13319 - COS Spectroscopy of Pulsating, Metal-Rich, Extremely Low Mass White Dwarfs

Cycle: 21, 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) SDSS-J074511.56+194926.5	COS/NUV	5	25-Nov-2013 21:26:20.0	yes
02	(1) SDSS-J074511.56+194926.5	COS/NUV	5	25-Nov-2013 21:26:37.0	yes
03	(2) SDSS-J111215.82+111745.0	COS/NUV	3	25-Nov-2013 21:26:51.0	yes
04	(2) SDSS-J111215.82+111745.0	COS/NUV	4	25-Nov-2013 21:27:00.0	yes

17 Total Orbits Used

ABSTRACT

Our goal is to simultaneously probe two phenomena in newly discovered extemely low mass (ELM) He-core white dwarfs. Optical spectroscopy suggests that these ELM white dwarfs are the most metal-rich white dwarfs known. COS UV spectroscopy will establish this and map the detailed metal abundance patterns, allowing us to discriminate between a debris disk origin and radiative levitation origin for their super-solar metal

abundances. Second, optical photometry suggests that one of these targets is a pulsating white dwarf, and in fact may be the first known white dwarf with p-mode pulsations. COS time-tag capability provides a unique opportunity to confirm that this star exhibits p-mode pulsations. Such modes would probe this star even deeper than the g-mode pulsations also present, and could possibly constrain stable nuclear burning predicted in these low-mass white dwarfs.

OBSERVING DESCRIPTION

Our observations are designed to accomplish two goals: to obtain complete UV spectral coverage to detect all observable metal lines, and to probe the NUV portion of the spectrum, below 2000 Angstroms, where p-mode pulsations have their largest predicted amplitudes. Our targets were chosen because they are two of the brightest ELM white dwarfs discovered so far and allow us to simultaneously probe several phenomena, using the same data, which will help constrain the origin and evolution of these stars. We will use the NUV G230L grating with three different nominal wavelength settings of 2635, 2950, and 3360 Angstroms. We present below a more detailed description of the observations for each of our targets including the exposure time based on the number of orbits awarded to this obseerving program, to achieve a minimum S/N = 20 at 2600, 1850(for J0745)/1700(for J1112) and 2250 Angstroms. In all cases, we have chosen to divide our observations into 4 subexposures using different offsets to correct for the fixed-pattern defects of the detector. Furthermore, we have used the auto-adjust feature in the Orbit Planner to maximize our use of our allotted orbits.

SDSS J074511.56+194926.5: This star is a soon to be published tidally distorted ELM white dwarf binary with a best-fit period of P ~ 2.7 hr and a radial velocity semi-amplitude of K = 116.2 km/s. The mass function allows for a minimum companion mass of M_2 > 0.11 Msol assuming a 0.16 Msol primary. Using our grid of model atmospheres we measure Teff = 8340 K and log g = 6.17. Our preliminary analysis of the optical spectrum of J0745 reveals that it may be the most metal-rich white dwarf discovered to date. We note that this white dwarf, unlike our other target, displays ~1.3 % optical photometric variability due to ellipsoidal variations. The COS time-tag capability will allows to constrain these ellipsoidal variations in the more highly limb-darkened UV and thereby constrain the orbital inclination and mass of the unseen secondary. We used the COS ETC coupled with our model fit of this star normalized to the SDSS g-band magnitude to estimate the exposure time for our observations. Since we have been awarded 10 orbits for this target, we will break up the observations into two separate visits in order to avoid scheduling difficulties due to the SAA. Each visit will begin with a target acquisition exposure (please refer to ETC ID 517298). Visit 1 will cover the wavelength settings for 2635 and 3360 Angstroms with G230L for a total exposure time of 5342 and 5700 s respectively. Next, Visit 2 will cover the 2950 wavelength setting with a total exposure time of 17320 s.

SDSS J111215.82+111745.0: J1112, a pulsating ELM white dwarf binary with a period P ~ 4.1 hr and a radial velocity semi-amplitude of K = 116.2 +/- 2.8 km/s. The mass function allows for a minimum companion mass of M_2 > 0.14 Msol assuming a 0.17 Msol primary. Our measured atmospheric parameters for this star are Teff = 9590 K and log g = 6.36. This is the hotter and brighter of our two targets and the COS time-tag capability will allow us to constrain potential p-mode oscillations. With NUV integrated photon rates of roughly 42 counts/s, such amplitudes would be possible to detect by binning the COS time-tagged photons into 30 s intervals over the course of the requested orbits. We used the COS ETC coupled with our model fit of this star normalized to the SDSS g-band magnitude to estimate the exposure time for our observations. We have been awarded 7 orbits for this target which will constitute a single visit (Visit 3). The visit will begin with a target acquisition exposure (please refer to ETC ID 517337). Next Visit 3 will cover the three wavelength settings for 2635, 2950 and 3360 Angstroms with G230L for a total exposure times of 5332, 11960 and 2672 s respectively.

Visit

Proposal 13319, J0745 (01), scheduled Tue Nov 26 02:27:08 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/NUV

Special Requirements: (none)

Fixed Targets

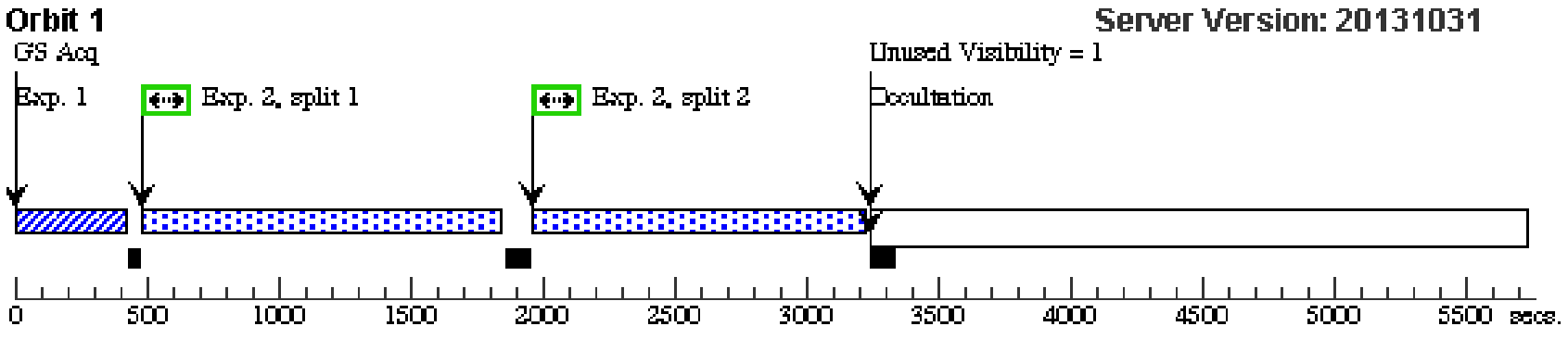
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SDSS-J074511.56+194926.5	RA: 07 45 11.5680 (116.2982000d) Dec: +19 49 26.58 (19.82405d) Equinox: J2000	Proper Motion RA: 0 Proper Motion Dec: 0 Parallax: 0" Epoch of Position: 2000	V=16.490742+/-0.007904 u = 17.43	Reference Frame: ICRS

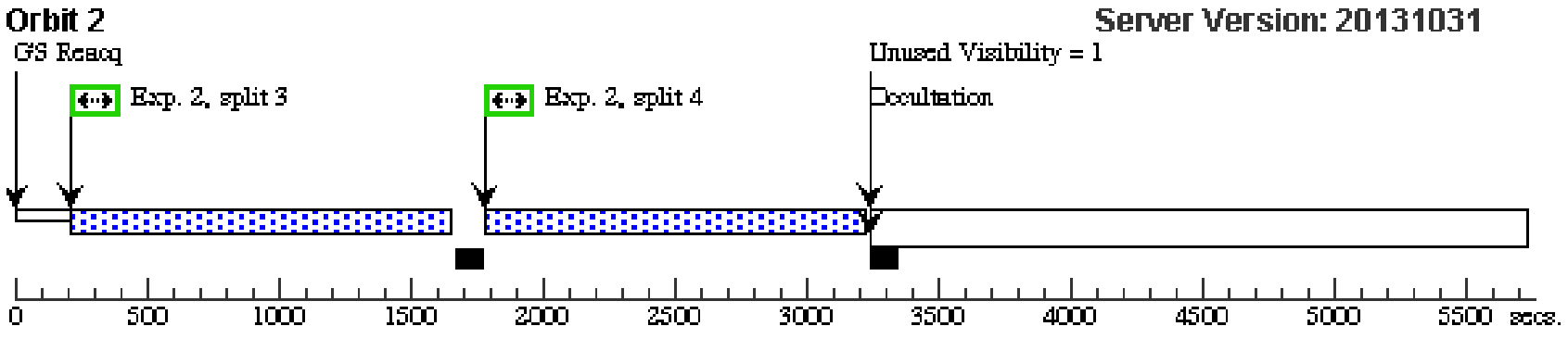
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

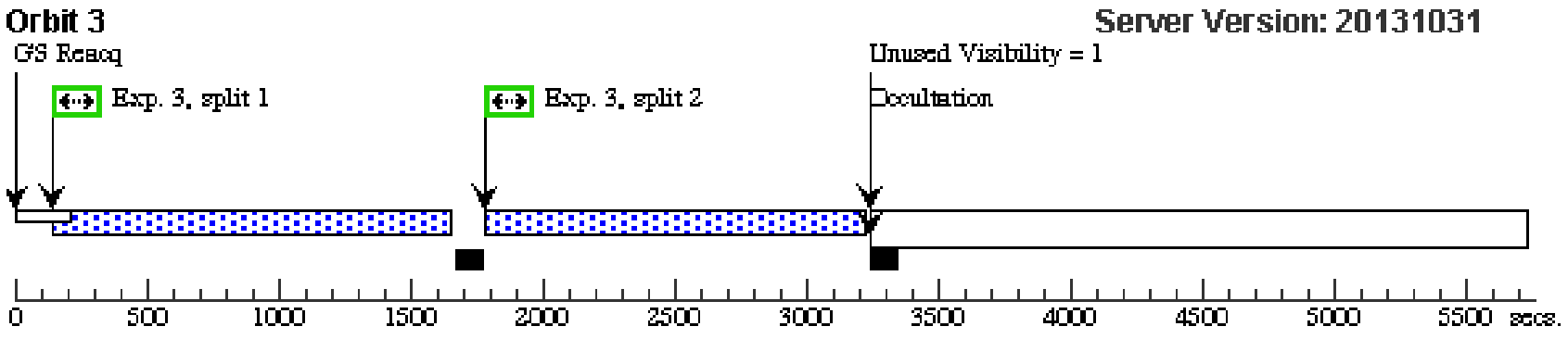
Exposures

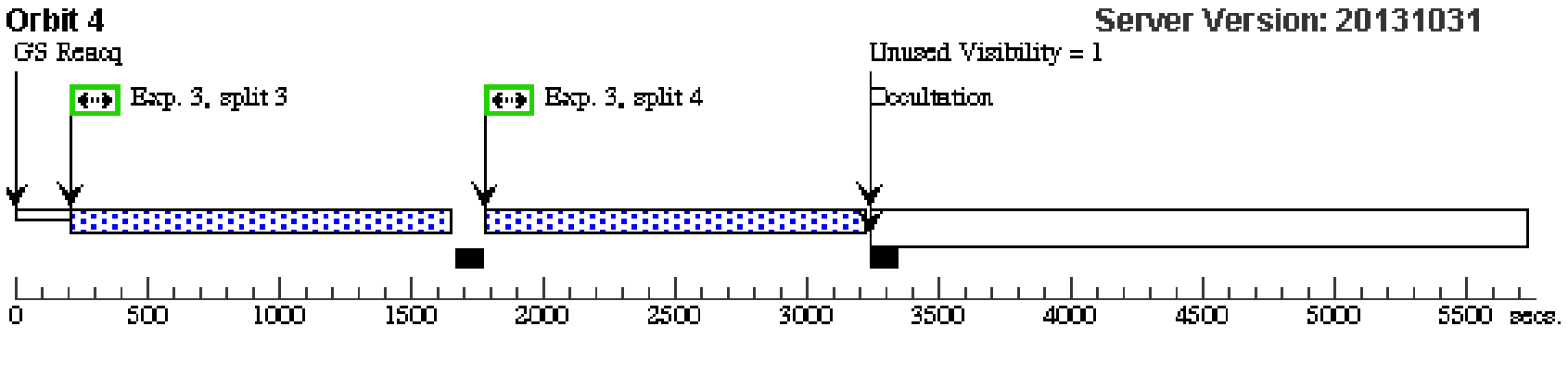
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Target Acquisition (517298)	(1) SDSS-J074511.56+194926.5	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				7 Secs (7 Secs) *[==>]*	*[1]*
2	G230L (2635) (491760)	(1) SDSS-J074511.56+194926.5	COS/NUV, TIME-TAG, PSA	G230L 2635 A	BUFFER-TIME=1453; FP-POS=ALL			1240 Secs (5342 Secs) *[==>1246.0 Secs (Split 1)]* *[==>1246.0 Secs (Split 2)]* *[==>1425.0 Secs (Split 3)]* *[==>1425.0 Secs (Split 4)]*	*[1]* *[2]*
3	G230L (3360) (491770)	(1) SDSS-J074511.56+194926.5	COS/NUV, TIME-TAG, PSA	G230L 3360 A	BUFFER-TIME=1445; FP-POS=ALL			1400 Secs (5700 Secs) *[==>1425.0 Secs (Split 1)]* *[==>1425.0 Secs (Split 2)]* *[==>1425.0 Secs (Split 3)]* *[==>1425.0 Secs (Split 4)]*	*[3]* *[4]*
4	G230L (2950) (491765)	(1) SDSS-J074511.56+194926.5	COS/NUV, TIME-TAG, PSA	G230L 2950 A	FP-POS=ALL; BUFFER-TIME=1457			669 Secs (2676 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	*[5]*

Orbit Structure





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3500
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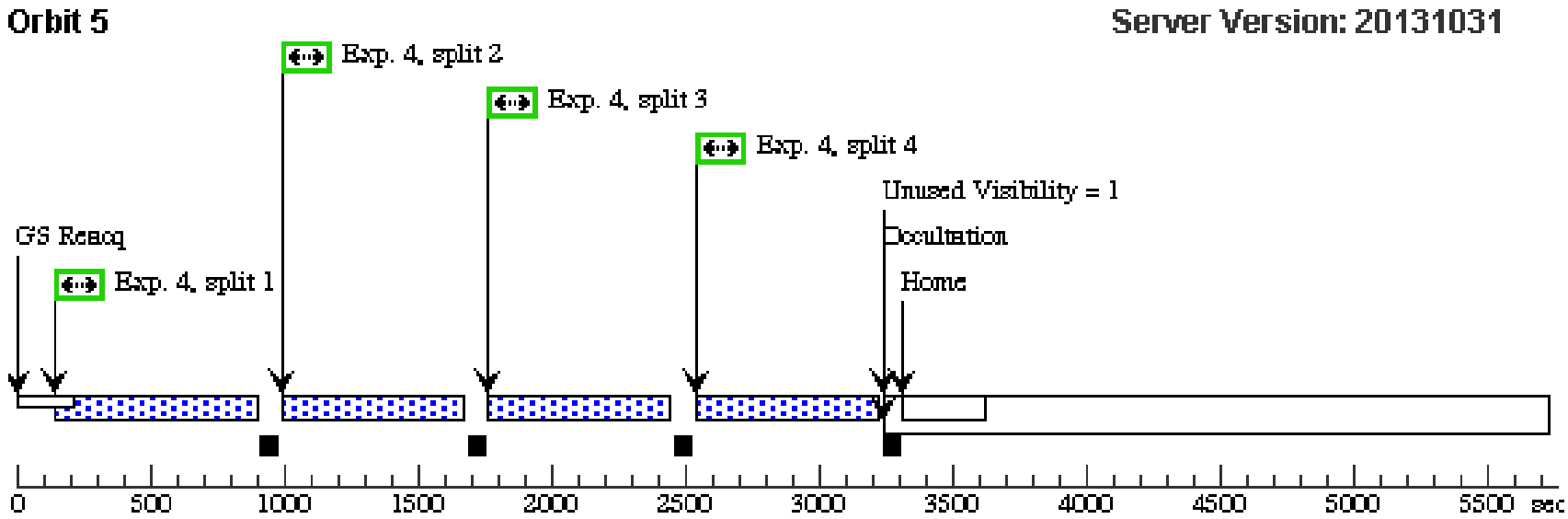
5500
secs.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Exp. 4, split 3
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Unused Visibility = 1
GS Reacq
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Occultation
Home
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1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 13319, J0745 (02), scheduled Tue Nov 26 02:27:12 GMT 2013

Diagnostic Status: Warning

Scientific Instruments: COS/NUV

Special Requirements: (none)

Diagnostics

(J0745 (02)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SDSS-J074511.56+194926.5	RA: 07 45 11.5680 (116.2982000d) Dec: +19 49 26.58 (19.82405d) Equinox: J2000	Proper Motion RA: 0 Proper Motion Dec: 0 Parallax: 0" Epoch of Position: 2000	V=16.490742+/-0.007904 u = 17.43	Reference Frame: ICRS

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

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Target Acquisition (517298)	(1) SDSS-J074511.56+194926.5	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				7 Secs (7 Secs)	
								[==>]	***[1]***
2	G230L (2950) (491765)	(1) SDSS-J074511.56+194926.5	COS/NUV, TIME-TAG, PSA	G230L 2950 A	FP-POS=ALL; BUFFER-TIME=1457			584 Secs (2336 Secs)	
								[==>(Split 1)] *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	***[1]***
3	G230L (2950) (491765)	(1) SDSS-J074511.56+194926.5	COS/NUV, TIME-TAG, PSA	G230L 2950 A	FP-POS=ALL; BUFFER-TIME=1457			2900 Secs (11980 Secs)	
								[==>2995.0 Secs (Split 1)]	***[2]***
								[==>2995.0 Secs (Split 2)]	***[3]***
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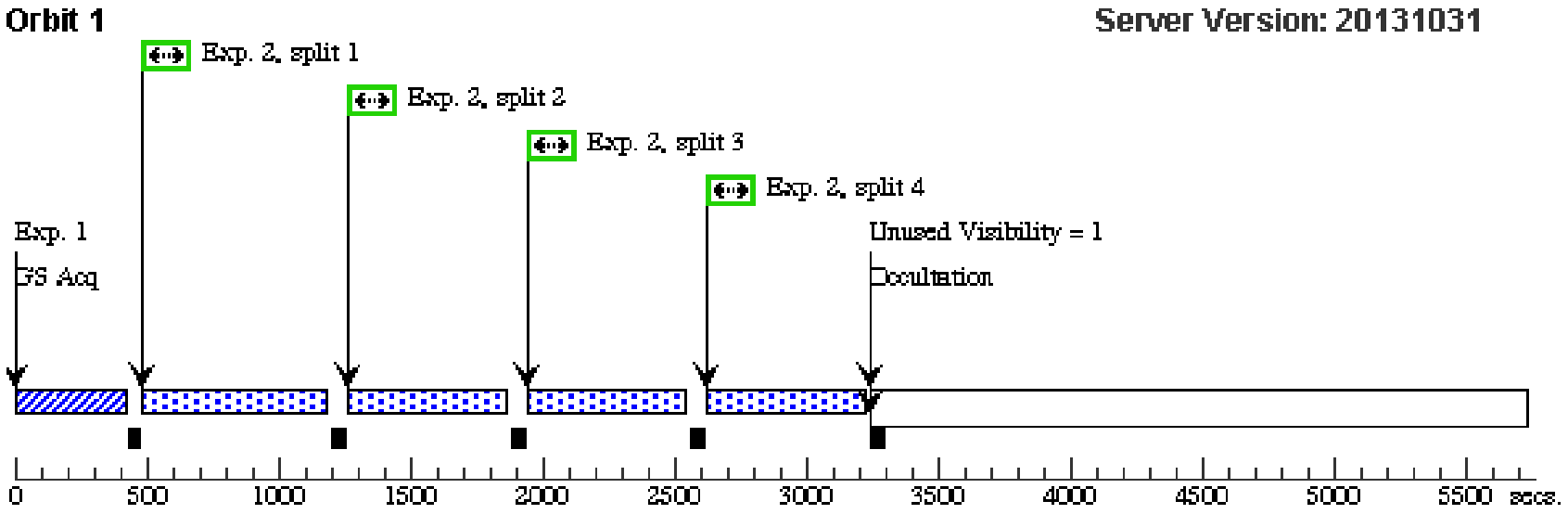
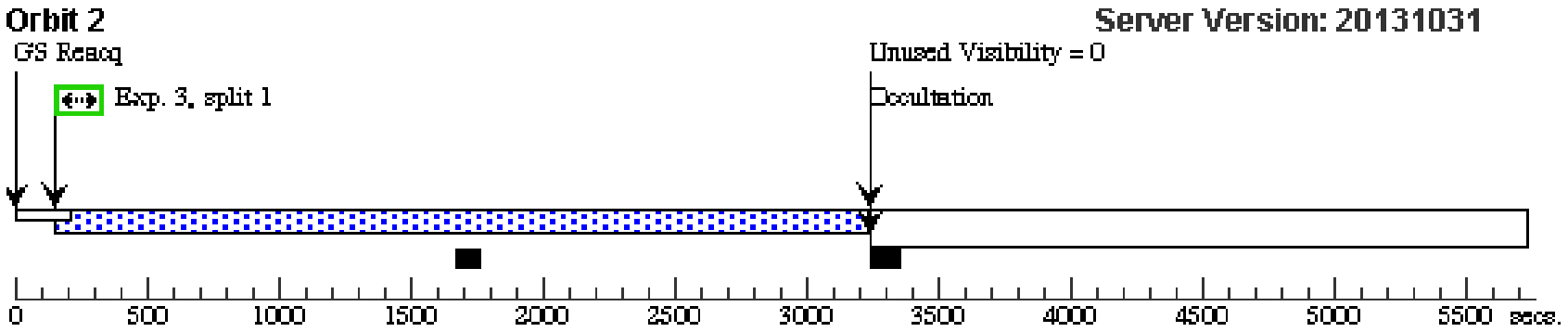
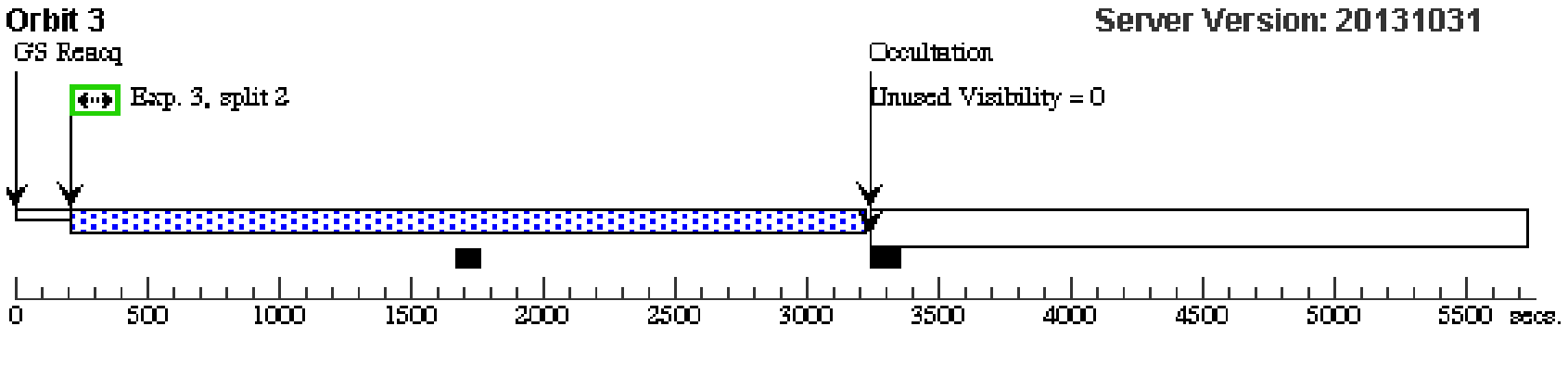
								[==>2995.0 Secs (Split 4)]	***[5]***

Orbit Structure



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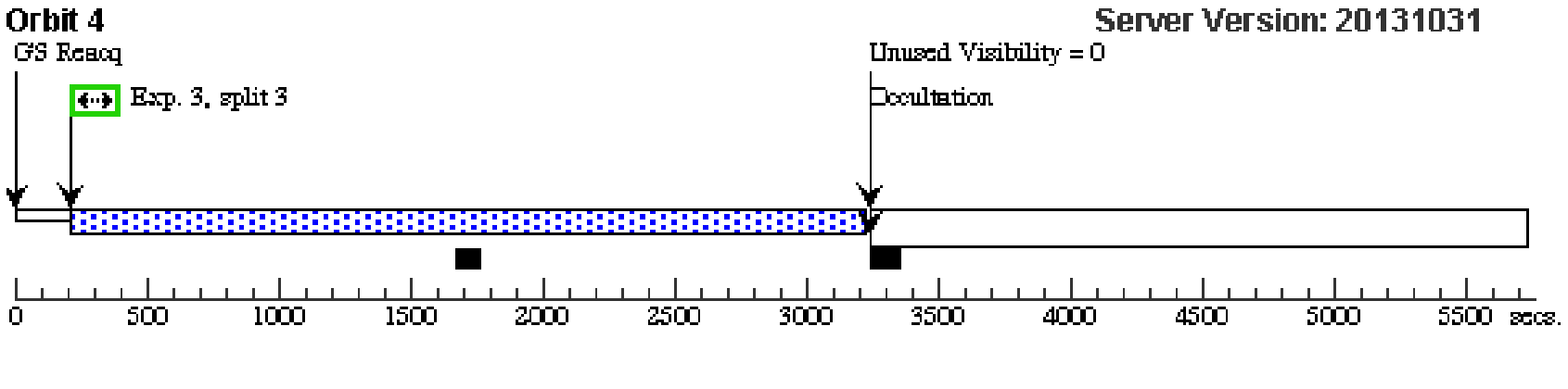
secs.


Orbit 4
Server Version: 20131031
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Exp. 3, split 3
Unused Visibility = 0
Occultation
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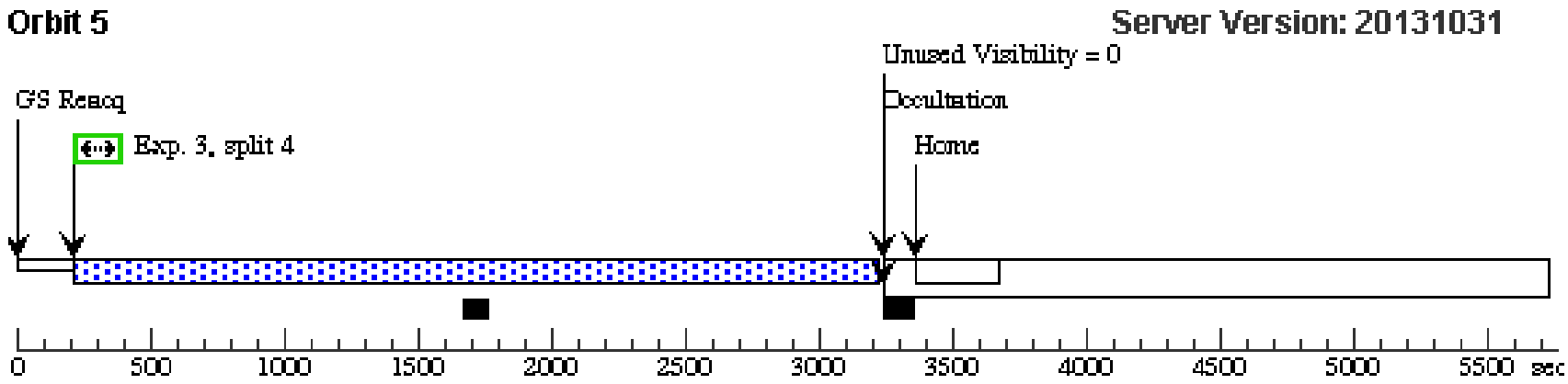
secs.


Orbit 5
Server Version: 20131031
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Exp. 3, split 4
Occultation
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1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 13319, J1112 (03), implementation Tue Nov 26 02:27:14 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/NUV

Special Requirements: (none)

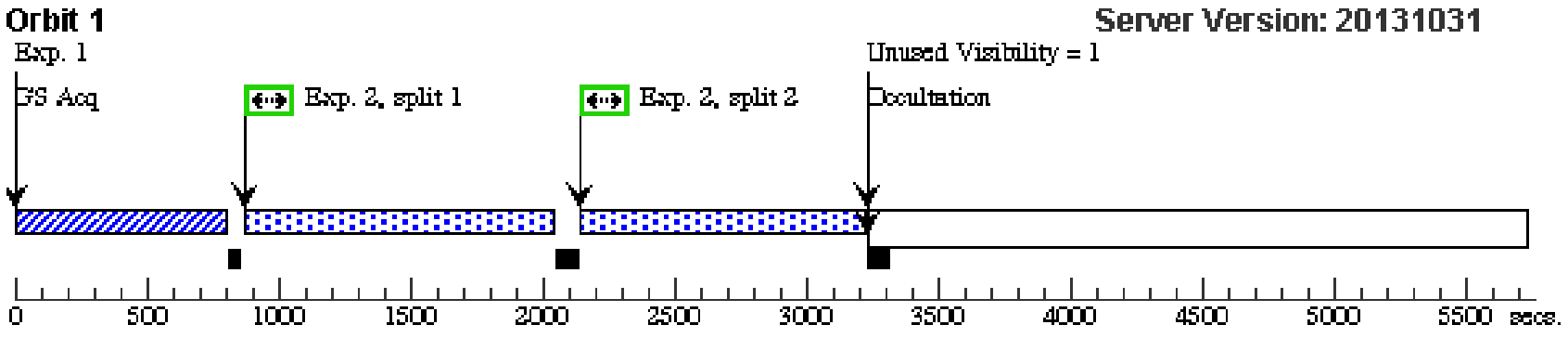
Fixed Targets

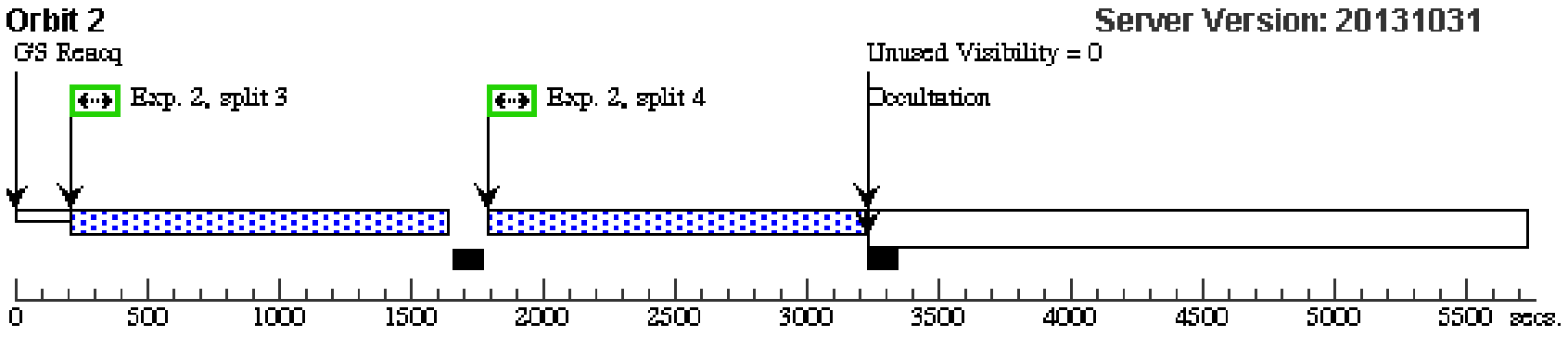
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SDSS-J111215.82+111745.0	RA: 11 12 15.8600 (168.0660833d) Dec: +11 17 44.80 (11.29578d) Equinox: J2000	Proper Motion RA: 0 Proper Motion Dec: 0 Epoch of Position: 2000	V=16.307135+/-0.015945 u = 17.16	Reference Frame: ICRS

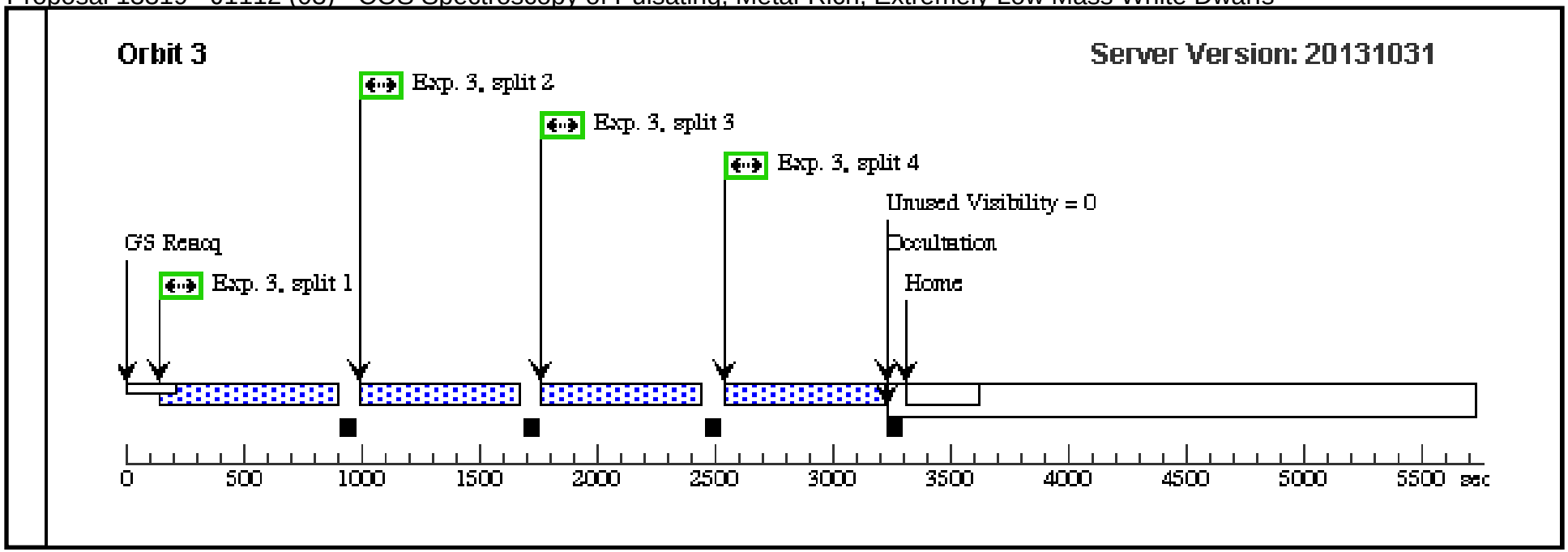
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Target Acquisition (545413)	(2) SDSS-J111215.82+111745.0	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				184 Secs (184 Secs)	
								[==>]	***[1]***
2	G230L (2635) (491791)	(2) SDSS-J111215.82+111745.0	COS/NUV, TIME-TAG, PSA	G230L 2635 A	FP-POS=ALL; BUFFER-TIME=1408			1240 Secs (4956 Secs)	
								[==>1060.0 Secs (Split 1)] *[==>1060.0 Secs (Split 2)]*	***[1]***
								[==>1418.0 Secs (Split 3)] *[==>1418.0 Secs (Split 4)]*	***[2]***
3	G230L (3360) (491780)	(2) SDSS-J111215.82+111745.0	COS/NUV, TIME-TAG, PSA	G230L 3360 A	FP-POS=ALL; BUFFER-TIME=1406			650 Secs (2672 Secs)	
								[==>668.0 Secs (Split 1)] *[==>668.0 Secs (Split 2)]* *[==>668.0 Secs (Split 3)]* *[==>668.0 Secs (Split 4)]*	***[3]***

Orbit Structure



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Exp. 3, split 3
Exp. 3, split 4
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GS Reacq
Occultation
Exp. 3, split 1
Home
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1500
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2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 13319, J1112 (04), implementation Tue Nov 26 02:27:15 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/NUV

Special Requirements: (none)

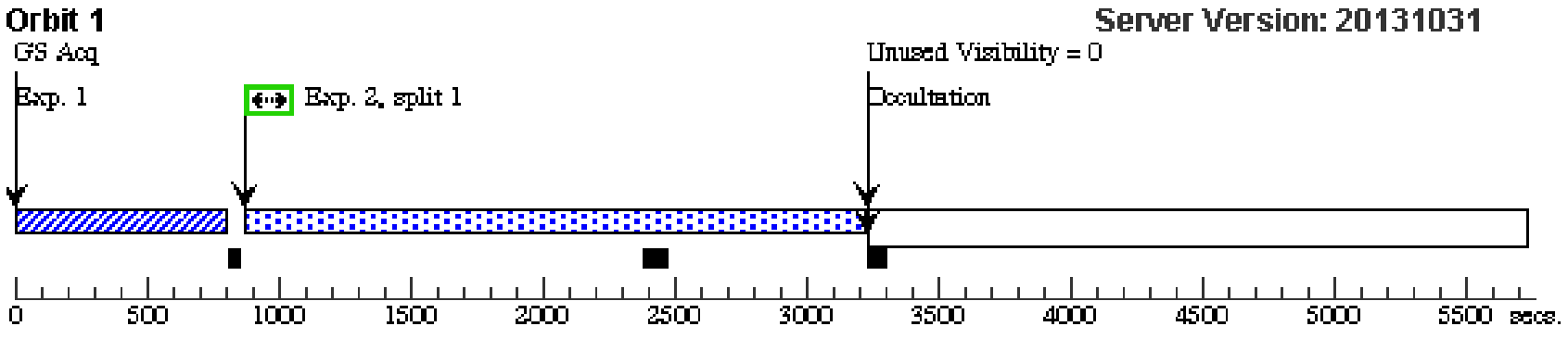
Fixed Targets

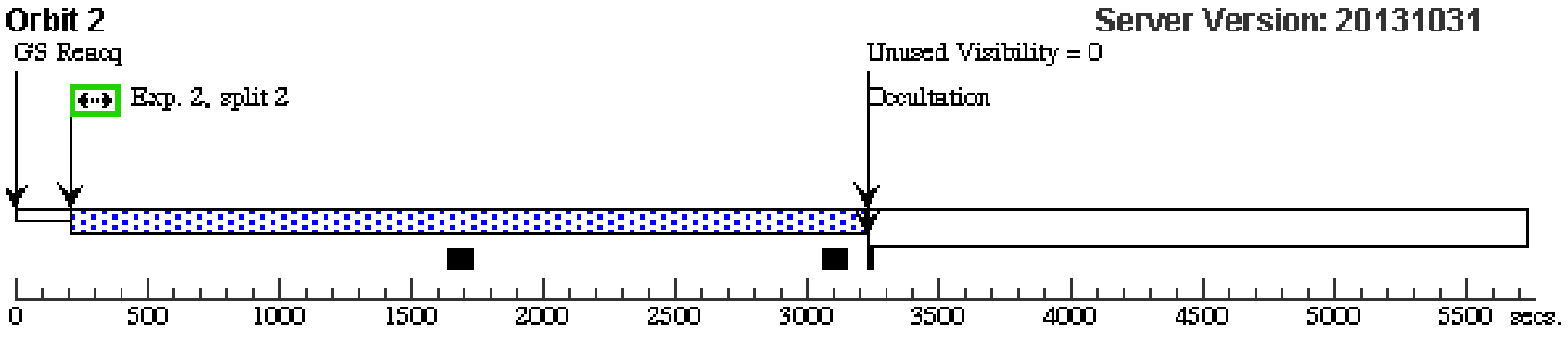
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SDSS-J111215.82+111745.0	RA: 11 12 15.8600 (168.0660833d) Dec: +11 17 44.80 (11.29578d) Equinox: J2000	Proper Motion RA: 0 Proper Motion Dec: 0 Epoch of Position: 2000	V=16.307135+/-0.015945 u = 17.16	Reference Frame: ICRS

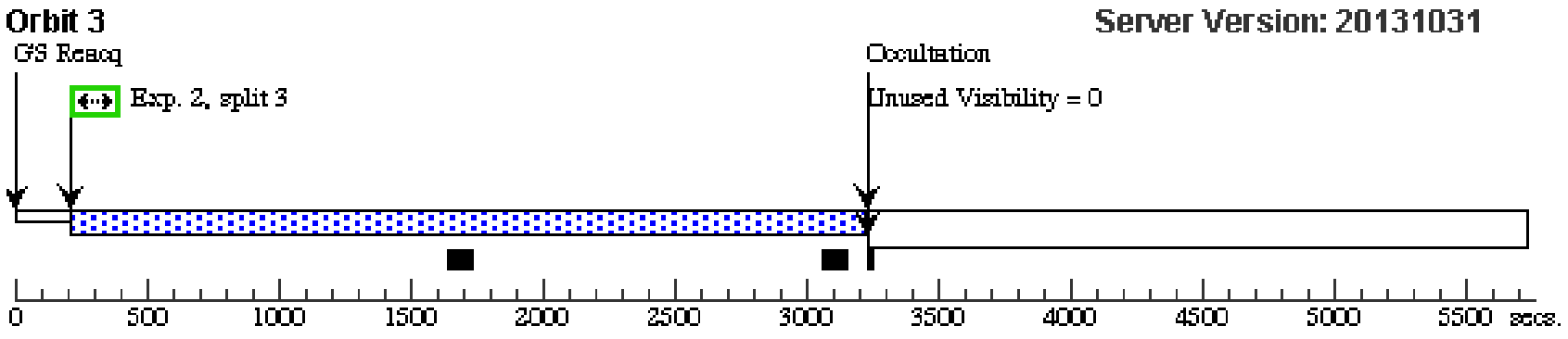
Exposures

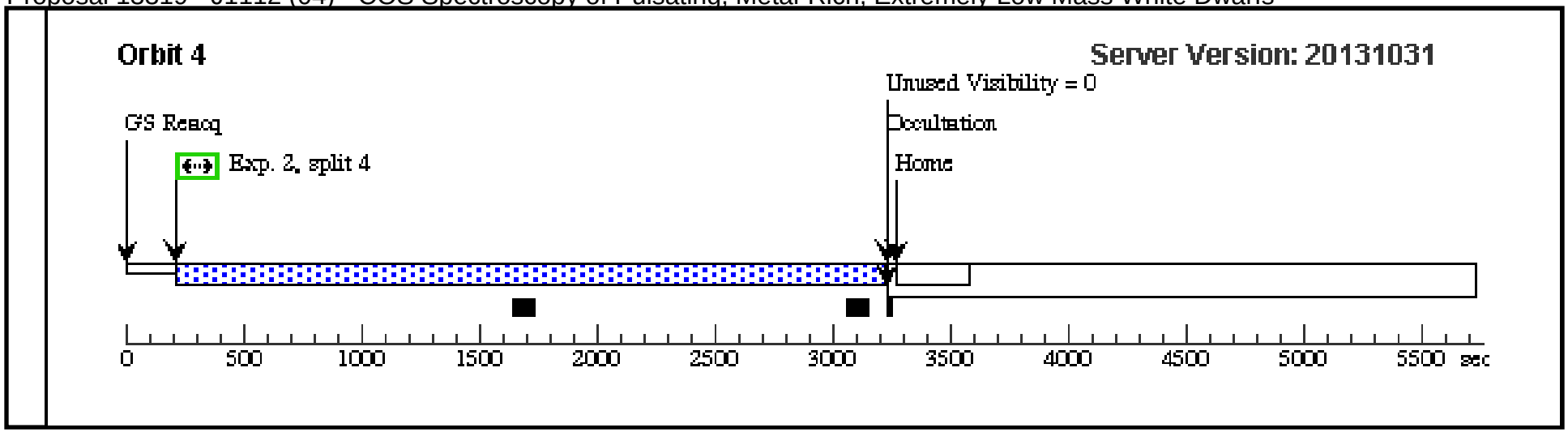
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Target Acquisition (517337)	(2) SDSS-J111215.82+111745.0	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				184 Secs (184 Secs)	
								[==>]	***[1]***
2	G230L (2950) (491787)	(2) SDSS-J111215.82+111745.0	COS/NUV, TIME-TAG, PSA	G230L 2950 A	FP-POS=ALL; BUFFER-TIME=1420			2700 Secs (11216 Secs)	
								[==>2246.0 Secs (Split 1)]	***[1]***
								[==>2990.0 Secs (Split 2)]	***[2]***
								[==>2990.0 Secs (Split 3)]	***[3]***
								[==>2990.0 Secs (Split 4)]	***[4]***

Orbit Structure








Orbit 4
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Occultation
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sec