18136 - Where is the central black hole in the LMC?

Cycle: 33, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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Mr. Maximilian Haeberle (CoI) (ESA Member)	Max Planck Institute for Astronomy

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
03	(1) NGC-1916	WFC3/UVIS	3	18-Aug-2025 09:00:21.0	yes
02	(3) HVS7	WFC3/UVIS	2	18-Aug-2025 09:00:23.0	yes
04	(2) HVS3	WFC3/UVIS	2	18-Aug-2025 09:00:25.0	yes

7 Total Orbits Used

ABSTRACT

The presence of massive black holes remains poorly constrained in dwarf galaxies, especially in the late-type dwarfs that dominate the population. The nearest late-type dwarf galaxy, the Large Magellanic Cloud (LMC), is an important case in point. Despite its proximity, the presence of a massive black hole in the LMC remains unsettled, largely because of the uncertainty in the location of the center of this tidally disturbed galaxy. The recent discovery of a population of hypervelocity stars emanating from the central regions of the LMC strongly suggest that a massive black hole is present, but its location is poorly constrained. We will address this in two ways: first, we will obtain new HST imaging for two LMC hypervelocity stars, combining these data with Gaia to measure ultra-precise proper motions and localize their origin near the LMC's center a factor of 9 better than existing constraints. Second, we will obtain new imaging of NGC1916, the most likely nuclear star cluster of the LMC. When combined with archival HST data, this will allow us to measure high-precision proper motions (~3 km/s), enabling clean identification of cluster members. With this data we will weigh any black hole in this cluster through both dynamical modeling and the possible identification of any fast stars near the black hole. If a massive black hole is present in the LMC, these proposed observations offer the best chance to both reveal it and constrain its mass.

OBSERVING DESCRIPTION

Exposure time strategies:
NGC1916 -- matching previous observations in F555W and F814W with 10x exposure time differences for optimal proper motion determination. Getting F438W observations for stellar populations distinctions.
F814W: 3x35s + 4x350s
F555W: 3x35s + 5x350s
F438W: 3x35s + 3x670s

HVS3 --Match previous observation filter to obtain 10x350s exposures in F850LP (30% saturation); we will also take 3x45s in F814W (15% saturation); these can mitigate potential issues with the distortion solution in F850LP.

HVS 7 -- For filter consistency, we will obtain 4x35s and 5x350s (9%/90% saturation) in F606W, and 4x440s in F467M (30% saturation), which has an accurate distortion solution & PSF.

Dither pattern are used with POS TARGS; for targets with 3/4/5 exposures per filter we use a dither sequence that gets 0.5 pixel dithers in x/y/x&y along with integer pixel dithers to make sure hot pixels don't impact more than a single exposure. For HVS3, the 10 exposures use a 1/3rd pixel offset grid for the first 9 exposures and then use 1/2 pixel offset. These are added to integer pixel offsets.

Flash set to near the minimum values to reduce CTE issues for all exposures.

Visit

Proposal 18136, NGC1916_fullframe (03), implementation Mon Aug 18 13:00:26 GMT 2025

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

(NGC1916_fullframe (03)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(NGC1916_fullframe (03)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Fixed Targets

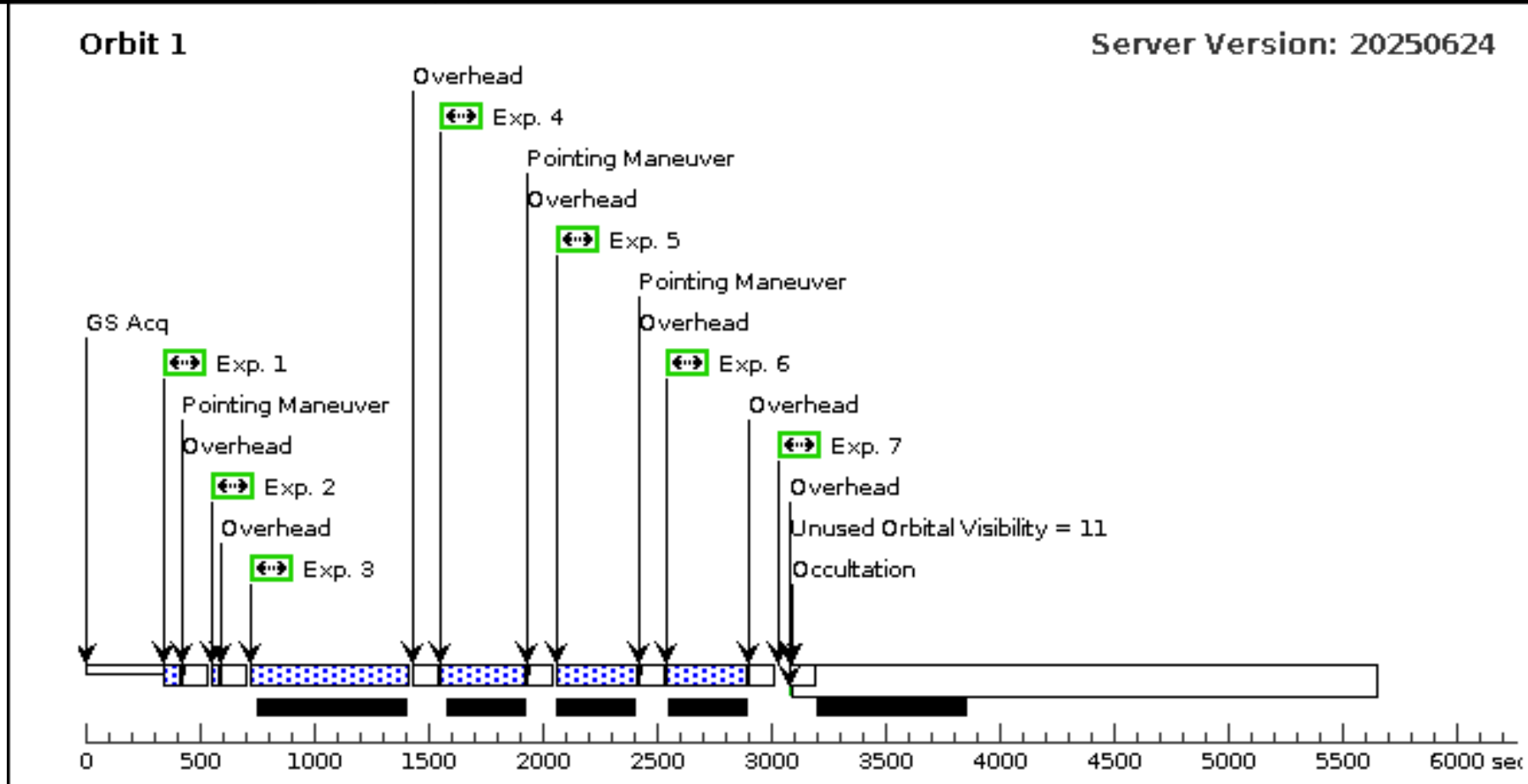
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NGC-1916	RA: 05 18 37.8700 (79.6577917d) Dec: -69 24 22.90 (-69.40636d) Equinox: J2000	Epoch of Position: 2000	V=10.38	Reference Frame: ICRS

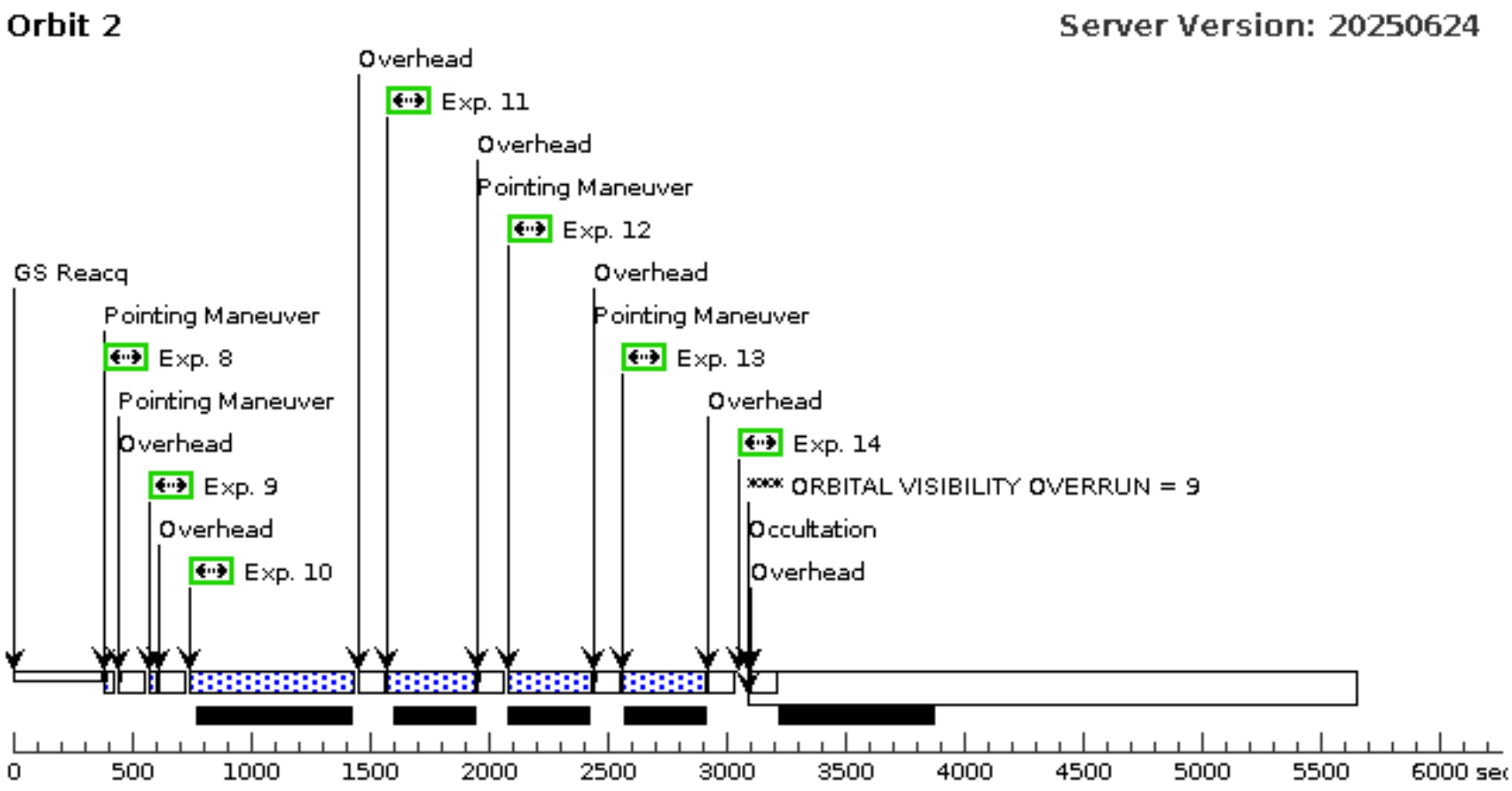
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STELLAR CLUSTER
Description=[GLOBULAR CLUSTER]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F814W_short_1	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=16	POS TARG 0,0		35 Secs (35 Secs)	
								[==>]	***[1]***
2	F814W_short_2	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=16	POS TARG 0.46,0.46		35 Secs (35 Secs)	
								[==>]	***[1]***
3	F438W_long_1	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F438W	FLASH=11	POS TARG 0.46,0.46		670 Secs (670 Secs)	
								[==>]	***[1]***
4	F814W_long_1	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=10	POS TARG 0.46,0.46		350 Secs (350 Secs)	
								[==>]	***[1]***
5	F814W_long_2	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=10	POS TARG 0.08,0.54		350 Secs (350 Secs)	
								[==>]	***[1]***
6	F814W_long_3	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=10	POS TARG 0.38,0.08		350 Secs (350 Secs)	
								[==>]	***[1]***
7	F814W_short_3	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=16	POS TARG 0.38,0.08		35 Secs (35 Secs)	
								[==>]	***[1]***
8	F555W_short_1	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F555W	FLASH=16	POS TARG 0.46,0.46		35 Secs (35 Secs)	
								[==>]	***[2]***
9	F555W_short_2	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F555W	FLASH=16	POS TARG 0,0		35 Secs (35 Secs)	
								[==>]	***[2]***
10	F438W_long_2	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F438W	FLASH=11	POS TARG 0,0		670 Secs (670 Secs)	
								[==>]	***[2]***
11	F555W_long_1	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F555W	FLASH=10	POS TARG 0,0		350 Secs (350 Secs)	
								[==>]	***[2]***
12	F555W_long_2	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F555W	FLASH=10	POS TARG 0.46,0.46		350 Secs (350 Secs)	
								[==>]	***[2]***
13	F555W_long_3	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F555W	FLASH=10	POS TARG 0.08,0.54		350 Secs (350 Secs)	
								[==>]	***[2]***
14	F555W_short_3	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F555W	FLASH=16	POS TARG 0.08,0.54		35 Secs (35 Secs)	
								[==>]	***[2]***
15	F438W_short_1	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F438W	FLASH=16	POS TARG 0,0		35 Secs (35 Secs)	
								[==>]	***[3]***
16	F438W_short_2	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F438W	FLASH=16	POS TARG 0.08,0.54		35 Secs (35 Secs)	
								[==>]	***[3]***
17	F438W_long_3	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F438W	FLASH=11	POS TARG 0.08,0.54		670 Secs (670 Secs)	
								[==>]	***[3]***
18	F555W_long_4	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F555W	FLASH=10	POS TARG 0.38,0.08		350 Secs (350 Secs)	
								[==>]	***[3]***
19	F555W_long_5	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F555W	FLASH=10	POS TARG 0.21,0.21		350 Secs (350 Secs)	
								[==>]	***[3]***
20	F814W_long_4	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=10	POS TARG 0.38,0.08		350 Secs (350 Secs)	
								[==>]	***[3]***
21	F438W_short_3	(1) NGC-1916	WFC3/UVIS, ACCUM, UVIS2	F438W	FLASH=16	POS TARG 0.46,0.46		35 Secs (35 Secs)	
								[==>]	***[3]***

Orbit Structure

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Exp. 9
Overhead
Exp. 10
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Overhead
Pointing Maneuver
Exp. 12
Overhead
Pointing Maneuver
Exp. 13
Overhead
Exp. 14
**** ORBITAL VISIBILITY OVERRUN = 9
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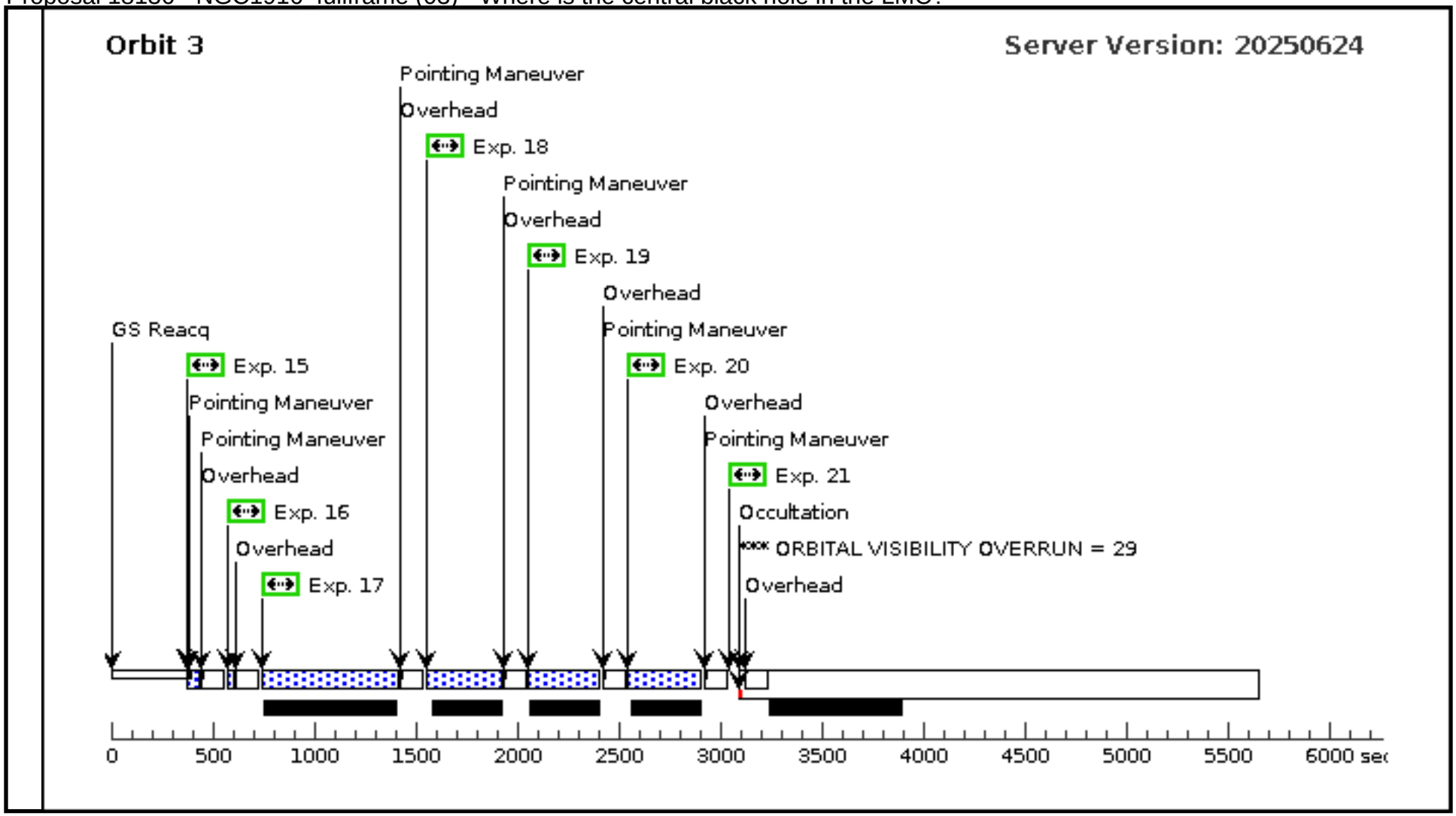
5000
5500
6000 sec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Server Version: 20250624
GS Reacq
Exp. 15
Pointing Maneuver
Pointing Maneuver
Overhead
Exp. 16
Overhead
Exp. 17
Pointing Maneuver
Overhead
Exp. 18
Pointing Maneuver
Overhead
Exp. 19
Overhead
Pointing Maneuver
Exp. 20
Overhead
Pointing Maneuver
Exp. 21
Occultation
*** ORBITAL VISIBILITY OVERRUN = 29
Overhead
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Visit

Proposal 18136, HVS7 (02), implementation Mon Aug 18 13:00:26 GMT 2025

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

(HVS7 (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(HVS7 (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Fixed Targets

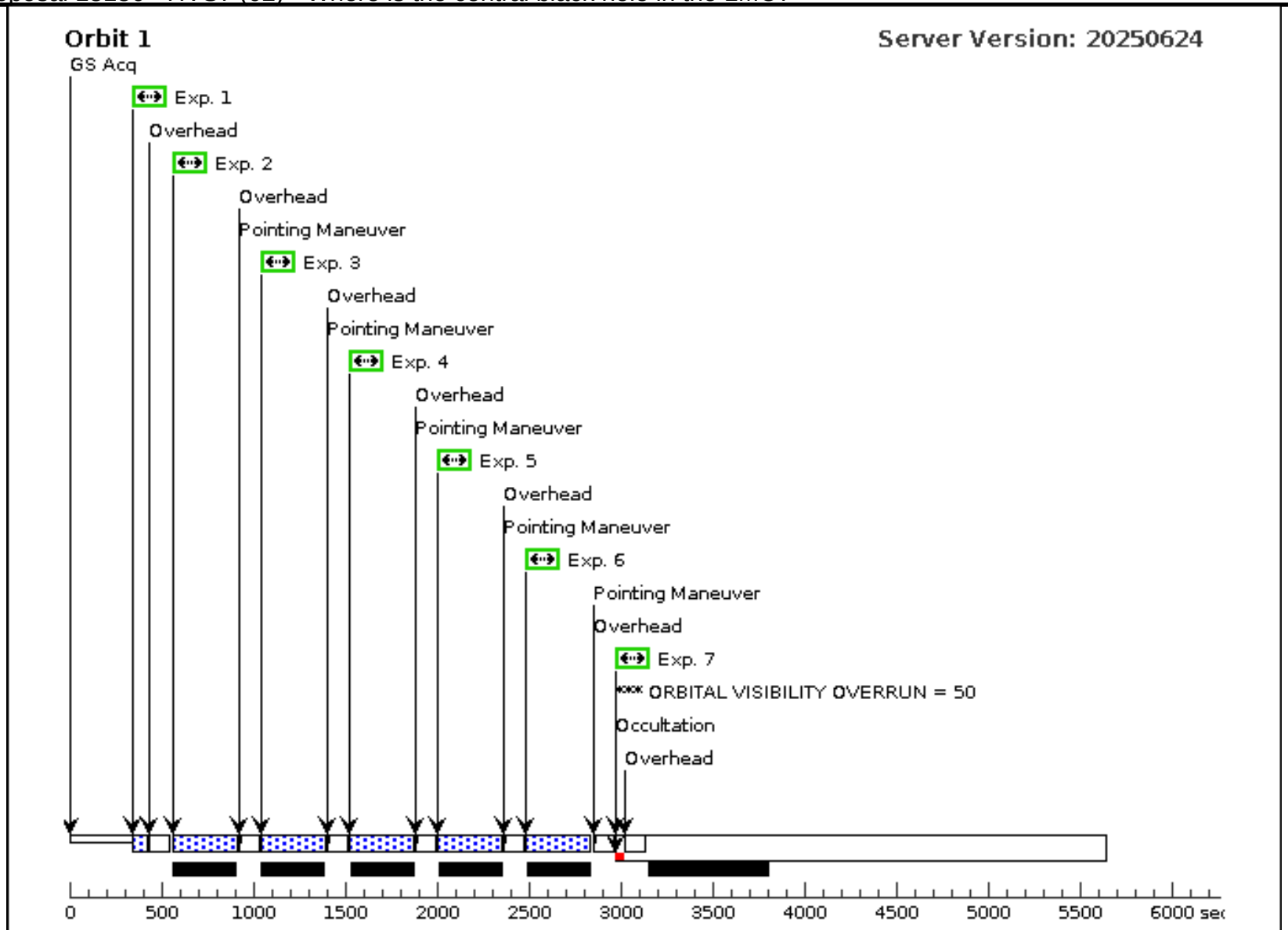
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	HVS7	RA: 11 33 12.1224 (173.3005100d) Dec: +01 08 24.84 (1.14023d) Equinox: J2000		V=17.9+/-0.2 G=17.934, BP-RP=-0.105	Reference Frame: ICRS

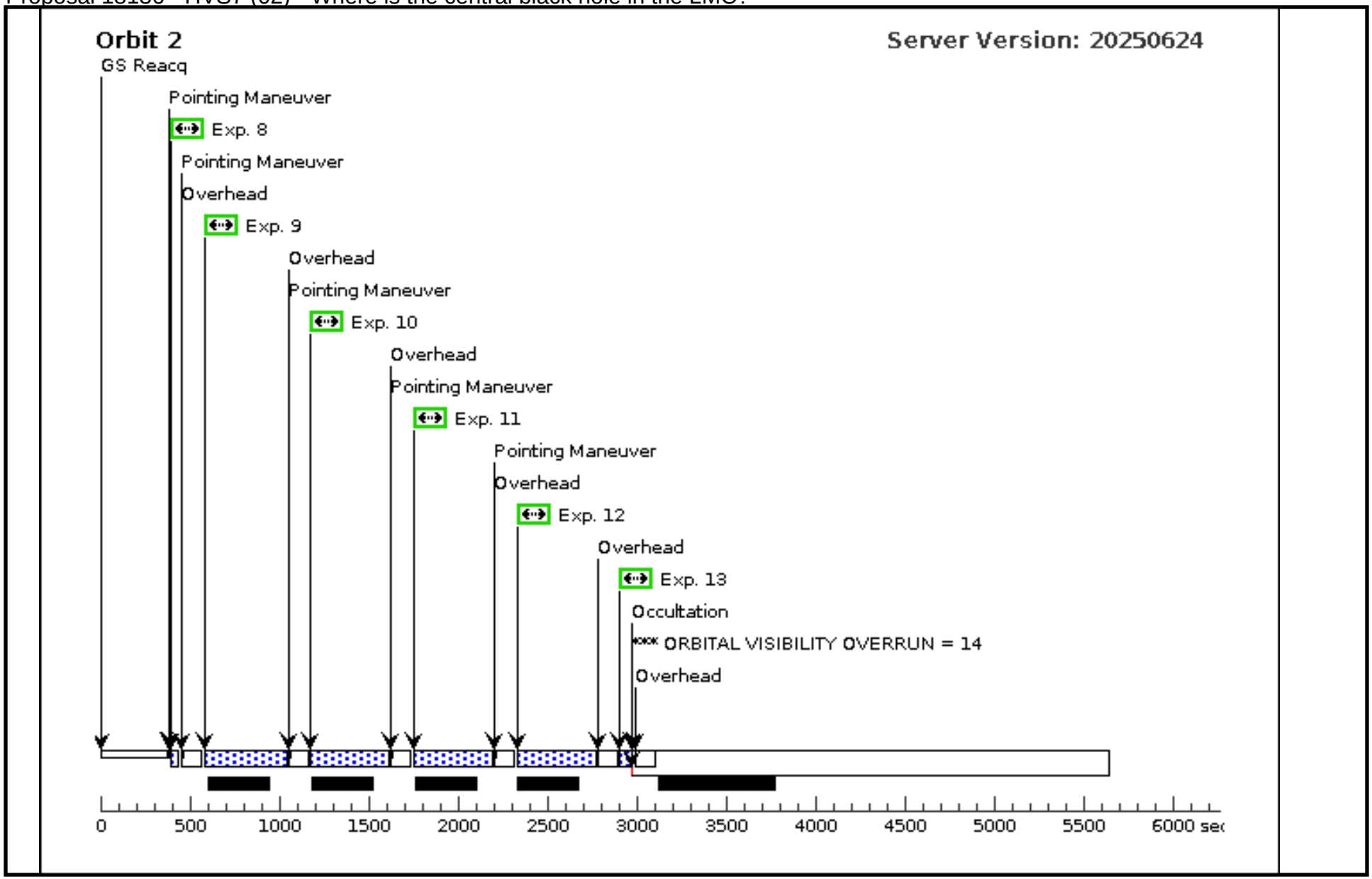
Comments:
Category=EXT-STAR
Description=[B3-B5 III-I]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F606W_short_1	(3) HVS7	WFC3/UVIS, ACCUM, UVIS1	F606W	FLASH=16	POS TARG 0,0		45 Secs (45 Secs)	
								[==>]	***[1]***
2	F606W_long_1	(3) HVS7	WFC3/UVIS, ACCUM, UVIS1	F606W	FLASH=3	SAME POS AS 1		350 Secs (350 Secs)	
								[==>]	***[1]***
3	F606W_long_2	(3) HVS7	WFC3/UVIS, ACCUM, UVIS1	F606W	FLASH=3	POS TARG 0.46,0.46		350 Secs (350 Secs)	
								[==>]	***[1]***
4	F606W_long_3	(3) HVS7	WFC3/UVIS, ACCUM, UVIS1	F606W	FLASH=3	POS TARG 0.08,0.54		350 Secs (350 Secs)	
								[==>]	***[1]***
5	F606W_long_4	(3) HVS7	WFC3/UVIS, ACCUM, UVIS1	F606W	FLASH=3	POS TARG 0.38,0.08		350 Secs (350 Secs)	
								[==>]	***[1]***
6	F606W_long_5	(3) HVS7	WFC3/UVIS, ACCUM, UVIS1	F606W	FLASH=3	POS TARG 0.21,0.21		350 Secs (350 Secs)	
								[==>]	***[1]***
7	F606W_short_2	(3) HVS7	WFC3/UVIS, ACCUM, UVIS1	F606W	FLASH=16	POS TARG 0.46,0.46		45 Secs (45 Secs)	
								[==>]	***[1]***
8	F606W_short_3	(3) HVS7	WFC3/UVIS, ACCUM, UVIS1	F606W	FLASH=16	POS TARG 0.08,0.54		45 Secs (45 Secs)	
								[==>]	***[2]***
9	F467M_long_1	(3) HVS7	WFC3/UVIS, ACCUM, UVIS1	F467M	FLASH=15	POS TARG 0,0		440 Secs (440 Secs)	
								[==>]	***[2]***
10	F467M_long_2	(3) HVS7	WFC3/UVIS, ACCUM, UVIS1	F467M	FLASH=15	POS TARG 0.46,0.46		440 Secs (440 Secs)	
								[==>]	***[2]***
11	F467M_long_3	(3) HVS7	WFC3/UVIS, ACCUM, UVIS1	F467M	FLASH=15	POS TARG 0.08,0.54		440 Secs (440 Secs)	
								[==>]	***[2]***
12	F467M_long_4	(3) HVS7	WFC3/UVIS, ACCUM, UVIS1	F467M	FLASH=15	POS TARG 0.38,0.08		440 Secs (440 Secs)	
								[==>]	***[2]***
13	F606W_short_4	(3) HVS7	WFC3/UVIS, ACCUM, UVIS1	F606W	FLASH=16	POS TARG 0.38,0.08		45 Secs (45 Secs)	
								[==>]	***[2]***

Orbit Structure

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Server Version: 20250624
GS Reacq
Pointing Maneuver
Exp. 8
Pointing Maneuver
Overhead
Exp. 9
Overhead
Pointing Maneuver
Exp. 10
Overhead
Pointing Maneuver
Exp. 11
Pointing Maneuver
Overhead
Exp. 12
Overhead
Exp. 13
Occultation
*** ORBITAL VISIBILITY OVERRUN = 14
Overhead
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Visit

Proposal 18136, HVS3 (04), implementation Mon Aug 18 13:00:27 GMT 2025

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

(HVS3 (04)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(HVS3 (04)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Fixed Targets

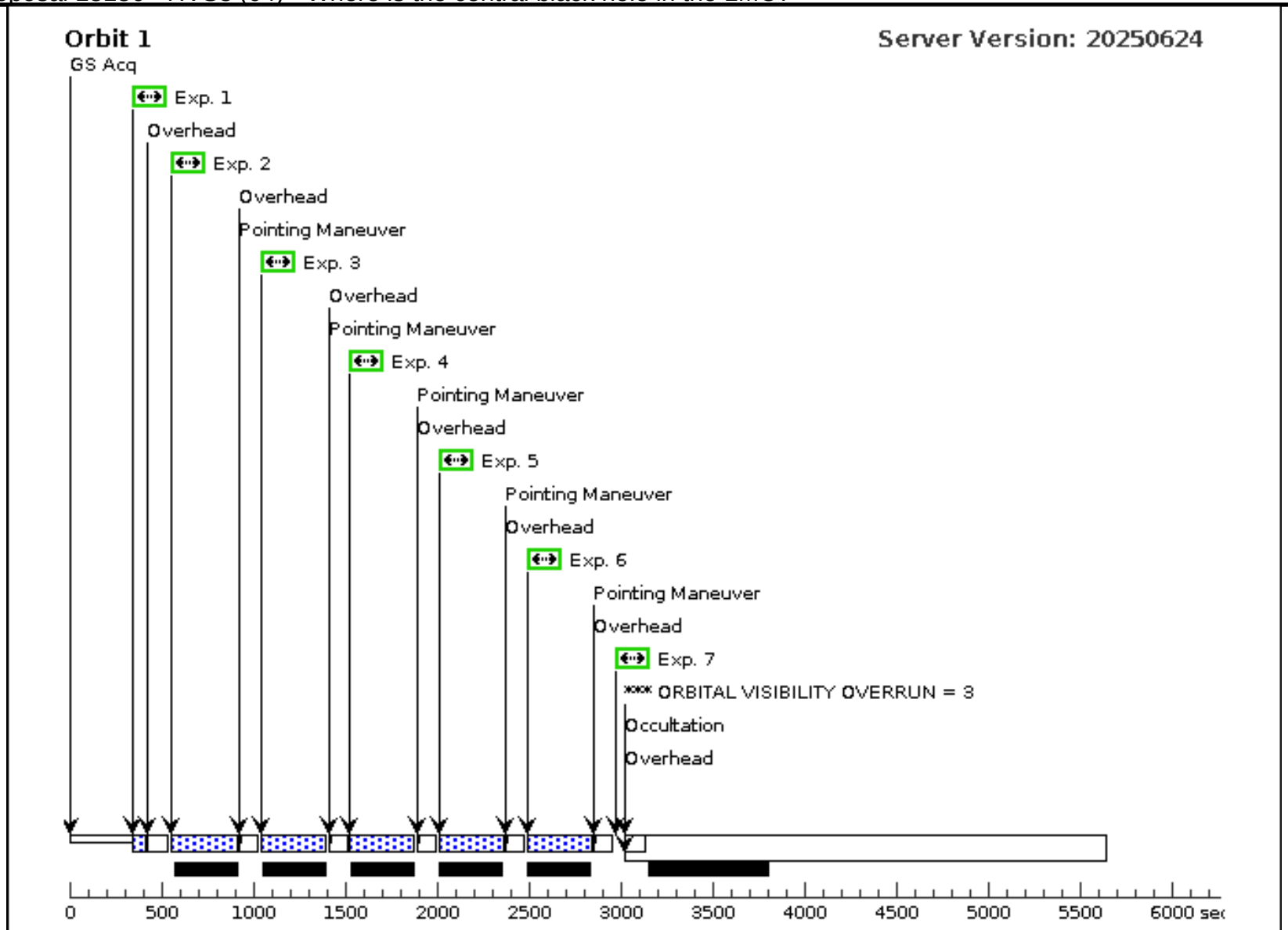
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	HVS3	RA: 04 38 12.7700 (69.5532083d) Dec: -54 33 11.90 (-54.55331d) Equinox: J2000		V=16.42+/-0.2 aka HE 0437-5439	Reference Frame: ICRS

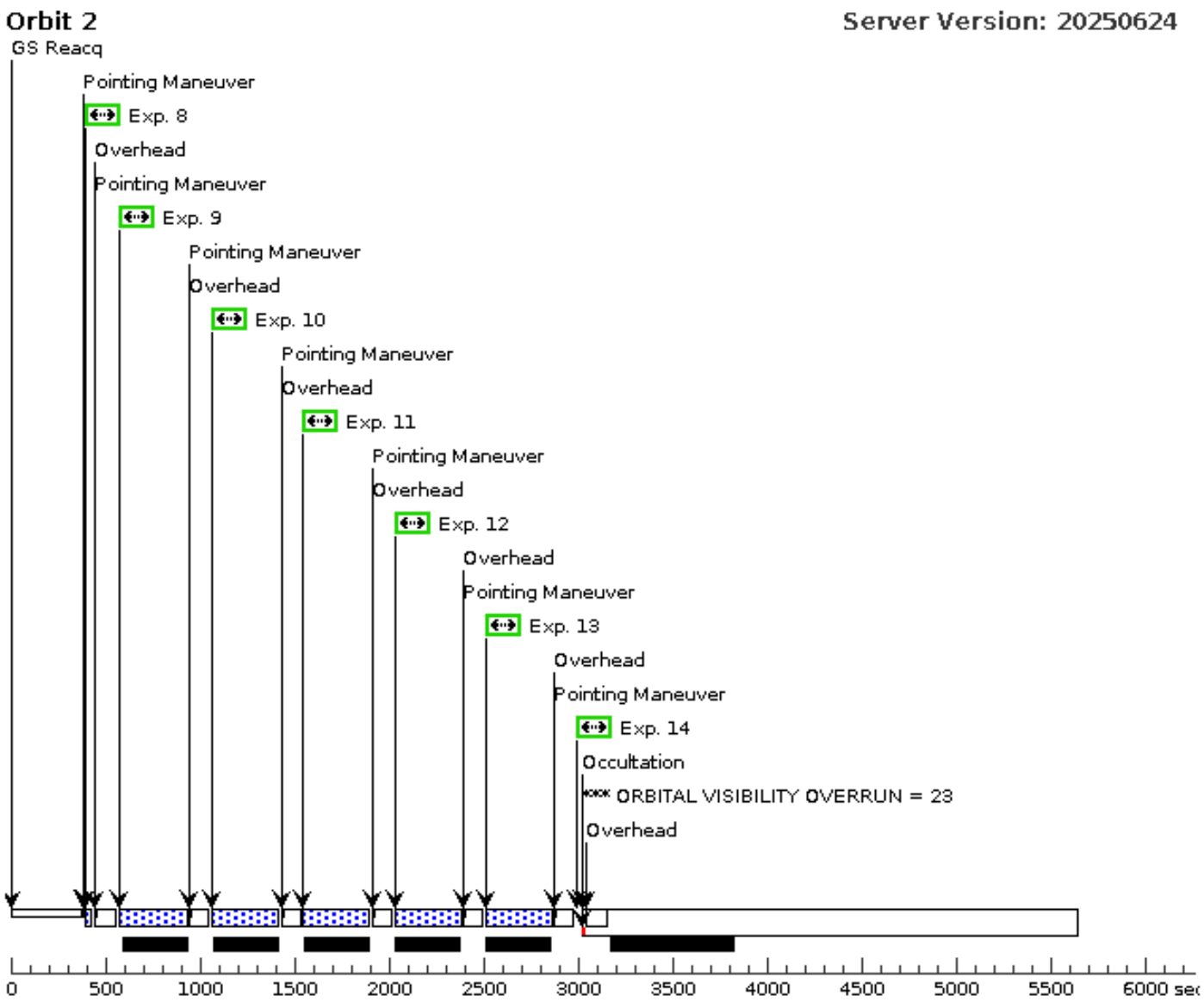
Comments:
Category=EXT-STAR
Description=[B0-B2 III-I]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F814W_short_1	(2) HVS3	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=16	POS TARG 0,0		35 Secs (35 Secs) *[==>]*	 ***[1]***
2	F850LP_long_1	(2) HVS3	WFC3/UVIS, ACCUM, UVIS1	F850LP	FLASH=14	SAME POS AS 1		350 Secs (350 Secs) *[==>]*	 ***[1]***
3	F850LP_long_2	(2) HVS3	WFC3/UVIS, ACCUM, UVIS1	F850LP	FLASH=14	POS TARG 0.293,0.293		350 Secs (350 Secs) *[==>]*	 ***[1]***
4	F850LP_long_3	(2) HVS3	WFC3/UVIS, ACCUM, UVIS1	F850LP	FLASH=14	POS TARG 0.587,0.587		350 Secs (350 Secs) *[==>]*	 ***[1]***
5	F850LP_long_4	(2) HVS3	WFC3/UVIS, ACCUM, UVIS1	F850LP	FLASH=14	POS TARG 0.667,0.080		350 Secs (350 Secs) *[==>]*	 ***[1]***
6	F850LP_long_5	(2) HVS3	WFC3/UVIS, ACCUM, UVIS1	F850LP	FLASH=14	POS TARG 0.08,0.667		350 Secs (350 Secs) *[==>]*	 ***[1]***
7	F814W_short_2	(2) HVS3	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=16	POS TARG 0.333,0.507		35 Secs (35 Secs) *[==>]*	 ***[1]***
8	F814W_short_3	(2) HVS3	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=16	POS TARG 0.08,0.54		35 Secs (35 Secs) *[==>]*	 ***[2]***
9	F850LP_long_6	(2) HVS3	WFC3/UVIS, ACCUM, UVIS1	F850LP	FLASH=14	POS TARG 0.507,0.333		350 Secs (350 Secs) *[==>]*	 ***[2]***
10	F850LP_long_7	(2) HVS3	WFC3/UVIS, ACCUM, UVIS1	F850LP	FLASH=14	POS TARG 0.333,0.507		350 Secs (350 Secs) *[==>]*	 ***[2]***
11	F850LP_long_8	(2) HVS3	WFC3/UVIS, ACCUM, UVIS1	F850LP	FLASH=14	POS TARG -0.08,0.253		350 Secs (350 Secs) *[==>]*	 ***[2]***
12	F850LP_long_9	(2) HVS3	WFC3/UVIS, ACCUM, UVIS1	F850LP	FLASH=14	POS TARG 0.253,-0.08		350 Secs (350 Secs) *[==>]*	 ***[2]***
13	F850LP_long_10	(2) HVS3	WFC3/UVIS, ACCUM, UVIS1	F850LP	FLASH=14	POS TARG 0.46,0.46		350 Secs (350 Secs) *[==>]*	 ***[2]***
14	F814W_short_4	(2) HVS3	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=16	POS TARG 0.38,0.08		35 Secs (35 Secs) *[==>]*	 ***[2]***

Orbit Structure

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GS Reacq
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Exp. 8
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Exp. 9
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Overhead
Exp. 11
Pointing Maneuver
Overhead
Exp. 12
Overhead
Pointing Maneuver
Exp. 13
Overhead
Pointing Maneuver
Exp. 14
Occultation
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5000
5500
6000 sec