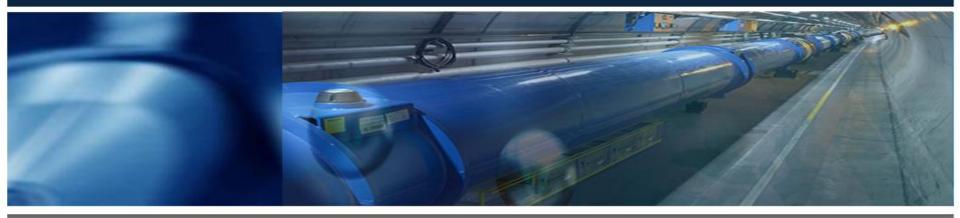
IT Accelerator Engineering Center ITAEC

## **Pedestal Analysis**



### Bokyeom Kim





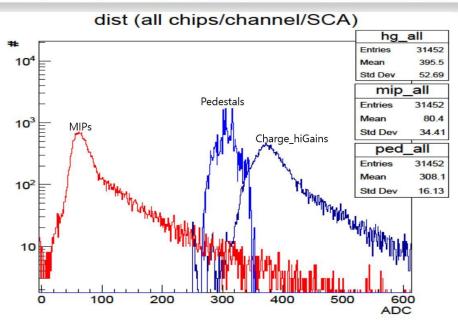
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- 1. What is Pedestal
- 2. Pedestal analysis in MIPscan
- 3. Pedestal analysis with W layer
- 4. Pedestal analysis with 1T magnet
- 5. Future Plan



# **1. What is Pedestal**



**Fig.2** Spectra of MIPs, pedestals and Charge\_hiGains of all chips of slab2 (3GeV positron beam was irradiated for 1800s at the center of the detector)

- Each channel only tags data as a hit if the charge is over the threshold value.
- The charges below the threshold value are tagged as pedestals and they are stored only when one of the charges in SCAs is over threshold value.
- Each channel has internal noises from system of the chip like power suppliers and those noises were the sources of pedestals
- When the real input signals from Minimum Ionizing Particles (MIPs) enter the channels, internal noises tend to mount on the real input signals, shifting zeros of hit\_charge (making a bias)
- The biases from electronic noises are called pedestals and we can get desired signals(MIPs) by subtracting pedestals from stored signals(Charge\_hiGains)



## 2. Pedestal Analysis in MIP scan

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pedestal_chip0	pedestal_chip1	pedestal_chip2	pedestal_chip3
pedestal_chip0	pedestal_chip1	`"[ pedestal_chip2	pedestal_chip3
Entries 64	Entries 128	Entries 128	Entries 960
Mean 300	Mean 302.4	Mean 294.2	Mean 309.9
Std Dev 13.31	Std Dev 14.62	Std Dev 7.29	Std Dev 8.07
0 200 200 300 300 320 340 500 300 ADC	0 200 200 500 500 520 540 560 300 400 A0C	0 266 280 300 525 340 360 360 400 ADC	260 280 300 320 340 360 386 400 ADC
pedestal_chip4	pedestal_chip5	pedestal_chip6	pedestal_chip7
pedestal_chip4	" pedestal_chip5	pedestal_chip6	pedestal_chip7
Entries 0	Entries 320	Entries 64	Entries 64
Mean 0	Mean 295.8	Mean 298.9	Mean 329.6
Std Dev 0	Std Dev 8.957	Std Dev 8.387	Std Dev 9.215
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pedestal_chip8	pedestal_chip9	pedestal_chip10	pedestal_chip11
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<sup>*</sup> pedestal_chip8	pedestal_chip9	. pedestal_chip10	pedestal_chip11
<ul> <li>pedestal_chip8</li> <li>Entries 320</li> <li>Mean 312.5</li> <li>Std Dev 9.369</li> </ul>	pedestal_chip9Entries64Mean309.6Std Dev17.04	pedestal_chip10 Entries 960 Mean 345.1 Std Dev 5.915	Pedestal_chip11 Entries 192 Mean 297.9 Std Dev 9.398
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Pedestal_chip8 Entries 320 Mean 312.5 Std Dev 9.369 Pedestal_chip12	pedestal_chip9 Entries 64 Mean 309.6 Std Dev 17.04 medestal_chip13 pedestal_chip13 Entries 128	Pedestal_chip10 Entries 960 Mean 345.1 Std Dev 5.915 Dedestal_chip14 pedestal_chip14 Entries 128	Pedestal_chip11 Entries 192 Mean 297.9 Std Dev 9.398 Dedestal_chip15 Entries 64

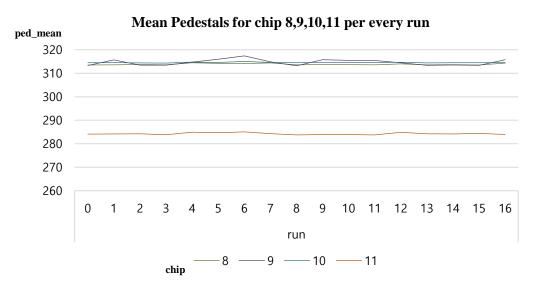
**Fig.7** Pedestal values of slab2 at grid 41 MIP scan

- The Pedestal result of the MIP scanning on grid 41.
- The chip 3,5,10 and12 showed significantly higher triggering frequencies than other chips.
- =>The pedestals only stored when there is a beam => generated pedestals were concentrated on beam area
- The chip 3 and 10 are fully triggered as one chip has 960 SCAs (64channels x 15SCAs)
- That is why the surrounding chips of them (chip 1, 2, 8 and 11) were triggered to acquire extra signals from centers.
- The chip 5 and 12 were not frequently triggered as chip 3 and 10 even if they were the irradiated chips.
- However, Chip 5 and 12 were not fully triggered, explaining the silence of pedestals in neighbor chips.



## 3. Pedestal Analysis with W layer

#### Stability Test with Constantly Energized Beams



**Fig.8** Reliability test with constant Energy (5.8GeV, chip 8,9,10 and 11 of slab2)

- only chip 8,9,10 and 11 were considered as those chips were targeted (other chips were rarely triggered) and fully triggered.
- The pedestal of chip 8 changed 0.02% on average during 17 beam exposures, 0.05% for chip 9, 0.002% for chip10 and 0.003% for chip11.
- The pedestals of all targeted chips were varied less than 0.1%, which is extremely low rate of change.
- Therefore, the SiW-ECAL prototype showed highly stable pedestals without breaking even the repeated 5.8 GeV high energy positron beam was injected.





#### Stability Test with varying Energies of the Beams

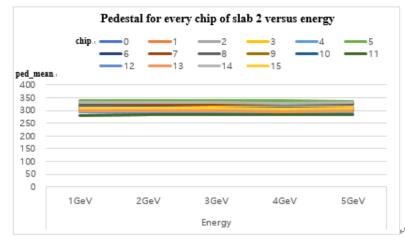


Fig.9 Reliability test with different energies (1 GeV to 5 GeV positron beam)+

- Every chip showed pedestals because of electromagnetic shower
- all chip showed almost straight lines of pedestals
- Slab2 of grid 24

Table1. Results of energy variation test+

Chip	AverageRate of change [%]	Ped_Mean
0	0.20	321.7
1	0.24	297.18
2	0.03	283.62
3	0.02	312.96
4	0.21	293.98
5	0.04	340.12
6	0.07	305.04
7	0.12	327.18
8	0.01	313.14
9	0.22	308.98
10	0.02	314.46
11	0.05	282.64
12	0.01	306.92
13	0.02	297.7
14	0.11	331.1
15	0.07	308.96
avg	0.09	309.105

• **Table.1** shows the numerical result that each chip showed less than **0.3%** of average variation of pedestals. It was **0.09%** on average.





#### Stability Test with varying Energies of the Beams

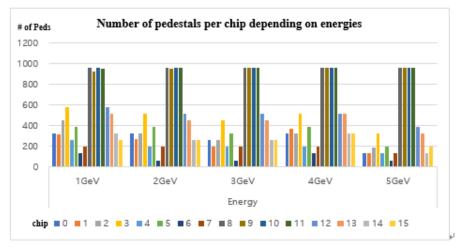


Fig.10 The number of pedestals per chip of slab 2 depending on energies.

- As we can see in **Fig.10**, the number of triggers (pedestals) were concentrated into chip 8,9,10 and 11.
- As the beam energy gets higher, the numbers of triggers of chip 8,9,10 and 11 tend to increase and the other ones decrease.
- The higher the beam energy, the higher the momentum of each charged particles, the lower events of electromagnetic shower, the less scattering happens in detector.



## 4. Pedestal Analysis with 1T Magnet

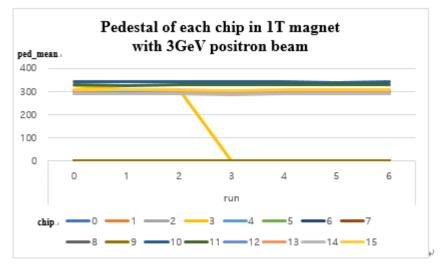


Fig.13 magnet dependency test result

- As Fig.13 shows Chip 0,1,2,4,5,6,7 and 9 didn't respond during entire beam injection.
- Chip 3 was triggered during run 0,1 and 2 but stopped responding.
- The other chips showed stable pedestals with **0.0038%** variation.
- Therefore, most of chips were independent on strong magnet

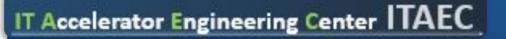




## 5. Future Plan

- Wrote a paper which has exactly same content of this presentation
- Planning to participate the conference, "International Symposium on Sensor Science" (9.27-9.29, Barcelona, Spain)
- or submit the paper to JKPS(The Journal of the Korean Physical Society) which is the Korean SCI journal.
- Welcome to another suggestion





# Thank You



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