How to observe at the 2.3m at SSO using IMAGER and DBS

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THIS IS NOT A COMPLETE GUIDE AND WILL BE UPDATED. IF YOU USE IT, PLEASE TELL ME ABOUT THINGS THAT HAVE CHANGED OR SIMPLY ARE WRONGLY DESCRIBED HERE!!!

IT'S BASED ON MY VERY PERSONAL EXPERIENCE AND JUST A LITTLE HELPER.. FEEL FREE TO CONTACT ME ANY TIME IF YOU NEED HELP OR THINK I COULD HELP YOU!

Contents

1 BEFORE YOU START

Get familiar with the facilities, have a look around and make sure that you know how to fill the dewars (ask other observers or technicians). Make sure you find out about any current technical problems, best in the night before your run!

1.1 Computers

Have you even got an account? You'll need one!! Set up several desktops at each computer (*misty, mouldy & moist*) to make analysis and monitoring easy e.g.. *CICADA*, logbook, IRAF, weather (www.weatherzone.com.au, you have to become a free member first, no problem), data transfer, netscape, etc....

Some have to be at each computer, some not (apparently:-))

Leave all the computers running all the time! The technicians come in every morning to check things, but usually they don't need the computers. Tell them that they should not log you out if they do need a terminal.

1.2 Disk space at SSO

Choose a disk (type *df* to see which one is avaliable) and create your subdirectory there. You need this subdirectory for the output from the CCDs. Later you can then *scp/ftp* all your data wherever you want, or dump to tape. Note that the network to SSO is slow, so tape is the preferred option for large datasets.

The other solution is to start TELDISC and wipe out the data from the observer before you. Then you can automatically create a new subdirectory with you username, follow the directions - I prefer the first version

1.3 Tapes

How are you going to get your data home? The SSO data disks get zapped fairly regularly. Don't lose your data. There are Exabyte (XB-8500 - 2.3GB and 5GB) and DDS3 (can read and write DDS2 and DDS3 - compressed and uncompressed) drives in the 2.3m control room. Run the *tape-status* command to see which tape drives are free. All the tape drive at the 2.3m are mounted on *misty*.

1.4 Dewars

Fill dewars every 12 hours (roughly) and don't forget! If they get too warm the vacuum must pumped again (by the technician). *CICADA* tells you the temperatures (CCD and SINK) if you click on the little thermometer button. If the CCDs get too warm, an orange sign appears directly under the 'shutter closed' sign (usually green) in the lower right corner.

Before going downstairs, write the temperatures from the CCDI and the SINK in the log book and again when you are done. In the morning, switch 'continuous flush and read temperature' in the AM200 menu in *CICADA*.

1.5 IRAF

IRAF is most helpful for having a quick look at your data, checking count levels, quick and dirty analysis - that sort of thing. I suggest you learn how IRAF works before you get to SSO.

1.6 STUFF TO BRING

- Data tapes
- Target list AND finding charts for each target (DSS etc)
- Twilight sky flats table if you're imaging or will take sky flats
- Empty fields list - for twilight flat fields.
- Spectrophotometric standards for flux calibration of spectra.
- Music. stay-awake-type music for the 3am doldrums.
- Coke. Lots of coke!

2 At the Beginning of the run

You need to setup the instrument (DBS). It is installed and the CCDs cooled right? Select the correct grating(s) (for HES FHB/A follow-up you want 600B. Also 600R if red is required) e.g.:

2.1 DBS Settings

Dichroic:

D1 - Blue-Red Transition from 5500 Å- 5800 Å

D6 - Mirror to blue arm (for observations in blue only - e.g. FHB/A followup)

Gratings:

Blue - 600B

Angle 7 deg 47 min

Central Wavelength 4398 Å

Wavelength Range 3442 Å- 5361 Å

Red - 600R

Angle 11 deg 50 min

Central Wavelength 6500 Å

Wavelength Range 5595 Å- 7520 Å

MAKE SURE YOU CHECK YOU GRATING ANGLES!!!! The grating angle may be changed on top of the DBS unit. The DBS observing webpage has instructions on how to do this or ask previous observer (when he/she is still there!).

3 When you start

First thing, you'll want to switch on the telescope. Well, this is not strictly, true - you can do your biases, quartz flats, and arcs without switching the telescope on, but if you're going to observe, you'll need it anyway.

3.1 TELESCOPE STARTUP

Is the power on? if not, push the "on" button. This is the round one on the left just above the CD player. you can leave the power on all the time from then on. only switch it off to reset things or so. If you switch it of the technicians, who come early in the morning, will switch it on again... same for the fluorescence light in the dome!

Log onto the VAX. (sounds very complicated but it happens automatically). Leftmost screen in the console.

```
hit 'break' (where F4 should be).
username: TELESCOPE
pwd: CERBERUS (check this with support staff)
user's id: KCF (this is Ken's setup, and defines stuff like the white
and green programmable push-buttons).
(answer questins if you choose another username)
```

For Ken's setup, push the bottom left button to get the info display and show what all the buttons do (it's the green one). That is quite an important button because you should use the display to monitor things while observing (warnings, focus, rotation angles, etc.)

On the VAX:

```
TEL$ startup
TEL$ config instrument_id imager (or dbs)
TEL$ config focal_station nasmyth_b (imager) or nasmyth_a (dbs)
TEL$ config focus_control auto
TEL$ aperture 1 (for dbs only - defines the aperture to be at the
                 intersection of the slit and the decker)
TEL$ config windscreen_control vertical_only_tracking
TEL$ display/termial=txa5 (to use the small screen next to the dbs_r
to monitor things - do it _after_ you've pushed "display" green button)
TEL$ enlist txa3 (if you want to use the imager autoguide -probably not)
TEL$ enlist txa6 (for dbs autoguider)

now choose position angle: rot P_A (imager) or rot V_A (dbs) on the
programmable buttons

TEL$ rot 0 (this aligns the dbs/imager nicely - eg sets the slit to the
default alignment (north-south I think))
```

Never even try to type "enlist txa5". The enlist command on the VAX allows other terminals (e.g. the autoguiders on txa3 & txa6) to issue telescope control commands. If you enlist the wrong one, you can no longer control the telescope and the VAX may need to be rebooted (call the technician on duty).

3.2 *CICADA* Startup

In an xterm, type '*cicada &*' to start *CICADA*. Don't log out or close *CICADA* during the night. If you have to (because it crashed or it develops problems) **you have to take new biases!!** Run one instance of *CICADA* on each of the three computers - one for each instrument (imager dbsred, dbsblue). There are stickers on the computers telling you where the recommended positions are. You can choose where you like.

CICADA: choose the correct CCD (start observing - first *CICADA* menu before getting the actual window), the number is written on the monitor.

CICADA menu: 'open ximtool', 'show counter'

- The first thing every night: Options → preferences: choose the correct subdirectory for the nights observations. I recommend to put all the data from every night in a separate subdirectory to avoid accidental overwriting...
- Choose (only once) an image prefix, e.g. ima for the imaging, dbs_r and dbs_b for spectroscopy data
- Set the counter right! e.g. 3001: 3=3rd night, 001=running number of images. counter is limited to 9999, so please yourself how you organise file names.
- Object name varies with what you are doing. don't forget to rename your images (object name) if you start something new! sing the history often make it easier (e.g. for the arc after every spectrum)
- Exposure types: choose 'bias' for bias, otherwise 'object'. this determines the fits header
- I almost only use 'save and display' even if its only a test images. but often you have to check the number of counts with these images, so you HAVE to save them and inspect them shortly later in IRAF. you can always copy things over the top, so its not a waste of numbers...
- Set the number of exposures e.g. 10 for bias, 10 quartz flats, otherwise 1!
- Set the right exposure time (calculated them with the exposure calculator or with the help of the counts from a test exposure)

3.3 Subregions and Binning

VERY IMPORTANT TO SET IT CORRECTLY ONCE IN THE VERY BEGINNING AND ONLY ONCE!! Otherwise the data reduction will be a pain...

I recommend the following for a full size image (imager) and a 2" slit spectrum (DBS). These are all things, which need to clearly chekced with the supervisor beforehand!!

	binning	overscan	x-offset	y-offset	width	height	region	comment
imager	1x1	100	206	140	700	700	1	full circ fov
dbs_b	1x2	100	0	200	1798	150	1	
dbs_r	1x2	100	0	239	1798	150	1	

N.B Binning given for XxY where X=dispersion; Y=spatial

These numbers are all recommendations and have to checked after the first images! NEVER trust any given numbers until you have checked them! The DBS CCD offsets 239 and 200 put the spectrum in the middle row of the CCD, you may want to change this after a test spectrum. The three CCD are different, but don't worry about it. This only explains why the offset is a bit different. It would be worth playing a bit the the region 2 defined with a smaller window for test images (which reduces the readout time)

Be careful with aborting, don't do it while the CCDs are reading out. This can crash things...You can do it while its counting and the shutter is open - things should be ok in this instance. If you abort while flushing it gets stuck and you have to reinitialise the CCD ($\rightarrow$ new biases)

3.4 BIASES

- You don't have to start the telescope, because only the CCD is used
- Choose bias as exposure type. this sets up a 0 sec exposure time automatically
- Choose 10 exposures, click expose; easy... (this should always be done as a first warm-up in the afternoon!)

3.5 DOME FLATS

If you have to do dome flats...

Imager

- Set the telescope up
- Switch dome lights off
- Don't open the shutter
- Close the mirror cover if open
- Choose a filter

Now type at the VAX console:

```
TEL$ switch flat on
turn knob with flatfield illumination on
TEL$ config windscreen_c close
TEL$ config instrument_id imager
TER$ config focal_station nasmyth_b
```

- Open mirror cover
- Write exposure name *dome flat* in *CICADA* object type menu
- Click the correct filter in *CICADA* to insert the name into the fits header
- Choose exposure type 'object'
- Begin the exposure

Exposure times varying with filter and illumination percentage. Repeat the exposures with all other filter (10 each).

The very first time you have to find out the illumination percentage and the exposure time by taking images and measuring the counts in ximtool (should be around 40.000). Next time you can use these times again! Just check with the first image if its still ok.

```
Close the mirror first.
TEL$ switch flat off
TEL$ config windscreen_c vertical_only_tracking
```

3.6 Twilight Sky Flats

If you're using the imager, you'll probably need to take sky flats using the twilight sky. So, KNOW WHEN TWILIGHT IS! Make sure you're ready to go, because you don't get much time. Try leaving the window open to check the outside brightness easily and get the right starting point, but don't forget to close it later (light pollution sucks!)

Before you start

Slew to an empty field (you did bring the empty field list with you right?). Take short test exposures to see when you can begin the sequence. Aim for around 40.000 counts or so.

Use the exposure table in Table 3 of Tyson, N.D & Gal, R.R,, 1993, AJ, 105, 1206 to work out the exposure time sequence. Just look for the current exposure time in the table (calculate the ratio of observed counts to desired counts ($\sim$43.000) and multiply by current exp time to get what the current exp time *should* have been). Work your way left for the next exposure time. CCD readout time for the imager is 1min.

After every successful image in a filter make a little offstep with the telescop typing: offset/step 10 and using the SLOW buttons to move the telescope (see also pointing). That improves the counts statictics of the sky flats.

The evening filter sequence is (U)BIRV and the reverse for morning twilight. Try for at least 3 in each filter, but don't stress too much if you don't get them all. It's better to have two good ones, than three bad ones and twilight time flies... it's only about 15-20 min. After this, you see stars appearing in you images and you know that it is too late!

3.7 FILTERS and LAMPS

The imager and DBS require different filter and lamps for calibration. There is a NeAr lamp for the DBS arc spectra (for wavelength calibration). For the flats, there is a quartz lamp (QI-1). The computer on the very left is for the filters and the arc lamps (DOS computer).

type: imager or dbs at DOS prompt to choose the instrument and then in the menu 'status and control'. This computer shows you the different modules in the instruments and you can see the status of filters, lamps etc.

Imager: Beamfilter: choose right filter. thats it.

DBS: In M1 click on arc lamps: choose the one you want (NeAr for HES work). Then arc mirror: in (this puts the lamp on and inserts a mirror into the beam to illuminate the CCD). With the filters and lamps filter you will need to vary the brightness (e.g. NeAr to the upper level, QI-1 to the lowest level! Check the counts and see how things look). Don't forget to put the lamp out if you are finished - if you do, the DBS autoguider will be completely saturate when you try to locate a star and move it onto the slit.

The filters are variable density, so it can be hard to find the correct combination of filter position and exposure time. I suggest counting the number of single clicks from the upper/lower limit and taking test exposures - e.g. DBS-B: 60 clicks from bright limit and 12s exp. Finally, the master computer for the dbs filters etc is downstairs in the dbs rack. From there you get the same screen as the PC, but also have access to the individual bits that control lamps etc. In an emergency, you can try doing things manually from here (like putting the arc lamp mirror in if it's sticking). Consult the technical staff...

4 OBSERVING

- Start vent fans
- Open shutter
- Open mirror cover

```
TEL$ tr/co RA DEC epoch - this is the command to slew and track a
target.
e.g.
TEL$ tr/co 12 33 14.3 -23 44 12 J2000
```

4.1 Autoguider

DBS

You probably only need the autoguider for the dbs to put the object into the slit, but always start the tracking, just to be sure.

```
TEL$ enlist txa6 - to enable the autoguider and allow it to issue
tracking commands the telescope
```

- Start maxim CCD on the PC (next to second telescope terminal display)
- Go to guide → start 3 sec exposure
- Go to move → click on to 'from' then click on to the star. click on 'to' and
- Click on to the position on the slit where you want to have the star → move

This should centre your target on the slit. Close the window, chose *track* and click start.

In the cicada window, set your exposure time, give it an Object name (will go into the fits header), make sure the sequence number is correct. Expose. Look ma - **real science** and everything!!

5 OBSERVING TIMELINE

Or, what should you do, and when, and in what order. Depends heavily on what you're doing, but this is a rough guide, from the HES followup work.

Time	**DBS**	**Imager**
Afternoon	If not started, start *cicada* on all CCDs. Check temps. FILL THE DEWARS!!! Take biases (10) Take Quartz Flats (10) Take an arc - check the dbs focus. If $>\sim$2.55, you need to focus dbs. Go and have dinner. Check out the sunset at the lookout or get ready for the sky flats. Twilight comes fast!	 Biases (10) Dome flats (10 in each filter)
Twilight	nothing to be done	Sky flats B I R V
Nautical Twilight	Check pointing & focus! 1st flux standard	 1st standard field (colour coeff field). all filters
Astronomical Twilight and Night Observing	Target 1 NeAr arc frame Target 2 NeAr arc frame . . Radial Velocity Std (if required) Target 3 NeAr arc frame Target 4 NeAr arc frame	Target 1 Target 2 Std Field 1 Target 3 Target 4 Std Field 1 Std Field 2 Target 5 Target 6 Std Field 2
Nautical Twilight (morning)	2nd flux standard (or during night)	Std Fields again (need to get them at all airmasses)
Twilight		Morning sky flats as above, if required

6 Shutting down for the Night

- close the mirror
- close the shutter
- `TEL$ halt` - halts all telescope movement
  `TEL$ park` - sends the telescope to the park position
  `TEL$ shutdown` - shuts down the VAX system and logs out
- Write temperatures in CCD book (before filling dewar)
- **FILL THE DEWARS!!!!**
- Switch the CCDs to continuous flushing and readout in *CICADA*
- Write final temperatures in the CCD book
- Fill out the nightly observing/weather report (on the MSSSO 2.3m webpage)
- Now go to bed (watch out for kangaroos).

7 Other Stuff you need to know

7.1 Pointing

Imager

```
TEL$ rot 0
```

Choose a bright star from the astronomical almanac and slew there. Take a very short exposure (100 msec) in display only mode. Inspect the image in ximtool (it will automatically be displayed in the open ximtool window). The star should be in the middle! If not, you can easily determine the pixel coord in the middle and then check if the star is there. Multiply the pixel number with 0.6 (the pixel scale) to get the offset in arcsec. Then:

```
TEL$ offset/step [offset in arcsec] (say 5)
```

Now use pushbutton 'slow' to move the telescope. Think about which direction (up moves the *telescope* up, and hence the star *down*). Take a second image to see if it worked out, if not repeat it.

Once you have the star centred on the the CCD:

```
TEL$ calib pointing
```

to keep the offset.

NOW CHECK IT

DBS You can change the pointing to the default (use calib point/show to see the current offsets), by issuing the command

```
TEL$ calib point Xc Yc
```

where Xc, Yc are on the whiteboard. These are the values from the latest pointing calibration. You can insert your own values for Xc, Yc to change the pointing directly (this should not neccessarily be done...).

Now slew to a target star and take an exposure with the DBS autoguider. The star should be in the field and close to the slit. For accurate pointing, in particular, for the imager, you may need to calibrate a telescope aperture. The 2.3m observers manual has instructions for this.

7.2 TELESCOPE FOCUSING

USING IMAGER

If you have to use standard fields (i.e. photometric standard fields) for your observations use them to focus the telescope.

- `TEL$ tr/co RA dec epoch`
- Take a 10 sec exposure in save and display mode (in CICADA)
- Load it in IRAF and inspect some stars with imexam ('r' gives you a radial profile). Have a look if the fit matches the star's profile. (probably not very good)
- Exit imexam with 'q'
- `TEL$ focus [integer]`
- The focus is displayed on the telescope control screen. Change it a bit (2 or 3) in one direction and repeat the exposure and the IRAF procedure. Is the fit better? repeat until you find a very good fit!
- The focus can change with temperature. You will later notice that while inspecting targets with IRAF, that the fit doesn't fit well anymore. Repeat the procedure.
- `TEL$ focus [final number which fits best]`

This procedure can sometimes take a little while...

USING DBS

- Slew to a star with 8-10 mag.
- Take a exposure with the dbs autoguider (2 sec)
- Leave the star where it is. In the autoguider window (CCD MAXIM), go to focus → reset
- Set the varying exposure time to 3 sec. Drag a little window around the star → start focus. Enlarge the little window to 400%
- Watch the changing images with frequency 3 sec.
- If the star looks nice and round → everything is fine
- Check the FWHM - this number is the seeing divided by the pixel scale, so the seeing will be this number time 0.6"/pixel. Is the number realistic?
- If the star doesn't look good (deformed) type *focus [no.]* in the console to change the focus. Watch the focus position at the telescope terminal and wait until it looks good! You have no chance to focus the telescope when the seeing is bad (about 3-5). Don't even try then. Update your log book instead or do other useful stuff!

7.3 Focusing the DBS

- This is a bit tricky and something different from focusing the telescope with each instrument. It can be time-consuming too! **N.B. Focus the DBS BEFORE you focus the telescope**. Thus, do it in the afternoon before you start observing (you only need the internal NeAr frames!) to save time!!
- Go downstairs and check the units of the collimator. Take a NeAr arc frame and run Ken's program *focus* (or *redfocus* for the red arm). Don't forget to check the sequence numbers and the path of your data in *CICADA*. Edit *focus* before you start...!
- Inspect the given mean FWHM of the averaged lines in the spectrum. It should be around 2.4!!
- If its not there (which is quite likely..) go downstairs and change the units in steps of five. Every time come up and take a new arc frame to inspect the FWHM. You should soon see in which direction the FWHM decreases. Later you can use 2 unit steps. Do this until you find the minimum point and the dbs is focused.

ATTENTION
While changing the units down there at the dbs you have to unlock it FIRST! When loosening the lock, hold the focus knob, otherwise it spins around. If you turn the knob without unlocking, you change the zero-point of the units. (That can make life very hard later because you can't find you good values anymore!!!)

While turning the unlocked knob you 'feel' that it goes easy (counter clockwise?) in one direction (thats why you have to hold it) and harder in the other direction. 'Feel' where the easy direction ends but don't turn further. This is the zero-point and you should write that down. Then go from this point in the 'harder' direction (I think clockwise?) and make the five step NeAr frames to find the minimum FWHM value.

7.4 Other sources of information

Some places for look for general and specific info.

- The 2.3m observing webpage is the first place to look.
  `http://www.mso.anu.edu.au/observing/2.3m/`
- ESO Spectrophotometric standard stars
  `http://www.eso.org/observing/standards/spectra/`
- ESO empty fields list for sky flats
  `http://www.ls.eso.org/lasilla/Telescopes/2p2T/D1p5M/misc/EmptyFields.html`
- A list of photometric standard stars was observing by Landolt and can be found in Landolt, A.U, 1992, AJ, 104, 304
- The table for twilight sky flat field exposure times may be found in Tyson, N.D & Gal, R.R,, 1993, AJ, 105, 1206. Table 3 is the one you're after. Full-frame readout time for the Imager CCD (CCD #11) is ~50s. I've had success using the 1min R/O table.
- Weather 1
  `http://www.weatherzone.com.au`
- Weather 2 (good for radar image - Morree station is close to SSO)
  `http://www.bom.gov.au`

7.5 MISC

If you go down to the toilet and come back up the lower stairs (under the telescope) and it starts beeping like hell don't be worried. This signals that an instrument is hanging right over the stairs which you probably have seen already...(if you took a torch, which i recommend:-). In general go via outside if an exposure is running or via inside the stairs if you can afford a little break. It stops beeping after a short while. It only happens if the instrument is there! YOU HAVE NOT CRASHED THE TELESCOPE!!!

Good luck...! :-)