17991 - Probing Magnetar Energy Input with the First Sample of Late-Time Superluminous Supernovae

Cycle: 33, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
Dr. Peter Blanchard (PI) (Contact)	**Harvard University**
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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) SN2021AHPL	WFC3/UVIS	1	23-Mar-2026 09:00:13.0	yes
02	(2) SN2022AAWB	WFC3/UVIS	1	23-Mar-2026 09:00:13.0	yes
03	(3) SN2022LXD	WFC3/UVIS	1	23-Mar-2026 09:00:13.0	yes
04	(4) SN2022NPQ	WFC3/UVIS	1	23-Mar-2026 09:00:13.0	yes
05	(5) SN2022XGC	WFC3/UVIS	1	23-Mar-2026 09:00:14.0	yes
06	(6) SN2023AAFK	WFC3/UVIS	1	23-Mar-2026 09:00:14.0	yes
07	(7) SN2023CMX	WFC3/UVIS	1	23-Mar-2026 09:00:14.0	yes
08	(8) SN2023OUS	WFC3/UVIS	1	23-Mar-2026 09:00:14.0	yes
09	(3) SN2022LXD	WFC3/UVIS	1	23-Mar-2026 09:00:15.0	yes

9 Total Orbits Used

ABSTRACT

Since the discovery of hydrogen-poor superluminous supernovae (SLSNe) over a decade ago, research has focused on identifying the source of their enormous luminosities that can reach up to a hundred times brighter than normal supernovae. Early on, it was realized that the standard radioactive decay model that powers normal supernovae is unable to explain these events. Since then, light curve modeling of large samples, spectral modeling of both early and late-time nebular spectra, and analyses of their dwarf host galaxies have pointed towards a scenario in which the spin-down of a newly-formed magnetar central engine provides energy that is thermalized in the SN ejecta and radiated in the UV/optical. Perhaps the best evidence in favor of this model are the recent HST observations of two events at 400-1100 days after peak that match the power-law decline predicted by magnetar energy input. These observations strongly motivate new observations of a large and diverse sample to measure the distribution of power-law slopes and assess whether the diversity evident in the early light curves of SLSNe correlates with diversity at late times. We therefore propose to observe 8 new SLSNe each at three epochs spread accross Cycles 32, 33, and 34 (plus one template observation of an old event). As the late-time optical light curve is highly sensitive to the thermalization of the magnetar's energy, a key goal is to compare our observations with recent radiative transfer simulations to infer properties of the magnetar wind nebulae, the region where the magnetar's energy is transfered to the ejecta. This will be the most comprehensive test to date of the magnetar model for SLSNe.

OBSERVING DESCRIPTION

In Cycle 32 we will observe 9 superluminous supernovae one time each in a single filter, 8 with WFC3/UVIS and one with ACS/WFC. Each visit will consist of a dithered observation (standard ACS or WFC3 dither pattern) in one filter lasting one orbit. We will observe 8 of these supernovae two additional times, once in Cycle 33 and a final epoch in Cycle 34.

Visit

Proposal 17991, SN2021ahpl Epoch 1 (01), scheduling Mon Mar 23 13:00:15 GMT 2026

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	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)

Fixed Targets

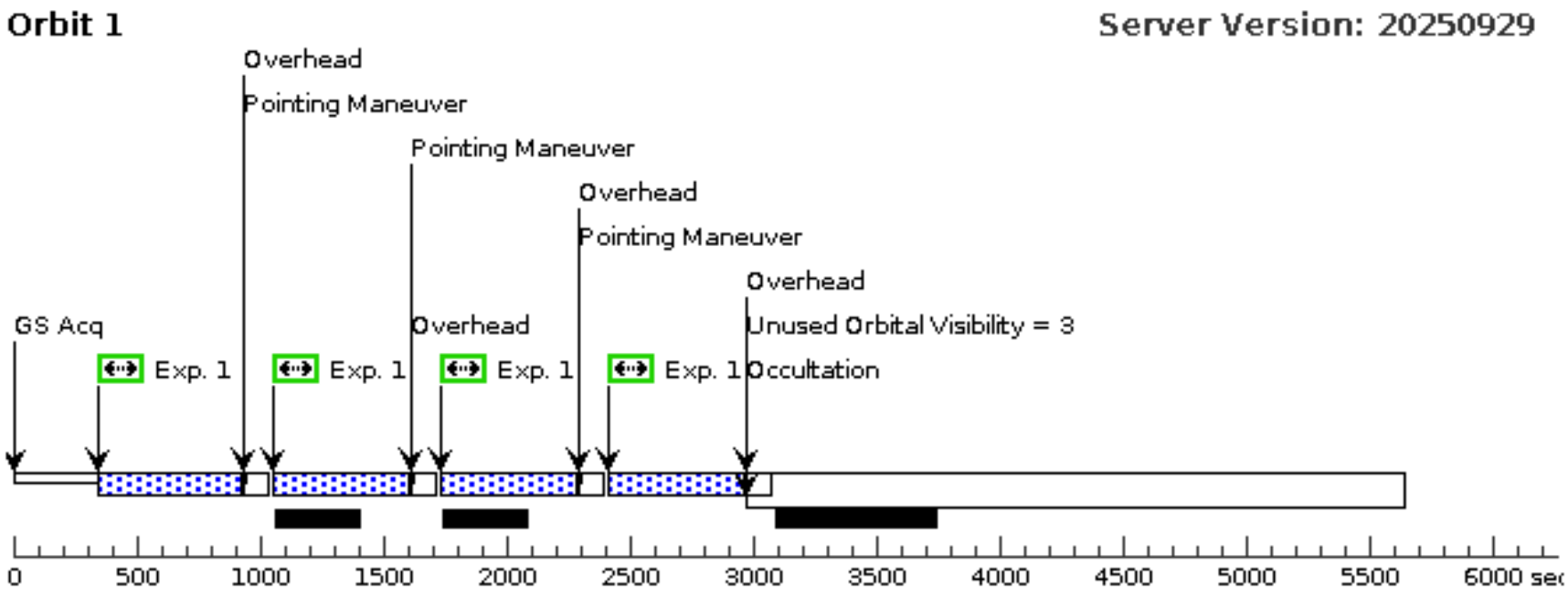
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN2021AHPL	RA: 15 15 57.9400 (228.9914167d) Dec: -19 17 31.96 (-19.29221d) Equinox: J2000		V=26.0	Reference Frame: ICRS

Comments:
Category=EXT-STAR
Description=[SUPERNOVA]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) SN2021AHPL	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F625W	FLASH=2.0		Pattern 2, Exps 1-1 in SN2021ahpl Epoch 1 (01) (2)	548 Secs (2192 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***

Orbit Structure



Visit

Proposal 17991, SN2022aawb Epoch 1 (02), scheduling Mon Mar 23 13:00:15 GMT 2026

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

(Exposure 1 (Pattern 3, Exps 1-1 in SN2022aawb Epoch 1 (02))) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

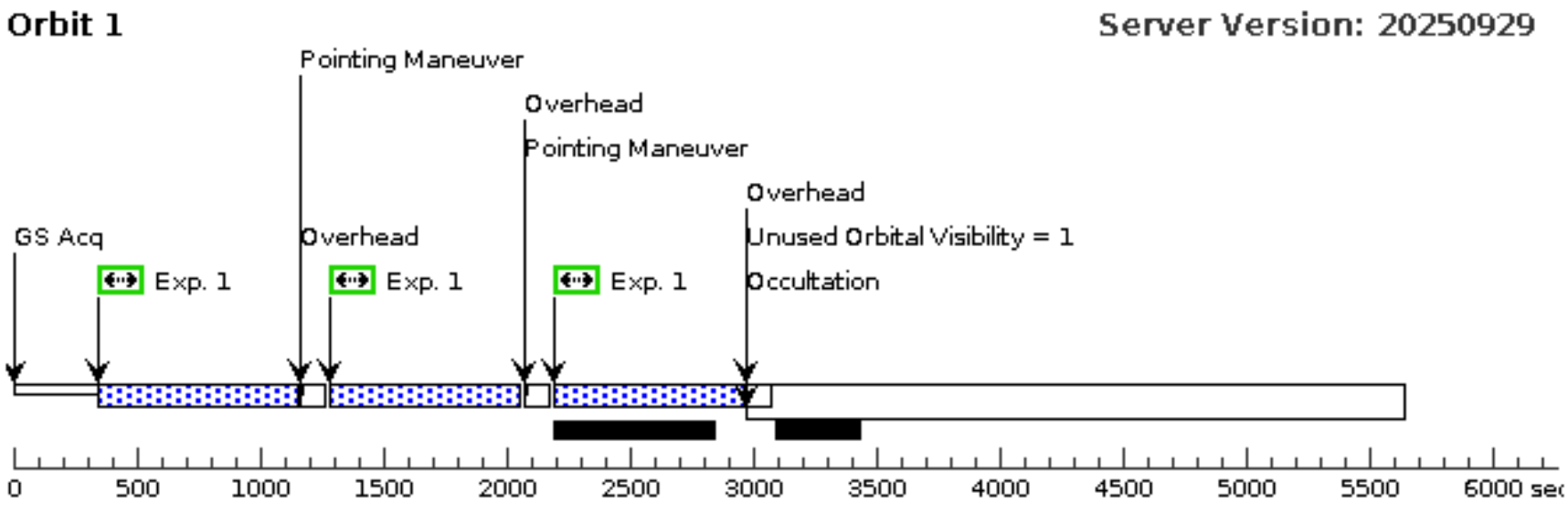
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SN2022AAWB	RA: 01 44 52.3800 (26.2182500d) Dec: +23 00 43.85 (23.01218d) Equinox: J2000		V=26.0	Reference Frame: ICRS

Comments:
Category=EXT-STAR
Description=[SUPERNOVA]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) SN2022AAWB	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F775W	FLASH=2.0		Pattern 3, Exps 1-1 in SN2022aawb Epoch 1 (02) (3)	776 Secs (2328 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***

Orbit Structure



Visit

Proposal 17991, SN2022lxd Epoch 1 (03), failed Mon Mar 23 13:00:15 GMT 2026

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

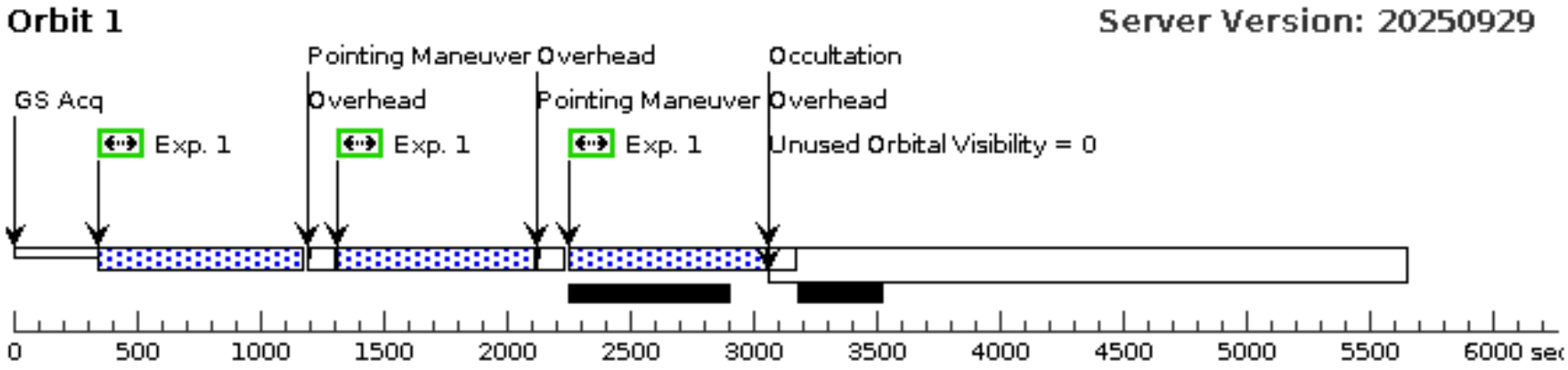
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	SN2022LXD	RA: 17 36 38.6830 (264.1611792d) Dec: +61 33 18.66 (61.55518d) Equinox: J2000		V=26.0	Reference Frame: ICRS

Comments:
Category=EXT-STAR
Description=[SUPERNOVA]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(3) SN2022LXD	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F850LP	FLASH=10.0		Pattern 3, Exps 1-1 in SN2022lxd Epoch 1 (03) (3)	802 Secs (2406 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***

Orbit Structure



Visit

Proposal 17991, SN2022npq Epoch 1 (04), scheduling Mon Mar 23 13:00:15 GMT 2026

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

(Exposure 1 (Pattern 3, Exps 1-1 in SN2022npq Epoch 1 (04))) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

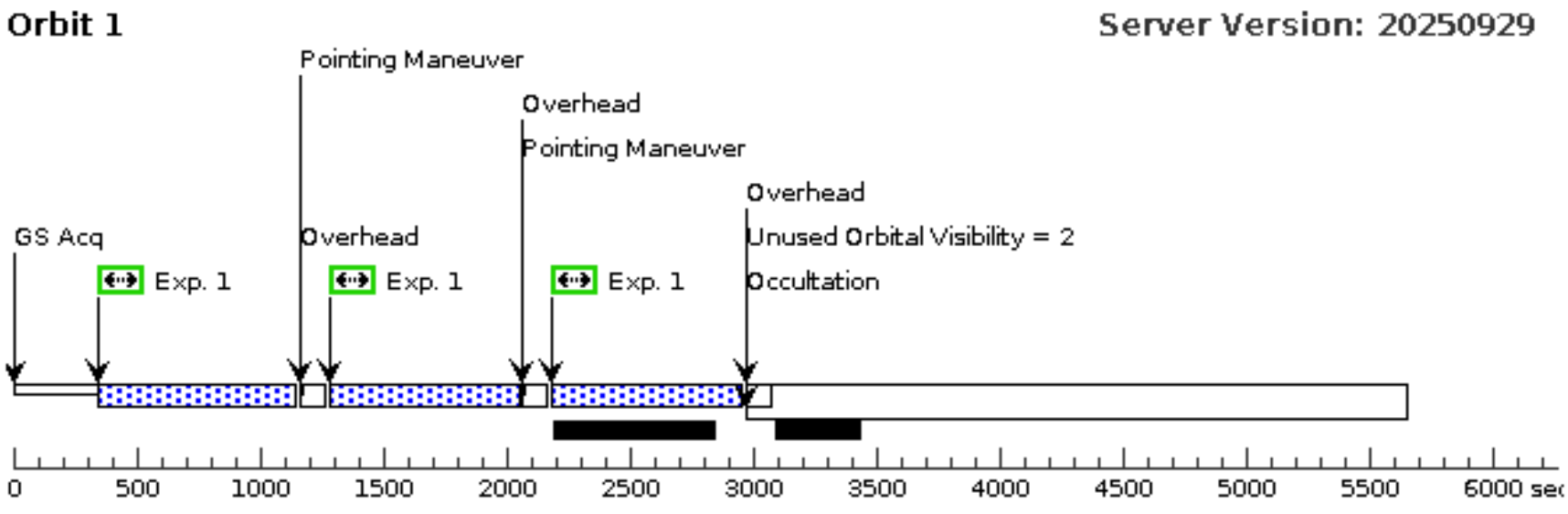
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	SN2022NPQ	RA: 16 21 3.7320 (245.2655500d) Dec: +14 50 54.75 (14.84854d) Equinox: J2000		V=26.0	Reference Frame: ICRS

Comments:
Category=EXT-STAR
Description=[SUPERNOVA]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(4) SN2022NPQ	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F775W	FLASH=2.0		Pattern 3, Exps 1-1 in SN2022npq Epoch 1 (04) (3)	774 Secs (2322 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***

Orbit Structure



Visit

Proposal 17991, SN2022xgc Epoch 1 (05), scheduling Mon Mar 23 13:00:15 GMT 2026

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

(Exposure 1 (Pattern 3, Exps 1-1 in SN2022xgc Epoch 1 (05))) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

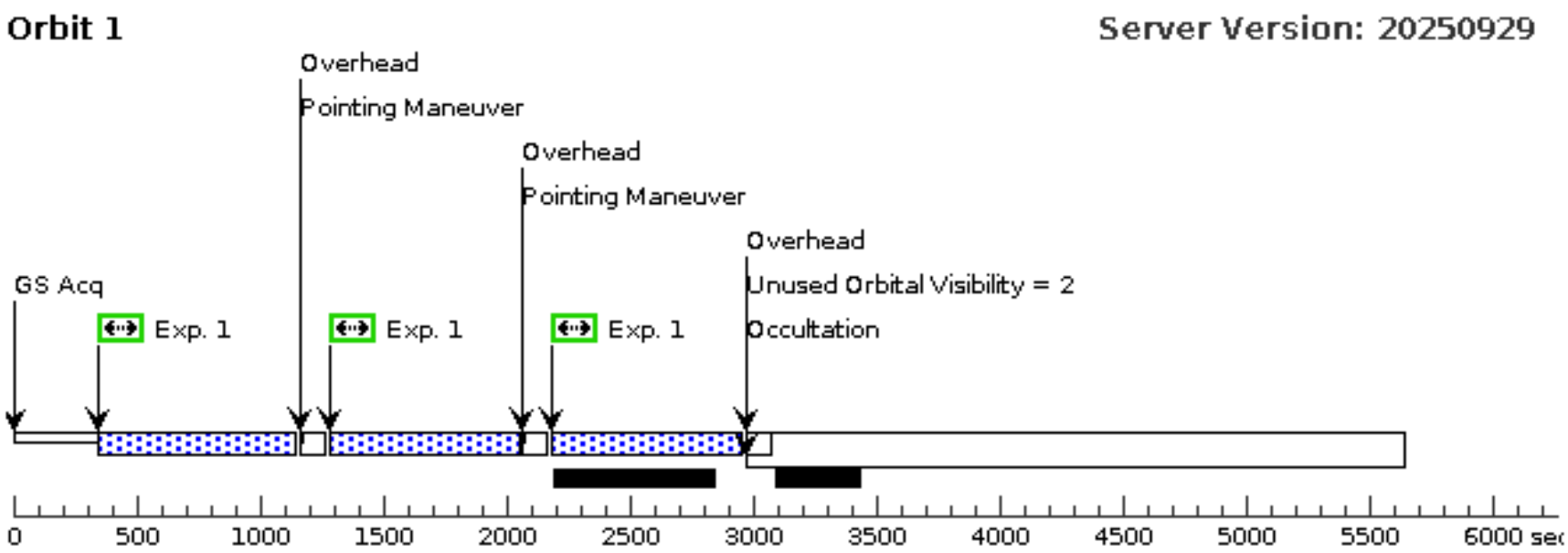
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(5)	SN2022XGC	RA: 07 12 41.8100 (108.1742083d) Dec: +07 18 59.95 (7.31665d) Equinox: J2000		V=26.0	Reference Frame: ICRS

Comments:
Category=EXT-STAR
Description=[SUPERNOVA]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(5) SN2022XGC	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F775W	FLASH=2.0		Pattern 3, Exps 1-1 in SN2022xgc Epoch 1 (05) (3)	775 Secs (2325 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***

Orbit Structure



Visit

Proposal 17991, SN2023aafk Epoch 1 (06), scheduling Mon Mar 23 13:00:15 GMT 2026

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

(Exposure 1 (Pattern 3, Exps 1-1 in SN2023aafk Epoch 1 (06))) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

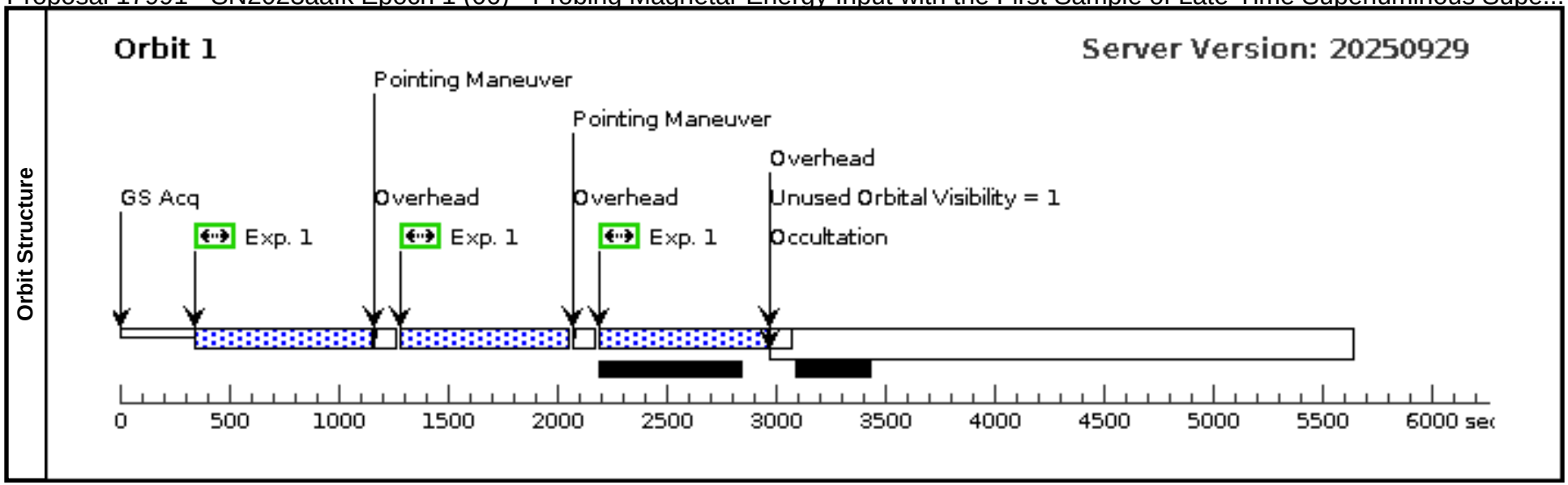
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(6)	SN2023AAFK	RA: 04 30 41.6710 (67.6736292d) Dec: +02 56 42.89 (2.94525d) Equinox: J2000		V=26.0	Reference Frame: ICRS

Comments:
Category=EXT-STAR
Description=[SUPERNOVA]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(6) SN2023AAFK	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F775W	FLASH=2.0		Pattern 3, Exps 1-1 in SN2023aafk Epoch 1 (06) (3)	776 Secs (2328 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20250929
Pointing Maneuver
Pointing Maneuver
Overhead
GS Acq
Overhead
Overhead
Unused Orbital Visibility = 1
Exp. 1
Exp. 1
Exp. 1
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Visit

Proposal 17991, SN2023cmx Epoch 1 (07), scheduling Mon Mar 23 13:00:15 GMT 2026

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

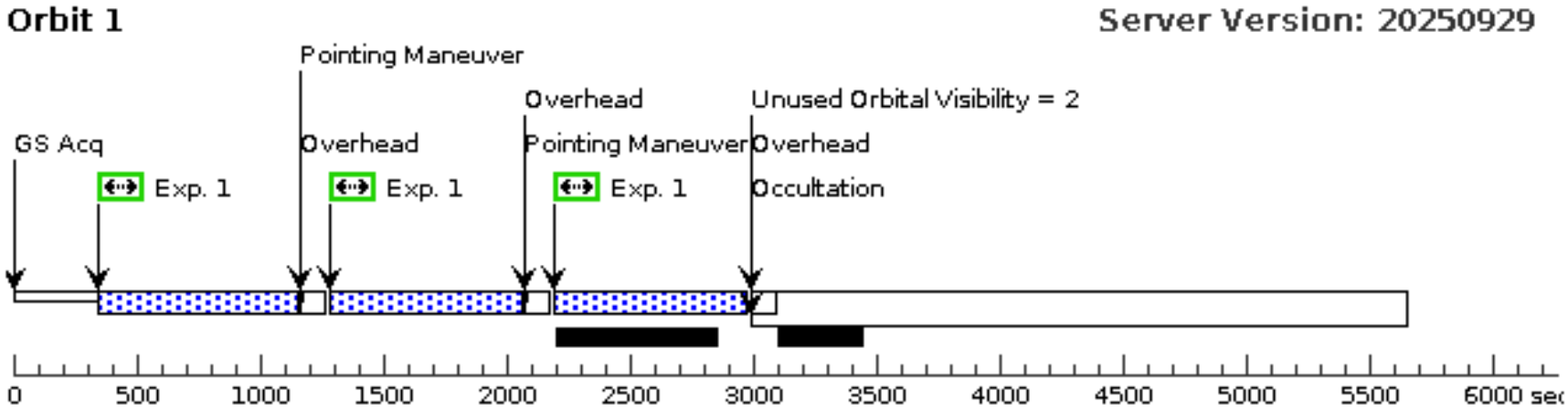
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(7)	SN2023CMX	RA: 07 06 54.6500 (106.7277083d) Dec: +37 58 35.54 (37.97654d) Equinox: J2000		V=26.0	Reference Frame: ICRS

Comments:
Category=EXT-STAR
Description=[SUPERNOVA]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(7) SN2023CMX	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F775W	FLASH=2.0		Pattern 3, Exps 1-1 in SN2023cmx Epoch 1 (07) (3)	780 Secs (2340 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	 ***[1]***

Orbit Structure



Visit

Proposal 17991, SN2023ous Epoch 1 (08), scheduling Mon Mar 23 13:00:15 GMT 2026

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

(Exposure 1 (Pattern 3, Exps 1-1 in SN2023ous Epoch 1 (08))) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

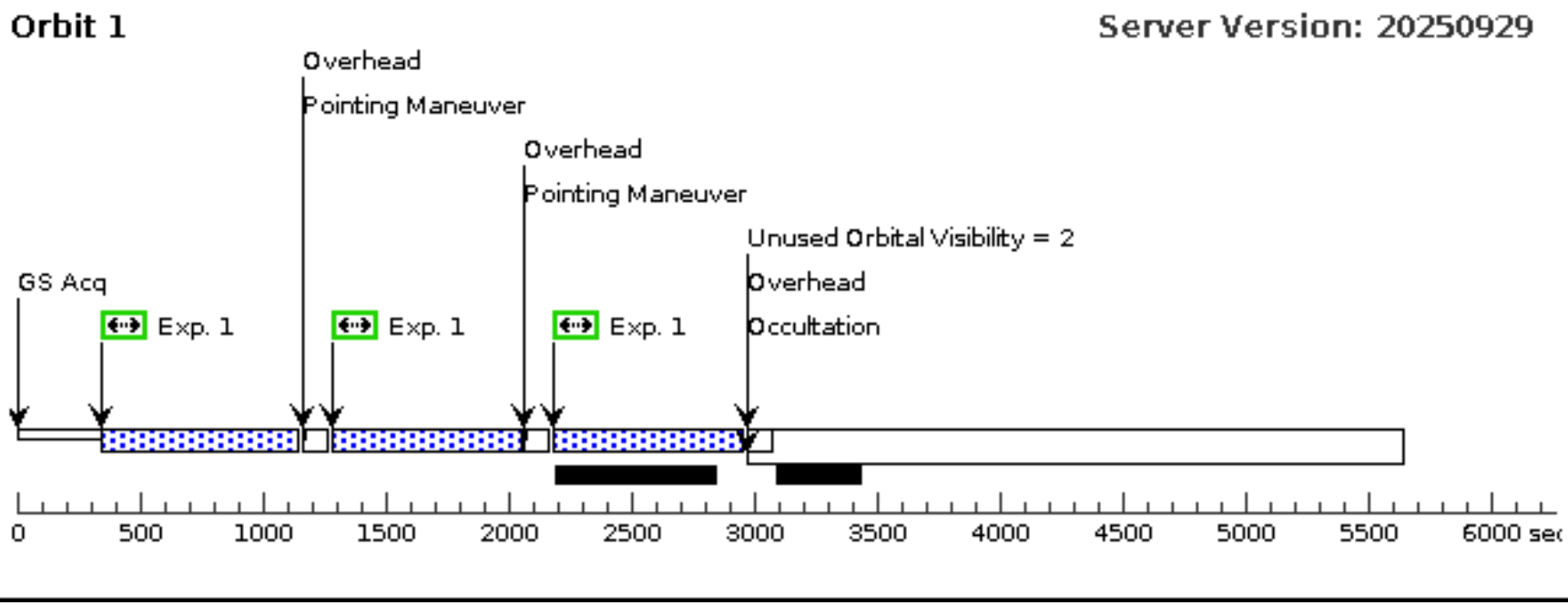
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(8)	SN2023OUS	RA: 04 25 50.1000 (66.4587500d) Dec: -09 09 28.08 (-9.15780d) Equinox: J2000		V=26.0	Reference Frame: ICRS

Comments:
Category=EXT-STAR
Description=[SUPERNOVA]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(8) SN2023OUS	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F775W	FLASH=2.0		Pattern 3, Exps 1-1 in SN2023ous Epoch 1 (08) (3)	775 Secs (2325 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***

Orbit Structure



Visit

Proposal 17991, HOPR repeat of visit 3 (09) Mon Mar 23 13:00:15 GMT 2026

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	SN2022LXD	RA: 17 36 38.6830 (264.1611792d) Dec: +61 33 18.66 (61.55518d) Equinox: J2000		V=26.0	Reference Frame: ICRS

Comments:
Category=EXT-STAR
Description=[SUPERNOVA]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(3) SN2022LXD	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F850LP	FLASH=10.0		Pattern 3, Exps 1-1 in HOPR repeat of visit 3 (09) (3)	802 Secs (2406 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***

Orbit Structure