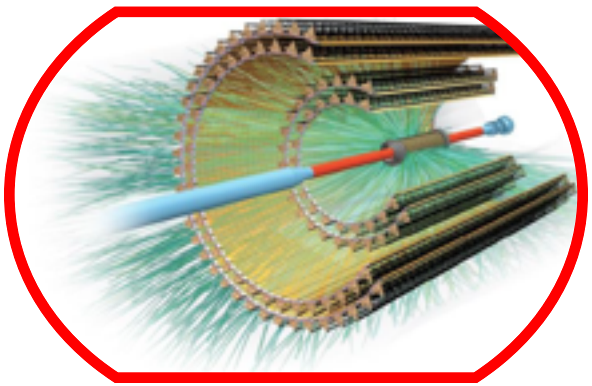
Summary of activities at SUT and SLRI

12th ALICE ITS upgrade, MFT and O2 Asian Workshop
November 19, Inha Univ.



THAI INSTITUTES IN INNER TRACKING SYSTEM (ITS) UPGRADE OF ALICE, CERN

Overview

A Large Ion Collider Experiment

ALICE

1. Introduction
2. The activities of SUT
3. SLRI-BTF
4. Wafer characterization
5. Ponits of Interest

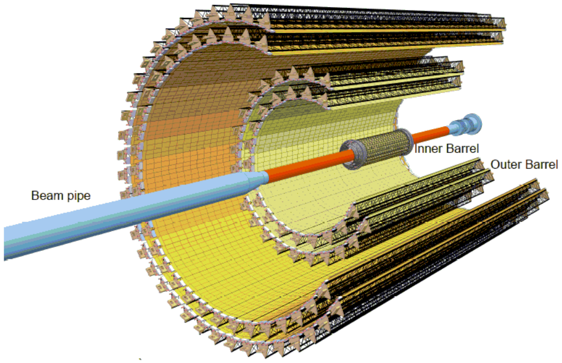
Background of Project Collaboration

A Large Ion Collider Experiment

ALICE

- Her Royal Highness Princess Maha Chakri Sirindhorn presided over in MOU signing ceremony between Suranaree University of Technology and ALICE
- At Srapathum palace
- On December 13th , 2012

Research Project of ITS



Collaboration of organizations in Thailand, ALICE and other counties

Research Procedure :

1) Find proper material to construct sensor
2) Test working and efficiency on prototype sensor
3) Simulate situation of advertent particle measurement

Time period : 2013-2020

Manpower : potential to produce 10 PhD. students in project

Collaboration in Thailand

AICE ITS upgrade Research Activities

ALICE

2015 → 1 → 2016 → 2 → 2017 → 3 → 2018 → 4 → 2019 → 5 → 2020

Suranaree University of Technology	Siam Photon	TMEC Thai Microelectronics Center
Material budget calculation of beam-pipe and stave design	electron reduction system (<100 e-/burst)	wafer quality assurance
Detector simulation and physics performance	sensor characterization using electron beam	Dummy chip
Testing at CERN		Thinning and dicing Wafer
		Silicon heat exchanger
Complete in 2019	Completed in Mar 2018	Completed in Sept 2018

Measurement of an upgraded ITS

ALICE

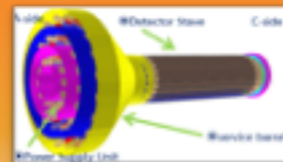
Material budget calculation of beam-pipe and stave design

Detector simulation and physics performance

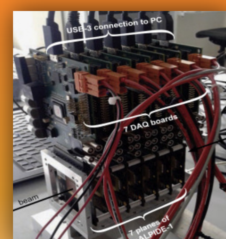
Testing at CERN

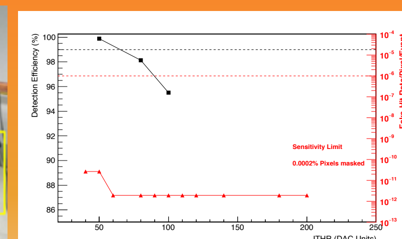
Complete in Sept 2019

Material budget calculation of IB



Characterization of MAP at SLRI-BTF





Data analysis of collision particles and tracking reconstruction in search of Lambda C and Hypertriton

In process

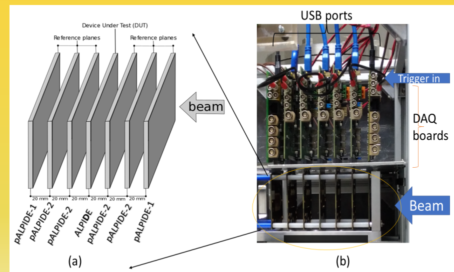
Siam Photon

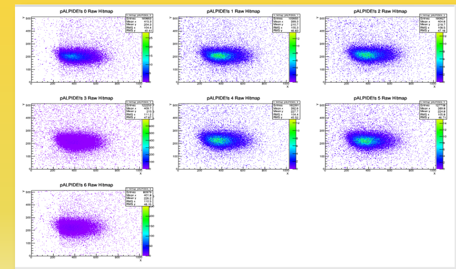
sensor characterization using electron beam

electron reduction system (<100 e-/burst)

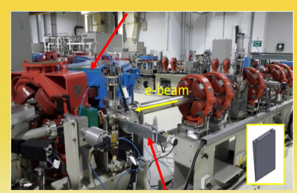
Completed in Mar 2018

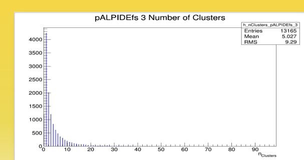
Characterize ALPIDE chip **with 1 GeV electron beam test**





Tuneable electron less 10 electron per bunch



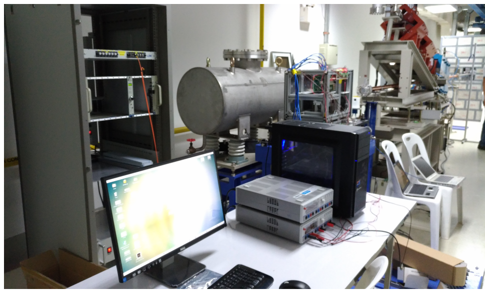


SLRI activities

- Synchrotron Light Research Institute Beam Test Facility (Thailand)
- Instruments: Telescope set up
- Result: Study a relation of a number of cluster of DUT with Cluster size on x and y axis (number of pixel) and DUT Detection efficiency (*latest done by Anatachai*)

Synchrotron Light Research Institute Beam Test Facility (Thailand)

SLRI BTF



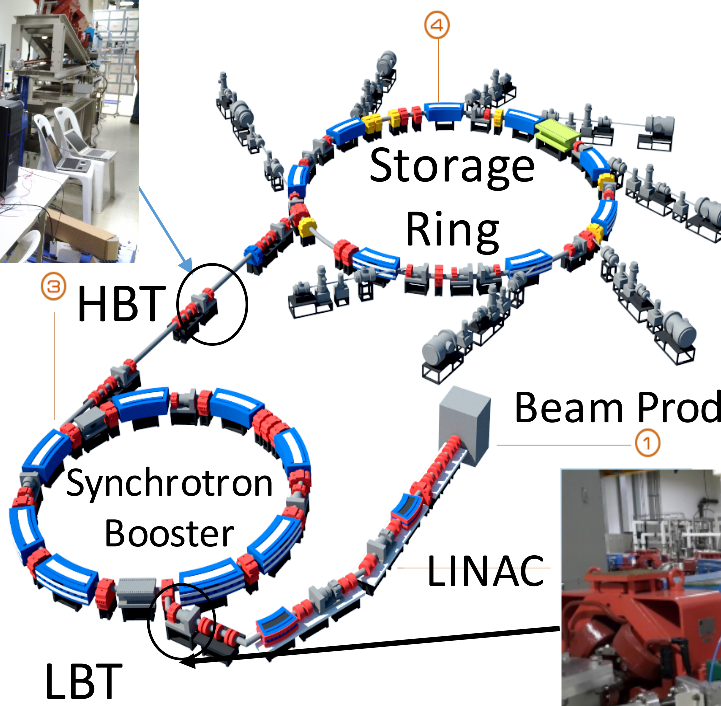
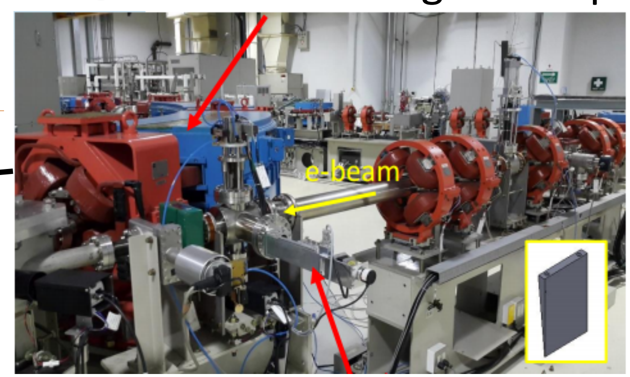


Table 1 Electron energy parameter at HBT

Energy	Up to 1.2 GeV
Energy spread	-0.05%
Pulse duration Bunch length	8.5 ns 0.5 ns
Repetition rate	0.5 Hz 1 GeV 0.3 Hz 1.2 GeV (upgrade)

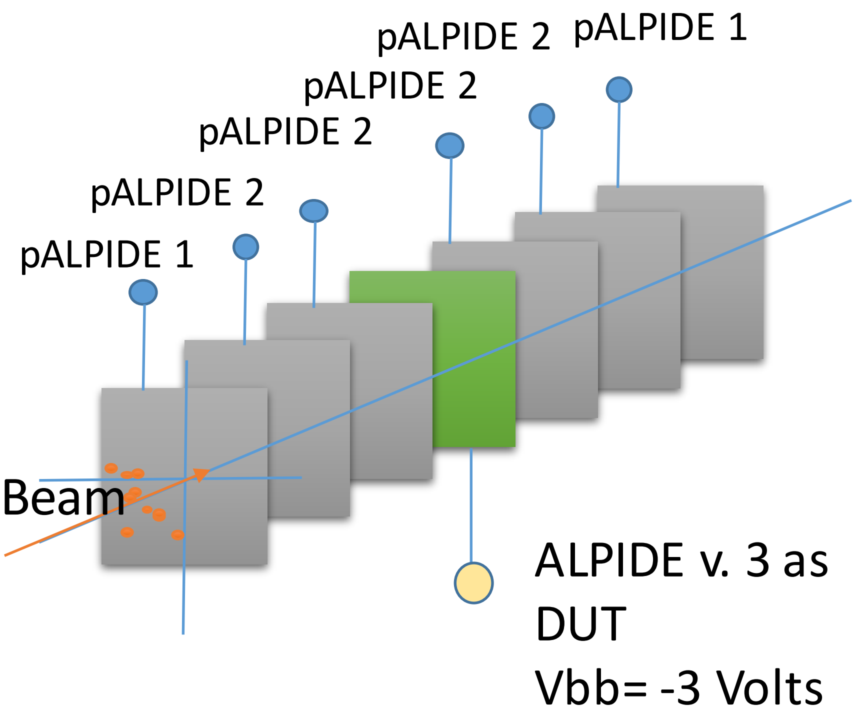
LBT target manipulation



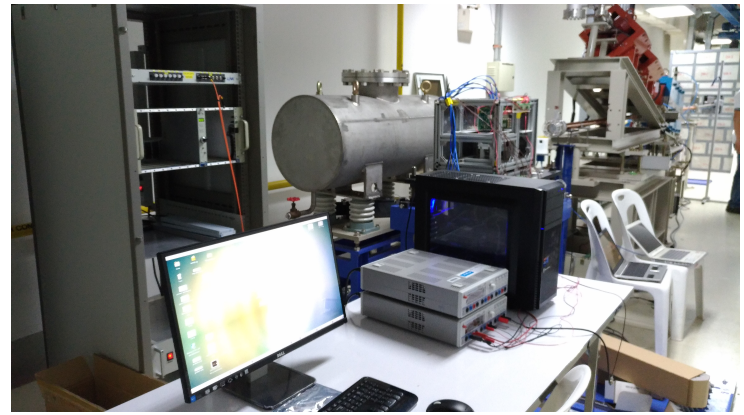
Target Manipulator

Instruments: Telescope set up

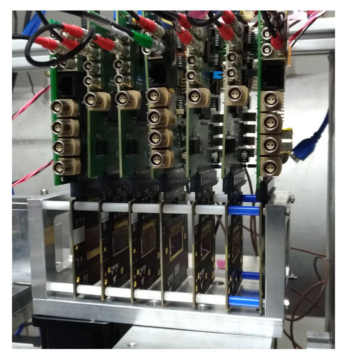
- 1st Version telescope components



SLRI-BTF

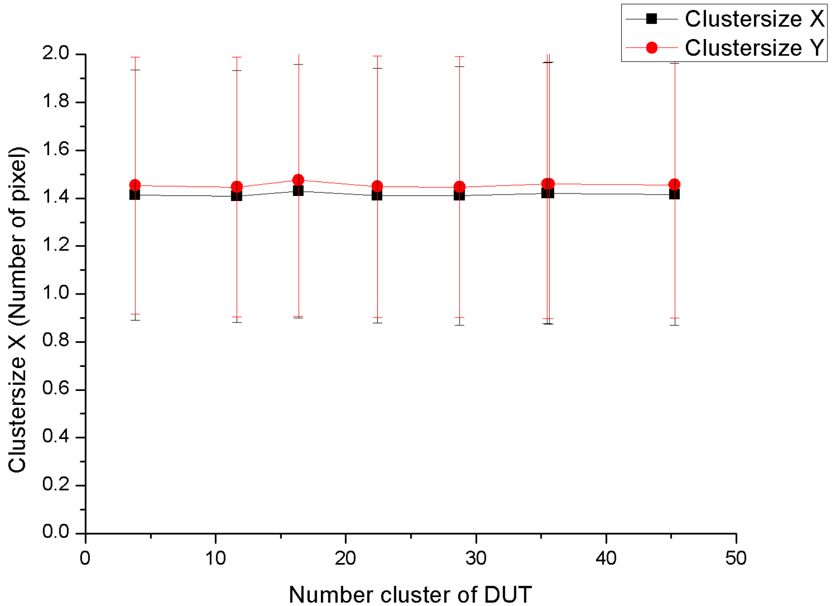


- Version 1 telescope

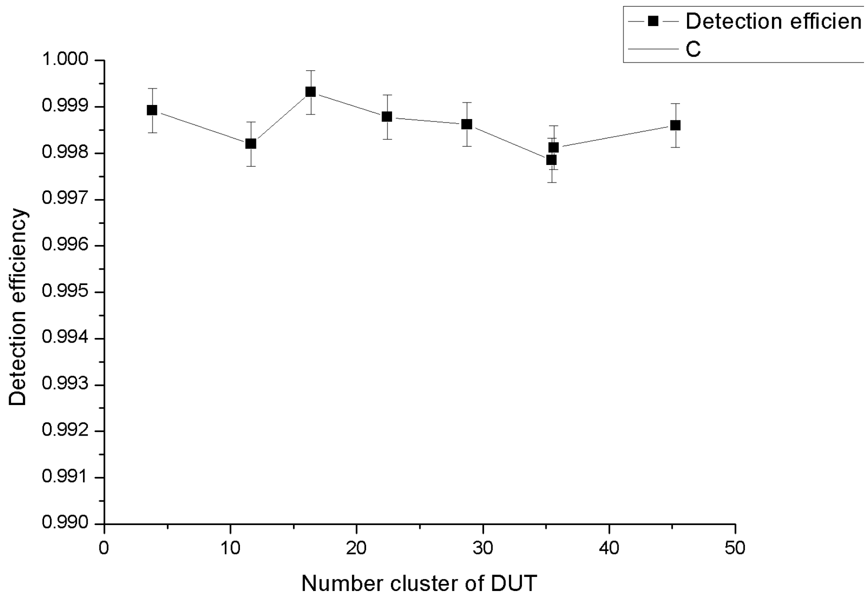


Result: (by Anatachai)

Study a relation of a number of cluster of DUT with Cluster size on x and y axis (number of pixel) and DUT Detection efficiency

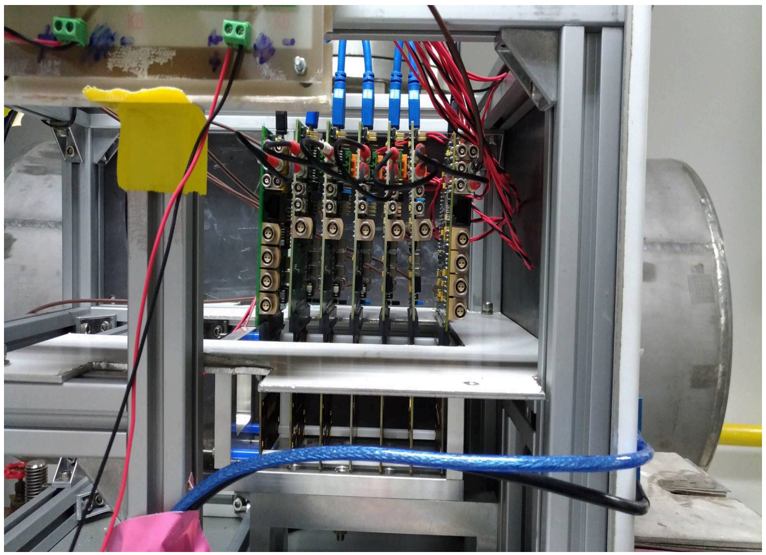


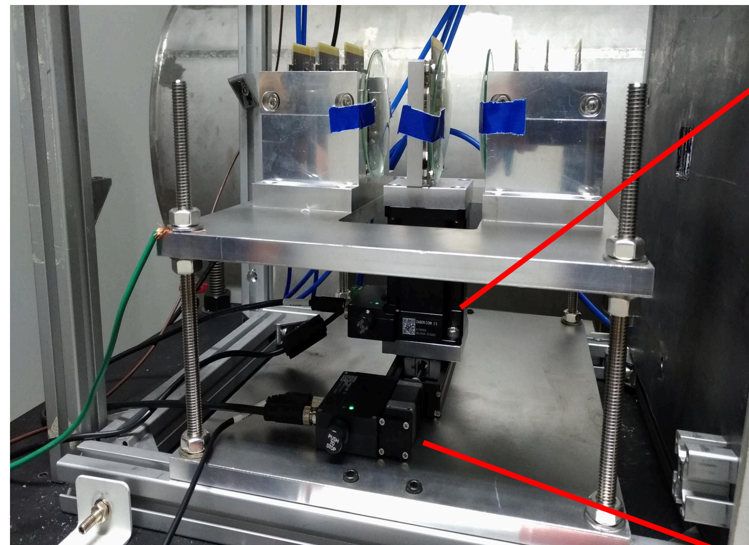
a number of cluster of DUT with Cluster size on x and y axis (number of pixel)



a number of cluster of DUT with DUT Detection efficiency

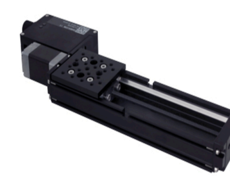
Telescope version2





Zaber vertical

Zaber linear



Installed the Zaber linear stages and Zaber vertical stages

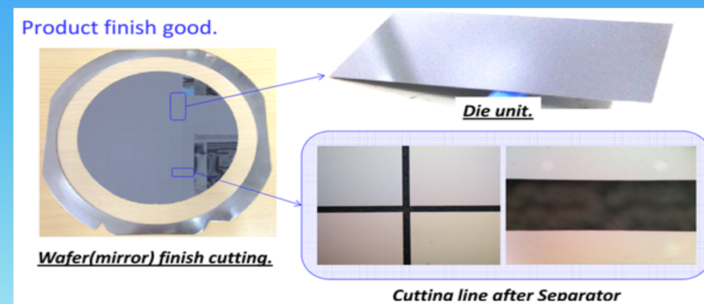
Wafer characterization

TMEC Thai Microelectronics Center

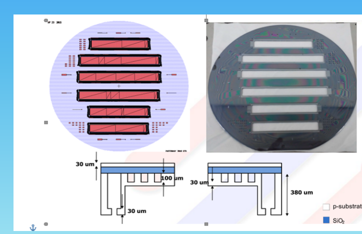
- wafer quality assurance
- Dummy chip
- Thinning and dicing Wafer
- Silicon heat exchanger

Completed in Sept 2018

High-resistivity Si epitaxial wafers using SRP and SEM



Silicon microchannel heat exchanger

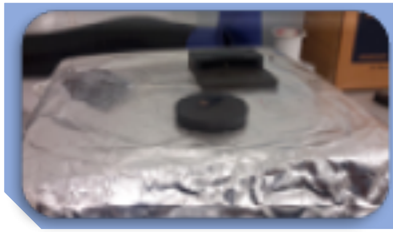


SRP preparations

Polish the sample with polishing wheel which contains the diamond polishing compound.

Size 1 µm for coarse grinding

Size 0.25 µm for fine grinding



Mount it with melted wax on the bevel block 1°

Sample has been cut in size 3x1 cm^2

SRP measurement

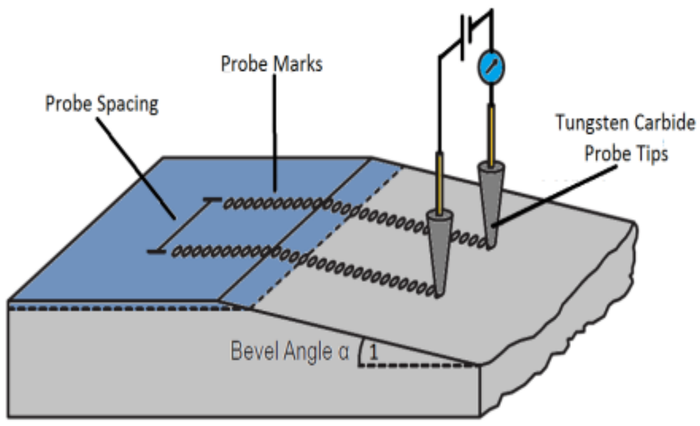


Fig : The probes are stepped along the beveled semiconductor surface.

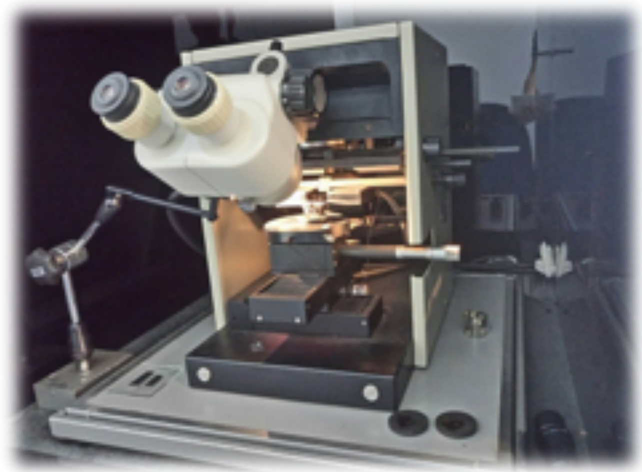


Fig 8: The SRP measurement station is able to adjust the smallest step of 1 μm. Each step moves lower inside material 17 nm.

SRP Result

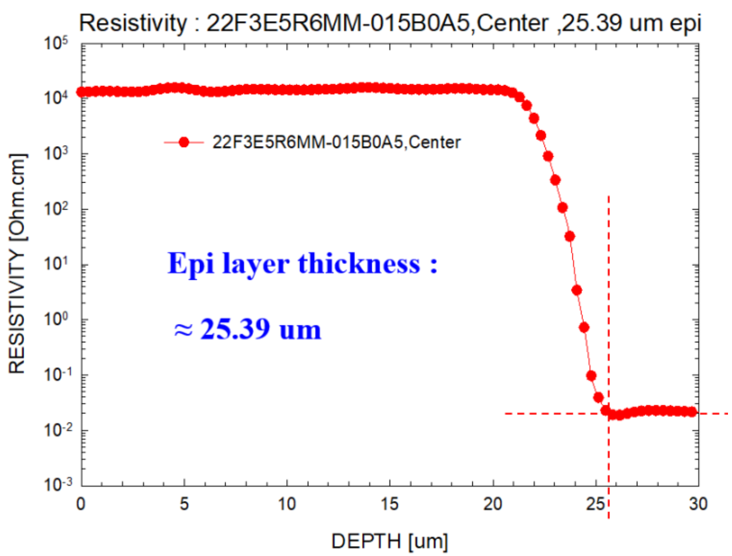


Fig: Resistivity profiling measured at different depths in the silicon wafer number 015B0A5.

**SRP shows the resistivities above 1 kΩ·cm from the depth in the range of 0-20 µm. Then the resistivity reduces sharply between 21-25 µm.

SEM

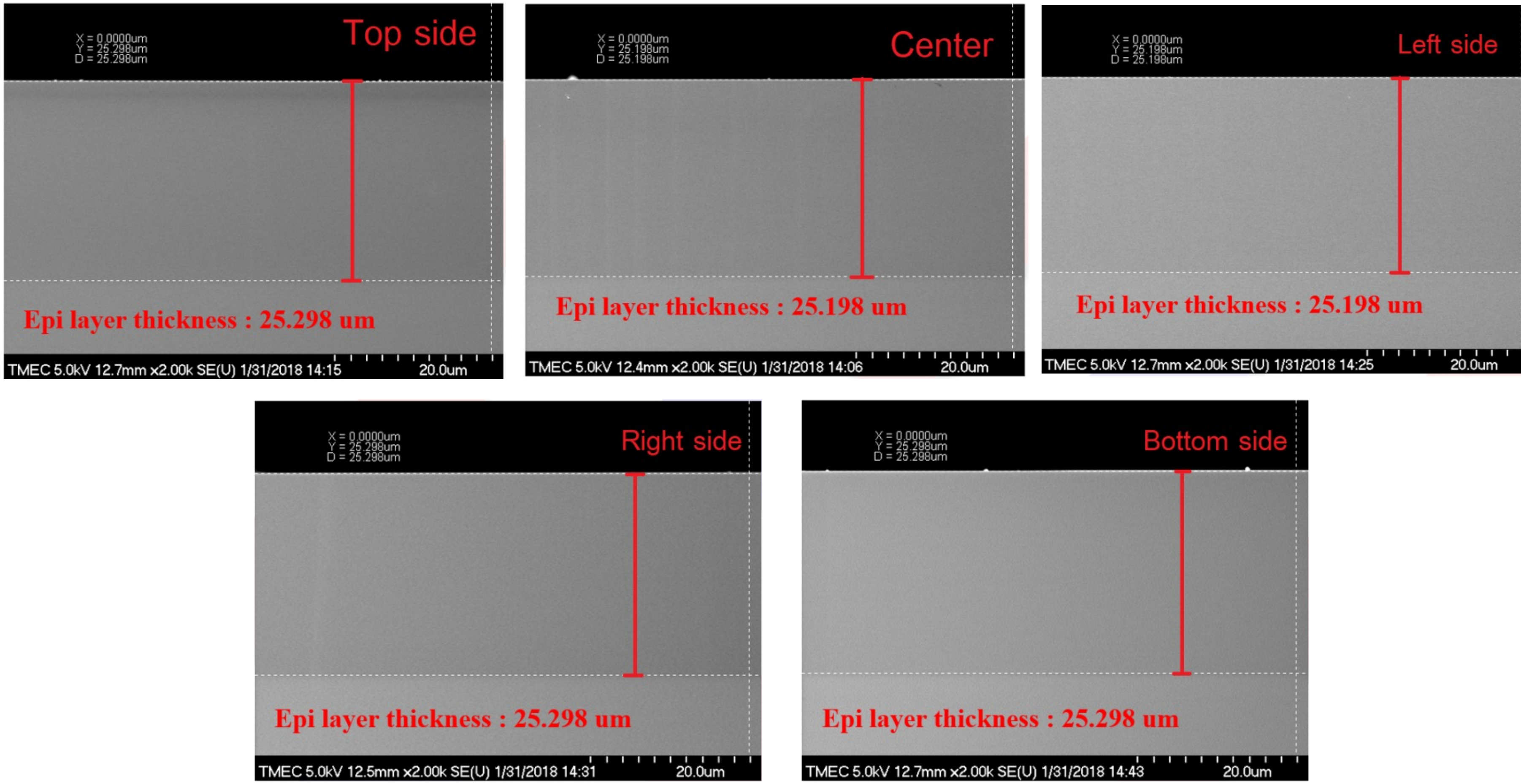


Fig : SEM cross section of each area in the silicon wafer.

SEM Result

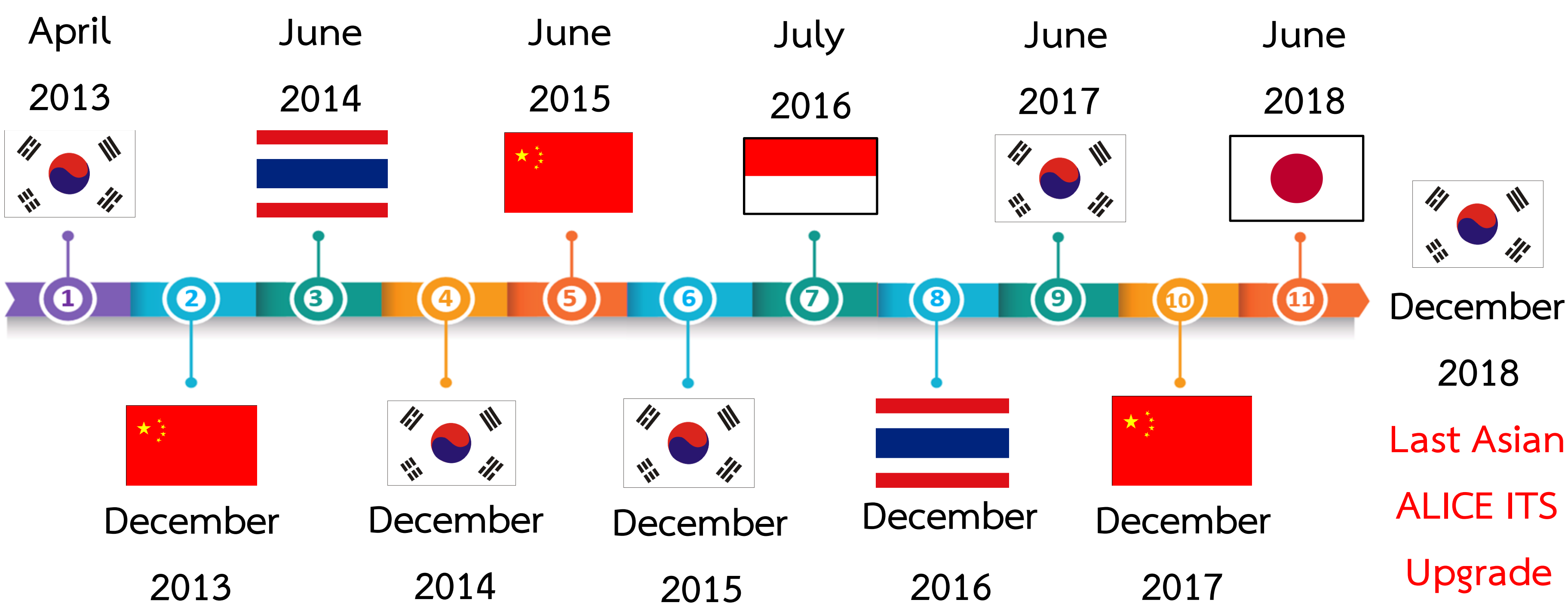
Picture	Epitaxial thickness(µm)
(a) Top	25.198
(b) Bottom	25.298
(c) Left	25.298
(d) Right	25.298
(e) Center	25.198

Table : SEM cross section results of five different areas in the silicon wafer.

ALICE ITS upgrade, MFT and O2 Workshop

A Large Ion Collider Experiment

ALICE



Point of interests.

Further reduction of the material thickness of the Inner Layers in LS3.

Table List of material budget contribution in separated part

parts	% contribution
Silicon sensor, which has a thickness of 50 µm	15
Electrical substrate (FPC)	50
Cooling circuit	20
Carbon space frame	15

1. Increasing the pixel size
    - continue collaborating and contribute to the next generation of silicon detectors, by SUT and TMEC

2. Thin and bend the sensor
    - contribute to the sensor characterization and beam test at SUT and SLRI

3. Implementation of mechanical structure
4. Use air flow to release the heat
    - contribute to the geometry construction and material test for the mechanical structure and cooling of IB3.

THANK YOU