

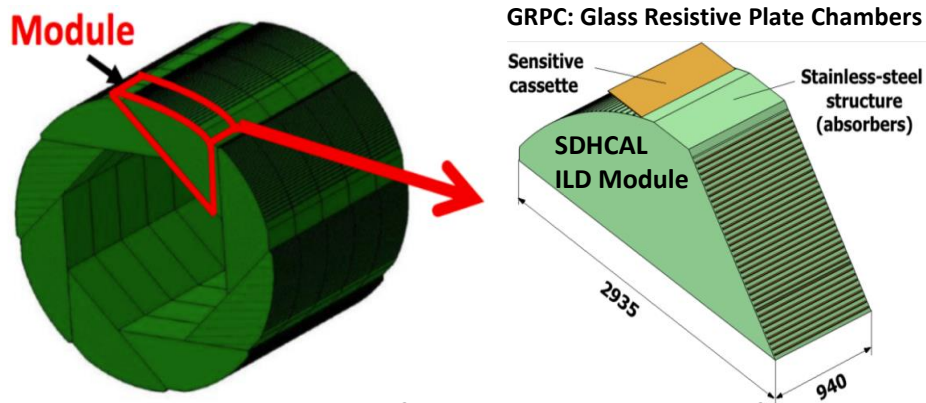
CEPC Hadron Calorimeters: layer thickness comparisons

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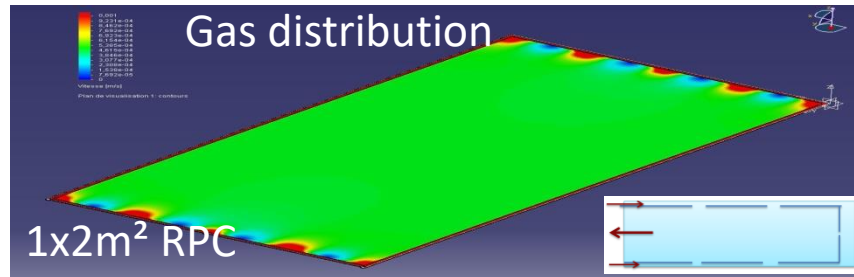
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Hadron Calorimeter: two major options

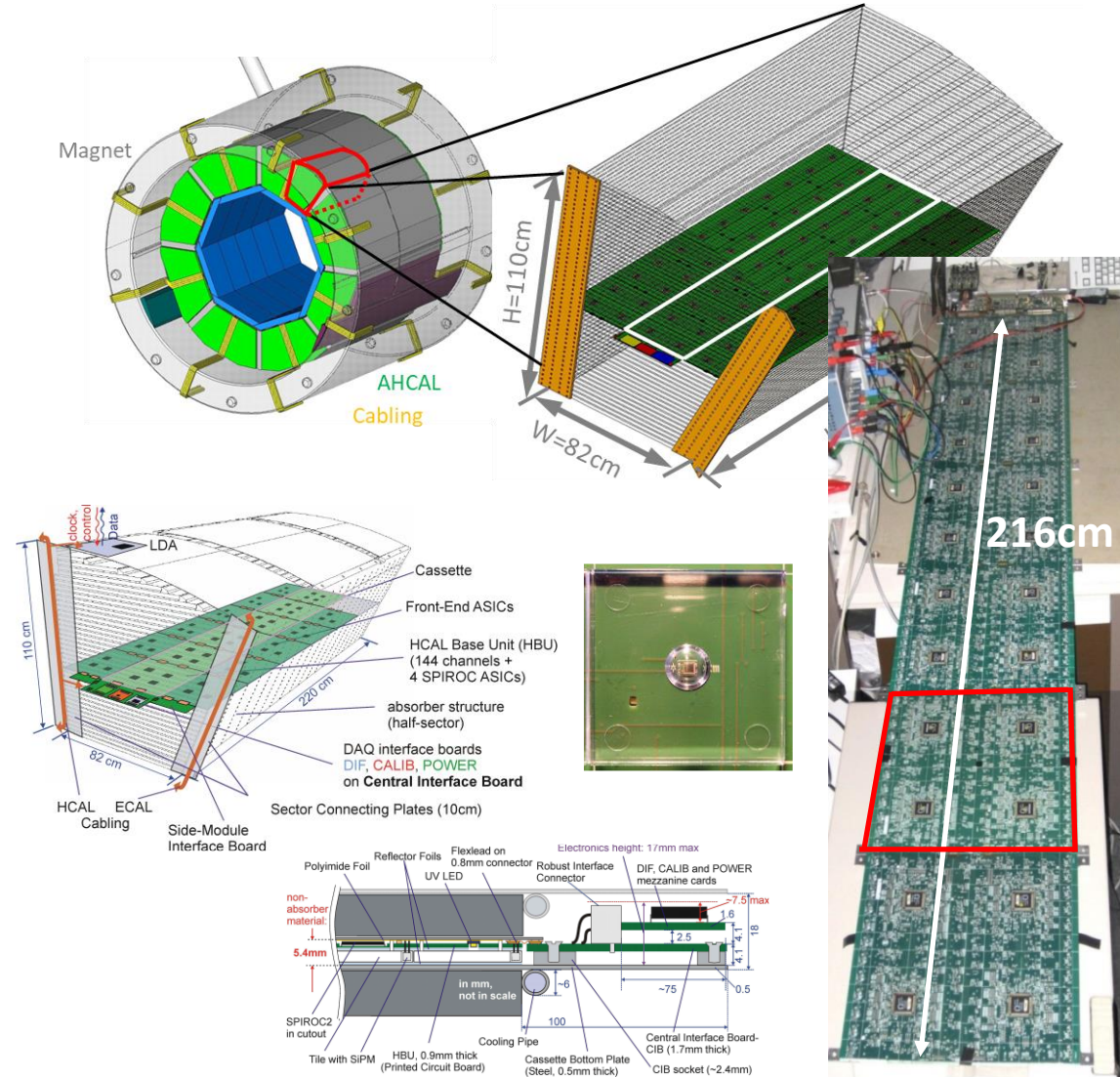
- SDHCAL: glass-RPC option



Assembled $1 \times 2 \text{ m}^2$ large RPC, $1 \times 0.33 \text{ m}^2$ PCBs



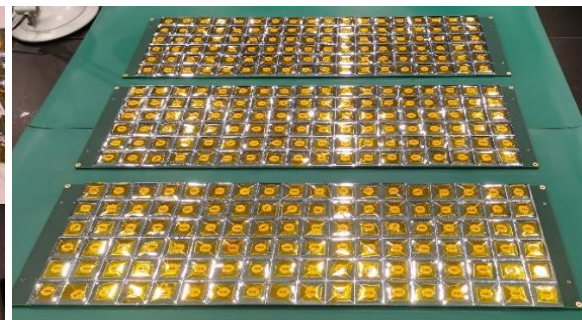
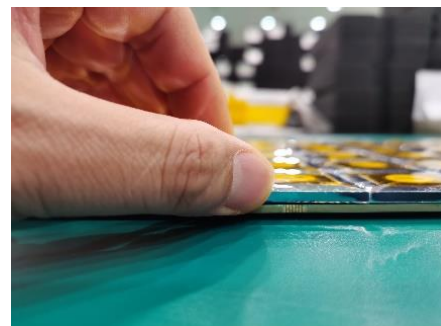
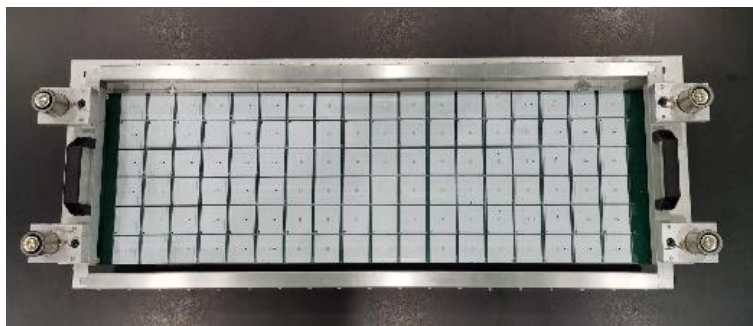
- AHCAL: scintillator-SiPM option



CEPC AHCAL prototype



其中闪烁体（包含ESR包装膜）厚度为3.5 mm，读出电子学板是2.5 mm，电子学元器件最大厚度为3 mm，为了防止盒子上盖板与元器件接触，预留1 mm的冗余设计。整个灵敏层盒子内部厚度为10 mm，考虑盒子的底板和上盖板，整个盒子厚度为14 mm。



Remarks and personal considerations

- 3mm is majorly for tantalum capacitors (from Yunlong) → can be thinner
- 1mm gap is too large, especially reserved for better insulation → <0.1mm (Kapton)
- 0.5 mm ESR wrapping seems too conservative → 0.2 mm or thinner likely to achieve

Projections to the Scintillating Glass HCAL option

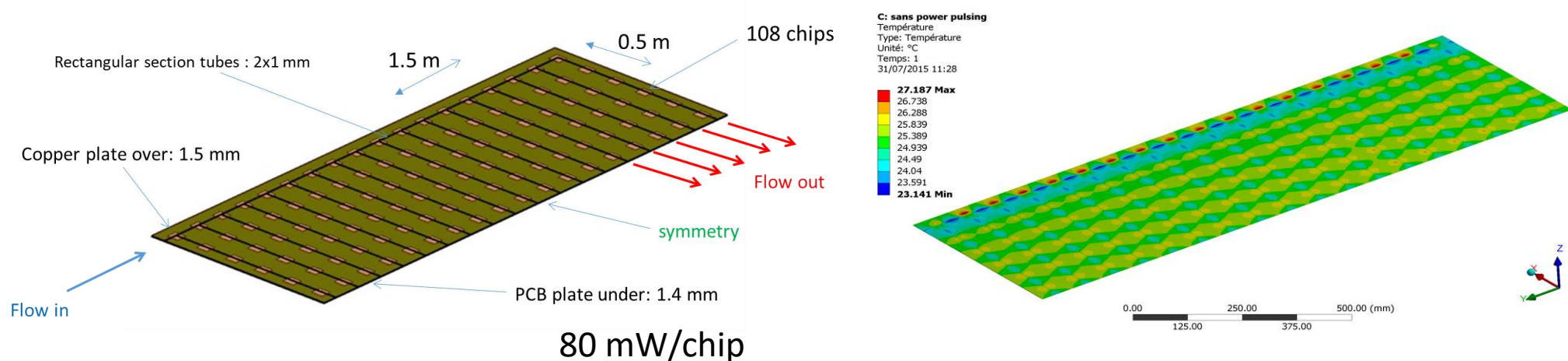
Components	CEPC-AHCAL Prototype	Scintillating Glass HCAL
Electronics Components	3mm (max. height) + 1mm (gap)	3mm (max. height) + 1mm (gap)
Readout PCB	2.5 mm	2.5mm
Scintillator Tiles	3mm scintillator + 0.5mm wrapping	10mm glass tile + 0.2mm wrapping
Sensitive Layer	10mm	16.7
Absorber Layer	20mm	13.8
One HCAL Layer	30mm	30.5mm
40-layer HCAL	1200mm	1220mm
48-layer HCAL	1440mm	1464mm

HCAL total depth is set to 1470mm after rounding up 1464mm

Active Cooling for circular colliders

[CALICE calorimeters overview](#),
2024 CEPC Workshop in Marseille

- Simulation studies: SDHCAL active cooling
 - Duty cycles of CEPC/FCCee are different from ILC → no power pulsing
 - Working on a simple cooling system using water circulating into copper pipes
 - (Simulation) Temperature distributions within $1.5 \times 0.5 \text{ m}^2$



Personal remarks:

Cooling pipes were routed on an extra copper plate on top of ASICs. But it seems not clear how thick are the copper plate/pipes and how they are integrated with absorber. Pending answer to the email that I sent to SDHCAL colleagues.

Presumably these pipes can be embedded into absorber plates and thus might not introduce a significant change in absorber thickness.

HCAL options for ILD

Hereby schematics of HCAL designs are summarised, with a focus on thickness estimates

- SDHCAL: glass-RPC option

Also as a baseline option in the CEPC CDR

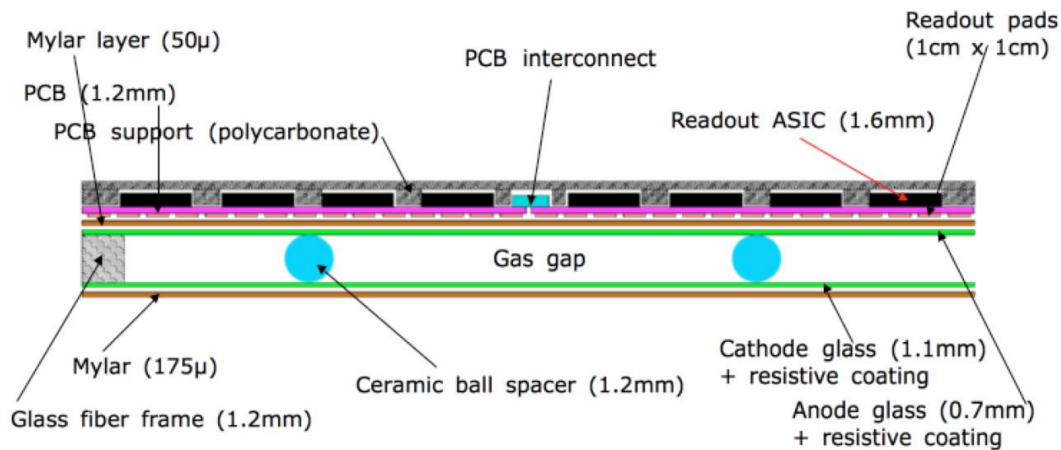


Figure 1. A schematic cross-section of a SDHCAL active layer (not to scale).

One active layer: 6 mm (3mm glass RPC + 3mm electronic board)

A cassette: two 2.5 mm thick stainless steel walls

The total thickness of a cassette is 11 mm

Ref1: "First results of the CALICE SDHCAL technological prototype"

doi:[10.1088/1748-0221/11/04/P04001](https://doi.org/10.1088/1748-0221/11/04/P04001)

- AHCAL: scintillator-SiPM option

