

# MIRC-X USER GUIDE

MIRC-X team – Version 1.2 – 2017-08-02

FOR USE BY OBSERVERS AND OPERATORS AT THE CHARA ARRAY





For edits and revisions, please email Monnier et al. team

**MIRC-X has been built using funds from:**

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&  
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# MIRC-X USER GUIDE

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## USEFUL INFORMATION

→ Static IP address for MIRCx server: 192.168.3.136 and hostname “champ”

The following images are intended to act as a guide to the nomenclature used in this document:

PolyScience water chiller:



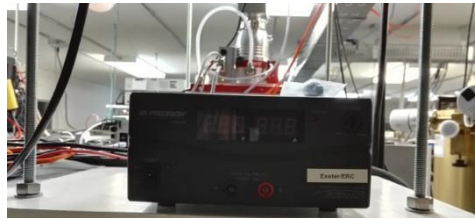
Think logical fiber extender:



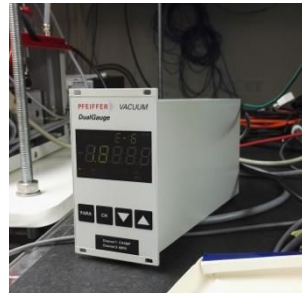
Pfeiffer Vacuum pump (also called the turbo pump):



Camera power supply (also called the BK precision unit):



Pfeiffer Vacuum DualGauge:



“BindMaster” power trip switch:



SafeSens box:



The steps in this section are to be carried out by CHARA staff or the MIRCx team **only**.

We recommend that pumping is initiated **at least 2 days** before the start of a MIRCx run. Cooling is envisaged to take ~3 hours.

Upon commencement of a MIRCx run, please follow the instructions below:

1. Pump vacuum/remove outgassing from hose/pipe: **Pump the hose for continuously two days (or pressure  $<3 \times 10^{-6}$ ) before going to next step or startup the camera.**

**\*\* CAUTION don't open the camera valve here that step will come later.**

  - a. Ensure the black valve on the HiPace section at the back of the turbo pump (Pfeiffer Vacuum pump) is **closed**.
  - b. Ensure turbo pump is attached to camera and that the camera valve (black knob on side of camera unit) is **closed**.
  - c. Check the Pfeiffer Vacuum pump display for the pressure inside the hose/pipe. **If that pressure  $>10^{-3}$  mbar, open the electromagnetic valve before starting the turbo pump.** If the Pfeiffer Vacuum pump display shows  $<10^{-3}$  mbar pressure then keep shut the electromagnetic valve. This work is important because if the hose/pipe has a lot of air in it, then it might damage the turbo pump (it can "slam" the turbo pump which is at atmospheric pressure). So it is recommended to watch Pfeiffer Vacuum pump display and take necessary actions before doing something.
  - d. Start the turbo pump using the power button. The "ActualSpd" value on the display goes up to ~1500 Hz. Wait until 1500 Hz speed is reached.
  - e. If the electromagnetic valve closed here, now open it to pump inside the hose. This will help to remove outgassing. **If you want to close the turbo pump during the night, close first the electromagnetic valve and then power off the turbo pump. Please make sure to follow "step c" above whenever the turbo pump is required to start.**
2. On the day of observing, start water chiller and camera fiber links:
  - a. Start the water chiller (PolyScience Unit - located by the computer racks) using the black switch on the rear of the unit. **Never start camera without starting the water chiller. Water chiller cools down the electronics of camera.**
  - b. Power up the "think logical" fiber extenders (one located on the computer racks and other at the camera).
3. Set up the camera power supply:
  - a. **If this is the beginning of a MIRCx run (else skip to point b):** Drain the body static current: **unplug the LEMO cable from the rear of the camera power supply** (black "BK precision" unit) and check the camera power supply voltage (24 V).
  - b. Turn off the camera power supply and plug the LEMO cable in at the **\*\*back\*\*** of the power supply unit.
  - c. Switch power supply to "ON".
4. Load the C-RED-ONE camera GUI:
  - a. If you're on a computer outside the lab (else, see point b), use login into the MIRCx server (ssh -XY spooler@champ), then skip to point c.
  - b. From the lab computer, open a terminal window on MIRCx (switching between computers is achieved using <scroll lock>, <scroll lock>, <space bar>) and login into spooler user account

- c. Open a terminal and enter command "credonelmAcq". The window in Fig.1 should pop up.

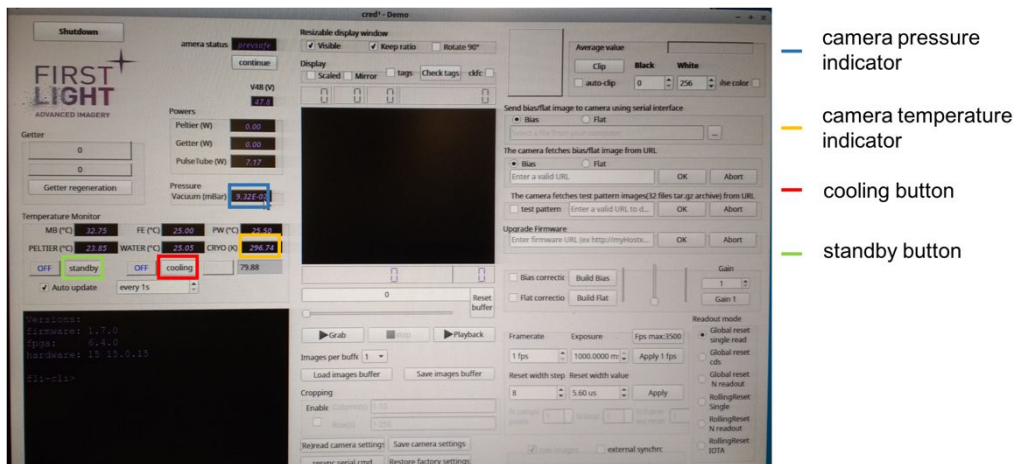


Fig 1: Screenshot of C-RED-ONE camera GUI highlighting locations of camera pressure and temperature indicators and cooling and standby buttons.

5. **Make a note of the camera and turbo pump pressures.** The turbo pump pressure is shown by the "Pfeiffer Vacuum DualGauge" in the lab. The camera pressure is visible in the C-RED-ONE camera GUI.
6. Check that the "camera status" in the C-RED-ONE camera GUI reads "ready".

**\*\* CAUTION REQUIRED FOR NEXT STEP When reaching for the knob to open and close the camera valve [see Fig.2], take care not to touch the nearby optics and fibers \*\*.**

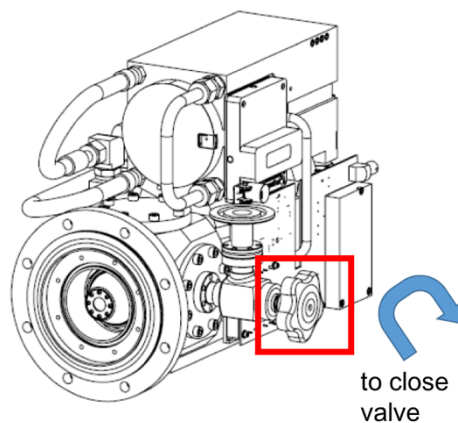


Fig 2: Camera schematic showing location of camera valve and direction of rotation one must use to **close** valve. To open the valve, rotate the knob so that the top moves towards the front of the camera and the bottom moves away.

**\*\* CAUTION REQUIRED FOR NEXT STEP When reaching for the knob to open and close the camera valve [see Fig.2], take care not to touch the nearby optics and fibers \*\*.**

7. Once the turbo pump pressure reaches  $\sim 1 \times 10^{-6}$  mbar, **slowly**<sup>\*1</sup> open the valve of the camera while monitoring both the camera and turbo pump pressures.
  - a. <sup>\*1</sup>**The change in camera pressure must NOT exceed a factor of 10 in 10 minutes.** [see Fig.3]

8. Once the camera pressure reaches  $1 \times 10^{-5}$ , open the camera valve fully and **wait until the turbo pump pressure  $< 3 \times 10^{-6}$  before moving to next step.**
9. Check once more that the "camera status" in the C-RED-ONE camera GUI reads "ready". If this is not the case, power cycle the camera and hit the "continue" button on the C-RED-ONE GUI.
10. Open the temperature and pressure monitoring plots:
  - a. On MIRCx, change directory into /data1/LogData and enter commands "/data1/LogData/PlotTemp.sh" and "data1/LogData/PlotVacuum.sh".
11. Ensure again that the camera pressure reads  $1 \times 10^{-5}$  mbar before hitting the "cooling" button on the camera GUI (see Fig.1) to start cooling. [You have to click the word "cooling" rather than the "on/off" label next to it]. The "camera status" will change to "isbeingcooled".

**\*\* CAUTION: Wait until the camera has cooled to 80 K \*\***

12. Remove the cap from the front of the camera.
13. Check the camera GUI to ensure that the camera is not in standby mode. The label next to the "standby" button should be "off" and the camera status should be "operational".

**The camera is now ready for observations.**

#### PRESSURE MAINTENANCE DURING OBSERVATIONS

It is recommended to operate the camera in vibration free environment.

**\*\* CAUTION: Please read carefully before taking any action \*\***

For that the camera can be pumped using the ion pump (Gauge acts as ion pump). To move to that step make sure that the camera pumped with turbo pump more than a few hours such that the pressure on the Pfeiffer Vacuum pump gauge display **less than  $< 5 \times 10^{-7}$  mbar** (while the camera is being cooled pressure reduces because the N<sub>2</sub> gas freezes up).

14. Close the electromagnetic valve by switching the "BindMaster" power trip switch to "OFF" position. A pop/click sound is normal. Check the pressure Pfeiffer Vacuum pump gauge display and of camera. If they are not moving fast (camera pressure should  $< 10^{-4}$ ) then only keep close the electromagnetic valve. Otherwise open the electromagnetic valve and keep pumping.
15. **\*\*CAUTION \*\*** If the pressure is stable when the electromagnetic valve is closed, switch the turbo pump off using the power button on the front on the unit, below the display panel. **For any reason, the camera pressure goes up ( $> 5 \times 10^{-4}$  mbar), the turbo pumping is required for the camera to lower the camera pressure. While switching ON the turbo pump please follow the STEP 1 above.** Check the Pfeiffer Vacuum pump display for the pressure inside the hose/pipe. **If the Pfeiffer Vacuum pump pressure  $> 10^{-3}$  mbar, close the camera valve first (Please remember that if you close the camera valve for a long time it cannot hold the pressure for a long time because of outgassing.), and then open the electromagnetic valve before starting the turbo pump.** If the Pfeiffer Vacuum pump display shows  $< 10^{-3}$  mbar pressure then keep shut the electromagnetic valve. This work is important because if the hose/pipe has a lot of air in it, then it might damage the turbo pump (it can "slam")



the turbo pump which is at atmospheric pressure). So it is recommended to watch Pfeiffer Vacuum pump display and take necessary actions before doing something.

The steps in this section are to be carried out by the observer once at the beginning of each night of observations.

Before going on-sky, we recommended that you conduct a fibre explorer map of a white-light source to ensure that there is light on all beams. To do this, follow steps 9a-9c in this section and steps 2a-2e in the following section.

1. Check the following with the telescope operator:
  - a. The VME is on.
  - b. The tip/tilt, ope and GPS servers are all running.
  - c. Tip/tilt comms have been run on cosmic\_debris.
2. Launch the camera server:
  - a. Open a xterm window on wolverine2 and enter command “**spooler**” (this logs you into the mircx server as user “spooler”).
  - b. Open 5 xterm& in **spooler**
  - c. In one xterm, open the camera GUI using command “**credonelmAcq**”. **\*\*You will not need to interact with this GUI directly. All commands sent to RTscheduler will update the C-RED-ONE GUI for you.\*\*** **Don't ever run credonelmAcq with other accounts, it will not be good. Because the shared memory opened with a particular user cannot be accessed by other users.**
  - d. In the 2<sup>nd</sup> and 3<sup>rd</sup> xterm windows, run RTscheduler and spooler using commands “**RTscheduler**” and “**spooler**”.
  - e. In the 4<sup>th</sup> xterm use command “**shutgtk**” to run the shutters GUI.

**If you backup data while taking observations that will impact frame grabbing speed. Please make sure to stop all unnecessary programs (e.g. firefox, ..)**
3. On wolverine2, launch mircx python GUIs from separate terminals using the following:
  - a. **mircx\_ircam**
  - b. **mircx\_parameters.**
  - c. **mircx\_gdt.**
  - d. **mircx\_fiberexplorer.**
  - e. **mircx\_sequencer.**
4. Set-up the MIRCx IRCam GUI:
  - a. Ensure that the camera is out of standby mode: hit the “CredStandBy” button and check the status bar at the top of the window (it should say “operational”). **It is normal for there to be a few seconds delay between pressing the buttons and the windows starting/stopping. Please be patient.**
  - b. You will typically be launching the default camera configuration for H-band observations. These are (at present) automatically launched into the MIRCx IRCam GUI upon opening it. If this is the case:
    - i. Press “Update DAQ parameters” and wait until it has finished.
    - ii. Press “Config Camera” and wait until it has finished.
  - c. **\*\*For higher level users:\*\*** If you wish to change the camera settings (for instance changing to J-band when this option is available), you will need to enter new values in the chosen boxes, hit “enter” (↵) on the keyboard in each box you change. Then repeat steps (i) and (ii) above. Instructions for saving a new set of pre-set camera configurations is provided in the [Troubleshooting and FAQs](#) section.

- d. Press the "Start Exposure" button. (For stop exposure, "Stop Exposure" can be used. Be patient here once you hit the "Stop Exposure" because it will only stop once end of the ramp.)
  - e. Set the L.H.S display to "2D Image" and click "START".
  - f. Set the R.H.S display to "Power Spectrum" and click "START".
  - g. Open and then close all **IR** shutters in the Shutters GUI (they will go grey). The opening and closing sequence ensures that all shutters are actually closed and not just appearing as such.
  - h. Press "Reset BG" button on MIRCx IRCam GUI.
  - i. Press "Take BG" button.
  - j. Wait until all backgrounds have been taken (a countdown sequence is printed in RTscheduler) and press "Use BG". For faint targets, you may wish to repeat step (iii) once or twice more before pressing "use BG". **Remember that if you change gain from one target to another, you will have to re-take backgrounds.**
5. Re-open the IR beams (they will go green) using the Shutter GUI.
  6. Set up the MIRCx parameters GUI:
    - a. Check the beam order and reference telescope. Typically, the reference telescope is W2 and the beam order is W1 S2 S1 E1 E2 W2 [i.e. 4 1 0 2 3 5].
    - b. Check the photometric channel (xchan) positions. The latest ones are typically attached to the screen [106 127 138 44 85 64] – please do not remove this post-it note. If these values change, please check with the operator and update the post-it.
    - c. Press "Send values to RT".
    - d. Check that this message has been received by the RTscheduler by pressing "Get values from RT" and ensuring that any values you changed have been maintained and not reverted to their previous values.
  7. Set up the MIRCx GDT GUI:
    - a. Check the beam order is correct: typically beam 1 = W1; beam 2 = S2; beam 3 = S1; beam 4 = E1; beam 5 = E2; beam 6 = W2. If they are not, press the "query tip tilt" button. If they remain incorrect, ask the telescope operator to re-run tip/tilt comms again and you can try re-launching the MIRCx GDT GUI.
    - b. Check that the correct telescopes are active by ticking the "use this tel" buttons.
    - c. Set the reference cart (typically W2) by clicking the "reference tel" circle.
    - d. Click the "START LOOP" button.
  8. Set up the MIRCx sequencer GUI by choosing the number of files to be saved. Typical number of files are:
    - a. 100 data, 10 background, 10 for each shutter (B1-B6), and 30 foreground (if running with fewer than 6 telescopes, you only need to take shutters for the beams you are using and so can enter "0" into the boxes for the beams not in use).
  9. Set up the Fiber Explorer GUI:
    - a. Select the "Detector Control" tab.
    - b. Click "Load detector config".
    - c. Update the xchan positions by clicking "load xchan pos from mircx". If they are not correct (i.e. do not match those on the mirc parameters GUI), redo steps 6b and 6c. If there is still a problem, get the telescope operator to check that the tip/tilt server is active.
  10. Check delay lines:

- a. Ensure that all the MAN buttons are pressed except for the reference cart (moving carts = grey, reference cart = green) on the "CHARA OPLE" GUI.

## You are now ready to observe!

### CONDUCTING ON-SKY OBSERVATIONS

At the beginning of the observing night, ensure that you have followed all the steps in the section entitled [Launching GUIs for on-sky observations](#).

**\*\*For higher level users\*\*** if you change the camera settings, please repeat step 4b of the section entitled [Launching GUIs for on-sky observations](#) and retake backgrounds.

After slewing to your chosen target,

1. On the shutter GUI, ensure the IR shutters are open (they will go green).
2. Use the MIRCx Fiber Explorer to optimize the fiber flux:
  - a. NLoops/Nreads (along with sub-array cropping) sets the FRAME time. We aim for about 3 ms (~300Hz). The #of frames per reset (Frm/Reset) sets the frames per reset. This is usually small enough to avoid saturation in a wide variety of targets. The #of coherence coadds should divide equally into this. So if frames per reset is 300, then Coherent coadds should be like 25,50,60, 100, 150, 300, etc. The # of frames (Nfrms) total is the # of frames in a file. If you multiply this # by the frame time (which is output on the mirc server window) then you know the time each file takes (spooler). # of incoherent coadds can be anything. #frames per set should be divisible by # of frames (NFrms).
  - b. If NReads and NLoops are higher the frame rate is low. NReads and NLoops should be not more than 90. When you want to change the NReads or NLoops, follow the sequence: "stop the exposure" (takes a while to stop the xposure, please wait) -> "Update the DAQ parameters" -> "Config Camera" -> "start exposure".
  - c. Gain can be set any time without stopping the exposure (enter gain number and "Update DAQ parameters"). The arrow mark at Gain button will allows to set gain 1 (just by hitting the arrow).
  - d. Change the coherent co-adds in the MIRCx IRCam GUI to ~250 (**this depends on the camera mode being used**) and hit the "Update DAQ Parameters" button. Coherent coadds can not be greater than frames per reset.
  - e. In the "Fiber Mapping" tab of the Fiber Explorer GUI, select all the telescopes you wish to use by ticking the "stage #" boxes and use the top row of data entries to define the search window around each fiber. At first, a value of 12 to 15 for the search range is recommended but this may be reduced to ~7 to 9 if the target is known to be within this field of view (i.e. for re-mapping if you wish to get more data on the same target). We recommend a value of 6 microns for the step size.
  - f. Click the "Perform xchan mapping" button. This will load two windows which (i) will show you whether you are getting light on the fiber(s) and (ii) fit a Gaussian to the intensity distribution and overlay the contours of this fit.  
**\*\*CAUTION must be employed if the Gaussian peak or the brightest pixel appears at one edge of the fibre map. If this happens, we recommend re-mapping with a larger search window\*\***

- g. You may need to re-map if the seeing is poor or, if you need to increase the signal to noise in the maps, click the "add to last" button to repeat step 2c.
  - h. If you are repeatedly having to "add to last" to improve SNR, you can change the number of frames from 1 to 2 or even 3 in the "Detector Control" tab.
  - i. Tick the "Stage #" boxes for the beams which have light on the fiber and click either "Move to Gauss peak" or "move to max" depending on whether the distribution is well-approximated by the Gaussian model.
3. **[optional - If you are wanting to get low visibility fringes on bright objects]** Take a flat field:
    - a. Keep the coherent co-adds number high (~250).
    - b. In the MIRCx IRCam GUI, enter 10000 for the save number and hit the "Update DAQ Parameters" button (this will take a set of data for flat fielding).
    - c. Wait 10 seconds or so and repeat step (3b) a few times. You should see the power spectrum image looks less noisy and the fringe weights in the MIRCx GDT GUI should be smaller than before.
    - d. You can reset the flat field by entering 10001 in the save number window of the MIRCx IRCam GUI and pressing the "Update DAQ Parameters" button..
    - e. You can toggle between two flat field methods using "M1" and "M2" options in the flats drop down menu in the MIRCx IRCam GUI.
  4. Ensure the save number in the MIRCx IRCam GUI is set to 0 (zero) (if it isn't, change it to zero and hit the "Update DAQ Parameters" button).
  5. Change the gain, coherent co-adds and PS co-adds in the MIRC IRCam GUI:
    - a. The values to use for these parameters depend on the seeing conditions, the camera set up parameters, and the faintness of your intended target. **The following suggested values serve only as a guide.**
    - b. We recommend using a gain of 30 in most cases but, for faint targets, a gain of 90 may be used.
    - c. For the coherent co-adds: check the idle state readout of the RTscheduler. The line labelled "Frametimes" gives you the integration time (read the line as label1, label2 (label2b), label3 (label3b), value1, value2 (value2b), value3 (value3b). "value1" is the mean integration time in milliseconds. This number multiplied by your coherent co-adds should be on a par with the atmospheric coherence time and thus be roughly within the following ranges, depending on your seeing conditions:
      - i. For bad seeing ( $R_0 > 5$ ), product of integration time and coherent co-adds should be ~ tens of milliseconds.
      - ii. For good seeing ( $R_0 > 10$ ), product should be ~30 to 50 milliseconds.
      - iii. For very good seeing ( $R_0 > 15$ ), product should be ~ 70 to 100 milliseconds.

We recommend you use a value of 50 when the frame rate is ~ 850 Hz and a value of 30 if using a frame rate of ~ 1 kHz.
    - d. For the PS co-adds: this controls the signal to noise in the power spectrum plot. To increase the SNR, increase the value of PS co-adds. We recommend a starting value of 5 but this could increase to 15 for fainter targets.
  6. Find fringes:
    - a. Press the "LOCK FRINGES" button.
    - b. Ensure there are no fringes in the MIRCx IRCam GUI display. If there are, try using the directional arrows on the MIRCx GDT GUI to increase or decrease the offsets slightly.
    - c. Click "CALC ALL" (this calculates the threshold for fringe detection - it may take a minute for each baseline). This will need changing if you change the

- coherent co-adds and/or the PS co-adds. Once this has finished, click "UPDATE THRESH" button in the same GUI window.
- d. Use any prior knowledge available to you to set an initial guess for the offsets in the text boxes for each telescope being used (except for your reference telescope) and chose a step size for this to loop through (recommend ~0.003mm). Alternatively, if you have nothing to base your initial guess on, set all to zero.
  - e. Ensure there is light on all beams.
  - f. Ensure the delay lines are in range for all beams and that metrology is good.
  - g. Ensure GPS time and CHARA time are good.
  - h. Click "LOOP -" or "LOOP +" for all baselines except the reference.
7. Locking fringes (when fringes are found on a particular pair of baselines, the button in the lower triangle of the matrix in the MIRCx GDT GUI will turn yellow).
    - a. If you are confident that this is a true fringe (check the power spectrum plot in the MIRCx IRCam GUI), click the yellow button in order to lock the fringe. (The button will go green). If the fringe is lost while locked, the button will turn red.
    - b. If, instead, you think the code has found a false positive and this is happening persistently, you can increase the "search threshold factor" and restart the search loop again.

Once a fringe is detected, the software will note the OPD difference between the involved delay lines in the upper triangle of the matrix. The software monitors the values in this upper triangle continuously and uses them to make predictions for the delay line position of missing fringes. To make its prediction, the algorithm requires the OPD values from at least one fringe involving the reference delay line and at least one cross-fringe. The predicted values appear in the row of buttons on the left side of the matrix. Clicking on the button will move the delay line to the corresponding position. In case of a false fringe detection, it is recommended to delete the wrong OPD value from the matrix, as spurious values will lead to wrong fringe position predictions. A spurious value can be detected from the upper triangle by simply clicking the button.

- c. Once you find and lock all the required fringes, click the "Send GDT info" button.
8. Take data!
    - a. Once all fringes are locked and found, click DATA on ShutterMatrix GUI to take data for the set number of files. The word "Data" will turn green when data is being recorded.
    - b. [Thank the interferometry gods accordingly.]
    - c. Once data recording has finished, Click "Data Acq" on cosmic\_debris to record an entry into the observing report.
  9. Take shutters!
    - a. Once the data acquisition has finished (indicated by the green 'DATA' light going off), click "SHUTTER" to take shutter sequence data.

When switching to a new target:

1. Unlock the fringes and click the "clear matrix" button in the MIRCx GDT GUI.

2. After the telescope has finished slewing, increase the coherent co-adds to their maximum value (~250, dependent on camera settings) and hit "Update DAQ Parameters" in the MIRCx IRCam GUI.
3. Redo the fiber mapping.
4. Enter values for the coherent and PS co-adds into the MIRCx IRCam GUI based on your seeing conditions, camera settings and required SNR (remember to hit enter with the mouse pointer in the window) and then hit "Update DAQ Parameters".
5. Calculate and update your thresholds for fringe detection in the MIRCx GDT GUI and repeat the fringe finding again.

**At the end of your night of observations, follow the steps in section [Shutting down GUIs following on-sky observations](#).**

b.

## SHUTTING DOWN GUIs FOLLOWING ON-SKY OBSERVATIONS

1. MIRCx GDT GUI:
  - a. Switch off the "Lock Fringes" and "Start Loop" buttons.
2. MIRCx Camera GUI:
  - a. Click "Stop" on the L.H.S and R.H.S displays.
  - b. Click "CredStandby".
  - c. Click "quit".
3. Close the spooler, RTScheduler and credonelmAcq using CTRL-C in the xterm window.
4. Close the remaining python GUIs.
5. Check the pressure and start pumping the camera with turbo pump. Please read carefully the startup procedures before implementing any action. If you have doubts please ask John Monnier. **While switching ON the turbo pump please follow the STEP 1 of startup procedures (page 12).** Check the Pfeiffer Vacuum pump display for the pressure inside the hose/pipe. **If the Pfeiffer Vacuum pump pressure  $>10^{-3}$  mbar, close the camera valve first and then open the electromagnetic valve before starting the turbo pump.** If the Pfeiffer Vacuum pump display shows  $<10^{-3}$  mbar pressure then keep shut the electromagnetic valve. This work is important because if the hose/pipe has a lot of air in it, then it might damage the turbo pump (it can "slam" the turbo pump which is at atmospheric pressure). So it is recommended to watch Pfeiffer Vacuum pump display and take necessary actions before doing something. Start the turbo pump and when it reaches 1500 HZ speed open the electromagnetic valve.



There is only a finite amount of space in the /data1 directory of the mircx server so the observer will also need to transfer data to /data3 and /data4 to ensure the observational data is backed-up locally. To do this:

1. Log into the mircx server using the command "observe" on wolverine2.
2. There are then two options:
  - a. If you wish to transfer all existing data from /data1 to /data3 and/or /data4, execute the command **mircx\_archivedata**.
  - b. Otherwise, if you wish to only transfer data from a specific night, execute the following command **mircx\_archivedata UTdate** where UTdate is the U.T. date of the observations you wish to transfer (format for UTdate = YYYYMmmDD e.g. 2017Jul12).
3. An overview of the total size of the files you wish to transfer and the available space on /data3 and /data4 will be printed to screen along with option statements to check whether (i) you wish to transfer the data to /data3 and (ii) you wish to transfer the data to /data4 (transferring to both is recommended if there is sufficient space to do this).
4. When the file transfer is complete, a summary report is provided:
  - a. The number of all original files with size zero is provided.
  - b. The total number of original files is printed.
  - c. The total number of copied files is printed.
  - d. The script will not transfer files of size zero or corrupted files which do not successfully compress using the "fpack" command used during transfer.
5. You will be asked by the script whether you wish to delete the original files. Please check that all the files that could be transferred were indeed transferred (check point 4d above) before deleting the original files.

If MIRCx is to be used again the following night, a full power down is not necessary. Instead:

1. (This step should have already been undertaken by the observer but please check that this is the case.) Using the camera GUI, place the camera into standby mode by pressing the "standby" button (press the word "standby", not the "on/off" label next to it). The camera status bar will then read "standby".
2. Replace the cap on the front of the camera.
3. Switch the turbo pump on using the power button on the front on the unit, below the display panel.
4. Once the fan speed in the turbo pump setting "ActualSpd" has reached **1500 Hz**, open the electro-magnetic valve by switching the "BindMaster" power trip switch to "ON" position.

If you have reached the end of the MIRCx observing run(s), you will need to undertake a full power down following the steps below:

1. (This step should have already been undertaken by the observer but please check that this is the case.) Using the camera GUI, place the camera into standby mode.
2. Using the camera GUI, switch off the cooling by pressing the "cooling" button.  
Continuous pumping is required during the warm up until the detector reaches room temperature.
3. **\*\*Once the detector reaches room temperature\*\*** Close the camera valve (turn so that the top of the valve moves away from the front of the camera).
4. Check that the turbo pump is switched off.
5. Check the display on the turbo pump and, once the setting "ActualSpd" reaches < 100 Hz, open the black valve on the rear of the turbo pump.
6. **CAUTION: \*\*Wait until the camera has returned to room temperature (293 K) before moving onto the next step\*\***. This avoids condensation on the camera sensor.
7. Switch off the camera power supply (BK precision unit).
8. Remove the LEMO cables from the back of the turbo pump power unit.
9. Switch off the water cooler.
10. Shutdown the camera GUI.
11. Switch off the "think logical" boxes.

In case of a power outage, the “SafeSens” box will close the circuit, resulting in the electro-magnetic valve to close. This avoids a pressure increase in the vacuum system.

Once the power is back on, follow these steps:

1. **Please read carefully the startup procedures before implementing any action. Please close the camera valve first.**
2. Switch the “Bind Master” power trip switch to “OFF” position.
3. Press the red button on the “SafeSens” box
4. Switch the “Bind Master” power trip switch to “ON” position.
5. Check the Pfeiffer Vacuum pump display for the pressure inside the hose/pipe. **\*\* CAUTION \*\*** Start the turbo pump. **While switching ON the turbo pump please follow the STEP 1 of startup procedures (page 12). If the Pfeiffer Vacuum pump pressure  $>10^{-3}$  mbar and then open the electromagnetic valve before starting the turbo pump.** If the Pfeiffer Vacuum pump display shows  $<10^{-3}$  mbar pressure then keep shut the electromagnetic valve. This work is important because if the hose/pipe has a lot of air in it, then it might damage the turbo pump (it can “slam” the turbo pump which is at atmospheric pressure). So it is recommended to watch Pfeiffer Vacuum pump display and take necessary actions before doing something. Start the turbo pump and when it reaches 1500 HZ speed open the electromagnetic valve.

**What happens if the water chiller fails while operating the camera?**

- Camera will turn itself off once water temperature rises above threshold

**During set up, what should I do if the camera status reads “FaultyVacuum” rather than “ready”?**

- Try power cycling the camera power supply.

**The MIRCx server is unresponsive and just hangs...what do I do?**

- You may have to re-boot the computer. [Also check the status of the camera (e.g. current and turbo pump pressure in the lab) to ensure its stability. Though the loss of the C-RED-ONE camera GUI should not affect the camera.]

**I want to prevent MIRC from using specific shutters (e.g. to use it in parallel with another combiner). What should I do?**

- During your set up, you will need to call `mircx_sequencer` manually to disable its use of the selected beams. Assuming you wish to disable beams 5 and 6, use the following commands on the mircx server:
  - » `cd $PYTHONMIRCX/mirc_python27/FiberExplorerNew`
  - » `python shutterMatrixCHARAimproved.py -disablebeams 5 6`

**How do I change the (x,y) extent of the plotting windows in the MIRCx IRCam GUI to reflect the wavelength range of the filter being used?**

- This is to be done by high-level operators **\*\*ONLY\*\***. Use the windows in the top half of the panel on the left hand side of the MIRCx IRCam GUI. For the “Cropping” “Row(s)” window, the first two values refer to the photometric channels and the second two to the fringes.
- To save any changes as a new camera setting, you can edit the file `$PYTHONMIRCX/ircam mircx_config.json` on wolverine2:
  - » We advise that you make a new list of configuration parameters with a new name rather than editing the “defaultsettings” values.
  - » Simply copy and paste the format of one of the other config set-ups and edit the required parameters.
  - » If you wish to have the MIRCx IRCam GUI launch with these settings as the new defaults, open file `$PYTHONMIRCX/scripts/mircx_ircam` and, in the line of the file reading `python $PYTHONMIRCX/ircam/mainWindow.py -t ClearlooksClassic -p defaultsettings $*`, replace the option parsed to “-p” (here this is “defaultsettings”) with the name you gave to your new configuration parameters.

### The are more files being saved than I am requesting for there to be. What is happening?

- You likely have the "Save number" in the MIRCx IRCam GUI set to a number other than zero. If this is the case, re-set this number to zero otherwise it will make a file each time you hit the "Update DAQ Parameters" button.

### What should the fibre map positions be?

- The z,x,y positions of beams 1 to 3 should be roughly as follows:
- Beam 1 z: 90200; Beam 1 x: 30326; Beam 1 y: 49112
- Beam 2 z: 82530; Beam 2 x: 31345; Beam 2 y: 38386
- Beam 3 z: 79760; Beam 3 x: 80653; Beam 3 y: 76431
- Beam 4 z: 84150; Beam 4 x: 73173; Beam 4 y: 66256
- Beam 5 z: 87250; Beam 5 x: 90519; Beam 5 y: 95604
- Beam 6 z: 89950; Beam 6 x: 70381; Beam 6 y: 96428

### How are flat fields taken in the lab with MIRCx?

- First, move the prism out of the way by turning the black knob on its motorized mount. A light on this knob begins flashing yellow when the mount is moving (it moves very slowly). Twist the knob in the opposite direction until light stops flashing to halt the mount. Place one piece of white paper near the image plane in front of the mirror (setup shown in left picture- note that paper could be smaller to control light scattering into camera that doesn't go through the lens). Try to find a good light source to VERY DIMLY illuminate this piece of paper (not LED). The illumination should be as smooth as possible (e.g. right picture). Take data with a large number of frames per reset at many gains (you want to adjust the light so the system saturates the whole detector near the end of the frames). Also take a background set without the light for all gains.

