How-tos for Essential Hall C Cryotarget Operations

G. Smith

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Abstract

This document provides brief instructions for performing the basic tasks every target operator is expected to perform. Somewhat dated but more detailed instructions are available from the *Hall C Cryogenic Target User Manual* at `http://www.jlab.org/Hall-C/document/manuals.html` where this document can also be found. More recent guidance can be found at the Hall C Cryotarget link, which is kept up-to-date, at `http://www.jlab.org/~smithg/target/Hall_C_Cryotarget.html`. Details appropriate for the currently running experiment can be found there.

Experiment specific stuff:

It is never a good idea to write down which loop contains which cryogen, because that can change even during a given experiment. Confirm this information with the target operator you are relieving, and make sure that the loop temperatures you observe are consistent with this information. We normally run LH2 at 19.00 K and LD2 at 22.00 K.

Solid targets hang off the bottom of the cryostack. There is no separate solid target ladder in the Hall C system any longer. Solid targets normally on the ladder include solid Aluminum dummy targets which simulate the entrance and exit windows of each cryotarget. These are typically about 8 times thicker than the cell wall thickness, but check the cryotarget web page for the list of precise thicknesses. Various optics target configurations are also provided on the target ladder. Other solid dummy targets usually include at least one Carbon target, a BeO target which can be viewed using the TV camera that looks into the scattering chamber, and an empty target position.

Keep the fast raster on at $\sim$2x2 mm^2 or larger. Run the fans at 60 Hz. Maintain 50-100W of reserve heater power at all times (this minimum heater power is what is left when the beam is on). The total beam power associated with the short, 4 cm targets is about 150 W (at 100 μA).

Starting the GUIs from scratch

To start the target control software, logon to either to jeffylab (aka cdaql6) or gzerol2 (`ssh cvxwrks@gzerol2`) under the cvxwrks account. The password is posted in the counting room. We prefer that you use gzerol2 to operate the target because jeffylab is now used primarily for DAQ. Note also that it is gzerol2 as in linux2, not as in the number twelve.

Type `cd $GUI` to get to the correct directory, then launch the software by typing `./tgtgui`. The main target GUI will then appear. This should remain running always. Secondary GUIs, the alarm handler, and the charts are all launched from the buttons on this main GUI. Use of the GUIs is intuitive. A nice description of them is provided, however, in a Users' Guide written by Chris Keith at `http://www.jlab.org/~ckeith/Atarg/ATARG_MAN.html`. If the alarm handler is not already running, launch it from the main GUI. *Make the alarm handler GUI sticky so it appears in all your workspaces on the desktop!*

Launch (all) the loop charts next from the appropriate `Charts` button on the main GUI, if they're not already running.

Target Motion

Cryotarget motion is now initiated directly from the main GUI. Before you put in a different target, there are two things to do. First, make sure you understand what the beam current and raster requirements are for the target you are moving to. Second, the new target (if it is a cryotarget) will almost certainly have an inadequate heater power for use with the beam, since we always close the JT valve on unused loops so that they pull only 50–100 Watts without beam. Before putting beam on a target, the heater power must be set to the expected beam power plus this 50–100 Watt reserve. A plot of the beam power vs beam current is posted in the counting room, and shown in Fig. 1. This comes from the expression $Power(Watts) = I_{beam}(\mu A)\ dE/dx(MeV/gm/cm^2)\ \rho(mg/cm^3)\ t(cm)$. Likewise, after removing a target from the beam, close the JT valve appropriate for that target until you're pulling only 50–100 W on the unused target in order to reduce the load we're putting on the ESR.

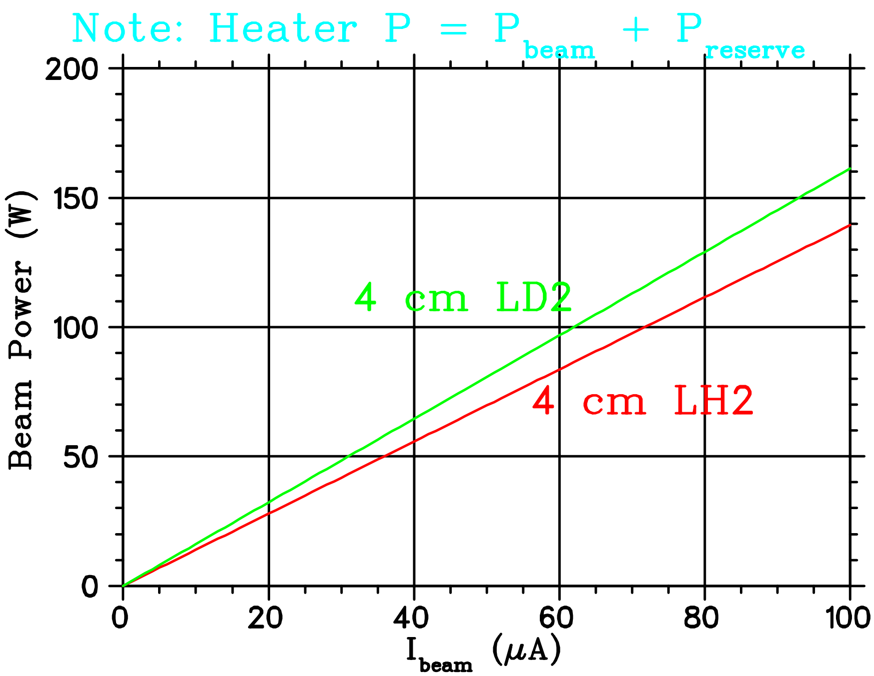

Figure 1: Values of the beam power deposited in the target as a function of beam current. The D2 curves are essentially identical to those for H2 (D2 has approximately twice the density but half the energy loss as H2). To set the heater power, an additional 100 Watts of reserve power should be added to the amount indicated from this graph.

To change targets, first call MCC to have the beam turned off and our FSD mask set, as well as to tell them what new target you are going to. Once the beam is off and the mask is set, click on the button associated with the target you want to go to. A little dialogue box will pop up asking if you are really ready to move the target ladder, click `OK`.

Watch the TV monitor to make sure the motion you just initiated makes sense. On the target motion GUI, you can also observe the encoder position changing and the green light should go on once the new target position has been reached. If for some reason you suspect the motion is out of control, kill it with the GUI button, or with the scram switch next to the target operator console. Resetting the scram switch will require intervention by the target group, so only use this in an emergency. Note also that the target motion is slower now than before, so have a little patience.

While it is moving, the `busy` light on the `Target Motion` GUI should light up, and the red `Tgt Motion` light on the panel to your right with all the red buttons on it should also light up. This panel indicates what is causing an FSD. The light is latched on so you should clear it by pressing the button once the target motion has been completed. The lights/buttons are diagnostic devices only and do not affect anything. The encoder position value will also change. You can check you're at the right encoder value from the `BDS Positions` button on the main GUI.

You should observe the cryostack motion on the TV monitor, if it has not burned out from radiation. The GUI cartoon is slow to catch up to reality, it may take a minute or two for it to adjust to the new position. You're there when the busy light goes out, and the green light goes on at the new position, and the encoder position has reached the right value. Since there are 51,200 encoder units per mm, don't be concerned if the numbers are not exactly the same in the first 4 digits.

When you're finished you call MCC back, have them reset the FSD mask and give us back the beam. You have to tell them what current to use. If you're not sure, check our official beam current limits at `http://opweb.acc.jlab.org/internal/ops/ops_webpage/op_limits/oplimits.html`. Verify that the beam current you asked for is what is delivered. Log the configuration change in hclog.

Alarm Handling

To service alarms, first click the button on the alarm handler GUI. This launches an alarm tree GUI which lights up those elements in the tree which have gone outside their limits. The main branches of the alarm tree are displayed on the left side of the GUI. Go to the main branch that is alarming and click on it. *Always service alarms from the lowest branch in the tree!* This will display the sub-branch items on the right hand side of the GUI. Click on the 'P' (for paramter) button next to the name of the alarming item. This brings up yet another GUI which shows the current value, the high and low alarm limits, and the more extreme hihi and lolo alarm limits for each item in the category you just clicked on. The offending items are highlighted. Jot down which item is causing the alarm. If by this time it is still out of the alarm limits you may have a problem. Call one of the target contact people to find out what to do, if you are not sure. They may advise you to change the alarm limits, but this should only be done or sanctioned by one of the target experts/contacts (Smith, Meekins, Seely, Keith). The more usual case is that the value has returned to its nominal value. In that case, all you have to do is click on the lit button in the leftmost column and that'll take care of it. Continue doing this until all alarms have been serviced.

IOC Reboot

You need to reboot the target IOC if the strip charts have flatlined, and/or the heartbeat GUI has stopped beating.The target temperature may have drifted away from it nominal value. During the reboot, the HPH gets set to zero. So before you reboot, you have to supply a constant auxillary power to the heaters. There are auxillary heater power supplies for this purpose, wired in parallel to the main heaters. You must know what the heater power is for each loop when the beam is off, you had better have written this down when you started your shift or else you're screwed. Anyway, the first thing to do is call MCC and have the beam turned off. There are charts next to the auxillary HPH pots which tell you what auxillary heater pot settings you need to have for a given heater power (see Fig. 2). Look up the pot setting for each loop using the beam-off power you know you had. (Note that if you're unsure, you can estimate that from the beam power plot which is also posted (see Fig. 1)). Dial that into the appropriate auxillary heater pot. Do not put heater power on loops which are warm! When you've done this for both cold loops, turn on the auxillary heaters using the switches right next to the pots. All this is located right next to the target control terminal in the counting room.

Then go to the CODA terminal, bring up the reboot GUI, enable it, and click on the reboot button for the target IOC (iochc4). Closely watch the DVMs just above the auxillary heater pots. They view the target temperatures via analog signals from the temperature controllers which do not pass through the IOC, and are therefore your only reliable link to what happening in the target during the reboot. If the temperatures vary much (say more than $\sim \pm 0.5°$) outside the desired goal temperatures, you may have to make some quick adjustments of the auxillary heater pot settings. Keep on top of this until you are back in PID mode and the auxillary heaters are turned off, still a couple steps away. OK, now wait a few minutes for the IOC to finish rebooting.

Once you're satisfied the IOC is back, flip off the switches for the auxillary HPHs. Continue to monitor the temperatures on the DVMs and make sure you have feedback again. You may get a 0.5K excursion when the aulillary heater is turned off, but that should recover in a matter of seconds. If not, restore the auxillary heater. While things are settling down you can service the alarms. When you're sure everything has settled down and you're all done you can call MCC and get the beam back on. Log the event in hclog.

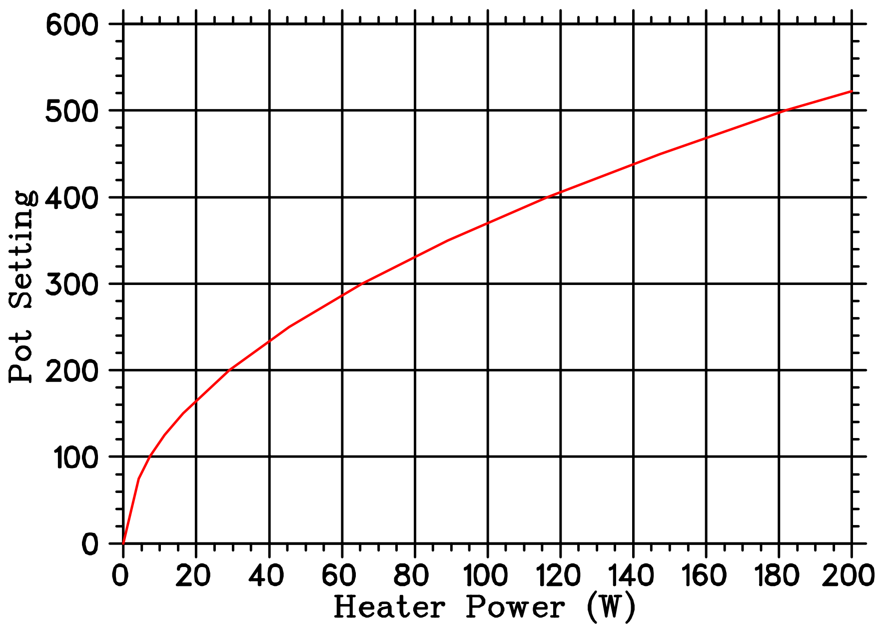

Figure 2: Values of the auxillary heater pot setting required to achieve a given heater power.

Heatload Adjustment

Since the high power heater power is linked to the temperature in each loop via a feedback (PID) mechanism, you can't affect the heater power directly. To adjust the heater power, you adjust the JT valves, accessible from the `JT Valves` button in the main GUI. Open the appropriate JT valve to raise the heater power. In the JT valve GUI you set the step size (in %) and step open or step closed. You should use a step size of 1 or 2% (not larger), and realize that it takes around 20 seconds or so to see the full effects of your change. Note that the high power heaters have upper limits associated with them (set in the high power heater GUI). These upper limits may prevent you from going as high as you want with the heater power, if so change the limits.

The fan speed (accessible from the `Fans` button in the main GUI) can also be adjusted. The nominal setting is 25% (of full speed) which is 60 Hz (the tachometer should read back 60 Hz for normal running). If the fan stalls or dies, you may need to reset it from the fan control GUI. (Note: In the regime we're operating in, a higher fan speed actually raises the temperature a little due to the increased heat load put out by the fan motor.)

Vacuum

The insulating vacuum for the target is maintained by a turbopump connected to the Hall C scattering chamber. If the turbopump trips, the controller must be reset from inside the hall. The turbopump controller is at face height, in rack HC01Z15 just behind the right hand side of the target gas panel. It a black box with a set of white strips and leds running diagonally across the face. The vacuum in the scattering chamber should be in the low 10^-6 Torr range or better. If it goes above $5x10^-5$ Torr the gate valves on both sides of the scattering chamber will close.

Target Logging & Checklist

The target logger must always be running. A cron table checks that it always is. The best way to check is to use the archiver to plot something. Links to the archiver are provided on the cryotarget web page.

The checklist is done by taking a snapshot of the main GUI and stripcharts and sticking that into hclog.