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Calibration Lamp Unit

The **Calibration Lamp Unit** area contains a pulldown menu to select one of the five available calibration lamps. The lamps are three halogen lamps to be used for flat field calibration, indicated with the names of the cross disperser they are used with, that is CD1, CD2, CD3-CD4. Note that the cross dispersers CD3 and CD4 use the same lamp. There is also a thorium lamp for wavelength calibration and finally a Hg lamp. 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.

SARG Units

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) than he/she is asked permission to move the lamp selection mirror and to switch on the corresponding lamp.

Iodine Cell

The **Iodine Cell** area contains a button to switch on and off the iodine cell and a window with the status of the cell.

Slit Viewer Unit

The **Slit Viewer Unit** area allows to move the slide in front of the slit viewer camera which accomodates a Nikon lens and a Shack-Hartmann array of lenses. The second pulldown menu allows to switch on and off the Laser Diose.

Polarimeter

The **Polarimeter** area will allow to manage the spectropolarimeter when it will be available.

OWIS command

Finally the **OWIS command** area allows the expert user to enter directly WSS commands related to the management of the OWIS 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.

Exposure Setup

START

RESUME

EXTEND

ABORT

PAUSE

STOP

Exposure Time

Exposure Type

Image Archiviati

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. Secondly 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.
3. The CCD temperature is checked and the coloured display below the CCD setup subwindow is updated. See paragraph 6.3 (Telemetry Window) for the explanation of the color code.
4. If the archive flag is set, a snapshot of the spectrograph system is made and written to the FITS header of the image.
5. 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.
6. 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.
7. 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.
8. Opens the lamp shutter if the exposure type is set to Flat Field or Comparison lamp.
9. Starts the exposure.

RESUME

This button allows to resume an exposure previously paused. It does not work when doing multiple exposure.

EXTEND

This button allows to extend the exposure time of an ongoing exposure. It does not work when doing multiple 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 an exposure or a series of exposures, reading the CCD and saving the data, acquired up to that moment, to the disk.

Exposure Time

Below these buttons there are two editable fields labelled **Exp. Time (sec)**. 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.

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 makes the system perform various operations. Note that for this reason a correct selection of the exposure type is **FUNDAMENTAL** for the correct execution of the exposure.

- 1. Flat Field**
- 2. Dark**
- 3. Bias**
- 4. Object**
- 5. Comparison Lamp**
- 6. Iodine Cell (object)**
- 7. Iodine Cell (flat)**

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" below the full resolution CCD image is updated with the word "Flat".
2. The keyword IMAGETYP 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" below the full resolution CCD image is updated with the word "Dark".
2. The keyword IMAGETYP 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.

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 performed is reported below:

1. The field "OBJECT" below the full resolution CCD image is updated with the word "Bias".
2. The keyword IMAGETYP 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 shutter of the lamps is closed.

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, 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 performed by the system when this exposure type is selected is the following:

1. The keyword IMAGETYP 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.

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" below the full resolution CCD image is updated with the word "Thorium".
2. The keyword IMAGETYP 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. The field *OBJECT* is NOT updated so the observer has to insert manually the name of the object is observing, an empty string will result in an error message. The following operations are automatically executed:

1. The keyword IMAGETYP 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 62°C. If the temperature is found to be less than 60°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 and a window saying “Removing CLS, Please Wait...” pops up.
8. The shutter of the lamps is closed.

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 spectrum 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" below the full resolution CCD image is updated with the word "flat".
2. The keyword IMAGETYP 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 62°C. If the temperature is found to be less than 60°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.

Image Archivation

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.

CCD Setup

CCD Binning

CCD & Outputs selection

CCD Boxes

CCD Command

CCD Temperature

CCD Binning

The **CCD Binning** pulldown menu is the first of the three pulldown menus in the CCD Setup 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.

CCD & Outputs selection

The **Outputs** and **CCD** pulldown menus are placed below the CCD binning 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.

CCD Box

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. Practically, 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). 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.

CCD command

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.

CCD Temperature

Finally there is a not editable field showing the **CCD temperature** overimposed on a colored background (see the Telemetry Window paragraph for an explanation of the color code). This field is updated everytime a CCD exposure is started and everytime a different binning is selected.

Quick Look

Load Image

Extract Order

Image Analysis

LOAD IMAGE

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.

EXTRACT ORDER

The **EXTRACT ORDER** procedure 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. 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” 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 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. 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 polynomial fit. The extracted spectrum is plotted in the graphic area.

Answering “No” will use the order extraction parameters obtained for the last extraction procedure. 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 buttons are listed below:

- 1. OVERPLOT**
- 2. FLAT DIV**
- 3. SUM**
- 4. GAUSSFIT**
- 5. RMS**
- 6. ZOOM**
- 7. UNZOOM**
- 8. PRINT**
- 9. DONE**

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 observer 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 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.

IMAGE ANALISYS

The **IMAGE ANALISYS** procedure provides the observer with a series of tools to obtain information on the quality of the data.

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, 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. The list of the buttons is the following:

- 1. X CUT**
- 2. Y CUT**
- 3. COLUMN**
- 4. ROW**
- 5. PROFILE**
- 6. CONTOUR**
- 7. SURFACE**
- 8. X FWHM**
- 9. Y FWHM**

X CUT

This procedure allows the user to display an horizontal cut (along the X direction) of the image shown 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. The pixel value and the number of counts are shown continuously 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.

Y CUT

The Y CUT procedure allows the user to display a vertical cut (along the Y direction) of the image shown 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 continuously 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

The COLUMN 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 be plotted. The pixel value and the number of counts are shown continuously 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 be plotted. The pixel value and the number of counts are shown continuously 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.

PROFILE

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 continuously 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 moved by dragging holding down the left mouse button and its size can be changed holding down the center mouse button. 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 continuously 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. 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 moved by dragging holding down the left mouse button and its size can be changed holding down the center mouse button. 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.

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 (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. 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).