



17278 - Testing the Limit: Late-time HST Observations of the Most Energetic GRB Ever

Cycle: 30, Proposal Category: GO
(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>
Prof. Ryan Chornock (PI) (Contact)	University of California - Berkeley
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Prof. Edo Berger (CoI)	Harvard University
Dr. Kate Denham Alexander (CoI)	University of Arizona
Dr. Peter Blanchard (CoI)	Northwestern University
Dr. Ashley Villar (CoI)	The Pennsylvania State University
Huei Sears (CoI)	Northwestern University
Natalie LeBaron (CoI)	University of California - Berkeley
Dr. Dan Milisavljevic (CoI)	Purdue University
Mr. Wynn Vicente Jacobson-Galan (CoI)	University of California - Berkeley
Dr. Tanmoy Laskar (CoI)	University of Utah

VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) GRB221009A	WFC3/IR WFC3/UVIS	3	12-Sep-2023 15:00:19.0	yes
02	(1) GRB221009A	WFC3/IR WFC3/UVIS	3	12-Sep-2023 15:00:20.0	yes
03	(1) GRB221009A	WFC3/UVIS	3	12-Sep-2023 15:00:21.0	yes

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
04	(1) GRB221009A	WFC3/IR	2	12-Sep-2023 15:00:22.0	yes
05	(1) GRB221009A	WFC3/IR	1	12-Sep-2023 15:00:22.0	yes

12 Total Orbits Used

ABSTRACT

We propose to capitalize on the unique opportunity of acquiring deep multi-band HST observations of the most energetic GRB ever detected. With a prompt gamma-ray duration of thousands of seconds, and discovered in the very nearby universe ($z=0.151$) GRB 221009A saturated most GRB detectors and was accompanied by one of the brightest radio, optical and X-ray afterglows detected to date. Here we propose late-time HST observations at ~ 200 -350 days after trigger to monitor the evolution of this unprecedented event at optical-NIR wavelengths as part of a multi-wavelength campaign across the spectrum. The immediate goals are to constrain the progenitor system and the intrinsic energetics of this burst. Additionally, the large gamma-ray energy release is suggestive of a massive accretion disk and opens the possibility for the first meaningful investigation of r-process nucleosynthesis in collapsars. HST mid-cycle 30 observations are essential for this remarkable object as it will fade by the time of Cycle 31.

OBSERVING DESCRIPTION

This proposal consists of 11 total orbits spread across 3 epochs. The goal is to measure the SED of the fading GRB afterglow+supernova, so the three epochs need to be adequately spaced.

Visit 1 (3 orbits): 2 orbits with UVIS/F814W and UVIS/F606W, 1 orbit with both IR/F110W and IR/F160W.

Visit 2 (3 orbits): 2 orbits with UVIS/F814W, and one orbit to get both IR/F110W and IR/F160W.

Visit 3 (3 orbits): 3 orbits of UVIS/F814W

Visit 4 (2 orbits): one orbit each of IR/F110W and IR/F160W.

[I have split the third epoch into 2 visits to enhance schedulability, with a restriction that they be taken within 7 days of each other]

There are four visibility windows for this source during Cycle 30. In order to schedule three epochs of observations with adequate spacing, we

Proposal 17278 (STScI Edit Number: 0, Created: Tuesday, September 12, 2023 at 2:00:23 PM Eastern Standard Time) - Overview
request that Visit 1 be scheduled during the first visibility window (31 March 2023 to 15 April 2023). The second visit should be scheduled during either of the next two visibility windows (either 29 May to 8 June or 12 July to 17 July). The third epoch (Visits 3 and 4) should then be scheduled during the final visibility window (after 14 Aug 2023).

Proposal 17278 - Visit 01 - Testing the Limit: Late-time HST Observations of the Most Energetic GRB Ever

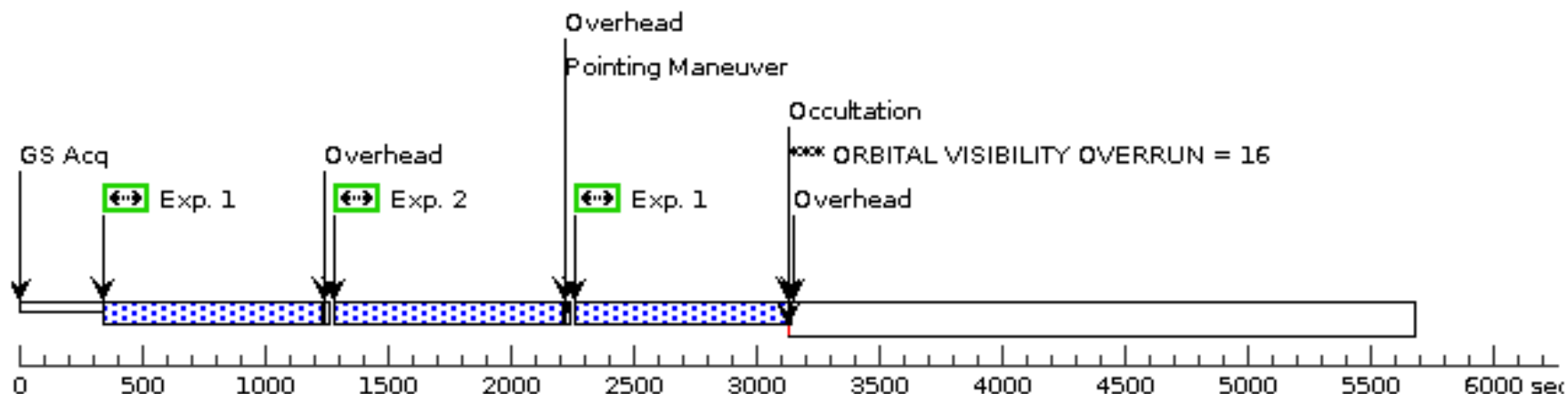
Visit	Proposal 17278, Visit 01, completed Tue Sep 12 19:00:23 GMT 2023				
	Diagnostic Status: Warning Scientific Instruments: WFC3/IR, WFC3/UVIS Special Requirements: BEFORE 30-APR-2023:00:00:00				
Diagnostics	(Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN				
	(Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN				
Patterns	#	Primary Pattern	Secondary Pattern		Exposures
	(1)	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		(1-2)
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes
	(1)	GRB221009A	RA: 19 13 3.5008 (288.2645867d) Dec: +19 46 24.23 (19.77340d) Equinox: J2000		V=24 fading
Comments: Category=EXT-STAR Description=[GAMMA RAY BURSTER]					
Reference Frame: ICRS					

Proposal 17278 - Visit 01 - Testing the Limit: Late-time HST Observations of the Most Energetic GRB Ever

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) GRB221009A	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F814W			Pattern 1, Exps 1-2 in Visit 01 (1)	750 Secs (2548 Secs)	
									[==>856.0 Secs (Pattern 1)]	[1]
									[==>856.0 Secs (Pattern 2)]	
									[==>836.0 Secs (Pattern 3)]	[2]
	2		(1) GRB221009A	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F606W			Pattern 1, Exps 1-2 in Visit 01 (1)	800 Secs (2678 Secs)	
									[==>906.0 Secs (Pattern 1)]	[1]
									[==>886.0 Secs (Pattern 2)]	
									[==>886.0 Secs (Pattern 3)]	[2]
	3		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=9; SAMP-SEQ=SPAR S50	POS TARG 0.000,0.000	Sequence 3-8 Non-Int in Visit 01	402.935899 Secs (402.936 Secs)	
									[==>]	[3]
	4		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=9; SAMP-SEQ=SPAR S50	POS TARG 0.451,0.403	Sequence 3-8 Non-Int in Visit 01	402.935899 Secs (402.936 Secs)	
									[==>]	[3]
	5		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=9; SAMP-SEQ=SPAR S50	POS TARG 0.451,0.403	Sequence 3-8 Non-Int in Visit 01	402.935899 Secs (402.936 Secs)	
									[==>]	[3]
	6		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=9; SAMP-SEQ=SPAR S50	POS TARG 0.000,0.000	Sequence 3-8 Non-Int in Visit 01	402.935899 Secs (402.936 Secs)	
									[==>]	[3]
	7		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=9; SAMP-SEQ=SPAR S50	POS TARG 0.902,0.806	Sequence 3-8 Non-Int in Visit 01	402.935899 Secs (402.936 Secs)	
									[==>]	[3]
	8		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=9; SAMP-SEQ=SPAR S50	POS TARG 0.902,0.806	Sequence 3-8 Non-Int in Visit 01	402.935899 Secs (402.936 Secs)	
									[==>]	[3]

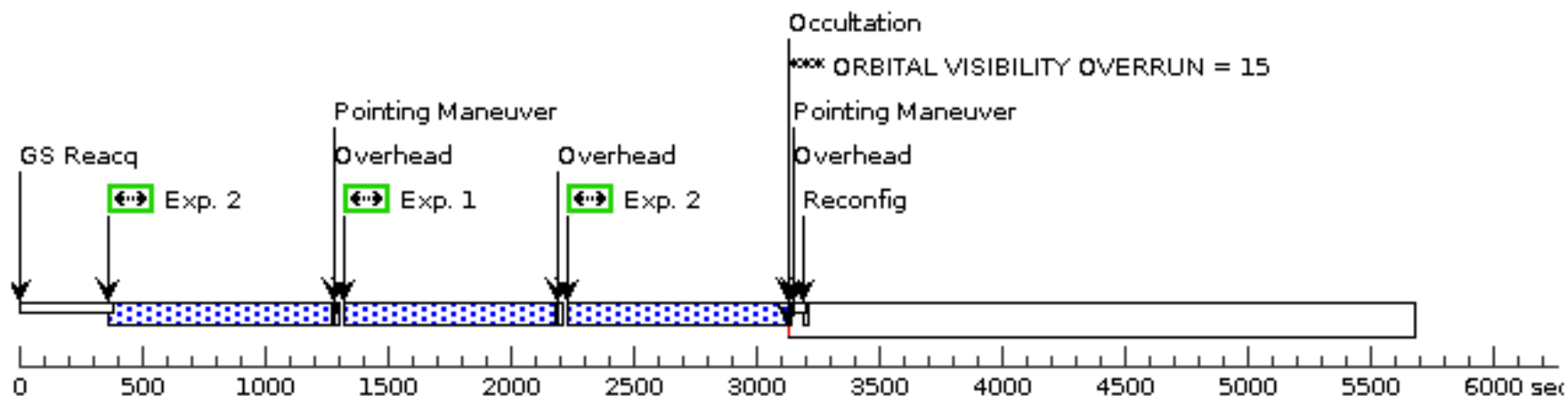
Orbit 1

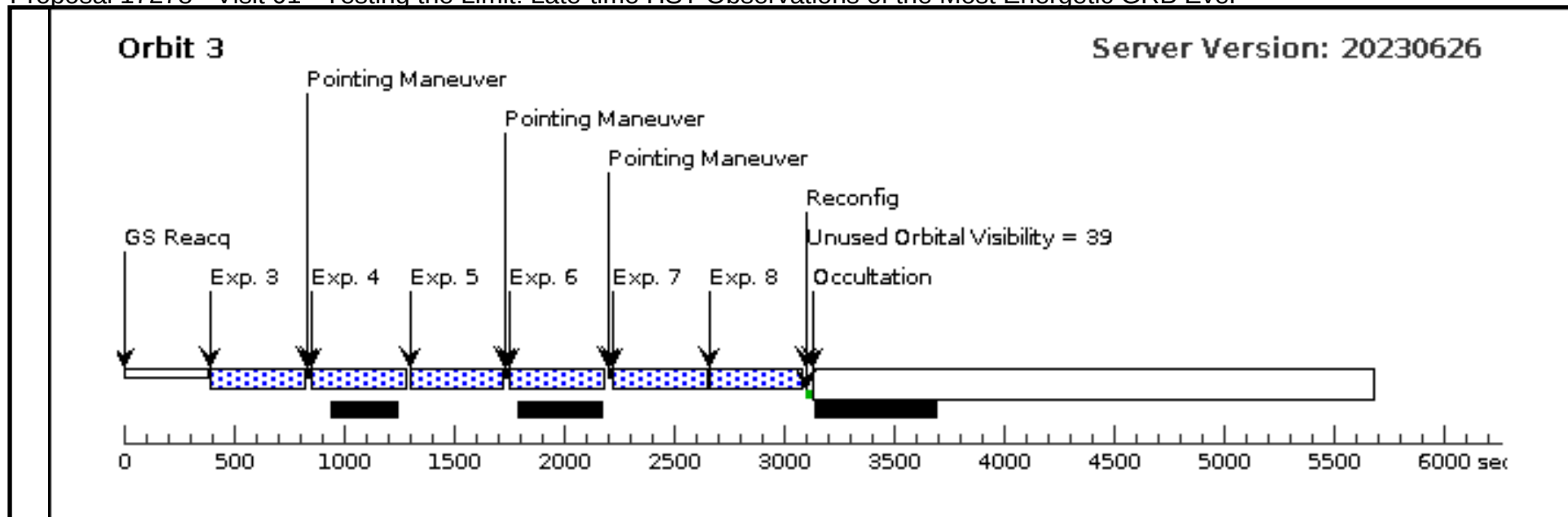
Server Version: 20230626



Orbit 2

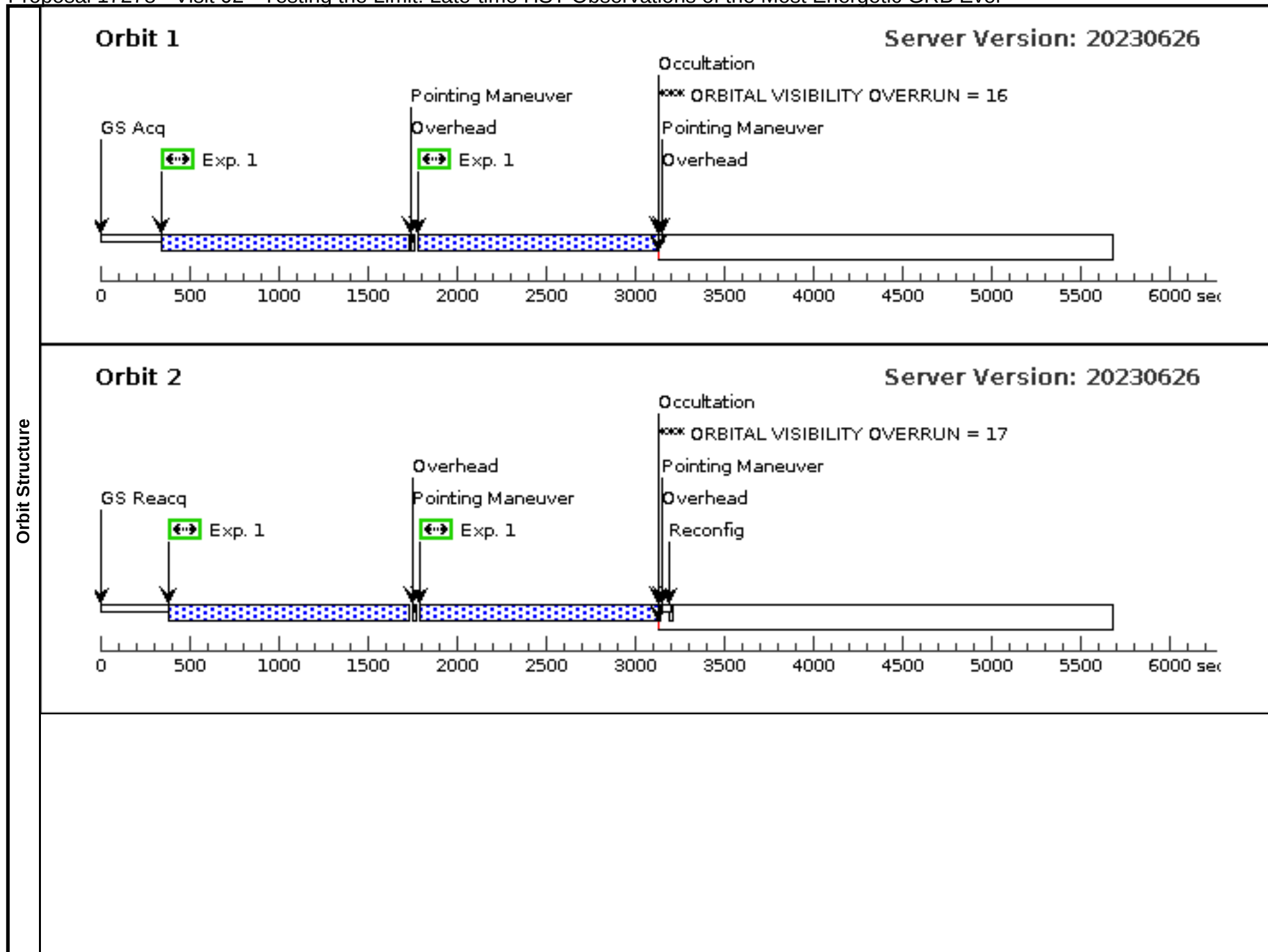
Server Version: 20230626

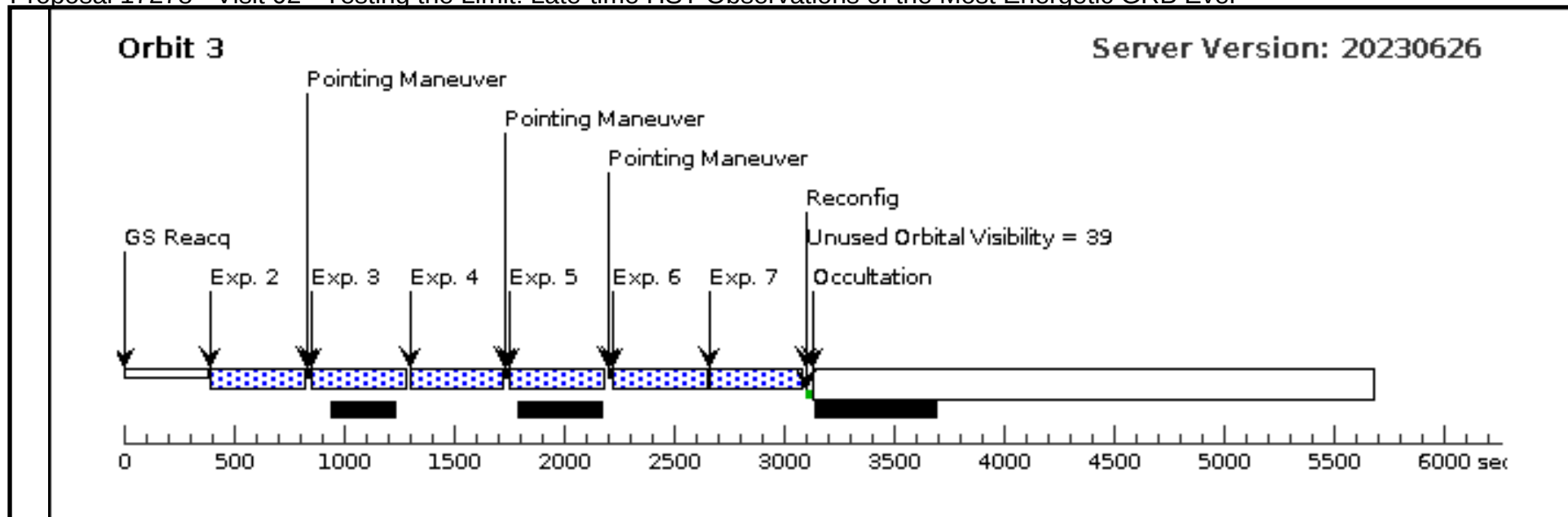




Proposal 17278 - Visit 02 - Testing the Limit: Late-time HST Observations of the Most Energetic GRB Ever

Visit	Proposal 17278, Visit 02, completed										Tue Sep 12 19:00:23 GMT 2023		
	Diagnostic Status: Warning												
	Scientific Instruments: WFC3/IR, WFC3/UVIS												
	Special Requirements: BETWEEN 01-MAY-2023:00:00:00 AND 31-JUL-2023:00:00:00												
Diagnostics	(Visit 02) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN												
	(Visit 02) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN												
Patterns	#	Primary Pattern					Secondary Pattern					Exposures	
	(4)	Pattern Type=WFC3-UVIS-DITHER-BOX Coordinate Frame=POS-TARG Pattern Orientation=23.884 Purpose=DITHER Angle Between Sides=81.785 Number Of Points=4 Center Pattern=false Point Spacing=0.173 Line Spacing=0.112										(1)	
Fixed Targets	#	Name		Target Coordinates		Targ. Coord. Corrections			Fluxes		Miscellaneous		
	(1)	GRB221009A		RA: 19 13 3.5008 (288.2645867d) Dec: +19 46 24.23 (19.77340d) Equinox: J2000					V=24 fading		Reference Frame: ICRS		
	Comments: Category=EXT-STAR Description=[GAMMA RAY BURSTER]												
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit		
	1		(1) GRB221009A	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F814W			Pattern 4, Exps 1-1 in Visit 02 (4)	1150 Secs (5420 Secs)				
									[==>1357.0 Secs (Pattern 1)]		[1]		
									[==>1357.0 Secs (Pattern 2)]				
									[==>1353.0 Secs (Pattern 3)]		[2]		
									[==>1353.0 Secs (Pattern 4)]				
	2		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=9;	POS TARG 0.000,0.000	Sequence 2-7 Non-Int in Visit 02	402.935899 Secs (402.936 Secs)				
						SAMP-SEQ=SPAR S50			[==>]		[3]		
	3		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=9;	POS TARG 0.451,0.403	Sequence 2-7 Non-Int in Visit 02	402.935899 Secs (402.936 Secs)				
						SAMP-SEQ=SPAR S50			[==>]		[3]		
	4		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=9;	POS TARG 0.451,0.403	Sequence 2-7 Non-Int in Visit 02	402.935899 Secs (402.936 Secs)				
						SAMP-SEQ=SPAR S50			[==>]		[3]		
	5		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=9;	POS TARG 0.000,0.000	Sequence 2-7 Non-Int in Visit 02	402.935899 Secs (402.936 Secs)				
						SAMP-SEQ=SPAR S50			[==>]		[3]		
	6		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=9;	POS TARG 0.902,0.806	Sequence 2-7 Non-Int in Visit 02	402.935899 Secs (402.936 Secs)				
						SAMP-SEQ=SPAR S50			[==>]		[3]		
	7		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=9;	POS TARG 0.902,0.806	Sequence 2-7 Non-Int in Visit 02	402.935899 Secs (402.936 Secs)				
					SAMP-SEQ=SPAR S50			[==>]		[3]			



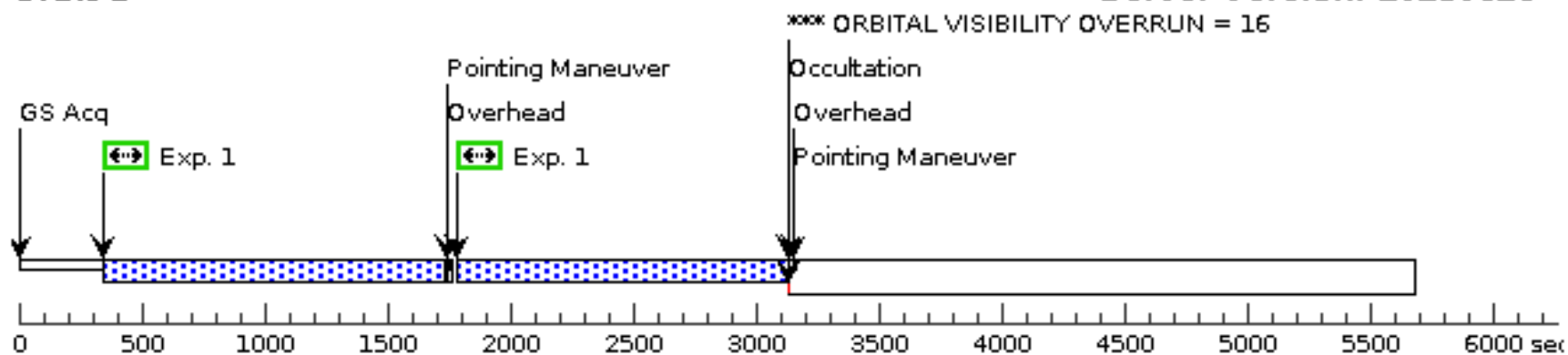


Proposal 17278 - Visit 03 - Testing the Limit: Late-time HST Observations of the Most Energetic GRB Ever

Visit	Proposal 17278, Visit 03, completed Tue Sep 12 19:00:23 GMT 2023				
	Diagnostic Status: Warning Scientific Instruments: WFC3/UVIS Special Requirements: AFTER 01-AUG-2023:00:00:00; SEQ 03,04 WITHIN 7 D				
Diagnostics	(Visit 03) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Visit 03) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Visit 03) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN				
Patterns	#	Primary Pattern	Secondary Pattern		Exposures
	(3)	Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=6 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
	(1)	GRB221009A	RA: 19 13 3.5008 (288.2645867d) Dec: +19 46 24.23 (19.77340d) Equinox: J2000		V=24 fading
Exposures	Comments: Category=EXT-STAR Description=[GAMMA RAY BURSTER]				
	#	Label	Target	Config,Mode,Aperture	Spectral Els.
	1	(1) GRB221009A	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F814W	
					Opt. Params.
					Special Reqs.
					Groups
					Exp. Time (Total)/[Actual Dur.]
					Orbit
					Pattern 3, Exps 1-1 i n Visit 03 (3)
					1250 Secs (8126 Secs)
					[==>1357.0 Secs (Pattern 1)]
					[==>1357.0 Secs (Pattern 2)]
					[==>1353.0 Secs (Pattern 3)]
					[==>1353.0 Secs (Pattern 4)]
					[==>1353.0 Secs (Pattern 5)]
					[==>1353.0 Secs (Pattern 6)]

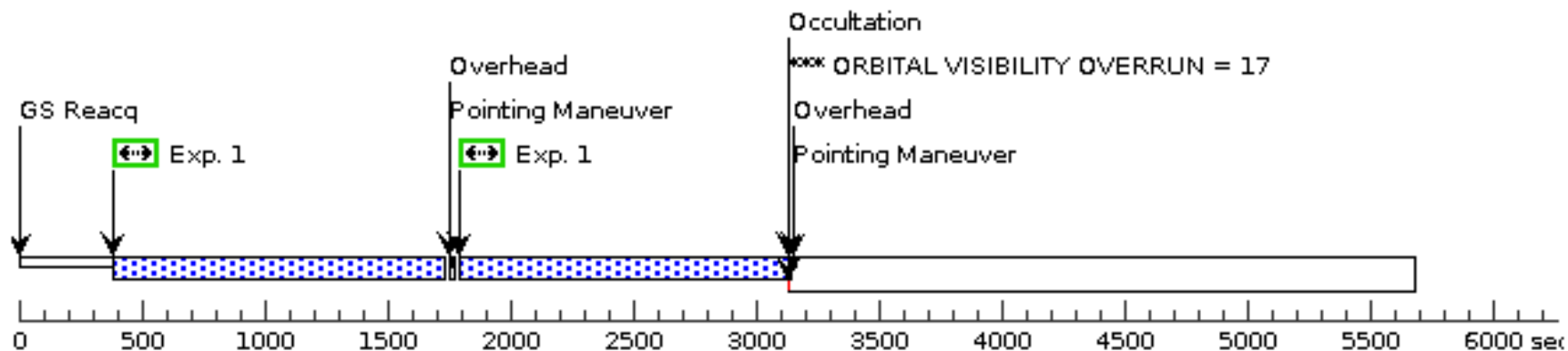
Orbit 1

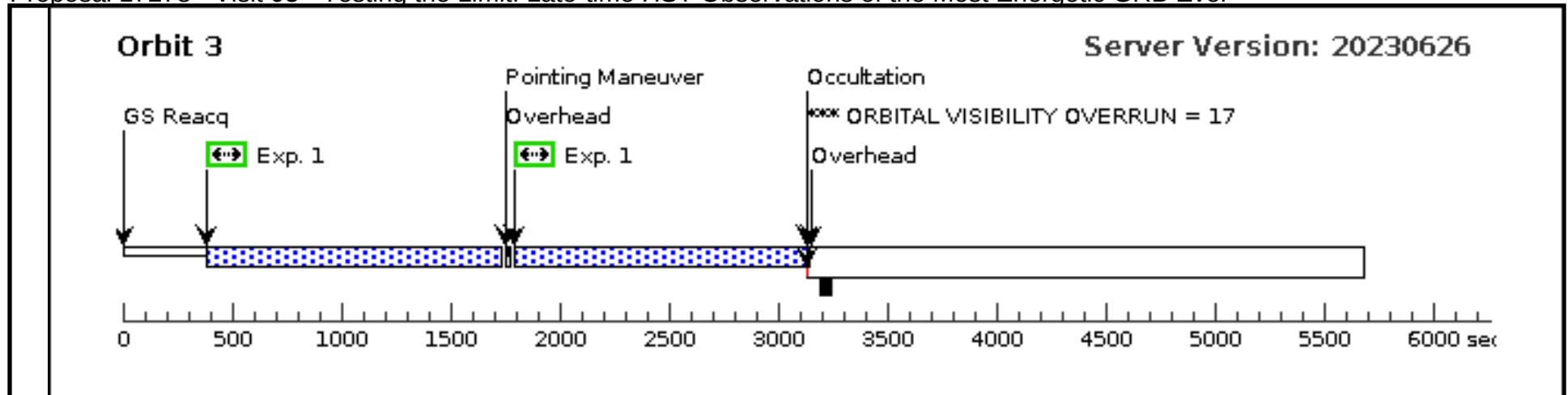
Server Version: 20230626



Orbit 2

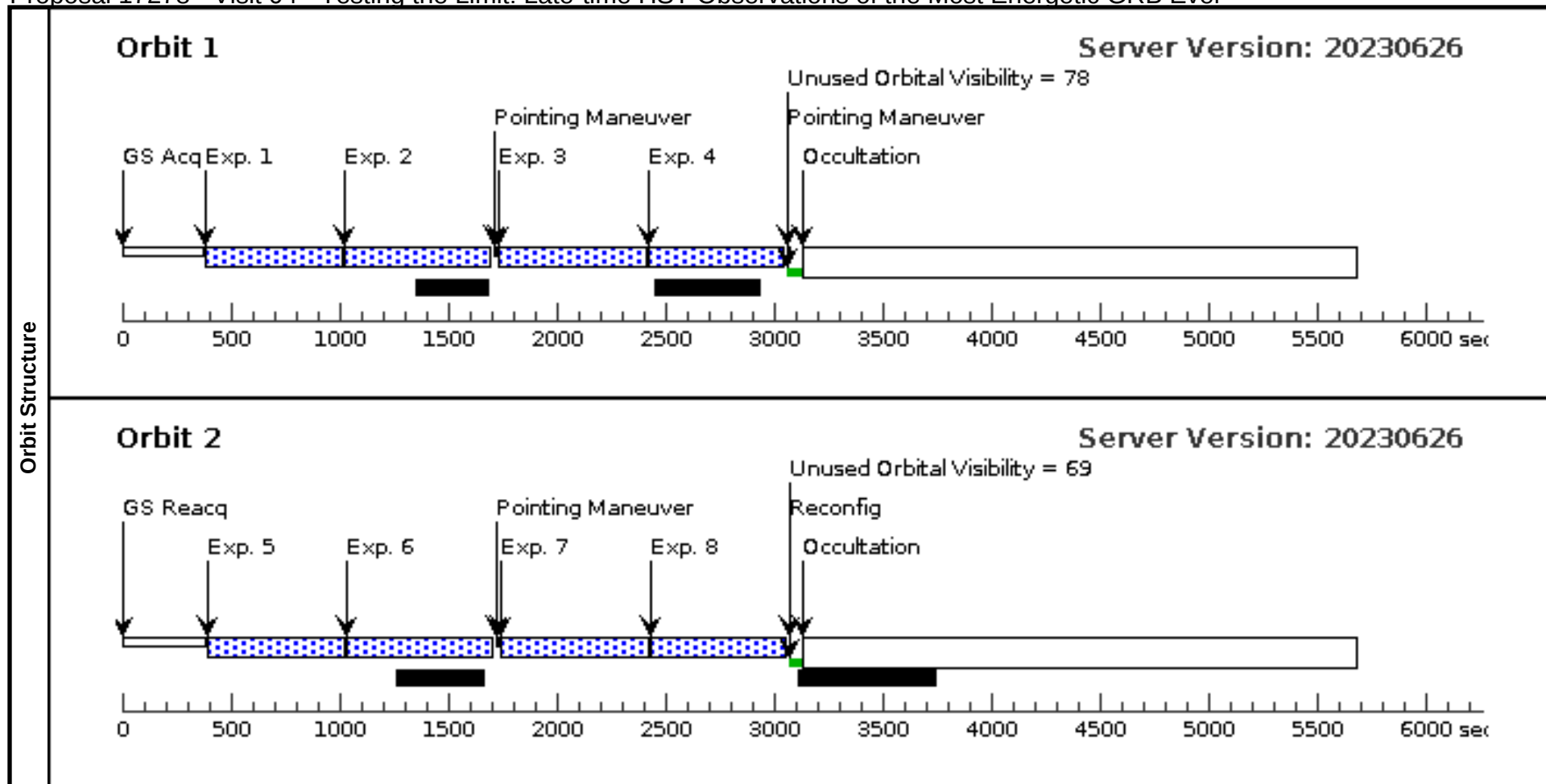
Server Version: 20230626





Proposal 17278 - Visit 04 - Testing the Limit: Late-time HST Observations of the Most Energetic GRB Ever

Visit	Proposal 17278, Visit 04, failed								Tue Sep 12 19:00:23 GMT 2023	
	Diagnostic Status: No Diagnostics									
	Scientific Instruments: WFC3/IR									
	Special Requirements: AFTER 01-AUG-2023:00:00:00; SEQ 03,04 WITHIN 7 D									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections		Fluxes		Miscellaneous		
	(1)	GRB221009A	RA: 19 13 3.5008 (288.2645867d) Dec: +19 46 24.23 (19.77340d) Equinox: J2000			V=24 fading		Reference Frame: ICRS		
Comments: Category=EXT-STAR Description=[GAMMA RAY BURSTER]										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=7; SAMP-SEQ=SPAR S100	POS TARG 0.000,0.000	Sequence 1-4 Non-Int in Visit 04	602.934229 Secs (602.934 Secs) [==>]	[1]
	2		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=14; SAMP-SEQ=SPAR S50	POS TARG 0.000,0.000	Sequence 1-4 Non-Int in Visit 04	652.938154 Secs (652.938 Secs) [==>]	[1]
	3		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=14; SAMP-SEQ=SPAR S50	POS TARG 0.542,0.182	Sequence 1-4 Non-Int in Visit 04	652.938154 Secs (652.938 Secs) [==>]	[1]
	4		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=7; SAMP-SEQ=SPAR S100	POS TARG 0.542,0.182	Sequence 1-4 Non-Int in Visit 04	602.934229 Secs (602.934 Secs) [==>]	[1]
	5		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=7; SAMP-SEQ=SPAR S100	POS TARG 0.339,0.485	Sequence 5-8 Non-Int in Visit 04	602.934229 Secs (602.934 Secs) [==>]	[2]
	6		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=14; SAMP-SEQ=SPAR S50	POS TARG 0.339,0.485	Sequence 5-8 Non-Int in Visit 04	652.938154 Secs (652.938 Secs) [==>]	[2]
	7		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=14; SAMP-SEQ=SPAR S50	POS TARG -0.203,0.303	Sequence 5-8 Non-Int in Visit 04	652.938154 Secs (652.938 Secs) [==>]	[2]
	8		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=7; SAMP-SEQ=SPAR S100	POS TARG -0.203,0.303	Sequence 5-8 Non-Int in Visit 04	602.934229 Secs (602.934 Secs) [==>]	[2]



Proposal 17278 - Visit 05 - Testing the Limit: Late-time HST Observations of the Most Energetic GRB Ever

Visit	Proposal 17278, Visit 05										Tue Sep 12 19:00:23 GMT 2023									
	Diagnostic Status: No Diagnostics																			
	Scientific Instruments: WFC3/IR																			
	Special Requirements: (none)																			
Fixed Targets	#	Name		Target Coordinates				Targ. Coord. Corrections				Fluxes				Miscellaneous				
	(1)	GRB221009A		RA: 19 13 3.5008 (288.2645867d) Dec: +19 46 24.23 (19.77340d) Equinox: J2000								V=24 fading				Reference Frame: ICRS				
	Comments: Category=EXT-STAR Description=[GAMMA RAY BURSTER]																			
Exposures	#	Label	Target	Config,Mode,Aperture		Spectral Els.		Opt. Params.		Special Reqs.		Groups		Exp. Time (Total)/[Actual Dur.]				Orbit		
	1		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR		F160W		NSAMP=7; SAMP-SEQ=SPAR S100		POS TARG 0.339,0. 485		Sequence 1-4 Non-Int in Visit 05		602.934229 Secs (602.934 Secs) [==>]				[1]		
	2		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR		F110W		NSAMP=14; SAMP-SEQ=SPAR S50		POS TARG 0.339,0. 485		Sequence 1-4 Non-Int in Visit 05		652.938154 Secs (652.938 Secs) [==>]				[1]		
	3		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR		F110W		NSAMP=14; SAMP-SEQ=SPAR S50		POS TARG -0.203,0. .303		Sequence 1-4 Non-Int in Visit 05		652.938154 Secs (652.938 Secs) [==>]				[1]		
	4		(1) GRB221009A	WFC3/IR, MULTIACCUM, IR		F160W		NSAMP=7; SAMP-SEQ=SPAR S100		POS TARG -0.203,0. .303		Sequence 1-4 Non-Int in Visit 05		602.934229 Secs (602.934 Secs) [==>]				[1]		
Orbit Structure	Orbit 1 Server Version: 20230626 The diagram illustrates the sequence of events for Orbit 1. It begins with 'GS Acq' at approximately 200 seconds, followed by 'Exp. 1' at 400s, 'Exp. 2' at 1000s, a 'Pointing Maneuver' at 1700s, 'Exp. 3' at 1800s, 'Exp. 4' at 2400s, a 'Reconfig' at 3000s, and 'Occultation' at 3100s. The 'Unused Orbital Visibility' period extends from 3100s to approximately 5700s. The timeline is marked from 0 to 6000 seconds.																			