16253 - Cycles and the Seven Dwarfs

Cycle: 28, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
10	(1) HD-131156A (2) HD-131156B	COS/FUV COS/NUV	2	10-Dec-2020 14:01:43.0	yes
11	(3) HD-165341A (4) HD-165341B	COS/FUV COS/NUV	2	10-Dec-2020 14:01:46.0	yes

4 Total Orbits Used

ABSTRACT

Somewhat erratic, unpredictable long-term starspot cycles of late-type stars are relevant for understanding the Sun's analogous high-energy modulations, in turn crucial to Earth-impacting "Space Weather" (SW). Similarly, stellar SW counterparts can have equivalent, or more severe, adverse effects on their exoplanets. The solar decadal oscillations are symptomatic of a deep-seated magnetic pump -- the Dynamo -- whose internal workings remain elusive. Key question: is Sun's 11-year cycle normal, or instead a transition state? A 3-year addition to earlier long-term joint Chandra/HST programs (previously involving Alpha Cen [G2V+K1V] and Procyon [F5IV]), will be carried out for two new targets, the nearby binaries Xi Bootis (G8V+K4) and 70 Ophiuchi (K0V+K5V).

The HST part of the program will measure FUV subcoronal (T~100,000 K) emission lines, like Si IV 140 nm, C IV 155 nm, and density-sensitive O

IV 140 nm, as well as important chromospheric (T~10,000 K) features, like O I 130 nm, C II 133 nm, and C I 165 nm, in both pairs of stars, with one COS visit per system each year. Analyses of these emissions, including dynamical information encoded in Doppler shifts and distortions of the line shapes, can provide insight concerning the thermal/pressure structure of the anomalously hot outer layers of these stars; and how these structural properties change with the ebb and flow of a magnetic activity cycle.

OBSERVING DESCRIPTION

Impact of Reduced Gyro Mode

The two targets, Xi Boo and 70 Oph, would be minimally affected by RGM, because there are no explicit time or orientation constraints on the observations: they can be carried out anytime during Cycle 28 when the targets are available. Further, the Visits are only 2 orbits, minimizing the possibility of re-acquisition failures. However, if target acquisition times are increased by RGM, then one or more of the exposures would have to be shortened. This can be done with minimal loss of science.

Phase II Observing Description (for normal 3-gyro operations)

Observational goal is to obtain FUV moderate-resolution spectra of both components of Xi Boo and 70 Oph using Cosmic Origins Spectrograph (COS) . The primaries, Xi Boo A and 70 Oph A, are nearly identical in FUV flux levels, about a tenth of well-studied (by STIS) Alpha Cen A. Normally, high-sensitivity COS would be off-limits for these primaries, because their strong Lyman-alpha features would violate FUV detector bright limits. However, the COS G130M-1222 setting places Lyman-alpha in the gap between detector sides A and B, so can be used for cool stars, as long as their other strong emissions (e.g., C II 133 nm) are "safe" (as is the case for Xi Boo A and 70 Oph A). When combined with COS G160M-1533, the spectral range 107-171 nm can be covered, with only two small gaps: 120.7-122.3 nm (Lyman-alpha) and 151.5-153.3 nm (devoid of important lines). COS's 15 km/s resolution is fully adequate for the relatively broad FUV emission features of these cool stars, especially the "hot" lines like Si III 120.6 nm (T~30,000 K), Si IV 139.3 nm (80,000 K), and C IV 154.8 nm (100,000 K). The COS FUV channel is so sensitive that a mere 1000 s exposure obtains S/N~100 (line peak) at Si III, 80 at Si IV, and 65 at C IV, for both primary stars. Each grating setting requires 4 "FP-Splits" to mitigate fixed pattern noise.

The pair of FUV settings plus FP-SPLITs can be done in a single orbit for the primary of each system, including the initial Guide Star and NUV

imaging target acquisitions.

At the beginning of the second orbit, the secondary star would be captured by a small offset manuever and NUV imaging acquisition. The same dual-setting FUV sequence then would be carried out, extending over the remaining unocculted part of the second orbit.

The COS visits would be once a year for each system (4 HST orbits per year, total): experience with Alpha Cen AB has shown that the FUV variability, while significant, is not as pronounced as that of the X-rays (which are observed twice a year for each system). Helpfully, key coronal forbidden lines Fe XII 134.9 nm (T~2 MK) and Fe XXI 135.4 nm (10 MK) are available in the FUV to assess the stellar coronal states at the times of the COS pointings. For this reason, the HST and Chandra observations need not be simultaneous. In fact, it is better to have them separated, since the FUV coronal forbidden lines would then provide an additional point on the high-energy timeline. Given the very deep COS exposures proposed here (especially at 134.9 nm and 135.4 nm, which receive double coverage in the 2 nm overlap between G130M and G160M), these coronal forbidden lines should be easily detectable in the primary stars (based on previous STIS experience), and perhaps even in the UV-fainter secondaries.

Visit

Proposal 16253, Visit 10, implementation Thu Dec 10 19:01:47 GMT 2020

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: ORIENT 131D TO 11 D

Diagnostics

(Visit 10) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

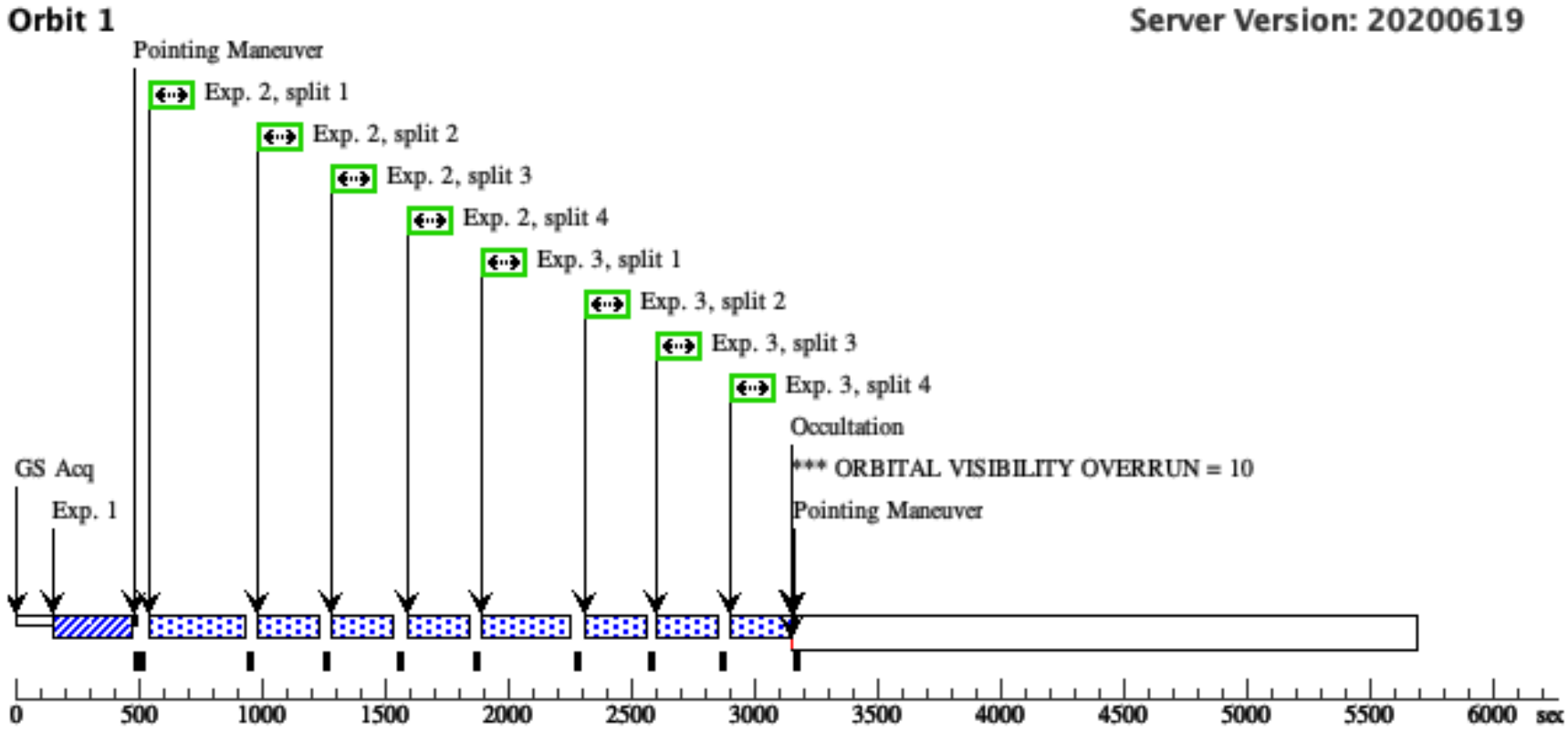
Fixed Targets

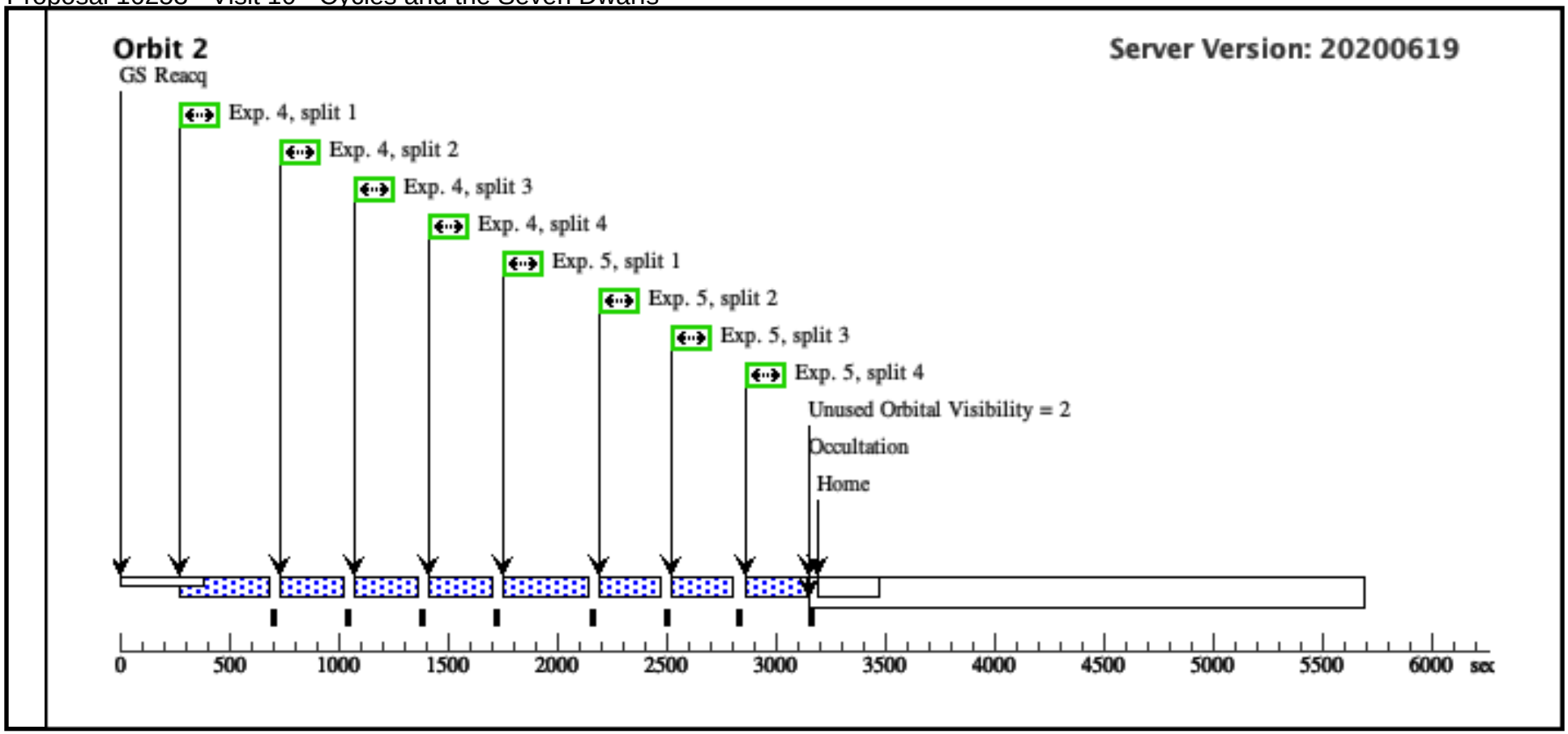
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD-131156A	RA: 14 51 23.3880 (222.8474500d)	Proper Motion RA: +0.128 arcsec/yr	V=+4.68+/-0.1	Reference Frame: ICRS
	Alt Name1: XI-BOO-A	Dec: +19 06 1.64 (19.10046d)	Proper Motion Dec: -0.042 arcsec/yr		
		Equinox: J2000	Parallax: 0.149"		
			Epoch of Position: 2000		
			Radial Velocity: +1.5 km/sec		
Comments: Target coords for epoch 2000 from SIMBAD, based on Gaia measurements for a mean epoch of 2015.5 corrected for Gaia proper motions *Category=STAR* *Description=[CORONA, G V-IV]* *Extended=NO*					
(2)	HD-131156B	Offset from HD-131156A	Radial Velocity: +2.3 km/sec	V=+6.82+/-0.1	Offset Position (HD-131156B)
	Alt Name1: XI-BOO-B	RA Offset: -0.328 Secs			
		Dec Offset: 2.25 Arcsec			
Comments: Target offset based on orbital model, good for 2021 +/- 1 yr *Category=STAR* *Description=[CORONA, K V-IV]* *Extended=NO*					

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(COS.ta.1367079)	(1) HD-131156A	COS/NUV, ACQ/IMAGE, BOA	MIRRORB		GS ACQ SCENARIO BASE1BE		10 Secs (10 Secs) *[==>]*	***[1]***
	Comments: Castelli-Kurucz Models G8V, renormalized to vegamag = 4.68 in filter Johnson/V								
2	(COS.sp.1367281)	(1) HD-131156A	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=2400; FP-POS=ALL			200 Secs (800 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	***[1]***
	Comments: h_hd131156_uvsum_1m_51163_etc.dat from StarCAT (STIS E140M-1425)								
3	(COS.sp.1367282)	(1) HD-131156A	COS/FUV, TIME-TAG, PSA	G160M 1533 A	BUFFER-TIME=4000; FP-POS=ALL			193 Secs (772 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	***[1]***
	Comments: h_hd131156_uvsum_1m_51163_etc.dat from StarCAT (STIS E140M-1425)								
4	(COS.sp.1367319)	(2) HD-131156B	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=9300; FP-POS=ALL			235 Secs (940 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	***[2]***
	Comments: B fluxes scaled by 0.14 from A [h_hd131156_uvsum_1m_51163_etc.dat from StarCAT (STIS E140M-1425)]								
5	(COS.sp.1367320)	(2) HD-131156B	COS/FUV, TIME-TAG, PSA	G160M 1533 A	BUFFER-TIME=13400; FP-POS=ALL			227 Secs (908 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	***[2]***
	Comments: B fluxes scaled by 0.14 from A [h_hd131156_uvsum_1m_51163_etc.dat from StarCAT (STIS E140M-1425)]								

Orbit Structure




Orbit 2
Server Version: 20200619
GS Reacq
Exp. 4, split 1
Exp. 4, split 2
Exp. 4, split 3
Exp. 4, split 4
Exp. 5, split 1
Exp. 5, split 2
Exp. 5, split 3
Exp. 5, split 4
Unused Orbital Visibility = 2
Occultation
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 16253, Visit 11, completed Thu Dec 10 19:01:47 GMT 2020

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: ORIENT 316D TO 196 D

Diagnostics

(Visit 11) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

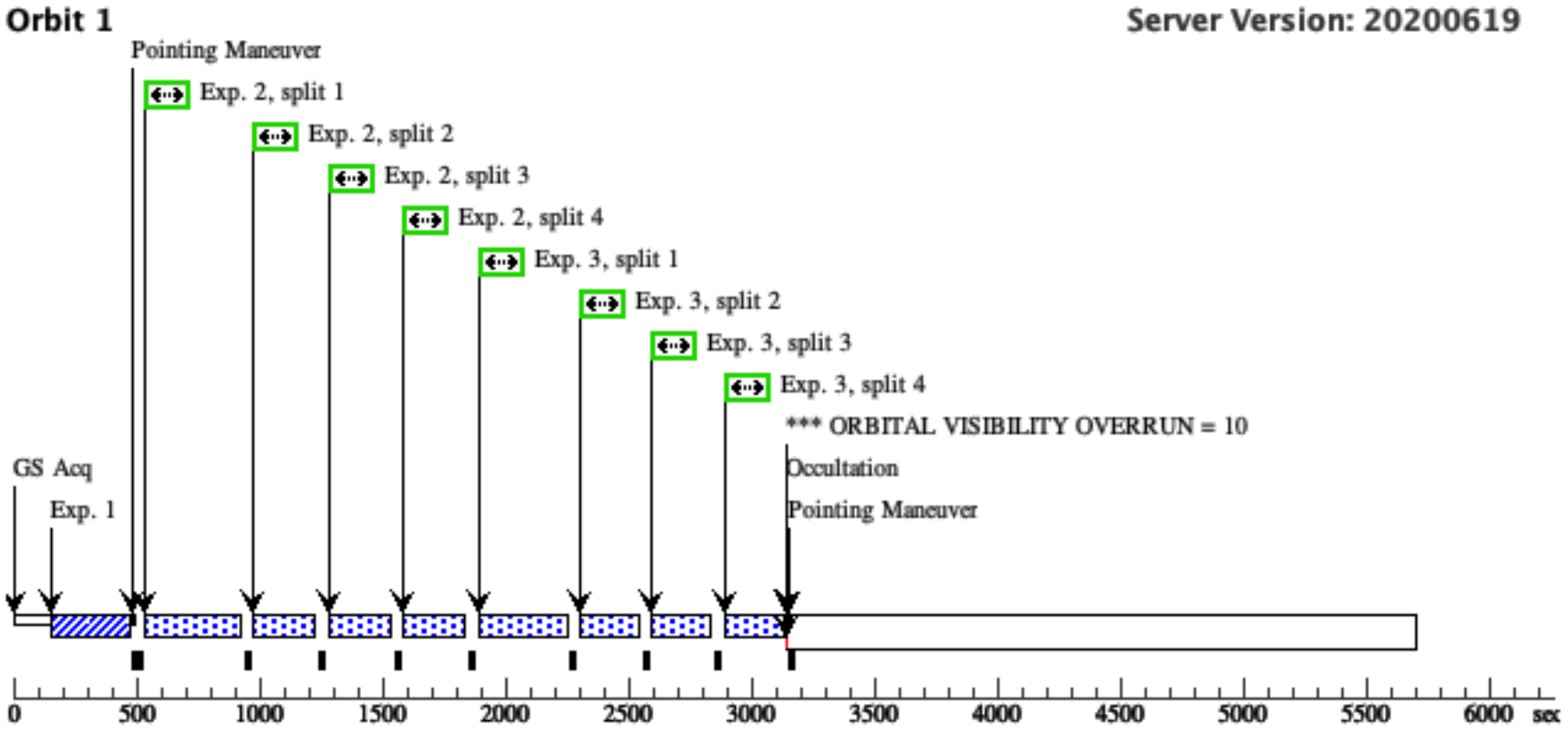
Fixed Targets

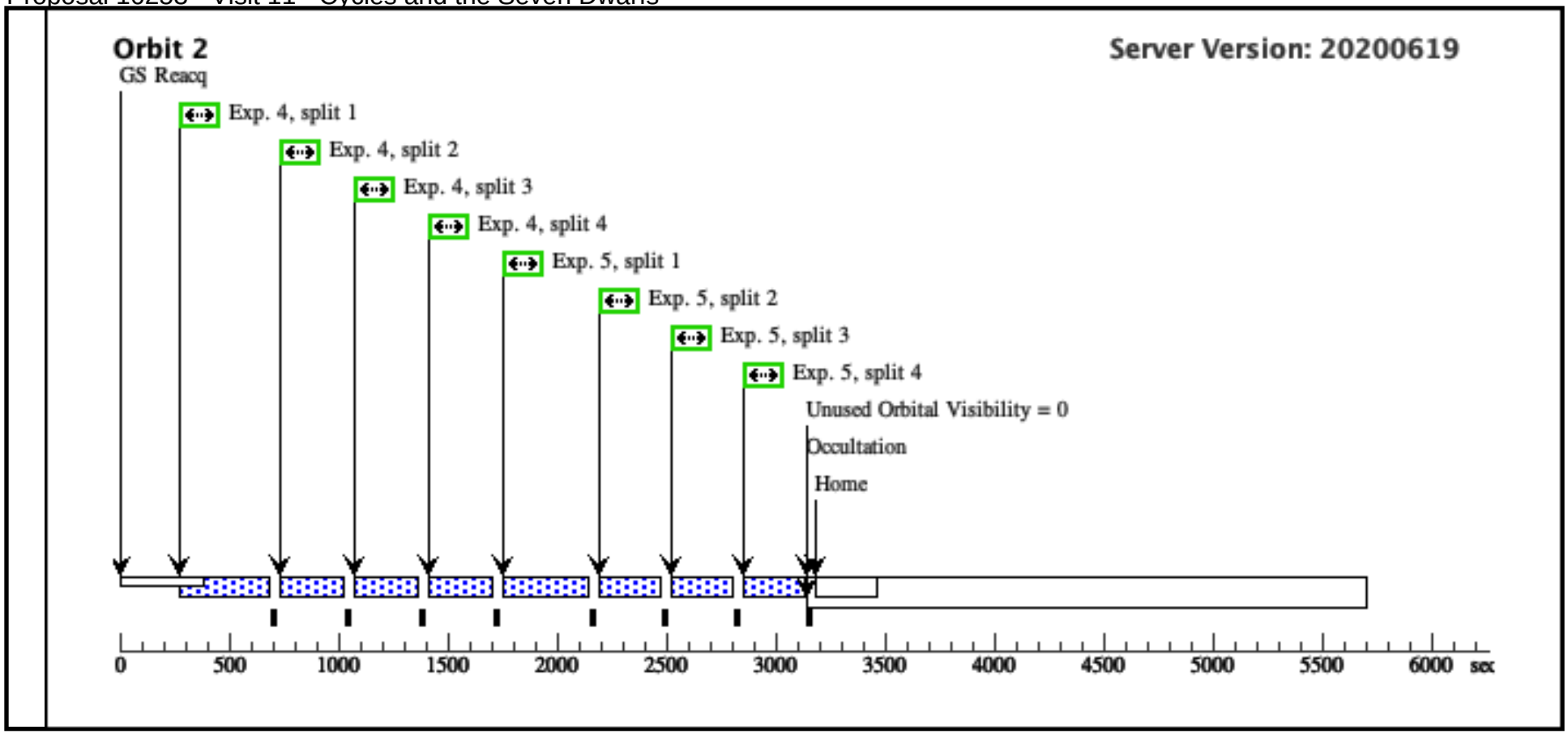
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	HD-165341A	RA: 18 05 27.4620 (271.3644250d)	Proper Motion RA: +0.124 arcsec/yr	V=+4.03+/-0.1	Reference Frame: ICRS
	Alt Name1: 70-OPH-A	Dec: +02 29 43.36 (2.49538d)	Proper Motion Dec: -0.963 arcsec/yr		
		Equinox: J2000	Parallax: 0.149"		
			Epoch of Position: 2015.5		
			Radial Velocity: -6.9 km/sec		
Comments: Target coords based on Gaia measurements for a mean epoch of 2015.5 (no proper motions cited in DR2); proper motions from Hipparcos. *Category=STAR* *Description=[CORONA, K V-IV]* *Extended=NO*					
(4)	HD-165341B	Offset from HD-165341A	Radial Velocity: -10.0 km/sec	V=+6.07+/-0.1	Offset Position (HD-165341B)
	Alt Name1: 70-OPH-B	RA Offset: 0.38 Secs			
		Dec Offset: -3.47 Arcsec			
Comments: Target offset based on orbital model, good for 2021 +/- 1 yr *Category=STAR* *Description=[CORONA, K V-IV]* *Extended=NO*					

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(COS.ta.1367302)	(3) HD-165341A	COS/NUV, ACQ/IMAGE, BOA	MIRRORB		GS ACQ SCENARIO BASE1BE		7 Secs (7 Secs) *[==>]*	 ***[1]***
Comments: Castelli-Kurucz Models K0V, renormalized to vegamag = 4.22 in filter Johnson/V (from BSC and WDS)									
2	(COS.sp.1367312)	(3) HD-165341A	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=2800; FP-POS=ALL			200 Secs (800 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	 ***[1]***
3	(COS.sp.1367313)	(3) HD-165341A	COS/FUV, TIME-TAG, PSA	G160M 1533 A	BUFFER-TIME=4300; FP-POS=ALL			191 Secs (764 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	 ***[1]***
4	(COS.sp.1367325)	(4) HD-165341B	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=9200; FP-POS=ALL			235 Secs (940 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	 ***[2]***
5	(COS.sp.1367326)	(4) HD-165341B	COS/FUV, TIME-TAG, PSA	G160M 1533 A	BUFFER-TIME=12700; FP-POS=ALL			224 Secs (896 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	 ***[2]***

Orbit Structure




Orbit 2
Server Version: 20200619
GS Reacq
Exp. 4, split 1
Exp. 4, split 2
Exp. 4, split 3
Exp. 4, split 4
Exp. 5, split 1
Exp. 5, split 2
Exp. 5, split 3
Exp. 5, split 4
Unused Orbital Visibility = 0
Occultation
Home
0
500
1000
1500
2000
2500
3000
3500
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4500
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5500
6000
sec