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DOLORES USER MANUAL

March 13, 2017

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Abstract

This is a really short introduction to the DOLORES instrument control system. Here the user will find a brief summary of the operations needed to start up the instrument, control it as well as the main features of the interface and little more.

Subject:	Instrument Users Manual
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Last Update:	March 13, 2017
Document Name:	20170313QuickUserGuide.pdf

1 How to start up the system

The DOLORES instrument is essentially composed by a CCD camera and motors to put the optical elements (Filters, Slits, Grisms ...) into the light path.

The motors are controlled by an *intelligent* electronic device based on the Arduino electronic device named **ArDolores**. The CCD is operated by a dedicated *CCD controller* electronic device. This two devices are able to receive command to perform operations by a web connection. So there are two dedicated web servers to communicate with the motors and CCD device respectively. The first one, *CCD controller program* hereafter, takes care to dispatch the commands to the CCD controller device. The second one, *Dolores webserver* hereafter, takes care to talk with the *CCD webserver*, to talk with the motors webserver and with the **Graphical User Interface**, *GUI hereafter*. The user will interact with the whole system using the *GUI* .

ArDolores and the *CCD controller* are electronic devices that are normally switched off at the end of the observation. The Telescope Operator will switch on this devices in the afternoon. If for some reason a new start up is required please ask to the Telescope Operator to do it. The visiting astronomer is allowed to operate only the *GUI* and the *Dolores webserver* interface (section 1.2). This interfaces are available to the user on the PC named "wsastro" inside the Control Room. In this section I'll describe how to start up and shut down the system.

1.1 CCD controller

The software to operate the *CCD controller program* runs on a Windows PC. This computer is located inside the "old control room". Sometimes it could be necessary to connect remotely with this computer to check if this program is working properly. Skip this step and try to awake the system. If you have some error message related with the CCD controller connection include this verification. To make this task as easy as possible you will find a luncher inside the directory "Local_Maintenance", on the wsastro Desktop, named "CCD_Lrs_Controller_Viewer". If you "click" on this you will open a remote desktop of the computer where the *CCD controller* program runs. A panel named CCD (see fig. 1) should be visible on the desktop. This is the graphical interface of the program itself. The "led" at the right of the "Connect" label on it could be in red (not connected) or green (connected to the CCD controller). This panel program should be always opened. If this window isn't visible it means that the program is not running. It will be necessary to start it up before to be able to observe with DOLORES. It's made with a double click on the icon "Shortcut to CCD" (see fig. 2). Once you are sure that the *CCD controller program* is

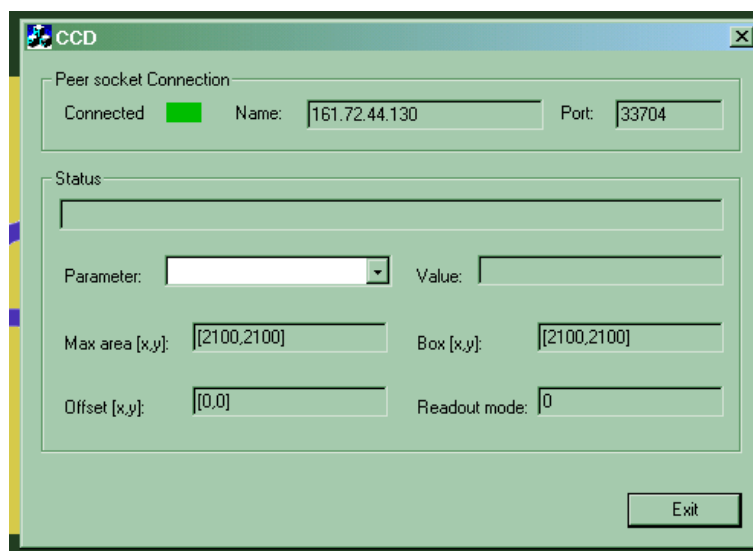


Figure 1: *CCD program control Window*. Notice that the aspect is a little different when the led is red.

running, check that the *CCD Controller device* and the *ArDolores* motors controller device are switched on.

This operation can be done opening the *Remote Power Sevice Controll* web page on a web-browser. The web direction is:

<http://ntcs-glassfish2.tng.iac.es:7080/webcontrolpanel/ui/login.jsf>

You will find a direct link on the wsastro desktop. Only the TNG staff can enter this page so the introducer astronomer or the telescope operator should do it for you. The appearance of this web



Figure 2: Icon to start up the CCD program control.

page is shown in Fig. 3. If the buttons are as in Fig. 3, this mean that the *CCD controller* and the **ArDolores** controllers are switched on. If this is not the case ask the Telescope Operator to switch on them for you.

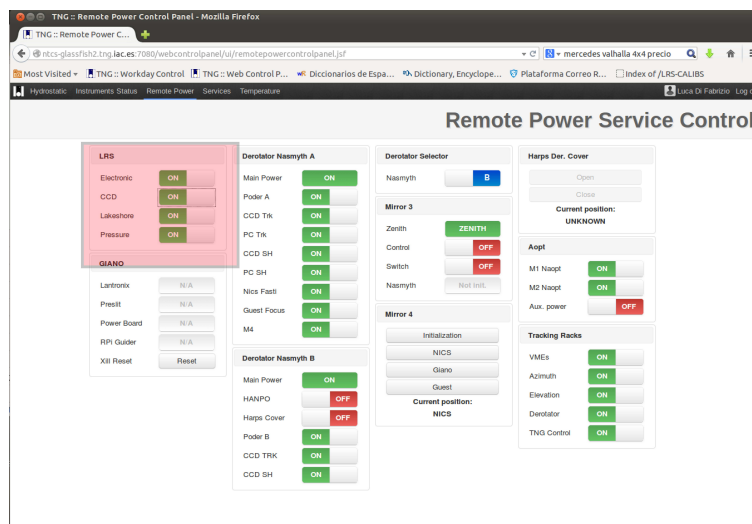


Figure 3: This is the appearance of the Remote Power Service Control Web page when the instrument is ready to startup. If the Motors and CCD buttons haven't the same configuration of this picture please ask the Telescope Operator to check it for you

1.2 The Start up GUI

Once you have switched **ON** the electronic devices you will need to start the *Dolores webserver*. To realize this operation you will need to interact with the "*ArDolores Startup/ShutDown*" GUI. On the WSASTRO desktop you will find an icon named "*LRS StartUp*". A double click on it, will pop up the panel shown in fig. 4. This interface allow the user to:

1.2.1 Start up the Motors Server

The Motors Server program is Started up and Shut down by the buttons on the right of the LRS "*Motors Service*" label. It will activate the motors server program and it will change the "*led*" color on the right from gray to green. The label will also change from "*OFF*" to "*ON*".

1.2.2 Start up the CCD server

Again on the panel described in fig. 5, press the "*CCD Service*" button. The "*led*" will change from gray to green and the label from *OFF* to *ON*.

1.2.3 What to check?

At this point you are ready to move the **DOLORES** motors and to use the CCD. The first time that you starts up the motors after to switch on the electronic device, **ArDolores** the label "*Initialize all*

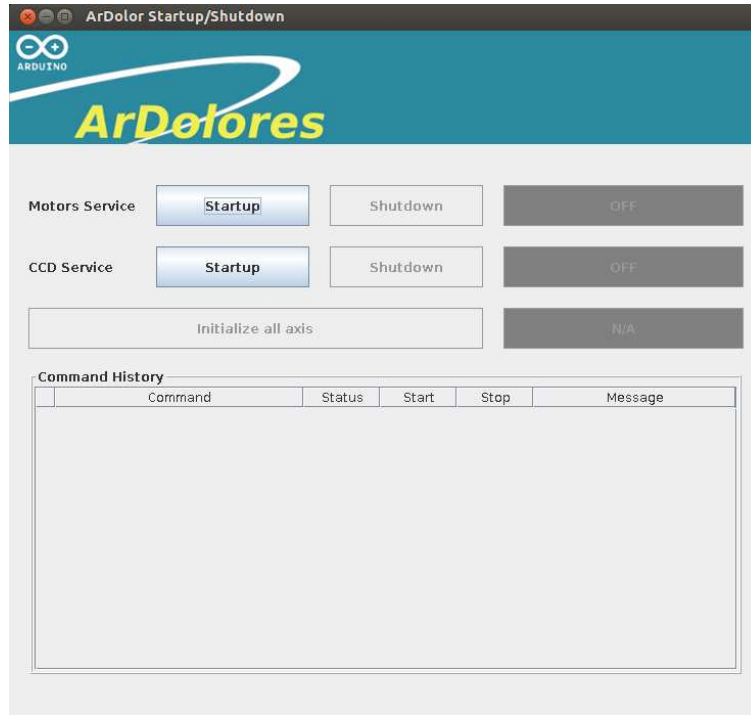


Figure 4: A double click on the "Dolores Motors Startup/Shut Down" icon on the WSASTRO desktop will open this panel. The actions to be done here are described in the text.

axis" will appear in red. This mean that you need to initialize all the axis because the **ArDolores** device has lost the memory of the motors position. The motors initialization is made by a "click" on the label "Initialize all axis" itself. This operation will take some minutes. Once finished, if everything went fine, the label will change to green and the word **INITIALIZED** will appear on it. If the red label **ERROR** appear ask the telescope operator to contact with the instrument responsible.

1.3 Open the DOLORES GUI

The astronomer will send commands to DOLORES through the **Graphical User Interface** program. To start it up, double click the "Lrs Instrument GUI" icon (see fig. 7) on the *WSASTRO* PC desktop. The LRS GUI interface will pop up. See fig 6 in the next section. To be able to start



Figure 5: A double click on the "Lrs Instrument GUI" icon on the *wsastro linux* PC will open the **DOLORES GUI**.

your first image, select the option "SYSTEM STARTUP" under the "LRS MANAGER" menu. Once the boot ends open the "**SEQUENCER**" under the "EXPOSURE SETUP" panel and send a dummy bias before to start. Now you must select your program name form the sequencer menu on the up left corner (see Figure 15 of section 3). **The property of the images that you will take will be assigned to this program. If you select the wrong program you will not be allowed to access the images from the archive. If you realize to have selected the wrong program name please contact your contact astronomer and the system administrator(s) (it@tng.iac.es) to correct your as soon as possible.** To select your program name scroll the list that you can find up on the left of the sequencer panel and click on your program name. The program is correctly selected when the background color is black. You can check the appearance in Figure 15 of section 3.

1.4 Start Up check list

Inside "Telescope Control Room" on the desk in front of the door, you will find the "wsastro" computer. On this PC (You usually do not need to execute the steps a and b):

- a) Check that the software to operate the CCD controller is running. To do that you will need to connect to a remote PC as described in section 1.1

If the program interface (see figure 1) is closed:

- b) Open the software to work with the controller. To do it make a double click on the icon named "*Shortcut to CCD*", see figure 2.
- c) ask the telescope operator to switch on the ArDolores and CCD controller devices from the Remote Power Service Control web page, see figures 3 and 4
- d) On the "wsastro" Desktop you will find an icon named "*Motor Service*". A double click on it will open the "*ArDolores StartUp/ShutDown Panel*" (*DMSP*).
- e) From the *DMSP* press the Start Up button to startup the LRS Motors Server. Wait until the "*led*" changes its state from **OFF** to **ON** and its color from gray to green.
- f) From the *DMSP* press the Start Up button to startup the LRS CCD Server. Again wait until the "*led*" changes its state from **OFF** to **ON** and its color from gray to green.
- g) Initialize the system if required. Click on the "Initialize all axis" button. This operation will take some minutes
- h) Open the LRS GUI with a double click on the "*LRS Instrument GUI*" icon. See figure 6.
- i) On the LRS GUI menu bar open the "LRS Manager" menu. Select "SYSTEM STARTUP".
- l) Open the sequencer and **Select your program name from the top left scroll menu labeled "Program Name"**
- m) Take one bias image to check that everything is working properly.

2 How to shut properly down the system

Once you have finished to work with DOLORES, please shut down the system as follows:
Take a dummy scientific image with all the optical elements off from optical path, and all the lamps switched off. Close the GUI click on the Sun image marked with the label "Bye Bye" at the GUI bottom and the GUI program will end.

2.0.1 Stop the servers

Once you have closed the GUI came back to the "*ArDolores Motors StartUp/ShutDown*" panel. Press the Motors Shut Down button and the CCD Server Shut Down button. The "LEDs" associated to these buttons will switch from "ON" to "OFF" while changing their color from green to gray. Now close the panel itself. Click on the cross at the top right of the panel.
Tell the Telescope Operator that you are done and he can switch off the "ArDolores" and CCD controller devices.

2.1 Shut down check list

1. On the wsastro PC:
 2. from the DOLORES GUI
 - a) Take a dummy scientific image with all the optical elements off from optical path, and all the lamps switched off.
 - b) Click on the Sun image marked with the label "Bye Bye" to close the GUI program
 3. On the "*ArDolores Motors StartUp/ShutDown*" panel
 - c) Now press the two Shut Down buttons. The first will stop the motors server program, while the second one will end the CCD Server Program.

- d) Close the panel itself. Click on the cross at the top right.
- e) Tell to the Telescope Operator that you are done and he can turn off the CCD controller device from the Telescope Control Panel

3 Graphical User Interface

The graphical user interface (GUI hereafter) allows the observer to interact with the instrument. This mean to set up the instrument, check its status, start an exposure and perform a quick analysis on the raw data.

The GUI itself is composed of two graphical interfaces. The "**Main Panel**" and the "**Sequencer**".

3.1 The Main Panel

The "**Main Panel**", see Fig. 6, gives the observer the possibility to display the images, to do a quick analysis of the raw data and to check the present instrument configuration. It is organized in the following sub-panels:

- The top menu bar where the observer can select various functions
- The image display area
- The CCD Status panel
- The LRS Status panel
- The cursors manager
- The shut down icon
- The image timing information panel
- The GUI terminal communication panel
- The exposure setup panel
- The CCD setup panel

Each of this panel can have a setup, information or analysis functionality.

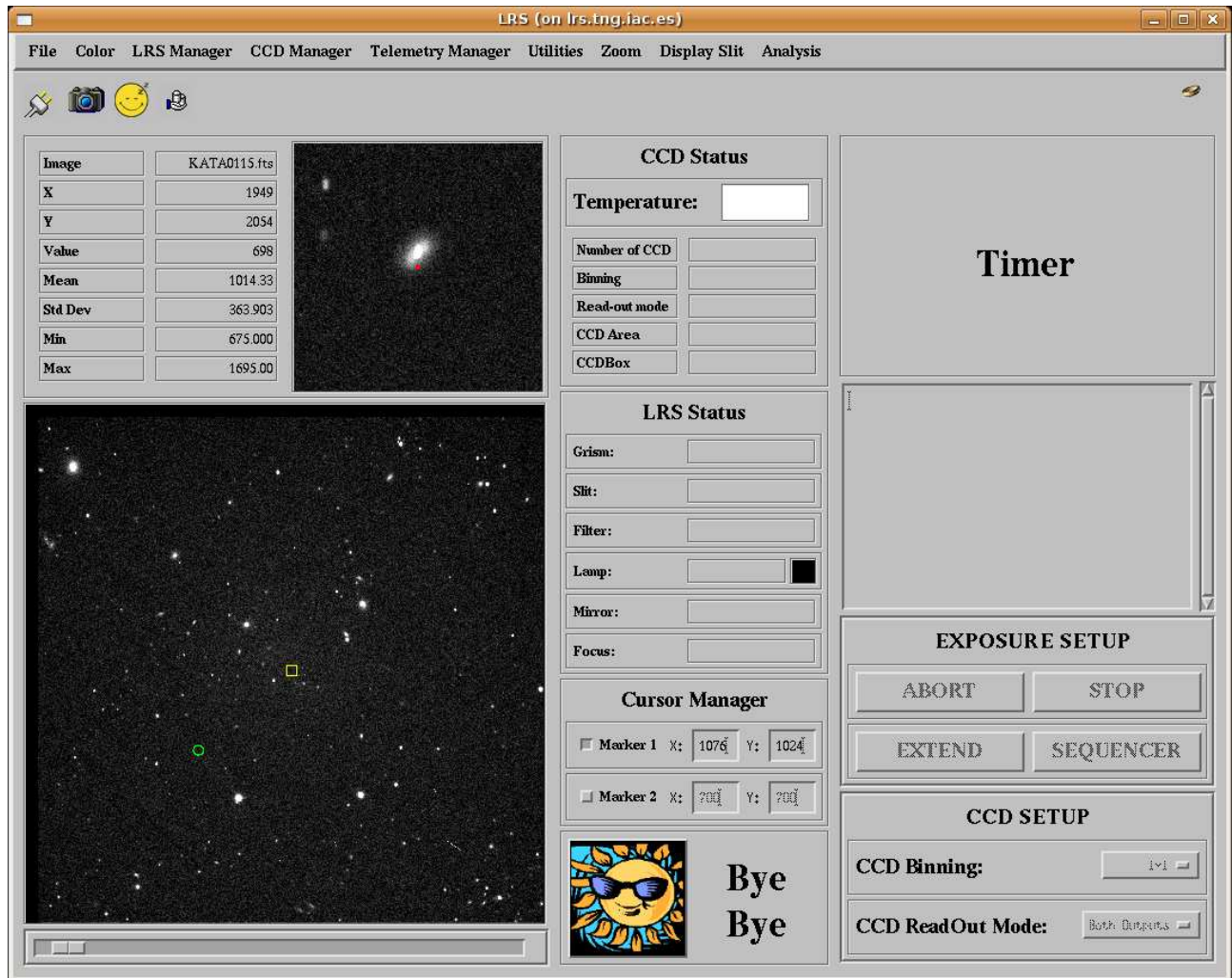


Figure 6: *The DOLORES GUI.*

3.1.1 Image Display Panel

I'll assume that the image display panel is composed by the following panels:

- The image display area
- The zoomed portion viewer
- The image information panel
- The CCD Status panel
- The LRS Status panel
- The cursors manager
- The shut down icon

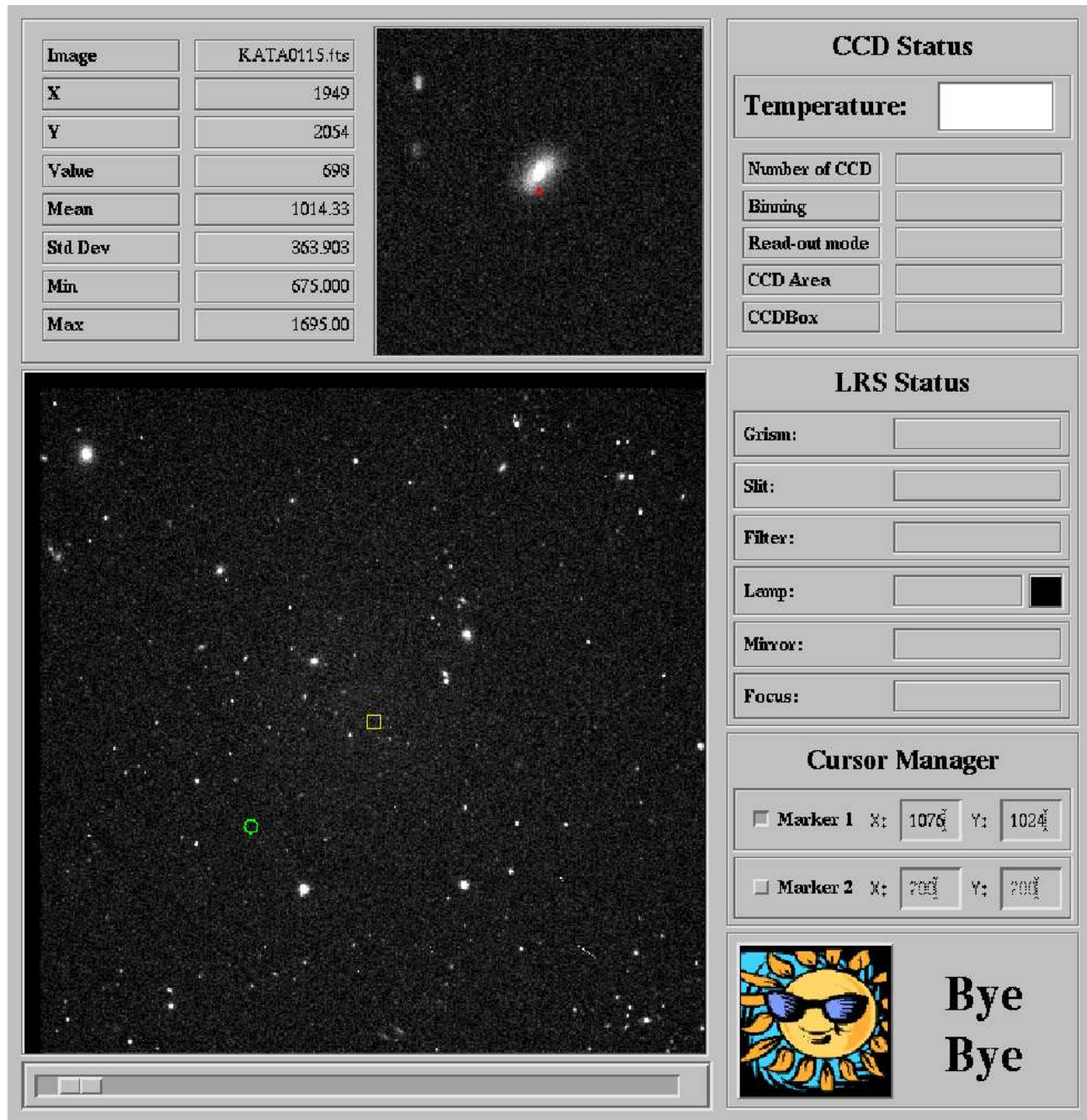


Figure 7: *Image Display panel.*

The observer will use the image display panel to see the acquired images, to send coordinates offset to the telescope, to center the target on the slit, to perform quick data analysis, to check the instrument configuration and to close the GUI. The most important part of this panel is the displayed image itself. The whole acquired image is shown at the left bottom while a zoomed portion is displayed over that on the right. Under the image there is a bar to change the image cuts. On the left of zoom viewer there is the image information panel. The observer will read here the displayed image name, the current cursor position and some image statistics at the cursor position.

At the right of the image there are the remaining four panels that starting from the top are the **CCD status** that sums up informations about the CCD as binning, readout mode and CCD box. Under this panel there is the **LRS Status** panel that sums up the present instrument configuration. Then there is the **Cursor Manager** panel that allows the user to fix two reference position on the image. The last panel is the **Bye Bye** one that is only a big button to close the GUI interface. Some special functions can be started pressing some reserved key on the keyboard or using the mouse buttons.

The only functions activated by the mouse buttons directly on the image are the selection of the zoomed area to be displayed and the markers set up.

To select the zoomed area press once the left button on the image. The zoomed portion will appear on the zoom viewer.

To define the marker position by fitting the position of an object (something on which a centroid can be calculated) select one of the markers activating its button in the cursor manager panel and then click on the object with the central button.

Special keys defined are similar to the imexam IRAF task ones. To use this functions select a position on the image using the mouse cursor and then:

- j* press the **j** to perform a gaussian fit along the rows of the selected position. This function is used, for example, to calculate the slit position
- k* press the **k** to perform a gaussian fit along the columns in the selected position
- l* press the **l** key to see a cut along the selected line
- c* press the **c** key to see a cut along the selected column
- h* press the **h** key to see a counts histogram around the selected position
- r* press the **r** key to see a radial profile gaussian fit in the selected position
- g* press the **g** key to see a 2d gaussian fit, and its parameters, around the selected position
- s* press the **s** key to see a surface plot in a box around the selected position
- e* press the **e** key to see a isophotic contour plot around the selected position
- p* press the **p** key to open an IRAF phot like program to perform a quick aperture photometry. This will open a panel on which the user will be able to define an aperture and a sky around the object. A raw estimation of the star magnitude (as $-2.5 \times \log(\text{Flux})$) and Flux inside the aperture will be retrieved
- x* press the **x** key to open the spectrum extraction and quick-look program. If you press this key on the trace of a spectrum a graphical interface will pops up to guide you through the spectrum extraction. Once ended the plot of the extracted spectrum will appear. On the extracted spectrum window some **IRAF splot** like key are active: Press the **a** key twice to retrieve a zoomed spectrum portion. Press the **k** key on a feature to retrieve a gaussian fit on it. Press the **e** key to retrieve the equivalent width of a feature. Press the **s,r** key to retrieve a smoothed or original version of the spectrum. Press the **=** key to save a postscript copy of the plot
- q* Always close the plots using the **q** key or with the top right cross. Due to IDL feature if you leave pending plots while reading out or moving the motors you will produce a crash of the interface. In this case you have only to shoot it down and start it up again (section 1.4 points h and i

More functions are available but they require to be previously selected on the **menu bar** panel.

3.1.2 The top bar menu

The user will find on the menu bar panel (see Fig. 8) various utilities grouped under lists. Starting from the left the list named **file** (see Fig. 9) from which the user can load an image, display the image header and exit the GUI program (the same as the Bye Bye button).



Figure 8: Menu bar panel.

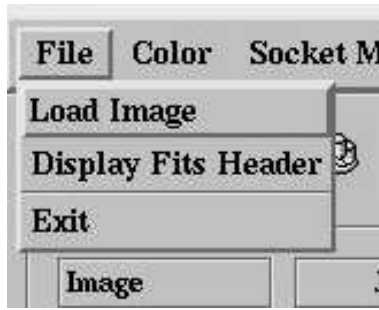


Figure 9: *The file list on the menu bar panel.*

The second list is the **color** one from which the user can change the color image palette. See Fig. 11



Figure 10: *The color list on the menu bar panel.*

The subsequent **LRS Manager** list only has the "System Startup" entry. This is to start up the system after opening the GUI program (see section 1.3). The **CCD Manager** and **Telemetry manager** lists contains maintenance functions and have no utility for the user. Under the next, **Utilities** the user will find various useful utilities. See Fig. 12. The Display AZ/EL axis will plot the projection of elevation and Azimuth on the current image, The display compass will show the North and East on the image. The clear markers function will delete all the displayed markers while the save and retrieve markers will allow the user to save the defined makers position on a file and to load them. Is strongly recommended to save the markers positions because they will be lost in the case of a GUI crash.

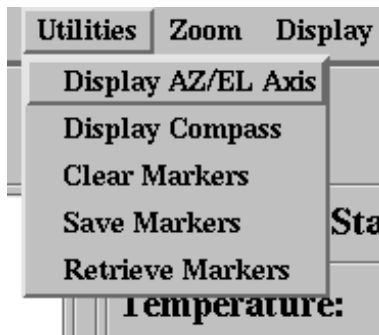


Figure 11: *The Utility list on the menu bar panel.*

Under the **Zoom** list the user will find some useful function to rotate and flip the image axis. The zoom function itself is not implemented yet.

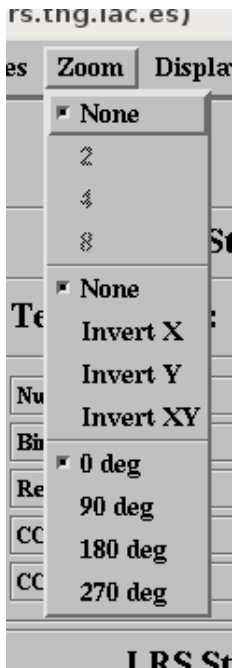


Figure 12: The **Utility** list on the menu bar panel.

The **Display slit** will only display a plot of the selected slit on the image. The last list, **Analysis**, contain various entry to help the user to move the target to the desired marker position. These functions needs the maker(s) to be defined and active. The list has the 1 object, 2 object, MOS and M2 focus.

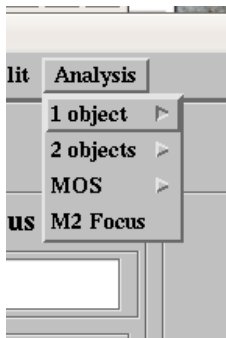


Figure 13: The **Analysis** list on the menu bar panel.

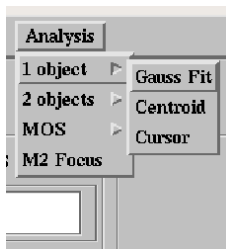


Figure 14: The **Analysis 1 object** option.

The **1 object** entry will help the user to retrieve the target position on the image and to calculate the coordinates offset to move the telescope to put the selected object on the marker position. The functions can send the offsets to the telescope. **If you decide to send the offset from the interface to the telescope remember to inform the telescope operator. He will see that the telescope is moving and must know that everything is fine.** The case of sending offset to center two object or a MOS mask is different because it involves. A position angle offset. Remember to ask the telescope operator to switch the atoguide off before to send the offset.//

To calculate the offset the user can choose through three algorithms, (see Fig 14), **Gauss Fit** will perform a 2d gaussian fit on the target, **Centroid** will calculate the x and y coordinate using the centroid IDL function, **Cursor** allow the user to select the x and y position with the cursor.

To use these functions the user needs to select the object with the mouse. In detail the operations to use these functions are:

Gauss fit Select one of the marker. Select the function that you want to use from the drop list, move the cursor on the image, select the target position with the left mouse button, select the object to be fitted with the right mouse button. This last operation can be done on the zoom viewer. An orange window with the calculated offsets will pop up asking if you want to send the offsets to the telescope. If you answer yes, please before tell to the telescope operator that you are sending coordinates offset. Remember that the auto-guide must be inactive in this case. If you want to send the offsets while auto-guiding tell them to the telescope operator and answer "NO" on the window

Centroid Select one of the marker. Select this function from the drop list. Select a zoomed area around your target with the left mouse button. Select the object for which you want to calculate the centroid with the right button. You can do this operation on the zoomed portion or directly on the image. An orange pop up will rise suggesting RA and DEC offsets to be send to the telescope to move the target to the selected marker. If the auto-guide is not active you can send the offset directly to the tracking by answering yes. Otherwise tell this offsets to the telescope operator and he will apply them for you.

Cursor Select one of the marker. Select this option from the drop list. Mark the area around the selected target with the left button. Select the pixel of the target that you want to move over the marker with a right button click on the zoomed portion.

Consider that gaussfit is a good choice for target not saturated and with a good S/N. Centroid can still work on not strongly saturated targets. Cursor is the only chance to center really faint or badly saturated object.

3.1.3 The image timing information

This panel is an information utility. On it will appear the status of the actual image. If an exposure is active a count down clock will appear to inform about the remaining exposure time. If the image is in read out status a chronometer will appear. When no exposure is active the DONE label is present.

3.1.4 The GUI terminal communication panel

On this panel will appear the command send to the CCD controller and to the motors and some message.

3.1.5 The exposure setup panel

The exposure setup panel is composed by 4 button. The sequencer button opens the sequencer GUI (see below). The ABORT button will abort the ongoing exposure, no image is returned. The STOP button will end the ongoing exposure. The actual image is read out and saved. The extend function allow to extend the actual image exposure time. **The EXTEND function is in test phase. If you extend the actual image just when the read out begin the GUI will crash and you will need to close and reopen it**

3.1.6 The CCD setup panel

The CCD setup panel allow to select the binning and read out mode. At the moment the CCD can be read only with the Left read out option.

3.2 The Sequencer

The "Sequencer" allows the observer to set up and to start a single exposure or a series of them. The sequencer is shown in Fig. 15.

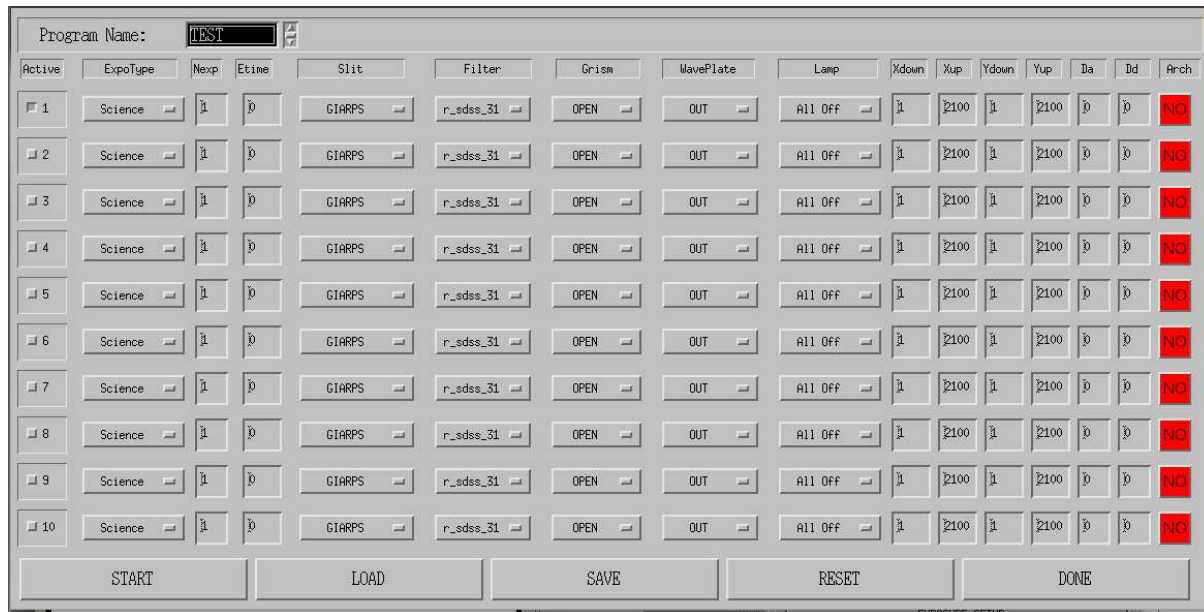


Figure 15: *The Sequencer GUI.*

Up, on the left (see Fig. 16) you will find a list of programs names. **Please remember to select the correct program name each time you open the sequencer. Look for your program name under the scroll list and click on it. The background color of your program name will change to black when it is correctly selected. You will be allowed to retrieve only the images of your program from the archive.** In case you forget to set your correct program name remember to send an e-mail to your contact astronomer and to it@tng.iac.es.

The Sequencer is organized in row. Each row is a blueprint of an image to be started.

Each row is organized in fields that from the left to the right are:

Active The Active field is a button to activate a row

Expo Type Is a drop list where you have to select which kind of exposure you want to start. You can select trough science,calib, flat, bias or dark

Cycle You can repeat the same image more than once. When you reuse the same exposure configuration no check is done on the instrument axes. So it takes less time than activating more row with the same configuration.

Exptime Here you decide how many seconds you will expose.

Slit Here you can choose to do photometry, in which case you choose the beam position, or spectroscopy with one of the five possible long slit or Multi Object spectrometry selecting a MOS Mask

Filter If you are doing photometry you can select a filter here. Filters coupled with a grisms as blocking orders don't need to be selected. They will be inserted automatically.

Lamp If you selected Calib as image type you are allowed to switch **ON** one of the lamp set described under this drop list.

Xdown Xup If you are interested in boxing the CCD select the starting X as Xdown and the ending X as Xup

Ydown Yup If you are interested in boxing the CCD select the starting Y as Ydown and the ending Y as Yup

Da Delta alpha. This will send an offset in arcseconds in the **RA** direction. This offset is applied to the telescope before to start the exposure. Up to 60 arcseconds of sky offset are allowed. This functionality is aimed to make pattern in case it is required to combine multiple images

Dd Delta Declination. This will send an offset in arcseconds in the **DEC** direction. This offset is applied to the telescope before to start the exposure. Up to 60 arcseconds of sky offset are allowed. This functionality is aimed to make pattern in case it is required to combine multiple images

Arch If you want to save this image remember to press this button. Image not archived will not be sent to the Archive. In any case they will be saved locally. If you forget to activate this button send an e-mail to your contact astronomer and to it@tng.iac.es

The observer can decide to activate only one row or more of them.

At the Sequencer bottom there are four buttons. **START** will begin to execute the selected row from the top to the bottom. Once started it's still possible to modify a sequencer row not started yet. The **SAVE** button allows the observer to save the sequencer configuration for further use. **LOAD** button allow the user to charge a saved sequencer. The **RESET** button sets all the rows to the default configuration. **DONE** will close the Sequencer.

4 Observation hints

4.1 General operations

Before to start the observation you will need to do some general operations.

4.1.1 Focusing

The telescope has a program to calculate the focus variation versus the temperature and elevation variation. The telescope operator will adjust the focus for you during the pointing. Anyway remember to ask occasionally the telescope operator to check the focus while reading out the current image. For the focus program to work properly you will need, anyway, to set the focus zero-point. In theory once a night should be sufficient. In practice you could have to repeat it during the night if the weather parameters (temperature, improved seeing, ...) changes. To do the focus take a 20-30 seconds (take exposures longer than 10 seconds anyway to avoid the seeing variability) of a not crowded field. Take this image without photometric filters and inserting the pyramid sensor (**grisms** drop-list on the sequencer). The pyramid will split each spot into 5 spots in your image. Use the **M2 focus** from the GUI **top bar menu** under **Analysis** and follow the instructions. Eventually repeat to check.

4.1.2 Sky flats and standard stars

If you take sky-flats or standard stars during your observation it would be useful for the TNG users if you remember to switch the program name to **CALIB**. This is true for afternoon calibration too. If you do so the calibration images you take will be available to the TNG user community immediately. Remember to select your program name before to start your program. If you forget to do that warn up your support astronomer and the software team (it@tng.iac.es) or your scientific images will be public too. On the tracking computer are available coordinates catalog for the most used photometric and spectrophotometric standard star as blank fields for flat fielding. In the web page you will find links to useful standard star catalogs.

4.2 Acquiring Calibration lamps during the night

Calibration lamps can be acquired during the night only if the telescope autoguide has been switched off. If it is necessary to take Calibration lamps during the night alert the telescope operator before to start to take images. He will switch off the autoguide and advise you when you will be ready to start the lamp images. When you finish advise the operator to switch the auto-guide on again. Even if you are observing the same object you will need to center it again on the slit before to start a new scientific image.

4.2.1 Targets catalog

A User Target Catalog in the format readable by the telescope tracking computer is recommended and welcome. This must be an ASCII file which name is given by the observing period an underscore the tac, cat, itp identifier the program number and a .cat extension. If, for example, you are observing the program TAC13 during AOT19 your User Target Catalog should be named as `aot19_tac13.cat`. The first line must be left blank or include a fields descriptor line. Each line will

describe one object name and coordinates. Each line has 9 fields separated by SPACES. Fields are:

ASCII name descriptor	Right ascension	declination	Equinox	RA proper Motion as "/year	DEC proper Motion as "/year	parallax	Radial Velocity	EPOCH
NAME	RA	DEC	EQX	MPRA	MPDEC	PAR	RV	EPOCH
M71	19:53:42.020	18:46:42.14	2000.00	0.001	0.002	0.0	0.0	2000.00
M15	21:29:56.290	12:10:00.45	2000.00	0.0	0.0	0.0	0.0	2000.00

4.2.2 Position Angle

If you need a position angle different by the standard one tell it to the telescope operator during the pointing. It will avoid the overhead time taken by the derotator to reach the final position.

4.3 MOS observation

4.3.1 MOS to be mounted on the focale plane

Due to time required to mount the MOS MASKS on the focal plane the observer should communicate as soon as possible the MASK schedule for almost the first observing night.

An astronomer will be on duty to change the MOS MASK configuration on demand the morning before their use.

If a MOS configuration change is required for the next night this must be communicated, before the end of the current night, by sending an e-mail with the new configuration to the address mos@tng.iac.it.

MOS and Long slits are locate on a different plane. This mean that there is a focus offset between MOS and long slits. The astronomer in charge to mount the MOS will setup the internal camera focus for the MOS. The use one long slit during a MOS run is a special case. Remember to tell it to your contact astronomer. If you are mixing MOS and long slits during your observation you will need to ask to set the telescope focus for the long slit configuration each time you will switch from MOS to long slit and vice versa.

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