18051 - Evolution of the Newly Discovered Jet in the Symbiotic System HM Sge

Cycle: 33, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
Mr. Warren J. Hack (PI) (Contact)	**Eureka Scientific Inc.**
Dr. Margarita Karovska (CoI)	Smithsonian Institution Astrophysical Observatory

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) V-HM-SGE	WFC3/UVIS	2	30-Sep-2025 08:00:14.0	yes
02	(1) V-HM-SGE	WFC3/UVIS	3	30-Sep-2025 08:00:16.0	yes

5 Total Orbits Used

ABSTRACT

We propose HST/WFC3 observations of the interacting Symbiotic binary HM Sge to study the evolution of the jet we discovered using the archival April 2021 observations, which was likely ejected during a powerful outburst
during 1975-1980. Since 1975, HM Sge has been slowly getting fainter, that is until recently, when a dramatic dimming of the light curve began in late 2021/early 2022, indicating a new powerful mass ejection and dust formation, similar to the outburst and jet producing events in two nearby Symbiotics CH Cyg and R Aqr. Our goal is to carry out a timely high-angular resolution (0.025") multi-wavelength (UV-Optical) line-emission study of the newly discovered jet and the recent ejecta by zooming in on the central 3" radius (3000 AU) circumbinary region, reaching as close as 25 AU to the central binary. This will allow us to determine the spatial/spectral evolution of the distribution and the characteristics of the new jet and more recent ejecta, and to gain a unique insight into jet formation and early propagation in symbiotic and other accretion-powered systems.

OBSERVING DESCRIPTION

We will take multi-wavelength observations of HM Sge to study the newly discovered jet and to measure the line ratios in the region powering the new jet and the recent dimming event. The HST observations are critical because of the required high-angular resolution, and especially the access to UV and optical lines - which are a key to this study. The UV component of this proposal is essential to the science investigation, and is in accordance with the HST UV initiative. We request a total of 5 orbits, in 1 visit. The target visibility is very good. We plan to carry out HST WFC3/UVIS imaging of HM Sge, using the 4-point dither mode in several filters (see table). Combining the dithered images will result in improvement of the sampling of the PSF and will allow us to further enhance the (nominal 0.04"/pixel) resolution using deconvolution techniques such as Richardson-Lucy reaching 0.025"/pixel (~25 AU). We also plan several long exposures to image the fainter outer structures and determine their morphology and evolution when compared to the archival HST observations.

We plan to use the following filters (UV-Optical) centered on emission lines and nearby continua.

F275W UV cont. set of 4x180s exp
F280N Mg II set of 4x120s exp + 4x200s exp
F336W U Band cont. set of 4x30s exp
F373N [OII] set of 4x85s + 2x500s exp
F343N [NeV] set of 4x90s exp
F487N H-beta set of 4x30s exp
F502N [O III] set of 4x40s + 2x660s exp
F547M cont. set of 4x8s exp
F656N H-alpha set of 4x10s + 2x600s exp
F658N [N II] set of 4x20s exp
F673N [S II] set of 4x15s exp
F763M cont. set of 4x5s exp

The exposure times are based on the online WFC3 ETC calculations as verified by the 2024 WFC3 observations. We will optimize the efficiency of the observing time by using 1024x1024 subarray readouts with a ~40"x40" field of view to minimize the overheads. This field of view also includes a suitable PSF candidate for subsequent deconvolution of the image.

Visit

Proposal 18051, Visit 01, implementation Tue Sep 30 12:00:17 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1-4), (5-7)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	V-HM-SGE	RA: 19 41 57.0796 (295.4878317d) Dec: +16 44 39.81 (16.74439d) Equinox: J2000	Proper Motion RA: -0.443 mas/yr Proper Motion Dec: -7.103999973878672 mas/yr Parallax: 9.735000000000001E-4" Epoch of Position: 2000	V=13.00	Reference Frame: SIMBAD

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

SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.This object was generated by the targetselector and retrieved from the SIMBAD database.

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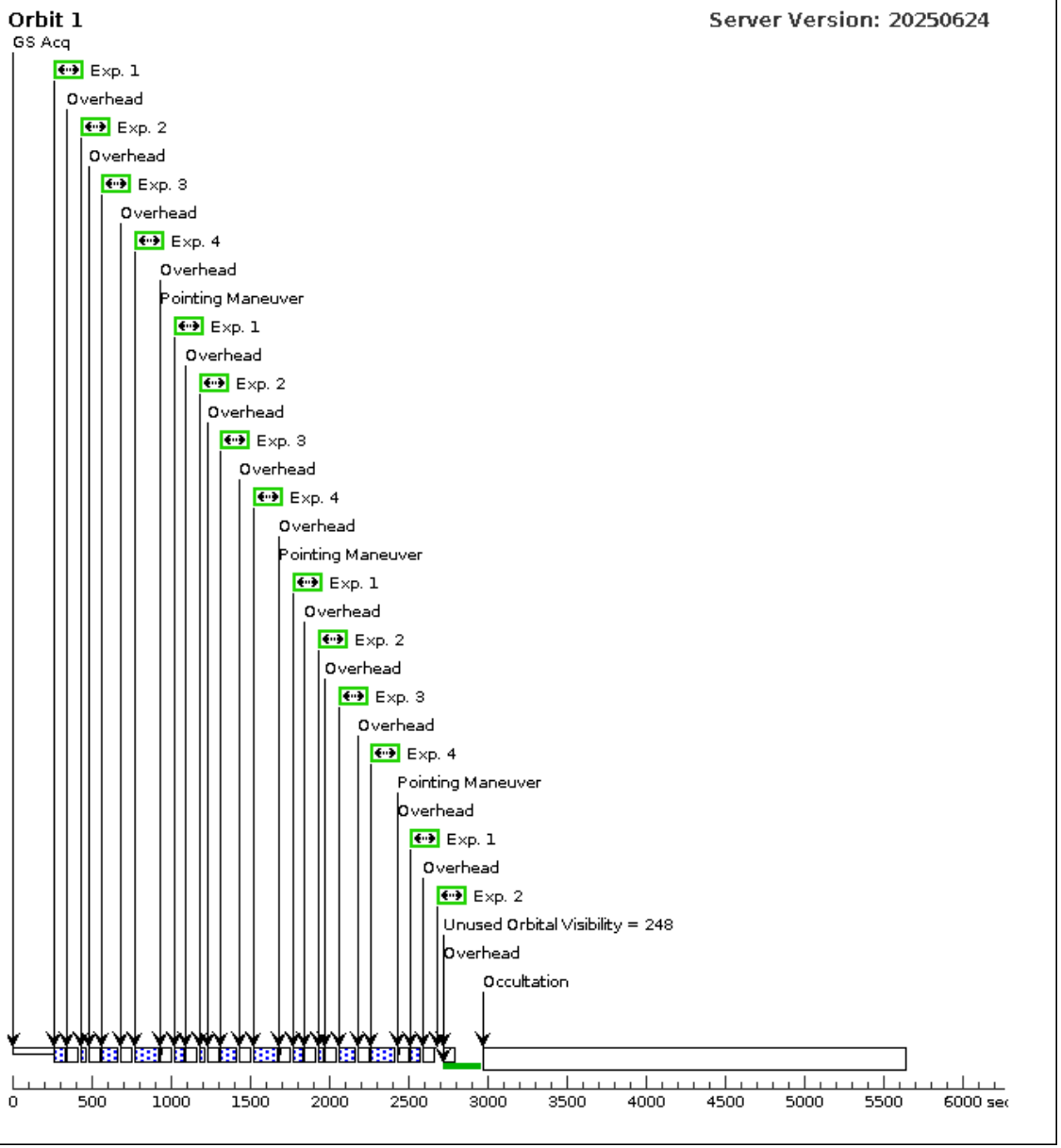
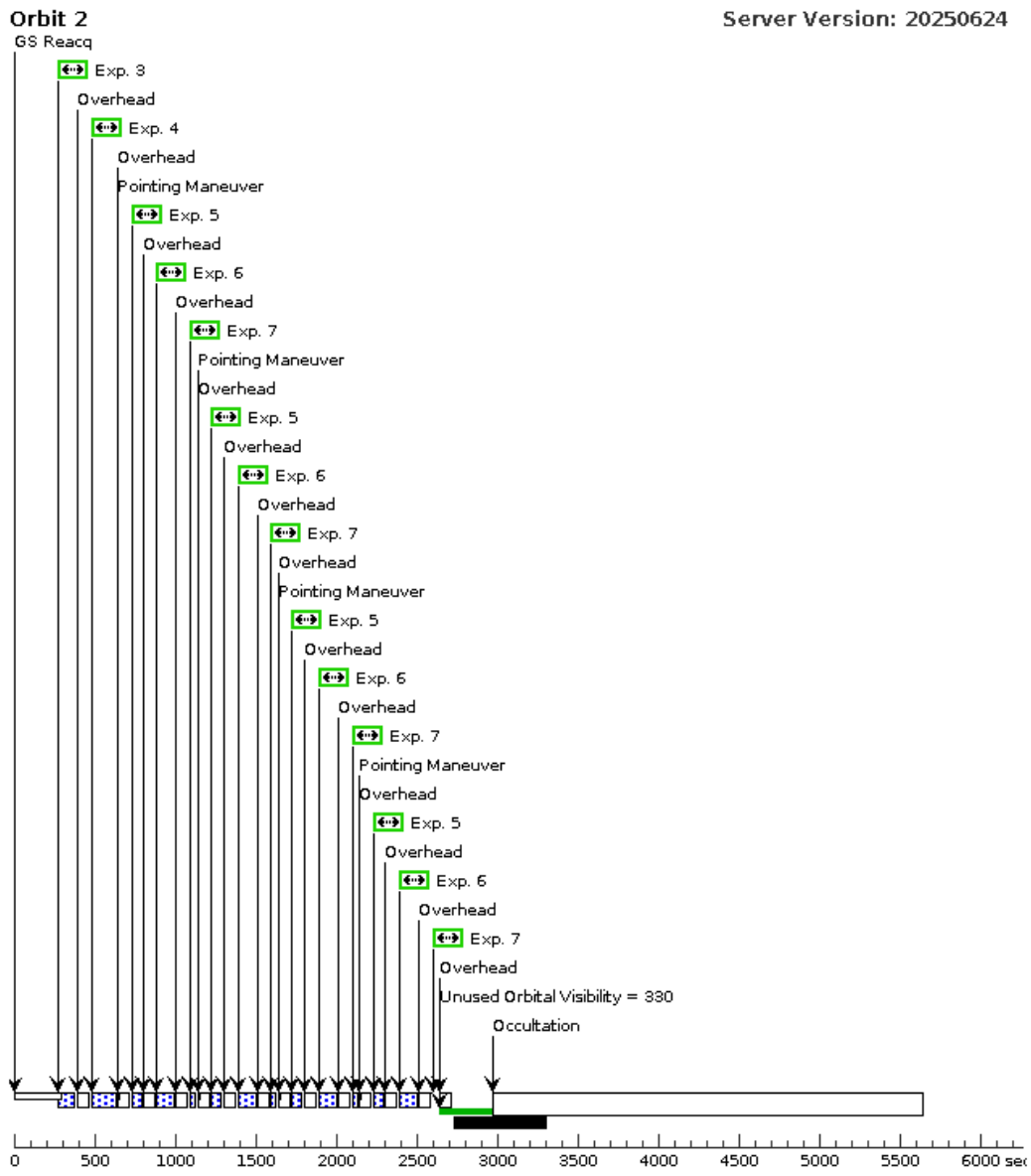
Category=STAR
Description=[JET, SYMBIOTIC STAR]

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-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F502N	FLASH=20	GS ACQ SCENARIO ONEB1OR	Pattern 1, Exps 1-4 in Visit 01 (1)	40 Secs (160 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	
2	(WFC3UVIS.im.780074)	(1) V-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F547M	FLASH=20		Pattern 1, Exps 1-4 in Visit 01 (1)	8 Secs (32 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	
3	(WFC3UVIS.im.832643)	(1) V-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F373N	FLASH=20		Pattern 1, Exps 1-4 in Visit 01 (1)	85 Secs (340 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	***[2]***
4	(WFC3UVIS.im.832644)	(1) V-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F280N	FLASH=20		Pattern 1, Exps 1-4 in Visit 01 (1)	120 Secs (480 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	***[2]***
5		(1) V-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F487N	FLASH=20		Pattern 1, Exps 5-7 in Visit 01 (1)	30 Secs (120 Secs)	
								[==>(Pattern 1)]	***[2]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	
6		(1) V-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F343N	FLASH=20		Pattern 1, Exps 5-7 in Visit 01 (1)	90 Secs (360 Secs)	
								[==>(Pattern 1)]	***[2]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	
7		(1) V-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F656N	FLASH=20		Pattern 1, Exps 5-7 in Visit 01 (1)	10 Secs (40 Secs)	
								[==>(Pattern 1)]	***[2]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	

Orbit Structure




Orbit 2
Server Version: 20250624
GS Reacq
Exp. 3
Overhead
Exp. 4
Overhead
Pointing Maneuver
Exp. 5
Overhead
Exp. 6
Overhead
Exp. 7
Pointing Maneuver
Overhead
Exp. 5
Overhead
Exp. 6
Overhead
Exp. 7
Overhead
Pointing Maneuver
Exp. 5
Overhead
Exp. 6
Overhead
Exp. 7
Pointing Maneuver
Overhead
Exp. 5
Overhead
Exp. 6
Overhead
Exp. 7
Overhead
Unused Orbital Visibility = 330
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Visit

Proposal 18051, Visit 02, implementation Tue Sep 30 12:00:17 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(2-5)
(2)	Pattern Type=LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.15 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides= Center Pattern=false		(6-9)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
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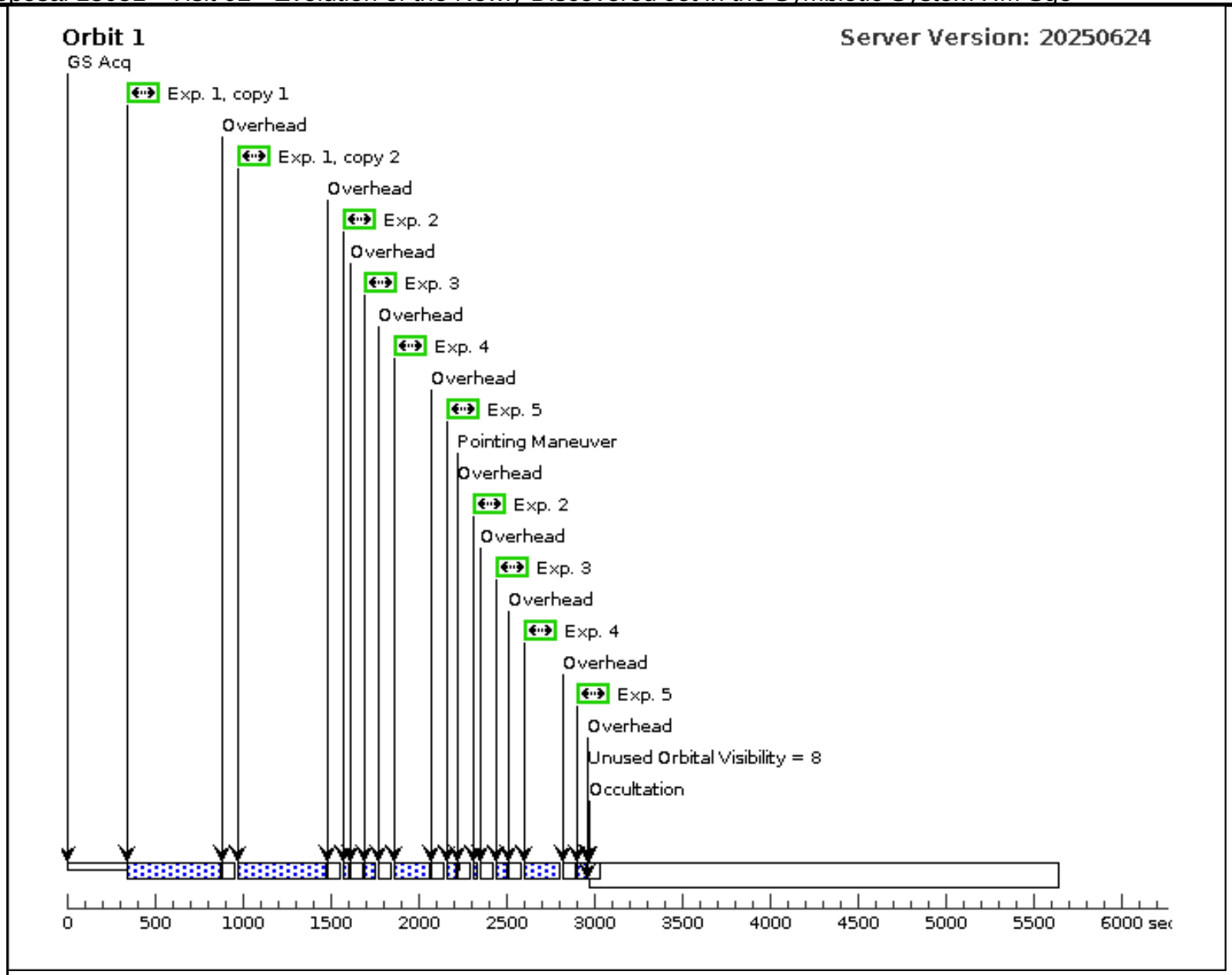
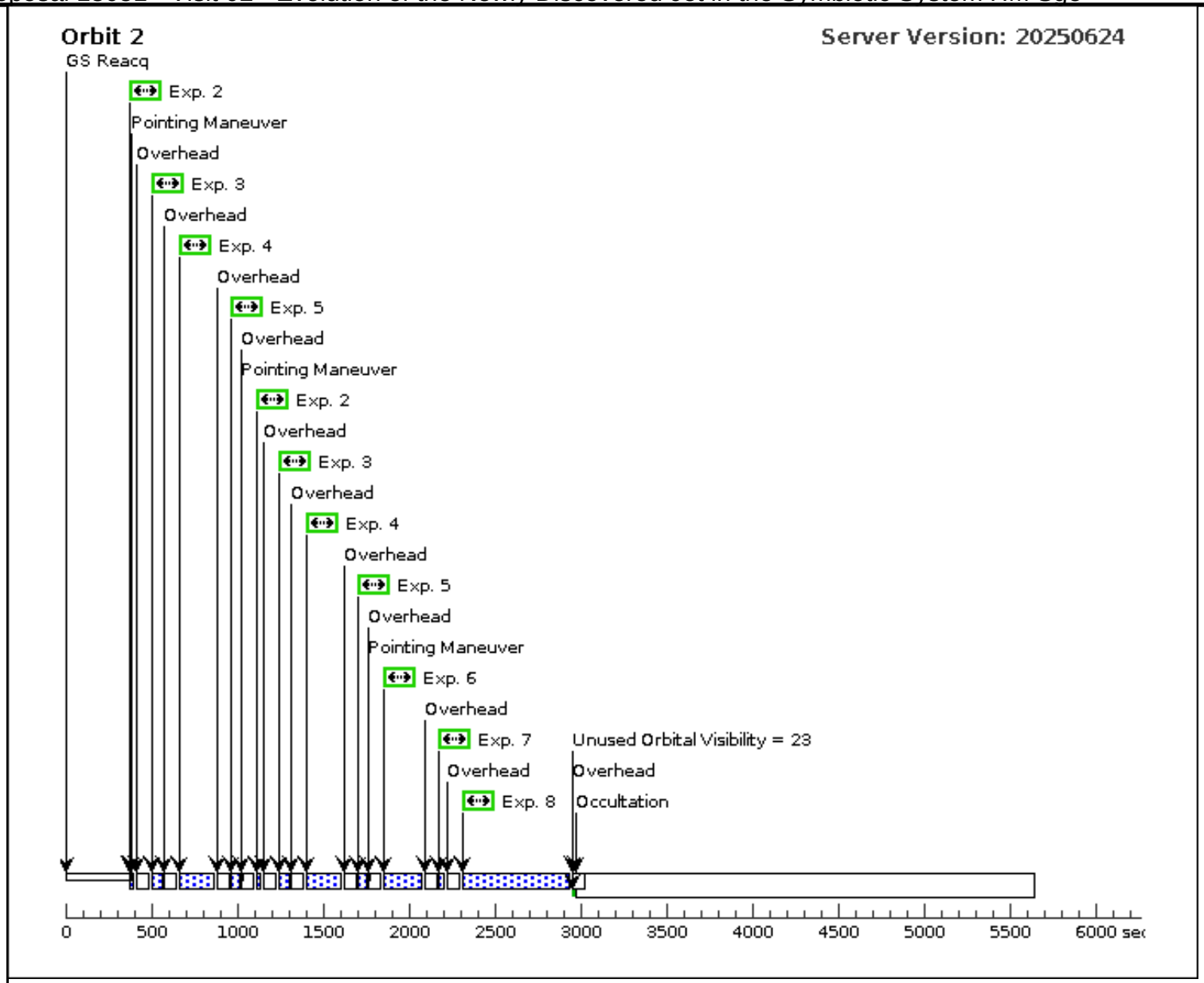
Category=STAR
Description=[JET, SYMBIOTIC STAR]

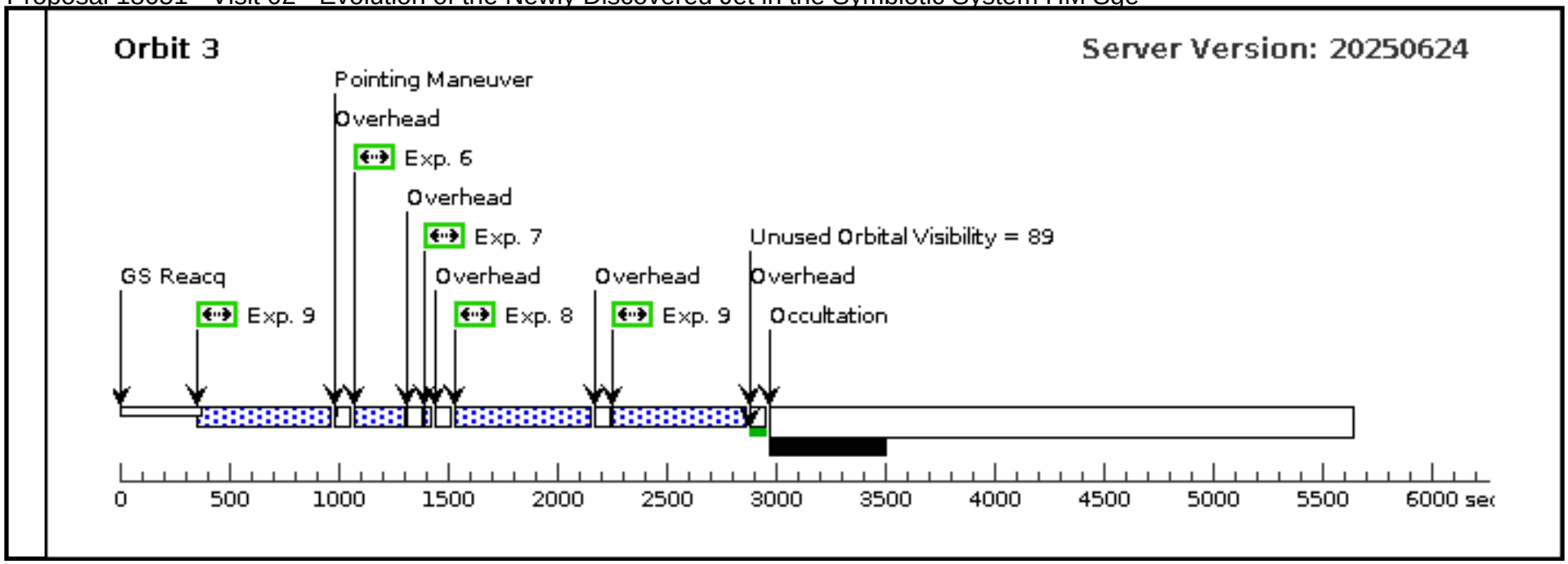
Exposures

#	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-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F373N	FLASH=20			500 Secs X 2 (1000 Secs)	
								[==>(Copy 1)]	***[1]***
								[==>(Copy 2)]	
2	(WFC3UVIS.im.780079)	(1) V-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F763M	FLASH=20		Pattern 1, Exps 2-5 in Visit 02 (1)	5 Secs (20 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	***[2]***
								[==>(Pattern 4)]	
3	(WFC3UVIS.im.780075)	(1) V-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F336W	FLASH=20		Pattern 1, Exps 2-5 in Visit 02 (1)	30 Secs (120 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	***[2]***
								[==>(Pattern 4)]	
4	(WFC3UVIS.im.780140)	(1) V-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F275W	FLASH=20		Pattern 1, Exps 2-5 in Visit 02 (1)	180 Secs (720 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	***[2]***
								[==>(Pattern 4)]	
5	(WFC3UVIS.im.780140)	(1) V-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F658N	FLASH=20		Pattern 1, Exps 2-5 in Visit 02 (1)	30 Secs (120 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	***[2]***
								[==>(Pattern 4)]	
6	(WFC3UVIS.im.780074)	(1) V-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F280N	FLASH=20		Pattern 2, Exps 6-9 in Visit 02 (2)	200 Secs (400 Secs)	
								[==>(Pattern 1)]	***[2]***
								[==>(Pattern 2)]	***[3]***
7	(WFC3UVIS.im.780079)	(1) V-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F673N	FLASH=20		Pattern 2, Exps 6-9 in Visit 02 (2)	15 Secs (30 Secs)	
								[==>(Pattern 1)]	***[2]***
								[==>(Pattern 2)]	***[3]***
8	(WFC3UVIS.im.780074)	(1) V-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F502N	FLASH=20		Pattern 2, Exps 6-9 in Visit 02 (2)	600 Secs (1200 Secs)	
								[==>(Pattern 1)]	***[2]***
								[==>(Pattern 2)]	***[3]***
9	(WFC3UVIS.im.780074)	(1) V-HM-SGE	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F656N	FLASH=20		Pattern 2, Exps 6-9 in Visit 02 (2)	600 Secs (1200 Secs)	
								[==>(Pattern 1)]	***[3]***
								[==>(Pattern 2)]	

Orbit Structure




Orbit 2
Server Version: 20250624
GS Reacq
Exp. 2
Pointing Maneuver
Overhead
Exp. 3
Overhead
Exp. 4
Overhead
Exp. 5
Overhead
Pointing Maneuver
Exp. 2
Overhead
Exp. 3
Overhead
Exp. 4
Overhead
Exp. 5
Overhead
Pointing Maneuver
Exp. 6
Overhead
Exp. 7
Unused Orbital Visibility = 23
Overhead
Overhead
Exp. 8
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec


Orbit 3
Server Version: 20250624
Pointing Maneuver
Overhead
Exp. 6
Overhead
Exp. 7
Unused Orbital Visibility = 89
GS Reacq
Overhead
Overhead
Overhead
Exp. 9
Exp. 8
Exp. 9
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec