

5. Calibration Discussion

1. Current "calibrations" in use in reconstruction:

1. Function for CDC time-to-distance relationship
2. Function for correction for deflection due to Lorentz force in FDC
3. Charge-to-energy unit conversion for FDC cathode strips and CDC wires

hdgeant

Hits are turned into clusters with times
calculated from hard-wired numbers

HDGeant/hitCDC.c

```
102 // drift radius
103 float dradius=sqrt(xyzcluster[0]*xyzcluster[0]+xyzcluster[1]*xyzcluster[1]);
104
105 // Find the drift time for this cluster. Drift time depends on B:
106 // (dependence derived from Garfield calculations)
107 float B[3],Bmag,x[3];
108 transformCoord(xyzcluster,"local",x,"global");
109 gufld_db_(x,B);
110 Bmag=sqrt(B[0]*B[0]+B[1]*B[1]+B[2]*B[2]);
111 float d2=dradius*dradius;
112 float d3=d2*dradius;
113 float tdrift=t+(-49.41+4.74*Bmag)*dradius+(1129.0+78.66*Bmag)*d2;
114
115 //Longitudinal diffusion
116 int two=2;
117 float rndno[2];
118 grndm_(rndno,&two);
119 float rho = sqrt(-2*log(rndno[0]));
120 float phi = rndno[1]*2*M_PI;
121 float dt=(7.515*dradius-2.139*d2+12.63*d3)*rho*cos(phi);
122 tdrift+=dt;
```

CDC time-to-distance

(in reconstruction)

CDC/DCDCTrackHit_factory.cc

```
102
103     DCDCTrackHit *hit = new DCDCTrackHit;
104     hit->wire = cdcwires[cdchit->ring-1][cdchit->straw-1];
105     hit->is_stereo=((cdchit->ring>4&&cdchit->ring<13)
106                 ||(cdchit->ring>16&&cdchit->ring<25))
107                 ?true:false;
108     hit->tdrift = cdchit->t;
109     double w_eff=29.5e-9;
110     double gas_gain=1e5;
111     double electron_charge=1.6022e-4; /* fC */
112     hit->dE=cdchit->q*w_eff/(gas_gain*electron_charge);
113     hit->dist = hit->tdrift*55.0E-4; // Use number hardwired in simulation for now
114     hit->AddAssociatedObject(cdchit);
```

CDC variance

TRACKING/DTrackFitterRiemann.cc

(not used?)

```
// Smearing function from Yves
inline double cdc_variance(double x){
    // return CDC_VARIANCE;

    x*=10.; // mm
    if (x>7.895) x=7.895; // straw radius in mm
    else if (x<0) x=0.;
    double sigma_d
        =(108.55 + 7.62391*x + 556.176*exp(-(1.12566)*pow(x,1.29645)))*1e-4;

    return sigma_d*sigma_d;
}
```

TRACKING/DTrackFitterKalmanSIMD.h

(used throughout tracking code)

```
502 // Smearing function derived from fitting residuals
503 inline double DTrackFitterKalmanSIMD::cdc_variance(double B,double t){
504     //return CDC_VARIANCE;
505     if (t<0.0) t=0.0;
506
507     //double sigma=0.11/(t+3.6)+4.65e-3;
508     double sigma=0.11/(t+3.6)+4.25e-3;
509     return sigma*sigma;
510 }
```

These should be made into calibration constants

CDC Parameters in CCDB

```
harriet:~>jcalibread -L | grep CDC/
```

```
CDC/cdc_drift
```

```
CDC/cdc_parms
```

namepaths in CCDB

```
harriet:~>jcalibread CDC/cdc_drift
```

```
JANA >>Created JCalibration object of type: JCalibrationCCDB
```

```
JANA >>Generated via: JCalibration using CCDB for MySQL and SQLite databases
```

```
JANA >>Run:100
```

```
JANA >>URL: sqlite:///Users/davidl/HalID/ccdb.sqlite
```

```
JANA >>context: default
```

```
Values for "CDC/cdc_drift" for run 100
```

```
-----  
value 0.0734692
```

drift velocity (read in but apparently not used)

```
harriet:~>jcalibread CDC/cdc_parms
```

```
JANA >>Created JCalibration object of type: JCalibrationCCDB
```

```
JANA >>Generated via: JCalibration using CCDB for MySQL and SQLite databases
```

```
JANA >>Run:100
```

```
JANA >>URL: sqlite:///Users/davidl/HalID/ccdb.sqlite
```

```
JANA >>context: default
```

```
Values for "CDC/cdc_parms" for run 100
```

```
-----  
CDC_DRIFT_SPEED .0055
```

```
CDC_MAX_HITS 1000
```

```
CDC_PEDESTAL_SIGMA 50.0
```

```
CDC_STRAW_RADIUS 0.8
```

```
CDC_TDRIFT_SIGMA 2.8181818181818e-9
```

```
CDC_THRESHOLD_FACTOR 4.0
```

```
CDC_THRESH_KEY 1.
```

```
CDC_TIME_WINDOW 1000.0
```

```
CDC_TWO_HIT_RESOL 25.
```

HDGeant/hitCDC.c

```
34 // Drift speed 2.2cm/us is appropriate for a 90/10 A  
35 static float DRIFT_SPEED = 0.0055;  
36 static float TWO_HIT_RESOL = 25.;  
37 static int MAX_HITS = 1000;  
38 static float THRESH_KEY = 1.;  
39 static float THRESH_MV = 1.;  
40 static float STRAW_RADIUS = 0.776;  
41 static float CDC_TIME_WINDOW = 1000.0; //time window  
42 static float ELECTRON_CHARGE = 1.6022e-4; /* fC */  
43 static float GAS_GAIN = 1e5;
```

*only these are copied from CCDB
by hdgeant*

?

DCDCHit_factory.cc

```
25 //-----
26 // brun
27 //-----
28 jerror_t DCDCHit_factory::brun(jana::JEventLoop *eventLoop, int runnumber)
29 {
30     /// Read in calibration constants (Needs to be done!)
31     a_scale = 1.0E6/1.3E5;
32     a_pedestal = 0.0;
33     t_scale = 8.0; // 8 ns/count
34     t_offset = 0;
35
36     return NOERROR;
37 }
```

```
39 //-----
40 // evnt
41 //-----
42 jerror_t DCDCHit_factory::evnt(JEventLoop *loop, int eventnumber)
43 {
44     /// Generate DCDCHit object for each DCDCDigiHit object.
45     /// This is where the first set of calibration constants
46     /// is applied to convert from digitized units into natural
47     /// units.
48     ///
49     /// Note that this code does NOT get called for simulated
50     /// data in HDDM format. The HDDM event source will copy
51     /// the precalibrated values directly into the _data vector.
52
53     vector<const DCDCDigiHit*> digihits;
54     loop->Get(digihits);
55     for(unsigned int i=0; i<digihits.size(); i++){
56         const DCDCDigiHit *digiHit = digihits[i];
57
58         DCDCHit *hit = new DCDCHit;
59         hit->ring = digiHit->ring;
60         hit->straw = digiHit->straw;
61
62         // Apply calibration constants here
63         double A = (double)digiHit->pulse_integral;
64         double T = (double)digiHit->pulse_time;
65         hit->q = a_scale * (A - a_pedestal);
66         hit->t = t_scale * (T - t_offset);
67         hit->d = 0.0;
68         hit->itrack = -1;
69         hit->ptype = 0;
70
71         hit->AddAssociatedObject(digiHit);
72
73         _data.push_back(hit);
74     }
75
76     return NOERROR;
77 }
```

First application of calibration constants:
Converting into physical units

(needed for raw data, but not for simulated HDDM data)