中国科学院高能物理研究所
Institute of High Energy Physics, Chinese Academy of Sciences

2022年5月~8月工作报告

报告人：车逾之
导　师：阮曼奇

实验物理中心 高能量物理组

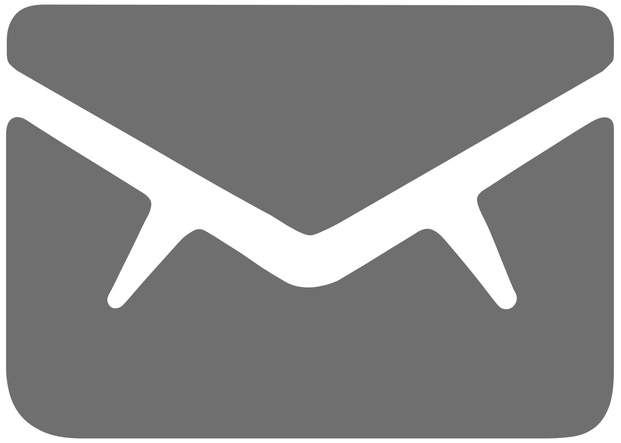
2022年9月2日

1. Cluster Timing: 完成初稿、听取专家意见、准备发表

😀 完成 Cluster Timing 初稿

😀 收到了所内硬件组以及法国 PFA 组专家的宝贵意见

😀 更多细节的讨论……



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Cluster time measurement with CEPC calorimeter

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Received: date / Accepted: date

Abstract We have developed an algorithm dedicated [illegible] future Higgs factories. The time response of individual channel is parameterized according to the CMS experimental result [1]. The particle Time-of-Flight (ToF) can be measured with a resolution of 5 ∼ 20 ps for electromagnetic (EM) showers and 80 ∼ 160 ps for hadronic showers above 1 GeV. The presented algorithm can significantly improve the time resolution, compared to a simple averaging of the fast component of the time spectrum. The effects of three detector configurations are also quantified in this study. ToF resolution depends linearly on the timing resolution of a single silicon sensor and improves statistically with increasing incident particle energy. A clustering algorithm that vetos isolated hits improves ToF resolution.

Keywords Time of Flight · High Granularity Calorimeter

the High Luminosity configuration (HL-LHC) [2] and [illegible] the correct interaction. Since the typical time spread of pile-up events is at the hundred picosecond level, a ToF measurement with a resolution of about 20 ∼ 30 ps can significantly mitigate the effect of pile-up [3–7].

For future electron-positron colliders, the e^-e^+ Higgs factories are identified as the highest-priority next collider by the European Strategy statement [8]. As one of the collider concepts, the circular e^-e^+ collider can also operate at center-of-mass energy of 91.2 GeV for a Z factory with high luminosity, providing a valuable flavor physics opportunity. Particle identification (PID) is critical for the flavor physics measurements. A common method for separating $K/\pi/p$ is to measure the ToF and dE/dx of the particles. The K/π and K/p separation power provided by dE/dx decreases sharply as the particle momentum approaches 1 GeV and 2 GeV. Therefore, the ToF plays an essential role in compensat-

10:10 → 10:35 **Cluster time measurement with CEPC calorimeter**

报告人: Manqi RUAN (Chinese Academy of Sciences (CN)), Yuzhi Che (Institute of High Energy Physics, Chinese academy of sciences)

yuzhi_0630.pdf

1. Cluster Timing: “超光速”前沿 & 多峰结构

- **有限的cell size**导致了簇团时间谱上的**“超光速”前沿和多峰结构**。未来，单个cell本征时间分辨到达ps量级时，这些结构会对时间重建造成影响。

- 强子簇射的物理模型（QGSP_BERT & QGSP_BERT_HP）在入射能量10GeV上下存在**人为跳变**，未来的MC模拟在时序上有进步空间。

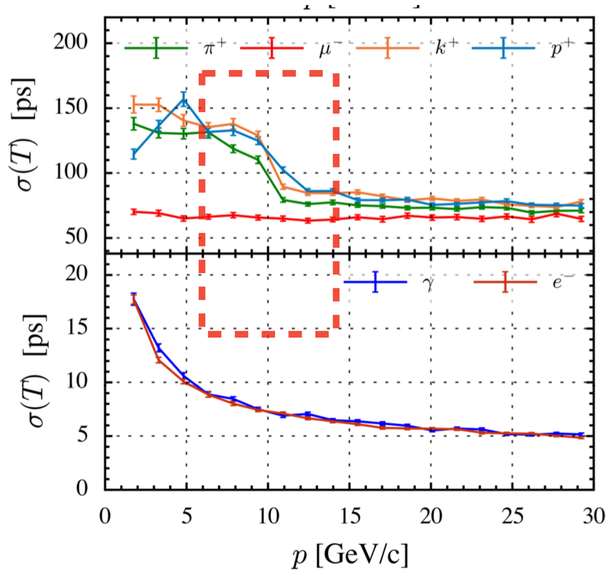
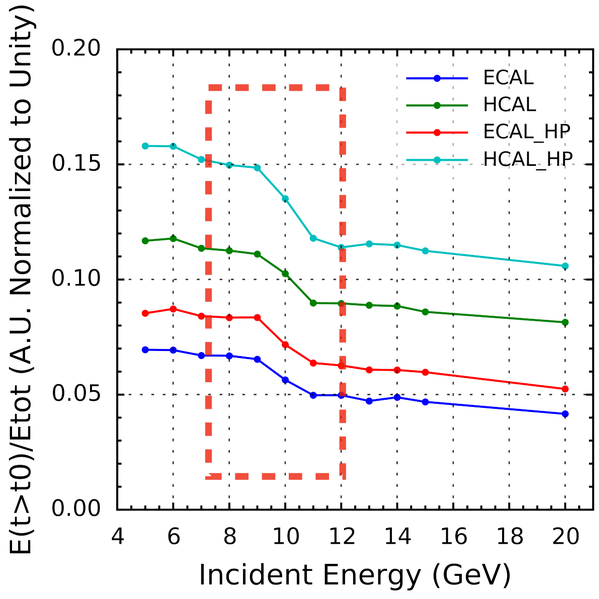
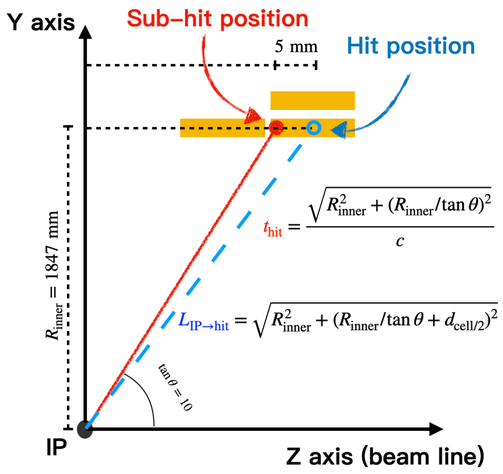
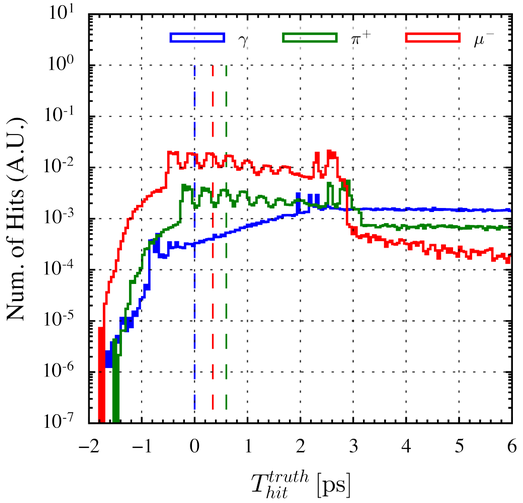


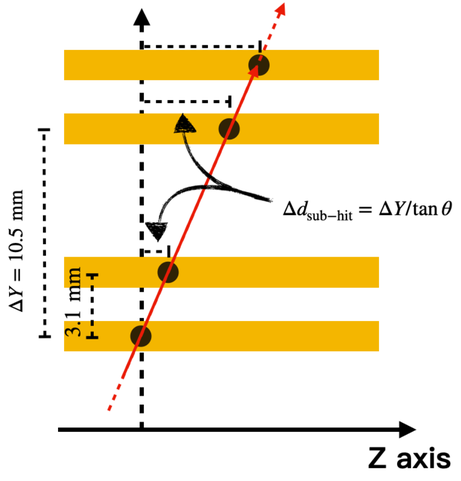
Fig. 11 With $R = 0.4$, the time reconstruction bias (top) and resolution (bottom) of e^-, μ^-,π^+,K^+ and p as a function of the incident momentum.

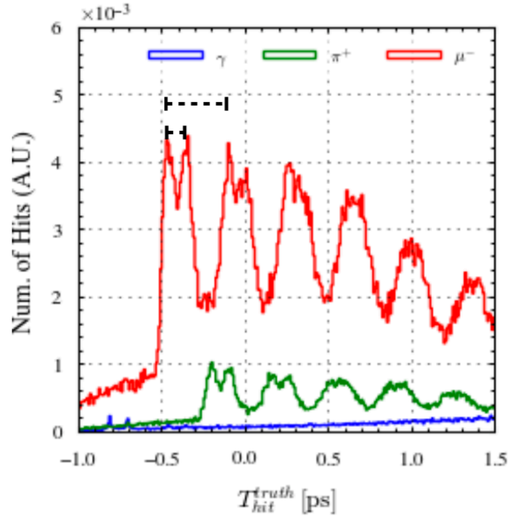


pion簇射中晚于300ns的沉积能量占比 vs. 入射能量





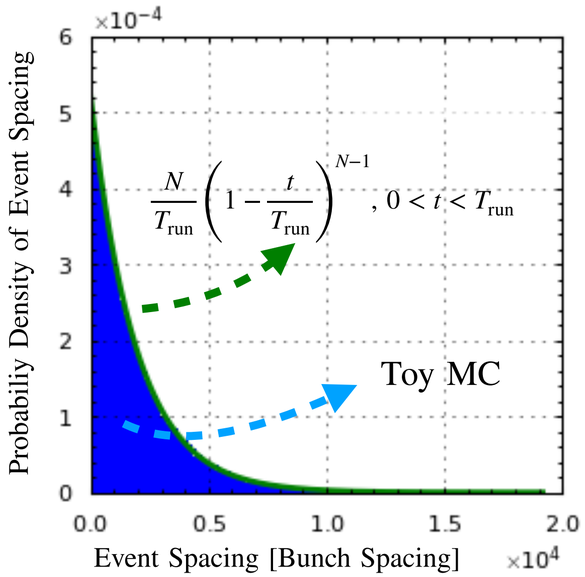


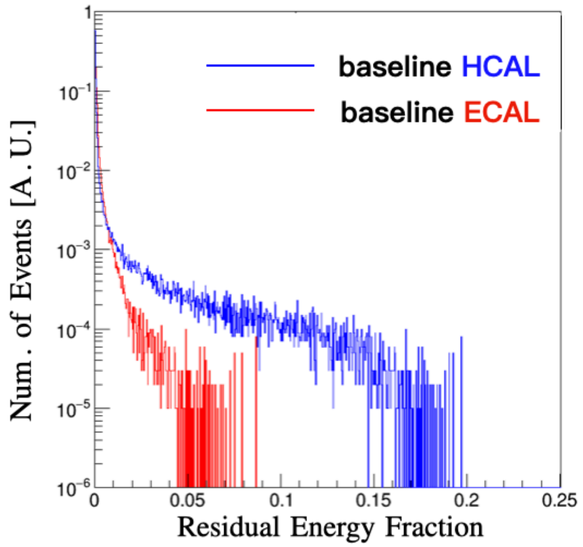


https://indico.in2p3.fr/event/27613/

2. Off-time pile-up: 强子簇射中的能量堆叠

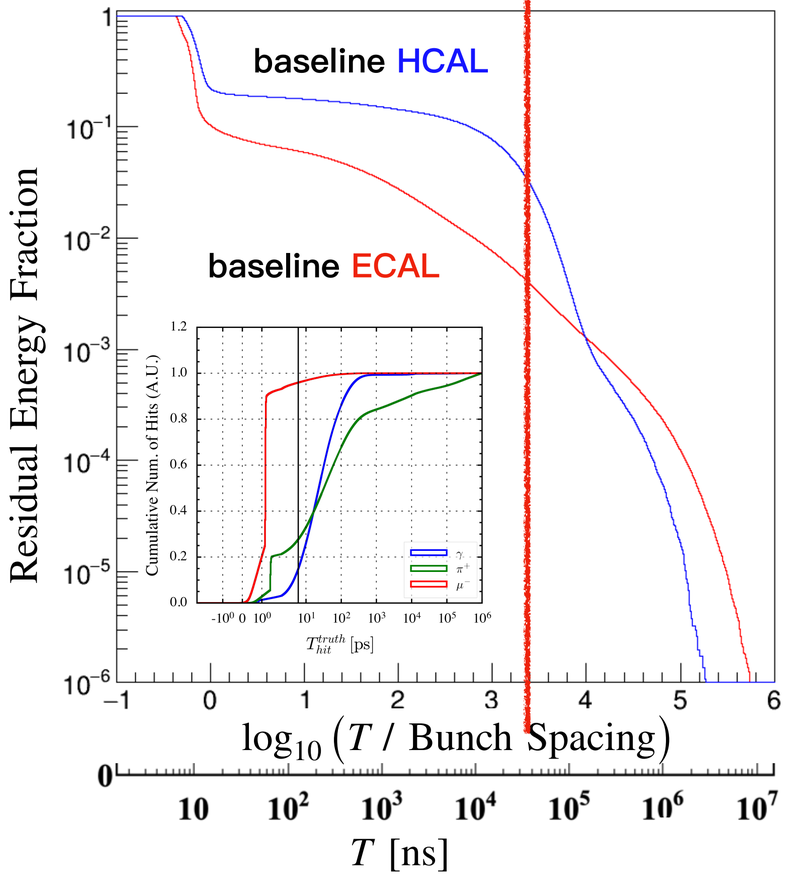
- 强子簇射的**慢成分**可能会与下一个event造成堆叠
- 以Z pole为例，相邻两个event之间时间间隔约30 μs，对应着**<1%**的ECAL能量堆叠和**~3%**的HCAL能量堆叠。
- 具体的物理分析需要防止**能量堆叠造成的假信号**影响分析结果。





3:30 PM → 3:50 PM **Analysis of off-time pile up at CEPC** 20m
Speaker: Manqi Ruan (IHEP)
Offtime Pileup Pres...

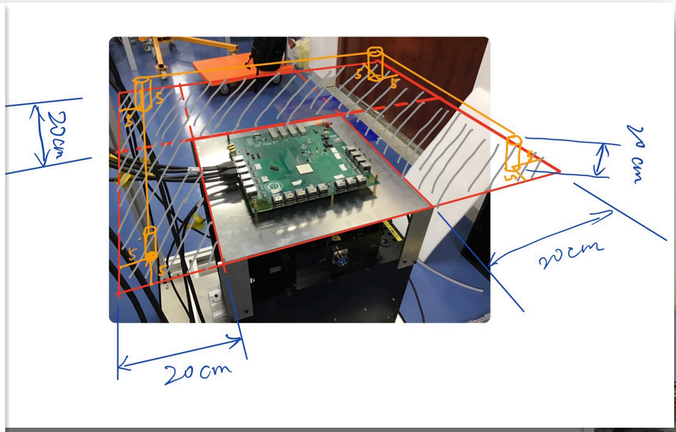
536. Time of Flight measurement potential at CEPC calorimeter
Yuzhi Che (IHEP)
8/11/22, 9:00 AM
Oral report | Parallel Session VII (1)...

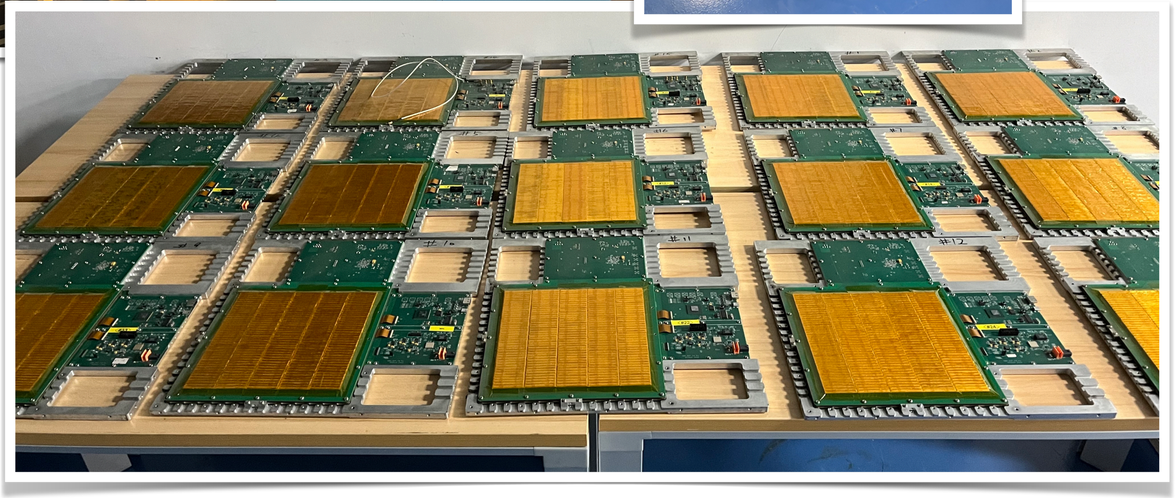


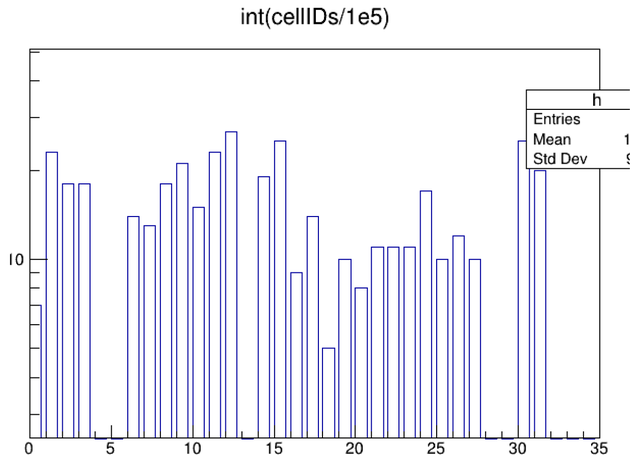
The total residual energy fraction in $Z \to qq$ events.

Work with Muchen & Fanjie: https://indico.ihep.ac.cn/event/17644/

3. ScECAL 样机 @ USTC：拆装、支撑结构设计 & 数据解包







With Jiaxuan: http://cicpi.ustc.edu.cn/indico/conferenceDisplay.py?confId=5226

总结

- **Cluster Timing：**
  - 完成初稿、听取意见、准备发表
  - 电磁量能器中簇团时间谱前沿出现皮秒量级的“超光速”和“锯齿”结构，与像素尺寸、入射方向相关。
  - 蒙卡模拟在强子簇射模拟上有改进空间，随着未来电子学技术的进步，值得更深入研究。**[Discussion on Timing]**(https://indico.in2p3.fr/event/27613/)
- **Off-time pile-up:** 以 Z pole 为例，存在百分之量级的簇团能量堆叠
  [高能物理年会](https://indico.ihep.ac.cn/event/16065/contributions/114781/)
- **准备Beam Test：**
  - 熟悉ScECAL样机拆装、数据解包与校准
  - 配合电子学同学进行超层维护，即时诊断数据
  - 设计DAQ电路板及线缆的支撑结构，实地考察了解ScECAL、AHCAL的大型转台

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谢 谢！

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实验物理中心 高能量物理组

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