AGN05

MDM Reverberation Mapping Program

2005 January – April

PROCEDURES MANUAL FOR OBSERVERS

Version 2.1

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General Outline of Procedures

1.**Startup procedures:** Carried out late afternoon. Bring up the control system in the observing room. Fill the camera dewar on the observing floor. Take test frames to make sure that the CCDS is working. Check focus of spectrograph. Take long arc-lamp exposures. Take flat fields and bias frames.
2. Twilight set-up: Open dome, power up telescope. Initialize tracking, move to bright star to reset encoders, if necessary. Focus telescope.
3. Observe: towards end of twilight, begin observing (a) targets, (b) flux standard stars, (c) wavelength calibrations, and (d) flat fields. See suggested program below. Periodically check telescope focus and weather conditions. Keep a log.
4. Shutdown procedures: Take final calibrations, if needed. Stop tracking, move telescope to stow position. Close telescope. Move dome to stow position and close. Take flat fields. Fill camera dewar. Copy data to tape.

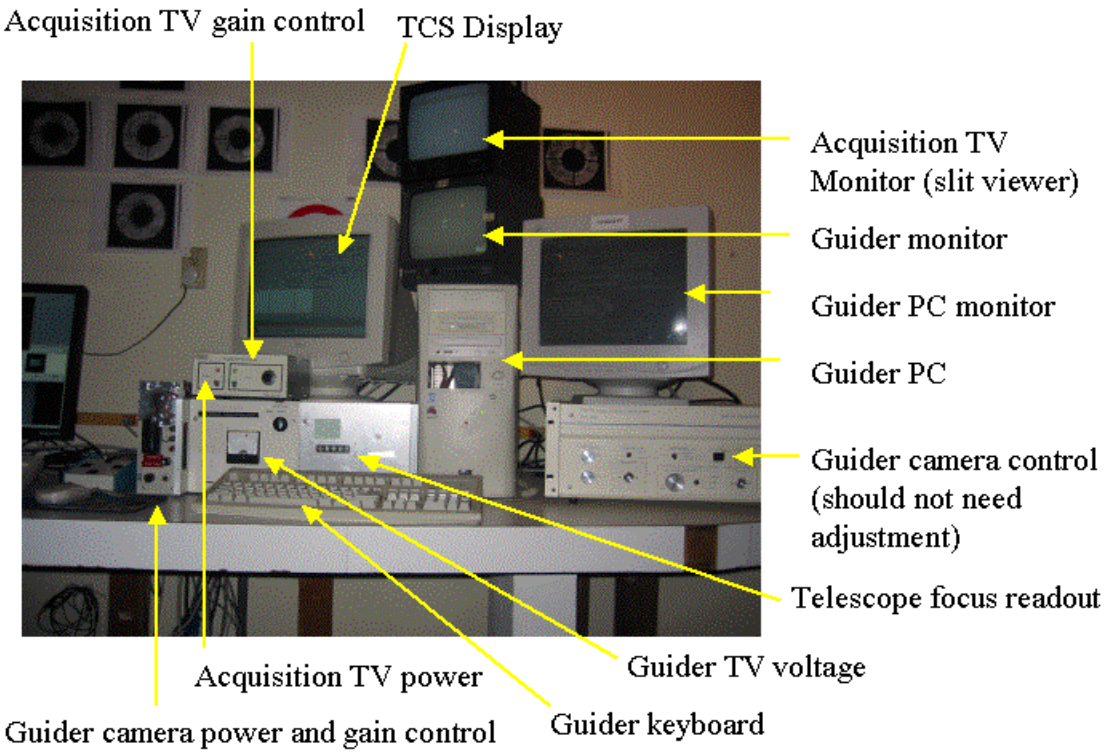
Site Safety Rules

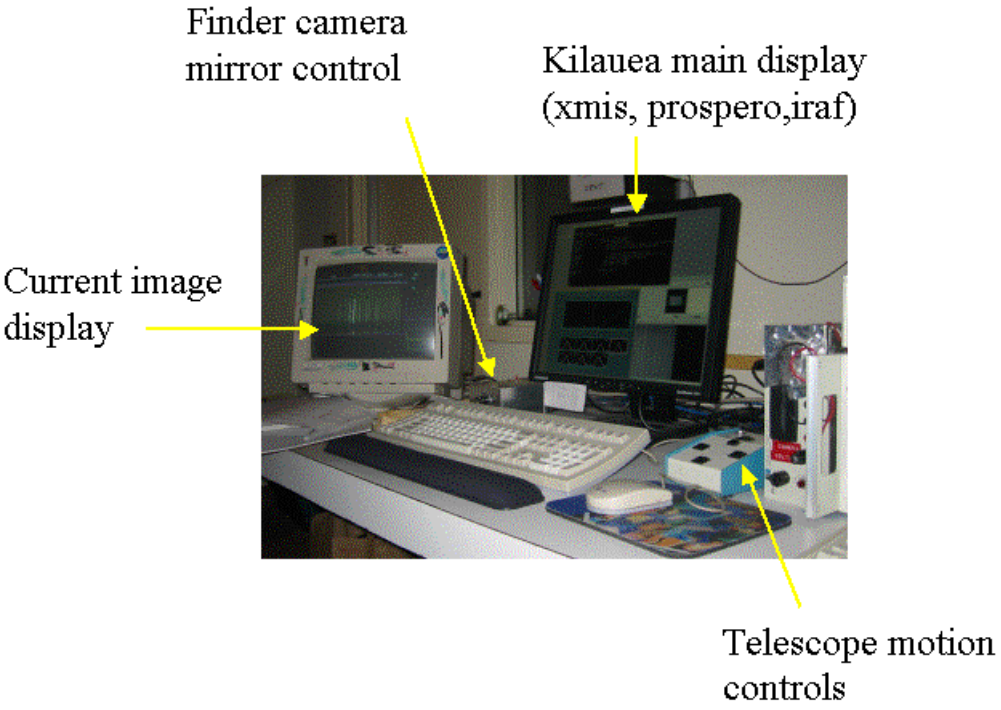
The observer has responsibility for protection of the telescope and instruments. This responsibility is exceeded only by responsibility for human safety on the site.

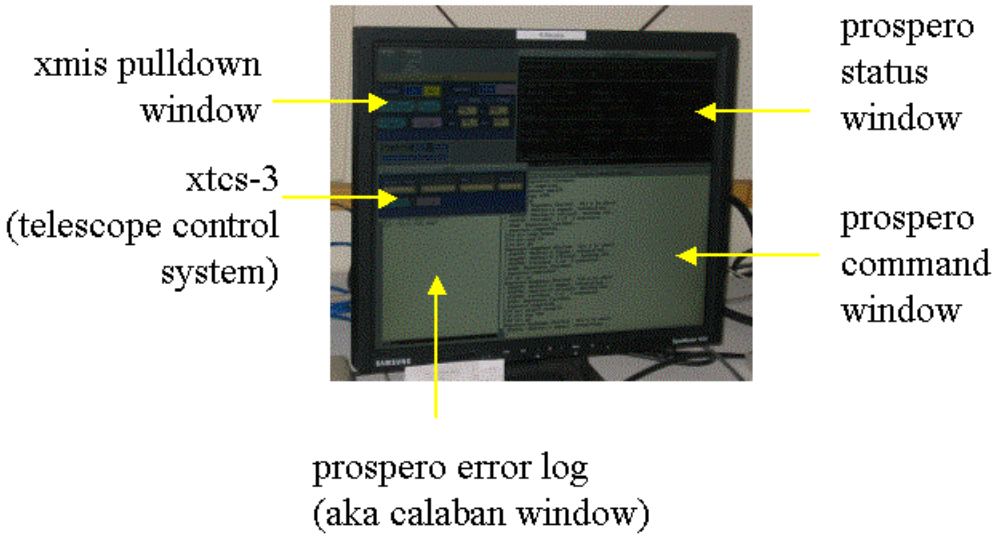
The telescope must not be used if any of the following conditions obtain:

1. The wind speed exceeds 40 mph.
2. Humidity exceeds 85%.
3. There is condensation forming on cold metal surfaces such as railings or cars.
4. Dust is visible in a flashlight beam.
5. There is a threat of rain or lightning.

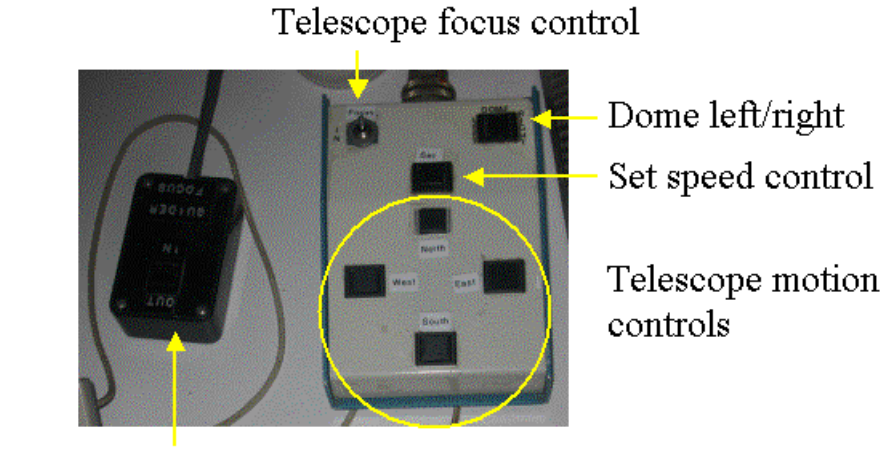
6. INSIDE THE CONTROL ROOM: What *is* all this crap?



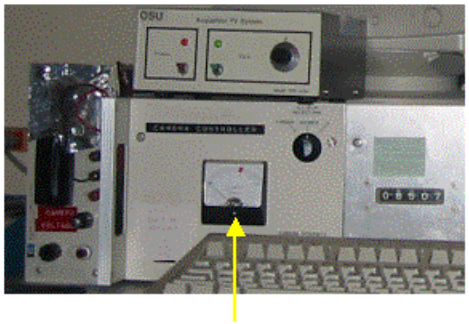




Telescope Focus Paddle and Control Paddle



Guide Camera Power



Voltage meter

Voltage: outer – crude control
inner – fine control

Power on/off (push button)

Startup Procedures: Inside the Control Room

1. We assume that the IC and WC (in the computer room) are functioning and that the CCDS is installed and working. We will further assume that prospero (the data-taking system) is operating. If any of these assumptions are incorrect, please consult (1) the 1.3-m Telescope manual, (2) the Prospero manual, and (3) the Boller and Chivens CCDS manual. Hard copies of the first two documents are available in the white loose-leave notebook labeled "Telescope Manual" in the observing room. Do not be afraid to ask for help.
2. Turn on power supplies and monitors for guider and acquisition TV. Everything else should already be on.
3. Go to the xtcs3 window on Kilauea, click on the pink "setup" button to bring up a pull-down menu, then select "clear link" and release. Click again on "setup" and this time select "set UT" and release. The response should say "UT set on TCS".
4. Use Prospero command 'jd' to list the current Julian Date and take note of the integer JD. For example, at MST 2005 January 25 18:00 the JD is 2453396.
5. Initialize the observing session by entering "RUNINIT" in the prospero command window on the computer Kilauea. You will be prompted with several questions and should respond as below:
    a. "Initialize Session <y|n>?" Answer: y
    b. "Enable Writing Files to Disk <y|n>? Answer: y
    c. "Image Directory Path" Answer: /data/tambora/visitor
        i. This is where the data will be stored.
        ii. If this changes, it will be on the dry erase board in the observing room.
        iii. Current set path is displayed in prospero status window (above the command window).
    d. "Root file name for image: Answer: jdNNNN. (where NNNN are the least significant digits in the current Julian Day number. Don't forget the trailing period. Current Julian day number can also be read from the TCS monitor. For example, at MST 2005 January 25 18:00 the JD is 2453396 so NNNN = 3396. It is IMPORTANT to get this right for our own bookkeeping purposes. Note that Julian date begins at 5:00 am MST; the rootname we use is that for the beginning of the local night.
    e. "Starting image number" Answer: 1
    f. "Observers names" Answer: last names of observers
    g. "FITS header comment card for tonight: Answer: 'MDM Reverberation JDNNNN', where as above, NNNN is the least significant digits in the Julian Date.
    h. "Save setup <y|n>:" Answer: y
6. We use the 350 l/mm grating in first order. The grating and order may not be listed in the Prospero status window, if Prospero has been restarted since the previous nights observing. These parameters can be updated by entering "grooves 350" and "order 1". The central wavelength will also need to be entered. How to determine this is described in the next section on how to check the spectrograph focus.

Startup Procedures: Observing Floor

Fill the camera dewar on the observing floor (see Figure 1, below):

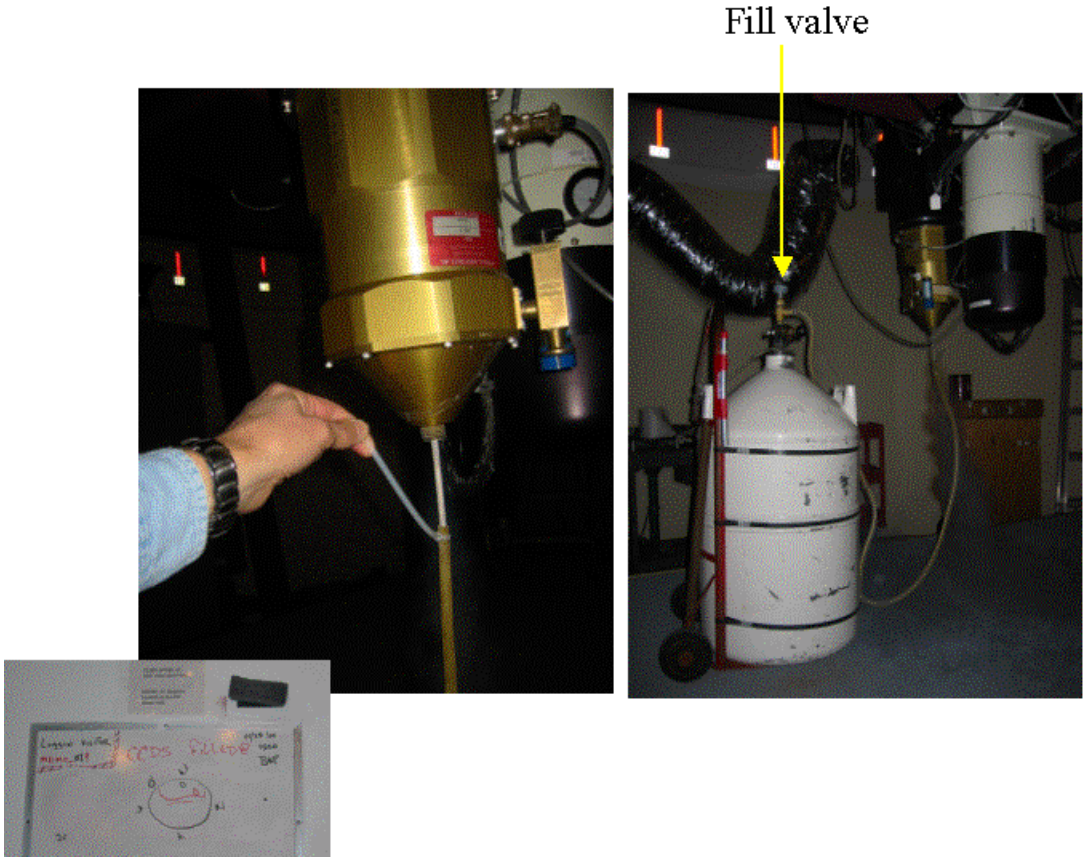


Figure 1. Insert fill tube into bottom of camera dewar, gently pushing it in as far as it will go (upper left). Turn on the fill valve (upper right) on the liquid nitrogen tank. Record fill time on dry erase board in control room (lower left). Camera dewar is full when liquid N_2 pours onto floor. Turn off fill valve. Do not attempt to move the liquid nitrogen tank until the fill tube has completely thawed or it will shatter. Fill tube will fall out when it has thoroughly thawed out. Return liquid nitrogen to stow position on platform.

Startup Procedures: Check Spectrograph Focus [script: chkfocus + iraf implot]
Before you take any calibration data you need to check the spectrograph focus as follows:

1. Note the current collimator focus in the prospero status window on Kilauea. The dial units are the ones in square brackets (e.g., [860]).
2. Run the script 'chkfocus' or follow steps (a) to (d) below:
    a. Place the finder mirror in the beam by flipping the Finder Mirror switch to "in". The finder probe takes 20 seconds or so to insert, to please wait.
    b. Change the slitwidth to 1 arcsecond by entering "setslit 47" (47 microns = 1 arcsecond).
    c. Turn on the Xenon lamp by clicking the "Xe" button in the MIS Lamp window. Check the TV monitor to see that the lamp comes on.
    d. Enter "exp 120" to set the exposure time and enter "go" to start the exposure.
3. Once done, turn off lamps (if on) go to the IRAF command window and examine this exposure by entering "implot filename.nnnn" where 'filename.nnnn' is the name of the comparison lamp exposure you just took.
4. In the IRAF graphics window, enter ": a 20" and ":l 350" (letter 'l') to display the average of 20 rows around line 350 (where the spectra appear on the CCD).
5. Measure the line widths of the arc lines using key 'p': place the cursor at the base of the blue wing of the line, hit 'p' and place cursor at the base of the red line wing and hit 'p' again. The line width and center will be displayed at the bottom of the graphics window.
6. Repeat this for the other lines taking note of the line widths.
7. For a good focus the line width should be about 2.4-2.5 pixels. If the line widths typically have this value, the focus is good. If not, you'll have to refocus the spectrograph (see separate section at the end of this manual).
8. Once the focus is good, you are ready to take the afternoon/early evening calibration data. See the next section for this task.

Startup Procedures: Determine central wavelength (if missing in status window)
At this point (when the spectrograph is focused) you can check or determine the central wavlength as follows:

1. With a well-focused Xenon arc lamp, for example the spectrum you just took, plot the spectrum with “implot” as described above.
2. Find the Xenon spectral line atlas in the CCDS manual that covers the range from 4000Å to 6000Å. Using this atlas identify two well-defined spectral lines at either end of the chip. Good reference lines are the 4500Å, 5028Å, and 5823Å lines located at approximate pixel position 125, 512, and 1116, respectively.
3. Using key ‘p’ (in task “implot”) determine the centroid of two lines (e.g., the 4500Å and 5823Å lines) and take note thereof.
4. In Prospero run script ‘xwave’ and enter pixel and wavelength positions as the script queries for them. The script will return the central wavelength and the approximate linear dispersion. Note: the central wavelength is only accurate to within a few Ångstrøms.
5. You can update the central wavelength value in the Prospero status window with command ‘newcenter center-wavelength’ where ‘center-wavelength’ is the central wavelength you just determined

Startup Procedures: Calibration Images [script: startcal]

There are a number of calibration images that need to be taken at the beginning of each night: (a) long Xe and Ar lamp spectra that will be used for primary wavelength calibration (shorter exposures through the night will be used to correct for small offsets), (b) long flat-field exposures (shorter exposures through the night will also be taken), and (c) bias frames to detect any zero-point offset. These can all be taken in the afternoon or early evening, but should be done before it is dark enough to observe. You can take these data using script 'startcal' or follow the procedure described below.

1. Begin with long Ar + Xe lamp calibration spectra. These are the only observations that should be taken with a 1 arcsecond slit (enter "setslit 47" in the prospero command window)
    a. Move the finder mirror to the "in" position.
    b. Turn on the Ar arc lamp by clicking on the appropriate box in the xmis lamps window.
    c. Enter "comp Ar" in the prospero window
    d. Enter the exposure time "exp 300" in the prospero window
    e. Enter "go" to begin the observation.
    f. When the exposure is complete, examine it on the display and see if it needs to be repeated.
    g. Turn off the Ar lamp by clicking on "off" in the xmis lamps window.
    h. Turn on the Xe arc lamp by clicking on the appropriate box in the xmis lamps window.
    i. Enter "comp Xe" in the prospero window
    j. Enter the exposure time "exp 120" in the prospero window
    k. Enter "go" to begin the observation.
    l. When the exposure is complete, examine it on the display and see if it needs to be repeated.
    m. Turn off the Xe lamp by clicking on "off" in the xmis lamps window.
    n. Change the slitwidth back to 5 arcsecond ("setslit 235").
2. Run a set of flat-field images
    a. Turn on the flat-field lamp by clicking on the "flat" box in the xmis lamps window.
    b. Enter "flat flat" in the prospero command window.
    c. Enter the exposure time "exp 150" in the prospero command window.
    d. Enter "mgo 12" to begin the observation, where 12 is the number of separate exposures that will be made.
    e. Turn off the flat-field lamp by clicking on "off" in the xmis lamps window.
    f. Examine the exposures on the display to check for quality.
3. Run a set of bias frames
    a. Make sure all lamps are off
    b. Enter "bias bias" in the prospero command window, which automatically sets the exposure time to zero.
    c. Enter "mgo 12" to obtain 12 individual bias frames.
    d. Examine the exposures on the display to check for quality.

e. If no further calibrations are to be made, move the finder mirror back to the "out" position. It takes about 10-15 seconds for the probe to move all the way out of the beam.

Twilight Set-Up: Open dome.

1. Make sure that dome is at stow position, azimuth = 51° (the red marker in the middle of the dome slit will line up just to the right of the 50° azimuth marker). Open/close functions work only at stow position. See Figure 2 below.
2. Set dome main shutter switch to open. See Figure 3 below.
3. Press main shutter control button.
4. Press and hold dropout shutter control button till dropout is completely open.
5. To move dome, select left or right motion (Figure 3 below).
6. Open the doors to the outside to improve air circulation in the dome.

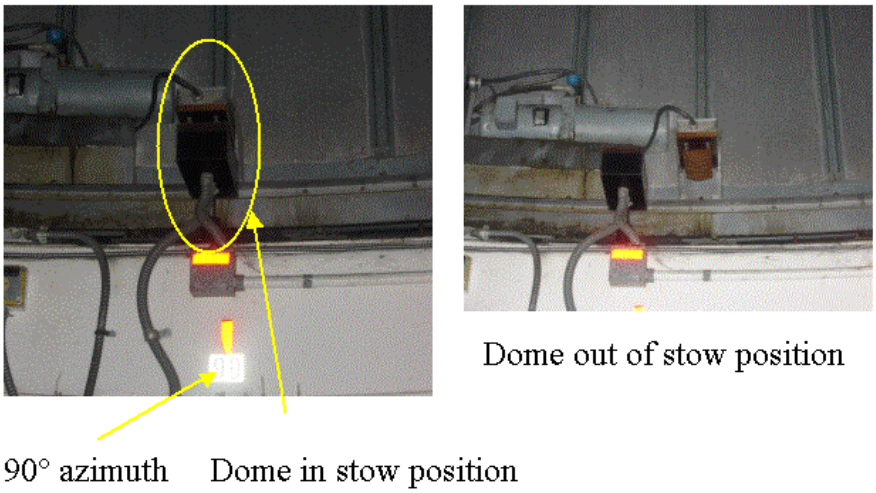


Figure 2. Dome in stow position at 51 degrees azimuth (left); note alignment of electronics contacts at azimuth 90 degrees. Right side shows electronics out of contact, where dome shutter controls will not operate.

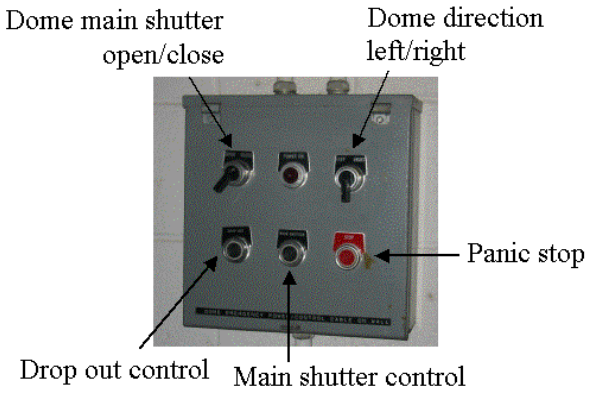


Figure 3. Dome controls. Open main first, then dropout.

Twilight Set-Up: Power-up telescope.

1. Before doing anything, make sure that there is nothing on the floor that can interfere with the motion of the telescope. In particular, make sure that the liquid nitrogen tank and the ladder have been moved to the northeast corner of the platform by the TCS, and make sure that the platform is down (see Figure 4 below).
2. Refer to Figure 4 (below), Telescope Control System. Turn on power.
3. Press start (note: not on uninterrupted power. May need to be reset after even short outage)
4. Proceed to open telescope (next section) prior to carrying completion of power-up.
5. After opening telescope, set tracking rate to 60 Hz setting by turning tracking rate knob to farthest clockwise setting.
6. Move telescope to desired location using speed and directional controls. You should ALWAYS be on the observatory floor and watching the telescope when you slew. The instrument can run into the floor, and the telescope can run into the north pier.
    a. Slew: high speed moves. Moves more than a degree or so require simultaneously holding down the slew button and directional button
    b. Set: medium speed moves (< minutes). You must hold down the set button and a directional button.
    c. Guide: low speed moves (seconds). Hold down the directional button only.

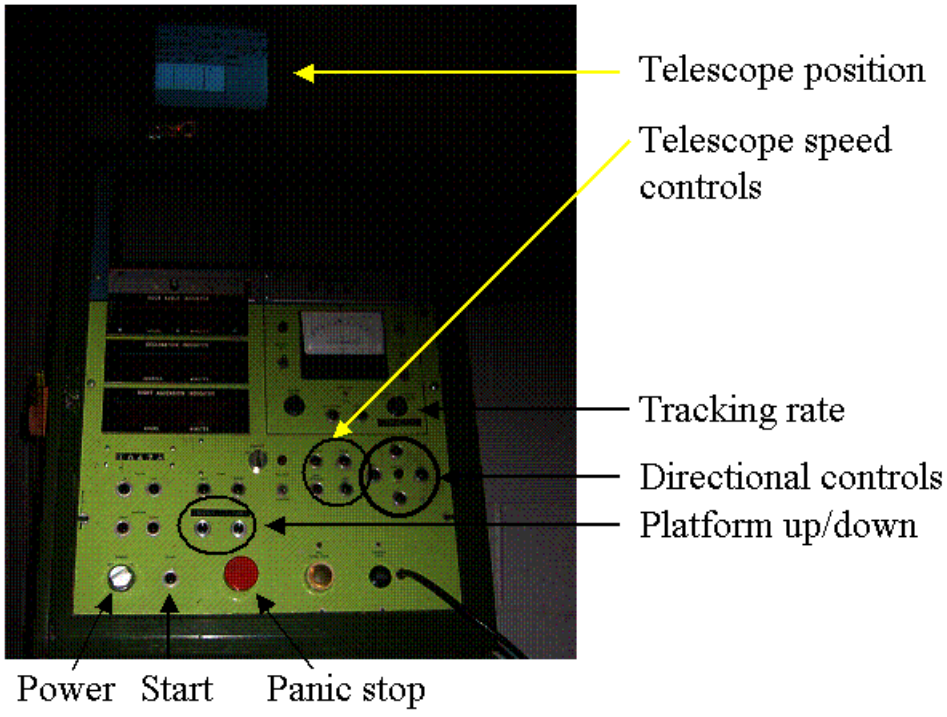


Figure 4: The Telescope Control System on the observing floor of the 1.3-m telescope.

Twilight Set-Up: Opening the telescope.
The dome must be opened entirely before the telescope is opened (to keep any debris on the dome from falling on to the mirror).

1. Make sure that the telescope is pointed toward the zenith (approximate is good enough).
2. Refer to Figure 5 (below). Open the mirror cover. You will need a ladder to reach the mirror crank, which is in the northwest corner of the telescope (refer to diagram below). This makes a loud noise when it opens, so you'll have no doubt about it). Be sure to move the ladder back to its stow position when you are done.
3. Open the MIS hatch cover above the mirror hatch (accessible from the east side of the telescope, see diagram). Open and closed positions are clearly marked.

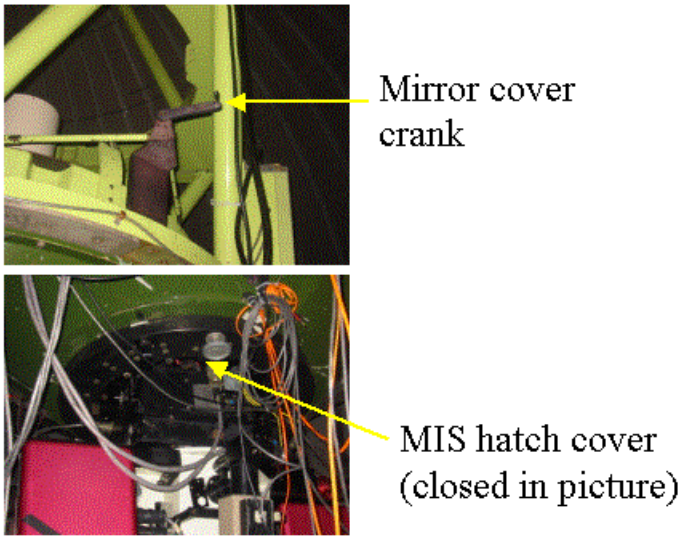


Figure 5. Open the mirror cover by turning the mirror cover crank (top). Open the MIS box hatch shutter (bottom).

Twilight Setup: Focus the Telescope

1. Select a star near the zenith from the SAO catalog, somewhere in the range (approximately) 8-10 mag. Be sure to enter the correct epoch into the xtcs3 window. Alternatively, you can use the first standard star, Feige 34.
    - You can find an SAO star by using the printed version in the observing room or do a SIMBAD search on the web near RA = sidereal time and DEC= +32 00 00.
2. In the observing room, move the guide probe into the beam. Make sure that the Acquisition TV and Guider voltages are turned all the way down.
3. On the observing floor, move to the position of the (SAO) star. Make sure that the telescope is open (as described above) and that tracking is on. Rotate the dome so that the telescope is looking out through the shutter: note that on the TCS display, on the lower right, there is a small stylized window with a single character in or out of the window. The character is an asterisk "*" inside the window if the

telescope is looking out of the shutter. The character is a zero “0” if the dome is occulting the telescope. Make sure that you see that the asterisk is inside the window. Remember that the dome does not track automatically, you must do it manually. You can do this from the control room using the dome left/right rocker switch on the hand paddle in the observing room.

4. In observing room, slowly turn up the Guide camera voltage and the star should appear on the guider monitor. If not, you may need to search in the outskirts of the field of view by moving the telescope using the telescope hand paddle.
5. Once the star is correctly identified, move the guide probe to the out position (‘origin’ or ‘slit’ positions).
6. Slowly turn up the voltage (i.e., gain) for the Acquisition TV (slit viewer). The star should appear on the Acquisition TV monitor. Note that the star may fall on the slit, so moving the telescope toward the East or West should make the star be reflected off of the slit jaws.
7. Record the current telescope focus.
8. Now use the focus switch on the hand paddle to run the telescope focus to LOWER numbers. Watch the star image as you do this, and you’ll see it become a “doughnut” as the telescope moves out of focus.
9. Now move the focus towards larger numbers and note where the focus is optimal. Run through the focus to higher numbers until again the image becomes a doughnut.
10. Repeat this process until you feel that you have found the best focus position.
11. Move the focus to a value somewhat lower than the optimal focus, and then move to the optimal focus from lower numbers.
12. Check the focus throughout the night, for example, when you are observing flux standards. The focus will change during the night as the temperature drops, so keep an eye on it.

A Routine Observation

1. Keep a record of all observations on spectrograph logsheet. You can print copies by opening an xterm window on Kilauea and typing "logsheet". You will be asked if this is for imaging or spectroscopy (answer "s") and number of copies. These will be printed on the HP printer in the computer room.
2. Make sure that the slit is set to a width of 5 arcseconds for all science observations and calibrations.
3. Make sure guider camera and acquisition camera voltages are turned down.
4. Make sure the Finder Mirror is out of the light beam.
5. Move the guider to the center of the field of view of the telescope. To do this, go to the xmis window and in the guider subwindow, move the cursor to "preset", click on it and hold down, which will give a pull-down menu. Select "center".
6. Make sure that the TCS epoch (in the TCS monitor) corresponds to the epoch of your target coordinates (generally 2000.0).
    a. If it is incorrect, adjust by going to the xtcs-3 window, click on blue TCS Epoch button. This pops up a window that says "Display Epoch". Click in the box and enter the correct epoch, and then hit "enter" on the keyboard. The new epoch should now appear on the TCS monitor.
7. Go to TCS in dome, and move telescope to target while watching the telescope move (shine your flashlight on telescope). You must be in the dome to use slew speed. Rotate the dome so the telescope is pointing out (remember to look at the window display on the TCS monitor to make sure the asterisk is in the window.
8. In the control room slowly raise voltage on Guider Camera while watching the guider monitor (in case a bright star is in the field). Identify your target.
9. Use telescope control hand paddle to move telescope so that target is in the white circle (note: position of circle is also marked on monitor with red grease pencil. Moving the target to this position will correctly place it on or near the slit).
10. Enter the (X,Y) positions of the guide stars for this object. The (X,Y) coordinates are on the finder charts for each target and each calibration star. The positions are entered in the xmis window, on the right side, under guider. Click in the X window, enter the X position, then hit "enter" on the keyboard. Repeat for Y. This moves the guide probe to the guide star position.
    a. If the guide star is in an unfavorable position on the guider monitor, you can adjust the guide probe position by entering DX and DY values in the appropriate windows in the same xmis box. Good initial increments are ±500 or ±1000 units.
11. Slowly turn up the voltage on the acquisition TV. The target should be near the slit, near the arrow marked in red grease pencil on the acquisition TV monitor. Use the telescope control panel to move the target into the slit at that position.
12. Use the arrows on the guider keyboard so that the guide star is centered in the box. You can toggle between fast and slow speeds by hitting the "5" button on the numerical pad on the guider keyboard. Then hit "s" (lower case only) on the guider keyboard to start guiding.
13. Watch the acquisition TV to make sure that the guider does not pull the target out of the slit. Watch for several cycles.

a. If the target is pulled off the slit, then stop guiding by hitting "q" (lower case only) on the guider keyboard. Put the object back in the slit using the telescope control paddle. Now use the arrows on the guider keyboard to recenter the box on the guider TV. Hit "s" to start guiding.
b. If the background is particularly high, you can try decreasing the size of the guider box by using the minus sign on the guider keyboard (minus is just to the left of 0).
c. If the star is bigger than the box, make the box bigger by hitting the plus sign.

14. Once guiding is stable, go back to the prospero command window and prepare to set up an observation. You can use script 'agnsetup' (for AGNs). Script 'dostd' helps you do this before starting an exposure of a standard star. Alternatively, do as follows:
    a. Enter "object name", where name is the target designator (e.g., NGC3227; don't leave blank spaces).
    b. Set exposure time using "exp 1200" (i.e., 1200 seconds)
    c. Check guiding one last time
    d. Enter "go" to begin the observation.
        i. If you need to end the observation, you can use "X" to abort (the observation is discarded) or "S" for stop and save. Note that you cannot pause and resume. Do not ever abort an observation by using CTRL-C. After entering "X" or "S", wait to be prompted by prospero before entering additional commands.
15. Once an observation is complete, it is stored automatically. Watch the display monitor as the data are read out. Check for quality to make sure a repeat is not needed. Check also that the data are written to disk. The Caliban (error log) window and a listing (command 'ls') in a Unix xterm will tell you this.
16. The final observation of each target should be followed by an arc lamp for wavelength calibration. Script 'agncal' will help you do this. You can also use the procedure below. We do NOT need an arc lamp observation for standard stars.
    a. Move the finder mirror to the "in" position.
    b. Turn on the Xe arc lamp by clicking on the appropriate box in the xmis lamps window.
    c. Enter "comp Xe" in the prospero window
    d. Enter the exposure time "exp 120" in the prospero window
    e. Enter "go" to begin the observation.
    f. When the exposure is complete, examine it on the display and see if it needs to be repeated.
    g. Turn off the Xe lamp by clicking on "off" in the xmis lamps window.
    h. If no further calibrations are to be made, move the finder mirror back to the "out" position.
17. If possible, between observations of targets, take additional flat field calibration images. This procedure is included in script 'agncal'. We do NOT need separate flat-field images for standard stars.
    a. If the finder mirror is out, move it to the "in" position.

b. Turn on the flat-field lamp by clicking on the “flat” box in the xmis lamps window.
c. Enter “flat flat” in the prospero window.
d. Enter the exposure time “exp 150” in the prospero window
e. Enter “go” to begin the observation.
f. When the exposure is complete, examine it on the display and see if it needs to be repeated.
g. Turn off the flat-field lamp by clicking on “off” in the xmis lamps window.
h. If no further calibrations are to be made, move the finder mirror back to the “out” position. It takes about 10-15 seconds for the probe to move all the way out of the beam.

SUGGESTED OBSERVING SEQUENCE

Names of scripts that will do these tasks are listed in square brackets.

1. Take calibration data in the afternoon **[script: startcal]**
   a. Long Ar (300 secs) and Xe (120 secs) arc spectra at zenith with a 1 arcsecond slit. (NOTE: all other observations are to be made with a 5 arcsecond slit)
   b. Flats (12×150 secs) at zenith with a 5 arcsecond slit.
   c. Bias exposures (12×0 secs) at zenith
2. Sky flats (twilight) [TO BE DONE ONLY ON OCCASION BY EXPERIENCED OBSERVERS]
3. Standard star (Feige 34, nominal 2×300 sec) **[script: dostd]**
4. NGC 3227 (priority 1 target, nominal 3×1200 sec) **[scripts: agnsetup, doagn]**
5. Xe Arc (1×120 sec) **[script: agncal]**
6. Flat field (1×150 sec) **[script: agncal]**
7. NGC 3516 (priority 1 target, nominal 3×1200 sec) **[scripts: agnsetup, doagn]**
8. Xe Arc (1×120 sec) **[script: agncal]**
9. Flat field (1×150 sec) **[script: agncal]**
10. NGC 4051 (priority 2 target, nominal 3×1200 sec) **[scripts: agnsetup, doagn]**
11. Xe Arc (1×120 sec) **[script: agncal]**
12. Flat field (1×150 sec) **[script: agncal]**
13. NGC 4151 (priority 1 target, nominal 3×1200 sec) **[scripts: agnsetup, doagn]**
14. Xe Arc (1×120 sec) **[script: agncal]**
15. Flat field (1×150 sec) **[script: agncal]**
16. Standard star (Feige 56, nominal 2×300 sec) [OMIT IF THIS WILL INTERFERE WITH COMPLETING PROGRAM] **[script: dostd]**
17. NGC 4593 (priority 1 target, nominal 3×1200 sec) **[scripts: agnsetup, doagn]**
18. Xe Arc (1×120 sec) **[script: agncal]**
19. Flat field (1×150 sec) **[script: agncal]**
20. NGC 5548 (priority 2 target, nominal 3×1200 sec) **[scripts: agnsetup, doagn]**
21. Xe Arc (1×120 sec) **[script: agncal]**
22. Flat field (1×150 sec) **[script: agncal]**
23. Standard star (Feige 98, nominal 2×300 sec) **[script: dostd]**
24. Flats (12×150 secs) at zenith **[script: endcal]**

Shutdown procedures:

1. Make sure that the voltages are turned all the way down on the guider and acquisition TV cameras. Turn off the power on the guider and acquisition TV monitors.
2. Move the telescope to the approximate zenith.
3. Turn off the telescope tracking by turning the tracking knob on the TCS all the way counterclockwise to the off position.
4. Remember to keep the lights off in the dome until the dome is closed. Do not make any calibration images while the interior dome lights are on since the instrument is not light-tight.
5. Close the MIS box hatch shutter.
6. Close the mirror cover using the hand crank on the telescope.
7. Move the dome to its stow position at azimuth = 51° (the red marker in the middle of the dome slit will line up just to the right of the 50° azimuth marker). Open/close functions work only at stow position. See Figure 2 above.
8. Set dome main shutter switch to close. See Figure 3 above.
9. Press and hold dropout shutter control button till dropout is completely closed. Make sure that the dropout is completely closed before closing the main shutter.
10. Press main shutter control button to close the main shutter.
11. Move the telescope to the exact zenith as follows. Use the hand paddle controls in the observing room while watching the tilt sensors. The tilt sensors are small LCD displays in the computer room at the top of the second rack from the right (see Figure 6 below). The telescope should be moved until both the east/west and north/south displays read 000.
12. Complete any calibration observations that you need. You are encouraged to take a second set of long flats and a set of bias frames, if possible (e.g., script: endcal).
13. Write your data to tape (detailed instructions follow).
14. Fill the camera dewar and record the time on the dry erase board in the observing room.
15. Submit observing report. Open web browser and go to http://chichon.kpno.noao.edu (http://140.252.83.3) and click on “Submit a Nightly Observer’s Report”. This is mostly self-explanatory. Be sure to report ANY problems you have.
16. Make sure all the lights are out on the observing floor and in the observing room. Make sure that the fill valve on the liquid nitrogen tank is closed.

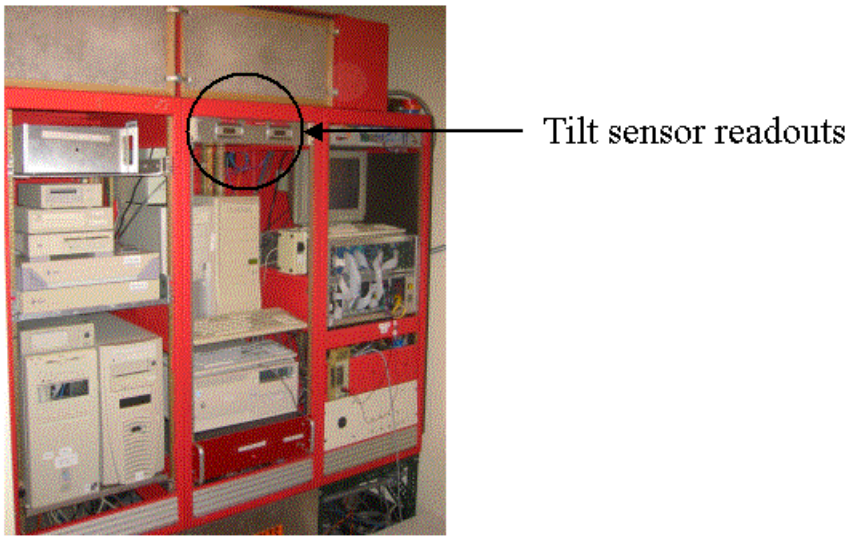


Figure 6. Tilt sensor readouts in the computer room.

Writing Data to Tape:

1. Go to the computer room (door on the left in control room, by the glass window) and insert your dat tape into the dat drive atop the Kilauea and Tambora PCs located in the second rack from the left. The dat drive name is "/dev/rst5". Make sure your dat tape is NOT write-protected before inserting tape.
2. In the control room, use either the Xterm on Hill or Kilauea to access the dat drive. If you work from Hill use the background pulldown menu to create an xterm on Kilauea: use the left mouse button with cursor on background and select first "Local Xterms" and then "Kilauea Xterm". Use the password on the white board on the door to the telescope dome.
3. In the xterm, enter "mt –f /dev/rst5 status" to get the status of the dat drive and to ensure you can access the drive. The returned comment will let you know if the dat drive is busy, has no tape loaded, or at which file number the tape is positioned. If you just inserted the tape, it will be at file number zero.
4. If the tape is new you should be ready to write the data. If you already have data on the tape, you can append the data by forwarding the tape to the end of the data stream on the tape using the command "mt –f /dev/nrst5 eom". The 'n' in the 'nrst' indicates that the tape drive does not rewind itself after end task (like forwarding, writing tape with the "tar" command (see below), reading tape, etc.). If you forget the 'n' you may overwrite the data already on the tape since the tape will rewind itself at the end of the data stream.
5. Enter "cd /data/tambora/visitor" to go to the directory where the data usually is kept. A note on the white board will say the full path to where the data actually is located for the run. That path should be used if it differs from the one noted here.
6. List the directory (Unix command 'ls') and take note of the files you need to write to tape. Note that there may be subdirectories with data irrelevant to the current project in the usual data directory. Generate a subdirectory named 'jdnnnn' where

‘jdnnnn’ is the root-filename relevant to that nights observing. Move all the data you have taken for the past 24 hours into this subdirectory.

7. Write the data to tape using the “tar” command by entering “tar –cvf /dev/nrst5 ./jdnnnn”. Remember the preceding ‘./’ to the subdirectory name and the ‘n’ in the device name (/dev/nrst5).
8. Repeat item 6 for any additional data you may want to write. Recall that the command “mt –f /dev/nrst5 status” will always tell you where the tape is positioned.
9. Once done writing the tape you should check to see the data were in fact written to tape. Rewind the tape with command “mt –f /dev/rst5 rewind”. Read the tape with “tar –tvf /dev/nrst5”. A listing of the tape contents will appear in the xterm window. If you have more than one tar file on the tape, you will have to forward the tape to the next tar file by entering “mt –f /dev/nrst5 fsf 1”. Command “mt –f /dev/nrst5 status” will say if indeed the tape drive has advanced to the next filenumber.
10. When tape is checked you can rewind and eject the tape with “mt –f /dev/rst5 rewoffl”. Pressing the button on the tape drive itself will do the same.
11. On the tape sleeve mark down the data written (e.g., “file 0: ./jd3395 ; file 1: ./jd3396; etc…”).

Miscellaneous Hints and Pointers:

Guider voltage: The guider voltage has a tendency to decrease by itself which may cause you to lose your guide stars if you do not notice. So it is a good idea to keep an eye on the guider voltage and continuously adjust it such that there is good signal for guiding. Hitting key '?' on the guider pc keyboard will tell you how to use keys "1, 2, 3, 4" and "Z" and "z" to adjust the brightness level on the guider monitor which the guider PC is also using. Good guiding requires a count level between 12000 and 20000. It is OK that some of the pixels in the box are saturated.

Guide stars: If for some reason the guide stars provided do not work for a particular position on the sky (e.g., too close to the moon), you may need to search for a new guide star by scanning the field after having positioned the target at or near the slit. This is done by positioning the guider probe in either "Origin" or "Slit" position (MIS window) and use the DX and DY windows to move the probe. Click on either of these boxes and enter a value of 1000 which is a good stepsize. Each time you hit enter while the mouse is in either the DX or DY window the probe will move 1000 steps in X or Y, respectively. Do not hit enter too quickly after one another. At the same time keep an eye on the Guide Probe monitor to look for suitable guidestars: not too faint or so bright that they bleed too much (the guider will tend to guide off of the bleeding flux and then pull your target off the slit; however, you can try adjusting the guide camera gain level using keys '1', '2', '3', '4', 'z', and 'Z'). It is a good idea to scan in one direction first, say in X, and step up or down in Y when you reach the end of the guide probe range, and go back (enter "-1000" in DX) in the X-direction. Alternatively, you can start off placing the guide probe at, say, X=1000 and Y=3000, then enter '25000' in the X position which makes the guide probe move from X=1000 to X=25000. Keeping an eye on the guider TV you can scan the field and click "Stop" in the guider control window when a suitable guide star appears in the field. NOTE: If the guide probe has a Y position greater than 13,000 it will start occulting the light beam and you cannot observe your target. The free range in the X-direction for a given Y-direction is not properly mapped out yet so always keep an eye on the TV acquisition monitor as well to ensure you have not found your favorite guidestar too close to the target field thereby occulting your field of view.
Once you have found a suitable guidestar, note its X and Y position and continue to set up the observations as described in the main manual (page 14).

Dome Encoders: TCS monitor lists the dome encoder value. If this is clearly wrong (for example, the telescope is pointing out the dome shutter but the TCS monitor indicates it is NOT, then you'll have to reset the dome encoders. The location of the dome is that of the red marker in the middle of the shutter. Just below the dome rails the azimuth is indicated. Note the position. In the control room, in the xtcs3 window click the "Setup" button and select "Set Dome AZ encoders". Enter the dome position in the window that pops up and hit enter on keyboard. If the dome position does not update on the TCS monitor, you need to restart the xtcs3 window by doing the following: Click "Setup" again and select "QUIT". Using the left mouse button with the mouse positioned in the

background, select “Telescope Controls”, and then select “xtcs3”. A new xtcs3 window will appear with a big button labeled “INITIALIZE”. Click this button and wait until a message appears in bottom of the xtcs3 window that the initialization is complete. Repeat the exercise to reset the dome encoders by clicking “Setup” and follow the instructions above. If this does not reset the dome encoders properly you will have to return the dome to the home position (azimuth 51) and repeat the exercise. Once dome encoders are correct you can return the dome to the desired position for observing.

Focusing the Spectrograph

The best spectrograph (collimator) focus value is typically around 860. To check that the current setting holds (this can change with temperature changes) run through a focus sequence as follows:

1. Place the finder mirror in the beam by flipping the Finder Mirror switch to “in”.
2. Turn on the Xenon comparison lamp in the MIS Lamps window by clicking on the Xe button.
3. Check that the slitwidth setting in the Prospero Status window is as desired. You need a 1 arcsecond slit. The CCDS manual has a table with the slitwidth settings in microns for a desired slitwidth in arcseconds (1 arcsec = 47 microns; 5 arcseconds = 235 microns). If you need to change the slitwidth use command “setslit nnn” in the prospero command window where ‘nnn’ is the slitwidth setting in microns. Watch the slitwidth change on the TV acquisition monitor. The slitwidth setting will update in the Prospero Status window.
4. Change to collimator dial units to 750 by entering “setfocus 750” in the Prospero command window. You should always approach the dial settings/units from lower dial values. Then set the value to the first focus value that you will take an exposure at. For a nominal best spectrograph focus value of 860, a starting value of about 820 should suffice. That is, enter ‘setfocus 820’ and wait for the collimator focus value to update (you’ll receive a Prospero prompt).
5. Change the filenames for the focus exposures by entering “filename focus.” (remember the trailing period). Change the image number to quickly identify the images by entering “newext nn” where ‘nn’ is the desired image number. A convenient approach is to start the first sequence with image number ‘1’, and subsequent sequences (if necessary) starting at number ‘10’.
6. Enter “exp 120” to set the image ID and the exposure time.
7. Enter ‘go’ to take the first exposure.
8. When exposure is done, change the spectrograph focus value to 835 (“setfocus 835’) and start the next exposure (enter “go”).
9. Repeat this sequence by incrementing the spectrograph focus value by 15 units before taking each new exposure. Continue until you reach a focus value of 895 or 910.
10. After having taking this focus sequence, go to the IRAF window. IRAF will be running in one of the four virtual desktop workspaces other than that occupied by Prospero and the MIS/TCS controls.
11. In IRAF, enter “epar specfocus”. If you get the error: “ERROR: task (specfocus) not found”, load the ‘nmisc’ package by entering “nmisc”, then edit the parameter file

again with “epar specfocus”. Once inside the parameter file edits, change the parameters to the following values:

“images = “	focus.00xx (‘xx’= ‘0?’ for the first sequence, and ‘xx’=’1?’ for the second sequence, etc)
“ (focus = “	820x15
“(corwidt = “	20
“(level = “	0.5
“(shifts = “	yes
“(dispaxis = “	1
“(nspectr = “	1
“(ndisp = “	1
“(slit1 = “	340
“(slit2 = “	365

Note: you can also list the images you want to work on (in sequence: with increasing focus values for increasing row numbers in the file) in a file (e.g., “focus_input”). Then you change the value of the “images” parameter to “@focus_input”

12. Save the parameters and quit with “:wq”
13. Run the specfocus program to compute the best spectrograph focus by entering “specfoc”. The program will in the end show a plot with a graph that should be a parabola with a minimum arc line width at what is supposed to be the best spectrograph focus and several smaller diagrams with line profiles for each spectrograph collimator setting and with the average line width of that image labeled. The title will say which setting gives the best average focus setting (for these images and parameter settings) and what the best average line width is. You can print the plot by entering “=” with the cursor in the graphics window.
14. The program can be fooled, especially if the focus settings used are way off, if one or more of the images were contaminated by light in the dome or somehow corrupted, or even if all the arc lines are in one half of the spectrum (as is the case, for example, with the Xenon lamp). Therefore it is a good idea to check the image which the “specfocus” program selects as being the best focus image. Check the image by entering “implot filename.nnnn”. This will allow you to examine graphically the image. With the cursor in the graphics window type (no quotes) “:a 20” and then “:l 350” (letter ‘l’). This will plot the average of 20 lines centered around line 350 (where the targets are positioned on the chip). You’ll see a comparison lamp spectrum with the various emission lines. Measure the line widths of the lines from the blue (left) to the red (right) by placing cursor at the very base of the line on the blue side of the profile and hit ‘p’; repeat for the red side. The measured line width and center will appear at the bottom of the graphics window. Go through especially the stronger lines to ensure that there is NOT a large spread in the line widths or a systematic increase or decrease in the linewidths. With a 1 arcsecond slit and a good focus the linewidths should be around 2.4 - 2.5 pixels (1 pixel is approximately 1.3366Å).
15. If the linewidths look reasonable, the best focus value returned by “specfocus” can be used. Set the spectrograph focus by first setting the collimator dial value on the lower side of this best focus by entering, for example, ‘setfocus 800’ and then ‘setfocus nnn’ where ‘nnn’ is the best focus value computed.

16. If the inspection of the "best focus image" suggests that there is something wrong, check the other images taken before and after this image to see how the linewidths behave. If one or more of your focus sequence images are corrupted (e.g. by strong stray light) that can confuse the "specfocus" program you'll need to rerun the focus sequence. Also, if you haven't reached the minimum of the parabola (less likely unless there has been dramatic temperature changes in the past 24 hours or so) you'll also need to redo the focus sequence, making sure that you cover a sufficient range in spectrograph collimator focus values to determine the minimum linewidth of the arc lines. You may benefit from using a smaller focus increment (e.g., 10 dial units).
17. After having completed the spectrograph focusing, change the filename back to the one to use for that nights observing, change the image number to the next one in sequence (make sure you do NOT overwrite exisiting data) using "newext nnn".
18. You are now ready for taking afternoon calibrations.

"Cold Start" of the Data Acquisition System

In the computer room the IC and WC computers have separate keyboards (labeled) but share the same monitor; you can switch between them using the dial located between the two keyboards.

1. At this point Prospero and Caliban should not be running (if they are, type "quit'' in each of the prospero and caliban windows).
2. If the IC is still running the CCDS program, quit out of it with "quit". At this point the screen display on the computer room monitor will disappear (but can be seen on the monitor to the left of the Kilaeua terminal showing the most recent data taken). Type "mono" on the IC keyboard to regain the display in the computer room.
3. Type "quit" on the WC keyboard if the WC computer is running its Ariel program.
4. If the Caliban computer is not running, turn it on. Once up, run the caliban program from the "Caliban window" (the 'error log window'; see Figure on page 4) by typing 'caliban' in this window. If the caliban window is not up, use the left mouse button placed in the background to bring up the main menu. Chose "Data Acquisition" and then "Caliban". (Rick: Is this when to bring up Caliban before the IC?)
5. Use the pulldown menu to select "xcts/xmis startup" under Telescope Control if the xtcs and xmis windows aren't already up.
6. Turn on the IC and WC computers – or press the reset buttons on both computers if the computers are still running.
7. Once up again, the WC computer should have, in the top panel, all links high-lighted except the 'upsync' and 'downsync' links. If not, recycle the power on the WC computer again. Make sure the WC comes up before you continue.
8. Once the IC computer is up and asking whether to start "CCDS or TIFCAM", enter 'c' on the IC keyboard. This starts the CCDS program. Wait for it to come up.
9. Start prospero using the background mouse menu (left button). In pull-down menu chose "Data Acquisition" and next "prospero".
10. (If Caliban is not yet started, do start it as described in item 3 above).
11. In Prospero run "startup". If in the Prospero status window the caliban links are not up and talking to the IC computer ('CB' and '-SWAP' links are shown in red), try taking a short exposure, rerun "startup". Iterate until Caliban links turn green and

Caliban is in fact writing the data to disk. If this doesn't work, run "runinit", take a short exposure, and type "startup".

12. At this point everything should be up and running and you are ready to run "runinit" and continue the setup for the calibration and/or observing.