User InterFace Manual

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1. Introduction

The SARG User Interface allows the observer to perform all the operations necessary to manage the SARG spectrograph during a typical observational session.

It is composed of three different logical blocks which correspond to three different windows. There is an initialization window, a user interface window and a telemetry window.

The purpose of the Initialization Window is to initialize the CCD detectors and the mechanisms of the spectrograph.

The SARG User Interface Window is the core of the user interface. Through this window the observer can 1) control the CCD setup, choosing among the outputs and readout modes the ones more suitable for the observations; 2) control the SARG configuration selecting the correct combination of filters, grisms, slits, lamps etc.; 3) set the exposure time and the observing mode (calibration, spectrum, dark, etc). The management window contains also a part devoted to quick look analysis of the spectra with limited reduction facilities, as order extraction, spatial and spectral resolution estimates, available on-line. Finally a full resolution and a rebinned image of the acquired spectrum are shown.

The Telemetry Window is divided in two main sections. The first section is devoted to the spectrograph. It gives the status of all mechanisms and lamps inside SARG and also allows to monitor the temperature of the different part of the spectrograph. The second one, devoted to the CCD, gives general information about the CCD related temperatures, readout modes, biases and clocks.

2. Initialization Window

The SARG Initialization window allows the observer to carry out few preliminary operations necessary before starting an observational session. In particular the observer will have to initialize the CCD detectors and, if necessary, the SARG slides, tables and wheels. Limited diagnostics is available on-line in case of system fault with suggestions for possible solutions of the problem. Figure 1 shows how the initialization window looks like.

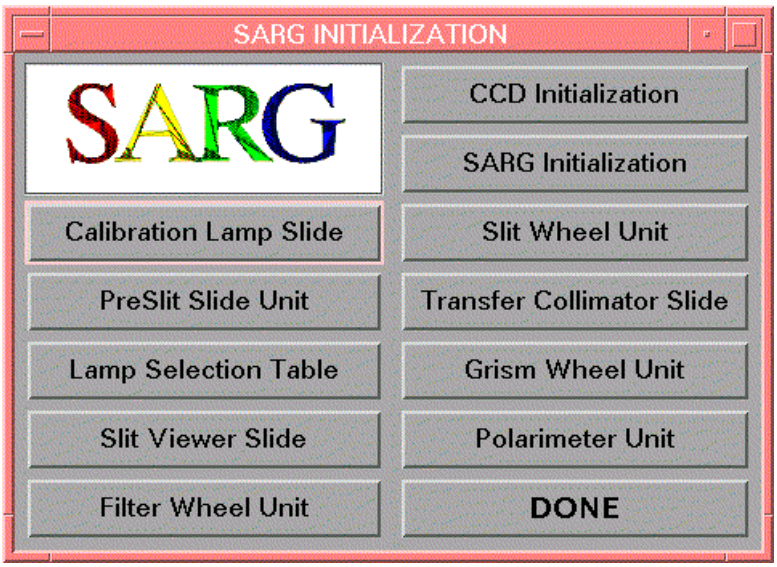

Figure 1 – SARG Initialization Window

- *CCD Initialization*

  The CCD Initialization button performs several functions. First of all, it starts the communications between the transputer on the CCD controller and the transputer on the VME. Then it executes an initialization file that loads the CCD biases and clocks, actually making the CCD operating. By default the CCD configuration loaded corresponds to two outputs-amplifier readout without binning. A dialog box pops up just before the initialization file is executed asking to confirm the loading of the default CCD configuration. If NO is selected then the CCD initialization is stopped, the SARG Initialization Window is closed, and the CCD DETECTOR SETUP subwindow in the SARG Main window is made sensitive. Using the CCD binning menu is then possible to select the appropriate readout mode and binning.

- *SARG Initialization*

  The SARG initialization button performs the initialization of all slides and wheels (9 in all) inside the spectrograph. At the end of the initialization procedure all the slides and wheels will be in their default positions which will be shown in the management window. The time necessary to perform the initialization of the entire spectrograph is estimated to be of the order of 10 minutes.

- *Calibration Lamp Slide*

  The Calibration Lamp Slide (CLS) allows to illuminate the SARG spectrograph with the calibration lamps inserting a 45 degrees plane mirror into the optical path. This

button will initialize the slide putting it into its default position which is off the optical path. Estimated initialization time 20 seconds.

- *Preslit Slide Unit*

  The Preslit Slide (PS) contains few neutral filters and the Iodine Cell. After the initialization the PS will be in its default position which is empty. Estimated initialization time 45 seconds.

- *Lamp Selection Table*

  The Lamp Selection Table allows the selection of one of the five calibration lamps. The initialization button will set the table in its default position in front of the CDAll lamp. Estimated initialization time 15 seconds.

- *Slit Viewer Slide*

  The Slit Viewer Slide has three possible positions, the default one which is open then in the other two positions are placed a blue filter and a diaphragm. Estimated initialization time 25 seconds.

- *Filter Wheel Unit*

  The Filter Wheel allows to accomodate up to 11 different filters (the default position is open). The initialization button will select the default position. Estimated initialization time 95-140 seconds.

- *Slit Wheel Unit*

  The Slit Wheel accomodates 4 short slits, 2 long slits, 1 slit for polarimetric mode, and an image slicer. Furthermore is an open position is available for efficiency measurements. The initialization procedure will select the short slit corresponding to a resolution R=165000. Estimated initialization time 85-135 seconds.

- *Transfer Collimator Slide*

  The Transfer Collimator Slide allows to move the collimator to focus the observed spectrum onto the detector. There are two possible positions, one corresponding to the image slicer and the second one corresponding to a generic slit. By default the second position is the one selected after the initialization procedure. Estimated initialization time 35 seconds.

- *Grism Wheel Unit*

  The Grism Wheel has five different positions. An empty position is the default one while the others contain four different grisms. Estimated initialization time 195 seconds.

- *Polarimeter Unit*

  The Polarimeter Unit has three different tables: a linear stage to move the unit in and out the optical path; two rotary stage to insert and rotate the $\lambda/2$ and $\lambda/4$ retarders. Estimated initialization time of this unit is 120 seconds.

- *DONE*

  This button is to exit the Initialization Window once you have done with it.

3. Main Window

The SARG main window is the core of the SARG user interface. It is not conceived as an all in one window, in fact, not all the possible operations can be perfomed from it even if they can be started. For example initializing the system or reading the system telemetry can be done pressing the SARG Initialization button and the SARG Status button.

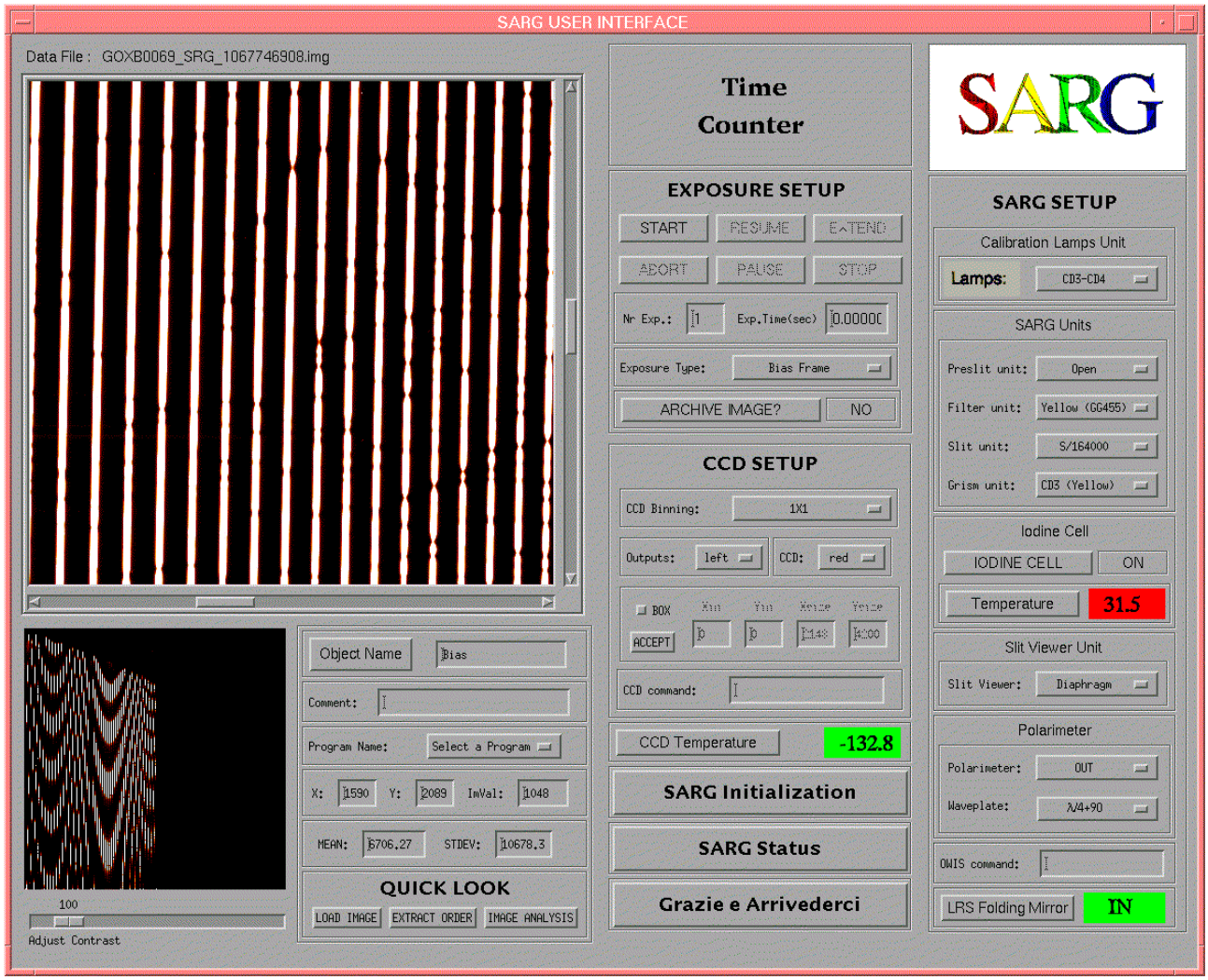

Figure 2 – SARG user interface main window

As it can be seen from figure 2 the SARG User Interface Window is composed by several different subwindows easy to identify. Going from right to left we have the SARG SETUP subwindow which allows the observer to manage the whole spectrograph but the CCD detector. On the top part of the central column there is a TIME COUNTER which executes a countdown after an exposure is started an also tells the user how much time is needed to read a CCD image and write it to the workstation hard disk. Next we have the EXPOSURE SETUP subwindow which allows to start/stop an exposure, to set the number of exposure, the exposure time and the exposure type and to archive an image. Then there is the CCD SETUP window to set the CCD to read, the binning, and the CCD outputs and to define a CCD subarea to read. Finally there are three Utility Buttons which allow to initialize

SARG, to read the istrument's telemetry and to exit the interface. The leftmost column, let's call it VISUALIZATION subwindow has two graphic windows to show a full resolution image of the spectrum and a rebinned image of it. Furthermore there is a QUICK LOOK subwindow with three buttons which give access to few reduction routines which allow the observer to assess the quality of the data on line. The rest of the chapter will be devoted to a more accurate description of the characteristics of the various parts of the main window user interface.

3.1. SARG SETUP subwindow

The SARG setup subwindow is composed by 6 different working areas as shown in figure 3. The **Calibration Lamp Unit** area contains a pulldown menu to select one of the five available calibration lamps.

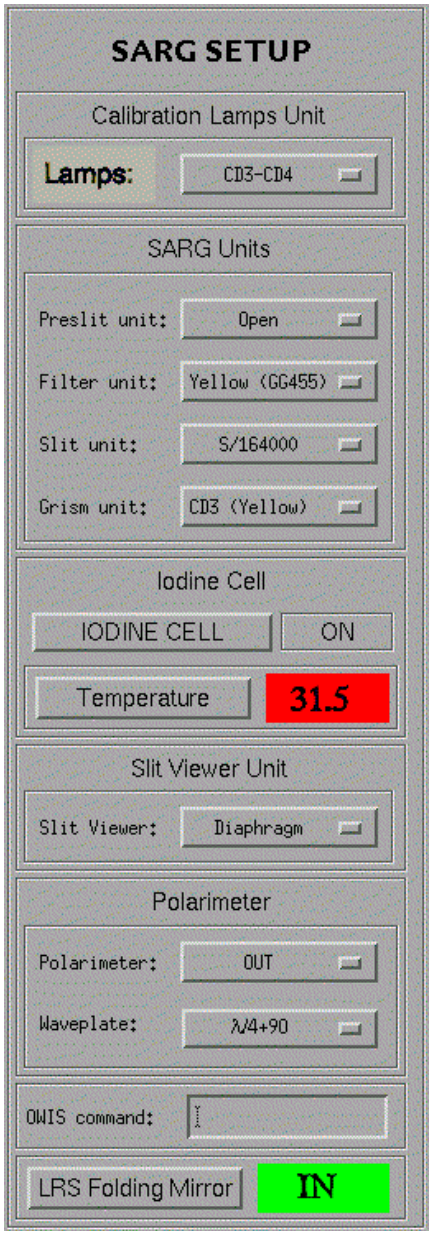

Figure 3 – SARG SETUP subwindow

The lamps are four halogen lamps to be used for flat field calibration, three of them are indicated with the names of the cross disperser they should be used used with,

that is CD1, CD2, CD3-CD4, the fourth one is called CDAll. The cross dispersers CD3 and CD4 use the same lamp. The CDAll lamp has no filter in front of it as the others have and it is mainly used with the blue (CD1) grism. Finally there is also a thorium lamp for wavelength calibration. Choosing a lamp from the menu inserts the calibration mirror along the optical path, switches on the lamp and move the mirror of the lamp selection table in front of it.

In the **SARG Units** area there are four different pulldown menus. They allow the observer to move the preslit slide, holding a set of neutral filters and the iodine cell, the filter wheel, holding four broadband filters and a Na interference filter, the slit wheel and the grism wheel. Selecting an element from a pulldown menu moves the mechanism to the desired position. When selecting the image slicer (IS) from the Slit unit menu the Transfer Collimator Mirror is automatically moved to the position corresponding to the spectrograph focus with the image slicer and viceversa, that is, deselecting the image slicer makes the Transfer Collimator Mirror go back to the normal focus position. Furthermore if the observer decides to change grism while having selected as exposure type "Flat Field" (see EXPOSURE SETUP below) then he/she is asked permission to move the lamp selection mirror and to switch on the corresponding lamp.

The **Iodine Cell** area contains a button to switch on and off the iodine cell with a window showing the status of the cell by its side. Below there is a second button to query the temperature of the cell. (see the Telemetry Window paragraph for an explanation of the color code).

The **Slit Viewer Unit** area allows to move the slide in front of the slit viewer camera either a diaphragm or a blue filter.

The **Polarimeter** area allows to manage the spectropolarimeter. The upper pulldown menu move in and out the optical path the polarimetric unit. The lower menu allows to select, insert and/or rotate along the optical path the λ/2 and λ/4 retarders. There 6 allowed positions: λ/4, λ/4+90, λ/2, λ/2+22.5, λ/2+45, λ/2+67.5.

The **OWIS command** area allows the expert user to enter directly WSS commands related to the management of the OWIS motors controller and of the lamp controller. **This window exists for debugging and testing purposes only and MUST NOT be used in any case by the general observer**.

Finally there is a button to query the position of the folding mirror inside LRS that feeds the SARG spectrograph.

3.2. Time Counter Panel

On the top part of the central column there is a time counter subwindow. During the exposure the time left to the end of the exposure (left panel of figure 4) is shown in this window.

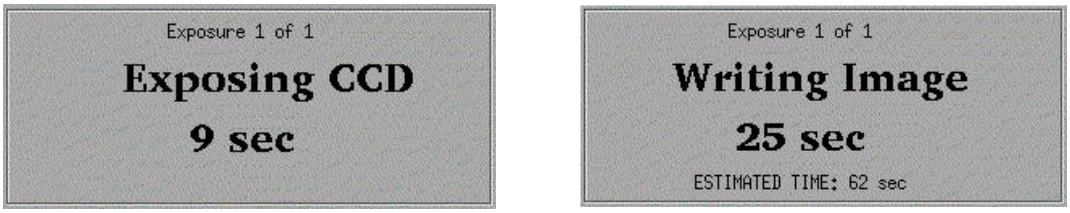

Figure 4 – Two examples of timer counter panel

After the exposure is ended the CCD is read-out and the image is saved to the hard disk of the HP workstation. The time spent by the system in doing these operations is shown in the time counter subwindow together with an estimate of the total time necessary to do them (see right panel of figure 4). When the image is saved to the disk the writing DONE!!! is displayed in the window.

3.3. EXPOSURE SETUP subwindow

This subwindow contains seven button performing various functions, a pulldown menu and two editable fields, as shown in figure 5. Going from up to down, first of all, we find six buttons:

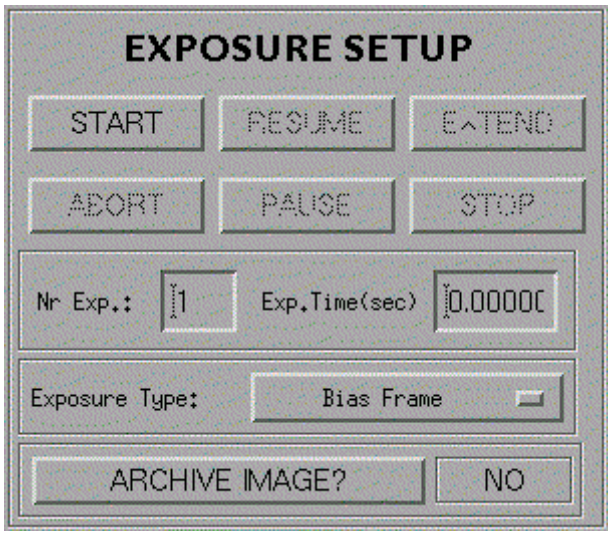

Figure 5 – Exposure setup subwindow

- START

This button is used to start an exposure or a series of identical exposures. Before actually starting the exposure a procedure, which performs a series of operations, is launched.

1. The procedure checks if the archive flag is set or not (see below). In case the flag is not set a pop up window appears informing the user that the exposure (or the series of exposures) will not be archived and asking to proceed or not.
2. The procedure checks if the name of an observational program has been selected from the *Program Name* pulldown menu. If not an error message will be displayed. Note that the exposure will not start until a valid program name has been selected.
3. The procedure reads the name of the object and informs the user if the *OBJECT* field is empty. Note that the exposure will not start until a valid string is inserted in this field.
4. The CCD temperature is checked and the coloured display below the CCD setup subwindow is updated. See paragraph 4 (Telemetry Window) for the explanation of the color code.
5. If the archive flag is set, a snapshot of the spectrograph system is made and written to the FITS header of the image.

6. The time necessary to read the CCD and save the image to disk is calculated. This estimate will appear in the Timer Counter subwindow during the readout of the CCD.
7. Refresh of the pulldown menus in the SARG setup subwindow. This is done because sometimes it can happen that, due to synchronization problems between the SARG VME and the workstation, a pulldown menu in the SARG setup subwindow is not correctly updated at the end of a movement.
8. Checks the exposure time and informs the user when it is set to 0 and the exposure type (see below) is not a bias. Note that the exposure will not start until an exposure time greater than zero or a bias exposure type is set.
9. Opens the lamp shutter if the exposure type is set to Flat Field or Comparisom lamp.
10. Starts the exposure.

- RESUME

  This button allows to resume an exposure previously paused.

- EXTEND

  This button allows to extend the exposure time of an ongoing exposure. When doing multiple exposure it works only for the ongoing exposure.

  ABORT

This button aborts an exposure or a series of exposures. In this case the CCD is not read out and **ALL THE DATA ARE LOST.**

- PAUSE

  This button allows to pause an ongoing exposure. The exposure time is stopped, the CCD shutter is closed but the CCD remains in integration. The exposure can be restarted using the RESUME button.

- STOP

  This button terminates the exposure or the series of exposures, reading the CCD and saving the data acquired up to that moment to the disk.

Below these buttons there are two editable fields labelled *Nr. Exp.*and *Exp. Time (sec)* respectively. In the first field the user has to insert the number of exposures that wants to take with a given configuration of the instrument. The second field is used for the exposure time. The exposure time **has to be given in seconds**. No carriage return is necessary to make the interface accept the values written in the two fields. **Beware** that at the end of a multiple exposure the number of exposures is automatically reset to 1.

Next in this subwindow there is a pulldown menu labelled *Exposure Type*. The user can choose among seven different type of exposures: Flat Field, Dark, Bias (default), Object, Comparison lamp, Iodine Cell (Object), Iodine Cell (Flat). The selection of any item of the list makes the system perform various operations (see below). Note that for this reason a correct selection of the exposure type is **FUNDAMENTAL** for the correct execution of the exposure.

❖ Flat Field

The Flat Field exposure type has to be selected whenever an image of the spectrum of a flat field lamp has to be taken. The following operations are automatically performed by the system when the flat field exposure type is selected. No exposure can be started before this procedure is completed.

1. The field “OBJECT” (and the correspondent FITS keyword) placed below the full resolution CCD image is updated with the word “Flat”.
2. The keyword OBS-TYPE in the FITS header is set to “flat”.
3. The exposure time is checked and if found equal to zero a window with an error message will pop up.
4. The position of the iodine cell is checked and the cell is removed from the optical path if necessary. In this case a window saying “Removing Iodine Cell, Please Wait…” pops up.
5. The position of the grism wheel is read.
6. The lamp corresponding to the grism is switched on.
7. The position of the Calibration Mirror Slide (CLS) is checked and if necessary the mirror is inserted. In this case a window saying “Inserting CLS, Please Wait…” pops up.
8. The position of the Lamp Selection Table (LST) is checked and if necessary the mirror is positioned in front of the selected lamp. In this case a window saying “Moving LST, Please Wait…” pops up.

❖ Dark

The Dark exposure type has to be selected whenever an image of the CCD dark current has to be obtained. These exposure are taken keeping the CCD shutter closed. The operations done by the system, when the dark exposure type is selected, are listed below.

1. The field “OBJECT” (and the correspondent FITS keyword) placed below the full resolution CCD image is updated with the word “Dark”.
2. The keyword OBS-TYPE in the FITS header is set to “dark”.
3. The exposure time is checked and if found equal to zero a window with an error message will pop up.
4. All the lamps are switched off.
5. The position of the Calibration Mirror Slide (CLS) is checked and if necessary the mirror is removed. In this case a window saying “Removing CLS, Please Wait…” pops up.
6. The shutter of the lamps is closed. This operation would not be necessary because the lamp shutter is automatically closed at the end of any exposure involving a lamp but it is kept for security reason.

❖ Bias

The Bias exposure type has to be selected when an image of the CCD bias has to be taken. The list of the operations automatically perfomed is reported below:

1. The field “OBJECT” (and the correspondent FITS keyword) placed below the full resolution CCD image is updated with the word “Bias”.

2. The keyword OBS-TYPE in the FITS header is set to “zero”.
3. The exposure time is automatically set to zero and the “Exp. Time” field is updated.
4. All the lamps are switched off.
5. The position of the Calibration Mirror Slide (CLS) is checked and if necessary the mirror is removed. In this case a window saying “Removing CLS, Please Wait…” pops up.
6. The shutter of the lamps is closed. This operation would not be necessary because the lamp shutter is automatically closed at the end of any exposure involving a lamp but it is kept for security reason.

❖ Object

The Object exposure type is selected whenever the spectra of an astronomical object has to be taken without the iodine cell. **BEWARE** that the field “OBJECT” is **NOT** updated so the observer has to insert manually the name of the object is observing or press the OBJECT button to get the object name from the tracking system. An empty string will result in an error message. **NOTE** that no exposure can be started until a valid string is inserted in the field “OBJECT”. The list of the operations automatically perfomed by the system when this exposure type is selected is the following:

1. The keyword OBS-TYPE in the FITS header is set to “object”.
2. The exposure time is checked and if found equal to zero a window with an error message will pop up.
3. All the lamps are switched off.
4. The position of the Calibration Mirror Slide (CLS) is checked and if necessary the mirror is removed outside the optical path. In this case a window saying “Removing CLS, Please Wait…” pops up.
5. The position of the iodine cell is checked and the cell is removed from the optical path if necessary. In this case a window saying “Removing Iodine Cell, Please Wait…” pops up.
6. The shutter of the lamps is closed. This operation would not be necessary because the lamp shutter is automatically closed at the end of any exposure involving a lamp but it is kept for security reason.

❖ Comparison lamp

The comparison lamp exposure type is the one that the observer has to select to take a spectra of the thorium lamp for wavelength calibration purposes. The systems performs the following automatic operations when the Comparison lamp exposure type is selected.

1. The field “OBJECT” (and the correspondent FITS keyword) placed below the full resolution CCD image is updated with the word “Thorium”.
2. The keyword OBS-TYPE in the FITS header is set to “calib”.
3. The Thorium lamp is switched on.

4. The position of the Calibration Mirror Slide (CLS) is checked and if necessary the mirror is inserted in the optical path. In this case a window saying "Inserting CLS, Please Wait…" pops up.
5. The position of the iodine cell is checked and the cell is removed from the optical path if necessary. In this case a window saying "Removing Iodine Cell, Please Wait…" pops up.
6. The position of the Lamp Selection Table (LST) is checked and if necessary the mirror is positioned in front of the thorium lamp. In this case a window saying "Moving LST, Please Wait…" pops up.

❖ Iodine Cell (Object)

This exposure type has to be selected whenever a scientific observation using the iodine cell has to be done. **BEWARE** that the field "OBJECT" is **NOT** updated so the observer has to insert manually the name of the object is observing or press the OBJECT button to get the object name from the tracking system. An empty string will result in an error message. **NOTE** that no exposure can be started until a valid string is inserted in the field "OBJECT". The operations automatically done by the system are listed below:

1. The keyword OBS-TYPE in the FITS header is set to "object".
2. The status of the iodine cell is checked. The iodine cell is switched on if it were not. **NOTE** that it takes approximately **TWO HOURS** before the iodine cell reaches the working temperature, so it is necessary to switch it on early in the afternoon to have it ready at the beginning of the observations.
3. The temperature of the iodine cell is checked. The working temperature is about 61°C. If the temperature is found to be less than 59°C then a warning message (Iodine cell warming up…) will pop up and the procedure will be stopped. No exposure will be taken until the temperature of the cell will not be in the correct interval.
4. The position of the iodine cell is checked and the cell is inserted along the optical path if necessary. In this case a window saying "Inserting Iodine Cell, Please Wait…" pops up.
5. The positions of the slit wheel and of the grism wheel are checked. If the slit selected is the Image Slicer then the grism wheel, if necessary, will be moved to the CD2 (green) grism. If the S/144000 is selected then the grism wheel, if necessary, will be moved to the CD3 (yellow) grism. In both cases a window saying "Moving Grism Wheel, Please Wait…" pops up.
6. All the lamps are switched off.
7. The position of the Calibration Mirror Slide (CLS) is checked and if necessary the mirror is removed outside the optical path. In this case a window saying "Removing CLS, Please Wait…" pops up.
8. The shutter of the lamps is closed. This operation would not be necessary because the lamp shutter is automatically closed at the end of any exposure involving a lamp but it is kept for security reason.

❖ Iodine Cell (Flat)

The Iodine Cell (Flat) exposure type has to be selected whenever an image of the spectrum of a flat field lamp with the absorption sepctrum of the iodine cell superimposed on it has to be taken. The following operations are automatically performed by the system when the flat field exposure type is selected:

1. The field “OBJECT” (and the correspondent FITS keyword) placed below the full resolution CCD image is updated with the word “flat+cell”.
2. The keyword OBS-TYPE in the FITS header is set to “flat”.
3. The status of the iodine cell is checked. The iodine cell is switched on if it were not. **NOTE** that it takes approximately **TWO HOURS** before the iodine cell reaches the working temperature, so it is necessary to switch it on early in the afternoon to have it ready at the beginning of the observations.
4. The temperature of the iodine cell is checked. The working temperature is about 61°C. If the temperature is found to be less than 59°C then a warning message (Iodine cell warming up…) will pop up and the procedure will be stopped. No exposure will be taken until the temperature of the cell will not be in the correct interval.
5. The positions of the slit wheel and of the grism wheel are checked. If the slit selected is the Image Slicer then the grism wheel, if necessary, will be moved to the CD2 (green) grism. If the S/144000 is selected then the grism wheel, if necessary, will be moved to the CD3 (yellow) grism. In both cases a window saying “Moving Grism Wheel, Please Wait…” pops up.
6. The lamp corresponding to the grism is switched on.
7. The position of the Lamp Selection Table (LST) is checked and if necessary the mirror is positioned in front of the selected lamp. In this case a window saying “Moving LST, Please Wait…” pops up.
8. The position of the Calibration Mirror Slide (CLS) is checked and if necessary the mirror is inserted. In this case a window saying “Inserting CLS, Please Wait…” pops up.

Finally in the EXPOSURE SETUP subwindow we find the *ARCHIVE IMAGE* button. The purpose of the button is to send the CCD image to the archive or not. By default the image WILL NOT BE SENT to the archive and the flag is set to NO. However in this case every time an exposure is started the observer will be asked to confirm this choice.

3.4. CCD SETUP subwindow

This subwindow (see fig. 6) contains three pulldown menus, two buttons, five editable fields and one not editable field.

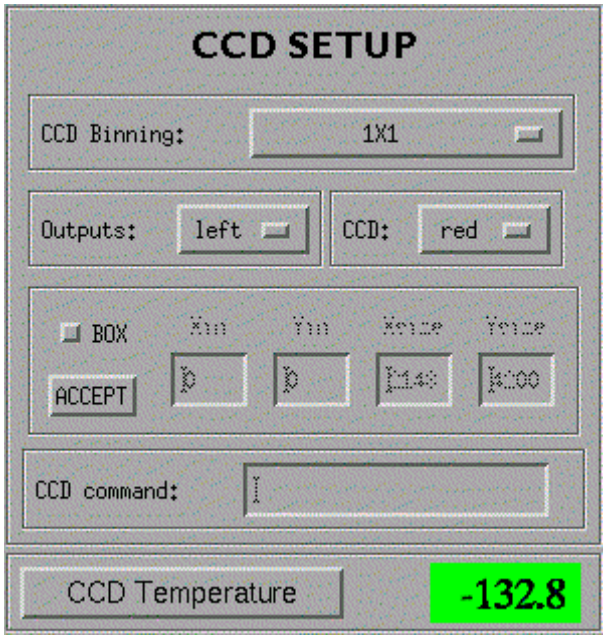

Figure 6 – CCD setup subwindow

The **CCD Binning** pulldown menu is the first of the three pulldown menus in this subwindow. It allows to choose among 9 different CCD binnings (1×1, 1×2, 1×4, 2×1, 2×2, 2×4, 4×1, 4×2, 4×4). Selecting one of the items from the menu will initialize the CCD loading the clock tables and bias voltages corresponding to the desired binning. Once the item is selected the observer is asked for confirmation. The initialization will take few seconds and during this time a window will pop up informing the CCD is being initialized.

The other two pulldown menus, situated below the first one, are the **Outputs** menu and the **CCD** menu. The first one allows to select the output amplifier to use to read the CCDs (left, right or both) while the second one allows the observer to select the CCD to read (red, blue or both). The red CCD is the one where the red part of the spectrum dispersed by the echelle is imaged so that it is clear what the blue CCD is.

Next, going from up to down, there are two buttons and four editable fields which can be used to select CCD subareas (boxes). The **Box** button is by default not selected so that the **ACCEPT** button and the **Xin**, **Yin**, **Xsize**, **Ysize** fields are not active. By default, the whole area of the CCDs is selected to be read-out. The dimensions of the area will be a function of the CCD binning (see the chapter on the CCD scientific detectors of the SARG user manual). When the **Box** button is selected the four fields will be editable and the **ACCEPT** button is made active. To select a CCD subarea the observer has to enter the coordinates of the lower left corner of the subarea and the dimensions of the subarea in the proper field and **MUST PRESS** the **ACCEPT** button. **BEWARE** not to exceed the maximum logical dimensions of the

CCD. These dimensions are shown in the same fields at the end of the CCD initialization procedure. When the **Box** button is deselected the **Xin** and **Yin** are set to zero while **Xsize** and **Ysize** are set to the default values, that is the maximum possible depending on the binning.

The **CCD command** area allows the expert user to enter directly WSS commands related to the management of the CCD controller and of the shutters. **This window exists for debugging and testing purposes only and MUST NOT be used in any case by the general observer**.

Finally there is button to query the **CCD temperature** which is shown on the side overimposed on a colored background (see the Telemetry Window paragraph for an explanation of the color codes). This field is also updated everytime a CCD exposure is started and everytime a different binning is selected.

3.5. Utility Buttons

At the end of this central section of the Management Window there are three buttons each of them starting a different procedure (fig.7).

The **SARG Initialization** button will open the SARG Initialization window. The reader is referred to section 2 for complete description of the functions of this window.

Pressing the **SARG Telemetry** button will open the Telemetry Window. Again the reader should refer to section 4 for a description of the characteristics of this window.

Finally the **Grazie e Arrivederci** button exit the SARG user interface turning off the lamps and the iodine cell. Beware that pressing this button is not equivalent to press the RELEASE button on Nasmyth control panel.

Figure 7 – Utility Buttons

3.6. Visualization subwindow

The leftmost column of the main window contains, basically, a series of facilities that allows the user to “interact” with the observed images (see fig.8).

The two graphic windows are used to display a full resolution and a binned image. The binned image graphic window is sensitive to mouse button events, in particular, clicking on the image with the leftmost button of the mouse will bring to the center of the full resolution window an area of about 500×500 pixels centered around the cursor. The full resolution image graphic window is, instead, sensitive to mouse motion events, that is, moving the mouse inside the graphic window is possible to

read the coordinates (pixel number and column) and the image value of the point where the mouse is positioned. These values are continuously displayed together with the average signal and standard deviation in an area of 40×40 pixels centered around the cursor position in five not editable fields to the right of the binned image graphic window labelled: **X**, **Y**, **ImVal**, **MEAN**, **STDEV**.

The filename corresponding to the current image of the spectrum is shown in field labelled **Data File** above the window showing the full resolution image.

This subwindow contains also a button labelled **OBJECT** with an editable field on its side. The field OBJECT, as we have seen, is usually updated automatically except when the Object and the Iodine Cell (Object) exposure types are selected. Below the **OBJECT** button there is an editable field labelled **Comment.** This field is written to the image header so it can be used by the observer to insert any useful information not automatically included in the FITS header by the interface. Below the **Comment** field there is a pulldown menu labelled **Program Name**. Before starting any exposure the observer must select a program from the menu otherwise an error message will be displyed and exposure will not be started.

Below the binned image graphic window there is a scroll bar labelled **Adjust Contrast** which can be used to modify the color cuts of the displayed images.

3.7. QUICK LOOK subwindow

Inside the Visualization window there is an area labelled **QUICK LOOK** which contains three buttons.

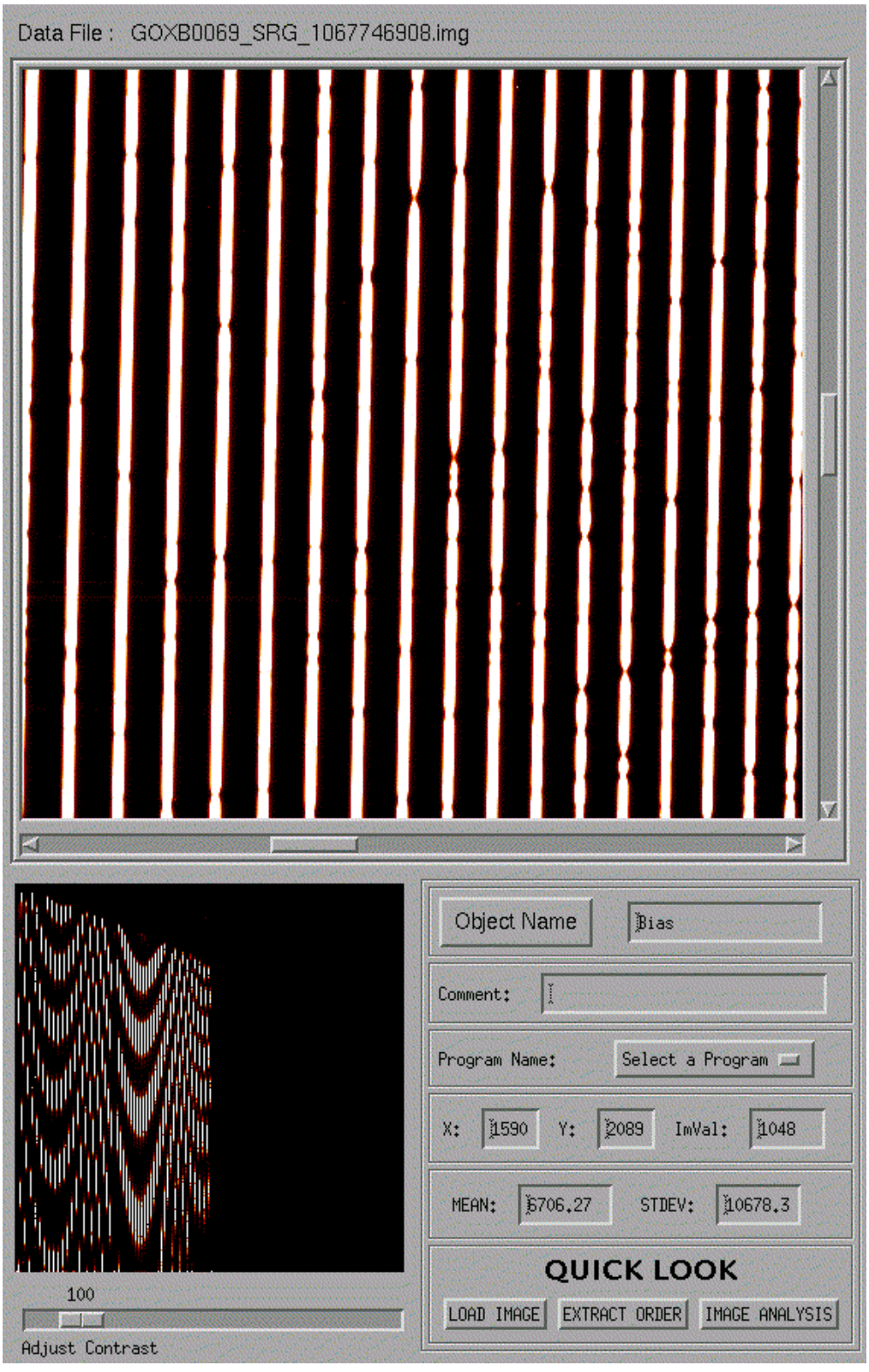

Figure 8 – Visualization subwindow

The LOAD IMAGE button allows to load an image in FITS or binary format. When pressed a dialog window will pop up. To pick up the image double click on the corresponding filename or select it and then press OK. The **Data File** field will be updated with the name of the selected file.

The EXTRACT ORDER button starts a procedure for the extraction of a spectrum order while the IMAGE ANALYSIS button starts a procedure that gives the observer some instruments to assess the quality of the data.

3.7.1. Order Extraction

The EXTRACT ORDER procedure, started pressing the corresponding button in the QUICK LOOK subwindow of the Management window, is an easy, fast, interactive way to extract an order from the displayed spectrum and to perform a number of operations with it.

When pressing the extract order button a window asking "Use previous fit parameters?" will pop up. Answering "Yes" will start the order extraction from the beginning, answering "No" will use the order extraction parameters obtained for the last extraction procedure.

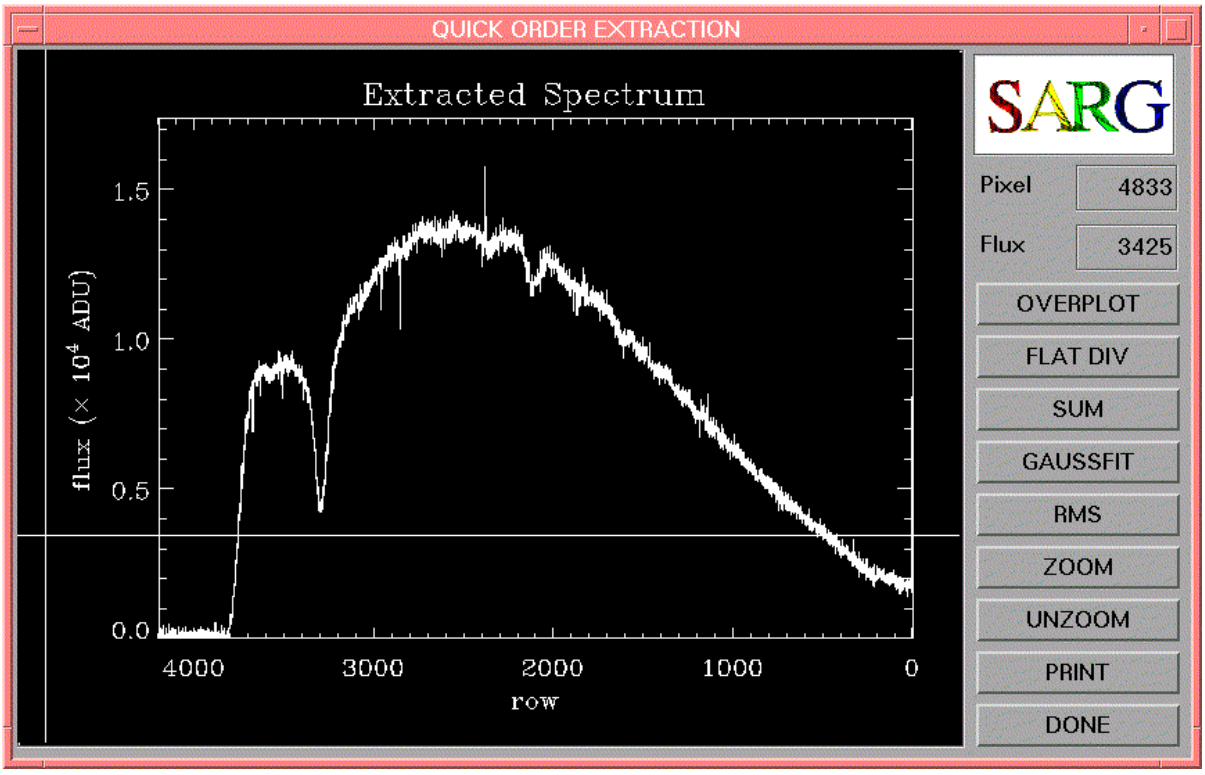

Figure 9 – An example of spectrum extracted. The line at pixel number 3300 is the Hα while the line at pixel number 2100 is the HeI6678

- YES

  The first operation to do is to select the order of the spectrum to extract. An informational window saying "Select the order to extract" will pop up after answering "Yes". To select the order the observer has to position the cursor in the full resolution image graphic window and click once on the order to extract. A window with the title "QUICK ORDER EXTRACTION" (fig. 9) will be created. The window contains a graphic area and a series of buttons. The functions of the

buttons will be described later. Note that at this moment all the buttons but the one labelled DONE are not sensitive to mouse actions. In the graphic area is shown an horizontal cut of the echelle spectrum centered around the selected order. If the binning is 1×1 only one order will be displayed, when the binning in the spatial (X) direction is greater than 1 more orders will be shown, with the central one being the one to extract. The procedure will ask then to select a lower and an upper limit in the spatial direction (along columns). These limits define a window inside which the echelle order is traced and extracted. Five points to the right of this window and five points to the left are also used to estimate the background to subtract during the extraction of the order. Once the two limits are set the echelle order is traced and plotted in the graphic area. The tracing procedure looks for the maximum in the previously selected window and follows it through the entire CCD every ten pixels along the dispersion direction. The trace of the echelle order has to be fitted and the procedure again asks to select an upper and a lower limit between which it performs a polinomial fit. The extracted spectrum is plotted in the graphic area (fig. 9) .

- NO

  The user is asked for the procedure to subtract the background or not.

  If the answer is “Yes” then the procedure uses all the information recorded in the log of the last order extraction creates the “QUICK ORDER EXTRACTION” window and the plots the new extracted spectrum.

  If the answer is “No” then the procedure extracts the order subtracting only an average value of the bias calculated in the overscan area simply not to have negative values shown in the plot.

Once the extraction process is over, the graphic area become sensitive to mouse motion events and the pixel number and the corresponding flux start to be displayed on the top right part of the window. Furthermore all the buttons are made active. The functions of each button are listed below:

- OVERPLOT

  The OVERPLOT button allows the observer to superimpose to the extracted spectrum, plotted in the graphic window, the corresponding order of a different spectrum. The procedure asks for the file name of the other spectrum and once this is given plots in the graphic window the horizontal cut corresponding to the echelle order to overplot. The extraction procedure is identical to the one described above and at the end of it the original spectrum and the new one just extracted are displayed superimposed on each other.

- FLAT DIV

  The FLAT DIV button allows to correct the extracted spectrum for the echelle blaze function through flat field normalization. Once the observer presses the button a dialog window asking for the name of the flat field spectrum will pop up. Once the flat field spectrum is loaded an horizontal cut corresponding to the echelle order to normalize will be plotted in the graphic window. The procedure is then similar to a normal order extraction with the difference that the background is estimated using fewer points, this due to the fact the inter order space is much less with flat fields. We suggest to choose the window for the extraction as large as possible to have an optimum extraction of the flat field spectrum. Finally before

the normalization the extracted flat field spectrum is shown and the observed is asked to redo the flat field extraction or not. If the answer is not the normalization is performed and the normalized spectrum is displayed.

- SUM

  The SUM button performs the sum between the spectrum displayed in the graphic window and same order extracted from a different spectrum. The procedure works as for the OVERPLOT procedure with the difference that only the sum of the two spectra is plotted at the end.

- GAUSSFIT

  The GAUSSFIT button allows to perform a gaussian fit of a spectral feature displayed on the spectrum of the extracted order. The user has to specify the limits between which the fit has to be done. The procedure try to fit the feature using a gaussian and a straight line to take into account the presence of a continuum background. The fit is overplot on the spectral feature and the center, the FWHM and the depth/height of the gaussian are displayed in the graphic area.

- RMS

  This button allows to compute the average value of the flux and the standard deviation from it in a window specified by the observer. The S/N ratio is then calculated as ratio between these two quantities and displayed on the top part of the graphic area.

- ZOOM

  Through the ZOOM button the observer can enlarge a part of a displayed spectrum by specifying the lower left and the upper right corner of the area to be plotted. The ZOOM command can be invoked as many times as wanted.

- UNZOOM

  The UNZOOM button redraw the displayed spectrum using the original limits.

- PRINT

  The PRINT button makes an hardcopy of the graphic area and send it to the printer.

- DONE

  Exit the ORDER EXTRACTION procedure

3.7.2. Image Analysis

The IMAGE ANALISYS procedure provides the observer with a series of tools to obtain information on the quality of the data as for example, estimates of the resolution, presence of saturation on the CCD, influence of the seeing on the spectrum spatial distribution etc.

When pressing the IMAGE ANALISYS button in the QUICK LOOK subwindow a new window with title IMAGE ANALYSIS will be created or brought to the front if already present in the workspace. The window has a graphic area , a menu with nine different buttons (options) a PRINT and a DONE button.

The buttons in the menu are exclusive, that is, pressing a button allows the observer to perform only the task which corresponds to that button.

- X CUT

  This procedure allows the user to plot an horizontal cut (along the X direction) of the image displayed in the management window. When pressing the button an informational window will appear explaining that the user has to click on the image with the left mouse button to define the beginning and ending points of the cut. Once done the cut will be plotted in the graphic window together with the row number (see fig.10). The pixel value and the number of counts are shown continuosly on the lower left corner of the graphic window. Until the X CUT item is selected the user can continue to display cuts of the image shown simply defining the new limits with the mouse.

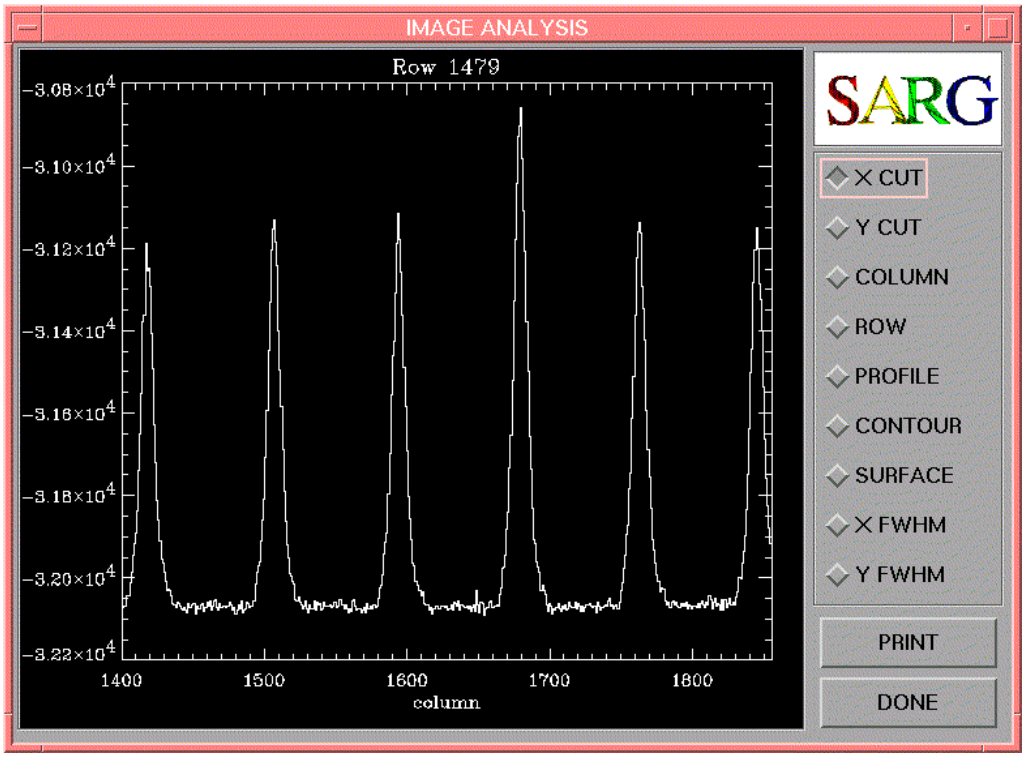

Figure 10 – Image analysis procedure, example of X CUT extraction.

- Y CUT

  This procedure allows the user to plot a vertical cut (along the Y direction) of the image displayed in the management window. When pressing the button an informational window will appear explaining that the user has to click on the image with the left mouse button to define the beginning and ending points of the cut. Once done the cut will be plotted in the graphic window together with the column number. The pixel value and the number of counts are shown continuosly on the lower left corner of the graphic window. Until the Y CUT item is selected the user can continue to display cuts of the image shown simply defining the new limits with the mouse.

- COLUMN

This procedure allows the user to display an entire column of the image shown in the management window. When selecting the button an informational window will appear explaining that the user has to click once on the image with the left mouse button to select the column that has to plotted. The pixel value and the number of counts are shown continuosly on the lower left corner of the graphic window. Until the COLUMN item is selected the user can continue to display columns of the image simply clicking on it with the mouse.

- ROW

  This procedure allows the user to display an entire row of the image shown in the management window. When selecting the button an informational window will appear explaining that the user has to click once on the image with the left mouse button to select the row that has to plotted. The pixel value and the number of counts are shown continuosly on the lower left corner of the graphic window. Until the ROW item is selected the user can continue to display rows of the image simply clicking on it with the mouse. Fig.11 shows an example of row extraction.

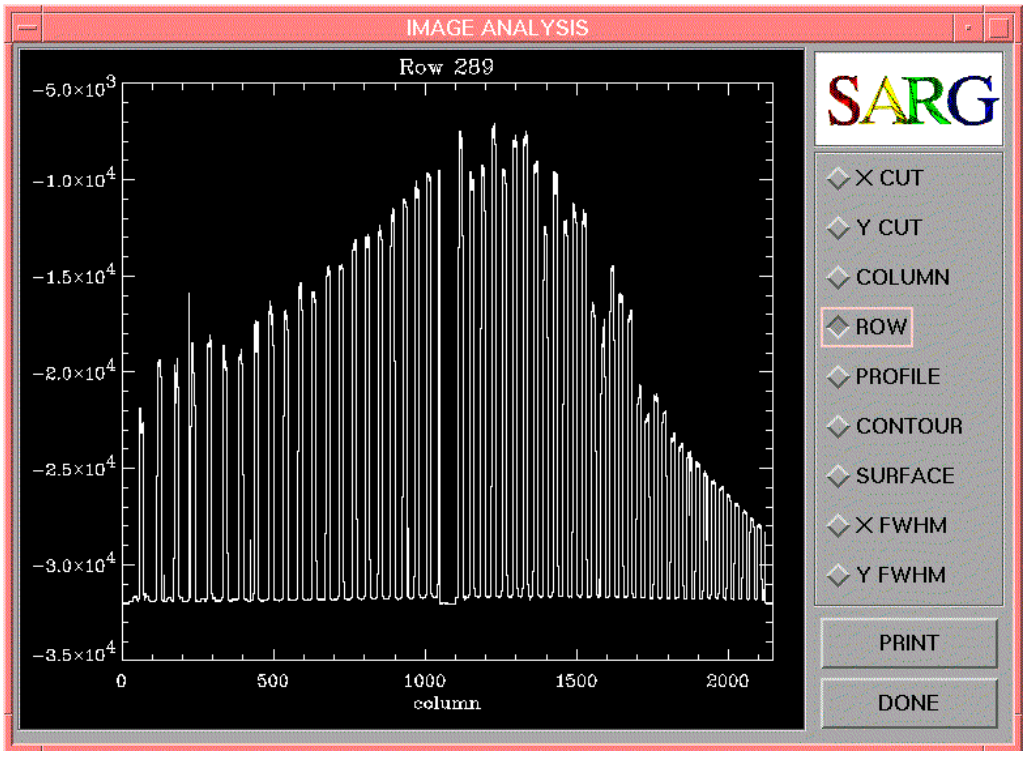

Figure 11 – Image analysis procedure, example of ROW extraction.

- PROFILE (NOT ACTIVE)

  This procedure extracts a profile from the image displayed in the management window. The user has simply to click on the image with the left mouse button to mark the beginning and ending points of the profile to plot. The pixel value and the number of counts are shown continuosly on the lower left corner of the graphic window. Until the PROFILE item is selected the user can continue to extract profiles from the image clicking on it with the mouse to mark the new limits of the profile.

- CONTOUR

The CONTOUR procedure draws a filled contour plot of a subarea of the image displayed in the management window. Clicking on the left mouse button on the image will make a variable sized box cursor appear in the graphic window. The box can be dragged holding down the left mouse button and moving the mouse, and its size can be changed holding down the center mouse button and, again, moving the mouse. Pressing the right mouse button will exit the procedure and return the box parameters that will be used to define the subarea whose contour will be drawn. To repeat the procedure the user has to press again the left mouse button on the image. The X and Y coordinates of the pixel in the contour plot are shown continuosly on the lower left corner of the graphic window.

- SURFACE

The SURFACE procedure draws a wire-mesh representation of a subarea of the image displayed in the management window, projected into two dimensions and with hidden lines removed (see fig. 12). Clicking on the left mouse button on the image will make a variable sized box cursor appear in the graphic window The box can be dragged holding down the left mouse button and moving the mouse, and its size can be changed holding down the center mouse button and, again, moving the mouse. Pressing the right mouse button will exit the procedure and return the box parameters that will be used to define the subarea to be drawn. To repeat the procedure the user has to press again the left mouse button on the image.

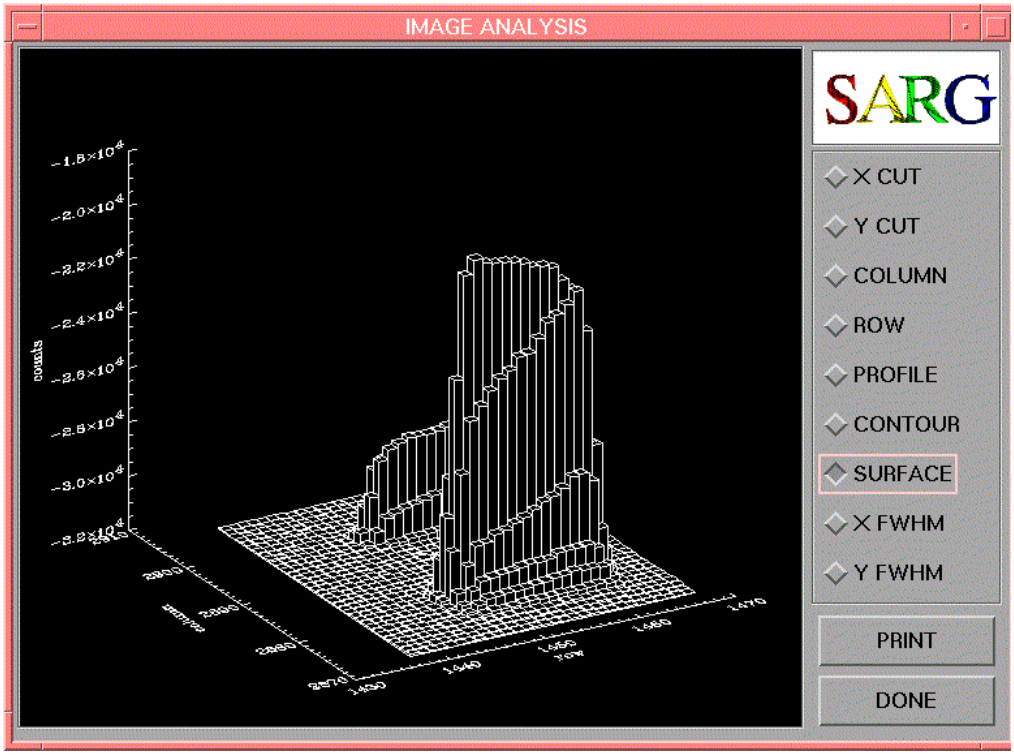

Figure 12 – Image analysis procedure, example of SURFACE.

- X FWHM

The X FWHM procedure computes a gaussian fit of an horizontal profile of the image displayed in the management window. The user has to click on the left mouse button while having the cursor on the image. Then in the graphic area will be plotted an horizontal profile 40 pixels wide centered around the selected point.

The user will be asked to select a lower and an upper limit which will define the window for the fit. The procedure fits the plotted profile using a gaussian and a straight line to take into account the presence of a background. The fit is overplot on the profile and the center, the FWHM and the depth/height of the gaussian are displayed on top of the graphic area. Until the X FWHM item is selected the user can continue to fit horizontal profiles repeating the procedure from the beginning, i.e. has to click on the image.

- Y FWHM

  The Y FWHM procedure computes a gaussian fit of an vertical profile of the image displayed in the management window (see fig. 13). The user has to click on the left mouse button while having the cursor on the image. Then in the graphic area will be plotted a vertical profile 20 pixels wide centered around the selected point. The user will be asked to select a lower and an upper limit which will define the window for the fit. The procedure fits the plotted profile using a gaussian and a straight line to take into account the presence of a background. The fit is overplot on the profile and the center, the FWHM and the depth/height of the gaussian are displayed on top of the graphic area. Until the Y FWHM item is selected the user can continue to fit vertical profiles repeating the procedure from the beginning (click on the image).

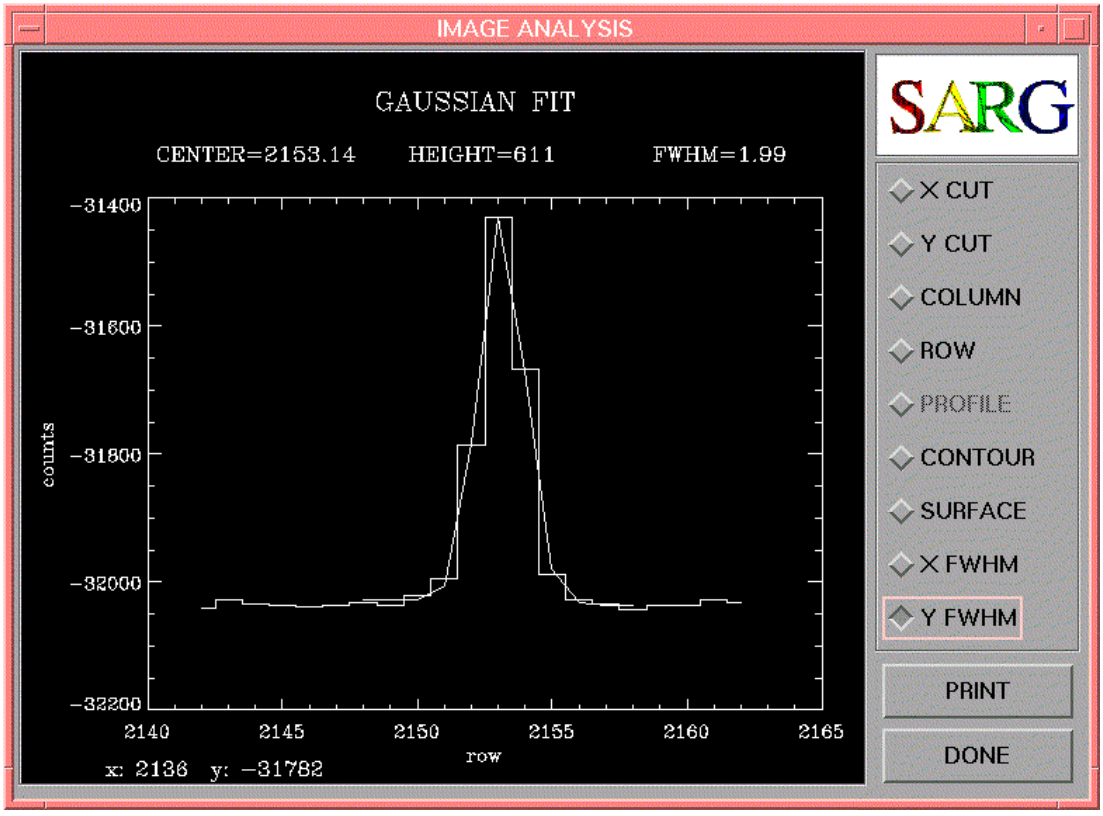

Figure 13 – Image analysis procedure, example of the result of the Y FWHM procedure.

4. Telemetry Window

The SARG telemetry window allows the observer to know in real time the configuration of the spectrograph and of the detector. The user can retrieve information on the status of a single element or parameter, a group of them. The Telemetry window is divided in seven different subwindows as shown in figure 9 and listed below.

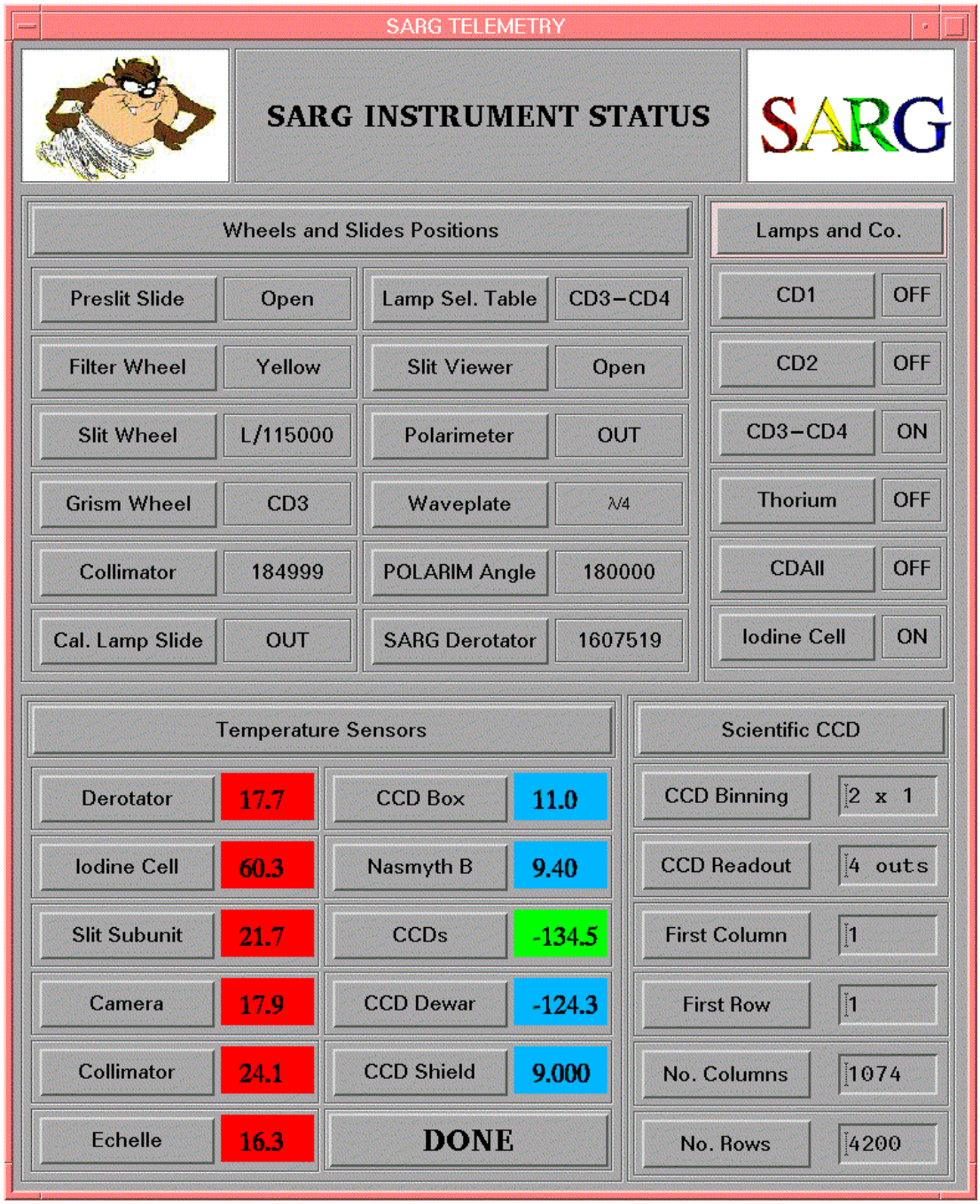

Figure 14 – SARG Telemetry subwindow

- *Wheels and Slides Positions Subwindow*

The SARG spectrograph has 9 different wheels, slides or tables that can be moved. Through the telemetry window it is possible to know the status of all of them but the

derotator wheel which is managed by separate WSS tasks. The Wheels and Slides Positions subwindow allows the observer to know the position of the various moving elements. In the case of the Transfer Collimator Slide instead of showing the "logical" position two numbers are shown, 185000 which refers to the normal focus position and 216000 corresponding to the Image Slicer focus. Pressing the All Wheels button in the General Telemetry subwindow all the fields in the Wheels and Slides Positions subwindow will be updated with the current positions. The position of a single wheel or slide can be retrieved pressing the corresponding button.

- *Lamps and Co. Subwindow*

This subwindow allows the observer to know the status of the five calibration lamps, of the laser diode and of the iodine cell. Pressing the individual button the corresponding field will be updated with the status of that particular lamp, i.e. OFF or ON will appear in it. The All Lamps button in the General Telemetry subwindow will read the status of all devices listed in the Lamps and Co. subwindow.

- *Temperature Sensors Subwindow*

The temperatures of the eight sensors inside the spectrograph can be obtained individually by pressing the various buttons in this subwindow or globally by pressing the All Sensors button in the General Telemetry subwindow. All sensors but the Iodine Cell sensor, should indicate a temperature around 20°C. The working temperature of the iodine cell is around 62°C and it takes about two hours since switching the cell on to reach it. There are three color codes related to the temperature shown in the various fields in the subwindow: blue, red and green. The temperatures measured by sensors external to the SARG spectrograph are shown only in blue. The other temperatures are shown on a red or green background depending on their being outside or inside a predefined range. For example the background of the Iodine Cell sensor temperature will be red until the iodine cell exceeds the temperature of 59°C.

- *Scientific CCD Subwindow*

This subwindow gives information on the temperatures measured by the sensors inside the CCD dewar, i.e. the CCD temperature, the temperature of the liquid nitrogen vessel and the temperature of the dewar shield. There are four different color used as background to the measured temperatures. The blue background is used for the shield temperature and for the dewar temperature. The CCD temperature can be shown on three different backgrounds: green, yellow and red. If the background color is green then the CCD is working within the correct temperature range (between –130°C and –135°C). A yellow background is displayed on two different occasions: 1) the liquid nitrogen is exhausted so the temperature is starting to increase ($-130°C < T < -125°C$), in this case an the dewar must be refilled at once; 2) the CCD controller has been just switched on so the CCD temperature is lower ($T < -135°C$) than the working temperature, in this case the observer should wait until the green background is displayed. Finally the temperature is shown on a red background only when the liquid nitrogen is exhausted ($T > -125°C$), in this case the resident astronomer or the night assistant **must be informed** because, depending on the temperature shown, it could be necessary pumping out the dewar before refilling it with liquid nitrogen. The CCD subwindow also displays the CCD binning in use. As in all the other subwindows it is possible to know the value of a single field by pressing on the

corresponding button or of all the field pressing the CCD General button in the General Telemetry subwindow.

- *CCD Biases Subwindow*

This subwindow gives the telemetry of the bias voltages of the CCD. It works as the others. You can read the value of a bias voltage pressing the corresponding button. The All Bias button in the General Telemetry subwindow allows to read all the CCD bias voltages all at once.

- *CCD Clocks Subwindow*

This subwindow gives the telemetry of the bias voltages of the CCD. It works as the others. You can read the value of a clock voltage pressing the corresponding button. The All Clock button in the General Telemetry subwindow allows to read all the CCD clock voltages all at once.

- *General Telemetry Subwindow*

The General Telemetry subwindow allows to read the global telemetry using the Telemetry Total button or to update all the fields at once.

5. Online Help

A limited help online is available. Pressing this HELP button will open an help file (PDF format) which explains the main functions that can be performed in that particular subwindow. The user has to refer to the SARG user manual for a detailed explanation of the User Interface.