14469 - The HST-ALMA connection: measuring the FUV spectrum of a newly discovered transition disk down to the H2 and CO photodissociation regime

Cycle: 23, Proposal Category: GO

(UV Initiative)

(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) V-RY-LUP	COS/FUV COS/NUV STIS/CCD STIS/NUV-MAMA	5	12-Dec-2015 21:03:35.0	yes

5 Total Orbits Used

ABSTRACT

The physical properties of planets reflect the physical and chemical content of the disk in which they form. Direct resolved observations of disks, e.g., with ALMA, provide us with crucial information on the disk properties to verify planet formation theories. Transition disks are considered the best targets to test these theories as they might be objects where planet formation is on-going. ALMA observations have now reached levels of detail that demand as much detail in the modeling. A major input for models to reproduce resolved ALMA observations of gas in disks, the shape and intensity of the FUV radiation impinging on the disk, is still poorly understood. We thus propose to observe the FUV spectrum of an almost unextincted and still accreting young star surrounded by a transition disk, RY Lup, discovered with our new high-resolution ALMA observations last month.

Our proposed observations aim at:

1) characterizing the FUV flux of a young star surrounded by a transition disk detected with resolved observations both in dust (0.87mm) and gas (13CO, C18O, and CN) emission with ALMA,

2) studying the chemical properties of this disk to model its gas content, in particular including the FUV flux in the wl<1100 AA region reachable only with HST, which is crucial for H2 and CO photodissociation,

3) obtaining simultaneous coverage of the FUV and NUV spectrum to determine the physical origin and shape of the FUV excess above the disk accretion emission.

Finally, the FUV flux determined here will also be a crucial ingredient for disk evolution models, such as photoevaporation models, to test whether they can explain the observed cavity of this transition disk.

OBSERVING DESCRIPTION

Our observing strategy is driven by the aim to provide a good wavelength coverage for measuring continuum and Lyalpha fluxes. Specifically, we want to cover the wavelengths range from approx. 1000 AA up to 4000 AA, i.e., from the spectral region that drives CO and H2 photodissociation up to the Balmer continuum and jump region, that provides a direct measure for the excess continuum caused by accretion. Another important requirement is the near-simultaneity of our observations in the various bands, as young stars are known to vary on timescales of about one day. Therefore, we use three COS gratings, namely G140L (at 1280 AA, two orbits), G130M (at 1291 AA, one orbit) and G160 M (at 1577 AA, one orbit) as well as two STIS gratings (G230L/G230LB1 and G430L in one orbit).

ORBIT 1: Spectral range 1700 - 5700 AA: We observe the NUV range with the G230L grating (MAMA detector). A short exposure (ca. 1min) with the STIS G430L grating to cover the Balmer jump is done before the G230L one.

ORBITS 2-3: Spectral range wl <1100 AA: To measure the flux of the continuum we do not need high spectral resolution below 1100 AA, because contaminating H2 lines are rarer than at longer wavelengths. Therefore, we use the G140L grating centered at 1280 AA to cover this region (spectral resolution about 1 AA) as it provides the highest sensitivity. At these wavelengths, the background is expected to be relevant. Binning the spectrum to large bins (1 AA) free of emission lines mitigates this effect. We use only FP-POS=1 and 2 to avoid the gap at short wavelengths (~1140 and 1120, respectively) of the FP-POS=3 and 4 position as this wavelength range is crucial for our science case.

ORBITS 4-5: Spectral range 1200 to 1700 AA: In this region, a wealth of H2 emission lines is present so that higher spectral resolution than provided by the G140L grating is necessarily required to disentangle continuum and emission lines. To provide a good sampling of the continuum in this region, we use the G130M centered at 1291 AA and 1318 AA, and the G160M set to 1577 AA and 1611 AA for one orbit each. The reason to use two different central wavelengths is to have complete wavelength coverage. Similarly, we will also determine the flux of the emission lines with high S/N. In particular, Lyalpha provides the majority of the FUV flux for CTTSs and the G130M spectrum also covers the Lya emission line at sufficiently high spectral resolution to reconstruct the intrinsic Lya flux using the method presented in Schindhelm et al. (2012, ApJ, 756, L23). This will allow us to determine the Lya to continuum ratio for our target, which is an important parameter for disk chemistry modeling (e.g., Walsh et al. 2012).

All observations should be performed as close in time as possible, that is within one day at most. According to the HST Primer, we can group all orbits into one visit, but we can also seperate the first orbit into a seperate visit using a "group WITHIN" constraint. We prefer an execution for this program in the observability window between March, 10th-25th 2016.

Detector safety: There exists a STIS G140L spectrum of this source so that we base our estimates on these data. We performed the ETC runs using these spectra that cover the wavelength range from 1150 to 1710 AA. They show that the expected count rates are well below the brightness limits for the G160M/G130M/G140L exosures. The most critical one is the G130M spectrum that includes the Lya line, which is the strongest stellar emission line. The brightest pixel has a count rate of 0.1 counts/sec, which is more than a factor of six below the brightness limit. Young stars are mildly time variable and optical monitoring of RY Lup shows variability of a factor of about four and we expect roughly a similar variation in Lya so that the the flux is still below the limit in the brightest state.

BOT reports errors, because it misinterprets our target as an O V star. Coordinates match exactly. Our target is NOT an O V star. The archival HST STIS G140L spectrum of our target shows that it is safe to observe with all configurations used in this program (cf. respective ETC runs).

Visit

Proposal 14469, Visit 01 Sun Dec 13 02:03:36 GMT 2015

Diagnostic Status: Warning

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD, COS/FUV, COS/NUV

Special Requirements: (none)

Diagnostics

(Visit 01) Warning (Form): For the best data quality, it is strongly recommended that all four FP-POS positions be used when observing at a given COS CENWAVE setting.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	V-RY-LUP	RA: 15 59 28.3742 (239.8682258d) Dec: -40 21 51.64 (-40.36434d) Equinox: J2000		V=9.9	Reference Frame: ICRS

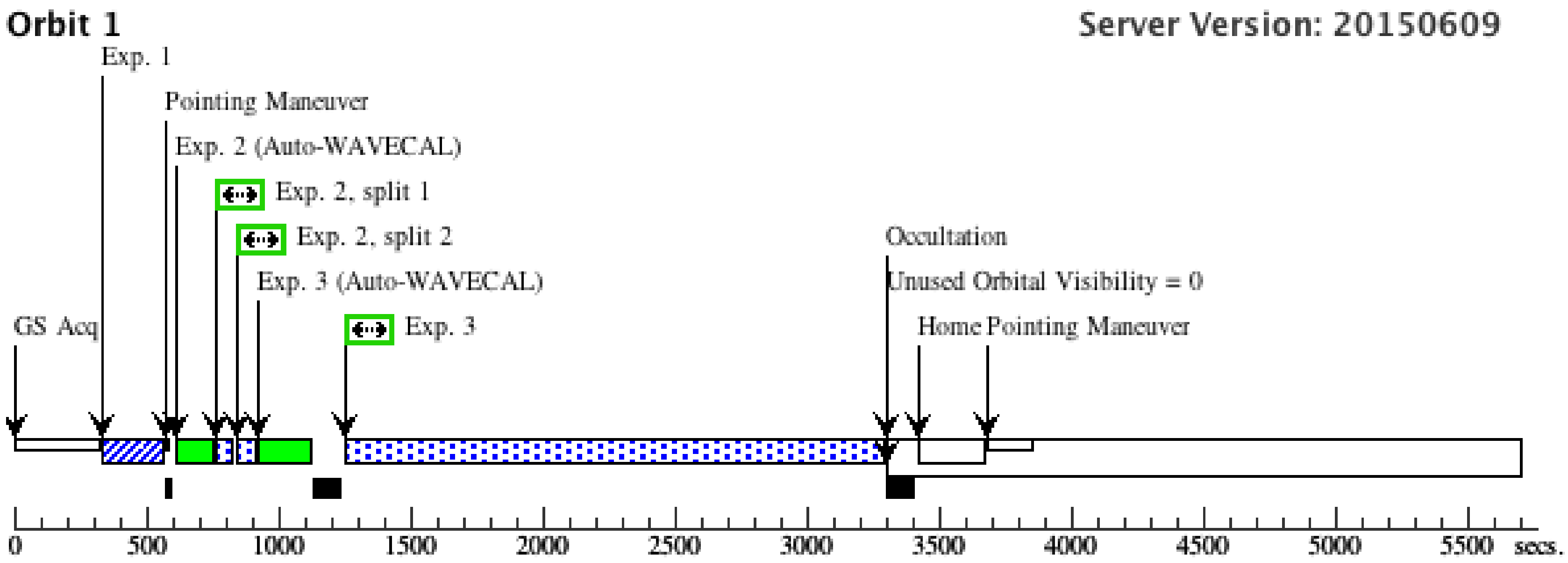
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Coordinates are adjusted for 2016 using proper motion information from Hipparcos
Extended=NO

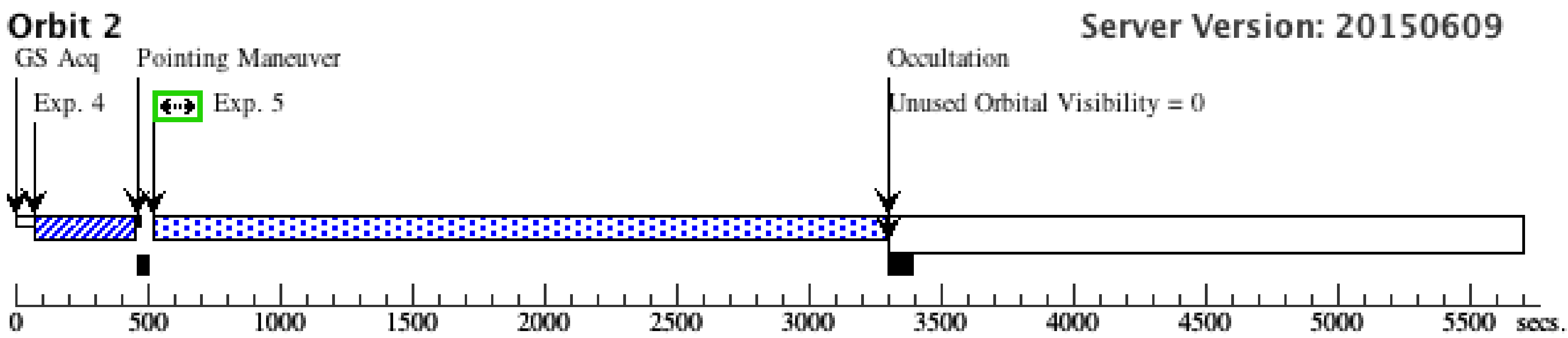
Exposures

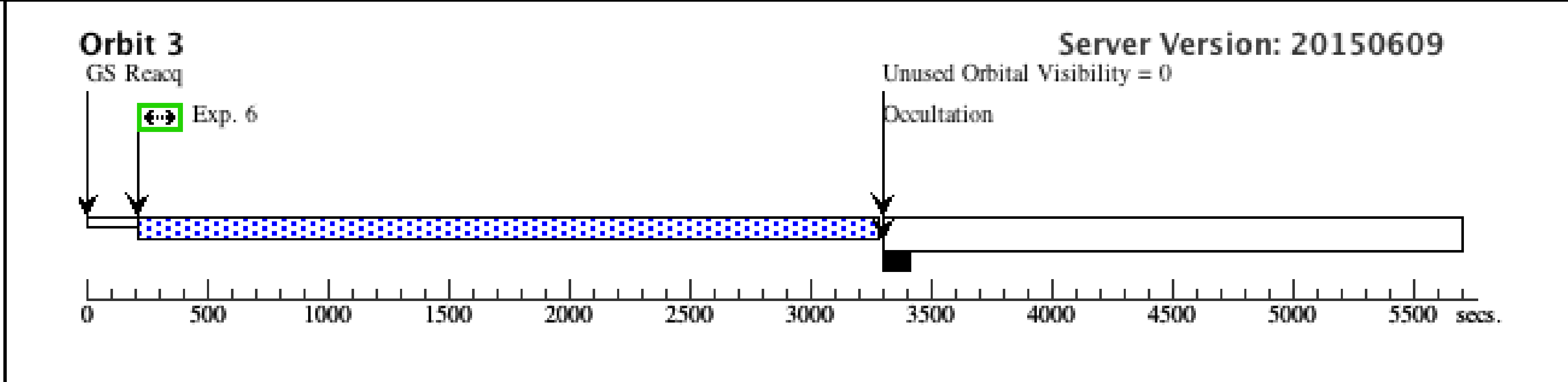
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(STIS.ta.756304)	(1) V-RY-LUP	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			0.1 Secs (0.1 Secs) *[==>]*	*[1]*
Comments: *ETC is for the observed flux-calibrated optical spectrum for this target observed few months ago with VLT/X-Shooter*									
2	(STIS.sp.756307)	(1) V-RY-LUP	STIS/CCD, ACCUM, 52X0.2	G430L 4300 A	CR-SPLIT=2			60 Secs (60 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	*[1]*
Comments: *ETC is for the observed flux-calibrated optical spectrum for this target observed few months ago with VLT/X-Shooter*									
3	(STIS.sp.756325)	(1) V-RY-LUP	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				2400 Secs (2027 Secs) *[==>2027.0 Secs]*	*[1]*
Comments: *This ETC run is done using the IUE spectrum of this target. This target is variable within a factor of 4 in V. We are a factor of ~15 below the brightness limit.*									
4	(COS.ta.756346)	(1) V-RY-LUP	COS/NUV, ACQ/IMAGE, PSA	MIRRORB				30 Secs (30 Secs) *[==>]*	*[2]*
Comments: *This ETC run is done using the IUE and optical spectra of this target*									
5	(COS.sp.756926)	(1) V-RY-LUP	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=3000; FP-POS=1			2450 Secs (2596 Secs) *[==>2596.0 Secs]*	*[2]*
Comments: *This ETC run is done using the STIS G140L spectrum of this target.*									
6	(COS.sp.756926)	(1) V-RY-LUP	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=3000; FP-POS=2			2450 Secs (3021 Secs) *[==>3021.0 Secs]*	*[3]*
Comments: *This ETC run is done using the STIS G140L spectrum of this target.*									
7	(COS.sp.756934)	(1) V-RY-LUP	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=1000; FP-POS=1			658 Secs (620 Secs) *[==>620.0 Secs]*	*[4]*
Comments: *This ETC run is done using the G140L spectrum of this target. We have removed the peak of the observed Lyalpha as this was due to girocoronal emission.*									
8	(COS.sp.756934)	(1) V-RY-LUP	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=1000; FP-POS=2			658 Secs (620 Secs) *[==>620.0 Secs]*	*[4]*
Comments: *This ETC run is done using the G140L spectrum of this target. We have removed the peak of the observed Lyalpha as this was due to girocoronal emission.*									
9	(COS.sp.756935)	(1) V-RY-LUP	COS/FUV, TIME-TAG, PSA	G130M 1318 A	BUFFER-TIME=1000; FP-POS=3			658 Secs (620 Secs) *[==>620.0 Secs]*	*[4]*
Comments: *This ETC run is done using the G140L spectrum of this target.*									
10	(COS.sp.756935)	(1) V-RY-LUP	COS/FUV, TIME-TAG, PSA	G130M 1318 A	BUFFER-TIME=1000; FP-POS=4			658 Secs (620 Secs) *[==>620.0 Secs]*	*[4]*
Comments: *This ETC run is done using the G140L spectrum of this target.*									
11	(COS.sp.756936)	(1) V-RY-LUP	COS/FUV, TIME-TAG, PSA	G160M 1577 A	BUFFER-TIME=3000; FP-POS=1			650 Secs (648 Secs) *[==>648.0 Secs]*	*[5]*
Comments: *This ETC run is done using the G140L spectrum of this target.*									
12	(COS.sp.756936)	(1) V-RY-LUP	COS/FUV, TIME-TAG, PSA	G160M 1577 A	BUFFER-TIME=3000; FP-POS=2			650 Secs (648 Secs) *[==>648.0 Secs]*	*[5]*
Comments: *This ETC run is done using the G140L spectrum of this target.*									

13	(COS.sp.756 (1) V-RY-LUP 937)	COS/FUV, TIME-TAG, PSA	G160M 1611 A	BUFFER-TIME=3000; FP-POS=3		650 Secs (648 Secs) *[==>648.0 Secs]*	***[5]***
	Comments: This ETC run is done using the G140L spectrum of this target.						
14	(COS.sp.756 (1) V-RY-LUP 937)	COS/FUV, TIME-TAG, PSA	G160M 1611 A	BUFFER-TIME=3000; FP-POS=4		650 Secs (648 Secs) *[==>648.0 Secs]*	***[5]***
	Comments: This ETC run is done using the G140L spectrum of this target.						

Orbit Structure



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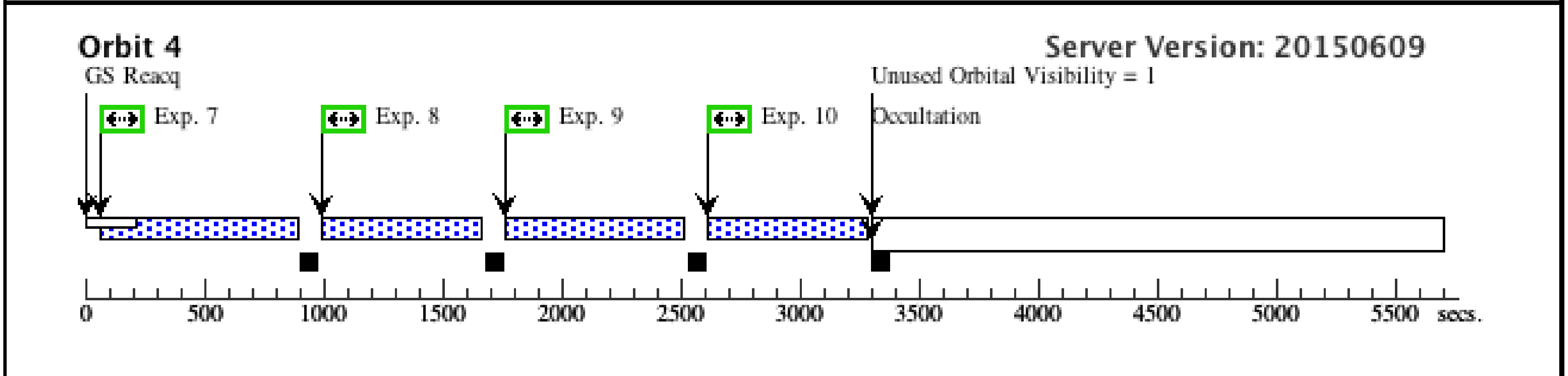
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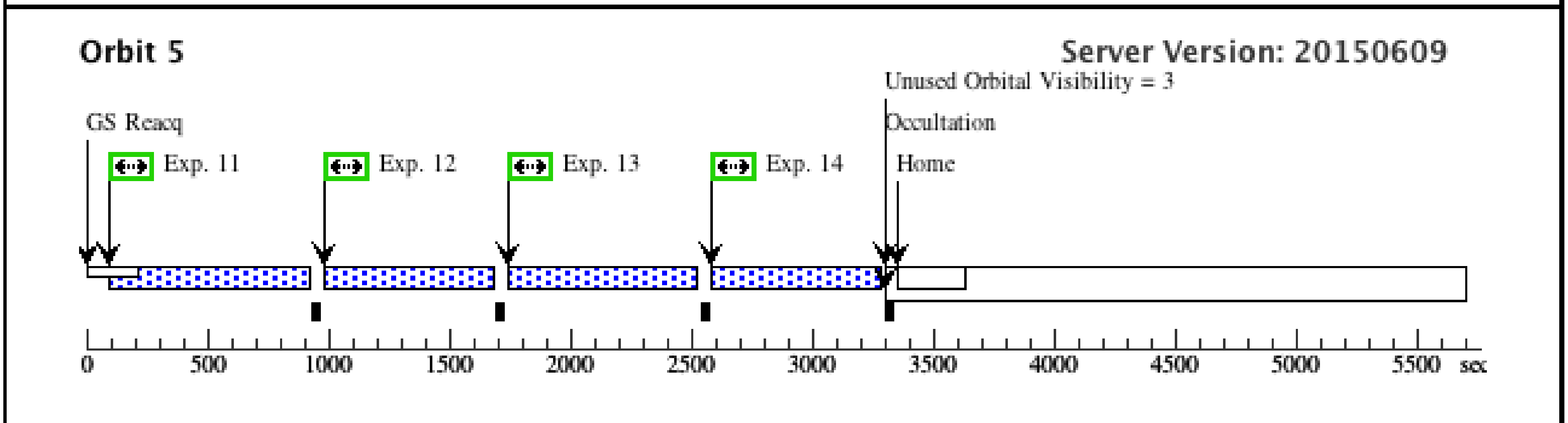
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Exp. 13
Exp. 14
Home
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