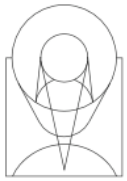


STIS Calibration Plan for Cycle 12

presented by Linda Dressel

for the STIS group

STIS Calibration Plan for Cycle 12

RATIONALE FOR THE STIS CYCLE 12 CALIBRATION PROGRAM

Because STIS is a mature instrument, many routine calibration programs have already been optimized and should continue as is.

Because GO usage of STIS dropped by ~40% in cycle 11 with the introduction of new instruments, we should continue to trim calibration programs where possible.

Because STIS is an aging instrument with declining sensitivities and steadily increasing CTI effects, we need to characterize and ameliorate the deterioration in performance.

We have an opportunity and responsibility to perform photometric calibrations that will prove useful to NICMOS, WFC3, and JWST as well as to STIS.

We will benefit from physical modelling of STIS by providing observations to support the ECF STIS Calibration Enhancement project.

STIS Calibration Plan for Cycle 12

PLANS FOR MONITORING PROGRAMS

1. STATUS QUO: Half of the monitoring programs should be continued with the same frequency of observation to test instrument performance at adequate intervals or to produce reference files of acceptable accuracy.

2. REDUCTIONS: Nearly half of the monitoring programs can be performed at a lower frequency of observation, or trimmed of exposures no longer needed, or modified to supplement data from larger programs in previous cycles, or skipped this cycle.

3. EXPANSIONS: One monitoring program (CCD Spectroscopic Sensitivity Monitor) needs additional visits to better determine flux dependence on several parameters.

PLANS FOR SPECIAL PROGRAMS

1. COMPLETED: Four of five cycle 11 special programs have been completed and need no further observations.

2. CONTINUATION: More observations are needed for three special programs continued from cycle 11 (one program) or revisited from previous cycles (two programs), to provide absolute photometry and to improve photometric (CTE) corrections.

3. NEW: One small program is needed early in cycle 12 to test new pseudoaperture positions defined for spectroscopy.

STIS Calibration Plan for Cycle 12

MONITORS: STATUS QUO

[12 EXT]	**[6 EXT]**	CCD Sparse Field CTE - External
[1 EXT]	**[1 EXT]**	CCD Full Field Sensitivity
[3 EXT]	**[3 EXT]**	MAMA Full Field Sensitivity
[790 int]	[732 int]	CCD Dark Monitor (13 mo cycle --> 12 mo cycle)
[395 int]	[366 int]	CCD Bias Monitor (13 mo cycle --> 12 mo cycle)
[168 par]	[137 par]	CCD Hot Pixel Annealing (change in bookkeepping only)
[96 int]	[64 int]	CCD Sparse Field CTE - Internal (13 mo --> 12 mo cycle)
[1 par]	[1 par]	Slit Wheel Repeatability
[226 int]	[192 int]	MAMA Darks (14 mo cycle --> 12 mo cycle)
[4 int]	[4 int]	MAMA Fold Distribution
[ ]	[ ]	MAMA Anomalous Recovery (as needed)

MONITORS: REDUCTIONS

[16 EXT]	**[11 EXT]**	MAMA Sensitivity and Focus (L: 6-->4; M: 4-->1)
[42 int]	[21 int]	CCD Performance Monitor (discontinue 2x2 darks)
[24 int]	[12 int]	CCD Readnoise Monitor (monthly --> bimonthly)
[68 int]	[21 int]	CCD Spectroscopic Flats (monthly --> bimonthly, G430L&M)
[17 int]	[8 int]	CCD Imaging Flats (monthly --> bimonthly)
[7 int]	[1 int]	CCD Spectroscopic Dispersion Monitor (G230MB(1713A) only)
[36 int]	[6 par]	MAMA Dispersion Solution (deep E for ECF physical model)
[10 int]	[0 int]	MAMA FUV Flats
[10 int]	[0 int]	MAMA NUV Flats

MONITORS: EXPANSIONS

[8 EXT, 6 int**]**	**[10 EXT**, 9 int**]**	CCD Spectroscopic Sensitivity Monitor

STIS Calibration Plan for Cycle 12

SPECIAL PROGRAMS: COMPLETED

[4 EXT] --> [0]	E1 Aperture Throughputs
[3 EXT] --> [0]	Spectroscopic PSF
[2 EXT, 2 int] --> [0]	CCD Side 2 Gain Ratio Check
[2 EXT] --> [0]	Echelle Blaze Shift vs MSM Monthly Offset

SPECIAL PROGRAMS: CONTINUATION

[19 EXT] --> [5 EXT]	FASTEX (5 STIS orbits; see also NICMOS)
[0 EXT] --> [2 EXT]	CTE for Extended Targets (from 8839 - cycle 9, imaging)
[0 EXT] --> [7 EXT]	Spectroscopic Sensitivity from Primary Standards: First Order Gratings (from 8916 - cycle 10)

SPECIAL PROGRAMS: NEW

[ ] --> [2 EXT]	Test of New and Revised Pseudoaperture Positions

STIS Calibration Plan for Cycle 12

NUMBER OF STIS CALIBRATION ORBITS: CYCLE 11 VS CYCLE 12

		EXT	par	int
monitors:	cycle 11	**40**	169	1731
	cycle 12	**31**	144	1430
	delta	**-9**	-25	-301
specials:	cycle 11	**30**	0	2
	cycle 12	**16**	0	0
	delta	**-14**	0	-2
combined:	cycle 11	**70**	169	1733
	cycle 12	**47**	144	1430
	delta	**-23**	-25	-303

LIMITS ON NUMBER OF EXTERNAL ORBITS FOR CYCLE 12:

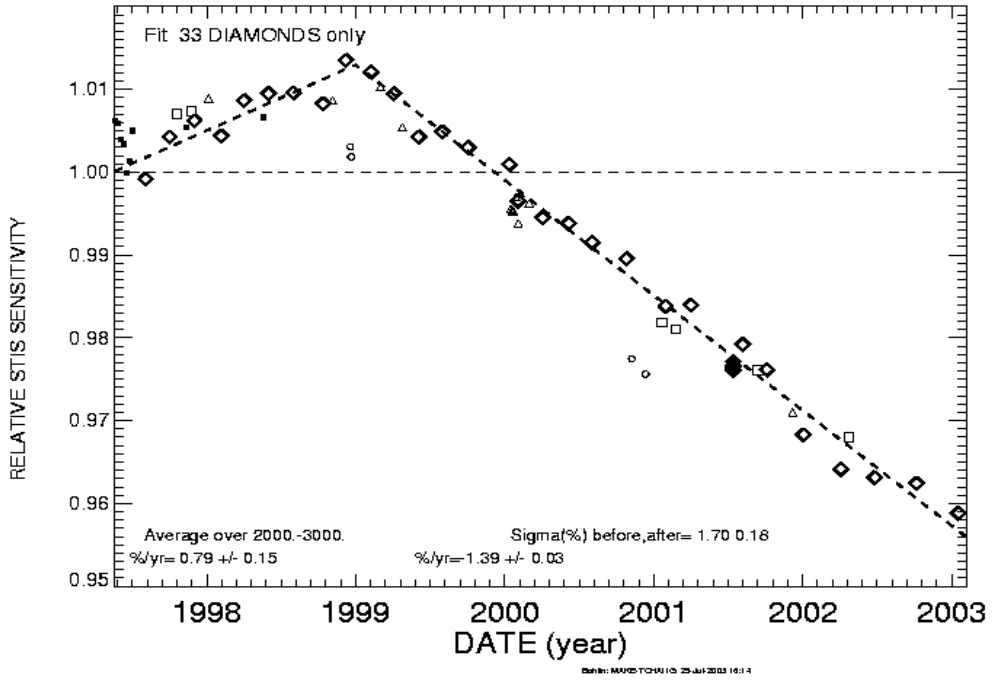
# of cycle 12 STIS GO prime orbits x 10% = 892 x 0.1 = **89**

# of cycle 12 cal orbits x STIS fraction = 376 x 0.168 = **63**

# of cycle 12 EXT cal orbits requested = **47**

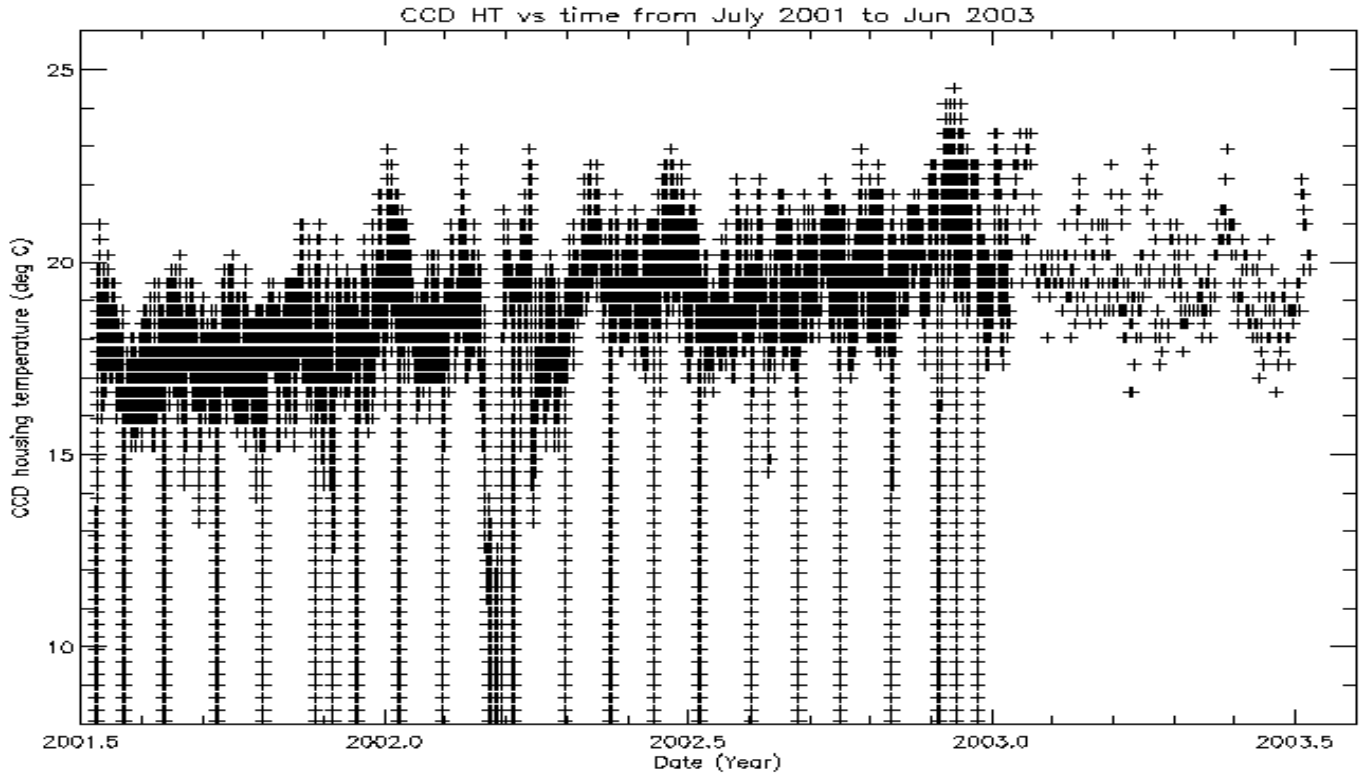
MONITORS: EXPANSIONS - CCD Spectroscopic Sensitivity Monitor

Fluxes in CCD spectral images depend on evolving instrumental sensitivity, CTE losses, and detector temperature. Temporal evolution has been greatest for G230LB:



STIS Calibration Plan for Cycle 12

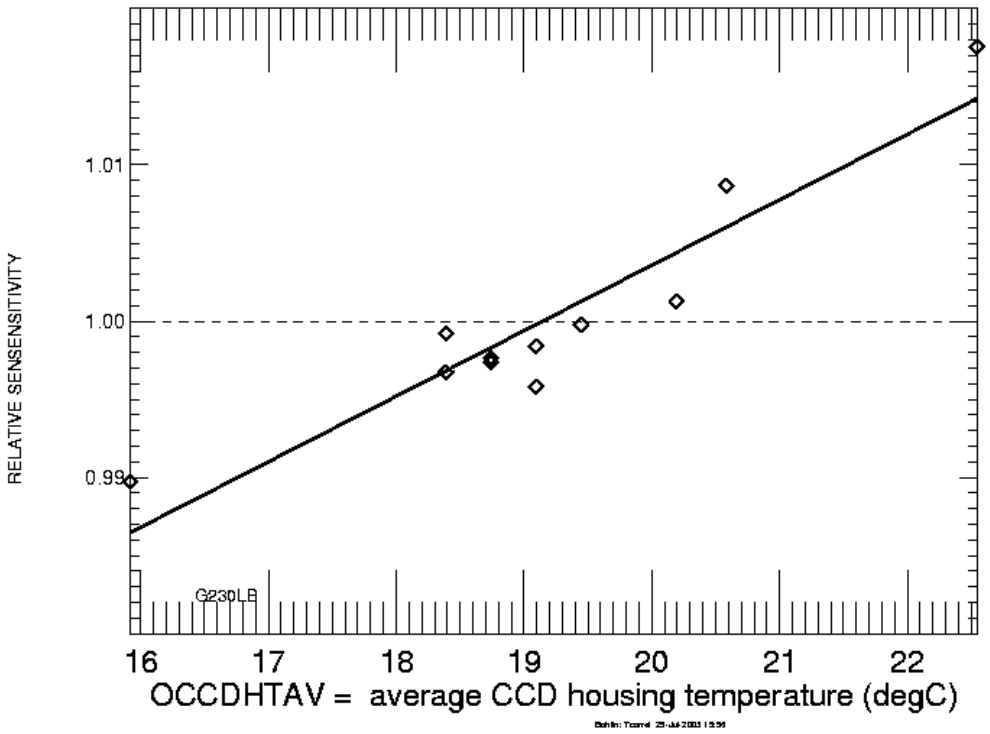
Detector temperature has been more variable since operations with side 2 electronics began in July 2001:



STIS Calibration Plan for Cycle 12

Sensitivity Monitor observations have not sampled detector temperature very well over the range encountered in science observations (~16 to 24 C).

Dependence of sensitivity on detector temperature for G230LB:



STIS Calibration Plan for Cycle 12

More L mode observations in cycle 12 (only) should enable us to better determine the dependence of sensitivity on detector temperature, while also testing newly implemented CTE corrections.

Requested changes in external orbits from cycle 11 to cycle 12 are:

```
CCD L modes:  4 orbits -->  8 orbits  (4 visits --> 8 visits)
CCD M modes:  4 orbits -->  2 orbits  (2 visits --> 1 visit)
total:        8 orbits --> 10 orbits
```

L mode data is used to determine sensitivity evolution for L and M modes. M mode observations are less essential, providing information on how well the two modes track each other and providing an extra check of CTE corrections.

The increase in CCD Sensitivity Monitor orbits is compensated for by the requested reduction in MAMA Sensitivity monitor orbits:

```
MAMA L modes:  6 orbits -->  4 orbits  (6 visits --> 4 visits)
MAMA M modes:  4 orbits -->  1 orbit   (4 visits --> 1 visit)
MAMA prism:    2 orbits -->  2 orbits  (1 visit  --> 1 visit)
MAMA echelle:  4 orbits -->  4 orbits  (2 visits --> 2 visit)
total:        16 orbits --> 11 orbits
```

STIS Calibration Plan for Cycle 12

SPECIAL PROGRAMS: CONTINUATION - FASTEX (Faint Standard Extension)

Purpose: Begin annual revisits of faint FASTEX star with well established photometry to monitor our predictions of the CTE correction for low signal levels and high background level.

Method: spectra with G430L (standard and E1 aperture position), G750L; **1 orbit**

Target: WD 1657+343 - faintest of 4 pure H WD stars that comprised the original FASTEX program

Previous observations: 3 times in 2000, once in 2002 to firmly establish the absolute flux levels

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Purpose: Observe a faint solar analog star to establish it as a photometric standard. Such a standard is needed by the SNAP project, NICMOS, and WFC3, and is a significant step in the right direction toward providing faint standards for JWST.

Method: spectra with G430L (standard and E1 aperture position), G750L; **4 orbits**

Target: A faint (V = 16.5 +/-0.5) solar analog in a field with low reddening to be identified by the SNAP team; approximate position is 16 20 +55 30

Cross-instrument comparison: NICMOS grism observation is planned for cycle 12; STIS spectra are required to establish the standard over the full range from 0.3-2 microns.

SPECIAL PROGRAMS: CONTINUATION - CTE for Extended Targets

Purpose: Determine the effects of CTE on the photometry and isophotes of extended sources.

Method: Observe a rich cluster of galaxies using both the B and D readout amplifiers, to get different distances from each galaxy to the readout

Target: A1689, with galaxy diameters ~ 2-3"

Previous cycle observation: cycle 9 (program 8839, Dec 2000)

Cross-instrument comparison: WFPC2 (Feb 2000)

Orbits: 2 (one per readout amplifier)

SPECIAL PROGRAMS: CONTINUATION -
Spectroscopic Sensitivity from Primary Standards: First-order gratings

Method and Purpose:

Observe 3 primary flux standards in all spectroscopic L-modes. Compare observed and model spectra to update calibration reference files describing spectroscopic sensitivity (and CTE loss) as a function of time.

Step one target along the slit with two short exposure times to get high S/N at low signal levels and low background level. Verify the CTE formula for STIS Spectroscopic modes recently derived using the two-amplifier readout method.

Targets: G191B2B, GD71, GD153

Previous cycle observation: cycle 10 (program 8916, Sep 2001 - Jul 2002)

Orbits: **5** for all L modes + **2** for slit stepping = **7**

SPECIAL PROGRAMS: NEW - Test of New and Revised Pseudoaperture Positions

Purpose: Check positions and throughputs for E1, E2, D1, and WEDGEA0.6 pseudoapertures

E1 = long slit at ~row 900 (to place the target near the default readout amplifier)
E2 = target coincident with 52x0.1E1 position to match fringe flats taken with that slit
D1 = long slit at a location on the FUV-MAMA where the irregular glow is faintest
WEDGEA0.6 = a location on a narrow (0.6") part of a wedge in the coronographic mask

Method: ACQ/PEAKs, spectra (with fringe flats as needed), image (WEDGEA0.6)

Targets: BD+75D325, WD2126+734

Orbits: 2

STIS Cycle 12 Calibration Plan

ID	Proposal Title	Frequency	Estimated Time (orbits)		Scheduling Required	Resources Required (FTE weeks)	Products	Accuracy Required	Notes
			"External" Prime	"Internal" & Parallel					
CCD Monitors									
	CCD Performance Monitor	2 per year		21	Dec 03 Jun 04	3	CDBS, ISR, STAN	0.1 ADU, drk 0.5 e-/hr,rms 0.05e-/hr/pix	Measures bias level, read noise, CTE and gain to check the performance and commandability of CCD (only amp D).
need 2	CCD Dark Monitor	2 per day		732	start 10/1/03	2	CDBS	> 5%	Monitor CCD behavior and chart growth of hot and bad pixels
need 2	CCD Bias Monitor	daily		366	start 10/1/03	2	CDBS	0.1 ADU; rms 0.3-0.8 ADU	Track evolution of hot columns. Build high-S/N superbias.
	CCD Read Noise Monitor	bimonthly		12	start Oct/Nov 03	1	ISR	0.05 DN	For all amplifiers (A, B, C, D), full frame Gain=1, 4 binnings=1x1,1x2,2x1,2x2
	CCD Hot Pixel Annealing	monthly		137_P	28-day month	3	reports; CDBS		Anneal hot pixels, track their growth.; examine CTE performance
	CCD Spectroscopic Flats	bimonthly		21		1	CDBS; ISR	<5%	G430M and G430L
	CCD Imaging Flats	bimonthly		8	50CCD+LP bimonthly; OII, OIII every 6 mo	3	CDBS; ISR	0.5% pixel-to-pixel 0.8% for OII	Investigate flat-field stability
	CCD Spectroscopic Dispersion Monitor	once		1		1	CDBS; ISR	0.2 pixel	G230MB(1713) for row 900, to supplement cycle 11 data
	CCD Sparse Field CTE Internal	2 per year		64	~Mar 04; ~Sep 04	0	ISR algorithm & coeff.	1%	Measures CTE using internal cal lamps and readouts at Gains 1 & 4.
	CCD Sparse Field CTE External	annually	6		beginning or end of CVZ passage, late in cycle	0	ISR; algorithm & coeff.	1%	Measures CTE at different signal levels with varying background, amps B&D. Establish accurate correction for low count level non-linearity CTE.
	CCD Full-Field Sensitivity Monitor	annually	1			2	ISR, STAN	1%	Monitor CCD sensitivity over whole field of view using standard star field.

ID	Proposal Title	Frequency	Estimated Time (orbits)		Scheduling Required	Resources Required (FTE weeks)	Products	Accuracy Required	Notes
			"External" Prime	"Internal" & Parallel					
	Slit Wheel Repeatability	annually		1_P	between mar & may 04	0.4	ISR	0.1 pixel	Check stability of STIS slit wheel.
	CCD Spectroscopic Sensitivity Monitor	L: 8 per yr M: 1 per yr	10	9	L: periodic M: midcycle	4	CDBS, ISR, report	2%	Measure dependence of sensitivity on time; determine flux corrections depending on detector temperature and CTI
MAMA Monitors									
	MAMA Dispersion Solutions	once		6_P		0	CDBS, ISR	0.1 pixel	Deep wavecals for ECF physical modelling of optical elements; uses E140H,G140M,E230H,G230M
	MAMA Full-field Sensitivity	annually	3		midcycle	2	CDBS, ISR	1%	Star cluster in imaging mode. Monitor astrometric and PSF stability
	MAMA Sensitivity & Focus Monitor	L: 4 per yr M: 1 per yr prism: 1/yr echelle: 2/yr	11		L,M,echelle: periodic	4	CDBS, ISR, report	2% for sens, 10% for focus	Standard star spectra at field center to monitor sensitivity; measure focus once.
	MAMA Dark Monitor	twice weekly		192	2 visits each week,each det	8	CDBS, ISR	1%	Check health of MAMA detectors.
	MAMA Fold distribution	2 per year		4	spring and fall, each year	0.6	report, TIPS	95%	Monitor performance of MAMA microchannel plates
	MAMA FUV/NUV Anomalous Recovery	As needed	N/A		As needed	0.8	N/A	N/A	Permit recovery of MAMA detectors after an anomalous shutdown.
Special Calibration Programs									
	Faint Standards Extension (FASTEX)	std WD annually; solar analog 2 visits	5		visits to same star separated by 4 weeks or more	4	new standards, paper	1-2%	Use previously observed photometric std WD to test CTE model. Observe faint solar analog in SNAP field with G430L, G750L (to complement NICMOS grism)
	CTE for Extended Targets: Imaging	once	2			2	ISR	1-2%	Measure CTI for galaxies in cluster

ID	Proposal Title	Frequency	Estimated Time (orbits)		Scheduling Required	Resources Required (FTE weeks)	Products	Accuracy Required	Notes
			"External" Prime	"Internal" & Parallel					
	Spectroscopic Sensitivity from Primary Standards: First-order Gratings	once	7		early in cycle	4	CDBS, ISR	<1%	Observe same photometric primary std stars with L gratings on all detectors for cross calibration; test CTE model
	Test of New and Revised Pseudoaperture Positions	once	2		as early as possible	1	CDBS	5% throughput, 0.1 pix position	Test throughput and positional accuracy of new and revised pseudoapertures
TOTAL TIME (including all executions)			**47** *C8: 135* *C9: 84* *C10:108* *C11: 70*	**1574** *C8: 1723* *C9: 1890* *C10:1725* *C11:1902*		*C8: 168* *C9: 105* *C10: 107* *C11: 86*	**(Total Cycle 12 STIS GO orbits: 892)**		

_P Parallel orbits

Title: STIS Cycle 12 Faint Standard Extension: FASTEX
PI: Bohlin
Co-I(s): Goudfrooij

Total Prime Orbits: 5
One visit of one orbit on an original FASTEX star; two visits of 2 orbits each on a new faint solar analog

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PURPOSE:

1. WD 1657+343 is the faintest of four pure hydrogen WD stars that comprised the original FASTEX program and has been observed thrice in 2000 and once in 2002 to firmly establish the absolute flux levels. Annual revisits of one orbit should occur to monitor our predictions of the CTE correction, which is increasing with time on orbit. G430L at both the standard and E1 aperture position are required at the exposure times already established as standard. The remaining time in the orbit will be spent extending the wavelength coverage using G750L.

2. To date, HST has not provided any faint solar analog stars to compliment the three V=12-13.5 mag solar analogs provided by M. Rieke for NICMOS calibration. As instrumentation in space and on the ground becomes more sensitive, fainter flux standards are required. A solar analog in a field with low reddening is an excellent choice for a fainter standard, because unreddened pure hydrogen WDs are rare beyond V=16, because Solar absolute fluxes are well measured at all wavelengths, and because the fluxes do not fall off as fast as the hot WDs at longer wavelengths. A 16.5 G star may not be faint enough for most JWST modes but will provide a significant step in the right direction. The SNAP program requires such a spectrophotometric standard, which lies at the bright limit of its spectroscopy mode. NICMOS grism observation of this standard are planned for cycle 12 and STIS spectra are required to establish the standard over the full range from 0.3-2 microns. The particular star has not yet been identified; but ongoing efforts by the SNAP calibration team (Bohlin is a member) are expected to identify a good target by the end of 2003. The SDSS stripe 38 data, which passes through the center of the SNAP north field is currently being observed. Several candidates have already been found with the SDSS Photometric Telescope and are scheduled for classification spectra this fall.

DESCRIPTION:

Only G430L and G750L spectra are required for both targets. Overheads including guide star and target acquisition account for about 15 min in the first orbit and only 5 min in the second, leaving about 35 and 45 min of exposure time in the first and second orbit, respectively. Wavecals run ~4 min, E1+centered pair of exp requires 1 wavecal, while exp overhead is ~2min for CCD spectra.

Multiple visits per star are required for establishing the repeatability of the flux level. The repeat visit should be delayed by at least one month, since that is the time scale for measurable changes in the CCD flat field. The delay must also be long enough to avoid thermal correlations that often make repeatability better on the few orbit time scales.

Products: Reference files, ISR

Fraction of science programs supported by this calibration: 35% (PLUS NICMOS/WFC3 IR/JWST science!)

Title: CTE for Extended Targets: Imaging
PI: Bahram Mobasher
Co-I(s): Paul Goudfrooij

Total Prime Orbits: 2

PURPOSE:

Determine the effect of Charge Transfer Efficiency (CTE) on photometry of extended sources.

DESCRIPTION:

This is a follow-up study to proposal 8839 to study STIS CTE calibration for extended objects. This takes images of galaxies to measure the effects of CTE on the isophotes of galaxies. The aim is to image small (2-3") extended sources in a suitably rich galaxy cluster. The target, A1689, has been observed by WFPC2 in the WF2 and WF4 chips (in Feb 2000), so that cross-instrument comparison will be straightforward. One orbit is needed per amplifier, i.e. two orbits total.

Accuracy: Percent level
Comments on Accuracy: counting statistics and high s/n background

Products: ISR, STAN

Fraction of science programs supported by this calibration: 40%

Title: Spectroscopic Sensitivity from Primary Standards: First-order gratings, Cycle 12
PI: Brown
Co-I(s): Goudfrooij, Bohlin, Stys

Total Prime Orbits: 7
2 orbits for GD71 in all L modes, 2 orbits for GD153 in all L modes, 1 orbit for G191B2B in all CCD L modes, and 2 orbits of G191B2B for CTE determination using G430L (5 steps along slit at two exposure times).

PURPOSE:

We will observe the primary flux standards G191B2B, GD71 and GD153, obtaining first-order spectra in all L-modes (G191B2B only in the CCD modes due to its high brightness in the UV). By comparing observed and model spectra, we will update calibration reference files describing spectroscopic sensitivity (and CTE loss) as a function of time. On visit of G191B2B will be spent on verifying the recently derived CTE formula for STIS Spectroscopic modes with the CCD, 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.

DESCRIPTION:

For the MAMA & CCD L-modes, we will obtain S/N >= 100 spectra to get a good measurement of the STIS throughput. For the FUV-MAMA L modes, this will be performed at the current MSM default location (3" below the repeller wire).

Accuracy: < 1%
Comments on Accuracy: Tests with existing calibration spectra indicate that a fourth order polynomial is adequate to describe the blaze function of the gratings. Monte Carlo analysis indicates a maximum error of 0.1% in a fourth order polynomial fitted to data with a peak S/N ratio of 20 per resolution element. Errors of 0.1% are well below other sources of error in our flux calibration procedure. The total error (including time dependences of throughput and CTE for the CCD) will stay below 1%.

Products: New CDBS absolute sensitivity reference files; Possible changes to the CTE parameters in the CCD Table Reference Files; ISR.

Fraction of science programs supported by this calibration: 100% (yes, imaging modes too!)

Title: Test of New and Revised Pseudoaperture Positions
PI: Proffitt

Total Prime Orbits: 2

PURPOSE:

Check aperture positions and throughputs for E1, E2, D1, and WEDGEA0.6 pseudoapertures

DESCRIPTION:

1st visit test new CCD pseudo apertures. Do peakup with regular central aperture, and then peakups with 52X0.05E1 and 52X0.1E1. Also take WEDGEA0.6 image, E2 spectra, and corresponding fringe flats. 2nd visit. Peakup at center of detector and then at 52X0.05D1 and 52x0.1D1. Then take G140L spectra through regular 52X2 followed by G140L with each D1 aperture.

Accuracy: 5% accuracy for aperture throughputs, 0.1 pixel accuracy for narrow slit positions.

Products: Revised reference files. Documentation updates.

Fraction of science programs supported by this calibration: 15% of STIS