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

2023年1月~4月工作报告

报告人：车逾之
导　师：阮曼奇

高能量物理组
实验物理中心

2023年4月23日

Section No.1
CEPC 量能器样机
束流测试

1 Test-beam Analysis

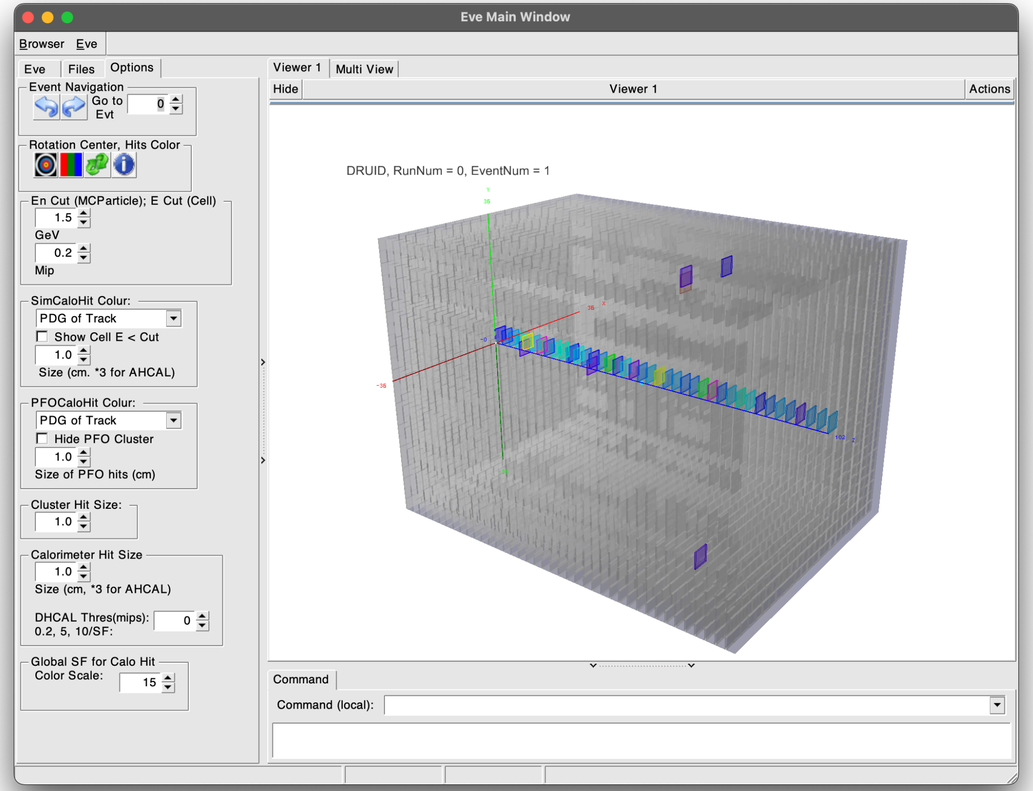
- Druid Upgrade for TB/new Platform
- Data Conversion Validation
- Test-beam Data Wiki
- Data Analysis

2 τ physics on BESIII

Druid Upgrade for TB/new Platform

- **升级了现有的Druid软件，解决以下问题：**
  - 不能在本地高MacOS/Linux/ROOT/LCIO版本环境运行
  - 不适配 Test–beam 几何，不支持真实实验数据类型

	Baseline 版本	**Test-beam新版本**
探测器几何（Cell size, position….）	CEPC Baseline	CEPC Baseline **Test-beam Prototype**
RawCalorimeterHit	❎	⭕
ROOT版本	5.34/18	**6.24/06**
LCIO版本	v02-04	**v02-17**
计算机环境	CentOS <= 7	**Windows WSL, MacOS 12, Linux(Ubuntu, …)**



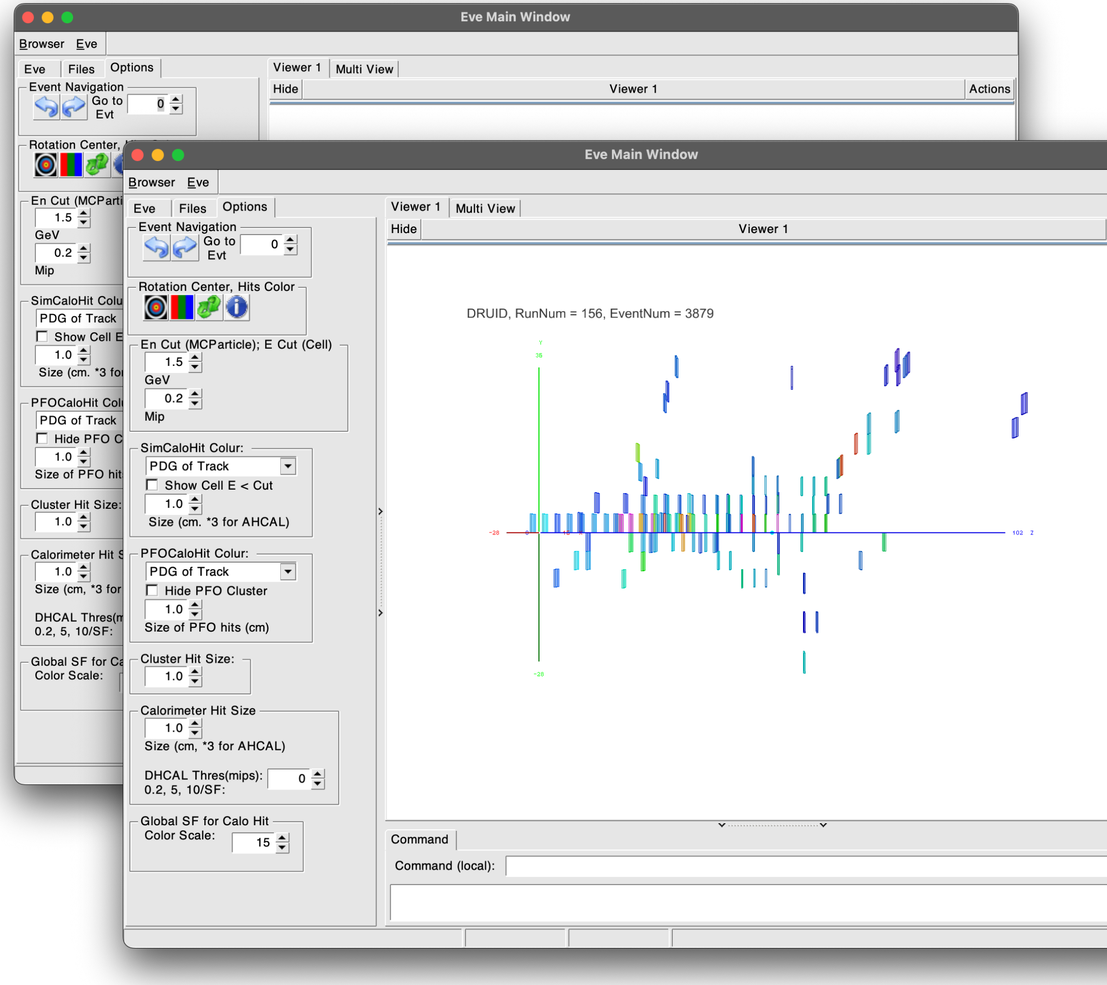
样例：Test-beam Raw Data中的μ事例

GitLab Link: https://code.ihep.ac.cn/cheyuzhi/druid.git

Druid Upgrade for TB/new Platform

- **升级了现有的Druid软件，解决以下问题：**
  - 不能在本地高MacOS/Linux/ROOT/LCIO版本环境运行
  - 不适配 Test–beam 几何，不支持真实实验数据类型

	Baseline 版本	**Test-beam新版本**
探测器几何（Cell size, position….）	CEPC Baseline	CEPC Baseline **Test-beam Prototype**
RawCalorimeterHit	❎	⭕
ROOT版本	5.34/18	**6.24/06**
LCIO版本	v02-04	**v02-17**
计算机环境	CentOS <= 7	**Windows WSL, MacOS 12, Linux(Ubuntu, …)**



样例：Test-beam原始数据中的hadronic shower

GitLab Link: https://code.ihep.ac.cn/cheyuzhi/druid.git

Data Conversion Validation & Wiki Document

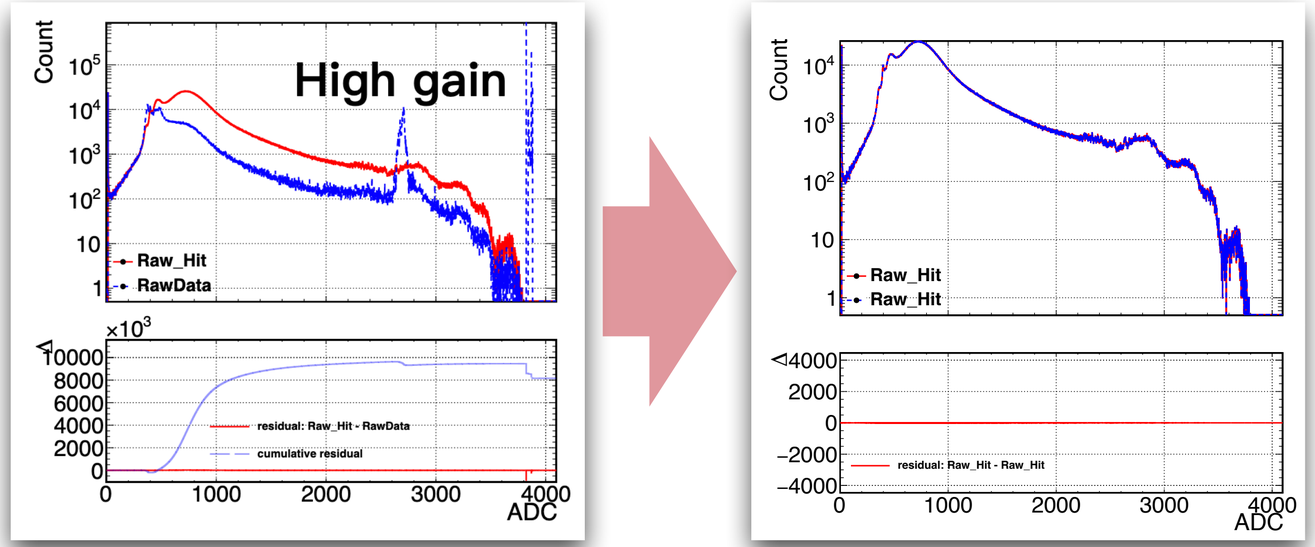
Test-beam数据需要迁移到CEPC框架下

- 基于初步Calibration结果的快速数据转换（去年冬季）
- 基于原始数据的全流程数据转换（Francios@SJTU）：
  - 一致性检验

起草《数据转换工作总结》：

- 解包/校准程序: 版本、源码/数据路径
- 数据格式、协议
- ……

现作为组内文档共同维护



https://note.ihep.ac.cn/s/xaSDNdk54#

2 个月前 69 views

OWNED THIS NOTE

Summary of Test-Beam Data Conversion (Draft)

Last Update: Feb. 21, 2023, Yuzhi Che

Waiting for supplement ...

Introduction

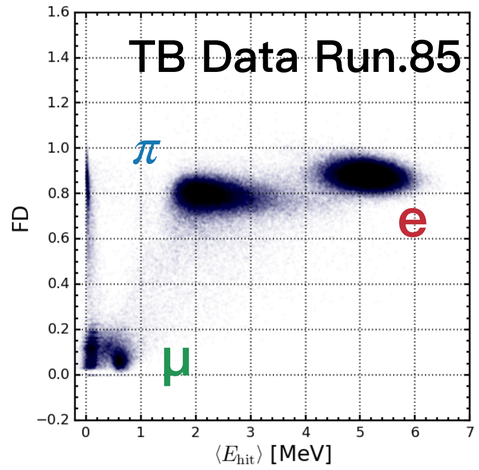
The taskforce of CERN Test-Beam data format conversion aims to convert the raw testbeam data (of CEPC Sc-ECAL and AHCAL prototype, collected at CERN) to the CEPC framework so that benifit the future data analysis. This work began from Nov. 30, 2022 [Kickoff Meeting], and till the February in 2023, the first iteration result was basically completed.

The work of data conversion can be divided into two branches, as shown in the following plot, namely Fast conversion and Full conversion. The first branch, Fast conversion, means to provide a brief version of result and surpport the beginning of high level analysis which relies on the CEPC software. Three intermediat stages are included in this work. Firstly, the binary data is

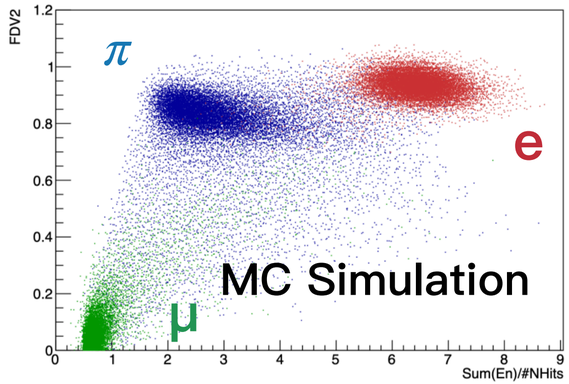
Summary of Test-Beam Data Conv...
Introduction
Binary Raw Data
Data Decoding
Data Calibration & Fast Conversion
Expand all
Back to top
Go to bottom

Analysis: Fractal Dimension for PID

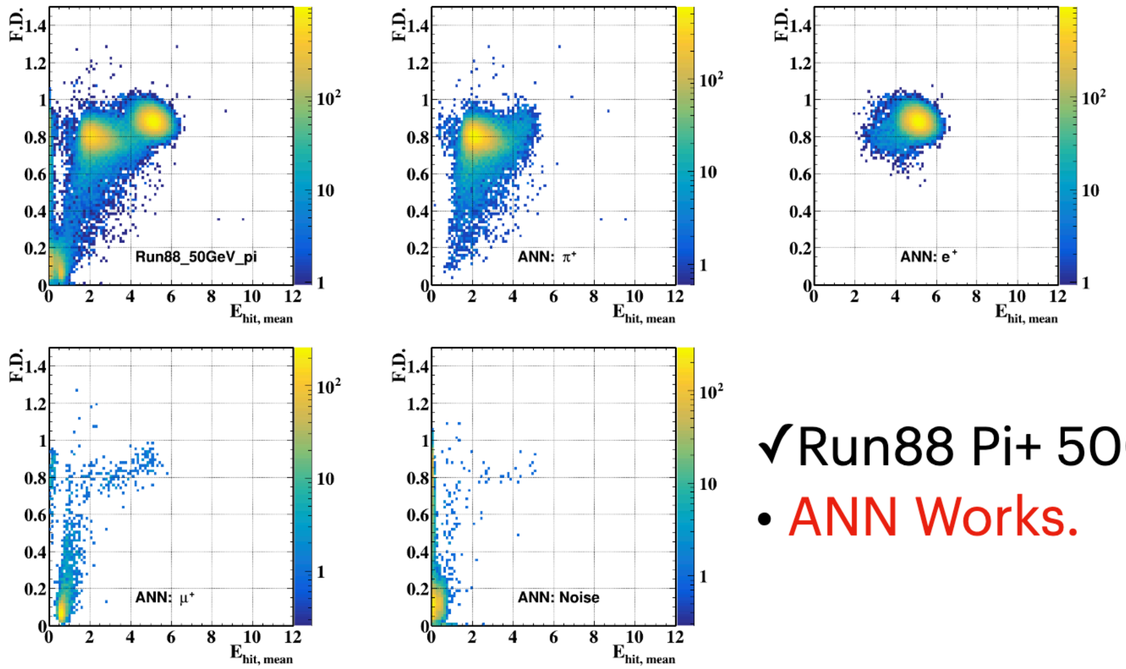
- **Q: MC/Data不一致，需要预分类数据辅助调试。**
- **Fractal Dimension变量**配合average hit energy在TB Data中显示出了优秀的PID能力
- **分类结果被普遍接受，应用于**
  - MC/Data一致性检验/诊断
  - 机器学习PID模型开发
  - 探测器分辨率、线性的初步估计



夏欣 @ IHEP



宋思远 @ SJTU



✓Run88 Pi+ 50GeV .

- ANN Works.

Section No.2
τ Physics on BESIII

1 Test-beam Analysis

2 τ physics on BESIII

- $\tau\tau$产生阈以上的$\sigma(ee \to \tau\tau)$初步测量
- BESIII各能量点数据集优劣势分析
- 4180MeV/4270MeV数据inclusive/exclusive hadronic τ decay筛选性能估计
- ……

BESIII on τ: 统计优势

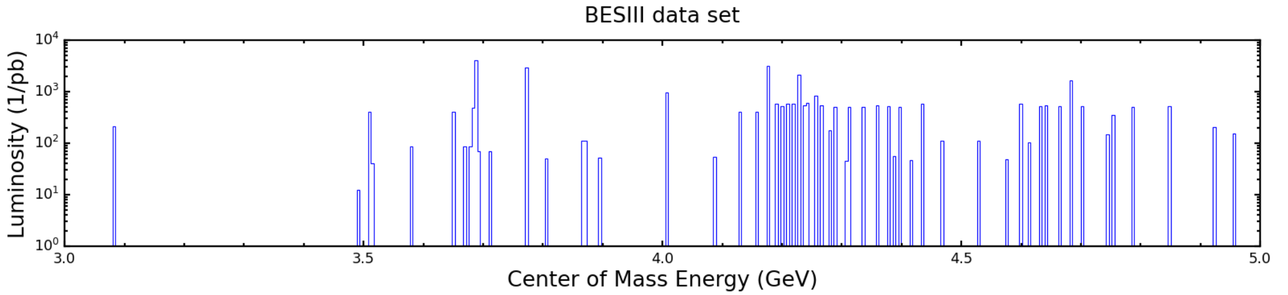
- 利用数据亮度、$ee \to \tau\tau$ 波恩截面估算BESIIII上τ产额（去年冬季）

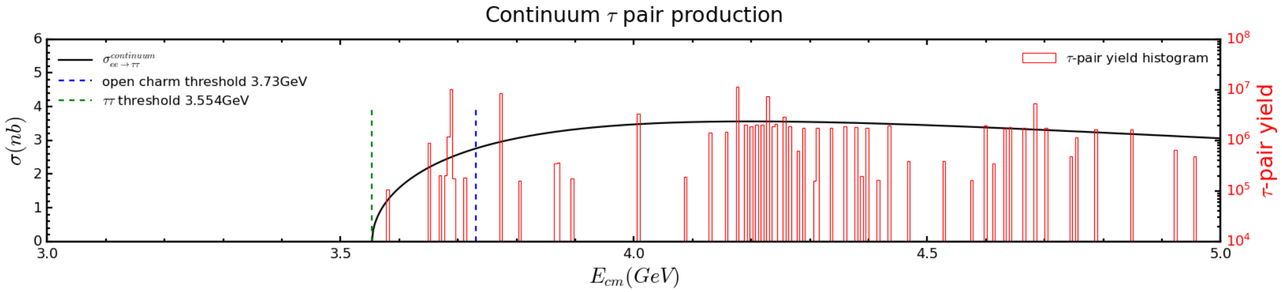
- 利用$ee \to \tau\tau \to e\nu\nu\ \mu\nu\nu$过程初步测量$\tau\tau$产额

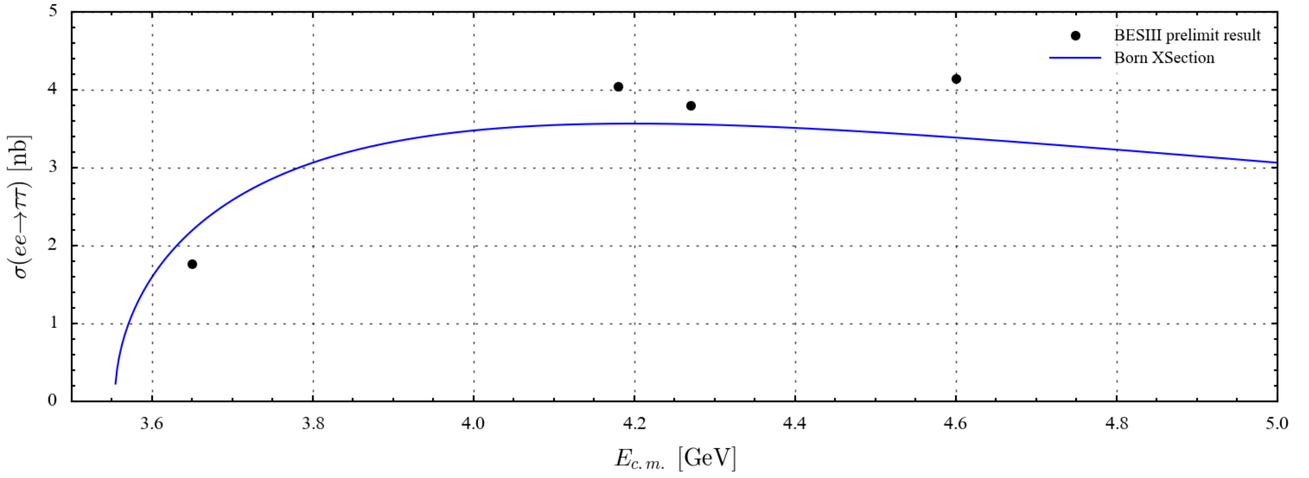
  - $\sigma(ee \to \tau\tau) = \dfrac{N_{evt}^{selt} \cdot p}{\varepsilon \cdot \mathscr{L}}$

  - $\varepsilon = N^{MC}_{\text{select, } \tau\tau} \Big/ N^{MC}_{\text{total, } \tau\tau}$

BESIII上τ pair储量： $\sim 10^8$





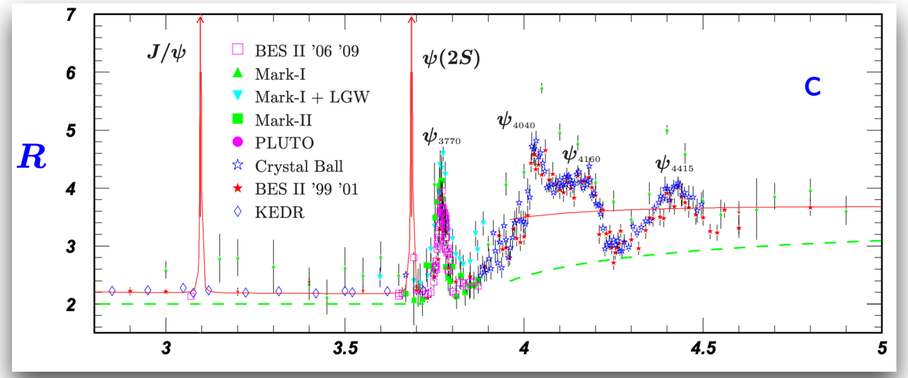


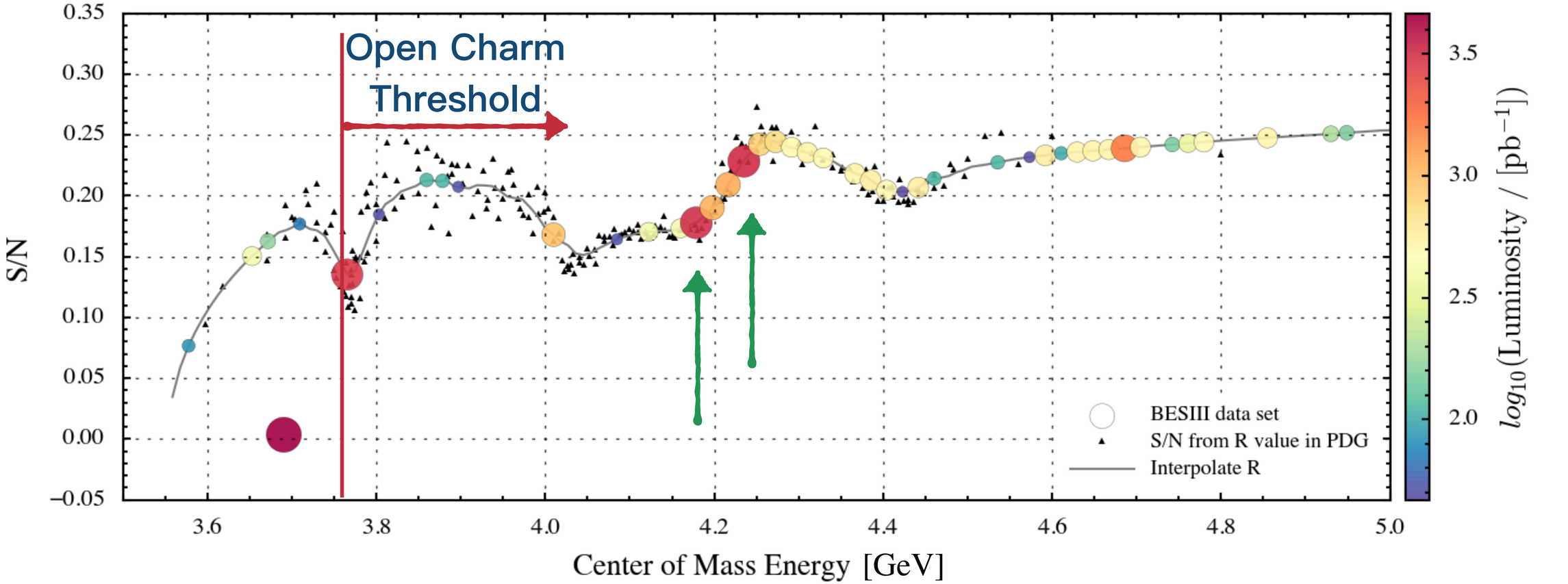
BESIII on τ

BESIII上的ττ样本：

统计量优势： 10^8**量级**

质心系能量低，本底相对复杂，PID能力较弱： Open charm,
$ee \to q\bar{q}, (q = u, d, s)$, $ee \to \gamma\gamma$,



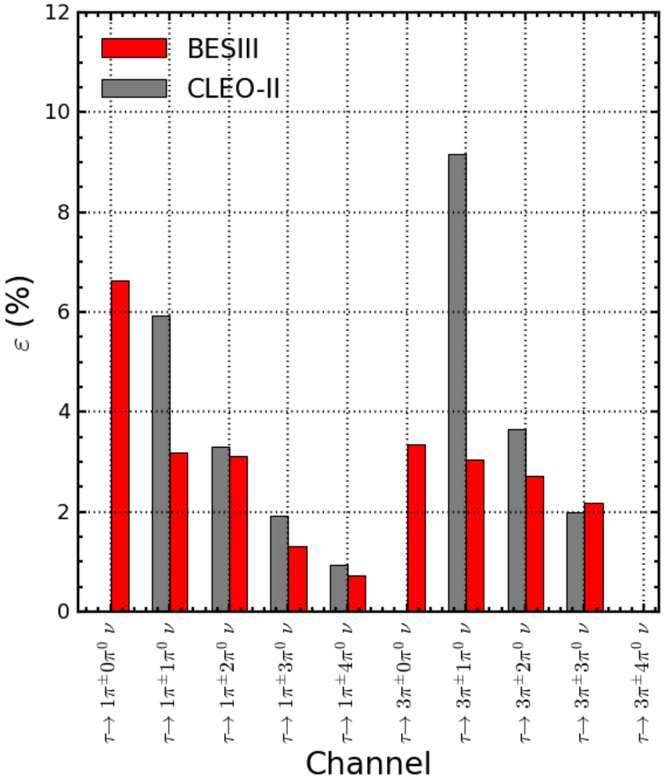


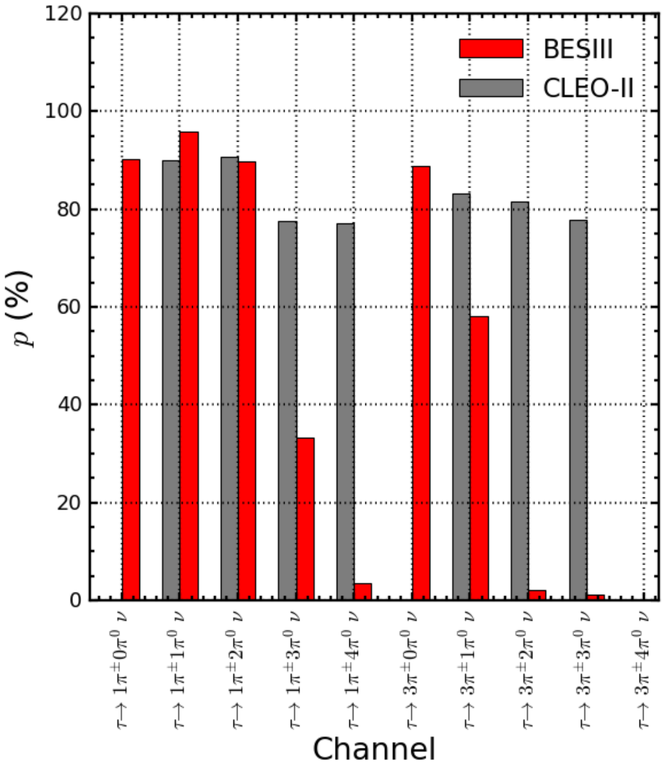
BESIII on τ: 4180 MeV & 4270 MeV

使用$\tau_{tag} \to e\nu\nu$, $\tau_{sig} \to n\pi^{\pm} + m\pi^{0} + \nu$, 选择hadronic tau decays

估计各non-strange hadronic衰变道的选择效率。

	4180 MeV	4260 MeV
Efficiency	2.7%	2.7%
Purity	79%	81%
S/N wo. selection	0.15	0.18
S/N wi selection	4.2	4.6

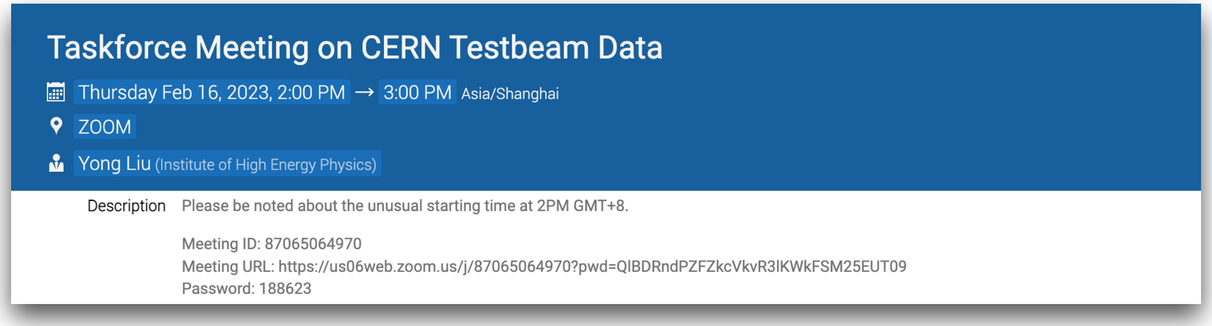




- 效率包括了τ decay的分支比：$\varepsilon = N_{\tau\tau}^{selt} / N_{\tau\tau}^{total}$
- 目前 exclusive 效率/纯度估计不包含π^{0}重建引起的migration效应

Summary & Future

- **CEPC样机束流测试实验：**
  - 数据转换程序一致性检验
  - Druid升级适配新系统/原始实验数据
  - 基于Fractal Dimension的数据预筛选
- **BESIII上的τ物理分析：**
  - $\tau\tau$产生阈以上的$\sigma(ee \to \tau\tau)$初步测量
  - BESIII各能量点数据集优劣势分析
  - 4180MeV/4270MeV数据inclusive/exclusive hadronic τ decay筛选性能估计
- **1月30日，Cluster Timing 文章在EPJC发表：**
  https://link.springer.com/article/10.1140/epjc/s10052-023-11221-7



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

谢　谢！

车逾之

2023年4月23日