The Status of the HCAL

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Qian Sen, on behalf of the HCAL Group

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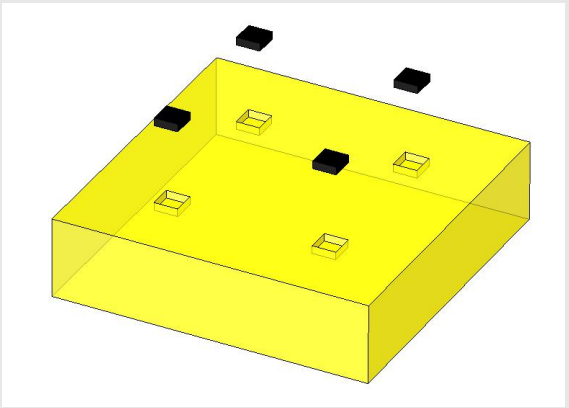
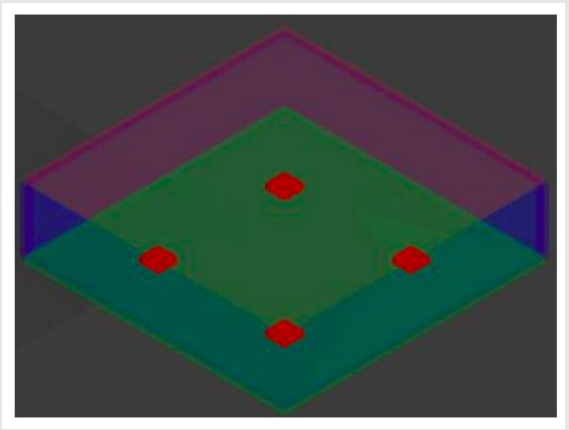
Recent Progress for GS-HCAL--Design+SiPM

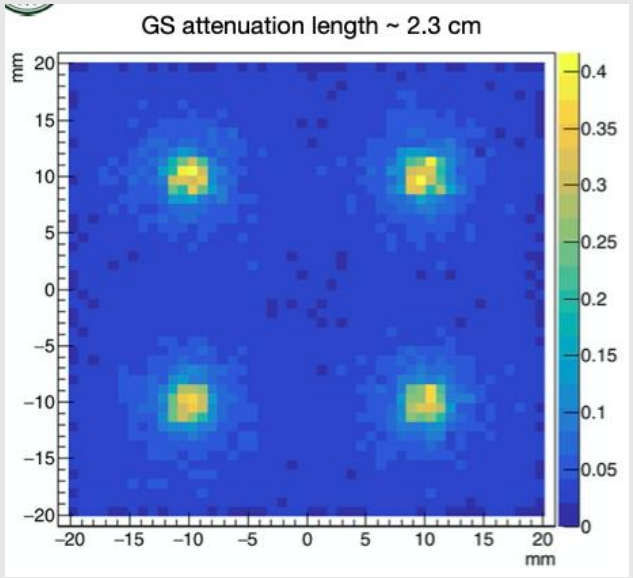
--by Fangyi Guo & Hengne Li --by Xie Yuguang，Han Jifeng，Luo Guang

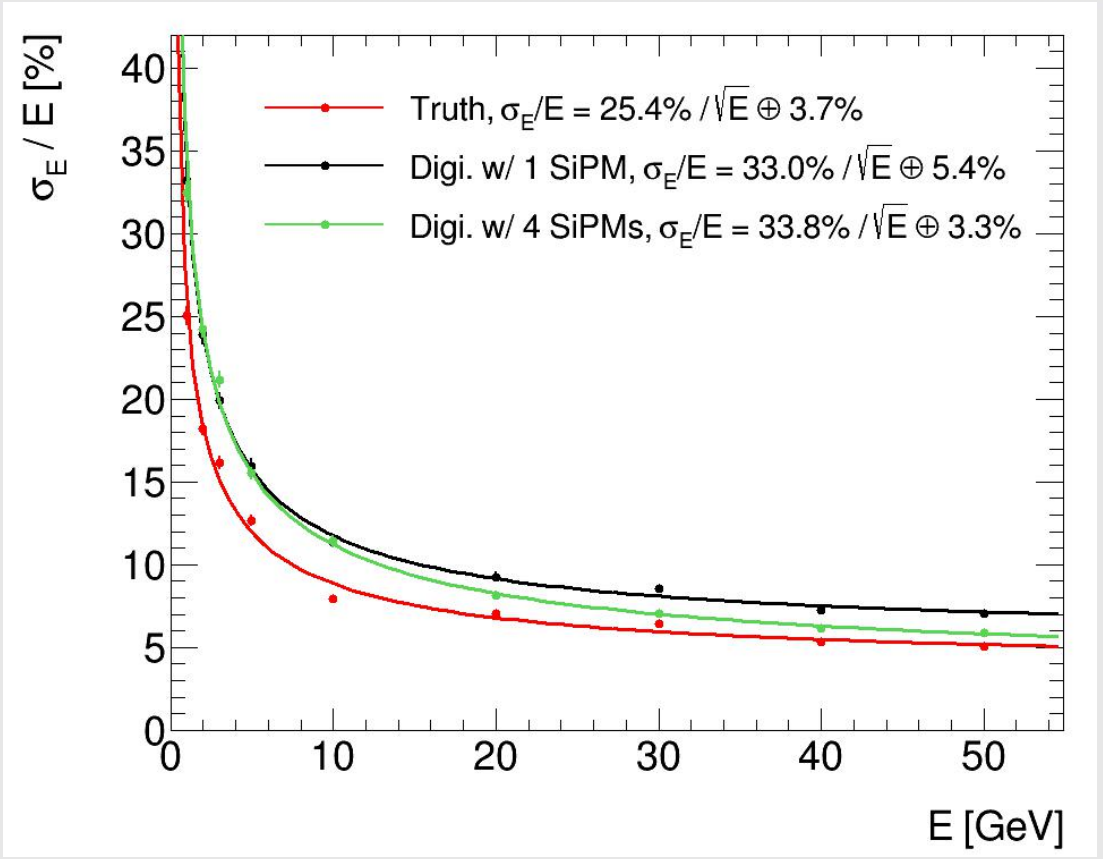


Mechanics



Design





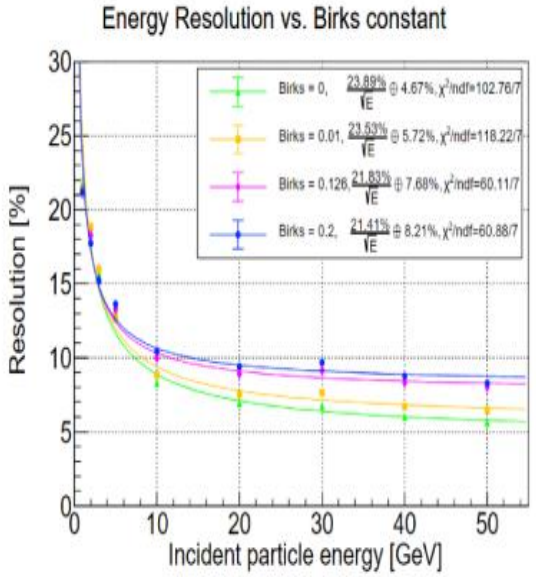
- **Energy resolution:**
  - π^- single p, θ~90°, ϕ~0°, Birks constant 0.
  - Shower start at first 12 cm (4 layers)
  - 4 SiPMs can improve the tile uniformity and reduce the constant term.

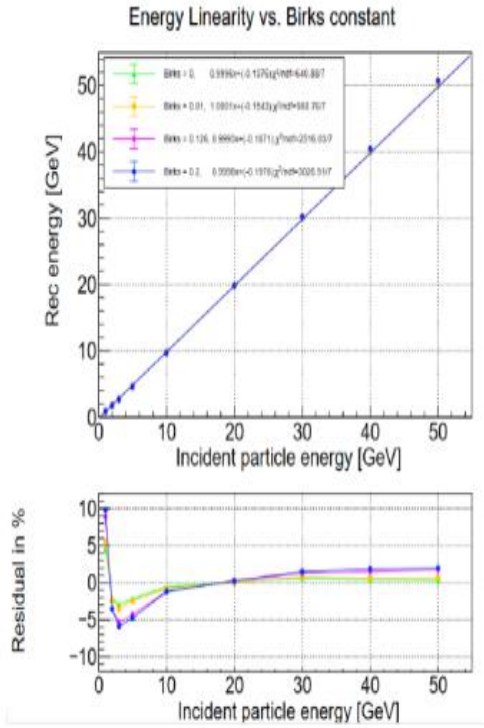
Current status of the GS-HCAL GS

--by Ren Jing， Hua zhehao

Glass quenching: Birks effect

- **Simulate with different Birks constant**
  - Truth energy in simulation, no digitization considered
  - For BGO: C_{Birks}~0.008
  - Lack of glass measurement result. Suppose ~ 0.01.





	类型	密度 (g/ml; g/cm³)	kB (×10⁻³gMeV⁻¹cm⁻²)
有机闪烁体	聚苯乙烯(C_8H_8)	1.06	9
	PXE($C_{16}H_{16}$)液闪	0.7734	6.8
	伪二甲苯(C_9H_{12})	0.857	9.4
			42（质子）
闪烁晶体	$CdWO_4$	7.9	5.3
			5.1(用于F离子)
	CaF_2(Eu)	3.18	10.5
	$ZnWO_4$	7.41	9.0
	$CaWO_4$	6.062	6.2
			8(用于O离子)
			9.8(用于仅电子部分的SP)
	CsI(TI)	4.53	3.2(Cs和I离子)
			2.3(α粒子)
	CsI(Na)	4.51	5.5
	NaI(TI)	3.67	3.8(初始值)
			6.5(低能区间)
			1.25(α粒子)
	CeF_3	6.16	11.1
	BGO	7.13	8 (CEPC模拟)

闪烁玻璃的Birks常数测试

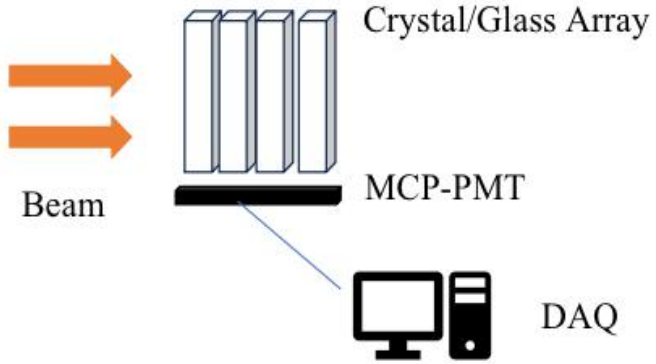
$$Q_{\mathrm{Birks}}(\epsilon) \equiv 1/(1+kB\epsilon).$$

$$Q_{\mathrm{Voltz}}(\epsilon) \equiv f + (1-f)e^{-V(1-f)\epsilon},$$

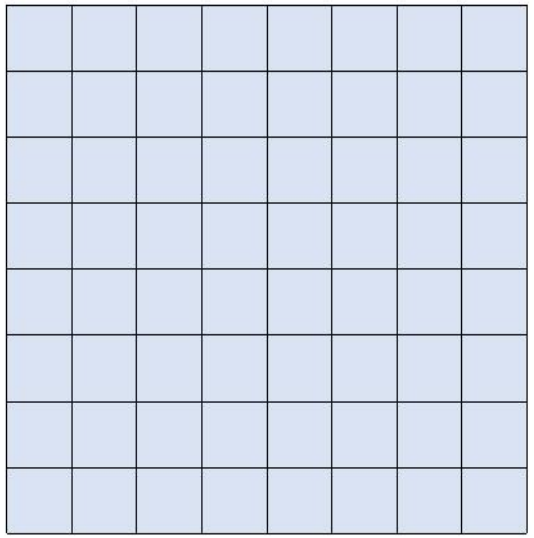
$$Q_{\mathrm{Chou}}(\epsilon) \equiv 1/(1+kB\epsilon + C\epsilon^2),$$

$$Q_{\mathrm{Wright}}(\epsilon) \equiv \frac{1}{W\epsilon}\log(1+W\epsilon),$$

1. 数据收集：通过实验测量不同入射动能下的平均光产额，得到数据集；
2. 根据单位距离发光、单位距离能损：dL/dx, dE/dx，计算得到淬灭因子Q随能损的曲线；
3. 选择不同的猝灭函数拟合Q的曲线，计算模型的可信度，最终得到Birks常数；



闪烁晶体/玻璃阵列制备



尺寸要求：

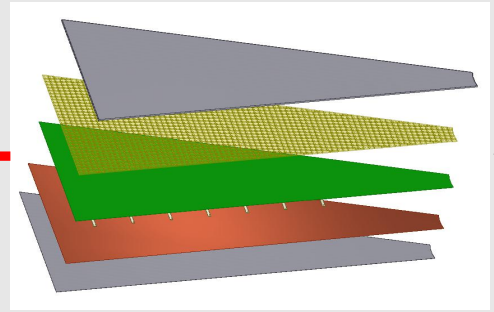
- 晶体尺寸：5.6*5.6*40 mm^3
- 反射层/胶厚度：0.3 mm
- 金属不锈钢/铝箔外壳厚度：1.55 mm
- 整体（晶体+不锈钢外壳）尺寸：

50*50*40 mm^3

- BGO晶体阵列：已联系中电26所，预计制备时间6周
- 闪烁玻璃阵列：已联系北玻院，目前需要探讨阵列制备方面问题

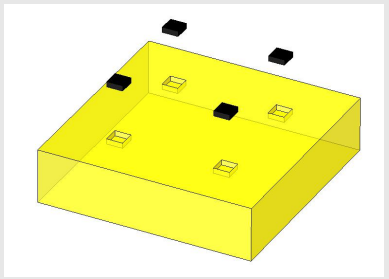
the Conceptual Detector Design of GS-HCAL

- Endcap-module



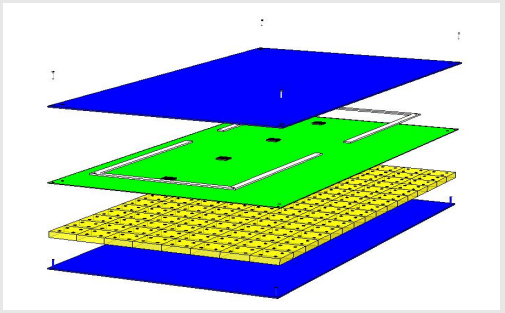
X 1400

- GS-Cell
  5.20M Pics



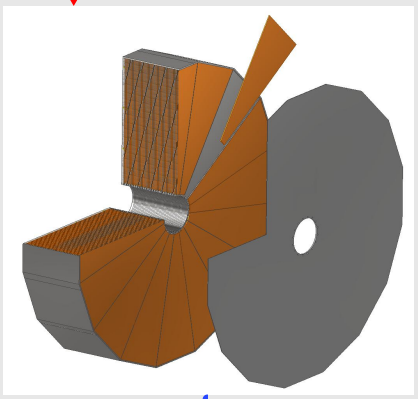
X 4000

- Barrel-module



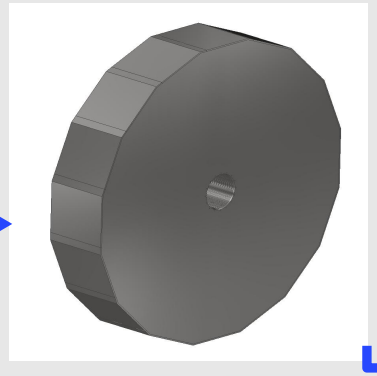
X 48

- Endcap-Prototype

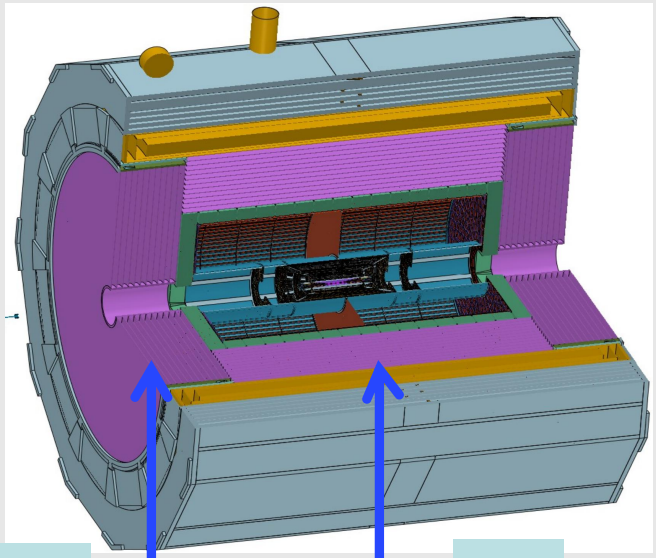


X 16

- Endcap-Detector



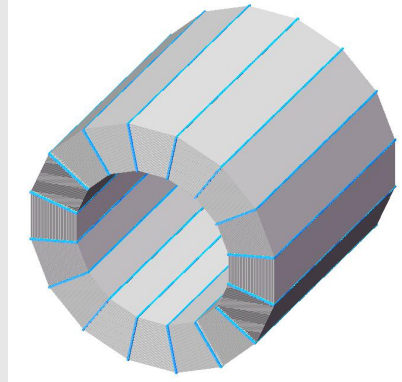
- CEPC-GS-HCAL



X 2

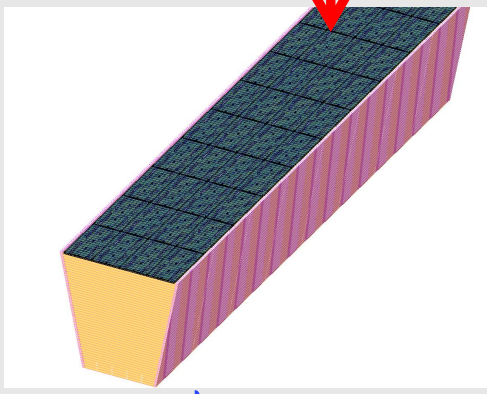
X 1

- Barrel-Detector



X 16

- Barrel-Prototype



X 48

Current status of the GS-HCAL TDR

Chapter 8 Hadron calorimeter--V2.0: 45P+10P -->

- 8.1 Physics Requirements of HCAL（Ruanmanqi， Yanghaijun）--2P
- 8.2 Design of the GS-HCAL（Lihengne，Guofangyi）--10P 80%
- 8.3 The Glass Scintillator（Renjing，Huazhehao）--10P 80%
- 8.4 The SiPM （Xieyuguang, Hanjifeng）--8P 50%
- 8.5 The Electronics & DAQ (Changjinfan, Lifei)--1P
- 8.6 The Mechanics (Peiyantian, Shangbofeng) --10P 60%
- 8.7 The Detector Layout （Yuboxiang，Zhangyonglong）--5P 80%
- 8.8 The Backup Desigh --10P （ready！）
  - 8.8.1 Semi-Digital HCAL based on RPC (SDHCAL) （Yanghaijun）-5
  - 8.8.2 Analogue HCAL based on plastic scintillator (PS-HCAL) （Liujianbei）-5

Backup

The Manpower of the HCAL

- 1. The PS-HCAL
  - **Jianbei Liu,** Haijun Yang, Boxiang Yu，Yunlong Zhang，……，
- 2. The GS-HCAL： Sen Qian （IHEP）
  - Sub-system: 2 Conveners + others
  - Physics：**Manqi Ruan(IHEP)，Haijun Yang(SJU)，**
  - Software: Sengsen Sun(IHEP)；
  - Design: **Fangyi Guo(IHEP), Hengne Li(SCNU)，**
  - Glass Scintillator: **Sen Qian(IHEP), Jing Ren(HEU)，** the GS collaboration Group
  - SiPM: **Yuguang Xie(IHEP), Jifeng Han(SCU)，**
  - Electronics: **Jingfan Chang(IHEP)，**
  - DAQ：**Chen Boping(IHEP),**
  - Mechanics: **Yatian Pei(IHEP), Junsong Zhang**
  - Detector：**Boxiang Yu(IHEP), Yunlong Zhang (USTC)，**

The Manpower of the subsystem of GSHCAL

Physics：Manqi Ruan(IHEP)，Haijun Yang（SJTU），

Software: Sengsen Sun(IHEP)；

Design: Fangyi Guo(IHEP), Hengne Li(SCNU), Qingming Zhang(XJTU), Weizheng Song(IHEP), Peng Hu(261) Dejing Du(IHEP), Hongbing Diao(SUTC), Jiyuan Chen(SJTU), ……

--to design the GS-HCAL detector based on the CEPCSW;

Glass Scintillator: Sen Qian(IHEP), Jing Ren(HEU)， the GS collaboration Group;

--R&D of the GS for CEPC-HCAL, a special group independent of CEPC;

SiPM: Yuguang Xie(IHEP), Jifeng Han(SCU), Guang Luo(SYSU),

--to do the research of SiPM for CEPC-HCAL, the electronics of SiPM for the GS performance test;

Electronics: Jingfan Chang(IHEP),

--to design the ASIC and FEE for CEPC-HCAL; the power supply, the cables and so on;

DAQ: Chen Boping(IHEP),

Mechanics: Yatian Pei(IHEP), Junsong Zhang(IHEP), Shang Bofeng(ZZU)

--to design the Mechanics of the GS-CEPC-HCAL; also the cell, the module, the cooling system;

Detector：Boxiang Yu(IHEP), Yunlong Zhang (USTC)

--to study the module of the GS-HCAL with GS and SiPM, the cosmic ray test, the beam test;