Production and test of Si sensors for W-Si sandwich calorimeter

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- Sensor production
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  - Fabrication
  - Packaging
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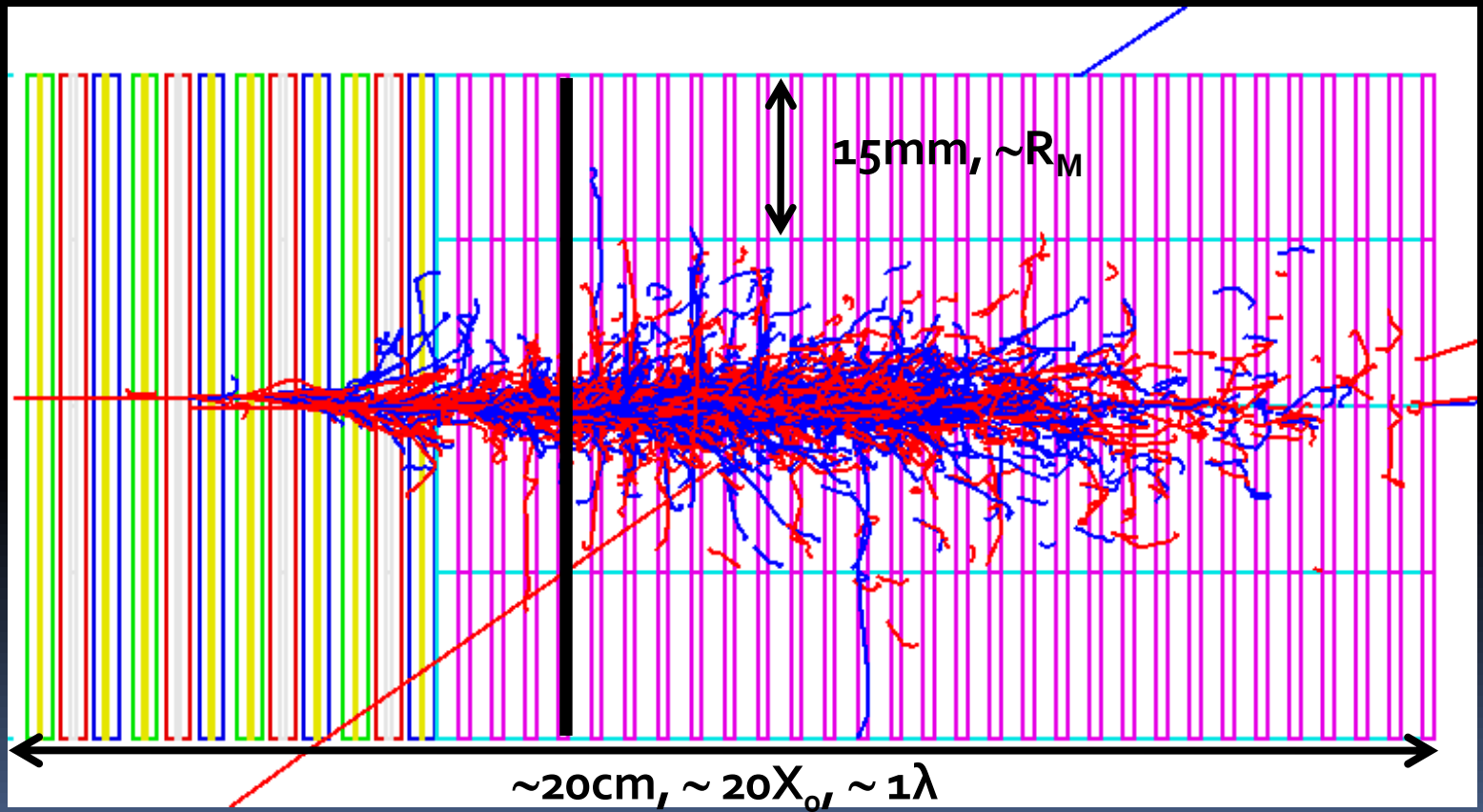
W-Si sandwich calorimeter, Basics

- EM Shower in a typical prototype



W-Si sandwich calorimeter, Basics

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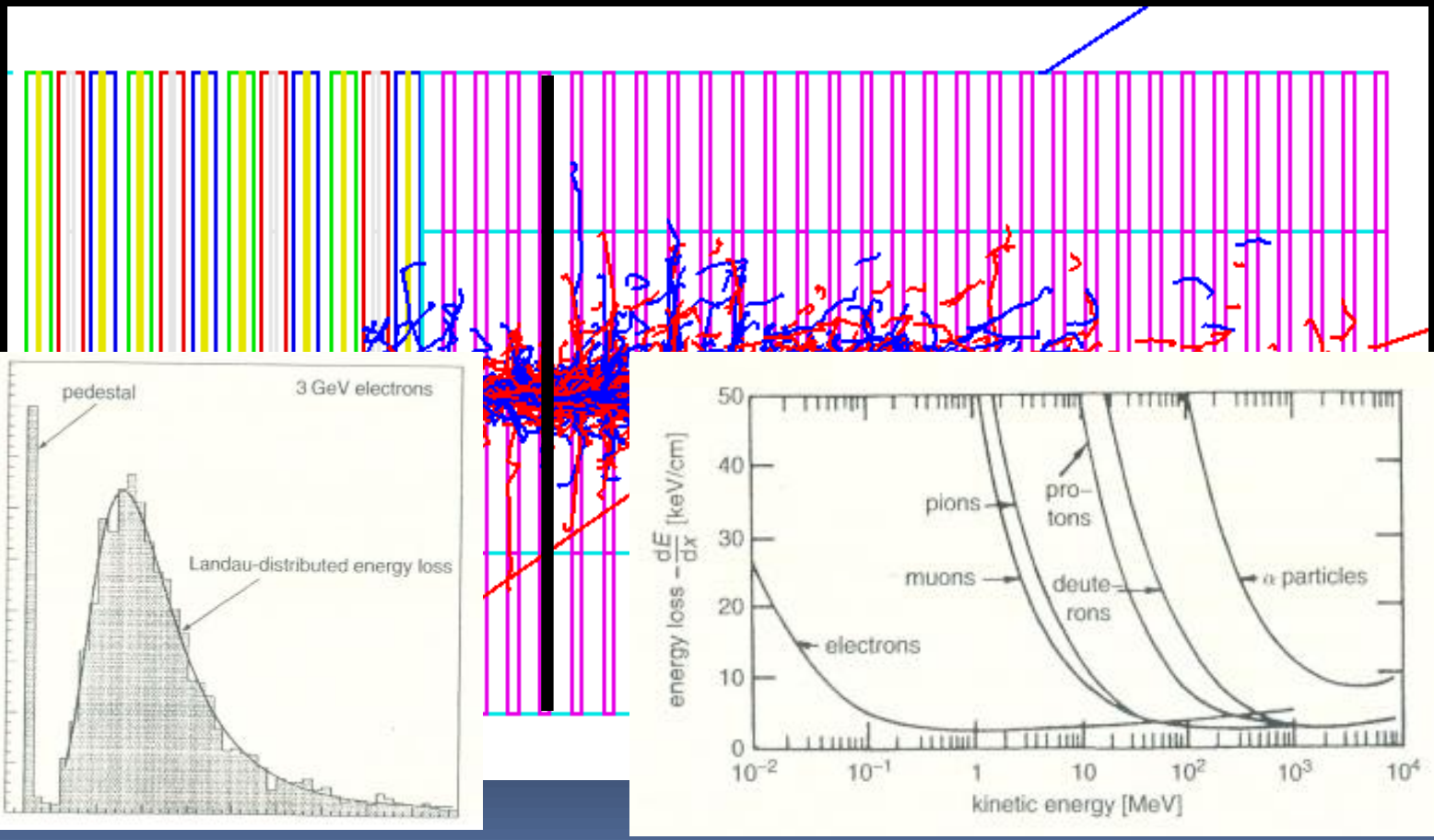
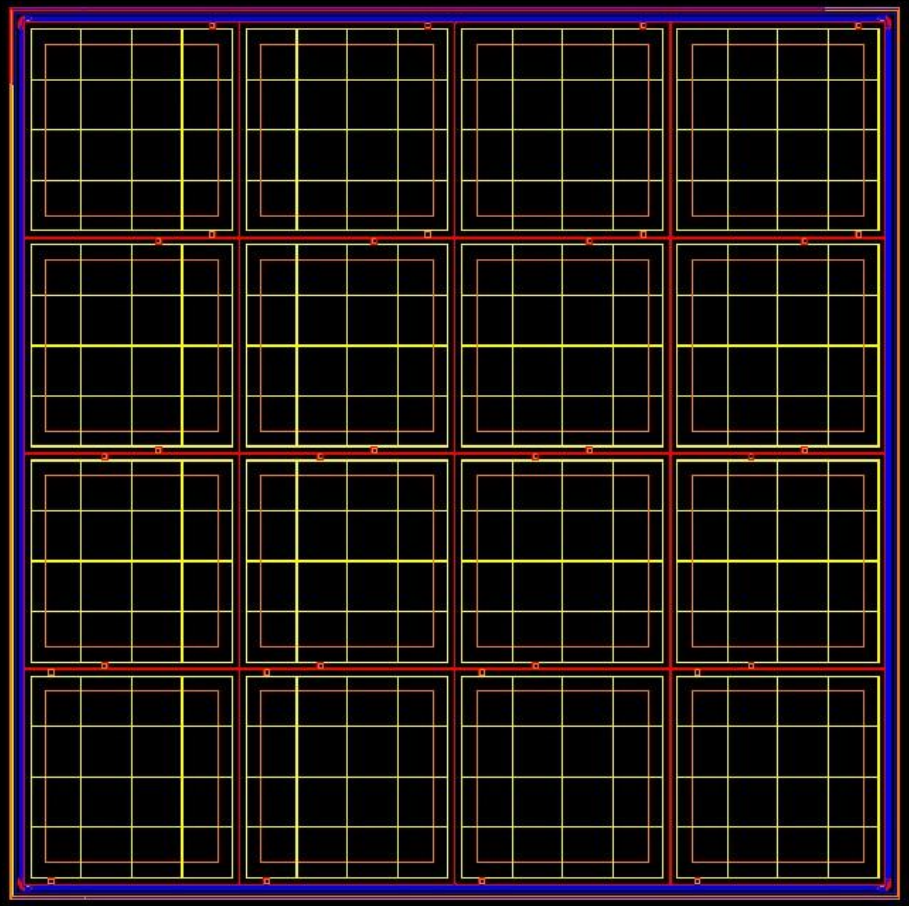
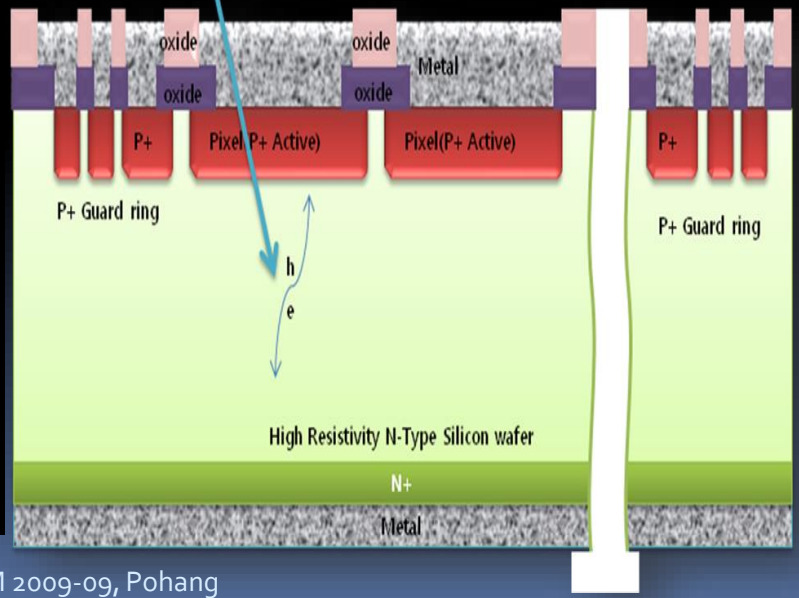


Detector schem



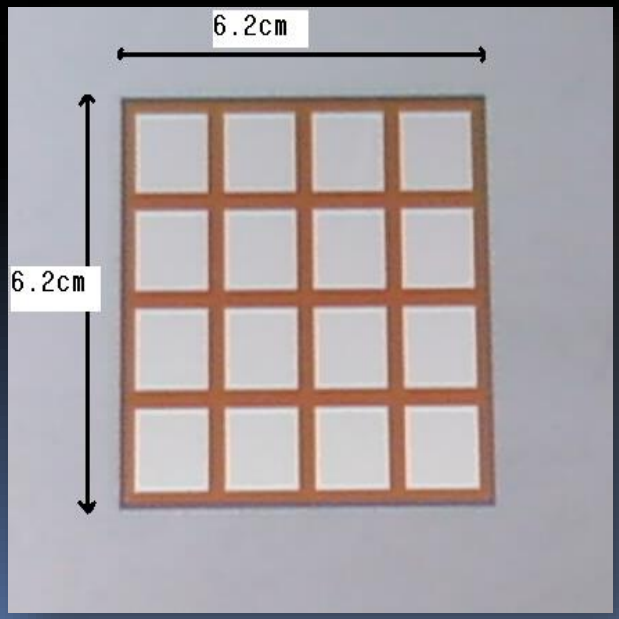


W-Si sandwich calorimeter, Basics

- Ideal for EM signal (γ, e, π^0) under forward high multiplicity
  - Compact EM shower inside calorimeter (W)
  - 3D tracking under large background possible though Si layers (Si)
  - Easy adjustment of the detector granule (Si)
  - Good energy resolution (W-Si)
  - Expensive (Si), but we(Korea) can do well.

Sensor production

- Sensor production
  - 6.2 cm x 6.2 cm n type wafer substrate and p type pattern
  - 4 X 4 (1.5cm each) pad : 16 channel per sensor

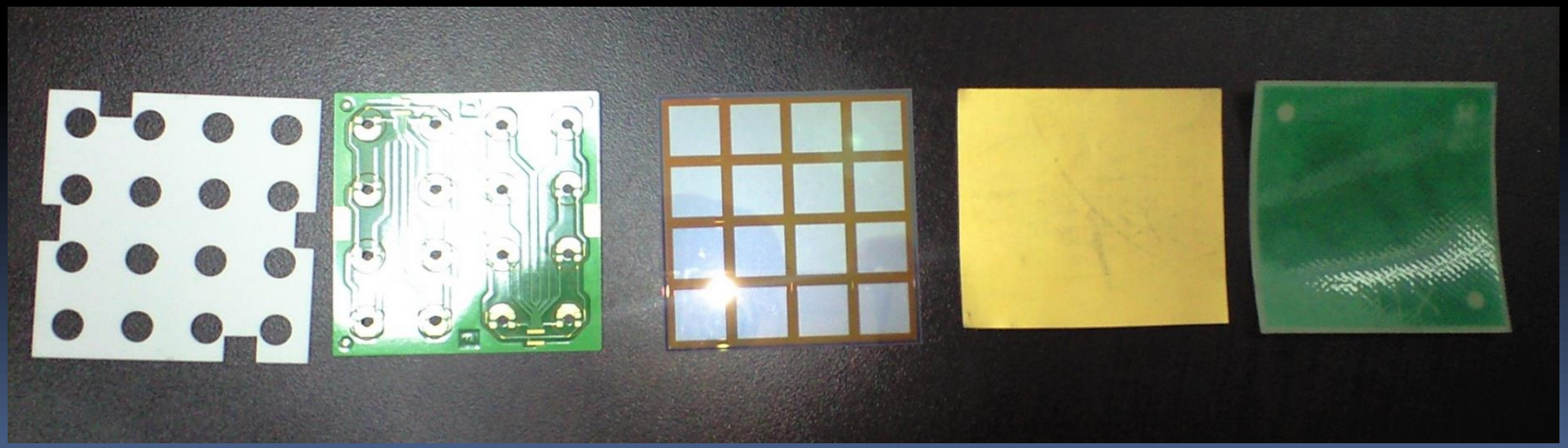


Fabrication

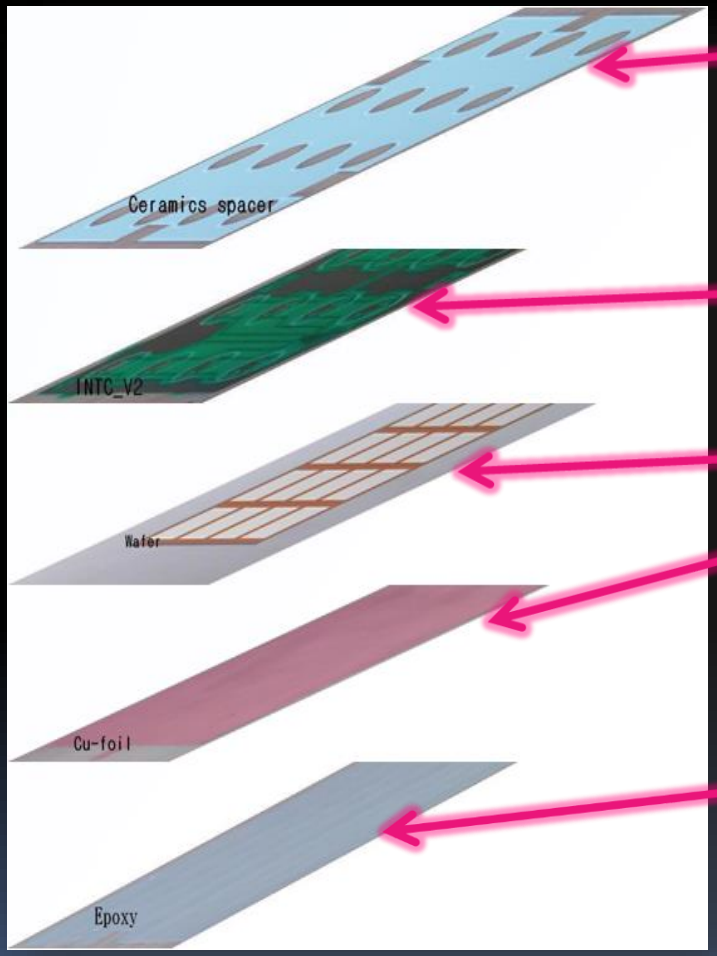
- Mask production
  - Optical
  - Electron lithography
- ETRI Production
  - Lithography
  - Developing
  - Implantation
  - Etching

Packaging

- Micro module production
  - Ceramic spacer
  - INTC(Inter connect) board
  - Silicon Sensor
  - Cu foil
  - epoxy plate

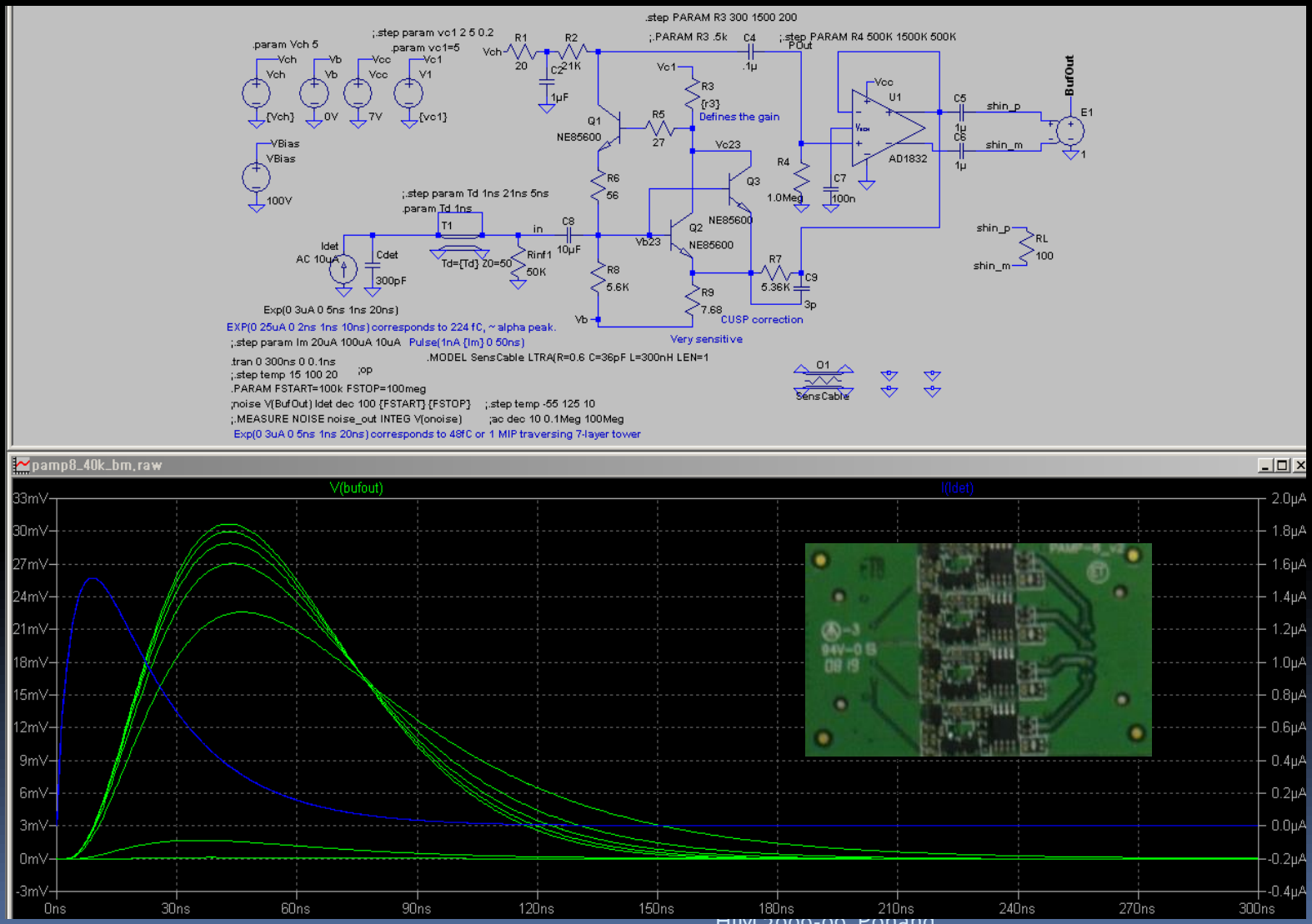


Components for micro-module



- Ceramic spacer
  - **Protection** from warping and heat
- INTC(Inter connect) board
  - **Electrical connection** to sensor
- Silicon Sensor
- Cu foil
  - Connection of sensor back plane to **ground**
- Epoxy plate
  - Electrical and physical **protection**

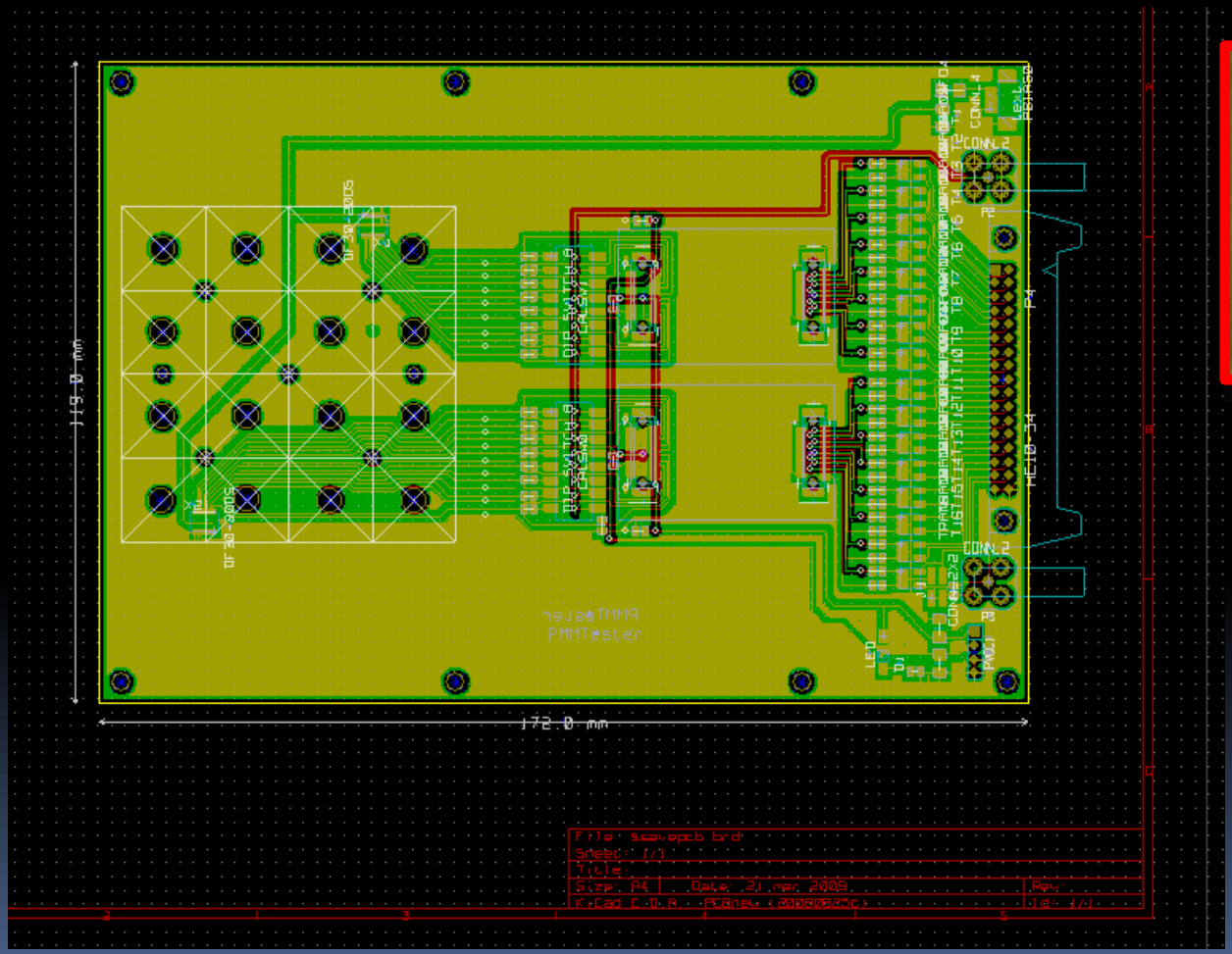
Signal conditioning

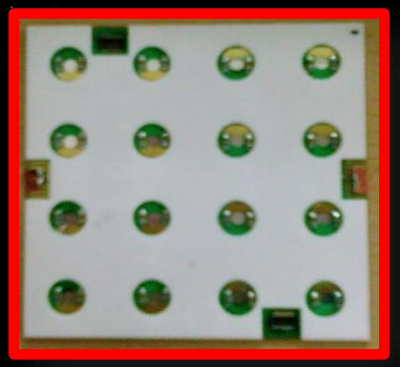


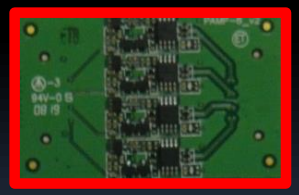
Cosmic muon test

- Most electrons passing a sensor layer are MIPs, which deposit minimum ionization energy as like cosmic muon.
- Cosmic test requires a setup of test electronics made up of silicon sensor, preamp hybrid card, test board, and bridge board.

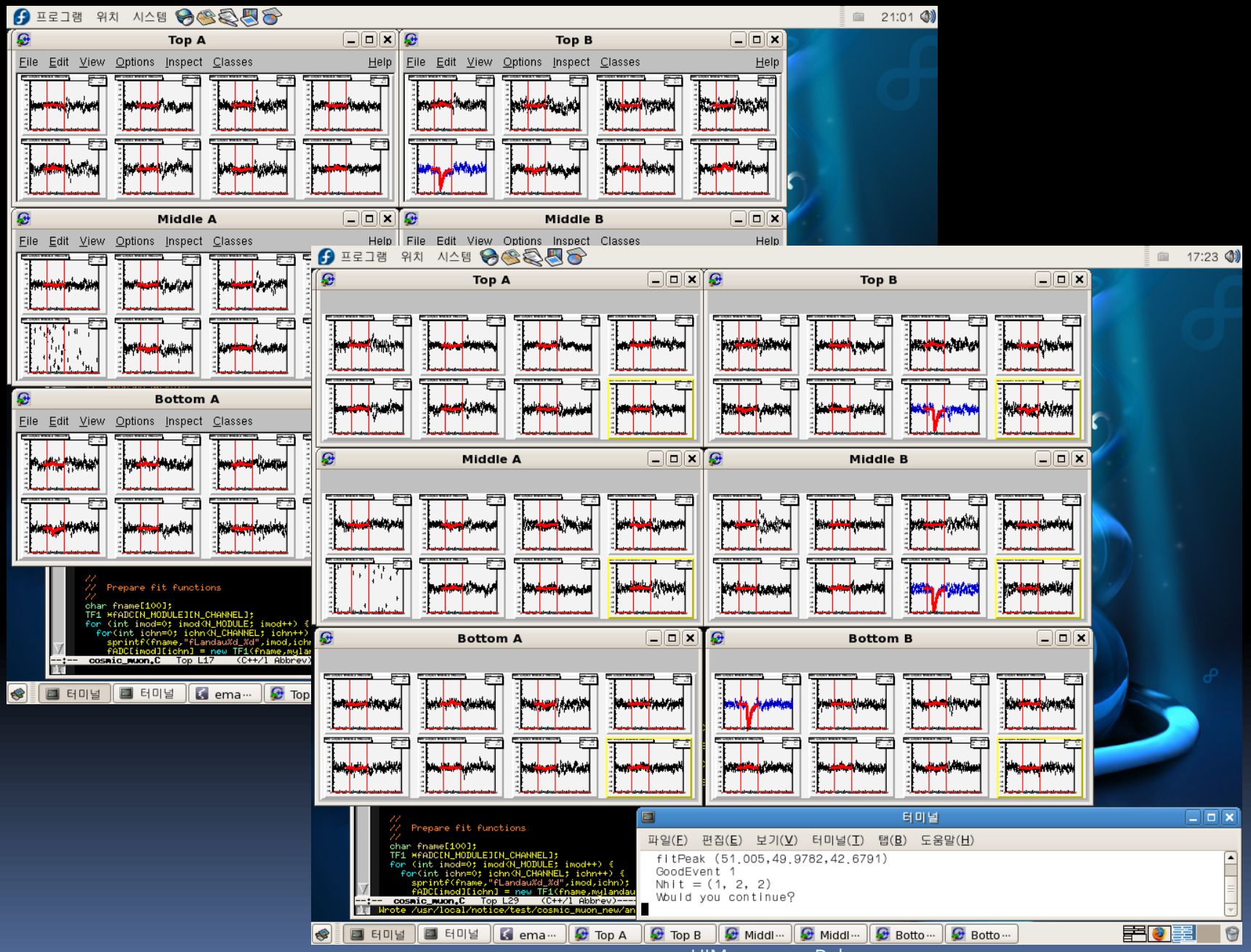
Cosmic muon test







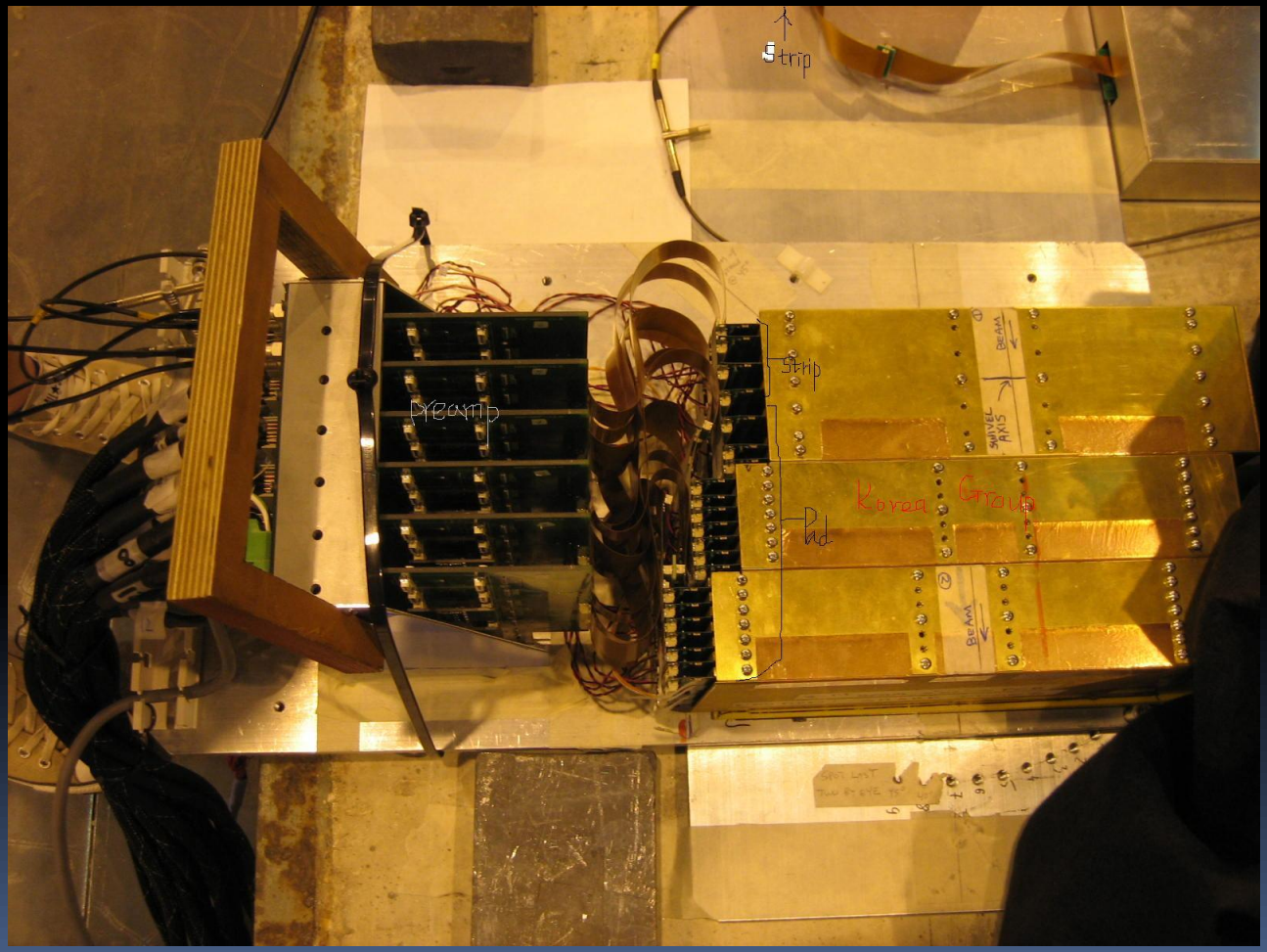
Cosmic muon test

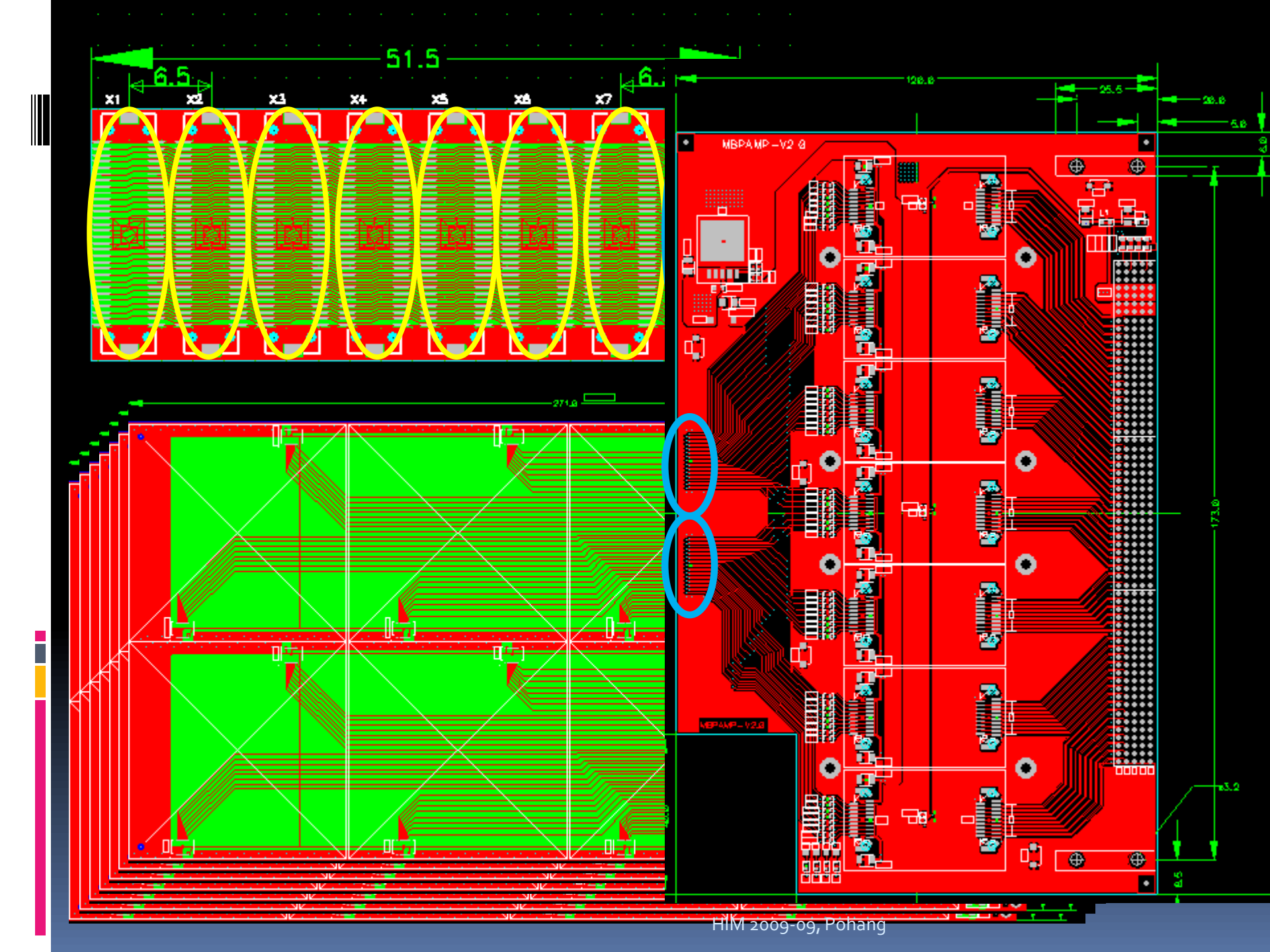

Top A
Top B
Middle A
Middle B
Bottom A
Bottom B
File Edit View Options Inspect Classes Help
프로그램 위치 시스템
21:01
17:23
// Prepare fit functions
char fname[100];
TF1 *fADC[N_MODULE][N_CHANNEL];
cosmic_muon.C Top L17 (C++/l Abbrev)
터미널
파일(F) 편집(E) 보기(V) 터미널(T) 탭(B) 도움말(H)
fitPeak (51.005,49.9782,42.6791)
GoodEvent 1
Nhit = (1, 2, 2)
Would you continue?
cosmic_muon.C Top L29 (C++/l Abbrev)
Wrote /usr/local/notice/test/cosmic_muon_new/an
터미널
ema...
Top A
Top B
Middl...
Botto...

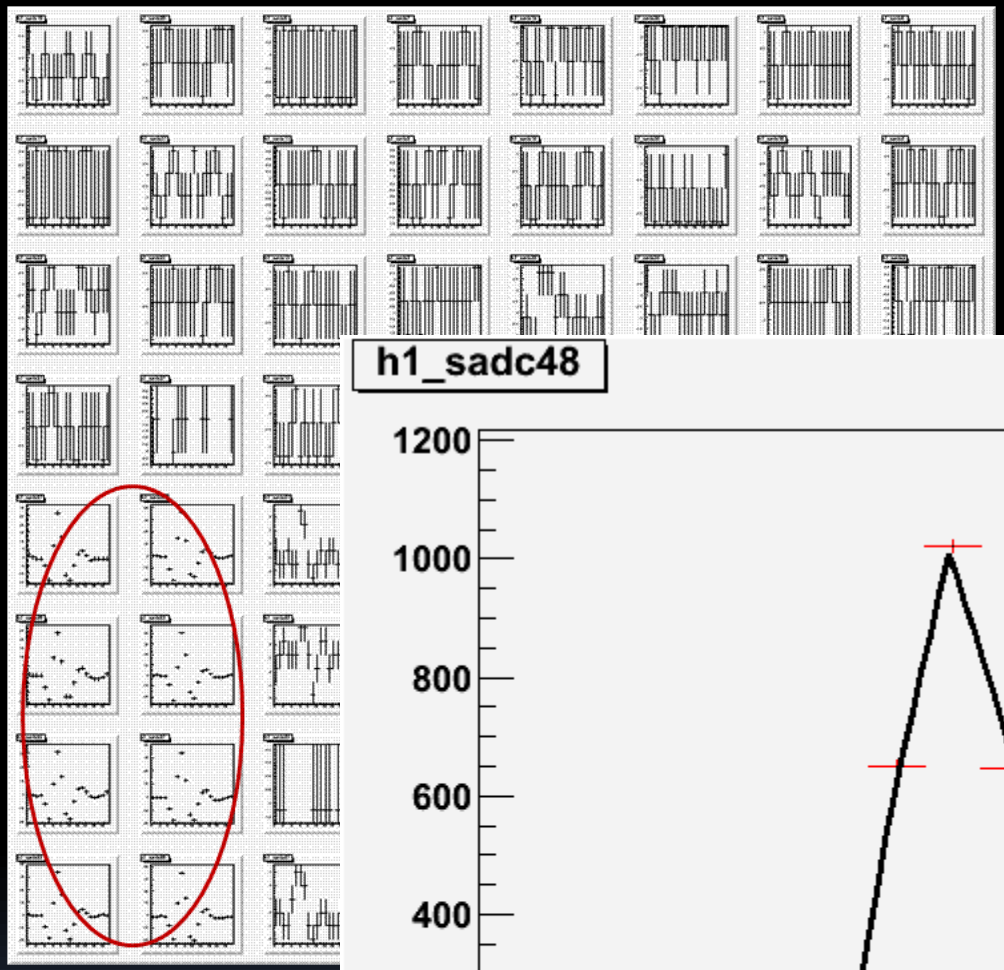
Beam test at CERN

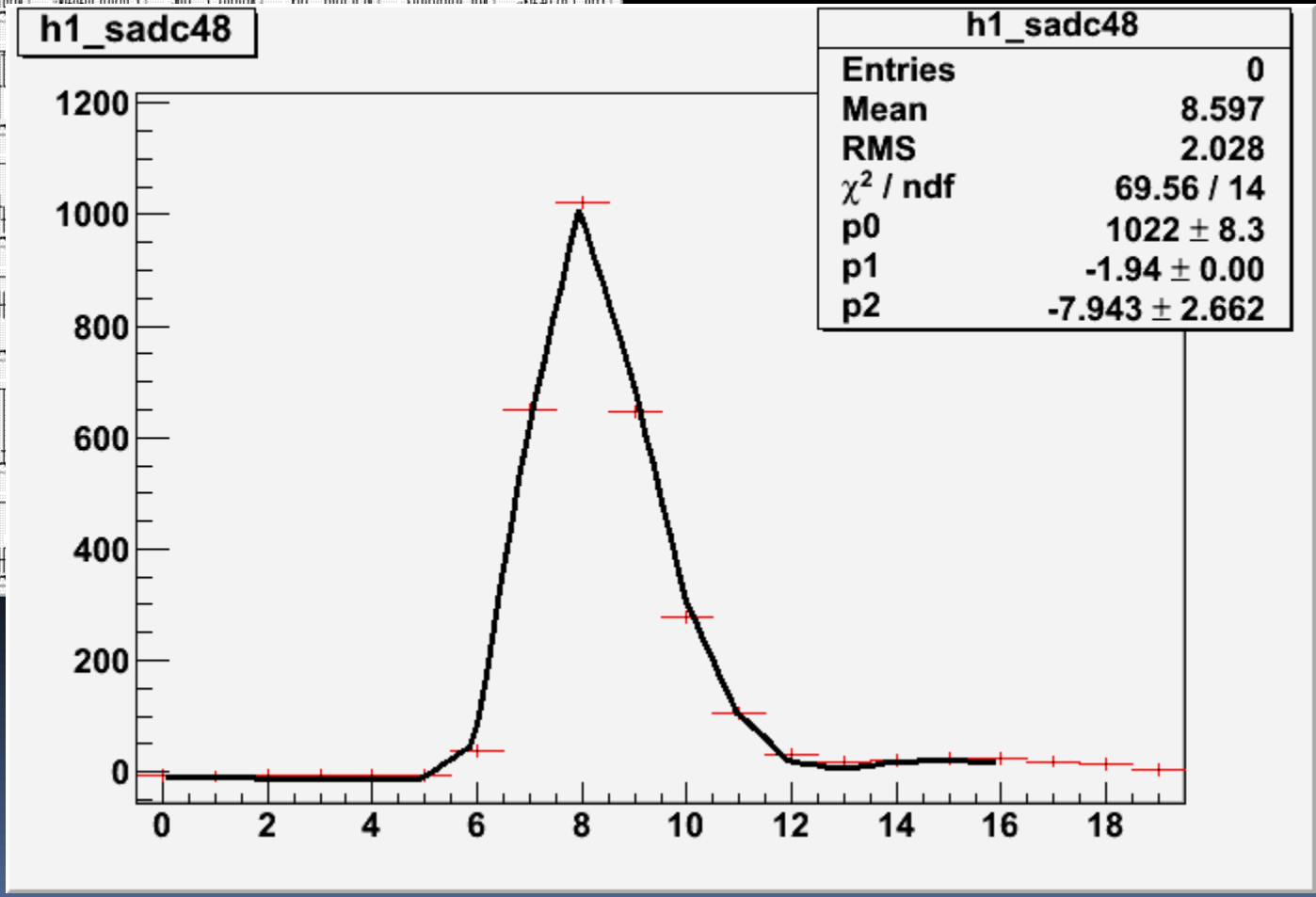
- Beam test had been taken 09.06.22~29 at PS and SPS
- 4 Sensor were used for each layer, and a super module had 7 W-Si layers.

Beam test setup




51.5
6.5
X1
X2
X3
X4
X5
X6
X7
MBPAMP-V2.0




h1_sadc48
h1_sadc48
Entries 0
Mean 8.597
RMS 2.028
χ^2 / ndf 69.56 / 14
p0 1022 ± 8.3
p1 -1.94 ± 0.00
p2 -7.943 ± 2.662
1200
1000
800
600
400
200
0
0
2
4
6
8
10
12
14
16
18

Summary

- W-Si calorimeter can effectively measure EM signal under large multiplicity
- Si sensor plays a key roll in the function
- We are conducting production & test of the Si sensors and see a good prospect