

# POWGEN User Manual for Data Acquisition

## Introduction

The Data Acquisition System (DAQ) consists of a set of computers and electronics that allow control of beamline systems and govern the acquisition and storage of data collected at each instrument at SNS. The dasopi computer is the main computer and most of the work for setting up runs occurs on this computer. The large monitor for the dasopi computer sits towards the right side of the hutch (Figure 1). On the extreme left and right sides of the hutch are computers for data reduction, visualization and analysis, which are discussed in the document *POWGEN User Manual for Data Reduction*.



Figure 1. Powgen hutch, showing the analysis and control computers.

## Dashboard

The right side of the monitor for the dasopi control computer displays the instrument dashboard (Figure 2). The dashboard contains all the information and controls a typical user will need for their experiment.

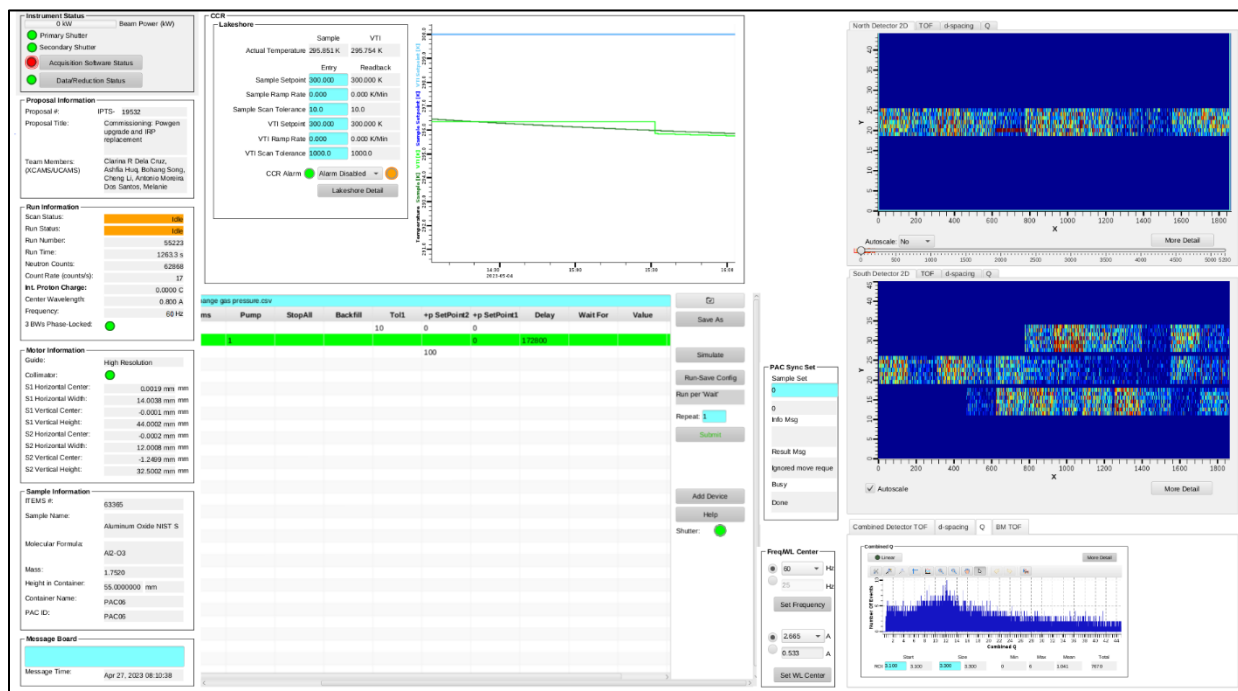


Figure 2. Dashboard overview. See Figures 3,4 & 5 for details of each dashboard section.

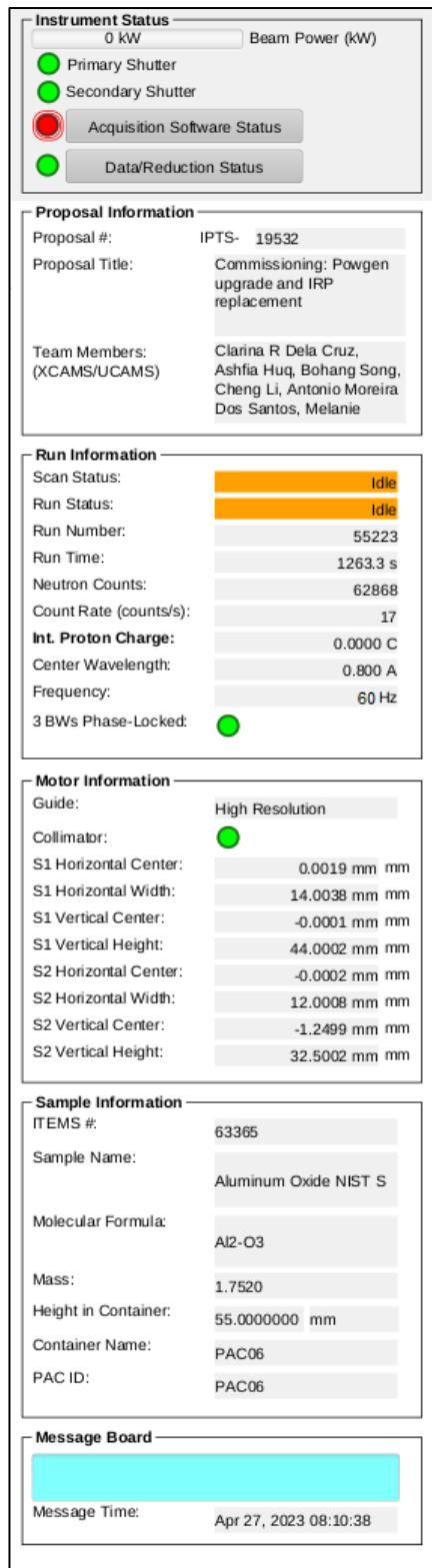


Figure 3. Instrument Status section of the dashboard.

**Instrument Status Display** The left column (Figure 3) of the dashboard displays the instrument status, including beam power and shutter status indicators at the top. The Proposal Information box indicates the currently selected proposal. The Run Information box includes status indicators for the scan (i.e. the table scan script) and the run (i.e. the individual data run), as well as the total time and collected beam (Int. Proton Charge) for the current run. In the same box is the status of the bandwidth choppers, including the selected center wavelength and frequency. The Motor Information box displays the current guide setting and slit positions. The Sample Information box displays the sample name, composition and other details. The Message Board is a place to leave quick notes for the instrument scientist or fellow proposal team members.

**Sample Environment and Table Scan Controls** The center section (Figure 4) of the dashboard displays a plot of the sample temperature and sample environment controls, including the setpoint, ramp rate and tolerance. Note that this area is customized for sample environment in use and may look different if you are not using the sample changer (PAC). Underneath the temperature plot are the table scan controls, used for automating data collection. The use of table scans will be discussed later. To the right of the table scan controls, the PAC Sync Set box may be used to select a sample. When using other sample environment equipment, this box will change appropriately. The Freq/WL Center box may be used to change the bandwidth chopper settings. Most user experiments will use a frequency of 60 Hz and one of the center wavelength options from the dropdown menu. In each case, you must first select the desired value, then press the Set button.

**Data Plots** The right section (Figure 5) of the dashboard displays data plots. At the top is the North (BL-12) side Detector 2D Plot, which displays the total counts across each detector face. Below that is the South (BL-10) side Detector 2D Plot. These plots should correspond to the expected pictures posted in the hutch. If one of the detectors displays no intensity, please contact beamline staff or the IHC (after hours). The bottom plot shows the diffraction data, summed across all detectors, as a function of d-spacing,  $Q$  ( $=2\pi/d$ ) or time-of-flight, as well as the beam monitor spectrum. Plot options are available in the toolbar (Figure 6). To zoom in, click the Rubberband Zoom button in the graph toolbar and then click and drag on the plot. Clicking the Stagger Traces button in the graph toolbar will autoscale the y-axis. Clicking the Reset Axes button will zoom both axes back out to full.

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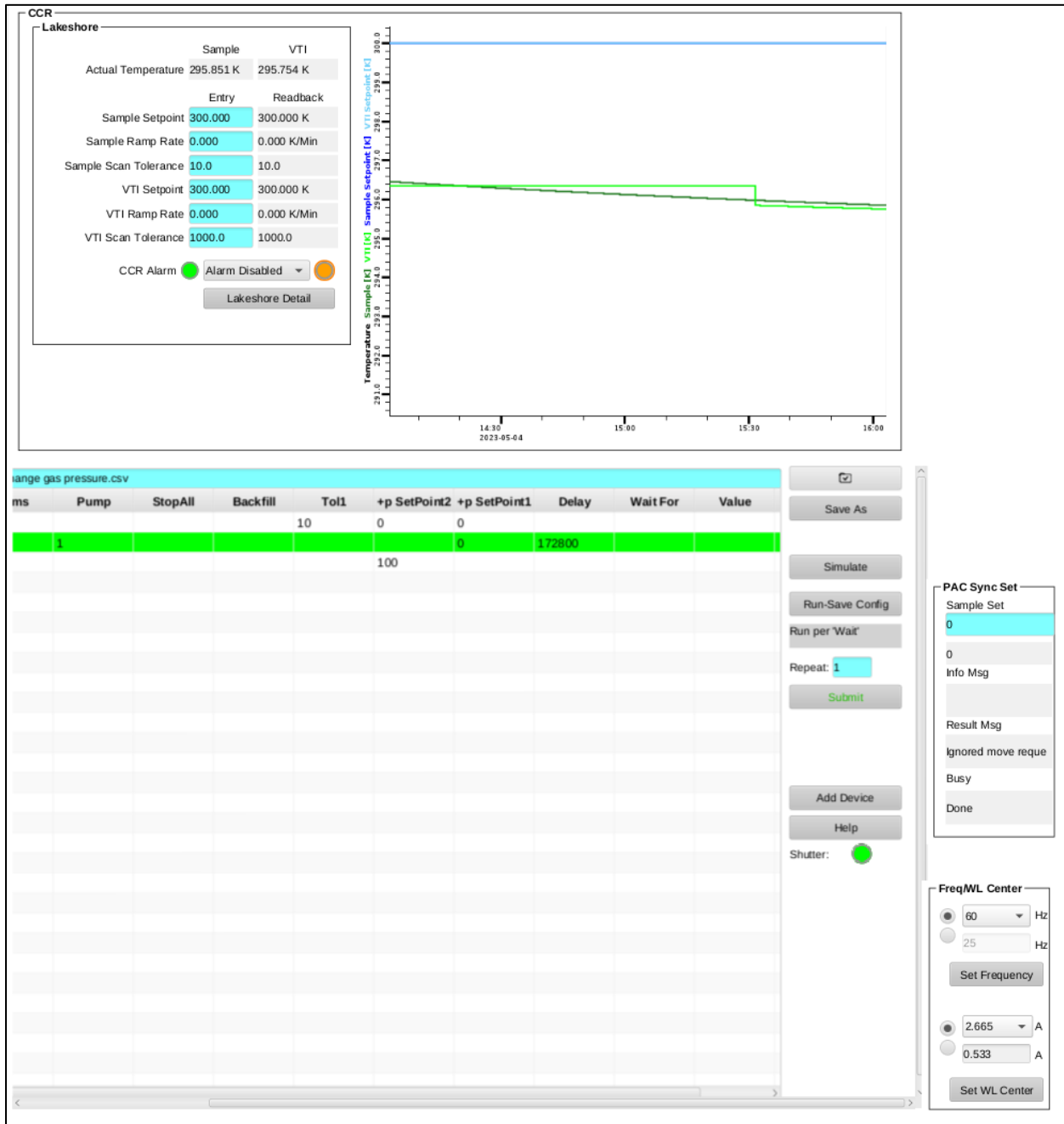


Figure 4. Center area of the dashboard, showing temperature controls at top and table scan controls at the bottom.

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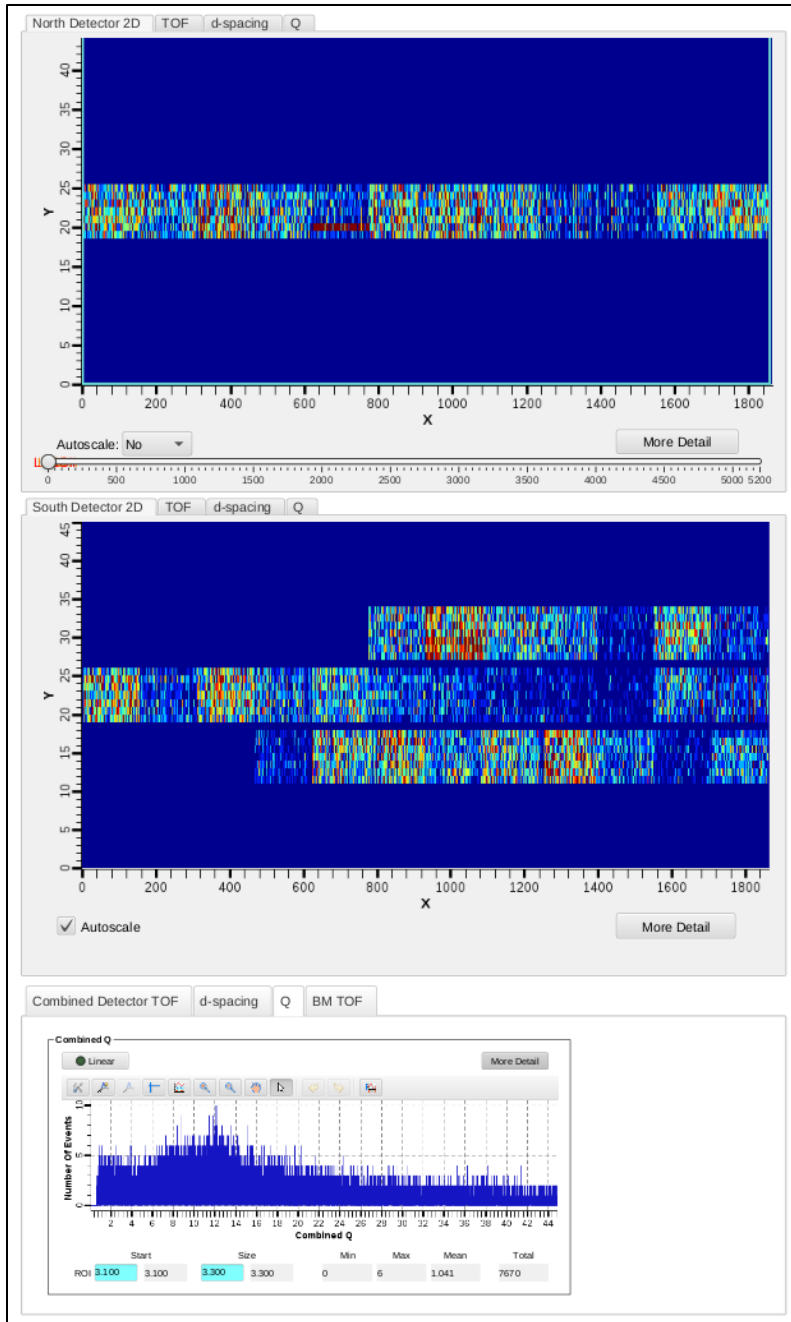


Figure 5. Right column of the dashboard, showing the northside (top) detectors, southside (middle) detectors and plots of combined detector data and beam monitor data (bottom).

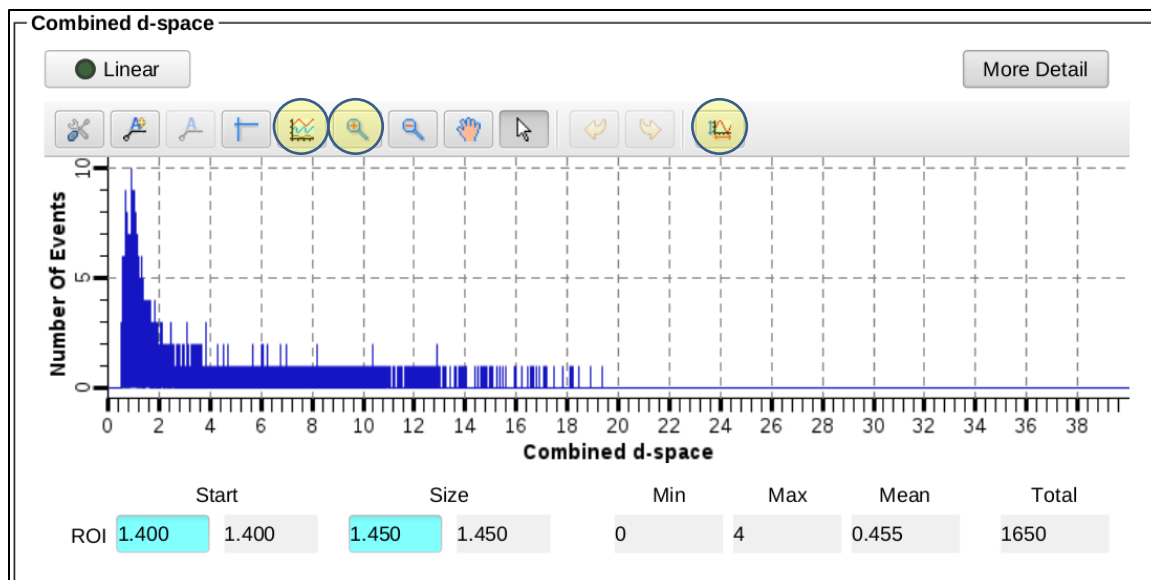


Figure 6. Combined graph, with the Stagger Traces, Rubberband Zoom and Reset Axes buttons highlighted (left to right).

## Additional Screens

Additional screens (Figure 7) are available on the left side of the monitor with more instrument information. The File Browser pane on the far left displays the file structure. Files may be opened from the File Browser pane by double-clicking. User table scripts are saved in /home/controls/top/files/.

Between the File Browser and Dashboard are tabbed windows with more information about the beamline equipment. The BL-11A POWGEN User Home tab has indicator lights for the status of each piece of beamline equipment. All status lights should be green when functioning properly. The Table Scan tab contains similar table scan controls as are in the Dashboard (Figure 4). The BL11A\_Skf\_Chop\_User tab shows status lights for each of the three bandwidth choppers, along with the frequency and phase settings. The PAC Seq tab shows the status of the sample changer, with the sample currently in beam highlighted in orange. The BL11A CCR tab shows the temperature controls and plot, as in the Dashboard (Figure 4). Other tabs may be present depending on the sample environment equipment installed at the beamline.

At the bottom in the Scan Monitor, which will be discussed in more detail below, the queue of scans is shown. Scans execute in order from the bottom to the top.

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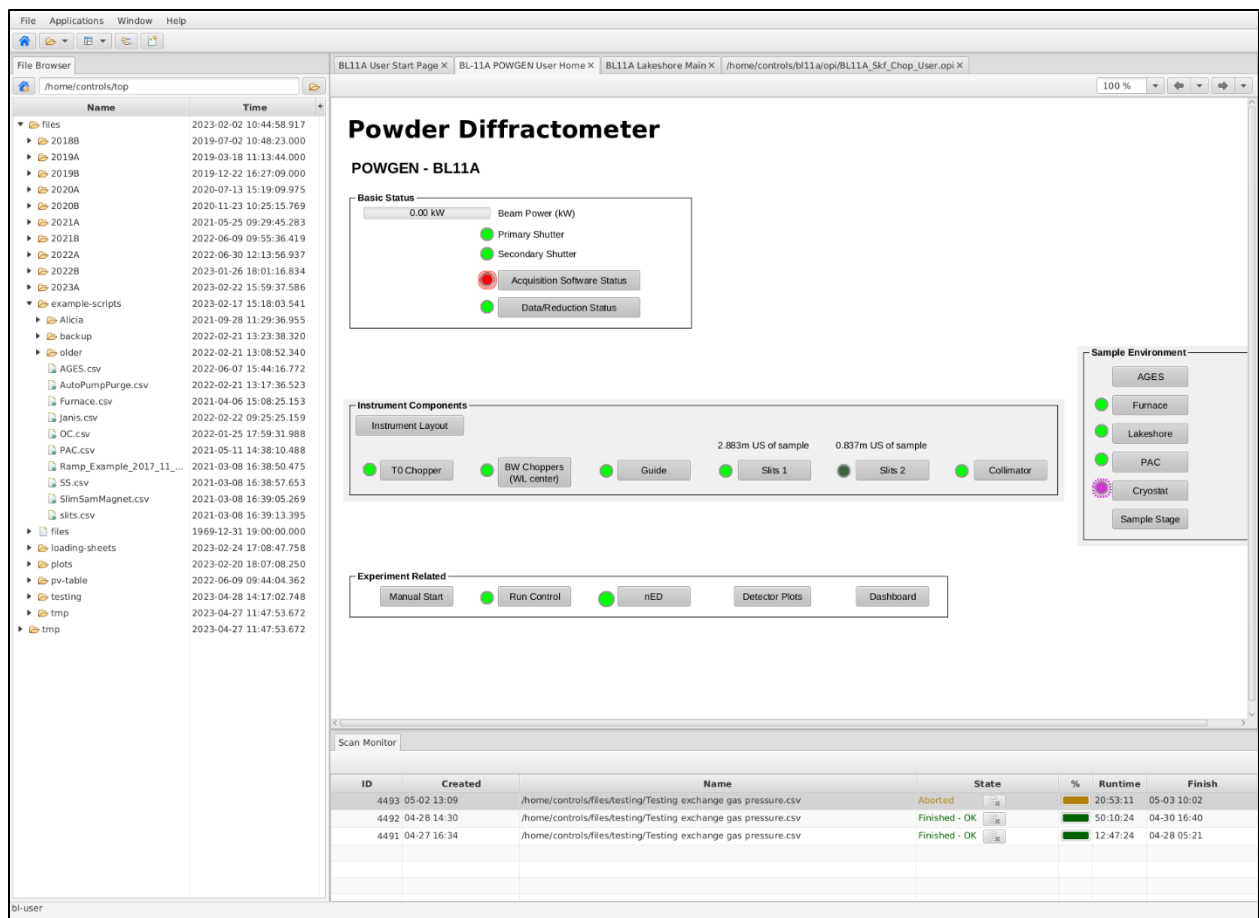


Figure 7. Additional screens shown on the left side of the control computer.

## Table Scan Scripts

The preferred mode of data collection is using table scans, which are spreadsheet files that lay out the desired data collection and instrument steps, e.g. count time, sample temperature and sample changer position. User table scans are saved in the folder `home/controls/top/files/cycle/IPTS-XXXXX`, where `cycle` is the run cycle (e.g. 2023-A) and `XXXXX` is the proposal number. Example scripts for each instrument setup are in the `home/controls/top/files/example-scripts` folder. They may be opened and edited with LibreOffice, installed on the `dasopi` computer.

**Preparing a Script** To prepare a table scan, copy the appropriate example script into your proposal folder and rename it. Open the script in LibreOffice and replace the example values with your desired values. Each line contains the instrument and data collection parameters for one run (or one set of similar runs). Table 1 describes the meaning of each column heading. Note that sample environment specific columns are only needed when using that sample environment. Each line of the table will be executed sequentially from top to bottom. Within a line, each column will be executed sequentially from left to right.

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Table 1. Table scan script column headings.

Column Heading	Description
<b>General Settings</b>	
<b>title</b>	title for the run
<b>comments</b>	additional information about the run, typically include sample environment
<b>ipts</b>	your proposal number
<b>items</b>	ITEMS number of the sample being measured
<b>guide</b>	selectable guide setting, either “High Resolution” or “High Intensity”
<b>frequency</b>	chopper speed in Hz, typically 60
<b>wavelength</b>	desired center wavelength in Å
<b>temp_INIT</b>	initial temperature, used only in simulations to estimate script times
<b>Delay</b>	wait time in seconds before starting data collection
<b>Wait For</b>	criteria to use to signal the end of the run, typically “pcharge”
<b>Value</b>	value of criteria to signal the end the run
<b>Email and Text Notification Settings</b>	
<b>NotifyEmail</b>	email addresses or phone numbers to which to send notifications
<b>NotifySubject</b>	text of the notification
<b>NotifyTrigger</b>	enter a value of 1 to send a notification
<b>PAC Sample Changer Settings</b>	
<b>pac</b>	sample position (1-24) to place in the beam position
<b>temp_LKS</b>	sample temperature in K
<b>ramp_LKS</b>	ramp rate in deg/min
<b>tol_LKS</b>	temperature tolerance window in K
<b>Janis Cryofurnace Settings</b>	
<b>SetPoint1</b>	sample temperature in K
<b>Ramp1</b>	ramp rate in deg/min
<b>Tol1</b>	temperature tolerance window in K
<b>SetPoint2</b>	VTI temperature in K
<b>Auto Pump/Purge Settings</b>	
<b>Pump</b>	enter a value of 1 to start vacuuming the sample space
<b>StopAll</b>	enter a value of 1 to stop vacuuming the sample space
<b>Backfill</b>	enter a value of 1 to backfill the sample space with ~100mbar of He
<b>Orange Cryostat Settings</b>	
<b>temp_CRYO_vti</b>	VTI temperature in K
<b>temp_CRYO_sample</b>	sample temperature in K
<b>ramp_CRYO_sample</b>	sample ramp rate in deg/min
<b>tol_CRYO_sample</b>	sample temperature tolerance window in K
<b>Furnace Settings</b>	
<b>temp_FURN</b>	sample temperature in °C
<b>ramp_FURN</b>	ramp rate in deg/min
<b>tol_FURN</b>	temperature tolerance window in °C
<b>AGES Gas Flow Settings</b>	
<b>gases, e.g. O2</b>	flow rate of that gas in sccm, see example script for valid gas names

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Data is typically collected either for a specified time or a specified cumulative beam power (known as pCharge). At Powgen, we routinely collect on pCharge. When collecting on pCharge, data collection time will be extended if the neutron beam goes down during a run, in order to reach the same beam exposure. The expected amount of pCharge per hour depends on the beam power, as in Table 2.

Table 2. Accumulated beam exposure per hour, as a function of beam power.

Beam Power (MW)	pCharge per hour (C/h)
0.85	3.3
1.00	3.7
1.10	4.3
1.20	4.5
1.30	4.7
1.40	5.0
1.55	5.3

In certain columns of the table scan script, specifically center wavelength and sample temperature, you may include multiple values, either as comma separated values enclosed in parentheses or as Python-compatible range commands. That line in the script will be repeated for each value. For example, if `(0.8,2.665)` is entered in the wavelength column, two runs will be collected, one with a center wavelength of 0.800Å and one with 2.665Å. Or, if `range(100,301,10)` is entered in the temperature column, runs will be collected every 10deg between 100 and 300.

**Simulation** Once your table scan file is prepared, you may simulate it. The program will run through the script, line-by-line, without actually changing any parameters, and estimate the total time. To simulate a script, it must first be loaded into the EPICS software. On the central area of the dashboard (Figure 4), click on the folder icon. Browse to and select your file. The table below should automatically be filled with the entries from your script. Finally, press the Simulate button. On the left side of the monitor, the simulation output will be displayed. Each change of an instrument setting will be outlined, along with the estimated time to execute each line of the script, and at the bottom, the total estimated time to execute the entire script will be listed. Check the simulation output carefully to ensure that everything is as expected.

**Submitting a Script** Once your script is ready and the simulation output has been verified, you may submit your script by pressing the Submit button (Figure 4). A line will be added to the top of the Scan Monitor pane (Figure 7, bottom), representing that script. The Scan Monitor shows the filename, status (Aborted, Failed, Finished or Running), runtime, estimated finish time and which command is currently executing.

Separate table scan scripts may be queued. While the first script is running, load and submit the second script. It will be added to the top of the Scan Monitor pane and will automatically be executed once the first script finishes. To abort a currently running script, you may press the abort button on the Scan Monitor Pane, which looks like a red square. You may also pause or resume a currently running script by pressing the appropriate buttons on the Scan Monitor Pane.