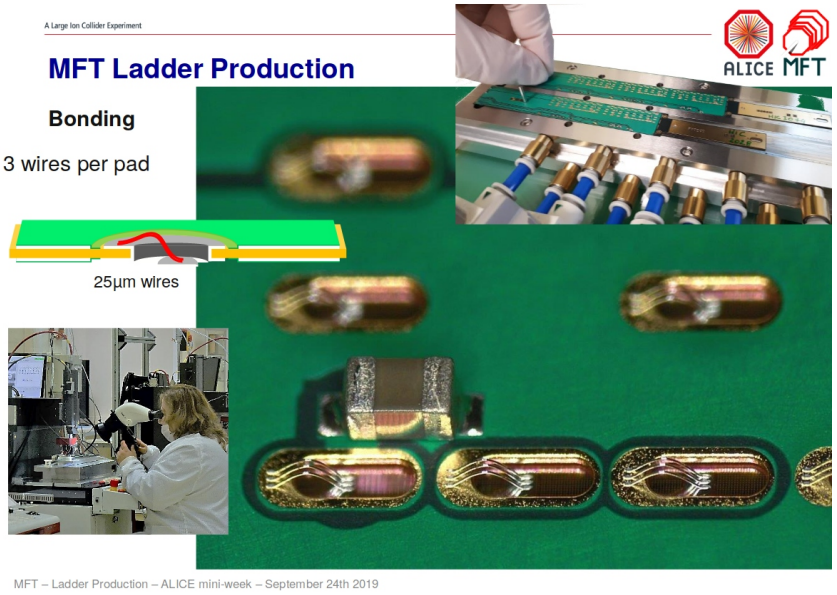
- glue preparation + FPC-chip gluing

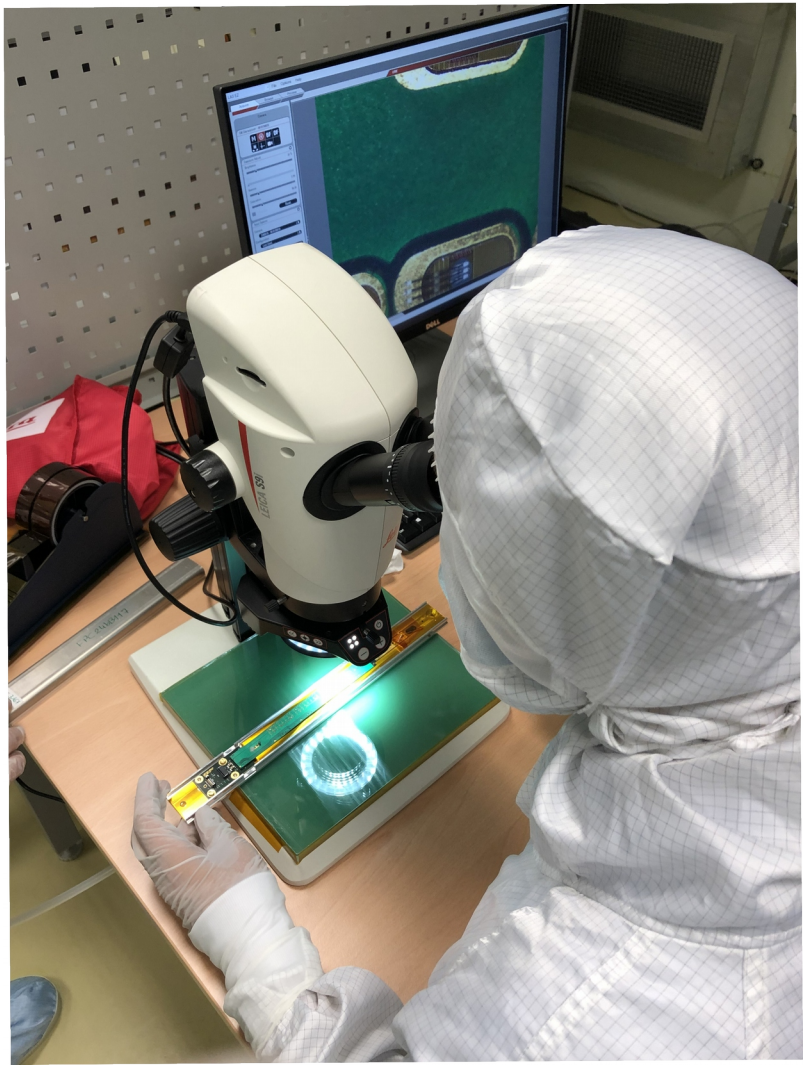


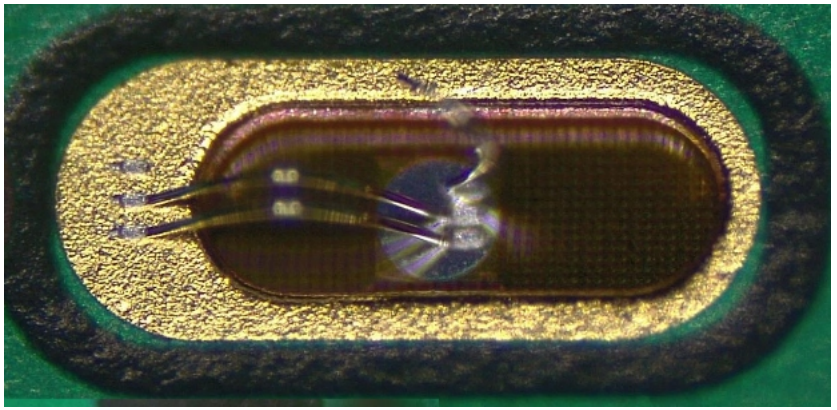


Bonding

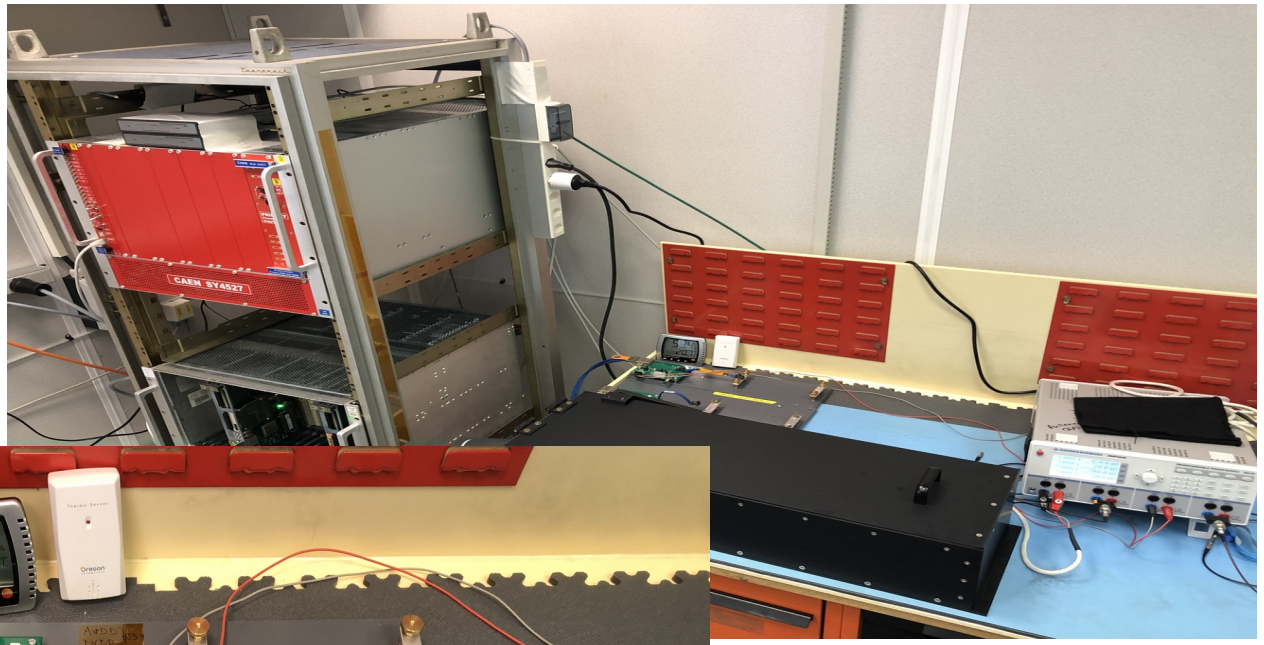
Pull tests (tests for wire bond strength and quality): average weight 11g

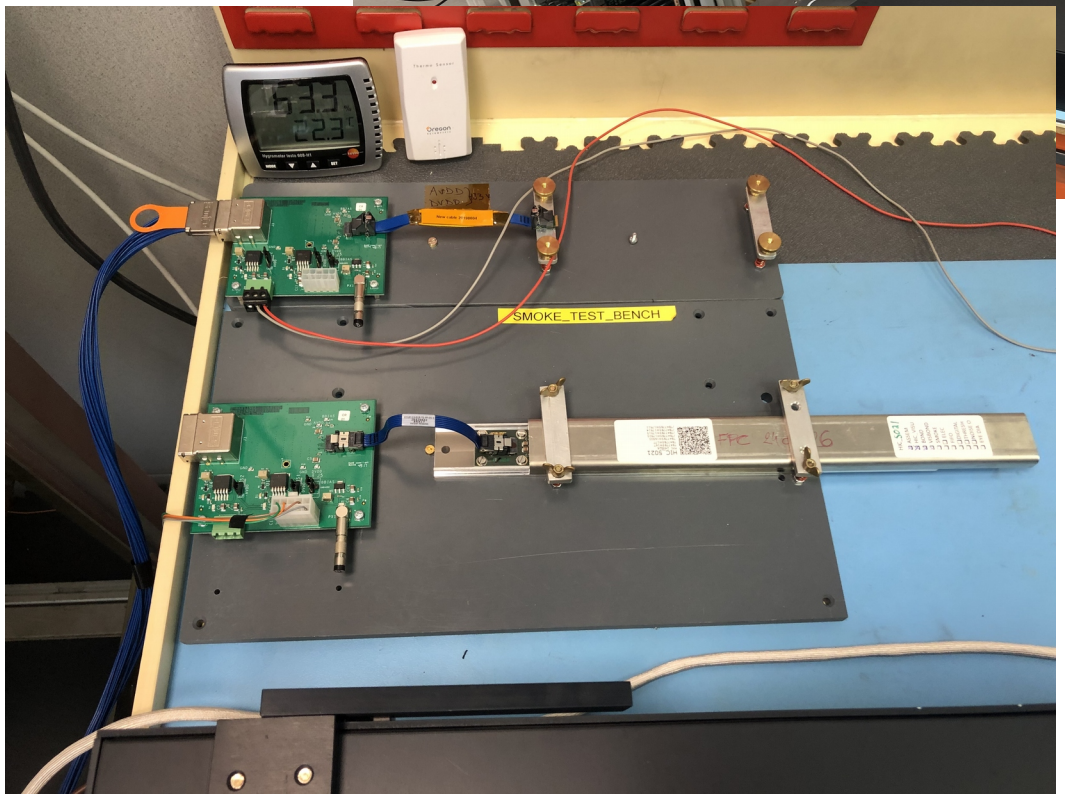






Ladder qualification





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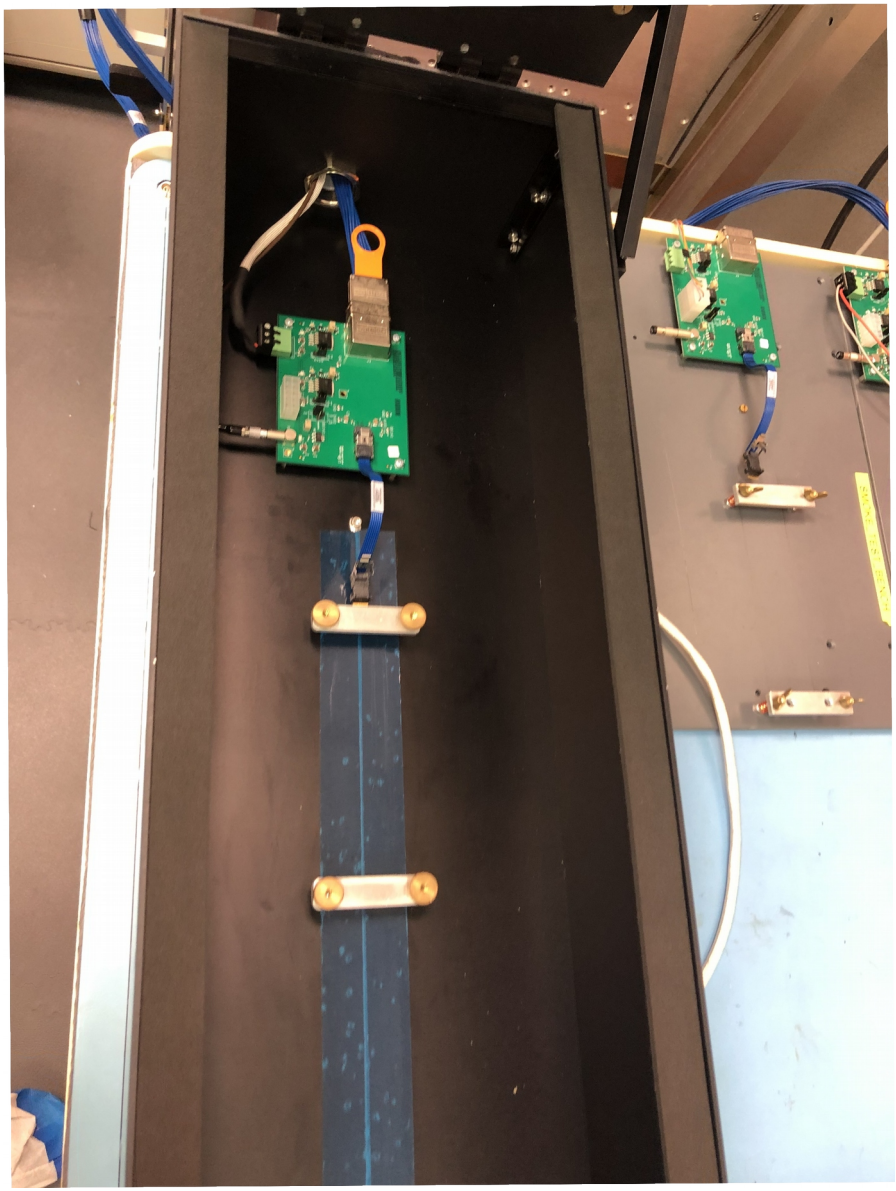

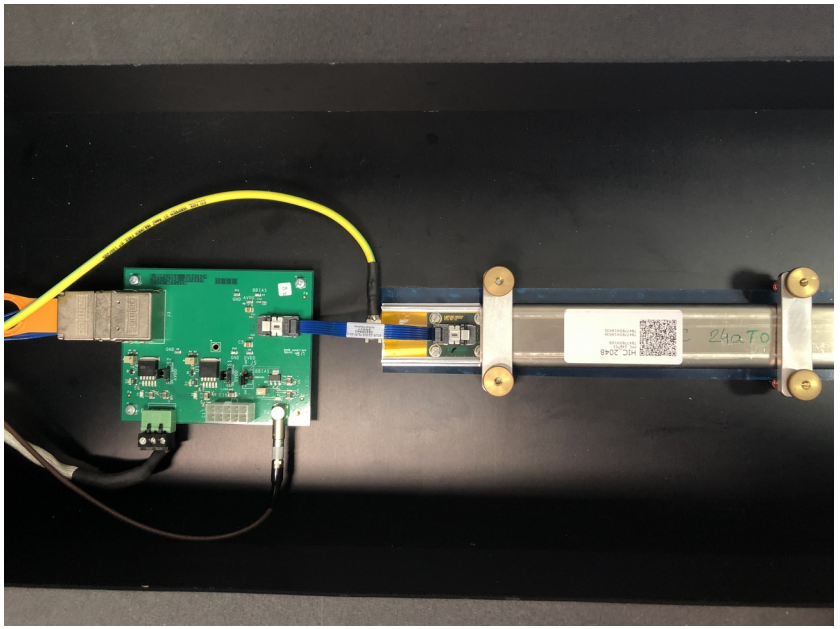

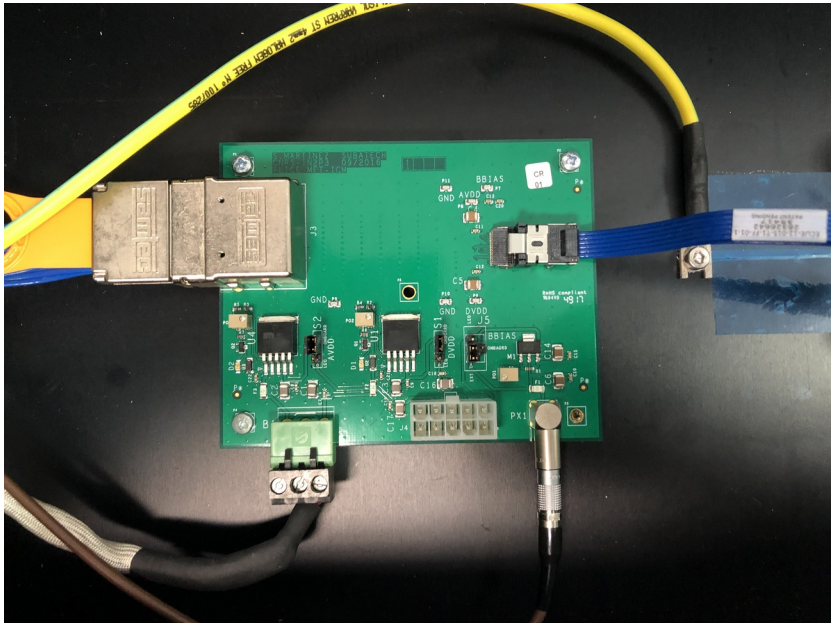

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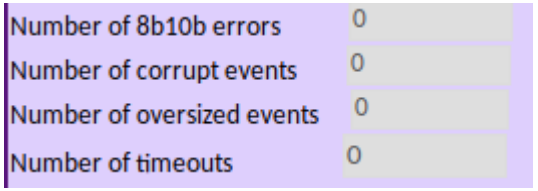

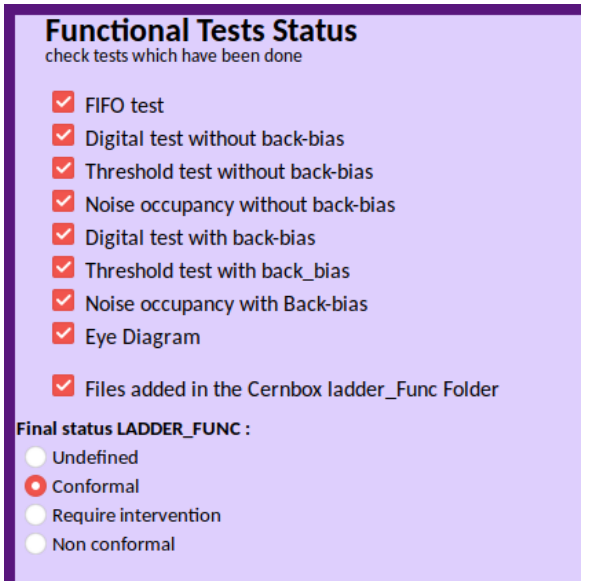

- Smoke test
- FIFO scan (slow control)
- Digital scan (digital circuitry test)
- Threshold adjustment (analog circuitry test + threshold equalization)
- Noise occupancy
- Eye diagram (output signal strength and stability test)

gold + silver yield: 88%

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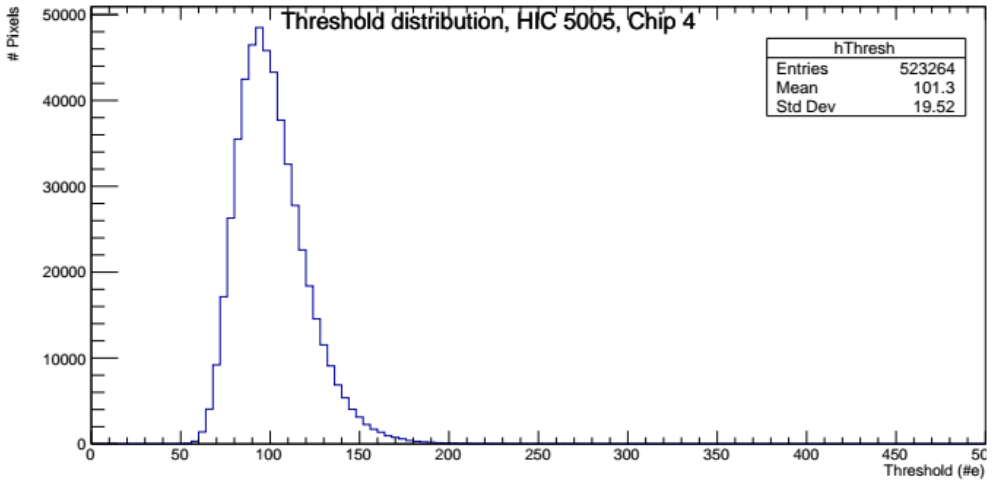
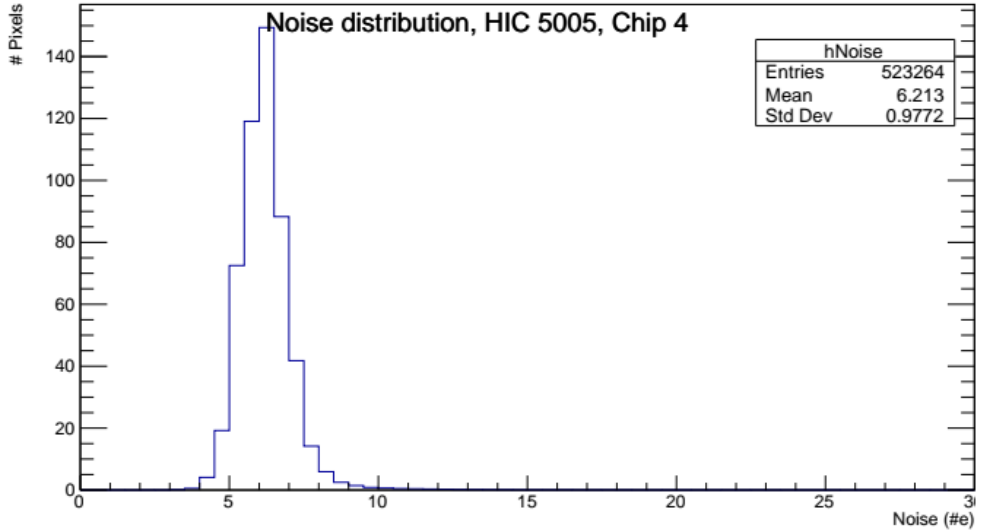
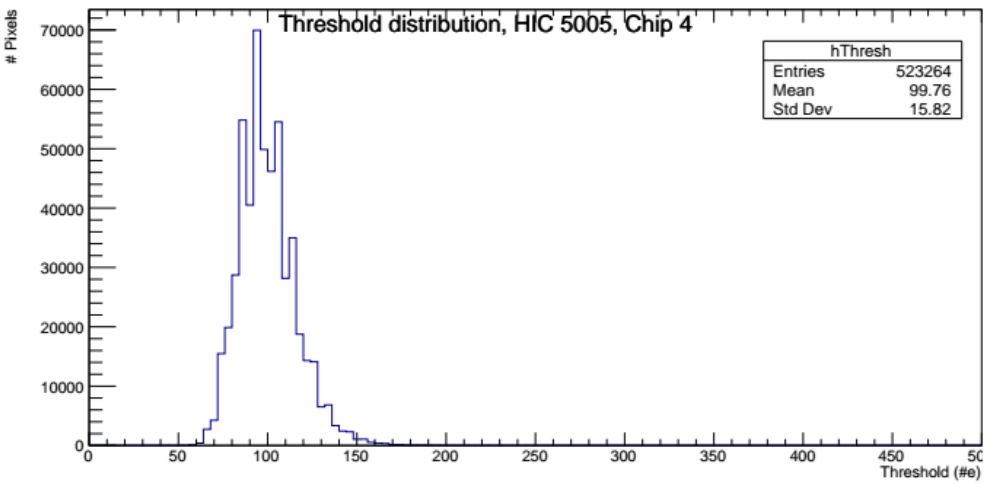
Threshold distributions

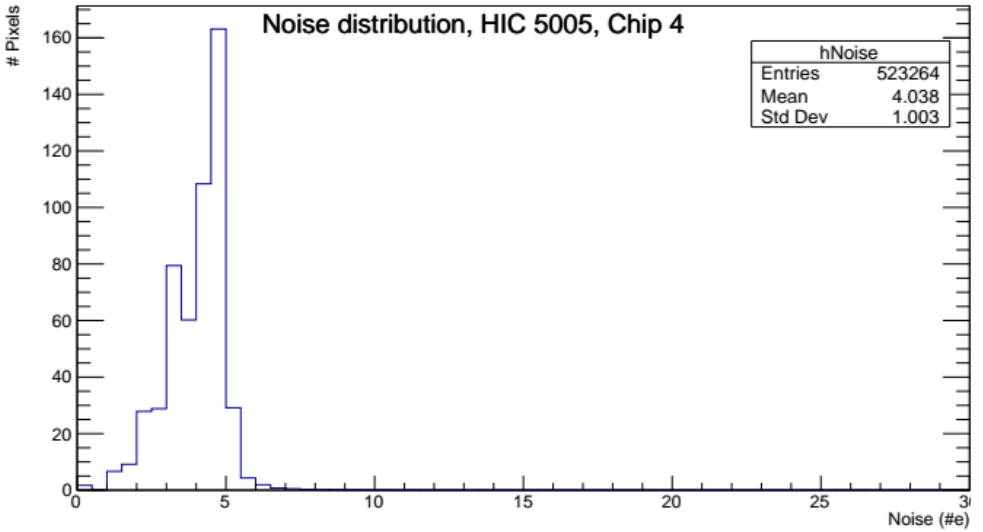
Without back-bias





With back-bias





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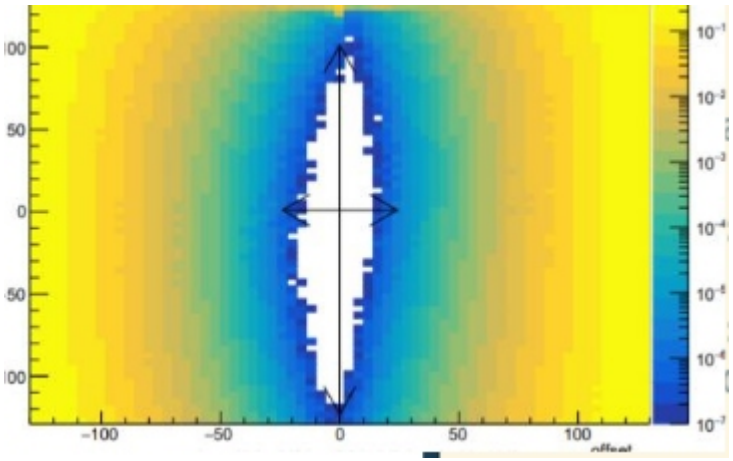
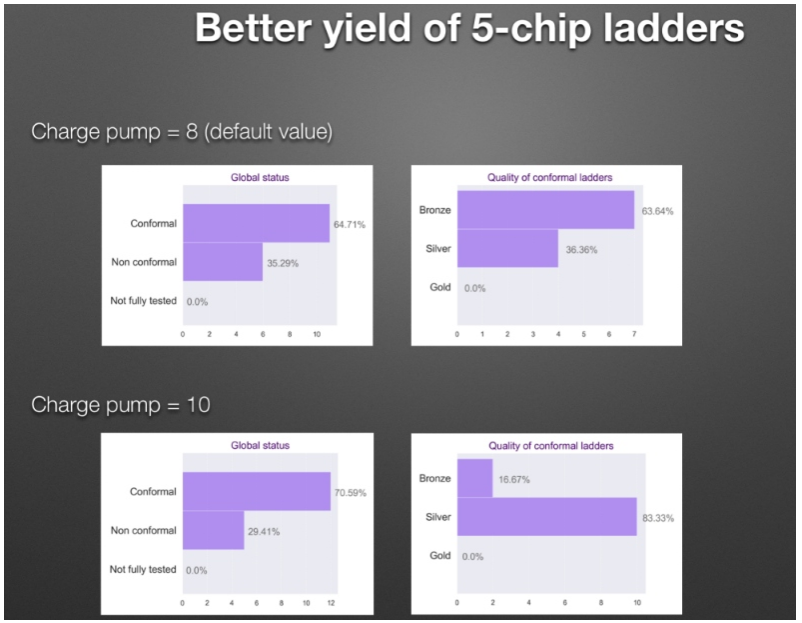




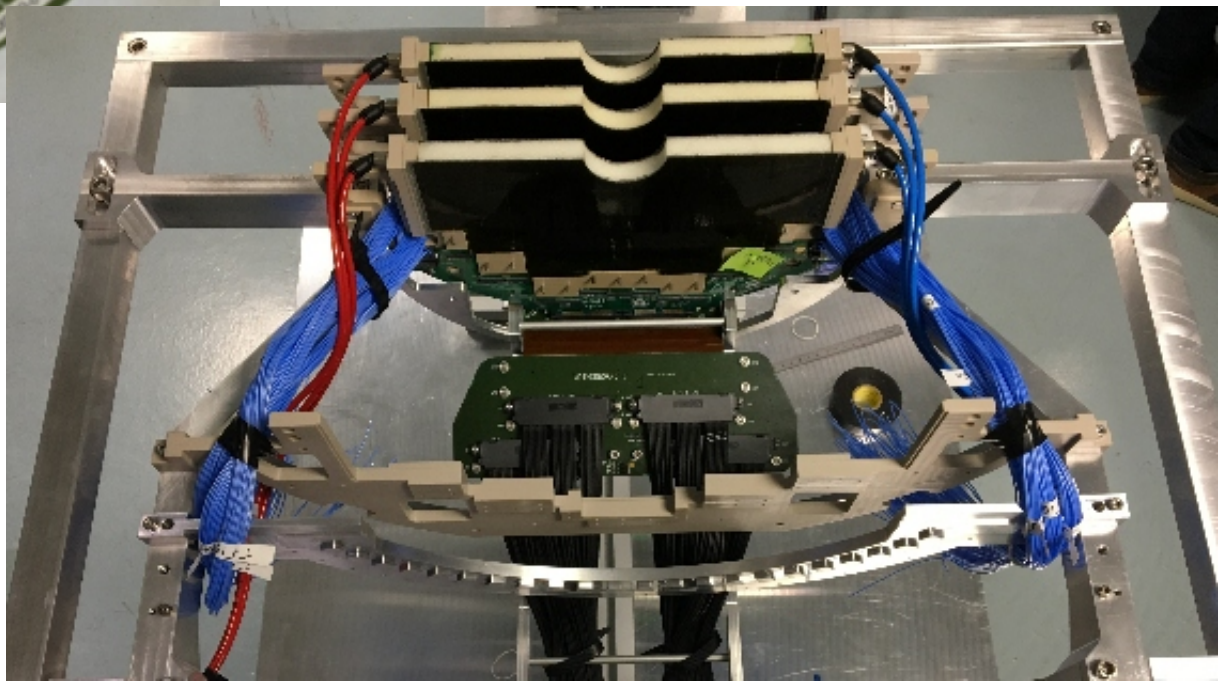
Qualification results

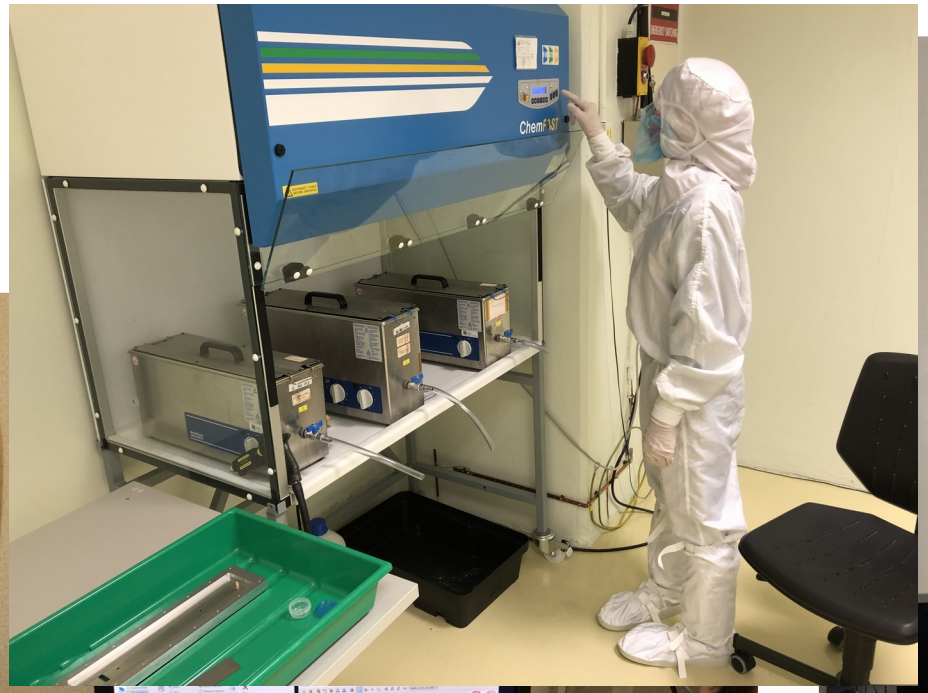
Sl No.	Ladder	FIFO	Digital	Threshold	Noise	Eye-diagram	Comments	Date of test
1	4094	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Gold	Bronze	Conformal	10-09-2019
2	5009 (Retested)	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Gold	Silver	Conformal	10-09-2019
3	5021	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Gold	Silver	Conformal	11-09-2019
4	4093	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Blue	Silver	Non-Conformal	11-09-2019
5	2048	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Gold	Silver	Conformal	11-09-2019
6	3103 (Retested)	Gold/ Gold	Silver/ Silver	Silver/ Silver	Silver /Gold	Silver	Conformal	11-09-2019
7	4009 (retested)	Gold/ Gold	Silver/ Silver	Silver/ Silver	Silver/ Gold	Bronze	Conformal	12-09-2019
8	3163	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Gold	Silver	Conformal	12-09-2019
9	3164	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Gold	Silver	Conformal	12-09-2019
10	3165	Gold/ Gold	Silver/ Gold	Silver/ Gold	Gold/ Gold	Silver	Conformal	12-09-2019
11	2049	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Gold	Silver	Conformal	12-09-2019
12	3084 (retested)	Gold/ Gold	Red/ Red	Red/ Red	Gold/ Gold	Silver	Non-conformal	12-09-2019
13	2050	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Gold	Silver	Conformal	13-09-2019
14	3158	Gold/ Gold	Silver/ Gold	Silver/ Gold	Gold/ Gold	Gold	Conformal	13-09-2019
15	4010 (retested)	Gold/ Gold	Silver/ Silver	Silver/ Silver	Silver/ Gold	Bronze	Conformal	13-09-2019
16	3161	Gold/ Gold	Gold/ Gold	Gold/ Gold	Gold/ Gold	Silver	Conformal	13-09-2019

Qualification results

Sl No.	Ladder	FIFO	Digital	Threshold	Noise	Eye-diagram	Comments	Date of test
1	4032 (retested)	Gold/ Gold	Silver/ Gold	Silver/ Silver	Silver/ Gold	Bronze	Conformal	16-09-2019
2	4036 (retested)	Gold/ Gold	Silver/ Silver	Silver/ Silver	Silver/ Gold	Bronze	Conformal	16-09-2019
3	4045 (retested)	Gold/ Gold	Silver/ Silver	Silver/ Silver	Silver/ Gold	Bronze	Conformal	16-09-2019
4	3166	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Gold	Gold	Conformal	17-09-2019
5	3167	Gold/ Gold	Gold/ Gold	Gold/ Gold	Gold/ Gold	Silver	Conformal	17-09-2019
6	3168	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Gold	Silver	Conformal	17-09-2019
7	3169	Gold/ Gold	Silver/ Gold	Silver/ Gold	Gold/ Gold	Silver	Conformal	17-09-2019
8	5005 (retested)	Gold/ Gold	Silver/ Silver	Silver/ Silver	Silver/ Gold	Silver	Conformal	17-09-2019
9	3171	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Gold	Silver	Conformal	18-09-2019
10	3172	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Gold	Silver	Conformal	18-09-2019
11	3173	Gold/ Gold	Silver/ Silver	Silver/ Red	Gold/	Silver	Non-conformal	19-09-2019
12	3174	Gold/ Gold	Gold/ Gold	Gold/ Gold	Gold/ Gold	Gold	Conformal	19-09-2019
13	3176	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Gold	Silver	Conformal	19-09-2019
14	3175	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Gold	Silver	Conformal	19-09-2019
15	3170	Gold/ Gold	Silver/ Silver	Silver/ Silver	Gold/ Gold	Silver	Conformal	19-09-2019
16	3177	Gold/Gold	Gold/Gold	Gold/Gold	Gold/Gold	Silver	Conformal	24-09-2019

Ladder assembly → half-disk assembly → cone assembly

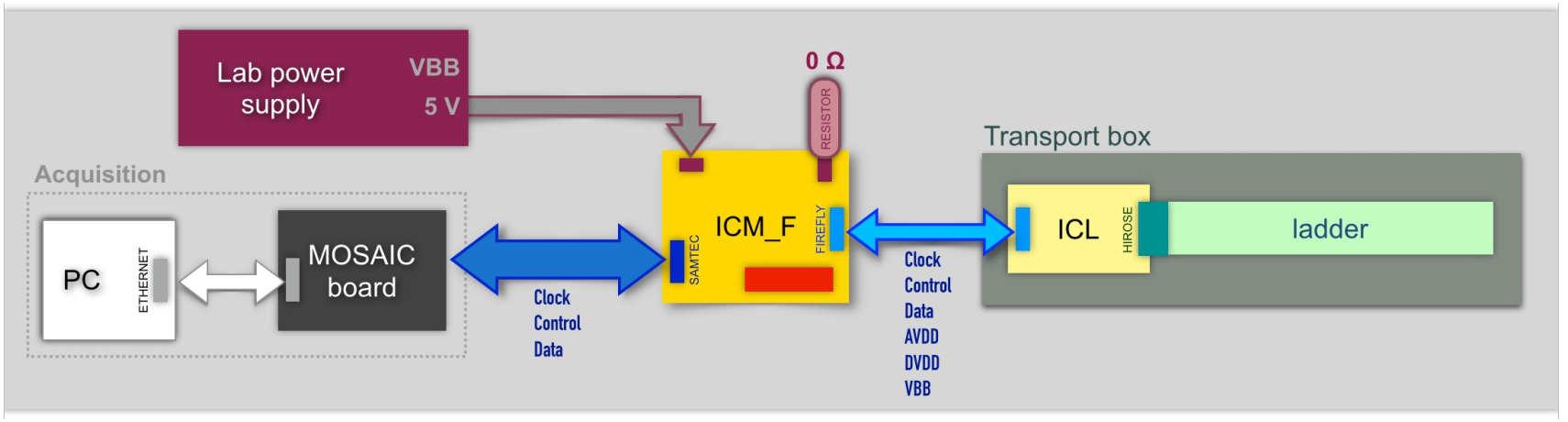




Thank you

Additional slides

- Functional tests without back-bias



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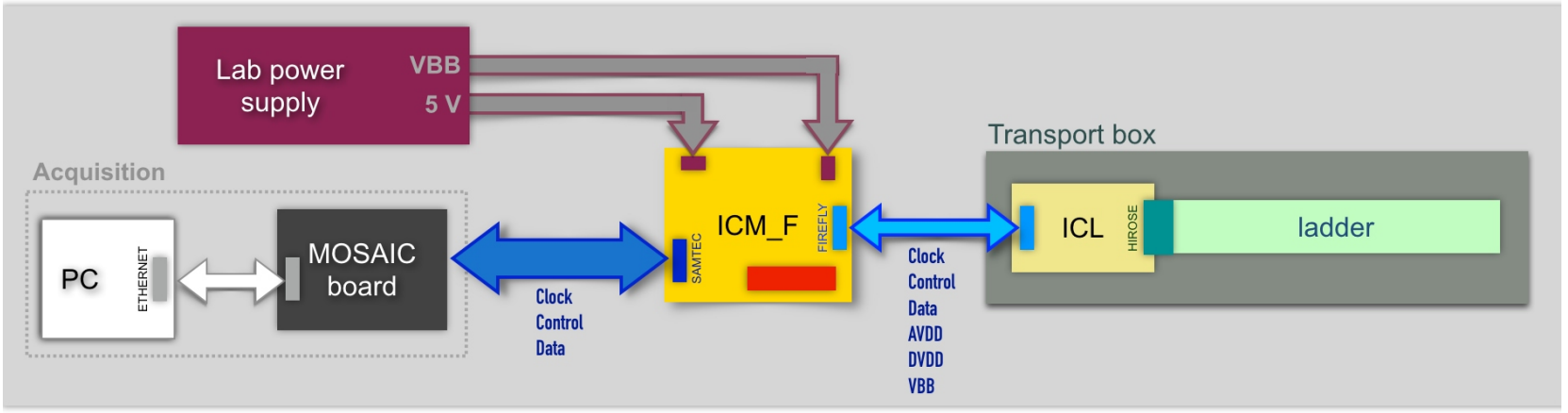
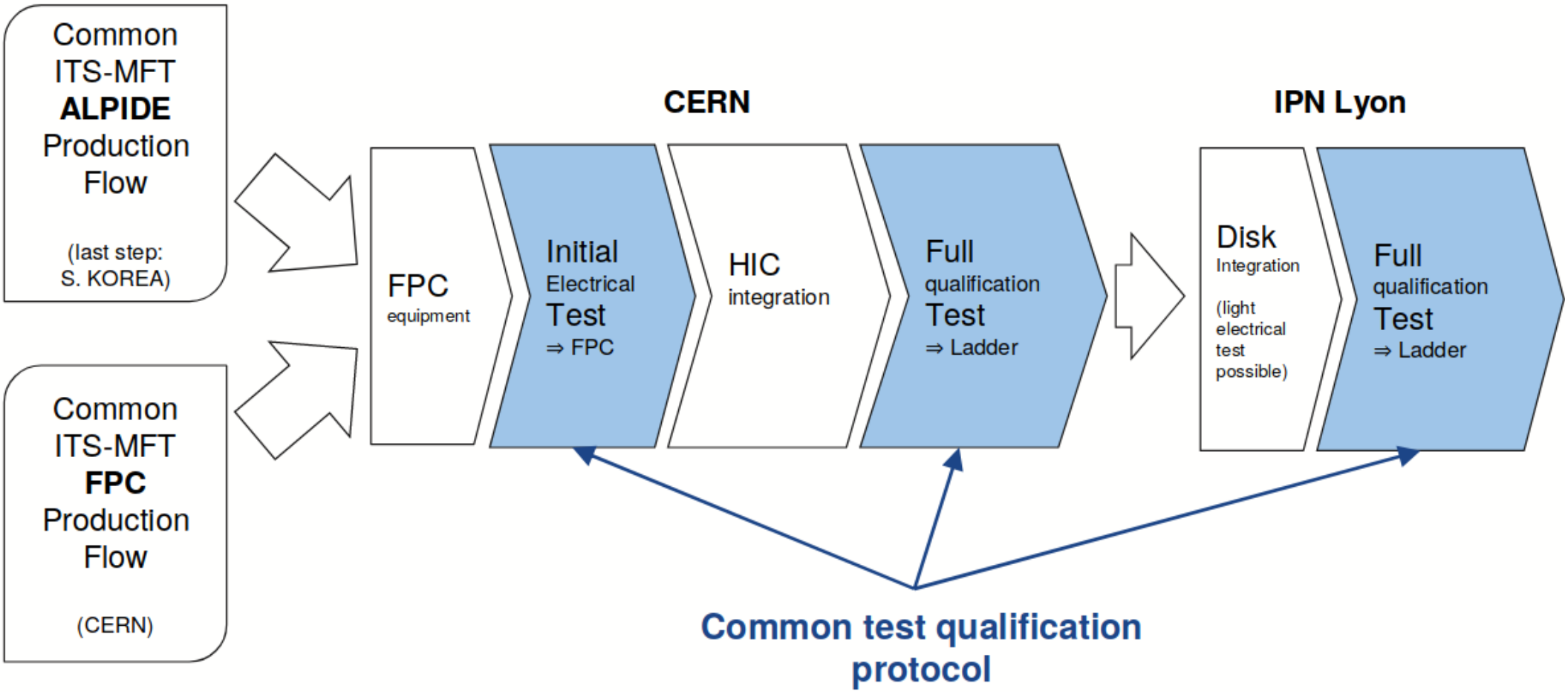
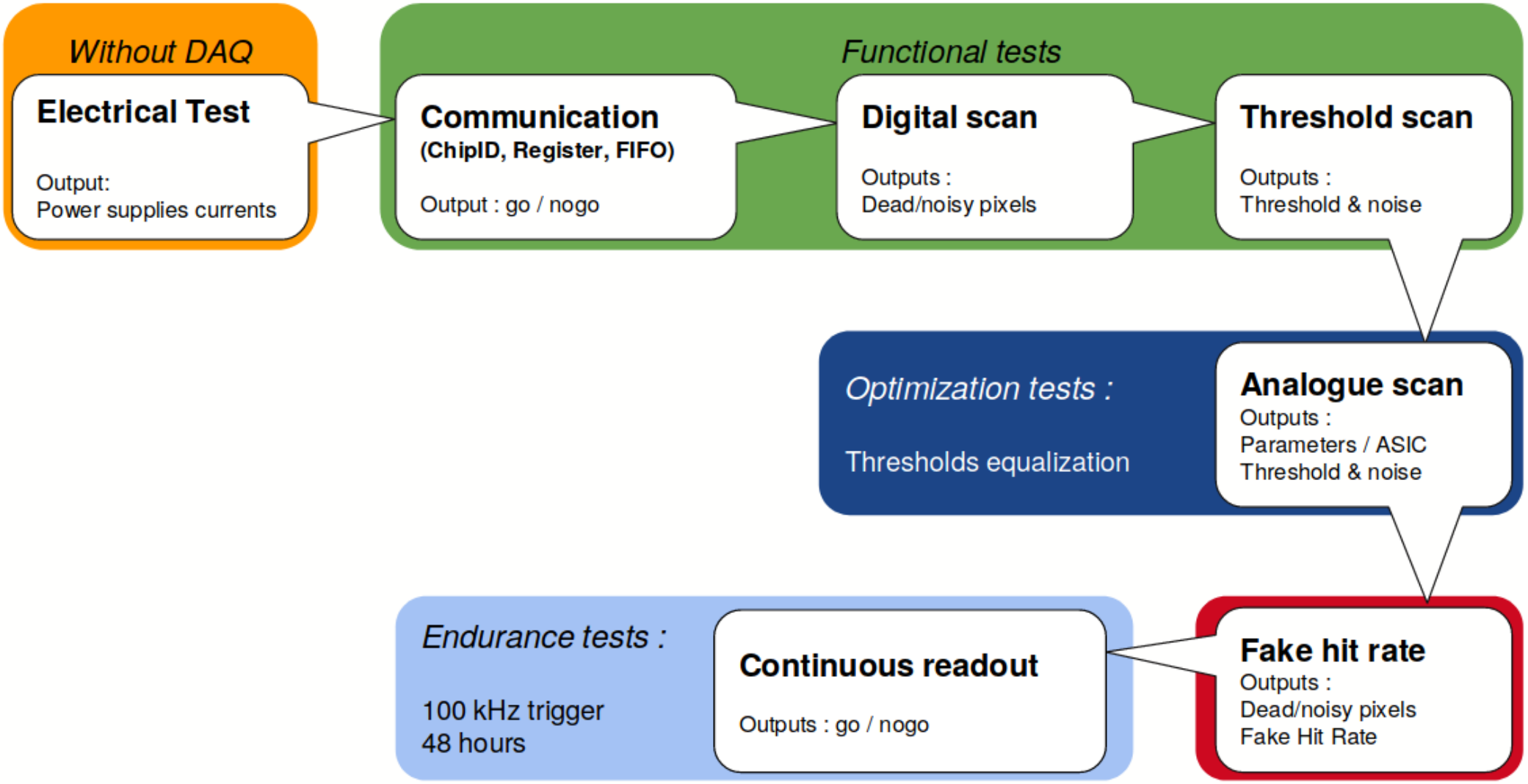



Common ITS-MFT ALPIDE Production Flow
(last step: S. KOREA)
Common ITS-MFT FPC Production Flow
(CERN)
CERN
IPN Lyon
FPC equipment
Initial Electrical Test ⇒ FPC
HIC integration
Full qualification Test ⇒ Ladder
Disk Integration
(light electrical test possible)
Full qualification Test ⇒ Ladder
Common test qualification protocol

Procedure overview :