Advanced Si Sensors, What Has Been Done and Can Be Done By Korea

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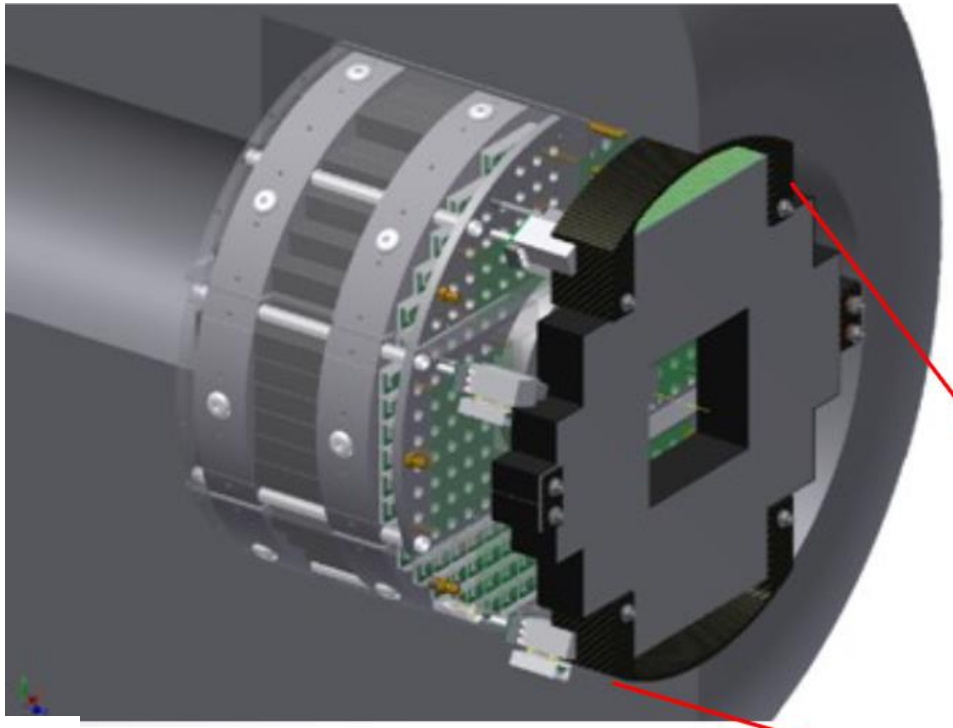
PHENIX MPC-Ex & PIN-structured Si sensor

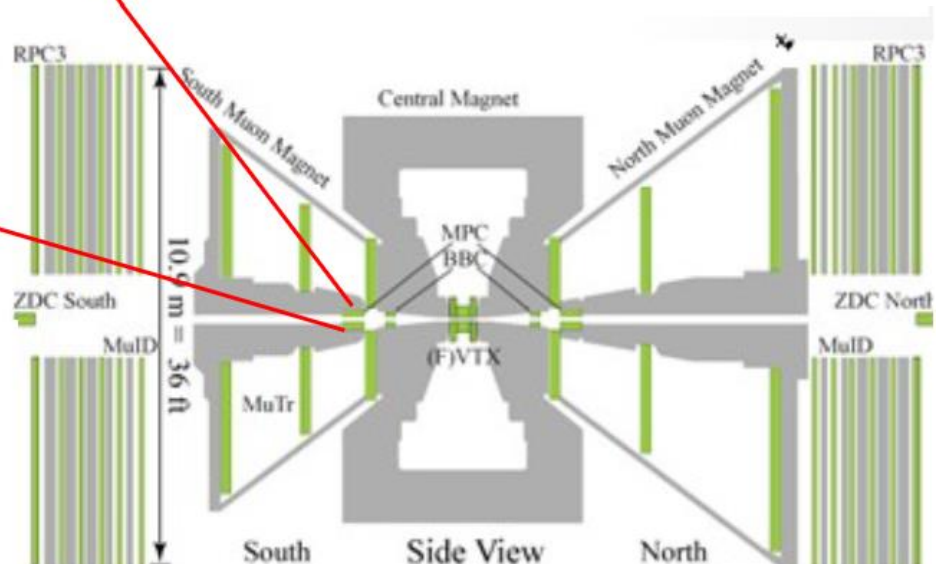
PHENIX MPC-Ex & PIN-structured Si sensor

PHENIX MPC-Ex



$3.1 < |\eta| < 3.8$

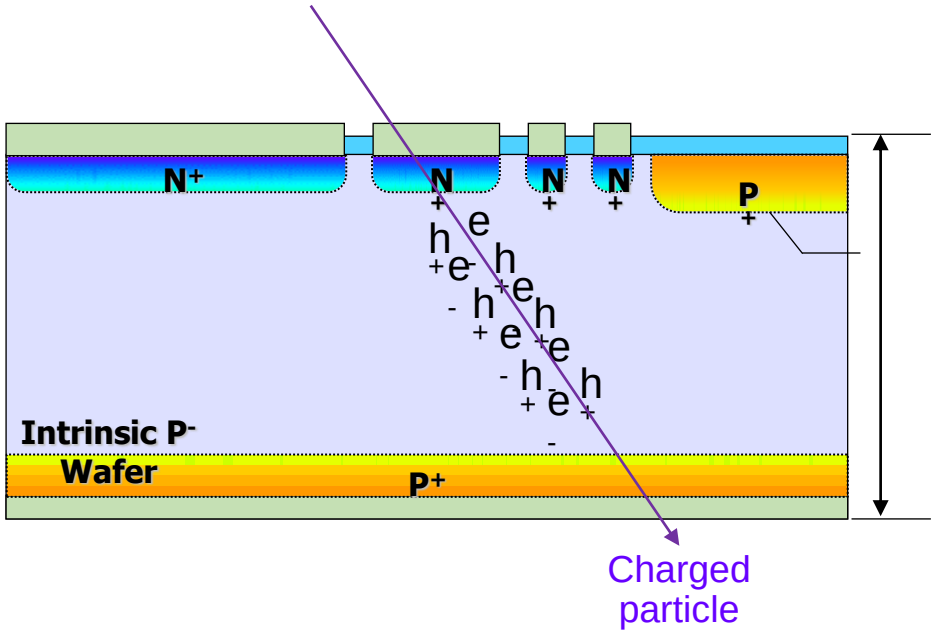
Compact
Flexible segmentation



Pre-shower detector with W/Si sandwich geometry
Pattern segmentation optimized to separate γ's from the forward high energy π^0 up to 80 (GeV/c) for a prompt γ measurement.

PHENIX MPC-Ex & PIN-structured Si sensor

PIN-structured Si sensor



- Traditional sensor
- Medium scale production (~ 400 $6\,(cm) \times 6\,(cm)$ units)
- Design/Fabrication process understood

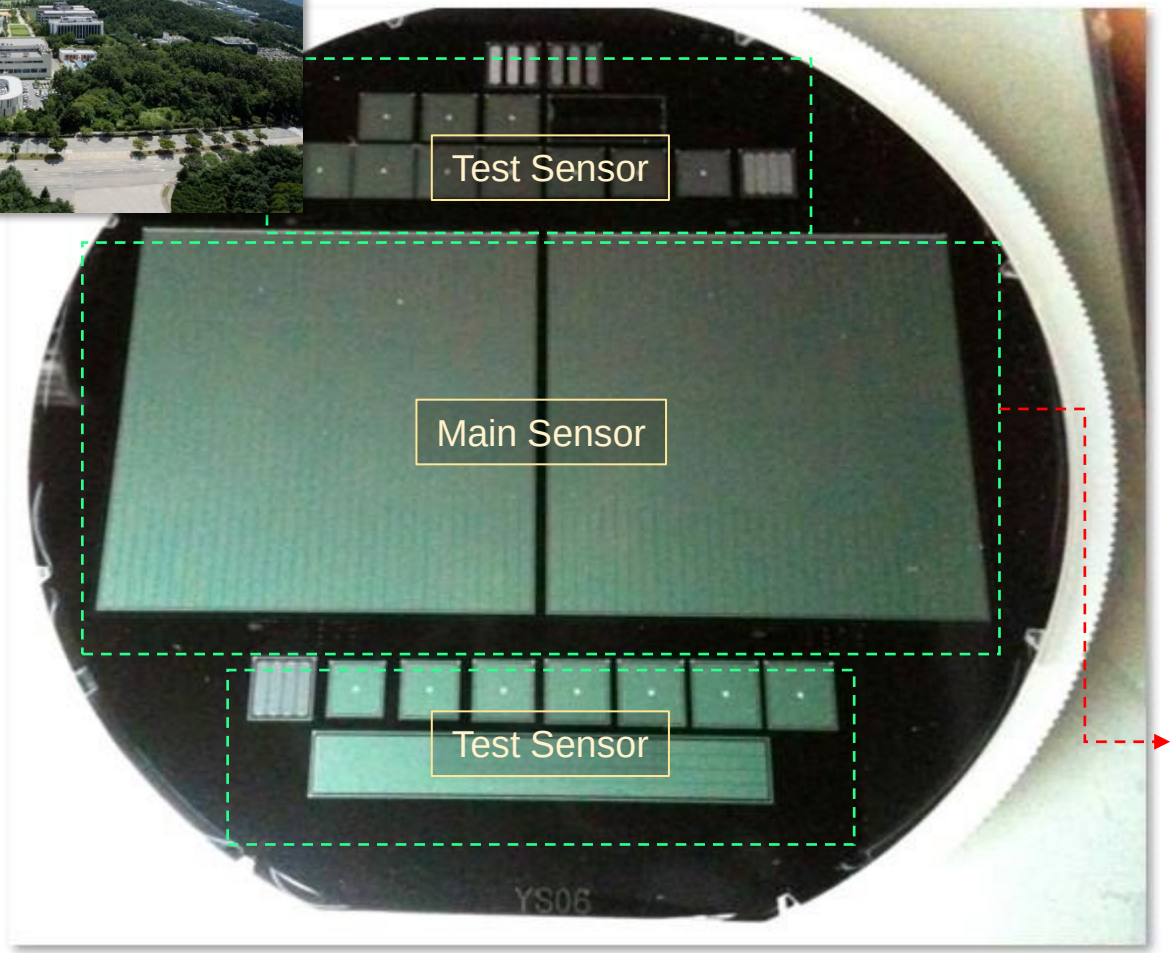
- Readout ASIC has to match the ever-developing back end. Involvement in HGCROC R&D (CMS, High Granularity Calorimeter Read Out Chip) under exploration.

PHENIX MPC-Ex & PIN-structured Si sensor

PIN-structured Si sensor (Korean involvement)

Good products ~400 ea to PHENIX MPC-Ex

Past(~ 10 years ago)
Ewha Womans Univ.,
Hanyang Univ.
Jeonbuk National Univ.,
Myongji Univ.,
SKKU,
Yonsei Univ.,
(Order in ABC)



Sensor Packaging

PHENIX MPC-Ex & PIN-structured Si sensor

PIN-structured Si sensor

ETRI SEMICONDUCTOR PROCESS SHEET

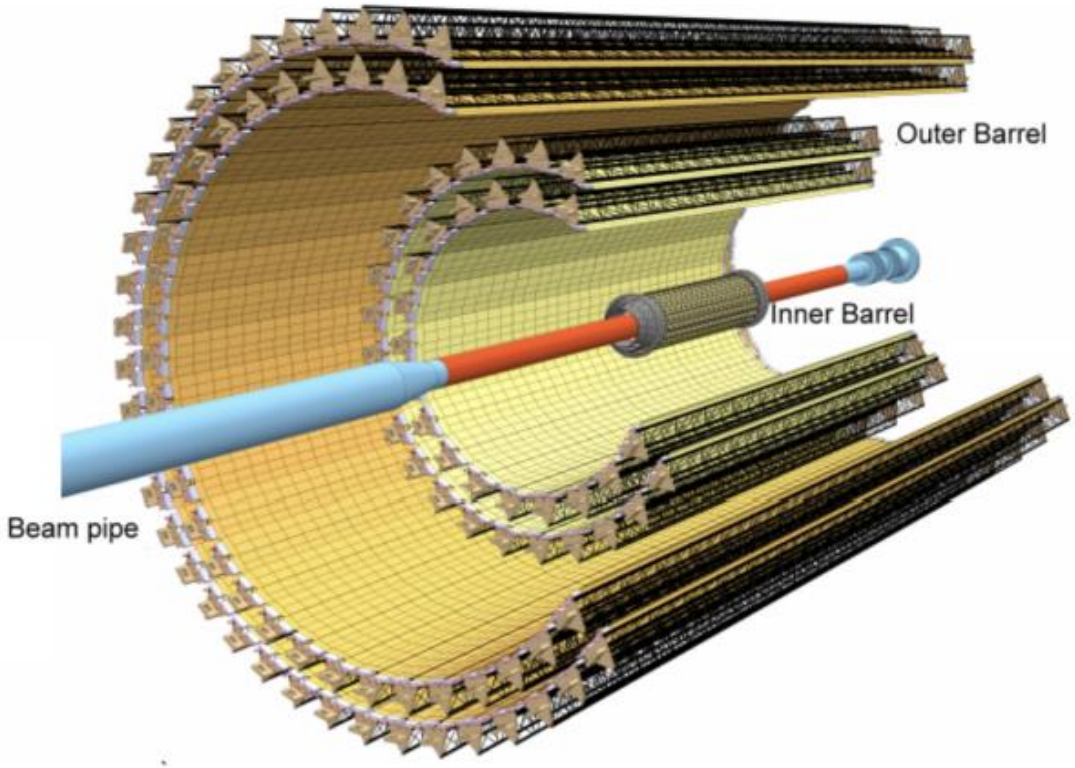
JOB : MiniPAD Sensor 1차				PAGE
DIV.: 연세대산학협력단	ENG.: 하지만/이준성	TEL : 5209/5516	START : . . .	RUN# / 1
CONT.	PRIOR RUN #	F.SEQ #	END : . . .	APP. / 6

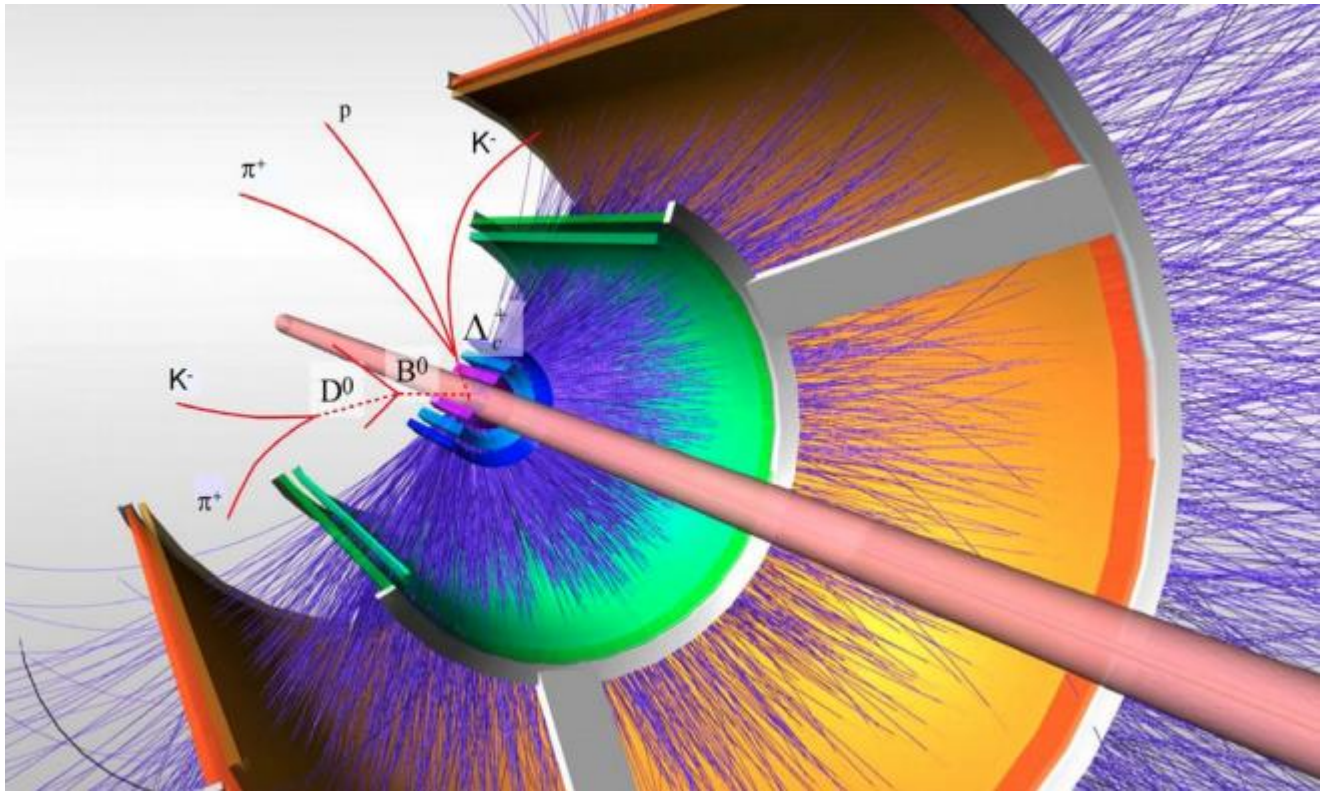
SEQ	PROCESS	P.CODE	WAFER INSTRUCTN	TARGET & MEASURE	DATE	I/O	OPER	RE-MARK
1	Wafer Scribe (Laser Mark) N-type, (100), YS01-07 : 5000Ω.cm / 650±25μm YS08-10 : 5000Ω.cm / 425μm YS11-15 : 3500Ω.cm / 650-700μm	LM01-L001	YS01-YS07 YS08-YS10 YS11-YS15					

ALICE ITS2 upgrade & ALPIDE from the CIS technology

ALICE ITS2 upgrade & ALPIDE from the CIS technology

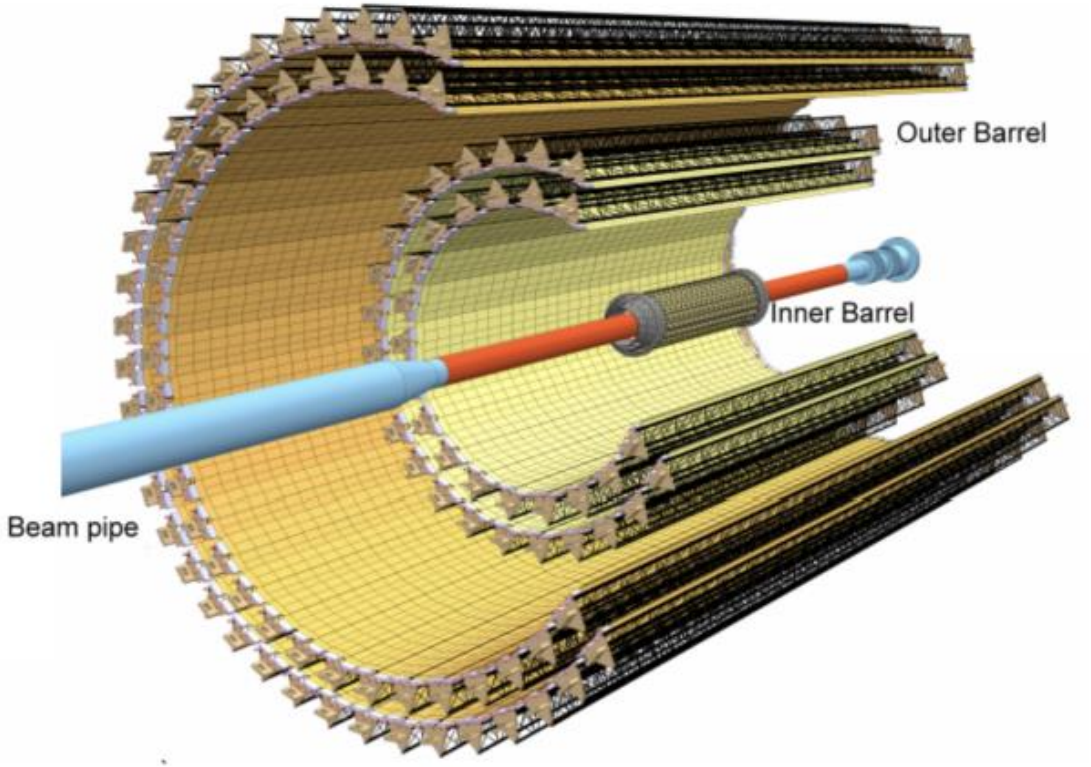
ALICE ITS2 upgrade





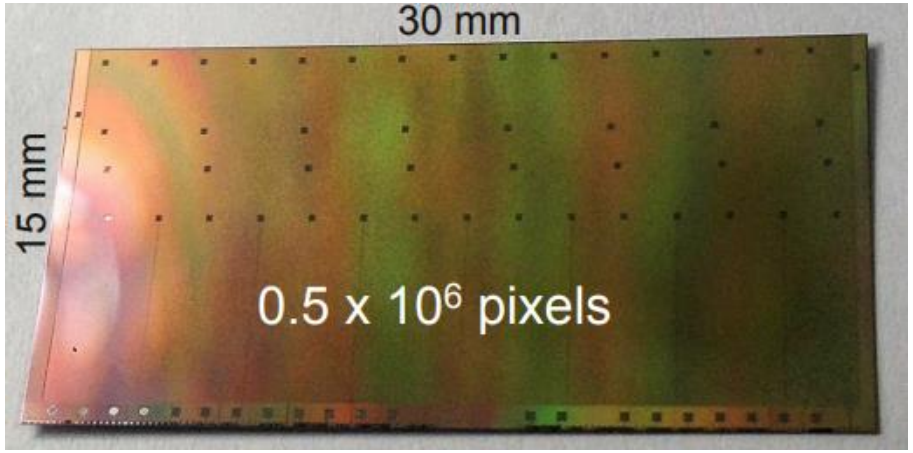
ALICE ITS2 upgrade & ALPIDE from the CIS technology

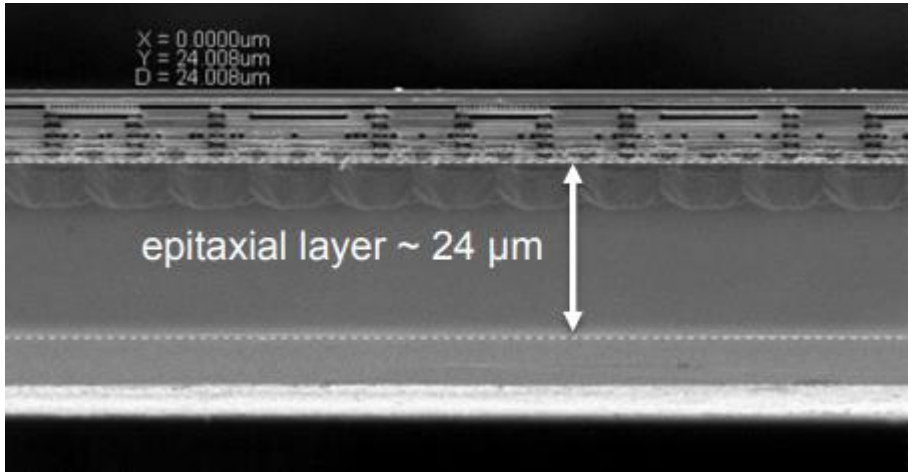
ALICE ITS2 upgrade



7 pixel layers
Total Area: 10 m^2
Distance to IP: 21 mm
Material budget: 0.3% X_0 (Water Cooling!)
Tolerance to Radiation:
2.7 Mrad,
1.7 x 10^{13} 1 MeV n_{eq}/cm^{-2}
Readout:
Pb+Pb at 100 kHz

ALPIDE from the CIS technology





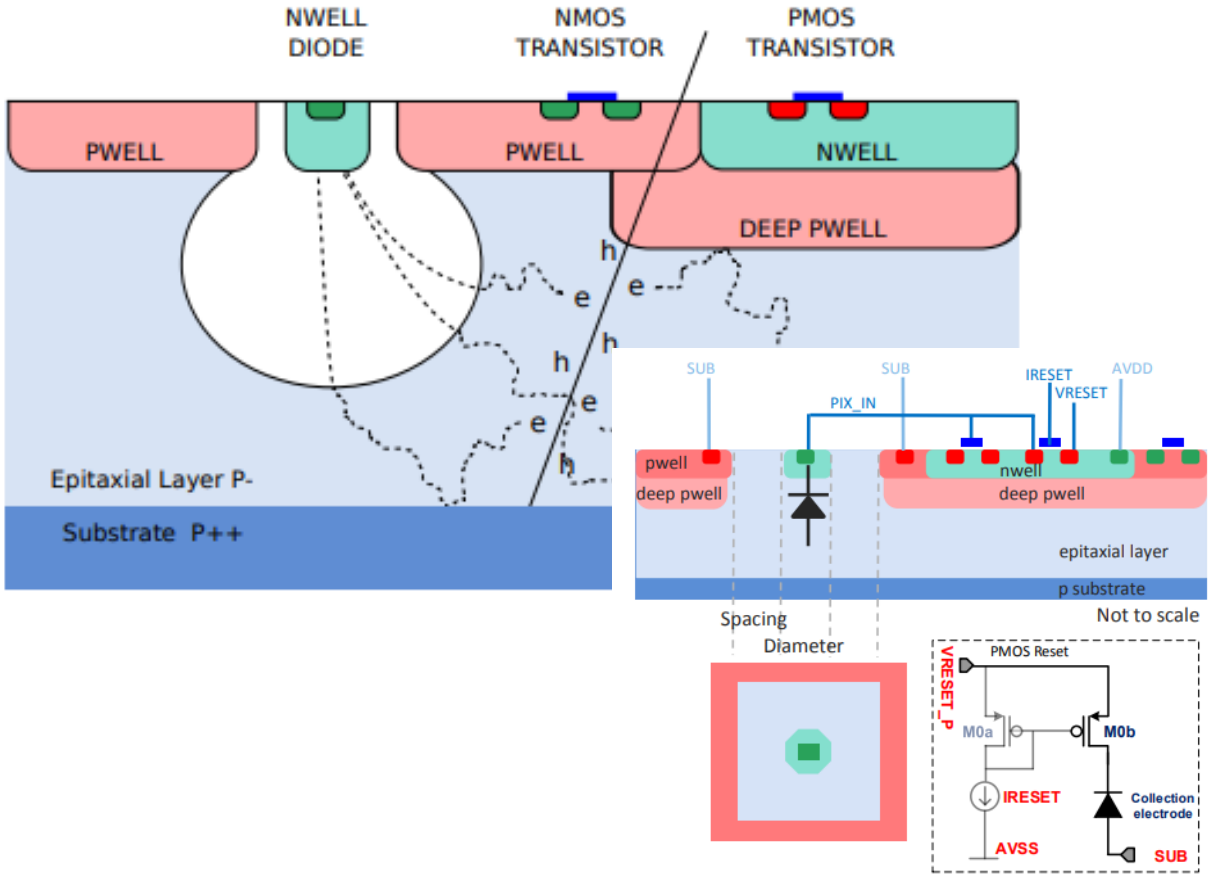
ALPIDE
0.18 µm CMOS technology, TowerJazz

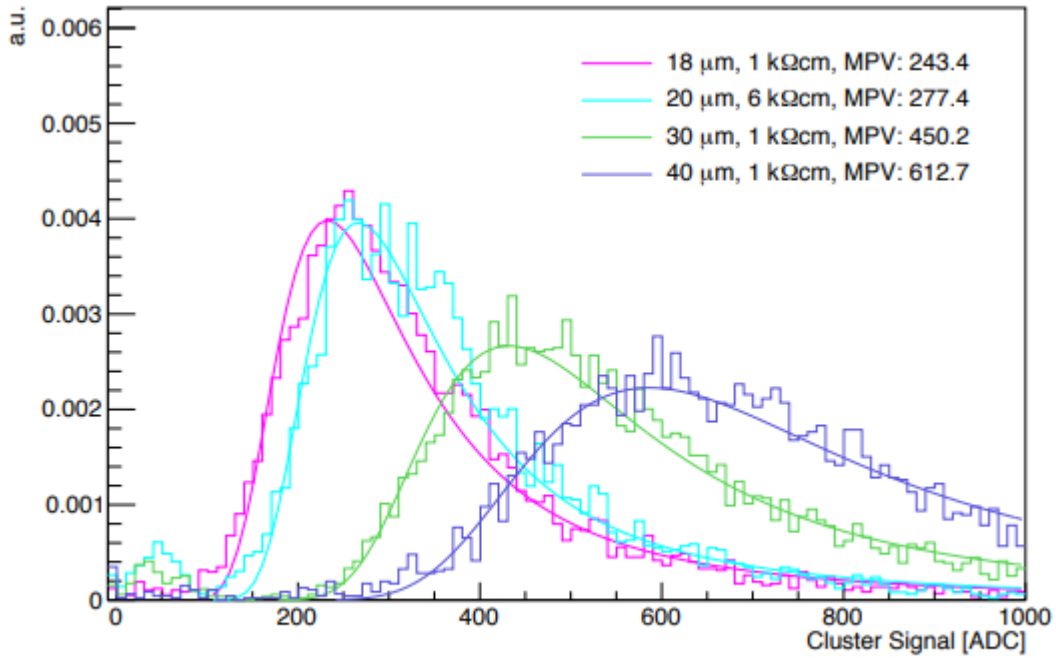
Size: 1.5 x 3 cm^2, 50/100 µm thick
Pixel size: 29 x 27 $(\mu m)^2$
Efficiency: > 99%
Fake hit rate: $\ll 10^{-5}$
Integration time: $10\ \mu s$
Power density: $35\ mW/cm^2$
Hit density: $18/cm^2$

ALICE ITS2 upgrade & ALPIDE from the CIS technology

ALPIDE from the CIS technology

Pixel

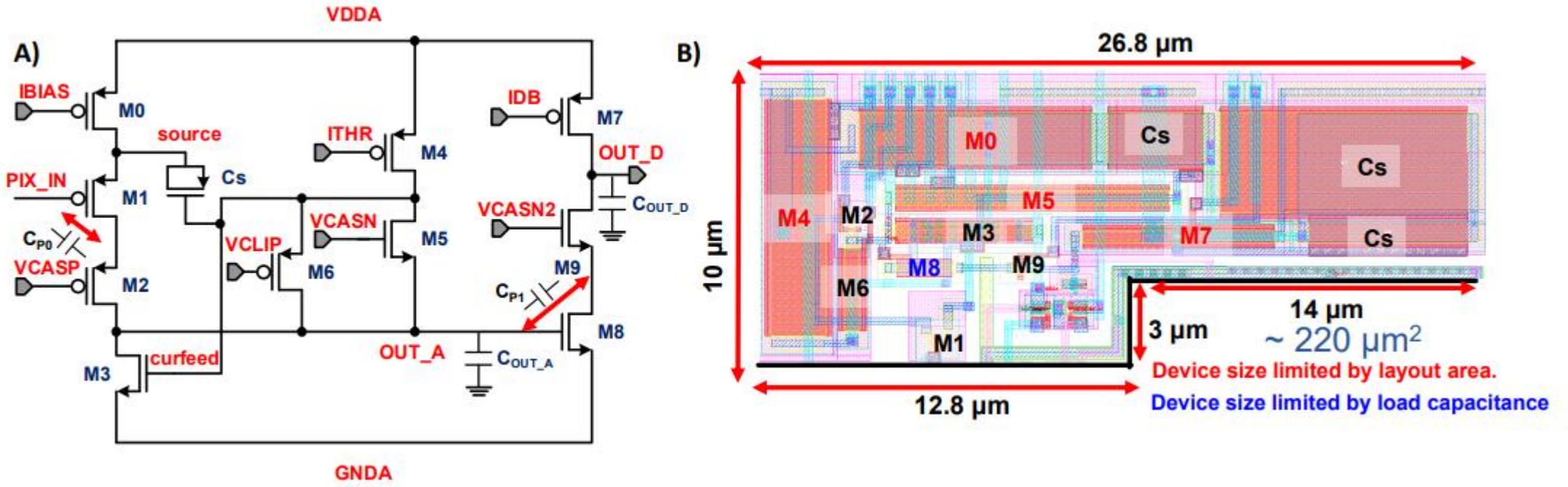




3.2 GeV/c electron test beam, pixel size 20 µm x 20 µm
J. Van Hoorne, PoS (TIPP2014) 125

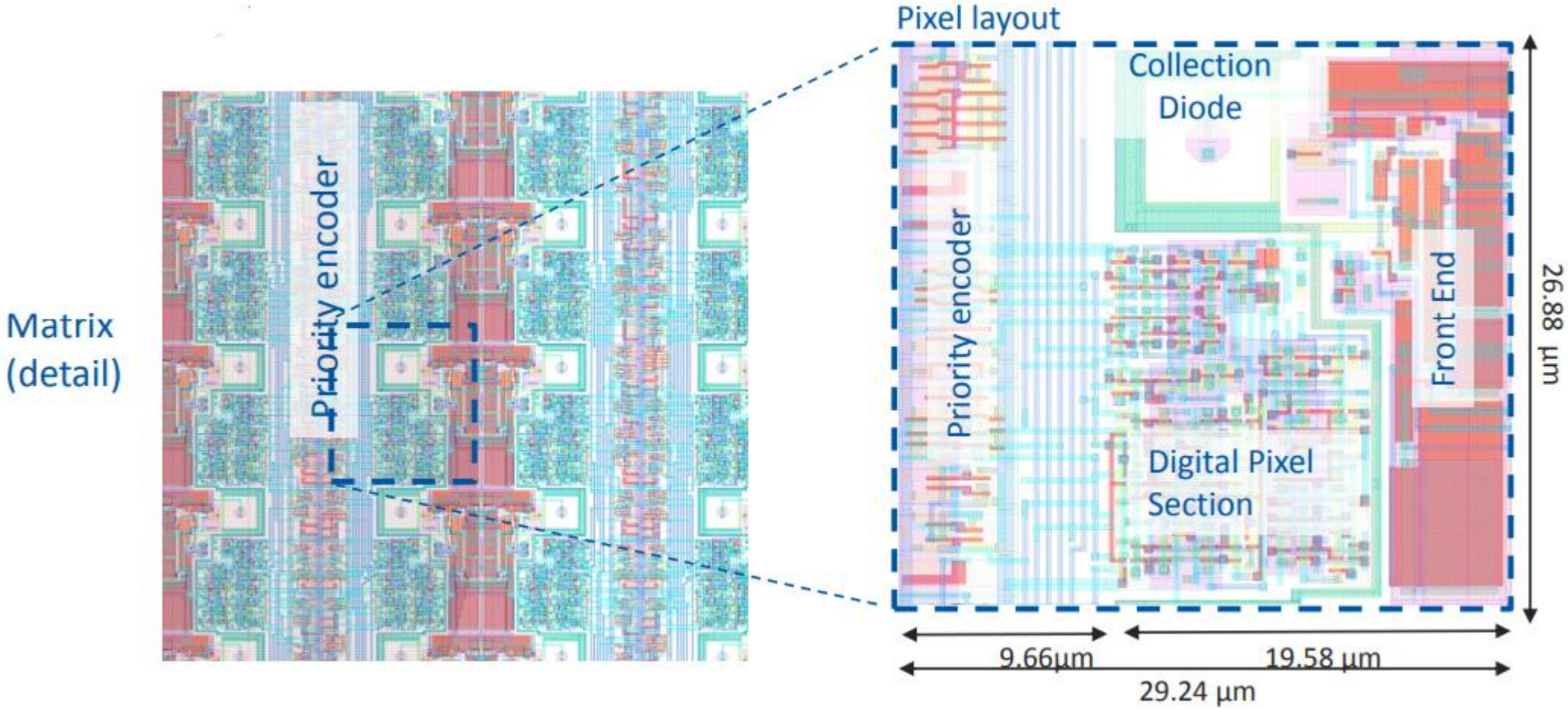
ALPIDE from the CIS technology

Front end



ALPIDE from the CIS technology

Real time zero suppression (priority encoder)



ALICE ITS2 upgrade & ALPIDE from the CIS technology

Korean involvement

Limited involvement in the circuit design (FEE & peripheral circuit of the chip)

Participation in the sensor characterization

Main involvement in **post-processing**

Thinning & Dicing (All sensors processed by the Korean company FUREX)

Mass production test (All key components produced by Korean companies)

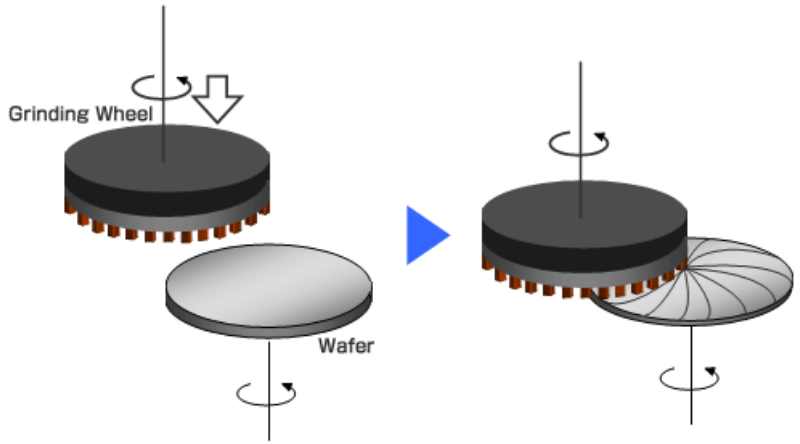
- Probe-card, NOTICE/EQENG
- Automatic Test Equipment, C-On

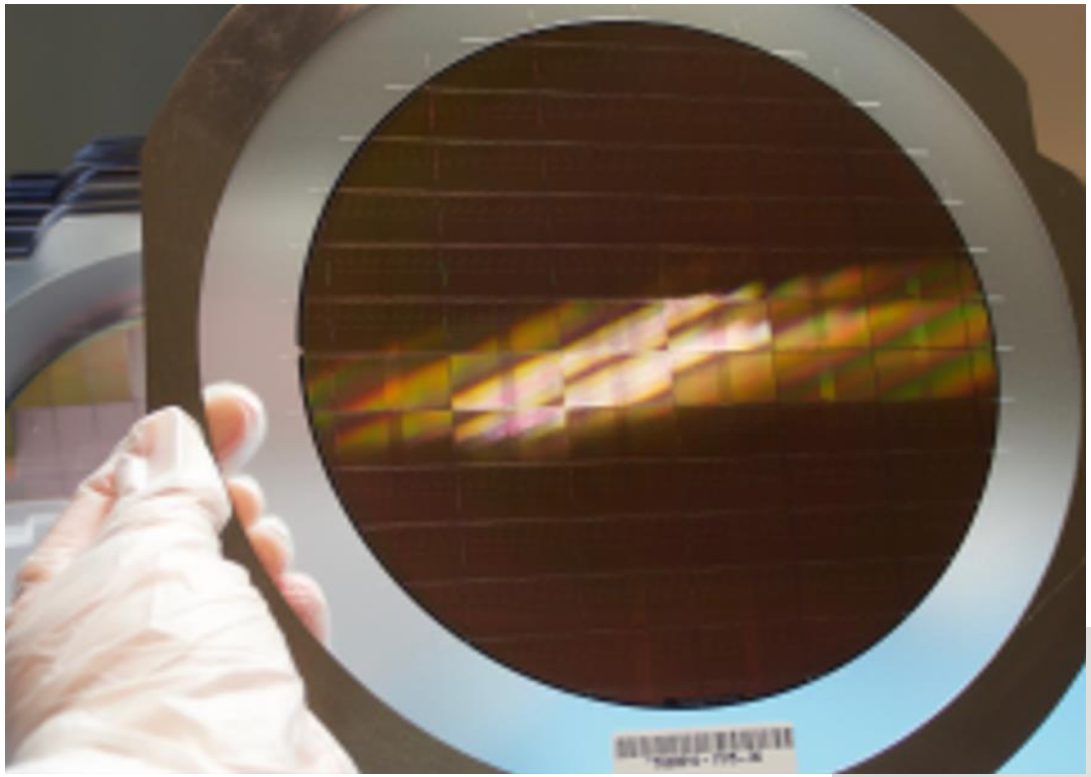
Module Assembly

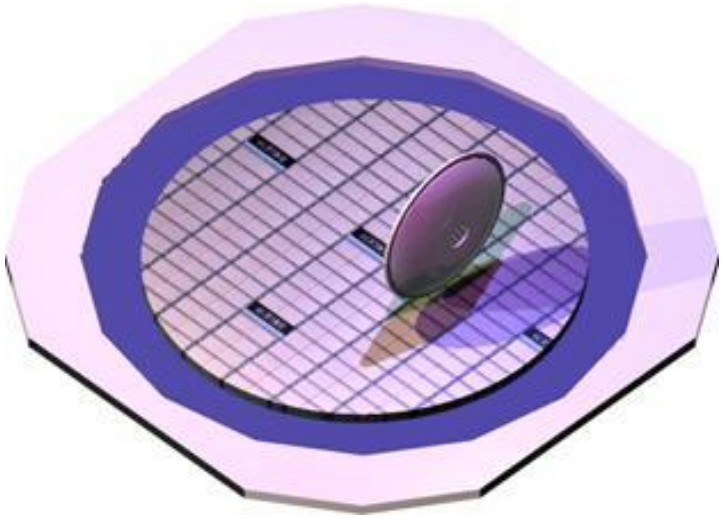
- Wire-bonding by the Korean company Sejung

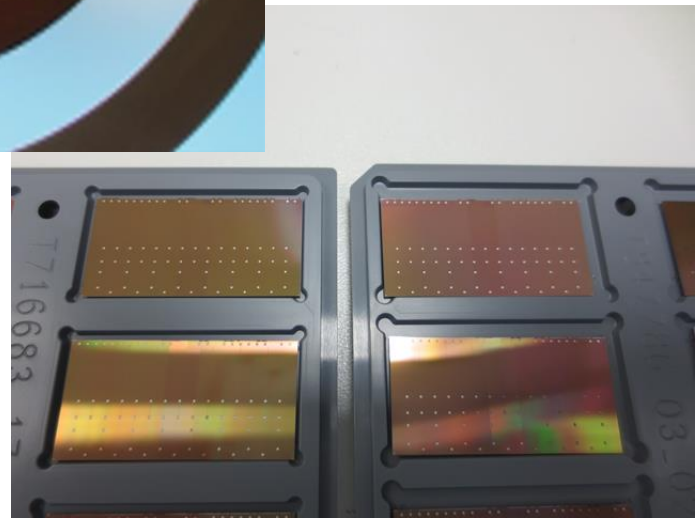
ALICE ITS2 upgrade & ALPIDE from the CIS technology

Korean involvement









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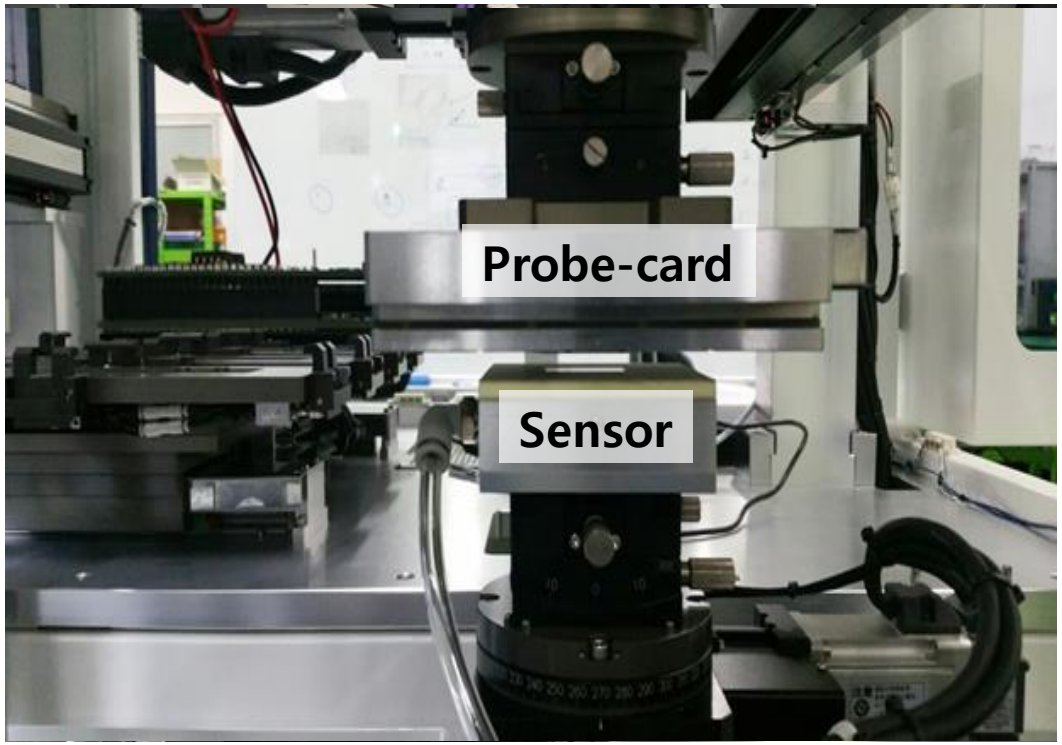
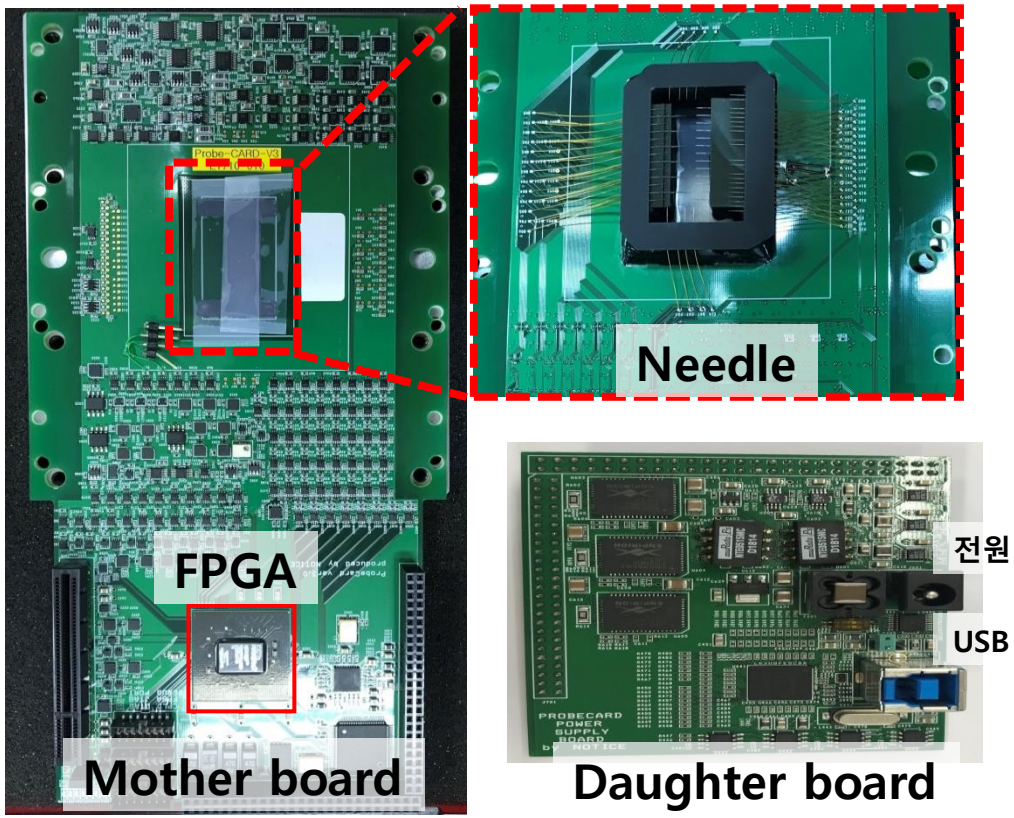
Korean involvement





ALICE ITS2 upgrade & ALPIDE from the CIS technology

Korean involvement

The ALICE collaboration presents the

ALICE Industry Award 2020

to

C-ON Tech

NamdongGu Incheon, South Korea

in recognition of the exceptional commitment to the development of a high-precision automated system for the mass production visual inspection and electrical tests of the ALPIDE monolithic pixel sensor ASIC. The extraordinary dedication of C-On Tech contributed to the successful production of the ALICE Inner Tracking System and Muon Forward Tracker.

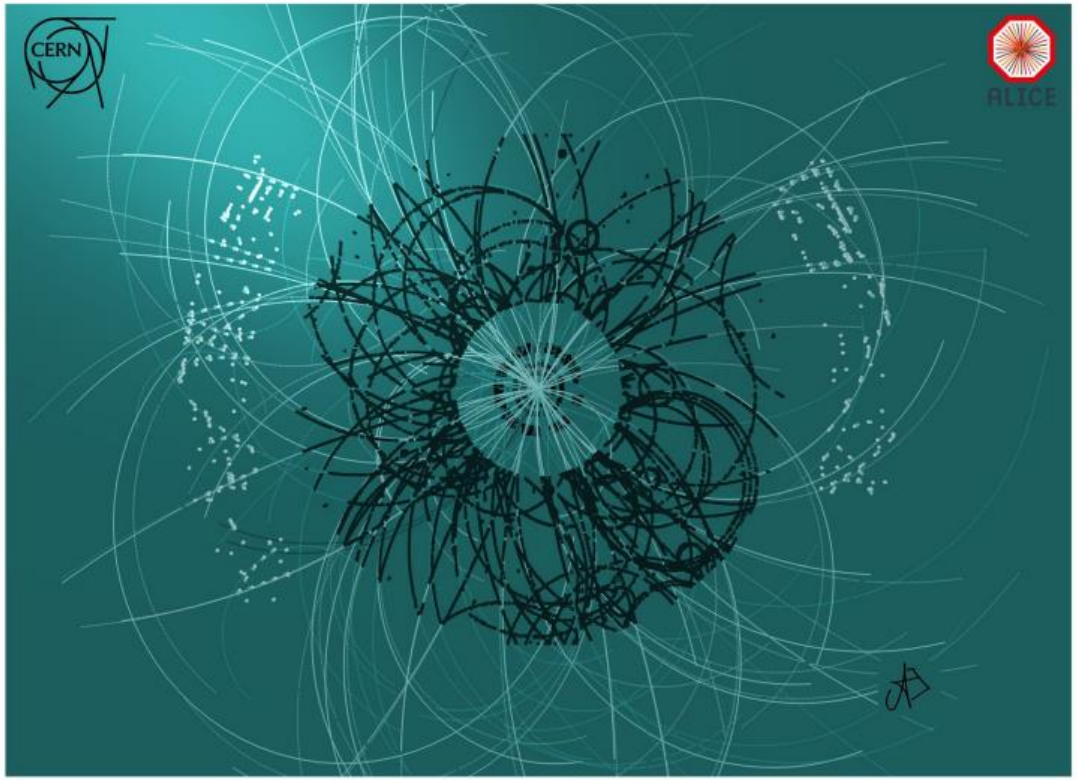
CERN

Chair of the ALICE management board

Chair of the ALICE collaboration board

ALICE

ALICE Industry Award 2020 to Korean Comp

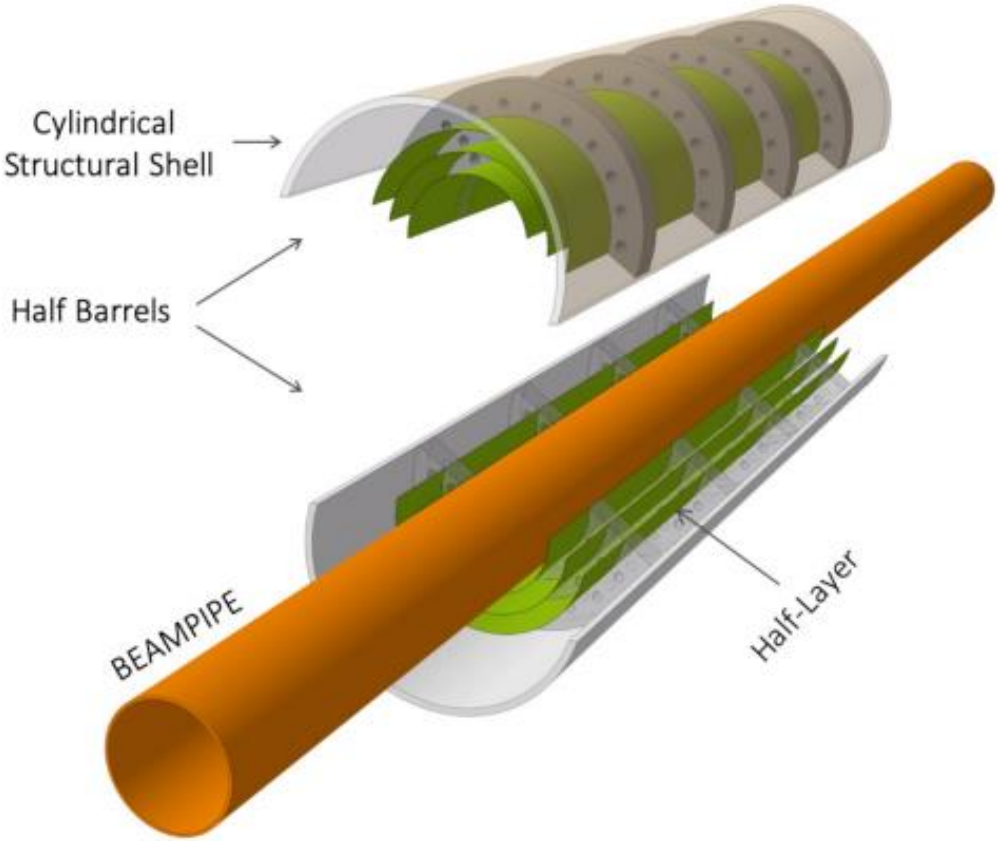


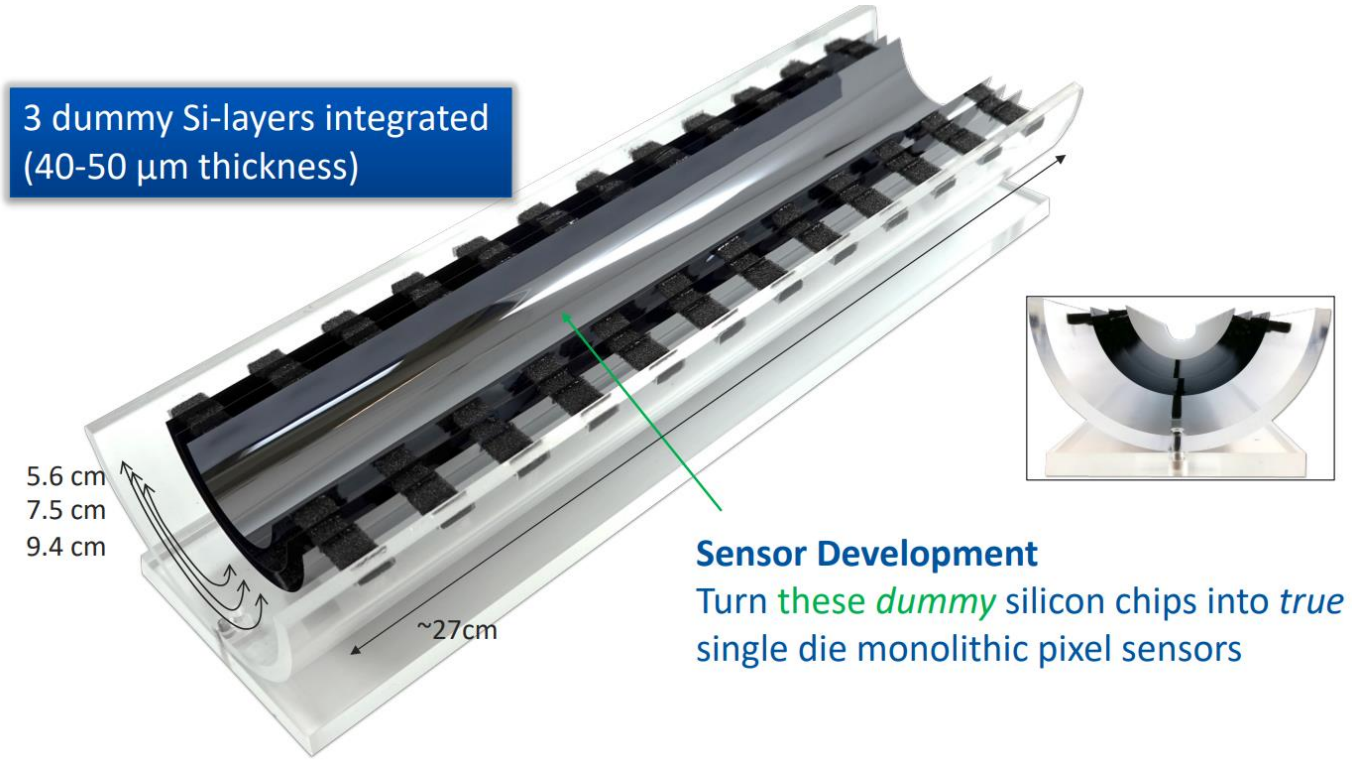
ALICE Industry Award 2020 - C-ON Tech

Prospect & Korean Potential

Prospect & Korean Potential

Prospect: Monolithic **Stitched** Sensor (ITS3)





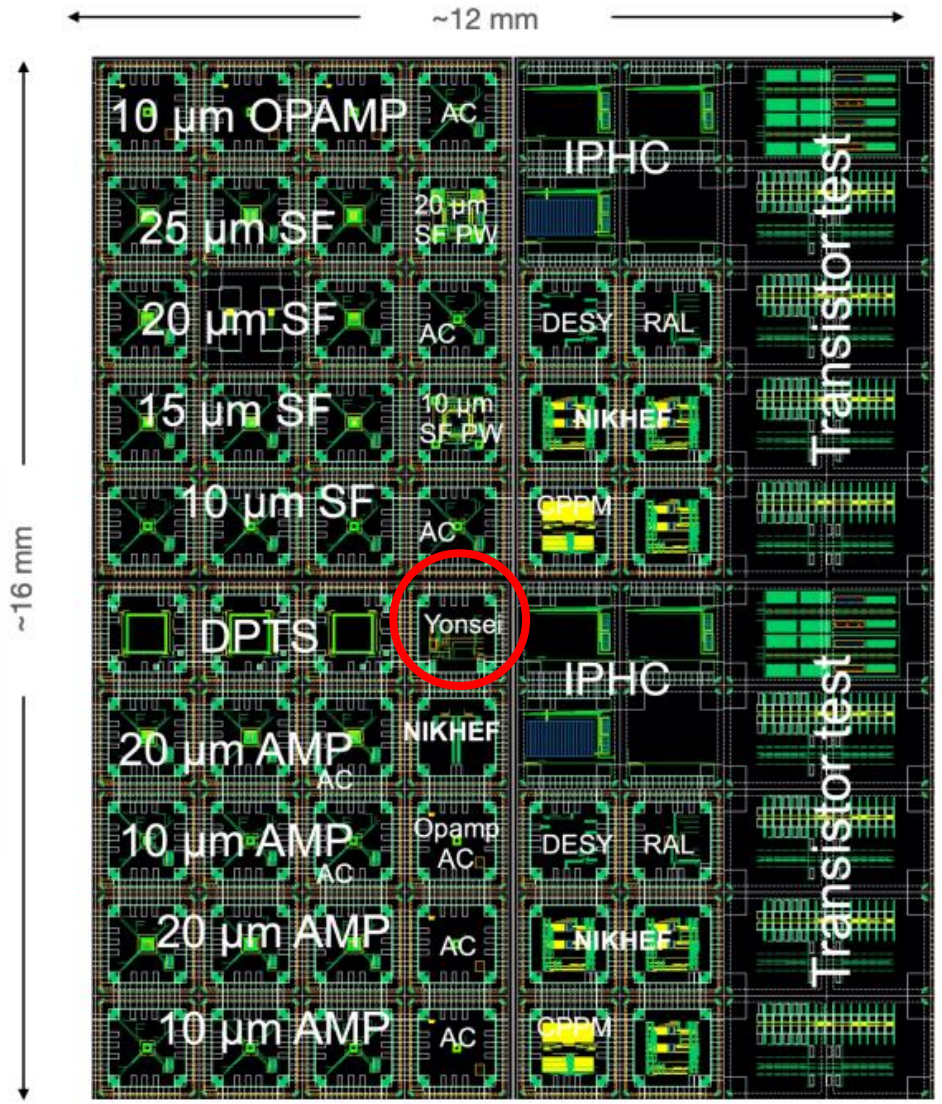
Sensor Development
Turn these *dummy* silicon chips into *true* single die monolithic pixel sensors

Prospect & Korean Potential

Prospect: Monolithic **Stitched** Sensor (ITS3)

A Ph.D in E.E. is participating in the design team.

Post-processing technology for ITS3 is not main stream industry, and there's limited involvements.



Summary

- There's a strong background in Korea for the Si sensors.
- We have also seen the Korean strength in the post-processing of the Si sensors.
- Involvement in the stitched sensor R&D, the ITS3 upgrade of the ALICE experiment.