WFI @ MPG/ESO 2.2-m

Observers' Cookbook

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Contents

1 Introduction

The following notes are meant as a quick reference for observers using the WFI at the 2p2 Telescope. We invite observers to add comments and suggestions (please write in the control room copy) to these notes which they feel maybe of help.

2 Important Do's and Don'ts

- **Do** report all problems via the REMEDY system and **do** use separate reports for separate problems.

- **Don't** ever move or delete WFI fits files from w2p2ins or w2p2drs. Doing so can hang the automatic data saving. Also do not alter the files in anyway as they have to be ingested by the Garching archive.

- **Do** contact the ESO public relations department (ips@eso.org) if you feel that your images may make an interesting press release.

3 Logging In

The w2p2tcs, w2p2ins and w2p2drs workstations are started in the afternoon by operations. However, if you do need to login to one of these workstations, here are the user ID's and passwords to use:

On w2p2tcs the userid is:	**tcs**
and the password is:	(see control room noticeboard)
On w2p2ins the userid is:	**daisy**
and the password is:	(see control room noticeboard)
On w2p2drs the userid is:	**drs**
and the password is:	(see control room noticeboard)

To use the kila guest account on one of the xterms, click on 'direct' and enter `kila` as the host address and then click on 'Connect'. Login on kila as '2p2guest' with password (see label on Xterminal).

If you login on w2p2drs, you will need to re-start the tapelog display. This can be done by typing `tapelog` from any window.

4 Online file list

On w2p2drs there is a c-shell script, `ObsLogN`, which produces a running log file of images as they arrive at the w2p2drs workstation. This procedure is started in the afternoon by operations in the `ObsLogN` workspace of w2p2drs.

If you login on w2p2drs, you can start the procedure by typing `ObsLogN` in a wide xterm/hpterm. A list will be made of the images already in the `/data` directory, and this list will be updated as new images arrive. To stop the automatic logging type control-C, this will give the option to print the listing.

5 Flats

5.1 Dome flats

To take dome flats in the afternoon, you must:

- Ensure TCS is started up. If the TCS has not been started, page 2p2 Team operations at 93-62.
- Preset the telescope to the 'FF Scr' position and open the mirror cover. This is done from the TCS setup panel, which is found in the TCS Setup workspace on w2p2tcs. In the same panel ensure that the dome is in 'automatic' mode.
- Go upstairs and open the protective WFI shutter (hold switch on WFI control unit until green light appears).
- either use the flat field lamp (its voltage regulator is located in the control room) or open the door slightly to illuminate the screen.
- Acquire images using DAISY+.

Table 1 gives an estimate of counts obtained for the broadband WFI filters for a given rheostat voltage.

6 Start of the Night

6.1 Pointing

We strongly recommend (especially if you will be observing fields with only stars) that you check the telescope pointing at the start of the night. Do this by either presetting to a Landolt

Table 1: Approximate Rheostat Settings

Filter	Voltage	Exposure (s)	Counts
U/38	200	30	27000
B/99	100	10	28000
V/89	100	3	32000
Rc/162	60	4	28000
I/lwp	50	3	35000
Z+/61	50	15	27000

star field you wish to observe anyway, or by presetting to a bright star (from the astronomical almanac) and acquiring an image with a narrow blue filter. The star to which you preset should appear appear in the upper right corner of CCD #56 at pixel coordinates (x,y) = (4100,3920). Any object should fall within ~60 pixels of this point. Please note that the coordinates of the stars in the Landolt catalogue are not very accurate, which might result in larger offsets for these stars.

6.2 Image quality

At extreme (Zenith Distance ~60°) positions to the East and North the telescope shows some mild intrinsic astigmatism which affects the image quality. However, on some occasions the image quality has also become severely degraded as compared to the seeing from the DIMM close to zenith, often accompanied by astigmatic effects as indicated by a significant difference (>20-30 eu) between the optimal focus in the 'X' and 'Y' direction. The cause of this is currently under investigation. Past experience has shown that moving the telescope to extreme E, then W, then N, and then S positions can cure this problem (this procedure is carried out every afternoon).

6.3 Vignetting

At extreme (HA≥-4hr) positions to the East the telescope is slightly vignetted by the dome.

6.4 Sky flats

It has been reported that a good standard position for flat fields is at delta = -29°15^m and alpha = ST+1 hour. This forces the dome into a direction which avoids stray light from the Schmidt telescope.

7 Focusing the Telescope

The WFI is focused using a classical focus sequence. However, instead of the telescope being offset between successive exposures, the charge on Mosaic CCD 'a' is shifted by a specified number of pixels, and only CCD 'a' is read out.

When a good focus is obtained, one can correct the focus for variations of the serrurier temperature by applying the relation $\frac{dFocus}{dT_{serr.}} = -66\, e.u./degrees$. Within ~20-30 degrees from zenith the focus does not show strong variations, but for larger zenith distances there is a significant effect which to first order is equal to the zenith distance in degrees. However, people are advised to independently check the focus at such large zenith distances.

If the `Focus Comp. for filters` button on the DAISY+ panel is activated (i.e., it is green), then **relative** focus offsets between the filters are automatically applied when changing filter. If the `Focus Comp. for temp` button is active, then the focus is automatically corrected for temperature changes of the long serrurier. **Note that** the automatic temperature compensation is not yet enabled, and temperature corrections to the focus should be made by hand (simply add the appropriate offset to the *current* focus value).

It is *very important* to realise that the temperature compensation should be applied to the actual telescope focus. Correcting the focus previously determined for a change in temperature and then applying this value will result in a bad focus unless the filter used for the focus determination is in the beam. If you are scratching your head at this point, please ask your introducing astronomer or TIO to explain further.

In general the telescope should be refocused when the nominal focus changes by more than 20 encoder units, but this also depends on the external seeing conditions. We do not yet have sufficient data to establish the focus relation with a high accuracy, and we recommend that you re-determine the focus regularly (approximately every 2 hours), when the telescope is moved over large distance on the sky, or when the serrurier temperature changes by a large amount ($\geq$2 degrees).

To execute a focus sequence you must:

- Preset the telescope to the field you wish to observe. If your field is very crowded move to a position which is close by and less crowded.
- **'Exposure' section of DAISY+:** set 'Exp.Time (sec)' to around 15 seconds (a shorter exposure time is of no use as the atmospheric scintillation is not averaged out), and set the 'Identifier' to the name you wish. The value of 'Repeat' should be set to 1.
- **'CCD' section of DAISY+:** set 'Exp.Type' to 'Foc' and 'Binning (XxY)' to '1x1'.
- **'Instrument' section of DAISY+:** select the filter you wish to use for the focus sequence.
- Calculate an estimated focus value using the equation $Foc = 25740 - 66 * T_{serr.}$. This is for the B filter, if you are using another filter, make the appropriate offset (see Table 2).

Note that a small program has been written to provide the focus estimate and sequence start value. This can be executed (on w2p2drs) by typing:
`FocEst`
Enter the start value in the 'Start Focus' box of the 'Focus Sequence' section.

- **'Focus Exposure' section of DAISY+:** set 'Start Focus:' to (Estimate - 4*40), set 'Step Size (eu):' to 40, set 'No. of Steps:' to 9, and set 'Offset (pixels)' to 50.
- Check that the autoguider is on, and start the focus exposure (click on 'Start Single Exp.').

With the offset set to 50 pixels, the first exposure (i.e. that obtained with the lowest focus value) is the uppermost star in the sequences. The focus sequences can be analysed by using either the RTD on w2p2ins or a MIDAS script on w2p2drs.

To analyse a focus sequence using the RTD on w2p2ins:

- From the RTD menu, select 'Pick Object' from the 'View' menu. A window will appear.
- in the 'Pick Object' window click on 'Pick Object...' and then click on a star in the focus sequence. The FWHM measured for this star is reported back in the 'Pick Object' Window. Using the measured FWHM's, you can calculate the best focus value. Note that it is best to use a zoom factor of 1 on your image as then the entire 'sample box' in the 'Pick Object' window is filled.

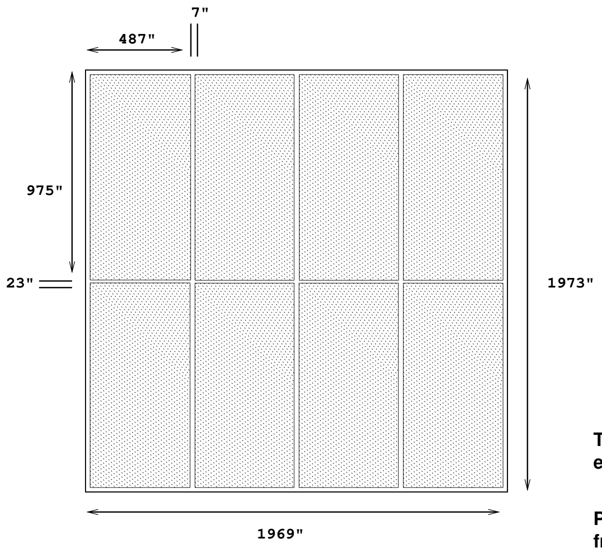
To analyse focus sequence using MIDAS on w2p2drs:

- `midas> create/disp`
  (only needed if display is not present)
- `midas> load wfiXXXXX.fits scale=-3`
  (the `.fits` extension is mandatory)
- `@@ wfi_focus <start-value> <step> <exposures>`
  where <start-value> is the start value of the focus in the sequence, <step> is the step size in encoder units (40 if above instructions followed), and <exposures> is the number of images in the focus sequence (9 if above instructions were followed). If you do not enter these values on the command line, you will be prompted.
- Move the cursor into the display window, and resize the box using the cursor keys. Click on the uppermost star of a sequence with the left mouse button, and then exit with the right mouse button.
- A graph will be produced of step number against FWHM (in both X and Y) and a fit made to the data. The program reports back the optimum focus value and the seeing at that focus setting.
- If the display is cluttered with markings, you may erase them by using:
  `midas> clear/chan overlay`

Table 2: WFI Filter Focus Offsets (N.B.: FocX = FocB + OffX)

Name	ESO-ID	Offset
–Broad–		
U/38	841	-75
B/99	842	0
V/89	843	-100
Rc/162	844	-50
Ic/lwp	845	-55
Z+/61	846	-20
White	...	-30
–Medium–		
416/29	872	-5
445/18	873	-40
461/13	874	-11
485/31	860	-40
516/16	871	-50
518/16	862	-35
531/17	875	0
571/25	863	-45
604/21	864	-30
620/17	866	-5
646/27	867	-10
679/19	868	-30
696/20	869	-20
721/25	847	-40
753/18	848	-25
770/19	849	-25
790/25	850	-20
815/20	851	-20
837/20	852	-10
856/14	853	-20
884/39	870	-55
914/27	854	-25
–Narrow–		
396/12	865	-50
OIII/8	859	-15
OIII/2	...	-30
504/10	861	-40
Halpha/7	856	-10
665/12	858	-25
SIIr/8	857	-30

Suggested Dithering Patterns for the WFI



Coverage: 0.57 x 0.54 deg (0.238 "/pix)

$0 < |\delta| < 30^\circ$

Pos	RA	Dec
0	---	---
1	+32	+24
2	−64	+24
3	−32	−72
4	+128	−24
5	−80	−24
6	+64	+144
7	−96	−60
8	+64	−48
9	−96	+72

$30^\circ < |\delta| < 45^\circ$

Pos	RA	Dec
0	---	---
1	+32	+24
2	−64	+24
3	−16	−72
4	+96	−24
5	−64	+120
6	+32	−144

$|\delta| > 45^\circ$

Pos	RA	Dec
0	---	---
1	+32	+24
2	−64	−48
3	+36	−24
4	−8	+96
5	+40	+24
6	−72	−144

These patterns minimise the effect of field rotation.

Progressive offsets (in arcsec) from the preceding position.

Figure 1: Suggested Dithering Patterns to Cover the Interchip Gaps of the WFI, as a Function of Declination of the Field.

8 Dithering Sequences

When dithering in RA, a small rotation is introduced between frames. To understand why consider the extreme case of a field very close to the pole. Any offset in RA will result not only in a translation but also in a rotation. Even if the angle is small, the large FoV of the WFI will make it impossible to stack and vertically co-add the images. Of course, one can rotate the sub-images but this has ugly side effects.

If you wish to combine your mosaiced images, you should use one of the three dithering patterns given in Tables 3, 4 and 5 (see also Fig. 8). Note that by observing the first 5 positions given in Table 3, you will have at least three observations at each point. For the dithering sequences given in Tables 4 and 5, 6 positions are required to have at least three observations at each point, whereas 7 positions will give 4 observations at each point.

If you wish to observe a field more times than offset givens in the table, then start again at the zero position with slight offset in delta (e.g. +/–15″)

Table 3: Recommended Dithering Pattern for $0 \le |\delta| \le 30$ (offsets in $''$)

Seq.	From Last		From Zero	
num.	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$
0	...	...	0	0
1	+32	+24	+32	+24
2	–64	+24	–32	+48
3	–32	–72	–64	–24
4	+128	–24	+64	–48
5	–80	–24	–16	–72
6	+64	+144	+48	+72
7	–96	–60	–48	+12
8	+64	–48	+16	–36
9	–96	+72	–80	+36

Table 4: Recommended Dithering Pattern for $30 < |\delta| \le 45$ (offsets in $''$)

Seq.	From Last		From Zero	
num.	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$
0	...	...	0	0
1	+32	+24	+32	+24
2	–64	+24	–32	+48
3	–16	–72	–48	–24
4	+96	–24	+48	–48
5	–64	+120	–16	+72
6	+32	–144	+16	–72

Table 5: Recommended Dithering Pattern for $|\delta| > 45$ (offsets in $''$)

Seq.	From Last		From Zero	
num.	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$
0	...	...	0	0
1	+32	+24	+32	+24
2	–64	–48	–32	–24
3	+36	–24	+4	–48
4	–8	+96	–4	+48
5	+40	+24	+36	+72
6	–72	–144	–36	–72

9 Data Analysis on w2p2drs

We currently offer no online reduction package on w2p2drs for the analysis of your data. However, the below may be of some help:

9.1 Location of data

On w2p2ins, the WFI data is stored in /data/fits, while on w2p2drs the data is stored in /data. Note that you should only use w2p2drs for data reduction.

If it appears that data is corrupted on w2p2drs, you may ftp a new copy from w2p2ins.

9.2 Using the Second Screen

To use the right hand screen for an image display (such as skycat or saoimage), type the following in an Xterm:

```
setenv DISPLAY w2p2drs:0.1
```

Any application subsequently started from this xterm will be displayed on the right hand screen. To return to the original situation for the same Xterm type:

```
setenv DISPLAY w2p2drs:0.0
```

9.3 Mosaic Data and MIDAS

There is a wfi context in Midas which offers a few 'useful' commands. To start the context type in Midas:

```
w2p2drs> set/con wfi
```

This is normally done in the afternoon by operations. Hit return when asked about a mask.

In all cases you get a short help if you type the command without parameters (except `debias/wfi`...). Note that sometimes you can use the `<file-number>`, and sometimes you need the whole `<file-name>` where it automatically will work with the files from the different CCD (i.e., `<file-name>`, `<file-name>a`, `<file-name>b`, etc.).

Reading in of files:

```
w2p2drs> input/wfi <file-number>
```

Focus:

```
w2p2drs> focus/wfi <file-number>
```

This displays the focus image with appropriate cut levels, and it will ask you the values (`start value, step size and number of steps`) you used for the focus sequence. It also allows you to look at the focus for different stars. You can also use:

```
@@ wfi_focus <start-value> <step> <exposures>
```

on the image if it is already loaded in the display.

Computations:

```
w2p2drs> compute/wfi <prefix-output> = <first-file> <operant> <second file>
```

this makes the same calculation CCD by CCD

Debiasing:

```
w2p2drs> debias/wfi <file-name>
```

this will use the overscan for each CCD to subtract the bias. The output files will have an 'rb' prefix.

Mosaic:

```
w2p2drs> mosaic/wfi <file-name> nomask
```

This will take the 8 images and combine them into one. You should always use the `nomask` option for the time being. You can then do calculations (e.g. divide by FF) using standard Midas commands with the whole mosaic in one go.

Seeing:

```
w2p2drs> @@ wfi_seeing
```

This will measure the mean seeing from a set of stars.

9.4 Mosaic Data and IRAF

IRAF has a mosaic image package (mscred), and this is installed on w2p2drs. Frank Valdez, from the IRAF group, has created the package esowfi, which customizes mscred for its use with WFI images. The package esowfi adds the single task `esohdr`, used to modify the headers of the WFI images, changing the format of a few keywords, and adding an astrometric solution. At present, the astrometry only works for images binned 1x1.

We suggest that you read the help for the various mscred packages; there may still be some bugs in the software. The ESO Imaging Survey team has a web page (URL:

http://www.eso.org/science/eis/eis_proj/pilot/wfi/

where they offer some advice for the reduction of WFI data with IRAF.

Note that there is a login.cl file in `/home/drs` which has been edited such that the mscred package can be used. It has happened in the past that observers have deleted this file by typing 'mkiraf'. If you are having problems with running the mscred package, from `/home/drs` type: `cp .login.cl.original login.cl`, and then re-start IRAF.

Below are some instructions on how to use this package.

- From an xterm on w2p2drs in the directory `/home/drs` type:
  - `w2p2drs> setenv DISPLAY w2p2drs:0.1`
  - `w2p2drs> ./saoimage.e &`
  - *or* `w2p2drs> ./ximtool &`

  Note: Do not start both saoimage and ximtool at the same time! With ximtool it is very easy to blink frames for comparison. No mscred or headfix is need. First load two images: `disp wfixxxxx[#]1` and then `disp wfixxxxx[#]1` (# is the CCD, 1 to 8, to display). Then use the ximtool blink button.

  After starting saoimage, resize the display to cover the entire screen (click on upper right corner of window frame).

- IRAF works best if one uses an xgterm, so this is the default selected. Thus, before staring IRAF start an xgterm session with the command `xgterm -sb -fn 10x20 -bg white -fg black`.

- Start IRAF from the above xgterm, fire up esowfi, and change to the /data directory:
  - `w2p2drs> cl`
  - `cl>esowfi`
  - `es> cd /data`

- To display WFI mosaic with iraf, one should fix the header, so you must copy the file wfixxx to a different name (recall, you are not allowed to alter the wfi files!) using the UNIX 'cp' command, i.e. `cp wfixxx ewxxx`. You may now fix the image header of the new file using the command `esohdr`, from the package `esowfi.`
  - `es> esohdr ewxxx`

- To display a mosaic, set stdimage to `imt8192` or, for 2x2 binning, to `imt4096`. The image will display much faster if imt4096 is used.

  - es> set stdimage = imt8192
  - es> mscdisplay aaaxxx 1

- To display a single CCD, or a focus exposure type:
  - es> display aaaxxx[extension] 1
- To get statistics of an image:
  - cl> mscstat aaaxxx
- To examine an image:
  - cl> mscexam

  type a '?' in the saoimage window for a list of available imexamine options.

9.5 IDL

IDL version 5.2 and the Astronomy Users Library are installed on the w2p2drs workstation.

Before using IDL, it is a good idea to source 'idl_startup' or 'idl_startup.ksh', depending on the shell you are using. These files contain shell environment variables to support IDL.

There is an IDL manual available at the telescope.

10 Data Saving

To save data to tape, first decide on the media which you wish to use. The options are DAT (DDS3 drives are on both w2p2ins and w2p2drs, note that a DDS2 tape will work as a DDS2 tape in the DDS3 drive, and a DDS3 tape will be rejected from a DDS2 drive), 40GB DLT (w2p2ins), or 70GB DLT (w2p2drs).

Before selecting, please check if the data can be read at your home institute. This especially concerns the DDS3 DAT and 70GB DLT tapes which are not yet in common use.

Next, make a 1 column listing of the files you wish to save (recall that the images are in `/data/fits` on w2p2ins and `/data` on w2p2drs). This is best done from a UNIX prompt with:

```
ls -1 wfi*.fits > my_data
```

Note that the argument for ls is -1 (digit one). Edit `my_data` and delete files you do not wish to save. Next issue the wfits command:

```
wfits -l my_data
```

Note that the argument for wfits is an l ('ell'). You will be asked whether to save to DAT or DLT, and whether you wish to save files using the UNIX `dd` command or the UNIX `tar` command. The `dd` command offers the advantage that the files can be read from tape with MIDAS/IRAF, whereas the tar command allows the files to be read to disk and their original names recovered.

After writing your tapes, you can type `rlist` on both w2p2ins and w2p2drs, to verify that your tapes were correctly written. You will be asked some questions, after which time a list will be made of your tape.

More details on tape saving can be found at:
`http://www.ls.eso.org/lasilla/Telescopes/2p2T/E2p2M/WFI/tapes`

11 Acquired Wisdom

We are not aware of any significant electronic noise being added to the images when performing all thinkable operations during integration or readout. This includes refocusing during an integration, and changing filter or presetting to a new object during read-out.

Seeing can be degraded when observing towards the North. This is due to heating in the daytime of the road in front of the telescope which only loses its heat during the night. Recently the road in front of the telescope has been painted white, which should let the road cool-down faster at the start of the night.

Nearly all the narrowband filters show (to some extent) ghosts. Ghosts are particularly noticeable in the SII/7 filter. There is nothing that can really be done about this.

12 Problems and Solutions

12.1 DAISY+ Crashes/Hangs

From any Xterm on w2p2ins, type `stop_daisy`. You will see the DAISY+ session close down. You may then type `start_daisy`. **NOTE:** ensure that all files have been successfully ftp'ed to the w2p2drs workstation *before* stopping DAISY+.

12.2 Fake Vignetting

Some times it appears that the CCDs are being vignetted. In most of these cases (we have only once had the shutter stuck) the problem has turned out to be actually scattered Moon light causing an unusual illumination of the CCD. If you have unusual looking images, check to see if you are observing scattered moonlight. A sign that this is so will be very high background levels, and normal background levels in the 'vignetted' part of the mosaic.

12.3 FIERA Connectivity

If there is any problem with (the connection to) the FIERA workstation either with DAISY+ or the TCS one can try the following. From any Xterm on w2p2ins, type `stop_daisy`. You will see the DAISY+ session close down. Then type `fcdStartWFOV.sh`. This will restart the connections between the various workstations. When this is finished you should type `start_daisy`.

If this fails, you should ask the Telescope Instrument Operator to check the power supply, which is attached to the west side of the M1 cell.

12.4 Images are all 0's

This occasionally happens, and the solution is to reboot the FIERA controller, and restart the data acquisition system. From w2p2ins:

- Start the system log: `tail -f /var/adm/syslog/syslog.log`
- Reboot the FIERA: `rlogin odt5 -l reboot`
- When the system log shows something like:

```
dt5 ccs ccsSHManager 104 61 CCS semaphore (Id = 2) CREATED
wodt5 ccs ccsSHManager 104 61 CCS shared memory (Id = 3) CREATED
wodt5 ccs ccsSHManager 104 61 Shared Memory Area Created: ID = 3
wodt5 log logManager 104 61 Initialize/Configure logManager
wodt5 log logManager 104 61 Read configuration file
```

  Follow the instructions in the 'FIERA Connectivity' section to restart the instrument control software.

12.5 Automatic Data Saving Stopped

Check that:

- The file to be saved exists.
- The file being saved has read and write permissions set correctly. If you make a `ls -l` of the file being saved, you should see the permissions set as: `-rw-rw-r--`. The permission can be set typing `chmod 776` <*file-name*>.

  If the file has no permissions set, and it is not increasing in size, then the transmission of the file between w2p2ins and w2p2drs failed. If this is the case you must make a cd to /data/fits on w2p2ins, and ftp the corrupted file to the /data directory on w2p2drs. During the transfer the file cannot be accessed, so the writing to tape will only start after the ftp is complete.

12.6 Poor Offsetting in Delta

Currently, the main delta hydraulic pump is unable to provide sufficient pressure, and so the auxiliary pump is used. However, if there is a power cut the system reverts back to using the primary pump. To see if there is sufficient pressure, go to the telescope base and look at the delta pressure meter, if it is significantly below 130 bars, contact 2p2 Operations.