

Using The Robot



Robot gripper with fingers



Click on USER-RBT on the synoptic to open the robot window



Sample Positions				
	Puck		Pin	
Next	13	13	16	16
Current	0	0	0	0

Program Running: Stop Reset Initialise

Current Program Line: 0 Qok

Robot Location: 0 Home

Errors:

- Program Error: 0
- Command Error: 0
- Controller Error: 40 QokDoor Switch Signal is Input

Exit

It is useful to have this window available as it always shows the status of the robot – what it is doing and where it is.

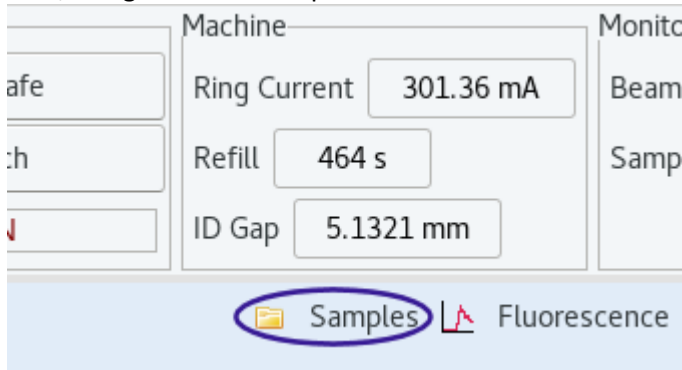
NOTE: There is a Stop button in this window – this is the only way to stop the robot, if necessary

It also shows any errors relating to the robot:

e.g., *QokDoor Switch Signal is Input* shown above indicates the hutch interlock has been broken

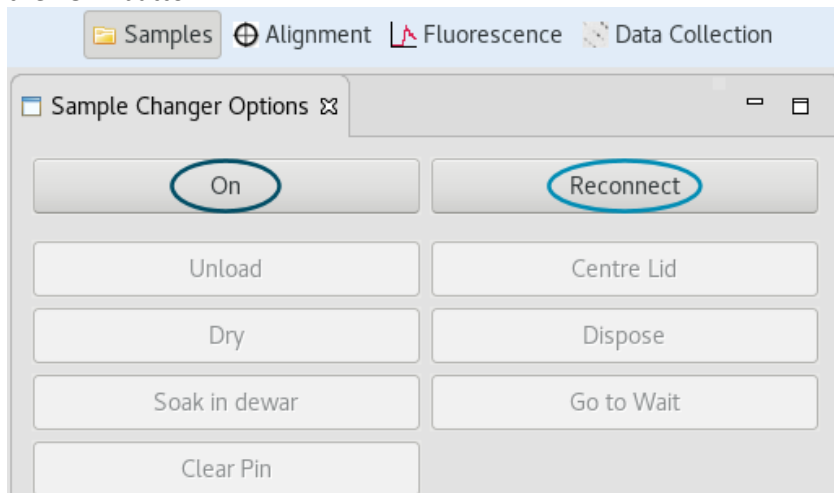
Connect to the Robot

First, navigate to the Samples tab in the GDA

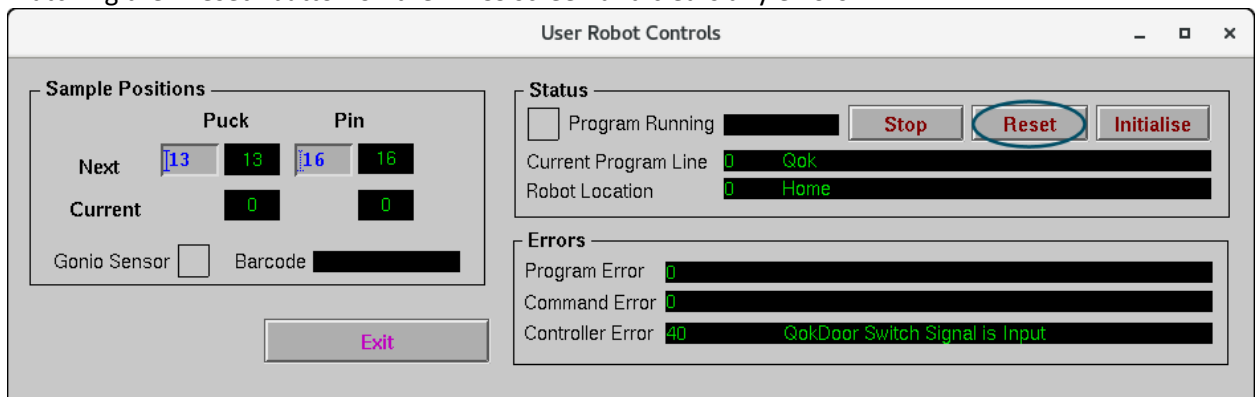


It should no longer be necessary to make a connection between the GDA and the robot every time a new GDA client is opened as this is done automatically. However, if the GDA is not communicating with the robot, and the “On” button is available, this can be done.

In the Sample Changer Options tab (this can be found to the right of the list of samples and pucks) click the “On” button.

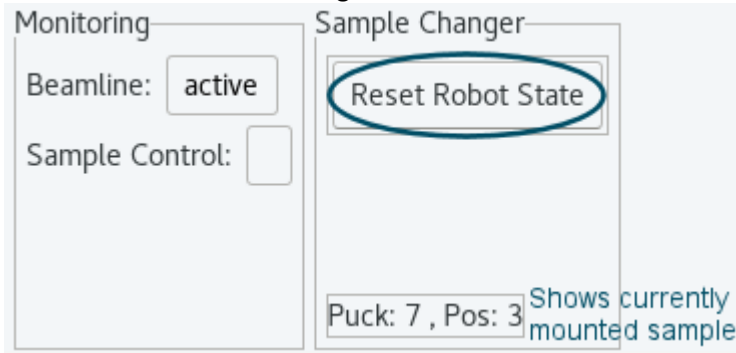


If the only button available is the “Reconnect” button, press this next. Reconnect is really a reset button, matching the “Reset” button on the EPICS screen and clears any errors.



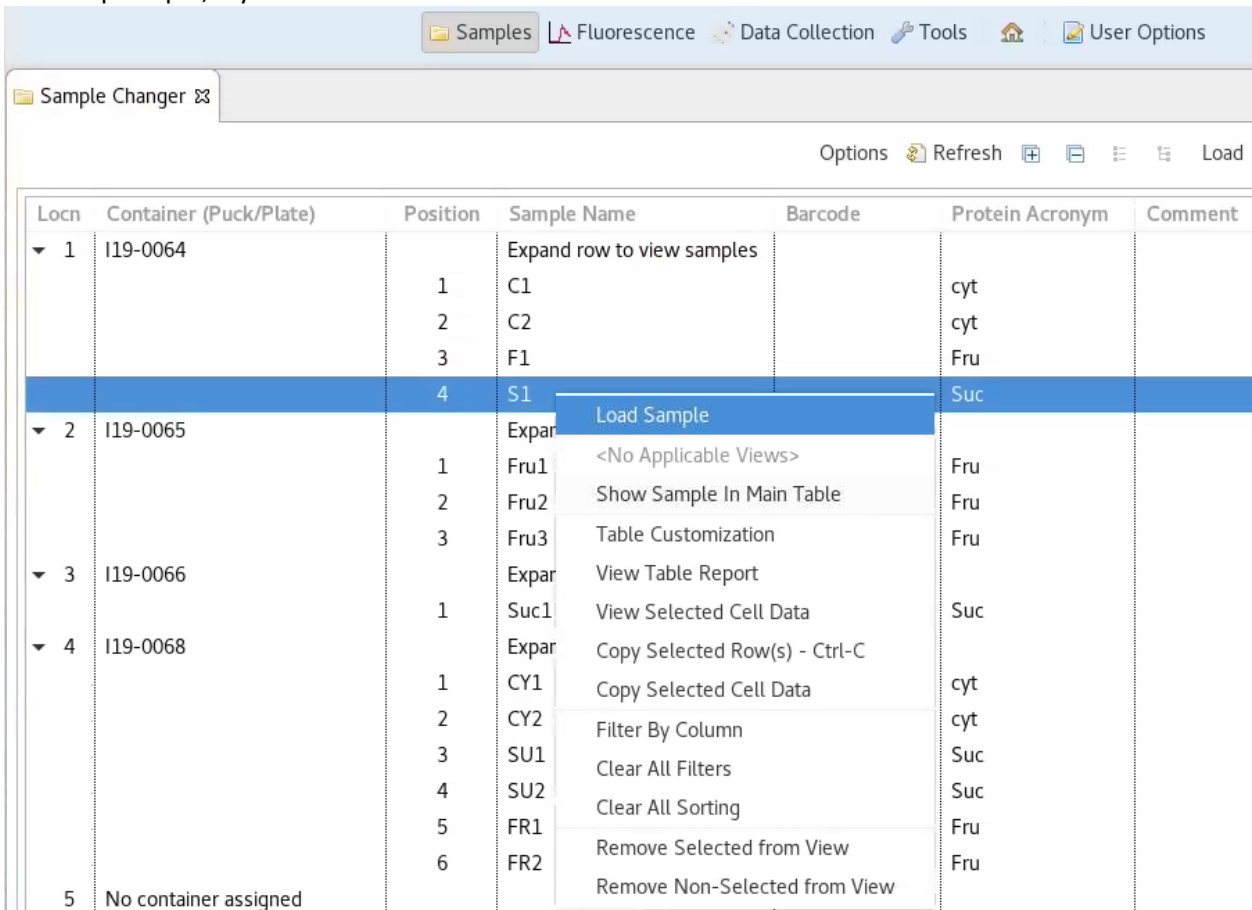
Any robot errors are shown in this window – whilst some messages are not show-stoppers, others will need clearing, for example, if there are any issues with sample loading/unloading, listed under Program Error.

If all the buttons in the Sample Changer tab are greyed out, first try clicking in the GDA window. If this doesn't help (for example, all buttons are disabled after pressing Reconnect), it may be necessary to switch the robot status by pressing the "Reset Robot State" button – this should make all the robot function buttons available again.



Load a Sample

To load a sample, check the list of samples in each puck on the left-hand side of the Samples view. Right click on the sample you want to load, and then select Load Sample from the pop-up menu. Click Yes, when it prompts, if you are sure.



At this point, the goniometer should move to the sample mount position, then the robot should go and soak in the appropriate Dewar for 30 seconds and then it should mount the requested sample. Check for messages in the Jython Console window of the Data Collection view and see page 68 section if loading fails.

Exchange a Sample

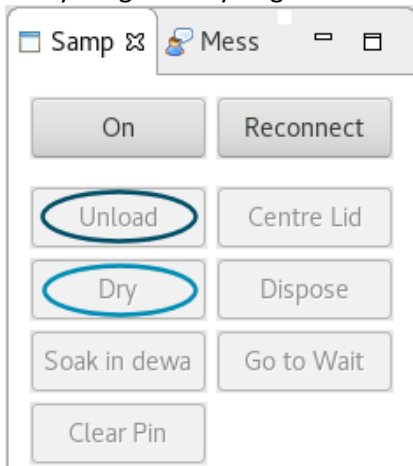
To change samples, simply right-click on the next sample to be loaded and select Load Sample. The robot program will unload the current sample, replace it in the Dewar, collect the next sample and load that. Sample exchanges can be queued.

Between sample exchanges, the robot will sit with the gripper in the Dewar – this reduces time spent drying and soaking and makes exchanges quicker. The robot will take itself off to dry every 45 minutes - it will dry after the next sample mount once the time is up and then go back to waiting in the Dewar. If 60 minutes are reached without any action, it will take itself off to the dryer anyway and then sit at the wait position assuming beamtime has either paused or ended.

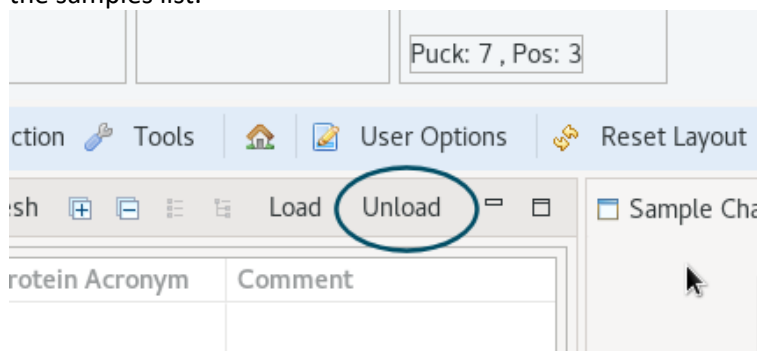
Unload a Sample

Although it is possible for the next user to unload your final sample, it will cause less confusion and reduce the chance of the sample turning into a snowball if you unload it when you are finished.

At the end of your session, the final sample needs to be unloaded – use the “Unload” button from the list in the Sample Changer tab. This will place the final sample back in the puck and ensure that everything is ready to go for the next user.



Alternatively, it is possible to add an unload to the queue - just use the “Unload” button at the top of the samples list.



It is also recommended to unload the sample if you are planning to go for a break of an hour or more as the sample can get icy when left stationary in the cryostream flow, which can then cause the robot issues when it tries to pick it up (as well as potentially damage the sample).

The “Dry” button can be used to send the robot to the dryer at any time it seems either necessary or prudent beyond the set drying times. It may be necessary to press the “Reset Robot State” button first to make the “Dry” button available.

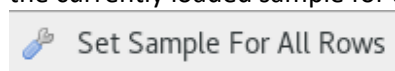
Useful Notes:

1. Make sure to unload your final sample as, once your pucks have been exchanged for the next visit, there will not be a position to unload the sample to – your sample will be lost and the changeover will not happen smoothly – note that an unload can be added to the queue so this happens automatically after your final data collection.
2. If the puck positions were assigned after opening the GDA, click on the “Refresh” button to update the sample information.
3. It is possible to queue a sample exchange from the samples page: to exchange the sample, simply right click on the next sample to be looked at and select load from the drop down. The exchange script will be added to the end of the queue.
4. It is possible to just start the exchange process by clicking on the button “Queue Prepare Sample Mount” (Prepare Sample Mount is the first script run as part of the robot load script) from the list of scripts in the Axis Control tab. Queuing this part means the detector is moved back, the beamstop and collimation are out and the comes light in immediately after the data collection rather than being run at the start of the sample exchange. This may be a clearer indication that the data collection has finished.

Data Collection

For samples registered in ISPyB, it is possible to use the information already provided to populate the Default Folder and Default Prefix fields. By using the \$ variables, this information can be picked up automatically for each sample without the need to type it in each time.

If a run list is loaded (either the Default Run List or one from the Select Collection Strategy dropdown) after a sample registered in ISPyB has been mounted by the robot, the Sample ID column will automatically display the current sample. If the currently loaded run list is required, then clicking on the “Set Sample For All rows” button on the far-right (above the run options) will update the Sample ID to the currently loaded sample for all rows in the data collection.



Row Sel.	Sample ID	Code	Folder	Prefix
1	Not-defined			
2	Not-defined			
3	Not-defined			
4	Not-defined			
5	Not-defined			

Row Sel.	Sample ID	Code	Folder	Prefix
1	04-06			
2	04-06			
3	04-06			
4	04-06			
5	04-06			

Having the Sample ID defined means data collections are linked to the sample registered in ISPyB.

It also activates the \$ variables. Type \$ in the Default Folder / Default Prefix boxes for the list of options to automatically appear and then double click on the required variable. Multiple variables can be selected and/or additional text can be included – it is tidier to include an underscore or hyphen between variables.

Axis Start (°)	Axis Rotation / Image (°)	Axis Delta (°)	Axis End (°)	Expt Type	Number of Images	Time (s)
0.00	0.100	0.00	45.00	Standard	450	0.100
0.00	0.200	0.00	180.00	Standard	900	0.200
-145.00	0.200	0.00	25.00	Standard	850	0.200
-145.00	0.200	0.00	25.00	Standard	850	0.200
-145.00	0.200	0.00	25.00	Standard	850	0.200

Default Folder: Default Prefix:

The value to populate the variable is taken automatically from the information input into ISPyB - it does not update to reflect this on the table page but the names that will be used can be seen in the Data Collection Settings tab.

Folder [Configure Defaults](#)

Prefix [Configure Defaults](#)

Troubleshooting

If you need an EHC to intervene in the hutch, please press the “Make Hutch Safe” button to close the shutter and create space at the sample position.

Beamline I19-1 - Tel. +44 1235 778418 (Out of hours: +44 1235 77 8787) - GDA - 9.32.0

File Edit Search Run Window Help Messages Feedback

Baton 119 EH1

Energy: 17997.6 eV
Wavelength: 0.68890 Å
Detector distance: 500.00 mm

Hutch Control: **Make Hutch Safe**
Hutch Shutter: CLOSED

Machine: Ring Current: 300.54 mA
Refill: 341 s
ID Gap: 5.1952 mm

Monitoring: Beamline: active
Sample Control:

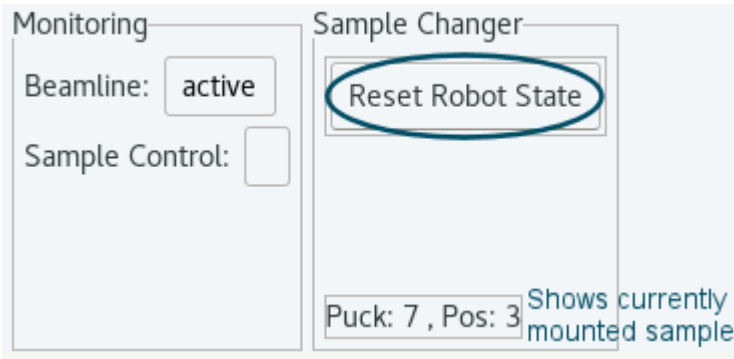
Sample Changer: Reset Robot State
Puck: 7, Pos: 3

1. Can not centre the sample

It should be possible to start centring as soon as the robot has finished loading the sample – remember there is an auto centring routine which will try to run first. There are 3 likely causes for manual centring not working:

a) The robot is still active

Click on the “Reset Robot State” button to deactivate the robot and pass control back to the GDA. (There is never any harm in pressing this button, even if that wasn't the cause.)



b) One of the centre axes is in an error state

Check the status of the axes in EPICS:
Click on DIFF1S to open all of the axes



If any of the centring axes (Centre X, Y, Z) are flashing red, click on any of the buttons for the affected axis

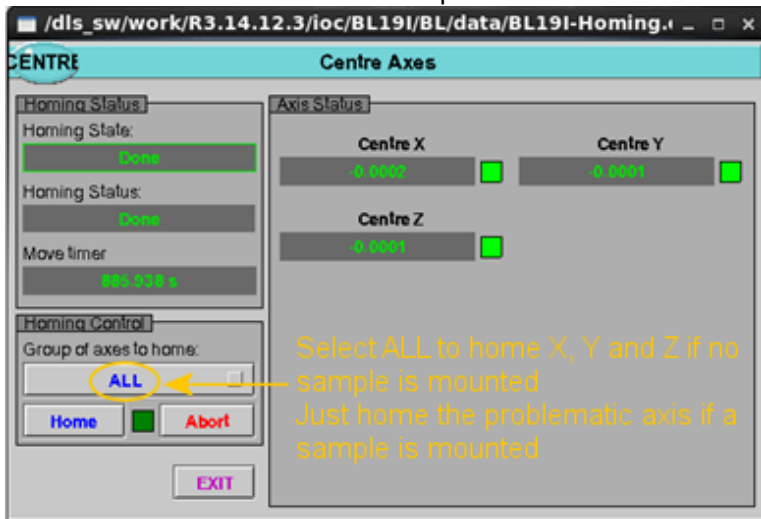
Normally, this will be enough and the motor should work again.

If there is still an issue, then the axis will need rehoming.

Click on the "Homing Screens" button on the synoptic and select Centre Axes from the list.



Select the relevant axis from the drop-down menu and click *Home*



A good starting point for crystal centring is $x=0.9$, $y=3.1$, $z=-1.2$. Type these numbers in the DIFF1S window, in the relevant boxes with the blue numbers and press *enter*.

c) The robot has mis-seated the sample on loading

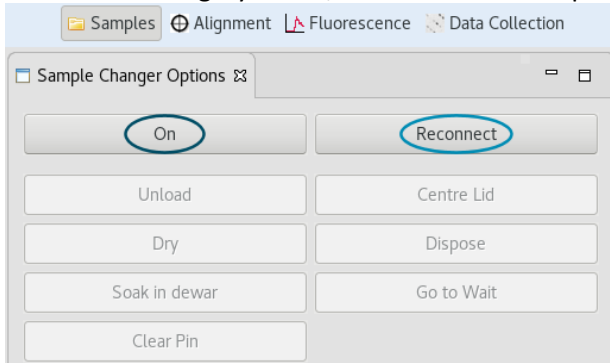
The robot loading relies on the sample mount being in the correct location. Sometimes one (or more) of the centre axes can get lost and then, when the sample stages drive to the robot mount position, the real position is not correct although the motors think they are right.

- Unload the sample (or ask the local contact/EHC to mount it correctly)
- Then rehome the Centre Axes as described above in 1b

2. Can not load / exchange a sample

a) If the robot doesn't move and no messages appear in the Jython console

Check the GDA connection to the robot is ON - go to Samples in the main tabs menu and check the button status in the Sample Changer Options tab. If the "On" button is available but all buttons underneath are greyed out, the robot will not operate until the "On" button is clicked.



It will also be necessary to click Reconnect if there are any program or controller errors reported.

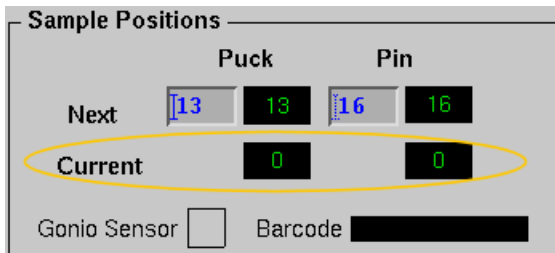
b) If the robot doesn't move and there is an error message stating "Dewar lid not found"

Use the webcam to check for ice on the white Dewar lid – the lid hole is defined as a circle within a square and if the lid is very icy, the red square can become obscured. Use the hair dryer in the hutch (or ask the local contact or EHC to use the hair dryer) to warm up the lids and remove all ice and moisture.

Also ask them to check the lid heater is enabled.

c) If the robot doesn't move and there is an error message stating "Pin not sensed on goniometer before load"

i) No pin mounted - Check (using the cameras) to see whether there is a sample mounted. If there isn't, for example one was removed manually, check if the system thinks there is a sample mounted, either in the GDA, the EPICS window or in ISPyB. They should all report current Puck: 0, Pin: 0 when there is no sample mounted. If different values are shown, ask the EHC or local contact to manually correct this.



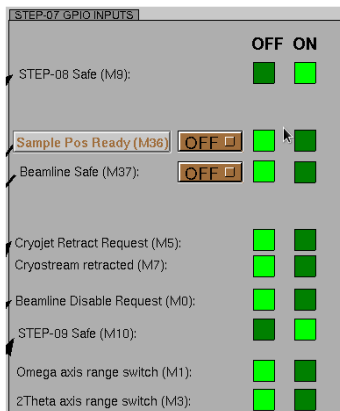
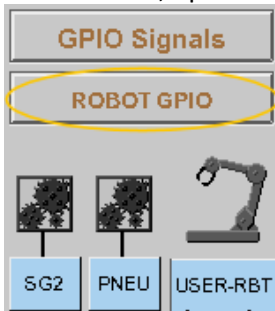
ii) A pin is mounted - If there is a pin mounted but the pin sensor can't see it, ask the local contact or EHC to check the pin is mounted correctly and that the pin sensor is working.

d) If the robot doesn't move and there is an error message stating the "Sample position is not ready" or "Beamline not safe"

This means one or more of the goniometer axes has failed to move to the correct position for the robot to be able to mount/retrieve a sample.

- Ensure you are using the GDA to run robot scripts - EPICS does not run the script to drive the goniometer to the load position.
- Check the status of the EH1 diffractometer and make sure none of the axes (mostly likely Centre Z) are in a red error state - see 1b, above.
- The omega and 2 theta axis positions are confirmed as being in the safe range by the colour sensor readings – occasionally the sensor fails to see the yellow indicator tape (there is no warning period, it just fails).

To check this, open DIFF1S and ROBOT GPIO from the main synoptic:



Here, 2 theta is at 90 degrees and omega is set to 4 degrees – both axes are outside of the acceptable range for the robot to mount a sample

→ GPIO status is OFF

When 2 theta and omega are at 0 degrees, they should be within the range switches

→ GPIO status is ON

If the sensor is not working, then the GPIO will show as being off, even if the axis is at 0 degrees

If this is the problem, call the local contact / EHC and ask them to add another layer of yellow tape in the appropriate place. If an EHC needs to access the tape locations, please drive to:

omega = -20°

2 theta = 90°

e) If the robot moved but failed to collect the sample from the goniometer

There is a pop-up error reporting "Pin sensed on goniometer mid-exchange". Check the end effector for ice – if it is too cold and icy, the gripper is unable to close and will fail to close around the mounted sample.

Press "Reconnect" to clear the error.

Then, either wait a couple of minutes and try again or press "Reset Robot State" followed by "Dry" to send the robot to the dryer before trying again. (The end effector sometimes gets icy when the Dewar refills.)

f) If the robot moved but failed to load the next sample

There is an error reported stating *“No pin mounted after load”*.

- i) This could be due to the formation of ice causing the end effector to be unable to collect the next sample in the Dewar - send the robot to dry – see 2e, above.
- ii) The sample in that position is misaligned or not present - ask the local contact or EHC to check the sample puck in the Dewar.

g) The robot crashed, but has done a slow recovery back to the wait position

- i) Note where the robot crashed and, if this is likely to be an issue again, call the local contact or EHC.
- ii) If the robot crashed and it wasn't clear what caused the problem, or it won't be an issue again, it is possible to continue.
Click on the “Reconnect” button once recovery is complete, to clear the error.
If the error doesn't clear, request assistance from the local contact or EHC.

h) The robot crashed and remains in the crash position

If the robot has stopped near the wait position:

- First click on the “Reconnect” button to clear the error
- Then click on the “Reset Robot State” button to bring the buttons back
- Then click on the “Go to Wait” button
- It should be possible to continue

NOTE: this will only work if the robot knows its actual location. If this doesn't work call the local contact or an EHC for assistance.

If the robot is anywhere other than near the home location, call the local contact or EHC for assistance.

3. Need to tell the system which sample is mounted

a) Previous user group has left the last sample mounted

Please remember to unload your final sample!

As long as the pucks haven't been removed, just carry on and load your next sample - EPICS knows which sample is mounted, even if you don't, so the exchange will happen safely.

If the pucks have been changed so the sample can't be returned, use the “Dispose” button.

b) The robot has failed to return the sample to the puck

The robot picked up the sample from the goniometer but failed to leave it in the puck. This sometimes happens if there is an e-stop. (Note that sometimes the gripper holds on to the sample, and sometimes it drops it on the floor after an e-stop.)

Once the robot is back in the home position, click on Dispose in the Sample Changer tab of the GDA - it might be necessary to clear any errors by doing a “Reconnect” first and then a “Reset Robot State” to make the buttons active again. The sample should be dropped in the pot on the dryer and make it possible to continue. It may be necessary to ask the local contact or EHC to update the mounted pin information.

If this fails, ask the local contact or EHC to remove the sample manually and, if necessary, update the mounted pin information.