16312 - EFFECTS OF RECENT PERIASTRON PASSAGE AND ECLIPSE IN THE SYMBIOTIC SYSTEM R AQR

Cycle: 28, 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-R-AQR	WFC3/UVIS	5	27-Apr-2021 10:00:16.0	yes

5 Total Orbits Used

ABSTRACT

We propose HST/WFC3 observations of the R Aqr symbiotic system, with joint Chandra and VLA observations, to carry out a high-angular resolution multiwavelength study of the binary environment and of the spatial and spectral characteristics and propagation of the ejecta resulting from the recent - earlier than expected - periastron passage of the WD accretor. The proposed observations follow up on the 2019 to early 2020 DDT/ToO

HST+Chandra+VLA observations which show dramatic changes within 1" from the central binary since 2018, including newly ejected material obscuring the evolved Mira-type star and formation of a new jet. The observations are critical for studying the effects of the WD periastron passage, which include enhanced accretion and mass/jet ejections in this nearby symbiotic binary. These phenomena are observable only about twice a century, with the next periastron expected in about 40 years.

OBSERVING DESCRIPTION

We request a total of 5 orbits, in 1 visit.

We plan to carry out HST WFC3/UVIS imaging of R Aqr, using the 4-point dither mode in several filters. This approach will allow us to reach the maximum resolution of 0.025"/pixel and also assist in cosmic ray removal. This will nearly double the number of pixels covering the regions of interest. Furthermore, better sampling of the PSF will allow further enhancement in the resolution using deconvolution techniques such as Richardson-Lucy or EMC2.

We have selected a set of filters to separate line and continuum emission , and to distinguish shocked from photoionized emission. The high-resolution images obtained in the spectral lines e.g., CII] 2326angstroms(A), Mg II 2800A, [OII] 3726A, [OIII] 5007A, H-alpha, and [SII] 6731A, will provide information on the ionization state of the gas. The CII] line can also help determine the (dust) extinction and it is sensitive to carbonatious grain-depletion. The Mg II 2800A line is expected to have a resonant scattering component and will also provide information on the ionization state of the gas. The [OII] 3726A line is a density indicator (the line is bright when the density is low). Furthermore, the [OII] 3726A/[CII] 2326A ratio is a good indicator of temperature and density characteristics of the gas. The SII] 6731A/H-alpha ratio will allow us to identify shocked vs. ionized gas emission, e.g., the ratio will be >=0.4 for shocked gas, and smaller for photoionized gas.

The exposure times are based on the online WFC3 ETC calculations as verified by the 2020 WFC3 observations of R Aqr. We optimize the efficiency of the observing time by using subarray readouts (1024x1024 readout) to minimize the overheads, while still providing a >=40"x40" field of view. Our observations include some flash exposure in order to partially remediate the effects of charge-transfer inefficiency due to the age of the detector. The Phase II proposal was generated using the latest APT based on the desired exposure times to avoid saturation and on the use of dither patterns, and makes the most efficient use of the observing time.

In the event a reduced gyro mode will need to be used for this proposal, it will not have any significant impact as long as the target is in the HST

field-of-regard when the observations need to be taken in order to catch this time-sensitive behavior of the target since we have no roll constraints for our observations. We request that these observattions be coordinated with the Chandra observations.

Visit

Proposal 16312, Visit 01, implementation Tue Apr 27 14:00:18 GMT 2021

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

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

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

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

(Exposure 1 (Pattern 2, Exps 1-4 in Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 2 (Pattern 2, Exps 1-4 in Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 3 (Pattern 2, Exps 1-4 in Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 4 (Pattern 2, Exps 1-4 in Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 5 (Pattern 2, Exps 5-8 in Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 6 (Pattern 2, Exps 5-8 in Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 7 (Pattern 2, Exps 5-8 in Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 8 (Pattern 2, Exps 5-8 in Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 9 (Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 10 (Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 11 (Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 12 (Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 13 (Pattern 2, Exps 13-13 in Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 13 (Pattern 2, Exps 13-13 in Visit 01)) Warning (Form): POS TARG & PATTERN should be used carefully with WFC3 quad filters to avoid placing the target on the vignetted part of the field of view or moving it to another quadrant.

(Exposure 14 (Pattern 2, Exps 14-14 in Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 14 (Pattern 2, Exps 14-14 in Visit 01)) Warning (Form): POS TARG & PATTERN should be used carefully with WFC3 quad filters to avoid placing the target on the vignetted part of the field of view or moving it to another quadrant.

(Exposure 15 (Pattern 2, Exps 15-15 in Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

(Exposure 15 (Pattern 2, Exps 15-15 in Visit 01)) Warning (Form): POS TARG & PATTERN should be used carefully with WFC3 quad filters to avoid placing the target on the vignetted part of the field of view or moving it to another quadrant.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=SPIRAL	Coordinate Frame=POS-TARG		(1-4), (5-8), (13), (14), (15)
	Purpose=DITHER	Pattern Orientation=46.86		
	Number Of Points=4	Angle Between Sides=		
	Point Spacing=0.145	Center Pattern=false		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	V-R-AQR	RA: 23 43 49.4616 (355.9560900d)		V=10+/-3.0	Reference Frame: ICRS
		Dec: -15 17 4.20 (-15.28450d)			
		Equinox: J2000			

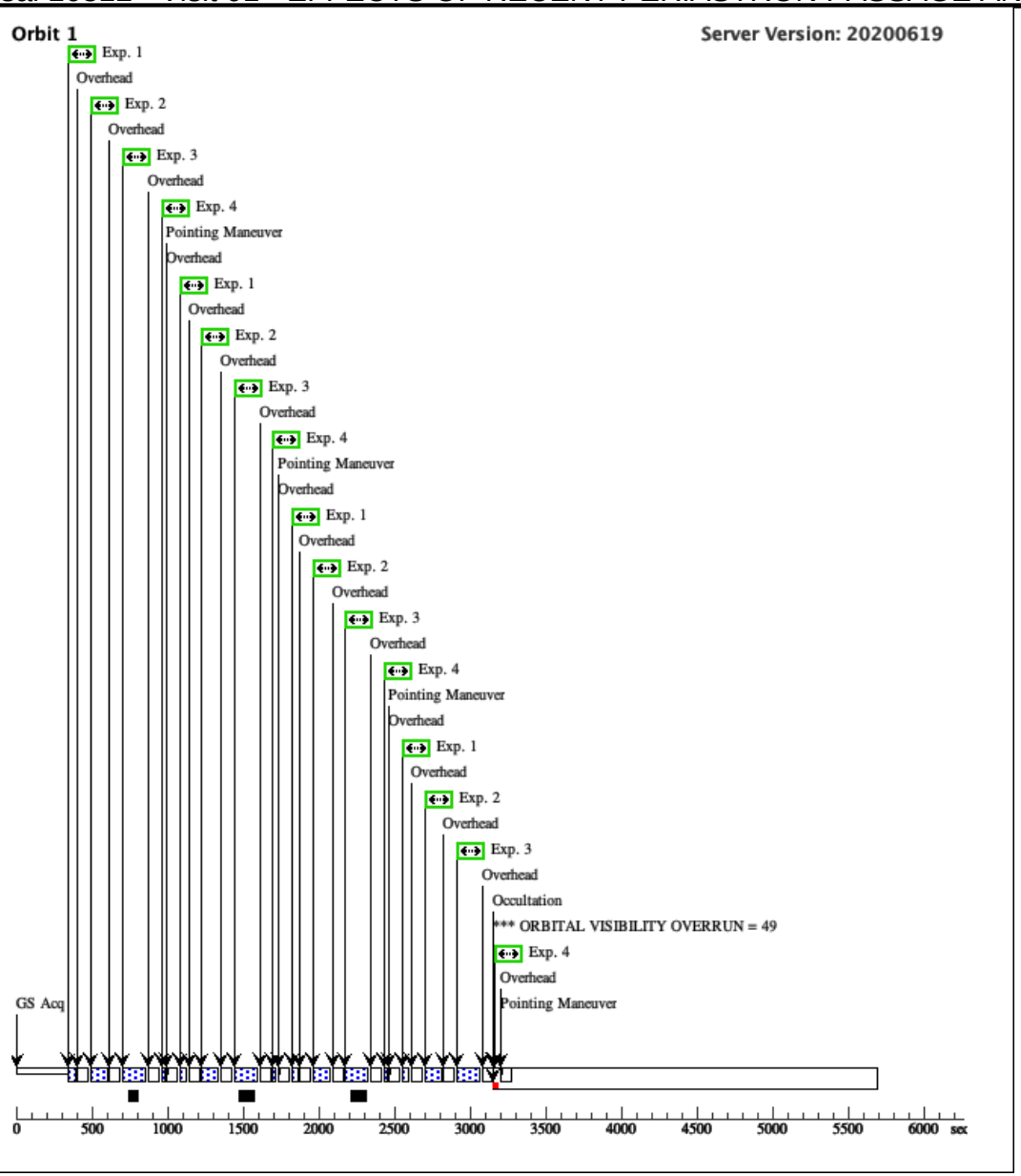
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[ACCRETION DISK, INTERACTING BINARY, JET, SYMBIOTIC STAR]

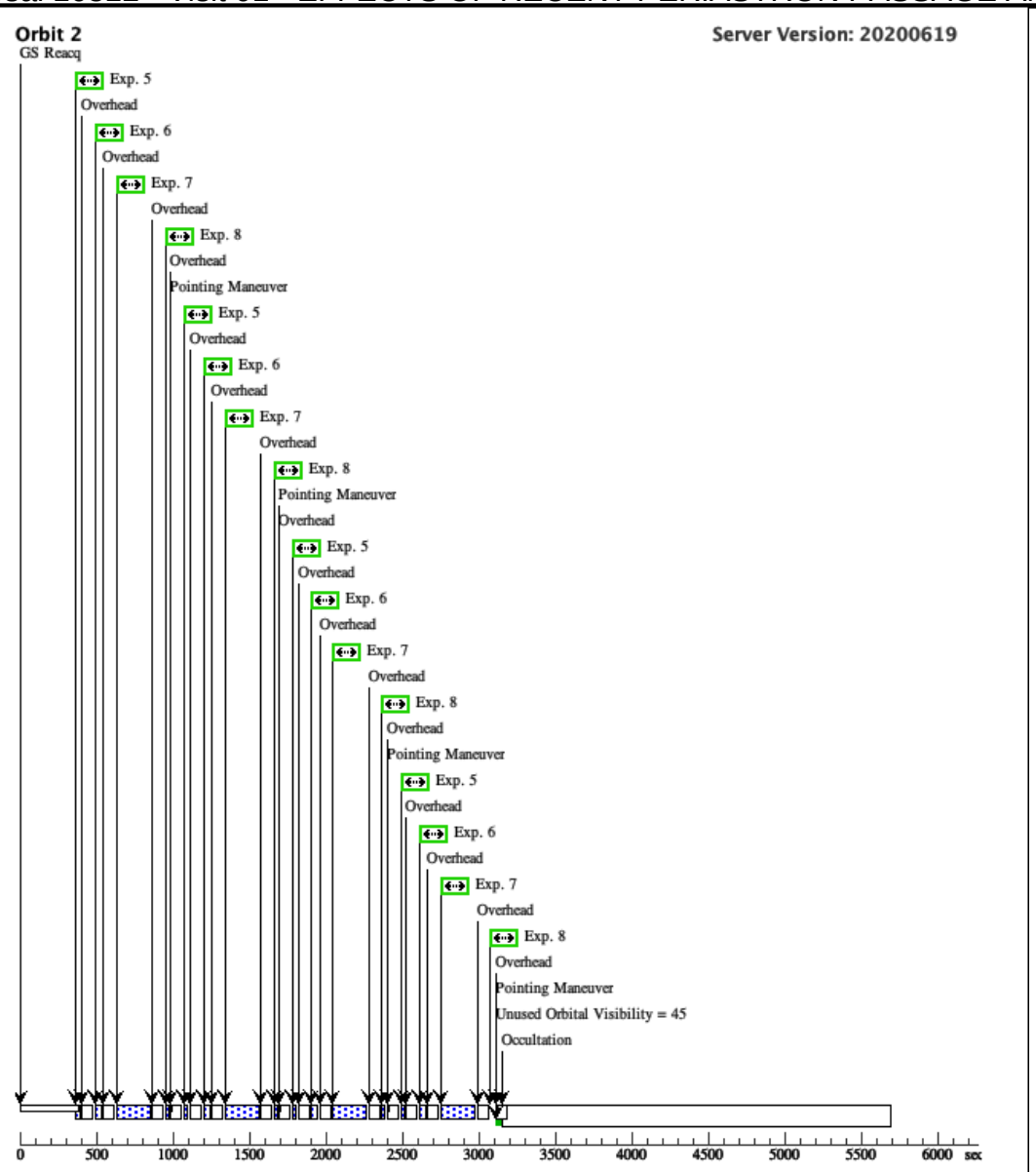
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(WFC3UVIS.im.780074)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F502N	FLASH=20	GS ACQ SCENARIO BASE1B3	Pattern 2, Exps 1-4 in Visit 01 (2)	15 Secs (60 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2	(WFC3UVIS.im.832643)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F373N	FLASH=20		Pattern 2, Exps 1-4 in Visit 01 (2)	95 Secs (380 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
3	(WFC3UVIS.im.832644)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F280N	FLASH=20		Pattern 2, Exps 1-4 in Visit 01 (2)	125 Secs (500 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
4	(WFC3UVIS.im.780078)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F656N	FLASH=20		Pattern 2, Exps 1-4 in Visit 01 (2)	5 Secs (20 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
5	(WFC3UVIS.im.780079)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F673N	FLASH=20		Pattern 2, Exps 5-8 in Visit 01 (2)	5 Secs (20 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
6	(WFC3UVIS.im.780075)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F336W	FLASH=20		Pattern 2, Exps 5-8 in Visit 01 (2)	10 Secs (40 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
7	(WFC3UVIS.im.780140)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F275W	FLASH=20		Pattern 2, Exps 5-8 in Visit 01 (2)	200 Secs (800 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
8	(WFC3UVIS.im.780140)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F547M	FLASH=20		Pattern 2, Exps 5-8 in Visit 01 (2)	1 Secs (4 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
9	(WFC3UVIS.im.780074)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F373N	FLASH=20			500 Secs X 2 (1000 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]*	***[3]***

	10	(WFC3UVIS.im.780074)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F656N	FLASH=20			450 Secs X 2 (900 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]*	***[3]***
	11	(WFC3UVIS.im.780074)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F280N	FLASH=20			180 Secs X 2 (360 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]*	***[3]***
	12	(WFC3UVIS.im.780074)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F502N	FLASH=20			500 Secs X 2 (1000 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]*	***[4]***
	13	(WFC3UVIS.im.780080)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ243N	FLASH=20		Pattern 2, Exps 13-13 in Visit 01 (2)	170 Secs (680 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[4]***
	14	(WFC3UVIS.im.780080)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ437N	FLASH=20	GS ACQ SCENARIO BASE1B3	Pattern 2, Exps 14-14 in Visit 01 (2)	50 Secs (200 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[5]***
	15	(WFC3UVIS.im.780080)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ232N	FLASH=20		Pattern 2, Exps 15-15 in Visit 01 (2)	160 Secs (640 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[5]***

Orbit Structure




Orbit 2
Server Version: 20200619
GS Reacq
Exp. 5
Overhead
Exp. 6
Overhead
Exp. 7
Overhead
Exp. 8
Overhead
Pointing Maneuver
Exp. 5
Overhead
Exp. 6
Overhead
Exp. 7
Overhead
Exp. 8
Pointing Maneuver
Overhead
Exp. 5
Overhead
Exp. 6
Overhead
Exp. 7
Overhead
Exp. 8
Overhead
Pointing Maneuver
Exp. 5
Overhead
Exp. 6
Overhead
Exp. 7
Overhead
Exp. 8
Overhead
Pointing Maneuver
Unused Orbital Visibility = 45
Occultation
0
500
1000
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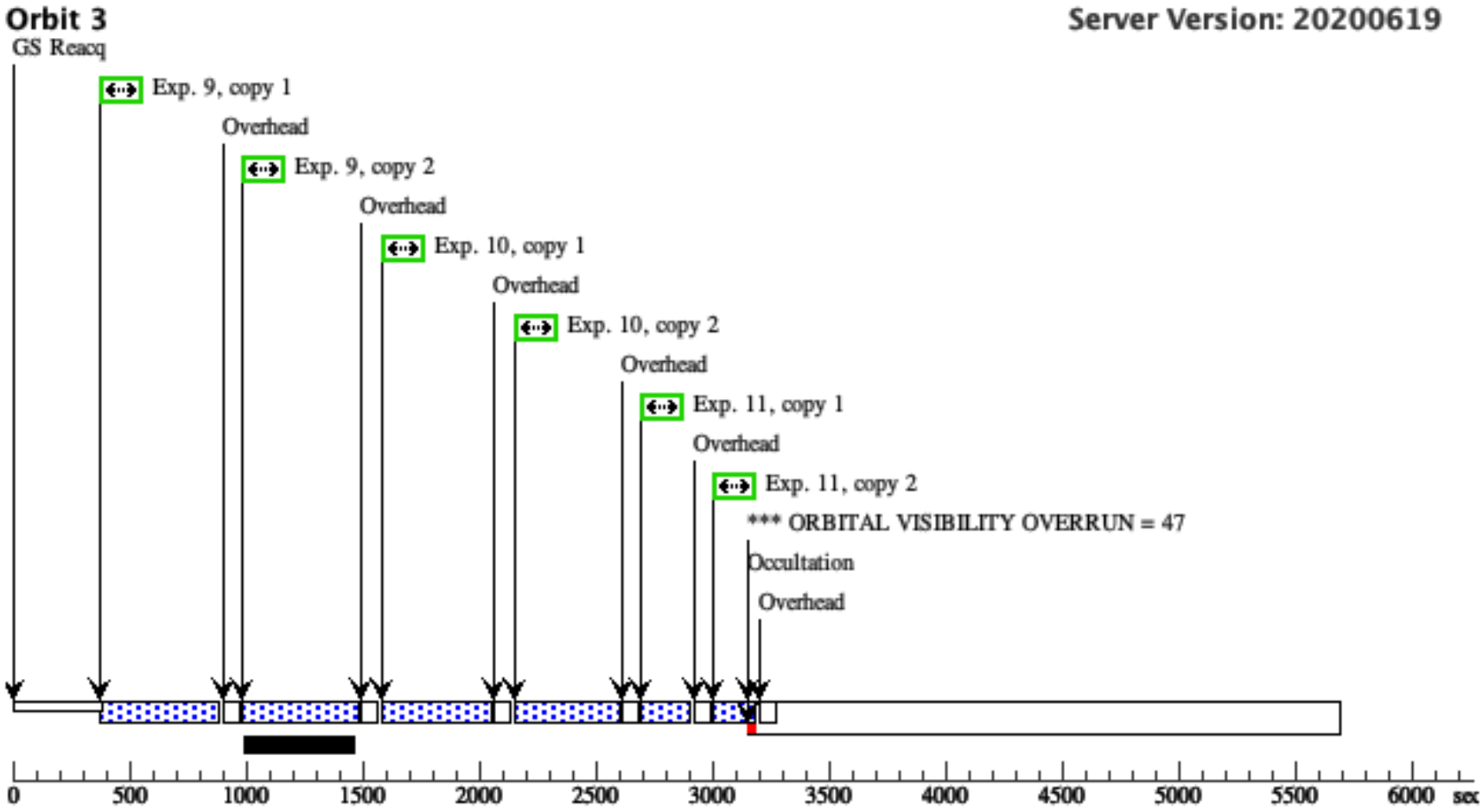
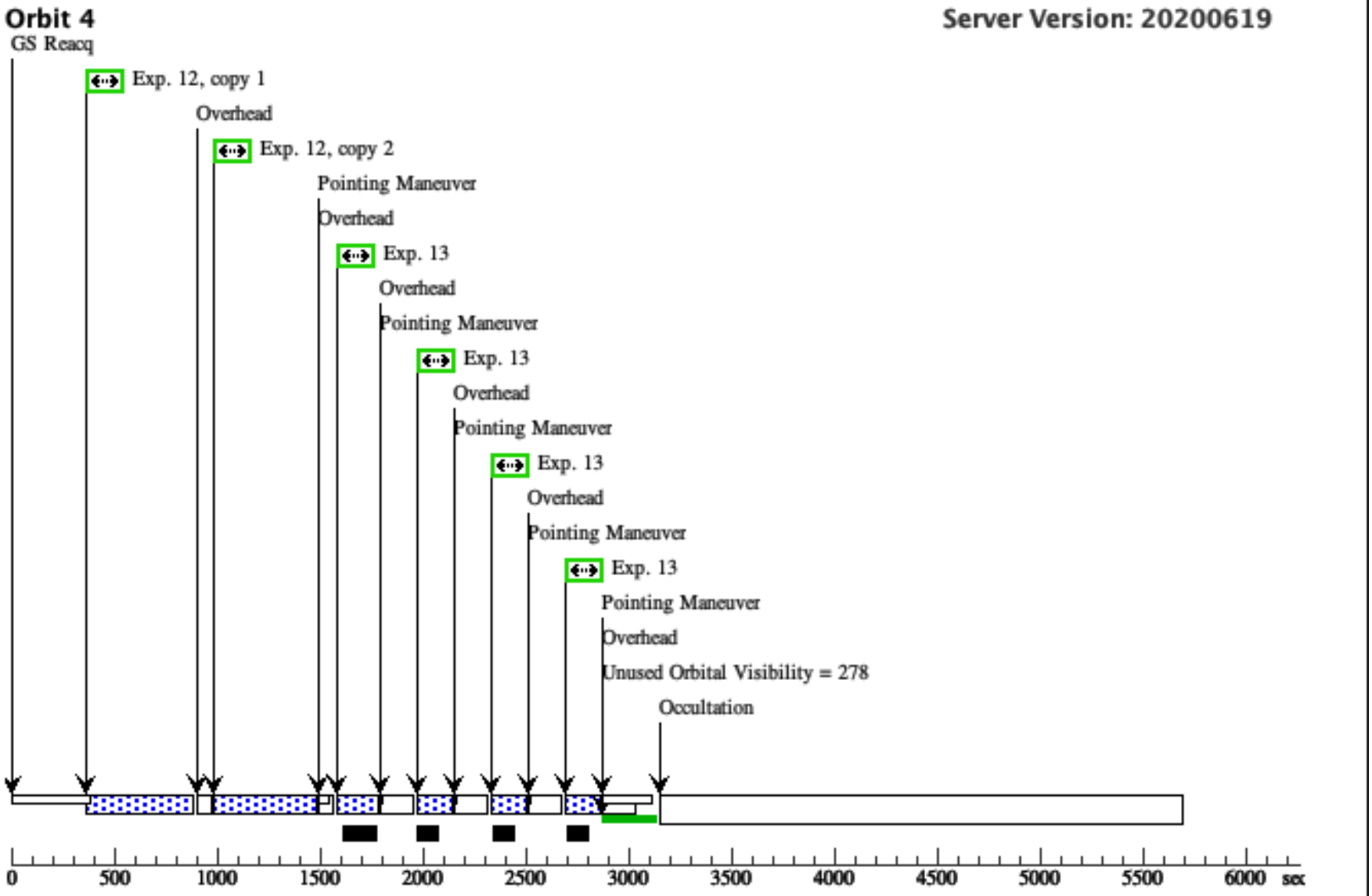
2500
3000
3500
4000
4500
5000
5500
6000
sec


Orbit 3
Server Version: 20200619
GS Reacq
Exp. 9, copy 1
Overhead
Exp. 9, copy 2
Overhead
Exp. 10, copy 1
Overhead
Exp. 10, copy 2
Overhead
Exp. 11, copy 1
Overhead
Exp. 11, copy 2
*** ORBITAL VISIBILITY OVERRUN = 47
Occultation
Overhead
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec


Orbit 4
Server Version: 20200619
GS Reacq
Exp. 12, copy 1
Overhead
Exp. 12, copy 2
Pointing Maneuver
Overhead
Exp. 13
Overhead
Pointing Maneuver
Exp. 13
Overhead
Pointing Maneuver
Exp. 13
Overhead
Pointing Maneuver
Exp. 13
Pointing Maneuver
Overhead
Unused Orbital Visibility = 278
Occultation
0
500
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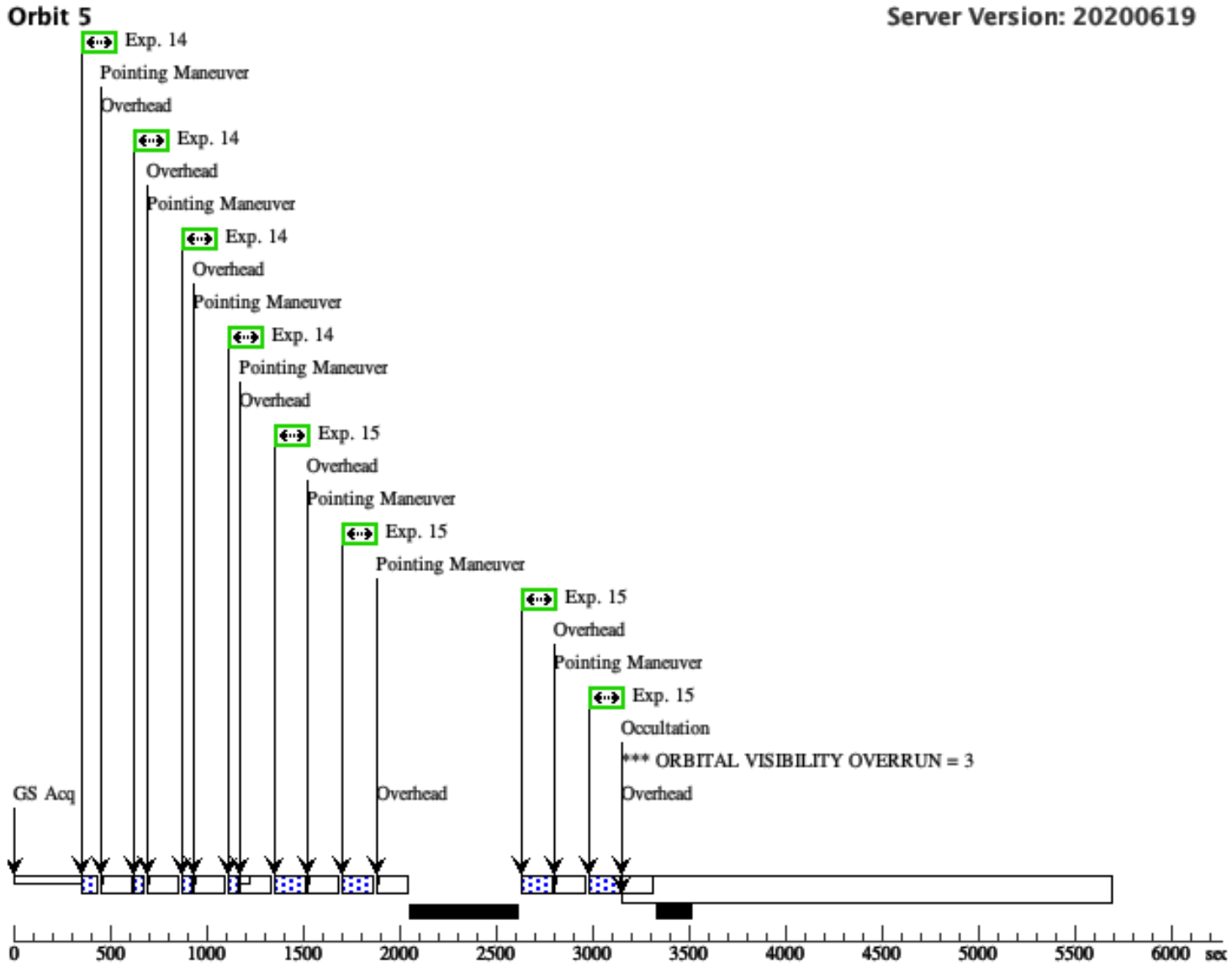
2500
3000
3500
4000
4500
5000
5500
6000
sec


Orbit 5
Server Version: 20200619
Exp. 14
Pointing Maneuver
Overhead
Exp. 14
Overhead
Pointing Maneuver
Exp. 14
Overhead
Pointing Maneuver
Exp. 14
Pointing Maneuver
Overhead
Exp. 15
Overhead
Pointing Maneuver
Exp. 15
Pointing Maneuver
Exp. 15
Overhead
Pointing Maneuver
Exp. 15
Occultation
*** ORBITAL VISIBILITY OVERRUN = 3
GS Acq
Overhead
Overhead
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec