11659 - Probing the Interior of SN1006

Cycle: 17, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. P. Frank Winkler (PI)	**Middlebury College**	**winkler@middlebury.edu**
Dr. Knox S. Long (CoI)	Space Telescope Science Institute	long@stsci.edu
Dr. Robert A. Fesen (CoI)	Dartmouth College	fesen@snr.dartmouth.edu
Dr. Andrew J. S. Hamilton (CoI)	University of Colorado at Boulder	andrew.hamilton@colorado.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) STAR-1503-4159	COS/FUV COS/NUV	1	12-Mar-2009 21:09:46.0	yes
02	(2) QSO-1503-4155	COS/FUV COS/NUV	5	12-Mar-2009 21:09:54.0	yes
03	(3) QSO-1504-4152	COS/FUV COS/NUV	4	12-Mar-2009 21:10:11.0	yes

10 Total Orbits Used

ABSTRACT

The remnant of SN 1006 is unique among all supernova remnants in having 3 identified background UV sources that can be used to probe cold, otherwise unseen ejecta within the remnant shell. We propose high-resolution spectra from COS to obtain spectra of all three of these. The brightest of these, the Schweizer-Middleditch star (the only one with extensive previous high-quality UV spectra) shows Si II absorption with an extremely unusual asymmetric profile with a sharp edge on the red end, indicating the velocity of material just entering the reverse shock. Our new spectrum can be compared with STIS observations from 1999 to measure definitively the velocity change as the reverse shock eats its way into ever-more-slowly-expanding ejecta. One may well ask, however, if this profile is truly representative, and we seek to answer that with a spectrum of a background quasar at a similar distance of the SM star from the projected center, but in a different direction. And by investigating the detailed structure of these two sources and a second quasar, we can probe small-scale structure in the ejecta. No object other than SN1006 offers a similar opportunity to probe the distribution of ejecta within the remnant of a Type Ia supernova.

OBSERVING DESCRIPTION

Our science goals require high-resolution FUV spectra of the Schweizer-Middleditch star and the two QSOs that lie behind SN1006. The most important wavelength range covers the very broad Si II line (rest wavelength 1260 Ang), though we expect this to be highly broadened and Doppler-shifted, so we require spectra covering a contiguous range 1230-1310 Ang with good resolution and the reasonable signal/noise. Our goal is S/N = 20 for the S-M star, and S/N = 5 for the two QSO's (which we may bin-up in software afterwards). Secondary but important lines that we will also cover with this same setup are spectra of Si III line just to the red of Lyman alpha, and Si IV 1400 Ang.

Visit

Proposal 11659, Visit 01, implementation Fri Mar 13 01:10:16 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

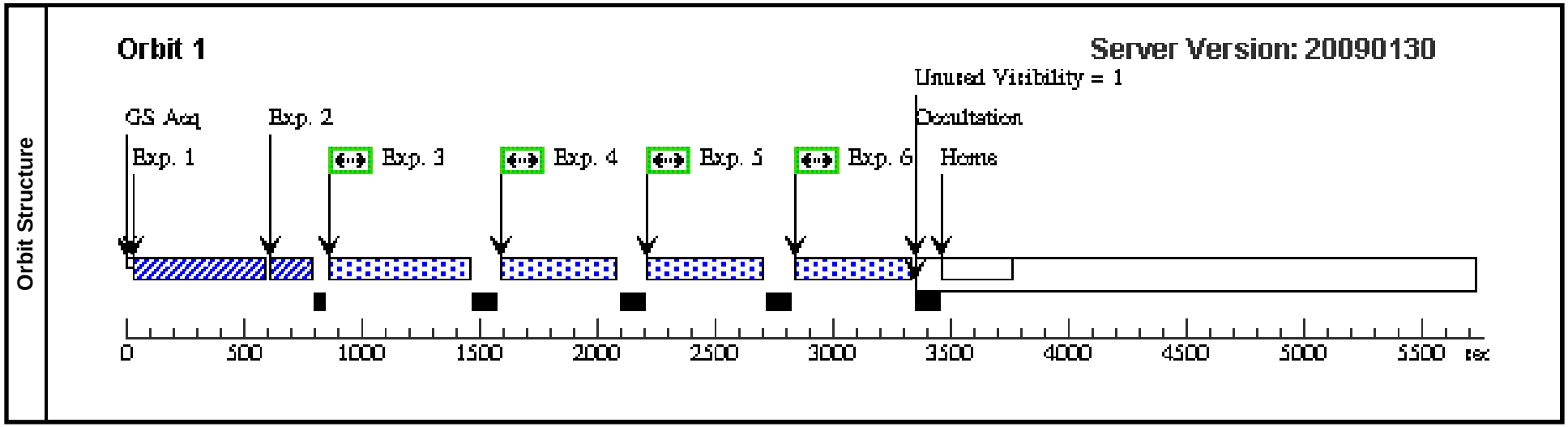
Comments: Acquisition and FUV spectra of S-M star

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	STAR-1503-4159 Alt Name1: SCHWEIZER-MIDDLEDITCH Alt Name2: S9DC012650	RA: 15 02 53.1780 (225.7215750d) Dec: -41 59 16.52 (-41.98792d) Equinox: J2000		V=16.74+/-0.04	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	Target Acq/ Search	(1) STAR-1503-4159	COS/NUV, ACQ/SEARCH, PSA	MIRRORB	SCAN-SIZE=2			30 Secs *[==>]*	 ***[1]***
2	Target Acquisition	(1) STAR-1503-4159	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				30 Secs *[==>]*	 ***[1]***
	Comments: Needs mirror B since too bright. (Mirror A gives 208 cts/pixel max) *See ETC: COS 71702*								
3		(1) STAR-1503-4159	COS/FUV, TIME-TAG, PSA	G130M 1327 A	FP-POS=1; BUFFER-TIME=439			439 Secs *[==>]*	 ***[1]***
	Comments: FUV spectra of S-M star. Use FP-POS=1,2,3,4 rather than AUTO to achieve maximum exposure and optimum resolution and S/N. *See ETC: COS71708 for estimate of exposure and buffer times.*								
4		(1) STAR-1503-4159	COS/FUV, TIME-TAG, PSA	G130M 1327 A	FP-POS=2; BUFFER-TIME=439			439 Secs *[==>]*	 ***[1]***
	Comments: FUV spectra of S-M star. Use FP-POS=1,2,3,4 rather than AUTO to achieve maximum exposure and optimum resolution and S/N. *See ETC: COS71708 for estimate of exposure and buffer times.*								
5		(1) STAR-1503-4159	COS/FUV, TIME-TAG, PSA	G130M 1327 A	FP-POS=3; BUFFER-TIME=439			439 Secs *[==>]*	 ***[1]***
	Comments: FUV spectra of S-M star. Use FP-POS=1,2,3,4 rather than AUTO to achieve maximum exposure and optimum resolution and S/N. *See ETC: COS71708 for estimate of exposure and buffer times.*								
6		(1) STAR-1503-4159	COS/FUV, TIME-TAG, PSA	G130M 1327 A	FP-POS=4; BUFFER-TIME=439			439 Secs *[==>]*	 ***[1]***
	Comments: FUV spectra of S-M star. Use FP-POS=1,2,3,4 rather than AUTO to achieve maximum exposure and optimum resolution and S/N. *See ETC: COS71708 for estimate of exposure and buffer times.*								


Orbit Structure
Orbit 1
Server Version: 20090130
Unused Visibility = 1
GS Acq
Exp. 1
Exp. 2
Exp. 3
Exp. 4
Exp. 5
Exp. 6
Occultation
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 11659, Visit 02, implementation Fri Mar 13 01:10:17 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

Comments: Acquisition and FUV Spectra of fainter QSO: 1503-4155
this takes 5 orbits

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	QSO-1503-4155	RA: 15 02 55.2690 (225.7302875d)		V=19.5+/-0.3	Reference Frame: ICRS
	Alt Name1: S9DC018293	Dec: -41 54 29.82 (-41.90828d)			
		Equinox: J2000			

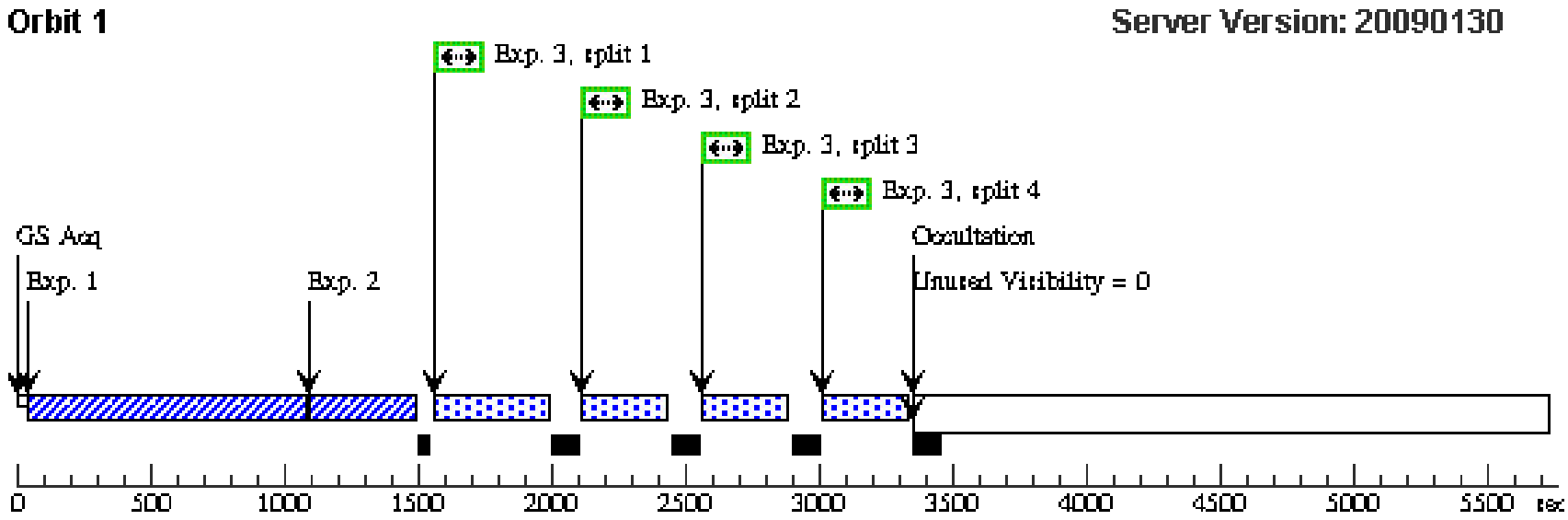
Exposures

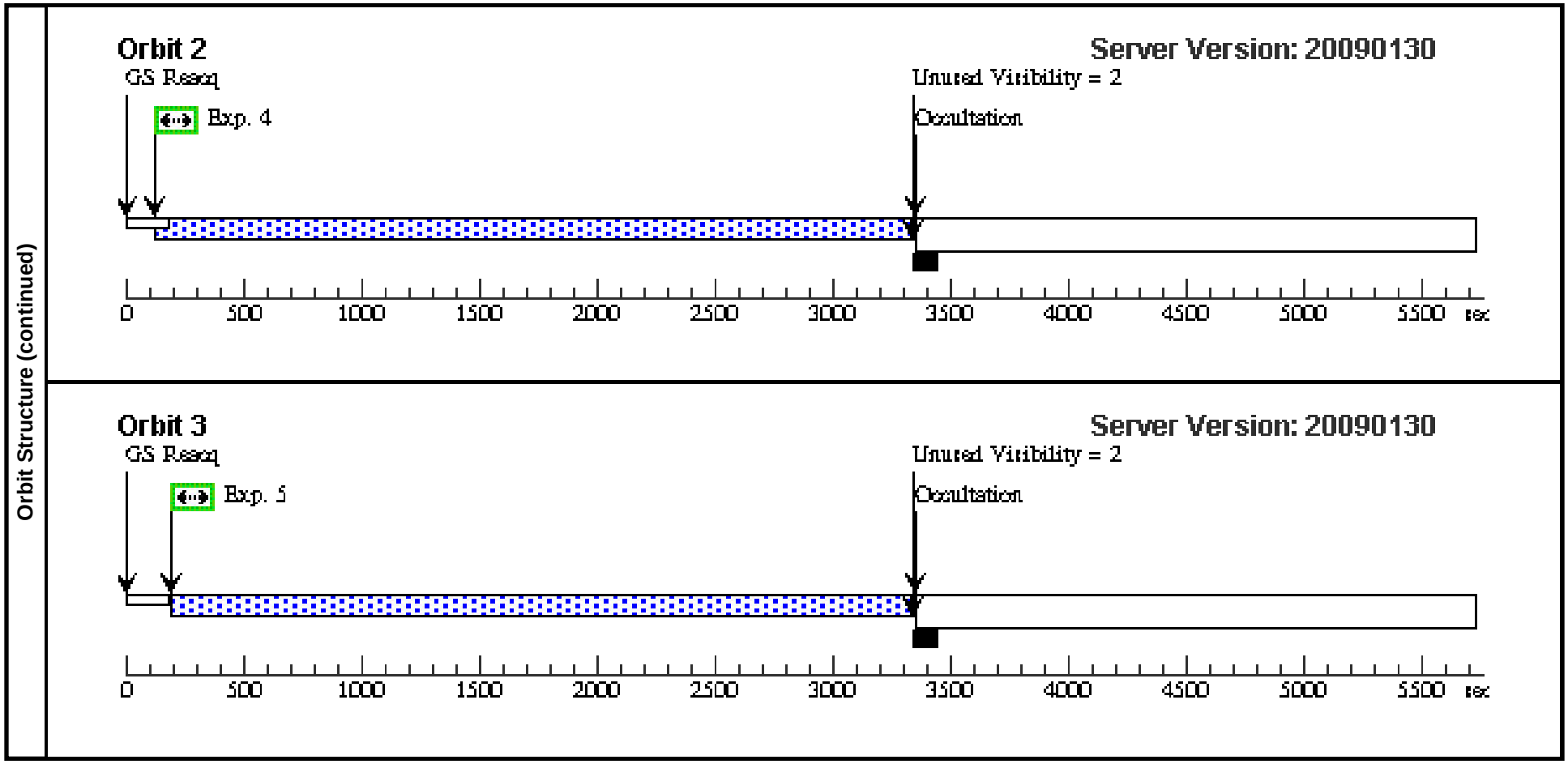
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	Acq/Search	(2) QSO-1503-4155	COS/NUV, ACQ/SEARCH, PSA	MIRRORA	SCAN-SIZE=2			150 Secs *[==>]*	*[1]*
Comments: Search for Target Acquisition									
2	Target acquisition	(2) QSO-1503-4155	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				150 Secs *[==>]*	*[1]*
Comments: Target acquisition for QSO1503-4155 *ETC: COS72115* *Time is conservative; should give S/N well over 40*									
3	FUV spectrum 1 (FP-POS=AUTO)	(2) QSO-1503-4155	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=2655; FLASH=YES; FP-POS=AUTO			1060 Secs *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	*[1]*
Comments: First of 5 FUV spectra exposures *ETC: COS72086*									
4	FUV spectrum 2/5 (FP-POS=1)	(2) QSO-1503-4155	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=3090; FLASH=YES; FP-POS=1			3090 Secs *[==>]*	*[2]*
Comments: Second of 5 FUV spectra; full orbit with FP-POS=1 *ETC: COS72086*									
5	FUV spectrum 3/5 (FP-POS=2)	(2) QSO-1503-4155	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=3090; FLASH=YES; FP-POS=2			3090 Secs *[==>]*	*[3]*
Comments: Third of 5 FUV spectra; full orbit with FP-POS=2 *ETC: COS72086*									

Exposures (continued)

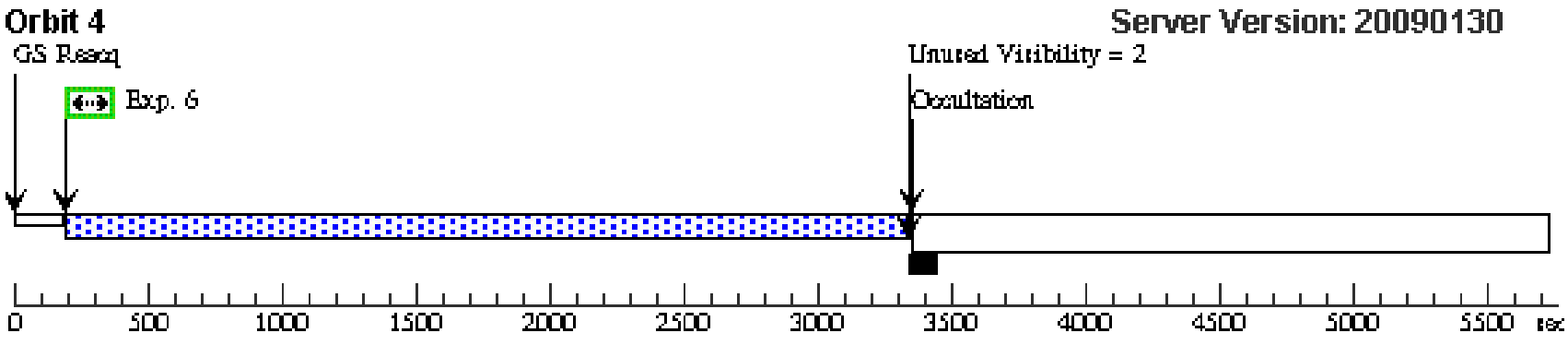
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
6	FUV spectrum 4/5 (FP-POS=3)	(2) QSO-1503-4155	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=3090; FLASH=YES; FP-POS=3			3090 Secs *[==>]*	*[4]*
	Comments: Fourth of 5 FUV spectra; full orbit with FP-POS=3 *ETC: COS72086*								
7	FUV spectrum 5/5 (FP-POS=4)	(2) QSO-1503-4155	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=3090; FLASH=YES; FP-POS=4			3090 Secs *[==>]*	*[5]*
	Comments: Fifth of 5 FUV spectra; full orbit with FP-POS=3 *ETC: COS72086*								

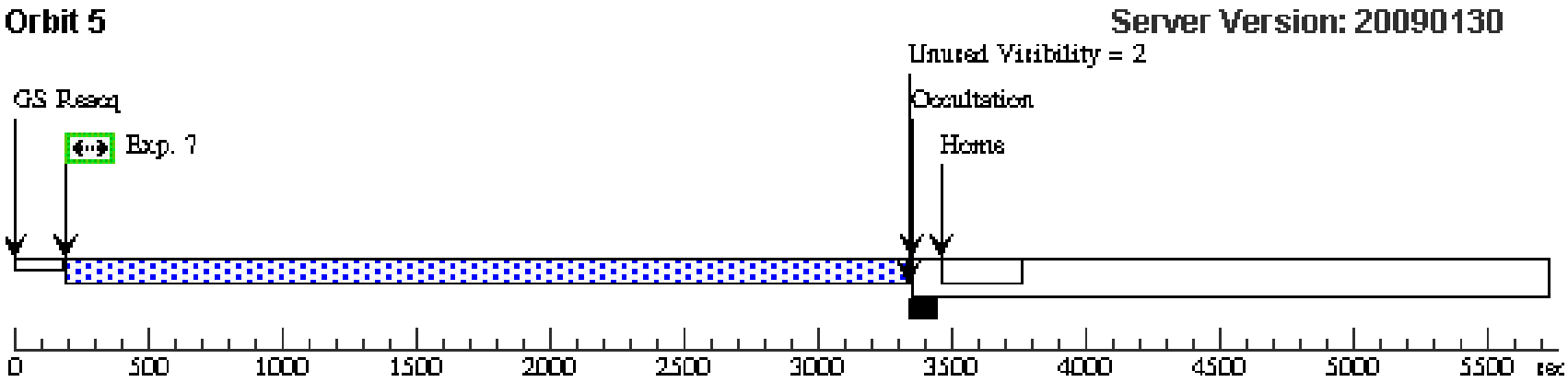
Orbit Structure




Orbit Structure (continued)
Orbit 2
Server Version: 20090130
GS Reacq
Unused Visibility = 2
Exp. 4
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec
Orbit 3
Server Version: 20090130
GS Reacq
Unused Visibility = 2
Exp. 5
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Orbit Structure (continued)





Visit

Proposal 11659, Visit 03, implementation Fri Mar 13 01:10:18 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

Comments: Acquisition and FUV Spectra of fainter QSO: 1503-4155
this takes 5 orbits

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	QSO-1504-4152	RA: 15 03 34.0010 (225.8916708d)		V=18.3+/-0.2	Reference Frame: GSC2.3
	Alt Name1: S9DC020963	Dec: -41 52 23.46 (-41.87318d)			
		Equinox: J2000			

Exposures

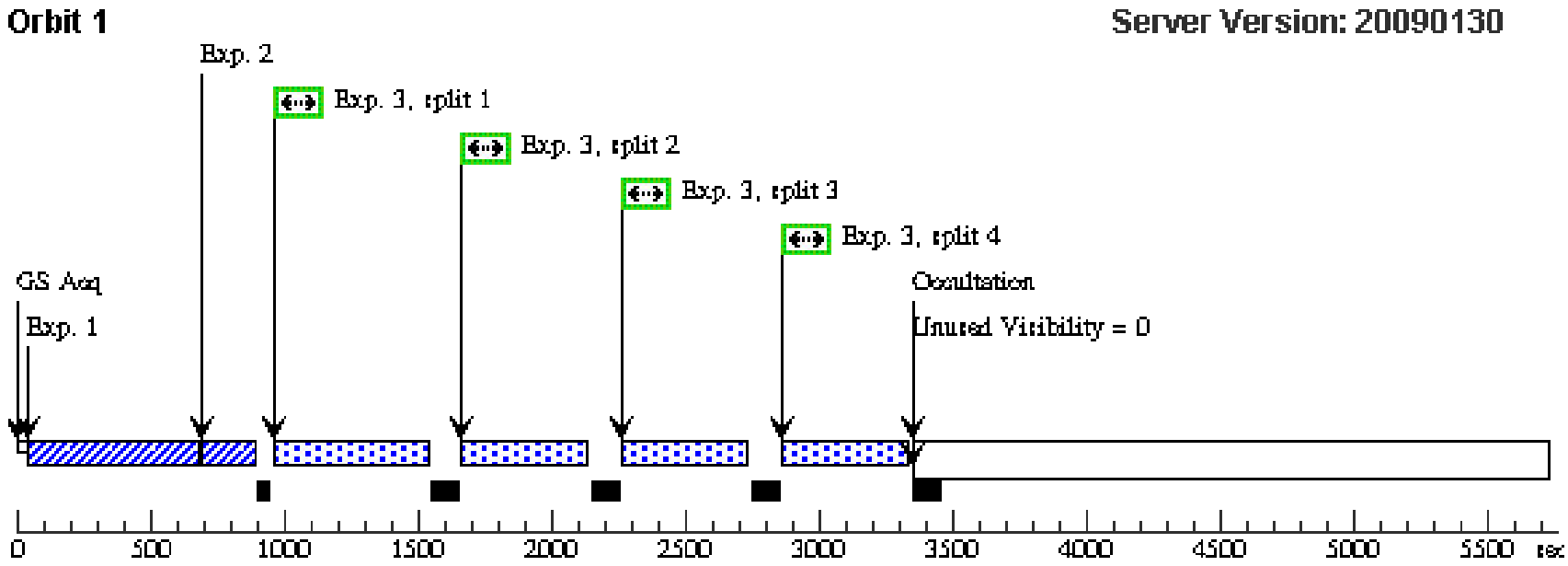
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	Acq Search	(3) QSO-1504-4152	COS/NUV, ACQ/SEARCH, PSA	MIRRORA	SCAN-SIZE=2			50 Secs	
								[==>]	***[1]***
2	Target acquisition	(3) QSO-1504-4152	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				50 Secs	
								[==>]	***[1]***
Comments: Predicted S/N=55 (ETC: COS72127)									
3	FUV spectrum 1/4	(3) QSO-1504-4152	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=415; FLASH=YES; FP-POS=AUTO			1660 Secs	
								[==>(Split 1)] *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	***[1]***
Comments: First of 4 FUV spectra exposures *See ETC: COS72085*									
4	FUV spectrum 2/4	(3) QSO-1504-4152	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=633; FLASH=YES; FP-POS=AUTO			2532 Secs	
								[==>(Split 1)] *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	***[2]***
Comments: Second of 4 FUV spectra exposures									
5	FUV spectrum 3/4	(3) QSO-1504-4152	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=633; FLASH=YES; FP-POS=AUTO			2532 Secs	
								[==>(Split 1)] *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	***[3]***
Comments: Third of 4 FUV spectra exposures									

Exposures (continued)

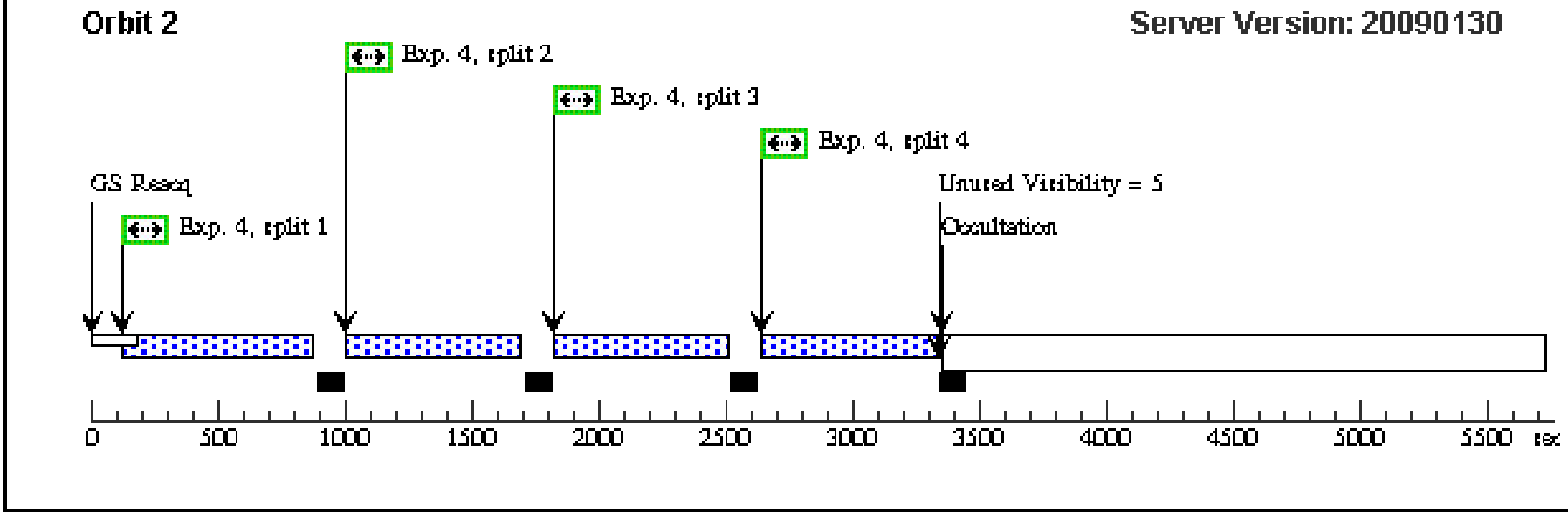
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
6	FUV spectrum 4/4	(3) QSO-1504-4152	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=6333; FLASH=YES; FP-POS=AUTO			2532 Secs	
								[==>(Split 1)] *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	***[4]***

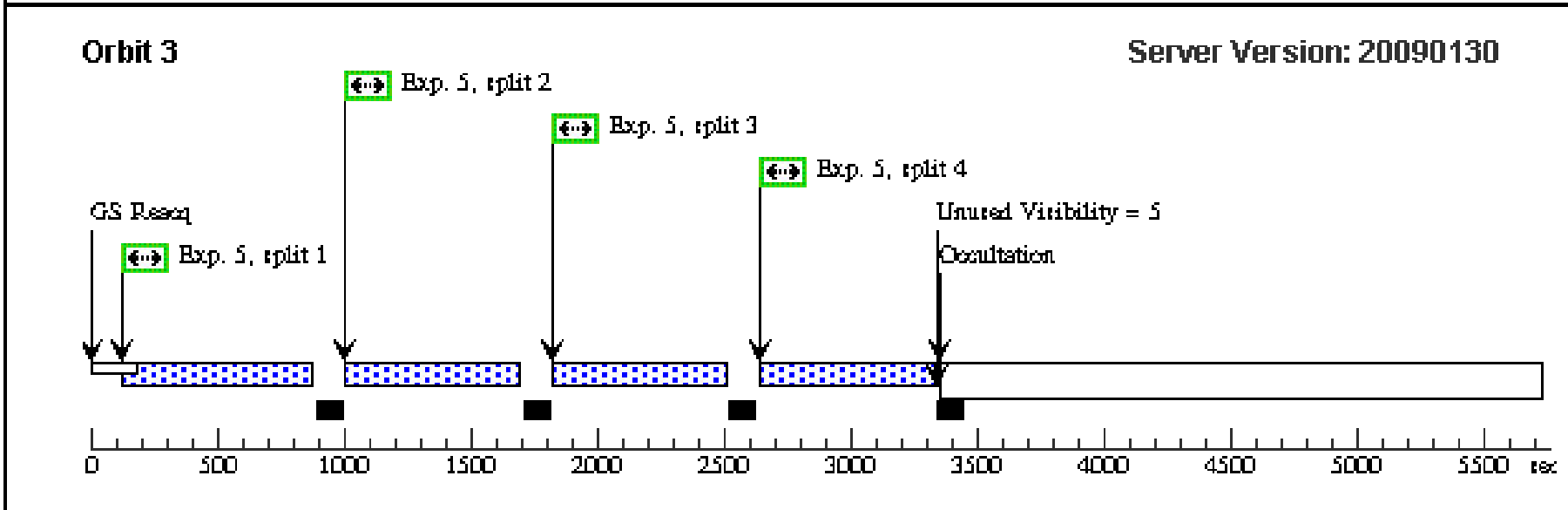
Comments: Fourth of 4 FUV spectra exposures

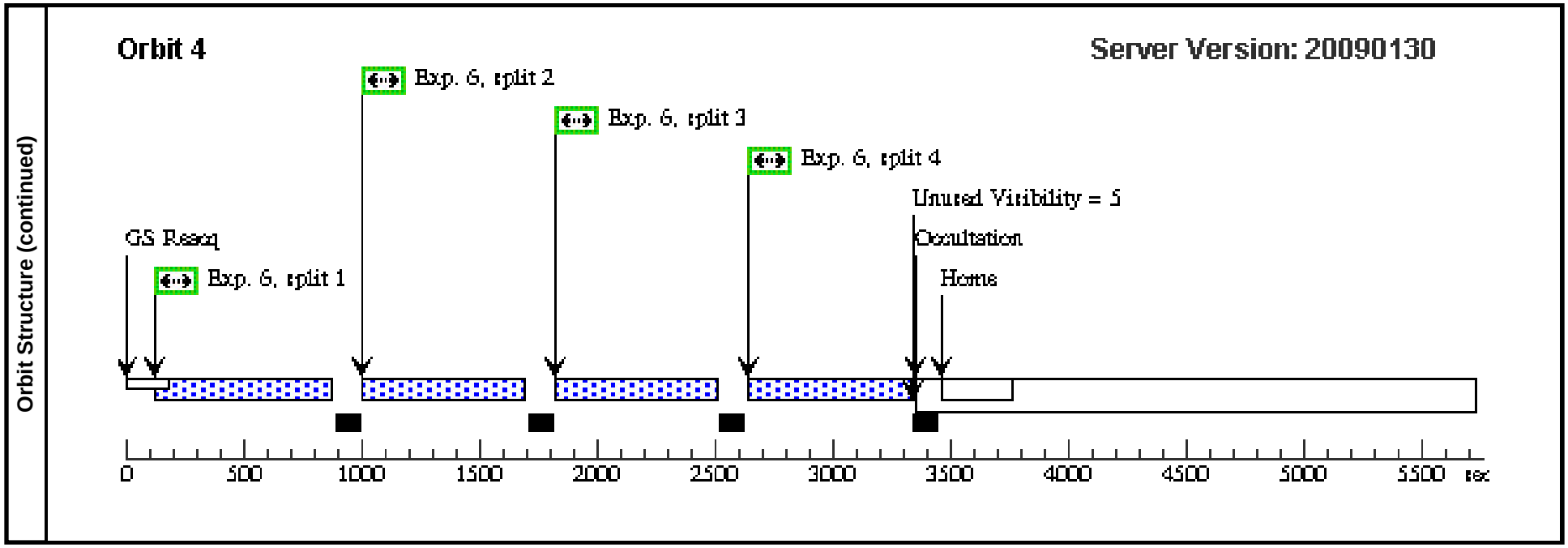
Orbit Structure



Orbit Structure (continued)






Orbit Structure (continued)
Orbit 4
Server Version: 20090130
Exp. 6, split 2
Exp. 6, split 3
Exp. 6, split 4
Unused Visibility = 5
GS Reacq
Occultation
Exp. 6, split 1
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec