

Cycle 12 Phase 2 Update for STIS

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STIS has been operating with some significant changes in its performance since the release of the STIS Instrument Handbook (IHB) version 6.0. This update provides the latest information regarding STIS performance and policies which are relevant to the preparation of Cycle 12 Phase 2 proposals. The items presented here may also be found on the STIS web page at <http://www.stsci.edu/hst/stis>. As always, new information will be regularly described in the Spectrographs STAN (Space Telescope Analysis Newsletter) and posted on the web pages. General help or documentation may be obtained by sending email to help@stsci.edu.

This update should be used in conjunction with the STIS IHB v6.0 and the Cycle 12 Phase 2 Proposal Instructions to aid you in the completion of your Phase 2 proposal for Cycle 12. If you have specific questions not covered in the documents, you should consult your Program Coordinator, Contact Scientist (if one has been assigned), or send email to help@stsci.edu.

0.2X0.2 Aperture Supported for all First Order Spectra

The 0.2X0.2 aperture is now fully supported for all first order grating spectroscopy (G140L, G140M, G230L, G230M, G230LB, G230MB, G430L, G430M, G750L, and G750M) with both the MAMA and CCD detectors. Such data will now be fully calibrated by the pipeline. For observations with the NUV-MAMA PRISM, the 0.2X0.2 aperture will remain as available-but-unsupported.

Support in the Exposure Time Calculator (ETC) for this aperture with the first order gratings will be available soon. In the meantime, observers can estimate count rates by selecting the 52X0.2 aperture in the ETC menu.

Use of the 0.2X0.2 aperture for first order MAMA spectra will greatly simplify the process of checking for nearby field objects that might be bright enough to endanger the detector. Its use is therefore strongly encouraged for MAMA SNAP programs. This aperture may also be useful for first order spectroscopy of targets in crowded fields, or when observing a faint object near a bright target.

One disadvantage of using this aperture is that it will be more difficult to subtract any sky background (including geocoronal lines), since there will not be any region of the detector exposed to the sky alone.

New STIS Aperture Locations

A number of new aperture locations are being implemented for STIS. These are expected to become available and fully supported at some point during Cycle 12. Here we describe these new aperture locations and their intended purposes. We also provide the POS TARG parameters that will allow these new aperture positions to be specified as offsets from existing apertures. This will allow these new aperture locations to be used before they are fully implemented in the HST ground system.

Note that all of these new apertures define new positions within existing apertures. As a result, the APERTURE keyword in the headers of the archived data will contain the name of the parent aperture, while the PROPAPER keyword will contain the aperture name specified in the Phase 2 proposal. For example, if the Phase 2 proposal requests the 52X0.1D1 position, the APERTURE keyword will be set to 52X0.1, while the PROPAPER keyword will be 52X0.1D1.

E2 Aperture Positions for Better Fringe Flats

In 1999, the E1 aperture positions were introduced to allow first order CCD spectra to be positioned at row 900 near the CCD readout amplifier, thereby reducing the effects of Charge Transfer Inefficiency (CTI). This works well, however, for G750L and G750M spectra taken near row 900, the fringe flats have to be done using the 52X0.1 aperture rather than the 0.3X0.09 aperture, which is usually used for fringe flats near the center of the detector (see [Fringe Flat Fields](#) in the STIS Instrument Handbook for a more detailed discussion of IR fringe flats). Unfortunately, the 52X0.1 slit is shifted by about one pixel in the dispersion direction from the centers of the wider long slits. This misalignment reduces the accuracy of fringe subtraction.

To address this, we are defining three new aperture locations: 52X2E2, 52X0.5E2, and 52X0.2E2. When these apertures are specified, the target will be placed off-center in the slit, at a position coincident with the 52X0.1E1 aperture. This will improve the match between the fringes in the target and lamp spectra. Be aware, however, that the 52X0.2E2 aperture position is offset sufficiently from the physical center of the aperture that there will be noticeable changes in the aperture throughput.

These E2 aperture positions should only be used for ACCUM exposures with the G750L or G750M gratings when fringe flats with the 52X0.1 aperture are also being done. If a peakup is desired before using the E2 apertures, the peakup should be done using the 52X0.1E1 aperture.

D1 Aperture Positions for Low FUV Dark Current

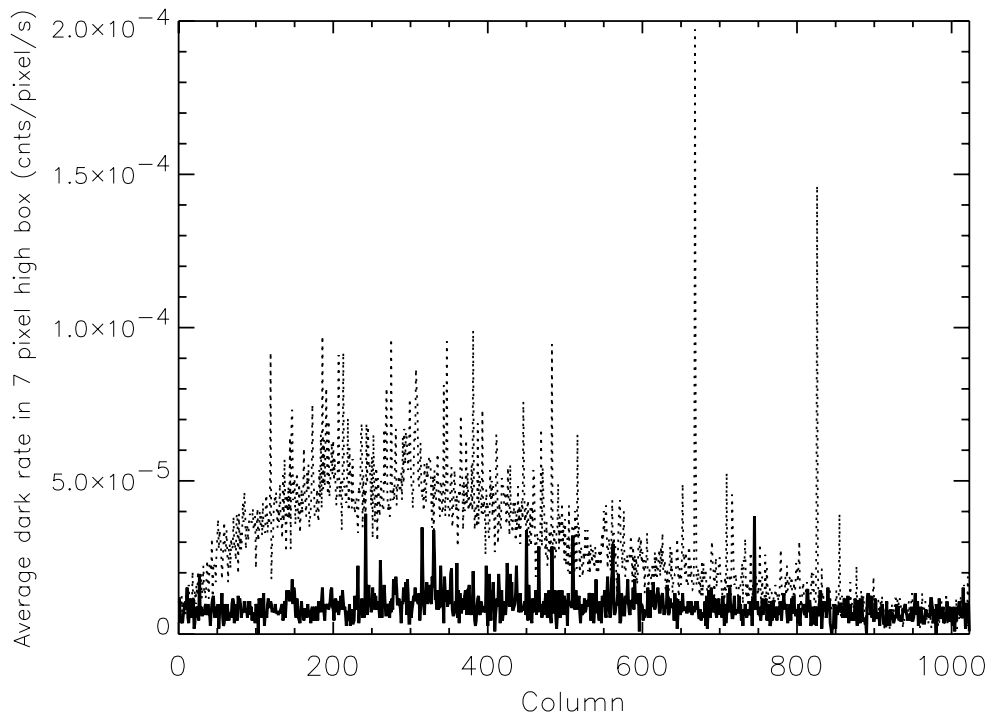
The FUV MAMA suffers from an irregular dark glow that varies unpredictably in intensity. When this glow is absent, the typical dark rate of the FUV MAMA detector is about 6×10^{-6} cts/pixel/s. When the glow is strong, it can enhance the dark current to as much as 1×10^{-4} cts/pixel/s over a large fraction of the detector. For first order spectra, the best way to minimize this extra dark current is to put the target at a location on the detector where the extra dark current is small.

For first order spectra of faint sources less than about 1" in angular extent, we recommend that this be done by placing the target about 2" above the bottom edge of the FUV MAMA detector. Since for the G140L and G140M the locations where the regular aperture positions project onto the center of the detector are already displaced about 3" below the center (in order to avoid the shadow of the FUV MAMA repeller wire), this requires an additional displacement of about -6.8" in the cross dispersion, or y, direction. This can reduce the extra dark current by up to a factor of 6 (see Figure 1). The instrument calibrations may not be quite as accurate at this position as they are at the center of the detector. Background subtraction may also be more difficult due to the proximity to the edge of

the detector. Therefore, use of this position is recommended only for objects sufficiently faint that the FUV MAMA dark current is the major limitation on the achievable accuracy.

The D1 apertures listed in the table below will be supported for first order spectroscopic ACCUM or TIME-TAG observations with the G140L and G140M. The 52X0.1D1 and 52X0.05D1 will also be supported for CCD ACQ/PEAK observations. Note that the 25MAMAD1, F25QTZD1, and F25SRF2D1 aperture locations, as well as the equivalent POS TARGS given in table 1, are intended only for first order FUV MAMA slitless spectroscopy. Because FUV MAMA imaging modes do not include an offset to avoid the repeller wire, use of these same POS TARGs for FUV imaging observations would not put the target at the same place on the detector. Users who wish to offset faint imaging targets to avoid the worst of the FUV dark current should look at [figure 7.16](#) in the STIS Instrument handbook, or consult with a STScI Instrument scientist via help@stsci.edu.

Figure 1: The FUV MAMA mean dark current as a function of the detector column number (in a seven pixel high extraction box near the standard extraction position located 3" below the detector center)-(dotted line)- is compared with that in a box near the proposed pseudo-aperture position 6.8" further down (solid line). The data used are an average of 116 dark monitor exposures, each of 1380 seconds, taken between July 2001 and September 2002. This illustrates the typical reduction in the dark current affecting first order spectra that will result from putting the target 2" above the bottom of the detector.



New WEDGEA0.6 Coronagraphic Aperture

A number of aperture locations are defined within the STIS coronagraphic mask (see [Coronagraphic Imaging-50CORON](#) in the STIS IHB for further details). These allow different widths of the occulting wedges to be selected for use with CCD imaging observations. A number of observers have found it useful to use a non-standard wedge position that is narrower (about 0.6" wide) than any of the pre-defined locations. During Cycle 12, this location will be added to the supported list as WEDGEA0 . 6.

List of New STIS Apertures and Equivalent Offsets from Existing Apertures

For users who wish to use the new aperture positions before they become officially available, we supply below a list of equivalent POS TARG offsets from existing supported apertures (Table 1). Note that data taken in this way will be archived with the old aperture name in the PROPAPER header keyword.

Note that POS TARGs along the lengths of long slits automatically take into account the small angle between the slit and detector axis. So in principle, it is only necessary to specify a POS TARG in the y direction to move the target along the length of a long slit. In practice, the slits are slightly curved, so the table of recommended offsets below does include small offsets in the x-direction to keep the target well centered in the slit.

Table 1: The new STIS aperture location names are listed in the first column. The equivalent pointing can be achieved by specifying the aperture in the second column together with the POS TARG listed in the third column.

New Aperture	Existing Aperture	POS TARG
52X0 . 2E2	52X0 . 2E1	-0.060, 0
52X0 . 5E2	52X0 . 5E1	-0.053, 0
52X2E2	52X2E1	-0.048, 0
25MAMAD1	25MAMA	0.007, -6.8
F25QTZD1	F25QTZ	0.007, -6.8
F25SRF2D1	F25SRF2	0.007, -6.8
52X0 . 05D1	52X0 . 05	0.001, -6.8
52X0 . 1D1	52X0 . 1	0.004, -6.8
52X0 . 2D1	52X0 . 2	0.007, -6.8
52X0 . 5D1	52X0 . 5	0.011, -6.8
52X2D1	52X2	0.025, -6.8
WEDGEA0 . 6	WEDGEA1 . 0	-0.067, -7.4

Correcting for Charge Transfer Inefficiency of the STIS CCD

The correction for the change in sensitivity with time for the STIS CCD modes is complicated by the gradual loss of charge transfer efficiency (CTE) of the CCD. The amount of this CTE loss depends on the time on orbit, the location on the CCD chip with respect to the readout amplifier, the source signal, and the background levels.

It should be noted at the outset that the CTE effects have not, as yet, been incorporated into the STIS Exposure Time Calculators (ETCs). Thus, should you believe the CTE losses described herein may impact your program, you will need to provide longer exposure times in your Cycle 12 Phase 2 proposal to compensate for the anticipated losses. In particular, Cycle 12 observers using the STIS CCD to observe faint targets (especially spectroscopy of point sources or imaging of faint point sources) with less than a few hundred counts (integrated over an aperture of 5 pixel diameter) above a low background, are advised to adjust their exposure times appropriately, within the restrictions of their allocated number of orbits. Furthermore, observers using the CCD for long-slit spectroscopy of sources having a spatial extent less than about 3", are urged to use the pseudo-apertures located near row 900 of the CCD (the 52X*E1 apertures; see [Section 7.2.7](#) of the STIS Instrument Handbook).

From recent analysis of the charge transfer efficiency of the CCD, we have derived a formula to correct spectroscopic observations of point sources for the parallel-register Charge Transfer Inefficiency ($CTI = 1 - CTE$). For spectra at the standard reference position at the CCD center, CTE losses as big as 20% are corrected to within 1% at high signal levels, and to within ~1.5% at a low signal level of ~100 electrons, after application of the formula presented below:

$$CTI(B, G, t) = 0.0447 G^{-0.720} \times \exp\left(-3.85 \left(\frac{B}{G}\right)^{0.17}\right) \times [1 + 0.243(t - 2000.6)]$$

Where G represents the gross counts within the standard 7-pixel extraction box (for spectroscopy), B is the total background level (which is the sum of the sky, the dark current, and the spurious charge associated with STIS CCD readouts (see STIS Instrument Science Report 97-09)), and t is the time of observation (in years). The unit of the resulting CTI is fractional charge loss per pixel transfer.

To help successful Cycle 12 observers work out the impact of CTE losses to their spectroscopic CCD exposures during the preparation of their Phase 2 proposals, we have constructed an IRAF CL script which is now available from <http://www.stsci.edu/hst/stis/software/scripts> within the

STIS web site. This script needs three input parameters: gross and background counts, and time of observation. The appropriate gross and background counts can be found from the tabular output of a run with the Spectroscopic STIS ETC. The script then calculates the appropriate dimming factor to be applied to the target flux (or surface brightness) for input into a follow-up run of the ETC, which will then produce output data corrected for CTE loss.

Further analyses of CTE effects on imaging and spectroscopic observations of *extended* objects (e.g., galaxies) are in progress, and will be reported as STIS Instrument Science Reports (ISRs) on the web. For now, we recommend observers of extended objects to use the CTI correction formula mentioned above, which was derived using observations of point sources.

Updates to the STIS Exposure Time Calculators

The STIS Exposure Time Calculators (ETCs) (available at <http://www.stsci.edu/hst/stis/software>) were updated on 6 December 2002 to include new values for dark currents, an improved zodiacal sky spectrum, and the time dependence of the sensitivity for the MAMA detectors, as described below.

New values for the dark current have been included to reflect the changes in the instrument after servicing mission 3B in March 2002. The new rate for the CCD is 4.4×10^{-3} electrons/pixel/s for both GAIN=1 and GAIN=4, replacing the old value of 3.0×10^{-3} electrons/pixel/s. The NUV-MAMA now has a dark rate of 1.2×10^{-3} cts/pixel/s, replacing the old value of 1.4×10^{-3} cts/pixel/s. Finally, the FUV-MAMA has a glow region where the dark current is higher. Due to this effect, the dark current varies from 7.0×10^{-6} to 1.5×10^{-4} across the face of the detector. The ETC now uses a dark rate of 7.0×10^{-5} counts/pixel/s, replacing the old value of 7.0×10^{-6} counts/pixel/s. Note that the read noise values have not been changed since the previous update to the ETCs on 15 August 2001, following the switch to "side 2" electronics in July 2001.

The spectral shape for the zodiacal sky background has been updated taking into account the most recent measurements and models. Details on the zodiacal spectrum are given in WFC3 ISR 2002-12 by Giavalisco et al., available at <http://www.stsci.edu/instruments/wfc3/wfc3-docs.html>. The absolute photometric calibration has not been changed since the previous update of the ETCs on 15 August 2001. ($V = 22.1$, 22.7 and 23.3 mag/square arcsec for high, medium, and low zodiacal background.)

The ETCs now use `stdas.hst_calib.synphot` with new reference files to include time-dependent variations of the sensitivity in computations for MAMA first-order spectral and imaging modes. The epoch currently used

for the sensitivity computations is 2002.5. The expected time evolution is ~2% per year. Evolution of the sensitivity for different gratings and wavelength settings is shown in STIS ISR 2001-01R, available at <http://www.stsci.edu/hst/stis/documents/isrs>.