BesIII MDC Tracking Paramters

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1 Introduction

This document provides the definitions of the track parameters used in BESIII Main Drift Chamber(MDC) tracking.And track information in TDS.

2 Coordinate System

- The coordinate system is right-handed.
- The +z axis is parallel to the magnetic field of the solenoid, points to the east and in the direction of the high energy positron beam.
- The +y axis points vertically upward.
- The +x axis points horizontally to the center of BEPCII ring.
- Take east endplate of MDC as backward and west as forward.

3 The Reference Point

The results of all track fits, wherever they are done, use the origin as the reference point(pivot).

4 Fit parameters

There are five parameters $(d_\rho,\phi_0,\kappa,d_z,tan\lambda)^T$ for the track fits.These parameters are defined at the point of orbit that is closest to the z-axis.For tracks that turn through more than 360 degrees, the solution that has the smallest absolute value of z is chosen.The five parameters,in the order they appear in the error matrix,are:

d_ρ The distance in the x-y plane form the pivot to the orbit (cm). The sign is positive if $(\vec{r} \times \vec{p})$ is in the positive z direction, where $\vec{r}$ is the vector form origin to the track and $\vec{p}$ is the tangent to the track direction.

ϕ_0 The azimuthal angle specify the pivot with respect to the helix center (rads).The sign is defined by the sign of $(\vec{i} \cdot \vec{w})$, where $\vec{w} = \vec{p} \times \vec{k}$, $\vec{k}$ is the z-axis vector and $\vec{i}$ is the x-axis vector. The domain of ϕ_0 is [0,π/2).

κ $1/P_t$, reciprocal of the transverse momentum($(GeV/c)^{-1}$). The sign of κ represents the charge of the track assigned by the track fitting.

d_z The distance of the helix from the pivot in the z direction (cm). The sign is same as z coordinate sign.

$tan\lambda$ The slope of the track, tangent of the dip angle. $tan(\lambda) = cot(\theta)$, $\theta = \pi/2 - \lambda$

5 Sign Conventions and Domains

ϕ The azimuthal angle ϕ of hits on the track is defined $\vec{w} \cdot \vec{v}$.The domain of ϕ is [0,π/2).

θ The polar angle θ is zero on the +x axis and π on the -z axis.

EntranceAngle The entrance angle of a track in a cell is defined as: ϕ_{track}-ϕ_{hit}. The domain of the entrance angle is[$-\pi$/2,π/2).

WireAmbiguity The sign of wire ambiguity depends on the track is :

Ambiguity	setFlagLR	$\phi_{wire} - \phi_{hit}$	SetDriftDistLeft	SetDriftDistRight
left	0	< 0	$-\|driftDist\|$	999
right	1	> 0	-999	$+\|driftDist\|$
ambig	2		$-\|driftDist\|$	$+\|driftDist\|$

ϕ terminal The azimuthal angle of the outmost hits on the track. Now is the azimuthal angle of hits that at outmost layer on the track and have maximum cell No. or maximum azimuthal angle of wire on the end plate.

6 Extractors of MdcTrack and MdcRecHit Class

```
MdcTrack class extractors:
   int getId( void )             // index of tracks for one event,
                                 // begin with 0,if this hit
                                 // belongs to no track,set as -1
   HepVector& getHelix( void )   // 5 track parameters
```

```
   float getDr( void )           // d_r
   float getFi0( void )          // φ_0
   float getCpa( void )          // κ
   float getDz( void )           // d_z
   float getTanl( void )         // tan(λ)

   HepPoint3D&  getPivot( void ) // position of pivot
   float getX0( void )           // x of pivot
   float getY0( void )           // y of pivot
   float getZ0( void )           // z of pivot
   HepPoint3D&  getPoca( void )  // position of closest approach to origin
   float getVX0( void )          // x of poca
   float getVY0( void )          // y of poca
   float getVZ0( void )          // z of poca
   HepSymMatrix& getError( void )// error matrix for track parameters
   float getChisq( void )        // chi square of helix fit
   float getNdf( void )          // number of degree of freedom for the fit
   float getFiTerm( void )       // phi angle value at track terminated point
   int getNhits( void )          // number of  total hits contained
   int getNster( void )          // number of  stereo hits contained
   int getStat( void )           // status flag
   float getMass( void )         // mass of  this particle
   int getCharge( void )         // charge of  this track
   HitRefVec getVecHits(void)    // hit list of the track

MdcRecHit class extractors:
   int getId(void)                 // index of hits for one event
                                   // begin with 0
   float getDriftDistLeft(void)    // drift distance left
   float getDriftDistRight(void)   // drift distance right
   float getErrDriftDistLeft(void) // error of drift distance left
   float getErrDriftDistRight(void)// error of drift distance right
   float getChisqAdd(void)         // contribution to chisquare
   int getFlagLR(void)             // flag indicating left or right
                                   // 0:left 1:right 2:ambig
   int getStat(void)               // status flag
   const Identifier getMdcId(void) // MDC identifier
   TrkRefVec getTrack(void)
   float getTdc(void)              // corrected TDC
   float getAdc(void)              // corrected ADC
   float getDriftT(void)           // drift time
   float getDoca(void)             // distance of closesest approach
                                   // for helix in the cell
   float getEntra(void)            // entrance angle in azimuth
```

```
float getZhit(void)              // z coordinate of the hit
```