11561 - An intensive COS spectroscopic study of the planetary debris disks around two warm white dwarfs

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) SDSSJ084539.17+225728.0	COS/FUV COS/NUV	3	23-Feb-2010 21:00:54.0	yes
02	(1) SDSSJ084539.17+225728.0	COS/NUV	5	23-Feb-2010 21:01:03.0	yes
03	(2) SDSSJ122859.93+104032.9	COS/FUV COS/NUV	3	23-Feb-2010 21:01:11.0	yes
04	(2) SDSSJ122859.93+104032.9	COS/NUV	5	23-Feb-2010 21:01:20.0	yes

16 Total Orbits Used

ABSTRACT

It is very likely that the gas giants in our Solar system will survive the evolution of the Sun into a white dwarf, and the same is thought to be generally true for Jovian planets around solar-like stars if their initial orbits are wider than ~3AU. Despite this prediction, no unambiguous detection of a planet around a white dwarf has been announced so far. However, over the past few years, about a dozen white dwarfs have been identified which host metal-rich debris disks that are thought to stem from the tidal disruption of asteroids. In most cases the debris disks are observed in the form of an infrared flux excess, and offer relatively little diagnostic potential for the study of their structure. We have discovered three warm (T~20000K) white dwarfs with metal-rich debris disks in a gaseous phase which display strong double-peaked CaII emission lines in the I-band and weak Fe 5169A emission. The line profiles can be modelled in terms of Keplerian disks with an extension of ~1Rsun around the white dwarfs. Photospheric MgII 4481A absorption demonstrates that the white dwarfs are accreting from the debris disks. Besides these spectral features, the optical wavelength range is devoid of other useful metal transitions. Here, we propose an intensive spectroscopic ultraviolet study of these systems, which will provide (a) ~1000 photospheric absorption lines of 15 chemical elements, allowing an accurate abundance study of the material accreted from the debris disks, and (b) ~2 dozen additional emission lines of Mg, Cr, Ti, and Fe that will provide detailed insight into the dynamical, thermal, and density structure of these exo-planetary debris disks.

OBSERVING DESCRIPTION

The main scientific thrust of this proposal is (1) to determine the photospheric abundances of the two white dwarfs SDSS1228+1040 and SDSS0845+2257, which reflect the abundances in the debris disks, and (2) to obtain high-quality observations of the Mg, Cr, Ti, and Fe emission line profiles predicted to be present in the near-ultraviolet. Both goals need sufficiently high spectral resolution to avoid blending of the photospheric absorption lines, which would hinder accurate abundance determinations, and to fully resolve the kinematic structure of the emission line profiles, which will have a complex structure due to the number of components.

We will cover the far-ultraviolet (FUV) of the spectrum with three orbits of COS G130M/ G160M observations per target, where two different central wavelength settings (1291/1327 & 1577/1623) will be used to cover the gaps between the two FUV detector segments. Given the large degree of overlap between these settings, we decided to adopt only two different FP-POS positions for each G130M observation. The expected S/N of the

G160M observations is too low to warrant FP-POS dithering, so we go for single exposures.

The emission lines from the debris disk in the near-ultraviolet (NUV) will be observed with the G225M/G285M gratings, using a total of 6 central wavelengths (2339/2373/2410 & 2657/2695/2739) to get nearly continuous coverage over the range 2225-2875, requiring 5 orbits per object. No FP-POS dithering will be done as the grating seetings overlap already to a large degree.

All observations will be done in TIME-TAG mode using TAG-FLASH wavelength calibrations.

Both targets are GSC-II objects, and have measured GALEX FUV and NUV fluxes.

REAL TIME JUSTIFICATION
N/A

Visit

Proposal 11561, Visit 01, scheduling Wed Feb 24 02:01:25 GMT 2010

Diagnostic Status: Warning

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

Diagnostics

(Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN

(Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN

(Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN

Fixed Targets

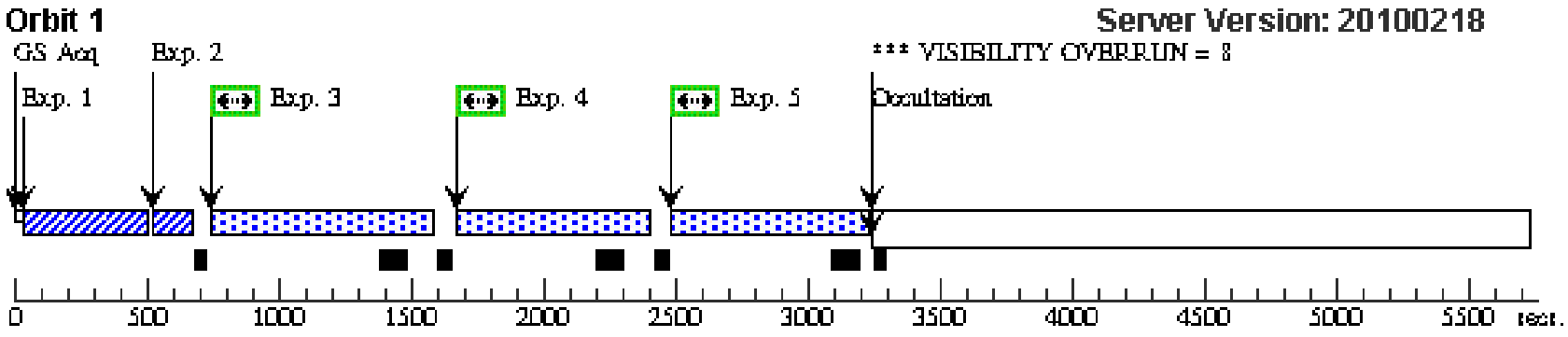
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SDSSJ084539.17+225728.0 Alt Name1: N90T010555	RA: 08 45 39.1700 (131.4132083d) Dec: +22 57 28.00 (22.95778d) Equinox: J2000	Proper Motion RA: -0.0012s/yr Proper Motion Dec: -0.063"/yr Epoch of Position: 2004.28	V=16.0+/-0.1 GALEX FUV: 1941.27 +/- 46.05 microJy, GALEX NUV: 2475.09 +/- 31.39 microJy (looked up in GR2, as GR4 seems to be not yet completely ingested at MAST)	Reference Frame: ICRS

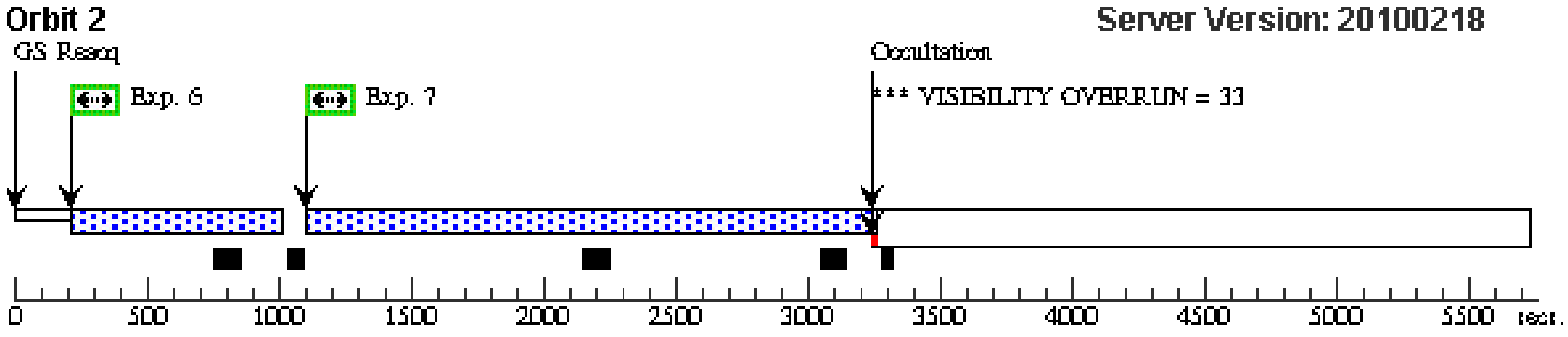
Comments: This is a nearby white dwarf, no extinction

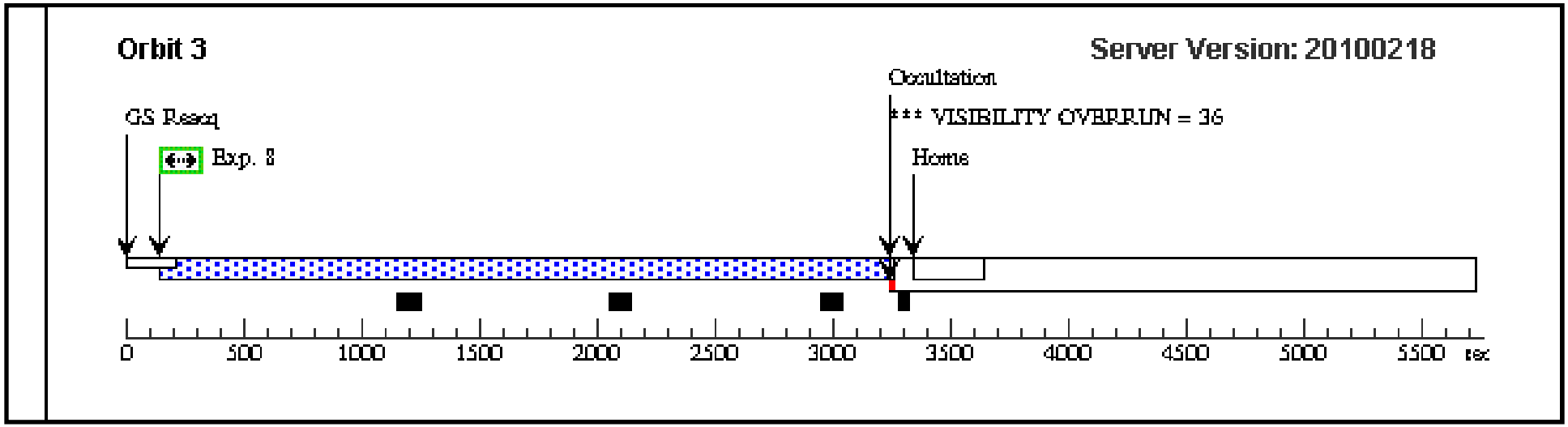
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	ACQ/Search for SDSS0845	(1) SDSSJ084539.17 +225728.0	COS/NUV, ACQ/SEARCH, PSA	MIRRORB	SCAN-SIZE=2			7.2 Secs *[==>]*	 ***[1]***
Comments: I used a 19000K DB model spectrum scaled to an SDSS g=15.7, which reproduces within ~15% the observed GALEX fluxes of SDSS0845+2257, as input for the COS ETC to calculate the exposure time for a S/N=40s image (COS72608)									
2	ACQ/Image for SDSS0845	(1) SDSSJ084539.17 +225728.0	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				7.2 Secs *[==>]*	 ***[1]***
Comments: I used a 19000K DB model spectrum scaled to an SDSS g=15.7, which reproduces within ~15% the observed GALEX fluxes of SDSS0845+2257, as input for the COS ETC to calculate the exposure time for a S/N=40s image (COS72608)									
3	G130M@1291 FP-POS=1 for SDSS0845	(1) SDSSJ084539.17 +225728.0	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=500; FLASH=YES; FP-POS=1			680 Secs *[==>]*	 ***[1]***
Comments: Because I plan to get two different wavelength settings with the G130M grating that will overlap to a large degree, I decided that two FP-POS positions per central wavelength should be enough. This is -2 step for 1291A.									
4	G130M@1291 FP-POS=4 for SDSS0845	(1) SDSSJ084539.17 +225728.0	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=500; FLASH=YES; FP-POS=4			680 Secs *[==>]*	 ***[1]***
Comments: Because I plan to get two different wavelength settings with the G130M grating that will overlap to a large degree, I decided that two FP-POS positions per central wavelength should be enough. This is +1 step for 1291A.									
5	G130M@1327 FP=POS=1 for SDSS0845	(1) SDSSJ084539.17 +225728.0	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=500; FLASH=YES; FP-POS=1			630 Secs *[==>]*	 ***[1]***
Comments: Because I plan to get two different wavelength settings with the G130M grating that will overlap to a large degree, I decided that two FP-POS positions per central wavelength should be enough. This is -2 step for 1327A.									
6	G130M@1327 FP-POS=4 for SDSS0845	(1) SDSSJ084539.17 +225728.0	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=500; FLASH=YES; FP-POS=4			745 Secs *[==>]*	 ***[2]***
Comments: Because I plan to get two different wavelength settings with the G130M grating that will overlap to a large degree, I decided that two FP-POS positions per central wavelength should be enough. This is +1 step for 1327A.									
7	G160M@1577 for SDSS0845	(1) SDSSJ084539.17 +225728.0	COS/FUV, TIME-TAG, PSA	G160M 1577 A	BUFFER-TIME=900; FLASH=YES			1995 Secs *[==>]*	 ***[2]***
Comments: The expected S/N with the G160M grating does not warrant the additional overhead necessary for FP-POS splitting. Two different central wavelength are observed, which should help to iron out to some extent fixed pattern noise.									
8	G160M@1623 for SDSS0845	(1) SDSSJ084539.17 +225728.0	COS/FUV, TIME-TAG, PSA	G160M 1623 A	BUFFER-TIME=900; FLASH=YES			2999 Secs *[==>]*	 ***[3]***
Comments: The expected S/N with the G160M grating does not warrant the additional overhead necessary for FP-POS splitting. Two different central wavelength are observed, which should help to iron out to some extent fixed pattern noise.									

Orbit Structure



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Visit

Proposal 11561, Visit 02, scheduling Wed Feb 24 02:01:26 GMT 2010

Diagnostic Status: Warning

Scientific Instruments: COS/NUV

Special Requirements: (none)

Diagnostics

(Visit 02) Warning (Orbit Planner): VISIBILITY OVERRUN

Fixed Targets

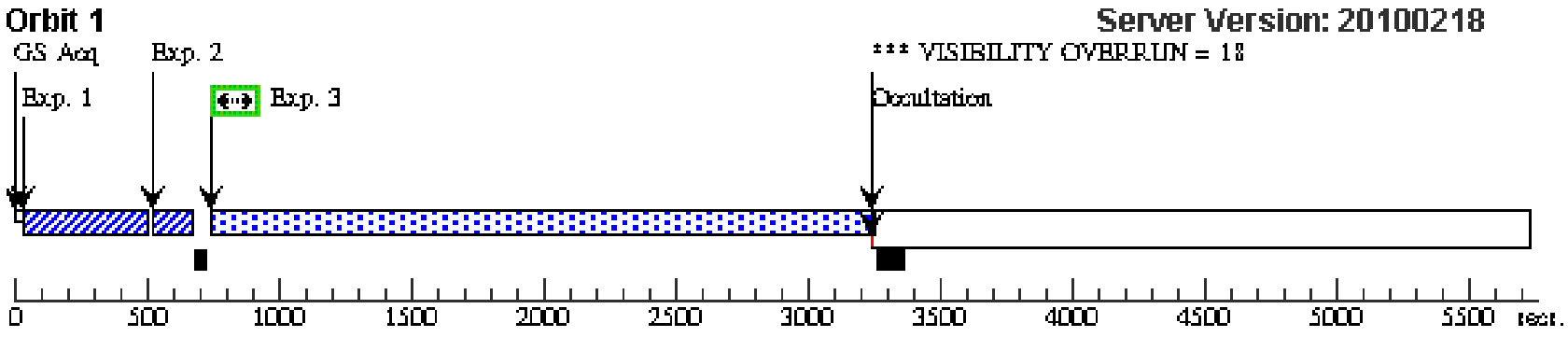
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SDSSJ084539.17+225728.0 Alt Name1: N90T010555	RA: 08 45 39.1700 (131.4132083d) Dec: +22 57 28.00 (22.95778d) Equinox: J2000	Proper Motion RA: -0.0012s/yr Proper Motion Dec: -0.063"/yr Epoch of Position: 2004.28	V=16.0+/-0.1 GALEX FUV: 1941.27 +/- 46.05 microJy, GALEX NUV: 2475.09 +/- 31.39 microJy (looked up in GR2, as GR4 seems to be not yet completely ingested at MAST)	Reference Frame: ICRS

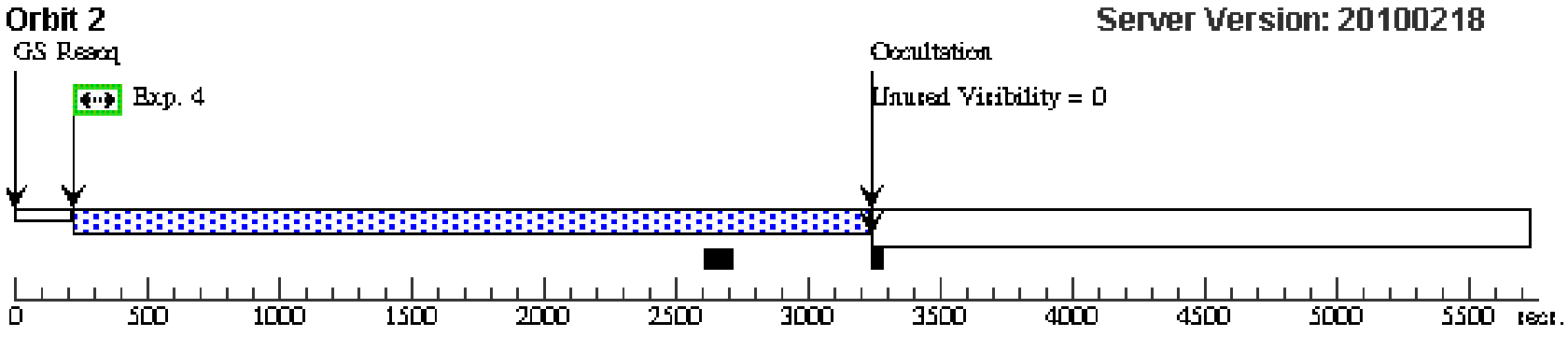
Comments: This is a nearby white dwarf, no extinction

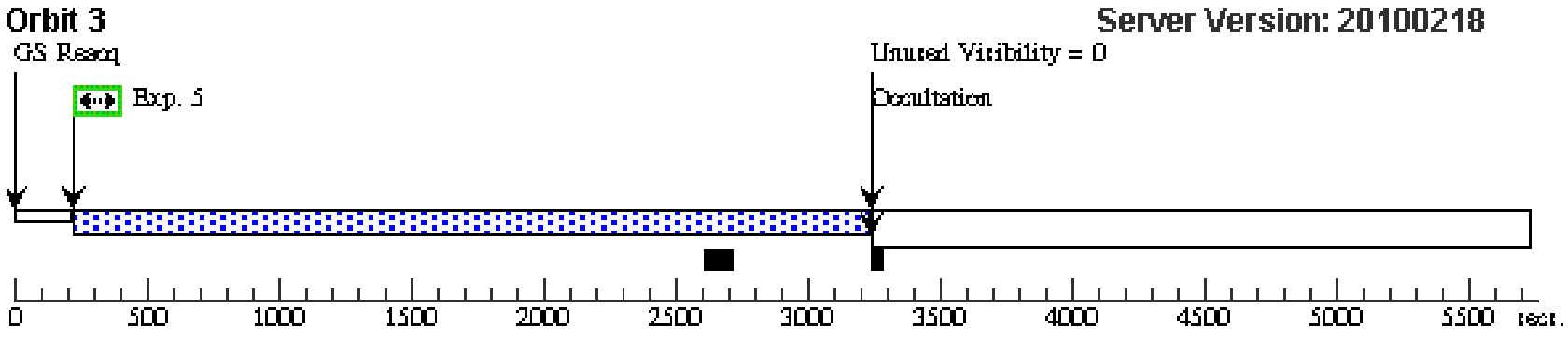
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	ACQ/Search for SDSS0845	(1) SDSSJ084539.17 +225728.0	COS/NUV, ACQ/SEARCH, PSA	MIRRORB	SCAN-SIZE=2			7.2 Secs *[==>]*	***[1]***
Comments: I used a 19000K DB model spectrum scaled to an SDSS g=15.7, which reproduces within ~15% the observed GALEX fluxes of SDSS0845+2257, as input for the COS ETC to calculate the exposure time for a S/N=40s image (COS72608)									
2	ACQ/Image for SDSS0845	(1) SDSSJ084539.17 +225728.0	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				7.2 Secs *[==>]*	***[1]***
Comments: I used a 19000K DB model spectrum scaled to an SDSS g=15.7, which reproduces within ~15% the observed GALEX fluxes of SDSS0845+2257, as input for the COS ETC to calculate the exposure time for a S/N=40s image (COS72608)									
3	G230L @ 2635a	(1) SDSSJ084539.17 +225728.0	COS/NUV, TIME-TAG, PSA	G230L 2635 A	BUFFER-TIME=2400; FLASH=YES			2400 Secs *[==>2397.0 Secs]*	***[1]***
4	G230L @ 2635b	(1) SDSSJ084539.17 +225728.0	COS/NUV, TIME-TAG, PSA	G230L 2635 A	BUFFER-TIME=2400; FLASH=YES			2400 Secs *[==>3000.0 Secs]*	***[2]***
5	G230L @ 2635c	(1) SDSSJ084539.17 +225728.0	COS/NUV, TIME-TAG, PSA	G230L 2635 A	BUFFER-TIME=2400; FLASH=YES			2400 Secs *[==>3000.0 Secs]*	***[3]***
6	G230L @ 2950a	(1) SDSSJ084539.17 +225728.0	COS/NUV, TIME-TAG, PSA	G230L 2950 A	BUFFER-TIME=2400; FLASH=YES			2400 Secs *[==>3000.0 Secs]*	***[4]***
7	G230L @ 2635b	(1) SDSSJ084539.17 +225728.0	COS/NUV, TIME-TAG, PSA	G230L 2950 A	BUFFER-TIME=2400; FLASH=YES			2400 Secs *[==>3000.0 Secs]*	***[5]***

Orbit Structure



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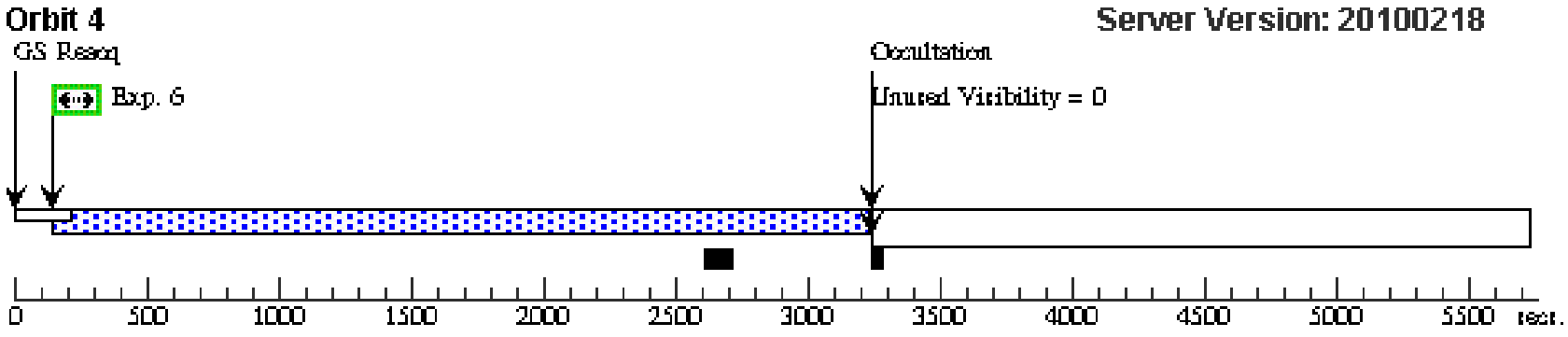
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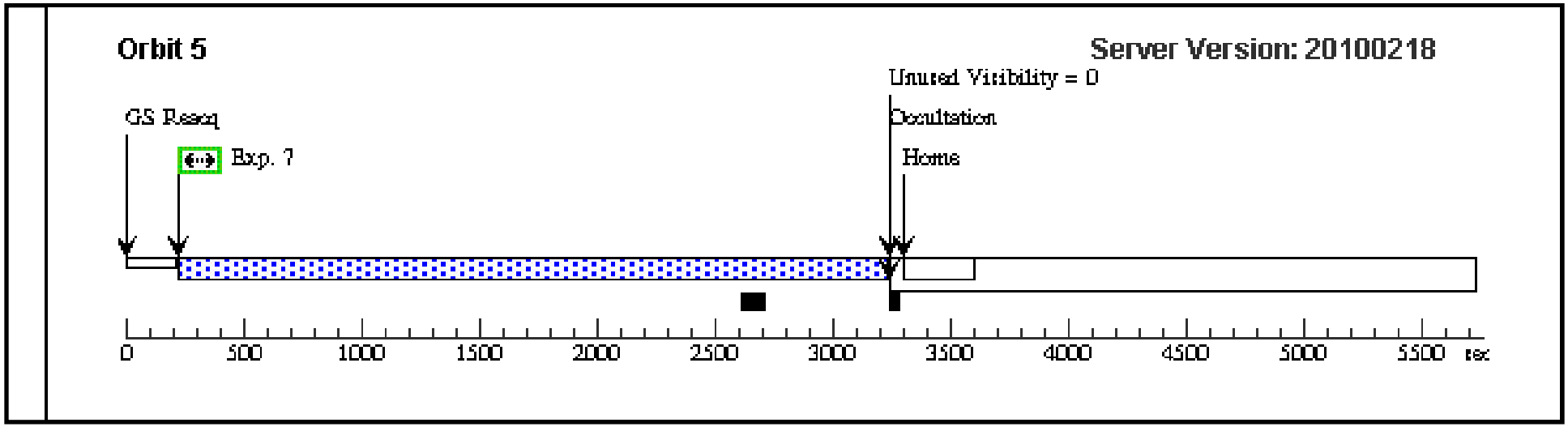
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Visit

Proposal 11561, Visit 03, scheduling Wed Feb 24 02:01:27 GMT 2010

Diagnostic Status: Warning

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

Diagnostics

(Visit 03) Warning (Orbit Planner): VISIBILITY OVERRUN

(Visit 03) Warning (Orbit Planner): VISIBILITY OVERRUN

(Visit 03) Warning (Orbit Planner): VISIBILITY OVERRUN

Fixed Targets

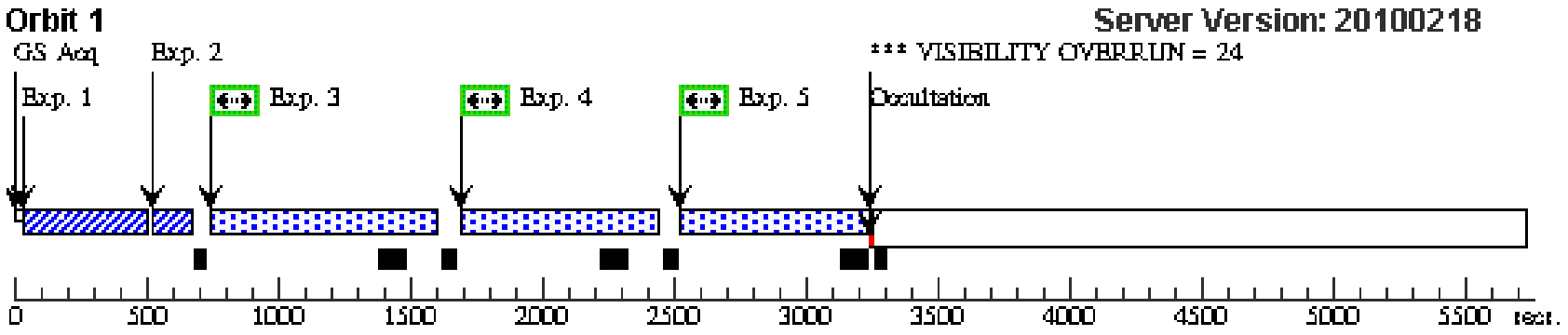
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SDSSJ122859.93+104032.9 Alt Name1: N4W4001867	RA: 12 28 59.9300 (187.2497083d) Dec: +10 40 32.90 (10.67581d) Equinox: J2000	Proper Motion RA: -0.0033s/yr Proper Motion Dec: -0.026"/yr Epoch of Position: 2003.94	V=16.5+/-0.1 GALEX FUV: 2352.02 +/- 45.70 microJy, GALEX NUV: 1696.94 +/- 26.43 microJy	Reference Frame: ICRS

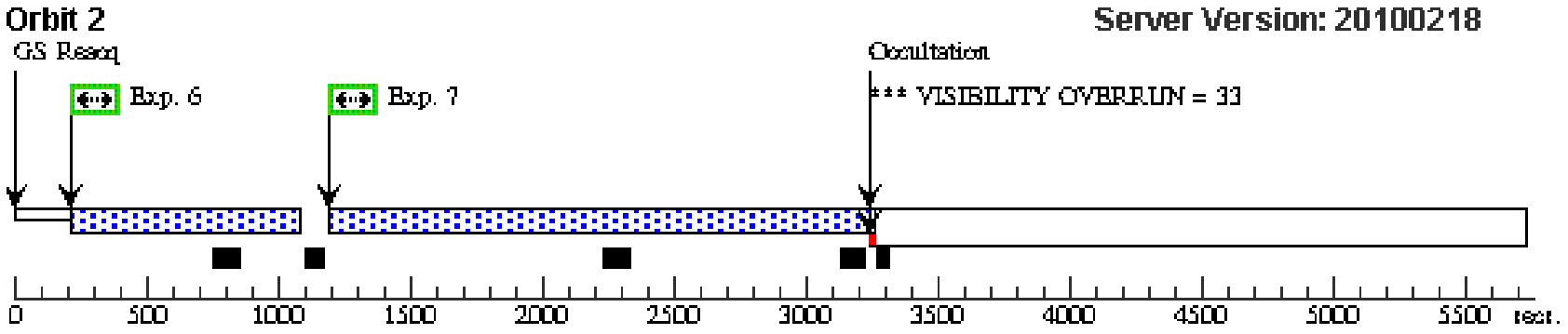
Comments: This is a nearby white dwarf, no extinction.

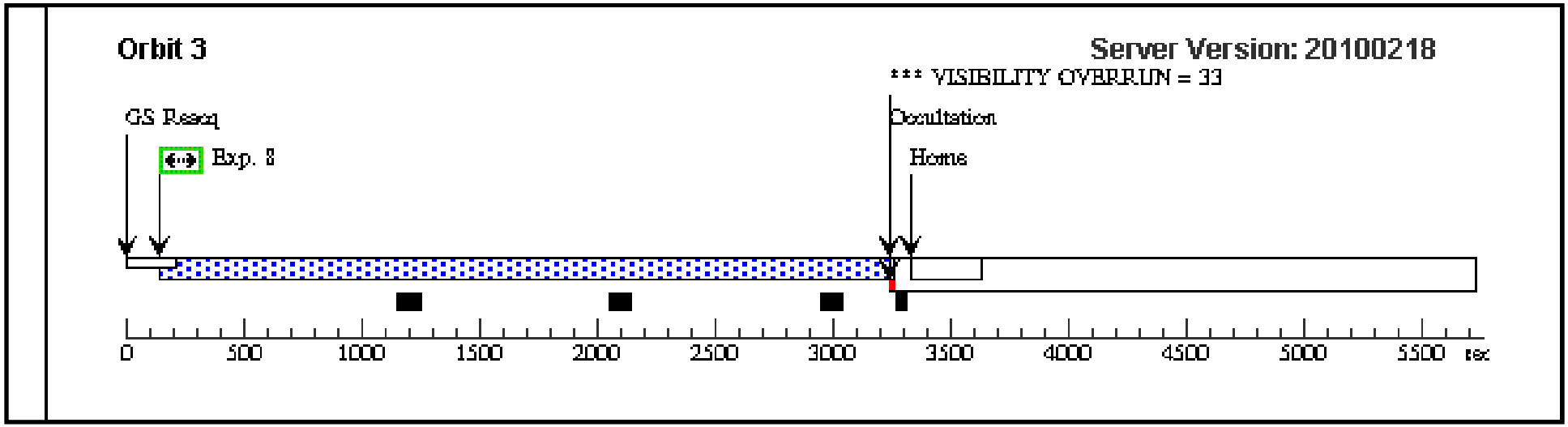
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	ACQ/Search for SDSS1228	(2) SDSSJ122859.93 +104032.9	COS/NUV, ACQ/SEARCH, PSA	MIRRORB	SCAN-SIZE=2			7.2 Secs *[==>]*	 ***[1]***
Comments: I used a 22000 DA model spectrum scaled to an SDSS g=16.3, which reproduces the observed GALEX fluxes of SDSS1228+1040 within ~15%, as input for the COS ETC to calculate the exposure time for a S/N=40 detection -> 7.2s (COS72608)									
2	ACQ/Image for SDSS1228	(2) SDSSJ122859.93 +104032.9	COS/NUV, ACQ/IMAGE, PSA	MIRRORB		GS ACQ SCENARIO BASE1B3		7.2 Secs *[==>]*	 ***[1]***
Comments: I used a 22000 DA model spectrum scaled to an SDSS g=16.3, which reproduces the observed GALEX fluxes of SDSS1228+1040 within ~15%, as input for the COS ETC to calculate the exposure time for a S/N=40 detection -> 7.2s (COS72608)									
3	G130M@1291 FP-POS=1 for SDSS1228	(2) SDSSJ122859.93 +104032.9	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=500; FLASH=YES; FP-POS=1			700 Secs *[==>]*	 ***[1]***
Comments: Because I plan to get two different wavelength settings with the G130M grating that will overlap to a large degree, I decided that two FP-POS positions per central wavelength should be enough. This is -2 step for 1291A.									
4	G130M@1291 FP-POS=4 for SDSS1228	(2) SDSSJ122859.93 +104032.9	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=500; FLASH=YES; FP-POS=4			700 Secs *[==>]*	 ***[1]***
Comments: Because I plan to get two different wavelength settings with the G130M grating that will overlap to a large degree, I decided that two FP-POS positions per central wavelength should be enough. This is +1 step for 1291A.									
5	G130M@1327 FP=POS=1 for SDSS1228	(2) SDSSJ122859.93 +104032.9	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=500; FLASH=YES; FP-POS=1			602 Secs *[==>]*	 ***[1]***
Comments: Because I plan to get two different wavelength settings with the G130M grating that will overlap to a large degree, I decided that two FP-POS positions per central wavelength should be enough. This is -2 step for 1327A.									
6	G130M@1327 FP-POS=4 for SDSS1228	(2) SDSSJ122859.93 +104032.9	COS/FUV, TIME-TAG, PSA	G130M 1327 A	BUFFER-TIME=500; FLASH=YES; FP-POS=4			819 Secs *[==>]*	 ***[2]***
Comments: Because I plan to get two different wavelength settings with the G130M grating that will overlap to a large degree, I decided that two FP-POS positions per central wavelength should be enough. This is +1 step for 1327A.									
7	G160M@1577 for SDSS1228	(2) SDSSJ122859.93 +104032.9	COS/FUV, TIME-TAG, PSA	G160M 1577 A	BUFFER-TIME=900; FLASH=YES			1907 Secs *[==>]*	 ***[2]***
Comments: The expected S/N with the G160M grating does not warrant the additional overhead necessary for FP-POS splitting. Two different central wavelength are observed, which should help to iron out to some extent fixed pattern noise.									
8	G160M@1623 for SDSS1228	(2) SDSSJ122859.93 +104032.9	COS/FUV, TIME-TAG, PSA	G160M 1623 A	BUFFER-TIME=900; FLASH=YES			2992 Secs *[==>]*	 ***[3]***
Comments: The expected S/N with the G160M grating does not warrant the additional overhead necessary for FP-POS splitting. Two different central wavelength are observed, which should help to iron out to some extent fixed pattern noise.									

Orbit Structure



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Visit

Proposal 11561, Visit 04, completed Wed Feb 24 02:01:28 GMT 2010

Diagnostic Status: Warning

Scientific Instruments: COS/NUV

Special Requirements: (none)

Diagnostics

(Visit 04) Warning (Orbit Planner): VISIBILITY OVERRUN

(Visit 04) Warning (Orbit Planner): VISIBILITY OVERRUN

(Visit 04) Warning (Orbit Planner): VISIBILITY OVERRUN

(Visit 04) Warning (Orbit Planner): VISIBILITY OVERRUN

(Visit 04) Warning (Orbit Planner): VISIBILITY OVERRUN

Fixed Targets

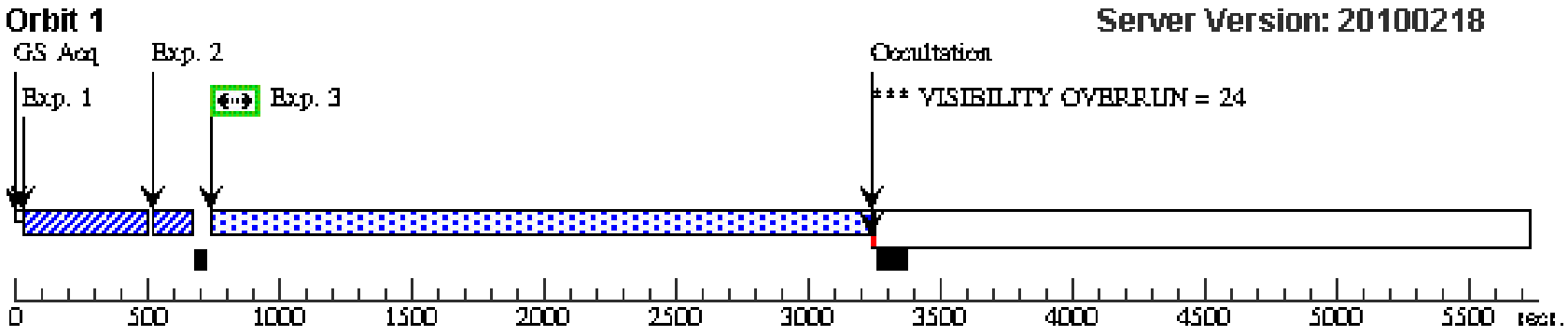
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SDSSJ122859.93+104032.9 Alt Name1: N4W4001867	RA: 12 28 59.9300 (187.2497083d) Dec: +10 40 32.90 (10.67581d) Equinox: J2000	Proper Motion RA: -0.0033s/yr Proper Motion Dec: -0.026"/yr Epoch of Position: 2003.94	V=16.5+/-0.1 GALEX FUV: 2352.02 +/- 45.70 microJy, GALEX NUV: 1696.94 +/- 26.43 microJy	Reference Frame: ICRS

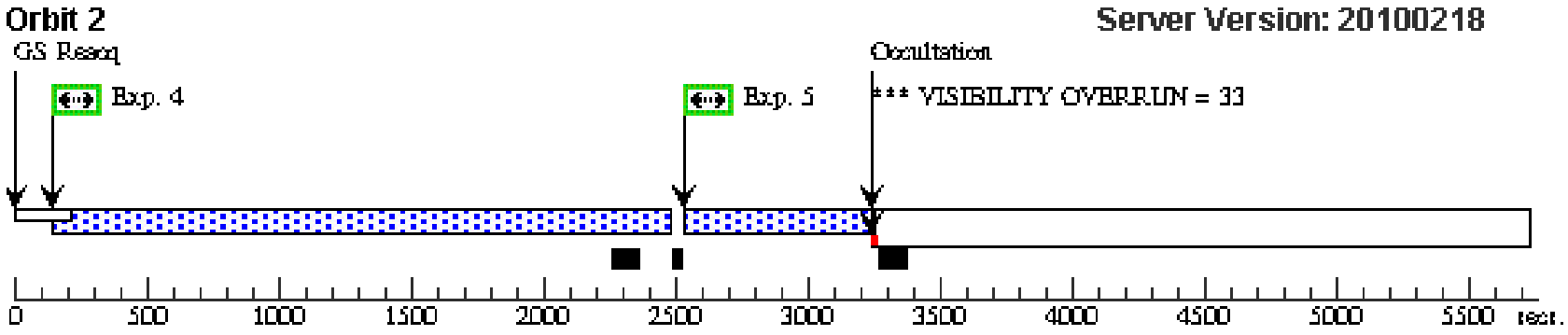
Comments: This is a nearby white dwarf, no extinction.

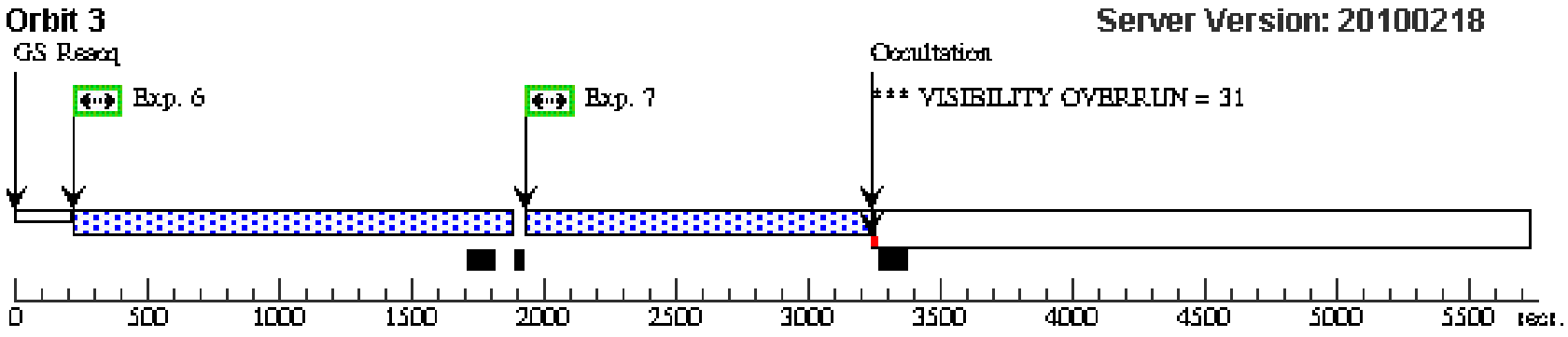
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	ACQ/Search for SDSS1228	(2) SDSSJ122859.93+104032.9	COS/NUV, ACQ/SEARCH, PSA	MIRRORB	SCAN-SIZE=2	GS ACQ SCENARIO BASE1B3		7.2 Secs *[==>]*	 ***[1]***
	Comments: I used a 22000 DA model spectrum scaled to an SDSS g=16.3, which reproduces the observed GALEX fluxes of SDSS1228+1040 within ~15%, as input for the COS ETC to calculate the exposure time for a S/N=40 detection -> 7.2s (COS72608)								
2	ACQ/Image for SDSS1228	(2) SDSSJ122859.93+104032.9	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				7.2 Secs *[==>]*	 ***[1]***
	Comments: I used a 22000 DA model spectrum scaled to an SDSS g=16.3, which reproduces the observed GALEX fluxes of SDSS1228+1040 within ~15%, as input for the COS ETC to calculate the exposure time for a S/N=40 detection -> 7.2s (COS72608)								
3	G225M@2339A for SDSS1228	(2) SDSSJ122859.93+104032.9	COS/NUV, TIME-TAG, PSA	G225M 2339 A	FLASH=YES; BUFFER-TIME=2300			2381 Secs *[==>]*	 ***[1]***
4	G225M@2373A for SDSS1228	(2) SDSSJ122859.93+104032.9	COS/NUV, TIME-TAG, PSA	G225M 2373 A	FLASH=YES; BUFFER-TIME=2050			2250 Secs *[==>]*	 ***[2]***
5	G225M@2410A, pt.1 for SDSS1228	(2) SDSSJ122859.93+104032.9	COS/NUV, TIME-TAG, PSA	G225M 2410 A	FLASH=YES; BUFFER-TIME=635			635 Secs *[==>]*	 ***[2]***
6	G225M@2410A, pt.2 for SDSS1228	(2) SDSSJ122859.93+104032.9	COS/NUV, TIME-TAG, PSA	G225M 2410 A	FLASH=YES; BUFFER-TIME=1500			1650 Secs *[==>]*	 ***[3]***
7	G285@2657A, pt.1 for SDSS1228	(2) SDSSJ122859.93+104032.9	COS/NUV, TIME-TAG, PSA	G285M 2657 A	FLASH=YES; BUFFER-TIME=1200			1200 Secs *[==>]*	 ***[3]***
8	G285@2657A, pt.2 for SDSS1228	(2) SDSSJ122859.93+104032.9	COS/NUV, TIME-TAG, PSA	G285M 2657 A	FLASH=YES; BUFFER-TIME=970			1070 Secs *[==>]*	 ***[4]***
9	G285@2695A, pt.1 for SDSS1228	(2) SDSSJ122859.93+104032.9	COS/NUV, TIME-TAG, PSA	G285M 2695 A	FLASH=YES; BUFFER-TIME=1620			1810 Secs *[==>]*	 ***[4]***
10	G285@2695A, pt.2 for SDSS1228	(2) SDSSJ122859.93+104032.9	COS/NUV, TIME-TAG, PSA	G285M 2695 A	FLASH=YES; BUFFER-TIME=500			600 Secs *[==>]*	 ***[5]***
11	G285@2739A for SDSS1228	(2) SDSSJ122859.93+104032.9	COS/NUV, TIME-TAG, PSA	G285M 2739 A	FLASH=YES; BUFFER-TIME=2269			2269 Secs *[==>]*	 ***[5]***

Orbit Structure






Orbit 3
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GS Reacq
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Exp. 7
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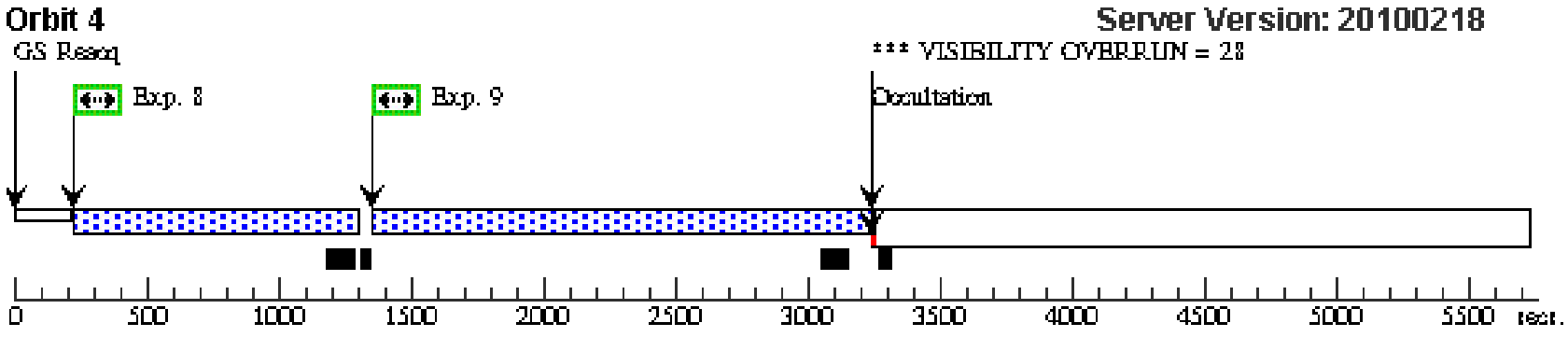
Orbit 4
Server Version: 20100218
GS Reacq
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Exp. 8
Exp. 9
Occultation
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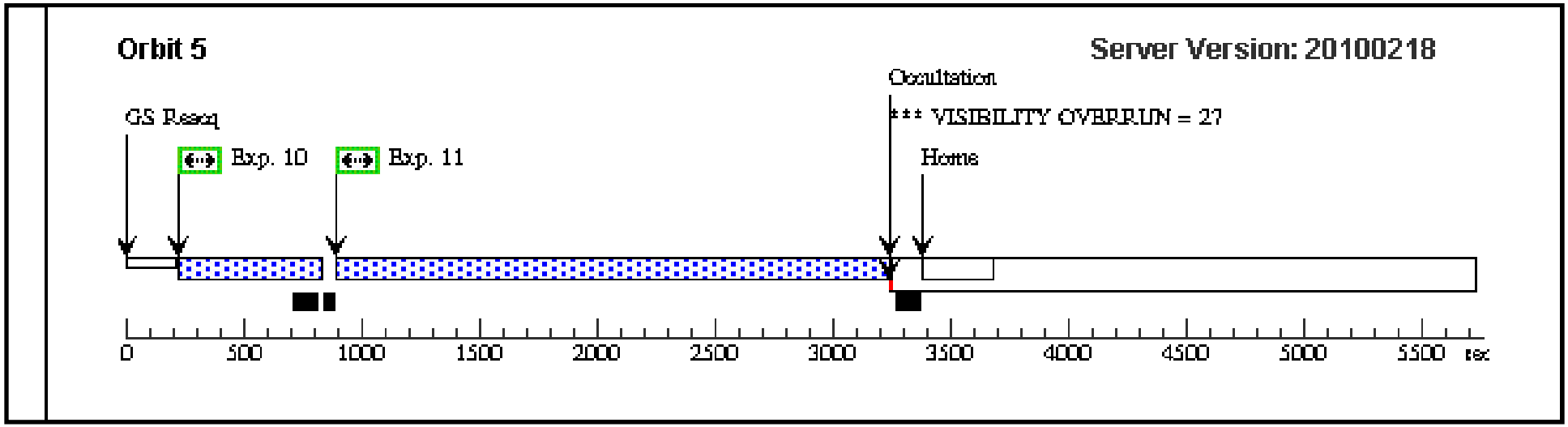
sec.


Orbit 5
Server Version: 20100218
Occultation
GS Reacq
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Exp. 10
Exp. 11
Home
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sec