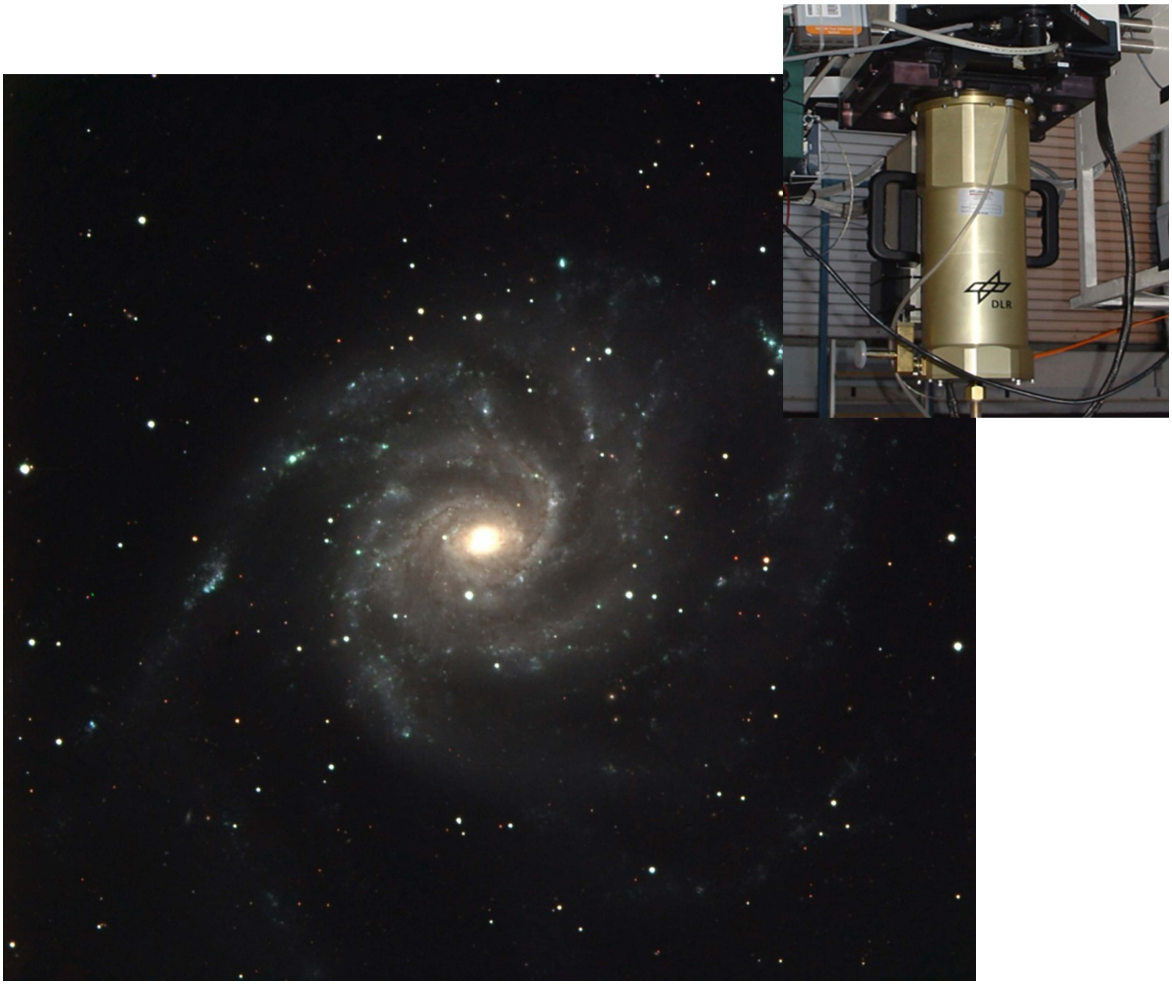
Observing with the DLR-MKIII CCD Camera at the CA 1.23m Telescope



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1 Observation Guide Using the DLR-MKIII Camera

1.1 Introduction

The DLR-MKIII camera is a fast-readout, low noise, cryogenically cooled scientific camera presently installed at the CA 1.23m telescope. It is equipped with an e2v CCD231-84-NIMO-BI-DD CCD sensor with 4k x 4k pixels and 15μm pitch. The sensor has 4 output amplifiers that can be used individually or in parallel for faster readout. The chip is antireflection coated (ER1) and is manufactured out of deep-depletion high-resistivity silicon. This technology maximizes the quantum efficiency of the detector especially in the red and near-infrared spectral bands. The usable dynamic range of the camera is limited by the capacity of the video processor which is linear up to about 32k DN (regardless of readout speed or binning setting).

In conjunction with the Bonn shutter installed at the 1.23m telescope, exposure times as low as 0.1s can be achieved with a homogeneity error less than 1%. The shutter fast speed facilitates the acquisition of bright sources and sky flats. The camera acquisition software supports a shutterless frame-transfer readout mode, which can be used in conjunction with a frame-transfer mask placed in the filterwheel to achieve concurrent exposure and readout of a sub-region of the CCD. This readout mode is useful in those cases where high time resolution (as in the case of planetary occultations) is necessary. As an additional benefit when using the frame-transfer readout, the shutter wear and tear associated with lengthy short-exposure sequences is completely avoided.

The camera is installed at the telescope's Ritchey-Chretien focus with no field corrector, and has a plate scale of 0.314"/pixel. The corresponding field of view (FOV) is 21.4' x 21.4'. The 4-position filterwheel accepts circular filters with a diameter of 100 mm that cover the whole FOV. Alternatively, an 8-position filterwheel can be installed, that accepts 50 mm circular filters, which only cover the central region of the CCD.

1.2 Setup

1.2.1 Prepare telescope and camera for observation

The DLR camera can be operated locally or remotely. In both cases the procedure for the observations is basically the same, as remote observations are performed through Windows Remote Desktop sessions, which seamless relay the remote computer's desktop. The only difference is represented by the necessity of properly configuring the remote session in case of remote observations. In particular, special certificates need to be installed on the remote client computer in order to access the camera acquisition computer (*Andor-controller)* and the telescope control computer (*wastro12*). The necessary certificates, along with installation instructions, can be obtained from the CAHA IT staff. Figure 1 shows a sketch of the network topology for the remote observations.

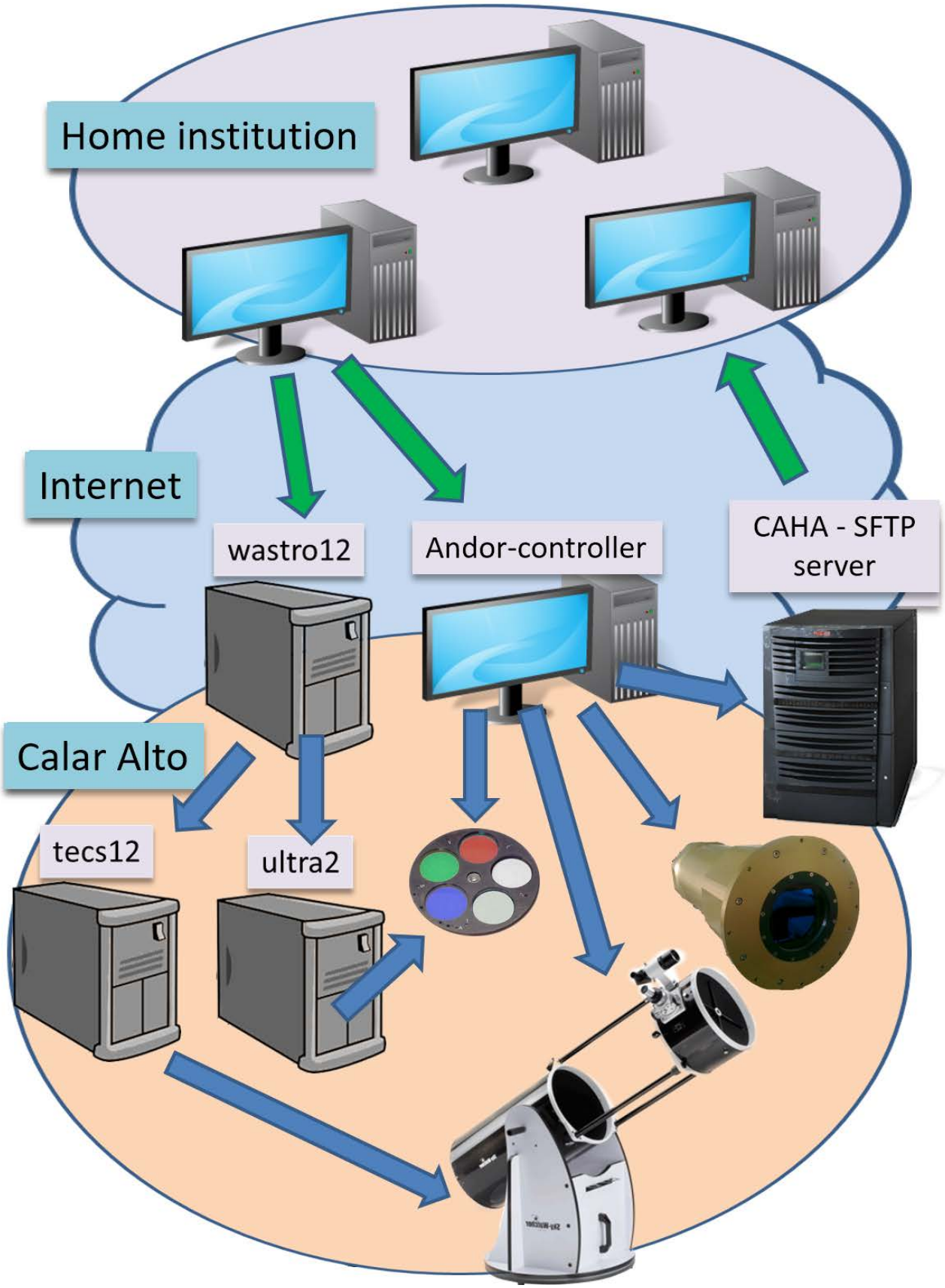

Figure 1 Network topology

Two Remote Desktop sessions are needed to perform the observations:

- The first one to the Windows 11 PC *Andor-controller*. This computer controls the acquisition, the telescope and filterwheel operations. The CCD camera is attached directly to this computer, while the telescope and filterwheel are controlled by *Andor-controller* by requesting *rts2* services. *rts2* is a distributed Telescope Control System (TCS) developed by Petr Kubanek, which runs on various workstations in Calar Alto, and that provides services for operating and retrieving status information from the telescope and the filterwheel. In turn, *rts2* communicates with the telescope by using the telescope's native TECS protocol. *rts2* is also capable of controlling the acquisition of the DLR camera. However, this mode of operation is not supported by DLR.
  The *Andor-controller* PC can be accessed through a Remote Desktop session by logging on as user *obs13* onto *Andor-controller.caha.es*, after the proper certificates have been installed (see above). The access password and detailed Remote Desktop configuration instructions can be obtained from the Calar Alto IT staff.

- The second Remote Desktop session connects to *wastro12.* This Windows PC computer solely acts as a gateway to the Sun workstation *ultra2*, to which the filterwheel is directly connected. This gateway configuration is necessary because Solaris - the *ultra2* operating system - does not support the Remote Desktop protocol, and its native X-Windows protocol is not routed through the Calar Alto firewall for security reasons. The *wastro12* PC is also used to start and monitor the TECS services on the *tecs12* workstation – a second Sun workstation - to which the telescope control hardware is directly interfaced. *tecs12* runs the telescope graphical user interface (GUI), which allows switching the telescope and dome on/off and allows manual pointing of the telescope.

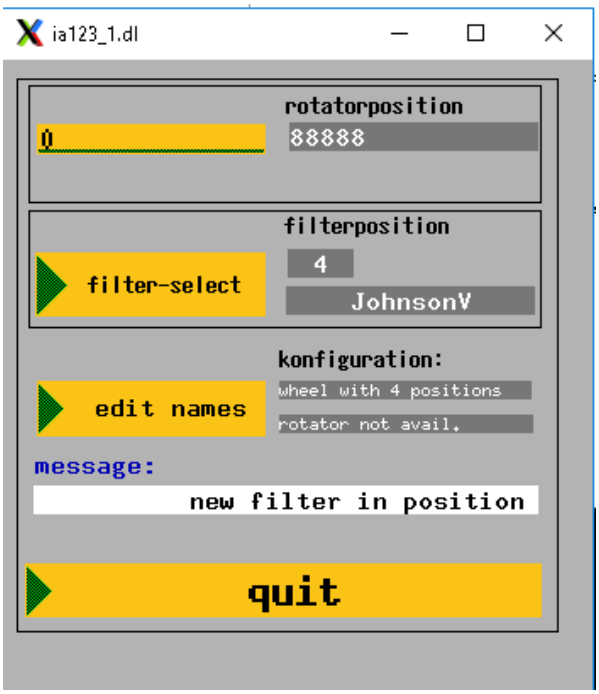

Figure 2 Filterwheel GUI

The *wastro12* PC can be accessed through a Remote Desktop session by logging on *wastro12.caha.es*. The *ultra2* and *tecs12* workstations can be accessed from *wastro12* by using the Windows X-terminal server application MobaXterm. The respective access credentials can be obtained by the Calar Alto IT staff.

Note: please make sure that the tcp/ip ports used by the Remote Desktop protocol are routed through the firewall of your home institution. In case of doubts please contact your system administrator.

Figure 3 Telescope GUI

1.2.2 Set up *ultra2*

- Close any existing filterwheel GUI on *wastro12* by pressing the Quit button (see Figure 2) and confirming.
- Close any existing *ultra2* terminal window.
- Start a new *ultra2* terminal window on *wastro12* by using the *MobaXterm* X-Windows application. The access credentials for *ultra2* can be obtained from the Calar Alto IT staff.
- On the *ultra2* terminal window appearing on *wastro12* after log-in, check that no instances of the *ia123* process are running, otherwise anomalies in the filterwheel operations may arise. This check can be performed by typing **ps -al** in the *ultra2* terminal window.
  In case an instance of the *ia123* process is still running, it should be killed by typing **kill PID**, where PID is the process ID corresponding to *ia123* as listed in **ps -al**.
- Start the filterwheel GUI by typing **ia123&** in the *ultra2* terminal window.

1.2.3 Set up *tecs12*

- Check whether the telescope GUI is running on *wastro12* (see Figure 3), in which case, exit it.
- Check whether the "*start tecs*" GUI is running on *wastro12* (see Figure 4), in which case, exit it.
- Start a new *tecs12* terminal window on *wastro12* by using the *MobaXterm* X-Windows application. The access credentials for *tecs12* can be obtained from the Calar Alto IT staff.
- Launch the "*start tecs*" GUI by typing **start** on the *tecs12* terminal window.

Figure 4 start tecs GUI

1.2.4 Restart the *rts2* system

- Restart the *rts2* system by pressing the "Restart RTS2" icon  on the *wastro12* desktop. This step synchronizes the information in the *rts2* system with the TECS database. It also interrogates TECS about the model of the filterwheel installed (4-position or 8-position). The initialization procedure asks for user confirmation that the filterwheel detected is indeed the one meant to be installed.
  The initialization routine displays verbose information during this process, which in general lasts 2 minutes, during which several warning messages might be displayed. The user should not be bothered by those messages. Also, the "*start gui*" button on the *start tecs* GUI (Figure 4) turns red. At the end of initialization, the user is prompted to press a key on *wastro12* to close the initialization window. After a short while, the "*start gui*" button on the *start tecs* GUI should turn green again. Should the "*start gui*" button not turn green within 4 minutes of the start of initialization, please try to start the *rts2* initialization procedure again.

1.2.5 Set up *Andor-controller*

- Log into Andor-controller with the credentials provided by the CAHA IT staff.
- Create on *Andor-controller* a directory for the night. The images should be stored locally on drive e:\ . Please follow exactly the naming convention from existing folders. The date on the directory name should correspond to the beginning of the night.

- Create a directory for the night on the SFTP server *cadata.caha.es*, where the data will automatically be uploaded upon acquisition. The credentials for logging on the SFTP server can be obtained from the CAHA staff. The directory on the SFTP server can be created with any SFTP client from any computer. The most convenient way, however, is to use the FileZilla application on *Andor-controller*. Please follow the naming convention from the previous nights.

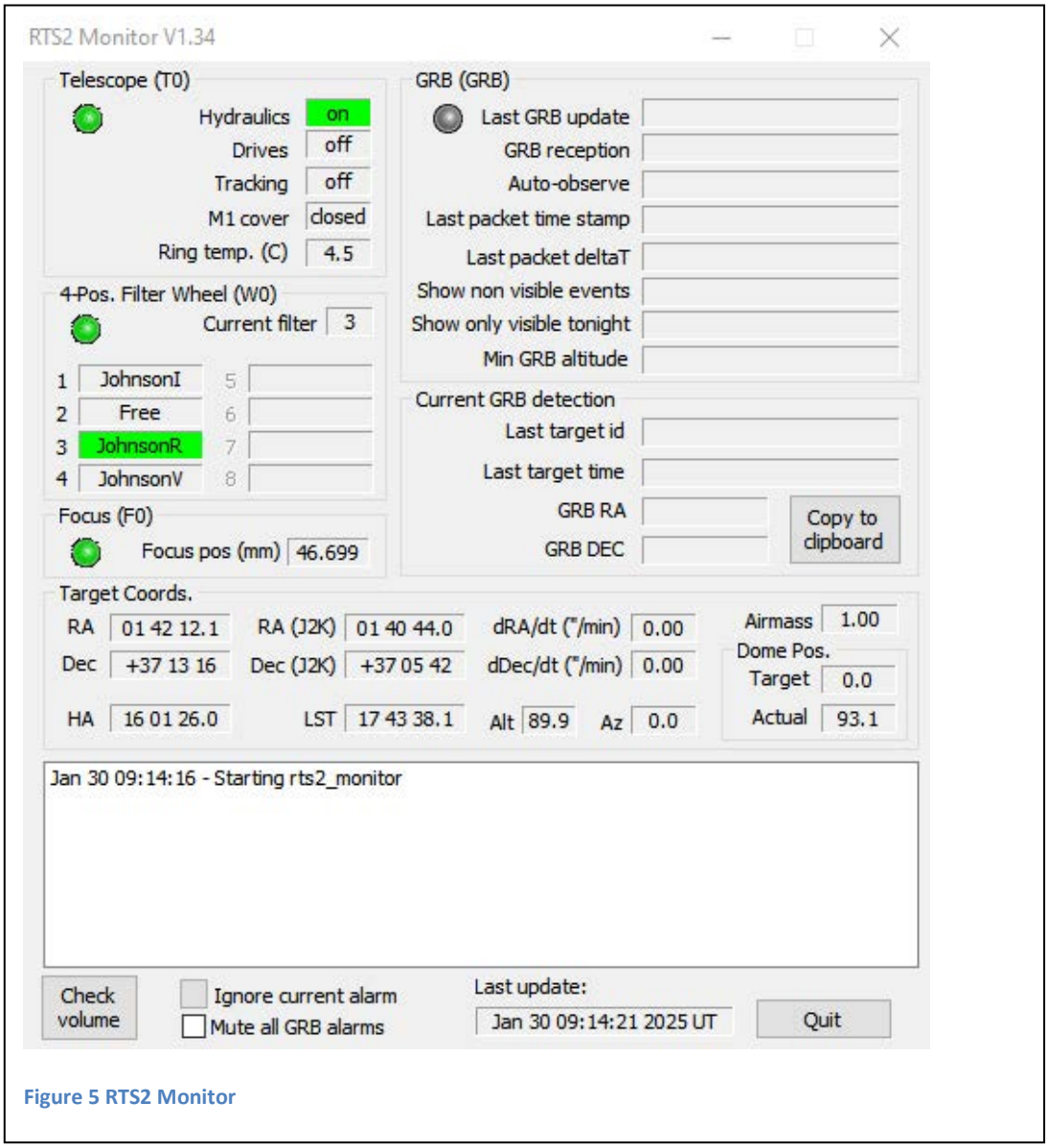

Figure 5 RTS2 Monitor

- Start the RTS2-monitor application, which provides a display of the current telescope and filterwheel status (see Figure 5). After the *rts2* initialization performed on *wastro12* in a previous step, the 3 LEDs on the left-hand side of RTS2-monitor should be lit green. If, after 2 minutes of *rts2* initialization these LEDs are still grayed-out or yellow, please perform the *rts2* initialization again. Automatic GRB notifications are no longer supported. Therefore, the GRB LED is always grayed out.
- Check that the filter positions shown on RTS2-monitor show the correct number and labels

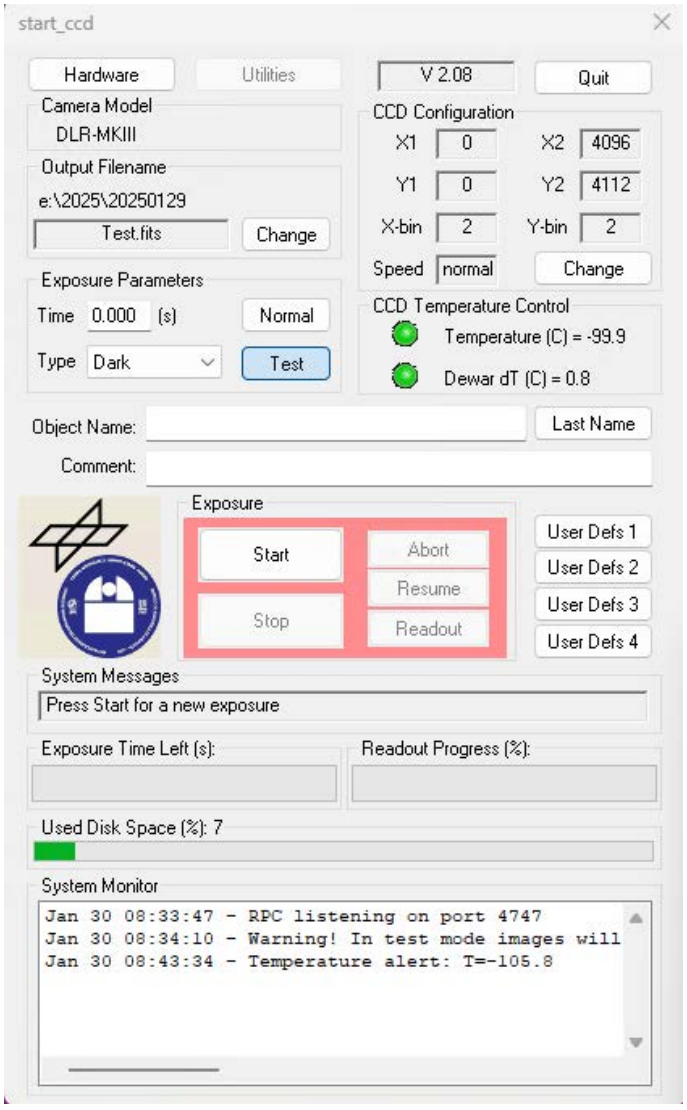

Figure 6 start_CCD program

of the filters.

- Perform a test operation of the filterwheel from *Andor-controller* by issuing an '*ia_filter n*' command in a CMD console. Check in *rts2-monitor* that the desired filter position is reached.

- Start the acquisition program by clicking on the *AstPhot* icon on *Andor-controller* and select File/Acquire. You will be prompted for an observer

name, an image name prefix and the folder in which the images are stored before the GUI appears. The camera GUI *start_ccd* (Figure 6) has a similar functionality as the one for the old camera on *ultra2*. Images acquired will be displayed automatically in *AstPhot*. It is advisable to reduce the size of the displayed image in *Astphot* in order to speed up the update of the remote screen. This is done by the command Window/Zoom/Squeeze in *AstPhot* (or the shortcut Ctrl-).

- Launch the *start_SFTP* applet (Figure 7) by clicking on the respective icon on the *Andor-controller* desktop. Make sure that the name of the destination directory shown in the field '*Directory on SFTP server*' is correct and exists on the *cadata.caha.es* server. This will ensure that the images acquired are automatically uploaded to the SFTP server. Note that eventual existing files in the destination directory on the SFTP server with the same file name as the images to be copied will not be overwritten. Instead, the program will rename the newer files by appending a serial number. However, since uploading files to an already populated directory is frequently the sign of a mistake in the directory naming convention, the user should do proper double-checking if this condition occurs.

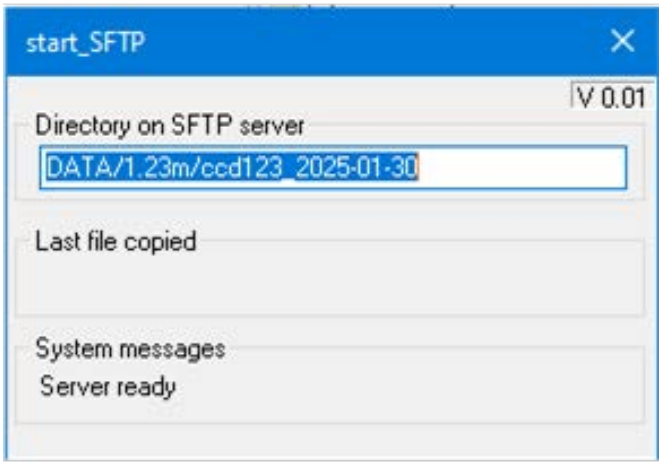

Figure 7 start_SFTP applet

1.2.6 General remarks

Pragmatics

- Please leave the camera acquisition GUI running at all times during your campaign, as this will ensure proper CCD temperature controlling.
- At the end of your campaign you can close the camera acquisition GUI, but please leave the power supply on in the exit confirmation dialog box.
- The power supply should only be switched off by the CAHA staff when the camera is going to be warmed up and dismounted.

Operations

- Both telescope and filterwheel operations can be performed either directly from the TECS GUI or via *rts2* commanding from the Andor-controller PC. The latter supports both direct commanding through the Windows CMD console, and commanding through python 2.7 scripts. However, it is strongly discouraged to mix GUI and CMD-console commanding during the same observing session. The reason is that the *rts2* subsystem retrieves filterwheel and status information directly by interrogating TECS and the filterwheel GUI. In order not to overload the limited computer resources of *ultra2* and *tecs12*, however, *rts2* performs polls with a rather low frequency and caches the results of the poll. If the user changes the filter position or moves the telescope manually via the GUI, the content of the rts2 cache will be outdated, until a new poll takes place. The consequence of this behavior will range from possible wrong telescope and filter entries in the image headers to a complete lock-up of the filterwheel. For this reason, is recommended that, after the initial setup on *ultra2,* the user solely controls the telescope and filterwheel from the *Andor-controller* via CMD-console. Only in this way can it be guaranteed that the image header entries are consistent and the fiterwheel and telescope are commanded properly.

2 Scripting Reference

These python 2.7 scripts can be used to control the telescope and the camera. They can be both be used directly from the Windows CMD command line, or called from a python script. Look at *oscript_rts2.py* on the desktop for examples on how to examine the exit codes.

2.1 Scripts

2.1.1 `dark`

Take a series of dark or bias exposures. The object name is set to 'darkXXX.Xs', where XXX.X is the exposure time. If the exposure time is 0 the object name is set to bias.

Arguments

Exposure Time - Exposure time in seconds.

Number of images - Optional, default: 20

Example

```
dark 30 15
```

This will take 15 dark exposures with 30s each.

2.1.2 `multidark`

Take dark or bias exposures with multiple exposure times. Up to 8 exposure times are supported.

Arguments

Number of images

Exposure Time(s) - List of exposure times in seconds, if 0 object name is set to bias

Example

```
multidark 10 0 50 120
```

This will take 10 bias images, 10 dark exposures with 50s and 10 dark exposures with 120s.

2.1.3 `focus`

Take a sequence of 8 exposures at different focus positions. It is recommended to set up a sub region of the CCD and set the binning to 1x1 before starting a focus sequence. The result of the

sequence is a composite image that consists of 8 exposures, each one shifted by 30 lines (last exposure is shifted by 60 lines to make the shift direction easily recognizable).

Arguments

Focus position - Initial focus position at the start of the sequence

Exposure time - Optional, Exposure time in sec, default: current value in acquisition program GUI

Step - Optional, amount the focus is increased between the exposures in cm, default: 0.03

Example

```
focus 45.5 5 0.1
```

This will take a focus sequence with 5s exposure time each step, starting at 44.5 and increasing focus position by 0.1 each step.

2.1.4 single

Take multiple images of a single field without moving the telescope.

Arguments

Object name - Name of object for Fits header

Exposure time - Exposure time in seconds

Number of images - Optional, default: 20

Example

```
single 1_Ceres 30 15
```

This will take 15 30s exposures and write the object name 1_Ceres in the Header. The telescope position must be set with the command `t_posit` beforehand.

2.1.5 dither

Take multiple images of a single field randomly moving the telescope between the images (max 100 arcsec in RA and DEC). The script will continuously take images until it is ended by pressing ctrl+c. Exposure time and name of the field are prompted by the script.

Arguments

RA - RA in hh mm ss.s

DEC - Dec in dd mm ss.s

tracking_RA - Optional, additional tracking in RA in arcsec/h

tracking_DEC - Optional, additional tracking in DEC in arcsec/h

Example

```
dither 10 9 50.2 40 13 12.5
```

This will move the telescope to the given coordinates, prompt for exposure time and field name and start image acquisition. Please note that the tracking is specified in terms of coordinate motion, and not plane-of-the-sky projected motion.

2.2 Telescope Commands

2.2.1 ia_filter

Set filter. In order for this command to work, the filter GUI must be running on *ultra2*.

Arguments

filter number - Number of filter to be set

Return values

0 on success, 1 if filter cannot be set (failed to set requested filter, filter number out of range)

Example

```
ia_filter 2
```

Set 2nd filter in wheel.

2.2.2 t_dspeed

Set telescope R.A. and Decl. coordinate motions.

Arguments

tracking RA - additional tracking in RA in arcsec/h

tracking DEC - additional tracking in DEC in arcsec/h

Return values

0 (success), 2 (telescope moving)

Example

```
t_dspeed 10.5 -20.3
```

Please note that the tracking is specified in terms of coordinate motion, and not plane-of-the-sky projected motion.

2.2.3 t_focus

Set telescope focus position.

Arguments

focus position - Focus position to be set

Return values

0

Example

```
t_focus 46.95
```

Set focus position to 46.95.

2.2.4 t_moving

Check if telescope is currently moving.

Arguments

none

Return values

1 (telescope is moving), 0 (telescope not moving).

2.2.5 t_offset

Move the telescope by the specified offset from the last `t_posit` pointing.

Arguments

offset RA - offset in RA in arcsec

offset DEC - offset in DEC in arcsec

ad|xy – Optional. Specifies whether the offsets correspond to RA/Dec coordinates or in projected sky coordinates. Default: **ad**.

Return values

0 (success), 2 (telescope moving), 3 (telescope not ready (e.g. drives off)).

Example

```
t_offset 30 30
```

Caution: the offset is computed from the last position reached through a `t_posit` command. If the telescope is pointed via the TECS GUI or through a direct TECS command, `t_offset` will produce erratic results.

2.2.6 t_posit

Point the telescope to the specified position. Coordinates are in J2000 and can be entered either in deg or hms/dms.

Arguments

wait|nowait - return immediately or wait until pointing finished

RA - Right ascension in deg or HH MM SS.SS

DEC - Declination in deg or sDD MM SS.SS

Return values

0 (success), 1 (wrong syntax), 2 (telescope - already moving), 3 (coords malformed), 4 (coords not reachable), 5 (telescope is not ready (e.g. drives off)), 6 (commanded position is not reachable), 7 (timeout (only with wait option)), 8 (pointing failed (reached coordinates differ from commanded coordinates, can only be checked with **wait** option)).

Example

```
t_posit nowait 10 9 50.2 40 13 12.5
```

This will move the telescope to RA=10 h 9 m 50.2 s and DEC=40 deg 13 m 12.5 s and return immediately.

2.2.7 t_request

Get telescope status (RA, DEC, HA, LST, AIRMASS) and print it to the console.

Arguments

none

Return values

0

2.2.8 t_state

Get operational state of the telescope.

Arguments

none

Return values

1 - hydraulics off, 2 - drives off, 3 - tracking off, 4 - m1_cover closed, 10 - ready for observing.

2.3 Camera Commands

To use these commands the acquisition program *start_ccd* on *Andor-controller* must be running.

2.3.1 camera_dlr1_start

Start an exposure.

Arguments

wait|nowait – Optional. Return immediately or wait until exposure finished. Default: **wait**.

Return values

0 - success, 1 - error

2.3.2 camera_expmode

Set exposure mode.

Arguments

test|normal

Return values

0 - success, 1 – error

2.3.3 camera_exptime

Set exposure time.

Arguments

exposure time - Exposure time in seconds

Return values

0 - success, 1 – error

2.3.4 camera_exptype

Set exposure type.

Arguments

science|dark|flat|focus

Return values

0 - success, 1 – error

2.3.5 camera_objectname

Set object name.

Arguments

object name - name of object to be exposed next

Return values

0 - success, 1 - error

Example

```
camera_objectname 'some object'
```

Object names containing spaces must be single-quoted.

2.3.6 camera_userdef

Select predefined user settings (binning, chip geometry, readout speed, amplifier) in *start_ccd*. The settings must be defined in *start_ccd* and correspond to the User Setting buttons 1 to 4 .

Arguments

1|2|3|4

Return values

0 - success, 1 - error

Example

```
camera_userdef 3
```

Set userdef 3 in *start_ccd*.

2.3.7 camera_bin

Set binning in *start_ccd*.

Arguments

binning x

binning y

Return values

0 - success, 1 - error

Example

```
camera_bin 2 2
```

Set binning in *start_ccd* to 2 by 2.

2.3.8 camera_speed

Set readout speed in *start_ccd*.

Arguments

slow|normal|fast

Return values

0 - success, 1 - error

Example

```
camera_speed fast
```

Set readout speed in *start_ccd* to fast.

2.3.9 camera_amp

Select readout amplifier. If set to 4 all amplifiers are used simultaneously. Please note that changing output amplifier will change the orientation of the image.

Arguments

0|1|2|3|4

Return values

0 - success, 1 – error

Example

```
camera_amp 4
```

Use all amplifiers simultaneously.

2.3.10 camera_format

Set CCD geometry. Note that only full frame format is supported if all readout amplifiers are used.

Arguments

X1 - first column

X2 - last column +1

Y1 - first row

Y2 - last row +1

where the coordinates are counted starting from 0 and refer to pre-binning values. Please note that reading out from all output amplifiers simultaneously (camera_amp 4) does not allow the selection of a sub-region.

Return values

0 - success, 1 - error

Example

```
camera_format 1000 3000 1000 3000
```

Defines a 2000 x 2000 pixel sub-region centered approximately at the center of the CCD.

3 F.A.Q.

1. **I cannot access the *Andor-controller* PC with a Remote Desktop session.**
    - Make sure that the proper certificates are installed on the local PC. (Only Windows clients are currently supported).
    - Make sure that *Andor-controller* is switched on by pinging it from *wastro12*.

2. **I don't find the icon of the camera acquisition program on the *Andor-controller* desktop. Where is it?**
    - The camera GUI is accessed through the AstPhot program by selecting File/Acquire.

3. **I cannot start the camera acquisition program. A warning says that there is another instance already running.**
    - Only one instance of the camera acquisition program can be running at a time. This warning occurs if another user is logged onto *Andor-controller* and left an acquisition session open. In such case contact the DLR or CAHA staff to close the open session.

4. **I restarted the *rts2* system on *wastro12* but the *"start GUI"* button on the "*start tecs*" application is still red after a few minutes.**
    - Please try to restart rts2 again. If after a few attempts the button stays red, please contact CA staff.

5. **The filterwheel does not respond or loses its position. The filterwheel GUI reports ********* as a filter number.**

    These are possible symptoms that multiple instances of the *ia123* daemon are running on the *ultra2* workstation.
    - Close the filterwheel GUI.
    - List all running processes in an *ultra2* terminal (***ps -al***)
    - Check if there is any running instance of ia123. If so, look up its process id number (pid)
    - Kill the process by issuing a kill <pid> command in an *ultra2* terminal.

    Another possibility is that the user has mixed GUI and CMD operations. If that is the case, please re-initialize *rts2* on *wastro12* as described earlier. In case there was a filterwheel lock-up, it might be necessary to move the filter manually from the GUI before passing to CMD operations.

6. **Images are not automatically uploaded to the CAHA SFTP server**
    - Make sure that the *start_sftp* program is running on the *Andor-controller* PC.
    - Check the transfer status and the last image transferred in the notification area of the *start_sftp* program.
    - Make sure the target directory is existing on the CAHA server (*start_sftp* does not create the target directory).

- If you are using a GUI-based SFTP client (as FileZilla) to check the existence of the files on the CAHA SFTP server, make sure you refresh the view of the client after a transfer, as these clients don't usually refresh the directory content automatically.
- Make sure the *start_sftp* program points to tonight's directory on the SFTP server. If the program still points to an older directory, newer files with the same name will be renamed without warning.

7. The image FITS header shows incorrect object coordinates (or filter number or focus position or mirror temperature) information.

- Telescope status information is retrieved by the camera acquisition by interrogating *rts2* services. If such information is not retrieved correctly, some *rts2* services might not be running or be out of synch. In such case re-initialize *rts2* by pressing on the '*Restart rts2*' icon on *wastro12*. Please note that the *rts2* services need a few minutes to be restarted. If the acquisition program is started before that period, it will report warnings, as the communication with *rts2* is not yet established.

8. An error message is displayed in the notification area of the camera acquisition program, saying that information cannot be obtained from *rts2*.

- See point 6.

9. The CCD acquisition program shows unrealistic CCD temperatures.

- The CCD temperature controller has crashed, possibly due to electrostatic discharge during nitrogen refill.
- Try a soft reset of the camera by restarting the acquisition program (and leaving the power supply on in the confirmation dialog).
- If a soft reset did not help, try a camera hard reset by closing the acquisition program and switching off the power supply in the confirmation dialog. Wait one minute and open the acquisition program again.
- If none of the above works, just panic.

10. The dewar dT has dropped to a value lower than −2.5 C.

- The dewar dT measures the temperature difference between the dewar and the local air. If this value drops below −2.5 C the dewar isolation is degraded and condensation on the optical window may occur. Contact the CAHA staff for reestablishing a good vacuum.

11. The Temperature LED control on the camera acquisition program has turned red.

- The CCD temperature is increasing. Liquid nitrogen needs to be refilled.

12. The *t_offset* command does not work as expected.

- The *t_offset* command moves the telescope by a user-specified amount with respect to the last position reached through a *t_posit* command. As an example, issuing twice the *t_posit* command with the same parameters will cause the telescope to be moved once. Issuing the *t_posit* command after the telescope has been moved

through the TECS GUI or through a direct TECS command may result in an unpredictable behavior.

13. What is the system gain of the camera in el/s?

- The system gain of the camera is listed in the image FITS header for the particular camera setup used.

14. What is the readout noise of the camera for my configuration?

- The easiest way to determine the current readout noise of the camera is to compute the standard deviation of a sub-region of a bias frame (e.g. by typing 's' in *AstPhot*) and multiply the result by the system gain.

4 Appendix I: Start-of-night checklist

1. Establish a Remote Desktop connection to *wastro12.*
2. Ensure that all GUIs and terminal windows to *tecs12* and *ultra2* are properly closed.
3. Establish an X-Window connection to *ultra2* from *wastro12.*
4. Verify that no instance of the *ia123* process on *ultra2* is running.
5. Launch the filterwheel GUI by typing **ia123&** in the *ultra2* terminal.
6. Establish an X-Window connection to *tecs12* from *wastro12.*
7. Launch the *start tecs* GUI by typing **start** in the *tecs12* terminal.
8. Restart the *rts2* system by pressing the corresponding icon on the *wastro12* desktop.
9. Start the telescope GUI on *tecs12* by pressing the *start tecs* button on the *start tecs* GUI.
10. Establish a Remote Desktop connection to *Andor-controller.*
11. Start the *rts2-monitor* applet on *Andor-controller*.
12. Ensure the 3 left-hand side LEDs on *rts2-monitor* are green.
13. Create a local directory for the night on *Andor-controller.*
14. Create a directory for the night on the SFTP server.
15. Launch - or update the destination field of - the *start_sftp* applet and verify that it is pointing to the correct SFTP directory.
16. If not running, start *Astphot* and start a *start_ccd* acquisition session.
17. Set acquisition directory in *start_ccd* to the directory created for the night.

5 Appendix II: End-of-night checklist

End of night

1. Park and shut down the telescope from the telescope GUI on *ultra2*.
2. Close the *SFTP_start* applet on *Andor-controller*.
3. Leave the *start_ccd* program on *Andor-controller* running.
4. Fill out carefully the night report after clicking on the "NightReport - 1.23" icon in the wastro12 desktop, reporting in detail any technical issue you may have suffered.

End of campaign

In addition to the previous steps:

1. close all GUIs and open terminal windows in *wastro2*.
2. Leave the *start_ccd* program on *Andor-controller* running.

6 Appendix III: Spanish keyboard mapping