18125 - Brown dwarfs or white dwarfs with debris disks? Exploring the faintest stars of 47 Tucanae with HST and JWST

Cycle: 33, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
Prof. Antonino Paolo Milone (PI) (ESA Member) (Contact)	**Universita degli Studi di Padova**
Dr. Emanuele Dondoglio (CoI) (ESA Member)	INAF - Istituto Nazionale di Astrofisica
Dr. Anna Fabiola Marino (CoI) (ESA Member)	INAF - Osservatorio Astronomico di Padova
Dr. Maria Vittoria Legnardi (CoI) (ESA Member)	Universita degli Studi di Padova
Fabrizio Muratore (CoI) (ESA Member)	Universita degli Studi di Padova
Dr. Emanuele Bortolan (CoI) (ESA Member)	Universita degli Studi di Padova
Dr. Marco Tailo (CoI) (ESA Member)	Universita di Bologna
Sofia Lionetto (CoI) (ESA Member)	Universita degli Studi di Padova
Dr. Giacomo Cordoni (CoI)	Australian National University
Prof. E. P. Lagioia (CoI)	Yunnan University
Tuila Ziliotto (CoI) (ESA Member)	Universita degli Studi di Padova
Dr. Alessandra Mastrobuono Battisti (CoI) (ESA Member)	Universita degli Studi di Padova

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(2) NGC-104	WFC3/UVIS	1	02-Dec-2025 14:01:17.0	yes
02	(2) NGC-104	WFC3/UVIS	1	02-Dec-2025 14:01:17.0	yes
03	(2) NGC-104	WFC3/UVIS	1	02-Dec-2025 14:01:18.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
04	(2) NGC-104	WFC3/UVIS	1	02-Dec-2025 14:01:18.0	yes
05	(2) NGC-104	WFC3/UVIS	1	02-Dec-2025 14:01:18.0	yes
06	(2) NGC-104	WFC3/UVIS	1	02-Dec-2025 14:01:18.0	yes
07	(2) NGC-104	WFC3/UVIS	1	02-Dec-2025 14:01:18.0	yes
08	(2) NGC-104	WFC3/UVIS	1	02-Dec-2025 14:01:19.0	yes
09	(2) NGC-104	WFC3/UVIS	1	02-Dec-2025 14:01:19.0	yes
10	(2) NGC-104	WFC3/UVIS	1	02-Dec-2025 14:01:19.0	yes
11	(2) NGC-104	WFC3/UVIS	1	02-Dec-2025 14:01:19.0	yes
12	(2) NGC-104	WFC3/UVIS	1	02-Dec-2025 14:01:19.0	yes
13	(2) NGC-104	WFC3/UVIS	1	02-Dec-2025 14:01:19.0	yes

13 Total Orbits Used

ABSTRACT

Recent JWST photometry has identified a sequence of ultracool stars in 47 Tucanae, potentially representing a population of brown dwarfs. If this hypothesis holds, the abundance of brown dwarfs would significantly exceed predictions based on a standard mass function.

However, JWST's infrared capability alone is insufficient to distinguish between brown dwarfs and potential white dwarfs with debris disks. To investigate this faint stellar population further, we propose deep UVIS/WFC3 observations in the F606W filter, which is the only dataset that, combined with archival NIRCam data, allows us to examine whether stars in this color-magnitude diagram (CMD) region, traditionally linked to brown dwarfs, may also include white dwarfs with debris disks.

By analyzing the distribution of stars in CMDs generated with the new F606W observations alongside archival JWST data in the F115W and F322W2 bands, we aim to test two scenarios: (1) if these stars are exclusively brown dwarfs, they will remain undetected in F606W due to their low luminosity in this band; (2) if a subset comprises white dwarfs with debris disks, these stars will follow the white dwarf cooling sequence, as debris disk flux primarily enhances F322W2 but has minimal impact on F606W and F115W. This study seeks to refine our understanding of low-mass object distributions in globular clusters and may provide new insights into planetary system remnants around white dwarfs.

OBSERVING DESCRIPTION

We propose deep HST/UVIS observations in the F606W filter to study faint stellar populations specifically white dwarfs and M-dwarfs, in the Galactic globular cluster 47 Tucanae (NGC 104).

The observations are dithered and distributed across 13 single-orbit visits to maximize scheduling flexibility within HST's constraints.

The field is centered at RA = 00h 20m 58.8s, Dec = -72 -06 -30.6, in the outer regions of 47 Tucanae, and overlaps with JWST/NIRCam data collected as part of Program 2560.

Visit

Proposal 18125, Visit 01, implementation Tue Dec 02 19:01:20 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=LINE	Coordinate Frame=POS-TARG		(1)
	Purpose=DITHER	Pattern Orientation=100		
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	Point Spacing=6	Center Pattern=false		
	Line Spacing=			

Fixed Targets

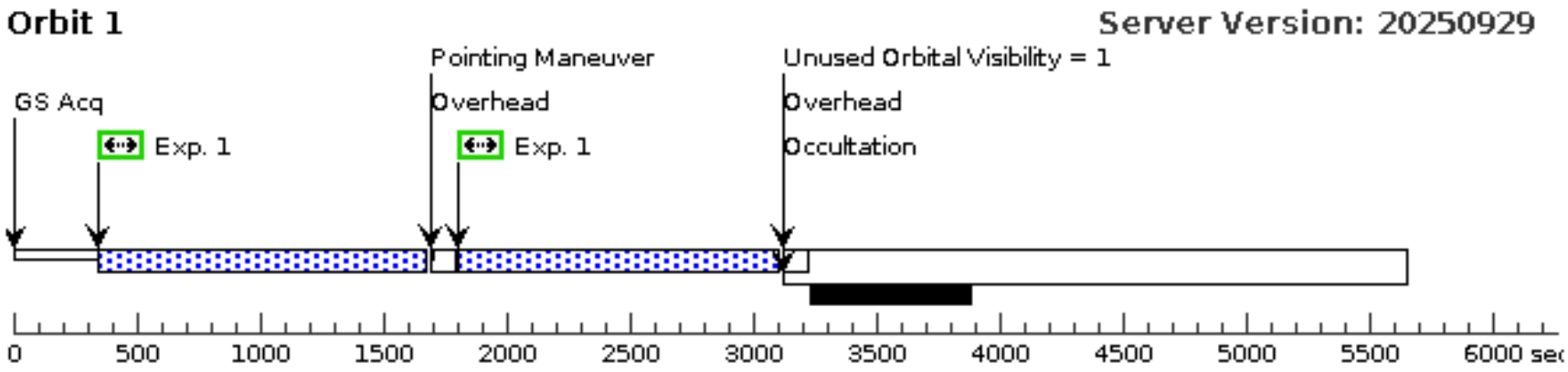
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-104	RA: 00 20 58.3800 (5.2432500d)	Parallax: 2.32E-4"	V=4.09	Reference Frame: ICRS
		Dec: -72 06 30.60 (-72.10850d)	Epoch of Position: 2000		
		Equinox: J2000			

Comments:
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		(2) NGC-104	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W			Pattern 1, Exps 1-1 in Visit 01 (1)	1302.0 Secs (2604 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[1]***

Orbit Structure



Visit

Proposal 18125, Visit 02, implementation Tue Dec 02 19:01:20 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

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	Purpose=DITHER	Pattern Orientation=100		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=6	Center Pattern=false		
	Line Spacing=			

Fixed Targets

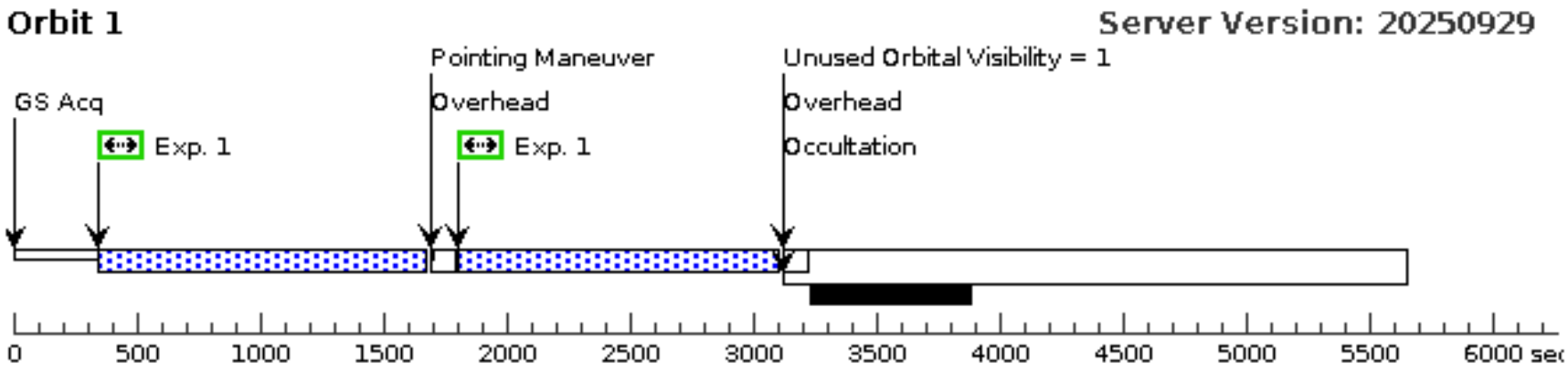
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-104	RA: 00 20 58.3800 (5.2432500d)	Parallax: 2.32E-4"	V=4.09	Reference Frame: ICRS
		Dec: -72 06 30.60 (-72.10850d)	Epoch of Position: 2000		
		Equinox: J2000			

Comments:
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		(2) NGC-104	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W		POS TARG -3,0	Pattern 1, Exps 1-1 in Visit 02 (1)	1302 Secs (2604 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 18125, Visit 03, implementation Tue Dec 02 19:01:20 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

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	Purpose=DITHER	Pattern Orientation=100		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=6	Center Pattern=false		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-104	RA: 00 20 58.3800 (5.2432500d)	Parallax: 2.32E-4"	V=4.09	Reference Frame: ICRS
		Dec: -72 06 30.60 (-72.10850d)	Epoch of Position: 2000		
		Equinox: J2000			

Comments:
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
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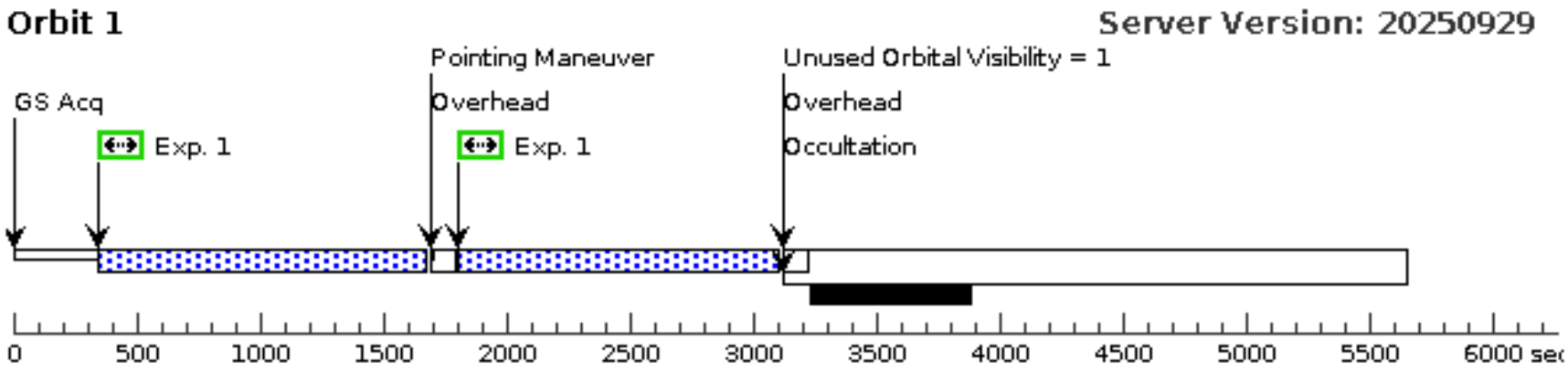
Orbit Structure



Visit

Proposal 18125, Visit 04, implementation Tue Dec 02 19:01:20 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

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	Purpose=DITHER	Pattern Orientation=100		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=6	Center Pattern=false		
	Line Spacing=			

Fixed Targets

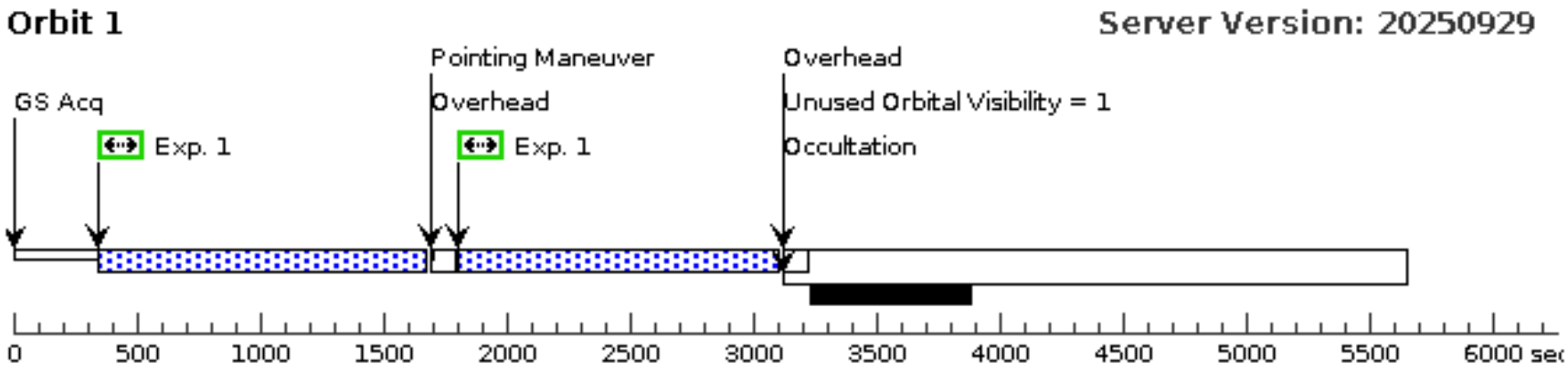
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-104	RA: 00 20 58.3800 (5.2432500d)	Parallax: 2.32E-4"	V=4.09	Reference Frame: ICRS
		Dec: -72 06 30.60 (-72.10850d)	Epoch of Position: 2000		
		Equinox: J2000			

Comments:
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		(2) NGC-104	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W		POS TARG 0,-3	Pattern 1, Exps 1-1 in Visit 04 (1)	1302 Secs (2604 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[1]***

Orbit Structure



Visit

Proposal 18125, Visit 05, implementation Tue Dec 02 19:01:20 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

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	Number Of Points=2	Angle Between Sides=		
	Point Spacing=6	Center Pattern=false		
	Line Spacing=			

Fixed Targets

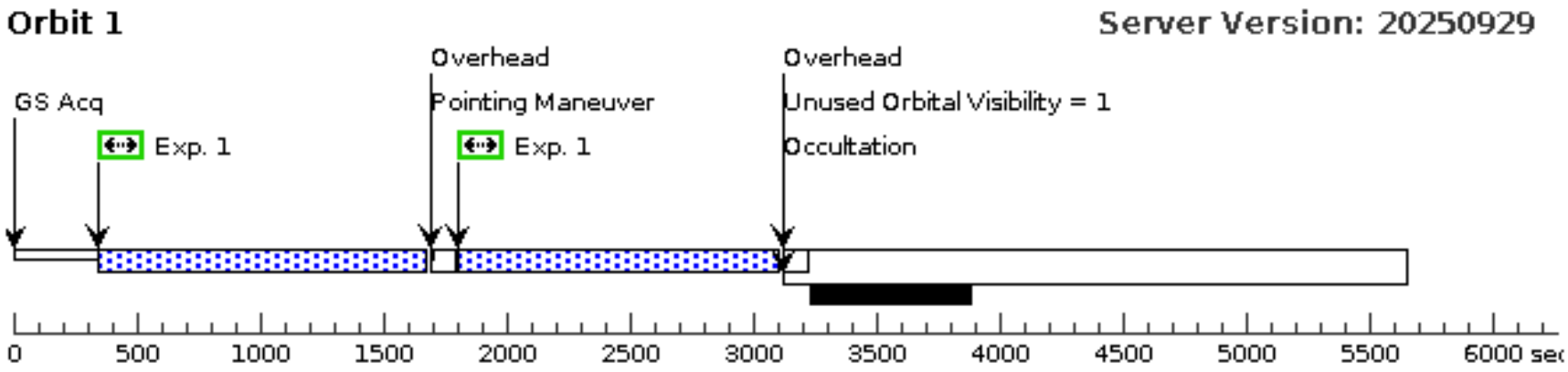
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-104	RA: 00 20 58.3800 (5.2432500d)	Parallax: 2.32E-4"	V=4.09	Reference Frame: ICRS
		Dec: -72 06 30.60 (-72.10850d)	Epoch of Position: 2000		
		Equinox: J2000			

Comments:
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		(2) NGC-104	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W		POS TARG 0,3	Pattern 1, Exps 1-1 in Visit 05 (1)	1302 Secs (2604 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 18125, Visit 06, implementation Tue Dec 02 19:01:20 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
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	Purpose=DITHER	Pattern Orientation=100		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=6	Center Pattern=false		
	Line Spacing=			

Fixed Targets

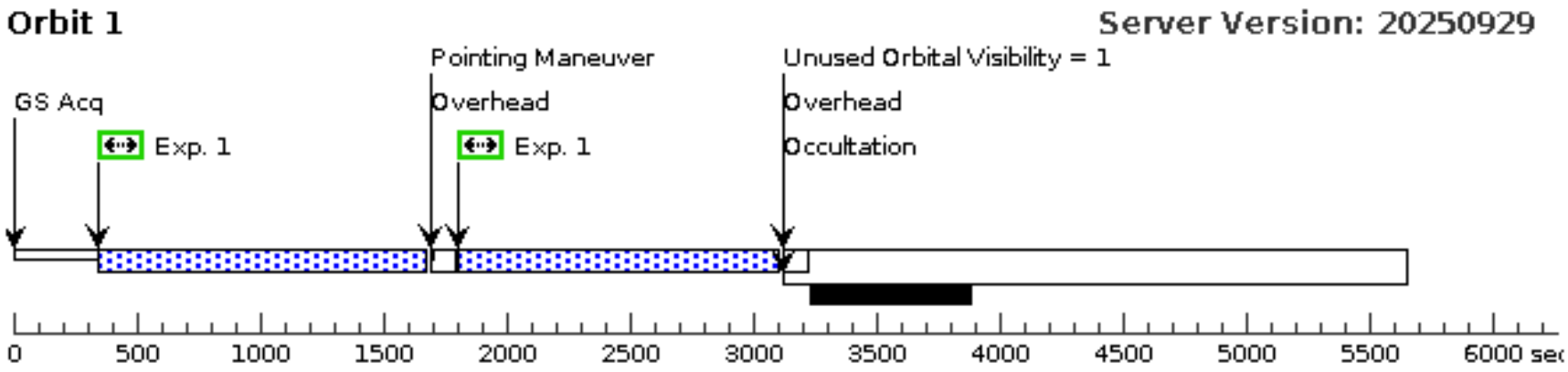
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-104	RA: 00 20 58.3800 (5.2432500d)	Parallax: 2.32E-4"	V=4.09	Reference Frame: ICRS
		Dec: -72 06 30.60 (-72.10850d)	Epoch of Position: 2000		
		Equinox: J2000			

Comments:
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		(2) NGC-104	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W		POS TARG 3,3	Pattern 1, Exps 1-1 in Visit 06 (1)	1302 Secs (2604 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 18125, Visit 07, implementation Tue Dec 02 19:01:20 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
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	Purpose=DITHER	Pattern Orientation=100		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=6	Center Pattern=false		
	Line Spacing=			

Fixed Targets

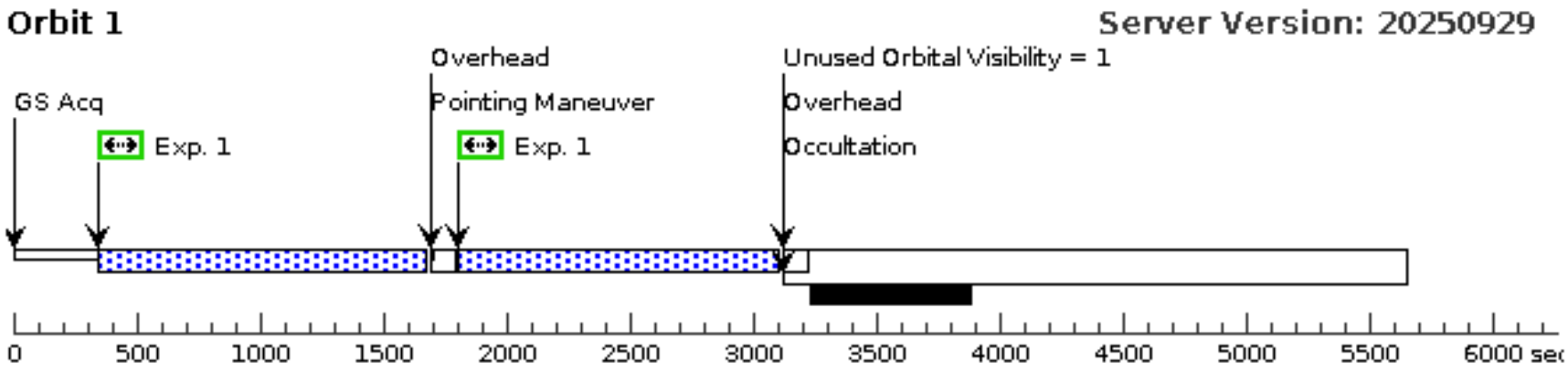
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-104	RA: 00 20 58.3800 (5.2432500d)	Parallax: 2.32E-4"	V=4.09	Reference Frame: ICRS
		Dec: -72 06 30.60 (-72.10850d)	Epoch of Position: 2000		
		Equinox: J2000			

Comments:
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		(2) NGC-104	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W		POS TARG -3,-3	Pattern 1, Exps 1-1 in Visit 07 (1)	1302 Secs (2604 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 18125, Visit 08, implementation Tue Dec 02 19:01:20 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
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	Number Of Points=2	Angle Between Sides=		
	Point Spacing=6	Center Pattern=false		
	Line Spacing=			

Fixed Targets

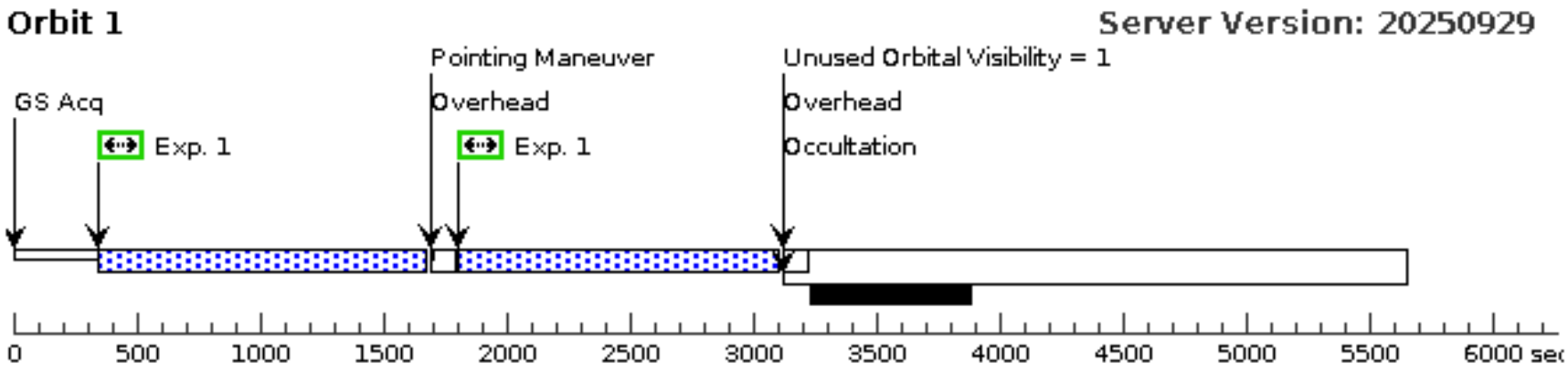
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-104	RA: 00 20 58.3800 (5.2432500d)	Parallax: 2.32E-4"	V=4.09	Reference Frame: ICRS
		Dec: -72 06 30.60 (-72.10850d)	Epoch of Position: 2000		
		Equinox: J2000			

Comments:
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		(2) NGC-104	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W		POS TARG -6,0	Pattern 1, Exps 1-1 in Visit 08 (1)	1302 Secs (2604 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 18125, Visit 09, implementation Tue Dec 02 19:01:20 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
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	Purpose=DITHER	Pattern Orientation=100		
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	Line Spacing=			

Fixed Targets

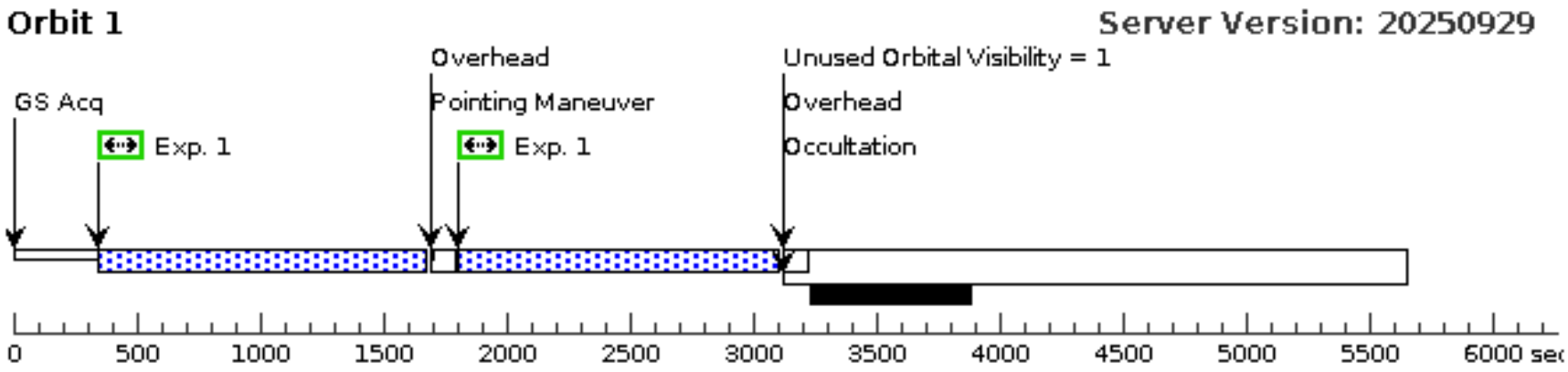
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-104	RA: 00 20 58.3800 (5.2432500d)	Parallax: 2.32E-4"	V=4.09	Reference Frame: ICRS
		Dec: -72 06 30.60 (-72.10850d)	Epoch of Position: 2000		
		Equinox: J2000			

Comments:
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		(2) NGC-104	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W		POS TARG 0,6	Pattern 1, Exps 1-1 in Visit 09 (1)	1302 Secs (2604 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 18125, Visit 10, implementation Tue Dec 02 19:01:20 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
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Fixed Targets

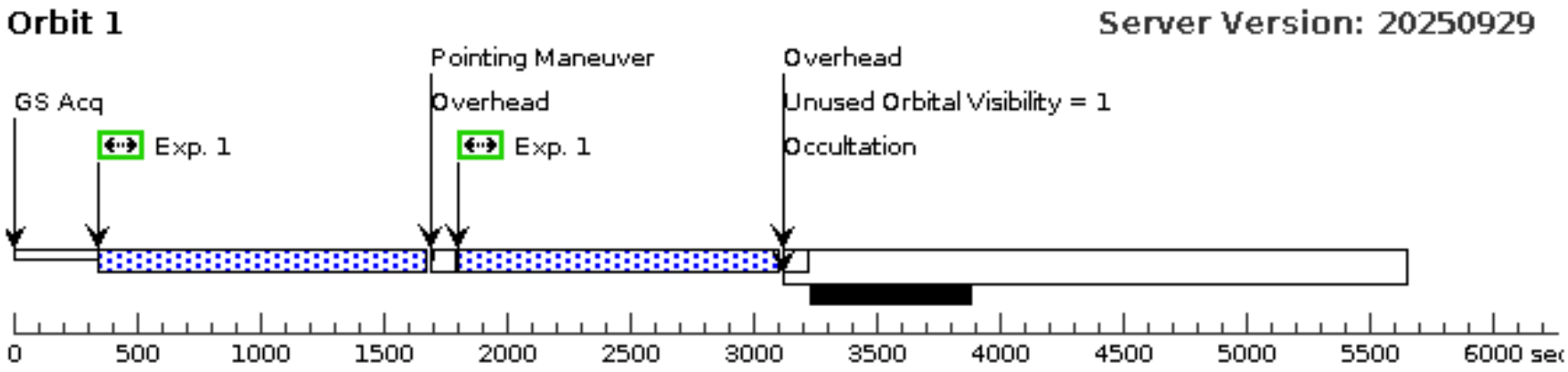
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-104	RA: 00 20 58.3800 (5.2432500d)	Parallax: 2.32E-4"	V=4.09	Reference Frame: ICRS
		Dec: -72 06 30.60 (-72.10850d)	Epoch of Position: 2000		
		Equinox: J2000			

Comments:
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		(2) NGC-104	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W		POS TARG 0,-6	Pattern 1, Exps 1-1 in Visit 10 (1)	1302 Secs (2604 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 18125, Visit 11, implementation Tue Dec 02 19:01:20 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=LINE	Coordinate Frame=POS-TARG		(1)
	Purpose=DITHER	Pattern Orientation=100		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=6	Center Pattern=false		
	Line Spacing=			

Fixed Targets

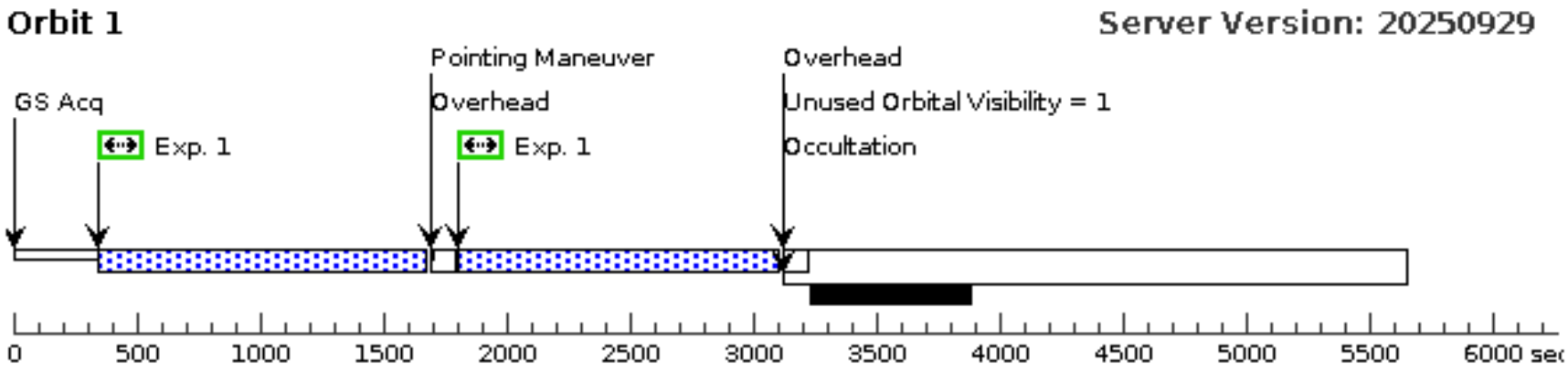
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-104	RA: 00 20 58.3800 (5.2432500d)	Parallax: 2.32E-4"	V=4.09	Reference Frame: ICRS
		Dec: -72 06 30.60 (-72.10850d)	Epoch of Position: 2000		
		Equinox: J2000			

Comments:
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		(2) NGC-104	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W		POS TARG 6,0	Pattern 1, Exps 1-1 in Visit 11 (1)	1302 Secs (2604 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[1]***

Orbit Structure



Visit

Proposal 18125, Visit 12, implementation Tue Dec 02 19:01:20 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
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	Purpose=DITHER	Pattern Orientation=100		
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	Point Spacing=6	Center Pattern=false		
	Line Spacing=			

Fixed Targets

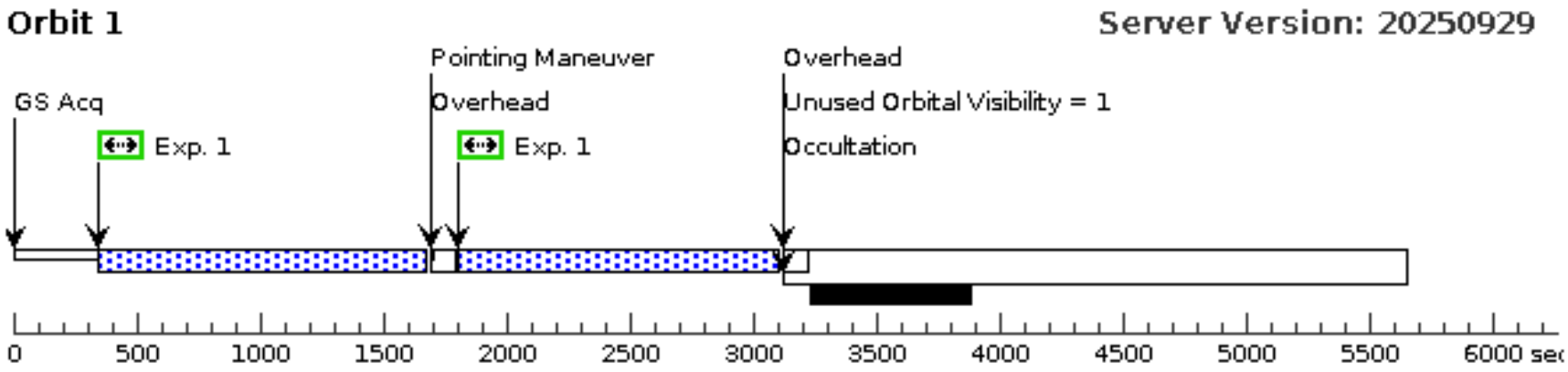
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-104	RA: 00 20 58.3800 (5.2432500d)	Parallax: 2.32E-4"	V=4.09	Reference Frame: ICRS
		Dec: -72 06 30.60 (-72.10850d)	Epoch of Position: 2000		
		Equinox: J2000			

Comments:
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		(2) NGC-104	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W		POS TARG 6,6	Pattern 1, Exps 1-1 in Visit 12 (1)	1302 Secs (2604 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 18125, Visit 13, implementation Tue Dec 02 19:01:20 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=LINE	Coordinate Frame=POS-TARG		(1)
	Purpose=DITHER	Pattern Orientation=100		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=6	Center Pattern=false		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-104	RA: 00 20 58.3800 (5.2432500d)	Parallax: 2.32E-4"	V=4.09	Reference Frame: ICRS
		Dec: -72 06 30.60 (-72.10850d)	Epoch of Position: 2000		
		Equinox: J2000			

Comments:
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		(2) NGC-104	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W		POS TARG -6,-6	Pattern 1, Exps 1-1 in Visit 13 (1)	1302 Secs (2604 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[1]***

Orbit Structure