



清华大学  
Tsinghua University



*XIV Collaboration Meeting of the MPD Experiment at the NICA Facility*

# The progress of ECal production in China

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Summary

# MPD-ECal production

## MPD-ECal requirements:

particle occupancy :  $< 5\%$

Time resolution :  $< 1\text{ns}$

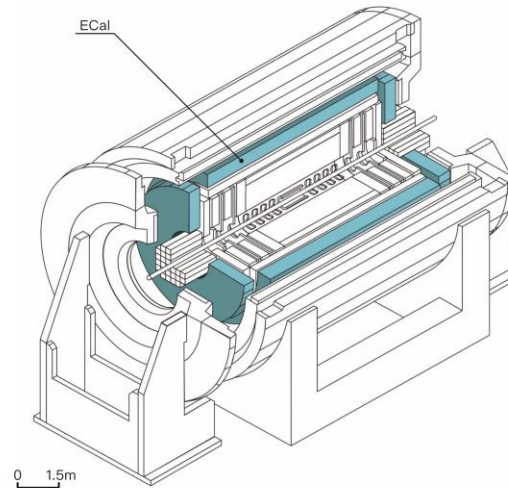
Energy resolution :  $< 5\%$

@1GeV

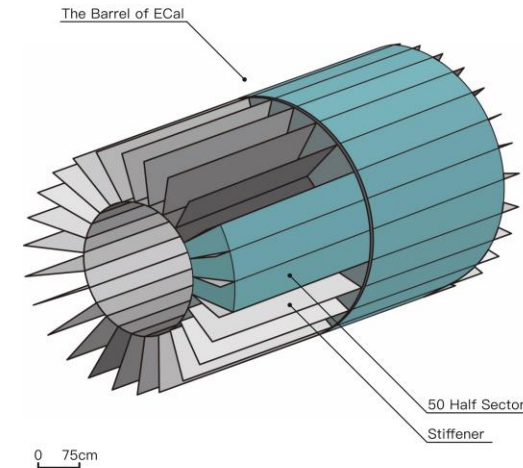
Operate in the magnetic FIELD :

$\sim 0.5\text{T}$

Adequate space resolution.

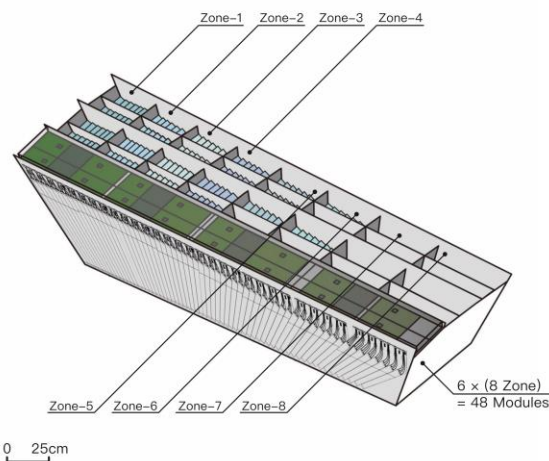


MPD-ECal

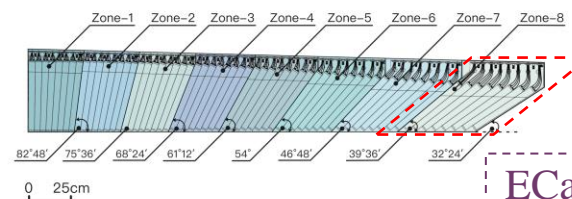


The Barrel of ECAL

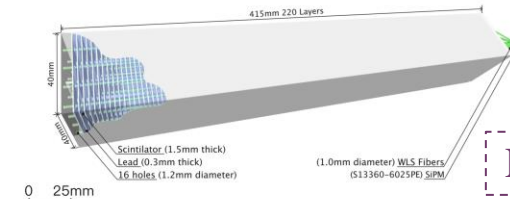
ECAL Half-Sector



ECAL 8-Zone



ECAL Module



ECAL Tower

## The ECAL-MPD

1 Barrel

50 Half-sector

300 8-Zone module

2400 Module

38400 Tower

➤ **ECal module:**

**Construction of 8 sectors. 768 modules in total.**

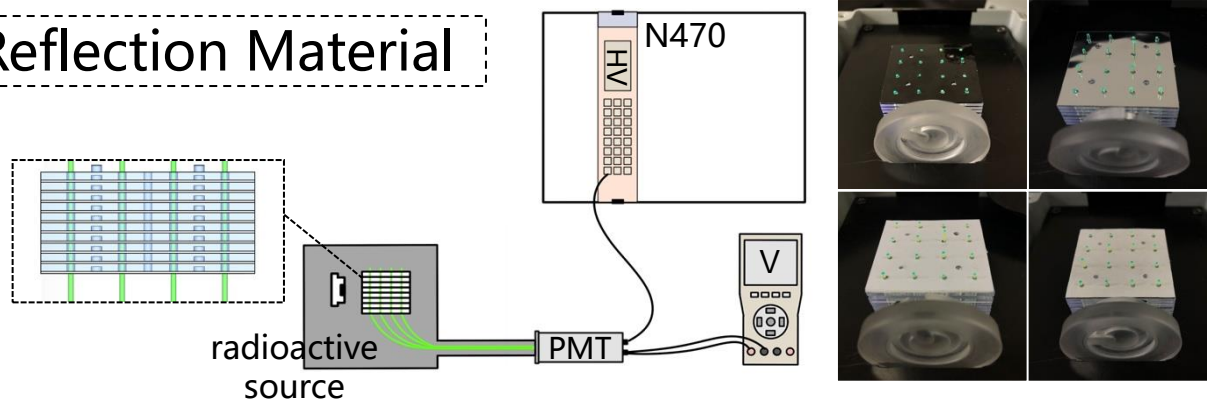
<b>Institutes: Tsinghua University</b>	<b>60%</b>
<b>Shandong University</b>	<b>20%</b>
<b>Fudan University</b>	<b>10%</b>
<b>University of South China</b>	<b>10%</b>
<b>Huzhou University</b>	

➤ **ECal PCB:**

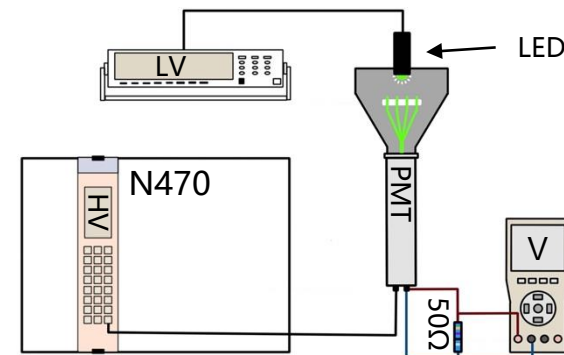
**Production of 1200 PCBs (without SiPMs).**

# Performance research of key material

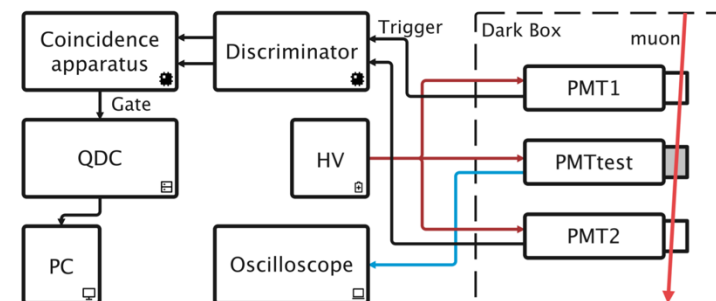
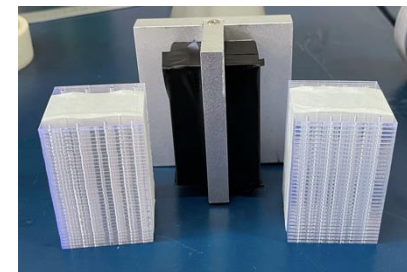
## Test of Reflection Material



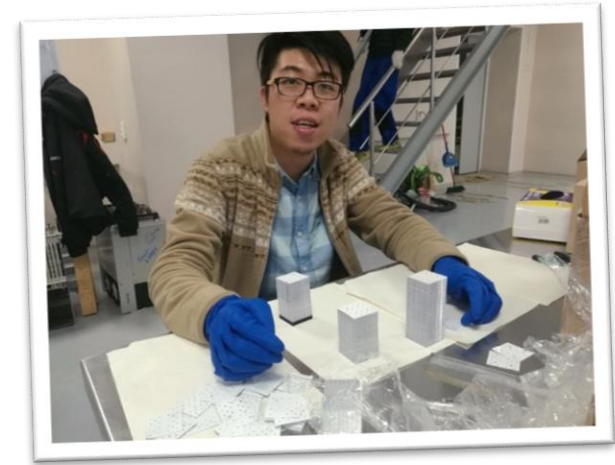
## Test of Scintillator



Material	Voltage(V)	background(V)	Coat Thickness (um)
Lead	0.22	0.03-0.04	0
Polished black	0.22	0.03-0.04	112
TYVEK 1	0.54	0.04-0.05	519.5
TYVEK 2	0.5	0.04-0.05	156
Paper	0.44	0.03-0.04	99
Silver plated paper	0.43	0.03-0.04	120
Sample 0	0.45	0.04-0.05	36.5
Sample 1	0.49	0.03-0.04	79
Sample 2	0.43	0.03-0.04	45.5
Sample 3	0.45	0.04-0.05	37.5
Mass production	0.47	0.04-0.05	56.5
Water-based 1	0.21	0.01-0.02	91
Water-based 2	0.21	0.01-0.02	36
Powder	0.31	0.02-0.03	37



# Special machine for tower assembling



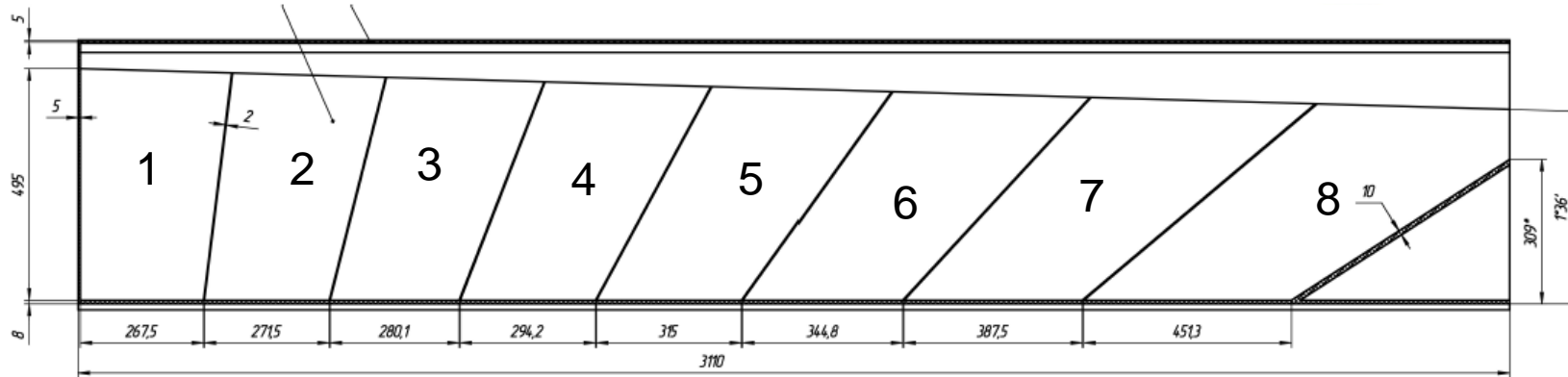
Manual assembling,  
~45min/tower

- An assembling machine is developed.
- Assemble a tower in 20 min.
- The efficiency and quality have been improved.

# Modules production in China

In the first stage, 8 sectors have been produced in China

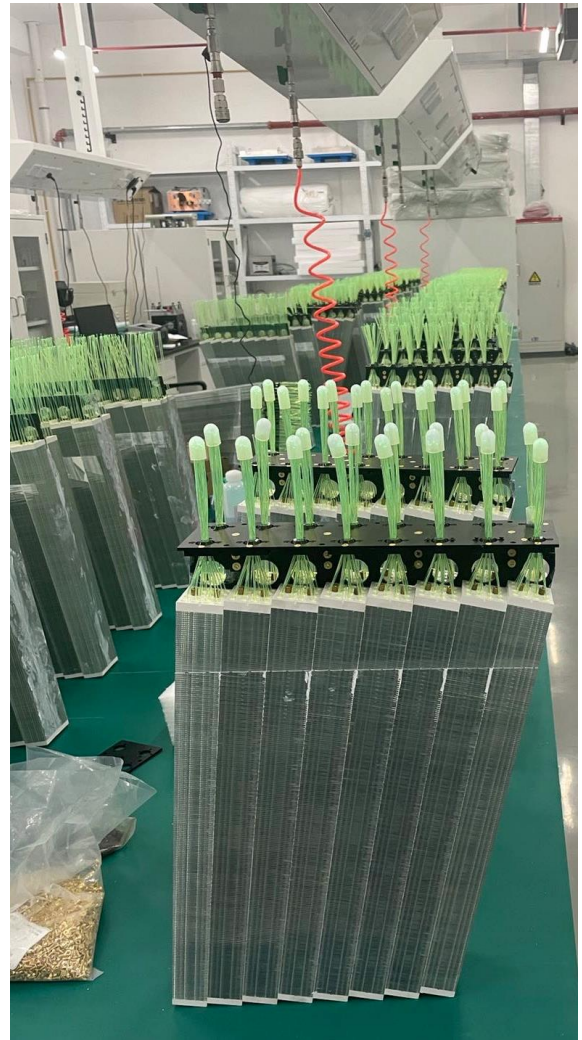
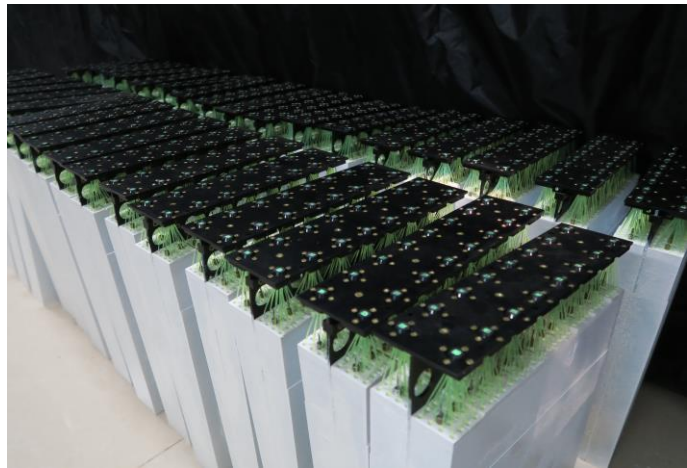
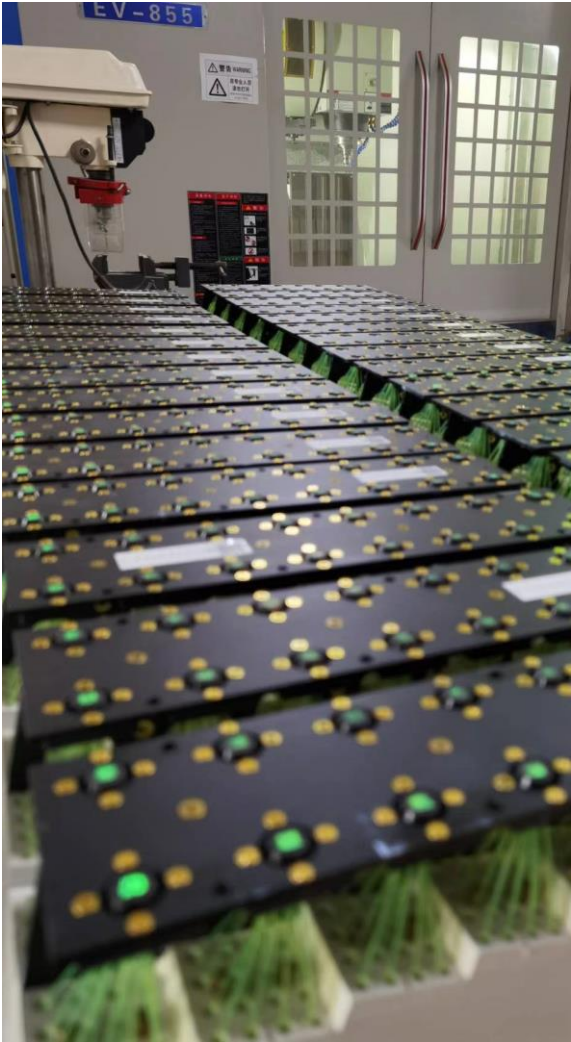
*8 sectors = 16 half sectors = 768 modules = 12288 towers*



## Modules produced in each institutes

	1	2	3	4	5	6	7	8	Total	Progress
THU	19	19		38	96	96	96	96	460	Finished
SDU			96	58					154	Finished
FDU		77							77	Finished
USC	77								77	Finished

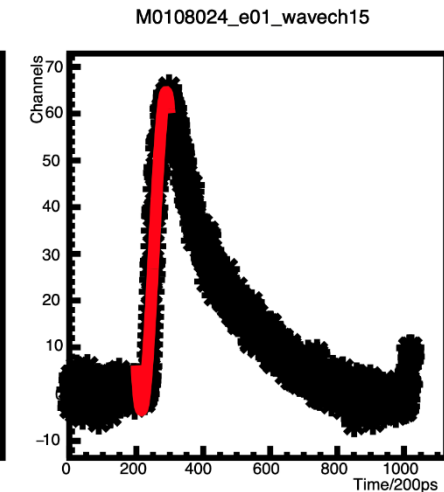
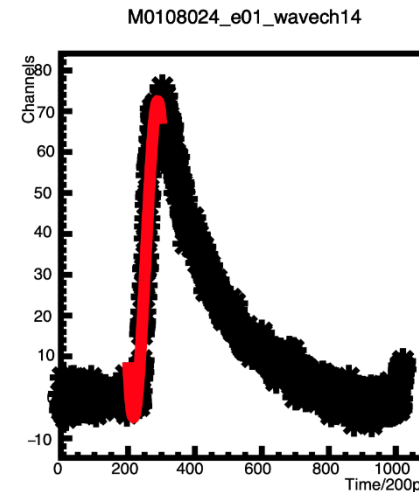
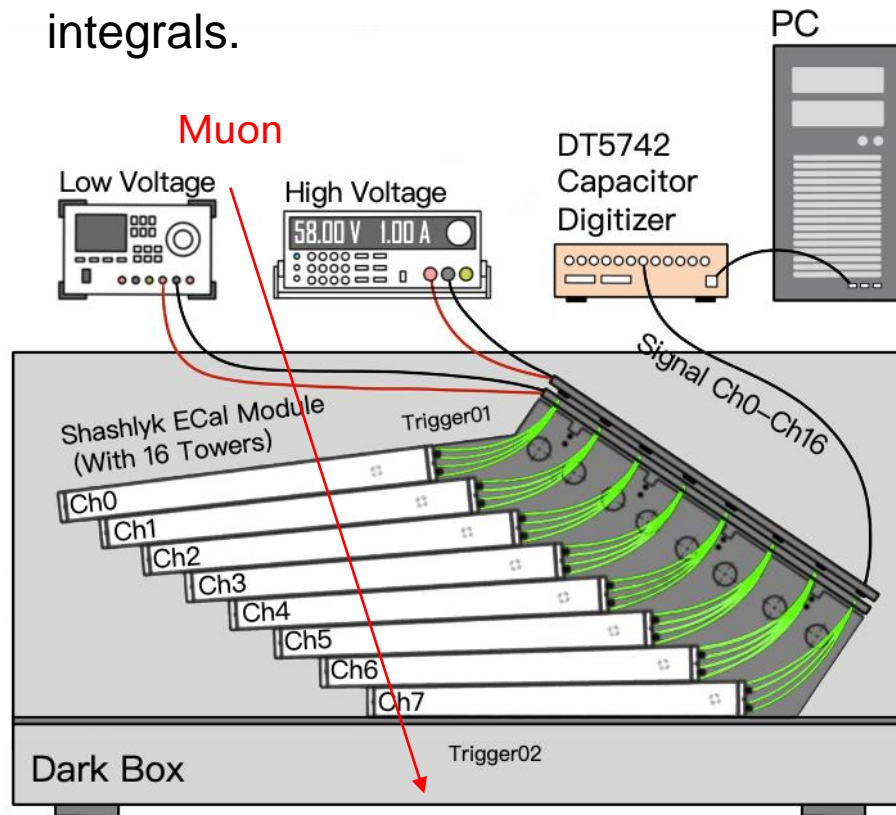
# Mass production in China



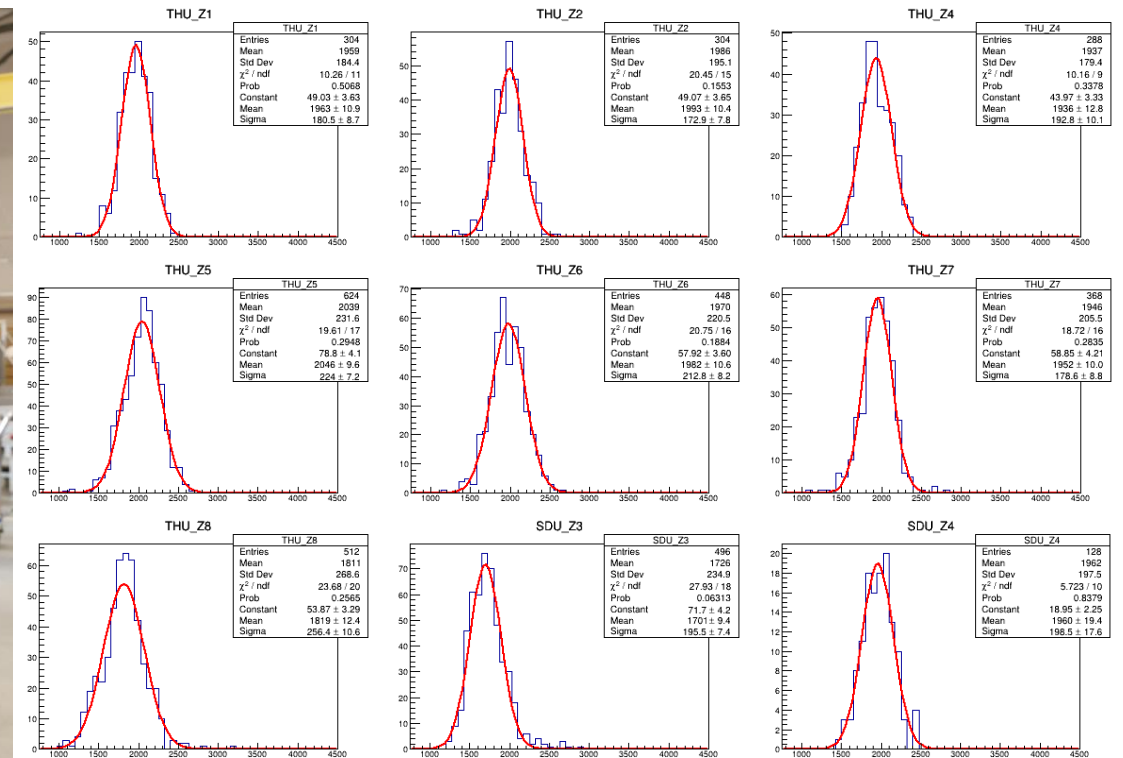


# Cosmic ray test

- A special dark room for test.
- The auto-triggering of DT5742 is used.
- ADC integrals are calculated from waveform (Fig. 2) of selected events. Peaks are extracted from distribution of integrals.



## ➤ Cosmic test in JINR

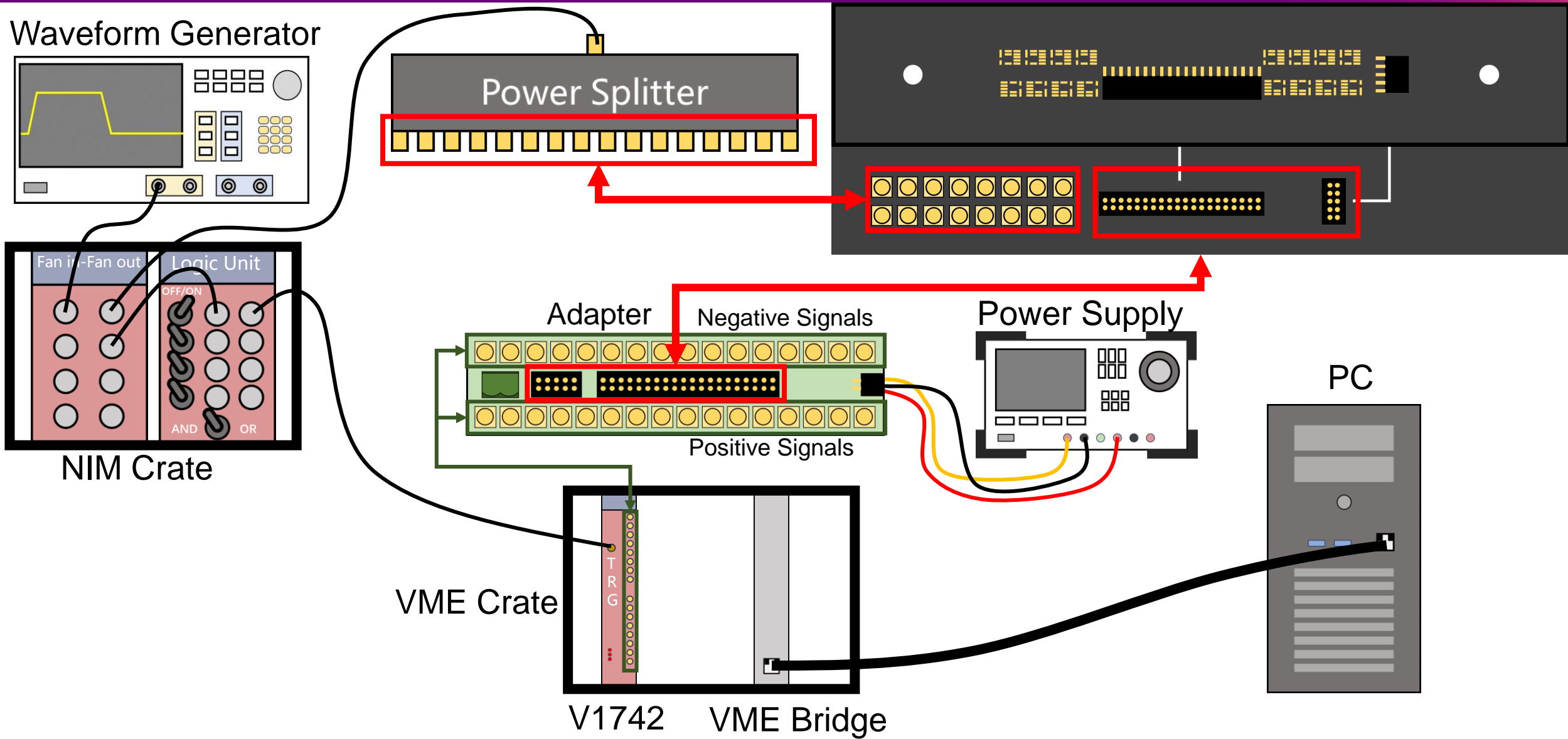


# PCBs production in China



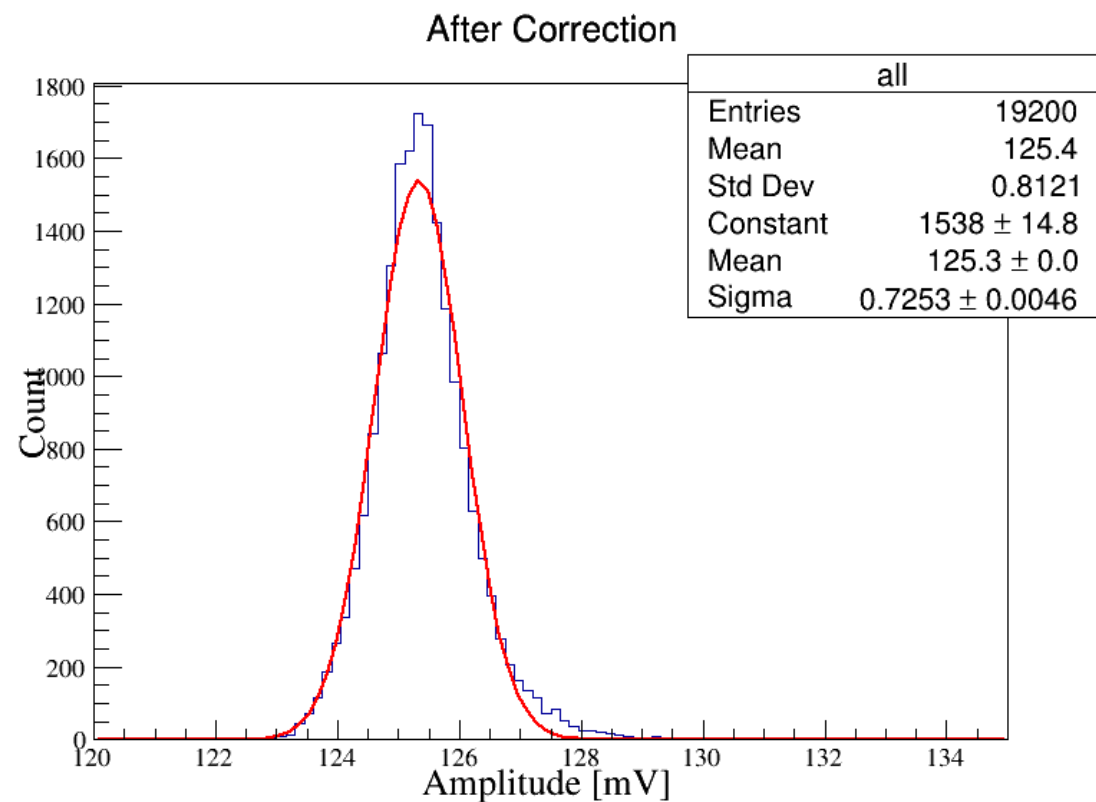
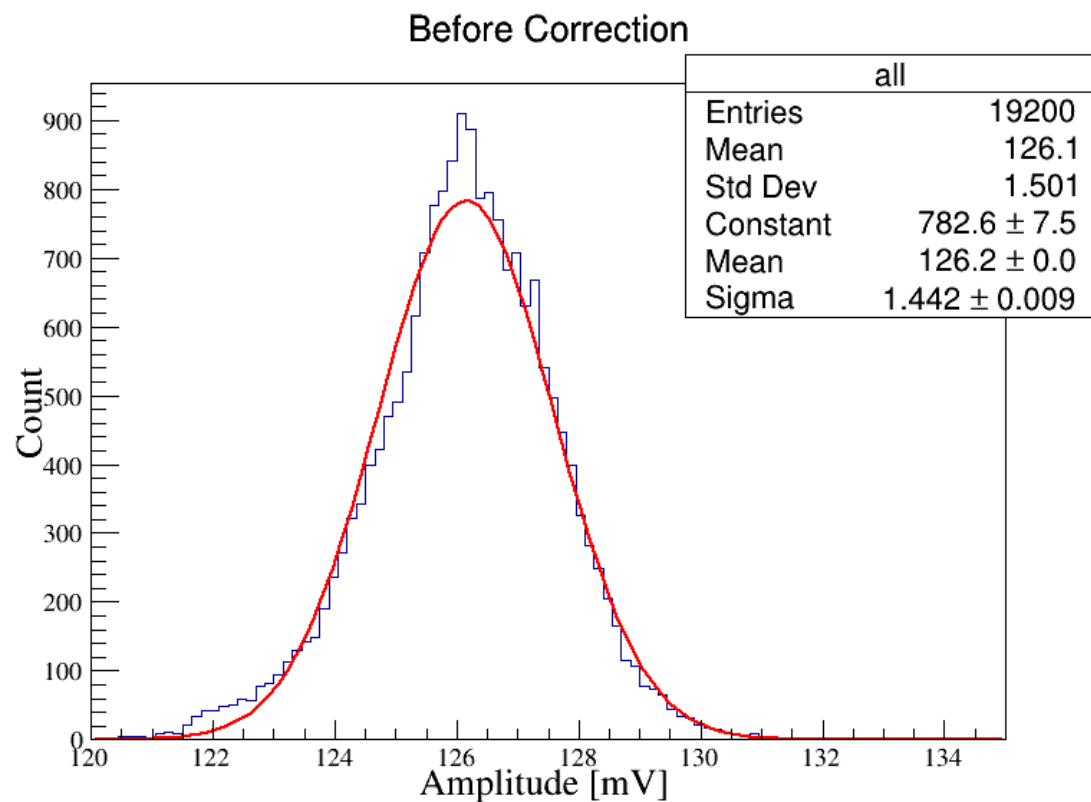
	T123	T4	T5	T6	T7	T8	Total	Production	Test	Shipment
THU	450	150	150	150	150	150	1200	Finished	Finished	Finished

# Batch test of ECal PCBs

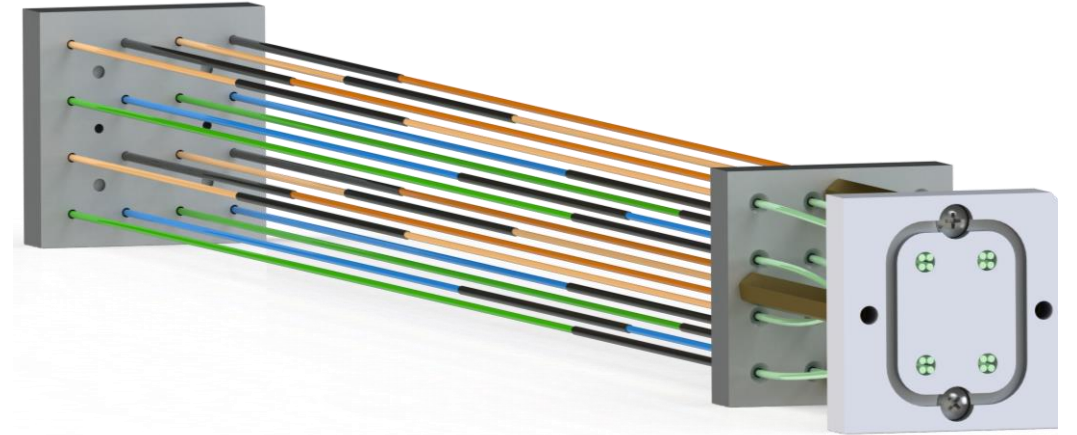
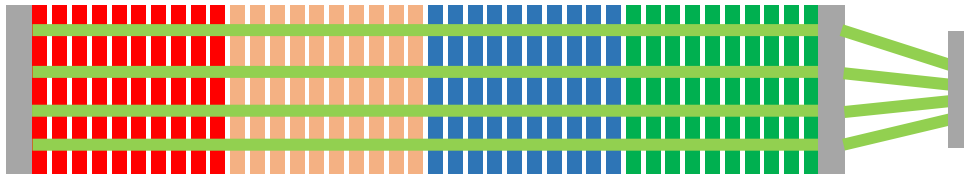


- The response of PCBs is related to the temperature slightly

*1200 boards, 19200 channels*



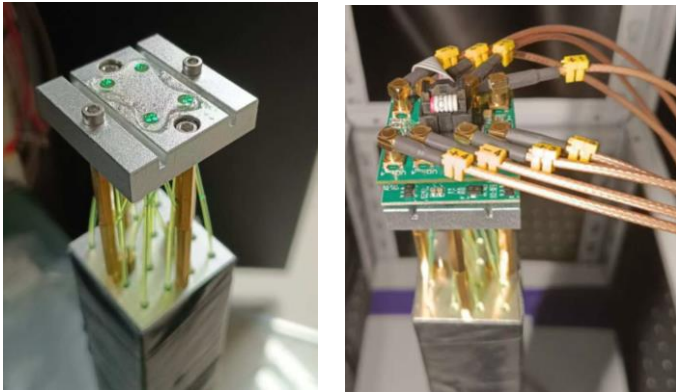
# The structure of 5D ECAL



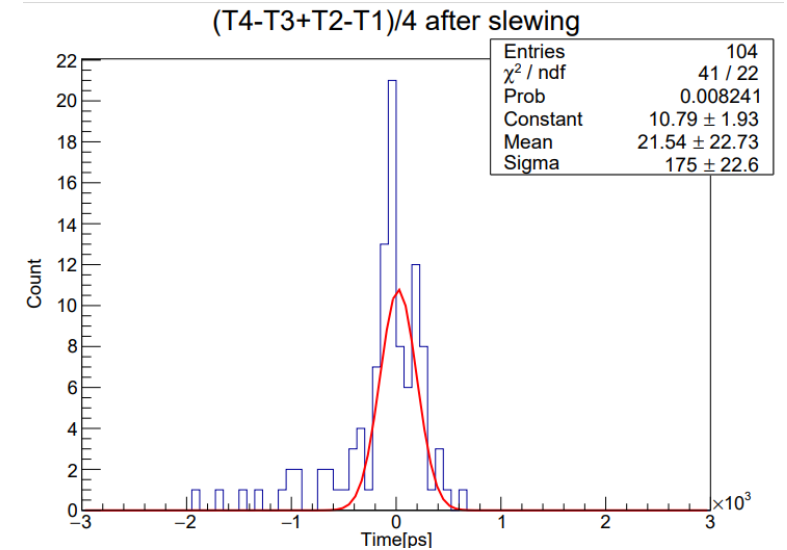
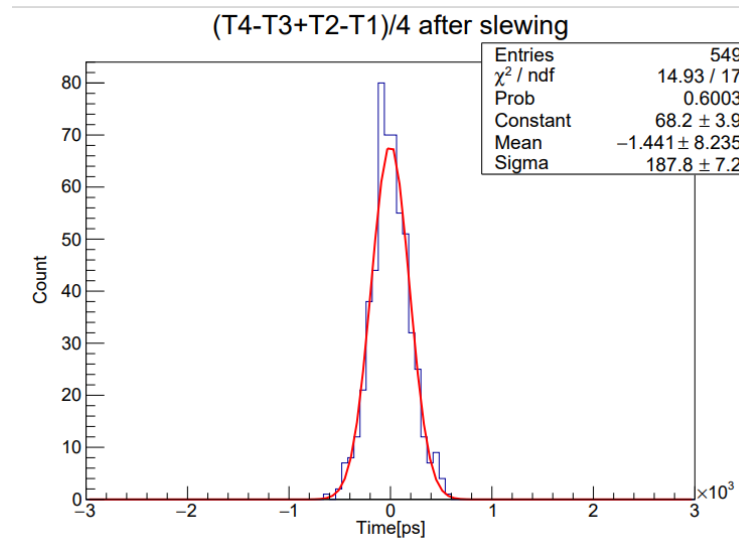
Transverse size, mm <sup>2</sup>	40 × 40
Number of layers	216
Thickness of scintillator, mm	1.5
Thickness of lead absorber, mm	0.3
Moliere radius, mm	62
Number of radiation length, X <sub>0</sub>	11.8
Number of WLS fibers	16
Shading material	Aluminum ally tubes internal: φ1.3mm external: φ1.5mm

- 216 layers are separated into 4 parts, each part consists of 54 layers
- Readout with 16 WLSFs, each part is readout with 4 WLSFs+SiPM
- Mask technology of WLSF
- 5D: x,y,z, energy (<5%), time (<100ps)

# Performance of prototype (Cosmic test)

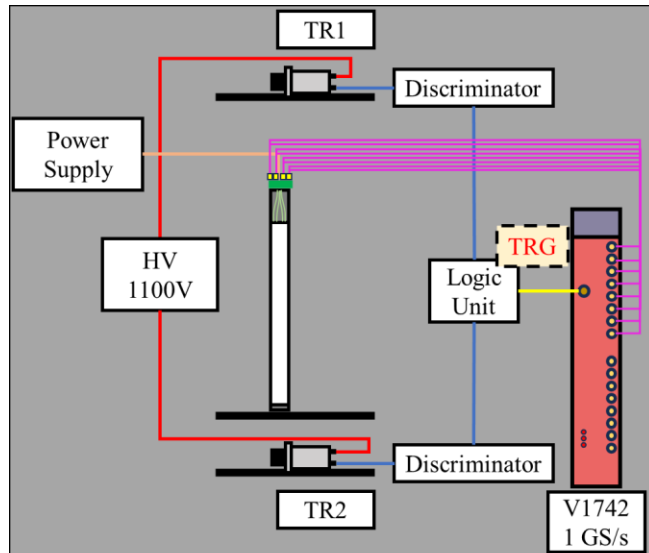


Bandwidth: ~250MHz



- Sampling Freq. 1GS/s
- 549 effective events (~6 weeks)
- Time resolution: 187.8 ps

- Sampling Freq. 5GS/s
- 104 effective events (~2 weeks)
- Time resolution: 175 ps



- ✓ The China Group has established a **complete QA & QC system**. QA & QC of Material, Tower and Module have **reached the requirements**.
- ✓ **768 modules** have been delivered to JINR.
- ✓ **1200 PCBs** have been produced and tested in China and delivered to JINR.
- A new 5D Ecal shows the potential PID capability of TOF+Ecal.