# Segmented absorber calorimeter response for electorons

LCWS2016 @ Morioka
December 2016
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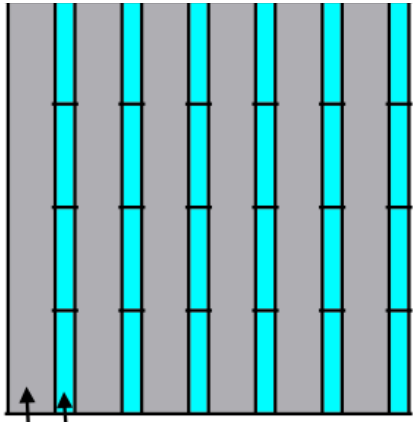
Shinshu University

# Active Absorber CAL for PFA

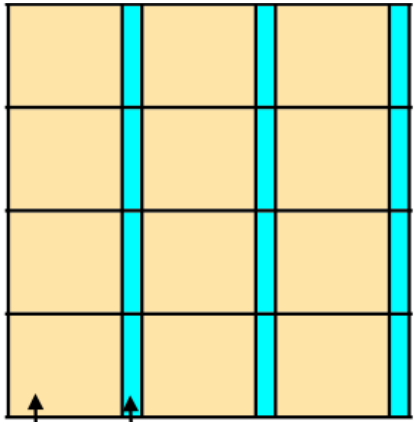
Current design of AHCAL



scintillator tile
readout with a thin PPD

Iron absorber
no information

AA CAL for PFA

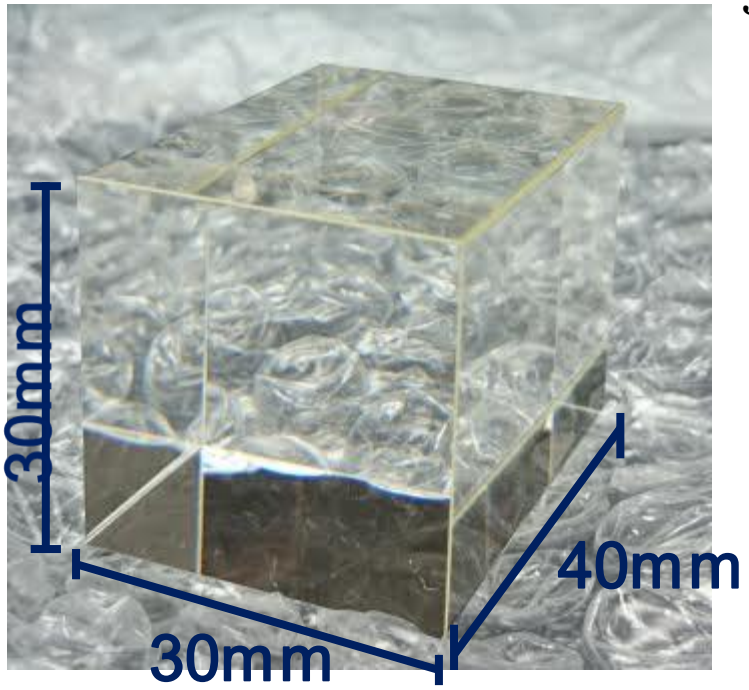


strip scintillator
with a fine segmentation

transparent heavy absorber
Typically a lead glass blocks
Each block is read
out with a PPD

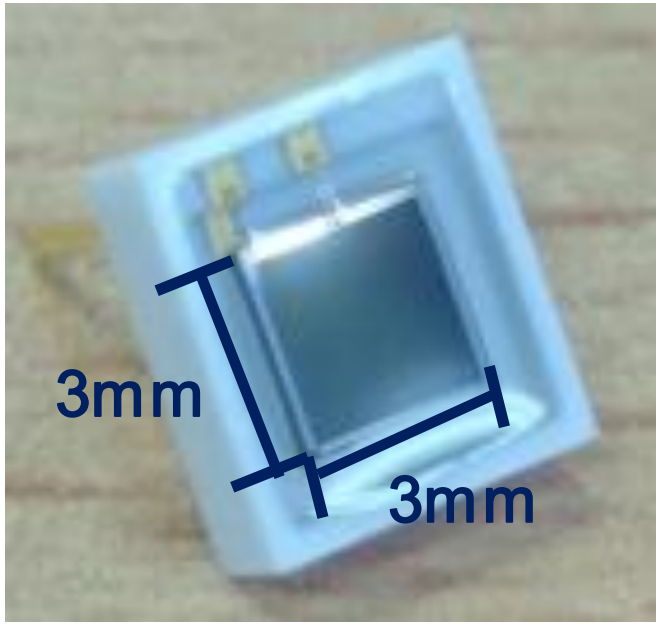
- Active Absorber could give more information
- especially for EM showers
- much better resolution is expected

# Active Absorber




Lead Glass (SF6W)

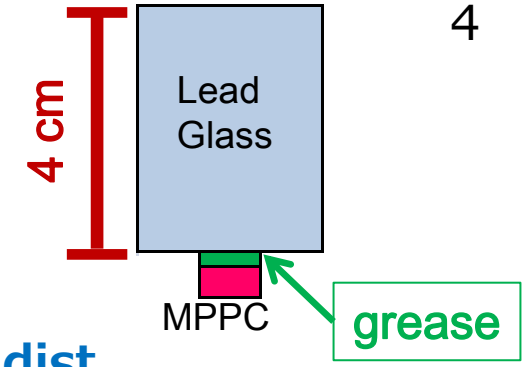
- Size : 30×30×40 $mm^3$
- Refractive index: 1.8
- Density: 5.2 $g/cm^3$
- $X_0$ ~ 17 mm
- I nuclear interaction length= 17 cm

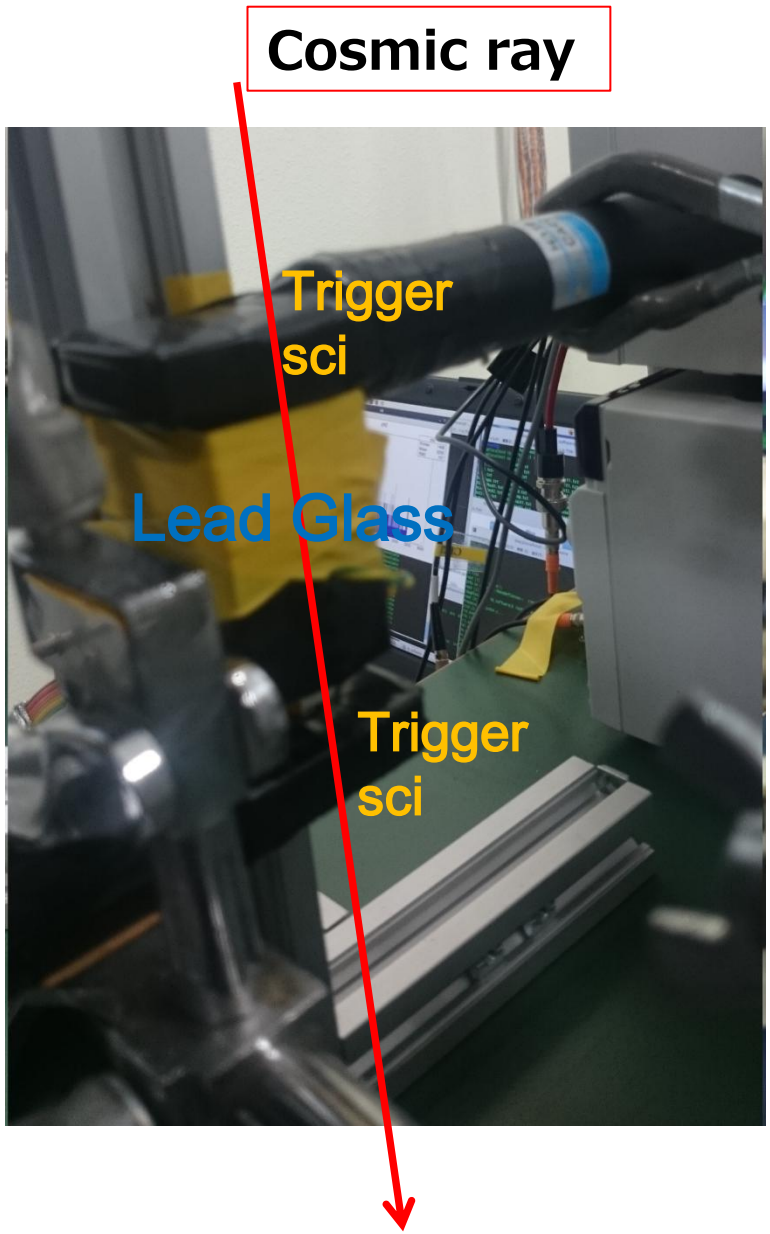



MPPC (S13360-3050CS)

- Pixel pitch: 50μm
- Effective photosensitive area: 3mm×3mm
- Number of pixels: 3600

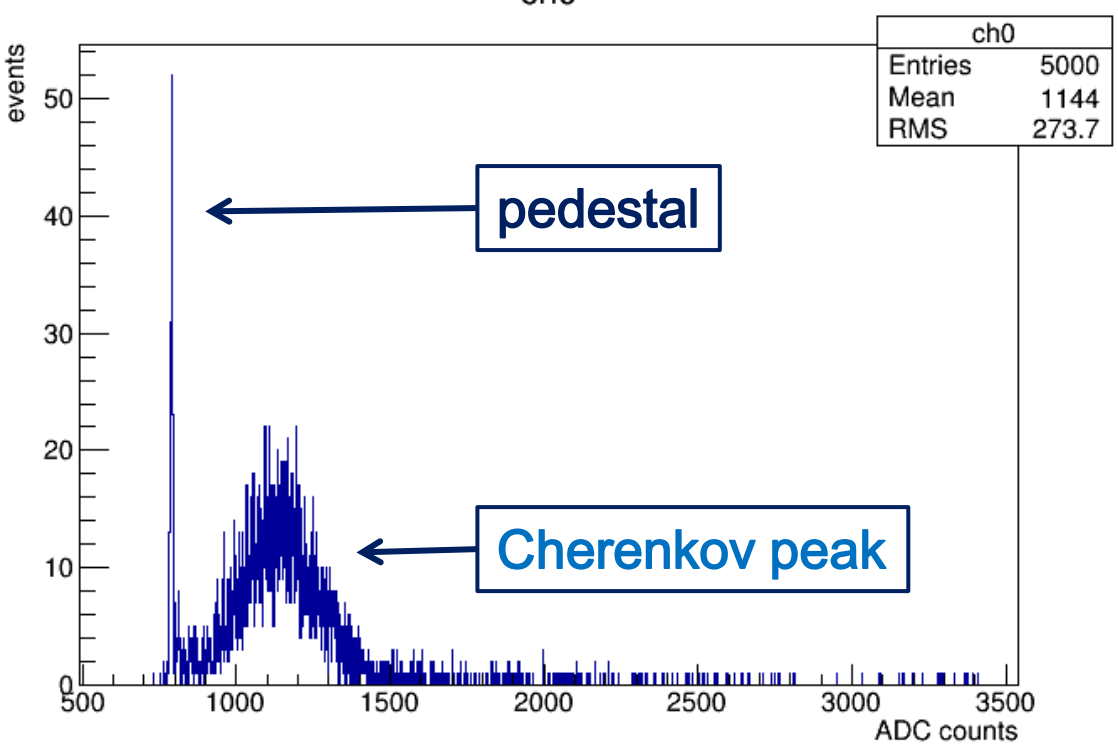
# Cosmic ray test @shinshu



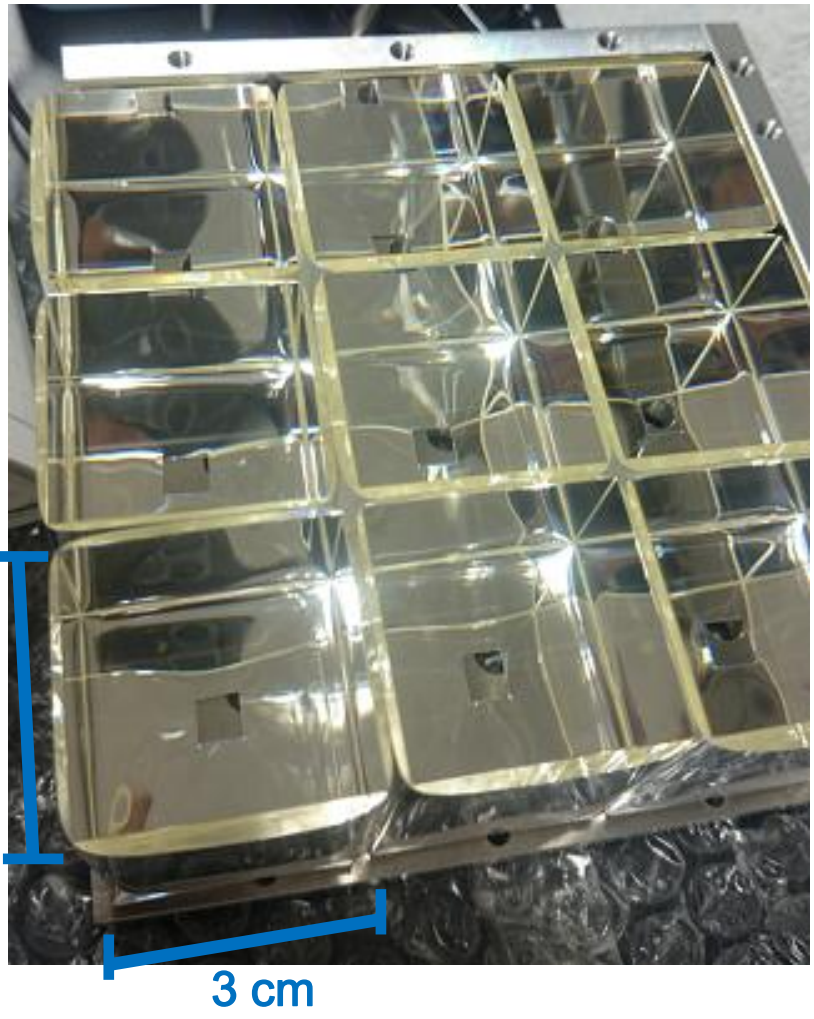

## Cerenkov signal ADC dist

**Cosmic ray passing 4cm long**
**MPPC is attached with optical grease**
**dV = $dV_{op}$ - $dV_{BR}$ = +1.5V**

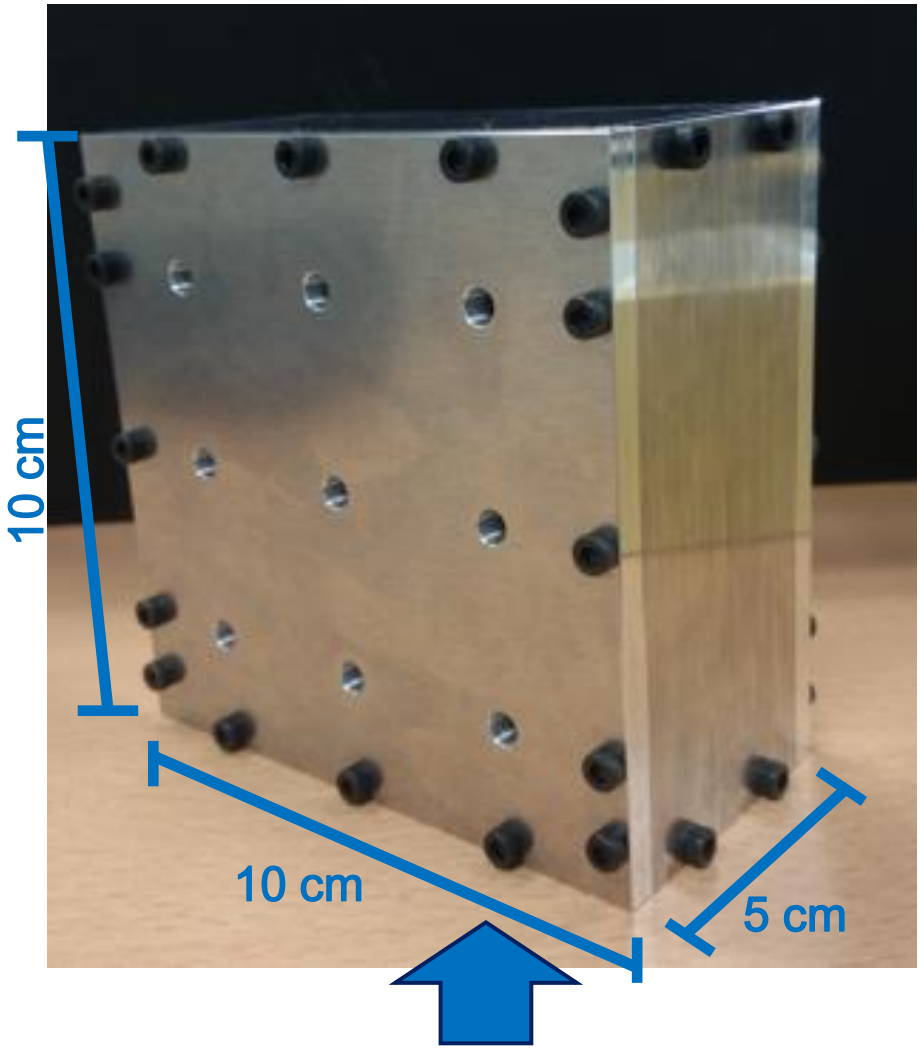


# Active Absorber layer

3×3 matrix of Lead Glass blocks

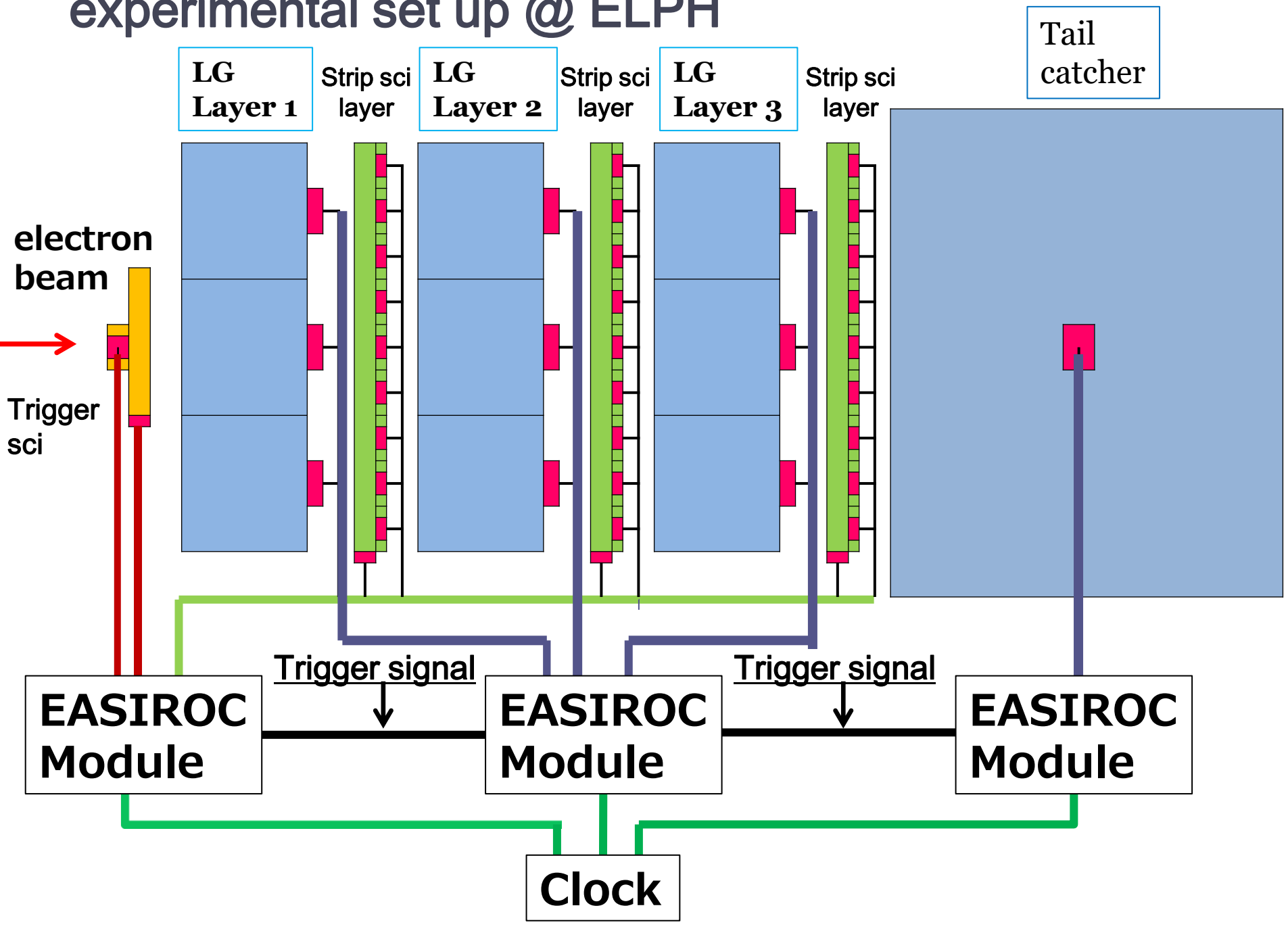



Aluminum case for 9 blocks

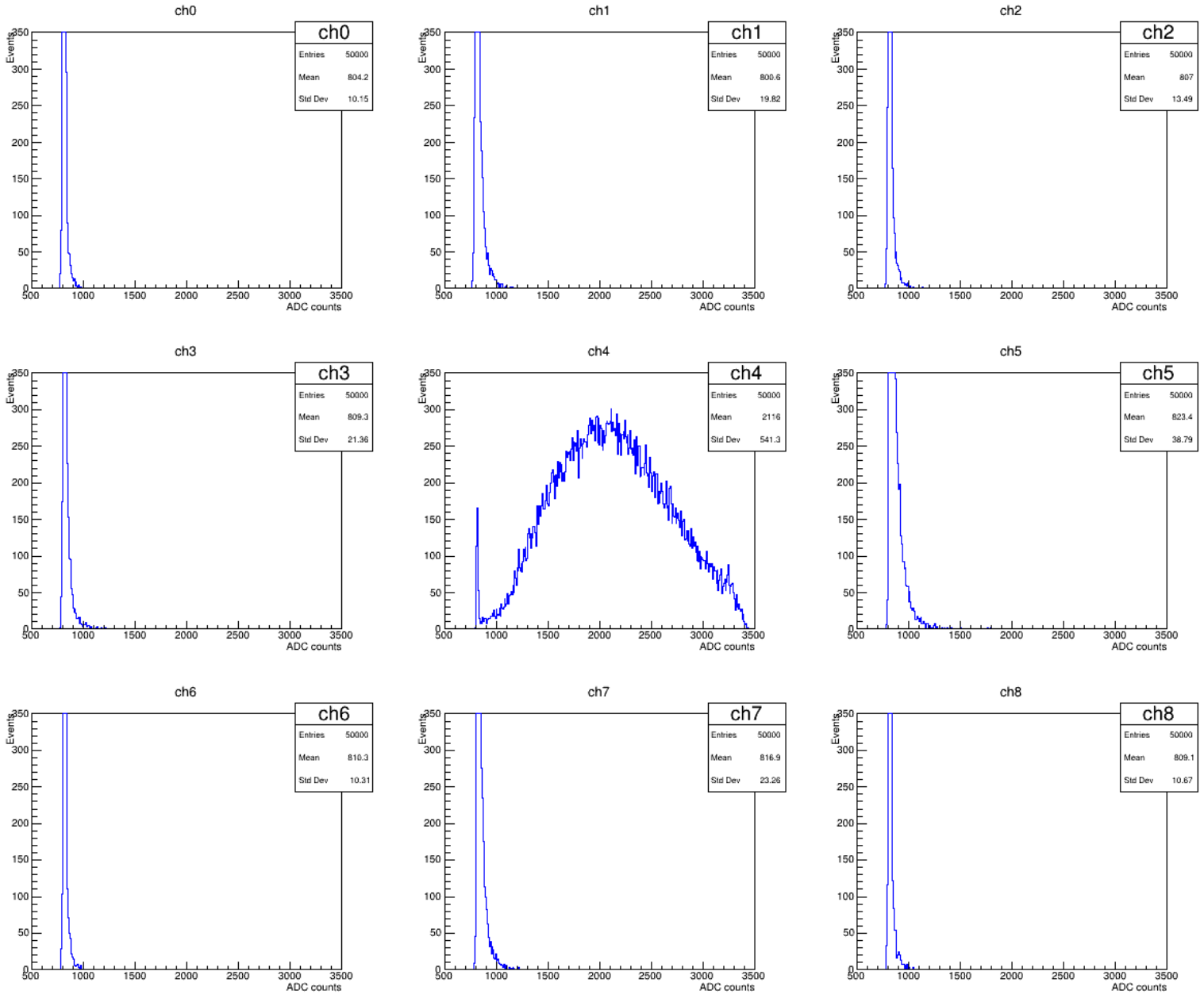



- Placing nine Lead Glass blocks in an aluminum case
- We made three Lead Glass layers.

# experimental set up @ ELPH

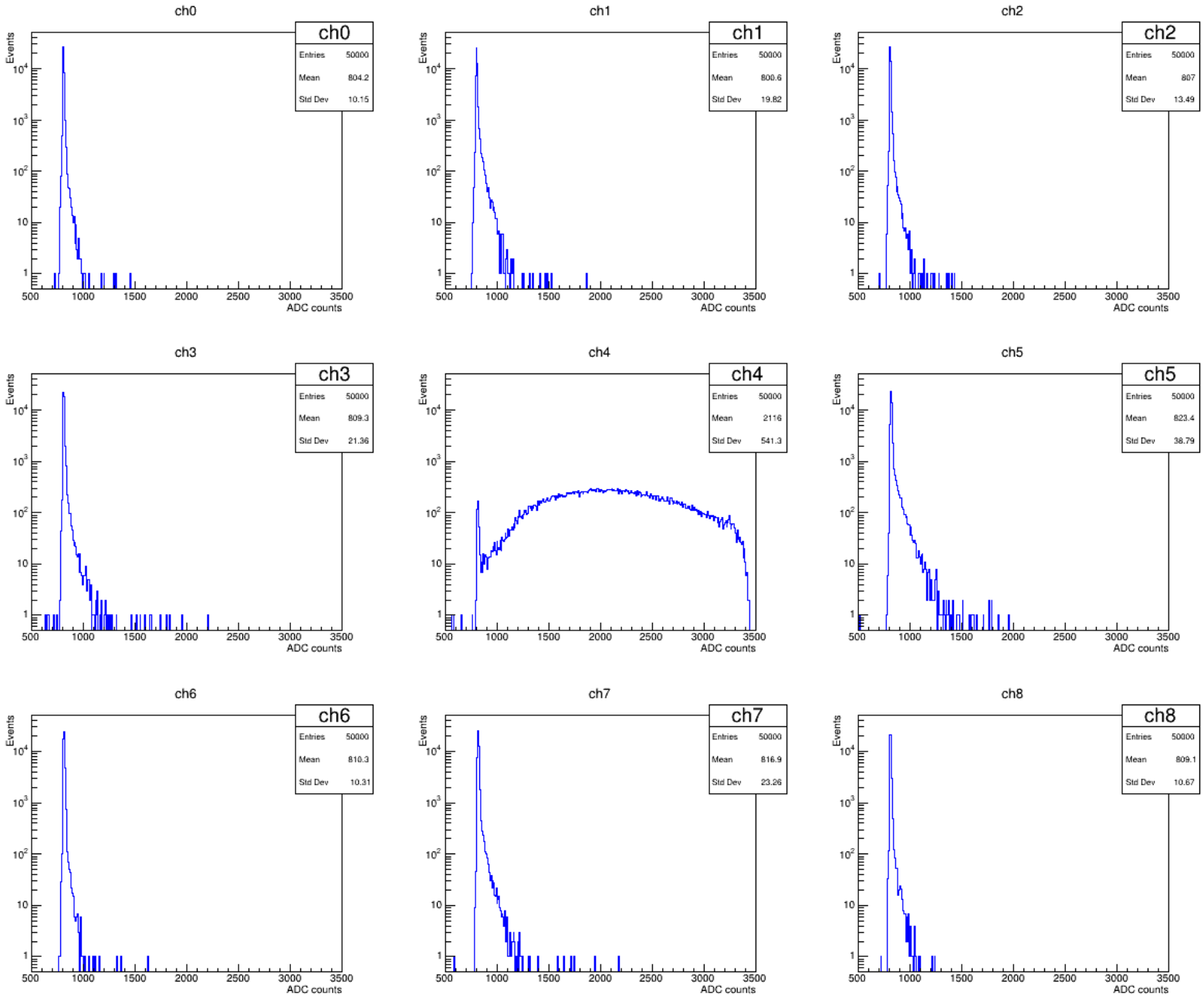


# Layer1 400MeV electron (ADC dist ) @ELPH



# Layer1 400MeV electron (ADC dist log scale) @ELPH

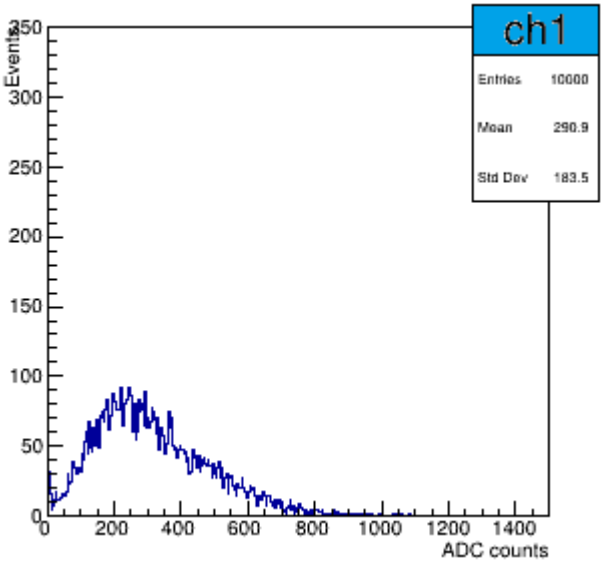


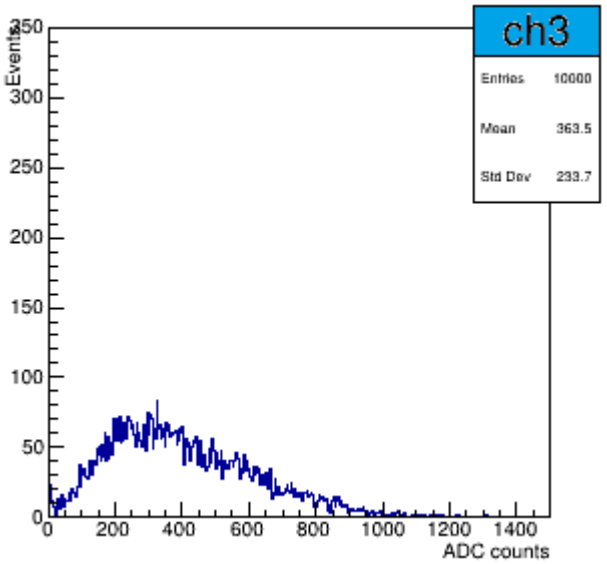


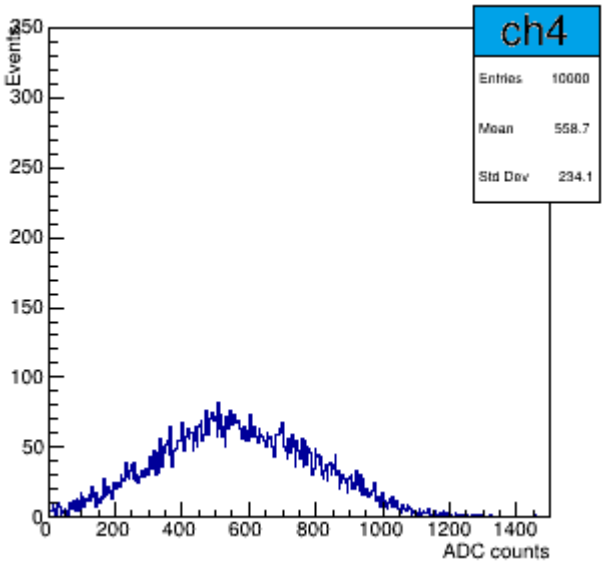
# 100MeV electron calibration

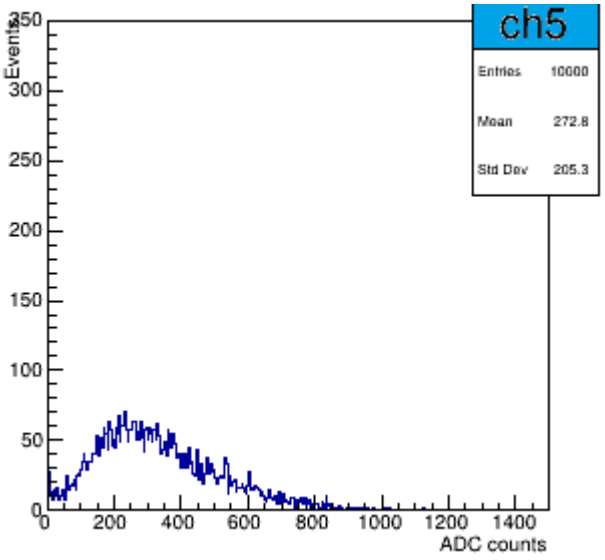
## Layer 1

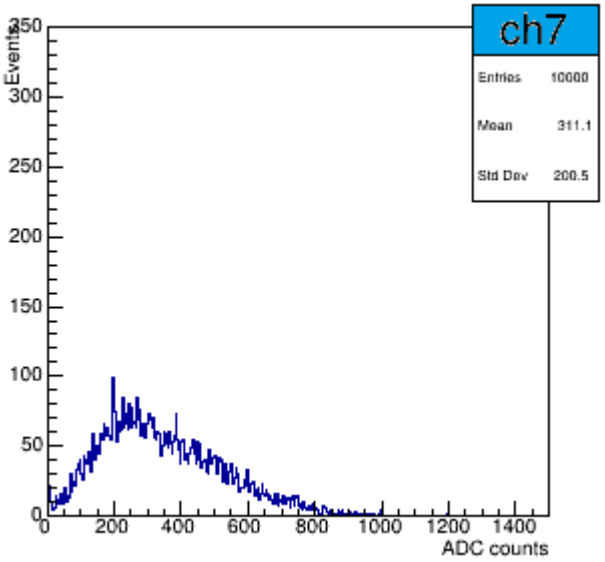
| | | |
|---|---|---|
| ch0 | ch1 | ch2 |
| ch3 | ch4 | ch5 |
| ch6 | ch7 | ch8 |



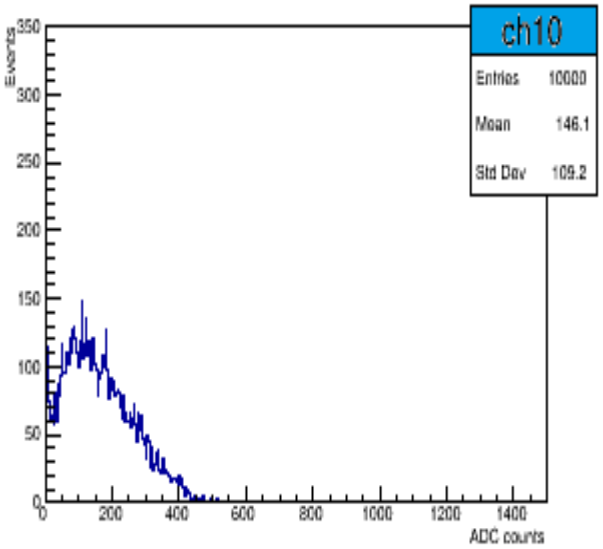



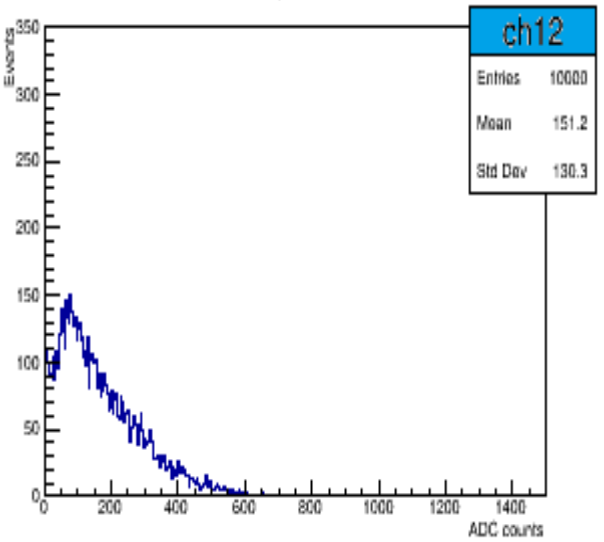

- ADC distributions for 100MeV calibration
- Electron beam irradiated channel by channel with shifting detector

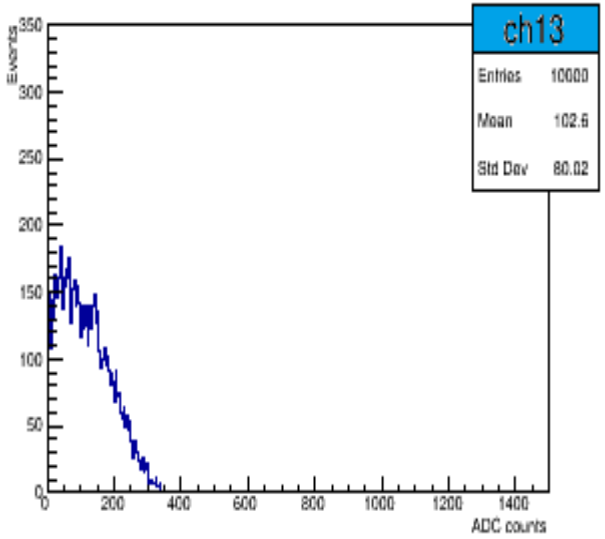
# 100MeV electron calibration

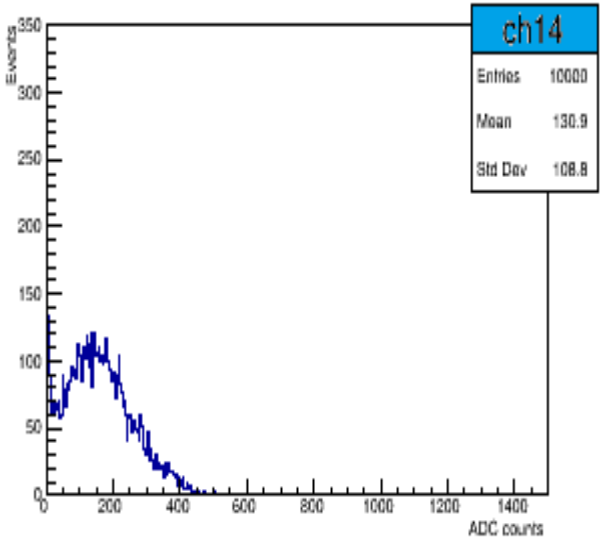
## Layer 2

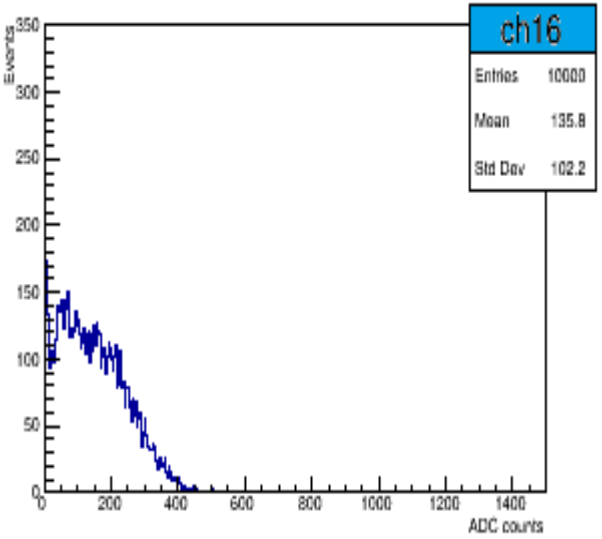
| | | |
|---|---|---|
| ch9 | ch10 | ch11 |
| ch12 | ch13 | ch14 |
| ch15 | ch16 | ch17 |



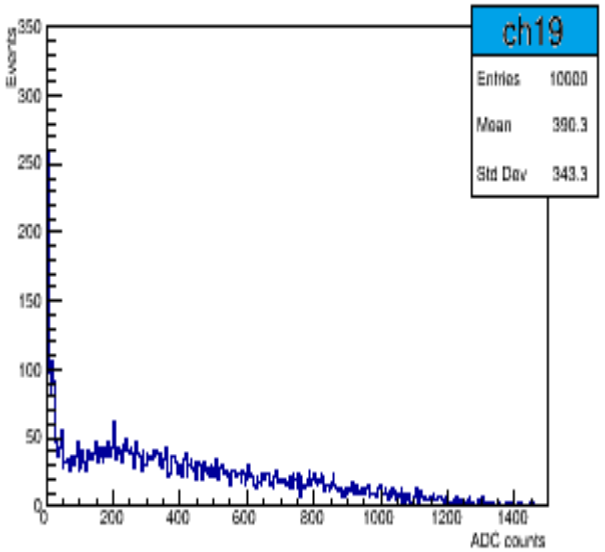



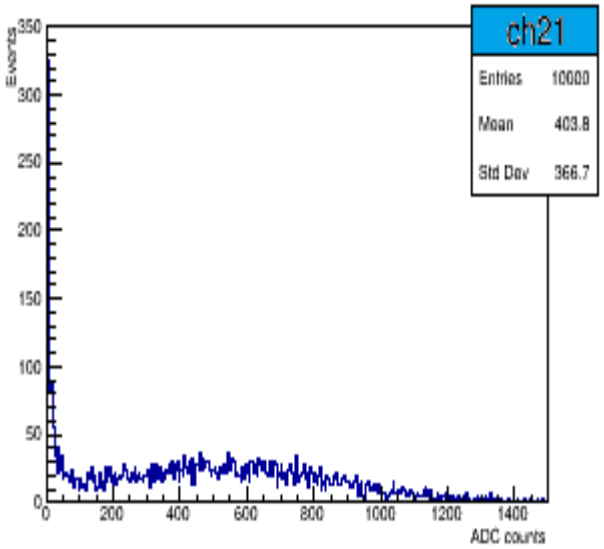

- ADC distributions for 100MeV calibration
- Electron beam irradiated channel by channel with shifting detector

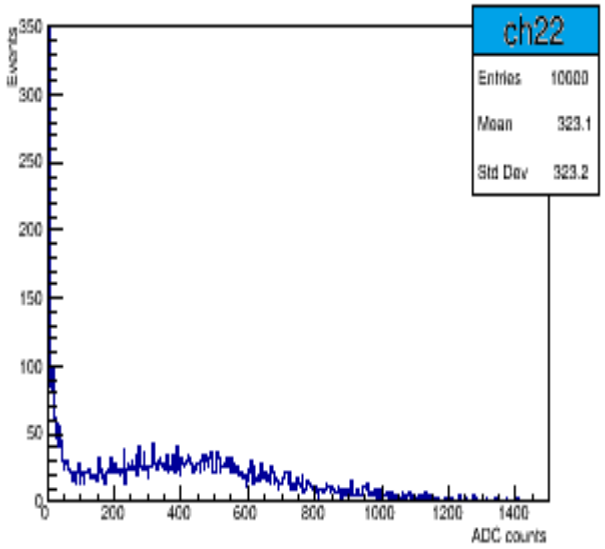
# 100MeV electron calibration

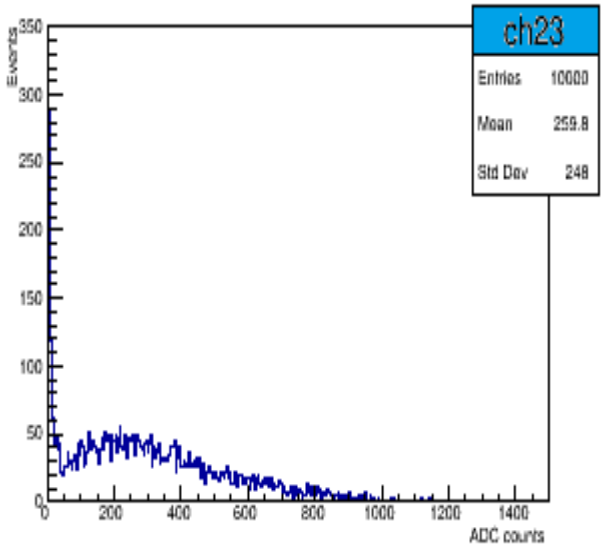
## Layer 3

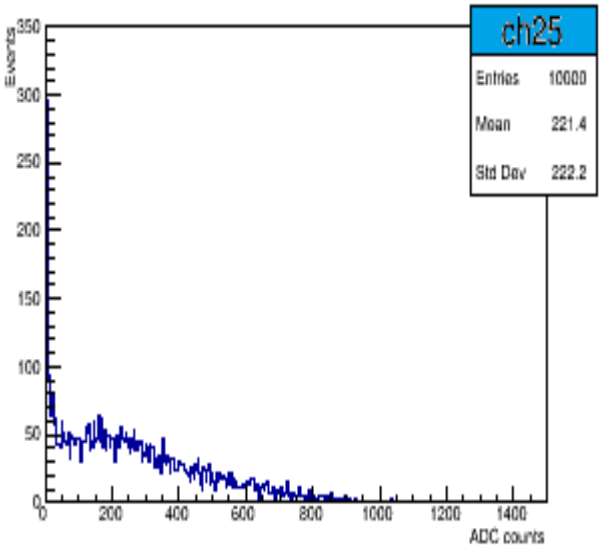
| | | |
|---|---|---|
| ch18 | ch19 | ch20 |
| ch21 | ch22 | ch23 |
| ch24 | ch25 | ch26 |




- ADC distributions for 100MeV calibration
- Electron beam irradiated channel by channel with shifting detector

# 100MeV electron calibration

Layer 1

| | | |
|---|---|---|
| ch0 | ch1 | ch2 |
| ch3 | ch4 | ch5 |
| ch6 | ch7 | ch8 |

Layer 2

| | | |
|---|---|---|
| ch9 | ch10 | ch11 |
| ch12 | ch13 | ch14 |
| ch15 | ch16 | ch17 |

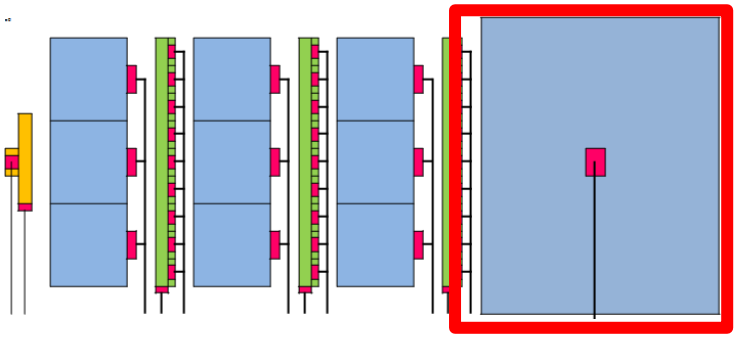
Layer 3

| | | |
|---|---|---|
| ch18 | ch19 | ch20 |
| ch21 | ch22 | ch23 |
| ch24 | ch25 | ch26 |

- **channels not irradiated by electron beams at the corners of layer**

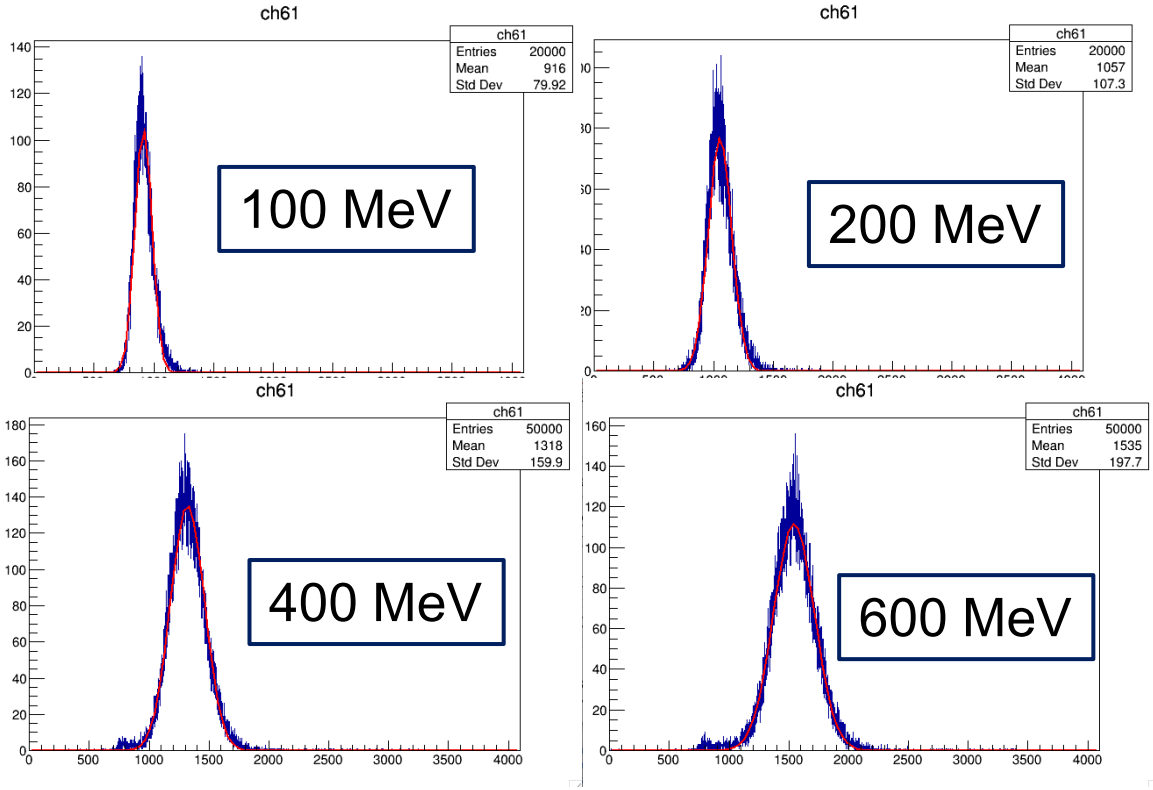
- **considering a method of calibrating these channels using side channel's shower leakage**

# Tail Catcher calibration

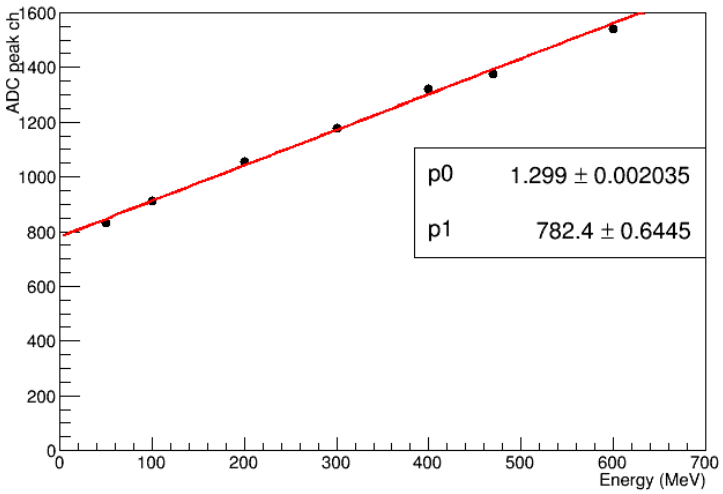


## ADC dist for Tail Catcher calibration

**Electron beam energy : 100MeV, 200MeV, 400MeV, 600MeV**




## ADC peak ch vs Energy




- combine these information and Active Absorber layer information

# Summary

- We made Active Absorber using Lead Glass blocks.
- detecting Cherenkov light with MPPC

- Measure the EM shower at ELPH (11/21).
- Calibration of Active Absorber layer was performed at 100MeV.
- Energy scan from 100MeV to 800MeV will result energy resolution.

- Analysis on going.

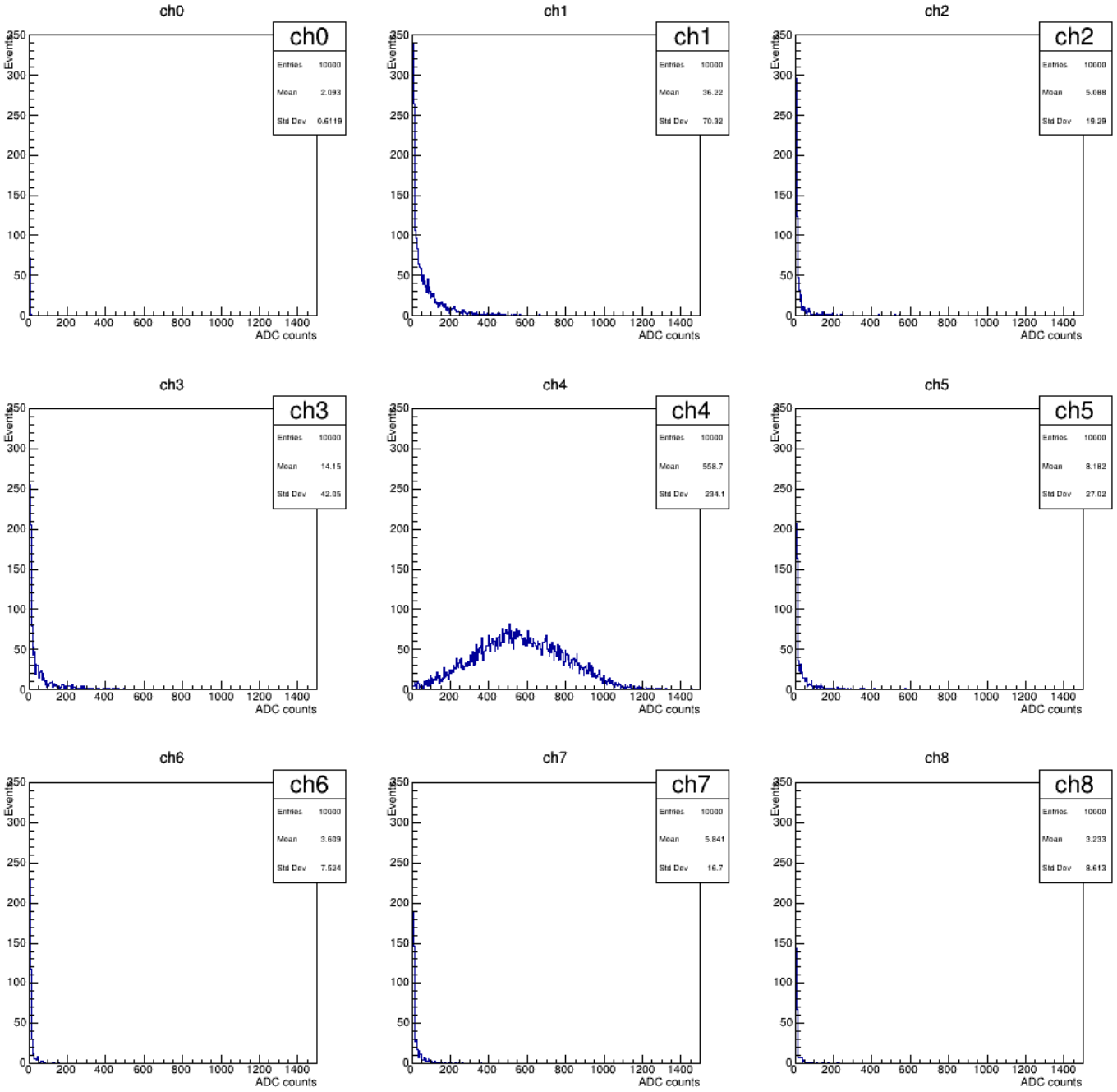
Plan

- combine Active Absorber layer and Strip layer information
- Temperature correction

# Back up

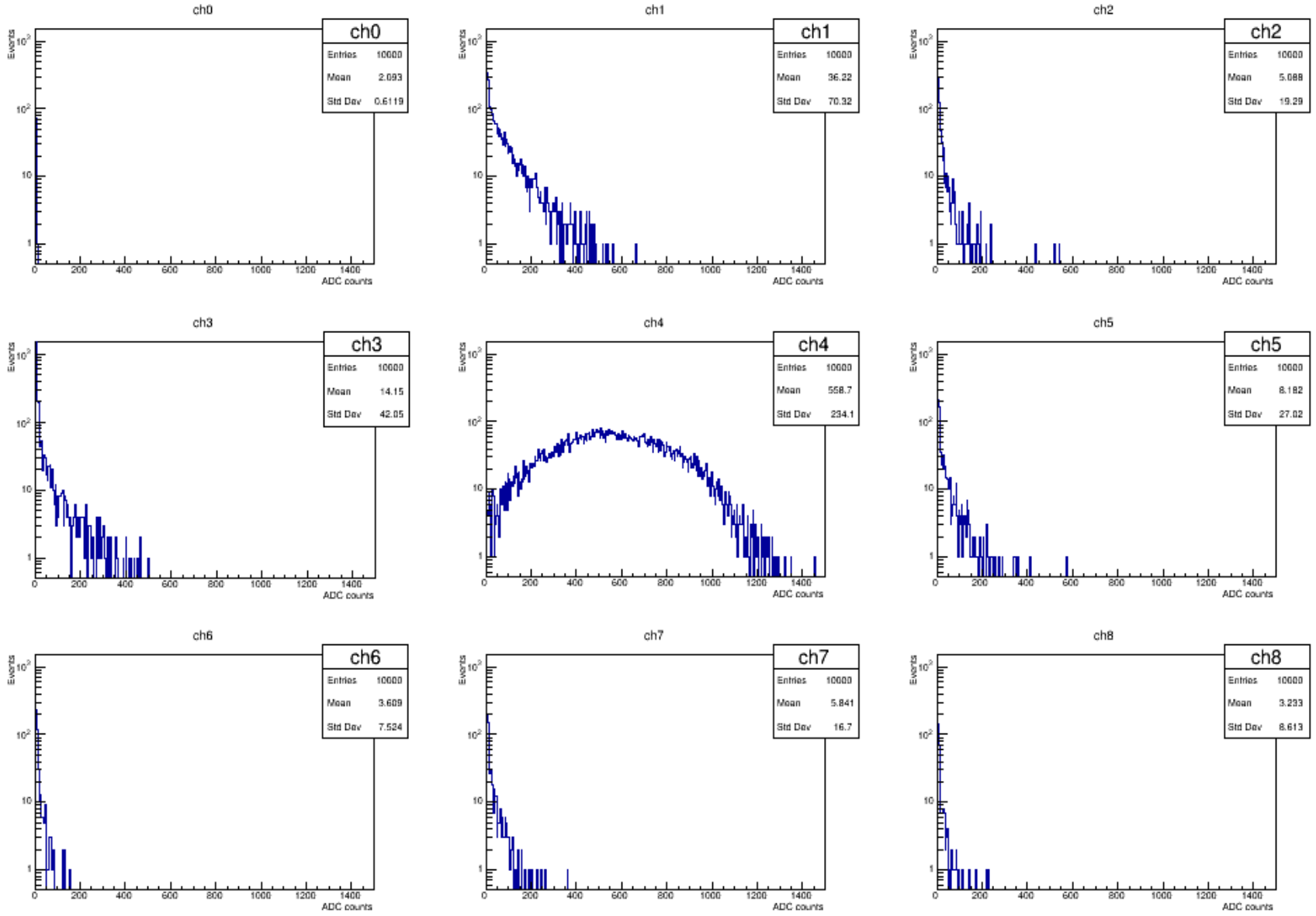
# Layer 1 100MeV electron (ADC dist ) @ELPH



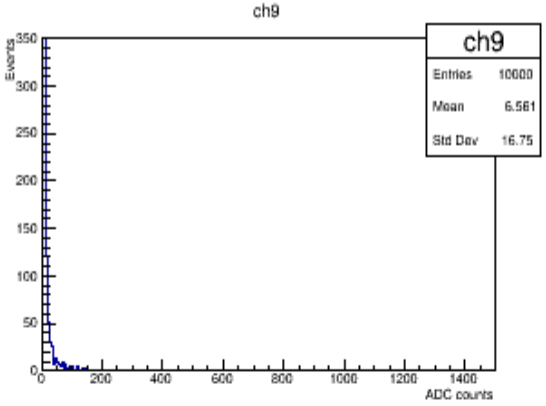


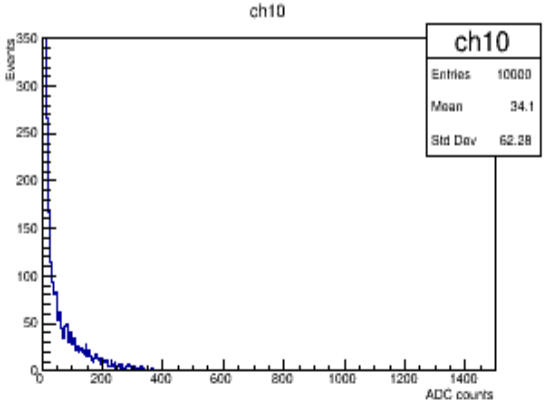
# Layer 1 100MeV electron (ADC dist log scale) @ELPH

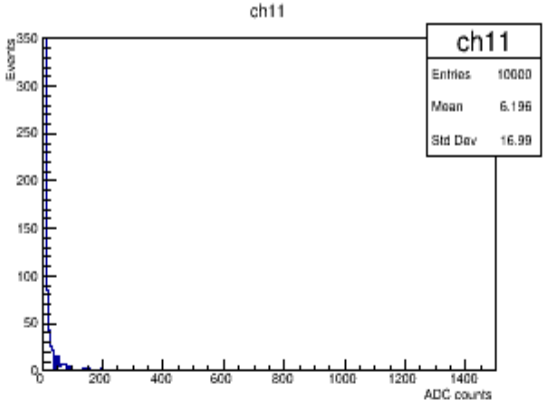


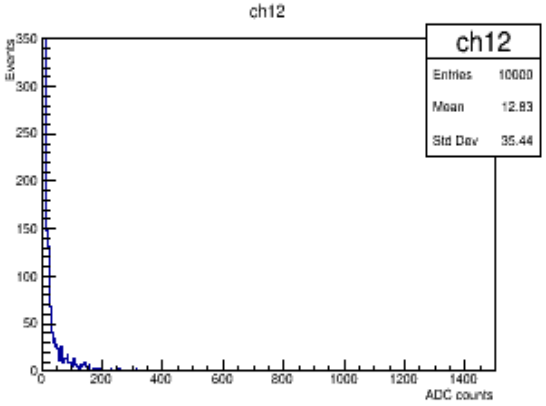


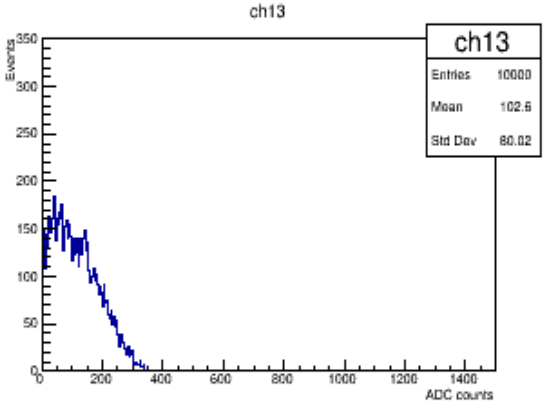
# Layer 2 100MeV electron (ADC dist ) @ELPH

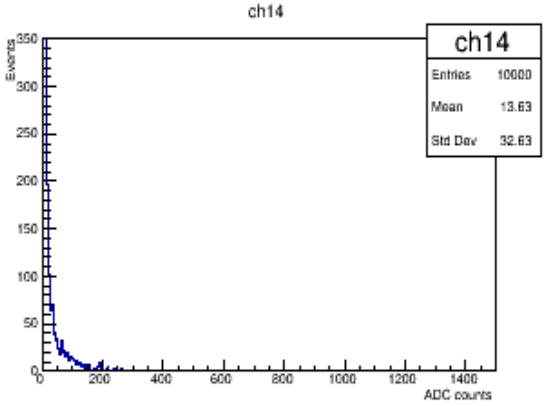


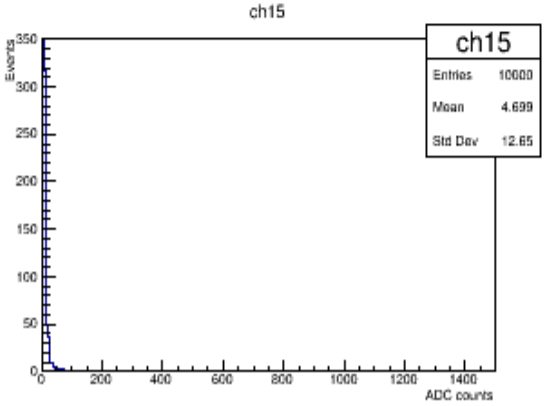



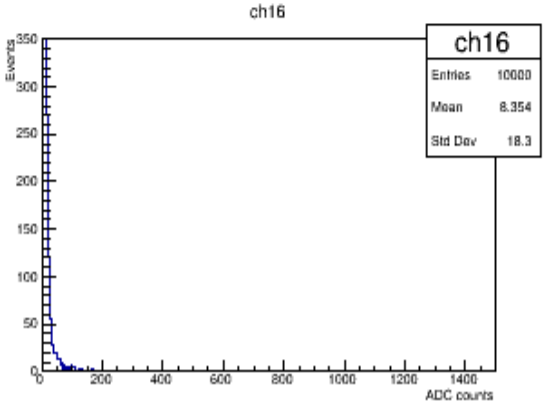



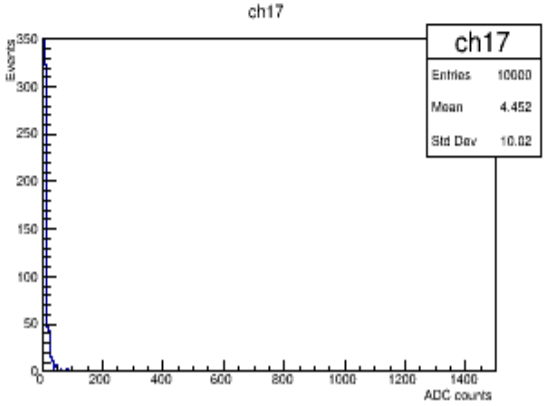



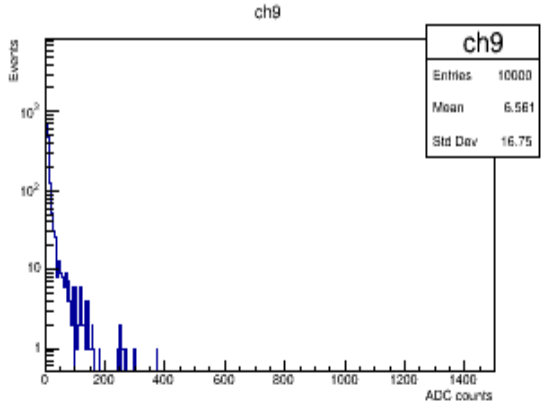



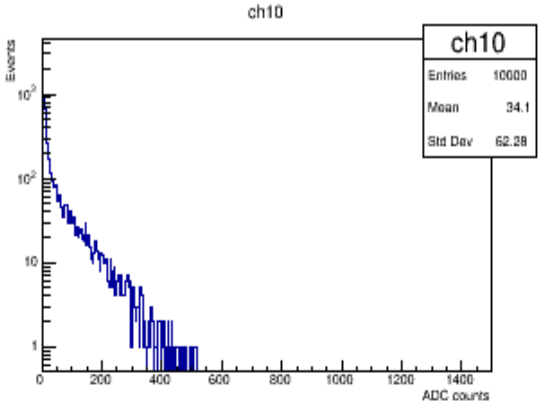



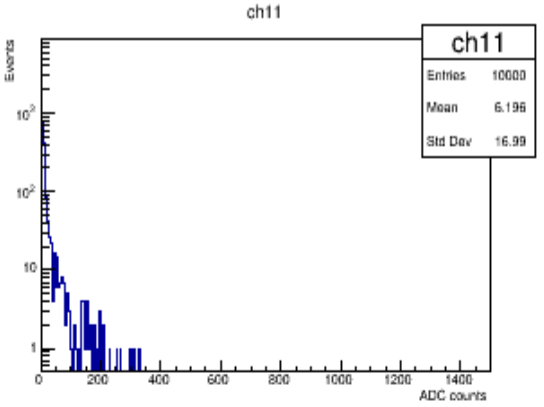



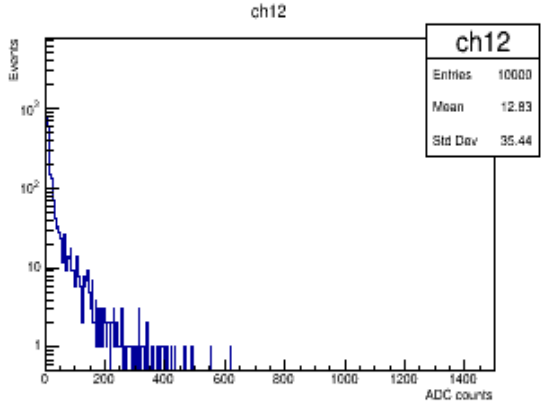



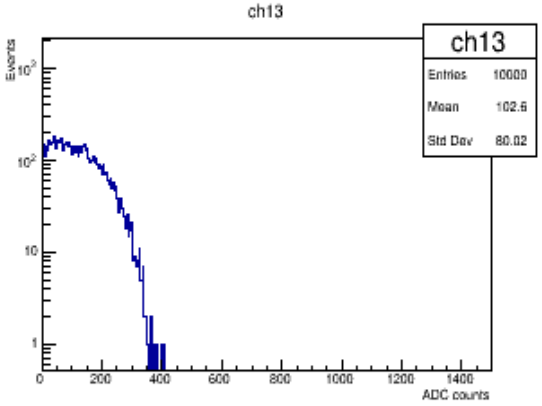
# Layer 2 100MeV electron (ADC dist log scale) @ELPH

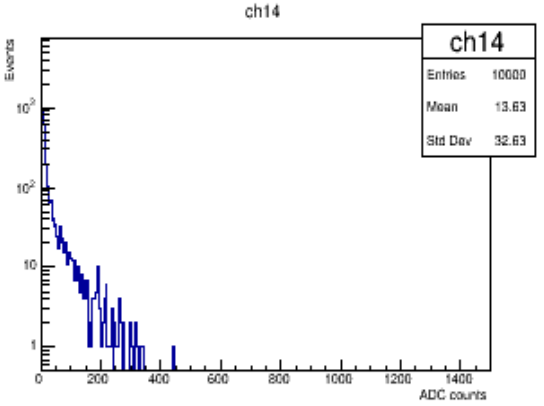


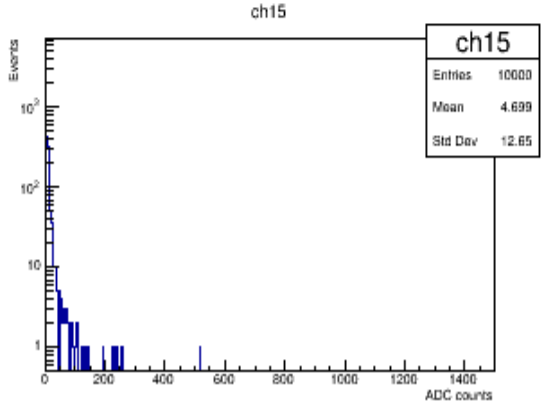



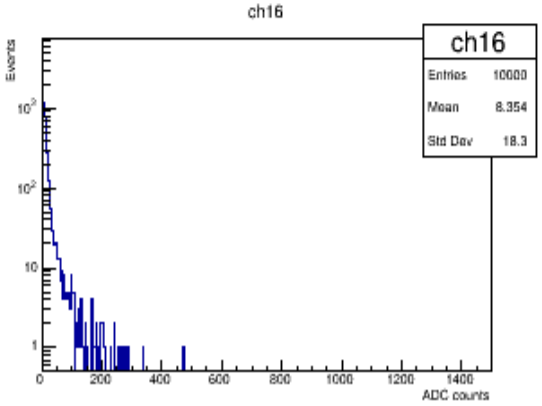



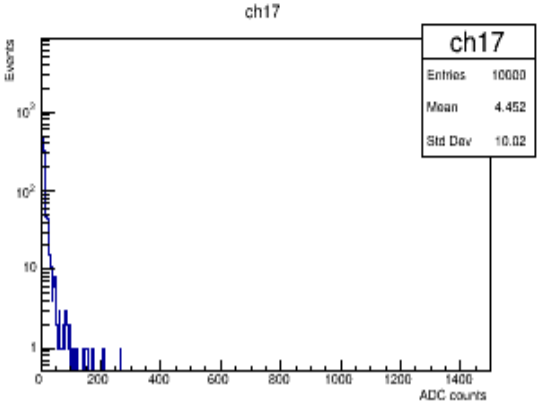



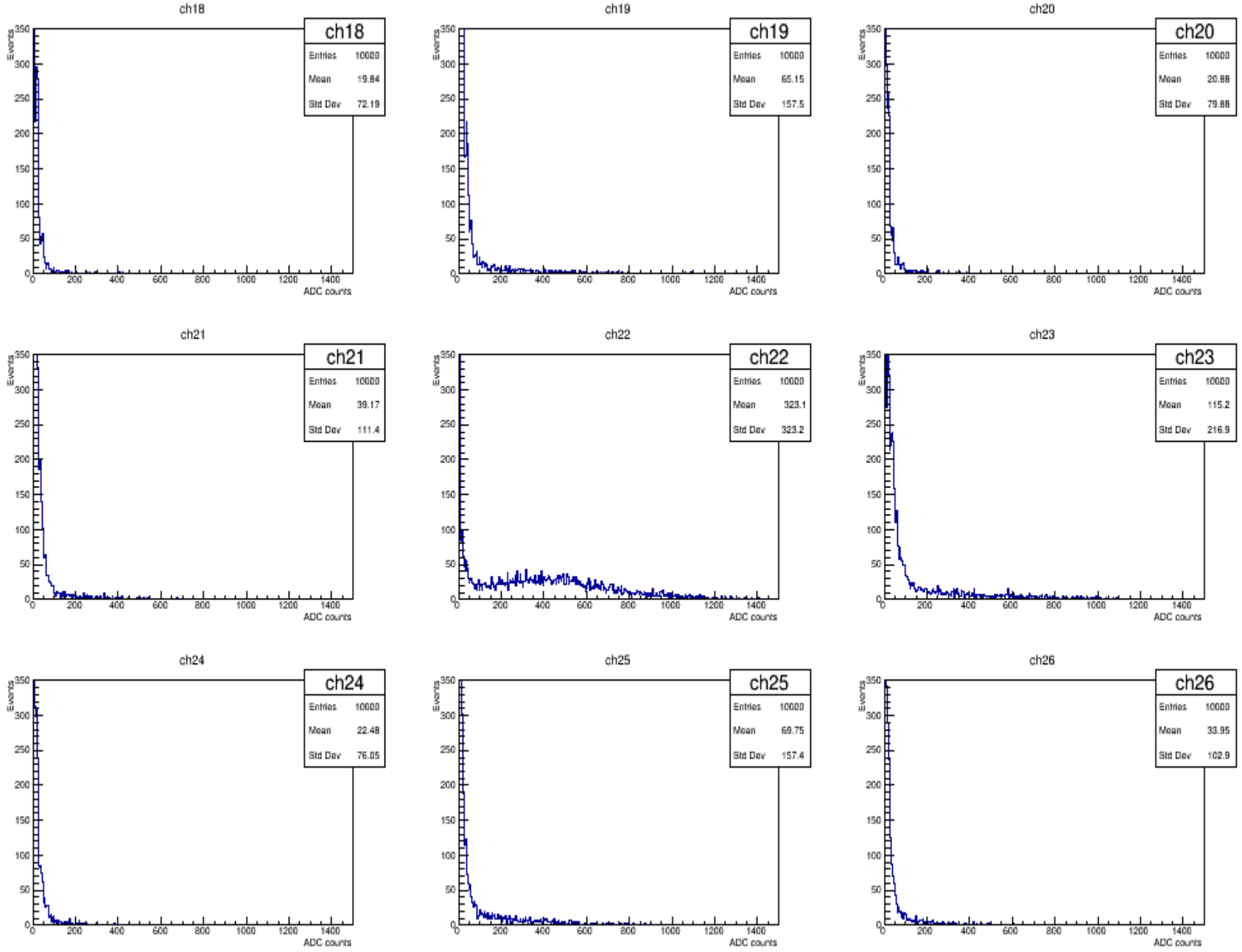



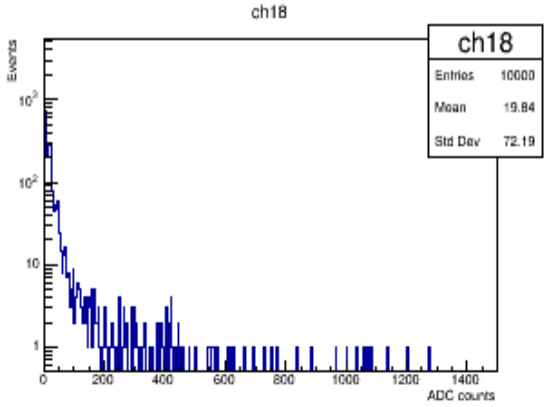
# Layer 3 [75μ MPPC] 100MeV electron (ADC dist log scale) @ELPH

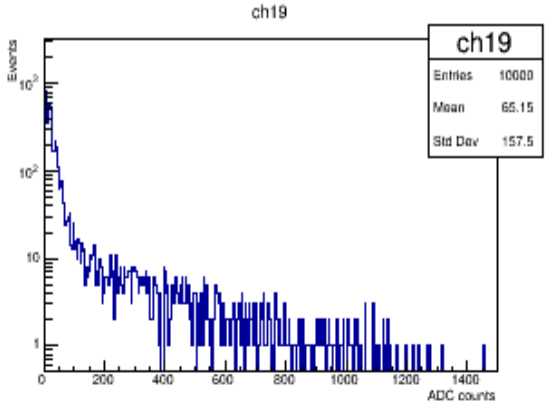


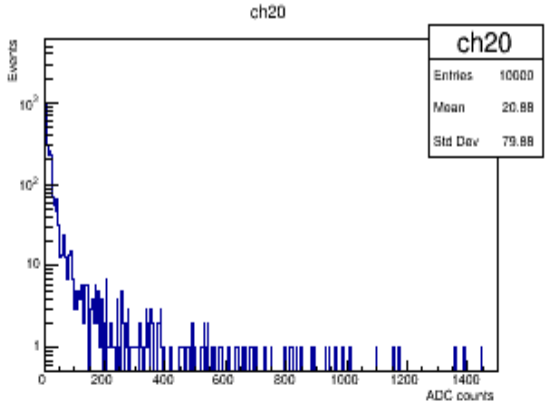


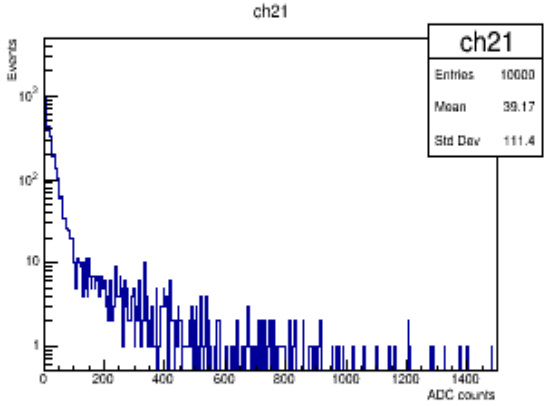
# Layer 3 [75μ MPPC] 100MeV electron (ADC dist log scale) @ELPH

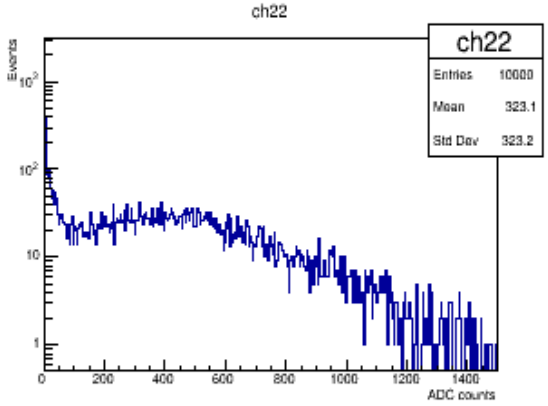


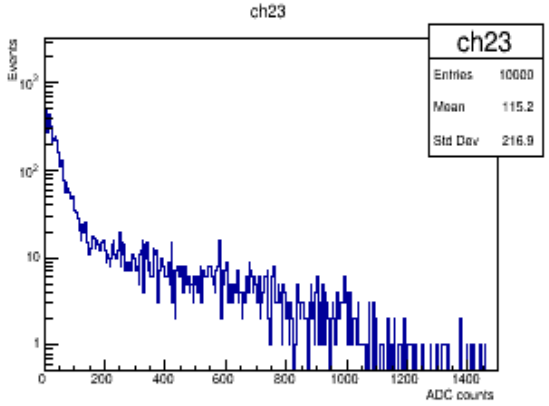


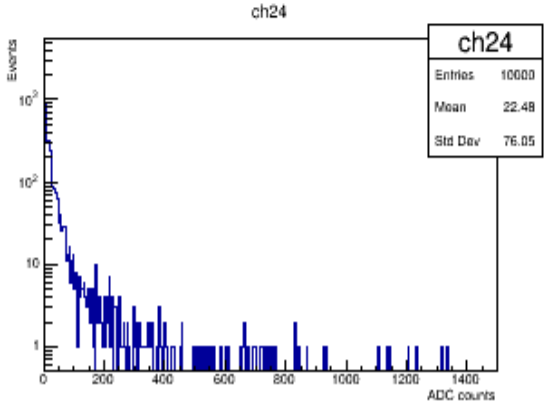



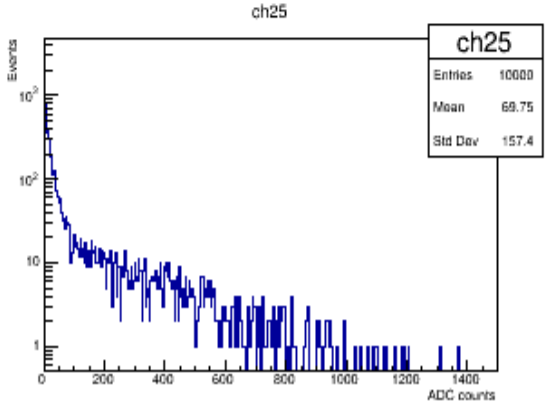



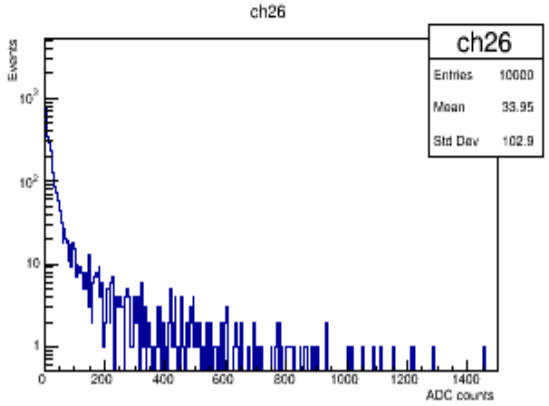



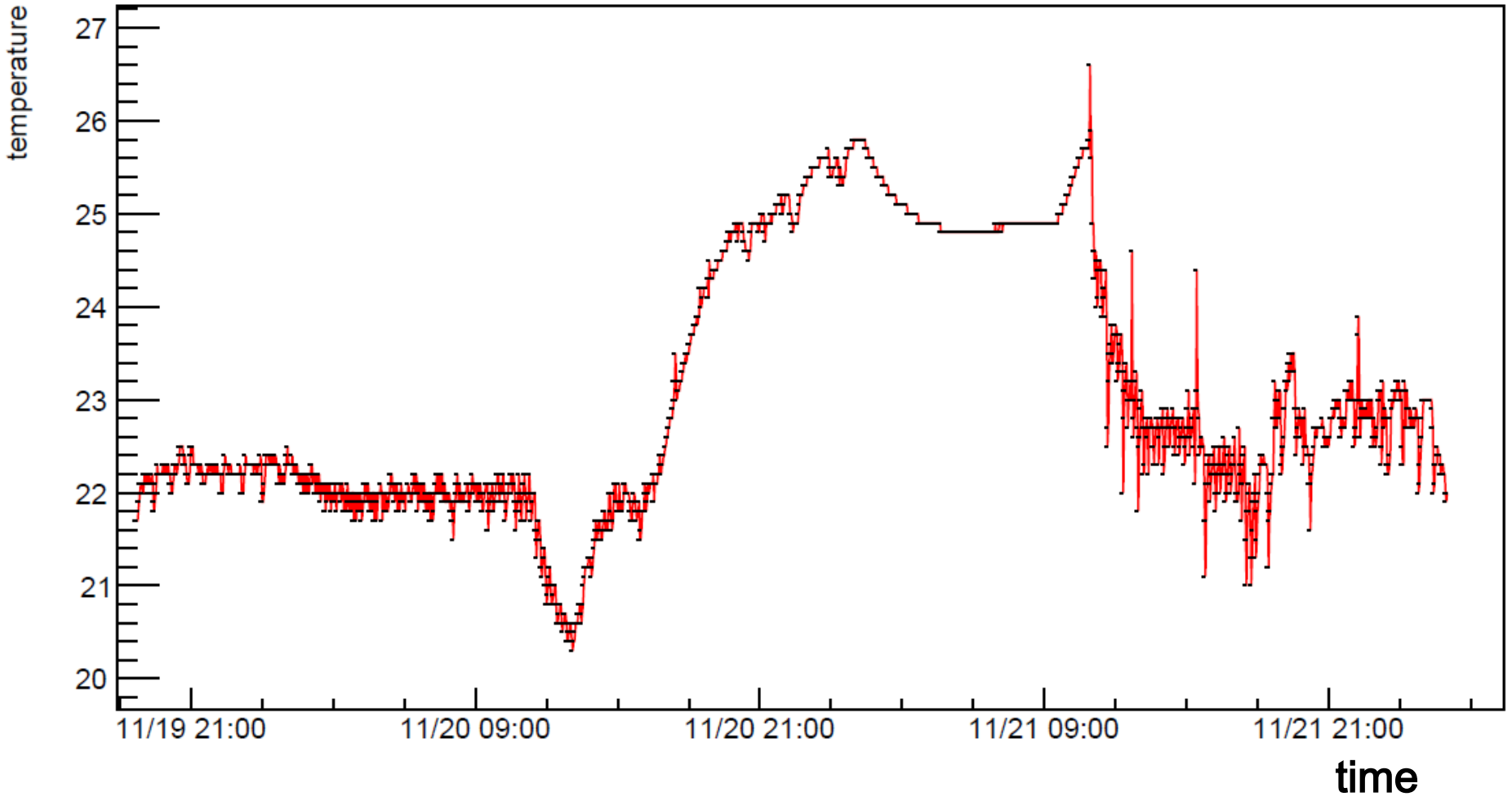



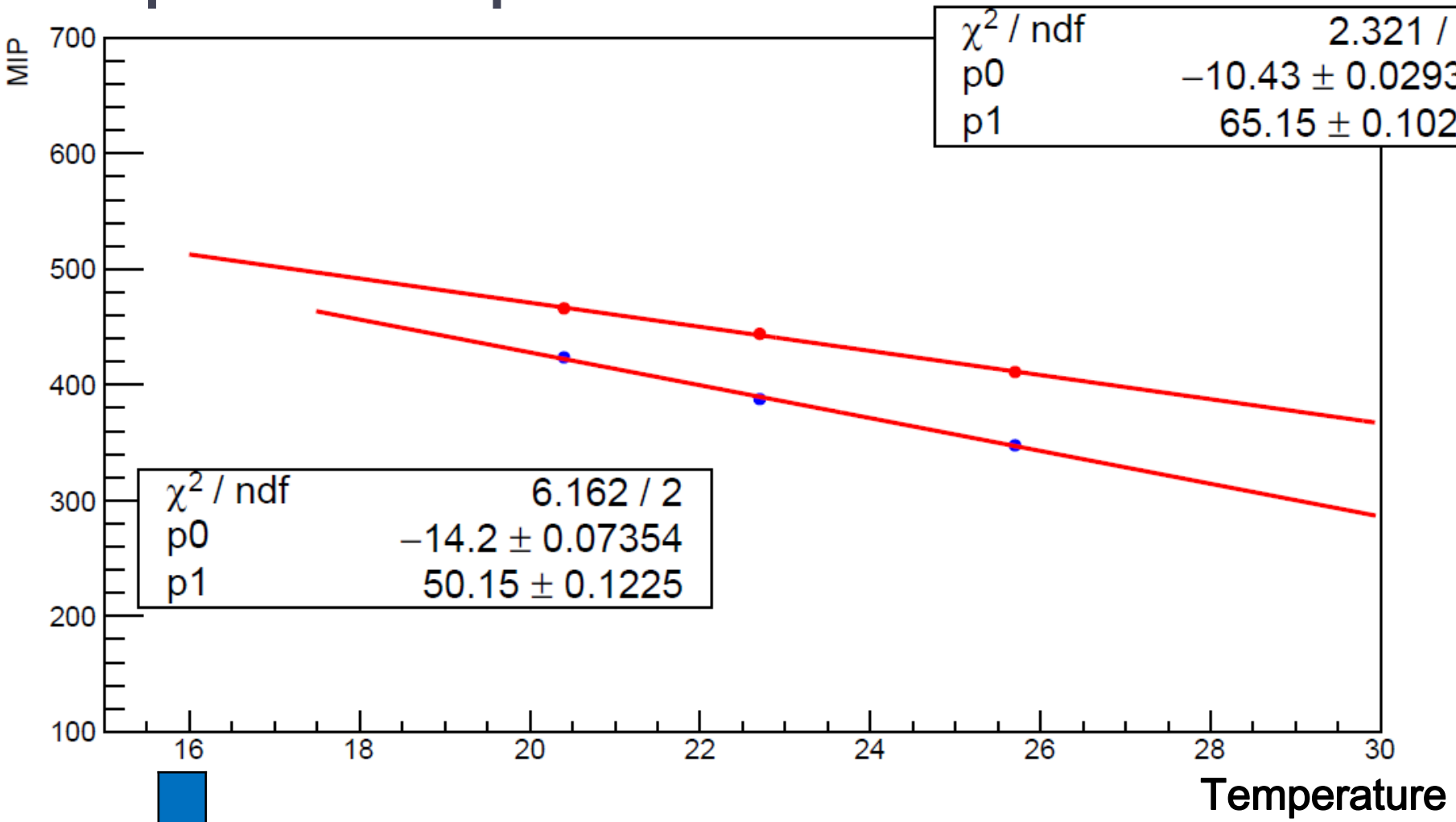



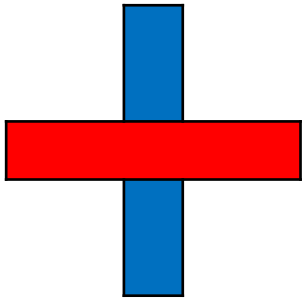



# Temperature



# Trigger counter
# MIP peak vs temperature



**red points : horizontal strip scintillator**
**blue points : vertical strip scintillator**