17137 - Rise of the Titans: Stellar Properties of a Binary Hyper-Luminous Starburst Within the First Billion Years

Cycle: 30, Proposal Category: GO

(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) HELMS54	ACS/WFC	2	15-Nov-2023 17:00:19.0	yes
02	(1) HELMS54	WFC3/IR	2	15-Nov-2023 17:00:20.0	yes
52	(1) HELMS54	WFC3/IR	2	15-Nov-2023 17:00:21.0	yes
03	(1) HELMS54	WFC3/IR	2	15-Nov-2023 17:00:22.0	yes

8 Total Orbits Used

ABSTRACT

We propose HST/WFC3-IR and ACS observations in 4 bands to characterize the nature and the environment of HeLMS-54, the most distant binary hyper-luminous starburst known, at a redshift of 5.9. This rare, gas-rich (Mgas>2x10^11Msun), dusty starburst (SFR~2900Msun/yr) system was recently discovered with ALMA, NOEMA, and Herschel. It consists of two merging galaxies ~1-2kpc in diameter with dynamical masses of >10^11Msun each, separated by only 19kpc, resolved in dust emission by ALMA at 0.15" (1kpc) resolution. We here request imaging of the rest-frame ultraviolet light at matching resolution to measure the unobscured star formation rate, stellar mass and star formation history of this system through a complete SED analysis, as well as the morphology and sizes of the stellar disks and the UV extinction profile. We will also use the multi-band data to search for dropout galaxies in its environment on Mpc scales using the Lyman-break technique, which will put constraints on its formation history and the dark matter halo mass scale. This investigation could reveal the presence of a massive proto-cluster of galaxies within the first billion years of the Big Bang. Finally, the HST imaging will unambiguously address the possibility of a weak gravitational magnification of this system. Given its extreme cosmic rarity, this is key to properly place the existence and evolution of HeLMS-54 into context with cosmological simulations and models of starburst galaxies at different epochs. This study will be an important pathfinder for detailed investigations of the most exceptional star-forming environments in the early universe with JWST.

OBSERVING DESCRIPTION

Program uses 6 orbits, 4 with WFC3/IR in the F098M, F125W, and F160W filters, and 2 with ACS/WFC and the F606W filter.

It is broken up into three visits, one consisting of the two ACS orbits, and the others consisting of the two WFC3 IR orbits each. There is no restriction on the orientation angle.
We would prefer to schedule all 4 WFC3-IR orbits together to have similar orientation angles, but we do not make it a requirement given the recommendations for this cycle.

All observations are of the same target field (HeLMS-54). 4-point position/readout dither patterns are employed, primarily to improve the PSF through subpixel sampling, i.e., to mitigate the effects of the large detector pixel sizes (especially for WFC3/IR), as well as to offset by a sufficiently large amount to move persistent pixels to different locations on the sky in each exposure, and to provide good cosmic ray rejection. For ACS/WFC, this is also important to cover the 50 pixel gap in y direction between the two detector chips.

The ACS/WFC dither pattern consists of 2 positions with offset large enough to cover the inter-chip gap, and 2 subpositions each to dither on subpixel scales.

The WFC3/IR dither patterns consist of 2 postions large enough to cover the "death star" feature, and 2 subpositions each to dither on subpixel scales. For the single F098M/F125W orbits, 4 positions are targeted. For the two F160W orbits, each orbit contains two subpixel dither positions, and the larger re- positioning is done between orbits.

Visit

Proposal 17137, ACS (01), completed Wed Nov 15 22:00:22 GMT 2023

Diagnostic Status: Warning

Scientific Instruments: ACS/WFC

Special Requirements: (none)

Diagnostics

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

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

Patterns

#	Primary Pattern		Secondary Pattern		Exposures
(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=3.034 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.29 Angle Between Sides= Center Pattern=false	Pattern Type=LINE Purpose=BACKGROUND Number Of Points=2 Point Spacing=0.149 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=34.25 Angle Between Sides= Center Pattern=false	(1)

Fixed Targets

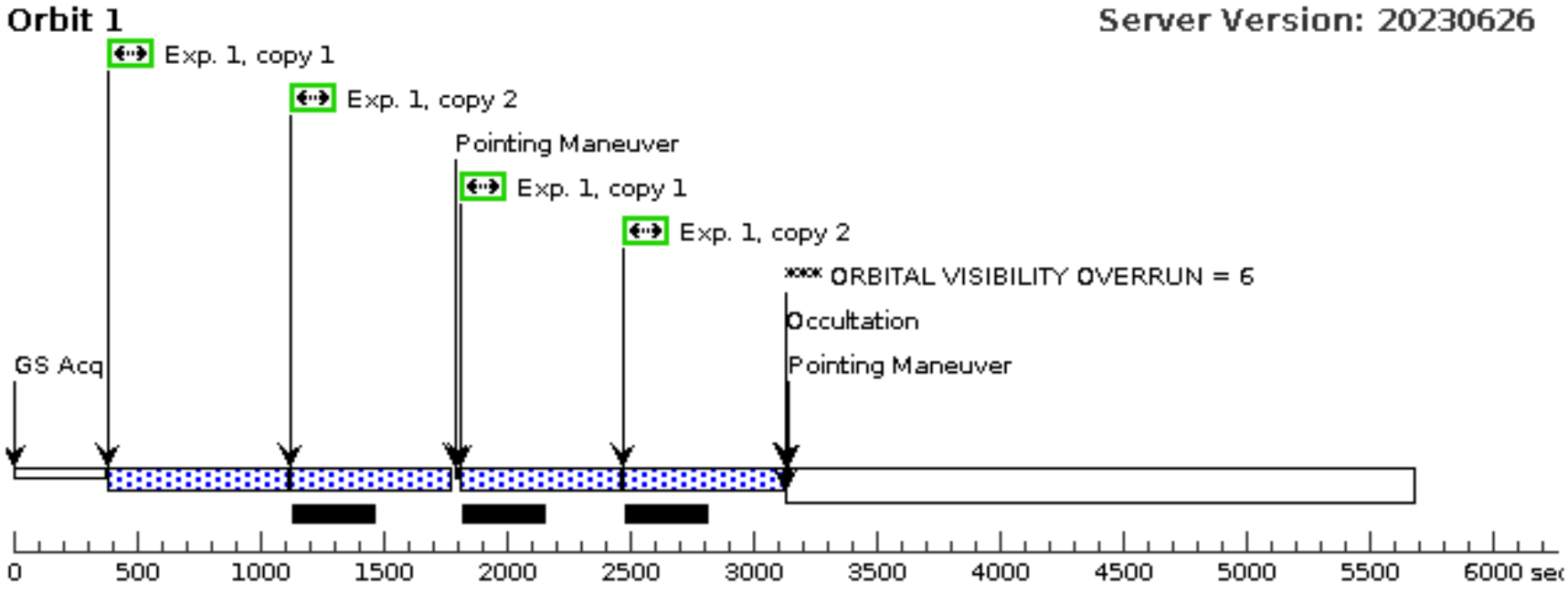
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HELMS54	RA: 00 45 32.7700 (11.3865417d) Dec: -00 01 24.32 (-.02342d) Equinox: J2000		V=27.0	Reference Frame: ICRS

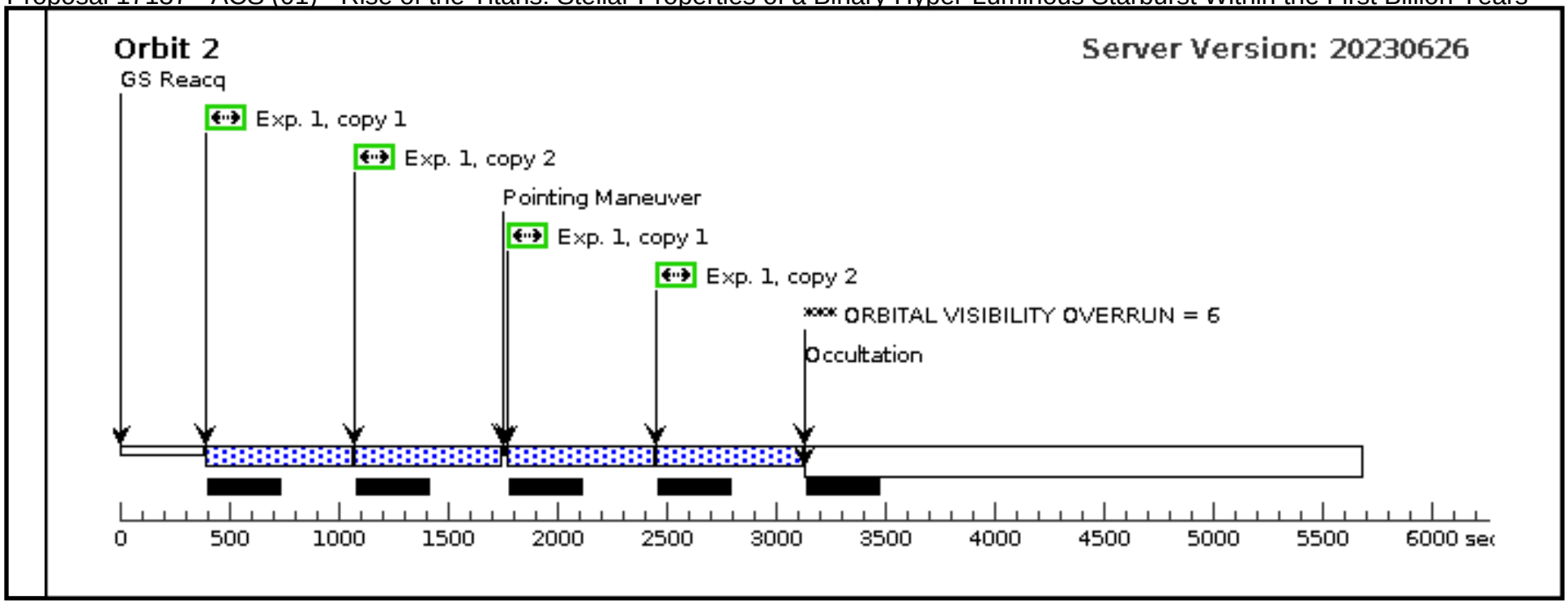
Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY, INTERACTING GALAXY, STARBURST]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	exp1	(1) HELMS54	ACS/WFC, ACCUM, WFC	F606W	CR-SPLIT=NO		Pattern 1, Exps 1-1 in ACS (01) (1)	586 Secs X 2 (4283 Secs)	
								[==>526.0 Secs (Pattern 1,1, Copy 1)] *[==>526.0 Secs (Pattern 1,1, Copy 2)]* *[==>526.0 Secs (Pattern 1,2, Copy 1)]* *[==>527.0 Secs (Pattern 1,2, Copy 2)]*	***[1]***
								[==>544.0 Secs (Pattern 2,1, Copy 1)] *[==>544.0 Secs (Pattern 2,1, Copy 2)]* *[==>545.0 Secs (Pattern 2,2, Copy 1)]* *[==>545.0 Secs (Pattern 2,2, Copy 2)]*	***[2]***

Orbit Structure




Orbit 2
Server Version: 20230626
GS Reacq
Exp. 1, copy 1
Exp. 1, copy 2
Pointing Maneuver
Exp. 1, copy 1
Exp. 1, copy 2
*** ORBITAL VISIBILITY OVERRUN = 6
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Visit

Proposal 17137, WFC3-IR-1 (02), failed Wed Nov 15 22:00:23 GMT 2023

Diagnostic Status: Warning

Scientific Instruments: WFC3/IR

Special Requirements: (none)

Diagnostics

(WFC3-IR-1 (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Fixed Targets

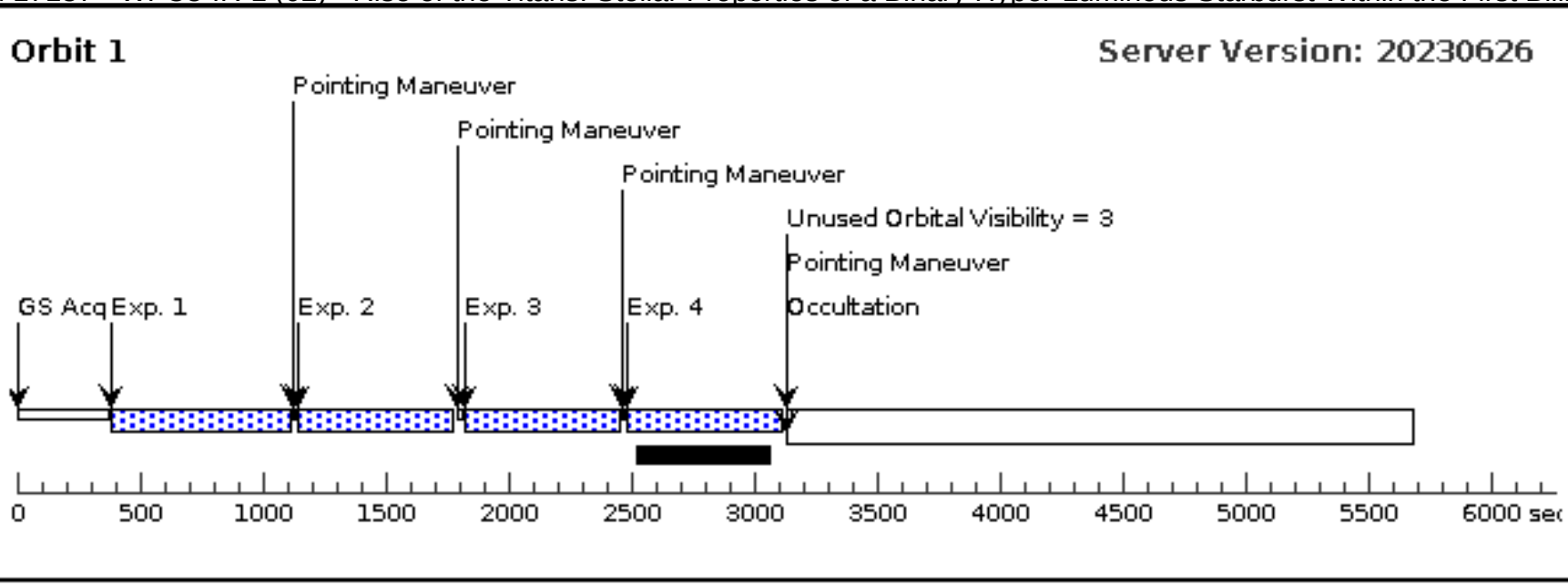
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HELMS54	RA: 00 45 32.7700 (11.3865417d) Dec: -00 01 24.32 (-.02342d) Equinox: J2000		V=27.0	Reference Frame: ICRS

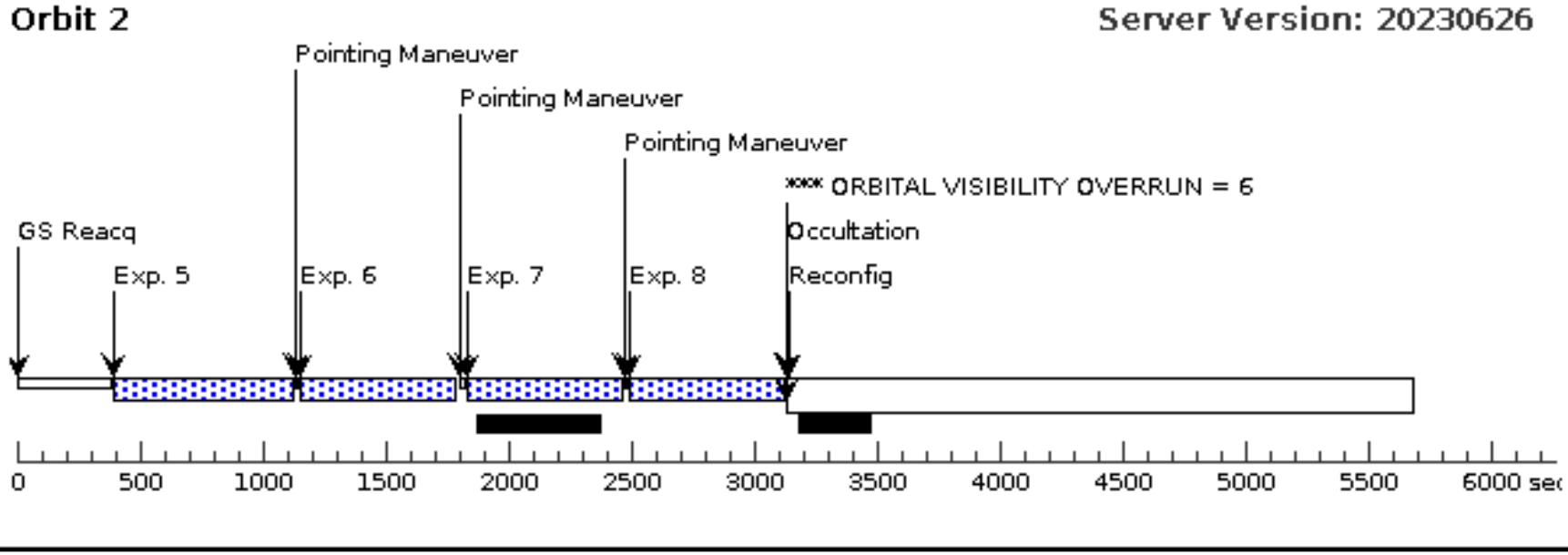
Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY, INTERACTING GALAXY, STARBURST]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	dither1	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F098M	NSAMP=8; SAMP-SEQ=SPARS100	POS TARG -3.3875, -3.0275		702.934552 Secs (702.935 Secs) *[==>]*	*[1]*
2	dither2	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F098M	NSAMP=7; SAMP-SEQ=SPARS100	POS TARG -3.8615, -3.4515		602.934229 Secs (602.934 Secs) *[==>]*	*[1]*
3	dither3	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F098M	NSAMP=7; SAMP-SEQ=SPARS100	POS TARG 3.3875,3.0275		602.934229 Secs (602.934 Secs) *[==>]*	*[1]*
4	dither4	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F098M	NSAMP=7; SAMP-SEQ=SPARS100	POS TARG 3.8615,3.4515		602.934229 Secs (602.934 Secs) *[==>]*	*[1]*
5	dither1-2	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F125W	NSAMP=8; SAMP-SEQ=SPARS100	POS TARG -3.3875, -3.0275		702.934552 Secs (702.935 Secs) *[==>]*	*[2]*
6	dither2-2	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F125W	NSAMP=7; SAMP-SEQ=SPARS100	POS TARG -3.8615, -3.4515		602.934229 Secs (602.934 Secs) *[==>]*	*[2]*
7	dither3-2	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F125W	NSAMP=7; SAMP-SEQ=SPARS100	POS TARG 3.3875,3.0275		602.934229 Secs (602.934 Secs) *[==>]*	*[2]*
8	dither4-2	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F125W	NSAMP=7; SAMP-SEQ=SPARS100	POS TARG 3.8615,3.4515		602.934229 Secs (602.934 Secs) *[==>]*	*[2]*

Orbit Structure





Visit

Proposal 17137, WFC3-IR-1-REPEAT (52) Wed Nov 15 22:00:23 GMT 2023

Diagnostic Status: Warning

Scientific Instruments: WFC3/IR

Special Requirements: (none)

Comments: Repeat of failed visit 02.

Diagnostics

(WFC3-IR-1-REPEAT (52)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Fixed Targets

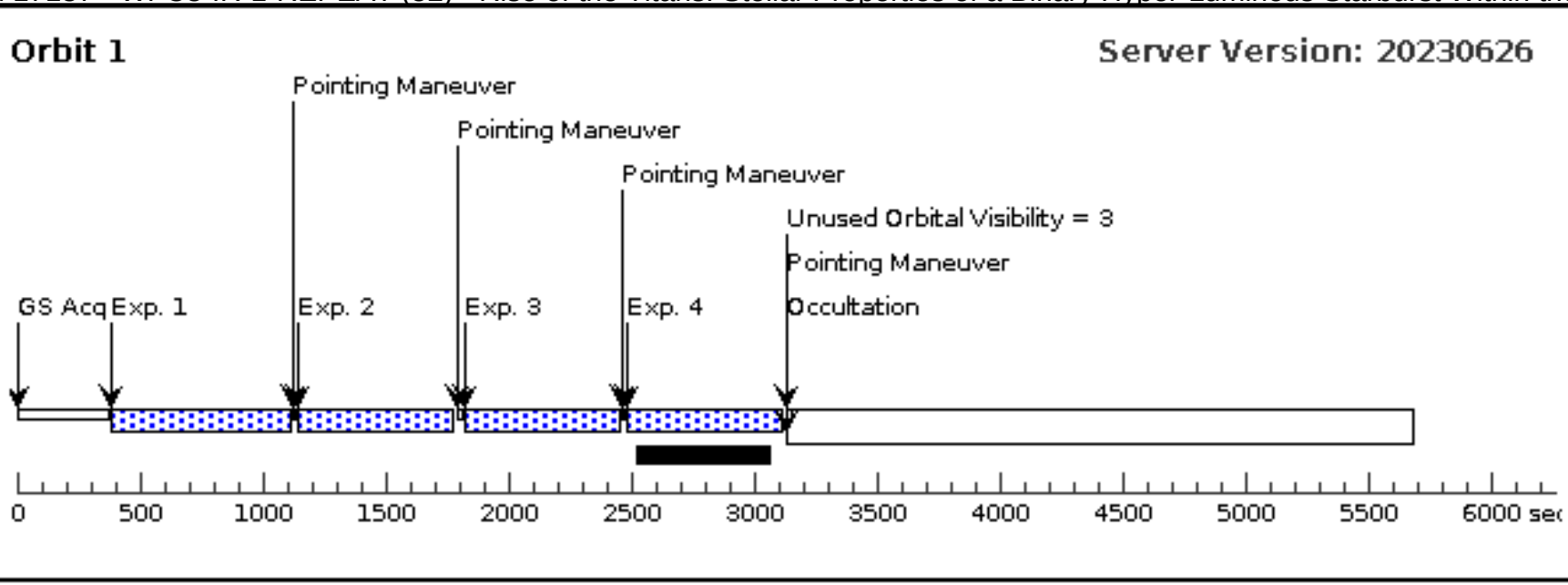
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HELMS54	RA: 00 45 32.7700 (11.3865417d) Dec: -00 01 24.32 (-.02342d) Equinox: J2000		V=27.0	Reference Frame: ICRS

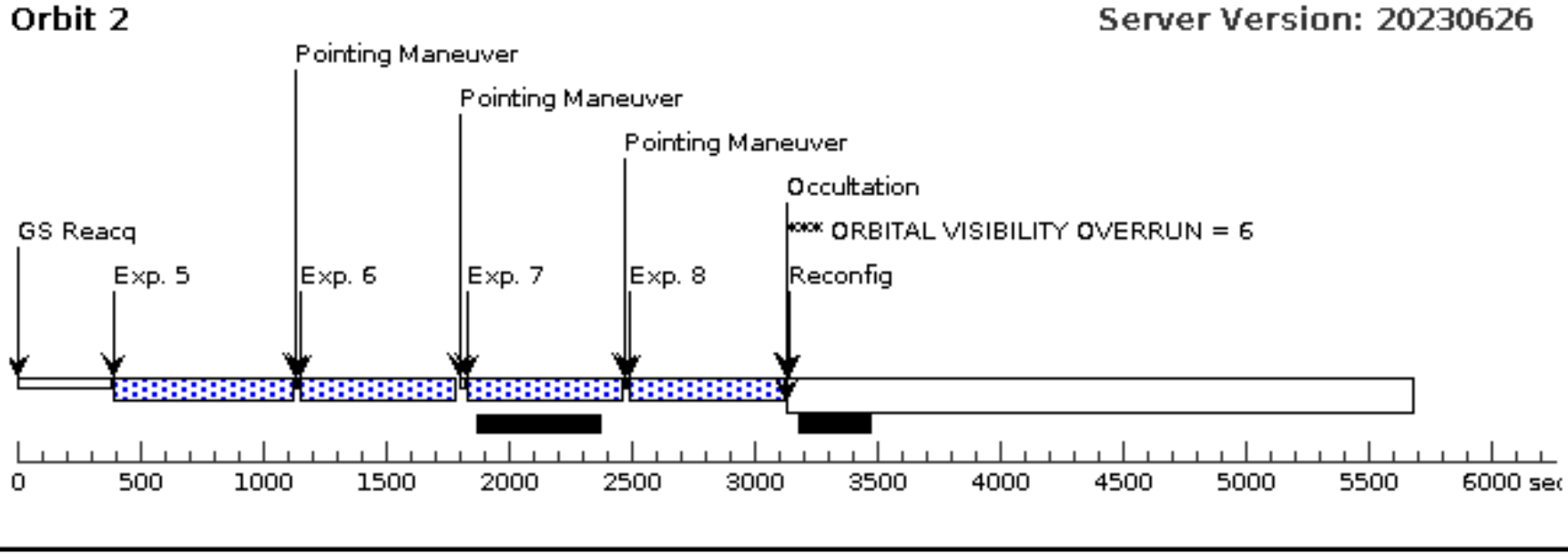
Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY, INTERACTING GALAXY, STARBURST]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	dither1	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F098M	NSAMP=8; SAMP-SEQ=SPARS100	POS TARG -3.3875, -3.0275		702.934552 Secs (702.935 Secs) *[==>]*	***[1]***
2	dither2	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F098M	NSAMP=7; SAMP-SEQ=SPARS100	POS TARG -3.8615, -3.4515		602.934229 Secs (602.934 Secs) *[==>]*	***[1]***
3	dither3	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F098M	NSAMP=7; SAMP-SEQ=SPARS100	POS TARG 3.3875,3.0275		602.934229 Secs (602.934 Secs) *[==>]*	***[1]***
4	dither4	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F098M	NSAMP=7; SAMP-SEQ=SPARS100	POS TARG 3.8615,3.4515		602.934229 Secs (602.934 Secs) *[==>]*	***[1]***
5	dither1-2	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F125W	NSAMP=8; SAMP-SEQ=SPARS100	POS TARG -3.3875, -3.0275		702.934552 Secs (702.935 Secs) *[==>]*	***[2]***
6	dither2-2	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F125W	NSAMP=7; SAMP-SEQ=SPARS100	POS TARG -3.8615, -3.4515		602.934229 Secs (602.934 Secs) *[==>]*	***[2]***
7	dither3-2	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F125W	NSAMP=7; SAMP-SEQ=SPARS100	POS TARG 3.3875,3.0275		602.934229 Secs (602.934 Secs) *[==>]*	***[2]***
8	dither4-2	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F125W	NSAMP=7; SAMP-SEQ=SPARS100	POS TARG 3.8615,3.4515		602.934229 Secs (602.934 Secs) *[==>]*	***[2]***

Orbit Structure





Visit

Proposal 17137, WFC3-IR-2 (03), completed Wed Nov 15 22:00:23 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HELMS54	RA: 00 45 32.7700 (11.3865417d) Dec: -00 01 24.32 (-.02342d) Equinox: J2000		V=27.0	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY, INTERACTING GALAXY, STARBURST]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	dither1	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F160W	NSAMP=14; SAMP-SEQ=SPARS100	POS TARG -3.3875, -3.0275		1302.93649 Secs (1302.936 Secs) *[==>]*	*[1]*
2	dither2	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F160W	NSAMP=14; SAMP-SEQ=SPARS100	POS TARG -3.8615, -3.4515		1302.93649 Secs (1302.936 Secs) *[==>]*	*[1]*
3	dither3	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F160W	NSAMP=14; SAMP-SEQ=SPARS100	POS TARG 3.3875,3.0275		1302.93649 Secs (1302.936 Secs) *[==>]*	*[2]*
4	dither4	(1) HELMS54	WFC3/IR, MULTIACCUM, IR-FIX	F160W	NSAMP=14; SAMP-SEQ=SPARS100	POS TARG 3.8615,3.4515		1302.93649 Secs (1302.936 Secs) *[==>]*	*[2]*

Orbit Structure