The Status of the HCAL

2025-04-29

Qian Sen, on behalf of the HCAL Group

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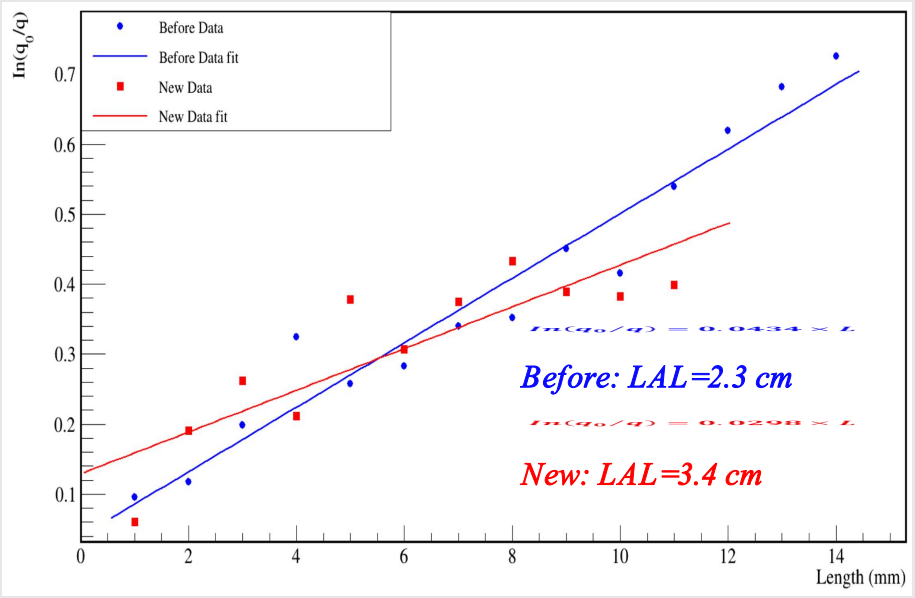
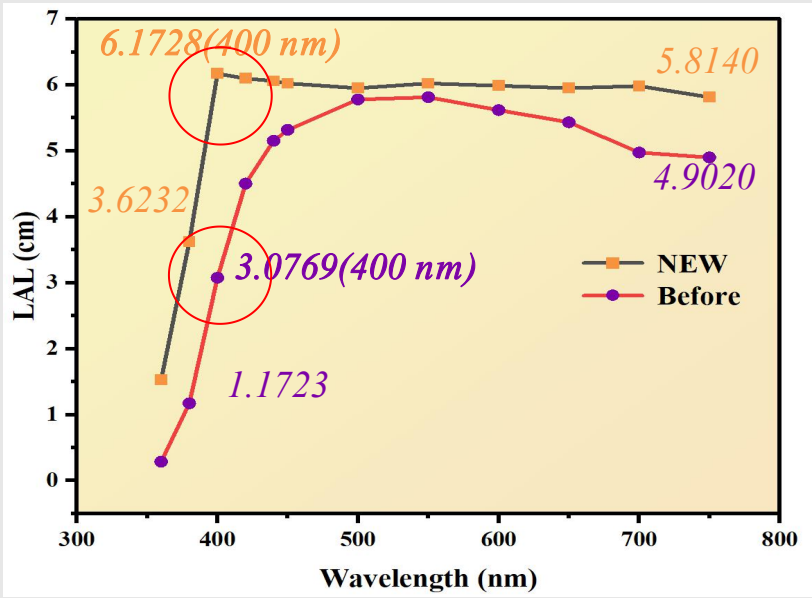
Current status of the GS-HCAL Glass Scintillator

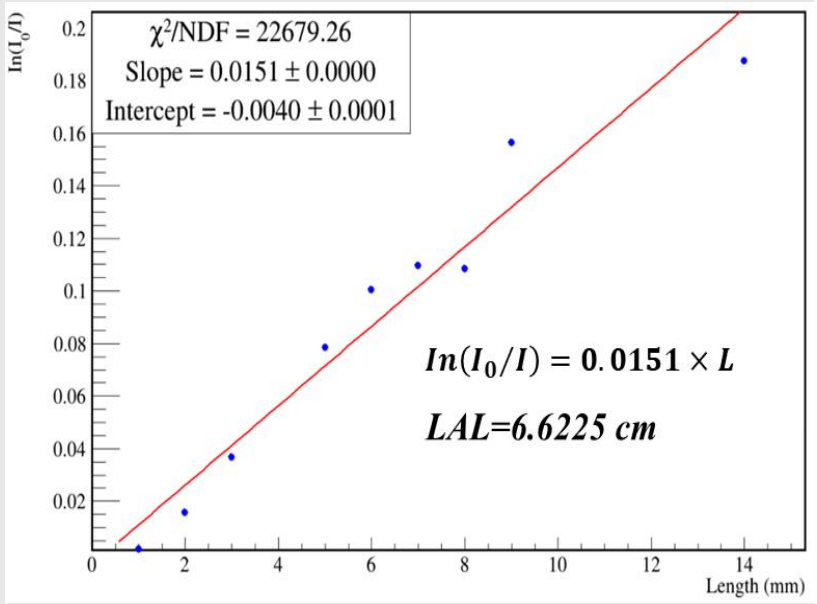
Light attenuation length Calculated by LY, transmittance and light intensity



Calculated by LY



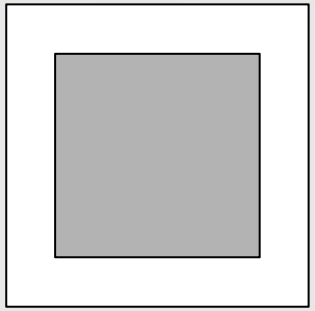
Calculated by transmittance

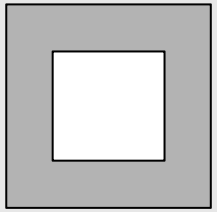


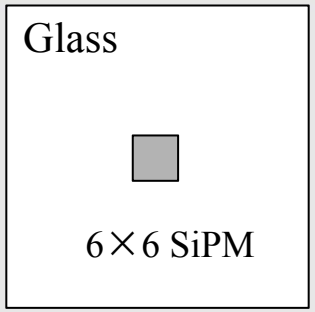
Calculated by light intensity

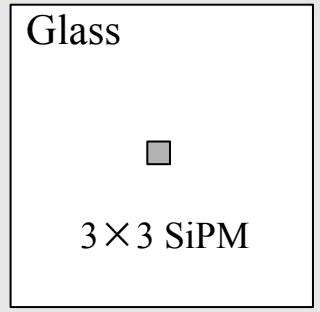
- The new LAL calculated by LY is **3.4 cm（New）**, the previous test is 2.3 cm
- The new and previous LAL calculated by transmittance are **6.1728 cm（New）** and 3.0769 cm in the wavelength of 400 nm
- LAL calculated by light intensity is 6.6225 cm（New）

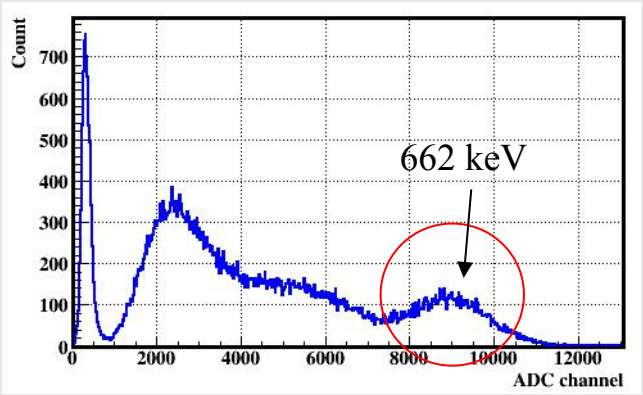
Current status of the GS-HCAL SiPM+GS

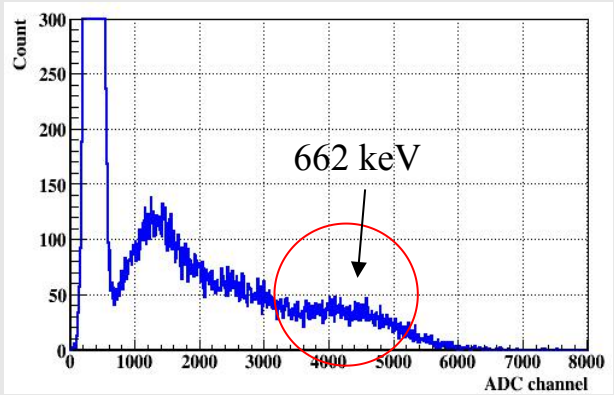


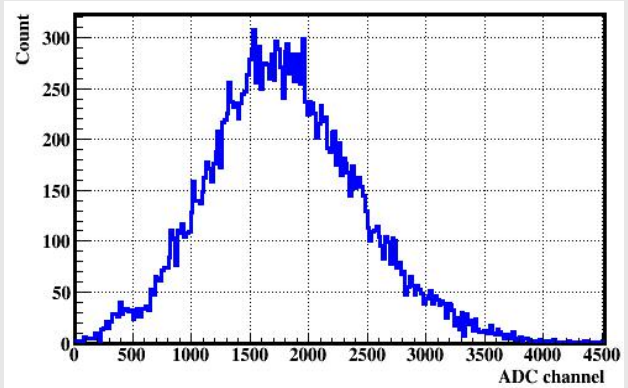


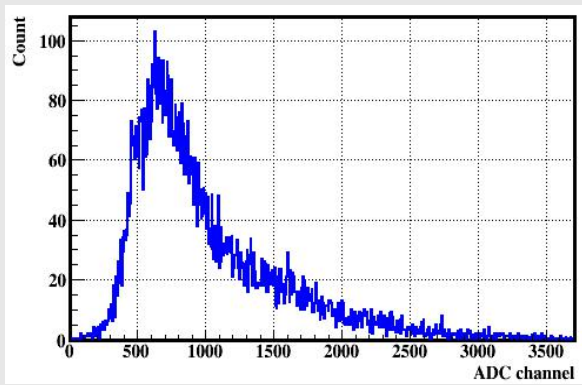












GS：5mm*5mm*5mm
SiPM：6 mm*6mm

GS：5mm*5mm*5mm
SiPM：3 mm*3mm

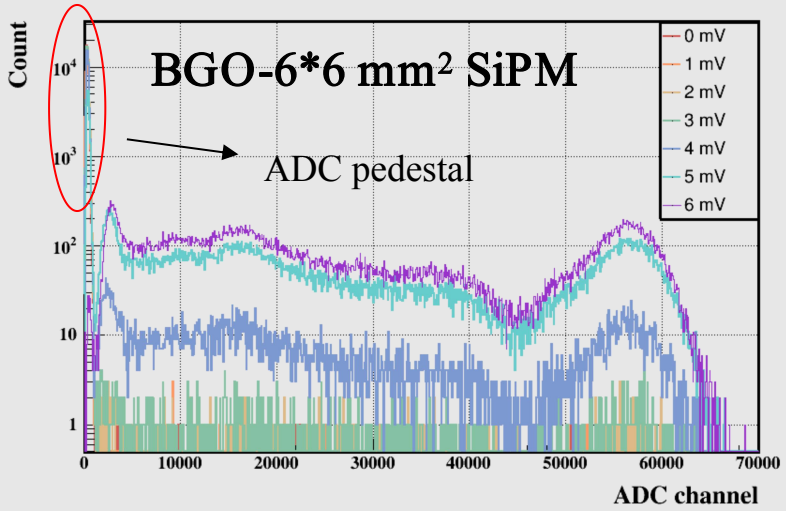
GS：40mm*40mm*10mm
SiPM：6 mm*6mm

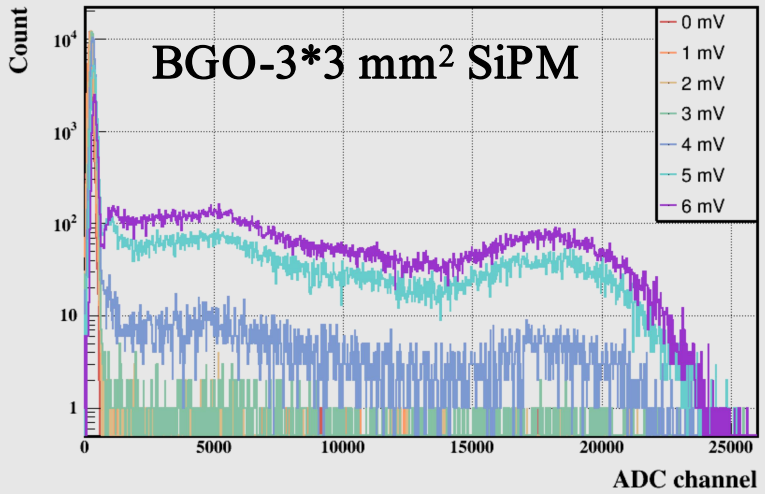
GS：40mm*40mm*10mm
SiPM：3 mm*3mm

1. HPK 13360S-6025CS 6×6 mm^2, PDE@400 nm=23%
2. HPK 13360S-3025CS 3×3 mm^2, PDE@400 nm=23%

SiPM coupled glass	LY (ph/MeV)
Single 3×3 mm	51
Single 6×6 mm	190
PMT test (2inch-XP2020)	922

Current status of the GS-HCAL SiPM+GS





Experimental conditions

- Scintillator: BGO, GS
- Dimension: 5*5*5 mm³
- Detector:

1. HPK 13360S-6025CS

6×6 mm², PDE@400 nm=23%

2. HPK 13360S-3025CS

3×3 mm², PDE@400 nm=23%

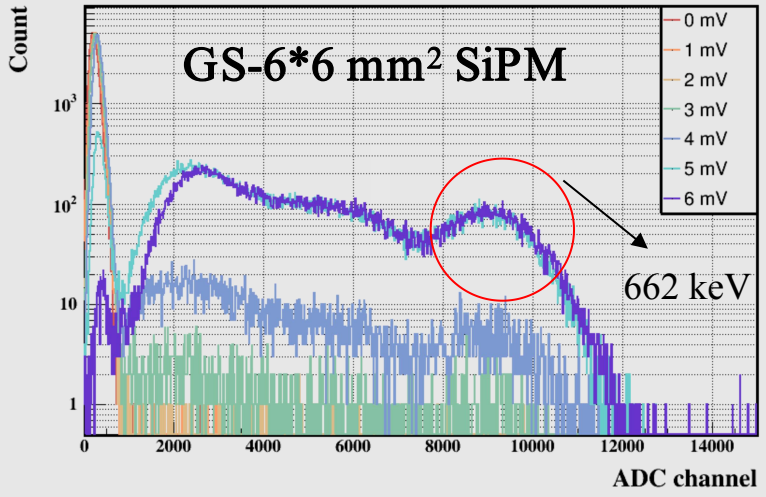
DAQ: DT5751

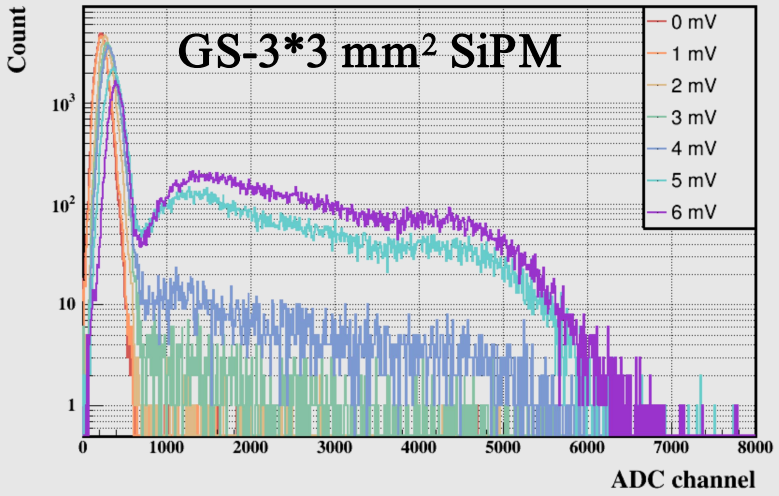
Integral gate: 1000 ns

Coupling: Silicone grease

Reflector: Teflon

Source: ^{137}Cs



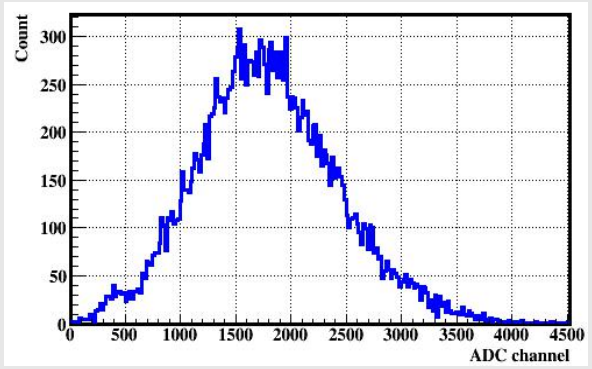


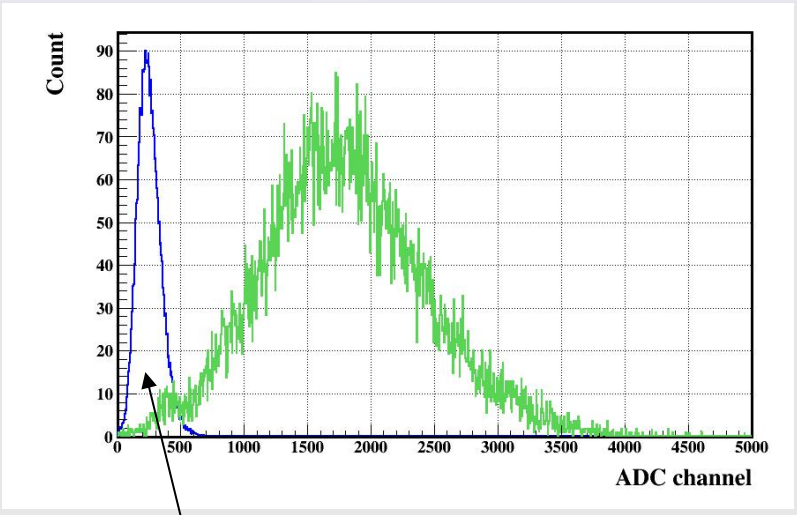
- The influence of threshold setting on energy spectrum testing was investigated
- With increase of the threshold, count rate of noise decreases and scintillation signal increases
- Excluding the pedestal, the light yield of BGO is 7919 ph/MeV (11.7%@662keV), and that of GS is 1331 ph/MeV (24.7%@662keV).

Glass

6×6 SiPM

GS：40mm*40mm*10mm
SiPM：6 mm*6mm



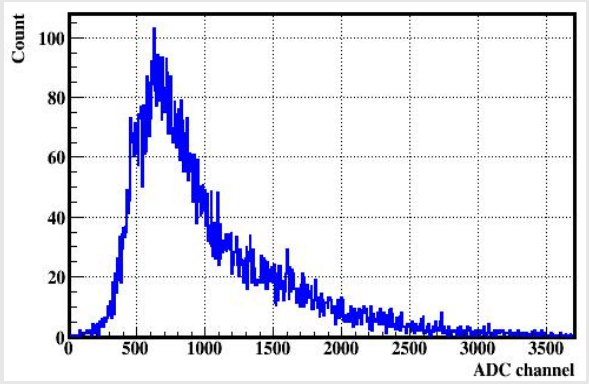


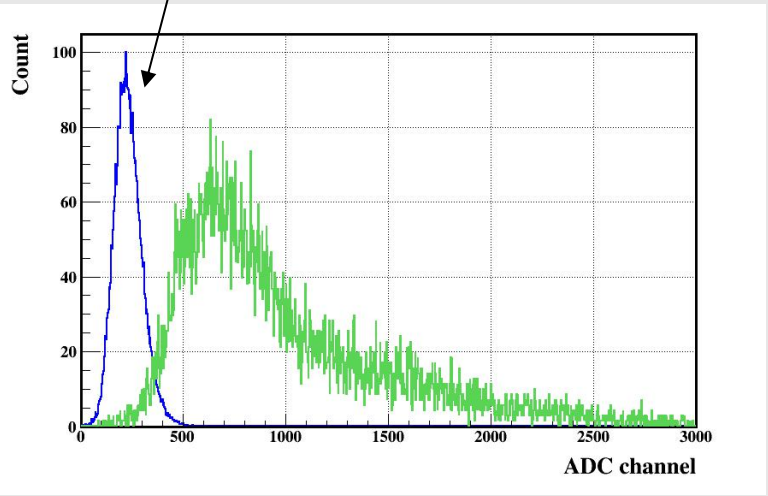
Electronic pedestal

Glass

3×3 SiPM

GS：40mm*40mm*10mm
SiPM：3 mm*3mm





Current status of the GS-HCAL Simulation

- Two Post Doctors of SJTU join us for the milulation work with Guo Fangyi and Li Henne

Overview

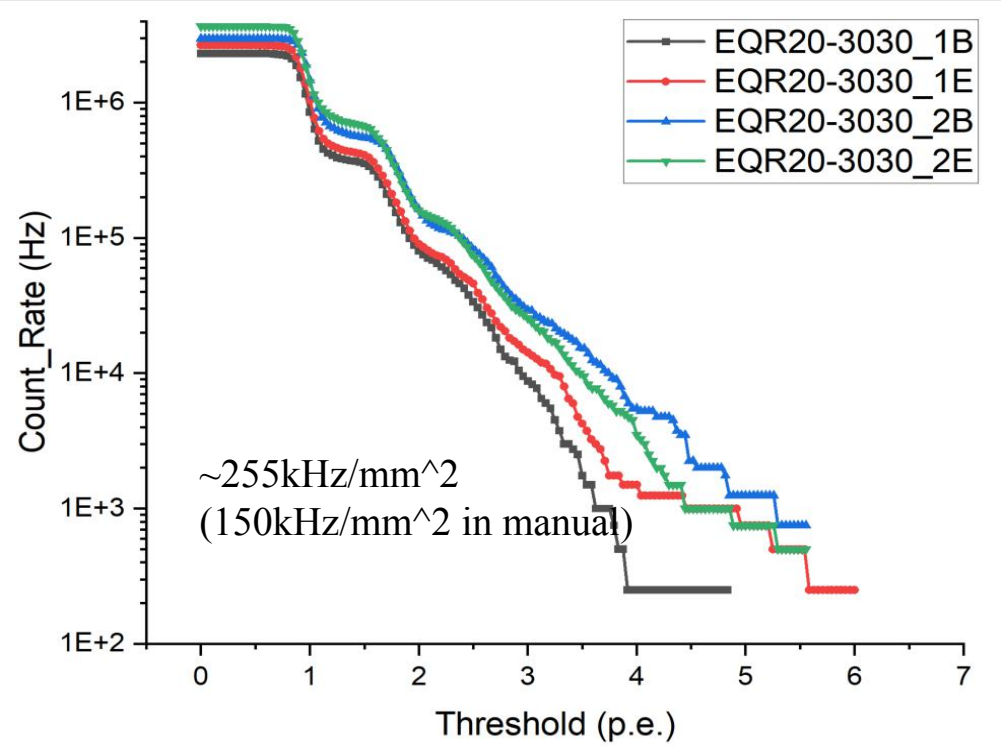
上海交通大學 SHANGHAI JIAO TONG UNIVERSITY | 李政道研究所 Tsung-Dao Lee Institute

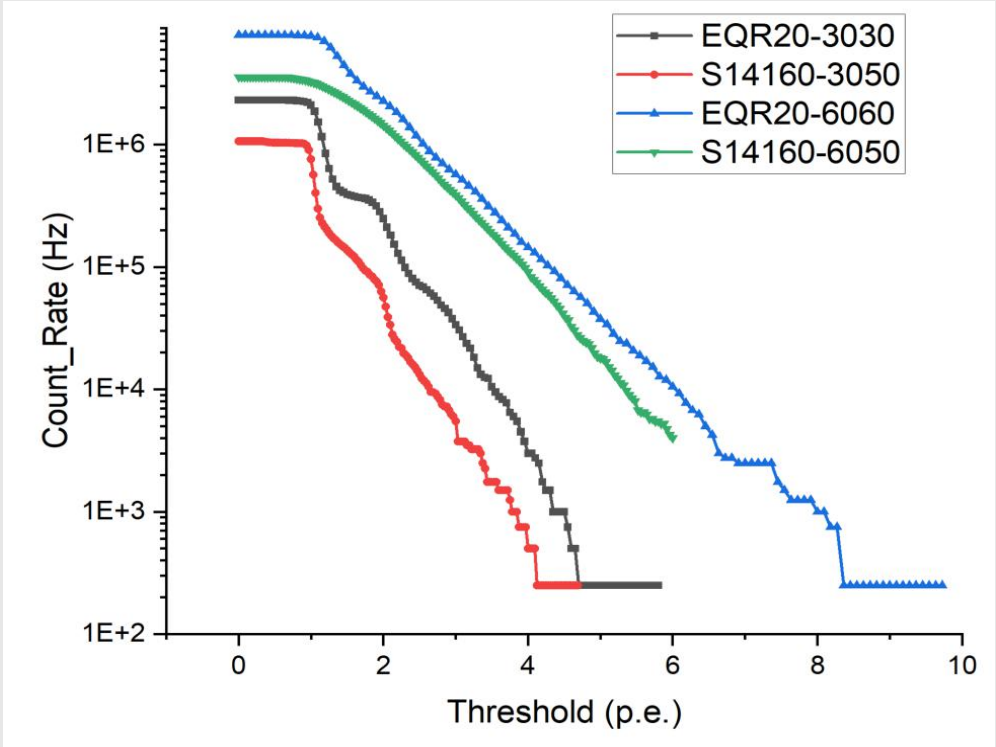
- Starting from Fangyi's instruction
- Short term task:
  - 4 SiPM -> 1 SiPM
  - Scan attenuation length
    - {40, 60, 80} x {6*6, 3*3} need map -> 6 sets
  - With a higher light yield
    - -> 50 ~ 200 {50, 80, 100, 150, 200}
    - With Latt {20, 30, 45, 50, 55}, 6*6
  - SiPM
    - 6*6 -> 3*3
    - PDE Raise to 60%
- Current sets:
  - Geometry: HCAL only
  - Birks: 0.01
  - Light yield: 80 p.e./MIP
  - Threshold: 0.1 MIP -> 8P.E/LY
  - Attenuation length: 23 mm
  - SiPM readout scheme: 1 SiPM. 6025PE
  - ADC saturation: 8192 channel, 3 gain modes.

Current status of the GS-HCAL SiPM

DCR

1) 1 p.e. ≦ 3mV
2) NDL SiPMs (3*3) DCR is not so consistent. HPK has lower DCR (50% of NDL) .
3) For 5 p.e. threshold, NDL DCR is ~28 Hz/mm^2, and HPK DCR is ~12 Hz/mm^2.





Current status of the GS-HCAL SiPM

➢ SiPM radiation resistance test (supported by FuDan)

1). Test PCB and SiPM samples

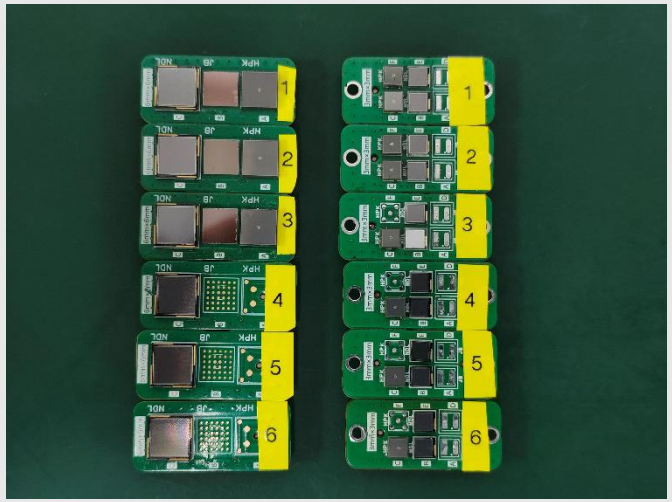
ready, HPK, NDL and JBT,

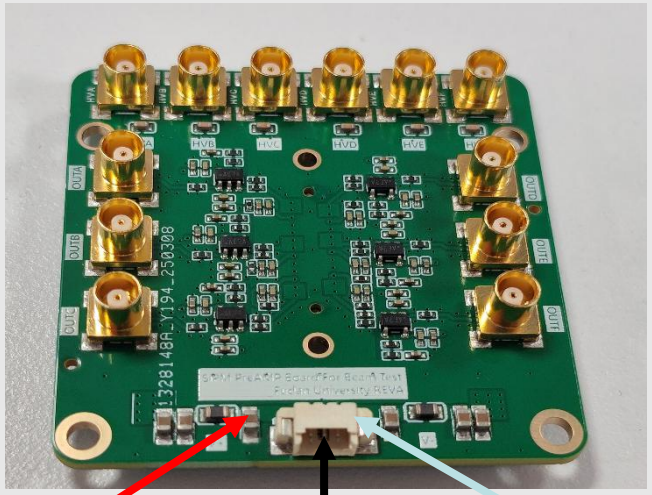
① 3*3(18pces) mm^2 SiPMs.

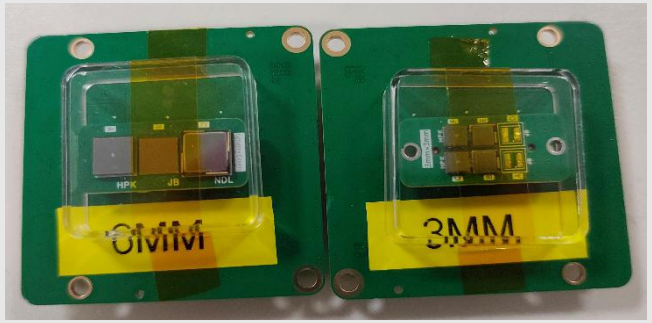
② 6*6 (12pces) mm^2 SiPMs.

2). Compare:

I/V curve, Id, DCR, relative gain, etc.

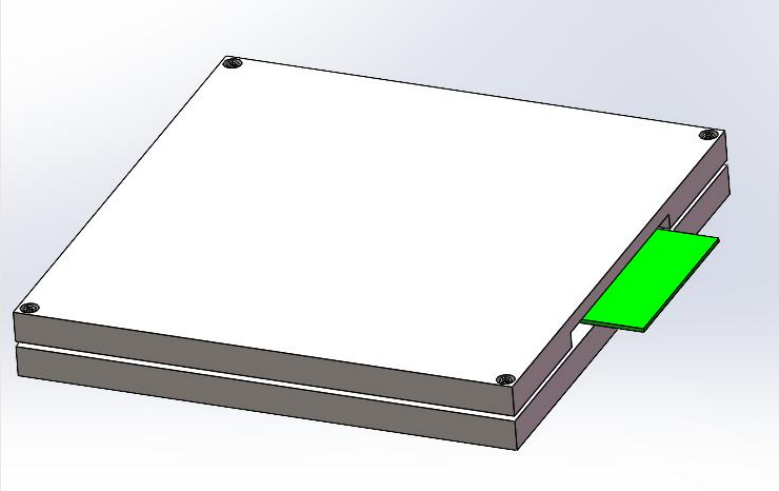


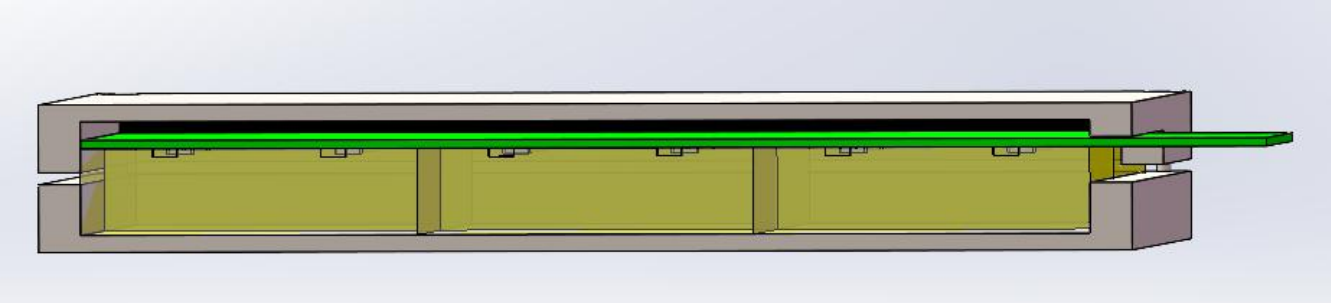


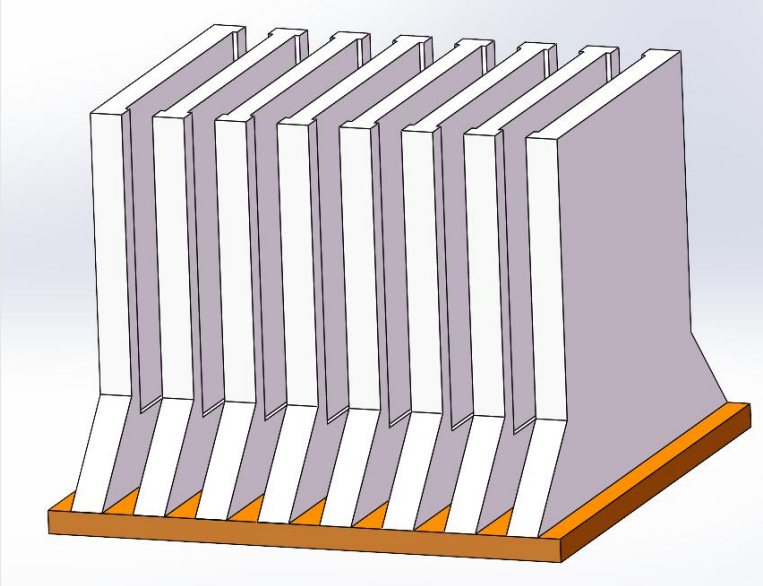


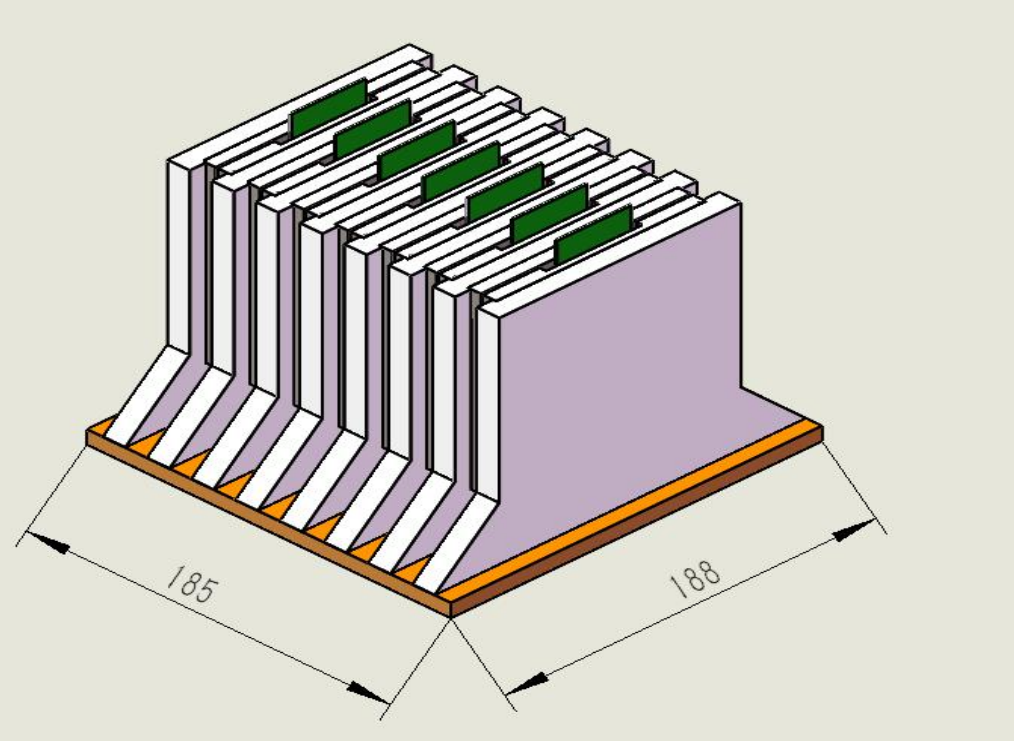
Item			NDL	HPK	JBT
1	SiPM	3*3	2*6 = 12 (EQR20 11-3030D-S)	1*6 = 6 (S14160-3050HS)	0 (RQL3035QFN)
2	SiPM	6*6	1*6 = 6 (EQR20 11-6060D-S)	1*3 = 3 (S14160-6050HS)	1*3 = 3 (JSP-TP6050-SMT)
3	base(PCB)		2 SiPM/PCB	2 SiPM/PCB	2 SiPM/PCB
4	FEB+SiPM		3 sets (4-3*3 SIPM)	3 sets-(4-6*6 SIPM)	-
	Compare: I/V, Id, DCR, rGain(50%), etc.				

Current status of the GS-HCAL Mini-Prototype





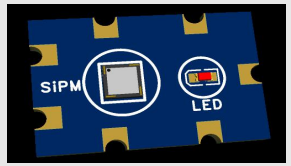




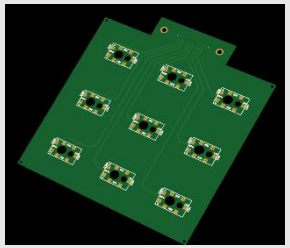
Current status of the GS-HCAL Mini-Prototype

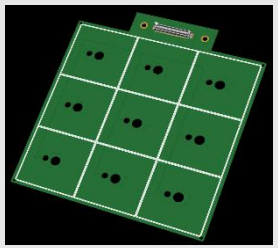
➢ Mini-prototype consideration

One 3*3mm^2 SiPM + 1 LED/Cell

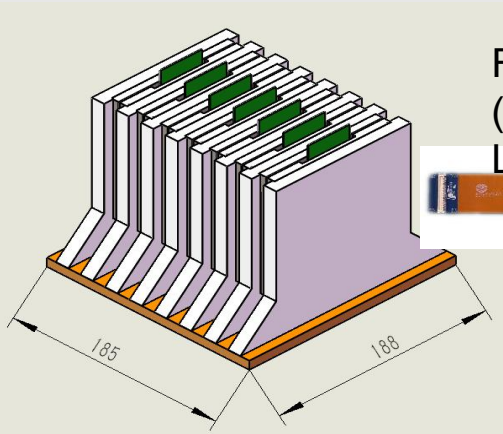


3*3=9 cells / layer. Prepare both W&O preamp

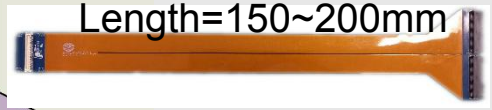




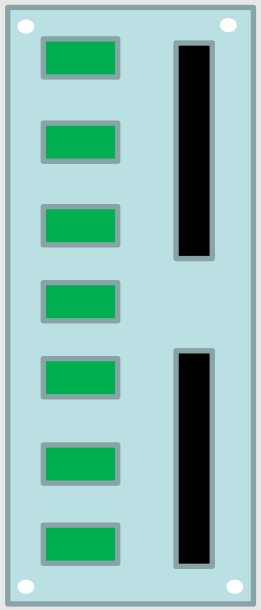
7 layers for Mini-Prototype(63chs)



Flexible cable? X7
(9X7=63chs)
Length=150~200mm



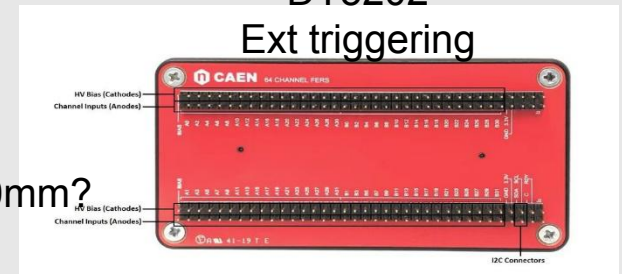
Adapter board
7 in 2 out
What connectors?



What cable? X2
(32X2=64chs)
Length=200~300mm?

Consider:
Grounding
Shielding
Support (As whole module, green frame)

DT5202
Ext triggering



Backup

The Manpower of the HCAL

- 1. The PS-HCAL
  - **Jianbei Liu,** Haijun Yang, Boxiang Yu，Yunlong Zhang，……，
- 2. The GS-HCAL： Sen Qian （IHEP）
  - Sub-system: 2 Conveners + others
  - Physics：**Manqi Ruan(IHEP)，Haijun Yang(SJU)，**
  - Software: Sengsen Sun(IHEP)；
  - Design: **Fangyi Guo(IHEP), Hengne Li(SCNU)，**
  - Glass Scintillator: **Sen Qian(IHEP), Jing Ren(HEU)，** the GS collaboration Group
  - SiPM: **Yuguang Xie(IHEP), Jifeng Han(SCU)，**
  - Electronics: **Jingfan Chang(IHEP)，**
  - DAQ：**Chen Boping(IHEP),**
  - Mechanics: **Yatian Pei(IHEP), Junsong Zhang**
  - Detector：**Boxiang Yu(IHEP), Yunlong Zhang (USTC)，**

The Manpower of the subsystem of GSHCAL

Physics：Manqi Ruan(IHEP)，Haijun Yang（SJTU），

Software: Sengsen Sun(IHEP)；

Design: Fangyi Guo(IHEP), Hengne Li(SCNU), Qingming Zhang(XJTU), Weizheng Song(IHEP), Peng Hu(261) Dejing Du(IHEP), Hongbing Diao(SUTC), Jiyuan Chen(SJTU), ……

--to design the GS-HCAL detector based on the CEPCSW;

Glass Scintillator: Sen Qian(IHEP), Jing Ren(HEU)， the GS collaboration Group;

--R&D of the GS for CEPC-HCAL, a special group independent of CEPC;

SiPM: Yuguang Xie(IHEP), Jifeng Han(SCU), Guang Luo(SYSU),

--to do the research of SiPM for CEPC-HCAL, the electronics of SiPM for the GS performance test;

Electronics: Jingfan Chang(IHEP),

--to design the ASIC and FEE for CEPC-HCAL; the power supply, the cables and so on;

DAQ: Chen Boping(IHEP),

Mechanics: Yatian Pei(IHEP), Junsong Zhang(IHEP), Shang Bofeng(ZZU)

--to design the Mechanics of the GS-CEPC-HCAL; also the cell, the module, the cooling system;

Detector：Boxiang Yu(IHEP), Yunlong Zhang (USTC)

--to study the module of the GS-HCAL with GS and SiPM, the cosmic ray test, the beam test;