PreCam User's Guide† (Draft - Version 2.4)

Adam J. Sypniewski
(ajsyp@umich.edu)

updated‡ by Wolfgang Lorenzon

University of Michigan
(November 26, 2010)

and by Douglas Tucker

Fermilab

(December 10, 2010)

and by Tomasz Biesiadzinski

University of Michigan

and Joe Bernstein

Argonne National Lab

(December 11 & 12, 2010)
and Brian Gerke

SLAC

(Jaunary 4-6, 2011)

January 8, 2011

†A copy of this document can be found at http://sites.google.com/site/precamsurvey/home/precam-users-guide together with the source files (in attachment section).

‡Updates take into account changes due to the new SISPI version and the ObStac software that were installed in November.

Contents

Remarks

Parts of this manual were taken from Pat Seitzer's "Curtis-Schmidt Telescope Operations Guide." You should refer to Pat's manual for instructions on initializing and shutting down the telescope each night.

1 Nightly Checklist

This checklist is an overview of what you should do every night, starting in the afternoon. It is *not* a replacement for reading and understanding the other telescope guides/resources. It *is* a place to start to get acquainted with basic nightly operations. Now, onward to the nightly checklist.

1. Go up into the dome. Make sure the cables are not tangled, and that everything appears to be in order. Make sure that the telescope is in the "service" position (nearly horizontal). If not, issue the `service` command from a terminal window (while you are sitting in the directory `~/tcs/dfmtcsdes`).

2. Create a new directory and template log for the night by issuing the following command from a terminal window:
   `> cd ~/tcs`
   `> python generate_log.py`
   This script will create a sub-directory in `/data1/images` called YYYYMMDDUT, where YYYY, MM, DD are the UT date for the night, and it will create a template log file within this directory called "PreCamYYYYMMDDUT.log".
   Alternatively, you can manually create the `/data1/images/YYYYMMDDUT` sub-directory and copy into this sub-directory the template logfile `/data1/images/PreCam_template.log`, re-naming it to a form `PreCamYYYYMMDDUT.log`.
   In either case, start documenting/recording/logging everything you do into this log file.

3. Check that the compressor and heater (section 7.7) are on.

4. Open the shutter gas cylinder (section 7.6). Do **NOT** adjust the regulator. Enter the pressure readings into the manual log you created above.

5. If it is not already running, start LabView (section 2.3).

6. In LabView, ensure that the RTD offset is set to 1 ohms. Verify that the temperature is -100°C (173K) and pressure is below 90μTorr (`9E-5` Torr). If the pressure is above 90μTorr, or if you believe it will exceed 90μTorr during the night's observing run, you will need to evacuate the dewar (section 5).

7. If it is not already running, start SISPI (section 2.2). ***After*** SISPI has fully started, don't forget to enter the `configure` and `PAN SET` commands in the SISPI CONSOLE window:
   `> configure`
   `> PAN SET ccd_vsub_enbl=1`
   `> PAN SET sl5_ccd_adcoffsets -5.0` (this is SL5 and not S15)
   `> PAN SET geometry overscan 50`
   `> PAN SET geometry yoverscan 50`

8. In the SISPI CONSOLE window, set the `observer` keyword to the names of those observing tonight; e.g.:
   `> set observer ‘‘N. Copernicus, T. Brahe, G. Galilei’’`

9. Take a 1-second exposure test frame from the SISPI CONSOLE window (to make sure everything works and to clear any charge that has built up on the CCD):

   `> set exptime 1.0`

   `> set exptype object`
   `> expose`
   and check it with `ds9` (the data are in `/data1/images/fits/`; see section 2.7). It would be good to make a note of this throwaway image in the night log, for completeness. (As a side benefit, this will help avoid a mildly annoying-but-benign alert during your first run of the python observing script of the afternoon/night.)

10. Start up ObsTac, if it is not already running (check the webpage below). You can do this from your laptop or from precam1:
    `> ssh -L8091:localhost:8091 -X precam@ctiozw.ctio.noao.edu`
    (You can also just enter the bash alias command `precamObsTac`) on `precam1`.
    `> cd ~`
    `> setup obstac`
    `> .  obstac_db_fix.sh`
    `> start_obstac`
    In a web browser, open up the following webpage:
    `http://localhost:8091/html/precam.html`

11. Ask ObsTac to create the ObsTac observing plan for the night.
    On the ObsTac homepage (`http://localhost:8090/html/precam.html`):

    (a) Click on the link in the section called “See the queue.” If there is already a queue in place, scroll down to the bottom of the page and click on “Empty.”

    (b) Use the back button on your browser to return to the main ObsTac page.

    (c) go the the section “Fill the queue (automatic survey)”, enter the MJD of the night, of the observation, indicate whether the night is expected to be photometric or not, and click on the “Fill the queue” button. (Since conditions might change, you might need to redo the observing plan later. Alternatively, just create a second, backup queue once the first one has finished.)

    (d) Check the queue page occasionally to see if it is finished (when it is finished it creates a single observation at the beginning of the *next* night).

12. Open up a new terminal window and set it up in preparation for using the python observing scripts (If SISPI is already operating nominally from the previous night, and

the terminal you were using to run observing scripts is still open and connected to SISPI, you may skip this step.):
`> setup SISPI`
`> setup obstac`
`> join_instance <InstanceName>`
(get the `<InstanceName>`, e.g. `PCObs10`, from one of the SISPI windows)
`> cd ~/tcs`

13. Take a test bias exposure:
`> python precam_acquire_images.py bias_singlebias.config`
Log this exposure by copying and pasting the log snippet from
`~/acquire_logs/precam_acquire_bias_?????-?????.log`
into the indicated place in the log file (where `?????` matches the number of the exposure you just took). Inspect the exposure with `ds9` (section **??**) and make sure that everything looks OK.

14. Open up the following webpages:
    (a) CTIO Environmental webpage: `http://www.ctio.noao.edu/environ/environ.html`
    (b) Quick Reduce webpage: `http://ctiozw.ctio.noao.edu:8080/`
    (standard DES access applies; also, this address may be subject to change, so check with the previous observer)
    (c) TASCAM: `http://www.ctio.noao.edu/site/lastpic.php`

15. Retrieve the ObsTac observing plan for the night:
    (a) On the ObsTac homepage, go to the "See the queue" section and click to see the queue.
    (b) On the ObsTac Queue webpage, continue to "refresh" the page until the number of queue entries stops increasing. If the fill was started on time, the queue should already be full.
    (c) At the bottom of the ObsTac Queue webpage, download the tab-delimited table, saving it with a unique name (e.g., `queue_mjd55540.tsv`).
    (d) Copy the tab-delimited table to the `~/tcs` on precam1; e.g.:
    `> scp -p queue_mjd55540.tsv precam@ctiozw:~/tcs`

16. Take a sequence of 25 bias frames (section 2.6):
`> cd ~/tcs`
`> python precam_acquire_images.py bias_frames.config`
and insert log snippet from
`~/tcs/acquire_logs/precam_acquire_bias_????-????.log` into the manual log you prepared above. Check the biases using `Quick Reduce` or `ds9` (section 2.7). The images will be in /data1/images/fits (as will all the images taken during the night).

17. Take a sequence of dark frames (section 2.6) – 5 darks for each of the PreCam target science exposure times (36sec, 51sec, 65sec, 162sec, 73sec), and 10 darks for the PreCam standard star field exposure time (10sec):
`> cd ~/tcs`
`> python precam_acquire_images.py dark_frames.config`
and insert log snippet from
`~/tcs/acquire_logs/precam_acquire_dark_????-????.log` into the manual log you prepared above. Check the darks using `Quick Reduce` or `ds9` (section 2.7).

18. *During November, December, and January, this is a convenient time in the afternoon/evening to go for dinner.*

19. Setup for dome flats:
    (a) Follow Steps 1 and 3(a-e) of the "Curtis-Schmidt Nightly Startup" checklist (step 2 does not apply unless there is an emergency, since it requires entering the off-limits inner control room). from Pat's Curtis-Schmidt Operations Guide.
    (b) Turn on the dome flat lamps.
    (c) Follow Steps 4(a-b) of the "Curtis-Schmidt Nightly Startup" checklist from Pat's Curtis-Schmidt Operations Guide.
    (d) Follow Steps 3(j, f, & g) **(ONLY)** of the "Curtis-Schmidt Nightly Startup" checklist.

20. Take a sequence of dome flats (section 3), 5 for each DES filter, at sunset (starting not more than ~ 10 minutes before the sun sets). A second set of flats will be taken in the morning:
`> cd ~/tcs`
`> python precam_acquire_images.py flat_field_night.config`
(Important: the presence of any file in the data directory `/data1/images/fits`, other than the fits files created by the acquisition process, will cause a failure in the execution of `precam_acquire_images.py`.)
When prompted by a PreCam alert, make sure that the telescope is pointing at the dome flat screen. You may need to use the handpaddle to make minor adjustments. While in the dome, check that the cables on the floor below the telescope will not be pulled too hard when the telescope moves.
At the end of the flat field sequence, when asked to enable tracking, select "NO." Tracking of the telescope and dome will be re-enabled later.
Insert log snippet from
`~/tcs/acquire_logs/precam_acquire_flat_????-????.log` into the manual log you prepared above. Check the flats using `Quick Reduce` or `ds9` (section 2.7).

21. Go watch the sunset while your flat field sequence is running (if the sequence finishes before the sun sets, you started too early and your flats will likely be contaminated by scattered light and shadows).

22. After completing the dome flats, return the telescope to the "service" position by entering the `service` command.

23. Once the telescope has come to a halt at the "service" position, turn off the dome flat lamps.

24. Continue with the Curtis-Schmidt startup procedure by following Steps 3(h-k), 4(c), and 5 of the "Curtis-Schmidt Nightly Startup" checklist..

25. Initialize the telescope's pointing:

    (a) Soon after sunset (as soon as you're done with flats), observe a bright star near zenith.

    In late-November to mid-December, HR105 is a reasonable star to use soon after sunset:

    `> cd ~/tcs`

    `> python precam_acquire_images.py zenith_HR105.config`

    If you are observing at a time when HR105 is not overhead, you need to choose another bright star, one whose Dec is around -30° (±10°), and one whose RA is roughly equal to the Local Sidereal Time (LST) to within an hour. If you need to use a bright star other than HR105, use zenith_HR105.config as a template: copy it and edit accordingly for the star you have chosen to use.

    (b) Use ds9 to check the bright star's position on the PreCam focal plane:

    `~/ds9 -zscale -mosaicimage wcs /data1/images/fits/PreCam_xxxxxxxx.fits`

    where `PreCam_xxxxxxxx.fits` is the name of the file containing the 1-sec exposure taken by the python script. Or, use the `displayfits` script with arguments `MMMMM` and `NNNNN`, where `MMMMMM` and `NNNNNN` are the file index values.

    (c) The star should be just slightly right of center in the ds9 display (about halfway between the top and bottom of the PreCam focal plane, and just to the left of the gap between the two PreCam CCDs).

    (d) If you need to adjust the pointing, follow Step 6 of the the "Curtis-Schmidt Nightly Startup" checklist. If the pointing is completely lost, that is, the reference star cannot be located anywhere in the image, see section B.

    (e) Insert log snippet from

    `~/tcs/acquire_logs/precam_acquire_object_????-????.log` into the manual log you prepared above.

26. Perform a quick focus sweep in ***r*-band** about 30 min after sunset:

    (a) Observe a globular cluster (preferably centered in the gap between the CCDs) relatively near zenith at several focus positions. In late-November/early-December, NGC288 is a good choice:

    `> cd ~/tcs`

    `> python precam_acquire_images.py focus_sweep_NGC288r_quick.config`

(b) After the focus sweep has completed, analyse the images using this command:
`> python focus_analysis.py NNNN MMMM`
where NNNN and MMMM are, respectively, the starting and ending exposure numbers of the focus sweep sequence. This script will find the focus value that provides a reasonable focus over most of the PreCam focal plane (recall that the Curtis-Schmidts surface of focus resembles more a sphere than a plane) and update the focus parameter file (`~/tcs/focus_default.inc`) accordingly, making use of the focus offsets of the other filters relative to *r*-band.

(c) You should also double-check the results from the analysis script using `ds9` or `displayfits` on the focus sweep images.

(d) You should also double-check that the `focus_default.inc` file in the `~/tcs` directory has reasonable values for the focus (e..g, the focus value for *r*-band should be ≈7200).

(e) Insert log snippet from
`~/tcs/acquire_logs/precam_acquire_object_????-????.log` into the manual log you prepared above.

(f) It would also be good to copy the new `focus_default.inc` file into the manual log.

27. A little over an hour after sunset, it is time to start the ObsTac observations. For best results, submit the above command about 5-10 min after the earliest start time in the ObsTac queue file (e.g., `queue_mjd55540.tsv`). Here is what to do:

    (a) `> cd ~/tcs`

    (b) Copy the previous ObsTac config file:
    `> cp obstac_mjd55539.config obstac_mjd55540.config`

    (c) Edit the new ObsTac config file so that the keyword `OBSTAC_FILE` points to the ObsTac queue file you created earlier (e.g., `queue_mjd55540.tsv`).

    (d) Submit the following command:
    `> python precam_acquire_images.py obstac_mjd55540.config`

    (e) Insert log snippet from
    `~/tcs/acquire_logs/precam_acquire_obstac_????-????.log` into the manual log you prepared above. *Unlike the other log snippets, the ObsTac log snippets update continually while the observing script is running.*

28. When the ObsTac observing script is finished, update the ObsTac database by uploading the `~/tcs/acquire_logs/queue_XXXXXX.DONE` file to the ObsTac webpage (`http://localhost:8091/html/precam.html`) under the section "Add completed exposures to the ObsTac database (from a file)".

29. If you still have half an hour or more to the beginning of nautical (12°) twilight, create another ObsTac queue file, run it, and upload its DONE file when it finished. Repeat as necessary.

30. Finish up your observations around the beginning of nautical (12°) twilight (about an hour before sunrise).

31. Take a second sequence of dome flats (section 3), 5 for each DES filter:

    (a) Issue the `service` command to return the telescope to "service" position.

    (b) Issue the `dome off` command to stop dome tracking.

    (c) Close the dome, close the hatch, turn the fan off.

    (d) Turn the flat field lights on.

    (e) `> cd ~/tcs`
    `> python precam_acquire_images.py flat_field_morning.config`
    When prompted by a PreCam alert, make sure that the telescope is pointing at the dome flat screen. You may need to use the handpaddle to make minor adjustments. While in the dome, check that the cables on the floor below the telescope will not be pulled too hard when the telescope moves.
    At the end of the flat field sequence, when asked to enable tracking, select "NO."

    Insert log snippet from

    (f) `~/tcs/acquire_logs/precam_acquire_flat_????-????.log` into the manual log you prepared above. Check the flats using `Quick Reduce` or `ds9` (section 2.7).

32. At the end of the night, follow the section in Pat Seitzer's "Curtis-Schmidt Telescope Operations Guide" entitled "Curtis-Schmidt End of Night." The **End of Night** form referred to in Step 6 is located here:
`http://www.ctio.noao.edu/new/Tools/Forms/EON/Form.php?telescope=Schmidt`

33. Close LabView and SISPI if neccessary (make sure you do it the right way). **(If SISPI has been running OK, it is OK to keep SISPI and LabView running throughout the course of your observing run.)**

34. Close the shutter gas cylinder (do **not** change the regulator). Record the pressure in the manual log.

35. Do not turn off the the compressor or heater.

36. Make final edits to your manual log in
`/data1/images/YYYYMMDDUT/PreCamYYYYMMDDUT.log`

37. Run the end-of-night script:
`> cd ~/tcs`
`> python endnight.py`
This script will:

(a) copy the TOLOLO Site Environmental Web Page (http://www.ctio.noao.edu/environ/envi into the night's data directory;

(b) move the night's SIPSI FITS files from /data1/images/fits to /data1/images/YYYYMMDDUT, where YYYYMMDDUT is the directory you created during the afternoon with the python generate_log.py command;

(c) run the banding RMS calulation code saving the results in /data1/images/YYYYMMDDUT/root

(d) start the pushdir process of copying the contents of /data1/images/YYYYMMDDUT to Rio and FNAL; and

(e) gzip-compress and copy the PanView FITS images to /data2/images.

38. Upload the finished ObsTac file (ending in .DONE from the directory ~/tcs/acquire_logs/ under the section entitled "Add completed exposures to the ObsTac database (from a file)" (see section 9.3.6 for more details). View the image of the night's completed hexes under the section of the ObsTac webpage entitled "See completed hexes". Save a copy of this image.

39. Post a copy of the CTIO End-of-Night form and your PreCamYYYYMMDDUT.log to the DES PreCam Observing mailing list (des-precam-obs@listserv.fnal.gov.

2 Computer Control

2.1 Basic Info

The telescope can be controlled using the computer shown in figure 1. There are two computers called precam1 and precam2. Usually, precam1 will be used; however, if precam1 fails, the peripheral devices (monitor, ethernet, etc.) can be moved to precam2 instead.[1]

Log onto the computer with the user name and password. The directories of interest are:

[1] In terms of network name resolution (for SSH, etc.) the precam1 computer is called ctiozw and precam2 is called ctiozv while in the Curtis-Schmidt dome (they have similar, but different names while in the Coudé room). Note that some of the configuration settings are different on precam2, so if it becomes necessary to use precam2, you may need to modify these instructions.

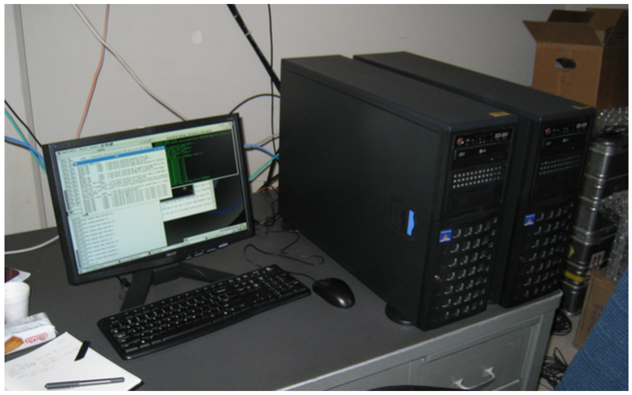


Figure 1: The primary computers used for controlling the telescope. The `precam1` computer is on the left; the `precam2` computer is on the right.

~	The `precam` user home directory containing the `setup_sispi_cs` script for launching SISPI, `ds9` for viewing image files, and the `eups` version management system.
~/tcs	Contains the `tcsclient` script for controlling the telescope, and several useful scripts for taking multiple images).
~/tcs	Updated version of the ~/tcs director; it contains several useful scripts for taking multiple images (see Appendix E for a list of those scripts).
~/tcs/dfmtcsdes	Contains Perl scripts for performing common telescope tasks during start-up, shut-down, and maintanence.
/data1/images	Default directory to which newly made images are saved (assuming you are using the `precam1` computer).

When using the control computer, we recommend taking advantage of the multiple workspace (desktops) located in the lower-right corner of the screen. You can click on the different boxes to switch workspace, or press `Ctrl-Alt-Left Arrow` or `Ctrl-Alt-Right Arrow`.

2.2 Starting SISPI

To start SISPI, open a new terminal and type:

```
> cd ~
> source setup_sispi_cs
```

IMPORTANT: The **only** way you should **ever** exit SISPI is to select the **original** terminal window that you started SISPI with, and then press `Ctrl-C`. Trying to close it in any other way (such as just “X”-ing out of the original window or closing any/all of the SISPI child windows) will result in a dirty close.

Starting SISPI will open a great multitude of windows, and it will take a little while to start. The most important windows are PanVIEW_debug, OCS, IB1 (Image Builder), and the CONSOLE; the others can be **minimized** (*not* closed) if they are in the way. SISPI is loaded and ready to go once the PanVIEW_debug window shows “detext is now 1.” **WAIT** until SISPI is ready, enter the following into the CONSOLE window:[2]

```
> configure
> PAN SET ccd_vsub_enbl=1
> PAN SET sl5_ccd_adcoffsets -5.0      (this is SL5 and not S15)
> PAN SET geometry overscan 50
> PAN SET geometry yoverscan 50
```

The `ccd_vsub_enbl` command enables the CCDs. The `sl5_ccd_adcoffsets` command changes the DC voltage offset on the CCDs (to reduce noise). The `overscan` and `yoverscan` commands choose the number of CCD rows and columns to use as overscan lines.

After performing the above configuration, it is useful (but not essential) to set a few default values from within the CONSOLE window:

```
> set observer ‘‘N. Copernicus, T. Brahe, G. Galilei’’
> set focus 7150
> set exptime 1.0
> set exptype object
```

You can change these default values as you see fit (e.g., since it will appear in the FITS headers, you may want to reset the `observer` default whenever the observing team changes).

2.3 Using LabView

Important camera/suhtter information can be read off in LabView. This includes the duration of the current exposure, shutter status, the dewar temperature, and the dewar pressure. To launch LabView, enter the following command at a terminal window:

```
> labview
```

[2] Note that commands entered in the CONSOLE are sent directly to OCS, unless they begin with `PAN`, in which case they are sent to PanVIEW instead.

Then, from the LabView window that appears, go to the "Operate" and choose "Debug Application or Shared Library." A dialog window will pop up. Enter `169.254.110.160` as the IP address and then click "Refresh." You should see `startup.rtexe` appear in the "Application or shared library" box. Click "Connect." After a moment, the shutter server window should appear as in figure 2.

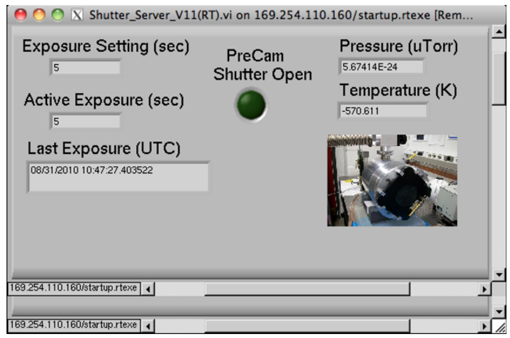


Figure 2: The LabView shutter server. "Exposure Setting" displays the total duration of the most recent, non-zero expose command. "Active Exposure" shows the current amount of time the shutter has been open for during an on-going exposure. The "PreCam Shutter Open" light is bright green when the shutter is open.

After starting LabView and the shutter server window (2) appears, you should scroll down to where it says "RTD Offset (Ohm)" and make sure that the value is set to 2 Ohms. (This is important for ensuring that the temperature values shown in LabView match that shown on the compressor [Sect. 7.7]).

> IMPORTANT: To exit the LabView shutter server, you should **right-click** anywhere in the window, and choose "Remote Debugging" → "Quit Debug Session" from the popup context menu. You can now terminate LabView in a normal way.

Note that only one instance of LabView can be run at a time. You will receive an error message in the event that you try to start two instances. This mostly becomes a problem when using remote login.

2.4 How to Observe

Observing requires two steps:

1. Moving the telescope to the right position.

2. Taking the correct sequence of exposures.

The Curtis-Schmidt Telescope Control System (TCS) is independent of SISPI, which handles the data-taking for PreCam. A suite of Python scripts have been written, some of which communicate with both TCS and SISPI, others of which only communicate with one or the other. ObsTac-generated observations have been completely automated. These scripts will only communicate with SISPI from the terminal window which has been prepared thusly:

> setup SISPI
> join_instance <InstanceName> (e.g., PBObs10; get this from one of the SISPI windows)
> cd ~/tcs

This should *only* be done in a single terminal window for a given SISPI.

> The rest of this sub-section (Sect. 2.4) is slightly out-of-date. We now use a single python observing script, precam_acquire_images.py, which takes as an argument the name of a configuration file describing the type of observation and its parameters. For details, see Appendix 1 (Nightly Checklist) and Appendix E.1 (Python Scripts)

In a terminal window which has been thus prepared, one can for example run

> python stripe82_obstac.py

and it will tell the TCS to move and then tell SISPI to take images. These scripts read in a .txt file which must be prepared separately. The scripts tell the telescope where to move and what filter to set, and then tell SISPI to take certain exposures. Within the Python script, the FILE variable shows what .txt file is utilized by that script, e.g. FILE = ''queue_as_tsv_5.txt'' is currently what stripe82_obstac.py is set to read. queue_as_tsv_# are the files that are generated by ObsTac and contain a list of tab-separated values. Python scripts which handle ObStac input should **not** be edited, except for the input FILE (which can be modified as necessary for each night's observations).

A plethora of other scripts are designed to take exposures but do **not** put the telescope in the right position. The first category of these are utility scripts (for details see Appendix E). Examples include: bias_frames2.py, for taking bias images (scope position is irrelevant); dark_frames2.py, for taking dark images (telescope position is irrelevant); flat_field2.py, for taking flat field images (telescope must be moved to domeflat position first); flat_ptc2.py, for taking a photon transfer sequence (telescope must be moved to domeflat position first); focus_sweep2.py, for taking images at a variety of focus settings (telescope must be moved to appropriate source first). Each of these scripts runs off of a separate .txt file with its own required input fields that do not necessarily match those of another script. New text files can be created, and the FILE variable in the Python script set, as needed. In general, if multiple versions of a Python script exist, the one labeled *2.py is more recent and thus more accurate for the existing commands.

To move the telescope into the appropriate position for these scripts, the coordinates must be entered into the TCS console and the slew command executed (see section 2.5 for detailed instructions).

In addition to the utility scripts, there is a library of scripts that are designed for specific targets, usually standard stars. These write all the appropriate headers for the target in question and, like other scripts, get their observing instructions from the corresponding `.txt` file but do not themselves move the telescope into position. Examples include: bd17.py, cdfs.py, dls0520.py, e28.py, sa95d.py (see Appendix E.1).

The type of script that moves the telescope and then waits for the observer to take exposures via the OCS interface is not commonly used any longer. Examples of this include tcsmulti2.py. Although the code functions currently, is not detailed here any longer.

The final important script is tcsclient.py (or tcsclientdr.py, with very similar functionality). If AND ONLY IF you are familiar with the internal workings of the Curtis-Schmidt TCS, you can send commands in “TCS format” directly to the TCS computer (this script is actually what translates all of our focus, filter, move, etc. commands into the appropriate format).

2.5 Moving the Telescope

The TCS can be operated from the console either downstairs or upstairs. Assuming everything is properly set up (see Curtis-Schmidt Nightly Startup), all commands will be issued from the TCS GUI. Under Telescope/Movement, there are options for `Slew`, `Offset`, `Object Library` and `Mark/Move`. The latter two are useful for known objects (e.g. zenith stars–see Curtis-Schmidt Nightly startup–or NGC/Messier objects). The first two are how we do most of our movements (those not contained within a Python script, at least). Under the `Slew Position` tab, `RA` is entered in HH:MM:SS and `Dec` is entered in DD:MM:SS (as labeled). Once the desired position is entered, click `Apply`, and the entered position should show up in the `Next Object` row of the main TCS window. To move, click `Start Slew`. To cancel the next object entry, click `Stop` (as is done with pointing initialization–see Curtis-Schmidt Nightly Startup). `HA` and `Dec` slews are also allowed, provided tracking is turned off first. If not, the telescope will never finish slewing, because tracking will keep it from settling at an `HA` value. Also note that going from 59 to 0 in Min will increment the Hours/Degrees, and going from 59 to 0 Sec will increment Min!

Under the `Offset` tab, offsets are in arcseconds, with positive `RA` moving the telescope east and positive `Dec` moving the telescope north. On the image display `ds9`, north is *up* and east is *left*. If you want to move a star up in the field for subsequent exposures, the telescope must be offset *down*. If you want to move a star left in the field for subsequent exposures, the telescope must be offset *right*.

2.6 Taking Images

Once the telescope is in position, you can take single images using the OCS console in SISPI[3]. If you take multiple images, we recommend the use of Python scripts instead (see Appendix E.1). Before issuing exposure commands, you need to set the exposure time and exposure type

```
> set exptime X
> set expType='name'
```

where "X" is the exposure time in seconds, and "name" the exposure type that can be either "object", "bias", "flat" or "dark". Now you can execute the exposure command

```
> expose X,Y,Z
```

where "X", "Y", and "Z" can be various comma-separated parameters such as "count", "RA", "dec", "note", and "filter". For example, to take two images with a right ascension of 30.9, a declination of -30.9, in the 'r' filter and a note of '47 Tuc', you enter

```
> expose count=2,RA=30.9,dec=-30.9,note='47 Tuc',filter='r'
```

(N.B.: the parameter `note` cannot accept special characters. Use `[a-z][0-9] only!)`

To take a zero second image with the shutter closed (known as a *bias*), enter:

```
> set expType='bias'
> expose
```

Once you send the expose command, the PanVIEW console windows should display activity. You can see the status of the shutter in the LabView shutter server window. After exposure is done, the image must be processed. Once the image is fully processed and ready for viewing, you can check the image number in the DHS1 console in case you lost track (these image numbers are sequentially generated by SISPI) and you can view the image using `ds9` (see section 2.7 for more information).

If you notice your image has saturated regions, the CCDs may have built up excess charge due to dark currents. This charge build-up is cleared when the CCD is read. Thus, if you just took an image and this is the case, simply take the image again. If it has been some time since your last exposure (say, 15 minutes), you may want to thwart this charge build-up by *clearing* the CCDs. You can achieve this by simply taking a "throw-away" image; a zero-second dark image (called a *bias*) is sufficient.

[3]These commands have changed significantly with the installation of the updated SISPI.

2.7 Viewing Images

Once an image has been taken, it is saved to disk in `/data1/images/fits`. These images can be viewed using `ds9`. To start `ds9`, enter the following at a terminal:

```
> ~/ds9 &
```

The `ds9` program will start. To open a file and look at both CCDs side-by-side, go to the "File" menu and choose "Open Other" → "Open Mosaic WCS...". You will need to navigate to the appropriate directory (usually `/data1/images/fits`) and select the image of interest. Once an image is loaded, you can zoom, rescale the intensity, etc., using the toolbar buttons.

Alternatively, you can open an image or a set of images from the command line. For example, if you want to look at images 7180 – 7189, you can type:

```
> ~/ds9 -zscale -mosaicimage wcs /data1/images/fits/PreCam_0000718*.fits &
```

where the `-zscale` option provides a nice scaling of the data.

There is no special procedure for closing `ds9`.
In addition, looking at sequences of files was made easier with a script `displayfits`. It is a python script aliassed in the .bashrc file. It wraps ds9 with `zscale` enabled. By default it open wcs mosaics but this behavior can be suppressed by passing the `nowcs` command as the last argument. For example, to open 5 fits files with indecies 00011098 to 00011102 one needs to execute the command

```
> displayfits 11098 11102 &
```

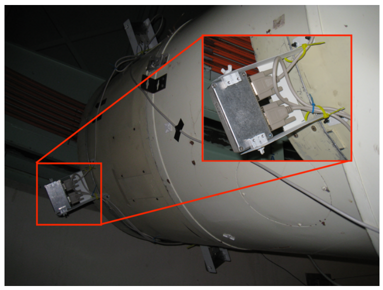
To open a single file, for example PreCam_00007184.fits one needs to execute

```
> displayfits 7184 7184 &
```

3 Dome Flats

To take dome flats, first ensure that the dome and hatch are both closed. Make sure that there is nothing in the way of the telescope and that the main optics cover (section 8.2) is off.
Turn on the flat-field illumination system (figure 3) by flipping the power switch to the ON position. Ensure that all of the LED switches are ON except for the 810nm switch (it is too bright). Note that the direction of the ON position for each switch is the same as the main power switch. You should see the LEDs illuminating the flat-field screen.
You may need to move the telescope to the service position (section 4) to remove the optics cover and turn on the LEDs. Previously, to take dome flats it was neccessary to open a

new terminal and execute the `domeflats` command from the `dfmtcsdes` directory. This functionality is now inluded in `precam_acquire_images.py` when running a ”flat” config file. Either command will turn off rate correction and telescope tracking, send the dome to 270° azimuth (west), and point the telescope roughly at the flat-field (east). You will hear the TCS box in the “darkroom” beep when the telescope is in position. You should now verify that the telescope is, in fact, pointing at the flat-field screen. If it is not, use the handpaddle (section 8.3) to correct the telescope position.[4]



(a) Location at end of barrel

(b) Front, showing LEDs

(c) Control box; the 810nm on/off switch is marked in red

Figure 3: Flat-Field Illumination System. Note that there are a total of 4 illumination boxes at the end of the telescope.

You should consult the PreCam observing plan/commission tests for dome flat measurements. You may need to clear the CCD first. See section 2.6 for information on taking images.

If you performed dome flats in the order of the “Nightly Checklist” (section 1), then you can stop here. Otherwise, if you want to leave the dome flats position and continue observing, issue the following commands to turn on dome tracking, rate correction, and sidereal tracking:

```
> dome on
```

[4]If the telescope is consistently mis-aligned, you can take note of the correct HA and DEC and modify the Perl script and the flat field configuration file.

```
> track on
```

Alternately, you can use the `tcsclient` script to prepare the telescope for observing:

```
> cd ~/tcs
> python tcsclient.py ''#21,0;''
> python tcsclient.py ''#19,1;''
> python tcsclient.py ''#14,15.041,0.0,0.0,0.0;''
```

4 Service position

To send the telescope to the service position, we need to return the dome to home (90° East), turn off rate correction and sidereal tracking, and send the telescope to the service position. This can be done using the `dfmtcsdes` scripts (see section 2.1):

```
> service
```

Alternately, you can send the telescope to the service position by using the `tcsclient` script:[a]

```
> cd ~/tcs
> python tcsclient.py ''#21,1;''
> python tcsclient.py ''#19,0;''
> python tcsclient.py ''#14,0.0,0.0,0.0,0.0;''
> python tcsclient.py ''#30;''
> python tcsclient.py ''#12;''
```

[a]Refer to section C.2 for more information.

You will hear the TCS box in the "darkroom" beep when the telescope is in position.

If you want to leave the service position and continue observing, you can issue the following commands to turn on dome tracking, rate correction, and sidereal tracking:

```
> dome on
> track on
```

Alternately, you can use the `tcsclient` script to prepare the telescope for observing:

```
> cd ~/tcs
> python tcsclient.py ''#21,0;''
> python tcsclient.py ''#19,1;''
> python tcsclient.py ''#14,15.041,0.0,0.0,0.0;''
```

5 Evacuating the Dewar

In order to ensure that water condensation does not impede camera operation, a balance must be struck between dewar temperature and pressure (to keep the CCD above the dewpoint). The target temperature is 173K ($-100°C$). The target pressure is below 90μTorr. If the pressure is above 90μTorr, or if you believe it will exceed 90μTorr during the night's observing run, you need to evacuate the dewar, following these directions.

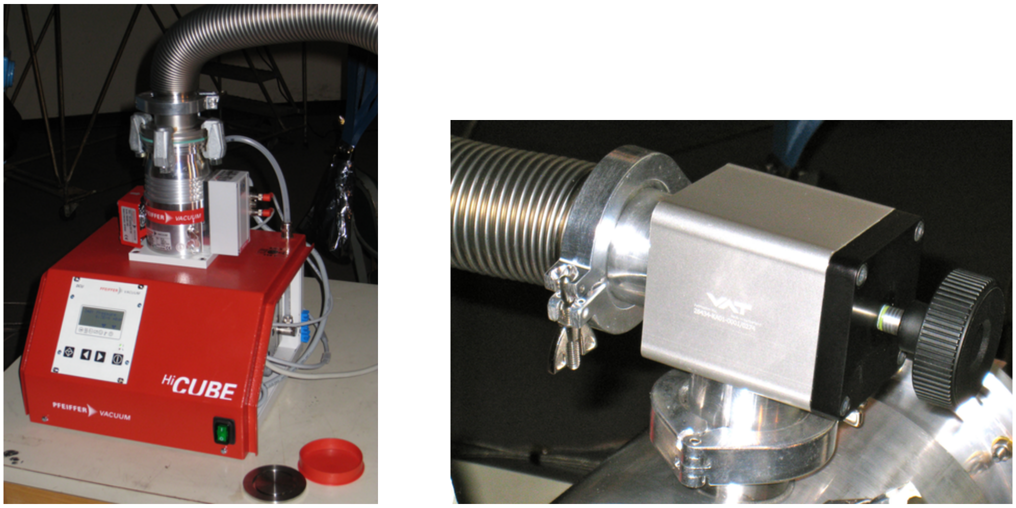
> IMPORTANT: The PreCam CCD is extremely sensitive to electro-static discharge (ESD). Always take appropriate precautions before servicing the camera. The exposed, braided cable on the telescope is grounded. Also, once you turn on the pump, the pump should not be moved or tilted until the turbo-pump has fully stopped and the power is off. Furthermore, we are not fully aware of how PreCam's pumping cycle is going to work; therefore, be aware that the frequency of pumping may be more or less often than you expect.

1. Make sure the telescope is in the service position (section 4).
2. Bring the pump (figure 4a) near the camera and make sure the pump is off. Note that the metal cylinder protruding from the top of the pump is a turbo-pump.
3. Attach the vacuum hose to the pump if it is not already attached. If you need to attach the hose, do the following:
   (a) Unscrew the clamp on the top of the turbo-pump
   (b) Set the blank-off aside. The blank-off is a metal disk which acts as a cover for the vacuum pump. The clamp was previously holding it in place.
   (c) Place the hose over the hole to the pump, making sure that the O-ring is between the pump and the hose.
   (d) Reattach the clamp and tighten it as tightly as you are able by hand. Make sure that the washer is touching the wingnut.
4. Be sure that you, the pump, and the vacuum hose (the top of the pump is electrically isolated from the rest of the pump) are grounded to avoid any ESD damage to the camera.
5. Before proceeding any further, **make sure the pressure valve is closed** (figure 4b) on the camera (closed is in the clockwise direction).
6. Attach the vacuum hose to the camera. This is done in a similar manner as listed above. Make sure that the O-ring is in place, that the vacuum clamp is as tight as you can turn it,and that the wingnut is touching the washer.

7. Make sure the black relief valve, located on the back of the turbo-pump, is fully closed.
8. Plug the pump in and press its power switch to turn it on. There will be a few seconds of delay while it initializes.
9. Press the right-arrow button on the pump until 309 appears on the screen. This is the speed of the turbo-pump.
10. Press the turbo-pump on/off switch. It is the right-most button of the four buttons near the display. This will turn the pump on.
11. If you are still at reasonably low pressure (a few times 10^{-4} torr or less), the turbo-pump must reach its maximum speed of 1500Hz before the pressure valve on the camera is opened. Once the pump reaches 1500Hz, open the pressure valve. (If you are at higher pressures than this, consult with the folks at Argonne regarding when to open the valve as the pump spins up. Do not expose a fully spun-up pump to high pressures.)
12. The pressure should begin dropping. You can monitor the pressure using LabView. Wait until the pressure is sufficient for completing the observing run.
13. Before proceeding any further, **close the pressure valve** on the camera by turning it clockwise. Failure to do this will cause you to lose vacuum. Give it an extra hard turn at the very end to make sure it is fully closed (the last few degrees of rotation give a little extra resistance).
14. Turn the turbo-pump off by pressing the right-most switch of the four near the display (**not** the power switch).
15. Wait until the turbo-pump speed is 0Hz. You may then open the relief valve and turn the pump off (green power switch).
16. Remove the vacuum hose from the camera. Reattach the blank-off using the O-ring and clamps. Be sure the clamp is as tight as possible using your hands and that the wingnut is touching the washer. Place the plastic cap back on the exposed end of the hose. You may leave the hose attached to the vacuum pump.
17. Unplug the pump and put it away.

If PreCam doesn't seem to achieve the desired pressure (note that it may take several hours before you know how low the pressure will go), then pump it as low as possible, following the evacuation directions. Once the pump is disconnected and put away, check the pressure in LabView. You now need to adjust the heater (section 7.7) so that the temperature is above the dewpoint. Consult table 1 to determine the dewpoint, which is the lowest temperature you can adjust the heater to.

For example, if the lowest pressure you are able to pump the dewar down to is 4000μTorr, then the lowest temperature you can set the heater to is -80°C (because, from the table, you aren't allowed to go to -90°C until you've achieved a vacuum pressure of 1000μTorr).



(a) Vacuum pump with hose attached. The power switch is the green switch in the lower-right. The right-most button near the display is the turbo-pump on/off switch. The blank-off and cap are in the lower-right.

(b) Pressure valve on the camera with hose attached. The valve is the black knob on the right

Figure 4: Vacuum pump and pressure valve.

6 Focus and Filter

6.1 Focus

The camera focus can be changed over a range of 10mm (10,000μm). To change the camera focus, issue the commands

```
> cd ~/tcs
> python tcsclient.py focus move X
```

where “X” is the desired focus position measured in microns, and can range from 0 to 10,000.

Dewar Pressure (μTorr)	Dewpoint (°C)
100	−100
1 000	−90
5 000	−80
20 000	−70
100 000	−60

Table 1: Dewpoint temperature at a given pressure.

0 moves the focus in, and $10,000$ moves the focus out. If you move the focus, you should always verify its position using

```
> python tcsclient.py focus status
```

This will return the current position of the camera focus. If this returns "active," then the focal plane is still moving. If this returns "ok," then the focus is ready.

Alternately, you can verify the focus in hardware by referring to the focus dial near the camera (see figure 5 for details).

The best focus is usually between $7,100 - 7,250$. You should be aware that for warmer temperatures the best focus value tends lower.

Note: in case the focus status check returns an error messge, software limit for example, initialize first with

```
> sch focus init
```

which will take the focus to 0 and initialize everything.

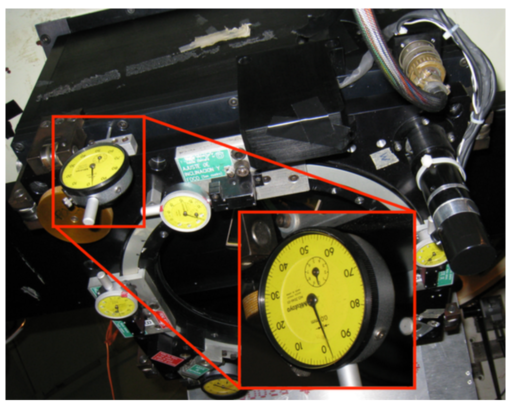


Figure 5: Focus dial shows position of focal plane. It is located on the tilt-and-focus box opposite the camera. Note that the camera is not attached in this picture. The small dial is in millimeters. Ticks on the large dial are in units of 10μm.

Note that the PreCam surface-of-focus is more of a sphere than a plane, so it is impossible to get perfect focus over the entirety of the PreCam focal plane: if the center is in good focus, the corners will be in bad focus. As a reasonable compromise, using a focus that is 50μm larger than the best focus in the center of the PreCam focal plane seems to do a reasonable job over a large area of the PreCam focal plane.

Note also that the PreCam DES filters (Sect. 6.2) have been determined to be *non*-parfocal. As of December 2, 2010, the focus offsets (relative to r-band are as listed inTable 2.

Filter	Focus Offset (μm)
g	+15
r	0
i	−40
z	−70
y	−60

Table 2: Focus offsets for the PreCam DES filters (relative to r-band).

6.2 Filter

The PreCam filter changer has five DES filters: g, r, i, z, and y. If you are using the Python observing scripts, then filter changing is done for you. If you need to switch filters manually, enter

```
> cd ~/tcs
> python tcsclient.py filter move X
```

where "X" is the number corresponding to the desired filter: 1 for g, 2 for r, 3 for i, 4 for z, and 5 for y. If you issue the `filter move` command, you should follow up with a status check (this command can also be used to verify which filter is currently in place):

```
> python tcsclient.py filter status
```

Continue issuing this command until it returns "ok," which indicates that the filter is in place. If it returns "active," the filter changer is still moving.

Alternately, you can verify the current filter in hardware. At one end of the filter changer (section 7.2) is a large, protruding cylinder. Near it is a small knob with "open" and "closed" positions (figure 6). This knob prevents light leakage during exposures and should normally be kept in the "closed" position. To check the filter status, turn the knob to "open" and shine a flashlight in the hole next to the knob. If you look carefully, you will see a number which corresponds to the currently selected filter. Be sure to move the knob to the "closed" position when you are done.

Note: in case the filter status check returns an error messge, initialize first with `> sch`

```
filt init
```

Once the filter is in place, the telescope status has been verified, and the telescope coordinates are correct, you are ready to take images (see section 2.6 for information on taking images). For more information on using the `tcsclient` script, see section C.1.

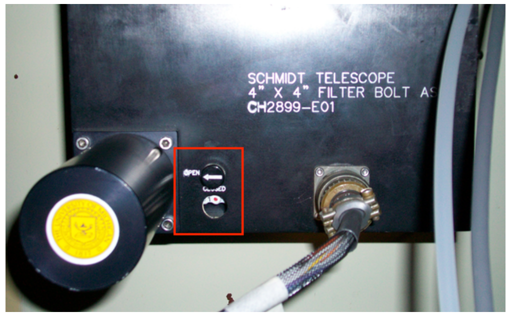


Figure 6: The filter status hole on the filter changer mechanism.

7 PreCam Components

7.1 Camera

The PreCam camera (figure 7) attaches to the tilt-and-focus box on the side of the telescope. It contains two CCDs. These CCDs are extremely sensitive to electro-static discharge (ESD); proper caution must be taken when handling/touching the camera. It is held in place by four, small, yellowish-gold clamps.

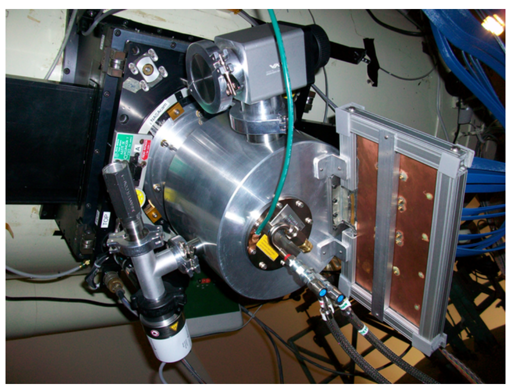


Figure 7: PreCam. Two of the mounting clamps are visible. The pressure valve and vacuum intake are visible at the top of the image. The VIB board is the copper rectangle on the right. The pressure gauge is the off-white cylinder in the lower-left. The cooling lines are attached in the center of the back of the camera. The green grounding cable attaches to the telescope ground.

7.2 Filter Changer

The filter changer (figure 8) holds the five DES filters (g, r, i, z, and y). It is a long, thin, rectangular box located on the telescope in front on the camera. It is controlled by the focus and filter box (section 8.1). To change the active filter, refer to section 6.2.

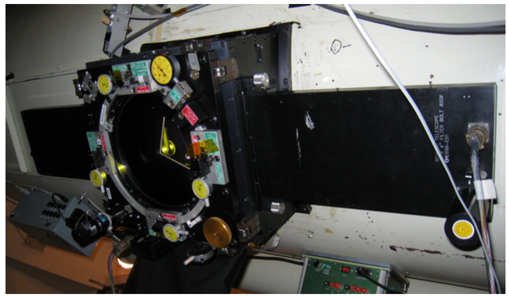
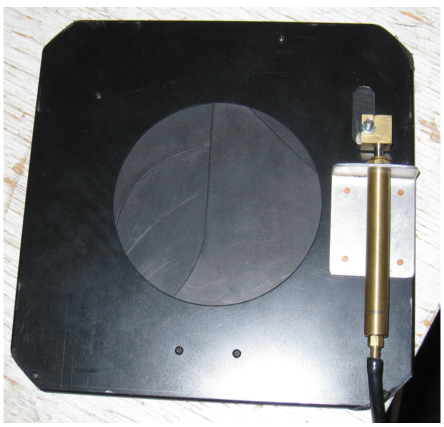


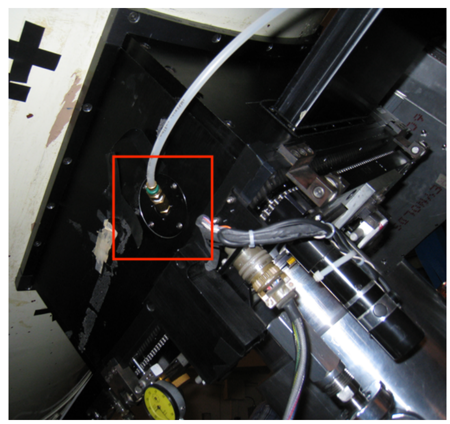
Figure 8: Filter changer. The camera is not attached in this picture.

7.3 Shutter

The shutter (figure 9a) attaches to the front of the camera. A pneumatic hose **screws** into the bottom of the shutter, is fed through the black tilt-and-focus box (figure 9b), and attaches to the shutter gas solenoid (section 7.5).



(a) Camera shutter. The pneumatic host is attached in the lower-right.

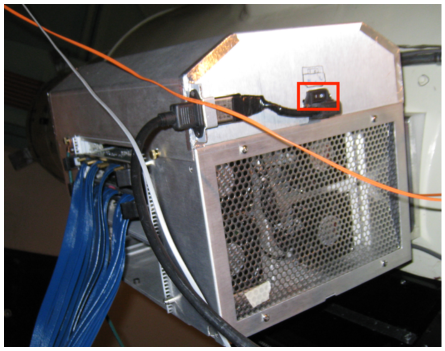


(b) Tilt-and-focus box, showing where the pneumatic hose emerges.

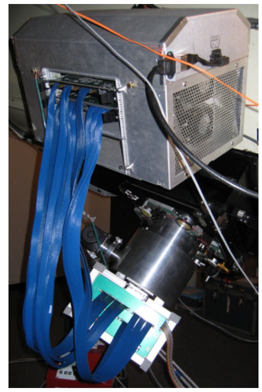
Figure 9: Shutter and Hose

7.4 Monsoon Crate

The monsoon crate (figure 10a) contains the CCD readout electronics. The power should *always* remain on.[5] It is located on the side of the telescope shaft. The blue cables connect to the camera's VIB board (figure 10b).



(a) Monsoon crate. The power switch is marked is red.



(b) Blue monsoon crate cables connect to the green VIB board.

Figure 10: Monsoon crate and VIB board.

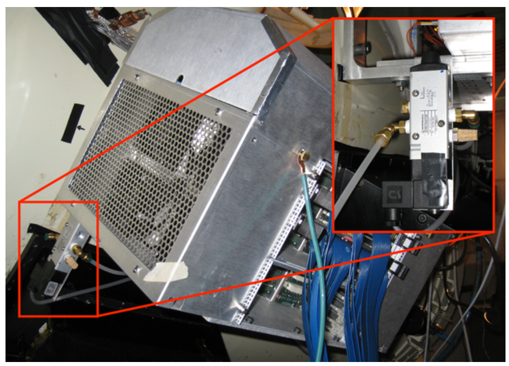


Figure 11: Shutter Gas Solenoid. The inset image shows the pneumatic hose which attaches to the shutter coming out of the solenoid on the left-hand side. This hose is disconnected in the main image.

7.5 Shutter Gas Solenoid

The shutter gas solenoid (figure 11) is responsible for causing the shutter to open and close. It is located on the back of the monsoon crate, and is triggered by a signal from the shutter module on the power supply box (section 7.8). One pneumatic hose runs through the tilt-and-focus box to the shutter (section 7.3), and the other runs to the shutter gas cylinder (section 7.6).

If the pneumatic hose needs to be detached in order to remove the camera and shutter during maintenance, push the green ring in while pulling the hose out. To reinsert the hose, just push it in.

[5] Although the monsoon crate should never be turned off; however, if it needs to be turned back on after maintenance, it may take up to twenty minutes to communicate with SISPI again.

7.6 Shutter Gas Cylinder

The shutter gas cylinder (figure 12) controls the gas flow to the shutter gas solenoid. At the beginning of every night, the tank should be opened (the silver, octagonal knob) and the flow valve should be opened (the small black, round plastic knob). At the end of every night, these two knobs should be shut off. The regulator (metal bar with gauge attached) should **not** be adjusted. The pressure should always read 42psi when using the telescope.

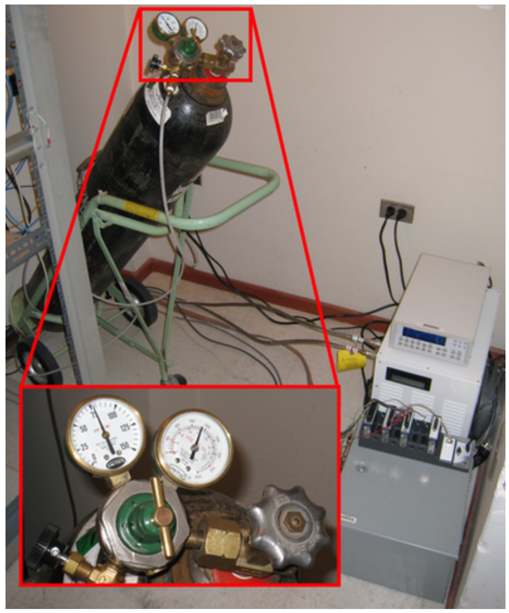


Figure 12: Shutter Gas Cylinder

7.7 Heating and Cooling System

The heater and compressor are located on the floor of the control room (figure 13). The compressor is sitting on the floor; the Lake Shore heater unit is located on top of the compressor. The power switch for the compressor is located on the right side of the unit. The power switch for the heater is on the back of the unit. Both of these units should **always** remain on.

The sensor temperature is shown on the top of the heater display, and the setpoint (target) temperature is shown on the bottom of the display. Both temperatures are given in units of °C.

Ideally, you shouldn't need to change the heater settings. However, if it is necessary to change the setpoint (target) temperature, press the "SETPOINT" button (button number 6). Then enter the desired target temperature (taking into account the offset) and press "ENTER." Now, you still need to enable the heaters. To do this, press "HEATER RANGE." Then press the "up arrow" until "High" is displayed. Then press enter. The heater is now ready.

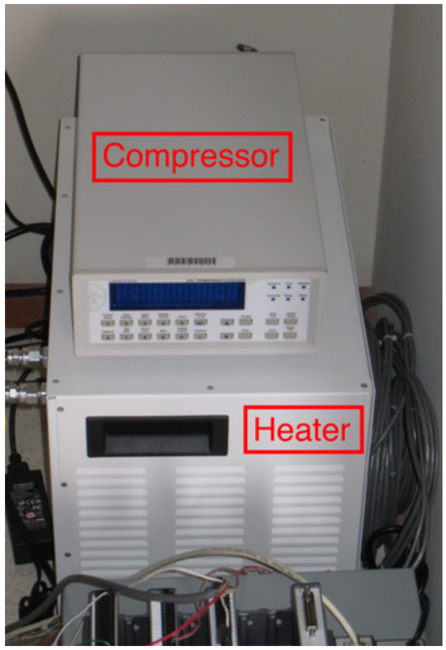


Figure 13: Heater and Compressor. The power supply box and control modules are visible in the foreground.

7.8 Power Supply Box

The power supply box (figure 14) is located on the floor on the control room in front of the compressor. Its sole purpose in the current configuration is to provide a 24V signal to the shutter gas solenoid (section 7.5) during an exposure.

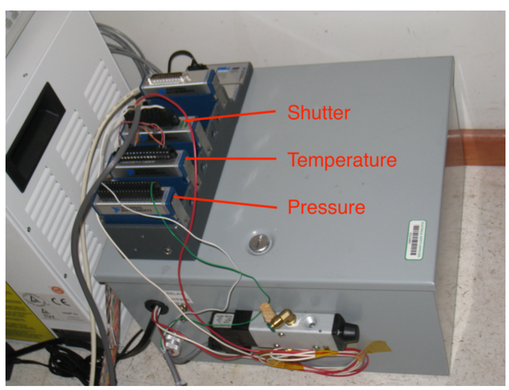


Figure 14: Power Supply Box. The pressure, temperature, and shutter control modules are also shown.

On top of the power supply box are three modules. Two are used for reading off the pressure and temperature of the camera dewar. The third triggers the shutter during exposure.

8 Telescope Components

8.1 Focus and Filter Box

The focus and focus box (figure 15) is responsible for interpreting the focus commands. It is attached to the side of the telescope shaft. To change the active filter, refer to section 6.2. To change the camera focus, refer to section 6.1.

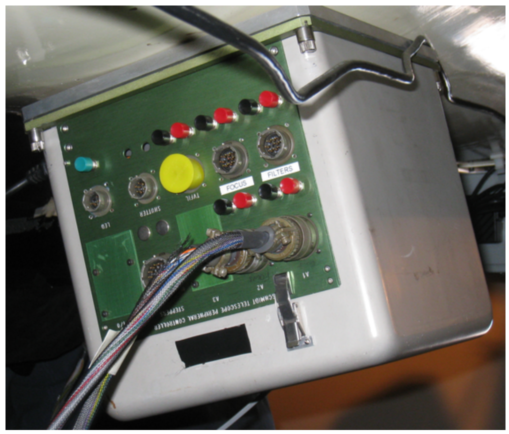


Figure 15: Focus and Filter Box

8.2 Optics Cover

The main optics cover protects the telescope from damage. It covers the end of the telescope. To remove it, you will likely need a step stool. Carefully remove it, being aware of the flat-field illumination system (figure 3). It can be placed in the north-east corner of the dome (figure 16).

Figure 16: Main optics cover sitting in the corner of the dome.

8.3 Telescope Mount

The telescope is on an equatorial mount as shown in figure 17. Hanging on the mount is the handpaddle which can perform gross telescope and dome movement. On the equatorial (RA) axis you will find the marks used for calibrating the telescope at startup.

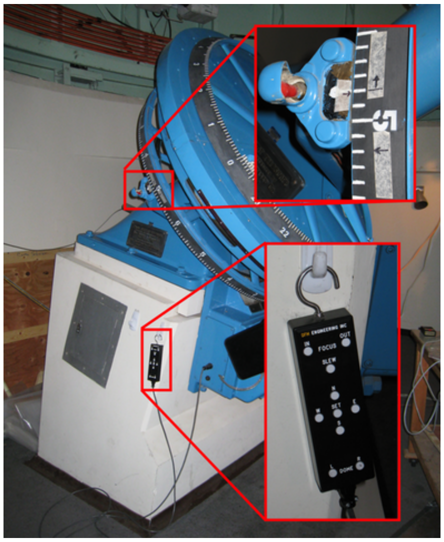


Figure 17: Telescope Equatorial Mount

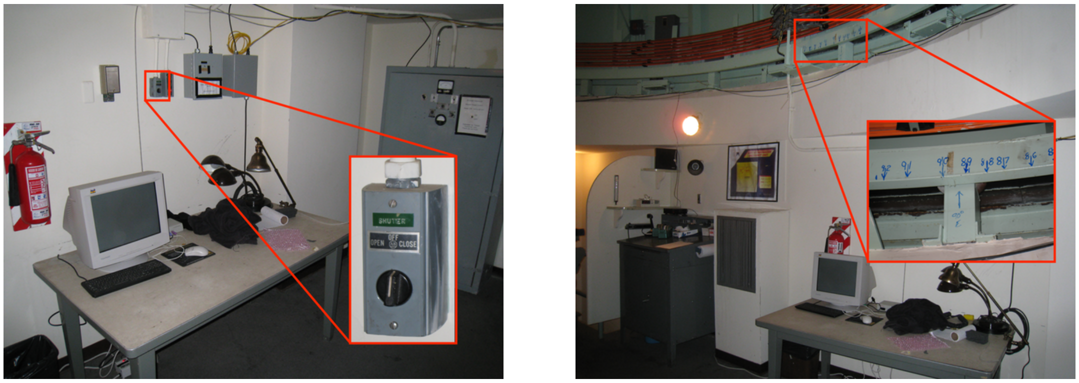
If you want to rotate the dome, press and hold the desired "L" or "R" button at the bottom of the control (near the word "DOME"). To slew (turn) the telescope, hold down the "SLEW" button and, at the same time, press the direction corresponding to the desired slew direction. During telescope calibration at the beginning of the night, the relevant directions are "W" and "E."

8.4 Dome

The dome has markings on it to show if it is oriented toward 90° East. These markings are located on the west wall (figure 18b). These marks are useful when performing basic telescope calibration at the beginning of every night (they are mentioned in Pat Seitzer's guide).

If you need to rotate the dome, use the handpaddle located on the telescope mount (section 8.3).

The dome shutter control (figure 18a) opens and closes the dome. To open or close the shutter, move the switch to the respective position. Always return the switch to the "Off" position after opening or closing the dome.



(a) Dome shutter control

(b) Dome orientation markings

Figure 18: Dome

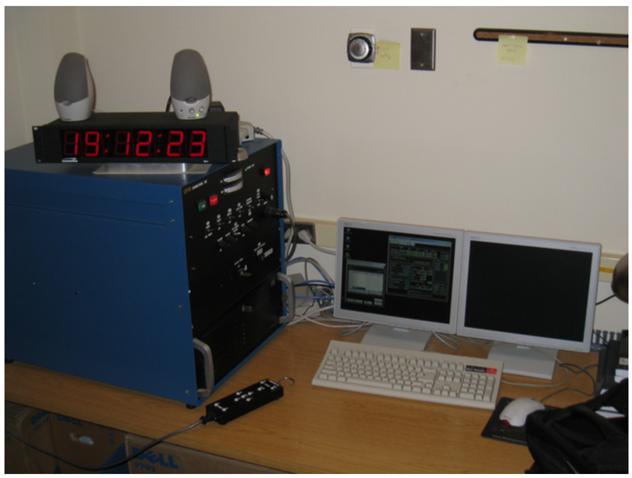


Figure 19: Telescope Control System showing the TCS cabinet and the TCS console.

8.5 Telescope Control System

The telescope control system (TCS; figure 19) controls telescope and dome movement. It is located in the left (north) wall of the "darkroom." The clock shows UTC (GMT) time. The computer (the TCS console) displays the current state of the telescope and dome. It is also used for calibrating the telescope at the beginning of the night. Many of the controls you need to verify are located on the blue TCS cabinet.

9 ObsTac

Based on Eric Neilsen's notes. Please direct any questions to Eric (neilsen@fnal.gov).

9.1 Starting ObsTac

There are two ways to start ObsTac: stand-alone, and using the SISPI architect. For now, we will only consider running in stand-alone mode.
First of all, log on to the precam2:

```
> ssh -L8090:localhost:8090 -X precam@ctiozv.ctio.noao.edu
```

Then setup the current version of the obstac product:

```
> setup obstac
```

Next, since the current version of the DB product on the CTIO nodes does not set up the environment variables correctly for obstac, do the following:

```
> cd ~
> setup obstac
> export SISPI_OBSTAC_DB_HOST=$SISPI_DB_HOST
> export SISPI_OBSTAC_DB_NAME=$SISPI_DB_NAME
> export SISPI_OBSTAC_DB_USER=$SISPI_DB_WRITER
> export SISPI_OBSTAC_DB_PORT=$SISPI_DB_PORT
> export SISPI_OBSTAC_DB_WRITER_PASSWORD=$SISPI_DB_WRITER_PASSWORD
```

As a short cut to the above, on precam2 you can issue the following command instead:

```
> .  obstac_db_fix.sh
```

Finally, issue the obstac executable `start_obstac` command:

```
> start_obstac
```

These commands will start the obstac web interface. Stopping the process (eg with a ctrl-c) will stop it.

9.2 Star Flats with ObsTac

9.2.1 Introduction

This version of the instructions apply when SISPI does not automatically execute observations on the queue, but rather follows a text file Performing a precam starflat grid test has the following stages:

1. Define the grid
2. Create a tiling of that grid
3. Fill the queue with a observations
4. Download the text file containg the contents of the queue

5. Feed the queue file to SISPI for observation
6. Upload the output .DONE file to obstac for inclusion in the exposure table

9.3 Define a Star Flat Grid

Each starflat grid consists of a collection of hexes. Unlike hexes for other programs, obstac does not create these hexes when initializing its database. Instead, observers create them as desired. Starting at obstac's precam homepage: `http://localhost:8090/html/precam.html`, scroll down to the sections entitled "Fill the queue (starflat)", and follow the link on the end of the first sentence, "Select or create a starflat grid here." This brings up this page: `http://localhost:8090/precamstarflatgrids` which shows a table of grids that have already been defined, and a form for creating a new tiling. The forms of the field have the following meanings:

- RA – the RA of the center of the grid in decimal degrees
- Decl – the declination of the center of the grid in decimal degrees
- #RA – the number of columns (positions in RA) in the grid
- #Decl – the number of rows (positions in Dec) in the grid
- Spacing – the separation between rows (and columns) in arcseconds.

Currently, the same spacing is always used for RA and declination. Create the grid using the "Add" button, and your new grid will appear in the table.

9.3.1 Create a Tiling

A tiling is a single set of exposures on a grid, where a set is one exposure for hex for each filter. So, if you want to observe a grid twice in each filter, you should create two tilings. Each precam starflat tiling corresponds to a single grid, so the tiling id alone is sufficient to uniquely identify a set of starflat grid observations; the grid id is not necessary. To create a new tiling, go to the "Precam starflat grids" page: `http://localhost:8090/precamstarflatgrids`. Note that the far right hand column of the table of grids is a set of "tilings" links. Follow that link for the row of the grid you want to create a tiling for. This link will take you to the "Precam starflat tilings" page. If you know the grid id, you can go directly. For example, for a grid id of 5, the URL is `http://localhost:8090/precam_starflat_tilings?grid_id=5`. This page begins with a table of the existing tilings for the grid. To add a tiling, use the "add tiling" button; there is no other form to fill out.

9.3.2 Fill the Queue with Observations

If you want the queue to start with your grid, you must first empty the queue. Go the the queue page: `http://localhost:8090/obsqueue?program=5` (also linked to from the second section of the obstac precam homepage), and hit the "Empty" button at the bottom of the page. Once you have created a tiling to observe, it can be added to the queue. On the "Precam starflat tilings" page, there is a form for just that after the table of tilings. Check the tiling you wish to observe in the list of tilings, fill out the form, and hit "Fill the queue". The queue will not fill instantly; go to the queue page, and refresh it a few times until new exposures stop appearing.

9.3.3 Download the Queue Contents as a text file

After the table of observains in the queue on the queue page, in the section entitled "Text list," there is a link to the file with the contents of the queue as a TXT or TSV file. Hit the link, and save the file on local disk somewhere.

9.3.4 Observe with SISPI

The script that consumes the queue file and performs the observation is outside obstac's scope. Appropriate instructions should be added here as they become available.

9.3.5 Supplement the Queue File with Results of the Exposures

The following functionality is now included in the `precam_acquire_images.py` when it generates a .DONE file in the `/home/precam/tcs/acquire_logs` directory. It is not neccessary to modify the queue file.

Once the observations have been completed, obstac's exposure tables need to be update. Obstac can ingest a queue file in a format similar to the one it produced, but two additional columns are needed: one with the exposure ID, and another with the "mountain done" state.

So, if the queue file produced by obstac looked like this:

```
4.72834674039 0.65 i 65.0 precam5_6 2010-11-20T02:38:12Z 2010-11-20T04:43:51Z
1.26512217523 sci
4.72834674039 0.65 i 65.0 precam5_6 2010-11-20T02:38:12Z 2010-11-20T04:43:51Z
1.26512217523 sci
```

and the exposure IDs for the exposures were 101 and 102, and the first succeeded and the second failed, then the file to upload back into obstac should look like this:

```
4.72834674039 0.65 i 65.0 precam5_6 2010-11-20T02:38:12Z 2010-11-20T04:43:51Z
1.26512217523 sci 101 DONE
4.72834674039 0.65 i 65.0 precam5_6 2010-11-20T02:38:12Z 2010-11-20T04:43:51Z
1.26512217523 sci 102 UNDONE
```

In other words, the new colums should look like this:

```
101 DONE
102 UNDONE
```

9.3.6 Upload the Modified Queue file to ObsTac

Near the end of the precam obstac homepage, there is a section entitled "Add completed exposures to the ObsTac database (from a file)." Fill in the filename, and hit "Upload" to update obstac's exposure database. You can verify the contents of obstac's exposure database using the form in the "See completed hexes" section of the precam obstac homepage.

9.4 Filling a Queue with Stripe 82, a Grid, a Struts, or an Uprights Program

Under construction.

9.5 Filling a Queue with the Automated Survey Program

Under construction.

A Good Practice

Here we collect some remarks, in no specific order, for good practice that did not fit naturally in any of the sections in this document.

1. You will need to keep track of which terminal window was used to start SISPI and which terminal window is connected to SISPI to send commands. You may need to keep track of this for many nights in a row if everything is going smoothly. It is therefore a good idea to give these windows a descriptive title by selecting Terminal-¿Set Title from the pull-down menus on each terminal.

2. If the telescope or dome misbehaves during the Nightly Checklist procedures, follow the checklist in the "Curtis-Schmidt Nightly Startup" checklist from Pat's Curtis-Schmidt Operations Guide.

3. You should be documenting/recording/logging everything you do. It is better to write down too much than too little.

4. When going in and out of the control room, shut the door! The curtain up to the dome is not always good at blocking the light.

5. Only one window should join the SISPI instance (for details how to do this see appendixE.1). This window should be on the PreCam computer in the control room.

6. Keep coordinates straight! TCS needs decimal *hours* (except in GUI interface), FITS headers should be in decimal *degrees*. Most scripts have the value recorded in decimal hours, which is then converted to degrees before the `expose` command is executed.

7. When moving the dome with the hand-paddle, do ***not*** just move it by a fraction of a degree. That is ***very*** bad for the dome motors.

8. Just a reminder that the bearings on the Curtis-Schmidt dome shutter are starting to show their age (see Pat Seitzer's email from Nov. 11) Pat suggests:
   "Please listen carefully when the dome opens and closes. If you hear strange noises, please report them immediately on the [CTIO] nightly report. You probably will have to turn the fan off to hear anything."

B Telescope Pointing Troubleshooting

In case the telescope pointing is unknown, that is, the reference star cannot be located in the images, follow the steps outlined:

1. `track off`

   followed by `itcs` to set TCS time (this resets the epoch to epoch of date)

2. park the telescope at the zenith using the handpaddle - there are tape marks on the ha and dec setting circles when you are there.

3. in the TCS GUI - initialization/position. initialize at zenith.

4. verify ha = 0.0 and dec = -30.?? on TCS display.

This should put you within 0.5 degrees.
Also wise to check dome encoder setting at the same time just to be sure.

1. `dome off`

2. move dome using handpaddle to east until arrows line up over east hatch.

3. `idome`

C tcsclient script

The `tcsclient` (or the similar `tcsclientdr`) script is a Python script which simplifies many of the
non-exposure-related tasks. It is located in the ~/tcs directory.

C.1 "Built-in" commands

The `tcsclientdr` script has several useful commands you can pass it. These commands take the form:

```
> python tcsclientdr.py X
```

where "X" is one of the following commands.

Command	Description
getstatus	Returns the telescope status. Ideally, the return value should be `[0, 0, 0, 1, 0, 1, 1, 1]` when the telescope is ready to expose. The number of interest in the return value is the fifth entry in the array (fourth zero-based entry). If this flag is set (equal to 1), then the target is out of range (below the horizon). If this flag is not set (equal to 0), then then telescope will be able to see the target.
getcoords	Returns the telescope coordinates, including HA, RA, DEC, Airmass, etc.
filter move F	Changes to filter F. F can be one of the numbers 1, 2, 3, 4, 5 to select the respective g, r, i, z, Y filter. This command should be followed by the "filter status" command. See section 6.2 for more information.
filter status	Checks the status of the filter changer and returns the current filter. If this returns "active," then the filter changer is still changing filters. If this returns "ok," then the new filter is in place and ready to go. See section 6.2 for more information.
focus move F	Changes the focus to position F. F is the position of the focal plane measured in microns and can range from 0 to $10,000$. 0 moves the focus in, and $10,000$ moves the focus out. This command should be followed by the "focus status" command. See section 6.1 for more information.
focus status	Checks the position of the focus mechanism and returns the current focal position. If this returnes "active," then the focal plane is still moving. If this returns "ok," then the focus is ready. See section 6.1 for more information.
filter init	Initialize filter bolt (should run this every time you remount the camera or otherwise reset the system, e.g., after a power outage).
focus init	Initialize the focus mechanism (should also run this after any remounting of the camera or reset of the systems)

C.2 TCS commands

People have gone to "great lengths" to make TCS transparent to the operator. The `tcsclient` script has many useful and simple commands, and the Perl scripts in the `~/tcs/dfmtcsdes` directory (documented in Pat Seitzer's "Curtis-Schmidt Telescope Operations Guide") can greatly reduce the work of the observer. However, sometimes you need to send commands directly to the TCS. The `dfmtcsdes` scripts have examples of how to accomplish this in Perl.

The `tcsclient` script, however, is already ready to send raw commands to the TCS. These commands take the form:

```
> python tcsclient.py ``#X;''
```

where "X" is replaced with the appropriate TCS command number (note the semi-colon at the end of the command). If the command requires arguments to be passed, they are supplied as comma-spaced values following the command number. For example, command 30 prepares the telescope to move to the service position. Command 12 tells the telescope to actually move. Neither of these commands take any arguments. Thus, to move the telescope to the service position, enter the following at a terminal:

```
> python tcsclient.py ``#30;''
> python tcsclient.py ``#12;''
```

Similarly, rate correction can be toggled with command 19. It takes a single, boolean argument: 1 to turn rate correction on, or 0 to turn it off. Thus, turn turn on rate correction, issue

```
> python tcsclient.py ``#19,1;''
```

A partial list of commands is:

Command	Description
6	Prepares the telescope to move to a given position in the sky (must be followed by command 12 to actually move). It takes three arguments: RA, DEC, and EPOCH. An example would be: `` ``#6,0.4014,-72.0817,2000.0;'' ``
12	Moves the telescope to a pre-determined location. You will hear the TCS box in the "darkroom" beep when the telescope is in position.
14	Toggle sidereal tracking. To turn it on, use: `` ``#14,15.041,0.0,0.0,0.0;'' `` as the entire argument to the `tcsclient` script. To turn it off, use: `` ``#14,0.0,0.0,0.0,0.0;'' ``
19	Toggles rate correction. It takes a boolean argument: 1 to enable rate correction, or 0 to disable it.

Command	Description
21	Toggles dome tracking. It takes a boolean argument: 0 to turn it off (and return the dome to home position), or 1 to turn it on.
26	Queries the telescope status. The number of interest in the return value is the fifth entry in the array (fourth zero-based entry). If this flag is set (equal to 1), then the target is out of range (below the horizon). If this flag is not set (equal to 0), then then telescope will be able to see the target. Ideally, the return value should be `[0, 0, 0, 1, 0, 1, 1, 1]` when the telescope is ready to expose.
30	Prepares the telescope to return to the service position (must be followed by command 12 to actually move)

D Moving the Telescope-The Difficult Way

If **and only if** you are familiar with the internal workings of the Curtis-Schmidt TCS, you can manually move the telescope to a single target position by entering the following, replacing `RA`, `DEC`, and `EPOCH` with the appropriate target coordinates (`RA` in HH:MM:SS, and `DEC` in DD:MM:SS)

```
> cd ~/tcs/dfmtcsdes
> slew RA DEC EPOCH
> go
```

> Alternately, you can use the **`tcsclient`** script, replacing `RA`, `DEC`, and `EPOCH` with the appropriate target coordinates (`RA` in HH.HHH, and `DEC` in DD.DDD):[a]
>
> ```
> > cd ~/tcs
> > python tcsclient.py ''#6,RA,DEC,EPOCH;''
> > python tcsclient.py getstatus
> > python tcsclient.py ''#12;''
> ```
>
> Command 6 prepares the telescope to move to the selected target. The **`getstatus`** command returns the telescope status. You should ensure that the telescope status reads `[0, 0, 0, 1, 0, 1, 1, 1]`. Pay particular attention to the fifth flag (the fourth zero-based flag) of the telescope status response; if this flag is set (equal to 1), then the target is out-of-range. Command 12 causes the telescope to actually move to the target.
>
> [a] Refer to section C.2 for more information on using **`tcsclient`**.

Note that you will hear the TCS box in the "darkroom" beep when the telescope is in position. You can verify the telescope position by issuing

```
> cd ~/tcs
> python tcsclient.py getcoords
```

E Utility scripts

Several utility scripts have been created to simplify many of the exposure-related and book-keeping tasks. They are located in the ∼/tcs directory; newer versions are available in the ∼/tcs directory. Some of those scripts might change to accommodate specific user needs. The most commonly used scripts are listed here.

E.1 Python scripts

Many of the nightly tasks, such as taking biases, dark images, and dome flats, have been simplified by means of the Python script called `precam_acquire_images.py`, which can be found in the ∼/tcs directory. `precam_acquire_images.py` takes a single argument, a configuration file. There are configuration files for taking biases, darks, dome flats, zenith pointing standards, and even ObsTac-generated target lists. Examples of using the `precam_acquire_images.py` are shown below. If none of these configuration files meets your needs, you can copy one and edit the copy accordingly.

Before you run the first Python script make sure that you enter the following commands in a terminal window

```
> join_instance PCObs#
> setup SISPI
> cd ~/tcs
```

where "#" stands for whatever the current instance name is (see `setup_sispi_cs`).

Now you are ready to execute one of the Python scripts listed here:

E.1.1 biases

To take bias frames issue the command

```
> python precam_acquire_images.py bias_frames.config
```

E.1.2 dark frames

To take dark frames issue the command

```
> python precam_acquire_images.py dark_frames.config
```

E.1.3 flat fields

To take regular dome flat fields issue the command

```
> python precam_acquire_images.py flat_field.config
```

E.1.4 photon transfer curves

To take photon transfer curves issue the command

```
> python precam_acquire_images.py flat_ptc.config
```

E.1.5 focus sweeps

To take focus sweeps issue the command

```
> python precam_acquire_images.py focus_sweep_NGC288r_quick.config
```

E.1.6 ObsTac-Generated Observing Lists

To run through an ObsTac-generated observing list (in this case, a list generated for the night of MJD55540):

```
> python precam_acquire_images.py obstac_mjd55540.config
```

E.1.7 various specific fields

Here is a list of configuration files for various standard fields that can be covered depending on circumstances:

standard_06-30.config	standard_CDFS.config	standard_DLS0520.config
standard_E2a.config	standard_MCT2019.config	standard_PG2336.config
standard_SA114C.config	standard_SA93A.config	standard_SA94A.config
standard_SA95D.config	standard_TPHEB.config	

E.2 Shell script

E.2.1 transform.s (Outdated?)

ObStac-generated observations create many lines (from tens to several hundreds) of instructions of where to move the telescope and what kind of exposure to take. Instructions for measuring in Stripe 82, for example, are written by ObStac into files of the form `queue_as_tsv_#.txt` and read by the Python script `stripe82_obstac.py`. To help observer record the exposure time, filter setting, and RA and dec values for each observation in the nightly log file, we have written a simple shell script, `transfer.s`, that transfers the ObStac output format to the nightly log file format. The shell script needs an input file (e.g. `queue_as_tsv_7.txt`) and creates an output file (e.g. `logfile`) and is executed as

```
> cd ~/tcs
> transform.s queue_as_tsv_7.txt logfile
```

The content of `logfile` can then be copied by your favorite editor into the nightly log file. For completeness, the main content of `tranform.s` is

```
more queue_as_tsv_7.txt|awk '{printf``4000\t\t\t%3.0f\t%s\t%6.2f\t%6.2f\t\n'',$4,$3,$1,$2}' >> logfile
```

Although it should not be necessary to modify `tranform.s`, you should only edit it if you are familiar with shell script and awk.

F Printing

Compiling this document in latex produces a `.PDF` file that is approximately 15MB big, because the `.PNG` files have much larger resolution than necessary. If `Adobe Acrobat` is installed on your Windows based PC (or laptop), you can print the `.PDF` file to the "Adobe PDF" printer and therefore reduce the `.PDF` file size to approximately 600kB.

The only printer currently available to PreCam is the Lexmark T644 printer on the ground floor of the Blanco telescope (IP address is `139.229.13.80`). There is no printer queue installed on the PreCam computers. So this document must (currently) be printed from a laptop computer with the Lexmark T644 printer installed.

On a Windows machine, you set up the printer using the "Add a Printer Wizard", and choosing "Local Printer attached to this computer". Under "Select a Printer Port", choose "create a new port" and "Standard TCP/IP port", and follow the Wizard that pops up.

On an Apple Mac, the print settings for the Lexmark printer are
address: `lpd://139.229.13.80/`
name: `CTIO4m-npt0`

You can also find a "CTIO printers HowTo" at
`http://www.ctio.noao.edu/sys/printers.php`.