The 2005 HST Calibration Workshop
Space Telescope Science Institute, 2005
A. M. Koekemoer, P. Goudfrooij, and L. L. Dressel, eds.

The STIS Closeout Plan

Paul Goudfrooij and the STIS Team: Alessandra Aloisi[1], Rosa Diaz-Miller, Linda Dressel, Jessica Kim Quijano, Jesús Maíz-Apellániz[1], and Charles Proffitt[2]

Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218

Abstract. The huge archive of STIS observations constitutes a unique —and arguably the most comprehensive— source of spectroscopy in the UV and spatially-resolved spectroscopy in the optical available to the entire astronomy community. The main goal of the STIS close-out plan is to render the full archive of STIS data in a calibration status suitable for performing high-level and high-accuracy science before STIS support at STScI is phased out. In addition, we intend to implement software improvements as well as enhancements related to the retrieval of STIS data from the *HST* archive. Detailed information on the various close-out activities is presented.

1. Introduction

The Space Telescope Imaging Spectrograph (STIS) stopped science operations on August 3, 2004, due to a failed power supply in its side-2 electronics (its side-1 failed already in May 2001; more details on the STIS failure can be found in Goudfrooij 2005). STIS was an extremely versatile spectrograph and imager offering a diversity of instrument modes unmatched by any other *HST* instrument. Since the start of Cycle 7 (the first *HST* cycle in which STIS was available), STIS was one of the most productive *HST* instruments. As of November 1, 2005, over 900 refereed publications using STIS have appeared in the literature[3], with a total number of citations exceeding 16,000. Analysis of STIS data has had a major impact on virtually all science categories, in particular the morphology and physics of stellar outflows, the composition and dynamics of the interstellar medium, the demography of super massive black holes in the centers of galaxies, and the baryon content in the local universe.

It is clear that the huge archive of STIS observations constitutes a unique and comprehensive source of UV spectroscopy and spatially-resolved spectroscopy in the optical region, available to the astronomy community. As such, it deserves an appropriately high level of attention from STScI in terms of providing adequate calibrations before STIS team resources are taken away. The STIS Closeout Plan was designed with this in mind.

2. Main Goals of STIS Closeout Plan

The extraordinary versatility of STIS presented a significant challenge to the STIS team in terms of being able to keep up with the characterization and calibration of all sup-

[1]Affiliated with the Space Telescope Division, European Space Agency

[2]Operations Astronomer, Computer Science Corporation

[3]Using information from the NASA Astrophysics Data System (ADS)

ported observing modes[4], many aspects of which are/were complex and/or time-dependent. The main goal of the STIS Closeout Plan is to render the archive of STIS data taken in 'supported' modes (plus a subset of the 'available-but-not-supported' observing modes; see Table 1) in a calibration status suitable for performing high-level and high-accuracy science before STIS support at STScI will have to be phased out for the benefit of new instruments to be installed in *HST* Servicing Mission 4. We currently estimate that this phase-out for STIS support will occur by the end of 2006.

The goal for the final overall level of calibration accuracy to be reached for all (previously) supported STIS observing modes is listed in Chapter 16 of the STIS Instrument Handbook (Kim Quijano et al. 2004). In addition, we intend to implement software improvements as well as enhancements related to the retrieval of STIS data from the *HST* archive. The activities in the STIS Closeout Plan can be divided into one of the following three main classes:

1. Already planned tasks of moderate-to-high priority which did not yet come to completion. These tasks are related to STIS calibration of regularly used observing modes and the subsequent implementation into software (within the pipeline or as off-line IRAF tools) or pipeline reference files;

2. New tasks related to, e.g., the enhancement of archive capabilities regarding STIS data, or to a proper documentation of all activities regarding the use of STIS data and of the monitoring activities used by the STIS branch over the years;

3. Tasks related to the implementation by STScI of the software and other deliverables created by the Space Telescope-European Coordinating Facility (ST-ECF) in Germany as part of its STIS-CE (Calibration Enhancement) project.

In the following sections we will provide the reader with specific, but brief, information about each ongoing or planned significant activity in the STIS Closeout Plan as of Nov 15, 2005. The activities are organized by main category: Calibration, Pipeline, Archive Enhancement, and User Information. The overall priority of each activity is indicated after each title; the priorities were assigned based mainly on two factors regarding the observing mode involved, namely *(i)* statistics on its usage, and *(ii)* the uniqueness of its capability relative to those offered by other instruments. For the calibration activities, we also list the ID of the calibration program(s) involved if appropriate.

3. Description of Activities in the Closeout Plan

3.1. Calibration Activities

E-Mode Sensitivities (Priority: Crucial): This activity will deliver the final sensitivity calibrations for the echelle modes of STIS. This includes final reference file updates for wavelength-dependent aperture corrections, wavelength-dependent extraction size corrections, and wavelength-dependent time dependences, using all calibration data collected through the summer of 2004. The SYNPHOT component files for the echelle modes also need to be updated (the current versions are not consistent with the photometric sensitivity reference files in the pipeline; e.g., the former do not include the echelle blaze functions, only the 'envelope' of the sensitivity curves). Results of this activity will be documented in an Instrument Science Report (hereafter ISR, which are available through the STIS instrument web site at http://www.stsci.edu/hst/stis). (See Aloisi (2006) in this volume.)

[4]The supported set of observing modes included: 3 *detectors* (FUV-MAMA, NUV-MAMA, CCD), 4 operational *modes* (ACQ, ACQ/PEAK, ACCUM, TIMETAG), 44 *apertures* (filters, slits), and 133 grating/tilt combinations.

Table 1: Status of and calibration plan for spectroscopic STIS observations taken in "available-but-not-supported" mode[a]

Observing Mode	# exp.	Calibration Plan or limitation of data
Non-recommended echelle grating + small aperture combination	21	To be calibrated for final STIS archive
Echelle and first-order spectra taken with non-supported aperture	86	Limitations for each grating/aperture combination will be indicated in final close-out report
First-order spectra taken with 2×2 or 6×6 aperture	2587	Planning to calibrate for final archive (treated as slitless for 6×6 aperture).
Spectra taken with unsupported fiducial bars	67	Limitations for each grating/aperture combination will be indicated in final close-out report
Echelle spectra of extended objects with long slits	39	Calibration needs to be different for every individual science application. Will stay unsupported.
Spectra in G750L @ 8975Å or G750M @ 10363Å	3	2^{nd}-order overlap. Will stay unsupported; limitations will be indicated in final report.

[a] There are 3666 spectroscopic science observations in the STIS archive taken in "available" mode (header keyword CFSTATUS = 'AVAILABLE'), which is ~10% of the total.

HST Program Numbers: 8915, 8919, 9628, 10033

E-Mode Sensitivity Uncertainty due to Blaze Shifts (Priority: High): This activity is related to the previous one but is listed separately because it includes the complicated effort to derive a correction for the so-called Monthly Offsets and their associated blaze shifts, which do not repeat well for a given month of the year (i.e., the time dependence of the amplitude of the blaze shifts is currently not adequately corrected for). This effort shall be performed for both primary and secondary central wavelength settings, as they have had similar usage by GOs. This activity will involve writing at least one ISR, and may involve the need for code changes within CALSTIS. (See Aloisi (2006) in this volume.)

HST Program Numbers: 8915, 8919, 9619, 9628, 10033

MAMA Full-Field Sensitivity Monitor (Priority: Medium): These activities comprise flux measurements of various isolated stars covering the field of view of the STIS MAMA detectors, from images that are taken at regular time intervals so that the same star is imaged on different parts of the detector. These data are used to monitor the full-field sensitivity of the detectors as well as the astrometric and PSF stabilities. The data from Cycles 11 and 12 will have to be analyzed. The results will be compared to the previously determined time dependence of the sensitivity for the different imaging modes, and to evaluate the need for updates to the low spatial frequency flat fields for imaging modes. This activity will involve writing one ISR.

HST Program Numbers: 9622, 10028, 9623, 10032

MAMA Dark Monitor (Priority: Medium/High): This activity involves the measurement of the dark current levels of the two MAMA detectors, which have been taken twice a week for each detector. The NUV-MAMA dark data taken over the years will be assembled together to determine final functional forms of the global dark current levels as a function of time, tube temperature, and charge amplifier temperature. These scaling functions will be implemented into the STIS calibration pipeline (CALSTIS), involving new reference files as well as a code change. In the case of the FUV-MAMA detector, additional work is needed to determine a better parametrization of the dark level in the "glow" region of the detector. We already have a good idea on this from earlier preparation work, namely to parametrize the FUV-MAMA dark level as a function of the time elapsed since the high-voltage was turned on. For a "heritage" instrument, this can be implemented by delivering a reference table containing the turn-on times, or as a post-observation tool using another proxy that is dependent on the time elapsed since the high-voltage was turned on, e.g., the intensity level of hot pixels. These findings will be written up as two ISRs.

HST Program Numbers: 9615, 10034

CCD Bias and Dark Monitor (Priority: High): This activity involves a thorough investigation of the evolution of the CCD biases and darks as a function of time, including the number of hot columns in superbiases, the level of the spurious change in superbiases (Goudfrooij & Walsh 1997), and the number of hot pixels in darks at different intensity levels and as a function of row number (indicating the evolution of CTE loss). The main purposes of this activity are to provide useful information on the behavior of the performance of CCDs (of different architecture) in orbit, and to compare the results with the performance of other CCDs on HST. This activity will likely involve writing two ISRs.

CCD External Sparse-Field CTE monitor (Priority: High): This activity involves the analysis of the last two epochs of the *External* Sparse-Field CTE monitor calibration program. These data bear directly on the influence of CTE effects to the accuracy of point source photometry and spectroscopy. The analysis has been described before by Goudfrooij & Kimble (2002). The results will also be compared to those derived from the physical model of CTE loss of the STIS CCD by P. Bristow of the ST-ECF (see below). This activity will involve writing two ISRs, and it will also be used in the final version of a manuscript on the CTE performance of the STIS CCD, to be submitted to PASP.

CCD CTE effect on Extended Sources (Priority: Med/High): This activity involves the analysis of data observed during three calibration programs to determine the effects of CTE loss to surface photometry and spectroscopy of extended sources, as well as the time dependence of those effects: *(i)* the effects of CTE loss to CCD imaging of galaxies (e.g., luminosity, ellipticity, and position angle measurements at a given surface brightness), *(ii)* The effect of CTE loss to continuum fluxes and emission-line intensities in spectroscopy mode; *(iii)* The effect of CTE loss to *absorption*-line intensities, profiles, and equivalent widths in spectra. All results mentioned above will be compared to the correction applied by the physical model of CTE loss of the STIS CCD by P. Bristow of the ST-ECF (see below). In addition, the results from *(ii)* and *(iii)* above will also be compared to the CTE correction provided by the STIS pipeline (derived from point source spectrophotometry). This activity will involve writing three ISRs.

HST Program Numbers: 8839, 8927, 10038

Imaging Zeropoints and Color Terms (Priority: High): This activity involves the analysis of imaging data of sources with known photometry and covering a wide range of *(known)* SEDs (spectral energy distributions). The analysis will involve deriving the influence of the intrinsic colors to the derived zeropoints (i.e., the so-called 'color terms' in the photometric calibration), and a comparison with predictions using synthetic spectra (using SYNPHOT). This activity will involve writing a PASP paper. (See Proffitt (2006) in this volume.)

MAMA First-Order Dispersion Solutions (Priority: High): This activity involves the analysis of deep first-order MAMA wavecals taken in the context of a calibration program. Internal wavecals have been obtained at all primary and secondary central wavelengths. Exposure times were chosen to yield enough strong emission lines to constrain adequate wavelength solutions. Data were taken at the zero MSM offset position which is in the middle of the range covered by monthly offsets, and hence provides the best average dispersion solution. Dispersion solutions will now be derived using the recently published Pt/Cr-Ne line list (Sansonetti et al. 2004). (Note that the current dispersion solutions were derived using a Pt-Ne line list, even though the line lamps used on STIS were Pt-Cr-Ne hollow cathode lamps). A new dispersion (_dsp) reference file will be created and delivered. An ISR describing dispersion changes as well as the accuracy of the previously used dispersion solutions will be written and published.

HST Program Numbers: 9618

Grating Scatter for the G230LB Grating (Priority: Medium): This activity involves the analysis of measurements of red targets taken with *both* the G230L grating (a NUV-MAMA mode) *and* the G230LB grating (a CCD mode). The goal is to determine a correction for the influence of grating scatter (primarily from the far wings of the LSF, similar to the effects seen before for the UV gratings used in the Faint Object Spectrograph (Rosa 1994)) in case of CCD/G230LB spectra of red targets. This activity will involve communication with M. Gregg (see Gregg et al. (2006) in this volume) who is working on this issue as well in the context of his STIS SNAP program.

HST Program Numbers: 7723

Spectroscopic PSF Across Slit (Priority: High): This activity involves the characterization of the PSF across the slit for two commonly used long slits (52x0.1 and 52x0.2). Multiple G750L spectra are taken of a K giant star, stepping the slit across the star between exposures to sample the PSF along the dispersion direction. For chosen wavelength intervals, the relative fluxes in each slit position and spectral row are compared to the values predicted using TinyTim models. It is important to verify these models since they are used as input in the dynamical modeling of spectral images, e.g., in the dynamical modeling of galactic nuclei. This activity will involve writing one ISR. (See Dressel (2006) in this volume.)

HST Program Numbers: 9610

Faint Standards Extension (Priority: High): This activity involves analysis of CCD spectra of (faint) white dwarfs which were previously identified and verified as *bona fide* spectrophotometric standard stars. The purpose of this analysis is to provide a thorough verification of the previously established CTE corrections for CCD spectroscopy, namely by stepping the target along the slit (5 positions) with two (short) exposure times. This will verify the results using the two-amplifier readout method, and provide high-S/N data at low intensity levels and low background level. This activity involves the writing of one ISR and may also involve an update of the CTE parameters in the CCD Table Reference File, if necessary. First results from this activity are shown in this volume (Goudfrooij & Bohlin 2006).

HST Program Numbers: 10037, 10039

Trace Stability for Often-Used Modes (Priority: High): Spectral "trace" reference files prescribe the projection of spectra onto the detector at a given position along the spectrograph slit. They are used to produce rectified spectral images and extracted spectra. Accurate traces are needed when individual rows in spectral images are to be analyzed – e.g., in kinematic studies of galaxies, designed to measure the masses of supermassive black holes in galactic nuclei. Accurate traces are also needed for photometric accuracy when small extraction boxes are required to separate nearby point sources or to better isolate a point source from more extended emission. The spectral traces now in use were created from inflight data taken early in the orbital lifetime of STIS, and they can be seen to be in error in rectified spectral images taken in the last few cycles. This project will use calibration as well as GO data to derive spectral traces near the center of the detector (and, for CCD observations, at the E1 aperture positions), for the most commonly used gratings and central wavelengths at several epochs. We will examine changes in rotation and shape of traces, and produce new reference files where needed. The highest-priority grating settings, selected by total science observing time, are all L gratings as well as G750M at central wavelengths 6581, 6768, and 8561. Apart from the creation of calibration reference files where needed, this project will involve the writing of an ISR. (See Dressel et al. (2006) in this volume.)

3.2. Pipeline Activities

Rectification of Non-Dithered Spectra of Spatially Resolved Targets (Priority: High): This activity is to improve the quality of $1-3$ pixel high extractions of STIS CCD spectra taken with gratings for which the traces are tilted significantly with respect to the pixel array (especially G430M and G750M). The current pipeline extractions use bilinear interpolation which produces strong undulations in spectral extractions of $1-3$ pixels high. This activity is expected to involve interactions with the Eta Car Treasury Program[5] who have already implemented an interpolation routine which seems to work much better in that respect than that in our STIS pipeline. This activity will also involve writing an ISR. (See Davidson (2006), Barrett and Dressel (2006), and Dressel et al. (2006) in this volume.)

Spectral Dithering within MultiDrizzle (Priority: High): This activity will allow the handling of spectroscopic STIS data within the MultiDrizzle tool. The intent is to allow combination of sets of spectral images which involve inter-exposure offsets (dithers) in the dispersion direction (across the slit), the spatial direction (along the slit), or both. The correction for dithers in the dispersion direction will involve calibrations that are dependent on grating and aperture. We anticipate that this activity will involve a significant amount of testing by STIS Team members. It will also involve writing an ISR and —likely— the need for delivery of reference files that allow for a correction of the throughput loss associated with stepping a source across the slit.

STScI/ST-ECF Collaboration Items (Priority: High): This activity involves STIS Team work related to the implementation of deliverables of the STIS Calibration Enhancement (STIS-CE) project within the STScI environment, be it decision making and/or providing assistance regarding software modules within the CALSTIS pipeline, the STIS archive, or STIS-specific software to be released as IRAF/STSDAS tasks. The two main remaining projects related to ST-ECF deliveries will constitute *(i)* the testing and possible implementation of a new, physical model-based wavelength calibration module for the high-resolution echelle gratings, and *(ii)* the testing, evaluation, and possible implementation of the physical model-based correction for CTE

[5] see http://etacar.umn.edu

loss of the STIS CCD by P. Bristow. (See Bristow et al. (2006) and Kerber et al. (2006) in this volume.)

Final Calibration of STIS Data (Priority: High) This activity involves a comprehensive run of all archival STIS data through OTFR once all final calibrations, pipeline coding, and reference files have been tested and delivered to the various databases. The final set of calibrated STIS data will then be stored in the *HST* archive, and OTFR can be switched off for STIS use which would make more processing power available for OTFR requests of active *HST* instruments. It would also render calibrated STIS data to be readily available for viewing and plotting, which is relevant in the Virtual Observatory era.

3.3. Archive Enhancement Activities

Imaging PSF Library (Priority: Medium): This activity involves the work needed to allow the user to retrieve well-exposed imaging PSFs in a given observing mode (detector / filter combination) and location on the detector. This consists mainly of the identification and assembly of a data base of appropriate datasets, the creation and implementation of a Graphic User Interface (GUI) that performs the archive retrieval of the datasets involved, and the writing of an ISR (which can in principle be combined with the next activity). It can be foreseen that the GUI mentioned above would be developed for *all HST* instruments simultaneously.

Spectroscopic PSF Library (Priority: Medium/High): This activity involves work needed to allow the user to retrieve well-exposed spectroscopic PSFs in a given observing mode (detector / grating / slit combination) and location on the detector. This consists mainly of the identification and assembly of a data base of appropriate datasets, the creation and implementation of a Graphic User Interface that performs the archive retrieval of the datasets involved, and the writing of an ISR (which can in principle be combined with the previous activity). It can be foreseen that the GUI mentioned above would be developed for *all HST* instruments simultaneously.

GO Wavecal Association (Priority: High): This activity involves the development of a system (to be implemented within the *HST* archive) that automatically associates STIS GO wavecals (i.e., wavecals inserted by STIS GO's in their Phase-II proposals, which typically happens when they were allowed to forego the default automatic insertion of wavecals) with the appropriate science spectra, so that retrieval of the latter data will automatically attach the GO wavecals to them. (Currently, only science data are returned *(no wavelength calibration is performed by the pipeline)*, and the GO will need to issue a second archive query to find the GO wavecals based on the proposal/visit combination of the science data. Note also that if a calibrated spectrum is made without a proper wavecal, then serious errors in the wavelength and flux scales can result.) It can be foreseen that this activity would be performed in concert with association-related activities for other *HST* instruments.

Fringe Flat Association (Priority: High): This activity involves the development and implementation of a system within OPUS and the archive that automatically associates contemporaneous STIS CCD Fringe Flats (which have been inserted by STIS GO's in their Phase-II proposals when G750L or G750M spectra were taken) with the appropriate science spectra, so that retrieval of the latter data will automatically attach the appropriate fringe flats to them. (Currently, only the science data are returned and the GO will need to issue a second archive query to find the contemporaneous fringe flats based on the proposal/visit combination of the science data.) It can be foreseen that this activity would be performed in concert with association-related activities for other *HST* instruments.

Spectroscopic Preview Enhancement (Priority: High): This activity involves a review and improvement of the "preview" facility available within the *HST* archive pages for STIS spectra (the "Plot marked spectra" button), whose main purpose is to simplify the preparation of archival studies or proposals. While this facility certainly provides useful output already, there are several aspects that can be improved significantly, e.g., in the areas of the sky subtraction method currently in use and the automatic assignment of display parameters that are often imperfect. Moreover, the facility should also be able to present a 2-D image of the spectral data, so users can see the spatial extent of the target.

3.4. User Information Activities

Data Handbook Update (Priority: High): This activity involves a final review and update of the STIS chapter of the *HST* Data Handbook. The last update was made before a significant number of updates to the CALSTIS pipeline and stand-alone tasks in the STIS package within IRAF/STSDAS were implemented. Hence it is important to create a final, all-encompassing version of the Data Handbook for STIS. It should include a data analysis "cookbook" to guide users in the routine analysis of STIS spectral data.

Summary Document: The STIS Experience (Priority: High): This activity involves the writing of a document that summarizes our experience with the operation and calibration of the instrument. It will include sections on the MAMAs, the CCD, the Optics, etc. There will be many references to other available reports (e.g., ISRs, Instrument Handbook), but all kept in one document to provide an easy reference for comparisons with the operation and calibration of similar detectors in other (present and future) *HST* instruments.

Acknowledgments. The remarkable science legacy of STIS is the tangible result of years and years of effort by many individuals in the STIS Instrument Definition Team, Ball Aerospace, Goddard Space Flight Center, STScI, and elsewhere who defined, built, improved, tested, characterized, calibrated, and explained the instrument. In closing, we wish to thank the following individuals[6] who contributed so much of their time, effort and talent over the last 15 years for the benefit of STIS users. They have made working on STIS an amazing experience.

STIS Instrument Definition Team (IDT): B. Woodgate, T. Gull, A. Boggess, C. Bowers, A. Danks, R. Green, S. Heap, J. Hutchings, E. Jenkins, C. Joseph, M. Kaiser, R. Kimble, S. Kraemer, J. Linsky, S. Maran, H. Moos, F. Roesler, G. Timothy, D. Weistrop

STIS IDT Contractors: T. Beck, N. Collins, J. Feggans, W. Fowler, C. Grady, R. J. Hill, R. S. Hill, W. Landsman, D. Lindler, E. Malumuth, P. Plait, R. Robinson, J. Sandoval, C. Standley

STScI STIS Team, current: A. Aloisi, R. Diaz-Miller, L. Dressel, P. Goudfrooij, J. Kim Quijano, J. Maíz-Appelániz, C. Proffitt

[6] We know we are taking a risk of missing someone who contributed to STIS development. We apologize to those missed in this list.

STScI STIS Team, ex officio: S. Baum, R, Bohlin, T. Brown, J. Christensen, M. Clampin, I. Dashevsky, J. Davies, R. Downes, B. Espey, H. Ferguson, A. Gonnella, S. Friedman, G. Hartig, J. Hayes, S. Hulbert, R. Katsanis, S. Keener, E. Kinney, G. Kriss, C. Leitherer, M. McGrath, G. Mitchell, B. Mobasher, K. Sahu, A. Schultz, R. Shaw, E. Smith, D. Stys, J. Valenti, N. Walborn, J. Wilson

ST-ECF STIS Support: A. Alexov, P. Bristow, M. Fiorentino, F. Kerber, M. Rosa, J. Walsh

STScI STIS Engineering and Software Support: V. Balzano, P. Barrett, I. Busko, P. Hodge, C. Long, R. Pitts, T. Wheeler, D. Zak

Ball Aerospace: W. Meyer, D. Hood, V. Argabright, S. Becker, M. Bottema, R. Breyer, R. Bybee, P. Christon, A. Delamere, D. Dorn, S. Downey, P. Driggers, D. Ebbets, J. Gallegos, H. Garner, J. Hetlinger, R. Lettieri, C. Ludtke, D. Michika, R. Nyquist, D. Rose, R. Stocker, J. Sullivan, C. van Houten, R. Woodruff

References

Aloisis, A. 2006, this volume, 190

Barrett, P. & Dressel, L. 2006, this volume, 260

Bristow, P. et al. 2006, this volume, 299

Davidson, K. 2006, this volume, 247

Dressel, L. 2006, this volume, 277

Dressel, L. et al. 2006, this volume, 267

Goudfrooij, P., 2005, *STScI Newsletter*, 22, 6

Goudfrooij, P., & Walsh, J., 1997, *Instrument Science Report* STIS 1997-09 (Baltimore: STScI), available through http://www.stsci.edu/hst/stis

Goudfrooij, P., & Kimble, R. A., 2003, in *Proc. 2002 HST Calibration Workshop*, ed. S. Arribas, A. Koekemoer, & B. Whitmore (Baltimore: STScI), p. 105

Goudfrooij, P., & Bohlin, R. C., 2006, The 2005 *HST Calibration Workshop.* Eds. A. M. Koekemoer, P. Goudfrooij, & L. L. Dressel, this volume, 289

Kim Quijano, J., et al., 2004, *STIS Instrument Handbook* (Baltimore: STScI)

Gregg, M.D. et al. 2006, this volume, 209

Kerber, F. et al. 2006, this volume, 309

Proffitt, C. R. 2006, this volume, 234

Rosa, M. R., 1994, in Proc. 1993 *HST Calibration Workshop*, ed. J. C. Blades & S. J. Osmer (Baltimore: STScI), p. 190

Sansonetti, C. J., Kerber, F., Reader, J., & Rosa, M. R., 2004, ApJS, 153, 555