Wafer/Chip testing Progress/Plans

Sanghoon Lim
Pusan National University

Overview of chip production and test for ALICE ITS2

1500 raw wafers

Raw Wafer Production
MEMC (Italy)

5%

Raw Wafer QA
TMEC (Thailand)

1200 CMOS wafers

CMOS Manufacturing
TowerJazz (Israel)

8%
(2/25)

Wafer Probe Testing
CERN

60,000 chips

Thinning & Dicing
FUREX (South Korea)

Pick & Place
FUREX (South Korea), tbc.

100%

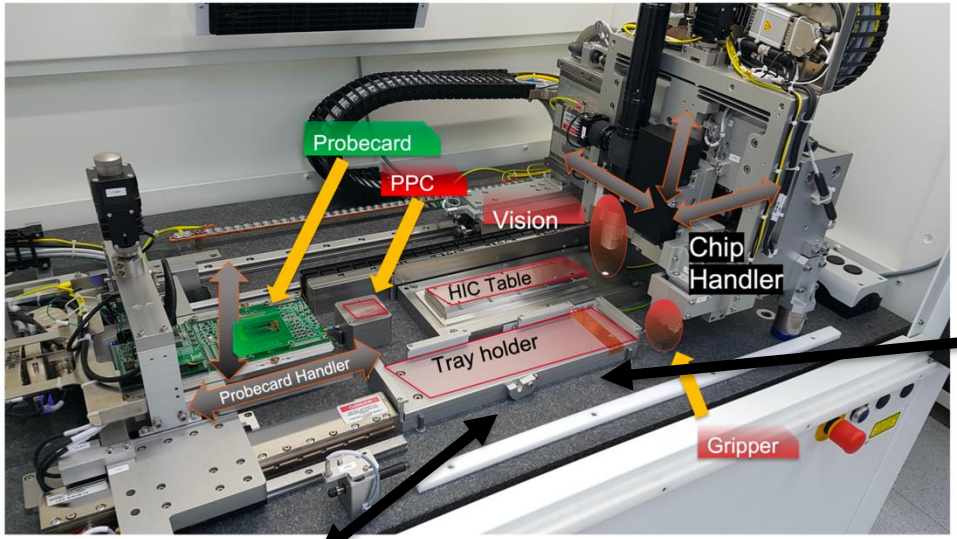
Chip Series Testing
Yonsei, Pusan/Inha
(South Korea)

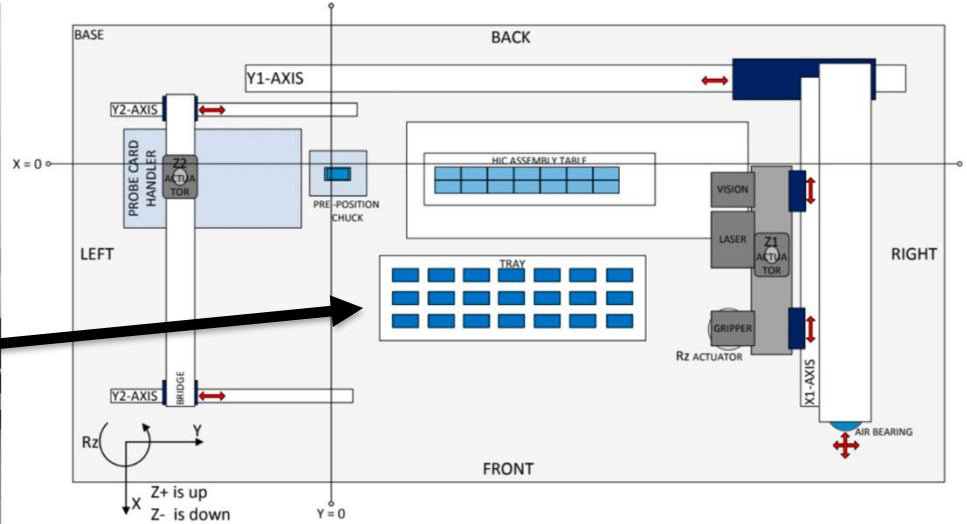
Detector assembly

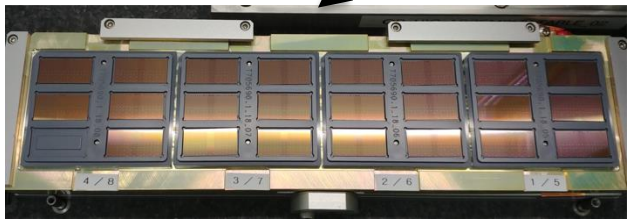
ALICE 3 Outer Tracker
2100 wafers, 120,000 chips

ePIC Barrel Imaging Calorimeter AstroPix
5000 wafers, 250,000 chips

Chip test machine (ALICE ITS2, ALICIA)

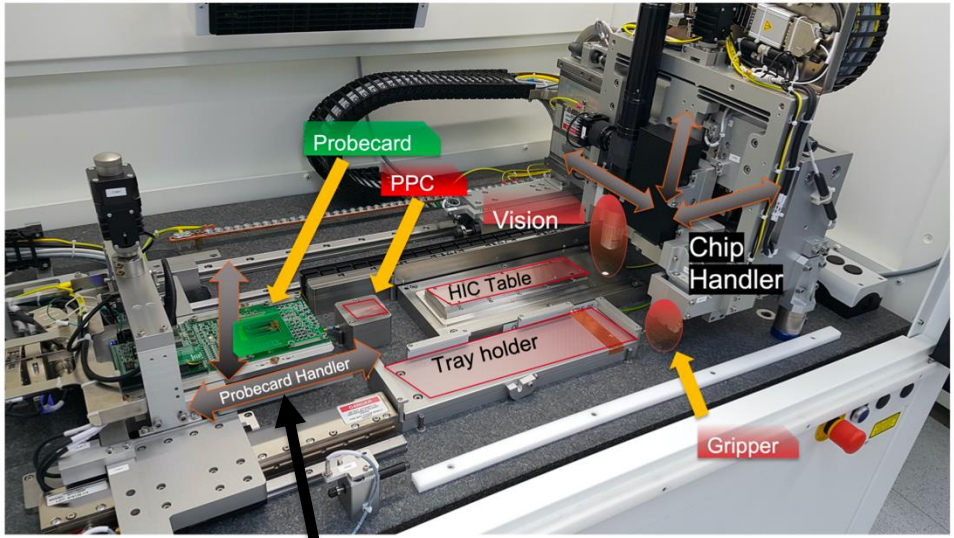


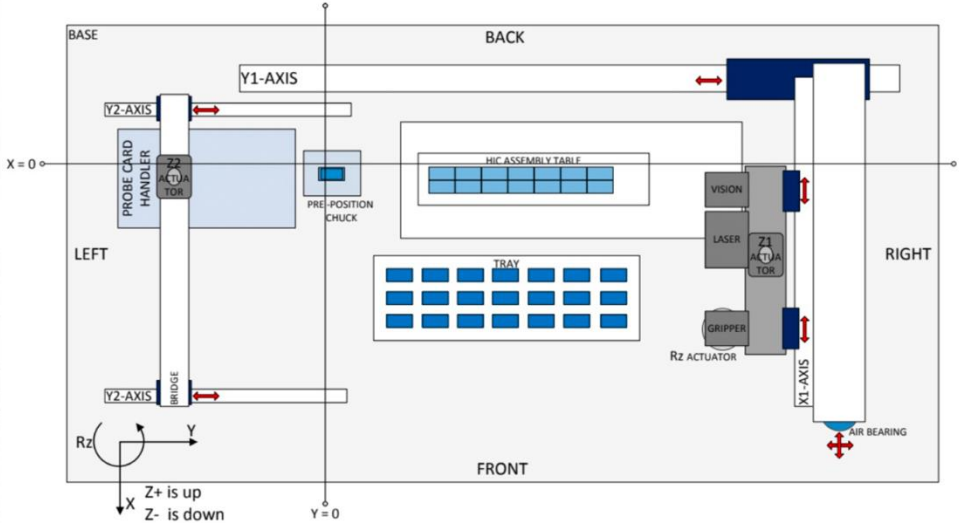


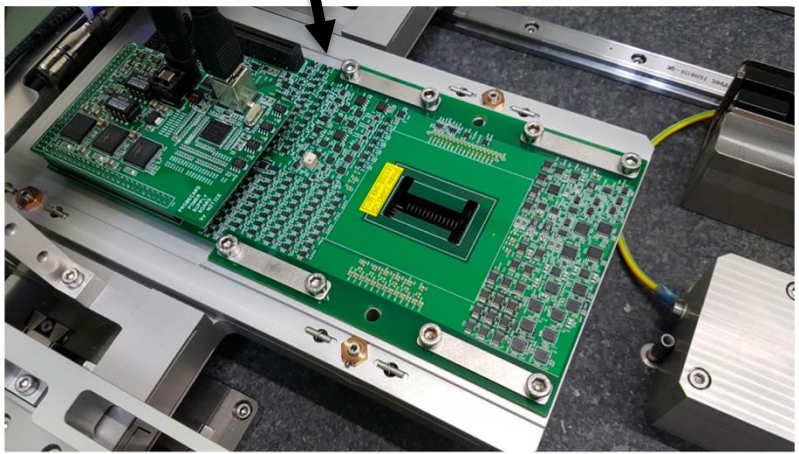


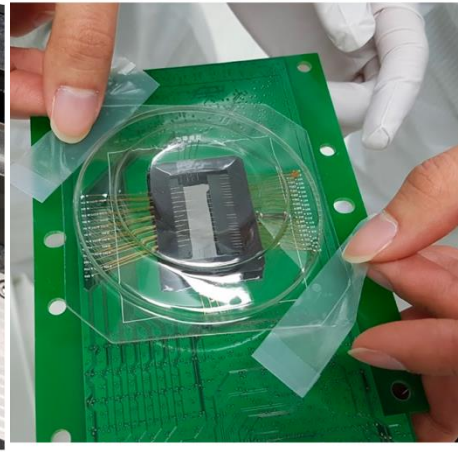
- After post-processing, sensors are contained in waffle packs and shipped to the testing facilities (PNU, Yonsei)
- The barcode on the waffle pack to keep track of wafer ID and fabrication run...
- After testing, chips are shipped to the assembly sites

Chip test machine (ALICE ITS2, ALICIA)



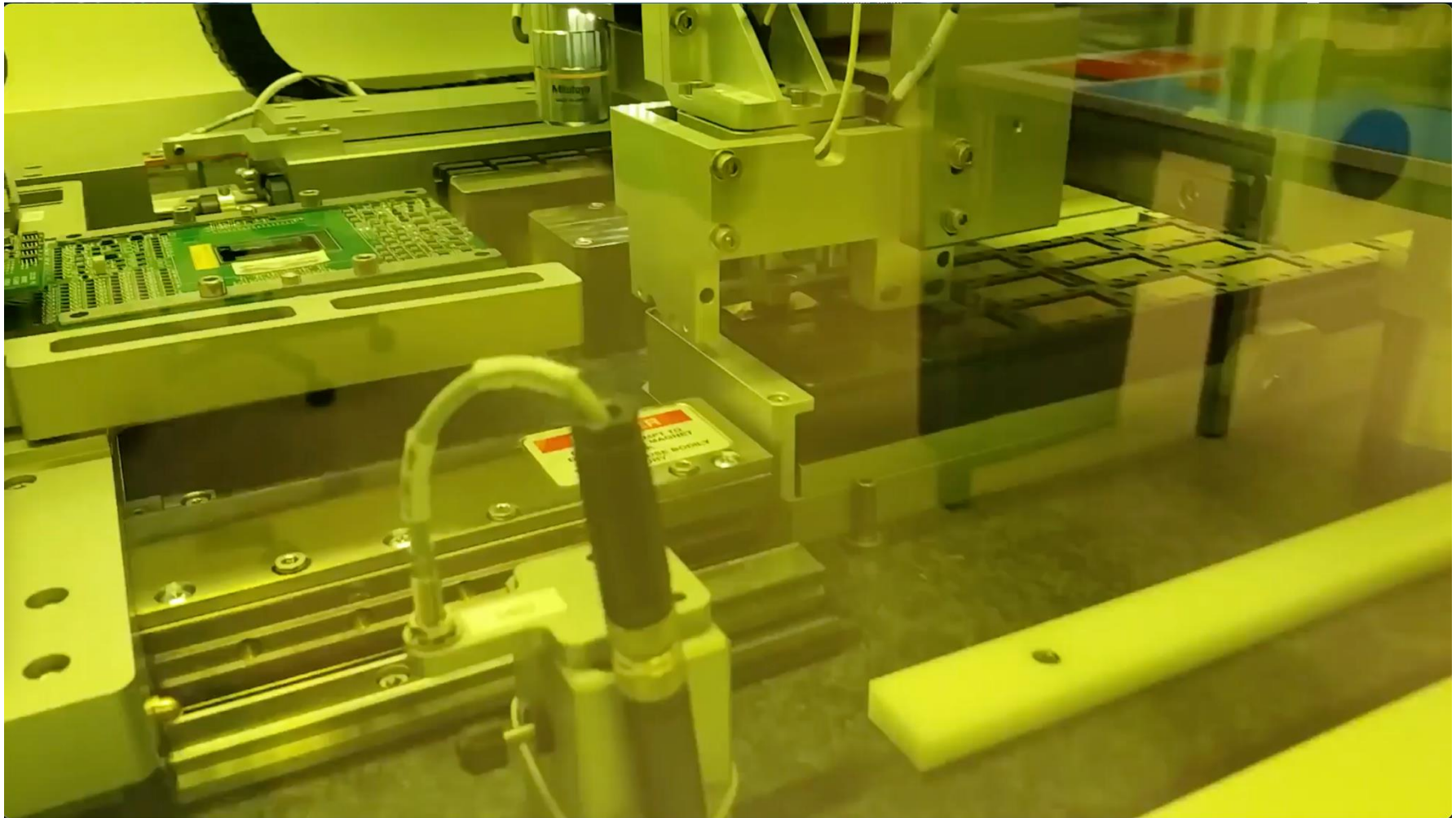




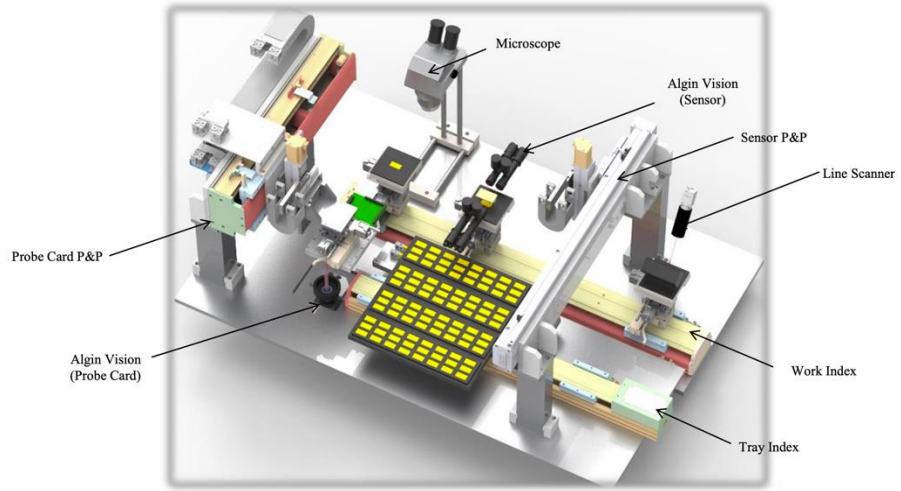


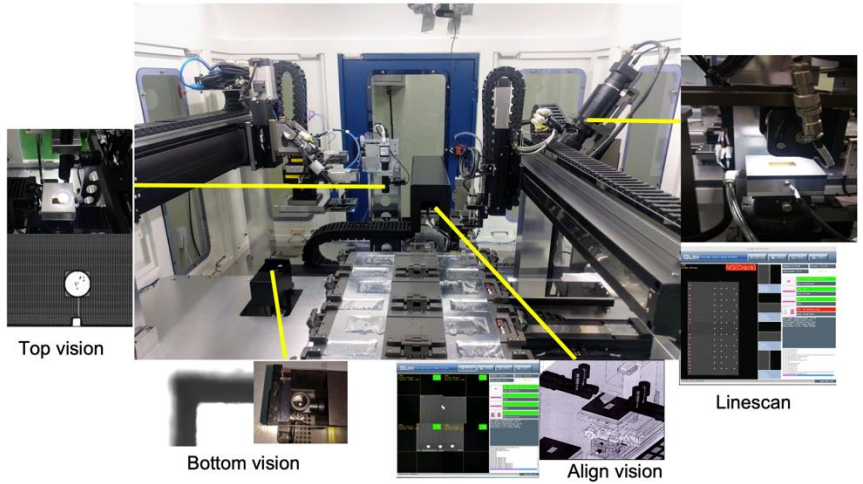
ALPIDE single-chip test bench

Chip test machine (ALICE ITS2, ALICIA)



Chip test machine (ALICE ITS2, COREA-YS-01)



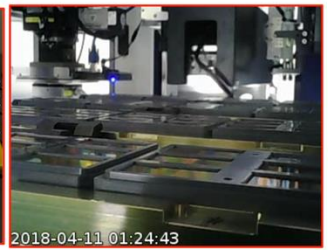


A simpler version of the machine dedicated to chip test

Arrival scan

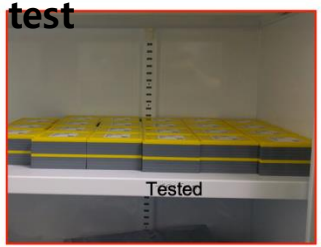
Sensor preparation

Class 100, ~10 min.



Fully automated test and remote control

Class 10, ~10 hours



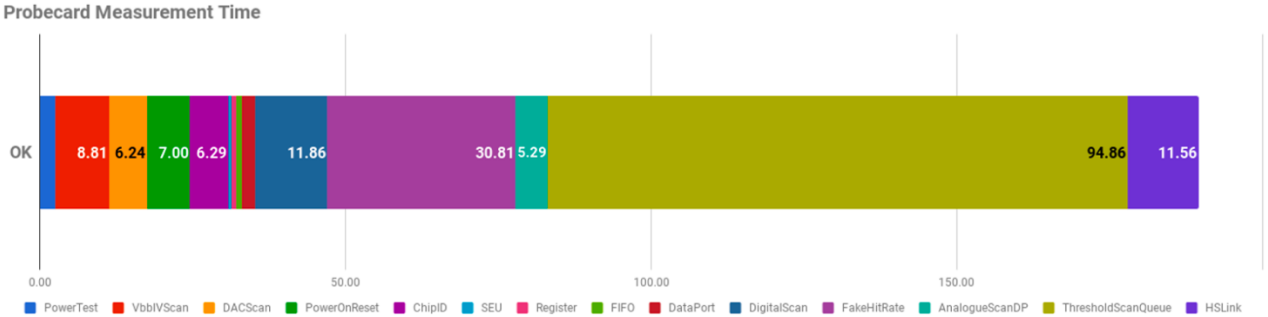
Storage inside cabinet

Packaging for shipment

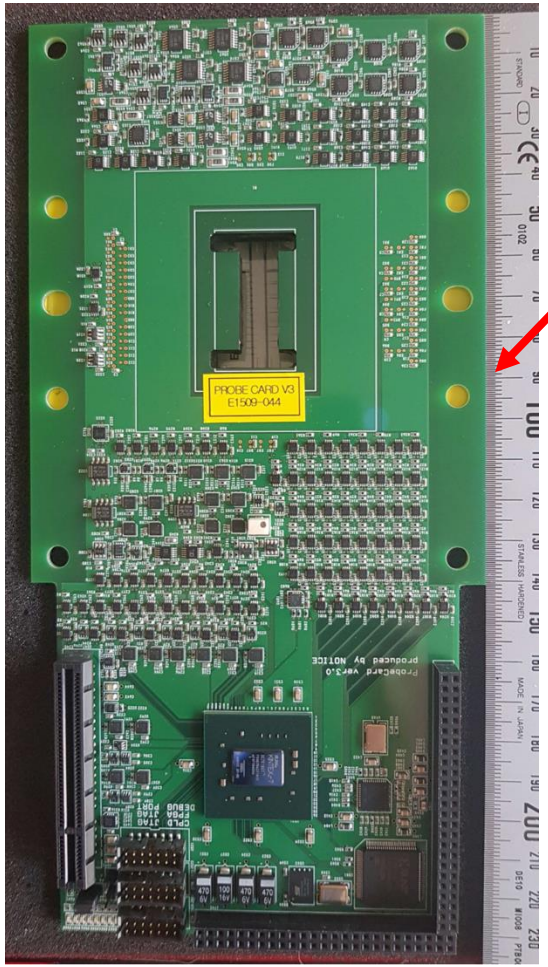
Shipment

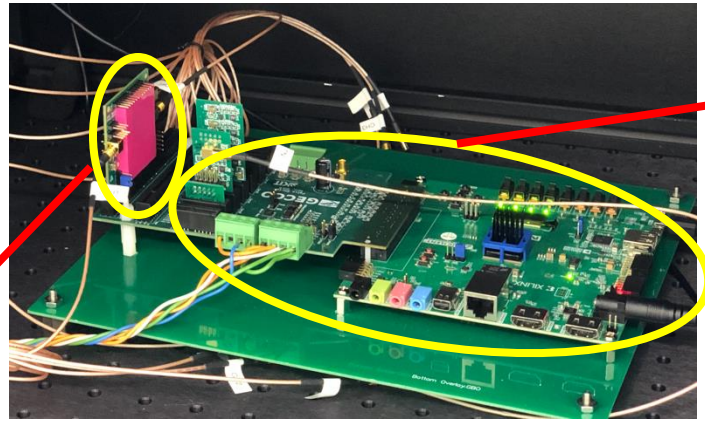
Chip test procedure (ALPIDE)

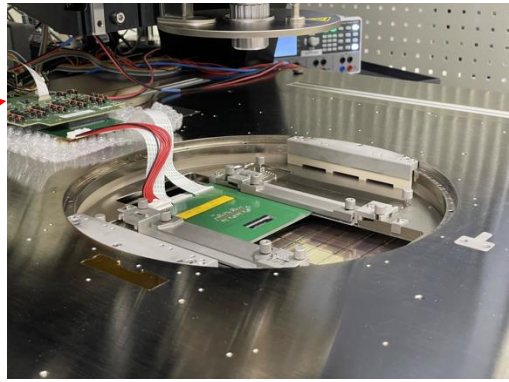
- **Powering test:** just power on/off
- **V_{bb} I-V test:** apply the reverse substrate bias from 0 V down to −6 V
- **DAC scan: v**erify that each DAC is working by scanning through all its code words
- **Power-on reset test:** check the functionality of the power-on reset
- **SEU check:** monitor the SEU counter and the flag bits on idle operation
- **Register test:** check all registers by writing and reading back to find stuck bit
- **FIFO test:** check all the generated memory blocks
- **Data port test:** verify its functionality to send quasi-static patterns in case of the readout test failure
- **Digital scan:** inject single hits directly into the in-pixel memories and read back
- **Fake hit rate:** measures the number of noisy pixels and faulty front ends
- **Analog scan DP:** exercise the analog front-end and the full readout chain of ALPIDE
- **Threshold scan:** test all analog front-ends/pixels by using analog pulse injection
- **High-speed link check:** check its functionality

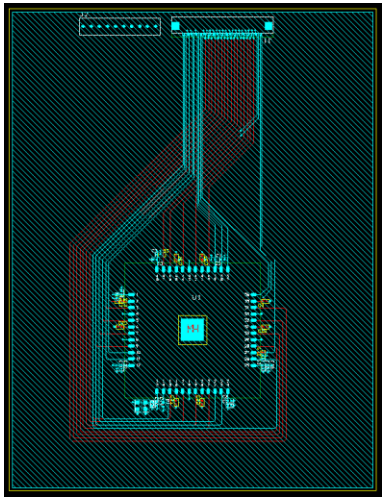


Probe card for AstroPix v3









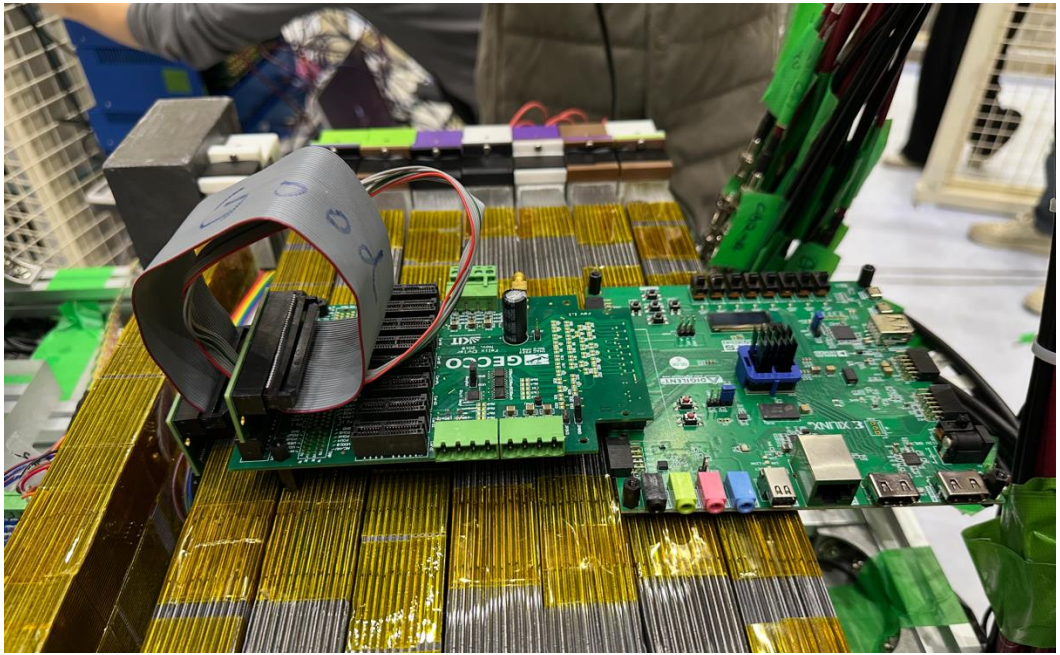
- Initial version for AstroPix v3:
  a simple version for the carrier card only
- Considering the same dimension as the ITS2 probe card to utilize the ALICIA machine for the initial test
- GECCO and FPGA development boards can be connected with flexible cables
- In addition, a circuit to check needle contacts should be added

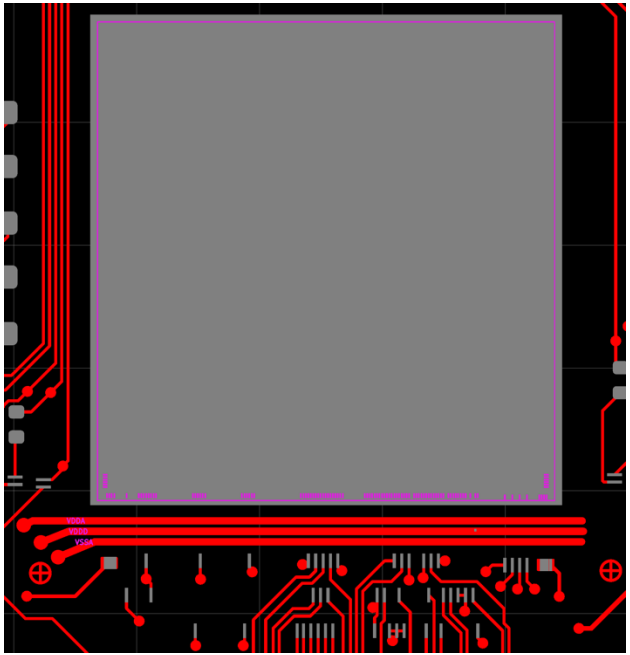
Probe card for ALPIDE (ITS2) Probe card for babyMOSS (ITS3)

Probe card for AstroPix v3

- Connection with a flexible cable has been tested for the test beam at KEK (2025 March)
  Quite noisy when using a cable longer than 15 cm

- Working with a PCB manufacturer to design a probe card
  Convert the v3 chip carrier board design file from Kicad to Orcad
  Re-distribution of bonding pads in the PCB for needles





Development of test system of AstroPix in Korea

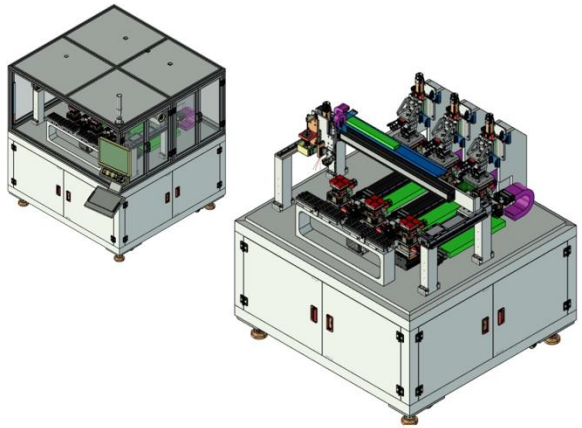
- **Developing a multi-line single-chip test system with C-ON tech**

- **Depending on the test procedure and time, one chip handler can cover multiple test stations**
  Initial design for the prototype machine with three stations

Introduction to Equipment

➢ Description

- Probe Test System
- Tray Loading : Manual
- Probe Test Motion : Z Axis – Servo Motor
- Chip Picker Motion : X,Y,Z Axis - Servo Motor
- Transfer Motion : Y Axis - Servo Motor
- Vision : Dispensing Align Top/Bottom Vision
- Main Equipment Size : 1600(W) x 1500(D) x 1700(H)
- Power : 220V 1P 60Hz



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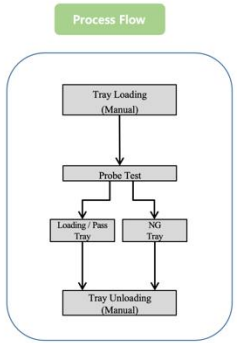
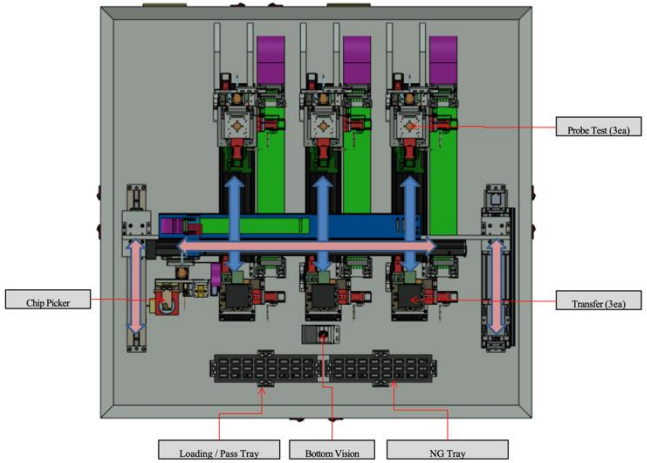
Process Flow





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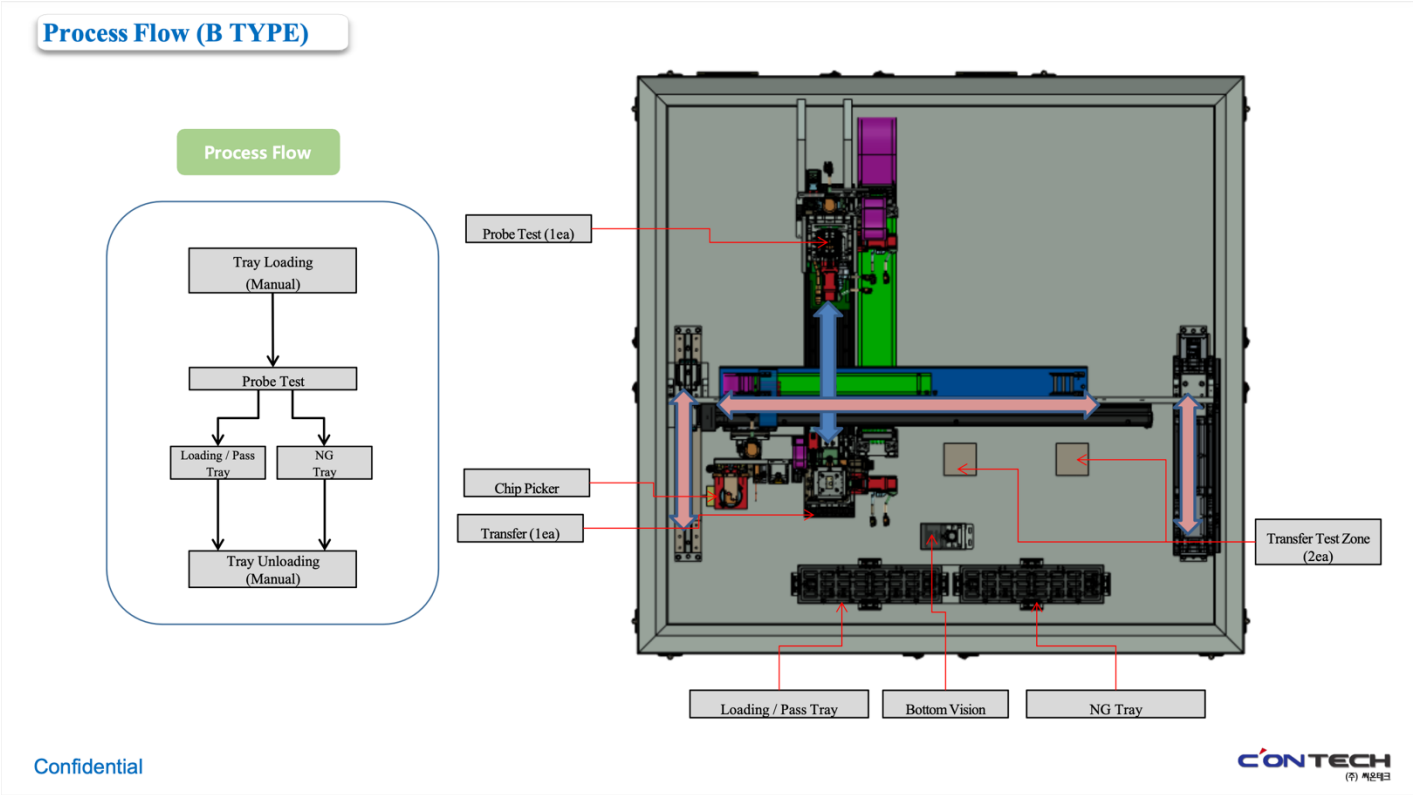
Development of test system of AstroPix in Korea

- **A machine production with a single-line will be started soon**



Wafer prober for ALICE ITS3

- **Wafer testing system for ALICE ITS3 at CERN**