Telescopio Nazionale Galileo

HARPS-N Quick Start Guide

Manual version 2.7
TNG-MAN-HARPN-0001

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Name Date Signature

Change Record

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V2.5	23/08/2017	New AG	
V 2.6	08/07/2021	§ 5.3.4	Web Interface for astronomers
V 2.7	10/01/2022	§ 5.8	Added new ESPRESSO DRS

Contents

1 Introduction

1.1 Scope

This User Manual is intended to give all necessary information to potential users of the HARPS-N instrument, to help them to use the instrument and manages the observation at the TNG telescope.
The following documents are closely related to this manual and should be consulted as well:

- The HARPS-N User Manual (TNG-MAN-HARPN-0002)
- The HARPS-N Quick Start Manual (TNG-MAN-HARPN-0001)
- The New Short Term Scheduler User Manual (NSTS)
- The DRS User Manual (OG-MAN-HAN-13-0004)
- HARPS-N DRS User manual (TNG-MAN-HARPN-0006)
- HARPS-N Autoguide Manual (TNG-MAN-HARPN-0005)
- HARPS-N LCU manual (TNG-MAN-HARPN-0004)
- The standard calibration

These manuals are available through the TNG web page

http://www.tng.iac.es/instruments/harps/

1.2 Additional information

The latest information updates about the HARPS-N instrument can be found on the HARPS-N web pages

http://www.tng.iac.es/instruments/harps/

1.3 Contact information

Feedback on this User Manual from users is encouraged. Please email to cosentino@tng.iac.es

1.4 Reference documents

[RD01] HARPS-N User Manual

[RD02] HARPS-N Operational Guide

[RD03] HARPS-N LCU Manual

[RD04] New Short Term Scheduler User Manual (NSTS)

[RD05] The DRS User Manual

[RD06] HARPS-N DRS User Manual

[RD07] Ucam User manual

[RD08] Templates Reference Guide

[RD09] Thorium-Argon Atlas

[RD10] Design of the LCU for HARPS-N

[RD11] HARPS-N Autoguide Manual

[RD12] The standard calibration

2 System Overview

The following parts compose the HARPS-N instrument control software:

- The Front End and Calibration Unit control software (LCU)
- The telemetry system (part of the LCU)
- The exposure meter counter
- The Autoguider (AG)
- The Sequencer
- The New Short Time Scheduler (NSTS)
- The scientific camera software (UCAM)
- The Data Reduction Software (DRS) using the TRIGGER to automatically execute reduction

The parts of the control software reside in various computers and communicate one with the other according with the scheme in Figure 1

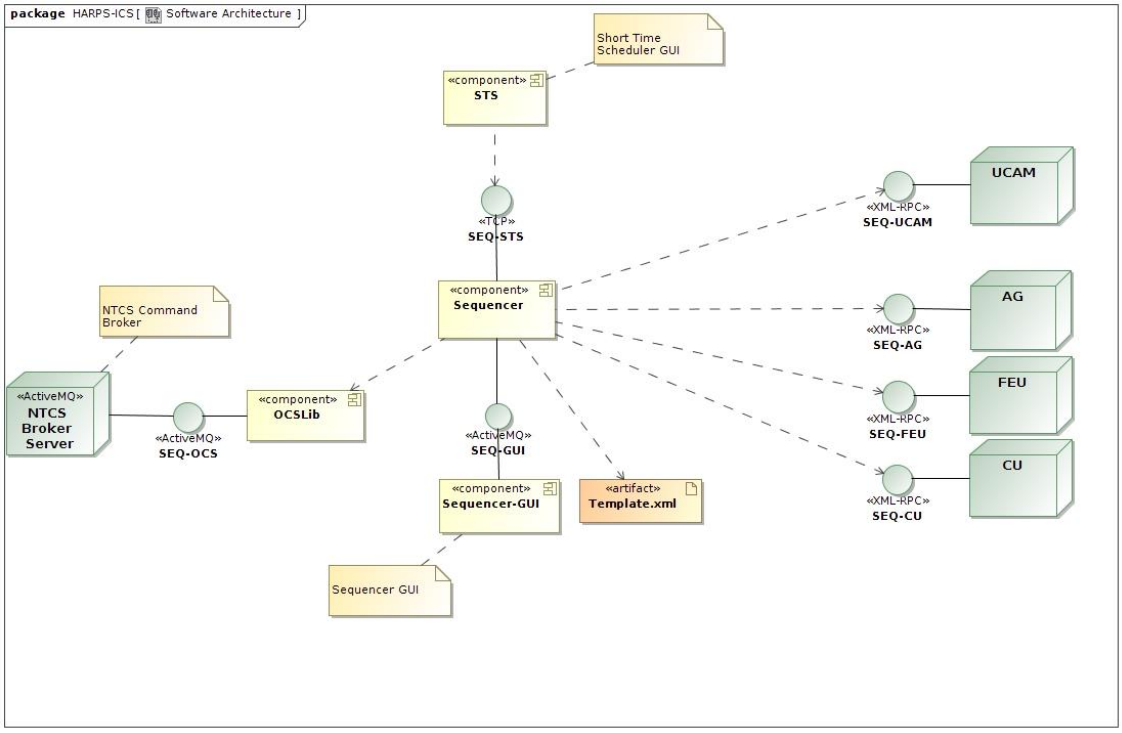

Figure 1 - The software architecture (to be upgraded)

Unit	Machine	IP	User
AG core	hanmgr	161.72.92.27	harps
Short Time Scheduler	brunello.tng.iac.es	161.72.44.35	guest
	barbera.tng.iac.es	161.72.53.4	guest
Sequencer/Expmeter	harps-ics.hn	161.72.92.10	hanmgr
Ucam	ucam.hn	161.72.92.32	ucam
Data Reduction Software	drs32.hn	161.72.92.15	harpn
Front End Unit (NEW)		161.72.92.20	harps
ESPRESSO DRS		161.72.92.17	drs

Table 1 - Units addresses

3 Important points to be aware of

3.1 Life time of ThAr lamps

The ThAr lamps have two important roles in a HARPS-like spectrograph. The first is to allow for precise wavelength calibration. The wavelength calibration sets the nightly 'zero point' of the instrument and is extremely important for the long-term radial-velocity repeatability. Therefore, always the same lamp should be used, which should live as long as possible. The second role is to track possible instrumental drifts. For this purpose, the 'simultaneous reference fiber' (fiber B or fiber 2) of HARPS is illuminated with the ThAr spectral reference, which is able to measure these drifts.

Given these two roles, we have foreseen in HARPS-N two different ThAr lamps:

A) **ThAr1** will be dedicated to the calibration. It is always used on fiber A and is switched ON only for calibration. The operational time must be as short as possible, typically of

10-15 minutes per day. **Immediately after ThAr calibration this lamp MUST be switched OFF.**

B) ThAr2 is always used on fiber B (sim. reference) for drift measurement. It is generally switched ON at the beginning of the night and switched OF at the end of the night by the 'End night' script. If not used for longer than an hour, it might be switched OFF during the night as well.
Note: The ThAr2 lamp now is used only in case or emergency, in substitution of the Fabry-Perot calibrator.

Important note: One should not forget to apply a warm-up time of **5-10 minutes after switching ON** again and before using it!

3.2 Observations without data reduction

The data reduction is an automatic but completely 'off line' process. The observations can be carried out without any loss of data or information even WITHOUT starting the DRS. **For no reasons the observations should be halted because of the DRS is not able to run or simply not running.** The one note of caution is that no quality feedback will be available from the DRS in these cases. The Observer should make sure that the instrument parameters are all ok and that a full calibration set has been carried out at the beginning or the end of the night.

3.3 Efficiency of the instrument

Efficiency of a spectrograph is a concern because it can strongly change with seeing, cloud conditions, calima, and air mass. The NSTS has some build-in functions to estimate the expected count rate and SNR as a function of seeing, airmass, stellar magnitude and exposure time. This function is called Exposure-Time Calculator.

At any time during the observations, the Observer may want to compare the obtained values with the expected values. It is therefore recommended to compare the NSTS/ETC predictions with the measured values provided by the DRS. The can be found in the headers of the reduced *e2ds_A.fits files in the reduced file folder:
`drs32>/data/reduced/YYYY-MM-DD/` The keywords `HIERARCH TNG DRS SPE EXT SNXX`, where XX is the order number, provide the SNR per extracted pixel of the corresponding order, which can be directly compared with the ETC value.

A script is available in the directory `~harpn/scripts/get_mes` which will provide some general information on the scientific exposures, and in particular the SNR for the orders 1 (390nm), 46 (550 nm) and 68 (690 nm). The script can be called as follows:

```
cd
cd scripts
./get_mes 2012-06-23
```

Another mean to verify instantaneous efficiency is to observer the exposure meter counts in the HARPS-N Exposure Meter panel on the LCU machine, or watching the "estimate SNR', shown in the sequencer GUI (Figure 12). As a reference, the expected count rate is given, as well as the 'efficiency', which is nothing else that the measure/expected count rate.

The efficiency given by the ETC has been verified to be 'realistic'. In case of big discrepancies between measured and expected SNR, the problem may be due to:

- de-focus of the telescope or bad image quality -> ask the operator to do Shack-Hartmann and/or focus procedure
- Calima (nothing can help)
- Clouds (nothing can help)
- Wrong seeing estimation

In case that none of them apply, please contact as soon as possible the HARPS-N Instrument Scientist.

3.4 Instrumental drifts

The data reduction software provides shortly after a thorium-calibration 'thoAB' exposure and a simultaneous-thorium 'tho_simult' exposure a measure of the instrumental drift (since the last calibration). **If this drift happens to be higher than 2 m/s we strongly recommend to re-do a wavelength calibration.**

We strongly recommend to monitor the instrumental drifts given by the DRS. In case of faint objects are observed in objAB mode (sky light on fiber B), at least one tho_simult observation on a bright target should be done every hour to monitor the drifts.

3.5 The 'End Night'

It is extremely important to execute the 'End Night' command from the Sequencer. This command will ensure that, among other, that:

- The dust cover is closed
- The AG is stopped
- The lamps are switched OFF

The Observer and the Operator must verify that at least these three tasks have been carried out correctly.

4 Start-up procedures

4.1 Telescope start-up procedure

Actor: **Telescope Operator**
Reference start time: **Nautical night start NN**

Procedure:

NN-90 min. **Telescope start-up**

NN-80 min. **Start-up the instrument**
Start-up LCU (5.2)
Start-up AG (5.3)
Start exposure meter (par. 4.5)

Important: Before the calibration acquisition and during the scientific observations, the operator have to verify that all the light of the dome, nasmyth, stairs, storehouse, etc. are turned off.

NN-60 min. **Open telescope dome (after the end of standard calibrations)**

NN-50 min. **Configure instrument for HARPS-N**
Set derotator to 'HARPS-N'

NN-30 min. If the image quality is poor, do a Shack-Hartmann
(usually, only to be done when starting a run)
Must be followed by a focus procedure

NN-20 min. Check telescope telemetry running
Start the exposure meter (see par. 4.5)

Very important: verify that active optic is ok, the 'look up table' upgraded and that the focus of the telescope is set to HARPSN position.

NOTE: The telescope has to be ready for HARPS operation before the 18:00 UT

4.2 Instrument start-up procedure

Actor:	**Support Astronomer/Visitor Astronomer**
Reference start time:	**Nautical night start NN**
Procedure:	**Instrument verification**
	Verify that telemetry is running and that the values are in green. Monitor specific HARPS-N sensors (see Figure 2): (From the http://tngweb.tng.iac.es/telemetry/systems/HARPS) CCD temperature Echelle temperature Detector-body temperature Head-Heater temperature Nitrogen level Pabry-Perot pressure Pabry-Perot temperature Enclosure T3 temperature Enclosure T2 temperature Vessel pressure
	Start-up the instrument From HARPS-ICS Terminal: Start-up Sequencer (multimedia, par 5.4) From **brunello**: Start-up NSTS (par. 4.6) Ask to the TO for the state of Expose meter From UCAM Terminal: Start-up UCAM (wsastro par 5.7) From DRS32 Terminal: Start up TRIGGER/DRS (brunello, par.4.8)
	Initialize instrument From Sequencer: Press '**LCU Init**' button (it takes ~ 1 minutes) Verify on LCU that **init** is executed Verify in the Sequencer that no errors are reported
	Calibrate instrument (daily calibrations) From Sequencer: Set ThAr1 and ~~ThAr2~~ lamps to 'ON' In NSTS: Insert File->OB->Standard calibration From sequencer press the 'Close' button in Dust Cover From Sequencer: Press Next OB to execute On DRS: Verify that quality control passes After calibration and from Sequencer: SWITCH OFF ThAr lamps
	Start night: On sequencer: Press '**Start Nigth**' button (it takes ~ 2 minutes) On sequencer: press the **'Open'** button in Dust cover On Sequencer: Verify that no errors are reported Verify the status in the **'instrument status webpage' (**Figure 3**)**
NN-15 min.	**Do through focus (optional)** In NSTS: Insert FOCUS OB From Sequencer: Execute NEXT OB The system should have set automatically the correct focus
NN	Start scientific observations

Very important: before the beginning of the observation ask to the TO if the active optic is ok, the 'look up table' upgraded and if the focus of the telescope is set to HARPSN position.
NOTE: HARPS has to be ready for observation before the 18:00 UT

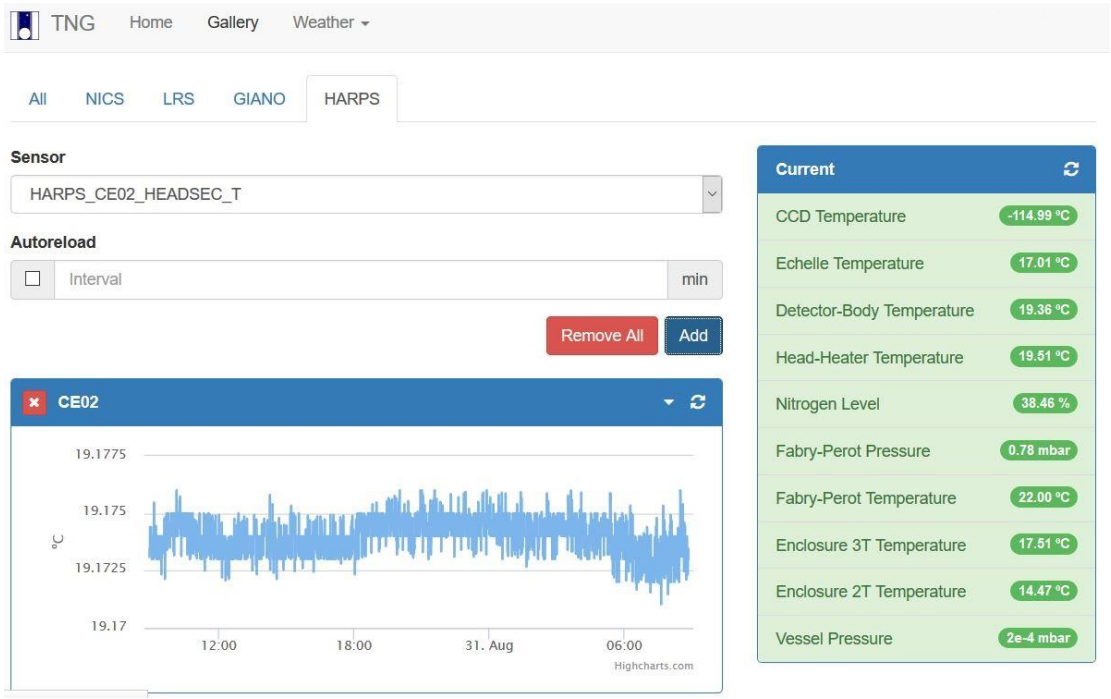

Figure 2 – HARPS-N sensors webpage (http://tngweb.tng.iac.es/telemetry/systems/HARPS)

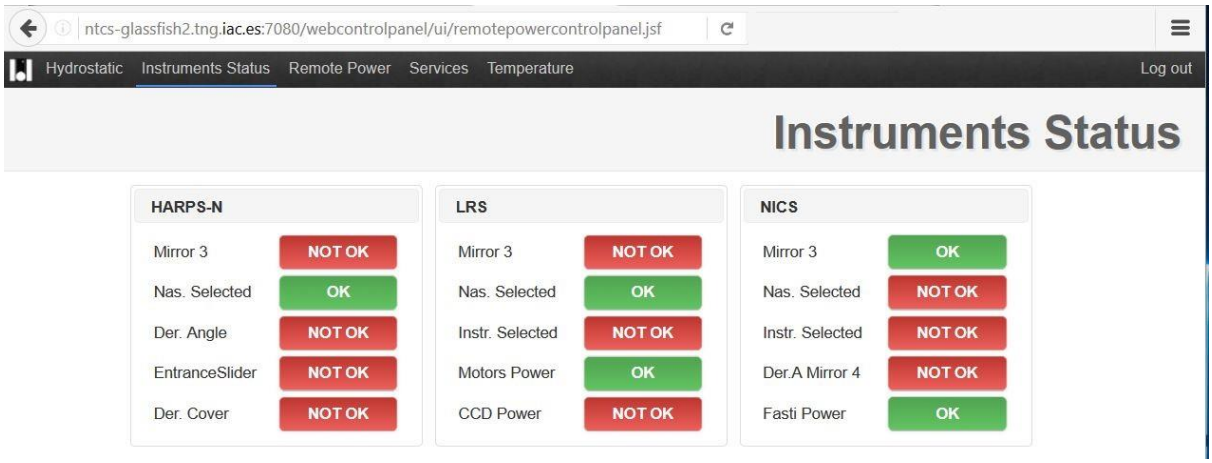

Figure 3 - Instrument Status webpage (ntcs-glassfish2.tng.iac.es:7080/webcontrolpanel/ui/remotepowercontrolpanel.jsf)

5 How to start-up the various subsystems

5.1 The HARPS-N Workstation environment

The workstation environment in the control room is shown in Figure 4 . The workstation WSOPER is under the control of the Telescope Operator (TO), the Brunello and WSASTRO workstations are under the control of the Visitor Astronomer (VA) and finally the Multimedia workstation is shared between the TO and the VA.

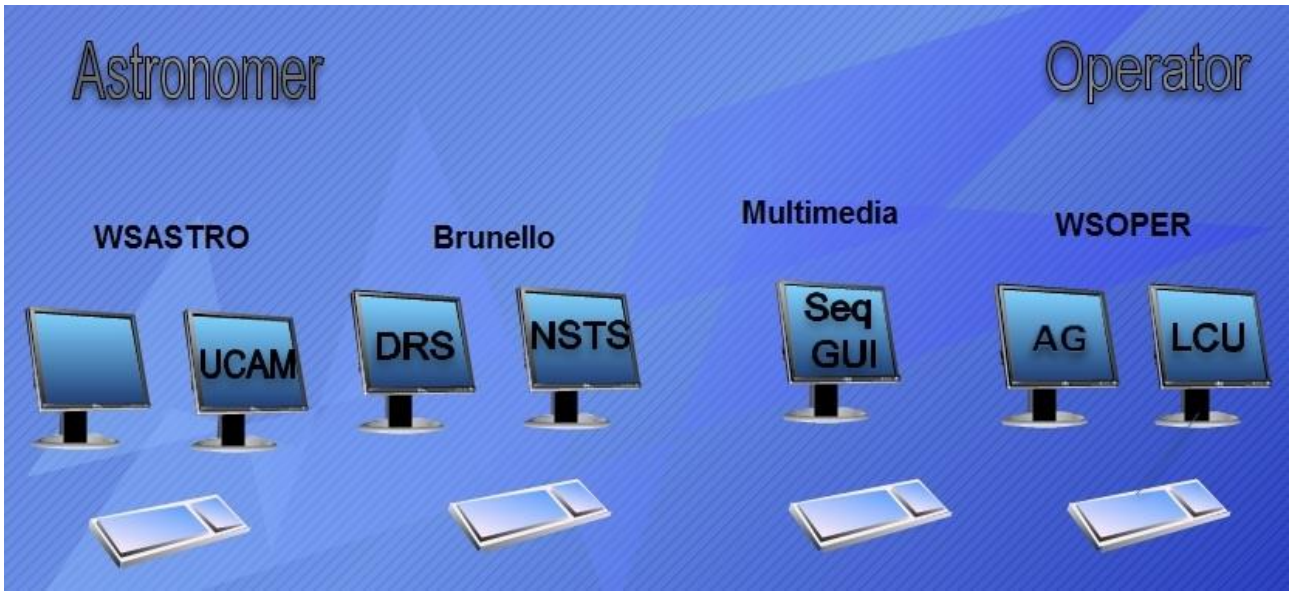

Figure 4 - Control room workstations

5.2 The Front End and Calibration Unit (LCU) Start-up

The software used to operate with the FEU runs on a Windows PC that is located in Nasmyth B, in a rack close to the Calibration Unit. The user will interact with the FEU software by a remote connection from a linux machine.
In order to connect to FEU computer and start the LabView software, is necessary to open a remote desktop connection (from the **wsoper** workstation located in the control room):

a) Click on the HarpsN-NewLCU icon (Figure 5) , or open a shell from any linux machine and type: `rdesktop -T LCU 161.72.92.20 -g89%`
This will start the remote connection with the FEU PC.

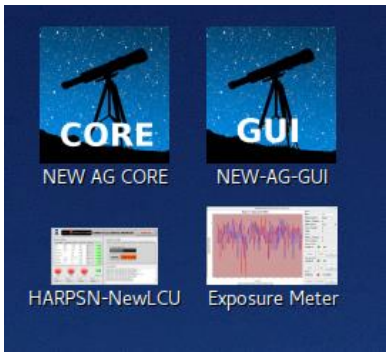

Figure 5 - WSOPER workstation desktop

b) Start the control software by clicking the icons corresponding to the control (Figure 6):

Figure 6 - FEU desktop screenshot

The LCU GUI starts and appears as shown in Figure 7. The LCU GUI is made up by three parts:

1. The Device status frame

2. The control system frame
3. The log report frame

More details about the LCU GUI are described in HARPS-N Operational Guide HARPS-N LCU Manual [RD02].

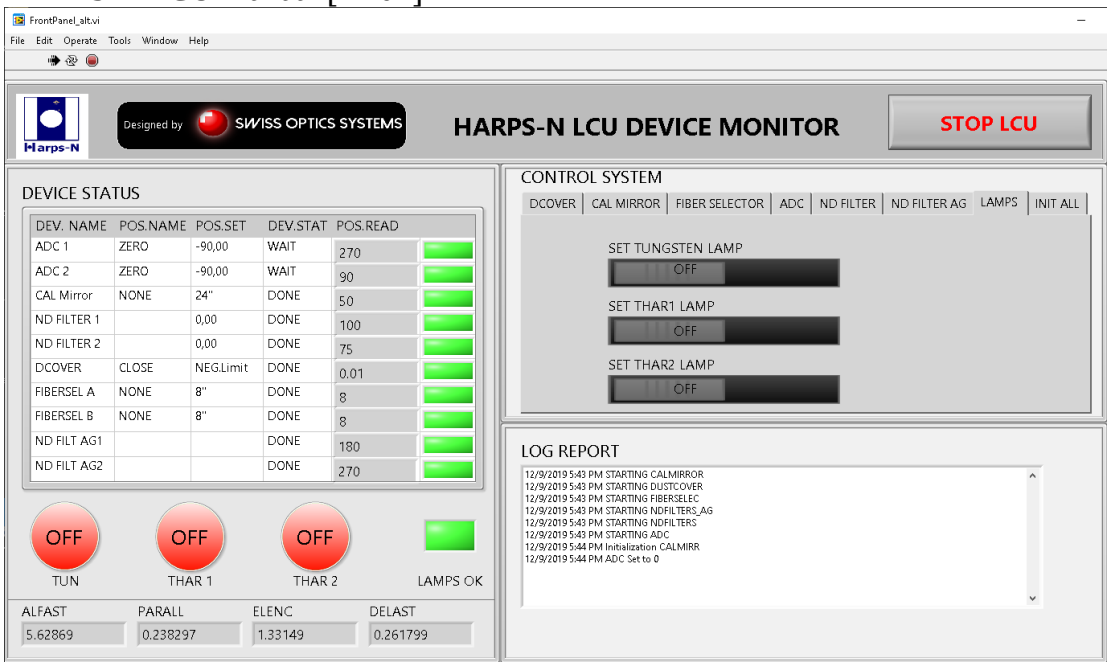

Figure 7 - HARPS-N LCU device monitor

5.3 Autoguider (AG) Start-up

The autoguide (AG) system is made up by two parts:

1. The CORE (new AG CORE) that is executed in the AG computer (nag = 161.72.92.27, user = hanmgr, password = 'the standard harpsn password')
2. The WEB-GUI, that is launched in a Chrome browser (different browsers are not fully compatible)

To use the autoguide in a proper way the user has to follow the instructions described below.

5.3.1 Start the autoguide

1. Start the AG core as described in the paragraph 5.3.5
2. Make sure that the "AG core" starts in a correct way, checking that the terminal shows the line**:: - AG Core Ready !** at the end of the log
3. Open the WEB GUI in a Chrome browser as described in paragraph 5.3.6.

5.3.2 Stop the autoguide

1. Make sure that the AG camera is NOT acquiring images; if yes stop the acquisition before of all.
2. Go into the "AG core" terminal and do CTRL+C
3. Make sure that the "AG core" ends in a correct way, checking that the terminal shows the line: **Exit AG Core. Bye !** at the end of the log

The WEB GUI will show the message of Figure 9 at the end of the operations.

5.3.5 The AG Core (start and stop)

The AG core manages the communication with the autoguide system (camera, tip tilt), with the telescope control system (TCS) and with the sequencer.

The first operation is the execution of the AG core from the nag machine. This operation can be done by a ssh connection from any machine of the control room or by click in the **CORE** icon in the **wsoper** machine (Figure 8).

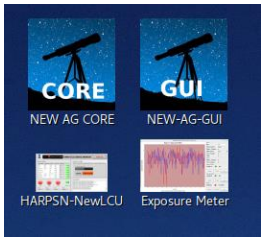

Figure 8 - wsoper machine: Icons to start the HARPSN features

After the connection the following operations can be done:

Start of the AG core → ag

Stop of the AG core → CTRL+C (to close all the connection properly)

At the end of observation the AG-CORE mast be closed with CTRL+C

VERY IMPORTANT NOTES:

NOT EXIT the Core software while the camera is taking images

5.3.6 Start the WEB GUI

The WEB-GUI starts a connection with the AG core, it has to be started after the AG core. In case of the AG core was down the browser will show an error message (Figure 9).

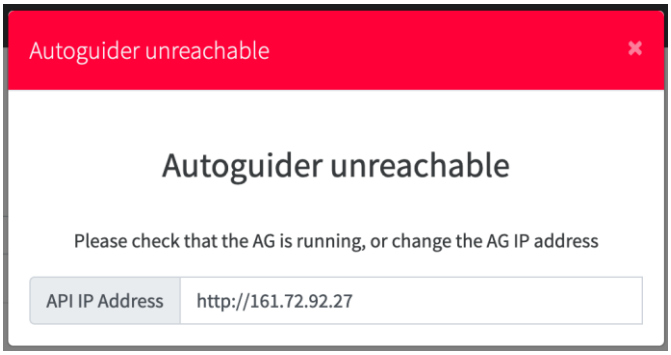

Figure 9 - Autoguider Unreachable message

The WEB-GUI can be started from the wsoper machine (Figure 8) and from Brunello with the **AG-GUI** icon, at the same time. The WEB-GUI available for the astronomer is a read-only version of the interface.

To launch the WEB-GUI click on the GUI icon in the wsoper /Brunello and enter with the TO user (Figure 10) in wsoper and with ASTRO user in brunello. For advanced operation there is available the EN account.

The credentials for the astronomer version are:

Login: ASTRO
Password: 1234

The astronomer user must to use only the ASTRO user.

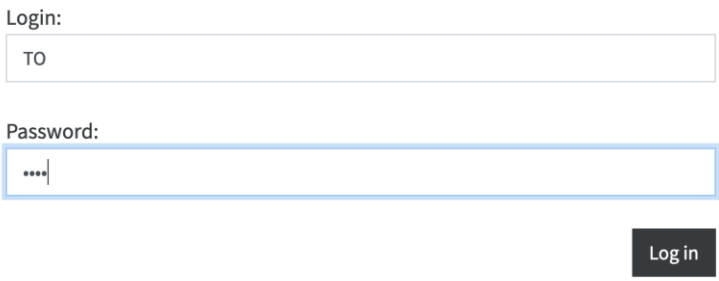

Figure 10 - WEB GUI login

After the introduction of the credentials the web interface will start.

5.4 Start up the Sequencer

From the **multimedia** workstation, click on the **HARPS-ICS** icon (the icon can be different from the Figure 11).
The icon opens a terminal in the Instrument Control System machine.

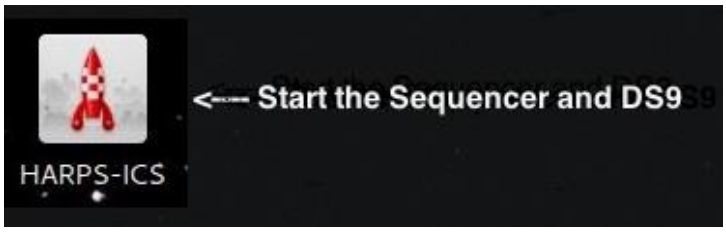

Figure 11 - Multimedia Workstation desktop

In another way, the terminal can be opened with the following command:

Open a HARPS-ICS terminals by executing:
ssh -X hanmgr@161.72.92.10 `from a linux machine)`

`After that, to start the Sequencer the commands are:`

1. Change to run directory → `cd /home/hanmgr/run`
2. Run the sequencer → `./run_sequencer.csh`

The script opens the Sequencer GUI and a DS9 terminal.

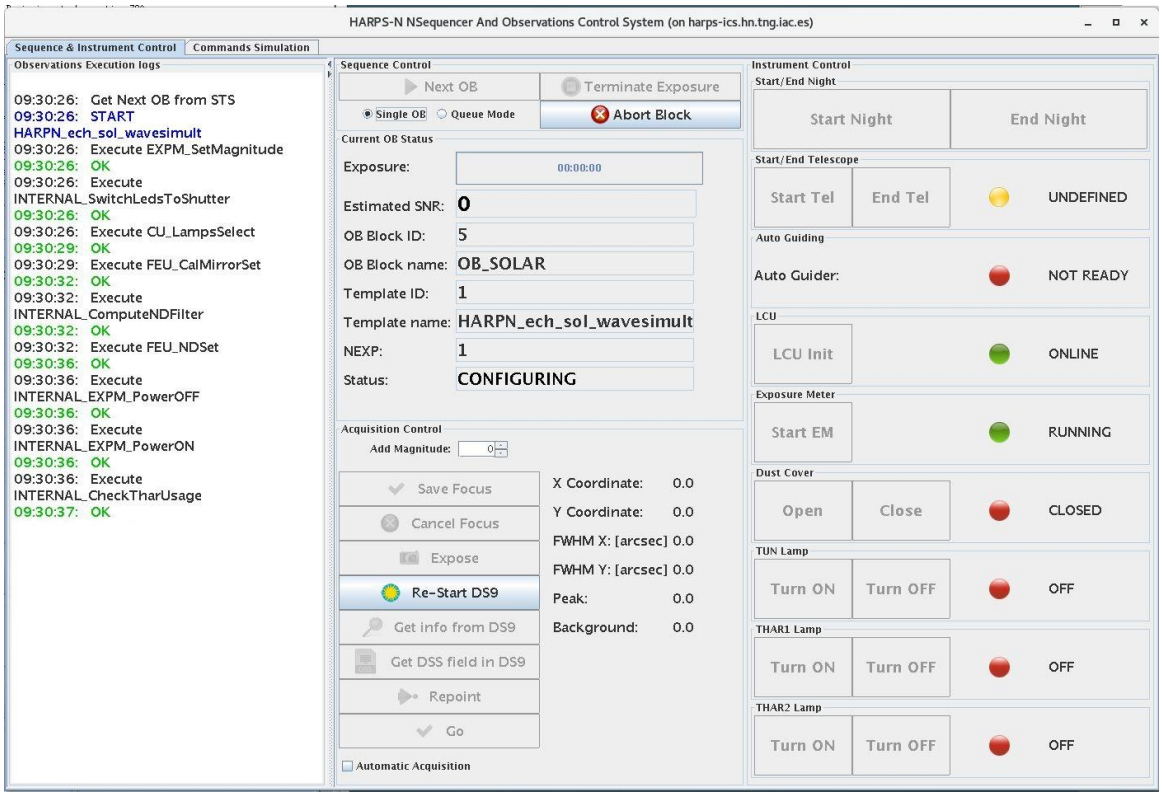

Figure 12 - Sequencer GUI

Note-1: If an error message ¨remove .#lock file in .Nsequencer" appears, see the par. 8.3.1

Note-2: The red log "Failed to fetch data from telemetry!" is not an error and can be ignored as error if appears during calibrations or in acquisition with exposure time less than 5 seconds.

Note-3: The yellow log "[…] Warning Final AG guide FITS file not found!" is a warning that don't affect the observation (we are working to fix this bug)

Table 2- Acquisition Control panel

Add magnitude	Increases/decreases the value of the magnitude of the selected star
Save Focus	send to OCS the command that update the serrurier focus
Cancel Focus	Moves M2 to the position prior to the focus procedure execution
Expose	Takes a new image with the AG camera
Re-Start DS9	Restart the DS9 window (when the DS9 window crash)
Get info from DS9	Takes coordinates and FWHM from the point clicked in the DS9 image
Get DSS fields in DS9	Visualizes the compass in the DS9
Repoint	puts the point clicked in the DS9 image into the fiber position and acquire a new image
Go	put the point clicked in the DS9 image into the fiber position and start the autoguider and the exposure
Automatic acquisition	Selects , puts in the fibre and start the acquisition of the brightest star of the field

5.4.1 Sequence Control buttons

Next OB → executes the next block available of the NSTS
Single OB → if checked executes one block when the user click on **Next OB** button
Queve Mode → if checked executes a series of NSTS blocks (according with the NSTS rules) when the user clicks on **Next OB** button
Terminate exposure → ends the current exposure and save it
Abort block → aborts the current block

5.4.2 Instrument control buttons

Start Night button → executes the **Telescope Start night** and open the **dust cover**
Start Tel button → executes the **Telescope Start night**
Dust Cover buttons → **Open** and **Close** the dust cover
Start EM button → starts the exposure meter and open the GUI
Note: The ***Start Night*** button includes the preparation to observation of the telescope and of the instrument.

More details about the **instrument control buttons** are shown in Appendix B **- Actions of multi task commands** (pag. 34)

5.4.3 The command simulation check window

In this window the user can simulate the execution of commands by clicking in the simulated check box (Figure 13).

- The "Turn on Simulation" button puts the telescope in simulation mode
- The "pointing with standard focus" button enables the automatic focus corrections (M2 movement)

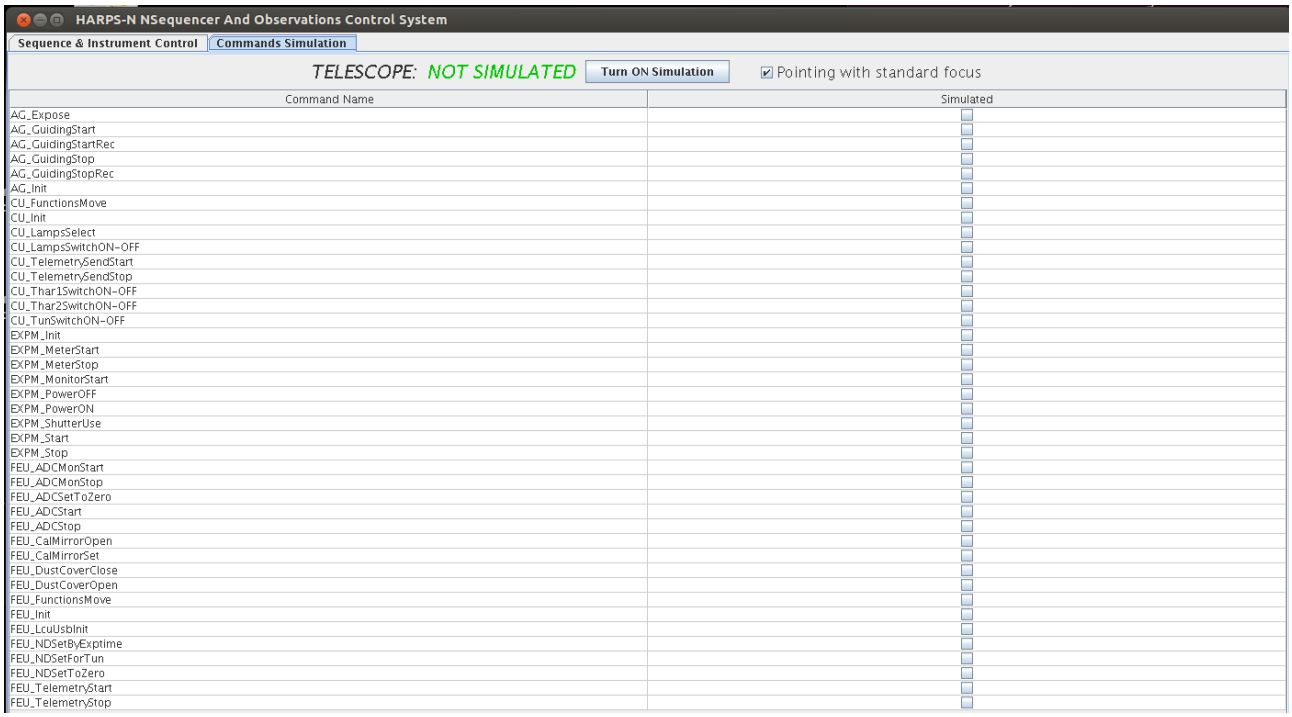

Figure 13 - Sequencer simulation window

5.4.4 Other changes

The sequencer now has a feedback with the NSTS.
If the NSTS is not in execution the sequencer visualizes a warning.

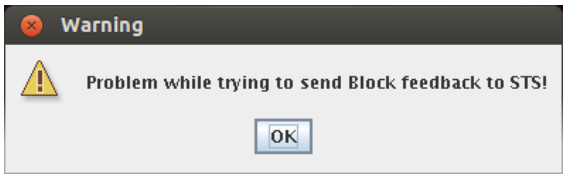

Figure 14 - warming of NTST connection failure

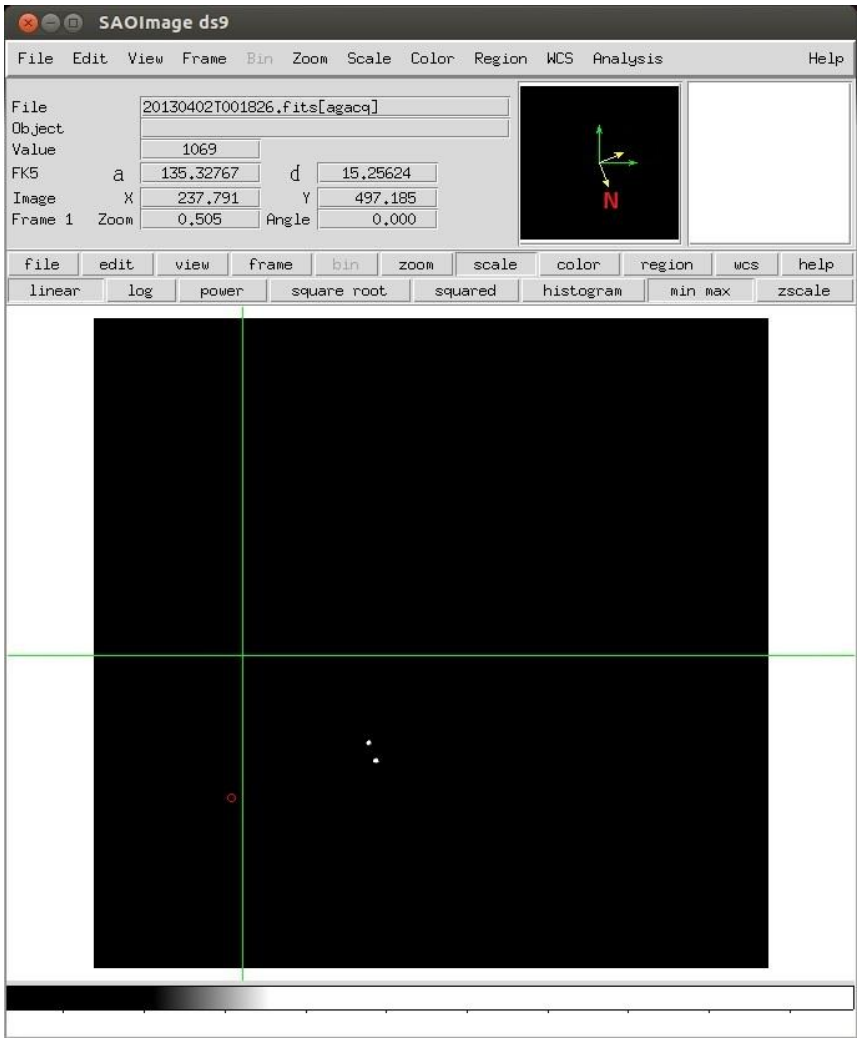

Figure 15 - The DS9 GUI with the star into the fiber, the field of view is 2.5

The compass is represented by the yellow axis, with the orientation shown in Figure 15.

Note: When the sequencer is restarted after an error, the status buttons are not refreshed to the correct status (except the lamps buttons, the LCU status and the Expose meter status, which are refreshed after a while). The undefined (yellow) status of the other buttons is not real and can be ignored if the user is sure that the instrument is initialized and ready to work.

5.5 Start up the Exposure Meter

The exposure meter can be started from the "**Start EM**" button in the sequencer GUI or from the **wsoper** workstation. The advised option is to start the Exposure meter from the wsoper workstation.

From the **wsoper** workstation click on the **HARPS-ICS** icon.

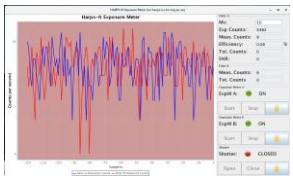

Figure 16 - Exposure meeter icon

The exposure meter have to be executed from a terminal in the following way:

1. Open a HARPS-ICS terminals by clicking the HARPS-ICS icon in the **wsoper** workstation (or execute: ***ssh -X hanmgr@161.72.92.10*** `from a linux machine`)
2. Change to run directory → `cd /home/hanmgr/run`
3. Run the expose meter → ./run_hexpm.csh

The script opens the exposure meter GUI.

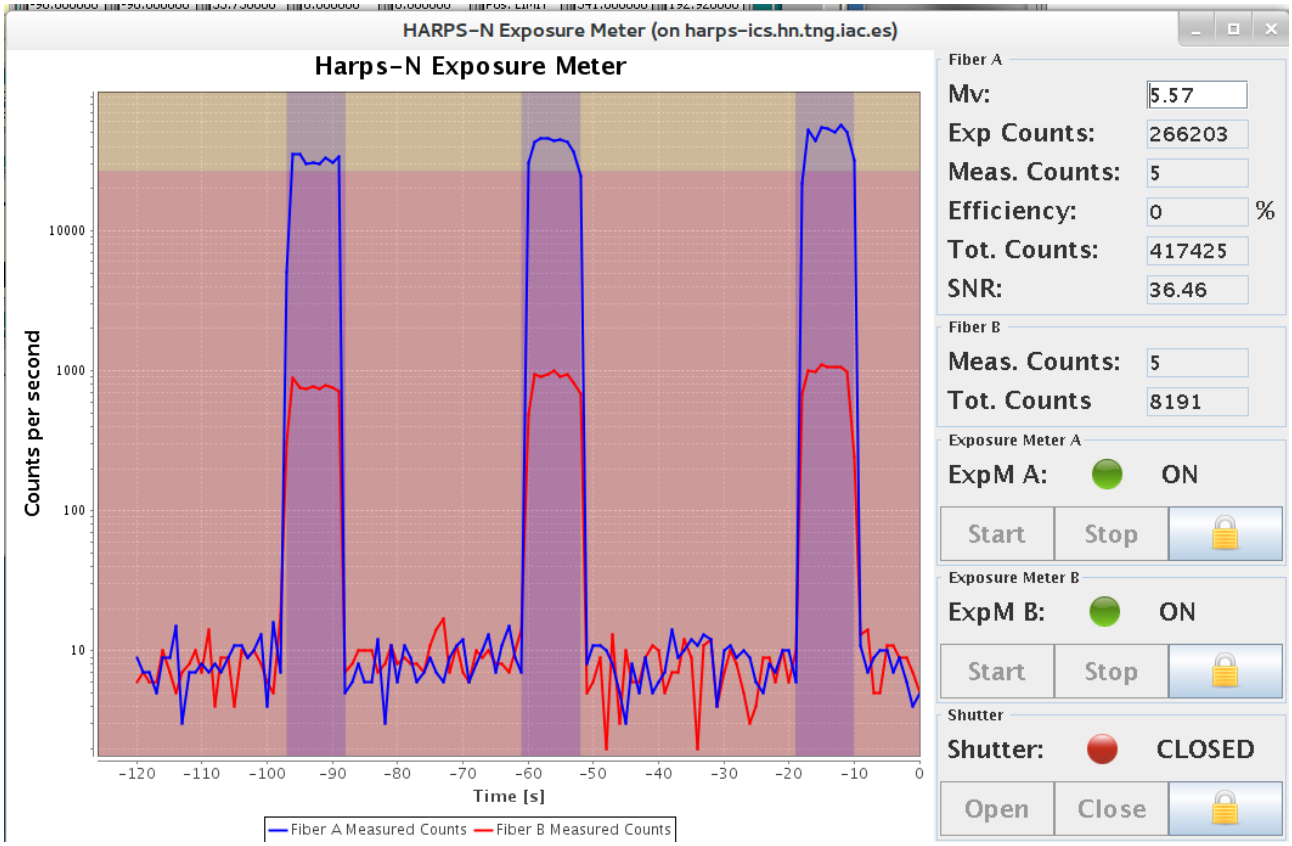

Figure 17 - Exposure meter GUI

The exposure meter GUI shows the status of the two exposure meters, the status of the shutter, some information about the observation and allows the user to change the Mv of the observed star (take care with this option).
The background of the graphic panel turns to darker when the shutter is open.

Table 3 - Exposure meter panel

Mv	Magnitude of the observed star (can be changed by user)
Exp Counts	Expected counts (counts/second)
Meas counts	Current number of counts (counts/second)
Efficiency	Current calculated efficiency
Tot. counts	Total number of counts
SNR	Signal to Noise Ratio (calculated)
ExpM	Status indicator of exposure meter
Shutter	Status indicator of shutter condition

5.6 Start up the New Short Time Scheduler (NSTS)

From the **brunello** workstation click on the **HARPS Short Time Scheduler** icon (the icons can be different from the Figure 18).

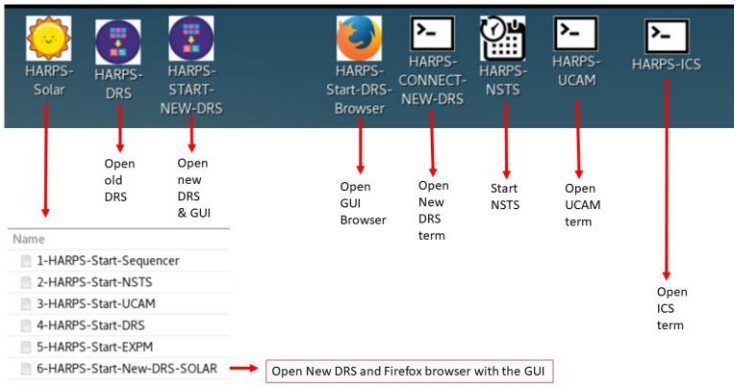

Figure 18 – brunello workstation desktop

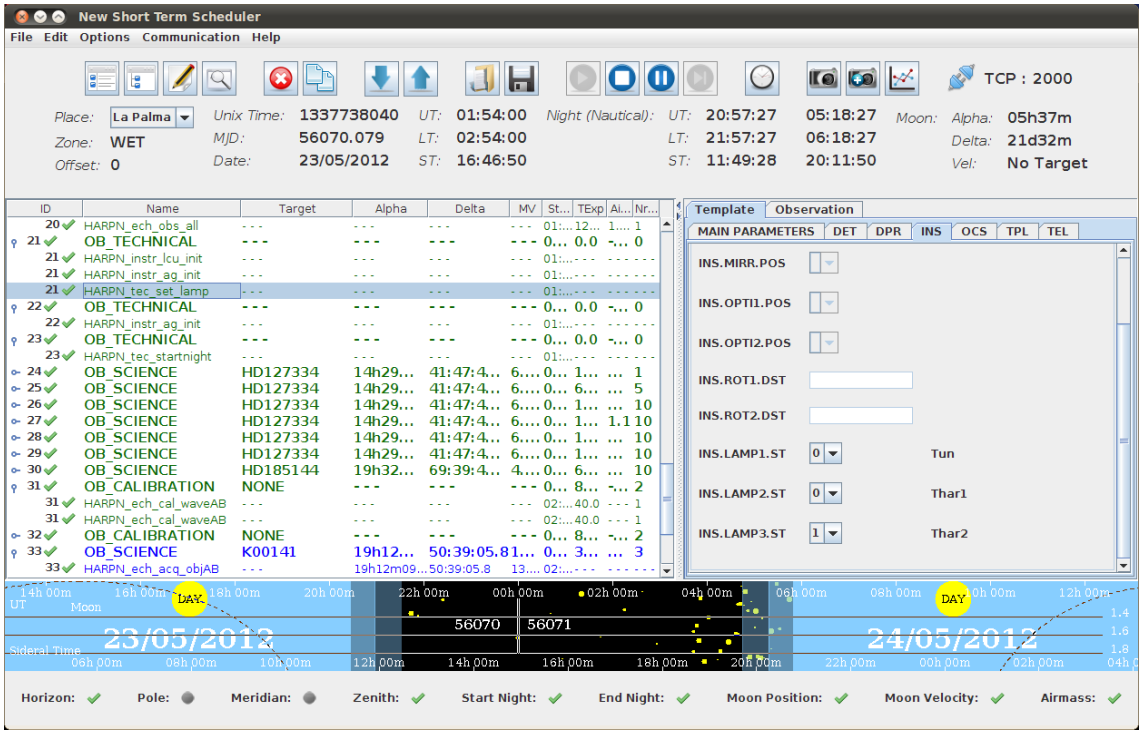

Figure 19 - Short Time Scheduler GUI

In another way, the NSTS can to be executed from a brunello terminal with the following commands**: java –jar /home/guest/NSTS/NSTS.jar**

5.7 Start up the scientific camera (UCAM)

From the **wsastro** workstation, click on the **HARPS-UCAM** icon (the icon can be different from the Figure 20).
The UCAM programs will start automatically:

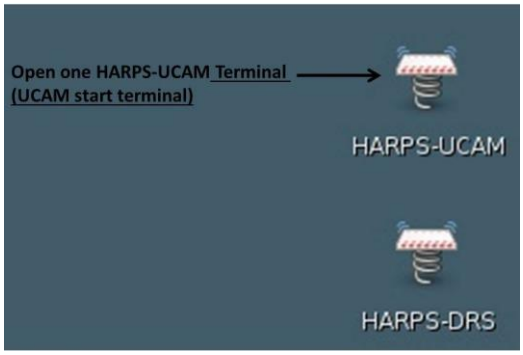

Figure 20 - Wsastro workstation desktop

In another way, these programs can to be executed from a terminal with the following commands:

1. Open a HARPS-UCAM terminals by executing:
   ssh –X ucam@ucam.hn from a linux machine
2. Start the UCAM software with the command → *goucam*

The command opens three terminals and starts the DS9 GUI and the UCAM GUI. Once UCAM has been launched, the camera must be initialized and enabled.

To do so, go in the UCAM GUI do the following step and click OK when requested

1) Click on **reset** button
2) Click on the ***initialise*** button
3) Click on the ***enable*** button
4) Click in the ***refresh*** button
5) In the *camera applications* panel choose *ccd231_read_2ch_app.xml* and click on the ***select*** button
6) click on the ***Execute*** button to verify the image acquisition

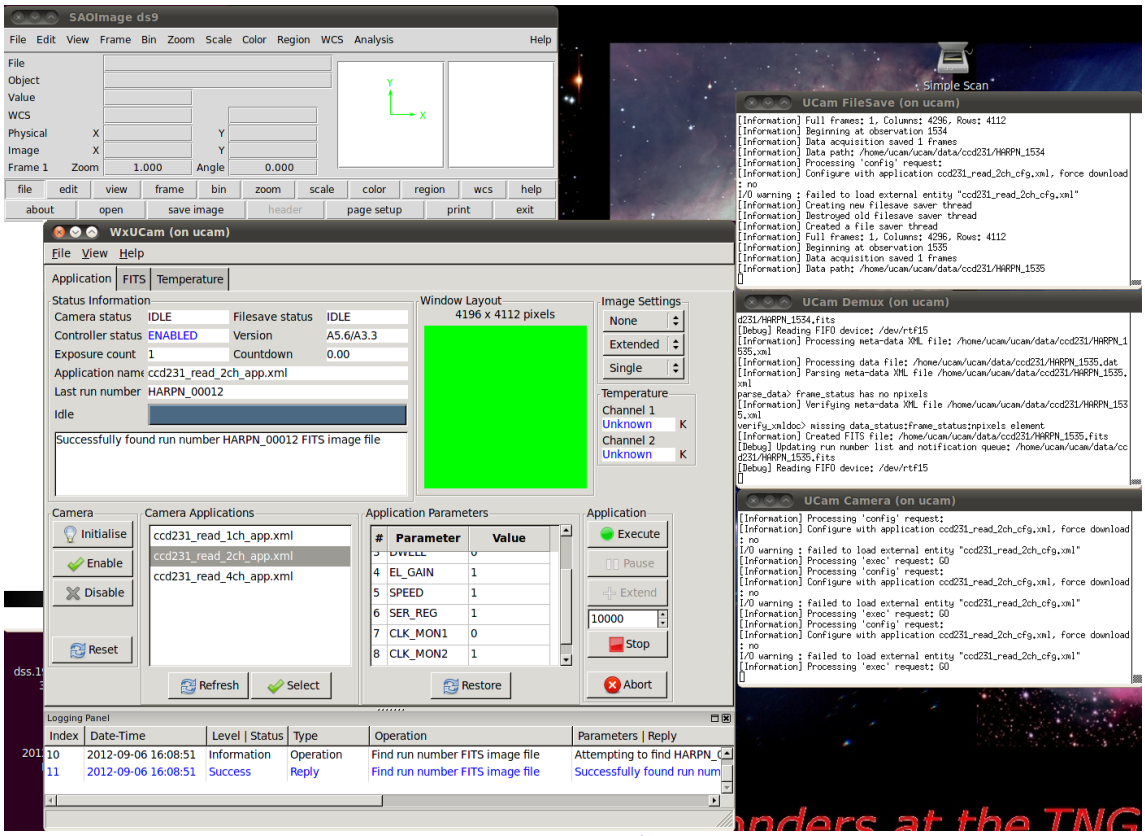

Figure 21 - A view of the UCAM machine after the 'goucam´execution

5.8 Start up the data reduction online software (DRS)

The DRS is an ensemble of recipes to reduce various frame type produced by HARPS-N. To each observation template, a specific reduction recipe has been associated, which will reduce the so recorded raw frames and produce second-level data products.

From 2012 to 2021 the operative DRS was the DRS-32 (Original DRS, **Error! Reference s ource not found.**) but, from 28th of October 2021 the ESPRESSO DRS (**Error! Reference source not found.**) was added at the HARPS-N reduction system to operate simultaneously in the data reduction of the calibration and scientific frames. Today, and for a limited period of time, the two DRS will be executed at the same time. More information about the two DRS and the way of use can be found in the HARPS-N DRS User Manual **Error! Reference source not f ound.**.

The automatic execution of the DRS and the association between template and recipe is carried out by the Trigger. In order to execute the trigger, one has to proceed as follows:

5.8.1 The DRS-32 Startup procedure (original DRS)

The procedure to start the original DRS is the following:

1) Open a HARPS-DRS terminals by clicking the HARPS-DRS icon in the **brunello** workstation, Figure 18 (or execute: ssh –Y harpn@drs32.hn from a linux machine)
2) Run the trigger and DS9 → **./start_DRS.csh**

The trigger will show any new raw frame arriving in the *current* night directory and automatically execute the corresponding recipe.
(the trigger can be started without ds9 → `trig.csh online`)

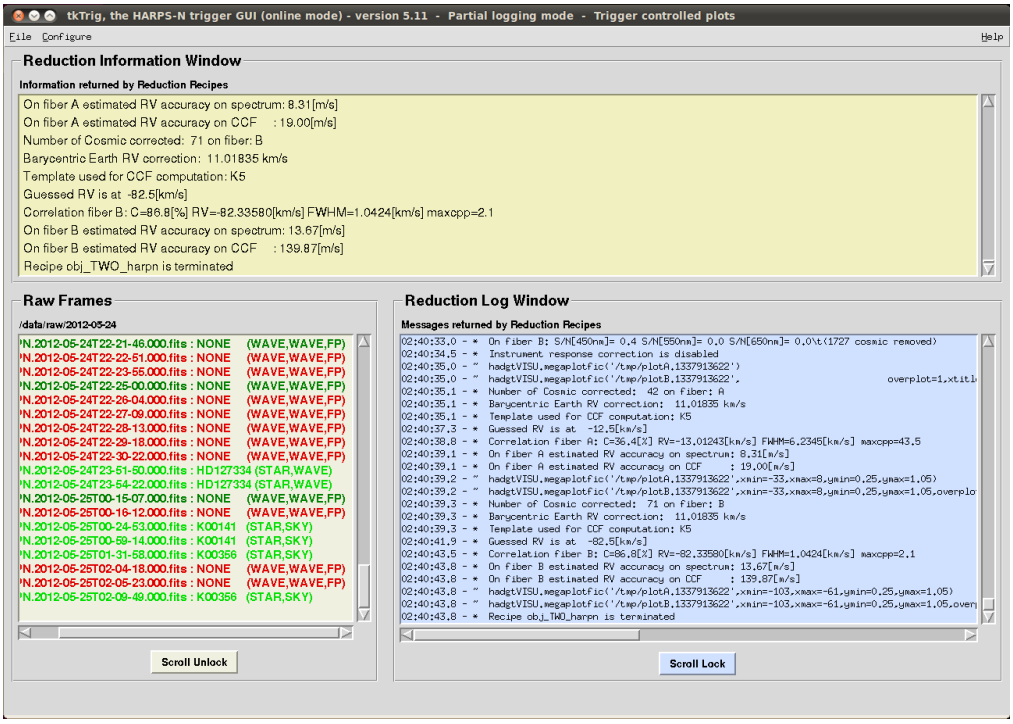

Figure 22 - Data Reduction Software

Important note: The data reduction is an automatic but completely 'off line' process. The observations can be carried out without any loss of data or information even WITHOUT starting the DRS. **For no reasons the observations should be halted because of the DRS is not able to run or simply not running**. The one note of caution is that no quality feed-back will be available from the DRS in these cases. The Observer should make sure that the instrument parameters are all ok and that a full calibration set has been carried out at the beginning or the end of the night.

In case the Observer would like to reduce another night that the current one, he/she may launch the trigger in the 'offline' mode by typing: `trig.csh 'online YYYY-MM-DD'`. If the night had already been reduced, but the Observer would like to re-reduce it, then he/she will first have to remove the file `YYYY-MM-DD.r` in the folder `/data/msg/`.

5.8.2 Start up the data reduction offline software (Original DRS: OFFDRS)

In case the Observer would like to analyse the results of the pipeline, he/she may launch the DRS offline by typing the command: ***`offdrs.csh`*** and selecting the night and the reduced data from the user interface.

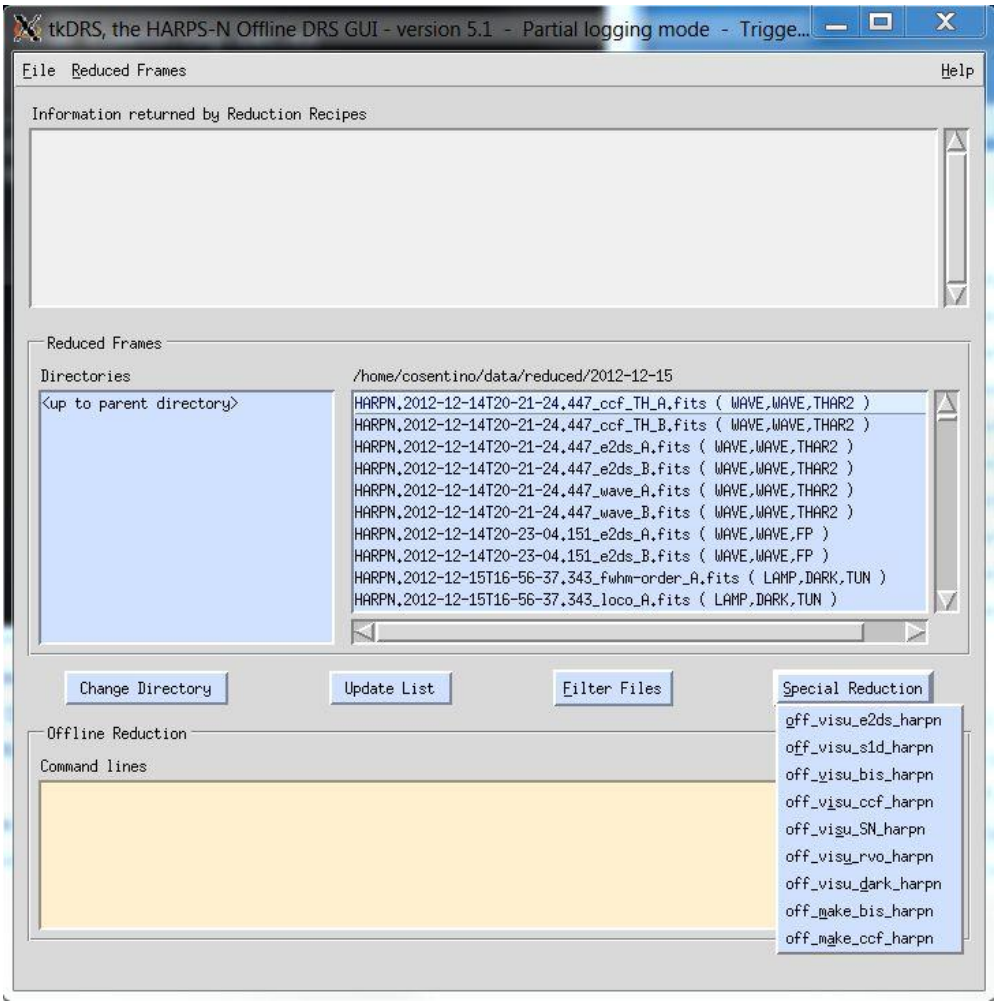

Figure 23 - Offdrs User interface

5.8.3 The DRS trigger (ESPRESSO DRS)

The fast method to start the ESPRESSO DRS is by click the HARPS-START-NEW-DRS icon in the Brunello desktop (Figure 18). This shortcut starts the ESPRESSO DRS and the WebGUI (Figure 24).

Another way to start the ESPRESSO DRS is the following:

1) Open a HARPS-DRS terminals by clicking the HARPS-CONNECT-NEW-DRS icon in the **brunello** workstation, Figure 18.
2) Run the trigger:
   a. cd Trigger
   b. python OnlineTrigger.py [options] → ***python OnlineTrigger.py -i HARPN***
   c. start the WEBGUI by clicking in the HARPS-START-DRS-GUI

The WEB GUI will show any new raw frame arriving in the *current* night directory and the trigger automatically execute the corresponding recipe (Figure 24).
More information about the ESPRESSO DRS can be found in the TNG-MAN-HARPN-0006, HARPS-N DRS User Manual **Error! Reference source not found.**.

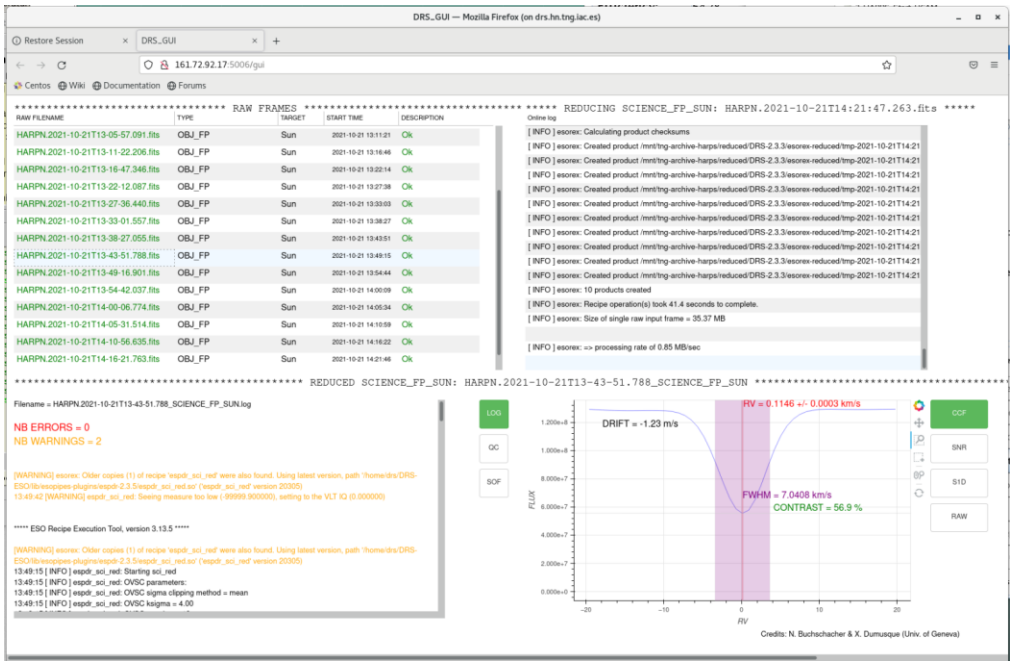

Figure 24 - The WEB GUI

6 How to shut-down HARPS-N (end of observations)

6.1 How to shut-down the subsystems

1. From the sequencer do an "END NIGHT" and wait until the processes ended
2. Close the NSTS
3. Close the exposure meter
4. Close the Sequencer GUI, the DS9 and the remote connections to harps-ics.hn
5. Close the DRS, the DS9 and the remote connection to drs32.hn
6. Close the UCAM software (the ds9, the GUI and the tree terminals) and close the remote connection to ucam.hn
7. Close all the AG CORE → CTRL+C (to close all the connection properly)
8. Close the LCU. (TO)
9. Power off the Dolores electronics (TO, if needed)

7 Troubleshooting

In the following, we will describe a series of known bugs and problems, and how to solve them. This chapter will evolve very rapidly due to the on-going software upgrades.

There is no light of the guiding camera after acquisition

- Have you changed the cuts and moved the image around in the DS9?
- Has there been any error in the Sequencer or elsewhere, which prevented the acquisition to be carried out?
- Has the telescope received and executed the pointing command and respective coordinates?
- Is the telescope dome open and the telescope started?
- Is the telescope configured for HARPS-N (ask the telescope operator):
    - M2 position for HARPS-N nominal focus
    - M3 position on Nasmyth B
    - M4 position 'ADC' for HARPS-N
    - Derotator position set for HARPS-N and stable!
- Has the L1-lens cover on the derotator been opened?
- Is the 'cal mirror' out of the beam ('NONE' position)? Check on LCU Device Monitor and whether there have been errors in the Sequencer. If necessary, move it 'manually' from the LCU Simple_client panel on the LCU machine

The Sequencer does not execute the expected action

It might happen that the OB doesn't executed the expected actions (i.e. telescope slew) and the "Next OB" button is inactive. In this case there are probably a communication problem between the sequencer and the NSTS.
In this case the solution is :

- Abort the current OB (only if the "next OB" button is shadowed)
- Close the sequencer (GUI and DS9)
- Close the NSTS (save the list before)
- Close the exposure meeter
- Execute the sequencer (paragraph 5.4)
- Execute the exposure meeter (5.5)
- Execute the NSTS (paragraph 5.6)

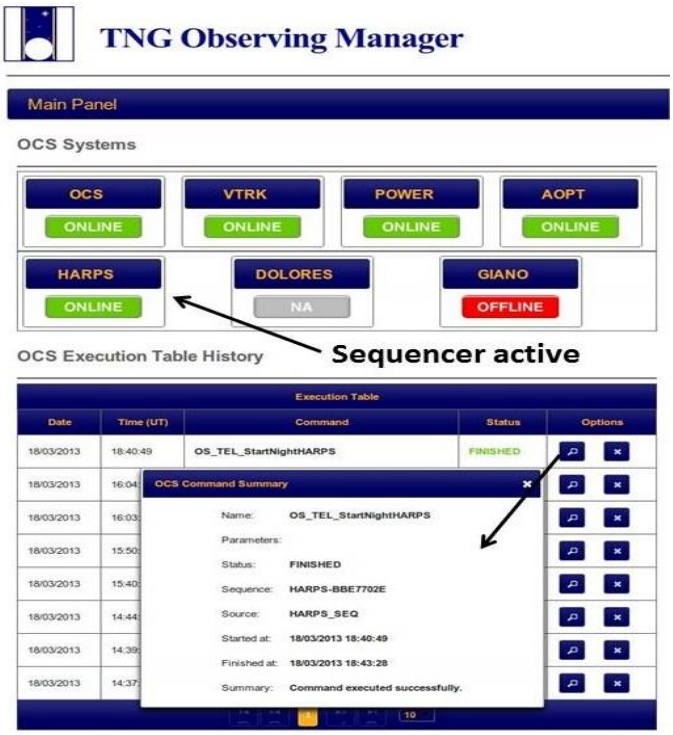

Figure 25 - TNG Observing Manager

Other Sequencer errors

- **Error**: The OB ends/frozen immediately after
  ****** NEXT OBSERVATION ******
  Solution: → close and restart the NSTS (save the list before)

- **Problem**: The sequencer is frozen and you want to stop it
  Solution: see *0 This part* will be completed after analyzing the "Bugzilla" and after receiving the feedback from the HARPS-N users that are encouraged to send me any comments and suggestion to revise this manual and, above all, to complete this paragraph.

The procedure to recovery LCU errors is the following:

1) Stop of the LCU by clicking the "STOP LCU" button (Figure 7).
2) Close the interface
3) Start the LCU again
4) Select the 'INIT ALL' tab
5) Click on "INITIALIZE ALL HARDWARE" button

Sequencer errors

- **Problem**: The sequencer terminate the exposure with an ABORT
  1. **Solution**: see

UCAM errors (5)

The Trigger/DRS remains stuck or crashed on a specific exposure
In case of DRS/trigger crashes, look into the terminal window to see if there is any python error message. Most of the time it is necessary to exit and restart the trigger.

1) Close the DS9 associated with the DRS
2) Close the terminal (CTRL+c)
3) Restart the DRS

If the problem persists, (stops always on the same exposure) proceed as follows:

- On the drs32.hn machine, edit the file "`/data/msg/<night>.r`"
- Add a line indicating the exact name of the RAW frame the DRS has to skip. Follow the format of the previous line considering that only the file name column is needed. In general you may add/remove frames that you want to skip or re-reduce, respectively.
- Save the file and re-start the Trigger.

Note: If this procedure don´t work the reason is a file format problem. Try to re-edit the file and delete the spaces after the line added.

If the DRS shows the error message "CalibDB locked. Waiting...", delete the file "/data/calibDB/lock_calibDB".

The Trigger/DRS return errors in all the calibration reduction
The reason can be a wrong configuration of the instrument, due to a LCU fail.
To verify it, consults the “standard calibration” document [RD12].
If the error depends of a wrong configuration of the instrument:

- Close the LCU.
- Restart the LCU and verify if there are errors*.
- Init the LCU and repeats the standard calibration, following the *standard calibration* document

*) In case of LCU errors, contact Manuel Gonzalez or Rosario Cosentino

8 Re-starting specific components in case of troubles

8.1 Autoguide errors

This part will be completed after analyzing the “Bugzilla” and after receiving the feedback from the HARPS-N users that are encouraged to send me any comments and suggestion to revise this manual and, above all, to complete this paragraph.

The procedure to recovery AG errors is the following:

1) Stop of the AG core → CTRL+C (to close all the connection properly)
2) Wait 30 seconds
3) Start of the AG core → ag

8.2 LCU errors

This part will be completed after analyzing the "Bugzilla" and after receiving the feedback from the HARPS-N users that are encouraged to send me any comments and suggestion to revise this manual and, above all, to complete this paragraph.

The procedure to recovery LCU errors is the following:

6) Stop of the LCU by clicking the "STOP LCU" button (Figure 7).
7) Close the interface
8) Start the LCU again
9) Select the 'INIT ALL' tab
10) Click on "INITIALIZE ALL HARDWARE" button

8.3 Sequencer errors

8.3.1 The sequencer don´t start

If an error message ¨remove .#lock file in .Nsequencer" appears follow the following instructions:

1. Connect to ICS-machine:
   ssh -X hanmgr@161.72.92.10 `from a linux machine)`
2. Change to .Nsequencer directory → `cd /home/hanmgr/.Nsequencer`
3. Delete the lock file → rm .#lock
4. Start the sequencer again

If appears this warning in the sequencer log: FRM_TIME Keyword hasn't been extracted correctly. Defined exposure time will be used instead

8.3.2 The sequencer remains frozen

When a sequencer remains frozen or doesn´t get the next block from the STS, the procedure to restart depends on the last operation executed and not terminated.
First verify with TO the status of exposure meter.

Case 1: The sequencer is crashing during a UCAM acquisition,

1. Close the sequencer GUI
2. Close the expose meter
3. Close all the windows of the UCAM software (only if the acquisition system is blocked)
4. Start the UCAM software (if it was closed before)
5. Start the sequencer GUI and the expose meter

Case 2: The sequencer is crashing during other conditions (telescope slew, repoint, init, etc) the procedure is the following:

1. Abort the current OB (only if the "next OB" button is shadowed)
2. Close the sequencer GUI and the expose meter
3. Start the sequencer GUI and the expose meter

8.3.3 The DS9 unexpectedly closes

When the DS9 unexpectedly closes, and the button "*Re-Start DS9*" doesn't work, the procedure to restart is the following:

1. Abort the current OB (only if the "next OB" button is shadowed)
2. Close the sequencer and the expose meter
3. Start the sequencer and the expose meter again

Note: When the sequencer is restarted the status buttons are not refreshed to the correct status (except the lamps buttons, which are refreshed after a while). The undefined (yellow) status of the other buttons is not real and can be ignored if the user is sure that the instrument is initialized and ready to work.

8.4 Expose meter errors

If the exposure meter is still running but the GUI is not visible on the screen or an error message ¨remove .#lock file in .HEXPM" appears, follow the following instructions:

2. Connect to ICS-machine:
   ssh -X hanmgr@161.72.92.10 `from a linux machine)`
3. Change to .HEXPM directory → `cd /home/hanmgr/.HEXPM`
4. Delete the lock file → rm .#lock
5. Start the exposure meter again

8.5 UCAM errors

8.5.1 The sequencer ABORT the Exposure

When the sequencer terminates the exposure with an 'ABORTED'

Example: Sequencer: Fri Nov 23 03:59:03 UTC 2012 /ObsBlockStatus/ABORTED
/ObsBlockStatus/ABORTED
Terminating Exposure...

Or the exposure ends after about 20 seconds

The solution is to restart the UCAM from the UCAM-GUI (Figure 21) as following:

1) Click on **reset** button
2) Click on the ***initialise*** button
3) Click on the ***enable*** button
4) Click in the ***refresh*** button
5) In the *camera applications* panel choose *ccd231_read_2ch_app.xml* and click on the ***select*** button (if not selected)
6) click on the ***Execute*** button to verify the image acquisition

8.5.2 The sequencer get stuck during exposure

If the exposure counter in the sequencer GUI exceeds the expected time (Exptime + 40 seconds) this means that the UCAM got stuck.

The solution is:

a) Abort the current OB (only if the "next OB" button is shadowed)

b) Restart the Sequencer and the sequencer GUI
c) restart the UCAM from the UCAM-GUI (Figure 21) as following:

1) Click on **reset** button
2) Click on the ***initialise*** button
3) Click on the ***enable*** button
4) Click in the ***refresh*** button
5) In the *camera applications* panel choose *ccd231_read_2ch_app.xml* and click on the ***select*** button (if not selected)

click on the ***Execute*** button to verify the image acquisition

Appendix A - Useful Harps-N webpages

HARPS-N TNG webpage	http://www.tng.iac.es/instruments/harps/
TNG Observing Manager	http://ntcs-glassfish1.tng.iac.es:7080/ntcs-ocsservice/manager/ui/observingmanager.jsf
HARPS-N Sensors	http://tngweb.tng.iac.es/telemetry/systems/HARPS
Instrument status	http://ntcs-glassfish2.tng.iac.es:7080/webcontrolpanel/ui/instrumentstatuspanel.jsf
Serrurier & M2 status	http://ntcs-glassfish1.tng.iac.es:8080/aopt-service/gui/ui/serrurier.jsf
TNG Telemetry Cache Service	http://ntcs-glassfish1.tng.iac.es:7080/ntcs-cacheservice/monitor/ui/telemetry.jsf
HARPSN wiki page	http://dokuwiki.tng.iac.es/dokuwiki/doku.php/instruments:harps:start

Appendix B - Actions of multi task commands

Telescope Start Night:

- Open the Dust Cover
- Open the HARPSN derotator cover
- Power on the Dolores electronics
- Initialize the Dolores movements
- Move the 'entrance slider' (M4) to the HARPS position
- Power on the M3 control
- Move M3 to Nasmyth-B (the TO had to set the telescope in Nasmyth-B mode)
- Power off the M3 control

Telescope End Night:

- Stop the guide
- Stop the telescope
- Close the HARPSN derotator cover
- Stop the LCU (move the motors at the default position)

Start Telescope:

- Open the HARPSN derotator cover
- Power on the Dolores electronics
- Initialize the Dolores movements
- Move the 'entrance slider' (M4) to the HARPS position
- Power on the M3 control
- Move M3 to Nasmyth-B (the TO had to set the telescope in Nasmyth-B mode)
- Power off the M3 control

End Telescope:

- Close the derotator-B cover

Appendix C - Actions of focus procedure commands

- Start the pointing (move the telescope)
- acquire an image from the autoguider camera and shows the image in the DS9
- Wait for User selects and puts the star in the hole position
- Send the offset to telescope (repoint)
- Send a M2 offset (- 0.25)
- start a loop of M2 offsets (0.083) and exposure meter acquisitions (default 7 step)
- Calculate best focus
- move M2 to best focus
- acquire an image from the autoguider camera and shows the image in the DS9
- wait for user actions (save or cancel focus)
  (While the user can execute actions: repoint, expose, get info, etc)

Appendix C – List of acronyms

ADC	Atmospheric Dispersion Compensator
AG	Auto-Guider
CCD	Charge Coupled Device
CCF	Cross Correlation Function
CFC	Continuous Flow Cryostat
CU	Calibration Unit
DFS	Data Flow System
DRS	Data Reduction Software
E2DS	Extracted 2-Dimensional Spectrum
ETC	Exposure Time Calculator
FEU	Front End Unit
FITS	Flexible Image Transport System
FWHM	*Full Width at Half Maximum*
HARPS-N	High Accuracy Radial velocity Planet Searcher in the North hemisphere
ND	Neutral Density
NSTS	New Short Time Scheduler
OB	Observing Block
RV	Radial Velocity
SA	Support Astronomer
SNR	Signal to Noise Ratio
TBC	To Be Confirmed
TBD	To Be defined
TBF	To be fixex
ThAr	Thorium Argon
TNG	Telescopio Nazionale Galileo
TO	Telescope Operator
VA	Visiting Astronomer