BigBite Drift Chamber Database

Seamus Riordan
riordan@jlab.org

Carnegie-Mellon University

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This document describes the various aspects of the BigBite spectrometer multiple wire drift chamber software pertaining to data read in from databases. The software facilitating this primarily includes the AGEn library specifically designed for the hardware in the GEn experiement and the Hall A ROOT/analyzer analysis package.

The ROOT/analyzer and AGEn library can be found in the Hall A CVS repository

```
cvs.jlab.org:/group/halla/analysis/cvs
```

under the names `analyzer` and `agen`, respectively.

The database for the BigBite drift chamber contains all the relevant geometry of the detector, the wiremaps to the data aquisition system, and detector specific information regarding data aquisition. This file is contained within the ROOT/analyzer database directory structure and follows the naming conventions as specified by the analyzer. By convention, the file name is `db_B.dc.dat`. A sample database for two planes can be found in Appendix A.

The database directory for an experiment can be found in the environment variable `$DB_DIR`. Inside this directory are a set of subdirectories representing a date. The analyzer automatically takes the time that a run was created and determines the appropriate directory to look for the database. This allows for experiment parameters to evolve over time and still allow old sets of data access to these parameters in a way that requires no user intervention.

The database is organized into sections marked by tags, which will be described in the following sections. Under the current implementation, units of time are given in nanoseconds, units of length are given in meters, and units of velocity are given in meters per nanosecond. The coordinate system is defined such that we have a right handed coordinate system, x is in the dispersion direction, and z is in the beam direction. This can be seen in figure 1.

In general, the spectrometer name, detector name, and plane names are arbitrary and defined when the object is created in the analysis scripts. For most of the examples, we will use a spectrometer name of `B` and a detector name of `dc`.

1 Section [b.global]

The section begining with the line `[b.global]` contains all the names of the planes and a short description of each of those planes. The names given in this section will be used in the plane section tags in the following sections. The section must end with a `[b.global.done]` tag. In the following example the spectrometer name is `b` and the plane names are `u1` and `u2`.

```
[ b.global ]
```

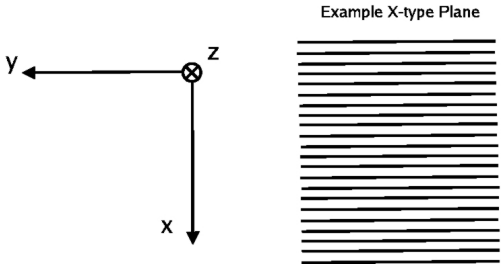

Figure 1: Coordinate system for Bigbite drift chambers

```
u1
first u plane
u2
second u plane
[ b.global.done ]
```

2 Section [B.dc.<plane name>.cratemap]

This section in the database contains the map for each of the individual wires to a TDC channel and asscocated reference channels for the BigBite drift chamber planes. Information specfic to read-out controllers and TDCs is stored in the file `db_cratemap.dat` file. Please refer to the general ROOT/analyzer documentation for more information.

There are two subsections contained here. The first is the reference channel section, which contains the channel number for a TDC that the reference line is connected to. The second subsection contains where the individual wires are connected to the TDC. The wires are associated by the ordering of the channels. For example, if 15 channels are given on the first line in the wire section, wires 1 through 15 are associated with those channels. Wire 16 would be associated with the first channel given in the second line, etc. Both sections follow the same format:

```
<ROC Number>  <TDC>  <First Channel>  <Last Channel>  <TDC Model>  <Reference Chan>
```

- ROC Number - Read-out controller number defined in `db_cratemap.dat`
- TDC - TDC number defined in `db_cratemap.dat`
- First Channel - The first channel number on the TDC for the wire bundle
- Last Channel - The last channel number on the TDC for the wire bundle
- TDC Model - TDC model number defined in `db_cratemap.dat`
- Reference Chan - Line number in the reference channel section referring to reference channel for the wire block. This is set to -1 in the reference channel section. Line counting starts at 0. If no reference channels are used, use -1

The reference channel section and wire section must each end with the line:

```
-1      0       0       0       0       0
```

For example:

```
[ B.dc.u1.cratemap ]
20      1       79      79      767     -1
20      2       32      32      767     -1
20      3       63      63      767     -1
20      4       63      63      767     -1
-1      0       0       0       0        0
20      1       62      48      767      0
20      3       32      47      767      2
20      2       32      47      767      1
20      2       16      31      767      1
20      4       64      48      767      3
-1      0       0       0       0        0
```

In this example for plane `u1`, all the TDCs are in read-out controller `20` and are of the model `767`. There are 4 TDCs we are considering, numbered 1 through 4. TDC 2 has a reference line hooked up to channel 32. Wires 1, 2, and 15 are connected to TDC 1 on channels 62, 61, and 48 respectively. The reference channel for these wires is on the first line (line 0) in the reference channel section. Wire 46 is connected to TDC 2 on channel 16. The reference channel for this wire is described by the second line (line 1) in the reference channel section.

Reference channels are not a necessity for all TDCs. If no reference channels are used, the reference channel section should be blank and the reference channel number should be set to `-1`. For example:

```
[ B.dc.u1.cratemap ]
-1      0       0       0       0       0
3       18      94      80      1877    -1
4       5       80      95      1877    -1
4       9       80      95      1877    -1
4       19      80      95      1877    -1
3       18      47      32      1877    -1
4       4       32      47      1877    -1
3       13      47      32      1877    -1
3       9       47      32      1877    -1
4       18      32      45      1877    -1
-1      0       0       0       0       0
```

3 Section [B.dc.<plane name>.geom]

This section contains all the information about the placement and geometry of a plane as well as information about its resolution and time to distance conversion methods. These are layed out in an intuitive way using the form:

```
<variable> = <value>
```

These variables are:

- `plane.z` - The Z axis position of the plane in meters
- `wire.1xp` - The position of the first sense wire in plane coordinates
- `wire.spacing` - The spacing between sense wires in meters
- `wire.angle` - The angle the wires for the planes are at with respect to the Y-axis in degrees. These must be between the values -90.0 and 90.0 degrees.
- `tdc.res` - The resolution of the TDC in nanoseconds

- `xp.res` - The assumed position resolution of the plane in meters
- `drift.min` - The minimum allowable drift time to consider when decoding raw data in nanoseconds
- `drift.max` - The maximum allowable drift time to consider when decoding raw data in nanoseconds
- `drift.v` - The constant drift velocity to assume if a 2D conversion table is not used to convert between drift time and drift distance given in meters per nanosecond
- `drift.c1` - An optional coefficient determined from the script fitdrift.C for polynomial drift time to distance conversion
- `drift.c2` - An optional coefficient determined from the script fitdrift.C for polynomial drift time to distance conversion
- `drift.c3` - An optional coefficient determined from the script fitdrift.C for polynomial drift time to distance conversion
- `geo.maxx` - The maximum x-coordinate for a track to be considered within the chamber given in meters
- `geo.minx` - The minimum x-coordinate for a track to be considered within the chamber given in meters
- `geo.maxy` - The maximum y-coordinate for a track to be considered within the chamber given in meters
- `geo.miny` - The minimum y-coordinate for a track to be considered within the chamber given in meters
- `geo.minth` - The minimum x slope given as a tangent for a track to be considered within experimental parameters
- `geo.maxth` - The maximum x slope given as a tangent for a track to be considered within experimental parameters
- `geo.minph` - The minimum y slope given as a tangent for a track to be considered within experimental parameters
- `geo.maxph` - The maximum y slope given as a tangent for a track to be considered within experimental parameters
- `geo.xcorr` - X correction in position of the plane in meters
- `geo.ycorr` - Y correction in position of the plane in meters
- `geo.thetacorr` - Polar angle correction of the plane in degrees from the x axis
- `geo.phicorr` - Azimuthal angle correction of the plane in degrees from the x axis
- `reconstructwith` - Determines if the plane is to be used in track reconstruction. `1` for true, `0` for false
- `conv.tablename` - File name of a 2D conversion table to be used for time to distance conversion

Here is an example of this section:

```
[ B.dc.u1.geom ]
plane.z = 0.0
wire.1xp = -0.7025
wire.spacing = 0.01
wire.angle = -60.0
tdc.res = 0.8
xp.res = 2.0e-02
```

```
drift.min = 0
drift.max = 10000
drift.v = 4.5e-05
geo.maxx = 0.85
geo.minx = -0.85
geo.maxy = 0.2
geo.miny = -0.2
geo.minth = -10.0
geo.maxth = 10.0
geo.minph = -2.0
geo.maxph = 2.0
geo.xcorr = 0.01
geo.ycorr = 0.0
geo.thetacorr = 0.0
geo.phicorr = 0.0
reconstructwith = 1
conv.tablename = 2dconvtable.dat
```

4 Section [B.dc.<plane name>.offsets]

This section defines the TDC offsets in nanoseconds to be applied to the drift time measured on a wire. Each wire number is listed and then the offset. After all the wires have been listed, `-1  0.0` must follow the last entry. The offsets are given in a format:

```
<wire number> <offset> ... -1  0.0
```

For a plane of 20 wires, the section will be similar to this:

```
[ B.dc.u1.offsets ]
  0   0.0    1   0.0    2 -19.2    3 -30.7    4 -34.0    5 -37.3
  6 -38.1    7 -39.8    8 -38.1    9 -43.9   10 -43.1   11 -38.1
 12 -40.6   13 -42.2   14 -43.1   15 -39.8   16 -44.7   17 -43.1
 18 -42.2   19 -49.6   -1   0.0
```

4.1 [B.dc.<plane name>.TTD]

This section is not read in and therefore not used.

A Sample Database

This is a sample database for two planes, u1 and u2 in a spectrometer named `B`and a chamber named `dc`:

```
# This file expects units:
# [time] = ns
# [distance] = m
# [velocity] = m/ns
[ b.global ]
u1
first u plane
u2
second u plane
[ b.global.done ]
```

```
############# RIGHT VDCS  ###################
# No of Crate, Slot, First, Last chans, Module
[ B.dc.u1.cratemap ]
20      1       79      79      767     -1
20      2       32      32      767     -1
20      3       63      63      767     -1
20      4       63      63      767     -1
20      5       15      15      767     -1
20      6       15      15      767     -1
20      7       15      15      767     -1
20      8       79      79      767     -1
20      9       127     127     767     -1
20      10      63      63      767     -1
20      11      63      63      767     -1
20      12      47      47      767     -1
21      1       111     111     767     -1
21      2       15      15      767     -1
21      3       15      15      767     -1
21      4       15      15      767     -1
21      5       31      31      767     -1
21      6       31      31      767     -1
21      7       63      63      767     -1
21      8       63      63      767     -1
21      9       15      15      767     -1
21      10      15      15      767     -1
21      11      63      63      767     -1
21      12      95      95      767     -1
-1 0 0 0 0 0
21 6 62 48 767 17
21 7 32 47 767 18
21 8 32 47 767 19
21 9 16 31 767 20
20 6 63 48 767 5
20 7 48 63 767 6
20 4 15 0 767 3
20 3 15 0 767 2
20 9 32 45 767 8
-1 0 0 0 0 0
[ B.dc.u1.geom ]
plane.z = 0.0
wire.1xp = -0.7025
wire.spacing = 0.01
wire.angle = -60.0
tdc.res = 0.8
xp.res = 2.0e-02
drift.min = 0
drift.max = 10000
drift.v = 4.5e-05
geo.maxx = 0.85
geo.minx = -0.85
geo.maxy = 0.2
```

```
geo.miny = -0.2
geo.minth = -10.0
geo.maxth = 10.0
geo.minph = -2.0
geo.maxph = 2.0
geo.xcorr = 0.0
geo.ycorr = 0.0
geo.thetacorr = 0.0
geo.phicorr = 0.0
reconstructwith = 0
conv.tablename = 2dconvtable.dat
# TDC Offset Values
[ B.dc.u1.offsets ]
  0 0.0    1 0.0    2 -19.2    3 -30.7    4 -34.0    5 -37.3
  6 -38.1    7 -39.8    8 -38.1    9 -43.9   10 -43.1   11 -38.1
 12 -40.6   13 -42.2   14 -43.1   15 -39.8   16 -44.7   17 -43.1
 18 -42.2   19 -49.6   20 -48.0   21 -45.5   22 -48.0   23 -47.2
 24 -47.2   25 -44.7   26 -44.7   27 -46.4   28 -41.4   29 -43.9
 30 -45.5   31 -40.6   32 -39.8   33 -43.9   34 -43.9   35 -43.1
 36 -38.9   37 -43.1   38 -41.4   39 -37.3   40 -41.4   41 -42.2
 42 0.0   43 -49.6   44 -41.4   45 -43.9   46 -38.9   47 -38.9
 48 -38.1   49 -39.8   50 -34.8   51 -36.5   52 -38.9   53 -38.9
 54 -45.5   55 -38.9   56 -37.3   57 -37.3   58 -45.5   59 -43.9
 60 -35.6   61 -40.6   62 0.0   63 -21.6   64 -38.9   65 -39.8
 66 -48.0   67 0.0   68 -35.6   69 -32.4   70 0.0   71 0.0
 72 0.0   73 0.0   74 0.0   75 -36.5   76 0.0   77 0.0
 78 0.0   79 0.0   80 0.0   81 0.0   82 0.0   83 0.0
 84 0.0   85 -27.4   86 0.0   87 0.0   88 0.0   89 0.0
 90 0.0   91 0.0   92 0.0   93 0.0   94 0.0   95 0.0
 96 0.0   97 0.0   98 0.0   99 0.0  100 0.0  101 0.0
102 0.0  103 0.0  104 0.0  105 0.0  106 0.0  107 0.0
108 0.0  109 0.0  110 0.0  111 0.0  112 0.0  113 0.0
114 0.0  115 0.0  116 0.0  117 0.0  118 0.0  119 0.0
120 0.0  121 0.0  122 0.0  123 0.0  124 0.0  125 0.0
126 0.0  127 -57.9  128 0.0  129 0.0  130 0.0  131 0.0
132 0.0  133 0.0  134 0.0  135 0.0  136 0.0  137 0.0
138 0.0  139 0.0  140 0.0  141 0.0
 -1  0.
# TTD Lookup Table
[ B.dc.u1.TTD ]
2.550e-08
0
[ B.dc.u2.cratemap ]
20      1       79      79      767     -1
20      2       32      32      767     -1
20      3       63      63      767     -1
20      4       63      63      767     -1
20      5       15      15      767     -1
20      6       15      15      767     -1
20      7       15      15      767     -1
20      8       79      79      767     -1
```

```
20      9       127     127     767     -1
20      10      63      63      767     -1
20      11      63      63      767     -1
20      12      47      47      767     -1
21      1       111     111     767     -1
21      2       15      15      767     -1
21      3       15      15      767     -1
21      4       15      15      767     -1
21      5       31      31      767     -1
21      6       31      31      767     -1
21      7       63      63      767     -1
21      8       63      63      767     -1
21      9       15      15      767     -1
21      10      15      15      767     -1
21      11      63      63      767     -1
21      12      95      95      767     -1
-1 0 0 0 0 0
21 5 29 16 767 16
21 7 0 15 767 18
21 9 48 63 767 20
21 3 63 48 767 14
21 10 32 47 767 21
20 5 47 32 767 4
20 4 47 32 767 3
20 3 47 32 767 2
20 9 0 14 767 8
-1 0 0 0 0 0
[ B.dc.u2.geom ]
plane.z = 0.0064
wire.1xp = -0.6975
wire.spacing = 0.01
wire.angle = -60.0
tdc.res = 0.8
xp.res = 2.0e-02
drift.min = 0
drift.max = 10000
drift.v = 4.5e-05
geo.maxx = 0.85
geo.minx = -0.85
geo.maxy = 0.2
geo.miny = -0.2
geo.minth = -10.0
geo.maxth = 10.0
geo.minph = -2.0
geo.maxph = 2.0
geo.xcorr = 0.0
geo.ycorr = 0.0
geo.thetacorr = 0.0
geo.phicorr = 0.0
reconstructwith = 0
conv.tablename = 2dconvtable.dat
```

```
#TDC Offset Values
[ B.dc.u2.offsets ]
  0 0.0    1 0.0    2 0.0    3 -36.5    4 -36.5    5 -34.8
  6 -35.6    7 -38.1    8 -38.1    9 -38.1   10 -39.8   11 -52.9
 12 -40.6   13 -36.5   14 -42.2   15 -48.0   16 -46.4   17 -108.1
 18 -51.3   19 -48.0   20 -43.1   21 -44.7   22 -49.6   23 -48.0
 24 -49.6   25 -44.7   26 -44.7   27 -44.7   28 -47.2   29 -43.9
 30 -45.5   31 -43.9   32 -43.1   33 -42.2   34 -43.1   35 -45.5
 36 -50.5   37 -48.0   38 -46.4   39 -44.7   40 -45.5   41 -44.7
 42 -44.7   43 -43.9   44 -52.9   45 -47.2   46 -42.2   47 -46.4
 48 -36.5   49 -41.4   50 -44.7   51 -43.9   52 -42.2   53 -41.4
 54 -38.9   55 -43.1   56 -38.9   57 -35.6   58 -43.9   59 -34.0
 60 -38.1   61 -29.1   62 -52.1   63 0.0   64 0.0   65 0.0
 66 0.0   67 0.0   68 0.0   69 0.0   70 0.0   71 0.0
 72 0.0   73 0.0   74 0.0   75 0.0   76 0.0   77 0.0
 78 0.0   79 0.0   80 0.0   81 0.0   82 0.0   83 0.0
 84 0.0   85 0.0   86 0.0   87 0.0   88 0.0   89 0.0
 90 0.0   91 0.0   92 0.0   93 0.0   94 0.0   95 0.0
 96 0.0   97 0.0   98 0.0   99 0.0  100 -41.4  101 0.0
102 0.0  103 0.0  104 0.0  105 0.0  106 0.0  107 0.0
108 0.0  109 0.0  110 0.0  111 0.0  112 0.0  113 0.0
114 0.0  115 0.0  116 0.0  117 0.0  118 -22.5  119 -29.9
120 0.0  121 0.0  122 0.0  123 0.0  124 0.0  125 0.0
126 0.0  127 0.0  128 0.0  129 0.0  130 0.0  131 0.0
132 0.0  133 0.0  134 0.0  135 0.0  136 0.0  137 0.0
138 0.0  139 0.0  140 0.0  141 0.0
 -1  0.
# TTD Lookup Table
[ B.dc.u2.TTD ]
2.550e-08
0
```