Cycle 25 STIS Final Calibration Program Plan

STIS Team

Cycle 25 Instrument Usage Statistics Based on Approved Programs

- STIS orbits comprise ~16.2% of all GO prime orbits in Cycle 25

Instruments	Prime Orbits Usage	SNAP Orbit Usage
ACS	12.7%	14.7%
COS	24.8%	16.0%
STIS	16.2%	5.2%
WFC3	46.3%	64.1%
FGS	0.0%	0%

STIS Cycle 25 Usage Statistics for each Configuration/Mode

Configuration/Mode	Percentage of STIS Prime Exposure Time		Percentage of STIS SNAP Exposure Time	
	C24	C25	C24	C25
CCD	**31.1%**	**16.2%**	**--**	**--**
CCD/Imaging	1.1%	7.7%	--	--
CCD/Spectroscopy	30.0%	8.4%	--	--
MAMA/FUV	**41.3%**	**49.8%**	**--**	**50.2%**
FUV/Imaging	14.3%	0%	---	--
FUV/Spectroscopy	27.0%	49.8%	--	50.2%
MAMA/NUV	**27.6%**	**34.1%**	**--**	**49.8%**
NUV/Imaging	0.1%	2.2%	---	--
NUV/Spectroscopy	27.5%	31.9%	--	49.8%

STIS Cycle 25 Usage Statistics for each Grating/Mirror Combination

Configuration/Mode	Grating/Mirror	Percentage of STIS Prime science Exposure Time		Percentage of STIS SNAP science Exposure Time	
		C24	C25	C24	C25
STIS/CCD	G230LB	0.1%	1.1%	--	--
(16.2%)	G230MB	--	0.05%	---	--
	G430L	19.6%	1.4%	--	--
	G430M	0.2%	1.4%	---	--
	G750L	8.1%	1.7%	--	--
	G750M	2.0%	2.8%	---	--
	MIRROR/CORON	1.1%	7.7%	--	--
STIS/MAMA-FUV	E140H	2.0%	7.3%	---	--
(49.8%)	E140M	7.1%	8.9%	---	--
	G140L	8.2%	13.1%	--	50.2%
	G140M	9.7%	20.5%	--	--
	MIRROR	14.3%	--	---	--
STIS/MAMA-NUV	E230H	9.4%	8.6%	--	--
(34.1%)	E230M	10.5%	8.1%	---	--
	G230L	7.7%	14.7%	--	49.8%
	G230M	--	0.5%	--	--
	MIRROR	0.1%	2.2%	---	--

STIS Calibration and Monitor Orbits Approved by Cycle

	# of Programs	External Orbits	Parallel Orbits	Internal Orbits	Total Orbits
Cycle 17	25	68	0	1816	1884
Cycle 18	20	22	0	1370	1392
Cycle 19	18	21	0	1418	1439
Cycle 20	20	21	0	1391	1412
Cycle 21	20	21	0	1392	1413
Cycle 22	19	21	0	1387	1408
Cycle 23	22	31	1	1380	1416
Cycle 24	21	27	1	1355	1386
Cycle 25	17* + 6	21 + 6	0	1345 + 10	1366 + 16

* Includes early submission programs only

Requesting additional programs/orbits indicated in red

STIS Cycle 25 Calibration and Monitoring Orbits Approved

Prop. ID	Title	External	External Parallel	Internal	Frequency (orbits x repeats)	Cycle 24 Allocation
CCD Monitors						
	STIS CCD Performance Monitor			14	2x7	14
	STIS CCD Dark Monitor			730	2x242 + 1x246	730
	STIS CCD Bias and Read Noise Monitor			369	1x182 + 1x183+1x4	369
	STIS CCD Hot Pixel Annealing			39*	3x13	39
	STIS CCD Spectroscopic Flat-Field Monitor			19	1x10 +9	19
	STIS CCD Imaging Flat-Field Monitor			4	1x4	4
	STIS CCD Spectroscopic Dispersion Solution Monitor			3	3x1	3
	STIS CCD Sparse Field CTE			50*	50x1	50
	STIS CCD Full Field Sensitivity	1			1x1	1
	STIS Slit Wheel Repeatability			1	1x1	1
	STIS CCD Spectroscopic Sensitivity Monitor	5			L 1x3, M 2x1	5
MAMA Monitors						
	STIS MAMA Spectroscopic Dispersion Solution Monitor			7	7x1	7
	STIS MAMA Full Field Sensitivity	3			1x3	3
	STIS MAMA Spectroscopic Sensitivity and Focus Monitor	12			1x3/L, 1x1/M, 2x4/E	12
	STIS FUV MAMA Dark Monitor			54	6x9	54
	STIS NUV MAMA Dark Monitor			52	2x26	52
	STIS MAMA NUV Flat-Field Monitor			11*	1x11	11
	STIS MAMA Fold Distribution			2	2x1	2
Special Programs						
	STIS E140M Sensitivity Curves	1			1x1	
	Optimizing STIS Spatial Scans	4			1x1, 3x1	
Contingency Programs						
	STIS MAMA Anomalous Recovery			(8)		(8)
TOTAL	**Cycle 25 orbits approved**	**26**	**0**	**1355 + (8)**		**Ext: 27 + 1** **Int: 1355+(8)**

* Internal parallel orbits > 1800s.

Green means "executing on alternating cycle only"

( ) Indicates contingency orbits not included in Cycle 25 request.

Red means new

Routine program submitted later

Cycle 25 STIS Calibration Plan:
Routine Programs & Monitoring

STIS Team

6/6/2017

STIS Calibration and Monitor Orbits Approved by Cycle

	# of Programs	External Orbits	Parallel Orbits	Internal Orbits	Total Orbits
Cycle 17	25	68	0	1816	1884
Cycle 18	20	22	0	1370	1392
Cycle 19	18	21	0	1418	1439
Cycle 20	20	21	0	1391	1412
Cycle 21	20	21	0	1392	1413
Cycle 22	19	21	0	1387	1408
Cycle 23	22	31	1	1380	1416
Cycle 24	21	27	1#	1355	1386
Cycle 25	17*	21	0	1345	1366

* Includes early submission programs only

\# Excludes parallel airglow observations taken for COS Team

STIS Cycle 25 Calibration and Monitoring Orbits Requested

Prop. ID	Title	External	External Parallel	Internal	Frequency (orbits x repeats)	Cycle 24 Allocation
CCD Monitors						
	STIS CCD Performance Monitor			**14**	**2x7**	**14**
	STIS CCD Dark Monitor			**730**	**2x242 + 1x246**	**730**
	STIS CCD Bias and Read Noise Monitor			**369**	**1x182 + 1x183+1x4**	**369**
	STIS CCD Hot Pixel Annealing			**39***	**3x13**	**39**
	STIS CCD Spectroscopic Flat-Field Monitor			**19**	**1x10 +9**	**19**
	STIS CCD Imaging Flat-Field Monitor			**4**	**1x4**	**4**
	STIS CCD Spectroscopic Dispersion Solution Monitor			**TBD**	**TBD**	**3**
	STIS CCD Sparse Field CTE			**50***	**50x1**	**50**
	STIS CCD Full Field Sensitivity	**1**			**1x1**	**1**
	STIS Slit Wheel Repeatability			**1**	**1x1**	**1**
	STIS CCD Spectroscopic Sensitivity Monitor	**5**			**L 1x3, M 2x1**	**5**
MAMA Monitors						
	STIS MAMA Spectroscopic Dispersion Solution Monitor			**TBD**	**TBD**	**7**
	STIS MAMA Full Field Sensitivity	**3**			**1x3**	**3**
	STIS MAMA Spectroscopic Sensitivity and Focus Monitor	**12**	**0**		**1x3/L, 1x1/M, 2x4/E**	**12**
	STIS FUV MAMA Dark Monitor			**54**	**6x9**	**54**
	STIS NUV MAMA Dark Monitor			**52**	**2x26**	**52**
	STIS MAMA NUV Flat-Field Monitor			**11***	**1x11**	**11**
	STIS MAMA Fold Distribution			**2**	**2x1**	**2**
Contingency programs						
	STIS MAMA Anomalous Recovery			**(6)**		**(6)**
	STIS Focus Parallel Measurements	**TBD**	**TBD**		**TBD**	**1**
TOTAL	**Cycle 25 orbit request**	**21**	**0**	**1345 + (6)**		**Ext: 27 + 4** **Int: 1355+(6)**

* Internal parallel orbits > 1800s.

Green means "executing on alternating cycle only"

( ) Indicates contingency orbits not included in Cycle 25 request.

Red: change from last cycle

TBD: Phase Is to be submitted later

STIS Cycle 25 Calibration: Changes from Cycle 24

- MAMA Spectroscopic Sensitivity program no longer includes parallel orbits for COS airglow observations for the COS Team. This change is due to COS policy changes that will follow the COS LP4 move in Cycle 25.

- Two programs alternate between even and odd cycles:

  - STIS MAMA NUV Flat-Field Monitor will execute in Cycle 25 instead of the FUV Flat-Field Monitor

  - CCD Sparse Field CTE Internal program observations will use the GAIN = 1 setting this cycle instead of GAIN = 4.

STIS Cycle 25 Calibration Programs to be Submitted Later

- The accuracy of the STIS spectroscopic dispersion solutions is under current investigation. The following regular calibration programs will be submitted later, pending the results of this work:
  - STIS CCD Spectroscopic Dispersion Solution Monitor
  - STIS MAMA Spectroscopic Dispersion Solution Monitor
- A continuation of the special/contingency STIS Focus Parallel Measurements programs from previous cycles may be submitted later, following ongoing work by the Telescopes Group.

STIS/CCD Programs

Note: STIS Cycle 25 Phase Is Include
Cycle 24 Usage Statistics

STIS CCD Performance Monitor
PI: Allyssa Riley

Purpose	To measure the baseline performance of the CCD detector.
Description	This program monitors the performance of the CCD detector on orbit for amplifier D only. Bias and flat field exposures are taken to measure read noise, CTE (EPER test), spurious charge, and gain values with full frame observations. Bias exposures are also taken in sub-array readouts to check the bias level for ACQ and ACQ/PEAK observations. All orbits < 1800s
Fraction GO/GTO Programs Supported	31% of STIS total exposure time.
Resources Required: Observations	14 internal orbits performed in 2 groups of 7
Resources Required: Analysis	2 FTE weeks for analysis and documentation.
Products	Possible update of the gain, bias level, and read noise values in ccdtab. This also provides a relative measure of CTI via the extended pixel edge response test. Possible flight software updates of table CCDBiasSubtractionValue. Summary in the end of cycle ISR and updates to the STIS monitor webpages.
Accuracy Goals	Read noise good to +/- 0.3 ADU, gain error < 0.08 ADU
Scheduling & Special Requirements	Visits occur every 6 months in Mar and Sept.
Changes from Cycle 24	Different software to analyze data and calculate gain (use quick_gain.py instead of stisgain2.py)

STIS CCD Dark Monitor (Parts 1, 2 and 3)
PI: Allyssa Riley

Purpose	Monitor dark current for the STIS CCD.
Description	Routine monitoring with Amp D and GAIN = 1: obtain 2 visits
Fraction GO/GTO Programs Supported	31% of STIS total exposure time
Resources Required: Observations	242 (part 1) + 242 (part 2) + 246 (part 3) internal orbits <1800s.
Resources Required: Analysis	6 FTE weeks; Retrieve and construct superdarks. These superdarks are compared to previous superdarks and the image statistics are checked to see if there are any anomalous statistical deviations. CTI analysis based on short darks is performed.
Products	Weekly CRDS reference files (superdarks) and a summary in the end of cycle ISR and update of the monitor webpage.
Accuracy Goals	Superdark rms < 0.012 e-/s and S/N > 1.0 per pixel in superdarks.
Scheduling & Special Requirements	Two orbits each day.
Changes from Cycle 24	No Changes

STIS CCD Bias and Read Noise Monitor (Parts 1 & 2)
PI: Allyssa Riley

Purpose	Monitor the bias in the 1x1 bin settings at gain=1, and 1x1 at gain = 4, to build up high S/N superbiases and track the evolution of hot columns. Also GAIN=1 and GAIN=4, 1x1 biases through AMPS A and C to use in combination with biases taken through AMP D for monitoring of the read noise
Description	Take full frame bias exposures in the 1x1 bin settings at GAIN = 1, and at GAIN = 4 with nominal AMP D. Take full frame biases through AMPs A and C in GAIN = 1 and 4 as well for performing read noise monitoring. All exposures are internal and fit in occultation orbits. In addition to routine monitoring, during one month we use 4 additional internal orbits of GAIN = 1, AMP A biases in support of absolute CTI measurements.
Fraction GO/GTO Programs Supported	31% of STIS total exposure time
Resources Required: Observations	182 (part 1) + 187 (part 2) internal orbits. Includes 4 (CTI) internal orbits <1800s
Resources Required: Analysis	2 FTE weeks. Retrieve and construct superbiases. These are compared to previous superbiases and the image statistics are checked to see if there are any anomalous deviations. Biases with AMPS A and C allow for monitoring of the read noise.
Products	Weekly CRDS reference files (superbiases) and a summary in the end of cycle ISR
Accuracy Goals	Superbiases RMS < 0.95 e- at GAIN = 1 1x1 and RMS < 1.13 e- at GAIN = 4 1x1, S/N > 1 per pixel.
Scheduling & Special Requirements	One orbit per day for the routine monitor. The additional bias for AMP A should be taken the same month as AMP A darks for CTI analysis
Changes from Cycle 24	No changes

STIS CCD Hot Pixel Annealing
PI: Allyssa Riley

Purpose	To anneal hot pixels and the effectiveness of the CCD hot pixel annealing is assessed by measuring the dark current behavior before and after annealing.
Description	The characteristics of the CCD will first be defined by a series of bias, dark and flat-field exposures taken before the anneal. The CCD Thermoelectric cooler will be turned off to allow the CCD detector temperature to rise from ~ -80 C to +5 C. The CCD will be left in the uncooled state for approximately 12 hours. At the end of this period the Thermoelectric cooler is turned back on and the CCD is cooled to its normal operating temperature. Since the CCD on Side-2 does not have thermistor, a 4 hour period, at a minimum, is necessary to ensure that the CCD is cool and stable. After the CCD has stabilized, bias, dark and flat-field images will be repeated to check for changes in the CCD characteristics. The flat-field exposures will permit evaluation of any window contamination acquired during the annealing period. Pure parallel mode.
Fraction GO/GTO Programs Supported	31% of STIS total exposure time.
Resources Required: Observations	39 internal orbits and all orbits >1800s.
Resources Required: Analysis	2 FTE weeks. By comparing the number of hot pixels before and after the anneal, we see if the hot pixels decrease and estimate the number of hot pixels that persist after the process.
Products	Hot pixel growth rate, median dark count rate, and a summary in the end of cycle ISR
Accuracy Goals	Measure the growth rate of hot pixels to within 1% if possible
Scheduling & Special Requirements	Pure parallel mode exposures. Anneals will execute every 4th week using 3 orbits.
Changes from Cycle 24	No changes.

STIS CCD Spectroscopic Flat-Field Monitor
PI: Joleen Carlberg

Purpose	Obtain medium resolution grating flats to determine the pixel-to-pixel variation for spectroscopic observations and produce the cycle 25 reference p-flat (M and L modes).
Description	We use the tungsten lamp and the G430M grating to determine the pixel-to-pixel variation of the STIS CCD in spectroscopic mode. The flat exposures are taken with the 50CCD and 52x2 apertures at 5 offset positions in order to map -with a sufficient SNR- the whole sensitive area of the detector. The expected cumulative signal ≥1.4E6 ADU/pixels; while the expected accuracy will be ≤1.5%. All orbits are less < 1800 s.
Fraction GO/GTO Programs Supported	31% of STIS total exposure time.
Resources Required: Observations	19 internal orbits <1800s
Resources Required: Analysis	2.5 weeks FTE
Products	Reference files, summary in end of cycle ISR and ISR as applicable
Accuracy Goals	≤1.5% flat field accuracy
Scheduling & Special Requirements	9 orbits with G430M/5612 & 50CCD spread across the cycle; 1 visit every ~40 days 10 orbits with the G430M/5612 & 52x2
Changes from Cycle 24	No changes

STIS CCD Imaging Flat-Field Monitor
PI: John Debes

Purpose	Purpose: Collect high SNR white light imaging flats (aperture=50CCD) for monitoring purposes and to create a new reference p-flat for chronographic (and imaging) observations.
Description	Once every 3 months, obtain a series of imaging CCD flats using the MIRROR and the unfiltered 50CCD aperture. The 3 months cadence will allow us to keep monitoring possible (but unlikely) variations across the cycle; while the combined observations will allow us to obtain an average signal ~620000 ADU/pix (similarly to the past cycles) and create a high accuracy (~1%) imaging p-flat. The remaining time in each orbit/visit will be used to monitor the stability of the CORON aperture due to the MSM limited reproducibility.
Fraction GO/GTO Programs Supported	31% of STIS total exposure time.
Resources Required: Observations	4 internal orbits
Resources Required: Analysis	4 weeks FTE
Products	Reference p-flat and TIR or ISR as relevant.
Accuracy Goals	~1% flat field accuracy
Scheduling & Special Requirements	1 orbit every 3 months.
Changes from Cycle 24	None.

CCD Sparse Field CTE Internal
Sean Lockwood

Purpose	Re-establish an accurate correction for parallel register CTE losses that can be used for direct analysis of science data with negligible background. Do measurements for one gain setting (GAIN=1), alternating with GAIN=4 every-other-cycle.
Description	The sparse field CTE will be measured via internal calibration lamp observations taken through narrow slits. Using the onboard tungsten lamp, narrow slit images are projected at different positions on the detector. At each position a series of exposures is taken alternating between the 'A' and 'C' amplifiers for readout. The further the charge needs to be shifted to be read out, the more charge it will lose. For the parallel CTE measurement, the test will use the the cross disperser slits: 0.05x31NDB and 0.05x31NDA. In order to test the effects of different bias voltages and readout timing, the whole series of exposures are executed once for GAIN=1 and once for GAIN=4 every-other cycle; this process requires a total of 50 orbits per cycle which includes various sets of biases and darks. For the CTE pixel based correction, the test requires 8 orbits for darks read out with amplifier A.
Fraction GO/GTO Programs Supported	31% of STIS total exposure time (cycle 24)
Resources Required: Observations	50 internal visits (7/50 visits will exceed the 1800 s limit by ~100 s in order to capture the full sequence of exposures required for best analysis.)
Resources Required: Analysis	3 FTE weeks
Products	Determine slope for time dependent empirical flux correction of CTE, possible update of ccdtab reference file, and inclusion in a summary ISR.
Accuracy Goals	1%
Scheduling & Special Requirements	Schedule between 01 November 2017 and 01 January 2018. Visits should execute in order.
Changes from Cycle 24	Data taken for gain=1 instead of gain=4; alternates every cycle.

STIS CCD Full-Field Sensitivity
PI: John Debes

Purpose	To monitor CCD sensitivity over the whole field of view.
Description	Measure a photometric standard star field in Omega Cen in 50CCD annually to monitor CCD sensitivity over the whole field of view. Keep the spacecraft orientation within a suitable range (+/- 5 degrees) to keep the same stars in the same part of the CCD for every measurement. This test will give a direct transformation of the 50CCD magnitudes to the Johnson-Cousins system for red sources. These transformations should be accurate to 1%. The stability of these transformations will be measured to the sub-percent level. These observations also provide a check of the astrometric and PSF stability of the instrument over its full field of view. All external orbits > 1800s.
Fraction GO/GTO Programs Supported	31%
Resources Required: Observations	1 external
Resources Required: Analysis	1 FTE week
Products	Summary in the end of cycle ISR
Accuracy Goals	1%
Scheduling & Special Requirements	ORIENT 310.0D TO 310.0 D; BETWEEN 15-JAN-2018:00:00:00 AND 20-MAR-2018:00:00:00
Changes from Cycle 24	None.

STIS Slit Wheel Repeatability
PI: Tony Sohn

Purpose	To test the repeatability of slit wheel motions.
Description	A sequence of lamp spectra taken using grating G230MB
Fraction GO/GTO Programs Supported	100% of STIS total exposure time.
Resources Required: Observations	One internal orbit (24 exposures, ~40 mins total) once per year.
Resources Required: Analysis	2 FTE days
Products	The average and maximum shifts observed in the dispersion and the spatial direction. Possible ISR that sums up analyses results for the past few cycles.
Accuracy Goals	Shifts should be smaller than 0.5 pixels.
Scheduling & Special Requirements	Between Nov 01,2017 and Jan 31, 2018
Changes from Cycle 24	No changes

STIS CCD Spectroscopic Sensitivity Monitor
PI: Joleen Carlberg

Purpose	Monitor the spectroscopic sensitivity of the STIS CCD using both low- and medium-resolution gratings to reveal contamination issues that may affect the spectroscopic throughput.
Description	This program will monitor the STIS CCD spectroscopic sensitivity using a high-declination spectroscopic calibration star (AGK+81D266). The results will be compared to previous observations to detect trends. The L modes will be observed at the nominal and E1 positions every four months with one orbit per visit. The M modes will be observed at the nominal and E1 positions as well, once per year with two orbits per visit.
Fraction GO/GTO Programs Supported	31%, Cycle 24
Resources Required: Observations	5 external orbits
Resources Required: Analysis	7 FTE weeks: 3 FTE weeks for sensitivity analysis, 2 weeks for ISR, 2 FTE weeks for CTE correction verification
Products	Updated STIS TDSTAB file, an ISR on STIS sensitivity monitoring, summary in end of cycle ISR
Accuracy Goals	Minimum signal to noise of 50 per resolution element at the least sensitive wavelength.
Scheduling & Special Requirements	1 orbit every 4 months for L modes. 2 orbits/year for M modes.
Changes from Cycle 24	No changes

STIS/MAMA Programs

STIS MAMA Full-Field Sensitivity
PI: John Debes

Purpose	To monitor the sensitivity of the FUV-MAMA and NUV-MAMA over the full field
Description	By observing the globular cluster NGC6681 once every year at roughly the same orientation, we will monitor the full-field sensitivity of the MAMA detectors and their astrometric and PSF stability. These observations will be used to look for contamination, throughput changes, or formation of color centers in the photocathode and window that might be missed by spectroscopic monitoring or difficult to interpret in flat-fielding. Although this test is done using MAMA imaging modes, the confirmation of detector stability and uniformity provided by this monitor is important for spectroscopic observations as well. All orbits > 1800s.
Fraction GO/GTO Programs Supported	69% of STIS prime exposure time
Resources Required: Observations	3 external orbits
Resources Required: Analysis	1 FTE week
Products	Summary in the end of cycle ISR
Accuracy Goals	1%
Scheduling & Special Requirements	Should roughly match most common orient from previous observations. ORIENT 260.0D TO 266.0 D; BEFORE 16-JUN-2018:00:00:00
Changes from Cycle 24	No Changes

STIS MAMA Spectroscopic Sensitivity & Focus Monitor
PI: Joleen Carlberg

Purpose	Monitor the sensitivity of each STIS MAMA grating mode to detect any changes due to contamination or other effects, and monitor the STIS focus in spectroscopic and imaging modes.
Description	- SENSITIVITY: Obtain exposures in each of the two low-resolution MAMA spectroscopic modes every 4 months, in each of the 2 medium-resolution modes once a year, and in each of the 5 echelle modes every 3 months, using unique calibration standards for each mode (L: GRW+70D5824, M: AGK+81D266, E: BD+28D4211), and compare the results to the first observations to detect any trends. - FOCUS: For this cycle we will continue to monitor the STIS focus (small aperture throughput as a function of UV wavelength) by including a direct comparison between the G230LB 0.1X0.09 and 52x2 throughput, as well as a narrow band OII CCD image during each L-Mode visit. We will continue to also include an OII image with the M-mode visit.
Fraction GO/GTO Programs Supported	Focus monitor: 100% of STIS exposures- Sensitivity monitor: 69% of STIS exposures
Resources Required: Observations	12 external orbits
Resources Required: Analysis	6.5 FTE weeks: 3 FTE weeks for sensitivity analysis, 2 weeks for ISR, 1.5 for focus.
Products	Updated STIS TDSTAB file and ISRs on STIS sensitivity monitoring and focus monitoring. Summary in the end of cycle ISR.
Accuracy Goals	Minimum signal to noise of 50 per resolution element at the least sensitive wavelength. 10% for focus changes.
Scheduling & Special Requirements	Visits need to be approximately equally spaced throughout the cycle.
Changes from Cycle 24	Previously, COS team obtained parallel observations of airglow during STIS echelle observations. This was discontinued due to new policies beginning in Cycle 25 for COS LP4.

STIS FUV MAMA Dark Monitor
Sean Lockwood

Purpose	Monitor the behavior of the dark current in the FUV MAMA detector, provide data for dark count corrections for faint object observations, and also provide a check on the health of the detector
Description	Every six weeks a set of six exposures of 1300s is taken with the FUV MAMA with the shutter closed. The exposures are evenly spread over a six-hour SAA-free period.
Fraction GO/GTO Programs Supported	41% (cycle 24)
Resources Required: Observations	54 internal visits
Resources Required: Analysis	2 FTE
Products	Dark current images and temperature-dependent formula for applying to an individual observation. Update to monitoring webpage.
Accuracy Goals	1%
Scheduling & Special Requirements	Groups of visits spaced apart ~every 6 weeks SAA free
Changes from Cycle 24	None

STIS NUV MAMA Dark Monitor
Sean Lockwood

Purpose	Monitor the behavior of the dark current in the NUV MAMA detector, provide data for dark count corrections for faint object observations, and also provide a check on the health of the detector
Description	Every two weeks a set of two 1300 s exposures is taken with the NUV MAMA with the shutter closed. The exposures are taken separated by six hours within an SAA-free period. This separates long and short term temporal effects.
Fraction GO/GTO Programs Supported	28% (cycle 24)
Resources Required: Observations	52 internal visits
Resources Required: Analysis	2 FTE
Products	Dark reference files and tables modeling time and temperature dependence of dark rates. Update to monitoring webpage.
Accuracy Goals	1%
Scheduling & Special Requirements	Pairs of visits spaced apart every 2 weeks SAA free
Changes from Cycle 24	None

STIS NUV MAMA Flat-Field Monitor
PI: Tony Sohn

Purpose	The goal of this program is to obtain NUV-MAMA flat-field observations to create new p-flats with a SNR of ~100 per low-res pixel. The flats are obtained with the DEUTERIUM lamp, and the MR grism G230M.
Description	Past experience and observations have shown that 11 visits are sufficient to build a p-flat with the required SNR~100 per low-res pixel. The G230M flats will be taken with the slit at 5 different offset positions in order to illuminate the detector region which are normally shadowed by the slit bars. The exact instrument setup (slit width and central wavelength) may change during the cycle depending on the desired count level of each exposure.
Fraction GO/GTO Programs Supported	28% of STIS total exposure time.
Resources Required: Observations	11 internal orbits and all orbits > 1800s.
Resources Required: Analysis	4 FTE weeks
Products	This cycle p-flat is primarily for monitoring purpose. The achievable SNR is limited by the Poisson noise. If applicable, a new reference p-flat will be created combining NUV flats from cycles
Accuracy Goals	1.0% accuracy in per low-res pixel (i.e., 2x2 high-res pixels)
Scheduling & Special Requirements	NUV- and FUV-MAMA flat observations are executed on alternate cycles to save lamp lifetime.
Changes from Cycle 24	This cycle is for NUV-MAMA flats, while Cycle 24 was for FUV-MAMA flats.

STIS MAMA Fold Distribution
PI: Thomas Wheeler

Purpose	The fold analysis provides a measurement of the distribution of charge cloud sizes incident upon the anode providing some measure of changes in the pulse-height distribution of the MCP and, therefore, MCP gain.
Description	While globally illuminating the detector with a flat field, the valid event (VE) rate counter is monitored, while various combinations of row and column folds are selected.
Fraction GO/GTO Programs Supported	69% of STIS prime orbits
Resources Required: Observations	2 internal orbits
Resources Required: Analysis	0.5 FTE day.
Products	The results will be sent to the STIS Team and Steve Franka of Ball Aerospace.
Accuracy Goals	N/A
Scheduling & Special Requirements	This proposal is executed annually.
Changes from Cycle 24	No changes.

Contingency Programs

STIS MAMA Recovery from Anomalous Shutdown
PI: Thomas Wheeler

Purpose	Safe and orderly recovery of either MAMA detector from an anomalous shutdown.
Description	The recovery procedure consists of three separate tests (i.e. visits) to check the MAMA's health after an anomalous shutdown. Each must be successfully completed before proceeding onto the next. They are: (1) signal processing electronics check, (2) slow, intermediate voltage high-voltage ramp-up, and (3) ramp-up to full operating voltage.
Fraction GO/GTO Programs Supported	69% of STIS prime orbits
Resources Required: Observations	6 internal orbits
Resources Required: Analysis	If activated, 0.5 FTE day per test.
Products	For tests 1-3, only a Go/No-Go to proceed will be given.
Accuracy Goals	N/A
Scheduling & Special Requirements	This is a contingency proposal activated only in the event of an anomalous shutdown. This proposal is usually followed by the STIS MAMA Fold Distribution proposal.
Changes from Cycle 24	No changes

Cycle 24 Usage Statistics

STIS Cycle 24 Usage Statistics for each Configuration/Mode

Configuration/Mode	Percentage of STIS Prime Exposure Time		Percentage of STIS SNAP Exposure Time	
	C23	C24	C23	C24
CCD	**24.1%**	**31.1%**	**100%**	**--**
CCD/Imaging	0.7%	1.1%	--	--
CCD/Spectroscopy	23.4%	30.0%	100%	--
MAMA/FUV	**35.7%**	**41.3%**	**--**	**--**
FUV/Imaging	11.0%	14.3%	---	--
FUV/Spectroscopy	24.7%	27.0%	--	--
MAMA/NUV	**40.2%**	**27.6%**	**--**	**--**
NUV/Imaging	0.8%	0.1%	---	--
NUV/Spectroscopy	39.2%	27.5%	--	--

STIS Cycle 24 Usage Statistics for each Grating/Mirror Combination

Configuration/Mode	Grating/Mirror	Percentage of STIS Prime science Exposure Time		Percentage of STIS SNAP science Exposure Time	
		C23	C24	C23	C24
STIS/CCD	G230LB	7.9%	0.1%	59.7%	--
(31.1%)	G230MB	--	--	---	--
	G430L	6.4%	19.6%	15.7%	--
	G430M	0.4%	0.2%	---	--
	G750L	7.6%	8.1%	24.6%	--
	G750M	1.3%	2.0%	---	--
	MIRROR/CORON	0.7%	1.1%	--	--
STIS/MAMA-FUV	E140H	7.7%	2.0%	---	--
(41.3%)	E140M	4.4%	7.1%	---	--
	G140L	7.3%	8.2%	--	--
	G140M	5.3%	9.7%	--	--
	MIRROR	11.0%	14.3%	---	--
STIS/MAMA-NUV	E230H	14.8%	9.4%	--	--
(27.6%)	E230M	7.4%	10.5%	---	--
	G230L	17.2%	7.7%	--	--
	MIRROR	0.8%	0.1%	---	--

Cycle 24 Instrument Usage Statistics Based on Approved Programs

- STIS orbits comprise ~27.6% of all GO prime orbits in Cycle 24

Instruments	Prime Orbits Usage	SNAP Orbit Usage
ACS	13.9%	25.4%
COS	20.5%	16.8%
STIS	27.6%	0.0%
WFC3	37.9%	57.7%
FGS	0.0%	0%

Cycle 25 STIS Special Calibration Program Plan

Tala Monroe
&
STIS Team

9/20/2017

STIS Cycle 25 Calibration and Monitoring Orbits Requested

Prop. ID	Title	External	External Parallel	Internal	Frequency (orbits x repeats)	Cycle 24 Allocation
CCD Monitors						
	STIS CCD Performance Monitor			14	2x7	14
	STIS CCD Dark Monitor			730	2x242 + 1x246	730
	STIS CCD Bias and Read Noise Monitor			369	1x182 + 1x183+1x4	369
	STIS CCD Hot Pixel Annealing			39*	3x13	39
	STIS CCD Spectroscopic Flat-Field Monitor			19	1x10 +9	19
	STIS CCD Imaging Flat-Field Monitor			4	1x4	4
	STIS CCD Spectroscopic Dispersion Solution Monitor			3	3x1	3
	STIS CCD Sparse Field CTE			50*	50x1	50
	STIS CCD Full Field Sensitivity	1			1x1	1
	STIS Slit Wheel Repeatability			1	1x1	1
	STIS CCD Spectroscopic Sensitivity Monitor	5			L 1x3, M 2x1	5
MAMA Monitors						
	STIS MAMA Spectroscopic Dispersion Solution Monitor			7	7x1	7
	STIS MAMA Full Field Sensitivity	3			1x3	3
	STIS MAMA Spectroscopic Sensitivity and Focus Monitor	12			1x3/L, 1x1/M, 2x4/E	12
	STIS FUV MAMA Dark Monitor			54	6x9	54
	STIS NUV MAMA Dark Monitor			52	2x26	52
	STIS MAMA NUV Flat-Field Monitor			11*	1x11	11
	STIS MAMA Fold Distribution			2	2x1	2
Special Programs						
	STIS E140M Sensitivity Curves	1			1x1	
	Optimizing STIS Spatial Scans	4			1x1, 3x1	
	~~Post-SM4 Time Dependent Sensitivity of the STIS PRISM~~	~~1~~			~~1x1~~	
Contingency Programs						
	STIS MAMA Anomalous Recovery			(8)		(8)
	~~STIS Focus Parallel Measurements~~	~~(1)~~	~~(1)~~		~~1x1~~	~~1~~

* Internal parallel orbits > 1800s.

Green means "executing on alternating cycle only"

( ) Indicates contingency orbits not included in Cycle 25 request.

Red means new

Routine program being discussed today

Strikethroughs indicate programs not approved

STIS Cycle 25 Calibration and Monitoring Orbits Requested (cont'd)

Prop. ID	Title	External	External Parallel	Internal	Frequency (orbits x repeats)	Cycle 24 Allocation
	STIS CCD Spectroscopic Dispersion Solution Monitor			3	3x1	3
	STIS MAMA Spectroscopic Dispersion Solution Monitor			7	7x1	7
Special Programs						
	STIS E140M Sensitivity Curves	1			1x1	
	Optimizing STIS Spatial Scans	4			1x1, 3x1	
	~~Post-SM4 Time Dependent Sensitivity of the STIS PRISM~~	~~1~~			~~1x1~~	
Contingency Programs						
	STIS MAMA Anomalous Recovery			(8)		(8)
	~~STIS Focus Parallel Measurements~~	~~(1)~~	~~(1)~~		~~1x1~~	~~1~~
TOTAL	**Cycle 25 orbit request**	**27 + (1)**	**(1)**	**1355 + (8)**		**Ext: 27 + 1 Int: 1355+(8)**

* Internal parallel orbits > 1800s.

Green means "executing on alternating cycle only"

( ) Indicates contingency orbits not included in Cycle 25 request.

Red means new

Routine program being discussed today

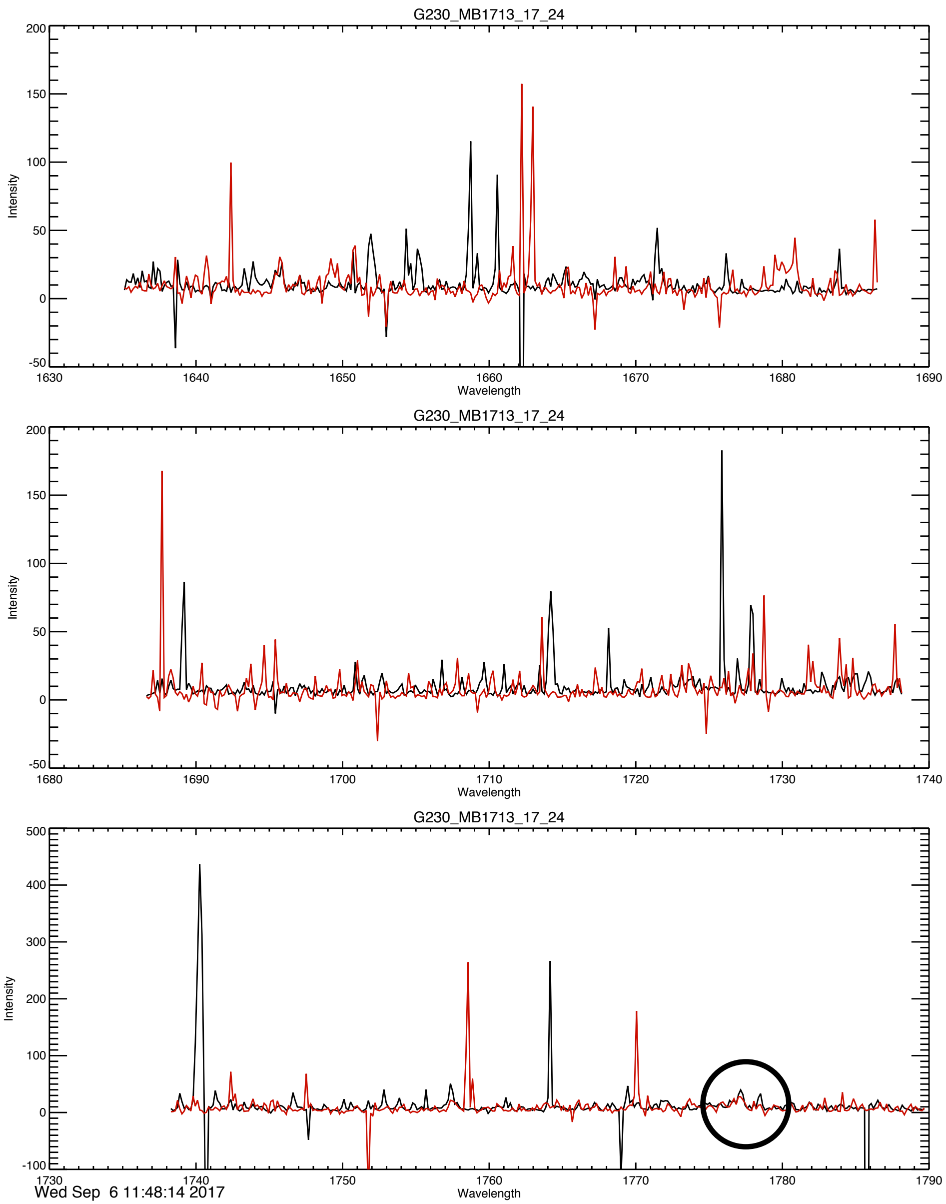
Strikethroughs indicate programs not approved

Routine STIS Spectroscopic Dispersion Solution Programs

STIS CCD Spectroscopic Dispersion Solution Monitor
PI: Daniel Welty

Purpose	To monitor the wavelength calibration / dispersion solutions for some configurations of the STIS/CCD.
Description	Internal wavecals will be obtained with all 6 gratings (G230LB, G230MB, G430L, G430M, G750L, G750M) supported for use with the CCD. All observations will be obtained with the 52x0.1 aperture, which maps to 2 pixels at the CCD. As in previous cycles, the HITM1 lamp will be used, rather than the LINE lamp. The HITM1 lamp has a more favorable spatial illumination pattern, dropping by only a factor of 3 at row 900 (near the E1 pseudo-aperture), relative to the peak brightness at row 420.
Fraction GO/GTO Programs Supported	8% of STIS total science exposure time
Resources Required: Observations	3 internal orbits
Resources Required: Analysis	4 FTE weeks
Products	Update wavelength dispersion reference file as needed, ISR, and a summary in the end of cycle ISR.
Accuracy Goals	0.2 pixels (wavelength accuracy for row 900) -- Wavelength coefficients are tabulated every 32 rows in the CCD dispersion (_dsp) reference file. Exposure times in this program have typically been chosen to yield a S/N ratio of at least 10 per pixel in row 900 after combining 32 rows. This constraint must be satisfied in the left, middle, and right thirds of the image. Existing recent HITM1 wavecals were used to estimate exposure times; some adjustments were made to compensate for the fading of the lamp at shorter wavelengths.
Scheduling & Special Requirements	These observations are taken once per cycle.
Changes from Cycle 24	G230MB/1713 dropped (few measurable lines); t_exp increased for G230MB/1995 and G230MB/2416.

STIS CCD Spectroscopic Dispersion Solution Monitor: Reason for dropping G230MB/1713



- A Cycle 17 (black) and Cycle 24 (red) wavecal is shown for G230MB/1713
- The strongest line is at 1777A, all other "features" are cosmic rays.
- All post-SM4 usage for this mode is only for the dispersion monitor.
- Exposure time has been redistributed to the other modes.
- The blue mode G230MB/1995 will still be monitored. This setting has also faded significantly, so increased exposure time will be beneficial.

STIS MAMA Spectroscopic Dispersion Solution Monitor
PI: Daniel Welty

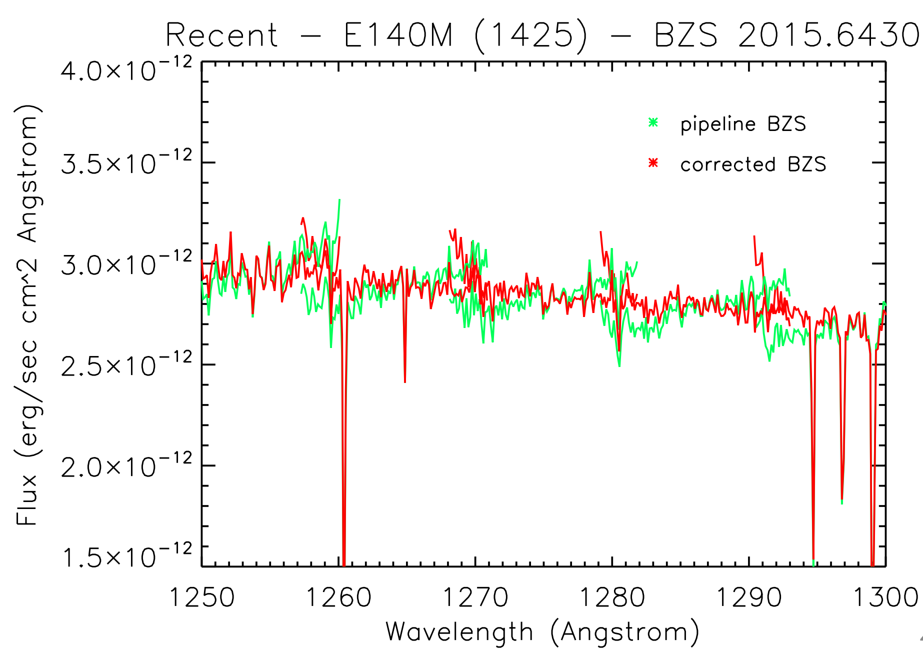
Purpose	To monitor the wavelength calibration / dispersion solutions for some STIS MAMA configurations.
Description	Internal wavecals will be obtained with gratings at primary and secondary central wavelengths chosen to cover Cycle 25 use and to overlap with configurations used in previous calibration programs (to continue long-term monitoring). This program uses the LINE lamp for a total of approximately 1.6 hours, typically at a lamp current of 10 mA, consuming about 0.1% of the 15000 mAhour lifetime. Moderately deep wavecals are included for some echelle modes and for some first order modes to ensure detection of weak lines. All orbits < 1800s.
Fraction GO/GTO Programs Supported	82% of STIS total science exposure time
Resources Required: Observations	7 internal orbits
Resources Required: Analysis	4 FTE weeks
Products	Update wavelength dispersion reference file as needed, ISR, and a summary in the end of cycle ISR.
Accuracy Goals	0.1 pixels internal wavelength precision.
Scheduling & Special Requirements	These observations are taken once per cycle. The shortest wavelength settings should avoid orbits in which the FUV glow is strong (if possible).
Changes from Cycle 24	No changes from Cycle 24.

STIS Special Programs

E140M Blaze Function

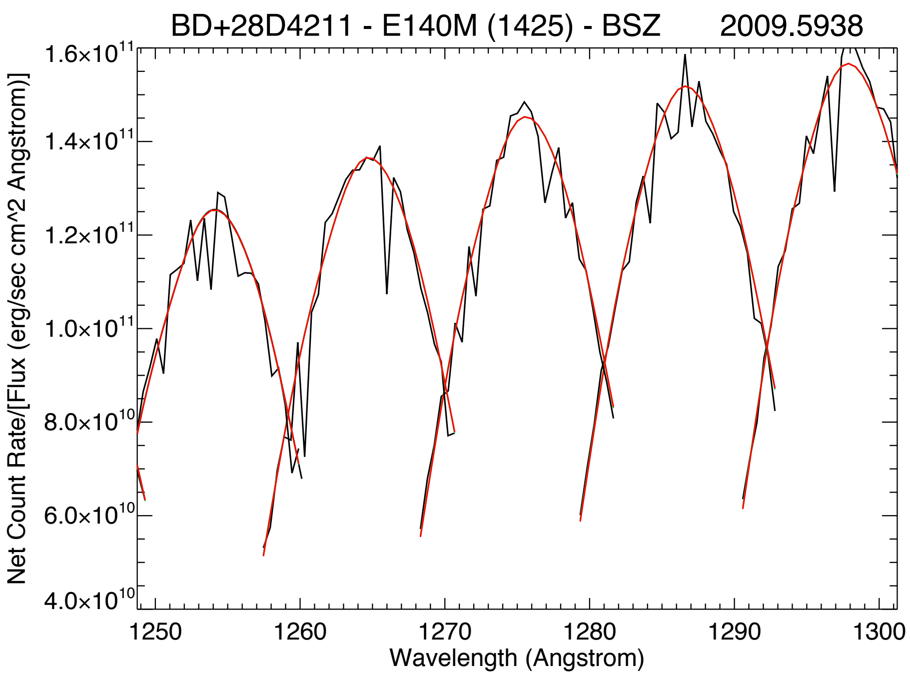
- The shape of the E140M blaze function appears to have changed since SM4.
- Turn-ups are present on blue edges for several spectral orders.

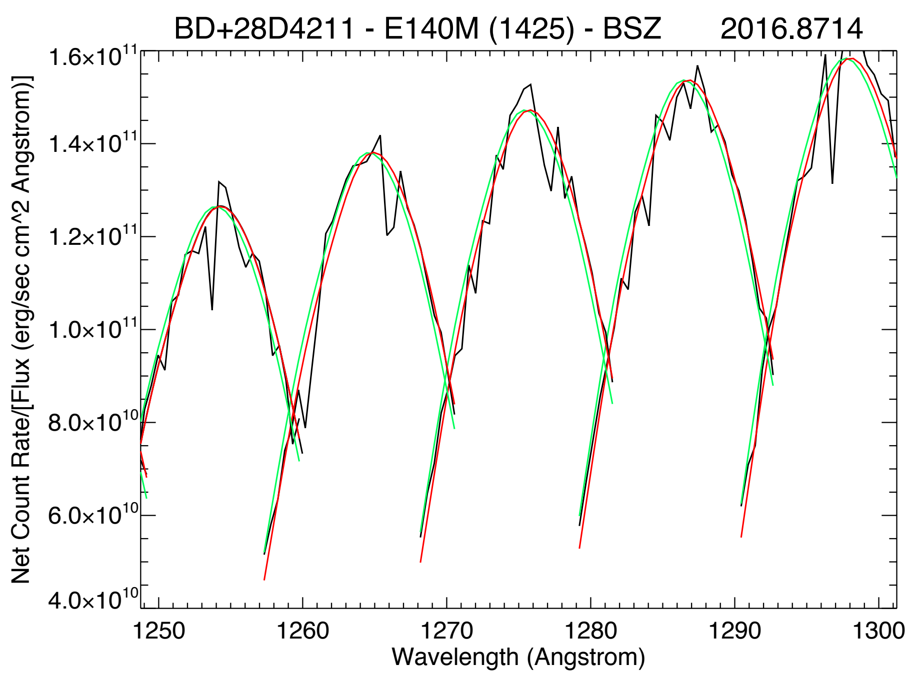
~14/43 orders affected at 5-10%.



Blaze Shape Changes

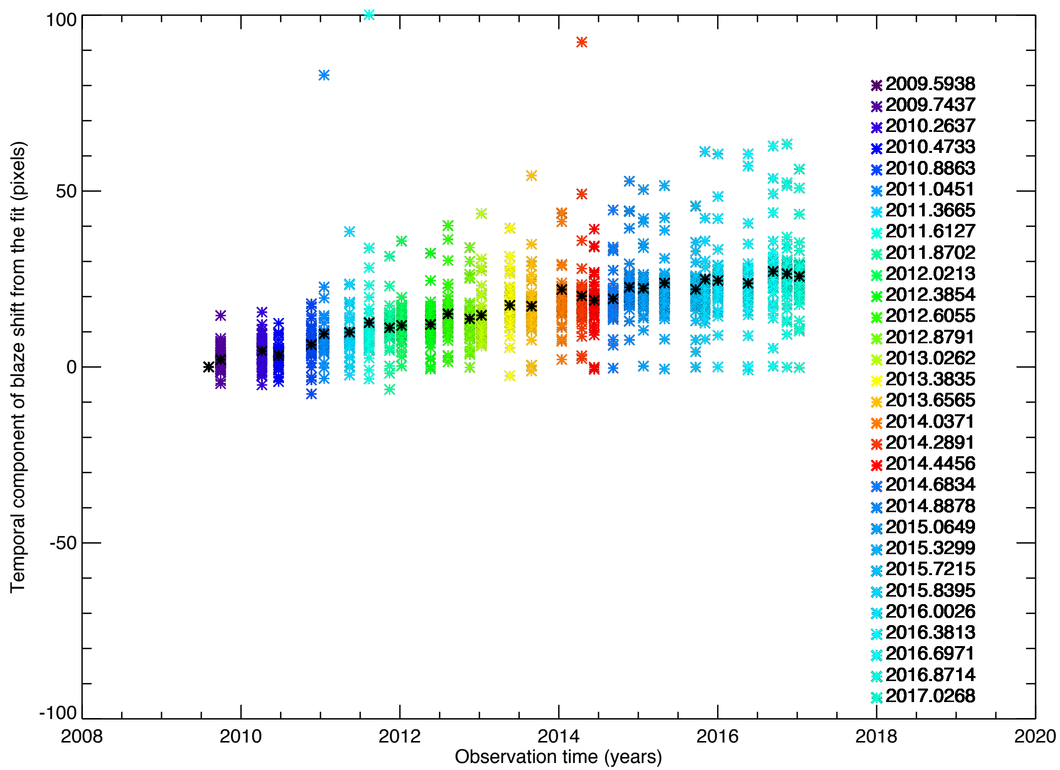
- The blaze shape has evolved. Both edges of sensitivities curves and order center cannot be aligned simultaneously.
- Division by the wrong blaze shape will introduce low order ripples in the order centers, and ~5-10% errors at the steep edges.





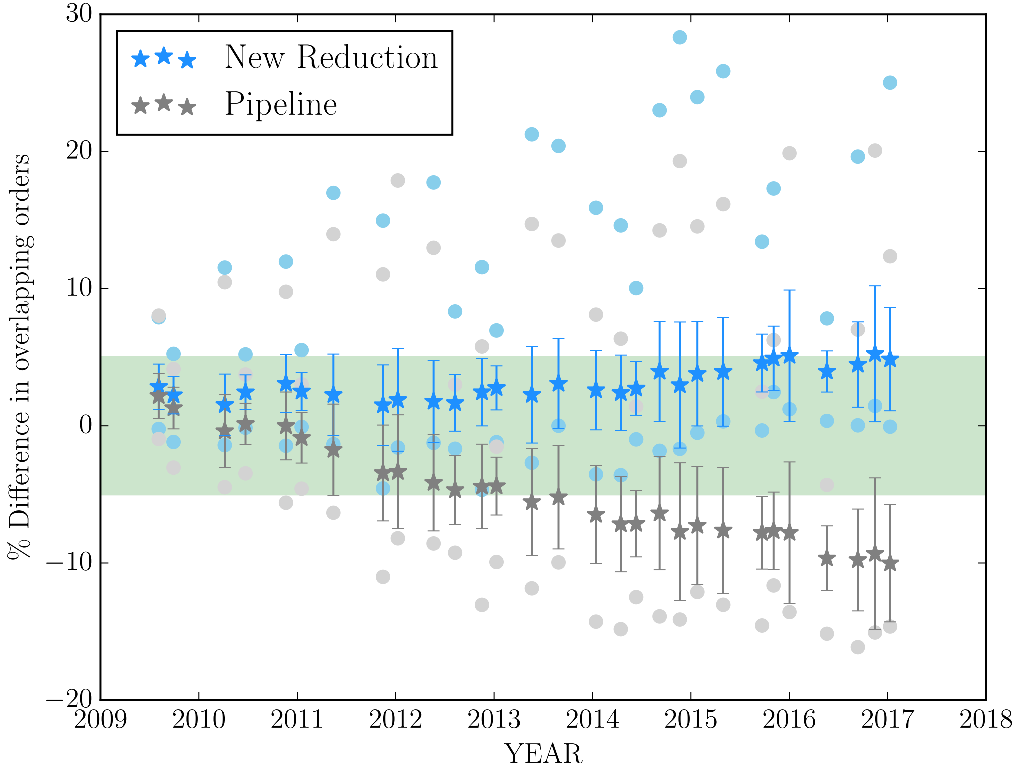
Temporal Blaze Shift

- Two things may be contributing to the increasing scatter of the orders:
  - An order dependence of the blaze function
  - Shape changes that limit the accuracy of cross correlations



E140M Relative Flux Accuracy

- Before and after *average* percent differences of overlapping spectral regions.
- The scatter grows with time, even when including an order dependence in blaze shift.



E140M's Importance

- E140M provides almost full simultaneous coverage of 1144 to 1710 A in a single observation.
- Identified as one of key modes for early inclusion in the STIS HSLA.

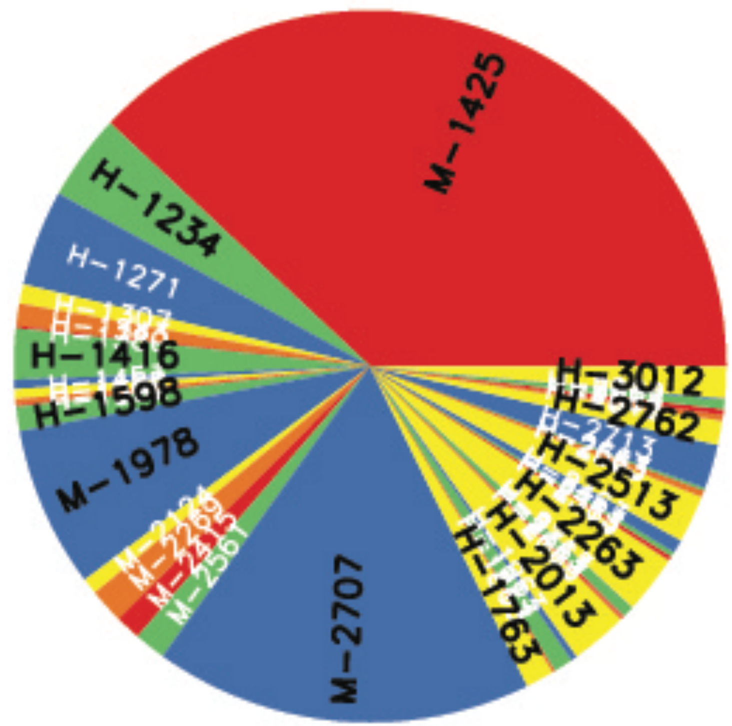


Figure credit: T. Ayres (HST Spring 2017 Symposium)

STIS E140M Sensitivity Curves
PI: TalaWanda Monroe

Purpose	Derive a new set of sensitivity curves for the E140M grating from observations of the DA white dwarf G191-B2B.
Description	The spectrophotometric white dwarf G191-B2B will be observed with the E140M grating to obtain an updated set of sensitivity curves for this highly used mode. Spectroscopic sensitivity monitoring observations of BD+284211 have shown that the blaze function shapes have changed since SM4 and now limit the relative photometric flux accuracy of ~14 of 43 E140M spectral orders to 5-10% at the edges. The blaze function shape changes have hindered attempts to determine the post-SM4 temporal blaze function shifts for this grating. Given the popularity of this unique FUV mode and consideration of STIS's archival legacy, we request 1 orbit to re-observe G191-B2B with the E140/1425 setting.
Fraction GO/GTO Programs Supported	9% of prime STIS exposures. Typically ~5-10% of prime STIS exposures each cycle
Resources Required: Observations	1 orbit
Resources Required: Analysis	6 FTE weeks: 3 FTE weeks for analysis, 1 week for testing, 2 weeks for ISR
Products	Updated PHOTTAB and RIPTAB reference files and ISR. Extraction of edge order 86.
Accuracy Goals	Peak SNR ~90 per resel.
Scheduling & Special Requirements	SAA-free orbit
Changes from Cycle 24	New program

Spatial Scans with STIS CCD

- Why do spatial scans instead of saturated GAIN=4 images, since with GAIN=4 total counts are preserved even after local saturation?
  - Bleeding along columns erases original spatial distribution of counts
  - Can't ID or correct individual cosmic-rays/hot pixels
  - Optimized flat-fielding is difficult. Fixed point-source illumination pattern differs from long-slit FLAT observations
  - Linearity of flux after saturation does have some limits at very high count levels, especially when source near the top of the STIS CCD detector
- Unsaturated scanned observations can potentially achieve comparable S/N without these problems
  - Scanned point-source should much more closely resemble long-slit p-flat and IR-fringe flat illumination than does a pointed spectrum
  - Allows individual bad pixels to be identified and corrected without discarding the entire wavelength bin

Use cases of STIS spatial scans

- Very high S/N observations to find and measure equivalent width of weak spectral features
  - Especially useful for DIBs and molecules in ISM at wavelengths where strong telluric lines make ground based observations challenging
  - G750L/M give R ~ 1,000 to 10,000 up to ~ 1.0137 µm
  - Demonstrated recently by Cordiner et al (2017 ApJL, 483L, 2) in attempt to detect C_{60} features
    - Scanned targets along 52X0.1 with G750M to match fringe flats
    - Obtained S/N > 600 per resel in absolute, not differential measure
    - Worked very well for this use case – at most need to tweak alignment
- Measure detailed high S/N spectra of standard stars
  - Value both relative and absolute flux calibration
- Scans of transiting planets in and out of eclipse
  - Need to define advantages if any over saturated observations

Examples of ground-based vs STIS spectra in the NIR are shown in Cordiner et al. (2017 ApJL, 483L, 2).

THE ASTROPHYSICAL JOURNAL LETTERS, 843:L2 (6pp), 2017 July 1 Cordiner et al.

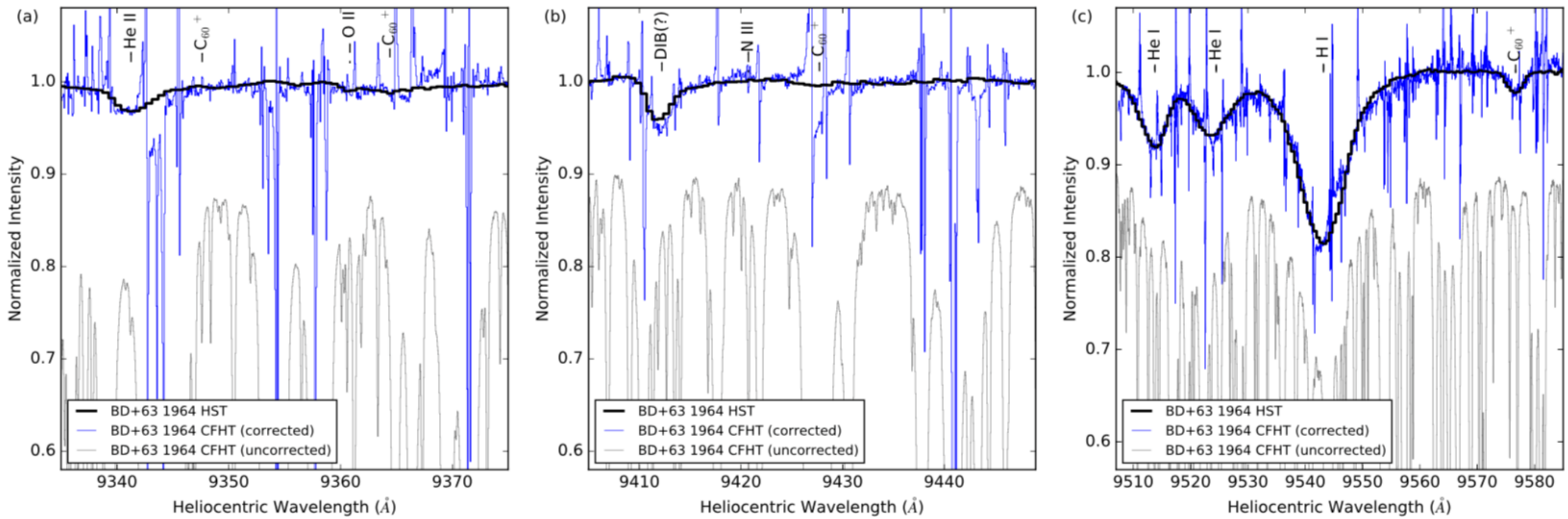
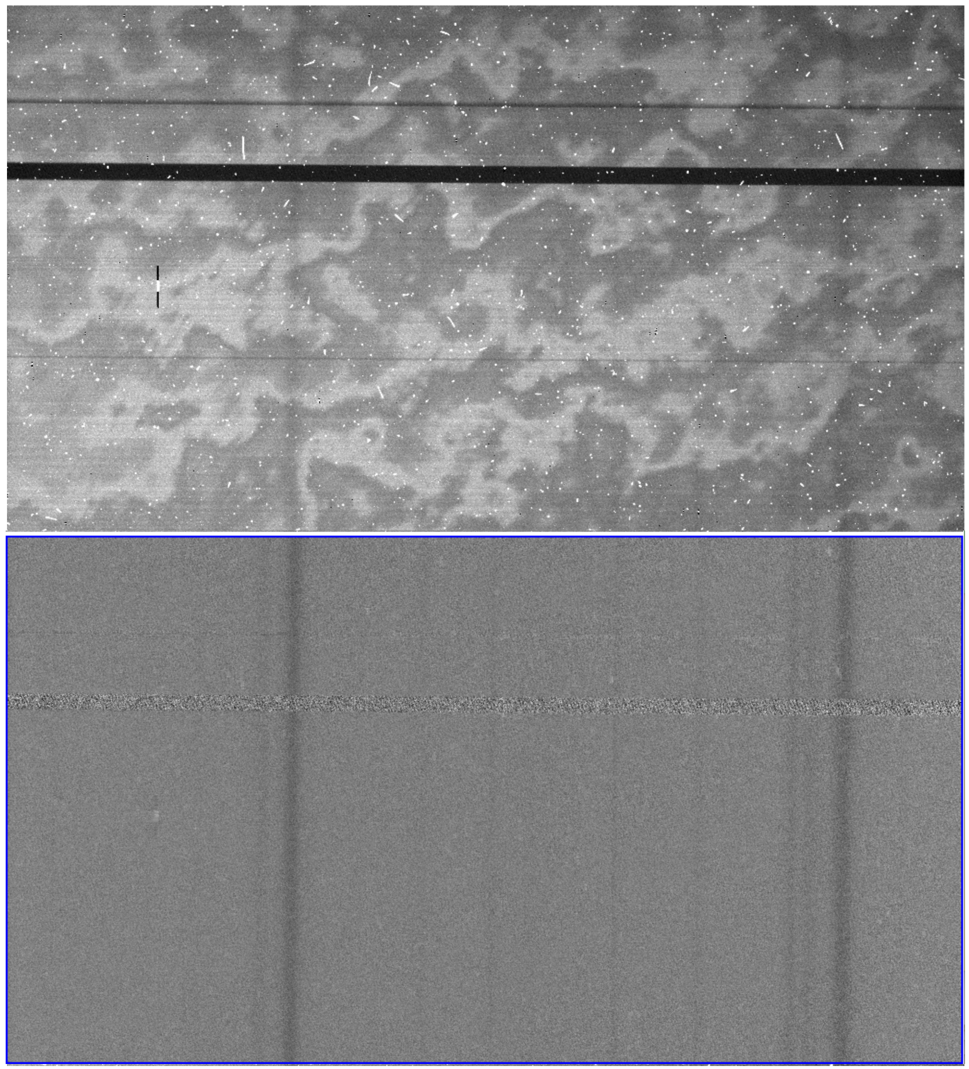


Figure 2. Comparison of *HST*/STIS and CFHT/ESPaDOnS spectra of BD+63 1964, normalized with a linear continuum. CFHT spectra were telluric-corrected using a TAPAS model; the uncorrected CFHT spectra (dominated by telluric absorption) are shown in gray with a vertical offset of −0.1. Artifacts in the corrected CFHT spectra are primarily due to incomplete cancelation around the strongest telluric lines. The match between the strengths of the H and He lines in panel (c) demonstrates close consistency of the STIS and ESPaDOnS calibrations.

- The strong impact of Telluric lines and the difficulty in making precise corrections at many wavelengths is illustrated.
- For DIB research, ultra high SNRs and no telluric features are necessary.

Artifacts & Cleaning of Trails



Questions

- Can we improve alignment between trail and fringe slit?
- How well would fringe removal work for
  - G750L instead of G750M?
  - With science in 2” rather than 0.1” wide aperture
    - Still need 0.1” aperture for fringe flats to look like point source
- What are limits on absolute flux repeatability for 2” wide aperture scans?
  - Want < 1% (0.1% ideally) absolute flux for standard stars
  - Need 10^{-4} repeatability for transit measurements

New Science Applications: Transit Work

- Both WFC3 G102 and STIS G750L cover the 0.970 micron water band
  - Bandpass of STIS G750L opens up additional science
    - Na & K lines
    - Wider measure of spectral slope for hazes
  - But current STIS measurements at 0.97 microns significantly noisier than WFC3 G102
      - See figure from Wakeford et al., Science 356, 628, (2017)
    - Likely due to variations in IR fringe alignment
    - If improved fringing correction can make STIS G750L as clean as WFC3 G102
      - May be complementary to G102 observations for bright targets
      - Better slope measurements could enable new science (hazes)
    - Would still want WFC3 G141 or JWST for longer wavelengths

Proposed Calibration Program

- Test 1: Verify fringe geometry & scan angle
  - Alternate external imaging scans in 52X2 with lamp images of 52X0.1
  - Verify alignment and angle for scans to best line up target with narrow slit fringe flats
  - 1 orbit
- Test 2: Flux Stability and Fringe Subtraction in Wide aperture scans
  - Compare G750L 52X2 trailed exposures to previous deep transiting planet exposures
  - Use bright target (e.g., 55 Cnc V=5.95)
  - Goals:
    - Compare repeatability to previous pointed observations
    - Test accuracy of fringe subtraction for wide aperture
  - 3 orbits: (1 orbit for thermal stability; 2 to compare)

Optimizing STIS Spatial Scans
PI: Charles Proffitt

Purpose	Optimize the alignment of spatial scans in large apertures with the narrow apertures used for fringe flats, and then verify the stability and repeatability of very high S/N spatial scans over multiple orbits.
Description	Visit 1: Using the STIS CCD MIRROR alternate scans of a ~ 12 mag point source in the 52X2 aperture with tungsten flat observations using the 52X0.1 to verify the geometry of the scan alignment with the aperture and detector. Visit 2: Perform high S/N G750L spatial scans of a bright star previously used for transiting planet observations with the same grating to verify the repeatability of scanning mode
Fraction GO/GTO Programs Supported	While the largest benefit is for the highest S/N observations, potentially even modest S/N observations of point sources affected by IR fringing might benefit from spatially trailed observations (about 9% of STIS observations).
Resources Required: Observations	4 orbits
Resources Required: Analysis	6 FTE weeks for analysis, 2 weeks for documentation
Products	Updated offsets and alignment angles for spatial scans. Information on repeatability for scans using 52X2 aperture
Accuracy Goals	Flux repeatability of 1 part in 10000 or better, either absolute for coarse binning of individual exposures or relative for the detection of small changes in narrow features from orbit to orbit.
Scheduling & Special Requirements	Avoid an actual planetary transit as the purpose of the test is to verify the repeatability, not do new science
Changes from Cycle 24	N/A

Programs Not Approved

Post-SM4 Time Dependent Sensitivity of the STIS PRISM

- The PRISM time-dependent sensitivity (TDS) requires an independent derivation from other optical elements
- Last derivation was done in ISR 2005-01
- Only a single PRISM calibration data set exists post-SM4
- There is insufficient data to measure even a linear trend in TDS for post-SM4 data

PRISM TDS

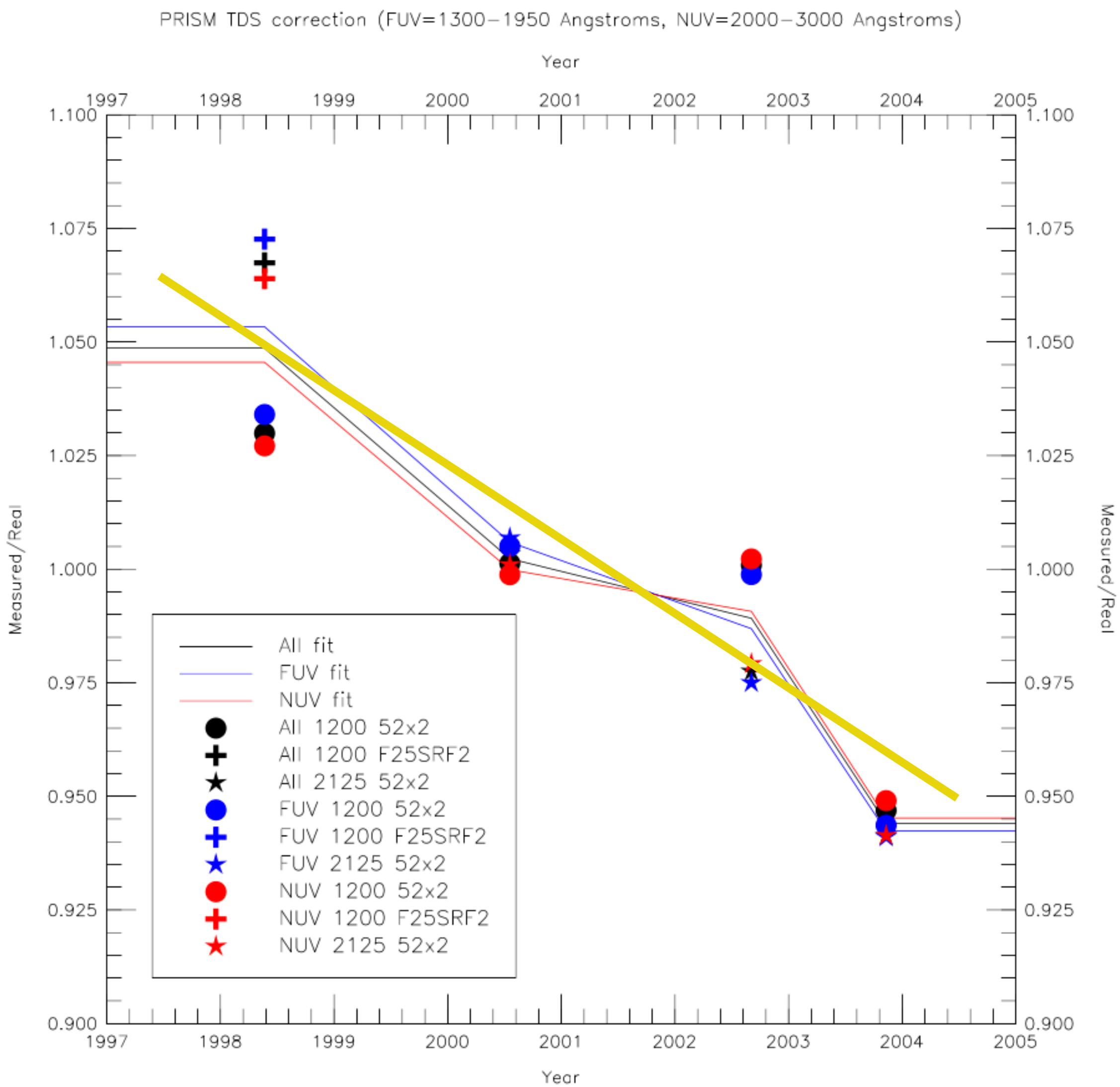
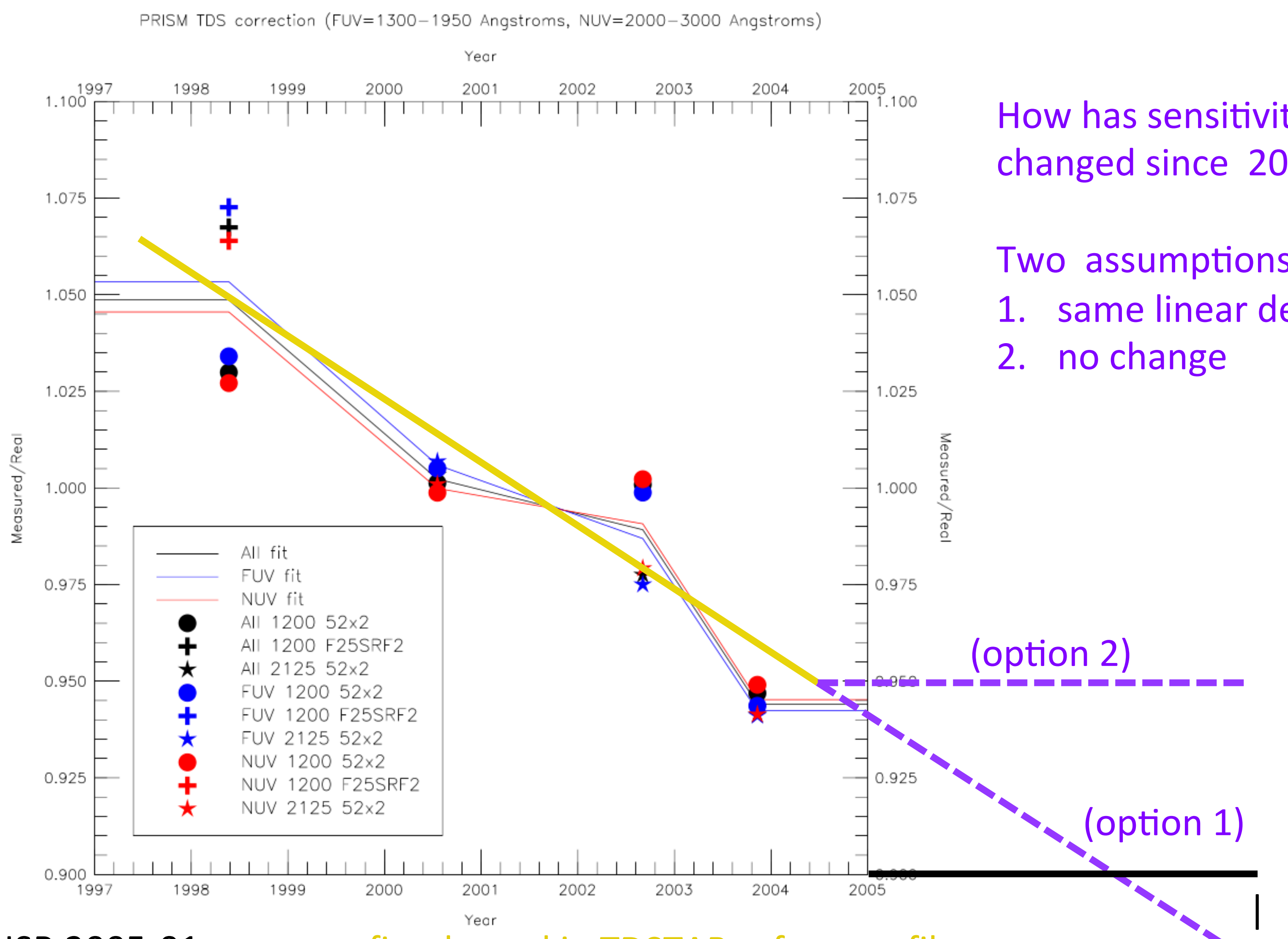


Fig 3 from ISR 2005-01 approx. fit adopted in TDSTAB reference file

PRISM TDS: 2009 extrapolation



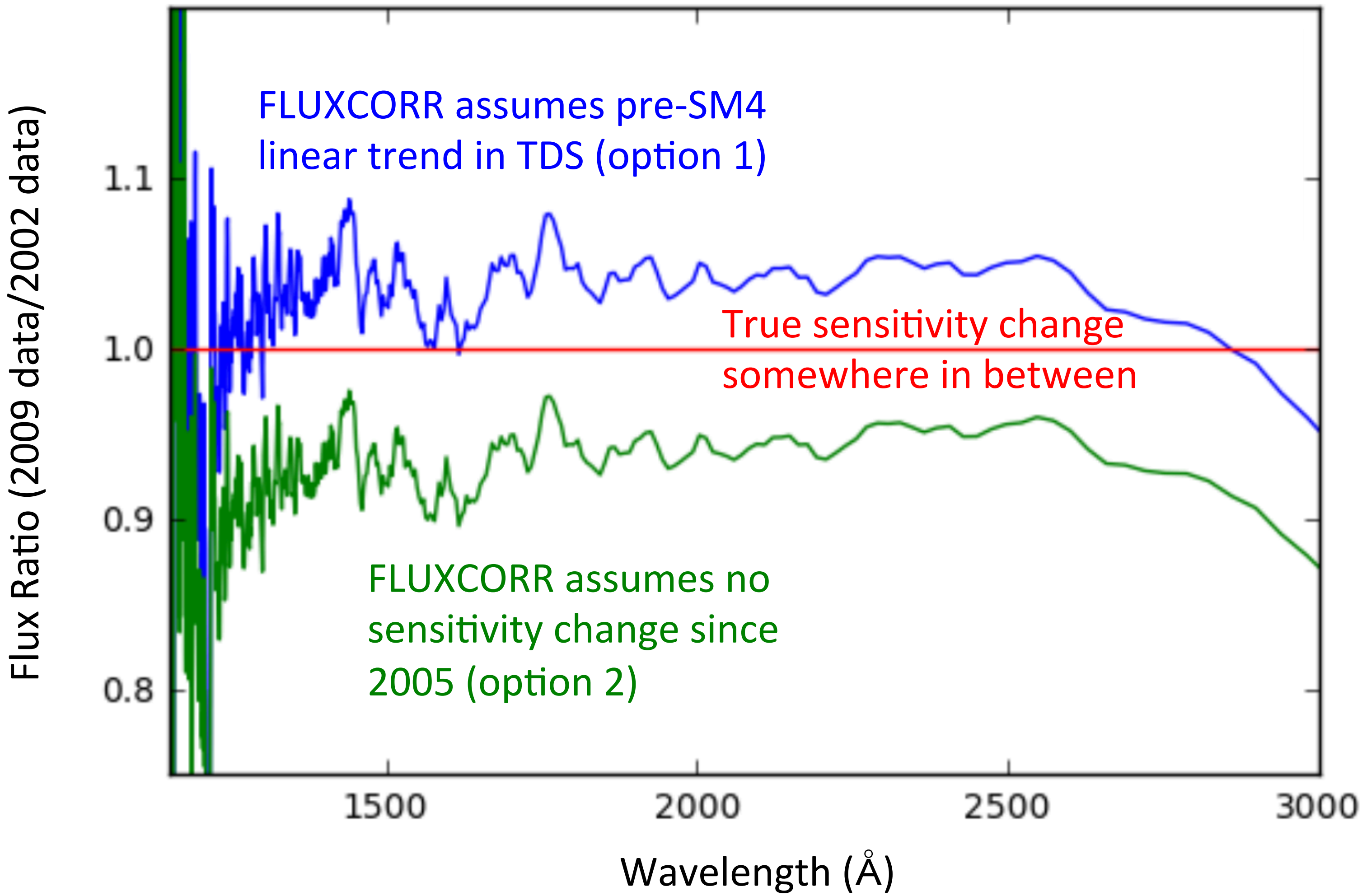
How has sensitivity changed since 2005?

Two assumptions:

1. same linear decline
2. no change

Fig 3 from ISR 2005-01 approx. fit adopted in TDSTAB reference file

PRISM TDS: 2009 extrapolation



Impact:

- In 2009 (5 years after last TDS measurement), PRISM TDS is incorrect by ~4% and we have no information on the current rate of change
- Presently, we are extrapolating the "flat slope" TDS out 13+ years

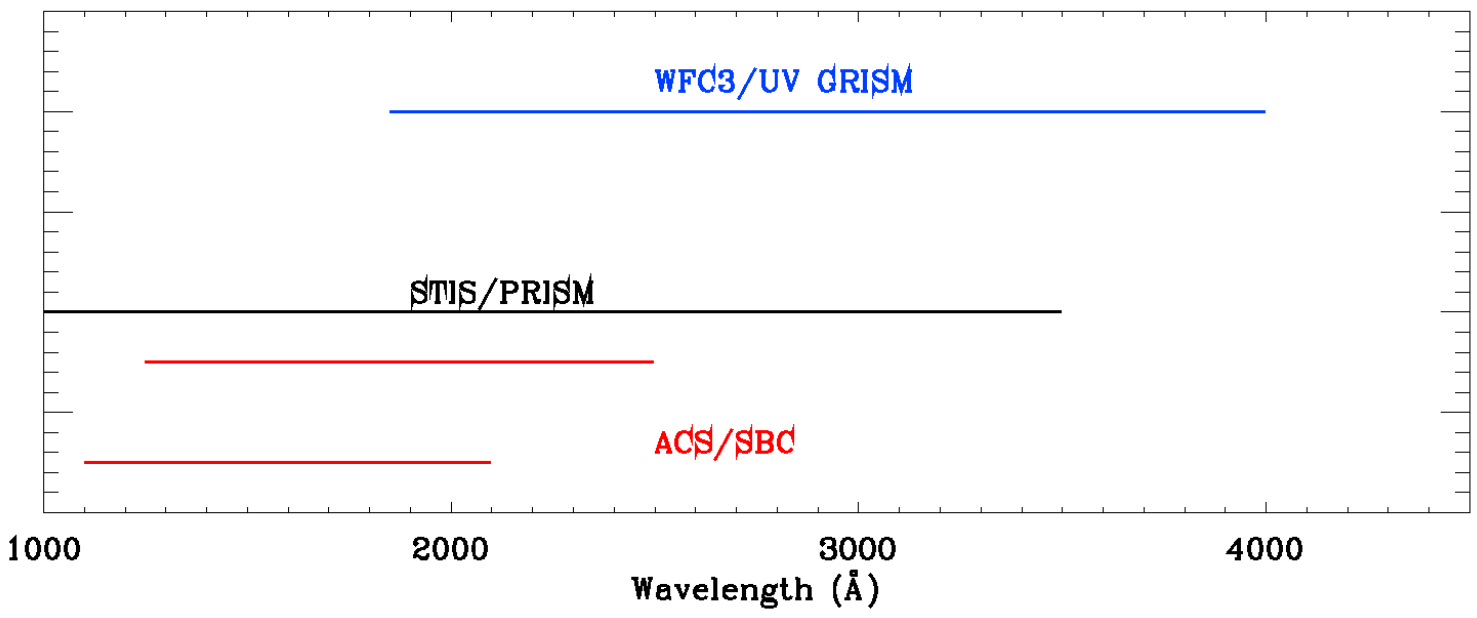
- ETC estimates are probably incorrect by *at least* 10%, maybe even more.
  - The ETC is conservative for purposes of BOP, to detriment of users who may receive less SNR than expected.

Usage:

- Pre-SM4:
  - 123 datasets.
  - Peak usage ~5% of NUV-MAMA time (in a few cycles)
  - Science supported:
    - GRBs
    - extinction curves
    - massive galaxy gas halos
    - pulsars
    - massive young clusters
    - obscured QSOs

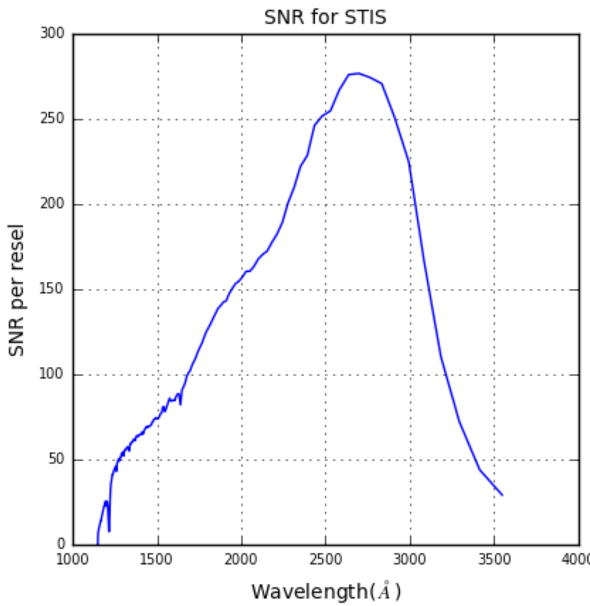
Usage:

- Post-SM4: No non-calibration usage
  - Capabilities currently superseded by ACS/SBC (UV) or WFC3/UV GRISM
    - ACS/SBC usage: 0-34% of time (avg: 7% over 8 cycles)
    - WFC3/UV GRISM usage: 0-7% (avg: 1.5% over 8 cycles)
  - STIS PRISM can be utilized in case of ACS or WFC3 failure



Resources Required:

- Orbits: 1
  - visibility of standard star HS2027+0651 is ~53 min
  - 2009 data were 2x770s = ~26 min of exposure time
  - APT calculations:
    - 2x960s can be done in 1 orbit
    - achieve similar S/N to 2009 even if sensitivity degraded by 24%



- FTE effort: 2 weeks

Summary

- PRISM was used at a low level pre-SM4 for a *wide variety of science cases*
- PRISM is a supported observing mode, but its flux calibration accuracy is presently unknown
  - Lack of good calibration may be discouraging use
  - If any new observations are requested, the S/N estimates may be very inaccurate
- Significantly improving this situation comes at relatively low cost

Measuring the Post-SM4 Time Dependent Sensitivity of the STIS PRISM
PI: Joleen Carlberg

Purpose	Measure a linear trend of the time-dependent sensitivity of the PRISM for the post-SM4 time period.
Description	Obtain PRISM observations of the standard star HS2027+0651, which will be compared to similar data taken in the Cycle 17 STIS MAMA Sensitivity program to measure a linear trend in the sensitivity changes with time of the PRISM setting.
Fraction GO/GTO Programs Supported	< 1%
Resources Required: Observations	One HST orbit
Resources Required: Analysis	2 weeks FTE
Products	Updated TDS reference file and associated ISR
Accuracy Goals	2%
Scheduling & Special Requirements	N/A
Changes from Cycle 24	N/A

Contingency Program Not Approved

STIS Focus Parallel Measurements
Charles Proffitt

Purpose	To determine the focus offset between the STIS OII filter and that of WFC3/UVIS and ACS/WFC. This will allow any long term secular changes in the relative focus of the three instruments to be determined.
Description	A UV bright star will be observed with STIS F28X50OII while parallel observations are done of rich star fields in 47 Tuc using WFC3 F410M and ACS F502N. This prime/parallel grouping is repeated 4 times for STIS+WFC3 using a small dither pattern. During two of these iterations there is also time to include a parallel ACS F502N image. Phase retrieval analysis should allow measurement of the relative focus of the three instruments independent of any uncertainties in the breathing model.
Fraction GO/GTO Programs Supported	100% of STIS external observations are affected by the focus
Resources Required: Observations	1 external orbit, 1 parallel orbit
Resources Required: Analysis	Estimate 2 FTE weeks
Products	A measurement of the focus offset between STIS and ACS and WFC3. Possible recommendations for adjustments to the STIS corrector.
Accuracy Goals	< 1 micron of equivalent secondary despace
Scheduling & Special Requirements	The ORIENT requirement of 255 to match previous iterations of this setup and ensure that the same stars are viewed in WFC3 and ACS will force execution of this program to occur between mid-May 2018 and mid-Jul 2018.
Changes from Cycle 24	None. Will request to activate program if focus monitor indicates significant focus change.

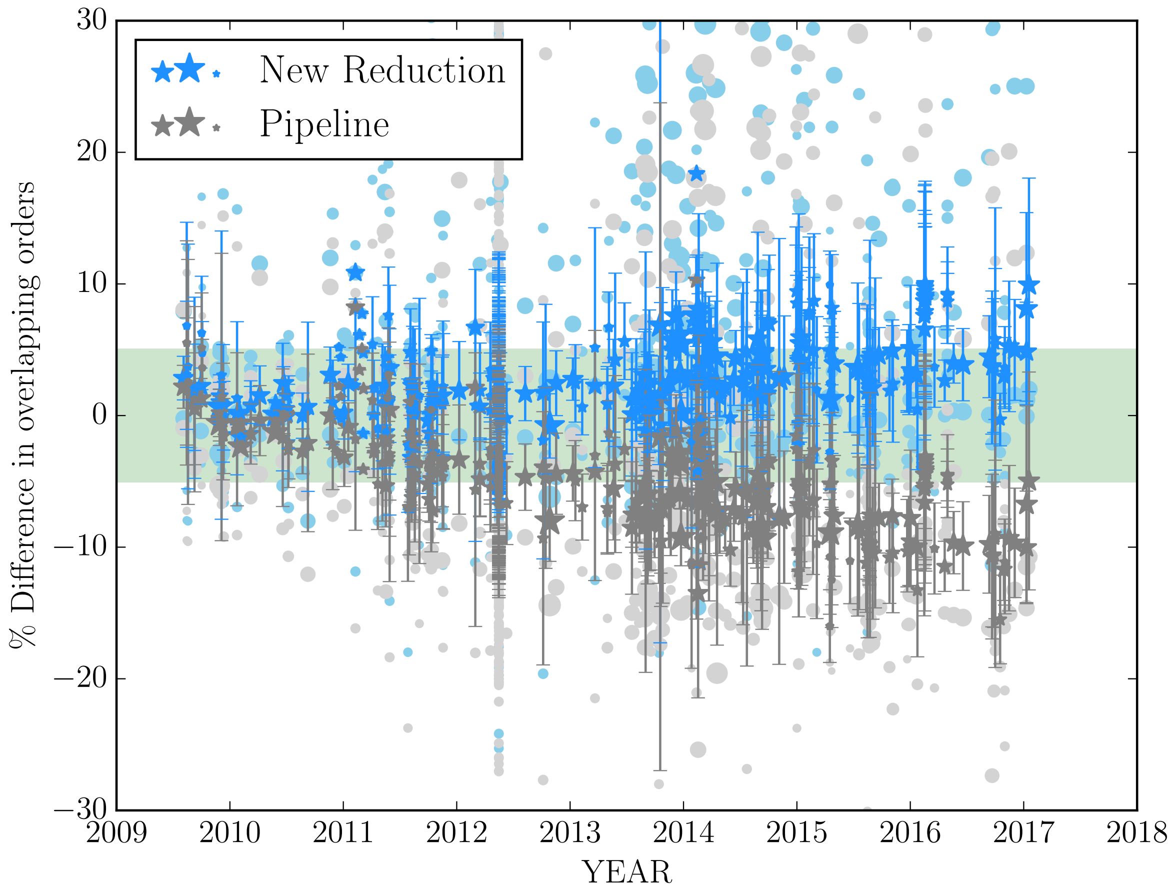
Backup Slides

STIS Sensitivity Accuracies

- Uncertainties specified in STIS IHB.

Attribute	Accuracy	Limiting Factors
CCD Spectroscopic Accuracies		
Absolute photometry[a]		Instrument stability Correction of charge transfer efficiency Time dependent photometric calibration Fringe correction (for $\lambda > 7500$ Å)
L modes	5%	
M modes	5%	
Relative photometry[b] (within an exposure)		Instrument stability Correction of charge transfer efficiency Time dependent photometric calibration Fringe correction (for $\lambda > 7500$ Å)
L modes	2%	
M modes	2%	
MAMA Spectroscopic Accuracies		
Absolute photometry[c]		Instrument stability Time dependent photometric calibration
L modes	4%	
M modes	5%	
Echelle modes[d]	8%	
Relative photometry (within an exposure)[e]		Instrument stability Flat fields Echelle modes: Blaze shift correction accuracy Scattered light subtraction
L modes	2%	
M modes	2%	
Echelle modes[f]	5%	

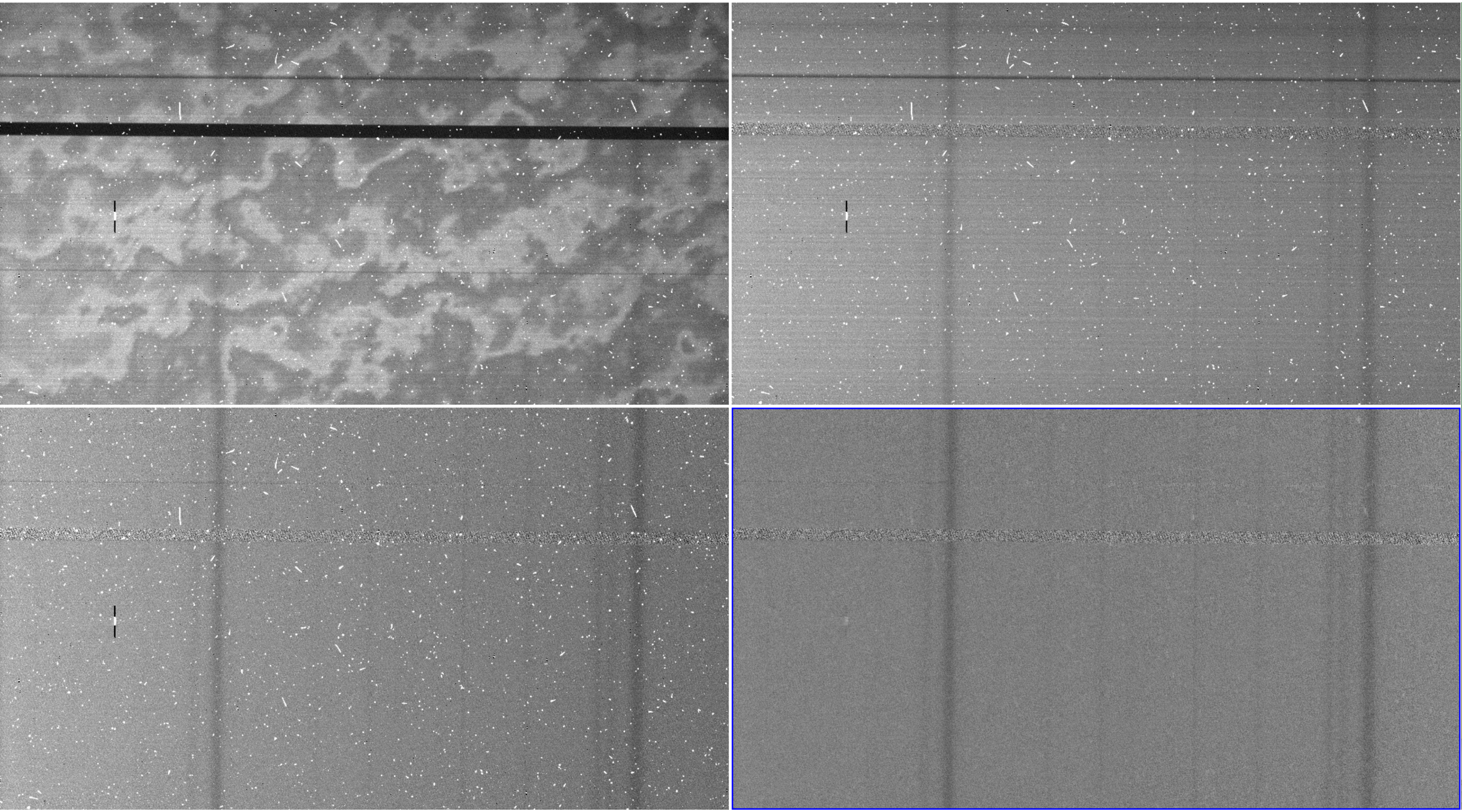
All E140M data sets



Orbit request

- ETC runs:
  - For SNR = 100 per resel: 77 min of exptime → 2 orbits needed
  - If only 1 orbit is requested:
    - Imaging ACQ & ACQ/Peak needed: will take ~16.4 min
    - 37 min of science time → SNR = 93 per resel at peak
      - SNR = 69 per resel at 1425

Artifacts & Cleaning of Trails



troscopy can be used to constrain their formation and evolution. The low gravity (4.17 ms^{-2}) and moderate equilibrium temperature ($T_{eq} \approx$ 990 K) (*1*) of HAT-P-26b results in a large atmospheric scale height, which is ideal for characterization studies that observe the wavelength dependence of the starlight filtered through the atmosphere during a transit.

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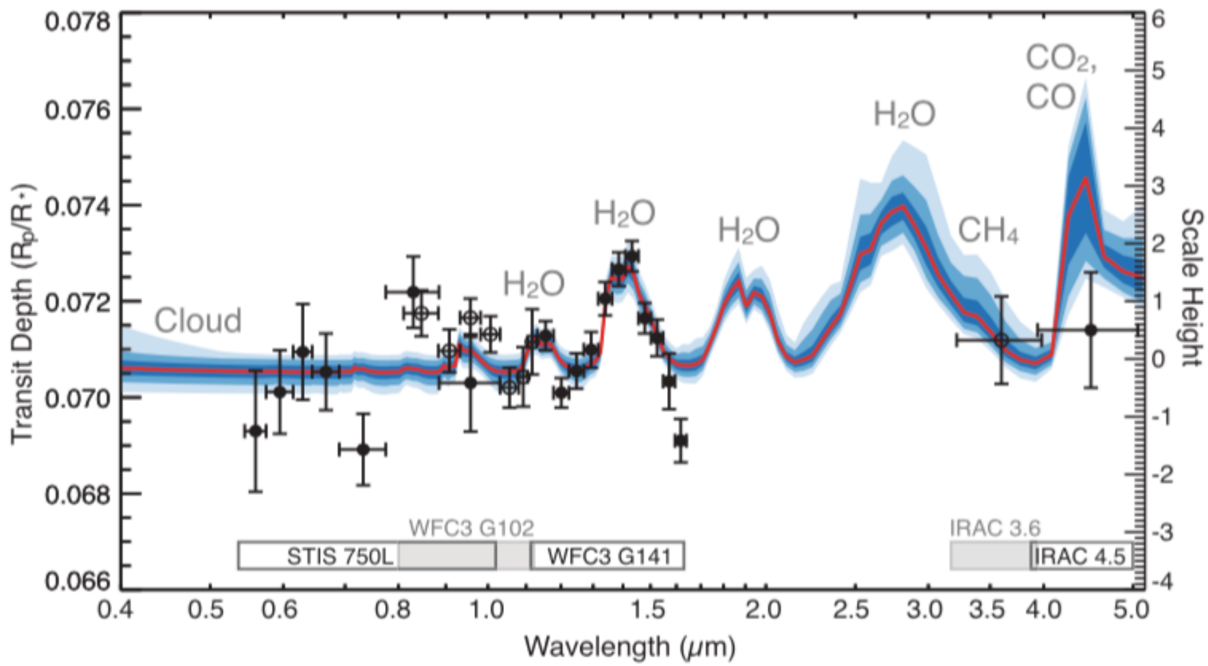


Fig. 1. The measured transmission spectrum of HAT-P-26b. We show the atmospheric transmission spectrum (open and solid circles alternating between different observational modes indicated by the labeled bars at the bottom) fitted with a model (red) derived by using the ATMO retrieval code (*18*). The best-fitting models have isothermal profiles and include a uniform cloud opacity. Shown here are the results for model M1 with 1σ, 2σ, and 3σ uncertainty shown in the dark- to light-blue shaded regions. The right-hand axis shows the corresponding scale of the atmospheric transmission in terms of planetary scale height, which is a logarithmic parameter of the atmosphere based on the planet's temperature, gravity, and mean molecular weight.

- Current STIS G750L (filled circles) measures between 0.9 and 1 micron are much noisier than WFC3 (open circles)
- WFC3 does have a 9X throughput advantage at 0.95 microns, but even allowing for this STIS spectra much noisier than Poisson statistics alone would suggests
- When averaging over 0.885 to 1.029 micron bandpass, STIS would be expected to give precision for HAPT-P-26b at the level of ~ 2e-4 but actual noise about 1e-3.

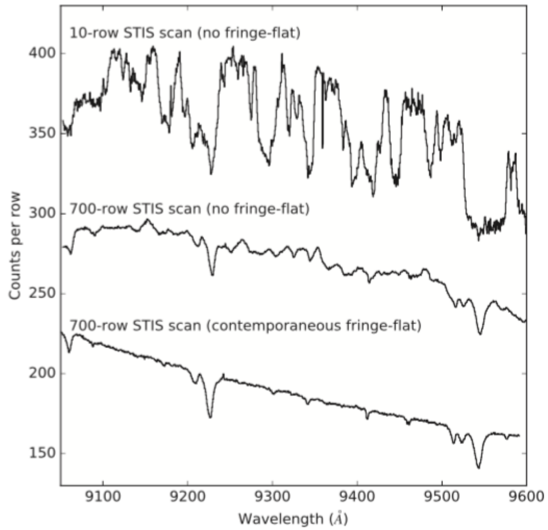


Figure 1. *HST* spectra of BD+63 1964 using three different scanning/flat-fielding schemes (with additive vertical offsets). Top: standard STIS spectroscopic acquisition and reduction (extracted over 10 dispersion rows), showing severe CCD fringing. Middle: a substantial reduction in fringe amplitude is achieved by STIS scanning (extracted over 700 dispersion rows). Bottom: the combined result of STIS scanning and flat fielding using a contemporaneous (in-orbit) fringe flat.

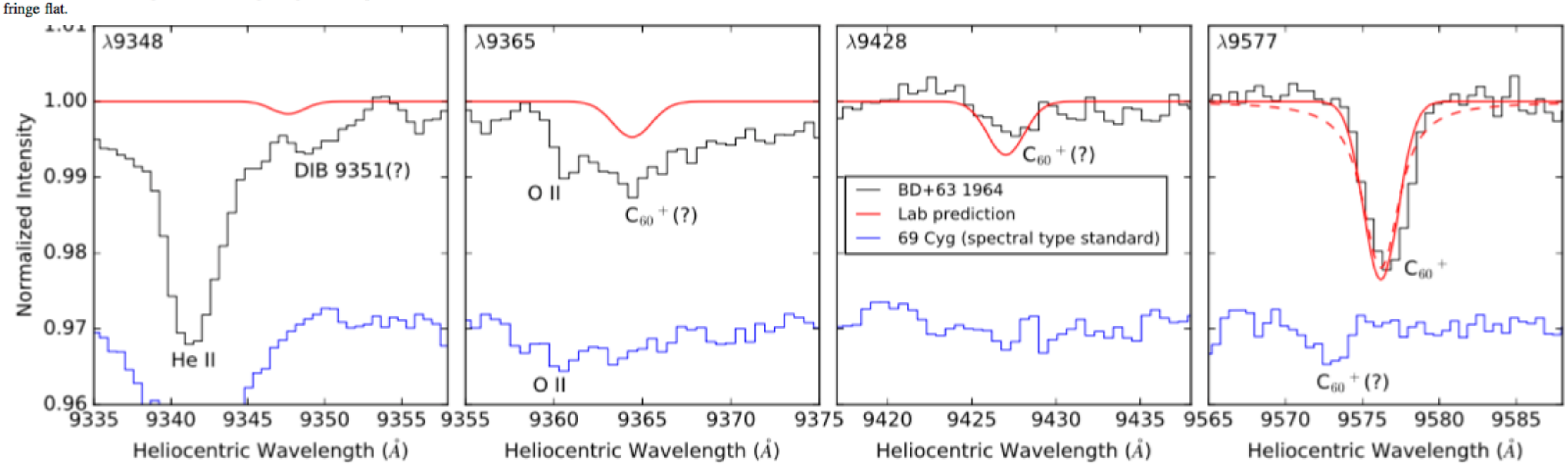
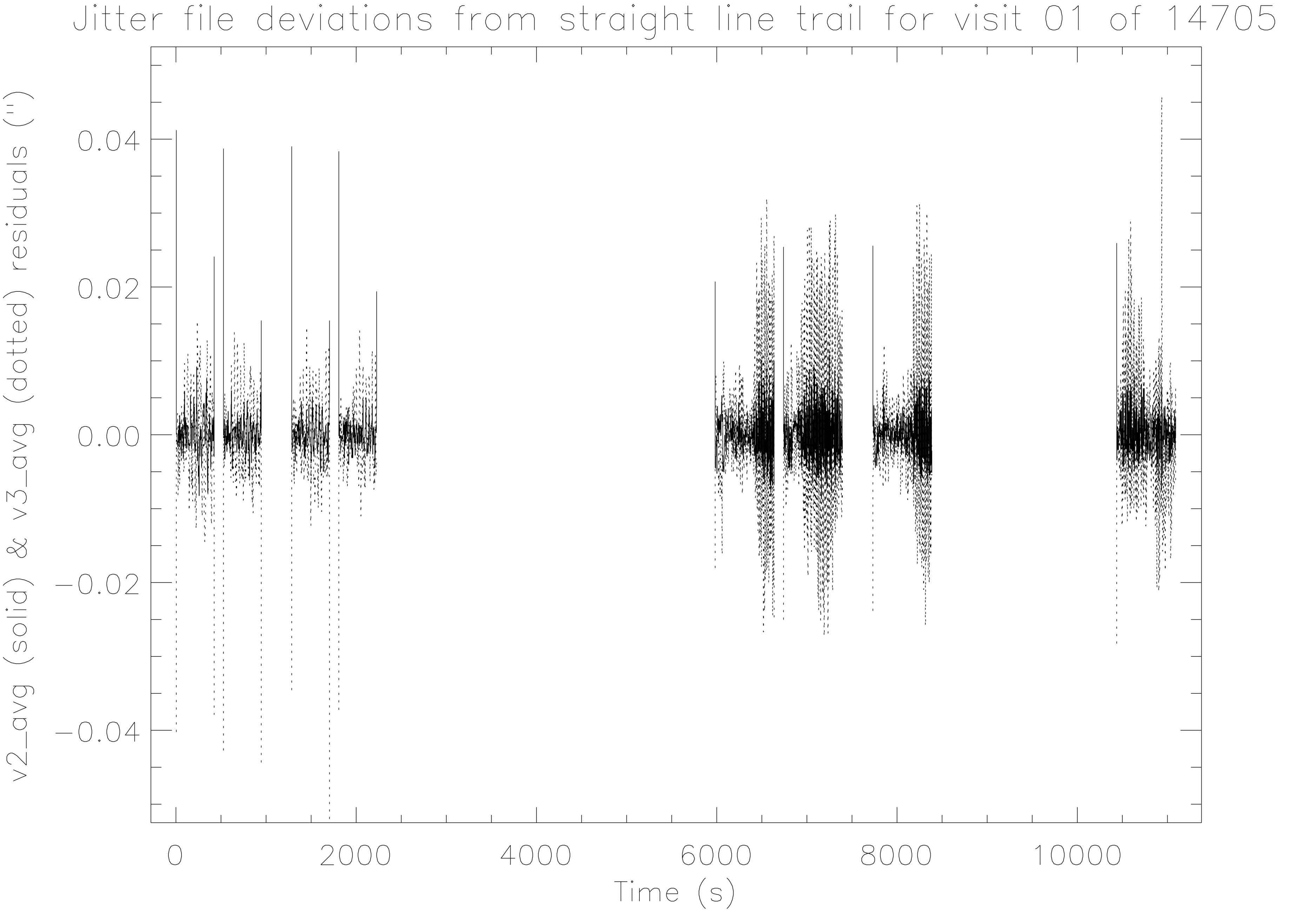


Figure 4. STIS NIR spectra of BD+63 1964 (black histograms) and the spectral-type standard 69 Cyg (blue histograms; shifted in wavelength to align the stellar features and offset vertically for display) for the four C_{60}^{+} bands in our spectral range. The red curves show predicted C_{60}^{+} DIB profiles based on Campbell et al. (2016b), Doppler-shifted to match the radial velocity of interstellar K I toward BD+63 1964. A Lorentzian model profile is also shown for λ9577 (dashed line). Detected and tentative (?) stellar and interstellar features are labeled.


Jitter file deviations from straight line trail for visit 01 of 14705
v2_avg (solid) & v3_avg (dotted) residuals (")
0.04
0.02
0.00
−0.02
−0.04
0
2000
4000
6000
8000
10000
Time (s)

Flux variations in 52X0.1 trails

- Trail through narrow 0.1” wide slit showed flux variations of a few percent over spatial/time scales of a few pixels/seconds (small scale horizontal bands) with occasional out-of-slit excursions
  - These bands follow tilt of spectral trace and so are throughput variations, not detector artifacts and remove well if normalized along trace
  - Flux also varies by about 20% over length of scan with rolloff towards top and bottom (misalignment of slit & scan?)
  - Above variations can be removed by normalizing to median along trace after fringe flat removal
- Slope of flux vs wavelength also varies slightly from scan-to-scan (focus changes with wavelength?)
- Smaller scale wavelength features seem stable to available S/N of data (few X 10^{-4} for coarse bins)

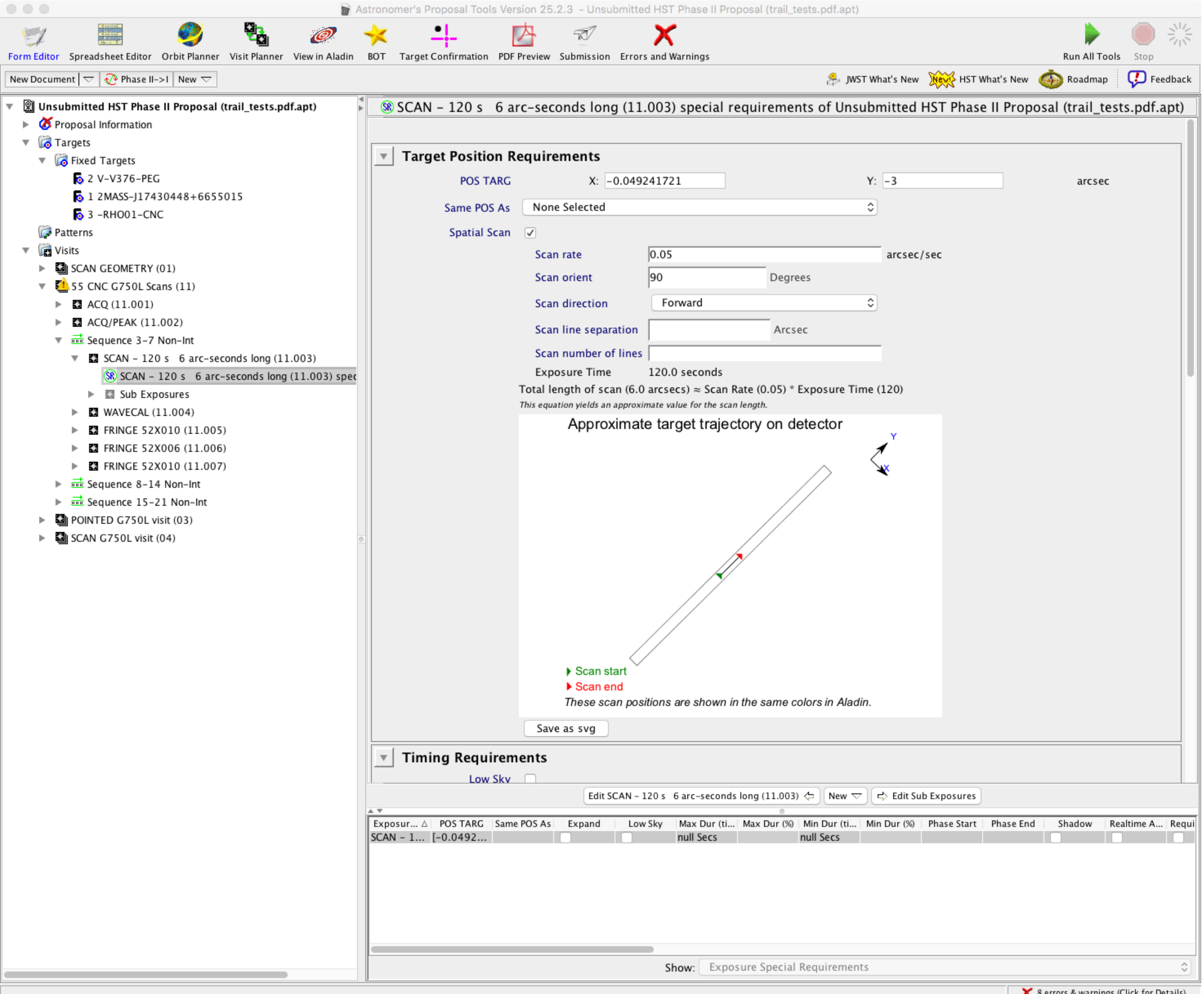
- The good
  - excellent IR fringe removal can be obtained for G750M with target trailed along narrow 52X0.1 slit
  - Throughput variations are usually modest, (comparable to pointed observations in similar slits?), and acceptable for measuring EQW's.
- However, trails along the 52X0.1 alone cannot
  - Check detailed alignment of trail with slit
  - Check flux stability for wide-aperture observations
  - Check accuracy of fringe removal for wide aperture observations
    - In wide slit wavelength/grating may make more difference
  - Preserve absolute flux calibration
- To compete with pointed observations for transiting planet observations or provide absolute calibration of standards, need to
  - Verify accuracy of fringe alignment and removal with science target in larger aperture
  - Verify repeatability of flux when scanning in large aperture
    - Different needs for absolute flux vs detection of narrow spectral features

Test 1: verify scan geometry

- Scan stellar image along 52X2 with -0.0492” X offset to align with lamp image of 52X0.1 using CCD MIRROR (imaging)
- V=12 A star saturates in about 0.36 s with 50CCD
- Scan rate of 0.5”/s covers 0.1 pixels /second or 1000 pixels in a 100 second scan
- Can do six such scans bracketed by Tungsten images of 52X0.1 slit in one orbit
- Accomplishes:
  - Verification angle of scan and position needed for alignment between source position and flat apertures
  - Repeatability of 52X0.1 slit image location and angle when switching between 52X2 (scan) and 52X0.1 (lamp flat)
  - Separates slit curvature and detector geometric distortion

Test 2: Verify flux stability in wide aperture

- Questions:
  - Do potential flat-fielding and CR-advantages of trail compensate for any non-repeatability in scan positions?
  - How well does fringe removal work when using target is in 2" wide slit
    - Do wider LSF wings compromise fringe removal?
- To test
  - Use bright target previously used for transiting planet scans
  - Do at least 3 orbits out of transit to verify repeatability at a high level (transiting planet workers typically throw out the 1st orbit's data as it shows transient behavior)
  - Bracket both ends of orbit with fringe-flat exposures
- Draft target
  - 55 Cnc G750L with gain=4 takes about 3.6s to full well for a pointed exposure
    - Previous observations (13665 Benneke) used saturated 40 s exposures x 42 iterations/orbit = 1680 s
  - Slow scan of 1 s/pixel or about 0.05 "/s should allow deep, unsaturated expos
  - 120 s scans cover about 120 pixels (~ 6") in Y direction
    - 15x120s SIZEAXIS2=376 scans gives 1800 s/orbit (Poisson S/N =16,000 @ 6500 Å)
- Alternate design
  - Add additional visit observing a bright broad-lined standard (Vega?) in wide aperture to demonstrate absolute stability and flux calibration, and use of trailing to measure standards in the near-IR, before starting with the 3 orbit transit test


Astronomer's Proposal Tools Version 25.2.3 - Unsubmitted HST Phase II Proposal (trail_tests.pdf.apt)
Form Editor
Spreadsheet Editor
Orbit Planner
Visit Planner
View in Aladin
BOT
Target Confirmation
PDF Preview
Submission
Errors and Warnings
Run All Tools
Stop
New Document
Phase II->I
New
JWST What's New
New!
HST What's New
Roadmap
Feedback
Unsubmitted HST Phase II Proposal (trail_tests.pdf.apt)
Proposal Information
Targets
Fixed Targets
2 V-V376-PEG
1 2MASS-J17430448+6655015
3 -RHO01-CNC
Patterns
Visits
SCAN GEOMETRY (01)
55 CNC G750L Scans (11)
ACQ (11.001)
ACQ/PEAK (11.002)
Sequence 3-7 Non-Int
SCAN - 120 s 6 arc-seconds long (11.003)
SCAN - 120 s 6 arc-seconds long (11.003) spec
Sub Exposures
WAVECAL (11.004)
FRINGE 52X010 (11.005)
FRINGE 52X006 (11.006)
FRINGE 52X010 (11.007)
Sequence 8-14 Non-Int
Sequence 15-21 Non-Int
POINTED G750L visit (03)
SCAN G750L visit (04)
SCAN - 120 s 6 arc-seconds long (11.003) special requirements of Unsubmitted HST Phase II Proposal (trail_tests.pdf.apt)
Target Position Requirements
POS TARG
X: -0.049241721
Y: -3
arcsec
Same POS As
None Selected
Spatial Scan
Scan rate
0.05
arcsec/sec
Scan orient
90
Degrees
Scan direction
Forward
Scan line separation
Arcsec
Scan number of lines
Exposure Time
120.0 seconds
Total length of scan (6.0 arcsecs) ≈ Scan Rate (0.05) * Exposure Time (120)
This equation yields an approximate value for the scan length.
Approximate target trajectory on detector
Y
X
Scan start
Scan end
These scan positions are shown in the same colors in Aladin.
Save as svg
Timing Requirements
Low Sky
Edit SCAN - 120 s 6 arc-seconds long (11.003)
New
Edit Sub Exposures
Exposur...
POS TARG
Same POS As
Expand
Low Sky
Max Dur (ti...
Max Dur (%)
Min Dur (ti...
Min Dur (%)
Phase Start
Phase End
Shadow
Realtime A...
Requi
SCAN - 1...
[-0.0492...
null Secs
null Secs
Show:
Exposure Special Requirements
8 errors & warnings (Click for Details)