



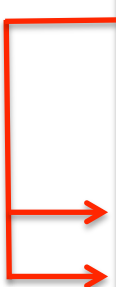
WFC3 Cycle 24 Calibration Plan

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Cycle 24 SI Usage

www.stsci.edu/hst/metrics/SiUsage

*Excluding SNAPs



	# Exp	% of HST Exp	Time	% of HST Time	Time/ Exp	% WFC3 Exp	% WFC3 time
ACS	3085	12%	503 hr	17%	587 sec		
COS	2497	10%	588 hr	19%	849 sec		
STIS	6421	25%	743 hr	24%	417 sec		
WFC3	13469	53%	1205 hr	40%	322 sec		
Total	25472	100%	3040 hr	100%			
UVIS	5364	21%	649 hr	22%	436 sec	40%	54%
IR .	8105	32%	556 hr	18%	247 sec	60%	46%

WFC3 Usage in Past Cycles

WFC3 use continues to be high because of its:

- panchromatic capabilities (wavelength range from 2000 Å to 1.7 μm);
- multiple observing modes (imaging, spectroscopy, spatial scans, variety of readout modes, 80 different filters)

	Stats Based on Number of Exposures				Stats Based on Total Exposure Time			
	UVIS N_exp	IR N_exp	IMAGE N_exp	SPEC N_exp	UVIS Exptime	IR Exptime	IMAGE Exptime	SPEC Exptime
Cy17	49%	51%	92%	8%				
Cy18	22%	78%	40%	60%				
Cy19	44%	56%	77%	23%				
Cy20	36%	64%	80%	20%				
Cy21	33%	67%	59%	41%				
Cy22	40%	60%	85%	15%				
Cy23	28%	72%	71%	29%	36%	64%	82%	18%
Cy24	40%	60%	61%	39%	54%	46%	83%	17%

WFC3 Usage with time

HST Cycle	GO Programs* % of HST orbits	Calibration** # External orbits	Calibration** # Internal orbits
CY17	46%	256	>2000
CY18	42%	134	1719
CY19	49%	125	1497
CY20	56%	83	1833
CY21	54%	98	1907
CY22	48%	114	1620
CY23	46%	98	1619
CY24	40%	69	1557

* MCT, SNAPs & Frontier Fields are not included

**Delta Calibration Programs are not included

WFC3 CY23 Calibration

**Programs discontinued in CY24

	ID	Program Title	Ext	Int	ID	Program Title	Ext	Int	
UVIS CCD	14366	UVIS anneal	0	79	14382	WFC3/UVIS contamination monitor	15	0	Photometry
	14367	UVIS bowtie monitor	0	130	14383	UVIS Shutter Characterization	3	1	
	14368 14369 14370	UVIS CCD daily monitor (dark & bias)	0	637	14384	WFC3 UVIS & IR photometry	11	0	
	14371	UVIS CCD un-flashed monitor	0	135	14385	WFC3 IR grisms wavelength calibration	4	0	Grisms
	14372	UVIS post-flash monitor	0	60	14386	WFC3 IR grisms flux/trace calibration	4	0	
	14373	UVIS CCD gain stability	0	18	14387	WFC3 UVIS grism wavelength calibration	1	0	
IR Detector	14374	IR dark monitor	0	95	14388	–1st grism order calibration in IR grisms**	2	0	Flats
	14375	IR linearity monitor	0	10	14389	UVIS Pixel-to-Pixel QE Variations via Internal Flats Monitor	0	51	
	14376	IR gain monitor	0	16	14390	UVIS internal flats	0	13	
CTE	14377	UVIS CTI monitor (EPER)	0	12	14391	IR internal flats	0	18	
	14378	UVIS CTE monitor (star cluster)	8	0	14392	CSM monitor with earth flats	0	200	
	14379	Characterization of UVIS traps with CI	0	36	14393	Astrometric calibration of all remaining UVIS filters	30	0	Astrometry
Persistence	14380	IR persistence: Amplitude Variations**	0	60	14394	Time Dependence of X-CTE & Astrometry	4	0	
	14381	IR Persistence: Position Dependent Model**	16	48					

WFC3 CY24 Calibration

*New in CY24

	ID	PI	Program Title	Ext	Int	ID	PI	Program Title	Ext	Int	
UVIS CCD	14529	Baggett	UVIS anneal	0	79	14882	Sahu	UVIS shutter monitoring	2	1	Photometry
	14530	Sunnquist	UVIS bowtie monitor	0	134	14815	Baggett	UVIS contam monitor	14	0	
	14531 14532 14533	Bourque	UVIS CCD daily monitor (darks & biases)	0	642	14878	McCullough	UVIS contamination using spatial scans*	6	0	
	14534	Khandrika	UVIS CCD un-flashed monitor	0	135	14883	Deustua	WFC3 UVIS & IR photometry	11	0	
	14535	Martlin	UVIS post-flash monitor	0	60	14870	Deustua	IR Zeropoint Linearity*	2	0	
	14536	Martlin	UVIS CCD gain stability	0	18	14871	Deustua & Bohlin	Improving the CALSPEC model for GRW+70D5824*	4	0	
	14879	Baggett	UVIS sink pixel map update*	0	20						
IR Detector	14537	Sunnquist	IR dark monitor	0	97	14543	Pirzkal	WFC3 IR grisms wavelength calibration	4	0	Grisms
	14538	Shanahan	IR linearity monitor	0	10	14544	Pirzkal	WFC3 IR grisms flux/trace calibration	4	0	
	14539	Shanahan	IR gain monitor	0	16	14545	Brammer	WFC3 UVIS grism wavelength calibration	1	0	
	14868	Riess	Improved Precision, Wavelength Dependence of the IR CRNL*	5	0	14546	Shanahan	UVIS Pixel-to-Pixel QE Variations via Internal Flats	0	51	Flats
CTE	14540	Khandrika	UVIS CTI monitor (EPER)	0	12	14547	Bajaj	UVIS internal flats	0	13	
	14541	Mack	UVIS CTE monitor (star cluster)	8	0	14548	Ryan	IR internal flats	0	18	
	14542	Martlin	Characterization of UVIS traps with CI	0	36	14549	McCullough	CSM monitor with Earth flats	0	200	
	14880	Anderson	UVIS CTE Model Re-Characterization*	0	15	14550	Platais	Astrometry monitoring	6	0	
	14881	Anderson	UVIS CTE Pixel-Based Model Evaluation*	2	0						Astrometry

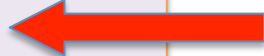

Routine Monitoring Plus New Calibration


The majority (23/30) of programs provide routine monitoring for the UVIS and IR channels. These calibrations have been obtained more or less continuously since WFC3 was installed in 2009 (SM4).

Seven new calibration programs (indicated at the top of each slide) will provide new results for Cycle 24. These include:

- Measuring the UVIS contamination via spatial scans
- Updating to the UVIS sink pixel map from 2014
- Re-Characterizing of the UVIS CTE model from 2013
- Evaluating the accuracy of the UVIS CTE pixel-based model
- Improving the precision of the IR count rate non-linearity for faint sources
- Testing the accuracy of the IR zeropoints for faint sources
- Improving CALSPEC model of GRW+70D5824 for absolute calibration

SUMMARY

	<u>External</u>	<u>Internal</u>	
CY24 Total	69	1557	
Monitor	50	1522	
New Calibration	19	35	
CY23 Total	98	1619	
(minus discontinued*)	80	1511	



IR persistence: Amplitude Variations
IR persistence: Position-Dependent Model
IR grism -1st order calibration

UVIS CCDs

To monitor the health of the UVIS channel we request 1084 internal orbits as follows:

1. 79 internal orbits (the cadence has been synchronized with the other HST instruments) to perform an anneal every month – [Same as last cycle](#)
2. 130 internal orbits to mitigate the hysteresis (bowtie) effect via a series of unsaturated and saturated internal flats. – [Same as last cycle](#)
3. 642 internals to perform a daily monitoring of the CCDs behavior using a series of dark and biases. Provide updated darks and hot pixel maps - [Same as last cycle](#)
4. 135 internals to assess how well post-flash is mitigating CTE with time using a series of unflashed darks - [Same as last cycle](#)
5. 60 internal orbits to monitor the stability of the post-flash LED with time - [Same as last cycle](#)
6. 18 internal orbits to verify the stability of the gain in the 4 UVIS quadrants for all available binning modes by taking a series of internal flats over a range of integration times. -- [Same as last cycle](#)
7. 20 internal orbits to update the UVIS sink pixel map from 2014 – [New Calibration](#)

WFC3/UVIS Anneal

Same as CY23

Number of External Orbits: 0

Number of Internal Orbits: 79

Goals: Perform regular anneal procedures to 1) repair hot pixels and 2) acquire internal exposures to assess the anneal's effectiveness as well as produce reference files for the calibration pipeline.

Description of the Observations: WFC3 anneals are performed every 28 days, a cadence which interleaves the WFC3 procedure with those from other instruments, one instrument per week. Internal biases as well as darks are taken before and after each procedure to provide a check of bias level, read noise, global dark current, and hot pixel population. A bowtie visit is acquired immediately after each anneal to provide a hysteresis-neutralizing image as well as verify that any hysteresis present has been successfully quenched. The Cycle 22 WFC3 anneals have been performed keeping the IR detector cold (IRTEMP=COLD). In Cycle 23, one iteration may be executed according to the original anneal procedure commanding which includes a partial warming of the IR detector; in that event, one post-anneal IR dark will be needed.

Orbits required: 79 total = $13 * 6 + 1$

- 13 iterations provide seamless continuity across cycle boundaries.
- 6 orbits per iteration (2 before and 2 after each anneal for biases/darks + 1 orbit for the anneal itself + 1 orbit for the attached post-anneal bowtie visit)
- 1 orbit for one IR dark to be taken in the event an original anneal procedure (warming the IR detector) is performed during Cycle 23

This is a continuation of programs 12343, 12687, 13071, 13554, 14000, 14366.

UVIS Bowtie Monitor

Same as CY23

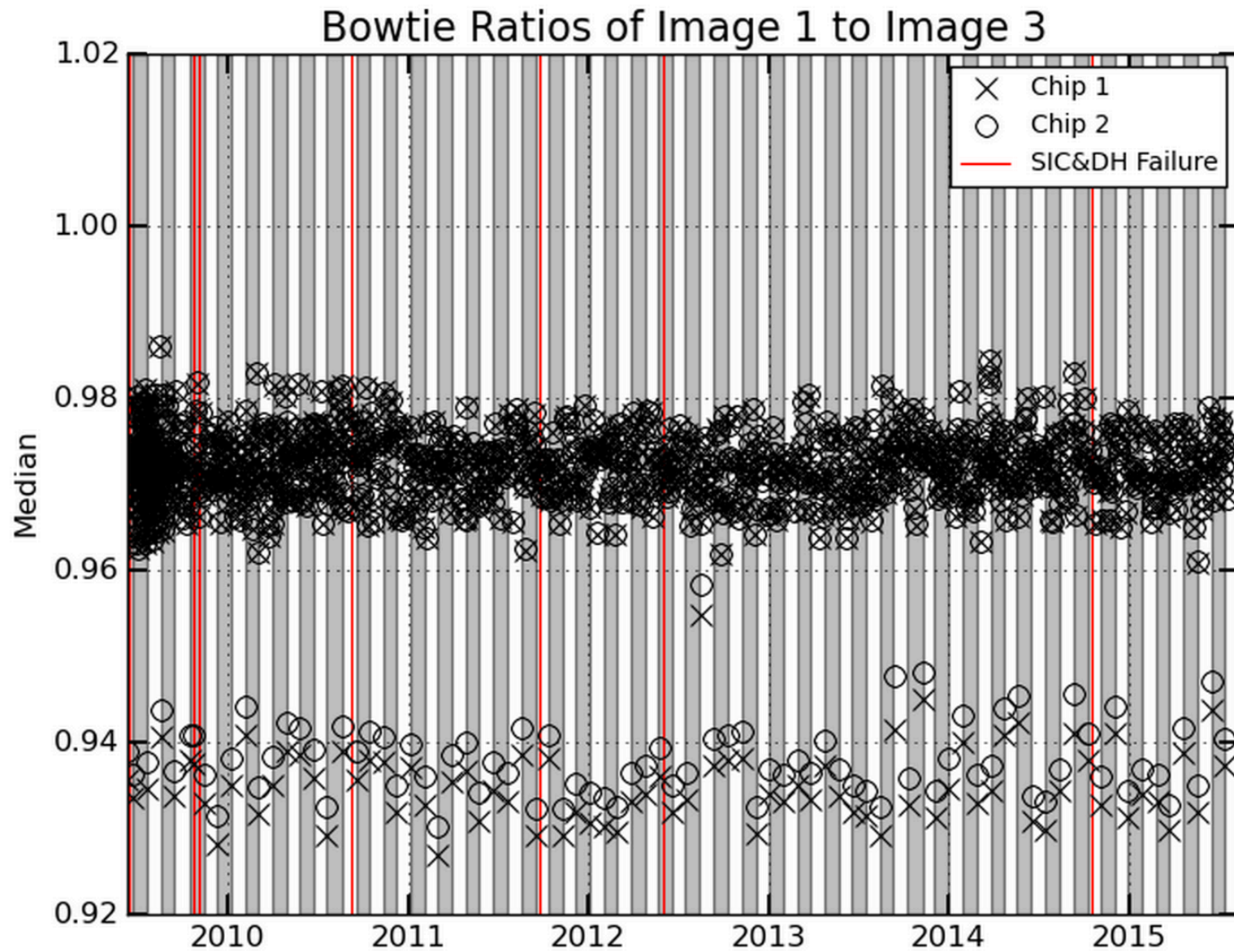
Number of External Orbits: 0

Number of Internal Orbits: 134

Goals: During thermal vacuum testing of internal flatfields, it was discovered that the UVIS detector exhibits occasional low-level (~1%) quantum efficiency offsets (i.e. hysteresis) across both chips, an effect later dubbed 'bowtie' due to its unique shape in the image ratios. The ground tests also revealed that the hysteresis could be negated by overexposing the detector by several times the full well amount. Thus, a multi-cycle 'bowtie monitoring' program was developed to detect and mitigate UVIS hysteresis on orbit. Like the preceding programs, each visit of this program acquires a set of three 3X3 binned internal flatfields. The first image is unsaturated in order to identify hysteresis, the second image is saturated to neutralize any QE offsets, and the third image is unsaturated to estimate the hysteresis removal efficiency.

Description of the Observations: Three UVIS internal tungsten flat field images are obtained using the F475X filter. This filter is utilized for (1) its high throughput, (2) its bandpass (<700nm), which is known to mitigate hysteresis and (3) its status as a low-priority filter for science observations. The three images are assembled into a single visit that is to be executed every three days: (1) an unsaturated image used as a check for hysteresis features, (2) a saturated 'QE pinning' exposure that is used to fill traps and mitigate QE offsets, and (3) an additional unsaturated image used to assess the hysteresis removal efficiency. Data analysis will include inspecting unsaturated frames and image ratios, identifying trends in image ratios over time, quantifying the efficiency of the neutralizing exposure, and investigating anomalies. The number of orbits includes room for contingency visits in the event of unexpected safing.

This is a continuation of programs 12344, 12688, 13072, 13555, 14001, 14367.



Same as CY23

WFC3/UVIS CCD Daily Monitor

Number of External Orbits: 0

Number of Internal Orbits: 642

Goals: Monitor the behavior of the UVIS CCDs with a daily set of bias and/or dark frames. These data will be used to generate bias and dark reference files for CRDS, which are used to calibrate all WFC3/UVIS images.

Description of the Observations:

The internals are acquired using a pattern of single-orbit visits repeated every 4 days (see below). All darks are 900 seconds in duration and all exposures will be post-flashed. A small number of un-flashed internals are requested in a separate proposal.

Day 1 – 2 visits; one with 2 biases + 1 dark, one with 2 darks

Day 2 – 2 visits, each with 2 darks

Day 3 – 1 visit with 2 darks

Day 4 – 2 visits, each with 2 darks

All non-Day-1-Visit-1 darks use “no-move” darks (i.e. TARGNAME=DARK-NM) in which the CSM is not moved to the IR position and a narrow-band filter configuration is employed to reduce any scattered light. Since Day-1-Visit-1 Visits start with biases, and thus the CSM is in the IR position, these darks do not have to be “no-move” nor does a narrow filter have to be employed. Several different filters are used in order to distribute usage across multiple wheels thereby avoiding overuse of any particular wheel.

Orbits needed: 642 internal (91 four-day cycles * 7 orbits/cycle = 637 + 5 contingency orbits = 642)

Three to four separate proposal numbers to cover this single program would facilitate APT processing.

This is a continuation of programs 12342, 12689, 13073, 13556, 14002/3/4, 14368/69/70.

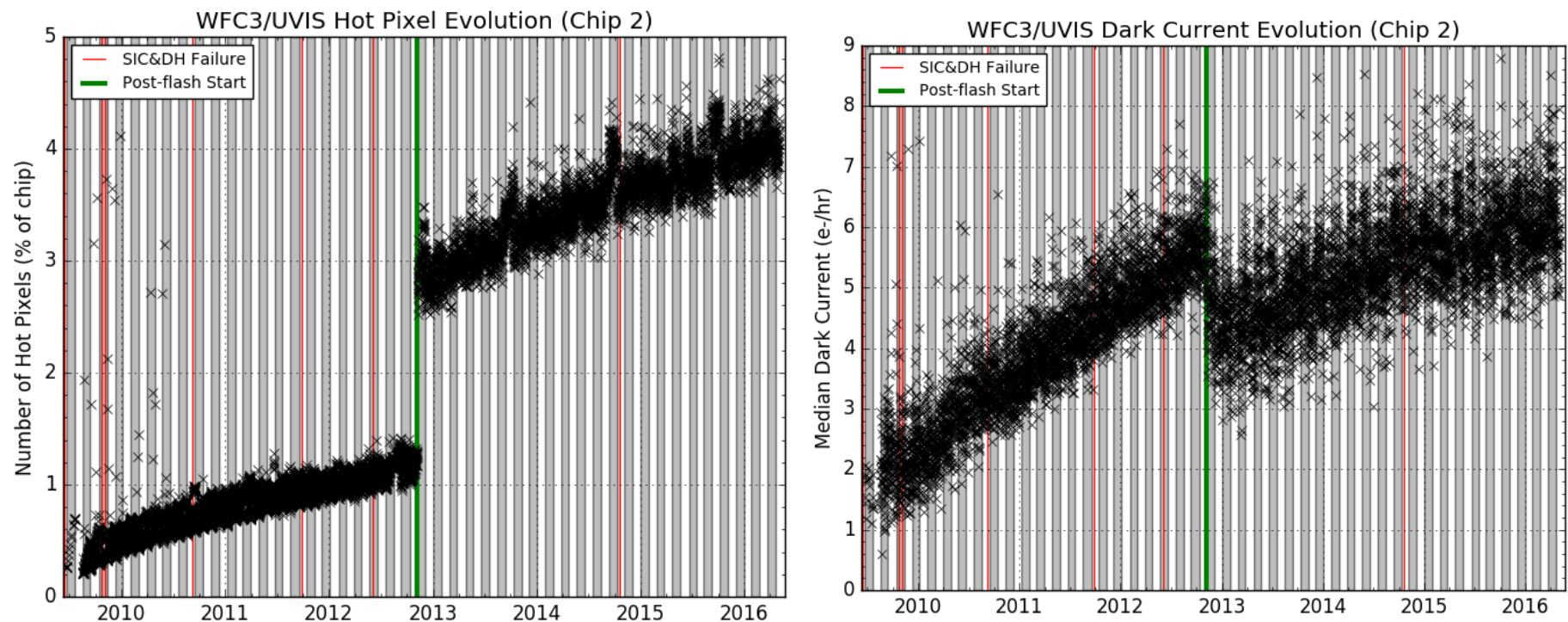
Same as CY23

WFC3/UVIS CCD Daily Monitor

Number of External Orbits: 0

Number of Internal Orbits: 642

Goals: Monitor the behavior of the UVIS CCDs with a daily set of bias and/or dark frames. These data will be used to generate bias and dark reference files for CRDS, which are used to calibrate all WFC3/UVIS images.



The hot pixel evolution (left) and the median dark current evolution (right) of WFC3/UVIS chip 2 since the installation of WFC3 on HST. Each gray/white region represents anneal cycles. Note that the implementation of post-flash occurred on day 1246.

Same as CY23

UVIS Un-flashed Monitor

Number of external orbits: 0

Number of Internal Orbits: 135

Goals: Temporal changes in CTE losses and the efficacy of the post-flash mode are monitored by a series of non-postflashed WFC3/UVIS darks taken before and after the monthly WFC3/UVIS anneal procedures. A large number of internals are taken as part of a daily monitor of warm/hot pixel growth and read noise, however they are all post-flashed. Thus, a small number of un-flashed internals are required to monitor the changes in CTE losses over time. These un-flashed internals, in conjunction with the post-flashed internals, will allow for an assessment of how well the post-flash is mitigating the CTE losses.

Description of the Observations: 900s darks in each iteration, 1 dark per visit, 5 visits pre and post-anneal. 13 anneals in cycle 23 times 10 orbits each, plus extra orbits to bridge end of cycle 22 last anneal

This is a continuation of programs 13559, 14005 , 14371

Same as CY23

WFC3/UVIS Post-flash Monitor

Number of external orbits: 0

Number of internal orbits: 60

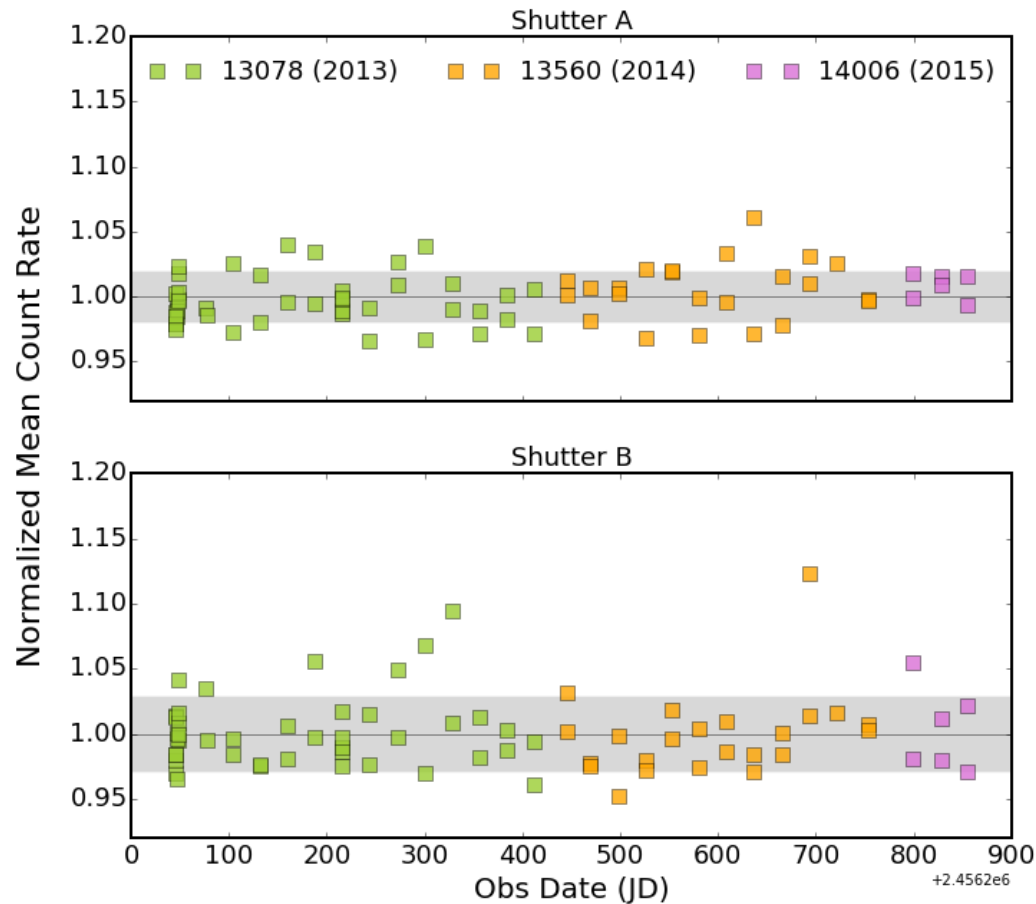
Goals: The flux and illumination pattern of the post-flash LED are monitored over time. The data are also used to generate post-flash reference files for the calibration pipeline.

Description of the Observations: Most observers with low-background (<12 e-) data are now making use of the post-flash (PF) mode in WFC3/UVIS. In this cycle, we propose monthly monitoring of the lamp characteristics plus sufficient orbits to allow a new generation of post-flash CRDS reference files to be created.

Each iteration of the monitor needs 3 orbits: two are used to obtain pairs of high S/N flashed Full-frames for both shutter blades (pattern check) and one orbit for 1kx1k subarrays taken at a variety of post-flash levels (brightness check). For new reference files, 12 orbits are needed; we request an extra set of 12 orbits in the event the LED illumination pattern changes more rapidly than anticipated. If it should remain stable, these 12 orbits would not be needed.

Orbits needed: 60 = 12x3 (pattern + brightness check) + 12(new reference) + 12 (on-hold).

This is a continuation of programs 13078, 13560, 14006, 14372



The figure above shows the Normalized Mean Count Rate from 2013 to 2015 of the UVIS2-C1K1C subarray with flash = 12 e^- . The \pm standard deviation of the entire data is shown with the grey bar centered at a mean count rate of 1.00.

Most values lie within the 1-sigma bar, the few outliers are being investigated for scattered light contamination.

Same as CY23

UVIS Gain Stability

Number of external orbits: 0

Number of internal orbits: 18

Goals: Monitor the absolute gain for the nominal detector readout.

Description of the Observations: Observations consist of 8 pairs of full-frame binned (BIN=2 and BIN=3) and unbinned internal calibration subsystem flat fields at nominal gain. Images are taken with a variety of exposure times to provide a mean-variance measurement of the gain. Two epochs, 9 orbits each, are requested, to be taken ~6 months apart. Six of these orbits will be for sampling the unbinned mode in order to increase the sampling at the lower signal levels.

This is a continuation of programs 11906, 12346, 12690, 13168, 13561, 14007, 14373

WFC3/UVIS Sink pixel map update

New Program

Number of External Orbits: 0

Number of Internal Orbits: 20

Goals: The purpose of this program is to identify when and where new sink pixels have formed, measure their impact as a function of image background, and update the calwf3 sink pixel mask file accordingly.

Description of the Observations: A unique type of chip defect, “sink pixels” contain an atypically high number of CTE traps. As a consequence, sink pixels appear as effectively delta-functions in high-background images and as long troughs in low background images (see next slide). As of mid-2014, about 0.05% of WFC3/UVIS pixels were identified as sinks deeper than 20e-; including the troughs, up to 0.5% of pixels are impacted by sinks (Anderson & Baggett, ISR 2014-19, based on data from proposal 13638 in Cycle 21). The sinks are currently flagged in the CTE-correction branch of calwf3 via the use of a sink pixel mask. However, the **number of sink pixels is known to increase with time**, likely because they are a result of radiation damage. Thus there is a need to inventory the current sink pixel population and propagate the results to the pipeline.

= 10 short darks* each at four post-flash levels [25e-, 50e-, 100e-, 200e-]**,
with 2 exposures per internal orbit

*to beat down poisson noise and properly reject CR's.

**12e- flashed darks are already in UVIS monitor

Sink pixels

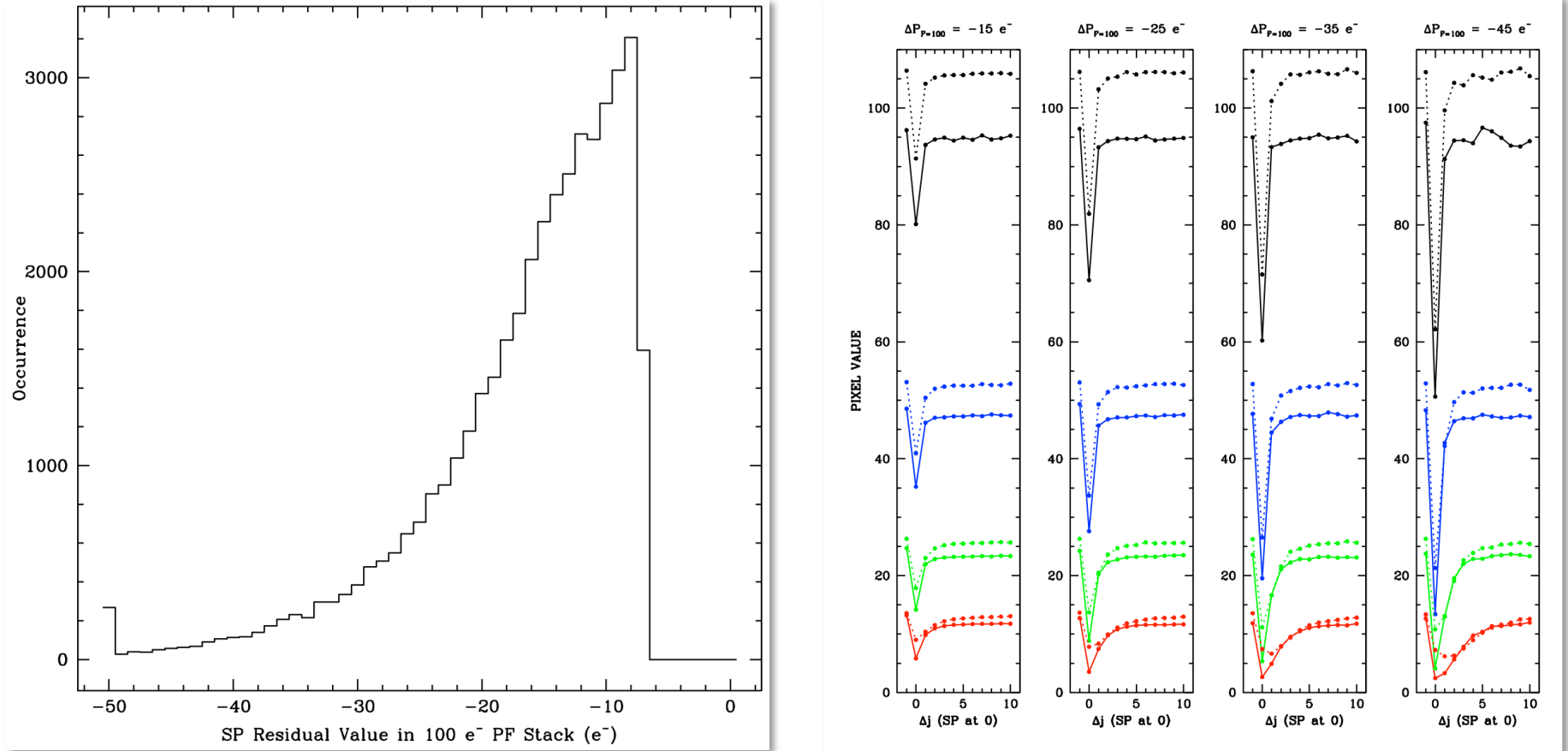


Figure 1. At left, the distribution of sink pixel depths in 2014; occurrence is the number of pixels in 4Kx4K. The bin at -7 ranges from -6.5 to -7.5 and since the cut-off was -7, the bin is only half-filled. At right, the average sink pixel profiles as function of background (red, green, blue, black). Solid and dotted lines: close to, and far from, amp. Figures taken from WFC3/ISR 2014-22.

IR Detector

To monitor the health of the IR channel and to verify the accuracy of the non-linearity correction, we request 123 internal orbits plus 5 external orbits:

1. 97 internal orbits to obtain IR dark calibration files. The number of orbits is dictated by the observing modes requested by GOs. - Same as last cycle
2. 10 internal orbits (saturated internal flats) to monitor the IR non-linearity and update the calibration reference file. - Same as last cycle
3. 16 internal orbits to verify the stability of the IR channel gain via a series of lamp flats. Different orbits are required to avoid persistence effects. - Same as last cycle
4. 5 external orbits (2 ACS + 3 IR) to extend the range & precision of the count rate non-linearity correction to faint objects and to test for any wavelength dependence – New calibration

Same as CY23

IR Dark Monitor

Number of External Orbits: 0

Number of Internal Orbits: 97

Goals: This program obtains data required to support the IR dark calibration. The structure overall is very similar to the previous IR dark monitor programs. About a quarter of the orbits are used for regular collection of SPARS200/full-frame dark observations. These long observations are used to monitor trends in the bad pixels (hot, unstable, or dead), zeroth read level, and dark current. The remaining portion of the orbits will be used to collect dark ramps for generating stacked IR dark calibration files for use by the MAST pipeline. The ramps will be collected for each observing mode at a cadence roughly scaled with the popularity of each observing mode in approved Cycle 23 programs, with the exception of the newly implemented SPARS5 sample sequence, which will be allocated extra orbits for this cycle only.

Description of the Observations: Full-frame and subarray dark calibration images will be collected. The total number of images collected over the course of the cycle for a given mode is based on the total number of input ramps used in the current superdark for that mode, and the popularity of that mode in cycle 22 external science observations. The IR dark current has remained effectively unchanged since launch (Hilbert & Petro, WFC3 ISR 2012-11). This stability allowed us to greatly relax the scheduling constraints compared to WFC3/IR dark monitor programs from previous cycles. With the exception of the SPARS200/Full-Frame hot-pixel monitoring observations (which occur once within every 2-week period), all observations have no set scheduling parameters, other than that they have to be taken sometime during Cycle 23.

This is a continuation of programs 12349, 12695, 13077, 13562, 14008, 14374

Same as CY23

WFC3/IR Linearity Monitor

Number of external orbits: 0

Number of internal orbits: 10

Goals: Monitor the signal non-linearity of the IR channel and, when necessary, update the IR channel non-linearity calibration reference file.

Description of the Observations: Each internal orbit will be used to acquire one internal flat (intflat) exposure up to saturation level in order to provide a pixel-to-pixel map of the non-linearity of the detector.

Starting last cycle we added a second trailing dark (using SPARS25, nsamp=15) after the final flat. The purpose is to measure the decay of any persistence that 'burps' out of the flats. Because the sample sequence and sample number is compatible, the darks can additionally be used in the IR dark program. Similar trailing darks have been added to the visits in the IR gain monitor.

This is a continuation of programs 12352, 12696, 13079, 13563, 14009, 14375

Same as CY23

WFC3/IR Gain Monitor

Number of external orbits: 0

Number of internal orbits: 16

Goals: Measure the gain of the IR channel and monitor the health of the instrument by comparing to values from previous cycles.

Description of the Observations: This proposal is unchanged from last cycle's. Each orbit of the 16 identical orbits will be used to acquire an internal flat (intflat) to compute the detector gain via the mean-variance technique. To manage persistence effects, the gain intflats are not taken back-to-back, but in their own orbits. Furthermore, each gain intflat is preceded by a dark ramp and a short low S/N narrowband exposure, to ensure the internal lamp is at full output. The gain intflats are acquired at $\sim 1/2$ full-well to minimize non-linearity corrections.

Starting last cycle we added a second trailing dark (using SPARS25, nsamp=15) after the final flat. The purpose is to measure the decay of any persistence that 'burps' out of the flats. Because the sample sequence and sample number is compatible, the darks can additionally be used in the IR dark program. Similar trailing darks have been added to the visits in the IR linearity monitor.

This is a continuation of programs 12350, 12697, 13080, 13564, 14010, 14376

Improved Precision, Wavelength Dependence of the IR Count Rate Non-Linearity

New Program

Purpose	Extend the range & precision of the Count Rate Non-Linearity correction to faint objects. Test for wavelength dependence.
Description	<p>The absolute photometric calibration was done using bright (11th mag) stars. We need to test the accuracy of applying these zeropoints to very faint objects (at the sky count-rate ~23rd mag). The ACS/WFC with F850LP is used to define a relative flux scale for stars for WFC3-IR filters. ACS is selected over WFC3/UVIS because it is more sensitive in F850LP, and the redder effective wavelength of the filter makes it closer to the F098M IR filter.</p> <p>The present uncertainty in CRNL is 0.01 mag/dex (factor of 10) and a difference of 12 magnitudes is 4.5 dex, making the uncertainty for faint objects up to 0.045. The goal of the new data is to improve this to 0.01 mag at 23rd mag. This is achieved by doubling the dynamic range of the data (using two exposure times, short and long) and by doing an outer field in 47 Tuc which is more rich in stars than NGC 3603 (past ISR used the WFC3-ERS program), but not as crowded as the Omega-Cen data obtained in Cycle 19. Crowding is important to consider when comparing the ACS data with 0.05"/pixels with undersampled IR data with 0.13"/pixels. Since the CRNL correction was derived using F160W, test 2 additional filters to quantify any wavelength dependence.</p>
Fraction GO/GTO Programs Supported	30% of IR programs . This program benefits GO's doing photometry on the very faint targets, near or at the sky level.
Resources Required: Observations	5 external orbits. 1 orbit each in ACS/WFC F775W & F850LP and in WFC3/IR F098M, F125W, & F160W. The data will be dithered to mitigate persistence.
Resources Required: Analysis	0.15 FTE. Analysis to be completed by the PI. Measure the photometry of the same stars in each filter and fit a count rate non-linearity term for each NIR filter, treating F850LP (plus color term, F775W-F850LP) as the 'truth' or benchmark. Because F850LP and F098M cover similar wavelength, calibrate CRNL for F098M and bootstrap to F125W and F160W (using color terms) to measure any wavelength dependence of the CRNL (as existed for NICMOS).
Products	Improved linearity correction to be applied by CALWF3 and supporting ISR.
Accuracy Goals	Reduce uncertainty in CRNL to 0.01 mag at 23 rd magnitude. Philosophy: "Much better statistics from large number of stars in cluster, linearity "truth" for IR detector set by CCD, rather than non-LTE stellar atmosphere models (hard to quantify systematics), extension to fainter count rates, near sky, than available from individual "standard stars" which is crucial for most GO's.
Scheduling & Special Requirements	None
Prior Results	<p>The most recent data is from Cycle 19, program 12700 in F098M only, but the Omega-Cen field is too crowded in the undersampled IR detector relative to the ACS CCD to achieve a clean result.</p> <p>Prior documentation: ISR 2011-15 for program 12335 (Asterisms), ISR 2010-07 for program 11360 (NGC3603)</p>

WFC3 CRNL Results to Date

ISR 2011-15, Figure 3

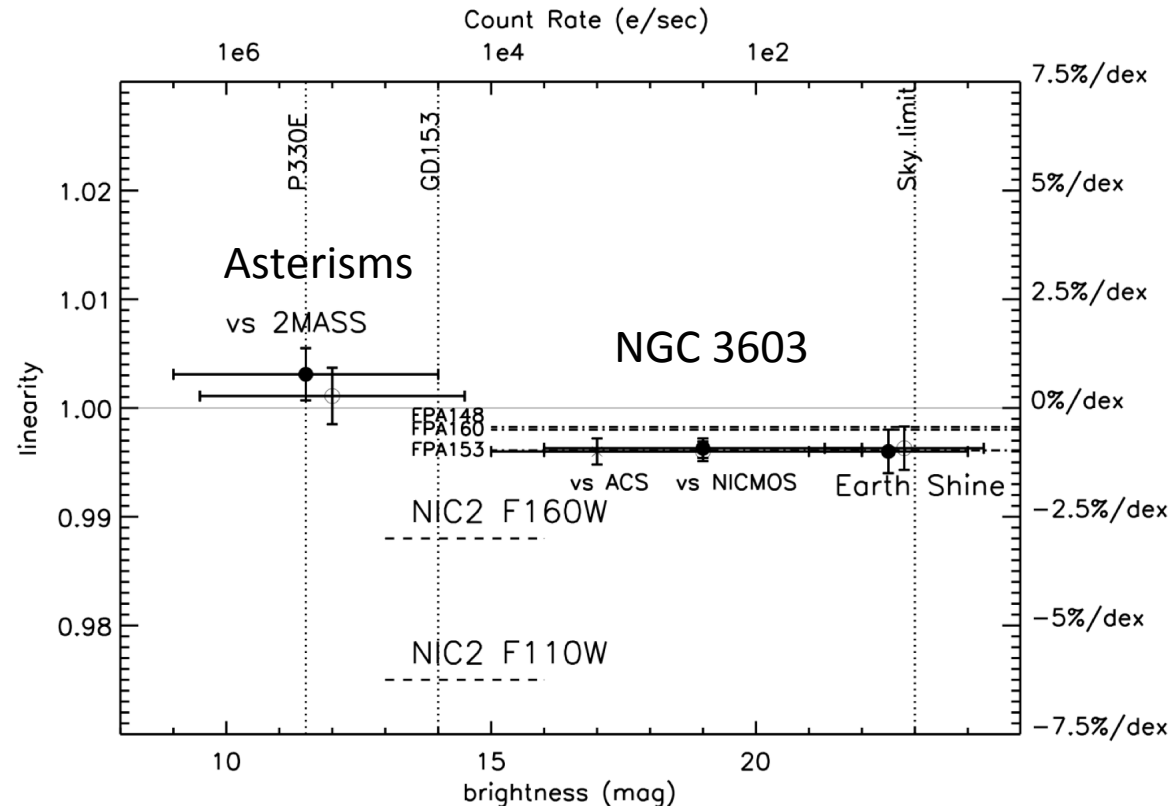


Figure 3: Comparison of assorted count-rate non-linearity measurements for WFC3-IR. The measurements reported here are labeled as “vs 2MASS” and those in Riess (2010) as “vs ACS” and “vs NICMOS”. Those from Riess & Petro (2011) are labeled as “Earth Shine”. Points determined from F160W are solid, from F125W are open circles and from F098M are open triangles. The values from the Goddard tested flight spares are indicated as “FPA” and those from NICMOS Camera 2 are indicated.

CTE Characterization and Calibration

This part of the calibration program requires 10 external and 63 internal orbits. As in Cycles 20–23, GOs can mitigate CTI effects using post-flash. To support these efforts we request:

1. 12 internal orbits to measure and monitor CTE via Extended Pixel Edge Response (EPER). Frequency every other month. – Same as last cycle
2. 8 external orbits to observe stellar fields characterized by different crowding and background (2 fields in 47 Tuc and one in NGC 6791) to calibrate the photometric and astrometric CTI corrections. – Same as last cycle
3. 36 internal orbits with charge-injected bias to monitor the length of the CTE trails. This information will be used as an input for J. Anderson's CTE algorithm. – Same as last cycle
4. 15 internal orbits of darks to recharacterize the UVIS CTE model derived in 2013 – New calibration
3. 2 external orbits on a star cluster to evaluate the accuracy of the pixel-based CTE model - New calibration

Same as CY23

WFC3/UVIS CTI Monitor (EPER)

Number of External Orbits: 0

Number of Internal Orbits: 12

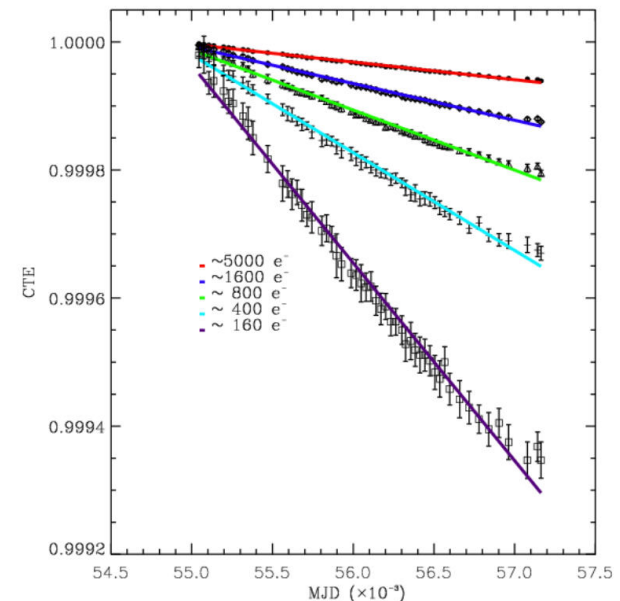
Goals:

- (1) Measure the WFC3/UVIS CCD Charge Transfer Inefficiency (CTI) using the Extended Pixel Edge Response (EPER) method.
- (2) Assess the CTE losses over time in a continuation of the multi-cycle CTE monitor program

Description of the Observations: 12 internal orbits (2 every other month) are used to assess the profiles of excess charge in the extended pixel region of the special EPER readout format and monitor the CTI of WFC3/UVIS.

Each visit-pair obtains internal lamp flat fields at a variety of illumination levels as well as two short dark exposures to be used as a bias measurement. A visit-pair is taken approximately every 8 weeks over the span of a year.

This is a continuation of programs 11924, 12347, 12691, 13082, 13565, 14011, 14377



CTE from Aug 2009 through Aug 2015 as a function of time for a range of signal levels. CTE continues to decline, decreasing most rapidly for the lowest signal level (160 e-). The apparent leveling off of CTE losses in recent data is under investigation.

Same as CY23

WFC3/UVIS External CTE Monitor: Star Clusters

Number of external orbits: 8

Number of internal orbits: 0

Goals: Monitor CTE degradation as a function of epoch and source/observation parameters. Calibrate photometric corrections. Provide data to test and monitor the Anderson pixel-based CTE correction model for WFC3/UVIS.

Description of the Observations: We continue, as begun in Cycle 20, using post-flash to sample background levels and monitor the efficacy of the post-flash model for CTE mitigation. Exposures of NGC 6791 and 47 Tuc in F502N (this filter gives approximately zero background) will monitor the maximum CTE in different field densities, and long exposures, dithered by 2000 pixels in detector Y, will measure absolute CTE. We sample various background levels to test whether the currently recommended level of 12 e- still yields the best charge transfer. The data are also used to test the effectiveness of the pixel-based CTE correction software.

In summary, there will be one orbit for NGC 6791 and three for 47 Tuc (observed in five different non-zero background levels). Four orbits per epoch, times two epochs, to yield eight orbits total.

This is a continuation of programs 12379, 12692, 13083, 13566, 14012, 14378

Same as CY23

Characterization of UVIS traps with Charge-Injection

Number of external orbits: 0

Number of internal orbits: 36

Goals: This program is designed to monitor the UVIS trap growth via charge-injected biases

Description of the Observations: We request 36 internal orbits to monitor the growth of UVIS traps. Line 25 charge-injected biases will be acquired every 10 days. Observations are designed to give the schedulers large flexibility, and therefore minimize the impact on the number of CSM moves.

This is a continuation of programs 12348, 12693, 13084, 13569, 14013, 14379

WFC3/UVIS CTE Model Re-characterization

New Program

Number of External Orbits: 0

Number of Internal Orbits: 15

Goals: In 2013, Anderson used a combination of short darks with various levels of post-flash with long darks to develop a pixel-based model of CTE for WFC3/UVIS. This “direct” approach is much more accurate than the original Anderson-Bedin (2010) correction based on the study of warm-pixel (WP) trails. In Cycle 24, Anderson will be using the direct approach with ACS/WFC to construct an improved model for that detector using the newer formalism he developed for WFC3/UVIS. This would be a good time to [re-evaluate the WFC3/UVIS correction](#) to ensure that the [parameters](#) are as well measured as possible, and in particular that 12 e⁻ remains a good post-flash level. We will also evaluate the CTE behavior in [subarrays as compared to full-frames](#).

Description of the Observations: We take [four short](#) (50s total exposure time + flash time) [full-frame darks with various backgrounds](#) per orbit. The necessary long (900s) darks with a moderate background (to suppress CTE losses) will be taken from the standard daily monitor program (14531). We will probe backgrounds of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18, 20, 22, 24, 27, 30, 35, 40, 45, 50, 55, 60, 70, 80, 90, 100, 110, 120, 135, 150, 165, 180, 200, 225, 250, 300 e⁻, for a total of [40 short darks](#). For the [subarray](#) evaluation, we take 100s darks with the [most popular subarrays plus 1 full-frame per orbit, 5 iterations](#), with post-flash of [12e- only](#), to perform the check.

15 internal orbits= 10 for the full-frame re-evaluation and 5 for the subarray check.

WFC3/UVIS CTE Pixel-Based Model Evaluation

New Program

Number of External Orbits: 2

Number of Internal Orbits: 0

Goals: The 2013 pixel-based model for CTE correction in WFC3/UVIS is in need of re-evaluation. There is a separate proposed internal calibration proposal to re-pin the WFC3/UVIS CTE model using combinations of short and long darks. This external program will be **done in conjunction with ACS/WFC in parallel (WFC3 prime)** in order to provide a direct evaluation of the efficacy of the pixel-based correction for a real astronomical scene, in terms of photometry, astrometry, *and* shape. We will take three long (700s) observations in the Galactic bulge and will take 3 short observations (35s) with the identical pointing and a range of backgrounds so that the pixel-based-CTE-corrected shorts can be compared with the “truth” from the deep set of exposures. The ACS exposures will be done in parallel as subarrays (which – in contrast to WFC3 - have the same readout time as full-frames). We chose the bulge since it will be a good field for both instruments at the same time; our field will not overlap previous fields.

Description of the Observations: We collect a total of **6 long and 6 short full-frame** WFC3 exposures (three each per orbit). The **long** observations will have a background **~15 electrons** while the **shorts** will have each of **12, 20, 30, 40, 50, and 60 electrons** background, to probe the CTE correction in all the typical background ranges.

ACS subarrays will be acquired in parallel in order to optimize use of valuable HST observing time.

WFC3 Photometric performance

39 *external* orbits and 1 *internal* orbit will be used to characterize the photometry:

1. 2 external plus 1 internal orbit will be used to monitor the accuracy of the shutter mechanism after 7 years of operation. – Reduced from last cycle (3 ext +1 int)
2. 14 external orbits will be used to measure the UVIS photometric throughput every 5 weeks to validate instrument throughput stability and characterize any wavelength dependence of the throughput loss observed at optical wavelengths. A new standard (GD153, 10 orbits) is introduced to account for possible variability in the previous standard (GRW), which will continue at a reduced cadence (4 orbits of data). – Same as last cycle
3. 6 external orbits are requested to improve the statistical accuracy of the UVIS contamination monitor by making use of spatial scans. – New calibration
4. 11 external orbits are requested to check photometric zero-points for a subset of the WFC3 UVIS and IR filters. - Same as last cycle
5. 2 external orbits are requested to validate the linearity of the IR zeropoints for faint sources – New calibration
6. 4 external STIS orbits are requested to improve the accuracy of the GRW+70 CALSPEC model – New calibration

WFC3/UVIS Contamination Monitor

Same as CY23

Number of External Orbits: 14

Number of Internal Orbits: 0

Goals: Periodically measure the photometric throughput of WFC3 during the cycle in a subset of key filters in the UVIS channel. The data provide a monitor of the flux stability as a function of time and wavelength as well as check for the presence of possible contaminants on the detector windows. While no contamination effects have been detected with prior data, small long-term photometric drifts are present in some filters (Gosmeyer et al., ISR 2014-20). These drifts do not appear to be due to changes in shutter behavior (Sahu et al., ISR 2015-12).

Description of the Observations: The monitor observing cadence is deliberately out of synchronization with the monthly anneals in order to sample the phase space. Each iteration obtains dithered subarray observations of a standard star in a subsample of filters in the UVIS, including the UV grism, on both UVIS detectors.

Given recent results that the white dwarf spectrophotometric standard GRW+70d5824 may not be as stable as previously thought (Bohlin & Landolt 2015), we propose to begin using another white dwarf standard (GD153), interleaving it with a small number of GRW+70 observations to tie it into the wealth of past monitor data.

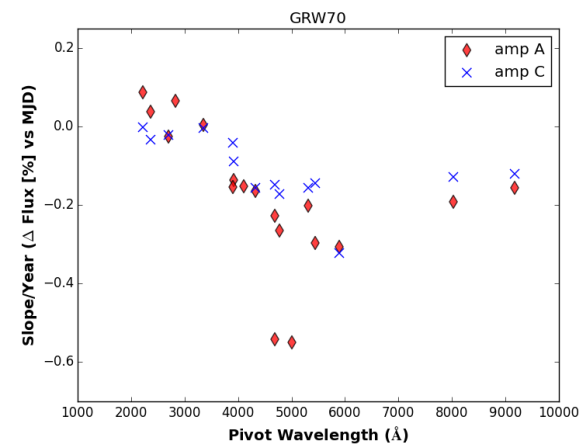
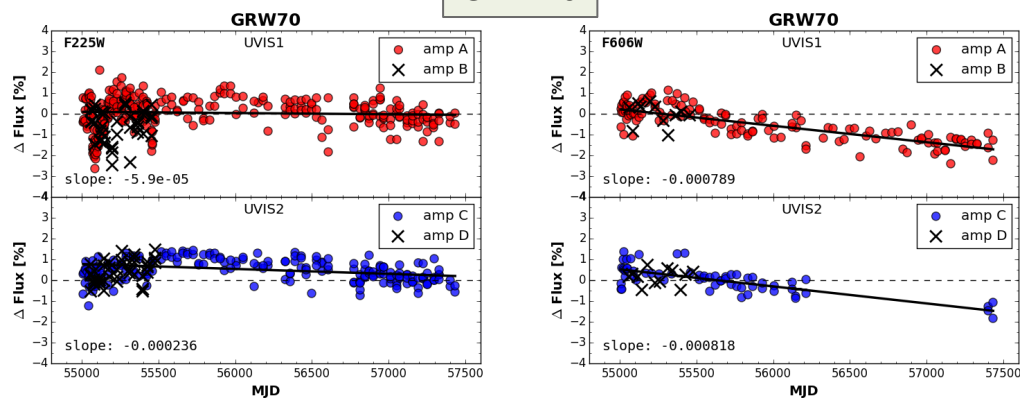
14 orbits total to cover the observing cycle and provide GD153/GRW overlap

10 orbits GD153 (one orbit every 5 weeks)

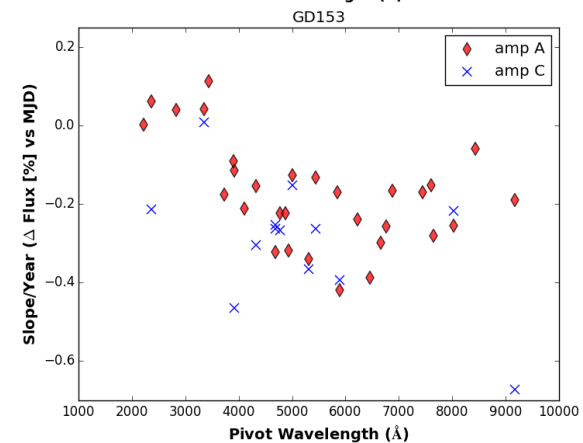
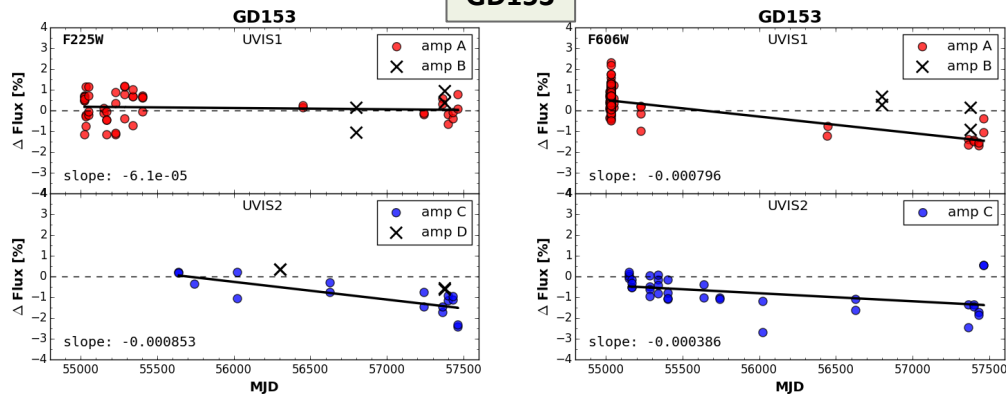
4 orbits GRW (every 3 months during the cycle)

This is a continuation of programs 12333, 12698, 13088, 13574, 14018, 14382.

GRW+70



GD153



New Program

WFC3/UVIS Contamination with spatial scan

Number of External Orbits: 6

Number of Internal Orbits: 0

Goals: Periodically measure the photometric throughput of WFC3 during the cycle in a subset of key filters in the UVIS channel. The data provide a monitor of the flux stability as a function of time and wavelength as well as check for the presence of possible contaminants on the detector windows. While no contamination effects have been detected with prior data, small long-term photometric drifts are present in some filters (Gosmeyer et al., ISR 2014-20). Since GD153 is a relatively new standard for this program (phased in during Cycle 23), we have requested a full cycle of static imaging to build up the baseline (10 orbits) accompanied by scanned orbits for half the time.

Given the good repeatability seen in scanned data (~0.1% rms, program 14020), we propose a gradual transition to scanned mode for contamination monitoring. This will allow for a more accurate assessment of the counter-intuitive slopes seen in the monitor data.

Description of the Observations:

6 orbits GD153, scanned (1 orbit every 10 weeks, contemporaneous with static images)
covers the full cycle and provides sufficient overlap between staring and scan mode.

Use as many of the filters used in the staring mode as will fit into a single orbit, at the very least
F218W, F225W, F275W, F606W, F814W

This is a supplement to Cy24 program 14815 which uses static images to monitor the contam using a new standard GD153 every 5 weeks plus reduced number of GRW+70 to tie into past observations (possible variability). Filters: F218W, F225W, F275W, F300X, F336W, F438W, F606W, F814W, G280

UVIS Shutter Monitoring

Same as CY23

Number of external orbits: 2

Number of internal orbits: 1

Goals: Monitor the performance of the UVIS shutter blades. The three specific objectives are:
(i) monitor the accuracy and stability of the blades by repeating tests from prior CAL programs,
(ii) compare the photometric behavior of both shutter blades, for short vs long exposures, and
(iii) check for any shutter shading effects.

Description of the Observations:

- (i) We will continue to monitor our Cycle 23 external target ('bright/faint pair') to look for any deviations. Prior observations (3x per year) were sufficient to characterize the shutter performance, so the frequency can be reduced to 2x per year (2 external orbits) for monitoring.
- (ii) We will continue to monitor the photometric behavior of blades A and B separately.
- (iii) Internal flats will be used to monitor any shutter shading effects (1 internal orbit)

This is a continuation of programs 11427 (SMOV), 14019, 14383

UVIS and IR Photometry

Same as CY23

Number of external orbits: 11

Number of internal orbits: 0

Goals: Monitor the photometric throughput and stability, measure zeropoints and determine color term corrections for **WFC3 UVIS and IR filters** as a function of time, wavelength and source brightness. Previous programs indicate that UVIS sensitivity is time dependent, hence zeropoints are also time dependent. **This is a continuation of CY 17–23 programs, (Cy23=14384).**

Description of the observations:

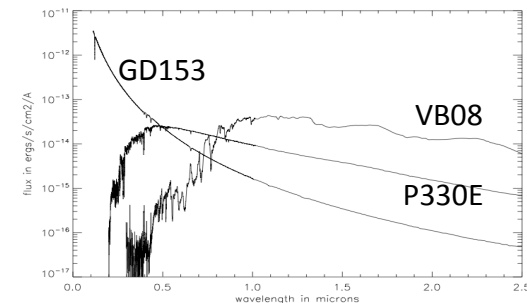
WFC3 UVIS: We image G191B2B, GD153, GD71 and P330E in a subset of broad- and medium-band UV and VIS filters at the corners (4 amps), using postflash. In Cycles 20 and 21 we obtained observations in ALL UVIS filters at all 4 corner subarrays. 2 orbits per star = **8 external orbits**

Star/Cycle	SMOV+17	18	19	20	21	22	23
G191B2B	AC, ALL					ABCD, subset	ABCD, subset
GD153	ABC, subset	A, subset		AD, ALL	BC, ALL	ABCD, subset	ABCD, subset
GD71	AC, subset	C, subset	C, subset			ABCD, subset	ABCD, subset
P330E	A, subset	A, subset		AD, ALL	BC, ALL	ABCD, subset	ABCD, subset

WFC3 IR: GD153, GD 71, P330E are imaged in all IR filters.

1 orbit per star = **3 external orbits**

Vega mags	B	V	R	I	J	H
GD153	13.06	13.35	13.45	13.67	14.01	14.21
GD71	12.78	13.03	13.17	13.34	13.73	13.90
P330E	12.97	12.92	12.56	12.21	11.77	11.45



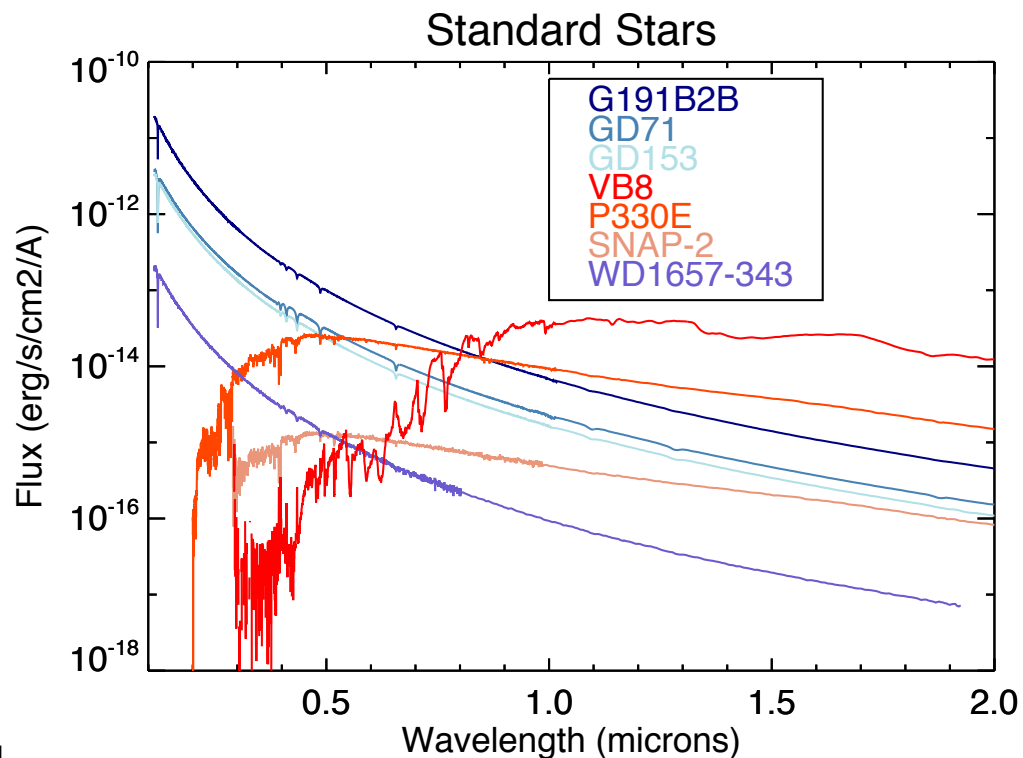
New Program

IR Zeropoint Linearity

Purpose	Check the linearity of the IR sensitivity (“zeropoints”) using standards of varying brightness.
Description	<p>The photometric monitoring program 14883 observes bright white dwarfs and GV flux standards for routine monitoring of the detector response. The inverse sensitivity (IS) measurements are therefore made for sources with high count rates and short exposure times. IR detectors are non-linear devices, thus zeropoints for faint sources may be different compared to those derived from bright stars. Recent studies show the IS derived from faint galaxies is 0.012 mag brighter than from bright stars Rubin et al 2015).</p> <p>This Cy 24 calibration program will derive and compare IS from faint star analogues to the bright star zeropoints. With the addition of the faintest white dwarf and the faintest G star gives dynamic range (DR) ~250. Including the bright M-star VB8 (GJ644C), observed in Cycles 18 and 22, (props 12334 and 14021), gives a DR between 500-1000 for wavelengths greater than 1 micron. See plot and table on next slide.</p>
Fraction GO/GTO Programs Supported	30% of IR programs .This program benefits GO’s doing photometry of faint targets
Resources Required: Observations	2 external orbits. 1 orbit for each standard (using subarrays) will allow us to sample all of the broad and medium filters. Two dither positions will allow for the rejection of artifacts.
Resources Required: Analysis	0.25 FTE. Analysis to be completed by a new RIA (H. Kurtz, 0.15) using the IR photometry pipeline developed by V. Bajaj (0.05), with oversight by the PI (0.05). “Measure photometry of bright and faint standards and use pysynphot to compare with the model spectrum to verify that the same zeropoint correction is valid for both.”
Products	Improved linearity correction to be applied by CALWF3 and supporting ISR.
Accuracy Goals	0.01 mag for any target. Obtaining S/N ~300 for both faint and bright standards will allow us to compare the zeropoint calibration. Following the ACS (Bohlin) calibration philosophy: “Single bright stars with photon statistical noise of ~0.3% are a more precise and straightforward approach than trying to use a multitude of cluster stars to measure the sensitivity”
Scheduling & Special Requirements	None
Prior Results	ISRs 2011-15 and 2010-07 state that the uncertainty in the CRNL is 0.01 mag/dex Rubin et al. 2015AJ....149..159R , “A Calibration of NICMOS Camera 2 for Low Count Rates”

At J-band:
Largest difference in magnitude for existing standards
GD153-VB8 = 14.0-9.8 = 4.2 mag (DR= 50)

With the new faint white dwarf standard
WD1657-VB8 = 17.0-9.8 = 7.2 mag (DR=760)



CALSPEC Standards

<http://www.stsci.edu/hst/observatory/crds/calspec.html>

	Vega mags	Spectral Type	B	V	R	I	J	H	Calspec Pedigree
THE HST Standard Stars	G191B2B	DA.8	-	11.69	11.93	12.108	12.543	12.669	_stisnic_006
	GD71	DA1	12.783	13.032	13.169	13.337	13.728	13.901	_stisnic_006
	GD153	DA1.2	13.17	13.346	13.8	13.3	14.012	14.2	_stisnic_006
	P330E	G2V	12.972	13.03	12.56	12.212	11.76	11.45	_stisnic_007
Bright Standard	VB8	M7V	18.7	16.7	16.61	12.24	9.776	9.2	_stisnic_006
Faint HST Standard Stars	WD1657+343	DA1	16.12	16.16 (g)	16.69 (r)	17.06 (i)	>17	>17	_stisnic_006
	SNAP-2	G0-5	17.09	16.23	16.41	--	14.97	14.59	_stisnic_006

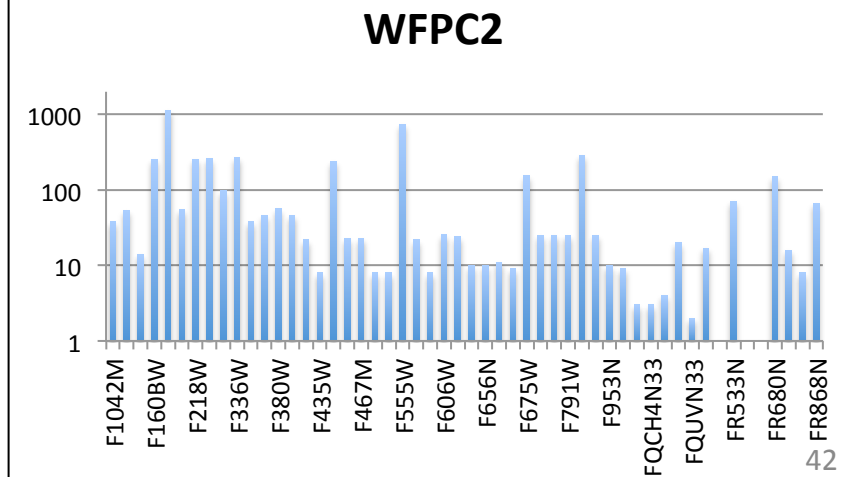
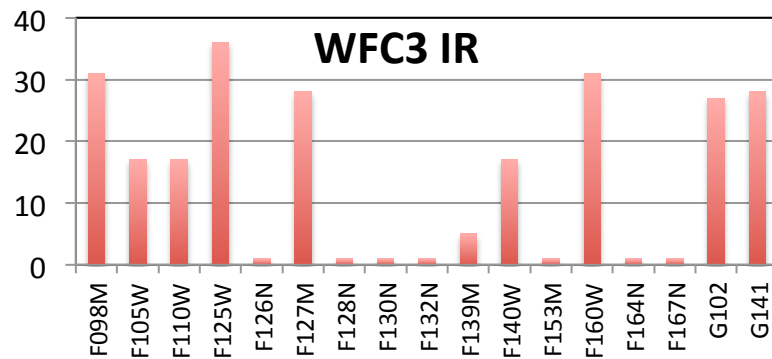
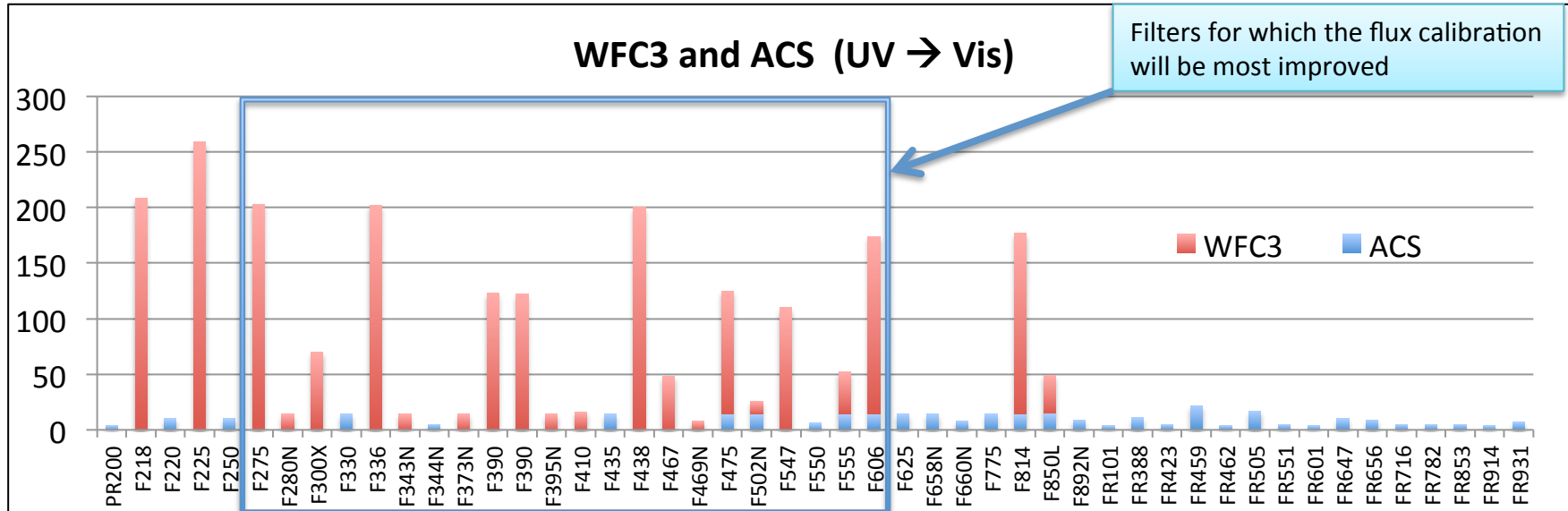
New Program

Improving the CALSPEC model for GRW+70D5824

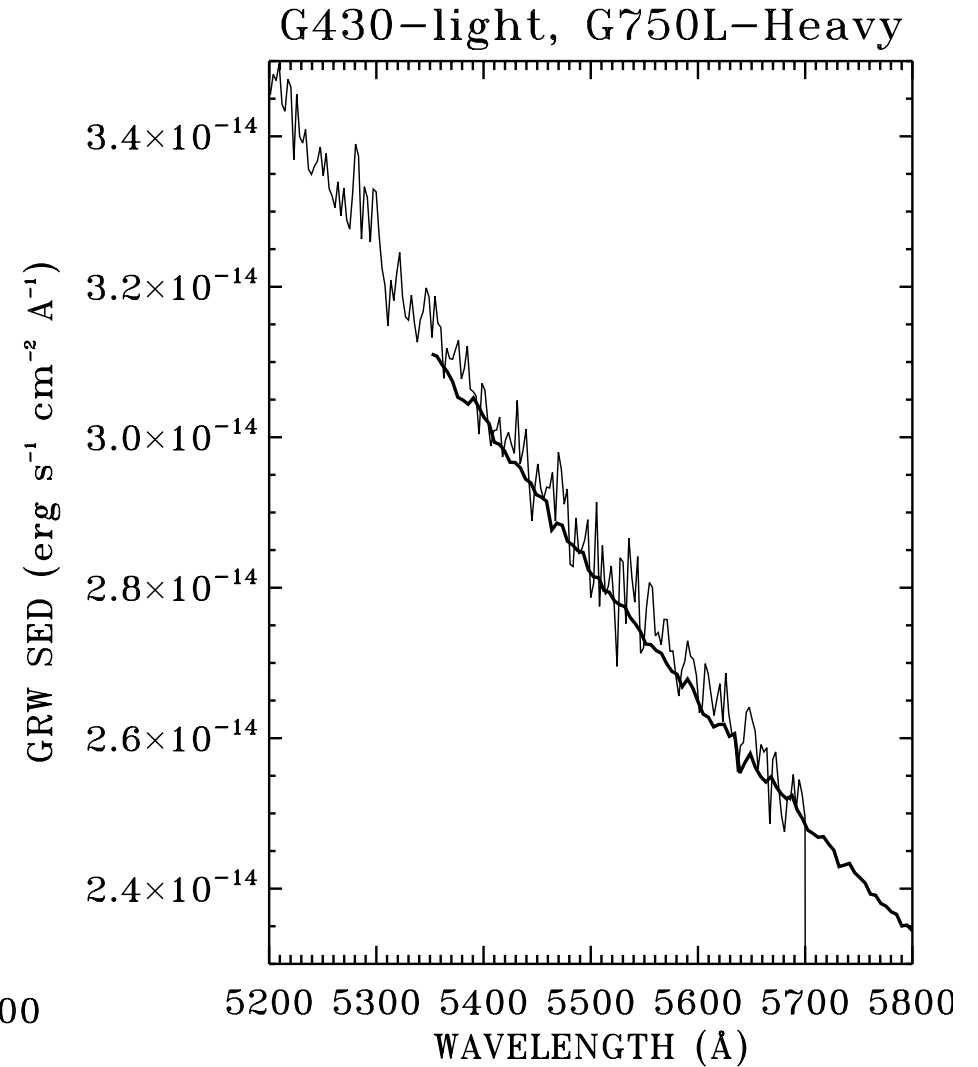
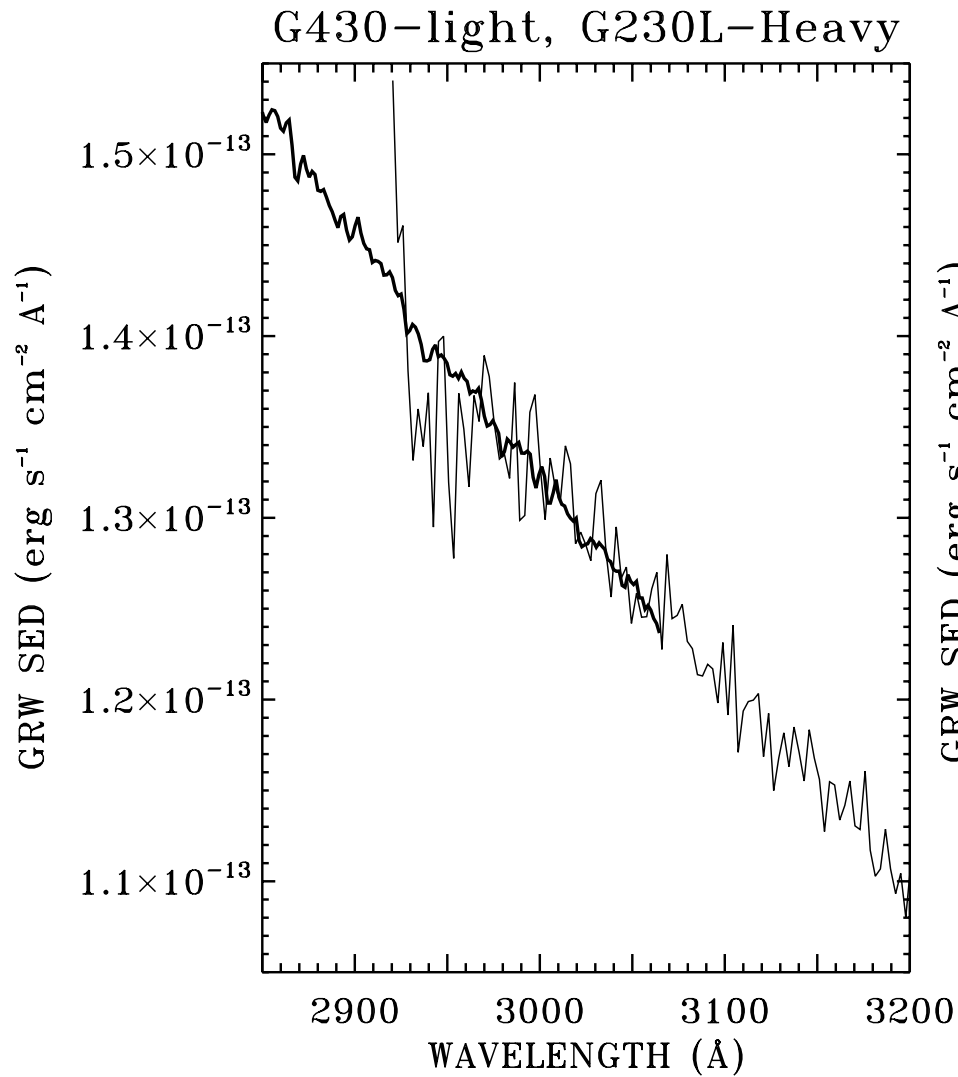
Purpose	Improve the usefulness of GRW+70D5824 as a flux standard by obtaining precise (high signal to noise) STIS spectroscopy between 0.3 and 1.0 microns. Our goal of providing a 1% flux cal (end to end) means that all various sub-pieces must be defined to sub-percent precision. In addition to providing a new excellent flux standard for the community, there are dozens of existing ACS and WFC3 observations of GRW that would become useful for cross-instrument flux calibration in the crucial 3000-5500Å range.
Description	GRW+70D5824 is a V=12.77 mag DA3 white dwarf, used by WFC3 and ACS and STIS in the UV to monitor contamination, PSF and focus changes. To date, there are 2500+ WFC3 (1300+ in the UV alone) and 320+ ACS datasets obtained for this purpose (WFPC2 has 7000+ observations). However, this very important, oft observed star is not a good CALSPEC flux standard. Its lone G430L STIS spectrum, used to establish its absolute flux between 3000 and 5500 Å and which covers some of the most important filters for ACS and WFC3, is of poor quality. Further, there are only two epochs of G750L (5240-10270 Å) spectra. However, by combining these new data with the 86 G140L (1150-1730 Å) and 89 G230L (1570-3180 Å) spectra, GRW+70D5824 will become one of the five best CALSPEC standards with complete STIS and NICMOS coverage to 2.5microns. We therefore propose to obtain high signal-to-noise STIS CCD spectroscopy of this star, with the goal of rendering the many already acquired datasets useful for flux calibration of WFC3 and ACS (and other HST instruments).
Fraction GO/GTO Programs Supported	A good flux calibration is required for ~50% of science programs.
Resources Required: Observations	4 external orbits with STIS. Three high quality G430L spectra (3 orbits) obtained in different visits (1 after each anneal) are required to beat down statistical noise to < 1%. For G750L, 1 orbit is requested to combine with the two existing epochs. The one existing G430L has low signal to noise. The 1-sigma repeatability (even in 200Å wide bins) ranges up to 0.5%. Three well exposed observations are required to reduce the 3-sigma statistical precision to <1%. (Two exposures would achieve a 1-sigma precision of ~0.4% and a 3-sigma precision of 1.1%.) For G750L, one additional exposure will reduce the 3-sigma precision from 1.1% to < 1%.
Resources Required: Analysis	0.1 FTE - Bohlin
Products	A new CALSPEC model will replace grw_70d5824_stisnic_006.fits from January 2015.
Accuracy Goals	Reduce the errors from 2-3% between 3000-5000Å and from ~1% from 5200-10000Å to <1% over the full wavelength range.
Scheduling & Special Requirements	Observations to be obtained following STIS anneals
Prior Results and/or changes from last cycle	Bohlin, Gordon, & Tremblay 2014, PASP, 126, 711 "Techniques and Review of Absolute Flux Calibration from the UV to Mid-IR" Bohlin, Dickinson, & Calzetti 2001, AJ, 122, 2118 "Spectrophotometric Standards From Far-UV To Near-IR: STIS & NICMOS Fluxes" CALSPEC database: http://www.stsci.edu/hst/observatory/crds/calspec.html

Total WFC3+ACS observations: ~3000

	UV	VIS	IR
WFC3	1300	900	250
ACS	50	300	--



GRW+70: low SNR G430L spectrum



WFC3 Grism Spectroscopy

9 external orbits are requested for grism spectroscopy:

- 1) We request 4 orbits to monitor and improve the flux calibration for both the IR grisms – Same as last cycle
- 2) We request 4 orbits to monitor and improve the wavelength calibration for both the IR grisms – Same as last cycle
- 3) We request 1 orbit to monitor the UVIS grism wavelength stability in both chips
Same as last cycle

Same as CY23

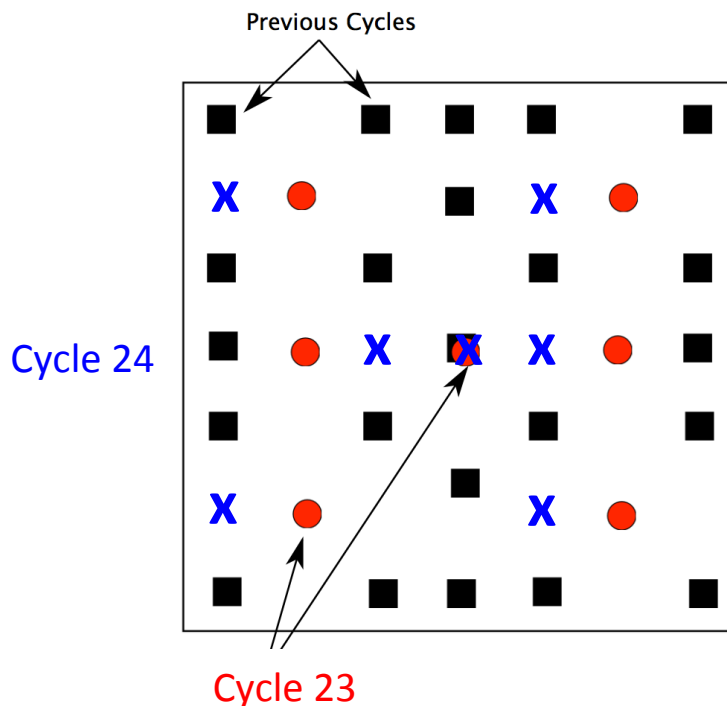
WFC3 IR grisms wavelength calibration stability and calibration

Number of external orbits: 4 (2 per grism)

Number of internal orbits: 0

Goals: Verify and refine the **wavelength** calibration

Description of the observations: 7 pointings of VY-22 using the G102 and G141 grisms. 1 previously observed position (center), and add 6 new positions to better calibrate the 2D variability of the grism wavelength dispersion relations.



This is a continuation of programs 12356, 12703, 13093, 13580, 14023, 14385.

Same as CY23

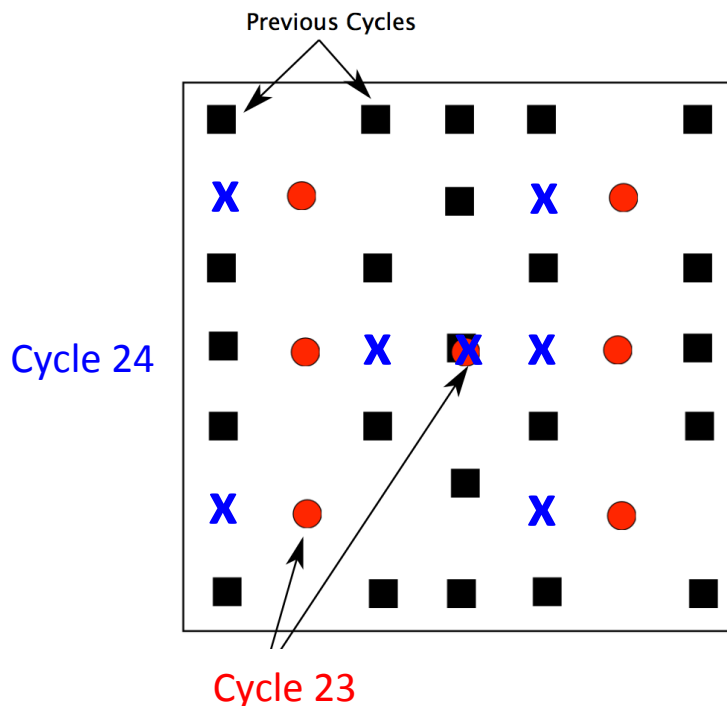
WFC3 IR grisms flux/trace calibration stability and calibration

Number of external orbits: 4 (2 per grism)

Number of internal orbits: 0

Goals: Verify and refine the **flux and trace** calibration

Description of the observations: 7 pointings of GD-153 using the G102 and G141 grisms. 1 previously observed position (center) and add 6 new positions, improving the 2D sampling of the field-of-view to better calibrate the 2D variability of the grism wavelength dispersion relations.



This is a continuation of programs 12357, 12702, 13092, 13579, 14024, 14386.

Same as CY23

WFC3 UVIS grism wavelength calibration stability and calibration

Number of external orbits: 1

Number of internal orbits: 0

Goals: Verify and refine the UVIS **wavelength** calibration. These calibration will improve our ability to process currently archived data as well as support current and future UVIS parallel observations.

Description of the observations: 4 pointings (2 per CHIP) of WR-14 using the G280 grism. Two (2) positions on each CHIP will repeat (critical as they show +1 and -1 orders) previously observed position and verify the stability of this mode.

This is a continuation of programs 12359, 12705, 13091, 13578, 14025, 14387.

Flatfield Calibrations

We request 282 internal orbits to:

- 1) Monitor a population of UVIS pixels with anomalous QE, 51 internal orbits
Same as last cycle
- 2) Monitor the health of the UVIS filters via int-flats, 13 internal orbits; Same as last cycle
- 3) Monitor the health of the IR filters via int-flats, 18 internal orbits; Same as last cycle
- 4) Monitor the health of the CSM by observing the bright earth, 200 internal orbits;
Same as last cycle

Same as CY23

UVIS Pixel-to-Pixel QE Variations via Internal Flats Monitor

Number of external orbits: 0

Number of internal orbits: 51

Goals: This program continues to monitor the population of pixels exhibiting anomalous QE variations between anneals. These pixels are randomly distributed across the detector and develop lowered sensitivity during the time between anneals. The sensitivity loss is greater in the blue than in the red and the population that develops is seemingly unique per each cycle. This program will focus on constraining the maximum low-sensitivity population existing before an anneal in both the UV and Visible filters.

Description of the Observations: Analysis of data from previous proposals has indicated that the low-sensitivity population in the UV tends to have a grouping (of a few pixels) behavior. To better sample the UV this cycle, we will acquire 6 long orbits using the D2 lamp (to minimize lamp cycles), 1 orbit every other month in the week before the anneal – capturing the maximum number of pixels with lowered sensitivity.

For the visible filters, we will obtain 36 orbits, 3 per month, using the tungsten lamp, to obtain data the week before the anneal, where the population is largest. Nine more orbits will be acquired, 3 early cycle, 3 during the middle, and 3 near the end, to sample the population numbers immediately following an anneal, where the population is lowest. The extra orbit each month will allow additional wavelength coverage between F814W and F438W, to better sample how the population grows towards bluer wavelengths

All UV orbits will require non-int to minimize cycling of the D2 lamp.

This is a continuation of programs 13169, 13585, 14027, 14389.

Same as CY23

WFC3/UVIS Internal Flats

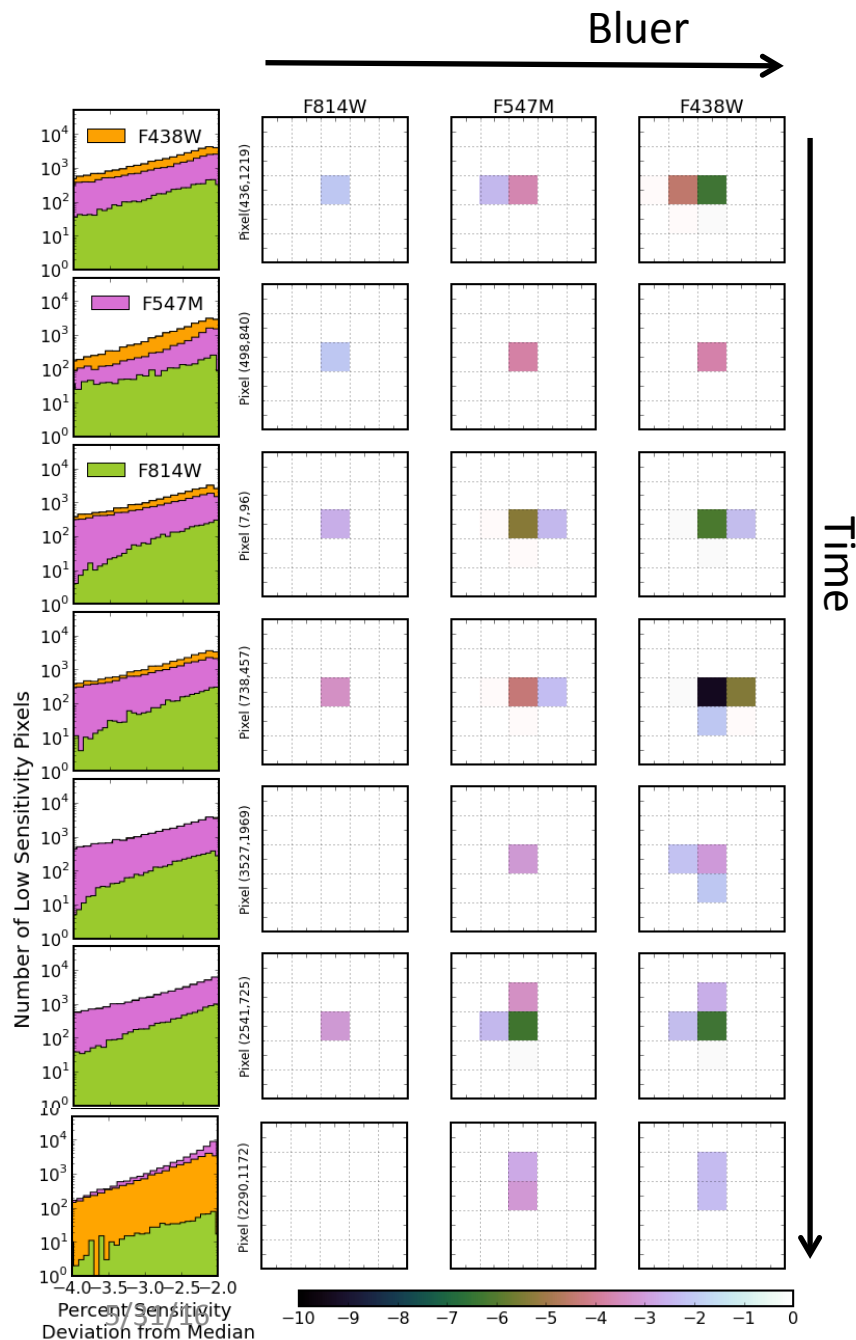
Number of external orbits: 0

Number of internal orbits: 13

Goals: Monitor the stability of the UVIS pixel-to-pixel sensitivity in all filters by obtaining internal flat fields with the tungsten and deuterium lamps

Description of the Observations: We will acquire internal flats in all UVIS filters once early in the cycle. This consists of 3 orbits with the D2 lamp for the filters F218W, F200LP, F225W, F275W, F280N, F300X, F336W, F343N, F373N, F390M, F390W, F395N, FQ232N, FQ243N, FQ378N, and FQ387N. Eight orbits with the Tungsten lamp will acquire the remaining 46 filters. Observations in the 4 filters, F390W, F438W, F606W, and F814W, with the Tungsten lamp will be repeated 2 times over the cycle for a total of 2 orbits

This is a continuation of programs 11432, 11914, 12337, 12711, 13097, 13586, 14028, 14390



The column on the left shows the total number of pixels with lowered sensitivity as a function of the percent of sensitivity deviation from a median ‘true’ internal flat. The total population grows with bluer wavelengths.

The F814W, F547M, and F438W columns show pixel regions (central pixel denoted to the left of the F814W image figures). On average, a pixel with lowered sensitivity in F814W sees an increased sensitivity deficit with bluer wavelengths. The affected pixel can grow into a small group of pixels experiencing lowered sensitivity with bluer wavelengths.

Each row is a separate epoch of data.

Same as CY23

WFC3/IR Internal Flats

Number of external orbits: 0

Number of internal orbits: 18

Goals: Monitor the stability of the IR pixel-to-pixel sensitivity in all filters by obtaining internal flat fields with the tungsten lamp.

Description of the Observations: We will acquire 2 exposures for the full set of IR filters once in the middle of the cycle. This requires 12 orbits (6x2). In addition we will acquire 3 exposures in each of the broad band filters, F105W, F110W, F125W, F140W, and F160W, to monitor those flats 2 times during the cycle (early and near the end). This requires another 6 orbits (2x3) for a total of 18 internal orbits

This is a continuation of programs 11433, 11915, 12338, 12712, 13098, 13587, 14029, 14391

Same as CY23

CSM Monitor

Number of external orbits: 0

Number of internal orbits: 200

Goals: This program will monitor, as often as practical, the position of the CSM. It is hoped that by doing so, we may detect anomalies before the CSM fails entirely, allowing us to postpone the latter.

Description of the Observations: Observe the dark Earth in F153M exactly as we have been doing for years.

This is a continuation of programs 13588, 14030, 14392.

Astrometric Calibration

We request 6 external orbits for the following:

1. Three one-orbit visits in each of the UVIS and IR channels throughout the cycle to monitor any evolution of the astrometry in the F606W reference filter.

Same as CY21

UVIS and IR Geometric Distortion Monitoring

Number of external orbits: 6

Number of internal orbits: 0

Goals: The observations of the standard astrometric catalog in the field of globular cluster Omega Cen will be used to evaluate the time dependency of UVIS and IR geometric distortion. The observations of the same field from the previous cycles have show that the WFC3 geometric distortion appears to be stable and there is no evidence of a secular changes on the two-and-half – years time scale. However, during each interval of the orbital target visibility, there is a linear trend of the UVIS and IR X & Y axes skew at the level of +/-2 and +/-7 mas, respectively (Kozhurina-Platais et.al 2012, WFC3-ISR-2012-03). Thus, the observations of Omega Cen through UVIS F606W filter and F160W IR filter will be used to: 1) derive the skew of the geometric distortion and look for any secular changes over time and/or during the orbital time of target visibility; 2) monitor the optical and mechanical stability of the WFC3/UVIS and IR, using a single filter in each channels; 3) continue of the multi-cycle WFC3 stability and/or or time-dependency; 4) establish if the WFC3 geometric distortion is HST roll-angle dependency.

Description of the observations: The observation of Omega Cen through F606W and F160W as a standard filters in UVIS and IR will be observed with the same pointing but with different roll-angle of the OTA during the three epochs with 3 month apart. Three UVIS exposures in 1 orbit will be observed in the following sequence of off-nominal (~360 degree) roll-angles: 0,+10,+15 degree. Similar to UVIS, three IR exposures in 1 orbit will be observed in the following sequence of off-nominal (~360 degree) roll-angles: 0,+10,+15 degree. In order to improve the schedule, a small range of roll is allowed at each specific roll angle. The order of the exposures in each orbit is specified by a SEQUENTIAL Special Requirement and the order of the orbits is specified by AFTER Special Requirements. To maintain accurate pointing control, 2-guide star acquisitions are used. If suitable guide stars can be found, the same pair of guide stars are used for all 6 exposures. The same sequence will be repeated three times with 3 months apart during the Cycle 21. The observations over three epochs with different HST roll-angle will be used to investigate the dependency of WFC3 geometric distortion over HST roll-angle.

Additional CY24 Metrics

www.stsci.edu/hst/metrics/SiUsage/WFC3

Totals_from cycle24_wfc3.dat:

#Lines	#Exps	Exp_Time	Time/Exp	
6873	13469	4340062.4	322.2	All observations
5441	11735	3203481.2	273.0	Prime
1432	1734	1136581.3	655.5	Coordinated Parallels
463	834	316756.6	379.8	SNAP

Overall_WFC3_Usage_Numbers:

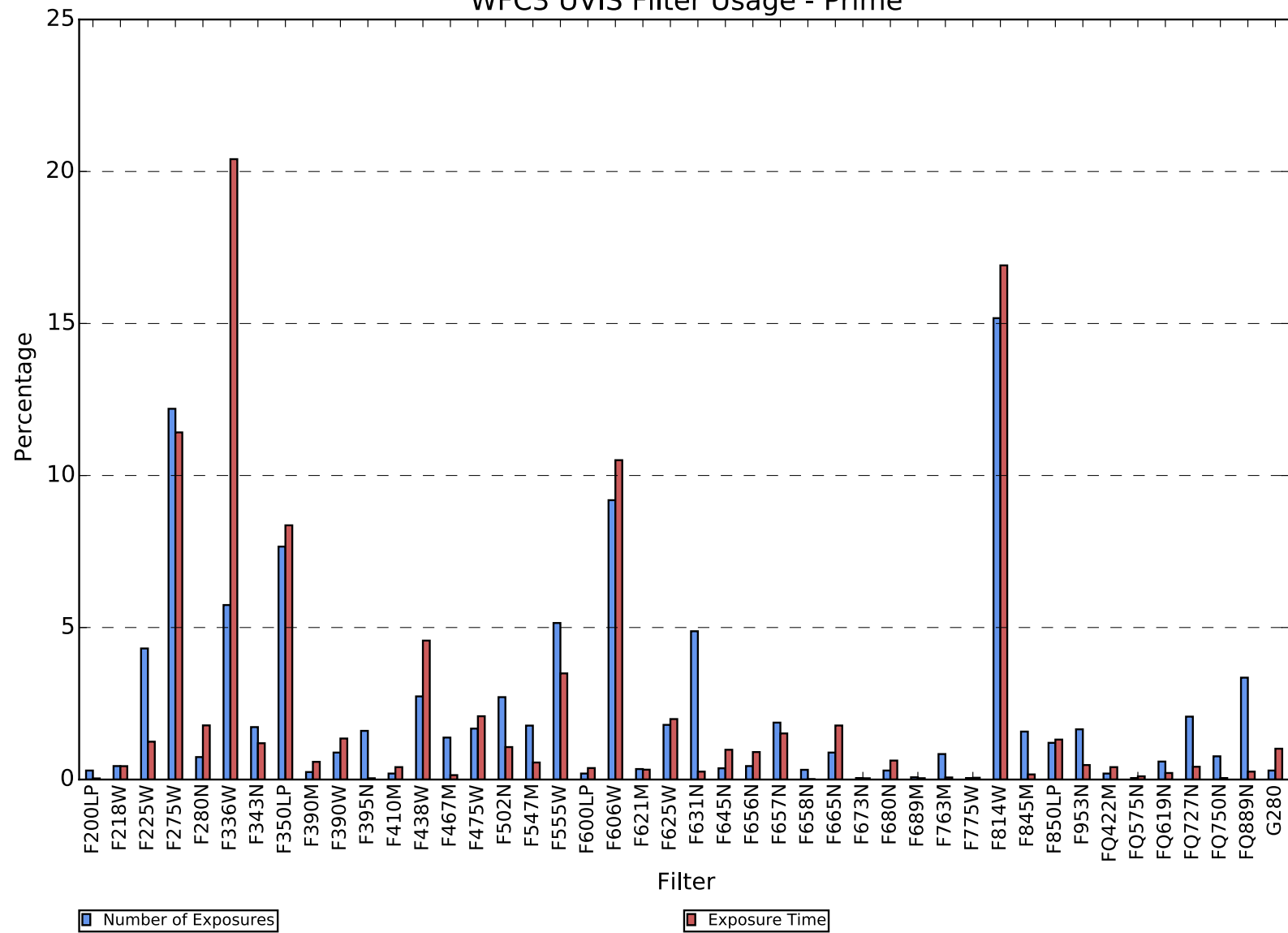
Distribution of Config Usage:

Config	#Lines	#Exps	Exp_Time	%_Exps	%_Time	
WFC3/IR	3199	8105	2003721.8	60.175	46.168	All observations
WFC3/UVIS	3674	5364	2336340.6	39.825	53.832	All observations
WFC3/IR	2872	7676	1771400.6	65.411	55.296	Prime
WFC3/UVIS	2569	4059	1432080.6	34.589	44.704	Prime
WFC3/IR	327	429	232321.3	24.740	20.440	Coordinated Parallels
WFC3/UVIS	1105	1305	904260.0	75.260	79.560	Coordinated Parallels
WFC3/IR	46	92	4046.6	11.031	1.277	SNAP
WFC3/UVIS	417	742	312710.0	88.969	98.723	SNAP

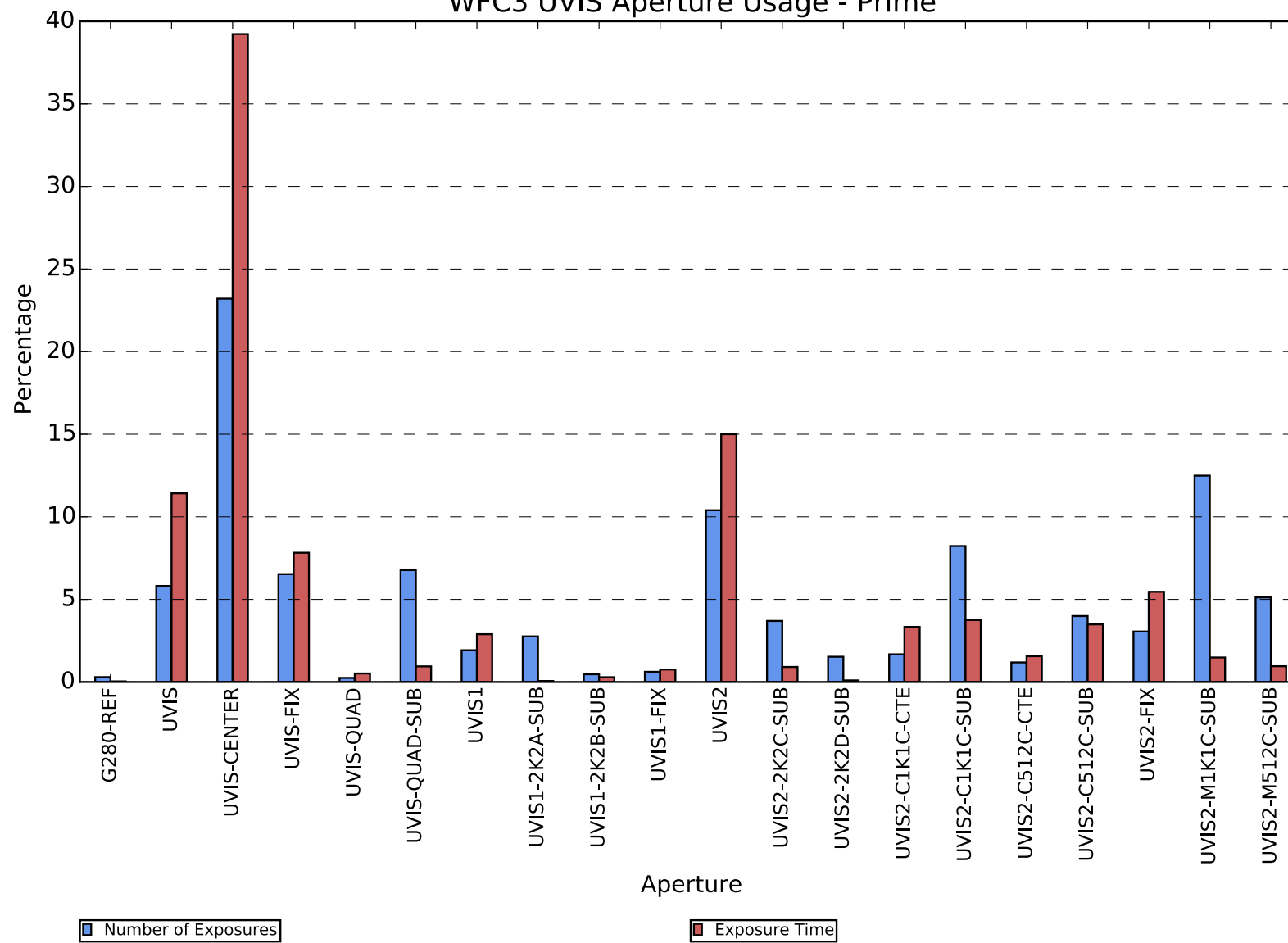
Distribution of Coord Pars Usage:

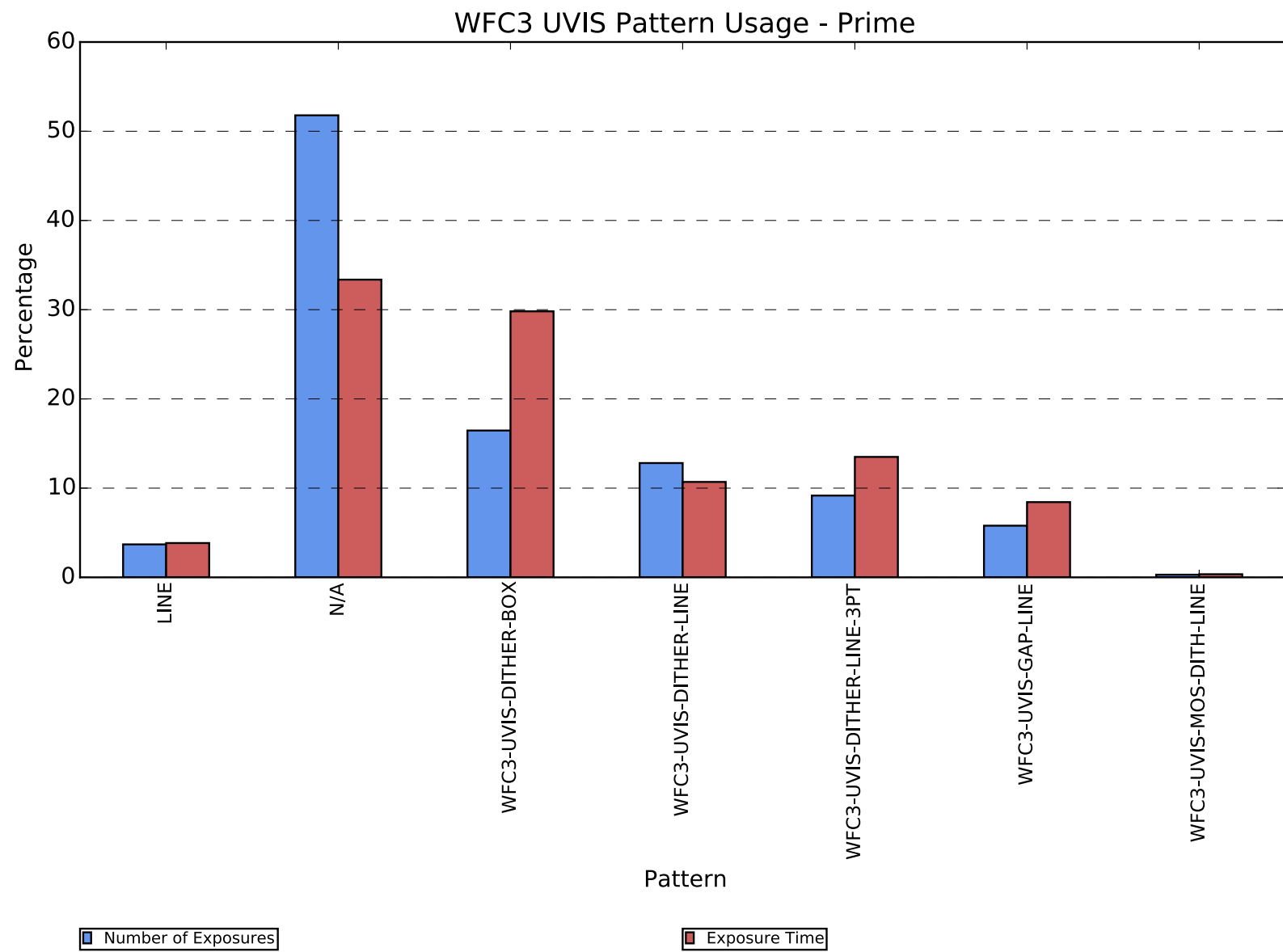
Pars	#Lines	#Exps	Exp_Time	%_Exps	%_Time	
N	5441	11735	3203481.2	87.126	73.812	All observations
Y	1432	1734	1136581.3	12.874	26.188	All observations
N	5441	11735	3203481.2	100.000	100.000	Prime
Y	0	0	0.0	0.000	0.000	Prime
N	0	0	0.0	0.000	0.000	Coordinated Parallels
Y	1432	1734	1136581.3	100.000	100.000	Coordinated Parallels
N	463	834	316756.6	100.000	100.000	SNAP
Y	0	0	0.0	0.000	0.000	SNAP

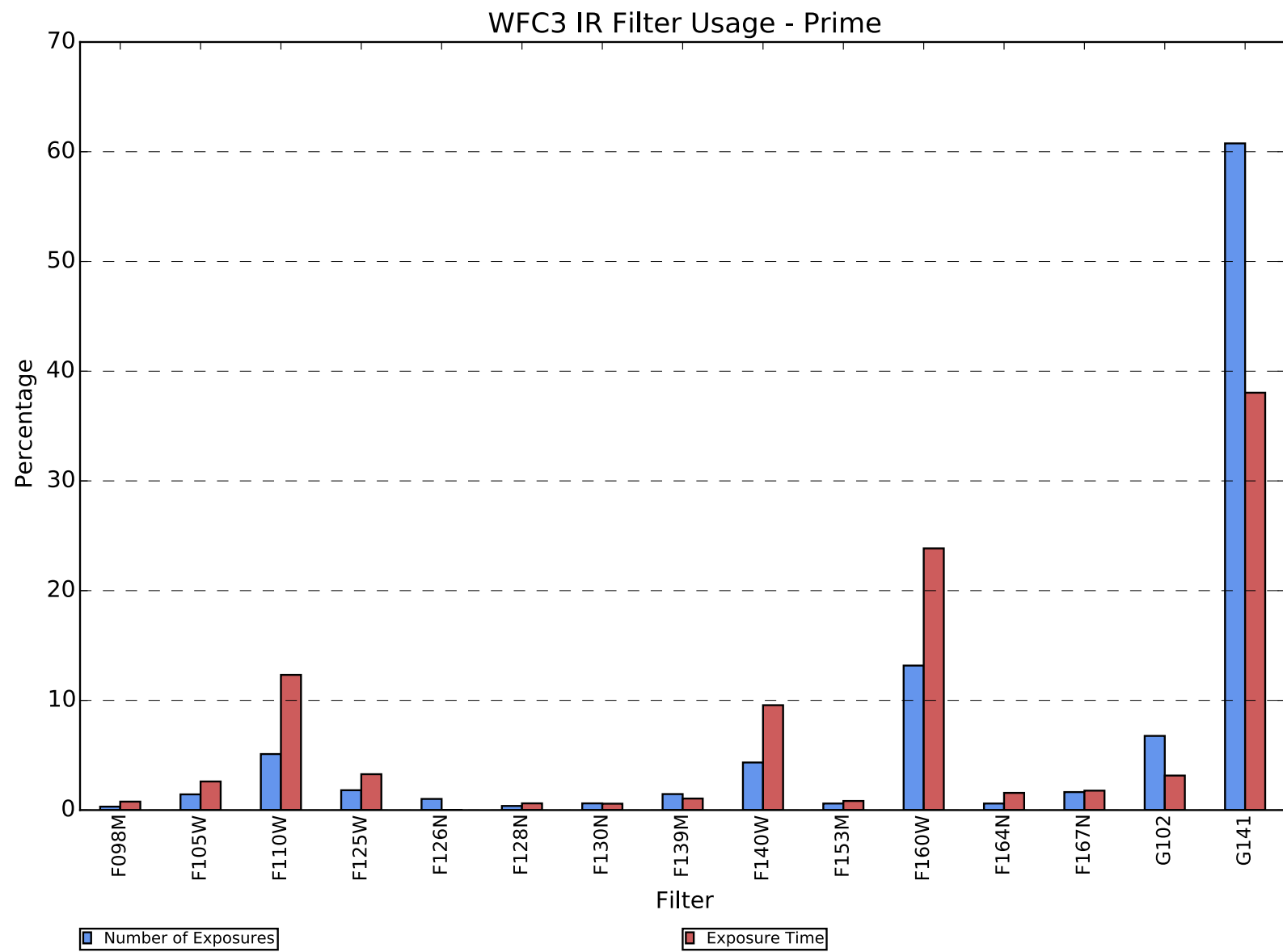
WFC3 UVIS Filter Usage - Prime



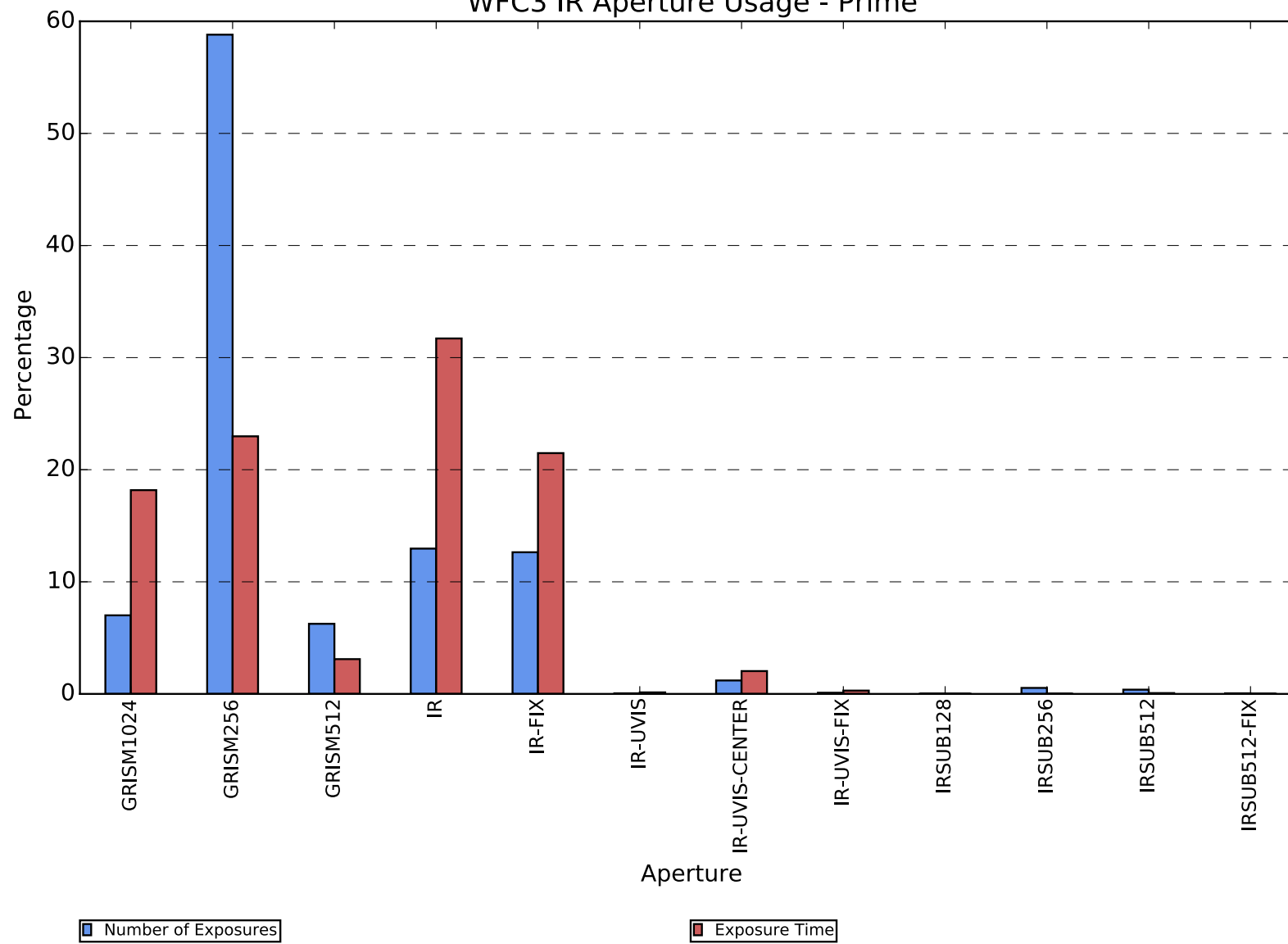
WFC3 UVIS Aperture Usage - Prime



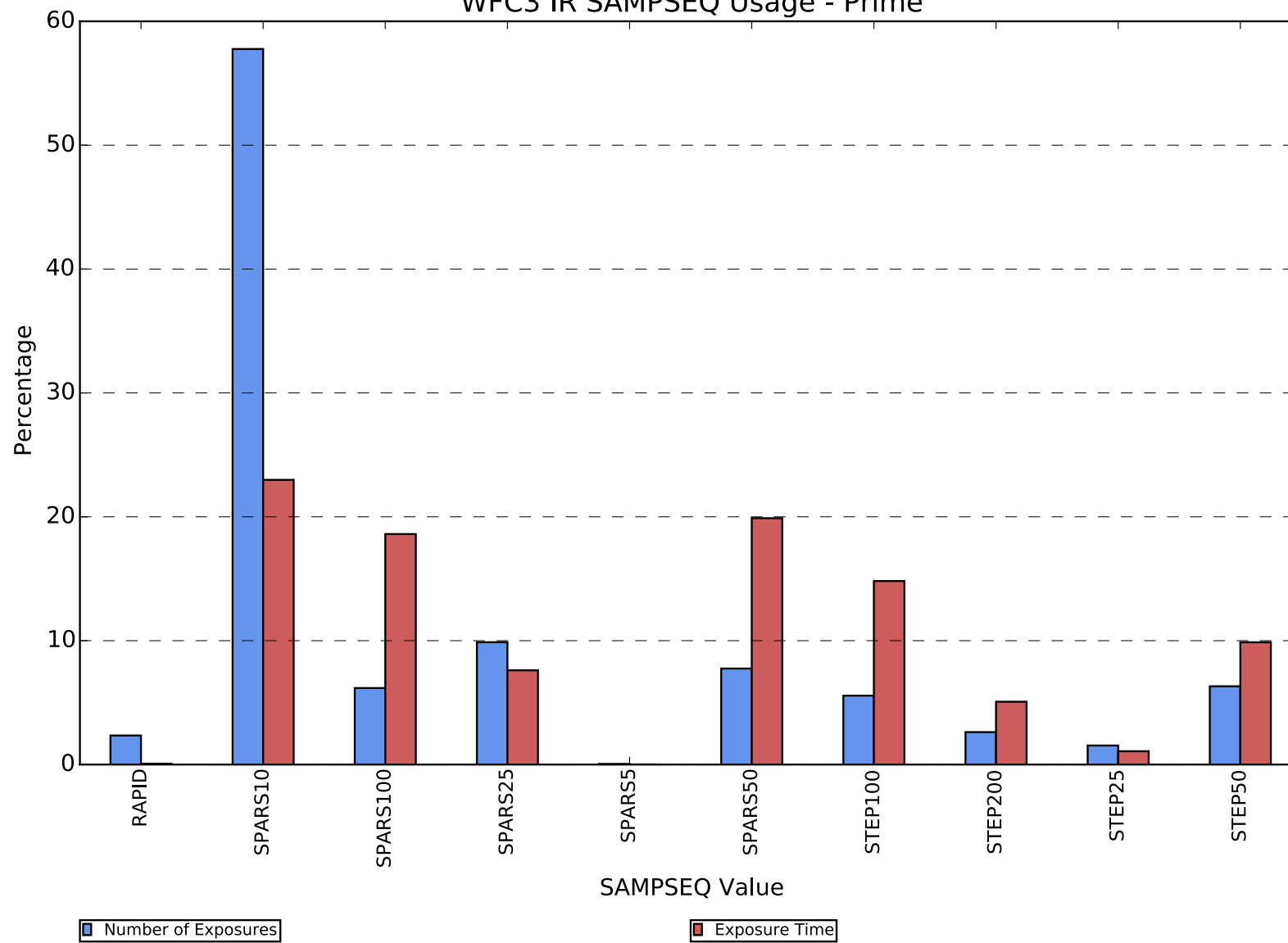


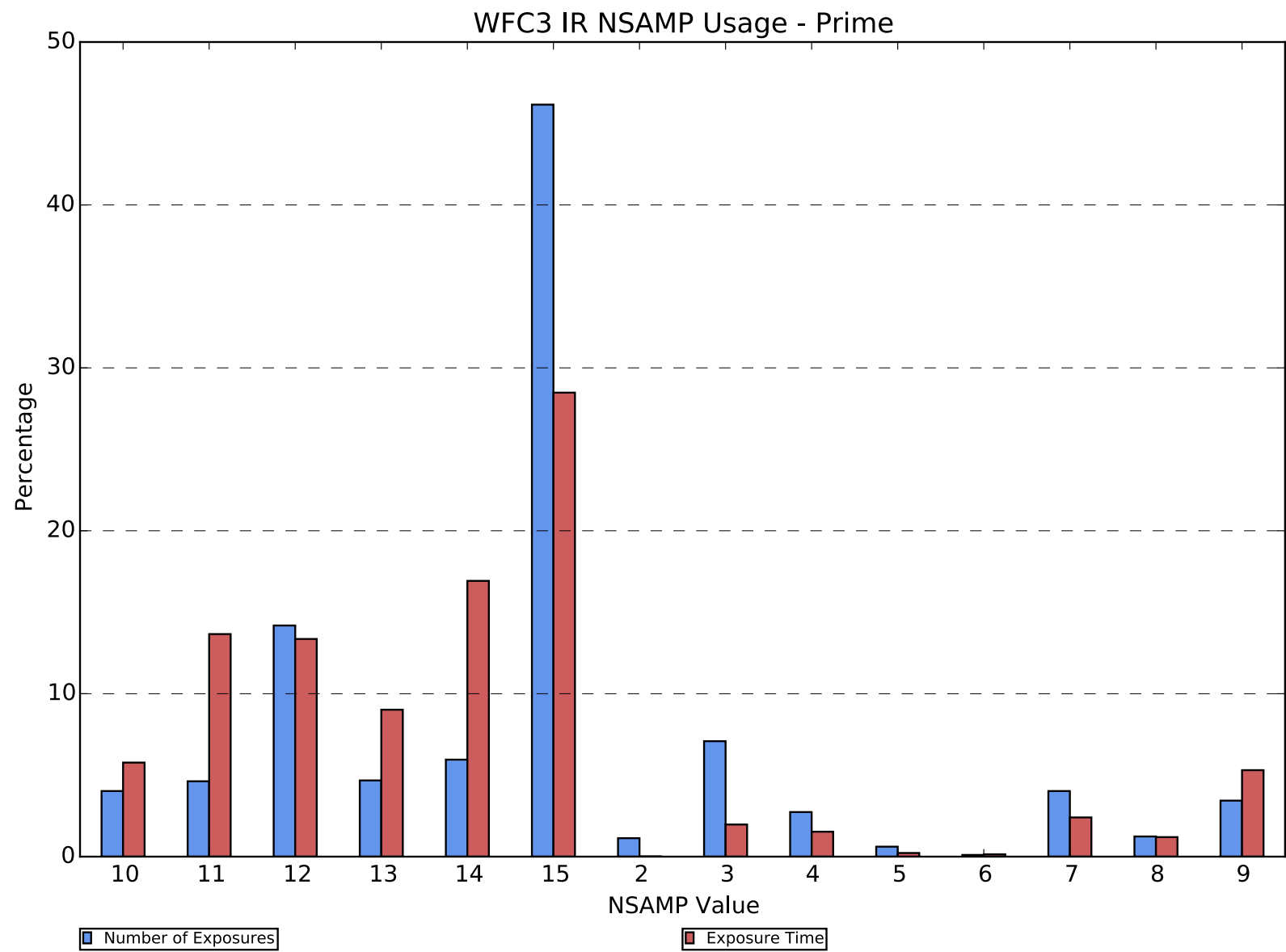


WFC3 IR Aperture Usage - Prime



WFC3 IR SAMPSEQ Usage - Prime





WFC3 IR Pattern Usage

