COS Cycle 17 Calibration Plan

		Orbits			
ID	**Title**	**Ext.**	**Par.**	**Int.**	**Notes**
	NUV Monitors				
11891	**NUV MAMA Fold Distribution**			**2**	
11894	**NUV Detector Dark Monitor**			**114**	**orig. alloc. 130**
11896	**NUV Spectroscopic Sensitivity Monitor**	**40**			**orig. alloc. 41**
11899	**NUV Imaging Sensitivity**	**2**			
11900	**NUV Internal/External Wavelength Scale Monitor**	**18**			
	FUV Monitors				
11895	**FUV Detector Dark Monitor**			**325**	
11897	**FUV Detector Sensitivity Monitor**	**36**			
11997	**FUV Internal/External Wavelength Scale Monitor**	**12**			
	Special Programs				
12010	**COS FUV Line Spread Function Characterization**	**2**			
	Contingency Programs				
11892	**NUV Detector After Anomalous Shutdown**			**4**	
11893	**FUV Recovery from Anomalous Shutdown**			**12**	
	total	**110**		**457**	
	Cycle 17 GO/GTO orbits	**1124**			

COS Cycle 17 Supplemental Calibration Plan

ID	Title	PI	External Orbits	Internal Orbits	Priority
	Sensitivity Monitoring				
12052	COS NUV Grating Efficiency Test	Osten		4	high
11897+	Additional COS FUV sensitivity monitoring	Osten	10		high
	Focus				
12080	G140L Focus Sweep	P. Ghavamian	5		medium/high
	New Settings				
12081	COS Flux Calibration Below 1150 Angstroms with G140L/1280	D. Massa	3		high
12082	Extending COS/G130M coverage down to 905Å with two new central wavelengths	S. Osterman (IDT)	2		medium/high
	Wavelength Calibration				
12083	G140L 1280 wavecal template	C. Oliveira		1	high
12084	G140L 1280 Internal to External Wavelength Scales	C. Oliveira	1		high
12085	STIS/E230M data to determine internal to external offsets in COS/ G230L	C. Oliveira	1		high
	Other				
12086	Generation of 1-D Fixed Pattern Templates	Massa	11		high
12096	COS FUV Lifetime Adjustment Study	Sahnow	3		high
	COS Observations of Geocoronal Lyman-alpha Emission	Dixon	(3)		medium/high
		total	36	5	

Proposal ID 12052 : COS NUV Grating Efficiency Test

P.I. R. Osten

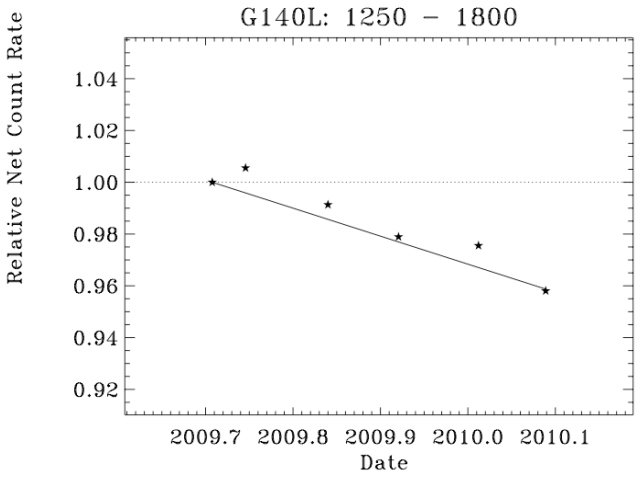
Purpose	Perform two more grating efficiency tests to enable better comparison of results of grating efficiency tests (GETs) done on the ground with external target spectroscopic sensitivity monitoring on orbit. Initial results from the NUV Spectroscopic Sensitivity Monitoring Program (11896) have shown a continued degradation of the bare aluminum gratings, at a steeper rate than was observed on the ground. The initial GET during SMOV continued the ground trend; performing the GET twice more on orbit will enable better comparison between external target sensitivity monitoring and the sensitivity trends determined on the ground.
Description	The GETS contains 10 NUV exposures designed to get the same S/N of various emission lines throughout the NUV band. The sequence and duration of exposures in this NUV GET are the same as used by the IDT on the ground from 2004-2009 to monitor the relative efficiencies of the NUV gratings. The sequence starts with a 20-minute wait, to ensure that the lamp has cooled from any usage in a previous visit.
Fraction GO/GTO Programs Supported	11% of COS GO/GTO exposures (by exposure time) use NUV dispersed light
Resources Required: Observation	4 internal orbits
Resources Required: Analysis	1 week; The COS IDT has developed data analysis procedures for analyzing GET data, which the institute will acquire, along with data from prior GETs. The institute team members will work with IDT members for quick turnaround of the initial GET data from this program to assess results in comparison with the results being returned by monitoring of external targets.
Products	Results will be included in an ISR and PASP paper describing the performance of the bare aluminum gratings.
Accuracy Goals	few percent
Scheduling & Special Requirements	first visit in February, 2010

Notes: This program is already approved, and is included here for completeness.

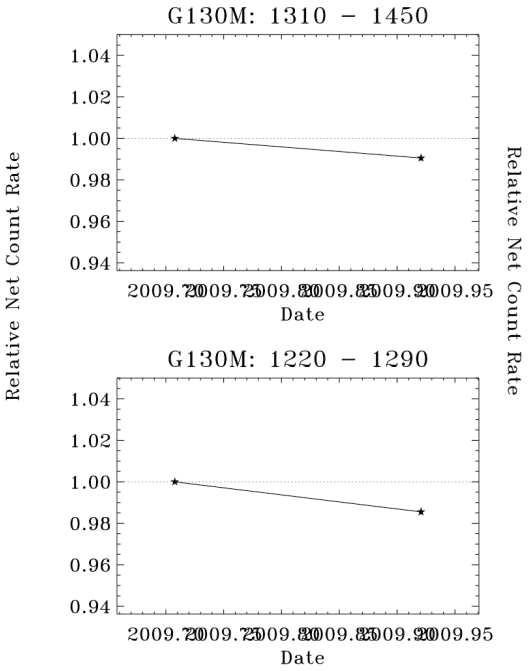
Proposal ID 11897+: Additional COS FUV sensitivity monitoring

P.I. R. Osten

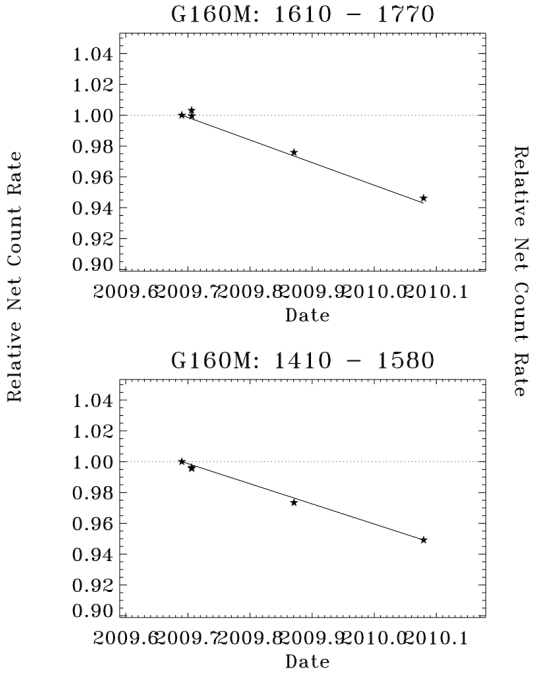
Purpose	Obtain more frequent monitoring of the COS FUV M mode spectroscopic sensitivity observations.
Description	Eary results from the Cycle 17 FUV Spectroscopic Sensitivity Monitoring program (11897) have indicated a currently unexplained degradation in the sensitivity at a large rate, which appears to affect longer FUV wavelengths more than short wavelengths. The current sensitivity monitoring program is set up to monitor the low-resolution modes monthly, while observing a limited set of central wavelengths in the medium-resolution modes once every three months. The decline is wavelength-dependent, and is larger at longer wavelengths. We seek additional observations in a subset of central wavelength settings of the G160M and G130M gratings in order to monitor the performance of these gratings as a function of wavelength. This data will be used to explore possibilities for the degradation, as well as provide users with more accurate time-dependent sensitivity values, which they can use to correct their data. The repeatability of FUV observations is currently estimated at 2-3%. The latest monitoring observations of G160M show a decrease of 4-6% in count rates relative to the initial measurements in Sept. 2009.
Fraction GO/GTO Programs Supported	37% (G160M), 41% (G130M) estimated by exposure time in these modes compared to total COS exposure time
Resources Required: Observation	10 external orbits (5 for G130M, 5 for G160M)
Resources Required: Analysis	1 week in addition to resources already required for 11897
Products	TDS reference file, ISR
Accuracy Goals	few percent
Scheduling & Special Requirements	monthly monitoring of FUV M modes



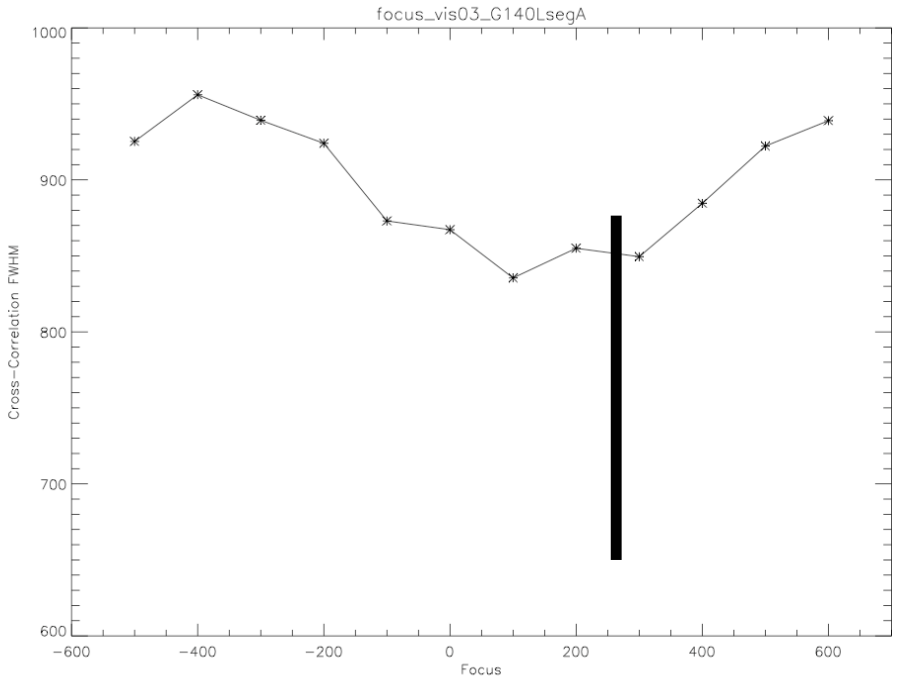
G140L/1105 sensitivity monitoring – trend is -10.4% per year decline, wavelength dependent (larger at longer wavelengths)



G130M/1309 sensitivity monitoring – 2 visits so far, implied slope of -5% per year (next visit is sometime in the March 1-7 week)



G160M/1600 sensitivity monitoring – trend is -14% per year, consistent with wavelength overlap in G140L



Current focus setting

During SMOV, we discovered that the initial focusing activities of the FUV channel of COS (G130M, G160M, G140L) did not place the instrument at optimal focus. Refocussing activities concentrated on the G130M & G160M gratings. Subsequent analysis of the G140L data reveals that there is only a shallow minimum, which appears to be offset from the current focus setting. Additionally, the uncertainty in optimum focus for the G140L grating appears to be larger than 50 focus steps, and the best focus appears to be shortward of the current setting of 250 focus steps.

Proposal ID 12080: G140L Focus Sweep

P.I. P. Ghavamian

Purpose	The purpose of this program is to identify the optimum focus setting for the COS FUV channel + G140L grating setup.
Description	The inclusion of additional focus positions is necessary because the G140L focus curve from SMOV (cross-correlation FWHM vs. focus position) is broad and shallow, making it difficult to measure the minimum in the curve. The best focus appears to be shortward of the current setting of 250 focus steps. A focus sweep will be performed using the B2Ia star AZV18 in the Small Magellanic Cloud. A sequence of time-tag spectra will be acquired with the G140L grating through the PSA aperture (CENWAVE=1105 A), at a range of focus settings. There will be 17 focus settings sampled, ranging from -800 to +800 in 100-step intervals. The optimum focus will be determined by cross-correlating prominent absorption features in the spectra with a template high resolution archival STIS E140M spectrum, then choosing the focus setting yielding the narrowest cross-correlation profile from the sequence. This is similar to the focusing procedure used for the G140L grating during SMOV (PID 11484, Visit 3), except that the new focus sweep will extend to more extreme focus positions around 0 (+/-800 instead of +/-600). After obtaining an exposure at the most extreme positive focus position (+800), the focus is returned to its nominal position (0). A final spectrum is then acquired at that position, for repeatability comparison with the earlier FOCUS=0 spectrum.
Fraction GO/GTO Programs Supported	9.3% of COS GO/GTO programs (by exposure time) use the G140L grating
Resources Required: Observation	5 external orbits
Resources Required: Analysis	2 weeks; cross-correlation scripts exist already
Products	FSW change (uplink of new focus position upon completion of analysis), ISR
Accuracy Goals	+/- 50 focus steps
Scheduling & Special Requirements	

Proposal ID 12081: COS Flux Calibration Below 1150 Angstroms with G140L

P.I. D. Massa

Purpose	Measure the COS FUV (900 - 1150Ang) G140L sensitivity, and determine if it has EUV (300-700) sensitivity.
Description	We currently have only a modestly accurate (~10%) estimate of the G140L FUVB FUV sensitivity (900-1150 A). This is based on low S/N data of a faint standard star and a set of relatively high S/N spectra of a bright WD which cannot be accurately modeled. The former have an accuracy worse than 20%, and the latter had to rely on FUSE absolute fluxes, which are only good to about 10%. Since this setting is now available to GOs, we should obtain an accurate (2-3%) characterization of the FUV G140L sensitivity. To do this, we intend to observe the hot WD GD50. This star has high S/N IUE, FUSE and EUVE observations. Further, it has been observed from the ground and its atmospheric parameters are reasonably well determined. Both Pierre Chayer and Ralph Bohlin have agreed to produce the models needed to use it as a high quality FUV flux calibration source. In addition, the existence of a good GD50 EUVE spectrum means that the same observations can be used to characterize the EUV sensitivity to 10% accuracy, if estimates of the COS EUV sensitivity are correct. NOTES: FUVA must be off for the G140L observations.
Fraction GO/GTO Programs Supported	The spectroscopic modes to be calibrated will only begin to be offered in Cycle 18, and there are no observations for the modes we propose to explore.
Resources Required: Observation	3 external orbits
Resources Required: Analysis	4 weeks
Products	New G140L flux calibration file; ISR on the sensitivity below 1150A.
Accuracy Goals	3% for G140L 900-1150A, 10% for 300-700A Comments on Accuracy: Accuracies are Poisson for 20 pixel bins
Scheduling & Special Requirements	There are currently two possibilities to implement this program: either it can be done soon with the existing 1230 cenwave setting, or in early fall with the new 1280 cenwave setting. The FP-POS setting must be chosen to eliminate the longest wavelengths.

Proposal ID 12082: Extending COS/G130M coverage down to 905Å with two new central wavelengths.

P.I. S. Osterman

Purpose

These observations will provide detailed sensitivity, wavelength range, and resolution measurements for two new lower wavelength COS FUV G130M central wavelength settings (covering 905-1171Å).

Description

A separate program (COS Flux Calibration Below 1150 Å with G140L) will make a measurement of the sensitivity below 1150 Å. However, because the response of the G140L drops by a factor of 70 between 1150 and 1050 Å, the targets it can observe will be limited. This is because many objects, which are bright enough to obtain high S/N fluxes at 1050 Å within a few orbits, will exceed the local count rate limit at 1150 Å. The G130M grating can be moved to a new set of positions that only include wavelengths below 1050 Å, circumventing the constraint imposed by the rapid decline in the response.

These new settings will extend COS/G130M coverage down to 905Å in two new bandpasses: 1021-1171Å (BLUE) and 905-1055Å (Ultra-BLUE). The modes are chosen to provide continuous coverage from 905Å to the existing coverage in the G130M/1291Å setting with approximately 30Å of overlap in each mode for cross-calibration purposes. The existing focus position for the G130M/1291Å setting will be used.

These new modes have the potential to provide greater than FUSE sensitivity at moderate (3,000-5,000) spectral resolution.

One targets will be observed for two orbits:

1) GD50, the same target being used in the Flux Calibration Below 1150 Å with G140L program. This will be used for an initial test of the FUV G130M response. Because no observations have been made at these new settings, we are not certain how sensitive the instrument will be. GD50 will certainly be safe at these new settings and although it may not provide enough counts to accurately calibrate them, a short observation at one setting will provide the information needed to develop an optimal calibration plan for the G130M short wavelength modes.

An additional two targets (two orbits each) may be implemented depending on the outcome of the initial measurements. These targets and additional orbits require approval:

2) WD0320-539 (GSC-08493-00891, one of the flux standards used in determining the G140L sensitivity). Segment A may need to be turned off for these observations.

3) REJ0503-289 (GSC-04717-00588, a hot EUVE bright WD). Segment A to be kept on for these observations.

The last two targets have been observed with COS/G130M, IUE, GALEX, HST+STIS and FUSE. The third target has been observed with EUVE, with flux measured down to 250 Å. WD0320-539 will be our primary flux standard for Segment B, REJ0503-289 will be our flux standard for segment A. Both targets will be used for wavelength calibration. The numerous narrow and broad lines in REJ0503-289 will be used for resolution measurements.

Fraction GO/GTO Programs Supported

This option is not available in Cycle 17.

P.I. S. Osterman

Resources Required: Observation	6 external orbits
Resources Required: Analysis	1 week of COS/STIS team work, plus significant ground system work. The COS IDT will perform all required data analysis.
Products	STScI will assist in mode implementation and any required adjustments to CALCOS and the COS reference files.
Accuracy Goals	Resolution and sensitivity to 10%, wavelength scale to 100 km/s.
Scheduling & Special Requirements	Special commanding and lamp flashing will be required. New OSM1 mechanism positions will need to be patched during commanding, similar to what is currently performed for some grating-specific target acquisition parameters.

Note: The IDT is interested in pursuing this program, and is willing to provide the resources for analysis.

Proposal ID 12083: G140L 1280 wavecal template

P.I. C. Oliveira

Purpose	To obtain lamp spectra with the new G140L/1280 setting (which will be available starting from Cycle 18). These spectra will be incorporated in the lamp template reference file, which is used by the pipeline to calibrate data obtained with G140L/1280.
Description	This program obtains lamp template spectra with G140L/1280 at all FP-POS, after an 1800 sec exposure that is used to let the OSM1 mechanism settle. This 1800 sec exposure has flashes of the lamp at regular intervals so that any drift if present can be monitored. The data obtained in this program will be used to update the FUV lamp template reference file used by the CALCOS pipeline.
Fraction GO/GTO Programs Supported	For Cycle 18 this mode (G140L/1280) will replace the mode G140L/1230.
Resources Required: Observation	1 internal
Resources Required: Analysis	1 week
Products	lamp template reference file, ISR
Accuracy Goals	150 km/sec (7.5-12.5 pix)
Scheduling & Special Requirements	

Proposal ID 12084: G140L 1280 Internal to External Wavelength Scales

P.I. C. Oliveira

Purpose	Observe external target (NGC330-B37) to measure the separation between the internal and external wavelength scales for the new G140L/1280 setting.
Description	This program observes the same target that was used in SMOV to obtain the offsets between the internal and external wavelength scales for the G140L/1230 setting (in program 11487). We use the same target acq strategy to ensure maximum centering accuracy. We obtain external data at FP-POS=3,4, and 1. The offsets will be determined from data obtained at FP-POS=3. Exposures obtained at FP-POS=4 and 1 will allow us not only to verify those offsets but more importantly to determine the full wavelength coverage of this new setting for which no thermal vacuum measurements have been performed. Special flash commands are used to ensure that any drift if present can be accurately removed.
Fraction GO/GTO Programs Supported	The G140L/1280 setting will replace the G140L/1230 setting in Cycle 18.
Resources Required: Observation	1 external
Resources Required: Analysis	3 days
Products	Analysis of data obtained in this program will be used to update the FUV wavelength dispersion reference file.
Accuracy Goals	150 km/s (7.5-12.5 pixels)
Scheduling & Special Requirements	special flash commands are used in engineering mode

Proposal ID 12085: STIS/E230M data to determine internal to external offsets in COS/G230L

P.I. C. Oliveira

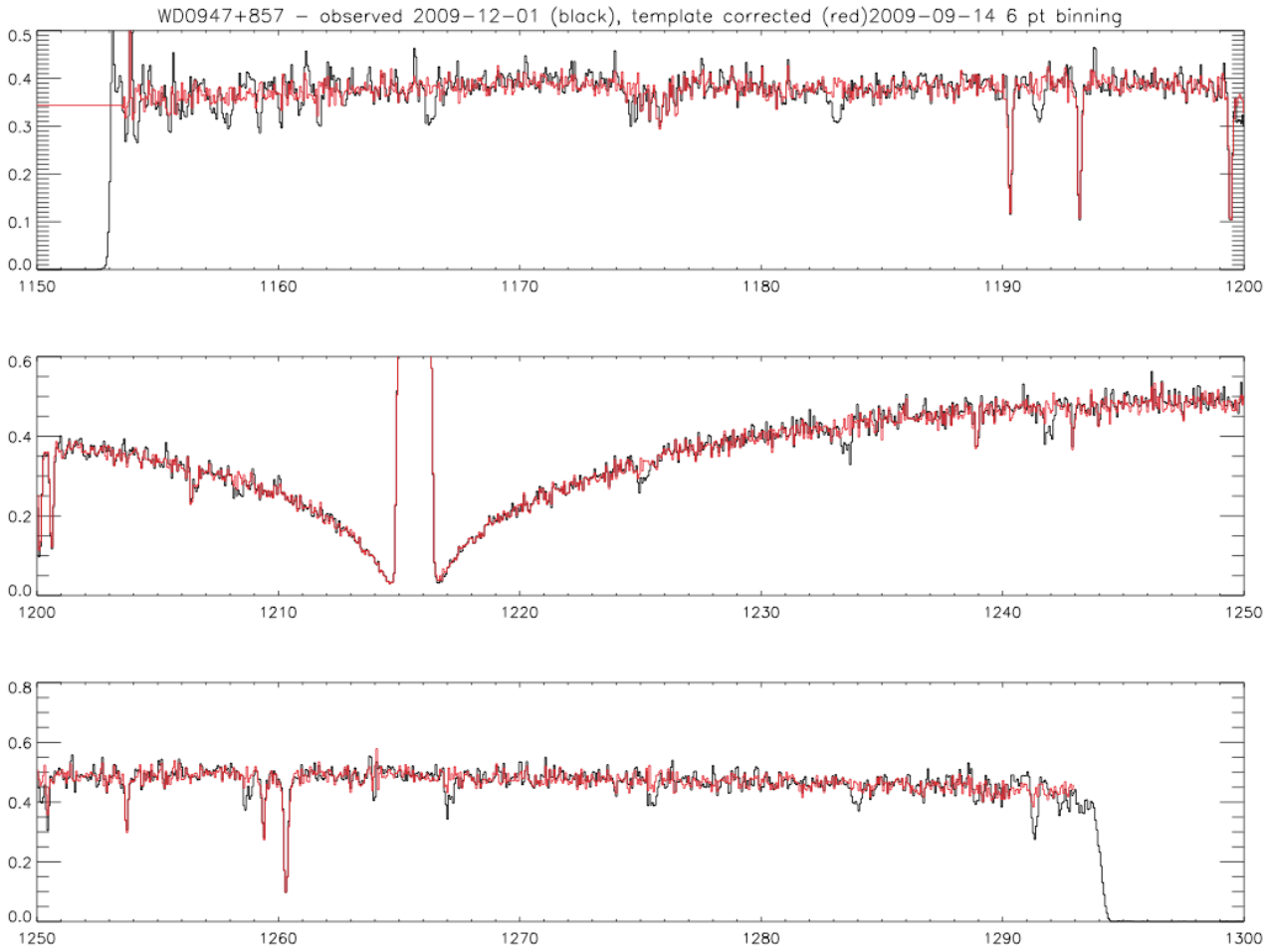
Purpose	Obtain STIS/E230M data of HD6655 to calibrate the COS G230L grating.
Description	This program observes HD6655, a radial velocity standard, with STIS/E230M/c2707. This target was observed by COS/G230L in the NUV wavelength calibration program executed during SMOV. Note that no STIS spectra of this target currently exist. These STIS observations will help us to determine the offsets of the COS/G230L internal to external wavelength scales. Observing HD6655 with this STIS setting will allow us to obtain S/N ~ 20 at 2350 A. The STIS data will overlap with stripe B of the COS/G230L 2635, 2950, and 3000 cenwaves, as well as with the stripe A of the 3360 cenwave.
Fraction GO/GTO Programs Supported	7.8% of COS GO/GTO programs in Cycle 17 (by exposure time) use the G230L grating
Resources Required: Observation	1 external
Resources Required: Analysis	1 week
Products	Analysis of data obtained in this program will be used to update the FUV wavelength dispersion reference file, ISR
Accuracy Goals	175 km/sec (8.3-15.5 pix)
Scheduling & Special Requirements	

Proposal ID 12086: Generation of 1-D Fixed Pattern Templates

P.I. D. Massa

Purpose	Obtain the data needed to construct 1-D fixed pattern templates to correct the grid wire shadows and detector features in COS medium dispersion spectra.
Description	Tests have shown that application of a 1-D fixed pattern template to a COS spectrum can reduce the fixed pattern noise in G140L, G130M or G160M spectra to an equivalent S/N of about 30/1. For this to occur, the template must be derived from data for the same grating and nearly the same central wavelength as the observation. This is because each grating has a different cross dispersion profile, and different central wavelengths fall at different cross dispersion detector locations. As a result, spectra obtained at each grating and central wavelength setting are derived from different regions of the detectors -- each with their own, unique detector features and grid wire shadows.
Fraction GO/GTO Programs Supported	88% of COS GO/GTO programs in Cycle17 use G140L, G130M or G160M (by exposure time) -- All these data contain grid wire shadows and detector features, which need to be removed.
Resources Required: Observation	11 external orbits
Resources Required: Analysis	5 weeks
Products	1-D flat field templates to correct G140L, G130M and G160M spectra for grid wires and detector features; ISR.
Accuracy Goals	2% Poisson
Scheduling & Special Requirements	

Notes: The COS team is still exploring the feasibility of a 2-D FUV flat; more investigation needs to be done before we can come up with a firm orbit request. The observations requested here can also be used for that purpose. They provide an immediate needed product for GOs to correct detector effects in their data. In addition, these observations provide a reference point to check the stability of the flat with time.



Example template is determined from SMOV high SNR program; observations were made in Sept. ’09. Black curve is the raw spectrum, obtained in Dec. ’09; red curve is the spectrum corrected with the template. Grid wires and some of the more egregious fixed pattern noise (at the edge of the detector) have been corrected.

Proposal ID 12096: COS FUV Detector Lifetime Position Test

P.I. D. Sahnow

Purpose	To identify the best regions on the FUV detector to use if and when a lifetime adjustment becomes necessary.
Description	The FUV channel was designed with the ability to select up to five separate lifetime positions on the detector. Lifetime adjustments may be made in order to allow the spectra to fall on a cleaner region of the detector, which has less gain sag, fewer hot spots, and/or fewer detector features. The purpose of this program is to identify the characteristics of the detector at all of the other lifetime positions so that a lifetime adjustment can be made quickly and easily when the time comes. The analysis will identify the detector characteristics at a number of Y locations on the detector so that the appropriate location to move to can be identified ahead of time. In addition, a strategy for the long-term use of the current position can be formulated once the characteristics of the other positions are determined. Finally, the exact Y positions for the four remaining lifetime positions may be fine-tuned after analyzing the data.
Fraction GO/GTO Programs Supported	0% before a lifetime position adjustment; 100% after.
Resources Required: Observation	3 external orbits
Resources Required: Analysis	1 week for program implementation and execution only; 3 weeks for full analysis.
Products	TIR on the detector characteristics at the various lifetime positions.
Accuracy Goals	N/A
Scheduling & Special Requirements	this requires special commanding

COS Observations of Geocoronal Lyman-alpha Emission

P.I. V. Dixon

Purpose	To obtain G130M and G140L spectra of the geocoronal Lyman-alpha emission feature with S/N ratios sufficient to trace the line wings.
Description	We have received two requests from GOs for high-S/N observations of the geocoronal Lyman-alpha line profile observed with the G130M and G140L gratings. Such observations would allow users to model and subtract the line wings from their spectra. Observations to date provide insufficient airglow data to construct such profiles. We propose airglow observations using both gratings. We will reduce the resulting spectra and provide users with fully calibrated 1- and 2-D templates for all of the strong airglow lines in the COS bandpass. We will determine if already approved observations can be obtained with COS in prime and STIS in parallel which will satisfy the demands of this program.
Fraction GO/GTO Programs Supported	50% of GO/GTO programs (by exposure time) in Cycle 17 use G140L or G130M.
Resources Required: Observation	3 external orbits
Resources Required: Analysis	1 week
Products	Lyman-alpha templates for both the G130M and G140L gratings. Templates for other strong airglow features will also be produced.
Accuracy Goals	G130M SNR=1.5 per pixel at 1213 A G140L SNR=4 per pixel at 1200 A
Scheduling & Special Requirements	