



基础知识与分析入门

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目录

1.课程目标；

2.高效沟通----“专业术语”以及“必备网站”

3.基本shell命令， vim编辑器基础----安装环境

课程目标

完成一个简易的物理分析

----初步测量 $\psi(3686) \rightarrow \pi^+ \pi^- J/\psi$ 的分支比;

第一课 基础知识和分析入门

第二课 分析算法

第三课 root、画图、rootfit实操

“专业术语”

- 1.分支比
- 2.数据&各种各样的MC? 什么是信号与本底?
- 3.误差?
- 4.各种各样的探测器?

本节简要介绍基础概念；更深入的内容请参考各位老师的专题报告。

一些“术语”---- 分支比

$$B(X \rightarrow f) = \frac{\text{衰变到你想研究的过程的事例数}}{\text{母粒子的总数}}$$

$$B(X \rightarrow f) = \frac{n^{obs} - n^{bkg}}{\epsilon N_X}$$

- B: 待测分支比, 无量纲
- n^{obs} : 观测事例数
- n^{bkg} : 预期的本底事例数
- N_X : 总事例数
- ϵ : 事例选择效率, 是主要的输入信息, 也是关注最多的核心部分

$$Br(\psi(3686) \rightarrow \pi^+ \pi^- J/\psi) = \frac{N_{sig}^{fit}}{N(\psi(3686)) \times Br(J/\psi \rightarrow e^+ e^-) \times \epsilon}$$

一些“术语”---- 数据&各种各样的MC?

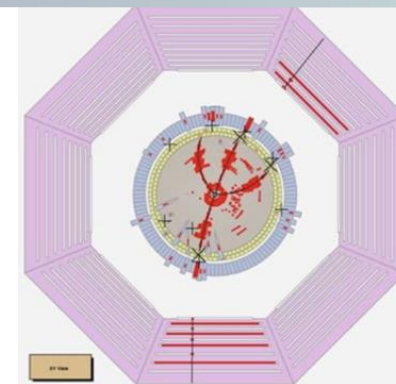
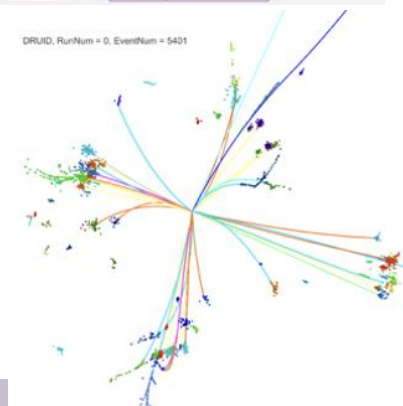
数据： 真实对撞产生的事例

- 通过在线触发条件，且经过刻度、重建（过滤）并保存在磁盘上的一个个事例（包括物理事例和非物理事例）。

信号： 我们想要研究的物理过程。

本底： 由于探测器等不可避免的因素影响，伴随着信号产生的物理和非物理过程。

分析目标： 在复杂的对撞事例中区分信号与本底，提取目标信号。



一些“术语”---- 数据&各种各样的MC?

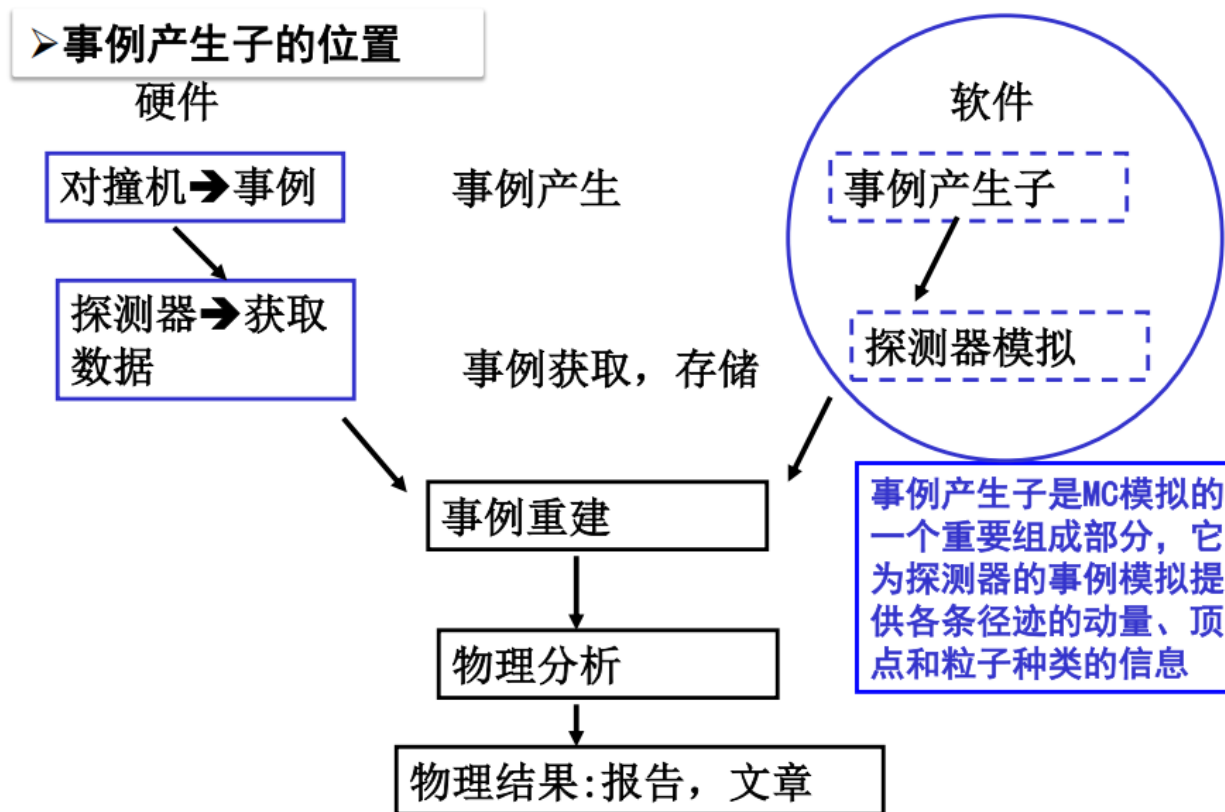
MC： 通过计算机模拟出各种各样我们设定好的物理过程。

蒙特卡洛方法 (Monte Carlo Method) 是一种利用随机抽样与概率统计来解决各种复杂问题的数值计算方法。

已有真实数据，为什么还需要 MC 模拟？

- 本底？
- 效率？

.....



一些“术语”---- 数据&各种各样的MC?

描述一个物理系统全部可能状态的空间

相空间MC：在相空间均匀分布的样本。

信号MC：在相空间按照某种物理规律分布的样本。

单举MC：inclusive MC “尽可能去还原真实数据的MC样本。”

特指
单个
过程

多个过程

decay卡：告诉计算机我们要制造什么过程的MC。

一些“术语”---- 数据&各种各样的MC?

decay卡：告诉计算机我们要制造什么过程的MC。

相空间MC

```
Decay D+
1.0      K- pi+ pi+
Enddecay
PHSP;
```

信号MC

```
Decay D+
1.0      K- pi+ pi+
Enddecay
D_DALITZ;
```

举例：Jpsi→pi+pi-pi0（来自朱凯老师PPT）

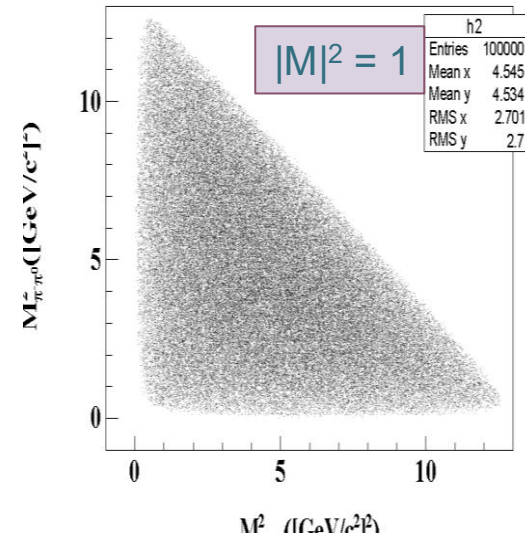
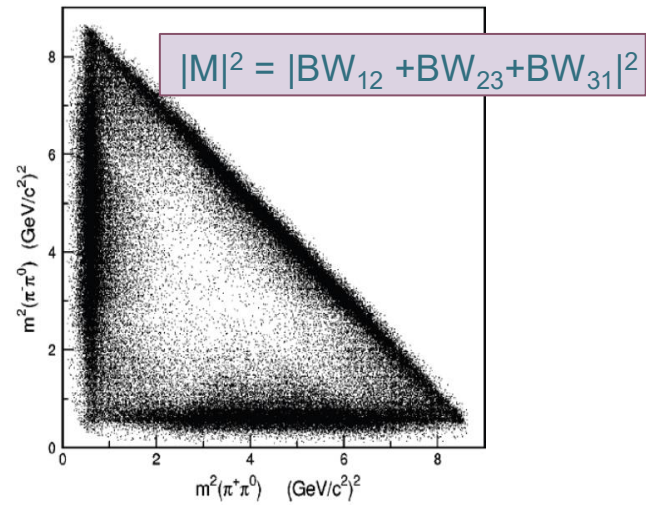


FIG. 3. The Dalitz plot for $J/\psi \rightarrow \pi^+ \pi^- \pi^0$.

$$d\Gamma = \frac{(2\pi)^4}{2M} |\mathcal{M}|^2 d\Phi_n (P; p_1, \dots, p_n),$$

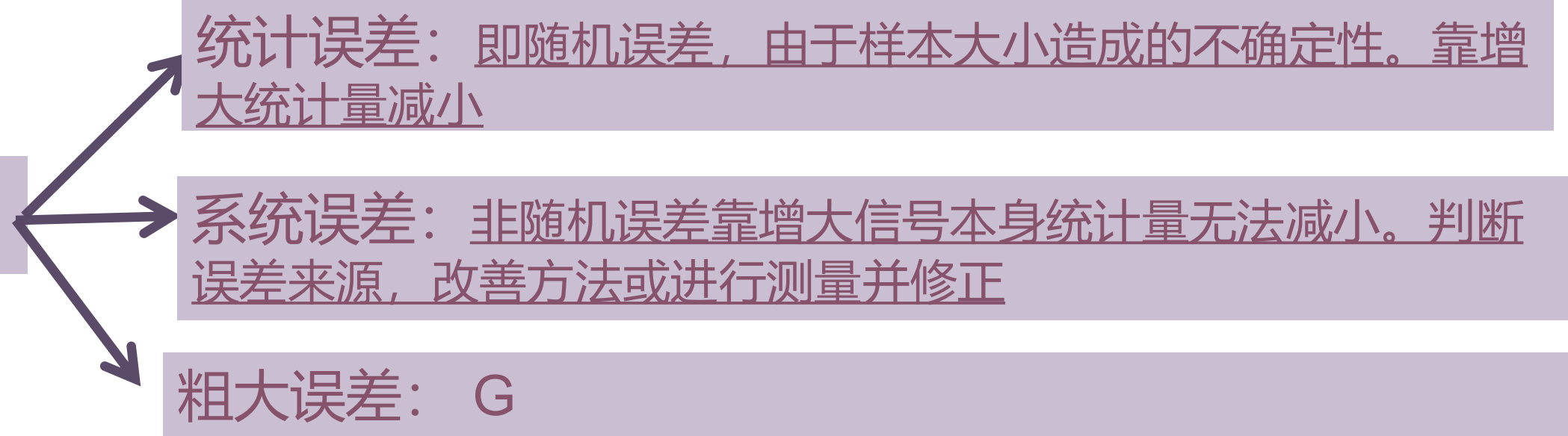
inclusive MC（节选...）

```
80 Decay D+
81
82 #Leptonic and semileptonic modes
83
84 0.000374      mu+      nu_mu      PHOTOS SLN;
85 0.00120       tau+      nu_tau      SLN;
86
87 0.0872        anti-K0      e+      nu_e      PHOTOS SLBKPOLE_DtoKlnu;
88 0.00231       anti-K_10    e+      nu_e      PHOTOS ISGW2;
89 0.0377        K-          pi+      e+      nu_e      DToKpienu;
90 0.0178        anti-K*0_noKpi e+      nu_e      PHOTOS SLP0LE_DtoKstarlnu;
91 0.00372       pi0          e+      nu_e      PHOTOS SLBKPOLE_Dtopilnu;
92 0.00111       eta         e+      nu_e      PHOTOS SLBKPOLE_Dtoetalnu;
93 0.0002        eta'        e+      nu_e      PHOTOS SLBKPOLE_Dtoetaplnu;
94 0.00245       pi+         pi-      e+      nu_e      DTopipienu;
95 0.001668      omega_no2pi  e+      nu_e      PHOTOS SLP0LE_Dtoomegalnu;
96 0.00017       pi0         eta      e+      nu_e      DToa0enu;
97
98 0.0876        anti-K0      mu+      nu_mu      PHOTOS SLBKPOLE_DtoKlnu;
99 0.0022        anti-K_10    mu+      nu_mu      PHOTOS ISGW2;
100 0.0527       anti-K*0      mu+      nu_mu      PHOTOS SLP0LE_DtoKstarlnu;
101 0.0019        K-          pi+      mu+      nu_mu      PHOTOS PHSP;
102 0.0035       pi0          mu+      nu_mu      PHOTOS SLBKPOLE_Dtopilnu;
103 0.00104      eta         mu+      nu_mu      PHOTOS SLBKPOLE_Dtoetalnu;
104 0.0002      eta'         mu+      nu_mu      PHOTOS SLBKPOLE_Dtoetaplnu;
```

一些“术语”---- 误差

误差： 给出值与真值之间的差异。

误差



```
graph LR; A[误差] --> B[统计误差：即随机误差，由于样本大小造成的不确定性。靠增大统计量减小]; A --> C[系统误差：非随机误差靠增大信号本身统计量无法减小。判断误差来源，改善方法或进行测量并修正]; A --> D[粗大误差： G];
```

统计误差： 即随机误差，由于样本大小造成的不确定性。靠增大统计量减小

系统误差： 非随机误差靠增大信号本身统计量无法减小。判断误差来源，改善方法或进行测量并修正

粗大误差： G

一些“术语”---- BESIII的各种各样探测器

正负电子产生原理

正电子产生：电子枪产生负电子，能量为150 MeV的负电子轰击大约1cm厚的钨靶时骤然减速，发生轫致辐射，产生光子，然后光子转化为正负电子对，再根据粒子在磁场中的偏转方向，将正电子聚焦收集起来，然后在直线加速器里进行加速，就得到高能量的正电子束。

负电子产生：当需要负电子时，就把钨转换靶提起来，用电子枪产生负电子。
电子枪：灯丝（钨丝）加热后，表面产生电子（本质：光电效应）。

探测的粒子

- 在对撞产生的数百种粒子中，绝大多数寿命极短，只有少数几种寿命大于 10^{-8} 秒，它们在探测器尺度（米）范围内被视为稳定粒子，称为末态粒子，如光子、电子、 μ 子、质子、 π 介子、 K 介子。
- 谱仪中产生的粒子（中间态粒子）可由末态粒子重建出来，因此在谱仪中，对末态粒子的分辨至关重要。

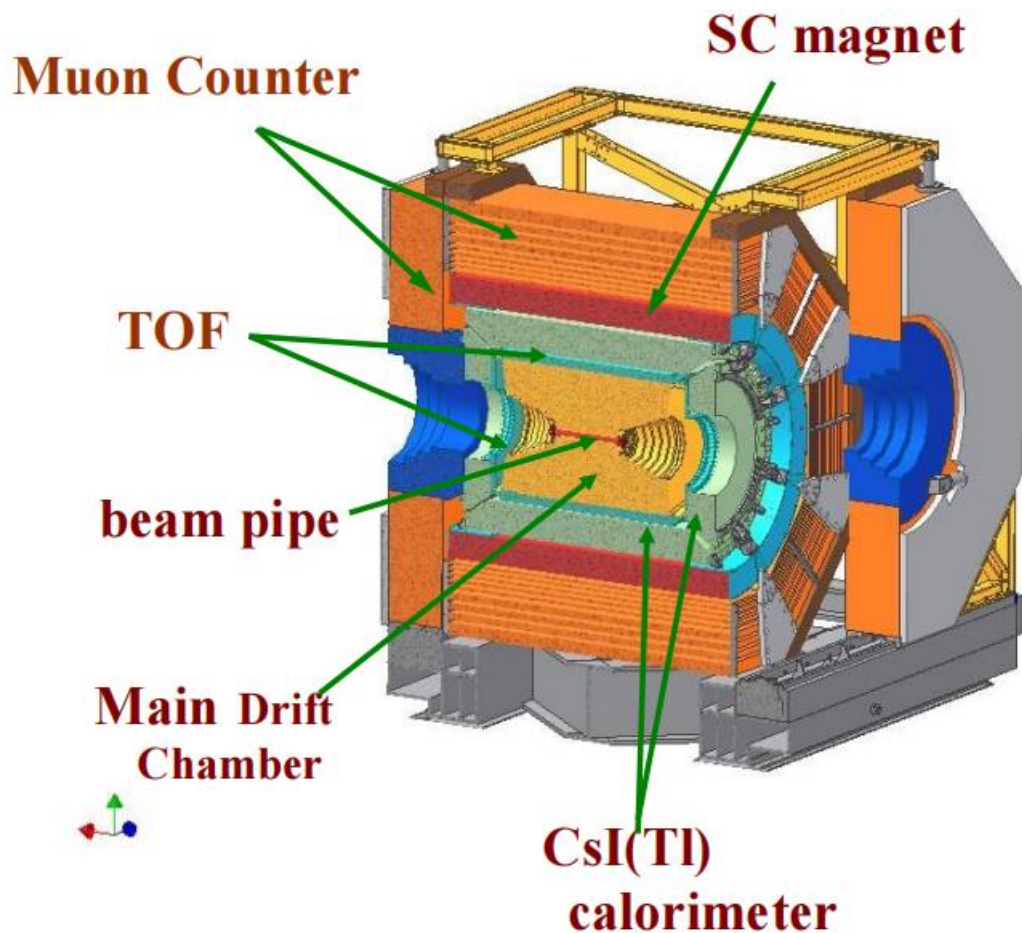
不同种类粒子与物质作用机理不同

$\gamma, e^{\pm}$ —— 电磁簇射

π, K, p —— 电离能损，强子簇射

μ —— 强穿透力（大射程）

BESIII的各种各样探测器---概览



典型的磁谱仪子探测器的功能



BESIII的各种各样探测器----MDC

主漂移室

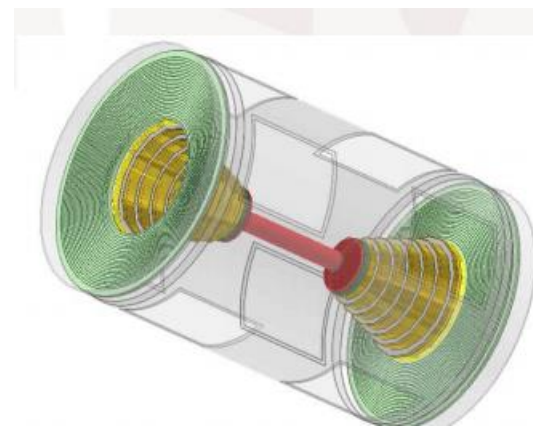
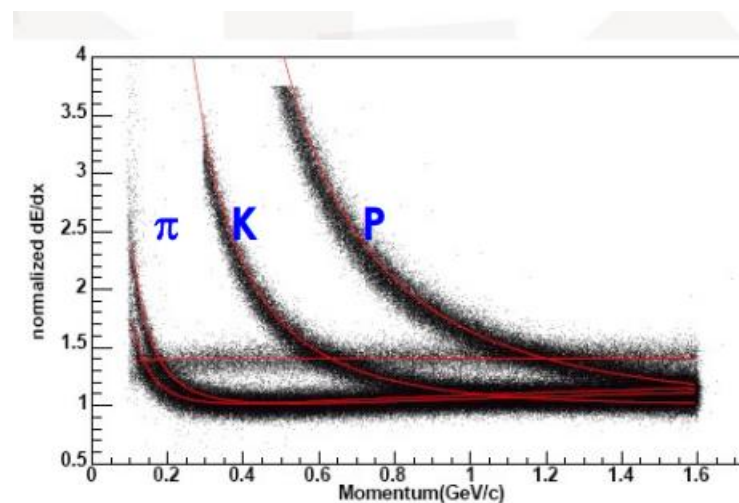
■ 主要任务:

- 1) 精确测量从相互作用点产生的带电粒子的动量和方向
- 2) 为带电粒子的鉴别提供足够好的 dE/dx 测量
- 3) 对带电粒子测量有尽可能大的立体角
- 4) 对低动量带电粒子径迹有尽可能大的重建效率
- 5) 为带电粒子的一级硬件触发提供信号

• 目的：鉴别粒子种类

不同粒子假设得到不同的期望值，与测量值比较可以得出被测粒子是某种粒子的几率

$$\chi^2 = \left(\frac{\frac{dE}{dx}(\text{测量}) - \frac{dE}{dx}(\text{期望})}{\sigma\left(\frac{dE}{dx}\right)_{\text{测量}}} \right)^2$$



BESIII的各种各样探测器----TOF 飞行时间计数器

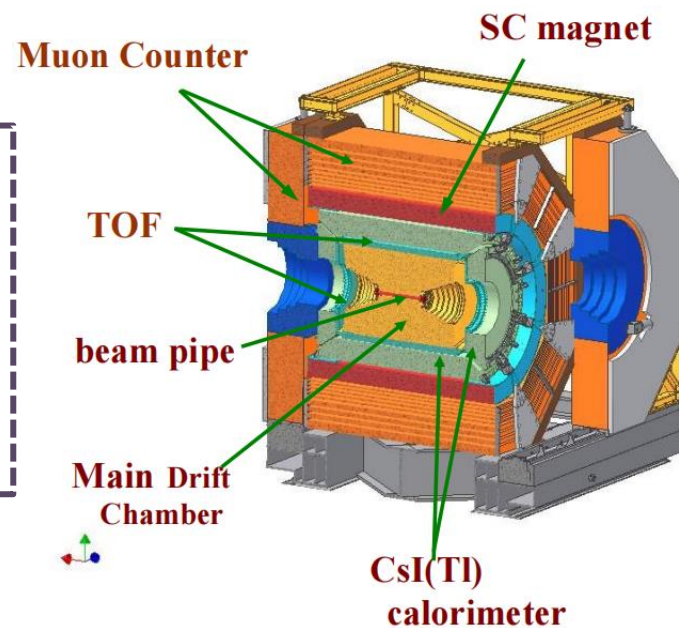
主要任务:

- 用于粒子鉴别，位于主漂移室外，塑料闪烁+光电倍增管（双端）带电粒子在闪烁体中激发产生荧光，通过光电转化输出信号，给出击中时间信息。
- 测量带电粒子在漂移室内的飞行时间，结合漂移室测得的粒子动量和径迹，来辨别粒子的种类。

工作原理

入射粒子进到闪烁体内，使闪烁体的原子分子电离和激发，受激原子分子退激发时发光，称作荧光。荧光光子打到光电倍增管的光阴极上转换成光电子，光电子在光电倍增管中倍增，最后被阳极收集，输出电压或电流脉冲，被电子学仪器记录。

注意它的结构，分为“桶部”和“端盖”。



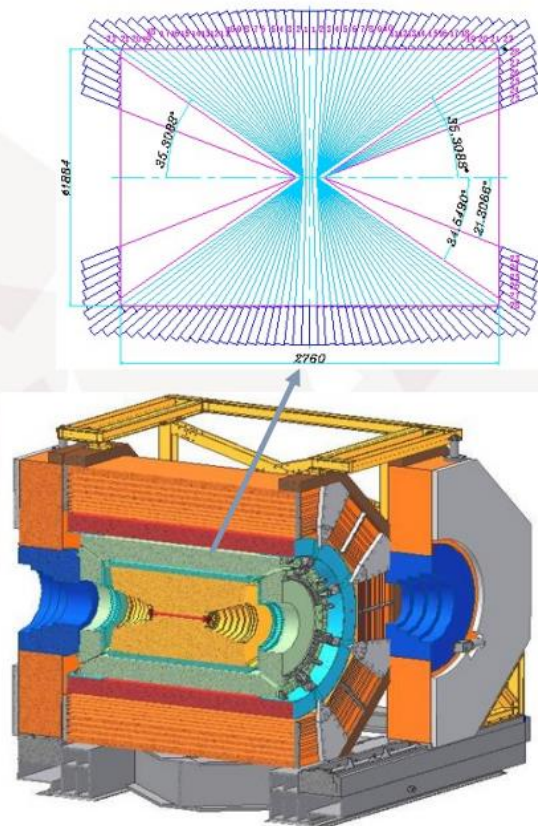
BESIII的各种各样探测器---EMC

电磁量能器

主要任务:

- 精确测量 γ 和电子的能量和位置
- 测量能区范围: 20MeV ~ 2GeV

注意它的结构，分为“桶部”和“端盖”。



工作原理

高能电子或光子通过介质，发生相互作用，高能电子韧致辐射产生 γ 光子，高能 γ 光子产生正负电子对.....，这样不断发生电子 - γ 光子 - 电子的级联过程，最后产生大量电子和 γ 光子。随着穿入介质厚度的增加，次级粒子的数目急剧增加，而每个电子、 γ 光子的能量逐渐减小，减至光子能量不能再产生电子对时，电子能量小于临界能量 E_c ，簇射停止。这时电子通过电离损失能量， γ 光子主要通过康普顿散射损失能量，最后被介质吸收。

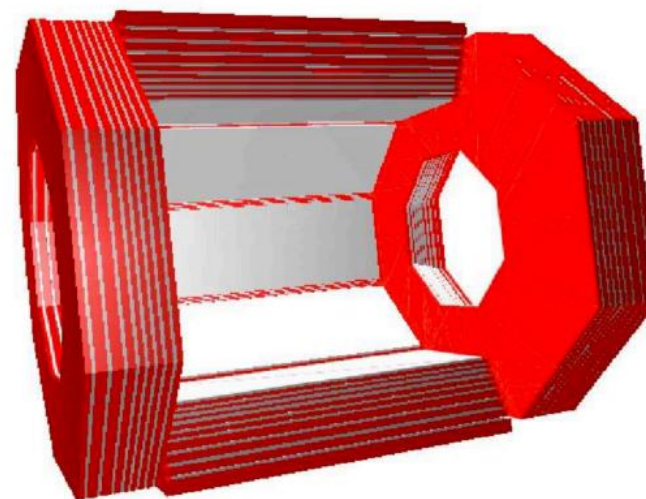
高能电子和光子在灵敏介质中电磁簇射 → 闪烁光/电信号 → 信号输出 → 能量、位置测量

示，EMC 和 TOF 一样，EMC 也由桶部和端盖组成，桶部的立体角覆盖范围为 $|\cos\theta| < 0.83$ ，端盖为 $0.85 < |\cos\theta| < 0.95$ 。整个 EMC 由 6272 个含钛的碘化铯晶体 (CsI (TI)) 组成，总重量约 24 吨。

BESIII的各种各样探测器----MUC mu子探测器

主要任务:

- 测量反应末态中的 μ 的位置和大致飞行轨迹。与内层探测器的粒子径迹相连接，精确测量 μ 子的动量并与其它带电粒子（尤其是 π ）区分开来。
- 在一些重要的物理上，尤其是在一些稀有衰变道的测量上， μ 、 π 分辨的好坏，对物理结果的影响很大。



MUC 也分为桶部和端盖两部分其覆盖立体角为 $|\cos\theta| < 0.89$ 。MUC 主要由 μ 子探测器和强子吸收体组成。其中强子吸收体部分为谱仪的轭铁， μ 子探测器由间距 2mm 的阻性板室构成。

必备网站

有什么经常听到，但是不太懂的专业术语请大家一起讨论，一起完善ppt

“必备网站”

1. BESIII官网: <http://bes3.ihep.ac.cn>

2. 文献查找相关

➤ arxiv: <https://arxiv.org/>

➤ inspire : <https://inspirehep.net/>

3. PDG/PDGLive : <https://pdglive.lbl.gov/Viewer.action>

4. overleaf: <https://latex.ihep.ac.cn/login>

5. 其他实用科研工具

必备网站----BESIII主页介绍

(from 李惠静老师ppt)

<http://bes3.ihep.ac.cn>

The screenshot shows the BESIII Experiment website. At the top, there is a blue header with the BESIII logo on the left and navigation links (DocDB, HyperNews, Indico) on the right. Below the header is a search bar with the text "Please enter keyword". The main content area is divided into two columns. The left column features a "ghlights" section with three articles, each accompanied by a small plot. The right column features a "Recent News" section with two news items and a "Coming Events" section with two event listings. At the bottom of the left column is a "Read more" link.

BESIII Beijing Spectrometer(BESIII) Experiment

DocDB HyperNews Indico

Please enter keyword

Home Collaboration Operations Research User Information

ghlights

White Paper on the Future Physics Programme of BESIII
The BESIII Collaboration officially released a draft version of its White Paper on the Future Physics Programme of BESIII ("white paper") at arXiv.org on Dec. 13. Feedback on the paper from...

BESIII Observes Polarization of Baryons in J/ψ Decay
The BESIII collaboration observed baryon polarization in baryon-antibaryon (matter-antimatter particle) events from J/ψ particles produced at the BEPCII collider. The paper was published in Nature...

BESIII Observes New Leptonic Decay Mode for D Meson
The BESIII collaboration has reported the world's first observation of the decay $D^+ \rightarrow \tau^+ \nu$ in a newly published Physical Review Letters paper that has been highlighted by the journal as an "Editors'..."

Recent News

04 2020-07 The BESIII Collaboration 2020 Summer meeting June 29-July 3, 2020, IHEP Beijing

03 2020-04 BESIII Collaboration Workshop on Data Quality and Software Held

[Read more](#)

Coming Events

19 2020-09 Workshop in Autumn of 2020, Sep. 19 - 22, 2020, IHEP, Beijing

28 2020-11 Collaboration Meeting in Winter of 2020, Nov.28 - Dec.2, IHEP, Beijing

Links

DocDB: 文档存放

HyperNews: 物理
分析审核

Indico: 会议相关

必备网站----BESIII主页

http://bes3.ihep.ac.cn

DocDB: <https://docbes3.ihep.ac.cn/cgi-bin/DocDB/DocumentDatabase>

Instructions

Your Account

Preferences

Limit Groups

DocDB Statistics

About DocDB

Document Database

[DocDB Home] [New] [Search] [Last 20 Days] [List Authors] [List Topics] [List Events] [Help] [Logout ihu@ing.ihep.ac.cn]

Create or change documents or other information

Search

for

(Advanced)

Show

BESIII DocDB-doc-#

-v

Show

documents modified in the last

20

days

Calendar of events

List:

Authors

All documents

Topics

Keywords

Events

(了解怎样搜索：DocDB-号，作者名字，关键词等)

作者名字：是按照姓氏排列，这里只显示第一个作者，但并非第一作者。

注意：与HyperNews号（BAM）不是同一个。

Last 50 documents modified			
BESIII DocDB-doc-#	Title	Author(s)	Last Updated
738-v3	Measurements of the branching fractions for $D_0 \rightarrow K^- \pi^+ \omega$, $D_0 \rightarrow K_S^0 \omega$ and $D^+ \rightarrow K_S^0 \omega$	Yupei Guo et. al.	20 Sep 2020
881-v5	Observation of $D^0 \rightarrow K_{1(1270)}^- e^+ \nu_e$	Yulan Fan et. al.	20 Sep 2020
895-v2	reply	Yulan Fan et. al.	20 Sep 2020
875-v29	Observation of a charged open-strange hidden-charm structure in $ee \rightarrow K(D_s D^{*0} + D_s^* D_0^0) + c.c.$	Peirong Li et. al.	19 Sep 2020
830-v8	Precise measurement the cross section of $e^+e^- \rightarrow \pi^+ \pi^- J/\psi$	Longzhou Liao et. al.	19 Sep 2020
910-v3	Search for the rare weak decay $\psi(3700) \rightarrow e^+ e^- \nu_e \bar{\nu}_e + c.c.$	Ziyuan Li et. al.	19 Sep 2020
719-v28	Study of tracking and pid efficiency of $K_{\pi 1}$	jiaojiao song	19 Sep 2020
913-v1	Observation of the doubly Cabibbo-suppressed decays $D^+ \rightarrow K^+ \pi^0 \pi^0$ and $D^+ \rightarrow K^+ \pi^0 \eta$	Hailong Ma et. al.	19 Sep 2020
814-v9	Cross sections for the reactions $e^+e^- \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$, $K^+ K^- K^+ K^- \pi^0$, $\pi^+ \pi^- \pi^+ \pi^- \pi^0$, $\rho \rho \pi^+ \pi^- \pi^0$ in the energy region between 3.773 and 4.600 GeV	Xinchou Lou et. al.	19 Sep 2020
827-v23	Amplitude Analysis and Branching Fraction Measurement of $D_s^+ \rightarrow K_S^- \pi^+ \pi^0$	Duanyou Chen et. al.	19 Sep 2020
886-v37	Amplitude Analysis and Branching Fraction Measurement of $D_s^+ \rightarrow K^- K^+ \pi^0$	Duanyou Chen et. al.	19 Sep 2020
919-v7	Cross section measurement of $e^+e^- \rightarrow \pi^+ \pi^- X(3823)$ and mass measurement of $X(3823)$	Zhiqing LIU et. al.	18 Sep 2020
707-v58	Measurement of Timelike Neutron Form Factors at BESIII	Samer AHMED et. al.	17 Sep 2020
878-v8	Study of $e^+ e^- \rightarrow \omega \pi^0 \pi^0$	Guangshun Huang et. al.	17 Sep 2020
918-v1	First measurement of $D^0 \rightarrow \rho^0 \nu_e \bar{\nu}_e \pi^0$	Hailong Ma et. al.	17 Sep 2020
921-v1	Systematic uncertainties of electron tracking and PID of J/ψ datasets	Dayong Wang et. al.	17 Sep 2020
864-v5	First observation of the decay $\chi_{cJ} \rightarrow \gamma \pi^0 \pi^0 \pi^0$	SHAN GU et. al.	16 Sep 2020
920-v1	Observation of $\psi(3770) \rightarrow \eta \pi^+ \pi^-$	Qingping Ji et. al.	16 Sep 2020
886-v4	Amplitude analysis and Branching Fraction Measurement of $D_s^+ \rightarrow \eta \pi^+ \pi^-$	Duanyou Chen et. al.	16 Sep 2020

DocDB 号 版本号

必备网站-----BESIII主页介绍

(from 李惠静老师ppt)

Example

DocDB 号

最新版本号

BESIII Document 492-v9

[DocDB Home] [New] [Search] [Last 20 Days] [List Authors] [List Topics] [List Events] [Help] [Logout lihujing@ihep.ac.cn]

Study of $j\psi(\psi\text{SIP}) \rightarrow e^+ \pi^- \pi^-$

Document #:

BESIII DocDB-doc-492-v9

Document type:

pdf

Submitted by:

Huijing Li

Updated by:

Li Huijing

Document Created:

12 Dec 2015, 22:45

Contents Revised:

10 Dec 2017, 21:45

DB Info Revised:

10 Dec 2017, 21:45

Update Document

Update DB Info

Add Files

lihujing@ihep.ac.cn

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Abstract:

Based on the data samples of 1.3×10^9 $j\psi$ events and 4.5×10^8 ψSIP events collected with the BESIII detector, a full partial wave analysis on the decays $j\psi \rightarrow e^+ e^- \pi^+ \pi^-$ is performed using the relativistic covariant tensor amplitude approach. For the ρ^0 intermediate contribution, the branching fractions are measured to be $\mathcal{B}(j\psi \rightarrow e^+ e^- \rho^0) = \mathcal{B}(j\psi \rightarrow e^+ e^- \pi^+ \pi^-)$ for $j\psi$ decay, respectively. The decay of ψSIP is observed for the first time. The ratio of the branching fractions between ψSIP decay and $j\psi$ decay is determined to be $\mathcal{R} = \frac{\mathcal{B}(j\psi \rightarrow e^+ e^- \rho^0)}{\mathcal{B}(j\psi \rightarrow e^+ e^- \pi^+ \pi^-)}$ or $\mathcal{R} = \frac{\mathcal{B}(\psi\text{SIP} \rightarrow e^+ e^- \rho^0)}{\mathcal{B}(\psi\text{SIP} \rightarrow e^+ e^- \pi^+ \pi^-)}$. In addition, for the first time, the branching fractions from the non-resonant decays are obtained to be $\mathcal{B}(j\psi \rightarrow e^+ e^- \pi^+ \pi^-)_{\text{NR}} = \mathcal{B}(\psi\text{SIP} \rightarrow e^+ e^- \pi^+ \pi^-)_{\text{NR}} = \mathcal{B}(\psi\text{SIP} \rightarrow e^+ e^- \pi^+ \pi^-)_{\text{NR}}$, and their ratio is calculated to be $\mathcal{R}_{\text{NR}} = \frac{\mathcal{B}(j\psi \rightarrow e^+ e^- \pi^+ \pi^-)_{\text{NR}}}{\mathcal{B}(\psi\text{SIP} \rightarrow e^+ e^- \pi^+ \pi^-)_{\text{NR}}}$.

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ghlights

White Paper on the Future Physics Programme of BESIII
The BESIII Collaboration officially released a draft version of its White Paper on the Future Physics Programme of BESIII ("white paper") at arXiv.org on Dec. 13. Feedback on the paper from...

BESIII Observes Polarization of Baryons in J/ψ Decay
The BESIII collaboration observed baryon polarization in baryon-antibaryon (matter-antimatter particle) events from J/ψ particles produced at the BEPCII collider. The paper was published in Nature...

BESIII Observes New Leptonic Decay Mode for D Meson
The BESIII collaboration has reported the world's first observation of the decay $D^+ \rightarrow \tau^+ \nu$ in a newly published Physical Review Letters paper that has been highlighted by the journal as an "Editors'..."

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Recent News

04 2020-07 The BESIII Collaboration 2020 Summer meeting June 29-July 3 , 2020 , IHEP Beijing

03 2020-04 BESIII Collaboration Workshop on Data Quality and Software Held

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Coming Events

19 2020-09 Workshop in Autumn of 2020 , Sep. 19 – 22, 2020, IHEP, Beijing

28 2020-11 Collaboration Meeting in Winter of 2020, Nov.28 – Dec.2, IHEP, Beijing

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☐ BAM-00106, Phase in J/ψ to $p\bar{p}$ decays, by Marco De
☐ BAM-00132 Search for D^+ to $h^+ e^+ e^-$ by Mingqiang Zhao et al

- ☒ BAM-00296, Search for Invisible Dark Photon Decays using Initial State Radiation, by Martin Ripka et al
- ☐ BAM-00299, Measurements of cross sections for $e^+e^- \rightarrow J/\psi X$ from 3.6 to 3.891 GeV, by Gang Rong et al.
- ☐ BAM-00301, Study of $e^+e^- \rightarrow \pi^+\pi^- \text{ChicJ}$ between 4.23 GeV and 4.60 GeV, by Patric Kiese et al.
- ☐ BAM-00311, $\text{ChicJ} \rightarrow \phi \phi$, by Yonggui Gao et al
- ☐ BAM-00313, Measurement of e^+e^- gamma $D\bar{D}$, by Yu Hu
- ☒ BAM-00314, Analysis of the Two-Photon Production of charged Kaon Pairs, by Meike Kuessner et al.
- ☐ BAM-00315, Measurement of $e^+e^- \rightarrow D\bar{D}$ cross sections at center mass energy between 3.81 and 4.60 GeV, by Jingyi Liu et al.
- ☐ BAM-00325, Vindhya Prasad et al., Measurement of $J/\psi \rightarrow e^+e^- \pi^0$
- ☐ BAM-00326, Ying Fu et al., Measurement of $\Psi(3686) \rightarrow K_S X$
- ☐ BAM-00327, Xinlei Gao et al., Measurement of $e^+e^- \rightarrow \omega \eta/\pi^0$
- ☐ BAM-00329, Yu Zhang et al., Search for $D^0 \rightarrow \pi^0 \nu \bar{\nu}$
- ☐ BAM-00330, Zhen Gao et al., Measurement of R values
- ☒ BAM-00331, Limin GU et al., Search for $\Sigma^+ \rightarrow p e^- e^-$ and $\Sigma^+ \rightarrow \Sigma^+ X$
- ☐ BAM-00336, Honghong Zhang et al., Study of Ψ' to $\omega \Lambda \bar{\Lambda}$
- ☐ BAM-00339, Frank Nerling et al., Search for $Z_c \rightarrow \eta_c \pi$ and measurement of cross sections of $Z_c \rightarrow \eta_c X$
- ☐ BAM-00340 Offline luminosity measurement of 4.0~4.6 GeV data by Yifan Yang et al

Category: Physics Groups

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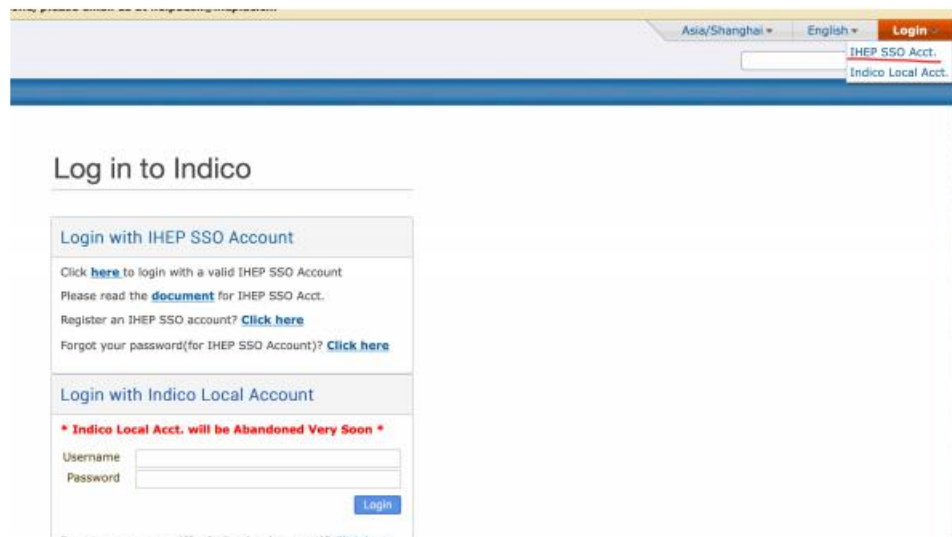
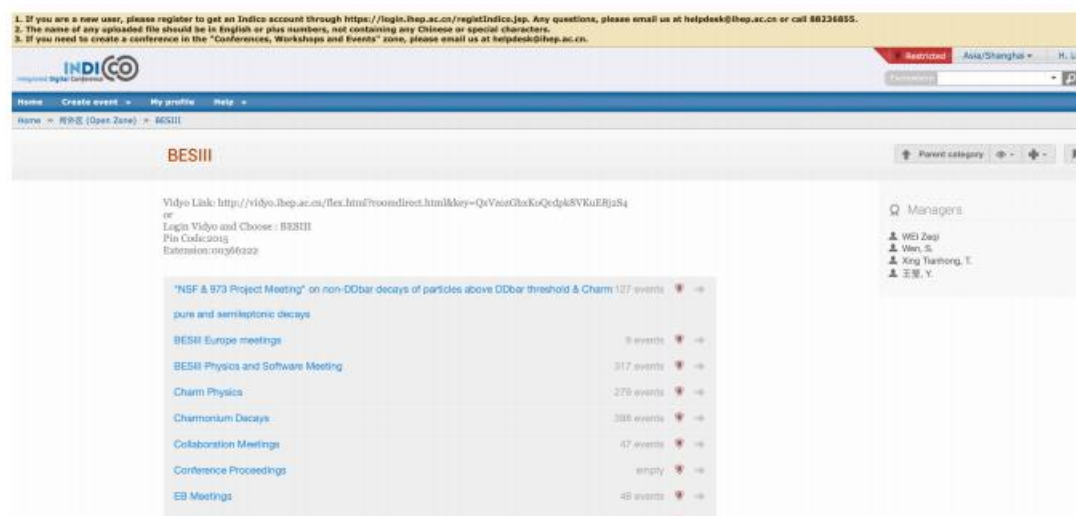
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Physics

cn.arXiv.org > hep-ex > arXiv:1709.00018

High Energy Physics - Experiment

Study of J/ψ and $\psi(3686)$ decays to $\pi^+\pi^-\eta'$

BESIII Collaboration: M. Ablikim, M. N. Achasov, S. Ahmed, M. Albrecht, A. Amoroso, F. F. An, Q. An, J. Z. Bai, Y. Bai, O. Bakina, R. Baldini Ferroli, Y. Ban, D. W. Bennett, J. V. Bennett, N. Berger, M. Bertani, D. Bettoni, J. M. Bian, F. Bianchi, E. Boger, I. Boyko, R. A. Briere, H. Cai, X. Cai, O. Cakir, A. Calcaterra, G. F. Cao, S. A. Cetin, J. Chai, J. F. Chang, G. Chelkov, G. Chen, H. S. Chen, J. C. Chen, M. L. Chen, P. L. Chen, S. J. Chen, X. R. Chen, Y. B. Chen, X. K. Chu, G. Cibirnetto, H. L. Dai, J. P. Dai, A. Dbeyssi, D. Dedovich, Z. Y. Deng, A. Denig, I. Denysenko, M. Destefanis, F. De Mori, Y. Ding, C. Dong, J. Dong, L. Y. Dong, M. Y. Dong, O. Dorjkhaidav, Z. L. Dou, S. X. Du, P. F. Duan, J. Fang, S. S. Fang, Y. Fang, R. Farinelli, L. Fava, S. Fegan, F. Feldbauer, G. Felici, C. Q. Feng, et al. (374 additional authors not shown)

(Submitted on 31 Aug 2017 (v1), last revised 19 Sep 2017 (this version, v3))

Using the data samples of 1.31×10^9 J/ψ events and 4.48×10^8 $\psi(3686)$ events collected with the BESIII detector, partial wave analyses on the decays J/ψ and $\psi(3686) \rightarrow \pi^+\pi^-\eta'$ are performed with a relativistic covariant tensor amplitude approach. The dominant contribution is found to be J/ψ and $\psi(3686)$ decays to $\rho\eta'$. In the J/ψ decay, the branching fraction $B(J/\psi \rightarrow \rho\eta')$ is determined to be $(7.90 \pm 0.19(\text{stat}) \pm 0.49(\text{sys})) \times 10^{-5}$. Two solutions are found in the $\psi(3686)$ decay, and the corresponding branching fraction $B(\psi(3686) \rightarrow \rho\eta')$ is $(1.02 \pm 0.11(\text{stat}) \pm 0.24(\text{sys})) \times 10^{-5}$ for the case of constructive interference, and $(5.69 \pm 1.28(\text{stat}) \pm 2.36(\text{sys})) \times 10^{-6}$ for destructive interference. As a consequence, the ratios of branching fractions between $\psi(3686)$ and J/ψ decays to $\rho\eta'$ are calculated to be $(12.9 \pm 1.4(\text{stat}) \pm 3.1(\text{sys}))\%$ and $(7.2 \pm 1.6(\text{stat}) \pm 3.0(\text{sys}))\%$, respectively. We also determine the inclusive branching fractions of J/ψ and $\psi(3686)$ decays to $\pi^+\pi^-\eta'$ to be $(1.36 \pm 0.02(\text{stat}) \pm 0.08(\text{sys})) \times 10^{-4}$ and $(1.51 \pm 0.14(\text{stat}) \pm 0.23(\text{sys})) \times 10^{-5}$, respectively.

Comments: 13 pages, 5 figures, 6 tables

Subjects: High Energy Physics - Experiment (hep-ex)

Journal reference: Phys. Rev. D 96, 112012 (2017)

DOI: [10.1103/PhysRevD.96.112012](https://doi.org/10.1103/PhysRevD.96.112012)

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[1] arXiv:2509.22535 [pdf, other]

Simultaneous probe of the charm and bottom quark Yukawa couplings using ttH events

CMS Collaboration

Comments: Submitted to Physical Review Letters. All figures and tables can be found at this [http URL](#) (CMS Public Pages)

Subjects: High Energy Physics - Experiment (hep-ex)

[2] arXiv:2509.22455 [pdf, html, other]

Prospects for Higgs Boson Research at the LHC

Andre Sopczak

Comments: 19 pages, 17 figures, presented at FFK2025, Warsaw, 2025

Subjects: High Energy Physics - Experiment (hep-ex)

[3] arXiv:2509.22340 [pdf, html, other]

step2point dataset: Detailed shower simulation for data representation studies

Anna Zaborowska (CERN), Peter McKeown (CERN)

Subjects: High Energy Physics - Experiment (hep-ex); Computational Physics (physics.comp-ph); Instrumentation and Detectors (physics.ins-det)

[4] arXiv:2509.21935 [pdf, html, other]

Reconstruction of the Effective Energy-deposition Vertex of Muon Showers using PMT Waveform in a Large-scale Liquid Scintillator Detector

Junwei Zhang, Yongpeng Zhang, Yongbo Huang, Jilei Xu, Junyou Chen, Yi Wang

Comments: 14 pages, 17 figures

Subjects: High Energy Physics - Experiment (hep-ex)

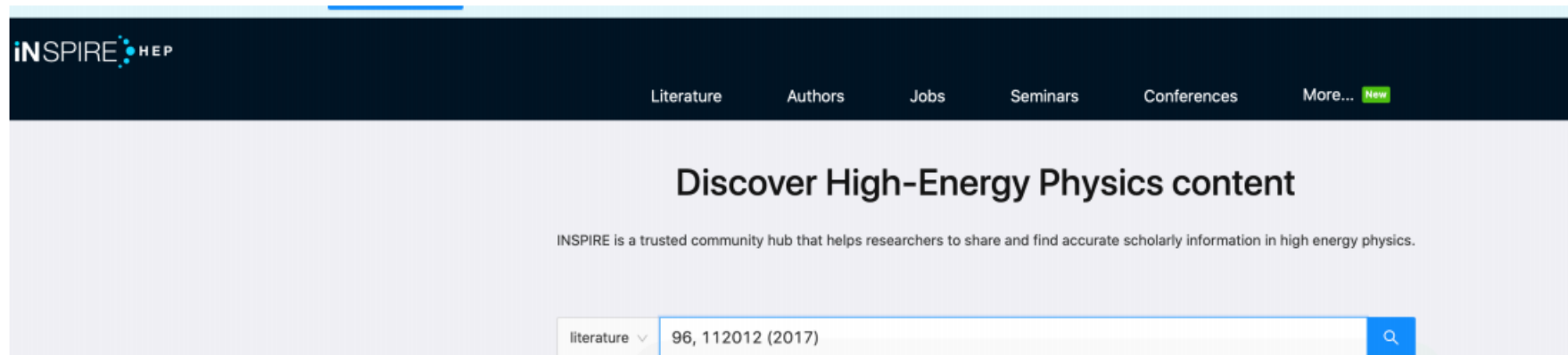
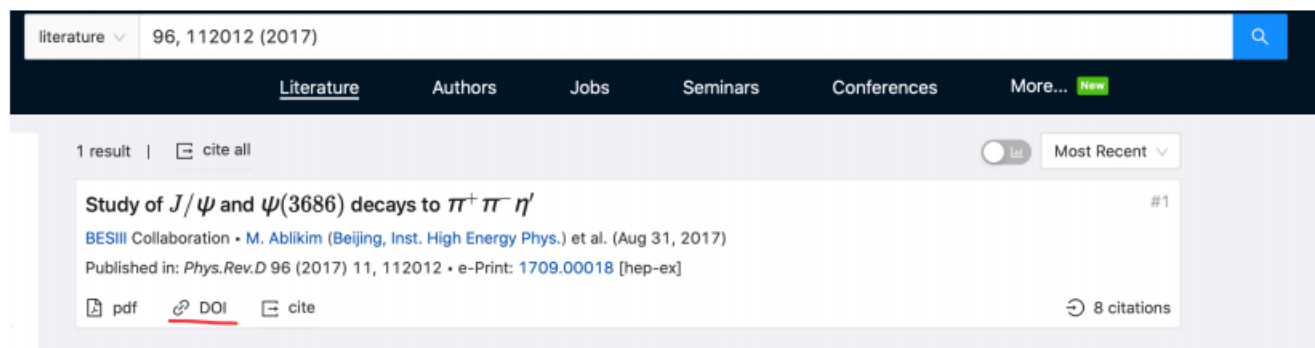
[5] arXiv:2509.21921 [pdf, html, other]

Search for the lepton number violating decay $\eta \rightarrow \pi^+ \pi^- \pi^+ \pi^- e^+ e^- + c.c.$ via $J/\psi \rightarrow \phi \eta$

BESIII Collaboration: M. Ablikim, M. N. Achasov, P. Adlarson, X. C. Ai, R. Aliberti, A. Amoroso, Q. An, Y. Bai, O. Bakina, Y. Ban, H.-R. Bao, V. Batozskaya, K. Begzsuren, N. Berger, M. Berlowski, M. B. B. B. Bianchi, F. Bianco, A. Bortone, I. Bratkov, R. A. Briere, A. Brueggemann, H. Cai, M. H. Cai, X. Cai, A. Calcaterra, G. F. Cao, N. Cao, S. A. Cetlin, X. Y. Chai, J. F. Chann, G. R. Che, Y. Z. Che, C. H. Chen

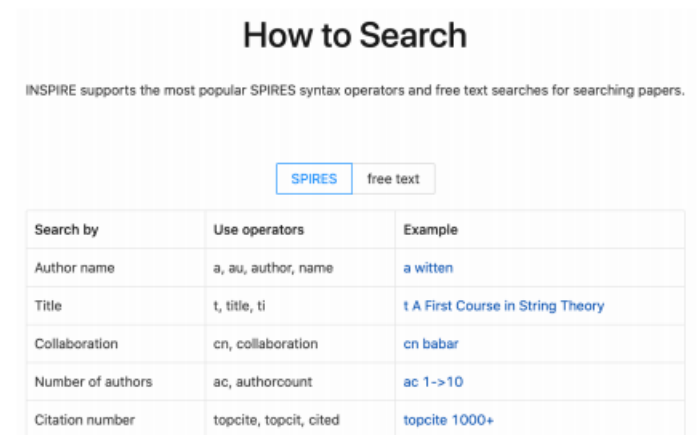
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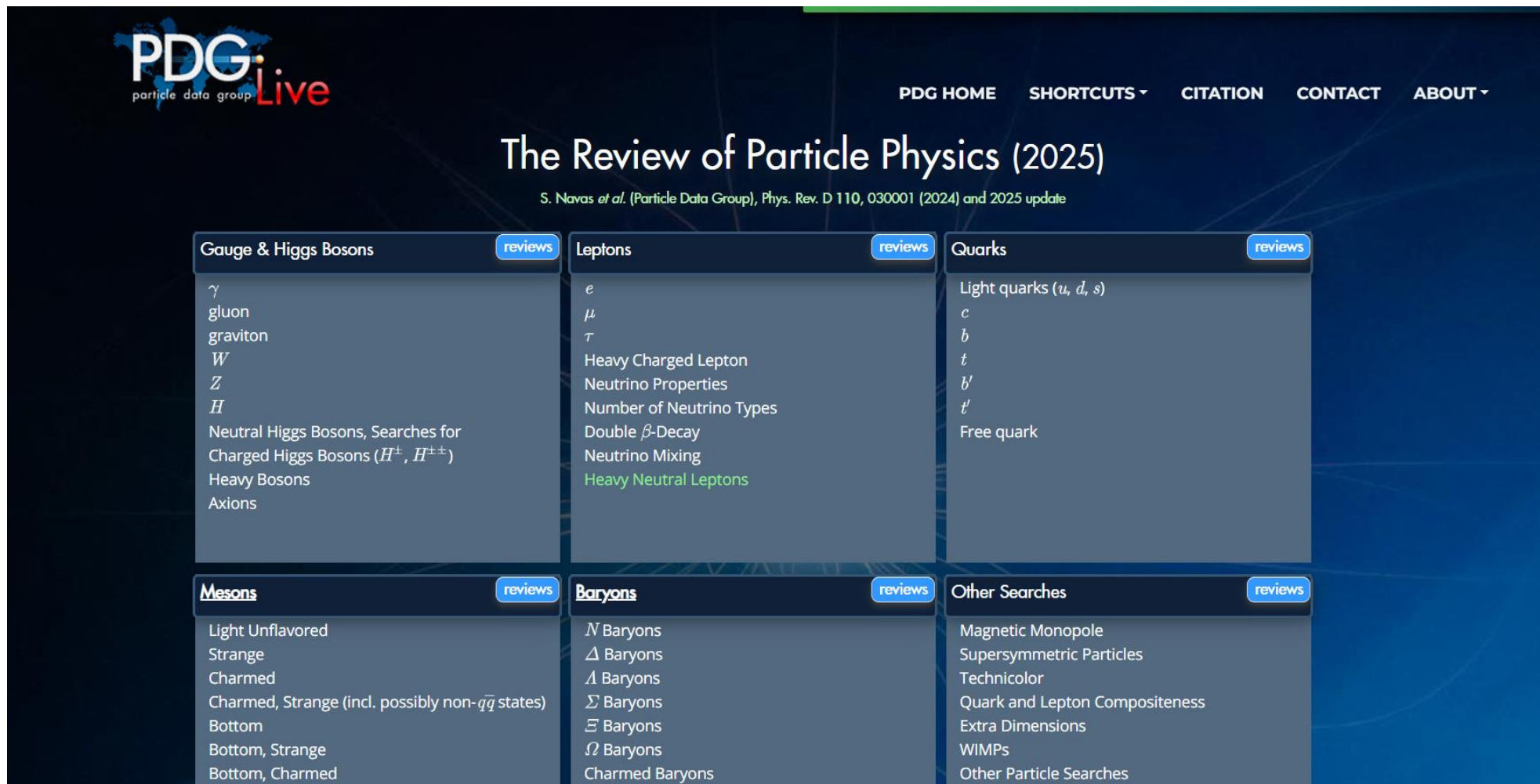
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The Review of Particle Physics (2025)

S. Navas *et al.* (Particle Data Group), Phys. Rev. D 110, 030001 (2024) and 2025 update

Gauge & Higgs Bosons	Leptons	Quarks
<ul style="list-style-type: none">γgluongravitonWZHNeutral Higgs Bosons, Searches forCharged Higgs Bosons ($H^\pm$, $H^{\pm\pm}$)Heavy BosonsAxions	<ul style="list-style-type: none">eμτHeavy Charged LeptonNeutrino PropertiesNumber of Neutrino TypesDouble β-DecayNeutrino MixingHeavy Neutral Leptons	<ul style="list-style-type: none">Light quarks (u, d, s)cbtb't'Free quark

Mesons	Baryons	Other Searches
<ul style="list-style-type: none">Light UnflavoredStrangeCharmedCharmed, Strange (incl. possibly non-$q\bar{q}$ states)BottomBottom, StrangeBottom, Charmed	<ul style="list-style-type: none">N BaryonsΔ BaryonsΛ BaryonsΣ BaryonsΞ BaryonsΩ BaryonsCharmed Baryons	<ul style="list-style-type: none">Magnetic MonopoleSupersymmetric ParticlesTechnicolorQuark and Lepton CompositenessExtra DimensionsWIMPsOther Particle Searches

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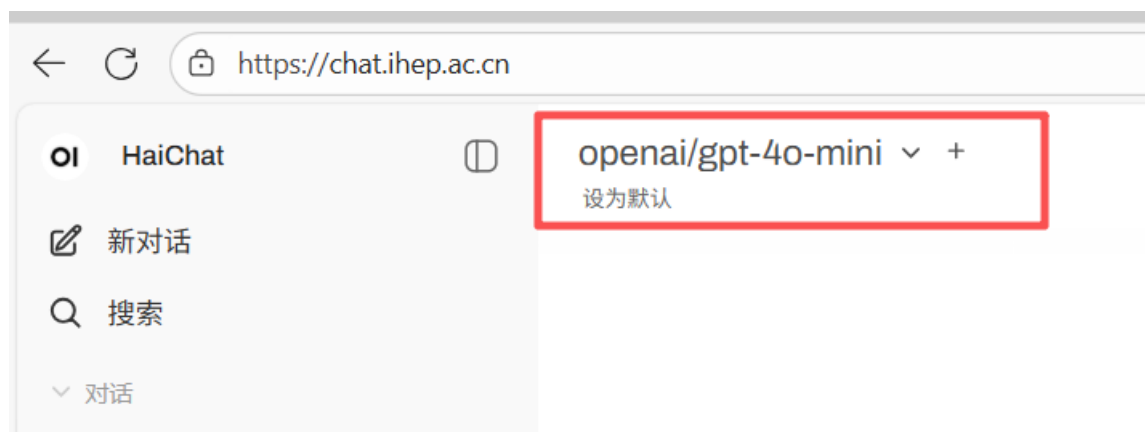
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<https://chat.ihep.ac.cn/>

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必备网站----CSDN

<https://www.csdn.net/>



可检索 C++、Python、LaTeX、ROOT 等问题。
结合社区经验与 AI，提高排错效率。

必备网站----公式截图转换latex

https://simpletex.cn/ai/latex_ocr

识别对象 (识别类型: 自动检测 ∨)

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$$\sigma(e^+e^- \rightarrow f) = \frac{N_f^{obs} - N_{bkg}}{\epsilon_f \cdot \epsilon_{trg} \cdot (1 + \delta) \cdot L}$$

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类型: 公式

公式模式

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$$\sigma(e^+e^- \rightarrow f) = \frac{N_f^{obs} - N_{bkg}}{\epsilon_f \cdot \epsilon_{trg} \cdot (1 + \delta) \cdot L}$$

☒ AI智能编辑 ∨

☒ AI增强识别 ∨

☒ 复制LaTeX ∨

☒ 复制MathML(Word) ∨

☒ 复制PNG ∨

```
\sigma(e^+e^-\to f)=\frac{N_f^{obs}-N_{bkg}}{\varepsilon_f\cdot\varepsilon_{trg}\cdot(1+\delta)\cdot L}
```

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<https://zh.snipaste.com>



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必备网站

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基本shell命令, vim编辑器 基础----安装环境

<https://www.runoob.com/linux/linux-tutorial.html>

改变目录cd

- ✚ **pwd** ---- print working directory
- ✚ **cd** ---- changing directory

<code>cd work</code>	This moves you to the work directory.
<code>cd .</code>	This moves you nowhere, but stay in your current directory.
<code>cd ..</code>	This moves you to the directory above your current directory.
<code>cd /</code>	This moves you to the root directory.
<code>cd ../..</code>	This moves you to TWO directories above your current directory.
<code>cd ~</code>	This moves you to your user home directory.
<code>cd -</code>	This moves you to the last visited directory.

- ✚ **use / to connect the subdirectory name:** /home/cp
- ✚ **a single period or ‘.’ means the current directory and double periods ‘..’ means the directory above**

目录中的文件ls

✚ Syntax : **ls** [**options**] [**file**]

✚ default: list files in the current directory.

✚ Options :

✚ **-a**: This lists all files, including hidden files.

✚ **-l**: This lists files in a long listing format.

✚ **--color**: color is used to distinguish file types.

To find more options, use the “**man ls**” command.

✚ Examples of **ls** command in use

<code>ls /home/dongly</code>	This lists all files in that directory.
<code>ls /home/dongly/*.sh</code>	This lists all the files with the file extension of <i>.sh</i> .
<code>ls /home/dongly/t*</code>	This lists all files beginning with the letter <i>t</i> .

文件复制cp

Copying Files

✚ Syntax: `cp [option] [source_file] [target_file]`
`cp [option] [source_dir] [target_dir]`

✚ option:

-i	The interactive option. The cp command will prompt the user before actually copying the file(s).
-f	Overwrite an existing destination file. (有危险，小心操作!)
-r	This forces the cp command to copy the files recursively.

```
cp -r /dir/* /dir2/ will copy all files and subdirectories omitting dir
cp -r /dir/ /dir2/ will copy all files and subdirectories including dir
```

文件移动mv

Moving Files or Renaming Files

✚ Syntax: `mv [option] [source_file/dir] [target_file/dir]`

✚ option:

-i	The interactive option. The mv command will prompt the user if the target_file/dir already exists.
-f	Overwrite the existing target file(s). (有危险, 小心操作!)

✚ **mv** command can be used to rename file or directory

建立目录mkdir

Creating Directories

✚ Syntax: `mkdir [option] [directory_name]`

✚ option:

<code>-p</code>	no error if existing, make parent directories as needed
-----------------	---

✚ Example:

```
mkdir documents
```

```
mkdir -p work/foo/num1
```

(建num1目录, 如果work和foo目录不存在, 也一起建好)

文件删除rm

Removing Files

✚ Syntax: `rm [option] [file1][file2]`
`rm [option] [dir1] [dir2]`

✚ option:

-i	The interactive option. The rm command will prompt the user before actually removing the file(s) (执行前确认, 这个重要!).
-f	Remove the file(s) without prompt. (有危险, 小心操作!)
-r	This forces the rm command to remove the files recursively .

✚ option **-i** is recommended: 提示交互操作

✚ Don't use `rm -rf /*` as root privilege.

```
rm -rf /dir1/* removes all files and subdirectories leaving dir1 empty
rm -rf /dir1/  removes all files and subdirectories including dir1
```

以上命令删除目录下所有文件, 小心使用!

查看目录大小\du

✚ 语法: `du [-s] 目录`

✚ `du dir1`

显示目录`dir1`的总容量及其子目录的容量 (以KB为位)。

✚ `du -s dir1`

显示目录`dir1`的总容量。

✚ `du -s *`

显示当前目录下各个子文件夹的大小。

文件统计和比较

 **wc file**

统计和显示文件**file**的字节数，单词数和行数。

 **diff**

 **diff file1 file2**

比较文件**file1**与**file2**内各行的不同之处。

 **diff -r dir1 dir2**

比较目录**dir1**与**dir2**内各文件的不同之处。

 **diff -i file1 file2**

忽略大小写的差异

其他常用工具和命令

- tee 输出到屏幕同时也输出到文件: **tee -a file (同时将输出追加到文件file中)**
 > file 输出到file, >>追加到file (>和>> 看不到屏幕输出)
- xpdf pdf 文档阅读器: xpdf xx.pdf
- latex 排版系统, 生成很多具有书籍质量的文档(投稿, 毕业论文, 演示报告)。
- pdflatex 用来编译用LaTeX格式写的tex文件, 生成PDF文件。
- gv Postscript文档浏览器 gv xx.ps; gv xx.eps
- eog 图片查看器, 支持JPG, PNG, GIF, TIFF or XPM等图片格式
- display 图片浏览工具

vim编辑器

一起浏览教程，结合示例练习，逐步熟悉常用操作。

Linux vi/vim | 菜鸟教程：

<https://www.runoob.com/linux/linux-vim.html>

vim编辑器

Vim的定制

下面是.vimrc文件的示例:

复制/home/cp/codes/linux/vimrc到个人目录下,
并更名为.vimrc

```
" 设置在哪些模式下使用鼠标功能, mouse=a表示所有模式
set mouse=a
" 设置路径, 在<C-W>f等命令中涉及此参数
" 打开光标的行列位置显示功能
set ruler
" 设置跳格距离
set tabstop=4
" 设置自动缩进格数
set shiftwidth=4
" 打开自动缩进功能
set smartindent
" 根据当前文件语法自动变色. VIM识别上百种文本文件的语法, 如html, c++, java等
syntax on
"在普通模式下, 映射F2键为删除一行
nmap <F2> dd
"编译代码文件
:map <F9> :w<CR>:!gcc -o %< %<CR>
"运行编译后的程序
:map <F5> :!./%<
```

练习1：linux基本用法

- 1.在自己的主目录下，创建个人文件夹，命名为 `research_work_你的名字`；
- 2.进入该文件夹，依次创建三个子目录：`mc`、`report`、`test`；
- 3.在`report`和`test`目录下，创建两个文件：`note.txt`；（`touch/vi`），文件里分别写上当前目录的位置。
- 4.拷贝`/besfs10/groups/jpsi/jpsigroup/user/yuanjing/phi_eta.dec`在`mc`目录下
- 6.将`report`文件夹更名为`report_你的名字`
- 7.删除`test`文件夹

vim编辑器：

- 1.进入上一步创建的`mc`的目录中，把`phi_eta.dec`在当前文件夹（`mc`）下复制一份 起名为`test.DEC`
- 2.把`test.DEC`中前四行代码 复制一遍 粘贴到最后一行（保留原来的格式，提示：命令模式使用`4yy p`）
- 3.全局替换：将整个文件中的`PSHP`替换为小写的`phsp`；保存退出
4. 使用`diff` 对比`phi_eta.dec`和`test.DEC` 文件 并截图发群里。

练习2： 安装环境

安装boss7.0.9环境

`/besfs10/groups/jpsi/jpsigroup/user/yuanjing/environment.sh`

<https://note.ihep.ac.cn/o9K22ZjcSzSBfAbIR24U0w>