

# Cycle 11 Phase II 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 5.1 (July 2001). This update provides the latest information regarding STIS performance and policies which are relevant to the preparation of Cycle 11 Phase II proposals. The items presented here may also be found on the STIS web page at <http://www.stsci.edu/instruments/stis>. As always, new information is 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](mailto:help@stsci.edu).

This update should be used in conjunction with the STIS IHB v5.1 and the Cycle 11 Phase II Proposal Instructions to aid you in the completion of your Phase II proposal for Cycle 11. If you have specific questions not covered in the documents, you should consult your Program Coordinator, Contact Scientist (if appropriate), or send email to [help@stsci.edu](mailto:help@stsci.edu).

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## Update on Charge Transfer Inefficiency of the STIS CCD

Our annual determination of the Charge Transfer Efficiency (CTE) of the STIS CCD has again indicated a deterioration of the parallel-register Charge Transfer Inefficiency ( $CTI = 1 - CTE$ ). The results reported here represent measurements performed on Sept. 13, 2001, i.e., after 4.5 years on-orbit.

It should be noted at the outset that CTE effects have not been incorporated into the STIS Exposure Time Calculators (ETCs) as yet. Thus, should you believe the CTE losses described herein may impact your program, you will need to provide longer exposure times in your Cycle 11 Phase II proposal to compensate for the anticipated losses. In particular, Cycle 11 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 pixels diameter) above a low background are advised to check their exposure times and adjust them if appropriate, 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 arcsec are urged to use the pseudo-apertures located near row 900 of the CCD (the 52X\*E1 apertures; see Chapter 7 of the STIS Instrument Handbook).

The CTE test employed imaging observations of a sparse star field and was executed with the STIS CCD in Clear mode (50CCD) and with CCDGAIN=1. The observations were taken in the Continuous Viewing Zone (CVZ) and using two exposure times (20 s and 100 s) in order to study the dependence of CTE on the sky background. All images were alternatively read out by two amplifiers, located on opposite sides of the CCD. The subsequent analysis consisted of aperture photometry of all sufficiently uncrowded stars in the field with intensities higher than 4 sigma above the background. A circular aperture with a radius of 2 pixels was used, centered on the stars. The CTI follows from the slope of the relation between the ratio of the count rates of stars in images read out by the two amplifiers and the Y coordinate (i.e., the CCD row number). The results of the analysis are provided in Table 1 where the CTI values (in units of relative charge lost per pixel) are listed as a function of the sky background and the object intensity within the aperture. The CTI results are listed for two epochs: 2.5 and 4.5 years after launch.

From a comparison of results at different epochs (including those listed in Table 1), *the CTI is increasing by about 15% per year on average*. This value can be used as a rule of thumb for estimating exposure times in Cycle 11.

Further analysis of CTE effects on imaging and spectroscopic observations of extended objects (e.g., galaxies) are being performed during the remainder of Cycle 10, and will be reported as STIS Instrument Science Reports (ISRs) on the web.

Table 1: CTI VALUES FOR THE STIS CCD AFTER 2.5 AND 4.5 YEARS IN ORBIT

| Intensity (e <sup>-</sup> ) | Sky (e <sup>-</sup> /pix) | CTI (15 Sep 99)                  | CTI (13 Sep 01)                  |
|-----------------------------|---------------------------|----------------------------------|----------------------------------|
| 150 ± 50                    | 3                         | (2.33 ± 0.38) x 10 <sup>-4</sup> | (3.25 ± 0.60) x 10 <sup>-4</sup> |
|                             | 6                         | (1.72 ± 0.40) x 10 <sup>-4</sup> | (2.08 ± 0.60) x 10 <sup>-4</sup> |
| 350 ± 100                   | 3                         | (1.77 ± 0.19) x 10 <sup>-4</sup> | (2.32 ± 0.70) x 10 <sup>-4</sup> |
|                             | 6                         | (1.39 ± 0.18) x 10 <sup>-4</sup> | (1.72 ± 0.72) x 10 <sup>-4</sup> |
|                             | 15                        | (0.54 ± 0.26) x 10 <sup>-4</sup> | (1.43 ± 0.72) x 10 <sup>-4</sup> |
| 1000 ± 500                  | 3                         | (1.39 ± 0.11) x 10 <sup>-4</sup> | (1.40 ± 0.51) x 10 <sup>-4</sup> |
|                             | 6                         | (1.15 ± 0.09) x 10 <sup>-4</sup> | (1.22 ± 0.51) x 10 <sup>-4</sup> |
|                             | 15                        | (0.78 ± 0.08) x 10 <sup>-4</sup> | (1.09 ± 0.36) x 10 <sup>-4</sup> |
|                             | 30                        | (0.57 ± 0.09) x 10 <sup>-4</sup> | (0.69 ± 0.36) x 10 <sup>-4</sup> |
| 5000 ± 1000                 | 3                         | (5.77 ± 0.57) x 10 <sup>-5</sup> | (7.00 ± 1.59) x 10 <sup>-5</sup> |
|                             | 6                         | (5.39 ± 0.35) x 10 <sup>-5</sup> | (6.86 ± 1.59) x 10 <sup>-5</sup> |
|                             | 15                        | (3.94 ± 0.38) x 10 <sup>-5</sup> | (5.05 ± 1.04) x 10 <sup>-5</sup> |
|                             | 30                        | (3.79 ± 0.47) x 10 <sup>-5</sup> | (4.24 ± 1.02) x 10 <sup>-5</sup> |
| 10000 ± 2000                | 3                         | (4.14 ± 0.41) x 10 <sup>-5</sup> | (5.18 ± 2.14) x 10 <sup>-5</sup> |
|                             | 6                         | (3.70 ± 0.55) x 10 <sup>-5</sup> | (5.22 ± 2.14) x 10 <sup>-5</sup> |
|                             | 15                        | (3.36 ± 0.28) x 10 <sup>-5</sup> | (4.35 ± 0.84) x 10 <sup>-5</sup> |
|                             | 30                        | (3.03 ± 0.29) x 10 <sup>-5</sup> | (4.03 ± 0.81) x 10 <sup>-5</sup> |
| 30000 ± 7000                | 3                         | (2.63 ± 0.59) x 10 <sup>-5</sup> | (4.10 ± 0.36) x 10 <sup>-5</sup> |
|                             | 6                         | (3.04 ± 0.29) x 10 <sup>-5</sup> | (3.05 ± 1.04) x 10 <sup>-5</sup> |
|                             | 15                        | (2.50 ± 0.21) x 10 <sup>-5</sup> | (2.52 ± 1.14) x 10 <sup>-5</sup> |
|                             | 30                        | (2.49 ± 0.20) x 10 <sup>-5</sup> | (2.71 ± 1.12) x 10 <sup>-5</sup> |

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## CCD Side 2 Read Noise

On 16 May 2001, the primary (Side 1) set of STIS electronics failed, and operations were subsequently resumed on the redundant (Side 2) set. Although most operations on Side 2 are equivalent to those on Side 1, different electronic components are involved, and there is an obvious pattern in STIS CCD data, causing an increase in the effective read noise (see STIS ISR 2001-005 for details). This increase in read noise is most obvious in short exposures (e.g., bias frames), because they are dominated by read noise (as opposed to Poisson noise from the dark counts or source counts), and because the increased read noise is spatially correlated on the scale of about 3 pixels. The pattern is not fixed on the detector: it changes from exposure to exposure, and drifts within each image, such that it appears as a "herring bone" pattern. Data taken through the nominal amplifier (D) show an increase in read noise of approximately  $1 \text{ e}^- \text{ pix}^{-1}$  for gain=1 and  $0.2 \text{ e}^- \text{ pix}^{-1}$  for gain=4. For reference, data taken through the D amplifier during its last few months on Side 1 had a read noise of approximately  $4.4 \text{ e}^- \text{ pix}^{-1}$  for gain=1 and  $7.5 \text{ e}^- \text{ pix}^{-1}$  for gain=4. In some cases, the pattern noise can be filtered out, but this filtering may introduce other artifacts into the CCD data (especially in the case of bright or crowded fields (ISR 2001-005)).

In short, users should assume a CCD read noise of  $5.4 \text{ e}^- \text{ pix}^{-1}$  for gain=1 and  $7.7 \text{ e}^- \text{ pix}^{-1}$  for gain=4 when planning their Cycle11 observations. Note that these numbers were already used within the STIS Exposure Time Calculators (ETCs) since Aug 15, 2001.

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## CCD Sensitivity Revisions

The red-end sensitivity of CCD imaging modes has recently been updated, the sensitivity at the long-wavelength end being lowered by as much as 18% with respect to previous estimates. This change is a correction to the previous calibration, and it does not reflect a time-dependent change in the CCD sensitivity. The revision is now reflected in the STIS Exposure Time Calculator (ETC), and users may wish to reconsider their exposure-time estimates to take this into account. Further details are linked in the July 2001 Spectrographs STScI Analysis Newsletter (STAN).

It should also be noted that when red targets are observed with the broadband CCD filters (50CCD and F28X50LP), the real point-spread function (PSF) is significantly broader than that assumed by the ETC. As a result, the ETC overestimates the fraction of the point-source counts that are contained within the nominal aperture used for S/N calculations. This

flux discrepancy will typically be at the 10 to 15% level, although for extremely red objects ( $B-V > 1.3$ ) it may be as large as 20 to 25%.

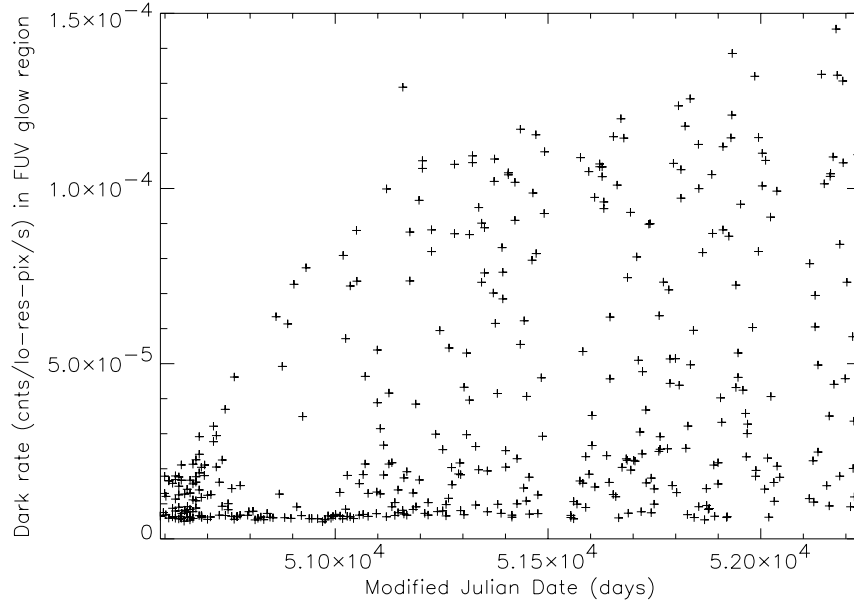
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## Enhanced FUV MAMA Dark Current

As discussed in Chapter 7 of the STIS Instrument Handbook, the FUV MAMA dark current produces an intermittent glow that, when present, is centered in the upper left quadrant of the detector and covers a substantial fraction of the detector's total area. (See Figure 7.16 in the STIS Instrument Handbook. Note that "bright area" in the figure caption refers to the darker region centered above and to the left of the detector center.) The dark current in this glow is 10 to 20 times higher than the dark current in the low state. Originally, this glow was present only intermittently, but as shown in Figure 2, over the last two years the glow has been present more often than it has been absent. In contrast, the dark current in the lower right-hand corner where the effect of the glow is minimal (Figure 3) shows little change over time.

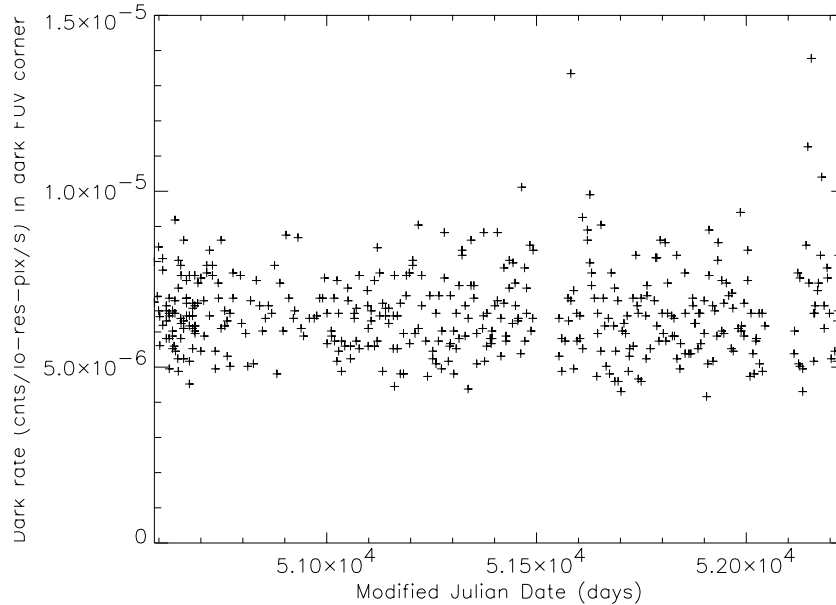
Note that even in the presence of this extra glow, the FUV MAMA dark current is still extremely low ( $< 2 \times 10^{-4}$  counts/pixel/second), and most observers will not need to concern themselves with this enhanced dark current. Those programs that might be adversely affected may be able to minimize the contamination from the enhanced dark current by moving their targets to a portion of the detector where the glow is reduced. For first-order spectroscopy with a long slit, a POS TARG of 0, -7 will place the spectrum between rows 50 and 150 on the detector. (The exact position will depend on the monthly MSM offset.) *Note that for narrow slits, it is important to first do a pickup (ACQ/PEAK) with the same POS TARG as is to be used for the science observation.* For imaging observations, the lowest dark current will be obtained by putting the target near the lower right-hand corner of the detector (e.g., POS TARG 7, -7), but be sure to make sufficient allowance for guide star acquisition errors (that is, if no ACQ was used to center the object on the detector; Guide Star acquisition errors are typically within 1 arcsec but occasionally up to 2-3 arcsec) and the angular extent of the target.

Figure 1: Dark Rate in FUV-MAMA Glow Region



The dark rate (counts/low-resolution-pixel/second) as measured in the region of the FUV-MAMA with the enhanced dark current is plotted versus observation time for individual dark exposures. Note that over the last three years, the enhanced dark rate has been present with much greater frequency than initially. The region of the detector used to compute rates shown here corresponds to the subarray [200:400,600:800] in images binned to 1024X1024.

Figure 2: Dark Rate in Dark FUV-MAMA Corner



The dark rate (counts/low-resolution-pixel/second) as measured in the lower right-hand corner (subarray [900:1000,10:110] in a 1024X1024 image) of individual FUV-MAMA dark exposures versus observation time.

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## Positional Accuracy of Moving Targets

STScI currently uses the best planetary-system ephemerides available from JPL. The accuracies of these ephemerides are posted at [http://ssd.jpl.nasa.gov/sat\\_eph.html](http://ssd.jpl.nasa.gov/sat_eph.html). Since July 2001 we have been using substantially improved ephemerides for the Galilean satellites of Jupiter. The RMS accuracy of the positions of these satellites relative to Jupiter is now 0.002 arcsec, compared to 0.04 - 0.17 arcsec previously.

In planetary-system spectroscopic observations with STIS, it is sometimes necessary to use a satellite as an acquisition object for an offset to a science target on the planet or another satellite. When planning such an observation with STIS, one should consult the help desk to see whether or not the ephemeris files in use at STScI will be able to provide an offset accurate enough for the chosen slit size.

Observers should be aware that moving targets are tracked by HST with the assumption that the object is moving on a linear track with constant velocity. Depending on the visit structure, the same linear track may continue through several exposures, interpolating between the object's position at the initial time and at the final time. The scheduling software sets a generally appropriate limit on the duration of a linear track, which depends on the target being tracked but not on details of the target motion at the time. In some situations (for example, near the inflection point of an orbit), the approximation could result in inadequate tracking for a narrow slit. If this may be a problem, the observer can consult the Program Coordinator of his/her proposal to find out how long the same track will be used for a series of exposures, and whether it is possible to break the visit into shorter tracks. Alternatively, one can plan to observe during a more linear part of the orbit if possible.

