Startup Guide for n^3He ***Analysis***

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Version:1.5

Contents

1 Resources

All the startup software and manual related to n^3He experiment can be found from the official git repository with detailed instruction.
The easiest way is to go to n3He wiki (n3he.wikispaces.com) and then click on software from the left panel.
Alternatively, here is a direct link.
Any new change goes to this git repository. You might want to clone the entire repository and pull periodically to be updated. Or you can also download the last release of only what your are interested in.

2 Quick start on basestar

On basestar the data is being transferred and saved to the directories:
/mnt/idata01/data/ (run number: 1-23661),
/mnt/idata02/data/ (run number: 23662 -31839),
/mnt/idata03/data/ (run number: 31840- 40703),
/mnt/idata04/data/ (run number:40704 -44385),
/mnt/idata05/data/ (run number:44386 - 45999),
/mnt/idata06/data/ (run number:46000 -)
and the analysis library is compiled in a shared directory /home/npdg/n3He/libn3He/lib

So a quick start using the compiled library can be as follows from any user account:

1. Add the following lines to the .bashrc file & save it

```
if [ -f /home/npdg/n3He/libn3He/bin/thisn3He.sh ]; then
      . /home/npdg/n3He/libn3He/bin/thisn3He.sh
fi
```

2. Start a new terminal , go to /home/npdg/n3He/libn3He/analysis/ directory & try running sample analysis scripts from ROOT.

3. The data browser GUI (named as n3HeData) can be opened issuing the command/home/npdg/n3He/n3HeData/n3HeData from the terminal. Copy the binary to your home directory if you will be using the GUI frequently.

Other user specific customization can be achieved following the instruction in the ReadMe file in the respective directory.
For a local version of the library and data browser please read the corresponding section.

3 Event length, dead time and file size

The event length set in the clean DAQ at 50 KHz sample rate is :830 . Theoretically the maximum possible value is 50KHz x 16.66 ms = 833 samples per T0 .
But 833 event length gives occasional overlap. So we set to 830.
For dirty DAQ at 100 KHz the theoretical number of samples 100KHz x 16.6666 ms = 1667
But to avoid overlap we set to 1660.
More over the DAQ has fixed dead time(readout time) of 35 samples(with no averaging) at the end of any event. This amount of time will be missed for every event.

Clean DAQ event length 830 with nacc=16,16 with hi resolution mode=1
Dirty DAQ event length 1660 with nacc=1,1 with hi resolution mode=0
where nacc=n,n indicates how many samples being averaged.

Thus number of sample per event:
Clean DAQ: (830-35)/16=49.68 $\sim$ 50 (1 header + 49 samples)
Dirty DAQ: (1660-35)=1625 (1 header + 1624 samples)
Thus the dead time in the DAQ will be –
Clean DAQ : (52 - 49) x 320 micro sec = .96 milli sec
Dirty DAQ : (1667-1624) x 10 micro sec =0.430 milli sec

Run Length/file size calculation:
With 25000 T0 per run-
Clean DAQ file size: 25000 T0 x 50 samples x 4 Byte per sample x 48 Channels =240×10^6 Bytes
Dirty DAQ file size (before process): 25000 T0 x 1625 samples x 4 Bytes per sample x 8 channels = 1300×10^6 Bytes
Dirty DAQ file seize (after process) : 25000 T0 x 1625 samples x 4 Bytes per sample x 2 channels = 325×10^6 Bytes

4 The data file structure

48 Clean DAQ channels divided into two modules:
Each sample is 4 bytes(in hexdump one contiguous pair consists one sample or 4 bytes). Out of this 32 bit(4 bytes) , our data is 24 bit and remaining least significant 8 bits are channel ID.

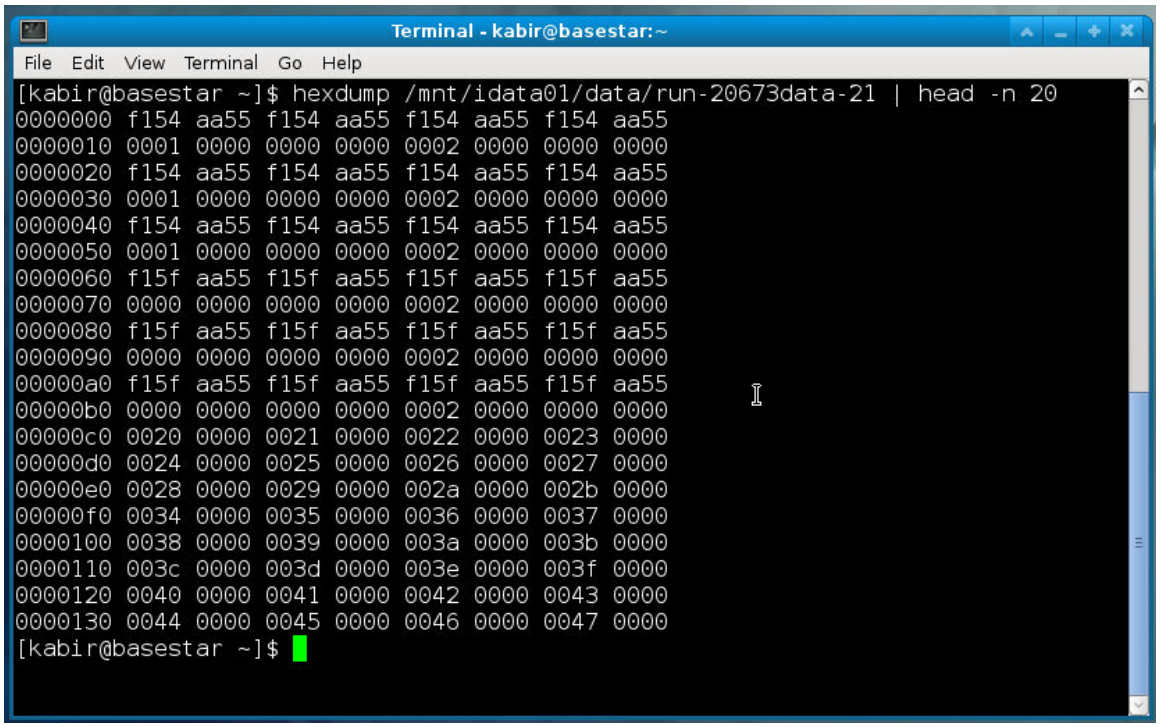


Figure 1: Typical view of hexdump

The above hexdump to be interpreted as follows:
With: mod= module ch = channel

```
mod1event1sample1Ch0 mod1event1sample1ch1 mod1event1sample1ch3 ..... ... ... ... ... mod1event1sample1ch8
mod1event1sample1Ch9 mod1event1sample1ch10 mod1event1sample1ch11 ..... ... ... ... ... mod1event1sample1ch16
mod1event1sample1Ch17 mod1event1sample1ch18 mod1event1sample1ch19 ..... ... ... ... ... mod1event1sample1ch23

mod2event1sample1Ch0 mod2event1sample1ch1 mod2event1sample1ch3 ..... ... ... ... ... mod2event1sample1ch8
mod2event1sample1Ch9 mod2event1sample1ch10 mod2event1sample1ch11 ..... ... ... ... ... mod2event1sample1ch16
mod2event1sample1Ch17 mod2event1sample1ch18 mod2event1sample1ch19 ..... ... ... ... ... mod2event1sample1ch23
```

```
mod1event2sample1Ch0 mod1event2sample1ch1 mod1event2sample1ch3 ..... ... ... ... ... mod1event2sample1ch8
mod1event2sample1Ch9 mod1event2sample1ch10 mod1event2sample1ch11 ..... ... ... ... ... mod1event2sample1ch16
mod1event2sample1Ch17 mod1event2sample1ch18 mod1event2sample1ch19 ..... ... ... ... ... mod1event2sample1ch23

mod2event2sample1Ch0 mod2event2sample1ch1 mod2event2sample1ch3 ..... ... ... ... ... mod2event2sample1ch8
mod2event2sample1Ch9 mod2event2sample1ch10 mod2event2sample1ch11 ..... ... ... ... ... mod2event2sample1ch16
mod2event2sample1Ch17 mod2event2sample1ch18 mod2event2sample1ch19 ..... ... ... ... ... mod2event2sample1ch23

....    ....          ....  ...        ................          .......................    .....
....    ....          ....  ...        ................          .......................    .....
....    ....          ....  ...        ................          .......................    .....
....    ....          ....  ...        ................          .......................    .....

Up to N number of events.
```

Now the first sample of any event is the event header with following structure:
mod1event1sample1Ch0=mod1event1sample1Ch1=
mod1event1sample1Ch2=mod1event1sample1Ch3 = Event Signature-1 (0xaa55f154)
,
mod1event1sample1Ch4= Event Number
mod1event1sample1Ch5 = checksum using path-1
mod1event1sample1Ch6 = sample number
mod1event1sample1Ch7 = checksum using path-2
Then this pattern repeats 3 more times (i.e. in quanta of 8 channels) up to channel-23

mod2event1sample1Ch0 =mod2event1sample1Ch1=mod1event1sample1Ch2
= mod2event1sample1Ch3= Event Signature-2 (0xaa55f15f)
mod1event1sample1Ch4= 0 (always)
mod2event1sample1Ch5 = checksum using path-1
mod2event1sample1Ch6 = sample number
mod2event1sample1Ch7 = checksum using path-2
Then this pattern repeats 3 more times (i.e. in quanta of 8 channels) up to channel-23

For Dirty DAQ the data is taken in 8 channels (bank mask B) with one module only and then processed to 2 channels. On Batch panel, M1 signal is connected to marked channel-26 and RFSF signal is connected to marked channel 27. This corresponds to ADC channel-5 (with checksum) and channel-6 (with sample number) where for ADC channel number starts with 0.

So for the Dirty DAQ after the processing the data structure is:

event1sample1Ch0 event1sample1ch1
event2sample1Ch0 event2sample1ch1
... ...
....

Up to N events.

with the first sample of any event being checksum and sample number i.e.
event1sample1ch0 = checksum.
event1sample1ch1 = sample number.

In the analysis we recommend to skip the last event to be safe in case the last event of the run is a partial event (though every effort has been made to avoid this).

Header of Different channels for each event in decimal format

ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:1	ch#5:0	ch#6:2	ch#7:0
ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:2	ch#5:2966364697	ch#6:704	ch#7:2966364697
ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:3	ch#5:2287808137	ch#6:1406	ch#7:2287808137
ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:4	ch#5:2075675947	ch#6:2108	ch#7:2075675947
ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:5	ch#5:3109521645	ch#6:2810	ch#7:3109521645
ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:6	ch#5:386965141	ch#6:3512	ch#7:386965141
ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:7	ch#5:1729520582	ch#6:4214	ch#7:1729520582
ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:8	ch#5:693835723	ch#6:4916	ch#7:693835723
ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:9	ch#5:1096971516	ch#6:5618	ch#7:1096971516
ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:10	ch#5:1003074332	ch#6:6320	ch#7:1003074332
ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:11	ch#5:2279207300	ch#6:7022	ch#7:2279207300
ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:12	ch#5:1877619817	ch#6:7724	ch#7:1877619817
ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:13	ch#5:1093183995	ch#6:8426	ch#7:1093183995
ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:14	ch#5:2947198100	ch#6:9128	ch#7:2947198100
ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:15	ch#5:1810161880	ch#6:9830	ch#7:1810161880
ch#0:2857759060	ch#1:2857759060	ch#2:2857759060	ch#3:2857759060	ch#4:16	ch#5:1067282547	ch#6:10532	ch#7:1067282547

Figure 2: Header of different channels for each event in decimal

der of Different channels for each event in hexadecimal format (The sample number is also in Hex)

ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:1	ch#5:0	ch#6:2	ch#7:0
ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:2	ch#5:b0cf2219	ch#6:2c0	ch#7:b0cf2219
ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:3	ch#5:885d2e89	ch#6:57e	ch#7:885d2e89
ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:4	ch#5:7bb84d2b	ch#6:83c	ch#7:7bb84d2b
ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:5	ch#5:b95788ed	ch#6:afa	ch#7:b95788ed
ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:6	ch#5:17109e95	ch#6:db8	ch#7:17109e95
ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:7	ch#5:671663c6	ch#6:1076	ch#7:671663c6
ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:8	ch#5:295b17cb	ch#6:1334	ch#7:295b17cb
ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:9	ch#5:416274fc	ch#6:15f2	ch#7:416274fc
ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:a	ch#5:3bc9b31c	ch#6:18b0	ch#7:3bc9b31c
ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:b	ch#5:87d9f184	ch#6:1b6e	ch#7:87d9f184
ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:c	ch#5:6fea3469	ch#6:1e2c	ch#7:6fea3469
ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:d	ch#5:4128a9fb	ch#6:20ea	ch#7:4128a9fb
ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:e	ch#5:afaaac94	ch#6:23a8	ch#7:afaaac94
ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:f	ch#5:6be4e0d8	ch#6:2666	ch#7:6be4e0d8
ch#0:aa55f154	ch#1:aa55f154	ch#2:aa55f154	ch#3:aa55f154	ch#4:10	ch#5:3f9d7073	ch#6:2924	ch#7:3f9d7073

Figure 3: Header of different channels for each event in hex

5 ADC count to Volt conversion and time bin

The resolution and device range of a DAQ device determine the smallest detectable change in the input signal. We can calculate the smallest detectable change,called the precision(code width), using the following formula.

$$Precision = \frac{ADCRange}{2^{resolution}}$$

Our DAQ is a 24 bit ADC. But each sample is stored as 32 bit wording. Out of this 32 bit least significant 8 bit is the channel ID and the remaining 24 bit contains the signal. And the ADC has a range of +10 V to -10 V. Then,

$$Precision = \frac{20Volt}{2^{32}}$$

Thus $4.656612873 \times 10^{-9}$ will be an approximation for the conversion factor from ADC value to volt (if the least 8 bits are NOT thrown away). But to be precise, it is recommended to throw away the least significant 8 bit out of 32 bit, (use $ADCCount >> 8$ in your analysis code), then

$$Precision = \frac{20Volt}{2^{24}}$$

i.e. $1.192092896 \times 10^{-6}$ will be the correct ADC count to volt conversion factor(if 24 bit is used throwing away least significant 8 bit).

The time bin depends on the sample rate at which the DAQ is taking data. For the n3He experiment we run the clean DAQs at 50 KHz sample rate and dirty DAQs at 100KHz. Again for clean DAQs 16 samples are averaged to give one sample and for dirty DAQ no averaging is used. Thus for clean (detector) data each time bin corresponds to:

$$16 \times \frac{1}{50KHz} = 320\mu sec$$

And for dirty data it is

$$\frac{1}{100KHz} = 10\mu sec$$

6 The ADC channel to wire map

Out of 48 clean ADC channels, only 36 ADC channels are connected to the pre-amps (ADC channels 0 to 17 and channels 24 to 41). Moreover there are five bad channels: DAQ21- channels 5 & 6(they are combined on channel 6), DAQ22 channels 35 and DAQ 24 channel-35,39(these have opposite polarity and can be corrected easily by flipping the sign in the analysis).
Following is the ADC channel to wire map for reference:

```
Number of layers = 16;
Number of wires per layer= 9;

Layer_to_DAQ_map[Nlayers]={21, 23, 21, 23, 21, 23, 21, 23,
                       22, 24, 22, 24, 22, 24, 22, 24};

Layer_to_ADC_channel_map[16][9] =
    {
      {0,1,2,3,4,5,6,7,8},
      {0,1,2,3,4,5,6,7,8},
      {9,10,11,12,13,14,15,16,17},
      {9,10,11,12,13,14,15,16,17},
      {24,25,26,27,28,29,30,31,32},
      {24,25,26,27,28,29,30,31,32},
      {33,34,35,36,37,38,39,40,41},
      {33,34,35,36,37,38,39,40,41},
      {0,1,2,3,4,5,6,7,8},
      {0,1,2,3,4,5,6,7,8},
      {9,10,11,12,13,14,15,16,17},
      {9,10,11,12,13,14,15,16,17},
      {24,25,26,27,28,29,30,31,32},
      {24,25,26,27,28,29,30,31,32},
      {33,34,35,36,37,38,39,40,41},
      {33,34,35,36,37,38,39,40,41},
    };
```

Thus , if we label layers and wires starting from 1, then the above mapping to be interpreted as -
The ADC21 , channel-0 corresponds to layer 1 wire 1.
The ADC24, channel-40 corresponds to layer 16 wire 8.

The ADC22, channel-5 corresponds to layer 9 wire 6. And so on.
Where (for Up-down asymmetry) wire 1 label starts from (beam) bottom of any layer. And wire 9 is the (beam) top wire of any layer.
And the layer counting starts from the face where beam enters the chamber.

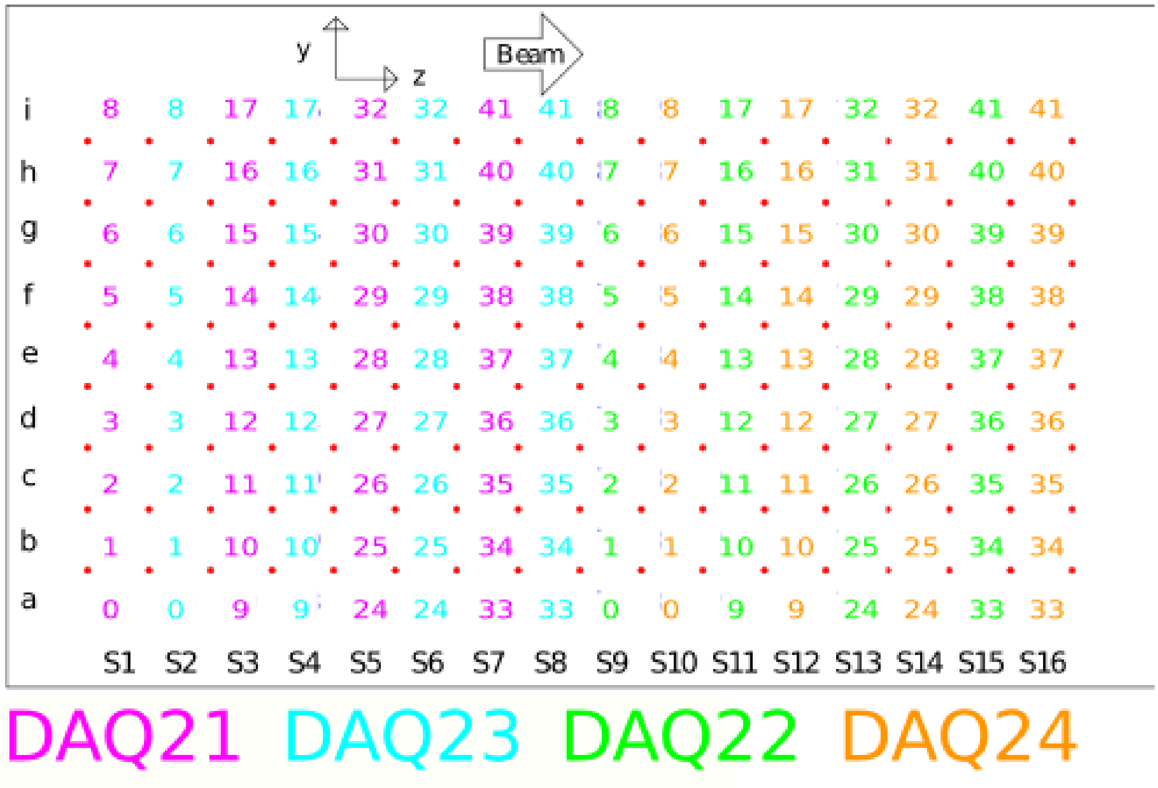


Figure 4: ADC to Wire Map

7 Setting up local version of n3He analysis library on basestar

Eventually you will want to set up your own version of the analysis library and ROOT environment. This way you can modify any part of the library and add more functionality.

1. Download the source code from here.
   lib3He is the analysis library for n3He experiment.
2. Make any necessary changes in Constants.h file that is required.
3. Do make to compile the library.
4. This will produce libn3He.so (shared library will be inside lib directory).
5. Place the .so file in a directory under LD_LIBRARY_PATH .
6. Now start root and load the Library as: gSystem− >Load("libTree") & gSystem− >Load("libn3He.so") . (For Online analysis)
7. For analysis from a script if you include TTree.h file then you need not to do gSystem− >Load("libTree"); Just load gSystem− >Load("libn3He.so"). You need to give full path unless the directory is included in LD_LIBRARY_PATH.
8. If you put the rootlogon.C file in macros directory under Root installation directory, then the library will be loaded automatically and step-6 is NOT necessary.
   If you do NOT have local version of ROOT, rather it's installed under root account(a shared version, which is the case for basestar by default), then just copy system.rootrc file from /usr/share/root to your home directory and rename it to .rootrc, Now add the directory having rootlogon.C file to the list of Unix.*.Root.MacroPath variable.
9. Now from your root script create a Tree by calling: TTreeRaw *my_tree = new TreeRaw(runNumber#) or Just TTreeRaw t(runNumber#)
10. Do my_tree− > Print() to print the tree and branch structure.
11. Now do what ever analysis you want using my_tree .

12. Try running example analysis scripts in “analysis” directory.

13. To make life easier it’s convenient to put the following command into your ~/.bash_profile or ~/.bashrc file:

```
if [ -f /path/to/libn3He/bin/thisn3He.sh ]; then
        . /path/to/libn3He/bin/thisn3He.sh
 fi
```

Note: This version of the library works both for ROOT 5 and ROOT 6.

8 Setting up local version of data browser on basestar

1. Download the source code from here.

2. In bin directory: contains just binary files(obtained after doing make) named n3HeData.

3. In libn3He directory: Contains all the library required for running the Data check GUI.

4. Modify and compile the library (Unless you have already set up the library): You need to change the Data file directory from Constants.h in libn3He to appropriate directory. Before you do make do: make clean in the same directory. and then make a fresh shared binary files after you make any changes.

5. Place .so file under LD_LIBRARY_PATH: Now make sure the shared library (libn3He.so) file is in a directory under your LD_LIBRARY_PATH.

   Alternatively, more convenient and professional way is as follows:

   Include command in your .bashrc file to run thisn3He.sh file each time you open the terminal. i.e. include the following lines:

   ```
   if [ -f path_to/libn3He/bin/thisn3He.sh ]; then
      . path_to/libn3He/bin/thisn3He.sh
   fi
   ```

6. Produce binary for GUI: To produce a new binary file named n3HeData, go to n3HeData directory, open makefile and change LIB_INCLUDE and GLIBS to appropriate location for you and then do make. It will produce n3HeData binary file in the same directory.

7. Run the GUI: Now run the binary file n3HeData by doing ./n3HeData from your recently compiled verson in n3HeData/ .

8. Modify the .desktop file (included one only for Ubuntu distribution) and .sh file in bin directory accordingly and place it in your desktop if you want to run the GUI just by double clicking from your desktop.

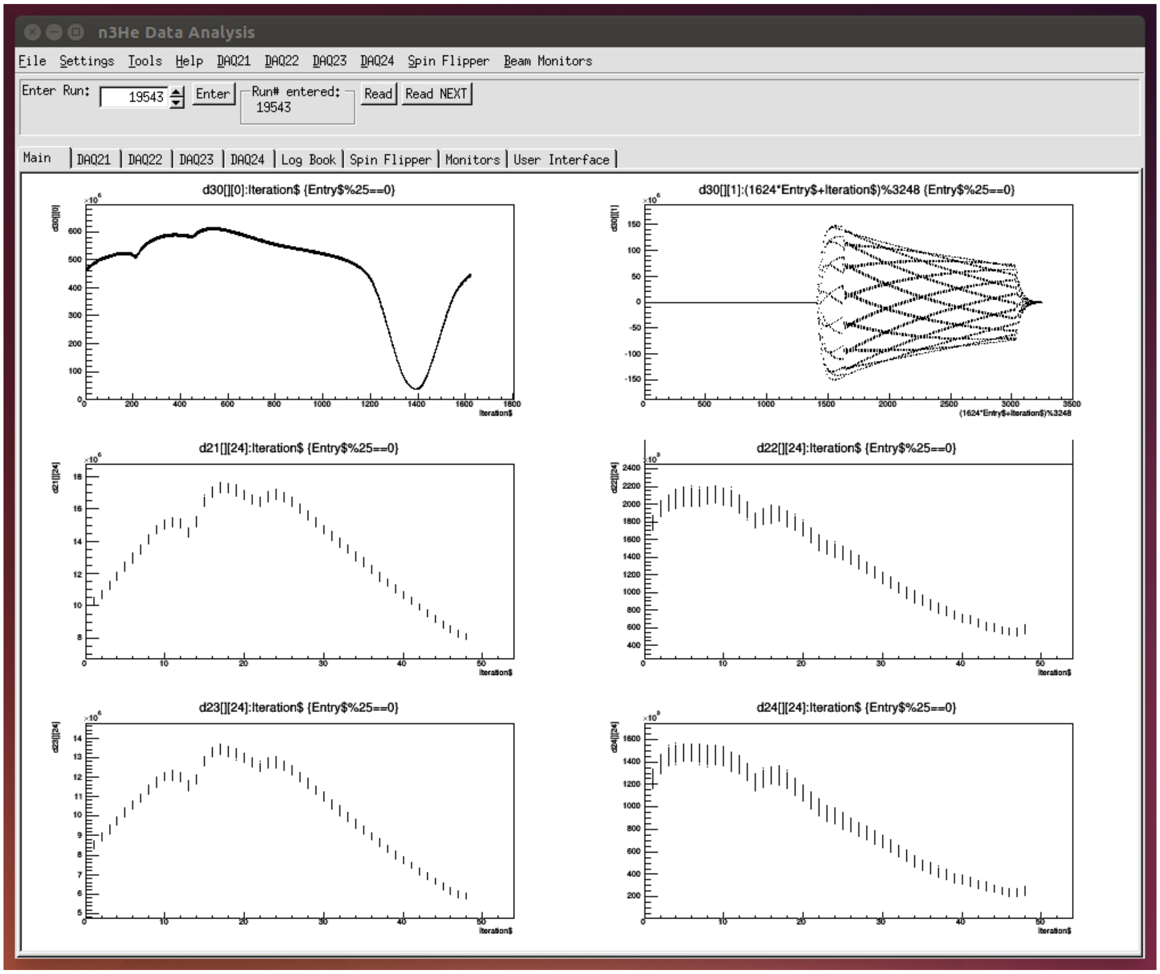


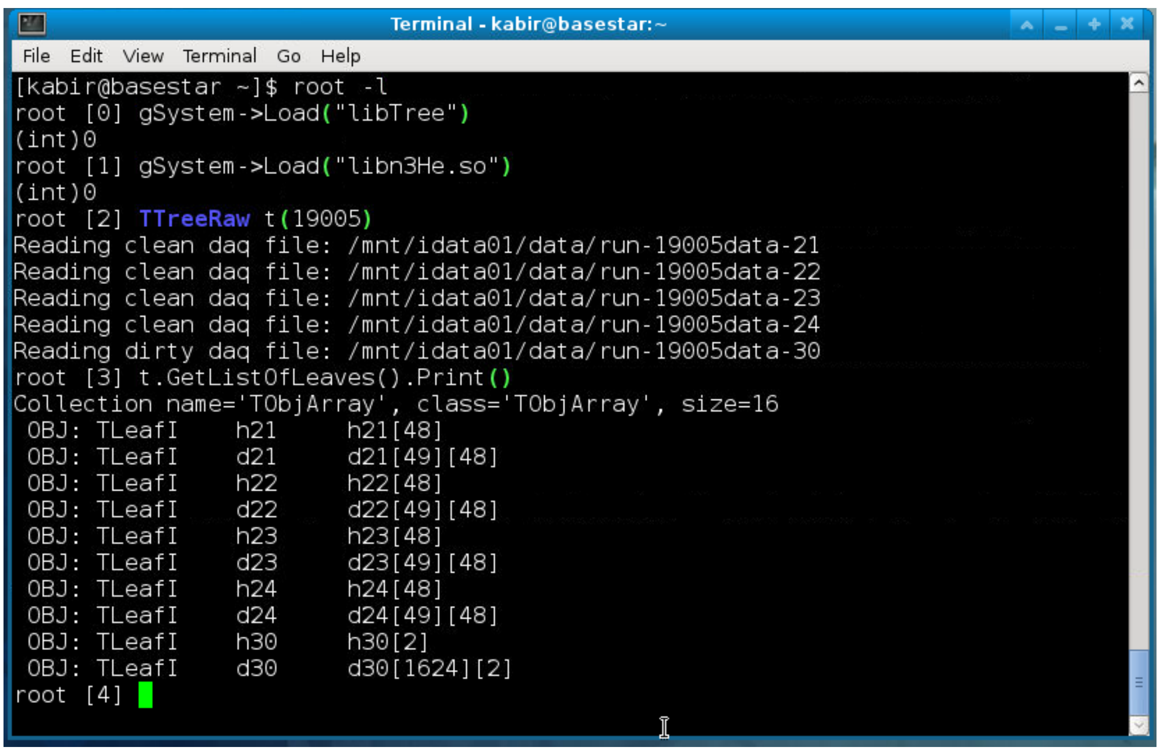
Figure 5: The n3He data browser

9 Current tree structure in n3He analysis libary

Currently n3He Tree has five branches corresponding to four clean DAQ and one dirty DAQ, following is the leaf list in the n3He Tree.

```
DAQ21_LEAF "h21[48]/I:d21[49][48]/I"
DAQ22_LEAF "h22[48]/I:d22[49][48]/I"
DAQ23_LEAF "h23[48]/I:d23[49][48]/I"
DAQ24_LEAF "h24[48]/I:d24[49][48]/I"
DAQ30_LEAF "h30[2]/I:d30[1624][2]/I"
```

where h used to indicate header and d used to indicate detector signal. 21 to 24 are clean DAQs and 30 is dirty DAQ. Clean DAQs contain detector signals. Dirty DAQ (after data processing) ADC channel-0 is monitor-1 signal and ACD channel-1 is RFSF signal.



```
Terminal - kabir@basestar:~
File Edit View Terminal Go Help
[kabir@basestar ~]$ root -l
root [0] gSystem->Load("libTree")
(int)0
root [1] gSystem->Load("libn3He.so")
(int)0
root [2] TTreeRaw t(19005)
Reading clean daq file: /mnt/idata01/data/run-19005data-21
Reading clean daq file: /mnt/idata01/data/run-19005data-22
Reading clean daq file: /mnt/idata01/data/run-19005data-23
Reading clean daq file: /mnt/idata01/data/run-19005data-24
Reading dirty daq file: /mnt/idata01/data/run-19005data-30
root [3] t.GetListOfLeaves().Print()
Collection name='TObjArray', class='TObjArray', size=16
 OBJ: TLeafI    h21    h21[48]
 OBJ: TLeafI    d21    d21[49][48]
 OBJ: TLeafI    h22    h22[48]
 OBJ: TLeafI    d22    d22[49][48]
 OBJ: TLeafI    h23    h23[48]
 OBJ: TLeafI    d23    d23[49][48]
 OBJ: TLeafI    h24    h24[48]
 OBJ: TLeafI    d24    d24[49][48]
 OBJ: TLeafI    h30    h30[2]
 OBJ: TLeafI    d30    d30[1624][2]
root [4]
```

Figure 6: The n3He leaf list

Now the library always skips the first four or five events since those might NOT be reliable. As a result the number of events in any branch for a typical n3He run is 24996 or 24995(This offset is set dynamically).Also in the analysis we recommend to skip the last event to be safe in case the last event of the run is a partial event (though every effort has been made to avoid this).

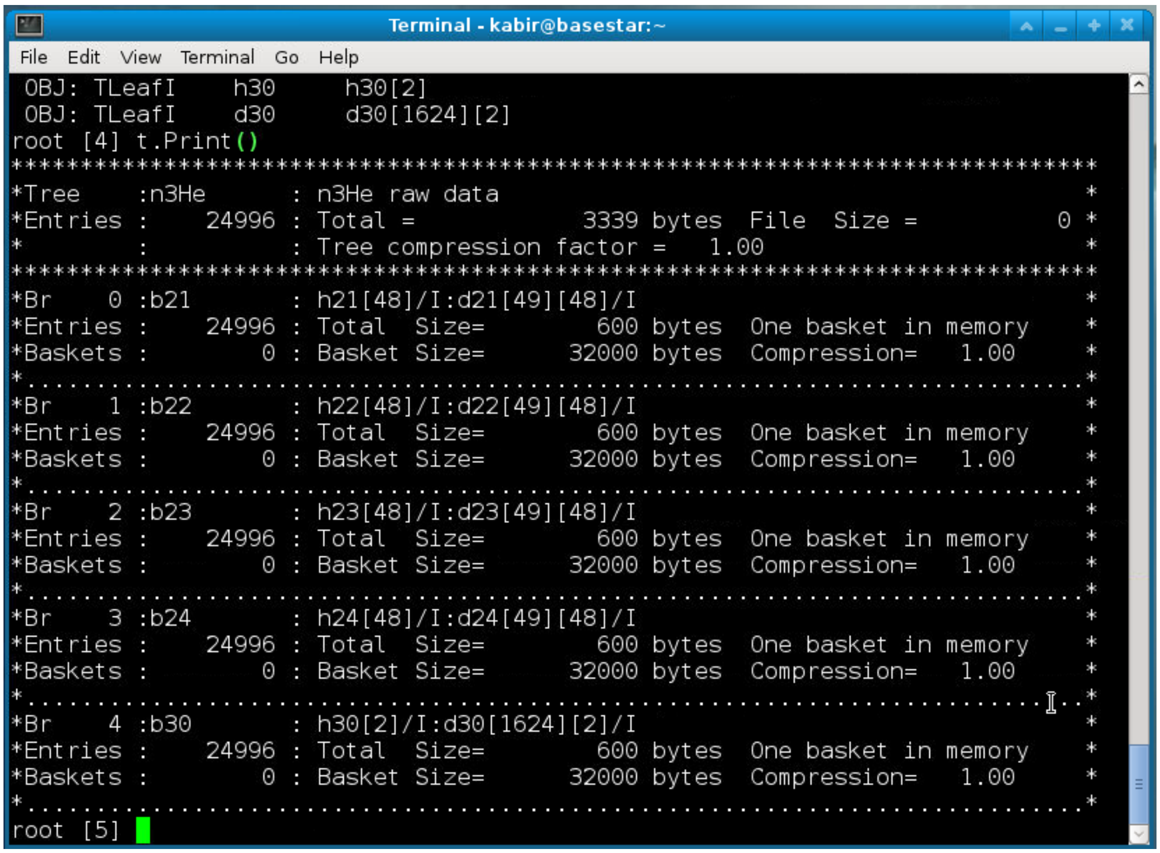


Figure 7: The n3He tree structure

10 Sample analysis

Sample online analysis on basestar:

```
//OnlineAnalysis.C
//Demo Online Analysis using n3He Library.(By Online I mean 'from
   CINT, doing analysis on the fly, less thoughtful but preferred
   in some conditions')
//Author: Latiful Kabir
//Date: 12/23/14

void OnlineAnalysis()
{
   gSystem->Load("libTree"); //You need to load libTree first in
      order to Load libn3He. This is not necessary if you include
      TTree.h
   gSystem->Load("libn3He.so");

   TTreeRaw *t=new TTreeRaw(19900);
   t->Draw("d21[][0]:Iteration$");
}
```

This script when you run using root -l OnlineAnalysis.C will produce the following output:

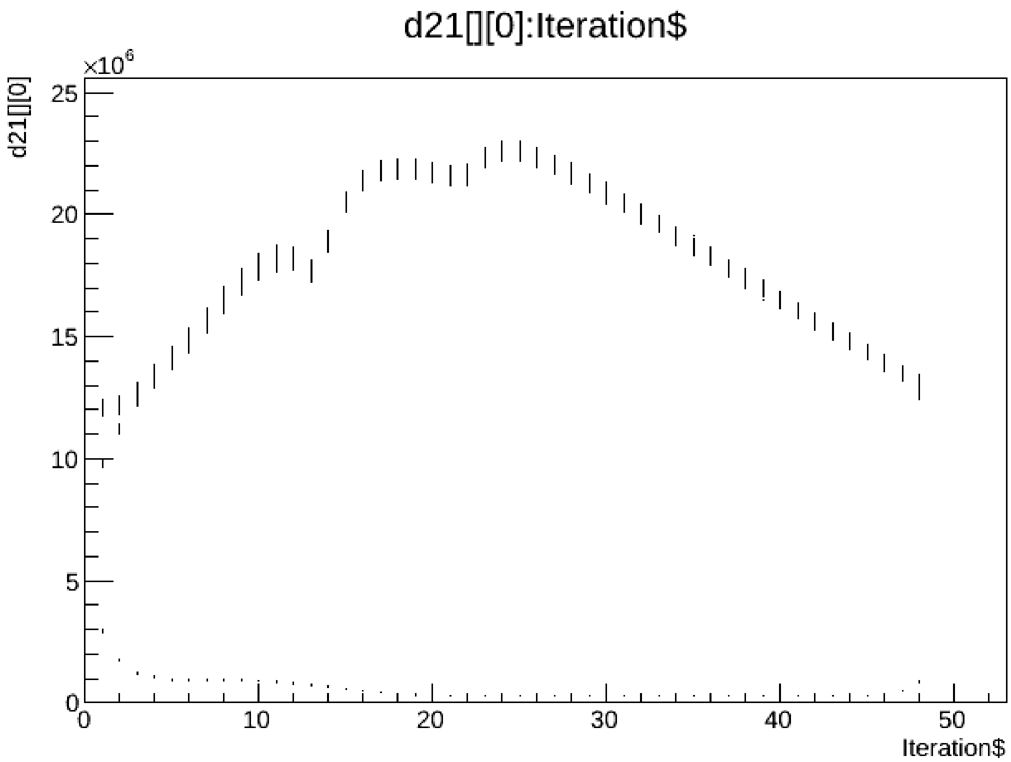


Figure 8: The Output from OnlineAnalysis.C

Sample offline analysis on basestar:

```
//OfflineAnalysis.C
//Demo Offline Analysis using n3He Library.(By Offline I mean 'in
   a script more thoughtful and serious analysis unlike from CINT)
//This script shows how to accress Tree using SetAddress
// and plots only the all event/pulses of channel-0
//Author: Latiful Kabir
//Date: 01/14/15
//This is the fastest and most preferred method for reading Tree

#include<TTree.h>
#include<TBranch.h>
#include<TGraph.h>
```

```
void OfflineAnalysis(){

    //Load the library unless loaded automatically by ROOT
     gSystem->Load("libTree");
     gSystem->Load("libn3He.so");

  //Create a TTreeRaw object with desired run number
  TTreeRaw *t=new TTreeRaw(17900);
  t->Print(); // Print to see what's inside the Tree
  int ch=0; //Channel to analyze

  //Create a struc buffer to keep your events
  struct myData
  {
      int header[48];
      int det[49][48];
  };

  myData md;

  //Get the branch you want to analyze
  TBranch *b=t->GetBranch("b21");
  b->SetAddress(&md.header[0]);

//----------------------------------------------------

  TGraph *g=new TGraph();

  //Loop through all the events in the run.
  for(int i = 0;i < b->GetEntries();i++)
  {
      //Load the samples for a event/pulse in buffer
      b->GetEntry(i);

      //Loops through the sample for the loaded event
      for(int k=0;k<49;k++)
     g->SetPoint(i*49+k,i*49+k,md.det[k][ch]);
  }

  g->Draw("AP");
```

```
  delete t;
}
```

This script when you run using root -l OfflineAnalysis.C will produce the following output when zoomed in:

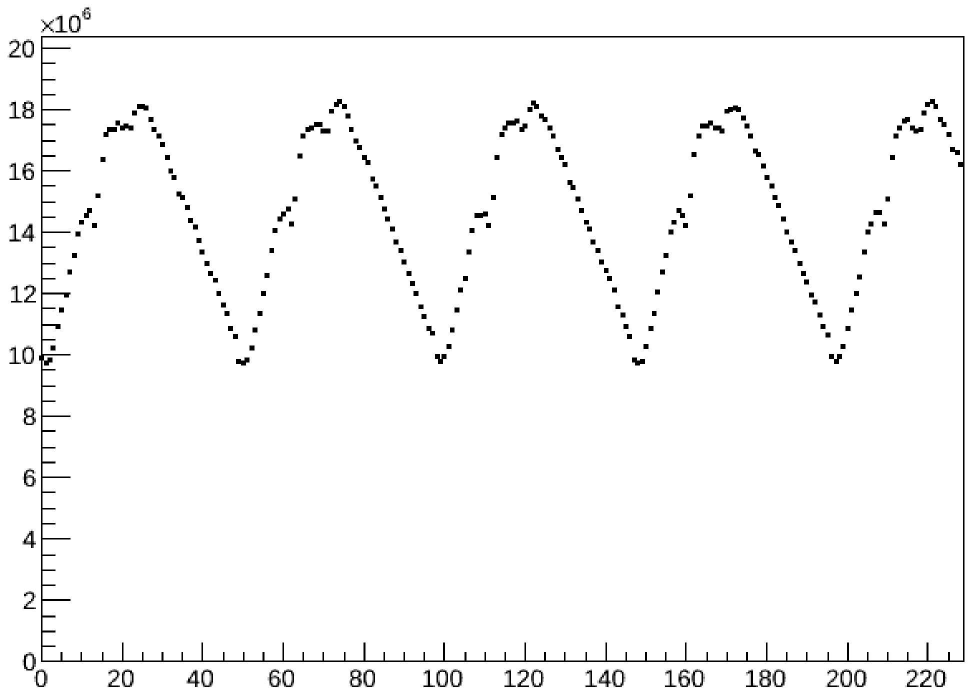


Figure 9: The output from OfflineAnalysis.C

11 Reference for TTreeRaw class

The base Class is TTree.
As a result all data and member functions from TTree are automatically inherited. For a list of TTree data and member functions go here

```
public:

   TString dataPath;
   TString *DaqLeaf;
   TString *dataFile;
   static int module[5];

   TBranch *b21,*b22,*b23,*b24,*b30;

   void Init(int runNumber);
   TTreeRaw(int runNumber);
   ~TTreeRaw();
```

This list will be updated gradually as new functionality is added to the TTreeRaw class.

12 Reference for Run numbers

Actual n3He data with full run length(25000 T0 per run) starts from 14586.

Left Right(PC) Asymmetry Data : Run numbers with beam before 16390 (exclude chopper tuning, polarimetry, beam scan, collimation data runs)

Run range used so far for PC asymmetry analysis :14785 - 15785

Chopper Tuning Data : 15867 - 15924

Instrumental Asymmetry Data : 17357 - 17889 , ...

U/D Asymmetry Data : Starts from run number 17400 and continues as we take data. **For the Up-Down analysis it is recommended to use run numbers after 18000 since we were still testing and changing things before that.**

The stable optimization of n3He library was done for run numbers starting from 17400.

Polarimetry Data : Consecutive short runs are generally polarimetry data. Its generally taken on Wednesday of first week of the month

850KW and 1.2MW runs: Runs before April 25 are 850KW and after that are 1.2MW.

Second Collimation scan runs: 37987-38022

Note: This list is NOT complete. For a complete list or reference work out through the paper log book.

13 Summary of 1st Beam Cycle Data

Run Range: 17400 to 38214 (excluding initial test runs)
Total Runs on tape(on basestar) : 20815
Number of GOOD Runs :16684
Number of runs with partial last event :246 (Still GOOD if last event is skipped)
Number of runs with header/trigger issue : 201
Number of runs with partial beam or NO beam :2820
Number of short runs : 802
Number of runs with synchronization issue : 19
Number of runs with NO data files on basestar: 43

For a complete list of individual run status check the file /mnt/idata05/summary/runList.txt on basestar.

14 List of n3He Parameters

Chopper 1 Phase : 14.045 CW
Chopper 2 Phase : 0.245 CCW
T0 Delay :13.5 ms
DAQ dead time : 0.96 ms
Distance between moderator and detector front face : 18 m (approx)
Vertical B-field(Guide field) value : -9.14$\pm$ 0.02 Gauss.
Number of time bin per event for detector data : 49
Number of time bin per event for M1 data : 1624
Width of each detector data time bin : 320 μ sec.
Width of each M1 data time bin : 10 μ sec
Each run length :
25000 T0 (events) (in raw file)
24996 $\pm$ 1 T0 (events) (when loaded in TTreeRaw)

Others to be included gradually ... ...