11619 - Definitive ISM Abundances through Low-mass X-ray Binaries as Lighthouses

Cycle: 17, 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) X-SCO-X-1	COS/FUV	1	06-May-2009 21:00:54.0	yes
02	(2) X-CYG-X-2	COS/FUV	4	06-May-2009 21:01:02.0	yes
03	(2) X-CYG-X-2	COS/FUV	4	06-May-2009 21:01:08.0	yes
04	(2) X-CYG-X-2	COS/FUV	4	06-May-2009 21:01:17.0	yes

13 Total Orbits Used

ABSTRACT

We propose observations of the UV spectra of two low-mass X-ray binaries (Sco X-1 and Cyg X-2) with existing Chandra X-Ray Observatory (CXO) data. From the X-ray data we will measure total (phase-independent) column densities of O, Ne, and Fe. From the UV data we will determine gas-phase column densities of H and O. The data in conjunction will allow us to make unique measurements of the total interstellar abundances of oxygen, neon, and iron, and direct measurements of the dust-phase abundances of O and Fe.

OBSERVING DESCRIPTION

We have been allotted 13 orbits to observe the ISM in the lines of sight toward two low-mass X-ray binaries, Sco X-1 and Cyg X-2. These lines of sight have X-ray spectra available in the Chandra archives, and our observations are intended to supplement that data by providing information on the gas-phase column densities, most importantly O I and H I. Combined with information from absorption edges found in the X-ray spectra, this will provide a unique disambiguation of abundances between the gas and dust phases in the diffuse ISM.

Slight modifications to this program have been made from Phase I, changes that were relatively small and were submitted to this program's Contact Scientist, Dr. Christina Oliveira. Dr. Oliveira in turn submitted these changes to the lead Contact Scientist, who approved the changes.

Our two targets are Sco X-1 and Cyg X-2. Sco X-1 is far brighter; we allocate one of our orbits to Sco X-1 and the remaining 12 orbits to Cyg X-2. The 12 Cyg X-2 orbits are requested to be in shadow, because measuring O I through the weak 1355.6 A line is a primary science goal, and shadow is particularly important for this wavelength. The total science exposure times for these two objects are 1688 s for Sco X-1 and 21,284 s for Cyg X-2.

The target signal-to-noise ratio (S/N) for Sco X-1 is 50 at the 1355.6 A O I line. Running the available HST and IUE spectra (which do not resolve the features we are looking for and are at poorer S/N) through the COS Spectroscopic ETC indicates that S/N of 54 will be obtained. The target S/N for Cyg X-2 is 20 (minimum) at the 1355.6 A O I line. Running the available IUE spectra through the COS Spectroscopic ETC indicates that S/N of 30 will be obtained (an average flux for this variable object and low airglow---i.e. shadow---are assumed on the ETC).

The science exposures will be taken in the COS/FUV mode, using the G130M grating at the 1291 A central wavelength. This minimum wavelength

is selected in order to maximize the chance of obtaining information on the Fe II triplet at 1142, 1143, and 1144 A. (Though throughput at these wavelengths is uncertain, they will be recorded by COS and will prove useful depending on the response of the HST optics.)

For each target we will use a target acquisition strategy that utilizes, in turn, ACQ/SEARCH, ACQ/PEAKXD, and ACQ/PEAKD in the same instrumental configuration as the science observations (COS/FUV with the G130M grating and a central wavelength of 1291). A search size of 3"x3" will be used for ACQ/SEARCH, in order to be conservative with regard to the coordinates. See comments elsewhere for more discussion on the quality of the coordinates.

FP-SPLIT procedures will be applied to both observations---the AUTO setting will be used for Sco X-1, while manual determinations of the FP-POS parameter will be used for Cyg X-2. In the three visits for Cyg X-2, the first orbits of each visit, which have less available science exposure time due to the acquisition procedures, will be taken at a different FP-POS value. In the end, the different FP-POS values will have the following amounts of science exposure time:
FP-POS=1: 5562 (1854*3) s
FP-POS=2: 5195 (1854*2+1487) s
FP-POS=3: 5265 (1854*2+1557) s
FP-POS=4: 5262 (1854*2+1554) s
Total: 21,284 s

Knowledge of the target coordinates is discussed in the "Comments" sections of "Targets". Bright limit concerns (or the lack thereof) are discussed in the "Additional Comments" below as well as the "Comments" sections of Visits 1 and 2.

ADDITIONAL COMMENTS
UPDATE: Comments below are from a previous submission. This submission is updated to have turned off data segment B (the short wavelength segment of the FUV detector) for Target 1 (Sco X-1) due to bright limit concerns.

As noted above, a request for slight changes to this program was submitted, through this program's Contact Scientist (Dr. Christina Oliveira), to the

lead Contact Scientist, and these changes were approved. The driving factor behind these changes was that further investigation after Phase I significantly relaxed our concerns about local bright limits. If bright limits are not a concern, the short wavelength segment of the FUV channel (the B segment) can remain on, instead of being turned off (as requested in Phase I). No local bright limit concerns exist for Cyg X-2. For Sco X-1, marginal local bright limit concerns exist. (Note that global bright limits are not a concern for either object.) The local bright limit concerns for Sco X-1 have been discussed with the Contact Scientist (Dr. Oliveira), and also were included in the discussion sent to the lead Contact Scientist. These will be discussed in further detail in the main "Comments" section of Visit 1.

Visit

Proposal 11619, Visit 01, implementation Thu May 07 01:01:21 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV

Special Requirements: (none)

Comments: UPDATE: Newest submission turns off data segment B of the FUV detector to alleviate bright limit concerns. Please ignore bright limit discussion below.

One visit consisting of one orbit will be used for Sco X-1. The target acquisition strategy for Sco X-1 is to perform a sequence of ACQ/SEARCH, ACQ/PEAKXD, and ACQ/PEAKD using the same instrumental configuration as the science exposure---the COS/FUV mode with the G130M grating at the 1291 angstrom central wavelength.

The total science exposure time is 1688 s. We have set the FP-POS option to "auto", therefore, the science exposure will be performed in four sub-exposures of 422 s each, covering each FP-POS setting. Buffer time using the COS Spectroscopic ETC has been calculated to be 242 s, so we set our buffer time to ~2/3 of this, to 159 s (the slight difference is due to optimizing available observation time). Only three seconds of unused orbit visibility remain after our attempts at optimization.

The target flags both local and global count rates in the Bright Object Tool based on the assumption that our target is an O5V star. The target is not an O5V star, but rather a low-mass X-ray binary with a relatively flat spectrum of ~2x10^-13 ergs/s/cm^2/A. The spectrum has emission lines, the most prominent of which are N V emission lines at ~1240 A. When an existing GHRS spectrum is run through the COS Spectroscopic ETC, a marginal (<2%) violation of the local count rate limit for variable objects occurs. However, we believe that available rough upper limits on the object's variability show that the object is well below the true local count rate limits (i.e. the non-variable case).

Both IUE and HST (GHRS) data have been taken of Sco X-1. These data are shown in Kallman et al. (1991), Vrtilek et al. (1991), and Kallman et al. (1998), with the former two discussing the IUE data and the 1998 paper discussing the HST data. Kallman et al. (1998) note that the UV line variability is ~20% for time scales as small as 0.5 hour.

When the GHRS data of data set Z34C010CT are run through the COS Spectroscopic ETC, it produces a marginal warning that the object exceeds the local bright limit for variable objects---the brightest pixel is 0.69 counts/s, the variable object local bright limit for COS in this arrangement is 0.67 counts/s. The IUE spectra for Sco X-1 show that the N V emission never exceeds about ~8x10^-13 erg/s/cm^2/A at its peak in 70 observations that span ~10 years (note that this is at low-resolution, but the lines are intrinsically very broad so the maximum flux should be only a factor of ~2 more at its peak). The maximum flux in the high-resolution GHRS data is ~1.5x10^-12 erg/s/cm^2/A. Again, however, this bright limit is for the variable case, which is a factor of 2.5 less than the actual local bright limit for nonvariable objects.

The integrated N V emission of the Z34C010CT data set is 3.8x10^-12 erg/s/cm^2, assuming a constant continuum level of 2.0x10^-13 erg/s/cm^2/A. This can be compared to Table 2 in Vrtilek et al. (1991), which lists N V line fluxes for 28 observations of Sco X-1. The average flux is 3.4x10^-12 erg/s/cm^2, with a standard deviation of 1.2x10^-12 erg/s/cm^2. The median line flux is 3.8x10^-12 erg/s/cm^2, while the maximum is 5.0x10^-12 erg/s/cm^2. Therefore, the worst-case, most conservative scenario is that if the object is putting out this maximum flux, the variable local bright limit is exceeded by ~25%, but the object is under the nonvariable bright limit by a factor of ~2. Note that the average case is then only a marginal concern, and a below-average output case presents no concerns whatsoever.

However, the integrated flux of the N V line in the Z34C010CT data set may be an underestimate, because the wavelength coverage of the line is incomplete, and some of the integrated flux may be omitted. If this is the case, the Z34C010CT data set is slightly closer to the maximum case and the worst-case scenario presented above is even less of a concern.

Though Sco X-1 should have some instrinsic emission at Lyman-alpha, the emission present in IUE and HST spectra is clearly geocoronal. This is known part because the column density of interstellar H I is ~10^21 cm^-2 (based on previous measurements in these spectra). With such a large interstellar optical depth, the sharp emission at line center cannot be intrinsic to the source.

In the event that we have not made the case that these observations pose little-to-no risk to the COS instrument, an alternate strategy is simple---for each exposure in Visit 1 (including the acquisition exposures), the optional parameter SEGMENT=A should be added, so that only the A segment is recorded, and the short wavelength B segment is not recorded. However, this is by far the less-preferable option and should only be employed if the risk to the COS instrument is unacceptable. (Our primary science goal of measuring the 1355.6 A line of O I would still be met, but other science goals would be sacrificed). In this Phase II proposal, the SEGMENT parameter has been ignored, meaning that both segments will be recorded.

There are no other nearby objects which flag the Bright Object Tool.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	X-SCO-X-1	RA: 16 19 55.0600 (244.9794167d)		V=12.2	Reference Frame: ICRS
	Alt Name1: SCO-X-1	Dec: -15 38 24.90 (-15.64025d)		~2x10^-13 erg/s/cm^2/A flat spectrum in the UV, as observed with FUSE, IUE, and GHRS	
		Equinox: J2000			

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

Proper motion unknown.

SIMBAD Coordinates:
16 19 55.07 -15 38 24.80
MAST Coordinates from previous observations:
16 19 55.06 -15 38 24.9

Target coordinates initially obtained with SIMBAD, but the source reference (Liu et al. 2007) was also consulted. Liu et al. 2007 does not give specific errors on coordinates, but indicates that unspecified errors are generally less than 1". Coordinates in J2000 reference frame from previous HST observations were adopted instead (difference is trivial---0.01 s of RA, 0.1" of DEC).

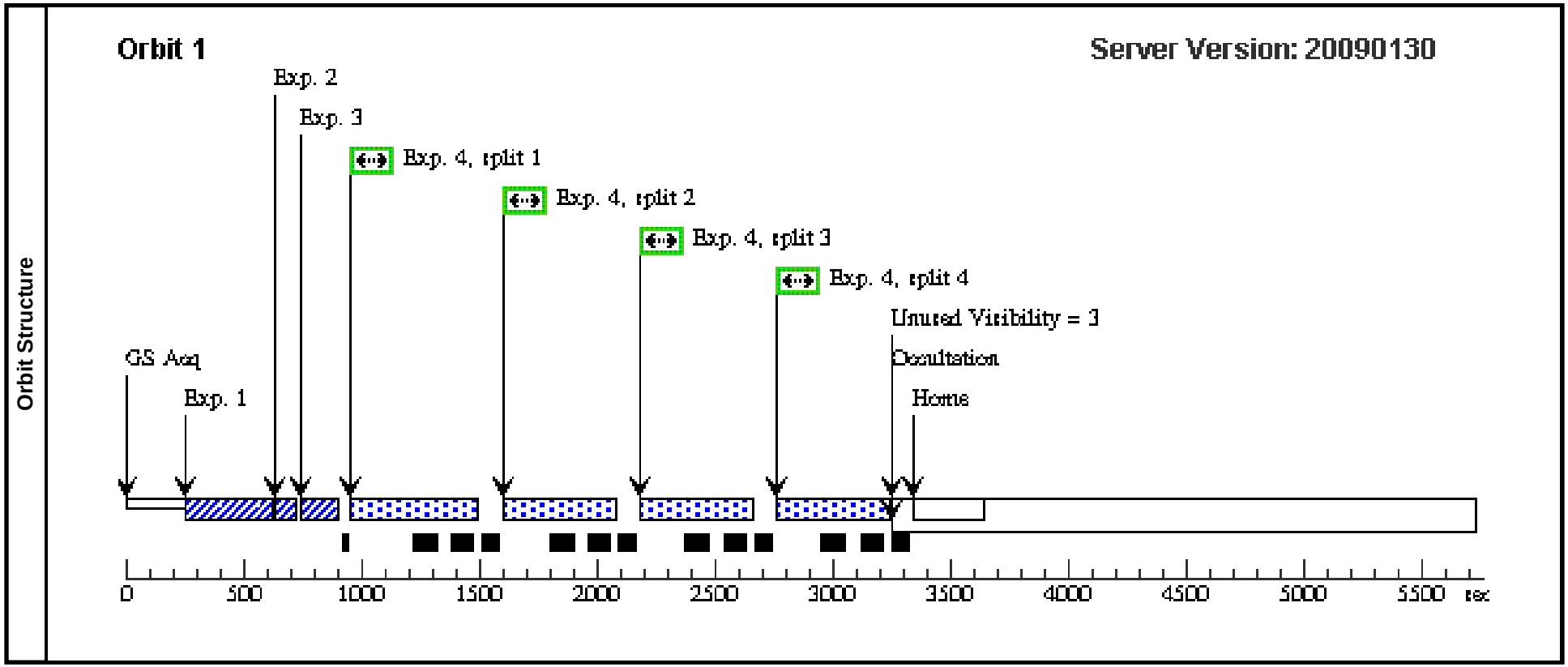
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) X-SCO-X-1	COS/FUV, ACQ/SEARCH, PSA	G130M	SCAN-SIZE=3;			1 Secs	
				1291 A	SEGMENT=A			*[==>]*	***[1]***
Comments: Segment=A enacted for bright limit concerns at ~1240 angstroms due to N V emission lines. SCAN-SIZE=3 selected in order to be conservative with regard to coordinates. See comments on coordinates in "Target" section. For discussion of bright limits, see main "Comments" section of this visit.									
2		(1) X-SCO-X-1	COS/FUV, ACQ/PEAKXD, PSA	G130M	SEGMENT=A			1 Secs	
				1291 A				*[==>]*	***[1]***
Comments: Segment=A enacted for bright limit concerns at ~1240 angstroms due to N V emission lines.									
3		(1) X-SCO-X-1	COS/FUV, ACQ/PEAKD, PSA	G130M	NUM-POS=5.0;			1 Secs	
				1291 A	STEP-SIZE=1.2;			*[==>]*	***[1]***
					SEGMENT=A				
Comments: Segment=A enacted for bright limit concerns at ~1240 angstroms due to N V emission lines. Optional NUM-POS and STEP-SIZE parameters based on recommendations of COS Science Team.									
4		(1) X-SCO-X-1	COS/FUV, TIME-TAG, PSA	G130M	FP-POS=AUTO;			1688 Secs	
				1291 A	BUFFER-TIME=160.0;			*[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	***[1]***
					SEGMENT=A;				
					FLASH=YES				

Comments: Segment=A enacted for bright limit concerns at ~1240 angstroms due to N V emission lines.

Buffer time calculated in the COS Spectroscopic ETC to be 242 s. This calculation assumes that both segments are on. However, the count rate from Segment A only is 4764.6 counts/s, which would result in a buffer time of 493 s (as calculated by the COS Spectroscopic ETC).

2/3 of the ETC buffer time would therefore be 329 s. We elect to further reduce the buffer time because of the potential variability of the object. We select a buffer time of 160 s, which is ~2/3 of the COS Spectroscopic ETC calculation assuming both segments on and maximizes observation time for buffer times <~250 s.


Orbit Structure
Orbit 1
Server Version: 20090130
Exp. 2
Exp. 3
Exp. 4, split 1
Exp. 4, split 2
Exp. 4, split 3
Exp. 4, split 4
Unused Visibility = 3
GS Acq
Exp. 1
Occultation
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 11619, Visit 02, implementation Thu May 07 01:01:23 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV

Special Requirements: ORIENT 190D TO 150 D; GROUP 02,03,04 WITHIN 30D

Comments: Three visits of four orbits each will be used for Cyg X-2. The target acquisition strategy for Cyg X-2 is to perform a sequence of ACQ/SEARCH, ACQ/PEAKXD, and ACQ/PEAKD using the same instrumental configuration as the science exposure---the COS/FUV mode with the G130M grating at the 1291 angstrom central wavelength. We have added the special requirement of "shadow" for these orbits, as our primary science goal is to measure the 1355.6 A line of O I, which is greatly affected by airglow.

The total science exposure time is 21,357 s. We manually set the FP-POS parameter in each exposure, so that all four FP-POS values are sampled. The science exposure time in the first orbit of each visit is 1557 s, while the science exposure time in the remaining three orbits is 1854 s (each orbit). Buffer time using the COS Spectroscopic ETC has been calculated to be 1907 s. Because we only take one science exposure per orbit, the overhead of the buffer time is not a concern, and as long as we do not set our buffer time to be too short (where data would be lost), we are free to choose our buffer time as long as it is less than ~2/3 of the ETC calculated value (which in this case would be ~1200 s). We therefore choose to set the buffer time to 1000 s.

Though Cyg X-2 should have some instrinsic emission at Lyman-alpha, the emission present in IUE and HST spectra is clearly geocoronal. This is known in part because the column density of interstellar H I is ~10^21 cm^-2 (this is estimated by the column densities of other elements derived through X-ray spectra, then applying reasonable abundances relative to hydrogen). With such a large interstellar optical depth, the sharp emission at line center cannot be intrinsic to the source. There are no other features of the spectra that would cause either local or global count rate concerns.

Note that Visits 2, 3, and 4 are identical, except that the value of the FP-POS parameters of the science exposures have been toggled so that the first orbits of each visit (with the shorter science exposure due to acquisition time) are at different FP-POS values.

There are, in essence, two scheduling windows for Cyg X-2---one continuous window (26 Aug 2008 to 16 Oct 2008) which may not happen after SM4 and three smaller, closely spaced windows (1 Aug 2009 to 24 Aug 2009, 7 Sep 2009 to 29 Sep 2009, and 12 Oct 2009 to 31 Oct 2009). While the object is variable even on timescales shorter than an orbit, it would be preferable to limit the three separate visits to all be accomplished in one of these two windows so that any variability on the timescale of one year is not an issue. Therefore, we have specified a scheduling restriction that all three visits occur within 30 days to reduce some of the variability, but still provide somewhat flexible scheduling. This restriction has been specified on Visit 2, but not on Visits 3 and 4, per the instructions of this program's PC.

A roll (orient) constraint, allowing for orientations of 190-360 degrees or 0-150 degrees (i.e. excluding 150-190 degrees) has been added in order to keep a nearby object out of the BOA. This object poses no bright object concerns according to the Bright Object Tool, and is unlikely to affect target acquisition because it is apparently dimmer than our target (and further dimmed if it falls in the BOA) and is outside the 3x3 ACQ/SEARCH area. However, we have specified this constraint in order to be conservative, and because the visit planner indicates that scheduling is not affected (implying that the orient constraint is already met due to other constraints).

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	X-CYG-X-2	RA: 21 44 41.1000 (326.1712500d)		V=14.5	Reference Frame: ICRS
	Alt Name1: CYG-X-2	Dec: +38 19 16.40 (38.32122d)		~5x10^-15 erg/cm^2/s/A flat spectrum in the UV as observed in several IUE/HST spectra	
		Equinox: J2000			

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

Proper motion unknown.

SIMBAD Coordinates
21 44 41.20 +38 19 18.0
MAST Coordinates from previous observations
21 44 41.10 +38 19 16.4

Target coordinates initially obtained with SIMBAD, but the source reference (Liu et al. 2007) was also consulted. Liu et al. 2007 does not give specific errors on coordinates, but indicates that unspecified errors are generally less than 1". Coordinates in J2000 reference frame from previous HST observations were adopted instead. Adopting new coordinates shows a slight improvement in pointing when viewed in Aladdin or the target confirmation charts (generated by a previous submission).

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(2) X-CYG-X-2	COS/FUV, ACQ/SEARCH, PSA	G130M	SCAN-SIZE=3			2.8 Secs	
				1291 A				*[==>]*	***[1]***

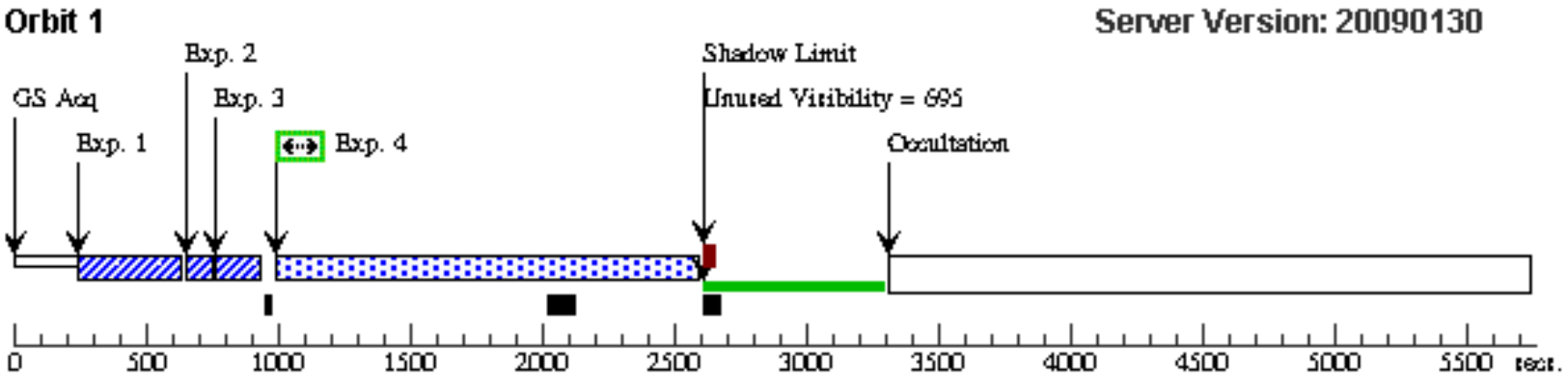
Comments: SCAN-SIZE=3 selected in order to be conservative with regard to coordinates. See comments on coordinates in "Target" section.

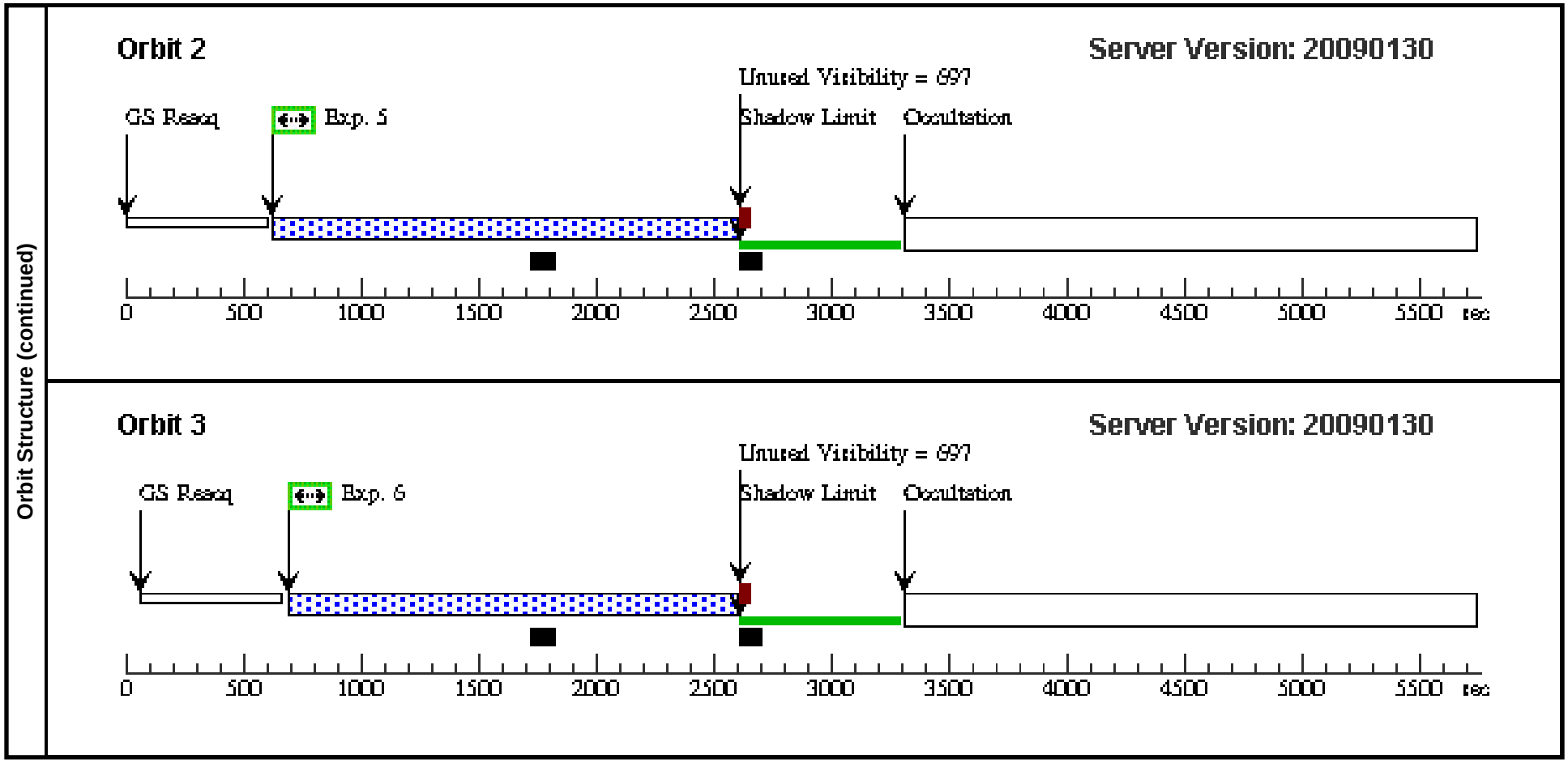
No bright object concerns. See main "Comments" section of this visit.

Exposures (continued)

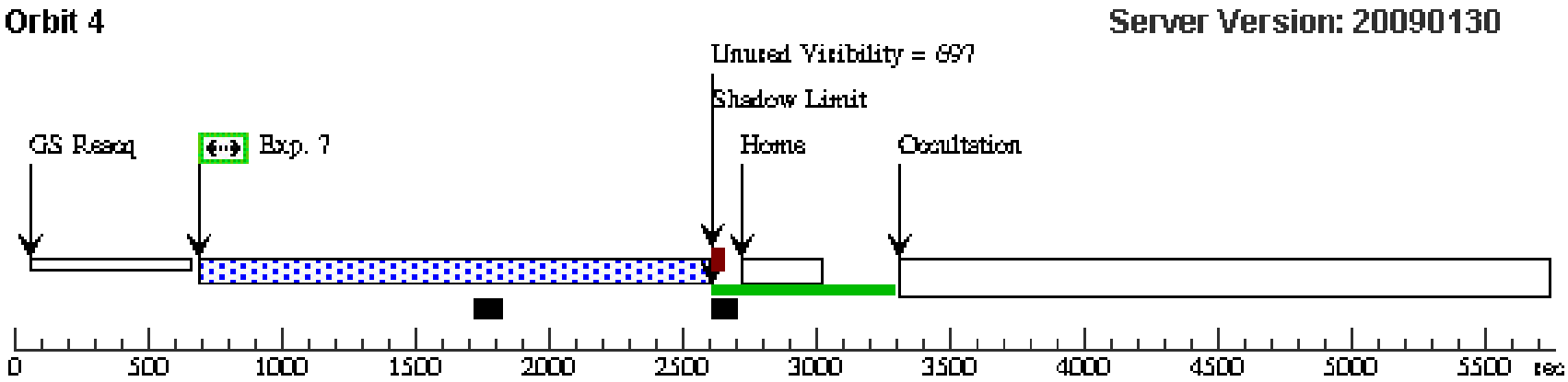
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
2		(2) X-CYG-X-2	COS/FUV, ACQ/PEAKXD, PSA	G130M 1291 A				2.8 Secs *[==>]*	 ***[1]***
3		(2) X-CYG-X-2	COS/FUV, ACQ/PEAKD, PSA	G130M 1291 A	NUM-POS=5.0; STEP-SIZE=1.2			2.8 Secs *[==>]*	 ***[1]***
Comments: Optional NUM-POS and STEP-SIZE parameters based on recommendations of COS Science Team.									
4		(2) X-CYG-X-2	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=1000.0; FP-POS=3; FLASH=YES	SHADOW		1552 Secs *[==>]*	 ***[1]***
5		(2) X-CYG-X-2	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=1000; FP-POS=1; FLASH=YES	SHADOW		1854 Secs *[==>]*	 ***[2]***
6		(2) X-CYG-X-2	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=1000; FP-POS=2; FLASH=YES	SHADOW		1854 Secs *[==>]*	 ***[3]***
7		(2) X-CYG-X-2	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=1000; FP-POS=4; FLASH=YES	SHADOW		1854 Secs *[==>]*	 ***[4]***

Orbit Structure




Orbit Structure (continued)
Orbit 2
Server Version: 20090130
Unused Visibility = 697
GS Reacq
Exp. 5
Shadow Limit
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec
Orbit 3
Server Version: 20090130
Unused Visibility = 697
GS Reacq
Exp. 6
Shadow Limit
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Orbit Structure (continued)



Visit

Proposal 11619, Visit 03, implementation Thu May 07 01:01:23 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV

Special Requirements: SAME ORIENT AS 02

Comments: Visits 2, 3, and 4 are identical, except that the value of the FP-POS parameters of the science exposures have been toggled so that the first orbits of each visit (with the shorter science exposure due to acquisition time) are at different FP-POS values.

See comments in various Visit 2 sections for additional information.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	X-CYG-X-2	RA: 21 44 41.1000 (326.1712500d)		V=14.5	Reference Frame: ICRS
	Alt Name1: CYG-X-2	Dec: +38 19 16.40 (38.32122d)		~5x10^-15 erg/cm^2/s/A flat spectrum in the UV as observed in several IUE/HST spectra	
		Equinox: J2000			

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

Proper motion unknown.

SIMBAD Coordinates
21 44 41.20 +38 19 18.0
MAST Coordinates from previous observations
21 44 41.10 +38 19 16.4

Target coordinates initially obtained with SIMBAD, but the source reference (Liu et al. 2007) was also consulted. Liu et al. 2007 does not give specific errors on coordinates, but indicates that unspecified errors are generally less than 1". Coordinates in J2000 reference frame from previous HST observations were adopted instead. Adopting new coordinates shows a slight improvement in pointing when viewed in Aladdin or the target confirmation charts (generated by a previous submission).

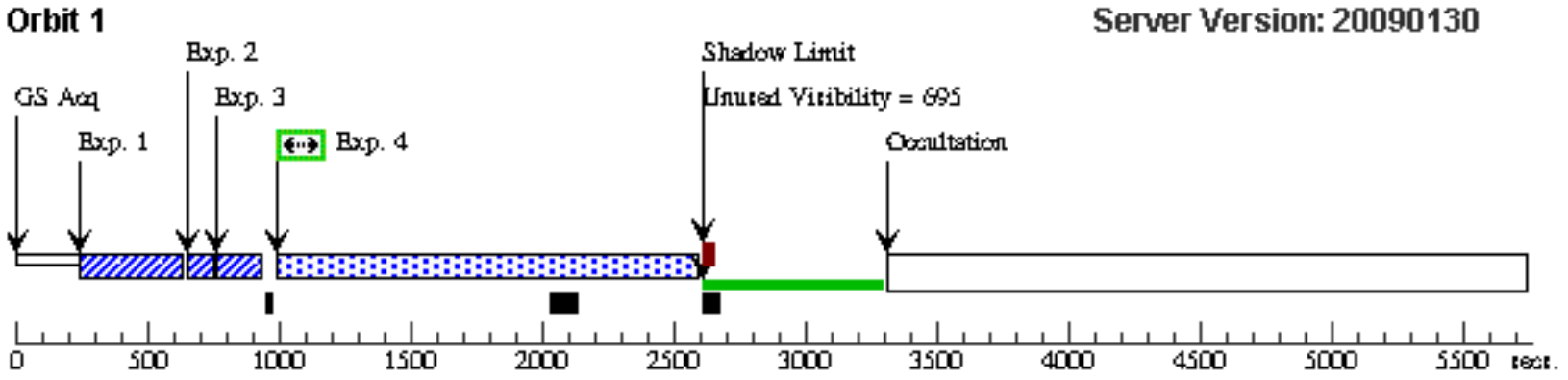
Exposures

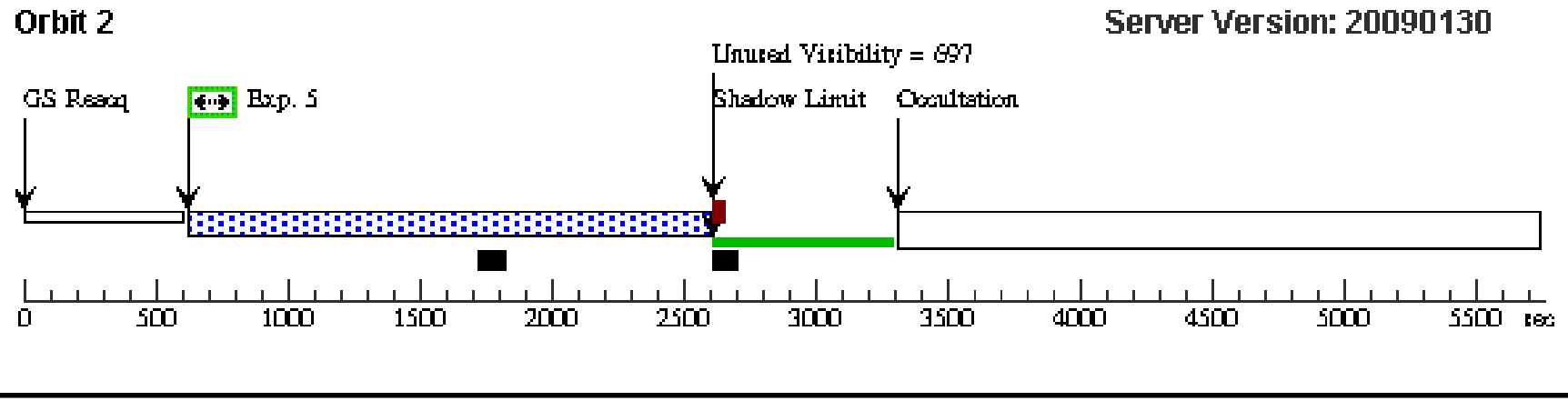
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(2) X-CYG-X-2	COS/FUV, ACQ/SEARCH, PSA	G130M 1291 A	SCAN-SIZE=3			2.8 Secs *[==>]*	 ***[1]***
2		(2) X-CYG-X-2	COS/FUV, ACQ/PEAKXD, PSA	G130M 1291 A				2.8 Secs *[==>]*	 ***[1]***
3		(2) X-CYG-X-2	COS/FUV, ACQ/PEAKD, PSA	G130M 1291 A	NUM-POS=5.0; STEP-SIZE=1.2			2.8 Secs *[==>]*	 ***[1]***
4		(2) X-CYG-X-2	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=1000.0; FP-POS=4; FLASH=YES	SHADOW		1549 Secs *[==>]*	 ***[1]***
5		(2) X-CYG-X-2	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=1000; FP-POS=1; FLASH=YES	SHADOW		1854 Secs *[==>]*	 ***[2]***
6		(2) X-CYG-X-2	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=1000; FP-POS=2; FLASH=YES	SHADOW		1854 Secs *[==>]*	 ***[3]***

Exposures (continued)

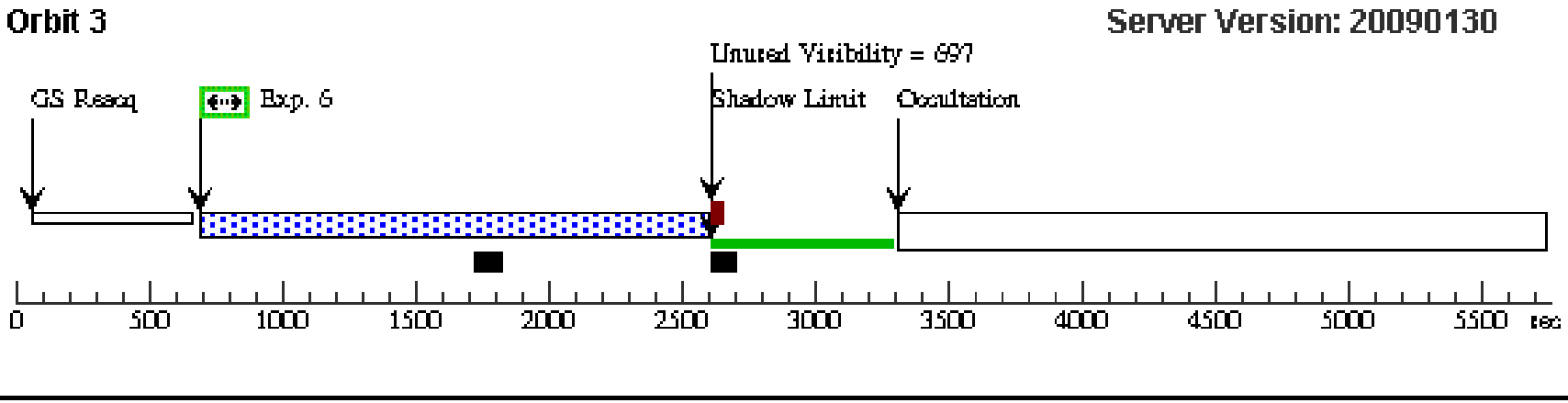
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
7		(2) X-CYG-X-2	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=1000; FP-POS=3; FLASH=YES	SHADOW		1854 Secs *[==>]*	*[4]*

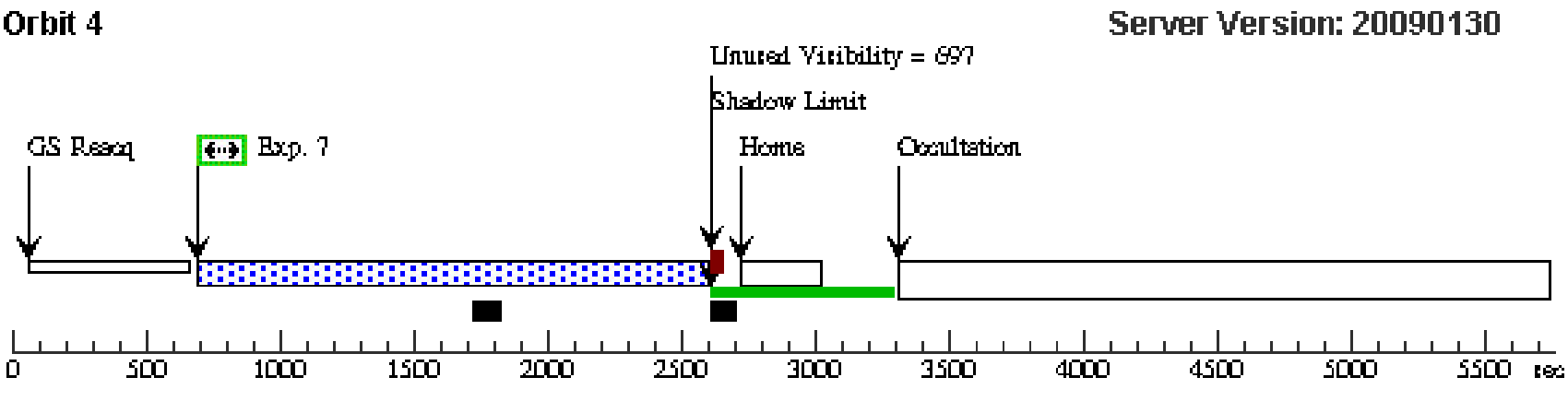
Orbit Structure





Orbit Structure (continued)





Visit

Proposal 11619, Visit 04, implementation Thu May 07 01:01:24 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV

Special Requirements: SAME ORIENT AS 02

Comments: Visits 2, 3, and 4 are identical, except that the value of the FP-POS parameters of the science exposures have been toggled so that the first orbits of each visit (with the shorter science exposure due to acquisition time) are at different FP-POS values.

See comments in various Visit 2 sections for additional information.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	X-CYG-X-2	RA: 21 44 41.1000 (326.1712500d)		V=14.5	Reference Frame: ICRS
	Alt Name1: CYG-X-2	Dec: +38 19 16.40 (38.32122d)		~5x10^-15 erg/cm^2/s/A flat spectrum in the UV as observed in several IUE/HST spectra	
		Equinox: J2000			

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

Proper motion unknown.

SIMBAD Coordinates
21 44 41.20 +38 19 18.0
MAST Coordinates from previous observations
21 44 41.10 +38 19 16.4

Target coordinates initially obtained with SIMBAD, but the source reference (Liu et al. 2007) was also consulted. Liu et al. 2007 does not give specific errors on coordinates, but indicates that unspecified errors are generally less than 1". Coordinates in J2000 reference frame from previous HST observations were adopted instead. Adopting new coordinates shows a slight improvement in pointing when viewed in Aladdin or the target confirmation charts (generated by a previous submission).

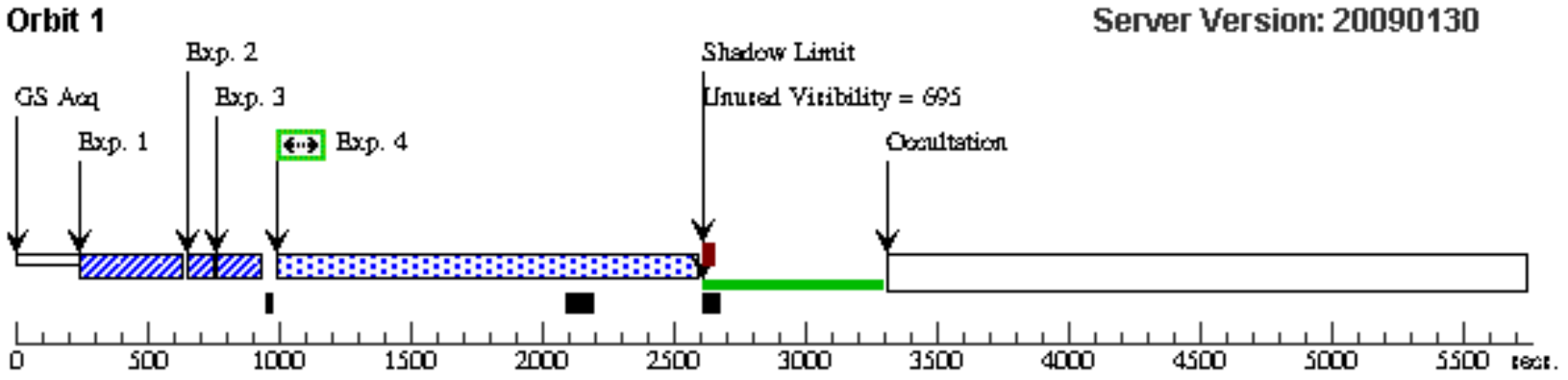
Exposures

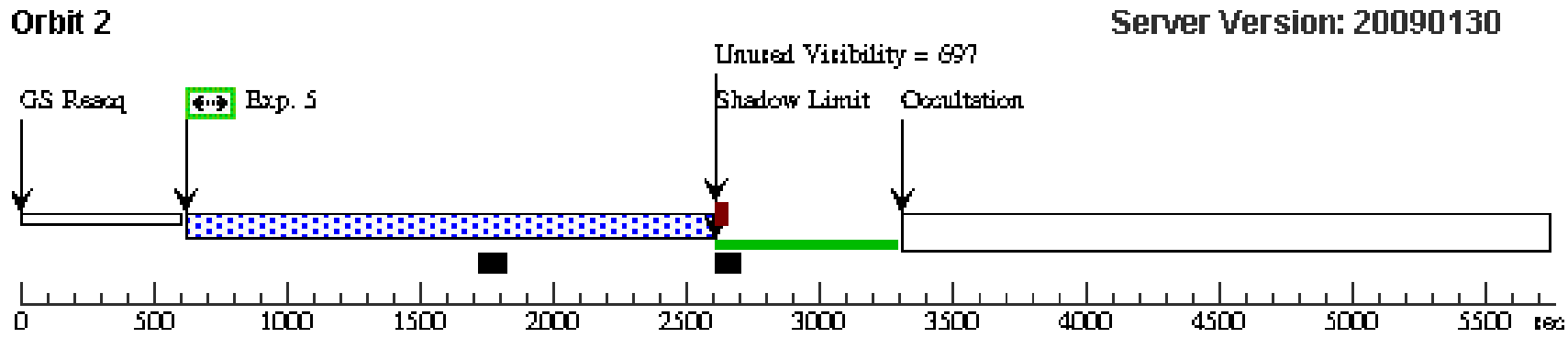
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(2) X-CYG-X-2	COS/FUV, ACQ/SEARCH, PSA	G130M 1291 A	SCAN-SIZE=3			2.8 Secs *[==>]*	***[1]***
2		(2) X-CYG-X-2	COS/FUV, ACQ/PEAKXD, PSA	G130M 1291 A				2.8 Secs *[==>]*	***[1]***
3		(2) X-CYG-X-2	COS/FUV, ACQ/PEAKD, PSA	G130M 1291 A	NUM-POS=5.0; STEP-SIZE=1.2			2.8 Secs *[==>]*	***[1]***
4		(2) X-CYG-X-2	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=1000.0; FP-POS=2; FLASH=YES	SHADOW		1482 Secs *[==>]*	***[1]***
5		(2) X-CYG-X-2	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=1000; FP-POS=1; FLASH=YES	SHADOW		1854 Secs *[==>]*	***[2]***
6		(2) X-CYG-X-2	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=1000; FP-POS=3; FLASH=YES	SHADOW		1854 Secs *[==>]*	***[3]***

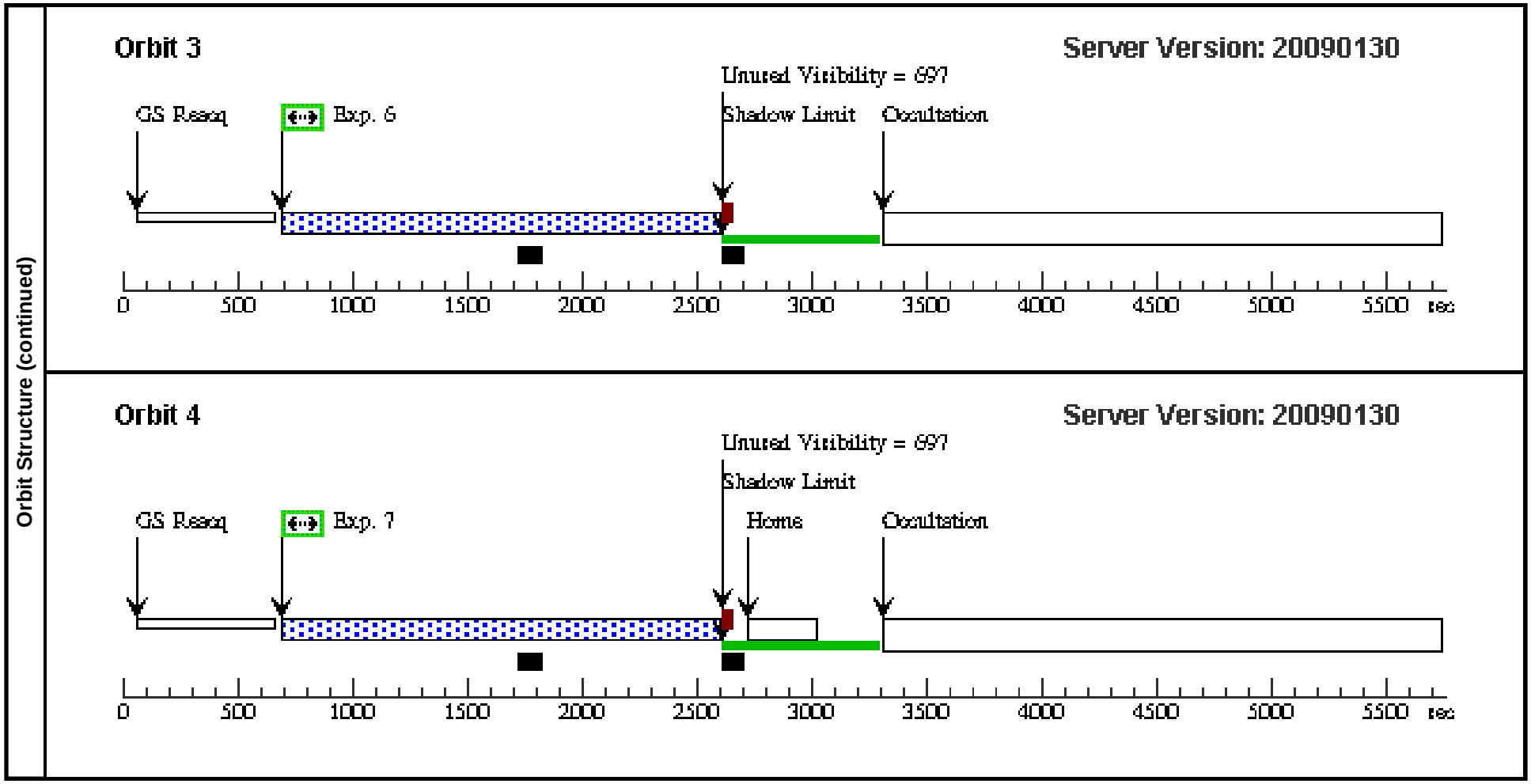
Exposures (continued)

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
7		(2) X-CYG-X-2	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=1000; FP-POS=4; FLASH=YES	SHADOW		1854 Secs *[==>]*	*[4]*

Orbit Structure






Orbit Structure (continued)
Orbit 3
Server Version: 20090130
Unused Visibility = 697
GS Reacq
Exp. 6
Shadow Limit
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec
Orbit 4
Server Version: 20090130
Unused Visibility = 697
Shadow Limit
GS Reacq
Exp. 7
Home
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec