FUGA HANDBOOK

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Contents

1. INTRODUCTION

The purpose of this handbook is twofold - firstly to make your life easier as an observer, and secondly to maximise the science return from the various GAIA alerts followup programs. To this end, we have adopted a philosophy of standardising observations – all data should be taken with the same set up and technique[1]. Not only does this make the observers task easier, but it also makes data reduction straightforward.

Please read this handbook carefully before observing!

1.1. **Proposals.** The proposals this handbook covers are:
- P29 (9 nights WHT - PI: Fraser)
- N15 (6 nights - WHT PI: Velzen)
- ITP2 (2+2 nights WHT - PI: Campbell)
- P14 (18 nights INT - PI: Hodgkin)
- N7 (12 nights INT - PI: Wevers)
- ITP2 (3+3 nights INT - PI: Campbell)
- ITP2 (10+5 nights Mercator (imaging) - PI: Campbell)

please contact the PI of the program in the first instance if you have any queries.

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[1]This philosophy is largely inspired by the PESSTO program (pessto.org) on the NTT.

2. Travel and logistics

2.1. Contact with ING. E-mail support astronomer
http://www.ing.iac.es/astronomy/planning/

3. The GAIA Marshall

4. INT+IDS

The Intermediate Dispersion Spectrograph (IDS) is a long-slit spectrograph which sits at the Cassegrain Focal station of the 2.5m Isaac Newton Telescope and is equipped with a 235-mm focal length camera.

With IDS on the INT, you are responsible for everything in the telescope. Full details can be found in the IDS manual (which you will need to refer to often):

http://www.ing.iac.es/astronomy/tonotes/int/observer/ids_man.html

On your first night, a support astronomer will walk you through all the procedures (unless you are coming in at the end of a run, in which case the previous astronomer will handover). But make yourself familiar with the manual before you begin. For subsequent nights there is no support astronomer (though the WHT is a phone call away).

There is an **IMPORTANT** little box that needs to be filled in on your first night, and checked on subsequent nights. It asks for the observer name(s) and the Programme ID. Please get the ID correct (P14 for UK time, N** for NL time). We will use this value in the automated recovery of data transferred to Cambridge (more below).

The online documentation is good, and the fault database is a useful resource for digging out problems you may see (and possible solutions). The INT is an old telescope ! So treat him/her/it gently (choose your preferred pronoun). Expect small hiccups, but hopefully no real showstoppers. Problems that we have seen in recent runs with INT+IDS include:

(1) The IDS shutter will often overshoot when you change slit width. **Solution:** reissue the SLITARC command. If you change the slit, pretty much expect this to happen - so watch for it. Avoid fiddling with the slit too much.

(2) Watch that the *camshutter* is open. If someone has been messing with the gratings/collimators/pretty much anything – it will be closed. You get very little light through to the detector, but still some, and a wierd distribution on e.g. the flatfield.

(3) We had one RED+2 shutter failure. We had to phone the WHT for help. He was able to remotely restart the MMS (And came over to show us how to do it. However I note a follow-up comment in the faults database:

http://www.ing.iac.es:8081/faultdb/DisplayFaultDetails.fmsc?FaultId=21437.

4.1. **Configuration.** By fixing the setup, we make the data as easy to process as possible with our (in development) pipeline.

We will use the RED+2 CCD with the R300V grating for all observations. This grating gives good wavelength coverage and throughput, and is well matched to the ISIS/ACAM configuration.

The Central Wavelength should be set to 5500. The RED+2 detector gives 4096 pixels in the wavelength direction, but about half of this is vignetted by the optics which means there are roughly 2200 useful pixels. The instrument is described in more detail here:

`http://www.ing.iac.es/astronomy/instruments/ids/ids_redplus2.html`

and the gratings are here:

`http://www.ing.iac.es/astronomy/instruments/ids/idsgrat\_tables.html`

But note that the flatfield curve they show in the manual is *nothing* like the one you'll see from your flats. Perhaps it's for a different grating. **ATTACH a picture of the figure curve**

This setup gives a disperions of 2.06 Åper pixel with a slitwidth of 1.06 arcseconds. We will match observations to the seeing (near as) and switch between 1.0, 1.5 and 2.0 arcseconds depending on conditions. So far we find the 1.5 arcsec slit the most useful go-to setting.

We window the chip, make sure the binning is set to be 1×1 (no binning) and set the readout mode to fast - this is all done in the ICS window.

You can do most of the following jobs in the afternoon before dinner.

4.1.1. *Preliminaries.*

(1) Check, then fill in the operations logbook. Make sure there are no restrictions in place before continuing.
(2) Make sure the telescope is in ENG mode (e.g. if you want to zeroset the encoders).
(3) Turn on the dome lights, and check the observing floor for obstructions.
(4) Turn on the oil pump (acknowledge alarm).
(5) Fill the cryostat with the telescope parked at Zenith.

4.1.2. *Zeroset the Encoders.*
The manual recommends that you only need to zeroset the encoders on your first night. I (STH) used to do this every night in case things have been altered in the day time. However, in recent runs, we found the pointing model to be pretty good (around 10-20 arcsecs) and stable from night-to-night. You can also shortcut the zeroset (accoding to the manual) with:

```
USER>calibrate last
```

4.1.3. *Check the instrument configuration.*
Choose the best guess of the focus (i.e. probably what you had in previous nights), and make sure the slit and central wavelength are set to sensible values (the focus value of the last night is written on the whiteboard).

```
 {\it on the TCS:}

  USER>show focal
  USER>focus 14.85
```

```
{\it on the ICS:}


   SYS>slitarc 1.0
   SYS>cenwave 5500
```

4.1.4. *Setup the Acquisition Camera.* This is described in the manual.

4.1.5. *Setup the CCD.*
```
   SYS>rspeed fast  {\bf or SLOW in the manual?}
   SYS>bin 1 1
   SYS>window 1 "[785:1150,1:4200]"
```

4.1.6. *Setup the Autoguider.* From an xterm:
```
lpss7>ssh -X gss@intgss
intgss>gss2
```
   NOTE: Do not forget to set the gss2 configuration to INTCass.

4.1.7. *Loading Catalogues.* The easiest way to handle objects is to update an ascii file of targets in the daytime if new objects need to be observed that night. Again this is described in the manual. The key thing is to be consistant with naming. These names appear in the headers for the files.

   Note that STH had problems when he tried to make his catalogue in OS X (Mavericks) using emacs, and was forced to retype the whole thing in linux.

   Our naming system follows to simple protocols, depending whether we are in verification or in production mode.

- GaiaVerif14xxx
- Gaia14xxx

There will be a catalogue of standard stars which you can also load called fuga_std.cat in the directory. **Not there yet - at the moment just choosing them at random from the ING spectrophotometric standards webpages - which is not super-clever, as some are better than others.**

When observing a spectrophotometric standard in the beginning and end of the night, don't saturate (stay below 30k counts peak... hard to go above this). **STH: I think more useful to put in approx exposure times for a limited preferred set of standards - or even have scripts for them.**

4.2. **Daytime Calibrations.** Take biases and flats and arcs with the three slit options. The configurations and exposure times are described here. There are scripts to make this relatively painless. Ideally take a set of calibrations every afternoon.

   The script does more or less the following:

```
SYS>multbias 10
SYS>compmirror in
repeat for 3 slits:
  SYS>slitarc [1.0, 1.5, 2.0]
  SYS>complamps CuAr+CuNe
  SYS>multarc 3 2 "CuAr+CuNe"
  SYS>multarc 3 60 "CuAr+CuNe"
  SYS>complamps W
  SYS>multflat 9 1 "W flat"
SYS>complamps off
SYS>compmirror out
```

NOTE: for slitwidths of 1.5 and 2.0 as, use a neutral density filter (NDF) to avoid saturation of the W flats.
In particular, use filter #1 for a 1.5 as slit and filter #2 for a 2.0 as slit. You can insert an NDF using the **compfilta X** command (where X=1..4). Make sure however not to use the NDFs for the arcs (compfilta 0 removes the filter again)!

The calibrations needed can be run automatically by sftp-ing the script daytimecal to the home dir of **intobs@lpss7** machine, changing the permissions (chmod a+x script) and running it. The script will take flats, biases and arcs for all slits, and takes about **15** minutes to run (with no user interactivity). However, the observer should always check that the calibrations were taken correctly (e.g. are the counts in the biases sensible, are the flats unsaturated). In particular, the exposure times used for flats and arcs may need to be adjusted depending on how recently the lamps were replaced.

The script starts with the widest slit, and works down. We suggest you manually set slitarc to be 2.0 before running this, and avoid problems with it overshooting right at the start.

The CCD will be focused by the support astronomer during the daytime with a Hartmann test. The observer should, however, verify that the CCD is not rotated by checking that the lines in an arc frame are aligned along the CCD rows. If the arc lines and CCD rows are significantly misaligned (>1 pix), ask the support astronomer to check this.

4.3. **Opening up.** Before opening and beginning observations, make sure that lights are off in the building, especially those just below the telescope. Respect the weather conditions and alarms before opening. If in doubt confer with the WHT.

Turn the dome east, open the dome shutter and the south doors before you open the mirror covers to avoid debris falling on the primary. The speakers really help to hear the mirror covers open and close, and the diagnostic light seems to work fine. If it's light in the dome, you can just see them through a gap in the telescope structure. (If you really want, you can visually check that the covers open fully

by putting the telescope in park ap1). Also, if you need to raise the lower dome shutter, close the mirror cover first.

And don't forget to shut the control room blind before beginning observations.

Finally switch the telecope out of engineering mode and into CMP (Computer) mode using the key on the control panel.

4.4. **Telescope pointing.**

It is worth spending a few minutes checking the pointing. As you move around the sky, especially towards large hour angle, or high airmass, you may need to repeat the exercise to get a locally good pointing calibration. This is described here in the IDS manual:

`http://www.ing.iac.es/astronomy/tonotes/int/observer/ids_man.html#pointing`

Again, in September 2014, the pointing was good, and repeatable.

4.5. **Nighttime Calibrations.**

We do not take any twilight flats.

4.5.1. *Focussing the telescope.*

There is a script to help run the telescope once you have found a suitable star (and the sky is dark enough to see it). There are also instructions for doing this manually. The easiest way to find a focus star is to choose a standard (that is not too bright) close to the South (i.e. HA 0). You can then observe this straight after with the telescope in focus, while the sky is still a little bright for faint targets. The exposure time needs to be around 10 seconds (or a bit more or less) to minimize the effects of short timescale variations in seeing.

Focussing on the INT can be a bit wayward at the start of the night when the seeing is often changing dramatically while the air is cooling and the telescope is still rather warmer. Opening reasonably early can help with this. In general we have found the focus to be pretty stable from night-to-night. If you have an urgent target setting fast, you can probably set the focus to last night's value, and get the spectrum before focussing more accurately later.

4.6. **Observing.**

4.6.1. *Target acquisition with blind offset and guiding.*

We recommend blind offsetting for most targets to minimize errors. It is possible to take a spectrum of a star that is too faint to be seen on the INT Acquisition Camera. Blind offsetting is really straightforward with the INT. And well described in the manual. We followed the procedure.

(1) gocat *target* **make sure you rotate the slit to the parallactic angle.** You need to match thr Mount PA value to the Par. Angle (both visible on the TCS Display). You can do this while the telescope is moving.

(2) Also while slewing, you can plug in the coords to the GSS guide star finder box, with the correct rotator angle, and copy the X-Y coords for a sensible guide star. You can autoxy X Y now too (e.g. autoxy 458000 321500).

(3) See if the target is bright and obvious. If necessary take a deep (60s) acquisition image. You can save your acquision images as FITS files from the ds9 window (under the file tab). We reccommend you do this if there is ambiguity/uncertainty. You might still want to blind offset though to avoid mis-identification. The acquisition window does have quite a small finder window (guess $<= 1x1$ arcmin).

(4) If target is bright/obvious, and you can get it in the slit -then do so, and start guiding and integrating (see below). If you are offsetting - then continue with the next step.

(5) (Optional) Go to the blind-offset star. Centre it in the slit (red cross).

(6) (Optional) Use `TCS>blind target` to offset to the target. Now your target should be at same slit position as the offset star was (assuming that you were not unlucky and had an offset star with a significant proper motion !)

(7) Quickly type field at the `USER>` prompt, followed by `GUIDE ON STAR n`

(8) You can change the guider integration time on the *Select* tab of the auto-guider window. Select from the drop down menu (rather than typing it in .. well that used to be true - I never re-experimented with this). Use this option to increase the integration time if your guide star is rather faint, or decrease it if it is saturating. You can also monitor how well the guider is performing. Under the *View* tab – also on the autoguider window – select "view data plots". You may want to change the scale for the XY-guide plots to something more sensible (+/- 1 arcsecond).

(9) once guiding is stable - and you are happy that the source is not poking out of the side (if you can see it) then start your run (run target 900 ... or whatever).

I'm not sure the above is optimal. Can't we do a `FIELD` before offsetting ? Test this

Also, note that there is an artifact in the middle of the left edge of the autoguider camera, so be careful never to use this as a guide star!

You can find blind-offset stars from SDSS, DSS, Aladin etc. You can also use a python script (written by MF) **(*** Is this avilable to download somewhere? on the wiki maybe? HC ****)** to create a finder chart around your science target, which also highlights nearby bright stars suitable for offsetting, and gives coordinates. Blind-offsetting is apparently good for up to 6 arcminutes.

It is recommended to do this beforehand while putting together your target list, so you don't lose time at the telescope. If this is not possible, you can add sources on the fly (see manual, paragraph: Loading catalogues).

4.6.2. *Calibrations.* Take arcs after each science exposure. There is a script called docal. You need to tell it the exposure time for your arc, e.g. `docal 8`. Once we have understood the stability of IDS, we may lessen the requirement. The script looks like the following (sort of):

```
SYS> compmirror in
SYS> complamps CuAr+CuNe
SYS> arc 8 "CuAr+CuNe"
SYS> complamps off
SYS> compmirror out
```

4.6.3. *Observation.* Exposure time will depend on the magnitude of the source (which may well have changed since the trigger !), and the conditions (seeing, cloud cover).

If you suspect the magnitude has changed significantly, it is useful to first do a short (e.g. 120s - 180s depending on mag) exposure and quickly check the signal you are getting, then extrapolate this to get the desired SNR (this goes with the sqrt of number of counts).

The ETC for INT+IDS can be used to provide realtime estimates if you are not sure - but the following table may help a little to guide you.
*** PUT TABLE IN ***
Try to break exposures up into ∼3 sub-exposures to help with cosmic ray rejection - especially if they are long exposures. We never did more than a 30 minute exposure. If you find you need to expose for more than about 30 minutes to even see a spectrum, then it is probably not worth doing with the INT, and should be done with the WHT (or perhaps SPRAT when it comes online).
NB : Morgan says he prefers single deep exposures - check this with him for why

4.6.4. *More on Aquisition Images.* If you want get an image and save it, you can do this from the aquisition TV image. You can also offset the source first so not covered by the slit. Expose for as long as needed. Then in the ds9 window click file and save frame as fits. Then this can be copied to the other machine by scp intobs@lpss7:filename.fits. Put it in the data directory for the night, and call it something sensible - e.g. target_acquision.fits.

4.7. **Tip: Matching observations to the seeing.** To determine the local seeing, there are a number of options:

(1) Use the DIMM-measurement on the meteorological data screen, however this measurement is outside the dome, on a different part of the mountain, and does not take into account air flows etc. through the dome. The INT seeing is usually worse than this.

(2) In the autoguider window, there is also an estimation of the seeing based on what the autoguider camera is observing. This tends to overestimate - especially if your guide star is saturated.

(3) Measure the fwhm of your spectral trace ('j' in imexam. One IDS pixel is 0.44 pixels.)

4.8. **Estimating the SNR of your exposures.** In order to estimate when you have reached a SNR of 20 - 30, you can use the following formula (also written on the whiteboard in the control room):

SNR = sqrt(counts * FWHM * gain * X)

where gain = 3.3, X = 1.06 and the FWHM is generally somewhere between 2 and 5. To determine the counts and FWHM, see quick look processing. If you observe a faint target in multiple exposures, you can just sum the counts in all exposures and take an average value for the FWHM to estimate the SNR of your exposures.

4.9. **Quick Look Processing.** You can quickly check the spectra that you took using the INTDRPC1 (right-most screen). A window in the ICS displays the status of your current exposure, as well as the number of the last two exposures (a full log of the night is also accessible in ICS). To view a spectrum, open up an iraf terminal and make sure you are in the right directory (named after the date). For example, to open spectrum r180265, type "disp r180265.fit[1] 1" in the iraf terminal, then type imexam. Using j, k, l and v you can examine your exposure. Particularly useful is the j-command, which fits a 1-D gaussian in the x-direction. Hover your mouse on the position of your object (which by the way is not in the center columns of the CCD, but doesn't matter) and press j; a new window will pop up showing you the gaussian fit. In the bottom of this image, the peak value (i.e. the number of counts) and the FWHM of the gaussian will be displayed. You can use these 2 values to estimate the SNR of your exposure.
Using the v-option you can look at the spectrum.

4.10. **End of Night.** The INT manual gives detailed notes on the shutdown of the system and closure of the telescope. Do fill in the observer's report and complete the logs. You can email this log to yourself and to sth@ast.cam.ac.uk (this is not essential - as we can dig them out of the data archive at the IoA), however do not try to send it to multiple adresses from the report box as it will probably crash. You don't need to worry about transferring data or copying data (unless you want to work on it yourself). All data is ftp'd to Cambridge in close to real time. We will setup an automated system for pipeline processing the data at the end of each working night, and sharing the results (via the Gaia Marshall).

5. WHT+ISIS

The Intermediate dispersion Spectrograph and Imaging System (ISIS) is a double-arm medium resolution longslit spectrograph, equipped with a dichroic to obtain spectra between 3300–9500 Å.

5.1. **Configuration.** We use a fixed configuration for ISIS as specified in the following section. This configuration is necessary to ensure that the pipeline can deal with the data, **and should not be modified by the observer.**

In the red arm, we use the RED+ CCD, while in the blue arm we use EEV12; these are the standard CCDs for ISIS. Both CCDs should be binned to 1×1 (i.e. no binning), the readout speed set to slow, and the window set to the default. Note that the default CCD readout speed (e.g. after a system reset) is 'fast' - so make sure that this is set correctly.

```
bin red 1 1
window red 1 "[585:1550,1:4200]"
rspeed red slow

bin blue 1 1
window blue 1 "[585:1550,1:4200]"
rspeed blue slow
```

We always use the R158R and R300B gratings, with central wavelengths in the red and blue arms of 7500Å and 4500Å respectively

```
cenwave red 7500
cenwave blue 4500
```

The standard 5300Å dichroic should be used at all times. To insert it into the light path, use the command

```
bfold 2
```

We use either 1.0, 1.5 or 2.0″ slits with ISIS, matched to the seeing. To change the slit use one of the following:

```
slit 1.0
slit 1.5
slit 2.0
```

Note that ISIS has an adjustable slit (rather than fixed slits in a filter wheel), and so the actual slit width will differ slightly ($<0.1''$) from the commanded value.

We use the Clear 8 dekker and the GG495 order blocking filter in the red arm

```
dekker 8
rfilta 3
```

5.2. **Calibrations.** On at least two occasions during each observing run, we need to take one complete set of bias frames, and a set of arcs and flats for each slit (1.0″, 1.5″, 2.0″). The first set of calibrations should be taken during the afternoon before the first night observing, the second should ideally be taken towards the end of the run. The dark current for ISIS is negligible, and so we do not need need to take darks.

The calibrations needed can be run automatically by copying the script isis_cal.sc to the **XXXX** machine, and running it. The script will take flats, biases and arcs for all slits, and takes about **XXXX** minutes to run (with no user interactivity). However, the observer should always check that the calibrations were taken correctly (e.g. are the counts in the biases sensible, are the flats unsaturated). In particular, the exposure times used for flats and arcs may need to be adjusted depending on how recently the lamps were replaced.

The CCD will be focused by the support astronomer during the daytime with a Hartmann test. The observer should, however, verify that the CCD is not rotated by checking that the lines in an arc frame are aligned along the CCD rows. If the arc lines and CCD rows are significantly misaligned (>1 pix), ask the support astronomer to check this.

The following instructions describe how to take calibrations manually (e.g. not using isis_cal.sc).

Before taking calibrations, ensure that ISIS is set up correctly as described in Section 5.1. Next, switch the light path to the ISIS calibration unit, and switch off all calibration lamps and remove neutral density filters.

```
agcomp
complamps off
compnd 0
```

5.2.1. *Biases.* To save time, it is possible to take biases simultaneously in the red and blue arms:

```
multbias red 20 "isis red bias" &
    multbias blue 20 "isis blue bias"
```

5.2.2. *Flats.* We take spectroscopic flats for each slit width using an internal tungsten lamp. First, turn on the lamps

```
complamps w
```

and wait ∼3 minutes for them to warm up. You will need to take flats in each arm separately (as the exposure times are much longer in the blue arm), and use neutral density filters to reduce the intensity of the lamp. Exposure times of less than 2 s should not be used to avoid vignetting by the shutter. The commands to set the slit width, insert neutral density filters (in this case with a total attenuation of 1.5), and take 20×2.5s flats in the red arm are:

```
slitarc 1.0                    % Set slit to 1.0\arcsec
```

```
compnd 1.2                        % Insert neutral density filter
multflat red 10 2.5 "ISIS red flat"
```

The exposure times and neutral density filters required for each slit and arm are listed in Table 1.

	Blue Arm (R300B)		Red Arm (R158R)	
Slit	Neutral Density	Exposure (s)	Neutral Density	Exposure (s)
1.0″	0	4	1.2	2.5
1.5″	XXXX	XXXX	XXXX	XXXX
2.0″	XXXX	XXXX	XXXX	XXXX

TABLE 1. Exposure times and neutral density filter values for spectroscopic flats with WHT+ISIS

When finished, turn off the lamp (a warning will sound if it is left on for more than 30 minutes), and remove all neutral density filters.

```
complamps off
compnd 0
```

5.2.3. *Arcs.* For wavelength calibration, we use both CuAr and CuNe lamps. These should both be turned on simultaneously, and the slit width set

```
slitarc 1.0                       % Set slit to 1.0\arcsec
complamps cune+cuar
```

Neutral density filters are not necessary for spectroscopic arcs, however the arcs for the red and blue arms must be taken separately as the lines in the blue are much weaker, and hence require longer exposure times. To take 2×2 s arcs in the red arm, and 2×40 s arcs in the red arm:

```
multarc red 2 2 "Arc Red 1.0"
multarc blue 2 40 "Arc Blue 1.0"
```

The exposure times for the arcs are given in Table 2.

	Blue Arm (R300B)	Red Arm (R158R)
Slit	Neutral Density	Exposure (s)
1.0″	40	2
1.5″	XXXX	XXXX
2.0″	XXXX	XXXX

TABLE 2. Exposure times for spectroscopic arcs with WHT+ISIS

When finished with arcs, turn off lamps, and reset the light path so that the calibration unit is so no longer in the beam, and ISIS is ready for observing.

```
agslit
comp lamps off
```

5.3. **Observing.**

5.3.1. *Target catalog.* Before observing, you should prepare a catalog of targets, standards etc, which the TO will load at the start of each night. When observing, you can use the name of the target when asking the ToO to move to the next target - this is much less error prone, and faster, than calling out coordinates. The format of the catalog is as follows, note that the name of the target must be less than 8 characters, and the file must be formatted with spaces rather than tabs.

```
SN2014XX      10 53 17.60 -12 10 54.7 J2000
TDE14a        13 37 31.87 +00 33 6.0  J2000
Feige34       10 39 36.71 +43 06 10.1 J2000
```

5.3.2. *Focussing.* Before starting observing each night, the focus of the telescope should be measured using observations of a bright star (usually the photometric standard will suffice). We wish to take a series of observations with a very wide slit (so that the profile of the spectrum is defined by the focus, and not the slit), and determine the minimum FWHM of the spectrum as the focus is adjusted. First, ensure that the calibration unit is removed, open the slit to 8.0″ and set the readout speed of the red arm to 'fast'.

```
agslit
slitarc 8.0
rspeed red fast
```

Once the bright star for focusing is centred in the slit, take a short exposure to check you have sufficient counts

```
glance red 7
```

The exposure time should always be longer than 7s to ensure that you are adequately sampling the seeing. Assuming the counts in the standard are ok, then take a sequence of exposures, changing the focus each time. The following command will take a series of 8×7s exposures, starting with a focus of 97.75 and incrementing this value by 0.05 before taking each sucessive exposure:

```
focusrun red 8 7 97.7 0.05
```

On the ISIS data reduction computer, in the IRAF window, run

```
! isis_focus
```

You will be prompted for the first spectrum in the sequence (which will be called something like r123456) and the number of images taken (in the example previously, 8). **more text here**
Set the focus to the measured best value with

```
focus 97.85
```

If no focus can be measured, then the focus should be set to the default value of **XXXX**

When you are finished setting the focus, it is crucial to set the readout speed and slit width back to their usual values.

```
slitarc 1.0
rspeed red slow
```

5.3.3. *Spectrophotometric standards.* To flux calibrate spectra, we take two spectrophotometric standards each night, selected from the list in 4. As the standards are bright, they can be observed during twilight.

5.3.4. *Target acquisition.* The TO controls the telescope itself, and will handle acquiring targets and guide stars. The role of the observer is to correctly identify...
Acquisition and blind offsets...
All observations should be taken at the parallactic angle, to minimise slit losses due to differential refraction. The telescope operator sets the position angle on the sky, so be sure to tell him or her that all observations are to be taken at parallactic.
Rotator limit...
High elevation / airmass constraints...
The slit width you use should be matched (as far as possible) to the seeing. If the seeing is $<1.2''$, then use the $1.0''$ slit. If the seeing is between 1.2 and $1.7''$, then use the $1.5''$ slit. If the seeing is $>1.8''$, then use the $2.0''$ slit.

5.3.5. *Starting an exposure.* To start a single exposure, use

```
run red 1800 "Title" &  run blue 1800 "Title" ; bell &
```

while to take a sequence of, say, 3×1200 s exposures, use the following

```
multrun red 3 1200 &  multrun blue 3 1200 ; bell &
```

The 'bell' command will cause the computer to chime when the exposure is finished - useful to make sure you do not forget to start the next exposure.

5.3.6. *Using* ISIS QUICKLOOK.

5.3.7. *Exposure times.* The following table (Tab. 3) gives the standard exposure times for classification spectra with ISIS.

Mag (G)	Exposure (s)		
	1.0″	1.5″	2.0″
G <15			
15<G<16			
16<G<17.5			
17.5<G<19			
19<G<20.5			

TABLE 3. ISIS classification times standard stars for INT / WHT, together with recommended exposure times for ISIS

6. Data reduction

7. WHT+ACAM

We will primarily

7.1. **Configuration.** Filters to use are
u (700 SlnU) g (701 SlnG) r (702 SlnR) i (703 SlnI) z (704 SlnZ)

7.2. **Calibrations.**

7.3. **Exposure times.**

8. Spectrophotometric standards

Spectrophotometric standards should be observed twice per night *for each slit width used*. Ideally, standards should be taken during evening and morning twilight, otherwise they should be taken during the night.

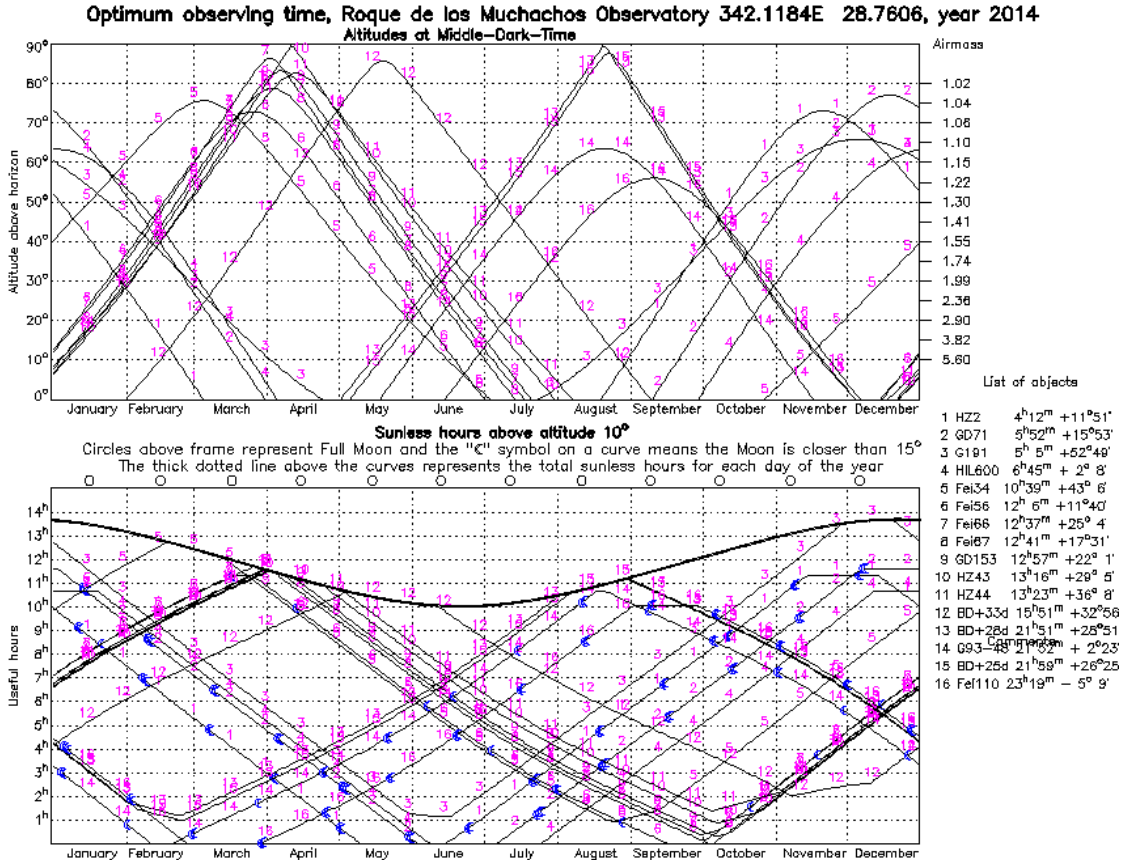We do *not* take standards with a wide slit to correct for slit losses.

Figure 1. Maximum elevation of spectrophotometric standards from La Palma throughout the year.

FRASER ET AL.

Name	RA	Dec	Mag (V)	Sp. Type	Exposure (s)		
					1.0″	1.5″	2.0″
HZ2	04 12 43.51	+11 51 50.4	13.86	DA3	30	25	20
GD71	05 52 27.51	+15 53 16.6	13.03	DA1			
G191-B2B	05 05 30.62	+52 49 54.0	11.78	DA1			
HILT600	06 45 13.33	+02 08 14.1	10.44	B1			
Feige34	10 39 36.71	+43 06 10.1	11.18	DO			
Feige56	12 06 47.30	+11 40 13.0	11.06	B5p			
Feige66	12 37 23.55	+25 04 00.3	10.50	sdO			
Feige67	12 41 51.83	+17 31 20.5	11.81	sdO			
GD153	12 57 02.37	+22 01 56.0	13.35	DA1			
HZ43	13 16 21.99	+29 05 57.0	12.91	DA1			
HZ44	13 23 35.37	+36 08 00.0	11.66	sdO			
BD+33d2642	15 51 59.86	+32 56 54.8	10.81	B2IV			
BD+28d4211	21 51 11.07	+28 51 51.8	10.51	Op			
G93-48	21 52 25.33	+02 23 24.3	12.74	DA3			
BD+25d4655	21 59 42.02	+26 25 58.1	9.76	O			
Feige110	23 19 58.39	-05 09 55.8	11.82	DOp			

TABLE 4. Spectophotometric standard stars for INT / WHT, together with recommended exposure times for ISIS

9. MERCATOR+MAIA

MERCATOR is 1.2 m semi-robotic telescope at La Palma.

MAIA, the Mercator Advanced Imager for Asteroseismology is a new fast 3-channel photometric instrument. A full description of the instrument can be found in Raskin et al., 2013, A&A 559, A26.