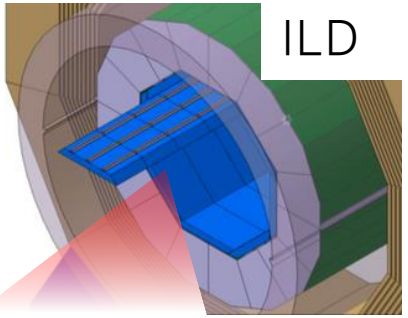
Preparation and performance study of a new short slab for ILD SiW-ECAL

Taikan Suehara, Izumi Sekiya,
K. Kawagoe, Y. Miura, T. Yoshioka
(Kyushu University)

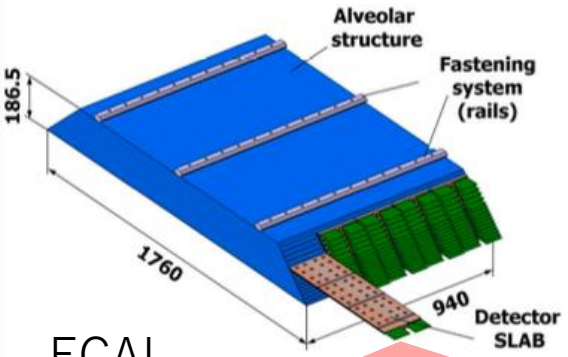
With supports from
R. Cornat (LPNHE), F. Magniette, J. Nanni, R. Guillaumat, V. Boudry,
V. Balagura, J-C. Brient (LLR), R. Poschl (LAL), S. Callier (OMEGA)



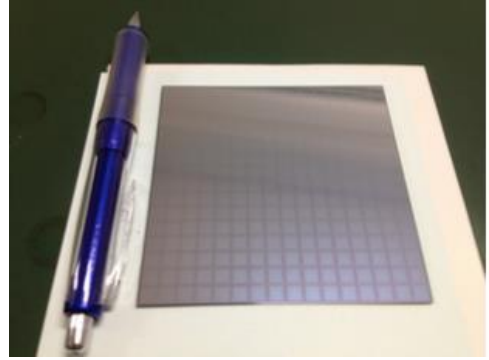
Introduction

Si-W ECAL for ILD

- 20-30 layers of sandwich calorimeter
  - 5.5 × 5.5 mm^2 segmented silicon sensors
  - Tungsten absorbers
  - PCB with ASICs (FEV)



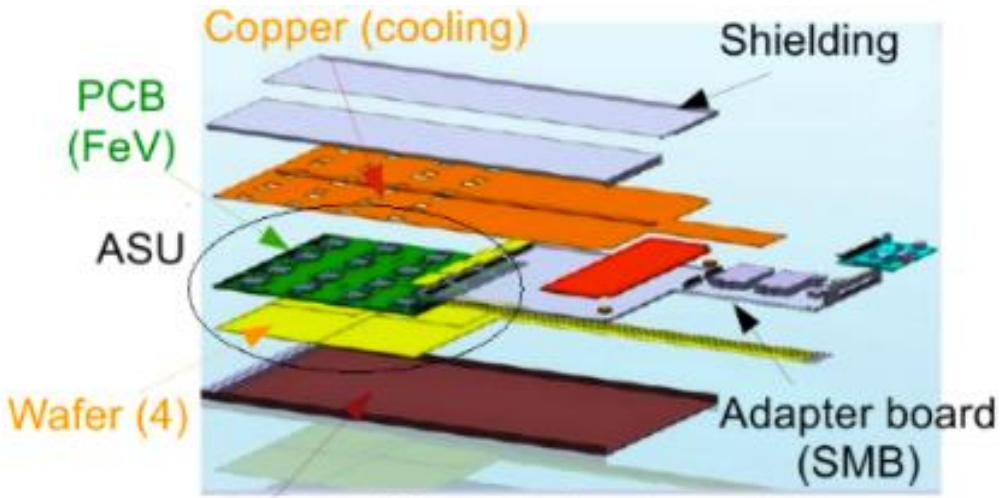
ECAL



size	89.7 × 89.7 cm^2
cell size	5.5 × 5.5 mm^2
# of cell	16 × 16 = 256

Slab (left picture)

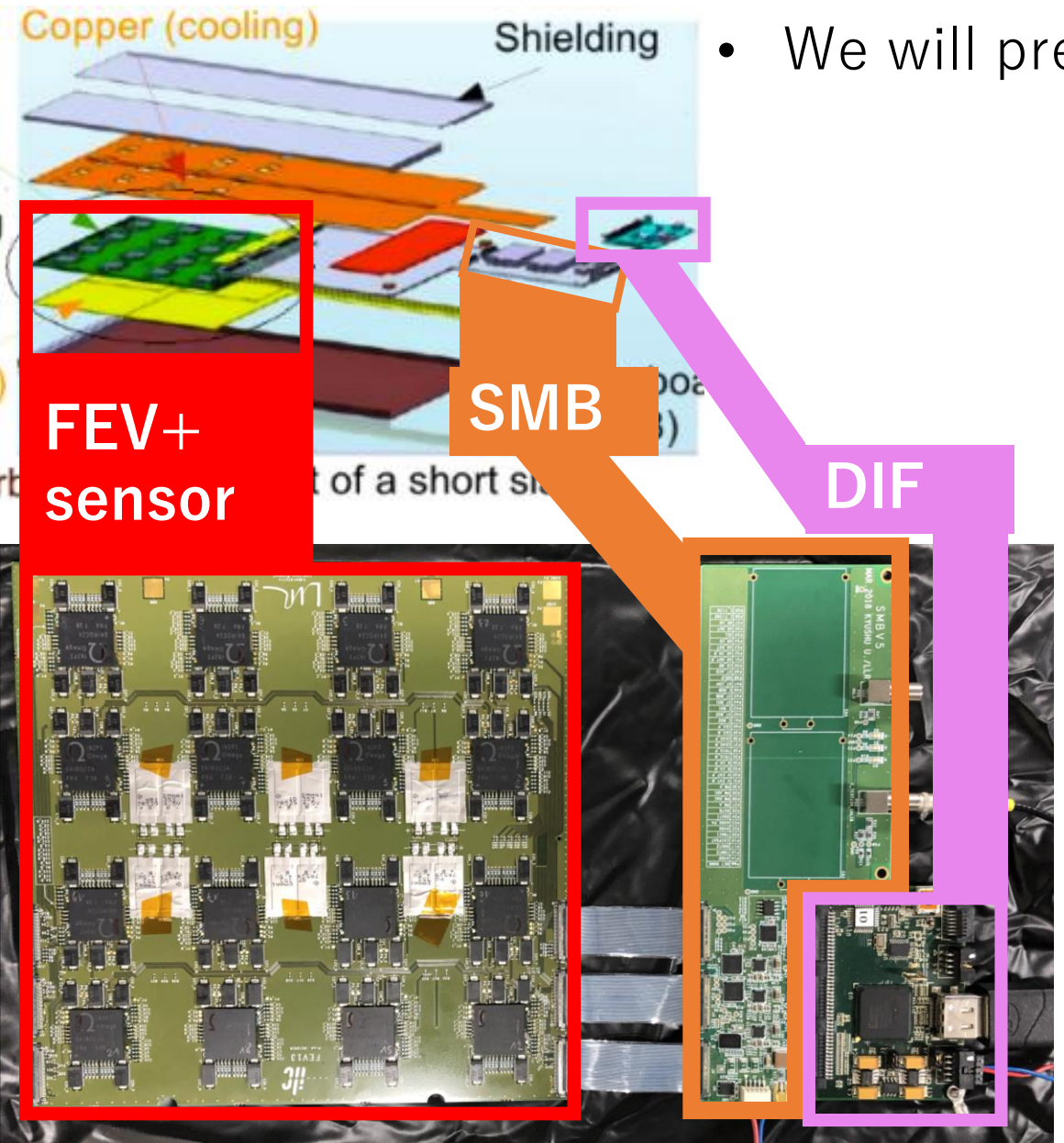
- A part of ILD ECAL
- Prototype was developed in France and tested



U layout of a short slab

We will prepare & check the performance of new short slab

Introduction

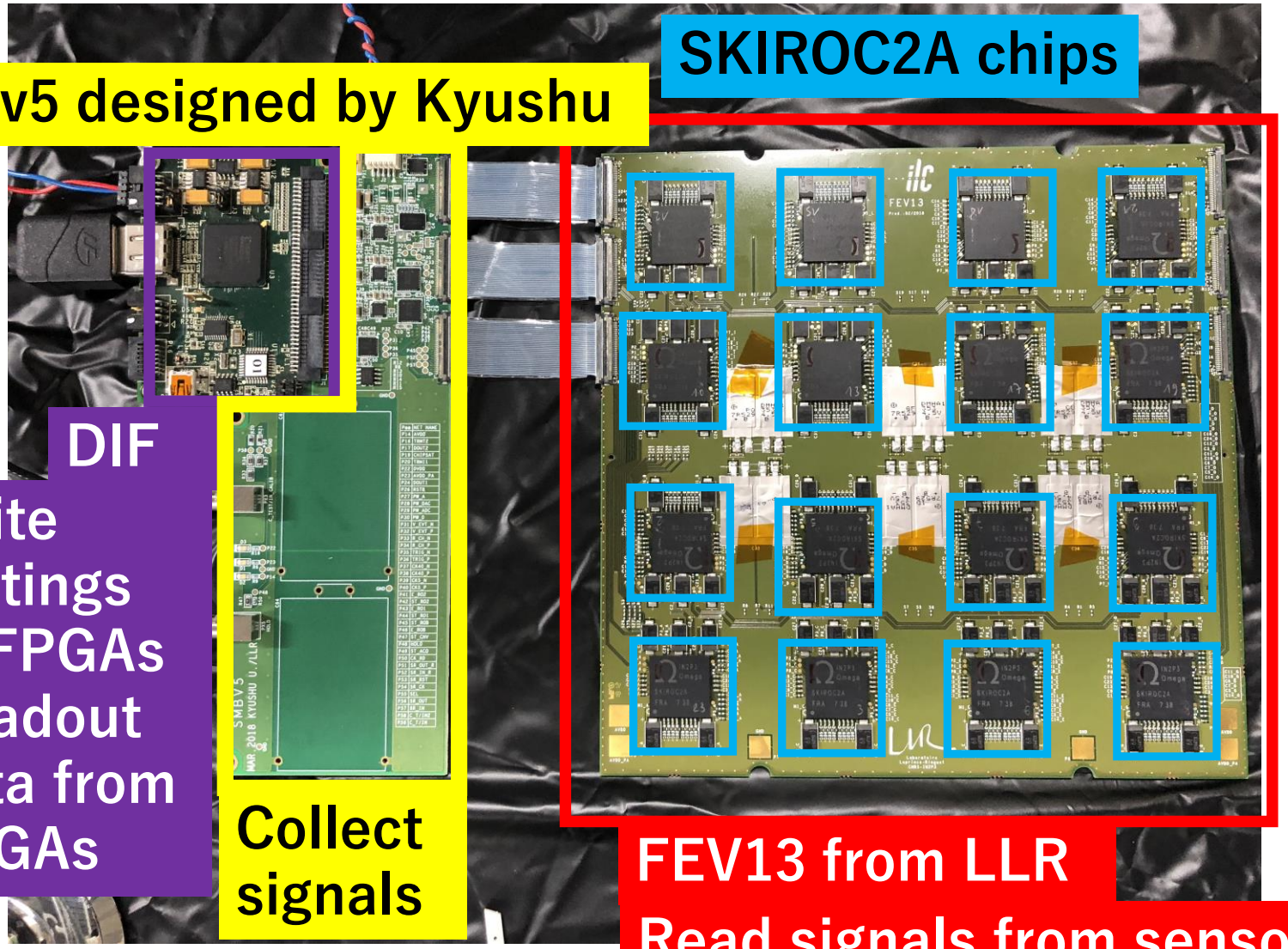


- We will prepare a new short slab of ILD ECAL
  - Si sensors
  - FEV13
  - SMB
  - DIF

<Procedure>

- Design jigs to assemble the FEV
- Select SKIROC2A chips
- Check the performance of the FEV without sensors
- Glue 4 Si sensors onto the FEV (training)
- Check the performance of the FEV before testbeam

A new short slab



SMB v5 designed by Kyushu

DIF

- Write settings in FPGAs
- Readout data from FPGAs

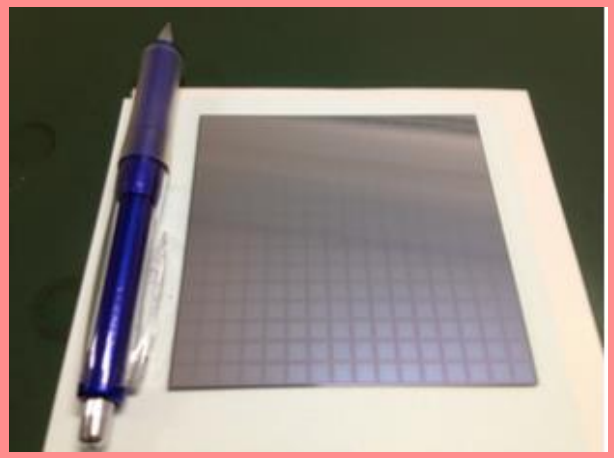
Collect signals

SKIROC2A chips

FEV13 from LLR

Read signals from sensors with ASICs

Back side of FEV



size	89.7 × 89.7 mm^2
cell size	5.5 × 5.5 mm^2
# of cell	16 × 16 = 256

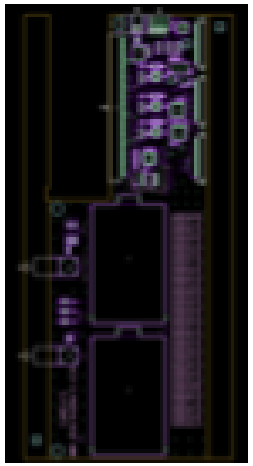
Modification of new short slab

- **Silicon sensors are thicker** : 320 μm → 650 μm thickness
  - It gives better separation of signal and noise
  - Full depletion voltage : around 120 V
- **ASICs are modified** : SKIROC2 → SKIROC2A
  - better trigger threshold control
  - a fix on the improper treatment of trigger on the edge of the clock
  - an improvement on the timing measurement
- **Better routing on FEV** : two power planes (analog, digital)
  → three power planes (analog, digital, preamplifier)
  - That plane reduces large noise from preamplifier
- **Power pulsing capacitors on FEV** : two 400 mF supercapacitors on SMB
  → very thin 40 mF supercapacitors on FEV
  - It meets the spatial requirement of the detector

Modification of new short slab (2)

- **Smaller footprint of SMB (lower figure)**
  - It meets the spatial requirement of the detector
- **Interconnection with flexible cables**
  : 1.0 mm pitch flexible circuit (FPC)
  → 0.4 mm pitch thin connectors
  with either a FPC cable or a micro-coaxial flat cables
  - easier assembly

new

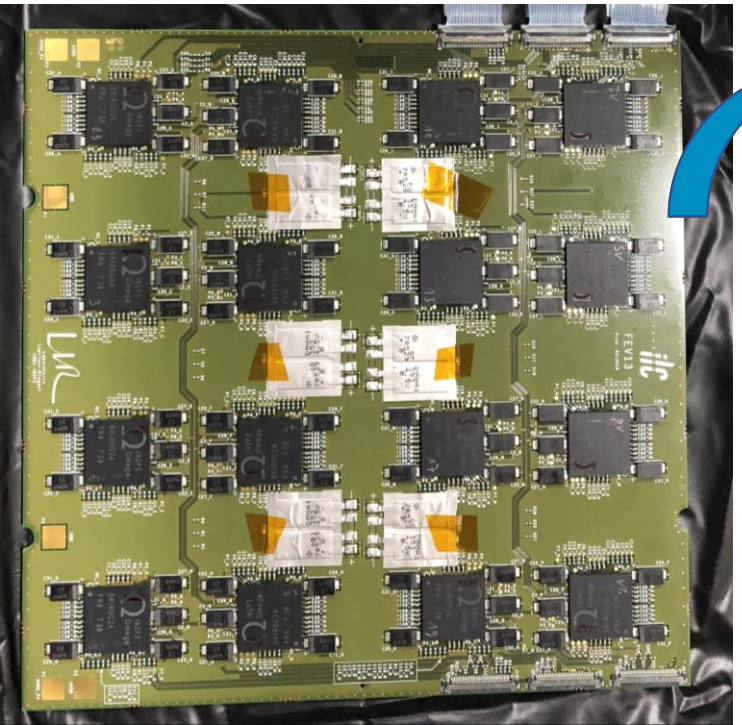


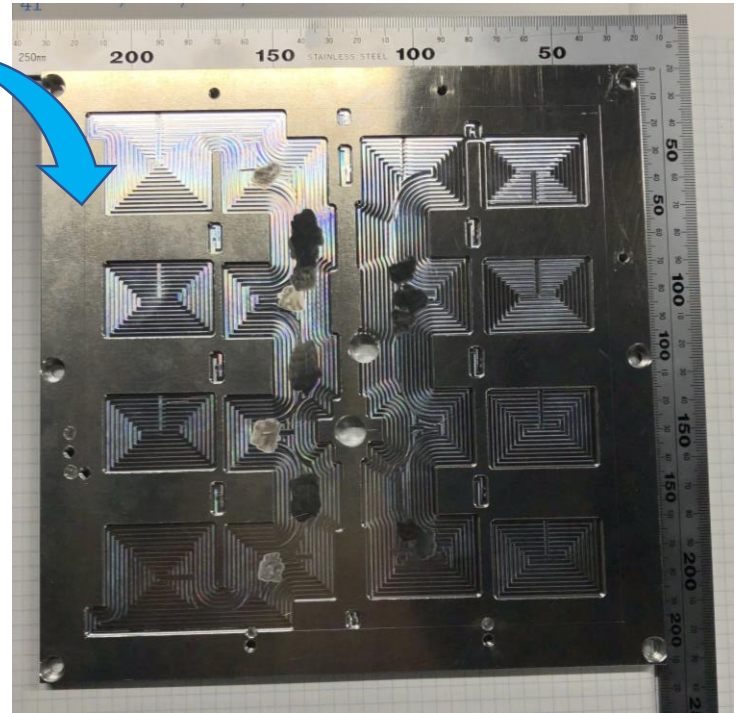
Layout of previous (left) and new SMB with similar scale

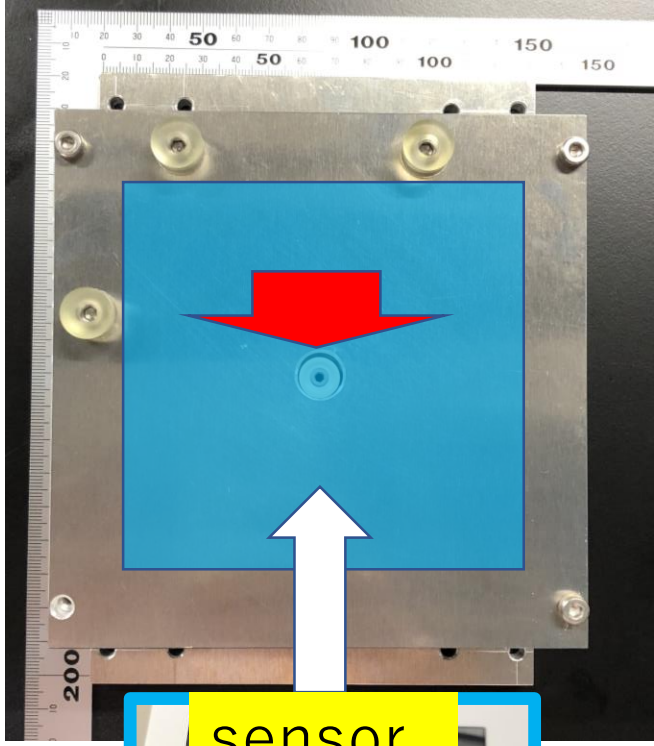
Preparation of jigs for Si sensors & FEV

- 2 jigs for Si sensors & FEV
- Fit these edges to the rubber cushions
  →Fix these on the jigs by vacuum

<FEV jig> ASIC chips & capacitors are mounted on the FEV
→Dig 1.5 mm of depth for these components

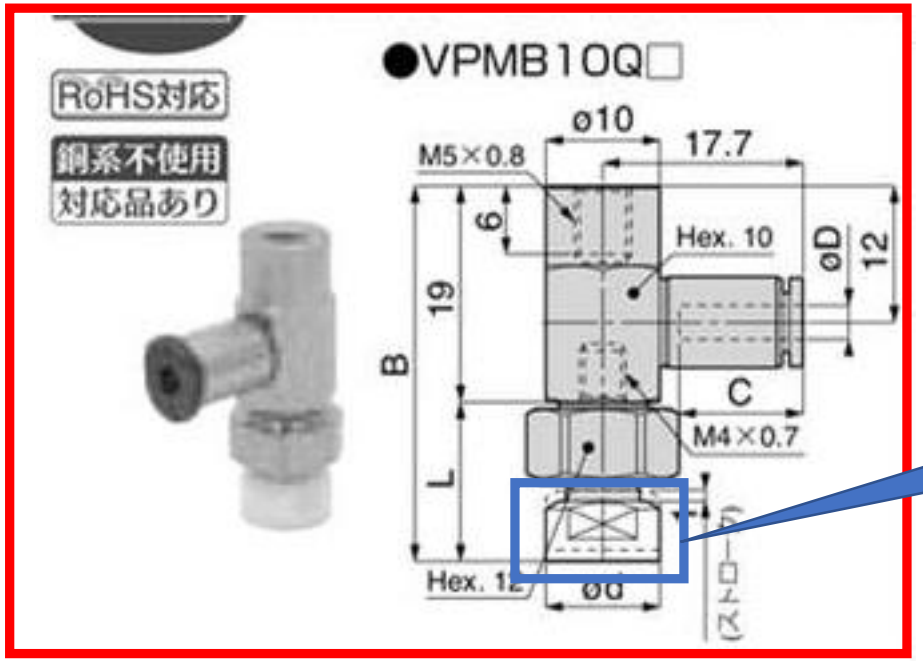






Vacuum system

- We use the vacuum
  - to fix the sensor & the FEV on jigs
  - to move the sensor onto the FEV by robot arm (automatic)
- We use pads not to damage the sensor
  - 3 pads on robot arm
  - 1 pad on each jig

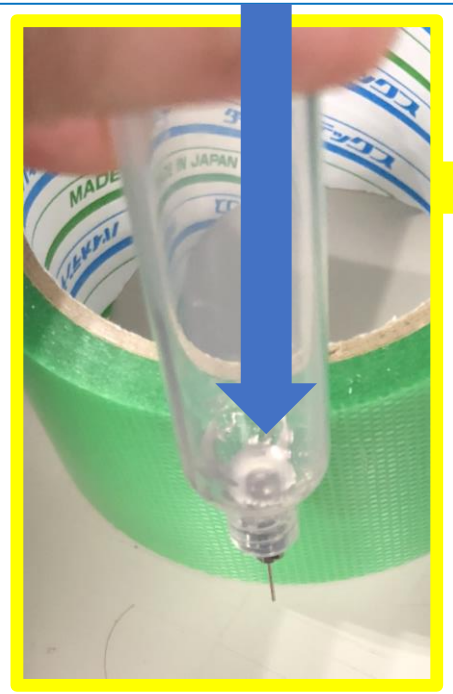


There is a spring inside the pad
→ It can touch the sensor softly

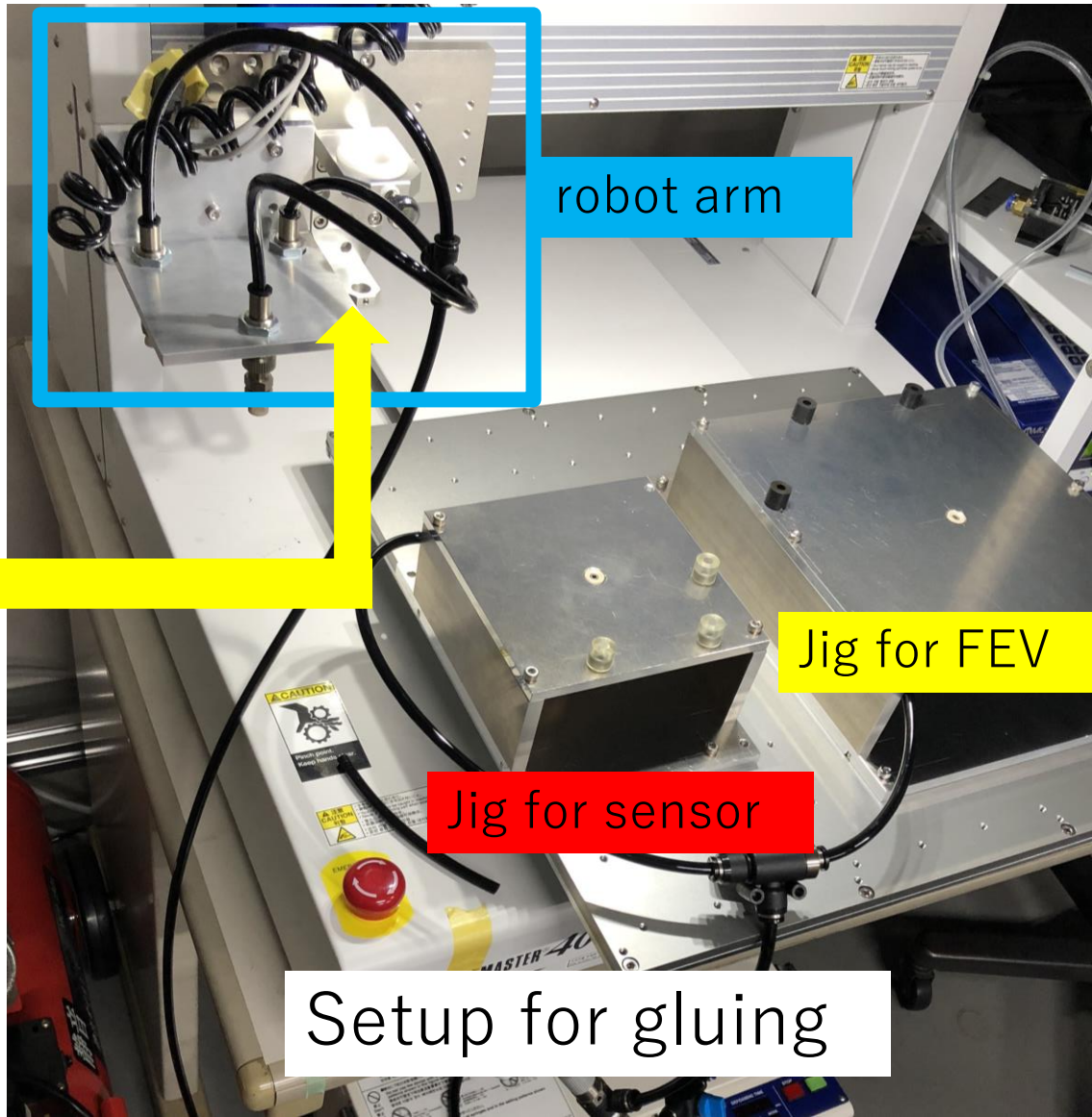
Gluing sensors onto FEV

Glue : E4110-LV (Part A &Part B)

- Conductive glue
- Mix ratio by weight … A:B = 10:1
- Viscosity (23°C): 350-850 cPs
  (as same as oil)
- Cure : 23°C/3 days



Set the syringe
to the robot arm



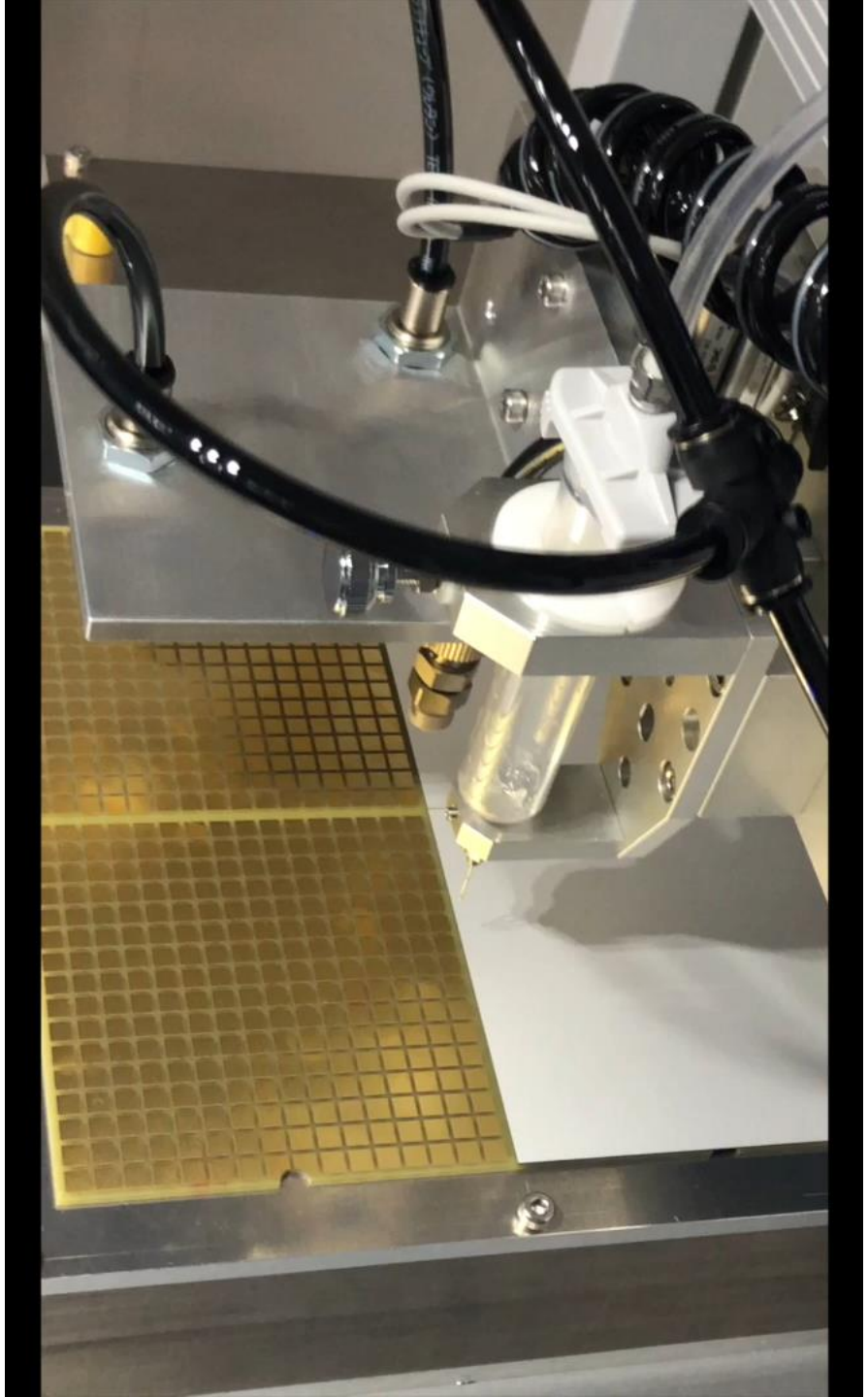
Setup for gluing

Preparation of jigs for FEV

Procedure of gluing

1. Set a FEV on the jig & fix by vacuum
2. Set a sensor on the smaller jig
3. Fix the sensor by vacuum
4. Put the glue on FEV cells (on 256 points) by giving high pressure
5. Lift & transport the sensor with the robot arm by vacuum
6. Glue the sensor on the FEV
7. Repeat 2~6

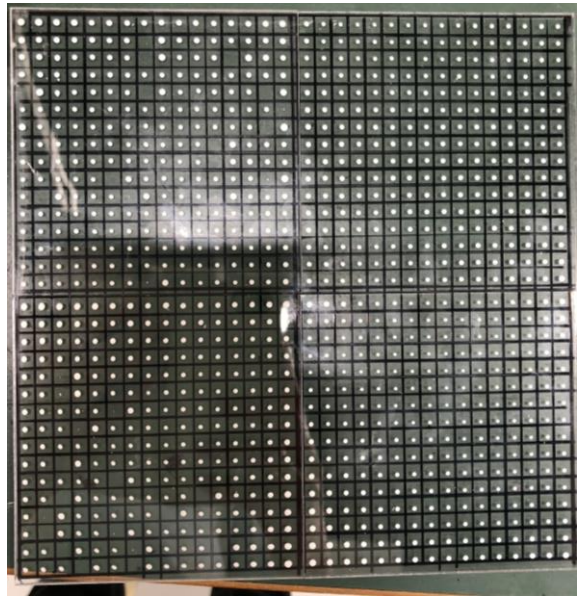
Gluing time: about 6 minutes for 1 sensor



optimizing of gluing

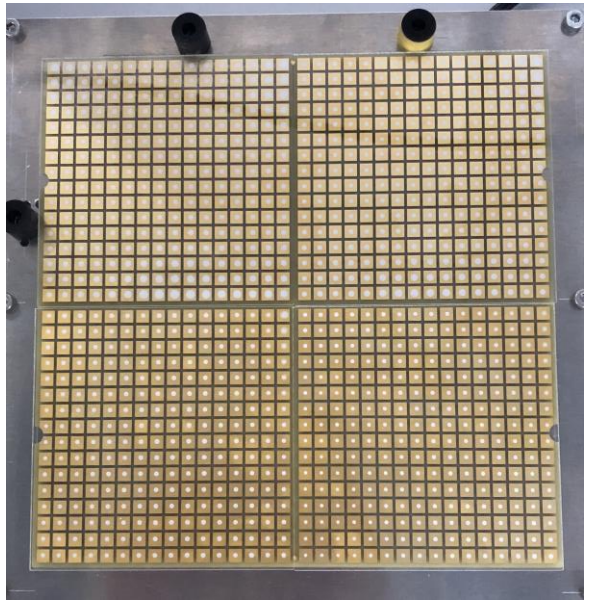
- We optimized gluing (dummy) sensors on to a (dummy) FEV

1. Small acrylic plates onto an acrylic plate



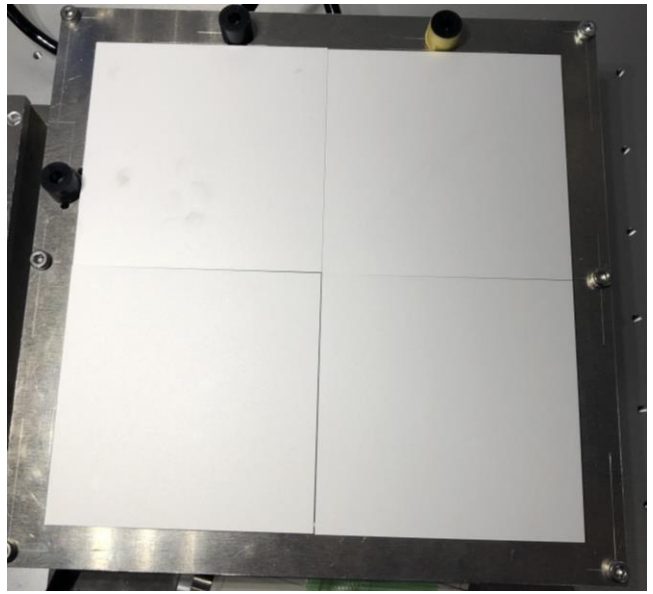
Checking amount of glue
Adjusting shot time & air pressure

2. Small acrylic plates onto a dummy FEV



Checking positions of glue & height of sensor from the FEV

3. dummy sensors onto a dummy FEV

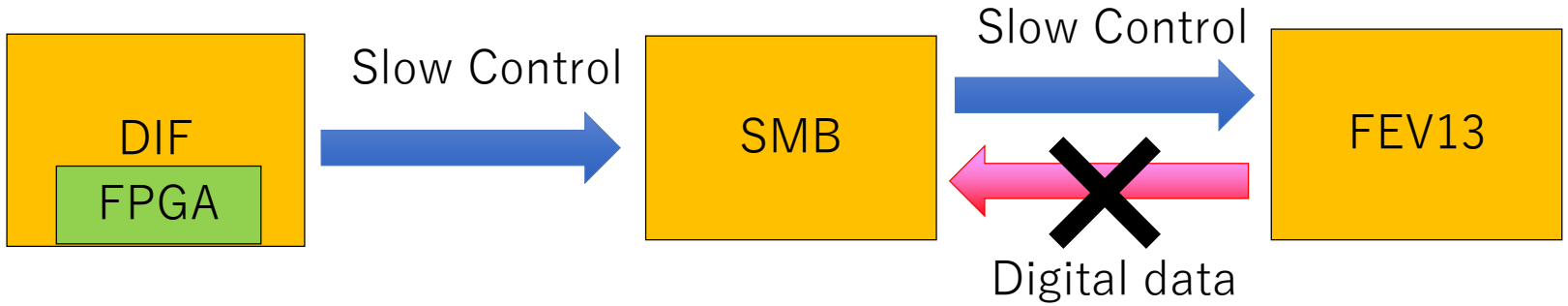


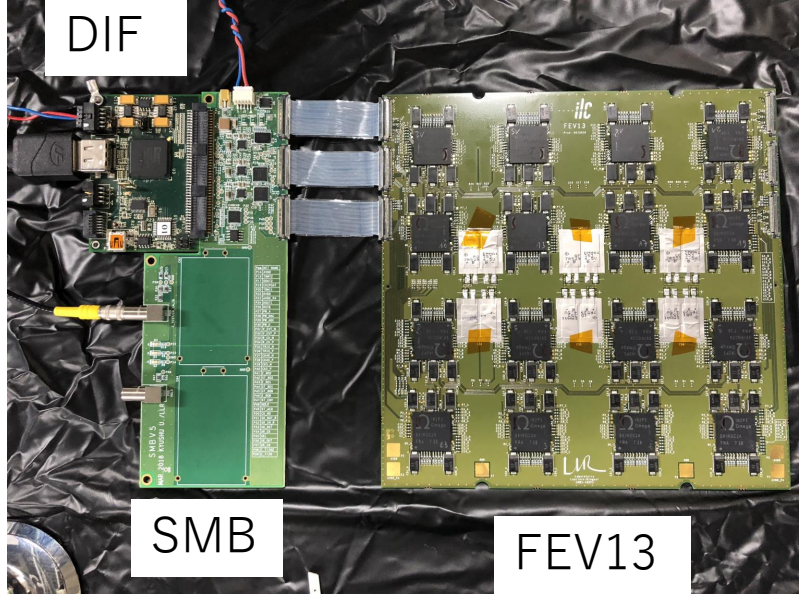
Checking positions of sensor
Testing of connecting

connection is OK

Checking performance of FEV w/o sensors

- We checked the FEV before mounting the sensors





- Slow control : succeeded in loading
  (Trigger threshold is changed in response to slow control)
- Digital data from SKIROC2A : cannot readout
  - No triggers
  - No Dout1,2 (data serial output)
  - No TransmitOn (active data readout)

Plans

- We will check the performance of the new slab at DESY testbeam in early July
- We have to …

  - check the FEV without sensors
  - glue 4 sensors onto FEV(Cure time is about 3 days)
  - check the FEV with sensors

  in three weeks
- At first, we have to complete validation of the FEV.
  - check around the trigger lines in detail
  - enable analog probe to check trigger/slow shaper

Summary

- We will prepare a short slab of ILD ECAL for DESY testbeam
- We designed & prepared jigs for Si sensors & FEV
- We optimized the gluing method
- About FEV, slow control is succeeded in loading, but data output can not be seen

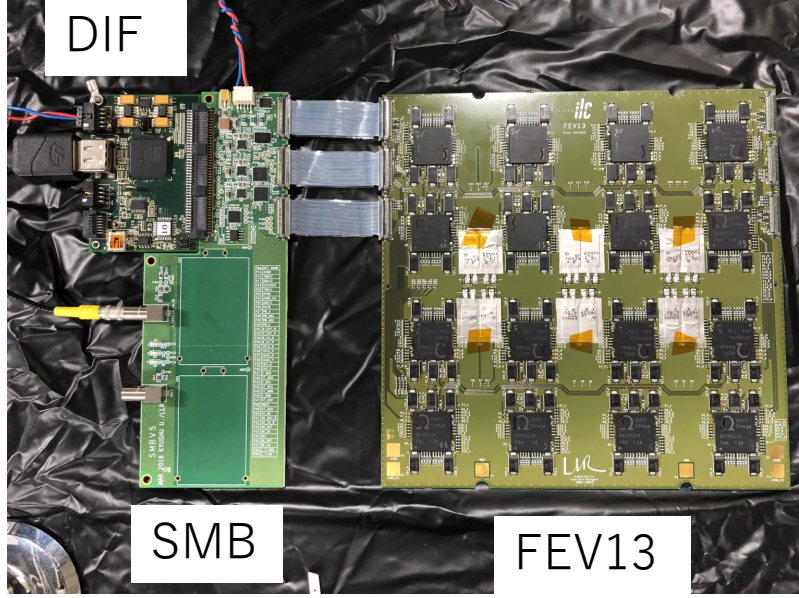
Under investigation

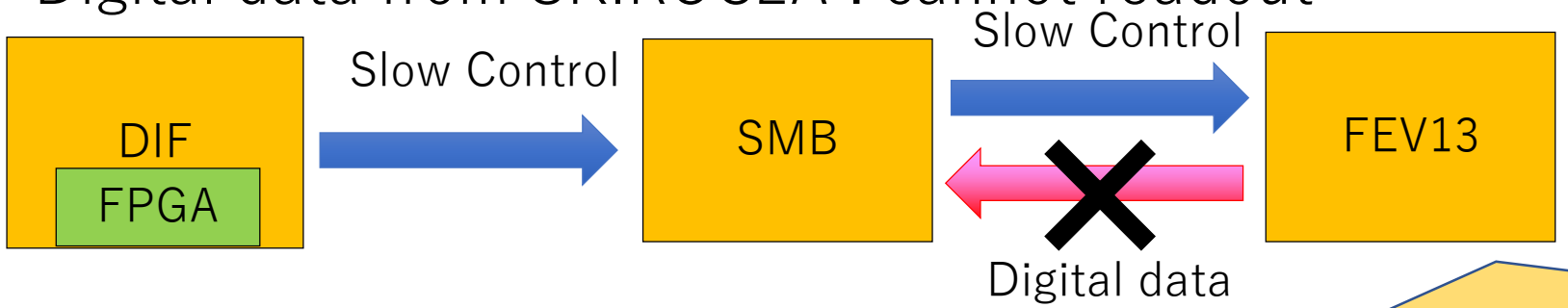
- We have to complete validation of the FEV, glue the sensors onto the FEV, and check the performance of it before DESY beamtest.

backup

Checking performance of FEV w/o sensors

- We checked the FEV before mounting the sensors
- Slow control : succeeded in loading
  (Trigger threshold is changed in response to slow control)
- Digital data from SKIROC2A : cannot readout





SKIROC2A

start_acq → **trig_out** → start_readout1 OK
end_readout1 OK
start_readout2 OK
end_readout2 Off
start_readout_bypass Off
end_readout_bypass Off
→ Chipsat → **dout1,2** → **transmition1,2**

start_acq: OK
trig_out: No triggers?
Chipsat: OK
dout1,2: no signal
transmition1,2: no signal