

# User Manual

## Notes for the reader

This manual is intended to supplement the existing TCS and instrument user's guides, filling the void of information about the telescope and facility, and providing recipes for observing with the telescope-instrument-TCS combination.

For detailed information about the TCS and instrument software, please refer to the manuals listed below, which are available in the warm room, the hostel library, and are linked to on the 1.0-metre section of the following web page:

<http://www.saa.ac.za/observing/operating-manuals>

- "[https://topswiki.saa.ac.za/1.0-m Telescope Control Software: A User's Guide](https://topswiki.saa.ac.za/1.0-m-Telescope-Control-Software-A-User's-Guide)"<https://topswiki.saa.ac.za> by Stephen Potter & Hannah Worters
- "[https://topswiki.saa.ac.za/SAAO CCD Camera Control Program, version 1.2](https://topswiki.saa.ac.za/SAAO-CCD-Camera-Control-Program-version-1.2)"<https://topswiki.saa.ac.za> by J. W. Menzies
- "[https://topswiki.saa.ac.za/SHOC User Guide](https://topswiki.saa.ac.za/SHOC-User-Guide)"<https://topswiki.saa.ac.za>, by Rocco Coppejans
- SHOC wiki <https://topswiki.saa.ac.za/index.php/SHOC>

Much of the manual assumes that the user has never before set foot in the dome, and has no local human to guide them. This is particularly true for Chapter~\ref{chap-tour}. {\bf If you are familiar with the telescope, you may wish to skip Chapter~\ref{chap-tour}, but please read Chapters~\ref{chap-limits} and~\ref{chap-faults} as some things have changed(!)}. Observing recipes are given in Chapters~\ref{chap-start} to~\ref{chap-end}, which may prove useful as checklists for experienced observers and novice users alike.

Please send comments/requests/omissions to [hannah@saa.ac.za](mailto:hannah@saa.ac.za).

## A guided tour of the 1-m dome

The purpose of this section is to introduce you to the facilities and equipment you will need during your run. The tour begins at the front door of the 1-m dome. To aid orientation, the domes of the 0.5-m, 0.75-m and 1.0-m are aligned East-West, perpendicular to the main road that passes SALT at the Northern end of the plateau and leads to the ``Robotic Row of telescopes in the South.

## Ground floor power & light switches

- The **main power switch** for the telescope and lighting circuits is just inside the second front door on the right. Switch this on when you enter. A red light will illuminate above the switch.

- **Foyer and stairwell light switches** can be found on the same wall, just around the corner to the right, at the foot of the stairs. There is a second switch for the stairwell/foyer lights at the top of the stairs.

## Ground floor facilities

As you enter the dome on the ground floor, you will find the following facilities:

- **Fire extinguisher:** mounted to the wall on the right as you enter.
- **First aid kit:** on a shelf to the left as you enter the dome.
- **Toilet:** through the first door on the left as you enter the dome. The light switch is outside the door on the right. (Don't be alarmed if you discover that these facilities are occupied during the night; the neighbouring IRSF does not have its own toilet.)
- **Kitchen:** located beyond the staircase on the right. It has recently been refurbished and has a sink with running water, a microwave, coffee maker, kettle, toaster, snackwich and an array of cutlery and cheerful crockery. There are jars of teas, coffees, hot chocolate, sugar and creamer. The kitchenware is cleaned daily by the hostel staff, except at weekends.

## Upstairs light switches

- **Light switches on the left at the top of the stairs.** One is for the stairwell/foyer lights; the other for the observing floor incandescents.
- The **switch for observing floor fluorescent lights** is located inside the small door facing the stairs, next to the controls for the air conditioning.
- The **switch for upper dome fluorescent lights** is on the grey Observing Floor Control Panel on the wall by the North pier.

## The Observing Floor

At the top of the stairs, you will find the telescope on the "[https://topswiki.sao.ac.za/observing floor](https://topswiki.sao.ac.za/observing-floor)". The North pier is nearest the stairs. Familiarise yourself with the following:

- **Blue console on the East side of the North pier.** You will use this console to slew the telescope to your targets. The telescope power switch and dome rotation controls are also on this console.
- **Grey box by the blue console.** If the telescope reaches its safe operating limits, the red light on this box will flash, an alarm will sound and the telescope drives and dome rotation will be disabled. There is an override key attached to the box, used to allow the telescope to be moved out of the limits -- see [Section~\ref{sec-limits}](#).
- **Emergency stop button on the grey box.** There is a large red button to press if the drive motors fail to stop. If you have reason to press this, call a technician to investigate.
- **XY-slide reset button on the grey box.** On the top of the grey box with the emergency stop button is a small blue button to press if the TCS XY-slides fail to respond.
- **PC monitor to the right of the North pier.** This screen displays pointing information, including your target coordinates and current telescope coordinates, for use when slewing the telescope.
- **Observing Floor Control Panel.** On the North wall by the North pier there is a grey box labelled "[https://topswiki.sao.ac.za/Dome Shutter and Windblind Control](https://topswiki.sao.ac.za/Dome%20Shutter%20and%20Windblind%20Control)", which has red buttons for opening/closing the dome shutter and raising/lowering the windblind. One must first switch

on the telescope power (blue console) and press the top button labelled "Request Local Control" to activate the panel. The red indicator will illuminate when the panel is active. To open/close the dome, push and hold the appropriate button until the shutters stop moving and you hear a beep. To raise/lower the windblind, push and hold the appropriate button until the blind reaches the desired height. **Do not raise the windblind while pointing into the wind; first rotate the dome by 180°, raise the blind then rotate back.** There is also a switch for the upper dome lights.

- *Yellow hand paddle on the wall facing the stairs. As of October 2011, the yellow paddle is no longer in use.* The Observing Floor Control Panel should be used to open/close the dome and raise/lower the windblind.
- **Dome flat lamp switch.** On the North wall, just above and left of the monitor, is a dimmer switch that controls the incandescent lamp used for taking dome flats (see Section~\ref{sec-domeflats}).
- A red **balance weight** on a rope, which can be hung from an appropriate place below the primary mirror cell if the telescope jumps while tracking (usually when tracking around the zenith).
- Tall and short **wheeled ladders** for hanging the weight and for accessing the reset buttons on the Merlin transputer crates. Make sure the ladders are clear of the telescope while observing (the taller ladder is usually stored on the West side of the observing floor under the catwalk, the other is pushed to the East side of the North pier).

## The Telescope

On the telescope itself, identify the following:

- **Mirror cover motor:** on the East side of the telescope below the primary mirror is a button to open/close the primary mirror covers.
- **Acquisition/guider box and autoguider camera:** the former is a large black box mounted directly below the primary mirror cell. The XY-slides and acquisition/autoguider camera are mounted on the South side of the guider box.
- **TCS Merlin crate:** above the autoguider camera is a small blue electronics crate. This is the Merlin transputer for the TCS. On the side is a red reset button that should be pressed if the TCS encounters a "Merlin error".
- **Filter wheels:** The blue metallic box below the acquisition/guider box contains the filter wheel(s), labelled on the East and West sides.
- **Instrument:** SHOC, STE3 or STE4 (or your own instrument) will be mounted below the filter box.
- **STE3/STE4** has its own blue **instrument Merlin crate** mounted to the cylindrical dewar. There is a red reset button on the side of the crate that should be pressed if the instrument control software hangs, crashes or reports a "Merlin error". There is no need for observers to fill the dewar with liquid nitrogen; this is done by technicians in the morning and afternoon.
- **SHOC** does not require liquid nitrogen; it is peltier-cooled. It has no Merlin crate. The control PC ("zashocnawe" or "zashocndisbelief") is mounted in a crate below the primary mirror cell.

## Filters

The blue metallic box below the acquisition/guider box contains the filter wheel(s), labelled on the East and West sides. Each wheel has 8 filter positions; position 1 is the reference and position 8 is always empty. **Filters must**

**not be removed from the filter wheels.**

You will have been allocated the appropriate wheel(s) for your run based on the filters specified in your observing proposal. A **filter wheel rota** can be found pinned to the notice board on the South pier. It details the filter in each position of each wheel and the name of the wheel(s) you have been allocated. If the incorrect wheel is in the telescope, please contact a technician. Please direct any other filter-related enquiries to hannah@sao.ac.za.

## The Warm Room

The warm room is situated on the East side of the observing floor. The light switch is a dial just inside the door on the right as you enter. Here you have the following resources at your disposal:

### Computing facilities

In the warm room, you will find:

- **If using STE3 or STE4**, a PC labelled **imag40**, running the CCD Camera Control software.
- A thin client with monitor labelled **ltsp** that saves the data from the instrument PC and can be used to run a web browser, ds9, etc. For SHOC, it can be used to run the instrument control software via a web browser. It is possible to download your data to a laptop on the network from this PC (use **scp** or **sftp ccd40@ltsp.suth** - the monitor is labelled with the password).
- A PC running the **Telescope Control Software (TCS)** for acquisition and guiding. Associated with this are a second monitor on a shelf (which displays the target and telescope coordinates, etc.) and **hand paddle** for fine adjustment of the telescope coordinates while acquiring an object.
- Several network cables and power sockets for use with laptops.
- A black & white printer. Print command: **lpr -Ppr30in filename**

At present there are no DVD writers, USB ports or DAT drives in the dome for copying data from ltsp.

### Operational resources

- A **duty technician** phone number list, on the wall.
- Laminated facility **start-up and shutdown recipes**.
- Assorted notices providing information on **telescope limits, weather resources**, etc.

**Log books, almanacs, etc.**

In the warm room, in labelled boxfiles on a shelf above the TCS monitor, you will find the following resources to help with your observations:

- **Users' guides** for the TCS, STE3/STE4, SHOC and the retired UCT CCD, which contains useful information about the online reductions programme for STE3/4.

- A triplicate **CCD Camera log book** in which to record details of each image if you are using STE3/STE4. If you finish a

log book, there are more on top of the metal cupboard on the observing floor. Please take the n

- A **Sutherland Almanac**, including bright stars, sunset/rise and twilight times, phases of the moon, etc.
- A catalogue of photometric **standard stars**.
- An A4 sheet entitled **Sutherland Observing Record**, on which to log the duration of observations, time lost, etc. each night.

#### General warm room resources

1. A **telephone** and a list of internal extensions and emergency numbers (please request a phone code on arrival if you wish to call outside SAAO). The following numbers apply:
  - Extension number: **9108** (to phone from within the observatory)
  - To phone the dome from outside: **023 100 0222** (+27 23 100 0222 from outside South Africa)
1. A new **stereo** compatible with iPods and iPhones, and plays CDs, MP3s from DVDs and USB devices, and has a radio.
2. An **air-conditioning unit**, the controls for which are behind the instrument PC, on the wall inside the small door.
3. Assorted desk **lamps**.
4. A portable **heater** under the desk.

Please do **not** plug lamps or heaters into the UPS sockets!

## Observing Limits

### Meteorological constraints

The dome must be closed when any of the following weather limits is reached:

- **Humidity:**  $T_{\text{external}} - T_{\text{dew}} \geq 1.5$
- **Wind speed:** 60 km/h. Dome must be parked **facing into the wind**.
- **Heavy cloud**

### Meteorological information

The following should be used for regular monitoring of external conditions while observing:

- DIMM seeing data and all the weather stations on the plateau are summarised on this page [\[1\]](#)
- For assessing sky conditions, SALT and LCOGT operate **bf all sky cameras**, also available on the website above.

## Telescope pointing limits

The operational limits of the telescope are depicted in Figure~\ref{fig-limits}. Please keep an eye on the instrument when slewing the telescope to ensure that it doesn't strike the pier.

If the telescope reaches the limits, the drive motors will cut out, dome rotation will be disabled, an alarm will sound and a red light will flash on the grey box on the East side of the North pier. To recover, turn the override key on the grey box, switch the drives to FAST mode and slew the telescope away from the limits. **Be very sure that you know which way to slew, as the telescope can be moved in any direction when the override key is turned.** If in doubt, call a technician.

- Limits.jpg  
1.0-m telescope observing limits

## Start-up recipes

### Facility start-up procedure

Follow this procedure to prepare the telescope and dome for observing:

1. **Check the weather conditions}. If they are within the limits specified in Section~\ref{sec-weather}, continue with step 2.**
2. Enter dome and {\bf hook both doors open} to allow good air circulation.
3. **Switch on the main power switch**, just inside the door on the right.
4. **Switch off the lights in the foyer** using the switches to the right of the stairs.
5. **Switch off any other downstairs lights** (kitchen, toilet, etc.).
6. **Switch off the observing floor incandescent lights** (switch at top of stairs) **and fluorescent lights** (switch inside **small** door to warm room).
7. On the blue console on the North pier, **switch on the telescope power and enable Auto Dome**.
8. **Request control** at the grey Observing Floor Control Panel by the North pier.
9. **Open the dome shutters** by pressing the appropriate red button on the Observing Floor Control Panel. Hold the button in until the shutters stop moving and the beep sounds.
10. If necessary, **lower the windblind** using the appropriate button on the Observing Floor Control Panel.
11. **Open the mirror covers** by pushing the appropriate button below the mirror cell.
12. **Switch on the coordinate repeater monitors** beside the North pier and in the control room above the TCS.

## TCS start-up procedure

### If the TCS software is running

If the TCS is up and running (as is usually the case), do the following at the start of the night:

- **Initialise the XY slides** by clicking **Initialize** in the "<https://topswiki.sao.ac.za>XY Slides Control"<https://topswiki.sao.ac.za> panel on the TCS display.
- **Select the appropriate guide mirror position**

The guide mirror must be **out of the beam** for:

- skyflats or domeflats
- while integrating with the instrument PC
- autoguiding

The guide mirror must be **in the beam** while:

- acquiring a field with the acquisition camera

The guide mirror can be moved in and out of the beam by clicking the large button above the "https://topswiki.sao.ac.zaXY Slides Control" box on the TCS screen. If the button is red and says "GUIDE MIRROR IS IN BEAM", clicking it will move the mirror, turning the button green and changing the message to "GUIDE MIRROR IS OUT OF BEAM". The converse is also true.

### **If the TCS PC is on but the software is not running**

If the TCS PC is alive and responding but the programme is not running, it can be started by double-clicking on the TCS icon on the desktop and entering the password in the pop-up box (consult local technical staff for the password). You should then follow steps 1 and 2 in Section~\ref{sec-tcsnormalstart}.

### **If the TCS PC is switched off or not responding**

Please call the duty electronics technician using the phone number displayed in the warm room.

## **Instrument start-up procedure**

### **STE3/STE4**

1. Follow the start-up procedure described in Sections 1 and 2 of the "https://topswiki.sao.ac.zaSAAO~CCD Camera Control Program, version 1.2" by J. W. Menzies, available in the warm room and on this page: [\[2\]](#)

**Important:** Ensure that the following are correct in the blue "https://topswiki.sao.ac.zaDetails of Run" startup panel:

- **CCD:** select STE3 or STE4
- **Wheel A & B:** enter "https://topswiki.sao.ac.za" into both boxes to enable filter wheels
- **Next file number:** if this is incorrect, existing images could be overwritten

1. Initialise the filter wheels, move to the desired filter and adjust the prebin or window setting, if required.
2. Take a bias frame (run a single line module with Repeats=1, Image Type=Bias and Save=Yes) and **check that it saves to**

/data/40in/imag40/YYYY/MMDD on ltsp.

(Note: The data is initially written to the local disk on imag40 (/data/ccd/image/xyx). An rsync job runs on asuthastro every 15 seconds which moves the data onto the SAN. This is accessible from the thin client, logged in as ccd40 in /data/40in/imag40/YYYY/MMDD.

## Observing recipes: sky flats & dome flats

### Sky flats

If sky conditions are photometric during morning/evening twilight, you will be able to take sky flats. See Section~\ref{sec-domeflats} if you need dome flats. Sky flats can be obtained in the following way:

1. Follow the **facility start-up** procedure in Section~\ref{sec-facstartup}.
2. Follow the appropriate **instrument setup** procedure (Section~\ref{sec-inststartup}).
3. **Slew the telescope to the zenith**, with the open dome shutter facing in the opposite direction to the rising/setting sun. Leave the drives in FAST mode (i.e. not tracking).
4. On the TCS, move the **guide mirror out of beam**.
5. On the instrument PC, **select the required filter**. If you need flats in a variety of filters, be sure to cycle through them in the correct order (e.g. UBVRi during evening twilight; IRVBU in the morning). This also applies if you need a range of prebin settings (i.e. start with low binning in the evening; high to low binning in the morning).
6. **With STE3/STE4**, click "<https://topswiki.sao.ac.za/Expose>"<https://topswiki.sao.ac.za/>, create a module, select "<https://topswiki.sao.ac.za/Flat>"<https://topswiki.sao.ac.za/> for the image type, and "<https://topswiki.sao.ac.za/Sky>"<https://topswiki.sao.ac.za/> from the pulldown menu beside it. Keep the count rates between 20000 and 50000. Remember to select "<https://topswiki.sao.ac.za/Yes>"<https://topswiki.sao.ac.za/> under "<https://topswiki.sao.ac.za/Save to Disk>"<https://topswiki.sao.ac.za/>. Snapshots can be used to gauge integration times and can be saved to disk if appropriate. Section~\ref{sec-SAAOskeyflats} gives a recipe for taking sky flats. See Section~4 of "<https://topswiki.sao.ac.za/SAAO~CCD Camera Control Program, version 1.2>"<https://topswiki.sao.ac.za/>, by J. W. Menzies, for more detailed instructions on setting up a module.
7. Take a **minimum of 15 flats in each filter/prebin setting**, keeping exposure times  $\geq 1$ s with STE3/4 to allow the shutter time to open and close (SHOC has no shutter so does not have this limitation).

### Sky flat recipe for the STE3/STE4: Modules

Since all exposures with the SAAO~CCD must be performed via a module (except for snapshots), it may seem challenging to set up and edit modules quickly enough to obtain sufficient sky flats during twilight. However, you can do this pretty quickly using the following example:

1. **Before twilight**, set up a module for your first filter and an exposure time of 1s (do not go below 1~s), with 1 repeat.
2. For evening twilight, perform steps 1-4 of Section~\ref{sec-sky} to setup the telescope and facility prior to sunset.
3. Click the small grey "<https://topswiki.sao.ac.za/On>"<https://topswiki.sao.ac.za/> button below the SAAO CCD image display.
4. Shortly before (morning) or after (evening) sunrise/set ~10 minutes after sunset for B) click "<https://topswiki.sao.ac.za/Snapshot>"<https://topswiki.sao.ac.za/> ? Exposure time = 1s. Click



- "https://topswiki.sao.ac.zaReady" https://topswiki.sao.ac.za to expose.
5. Hover the cursor over the top portion of the image display as the image reads out, and read off the count level in the yellow "https://topswiki.sao.ac.zaADU" https://topswiki.sao.ac.za box below the image. Assess how the exposure time needs adjusting to maintain counts of 20000-50000 as the sky darkens/brightens.
  6. **During readout** click "https://topswiki.sao.ac.zaExpose" https://topswiki.sao.ac.za ? acknowledge the error message ? "https://topswiki.sao.ac.zaSelect" https://topswiki.sao.ac.za module. Click on the desired module ? "https://topswiki.sao.ac.zaEdit" https://topswiki.sao.ac.za. Adjust the exposure time in the box at the bottom ? "https://topswiki.sao.ac.zaReplace" https://topswiki.sao.ac.za ? "https://topswiki.sao.ac.zaSave" https://topswiki.sao.ac.za ? "https://topswiki.sao.ac.zaContinue" https://topswiki.sao.ac.za.
  7. Enter number of modules = 1, Image Type = Flat ? Sky. Save to disk = Yes.
  8. When the CCD finishes reading out, click "https://topswiki.sao.ac.zaReady" https://topswiki.sao.ac.za.
  9. Repeat steps 5-8 until you have enough flats, or until the counts are too low in that filter.
  10. To move onto the next filter, repeat step 6, but edit the filter number as well as the exposure time.
  11. Continue steps 5-9 until you have sufficient flats in all your program filters.

With practice, you will easily be able to do this before the CCD finishes reading out in 2x2 binning.

## Dome flats

If poor weather conditions during twilight prevent you from obtaining sky flats, dome flats can be used instead. These can be obtained at any time by imaging a "https://topswiki.sao.ac.zauniformly" https://topswiki.sao.ac.za illuminated screen in the dome in the following way:

1. Follow the facility start-up procedure in Section~\ref{sec-facstartup}, but there is no need to hook the outside doors open and **do not open the dome. Remember to open the mirror covers.**
2. Follow the appropriate **instrument setup** procedure in Section~\ref{sec-inststartup}.
3. **Switch on the domeflat lamp** by turning the dial on the wall between the North pier and the blue console.
4. **Rotate the dome** to an azimuth of 180°, such that the lamp on the catwalk illuminates the round, white screen on the dome as uniformly as possible.
5. **Slew the telescope** to HA = -3h 16m, Dec = -14° 37'
6. **Expose and save** at least fifteen flats for each of the required combinations of filters and binning.

You may need to adjust the dial on the incandescent lamp between filters to achieve manageable exposure times. With STE3/4, keep exposure times ?1s to allow the shutter time to open and close.

## Observing recipes: on sky

The pointing model of the 1.0-metre is greatly improved in recent years, but is not quite perfect. It may be necessary to point to a bright star near your target to allow the TCS to calculate the pointing offset in each part of the sky. One set of offsets will be applicable to a range of positions.

## Determining pointing offsets using a bright star

Follow the facility start-up procedure in Section~\ref{sec-facstartup}.

1. Using the Astronomical Almanac or Sutherland Almanac, select a bright star ( $\sim 4^{\text{th}}$  mag) near your science target (ideally within RA~30m and dec~10°).
2. Check that the target and bright star selected are within the observing limits given in Section~\ref{sec-limits}.

### On the TCS:

1. **Initialise** the XY-slides.
2. Move the **guide mirror into the beam**.
3. Click "<https://topswiki.sao.ac.za/TARGET>"<https://topswiki.sao.ac.za> and type the RA & Dec of the bright star into the appropriate boxes, then click "<https://topswiki.sao.ac.za/SET>"<https://topswiki.sao.ac.za> and "<https://topswiki.sao.ac.za/CLEAR>"<https://topswiki.sao.ac.za>. The coordinates will appear in yellow on the monitors above the TCS and on the observing floor to help you point to the target.
4. Type the **equinox** of the bright star coordinates into the "<https://topswiki.sao.ac.za/SET>"<https://topswiki.sao.ac.za> EQUINOX"<https://topswiki.sao.ac.za> box and press "<https://topswiki.sao.ac.za/ENTER>"<https://topswiki.sao.ac.za> on the keyboard.

### At the blue console by the North pier:

1. Switch the central toggle switches to FAST.
2. Use the yellow RA & Dec buttons to slew to the bright star, watching both ends of the telescope as well as the coordinate display monitor. You should point to within 30s (RA) and 1-2 arcmin (dec) of your target coordinates.
3. Switch the central toggle switches to SLOW to commence tracking.

### Back at the TCS:

1. Set "<https://topswiki.sao.ac.za/ExpTime>"<https://topswiki.sao.ac.za> to ~1s and "<https://topswiki.sao.ac.za/WINDOW>"<https://topswiki.sao.ac.za> to "<https://topswiki.sao.ac.za/Fullframe>"<https://topswiki.sao.ac.za> to take images with the acquisition camera.
2. Use the hand paddle for fine adjustment of the telescope to the star's coordinates, while watching the image display for the bright star to appear.
3. If the bright star is not apparent, adjust "<https://topswiki.sao.ac.za/ExpTime>"<https://topswiki.sao.ac.za> to ~10s and look for light from the star beaming in from one side of the image, revealing its position. Looking through the finderscope might help determine in which direction to move the telescope. If this fails, reduce the exposure time and scan the field systematically in RA & Dec.
4. Once the bright star appears, select the minimum exposure time, centre the star on the image and click "<https://topswiki.sao.ac.za/P>"<https://topswiki.sao.ac.za> by the target button.
5. Select "<https://topswiki.sao.ac.za/ZEROPOINTS>"<https://topswiki.sao.ac.za> ? "[https://topswiki.sao.ac.za/Enter RA & Dec of Star](https://topswiki.sao.ac.za/EnterRA&DecofStar)"<https://topswiki.sao.ac.za>, then type the **catalogue coordinates** of the bright star into the boxes and press "<https://topswiki.sao.ac.za/SET>"<https://topswiki.sao.ac.za>.
6. The RA & Dec zeropoints will be displayed in the message box. Note them down with the HA & Dec as you will need to re-enter them using "<https://topswiki.sao.ac.za/ZEROPOINTS>"<https://topswiki.sao.ac.za>

? "https://topswiki.sao.ac.zaEnter Zeros Directly"https://topswiki.sao.ac.za if the TCS software is restarted, or if you return to this part of the sky after using different zeropoints in a different position. You do not need different zeropoints for different equinoxes. There is no need to note the collimation coefficient as it is ignored by the pointing model.

## Acquiring a target

1. Follow the facility start-up procedure in Section~\ref{sec-facstartup}.
2. Check that the selected target is within the observing limits given in Section~\ref{sec-limits}.

### On the TCS:

1. **Initialise** the XY-slides.
2. Move the **guide mirror into the beam**.
3. Click "https://topswiki.sao.ac.zaTARGET"https://topswiki.sao.ac.za and type the RA & Dec of the target into the appropriate boxes, then click "https://topswiki.sao.ac.zaSET"https://topswiki.sao.ac.za and "https://topswiki.sao.ac.zaCLEAR"https://topswiki.sao.ac.za. The coordinates will appear in yellow in the monitors above the TCS and on the observing floor to help you point to the target. (If you cannot see a "https://topswiki.sao.ac.zaTARGET"https://topswiki.sao.ac.za button, click the "https://topswiki.sao.ac.zaO"https://topswiki.sao.ac.za in the left-hand corner below the "https://topswiki.sao.ac.zaSET EQUINOX"https://topswiki.sao.ac.za box.)
4. Type the **equinox** of the target coordinates into the "https://topswiki.sao.ac.zaSET EQUINOX"https://topswiki.sao.ac.za box and press "https://topswiki.sao.ac.zaENTER"https://topswiki.sao.ac.za on the keyboard.

### At the blue console by the North pier:

1. Switch the central toggle switches to FAST.
2. Use the yellow RA & Dec buttons to slew to the target, watching both ends of the telescope as well as the coordinate display monitor. You should point to within 30s (RA) and 1-2 arcmin (dec) of your target coordinates.
3. Switch the central toggle switches to SLOW to commence tracking.

### Back at the TCS:

1. Set "https://topswiki.sao.ac.zaExp Time"https://topswiki.sao.ac.za to ~2-4s and "https://topswiki.sao.ac.zaWINDOW"https://topswiki.sao.ac.za to "https://topswiki.sao.ac.zaFull frame"https://topswiki.sao.ac.za to take images with the acquisition camera.
  2. Use the hand paddle for fine adjustment of the telescope to the target's coordinates while watching the image display for the target field to appear. Comparison with an  $8 \times 8$ ~arcmin finderchart is most helpful.
1. The position should be accurate if you have followed the procedure in Section~\ref{sec-brightstar}, so check your zeropoints. If not, adjust "https://topswiki.sao.ac.zaExp Time"https://topswiki.sao.ac.za to search for patterns in fainter stars to compare with your finderchart. If this fails, then reduce the exposure time and scan the field by systematically adjusting RA & Dec.

1. Once the target is identified, position it on the image display such that it falls on the centre of the science CCD.
  - **For STE4**, position the star approximately on coordinates (210, 270) of the TCS image display, to coincide with the centre of the science detector (for **STE3**, approximately (180,190)).
  - Move the **guide mirror out** to direct the beam to the science detector.

### On the instrument PC:

- Take a snapshot (STE3/4) or preview (SHOC) to check the positioning of the target on the detector and adjust using the handset.
- Using **STE3/4**, video mode can be invoked by clicking ["https://topswiki.sao.ac.za/Snapshot"](https://topswiki.sao.ac.za/Snapshot)<https://topswiki.sao.ac.za/>, entering an integration time, selecting ["https://topswiki.sao.ac.za/Video"](https://topswiki.sao.ac.za/Video)<https://topswiki.sao.ac.za/> and clicking ["https://topswiki.sao.ac.za/Ready"](https://topswiki.sao.ac.za/Ready)<https://topswiki.sao.ac.za/>. It can be stopped by clicking ["https://topswiki.sao.ac.za/Snapshot"](https://topswiki.sao.ac.za/Snapshot)<https://topswiki.sao.ac.za/> and ["https://topswiki.sao.ac.za/Stop"](https://topswiki.sao.ac.za/Stop)<https://topswiki.sao.ac.za/>. Video mode automatically prebins the CCD, so remember to change back to 1x1 afterwards, if appropriate.
- **For a short run of short exposures**, you may set up a module (STE3/4 - see ["https://topswiki.sao.ac.za/SAAO~CCD Camera Control Program version 1.2"](https://topswiki.sao.ac.za/SAAO~CCD%20Camera%20Control%20Program%20version%201.2)<https://topswiki.sao.ac.za/>, J.W. Menzies) and begin to observe

or

- **For a long run or for exposures ?100s, you should locate a guide star and setup the autoguider before integrating on your target.**

## Finding a guide star & autoguiding

### On the ltsp PC:

- Open a terminal (click the black screen icon on the top menu panel)
- Type `cd /usr/local/sao/40inGuiders`
- Type `source runit`

### In the DS9 interface that pops up:

- From the ["https://topswiki.sao.ac.za/Analysis"](https://topswiki.sao.ac.za/Analysis)<https://topswiki.sao.ac.za/> pull-down menu, select ["https://topswiki.sao.ac.za/DSS Server"](https://topswiki.sao.ac.za/DSS%20Server)<https://topswiki.sao.ac.za/>.
- In the ["https://topswiki.sao.ac.za/DSS Server"](https://topswiki.sao.ac.za/DSS%20Server)<https://topswiki.sao.ac.za/> window, click on the ["https://topswiki.sao.ac.za/DSS Server"](https://topswiki.sao.ac.za/DSS%20Server)<https://topswiki.sao.ac.za/> menu and select either ["https://topswiki.sao.ac.za/DSS@STSCI"](https://topswiki.sao.ac.za/DSS@STSCI)<https://topswiki.sao.ac.za/> or ["https://topswiki.sao.ac.za/DSS@ESO"](https://topswiki.sao.ac.za/DSS@ESO)<https://topswiki.sao.ac.za/>. SAO no longer connects.
- Enter RA & Dec of target (using colons to separate coordinate units) in 20'x20' field of view and click ["https://topswiki.sao.ac.za/RETRIEVE"](https://topswiki.sao.ac.za/RETRIEVE)<https://topswiki.sao.ac.za/>.

- Once the field image loads with the target in the centre, choose a relatively bright star outside the circle. Place the mouse cursor over the star and read off the  $\{XY\}$  coordinates in the grey info area above the image.

### On the TCS:

- With the **guide mirror in beam**, click on "https://topswiki.sao.ac.zaMove XY"https://topswiki.sao.ac.za, then on the target star position in the acquisition image, then on "https://topswiki.sao.ac.zaZero XY"https://topswiki.sao.ac.za. This centres the field on the target so that the XY slide coordinates will be compatible with those you read off DS9 for the guide star.
- Move the **guide mirror out of beam**.
- In "https://topswiki.sao.ac.zaExposures & Guiding"https://topswiki.sao.ac.za set "https://topswiki.sao.ac.zaExpTime"https://topswiki.sao.ac.za ~2s (adjust as necessary).
- In "https://topswiki.sao.ac.zaXY Slides Control"https://topswiki.sao.ac.za, click "https://topswiki.sao.ac.zaGo To"https://topswiki.sao.ac.za and enter X and Y slide coordinates of chosen guide star from DS9.
- In "https://topswiki.sao.ac.zaPointers"https://topswiki.sao.ac.za click "https://topswiki.sao.ac.zaXY+Win+G"https://topswiki.sao.ac.za then click the chosen guide star. This will centre the guide star on the image, window the chip and begin guiding.
- To stop or restart guiding (e.g. after brief intervals of cloud), press "https://topswiki.sao.ac.zaGUIDE"https://topswiki.sao.ac.za.

## TCS operations at the end of an observation

### At the end of an observation:

- Click "https://topswiki.sao.ac.zaInitialize"https://topswiki.sao.ac.za in "https://topswiki.sao.ac.zaXY Slides Control"https://topswiki.sao.ac.za.
- In "https://topswiki.sao.ac.zaExposures & Guiding"https://topswiki.sao.ac.za set "https://topswiki.sao.ac.zaWINDOW"https://topswiki.sao.ac.za to "https://topswiki.sao.ac.zaFull Frame"https://topswiki.sao.ac.za.
- Move "https://topswiki.sao.ac.zaGUIDE MIRROR"https://topswiki.sao.ac.za into beam to acquire next target.

### At the end of the night:

- In "https://topswiki.sao.ac.zaXY Slides Control"https://topswiki.sao.ac.za, click "https://topswiki.sao.ac.zaSTOP"https://topswiki.sao.ac.za to cease A/G camera integrations.
- In "https://topswiki.sao.ac.zaXY Slides Control"https://topswiki.sao.ac.za, click "https://topswiki.sao.ac.zaInitialize"https://topswiki.sao.ac.za to home the XY slides.

## Shutdown procedures

### End of night shutdown

The usual shutdown procedure at the end of the night is given below. This list is printed on a laminated sign displayed in the warm room for quick reference.

1. Stop instrument & autoguider exposures (TCS PC).
2. Initialise XY-slides (TCS PC).
3. Park telescope at HA= -1h, Dec = 0° in FAST mode (blue console).
4. Switch Dome to MANUAL (blue console).
5. Close mirror covers (telescope).
6. Close dome shutters (Observing floor control panel - listen for beep).
7. Lower wind blind (if appropriate - Observing floor control panel).
8. Switch OFF telescope power (blue console).
9. Switch OFF facility power at exit.

### Closing in bad weather

If any of the weather limits is reached during the night, **perform these steps first** (you may need to slew the telescope to a suitable position in order to access the mirror covers):

1. Close mirror covers.
2. Close dome shutters (listen for beep).
3. Continue with the remaining steps in Section~\ref{sec-end}.

## {STE3/STE4: CCD Camera log book

If using STE3 or STE4, please fill in the triplicate CCD Camera log book for each image obtained, pressing hard enough for your words to register on all three sheets. If you are using SHOC, there is no such log.

The fields are explained as follows: \begin{itemize} \item {\bf Telescope:} 1.0-m.

\item {\bf Focus:} This is telescope focus. You may wish to make a note of

the acquisition camera focus for your own purposes.

\item {\bf CCD Type:} This will be STE3 if the unbinned detector dimensions are \$512 \times 512\$ pixels, else STE4 for \$1024 \times 1024\$.

\item {\bf CCD temp:} This refers to the ``Cu Block *temperature reported in the ``Temperature* section of the instrument status panel of the STE3/4 CCD Camera Control software.

\item {\bf Filters:} Enter the filter in each position of the two wheels. See Section~\ref{sec-tel}.

\item {\bf Date and Observers:} are self-explanatory.

\item {\bf Run number:} This is a 3-digit number that will apply to your data for the duration of your observing run (unlike the UCT~CCD convention). It will be prefixed to your image files, which will be named a{\em nnnxxxx}.fits, where {\em nnn} is the run number, {\em xxxx} is the file number. To determine your run number, check the previous run number in the log book and add 1.

\item {\bf File No.} is the number of the image ({\em xxxx} where the

filename is a{\em nnnxxxx}).

\item {\bf Object}: target name.

\item {\bf RA \& Dec}: it may help you to write here the exact telescope

coordinates when pointing to your target, as opposed to the catalogue coordinates. This information, together with the associated zeropoints, will enable you to re-acquire the target quickly in future.

\item {\bf Equinox}: of your target coordinates.

\item {\bf Start UT}: is reported in the status panel of the CCD Camera Control software, and remains visible until the next exposure is started.

\item {\bf Start sidereal time}: can be read from the TCS coordinate display monitors.

\item {\bf Int Time}: the exposure time in seconds.

\item {\bf Preflash}: this is not required with the current detectors. This box can be used to record the prebin setting.

\item {\bf Filter and Seeing}: are self-explanatory.

\item {\bf Guide star X Y}: these are the XY-slide coordinates of the

guide star used for each observation. Read them from the TCS ``XY Slides Control window while guiding, as they are not necessarily identical to the values you read from DS9.

\item {\bf Remarks}: Any applicable notes, e.g. the RA \& Dec zeropoints for the

specific coordinates used.

\end{itemize}

## **Current known issues (last updated Nov 2013)**

### **Telescope pointing problems/time server error**

If you encounter telescope pointing problems, check the time and date displayed on the TCS, as the cause could be the time server. If the date/time is wrong, please call the electronics technician for assistance.

## Latest pointing zeropoints

Date: 29/10/2013

RA zeropoint (s): -127

Dec zeropoint ("https://topswiki.sao.ac.za): 41