



12556 - Investigating the Enigmatic Ultraviolet 2175 Å Extinction Feature and Correlation with Infrared Aromatic/PAH emission in M101

Cycle: 19, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) NUCLEUS+HODGE602	STIS/FUV-MAMA STIS/NUV-MAMA	2	12-Jul-2011 22:20:22.0	yes
02	(2) NGC5461	STIS/FUV-MAMA STIS/NUV-MAMA	2	12-Jul-2011 22:20:37.0	yes
03	(3) NGC5447	STIS/FUV-MAMA STIS/NUV-MAMA	2	12-Jul-2011 22:20:48.0	yes
04	(4) NGC5462	STIS/FUV-MAMA STIS/NUV-MAMA	2	12-Jul-2011 22:20:58.0	yes
05	(5) NGC5471	STIS/FUV-MAMA STIS/NUV-MAMA	2	12-Jul-2011 22:21:09.0	yes

10 Total Orbits Used

ABSTRACT

The 2175 Angstrom ultraviolet dust extinction feature has been known for more than 45 years, but the source of the extinction has yet to be positively identified. One of the leading contenders in dust grain models is small aromatic/PAHs grains. Through IR observations of HII regions in the spiral galaxy M101, PAHs have measured emission strengths that dramatically weaken at large radii and ionizations. The parameter space of these HII regions in terms of metallicity, ionization, and PAH emission strengths is the largest of any known galaxy. To explore the connection between the 2175 A extinction feature and IR aromatic/PAH emission strengths, we propose to observe the six regions in M101 (5 HII and the nucleus) using near-UV and far-UV gratings (G230L/G140L) with the MAMA detectors on STIS. The STIS instrument provides the opportunity to obtain high S/N UV spectra integrated over the same large spatial scales of the previous IR observations (~78 square arcsec) in minimal time (2 orbits per region). From the measured spectra, we will employ stellar evolutionary synthesis and radiative transfer models to extract the intrinsic strength of the 2175 A extinction feature. The 2175 A features strengths will be compared with the published emission strengths of five different aromatic/PAH features in all six regions. If the 2175 A feature is associated with aromatic/PAHs grains, we will see a strong correlation. The lack of a strong correlation will imply the need for significant modification of leading dust models.

OBSERVING DESCRIPTION

We are planning on observing six regions in M101 (5 HII regions and the nucleus) with the MAMA far-UV G140L and near-UV G230L gratings of STIS. Both the far-UV and near-UV data are required because of the broadness of the 2175 A feature, and the strength of the 2175 A bump is known to anti-correlate with the strength of the far-UV rise. To meet the objectives of this proposal, we require the 52"x2" slit. Two of the HII regions (nucleus and Hodge 602) are observable using the same slit but require the orientation of the slit to be 95-100 degrees east of north. For the 52"x2" STIS aperture, this requires the ORIENT parameter to be between 140.35-145.35 degrees or 320-325 degrees. The remaining HII regions do not require a specific slit orientation. To cover the same full 10" diameter of each HII region as observed in the IR, a total of five minimal slews of 1.8" each is required in the dispersion direction for a total of six observations per grating. The slightly smaller than 2" slews (1.8") for 6 slit positions is to ensure that the full 10" region is covered with some margin for pointing uncertainties (no target aquisition).

Our goal is to achieve at least a S/N of 50 at 1400 A and 2175 A in the far-UV and near-UV, respectively. This is the S/N required to get a 5-sigma detection of the weakest 2175 AA extinction feature seen in the previous HST FOS sample (i.e., Searle 5) at the flux level of our faintest target (nucleus). The near-UV and far-UV HII region fluxes are from archival M101 GALEX data of the Nearby Galaxies Survey. The fluxes are

measured in 10" diameter apertures and converted to surface brightnesses.

We estimate the gain in S/N we will achieve using STIS by summing up the 400 pixels in the spatial direction, binning the pixels in wavelength space (we only require a $R = 10$ to resolve the 2175 Å feature), and summing up over the five exposures. The final S/N is ~ 50 when these calculations are done. The minimum input S/N per resolution element using the online STIS exposure time calculator is 0.16 for the G230L near-UV grating, and 0.12 for the G140L far-UV grating. The calculations done for far-UV are identical to near-UV, and we assume a final $R = 10$ for both.

As an exception, we do not require a S/N of 50 for Hodge 602, which is significantly fainter than the other HII regions in our sample. The spectra of Hodge 602 is acquired at the same time as the nucleus and we require the final S/N of the nucleus to be 50. The final S/N of Hodge 602 will be ~ 20 . Both the nucleus and Hodge 602 are at the center of M101 and share similar parameter spaces in PAH strengths, ionizations, and metallicities. We will be able to detect a moderately strong 2175 Å extinction feature in Hodge 602.

Target acquisitions are not needed as we are targeting large extended regions (10" diameter) and our sources are not point sources. An error of 1" in the center of the STIS maps will compromise the comparison of the STIS versus Spitzer fluxes.

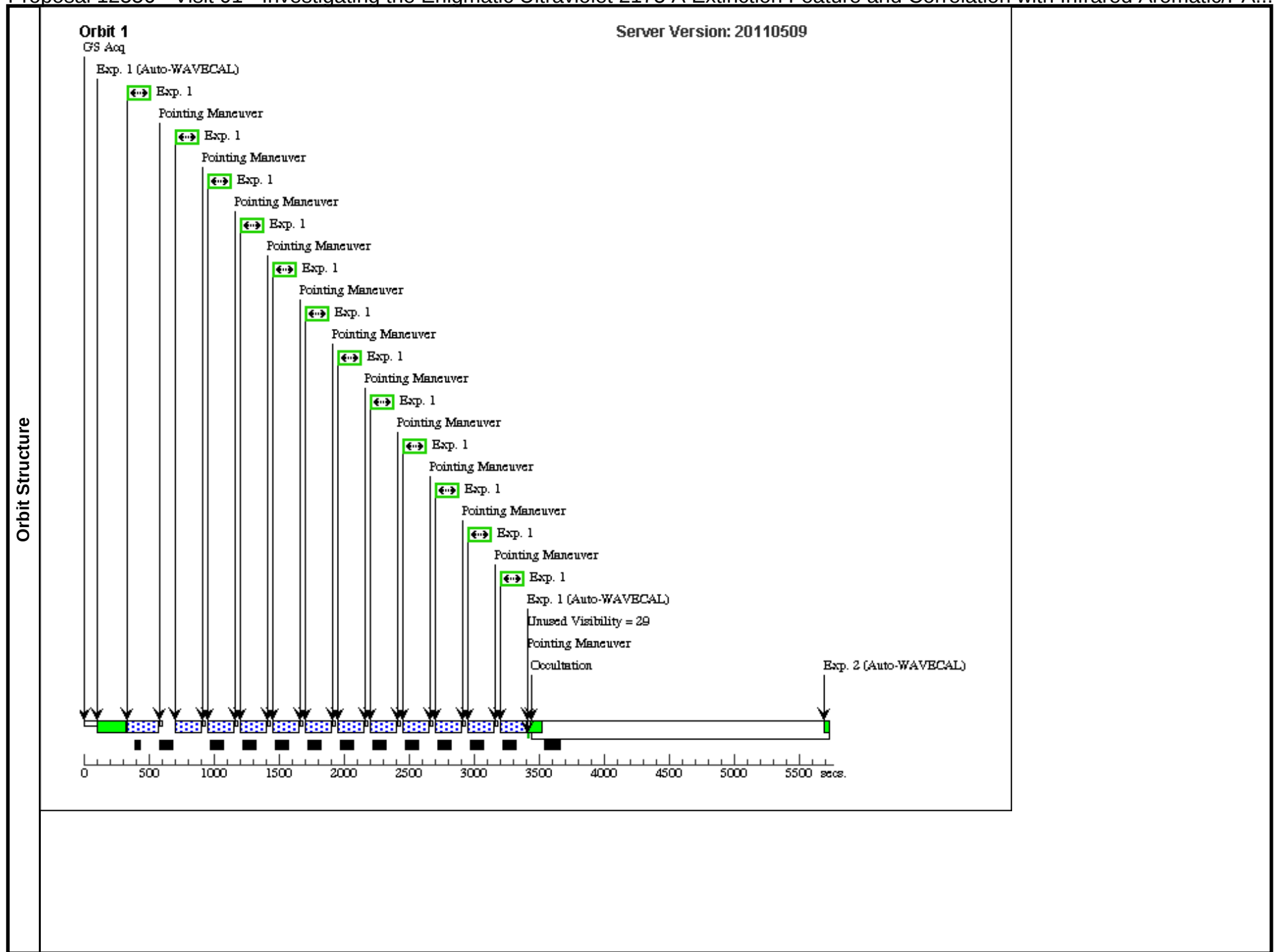
Proposal 12556 - Visit 01 - Investigating the Enigmatic Ultraviolet 2175 A Extinction Feature and Correlation with Infrared Aromatic/PA...

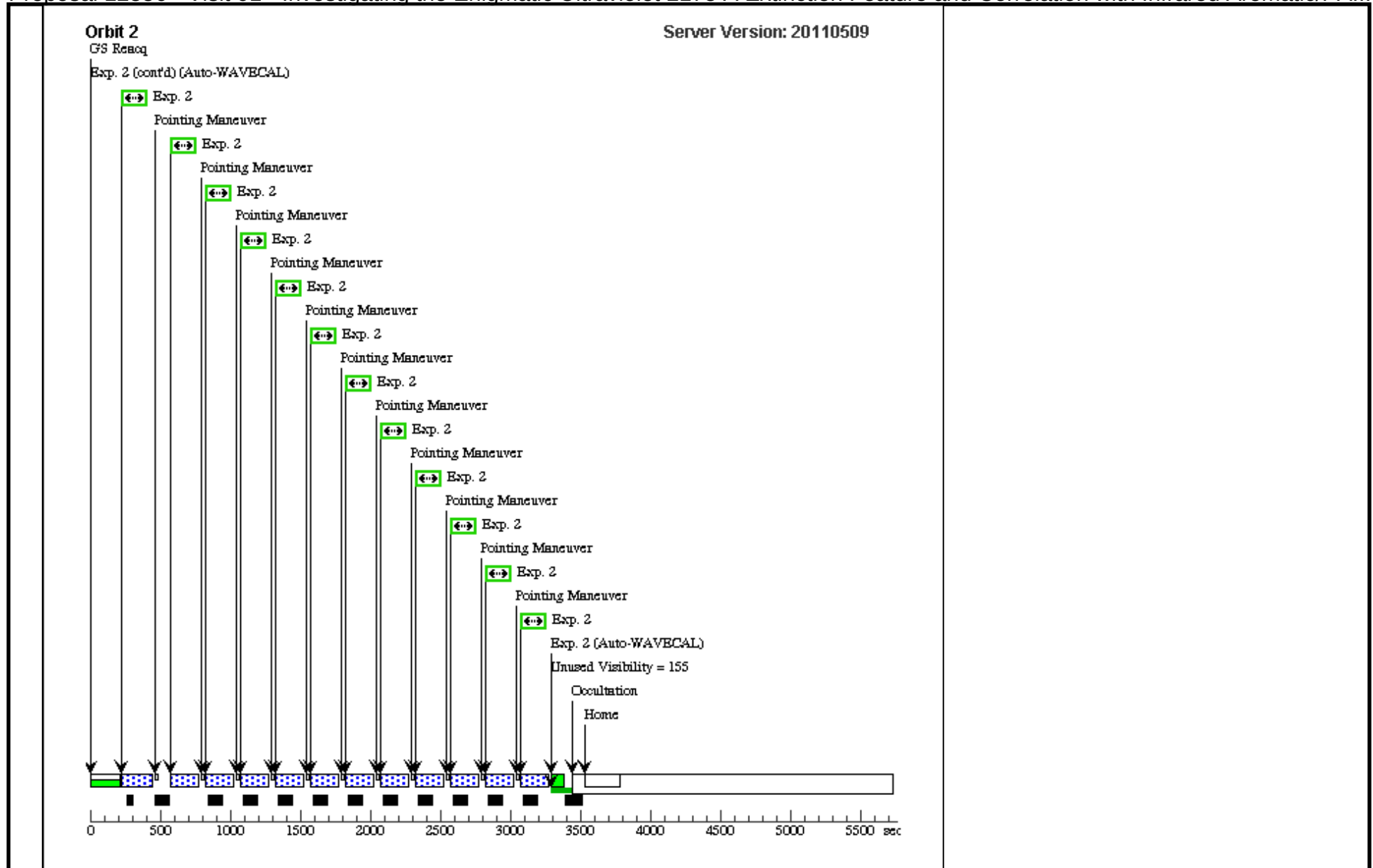
Visit	Proposal 12556, Visit 01, implementation Wed Jul 13 02:21:15 GMT 2011				
	Diagnostic Status: Warning Scientific Instruments: STIS/FUV-MAMA, STIS/NUV-MAMA Special Requirements: ORIENT 140.35D TO 145.35 D; ORIENT 320D TO 325 D <i>Comments: No target acq. needed given that the observation is to measure the total spectrum in a 10" diameter region. Small errors in the centering (within ~1") are ok.</i>				
Diagnosics	(Visit 01) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronagraphy with STIS or COS.				
Patterns	#	Primary Pattern		Secondary Pattern	
	(3)	Pattern Type=STIS-PERP-TO-SLIT Coordinate Frame=POS-TARG Purpose=MOSAIC Pattern Orientation=0.0 Number Of Points=6 Angle Between Sides= Point Spacing=1.8 Center Pattern=true Line Spacing=		Pattern Type=STIS-ALONG-SLIT Coordinate Frame=POS-TARG Purpose=DITHER Pattern Orientation=90.0 Number Of Points=2 Angle Between Sides= Point Spacing=20 Center Pattern=true Line Spacing=	(1), (2)
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes
	(1)	NUCLEUS+HODGE602	RA: 14 03 11.3000 (210.7970833d) Dec: +54 20 56.50 (54.34903d) Equinox: J2000		V=17.4 Reference Frame: ICRS Fluxes (ergs/s*cm^2*A*arcsec^2) for circular apertures of 10" diameter: GALEX near-uv=5.76e-17, GALEX far-uv=8.60e-17

Proposal 12556 - Visit 01 - Investigating the Enigmatic Ultraviolet 2175 A Extinction Feature and Correlation with Infrared Aromatic/PA...

Exposures

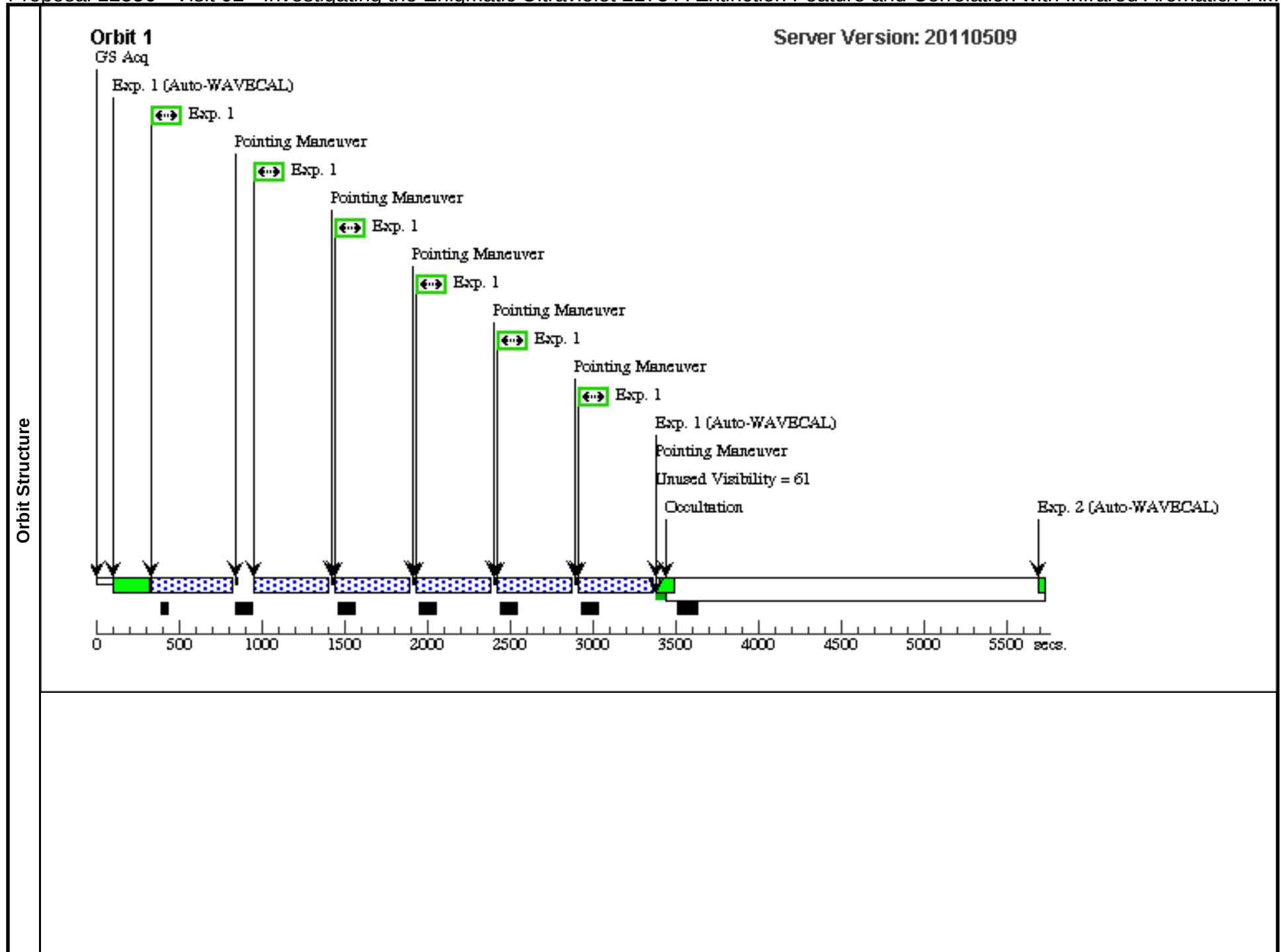
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	(189511)	(1) NUCLEUS+HO DGE602	STIS/FUV-MAMA, ACCUM, 52X2	G140L 1425 A			Pattern 3, Exps 1-1 i n Visit 01 (3)	186 Secs [==>(Pattern 1,1)] [==>(Pattern 1,2)] [==>(Pattern 2,1)] [==>(Pattern 2,2)] [==>(Pattern 3,1)] [==>(Pattern 3,2)] [==>(Pattern 4,1)] [==>(Pattern 4,2)] [==>(Pattern 5,1)] [==>(Pattern 5,2)] [==>(Pattern 6,1)] [==>(Pattern 6,2)]	[1]
Comments: All the ETC runs in the program are for a single slit. The final S/N will be the sum along the slit as well as a coadd of all 5 positions.									
2	(189235)	(1) NUCLEUS+HO DGE602	STIS/NUV-MAMA, ACCUM, 52X2	G230L 2376 A			Pattern 3, Exps 2-2 i n Visit 01 (3)	186 Secs [==>(Pattern 1,1)] [==>(Pattern 1,2)] [==>(Pattern 2,1)] [==>(Pattern 2,2)] [==>(Pattern 3,1)] [==>(Pattern 3,2)] [==>(Pattern 4,1)] [==>(Pattern 4,2)] [==>(Pattern 5,1)] [==>(Pattern 5,2)] [==>(Pattern 6,1)] [==>(Pattern 6,2)]	[2]
Comments: All the ETC runs in the program are for a single slit. The final S/N will be the sum along the slit as well as a coadd of all 5 positions.									





Proposal 12556 - Visit 02 - Investigating the Enigmatic Ultraviolet 2175 A Extinction Feature and Correlation with Infrared Aromatic/PA...

Visit	Proposal 12556, Visit 02, implementation Wed Jul 13 02:21:16 GMT 2011									
	Diagnostic Status: Warning Scientific Instruments: STIS/FUV-MAMA, STIS/NUV-MAMA Special Requirements: (none) <i>Comments: No target acq. needed given that the observation is to measure the total spectrum in a 10" diameter region. Small errors in the centering (within ~1") are ok.</i>									
Diagnostics	(Visit 02) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronagraphy with STIS or COS.									
Patterns	#	Primary Pattern				Secondary Pattern			Exposures	
	(1)	Pattern Type=STIS-PERP-TO-SLIT Coordinate Frame=POS-TARG Purpose=MOSAIC Pattern Orientation=0.0 Number Of Points=6 Angle Between Sides= Point Spacing=1.8 Center Pattern=true Line Spacing=							(1), (2)	
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous	
	(2)	NGC5461	RA: 14 03 41.3600 (210.9223333d) Dec: +54 19 4.90 (54.31803d) Equinox: J2000				V=16.7 Fluxes (ergs/s*cm^2*A*arcsec^2) for circular apertures of 10" diameter: GALEX near-uv=1.19e-16, GALEX far-uv=2.36e-17		Reference Frame: ICRS	
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	(189492)	(2) NGC5461	STIS/FUV-MAMA, ACCUM, 52X2	G140L 1425 A			Pattern 1, Exps 1-1 in Visit 02 (1)	440 Secs	
									[=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)] [=>(Pattern 5)] [=>(Pattern 6)]	[1]
	2	(189301)	(2) NGC5461	STIS/NUV-MAMA, ACCUM, 52X2	G230L 2376 A			Pattern 1, Exps 2-2 in Visit 02 (1)	445 Secs	
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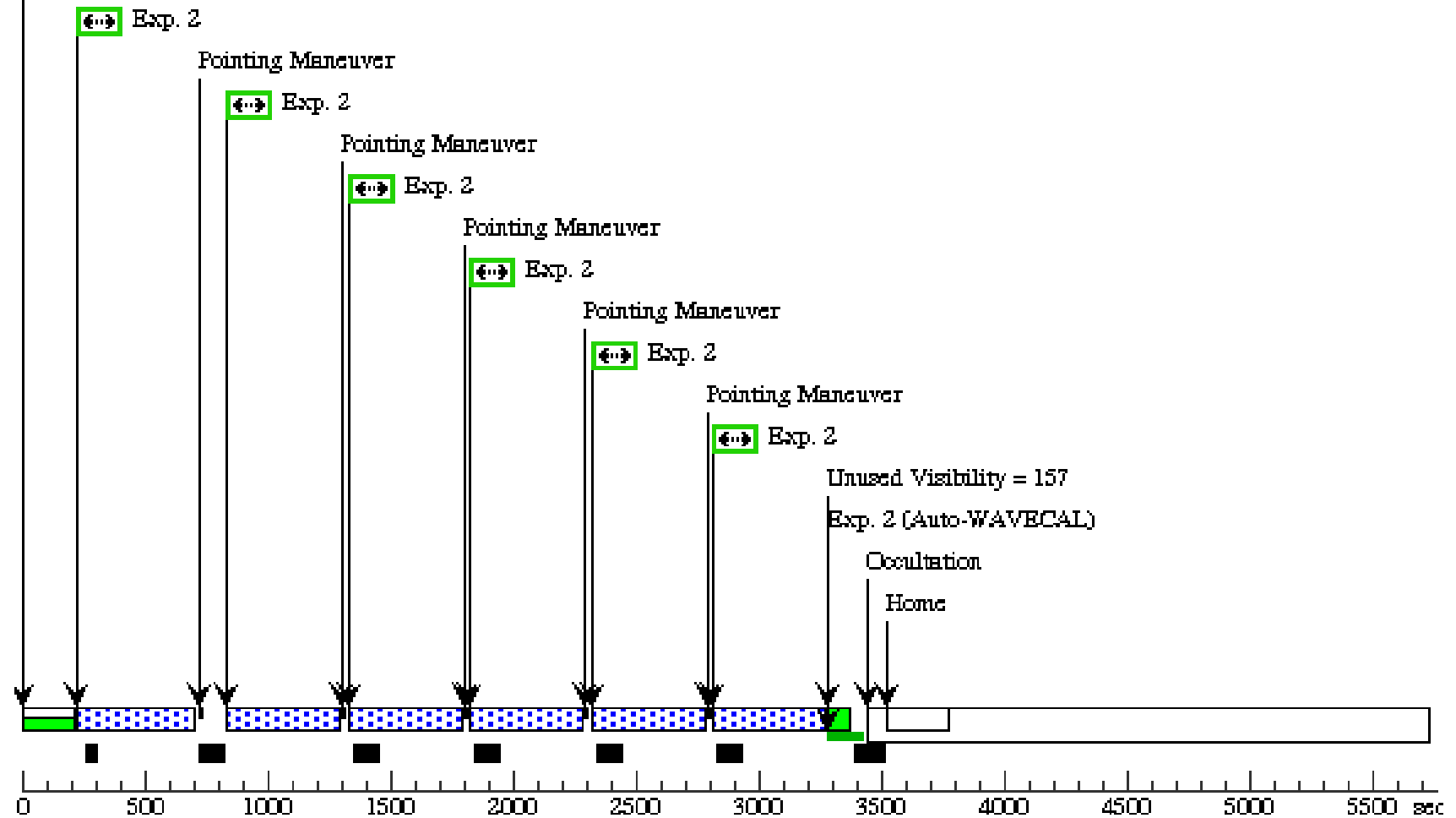


Orbit 2

Server Version: 20110509

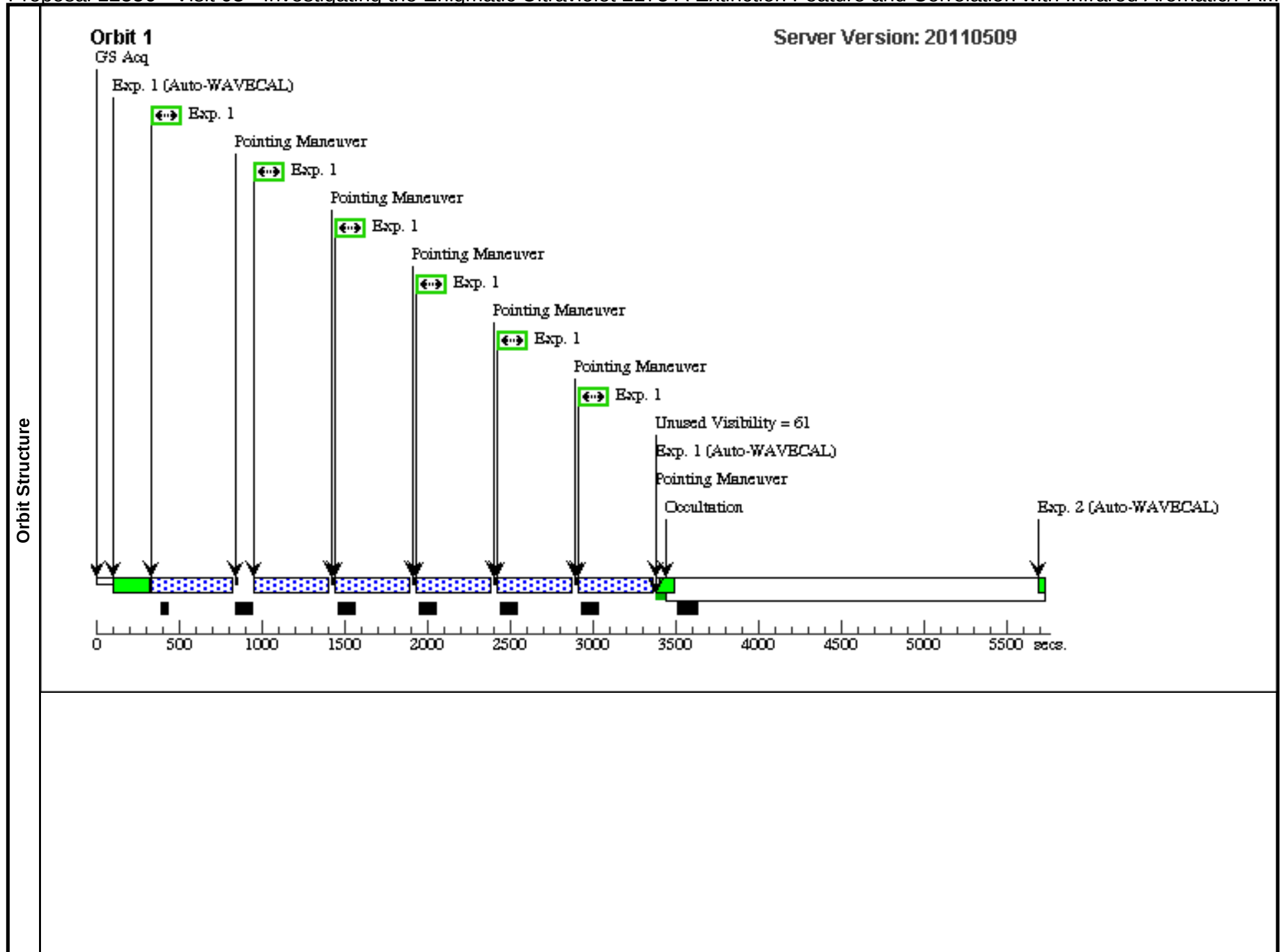
GS Reacq

Exp. 2 (cont'd) (Auto-WAVECAL)



Proposal 12556 - Visit 03 - Investigating the Enigmatic Ultraviolet 2175 A Extinction Feature and Correlation with Infrared Aromatic/PA...

Visit	Proposal 12556, Visit 03, implementation Wed Jul 13 02:21:17 GMT 2011									
	Diagnostic Status: Warning Scientific Instruments: STIS/FUV-MAMA, STIS/NUV-MAMA Special Requirements: (none) <i>Comments: No target acq. needed given that the observation is to measure the total spectrum in a 10" diameter region. Small errors in the centering (within ~1") are ok.</i>									
Diagnostics	(Visit 03) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronagraphy with STIS or COS.									
Patterns	#	Primary Pattern				Secondary Pattern			Exposures	
	(1)	Pattern Type=STIS-PERP-TO-SLIT Coordinate Frame=POS-TARG Purpose=MOSAIC Pattern Orientation=0.0 Number Of Points=6 Angle Between Sides= Point Spacing=1.8 Center Pattern=true Line Spacing=							(1), (2)	
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous	
	(3)	NGC5447	RA: 14 02 28.1800 (210.6174167d) Dec: +54 16 26.30 (54.27397d) Equinox: J2000				V=16.6 Fluxes (ergs/s*cm^2*A*arcsec^2) for circular apertures of 10" diameter: GALEX near-uv=1.11e-16, GALEX far-uv=2.76e-16		Reference Frame: ICRS	
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	(189476)	(3) NGC5447	STIS/FUV-MAMA, ACCUM, 52X2	G140L 1425 A			Pattern 1, Exps 1-1 in Visit 03 (1)	440 Secs	
									[=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)] [=>(Pattern 5)] [=>(Pattern 6)]	[1]
	2	(189332)	(3) NGC5447	STIS/NUV-MAMA, ACCUM, 52X2	G230L 2376 A			Pattern 1, Exps 2-2 in Visit 03 (1)	445 Secs	
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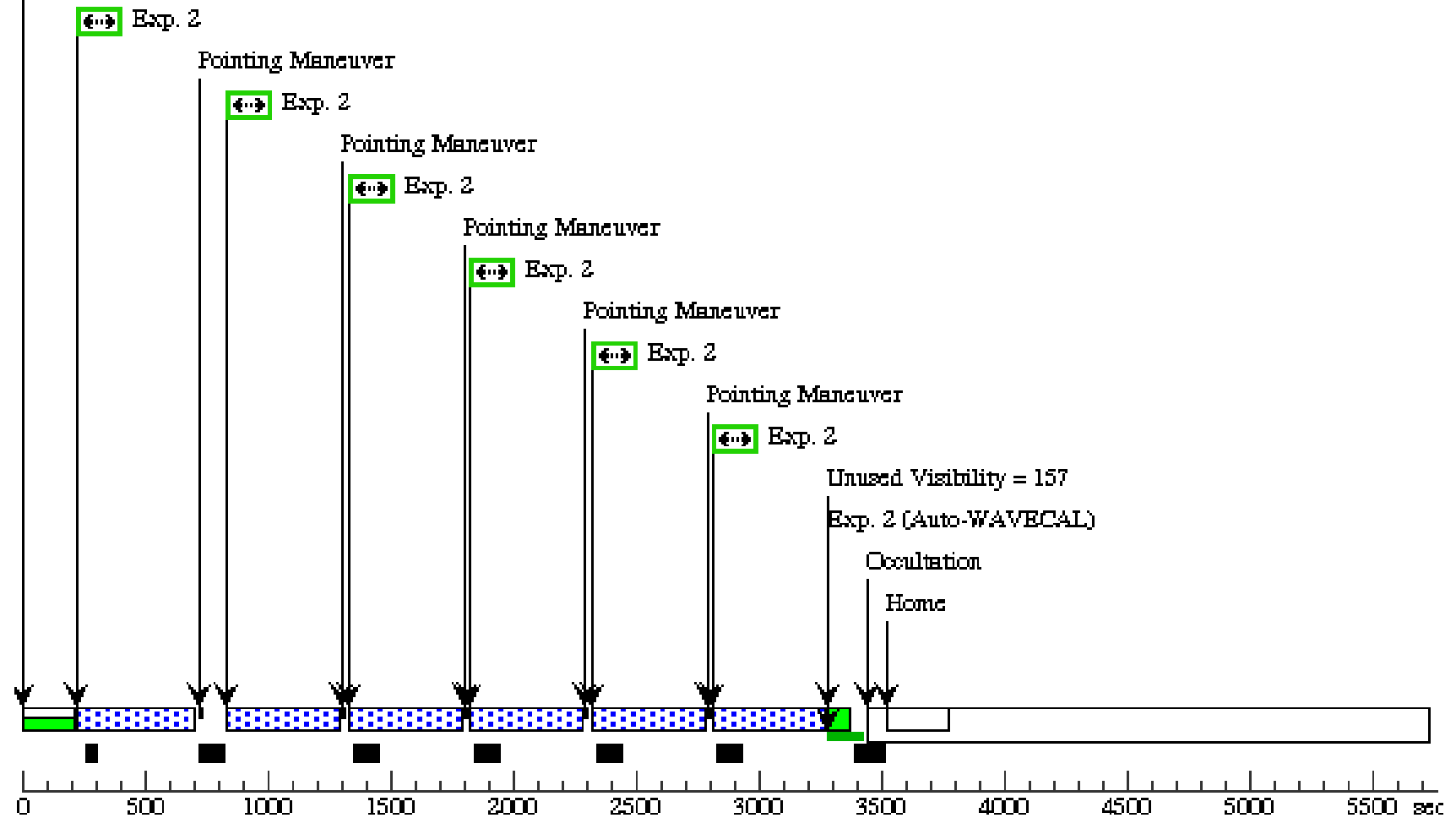


Orbit 2

Server Version: 20110509

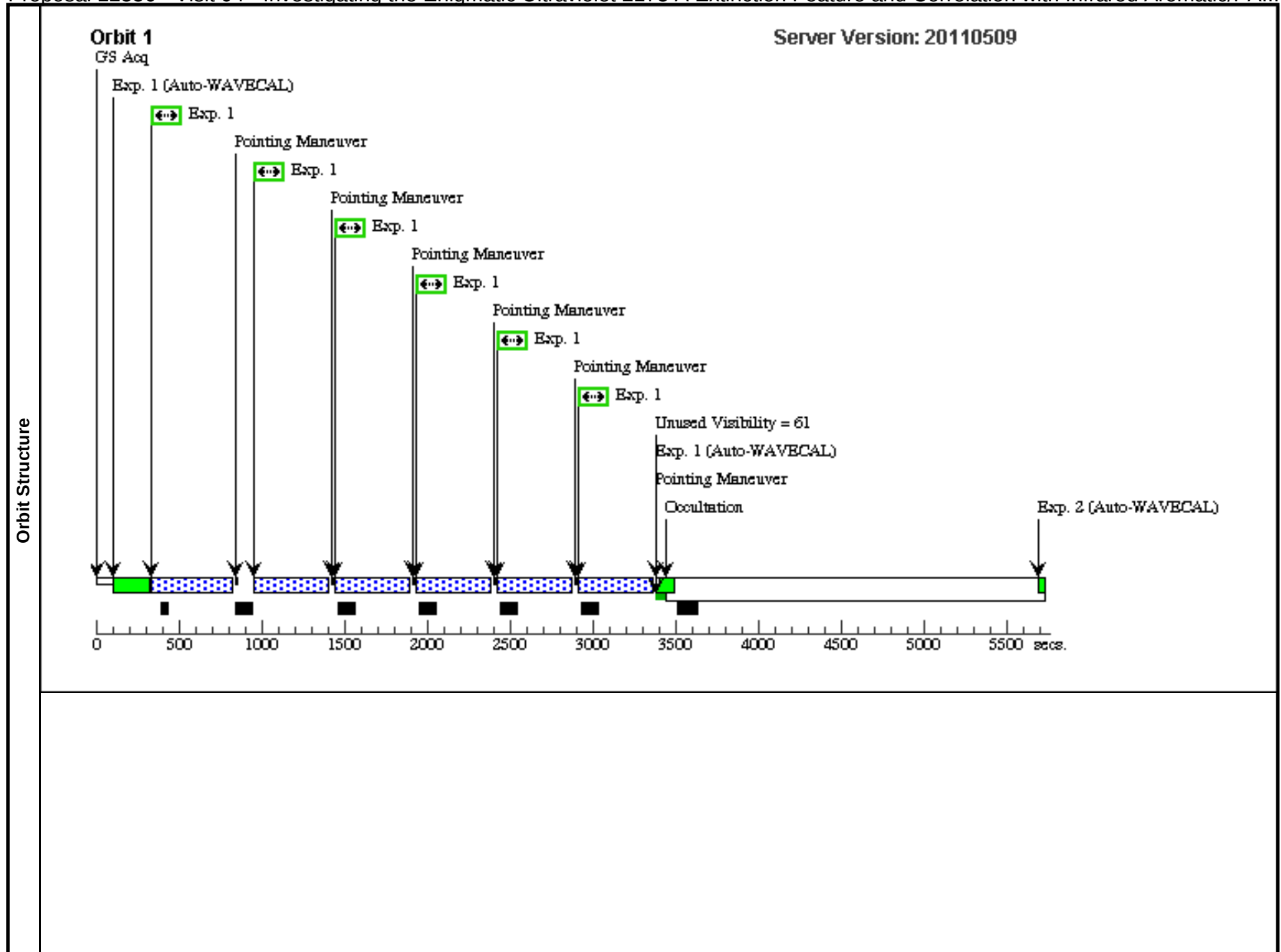
Exp. 2 (cont'd) (Auto-WAVECAL)

FS Reacq



Proposal 12556 - Visit 04 - Investigating the Enigmatic Ultraviolet 2175 A Extinction Feature and Correlation with Infrared Aromatic/PA...

Visit	Proposal 12556, Visit 04, implementation Wed Jul 13 02:21:18 GMT 2011									
	Diagnostic Status: Warning Scientific Instruments: STIS/FUV-MAMA, STIS/NUV-MAMA Special Requirements: (none) <i>Comments: No target acq. needed given that the observation is to measure the total spectrum in a 10" diameter region. Small errors in the centering (within ~1") are ok.</i>									
Diagnostics	(Visit 04) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronagraphy with STIS or COS.									
Patterns	#	Primary Pattern				Secondary Pattern			Exposures	
	(1)	Pattern Type=STIS-PERP-TO-SLIT Coordinate Frame=POS-TARG Purpose=MOSAIC Pattern Orientation=0.0 Number Of Points=6 Angle Between Sides= Point Spacing=1.8 Center Pattern=true Line Spacing=							(1), (2)	
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous	
	(4)	NGC5462	RA: 14 03 53.1900 (210.9716250d) Dec: +54 22 6.30 (54.36842d) Equinox: J2000				V=16.8 Fluxes (ergs/s*cm^2*A*arcsec^2) for circular apertures of 10" diameter: GALEX near-uv=6.66e-17, GALEX far-uv=1.69e-16		Reference Frame: ICRS	
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	(189463)	(4) NGC5462	STIS/FUV-MAMA, ACCUM, 52X2	G140L 1425 A			Pattern 1, Exps 1-1 in Visit 04 (1)	440 Secs	
									[=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)] [=>(Pattern 5)] [=>(Pattern 6)]	[1]
	2	(189348)	(4) NGC5462	STIS/NUV-MAMA, ACCUM, 52X2	G230L 2376 A			Pattern 1, Exps 2-2 in Visit 04 (1)	445 Secs	
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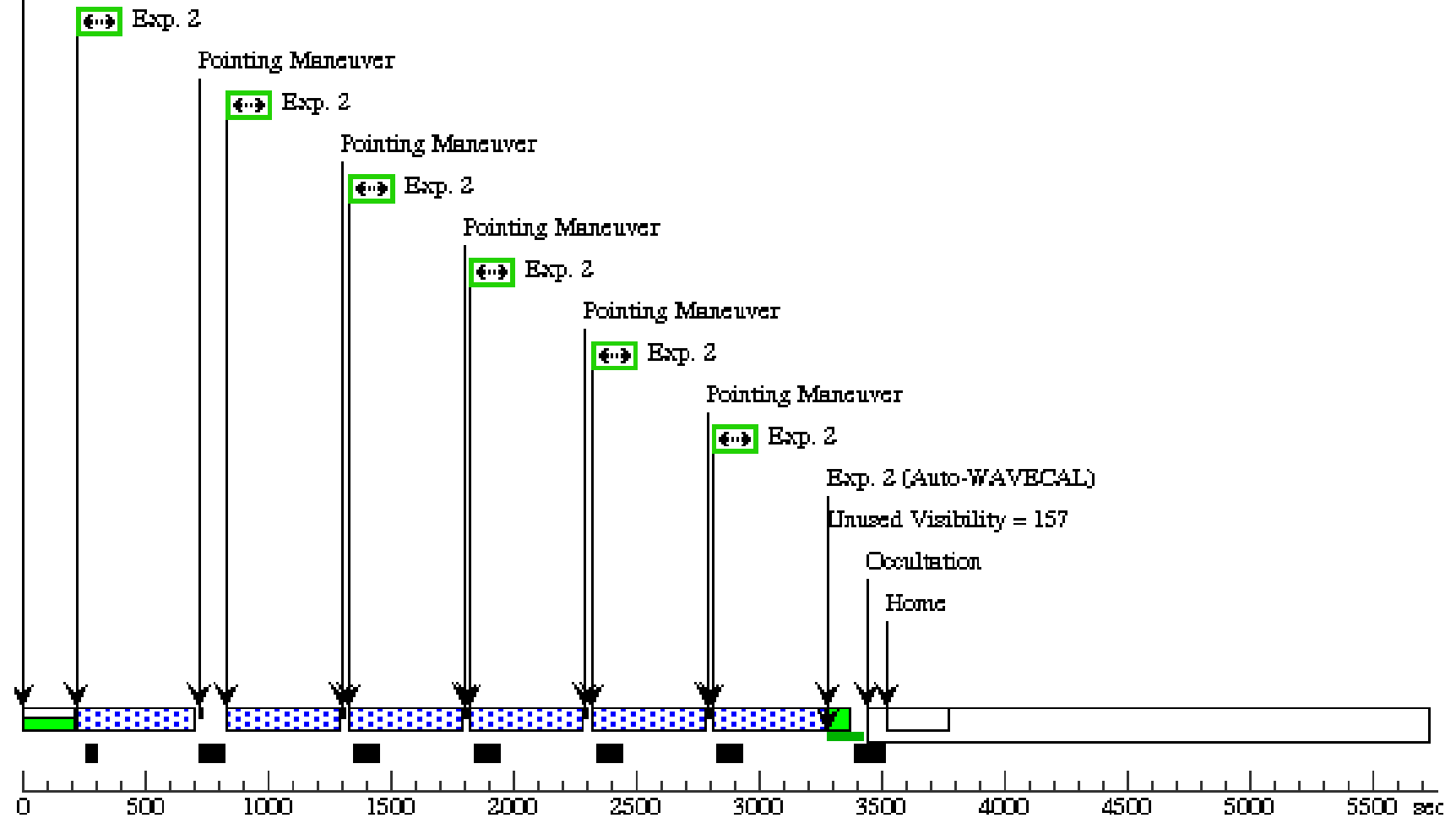


Orbit 2

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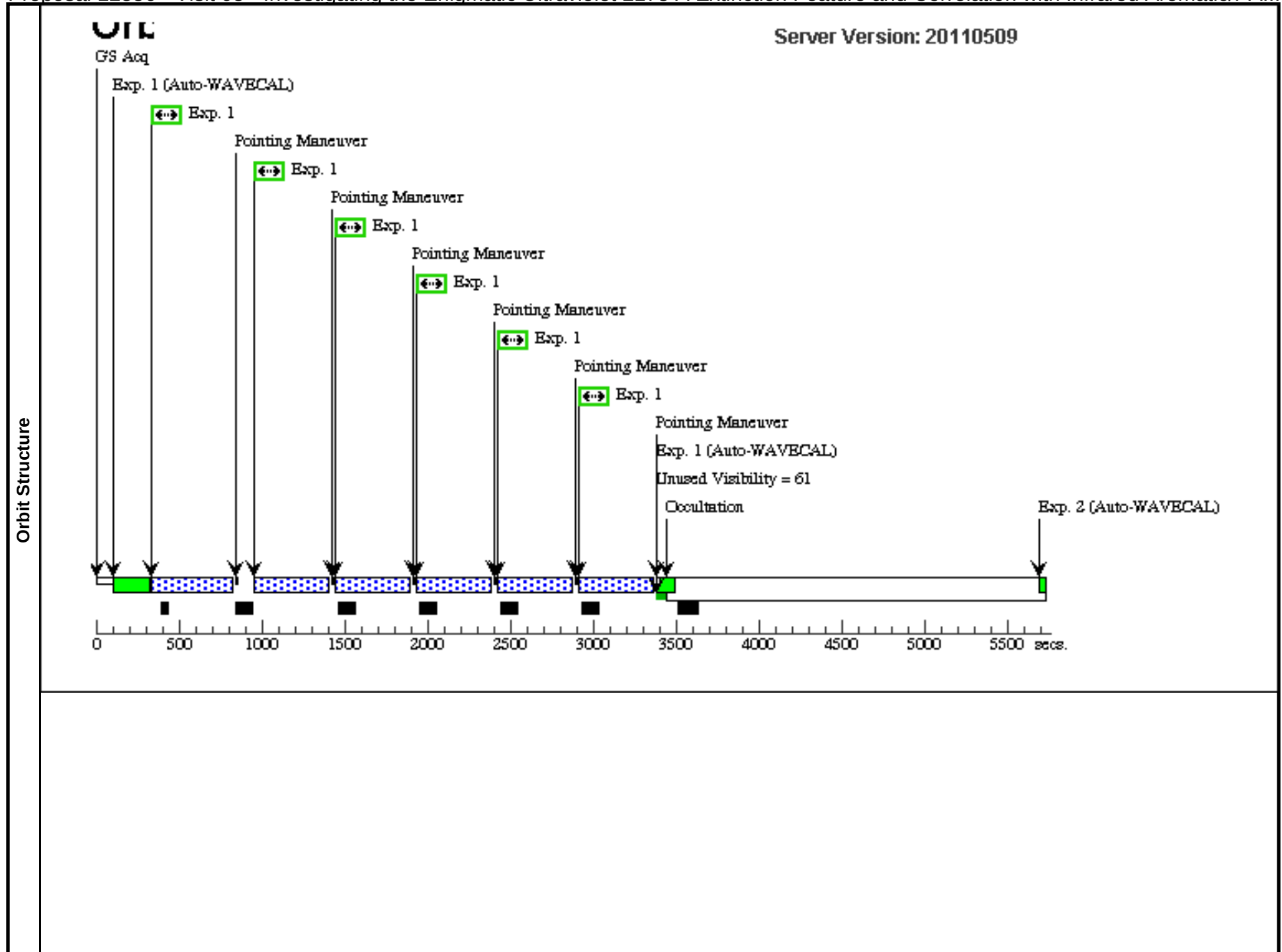
Exp. 2 (cont'd) (Auto-WAVECAL)

FS Reacq



Proposal 12556 - Visit 05 - Investigating the Enigmatic Ultraviolet 2175 A Extinction Feature and Correlation with Infrared Aromatic/PA...

Visit	Proposal 12556, Visit 05, implementation Wed Jul 13 02:21:18 GMT 2011									
	Diagnostic Status: Warning Scientific Instruments: STIS/FUV-MAMA, STIS/NUV-MAMA Special Requirements: (none) <i>Comments: No target acq. needed given that the observation is to measure the total spectrum in a 10" diameter region. Small errors in the centering (within ~1") are ok.</i>									
Diagnostics	(Visit 05) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronagraphy with STIS or COS.									
Patterns	#	Primary Pattern				Secondary Pattern			Exposures	
	(1)	Pattern Type=STIS-PERP-TO-SLIT Coordinate Frame=POS-TARG Purpose=MOSAIC Pattern Orientation=0.0 Number Of Points=6 Angle Between Sides= Point Spacing=1.8 Center Pattern=true Line Spacing=							(1), (2)	
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous	
	(5)	NGC5471	RA: 14 04 29.3500 (211.1222917d) Dec: +54 23 46.40 (54.39622d) Equinox: J2000				V=15.9 Fluxes (ergs/s*cm^2*A*arcsec^2) for circular apertures of 10" diameter: GALEX near-uv=2.12e-16, GALEX far-uv=4.07e-16		Reference Frame: ICRS	
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	(189403)	(5) NGC5471	STIS/FUV-MAMA, ACCUM, 52X2	G140L 1425 A			Pattern 1, Exps 1-1 in Visit 05 (1)	440 Secs	
									[= > (Pattern 1)] [= > (Pattern 2)] [= > (Pattern 3)] [= > (Pattern 4)] [= > (Pattern 5)] [= > (Pattern 6)]	[1]
	2	(189370)	(5) NGC5471	STIS/NUV-MAMA, ACCUM, 52X2	G230L 2376 A			Pattern 1, Exps 2-2 in Visit 05 (1)	445 Secs	
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Orbit 2

Server Version: 20110509

Exp. 2 (cont'd) (Auto-WAVECAL)

FS Reacq

