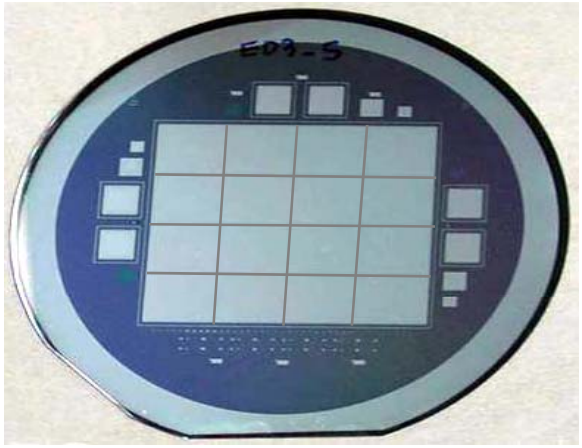
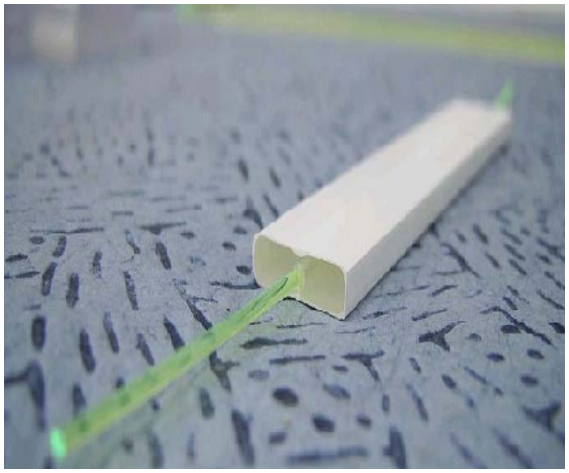
ILC Detector Activities in Korea

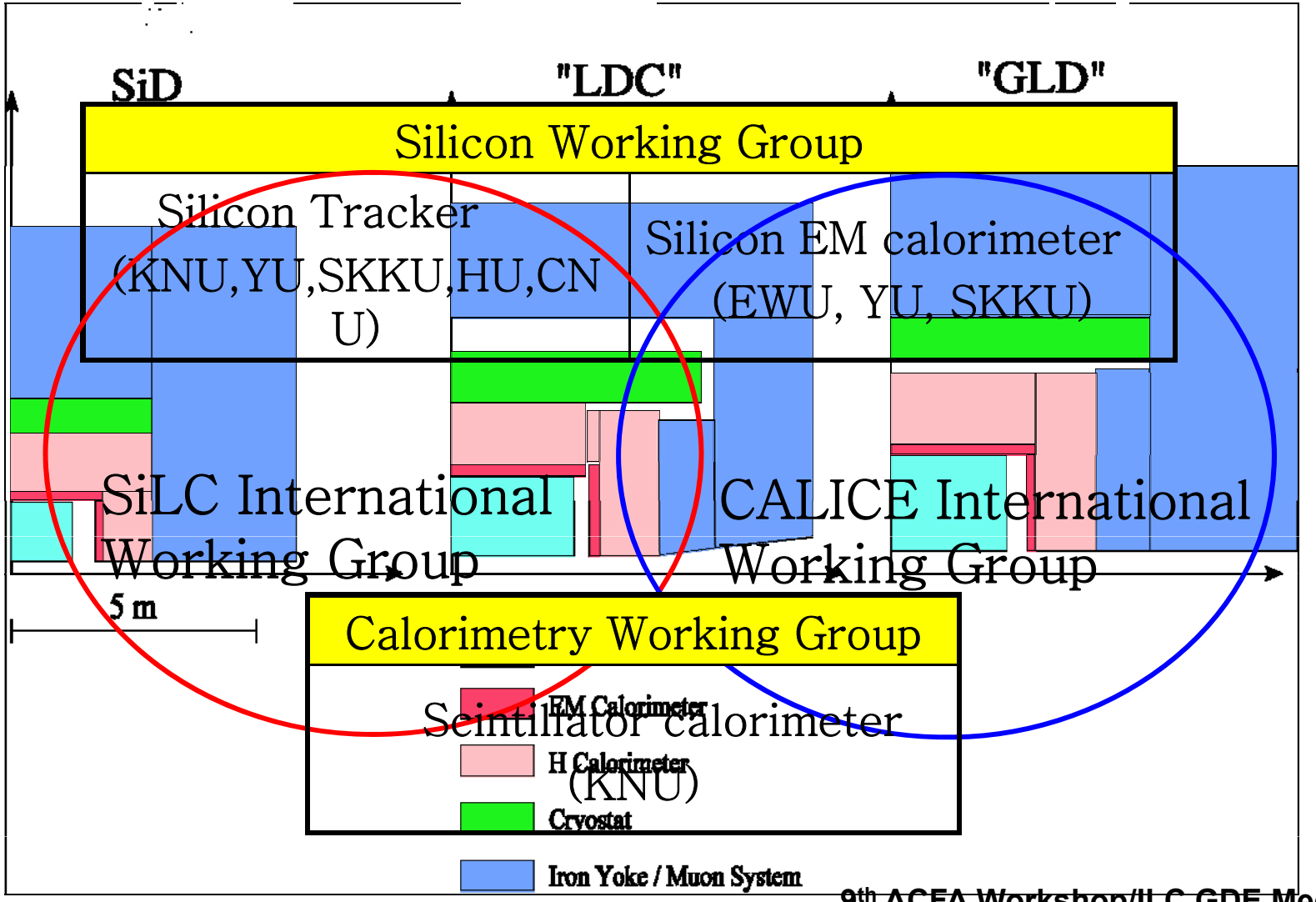




- Introduction
- Calorimeter
  - Silicon/Tungsten Ecal.
  - Scintillator Cal.
- Silicon Tracker
  - Simulation
  - Mechanical/Supporting Structures
  - Sensor Development
  - Beam Test
- Summary

H. Park (Kyungpook Nat'l Univ.)

ILC Detector R&D Group in Korea



Si/W Calorimeter as Main EMCal

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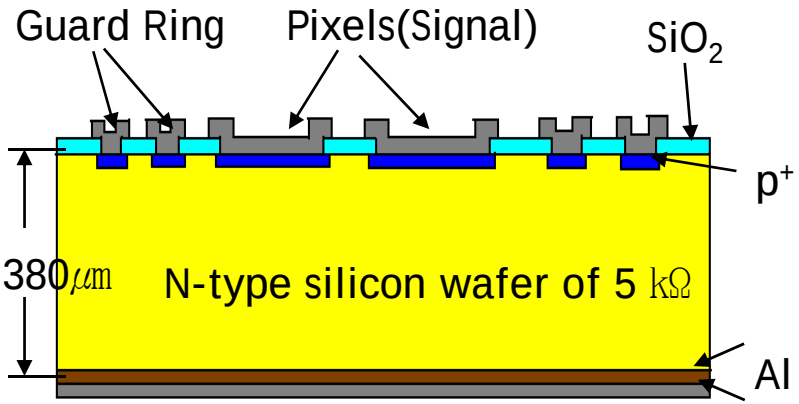
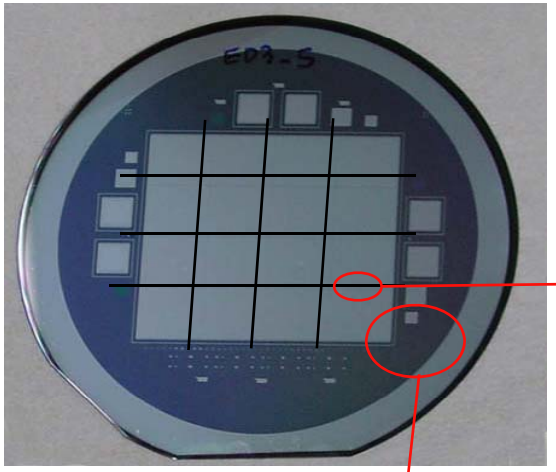
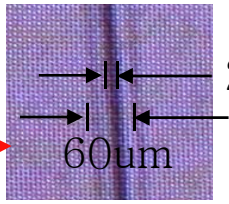
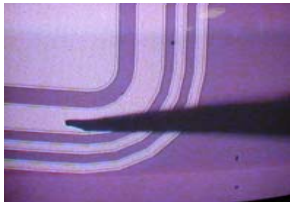
Silicon Sensor for EM Calorimeter



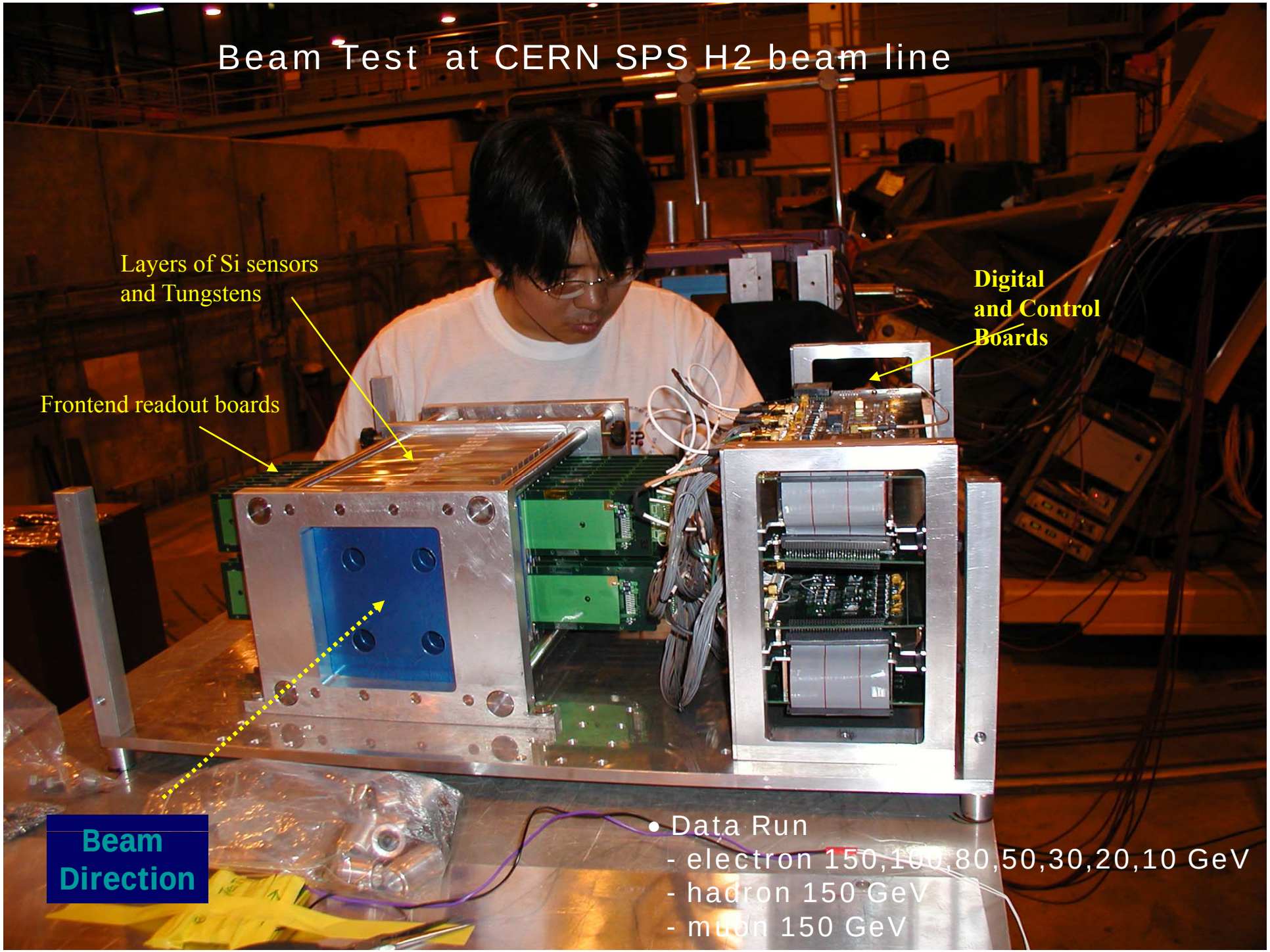




- Fabricated on 380um 5' high resistivity wafer
- 4 x 4 matrix (a pixel: 1.55 x 1.37 cm^2)
- A sensor size : 6.52 x 5.82 cm^2
  (including 3 guard rings)
- DC coupled

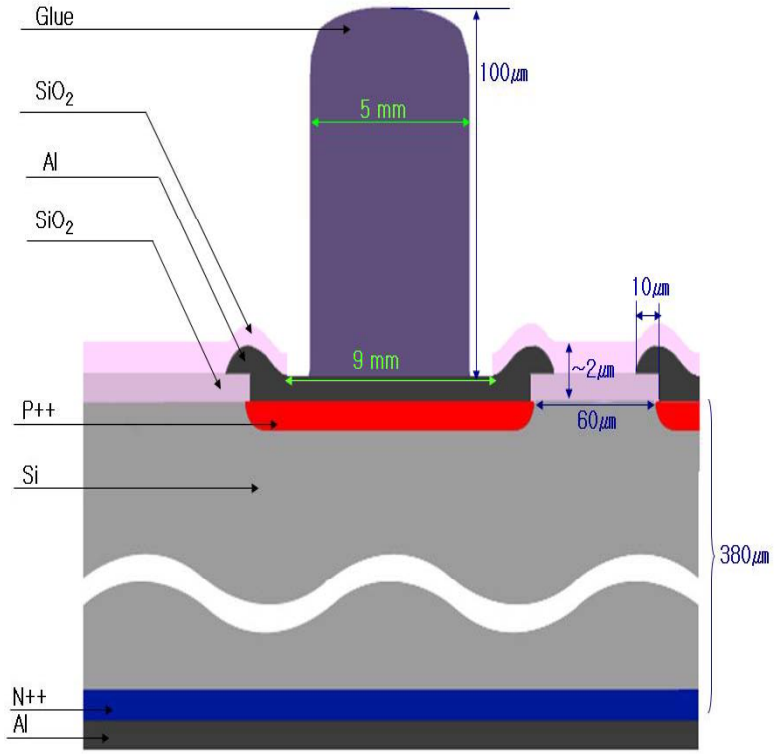


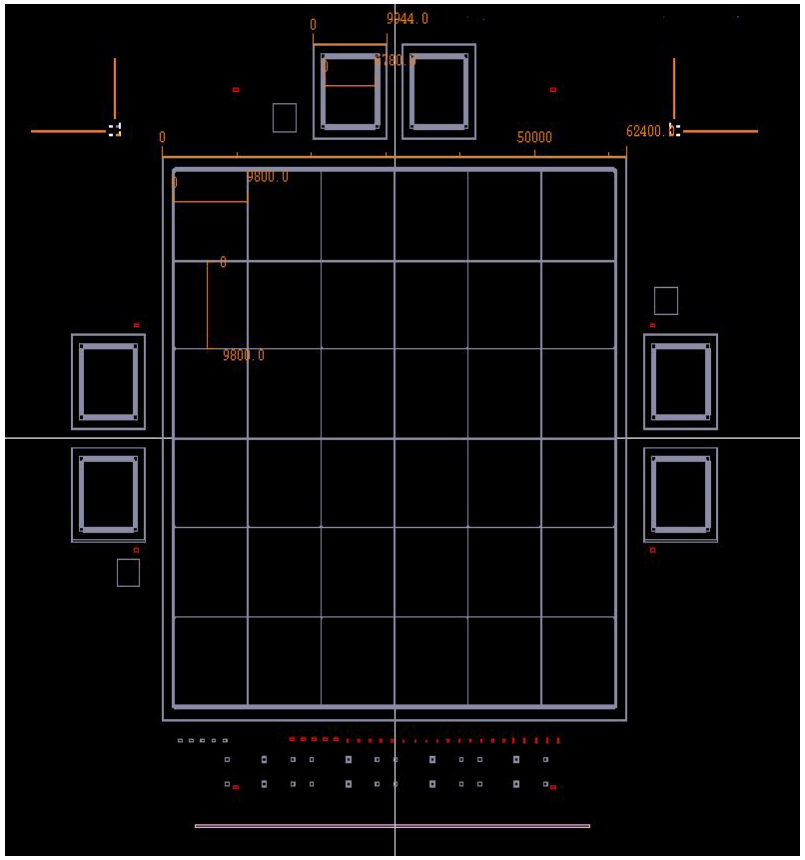
3 Guard Rings


Beam Test at CERN SPS H2 beam line
Layers of Si sensors
and Tungstens
Digital
and Control
Boards
Frontend readout boards
Beam
Direction
• Data Run
- electron 150,100,80,50,30,20,10 GeV
- hadron 150 GeV
- muon 150 GeV

Sensor Revision

- beam test at CERN in last september (CALICE)
- another revision/fabrication is in progress





Scintillator Calorimeter

S. Chang (KNU) talk in Calorimeter session on Feb 6.

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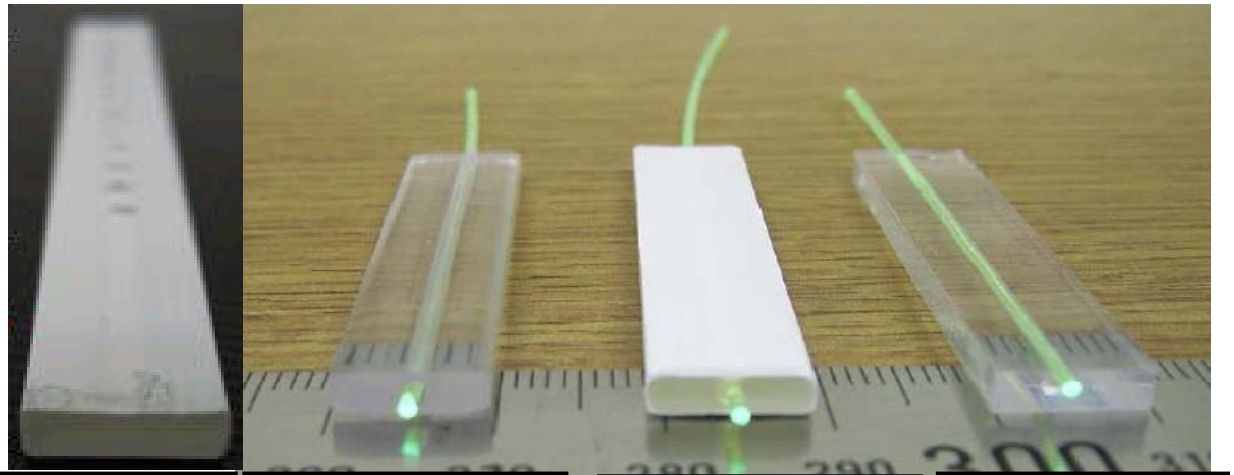
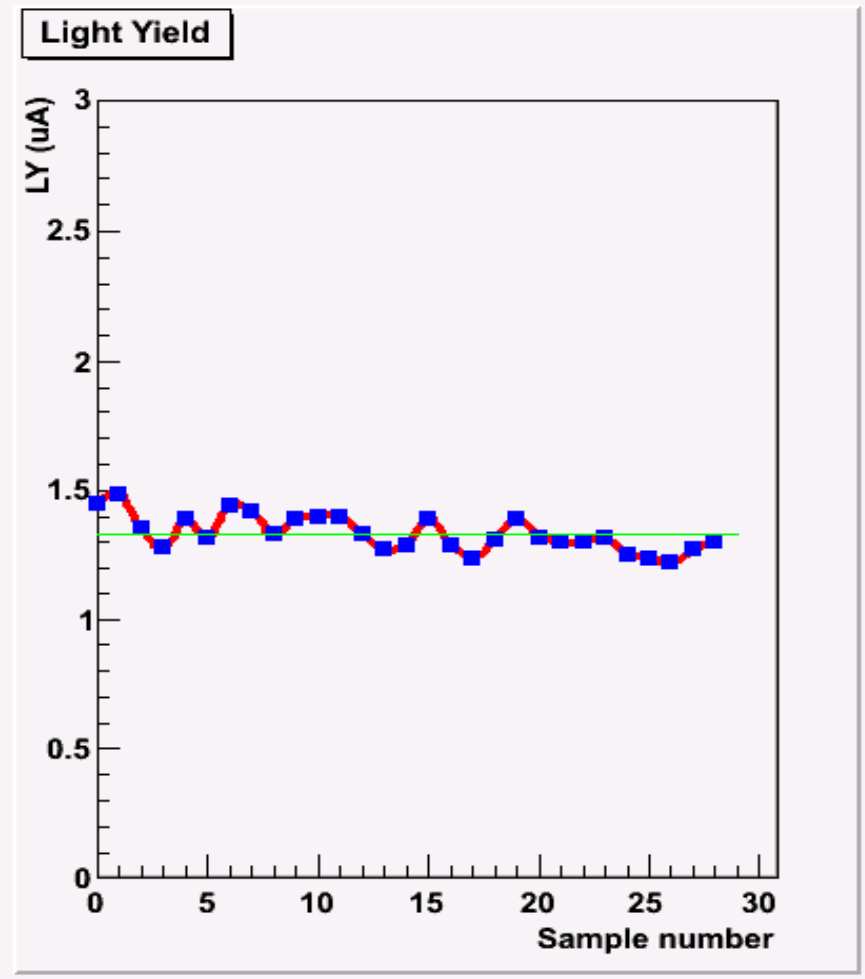
Extruded Plastic Scintillator

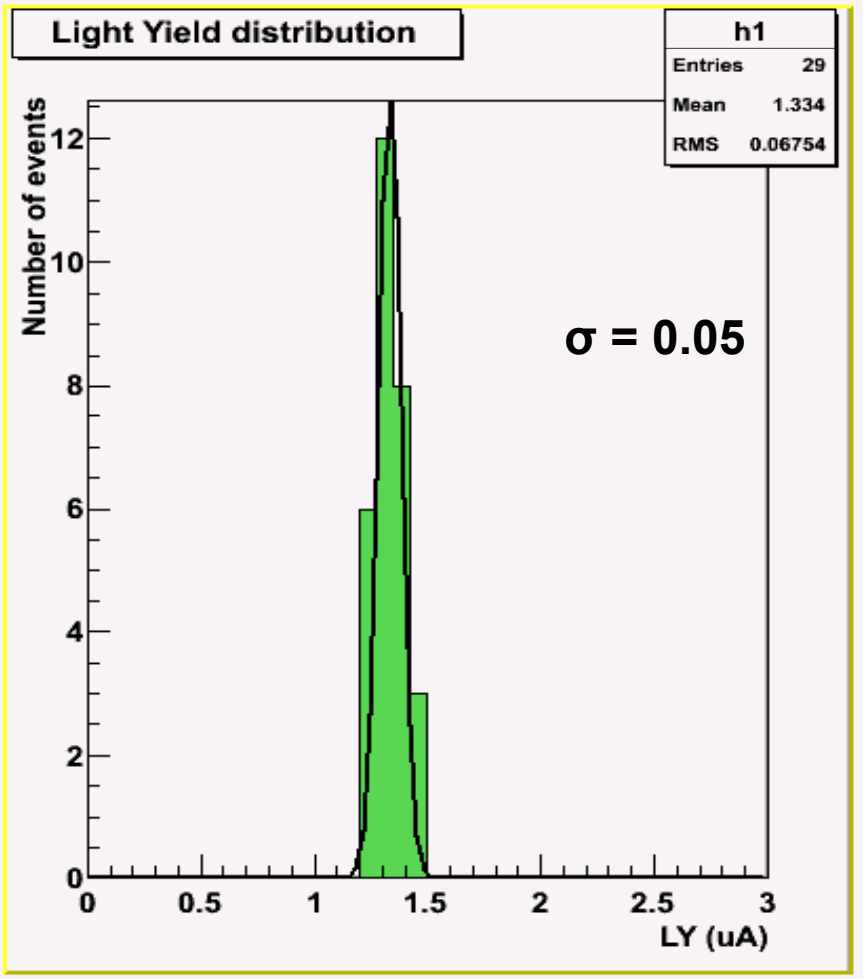
- Extrusion is easy to make numerous type of scintillator
- Lower cost than casting method
  - **primary dopants: PPO**
  - **secondary dopants: POPOP**



KNU strip with TiO_2 w/o hole	KNU strip w/o TiO_2 with hole	KNU strip with TiO_2 with hole	Kuraray tile with groove

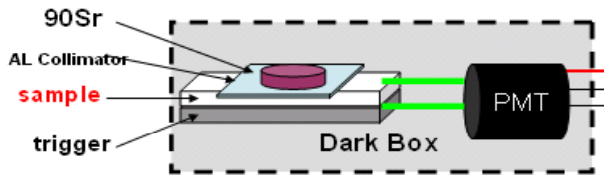
Light Yield Uniformity for all strips

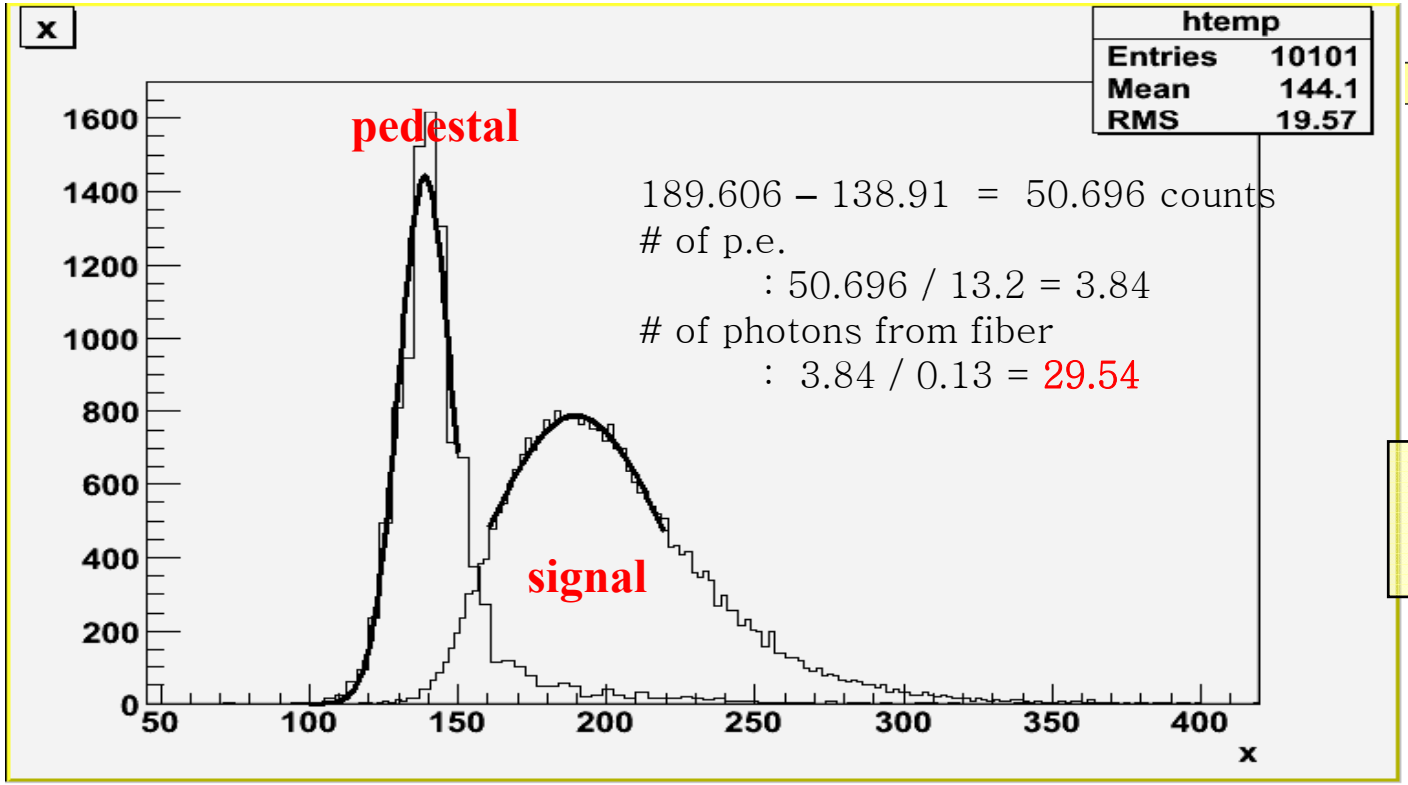


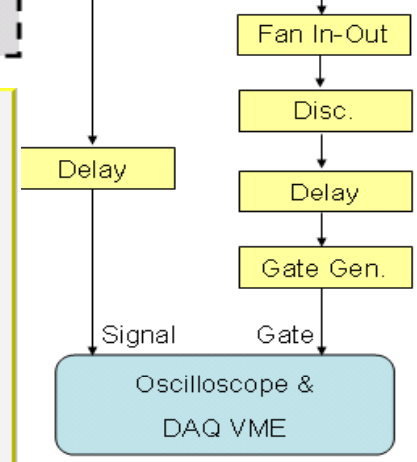


Measurement of absolute Light Yield

Sample : KNU tile
10mm x 50mm x 3mm



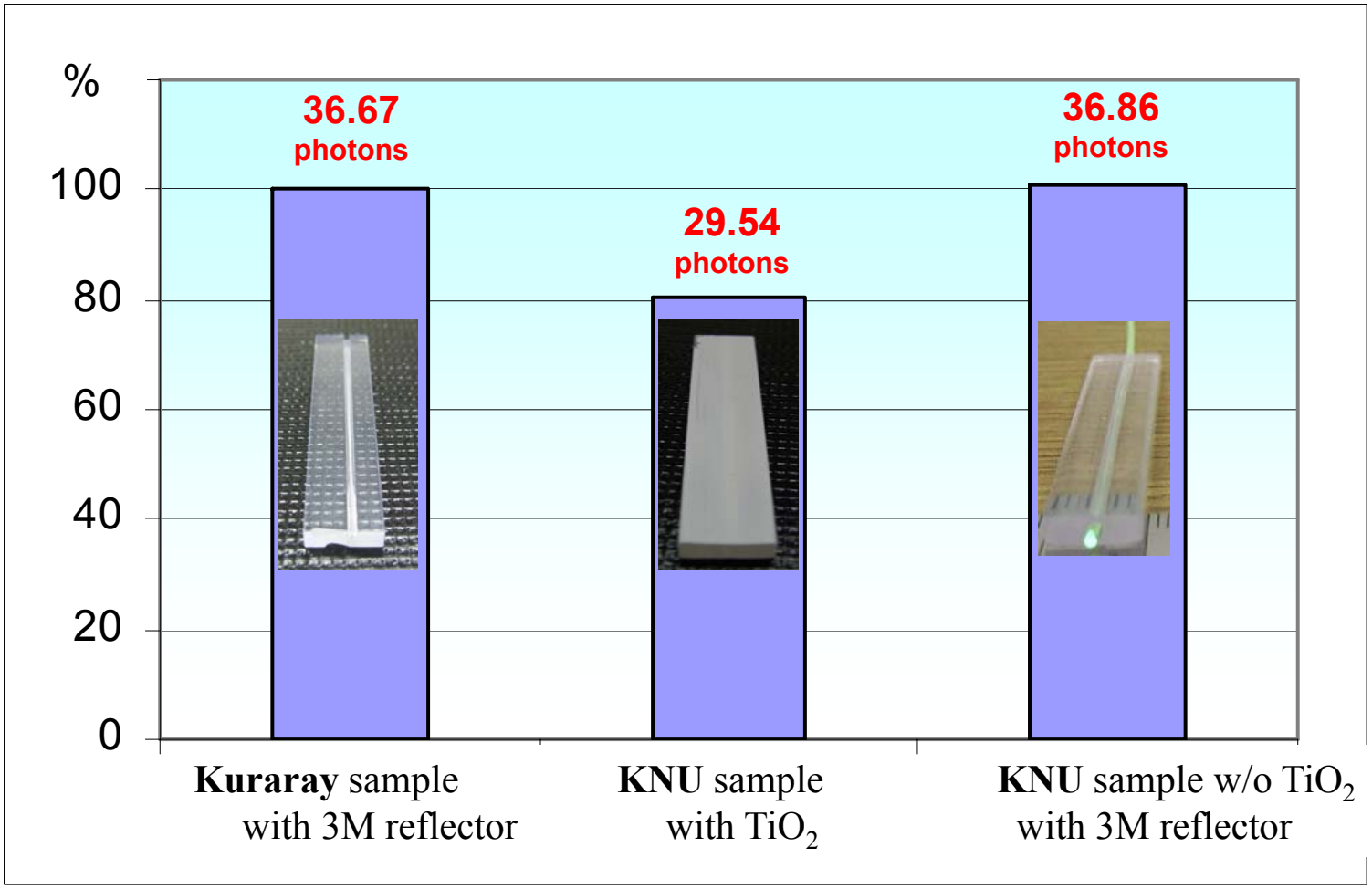




Fiber : 30cm kuraray Y11
PMT : MAPMT H6568
QDC : CAEN V792

$$\text{\# of photon from fiber} = \frac{\text{Pulse height (ADC counts)}}{\text{13.2 (ADC count / 1pe) * Q.E.}} = \sim 30 \text{ photons}$$

Light Yield Comparison



Silicon Tracker

H.J. Kim (KNU) talk in Tracking session on Feb 6.

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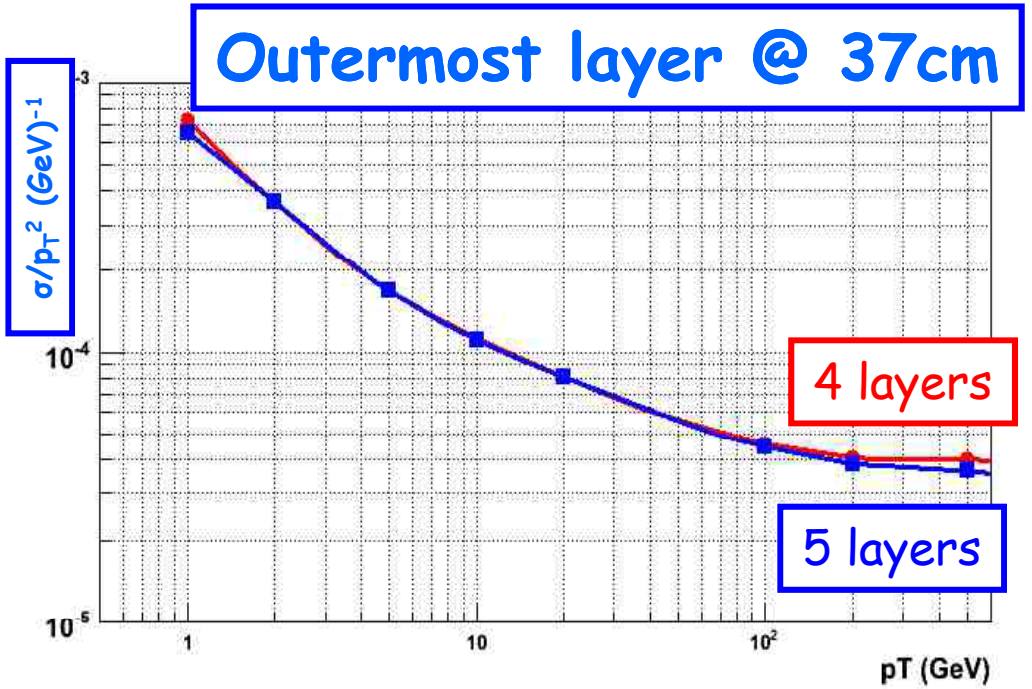
Simulation Studies

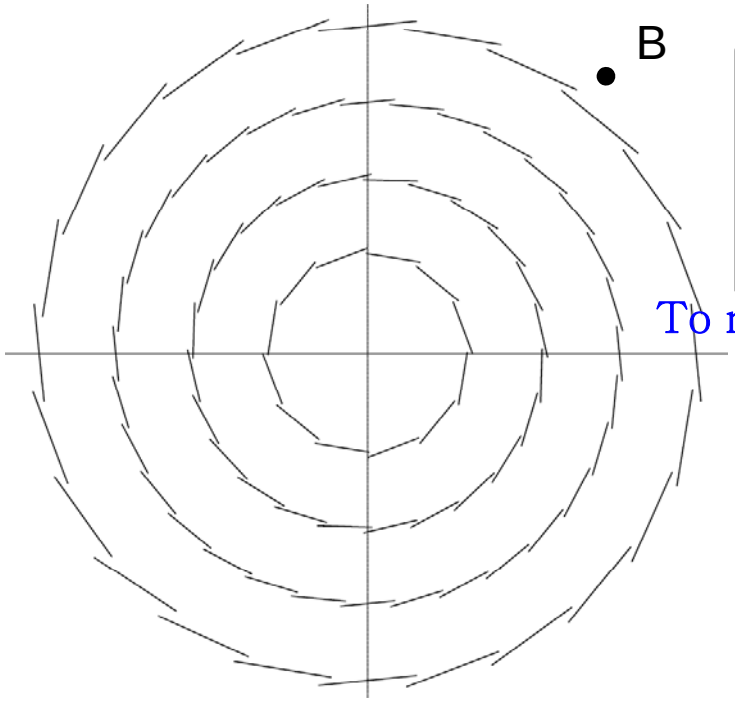
- Varying
  - -position resolution (10μm to 20μm)
  - -addition at outermost layer (at 37cm)
  - -silicon thickness (561μm to 300μm)



and checked the momentum resolution, but did not find significant changes

So far, the current configuration seems to be good

Barrel Inner Tracker Configuration



BIT	Half Z	Real Z (o 1.6 mm)	R	sensor type	
layer 1	185	195.2	90	50 X 50	5.76°
layer 2	330	340.4	160	50 X 50	5.76°
layer 3	475	485.6	230	50 X 50	5.76°
layer 4	620	620.4	300	90 X 90	5.76°

To make dead region free, module has 1.6 mm overlap

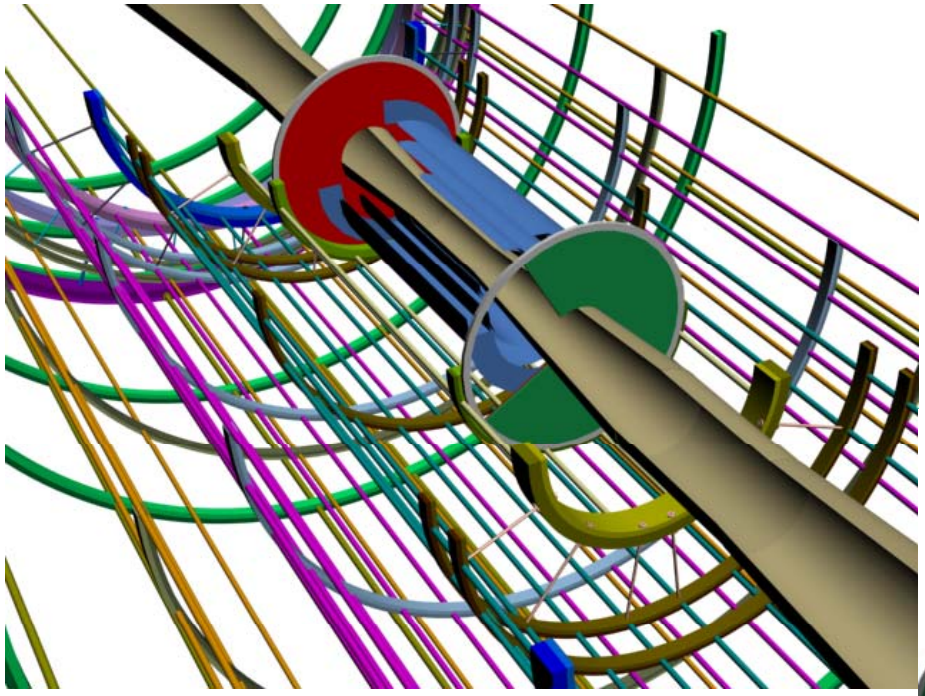
BIT	sensor area	# sensor of a module (o 1.6)	# module	# sensor	total area
layer 1	50 X 50	4	24	96	**240000** MM²
layer 2	50 X 50	7	48	336	**840000** MM²
layer 3	50 X 50	10	64	640	**1600000** MM²
layer 4	90 X 90	7	24	168	**1360800** MM²

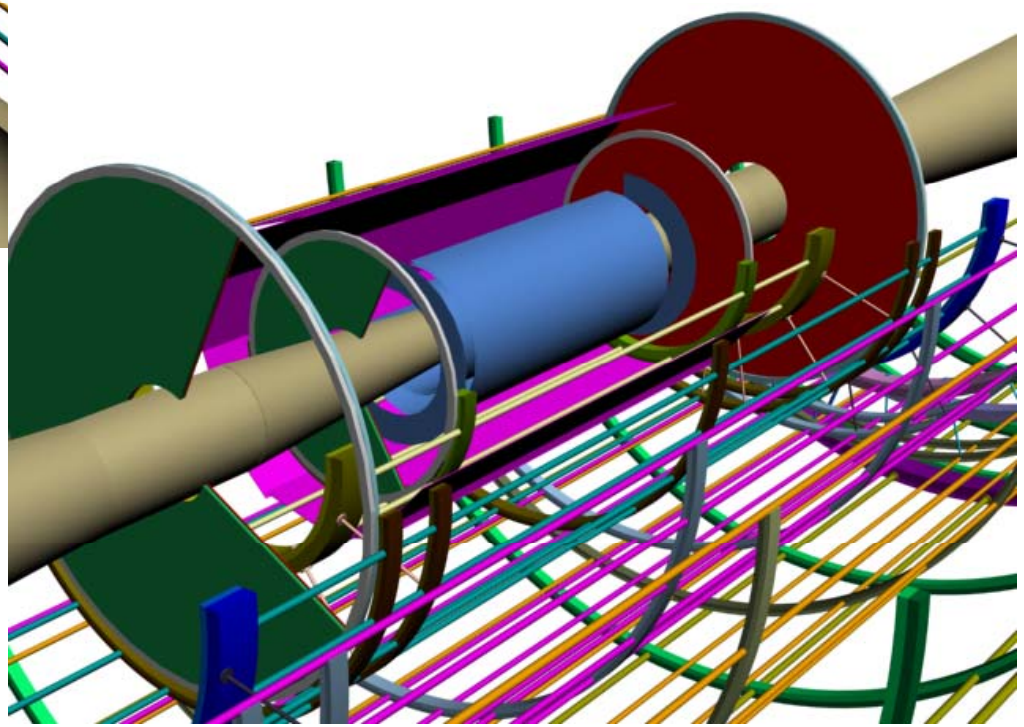
The Lorentz angle in a 3 T magnetic field

θ_L **for electron : 24.97**

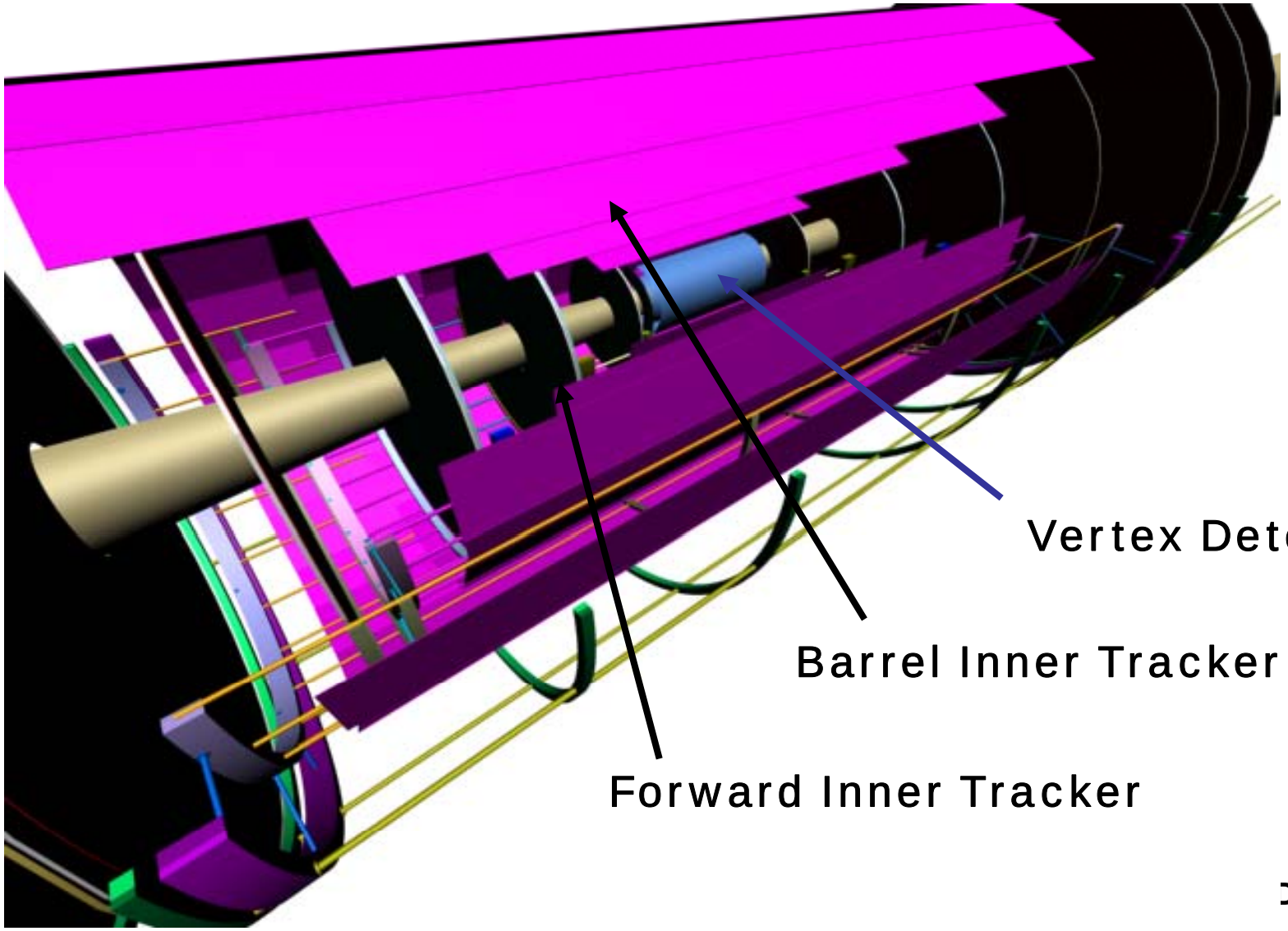
θ_L **for hole : 5.76**

IT Mechanical Structure





IT Mechanical Structure



Silicon Sensor Fabrication

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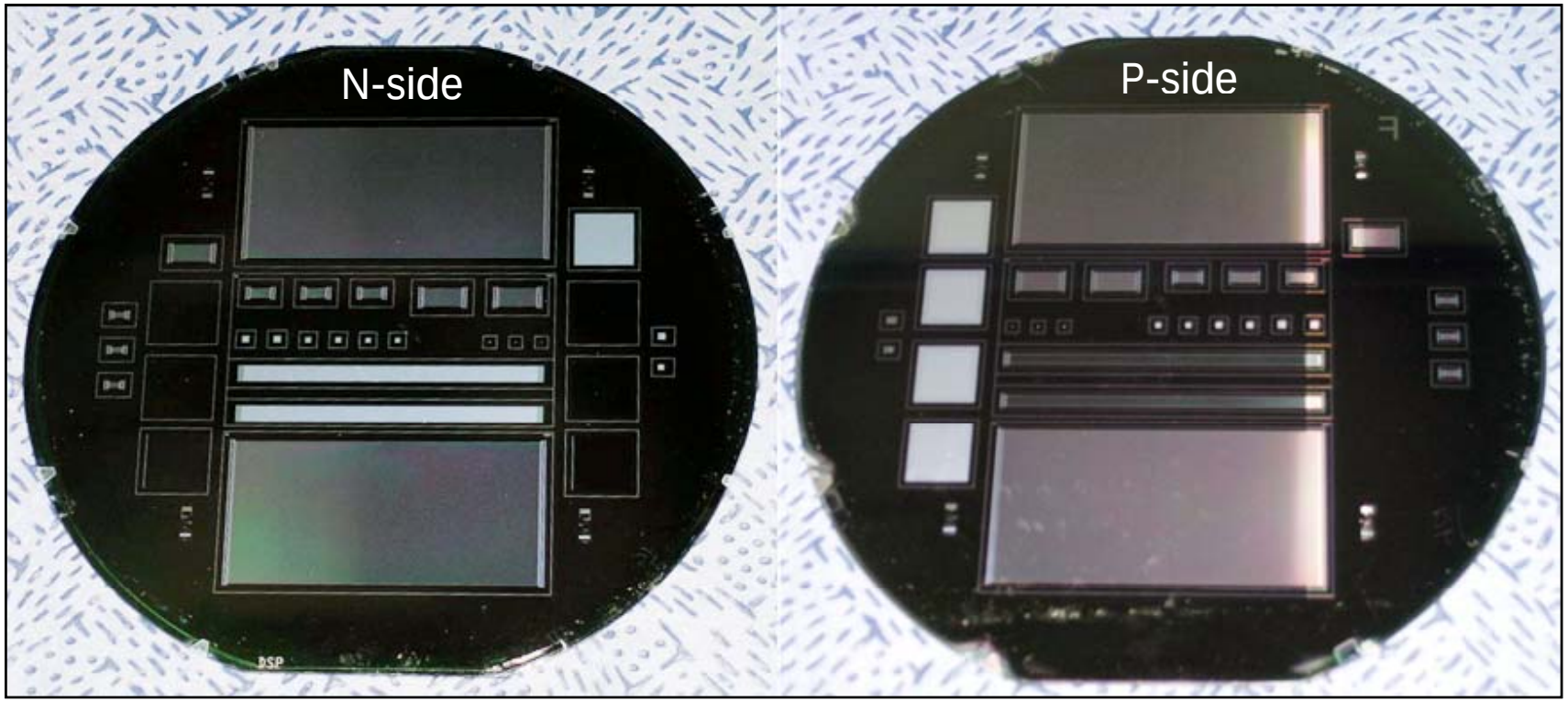
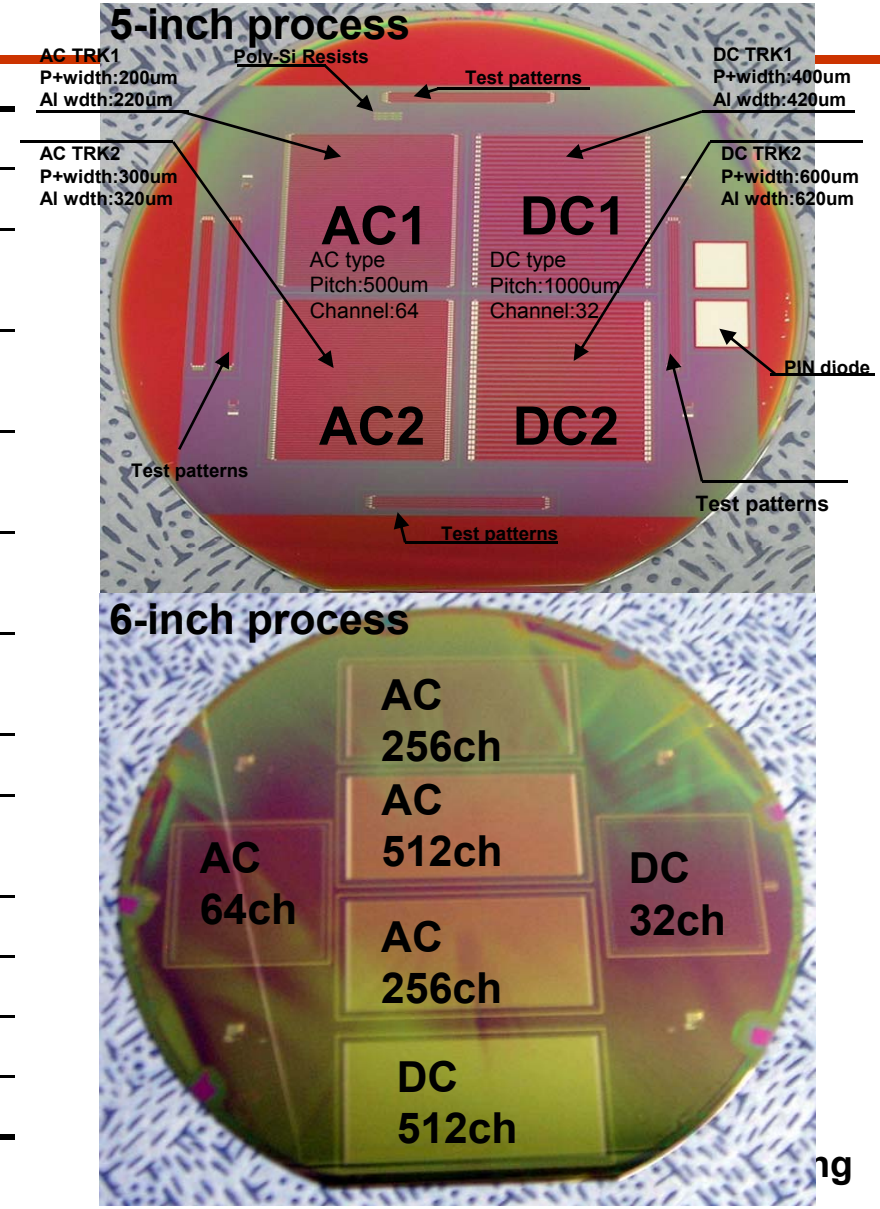
DC-DSSD Prototype



wafer	**TOPSIL (5inch, high resistivity, (100), FZ, DSP)**	**strip width**	**9μm**
		strip pitch	**50(100)μm**
thickness	**380 μm**	**readout pitch**	**50μm**
size	**51 x 26 mm^2**	**readout channel**	**512(512)**

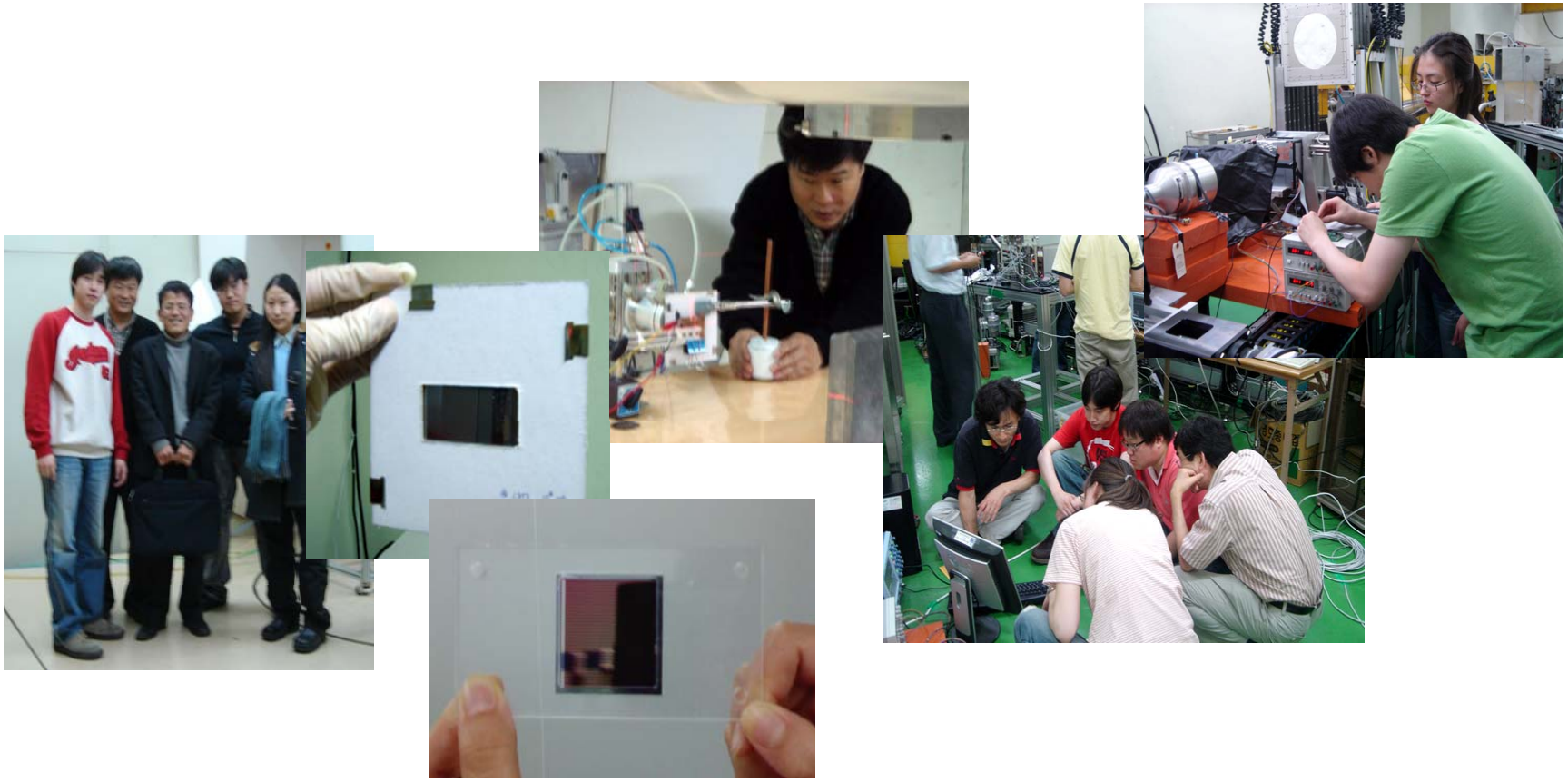
AC/DC SSD Prototype

AC-coupled Single-sided Silicon Strip Detector				
	5-inch		6-inch	
thckness(μm)	380		400	
Area (μm^2)	35000 × 35000		55610 x 29460	
Effective area (μm^2)	31970 × 31970		51264 x 25178	
SiO_2 layer thickness (nm)	1000		250	
Polysilicon length (μm)	10		8	
Polysilicon width (μm)	13500		480	
sheet resistance(kΩ)	~25		~400	
	Type 1	Type2	Type 1	Type2
Number of strips	64	64	256	512
Strip pitch (μm)	500	500	100	50
Strip width (μm)	200	300	8	8
readout width (μm)	220	320	12	12



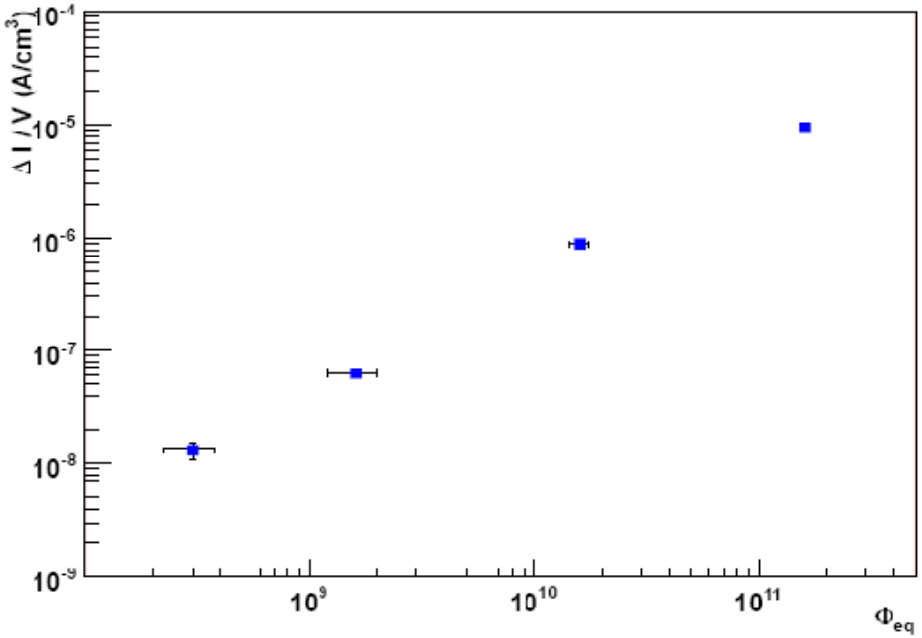
Radiation Damage/ Beam Test

Cyclotron in Korea Institute of Radiological and Medical Science :
35~45 MeV proton cyclotron



Radiation Damage Test

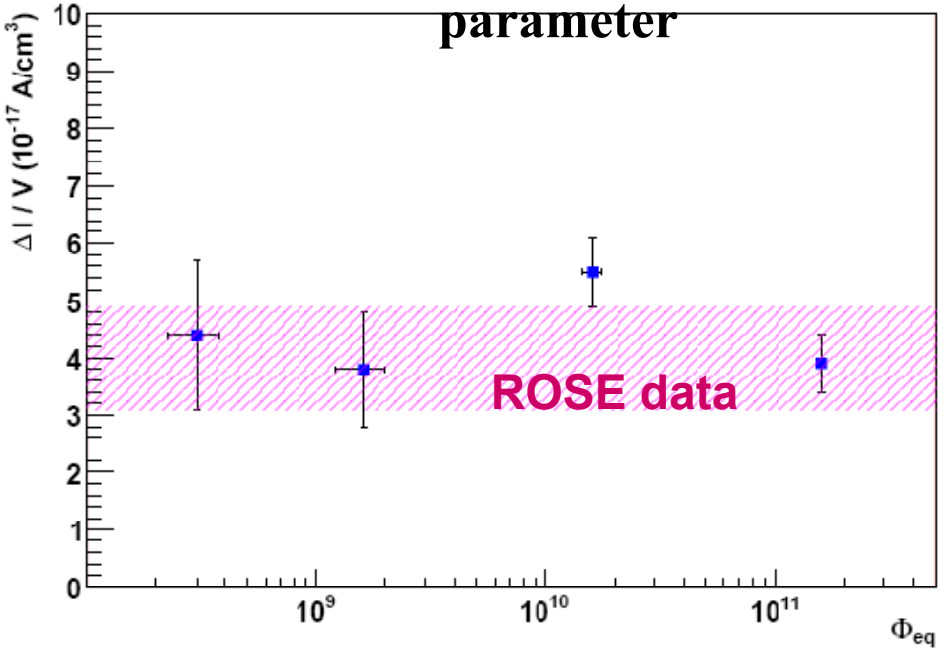
Fluence dependence of leakage current



•current increase is strictly proportional to fluence

•Damage induced bulk

Fluence independence of damage parameter

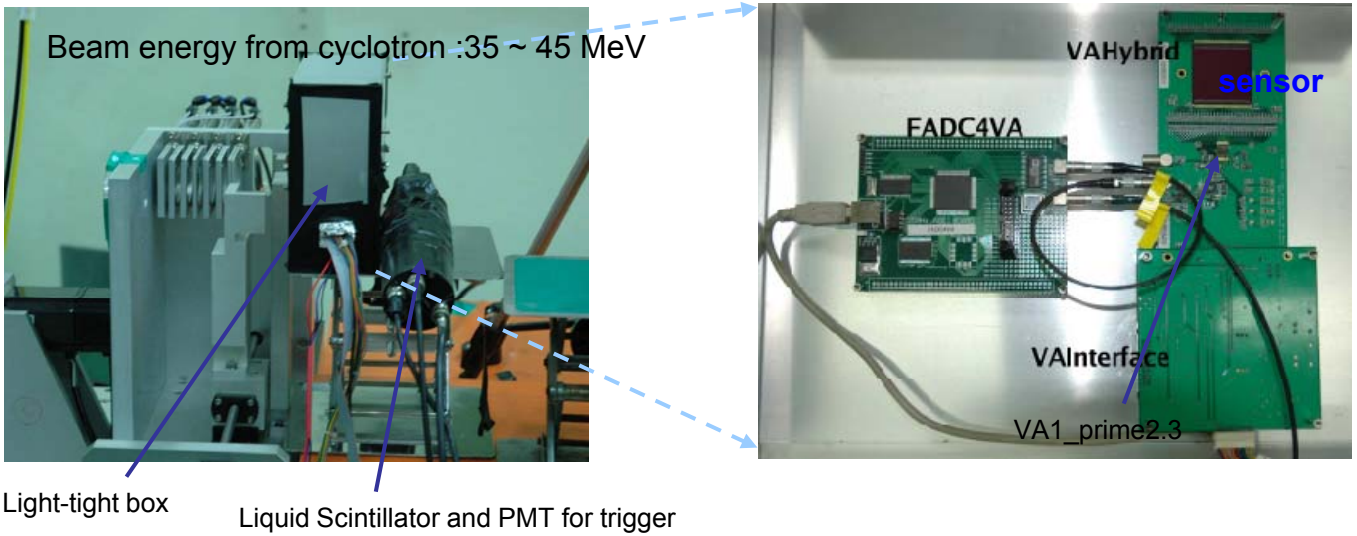


•current related damage rate α is expected to be independent of irradiation

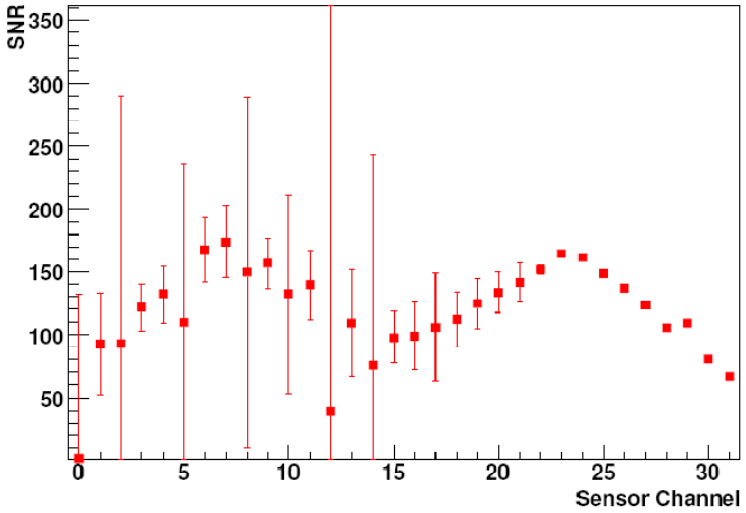
• $\Delta I / V = \alpha \cdot \Phi_{eq}$

• α can be used to monitor the particle fluence

Beam Test at KIRAMS



- SNR measurement results of each channel

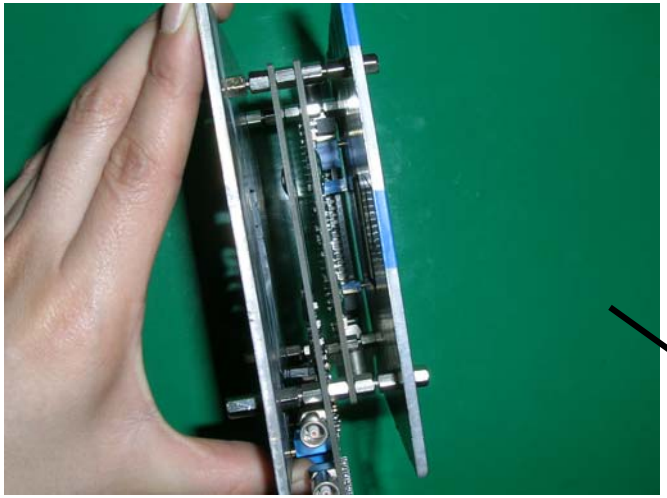


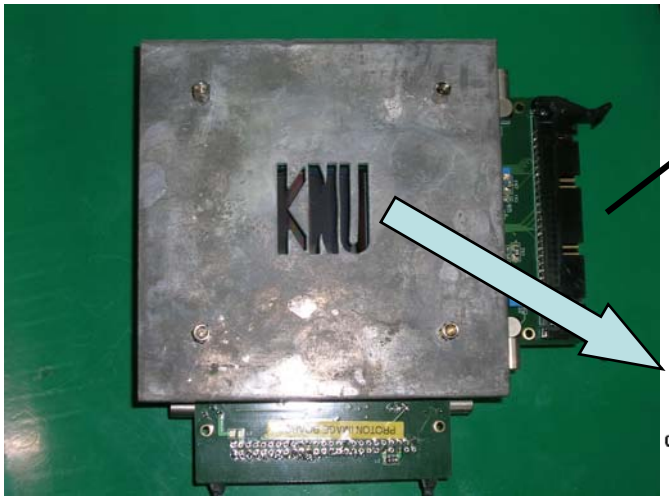
•The estimated S of N ratio of channel 0 to channel 22 have large errors because of few properly triggered events.

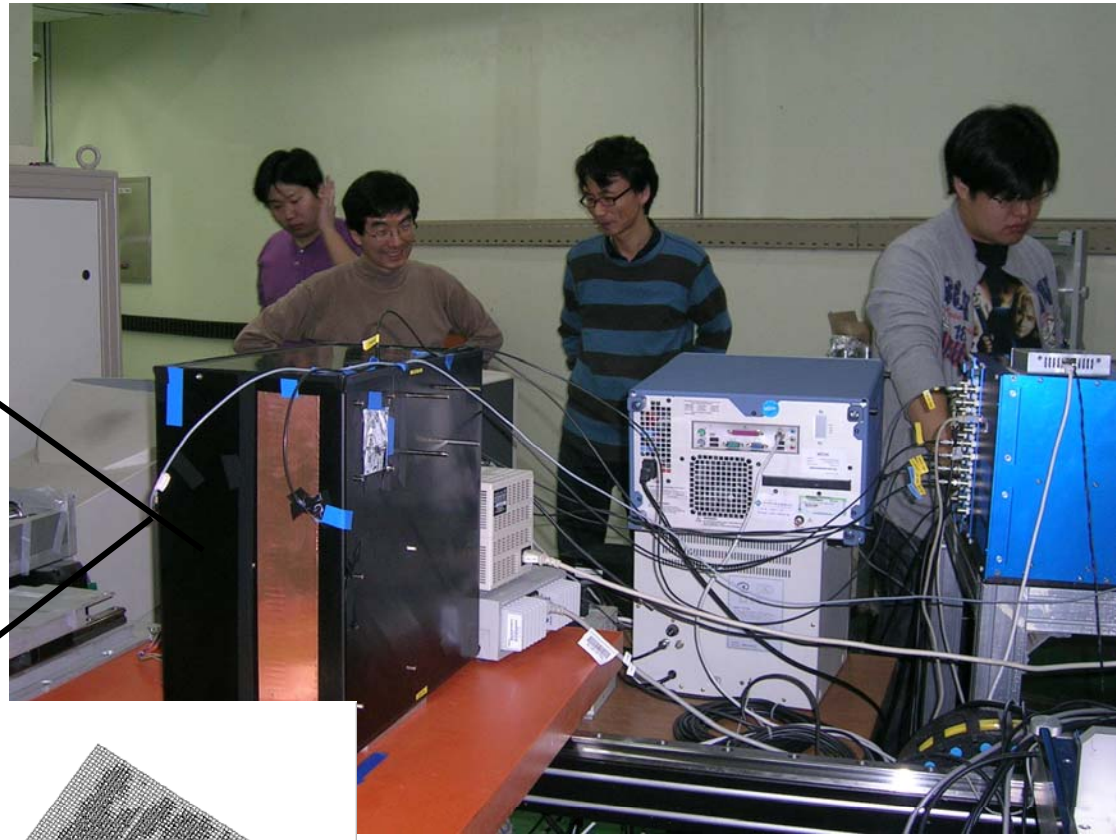
•Channels from 23 to 31 show good S of N ratio of between **67 and 164**.

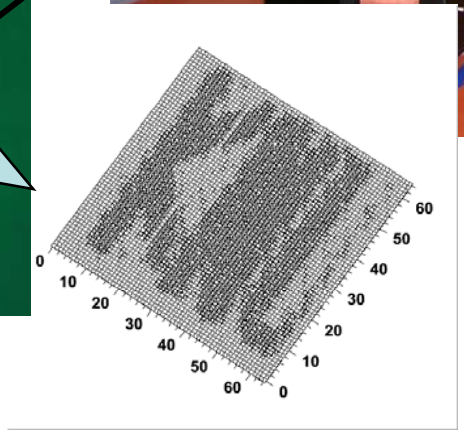
•If we correct this values for a **1MIP**, it corresponds about **7 to 17** of SNR.

Beam Test at KIRAMS

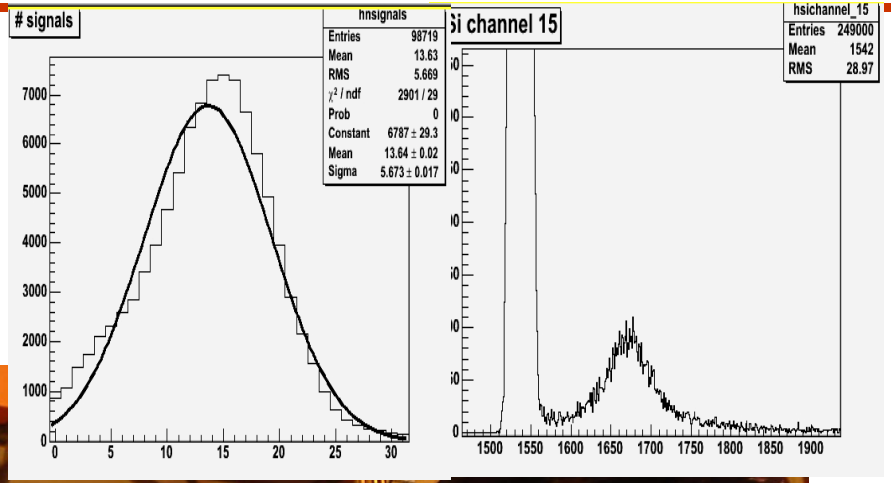




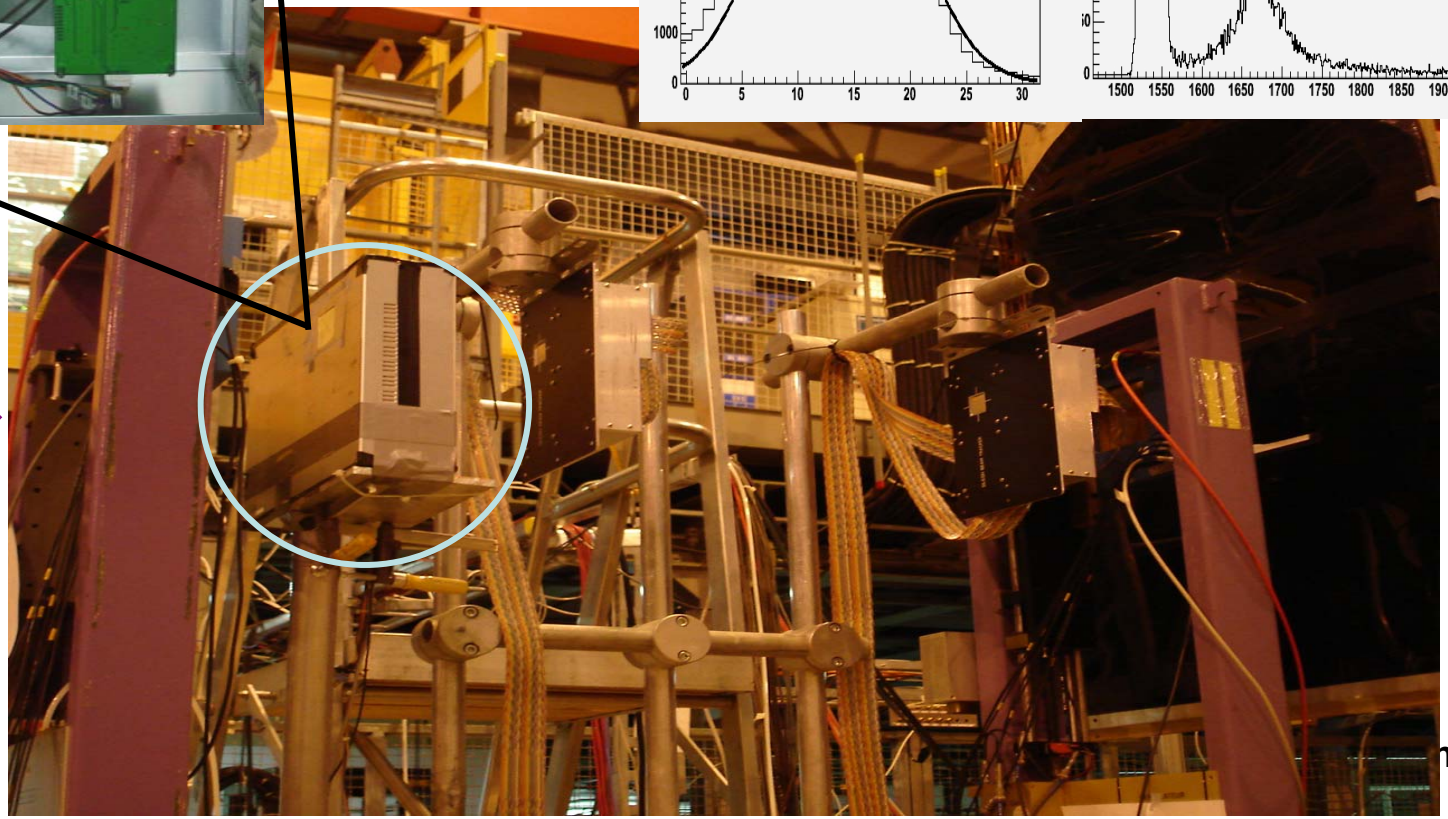




Beam Test at CERN



150 GeV
electron beam



Summary

√ sensor fabrication and beam test for EM calorimeter
√ detector configuration of FCAL/BCAL in progress

√ extrusion scintillator properties were tested
- good light yielding and uniformity
- beam test is scheduled in early spring

√ Mega strip concept is developed and will be produced soon

√ sensor fabrication and beam test for DC-DSSD and AC/DC-SSD
√ detector configuration of SIT (BIT and FIT)

√ funding project will be reviewed/renewed in spring.