12875 - Resolving the Thermal Conduction Front in the Bubble S308

Cycle: 20, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) SH2-308-SW-LIMB (2) SH2-308-SW-LIMB-ACQSTAR ANY	STIS/CCD STIS/FUV-MAMA WFC3/UVIS	5	10-Jul-2012 21:27:20.0	yes
02	(1) SH2-308-SW-LIMB (2) SH2-308-SW-LIMB-ACQSTAR ANY	STIS/CCD STIS/FUV-MAMA WFC3/UVIS	4	10-Jul-2012 21:27:50.0	yes
03	(1) SH2-308-SW-LIMB ANY	ACS/WFC WFC3/UVIS	2	10-Jul-2012 21:28:08.0	yes

11 Total Orbits Used

ABSTRACT

Heat conduction is one of the most fundamental processes in the interstellar and intergalactic media. Many astronomical systems contain cool (<10^4 K) gas in contact with hot (10^6 -10^8 K) gas; at the contact surfaces, heat conduction occurs and may play an essential role in the thermal structure and evolution of the system.

Observations of thermal conduction fronts have been extremely limited. Conventionally observations use absorption lines of collisionally ionized high ions as tracers of 1-3x10^5 K gas in the conduction front. Such observations allow the determination of column densities but not the relative locations of these tracer ions. Emission-line observations of a clear-cut, edge-on conduction front are needed to study the physical structure of a thermal conduction front.

We have identified a clean-cut, edge-on conduction front in the circumstellar bubble S308, using XMM-Newton X-ray observations and ground-based optical images and spectra. We request HST STIS spectroscopic observations of the NV and CVI emission lines in the transition region from the hot interior gas to the cool nebular shell, as well as WFC2 and ACS images to study mass-loading by nebular knots. These observations, combined with our complementary observations at optical and X-ray wavelength, allow us to determine the spatially-resolved temperature profile of a thermal conduction front. Comparisons with models further allow us to assess the efficiency of thermal conduction and mass-loading.

OBSERVING DESCRIPTION

The purpose of these observations are to obtain N V (and C IV) surface brightness measurements (using the STIS/FUV MAMA and G140L grating) over a region covering the interface layer between the nebular shell and X-ray emitting interior of the circumstellar bubble S308 in order to determine the temperature profile of the conduction layer. These will be supplemented by WFC3/UVIS F502N and F656N images ([OIII] and H-alpha) to show the detailed filamentary structure of the region being probed by the STIS spectra. Coordinated parallel WFC3 and ACS images will also be obtained at positions along the rim of the nebular shell. Below we describe the phase 2 setup we have used to make these observations.

STIS FUV/MAMA observations:

The STIS/FUV MAMA observations will use the 25x0.5 arcsec slit to obtain spectra in a cut with ~112.5 arcsec extent by stepping the aperture over 9 positions spaced by 12.5 arcsecond. Each individual pointing is further dithered by 0.5 arcseconds to aid in the removal of hot/dead pixels. A total of 18 STIS spectra will be obtained.

The STIS observations are divided into two visits or 5 and 4 orbit durations to allow for scheduling around passages through the SAA. A constraint on the first visit is used to orient the slit roughly perpendicular to the shell while a constraint of SAME-ORIENT (+/-5 degrees) is used for the second visit to ensure that the slit positions provide a nearly contiguous cut through the conduction layer. We note that the constraints specified in phase II have been somewhat narrowed compared to those in the technical justification of our phase 1 proposal. This was found to be necessary in order to specify all the slit offset positions relative to a single central offset position. The reason for the change is to build a phase 2 submission that requires no intervention from STScI personnel at the time of scheduling. (In our proposal we had assumed all offsets relative to a position at the endpoint of our cut. Since we specify two sets of orientations this cannot work as the offsets used would need to occur in a specific (easterly direction) rather than one based on a relative offset. (If this change is not acceptable we are willing to work with STScI personnel to find a different solution but the impact on the schedulability in the visit planner appears to be negligible.) Note, warnings exist with this submission because we have intentional used POS TARG to move the aperture to positions that do not include the reference position.

ACQ observations:
To acquire our slit positions we have specified an acquisition exposure at the beginning of each of the STIS/FUV MAMA visits. Since our target is diffuse and the filamentary emission may be confusing we instead have centered the acquisition frames on the closest bright star (2MASS 06531583-2403146) and use the F25ND3 filter with the STIS/CCD to verify the spacecraft pointing. Based on 2MASS and USNOB fluxes we find this star is consistent with having a spectral type of G4 V with m_V=14.1. The STIS target acquisition ETC predicts a 32s exposure is needed to obtain S/N=40 which we have used in our observations. The center of our desired slit position is measured in the same reference frame (ICRS) and given as the central position for the STIS and WFC3/UVIS observations. The position of the STIS aperture for the MAMA observations are given as POSTARG offsets in the Y-direction (i.e. along the slit).

MAMA Safety/ETC calculations:
Our target is comprised of faint diffuse emission. The ETC calculation that accompanies the individual exposures assumes a surface brightness of 8E-14 erg/cm/s/arcsec (10 times the expected peak surface brightness) to demonstrate the safety of these observations. The observations are designed to be sensitive to emission 100 times fainter (but which requires heavy binning in both the spatial and spectral directions). The Bright Object Tool has not flagged any observations as unsafe.

WFC3/UVIS: Primary Imaging

Two orbits were awarded to obtain imaging observations with the WFC3/UVIS in the F502N and F656N ([OIII] and H-alpha) filters. We use a simple WFC3-UVIS-GAP-LINE pattern to obtain 3 observations in each filter which cover the region of the STIS observations. An orient is used to ensure that the ACS FOV is within the nebular shell of S308 for coordinated parallel observations.

Coordinated Parallel Observations:
Parallel observations were awarded using WFC3/UVIS during the STIS/MAMA observations and ACS/WFC observations during the primary WFC3/UVIS observations. We have included appropriate parallel exposures with each of our primary observations.The dither used for the primary observations provides an offset for each of the parallel observations.

ADDITIONAL COMMENTS
When this phase 2 submission is review please verify that the mechanism used in visits 1 and 2 to acquire our target is viable (ACQ exposure of an object with specified coordinates, followed by a move to a second set of coordinates from which subsequent observsations use a relative offset). The precise location of the
apertures (within 0.5") is not critical but the overall offset and subsequient relative offsets are critical for the success of our science.

We would like to consider the use of post-flash to mitigate the effects of CTE in our observations but it is not clear whether we might not already benefit more by the fact that our observations use POS TARGY (i.e. it is not clear whether this might already aid in image reconstruction... i.e. does POS TARG Y for STIS correspond to the
proper direction for WFC3/UVIS as outlined in the white-paper provided shortly before the Cycle 20 phase2 deadline). If possible, when this phase 2 submission is reviewed we would like advise about whether or not these observations will benefit from the use of post-flash).

Visit

Proposal 12875, Positive offset positions (01) Wed Jul 11 01:28:17 GMT 2012

Diagnostic Status: Warning

Scientific Instruments: STIS/CCD, WFC3/UVIS, STIS/FUV-MAMA

Special Requirements: ORIENT 100D TO 130 D; ORIENT 265D TO 300 D

Comments: Offsets in positive (POSTARG Y) position. Note that the cumulative offset by more than the FOV of an individual slit position is intentional but generates warnings.

Diagnostics

(Positive offset positions (01)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE

(Positive offset positions (01)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE

(Positive offset positions (01)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE

(Positive offset positions (01)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE

(Positive offset positions (01)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE

(Positive offset positions (01)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SH2-308-SW-LIMB	RA: 06 53 12.0390 (103.3001625d) Dec: -24 03 13.79 (-24.05383d) Equinox: J2000		V=11.5+/-0.2	Reference Frame: ICRS
(2)	SH2-308-SW-LIMB-ACQSTAR Alt Name1: 2MASSJ06531583-2403146	RA: 06 53 15.8400 (103.3160000d) Dec: -24 03 14.64 (-24.05407d) Equinox: J2000		V=14.1+/-0.5 J=12.99, H=12.66, K=12.60	Reference Frame: ICRS

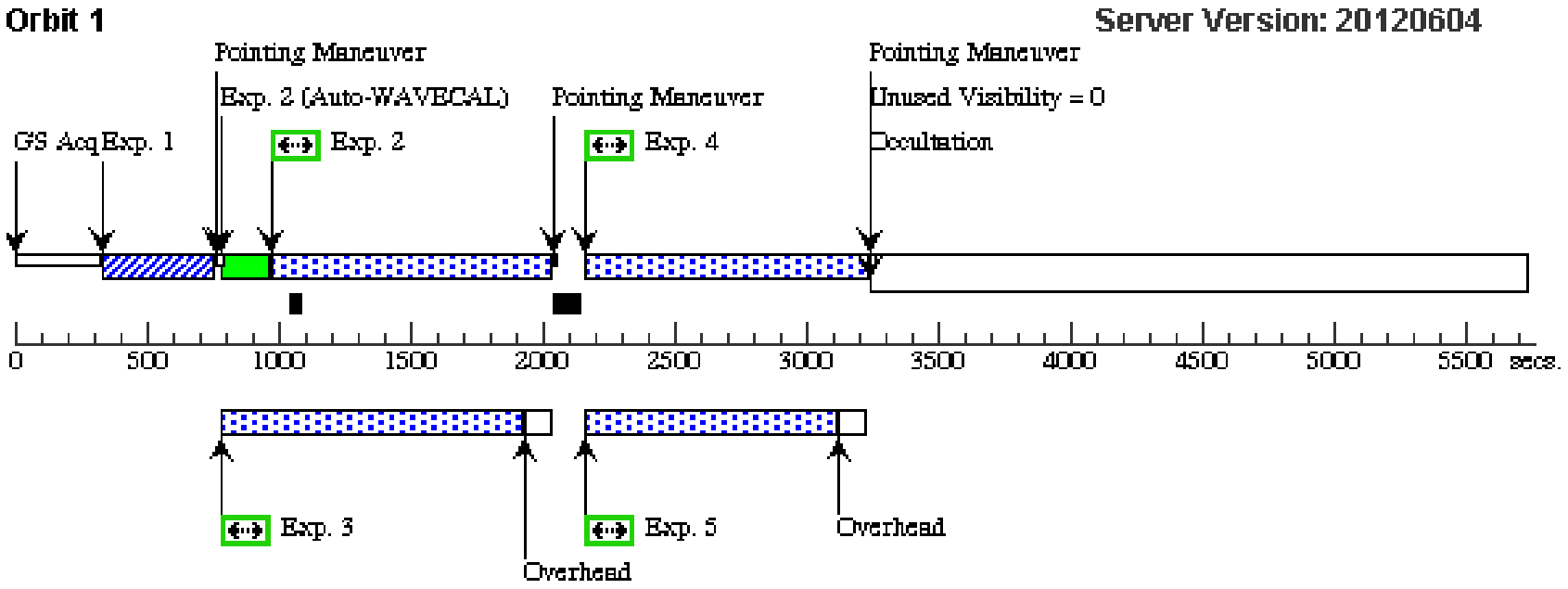
Comments: Star is 2MASS 06531583-2403146. Flux densities from 2MASS and USNOB1.0 are consistent with it being a G4 V star.

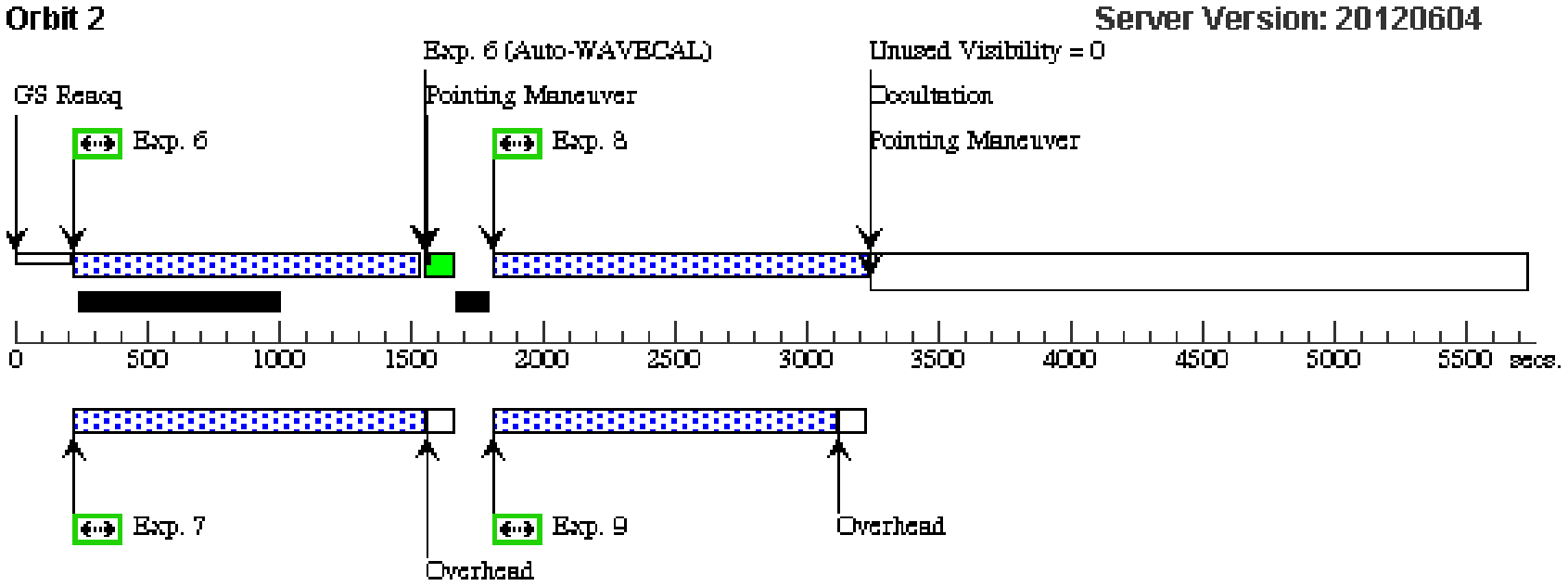
Exposures

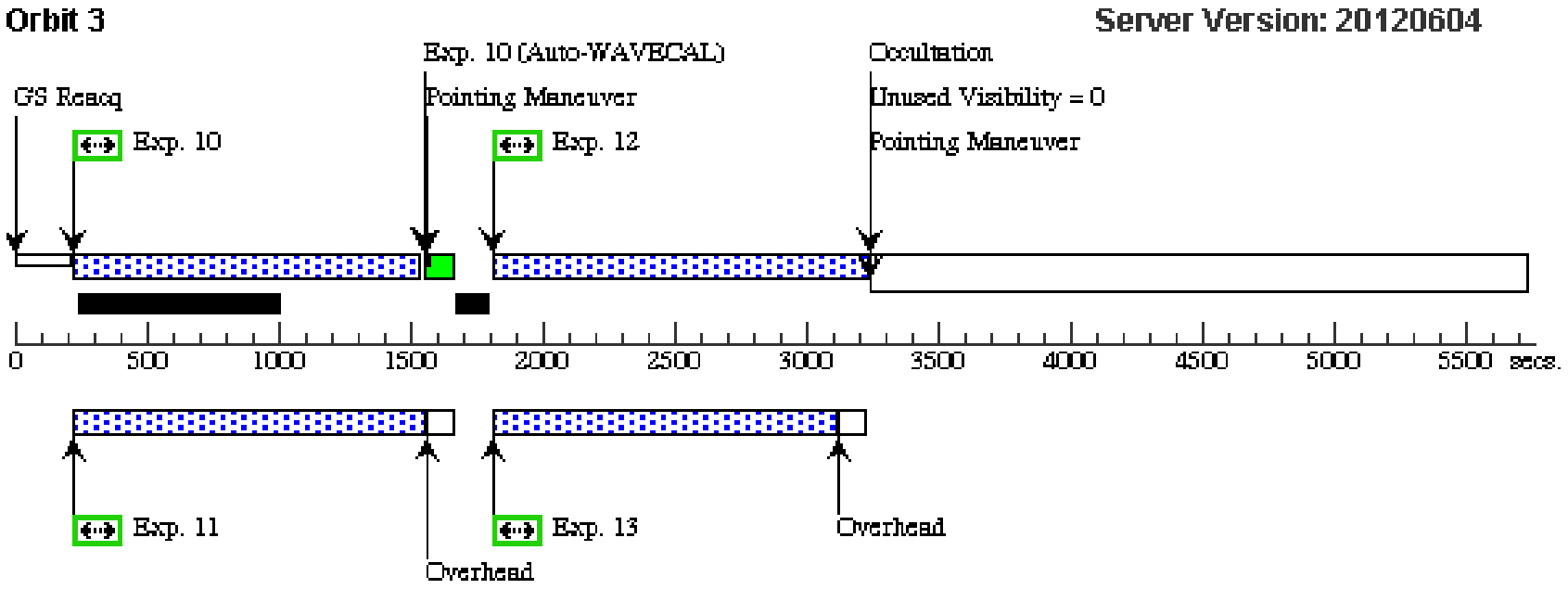
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	(416230)	(2) SH2-308-SW-LI MB-ACQSTAR	STIS/CCD, ACQ, F25ND3	MIRROR				32 Secs *[==>]*	 ***[1]***
Comments: This star sits amid filamentrary emission. Nearest star with even moderately comparable brightness is roughly 26 arseconds northeast.									
2	center pos (416356)	(1) SH2-308-SW-LI MB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,4	Prime + Parallel Group 2-3 in Positive offset positions (01)	1000 Secs *[==>]*	 ***[1]***
3		ANY	WFC3/UVIS, ACCUM, UVIS1	F502N			Prime + Parallel Group 2-3 in Positive offset positions (01)	900 Secs *[==>1108.0 Secs]*	 ***[1]***
4	center pos + dither (416356)	(1) SH2-308-SW-LI MB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,4.5	Prime + Parallel Group 4-5 in Positive offset positions (01)	1000 Secs *[==>1054.0 Secs]*	 ***[1]***
5		ANY	WFC3/UVIS, ACCUM, UVIS1	F656N			Prime + Parallel Group 4-5 in Positive offset positions (01)	900 Secs *[==>937.0 Secs]*	 ***[1]***
6	positive pos 1 (416356)	(1) SH2-308-SW-LI MB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,16.5	Prime + Parallel Group 6-7 in Positive offset positions (01)	1300 Secs *[==>]*	 ***[2]***
7		ANY	WFC3/UVIS, ACCUM, UVIS1	F502N			Prime + Parallel Group 6-7 in Positive offset positions (01)	900 Secs *[==>1299.0 Secs]*	 ***[2]***
8	positive pos 1 + dither (416356)	(1) SH2-308-SW-LI MB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,17.0	Prime + Parallel Group 8-9 in Positive offset positions (01)	1300 Secs *[==>1364.0 Secs]*	 ***[2]***
9		ANY	WFC3/UVIS, ACCUM, UVIS1	F656N			Prime + Parallel Group 8-9 in Positive offset positions (01)	900 Secs *[==>1289.0 Secs]*	 ***[2]***
10	positive pos 2 (416356)	(1) SH2-308-SW-LI MB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,29	Prime + Parallel Group 10-11 in Positive offset positions (01)	1300 Secs *[==>]*	 ***[3]***
11		ANY	WFC3/UVIS, ACCUM, UVIS1	F502N			Prime + Parallel Group 10-11 in Positive offset positions (01)	900 Secs *[==>1299.0 Secs]*	 ***[3]***
12	positive pos 2 + dither (416356)	(1) SH2-308-SW-LI MB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,29.5	Prime + Parallel Group 12-13 in Positive offset positions (01)	1300 Secs *[==>1364.0 Secs]*	 ***[3]***
13		ANY	WFC3/UVIS, ACCUM, UVIS1	F656N			Prime + Parallel Group 12-13 in Positive offset positions (01)	900 Secs *[==>1289.0 Secs]*	 ***[3]***
14	positive pos 3 (416356)	(1) SH2-308-SW-LI MB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,+41.5	Prime + Parallel Group 14-15 in Positive offset positions (01)	1300 Secs *[==>]*	 ***[4]***
15		ANY	WFC3/UVIS, ACCUM, UVIS1	F502N			Prime + Parallel Group 14-15 in Positive offset positions (01)	900 Secs *[==>1299.0 Secs]*	 ***[4]***
16	positive pos 3 + dither (416356)	(1) SH2-308-SW-LI MB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,+42.0	Prime + Parallel Group 16-17 in Positive offset positions (01)	1300 Secs *[==>1364.0 Secs]*	 ***[4]***
17		ANY	WFC3/UVIS, ACCUM, UVIS1	F656N			Prime + Parallel Group 16-17 in Positive offset positions (01)	900 Secs *[==>1289.0 Secs]*	 ***[4]***
18	positive pos 4 (416356)	(1) SH2-308-SW-LI MB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,+54	Prime + Parallel Group 18-19 in Positive offset positions (01)	1300 Secs *[==>1332.0 Secs]*	 ***[5]***

	19		ANY	WFC3/UVIS, ACCUM, UVIS1	F502N		Prime + Parallel Group 18-19 in Positive offset positions (01)	900 Secs *[==>1331.0 Secs]*	 ***[5]***
	20	positive pos 4 + dither (416356)	(1) SH2-308-SW-LI MB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A	POS TARG null,54.5	Prime + Parallel Group 20-21 in Positive offset positions (01)	1300 Secs *[==>1332.0 Secs]*	 ***[5]***
	21		ANY	WFC3/UVIS, ACCUM, UVIS1	F656N		Prime + Parallel Group 20-21 in Positive offset positions (01)	900 Secs *[==>1257.0 Secs]*	 ***[5]***

Orbit Structure



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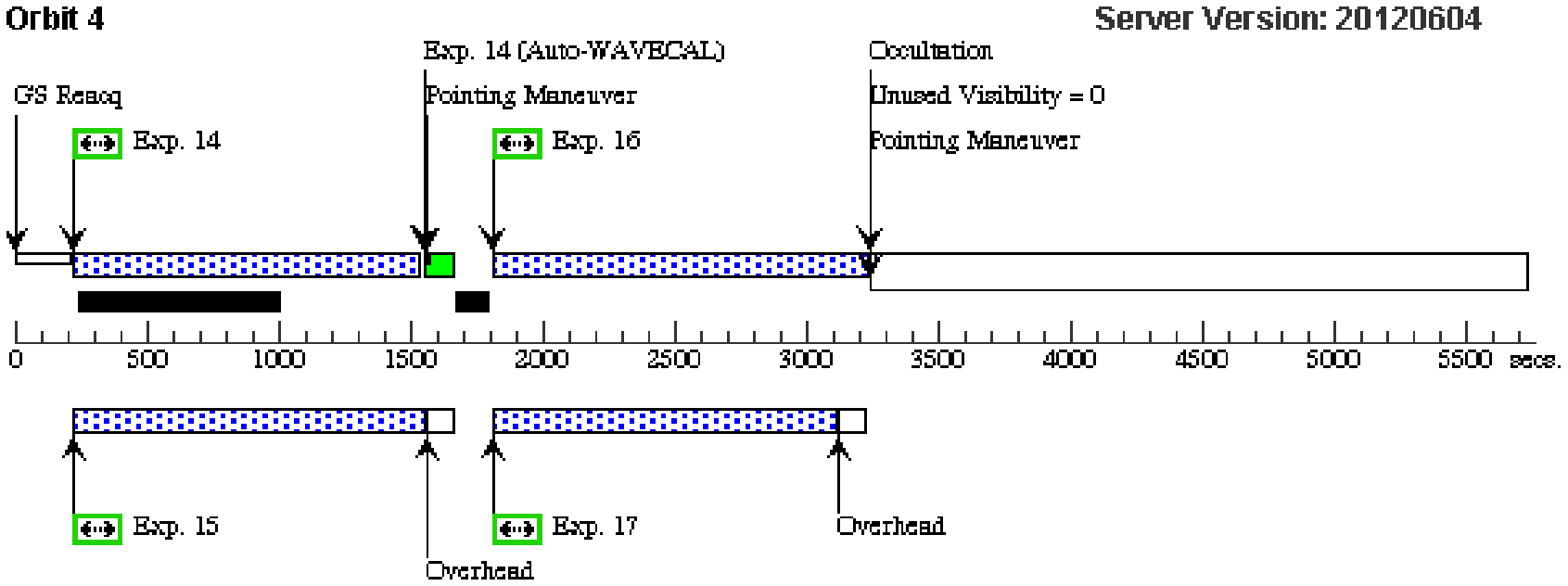
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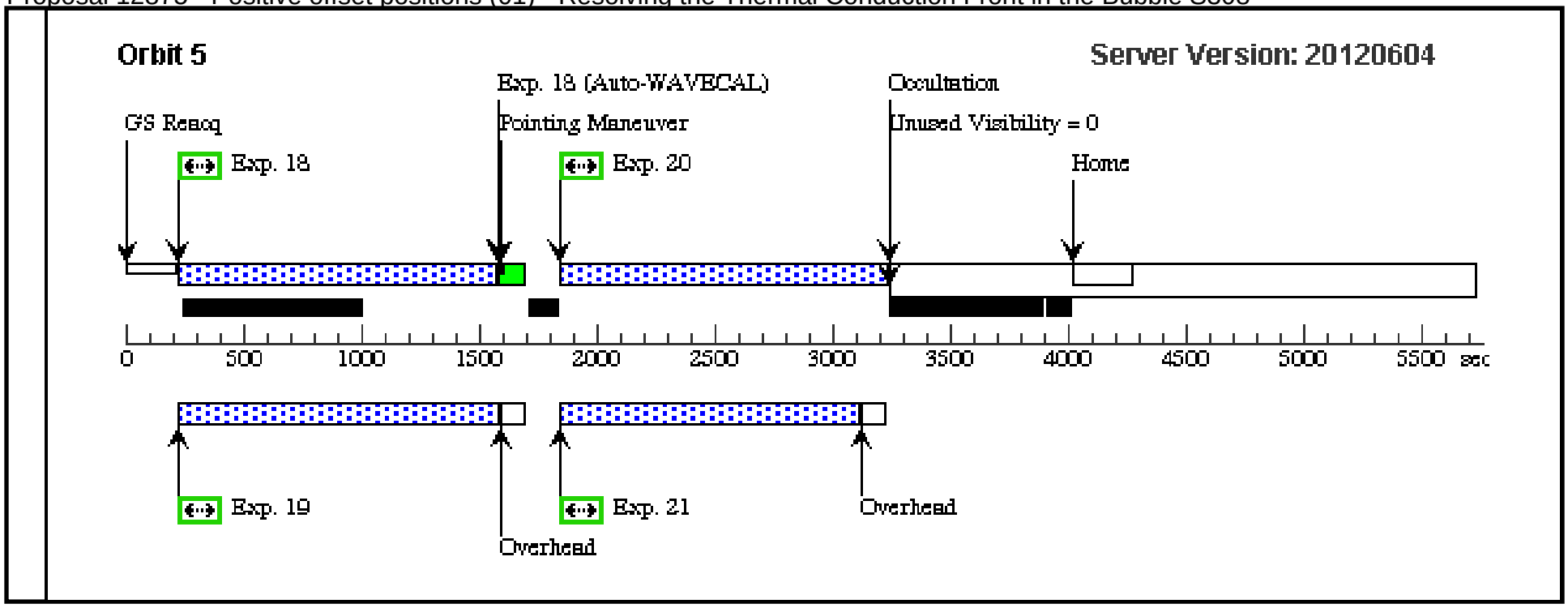
Overhead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sec
Exp. 19
Overhead
Exp. 21
Overhead

Visit

Proposal 12875, Negative Offset positions (02) Wed Jul 11 01:28:25 GMT 2012

Diagnostic Status: Warning

Scientific Instruments: STIS/CCD, WFC3/UVIS, STIS/FUV-MAMA

Special Requirements: ORIENT -5D TO 5D FROM 01

Comments: Offsets in negative (POSTARG Y) direction. Note that the cumulative offset by more than the FOV of an individual slit position is intentional but generates warnings.

Diagnostics

(Negative Offset positions (02)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE

(Negative Offset positions (02)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE

(Negative Offset positions (02)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE

(Negative Offset positions (02)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE

Fixed Targets

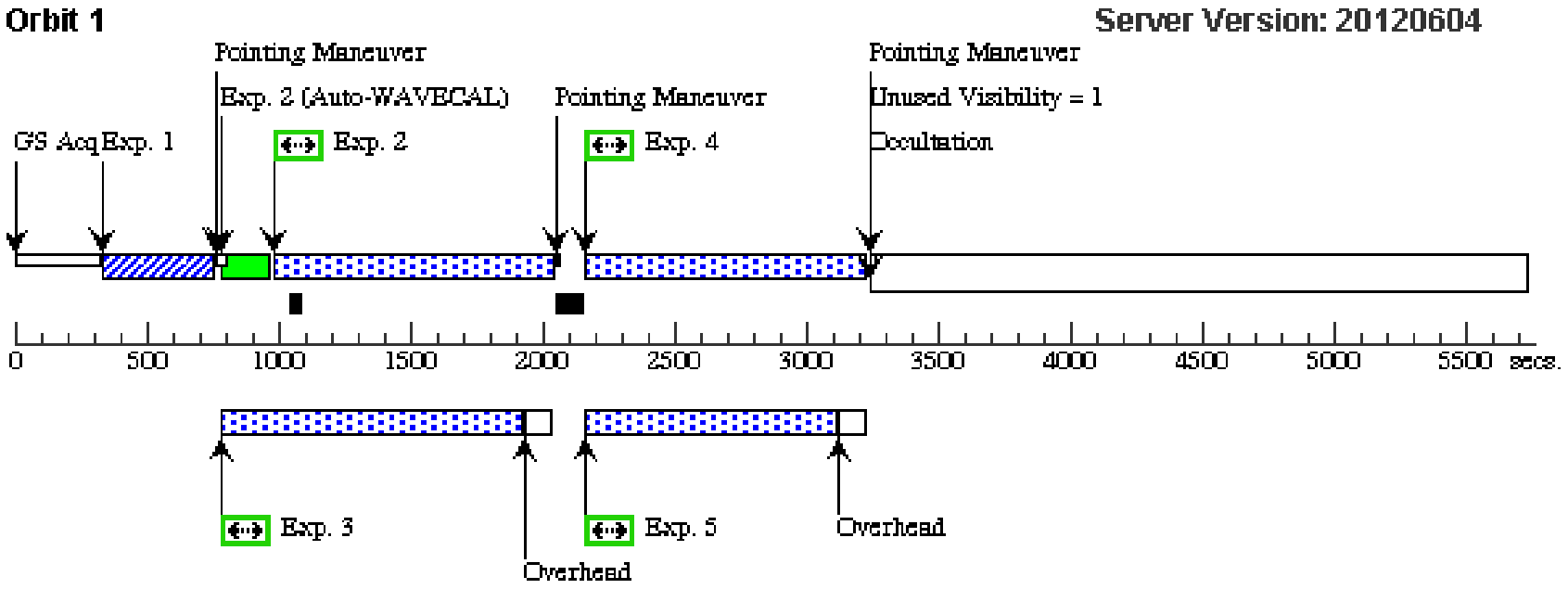
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SH2-308-SW-LIMB	RA: 06 53 12.0390 (103.3001625d) Dec: -24 03 13.79 (-24.05383d) Equinox: J2000		V=11.5+/-0.2	Reference Frame: ICRS
(2)	SH2-308-SW-LIMB-ACQSTAR Alt Name1: 2MASSJ06531583-2403146	RA: 06 53 15.8400 (103.3160000d) Dec: -24 03 14.64 (-24.05407d) Equinox: J2000		V=14.1+/-0.5 J=12.99, H=12.66, K=12.60	Reference Frame: ICRS

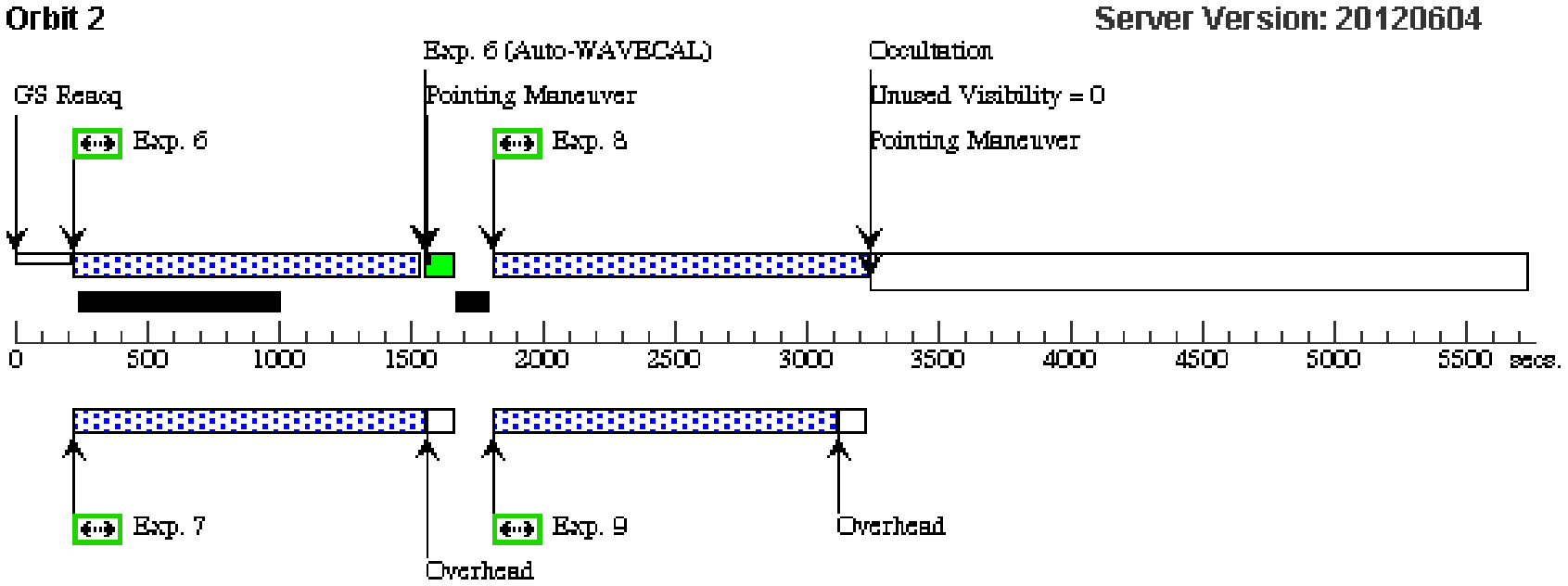
Comments: Star is 2MASS 06531583-2403146. Flux densities from 2MASS and USNOB1.0 are consistent with it being a G4 V star.

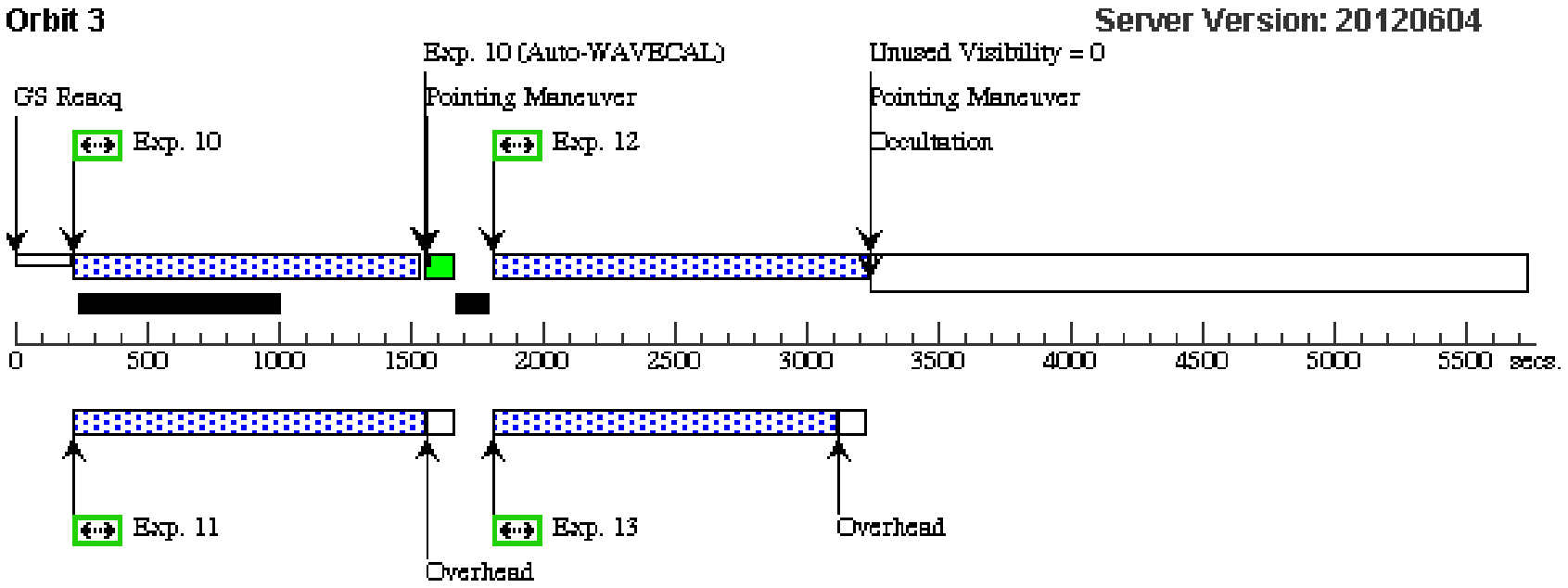
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	(416230)	(2) SH2-308-SW-LIMB-ACQSTAR	STIS/CCD, ACQ, F25ND3	MIRROR				32 Secs *[==>]*	 ***[1]***
Comments: This star sits amid filamentrary emission. Nearest star with even moderately comparable brightness is roughly 26 arseconds northeast.									
2	negative pos 1 (416356)	(1) SH2-308-SW-LIMB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,-8.0	Prime + Parallel Group 2-3 in Negative Offset positions (02)	1000 Secs *[==>]*	 ***[1]***
3		ANY	WFC3/UVIS, ACCUM, UVIS1	F502N			Prime + Parallel Group 2-3 in Negative Offset positions (02)	900 Secs *[==>1108.0 Secs]*	 ***[1]***
4	negative pos 1 + dither (416356)	(1) SH2-308-SW-LIMB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,-8.5	Prime + Parallel Group 4-5 in Negative Offset positions (02)	1000 Secs *[==>1051.0 Secs]*	 ***[1]***
5		ANY	WFC3/UVIS, ACCUM, UVIS1	F656N			Prime + Parallel Group 4-5 in Negative Offset positions (02)	900 Secs *[==>934.0 Secs]*	 ***[1]***
6	negative pos 2 (416356)	(1) SH2-308-SW-LIMB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,-20.5	Prime + Parallel Group 6-7 in Negative Offset positions (02)	1300 Secs *[==>]*	 ***[2]***
7		ANY	WFC3/UVIS, ACCUM, UVIS1	F502N			Prime + Parallel Group 6-7 in Negative Offset positions (02)	900 Secs *[==>1299.0 Secs]*	 ***[2]***
8	negative pos 2 + dither (416356)	(1) SH2-308-SW-LIMB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,-21.0	Prime + Parallel Group 8-9 in Negative Offset positions (02)	1300 Secs *[==>1364.0 Secs]*	 ***[2]***
9		ANY	WFC3/UVIS, ACCUM, UVIS1	F656N			Prime + Parallel Group 8-9 in Negative Offset positions (02)	900 Secs *[==>1289.0 Secs]*	 ***[2]***
10	negative pos 3 (416356)	(1) SH2-308-SW-LIMB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,-33.0	Prime + Parallel Group 10-11 in Negative Offset positions (02)	1300 Secs *[==>]*	 ***[3]***
11		ANY	WFC3/UVIS, ACCUM, UVIS1	F502N			Prime + Parallel Group 10-11 in Negative Offset positions (02)	900 Secs *[==>1299.0 Secs]*	 ***[3]***
12	negative pos 3 + dither (416356)	(1) SH2-308-SW-LIMB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,-33.5	Prime + Parallel Group 12-13 in Negative Offset positions (02)	1300 Secs *[==>1364.0 Secs]*	 ***[3]***
13		ANY	WFC3/UVIS, ACCUM, UVIS1	F656N			Prime + Parallel Group 12-13 in Negative Offset positions (02)	900 Secs *[==>1289.0 Secs]*	 ***[3]***
14	negative pos 4 (416356)	(1) SH2-308-SW-LIMB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,-45.5	Prime + Parallel Group 14-15 in Negative Offset positions (02)	1300 Secs *[==>]*	 ***[4]***
15		ANY	WFC3/UVIS, ACCUM, UVIS1	F502N			Prime + Parallel Group 14-15 in Negative Offset positions (02)	900 Secs *[==>1299.0 Secs]*	 ***[4]***
16	negative pos 4 + dither (416356)	(1) SH2-308-SW-LIMB	STIS/FUV-MAMA, ACCUM, 52X0.5	G140L 1425 A		POS TARG null,-46.0	Prime + Parallel Group 16-17 in Negative Offset positions (02)	1300 Secs *[==>1364.0 Secs]*	 ***[4]***
17		ANY	WFC3/UVIS, ACCUM, UVIS1	F656N			Prime + Parallel Group 16-17 in Negative Offset positions (02)	900 Secs *[==>1289.0 Secs]*	 ***[4]***

Orbit Structure



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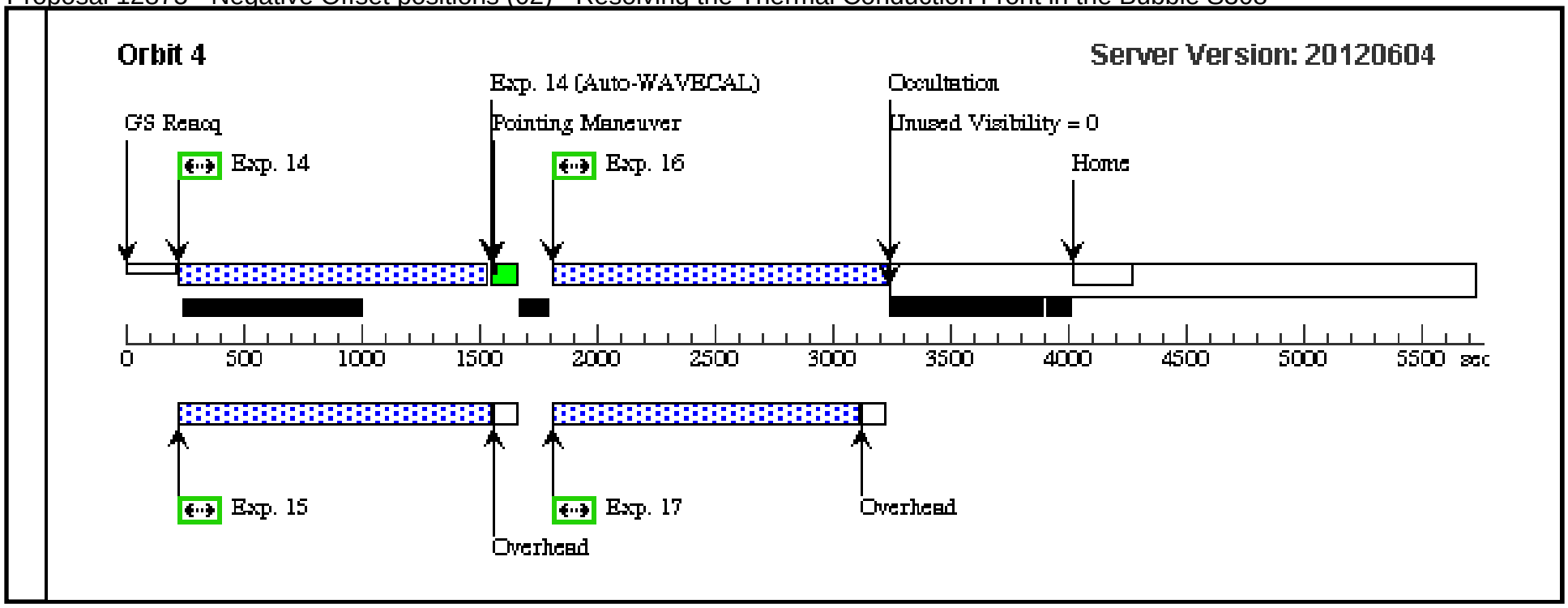
Overhead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Exp. 16
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1000
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3500
4000
4500
5000
5500
sec
Exp. 15
Exp. 17
Overhead
Overhead

Visit

Proposal 12875, imaging (03) Wed Jul 11 01:28:29 GMT 2012

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS, ACS/WFC

Special Requirements: ORIENT 120D TO 270 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-GAP-LINE	Coordinate Frame=POS-TARG		(1-2), (3-4)
	Purpose=MOSAIC	Pattern Orientation=85.759		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=4.414	Center Pattern=true		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SH2-308-SW-LIMB	RA: 06 53 12.0390 (103.3001625d) Dec: -24 03 13.79 (-24.05383d) Equinox: J2000		V=11.5+/-0.2	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) SH2-308-SW-LIMB	WFC3/UVIS, ACCUM, UVIS-CENTER	F502N			Pattern 1, Exps 1-2 in imaging (03) (1) Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in imaging (03)	800 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>1011.0 Secs (Pattern 3)]*	***[1]***
2		ANY	ACS/WFC, ACCUM, WFC1	F502N			Pattern 1, Exps 1-2 in imaging (03) (1) Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in imaging (03)	700 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>885.0 Secs (Pattern 3)]*	***[1]***
3		(1) SH2-308-SW-LIMB	WFC3/UVIS, ACCUM, UVIS-CENTER	F656N			Pattern 1, Exps 3-4 in imaging (03) (1) Prime + Parallel Group 3-4 in Pattern 1, Exps 3-4 in imaging (03)	800 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>1137.0 Secs (Pattern 3)]*	***[2]***
4		ANY	ACS/WFC, ACCUM, WFC1	F658N			Pattern 1, Exps 3-4 in imaging (03) (1) Prime + Parallel Group 3-4 in Pattern 1, Exps 3-4 in imaging (03)	700 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>1011.0 Secs (Pattern 3)]*	***[2]***

Orbit Structure