
CEPC Calorimeter Options: Input Materials (Template)

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Performance

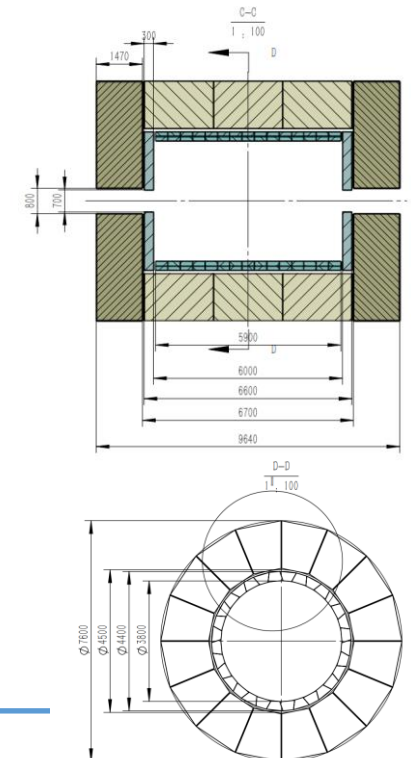
Items	Priority	Results / Status	Remarks
Boson Mass Resolution	A	~3.6% ($\nu\nu_{gg}$)	BMR < 4%
Intrinsic EM/hadronic energy resolution	A	26.5%/sqrt(E) + 8.3%	
Separation power			gamma/gamma, gamma/hadron, hadron/hadron
Lepton ID in jets			
Timing capability			
π^0 reconstruction			
Pile-up at Z-pole			

- Priority/importance for performance requirements: (A) must-have; (B) plus; (C) not essential

Cost

Parameter Name	Barrel	Endcaps (x2)	Sum
Inner Radius for HCAL	2250 mm	400 mm	NA
Length for barrel; Outer radius for endcap*	4600 mm	3800 mm	NA
Longitudinal Depth Z Depth for EndCap	$6\lambda_I$, ~1477 mm, 48 Layers	$6\lambda_I$, 1470 mm, 48 Layers	NA
Modularity	16 modules in phi, #rings along Z	Assuming any ideal geometry if no design?	NA
Material Volume (m ³)	GS 60 m ³ / Steel 83 m ³	GS 43 m ³ / Steel 60 m ³	GS 104 m ³ / Steel 143 m ³
Readout channels	3.75M	2.69M	6.5M channel
Power dissipation (kW)			
Cost: Materials	GS:16 CNY (2\$)/cc/ Steel: 0.448 CNY/cc		GS 1.66B / Steel 64M
Cost: electronics	SiPM: 200 CNY/piece / Ele: 20 CNY/channel		SiPM 1.3B /Ele 0.13B
Total Cost			3.15B

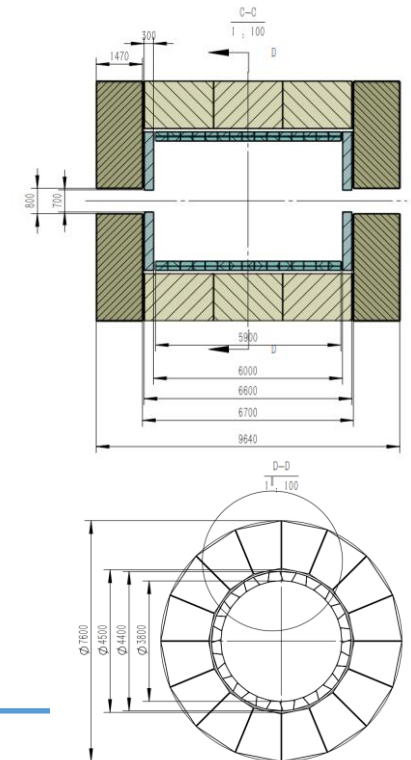
- Barrel总体积 185.4 m³;
EndCap总体积 131.9 m³
- 采样层结构按 GS 10 mm+
13.8 mm Steel + 其他
- 横向尺寸为4x4 cm²



Cost

Parameter Name	Barrel	Endcaps (x2)	Sum
Inner Radius for HCAL	2250 mm	400 mm	NA
Length for barrel; Outer radius for endcap*	4600 mm	3800 mm	NA
Longitudinal Depth Z Depth for EndCap	$6\lambda_I$, ~1400 mm, 48 Layers	$6\lambda_I$, ~1393 mm, 48 Layers	NA
Modularity	16 modules in phi, #rings along Z	Assuming any ideal geometry if no design?	NA
Material Volume (m ³)	GS 20.8 m ³ / Steel 109.5 m ³	GS 15.1 m ³ / Steel 79.2 m ³	GS 35.9 m ³ / Steel 188.7 m ³
Readout channels	3.72M	2.69M	6.4M channel
Power dissipation (kW)			
Cost: Materials	GS:16 CNY (2\$)/cc / Steel: 0.448 CNY/cc		GS 0.65B / Steel 85M
Cost: electronics	SiPM: 20 CNY/piece / Ele: 20 CNY/channel		SiPM 1.3B /Ele 0.13B
Total Cost			2.17B

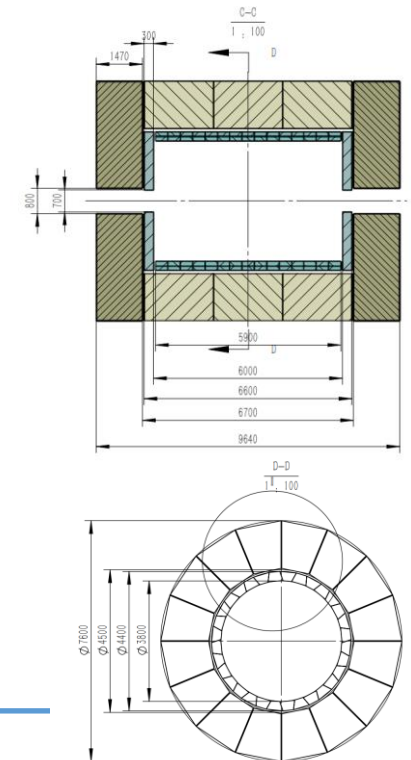
- Barrel总体积 173.5 m³;
EndCap总体积 125 m³
- 采样层结构按 GS 3.5 mm+18.4 mm Steel + 其他
- 横向尺寸为4x4 cm²



Cost

Parameter Name	Barrel	Endcaps (x2)	Sum
Inner Radius for HCAL	2250 mm	400 mm	NA
Length for barrel; Outer radius for endcap*	4600 mm	3800 mm	NA
Longitudinal Depth Z Depth for EndCap	$6\lambda_I$, ~1367 mm, 48 Layers	$6\lambda_I$, ~1360 mm, 48 Layers	NA
Modularity	16 modules in phi, #rings along Z	Assuming any ideal geometry if no design?	NA
Material Volume (m ³)	GS 7.1 m ³ / Steel 118.2 m ³	GS 5.2 m ³ / Steel 86.1 m ³	GS 12.3 m ³ / Steel 204.3 m ³
Readout channels	3.69M	2.69M	6.4M channel
Power dissipation (kW)			
Cost: Materials	GS:16 CNY (2\$)/cc / Steel: 0.448 CNY/cc		GS 0.2B / Steel 92M
Cost: electronics	SiPM: 200 CNY/piece / Ele: 20 CNY/channel		SiPM 1.3B /Ele 0.13B
Total Cost			1.72B

- Barrel总体积 167.3 m³;
EndCap总体积 122 m³
- 采样层结构按 GS 1.2
mm+20 mm Steel + 其他
- 横向尺寸为4x4 cm²



Technical readiness level

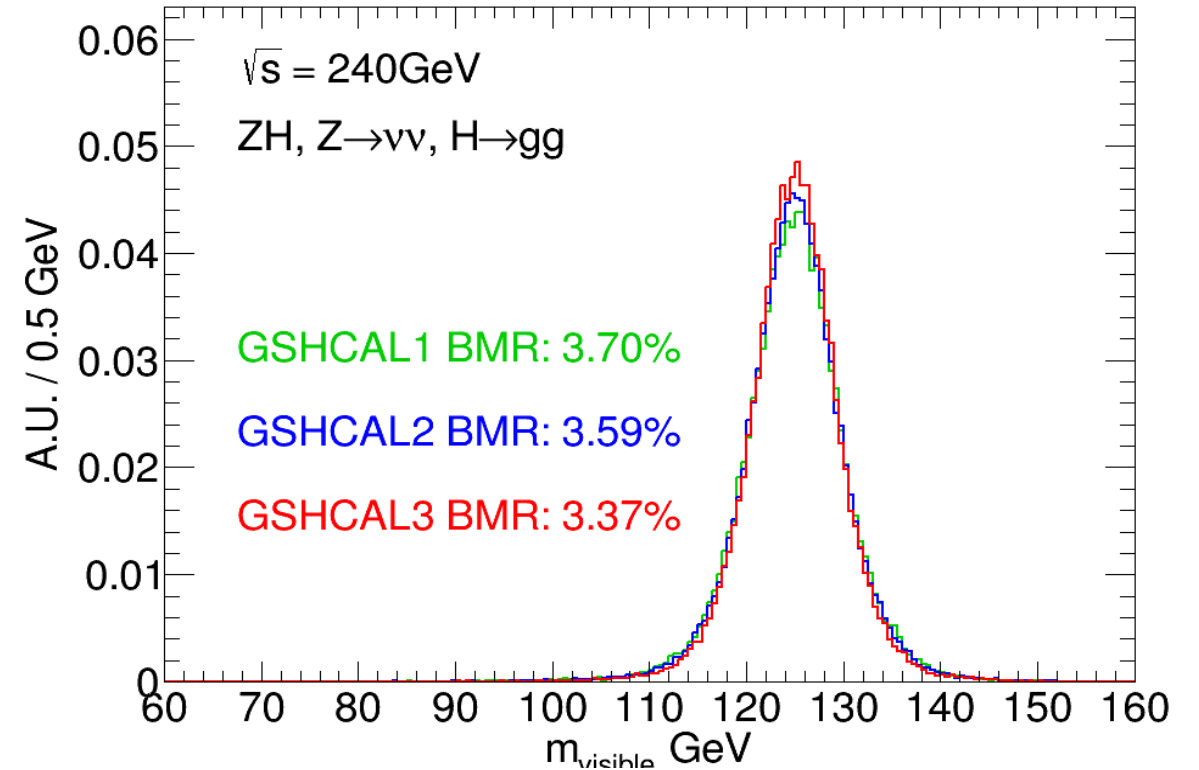
- Status and plans of simulation studies and R&D (a table template)
- Person power: Peng Hu, Du Dejing, GS collaboration colleagues

Category	Status	Design 1	Other Alternative Design (if any)
Technical Readiness Level	Full Simulation (system level)	6 lambda, ongoing	10mm GS+ 13.8mm steel, 5lambda Finished
	Full Simulation (module level)	ongoing	finished
	Prototyping R&D (common)	Ongoing within GS collaboration	Ongoing within GS collaboration
	Prototyping R&D (modules, units)	40x40x10 mm ³ unit Ongoing	ongoing

Cost

Nominal Setup

Parameter	GSHCAL1	GSHCAL2	GSHCAL3
Readout	Analog	Analog	Analog
Number of layers	40	40	40
Layer thickness	0.125 lambda (3mm GS +18.8mm Steel)	0.125 lambda (10mm GS +13.9mm Steel)	0.125 lambda (29.7 mm GS)
Total Nuclear Interaction Length	5 lambda	5 lambda	5 lambda
Transverse Cell Size	40x40 mm ²	40x40 mm ²	20x20 mm ²
Sensitive Material Density	6 g/cm ³	6 g/cm ³	6 g/cm ³
HCAL Thickness	873 mm	962 mm	1218 mm
HCAL Volume	13 m ³ (GS) 81 m ³ (Steel)	46 m ³ (GS) 64 m ³ (Steel)	159 m ³ (GS)
Number of Cells	2.7×10 ⁶	2.9×10⁶	5.4×10 ⁷



*Gaussian fitting range: Mean +/- 2 RMS

Cost

Parameter Name	Barrel	Endcaps (x2)	Sum
Inner Radius for HCAL	2250 mm	400 mm	NA
Length for barrel; Outer radius for endcap*	4600 mm	3800 mm	NA
Longitudinal Depth Z Depth for EndCap	$6\lambda_I$, ~1477 mm, 48 Layers	$6\lambda_I$, 1470 mm, 48 Layers	NA
Modularity	16 modules in phi, #rings along Z	Assuming any ideal geometry if no design?	NA
Material Volume (m ³)	PS 21.1 m ³ / Steel 120.5 m ³	PS 15.1 m ³ / Steel 86.1 m ³	PS 36.2 m ³ / Steel 206.6 m ³
Readout channels	3.77M	2.69M	6.5M channel
Power dissipation (kW)			
Cost: Materials	PS: 1.3 CNY/cc / Steel: 0.448 CNY/cc		PS 47M /Steel 93M
Cost: electronics	SiPM: 10 CNY/piece / Ele: 20 CNY/channel		SiPM 65M /Ele 130M
Total Cost			0.34B

- Barrel总体积 185.4 m³;
EndCap总体积 131.9 m³
- 采样层结构按PS 3.5 mm+
20 mm Steel + 其他
- 横向尺寸为4x4 cm²

