Observing procedure for the SIMON camera v1.0

Spring 2013 - Chile commissioning, collaboration between Université de Montréal (René Doyon) and AMNH (Mike Shara).

I. CYGA, the control computer.

The CYGA computer which controls SIMON runs on a Sun Microsystems OS, which is a little bit different from linux. It's a capricious computer, so users must be careful not to ask too much of it. For example, when you are taking an exposure with SIMON, try not to play with it too much or it could freeze. When you ask a command or press a button, please be patient; doing it twice before it's completed might also cause it to crash. Here are some basic information concerning CYGA :

- **They keyboard :** Notice the [stop] button on the left side of the keyboard. Pay attention not to press it by accident, as you may have to restart the computer (and this is quite long !)
- **Open a session :** The username is [MASKED] and the password is [MASKED]. Yes, like the band.
- **Open the command line shell :** Right click on the desktop, choose Tools, then Terminal.
- **Repeat a recent command in the terminal :** Press the up arrow on the keyboard.
- **Open the camera control software :** Type mir ctio in the command line. This will open MIR CTIO + a ds9 window. See point II for more details.
- **Verify disk space :** Type df in the command line prompt. If disk space is below 20%, please immediately contact people from Montreal.
- **Remotely connect to CYGA :** The IP address of CYGA on the 1.5m network is **[MASKED]**, and the listening port is **[MASKED]**. You can connect to it with any software that uses ssh encryption (sftp might also work).
- **Run a Bash script :** Simply enter its name in the command line window. If you get a "Permission Denied" error, then type chmod +x *name of the script* in the command line window.
- **Pause a Bash script :** Press [ctrl]+[z] while in the command line window. To resume it, enter fg in the command line. This is useful when encountering technical problems or when clouds are passing by.

- **Kill a script :** Press [ctrl]+[c] while in the command line window. Note this will not stop an undergoing exposure.
- **Get the list of running processes :** Enter top in the command line.
- **Kill a running process :** Enter kill *PID* in the command line, where *PID* is the process ID, which can be found in the list of processes (see previous point).
- **Launch IDL :** Type idl in the command line. **WARNING :** If you start an exposure in MIR CTIO while IDL is open in the terminal, MIR will freeze ! See VIII : troubleshooting section for information on how to reset MIR OMM.
- **Launch an IDL script :** Type the name of the script in the IDL command line (see previous point).
- **Quit IDL :** Type quit in the IDL command line.
- **Compress the data :** When in the folder containing the fits files you want to compress, enter gzip *.fits in the command line.
- **Where is the data ? :** In the directory /data/[yymmdd]/. For example, for the night of february 26 2013, the directory would be /data/130226/.
- **Superuser password : [MASKED]**
- **Reboot the computer :** This is **not** done the usual way. Type in su root in the command line. Enter the admin password (see previous point), then type reboot in the new command line.
- **Shut down the computer :** Neither is this done the usual way. Press on the [stop] +[a] buttons. The screen will go crazy and a new command line will open. In this new command line, type sync, then press [enter]. After a few minutes, the computer will shut down.
- **Force shutdown :** Use this only as a last resort, as it **will** corrupt core files in the computer. Hold down the power button for a few seconds.

II. MIR CTIO : the control software.

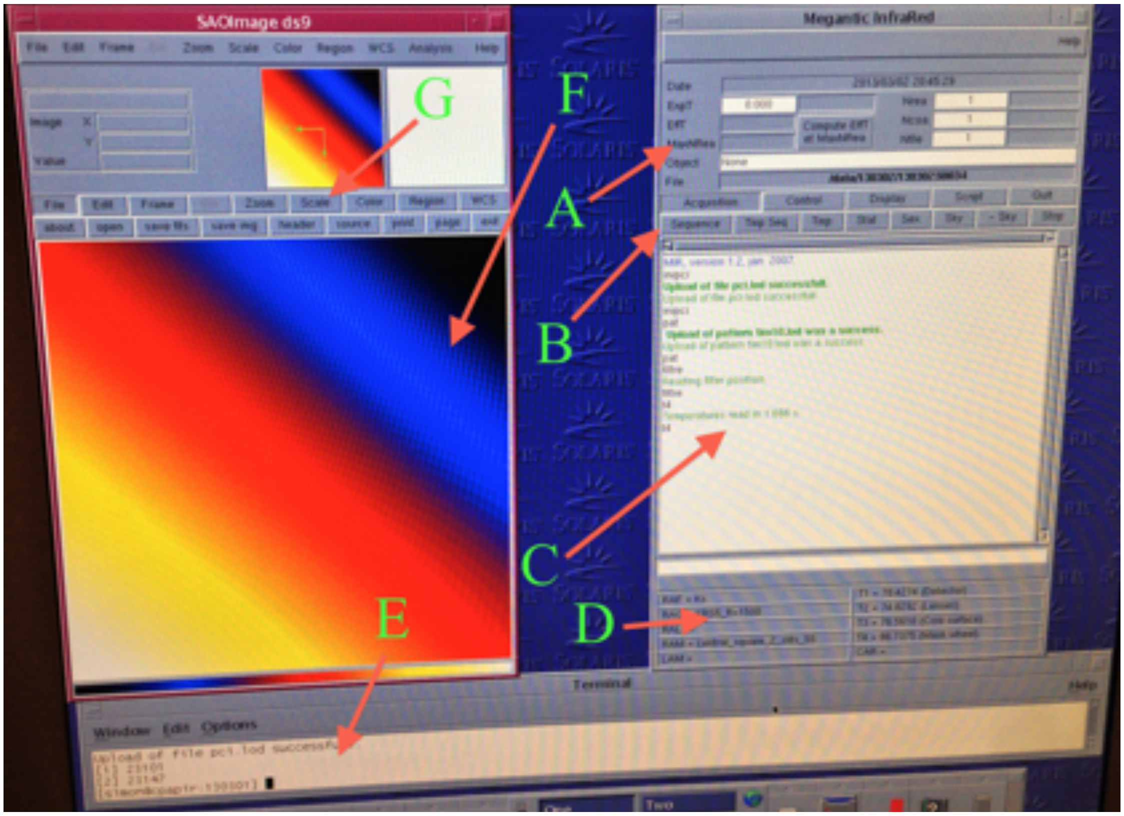


Image 2.1: A view of the SIMON control computer. Ds9, MIR CTIO and a terminal are open.

Open MIR CTIO by typing mir ctio in the Terminal (see image 2.1, E). When you do this, several things will happen :

1. If it’s the first time of the night you open it, it will create a data folder for the night in /data/, then define it as the default folder where every exposure you take will be saved. The “date” of the night changes at noon so as it stays the same throughout the night. Normally you want it to do this so if MIR is already opened when you arrive, close it and reopen it.
2. A control window will open on the right. Notice there is a command line in the MIR window.
3. A ds9 window will open on the left (see image 2.1, F).

The right window is called Megantic Infrared (that’s what MIR stands for). It’s a software created by Martin Riopel, a former astrophysics researcher at Université de Montréal who is now working in another field. It’s probably not useful to contact him since he did this a long time ago. When MIR opens, it will display the following things, one at a time :

MIR, version 1.2, jan 2007
inipci

Upload of file pci.lod successfull.
Upload of file pci.lod successfull.
inipci
pat
Upload of pattern tim10.lod was a success.
Upload of pattern tim10.lod was a success.
pat
filtre
t4
Temperatures read in 1.6 s.
t4

...if everything goes well ! It can happen that some of the messages are in red, which means that there was a problem. In this case, restart MIR (see Troubleshooting). However, if inipci fails for example, hitting the yellow "Resume" button and typing back inipci in the MIR command line will sometimes fix the problem. It seems that if you press on any MIR button before the commands are completed, it will cause some of these errors. The inipci and pat commands serve to establish the connection between SIMON and CPAPIR, whereas filtre and t4 read the position of the 4 filter wheels and the temperatures, respectively (see section IV). Filtre is french for filter. For some reason, inipci, pat and t4 commands are sent two times, but it doesn't cause any problem. If the red errors keep on happening, try rebooting the computer. If they still persist, turn off then on the camera, and do the same with the computer.

Here are some useful MIR commands :

- **filtre**: Get the current status of the filter wheels.
- **t4**: Get the current temperatures.
- **to_ctio E N**: Send small offsets (arcseconds East, North) to the telescope.
- **ti_ctio**: Update the current telescope information for the next fits images.

Here is an overview of the buttons and displays in the MIR window :

- **The input header** (See image 2.1, A): Those are the fields you can change, by clicking and entering a value :

    1. **ExpT :** The desired exposure time.

    2. **Nrea :** The number of times the detector should be read before storing data into the file. Normally, we always use 1.

    3. **Ncoa :** The number of coadditions desired. Coadditions are like if you combined 2 exposures together and save them as only one file. It has two advantages; it's faster than storing 2 files and it uses less disk space. However, you do lose information on the raw data.

4. **Nfile :** The number of files which will be saved to disk, or if you prefer, the number of exposures that will be taken when you press the “Sequence” button (we’ll see this later on).

5. **Object :** This is the name of the object that will be stored in the header of the fits file.

- **The display header** (See image 2.1, A): Those are the display fields you cannot change :

1. **Date :** The current local time on the computer.
2. **EffT :** The effective exposure time. SIMON cannot expose for arbitrary amounts of time for technical reasons. Hence, when you choose an exposure time that’s impossible for him, it will use the nearest possible value and display it here. For example, if you ask for 0 seconds, it will expose for ~ 3 seconds.

3. **MaxNrea :** This is the maximum number of readings on the detector. This shouldn’t be so useful for science.

4. **File :** The full path of the next file that will be saved to disk.

- **The display footer** (See image 2.1, D): Those are more display fields you cannot change :

1. **RAF :** The actual position of the Filter Wheel
2. **RAG :** The actual position of the Grism Wheel
3. **RAL :** The actual position of the Lyot Wheel
4. **RAM :** The actual position of the Mask Wheel
5. **LAM :** This field shall remain empty.

6. **T1 :** The temperature of the detector in Kelvin.
7. **T2 :** The temperature of the lenses in Kelvin.
8. **T3 :** The temperature of the cold surface in Kelvin.
9. **T4 :** The temperature of the mask wheel in Kelvin.
10. **CAR :** This field shall remain empty.

- **The command line** (see image 2.2, A). It is here that you must enter MIR-specific commands.

- **The exposure completion field** (see image 2.2, B). here, you can see the rate of completion for the current exposure.

- **The command display** (see image 2.1, C). Here you can read the output of the commands that MIR executes.

- **The tab buttons** (see image 2.1, B). Clicking any of those buttons will display a different set of control buttons (see next point). The following tabs are accessible :

    1. **Acquisition :** All that has to do with exposures and image analysis. Most of the useful commands are there.

    2. **Control :** All the commands that have to do with camera control can be found here.

    3. **Display :** All the commands that have to do with how the image is sent to ds9 (which serves as the display) can be found here. This tab is rarely useful.

    4. **Script :** This tab is for launching various scripts. Personally, I never used it.

    5. **Quit :** As the name says, this quits MIR CTIO. It also closes the ds9 display. This is the standard way of restarting MIR.

- **The acquisition buttons** (see image 2.1, B). Those buttons are accessible by clicking on the Acquisition tab button (see previous section).

    1. **Sequence :** This starts an exposure, which will be saved on disk. Notice that the MIR command line will turn red, meaning you cannot enter any more command lines during the exposure (Image 2.2, A), and just below, another red bad with a % value (Image 2.2, B) will show the completion of the exposure. When saving exposures to the disk, MIR will use the following syntax : yymmddS####.fits, where y/m/d stand for year/month/date,

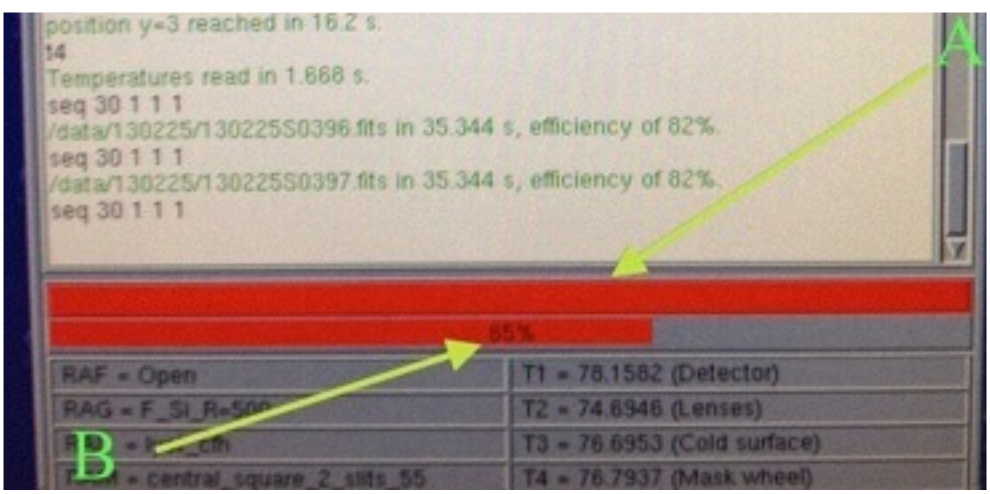


Image 2.2: The MIR CTIO command line turns red when exposing.

    2. **Tmp Seq :** I never used this button.

3. **Tmp** : This starts an exposure, which will *not* be saved on disk. (In fact each tmp sequence will be saved on the same file, which is in an obscure location).

4. **Stat :** I never used this button.

5. **Sex :** This calls Sextractor (Source Extractor) which fits a PSF profile to a star. You must first define a region in ds9 (see ds9 section) around a star by left-clicking the ds9 window. Then, pressing Sex will display the FWHM, peak value, integrated flux, etc for the star. This is very useful when making the focus (see the Science section).

6. **Sky :** This stores the current ds9 image in memory block #1, which will be useful for sky subtraction.

7. **- Sky :** This stores the current ds9 image in memory block #2, then sends (block #2 - block #1) to display in the ds9 image. Hence, by having done a small offset between the two exposures (with the to_ctio command - see section V), you get a sky-subtracted image with positive/negative stars. Very useful for recognizing a finder chart when sources are faint or sky is bright. Also useful to estimate signal to noise on an exposure.

8. **Stop :** This stops the current exposure. The red was normally showing exposure completion will turn completely red and the “Stop” button will transform into a yellow **Resume** button. You must then press it before being able to do anything else with MIR.

- **The control buttons.** Those buttons are accessible by clicking on the Acquisition tab button (see previous section).

    1. **Initialization :** I never used this button, but I suspect it would launch the inipci command.

    2. **Pattern :** I never used this button, but I suspect it would launch the pat command.

    3. **Filter :** The most useful button in this section. By clicking it, you will get an unrolling menu with various other options :

        a. **Initialization :** Initialize one of the filter wheels. Each of the filter wheels must be initialized at the beginning of a night, or after powering off SIMON, or SIMON’s controller. *DO NOT INITIALIZE THE LYOT WHEEL* (See troubleshooting) This will send the filter to its home position. You will get the following output :

Pay close attention to the output as if the command fails, you will get a ***green*** message saying "unable to reach home position". See Troubleshooting if this happens.

b. **Filter_Wheel :** Choose a position for the filter wheel.
c. **Grism_Wheel :** Choose a position for the grism wheel.
d. **Lyot_Wheel :** Choose a position for the lyot wheel. *DO NOT TOUCH* (See troubleshooting)
e. **Mask_Wheel :** Choose a position for the mask wheel.

f. **CAROUSEL :** Not useful for science.
g. **PLATE :** Not useful for science.

- The display buttons. Those buttons are accessible by clicking on the Control tab button (see previous section). I will not document them here as I never used them.

- The script buttons. Those buttons are accessible by clicking on the Script tab button (see previous section). I will not document them here as I never used them.

Note : MIR CTIO will always save fits files with the same syntax : *yymmddS####.fits*, where yymmdd are the year, month and day, and *####* is a 4-digits number. For example, the first .fits file as of march 5th 2013 would be named *130305S0001.fits*.

Note : If you want to change the headers with which the fits files are saved in MIR CTIO, you will have to use the par command. See "Reset the filter wheels control" in the Troubleshooting section for more information.

Note : Try **NEVER** to stop an exposure during integration. 9 times out of 10, this will eventually result in a computer crash, and you might lose up to 30 minutes of observing. In the worst case where you mistakenly start a 10-coadds 500-s exposure, maybe its better to do the following : Stop the exposure in MIR. Directly do a complete shutdown (including reset the camera controller) without even trying to close MIR. See the "complete shutdown" procedure in Troubleshooting.

Note : Try to **NEVER** press any MIR CTIO button during an exposure (ds9 or the terminal should be fine). However, I would even recommend that you do not touch the computer unless necessary when it's exposing. The same goes for when a filter wheel is turning. You can click on *some* buttons without problems like "Control", "Filter" (as long as you don't *select* an actual filter) or "Acquisition", but the best way I found to make the computer crash is the following : ask it to change the filter, then instead of clicking on the "Acquisition" tab to prepare for your next exposure, press "Initialize" just below by accident, because the mouse is so nice and responsive. Seriously, don't do it.

III. DS9.

Here are some useful things to know concerning the ds9 window :

- **In imaging mode**, the best “Scale” options are : zscale + linear.
- **In spectroscopy mode**, the best “Scale” options are : zscale + sqrt. In fact it’s the only scale mode in which you can manage to see something when taking acquisition with the central_square_2_slits_55 mask on.
- **Adjusting the scale** : Hold the right-click button when in the ds9 image. When moving left/right, you will adjust the luminosity, and when moving up/down, you will adjust the contrast. (See image 2.1, G)
- **Reviewing a previous exposure** : Use the File/Open, then select your previous fits file.
- **Having the right orientation** : Always make sure that under the Zoom scroll-down menu, the Invert Y and 90 deg options are selected.

IV. SIMON, the spectrograph + imager camera.

Here are some useful information about SIMON :

- Its platescale is 0.49 arcsecond / pixel.
- Its detector size is 1024 x 1024 pixels, or 7.51 x 7.51 minutes.
- Its electronic gain is 2.4 electrons / ADU.
- It can do science in the following filters :
    1. HII
    2. SP1
    3. Bracket γ
    4. J
    5. H
    6. K
    7. FeII
    8. Ks
    9. Paschen β*
    10. I*
- Some filters (those with a *) are only accessible in the lyot wheel. hence, you must put the filter wheel to "open" when you select them. However, currently the lyot wheel cannot be turned (see Troubleshooting), so those are inaccessible.
- Its zero-point magnitudes are the following :
    1. I = 22.3
    2. J = 21.3
    3. H = 22.5
    4. Ks = 21.8
- Its photometric sensitivities are the following *(coming soon - see Étienne Artigau)* :
    1. J =
    2. H =
    3. Ks =
- Its approximate sensitivities in the KRS-5 mode (2 pix. slit) are the following :
    1. H = 1.55e-8 seconds
    2. K = 3.00e-7 seconds

Note : It is possible that these values are affected by the fact that as of march 5th 2013, the CTIO 1.5m secondary mirror is misaligned. Hence, some aberrations probably cause throughput loss which affects these sensitivities.

- Its sensitivity in the F_Si mode is 7.78e-10 seconds, if you compare with H-band magnitudes.

  > *Note : It is possible that these values are affected by the fact that as of march 5th 2013, the CTIO 1.5m secondary mirror is misaligned. Hence, some aberrations probably cause throughput loss which affects these sensitivities.*

- Its spectral domain is 0.8-2.5 µm
- Its achromatic spectral domain is 1.1-2.4 µm
- Its spectral resolution is :
  1. Amici, R_{max} = 64
  1. F_Si, R_{max} = 760
  2. KRS5 with J, R_{max} = 2300
  3. KRS5 with H, R_{max} = 2800
  4. KRS5 with Ks, R_{max} = 3400
- The temperatures of SIMON should normally be around 70 Kelvin. If they go over 80 K, it's probable that the nitrogen level is getting low and they will start going up. When reaching 90 K, the thermal background will become high and then you should ask the TO to add more nitrogen. If you finish a target and you see a temperature about 80 K, take the time to replenish the nitrogen.
- There are two nitrogen tanks in SIMON: one for the detector and lenses, and a separate one for the filter wheels. The second one has a design flaw which causes it to loose some nitrogen when the telescope is placed in certain positions. Hence, the filter wheel temperature is the one that you should keep an eye on. Often we need to fill it up again during the night. To avoid this, it's a good idea to place the telescope a little bit to the North instead of directly at the zenith at the end of the night (see image 4.1).

Image 4.1: The telescope is tilted north so that nitrogen doesn't flow out from SIMON.

- You should avoid getting more than 10 000 ADU since the response will become nonlinear after this value. However, in the worst case you can correct for linearity with the following equation :

$$ADU_{corr} = 29.4 + 0.984789 * ADU + 1.95971*10^{-6} ADU^2 \text{ (for } ADU > 4122)$$

This equation should be applied after having subtracted the dark current and divided by a flat field.

- The detector will saturate at ~ 30 000 ADU. When this happens, you will get a value of 0 ADU as in all NIR detectors.

- As in every NIR detector, there are several dead pixels on SIMON's detector. This is one of the reasons why dithering is important (see the Science section).

- How to check the internal pressure of SIMON: To measure the pressure in SIMON, you must use the SenTorr instrument (see image 4.2). There are two connectors that should be plugged in it. One is mistakenly labeled "CPAPIR" (it should be labeled "SIMON"), the other one is labeled "TC1" (See image 4.5). The two must be plugged in the back of SIMON (See image 4.3). Then, plug SenTorr in a power outlet and press its power switch on (See image 4.5). Press the EMIS button (See image 4.4). You must wait around 5 minutes for the pressures to stabilize, and then you can read the pressure, which is displayed in the IG field (in scientific notation). The TC1 pressure will be displayed in the first field. It was found that sometimes, SenTorr either flashes all its lights without responding, or even doesn't open up at all. When this happens, we found that plugging only the "CPAPIR" cable and *not* plugging the TC1 cable worked well. After you noted down the value for the pressure, which should be below 5e-5 Torr, press EMIS again to turn off the display. Then, put the power switch back to off. Then you can unplug everything. If the pressure gets too high, you will have to ask the day crew to pump SIMON again so that it goes down. You must take the pressure at the beginning and at the end of the night.

Image 4.2: SenTorr attached to SIMON.

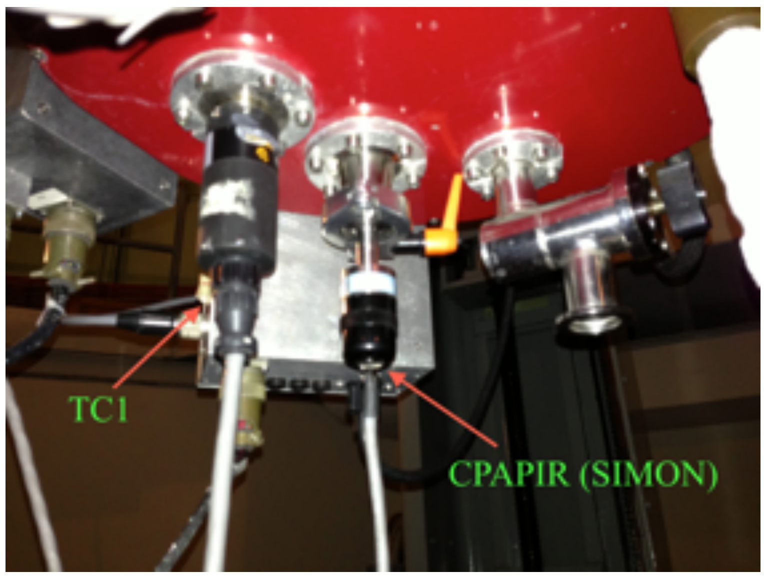


Image 4.3: Details on the SIMON input sockets

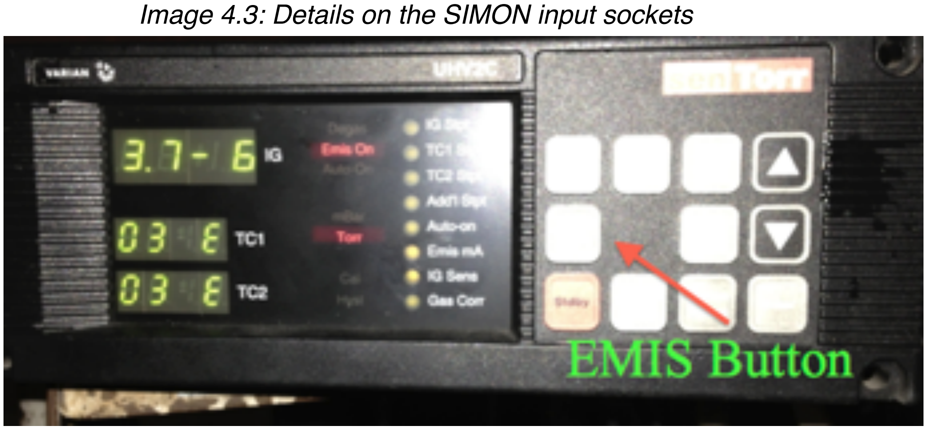


Image 4.4: Details on SenTorr displays.

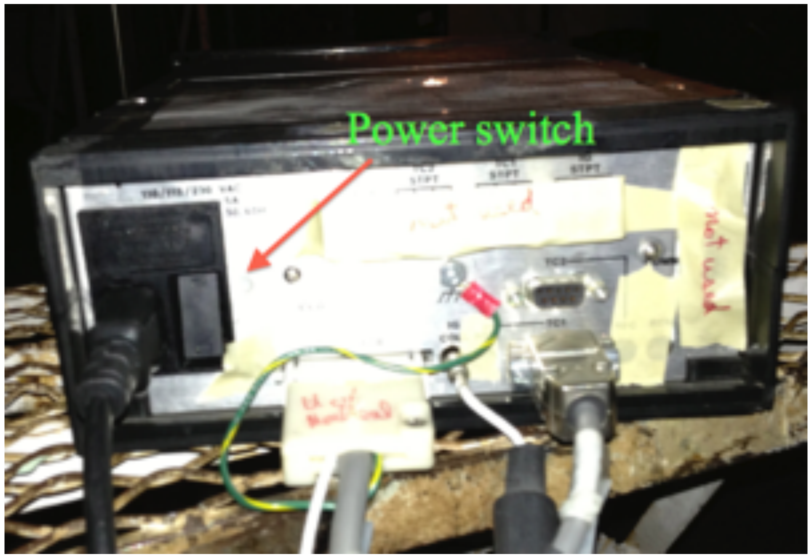


Image 4.5: Details on SenTorr's output sockets.

- **Adding nitrogen in SIMON:** First, locate the big nitrogen tank in the dome. You must plug the steel pipe into one of two SIMON's tank inputs without twisting the pipe itself. Gently screw it to the camera, then use a spanner to tighten it a little bit more (but don't force it). Then, you can activate the small lever close to the nitrogen tank output pipe. You will hear a loud sound due to air coming out of the instrument. When nitrogen flows out of the instrument's vent pipe, you can close back the tank. Use the insulating gloves and heat gun as needed to unscrew the pipe without damaging it (it will be frosted). The filter wheel tank must be replenished every 12 hours and the detector tank must be replenished every 24 hours (See images 4.6 to 4.8).

Image 4.6: The nitrogen tank attached to SIMON.

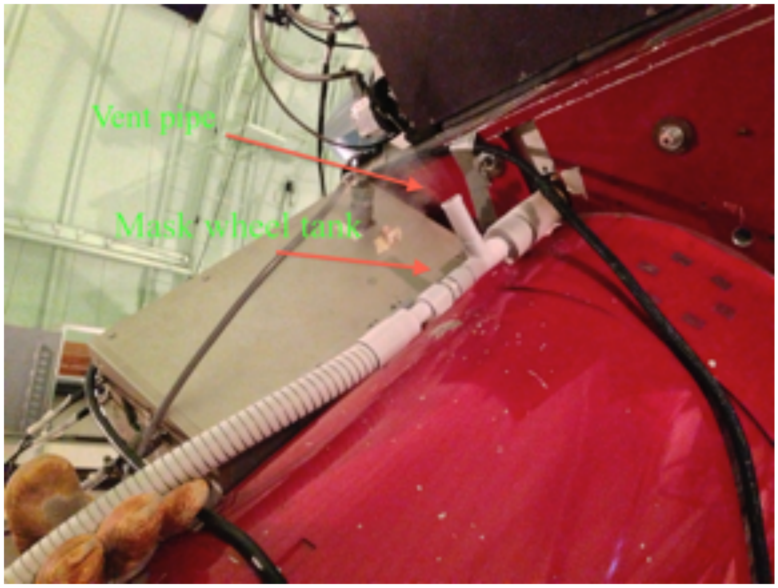


Image 4.7: Details on SIMON's mask wheel tank input socket.

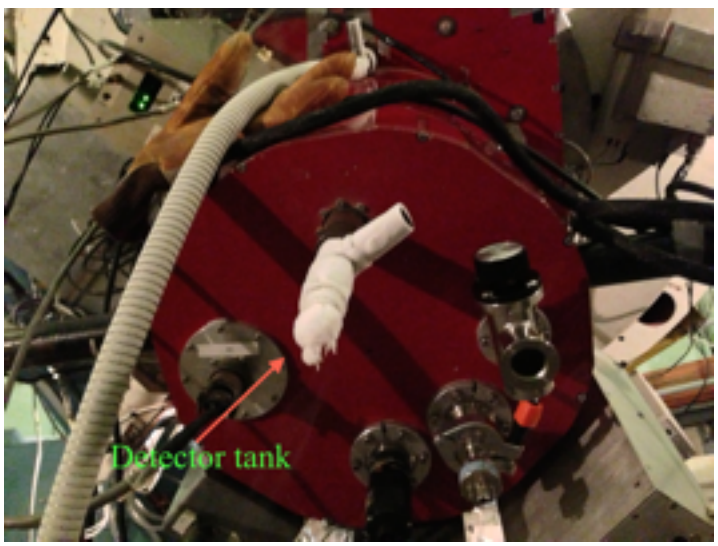


Image 4.8: Details on SIMON's detector tank input socket.

- When observing a star with SIMON in a given filter *F*, the current sky extinction can be estimated with the following formula :

$$E_F = ZP_F - 2.5 \log \phi_F - m_F - 2.5 \log G$$

Where ZP_F is the zero point, ϕ_F is the flux of the star in ADU / second, m_F is the documented apparent magnitude of the star and G is the SIMON's electronic gain (2.5 electron / ADU). You can estimate ϕ_F with the Sex function in MIR CTIO. Draw a box around the star in ds9 and then press the Sex button ; you will get its flux in ADU. Divide by the effective integration time and you get ϕ_F. You should always estimate extinction in non-photometric nights and adapt the exposure time to your targets by adding a factor $10^{E/2.5}$ where E is the extinction. In the spectroscopic mode, it's a good time to do this while you are placing the star into the slit.

- One you know the sensitivity S of the mode and filter you want to use, you can estimate the the exposure time T (in seconds) needed to achieve a certain signal-to-noise σ from the magnitude of your object m with the following equation :

$$T = S/\sigma^2 * 10^{2*m/2.5}$$

- Generally, the following considerations hold :
  1. Signal-to-noise is proportional to the square root of flux or exposure time.
  2. Signal-to-noise is proportional to the square root of the number of exposures.
  3. Flux is inversely proportional to the resolution.

- You can estimate the signal-to-noise in an image in the following way :
  1. (Facultative but yields more precision) : Subtract two offset images (to subtract the sky).
  2. Try to estimate the peak of your star (imaging) or your trace (spectroscopy) by looking at the maximum flux - the sky flux.
  3. Try to estimate the standard deviation of the flux in the sky.
  4. Your signal-to-noise is approximately "peak flux" / "deviation of sky".
  5. If you want to achieve a signal of σ_F and you measure σ_0 in a single exposures, you will need N = (σ_F/σ_0)^2 exposures.

- There is currently a problem with the detector readout in SIMON, which causes stars to appear "fuzzy" in the images. This is only due to a mixing of the Y columns in the detector and can easily addresses with post-processing.

V. Science and scripts.

- **General MIR commands :**

Those can be entered either in the command line or in MIR directly. They can also be used to build a bash script that will then be launched in the terminal.

- seq [texp] [nread] [ncoadds] [nfiles]. This takes [nfiles] sequences with the specified parameters.

- to_ctio [seconds_east] [seconds_north]. This stands for “Telescope Offset CTIO”. It sends an offset to the telescope. Use negative values for west or south.

- ti_ctio. This stands for “Telescope Information CTIO”. It updates the header information for the next image with telescope-related information.

- echo [value]. This outputs text to the user.

- **Making the focus :**

First, take an exposure. Select a star that is not too bright (when you see diffraction it’s probably too bright) and not too faint (you should have at least a signal-to-noise of ~5 on the star). You do this in ds9 by holding the right-click button to draw a green box around the star. Use the Sex button (see MIR CTIO), which will give you the PLMH (which means FWHM - Full Width at Half Maximum, in french). This is the seeing you get in pixels. (You can get the actual seeing in arcseconds by multiplying it with SIMON’s platescale 0.49 “/pix). Note down the actual focal position (which the telescope operator can give you) and the associated FWHM. Ask the TO to change the focal length, take a new exposure and press Sex again (you don’t need to select the star again !). By scanning several positions this way, you can determine which focus gave you the best (smallest) FWHM.

- **Science modes :**

- **Imaging mode :**

In the imaging mode, we usually do exposures separated by offsets to be able to achieve a good sky subtraction. Here is the current script for doing this :

script_ctio_imaging [texp] [nfiles] [observer_name] [target_name] [n_coadds]

Where you must replace [texp] with the exposure time in seconds, [nfiles] with the number of exposures you want at each position of the sky, [observer_name] with the name of the current observer ***without spaces***, [target_name] with the name of the science target ***without spaces*** and [ncoadds] with the number of desired coadds. The script will first ask you if he understood the right number of files and coadds you wanted (sometimes if fails to; you must press enter to confirm or control+C if it's wrong), then it will do [nfiles] exposures on the initial position, shift 2 minutes east, take [nfiles] exposures, shift 2 minutes north, take [nfiles] exposures, shift 2 minutes west, take [nfiles] exposures and finally shift 2 minutes south. Hence, the script makes a square pattern and ends on the same position than it started. Pay attention to the bell that rings each time an exposure is complete. When the script sends an offset to the telescope, you must wait for the telescope to settle (wait for the red message to disappear on the TCS computer screen - see image 5.1), and then press enter in the command line window. If you don't do this, the script will wait for you and you'll lose telescope time. Always lay an eye on the temperatures in MIR CTIO.

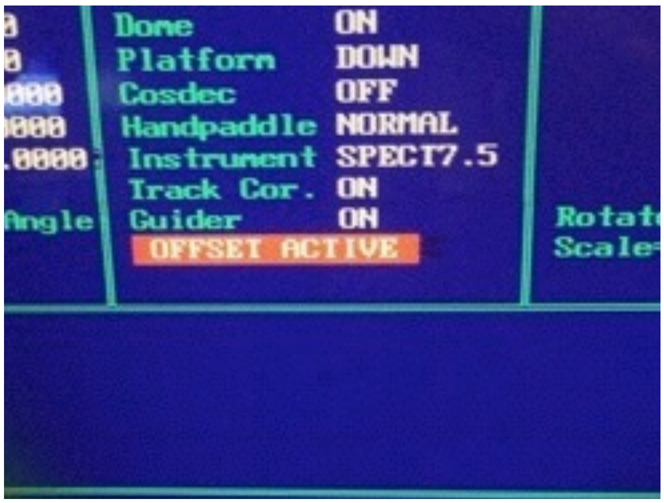


Image 5.1: The TCS computer indicating an offset is not over.

Don't forget to try and recognize the finder chart before launching the script ! If you can't recognize it, verify that the TO entered the good coordinates in the TCS. If they are good, you can try a "Sky - Sky" which makes it easier. (See Acquisition button sin the MIR CTIO section).

- **Spectroscopic mode :**

In the spectroscopic mode, we usually do exposures in an ABBA pattern along the slit to achieve a good sky subtraction. Here is the standard procedure, which is valid for any grism :

1. Put on the central_square_2_slits_55 mask in the mask wheel.

2. Put on the J filter in the filter wheel.

3. Change the ds9 "Scale" options to sqrt and zmax.

4. Normally you would put on the lyot_ctio filter in the lyot wheel, but since it doesn't move well, it should never been moved (it is currently placed in this position - see Troubleshooting).

5. Ensure the grism wheel is on its Open position.

6. Take a 0 seconds exposure with the Acquisition/Sequence button in MIR. Take more exposure time if your target is very faint.

7. If you see more than one star, try to recognize the finder chart.

8. Note the (X,Y) position of you target by placing your cursor over it in ds9. Don't forget the X position is vertical if you set up things well.

9. Note the X position of the desired slit. Left one is 2 pixels (.88") slit, right one is the 4 pixels (1.76") slit.

10. Note the approximative Y position of a region nearby the slit in the central square of the mask (see picture X).

11. Compute the offset needed to reach the position nearby the slit. Remember SIMON's platescale is 0.49" at CTIO, so the equation would be :

    West offset = (Y_goal - Y_object) * 0.49
    North offset = (X_goal - X_object) * 0.49

    You can deduce the direction of the offset by remembering you're moving the field of view, not the star itself. Also, remember North is up and East is **left** on the screen.

12. Make the offset with the to_ctio command.

13. Take a 0-sec exposure.

14. Ensure the star is really aligned with the slit (the easiest way is hover the mouse over the object and see if X_object = X_slit).

15. Put the object in the slit with an offset of 100 seconds to the west (for left slit) or east (for right slit) with the following command :

    Left slit : to_ctio -100 0
    Right slit : to_ctio 100 0

16. **Ask the TO for guiding**.

17. Take a 0-sec exposure.

18. Ensure the object is really well aligned with the slit, and not just on the border of it. Exposing for several minutes on a misaligned star will greatly alter the achieved signal to noise and is equivalent as losing telescope time.

19. Put on the desired grism.

20. Put on the desired filter.
    KRS5 grism -> filter is J,H or Ks.
    F_SI grism -> filter is Open.
    Amici_R=40 grism -> filter is Open.

21. In the command line, launch script_ABBA_ctio [texp] [object_name], where [texp] is the exposure time per individual image, and [object_name] the name of the science target ***without spaces***.

22. Pay attention to the bell that rings each time an exposure is complete. The script will ask you to stop the guiding. This is because it wants to send an offset, and if it does while guiding, the guider will lose its star and might send small random offsets that can remove the star from the slit (it really happens). When you stopped it, press enter.

23. Then the script will send the offset. The TO must move the guiding box to the new position and start guiding again. Make sure that the red message disappeared in the TCS computer screen (see image 5.1). Then, you can press enter again. If you don't press enter, the script will wait for you and you'll lose telescope time

24. If the intensity of the trace suddenly goes down, or if you just don't see any science trace (see image 5.3), verify with the TO that there is no passing cloud. If not, put back the grism to its open position, take a 0-sec exposure and verify that the target is still in the slit. If not, make an offset 100 seconds east, and return to step 8. If you do not recognize the target, ask the TO to point to its coordinates again.

25. It is possible that the script will stop after 4 exposures even if you asked for more. Pay attention, and if it happens just launch it again.

26. After you have observed your science target, don't forget to observe a spectroscopic standard ! A good way to find one is to go to on a Simbad coordinate search (http://simbad.u-strasbg.fr/simbad/sim-fcoo) and type in the coordinates of the science target. Use a search radius of 2 degrees or more. Once the output is generated, do a control+F search to find an A0 star. Open its SIMBAD page and ensure it's not a close binary or an A0n

star. You must observe the standard in the same spectroscopic mode and filter than the science. You really want to have a high signal to noise on this target, or else the signal to noise of your science target will be diminushed. An approximation of your final signal to noise is given by :

1/SN_FINAL = sqrt((1/SN_TARGET)^2 + (1/SN_STANDARD)^2)

Hence, the final signal to noise will be the same as the science target only if the standard star's signal to noise is very high. There is a simpler way to find spectroscopic standards using this page : http://www.gemini.edu/?q=node/10175, but it often goes down. Also when using it, open the SIMBAD web page for the star to verify the same things as before. Normally, you'd like to be the standard star to be at the same airmass than your science object at a precision of 0.1. However, we found that the changes are not quite significative if you have a difference of up to 0.3 airmass in reasonably good weather conditions. Decide on your spectroscopic standard before your science observation is over, or else you'll lose precious time !

27. Always lay an eye on the temperatures in MIR CTIO.

Note : In the F_Si spectroscopic mode, raw data should look like image 5.3. The multiple horizontal lines are the spectra of the sky through the slit, composed of several telluric emission lines. The vertical trace is the spectra of your science object. You should worry if you can't see one. The very large vertical trace in the middle of the screen is rubbish spectra from everything in the central imaging square of the mask; it won't be useful for any science. The spectra on the left are for objects in the 2 pix. slit, the ones on the right for objects in the 4 pix. slit (in image 5.3, there is only one object in the 2 pix. slit). The bottom of the image are larger wavelengths (K_s band), whereas the top of the screen are shorter wavelengths (*J* band). Since the sky is *way* brighter in the K_s band, it's normal that you see a big gradient in the intensity of the sky, rendering it hard to see all the trace at once with ds9's scale options. You should not worry because of this, since we will do what we call an ABBA pattern through the slits (which only means we take a spectra on two different A,B positions), so that we can subtract the sky all at once by looking at a subtraction of A and B images. We will then see a positive and negative trace (the spectrum of our target), which will be both useful for science.

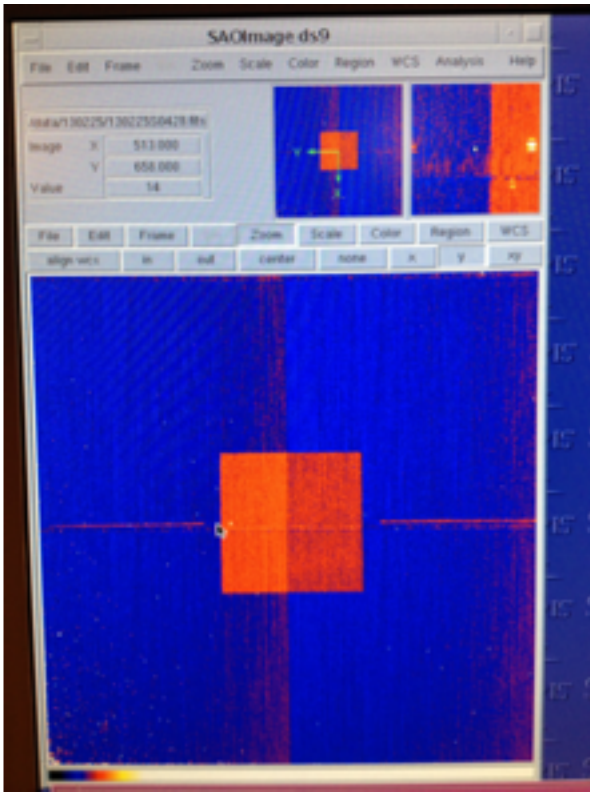


Image 5.2: Placing a star into the slit.

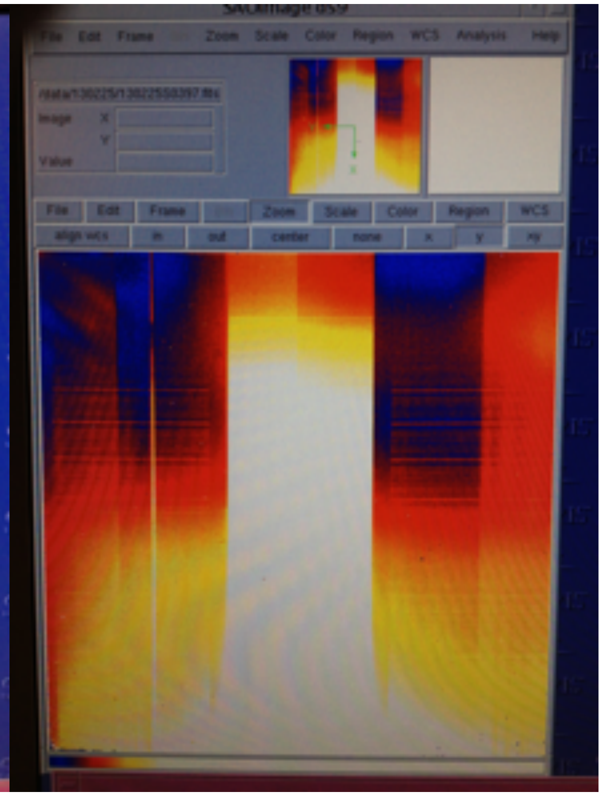


Image 5.3: what F_Si spectroscopy looks like

- **Compiling bash scripts :**

If you ever get a “permission denied” when you try to run a script, launch the following command in the terminal : chmod +x [script_name].

VI. Calibrations.

At the end or the start of each night, you must take FLATS calibrations, one ON and OFF set, ***for each science mode that you used***. For example, if you did imaging in the *J*, *H* and K_s filters, F_Si spectroscopy with the SP1 filter and then KRS-5 spectroscopy with the the Ks filter, you would need to do both FLATS_ON and FLATS_OFF in those exact same 5 configurations, which means 5 FLATS_ON sequences and 5 FLATS_OFF sequences. Normally, one sequence is composed of 11 files. Here are some steps to follow :

1. Ask the TO to put the telescope to the white spot.

2. Turn on the lamps.

3. Put the camera in the first science mode for which you want flats.

4. Remember that the configuration must be exactly as you did for the science. So for spectroscopy, you must put the grism, the filter and the slit.

5. Take a 10-seconds exposure.

6. Check the number of counts (ADUs) you get in ds9.

7. Adjust the lamp strength or integration time so as you get between 4 000 and 10 000 counts everywhere in the field. Normally, you don't want to have more than 40s of exposure, because it will be too long. Also, you might want to put the lamps to their maximum power of you need integration times that are too long (this is especially true with spectroscopic modes).

8. Set Nfiles = 11 as well as the right exposure time in the MIR header. Also set FLATS_ON as the object name. Press “sequence”.

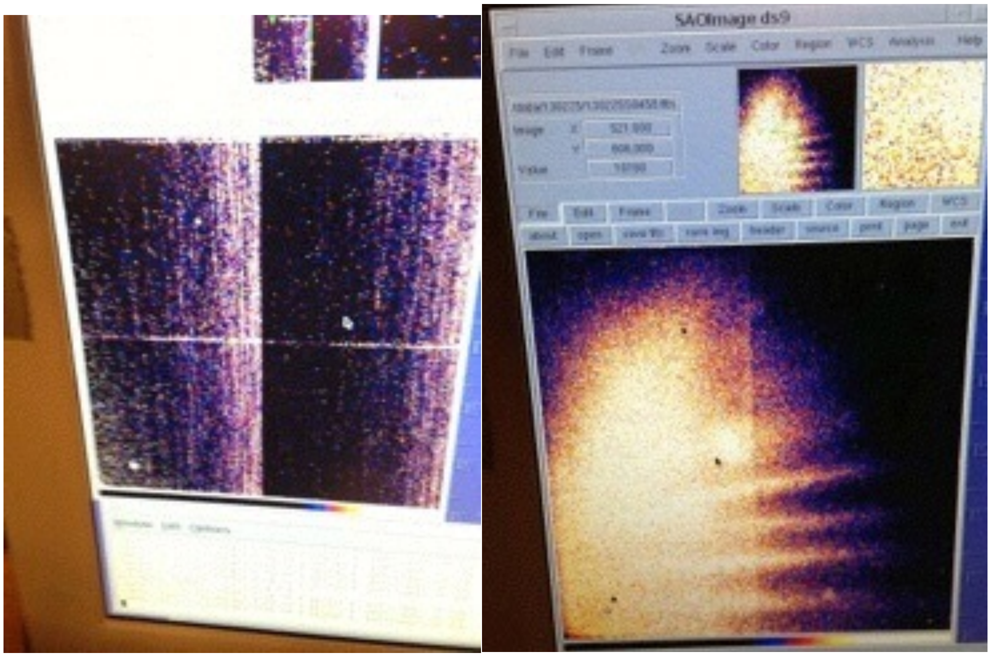
9. Turn off the lamps.

10. Change the object name to FLATS_OFF.

11. Press “sequence”.

12. Repeat steps 2-11 for every other science mode.

13. Try not to make flats when you could observe instead. Do them before sunset or after sunrise if you can. It is not dramatic to skip the flats one night, but you must have done them the day before or do them the day after in that case.



Images 6.1: What a FLAT_OFF and FLAT_ON look like in J-band imaging.

VII. Procedure for a standard night.

- Check the pressure in SIMON (see other section).

- Put nitrogen in the mask wheel tank of SIMON.
- If it's not already done, open the computer and log onto it (login : [MASKED], password: [MASKED].

- If MIR CTIO is already open, press QUIT, then reopen it again by typing mir ctio in the terminal.

- Type df in the terminal to ensure there is still space on the hard disk.

- Type t4 in MIR CTIO to see the temperatures. Ensure none is above 80 K.

- Initialize each filter wheel (see MIR CTIO section).

- Go in the current data folder with cd /data/yymmdd/, where yymmdd is the current date.

- Copy scripts to the current folder with cp /home/simon/script_ctio/script_ctio_imaging . and cp /home/simon/script_ctio/script_ABBA_ctio .

- Do the flats (now or at the end of the night).

- The TO will point a bright star to synchronize the telescope's pointing.

- Go to your first science object.

- Make the focus (see other section).

- Do the science.

- Make the focus again when the temperature has changed significantly.

VIII. Reading the list of science targets.

Étienne Artigau will always provide you with a list of targets for you to observe during the night. It will include the following things :

- The RA,DEC position of the object.
- Its magnitude.
- The science mode in which we want you to observe it.
- The total integration time needed.
- The airmass graph as a function of time if you click on the object name.
- A finding chart and more information if you scroll down the document.
- Special directions.

In case of spectroscopic observations, use the script_ABBA_ctio. Since it takes positions by a multiple of 4, try to get as close possible to the integration time we asked with *N* times an ABBA pattern of individual exposures between 150 - 350 seconds, where you choose *N* (you will have to launch the script *N* times). If you choose exposure times too large, the sky will become too bright in individual images, and if you choose exposure times too small, you will not be very efficient as you will spend a lot of time making offsets. However, for bright (5-7 magnitudes) standard stars, typical individual exposure times of less than 10-50 seconds are typical.

In case of imaging observations, use the sript_ctio_imaging. This one also takes exposures by a multiple of 4, so the same reasoning applies here. However, typical exposure times are more like 10-80 seconds.

Don't forget to take the FLATS_ON and FLATS_OFF for each science mode that you will use throughout the night. Also don't forget to take one A0 standard star immediately after each spectroscopic observation. Try to choose very bright standard stars, because we need to have a very high signal-to-noise for them, or else they will increase the noise in our science data - and we do not want this.

IX. Writing a log file.

When taking queue mode data, you ***must*** write a log file. You can write it in any software you wish, but it may contain the following night-related informations :

- The current date.
- The telescope + camera.
- The name of the observers.
- The current weather.
- The name of the Telescope Operator.
- Comments on any technical difficulties encountered in the night and how you resolved them.

Then, for each observation you should provide the following information :

- The science frame numbers.
- The name of the object
- The exposure time (per frame).
- The total number of valid exposures.
- The position of each filter wheel.
- The local time at which the script was launched.
- The airmass for the first exposure.
- The PI (Principal Investigator) associated with this data.
- The name of the script you have used.
- Any special comments.
- A comment for any fits file that is not valid, and the reason why (ex. slewed before the end of the exposure, or out of focus).
- You should tell the moment where you make the focus and the best seeing achieved (in arcseconds ; see Making the Focus in the science section).

CTIO - 1.5m -Simon	Observateurs : Amélie et Jonathan	Projet	Collaboration Shara - Doyon		Beau temps	Technicien Manuelo Hernandez						
Log 130301												
	Frame	Objet	Expos	Poses	Filtre	Gram	Lyot	Mask	LT	Airmass	PI	Commentaires
	6-15	FLATS_ON	30	10	J	Open	lyot_ctio	Imaging_square				
	Crash de l'ordinateur et il replante quand on ouvre MIR. Je fais un Halt, je ferme complètement SIMON avec la switch I/O et je resette le contrôleur des fibres optiques											
	Ça fonctionne.											
	29-32	2MASS J0306055	150	4	SP1	F_S_R-500	lyot_ctio	central_square_2	20h48	1.24	Jonathan Gagné	Ciel encore clair, c
	34-41	2MASS J0306055	200	8	SP1	F_S_R-500	lyot_ctio	central_square_2	21h01	1.28	Jonathan Gagné	
	57-60	2MASS J0340495	250	4	SP1	F_S_R-500	lyot_ctio	central_square_2	21h40	1.42	Jonathan Gagné	
	We make the focus. 1.0 length => 2.01"											
	70-73	2MASS J0425006	200	4	SP1	F_S_R-500	lyot_ctio	central_square_2	22h06	1.34	Jonathan Gagné	
		HD28867	30	4	SP1	F_S_R-500	lyot_ctio	central_square_2_slits_55		1.38	Jonathan Gagné	
	J'ai accroché "initialize" au lieu de "acquisition" et CYGA plante... je dois rebooter 3 fois											
	90-93	2MASS J0429184	200	4	SP1	F_S_R-500	lyot_ctio	central_square_2	22h54	1.37	Jonathan Gagné	
	100-103	2MASS J0429184	200	4	SP1	F_S_R-500	lyot_ctio	central_square_2	23h13	1.46	Jonathan Gagné	
	110-112	2MASS J0443076	30	2	J	Open	lyot_ctio	Imaging_square	23h36	1.47	Étienne Artigau	
	114-117	2MASS J0443076	250	4	SP1	F_S_R-500	lyot_ctio	central_square_2	23h41	1.50	Jonathan Gagné	
	122-125	2MASS J0443076	250	4	SP1	F_S_R-500	lyot_ctio	central_square_2	00h03	1.62	Jonathan Gagné	

Image 9.1: A typical log file.

X. Troubleshooting.

- **A temperature got above 80 K :**

If you see a temperature going above 80 Kelvin, you must know that this means a nitrogen tank is nearly empty. This also means the temperature will continue going up, and might reach 90 K in around 15 minutes. At this point, it will be very important to fill up the associated nitrogen tank. You must ask the TO to go up and fill it (he might need to put the telescope to the zenith, depending on your current position). After it's filled up, use the t4 command to ensure temperatures are going down to normal. The SIMON control computer will emit a sound when a temperature gets above 90K.

In particular, because of a design flaw the mask wheel tank can spill off nitrogen in some telescope positions. Normally, we always need to fill it up once during the night.

- **The inipci or pat command failed in MIR CTIO :**

When this happens, first try to enter it again manually by typing either inipci or pat in MIR CTIO. You can try it two or three times if it keeps on failing. If this does not work, press the Quit button in MIR and open it again. If it keeps on failing, do a complete shutdown (see other section). If you succeed in entering the inipci command manually, then you must also enter the following commands : t4, pat, filtre. If you succeed in typing the pat command manually, then you must also enter the filtre command manually.

- **The Lyot wheel :**

At the beginning of the commissioning run with SIMON, we have noticed a problem with the Lyot wheel. It has a hard time reading its position and thus fails to stop at the right place when you ask it to turn. Since the only position of the wheel that is really useful to this run is lyot_ctio, Philippe Vallée has put it manually in this place and turned off the wheel control. Hence, if you try to turn or initialize it, you will get the following message :

Error, motion of the Lyot wheel presently unavailable
Tests on this wheel have shown that it turns with difficulties
The lyot wheel should remain at its current position (lyot_ctio)
until it is serviced.
For further details, contact vallee@astro.umontreal.ca

It is better that you do not touch it at all, just in case it would actually turn out of its position.

- **Filter wheel unable to reach position :**

At the beginning of the commissioning run with SIMON, we have noticed a When you encounter this message, first try to reinitialize the wheel. Try it two times. If it does not work or you encounter “unable to reach home position”, follow steps in the next section. If you are able to reach to home position but you can’t get to any other position even after following all the steps in the next section, then go to the “manually operate filter wheels” section.

- **Filter wheel does not respond to the “filtre” command :**

See “reset the filter wheels control”.

- **Filter wheel unable to reach home position :**

This is a little more serious. First, try to Quit MIR and reopen it, then try again. If it still does not work, see “reset the filter wheels control” section. If it still does not work, do the complete shutdown procedure (see further below).

- **Reset the filter wheels control :**

First, pull then put up the “Display control” lever. The two red diodes indicate that the motors of the filter wheels are currently functional. If any of the four yellow diodes are lit up, this means the corresponding motor is *currently* turning. If it’s turning and you didn’t ask for it, it might be because it got stuck on. This can cause noise in the science data and errors in the instrument temperature readings. To reset the motors, first pull then put down the “40V” lever, then do the same with the “5V” lever. Wait a little bit and then put back up the “5V” first, and then the “40V”. Put back down the “Display control” lever so that no light is emitted in the dome during your observations. When you return to MIR CTIO, you will have to reinitialize each one of the filter wheels so you can turn them again (see the MIR CTIO section). Do not initialize the Lyot wheel since we do not move it anymore. If you want to put back the right name in the “lyot wheel position” in the file headers, enter the following command in MIR : par RAL “‘ lyot_ctio’” “Lyot Wheel (Z), position 6”. Notice that the first “‘ is made of two symbols : “ and then ‘. The second ‘“ is ‘ and then “. To view the current fits header parameters, type par. To get more help on this function, type par --.

Image 10.1: Filter wheel control box.

- **Read the status of the filter wheels :**

To read the current status and positions of the 4 filters wheels, you must locate the Local box attached to SIMON (see image 10.2). You have to pull then put up the “Display” lever to see the diodes status. There are 8 diodes, 2 for each wheel. The one labeled H is opened only when the wheel is on the home position. The one labeled F means the wheel is on any valid position (and not in between). Hence, if the wheel is stuck between two positions, you will se no light up for the filter wheel in question. After you read the status of the diodes, turn back off the display lever so you do not have light in the dome.

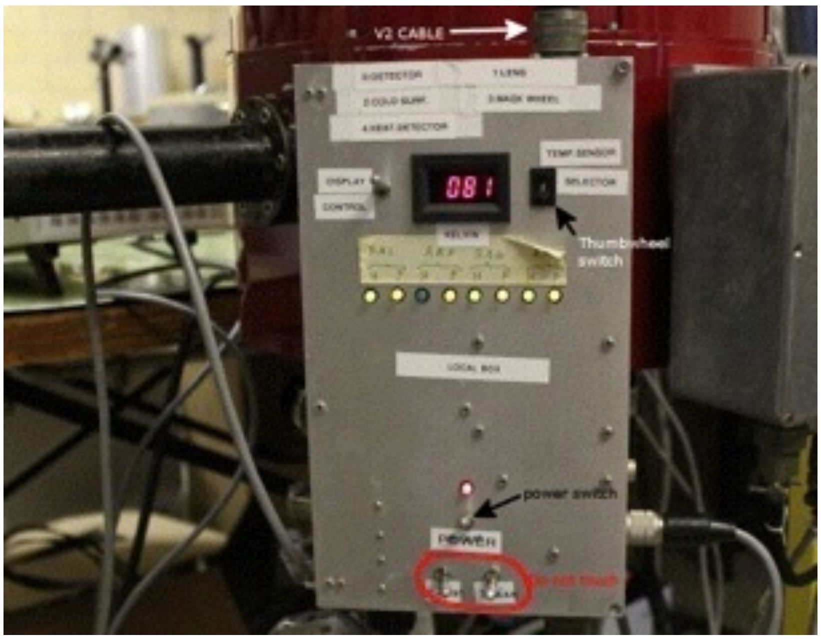


Image 10.2: The local box.

- **Manually operate the filter wheels :**

When a filter wheel really can’t find its position, the last resort is to manually operate it. However, if you ever need to do this, send a mail to the whole UdeM team to tell them you did, because this means SIMON needs some attention. The function you will need to do this is step [filter] [nsteps] [acceleration] [speed]. Acceleration is always 300 and speed is always 200. The filter values are the following :

- x : Filter wheel.
- y : Grism wheel.
- z : Lyot wheel (do not use).
- t : Mask wheel.

The number of steps depends on which filter position you want to go. Each filter has a different number of steps between each of its positions :

- Filter wheel : 822 steps.
- Grism wheel : 1480 steps.
- Lyot wheel : 822 steps.
- Mask wheel : 463 steps.

Each time you add a position to the wheel with the right number of steps, you will go ***UP*** one position in the filter list shown by MIR OMM. So for example, if you want to put the grism to the KRS5_R=1500 position and you are currently home, then you must count *backwards* the number of positions in MIR's filter list. In this case, you would need to go up 3 positions, so this is 3 * 1480 steps or 4440 steps. Hence, the command would be step y 4440 300 200. The output will be a strange message made up of letters and numbers; this is normal. Then you should take a 0-seconds exposure to see if the image is good. A misaligned grism will result in tilted traces. In this case you can try small steps such as step y 50 300 200 or step y -50 300 200 (or even smaller) until the trace is straight. If the trace is really misaligned, ***you are losing some flux***. However it might still be possible to reduce the data.

The reason why the step function is not perfect is the fact that it's imprecise. Normally, when you ask to change a filter, it gives a bigger amount of steps and the filter wheel reads a voltage bump when it gets to the right position and stops there. Hence, the reason why the filter can't reach any position might be that it doesn't see this voltage bump (possibly because the potentiometer is set to enough sensitivity, or the voltmeter is broken). We have noticed that the filter wheel has more trouble reading its position when the telescope is around a declination of -60 degrees.

- **Reset the SIMON controller :**

To reset the SIMON instrument, you first have to find the controller box which is attached to the telescope (see image 10.3). There are two buttons on it. One on the right (A) serves as the reset button. The other one (B) is an I/O switch that puts the power supply on or off. The first thing you should try when you want to reset SIMON is pressing A. If this does not work, Put B to O and then put it back to I.

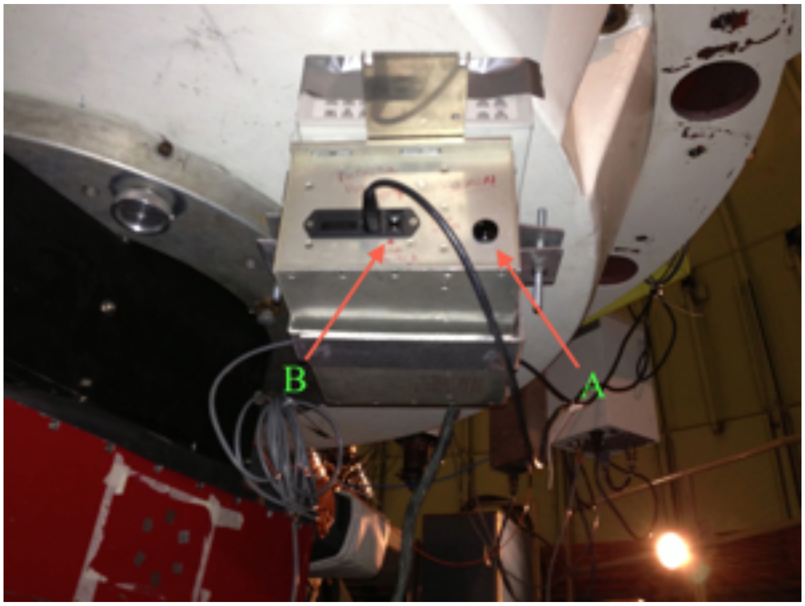


Image 10.3: The SIMON controller box.

- **Complete shutdown procedure :**

First, quit MIR OMM. Then, reset the fiber optics network card (see in next sections). Ask the TO to go in the dome and reboot SIMON (with the I/O switch on the controller). Then, type su root in the Terminal. The password is 68!=69. Type halt then press enter. The screen will go crazy and eventually you'll get to a white screen with a syncing message. When the last message you get is "ok", type power-off then press enter. The computer will immediately shut down. Unplug the power chord from behind the computer and plug it back. Finally, press the power button in front of the computer to turn it off again, and proceed with the normal login procedure.

- **Reset the fiber optics network card :**

Behind the SIMON control computer, you can find a place where two fiber optics connect. Just besides them, there is a narrow white button. Press it to reset the fiber optics network card.

Image 10.4: The network card reset button.

- **The SIMON computer emits a strange sound :**

When any of the temperatures reach 90K, the SIMON control computer will emit a sound from time to time. It resembles the sound of something hitting a nitrogen tank.

- **There is a lot of noise in the images :**

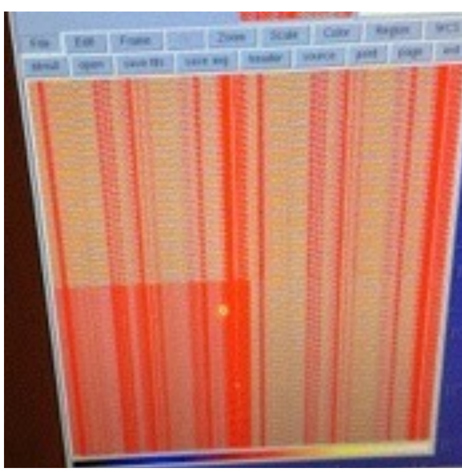


Image 10.5: Noise in the data *Image 10.6: A hairy PSF.*

First, you must know that there is currently a small problem with the readout of SIMON detector, which has for effect that the columns are not displayed in the right order in ds9. Visually, this means that the stars will look a little bit hairy (see image 10.6). This is not a serious problem since Étienne Artigau has written a small IDL code to replace the columns in the right order.

If you see noise that is not due to column swapping (e.g. see image 10.5), then you can try two things.

1. Ensure that the filter wheel motors are off (See "Read the status of the filter wheels"). If it is stuck on, it will induce noise in the data.

2. Reset the SIMON controller (ask the TO to do it, or see "Reset the SIMON controller"). In the case of image 10.5, this is what fixed the problem.

- **MIR CTIO has frozen :**

In the case where MIR is frozen and you really can't close it, try using the top command in the terminal. This will give you a list of presently running processes, which might contain wish8.3 and ds9. Notice their PIDs (Procces IDs) and kill them with the kill [PID] command in the terminal (e.g. kill 2913). If this does not work, you might have to reboot the computer.

- **The computer (and mouse) have frozen :**

First, try to reset the fiber optics (see section with same name). If this does not work, press the [Stop]+[a] keys. This will bring up a new terminal in the middle of the screen, in which you can type sync. You could also probably type in su root, the admin password 68!=69 and then type shutdown. If all of this does not work, then you can go the hard way : hold the computer's power button for a short time.

- **The computer doesn't boot because core files are corrupt :**

When you boot SIMON's computer, it could happen that some corrupt core files prevent you from logging in. You would get a message like "bad sector c0t0d0s3", if the file c0t0d0s3 is the broken one. You would be offered two options "control+d" to startup normally (which will probably not work), or entering "root" for maintenance. Type root, then the admin password 68!=69. After this, type the following command : fsck -y /dev/rdsk/c0t0d0s3/ (replace the filename with the good one). After this has completed, simply type in reboot.

- **Reboot MIR CTIO :**

Press on the QUIT button. Wait until ds9 and MIR windows are completely closed, then enter mir ctio in the Terminal.

- **The traces of my spectra or misaligned :**

This means the grism is not in its right position, and also that you are losing some flux. First, try to send the grism to its home position, then bank to the desired position and take a 0-sec exposure. See if it got better. If not, reboot MIR CTIO and try again. If it's still bad, see the "Reset the filter wheels control" section. If this didn't fix the problem, see the "Manually operate filters" section to adjust the exact position of the wheel so that your trace is straight.

XI. Data reduction.

- Imaging mode : All the software is already written and functional at Université de Montréal. Étienne Artigau is the one in charge of those kinds of reductions, so you can contact him for further help.

- Astrometry : If you just want to make the astrometry on an individual image, try nova.astrometry.net. This is a website using a very powerful astrometry algorithm that can put a standard astrometry header in a .fits file (it can correct higher-order distortions also). It can even make blind astrometry, which means it will find the astrometry even if you tell nothing about the position of your image in the sky or the size of your field of view. I strongly suggest that you read more on their algorithm if you are interested in data reduction.

- Spectroscopy - KRS5 : A complete IDL reduction package is under construction by Jonathan Gagné. It is near completion, however it still needs debugging and more thorough testing. If you want to get a copy or help in its development, contact him.

- Spectroscopy - F_Si : No reduction package has been written for this mode. However, it should not be very difficult to adapt the KRS5 reduction package to this mode. Jonathan Gagné will be the one doing this since he obtained a lot of data in this mode. Contact him for more information.

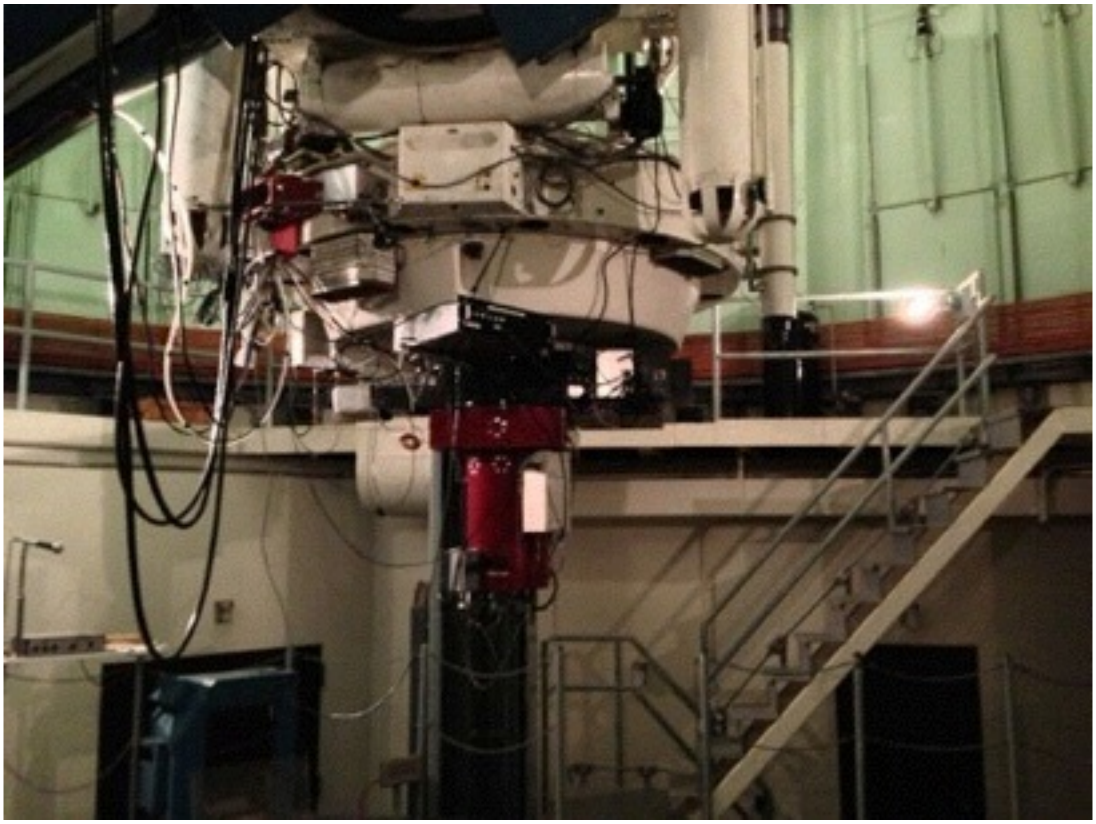
**Note : Michael Cushing has written *spextool*, which is a very efficient, user-friendly IDL tool to reduce spectroscopic data. The official version only works with the camera SpeX, but Jonathan Gagné has adapted it for reducing SIMON KRS5 spectroscopic data. However, it will need to be thoroughly tested to be sure it contains no errors. It would not be too hard to adapt it to the F_Si mode also. Contact Jonathan for more information.

XII. Contact information.

Please use the "home" phone numbers for emergency only. Try other options before.

- **Étienne Artigau :** Primary scientific support, software support and imaging data reduction support, Université de Montréal.
- **Philippe Vallée :** Technical support, Université de Montréal. For all troubleshooting with the physical problems you could encouter with SIMON. Also knows a lot about the software. If he doesn't know about the solution, don't bother searching elsewhere.
- **Jonathan Gagné :** Scientific + Software support and commissioning observer. Université de Montréal.
- **René Doyon :** Scientific support, Université de Montréal.
- **Michael Shara :** Scientific support, AMNH, United States.
- **Rodrigo Hernandez-Godoy :** Telescope Operator and Night Assistant.
- **Manuel Hernandez-Godoy :** Telescope Operator and Night Assistant.
- **Esteban Parkes :** Senior Engineer Manager and Head Mountain Electronics Group, Cerro Tololo & SOAR Telescope, Chile.
- **Nicole S. Van der Bliek :** CTIO Director, Chile.
- **Victoria Misenti :** Coordinator of Yale Research Observatories & Undergraduate Registrer, Yale University, United States.
- **Francisco Javier Rojas :** Electronic Engineer.
- **Loïc Albert :** SIMON camera designer, Université de Montréal.
- **1.5m Telescope Control Room :**
- **Amélie Simon :** Commissioning observer. Université de Montréal.
- **David Lafrenière :** Scientific contact, Université de Montréal.
- **Anthony Moffat :** Scientific Contact, Université de Montréal.
- **Noël Richardson :** Scientific Contact, Université de Montréal.
- **Frédérique Baron :** Scientific Contact, Université de Montréal.

- **Graham Kanarek :** Scientific Contact, Université de Montréal.



Simon attached on the 1.5m at CTIO

The awesomeness of the view in the dining room. Credit : Amélie Simon.