CLAS12 Slow Controls Operations Manual - v2.9

N. Baltzell

(Dated: March 23, 2023)

Contents

I. Overview

The operator interface for the Hall B controls systems is based on Control System Studio (also called CS-Studio or CSS) and allows access to all the necessary EPICS tools from a single application. This system is accessible by user `clasrun` directly from all `clonpc##` desktop computers in the Hall B Counting Room for shift workers (for remote access, see Section X).

To start the control system with only the main menu as shown in Figure 1, in a terminal run:

```
clascss
```

This menu should normally already be open on all the neccessary desktops in the counting house. The top portion of the menu is for specific detectors, while the bottom portion is for more general subsystems, and the most important parts for shift workers are described in the following sections.

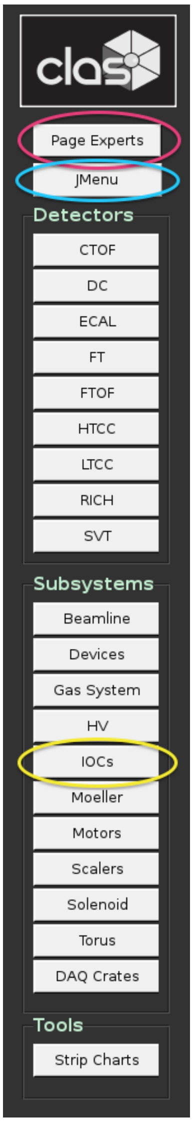

FIG. 1: The main menu.

II. Alarms

The user interface for the alarm handling system also runs in CS-Studio and includes visual and audible alarms. Generally, `clonpc17` (with the two high monitors near the windowed doors) should always be running a full screen alarm handler. To start the control system with the full alarm handler, in a terminal run:

```
clascss-alarm
```

The resulting window is shown in Figure 2 and contains the following sections:

1. Top Left: the *Area Panel*, an overview of the global alarm system status. The color of the areas reflects the most severe alarm in that area.
2. Bottom Left: the *Alarm Tree*, a hierarchical view of all alarm settings.
3. Bottom Right: the *Alarm Table* (see also Figure 3), containing a list of current alarms that need to be addressed and a separate list of already acknowledged alarms.

When an alarm triggers, it will enter the *Alarm Table* and its color will change according to its severity. The annunciator (running on `clonpc17`) will also audibly announce any new alarms or a count of currently active alarms.

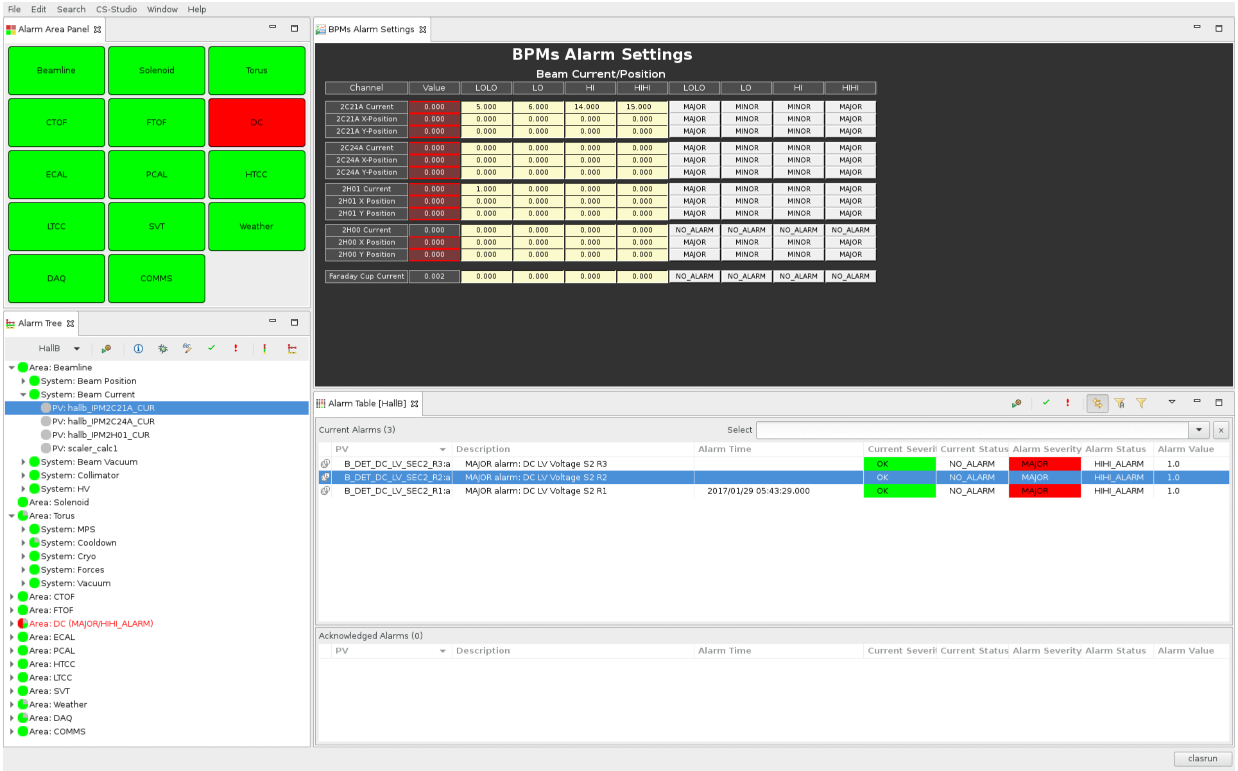

FIG. 2: The alarm handling screen.

By right-clicking on an alarm in the *Alarm Table*, a dropdown menu of actions is accessible (see Figure 4). This dropdown list contains access to a *Guidance* screen with instructions that should be read and followed on how to deal with the specific alarm.

The next step is to acknowledge the alarm using the *Acknowledge* option in the dropdown menu, which will silence the alarm and move it to the *Acknowledged Alarms* section until it is no longer in an alarm state.

For many alarms there is also an option in the dropdown menu starting with *Open* that will open a screen necessary to address the specific alarm using the information from the *Guidance* screen.

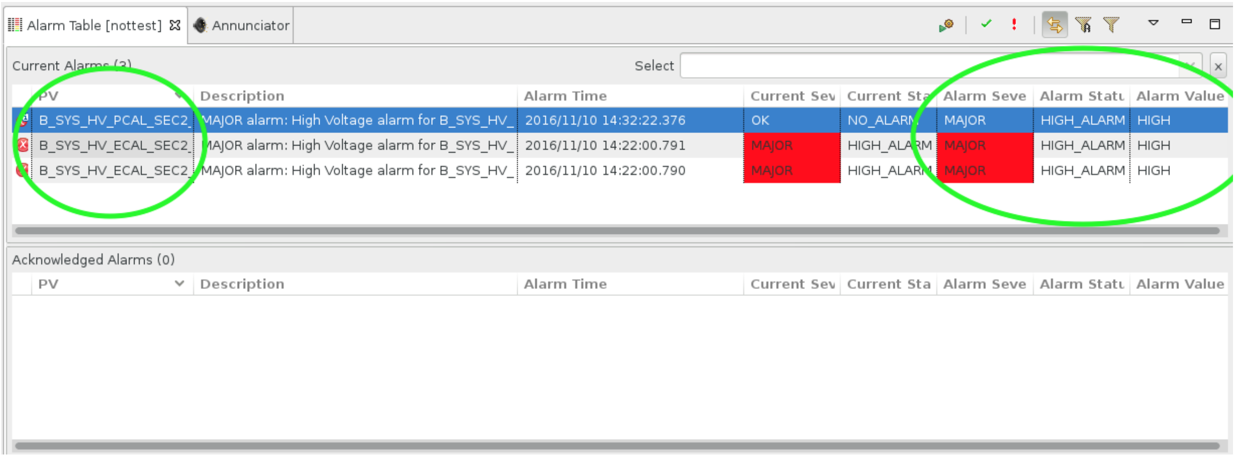

FIG. 3: The *Alarm Tree* portion of the alarm screen, showing an example of three outstanding alarms to be addressed. The first is no longer in an alarm state (denoted by the *OK* in the *Current Severity* column), and none of the three have been acknowledged (else they would have appeared instead in the lower *Acknowledged Alarms* section).

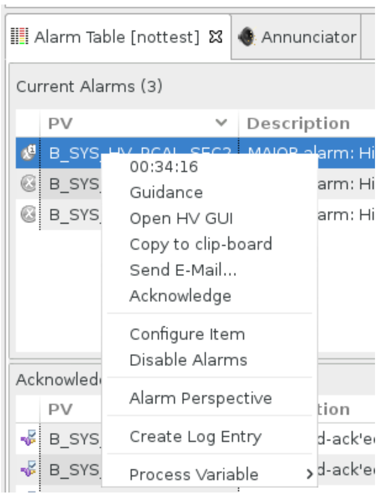

FIG. 4: An example dropdown menu accessible by right-clicking on an alarm in the *Alarm Table*. Important visible actions include a *Guidance* button, an *Open* screen action, and the *Acknowledge* action. **Note, the *Create Log Entry* item does not yet work** (see Section VI instead).

III. IOCs

EPICS input-output controllers (IOCs) are the backend responsible for the actual communication with the hardware devices in the hall. Figure 5 illustrates access to the IOC controls screens from the main CLAS12 menu, as well as the overview IOC heartbeat screen. The heartbeats should be flashing at 1 Hz for all IOCs, or else the IOC may be in need of reboot.

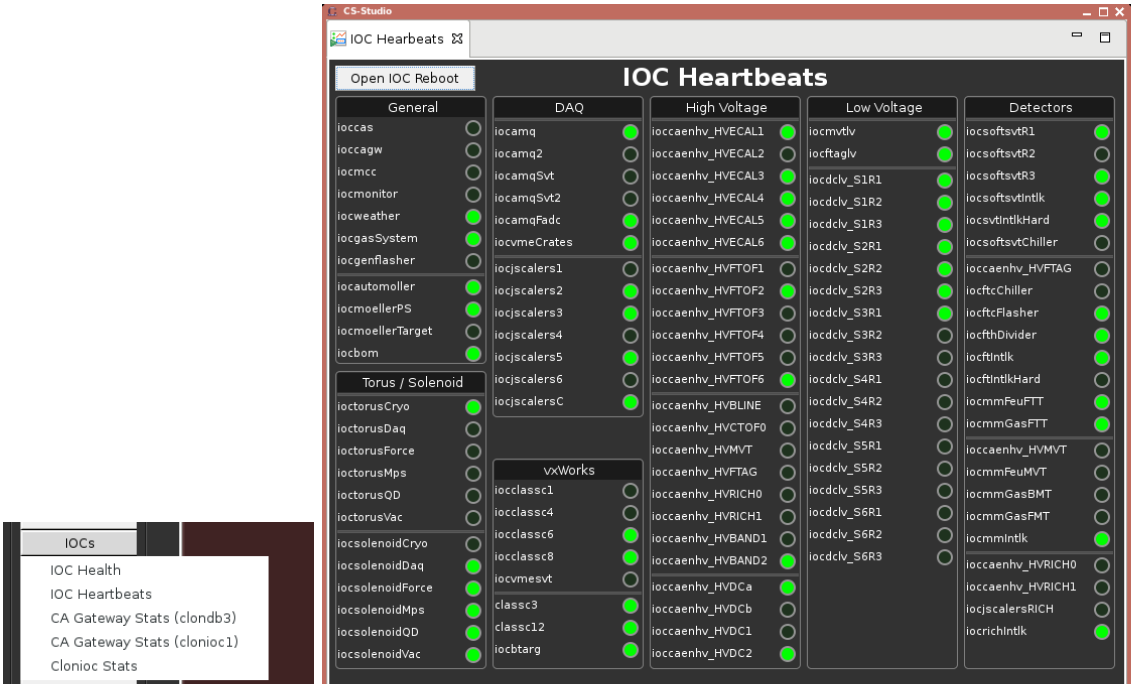

FIG. 5: Dropdown menu (left) from the *IOCs* button in the main CLAS12 controls menu showing links to the IOC health and heartbeat screens (right). The static pink "Disconnected" heartbeats here are IOCs that are intentionally offline at the time of this screenshot.

By clicking on the IOC in the heartbeat screen (or the IOC health screen in the main menu), controls to monitor (and reboot) the IOCs can be accessed, and an example is shown in Figure 6. Systems are in place to automatically start all necessary IOCs if for any reason they are not running (e.g. recovery from a power outage). *Note, rebooting IOCs should never be necessary, so please contact the slow controls expert before doing so, and at a minimum make a logbook entry including the motivation for a reboot.*

A. Motors

The beamline devices in Hall B include encoderless stepping motors. When their IOC is restarted, the actual motor stage position is unchanged (the motor does not move), but the software motor position is reset to zero. If the motor was at a non-zero position during IOC reboot, then a recalibration is required in order for the motor position in EPICS to reflect the actual motor

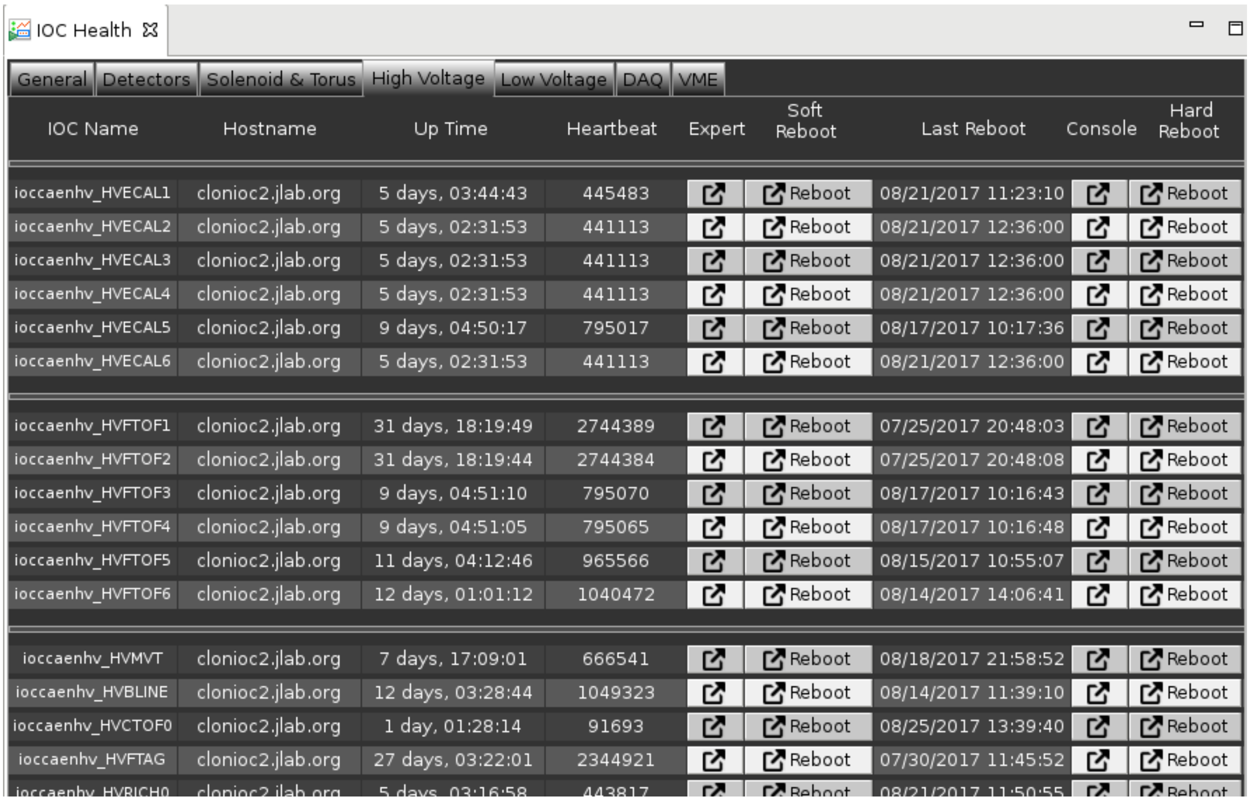

FIG. 6: The primary IOC health screen, showing hostnames, uptimes, heartbeats, and buttons to restart each IOC. Note the tabs at the top to show different subsets of IOCs (corresponding to the same subsets in the heartbeats screen in Figure 5).

position. The is generally the case for collimators and the beam stopper and viewer motors, because their normal position during running is non-zero. The harps are generally left at zero when not in use and thus do not require recalibration unless in active use during the IOC reboot. See Table I for a list of motors and their corresponding IOC.

`classc1`	`classc4`
Collimator	Beam Stopper
Harp 2C21	Beam Viewer
Harp 2C24	
Harp 2H01	
Møller Target	

TABLE I: Stepping motors on two VME IOCs in Hall B.

IV. High Voltage

The largest controls system in Hall B in terms of number of channels is high voltage (HV), with over 20 CAEN mainframes including SY527, SY1527, and SY4527 models. An overview screen of the status of all HV in Hall B is accessible from the HV button in the main CLAS12 menu as shown in Figure 7. Clicking on a detector's name in this overview screen will open a dropdown menu with options to turn its HV on and off or open its full controls screen (also accessible under each detector's button in the main menu).

Alarm conditions for HV, as displayed in the alarm handler, are explained in Table II. Possible hardware errors and their labels in tabular HV screens are explained in Table III. For the more expert operations of saving and restoring settings, see Appendix A.

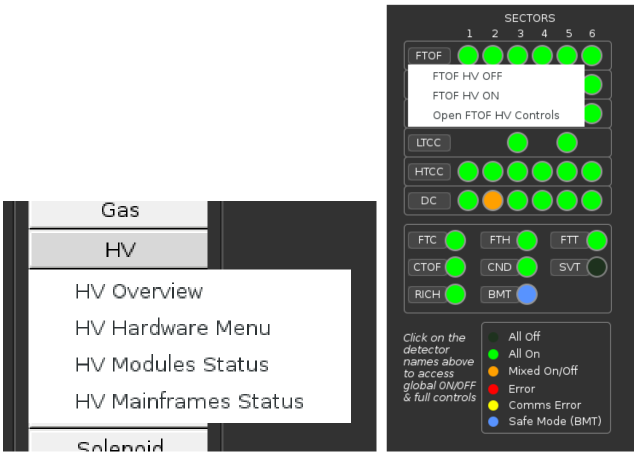

FIG. 7: Access to the HV overview screen from the main menu (left). Clicking on a detector's name in the overview screen (right) will open a dropdown menu including options to turn HV on and off for each detector.

Status	Severity	Cause
HIHI	MAJOR	Hardware error (e.g. tripped, see Table III)
HIGH	MINOR	Software measured voltage above setpoint
LOW	MINOR	Software measured voltage below setpoint
LOLO	MAJOR	Hardware communications error

TABLE II: High Voltage alarm conditions in Hall B, where status and severity are displayed in the alarm handler.

Label	Bit	Explanation
OFF	N/A	OFF
ON	0	ON
RUP	1	Ramping Up
RDN	2	Ramping Down
OVC	3	Over Current
OVV	4	Over Voltage
UVV	5	Under Voltage
ExTrip	6	External Trip
MAXV	7	Max Voltage
ExDis	8	External Disable
InTrip	9	Internal Trip
Calib	10	Calibration Error
ChUnplug	11	Unplugged
OVP	13	Over Power
PwFail	14	Power Failure
TempErr	15	Temperature Error

TABLE III: CAEN High Voltage hardware statuses, with their "Label" as displayed in detailed tabular control screens. All but the first 4 rows are considered hardware errors for alarm purposes.

A. Remote Reboots

Occaisonally CAEN HV mainframes can become unresponsive, triggering the `LOLO` communications alarm in Table II. All CAEN HV mainframes in Hall B are configured for remote reset, accessible using the script below, however the slow controls expert on-call should be contacted first. If necessary to reboot a mainframe, the hard option should only be attempted if the soft version is unsucessfull.

```
usage: caenhvReset.py [-h] [--soft] [--hard] mainframe
positional arguments:
  mainframe   hostname of mainframe
optional arguments:
  -h, --help  show this help message and exit
  --soft      CPU reboot only, should not affect voltages
  --hard      full power cycle, brings down all voltages
```

V. Strip Charts

There are two applications available for plotting time histories of slow controls variables: LivePlot and MyaPlot. Both are provided by the accelerator division and are accessible from the *Strip Charts* button at the bottom of the main CLAS12 controls menu as shown in Figure 8.

LivePlot connects to IOCs directly, acts as a live, automatically updating strip chart, and is appropriate for continuous monitoring. MyaPlot retrieves data exclusively from the Mya archive of previous years of slow controls data. Configuration files are loadable from their user interfaces to view a predetermined set of variables, or else you can choose any process variable (PV) to plot.

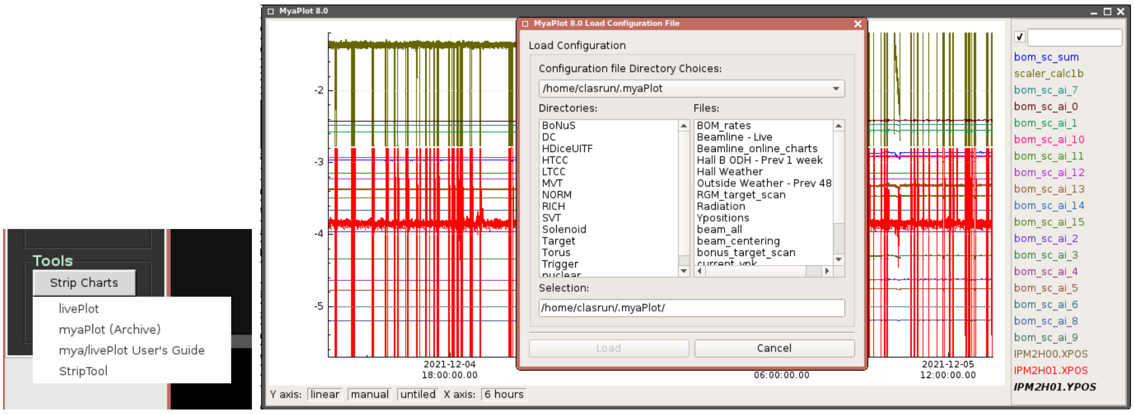

FIG. 8: Utilities for plotting time histories of slow controls variables are accessible from the *Tools* section of the CLAS12 main menu (left). An example of running MyPlot and loading a preset configuration file via the drop-down menu accessible via right clicking is shown on right.

VI. Logbook Entries and Screenshots

We use the JLab logbook system, and the primary Hall B logbook is called HBLOG and accessible in a web browser at

https://logbooks.jlab.org/book/HBLOG

In Hall B there are two primary methods for adding content to the logbook:

1. Use the web browser interface after logging in with your personal CUE credentials. That is the normal method used for filling out the shift checklist, updating a shift summary log entry, following up with comments on previous log entries, or adding more complex log entries.

2. Use our Hall B GUI that facilitates taking screenshots and quickly sending them to the HBLOG logbook as `user=clasrun`. This is accessed via the "logbook entry" item from the desktop menu, or via the following script in a terminal:

`logbookEntry.sh`

This is also the preferred method for taking screenshots and will always save them in `$HOME/screenshots` with timestamped filenames. See Figure 9 for details.

Note, the integrated logbook entry feature in CS-Studio (accessible by right-clicking in any CS-Studio screen) is currently NOT supported.

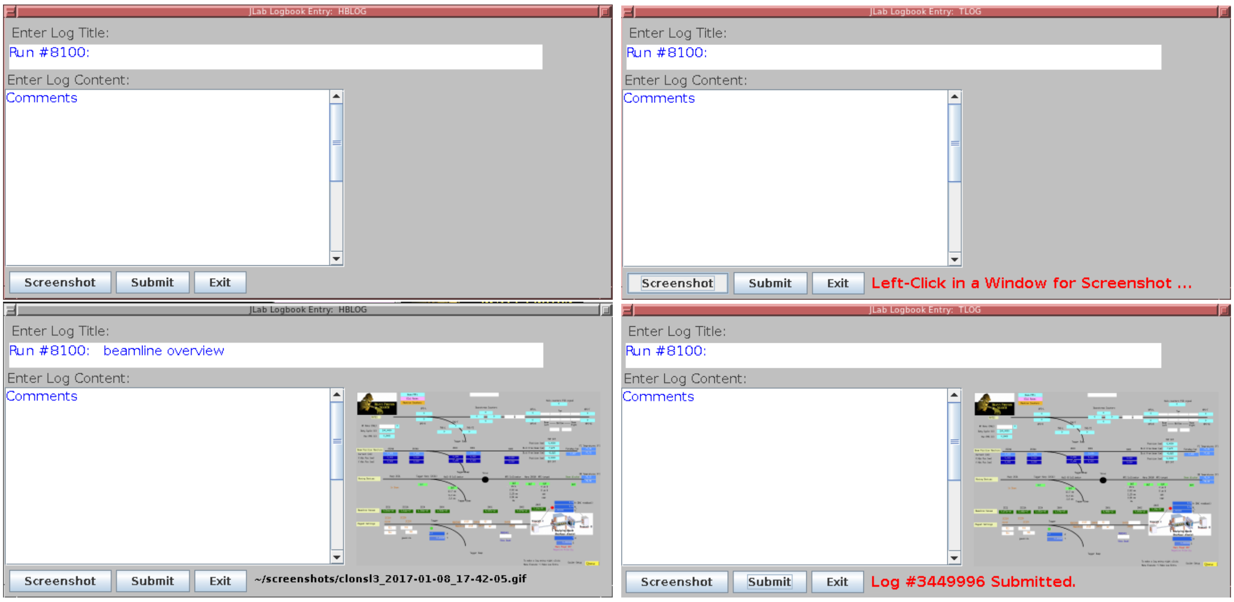

FIG. 9: Upon first opening the logbook/screenshot GUI (top left), only the log title has been automatically initialized (with the current run number). After clicking the "Screenshot" button (top right), it is waiting for you to left-click in the window you desire to capture (clicking the desktop instead of a window will capture the entire desktop). After taking a screenshot (bottom left), a snapshot of the image and its filename on disk are automatically displayed. Note that the "Screenshot" button can be used repeatedly to change the screenshot if you do not like the previous result, or just want to take more screenshots. The "Submit" button can be used to generate an entry in the HBLOG logbook, and after success the entry number will be displayed (bottom right).

VII. Cameras

We utilize a variety of web-accessible cameras in Hall B, listed on the "Monitoring" tab of the run wiki for a given experiment. The two primary ones are the beam viewers at the tagger dump and the Faraday cup. Due to radiation dose, the camera for the Faraday cup viewer is the most problematic; e.g. its usable CCD lifetime is about 6 months, and it suffers from occaisonal SEU-induced crashes. It is rebootable remotely from a `clonpc` via:

`beam-viewer-reboot`

VIII. Paging System Experts

Paging on-call experts is available from the main CLAS12 controls menu via the *Page Experts* button at the very top of the screen (see Figure 1). This will open a dropdown menu to choose the desired subsystem, and then open a new window in which to enter a message to be sent to the corresponding expert, as illustrated in Figure 10.

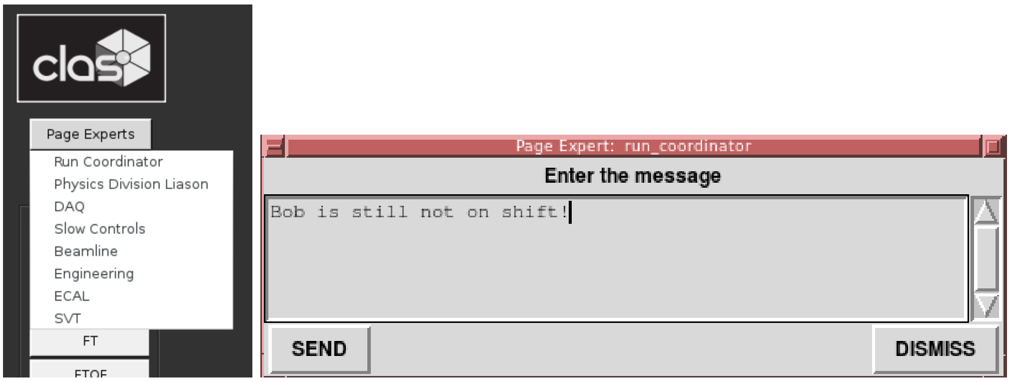

FIG. 10: The dropdown menu for choosing which expert to page (left) and the resulting dialog window in which to enter the message contents (right).

IX. Slow Controls Contacts

The individuals to be contacted for Hall B slow controls are shown in Table IV. The first point of contact for shift operations is always the on-call controls expert, accessible from the paging system described in Section VIII of this document and the phone number in the first row of Table IV. Additional contacts are listed in the table as a fallback.

Person	Phone Number	Email Address
On-Call	757-748-6922	N/A
Nathan Baltzell	757-259-5902	`baltzell@jlab.org`
Bryan McKinnon	N/A	`mckinnon@jlab.org`

TABLE IV: Hall B slow controls contacts.

X. Remote Usage

There are separate server-grade machines for remote controls access, all with access to the same software and running the same operating system as the desktops in the counting house. For access outside the counting house, login to the server `clonsl2`. ***In order to avoid heavly load on the machines used by counting house shift workers, it is important to not run on `clonpc` desktops remotely.*** All controls computers are behind JLab's `hallgw` gateway and require 2-factor authentication for remote access.

XI. Accelerator Screens

Starting in 2019, the accelerator's screen are accessible in a web-browser, and that is the preferred method in Hall B. It requires CUE login:

https://epicsweb.jlab.org

The following instructions are kept as a refernce on navigating the menu system, but JMenu should only be used if there are issues with the web server above.

The accelerator's screens are accessed from the main CLAS12 menu via the *JMenu* button (see Figure 11). This uses the `hbops` account on `hlbl00`, a machine owned and maintained by the accelerator group. If a prompt requests a username, password, or terminal type, just press *Enter*. The location of the button on the CLAS12 menu and the JMenu screen that should appear are shown in Figure 11.

Note, since we use a single account for operations, it is best to only have one instance of JMenu running. Multiple instances from the same account can popup windows on seemingly random computers and have occaisonally been known to result in freezing.

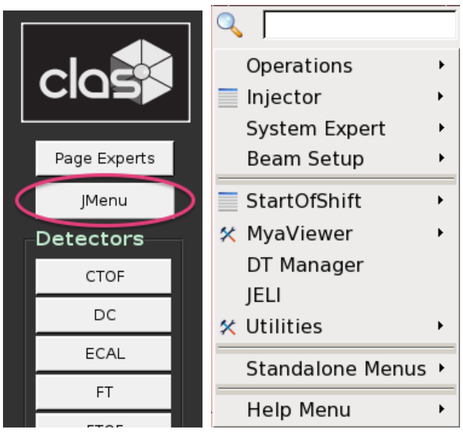

FIG. 11: The location of the button to access the accelerator screens from the CLAS12 controls menu (left) and the resulting accelerator JMenu main screen (right).

A. Tagger

To open the accelerator's controls for the Tagger magnet, from the main JMenu screen (Figure 11) navigate:

Operations → Magnets → Hall B Tagger

The tagger screen is shown in Figure 12.

B. FSD

To open the accelerator's main screen for the fast shutdown system:

Operations → *FSD* → *FSD Overview (Multi-Tree)*

From, there you can access the Hall B 2H001 FSD via:

2H001 → *Hall B HPS Halo Counters (new) (Collimator)* → *User Screen*

The 2H001 FSD screens are shown in Figure 13

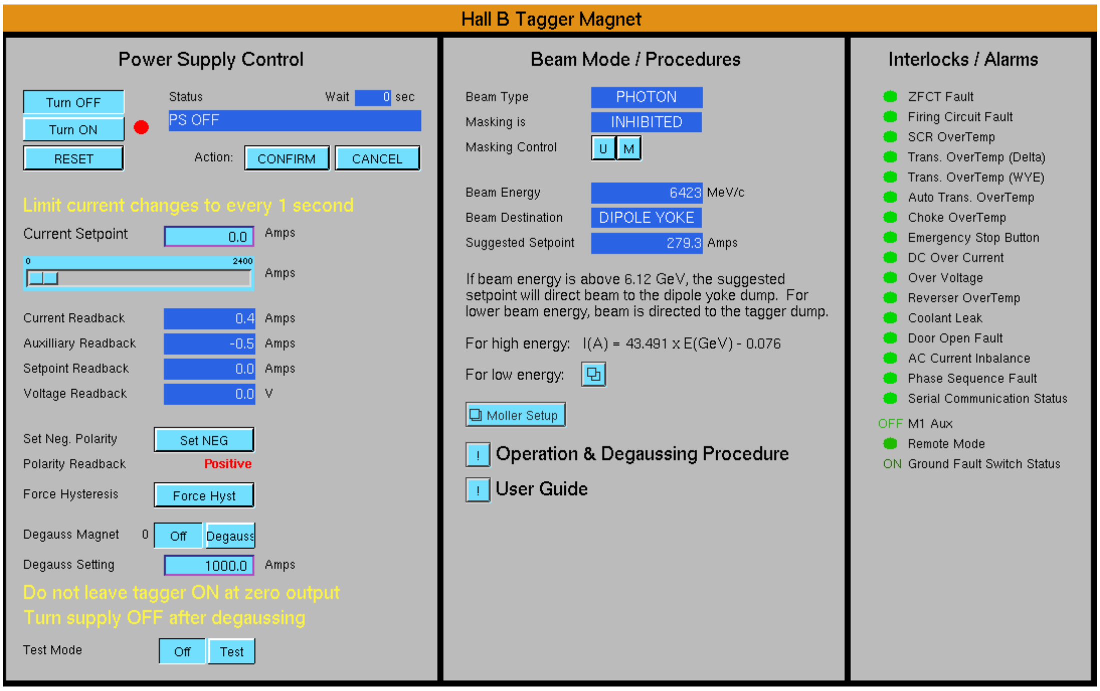

FIG. 12: The accelerator's Hall B Tagger magnet controls.

C. Beam Viewers

The accelerators cameras are accessible from *JMenu* via

Operation → *Viewers* → *Cross Point Switcher* → *Xpt Switcher*

which opens the screen in Figure 14. From there, the Hall B viewer is accessible via buttons:

→ ("Hall B Video - Live" button) ! → live BC4 (ffplay)

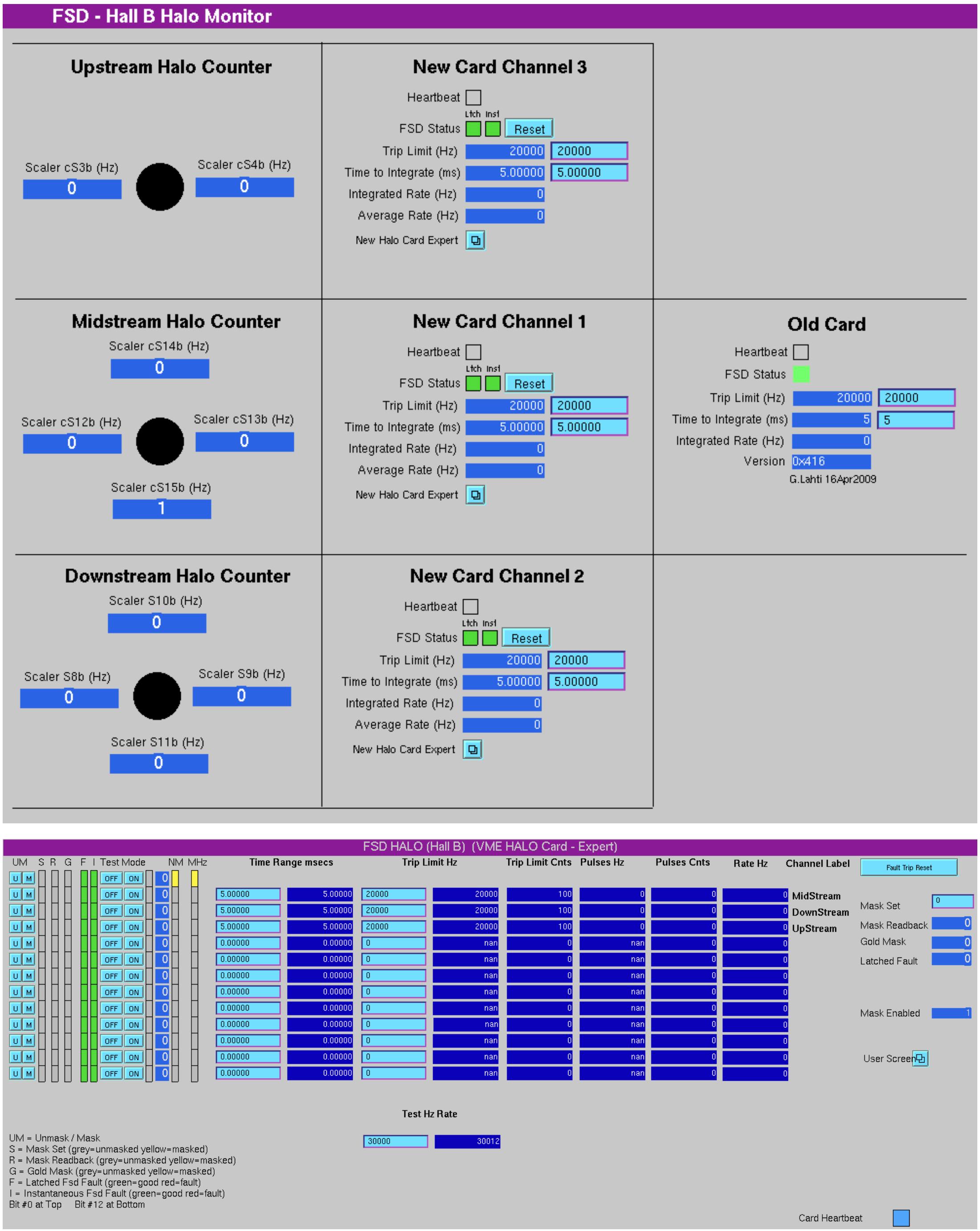

FIG. 13: The user (top) and expert (bottom) Hall B 2H001 FSD screens.

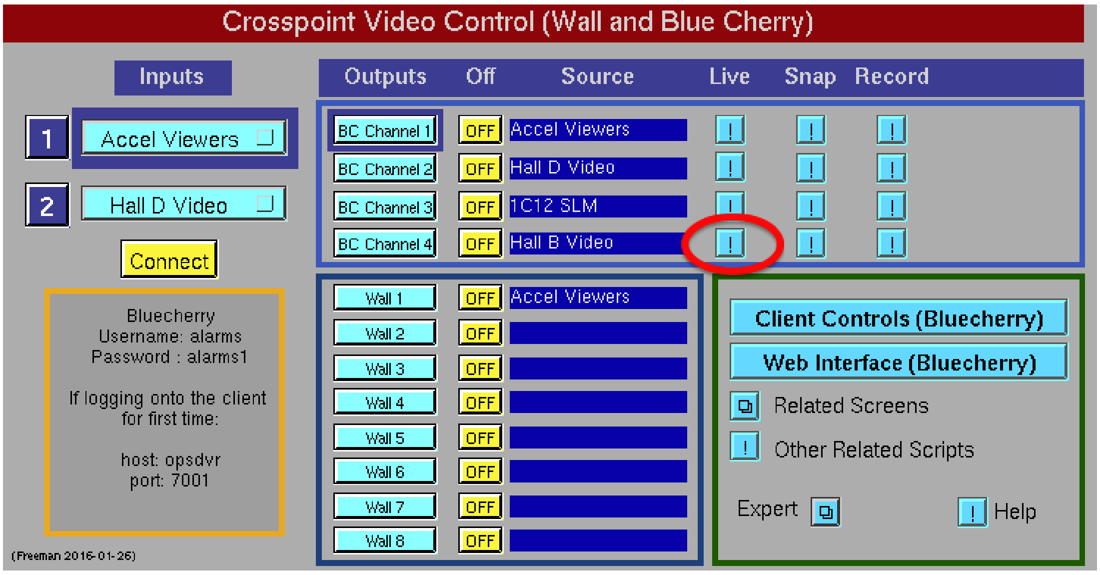

FIG. 14: Access to the accelerator's live beam viewers. The button for the Hall B viewer is circled in red.

Appendices

A. Burt Save/Restore

High voltage settings are saved and restored using `BURT`. The permanent location of the saved snapshots is:

`/usr/clas12/DATA/burt/`

The permanent location of request files is:

`$EPICS/tools/burtreq/`

The preferred method for saving/restoring BURT snapshots is via the application:

`burt-gui`

It has many conviences over older methods and is self-documenting. See Figures 15 and 16 for examples.

The older graphical interface to save/restore is accessible from detector's own screens in CS-Studio, where an example for is shown in Figure 17. When saving a new file, this interface chooses filenames based on the current timestamp but allows for the user to modify the name before saving. Detector experts can also generate files in the proper format (see Figure 18) and place them in their detector's subdirectory, and then use the same interface to restore from them.

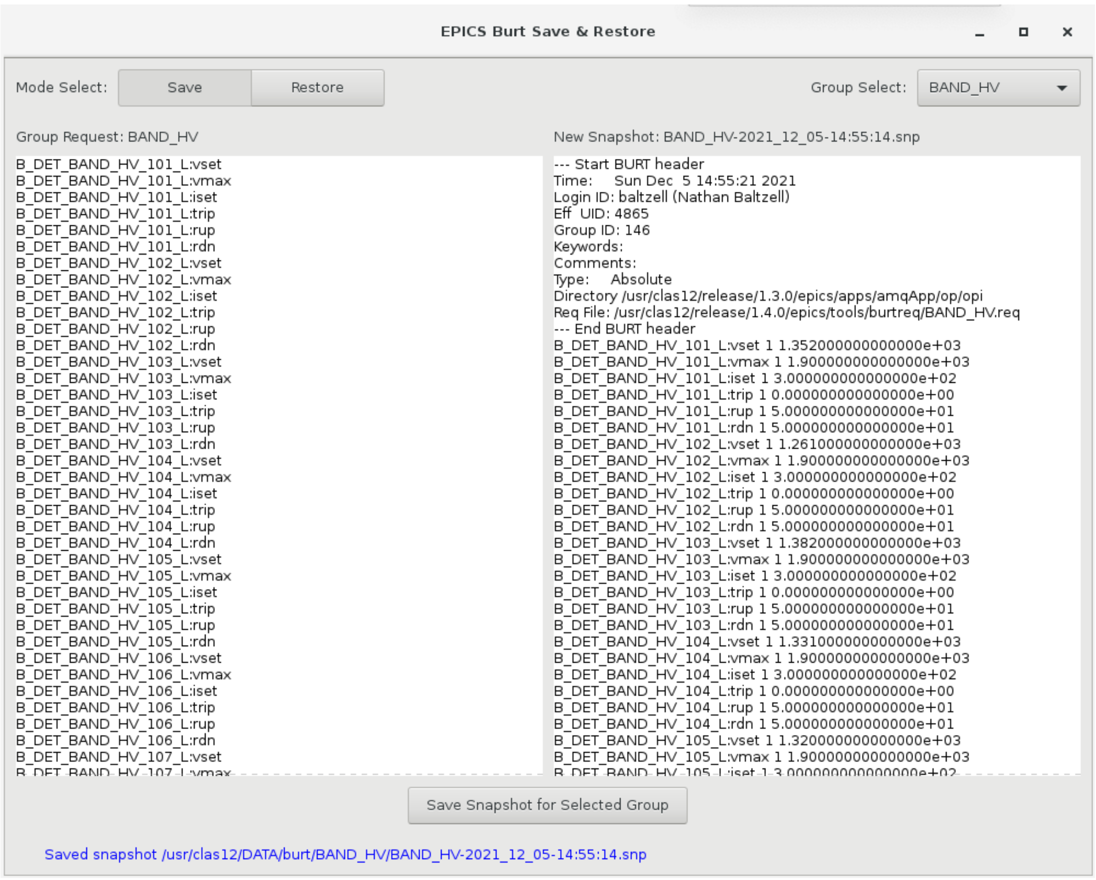

FIG. 15: Example usage of burt-gui in save mode.

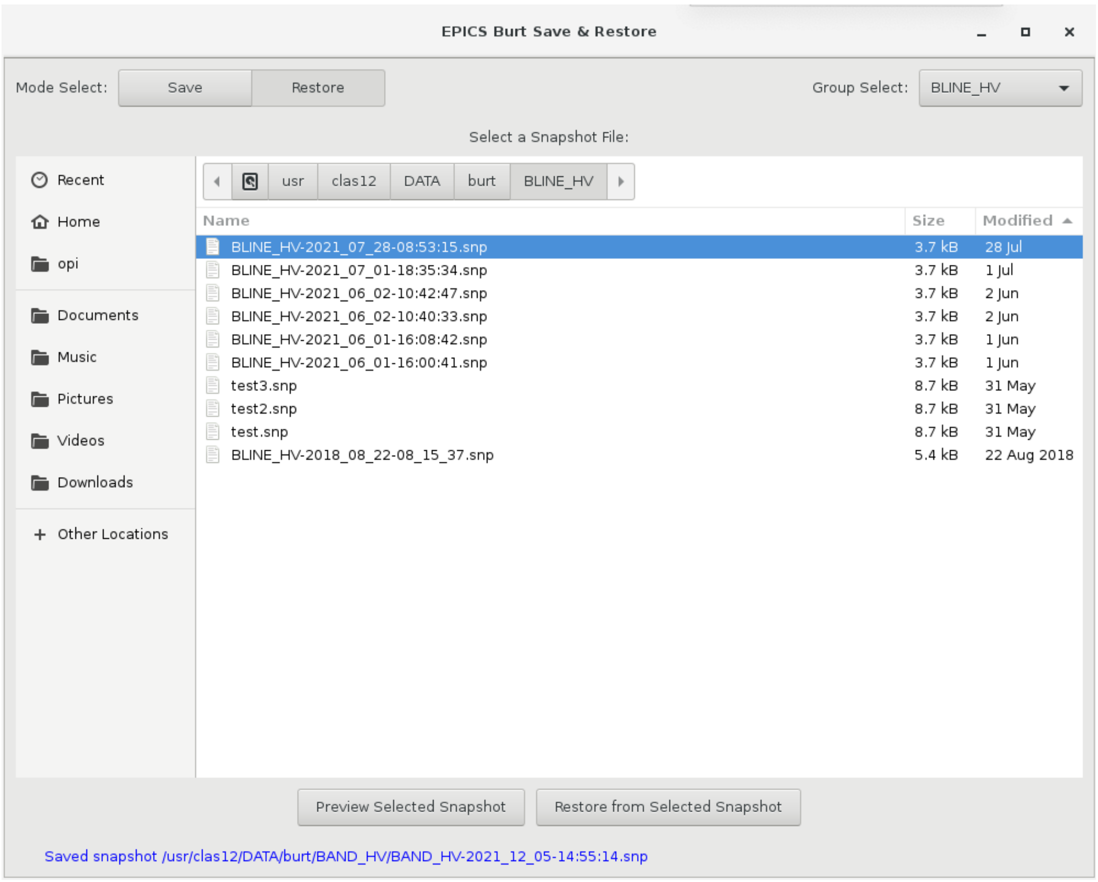

FIG. 16: Example usage of burt-gui in restore mode.

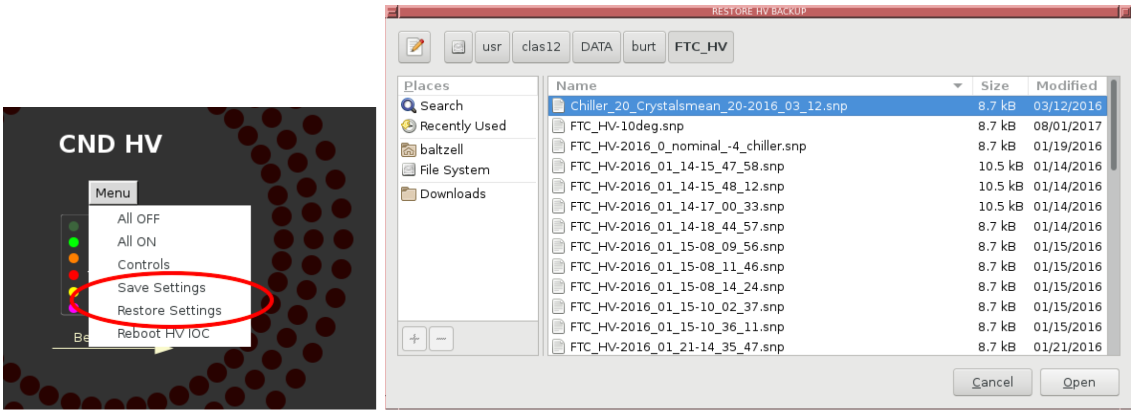

FIG. 17: Access to the old graphical interface for burt save/restore (left); this example is from the CND screen. Example of save/restore file list as presented for FTC (right).

```
--- Start BURT header
Time:     Sun Nov  5 08:33:40 2017
Login ID: baltzell (Nathan Baltzell)
Eff  UID: 4865
Group ID: 146
Keywords:
Comments: CND at 60 Volts.
Type:     Absolute
Directory /home/baltzell
Req File: /usr/clas12/release/1.3.0/epics/tools/burtreq/CND_HV.req
--- End BURT header
B_DET_CND_HV_Inner_Seg01_E1:vset 1 6.00000e+01
B_DET_CND_HV_Inner_Seg01_E2:vset 1 6.00000e+01
B_DET_CND_HV_Inner_Seg02_E1:vset 1 6.00000e+01
```

FIG. 18: Example of a burt snapshot header format.