



13861 - HST/COS FUV Spectrophotometry of the Key Binary Solar Twins 16 Cyg A&B: Astrophysical Laboratories for the Future Sun and Older Solar Analogs

Cycle: 22, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) -16-CYG-A	COS/FUV COS/NUV	6	07-Nov-2014 21:06:05.0	yes
02	(2) -16-CYG-B	COS/FUV COS/NUV	6	07-Nov-2014 21:06:09.0	yes

12 Total Orbits Used

ABSTRACT

The fortuitous location of the wide G1.5V/G2.5V binary 16 Cyg A&B as the brightest stars in the Kepler Field is a "game changer," permitting the determination of the stars' fundamental properties from asteroseismology analyses. Recent studies returned precise determinations of the stars' basic

properties including masses and age (6.8 ± 0.4 Gyr), along with the rotation periods. Thus, 16 Cyg A&B are now the oldest solar-mass analogs with reliable ages and physical properties. Only the Sun has better determined physical properties. 16 Cyg A&B now serve as old-age anchors for Rotation-Age-Activity-Irradiance relations (and Gyrochronology studies) for solar-type stars. Extensive Ca II HK spectrophotometry reveals low levels of chromospheric emission are below the lowest values for our Sun. These stars serve as critical test beds for studying solar/stellar dynamos for stars less active than the Sun. These advances have catapulted 16 Cyg A&B into a prominent place in solar/stellar astrophysics for studying the evolution, internal structure, magnetic dynamos, angular momentum loss, and FUV irradiances of old solar-mass stars. Although 16 Cyg has been observed from X-ray - IR, there are no observations in the FUV region where most of the crucial diagnostic chromospheric & transition region emissions occur. We request COS FUV medium resolution (G130M, G160M) spectra (six orbits/star). This permits the important FUV (1150-1750Å) line emission strengths, profiles and Doppler shifts to be analyzed and compared with the Sun and other solar-analogs. This program is complemented by Ca II HK, high precision uvby observations, and by proposed Chandra X-ray coronal observations.

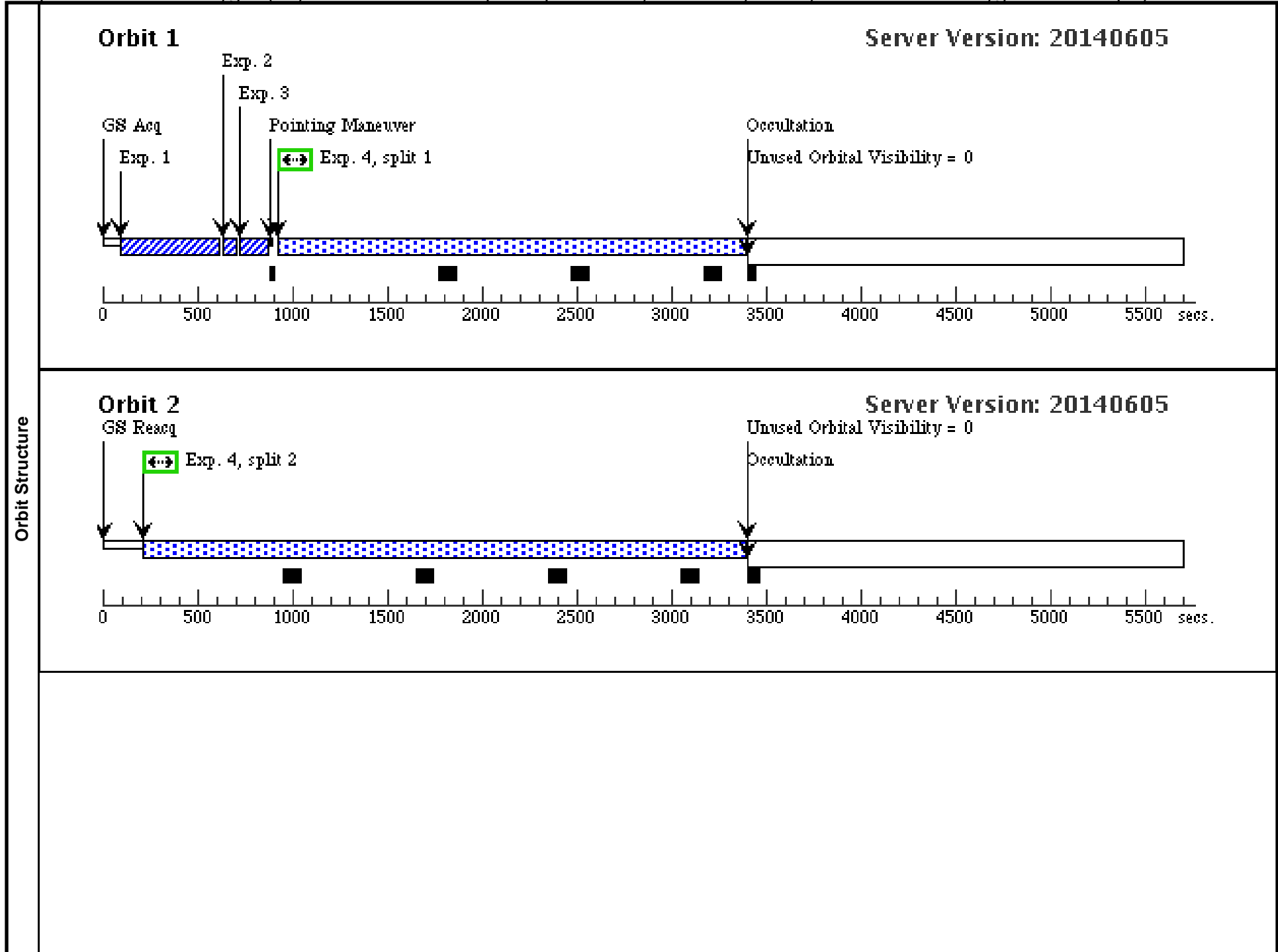
OBSERVING DESCRIPTION

We propose HST/COS FUV 1150-1750Å observations of 16 Cyg A&B (six HST orbits per star) to secure good signal/noise (S/N) medium resolution G130M and G160M spectrophotometry. We plan to use the Primary Science Aperture (PSA). Accounting for acquisitions, overheads and utilizing the "re-acquire" between orbits, this request will result in ~ 5.1 ksec (over 3 orbits) per G130M and G160M elements. We used our previous HST/COS FUV spectra of the solar twin 18 Sco (G2 V; $V = 5.50$ mag; $d = 13.90$ pc; age = 3.9 ± 0.5 Gyr) and archival COS FUV spectra of alpha Cen A (G2 V; $V = -0.01$; $d = 1.34$ pc; age = 4.9 ± 0.7 Gyr) to estimate exposure times and signal-to-noise (S/N) values for the important FUV emissions. We scaled these fluxes (via the inverse square law) to the distance of 16 Cyg A&B ($d = 21.10$ pc). Also, because 16 Cyg A&B are older, and from lower Ca II H&K emissions, we assumed that their FUV line fluxes could be ~ 60 - 75% lower. Our calculations show that 3 consecutive HST orbits with the G130M and G160M elements are required for each star. These exposures will result in S/N (~ 5 - 10) for the moderate-to-strong emission lines. The resulting FUV spectra will be suitable for securing reliable integrated emission line fluxes needed to carry out spectral diagnostics from emission line ratios, performing a Volume Emission Measure (VEM) analyses, as well as modeling the line profiles. Importantly, the simulations indicate that the resulting COS/FUV spectra will permit some of the weaker, but important, diagnostic line emissions to be measured and used to determine the physical properties of the stars' chromospheres and transition regions. These spectra will be compared with comparable FUV spectra available for the Sun from solar FUV/UV space missions such as SOLSTICE (SORCE). Also we plan direct differential comparisons with the HST/STIS or COS FUV spectra of alpha Cen A and 18 Sco.

Proposal 13861 - 16 Cyg A (01) - HST/COS FUV Spectrophotometry of the Key Binary Solar Twins 16 Cyg A&B: Astrophysical Labora...

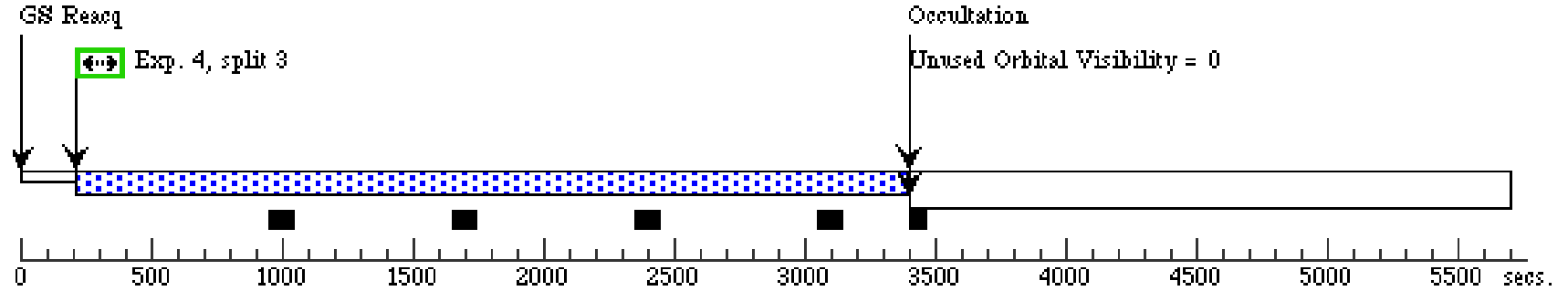
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Visit	Proposal 13861, 16 Cyg A (01), implementation Diagnostic Status: No Diagnostics Scientific Instruments: COS/NUV, COS/FUV Special Requirements: (none)									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	-16-CYG-A Alt Name1: HD186408	RA: 19 41 48.9534 (295.4539725d) Dec: +50 31 30.22 (50.52506d) Equinox: J2000	Proper Motion RA: -147.82 mas/yr Proper Motion Dec: -159.01 mas/yr Parallax: 0.04744" Epoch of Position: 2000 Radial Velocity: -27.61 km/sec	V=5.95+/-0.01 G1.5V	Reference Frame: ICRS				
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(G285M): S earch (COS.sa.645 576)	(1) -16-CYG-A	COS/NUV, ACQ/SEARCH, PSA	G285M 2676 A	SCAN-SIZE=3; STEP-SIZE=1.767; CENTER=FLUX-W T-FLR			0.6 Secs (0.6 Secs) [==>]	[1]
	2	(G285M): P eakXD (COS.sa.645 577)	(1) -16-CYG-A	COS/NUV, ACQ/PEAKXD, PSA	G285M 2676 A	STRIPE=MEDIUM			0.6 Secs (0.6 Secs) [==>]	[1]
	3	(G285M): P eakD (COS.sa.645 576)	(1) -16-CYG-A	COS/NUV, ACQ/PEAKD, PSA	G285M 2676 A	NUM-POS=5; STEP-SIZE=0.9; CENTER=FLUX-W T-FLR			0.6 Secs (0.6 Secs) [==>]	[1]
	4	(G130M): E xpose (COS.sp.626 168)	(1) -16-CYG-A	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FP-POS=ALL; BUFFER-TIME=70 0			1700 Secs (11677 Secs) [==>2308.0 Secs (Split 1)] [==>3123.0 Secs (Split 2)] [==>3123.0 Secs (Split 3)] [==>3123.0 Secs (Split 4)]	[1] [2] [3] [4]
	5	(G160M): E xpose (COS.sp.626 172)	(1) -16-CYG-A	COS/FUV, TIME-TAG, PSA	G160M 1577 A	FP-POS=ALL; BUFFER-TIME=50 0			1200.0 Secs (5882 Secs) [==>1470.0 Secs (Split 1)] [==>1470.0 Secs (Split 2)] [==>1471.0 Secs (Split 3)] [==>1471.0 Secs (Split 4)]	[5] [6]



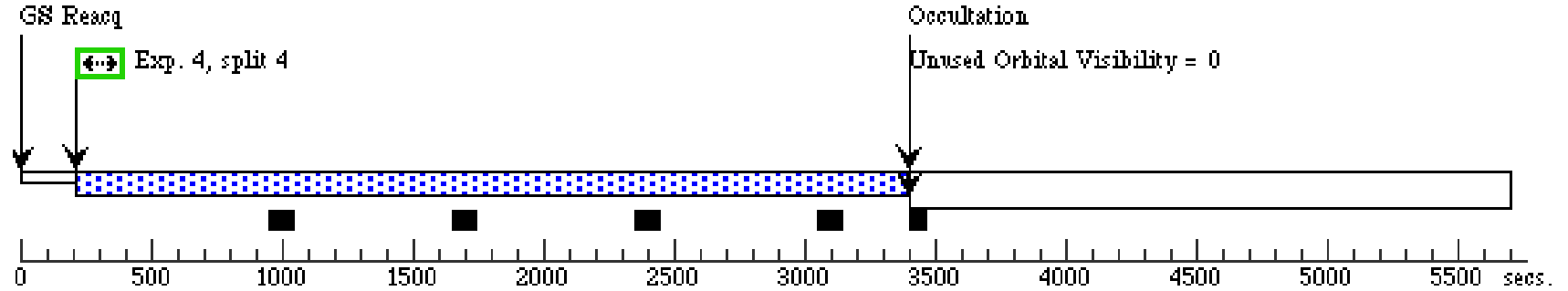
Orbit 3

Server Version: 20140605



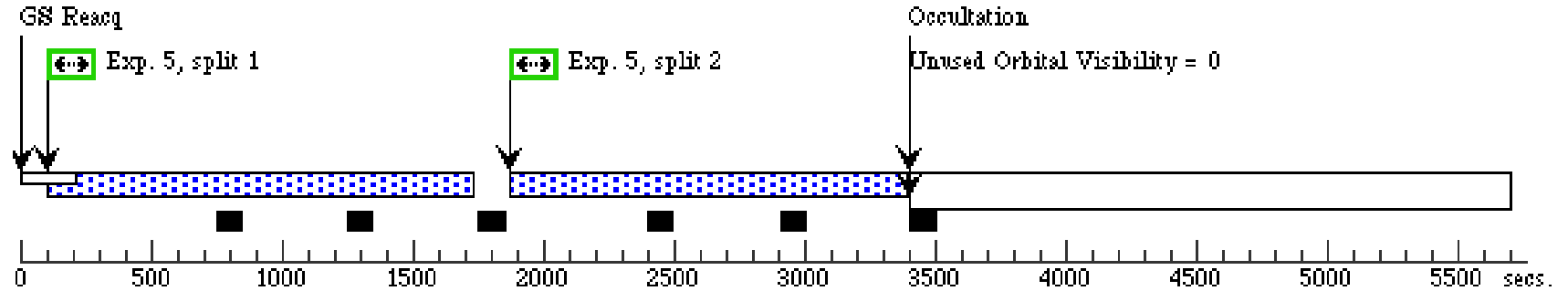
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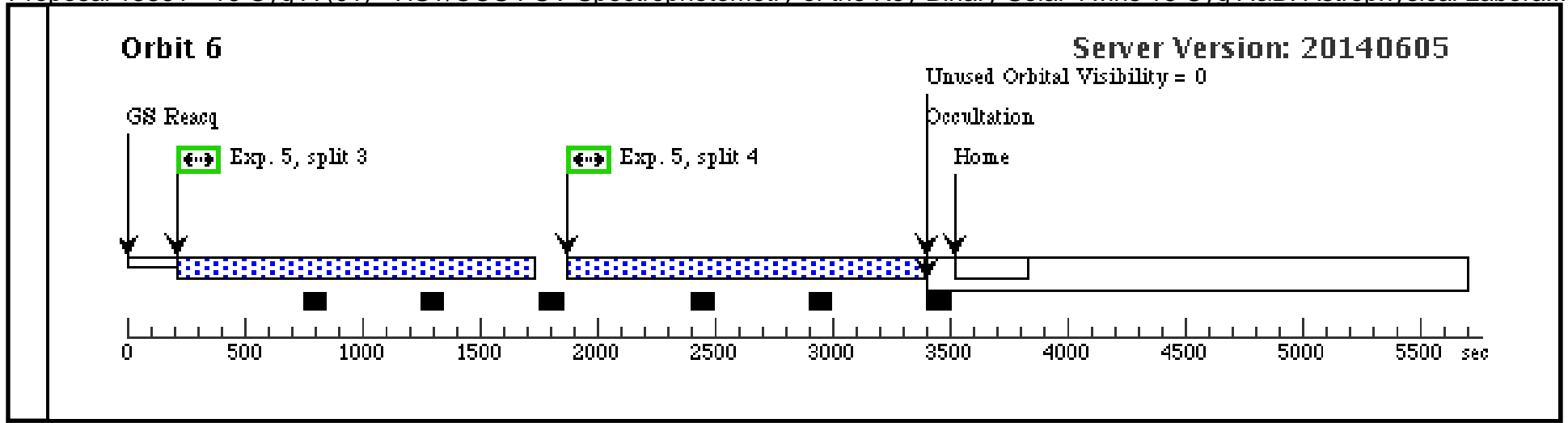
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Orbit 5

Server Version: 20140605

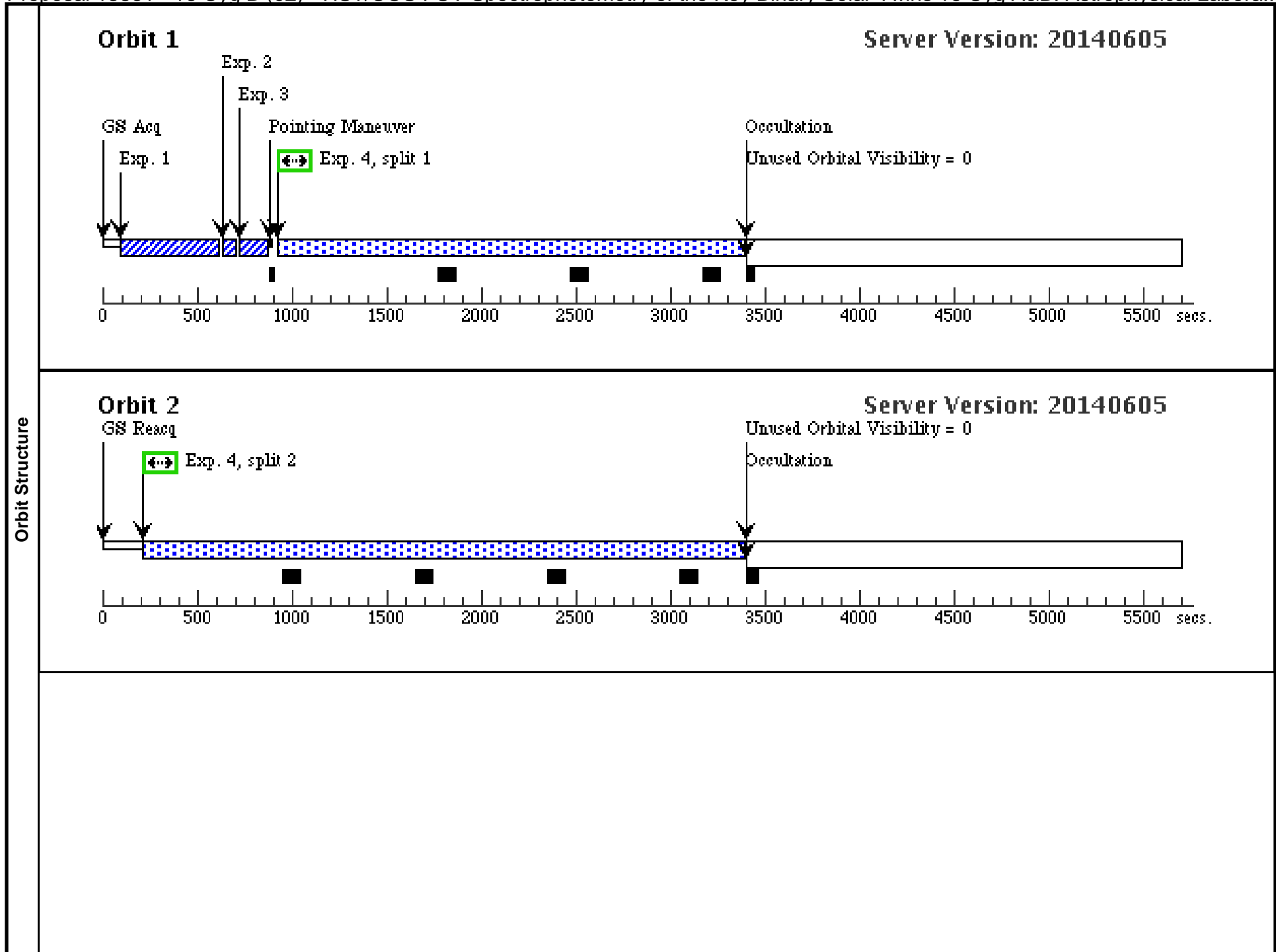




Proposal 13861 - 16 Cyg B (02) - HST/COS FUV Spectrophotometry of the Key Binary Solar Twins 16 Cyg A&B: Astrophysical Labora...

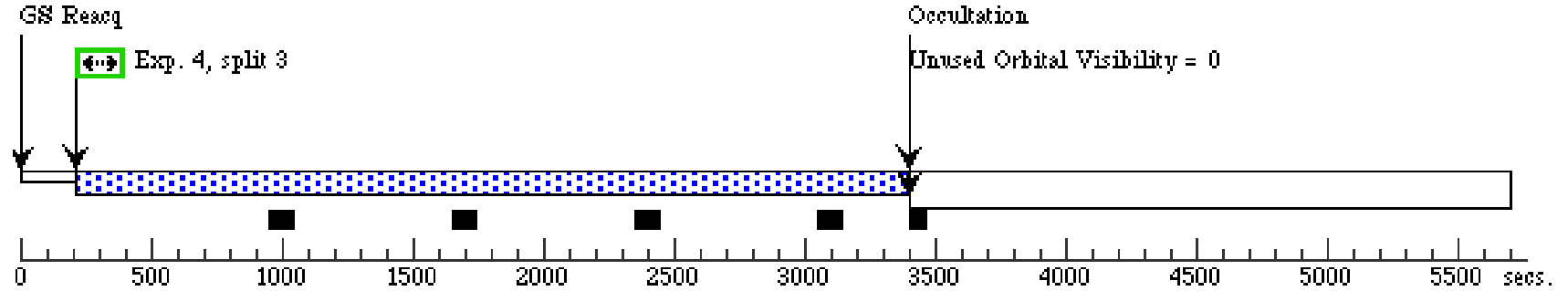
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Visit	Proposal 13861, 16 Cyg B (02), implementation Diagnostic Status: No Diagnostics Scientific Instruments: COS/NUV, COS/FUV Special Requirements: (none)									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
	(2)	-16-CYG-B Alt Name1: HD186427	RA: 19 41 51.9720 (295.4665500d) Dec: +50 31 3.08 (50.51752d) Equinox: J2000	Proper Motion RA: -135.11 mas/yr Proper Motion Dec: -163.78 mas/yr Parallax: 0.04714" Epoch of Position: 2000 Radial Velocity: -28.02 km/sec	V=6.2+/-0.01 G3V	Reference Frame: ICRS				
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(G285M): S earch (COS.sa.645 578)	(2) -16-CYG-B	COS/NUV, ACQ/SEARCH, PSA	G285M 2676 A	SCAN-SIZE=3; STEP-SIZE=1.767; CENTER=FLUX-W T-FLR			0.8 Secs (0.8 Secs) [==>]	[1]
	2	(G285M): P eakXD (COS.sa.645 579)	(2) -16-CYG-B	COS/NUV, ACQ/PEAKXD, PSA	G285M 2676 A	STRIPE=MEDIUM			0.8 Secs (0.8 Secs) [==>]	[1]
	3	(G285M): P eakD (COS.sa.645 578)	(2) -16-CYG-B	COS/NUV, ACQ/PEAKD, PSA	G285M 2676 A	NUM-POS=5; STEP-SIZE=0.9; CENTER=FLUX-W T-FLR			0.8 Secs (0.8 Secs) [==>]	[1]
	4	(G130M): E xpose (COS.sp.626 235)	(2) -16-CYG-B	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FP-POS=ALL; BUFFER-TIME=70 0			1700 Secs (11674 Secs) [==>2305.0 Secs (Split 1)] [==>3123.0 Secs (Split 2)] [==>3123.0 Secs (Split 3)] [==>3123.0 Secs (Split 4)]	[1] [2] [3] [4]
	5	(G160M): E xpose (COS.sp.626 236)	(2) -16-CYG-B	COS/FUV, TIME-TAG, PSA	G160M 1577 A	FP-POS=ALL; BUFFER-TIME=50 0			1200 Secs (5882 Secs) [==>1470.0 Secs (Split 1)] [==>1470.0 Secs (Split 2)] [==>1471.0 Secs (Split 3)] [==>1471.0 Secs (Split 4)]	[5] [6]



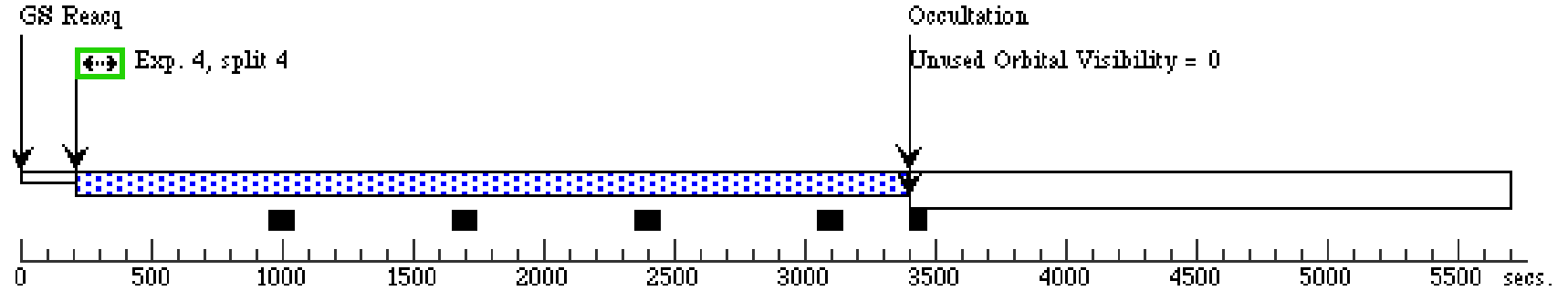
Orbit 3

Server Version: 20140605



Orbit 4

Server Version: 20140605



Orbit 5

Server Version: 20140605

