BESIII 离线软件

伍灵慧

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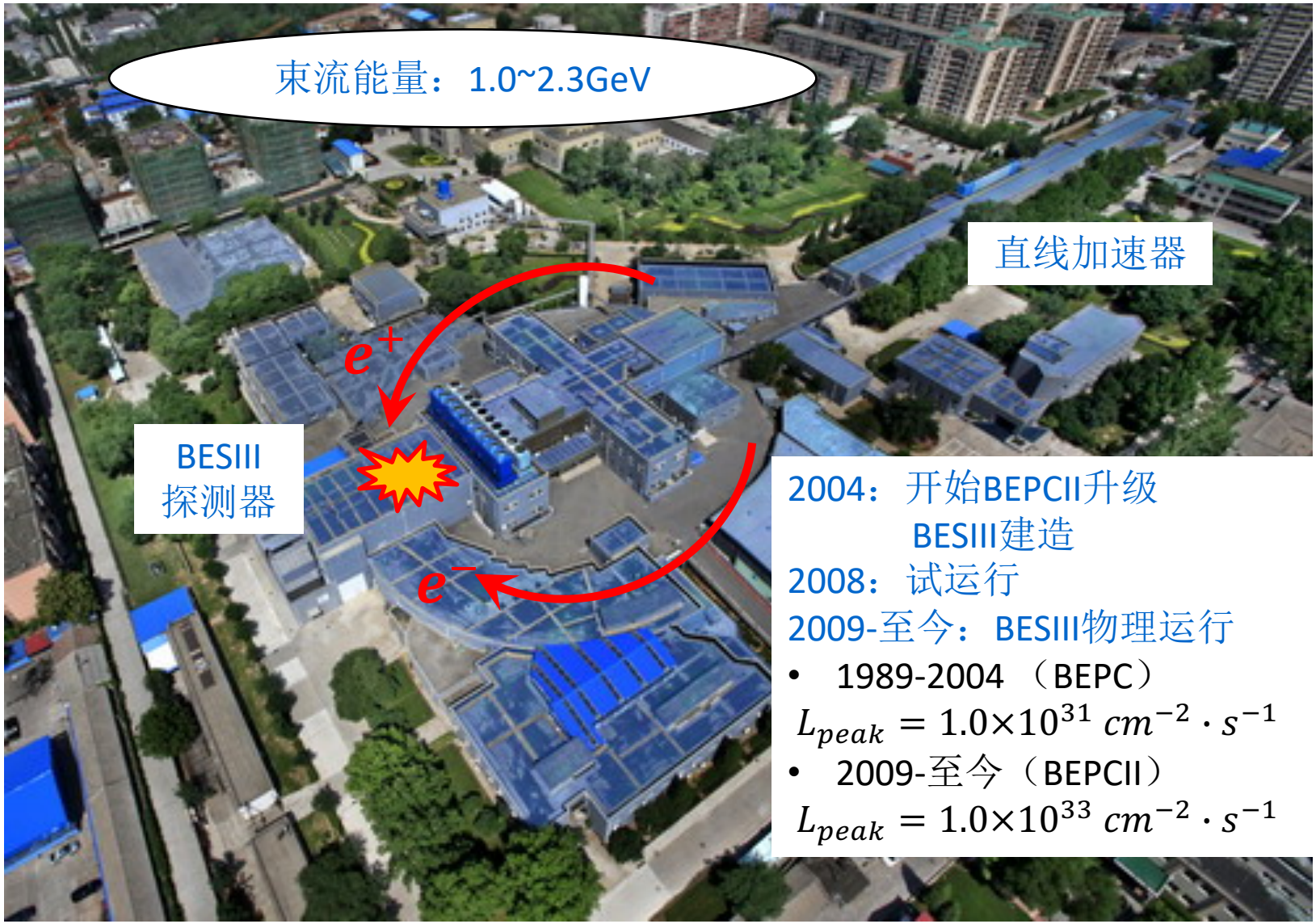
代表BESIII软件组

BEPCII & BESIII



2004：开始BEPCII升级
BESIII建造

2008：试运行

2009-至今：BESIII物理运行

- 1989-2004 （BEPC）

$L_{peak} = 1.0\times10^{31}\ cm^{-2}\cdot s^{-1}$

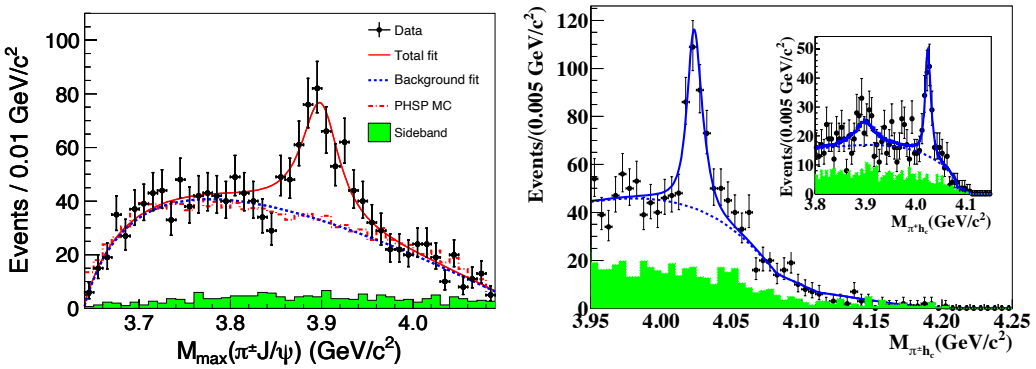
- 2009-至今（BEPCII）

$L_{peak} = 1.0\times10^{33}\ cm^{-2}\cdot s^{-1}$

BESIII实验

- BEPCII是运行在τ-粲能区的正负电子对撞机
- BESIII探测器是BEPCII上的大型通用粒子探测系统，自2009年运行以来，获取了海量τ-粲能区的物理事例，在奇特强子态、轻强子研究等方面取得了一系列重要的物理成果

2013年发现 $Z_c(3900)$和$Z_c(4020)$



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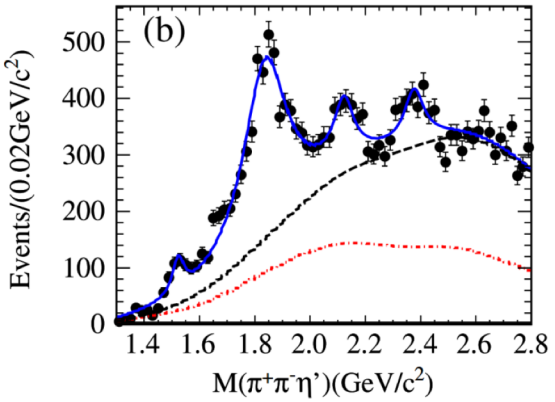
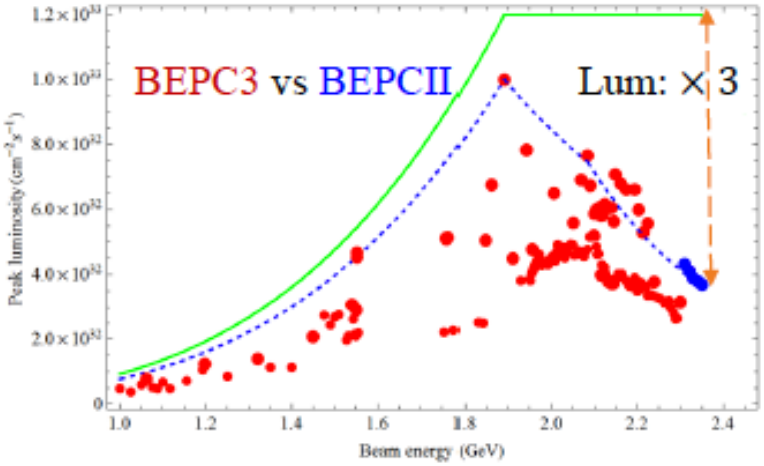




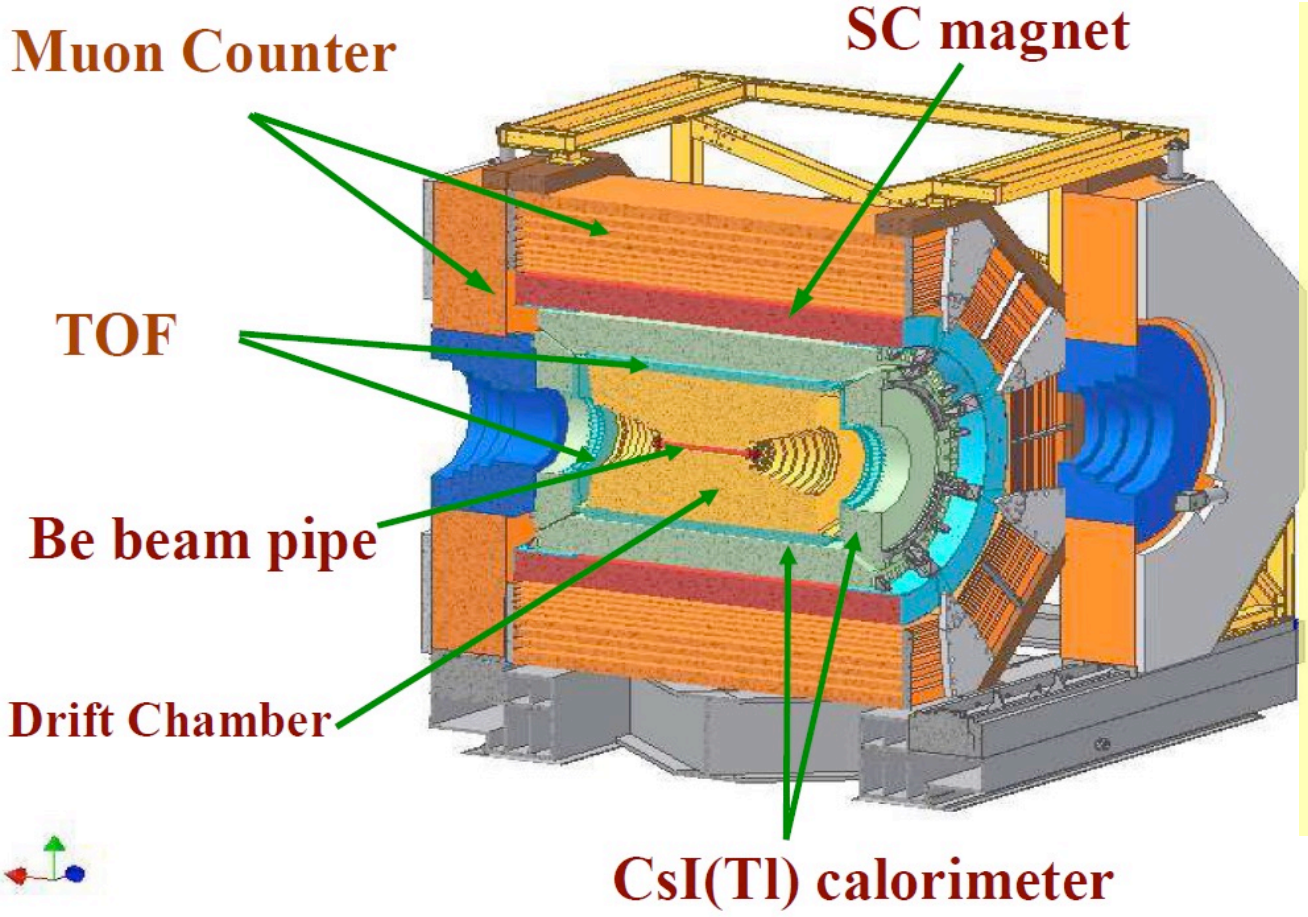
BEPCII 升级

- Luminosity Upgrade
  - $\sqrt{s} = 4.0\sim5.0GeV: 1.2\times10^{33}/cm^2\cdot s$
  - $\sqrt{s} = 5.0\sim5.6GeV: 0.5\sim0.8\times\frac{10^{33}}{cm^2}\cdot s$
- Energy Upgrade
  - Upper limit: $5.0\sim5.6GeV$

BESIII探测器设计要求

- 物理目标：τ-粲能区高精度的物理研究
- 探测器设计要求：
  - 在10MeV至2.5GeV的能量范围内，能精确测量光子的能量，有非常好的能量分辨率、位置分辨率和光子识别能力
  - 在50MeV至2.5GeV的动量范围内，能精确测量带电粒子的动量与方向，即非常好的动量分辨率、顶点位置分辨率、出射位置分辨率等
  - 在50MeV至2.5GeV的动量范围内能很好地鉴别各种粒子，如光子、电子、μ子、质子、π介子、K介子等
  - 电子学和数据获取系统应适应多束团模式和高计数率

BESIII探测器

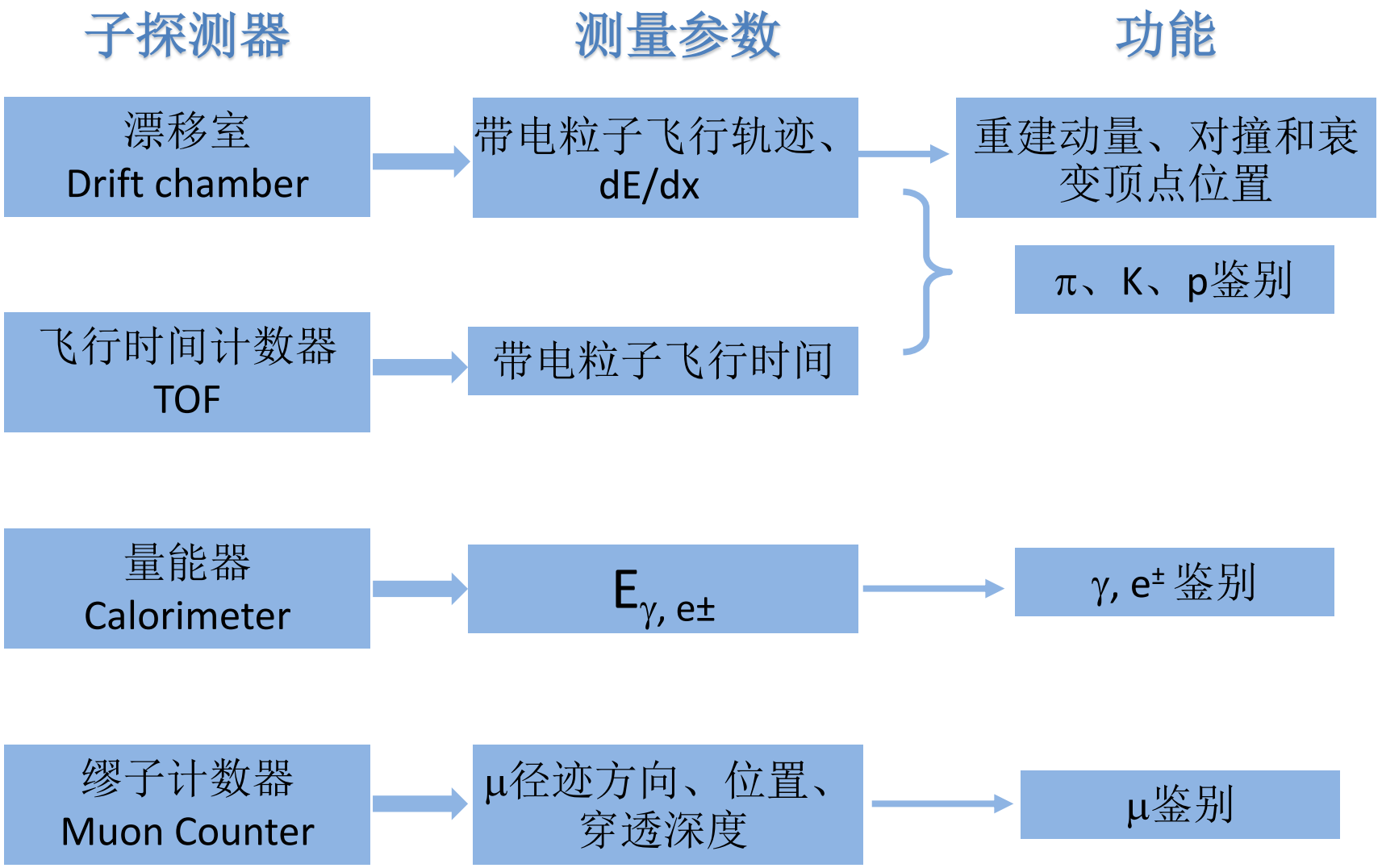


根据科学目标
优化整体方案

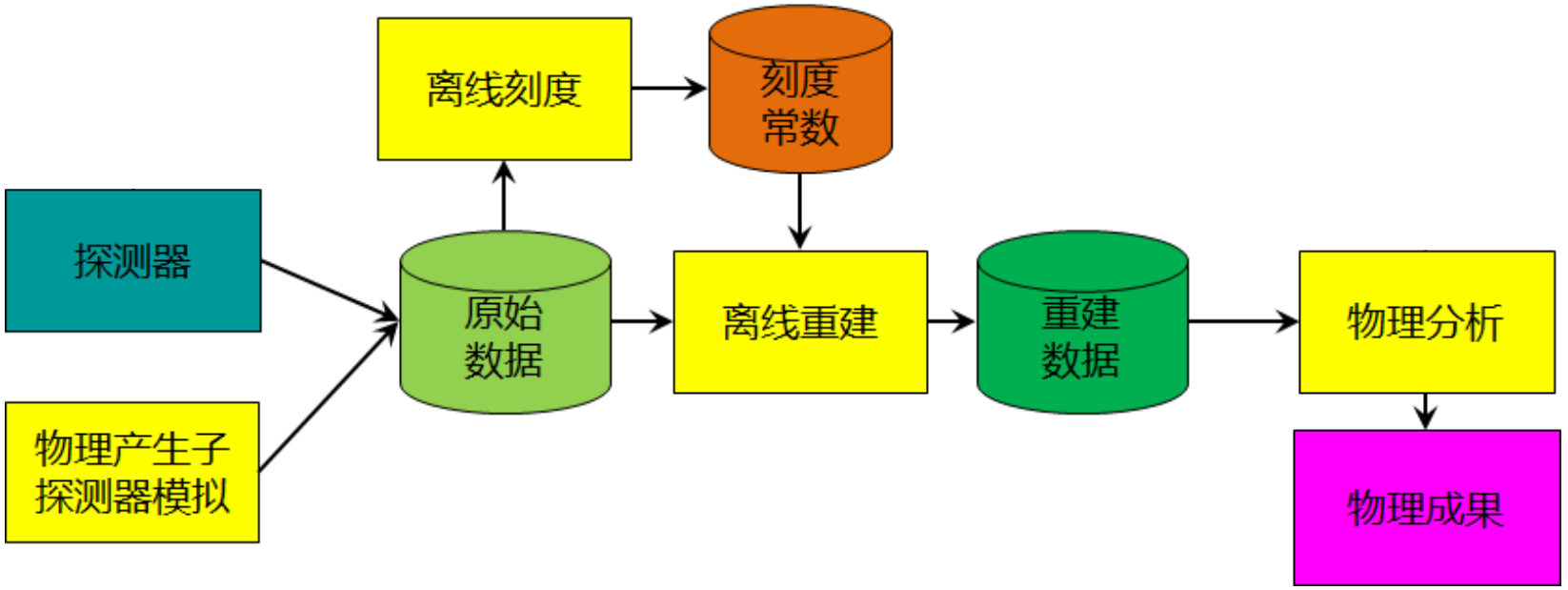
- 适应 BEPCII高计率
  - ➢$10^{33}cm^{-2}\ s^{-1}$
  - ➢对撞间隔 6 or 8ns
  - ➢事例率高达40kHz.
- 减少系统误差，与高统计性相适应
  - ➢ 提高动量能量分辨率
  - ➢ 提高 PID…
- 增加几何接收度

✓ 总重量： 730吨
✓ 读出道数：~3万道
✓ 数据率： ~50Mb/s

BESIII子探测器


子探测器
测量参数
功能
漂移室
Drift chamber
带电粒子飞行轨迹、
dE/dx
重建动量、对撞和衰变顶点位置
π、K、p鉴别
飞行时间计数器
TOF
带电粒子飞行时间
量能器
Calorimeter
$E_{\gamma, e\pm}$
γ, e± 鉴别
缪子计数器
Muon Counter
μ径迹方向、位置、穿透深度
μ鉴别

BESIII数据处理和物理分析流程



- 原始数据：探测器电子学信号的时间和幅度信息
- 重建数据：粒子的动量、能量和运动方向等物理量

离线软件的性能直接影响实验结果

- 重建、刻度→效率、分辨
- 模拟数据的一致性→系统误差

事例重建

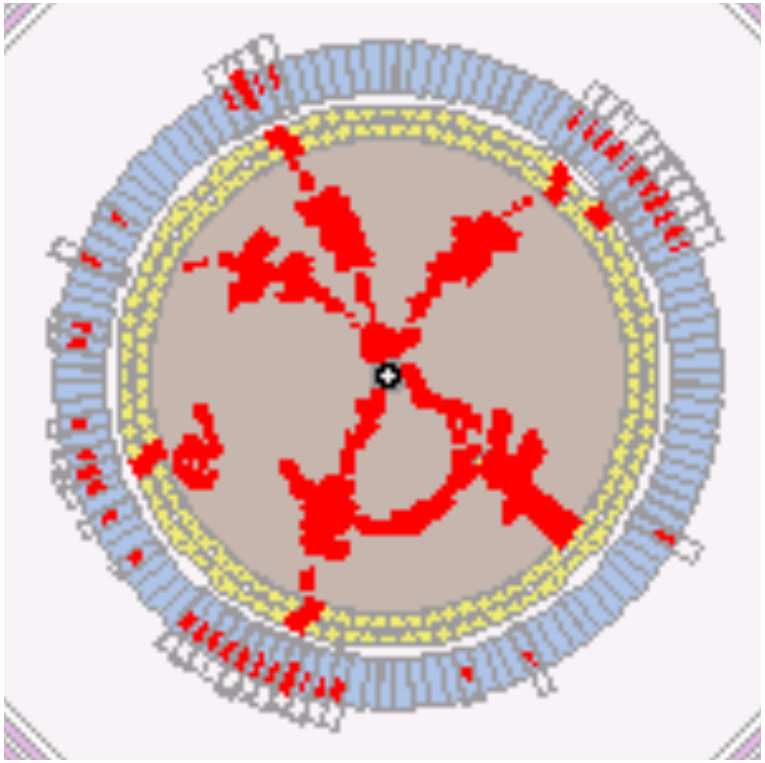
实验获取的原始数据

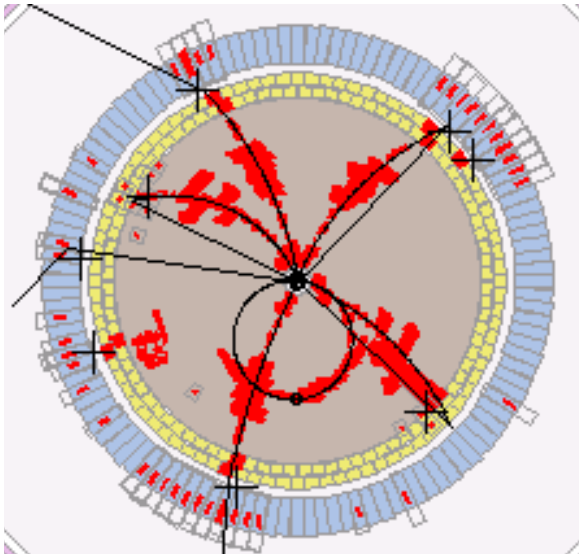
单元编号，ADC，TDC

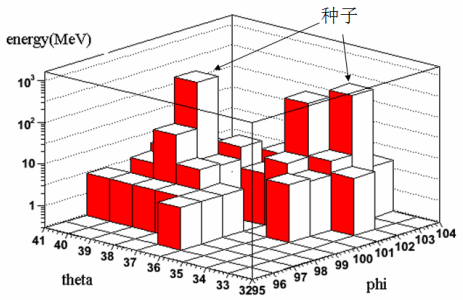
事例重建

物理分析使用的数据

径迹动量, shower能量

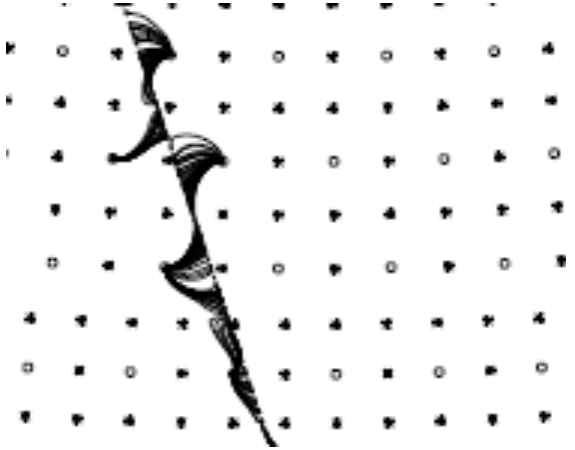






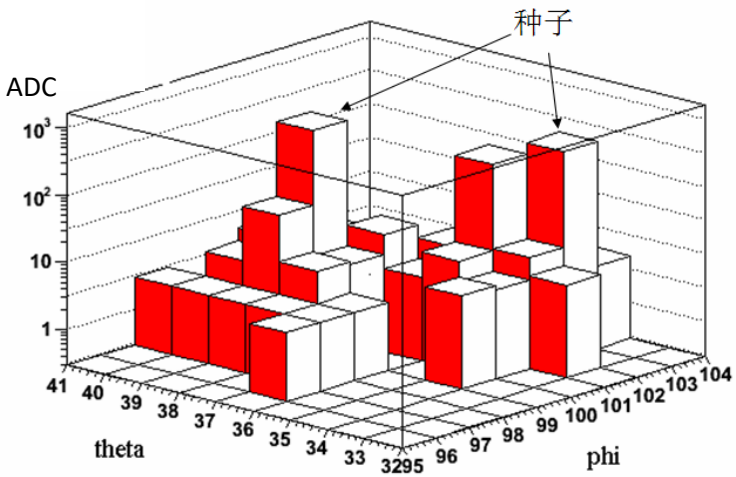
离线刻度

MDC中的径迹



漂移时间→漂移距离

EMC中的簇团

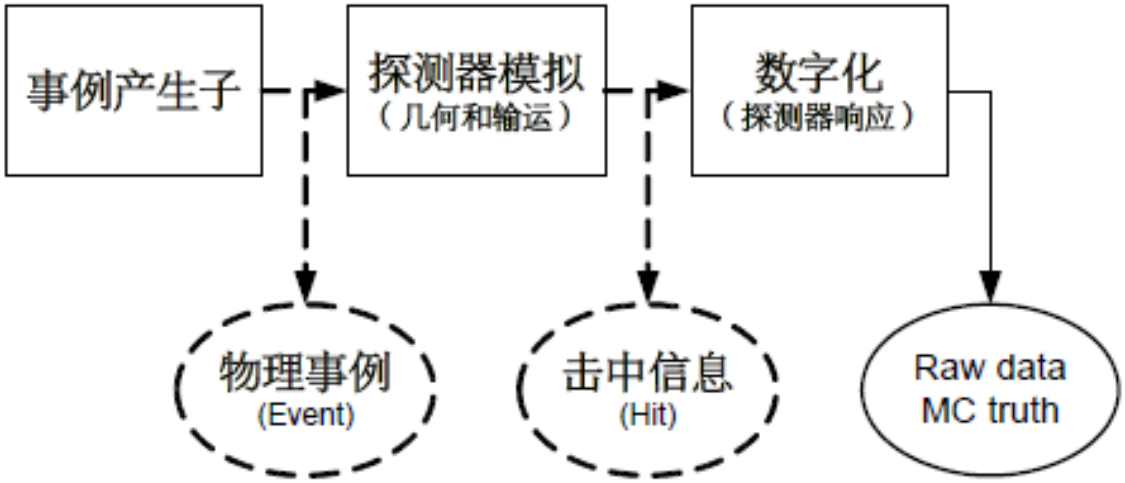


信号幅度→能量沉积

1ns = ? mm
1ADC= ?GeV

必须依赖
离线刻度

Monte Carlo模拟



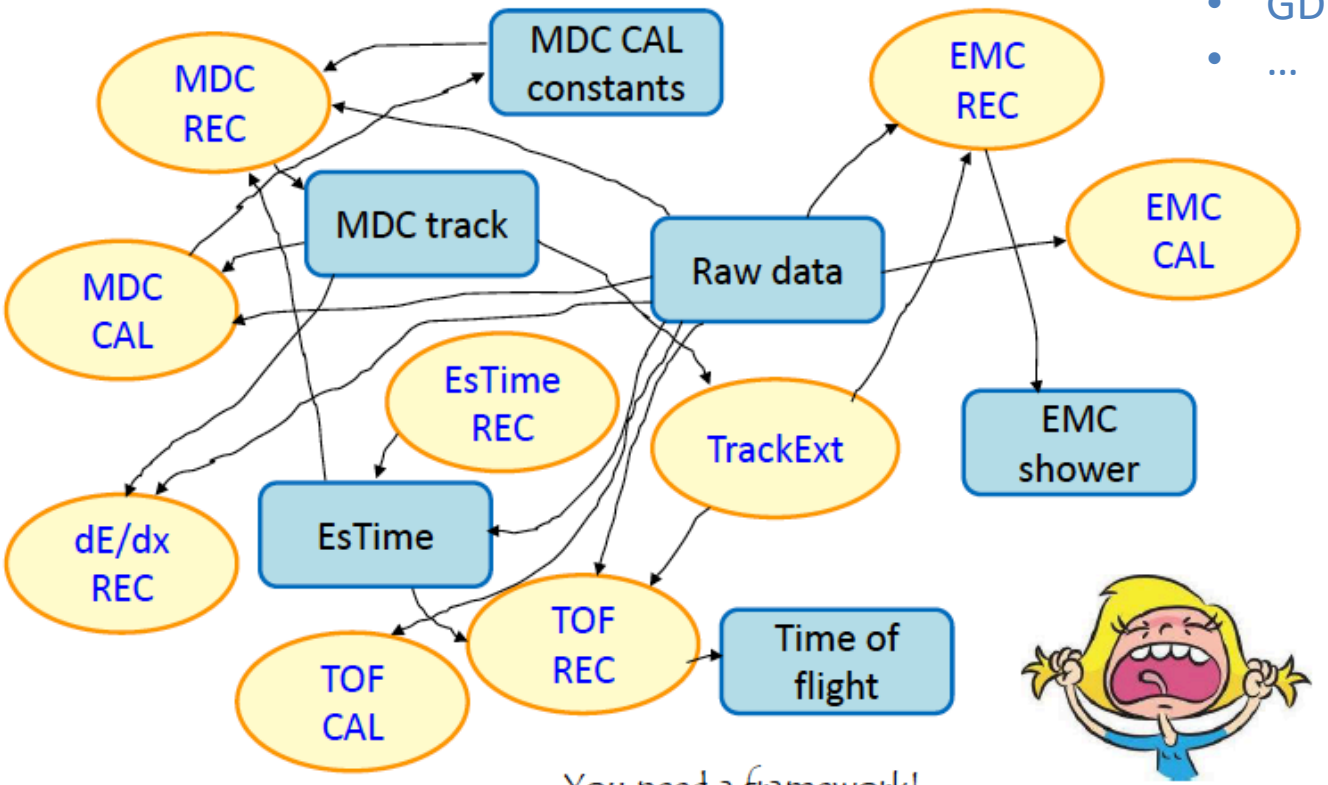
软件框架

BESIII软件框架

- 定义数据模型，提供有效的数据管理工具
- 定义软件模块间的相互关系及接口标准
- 实现动态库的链接机制

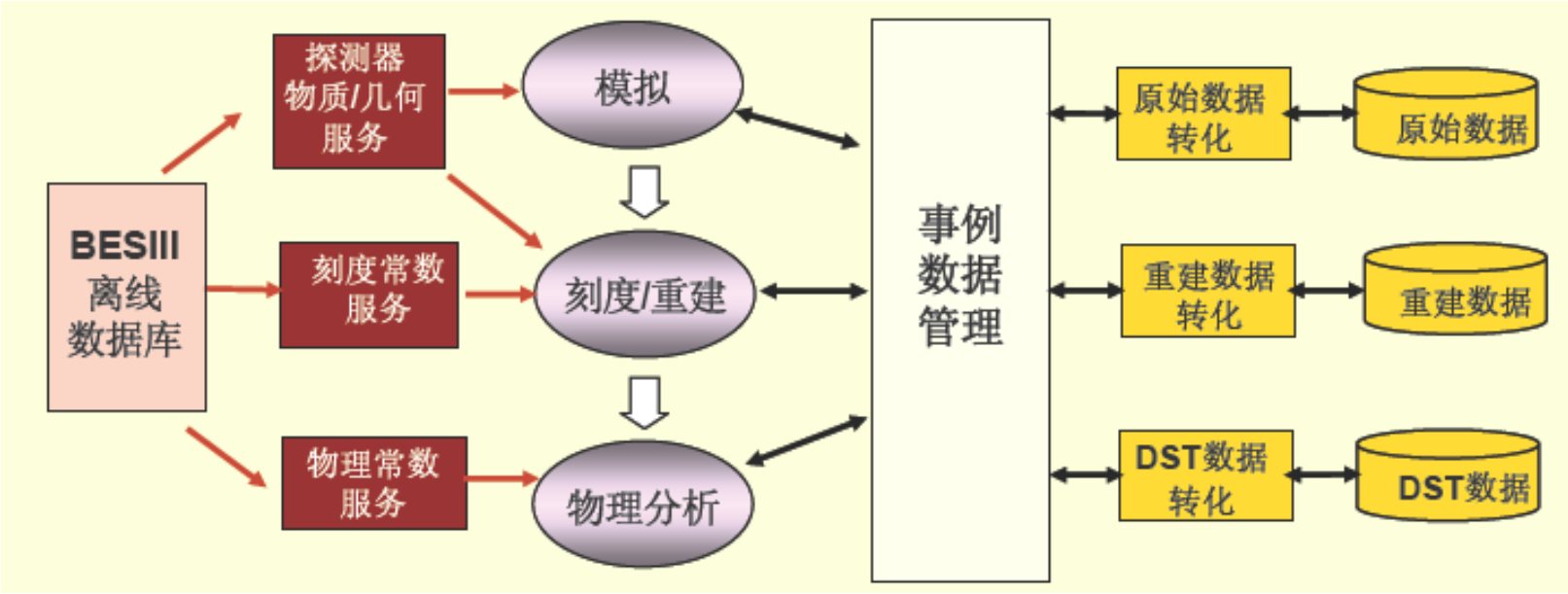
More than 300 packages in BOSS
Lots of external lib:

- Geant4
- ROOT
- CLHEP
- GDML
- …

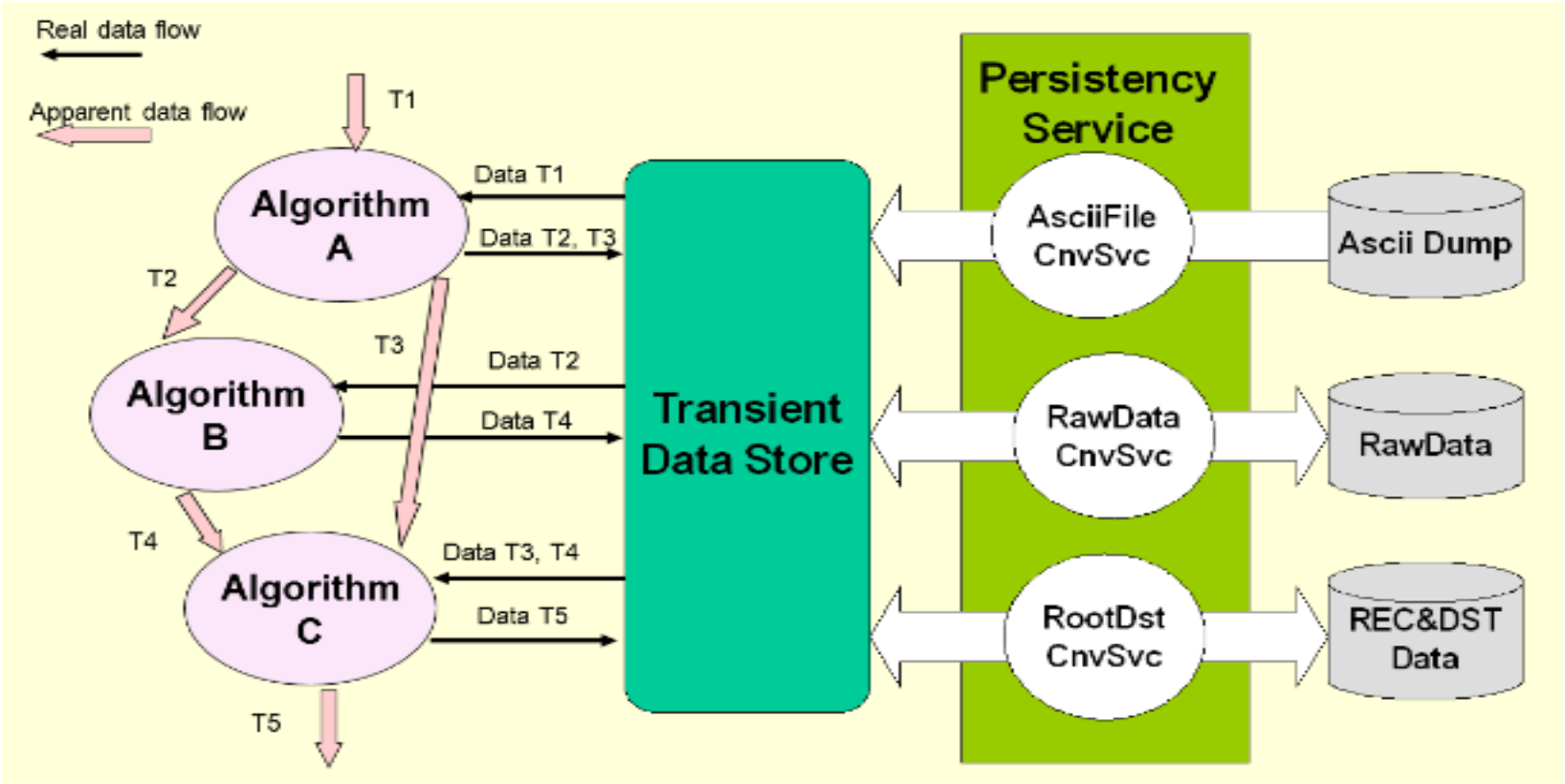


BESIII离线软件系统

- BESIII Offline Software System (BOSS)，采用 **GAUDI**为基础，以C++语言为主开发的离线数据处理软件平台
  - 提供有效的数据管理工具
  - 定义软件模块间的相互关系及接口标准
  - 实现动态库的链接机制



瞬态数据库



- 瞬态数据库(TDS): 程序运行期间各功能模块所需事例数据、探测器描述数据和直方图统计数据所存放的内存空间，只存在于框架运行期间

流程控制

- BOSS程序运行过程分为三大部分
  - 系统初始化 (initialize)
    - 创建应用管理器对象
    - 创建服务模块
  - 事例处理循环 (execute)
    - 事例读取
    - 事例处理
    - 事例存储
  - 作业结束 (finalize)
    - 关闭所有服务，删除对象，释放资源

软件配置管理

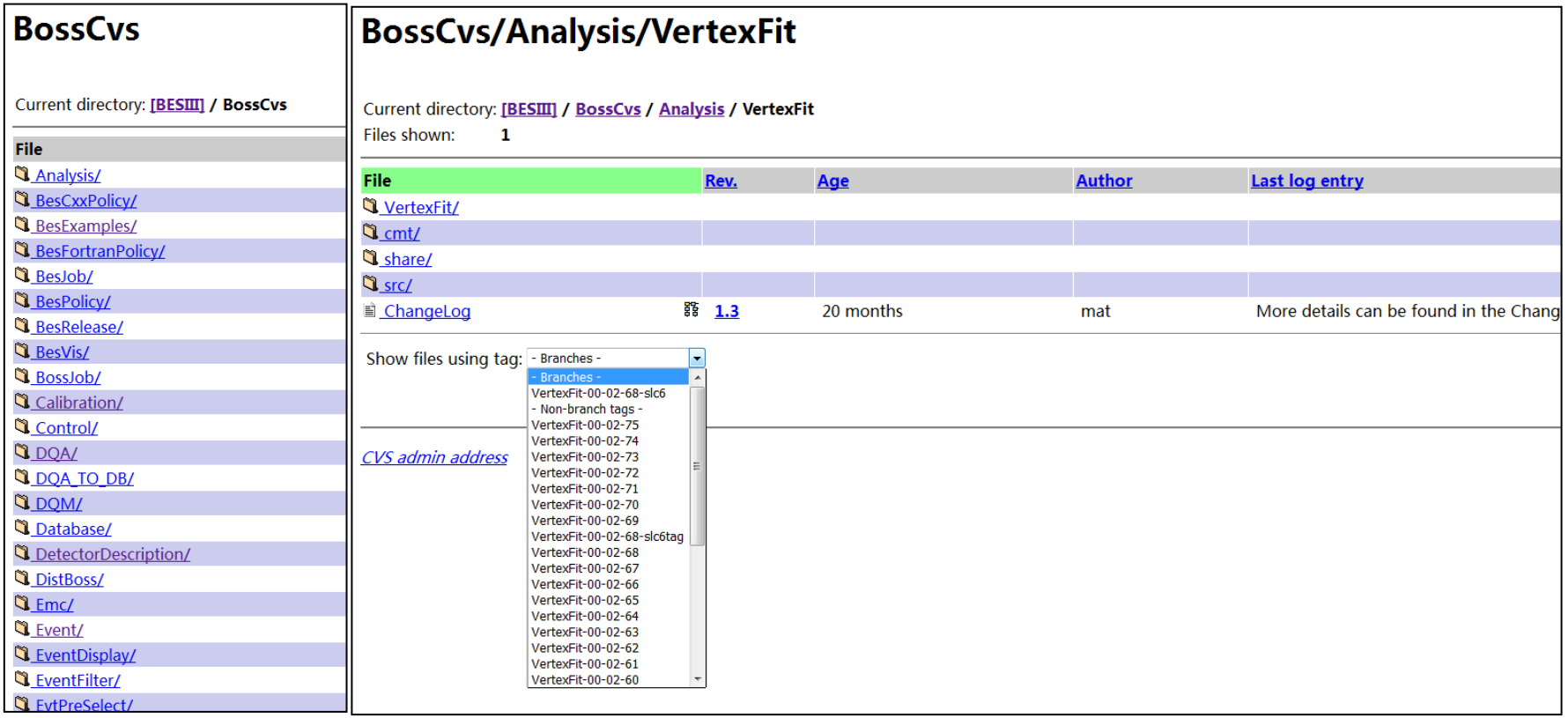
- 采用软件包来进行组织和管理软件。软件包是由一组相关功能的软件代码构成的，从功能逻辑上结合在一起的物理单元，它是软件发布的最小单元
- 采用配置管理工具CMT(Configuration Management Tool)来规范软件开发和发布过程，并且为该过程提供一套完整的配置管理工具
- 常用命令
  - cmt create <packagename> <version>
  - cmt co -r <tag-number> <package>
  - cmt config or cmt br cmt config
  - gmake or cmt br gmake
  - cmt show uses

软件代码管理--CVS

所内：http://koala.ihep.ac.cn/cgi-bin/viewcvs.cgi/BossCvs/

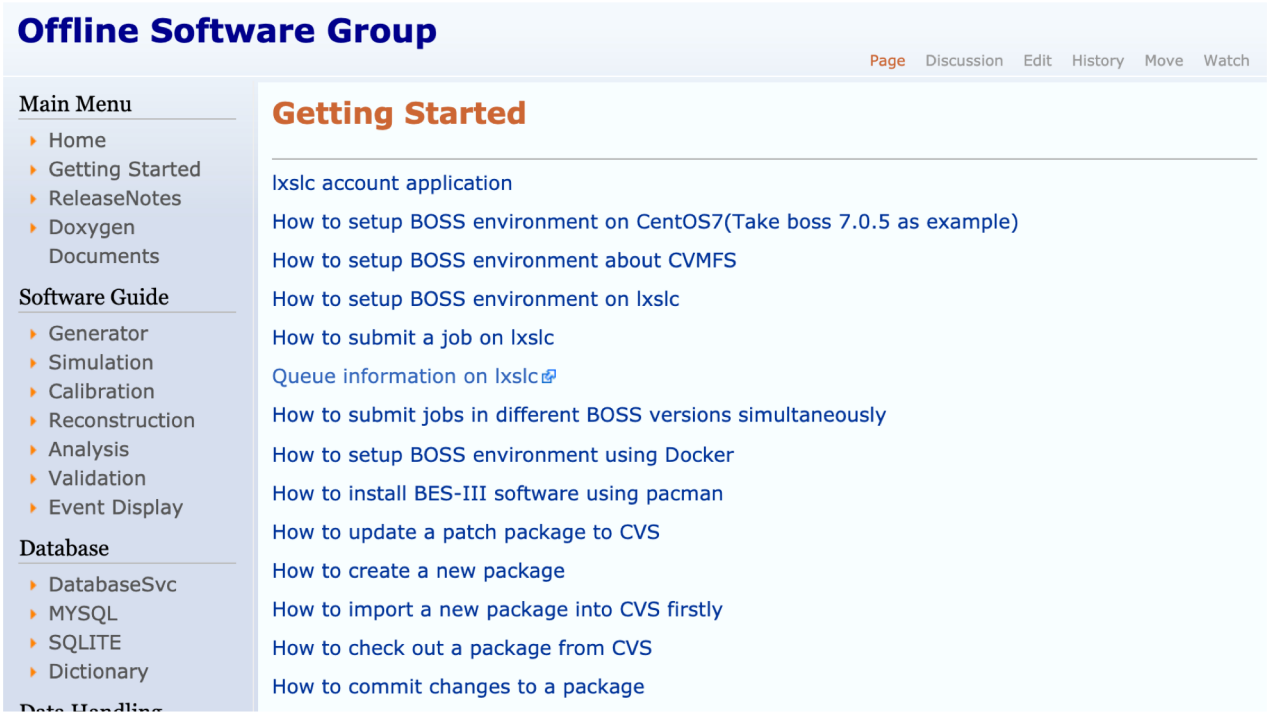
所外：http://docbes3.ihep.ac.cn/viewvc/cgi-bin/viewvc.cgi/BESIII/BossCvs/

BESIII软件首页有链接



BESIII软件文档网页

- http://docbes3.ihep.ac.cn/~offlinesoftware/index.php/Main_Page
- 有用的信息：
  - BOSS入门：Gaudi和CMT命令使用、设置环境及提交作业等
  - 各个Boss版本的release note
  - 读取DST和REC数据的接口列表
  - 模拟、重建、刻度、分析工具软件的相关文档
  - 原始数据的位置



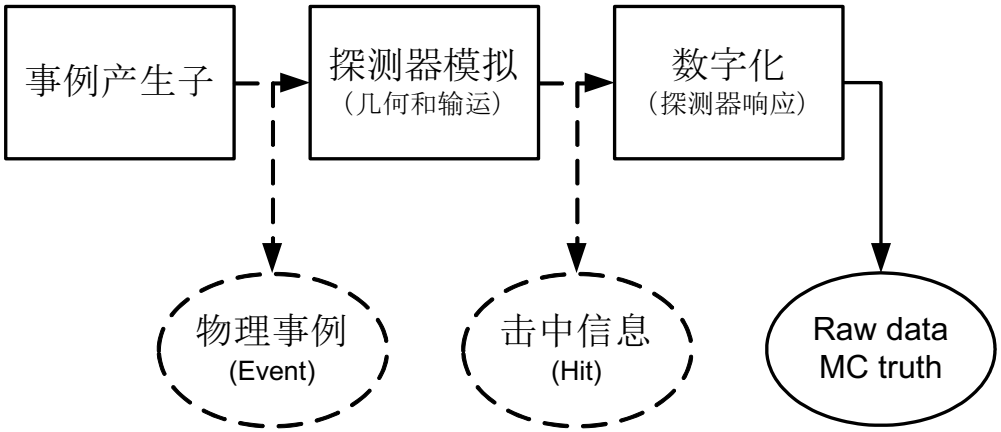
探测器模拟

探测器模拟

- BOOST(BESIII Object-Oriented Simulation Tool) 是一套基于Geant4开发的BESIII蒙特卡罗模拟软件
  - 蒙特卡罗模拟的基本思想
    - 产生符合特定概率分布的随机变量
    - 用统计方法把模型的数字特征估计出来，从而得到实际问题的数值解
  - Geant4
    - 基于C++语言和面向对象思想开发的模拟工具包，广泛应用于高能物理、核医学、辐射物理等涉及粒子与物质发生相互作用的领域

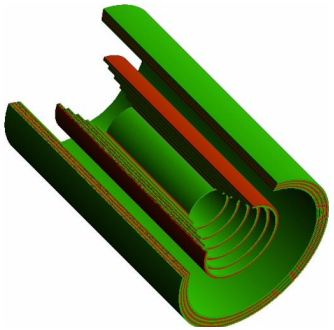
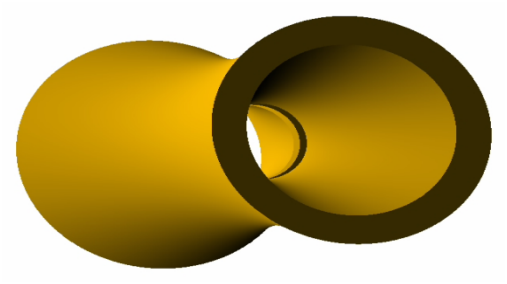
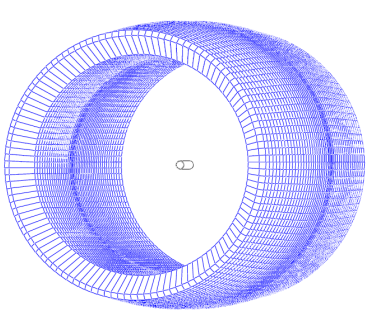
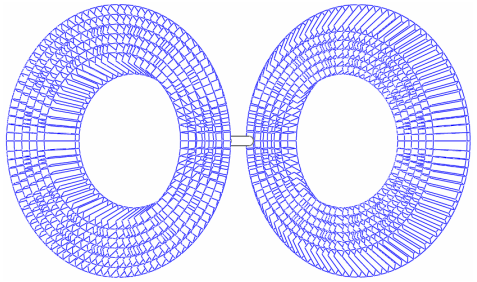
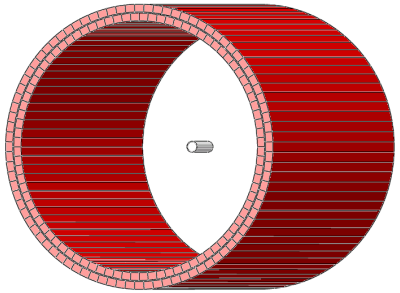
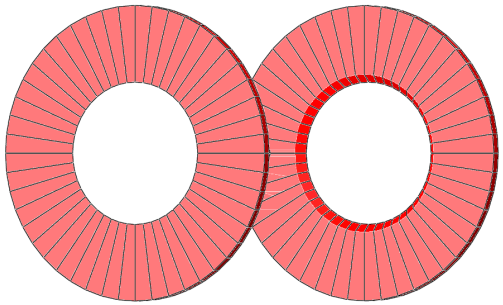
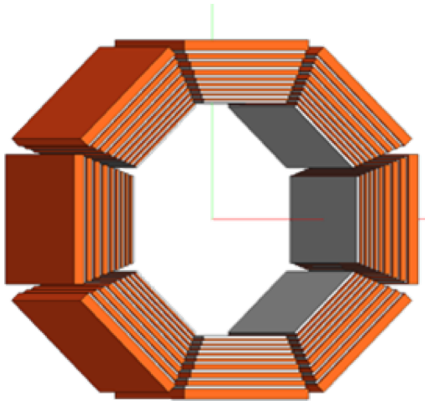
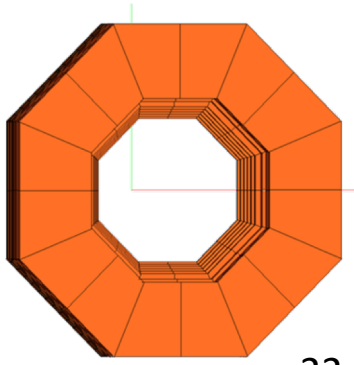
探测器模拟的过程

- 事例产生子产生物理事例，作为输入提供给探测器模拟程序
- 探测器模拟程序构造出探测器的几何结构，并模拟粒子在探测器中的输运及相互作用，同时记录下粒子在各个灵敏探测器中的击中信息
- 探测器响应程序利用击中信息，经过数字化过程以后得到的原始数据跟探测器在线取数时得到的真实数据具有相同的数据格式



BESIII探测器描述

- 探测器描述是进行探测器模拟的基础
- 完整的探测器描述包括探测器中每个几何单元的几何形状、尺寸、材料属性、图形显示属性、空间位置、几何单元之间的逻辑关系以及磁场分布等等

物理相互作用

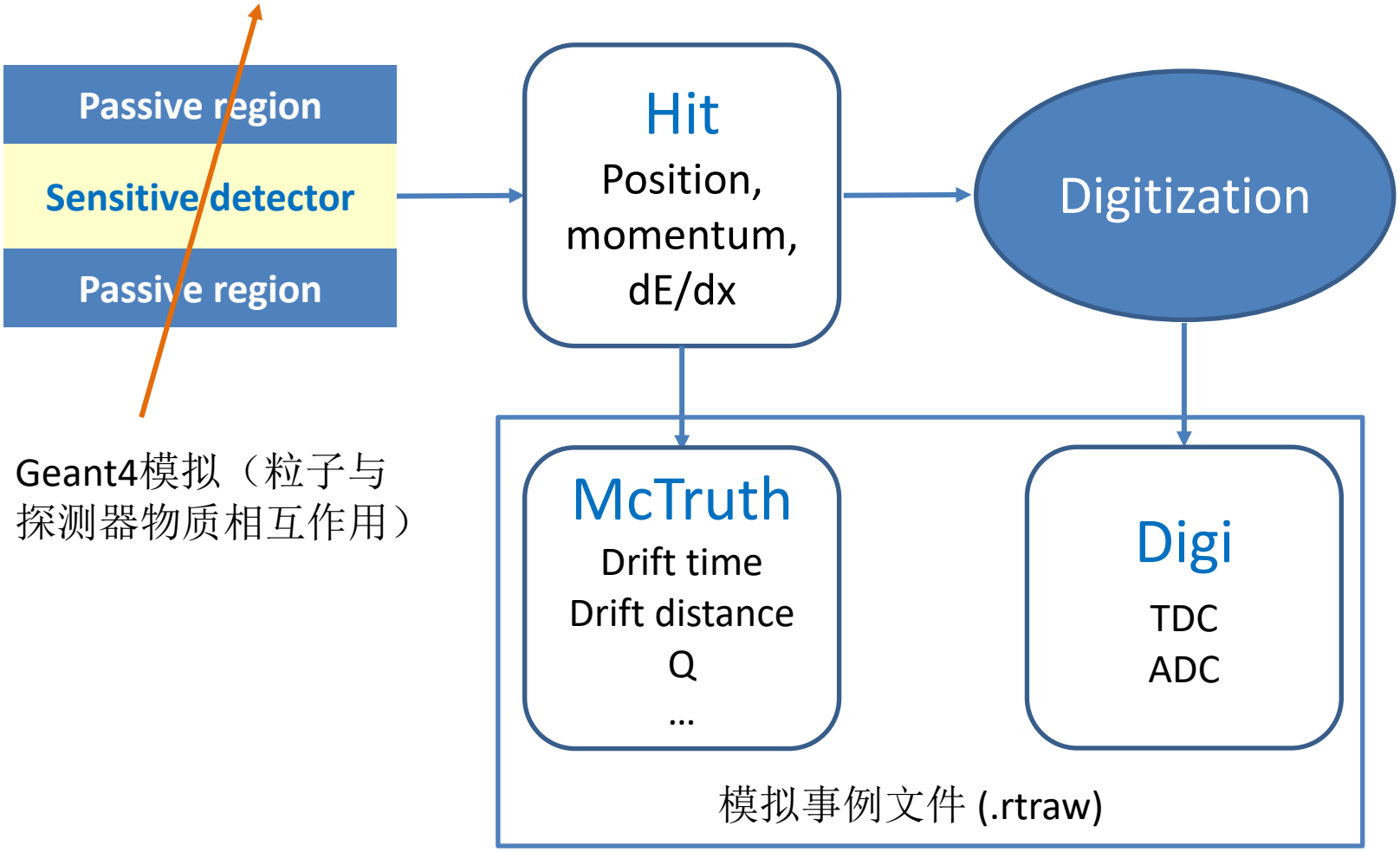
- 物理相互作用用于描述粒子与探测器物质的相互作用过程，是探测器模拟程序对粒子进行输运和跟踪的必要条件
- 物理相互作用的定义包括粒子和相互作用两部分
  - Geant4提供了各种基本粒子的定义，每个粒子的定义包含了该粒子的名称、质量、电荷、自旋等属性
  - 创建的每个粒子指定可能发生的相互作用类型
    - 输运、电磁作用、强相互作用、衰变、光学作用(Optical Photon)、以及用于快速模拟的参数化相互作用

击中信息和数字化

- 在探测器模拟过程中记录粒子在探测器中的击中信息(Hit)，然后在击中信息基础上结合探测器的实际性能进行数字化，最终得到可以跟实验数据对比的原始数据
- 击中信息
  - 以MDC为例，把每个漂移单元定义为灵敏探测器，Hit信息主要包括层号、丝号、沉积能量、飞行时间、漂移时间、漂移距离、左右、角度和位置等
- 数字化
  - 以MDC为例，为了模拟空间分辨，用双高斯分布对Hit信息中的漂移距离进行弥散。 测量时间由漂移距离经过X-T关系转换得到的漂移时间加上粒子飞行时间得到
- MC tuning: 根据数据调试数字化模型参数

探测器模拟流程

以MDC为例



Geant4模拟（粒子与探测器物质相互作用）

模拟jobOption

```
//DENG Zi-yan 2008-03-17

#include "$OFFLINEEVENTLOOPMGRROOT/share/OfflineEventLoopMgr_Option.txt"

//*************job options for generator (KKMC)***************
#include "$KKMCROOT/share/jobOptions_KKMC.txt"
KKMC.CMSEnergy = 3.097;
KKMC.BeamEnergySpread=0.0008;
KKMC.NumberOfEventPrinted=1;
KKMC.GenerateJPsi=true;

//*************job options for EvtGen***************
#include "$BESEVTGENROOT/share/BesEvtGen.txt"
EvtDecay.userDecayTableName = "rhopi.dec";

//**************job options for random number************************
BesRndmGenSvc.RndmSeed = 100;

//**************job options for detector simulation******************
#include "$BESSIMROOT/share/G4Svc_BesSim.txt"

//configure for calibration constants
#include "$CALIBSVCROOT/share/calibConfig_sim.txt"

// run ID
RealizationSvc.RunIdList = {-9989};

#include "$ROOTIOROOT/share/jobOptions_Digi2Root.txt"
RootCnvSvc.digiRootOutputFile = "rhopi.rtraw";


// OUTPUT PRINTOUT LEVEL
// Set output level threshold (2=DEBUG, 3=INFO, 4=WARNING, 5=ERROR, 6=FATAL )
MessageSvc.OutputLevel  = 5;

// Number of events to be processed (default is 10)
ApplicationMgr.EvtMax = 50;
```

产生子设置

随机数种子设置

指定run号范围

设置输出文件

decay文件

```
Decay J/psi
  0.3333 rho0 pi0 HELAMP 1.0 0.0 0.0 0.0 -1.0 0.0;
  0.3333 rho+ pi- HELAMP 1.0 0.0 0.0 0.0 -1.0 0.0;
  0.3333 rho- pi+ HELAMP 1.0 0.0 0.0 0.0 -1.0 0.0;
Enddecay

End
```

模拟jobOption

```
//DENG Zi-yan 2008-03-17

#include "$OFFLINEEVENTLOOPMGRROOT/share/OfflineEventLoopMgr_Option.txt"

//**************job options for generator (KKMC)***************
#include "$KKMCROOT/share/jobOptions_KKMC.txt"
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KKMC.BeamEnergySpread=0.0008;
KKMC.NumberOfEventPrinted=1;
KKMC.GenerateJPsi=true;

//**************job options for EvtGen***************
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EvtDecay.userDecayTableName = "rhopi.dec";

//**************job options for random number************************
BesRndmGenSvc.RndmSeed = 100;

//**************job options for detector simulation******************
#include "$BESSIMROOT/share/G4Svc_BesSim.txt"

//configure for calibration constants
#include "$CALIBSVCROOT/share/calibConfig_sim.txt"

// run ID
RealizationSvc.RunIdList = {-9989};

#include "$ROOTIOROOT/share/jobOptions_Digi2Root.txt"
RootCnvSvc.digiRootOutputFile = "rhopi.rtraw";


// OUTPUT PRINTOUT LEVEL
// Set output level threshold (2=DEBUG, 3=INFO, 4=WARNING, 5=ERROR, 6=FAT
MessageSvc.OutputLevel  = 5;

// Number of events to be processed (default is 10)
ApplicationMgr.EvtMax = 50;
```

```
ApplicationMgr.DLLs   += {"BesServices"};

#include "$REALIZATIONSVCROOT/share/jobOptions_Realization.txt"
#include "$BESSIMROOT/share/Bes_Gen.txt"
#include "$DETVERSVCROOT/share/joboptions_DetVerSvc.txt"

ApplicationMgr.DLLs += { "BesSim" };
ApplicationMgr.TopAlg += {"BesSim"};

// mdc noise model
G4Svc.MdcNoiseFile = "$MDCSIMROOT/share/run23096noise.root";

MdcTunningSvc.path_mdc = "$MDCTUNNINGSVCROOT/share/par/";

#include "$EMCSIMROOT/share/EmcSim.txt"
#include "$MUCSIMROOT/share/MucSim.txt"

G4Svc.Visualize       = false;
// interactive run mode
G4Svc.InteractiveG4 = false;

// geant4 verbosity
G4Svc.RunVerbosity    = 1;
G4Svc.EventVerbosity  = 0;
G4Svc.TrackingVerbosity = 0;

G4Svc.BesGenAction = false;

G4Svc.BoostLab = true;

// beam bunch position, unit (mm)
G4Svc.BeamPosX=0;
G4Svc.BeamPosY=0;
G4Svc.BeamPosZ=0;

// beam bunch size , unit (mm)
G4Svc.BeamSizeX=0.38;
G4Svc.BeamSizeY=0.0057;
G4Svc.BeamSizeZ=15;

// beam start time , unit (ns)
G4Svc.NBunch=3;
G4Svc.BeamStartTime=648;
G4Svc.BeamDeltaTime=8;

// beam bunch time sigma, unit (ns)
G4Svc.BunchTimeSigma = 0.02;

// Geant4 run macro file
G4Svc.FADSMacro = "$BESSIMROOT/share/run.mac";

// Magnetic field, 0: no magnetic field  1: uniform field  2: nonuniform field
BesSim.Field = 2;
#include "$MAGNETICFIELDROOT/share/MagneticField.txt"

//register MC data to TDS
BesSim.TDSFlag = true;

// PhysicsList(1:BesPhysicsList, 2:QGSP, 3:QGSP_BIC, 4:QGSP_BERT,
// 5:QGSP_BERT_HP, 6:BaBar, 7:CHIPS, 8:QBBC, 9:QGSP_BERT_CHIPS) default: QGSP_BERT_CHIPS
BesSim.PhysicsList = 9;

//realization
RealizationSvc.IfUseTrg = false;

#include "$EVENTNAVIGATORROOT/share/EventNavigator.txt"
```

boost设置

束团参数设置

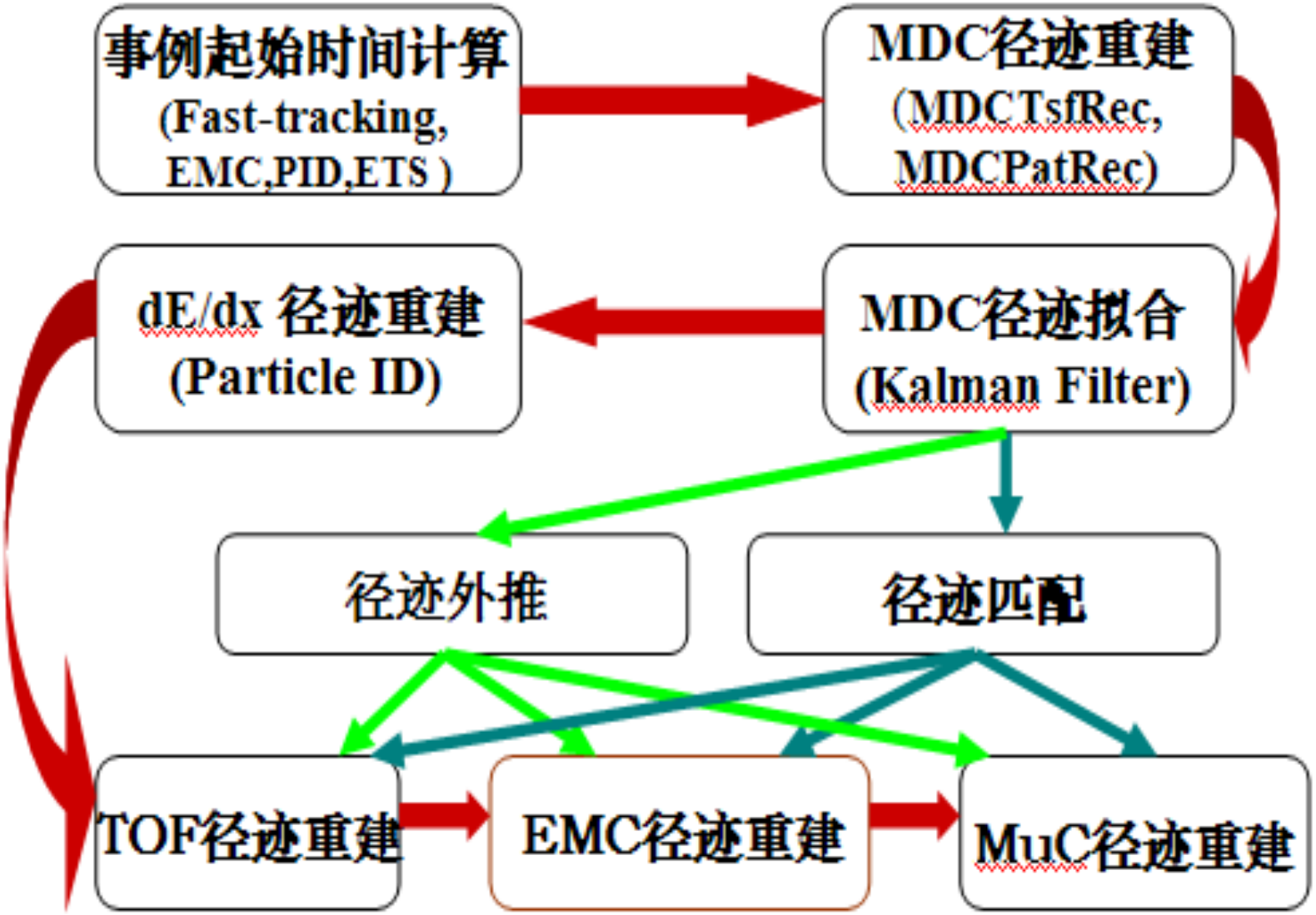
磁场设置

事例重建

BESIII事例重建软件包

子探测器	软件包	功能
MDC	MdcFastTrkAlg	MDC快重建
	MdcPatRec	基于模板匹配的MDC寻迹软件包
	MdcTsfRec	基于共形变换方法的MDC寻迹、CurlFinder低动量寻迹、runge-kutta拟合
	MdcHoughFinder	使用Hough变换方法寻迹
	KalFitAlg	基于Kalman滤波方法进行径迹拟合
	MdcDedxAlg	dE/dx重建
TOF	TofRec	TOF重建
	TofEnergyRec	TOF能量重建
EMC	EmcRec	EMC重建
MUC	MucRec	MUC重建
其它	EsTimeAlg	事例起始时间重建
	TrkExtAlg	径迹外推
	PrimaryVertexAlg	事例初级顶点重建
	VeeVertexAlg	次级顶点重建

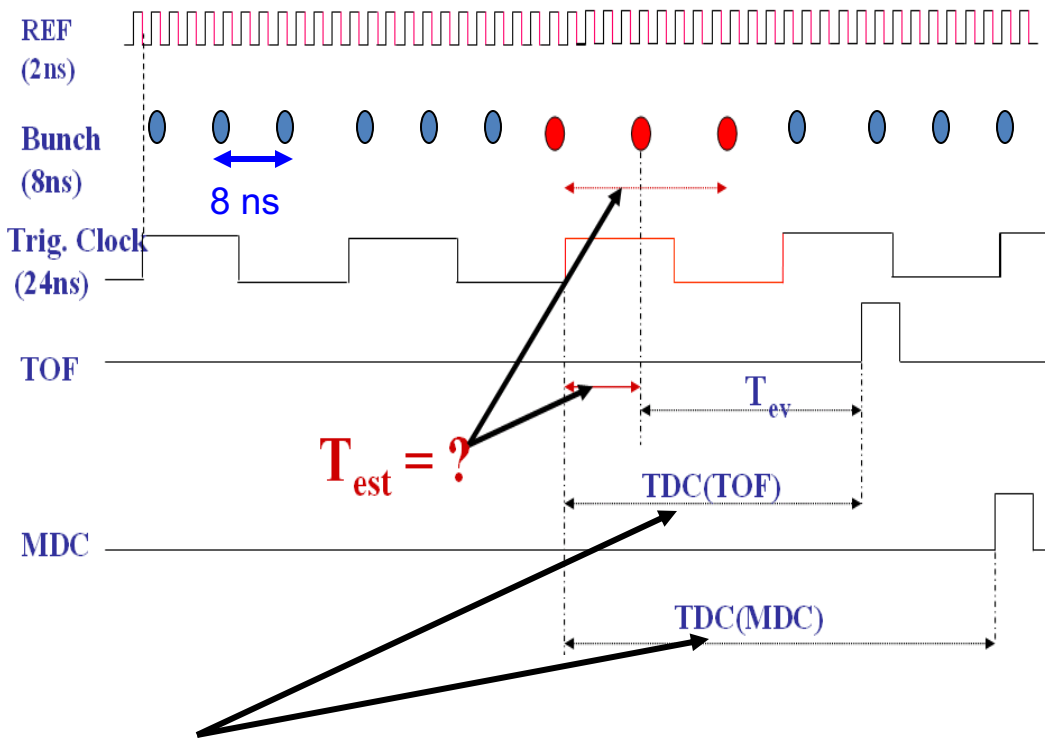
BESIII事例重建流程



事例起始时间（Event Start Time T_{est}）

RF 499.8MHz
2ns

Trigger/DAQ Clock 24ns

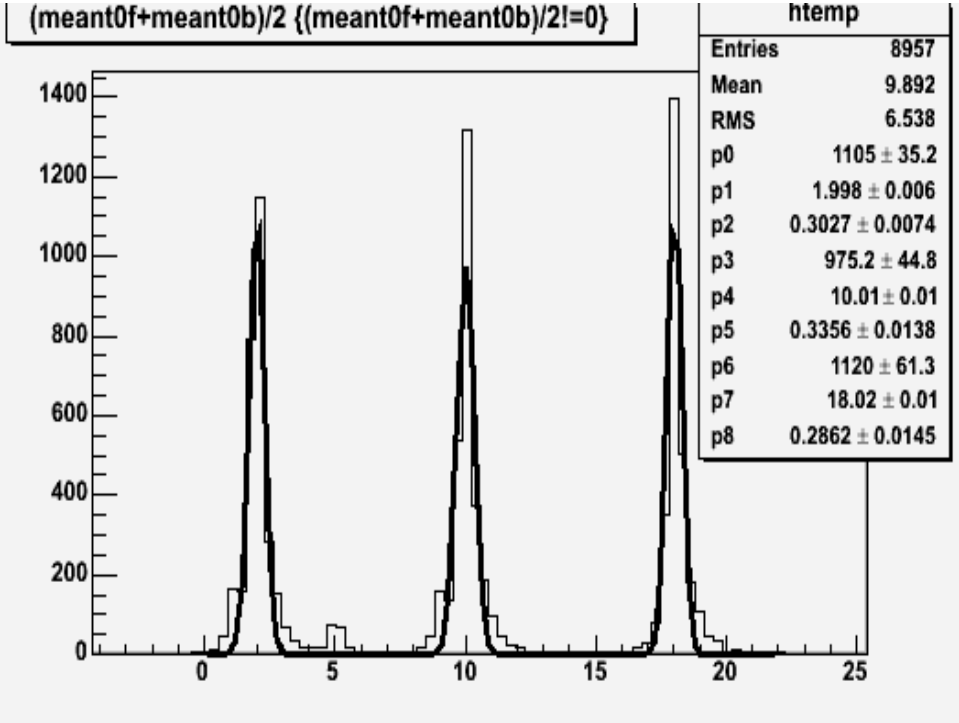


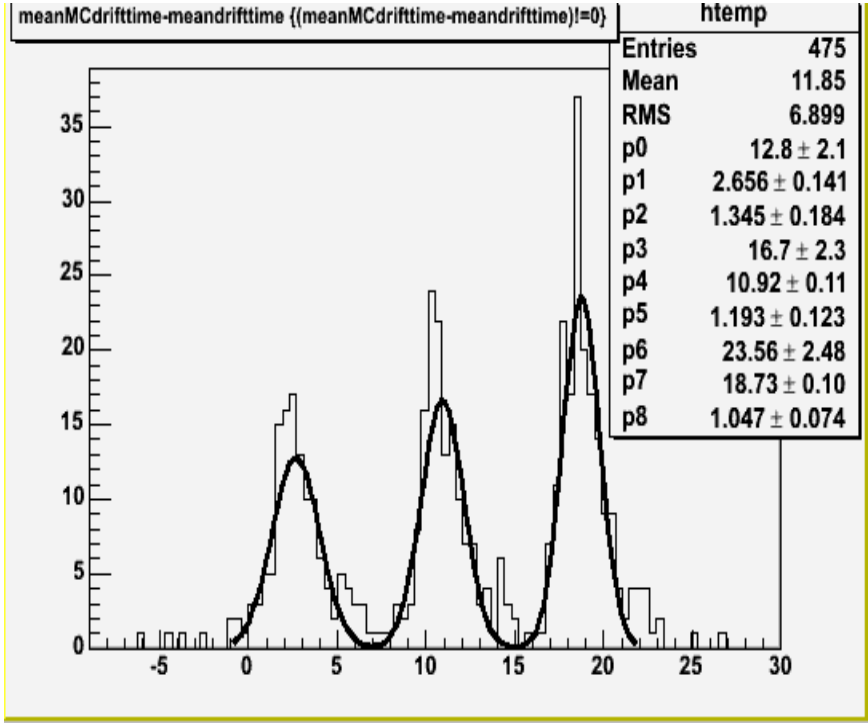
$$TDC = T_{ev} + T_{est}$$

$T_{est} = ?$ ← determined from offline data

T_{est}的确定

"hadrons", 10000, set T_{est} to "2","10","18"





By TOF

T_{est}: 1.998 ns σ: 0.30ns

T_{est}: 10.01 ns σ: 0.33ns

T_{est}: 18.02 ns σ: 0.29ns

By MDC

T_{est}: 2.6ns, σ: 1.4ns

T_{est}: 10.9ns, σ: 1.3ns

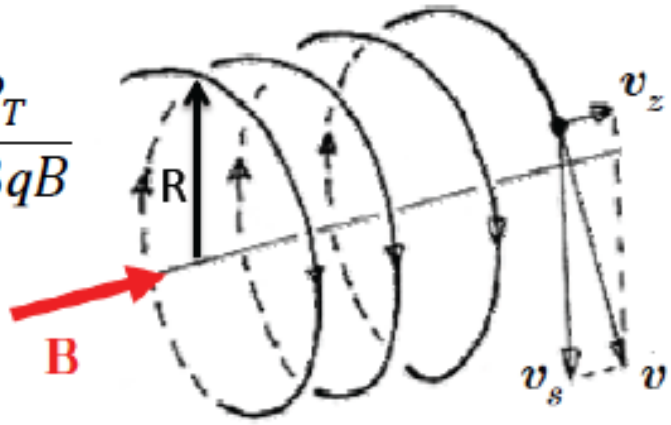
T_{est}: 18.7ns, σ: 1.1ns

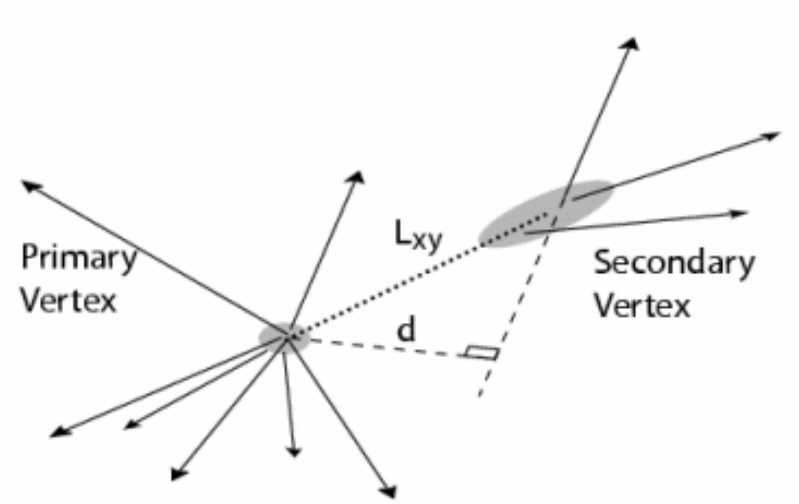
径迹重建

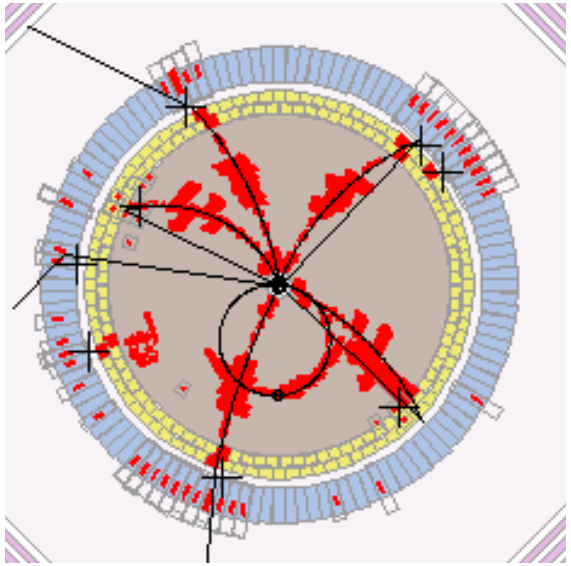
目的

- 顶点测量
- 动量测量
- 径迹外推与匹配

$$R = \frac{P_T}{0.3qB}$$

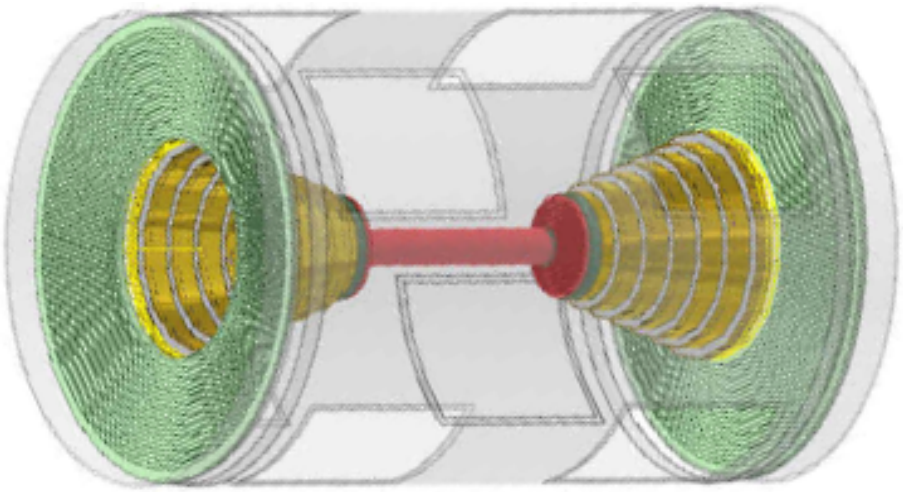






MDC径迹重建

BESIII漂移室 (MDC)



径迹寻找

PAT

TSF

Curlfinder

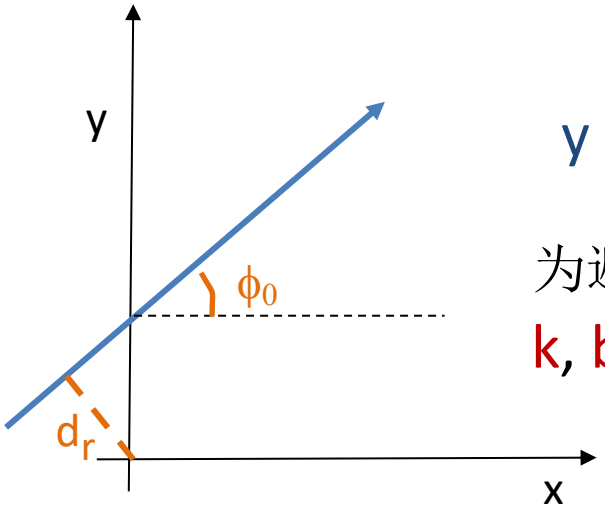
Hough transform

径迹拟合

Runge-Kutta fitting

Kalman fitting

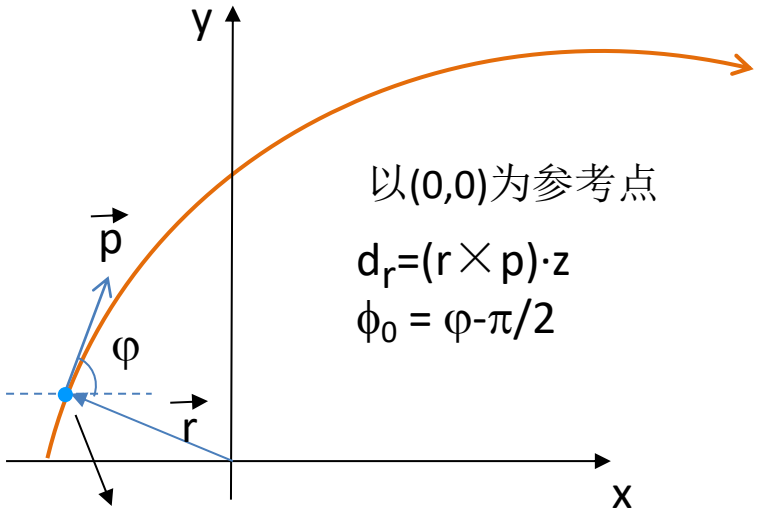
径迹参数



$y = kx + b$

为避免k无穷大

$k, b \rightarrow d_r, \phi_0$



以(0,0)为参考点

$d_r = (r \times p) \cdot z$

$\phi_0 = \varphi - \pi/2$

Poca (point of closest approach)

5个helix参数

d_r：螺旋线在x-y平面上的投影与参考点的距离 **ϕ_0**：参考点与螺旋线中心连线的方位角 **κ**：横动量的倒数 (1/Pt)，符号反映粒子电荷的正负	圆参数
d_z：z方向上螺旋线离参考点的距离 (poca点的z坐标) **tanλ**：λ为螺旋线与x-y平面的夹角	z向相关

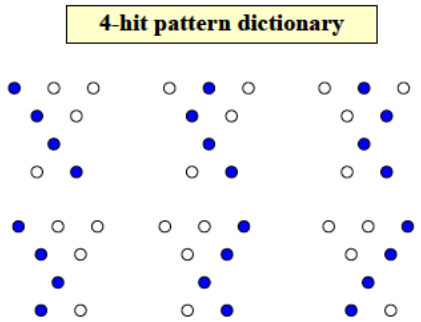
$$R = \frac{P_T}{0.3qB}$$

$P = P_T/\cos\lambda$

径迹寻找

- 目的：通过模式识别从原始数据中找出带电径迹及其击中
- 方法
  - PAT：模版匹配方法
  - TSF：共形变换方法
  - CurlFinder：低动量打圈径迹寻找算法
  - Hough变换：使用Hough变换方法寻迹

PAT算法中的模式字典



共形变换：将经过原点的圆变换为直线

圆方程

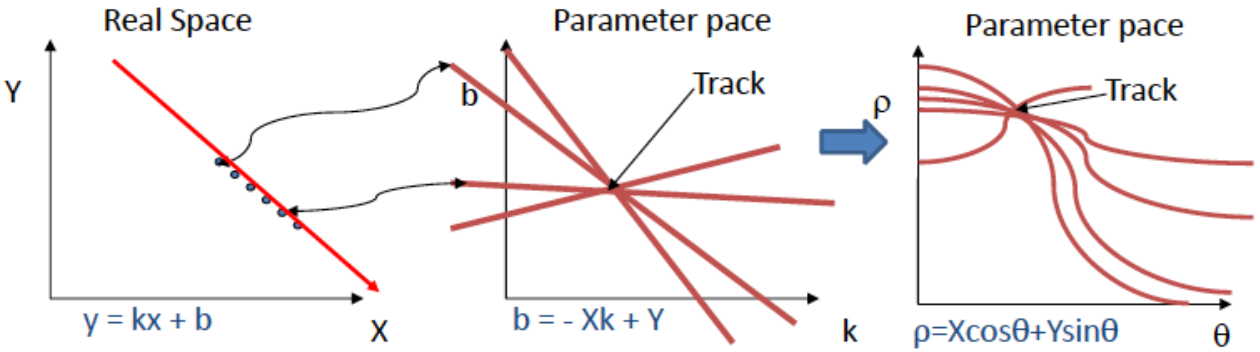
$(x-x_c)^2 + (y-y_c)^2 = r^2$

$X = 2x/(x^2+y^2)$

$Y = 2y/(x^2+y^2)$

Hough变换

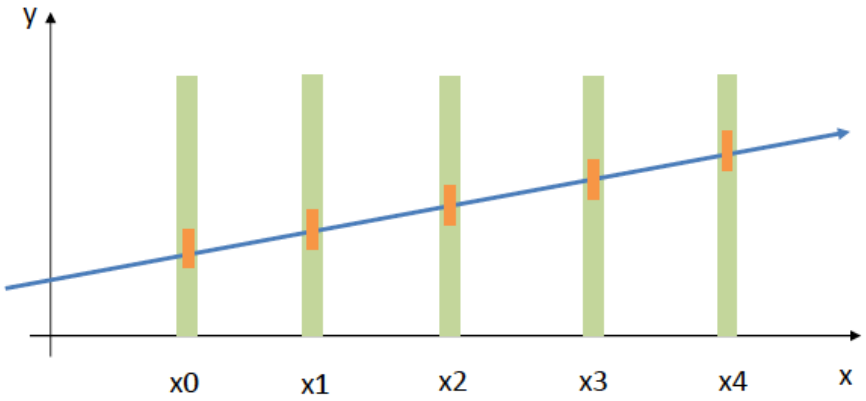
将击中变换到参数平面寻找径迹



最小二乘法径迹拟合

简单例子：二维直线拟合

$$\chi^2 = \sum_{i=1}^{N} \frac{(y_i - (kx_i + b))^2}{\sigma_i^2}$$



三维径迹拟合

$$\chi^2 = \sum_{i=1}^{N_{hit}} \frac{(d_{meas}^{(i)} - d_{track}^{(i)})^2}{\sigma_i^2}$$

d_{meas}：径迹与信号丝间的测量距离

d_{track}：拟合径迹与信号丝的距离

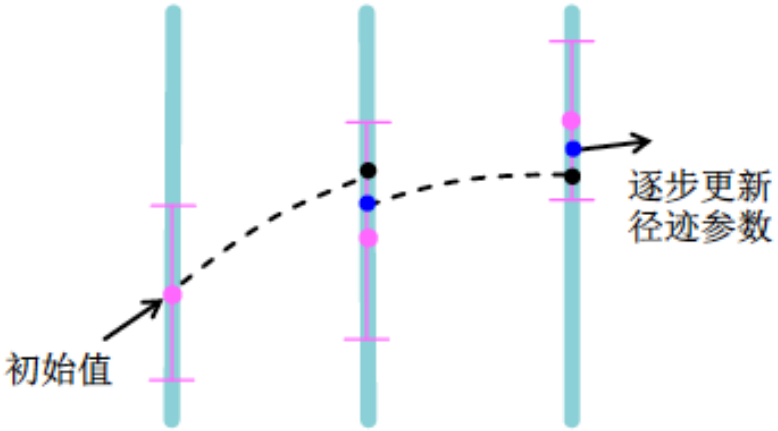
σ_i：该测量点的误差（空间分辨）

- 将径迹按理想螺旋线处理，无法考虑磁场不均匀、dE/dx、多次散射等效应，拟合精度有限
- 用于径迹寻找算法，给出径迹参数初值

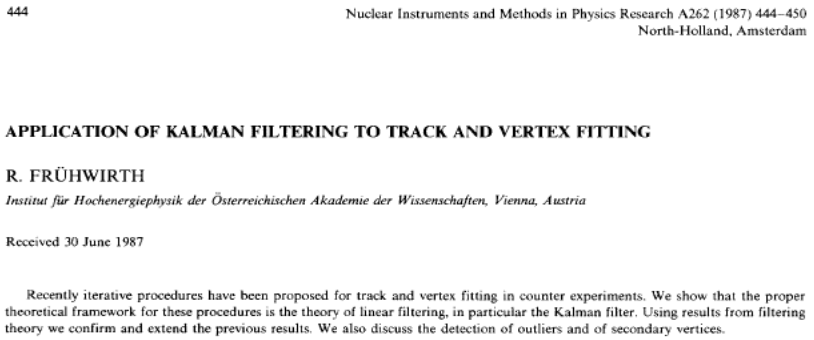
Kalman滤波方法的径迹拟合

- 基于最小二乘拟合，递推估计径迹参数
- 便于考虑考虑磁场不均匀、dE/dx、多次散射等效应，给出精确的径迹拟合结果

卡尔曼获奥巴马总统授予美国国家科学奖章(2009)



- 预测值（考虑磁场不均匀、多次散射等效应）
- 测量值（带误差）
- 更新后的值



444 Nuclear Instruments and Methods in Physics Research A262 (1987) 444–450
North-Holland, Amsterdam

APPLICATION OF KALMAN FILTERING TO TRACK AND VERTEX FITTING

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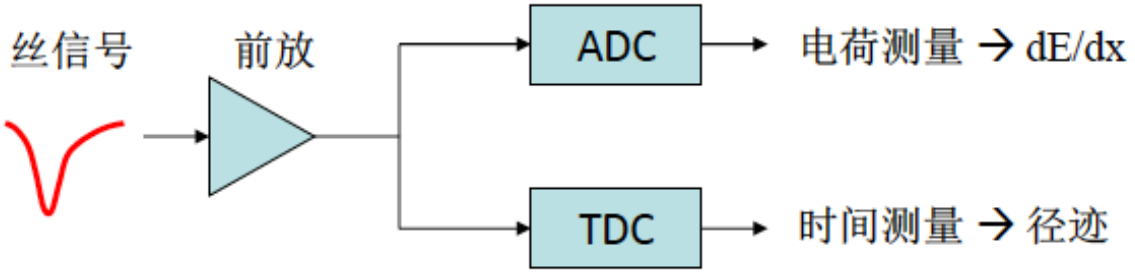
Received 30 June 1987

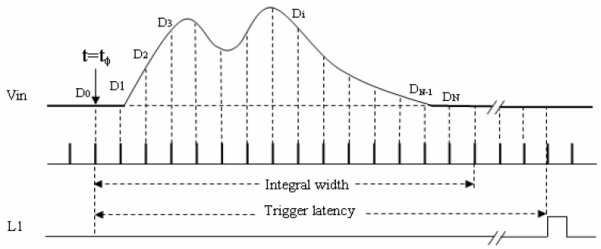
Recently iterative procedures have been proposed for track and vertex fitting in counter experiments. We show that the proper theoretical framework for these procedures is the theory of linear filtering, in particular the Kalman filter. Using results from filtering theory we confirm and extend the previous results. We also discuss the detection of outliers and of secondary vertices.

卡尔曼滤波被引入高能物理，应用于径迹拟合、顶点拟合、探测器校准等方面

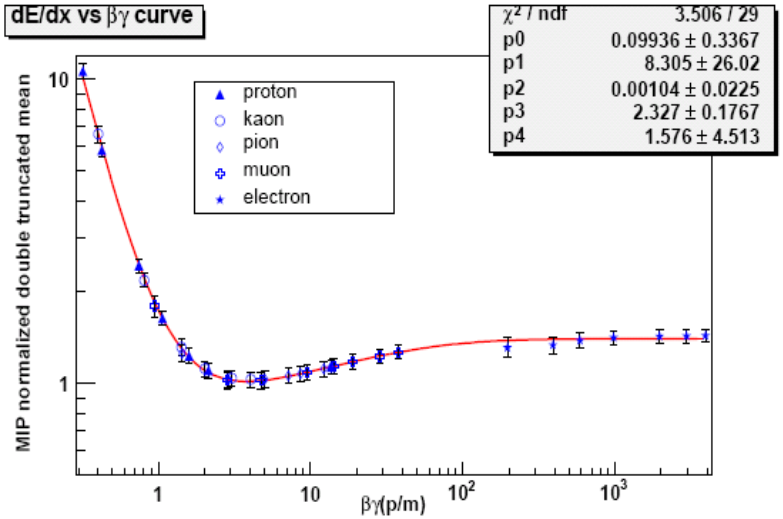
能量损失(dE/dx)测量



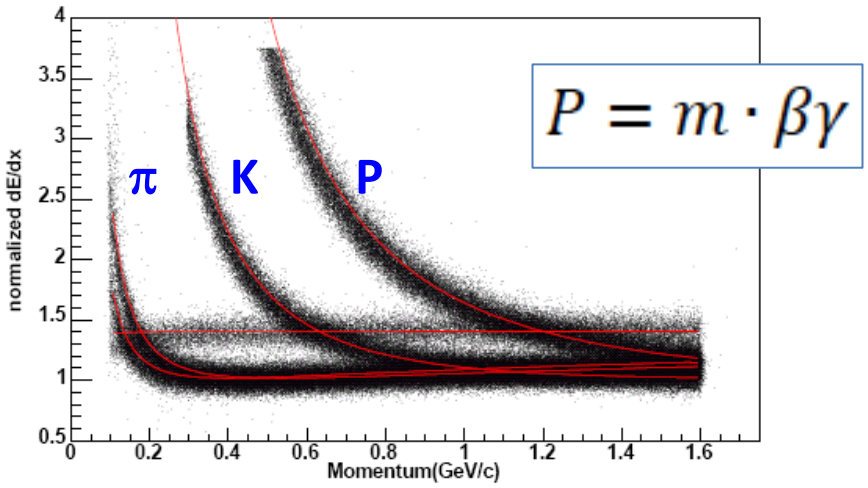
基于FADC数值积分方法
进行电荷测量



Bethe-Bloch 曲线



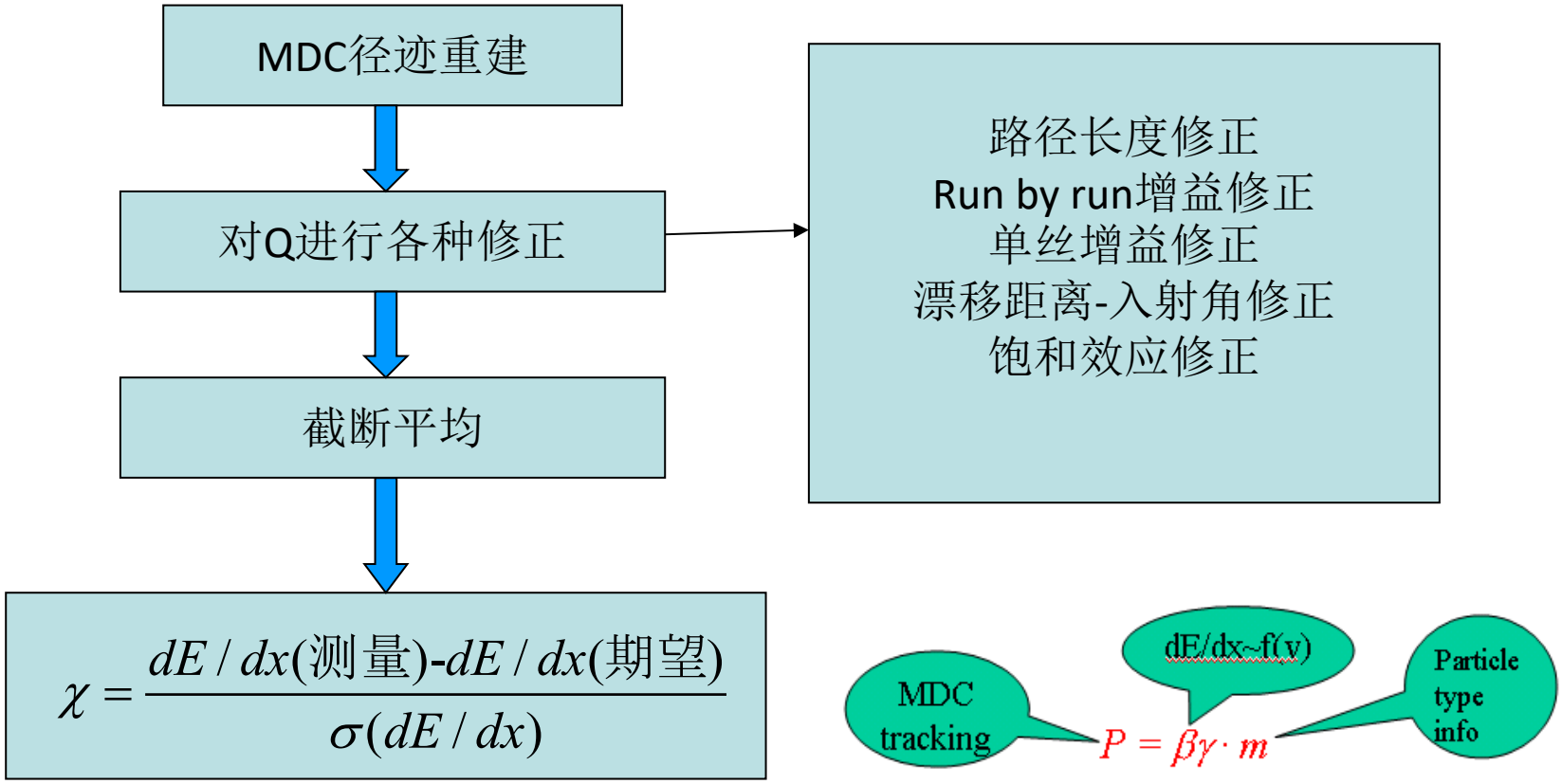
$$\chi = \frac{dE/dx(\text{测量}) - dE/dx(\text{期望})}{\sigma(dE/dx)}$$



$$P = m \cdot \beta\gamma$$

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

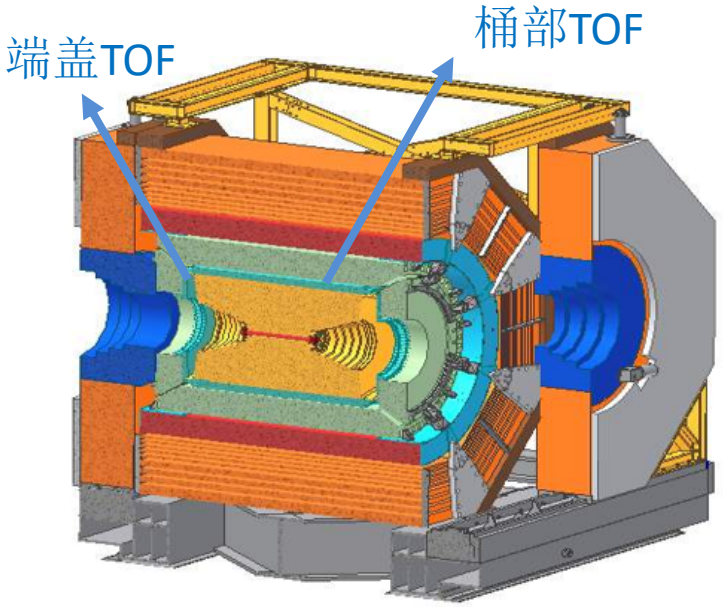
dE/dx重建流程

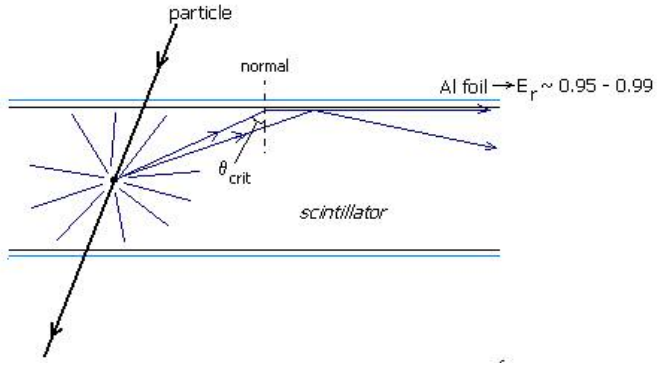


- 根据不同粒子的假设得到不同的χ值，比较χ值大小，可以得到该粒子属于某种粒子的几率，从而实现粒子鉴别

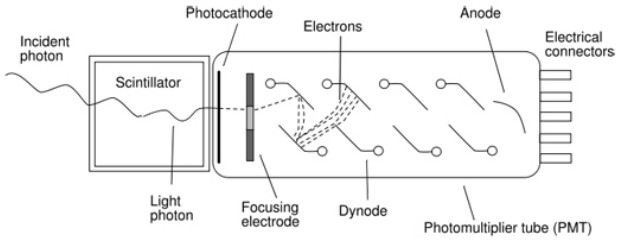
TOF重建

- 利用粒子击中TOF的信息计算粒子的飞行时间等物理量，供粒子鉴别使用
- 步骤
  - 利用电子学记录的脉冲幅度的粗时钟的信息进行T-Q匹配
  - 对于桶部TOF再进行闪烁体两端光电倍增管读出信息的匹配
  - 利用带电径迹的外推击中信息与TOF测量的信号进行匹配
  - 进行各项修正(Q、z依赖等)，得到粒子的飞行时间等信息

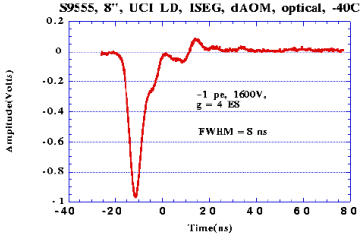




PMT：PhotonMultiplier Tube



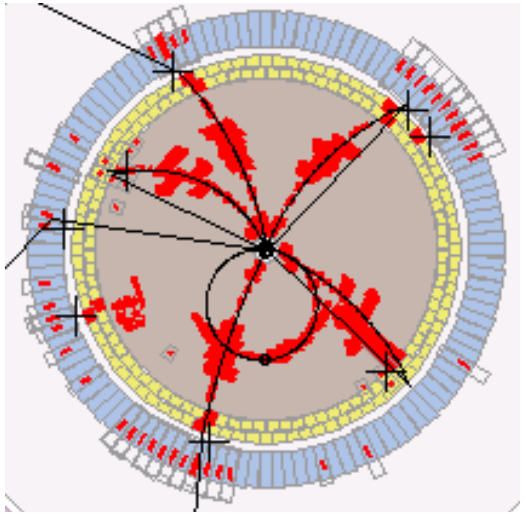
PMT 输出信号



TOF 粒子鉴别的原理

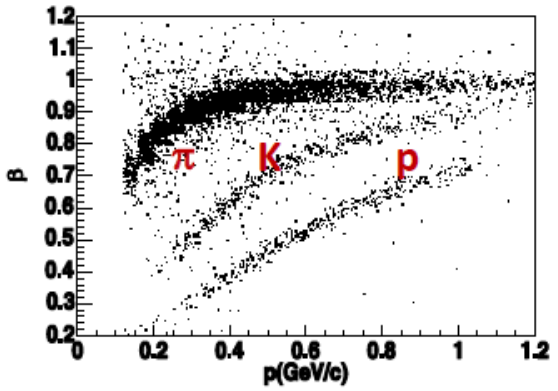
- 利用径迹探测器得到的粒子的动量p，飞行距离L，和假设的粒子质量➔预期时间

$$t^{i}_{predict} = \frac{L}{c\cdot\beta_i},\quad \beta_i = \frac{|\vec{p}|c}{E_i},\quad E_i = \sqrt{m_i^2 + p^2}$$



- 比较测量时间与预期时间差，实现粒子鉴别

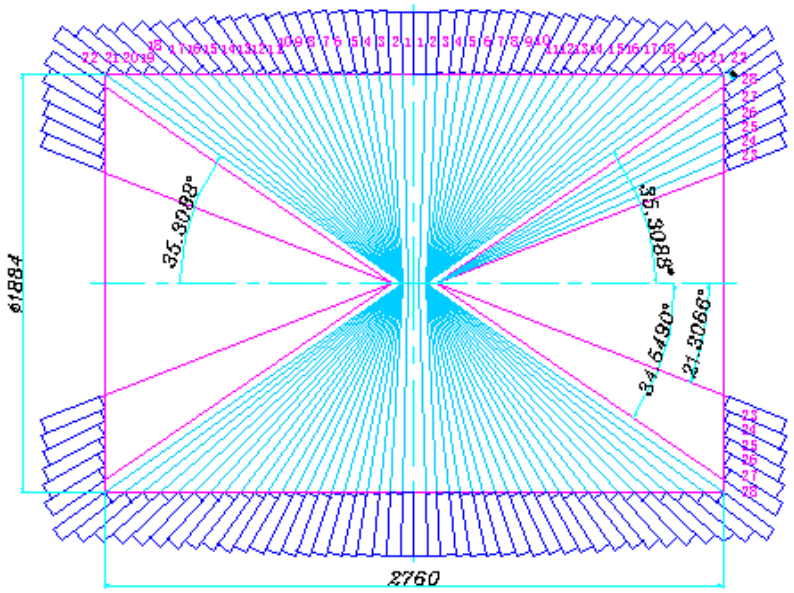
$$\chi^2 = \frac{(t_{measure} - t^{i}_{predict})^2}{\sigma^2}$$ ➔ 正态分布

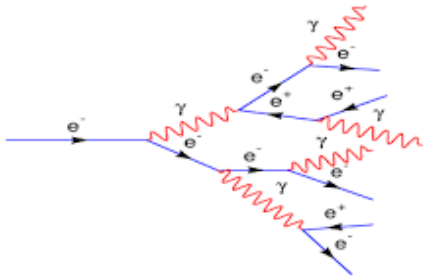


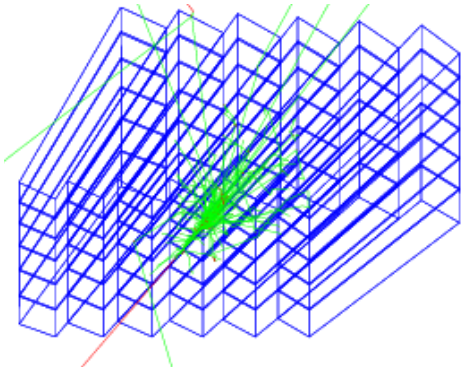
- 在粒子动量，磁场大小和探测器几何确定的情况下，粒子鉴别能力由时间分辨决定

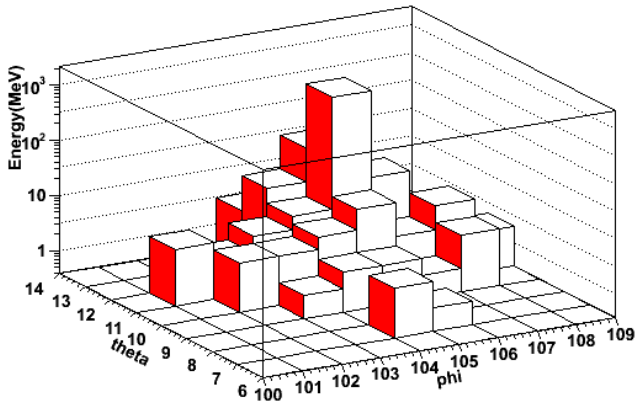
电磁量能器 (EMC)

一个高能电子或光子进入量能器后，将与晶体发生相互作用。光子通过电子对转换变为一对正负电子，电子又可以通过韧致辐射释放出光子，这两种作用交替进行，形成电磁簇射。电磁簇射在晶体中横向和纵向发展，把能量损失在一系列相邻的晶体中。量能器的重建算法，就是要寻找这些相邻的晶体，进而计算入射粒子的总能量和击中位置。

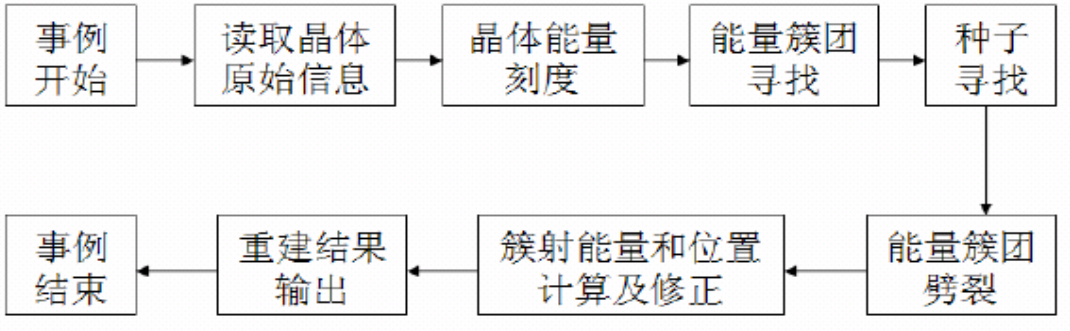


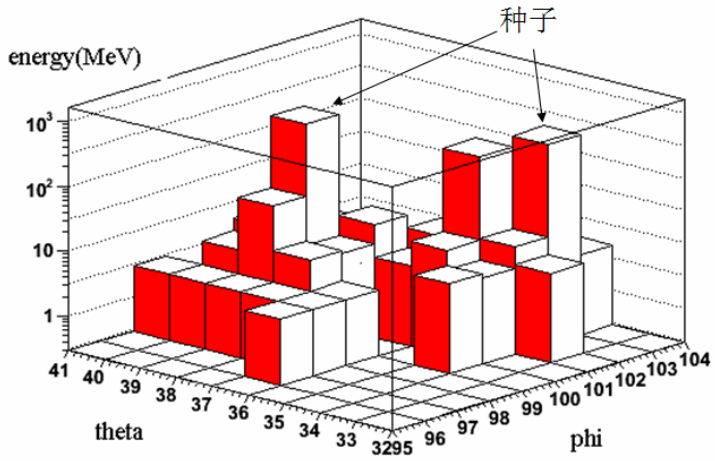




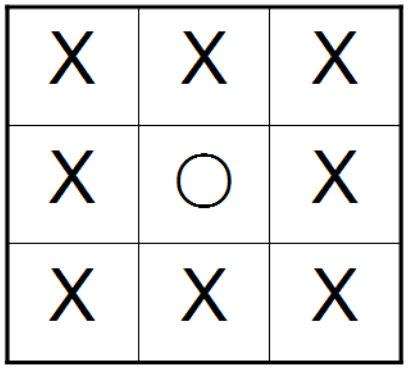


EMC重建

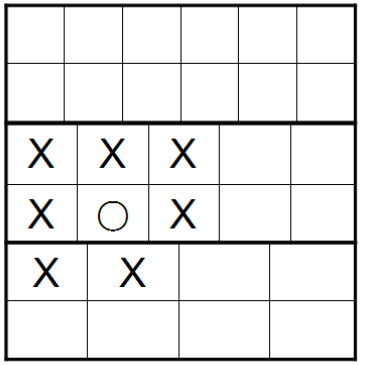




- 能量簇团寻找：一系列能量沉积大于某个阈值的相邻晶体的集合。
- 簇团劈裂：
  - 寻找种子：沉积能量的极大值
  - 按种子个数劈裂成一个或多个簇射，一个簇射对应一个入射粒子

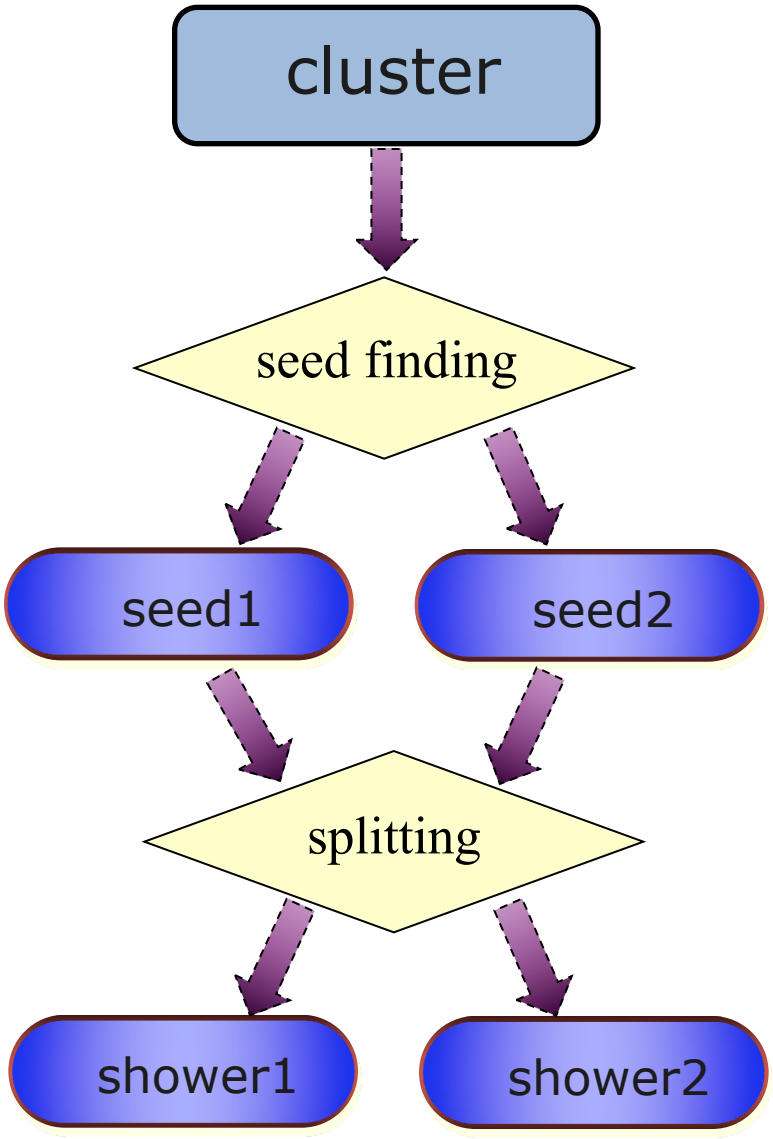


桶部相邻晶体定义

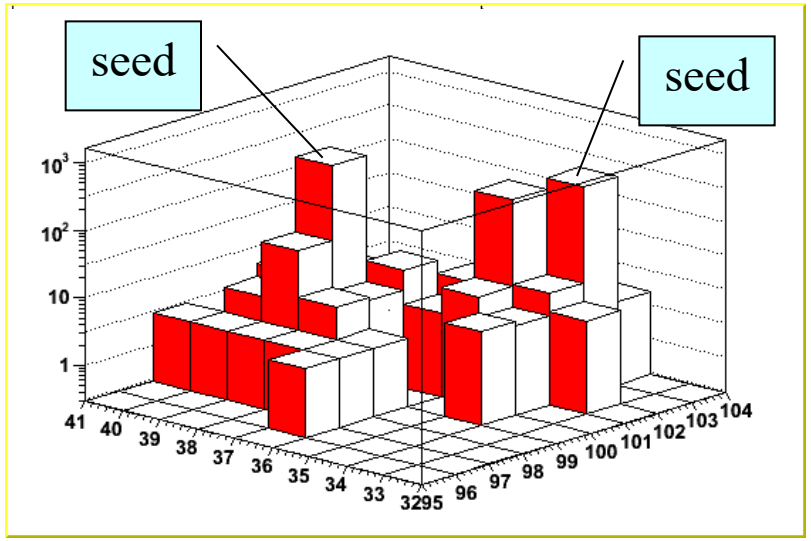


端盖相邻晶体定义

簇射团的劈裂

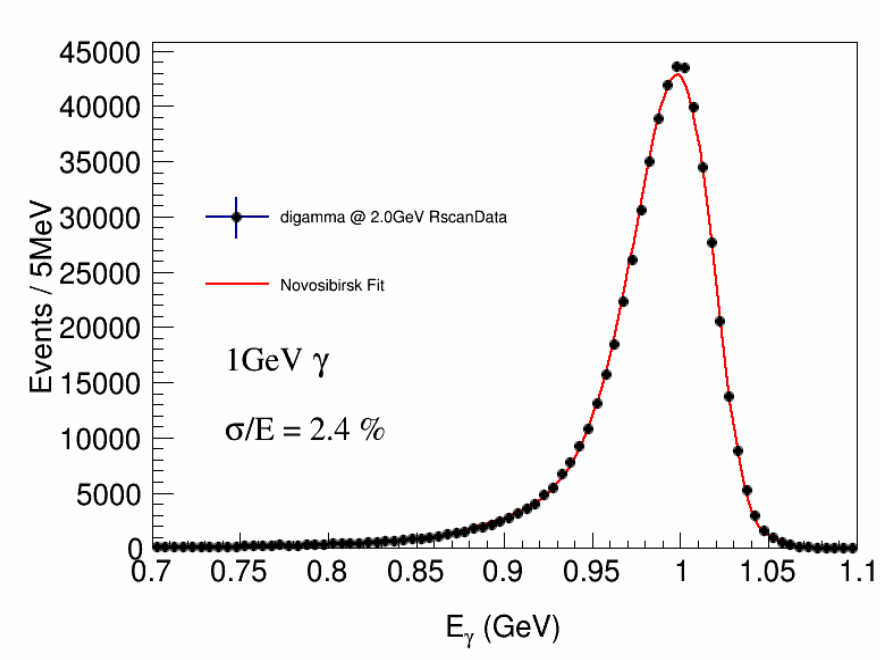


- 种子：局域最大
- 如果只有一个种子，只有一个簇射
- 如果存在多个种子，存在多个簇射，每个晶体对多个簇射都有贡献。



簇射能量计算

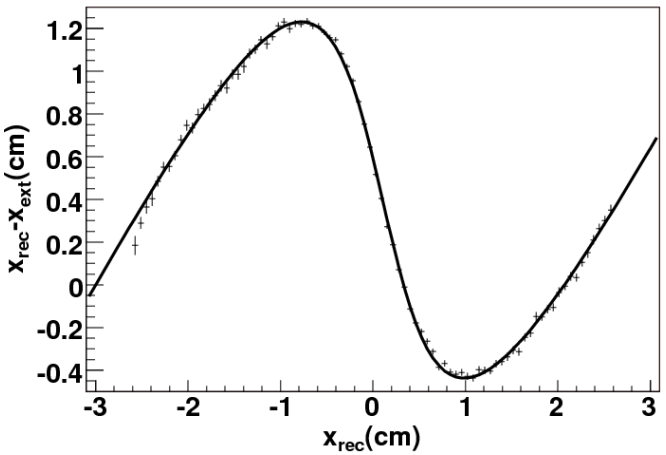
- 对簇射中所有晶体能量求和就得到了簇射的能量。不过参与求和的晶体数越多，簇射所包含的噪声也越多，这样会降低能量分辨。由于电磁簇射能量沉积比较集中，通常表示为种子周围9块晶体能量求和，称为e3×3；或25块晶体能量求和，称为e5×5。根据BESIII实际的噪声水平，目前默认采用e5×5作为簇射的能量。



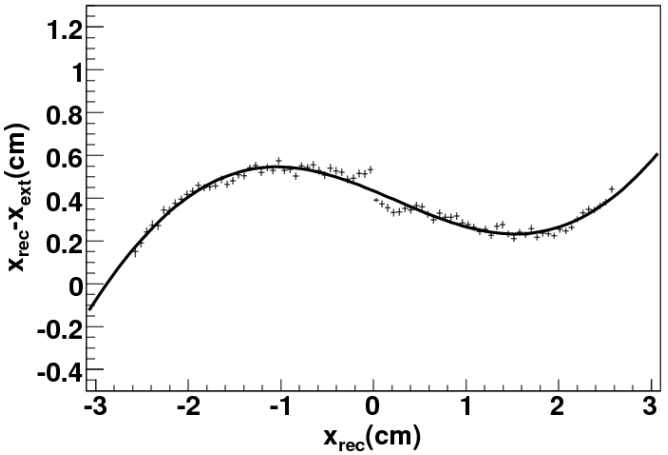
簇射位置修正

- **加权平均** $x_c = \sum_j^N w_j(E_j)x_j \Big/ \sum_j^N w_j(E_j)$
- **线性权重** $w_j^{(linear)}(E_j) = E_j$
- **对数权重** $w_j^{(log)}(E_j) = Max\{0, a_0 + \ln(E_j) - \ln(E_{tot})\}$
- **位置修正**
  - **修正粒子打到晶体表面不同位置带来的偏差**
  - **用bhabha事例，根据漂移室的径迹外推信息进行修正**
  - **修正公式**：$\Delta x = p_0 \times \arctan(p_1 \times x + p_3) + p_2 \times x + p_4$

线性权重函数

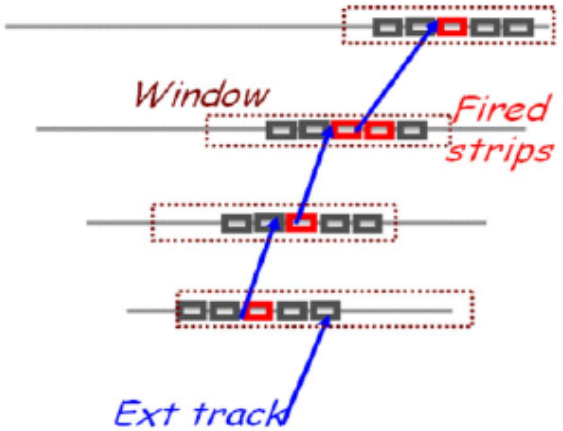


对数权重函数

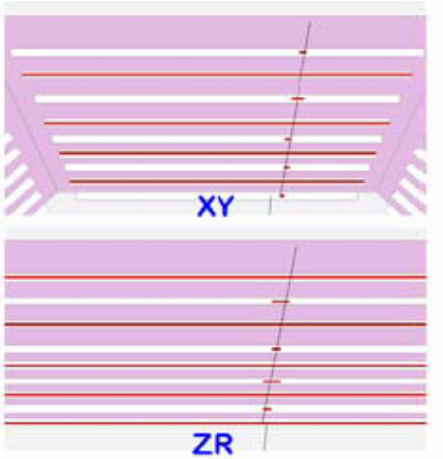


MUC 重建

- 主要任务：将击中信息构建成径迹，提供径迹的方向、位置、穿透深度等信息，供μ鉴别使用
- 重建步骤：几何构建、径迹寻找、径迹拟合、径迹参量计算
- 三种径迹寻找算法
  - 漂移室径迹外推算法：主要用于带电粒子重建
  - 自重建算法：适用于各种粒子，但对穿透层数有要求
  - EMC击中或MUC击中联合对撞点外推算法：主要用于中性粒子重建



MDC径迹外推

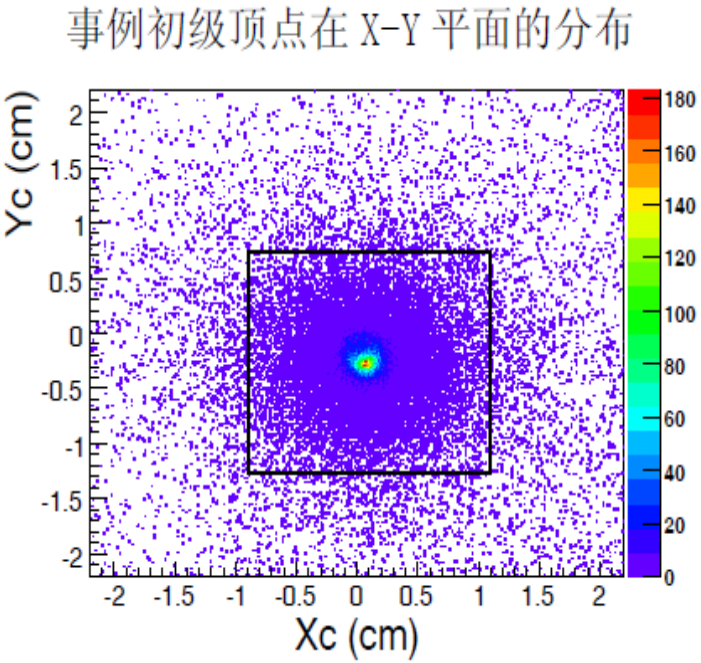


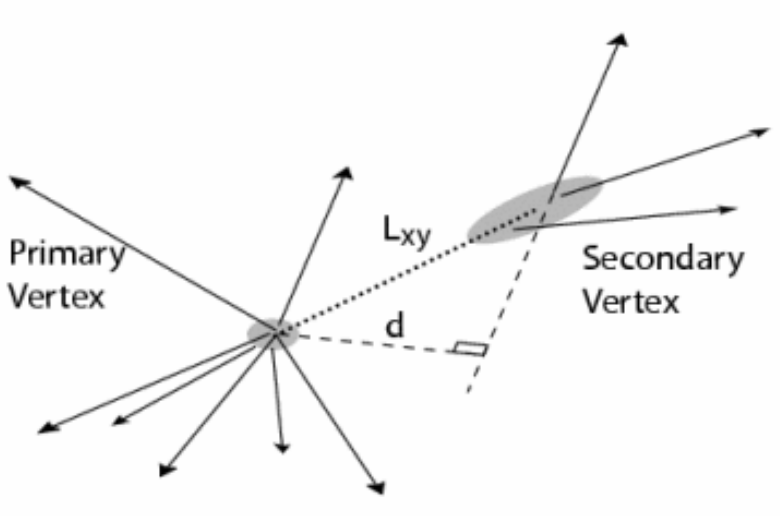
自重建

事例顶点重建

- 在高亮度条件下，高精度的物理分析要求能够在大量的末态带电粒子径迹中精确区分它们来自于事例的初级顶点还是次级顶点
- 初级顶点：位于对撞点，其分布依赖于对撞束团的形状
- 次级顶点：主要是Ks和Λ Λbar 的衰变点，其相对于事例对撞点有一定的飞行距离

```
#include "$PRIMARYVERTEXALGROOT/share/jobOptions_kalman.txt"
#include "$VEEVERTEXALGROOT/share/jobOptions_veeVertex.txt"
```





重建jobOption (1)

```
//input data
#include "$RAWDATACNVROOT/share/ReadRawDatajobOptions.txt"
#include "$TRIGMAKERALGROOT/share/jobOptions_TrigMakerAlg.txt"
#include "$OFFLINEEVENTLOOPMGRROOT/share/OfflineEventLoopMgr_Option.txt"
#include "$CALIBSVCROOT/share/job-CalibData.txt"
#include "$MAGNETICFIELDROOT/share/MagneticField.txt"
#include "$ESTIMEALGROOT/share/job_EsTimeAlg.txt"

// PAT+TSF+HOUGH method for MDC reconstruction
#include "$MDCHOUGHFINDERROOT/share/jobOptions_MdcPatTsfHoughRec.txt"

#include "$KALFITALGROOT/share/job_kalfit_numf_data.txt"
#include "$MDCDEDXALGROOT/share/job_dedx_all.txt"
#include "$TRKEXTALGROOT/share/TrkExtAlgOption.txt"
#include "$TOFRECROOT/share/jobOptions_TofRec_Data.txt"
#include "$TOFENERGYRECROOT/share/TofEnergyRecOptions_Data.txt"
#include "$EMCRECROOT/share/EmcRecOptions.txt"
#include "$EMCTIMERECROOT/share/EmcTimeRecOptions.txt"

#include "$MUCRECALGROOT/share/jobOptions_MucRec.txt"

#include "$HLTMAKERALGROOT/share/jobOptions_HltMakerAlg.txt"

#include "$EVENTASSEMBLYROOT/share/EventAssembly.txt"
#include "$PRIMARYVERTEXALGROOT/share/jobOptions_kalman.txt"
#include "$VEEVERTEXALGROOT/share/jobOptions_veeVertex.txt"

//output ROOT DST data
#include "$ROOTIOROOT/share/jobOptions_Dst2Root_data.txt"

//configure for calibration constants
#include "$CALIBSVCROOT/share/calibConfig_rec_data.txt"


//Set output level threshold (2=DEBUG, 3=INFO, 4=WARNING, 5=ERROR, 6=FATAL )
MessageSvc.OutputLevel = 5;

//input data file
RawDataInputSvc.InputFiles={"/bes3fs/offline/data/raw/round02/090307/run_0008093_All_file040_SFO-1.raw"};

//output data file
RootCnvSvc.digiRootOutputFile ="run.dst";

//Number of events to be processed (default is 10)
ApplicationMgr.EvtMax = 50;
```

框架设置

磁场设置

子探测器重建

输出文件类型设置 (dst 或 rec)

输入文件

输出文件

重建jobOption (2)

重建模拟事例

```
//input ROOT MC data
#include "$ROOTIOROOT/share/jobOptions_ReadRoot.txt"
#include "$OFFLINEEVENTLOOPMGRROOT/share/OfflineEventLoopMgr_Option.txt"

// background mixing
#include "$BESEVENTMIXERROOT/share/jobOptions_EventMixer_rec.txt"

#include "$CALIBSVCROOT/share/job-CalibData.txt"
#include "$MAGNETICFIELDROOT/share/MagneticField.txt"
#include "$ESTIMEALGROOT/share/job_EsTimeAlg.txt"

// PAT+TSF+HOUGH method for MDC reconstruction
#include "$MDCHOUGHFINDERROOT/share/jobOptions_MdcPatTsfHoughRec.txt"

#include "$KALFITALGROOT/share/job_kalfit_numf_data.txt"
#include "$MDCDEDXALGROOT/share/job_dedx_all.txt"
#include "$TRKEXTALGROOT/share/TrkExtAlgOption.txt"
#include "$TOFRECROOT/share/jobOptions_TofRec.txt"
#include "$TOFENERGYRECROOT/share/TofEnergyRecOptions_MC.txt"
#include "$EMCRECROOT/share/EmcRecOptions.txt"
#include "$MUCRECALGROOT/share/jobOptions_MucRec.txt"

#include "$EVENTASSEMBLYROOT/share/EventAssembly.txt"
#include "$PRIMARYVERTEXALGROOT/share/jobOptions_kalman.txt"
#include "$VEEVERTEXALGROOT/share/jobOptions_veeVertex.txt"

#include "$HLTMAKERALGROOT/share/jobOptions_HltMakerAlg.txt"
#include "$EVENTNAVIGATORROOT/share/EventNavigator.txt"

//output ROOT REC data
#include "$ROOTIOROOT/share/jobOptions_Dst2Root.txt"

//configure of calibration constants for MC
#include "$CALIBSVCROOT/share/calibConfig_rec_mc.txt"


//**************job options for random number**************************
BesRndmGenSvc.RndmSeed = 100;

//Set output level threshold (2=DEBUG, 3=INFO, 4=WARNING, 5=ERROR, 6=FATAL )
MessageSvc.OutputLevel = 2;

//ROOT input data file
EventCnvSvc.digiRootInputFile = {"rhopi.rtraw"};

//ROOT output data file
EventCnvSvc.digiRootOutputFile ="rhopi.dst";

//Number of events to be processed (default is 10)
ApplicationMgr.EvtMax = 50;
```

重建实验数据

```
//input data
#include "$RAWDATACNVROOT/share/ReadRawDatajobOptions.txt"
#include "$TRIGMAKERALGROOT/share/jobOptions_TrigMakerAlg.txt"
#include "$OFFLINEEVENTLOOPMGRROOT/share/OfflineEventLoopMgr_Option.txt"
#include "$CALIBSVCROOT/share/job-CalibData.txt"
#include "$MAGNETICFIELDROOT/share/MagneticField.txt"
#include "$ESTIMEALGROOT/share/job_EsTimeAlg.txt"

// PAT+TSF+HOUGH method for MDC reconstruction
#include "$MDCHOUGHFINDERROOT/share/jobOptions_MdcPatTsfHoughRec.txt"

#include "$KALFITALGROOT/share/job_kalfit_numf_data.txt"
#include "$MDCDEDXALGROOT/share/job_dedx_all.txt"
#include "$TRKEXTALGROOT/share/TrkExtAlgOption.txt"
#include "$TOFRECROOT/share/jobOptions_TofRec_Data.txt"
#include "$TOFENERGYRECROOT/share/TofEnergyRecOptions_Data.txt"
#include "$EMCRECROOT/share/EmcRecOptions.txt"
#include "$EMCTIMERECROOT/share/EmcTimeRecOptions.txt"

#include "$MUCRECALGROOT/share/jobOptions_MucRec.txt"

#include "$HLTMAKERALGROOT/share/jobOptions_HltMakerAlg.txt"

#include "$EVENTASSEMBLYROOT/share/EventAssembly.txt"
#include "$PRIMARYVERTEXALGROOT/share/jobOptions_kalman.txt"
#include "$VEEVERTEXALGROOT/share/jobOptions_veeVertex.txt"

//output ROOT DST data
#include "$ROOTIOROOT/share/jobOptions_Dst2Root_data.txt"

//configure for calibration constants
#include "$CALIBSVCROOT/share/calibConfig_rec_data.txt"


//Set output level threshold (2=DEBUG, 3=INFO, 4=WARNING, 5=ERROR, 6=FATAL )
MessageSvc.OutputLevel = 5;

//input data file
RawDataInputSvc.InputFiles={"/bes3fs/offline/data/raw/round02/090307/run_0008093_All_file040_SFO-1.raw"};

//output data file
RootCnvSvc.digiRootOutputFile ="run.dst";

//Number of events to be processed (default is 10)
ApplicationMgr.EvtMax = 50;
```

重建输出.rec文件

```
//input ROOT MC data
#include "$ROOTIOROOT/share/jobOptions_ReadRoot.txt"
#include "$OFFLINEEVENTLOOPMGRROOT/share/OfflineEventLoopMgr_Option.txt"

// background mixing
#include "$BESEVENTMIXERROOT/share/jobOptions_EventMixer_rec.txt"

#include "$CALIBSVCROOT/share/job-CalibData.txt"
#include "$MAGNETICFIELDROOT/share/MagneticField.txt"
#include "$ESTIMEALGROOT/share/job_EsTimeAlg.txt"

// PAT+TSF+HOUGH method for MDC reconstruction
#include "$MDCHOUGHFINDERROOT/share/jobOptions_MdcPatTsfHoughRec.txt"

#include "$KALFITALGROOT/share/job_kalfit_numf_data.txt"
#include "$MDCDEDXALGROOT/share/job_dedx_all.txt"
#include "$TRKEXTALGROOT/share/TrkExtAlgOption.txt"
#include "$TOFRECROOT/share/jobOptions_TofRec.txt"
#include "$TOFENERGYRECROOT/share/TofEnergyRecOptions_MC.txt"
#include "$EMCRECROOT/share/EmcRecOptions.txt"
#include "$MUCRECALGROOT/share/jobOptions_MucRec.txt"

#include "$EVENTASSEMBLYROOT/share/EventAssembly.txt"
#include "$PRIMARYVERTEXALGROOT/share/jobOptions_kalman.txt"
#include "$VEEVERTEXALGROOT/share/jobOptions_veeVertex.txt"

#include "$HLTMAKERALGROOT/share/jobOptions_HltMakerAlg.txt"
#include "$EVENTNAVIGATORROOT/share/EventNavigator.txt"

//output ROOT REC data
#include "$ROOTIOROOT/share/jobOptions_Dst2Root.txt"

//configure of calibration constants for MC
#include "$CALIBSVCROOT/share/calibConfig_rec_mc.txt"


//**************job options for random number**************************
BesRndmGenSvc.RndmSeed = 100;

//Set output level threshold (2=DEBUG, 3=INFO, 4=WARNING, 5=ERROR, 6=FATAL )
MessageSvc.OutputLevel = 2;

//ROOT input data file
EventCnvSvc.digiRootInputFile = {"rhopi.rtraw"};

//ROOT output data file
EventCnvSvc.digiRootOutputFile = "rhopi.dst";

//Number of events to be processed (default is 10)
ApplicationMgr.EvtMax = 50;
```

#include "$ROOTIOROOT/share/jobOptions_Rec2Root.txt"

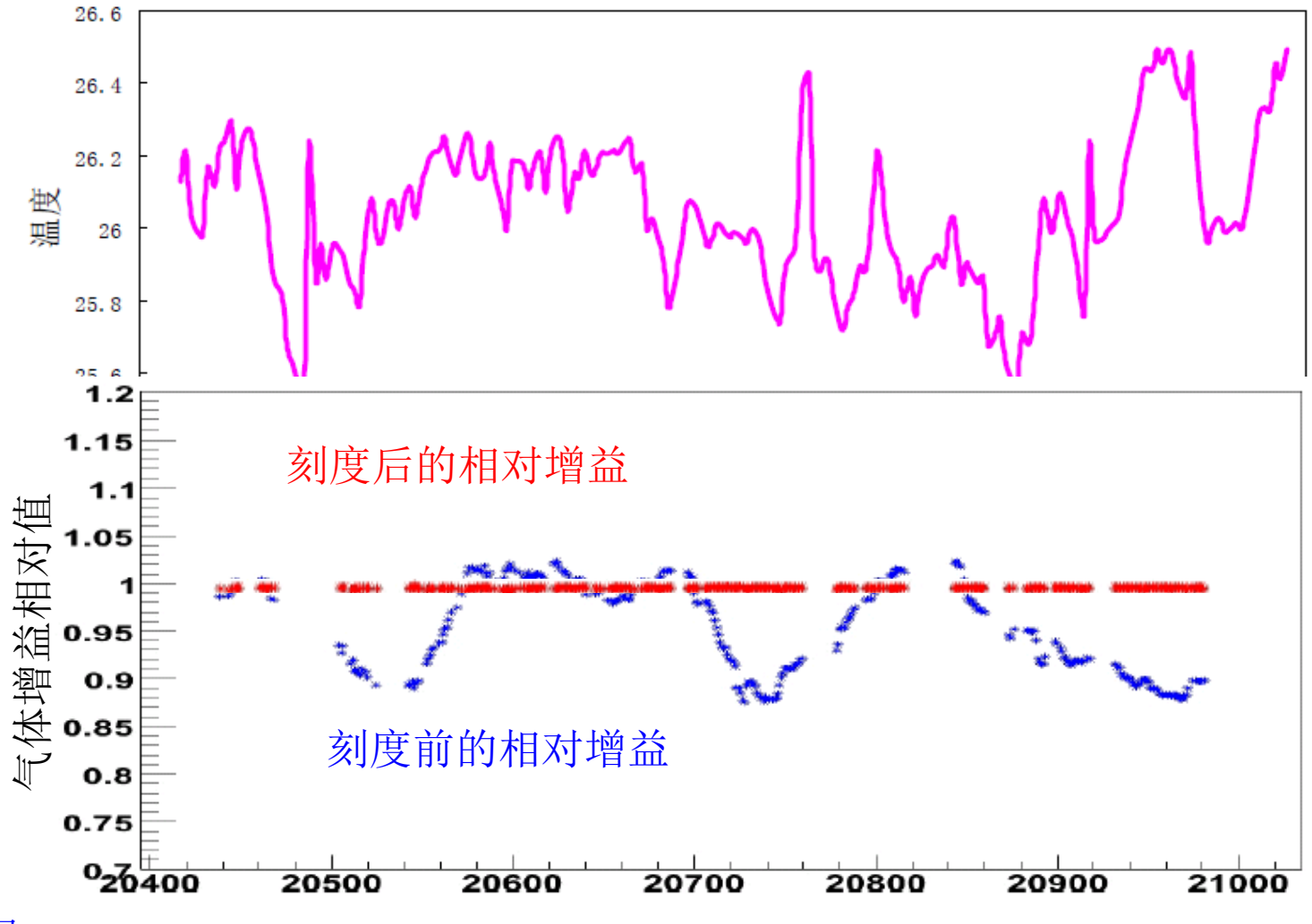
输出文件后缀改为 .rec

离线刻度

目的

- 提供事例重建所需要的函数关系
  - 如MDC的时间-距离的转换关系
  - 如EMC的ADC与能量沉积的转换
- 探测器不同部位的响应存在差别，需要通过刻度消除这些差别
  - 如电子学T0刻度消除不同电子学通道间的差异
- 受温度、湿度等外部环境的影响，探测器的响应会随着时间发生变化 动画演示
  - 如dE/dx run by run增益刻度
- 探测器的实际几何位置与理想位置之间存在差别，需要进行位置刻度 动画演示
  - 如MDC几何位置校准

- 受外部环境的影响，探测器的响应会随着时间发生变化，例如温度、气压的变化会导致漂移室气体增益的变化。因此，需要通过离线刻度消除这些差异

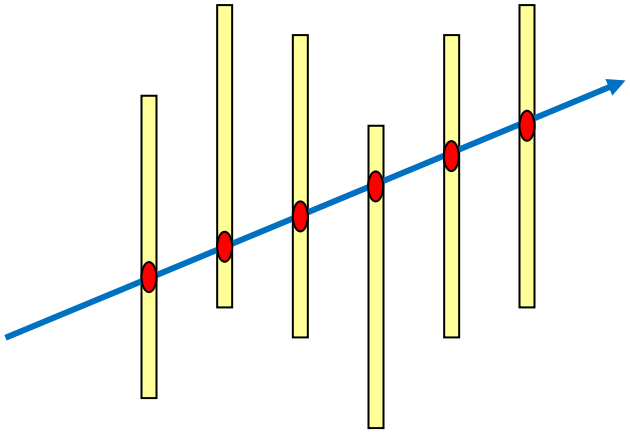


返回

- 探测器的实际几何位置与理想位置之间存在差别，需要进行几何位置刻度，即校准

实际的几何位置

径迹穿过探测器

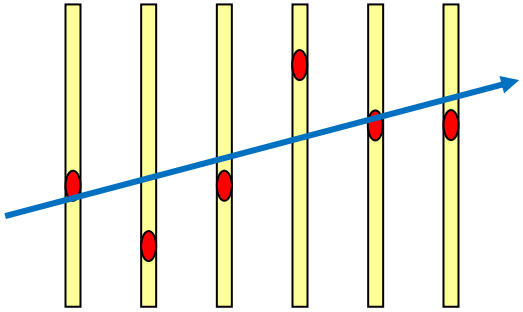


理想的几何位置

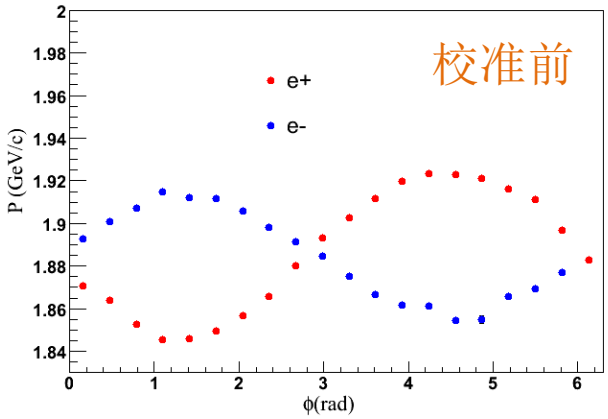
用理想位置进行拟合

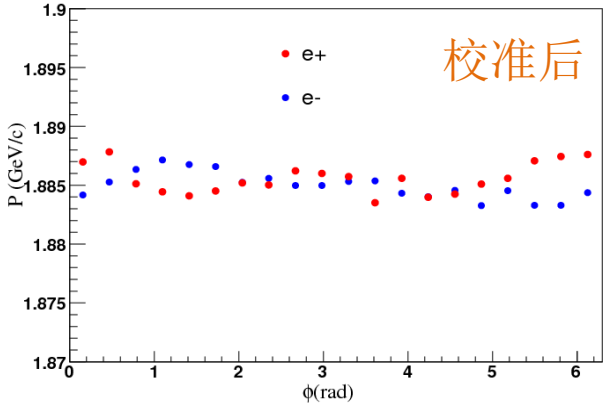
拟合结果偏离真实值

需要对探测器几何位置进行校准



P vs ϕ (质心系)

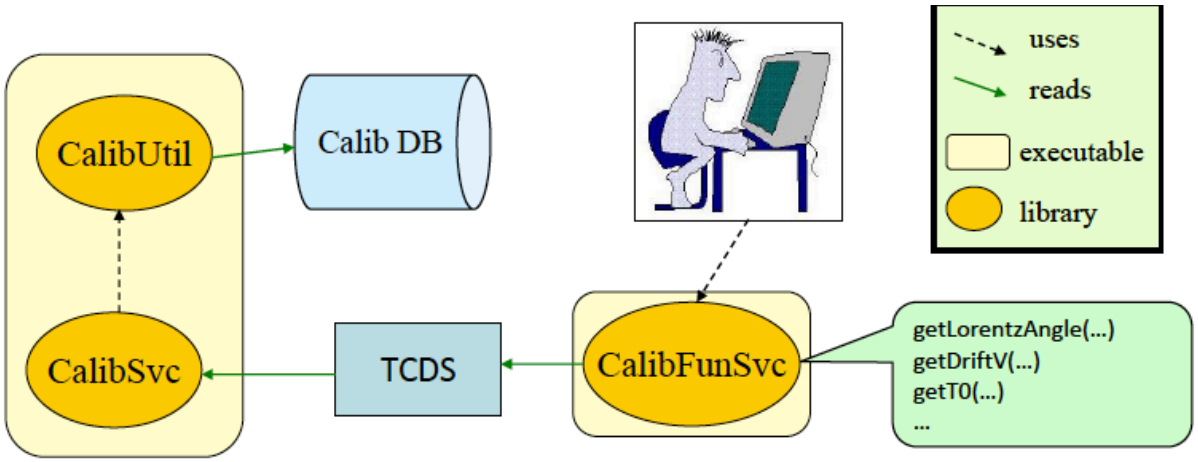




返回

刻度框架

- 目的
  - 对各子探测器离线刻度常数的管理
  - 对刻度常数产生、存储和读取的流程控制

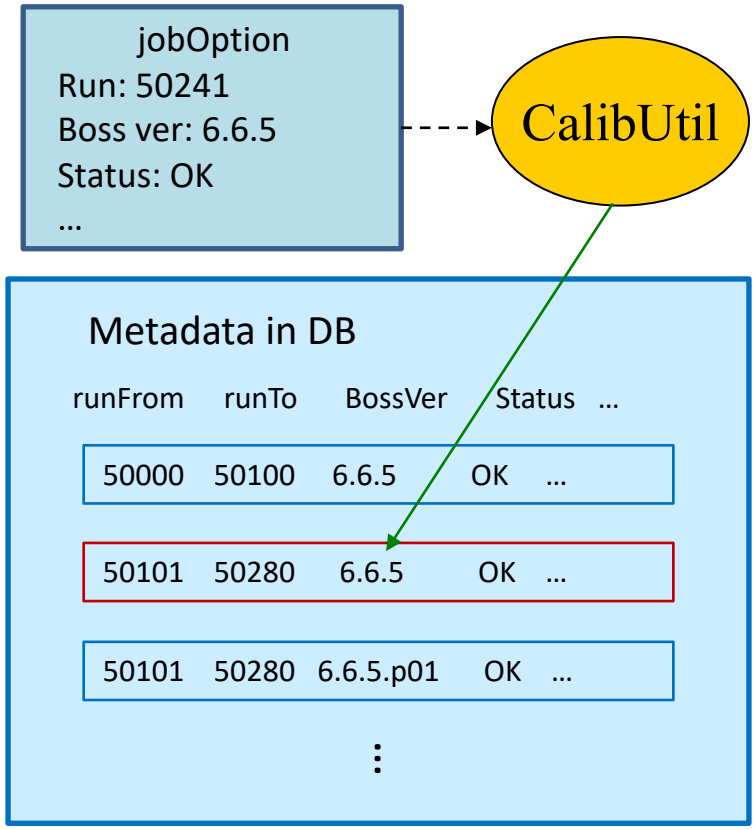


- **CalibUtil**: Search calibration data from data base
- **CalibSvc**: Data conversion service from DB to TCDS (Transient Calibration Data Store)
- **CalibFunSvc**: Interfaces to access TCDS and functions for calibration related calculations

刻度数据库

共找到2,183条。 [首页/上一页]1, **2**, 3, 4, 5, 6, 7, 8[下一页/尾页]

编号	起始运行号	结束运行号	文件名称	状态	BOSS版本	刻度参数版本	事例类型	创建时间	文件是否保存	
2203	43810	43833	TofCalConst43810.root	OK	7.0.1	12	Bhabha	2016-08-15	true	
2204	43834	43885	TofCalConst43834-43885.root	OK	7.0.1	12	Bhabha	2016-08-15	true	
2205	43978	44011	TofCalConst43978-44011.root	OK	7.0.1	12	Bhabha	2016-08-15	true	
2212	44012	44035	TofCalConst43886-43947.root	OK	7.0.1	12	Bhabha	2016-08-16	true	
2213	44036	44101	TofCalConst44036-44082.root	OK	7.0.1	12	Bhabha	2016-08-16	true	
2214	44102	44151	TofCalConst44102-44151.root	OK	7.0.1	12	Bhabha	2016-08-16	true	
2218	44152	44191	TofCalConst44152-44191.root	OK	7.0.1	12	Bhabha	2016-08-16	true	
2219	44192	44262	TofCalConst44210-44245.root	OK	7.0.1	12	Bhabha	2016-08-16	true	
2220	44263	44325	TofCalConst44263-44298.root	OK	7.0.1	12	Bhabha	2016-08-16	true	
2221	44326	44351	TofCalConst44335-44351.root	OK	7.0.1	12	Bhabha	2016-08-16	true	
2222	44352	44388	TofCalConst44368-44388.root	OK	7.0.1	12	Bhabha	2016-08-16	true	
2223	44389	44462	TofCalConst44389-44421.root	OK	7.0.1	12	Bhabha	2016-08-16	true	
2224	44463	44540	TofCalConst44463-44511.root	OK	7.0.1	12	Bhabha	2016-08-16	true	
2225	44541	44633	TofCalConst44541-44590.root	OK	7.0.1	12	Bhabha	2016-08-16	true	
2226	44634	44643	TofCalConst44634-44643.root	OK	7.0.1	12	Bhabha	2016-08-16	true	
2227	44644	44676	TofCalConst44644-44672.root	OK	7.0.1	12	Bhabha	2016-08-16	true	



jobOption中刻度设置

```
//input data
#include "$RAWDATACNVROOT/share/ReadRawDatajobOptions.txt"
#include "$TRIGMAKERALGROOT/share/jobOptions_TrigMakerAlg.txt"
#include "$OFFLINEEVENTLOOPMGRROOT/share/OfflineEventLoopMgr_Option.txt"
#include "$CALIBSVCROOT/share/job-CalibData.txt"
#include "$MAGNETICFIELDROOT/share/MagneticField.txt"
#include "$ESTIMEALGROOT/share/job_EsTimeAlg.txt"
```

刻度框架设置

```
//output ROOT DST data
#include "$ROOTIOROOT/share/jobOptions_Dst2Root_data.txt"

//configure for calibration constants
#include "$CALIBSVCROOT/share/calibConfig_rec_data.txt"


//Set output level threshold (2=DEBUG, 3=INFO, 4=WARNING, 5=ERROR, 6=FATAL )
MessageSvc.OutputLevel = 5;
```

刻度常数及版本设置

```
#include "$CALIBSVCROOT/share/calibConfig_sim.txt"
```

用于模拟作业

```
#include "$CALIBSVCROOT/share/calibConfig_rec_mc.txt"
```

重建模拟事例 (.rtraw文件)

```
#include "$CALIBSVCROOT/share/calibConfig_rec_data.txt"
```

重建data (.raw文件)

提示

➢ 不同round事例不要放在同一个job运行

2009、2012年psi’事例在同一个job运行出错：

```
**************************************************

 VertexDbSvc:: can not found vertex information for run:25338, boss version 6.6.4
3165.434u 199.541s 1:01:42.62 90.8%     0+0k 18906296+544io 90pf+0w
"psip_chi_047.txt.bosslog" 430L, 24191C
```

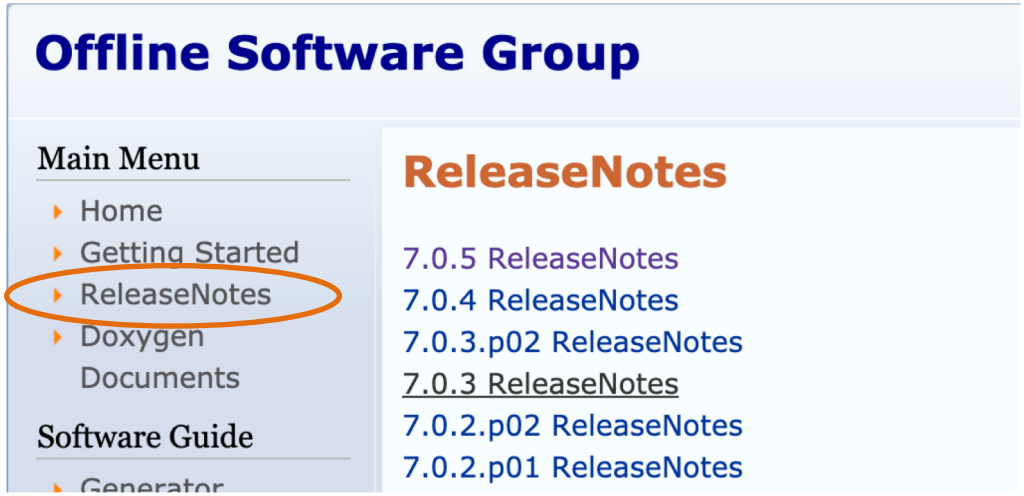
RunNo	Vx	Vy	Vz	SigmaVx	SigmaVy	SigmaVz	VerFitFunc	DistFitFunc	VerFitJob	SftVer
8093	0.011847	-0.274945	0.039516	0.050922	0.041505	0.891205	Kalman	single Gaussian	NULL	6.5.0
8093	0.012012	-0.274624	0.019707	0.050345	0.040717	0.884332	Kalman	single Gaussian	NULL	6.5.1
8093	0.012012	-0.274624	0.019707	0.050345	0.040717	0.884332	Kalman	single Gaussian	NULL	6.5.2
8093	0.032251	-0.153272	0.071922	0.049834	0.038147	0.883428	Kalman	single Gaussian	NULL	6.5.3
8093	0.0321	-0.152858	0.07359	0.05381	0.044683	0.889185	Kalman	single Gaussian	NULL	6.5.5
8093	0.031825	-0.152934	0.072242	0.053281	0.043975	0.887659	Kalman	single Gaussian	NULL	6.5.1.p01
8093	0.032209	-0.154852	0.068146	0.050745	0.041937	0.885907	Kalman	single Gaussian	NULL	6.6.4
8093	0.032252	-0.15485	0.06831	0.05072	0.041982	0.886416	Kalman	single Gaussian	NULL	7.0.5

RunNo	Vx	Vy	Vz	SigmaVx	SigmaVy	SigmaVz	VerFitFunc	DistFitFunc	VerFitJob	SftVer
25338	0.094185	-0.119021	0.340994	0.051563	0.041948	0.956543	Kalman	single Gaussian	NULL	6.6.2
25338	0.095864	-0.126865	0.330157	0.051179	0.041309	0.953427	Kalman	single Gaussian	NULL	6.6.4.p03

BOSS软件入门简介

BESIII软件发布

- 不同类型的BOSS版本：
  - 正式版：6.5.1，6.5.2 …
    - 供物理分析使用的正式版本
  - 测试版：6.5.2.a，6.5.2.b …
    - 介于正式版之间的临时版本，供软件测试使用
  - 补丁版：6.5.1.p01 …
    - 正式版本基础上做了重要改进之后发布的版本
- ReleaseNotes



各种类型数据文件

- **原始实验数据 (Data)**
  - 实验中探测器记录的原始数据

    如：run_0008093_All_file040_SFO-1.raw
  - 文件位置可查看
    - 软件组网页 → Raw Data
- **模拟产生的事例样本 (MC sample)**

  如：jpsi_round001_run10236_file10.rtraw
- **重建事例文件**
  - **Dst**文件 (如：rhopi.dst)
    - 只包含对物理分析有用的重建后的信息，如track信息
  - **Rec**文件 (如：rhopi.rec)
    - 包含：探测器原始信息，重建后的track及hit信息

BOSS -- 操作系统

- 2020年8月，运行BESIII离线软件的高能所计算集群将操作系统升级到CentOS，设置环境的方式略有变化
  - 登录lxslc7.ihep.ac.cn
  - For BOSS versions 7.0.5, 7.0.4, 7.0.3, 7.0.3.p01, 7.0.3.p02, and 6.6.5.p01:
    a) **Reset BOSS environment** using template /cvmfs/bes3.ihep.ac.cn/bes3sw/cmthome/cmthome-***-Slc6Centos7Compat
    b) Submit jobs: **boss.condor job_option.txt**
  - For BOSS versions 6.6.4, 6.6.4.p01, 6.6.4.p02, 6.6.4.p03:
    a) Start a singularity: /cvmfs/container.ihep.ac.cn/bin/hep_container shell SL5
    b) Reset BOSS environment using template /cvmfs/bes3.ihep.ac.cn/bes3sw/cmthome/cmthome-***-Slc6Centos7Compat
    c) Submit jobs: boss.condor -os SL6 job_option.txt

BOSS -- 环境设置 (1)

https://docbes3.ihep.ac.cn/~offlinesoftware/index.php/Main_Page → Getting Started

→ How to setup BOSS environment on CentOS7(Take boss 7.0.5 as example)

- 1. Make a directory for environment setting

  For example: mkdir cmthome706

- 2. Make a directory as your work area

  For example: mkdir workarea706

- 3. Copy the template files to your directory

  cd cmthome706
  cp /cvmfs/bes3.ihep.ac.cn/bes3sw/cmthome/cmthome-7.0.6/* .

- 4. Set up your CVS account

cmthome 模板目录

```
[wulh@lxslc705 ~]$ ls /cvmfs/bes3.ihep.ac.cn/bes3sw/cmthome/
cmthome-6.5.5                                cmthome-7.0.3.p02-Slc6Centos7Compa
cmthome-6.6.4                                cmthome-7.0.3-Slc6Centos7Compat
cmthome-6.6.4.p01                            cmthome-7.0.4
cmthome-6.6.4.p02                            cmthome-7.0.4-Slc6Centos7Compat
cmthome-6.6.4.p03                            cmthome-7.0.5
cmthome-6.6.5                                cmthome-7.0.5-Slc6Centos7Compat
cmthome-6.6.5.p01                            cmthome-7.0.6
cmthome-6.6.5.p01-Slc6Centos7Compat          cmthome-7.0.6.a
cmthome-6.6.5-Slc6Centos7Compat              cmthome-7.0.6.a-Slc6Centos7Compat
cmthome-7.0.3                                cmthome-7.0.6-Slc6Centos7Compat
cmthome-7.0.3-g27r1-g410-v2                  cmthome-7.0.7
cmthome-7.0.3-g27r1-g410-v2-Slc6Centos7Compat cmthome-7.0.7-Slc6Centos7Compat
cmthome-7.0.3-g27r1-g410-v3                  cmthome-cgem6.6.5.f-Slc6
cmthome-7.0.3.p01                            cmthome-cgem6.6.5.f-Slc6Centos7Co
```

细节参照网页上的操作说明

修改 setupCVS.sh (or setupCVS.csh, according to the shell) 中的用户名
source setupCVS.sh (or source setupCVS.csh)

例如：

```
export CVSROOT=':pserver:maqm@koala.ihep.ac.cn:/bes/bes'
export CVSIGNORE='setup.* cleanup.* x86_64-slc* *.make M
```

↓

```
export CVSROOT=':pserver:wulh@koala.ihep.ac.cn:/bes/bes'
export CVSIGNORE='setup.* cleanup.* x86_64-slc* *.make M
```

BOSS -- 环境设置 (2)

- 5. Connect with CMT

步骤5-7细节参照网页上的操作说明

source setupCMT.sh (or source setupCMT.csh)

- 6. Modify the requirements file

  - 找到 #macro WorkArea 一行，取消注释，并修改其中的用户工作区路径 (设置为步骤2指定的用户工作区)
  - 找到#path_remove CMTPATH “${WorkArea}”和#path_prepend CMTPATH “${WorkArea}”，取消注释

例如：

```
#Add your worarea to CMTPATH
#macro WorkArea "/home/bes/maqm/cvmfs/705"
# Add dev area to the front of your CMTPATH
#path_remove CMTPATH  "${WorkArea}"
#path_prepend CMTPATH "${WorkArea}"
```

→

```
#Add your worarea to CMTPATH
macro WorkArea "/home/bes/wulh/workfs/boss706"
# Add dev area to the front of your CMTPATH (bu
path_remove CMTPATH  "${WorkArea}"
path_prepend CMTPATH "${WorkArea}"
```

- 7. Config your environment settings

cmt config
source setup.sh (or source setup.csh)

设置完毕查看BOSS环境设置：

echo $CMTPATH

用户工作区 (WorkArea)

BOSS软件发布(BesArea)

```
[wulh@lxslc705 ~]$ echo $CMTPATH
/home/bes/wulh/workfs/boss706:/cvmfs/bes3.ihep.ac.cn/bes3sw/Boss/7.0.6:/cvmfs
/bes3.ihep.ac.cn/bes3sw/ExternalLib/SLC6/ExternalLib/gaudi/GAUDI_v23r9:/cvmfs
/bes3.ihep.ac.cn/bes3sw/ExternalLib/SLC6/ExternalLib/LCGCMT/LCGCMT_65a
```

BOSS -- 工作区软件配置编译

配置和编译

1. 进入用户工作区
   cd ${WorkArea}
2. Check out TestRelease
   cmt co -r TestRelease-00-00-95 TestRelease
3. 进入TestRelease下的cmt子目录
   cd TestRelease/TestRelease-00-00-95/cmt
4. 软件包配置
   cmt broadcast cmt config (或 cmt br cmt config)
   source setup.sh
5. 编译工作区软件
   cmt broadcast gmake (或 cmt br gmake)

TestRelease版本与所用BOSS版本发布区的TestRelease保持一致

Run examples

cd TestRelease/TestRelease-00-00-95/run
boss.exe HelloWorldOptions.txt
boss.exe jobOptions_sim.txt
boss.exe jobOptions_rec.txt
boss.exe jobOptions_ana_rhopi.txt

作业正常结束的信息

```
ApplicationMgr       INFO Application Manager Finalized successfully
ApplicationMgr       INFO Application Manager Terminated successfully
```

总结

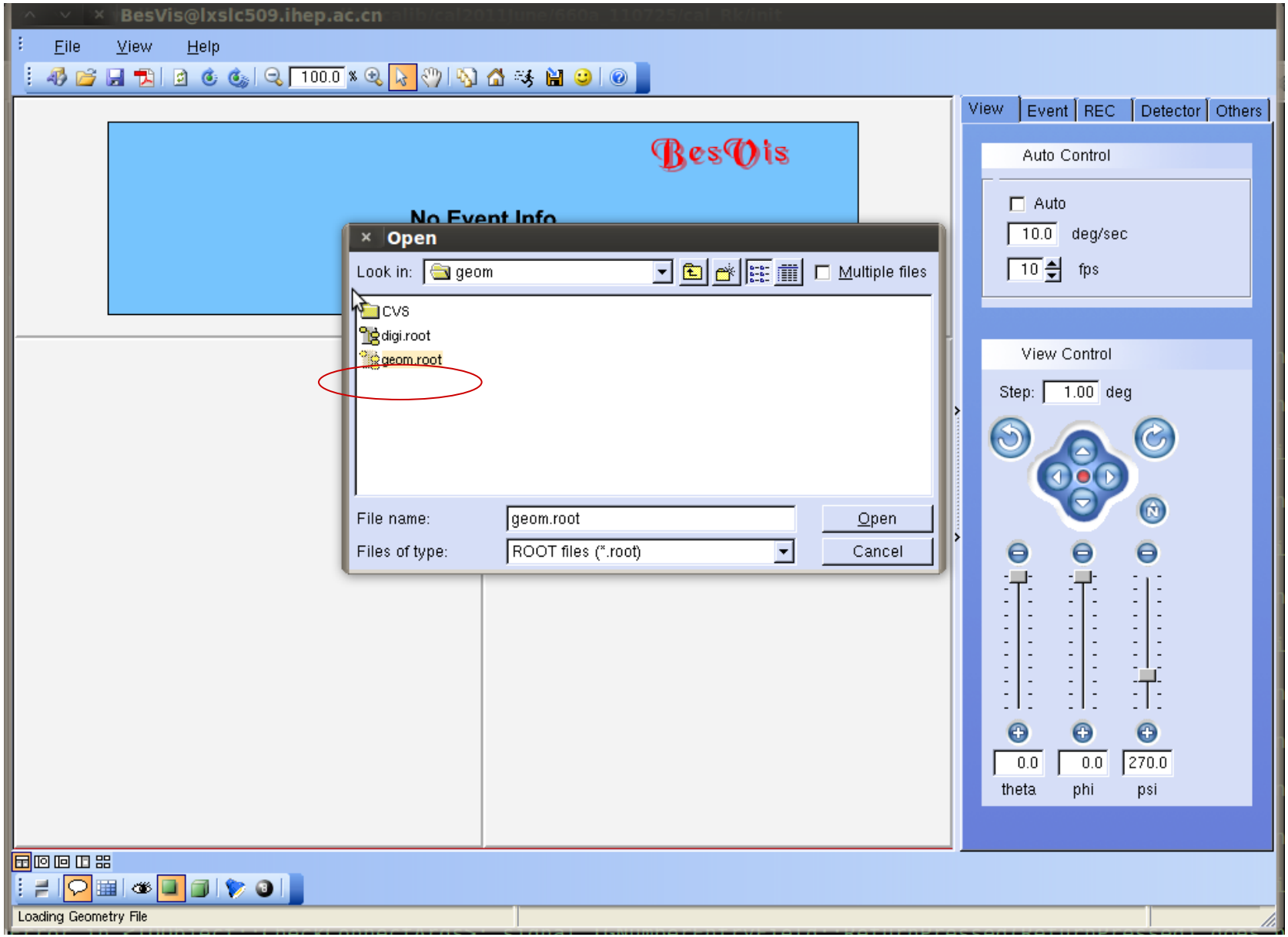
- BESIII离线软件系统(BOSS)
  - 软件框架
  - 探测器模拟
  - 事例重建
  - 离线刻度
- BOSS软件入门简介

Thanks!

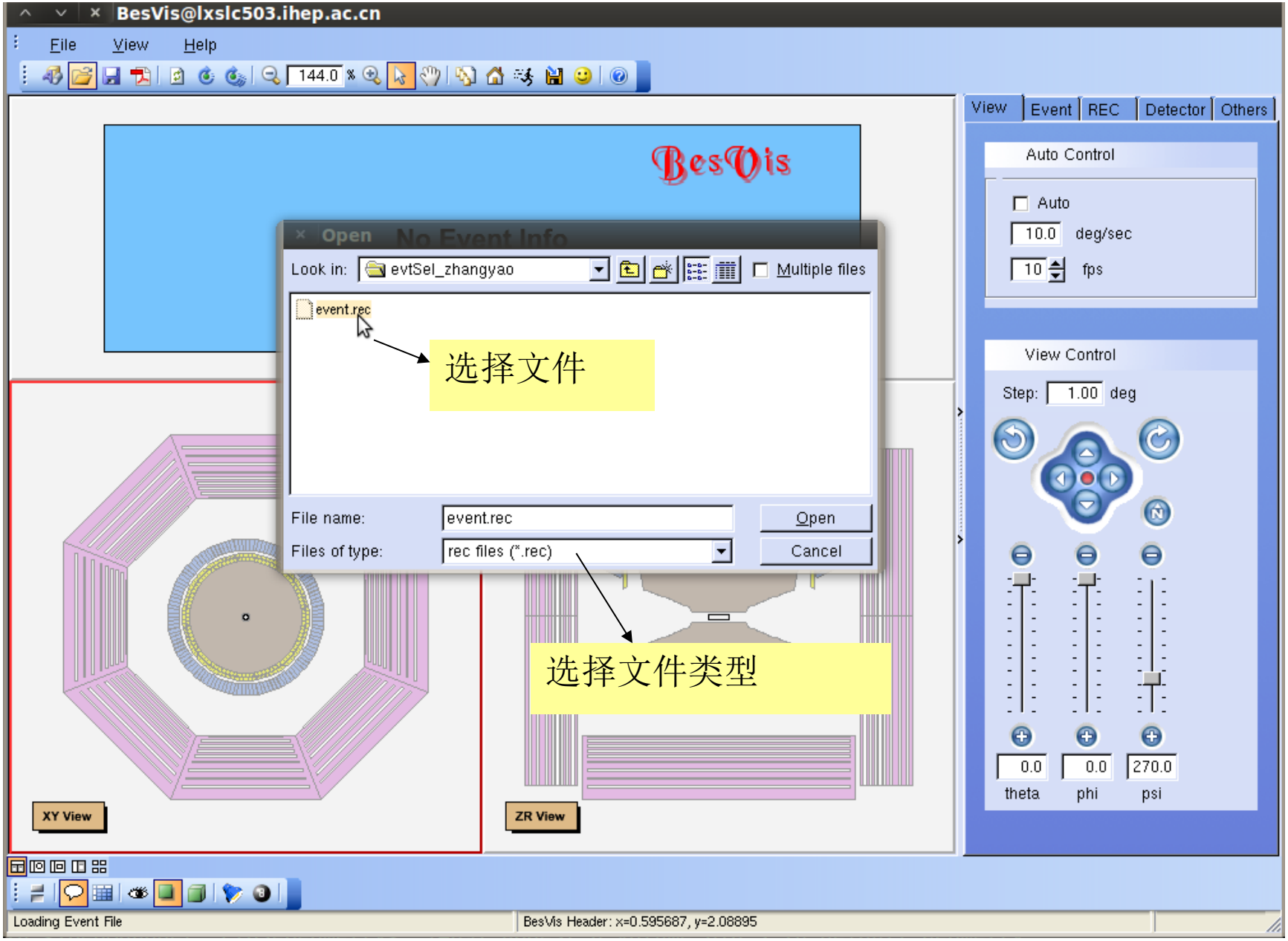
Backup

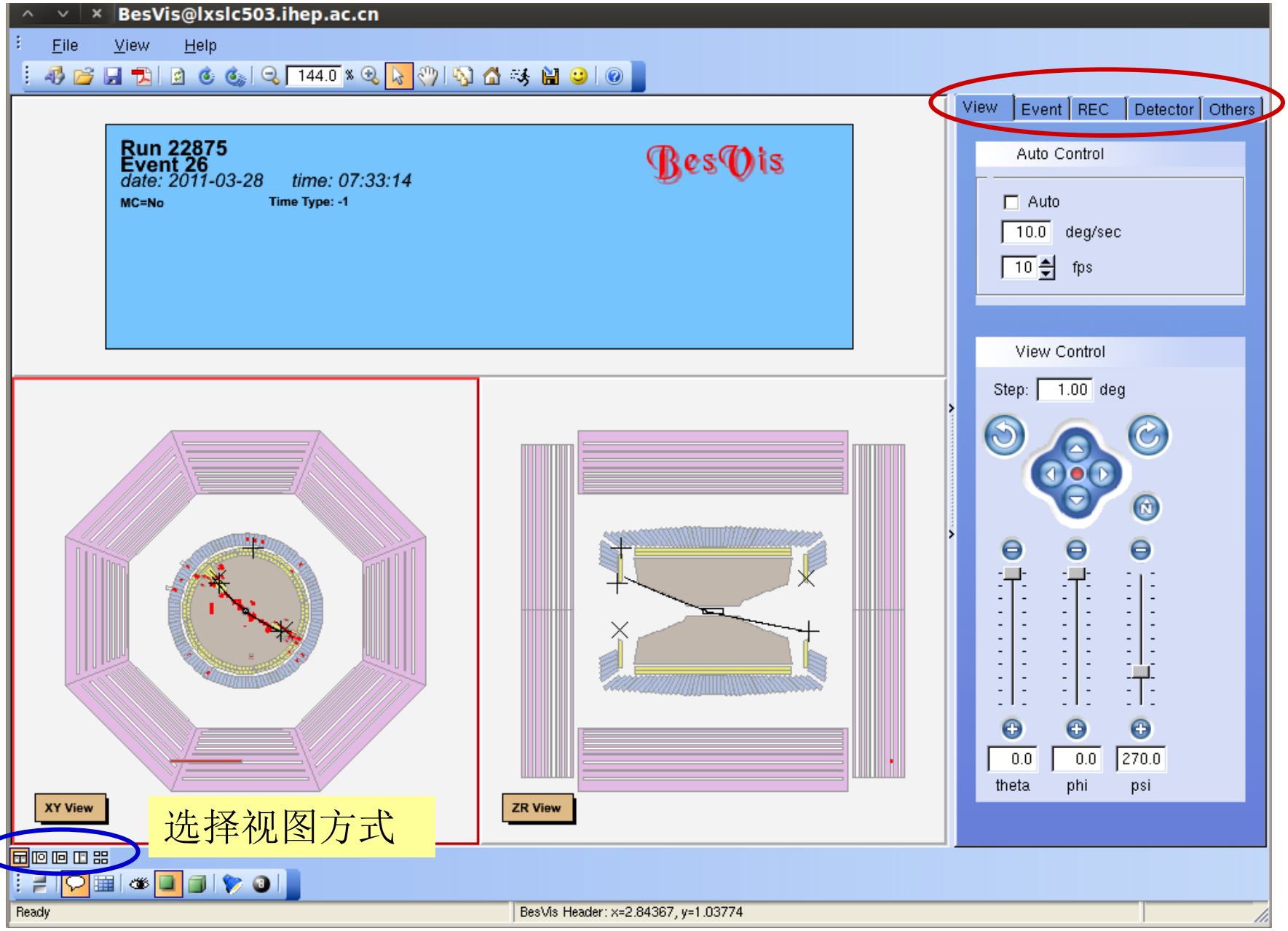
事例显示

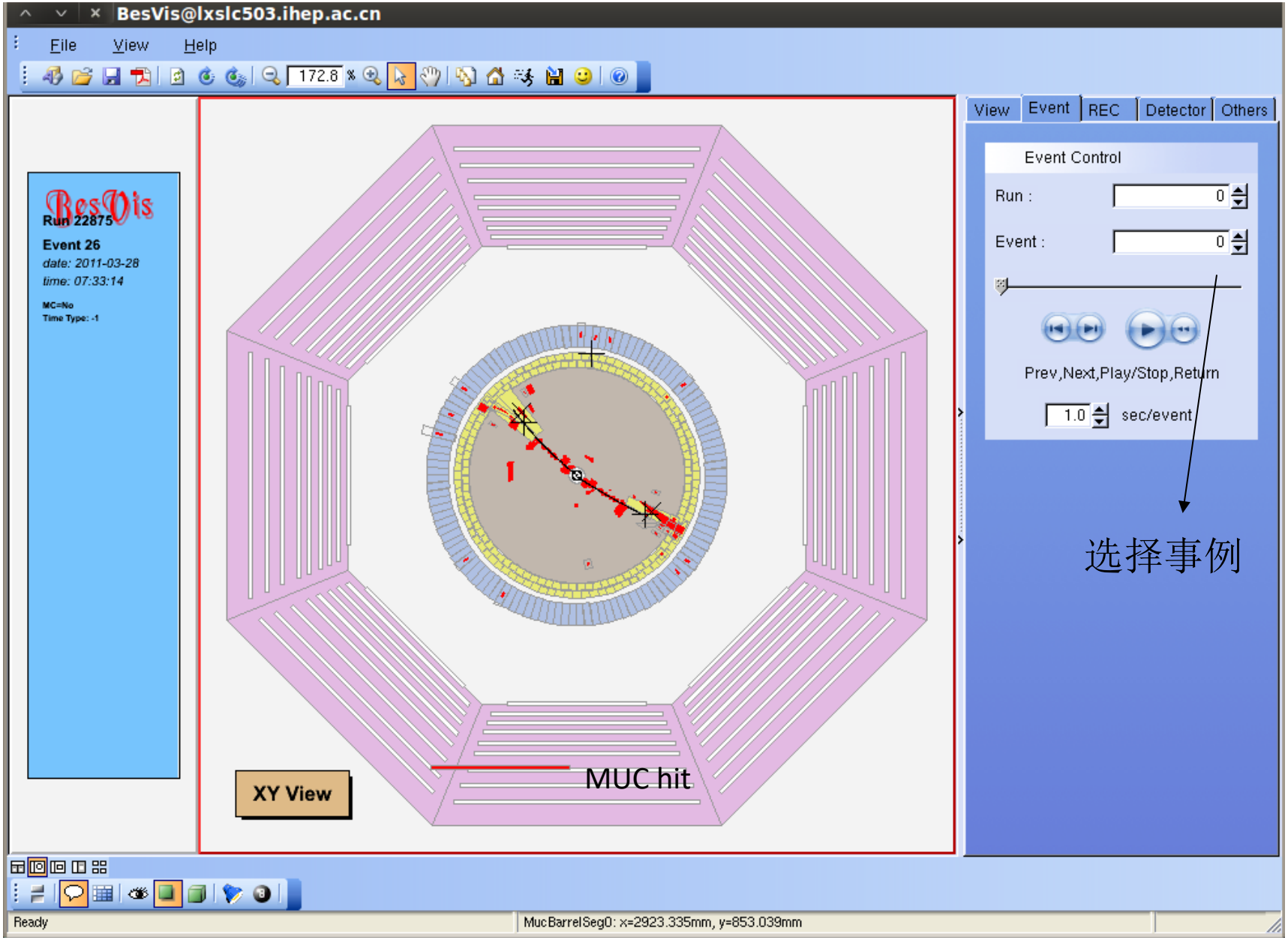
- 目的
  - 直观地显示每个事例中各子探测器的情况以及重建后的径迹，帮助查找问题。
- 运行步骤
  - 设置BOSS环境后，输入命令besvis.exe
  - 加载探测器几何文件：选择geom.root，单击“open”
  - 打开需要进行事例显示的文件：通过左上角小图标或File菜单进入选择文件的窗口
  - 通过工具栏选择合适的显示方式
    - 通过左下角工具条选择合适的视图
    - 上方工具栏可设置显示比例等
    - 右侧工具栏可选择事例号、子探测器等
- 目前可以用于事例显示的文件类型： *.rec, *.dst, *.rtraw

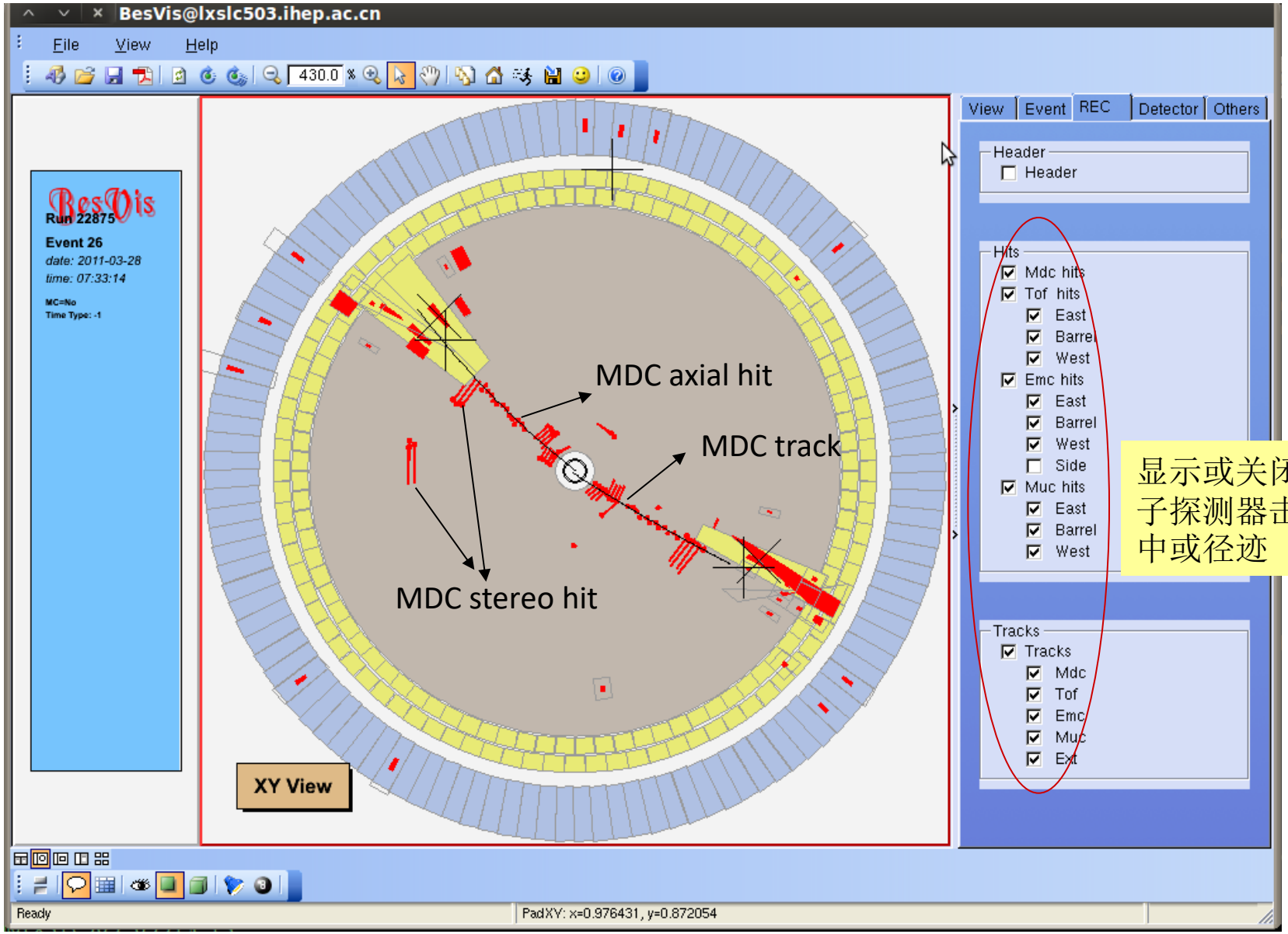


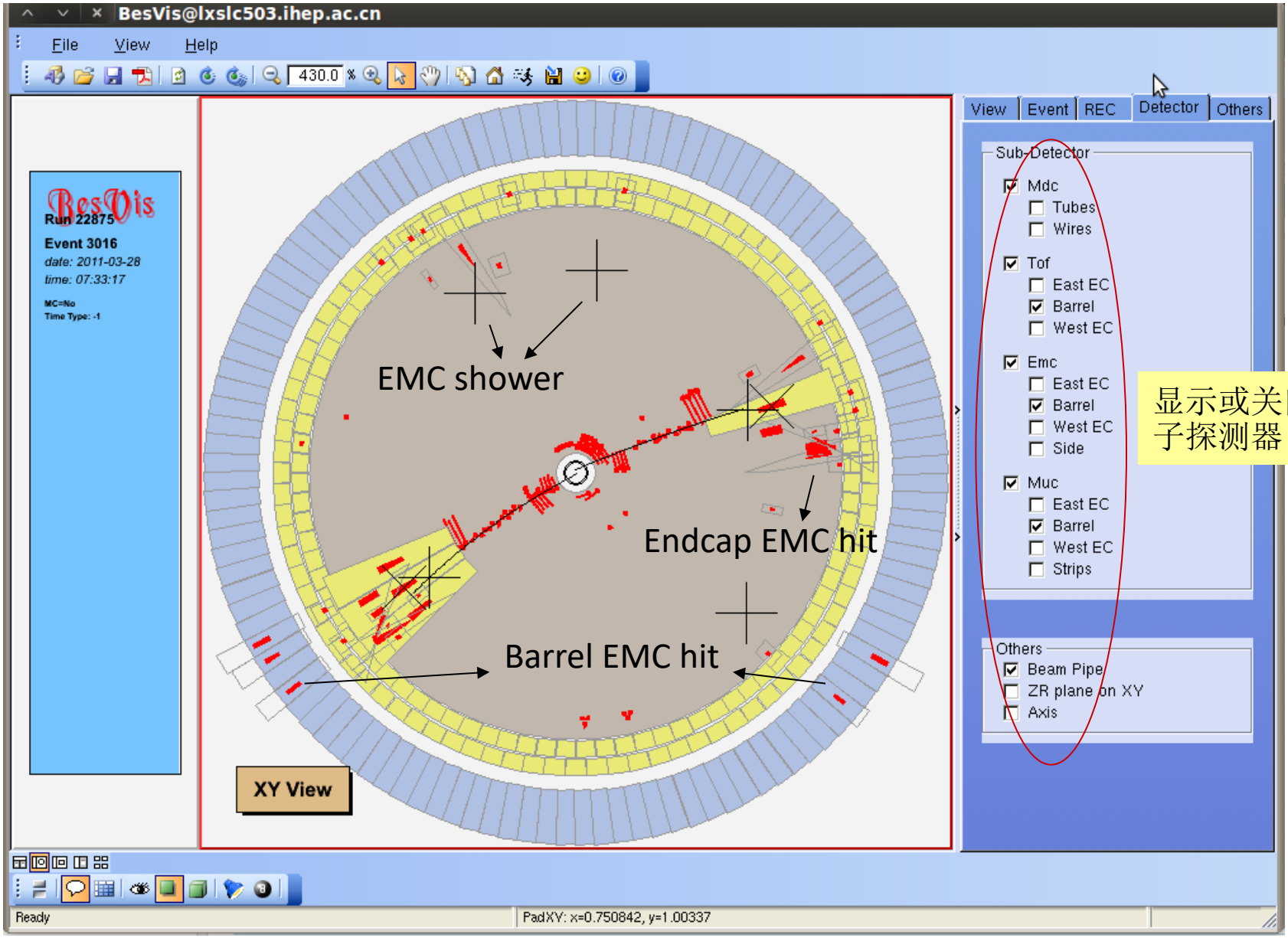
新版版本(如Boss7.0.6)下不需要这一步

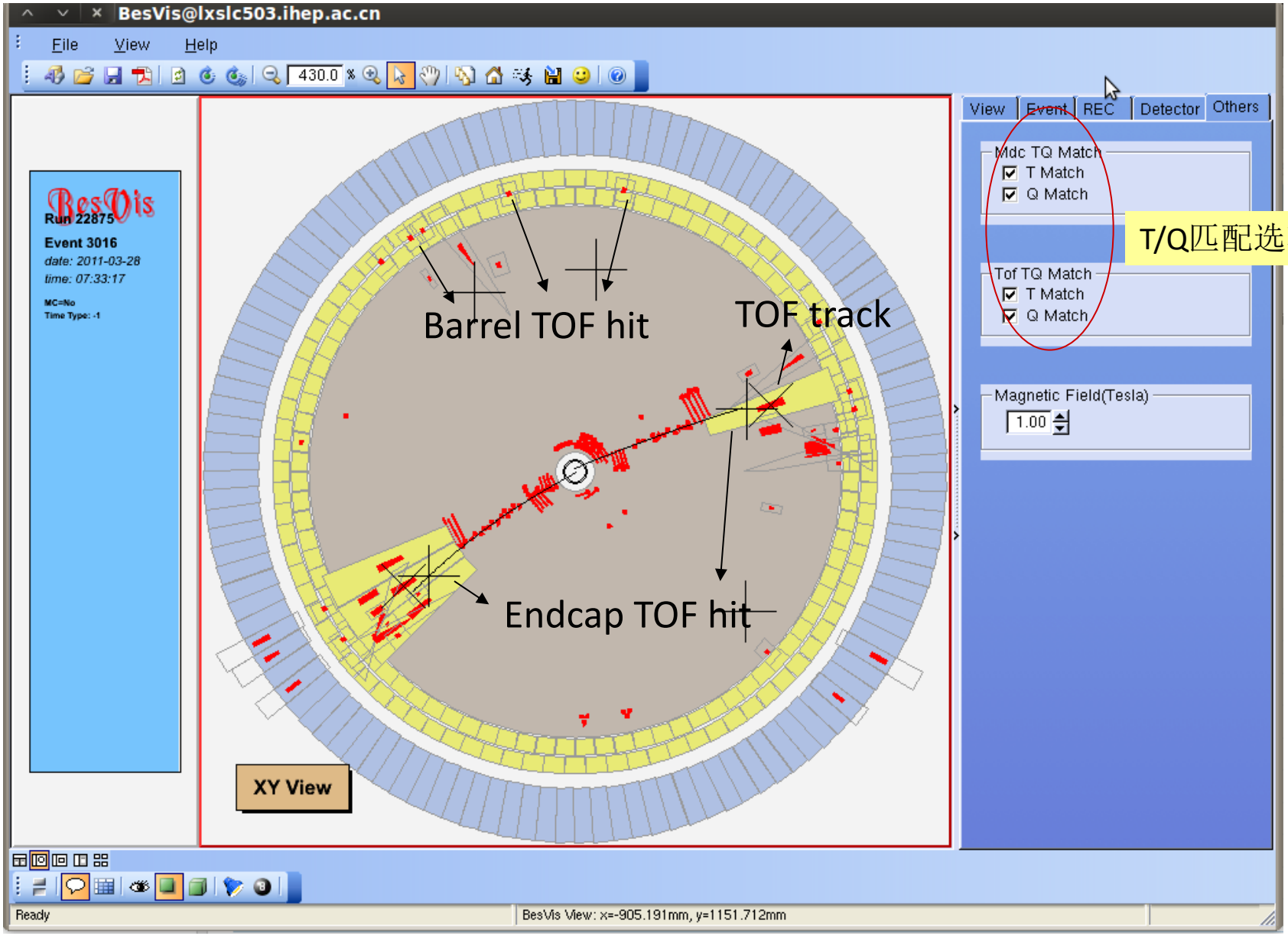

BesVis@lxslc503.ihep.ac.cn
File
View
Help
144.0
BesVis
Open
No Event Info
Look in:
evtSel_zhangyao
Multiple files
event.rec
选择文件
File name:
event.rec
Open
Files of type:
rec files (*.rec)
Cancel
选择文件类型
XY View
ZR View
View
Event
REC
Detector
Others
Auto Control
Auto
10.0
deg/sec
10
fps
View Control
Step:
1.00
deg
0.0
0.0
270.0
theta
phi
psi
Loading Event File
BesVis Header: x=0.595687, y=2.08895


BesVis@lxslc503.ihep.ac.cn
File
View
Help
144.0
Run 22875
Event 26
date: 2011-03-28 time: 07:33:14
MC=No
Time Type: -1
BesVis
View
Event
REC
Detector
Others
Auto Control
Auto
10.0
deg/sec
10
fps
View Control
Step:
1.00
deg
0.0
0.0
270.0
theta
phi
psi
XY View
ZR View
选择视图方式
Ready
BesVis Header: x=2.84367, y=1.03774


BesVis@lxslc503.ihep.ac.cn
File
View
Help
172.8
BesVis
Run 22875
Event 26
date: 2011-03-28
time: 07:33:14
MC=No
Time Type: -1
XY View
MUC hit
View
Event
REC
Detector
Others
Event Control
Run :
0
Event :
0
Prev,Next,Play/Stop,Return
1.0
sec/event
选择事例
Ready
MucBarrelSeg0: x=2923.335mm, y=853.039mm


BesVis@lxslc503.ihep.ac.cn
File
View
Help
430.0
BesVis
Run 22875
Event 26
date: 2011-03-28
time: 07:33:14
MC=No
Time Type: -1
MDC axial hit
MDC track
MDC stereo hit
XY View
View
Event
REC
Detector
Others
Header
Header
Hits
Mdc hits
Tof hits
East
Barrel
West
Emc hits
East
Barrel
West
Side
Muc hits
East
Barrel
West
Tracks
Tracks
Mdc
Tof
Emc
Muc
Ext
显示或关闭子探测器击中或径迹
Ready
PadXY: x=0.976431, y=0.872054


BesVis@lxslc503.ihep.ac.cn
File
View
Help
430.0
BesVis
Run 22875
Event 3016
date: 2011-03-28
time: 07:33:17
MC=No
Time Type: -1
EMC shower
Endcap EMC hit
Barrel EMC hit
XY View
View
Event
REC
Detector
Others
Sub-Detector
Mdc
Tubes
Wires
Tof
East EC
Barrel
West EC
Emc
East EC
Barrel
West EC
Side
Muc
East EC
Barrel
West EC
Strips
Others
Beam Pipe
ZR plane on XY
Axis
显示或关闭
子探测器
Ready
PadXY: x=0.750842, y=1.00337


BesVis@lxslc503.ihep.ac.cn
File
View
Help
430.0
BesVis
Run 22875
Event 3016
date: 2011-03-28
time: 07:33:17
MC=No
Time Type: -1
Barrel TOF hit
TOF track
Endcap TOF hit
XY View
View
Event
REC
Detector
Others
Mdc TQ Match
T Match
Q Match
Tof TQ Match
T Match
Q Match
Magnetic Field(Tesla)
1.00
Ready
BesVis View: x=-905.191mm, y=1151.712mm

T/Q匹配选项