

A User's Guide to Target Acquisition with STIS (Revision B)

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May 16, 1997

Revision A:

updated ACQ/PEAK accuracy (Page 4)

updated table of limiting exposure times (Table 2)

updated plots of exposure time to achieve a S/N of 40 (Figure 8)

Revision B:

updated statement on exposure time expansion (Pages 16 and 24)

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1. Introduction

The STIS Instrument Handbook (Chapter 8) presented an overview of target acquisition which represented our best knowledge on the workings and requirements of the STIS acquisition flight software at that time (June 1996). The majority of the information presented in the Handbook remains valid, although there have been some changes to how the acquisition data will be obtained and processed. We have also finalized the Phase II specifications for STIS target acquisition since the Handbook. In order to provide users with the updated information, and to put all the necessary information on STIS target acquisition in one place, we have generated this User's Guide. Note that we anticipate updates to this document based on SMOV results, and these will be communicated via the Space Telescope Analysis Newsletter (STAN) for inclusion during the Phase B (science optimization) processing of your program.

On-board target acquisitions with STIS differ considerably from previous HST instruments such as FOS and GHRS, which required raster scans to locate the target. STIS target acquisitions employ the CCD camera to image the target's field directly and onboard flight software processes the image to locate the position of the target. This should make STIS target acquisitions more robust than with the earlier generation HST spectrographs. Below we describe acquisition and pickup exposures for spectroscopy.

1.1 Initial pointing

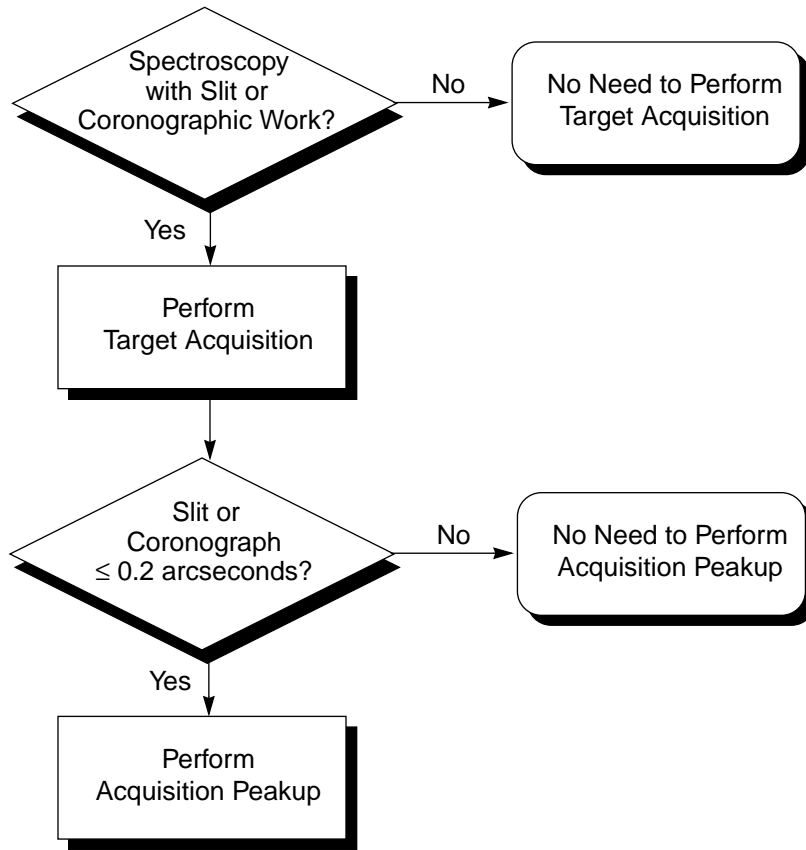
Following the initial guide star acquisition for your visit, the target location in the aperture plane will be known to an accuracy of ~1-2 arcseconds. For science observations taken through spectroscopic slits which are less than 3 arcseconds in either dimension and for imaging observations taken using one of the coronagraphic apertures, you will need to use an on-board STIS target acquisition and possibly an acquisition pickup exposure to center your target.

Figure 1 shows a decision flow for selecting whether you require an acquisition or an acquisition and pickup to center your target.

1.2 Acquisitions

STIS target acquisition exposures (MODE=ACQ) always use the CCD, one of the filtered or unfiltered apertures for CCD imaging and a mirror as the optical element in the grating wheel. Acquisition exposures center your target in the slit or behind a coronagraphic bar to an accuracy of ~0.1 arcseconds. A typical STIS target acquisition exposure takes ~8 minutes (use the expression -- $425 + 4 * t_{\text{exp}} + 0.2 * \text{checkbox}^2$ seconds -- to get a rough estimate for any given t_{exp}).

Figure 1: Determining Acquisition Needs

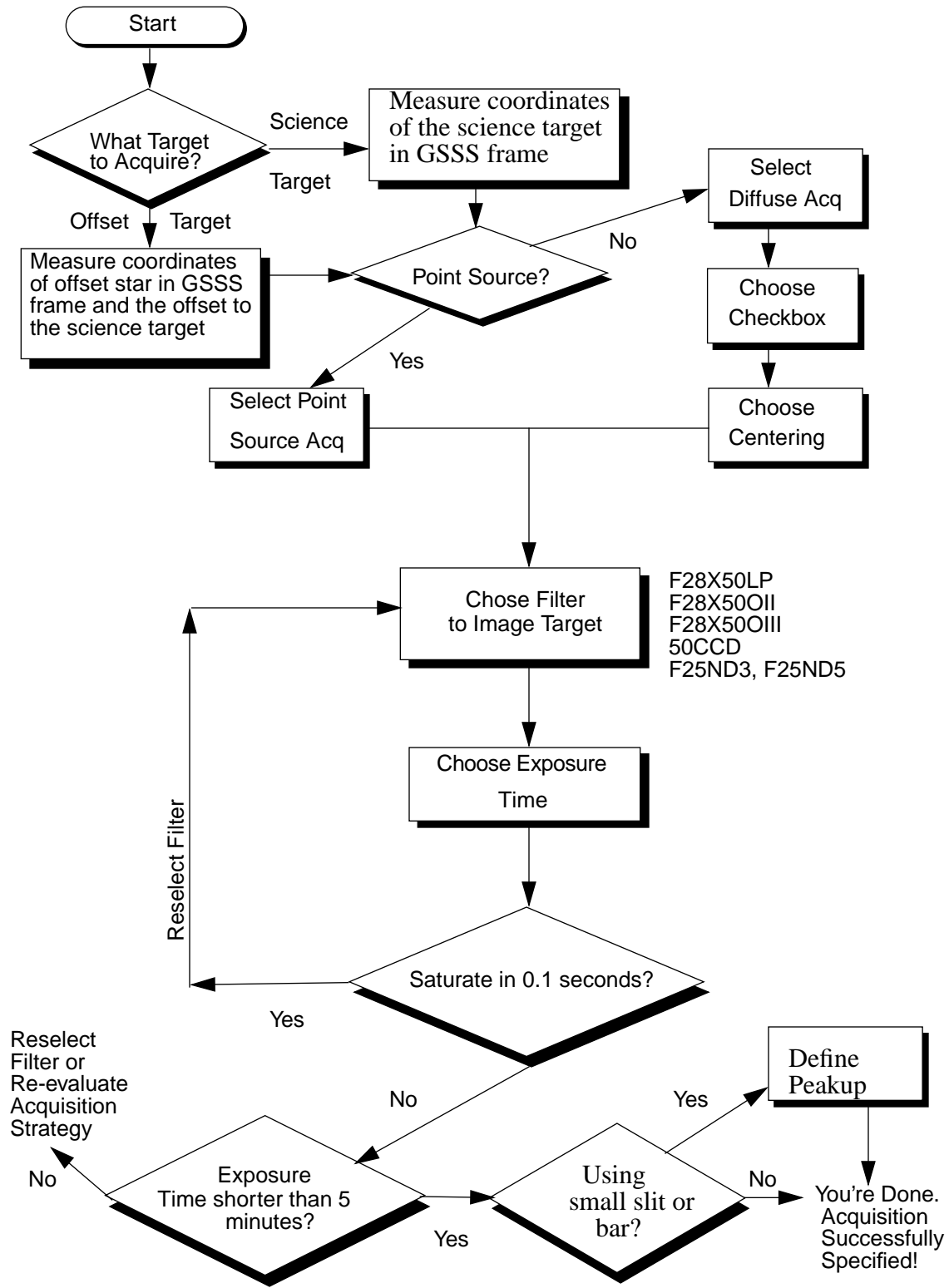


1.3 Peakups

Additionally, an acquisition peakup exposure (MODE=ACQ/PEAKUP) must be taken following the target acquisition exposure to refine the target centering of point or point-like sources in slits less than or equal to 0.2 arcseconds wide (or tall). Peakup exposures use a science slit or coronagraphic aperture and can be taken with either the CCD or one of the MAMAs as the detector and with either a mirror or a spectroscopic element in the grating wheel. Typical centering accuracies following a peakup sequence are 0.15 times the dimension of the slit or bar for both CCD and MAMA peakups. Typical STIS imaging point source peakups take ~ 5-10 minutes, though a peakup with the very small 0.1x0.09 echelle aperture will take ~20 minutes; see Appendix D for the formulae needed to determine the duration of a peakup acquisition.

Figure 2 shows the complete decision tree for STIS target acquisitions.

Figure 2: Process of Defining a Target Acquisition Scheme

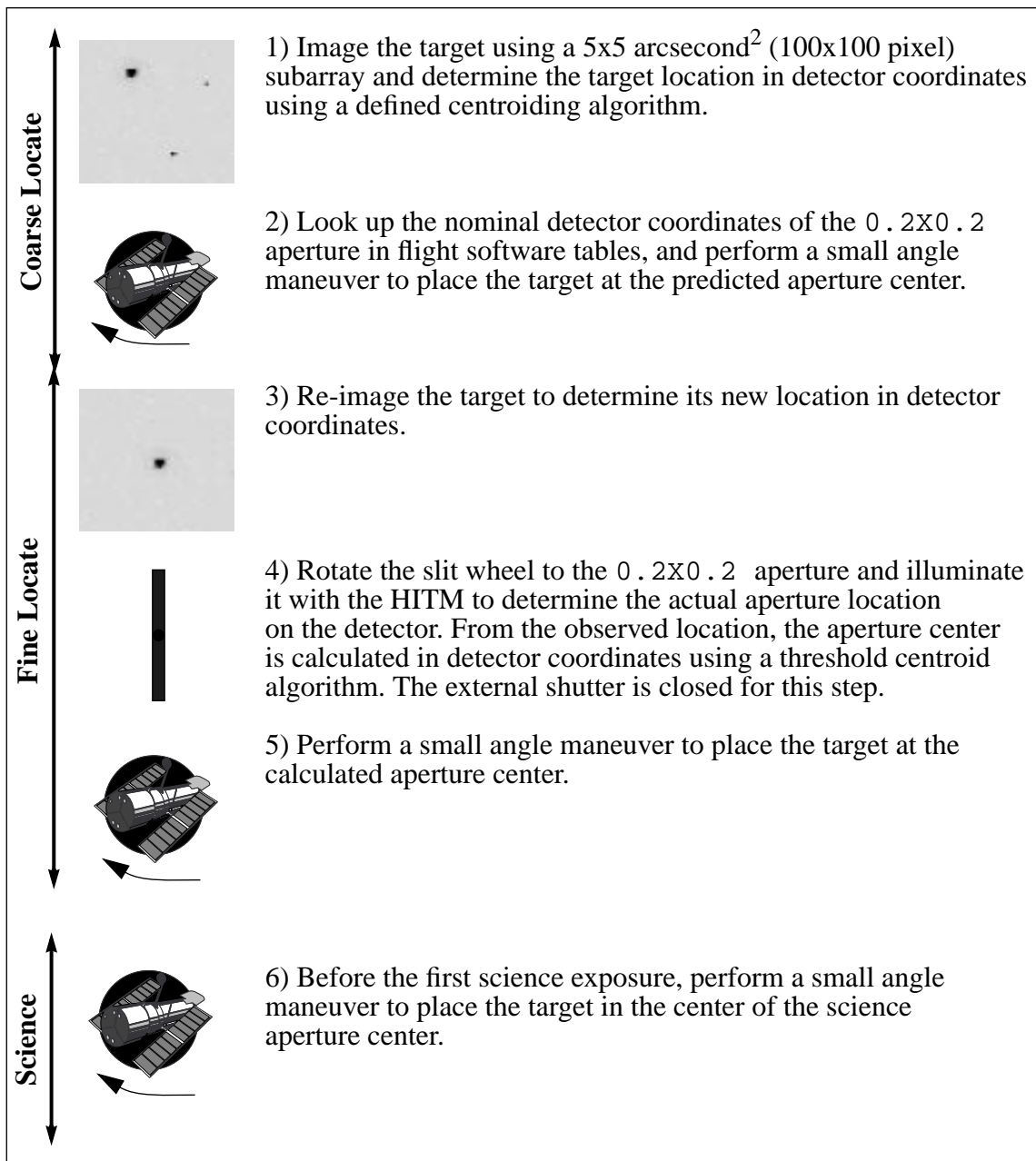


2. STIS On-board CCD Target Acquisitions (Mode=ACQ)

2.1 How it works

Acquisition exposures are controlled by the Flight Software (FSW). Figure 3 highlights the basic steps in the acquisition process. The sequence comprises two discrete stages - the coarse locate phase (steps 1-2) and the fine locate phase (steps 3-5); a sixth

Figure 3: Target Acquisition Schematic



step centers the target in the science aperture. The coarse locate phase is performed to place the target as close as possible to the aperture center prior to the final telescope move. This assures that the final slew needed to move the target into the aperture is a small one, and minimizes uncertainties in the calculation of the required slew caused by detector/optical distortions

- In step 1, the target is located. A pair of 5x5 arcsecond (100 x 100 pixel) CCD images are taken of the sky using a user-selected filtered or unfiltered imaging aperture; for diffuse acquisitions, the field will be somewhat larger (see 2.2.2 below). The flight software processes the images as needed (to remove the bias level, flag bad pixels and remove cosmic rays)¹ and applies one of two possible finding algorithms to determine the pixel coordinates of the target.
- In step 2, the spacecraft is then moved to place the target at the nominal center of the 0.2X0.2 slit.
- In step 3, the target is re-imaged and the target detector coordinates are re-determined. This second target location is performed to minimize the final slew in step 5, to reduce the error associated with that slew.
- In step 4, the location of the 0.2X0.2 slit is determined relative to the target. The external shutter is closed (to prevent a possible overlight condition), the 0.2X0.2 slit is rotated into the slit wheel, and an image of the slit is obtained by illuminating the slit with the HITM line lamps. The slit image is processed and a finding algorithm is then used to determine the pixel coordinates of the center of the slit.
- In step 5, the final phase, the flight software calculates the offset between the target location and the 0.2X0.2 slit, and performs a small angle maneuver of HST to place the target in the center of the aperture.
- In step 6, the object is placed in the science aperture (by a small angle maneuver) just prior to the execution of the science exposure.

An acquisition exposure produces science data, which includes the images of the target produced in steps 1 and 3, and the image of the 0.2X0.2 slit produced in step 4. These data will be returned to you with your science data as part of the pipeline products.

2.2 Target Location Algorithms

STIS supports two basic types of acquisitions: point source acquisitions (ACQTYPE=POINT) and diffuse source acquisitions (ACQTYPE=DIFFUSE). Diffuse source acquisitions are appropriate for sources that exhibit smooth or systematically peaking surface brightnesses *on some size scale*, such as centers of galaxies, planets, or nebulae.

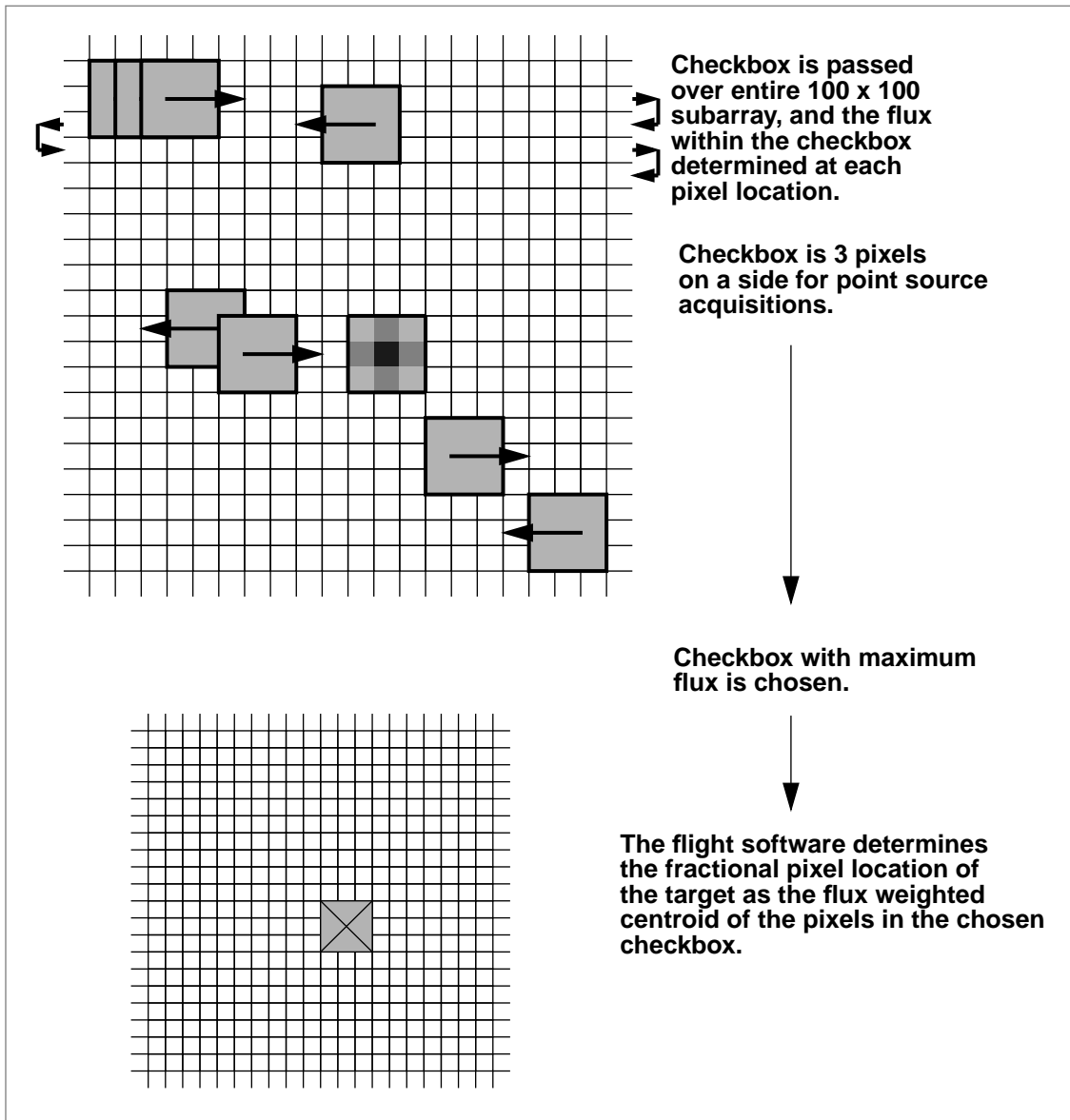
1. The processing done by the FSW is rudimentary; a single bias number is subtracted, bad pixels are set to the average of the 4 adjacent pixels, negative valued pixels are set to zero, and each pixel is assigned the minimum from the two images (as a form of cosmic ray rejection).

To locate the target the flight software first passes a square *checkbox* over the image and determines the flux contained within the checkbox at each pixel in the subarray. The flight software then selects the checkbox with the maximum flux and determines the target center within that checkbox according to the type of acquisition specified.

2.2.1 Point Source Acquisition

For point source acquisitions (ACQTYPE=POINT), the checkbox size is fixed at 3 x 3 pixels (0.15×0.15 arcsecond²) and the flight software determines the target location by finding the flux weighted centroid of the pixels in the brightest checkbox (see Figure 4).

Figure 4: How the Checkbox Works for Point Source Acquisitions



2.2.2 Diffuse Acquisition

For diffuse acquisitions (ACQTYPE=DIFFUSE), the flight software determines the target location either by finding the flux weighted centroid of the pixels in the brightest checkbox or by determining the geometric center of the brightest checkbox (see Figure 5). For DIFFUSE acquisitions, the user must specify both the centering method (DIFFUSE-CENTER=GEOMETRIC or CENTROID) and the checkbox size. The user sets CHECKBOX= n , where n must be an odd number less than 105: the checkbox will then have dimension $n \times n$ pixels. CHECKBOX should be set to the minimum size which assures that the brightest checkbox will be the one centered on the region of interest (i.e., if your object is peaked within a region of 1 arcsecond, set CHECKBOX=21 ($= 1 + 1$ arcsecond/0.05 arcsecond/pixel). The maximum checkbox is 105 pixels on a side, or $\sim 5 \times 5$ arcseconds. The subarray used for a diffuse source acquisition target image is CHECKBOX+101 pixels on a side.

Figure 5: How the Checkbox Works for Diffuse Acquisitions

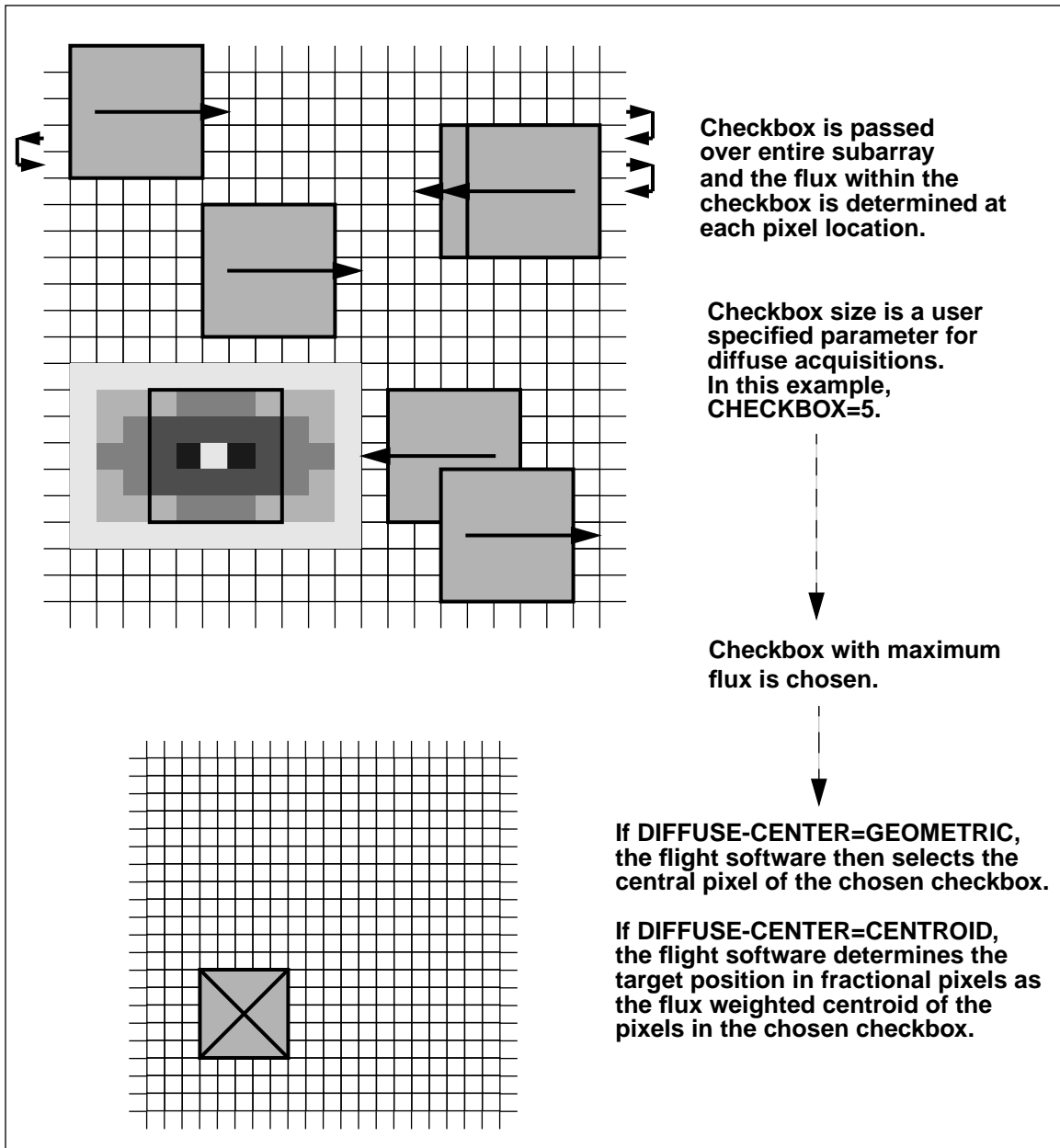
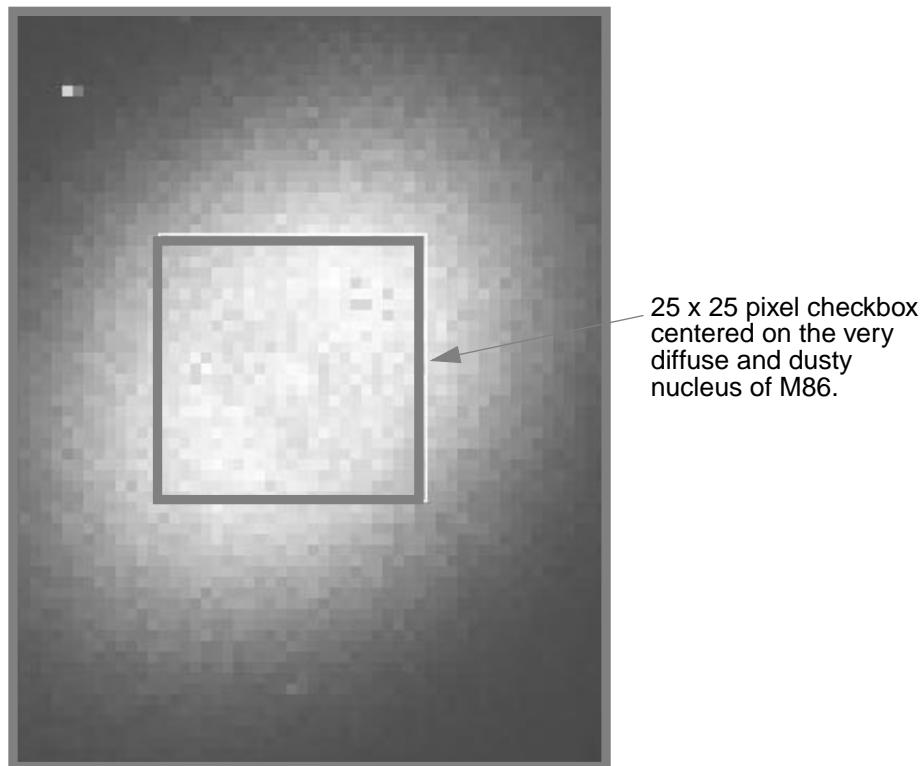


Figure 6 shows a simulated example of a diffuse source, the nucleus of the galaxy M86, acquired using a diffuse source acquisitions.

Figure 6: Simulated Diffuse Acquisition of Elliptical Galaxy M86, created by running the flight software algorithm on a WFPC2 image. CHECKBOX=25 produced good centering. Smaller values caused checkbox to center on local brightness enhancements offset from galaxy center.



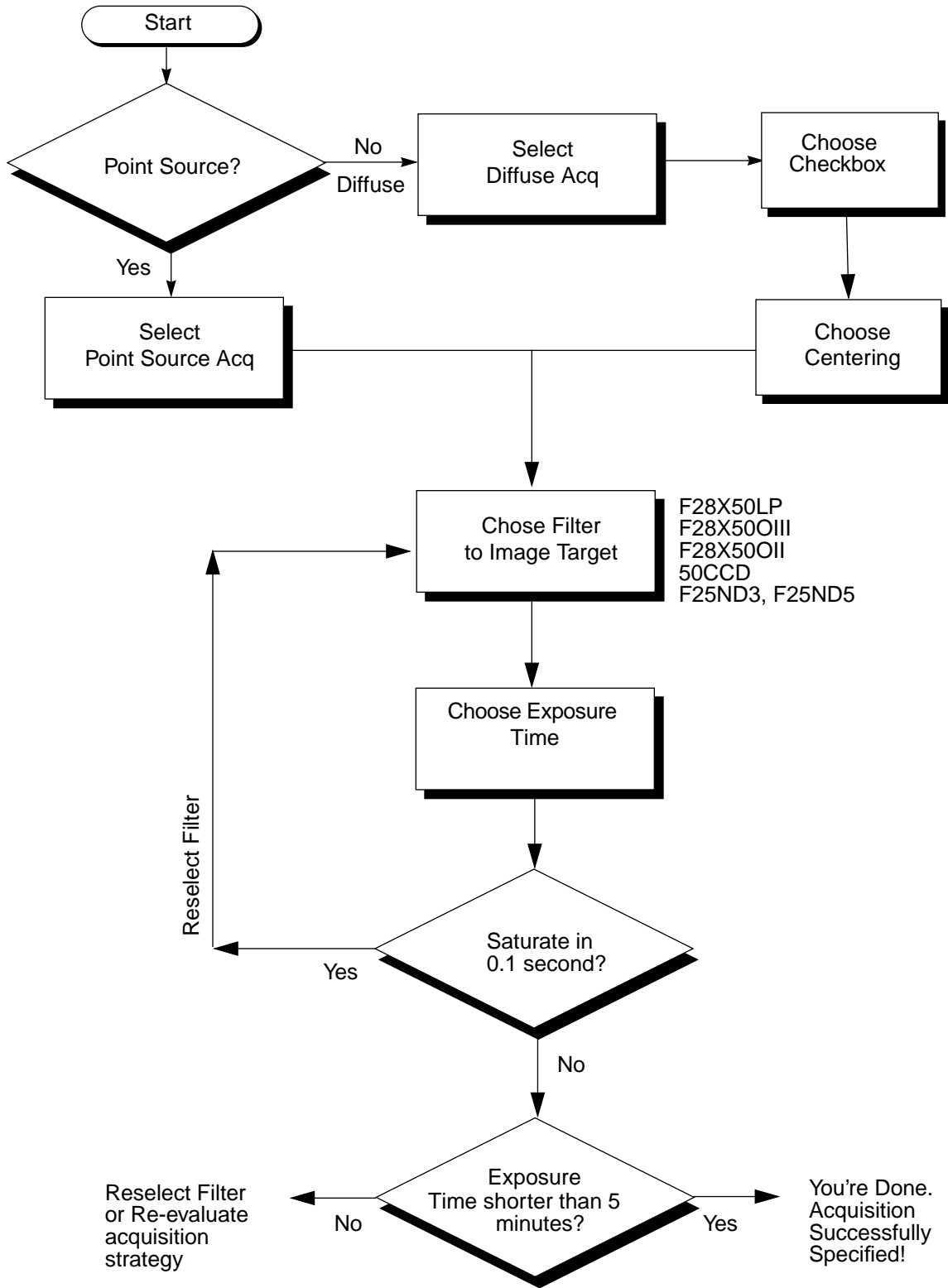
2.3 Selecting Target Acquisition Parameters

To plan your acquisition, you must select:

- The target you are going to acquire (science target or offset object)
- The type of acquisition, point or diffuse, and if you are performing a diffuse acquisition, the centering algorithm and checkbox size (see “2.2.2 Diffuse Acquisition” on page 9).
- The filtered APERTURE to be used for target imaging during the acquisition.
- The exposure time for the image used to determine the location of the target.
- The science aperture, which determines if you need a pickup acquisition.

Figure 7 shows the flow of specifying a target acquisition scheme.

Figure 7: Process of Choosing Target Acquisition Exposure



2.3.1 Selecting the acquisition object

The first step is to determine what object you are going to use for your target acquisition. Note that the STIS software will always acquire the brightest object in the 5x5 arcsecond² search area. If your target is isolated, or if there are no brighter objects **in the STIS bandpass** you have selected (see below) within 5 arcseconds of your target, then you can acquire your target directly. If there are brighter targets nearby, then you will need to acquire an offset target (generally the brighter nearby star), and then perform a blind slew to the science target. Note that HST performs small angle maneuvers (SAMs) quite accurately, with a 3 arcseconds maneuver having an error of 0.003 arcseconds, while a 2 arcminute maneuver (the maximum to assure that a single set of guide stars can be used for both targets) yields a 0.02 arcseconds error. The offset should not significantly affect target centering accuracy even in the smallest echelle slits, and your centering uncertainty will generally be dominated by your knowledge of the absolute offset between the acquisition star and your target. If you are uncertain if a nearby object is brighter than your target in the STIS bandpass, it is safest to select an isolated object and perform your acquisition on it.

If you are observing a diffuse source, you should first check to see if there is a suitable star which you can use as an acquisition target; an offset can then be used to move to the desired position, as needed. If you wish to acquire a diffuse object directly, then it is important to know your source structure as seen at ~0.1 arcsecond resolution to properly plan your acquisition strategy if you need accurate (a few tenths of an arcsecond) centering. We recommend that you first check the HST archive to determine if your target has been observed with HST by WF/PC, WFPC2, or FOC. If it has, that exposure can be used to determine the optimal acquisition strategy using the Target Acquisition Simulator (see Appendix B). If it has not yet been observed with HST, we suggest you take an early acquisition image, either with the STIS or with WFPC2, which you can use to determine your optimal acquisition strategy. This is particularly important if your science requires placement of a narrow slit accurately on a diffuse object.

Once you have selected your acquisition object, you need to measure its coordinates in the Guide Star reference frame; information on measuring coordinates can be found at <http://www-gsss.stsci.edu/support/phase2.html>. You will need to include the PLATE-ID along with your coordinates so that we can be certain to select the guide stars for your observation from the same plate on which your measurement was based. If you are deriving coordinates from WFPC2 data (i.e., from the *metric* task), you still need to provide a PLATE-ID; see Appendix A for instructions on determining the PLATE-ID from WFPC2 data.

2.3.2 Selecting the type of acquisition

If you are acquiring a point-like object, you should select the point source acquisition (ACQTYPE = POINT). This selection will find the flux-weighted centroid of the object using a 3x3 checkbox. If you are acquiring a diffuse object, you should select the diffuse source acquisition (ACQTYPE = DIFFUSE). A diffuse acquisition will also require the selection of the centering algorithm (DIFFUSE-CENTER = FLUX-CENTROID or GEOMETRIC-CENTER) and a checkbox size (CHECKBOX = 3-105). A Target Acquisition simulator (see Appendix B) is available to assist you in selecting the best checkbox size if you have an image at a similar resolution to STIS and in a similar bandpass.

2.3.3 Selecting the imaging aperture

The apertures available for target acquisitions are the same set that can be used for CCD imaging and are listed in Table 1 below. They include the visible long pass filter, the clear unfiltered aperture, the [OIII] narrowband filter, the [OII] narrowband filter, and the neutral density filters which provide attenuations for bright sources of 10^{-3} and 10^{-5} .

Table 1. Apertures for Target Acquisitions. Note that F28X50LP is the preferred target acquisition aperture. See the Instrument Handbook for more information on the properties of the apertures.

APERTURE Name	Filter	Comment
F28X50LP	optical longpass	preferred target acquisition aperture
F28X50OII	[OII]	use for bright sources or to center on emission line structure
F28X50OIII	[OIII] (has severe red leak)	use for bright sources or to center on emission line structure
F25ND3	neutral density, ND= 10^{-3}	use only for targets too bright for other filters
F25ND5	neutral density, ND= 10^{-5}	use only for targets too bright for other filters
50CCD	clear	use for acquisitions of faintest sources only

The longpass filter is the preferred target acquisition aperture (compared to the clear 50CCD aperture) because it blocks the ultraviolet photons, which can otherwise elevate the detector dark count in the subsequent science exposures. For bright sources which saturate the CCD in 0.1 second with the longpass filter (see Table 2), you can use either the narrow band OIII (F28X50OIII) or OII filters (F28X50OII) as the acquisition aperture, or one of the neutral density filters. The [O II] and [O III] filters can also be used to locate the target in the light of an emission line. Note that the [O III] filter has a large red leak at $\lambda > 10000\text{\AA}$ (see the “Calibration Resources” section on the STIS web page for the trans-

mission curve), so it should only be used with caution; the [O II] filter has a smaller red leak.



We recommend that you use the longpass F28X50LP filter for all target acquisitions of sources with V magnitudes between 10 and 23.

2.3.4 Determining the exposure time for the ACQ exposure

To achieve robust target location:

- A signal-to-noise ratio of 40 (over the checkbox) or 1700 electrons (425 DN) must be obtained on each target image obtained during the ACQ exposure.
- For DIFFUSE acquisitions with large checkbox sizes (i.e., CHECKBOX >9), 40 electrons/pixel (or equivalently 10 DN/pixel) must be obtained for the region of the source being “found”.
- The target image cannot be allowed to saturate the CCD full well (144,000 electrons).
- The exposure time must be less than 5 minutes for point source acquisitions and less than the maximum allowed (see below) for diffuse acquisitions.
- A GAIN of 4 is used for all acquisition images.

The maximum possible exposure time for a point source (ACQTYPE=POINT) acquisition exposure is 5 minutes; this limits acquisitions to sources brighter than 24.5 magnitudes in V. This limit is imposed because, for exposure times longer than this, the target acquisitions become compromised by coincident cosmic ray impacts, which will lead to acquisition failures.

The maximum possible exposure time for a diffuse acquisition (ACQTYPE=DIFFUSE) depends on the checkbox and is given by:

$$t_{max} = 5 \times 100 / (101 + CHECKBOX) \quad \text{minutes}$$

The minimum exposure time allowed for an acquisition is 0.1 seconds. Table 2 gives the limiting magnitudes at which the CCD will saturate in a 0.1 second exposure; sources brighter than these limits cannot be acquired with the CCD using these filters. However, remember that the ND filters can be used to acquire targets, which provide attenuations of 10^{-3} (7.5 Magnitudes) and 10^{-5} (12.5 Magnitudes) relative to clear (50CCD) filter. Note that the ND filters are contained in the slit wheel with other slits and apertures, and so cannot be used in conjunction with other filters. The table illustrates that it is possible to image any star using the suite of filters, including the neutral density filters, available for STIS.

To assist you in estimating your exposure times, we plot, in Figure 7, exposure time versus V magnitude to achieve a signal-to-noise ratio of 40 for stars having a range of

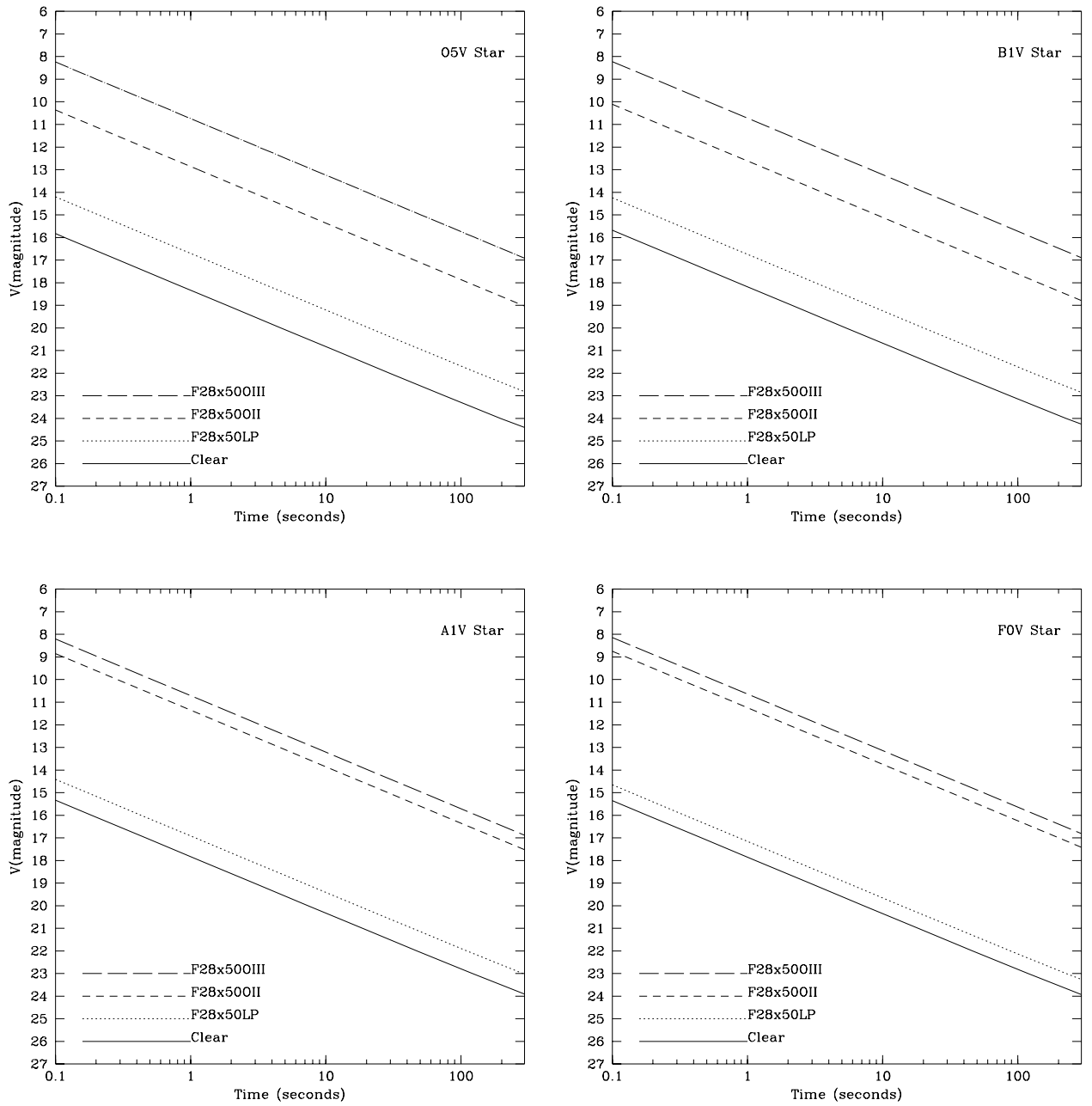
spectral types, for the clear, longpass, OIII, and OII filters. To determine the exact exposure time, you should use the STIS Imaging Exposure Time Calculator (see Appendix C for examples). Note that the overheads in target acquisition are substantially longer than most exposure times, so as long as you do not saturate (within 30% of the full well) your target, you should increase your exposure time by a factor of 2-5 above the minimum required (e.g. if the exposure time to obtain a S/N of 40 is 0.3 seconds, then you can lengthen it to 1 second if no saturation occurs). The exposure time entered into your Phase II template is the time for each of the two exposure in the ACQ sequence, unlike the case of CR-SPLIT observations where it is the total time.

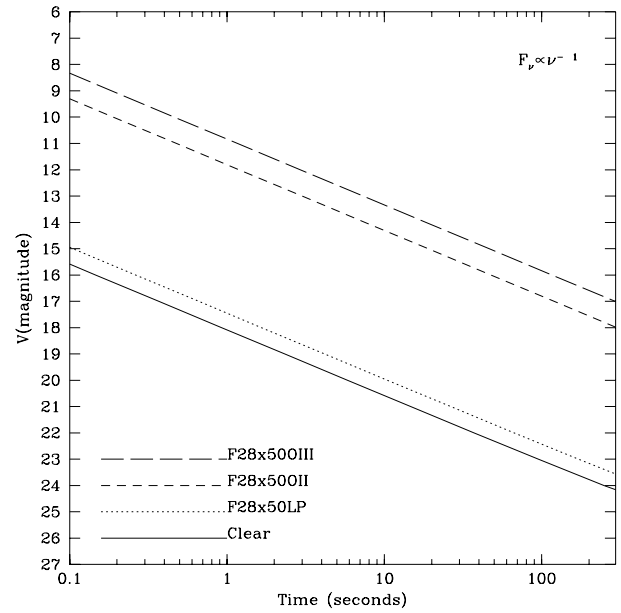
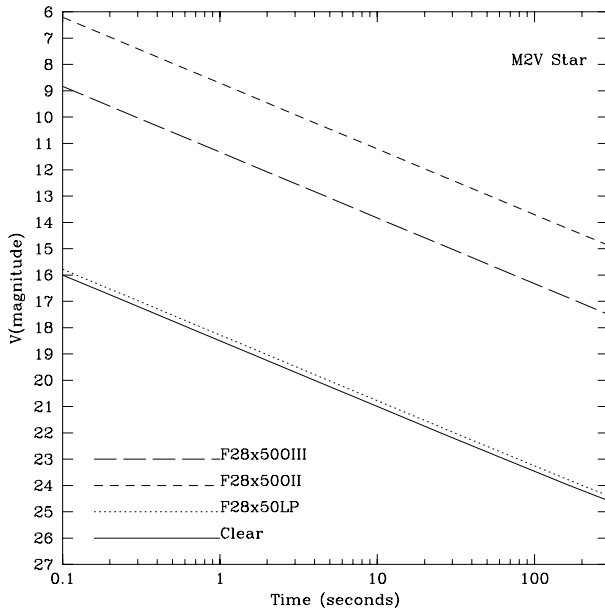
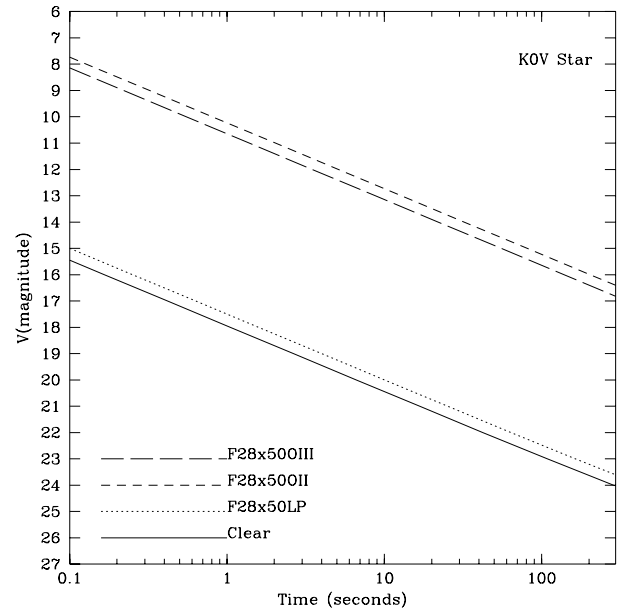
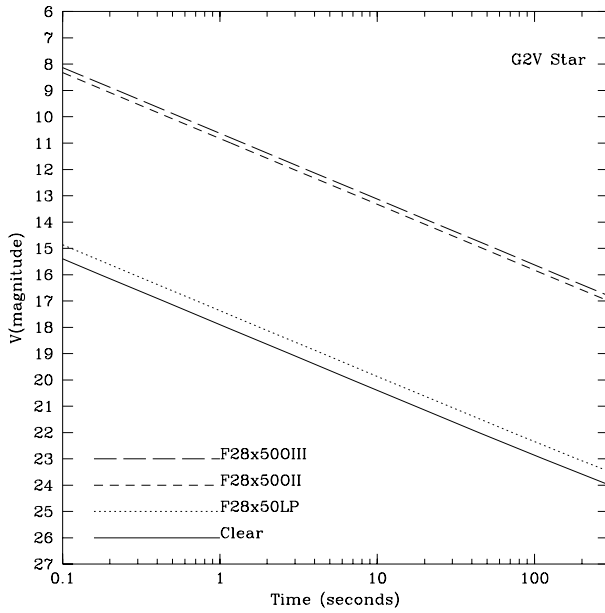
As part of your Phase II submission, you will need to specify the V magnitude of the object you are acquiring (the science target or the offset target). The RPS2 software will perform a check to make certain your target will not saturate the CCD (which would cause the acquisition to fail). Note that the test assumes the worst case (the 50CCD aperture and an M6 V spectral type), which may not be appropriate for your target/configuration. If RPS2 gives you a warning about the acquisition exposure, please double check to make certain you will not saturate.

Table 2. V Magnitude Limits for 0.1 Second CCD Exposure Time as a Function of Aperture. The neutral density filters, providing attenuations of 7.5 and 12.5 magnitudes are also available, though not listed in this table.

Spectral type	Limiting Magnitude			
	50CCD	F28X50LP	F28X50OII	F28X50OIII
O5V	10.3	8.7	4.8	2.7
B1V	10.2	8.7	4.6	2.7
B5V	10.0	8.8	4.2	2.7
B8V	10.0	8.8	3.8	2.7
A1V	9.9	8.9	3.3	2.7
A3V	9.8	8.9	3.2	2.7
A5V	9.8	9.0	3.2	2.7
F0V	9.8	9.1	3.2	2.6
F5V	9.9	9.2	3.1	2.6
G2V	9.8	9.3	2.8	2.6
G5V	9.9	9.4	2.7	2.6
K0V	9.9	9.5	2.2	2.6
K4V	10.1	9.7	1.4	2.6
K7V	10.2	9.9	0.9	2.8
M2V	10.5	10.3	0.7	3.3
M6V	10.5	10.3	0.6	3.3
$F_v \propto v^{-1}$	10.1	9.4	3.8	2.8

Figure 8: Time to Achieve a Signal-to-Noise ratio of 40 for CCD Acquisitions





2.4 Acquisitions of Bright ($V > 5.4 \text{ arcsec}^{-2}$) Extended Objects

This issue, discussed in the Instrument Handbook, is no longer a concern. The commanding has changed to close the external shutter during the slit illumination phase of the target acquisition to remove this limitation.

2.5 Specifying Acquisitions in Phase II

Acquisition exposures must be specified during Phase II as individual exposure logsheet lines which precede the science exposures for which they are intended. The user requests a target acquisition exposure by specifying `MODE=ACQ` on the proposal logsheet, and setting the optional parameter `ACQTYPE=POINT` or `ACQTYPE=DIFFUSE`. If `ACQTYPE=DIFFUSE` is selected, the observer must also specify `DIFFUSE-CENTER` and `CHECKBOX`. The special requirement “ONBOARD ACQ FOR <exp IDs>” must be supplied for acquisition exposures, where the <exp IDs> given identify the subsequent science exposures the acquisition is being taken for.

In addition, you are required to provide the V magnitude and spectral type of the acquisition target. This information will allow for both manual and automatic checks of your target acquisition exposure times.

Exposure Time Calculator and RPS2 examples are provided in Appendix C.

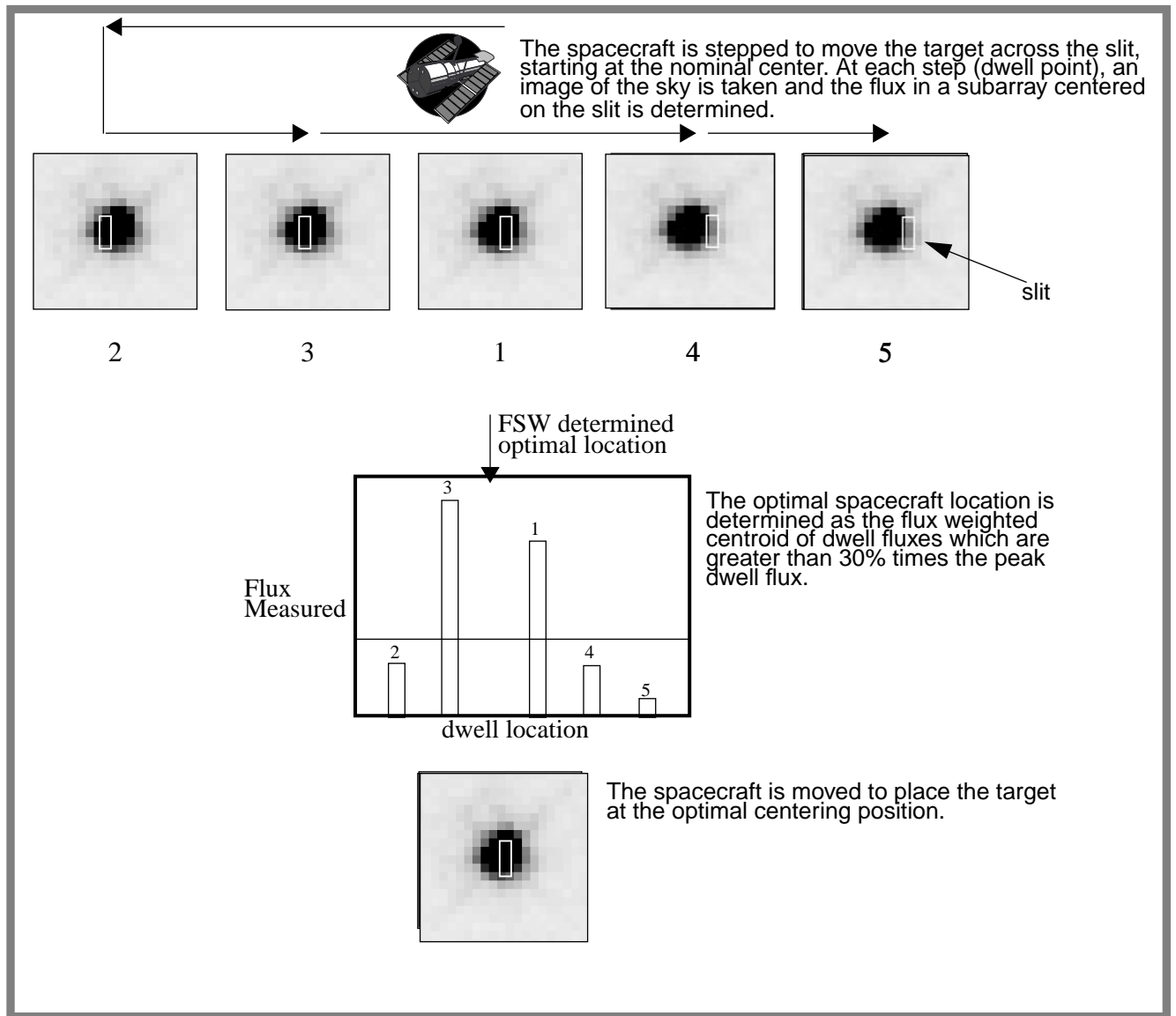
3. On-board Target Acquisition Peakups (`Mode=ACQ/PEAK`)

When using slits which are 0.2 arcseconds wide or less or the narrow coronagraphic bars, an acquisition peakup exposure should be performed following the acquisition exposure to center the target in a slit or coronagraphic bar. The drift rate by the observatory is less than 10 milli-arcseconds per hour. Thermal drifts internal to STIS are expected to be of the same magnitude. We recommend that for long series of exposures taken through slits which are less than 0.1 arcseconds in either dimension, a peakup be performed every 4-5 orbits. This will assure that drifts (caused either by thermal changes in the observatory or within STIS itself) do not cause the target to move out of the slit.

Figure 9 illustrates the basic peakup sequence. When a peakup exposure is performed, the telescope is moved to step the target across the slit or bar. At each step (or dwell point), an image² of the sky is taken and the total flux in a specified subarray is determined. The flight software then selects the position of maximum flux, using either a flux weighted centroiding technique to determine the optimum position to a fraction of a dwell step (`CENTROID=YES`) or by simply returning to the brightest dwell point (`CENTROID=NO`). At the conclusion of the `ACQ/PEAK` exposure, the FSW moves the telescope to position the target at the derived optimal position within the aperture.

2. For CCD `ACQ/PEAK`s the same type of processing is applied as in acquisitions by the FSW to remove the bias and cosmic rays is applied (see also footnote on page page 7).

Figure 9: Schematic of Peakup Sequence



Peakup exposures can be taken using either a mirror (to peak up in undispersed white light) or a grating (to peak up in dispersed light) and using either the CCD or the MAMA detectors. Subarrays can be specified to limit the region of the detector (sky) over which the flux is determined at each dwell point. The default CCD subarray sizes, 32 by 32 for white light (mirror) peakups and 32 in cross dispersion by 1022 in dispersion for dispersed light peakups, are appropriate for peakups on point sources. They should be changed only if you are performing diffuse source peakups or if you wish to isolate a single line in dispersed light peakups., and upon consultation with your Contact Scientist.



We recommend that you perform all CCD peakups using the mirror unless your target is too bright.

You do not specify the parameters of the stepping sequence employed during the peakup; it is predetermined, based on the aperture you have chosen. Table 3 below shows the scan sequence employed for all of the long and echelle slits. The scan sequence for a peakup may include a linear scan in the dispersion direction (SEARCH=LINEARAXIS1), a linear scan in the cross-dispersion direction (SEARCH=LINEARAXIS2), or a spiral search pattern (SEARCH=SPIRAL) and includes a number of steps (NUMSTEPS) and step intervals between each dwell point (STEP SIZE).

Table 3. . Scan Sequences and Parameters for Spectroscopic Slits

Slit (APERTURE)	AXIS2 spatial (arcsec)	AXIS1 dispersion (arcsec)	AXIS2 step size (arcsec)	AXIS1 step size (arcsec)	Scan Type	NSTEPS AXIS2	NSTEPS AXIS1	Total NSTEPS (numsteps)
52X0.1	52	0.1		0.075	LINEARAXIS1		5	5
52X0.2	52	0.2		0.150	LINEARAXIS1		3	3
0.2X0.2	0.2	0.2	0.150	0.150	1) LINEARAXIS2 2) LINEARAXIS1	3	3	6
0.2X0.09	0.2	0.09	0.069	0.069	1) LINEARAXIS2 2) LINEARAXIS1	3	5	8
0.2X0.06	0.2	0.063	0.048	0.048	1) LINEARAXIS1 2) LINEARAXIS2	3	5	8
0.1X0.2	0.1	0.2	0.075	0.150	1) LINEARAXIS1 2) LINEARAXIS2	5	3	8
0.1X0.09	0.1	0.09	0.075	0.069	SPIRAL			25
6.0X0.2	6	0.2		0.150	LINEARAXIS1		3	3

3.1 Selecting Peakup Parameters

To plan your acquisition peakup, you must specify:

- The detector and optical element.
- The APERTURE (science slit) upon which to peak up.
- The exposure time for the peakup image.

3.1.1 Selecting the detector and optical element

Peakups can be performed using either the CCD, the NUV-MAMA, or the FUV-MAMA. They can be performed either with a dispersive element in a spectroscopic con-

figuration using any of the allowed gratings detector combinations or in undispersed white light in an imaging configuration. “Tips on Acquisition Peakups” (below) provides advice on when to use a white light (mirror) and when to use a dispersive element (grating) for your peakup.

3.1.2 Selecting the aperture

A peakup can be done using any of the long or echelle slits in Table 3 as the APERTURE. You will (typically) want to specify the peakup aperture as the aperture used for the subsequent science observations, although it is possible to specify a smaller aperture than your science aperture if you require higher centering accuracy. Instances in which you may wish to utilize a smaller aperture for the acquisition are coronagraphic observations, observations requiring accurate photometry (where you need to be properly centered in a large slit), and bright source acquisitions.

For acquisitions under the narrow (≤ 0.2 arcseconds) occulting fiducial (52X0.2F1), a peakup acquisition using a small slit should be used. The bar and wedge positions on the 50CORON aperture (imaging) are all large enough that a peakup is not required. However, if you require accurate centering (for example, to place a calibration star at the same position under the bar or wedge to measure the scattered light profile), then a peakup is required. Note that a peakdown acquisition, as discussed in the Instrument Handbook, is no longer recommended.

3.1.3 Determining the Peakup exposure time

The required exposure time for CCD imaging (mirror) peakups is the time to obtain a minimum of 5000 electrons (1250 DN) from a point source, or equivalently, 5000 electrons from the peak of a diffuse source which is contained in a 4x4 pixel region. For CCD dispersive (grating) peakups, the exposure time is the time to obtain a minimum of 80,000 electrons (20,000 DN) from a point source (or equivalently, 80,000 electrons from the peak of a diffuse source integrated over 4 pixels in the cross-dispersion direction).³ For CCD dispersive peakups on a single emission line, the exposure time is the time to obtain a minimum of 5000 electrons in the chosen line, assuming a small sub-array is selected to isolate the line. For MAMA peakups, the exposure time is the time to obtain 5000 counts in the object (for both imaging and dispersive peakups).

To determine the exact exposure time, you should use the STIS Imaging Exposure Time Calculator (for imaging peakups) or the STIS Spectroscopic Exposure Time Calculator (for dispersive peakups). Be sure to include the effect of your chosen slit throughput (see Chapter 13 of the Instrument Handbook) in your calculation (e.g., for imaging peakups, where the Exposure Time Calculator does not account for slit loss). For CCD peakups

3. Note that the STIS CCD Phase II Update incorrectly states these limits as electrons per second.

you must be sure not to saturate the CCD during your peakup exposure. Table 2 lists the brightest magnitude star for a range of spectral types on which a CCD peakup exposure can be performed in white light, assuming zero slit losses. Note that the overheads in target acquisition are substantially longer than most exposure times, so as long as you do not saturate (within 30% of the full well) your target, you should increase your exposure time by a factor of 2-5 above the minimum required (e.g. if the exposure time to obtain the requisite number of electrons is 0.3 seconds, then you can lengthen it to 1 second if no saturation occurs).

There is a limit on the maximum exposure time allowed for CCD peakups, which is imposed to ensure that multiple coincident cosmic rays do not affect the centering accuracy⁴. Table 4, below, lists the maximum CCD exposure time for point source white light and dispersed light peakups for each aperture.

Table 4. Maximum Allowed Exposure Times for CCD Peakups

Slit (APERTURE)	Maximum Exposure Time for Dwell (minutes)
52x0.1	7.5
52x0.2	9.5
0.2x0.2	6.5
0.2x0.09	6.0
0.2x0.06	6.0
0.1x0.2	6.0
0.11x0.09	3.5
6.0x0.2	9.5

3.2 Tips on Acquisition Peakups

When do you Need to do a Peakup?

For Cycle 7, we recommend that peakups be employed for all slits which are less than or equal to 0.2 arcseconds wide or tall. For the larger slits (52x2, 52x0.5), there is no benefit in performing a peakup and peakups are therefore not permitted with these slits.

4. More generally, the maximum allowed exposure time for CCD ACQ/PEAKs is:

$$t_{max} = 17 \times 1 / (\sqrt{numsteps \times (SIZE - AXIS2) \times (SIZE - AXIS2) / 32 \times 32}) \text{ minutes.}$$

White Light or Dispersed Light, CCD or MAMA Peakups?

Most peakup exposures should be performed using the CCD in imaging mode (white light).

If your target is too bright to perform a CCD peakup with a camera mirror in place, you can use the echelle slit 0.2X0.05ND (which has an ND filter with a factor of 100 attenuation) or use a dispersed light peakup. Also note that if you wish to peakup in a particular line for which there is no imaging filter, a dispersed light peakup using a grating should be used. Observers should generally perform dispersed light peakups with the same grating and aperture they intend to use for their science observations.

If you are obtaining a long series (4 orbits or more) of MAMA observations in a narrow slit, you will need to perform re-centering peakups. In that case, you may choose to perform dispersed light peakups obtained with the same slit and grating used for the science observations to minimize overheads.

Contrary to our initial expectations, the accuracy of CCD peakup's is now thought to be essentially the same as that for the MAMAs. There may be a slight advantage using a MAMA peakup due to the smaller size of the point spread function in the ultraviolet, although bright object concerns may limit the utility of MAMA peakups. Generally we anticipate that most peakups will be done with the CCD.

If extremely high centering accuracy is required, observers should consider peaking up in a smaller slit than the science slit; the slit-to-slit positional accuracy is 0.005 arcseconds. This strategy has been widely used with the FOS, and will introduce an additional (small) overhead. Observers can contact their Contact Scientist to assist them in designing a peakup sequence with a smaller slit than the science slit.

3.3 Specifying Acquisitions in Phase II

The user requests a peakup acquisition exposure during Phase II by specifying `MODE=ACQ/PEAK` on the proposal logsheet. The default setting for the scan (`SEARCH`, `NUMSTEPS`, `STEP SIZE`) for your chosen `APERTURE` is then automatically selected from the lookup table. You specify a link to the science exposures following the target acquisition, using the logsheet special requirement `ONBOARD ACQ FOR <exp IDs>`. Exposure Time Calculator and RPS2 examples are provided in Appendix C.

4. STIS Post-Observation Target Acquisition Analysis

Unlike the previous spectrographs on HST, it will be possible to determine exactly where HST was pointed during your observations. There are methods, described below, for determining both a coarse (eyeball estimate) and a fine (the exact pixel) pointing.

4.1 Paper products - a coarse centering

After your observations have executed, you will receive, in addition to your data files, a set of paper products providing a high-level overview of your observations. Included in this package will be a summary page for the CCD acquisition, which will contain an image of the initial HST pointing, as well as an image following the initial centering (step 3 in the acquisition sequence). The object in the center of this image is the target that was acquired by STIS; the remaining steps in the acquisition sequence just center that target in the aperture. This level of accuracy is sufficient to check your acquisition of point sources. If you also performed an ACQ/PEAK, you will receive paper products which include a grid of the counts at each point in the pickup pattern and a confirmation image of the target after the final centering.

4.2 TAS - a fine centering

Once you have your data, you can use the Target Acquisition Simulator (TAS; see Appendix B) to determine the exact position in your source that was acquired. The TAS will take the STIS image of the initial pointing and, using the same algorithm as the flight software, tell you the location of the target, in pixel coordinates. This level of accuracy will be needed to check your acquisition on a diffuse source.

Appendix A: Determining the PLATE-ID of WFPC2 observations

All HST data has at least one guide star ID in the Standard Header Packet (SHP). Data from the SHP will be recorded in the SHH file that accompanies all HST observations. The guide stars that were used in any pointing will be recorded in the SHH as character strings associated with specific keywords in the header.

The Primary or Dominant guide star is associated with the keyword DGESTAR and the Secondary or Sub-dominant guide star is associated with the keyword SGESTAR. The guide star ID is a concatenation of the star number, the region number from the guide star catalogue, and the FGS used in the pointing:

e.g. 0123406789F2,

as a quoted character string. The actual guide star in this example is 01234 06789 and used FGS2.

To find the PLATE-ID that was used for the coordinates, run the WWW interface to *readgsc* (http://www-gsss.stsci.edu/support/rgscid_form.html) that will prompt for the guide star ID (in two fields). The output from this program will give the coordinates, estimated magnitude, associated errors, flags internal to the catalogue's structure, and the PLATE-ID. Note that for most guide stars there will be multiple entries (that have multiple PLATE-IDs), as the plates taken for the guide star catalog overlap. The first line from the output of *readgsc* will be for the primary plate -- the preferred plate for the guide star in question, and, if two guide stars were used, the PLATE-ID you should specify in your Phase II program. If the observation used a single guide star, it is possible that a secondary plate was used. Please contact your CS if this is the case.

Appendix B: The Target Acquisition Simulator

Overview of the Simulator

This STIS Target Acquisition Simulator (TAS) is intended to give observers a feeling for what target is likely to be selected when their observation is executed. This is particularly true for targets in crowded and/or complex fields, or spatially extended targets. The TAS implements the *same algorithms as the flight software*, and so should give results in good agreement what will happen on-orbit.

What the TAS will do

The TAS takes as input (see sample below) your image, extracts a subarray centered on the coordinates you provide, looks for the brightest (whole pixel) location by passing a checkbox over the subarray, and (if the “flux centroid” option is selected) refines that location by computing a flux-weighted centroid in the brightest checkbox. The TAS will output (see sample below) the results of its calculation (the pixel “acquired”), and include any warning messages that may apply.

What you should do

Since the TAS output does not at present display your image with the target location marked, you will probably find it useful to display the image on your machine (with, e.g., SAOimage) and find the target location with your cursor. Try different target types and checkbox sizes to see if the computed target location is sensitive to these input parameters if you using the TAS to define a diffuse source acquisition. If you input an actual STIS target acquisition image to determine where you were pointed, you should use the exact same parameters that you specified in your Phase II submission.

Limitations of the Simulator

There are a few limitations of the TAS that must be kept in mind when planning the acquisition strategy.

- Images with a spatial scale much different than that of STIS CCD images are not likely to be useful for simulating a target acquisition. Early acquisition or archival images obtained with FOC, WF/PC or WFPC-2 should be useful for the TAS, but early acquisition STIS/CCD images will obviously work best.
- Early acquisition or archival images will have been reduced differently than those obtained for an actual STIS observation. Moreover, the signal-to-noise ratio for these images is likely to be significantly higher than what can be realized during an acquisition on-orbit. Thus, for example, multiple targets of nearly equal total flux may result in a different selection on orbit than in the simulation.

User images will almost certainly have different photometric properties than those obtained on orbit (unless the STIS CCD was used with the same filter). Thus, it is generally not possible to simulate the S/N ratio, and therefore the rejection criteria, that will be enforced on orbit. Observers should not make use of the STIS Imaging Exposure Time Calculator for this purpose. As well, if your image was not obtained with the same band-pass, the apparent target brightness may be somewhat different during the actual acquisition.

Step-by-Step Instructions

There are a few simple steps to running the STIS Target Acquisition Simulator:

1. Transfer your image of the target to the STScI ftp area. The file must be in FITS format; it must not be smaller than 100x100 pixels nor larger than 1024x1024 pixels in size. Files placed in the ftp area will have a lifetime of a few days before being deleted, so it is in general not necessary to upload your image every time you invoke the TAS.

To transfer a file called “myimage.fit” with ftp:

```
twilo> ftp ftp.stsci.edu
ftp> cd outside-access/in.coming
ftp> binary
ftp> put myimage.fit
ftp> quit
```

2. Enter the name your image file in the dialog box. The file extension must be either `.fit.` or `.fits.`
3. Select a reference pixel within which the program will look for the target (if your image is larger than 100x100 pixels).
4. Indicate the spatial extent of the target. If the target is not a point-source, then you must also:
 - Select the centering algorithm, which is either *geometric* (brightest whole pixel), or *flux-weighted centroid* (fractional pixel).
 - Choose a size (in pixels) for the checkbox. The size of the (square) checkbox must be an odd number between 3 and 105 inclusive.
5. Click on the “Perform Calculation” button.
6. Repeat the steps above with different choices of target type and checkbox size to see if the result is sensitive to these parameters.

The following is an example of how to use the Target Acquisition Simulator. The image - tatest.fits - is of an elliptical galaxy (see next page). The image is 300x300 pixels, with the approximate center of the object at 110,150. A DIFFUSE source acquisition, using the flux-weighted centering algorithm, is being employed. Analysis of the image (which should ideally be an HST image in the same bandpass as the STIS acquisition image) shows that the object is centered at 109.4,153.9. After trying various CHECKBOX sizes, it was found that a size of 11 will properly acquire the objects.



STIS Target Acquisition Simulator

Fill out this form to simulate a STIS target acquisition with a FITS image you provide. See the [TAS Users Guide](#) for detailed instructions.

Please provide the name of your FITS Image:

ftp.stsci.edu:outside-access/fin.coming/

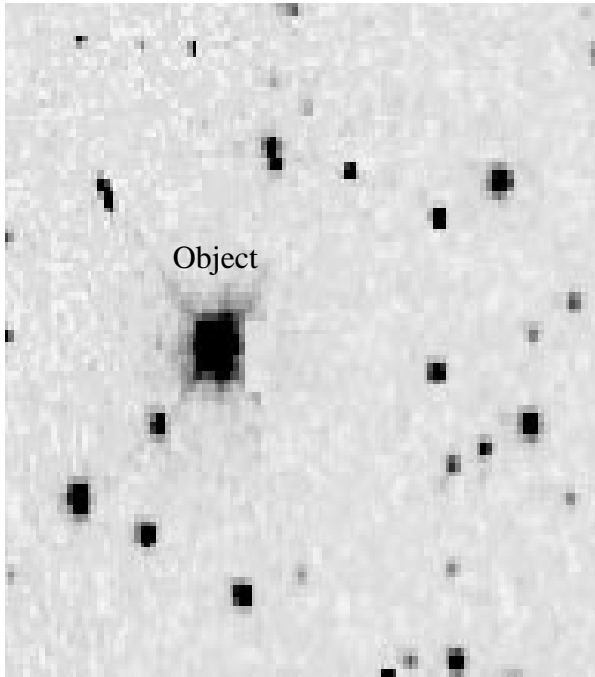
If the image is larger than 100x100 pixels, specify the center of the sub-image

in X: **and in Y:** **within which your target may be found.**

Specify the target spatial extent:

Point source.

Diffuse with Geometric centering, and checkbox size: pixels.



The field of an extended target to be acquired by STIS. The original image was 300x300 pixels, with the object roughly centered at 110,150. Ideally, this image should be at the same resolution, and in a similar bandpass, as the image to be obtained with STIS.



Results of the STIS Target Acquisition Simulator

TAS Software Version 1.1, 24-Feb-97

Here are the results of the target acquisition simulation:

Your Input

- **Image name:** tatest.fit[60:159,100:199]
- **Plate scale in X:** 0.09909999; **in Y:** 0.09909999 (arcsec/pixel)
- **Target type:** POINT
- **Size of checkbox:** 3
- **Centering method:** FLUX_CENTROID

TAS Results

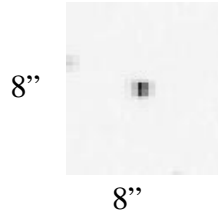
- **Brightest checkbox flux:** 11729.03418
- **Target location in X:** 109.447; **in Y:** 153.870

Warning Messages

None.

Appendix C: Examples

1) Point source acquisition of an isolated object - an isolated V=19 mag QSO (z=1.5) is to be acquired, with the science exposures to be obtained in the 52X0.5 slit.



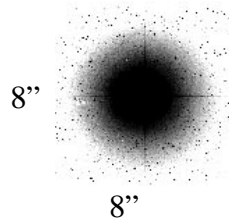
The target is isolated, so the science target will be acquired using a point source acquisition. The object is faint, so we can use the preferred F28X50LP filter. The Imaging Exposure Time Calculator is then used to determine an exposure time of 4.7 seconds. Note that the **GAIN=4 and CR-SPLIT=1 must be used** for the ETC to assure that you have a S/N of at least 40 in each of the two images obtained during the ACQ process. The object does not saturate the CCD, and the exposure time is less than 5 minutes, so we have devised a valid target acquisition. Given that the exposure time is so short, we can lengthen the time to 5.0 seconds (which yields a peak value of 1050 electrons, well below saturation) to make certain we have enough signal for a good acquisition. Since the science is being obtained in a wide slit, we do not need to perform an ACQ/PEAKUP, and our acquisition is complete.

Exposure Time Calculator

RPS2

<p>Detector and filter: CCD, Longpass</p> <p>Exposure Parameters Exposure time for S/N = 40</p> <p>Spectral Distribution QSO, z=1.5</p> <p>Flux V = 19, E(B-V) = 0</p> <p>Background Zod. Light/Earth = Average</p> <p>CCD Parameters binning = 1X1 Gain = 4 (REQUIRED) CR-SPLIT = 1 (REQUIRED)</p>	<p>Exposure_Number: 1 Target_Name: QSO Config: STIS/CCD Opmode: ACQ Aperture: F28X50LP Sp_Element: MIRROR Wavelength: Optional_Parameters: ACQTYPE=POINT Number_of_Iterations: 1 Time_Per_Exposure: 5.0 S Special_Requirements: ONBOARD ACQ FOR 2</p>
---	---

2) Point source acquisition of a bright, isolated object with a CCD dispersed light pickup - an isolated $V=3.5$ mag M2 I star is to be acquired, with the science exposures to be obtained in the 0.2×0.06 echelle slit.



The science target will be acquired with a point source acquisition, but because the object is so bright, we cannot use the preferred F28X50LP filter. Instead, we will use the F28X50OII filter, and the Imaging Exposure Time Calculator yields an exposure time of 0.03 seconds, which is less than the minimum allowed time of 0.1 seconds. Note that the **GAIN=4 and CR-SPLIT=1 must be used** for the ETC to assure that you have a S/N of at least 40 in each of the two images obtained during the ACQ process. We will therefore increase the exposure time to 0.5 seconds. The object does not saturate the CCD, and the exposure time is less than 5 minutes, so we have devised a valid target acquisition.

The science is being obtained in a narrow slit, so we need to perform an ACQ/PEAK acquisition. The target is far too bright to perform the pickup with the MIRROR, so we will need to do a dispersed light pickup. Since we cannot perform a CCD pickup with an echelle grating, we will use the G430M grating with the CCD and the science slit (0.2×0.06); note that for an ACQ/PEAK, this combination is legal. A one second exposure yields about 3000 electrons per pixel, while what is required is 80,000 electrons TOTAL in the spectrum. Since the spectrum is 1024 pixels long, our exposure time is valid, even after taking into account the slit loss. Given that the exposure time is so short, we can lengthen it to 3 seconds as an extra safety margin.

Exposure Time Calculator - ACQ

Detector and filter:
 CCD, 3729 [OII]

Exposure Parameters
 Exposure time for S/N = 40

Spectral Distribution
 Kurucz model M2 I

Flux
 V = 3.5, E(B-V) = 0

Background
 Zod. Light/Earth = Average

CCD Parameters
 binning = 1X1
 Gain = 4 (REQUIRED)
 CR-SPLIT = 1 (REQUIRED)

Exposure Time Calculator - ACQ/PEAK

1st Order CCD
 G430M

Detector and filter
 CCD, 50CCD (Slitless)

Exposure Parameters
 S/N reached in Exp. time = 1
 Central Wavelength = 4300

Spectral Distribution
 Kurucz model M2 I

Flux
 V = 3.5, E(B-V) = 0

Background
 Zod. Light/Earth = Average

CCD Parameters
 binning = 1X1
 Gain = 4 (REQUIRED)
 CR-SPLIT = 1 (REQUIRED)

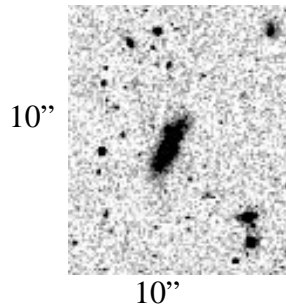
Exposure_Number: 1
 Target_Name: BRIGHT-STAR
 Config: STIS/CCD
 Opmode: ACQ
 Aperture: F28X50OII
 Sp_Element: MIRROR
 Wavelength:
 Optional_Parameters: ACQTYPE=POINT
 Number_of_Iterations: 1
 Time_Per_Exposure: 0.5 S
 Special_Requirements: ONBOARD ACQ FOR 2

Exposure_Number: 2
 Target_Name: BRIGHT-STAR
 Config: STIS/CCD
 Opmode: ACQ/PEAK
 Aperture: 0.2X0.06
 Sp_Element: G430M
 Wavelength: 4300
 Optional_Parameters:
 Number_of_Iterations: 1
 Time_Per_Exposure: 3.0 S
 Special_Requirements: ONBOARD ACQ FOR 3

RPS2 - ACQ

RPS2 - ACQ/PEAK

3) Diffuse source acquisition of a spiral galaxy - a isolated galaxy with at flux of $1.5 \times 10^{-14} \text{ erg cm}^{-2} \text{ s}^{-1} \text{ \AA}^{-1} \text{ arcsec}^{-1}$ at 2000 \AA is to be acquired, with the science exposures to be obtained in the 52X0.5 slit.



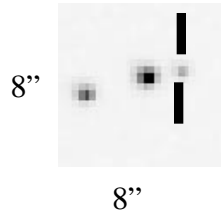
The target is isolated, so the science target will be acquired using a diffuse source acquisition. After running various checkbox sizes through the Target Acquisition Simulator (the image is from WFPC2), we determine that the appropriate CHECKBOX size is 9, and that we will use the FLUX-CENTROID algorithm. The object is faint, so we can use the preferred F28X50LP filter. The Imaging Exposure Time Calculator is then used to determine an exposure time of 3.1 seconds. Note that the **GAIN=4 and CR-SPLIT=1 must be used** for the ETC to assure that you have a S/N of at least 40 in each of the two images obtained during the ACQ process. The object does not saturate the CCD, and the exposure time is less than 5 minutes, so we have devised a valid target acquisition. Given that the exposure time is so short, we can lengthen the time to 5.0 seconds to make certain we have enough signal for a good acquisition. Since the science is being obtained in a wide slit, we do not need to perform an ACQ/PEAKUP, and our acquisition is complete.

Exposure Time Calculator

RPS2

<p>Detector and filter: CCD, Longpass</p> <p>Exposure Parameters Exposure time for S/N = 40</p> <p>Spectral Distribution Spiral Galaxy</p> <p>Flux $F_{2000} = 1.5 \times 10^{-14}$, $E(B-V) = 0$ Extended source: 3 arcsecond</p> <p>Background Zod. Light/Earth = Average</p> <p>CCD Parameters binning = 1X1 Gain = 4 (REQUIRED) CR-SPLIT = 1 (REQUIRED)</p>	<p>Exposure_Number: 1 Target_Name: GALAXY Config: STIS/CCD Opmode: ACQ Aperture: F28X50LP Sp_Element: MIRROR Wavelength: Optional_Parameters: ACQTYPE=DIFFUSE DIFFUSE-CENTER=FLUX-CENTROID CHECKBOX = 9 Number_of_Iterations: 1 Time_Per_Exposure: 5.0 S Special_Requirements: ONBOARD ACQ FOR 2</p>
---	--

4) Point source acquisition in a crowded field - a $V=19$ mag nova in a field with a brighter companion is to be acquired, with the science exposures to be obtained in the 52×0.2 slit.



The target is in a crowded field, so we need to determine what object to acquire. If only a ground-based image was available, and the spectral types of the neighboring stars were unknown, then an isolated offset star outside of the immediate field of the nova would need to be acquired. However, the above image was obtained with WFPC2 using the F555W filter, which has a similar bandpass to the STIS F28X50LP filter. We therefore know that the object to the southeast of the nova is clearly the brightest object in the field ($V=16.5$), and will be our acquisition object. The object is faint enough that we can use the preferred F28X50LP filter. The Imaging Exposure Time Calculator is then used to determine an exposure time of 0.8 seconds. Note that the **GAIN=4 and CR-SPLIT=1 must be used** for the ETC to assure that you have a S/N of at least 40 in each of the two images obtained during the ACQ process. Since we do not know the spectral type of the acquisition star, we will make a worst case (i.e., fewest counts) assumption that the star is of spectral type O5. The object does not saturate the CCD, and the exposure time is less than 5 minutes, so we have devised a valid target acquisition. Note that since we do not know the spectral type of the object, we need to confirm that if the star had a spectral type of M6 V (which gives the most counts in the F28X50LP bandpass) it would still not saturate. Given that the exposure time is so short, we can lengthen the time to 3.0 seconds to make certain we have enough signal for a good acquisition.

The science is being obtained in a narrow slit, so we need to perform an ACQ/PEAK acquisition. The peakup will be performed in the science slit (52×0.2), and we will use the CCD and the MIRROR. A one second exposure yields 780 electrons in the target, so an exposure time of 7 seconds yields 5460 electrons, which meets the minimum requirement of 5000 electrons. We need to lengthen the exposure time by a factor of 1.25 (see table 13.17 in the Instrument Handbook) to account for the slit throughput, for a final exposure time of 8.75 seconds, which we can expand to 10 seconds. The object does not saturate the CCD, and the exposure time is less than 9.5 minutes (the maximum time for a peakup with the 52×0.2 slit), so we have devised a valid peakup target acquisition.

Exposure Time Calculator - ACQ

Detector and filter:
 CCD, Longpass

Exposure Parameters
 Exposure time for S/N = 40

Spectral Distribution
 Kurucz model O5

Flux
 V = 16.5, E(B-V) = 0

Background
 Zod. Light/Earth = Average

CCD Parameters
 binning = 1X1
 Gain = 4 (REQUIRED)
 CR-SPLIT = 1 (REQUIRED)

Exposure Time Calculator - ACQ/PEAK

Detector and filter:
 CCD, CLEAR

Exposure Parameters
 S/N reached in exp. time = 1

Spectral Distribution
 User supplied spectrum = nova

Flux
 V = 19, E(B-V) = 0

Background
 Zod. Light/Earth = Average

CCD Parameters
 binning = 1X1
 Gain = 4 (REQUIRED)
 CR-SPLIT = 1 (REQUIRED)

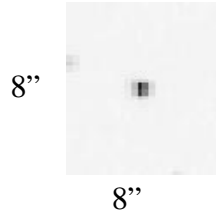
Exposure_Number: 1
 Target_Name: OFFSET-STAR
 Config: STIS/CCD
 Opmode: ACQ
 Aperture: F28X50LP
 Sp_Element: MIRROR
 Wavelength:
 Optional_Parameters: ACQTYPE=POINT
 Number_of_Iterations: 1
 Time_Per_Exposure: 3.0 S
 Special_Requirements: ONBOARD ACQ FOR 2

RPS2 - ACQ

Exposure_Number: 2
 Target_Name: NOVA
 Config: STIS/CCD
 Opmode: ACQ/PEAK
 Aperture: 52X0.2
 Sp_Element: MIRROR
 Wavelength:
 Optional_Parameters:
 Number_of_Iterations: 1
 Time_Per_Exposure: 10.0 S
 Special_Requirements: ONBOARD ACQ FOR 3

RPS2 - ACQ/PEAK

5) Point source acquisition of a QSO with fuzz - an isolated $V=16.5$ mag QSO ($z=0.2$) is to be acquired, with the science exposures to be obtained with the QSO behind the 5.2×0.2 fiducial bar.



The target is isolated, so the science target will be acquired using a point source acquisition. The object is faint, so we can use the preferred F28X50LP filter. The Imaging Exposure Time Calculator is then used to determine an exposure time of 0.95 seconds. Note that the **GAIN=4 and CR-SPLIT=1 must be used** for the ETC to assure that you have a S/N of at least 40 in each of the two images obtained during the ACQ process. The object does not saturate the CCD, and the exposure time is less than 5 minutes, so we have devised a valid target acquisition. Given that the exposure time is so short, we can lengthen the time to 3.0 seconds to make certain we have enough signal for a good acquisition.

The QSO is to be placed behind a fiducial bar, so we need to perform an ACQ/PEAK acquisition. The peakup will be performed in the 0.2×0.2 slit (peakdown acquisitions are not recommended), and we will use the CCD and the MIRROR. A one second exposure yields 5400 electrons in the target, and correcting for the aperture throughput (65% at 2400\AA , which is a worst case given that the CCD is peaked in the optical) yields 3510 electrons. We thus require slightly longer than 1 second to obtain the minimum requirement of 5000 electrons in the target, so we can expand our final exposure time to 5.0 seconds. The object does not saturate the CCD, and the exposure time is less than 6.5 minutes (the maximum time for a peakup with the 5.2×0.2 slit), so we have devised a valid peakup target acquisition.

Exposure Time Calculator - ACQ

Detector and filter:
 CCD, Longpass

Exposure Parameters
 Exposure time for S/N = 40

Spectral Distribution
 QSO, z=0.2

Flux
 V = 16.5, E(B-V) = 0

Background
 Zod. Light/Earth = Average

CCD Parameters
 binning = 1X1
 Gain = 4 (REQUIRED)
 CR-SPLIT = 1 (REQUIRED)

Exposure Time Calculator - ACQ/PEAK

Detector and filter:
 CCD, CLEAR

Exposure Parameters
 S/N reached in exp. time = 1

Spectral Distribution
 QSO, z=0.2

Flux
 V = 16.5, E(B-V) = 0

Background
 Zod. Light/Earth = Average

CCD Parameters
 binning = 1X1
 Gain = 4 (REQUIRED)
 CR-SPLIT = 1 (REQUIRED)

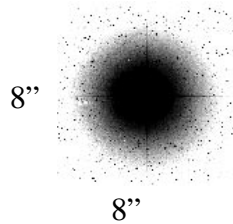
Exposure_Number: 1
 Target_Name: QSO-FUZZ
 Config: STIS/CCD
 Opmode: ACQ
 Aperture: F28X50LP
 Sp_Element: MIRROR
 Wavelength:
 Optional_Parameters: ACQTYPE=POINT
 Number_of_Iterations: 1
 Time_Per_Exposure: 3.0 S
 Special_Requirements: ONBOARD ACQ FOR 2

RPS2 - ACQ

Exposure_Number: 2
 Target_Name: QSO-FUZZ
 Config: STIS/CCD
 Opmode: ACQ/PEAK
 Aperture: 0.2X0.2
 Sp_Element: MIRROR
 Wavelength:
 Optional_Parameters:
 Number_of_Iterations: 1
 Time_Per_Exposure: 5.0 S
 Special_Requirements: ONBOARD ACQ FOR 3

RPS2 - ACQ/PEAK

6) Point source acquisition of a bright, isolated star - an isolated V=6.0 mag G2 V star is to be acquired, with the science exposures to be obtained with the star behind the WEDGEA1.8 mask.



The science target will be acquired with a point source acquisition, but because the object is so bright, we cannot use the preferred F28X50LP filter. Instead, we will use the F25ND3 neutral density filter, and the Imaging Exposure Time Calculator yields an exposure time of 0.14 seconds. Note that the **GAIN=4 and CR-SPLIT=1 must be used** for the ETC to assure that you have a S/N of at least 40 in each of the two images obtained during the ACQ process. The object does not saturate the CCD, and the exposure time is less than 5 minutes, so we have devised a valid target acquisition. Given that the exposure time is so short, we can lengthen the time to 0.5 seconds to make certain we have enough signal for a good acquisition.

The star is to be placed behind the WEDGE which is 1.8" in size, so we need to perform an ACQ/PEAK acquisition. The pickup will be performed in the (available) 0.3X0.05ND slit (peakdown acquisitions are not recommended), and we will use the CCD and the MIRROR. A one second exposure yields 52,450 electrons in the target after correcting for the filter throughput [both the neutral density (10^{-3}) and the slit throughput (55%)], while the brightest pixel has 29,510 electrons. We thus cannot significantly lengthen the exposure time without saturating the CCD. We have more than the minimum requirement of 5000 electrons in the target, the object does not saturate the CCD, and the exposure time is less than 6.0 minutes (the maximum time for a pickup with the similarly sized 0.2X0.06 slit), so we have devised a valid pickup target acquisition.

Exposure Time Calculator - ACQ

Detector and filter:
 CCD, F25ND3

Exposure Parameters
 Exposure time for S/N = 40

Spectral Distribution
 Kurucz model G2 V

Flux
 V = 6.0, E(B-V) = 0

Background
 Zod. Light/Earth = Average

CCD Parameters
 binning = 1X1
 Gain = 4 (REQUIRED)
 CR-SPLIT = 1 (REQUIRED)

Exposure Time Calculator - ACQ/PEAK

Detector and filter:
 CCD, CLEAR

Exposure Parameters
 S/N reached in exp. time = 1

Spectral Distribution
 Kurucz model G2 V

Flux
 V = 6.0, E(B-V) = 0

Background
 Zod. Light/Earth = Average

CCD Parameters
 binning = 1X1
 Gain = 4 (REQUIRED)
 CR-SPLIT = 1 (REQUIRED)

Exposure_Number: 1
 Target_Name: G-STAR
 Config: STIS/CCD
 Opmode: ACQ
 Aperture: F25ND3
 Sp_Element: MIRROR
 Wavelength:
 Optional_Parameters: ACQTYPE=POINT
 Number_of_Iterations: 1
 Time_Per_Exposure: 0.5 S
 Special_Requirements: ONBOARD ACQ FOR 2

RPS2 - ACQ

Exposure_Number: 2
 Target_Name: G-STAR
 Config: STIS/CCD
 Opmode: ACQ/PEAK
 Aperture: 0.3X0.05ND
 Sp_Element: MIRROR
 Wavelength:
 Optional_Parameters:
 Number_of_Iterations: 1
 Time_Per_Exposure: 1.0 S
 Special_Requirements: ONBOARD ACQ FOR 3

RPS2 - ACQ/PEAK

Appendix D: Acquisition Peakup overheads

Use the expressions below to get a rough estimate of the amount of time an ACQ/PEAK will take (including overheads).

Table 5. Acquisition Peakup Times, White Light or Dispersive

Aperture	Peakup	CCD Duration (seconds)	MAMA Duration (seconds)
<i>All Long Slits</i>			
52X0.1	5 steps AXIS1	$180+12*t_{exp}$	$180+6*t_{exp}$
52X0.2	3 steps AXIS1	$120+8*t_{exp}$	$120+4*t_{exp}$
52X0.5	3 steps AXIS1	$120+8*t_{exp}$	$120+4*t_{exp}$
52X2.0	3 steps AXIS1	$120+8*t_{exp}$	$120+4*t_{exp}$
52X0.5F1	3 steps AXIS1 3 steps AXIS2	$240+16*t_{exp}$	$240+8*t_{exp}$
<i>Echelle Slits for E230M and E140M</i>			
0.2X0.06	7 steps AXIS1 3 steps AXIS2	$360+24*t_{exp}$	$360+12*t_{exp}$
0.2X0.2	3 steps AXIS1 3 steps AXIS2	$240+16*t_{exp}$	$240+8*t_{exp}$
<i>Echelle Slits for E230H</i>			
0.1X0.09	25 step SPIRAL	$780+52*t_{exp}$	$780+27*t_{exp}$
0.1X0.2	5 steps AXIS1 3 steps AXIS2	$300+20*t_{exp}$	$300+10*t_{exp}$
<i>Echelle Slits for E140H</i>			
0.2X0.09	5 steps AXIS1 3 steps AXIS2	$300+20*t_{exp}$	$300+10*t_{exp}$
0.2X0.2	3 steps AXIS1 3 steps AXIS2	$240+16*t_{exp}$	$240+8*t_{exp}$