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WHT Acquisition Tool User Guide

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Chapter 1 Introduction

The purpose of this document is to provide a user guide to the new WHT acquisition tool which was originally developed to facilitate the acquisition process during AO operations. The application is based on the real-time display software that was developed by ESO and has been customised to provide acquisition functionality for ISIS, the AO system and the OASIS instrument at the WHT.

The user documentation is split across two documents. This document explains the process of performing acquisition using the customisations that have been incorporated into the ESO standard software. The second document [1] outlines the functionality provided by the standard ESO Real-time Display Software provided by ESO.

Chapter 2 A Guide To The Acquisition Tool

This chapter provides a guide to the features of the application that are to be used to perform acquisition related activities.

2.1 Starting the Tool

This section outlines how the Observer will start the acquisition tool from the observing system command line on the WHT ICS computer.

2.1.1 Preconditions for use

There are a number of prerequisites that need to be satisfied before the observer can successfully use the acquisition tool. These are as follows :

- It is necessary that the Observer has configured and started the observing system on the WHT ICS console.
- The NAOMI mechanical control system must be fully operational, specifically the WFS pickoff probe *if* it is to be used for NAOMI/INGRID acquisition.
- The telescope control system should be operational. To actually perform acquisition, the telescope *must* be tracking also.
- The Observer has, for the acquisition detector to be used, to have *calibrated* the acquisition tool correctly. The tool will not work successfully unless this has been done. This process only needs to be performed once per acquisition detector. It should be noted however though, that if the acquisition camera is *physically* moved or the system is re-aligned, it is advisable that the calibration process be **repeated** by the Observer to ensure accurate acquisition.
- Any camera servers that are to be used to provide acquisition frames should be running and configured into the observing system.

For AO related acquisition :

- The NCU slide must be in the *acquisition* position for acquisition.
- The telescope operator must have temporarily *suspended* framing on the television application associated with the acquisition camera server. Whilst this TV application is in *continuous* framing mode, the acquisition tool *cannot access* the camera server in order to retrieve its acquisition frames

For OASIS related acquisition :

- Windowing **must be enabled** on the OASIS camera server if *OASIS acquisition* is to be used. The detector should have a single window defined of the following dimensions : **1:2148,1035:3140.** If the correct windowing has not been set, the application will ask permission from the user to set the windowing itself.
- OASIS **must** be in imaging mode prior to acquiring acquisition frames.

2.2 Running the application

The acquisition tool can be started from the *whtics* observing system command line using the following command;

acqtool &

After a short period of time the main application window will appear on the console display and as follows :

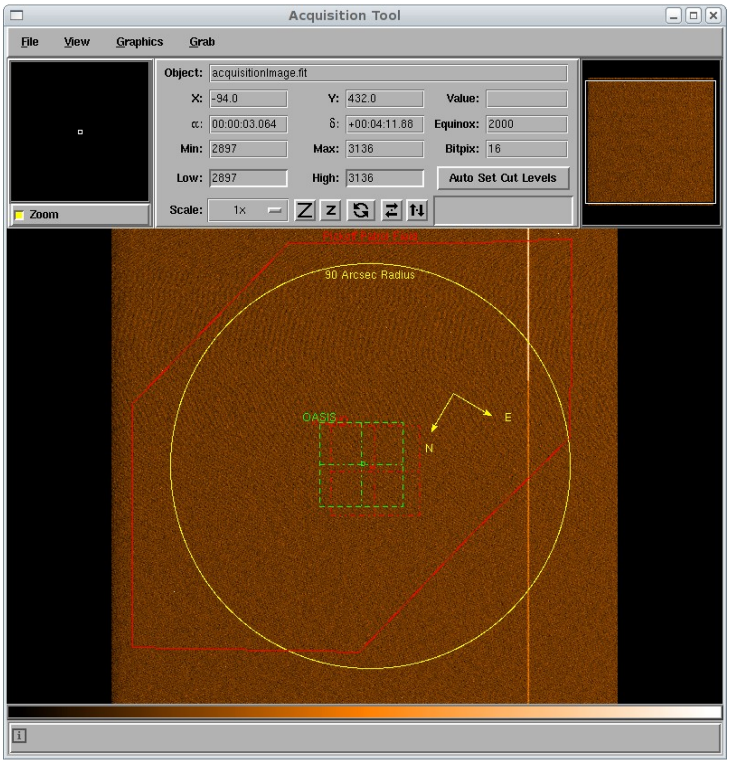


Illustration 1Main application window showing NAOMI/INGRID acquisition image and all overlays

2.2.1 The Main Display Page

The main window of the acquisition tool is broadly divided up into four segments.

2.2.1.1 Acquisition Image Display Area

The majority of the display is given over to *displaying* the acquisition image which can be served from one of the standard UltraDAS camera servers. Various image manipulation facilities exist to modify the appearance of the image and these are described in detail in document [1].

In the case of AO acquisition for NAOMI as shown above, overlaid on the acquisition image will be a *small red box* which represents the overlay of the *INGRID FOV* in acquisition detector space. Furthermore, there is a small red circle which is overlaid on the acquisition image which signifies the position in *acquisition detector space* of the NAOMI wave front sensor pickoff probe when it is in it's nominal acquisition position.

2.2.1.2 The Image Zoom Area

In the top left of the display is a small window which shows a *magnified* image of the area of the acquisition frame were the cursor is positioned. This image will update in real time as the cursor is moved around the acquisition image.

2.2.1.3 The Acquisition Image Information Area

Located at the upper central part of the main window is a status area which displays information about the acquisition frame.

The *RA* and *Dec* of the position on the acquisition image where the cursor lies is constantly updated as the cursor is moved around the acquisition frame.

Further information includes the X and Y pixel values that currently lie beneath the cursor when the user is moving the cursor over the acquisition image.

There are facilities at the bottom of the status area which allow the user to magnify the acquisition image.

The details of the rest of the status information displayed in this area is outlined in the document [1].

2.2.1.4 The Pan Window

This is a small window in the top right of the main application window which highlights the *actual area* displayed in the main acquisition image window. This will change depending on the level of zoom that has been applied by the user.

2.2.1.5 The Menu Bar

The menu bar across the top of the application permits the user access to most of the functionality provided by the acquisition tool. Once again, the functionality provided by the menu bar is best described in the *user guide section* of the document [1].

As part of the customisation of the ESO realtime display, an additional menu has been added which is labelled **Grab**. It is through this menu that the user will initiate frame grabs of acquisition images from the chosen camera server.

2.3 The NAOMI/INGRID Acquisition Frame Grab Window

The first step in the acquisition process is to *acquire* an acquisition frame from the chosen camera server. For normal AO acquisition, the user **should** use this dialogue window in order to acquire an acquisition image.

This can be done via the *Acquisition Frame Grab Window.* The user can access this window by selecting the menu option **Grab -> Grab Acquisition Image**. Alternatively, the user can press the keyboard shortcut **Ctrl-G** whilst the cursor is located over the main application window. Once done the following window will appear.

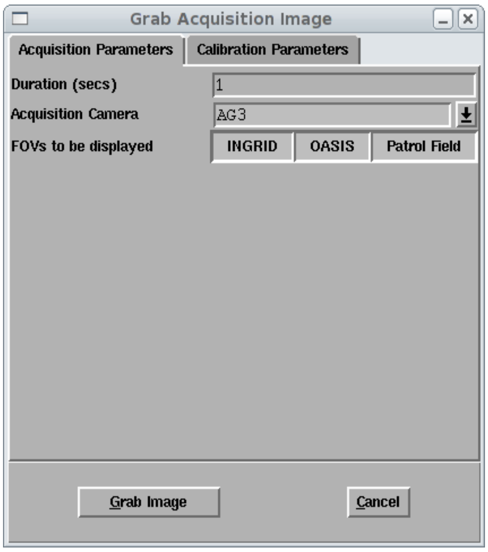


Illustration 2 NAOMI/INGRID Grab dialogue showing integration parameters

For *each* camera server that can be used for INGRID/NAOMI acquisition, there is a set of *calibration constants* that need to be determined by the Observer and entered into the application and subsequently saved.

The following sections describe the purpose of each of these calibration constants. It is critical that these calibration constants are calculated **correctly** otherwise the acquisition tool will not be able to perform acquisition accurately.

2.3.1 The Integration Parameters

The following parameters modify the nature of the acquisition images. To access these parameters, one should select the tab which is labelled **Acquisition Parameters.**

2.3.1.1 The FOV Display Selector

At the foot of the image grab dialog is a number of buttons which allow the user to select *which* of the FOVs should be overlaid on the acquisition image. Currently there are buttons to allow the user to select the OASIS FOV, the pickoff patrol field FOV and the INGRID FOV overlay. The requested changes to the FOV display will be invoked the *next* time an acquisition image is requested from a camera server.

2.3.1.2 The *Duration* Field

In this field the user can specify the *length* of the integration that is to be used by the camera server when retrieving an acquisition frame. This should be specified as a real number and expressed in units of *seconds*.

2.3.1.3 The *Acquisition Camera* Field

The WHT software manager can configure in the WHT ICS database the *cameras* that the acquisition tool can use to retrieve acquisition frames. The various cameras which can be used for this purpose are displayed in the selection box labelled *Acquisition Camera*. Each camera has associated with it its own unique set of *calibration constants* and as the user selects different camera servers, the user shall see that the calibration constants will change to those associated with that particular camera server.

The user should select in this field, the name of the camera server that is to *serve* the acquisition frame. In the case of NAOMI/INGRID, this is normally camera *AG3* and this is the default option.

2.3.2 The Calibration Parameters

The following parameters modify the nature of the calculations which are performed by the acquisition tooll with respect to the NAOMI/INGRID acquisition process. To access these parameters, one should select the tab which is labelled **Calibration Parameters.**

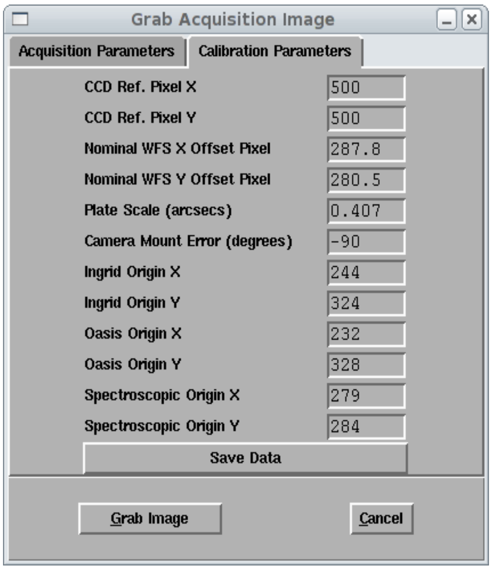


Illustration 3: NAOMI/INGRID Calibration Parameters Dialogue

2.3.2.1 The *CCD Ref. Pixel* Fields

The purpose of the *CCD Ref. Pixel* fields is to allow the Observer to specify the X and Y pixel on the acquisition frame that corresponds to the optical axis of the telescope. The pixel specified is used by the application as the reference position when calculating the RA and DEC position of the pixel underneath the mouse pointer as it is moved around the image.

2.3.2.2 The *Nominal WFS Pixel Offset* Fields

The purpose of the *Nominal WFS Pixel Offset* fields is to allow the Observer to specify the X and Y pixel on the acquisition frame of the overlay of the NAOMI WFS pickoff probe in acquisition detector space when it is set to 0,0.

2.3.2.3 The *Plate Scale* Field

In this field the Observer should enter the *plate scale* of the detector at its *current* focal station on the telescope. This should be entered as a real number and expressed in *arc seconds*. It should be noted that this constant is **absolutely crucial** to the calculations that are performed by the application and therefore the observer should ensure that the value provided in this field is as accurate as possible.

2.3.2.4 The *Camera Mount Error* Field

In this field the Observer should enter the *mount error* of the camera assuming a sky PA of 0 . This value should be entered as a *real number* and expressed in *degrees*.

Assuming that North is *up* on the detector, the value entered in this field should express the *number of degrees of rotation* to be applied in order to calculate *north* on the acquisition camera detector chip. The value entered can be a *positive* or *negative* real number depending on whether *North* on the detector is *clockwise* or *anticlockwise* respectively in relation to the assumption that *North* is up on the detector.

As an example, in the case of the AG3 chip, *North* is rotated 90° anticlockwise so therefore the value which will be entered into this field for the AG3 camera should be -90.

The *camera mount error* is used in the calculations that are performed during the acquisition process and therefore it is **crucial** that this constant is determined as accurately as possible by the observer ahead of any acquisition being performed.

2.3.2.5 The *INGRID Origin* Fields

Overlaid on the main acquisition image is a small red box which represents the *field of view of the INGRID detector*. The position of this *box* can be translated to different position on the acquisition image by specifying the *pixel coordinates* of the *top left-hand corner* of this *box*.

The software *automatically* calculates the relative size of the *field of view* of INGRID when overlaid on the acquisition image depending on the *plate scale* of the acquisition detector.

2.3.2.6 The *OASIS Origin* Fields

Overlaid on the main acquisition image is a green box which represents the *field of view of the OASIS detector*. The position of this *box* can be translated to different position on the acquisition image by specifying the *pixel coordinates* of the *top left-hand corner* of this *box*.

The software *automatically* calculates the relative size of the *field of view* of OASIS when overlaid on the acquisition image depending on the *plate scale* of the acquisition detector.

2.3.2.7 The *Spectroscopic Origin* Fields

Overlaid on the main acquisition image is a small green circle which represents the *spectroscopic centre* of OASIS. The position of this *circle* can be translated to different position on the acquisition image by specifying the *pixel coordinates* of the centre of this circle.

2.3.3 The *Save* Button

After any changes have been made to the calibration constants, the Observer **should** press the button labelled **Save** in order to save the calibration constants in the observing system database so they are preserved across restarts of the acquisition tool.

2.3.4 The *Cancel* Button

The **Cancel** button can be used to remove the grab window from the display.

2.3.5 The *Grab* Button

The button labelled **Grab** can be pressed to initiate the acquisition of a frame from the currently selected acquisition camera server. Once completed, the acquisition frame will be displayed in the main image area of the application window.

2.4 The ISIS Acquisition Frame Grab Window

The first step in the ISIS acquisition process is to acquire an acquisition frame from the TVCASS acquisition detector.

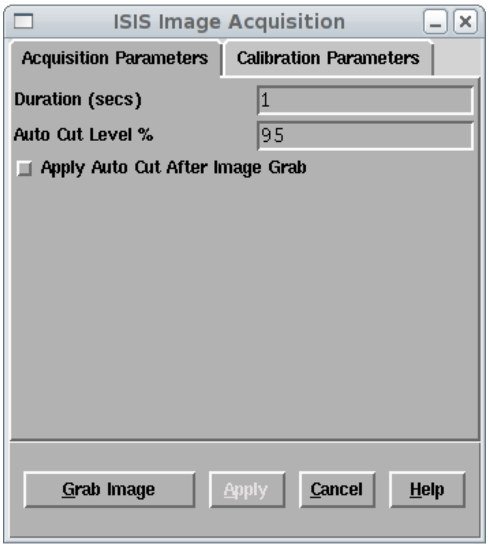
By default, the windowing associated with this chip will be set by the software to the following value of **[23:1011,200:700]** with the user's permission. This *may* be changed by the user by modifying the ISIS calibration constants but it should be born in mind that if the windowing is modified then the position of the default slit position and rotator centre will need to be modified accordingly also.

The software will check that the position of the TV camera in the A&G box is in the correct position and shall warn the user should it be found to be in any other position.

Should the readout speed of the detector not be set to fast, the application will request permission from the user to set the readout speed to fast before the acquisition image is taken.

The acquisition tool will check that the binning of the detector is set to 1x1 and if this is not the case, it will request permission from the user to set the binning accordingly.

The ISIS acquisition image dialogue can be accessed using the menu option **Grab-> Grab ISIS Acquisition Image** or by using the short cut key **Ctrl-I**. This will result in the following window being displayed.



The **Duration Field** will allow the user to specify the length of the integration when acquiring the acquisition image and will be expressed in seconds as a real number.

The **Autocut Level %** will, in conjunction with auto-scaling (requested using the check box labelled **Apply Auto Cut After Image Grab)**, will result in auto-scaling being applied to the acquisition image automatically after it has been displayed by the application.

The **Grab Image** button can be used to request that the application acquires an acquisition image from the TVCASS detector.

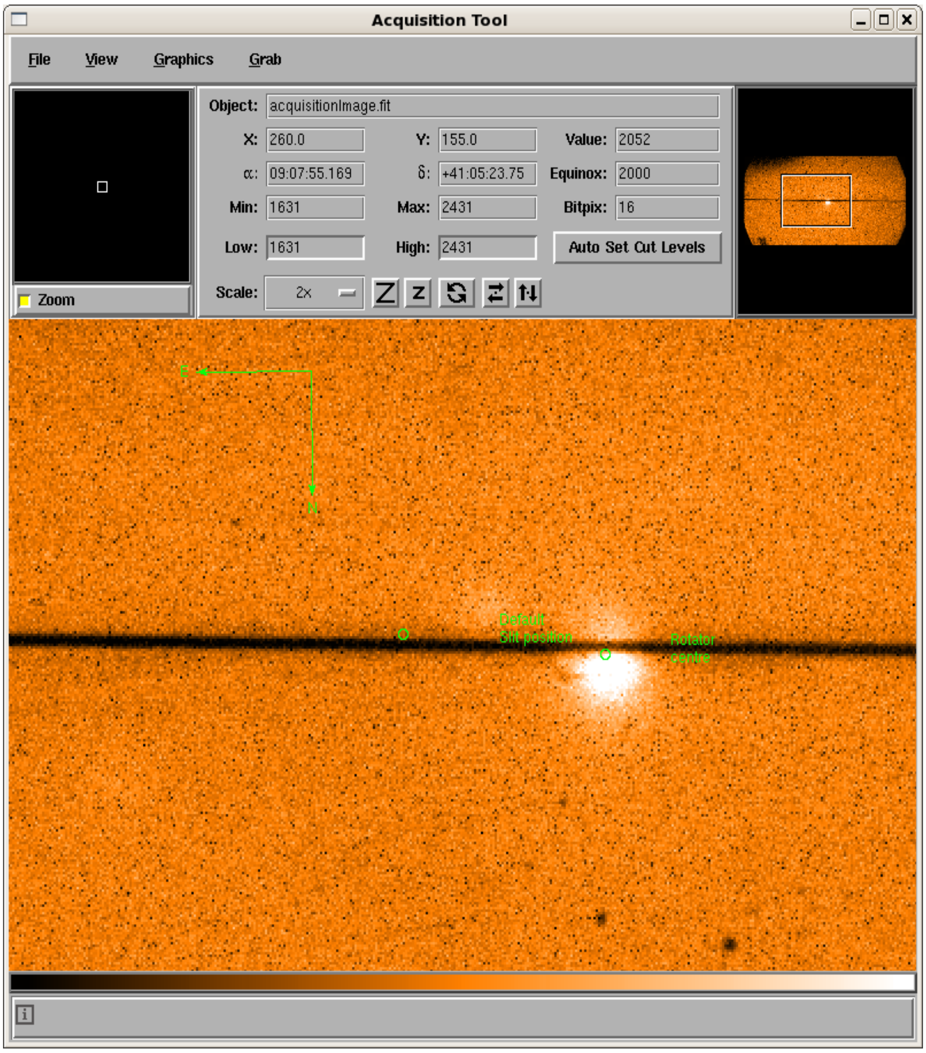


Illustration 4: ISIS Acquisition Image

2.4.1 ISIS Acquisition Calibration Parameters

In order to guarantee accurate ISIS acquisition, the tool needs to be correctly calibrated. There are a number of calibration constants which must be measured and entered into the tool before the application is used.

The dialogue window can be displayed by following the instructions outlined in section 2.4. Once displayed, the user should click upon the tab which is labelled **Calibration Parameters** from where he will be able to modify the various parameters.

The following sections outline the calibration constants which are associated with ISIS and their purpose.

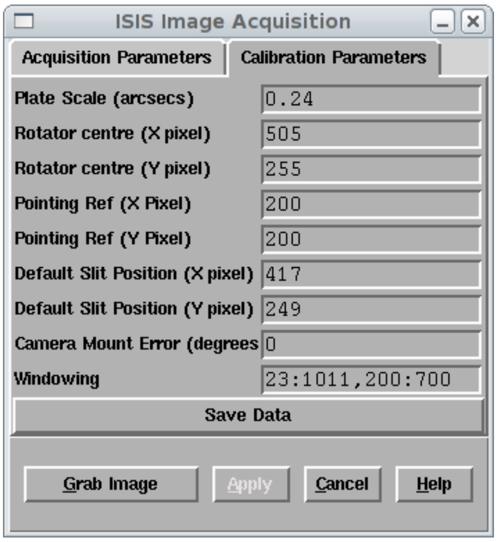


Illustration 5: ISIS Acquisition Calibration Constants

2.4.2 The *Plate Scale*

In this field the Observer should enter the *plate scale* of the TVCASS detector. This should be entered as a real number and expressed in *arc seconds*. It should be noted that this constant is **absolutely crucial** to the calculations that are performed by the application and therefore the observer should ensure that the value provided in this field is as accurate as possible.

2.4.3 The *Pointing Reference* Position

The pointing reference X and Y allows the user to define the pixel which is to be used as the pointing reference. The application will use this pixel as a reference when calculating the RA and DEC of the pixel which lies underneath the mouse pointer as the user moves the cursor around the image.

2.4.4 The *Rotator Centre* Position

The rotator centre X pixel and Y pixel represent the pixel coordinate upon the TVCASS detector upon which the rotator centre falls. The measurement of these two parameters is important for the ISIS acquisition mode which permits the user to position a user selected object upon the rotator centre.

2.4.5 The *Default Slit* Position

The default slit position X and Y pixel represent the pixel coordinate upon the TVCASS detector which corresponds to a nominal default position on the slit. The measurement of these two parameters is important for the acquisition mode that permits the user to position a user selected object upon the default slit position.

2.4.6 The *Camera Mount Error* Field

In this field the Observer should enter the *mount error angle* of the camera assuming a sky PA of 0 . This value should be entered as a *real number* and expressed in *degrees*.

Assuming that North is *up* on the detector, the value entered in this field should express the *number of degrees of rotation* to be applied in order to calculate *north* on the acquisition camera detector chip. The value entered can be a *positive* or *negative* real number depending on whether *North* on the detector is *clockwise* or *anticlockwise* respectively in relation to the assumption that *North* is up on the detector.

As an example, in the case of the AG3 chip, *North* is rotated 90° anticlockwise so therefore the value which will be entered into this field for the AG3 camera should be -90.

The *camera mount error* is used in the calculations that are performed by the during the acquisition process and therefore it is **crucial** that this constant is determined as accurately as possible by the observer ahead of any acquisition being performed.

2.4.7 The *Windowing* Parameter

The windowing parameter can be used to set the default windowing which will be used during integrations on the acquisition detector. The expected format of this calibration constant is laid out in document **INS-DAS-29 Operations Manual for UltraDAS**.

An example of expected format is listed below :

1251:1750,1:4200

Should the windowing be changed, be aware that it will be necessary to change other calibration constants accordingly which have a dependency on the size of the image i.e. Default slit position and default rotator centre.

2.4.8 The *Save Data* Button

By pressing the button labelled **Save Data,** the application will save any modified calibration data into the WHT ICS database so that it is preserved across restarts of the acquisition tool.

2.5 The OASIS Acquisition Frame Grab Window

The first step in the OASIS acquisition process is to *acquire* an acquisition frame from the OASIS science detector. OASIS acquisition functionality **cannot** be used unless there is a windowed OASIS image in the main acquisition image frame. The windowing of the OASIS camera server **must be** set to a **single** window of the following dimensions **1:2148,1035:3140**. If the application on attempting to take an integration discovers that the windowing has not been set correctly then it will ask for permission to set the windowing parameters itself.

This can be done via the *Acquisition Frame Grab Window.* The user can access this window by selecting the menu option **Grab -> Grab OASIS Image**. Alternatively, the user can press the keyboard shortcut **Ctrl-o** whilst the cursor is located over the main application window. Once done the following window will appear.

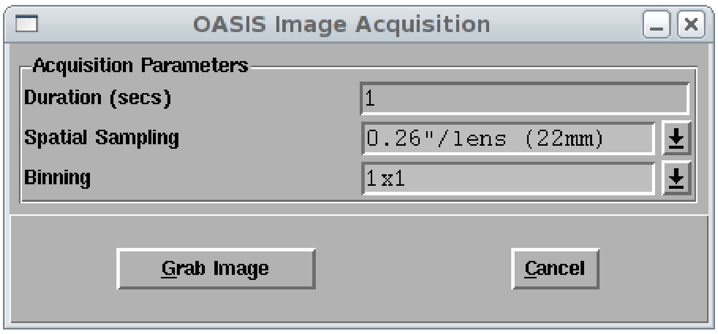


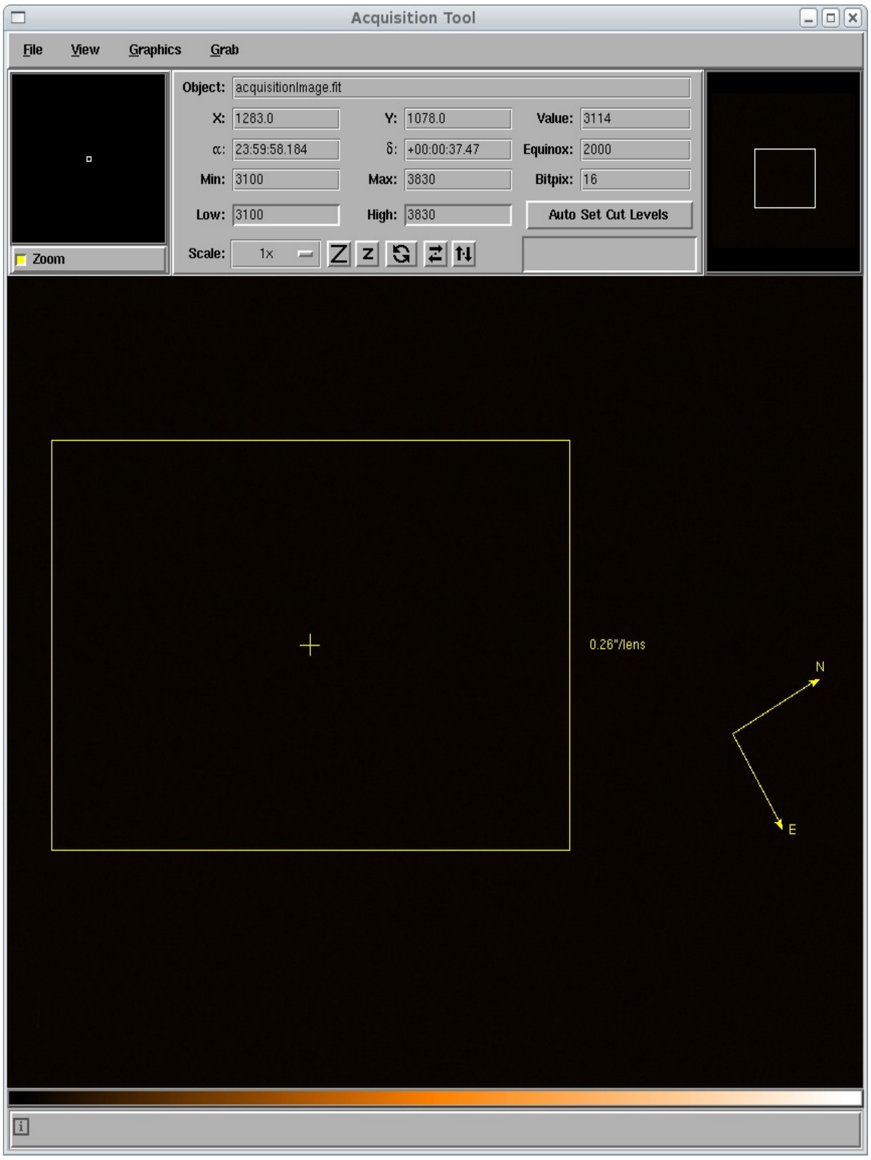
Illustration 6OASIS Image Acquisition Dialogue

The user can use the dialogue to specify the *integration time* for the grab of the acquisition frame and also allow him to select the type of *image enlarger* which is currently selected in OASIS. This can be one of *0.09"/lens (8.5mm),0.14"/lens (12.5mm),0.26"/lens (22mm) or 0.42"/lens (33mm)*. The purpose of selecting the image enlarger is so that the application can draw an overlay of the FOV of the enlarger over the acquisition frame once it is returned from the camera server.

The user may also select the binning mode which will be used when taking the acquisition image. Currently the user can select either **1x1** or **4x4** binning. The use of the 4x4 binning mode will accelerate the readout time of the acquisition and improve the S/N ratio of the objects in the field.

To get an image from the OASIS camera server, the user should press the button labelled *Grab Image.* The time to display the acquisition image from the OASIS camera server will depend on the readout speed and binning mode selected. Once the acquisition image has been displayed, the tool will reset the binning mode of the OASIS detector to the binning configuration prior to the integration being taken.

Illustration 7: An OASIS acquisition image



2.6 The Acquisition Control Window

After the user has successfully retrieved an acquisition frame from the camera server (see 2.3), she is then in a position to perform acquisition. There are currently three modes of acquisition supported by the tool.

In the first case, there is the NAOMI/INGRID acquisition mode which permits the user to set up the telescope and the WFS pickoff such that the source object is positioned on the desired location on the science detector and the WFS pickoff probe positioned over the guide object.

The second mode of operation facilitates OASIS acquisition and allows the user to finely tune the position of the source object on the OASIS enlarger FOV.

The third mode of operation facilitates ISIS acquisition and allows the user to position an object on the ISIS slit.

The acquisition control window can be displayed by selecting the menu option **View-> Pick Object** or by pressing the keyboard shortcut **Ctrl-p**.

The following sections outline the functionality in the application that will permit the observer to perform acquisition related tasks.

2.6.1 Displaying the Acquisition Control Window

There are two ways of displaying the acquisition control window. The first is to use the menu option **Graphics->Pick Object**. The second is by pressing the keyboard shortcut **Ctrl-P** whilst the mouse pointer is located over the main application window.

The following window will be displayed :

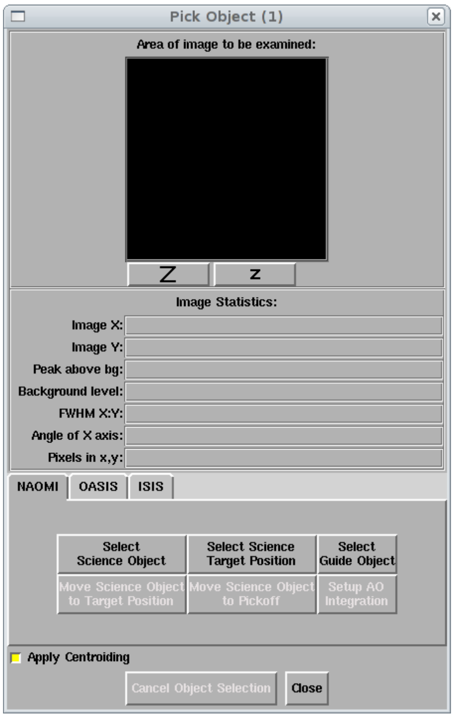


Illustration 8Acquisition Control Window

The following sections describe the various components of the *acquisition control window*.

2.6.1.1 The Magnification Window

At the top of the acquisition control window, there is a small image display which shows the *magnified area* of the acquisition image as the user moves the cursor around the main acquisition image. By default the magnification level is 10x. The user may change the level of magnification using the buttons labelled **Z** and **z** to increase and decrease the level of zoom respectively.

2.6.1.2 The Image Statistics

In the central part of the window are displayed statistics about the image. These are outlined in some detail in document [1].

The FWHM field will contain a FWHM measurement of an object *once* the user has selected a source from the main acquisition image. A FWHM measurement will be only be shown *if* it can be calculated i.e. The user has actually selected an object upon which FWHM measurement can be taken.

2.6.1.3 Centroiding

By default, centroiding will be applied to any object which is selected on an acquisition image . There may be times when the user does not wish centroiding to be applied to his object selection in which case it can be disabled by clicking the check box at the bottom of the acquisition control dialogue labelled *Apply Centroiding*.

2.6.2 NAOMI/INGRID Acquisition

This mode of acquisition will permit the user to perform acquisition for an AO integration. It will permit the user to select a *science object* and a *guide object* and position the science object on a user selected part of the science detector whilst simultaneously positioning the WFS pickoff probe over the guide object.

The following sections outline how this can be achieved.

2.6.2.1 The *Select Science Object* Button

The *Select Science Object* button when pressed, will permit the Observer to select the object on the main acquisition image that represents the *science target*.

After the button is pressed, the Observer will be expected to click *once* with the *left hand mouse button* on the the main acquisition frame. Once done, the image statistics in the acquisition control windows will be updated to reflect the selected object.

Note that the application will, if configured to, *automatically* centroid on a object that is selected by the observer and then perform an automatic FWHM calculation. The results of this calculation will be displayed within the *image statistics*.

In the case that the Observer incorrectly selects the wrong object, he can repeat the process by simply pressing the *Select Science Object* button.

2.6.2.2 The *Pick Science Target Position* Button

The *Pick Science Target Position* button when pressed, will permit the Observer to select the *pixel* on the main acquisition image that represents the destination pixel to which the *science object* selected will be repositioned.

After the button is pressed, the Observer will be expected to click *once* with the *left hand mouse button* on the main acquisition image that will define the *destination pixel* on the acquisition frame of the object which was selected in section 2.6.2.1.

In the case that the Observer mistakenly selects the wrong position, it is possible to perform the operation again by simply pressing the *Pick Science Target Position* button and repeating the process.

2.6.2.3 The *Select Guide Object* Button

The *Select Guide Object* button when pressed, will permit the Observer to select the object on the main acquisition image which represents the *guide object*.

After the button is pressed, the Observer will be expected to *click once* with the *left hand mouse button* on the acquisition image in order to select the *guide object*. Once this has been done, the image statistics in the *acquisition control window* will be updated to reflect the position that was selected by the Observer.

Note that the application will, if configured to do so, centroid on the object that is selected and perform an automatic FWHM calculation. The results of this calculation will be displayed within the *image statistics*.

In the case that the Observer mistakenly selects the wrong guide object, it is possible to repeat the process by simply pressing the *Select Guide Object* button once again.

2.6.2.4 The *Move Science object to Target* Button

The semantics associated with the *Move Science object to Target* button is to move the *science object* which was selected in section 2.6.2.1 to the *destination pixel* which was selected in section 2.6.2.2. This button will remain *insensitive* to user control until a *science object* and a *destination pixel* have been defined.

Once the button is pressed, the telescope will be instructed to *offset* by the calculated amount such that the *science object* is *shifted* such that once the next acquisition frame is taken, the *science object* will appear upon the previously selected *destination pixel* in the acquisition frame.

A new acquisition image will *automatically* be requested once the telescope offset has completed.

Once the move is completed, the *position* associated with the *science object* and the *destination pixel* will be reset. Should the Observer want to repeat the operation, he must select *anew* the science object and destination pixel.

2.6.2.5 The *Science Object to Pickoff* Button

The *Science Object to Pickoff* button can be used to reposition a *user selected science object* on the acquisition frame such that light from this object will fall on the NAOMI WFS pickoff probe should it be in position 0,0.

The precondition for this operation is that the observer has selected a *science object* as outlined in section 2.6.2.1. Until this has been done, this button will remain *insensitive* to user control.

Once the *Science Object to Pickoff* button has been pressed, the telescope will be *offset* such that the science object will be manoeuvred to the pixel on the acquisition frame that corresponds to the *nominal acquisition position* of the NAOMI WFS pickoff probe.

After the operation has completed, a new acquisition image will be requested from the camera server and displayed. The position associated with the *science object* will be reset. Should the user wish to repeat the operation, he must select a science source object once again.

Note that location of the *nominal acquisition position* of the wavefront sensor pickoff probe in acquisition detector space can be modified as detailed in section 2.3.2.2

2.6.2.6 The Setup AO Integration Button

This button will allow the user to set up an AO based integration. The tool will perform a *coordinated move* of both the *telescope* and the *wavefront sensor pickoff probe* such that the light from the *guide object* will fall upon the probe and the *science object* will be repositioned such it's light will fall on the *target pixel* in the acquisition frame.

The preconditions for this operation are that the user has selected a *science object* as detailed in section 2.6.2.1, he has selected a *target position* for the science object as detailed in section 2.6.2.2 and he has selected a *guide object* as detailed in section 2.6.2.3. Until **all** of these preconditions are met, this button will remain *insensitive* to user control.

Once the action has completed, a new acquisition frame will be requested from the camera server and displayed. The positions associated with the *science object*, the *guide object* and the *target position* will be subsequently reset. Should the Observer want to repeat the process, he must select all three positions anew.

2.6.3 OASIS Mode Acquisition

The OASIS acquisition mode is used to finely tune the position of the *science object* on the area of the science detector which overlays that of the currently selected OASIS enlarger. OASIS Mode Acquisition can be selected by clicking upon the tab labelled *OASIS* in the acquisition control window.

It should be noted that in order to use any of the following modes, the image which is currently in the acquisition tool frame buffer **must be** from the OASIS science detector, MITLL3. Furthermore, the image **must** be windowed according to the following parameters **1:2148,1035:3140** in order for the acquisition tool to function correctly.

There are various sub-modes of OASIS acquisition which are outlined in the following sections.

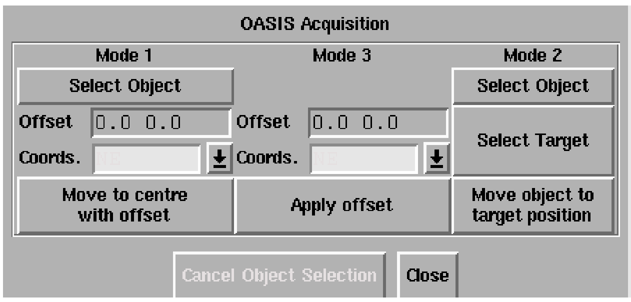


Illustration 9 OASIS Acquisition Panel

2.6.3.1 Mode 1

Mode 1 acquisition will allow the user to position a selected *source object* on the *centre* of the *currently* selected enlarger FOV subject to an *optional* offset which may be specified in arcsecs. The offset can be specified in a number of different coordinate systems (see section 2.6.3.4).

The user should first select his *source object* by pressing the button labelled *Select Object* in the column labelled *Mode 1* in the acquisition window (see 2.6). Then on the main acquisition image, the user should click on the position on the image where his source object is selected. Next he should select any offset which he wants applied (see 2.6.3.4).

The *source object* can then be relocated to the centre of the enlarger FOV by pressing the button labelled *Move To Centre With Offset.*

Note that while this operation is performed, the AO loop will be opened.

2.6.3.2 Mode 2

Mode 2 acquisition will allow the user to position a selected *source object* on a specified position of the detector (known as the *target*).

The user should first select his *source object* by pressing the button labelled *Select Object* in the column labelled *Mode 2* in the acquisition window (see 2.6). Then on the main acquisition image, the user should click on the position on the image where his *source object* is selected. Next he should select the *target* position by pressing the button labelled *Select Target* in the column labelled *Mode 2* in the acquisition window (see 2.6) and subsequently click on the main acquisition image the desired location of the chip he wants the *source object* to be relocated to.

To effect the move, the user should press the button labelled *Move Object to Target Position.*

Note that while this operation is performed, the AO loop will be opened.

2.6.3.3 Mode 3

Mode 3 OASIS acquisition will allow the user to *offset* the telescope *and pickoff* by a specified amount. The offset can be specified in a number of different coordinate systems (see section 2.6.3.4).

Once the offset has been defined then the *offset* can be applied by clicking upon the button labelled *Apply Offset.*

Note that while this operation is performed, the AO loop will be opened.

2.6.3.4 Mode Offsets

Offsets can be applied to the positional calculations for *mode 1* and *mode 2* OASIS acquisition. The offset should be specified as *two* space separated real numbers expressed in *arcsecs*.

The coordinate system which can be applied can be one of *NE or Pickoff.*

- The NE coordinate system will be used for when the observer provides offsets relative to NE. The offset will take into account the current Sky PA as part of the calculation.
- Offset will be specified in an X & Y coordinate system.

2.6.4 ISIS Mode Acquisition

The tool supports the acquisition of objects upon the ISIS slit. Despite the suspected issues arising from mount flexure and field distortion, commissioning has shown that the tool is acceptably accurate even when the object to be acquired is as much as 15 arc seconds away from the slit.

After an ISIS acquisition has been taken, the user should bring up the **acquisition control** dialogue window by selecting the menu option **View->Pick Object** or by pressing the **Control-p** key combination.

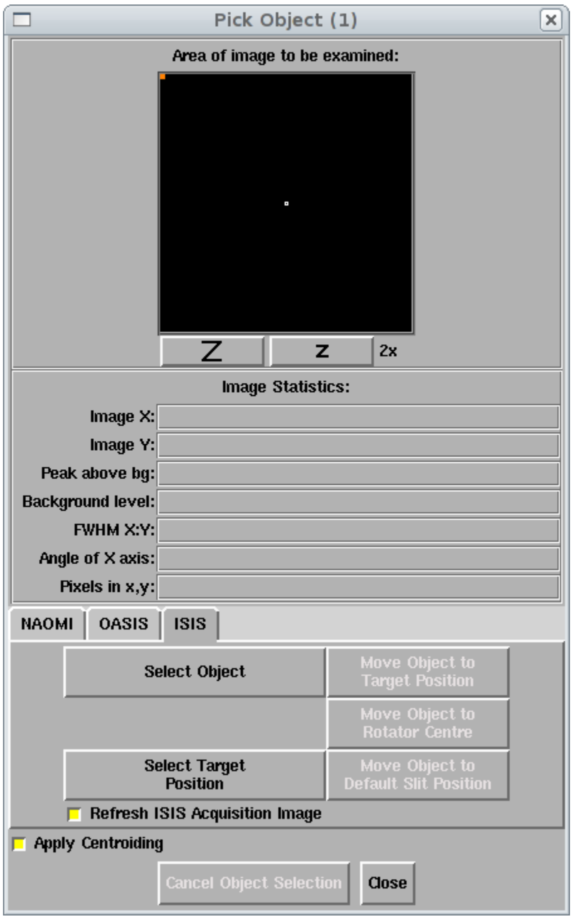


Illustration 10: ISIS Acquisition Dialogue Window

2.6.4.1 The *Move Object To Target Position* Mode

This mode of operation will allow the user to click upon an object displayed in the acquisition field and then have the telescope moved such that the object selected is *repositioned* upon the *user selected target position* on the slit. The user should therefore select *two* positions on the acquisition image using the *Select Object* and the *Select Target Position* buttons. To reposition the object on the target position, the user should then press the button labelled *Move Object To Target Position* which will result in the application calculating the offset to be applied to the telescope position and offloading it to the TCS.

Automatic centroiding on the selected object may be *enabled* or *disabled* by clicking the small box labelled *Apply Centroiding.*

2.6.4.2 The *Move Object To Rotator Centre* Mode

This mode will allow the user to click upon an object displayed in the acquisition field and then have the telescope moved such that the object is repositioned upon a user defined pixel on the acquisition image that corresponds to the rotator centre.

The user should therefore select a single position on the acquisition image using the *Select Object* button and then clicking upon the object using the left mouse button. To reposition the object on the rotator centre, the user should then press the button labelled *Move Object To Rotator Centre* which will result in the application calculating the offset to be applied to the telescope and offloading it to the TCS.

Automatic centroiding on the selected object may be enabled or disabled by clicking the small box labelled *Apply Centroiding*.

2.6.4.3 The *Move Object To Default Slit Position* Mode

This mode will allow the user to click upon an object displayed in the acquisition field and then have the telescope moved such that the object is repositioned upon a user defined pixel on the acquisition image that corresponds to the *default slit position*.

The user should therefore select a single position on the acquisition image using the *Select Object* button. To reposition the object on the default slit position, the user should then press the button labelled *Move Object To Default Slit Position* which will result in the application calculating the offset to be applied to the telescope and offloading it the TCS.

Automatic centroiding on the selected object may be enabled or disabled by clicking the small box labelled *Apply Centroiding*.

Chapter 3 Acquisition Scenarios

The following sections outline different acquisition scenarios and how they can be accomplished using the acquisition tool.

3.1 AO Acquisition Scenarios

All of the following scenarios assume that the observing system is functioning correctly, the telescope control system is in tracking mode and that the NAOMI system is fully operational. Furthermore, the user must position the NCU slide into the *Acquisition* position using the OASIS control GUI and that the TO must **stop** the selected *acquisition camera server* from framing temporarily so that the acquisition tool can access the camera server.

A full list of all of the preconditions for the successful use of the acquisition tool are detailed in section 2.1.1

3.1.1 Placing a Science Object on the Pickoff Probe whilst in Nominal Acquisition Position

One of the requirements of the tool was to be able to take an *observer selected* science object and align that object upon the *wavefront sensor pickoff probe* whilst in its *nominal acquisition position*.

This task can be achieved as follows :

- Acquire an acquisition frame from the selected camera server. This procedure is outlined in section 2.3.
- Using the *acquisition control window* (see section 2.6), press the button labelled *Select Science Object* (see section 2.6.2.1). On the acquisition frame in the main application window, select the *science object* that is to be aligned with the *wavefront sensor pickoff probe* by clicking upon it with the *left mouse button*.
- To align the *science object* with the *wavefront sensor pickoff probe nominal position*, the user should press the button labelled *Science Object to Pickoff*. This will result in an *offset* being applied to the telescope such that the *starlight* from the *science object* will fall on to the *wavefront sensor pickoff probe* (if at position 0,0) once the NCU slide has been moved back into the *science* position.

3.1.2 Placing a Science Object on an Arbitrary Part of the Acquisition Frame

The second requirement of the acquisition tool was to be able to select a *science object* in the acquisition frame and then reposition it on a *user defined position* on the acquisition frame.

This task can be accomplished as follows :

- Acquire an acquisition frame from the selected camera server. This procedure is outlined in section 2.3.
- Using the acquisition control window (see section 2.6), press the button labelled *Select Science Object* (see section 2.6.2.1). Now, on the acquisition frame in the *main application window*, select the *science object* that is to be moved onto the *wavefront sensor pickoff probe* by clicking upon it with the *left mouse* button. The position of the selected object will be displayed in the acquisition control window in addition to a magnified view of the science object.

- Using the acquisition control window (see section 2.6), press the button labelled *Pick Science Target Position* (see section 2.6.2.1). On the acquisition frame in the main application window, select the *position* on the acquisition frame to which the *science object* to be repositioned by clicking upon it with the *left mouse* button.
- By pressing the button labelled *Move Science Object to Target*, the application will apply an offset to the telescope such that the *science object* selected will be repositioned such that its starlight will subsequently fall on the target pixel that was previously selected.

3.1.3 Setting up an NAOMI/INGRID Integration

The third requirement of the acquisition tool was to be able to set up an NAOMI based integration. The requirements for this were to be able to select a *science object*, a *guide object* and a position in the *acquisition detector space* upon which the *science object* was to be positioned. The software was then to *offset* both the *telescope* and the *wavefront sensor pickoff probe* such that the *science object* was to be positioned on the user specified pixel on the acquisition frame and that the star light from the *guide object* would fall upon the *wavefront sensor pickoff probe*.

It is worth noting that it is perfectly acceptable to select the *same* object for both the *guide* and the *science* object.

The process involved in performing this task is outlined in the following sections :

- Acquire an acquisition frame from the selected camera server. This procedure is outlined in section 2.3.
- Using the acquisition control window (see section 2.6), press the button labelled *Select Science Object* (see section 2.6.2.1). In the acquisition frame in the main application window, select the *science object* by clicking upon it with the left mouse button. The position of the *selected object* will be displayed in the *acquisition control window* in addition to a magnified view of the science object.
- Using the acquisition control window (see section 2.6), press the button labelled *Pick Science Target Position* (see section 2.6.2.1). On the acquisition frame in the main application window, select the *pixel* upon which the *science object* is to be repositioned by clicking upon it with the *left mouse* button.
- Using the acquisition control window (see section 2.6), press the button labelled *Select Guide Object* (see section 2.6.2.1). On the acquisition frame in the main application window, select the *guide object* in the acquisition frame that the *wavefront sensor pickoff probe* is to be aligned with by clicking upon it with the *left mouse* button.
- Once all three positions have been selected, the button labelled *Setup AO Integration* will become sensitive to user control. By pressing this button, the tool will *offset* the telescope and the *wavefront sensor pickoff probe* such that the selected *science object* will be positioned upon the intended *target position* and that the *guide object* will be aligned with the *wavefront sensor pickoff probe*. This should be evident once the observer has changed the position of the NCU slide to *science*, and examined the NGS wavefront sensor display.

3.2 ISIS Acquisition Scenarios

The following sections outline some of the possible scenarios relating to object acquisition using the ISIS spectrograph.

3.2.1 Positioning an Object at a User Defined Position

One of the requirements was for the user to be able to position a selected object on a user defined pixel on the acquisition detector. This can be accomplished using the following sequence of actions.

- Ensure that ISIS calibration constants have been entered correctly (see section 2.4.1).
- Acquire an image using the ISIS grab dialogue (see section 2.4).
- Using the pick object dialogue, select the tab labelled ISIS and then press the button labelled **Select Object** (see ISIS Main Acquisition Dialogue illustration below)**.** Next, click upon an object in the acquisition image using the left mouse button.
- Select a target position on the acquisition image by pressing the button labelled **Select Target Position** (see ISIS Main Acquisition Dialogue illustration below) and then clicking on a target position in the acquisition image with the left mouse button.
- To perform the offset of the source object to the target position, press the button labelled **Move Object to Target Position** .

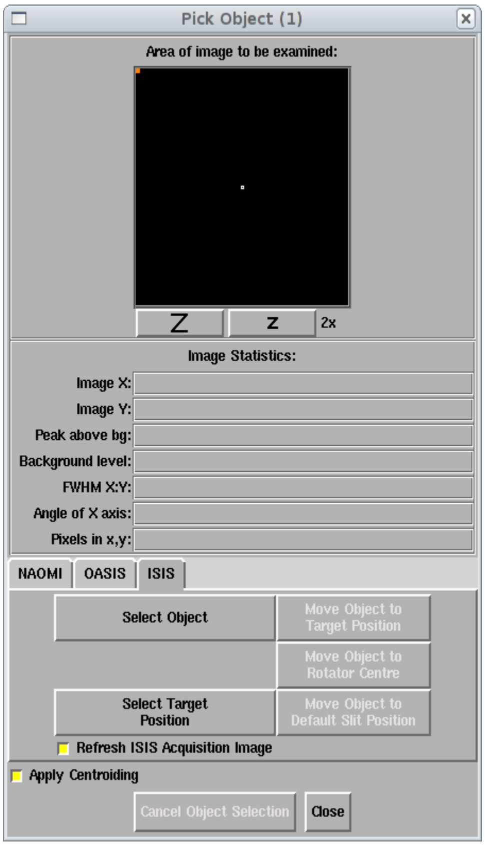


Illustration 11: ISIS Main Acquisition Dialogue

3.2.2 Positioning an Object on the Default Rotator Centre

One of the requirements was for the user to be able to position a selected object on a pixel that corresponded to the default rotator centre on the acquisition detector. This can be accomplished using the following sequence of actions.

- Ensure that ISIS calibration constants have been entered correctly (see section 2.4.1).
- Acquire an image using the ISIS grab dialogue (see section 2.4).
- Using the pick object dialogue, select the tab labelled ISIS and then press the button labelled **Select Object** (see ISIS Main Acquisition Dialogue illustration above)**.** Next, click upon an object in the acquisition image using the left mouse button.

- Now press the button labelled **Move Object to Rotator Centre** which should action the TCS to perform the appropriate offset (see ISIS Main Acquisition Dialogue illustration above).
- Should it be necessary to change the default rotator centre position, modify the ISIS calibration constants outlined in section 2.4.1

3.2.3 Positioning an Object on the Default Slit Position

One of the requirements was for the user to be able to position a selected object on a pixel that represented the default slit position on the acquisition detector. This can be accomplished using the following sequence of actions.

- Ensure that ISIS calibration constants have been entered correctly (see section 2.4.1).
- Acquire an image using the ISIS grab dialogue (see section 2.4).
- Using the pick object dialogue (see section 2.6.4), select the tab labelled ISIS and then press the button labelled **Select Object** (see above). Next click upon an object in the acquisition image using the left mouse button.
- Now press the button labelled **Move Object to Default Slit Position** which should action the TCS to perform the appropriate offset (see above).
- Should it be necessary to change the location of the default slit position, modify the ISIS calibration constants outlined in section 2.4.1

Chapter 4 Calibrating The Acquisition Tool

In order to ensure correct operation of the acquisition tool, the observer must ensure that the tool has been calibrated correctly *prior* to its use. Calibration only needs to be performed when engineering work has been undertaken and components which comprise the acquisition optical system have been physically moved.

4.1 Calibration for AO Acquisition

The application window which contains the calibration constants for AO acquisition is accessed by pressing the key combination **Ctrl-G** whilst the mouse is positioned over the main window of the acquisition tool. See section 2.3 for more details.

The following sections outline the process through which an astronomer can calculate accurate values for these calibration constants.

4.1.1 Measuring the CCD Reference Pixels

The purpose of the CCD reference calibration constants are outlined in section 2.3.2.1. For AO related acquisition, these constants are ***not*** currently used and therefore do not need to be calculated.

These calibration constants are measured by determining the *rotator axis* on the acquisition camera (i.e. by rotating the derotator with a star in the field of view and determining the pixel at the centre of the circle traced).

4.1.2 Measuring the Nominal WFS Pickoff Offset

The purpose of these calibration constants is outlined in section 2.3.2.2.

They can be measured as follows.

1. Using the acquisition control window, use the *Move Science object to Pickoff* function in order to position an object on the default pickoff position.
2. Using Topgui move the WFS pickoff probe to position 0,0.
3. Ask the TO to centre up object on the pickoff.
4. Change the NCU to the *acquisition* position and then note the *pixel* at which the star appears on AG3 and then save the pixel values in the calibration constants.

4.1.3 Measuring the Plate Scale

The purpose of this calibration constant is outlined in section 2.3.2.3.

The *plate scale* can be measured by shifting the telescope a number of arcsecs in x and y and measuring the *number of pixels* a star moves on the AG3 image. Of course, the scale *may* change with position on AG3, especially as a function of radius, so the measurement needs to be made using the central area (within 60 arcsec) of the detector.

4.1.4 Measuring the *Camera Mount Error* Field

The purpose of this calibration constant is outlined in section 2.3.2.4.

The *Camera Mount Error* can be measured using the following recipe.

1. Direction N is measured on AG3 by pointing telescope at star.

2. Move telescope 30" N.
3. Record PA of direction moved on CCD.

4.1.5 Calculating *INGRID Origin* Constants

The purpose of these calibration constants is outlined in section 2.3.2.5.

They can be measured using the following procedure :

1. Centre a star on INGRID.
2. Set the NCU slide to the *acquisition* position.
3. Measure the pixel coords on AG3 and then calculating from the known size of INGRID field, the *coordinates* of the corner.

4.1.6 Defining a Default Slit Position With ISIS

The default slit position with ISIS can be specified as follows :

1. Position the slit view mirror in the A&G box into position.
2. Use the acquisition tool to take an integration on the ISIS acquisition camera.
3. Once the acquisition image is displayed, modify the cuts so as the slit can be seen. If the slit cannot be seen then increase the integration time and repeat.
4. Using the mouse pointer, position the cursor over the position on the slit on the acquisition image which is to be the *default slit position* and take note of the X & Y pixel values which are listed in the statistics above the acquisition image.
5. Modify the Default Slit Position X and Y pixels in the ISIS acquisition calibration constants entering in the X and Y pixel values which were established in the above step.

Bibliography

1: A.Brightman, VLT Software Realtime Display Manual, http://www.ing.iac.es/~docs/external/eso/rtd.pdf