CEPC calorimeter dimensions: a brief summary

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CEPC Calorimeter Discussion (Thursday Apr. 25, 2024)

- Agenda: https://indico.ihep.ac.cn/event/22357/
- Minutes: https://indico.ihep.ac.cn/event/22357/?note=1334#3-minutes

CEPC Calorimeter TDR Weekly Meeting (Friday Apr. 26, 2024)

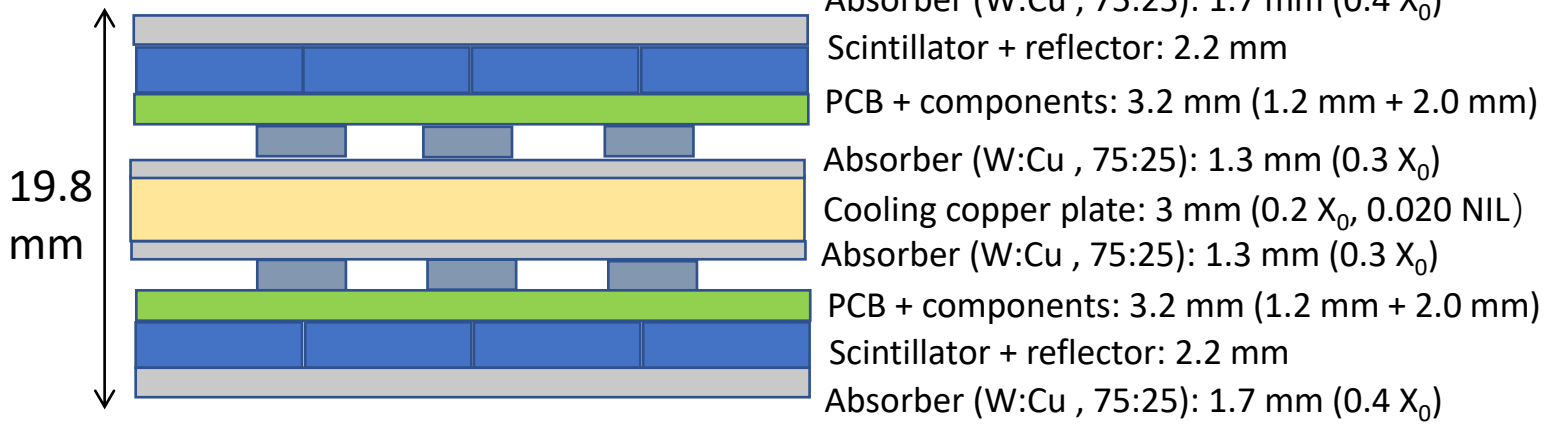
- Agenda: https://indico.ihep.ac.cn/event/22355/

CEPC ScW-ECAL: plastic scintillator strips - CuW

ECAL superlayer: each includes 2 sensitive layers

W:Cu=75%:25%, X0=4.32mm

Total thickness 297 mm



Single super-layer: 1.6 X_0, 0.08 NIL

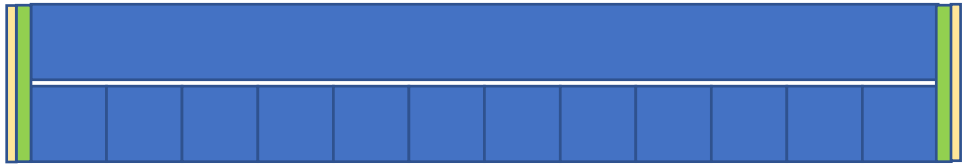
15 super-layers: 24 X_0, 1.2 NIL, thickness 297mm

Primarily discussed ScW-ECAL thickness reduction: CuW alloy also has good thermal conductivity, and a single superlayer can use only one layer of cooling copper plate. The thickness of a single superlayer can be reduced by 3mm.

CEPC crystal ECAL with long bars

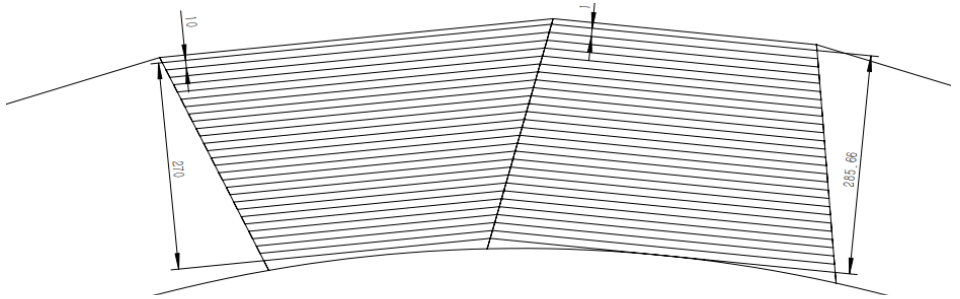
Total thickness 290 mm

Long crystal bars in adjacent layers arranged orthogonally.

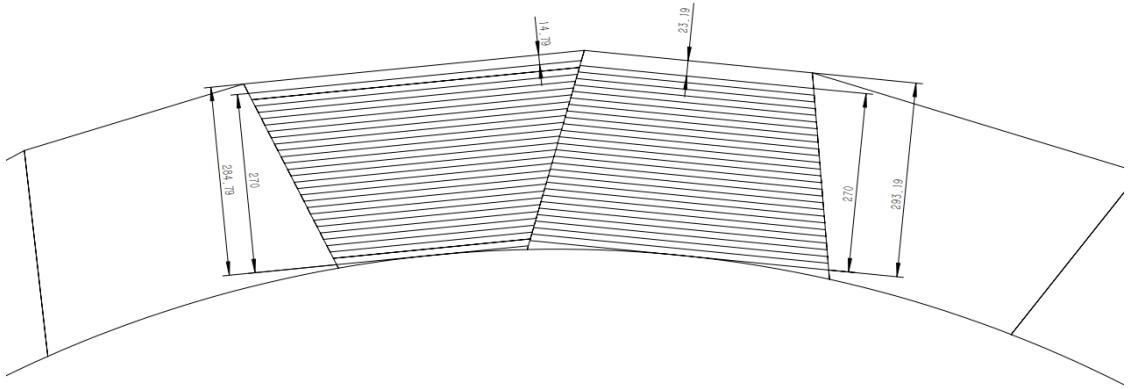


- Single BGO crystal thickness: 10 mm
- 27 layers: a total crystal thickness of 270mm, corresponding to 24.1 X_0 and 1.21 NIL
- Assuming wrapping layer thickness per side is 0.1mm, total wrapping thickness is ~5mm, and total crystal thickness 275mm
- On top of each module: boards for data aggregation and transmission are and active cooling system, are expected not to exceed 10mm. T total thickness of the calorimeter is about 285mm.
- Carbon fiber support structure: extra contribution to the total thickness of ~5 mm

Crystal length is 400mm on average, and actual length varies depending on the layer it is in (the schematics is not to scale). The side of the crystal module includes electronic readout boards and passive cooling layers (copper).



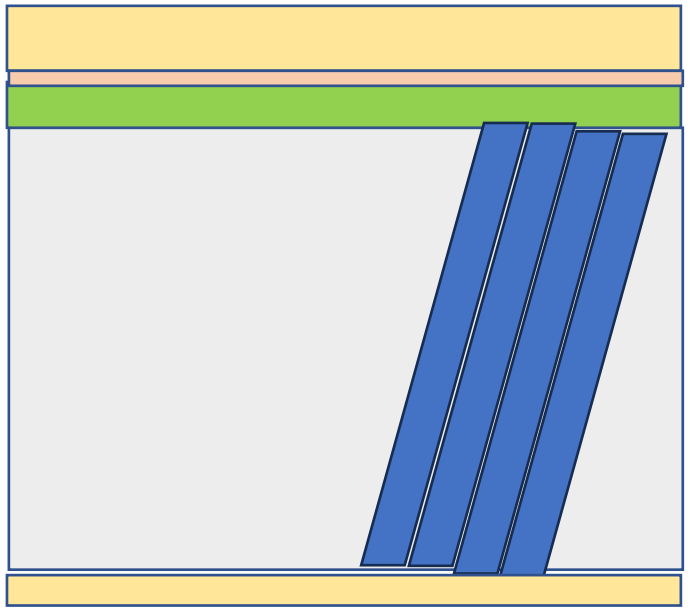
Layout 1: Each layer corresponds to the neighboring one (layers are not of equal thickness)



Layout 2: layers are of equal thickness

CEPC Stereo Crystal ECAL

Total thickness 297 mm



Carbon fiber support cylinder: 10mm

Cooling copper sheet: 3mm

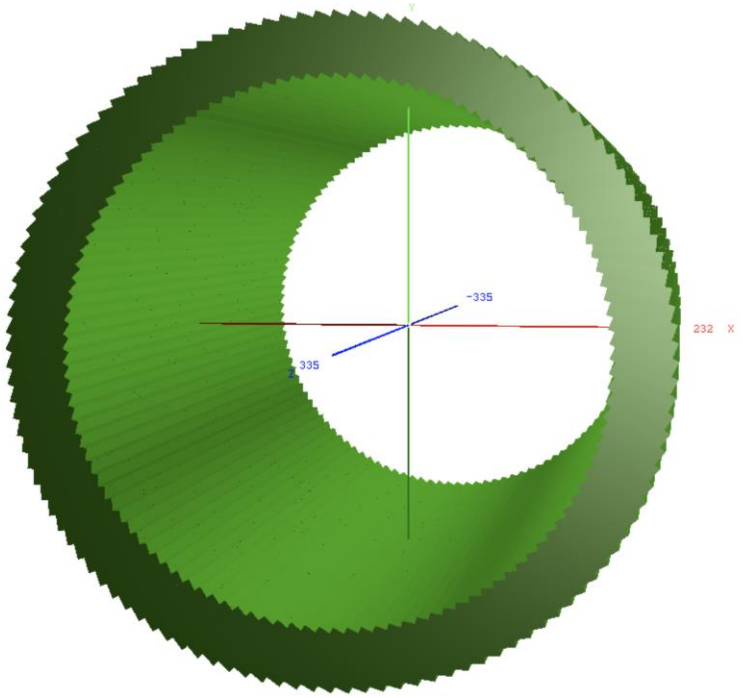
PCB, photosensors, electronics, cables for data transmission power supply : 10mm

BGO crystals: 269mm (24X0, 1.21NIL)

ESR wrapping thickness ~80 μm/side，Total ESR thickness = 80 μm/sin(20 degrees)* 2 sides* 10 layers = 4.7mm

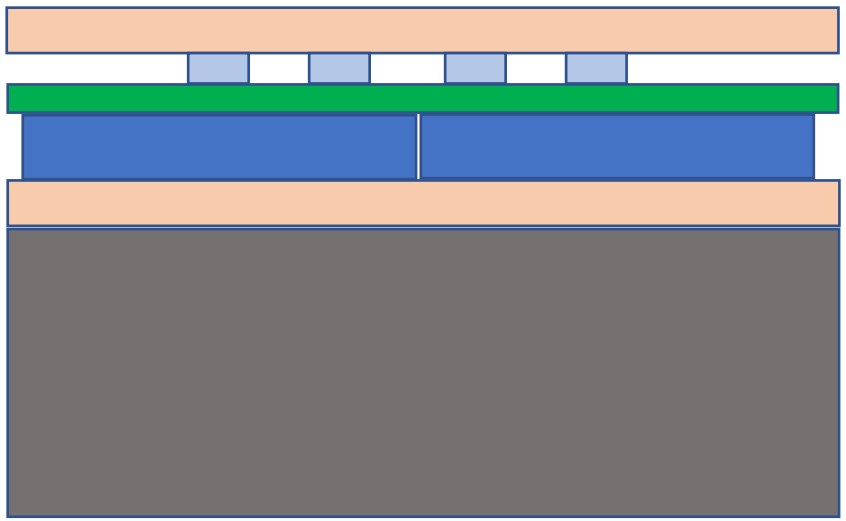
In total 274mm

Note: for a conservative design, a 3mm support layer of carbon fiber can be added internally.



Cylindrical profile

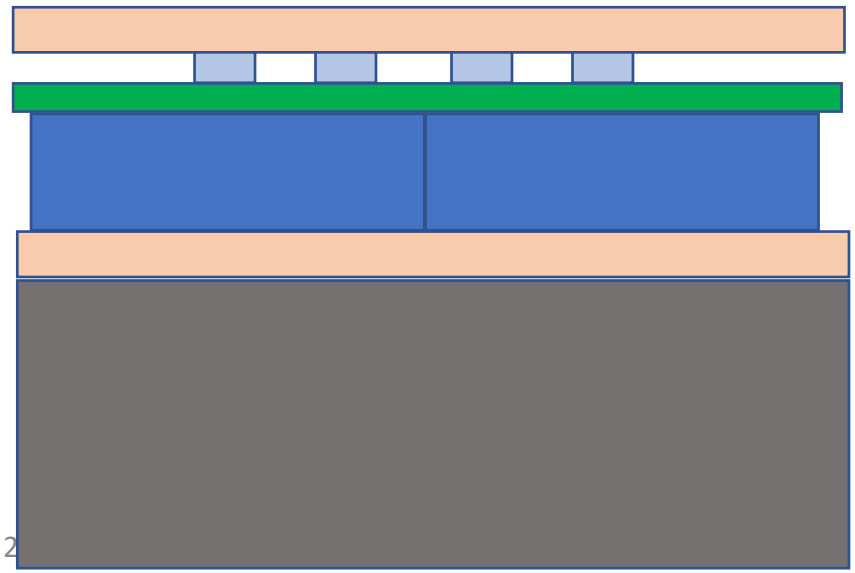
CEPC PS-AHCAL: plastic scintillator tiles - steel



Single layer: 1.18 X_0, 0.125 NIL (excluding scintillator/PCB)
48 layers: 56.8 X_0, 6.0 NIL, 1305.6 mm*

*Note: The total thickness of the plastic scintillator is 14.4cm, approximately 0.19 nuclear interaction lengths (NIL), corresponding to 31.6mm of iron. If considering this contribution, under the same total NIL, PS-AHCAL can be thinner than GS-AHCAL, i.e., 1305.6 - 31.6 = 1274 mm.

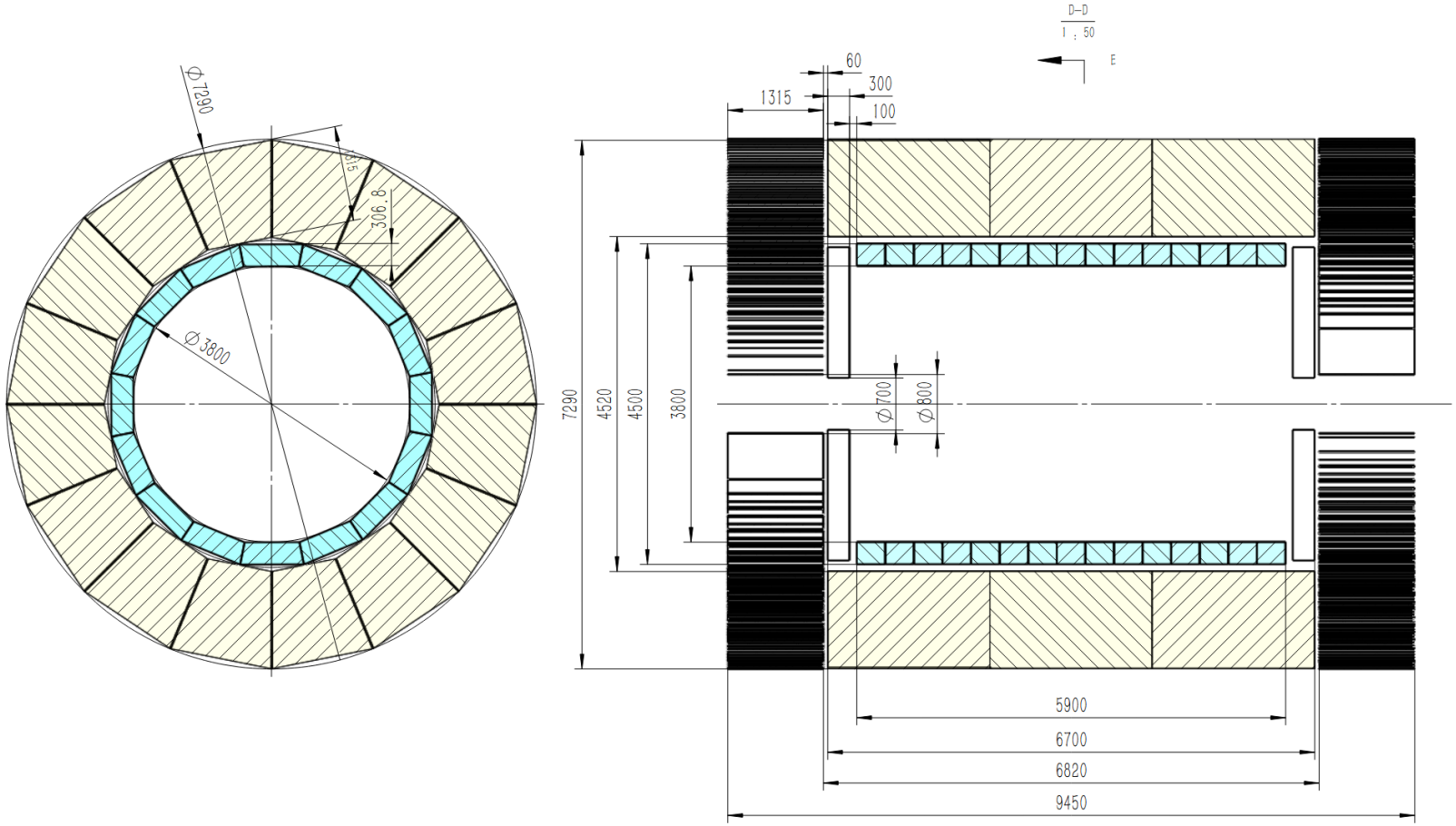
CEPC GS-AHCAL: glass scintillator tiles - steel



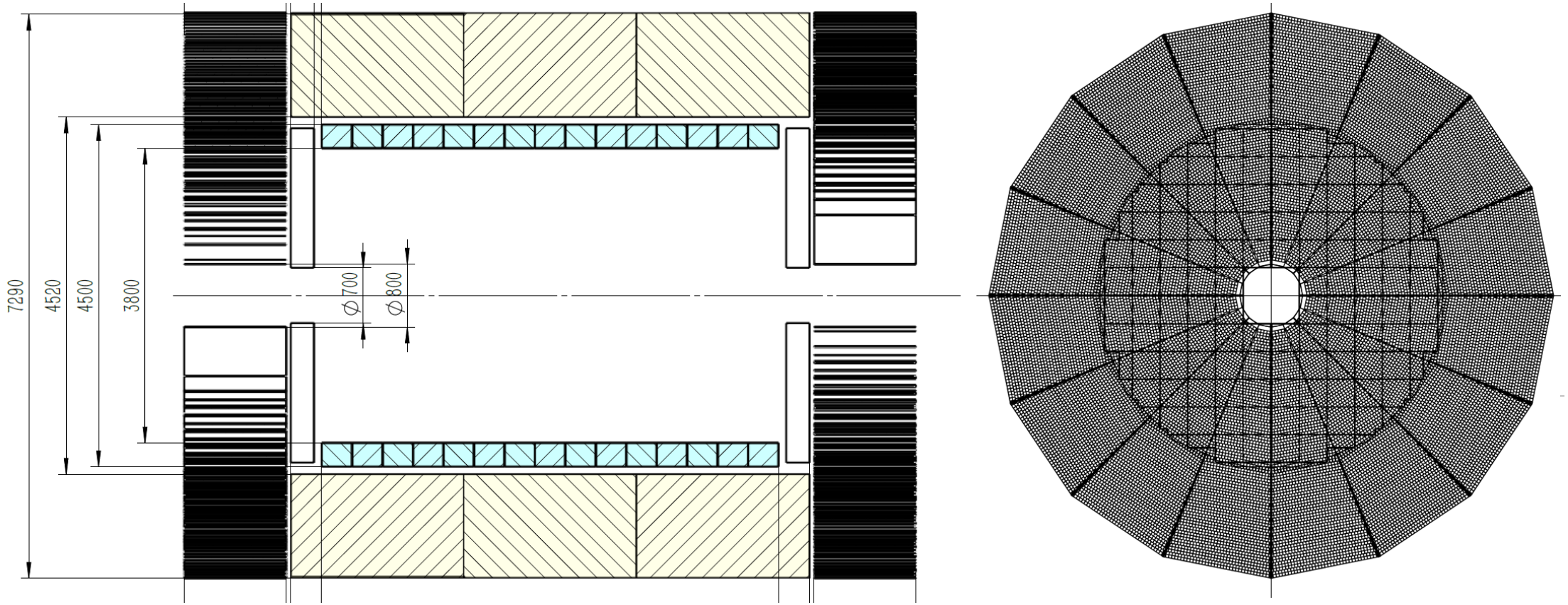
Single layer: 1.41 X_0, 0.125 NIL (excluding PCB)
48 layers: 67.7 X_0, 6.0 NIL, 1310.4 mm*

Summary: CEPC calorimeter dimensions

- ECAL total thickness: 300 mm ($24X_0$)
- HCAL total thickness: 1315 mm ($6\lambda_I$)

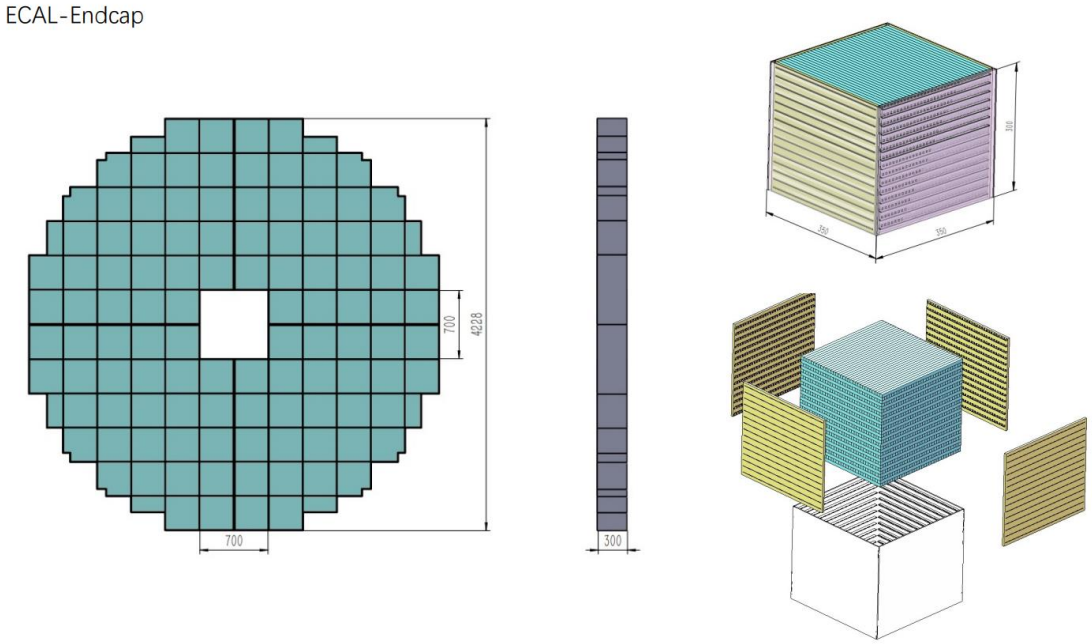


Update: first designs of endcap calorimeters

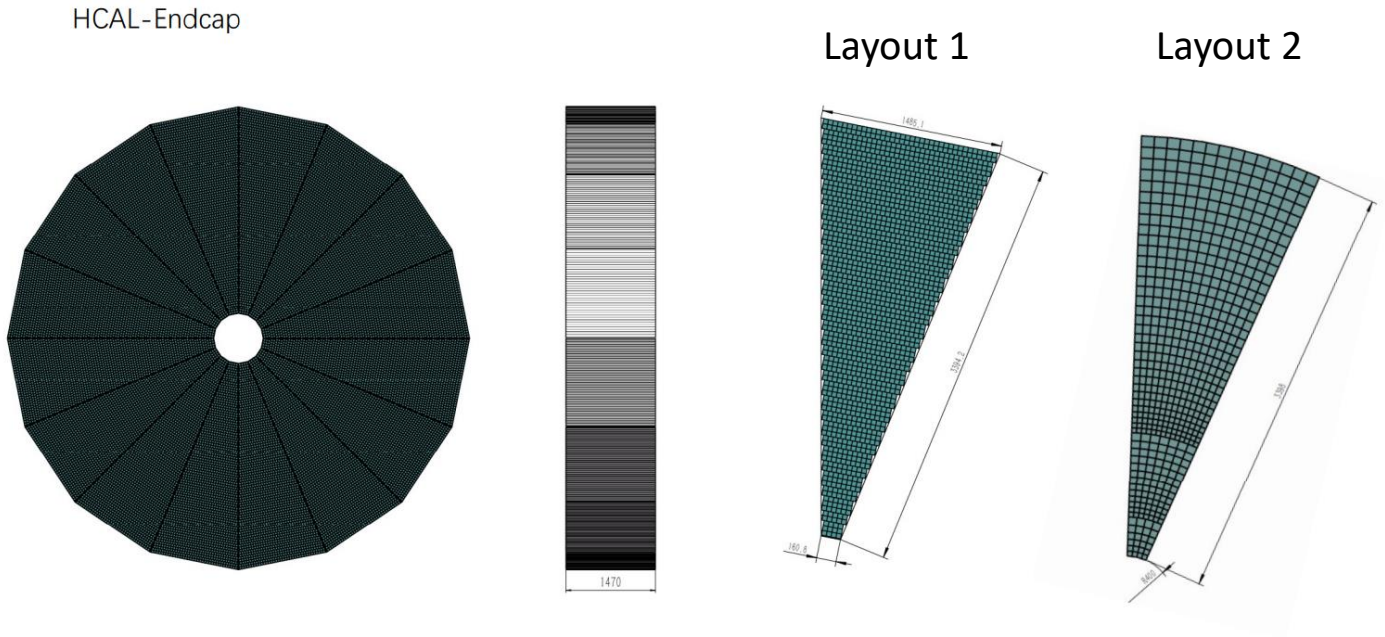


Update: first designs of endcap calorimeters

Endcap design of crystal ECAL



Endcap design of HCAL (“SiPM-on-Tile”)



[Designs of CEPC calorimeters in endcap regions](), Shaojing Hou (IHEP)