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Scripts Editor Documentation
Version 1.0
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0 Overview

The Scripts Editor is a GUI designed for writing, editing, and saving script files which the DECam instrument control system understands and which can be executed as exposure sequences. It is a stand alone application, usable outside the SISPI environment. It is intended as a convenience application, allowing telescope users to create an exposure list without understanding the details of SISPI's syntax.

Any list of exposures created in the Scripts Editor can be saved as a file, in a format which will be loadable into SISPI's OCS exposure queue. Such files are also reopenable within the Scripts Editor, allowing users to create part of an exposure sequence and then edit it further at a later time. Natively, SISPI's OCS understands .json formatted script files. Thus, files exported by the Scripts Editor are in .json format only. However, when reading in input scripts with the Scripts Editor, a simple .txt format is also supported. The format requires each exposure to be on a separate line, and each parameter within an exposure to be separated by a comma. e.g:
        ra=10.5, dec=-20, filter=r
        ra=10.7, dec=-20, filter=g.
Example .json and .txt scripts are included in the examples directory when the Scripts Editor source files are downloaded.

The Scripts Editor validates exposures before they can be saved. If an entered parameter is not valid, the exposure will not be added and a pop up message will tell the user. Similarly, scripts are also checked when opening files. A file cannot be loaded into the Scripts Editor if it contains invalid exposures.

Below is a screenshot of the Scripts Editor application. Its layout consists of four principal areas, the exposure parameters panel, the added exposures panel, a row of buttons, and a large text field bar labeled as 'Manual'. Within this overview section, only the most basic functionality of each of these features is outlined. Detailed comments are to follow in the proceeding sections. The exposure parameters panel lists the parameter which can be specified during an exposure. The user fills each parameter's field, and for any unfilled field DECam would assume the parameter's default value. As exposures are added, they appear in the added exposures panel. Exposures can be reordered, deleted, or edited once added to the list. Buttons will perform various commands, indicated by the labels on the buttons. For example, 'Add' will add an exposure to the added exposures panel. The 'Manual' check button and entry field is for adding exposures as text strings, using exactly the same syntax that the OCS expects when adding exposures. This is included as a time saver for experienced users who have become familiar with SISPI's syntax.

In addition to this documentation file, some documentation is available within the Scripts Editor itself. Hovering over the name of a parameter field pops up a tool tip help menu for that parameter.

The majority of this documentation will focus on describing in greater detail the usage and capabilities of the different areas described above such as the exposure parameters panel, added exposures panel, buttons, and 'Manual' field. As a general guideline, the order in which features will be described is moving either from left to right or from top to bottom as they appear in the

screenshot below.

The next section makes a brief aside to describe installation.
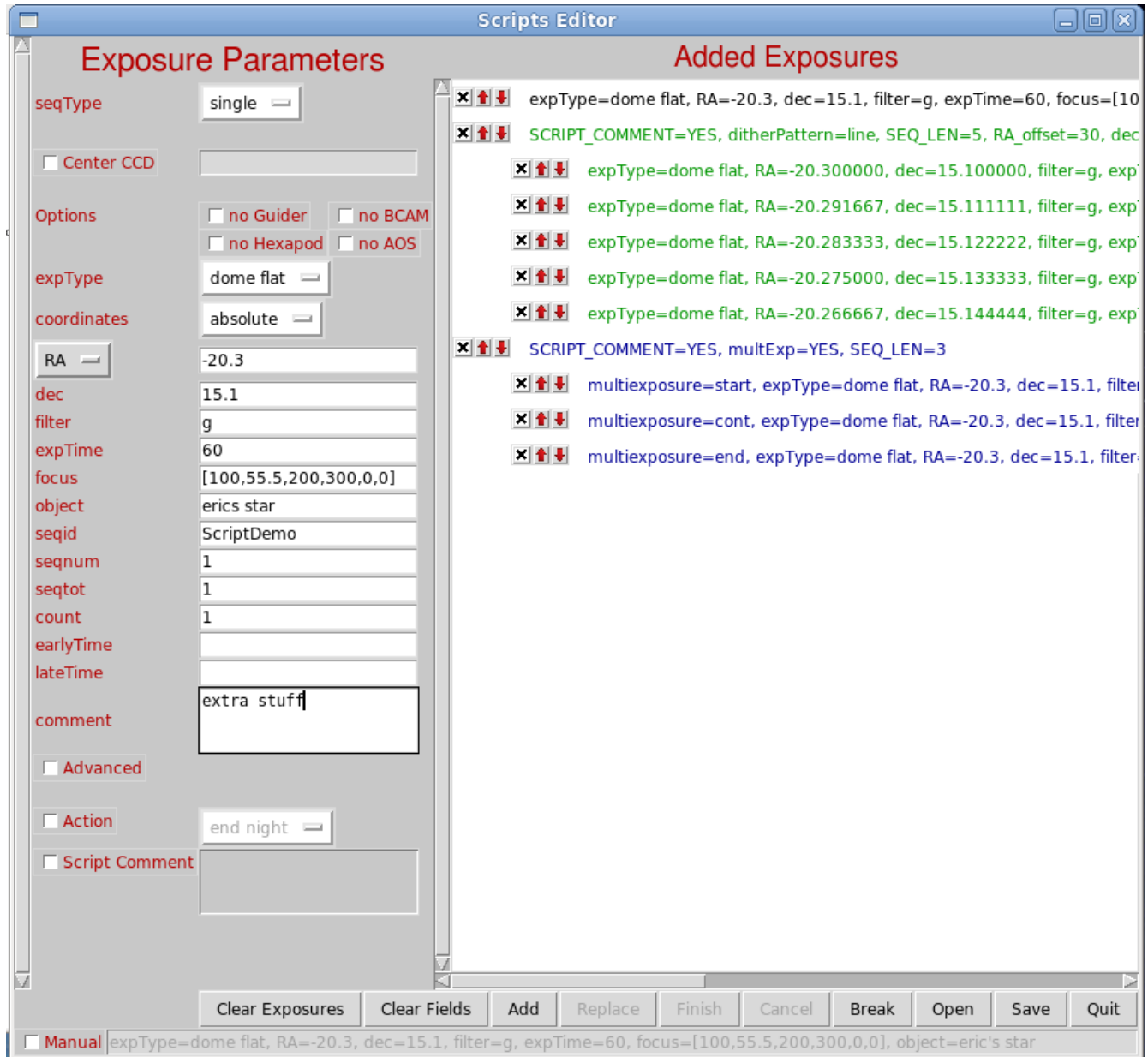
1 Installation

The Scripts Editor is a stand alone product and installation is intended to be straightforward. Download the tarball from the Scripts Editor page on the SISPI wiki at: https://cdcvs.fnal.gov/redmine/projects/sispi/wiki/Scripts Editor. Move the tarball to the desired directory for installation. Within this directory, extract the tarball using the command:
     tar xf Scripts Editor
Upon extraction, one should see a directory called Scripts Editor and a subdirectory within Scripts Editor called bin. Launching the executable within the bin directory called Scripts Editor starts the program.

The Scripts Editor is a python-based GUI, meaning python's module for handling GUIs, called Tkinter, must be installed. The json module is also required for opening and saving files in .json format.

1.1 Required Python Modules
   Tkinter
   json

2 Exposure Parameters Panel

A screenshot of the exposure parameters panel is shown to the right. This panel is where the user specifies the parameters for an exposure. There are a number of fields labeled in the left hand column. Each of these corresponds to one exposure parameter. Following subsections will explain each parameter. Here a few general comments are made about using the exposure parameters panel.

Most parameters contain a single line for text entry. Users fill in each of these lines to the desired value. Quotation marks are not necessary when entering string values, and should not be included. Every field need not be filled. If a line is left blank the parameter will inherit its default value when passed to the OCS. (There are a few exception in which parameters must be specified and not left as blank. These will be noted where relevant.) Three parameters which consist of a drop down menu of options to choose from are seqType, expType, and coordinates. One label itself (RA in the picture to the right) also includes a down menu. When checked (unchecked), the 'show Multi', 'show Dither', 'Advanced', and 'Script Comment' check boxes will pop up (down) additional windows, in which additional, context-dependent parameters can be edited. If such parameters are not relevant given the context, they will be "grayed out" and made uneditable. The 'Center CCD' field becomes active (inactive) when the check box is checked (unchecked). The 'Options' field consists of four check boxes, any of which may checked or unchecked.

The remainder of this section details individual parameters, commenting with regard to what the parameter means, acceptable entry types, etc. Subsections below include top lines whose format is:

　　　paramName (unabbreviated name if applicable) - type

2.1 SeqType (Sequence Type) – drop down menu

The sequence type specifies whether single or multiple exposures should be added. It can be one of three possible values: 'single', 'dither', or 'multiexposure'.

2.1.1 'single'

A user should select 'single' when he/she wants to add one exposure at a time; one exposure and one image.

2.1.2 'dither'

'dither' is used when the user wants to add multiple exposures at once in a particular dither pattern. Upon selecting 'dither', the 'show Dither' check box will also be checked, and the dither window will pop up, containing additional parameters, relevant only to exposures which are part of a dither pattern. (The 'show Dither' box can be checked/unchecked at any time to show/hide the dither window.) When a dither is added each of the dither's exposures has identical parameters except for the positions.

Dither window

The dither window contains four dither relevant parameters: DitherPattern, RA_offset, dec_offset, and num. The dither window is shown to the right.
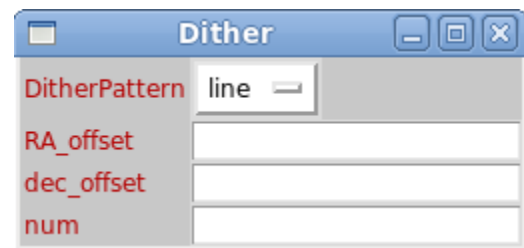

2.1.2.1 DitherPattern – drop down menu

DitherPattern selects one dither pattern from a list of available patterns. Currently, five example patterns are included: 'Rectangle', 'Center+Rectangle', 'Hexagon', 'line', and 'All CCDs'. Future edits of the Scripts Editor intend to support importing custom user defined dithers into the menu. However, this is not yet implemented in the current version. RA_offset and dec_offset correspond to some appropriate (RA,dec) step taken between exposures in a dither. Such steps are defined somewhat differently for different patterns. See the examples below as well as the diagrams for the patterns. The labels for RA_offset and dec_offset will change appropriately if AZ/EL or HA/dec coordinate systems are chosen from the exposure parameters panel.
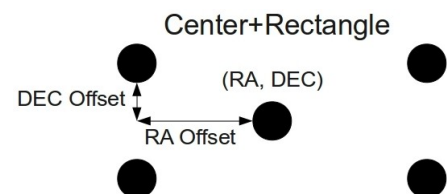
2.1.2.1.1 'Rectangle'

This dither pattern makes a rectangle, whose side lengths are (RA_offset,dec_offset) in (length,width). The first seeing is the "bottom left" corner of the rectangle, and its coordinates are that of the exposure parameters panel's 'RA' and 'dec' fields. Dithering moves counterclockwise.
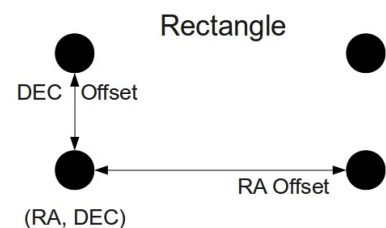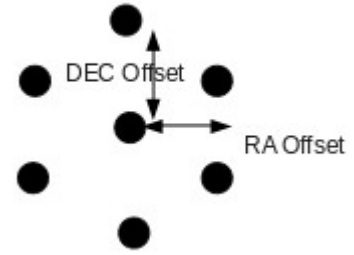

2.1.2.1.2 'Center+Rectangle'

Same as the 'rectangle' dither pattern, except there is an additional exposure taken at the center of the rectangle. The central image is taken first, and the

remaining images are taken in the same order as 'rectangle'. In this case, offsets are half the rectangle width and height.

2.1.2.1.3 'Hexagon'

This dither pattern makes a hexagon. (In spite of its name,) it is made up of seven exposures. The zeroth exposure is the "middle" of the hexagon, and it's coordinates are that of the exposure parameters panel's 'RA' and 'dec' fields. The next six exposures then form a hexagon around this. The DEC offset is to the "top" of the hexagon, and the RA offset is to the "right" of the hexagon.
Note, equal RA and DEC offsets makes a slightly non-regular hexagon.

2.1.2.1.4 'Line'

This dither pattern makes a line whose slope is 'dec_offset'/'ra_offset'. The first seeing is the "bottom left" of the line. It takes a set of five exposures.
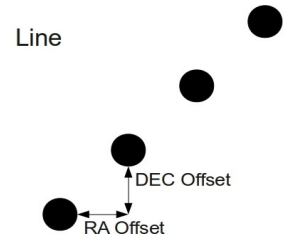
2.1.2.1.5 'All CCDs'

This dither pattern centers an object on each of the science CCDs in the focal plane. One enters the object's coordinates in the exposure parameters panel 'RA' and 'dec' fields. One must specify a 'Center CCD' in the exposure parameter panel, denoting the first CCD in the dither pattern.   62 exposures will be generated.   Ra_offset and dec_offset are irrelevant to 'All CCDs' and will be 'grayed out' when 'All CCDs' is selected.

2.1.2.2 RA_offset – float arcsec

'RA_offset' specifies some appropriate step size in RA between exposures of a dither. Unlike 'RA' from the exposure parameters panel, only decimal arcsec format is supported for RA_offset. If HA or AZ is selected instead of RA, RA offset becomes HA_offset or AZ_offset, also specified in decimal arcsec.

### 2.1.2.3 dec_offset – float arcsec

'dec_offset' specifies some appropriate step size in dec between exposurese of a dither. Unlike 'dec' from the exposure parameters panel, only decimal arcsec format is supported for dec_offset. If AZ is selected instead of RA, dec_offset becomes EL_offset, also specified in decimal arcsec.

2.1.2.4 num (number) — integer

'num' specifies the number or exposures in a dither pattern. This is not always adjustable. It must be an integer.

2.1.3 'multiexposure'

'multiexposure' refers to a sequence of exposures, in which all the exposures contribute to a single image. It is perhaps most easily explained with an example. Consider starting an exposure sequence by centering some object in some CCD. The shutter is closed, the camera is moved, the
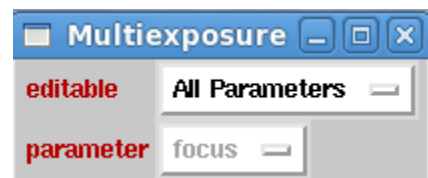
shutter opens again, and the object is now centered on a new CCD. The pattern is repeated, and now the object is centered on a third CCD.   During a multiexposure each of these three exposures does not generate a separate image, but instead modifies the single multiexposure image for the entire sequence. Thus, the final image would contain three copies of the object, each copy occurring at a different CCD on the focal plane. 'multiexposure' is particular useful for identifying ideal exposure parameters for the given observing conditions. For example, one could imagine varying the focus each time the shutter is closed. When the multiexposure is completed, the image contains multiple renderings of the same object, each rendering with a different focus setting, side by side on the different CCDs for ease of comparison.

While adding a multiexposure sequence, the Scripts Editor behaves slightly differently than when adding single exposures or dithers. After the first exposure of the multiexposure has been appended to the added exposures list, the application enters "multiexposure mode". During "multiexposure mode", a user cannot highlight any entries from the added exposures list. One must either finish or cancel this multiexposure sequence in order to exit "multiexposure mode" and return to the normal state. The idea is that one must enter the entire multiexposure sequence at once.

Multiexposure window
The multiexpsoure window contains two parameters called 'editable' and 'parameter'

2.1.3.1 'editable' – drop down menu
'editable' only has two choices, 'One Parameter' or 'All Parameters'.

If 'One Parameter' is selected the 'parameter' drop down menu will become active, and the user selects the one and only non-position parameter which will be editable throughout "multiexposure mode".   The first exposure is added just like any other single exposure. However, while entering subsequent exposures only 'parameter' in the exposure parameters panel will be editable until "multiexposure mode" completes. Position parameters, i.e. 'RA', 'dec', and 'Center CCD' are always editable. The idea of 'one parameter' is to restrict comparisons on a multiexposure image to a variation in a single parameter.

If 'All Parameters' is selected from the 'parameter' menu, all parameters in the exposure parameters panel remain editable throughout "multiexposure mode".

2.2 'Center CCD' – (CCD) string

'Center CCD' centers an object on the specified CCD. More specifically, when 'RA' and 'dec' are entered without 'Center CCD' checked, the center of the focal plane is moved to these coordinates. When 'Center CCD' is checked, the center of the specified CCD is moved to the given 'RA' and 'dec'. CCDs must be entered in string format such as 'N4'. This function is only available using RA/dec coordinate system. 'Center CCD' has a simple "memory", in the sense that it knows which CCD you were centered on in the exposure one up in the queue. However, if you delete/move exposures around in the queue, exposures anywhere in the queue are not recalculated after these actions.

2.3 'Options' – check box

Checking the boxes within 'Options' disables some component of the instrument control system. The labels on the check boxes describe what will be disabled. The four available options are: 'no Guider', 'no Hexapod', 'no BCAM', and 'no AOS'. Each is described below:

  2.3.1 no Guider: disable guiding observation

  2.3.2 no Hexapod: disable hexapod focal adjustments

  2.3.3 no BCAM: disable the BCAM laser system

  2.3.4 no AOS: disable automatic alignment.

2.4 'expType' (exposure type) – pull down menu

'expType' menu contains the possible exposure types: 'dark', 'dome flat', 'sky flat', 'zero', and 'object'. Each is described below:

  2.4.1 dark: exposure with the shutter closed

  2.4.2 dome flat: exposure using uniform light from the dome

  2.4.3 sky flat: exposure intended to be over a uniform sky

  2.4.4 zero: exposure with zero integration time

  2.4.5 object: observing some object.

2.5 'coordinates' – pull down menu

'coordinates' specifies what type of coordinates will be entered. It has two possible values, 'absolute' or 'relative'.

2.5.1 'absolute'
'absolute' denotes that the user will specify absolute (RA,dec).

2.5.2 'relative'
'relative' denotes that the (RA,dec) which the user specifies will be interpreted as relative to wherever the telescope is currently pointing.

2.6 'RA' (right ascension) – context dependent format
'RA' refers to the right ascension coordinate for the exposure. Unless 'Center CCD' is specified, the center of the focal plane will point at this coordinate. The accepted type for this parameter is context dependent, outlined below:

'absolute': float decimal degrees between [0,360] or hh:mm:ss.ss between [0,24 : 0,60 : 0,60]
> e.g. 10.50 or 10:30:50.00

'relative': float decimal arcsec or E/W arcsec
> e.g. -0.50 or E10.1.

Instead of 'RA', 'AZ' (azimuth angle) or 'HA' (hour angle) can be selected from the pull down menu, meaning coordinates will be be specified as either AZ/EL (elevation) or HA/dec instead of RA/dec. AZ/EL and HA/dec will only accept absolute coordinates like SISPI. 'Center CCD' functionality also is not available with AZ/EL or HA/dec. Accepted types for AZ and HA include:

AZ: decimal degrees between [0,360]

HA: decimal degrees between [0,360] or hh:mm:ss format between [0,24 : 0,60 : 0,60].

2.7 'dec' (declination) – context dependent format
'dec' refers to the declination coordinate for the exposure. Unless 'Center CCD' is specified, the center of the focal plane will point at this coordinate. The accepted type for this parameter is context dependent, outlined below.

absolute: float decimal degrees between [-90,90] or dd:mm:ss.ss between [-90,90 : 0,60 : 0,60]
> e.g. -10.50 or 20:30:50.00

relative: float decimal arcsec or N/S arcsec
> e.g. -0.80 or N10.1

If 'AZ' is selected, 'dec' changes to 'EL' (elevation). Accepted types for EL include:

EL: decimal degrees between [-90,90]

2.8 'filter'- string, integer (cassette number), (list)
'filter' specifies which filter is to be used for the exposure. Accepted formats are the one character strings or the integer filter cassette numbers, such as:

> r
> 1

Technically, a list such as [g,r] is fine, meaning both g and r filters would be used at the same time. However, the ability to do this may be removed in time. Available filters are:

> u
> g
> r
> i
> z

Y
pinhole (small hole)
block (solid block)
None (no filter)
out (same as None)

2.9 expTime (exposure time) – integer, float (in seconds)

'expTime' denotes the duration of the exposure in seconds.

2.10 focus – list, float

The focus is a list of the six Hexapod coordinates [x, y, z, tip, tilt, spin], with x, y, and z in µm and tip, tilt, and spin arcsec. The last coordinate is always 0.
     eg: [1.0,2.5,3,4,5,0]
If a single float, instead of a list if given, only the z component of the hexapod will be moved to the specified coordinate.

2.11 object – string

'object' refers to the name of an object, e.g. 'Nameless_Star'. It is entered into the FITS header as 'OBS_ID'

2.12 seqid (sequence identification) – string

'seqid' is the name of a sequence of exposures, e.g. 'special_dither'

2.13 seqnum (sequence number) – integer

'seqnum' is the index of an exposure within a sequence. e.g. 2 (of 5 for seqtot).

2.14 seqtot (sequence total) – integer

'seqtot' is the total number of exposures in some sequence, e.g. 5.

2.15 'count' – integer

The exposure will be repeated with the exact same parameters 'count' number of times.

2.16 'earlyTime' – string format: <YYYY-MM-DD HH:MM:SS>

The earliest time an exposure may be executed, e.g. 2012-08-31 15:20:00. End the string with a 'Z' for UTC, e.g. 2012-08-31 15:20:00Z, otherwise the time is local time.

2.17 'lateTime' – string format: <YYYY-MM-DD HH:MM:SS>

The latest time an exposure may be executed, e.g. 2012-08-31 15:20:00. End the string with a 'Z' for UTC, e.g. 2012-08-31 15:20:00Z, otherwise the time is local time.

2.18 comment – string

This field is used for comments about the exposure. They are added to the FITS header as comments.

2.19 Advanced – check box

The 'Advanced' box can be checked/unchecked at any time to show/hide the advanced window. The advanced window contains parameters like the those on the main exposure parameters panel, except that those on the advanced panel will likely be used much less often and few will need to adjust them. Those listed under the 'Multiexposure Only' heading are only relevant to adding multiexposures. The advanced parameters window is shown to the right.

Advanced Window

2.19.1 'epoch' – float

The year times are measured relative to, e.g. 2000.0.

2.19.2 wait – string/bool

'wait' is a command which tells the OCS to wait for something before taking the next exposure, e.g. False (meaning do not wait).

2.19.3 'hex_id' – integer

'hex_id' refers to which DES tiling hexagon the exposure belongs to.

2.19.4 'tiling_id' – integer

'tiling_id' refers to the index of the repetition of the tiling to which the current exposure will belong, e.g. 3 (meaning the 3rd tiling of some hex).

2.19.5 'Options' – check boxes

This is another list of exclusions which can be applied. Checking one of the boxes disables the specified component of the instrument control system/image pipeline. The available options are: 'no Output', 'no DTS', 'no PNG', 'no LOGBOOK', 'no Compress', 'no IMAGEHEALTH', 'no DS9'. Each is described below:

2.19.5.1 no Output: Disable all output for the exposure

2.19.5.2 no DTS: Disable data transport system, i.e. prevent the image from being sent anywhere

2.19.5.3 no PNG: Disable creating png images for files

2.19.5.4 no LOGBOOK: Turn off logging functionality

2.19.5.5 no Compress: Do not compress images

2.19.5.6 no IMAGEHEALTH: disable SISPI's imagehealth

2.19.5.7 no DS9: disable DS9 image program.

2.19.6 ccd_shift – check box

ccd_shift is a type of multiexposure which shifts the readout of a CCD onto a different CCD N positions away. When checked and entering a multiexposure, 'hexMin', 'hexMax', 'hexStep', and 'ccd_shift' become adjustable. Only the z-position of the focus changes between subsequent entries.

2.19.7 HexMin (hexapod minimum) – float

The first z-position, in μm, for the hexapod in a ccd_shift multiexposure, e.g. 110.5.

2.19.8 hexMax (hexapod maximum) – float

Upper limit of the z-poistion, in μm, for the hexapod in a ccd_shift multiexposure, e.g. 900.5.

2.19.9 hexStep (hexapod step) – float

Hexapod interval between entries of a ccd_shift sequence, e.g. 10.5

2.19.10 ccd_shift – integer

The number of CCDs to shift output between entries of a ccd_shift sequence, e.g. 1.

2.19.11 'Add Additional' button

The 'Add Additional' feature allows users to define their own keyword/value parameter pairs. When the button is clicked, a new line containing two blanks and a button labeled 'Remove' appears. Keywords are defined in the first blank, values are defined in the second blank, and the remove button will delete the line. As many additional parameters as needed can be defined. Any line with a blank keyword and value will be ignored, but an error will occur if only one in the pair is defined. User defined parameters will be included in the fits header when the exposure is taken.

2.20 'Script Comment'

The 'Script Comment' box can be checked/unchecked at any time to show/disable the script comment area. Script comments are lines which show up in the added exposures panel, but are not actually exposures. They are like comments in a programming language in that the OCS will not interpret them as exposures. Script comments can be used to label sections of an exposure queue if the user so desires.

3 Added Exposures Panel
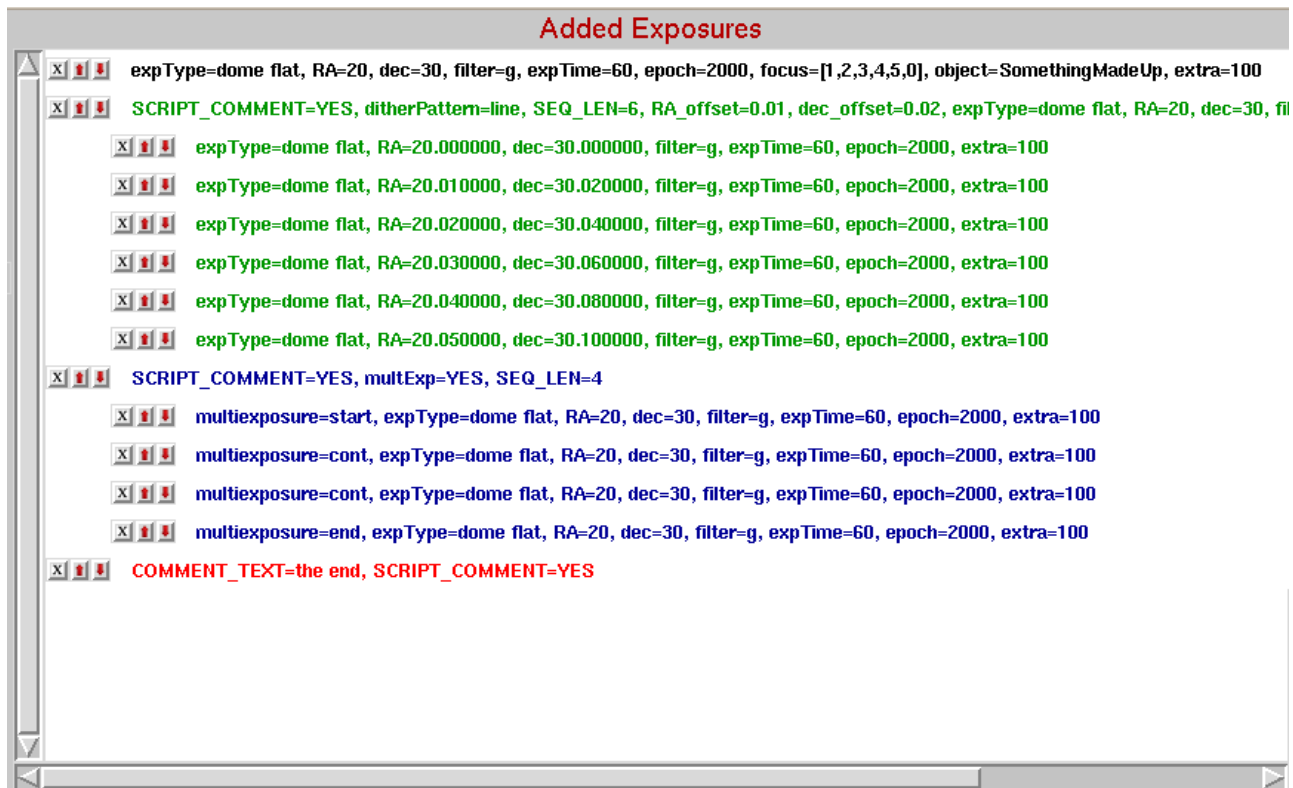
When an exposure is added, it is appended to the added exposures panel, which is pictured above. An exposure's line within the list displays that exposure as a string, as it would be passed passed to the OCS. Each line also includes three buttons. An 'X', and up and down arrows. The 'X' deletes the exposure from the queue, the up arrow moves the exposure up in the queue and the down arrow moves the exposure down in the queue.

When a dither is added, the number of dithers in the sequence will be appended to the list, as well as a 'dither top line' labeling the dither sequence as a whole. The top line will include information such as which dither pattern was selected and the central (RA,dec) coordinates. If the 'X' is clicked for the top line, the entire dither sequence will be deleted. And if either of the movement arrows are clicked, the entire dither sequence will move as a unit. Buttons on one of the individual exposures will either delete or move the exposures position within the dither.

Once a multiexposure has been finished and added to the exposures list, it will appear much like a dither sequence. There is a top line labeling the multiexposure as a whole. The sequence can be moved or deleted as a unit, or individual exposures can be moved or deleted within the multiexposure.

The different types of exposures appear with different text colors for visual separation. Single exposures are black, script comments are red, dithers are green, and multiexposures are blue.

When a user clicks on an added exposure, this exposure will be highlighted in the list and its parameters will be filled into the exposure parameter panel's fields. In this way, an existing exposure can easily be modified. The replace button will replace the currently highlighted

exposure with the new parameters specified in the exposure parameters panel. Alternatively, the add button will append the current parameter values in an exposure at the end of the queue. Cancel unhighlights the highlighted exposure, without adding anything. If a dither top line is highlighted, add or replace will apply to the dither as a whole. (One will not be able to change the dither pattern, but any other parameter is adjustable.) If a multiexposure top line is clicked, one of two situations are possible. For 'All Parameter' type multiexposures nothing will happen. (Such a sequence of exposures requires nothing in common, so there is nothing that is editable as a group.) For 'One Parameter' type top lines, all fields except the 'One Parameter' will be editable. When a user highlights an individual exposure within a 'One Parameter' type multiexposure, only the 'One Parameter' (and position parameters) will be editable. Editing individual 'All Parameter' type multiexposures, as well as individual exposures within a dither sequence will behave exactly like a single exposure—any field can be edited. (However, doing something this should be done with caution, because it is a way to modify only a piece of something that is usually treated as a group.)

One additional thing to keep in mind (as was alluded to in the 'Center CCD' section) if you delete/move exposures around in the queue, exposures anywhere in the queue are not recalculated after these actions. Make sure if you delete or move a number of exposures that you have not messed up something you intended to do.

4 Buttons

This section describes the functionality of each of the buttons near the bottom of the main window. A screenshot of these buttons is included above. Some of them have been described in previous sections, but descriptions are also included here for convenience. Not all buttons are active at all times. When a button is not currently in scope it will be 'grayed out' and inactive.

4.1 Clear Exposures
Removes all the exposures from the added exposures panels.

4.2 Clear Fields
Clears all the text field entries in the exposure parameters panel (as well as in dither, multiexposure, and advanced panels).

4.3 Add
Appends an exposure(s) to the added exposures list, based on the current exposure parameters. If the exposure is not valid, a message alerts the user, and the exposure is not added.

4.4 Replace
Replace the currently highlighted exposure with the current exposure parameters. (Only relevant if an exposure is highlighted.)

4.5 Finish
Exits 'multiexposure mode'. (Only relevant for multiexposures.)

4.6 Cancel
Unhighlights an exposure without adding or replacing it. Cancel is also a way to exit 'multiexposure mode' without adding the multiexposure sequence.

4.7 Break
Appends a break statement to the exposure queue. Break statements do not take an exposure.

4.8 Open
Opens a script file and appends it the exposure queue. Supported formats are .json and .txt. The syntax for text files is to separate keyword=value pairs in an exposure with commas, and to put each exposure on a new line. e.g.:
        ra=2.0, dec=10
        exptype=bias
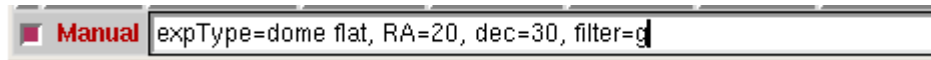If the file contains invalid exposures, an alert message ensues and the file is not loaded.

4.9 Save
Export the current added exposures list as a .json file.

4.10 Quit

Exit the Scripts Editor program.

5 Manual Tool

At the bottom of the main window, is a check box labeled 'Manual', which is pictured above. When this box is checked, all parameter fields are grayed out, and a user must enter an exposure as a pure text string, as would be done using SISPI's OCS. This feature is intended as a time saver for those who are SISPI experts and understand it's syntax.

6 Additional Comments

Script files can be edited manually, outside of the Scripts Editor using your favorite text editor. Importing the script into the Scripts Editor will validate that the script is allowable. One can also validate scripts from the command line using the validatescripts tool, located in the same directory as the ScriptEditory binary. validatescripts takes as a command line argument the name of the file to validate e.g.:

```
./validatescripts test_script.json
```

The current validatescripts tool is a beta version which has not been as rigorously tested as the Scripts Editor.