The ORCHID and DANG User Guide

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Abstract

DANG, The Detector Array for measuring Neutrons and Gammas, is a heterogeneous array of liquid scintillator detectors, large volume NaI(Tl) detectors, and ^{3}He detectors. ORCHID, the Oak Ridge Conditions at HFIR DAQ, is a data acquisition system written to take data from DANG and was designed to leverage the concurrency provided by modern multi-core processors. DANG and ORCHID are significant component of the ORNL efforts to characterize the backgrounds present in the area that the PROSPECT antineutrino detector (AD) will sit. This document aims to provide a guide to the usage of DANG and ORCHID.

Contents

1 Prerequisites

1.1 Access

One of the first requirements to usage of DANG and/or ORCHID is physical access to the array. This has several requirements for everyone, plus a few extra hoops for foreign nationals.

- General Requirements
  - General Employee Access Training for HFIR access
  - Basic Rad Training
- Additional requirements for foreign nationals
  - Addition of buildings 7900, 7970, 7970A, and 7972 to your PAS request. (The administrative assistant who initially set up your PAS request can help you here.)

Another requirement for usage of DANG and/or ORCHID is computer access. For in person or ORNL internal network access the computer controlling the array, the username is *prospect*. The password for that account can be obtained by speaking with James Matta, mattajt@ornl.gov. To access the the system remotely but from within the ornl internal network issue the following command into a linux terminal *ssh -X prospect@prospect1.phy.ornl.gov* then enter your password. At this point you will be remotely logged in to prospect1.

For remote access from outside the lab or the lab visitor network, because prospect1 is on the internal network as opposed to the open research network, the following requirements need to be met:

- Obtain a UCAMS three character ID
  - Apply for a UCAMS three character ID. This is a somewhat arcane process. If you are a UTK student your best bet is contacting Anne Gladman and asking how to get the process started. Otherwise, contact James Matta, mattajt@ornl.gov, and he will make inquiries.
- Get login1 added to the list of permissions for your UCAMS three character id. For employees, this can be done by contacting the ORNL Solutions Center, this may be the case for non-employees with a UCAMS password, but if they rebuff you, contact James Matta, mattajt@ornl.gov
- Contact the ORNL Solutions Center and get an RSA token so that you can login to login1.ornl.gov, there will be a small cost associated with this so make certain Alfredo Galindo-Uribarri, uribarri@ornl.gov, is aware of your doing this.

Once you have completed these requirements you can access the acquisition machine remotely by issuing the command *ssh -X 3-char-id@login1.ornl.gov* and then proceeding as if you are on the internal network as shown above.

1.2 GNU Screen

1.2.1 Basic Usage

ORCHID is typically run within a session of GNU screen. This makes is possible to start ORCHID from nothing without being physically at the terminal and not having ORCHID quit when you log out. However, GNU screen takes some getting used to. This is a very basic introduction to screen, more can be found in any of the numerous online tutorials about screen. I particularly recommend the tutorial at this site for further learning.

GNU screen is a terminal multiplexer that allows sessions to persist through logoffs. Commands are issued to screen (instead of the terminal within it) by typing *Ctrl+a* and then typing the letter for the command. Some commands are multi-letter or phrases these are used by typing *Ctrl+a*, then typing *:*, and then typing the multi-letter or phrase command.

To start a fresh screen session simply type *screen* in the terminal, to connect to an already existing screen session type *screen -x* instead. Below is the list of useful screen commands that may encountered in the use of ORCHID and DANG

- *Ctrl+a + :multiuser on* – Activate multiuser mode to prevent problems if two people log in to the same screen session. This should be used at screen startup.
- *Ctrl+a + c* – Create a new terminal window / 'tab' in the multiplexer.
- *Ctrl+a + #* – Jump to window / 'tab' number #. Screen starts on window / 'tab' *0*. Creating additional windows / 'tabs' gives them increasing numbers from *1* to *9*.
- *Ctrl+a + d* – Disconnect from the screen session without closing it.
- *Ctrl+a + k* – Kill the current screen window / 'tab'.

1.2.2 Setting Up A Screen Session For ORCHID

To set up a screen session to run orchid and the associated monitoring in the following steps need to be followed.

1. Open a terminal.
2. Start screen (*screen*).
3. Turn on multi user mode (*Ctrl+a + :multiuser on*)
4. Create five additional screen terminals (*Ctrl+a + c* used five times)
5. Switch to window 0 (*Ctrl+a + 0*)
6. Navigate to the ORCHID directory (*cd /home/prospect/ORCHID*)
7. Start ORCHID (*./orchid orchid_cfg*) (more on this later)
8. Switch to window 1 (*Ctrl+a + 1*)
9. Navigate to the ORCHID directory (*cd /home/prospect/ORCHID*)
10. Start display of the ORCHID log file (*watch -n 5 "tail -n 30 orchid_*.log"*)
11. Switch to window 2 (*Ctrl+a + 2*)
12. Navigate to the ORCHID *data* directory (*cd /media/ORNLData/ORCHID_Data*)
13. Start display of the ORCHID data directory (*watch -n 5 "ls -lh RUN_NAME — tail -n 30"*)
14. Switch to window 3 (*Ctrl+a + 3*)
15. Navigate to the ORCHID *data* directory (*cd /media/ORNLData/ORCHID_Data*)
16. Switch to window 4 (*Ctrl+a + 4*)
17. Navigate to the ORCHID directory (*cd /home/prospect/ORCHID*)
18. Switch to window 5 (*Ctrl+a + 5*)
19. Navigate to the DigitizerTester directory (*cd /home/prospect/DigitizerTester*)

With these steps done, window 0 is used for running ORCHID, window 1 is used for a continuous display of the ORCHID log file, window 2 is used for the continuous display of the ORCHID Data files, window 3 is used for running commands in the data directory (like transfers to the ORNL cluster), window 4 is used for running commands in the ORCHID directory (like the HV scripts mentioned below), and finally, window 5 can be used to run a program that reads all the settings registers of the digitizer and outputs them (*./digitizerReader*) or a program that clears the settings of the digitizer, which is useful if the program crashed or something (*./digitizerClearer*).

2 DANG Guide

2.1 Introduction

DANG, pictured on the left of Fig. 1 is a heterogeneous array consisting of eight large volume NaI(Tl) detectors, eight liquid scintillator detectors (containing NE213 liquid scintillator), and two ^{3}He neutron detectors, one moderated, and one unmoderated. The bottom two liquid scintillator detectors are normally not connected (NNC). The right of Fig. 1 shows a clearer layout for DANG, including the NNC liquid scintillator detectors. DANG is mobile and can be moved by unlocking the wheels under the platform and pushing. This will be discussed in somewhat greater detail later.

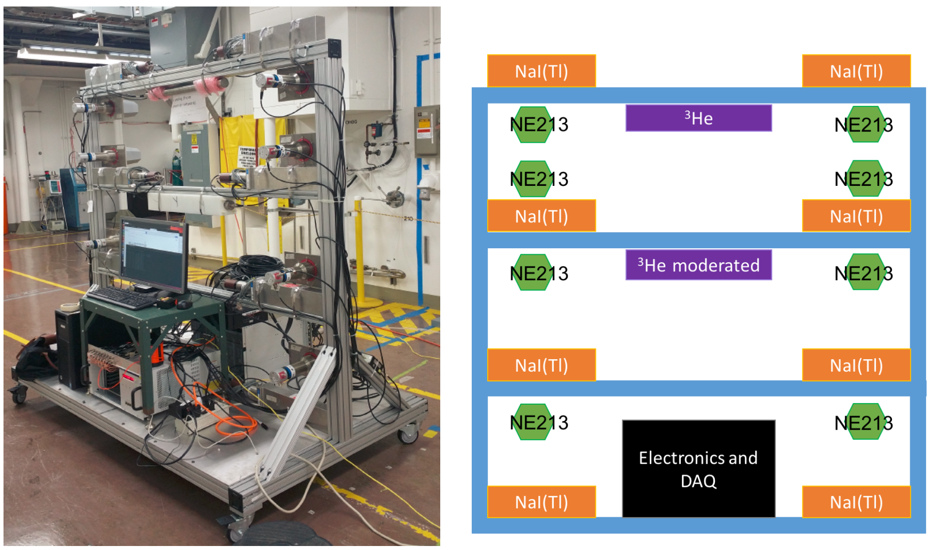

Figure 1: Left: Picture of DANG. Right: Diagram of DANG layout

2.2 Wiring

Fig. 2 shows the digitizer and high voltage connections for the DANG detectors. On the left of Fig. 2 the channel numbers for the VX1730 digitizer are superimposed on the detectors. On the right of Fig. 2, the HV channels are superimposed on the detectors shown in the layout. The format for the HV labels is $uXYY$ where X is the module number and YY is the channel number for that module. Module 0 is the positive voltage module, capable of providing up to $3mA$ at up to $3kV$ on each of its output channels. Module 1 is the negative voltage model, capable of providing up to $3mA$ at up to $-3kV$ on each of its output channels.

The liquid scintillator and NaI(Tl) detectors all have the anode output of their photo-multiplier tubes directly connected to the input of the VX1730 digitizer. However, the two ^{3}He detectors must follow a somewhat more complicated signal path. The output from their preamplifiers is connected to a NIM spectroscopic amplifier whose output is them connected to the digitizer. The spectroscopic amplifier shortens the signals from 100 microseconds to about twelve microseconds and converts a positive tail pulse into a negative gaussian pulse.

2.3 Mobility

A key feature of DANG is the ability to move the array into a variety of positions, this allows measurements of the background field to be made in a variety of locations to map the spatial background variations.

2.3.1 Instructions

To move DANG within a room:

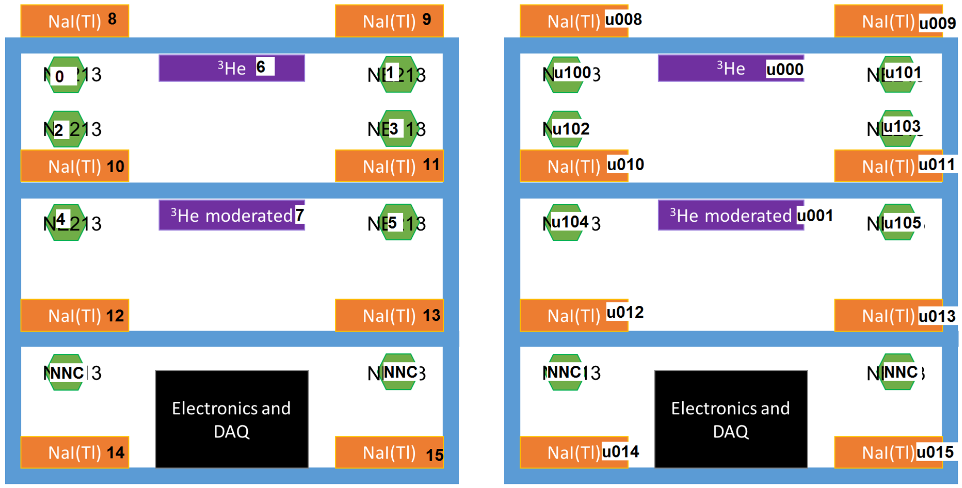

Figure 2: Left: Picture of DANG. Right: Diagram of DANG layout

- Stop data acquisition
- Unlock the wheels of DANG
- Move DANG to the desired location, making sure you do not run over trailing power and network cables
- Lock the wheels
- Change the data acquisition run-name and run-number
- Start data acquisition

To move DANG to another room (for instance from the "experiment room" which will host the PROSPECT AD "near position" to the "MIF room" which will host the AD "far position"):

- Stop data acquisition
- Shutdown ORCHID
- Shutdown the HV output
- Shutdown the computer
- Turn the VME Crate, NIM Crate, and MPOD Crate off
- Unplug the network and power connections
- Unlock the wheels of DANG
- Move DANG to the desired location, making sure you do not run over trailing power and network cables
- Lock the wheels
- Plug in the power connection (and the network connection if there is an available port, there isn't in the MIF room)
- Start the VME, NIM, and MPOD Crates

- Start the computer
- Reset the HV output
- Start the HV output
- Start ORCHID
- Set the data acquisition run-name and run-number
- Start data acquisition

2.3.2 Positioning

Positioning of the DANG array is relatively simple. The coordinate system is show in Fig. 3. In this coordinate system, the hinge of the back door of the MIF room is the origin. Moving from the origin towards the reactor wall, perpendicular to the wall that the MIF back door is part of, is moving in the positive X direction. Moving from the origin towards the roll-up door, parallel to the wall the MIF back door is part of, constitutes moving in the positive Y direction. With the positive Z direction pointing up a right-handed coordinate system is formed.

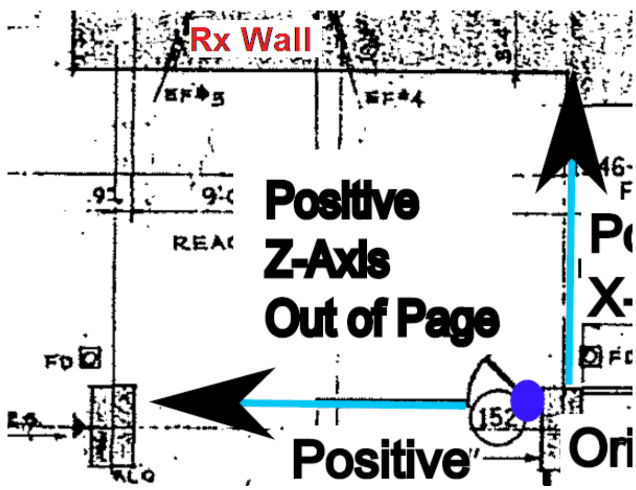

Figure 3: Coordinate system for DANG positioning. The purple dot shows the origin at the hinge of the back door to the MIF room.

Coordinate relative to the origin are measured in inches (because units pain is good for character!). To position DANG at a particular set of coordinates align the center of the outer edge of the right vertical pillar with the location of the coordinate on the floor (as shown in Fig 4). While maintaining that alignment, ensure that the long edges of DANG are parallel to the wall with the back door to the MIF room.

If the array is aligned in this fashion, with the right side facing the negative Y direction, then the detector center positions relative to the floor coordinates are given in Table 1.

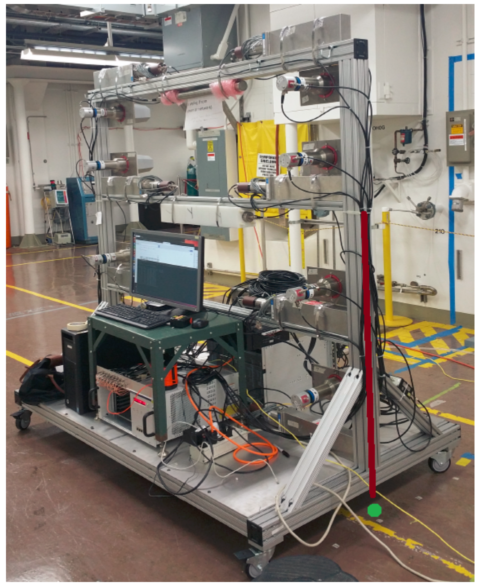

Figure 4: Diagram for aligning DANG with a particular set of coordinates.

Table 1: Detector position offsets, relative to the floor coordinate (X, Y, Z=0) when the coordinate is aligned under the outer edge of the right vertical pillar and the long edges are parallel to the MIF room back wall.

Det. Type	Det. Num.	X Offset	Y Offset	Z Offset
Liquid Scintillator	0	3.5	70.0	73.0
Liquid Scintillator	1	3.5	9.0	73.0
Liquid Scintillator	2	3.5	70.0	60.0
Liquid Scintillator	3	3.5	9.0	60.0
Liquid Scintillator	4	3.5	70.0	38.0
Liquid Scintillator	5	3.5	9.0	38.0
Unmoderated ^{3}He	6	0.0	39.0	75.0
Moderated ^{3}He	7	0.0	39.0	50.0
NaI(Tl)	8	0.0	68.0	81.0
NaI(Tl) (Alt. Base)	9	0.0	11.0	81.0
NaI(Tl) (Alt. Base)	10	0.0	68.0	55.0
NaI(Tl)	11	0.0	11.0	55.0
NaI(Tl)	12	0.0	68.0	33.0
NaI(Tl)	13	0.0	11.0	33.0
NaI(Tl)	14	0.0	68.0	11.0
NaI(Tl)	15	0.0	11.0	11.0

2.4 MPOD Usage

Using the MPOD is most conveniently achieved through a set of scripts in the ORCHID sub-directory of the prospect user's home directory ("/home/prospect/ORCHID", frequently referred to as " /ORCHID"). Running the script *resetHV.sh* will set the maximum currents and voltages to sane values for all the channels, send reset error condition signals to all the channels, and ensure that all the channels outputs are turned off. Running the script *startHV.sh* will set the output voltages to the values selected for all the detectors in the array (assuming the detectors are wired as shown in the right of Fig 2) and turn the outputs on. Running the script *stopHV.sh* will set all the detector voltages to 0 volts and deactivate all outputs. Finally *statHV.sh* will print out the current measurement of Terminal Voltages, Sense Voltages and Output Currents for all the channels. Below is a quick summary of these commands.

- *startHV.sh* – Turn on all used voltage channels and set their values as appropriate for the attached detectors.
- *stopHV.sh* – Turn off all used voltage channels and set their values to zero.
- *statHV.sh* – Print voltages and currents for all channels.
- *resetHV.sh* – Reset current and voltage limits, reset error conditions, ensure that all channels are off.

Table 2 contains the set voltages and expected currents for each detector that is currently in DANG.

Table 2: Detector position offsets, relative to the floor coordinate (X, Y, Z=0) when the coordinate is aligned under the outer edge of the right vertical pillar and the long edges are parallel to the MIF room back wall.

Det. Type	Det. Num.	Set Voltage	Typical Current
Liquid Scintillator	0	$1240V$	405.0μ
Liquid Scintillator	1	$1240V$	404.0μ
Liquid Scintillator	2	$1240V$	404.0μ
Liquid Scintillator	3	$1240V$	405.0μ
Liquid Scintillator	4	$1240V$	405.0μ
Liquid Scintillator	5	$1240V$	405.0μ
Unmoderated ^{3}He	6	$1700V$	0.0μ
Moderated ^{3}He	7	$1700V$	0.0μ
NaI(Tl)	8	$1000V$	187.0μ
NaI(Tl) (Alt. Base)	9	$1200V$	359.0μ
NaI(Tl) (Alt. Base)	10	$1200V$	359.0μ
NaI(Tl)	11	$1000V$	185.0μ
NaI(Tl)	12	$1000V$	185.0μ
NaI(Tl)	13	$1000V$	186.0μ
NaI(Tl)	14	$1000V$	186.0μ
NaI(Tl)	15	$1000V$	187.0μ

3 ORCHID Guide

ORCHID is a multi-threaded data acquisition system built on the boost, ncurses, and CAENComm libraries. It pipelines the acquisition by having a thread which manages pulling data from the digitizer, multiple threads to process the digitizer data blocks into individual events, a thread to query/monitor the MPOD system (and any other slow controls systems that may come later), a thread to manage user display and control, and finally a thread to take events and slow controls data and write it to disk.

3.1 Configuration Files

There are five configuration files for ORCHID. These configuration files contain a good deal of comments (lines starting with a #) explaining the input information within them. A brief explanation of each file follows.

The primary configuration file (usually called "orchid_cfg") stores a few basic settings. The path to the output directory for the data written. The number of processing threads to create, the number of times per second that the UI thread should update, the paths to the two digitizer configuration files, the paths to the two MPOD configuration files, the MPOD IP address, the slow controls polling rate, the MPOD SNMP support file, and options for if ORCHID should attempt to power on and power off the MPOD HV channels itself.

The MPOD module configuration file (usually called "orchid_mpod_mod_params.csv") is a csv that contains a line for every MPOD module that needs to be queried / controlled by ORCHID. The data here is simple, which modules are on and off, maximum voltages and currents, current trip times, what the module number is (set by slot number), etc.

The MPOD channel configuration file (usually called "orchid_mpod_chan_params.csv") is a csv that contains a line for every MPOD module channel combination that needs to be queried / controlled by ORCHID. The data here is simple, module number, channel number, ramp rate, voltage set point current set point, and maximum time that current can be exceeded in milliseconds.

The digitizer module configuration file (usually called "orchid_digitizer_mod_params.csv") is a csv that contains a line for every VX1730 digitizer module that needs to be queried / controlled by ORCHID. Unlike the HV configuration, you cannot break any equipment with this file, but you might "break" the data that we extract from DANG. There are a *lot* of entries in this file. I do my best in the comments of the file to explain what these options are, if you are in doubt contact James Matta, mattajt@ornl.gov.

The digitizer channel configuration file (usually called "orchid_digitizer_chan_params.csv") is a csv that contains a line for every VX1730 digitizer channel that needs to be queried / controlled by ORCHID. Unlike the HV configuration, you cannot break any equipment with this file, but you might "break" the data that we extract from DANG. There are a *lot* of entries in this file. I do my best in the comments of the file to explain what these options are, if you are in doubt contact James Matta, mattajt@ornl.gov.

3.2 Starting ORCHID

Once everything is connected and the HV is started, starting ORCHID is simple. Simply type *./orchid orchid_cfg* in the command line of window 0 in the screen session (as stated in the instructions for screen.) As ORCHID starts it will regurgitate the input files it read onto the screen as seen in Figs. 5, 6, 7, 8, and 9.

Once it has displayed this you can press *enter* to proceed with starting orchid or *Ctrl+c* to quit if, on review, you find a parameter is incorrect.

```
prospect@prospect1:~/ORCHID$ ./orchid orchid_cfg


  OOOO           kk              RRRR            dd
OO    OO         kk              RR  RR   ii     dd          eeee
OO    OO   aa    kk  kk          RR  RR          dd         ee  ee
OO    OO aa  aa  kkkk            RRRR     ii  ddddd  ggggg eeeee
OO    OO aa  aa  kk  kk          RR RR    ii dd  dd gg  gg ee
  OOOO     aa aa kk   kk         RR  RR   ii  ddddd  ggggg  eeeee
                                                        gg
                                                     gggg

  CCCC                    dd      tt
 CC                       dd ii   tt   ii                 ssss
CC       oo    n nnn      dd    tttttt      oo    n nnn  ss
CC     oo  oo  nn  nn  ddddd ii   tt   ii oo  oo nn  nn  ssss
 CC    oo  oo  nn  nn dd  dd ii   tt   ii oo  oo nn  nn     ss
  CCCC   oo    nn  nn  ddddd ii   tt   ii   oo    nn  nn ssss



          tt           HH  HH   fff  IIIIII
          tt           HH  HH  ff ff   II
  aa    tttttt         HHHHHH  ff      II   rrrrr
aa  aa    tt           HH  HH ffff     II   rr  rr
aa  aa    tt           HH  HH  ff      II   rr
  aa aa   tt           HH  HH  ff    IIIIII rr

DDDD
DD  DD
DD   DD   aa      qq
DD   DD aa  aa  qq  qq
DD  DD  aa  aa  qq  qq
DDDD      aa aa   qqqq
                    qq qq
                    qqqq

=============================================================================
=============================================================================
=                                                                           =
=                                                                           =
=     OOOO     RRRRRR          CCCCCC  HH      HH  IIIIIIIIII  DDDDD        =
=   OOO  OOO   RR   RRR      CCC       HH      HH  IIIIIIIIII  DD  DDD      =
=  OO      OO  RR      RR   CCC        HH      HH      II      DD    DDD    =
=  OO      OO  RR      RR  CCC         HH      HH      II      DD      DD   =
=  OO      OO  RR   RRR    CCC         HHHHHHHHHH      II      DD      DD   =
=  OO      OO  RRRRRR      CCC         HHHHHHHHHH      II      DD      DD   =
=  OO      OO  RR   RR     CCC         HH      HH      II      DD      DD   =
=  OO      OO  RR    RR     CCC        HH      HH      II      DD    DDD    =
=   OOO  OOO   RR     RR     CCC       HH      HH  IIIIIIIIII  DD  DDD      =
=     OOOO     RR      RR      CCCCCC  HH      HH  IIIIIIIIII  DDDDD        =
=                                                                           =
=                                                                           =
=============================================================================
=============================================================================
    Version:
            0.9.0
    Build Mode:
               OptDebug

```

Figure 5: ORCHID output at startup

```
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Reading Primary Input from the file: orchid_cfg
Input File Parsing: Succeeded
Input File Validation Succeeded
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Reading MPOD Module Data from the file: ./orchid_mpod_mod_params.csv
MPOD Module Data File Parsing: Succeeded
MPOD Module Data Validation Succeeded
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Reading MPOD Channel Data from the file: ./orchid_mpod_chan_params.csv
MPOD Channel Data File Parsing: Succeeded
MPOD Channel File Validation Succeeded
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Reading MPOD Module Data from the file: ./orchid_digi_mod_params.csv
MPOD Module Data File Parsing: Succeeded
Digitizer Module Data Validation Succeeded
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Reading MPOD Module Data from the file: ./orchid_digi_chan_params.csv
MPOD Module Data File Parsing: Succeeded
Digitizer Module Data Validation Succeeded
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~



Input Parameters
================================================================================

--------------------------------------------------------------------------------
Base Parameter Input File
[Start]
[GeneralBlock]
    WarnRate              = 200000
    UpdateFrequency       = 20
    ProcessingThreadCount = 3
    BaseOutputDirectory   = /media/ORNLData/ORCHID_Data/
[EndBlock]
[DigitizerBlock]
    PerChannelParameterFile  = ./orchid_digi_chan_params.csv
    PerModuleParameterFile   = ./orchid_digi_mod_params.csv
[EndBlock]
[PowerBlock]
    PerModuleParameterFile   = ./orchid_mpod_mod_params.csv
    PerChannelParameterFile  = ./orchid_mpod_chan_params.csv
    IPAddress                = 192.168.11.11
    WienerMibFileDirectory   = /usr/share/snmp/mibs
    PollingRate              = 1
    PerformPowerOn           = false
    PerformPowerOff          = false
[EndBlock]
[End]
--------------------------------------------------------------------------------
```

Figure 6: ORCHID output at startup

```
--------------------------------------------------------------------------------
MPOD Module Input File
Module, Channels, On, Max Rise(V/s), Max Fall(V/s), Max Set V(V), Max Set I(uA), Max Trip Time(ms)
     0,       16,  T,         100.0,         100.0,       2000.0,         500.0,                250
     1,       16,  T,         100.0,         100.0,       2000.0,         500.0,                250

--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
MPOD Channel Input File
Board, Chan, On, Rise Rate(V/s), Fall Rate(V/s), Voltage(V), Max I(uA), Trip Time(ms)
    0,    0,  T,           50.0,           50.0,     1700.0,      10.0,             50
    0,    1,  T,           50.0,           50.0,     1700.0,      10.0,             50
    0,    2,  F,            0.0,            0.0,        0.0,       0.0,             50
    0,    3,  F,            0.0,            0.0,        0.0,       0.0,             50
    0,    4,  F,            0.0,            0.0,        0.0,       0.0,             50
    0,    5,  F,            0.0,            0.0,        0.0,       0.0,             50
    0,    6,  F,            0.0,            0.0,        0.0,       0.0,             50
    0,    7,  F,            0.0,            0.0,        0.0,       0.0,             50
    0,    8,  T,           50.0,           50.0,     1000.0,     400.0,             50
    0,    9,  T,           50.0,           50.0,     1200.0,     500.0,             50
    0,   10,  T,           50.0,           50.0,     1200.0,     500.0,             50
    0,   11,  T,           50.0,           50.0,     1000.0,     400.0,             50
    0,   12,  T,           50.0,           50.0,     1000.0,     400.0,             50
    0,   13,  T,           50.0,           50.0,     1000.0,     400.0,             50
    0,   14,  T,           50.0,           50.0,     1000.0,     400.0,             50
    0,   15,  T,           50.0,           50.0,     1000.0,     400.0,             50
    1,    0,  T,           50.0,           50.0,     1240.0,     500.0,             50
    1,    1,  T,           50.0,           50.0,     1240.0,     500.0,             50
    1,    2,  T,           50.0,           50.0,     1240.0,     500.0,             50
    1,    3,  T,           50.0,           50.0,     1240.0,     500.0,             50
    1,    4,  T,           50.0,           50.0,     1240.0,     500.0,             50
    1,    5,  T,           50.0,           50.0,     1240.0,     500.0,             50
    1,    6,  F,            0.0,            0.0,        0.0,     500.0,             50
    1,    7,  F,            0.0,            0.0,        0.0,     500.0,             50
    1,    8,  F,            0.0,            0.0,        0.0,     500.0,             50
    1,    9,  F,            0.0,            0.0,        0.0,     500.0,             50
    1,   10,  F,            0.0,            0.0,        0.0,     500.0,             50
    1,   11,  F,            0.0,            0.0,        0.0,     500.0,             50
    1,   12,  F,            0.0,            0.0,        0.0,     500.0,             50
    1,   13,  F,            0.0,            0.0,        0.0,     500.0,             50
    1,   14,  F,            0.0,            0.0,        0.0,     500.0,             50
    1,   15,  F,            0.0,            0.0,        0.0,     500.0,             50

--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
```

Figure 7: ORCHID output at startup

```
--------------------------------------------------------------------------------
Digitizer Module Input File
_________________________________________________________________________________________________________
Link Number, DC Num, Link Type, VME Base Address, Enable Auto Flush, Propogate Triggers, Record Waveforms,
          0,      0,  DOptical,       0x00000000,                 F,                  F,                F,
____________________________________________________________________________________________________________
Link Number, DC Num, Analog Probe, Dual Trace, Rec Extra Word, Virt Probe 1, Virt Probe2, Chan Buff/Aggregate,
          0,      0,            0,          1,              T,            0,           0,                   8,
_____________________________________________________________________________________________________________________
Link Number, DC Num, Trig Count Method, Mem Full Mode, PLL Ref Clock, Gbl CP Trig Mask, Gbl Coin Window, Gbl Majority,
          0,      0,                 0,             0,             0,             0x00,               0,            0,
__________________________________________________________________________________________________________________
Link Number, DC Num, Ext Trig, CP TOut Mask, TOut Gen Log, TOut Majority, Ext Trig For TOut, Mem Buff Almost Full,
          0,      0,        T,         0x00,            0,             0,                 0,                    0,
__________________________________________________________________________________________________
Link Number, DC Num, Start/Stop Delay, Use Ext Trig, Interrupt Evnt Count, Aggregates Per Block
          0,      0,                0,            T,                    6,                  255

--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Digitizer Module Input File
__________________________________________________________________________________________________
Mod#, Chan#, Enabled, Rec Len, Big Range, Aggregate Evnts, PreTrigger, CFD Delay, CFD Fraction,
   0,     0,       T,      18,         T,            1023,          6,         5,            0,
   0,     1,       T,      18,         T,            1023,          6,         5,            0,
   0,     2,       T,      18,         T,            1023,          6,         5,            0,
   0,     3,       T,      18,         T,            1023,          6,         5,            0,
   0,     4,       T,      18,         T,            1023,          6,         5,            0,
   0,     5,       T,      18,         T,            1023,          6,         5,            0,
   0,     6,       T,      18,         T,            1023,          6,         5,            0,
   0,     7,       T,      18,         T,            1023,          6,         5,            0,
   0,     8,       T,     186,         T,            1023,          8,         5,            0,
   0,     9,       T,     186,         T,            1023,          8,         5,            0,
   0,    10,       T,     186,         T,            1023,          8,         5,            0,
   0,    11,       T,     186,         T,            1023,          8,         5,            0,
   0,    12,       T,     186,         T,            1023,          8,         5,            0,
   0,    13,       T,     186,         T,            1023,          8,         5,            0,
   0,    14,       T,     186,         T,            1023,          8,         5,            0,
   0,    15,       T,     186,         T,            1023,          8,         5,            0,
_____________________________________________________________________________________________________
Mod#, Chan#, Sh Gate, Lg Gate, Gt Offset, Trig Thresh, Fixed Bsl, Shaped Trig Width, Trig Holdoff,
   0,     0,      17,      38,         6,          65,         0,                 1,           16,
   0,     1,      17,      38,         1,          65,         0,                 1,           16,
   0,     2,      17,      36,         1,          65,         0,                 1,           16,
   0,     3,      17,      40,         1,          65,         0,                 1,           16,
   0,     4,      17,      38,         1,          65,         0,                 1,           16,
   0,     5,      17,      38,         1,          65,         0,                 1,           16,
   0,     6,     200,     400,        10,         100,         0,                 1,          800,
   0,     7,     200,     400,        10,         100,         0,                 1,          800,
   0,     8,     188,     376,        10,          65,         0,                 1,          100,
   0,     9,     188,     376,        10,          65,         0,                 1,          100,
   0,    10,     188,     376,        10,          65,         0,                 1,          100,
   0,    11,     188,     376,        10,          65,         0,                 1,          100,
   0,    12,     188,     376,        10,          65,         0,                 1,          100,
   0,    13,     188,     376,        10,          65,         0,                 1,          100,
   0,    14,     188,     376,        10,          80,         0,                 1,          100,
   0,    15,     188,     376,        10,          80,         0,                 1,          100,
__________________________________________________________________________________________________
Mod#, Chan#, PSD Thresh, Q Sens, Q Pedestal, DPP Trig Counting, Disc Mode, Polarity, Trig Mode,
   0,     0,          0,      1,          F,                 0,         0,        1,         0,
   0,     1,          0,      1,          F,                 0,         0,        1,         0,
   0,     2,          0,      1,          F,                 0,         0,        1,         0,
   0,     3,          0,      1,          F,                 0,         0,        1,         0,
   0,     4,          0,      1,          F,                 0,         0,        1,         0,
   0,     5,          0,      1,          F,                 0,         0,        1,         0,
   0,     6,          0,      1,          F,                 0,         0,        1,         0,
   0,     7,          0,      1,          F,                 0,         0,        1,         0,
   0,     8,          0,      2,          F,                 0,         0,        1,         0,
   0,     9,          0,      2,          F,                 0,         0,        1,         0,
   0,    10,          0,      2,          F,                 0,         0,        1,         0,
   0,    11,          0,      2,          F,                 0,         0,        1,         0,
   0,    12,          0,      2,          F,                 0,         0,        1,         0,
```

Figure 8: ORCHID output at startup

```
   0,    13,       0,       2,        F,              0,         0,        1,          0,
   0,    14,       0,       2,        F,              0,         0,        1,          0,
   0,    15,       0,       2,        F,              0,         0,        1,          0,

Mod#, Chan#, Bsl Mean, No Self Trig, PSD Cut Blw Thresh, PSD Cut Abv Thresh, Rej Over Range, Trig Hyst,
   0,     0,        1,            F,                  F,                  F,              F,         F,
   0,     1,        1,            F,                  F,                  F,              F,         F,
   0,     2,        1,            F,                  F,                  F,              F,         F,
   0,     3,        1,            F,                  F,                  F,              F,         F,
   0,     4,        1,            F,                  F,                  F,              F,         F,
   0,     5,        1,            F,                  F,                  F,              F,         F,
   0,     6,        1,            F,                  F,                  F,              F,         F,
   0,     7,        1,            F,                  F,                  F,              F,         F,
   0,     8,        1,            F,                  F,                  F,              F,         F,
   0,     9,        1,            F,                  F,                  F,              F,         F,
   0,    10,        1,            F,                  F,                  F,              F,         F,
   0,    11,        1,            F,                  F,                  F,              F,         F,
   0,    12,        1,            F,                  F,                  F,              F,         F,
   0,    13,        1,            F,                  F,                  F,              F,         F,
   0,    14,        1,            F,                  F,                  F,              F,         F,
   0,    15,        1,            F,                  F,                  F,              F,         F,

Mod#, Chan#, Use Lcl Shaped Trig, Lcl Shaped Trig Mode, Use Lcl Trig Val, Lcl Trig Val Mode, Lcl Trig Val as Veto,
   0,     0,                   F,                    3,                F,                 0,                    F,
   0,     1,                   F,                    3,                F,                 0,                    F,
   0,     2,                   F,                    3,                F,                 0,                    F,
   0,     3,                   F,                    3,                F,                 0,                    F,
   0,     4,                   F,                    3,                F,                 0,                    F,
   0,     5,                   F,                    3,                F,                 0,                    F,
   0,     6,                   F,                    3,                F,                 0,                    F,
   0,     7,                   F,                    3,                F,                 0,                    F,
   0,     8,                   F,                    3,                F,                 0,                    F,
   0,     9,                   F,                    3,                F,                 0,                    F,
   0,    10,                   F,                    3,                F,                 0,                    F,
   0,    11,                   F,                    3,                F,                 0,                    F,
   0,    12,                   F,                    3,                F,                 0,                    F,
   0,    13,                   F,                    3,                F,                 0,                    F,
   0,    14,                   F,                    3,                F,                 0,                    F,
   0,    15,                   F,                    3,                F,                 0,                    F,

Mod#, Chan#, Extra Wd Opt, Smooth Integ, Inp Smooth, DC Offset, Veto Dur Exten, Trig Validation Mask
   0,     0,            1,            F,          0,      3932,              0,           0x00000000
   0,     1,            1,            F,          0,      3932,              0,           0x00000000
   0,     2,            1,            F,          0,      3932,              0,           0x00000000
   0,     3,            1,            F,          0,      3932,              0,           0x00000000
   0,     4,            1,            F,          0,      3932,              0,           0x00000000
   0,     5,            1,            F,          0,      3932,              0,           0x00000000
   0,     6,            1,            F,          0,      3932,              0,           0x00000000
   0,     7,            1,            F,          0,      3932,              0,           0x00000000
   0,     8,            1,            F,          0,      3932,              0,           0x00000000
   0,     9,            1,            F,          0,      3932,              0,           0x00000000
   0,    10,            1,            F,          0,      3932,              0,           0x00000000
   0,    11,            1,            F,          0,      3932,              0,           0x00000000
   0,    12,            1,            F,          0,      3932,              0,           0x00000000
   0,    13,            1,            F,          0,      3932,              0,           0x00000000
   0,    14,            1,            F,          0,      3932,              0,           0x00000000
   0,    15,            1,            F,          0,      3932,              0,           0x00000000

--------------------------------------------------------------------------------

Ready to start!
Press enter to continue
```

Figure 9: ORCHID output at startup

3.3 The ORCHID “Power Up” Screen

This screen (seen in Fig. 10) allows the user to type one of two commands. “turnon” will turn the HV system if the general configuration file option ”PerformPowerOn” is set to True, otherwise it simply takes you to the “Main” menu. “quit” and “exit” will make ORCHID quit.

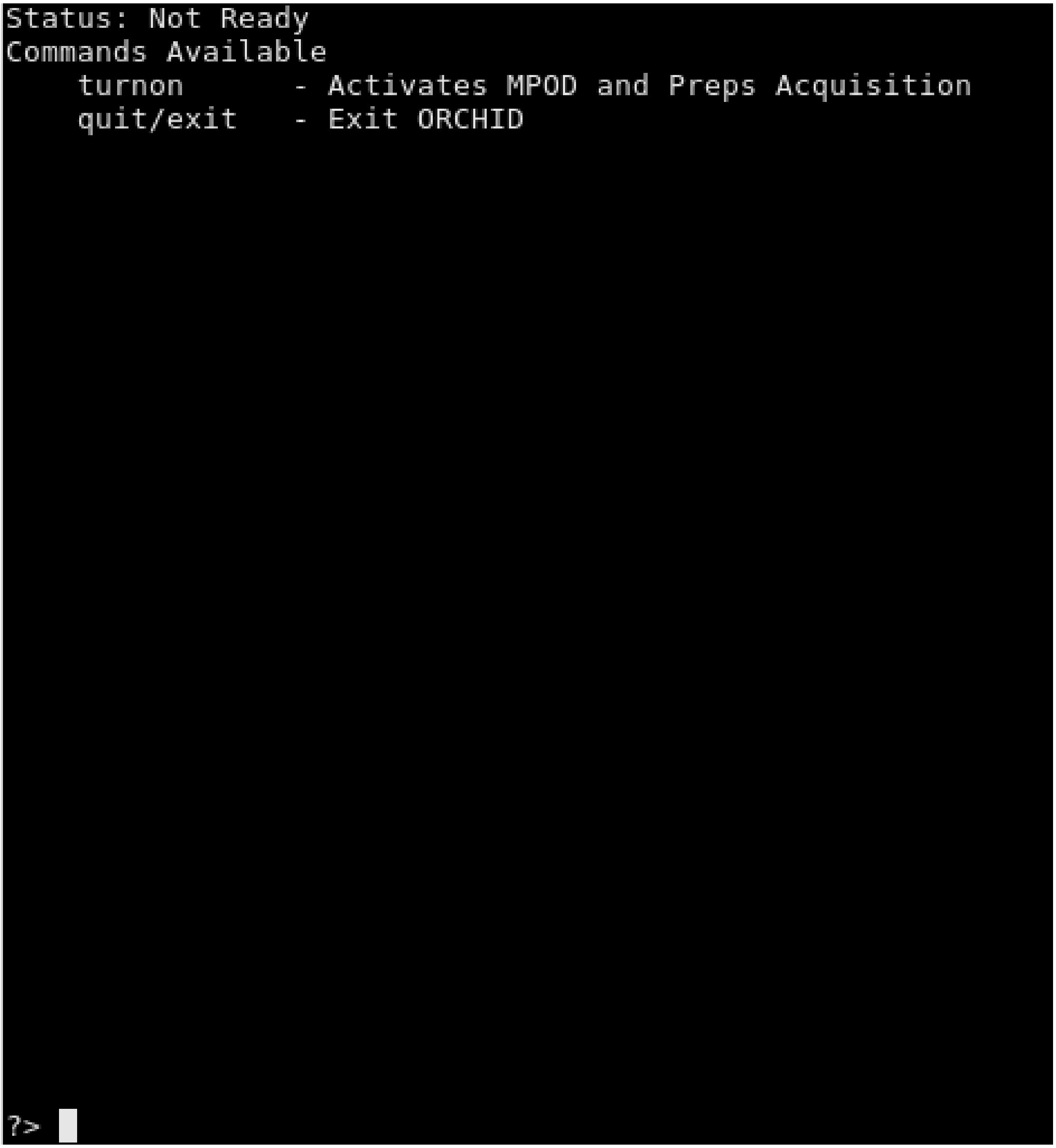

Figure 10: ORCHID power up screen

3.4 The ORCHID “Main” Screen

This screen (seen in Fig. 11) allows the user to start acquisition, change run titles, run numbers, turn off HV (returning you to the “Power Up” Screen), or quit. Below is a summary of the commands and their actions.

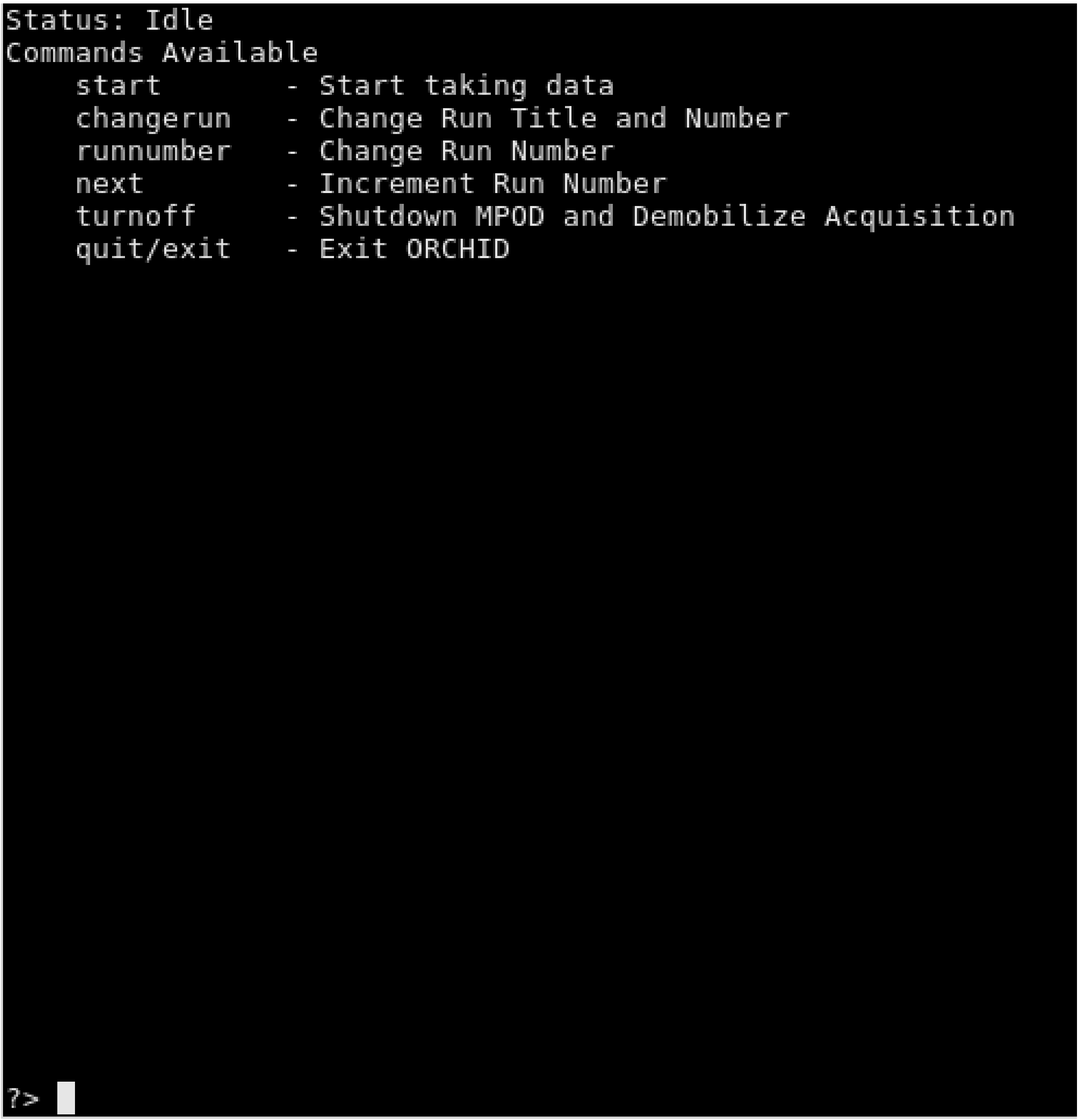

Figure 11: ORCHID main screen

- The ‘start‘ command starts data acquisition and slow controls event writing. It then transitions to the ’Data Taking Screen.’ On program startup the ‘start‘ command will not work until the ‘changerun‘ command has been used to set both the run title and run number. On subsequent returns to this screen after the first, ‘start‘ will not work until *at least* the run number has been changed, using either then ‘runnumber‘ or ‘next‘ commands.

- The ‘changerun‘ command allows the user to change both the run title and run number.
- The ‘runnumber‘ command allows the user to change the run number to an arbitrary value.
- The ‘next‘ command allows the user to increment the run number from its current value.
- The ‘turnoff‘ command varies with the option ”PerformPowerOff” as well. If ”PerformPowerOff” is set to ”False”, it will simply take the user back to the ’Initialize HV Screen’. If it is set to ”True” ORCHID will ramp down the MPOD HV and set the MPOD to off, then go to the ’Initialize HV Screen’
- The ‘quit‘ command functions exactly as expected, however its exact behavior will vary somewhat with the ”PerformPowerOff” option. If it is set to ”False” ORCHID will immediately exit. If ”PerformPowerOff” is set to ”True” then, before exitting, the quit command will cause ORCHID to ramp the MPOD channels to 0V then sends the ”Main power off” signal prior to exitting.

3.5 The ORCHID “Running” Screen

The running screen (seen in Fig. 12) is primarily an information display. It shows: trigger rates and counts for each channel on the digitizer, the run title, run number, file name, file path, and MPOD voltage and current readings. It should be noted that the HV readings are not in the same order as the digitizer channels. One needs to keep in mind the mapping between detector number and HV channel show on the right of Fig. 2. There are two commands available here though. “stop” will cease acquisition and return to the “Main” Screen. “quit” will stop acquisition, power the MPOD system off (if ”PerformPowerOff” is set to true in the configuration file), and exit ORCHID.

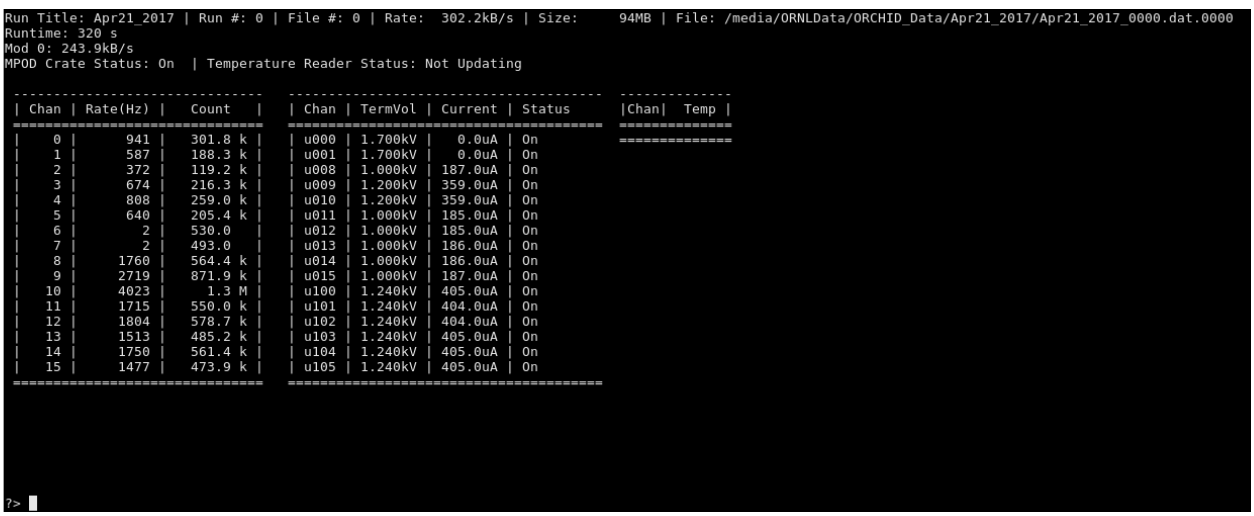

Figure 12: ORCHID running screen