

Status of Scintillator-W ECAL R&D

Mingyi Dong

On behalf of CEPC calorimetry working group

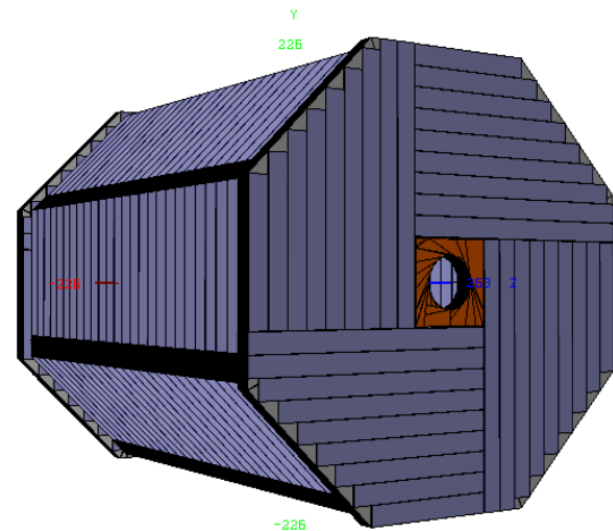
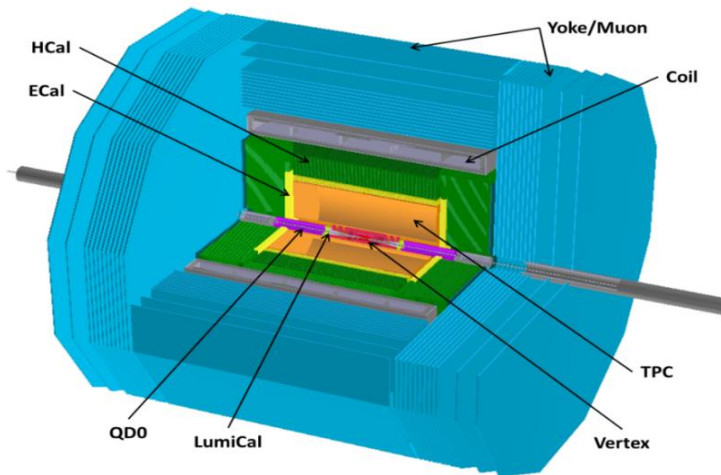
CEPC day July 24, 2020

Outline

- Brief review of Sci-W ECAL of CEPC
- CEPC Scin-W ECAL Status
 - Overview of the technological prototype
 - EBU production
 - Super-layer assembly and test
 - Mechanical support
- Plan and Summary

PFA Calorimeter

- Particle Flow Algorithm (PFA) calorimetry is considered for CEPC
 - Good energy resolution (electrons and photons with energy resolution $\sigma_E/E \approx 16\%/\sqrt{E} \oplus 1\%$, Jet energy resolution : $\sigma_E/E \approx (3\% - 4\%)$)
 - High granularity and minimum dead materials
 - Compact showers (small radiation length X_0 , and small Moliere radius R_M)
- A sampling calorimeter with scintillator-tungsten sandwich structure (ScW) is one of the ECAL options



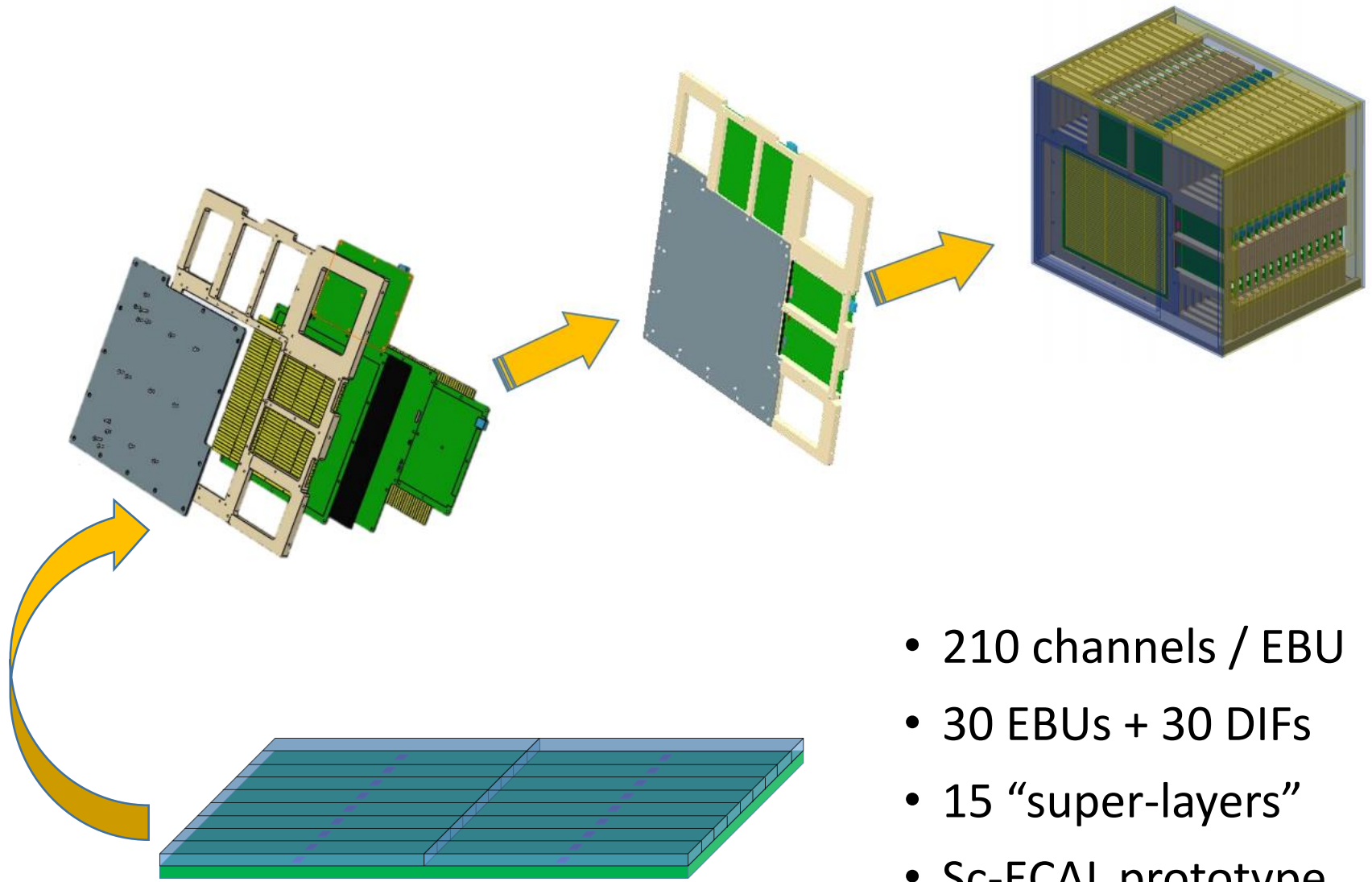
Technological Prototype

- A technological prototype are under construction and test
- Key parameters
 - 30 layers
 - Sensitive dimension: about 210mm \times 225mm each layer
 - Scintillator- tungsten sandwich structure
 - Each layer includes
 - Absorber: W-Cu (85:15) alloy with thickness of 3.2mm, $\sim 0.73 X_0$
 - EBU (embedded board unit)
 - Scintillator module : scintillator strip (45mm \times 5mm \times 2mm) + SiPM
 - Readout PCB based on SPIROC2e chips

Highlights of the design

- SiPM bottom-center embedded coupling with scintillator. High light output and good uniformity. MIP signals can be clearly separated from pedestal with 10 μm pitch SiPM
- Read out with SPIROC2e chips
- Readout electronics with temperature compensation and LED calibration circuits

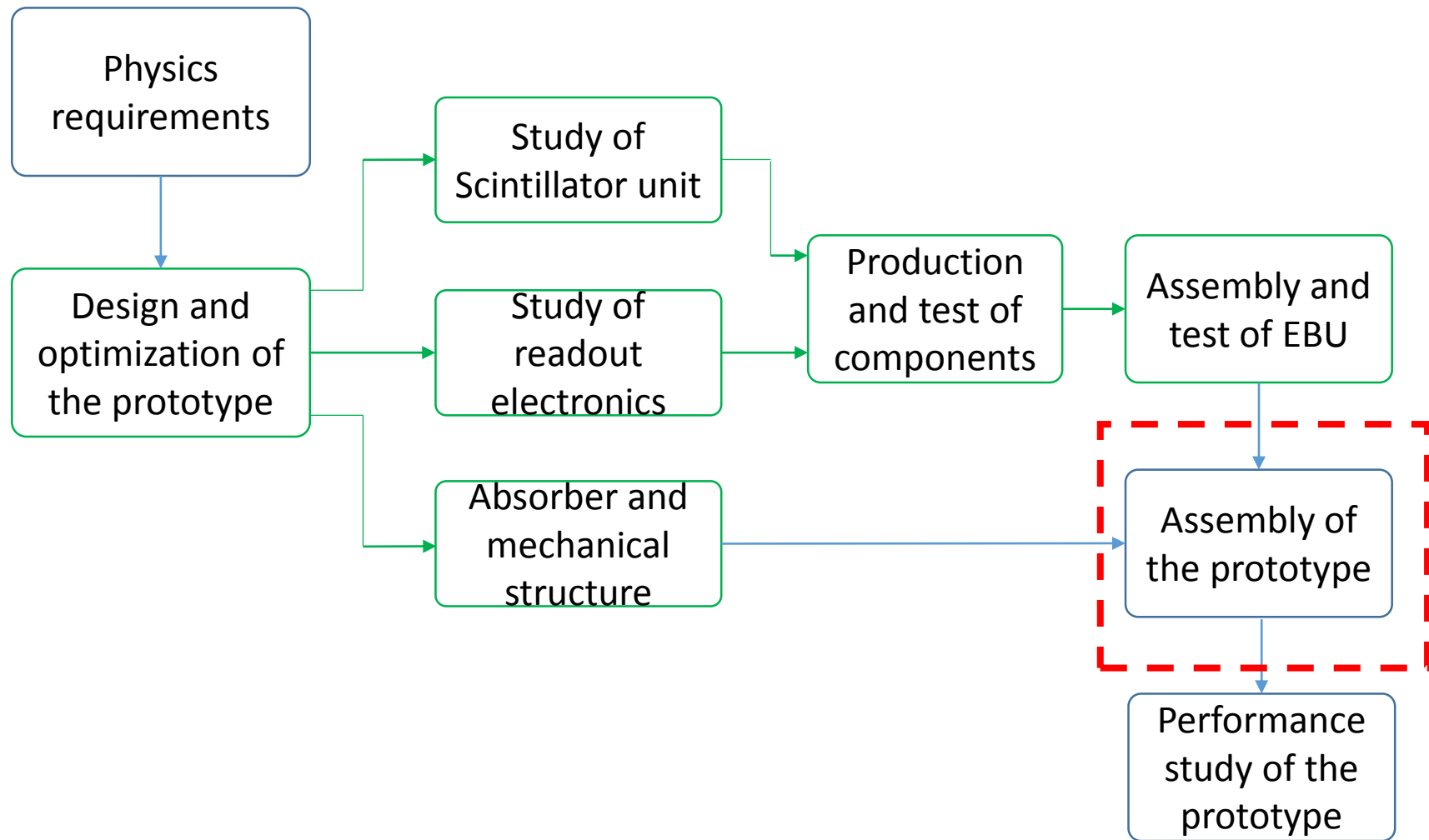
Technological Prototype



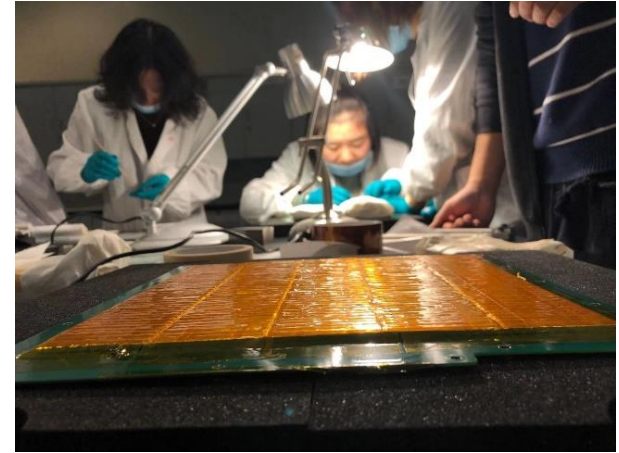
SiPM bottom-center embedded coupling

- 210 channels / EBU
- 30 EBUs + 30 DIFs
- 15 “super-layers”
- Sc-ECAL prototype

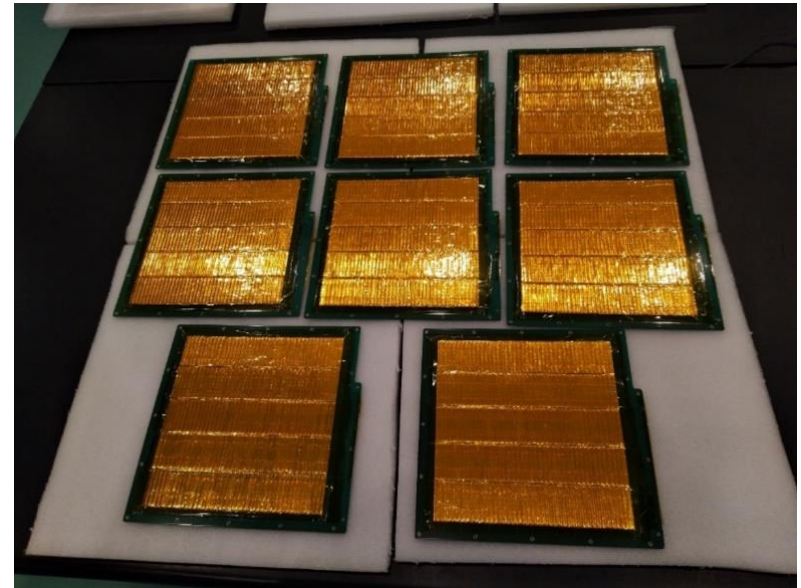
Technological Prototype



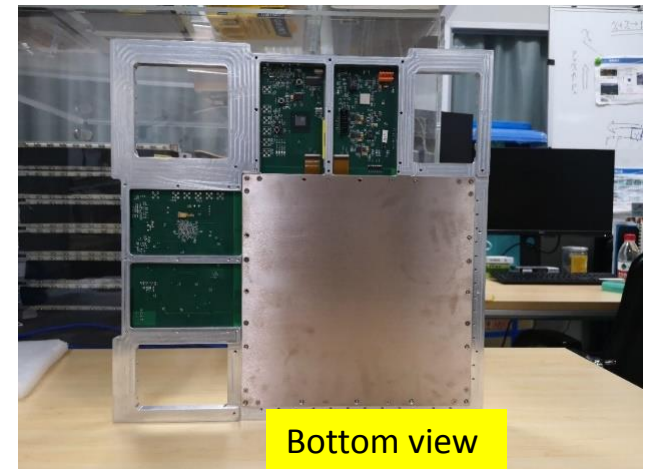
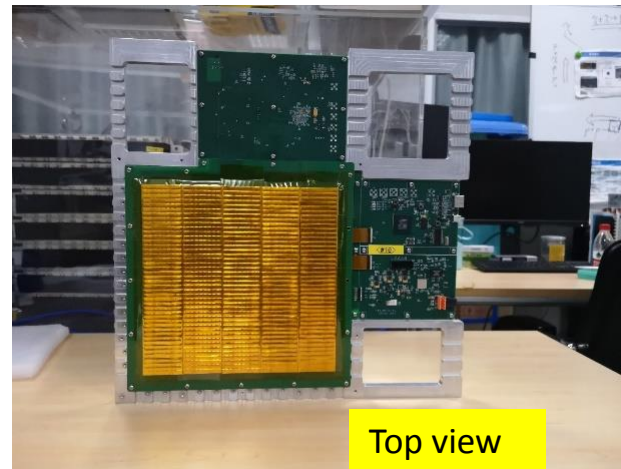
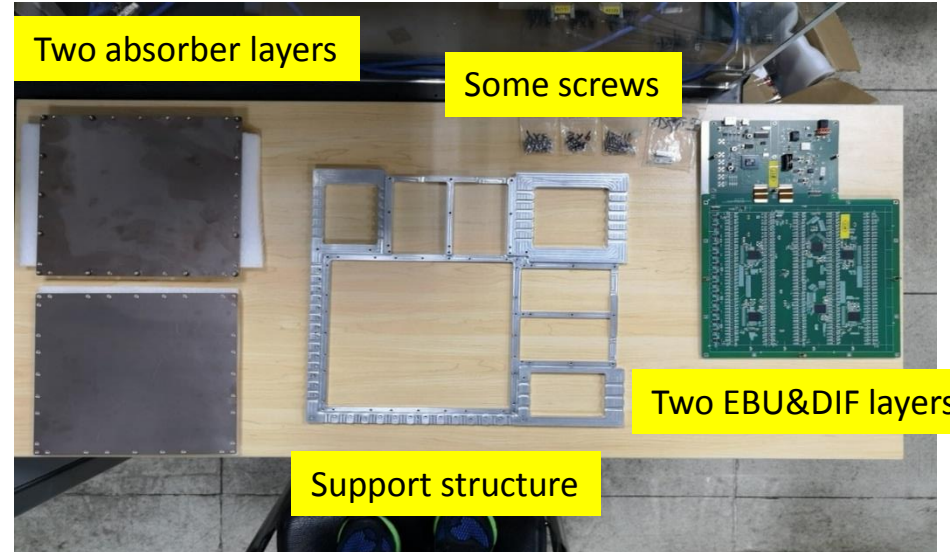
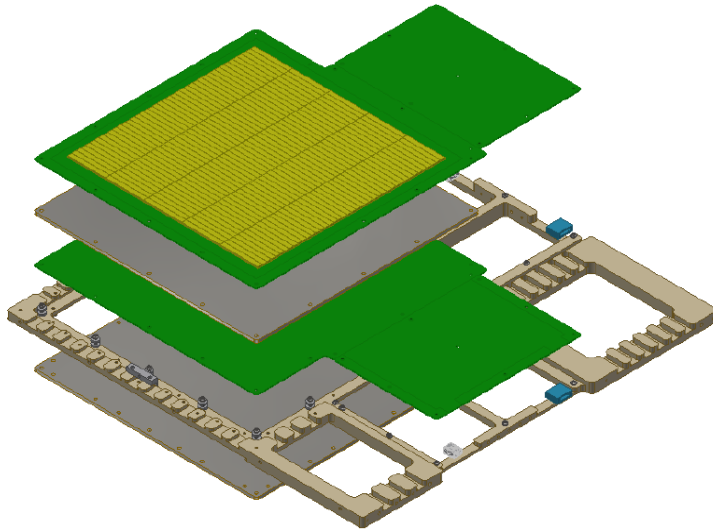
EBU production



- EBU production
 - Scintillator strip and ESR cutting and machining
 - Scintillator strips wrapping and test
 - PCB soldering and test
 - EBU assembly



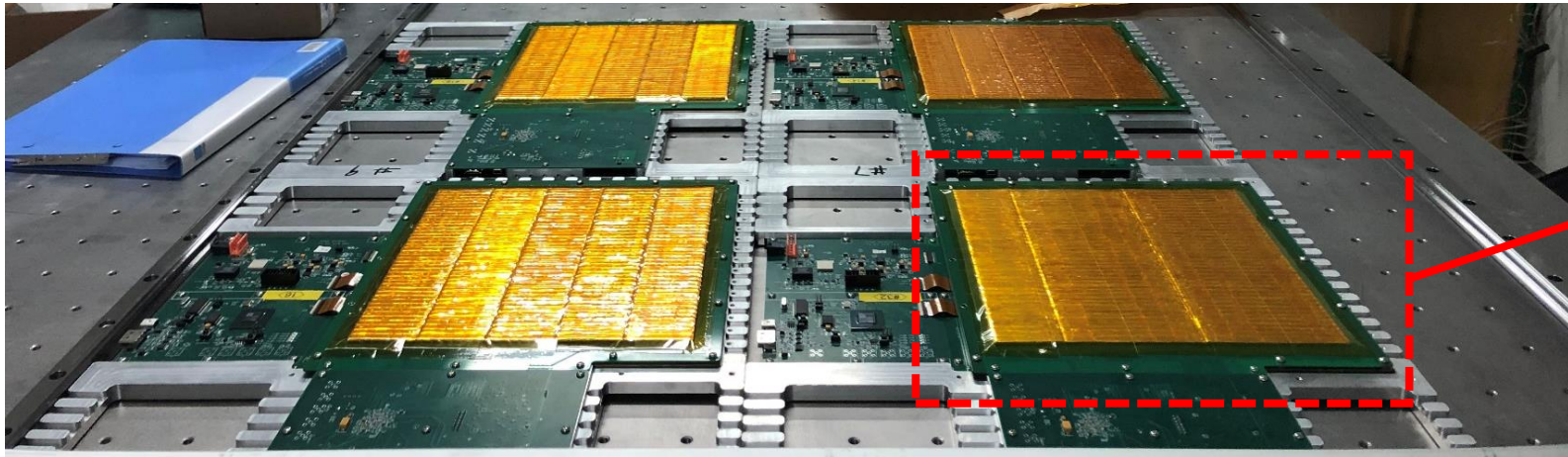
Super-layer assembly



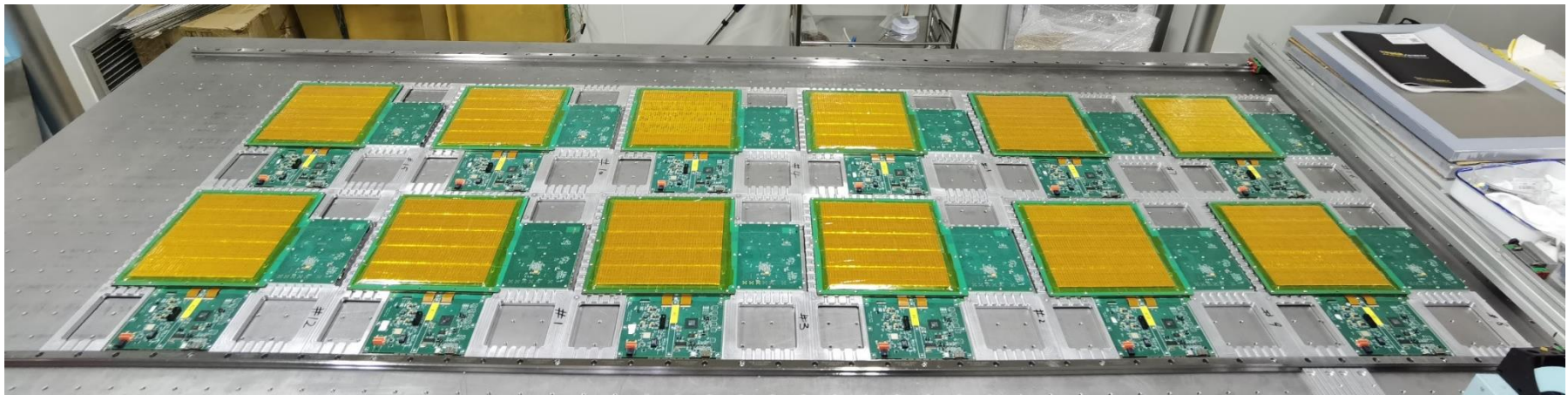
- Super-layer is a pluggable layer for the assembly of the prototype
- Consists of two EBU layers, two absorber layers and a mechanical frame

Super-layer assembly

- 16 super layer in total (includes one for Japanese group)

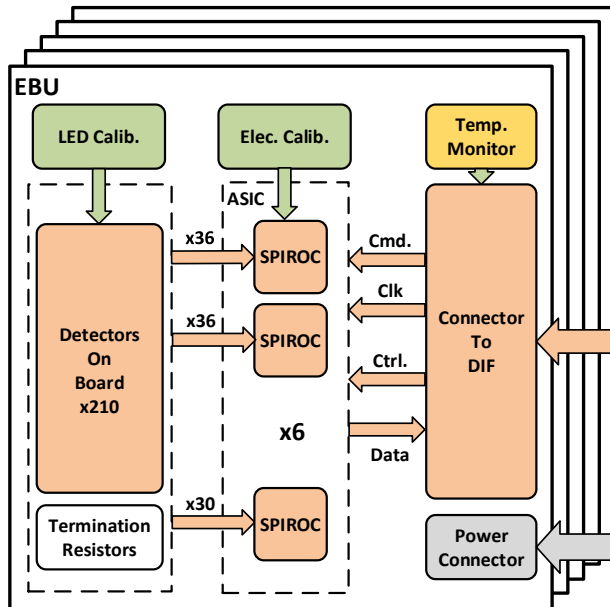


Japanese
group

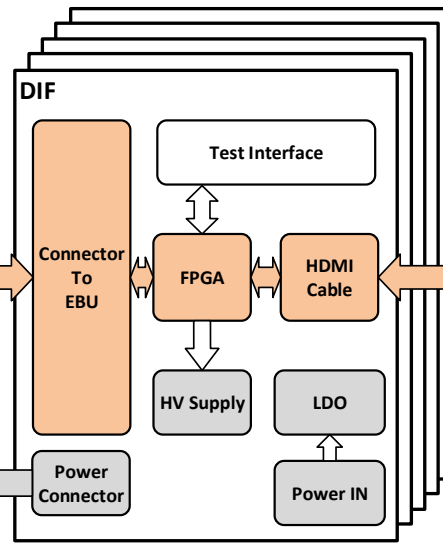


Readout system

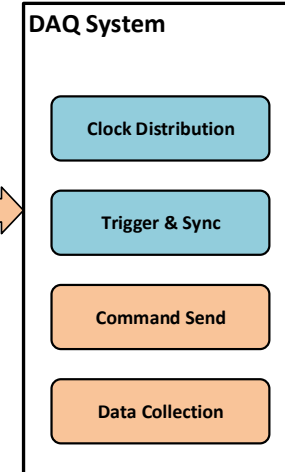
EBU x30



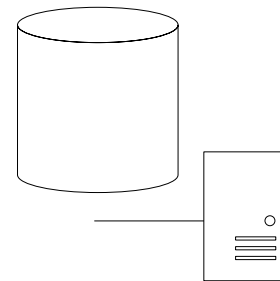
DIF x30



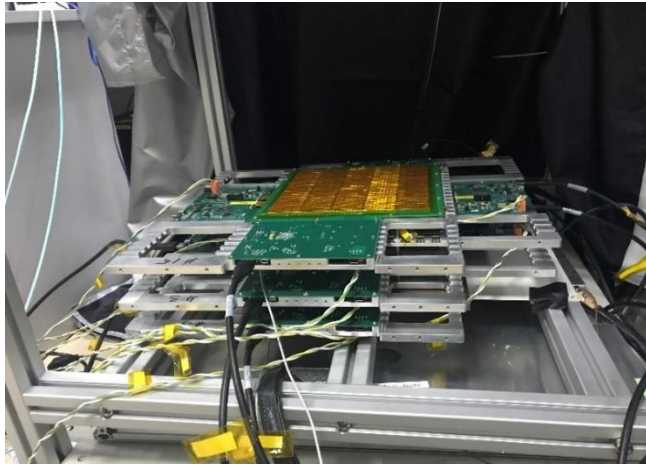
DAQ x 1



SERVER



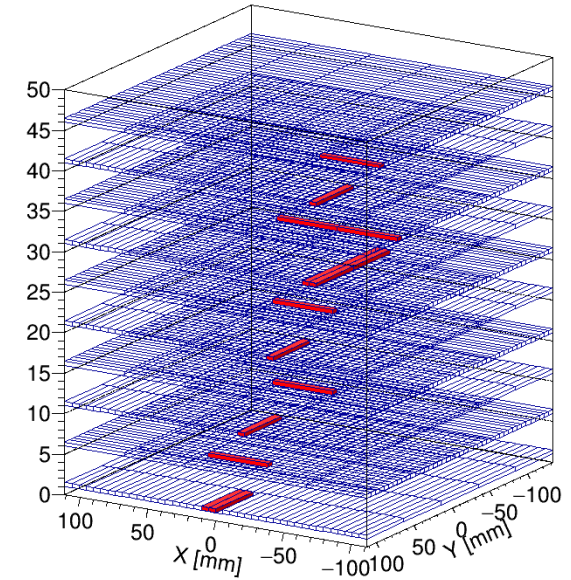
Super-layer commissioning



Cosmic-ray test



Light shielding

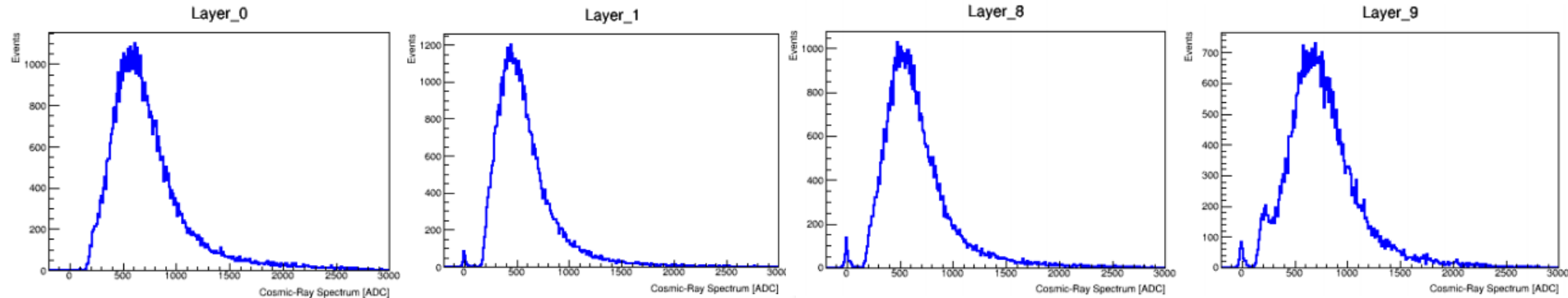


Cosmic ray event reconstruction

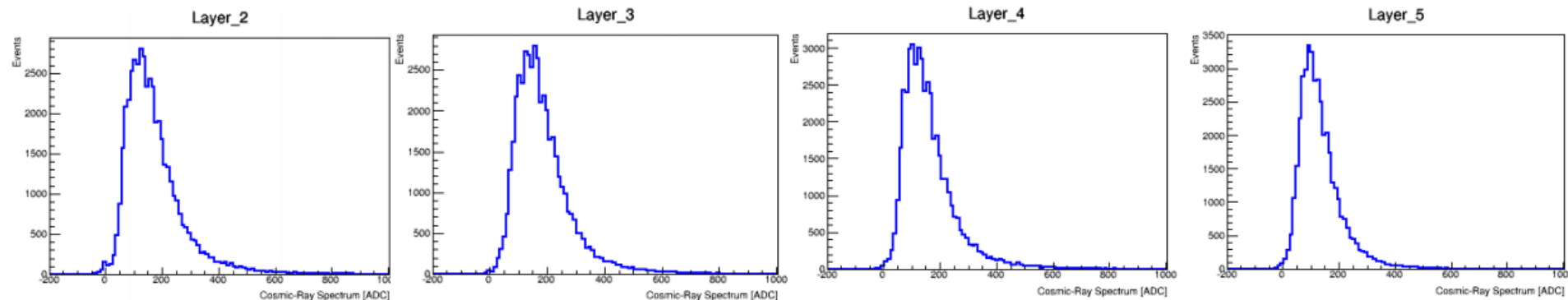
- 4 or 5 super layers combined together, and tested with cosmic rays one by one
- All combined systems worked
 - Data acquisition and transmission worked properly
 - Events were built correctly for all EBU layers

Super-layer commissioning

EBU with 15 μm pitch SiPM



EBU with 10 μm pitch SiPM

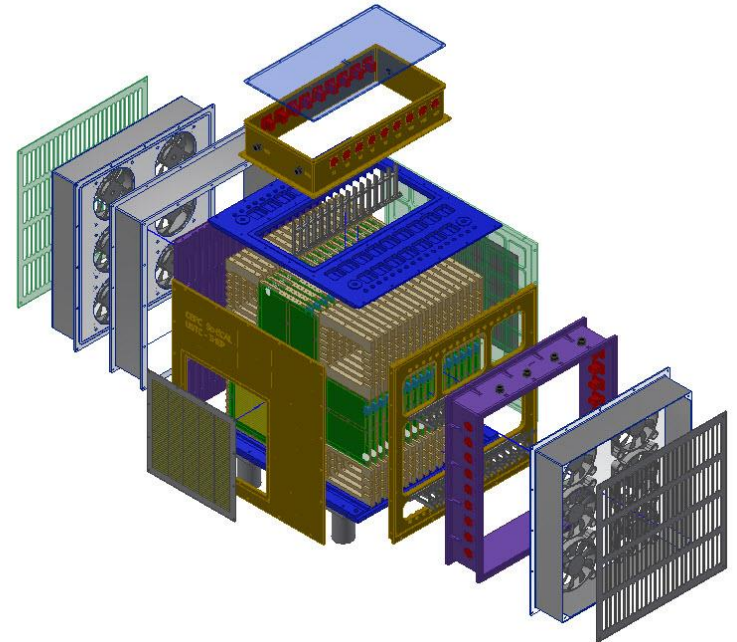


- MIPs signal after deducting pedestal
- Different SiPMs have different gain and photon detection efficiency

Mechanical structure



- The mechanical structure is designed and manufactured
- Has 17 slots and can hold at most 17 super-layers
- Has fans for air cooling
- The preassembly was performed



Plan

- Aug. , Finish the assembly of the prototype
- Aug.- Jan.,2021 , Cosmic-ray test
- Jan.,2021, prepare for beam test
- Feb.,2021, beam test at DESY (already applied)

Summary

- Finished the assembly and test of all 16 super layers
- Finished the manufacture of the absorbers and mechanical structure
- Cosmic-ray test of super layer groups was performed. Preliminary results show the system work properly

Thanks for your attention !