

NEWFIRM Startup, Data Taking, and Error Recovery Procedures

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This is a procedural guide to the NEWFIRM Observation Control System (NOCS). It covers system startup, script creation and data acquisition, daytime calibration frames, pointing and focus checks on the sky, use of the Quick Reduce Pipeline products, and recovery procedures from various problems. This guide is meant to supplement hands-on training at the telescope. It is not a stand-alone instrument manual.

Throughout this guide, look for the symbol ∇ . This denotes a NOCS command string to be entered by the user, followed by the “enter” key denoted as <cr>, in the command line window in the central monitor.

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1. Shutdown and logout

At the end of the night, protect the instrument by closing the warm entrance window cover, and shutting down the array controller and high level software.

In the Instrument Control System GUI on the right hand monitor, close the Environmental Cover. For more about this, see Sec. 3.3.

Use the Options button in upper left corner to activate the button bars running across the bottom of the GUI.

Click the one labelled “Close”.

From the command line window in the center monitor, shut down the various high level control processes. Type

```
▽ nocs stop all <cr>
```

This debiases the arrays, shuts down all processes and closes all GUIs.

Exit [observer@newfirm-kp](#) , and go back to [4meter@nutmeg](#) , by typing

```
▽ exit <cr>
```

This takes you back to the [4meter@nutmeg](#) prompt.
From here you can log out of *nutmeg* if you like.

Summary:

```
“Close” button in Instrument Control System GUI
nocs stop all <cr>
exit <cr>
```

2. Login and Startup

Log into *nutmeg* as 4meter and open a shell window or terminal window:

Bring up an xterm window

Login as 4meter

Password is _____ .

At [4meter@nutmeg](#) prompt, type

```
xhost + <cr>
```

Open a shell window from the toolbar (click on shell icon). Alternatively, open a terminal window (right click on mouse, then left click on “New Terminal”). Position this window in the lower left corner of the monitor.

In this window, ssh to machine *newfirm* as user “observer” with

```
ssh -X observer@newfirm-kp
PW for “observer” is _____ .
```

At the prompt [observer@newfirm](#), type

▽ nocs start all <cr> (three words, space between)

Several windows appear on all three monitors. This takes about one minute. Be patient and wait for the [observer@newfirm](#) prompt to reappear in the shell or terminal window. The “nocs start all” routine

- Brings up a VNC window to the Data Handling System screen on LH monitor
- Opens several windows and GUIs on RH monitor
- Opens a pair of GUIs on center monitor

Finally, after the [observer@newfirm](#) prompt has reappeared, bias the arrays with

▽ 400mvbias <cr>

This applies a 400 millivolt bias, the present default value. Array performance is not yet characterized at other bias values.

Startup error condition 1:

If the windows do not appear, and you get a sequence of error messages about “cannot connect”, the host permissions need to be reset on *nutmeg*:

Let the nocs start all process run to completion, returning the [observer@newfirm](#) prompt in the shell or terminal window

▽ Type “nocs stop all <cr> “ in this window to stop processes and close GUIs

▽ Type “exit <cr> “ in the shell or terminal window

At [4meter@nutmeg](#) prompt, type “xhost + <cr> “
ssh back to [observer@newfirm](#) and type “nocs start all <cr> “

Now all the windows will appear and you can proceed.

Startup error condition 2:

During the startup process, watch the GUI on the right hand monitor called “NEWFIRM Monsoon Supervisor Layer” once it appears. A string of about 14 blue **RECV** messages should appear. If you do not see any **RECV** messages, or if any red **ERROR** messages appear in the scrolling output,

Wait for the loading process to stop and observer@newfirm prompt to appear in shell or terminal window

Type in the shell window

▽ `nmslReset <cr>` (that's en-em-ess-ell-Reset)

The system will automatically load the Monsoon Supervisor Layer again. Watch for the blue **RECV** and red **ERROR** messages. Repeat this cycle until the load runs to completion with no red **ERROR** messages. If they appear at all, usually one or two `nmslReset` cycles are sufficient to get through this.

Summary:

log in to *nutmeg* as "4meter"

ssh connection to *newfirm* as "observer"

`nocs start all <cr>`

`400mbias <cr>`

`nmslReset <cr>` in the event of red ERROR messages

3. Further setup steps after login and startup

3.1 Setup actions in the DHS VNC window (left hand monitor)

3.1.1. Start IRAF.

Scroll down the window (scroll bar on right side of window) to access a toolbar of icons across the bottom.

Left-click on the "CL" icon. This opens a menu.

Click on "Restore" in this menu.

This opens an xterm with IRAF running in it, set to the *mscred* package. This is primarily useful for image display with *mscdisplay* and interactive image querying with *mscexamine* tools.

3.1.2. Rearrange the window layout on the desktop to your liking. I like to have the *z.super* window directly below the *ximtool* display, to see the raw image and the confirmation message as data pass through to the disc.

3.1.3. Check, and set if necessary, the root image name and the data directories:

Click on the NEWFIRM DHS Supervisor window to foreground it.

Click on the "Paths and Files" tab.

Check the root filename and image directories in the boxes near the top of the resulting page.

If you have logged in from the [4m@nutmeg](#) prompt, the startup script automatically sets the image root name, and creates directories for raw and processed images. These have numerical names in the form year-month-day based on the local (MST) date at startup, e.g. 20071031.

To verify the data paths, click on the raw image directory box, and hit “enter”. You’ll see an acknowledgement in the z.super window. Do the same for the processed image directory box.

You may create different directories than the default ones, using mkdir in the IRAF cl window. Enter these in the display boxes in place of the defaults, and click to select them.

If you want a different root name, delete the default, type in your preference, and hit “enter” to select it. You can do this at any time, for example different root names for different targets. The appended five digit number just keeps incrementing.

3.1.4. Start automatic flushing of the DHS memory

In the DHS Supervisor window, click on the Shared Memory Cache tab.
Click the “Continuous Polling” box at page bottom to activate this feature.

This helps to keep data flowing smoothly from memory to disk.

Summary:

- Open IRAF window from the row of icons at bottom of display
- Arrange desktop
- Go to NEWFIRM DHS Supervisor -> Paths and Files
- Create root image name, hit “enter”
- Click on raw image directory path, hit “enter”, verify path in z.super window
- Click on processed image directory path, hit “enter”, verify path
- Switch to NEWFIRM DHS Supervisor -> Shared Memory Cache
- Click “Continuous Polling” box at page bottom to activate this feature

3.2 Setup actions in the center monitor

The center monitor contains the script generating GUI and the shell command window. These are the tools you will be using most often. The script generating GUI has the cumbersome name “NOAO Extremely Wide Field Infra-Red Mosaic Imaging Camera”. It’s also called “NGUI”.

At startup there is also displayed a small Project Parameters GUI. Fill out the entries in this GUI and click Save. The GUI will close. This information is used for data archiving, including access permission for the astronomer(s) on the proposal. “Actual Observer” means the astronomer who is at the telescope doing the observing; this is not always the PI. “Proposal Identifier” is your proposal number, e.g. 2008A-0035.

After filling out and saving the Project Parameters GUI,

▽ In the shell window enter “nocs set project <cr>”

This synchronizes project parameter keywords in image headers across various subsystems of the observing software.

Summary:

Enter and save project parameters

Enter “nocs set project <cr>” in shell window

3.3 Setup actions in the right hand monitor

This displays a number of GUIs with which the observer interacts less frequently. The GUIs are large and overlap. The three that you will have a need for are

Monsoon Supervisor Layer: shows progress of detector readout

Instrument Control System: commands filter changes, and opening or closing of the Environmental Cover (warm dark slide above the Dewar Window).

Telescope Control System: commands telescope offsets and focus (other capabilities are presently disabled).

In the two Control System GUIs, click on Options at upper left, then on Enable Command Buttons, to turn on the command capability. Click on this again to turn the buttons off when done.

Arrange the GUIs so the Monsoon Supervisor Layer is foregrounded, and the two Control System GUIs are mouse-click accessible, not entirely hidden.

There are other windows and GUIs displayed on this monitor. Clicking both mouse buttons simultaneously on the blue background will pop up a list, from which a desired entry can be selected. This may be needed for troubleshooting procedures, detailed in the Appendix.

Summary:

Arrange Monsoon Supervisor Layer for visibility, and Instrument and Telescope Control System windows for mouse-click access.

4. Instrument startup

4.1. Open the Environmental Cover (warm dust cover over Dewar window):

Foreground the Instrument Control System GUI in the right hand monitor.

This GUI has a row of buttons across the bottom with filter names, and a second row below this one with two large buttons labeled “open” and “close”.

At top left, click on Options, then on Enable Command Buttons. This turns on the clickable buttons and enables you to command actions of the instrument.

Click the large button on bottom row labeled “open”. It will turn green when the Environmental Cover is open.

Click on Options, then on Enable Command Buttons again. This disables the buttons to prevent inadvertent actions such as closing the window.

4.2 Select filter:

You can select a desired filter through the Instrument Control System GUI by enabling the buttons and clicking on the filter button. However it is more convenient to do this via the observing scripts as described below.

4.3. Check Dewar temperatures:

Switch to Desktop 2 in the center monitor. This desktop displays GUIs for the Instrument Controller. They have been opened by a direct login to the instrument controller, independent of the “nocs start all” process. You can command the Environmental Cover and the filters through these GUIs, but the preferred user mode is via the Instrument Control System GUI.

If these GUIs are not open in Desktop 2, see error recovery procedure A.3.1 in the Appendix.

Look at the NICC Temperatures display. If it isn't open, click on “Temperatures” in the menu GUI.

Check value for item 19, fold mirror housing exterior. It should be 65 +/- 1 Kelvins.

Check value for item 50, array mount thermal mass. It should be 30.0 +/- 0.1 Kelvins.

If either of these values is out of range, contact the Instrument Scientist.

Switch back to Desktop 1 for data taking.

Summary:

Open Environmental Cover via Instrument Control System GUI
 Check key Dewar temperatures on center monitor, Desktop 2
 Switch back to Desktop 1

5. Data acquisition and scripts

5.1 Scripts

Data acquisition is done from shell scripts created by script-writing GUIs. The script-writing GUIs are called from a script selection GUI (“NOAO Extremely Wide Field” etc. or NGUI, on the center monitor). For compatibility with the pipeline, scripts are limited to the formats defined by buttons in NGUI. Script inputs are similarly limited to numerical values or buttons in each individual script GUI.

Above the script selection buttons in NGUI are two rows of options flags that enable or disable certain actions in all scripts. The default options have been chosen from observing experience and should only be changed in consultation with your support scientist. They will be referred to in the descriptions of individual scripts below.

Clicking on a script selection button, e.g. “Dark”, opens a GUI for that format. The GUIs generally all look alike, but differ in which buttons or entries in them are active or turned off. Each script-writing GUI is further divided into subsections called Configurations. The button “What’s This” at the bottom pops up a short description of the purpose and operation of the script.

Many scripts contain a section for Telescope Configuration, in which most of the parameters have been disabled. This is a temporary measure while we sort out what degree of direct control of the telescope by the observer is useful and desirable. Relative offsets and focus are enabled. Absolute pointing to RA, Dec is disabled.

Scripts are stored in `/home/observer/exec`.

5.1.1 To execute a script

After creating a script and clicking “OK” in the script GUI, type “rehash” in the shell window:

▽ rehash <cr>

To execute the script, type in the shell window

▽ <scriptname>.sh <cr> (for example, Dark5s.sh <cr>)

5.1.2 To abort a script in progress

See Appendix A, Section 2 “Errors while taking data”, item 1 “abort a script”.

5.1.3 To edit a script

A script can be inspected and edited in the shell window (or in a separate xterm window logged in as *observer@newfirm-kp*) with your favorite editor. This capability can be used to change observation parameters without creating a new script via the GUI. However, using the GUI is likely to be faster and less prone to error, or to omissions in the metadata blocks used by the reduction pipeline.

A super-script that is a sequence of GUI-created shell scripts can be created by hand for automatic execution. For example, to automatically run a set of dark scripts at various exposure times, gather the script names into a list file denominated as a shell script, e.g. “DoDarks.sh”. Execute this script to run all the dark sequences.

5.1.4 Descriptions of some commonly used scripts

I suggest reading through each of these descriptions and examining the associated script-writing GUI. Each successive description presumes knowledge gained by reading its predecessors. For a thorough and complete discussion of all the scripts, see “Detailed Guide to NEWFIRM NOCS Scripts”.

Note: the Quick Reduce Pipeline requires appropriate Dark and Dome Flat Sequence data taken with these scripts. Be sure to do this the afternoon of your first night. See Section 7.

5.1.4.1 Dark

The simplest script, with least number of user adjustable parameters. To start, press the Dark button in the script selection NGUI.

Consult with your startup person about the instrument and telescope configuration in which to take Dark frames. If in doubt, take darks with the Environmental Cover closed, telescope mirror covers closed, and the dome darkened.

Script Configuration: user variables are Object Name and Script Name.

Object Name (or image header) contains whatever information the observer wants to log in the header. Use only alphanumeric characters and the space bar for entries here.

Script Name should be something that readily identifies the script, e.g. Dark5s for a five second dark integration.

Observation Configuration: user variable is NumObs.

NumObs is the number of images to be recorded to disk.

The Filter selection is fixed as Dark.

Monsoon Configuration: user variables are *intTime*, *coadds*, *fSamples*, and *digAvg*s. Since dark frames are usually taken for dark subtraction from on-sky data, the user set parameters under Monsoon Configuration should match the on-sky data.

intTime is the basic integration time—the amount of time that will be spent collecting photons before the arrays are read out.

coadds is the number of integrations to take in sequence and sum into a single image. A coadded image is written as a sum, not an average.

fsamples is the number of Fowler samples to do in each *intTime*. *fsamples*=1 is recommended for sky background limited observations with broadband filters. *fsamples* = 4 or 8 could be used with narrowband filters, for which readout noise is a significant noise contribution.

*digAvg*s sets the value of a digital filter in the readout electronics. I recommend sticking with the default value of 4.

5.1.4.2 Focus

Takes a series of images, stepping the telescope focus in between. Offsets and acquires a “sky” frame first, then offsets back to initial position and runs through focus. For more information on the focus process, see Section 9 below.

Observation Configuration: filter selection is now enabled. The button is LEFT of the filter name.

Telescope Configuration contains the parameters for the focus sequence.

RA, Dec, and Epoch are presently commented out in the resulting shell script. Leave these parameters “as is”.

OFFSET RA, Dec defines the initial offset for the sky frame, in arcseconds. RA = 30 and Dec = 0 are reasonable choices.

FOCUS Start Focus, Step Size, # Focus Steps define the focus sampling. Start Focus is the starting value, Step Size is the focus increment, # Focus Steps is the number of steps. Start Focus value should be several steps less than the initial estimate of focus. Step Size = 50 and # Focus Steps = 7-10 are good choices.

Output images are analyzed with the focus analysis software tools described in Section 9 below. Section 9 also describes observational procedures and rules of thumb for focussing.

5.1.4.3 Test

A very simple script, the on-sky equivalent of Dark, adding filter selection. Good for quick snapshots to confirm pointing, check sky levels, etc. The pipeline will ignore any data taken with this script. Raw images are archived but not further processed. Use this script for any data that are not part of a calibration or science sequence.

Observation Configuration: filter selection is now enabled.

5.1.4.4 Standard

Adds dithering capability to the Test script. Used for standard stars. The data are flagged as “standard star” in the archive for later retrieval by other users.

Telescope Configuration is present but inactive; inputs are ignored.

Dither Configuration: sets the dither pattern and number of repeats.

RA and Dec are the offsets, in arcsec, between dither pointings.

Iterations is the number of times to repeat the pattern.

Settle, in seconds, is an open-loop wait time after the telescope motion and before the start of the integration.

GEOMETRY: 5PX is an X; 4Q is a box; RAxDec defines a rectangular pattern. For Random and From File options, see below.

For 5PX, the RA and Dec offsets are the distances from center to corner, *not* corner to corner. For RAxDec, the offsets are the distances between successive points. An RAxDec (or m x n) grid pattern is stepped through in successive pointings, beginning in the southeast corner and offsetting north and west. All of these regular patterns take the initial telescope pointing as the pattern center, and return to this position when done.

Random generates an irregular pattern. At each successive step, an RA and a Dec motion are chosen randomly with a value between zero and +/- the RA and Dec parameters. These positions are centered on the initial or home position and bounded by the RA and Dec parameters. An unbounded or random walk pattern can be chosen by selecting “Allow Brownian motion” in the NGUI options.

From File moves the telescope using a user-created list of successive relative offset positions. Consult with the Instrument Scientist for use of this option.

Setting Iterations > 1 will repeat the pattern. If using the guider, the pattern will be fixed on the same detector pixels pretty closely, which may not be desirable. If not guiding, telescope tracking drift will offset the pattern on the detector from cycle to cycle by a slight amount. To introduce deliberate offsets, use a mapping script such as DeepSparse.

Warning: If using an RAXDec pattern, examine the resulting script with an editor to check the commanded telescope offsets for correctness. We have had some difficulties getting this right in the script creation algorithm.

5.1.4.5 DitherStare

This script has the same configurations and functions as Standard, but the data are not flagged as “standard star” in the archive. Use it when observing science targets with a simple dither pattern.

See warning above about checking offsets in the resulting script if using RAXDec pattern.

5.1.4.6 DeepSparse

This and other similar scripts introduce Map Configuration parameters. This is a second set of telescope pointings superposed on the dither pattern. The telescope goes to the first pointing specified by the map parameters; executes a dither as specified by dither parameters; then goes to the second map position and executes a dither; and so on.

Map patterns and parameters are like those for dithers. The same rules apply as to location of starting point, how it walks through a pattern, and what RA, Dec offsets mean.

Map offsets can be any size. Large (~1600 arcsec) offsets displace the telescope by a full NEWFIRM field of view. Half-field offsets (~800 arcsec) can be used to position a moderately extended target on each quadrant of the array mosaic in succession. Small offsets (few arcsec) can be used to quasi-randomize a repeated regular dither pattern, with respect to which pixels are sampled.

A large motion will place a selected guide star completely out of range of the guide probe. The Guider Wait option will pause the data-taking to allow acquisition of a new guide star at each map position.

See warning above about checking offsets in the resulting script if using RAXDec pattern.

Telescope Configuration is present but inactive; inputs are ignored.

5.1.4.7 DeepRich

Like DeepSparse, this allows two levels of telescope motion, Dither and Map, which can be used in the same ways.

Telescope Configuration is now active and allows a third level of motion with the Offset parameters in RA and Dec. The offsets are applied at intervals during the dither-map cycle to move completely off of an extended target for sky frames.

6. Using the DHS windows while observing

Two functions of this set of windows are to display and interact with raw images, and to be sure the image recording onto disk is proceeding normally.

Ximtool image display features:

- Image display shows the raw incoming pixel frame, autoscaled to sky level.
- Orientation is North up, East left.
- Click on the T and C boxes in the toolbar to open up two more toolbars.
- Click on Pan, WCS, and ISM to get an image panner; X, Y coordinate display; and pixel value display.
- Mag +/- will change the size of the panner box.
- Hold down the right mouse key and pan around the image to change image brightness and contrast.
- Click on Display to bring up a GUI with these and other capabilities.

Images on the disc can be displayed to the Ximtool with IRAF using `mscdisplay` in the `mscred` package. `mscexam` or other tools can interact with the displayed image. However, if taking data, it will be overwritten by the next raw frame to be read out. A separate display window can be opened from the Iraf `cl` window and written to, to avoid these collisions.

`Imexam` etc. tools will not work on the autodisplayed raw frame since it was not retrieved from the disk.

Monitoring data logging:

This is done through the DHS Supervisor Window and the `z.super` window.

In the DHS Supervisor Window, click on the Shared Memory Cache tab. This displays the data presently in memory. A complete data set for a single image is five lines of text, all with the same exposure ID number at the end (ExpID column).

Lines of text will appear and disappear as data are read into memory and then processed onto the disc.

Processing steps are displayed in the `z.super` window. The main thing to look for is the highlighted box with message "Postproc DONE", updating at regular intervals.

If lines of text begin to build up without disappearing, 10 lines or more, try clicking the Update Status button at the bottom to flush data to disk. It does no harm to click this

more than once, to flush multiple frames. You should see processing occurring in the z.super window as text lines disappear from the DHS Supervisor Window.

If processing stops and text lines continue to build up, or if the Shared Memory Cache page turns **red**, there is a problem. Use the procedure in Appendix A.2.1 to abort any script that's running. Then consult A.2.5 and/or A.2.6 for further recovery procedures.

7. Taking dome flats and darks

The Quick Reduce Pipeline requires appropriate dome flats taken with the Dome Flat Sequence script to process your on-sky data. It also requires dark frames taken with the same parameters as the dome flats, and as the on-sky science data. Be sure to get these during the afternoon of your first night.

Dome flats are also advised as a precautionary measure for the full pipeline reduction. We are still learning how best to flatfield NEWFIRM science data.

Taking the dome flats:

Ask the operator to request that the telescope be set up for dome flats at 4:00 p.m.

Use a DomeFlatSequence script to take these data. This is necessary for the pipeline processing. This script allows you to choose which filters to use, and to set the integration time for each filter. It will take a set with "lamps off" in all filters, and then a set with "lamps on". DomeFlatSequence will prompt you to turn the lamps on or off, and set them to the desired value, at every filter change. Flat lamps on/off buttons and lamp voltage control are on the operator's console.

Take at least three dome flats in every filter. This is required by the pipeline.

Here are recommended lamp voltage settings and integration times for each filter:

Filter	Lamp setting	Integration time
J	Low 23V	7 sec
H	Low 17V	4 sec
Ks	Low 15V	1 – 2 sec **
1190	Low 53V	20 sec
1644	Low 40V	10 sec
2122	Low 17V	10 sec
2164	Low 20V	10 sec
1056	High 17V	10 sec
1063	High 17V	10 sec
J1	Low 30V	10 sec
J2	Low 30V	5 sec
J3	Low 30V	5 sec
H1	Low 17V	5 sec
H2	Low 17V	5 sec

** Depending on temperature in the dome. A value of 1 sec defaults to 1.24 sec which is the minimum readout time. In warm weather when the dome flat screen itself is emitting a lot of thermal radiation, it may not be possible to get unsaturated Ks flats.

Taking the dark frames:

You need to take dark frames with the same array parameters as the flat fields, and as your on-sky science data: integration time, coadds, Fowler samples, and digital averages. The quick reduction pipeline uses the complete set of darks, lamps off, and lamps on to generate linearized dome flats. The full science pipeline uses the on-sky data and matching darks to generate sky flats.

On your first afternoon you may have to estimate on-sky times for the various filters, from previous experience and/or advice of your setup person. For the broadband filters, darks taken at 10, 15, 20, 30, and 60 seconds would cover the normal range of integration times on the sky.

Close the Environmental Cover to take dark frames. Consult with your Instrument Scientist about the advisability of further closing up the telescope.

Use the Dark script to take these data. Take at least three frames at each combination of integration time, coadds, Fowler samples, and digital averages that you plan to use. To automatically run a set of dark scripts at various exposure times, gather the script names into a list file denominated as a shell script, e.g. "DoDarks.sh". Execute this script to run all the dark sequences.

8. How to check telescope pointing

The instrument pointing center must be in field center for the guider probe positioning calculations to work. Unfortunately, field center has no pixels in it, due to the ~35 arcsec gap between arrays in the 2x2 mosaic.

- At start of night, have Observing Assistant go to a bright star (3-6 mag).
- Take a short integration (1-2 seconds) in Test mode.
- If bright star is not seen in raw image, it may be shopping in The Gap. Offset the telescope by 100 arcsec in RA and in Dec and take another frame.
- You should see the star now. Use the cursor to determine the offset in pixels between star position and field center.
- Convert to arcsec at 0.40 arcsec/pixel.
- Apply this offset, in reverse, to the telescope to place the star at field center.
- Take a final stare frame to confirm positioning.

- Diffraction spikes on very bright stars may be seen. They should radiate from the inside corner of the active area of each array.
- Ask the Observing Assistant to “zero the telescope” at this position. This sets input coordinates for the star = current telescope position.

I recommend verifying pointing in this manner whenever you go to a new target more than 30 degrees or so from the previous pointing.

9. How to focus

Take a focus sequence using a FOCUS script (see script description in Sec. 5 above). Note that the first frame duplicates the first focus value, and is offset 30 arcsec East for “sky background” subtraction.

Ten seconds x 1 coadd is a good integration time. This will average out any rapid variations in seeing.

To get a starting focus value for the sequence, use these rules of thumb:

$$J \text{ focus} \sim 12000 - (100 \times T) \quad \text{where } T = \text{telescope truss temperature in } ^\circ\text{C}$$

$$H = J + 100 ; K_s = H + 100$$

A good step size is 100 (coarse) to 50 (fine) units. Set starting value and number of steps to bracket the estimated focus with three or four steps on each side.

After all the images in the sequence have been taken, run the IRAF focus analysis.

In IRAF cl window, type

```
▽ nffocus [file number] <cr>
```

[file number] is the running image number appended to the root filename, for any image in the focus sequence. The IRAF routine will find all the images in the sequence given any one of them.

This routine

- Subtracts the initial “sky background” frame from each focus frame.
- Generates an object catalog for each array at each focus value.
- Uses the catalog to identify round, unsaturated sources at each focus setting.
- Derives the FWHM for each of these sources.
- Displays a plot of source FWHM vs telescope focus in a graphics window.
- Displays its solution for best focus value from a fitting routine.

Occasionally, for unknown reasons, the `nffocus` routine hangs, leaving the IRAF `cl` window unresponsive to mouse or keyboard. See Appendix A.2.7 for recovery procedures.

Visually inspect the plot of FWHM vs focus setting as a sanity check. Your eye may do better than the curve fitting routine at identifying the best focus.

Note the focus value (“solution” and “eyeball”) then type `q` in the graphics window to quit this routine, or explore the data further with keystrokes below.

Keystrokes in the graphics window display the analysis in various ways, and can be used to delete suspect data points:

<code>f</code>	plots FWHM vs focus setting (default plot)
<code>b</code>	plots focus vs various spatial parameters
<code>t</code>	radial distribution of FWHM
<code>m</code>	magnitude distribution of FWHM
<code>d</code>	locate cursor over bad point, hit <code>d</code> to delete it
<code>x</code>	deletes entire data set for given focus value
<code>u</code>	reverses last delete action
<code>q</code>	exits the graphics window (may have to hold down firmly, not merely tap)

It may be useful to use the “`d`” (*delete*) keystroke to remove discordant data points from the FWHM data sets near the fitted best focus. If the fitted focus solution is stable, it won’t change much.

If the displayed FWHM vs. focus setting doesn’t have a clearly defined minimum, you probably haven’t gone through the best focus position. Run the focus script again with a different `START` value to try to bracket the estimated telescope focus.

Focus stability can be monitored on the science frames as observing proceeds. Both changing temperature and truss flexure will change the focus. I recommend running a focus sequence if the telescope truss temperature changes by 0.5 deg C or more, or if you move across the sky to a new target by more than 30 degrees.

The relation between telescope truss temperature and telescope focus is

$$\Delta\text{focus} = -130 \text{ units per } 1 \text{ deg C } \Delta\text{temperature}$$

That is, if the truss cools by 1 deg (-1 deg ΔT), the focus increases by 130 units.

To read the truss temperature, open a small GUI that continuously displays the truss, primary mirror, and ambient air temperatures:

Open an xterm window on `nutmeg`

Connect to *rose*

```
ssh rose <cr>
```

```
pw: usual 4-m login password
```

Start the GUI with

```
truss_temp.pl <cr>
```

Position the GUI in the center monitor of *nutmeg* for easy reference.

Alternatively, you can log in to the 4-m operator's computer *mocha* and issue the appropriate command:

Open an xterm window on *nutmeg*

From the [4m@nutmeg](#) prompt, connect to *mocha*

```
ssh 4m@mocha
```

```
pw: usual 4-m login password
```

Query the truss temperature with the command

```
TrussTemp <cr>
```

10. Accessing the Quick Reduce Pipeline products

The NEWFIRM Quick Reduce Pipeline web pages are under the purview of Mark Dickinson. At present they may be accessed at

<http://www.noao.edu/staff/med/newfirm/QRP/>

I especially recommend that observers read the section on “How to observe in a pipeline-friendly manner”.

To access the pipeline products, I recommend using the other three-screen computer in the 4-m control room, *tan*; or, you could work from a laptop. You need to open several windows in order to connect to or view several processes simultaneously:

- Open a web browser and point it to http://nfpipe-01-kp.kpno.noao.edu/NEWFIRM_pipeline/observer/. This is a web page showing a log of the data that the QRP has processed for your run so far. Initially, it will be empty until you take data for the QRP to process, such as dome flats, darks, or your first night-time observing sequences. You will need to reload/refresh this web page in your browser periodically. It will be updated as new data are processed and added to the QRP review log.
- Open one xterm window and log in to the *newfirm* computer via *ssh observer@newfirm*. From there, you can run the *plstatus* command to check that the pipeline is running properly.
- Open another xterm window and log in to the *nfpipe-01* computer via *ssh observer@nfpipe-01-kp.kpno.noao.edu*, using the same password as for *observer@newfirm*. From there, you can run the *dqquery* command, which provides data quality information for images that the pipeline has processed recently.
- Open an xgterm window and log in to the *newfirm* computer via *ssh -X observer@newfirm*. Open an image display (*ximtool* or *ds9*) in the background, and then start an IRAF session from the */home/observer/* directory by typing *'cl'*. Change directories to go to the location you specified for the QRP FITS output products. You can then display and otherwise analyze these images as they appear during the course of the night.

The QRP web page (first bullet above) provides access to a wealth of information and to the QRP images. You will see a log of data that the QRP has processed for your run so far, with various information about each observing sequence, including:

- image filenames
- UT at the start of the observing sequence
- observation type

- exposure times
- filter
- focus setting
- number of digital averages (DA) and Fowler samples (FS)
- airmass
- image title

In addition, this log reports the ranges spanned by some data quality parameters that are measured by the pipeline, such as:

- sky brightness (in ADU and mag per square arcsec)
- seeing FWHM
- magnitude zeropoint estimated from 2MASS stars (useful for monitoring relative transparency)
- estimated 5-sigma point source sensitivity

Clicking on the image filenames for a given sequence takes you to a pipeline review page with information about data from that sequence. There are review pages for processed, combined dark frames and dome flats, as well as for night-time on-sky observations. For night-time science observations, the QRP review pages provide:

- thumbnail pictures of the data
- links to images at two different higher resolutions for quick visual checks
- basic header information about each image
- links to the full FITS headers
- data quality measurements (seeing, magnitude zeropoint, depth, etc. - see above)

For dithered on-sky observing sequences, preview images are shown for each individual exposure, as well as for a stacked mosaics of the observations. The stacked images are shown in the second column of thumbnail images. If, during the course of an observing sequence, the telescope motions exceed a particular hardwired tolerance (currently 8 arcmin, but this may change), the QRP will break the sequence into multiple, independent stacks that will all appear in the 2nd column of thumbnail images.

FITS data products: When processing is complete for a sequence, FITS files of the combined image (the "mosaics" or "stacks") will be delivered to the directory that you specified (see above). The names of the files start with NFQR (for NEWFIRM Quick Reduce). FITS files are delivered only for on-sky observations, not for dome flats or dark calibrations.

The QRP products are not archived, so if you want to save them, move them to your local hard drive or otherwise retrieve and store them before your run is over. The QRP log and associated data products will be reset for the next observer.

Appendix A. Error recovery procedures

Here is a quick functional/symptomatic index to the error recovery procedures. In each section, the more common problems are presented first.

A.1 Global window management errors:

A.1.1 **no windows or GUIs appear** after doing “nocs start all”

A.1.2 **All NEWFIRM windows suddenly close**

A.2 DHS errors (left hand monitor):

A.2.1 **Images don't appear in image directory**

A.2.2 The **IRAF cl window** in the DHS display has **disappeared**

A.2.3 The **Ximtool** in the DHS has **disappeared** or been accidentally **closed**

A.2.4 **Shared Memory Cache Status window** shows a **red background**

A.2.5 **Data are stuck in the DHS shared memory cache**

A.2.6 **Data aren't being written to disk as .fits files**

A.2.7 **nffocus IRAF routine hangs**

A.2.8 **Data transfers appear to freeze**

A.3 Instrument control errors (right hand monitor GUI, or center command line window):

A.3.1 **Instrument Controller GUIs not seen** during instrument startup

A.3.2 **No communication with Environmental Cover or filter wheels**

A.3.3 **Filter wheel doesn't reach commanded position**

A.3.4 **Can't move filters and cannot “ssh” connect to *nicc*.**

A.4 Monsoon Supervisor Layer errors (right hand monitor GUI or command line window):

A.4.1 Red **ERROR** messages appear during startup

A.4.2 Red **ERROR** message appears about a **timeout error**

A.4.3 **Monsoon Supervisor Layer** window shows a red **ERROR** message during integration and readout cycle, **while DHS activity appears normal**

A.4.4 **NMSL task failure** error message

A.5 Problems with scripts:

A.5.1 To **abort a script**

A.5.2 **“Permission denied”** error message when executing a script

A.6 Problems with appearance of raw images:

A.6.1 **Raw image has identical count in every pixel**

A.6.2 **Raw image has negative counts and strange appearance**

A.6.3 **Raw image shows a strong center to edge gradient, or a vague shape covering the central part of the field**

A.1 Global window management errors

A.1.1. The “nocs start all” process ran to completion, returning [observer@newfirm-kp](#) prompt, but **no windows or GUIs appeared**: host permissions need to be reset on *nutmeg*.

- a) Type “ nocs stop all <cr> “ to stop processes
- b) Type “ exit <cr> “ to return to computer *nutmeg*
- c) At [4meter@nutmeg](#) prompt, type “ xhost + <cr> “
- d) SSH back to [observer@newfirm](#) and type “ nocs start all <cr> “

Now all the windows will appear and you can proceed.

A.1.2 **All NEWFIRM windows suddenly close** leaving only the 4-meter login prompt to nutmeg: a high level network communications glitch closed all the connections.

We've seen this happen once. The communications dropout appeared to spontaneously recover. However this left several NEWFIRM computers in a strange state.

A.1.2.1 First recovery procedure: observer restart of PAN computers

- a) Exit from any other [observer@newfirm-kp](#) logins. There may be some open on tan.
- b) Ask the Observing Assistant to shut down and reboot *newfirm*.
- c) Log back in to *newfirm* from nutmeg:


```
ssh -X observer@newfirm-kp
usual password
```
- d) Restart the PAN computers with these commands from the shell window:


```
panTools nuke nfpan-a-kp <cr>
panTools nuke nfpan-b-kp <cr>
```
- e) Continue with a normal system start:


```
nocs start all <cr>
400mvbias <cr>
```
- f) Reset the filename and directories in the NEWFIRM DHS Supervisor window
- g) Take a short test frame with a TEST script to verify that all appears normal.

A.1.2.2 Second recovery procedure: complete shutdown and reboot of PAN computers. This takes about 15 minutes. Try if the first procedure doesn't produce normal operation.

- a) Exit from any other [observer@newfirm-kp](#) logins. There may be some open on tan.
- b) Ask the Observing Assistant to turn off the Monsoon power in the Cass cage. This may require moving the telescope for access to the cage.
- c) Ask the Observing Assistant to shut down and reboot PAN A and PAN B computers. This takes about ten minutes.
- d) After both have been rebooted, ask the Observing Assistant to turn on Monsoon power in the cage.
- e) Ask the Observing Assistant to shut down and reboot *newfirm*.
- f) Log back in from *nutmeg* to *newfirm* and do a normal system start:

```
ssh -X observer@newfirm-kp
usual password
nocs start all
400mvbias
```

followed by the normal setup activities in all three monitors
Take a short single image with a TEST script to see if the system is now running normally (it should be).

A.2 Data Handling System (DHS) errors

A.2.1 **Images don't appear in image directory:** probably you forgot to click on the directory path in the NEWFIRM DHS Supervisor window when the DHS desktop was brought up.

- a) The images are in default directory /home/data .
- b) Move or copy the .fits files, and associated .dat, .trig, .txt files to the desired directory.
- c) Go to Supervisor Window, Paths and Files, and do mouse click <cr> on the path to set it for future images.

A.2.2 The **IRAF cl window** in the DHS display has **disappeared**.

- a) It may have been backgrounded by a stray mouse click. Check to see if it is hidden behind the DHS Supervisor window.
- b) If truly gone, scroll down to the icons at the bottom of the DHS window and click on an xgterm icon to open an xgterm window. Alternatively, select "New Xgterm window" from the window manager menu.
- c) In the xgterm window, type "cl <cr>" to start IRAF in this window.
- d) Type "mscred <cr>" to go to the right task, and cd to the current data directory.

A.2.3 The **Ximtool** in the DHS has **disappeared** or been accidentally **closed**.

- a) Scroll down to the icons at the bottom of the DHS window and click on an xgterm icon to open an xgterm window.
- b) In the xgterm window, type "ximtool & <cr>" to restart the Ximtool

Or alternatively,

Select "New Ximtool window" from the window manager menu.

A.2.4 DHS Supervisor, **Shared Memory Cache Status window** suddenly shows a **red background:** Data Collector Agent process (DCA) has crashed.

- a) Check the VNC screen to verify that the z.mosdca window has disappeared (if not, something else has crashed and we have a different problem).
- b) Complete the dataset for the last frame. From the shell, issue the command

▽ `ditscmd nohs nohs_endobs <cr>`

This moves data to DHS memory but not onto the disk.

c) Restart the system with

- ▽ debias
- ▽ nocs stop all
- ▽ nocs start all
- ▽ 400mbias

- d) In DHS Supervisor window, click on Paths and Files tab, and redefine the file root name and directory paths
- e) Click “Update Status” in the Supervisor window to list the exposure ID’s ExpID of images in the memory. These are numeric, e.g. 2454411.609138.
- f) Flush these to disk using, repetitively if necessary,

▽ `dhsflush <ExpID>` (for example, `dhsflush 2454411.609138`)

- g) This should save the data although the filenames will be <previous image filename> + <appended letter a, b, c, etc.>
- h) The filenames will begin incrementing normally when the next script starts.
- i) If you don’t care to save the data, use instead

▽ `dhsclean <cr>`

- j) See A.2.5.3 below for more on `dhsflush` and `dhsclean`, if these commands don’t seem to work from the shell window.

Debiasing and rebiasing the arrays may produce higher dark current or other transitory phenomena for tens of minutes. Running a set of short integration time “junk” frames may help stabilize them. It’s not advisable to take low background data, e.g. narrowband filters, immediately after a debias/rebias cycle.

A.2.5 Data are stuck in the DHS shared memory cache, indicated by many lines of entries in the DHS Supervisor, Shared Memory Cache display, and no processing activity in the `z.super` window. However Shared Memory Cache has not turned red (A.2.4 above).

The goal is to flush the DHS memory, preferably saving the data. There are several procedures to try.

A.2.5.1. First recovery procedure:

- a) Click on “Update Status” button on Shared Memory Cache page.
- b) Watch for activity in the `z.super` window. This indicates data transfer.
- c) Click on “Update Status” again to see if the memory is empty; if it isn’t, click a couple more times to see if this procedure flushes it.
- d) If no entries are seen in the Shared Memory Cache, you have succeeded.
- e) If data don’t entirely clear, go to next procedure A.2.6.2

A.2.5.2. Second recovery procedure:

- a) Stop any data taking script that is running with CNTRL-C in the shell window. Wait for the integration to complete and return [observer@newfirm-kp](#) prompt. (If no script is running, go to next procedure A.2.6.3)
- b) In the shell window, issue an end-of-observation command,

▽ `ditscmd nohs nohs_endobs <cr>`

- c) Watch for activity in the z.super window ending with a Postproc DONE message
- d) Click on “Update Status” again to see if the memory is empty; if it isn’t, repeat steps b-c for a couple more times to see if this procedure flushes it.
- e) If no entries are seen in the Shared Memory Cache, you have succeeded.
- f) If data don’t entirely clear, go to next procedure

A.2.5.3. Third recovery procedure:

- a) Switch to an unused desktop on *nutmeg* and open an xterm window
- b) Log in to *newfirm* with
`ssh -X monsoon@newfirm-kp <cr>`
password is _____ .
- c) Get the exposure ID number of stuck data from the field ExpID in the Shared Memory Cache window. The ExpID is numeric, e.g. 2454411.609138. There will be several lines with the same ExpID.
- d) In the monsoon login window you just created, type

▽ `dhsflush <ExpID> <cr>` (for example, `dhsflush 2454411.609138`)

- e) This should save the data although the filenames will be <previous image filename> + <appended letter a, b, c, etc.>
- f) The filenames will begin incrementing normally when the next script starts.
- g) Watch for activity in the z.super window and the Shared Memory Cache window
- h) Click on “Update Status” again to see if the memory is empty. If it isn’t, repeat steps d and h a couple more times.
- i) If data still don’t entirely clear, from [monsoon@newfirm-kp](#) type

▽ `dhsclean <cr>`

- j) You will lose the data with the “clean” procedure
- k) Click on Update Status to be sure the memory has cleared. If the exposures are still shown as present, but with parameter *shmId* set to -1, it will be necessary to go through a `debias - nocs stop all - nocs start all - 400mvbias` cycle to get the status window to show as empty.

A.2.6 Data aren’t being written to disk as .fits files. This probably indicates that a data disk is full. There are two disks which can produce this error. One is on *newfirm-kp*,

/nfdca; the other is on the Data Capture Agent computer, nfdca-kp, /home2/data. You need to check both disks, and clear off old data to make room.

A.2.6.1 First recovery procedure, to clean off data disks:

- a) On the left hand monitor, NEWFIRM DHS Supervisor window, Shared Memory Cache page, check the Disk Usage Bar in bottom right corner. If it reads 100% then /nfdca is full.
- b) In the IRAF window, cd to /nfdca/observer. You will likely find many nights' worth of data in subdirectories. Delete subdirectories, beginning with the oldest, while watching the Disk Usage Bar. Get it below 90%.
- c) The delete command you need is

```
rm -rf [subdirectory name]
```
- d) Now go to an unused desktop in the center monitor and open an xterm window on *nutmeg* (prompt will be 4meter@nutmeg).
- e) Connect to the Data Capture Agent computer *nfdca* with

```
ssh -X monsoon@nfdca-kp
```

```
password _____
```
- f) Check the available space on /home . If it's full, you need to delete some data.
- g) cd to the data directory with

```
cd /home2/data
```
- h) Do a directory listing, then delete old data with the command

```
_clean <cr>
```

Note the leading underscore
- i) This will remove any FITS image older than seven days.
- j) /nfdca and /home2/data each have the capacity to hold a month's worth of broadband data, so what you are deleting has been long since archived and checked.
- k) Take a short test image to see if the data are processed and stored to disk properly. If the raw image shows all pixels having exactly the same value, go to Procedure A.6.1 .
- l) Put an entry into Service, or have the OA make an entry, describing briefly what you've done. The Instrument Scientist may want to do further data deletion after checking with the Archive Scientist.

A.2.6.2 Second recovery procedure: if data disks aren't full, but data aren't being written to disk as fits files:

- a) Stop the observing system and exit in the usual way:

▼ nocs stop all <cr>
 ▼ exit <cr>

- b) Exit from any other [observer@newfirm-kp](#) logins that may be open on *nutmeg* or *tan*

c) Ask the OA to shut down and reboot the Data Capture Agent computer, *nfdca*. Then log back in as observer@newfirm-kp and restart with “nocs start all”, etc.

A.2.7 nffocus IRAF routine hangs leaving the IRAF cl window unresponsive to mouse or keyboard. This occasionally happens during the catalog creation process.

Kill the process and/or the IRAF window and start a new CL session.

A.2.7.1 First recovery procedure

- ▽
 - a) Type repeatedly in the CL window (5 or more times)
control-c
- ▽
 - b) If it returns a prompt, type
flpr <cr>
a couple of times. Recovery is complete.
- ▽
 - c) If instead the CL session is killed, restart it with
cl <cr>
and reset the path to your data directory.

A.2.7.2 Second recovery procedure

- a) Kill the IRAF window with the window manager button: click on the left hand icon in the top bar to open a menu, and then click on “close”.
- b) Open a new xgterm window from the row of icons along the bottom of the VNC window display.
- ▽
 - c) Type
cl <cr>
to start a new CL session, and reset the path to your data directory.

This leaves the hung process running, which does no harm. If your comfort level allows, you can clean things up as follows:

- d) Open another xgterm window from the row of icons.
- e) Log onto machine XXX with [insert login command and pw]
- ▽
 - f) Type
ps -x <cr>
to generate a process list. Look for an x_ecl.e process that is running, and an x_ace.e process that’s defunct. “ecl” is the IRAF CL and “ace” is the stuck cataloging and analysis process.
 - ▽
 - g) Kill the stuck CL process with
kill -9 [pid] <cr> where [pid] is the process number from the list
 - h) This will return a Unix prompt in the window with the hung CL session.

- i) If you had multiple IRAF sessions running, perhaps to do some image analysis, care is needed not to kill the wrong one. But you can always just restart any that you kill by mistake.

A.2.8 **Data transfers** to the DHS processing computers **appear to freeze**: bogus lock files in the /tmp directory are confusing the processes and must be removed.

We've seen this happen very rarely. Data seem to be coming from the PANs normally, but one or both of the *nfdhs* computers fail to process it. Typically, only half of the image is displayed, the final file is never written to disk, and the DHS becomes unresponsive.

First, check the data disks (A.2.6 above) to be sure this isn't just a "full disk" problem.

Lock files are created in the system /tmp directory for use by the Shared Memory Cache (SMC) system to describe how to attach to the current SMC. This file is named "/tmp/.smc501". In rare cases, multiple versions of this file have been created of the form "/tmp/.smc501_1" that cause confusion about how to attach to the shared memory cache on the machine.

Recovery consists of deleting all existing lock files, then restarting the system:

- a) Shut down the data taking system with
nocs stop all <cr>
- b) Open a new shell or terminal window on *nutmeg*
- c) In this window, connect to *newfirm* as user "monsoon":
ssh -X monsoon@newfirm-kp
password _____
- d) From this monsoon login on *newfirm-kp*, execute the command
/ndhs/dev/zzkpvm <cr>
This should remove all lock files.
- e) From this monsoon login on *newfirm-kp*, verify that the lock files are removed with the commands
ssh nfdhs-01 ls -a /tmp/.smc\
ssh nfdhs-02 ls -a /tmp/.smc\
[Note the use of \ escape before *]
Neither of these commands should list any files.
- f) Restart the system normally from the existing [observer@newfirm-kp](#) login with
nocs start all <cr>
This will create a single new lock file on each of the *nfdhs* machines.

- g) Repeat step (e) commands from the [monsoon@newfirm-kp](#) login, and verify that only one file of the form /tmp/.smc501 exists on each machine.
- h) To further verify that the SMC is operating properly, from your monsoon login issue these commands
 - ssh nfdhs-01 smcmgr -list
 - ssh nfdhs-02 smcmgr -list
 On each machine, only one entry of type ‘ SMCache ‘ should be listed.
- i) Exit from [monsoon@newfirm-kp](#) and close this window.

A.3 Instrument control errors

A.3.1 **Instrument Controller GUIs not seen** on Desktop 2 during instrument startup: need to restart the connection to *nicc*, the instrument controller computer.

- a) Open an xterm window on Desktop 2.
- b) Connect to *nicc* with
 - i. ssh -X [nicc@nicc-4m](#) <cr>
 - ii. pw is _____ .
- c) Start GUI menu with
 - i. /usr/local/nicc/start-menu

Click on “Temperatures” in the menu to open the temperature display GUI

A.3.2 **No communication with Environmental Cover or filter wheels:** need to reboot the Instrument Controller. A very rare circumstance.

Ask the OA to reboot the Instrument Controller.

This requires a halt, and subsequent restart, of the OA guider software.

The data system can be left running; no need to stop or log out.

This may require moving the telescope to enable access to the cage.

This process takes 10-15 minutes.

A.3.3 **Filter wheel doesn’t reach commanded position:** One of the filter wheels failed to sense its position. If the filter positioning was part of a script, the script will halt and generate an error message. We have had this failure with the lower filter wheel.

A.3.3.1 First recovery procedure:

Command the filter wheels to the desired filter position from the Instrument Control System GUI in the right hand monitor. Click the button for the desired filter.

This will take a minute or two. The wheel with sensor failure goes into a recovery mode in which it creeps along slowly, repeatedly querying its position sensors, until it finds a known position and detent. Then it completes the desired motion.

If you still get a “failed to reach filter position” error, try this procedure one more time. It may take the wheel a couple of tries to figure out where it is.

A.3.3.2 Second recovery procedure:

Command the filter wheels individually from the Filter Wheel GUI on Desktop 2 of the center monitor.

Go to Desktop 2. From the menu for NICC GUIs, click on Filter Wheels (near the top of the menu). A GUI will open that has a row of filter position buttons (J, H, K, etc.). Above them will be two rows of buttons labelled 1 through 8. These are the physical wheel detent positions for the upper filter wheel (upper row) and the lower filter wheel (lower row).

Any commanded filter position corresponds to a pair of wheel positions. J, for example, is position 1 (upper) and 8 (lower).

The filter wheel GUI will probably show a position button lit up green in the upper row. This indicates that it has arrived at the correct position for the upper wheel. It will probably show a position button lit up white in the lower row, indicating that it has not arrived at the correct position for the lower wheel. This is the wheel that has occasionally failed to register its position properly.

Click on the next button after the one lit up in white, in the lower row (lower filter wheel). This wheel only will move, attempting to find this position. If it fails, an error message about failure to find position will show up in the filter wheel GUI. If this happens, try again.

Once the lower filter wheel has succeeded in finding a position (button lights up in green) then try commanding the desired filter position from the bottom row of buttons.

If the wheel can't figure out where it is and position itself properly after three tries, call the Instrument Scientist, and keep trying. There is no further recovery procedure short of warming up and opening the Dewar.

A.3.4 Can't move filters and cannot “ssh” connect to *nicc*. The Environmental Cover responds to open/close command buttons, but filter wheels don't move. Attempt to ssh to *nicc* (A.3.1, or OA reboot procedure in A.3.2) has connection refused. We've seen this once.

Ask the OA to cycle AC power to the Instrument Controller.

This requires a halt, and subsequent restart, of the OA guider software.

The data system can be left running; no need to stop or log out.
 This may require moving the telescope to enable access to the cage.
 This process takes 10-15 minutes.

A.4 Monsoon Supervisor Layer (array controller) errors

A.4.1 **Red ERROR messages appear** in the Monsoon Supervisor Layer window while “nocs start all” process is running: need to run this window process again.

- a) Wait for the loading process to stop and observer@newfirm prompt to appear in shell window
- b) In the shell window, type “ nmslReset <cr> “ (that’s en-em-ess-ell-Reset)
- c) Process will run again in the Monsoon Supervisor Layer window.
- d) Watch for red **ERROR** messages.

Repeat this cycle until the process runs to completion with no red **ERROR** messages. If they appear at all, usually one or two nmslReset cycles are sufficient to get through this.

A.4.2 **Red ERROR message appears** in the Monsoon Supervisor Layer window upon startup, about a **timeout error** : the NOCS may have reconnected to a “ghost” memory page and gotten confused about how many PAN computers it’s talking to. We’ve seen this once. Recovery procedure is

In the command line window (shell or terminal window), type

▽ grep PANs /home/monsoon/log/* <cr>

A normal response would be something like:

```
+2454753.6885068165138364: mslSuperConfig status 0L > PANs: 2
```

The abnormal response is something like:

```
+2454751.8555645765736699: mslSuperConfig status 0L > PANs: 4
```

Where “4” rather than “2” indicates the confusion.

If you see an abnormal response, shut the NOCS down with

▽ nocs stop all <cr> ← **this is very important!**

and then execute

▽ shmUNuke 501 <cr>

then restart the system with

▽ nocs start all <cr>

A.4.3 **Monsoon Supervisor Layer** window shows a red **ERROR** message during integration and readout cycle, **while DHS activity appears normal**: a problem has occurred with communications to/from the array controller.

A.4.3.1 First recovery procedure:

a) In shell window, type

▽ nmslReset systran <cr>

- b) A process will run in the Monsoon Supervisor Layer Window. If it completes with no red **ERROR** messages, [if not go to second recovery procedure]
- c) Go to the DHS Supervisor Window, Shared Memory Cache, and click on Update Status.
- d) Watch the z.super window to see if an image is processed to disk.
- e) Click on Update Status again to see if the memory has cleared.
- f) If “Update Status” still shows DATA or META files in DHS memory, go to A.2.5 procedures to clear the memory.
- g) When you have succeeded with this, take a short single image to see if the system is now running normally.

A.4.3.2 Second recovery procedure:

If the Monsoon Supervisor Layer Window continues to show red **ERROR** messages at step (b) above, do a stop/start cycle:

a) Stop and restart the system with

▽ debias <cr>

▽ nocs stop all <cr>

▽ nocs start all <cr>

▽ 400mvbias <cr>

- b) In DHS Supervisor window, click on Paths and Files tab, and redefine the file root name and directory paths
- c) Take a short single image with a TEST script to see if the system is now running normally.

Debiasing and rebiasing the arrays may produce higher dark current or other transitory phenomena for tens of minutes. Running a set of short integration time “junk” frames

may help stabilize them. It's not advisable to take low background data, e.g. narrowband filters, immediately after a debias/rebias error recovery.

A.4.3.3 Third recovery procedure:

If system is still hung with red **ERROR** messages, try a hard reset of the Master Control Boards from the keyboard (these boards are in the Digital Head Electronics box on the Dewar):

- a) Issue the following command sequence from the shell window

```

▽      debias <cr>
▽      mnsnReset.sh mcbHrdReset <cr>
▽      nmslReset <cr>
▽      400mvbias <cr>

```

- b) Take a short single image with a STARE script to see if the system is now running normally.

See the note about debiasing and rebiasing the arrays above at A.2.6.2.

A.4.3.4 Fourth recovery procedure

This is a reset of the Master Control Boards at the boards with a reset button.

- a) From the shell window, do

```

▽      debias <cr>
▽      nocs stop all <cr>

```

- b) Ask the Observing Assistant to perform a hardware reset on the DHE Master Control Board. This may require moving the telescope for access to the Cass cage where these electronics reside.
- c) After the OA has done this, restart the system from the shell window with

```

▽      nocs start all <cr>
▽      400mvbias <cr>

```

- d) In DHS Supervisor window, click on Paths and Files tab, and redefine the file root name and directory paths
- e) Take a short single image with a STARE script to see if the system is now running normally.

A.4.4 **NMSL task failure** error message appears in the command line window or the Monsoon Supervisor Layer GUI. There is no activity in the MSL GUI. The Monsoon Supervisor has lost its connection to the router. To recover:

In the command line window, close any observation that may have been left open with

▽ `ditscmd nohs nohs_endobs <cr>`

and watch the DHS windows for activity indicating data transmission. Then shut down and restart the system with the usual

▽ `nocs stop all <cr>`

▽ `nocs start all <cr>`

▽ `400mvbias <cr>`

A.5 Problems with scripts

A.5.1 To abort a script:

- a) If the script will run to completion in a minute or two, just let it finish.

b) To abort, type CNTRL-C <cr> in shell window

- i. **During an integration while the countdown is proceeding:** type CNTRL-C <cr>, then **let the integration run to completion, with DONE in the Monsoon Supervisor Layer window.**
- ii. The script will stop when integration has finished but leaves the last integration unterminated in the data system.
- iii. Issue this command in the shell window to terminate the last integration:

```
▽      ditscmd nohs nohs_endobs <cr>
```

- iv. In the lefthand monitor, check that an image processed to disk.
- v. You are ready to take data again.

A.5.2 **“Permission denied”** error message when executing a script: for some reason, script was created as non-executable.

a) Check to see if it permissions are “rwx” (executable) or “rw—“ (non-executable):

```
▽      ls -l <scriptname>.sh
```

b) To make it executable, enter

```
▽      chmod +x <scriptname>.sh <cr>
```

```
▽      rehash <cr>
```

Should be OK to execute now.

A.6 Problems with appearance of raw images

A.6.1 **Raw image has identical count in every pixel**, for example all zero’s, or all 10000 ADU, or all –25000 ADU. The array control computers need to be restarted. These are the Pixel Acquisition Nodes, or PANs.

A.6.1.1 First recovery procedure: observer restart of PAN computers.

a) In the shell window (command line window in center monitor, issue this command string:

```
▽      nocs stop all <cr>
▽      panTools nuke nspan-a-kp <cr>
▽      panTools nuke nspan-b-kp <cr>
▽      nocs start all
```

▽ 400mvbias

- b) Reset the filename and directories in the NEWFIRM DHS Supervisor window
- c) Take a short test exposure using a TEST script to verify that all is well.

A.6.1.2 Second recovery procedure: complete shutdown and reboot of PAN computers. Try this if the first procedure doesn't restore normal operations. This takes ~15 minutes.

- a) Exit from any other observer@newfirm-kp logins. There may be some open on tan.
- b) Ask the Observing Assistant to turn off the Monsoon power in the Cass cage. This may require moving the telescope for access to the cage.
- c) Ask the Observing Assistant to shut down and reboot PAN A and PAN B computers. This takes about ten minutes.
- d) After both have been rebooted, ask the Observing Assistant to turn on Monsoon power in the cage.
- e) Log back in from *nutmeg* to *newfirm* and do a normal system start:

```
ssh -X observer@newfirm-kp
usual password
```

▽ nocs start all

▽ 400mvbias

followed by the normal setup activities in all three monitors

- f) Take a short single image with a TEST script to see if the system is now running normally (it should be).

A.6.2 **Raw image has negative counts and strange appearance:** the arrays aren't biased. Counts may be several hundred ADU negative with light on the array, and 1-2 thousand ADU negative with the dark slide in place. Appearance is "washed out" with cracks and other defects bright, not dark.

Rebias the arrays with

▽ 400mvbias

A.6.3 **Raw image shows a strong center to edge gradient, or a vague shape covering the central part of the field:** condensation on the entrance window. This must be removed by turning up the dry N2 gas flow, and waiting for the window to dry off.

First, verify that it is condensation. This will reduce the background sky level in the J band (because it is blocking incoming photons), but increase the background in K (because it is warm and emissive).

- a) Take a 5-10 second test exposure on the sky in J. Verify that the background level increases from the FOV center to FOV edge (i.e. background is darker in the center).
- b) Repeat in Ks. Verify that the background level decreases from FOV center to FOV edge (i.e. background is brighter in the center).

Then, clear the window by evaporating the condensate.

- c) Ask the OA to turn up the dry N₂ gas flow across the NEWFIRM entrance window.
- d) Take a Ks frame from time to time to monitor the background as the condensate is dried off the window.
- e) Clearing the window may take anywhere from a few minutes to an hour or more, depending on how badly it has fogged, and the ambient relative humidity.