

# Ladder assembly

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MFT Ladder Assembly – SEOUL - 2018, November 19<sup>th</sup>

[12th ALICE ITS upgrade, MFT and O2 Asian Workshop](#)

## MFT Ladder Production

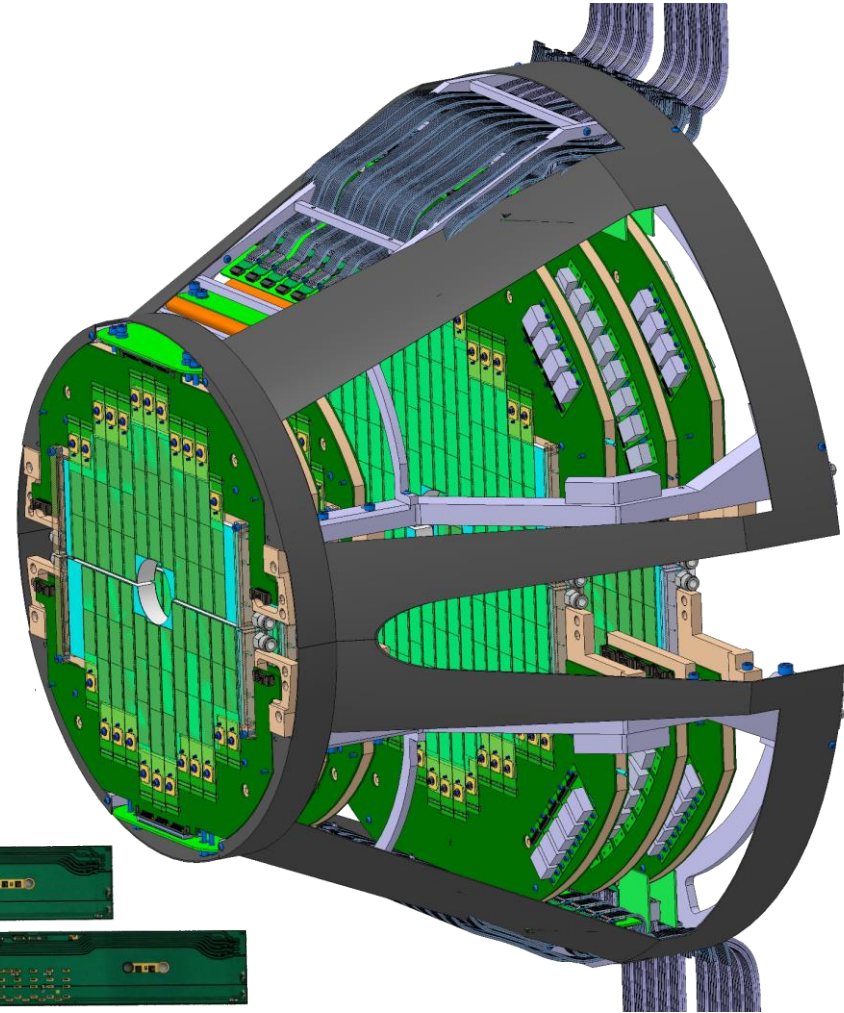
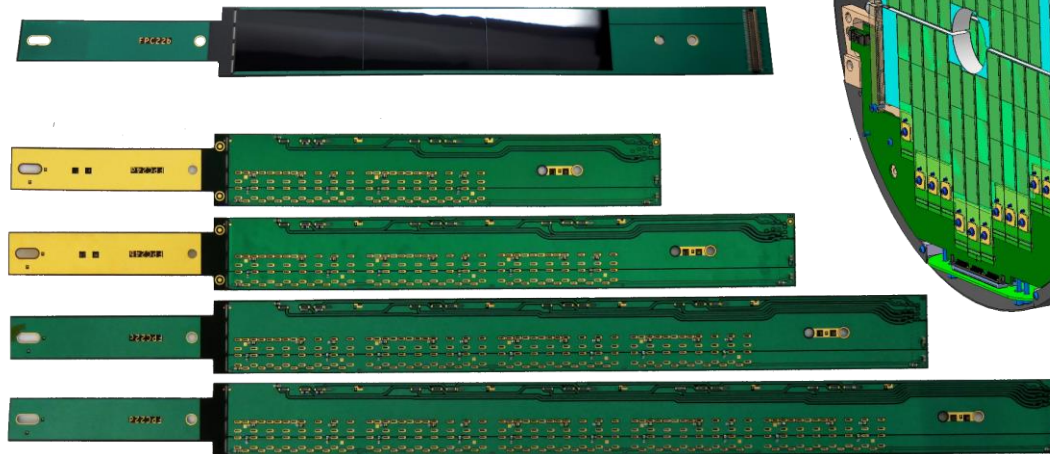
- Goal of MFT project
- Work environment and manpower
- Ladder production
  - Production overview
  - FPCs & Sensors
  - HIC assemblies
  - Bonding and conditioning
  - Ladder testing
- QA
  - Training
  - Procedures
  - Forms
  - Records in DB

# MFT Ladder Production

## Goal of MFT Project

5 disks equipped with ladders on both sides

604 ladders to do (spare included)  
2 to 5 silicon pixel sensors  
glued on an aluminum FPC bonded



# MFT Ladder Production

## Work environment and manpower

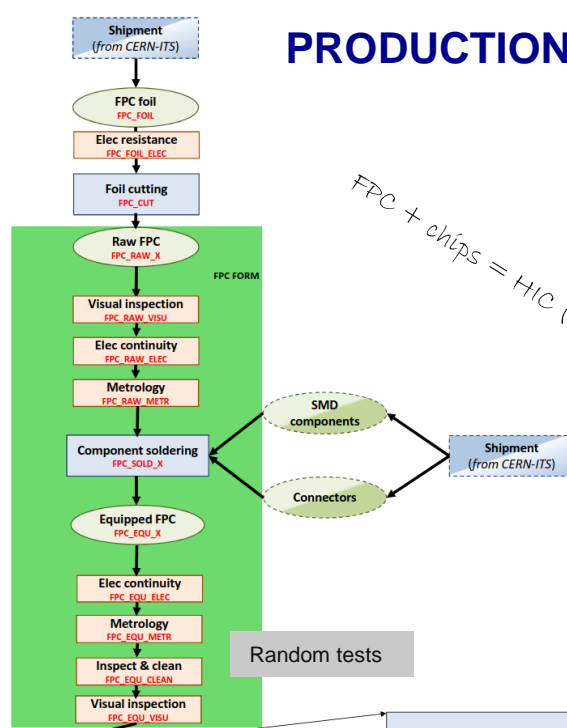
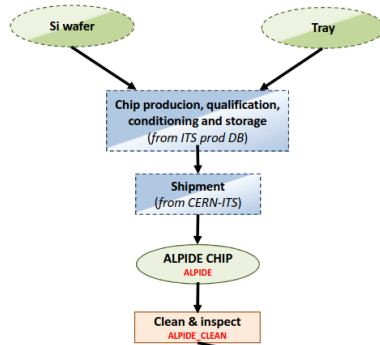
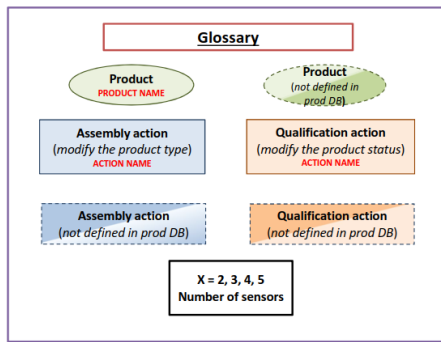
4 teams of 2 people  
for assemblies @DSF

- CEA Saclay (Antenna)
- LPC Clermont
- IPNLyon
- Subatech Nantes

2 persons (IPNLyon)  
for FPC inspection  
@grey room Antenna  
+ Kosei for qualification

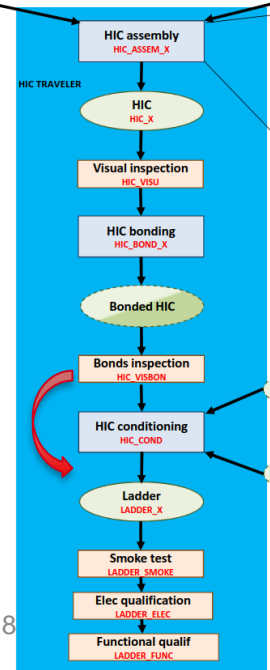


# PRODUCTION WORKFLOW



*FPC + chips = HIC (Hybrid Integrated Circuit)*

Random tests



Random tests

# MFT Ladder Production FPCs



# MFT Ladder Production

## FPCs

- FPCs are produced @CERN : batches of 4 foils of 26 FPCs:

2 x type d (5 sensors)



9 x type c (4 sensors)



12 x type b (3 sensors)



3 x type a (2 sensors)

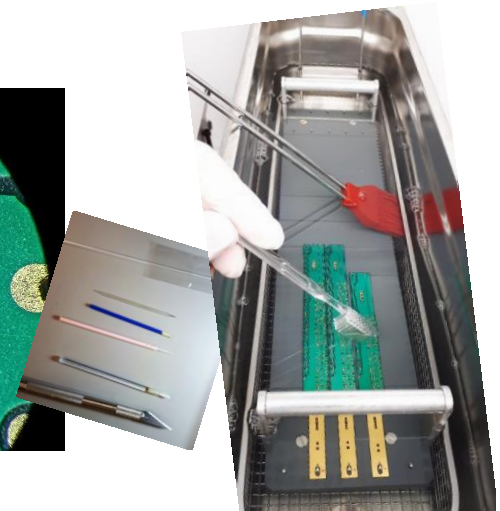
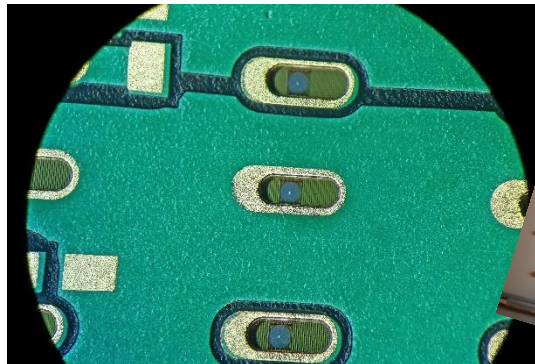
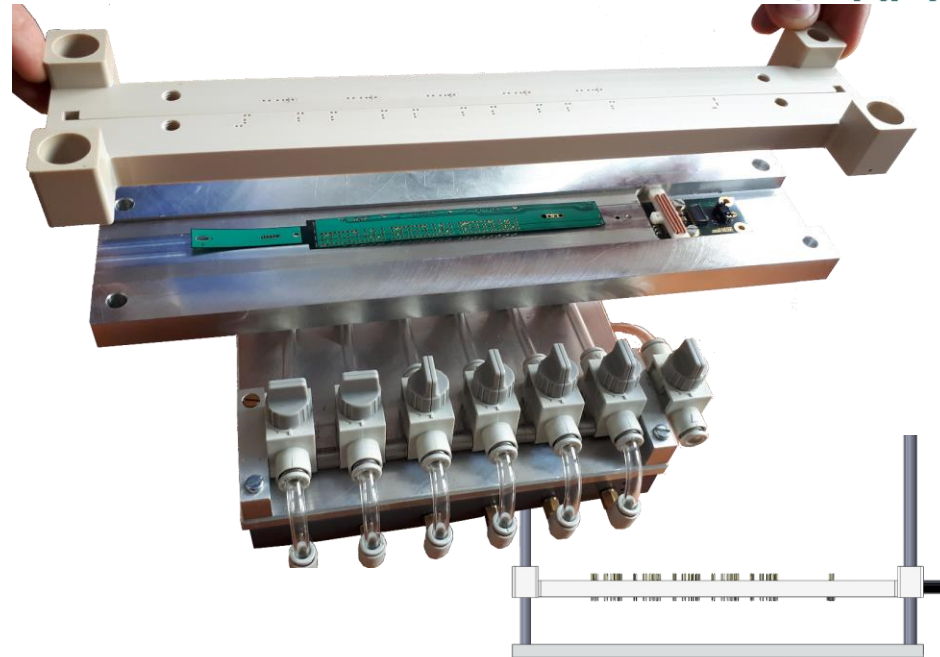


- Raw FPCs are separated by laser cutting in Italy and measured by metrology service @CERN.

# MFT Ladder Production

## FPCs

- Electrical test bench made by our student Paul TETAZ, to test electrical continuity,
- SMD components soldered by Ouestronics,
- « shaving », cleaning, visual inspection, data and pictures are stored in DB.

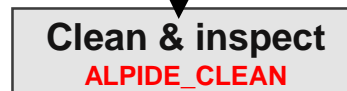
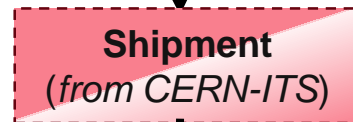
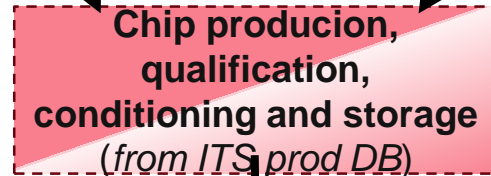
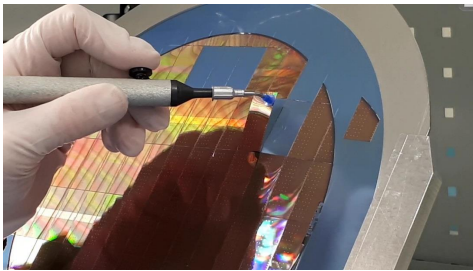




# MFT Ladder Production

## Sensors

Process Flow Diagram (from MFT AIT Diagram)



Additional tasks to take into account:

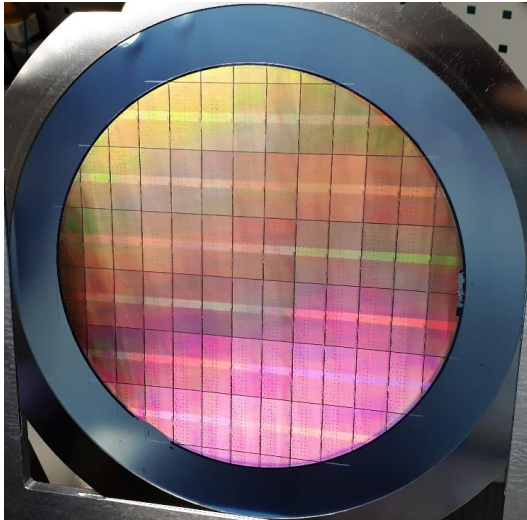
- Picking
- Cleaning
- Chip testing

# 2.5 hours per trays (23 Alpides)

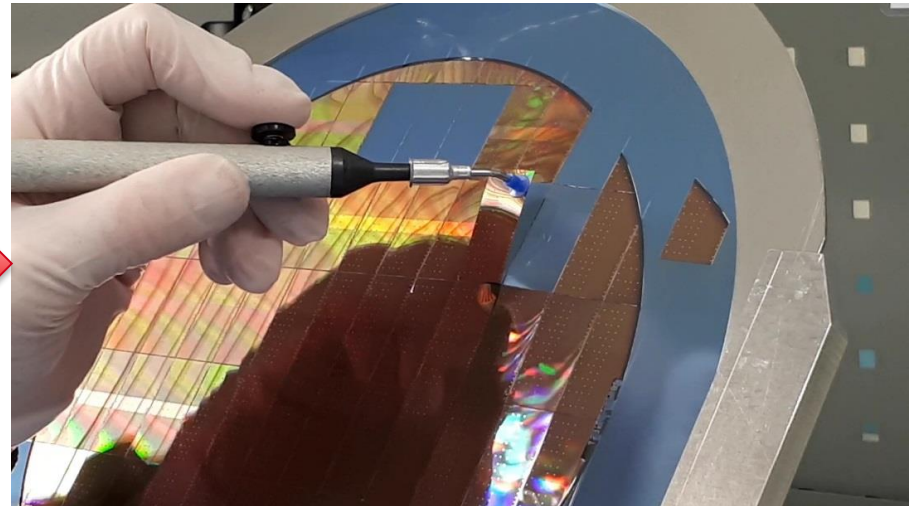
# MFT Ladder Production

## Sensors

- Picking of the sensors from the wafers



**Wafer**



**Picking of the sensors from the wafer**



**Visual inspection and cleaning**



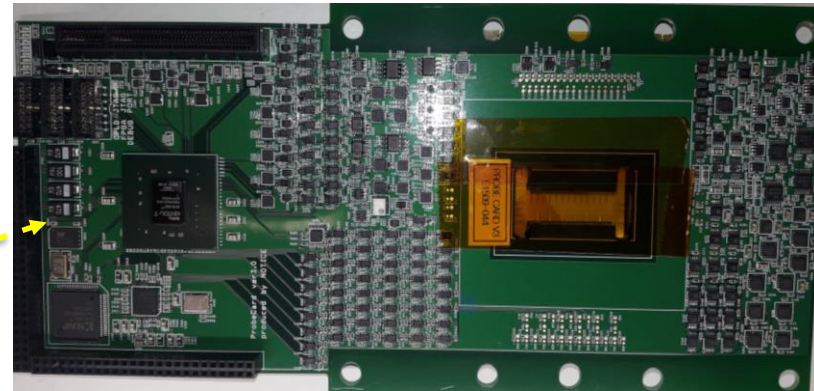
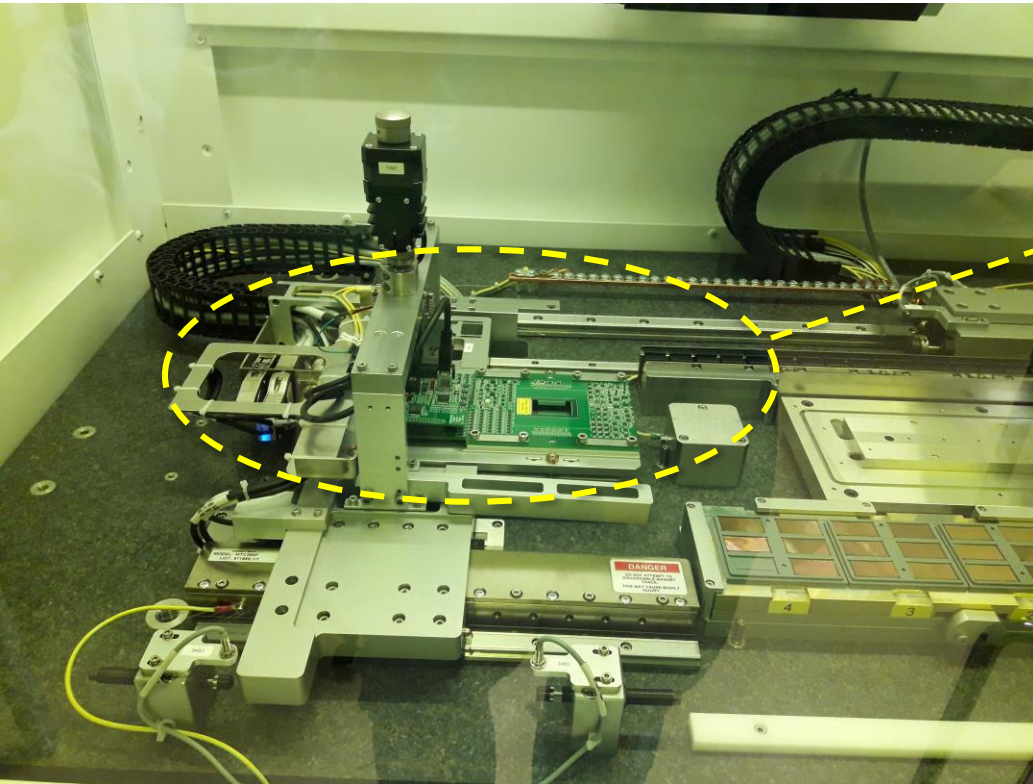
**Sensors placed into a tray**

# MFT Ladder Production

## Sensors

- Chip testing

Probe Card Test has been set up into the ALICIA-7

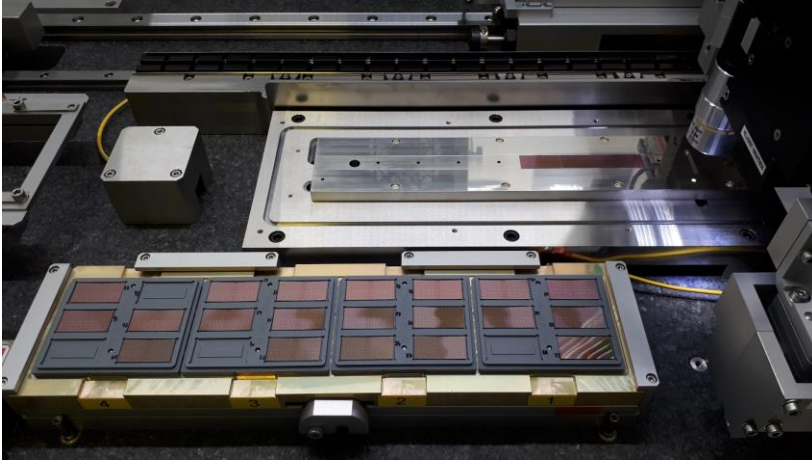


Testing of the sensors:

- Digital and Analogic power
- Functional tests

# MFT Ladder Production

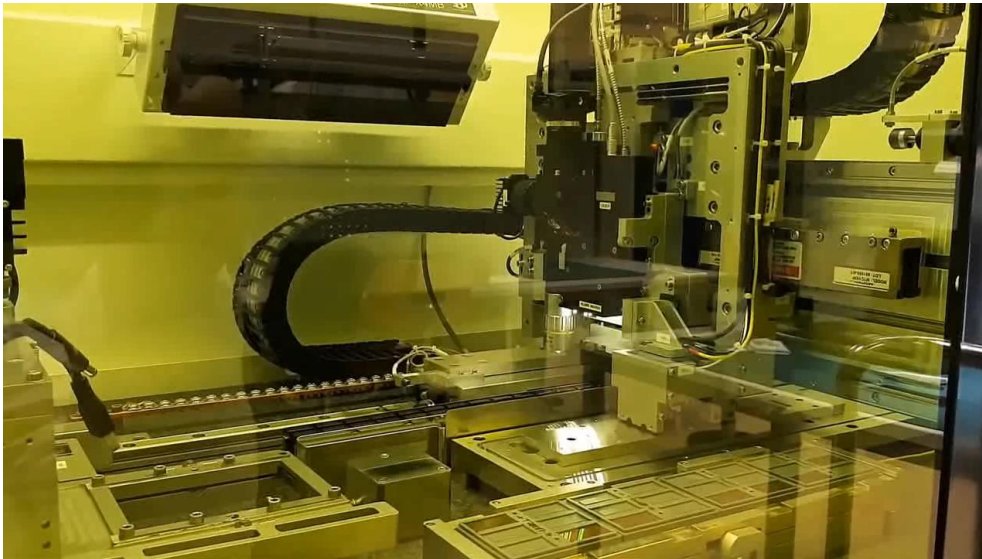
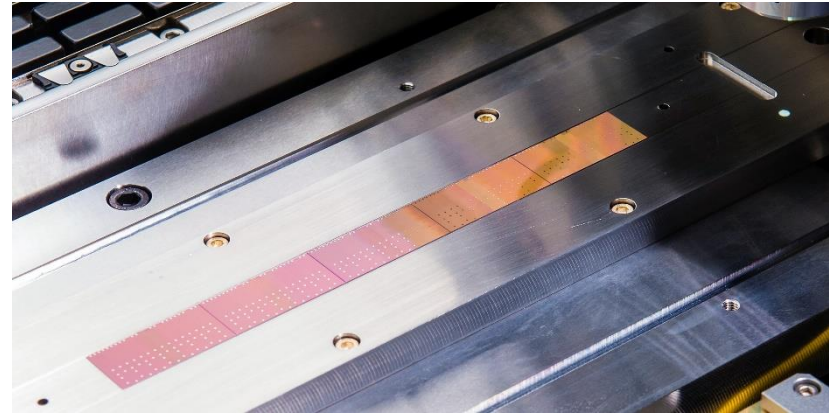
1- Tray of chips in MAM



# MFT Ladder Production



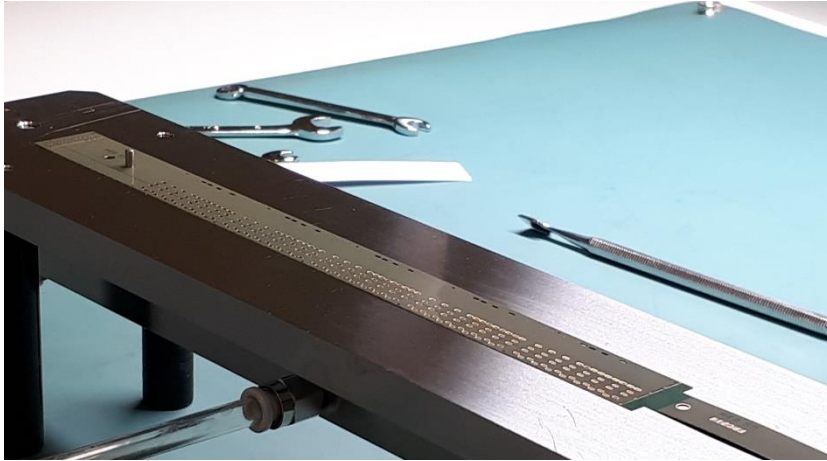
- 1- Tray of chips in MAM
- 2- Chip positioning by MAM



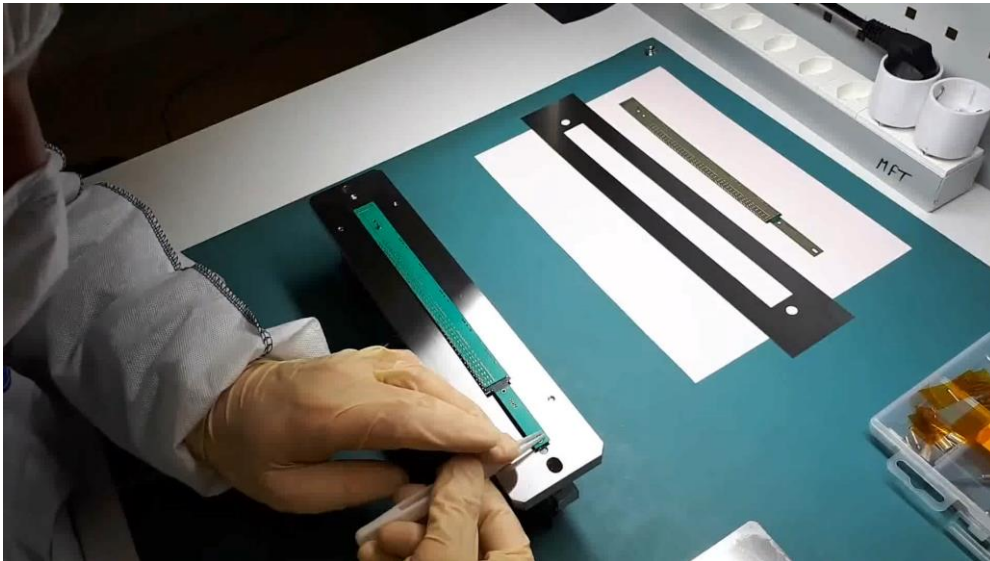
MAM tests:

- Dimensions inspection
- Edge integrity
- Pad Cleanliness

## MFT Ladder Production



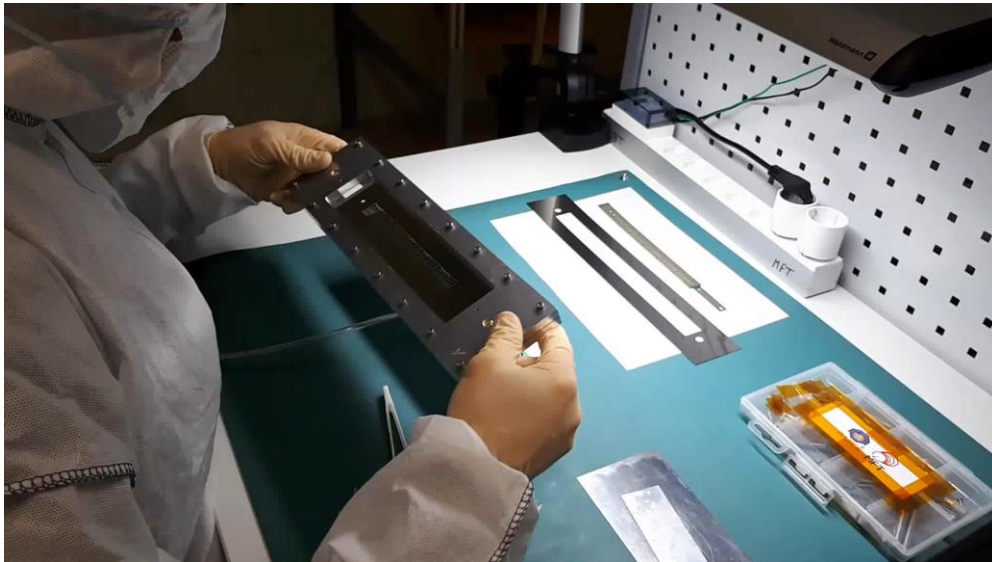
- 1- Tray of chips in MAM
- 2- Chip positioning by MAM
- 3- FPC positioning on JIG



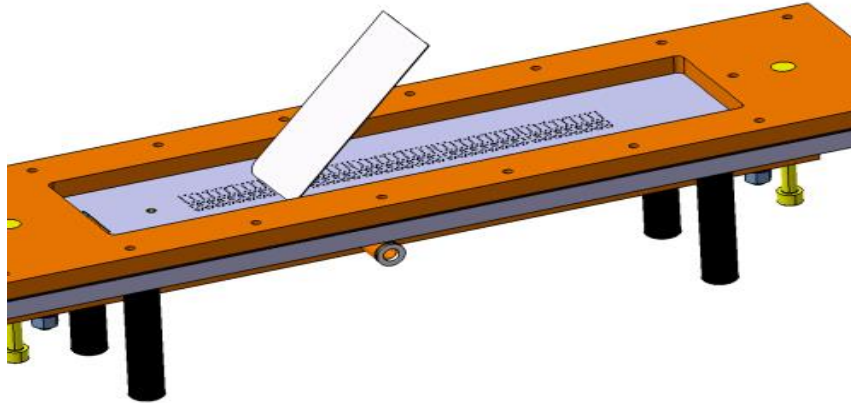
## MFT Ladder Production



- 1- Tray of chips in MAM
- 2- Chip positioning by MAM
- 3- FPC positioning on JIG
- 4- Stencil above FPC



## MFT Ladder Production



- 1- Tray of chips in MAM
- 2- Chip positioning by MAM
- 3- FPC positioning on JIG
- 4- Stencil above FPC
- 5- Glue application (Araldite 2011)





## MFT Ladder Production



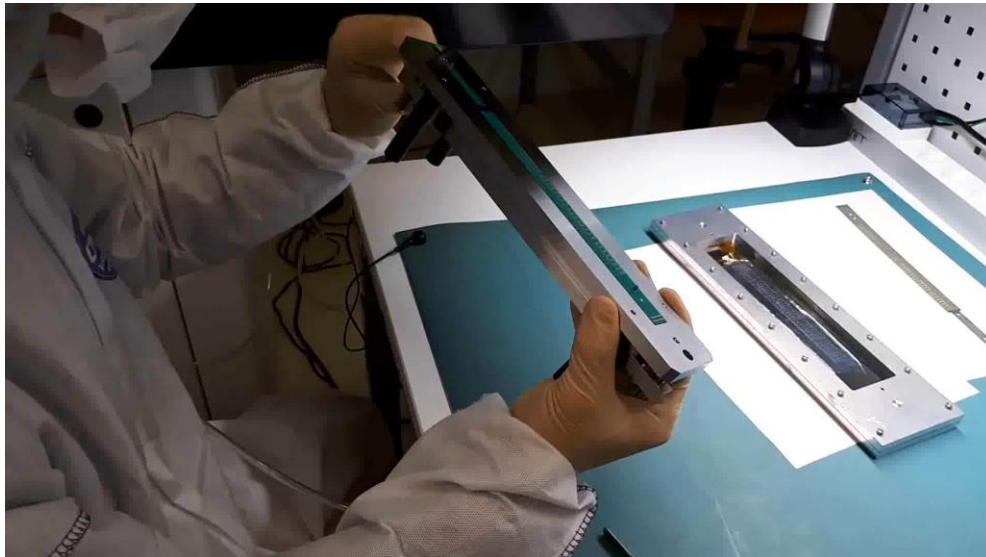
- 1- Tray of chips in MAM
- 2- Chip positioning by MAM
- 3- FPC positioning on JIG
- 4- Stencil above FPC
- 5- Glue application (Araldite 2011)
- 6- Stencil removing



# MFT Ladder Production



- 1- Tray of chips in MAM
- 2- Chip positioning by MAM
- 3- FPC positioning on JIG
- 4- Stencil above FPC
- 5- Glue application (Araldite 2011)
- 6- Stencil removing
- 7- FPC/Chips assembly



# MFT Ladder Production

## Bonding



# MFT Ladder Production

## Visual Inspection and conditioning

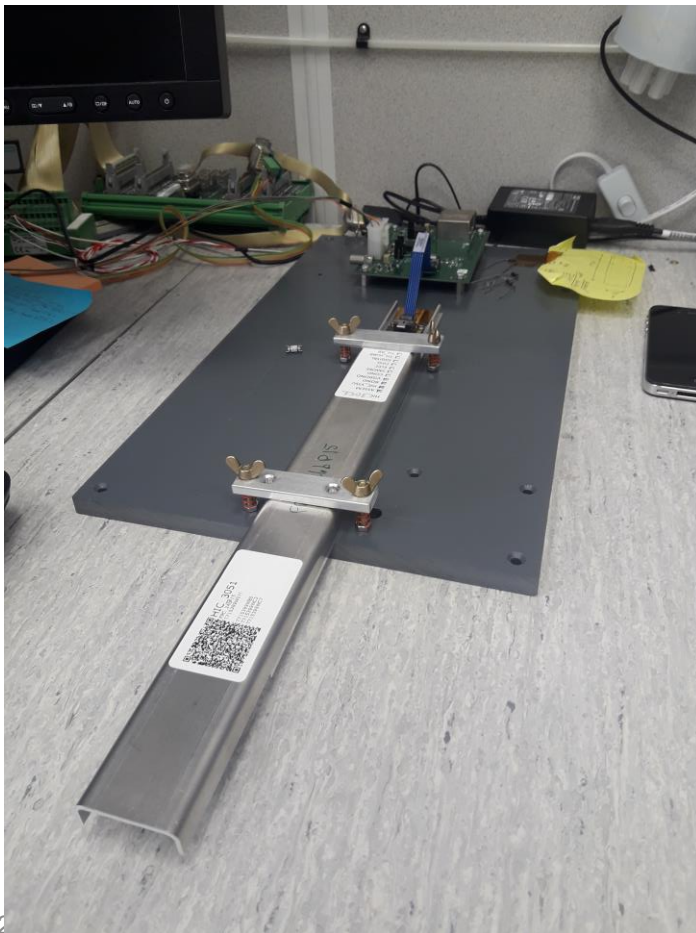
- HIC becomes a ladder once bonded
- Careful visual inspection at each step
  - Each ladder is stored in a metallic box and equipped with an ICL card
  - Each box has 2 labels (IDs, status), QR code to dedicated Cernbox folder (pics, forms, tests)



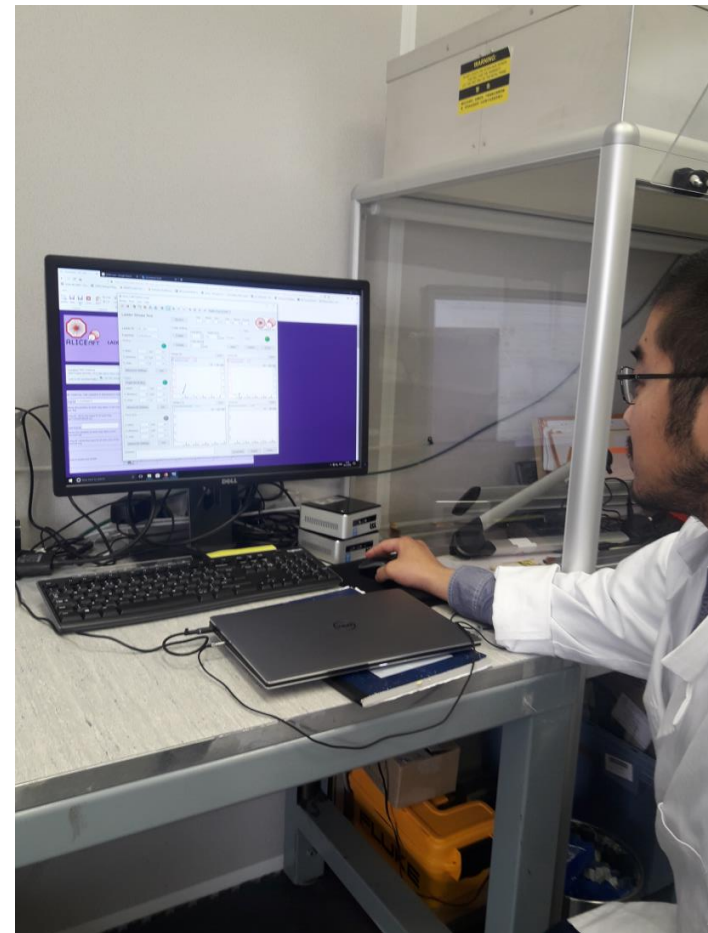
# MFT Ladder Production

## Smoke Test of the Ladder

Test of power supply: AVDD and DVDD



FPC test bench: Kosei

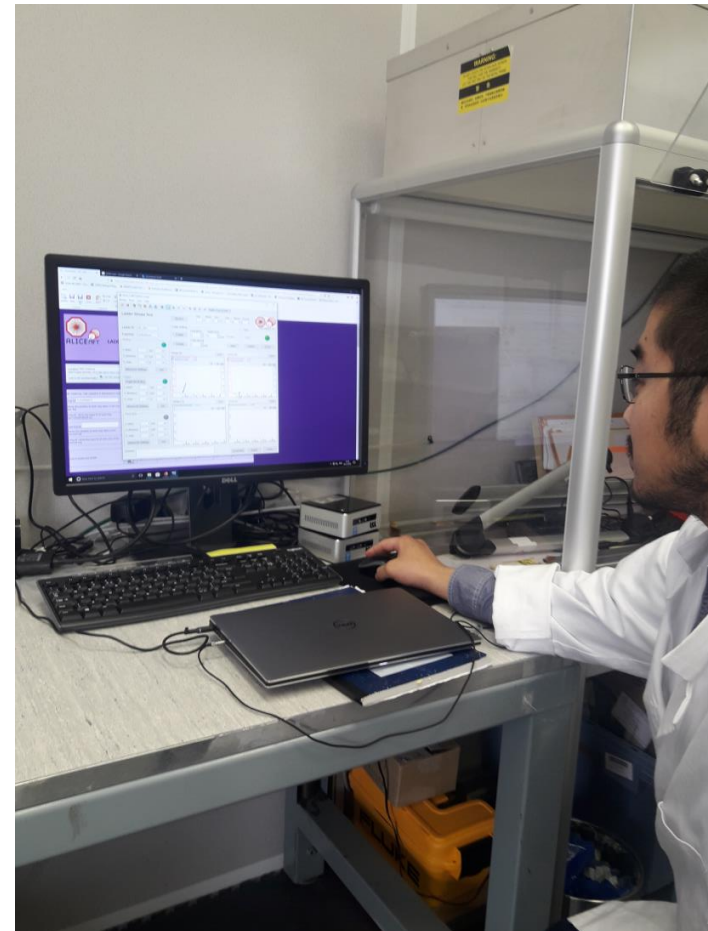


*Smoke test now integrate Back Bias tests*

# MFT Ladder Production

## Smoke Test of the Ladder

Test of power supply: current  $I_{AVDD}$  and current  $I_{DVDD}$



# MFT Ladder Production

## Functional tests of the Ladder

### Electrical test

Test A : power only

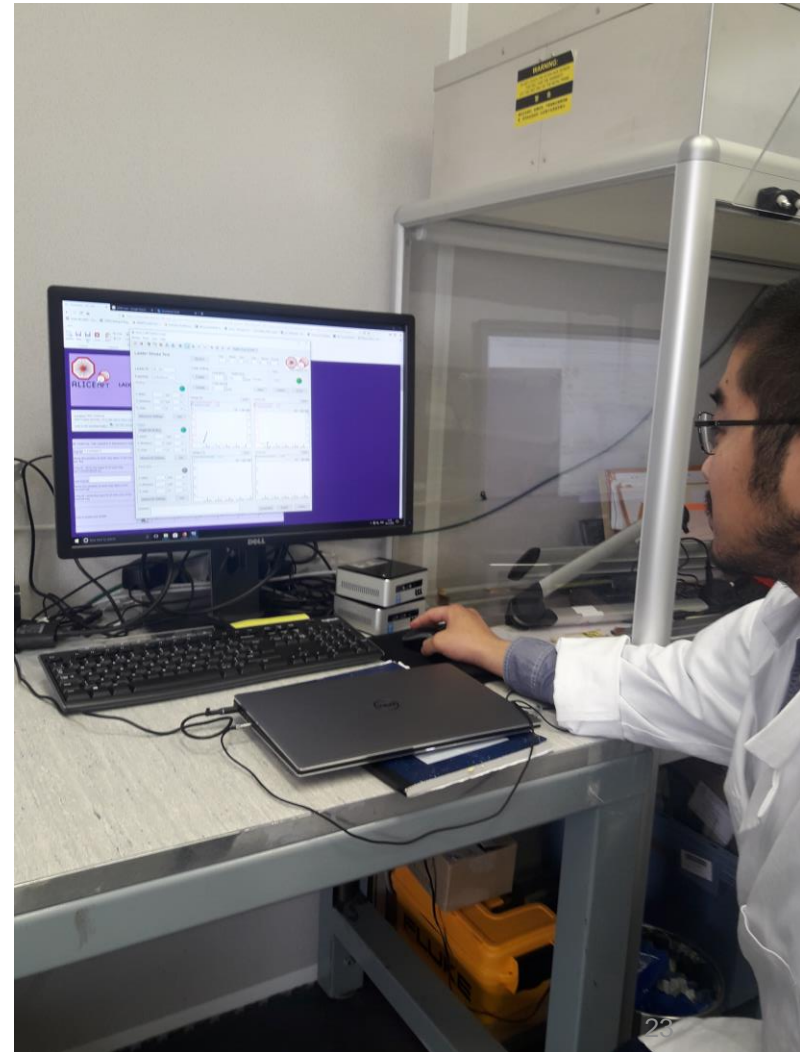
Test B : power + clock

Test C : power + clock + activity on chips  
(simultaneous digital scan on all working chips)

Fifo Scan

Digital Scan

Threshold scan



# MFT Ladder Production

## Storage and shipping tools: Transportation box being sent soon

- For the ladders, case Pelicase 1440 with dedicated foam .
  - 5 cases ordered and equipped @Subatech (Meriadeg)
  - Datalogger for humidity and temperature
  - Impact indicator

Pelicase 1440





# MFT Ladder Production

## QA: training sessions for operators







- Clean room (PPT + film + practical exercises)
- FPC preparations (@grey room Antenna)
- Assemblies (@DSF)
- Visual inspections (@DSF)
- Functional tests (@grey room Antenna)



# MFT Ladder Production

## QA: procedures

- Cleaning FPC (Shaving, cleaning, visual inspections)
- Picking of the chips
- Testing of the chips
- Tooling preparation
- ALICIA starting
- Chips positioning
- Glue preparation
- FPC\_Chip gluing
- HIC Removal
- Bonding Lab
- Visual inspections
- Conditioning
- Smoke test
- Functional tests (recently implemented)
- ...

	Fill the tray	<ul style="list-style-type: none"> <li>• Place the modules to make a tray: N°1 at N°1 place, N°2 at N°2, ... (N°5at N°1, N°6 at N°2, ...)</li> <li>• Use the dowel pins to position.</li> </ul>
	Check good position Close the doors	<ul style="list-style-type: none"> <li>• Be careful: you must check by pressing with your finger if the modules are well positioned!</li> <li>• If not, the MAM could be broken!</li> <li>• Check also the chips. Close the doors</li> </ul>
	Check if there is no tooling Click No tooling present	<ul style="list-style-type: none"> <li>• Ensure no tooling is present in Alicia: JIG, shims or pins</li> <li>• and click "NO tooling present" to start to work</li> </ul>
	Click on 	<ul style="list-style-type: none"> <li>• In the LOAD/UNLOAD column, click on LOAD TRAY. This button will communicate with both ALICIA and CERN database in order to load the status of the tray. If the button is disabled, you must connect to database (see Alicia Starting)</li> </ul>
	SCAN QR CODE (Type it with the keyboard if no QR code)	<ul style="list-style-type: none"> <li>• scan the QRcode to display the correct tray TR00xxxx in the database (CERN PC) (Long press on the scan showwer to start it if necessary)</li> <li>• The number appears on Alicia screen.</li> </ul>



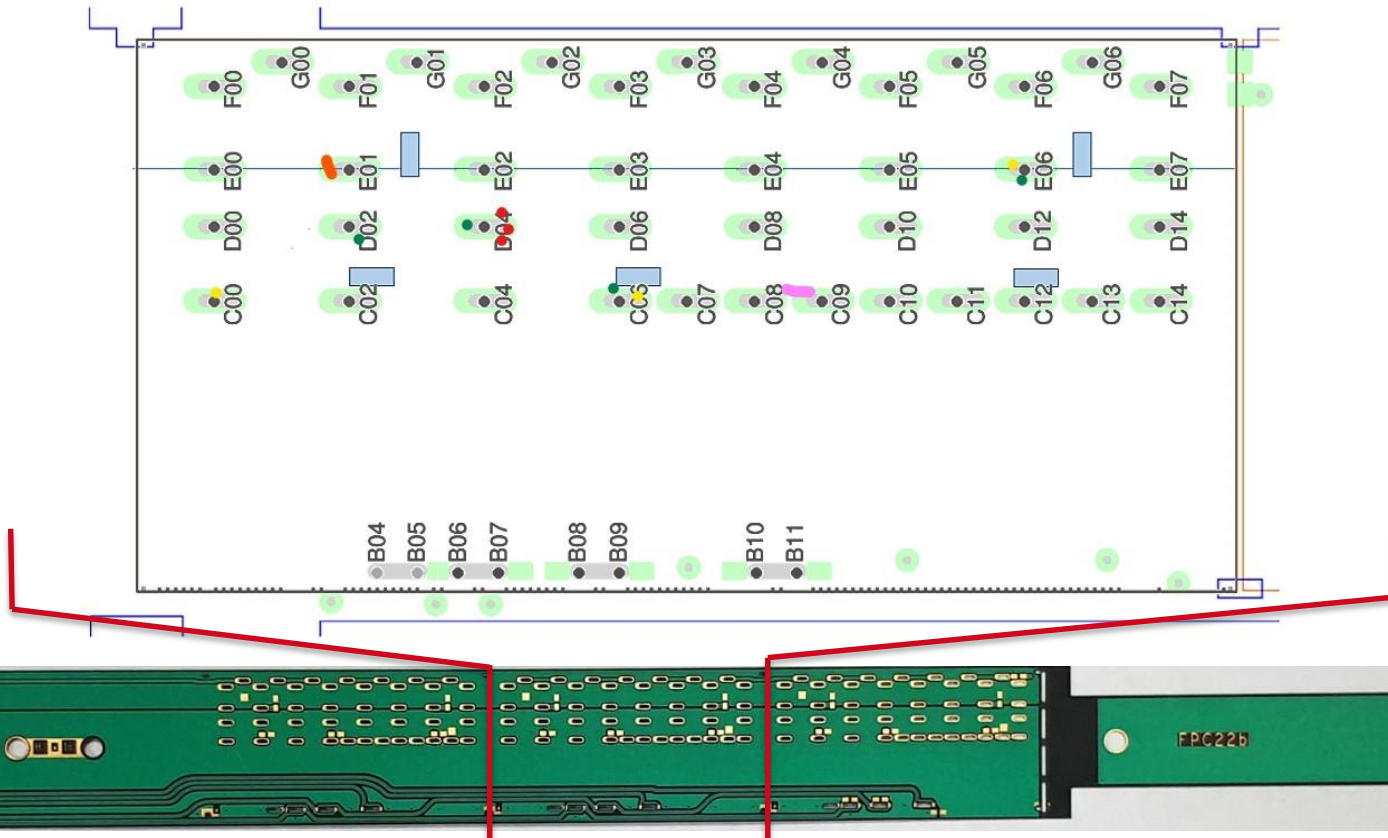
# MFT Ladder Production

## QA: Defect mapping

FPC is prepared («shaving») and cleaned (ultrasonic bath)

FPC defects reporting before assembly (with binocular), RECTO and VERSO:

Cracks, solder paste, bonds, varnish, foreign substance, folds, SMD, edges cut, ...



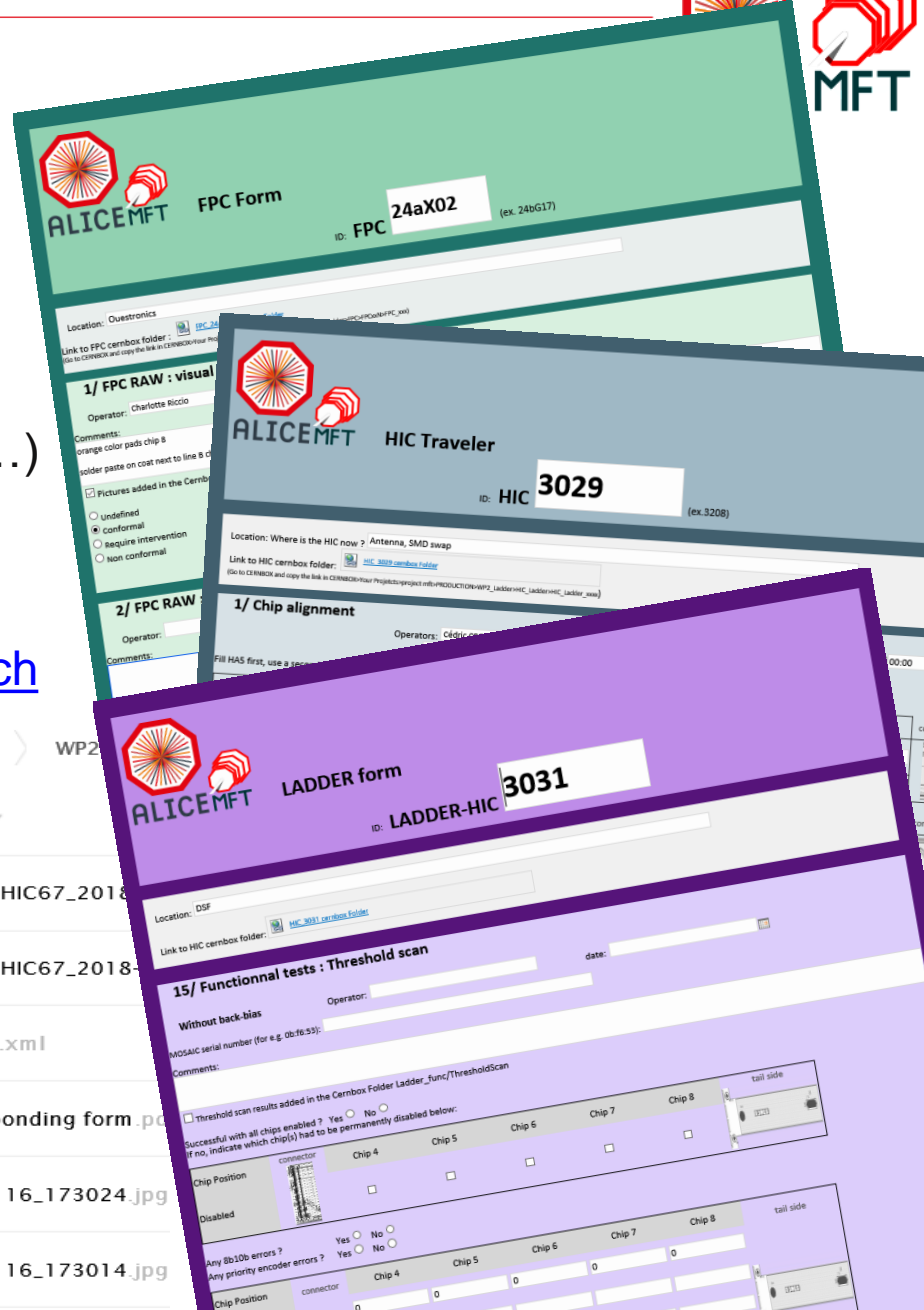
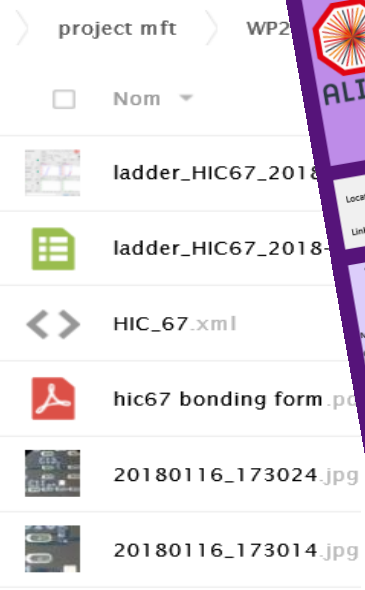
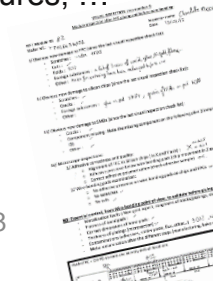


# MFT Ladder Production

## QA : forms

- XML forms, shareware libraries
- Fillable in any navigator (IE, firefox,...)
- Fills DB (id\_chips, id\_fpc, dates, ...)
- Stored in a workspace [espace.cern.ch](http://espace.cern.ch)
- Cernbox: all pictures, files, forms, tests, ...

Also in the Cernbox: usual QA records:  
Equipment certificates, non conformities,  
revues, user manuals, procedures, ...



# MFT Ladder Production

## Production status

Production start : 2018.04.01

First months: Training of the team

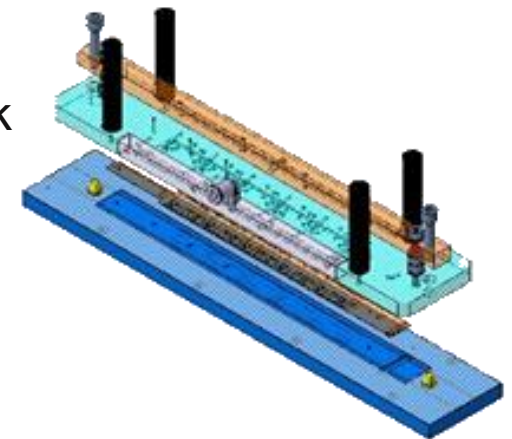
Today : 38 HICs bonded, between 5 to 8 ladders a week

Objective: production of 2 ladders a day

Tooling soon ready:    - electrical test bench,  
                              - new FPC JIG,  
                              - new bonding JIG

Last few problems to solve:

- A better FPC flatness: new FPC JIG Table, new stencil if not sufficient
- Better results for digital scan test with bigger capacitors value ( $1\mu\text{F} \Rightarrow 22\mu\text{F}$ )
- 6 new batches ordered that include improvements (drilling alignment)



# MFT Ladder Production

Thank you !

Any question ?



# MFT Ladder Production



