



# 17907 - One Last Time: HST/ACS Imaging of the Peculiar White Dwarf Supernova 2012Z

Cycle: 32, Proposal Category: GO  
(Availability Mode: SUPPORTED)

## INVESTIGATORS

<i>Name</i>	<i>Institution</i>
<b>Michaela Grace Schwab (PI) (Contact)</b>	<b>Rutgers the State University of New Jersey</b>
Dr. Saurabh W. Jha (CoI) (AdminUSPI)	Rutgers the State University of New Jersey
Dr. Huei Sears (CoI)	Rutgers the State University of New Jersey
Dr. Lindsey Kwok (CoI)	Northwestern University
Dr. Curtis McCully (CoI)	Las Cumbres Observatory Global Telescope Network
Prof. Ryan Foley (CoI)	University of California - Santa Cruz
Conor Larison (CoI)	Rutgers the State University of New Jersey
Dr. Or Graur (CoI) (ESA Member)	University of Portsmouth

## 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) SN-2012Z	ACS/WFC	3	22-Jan-2025 09:00:22.0	yes
02	(1) SN-2012Z	ACS/WFC	3	22-Jan-2025 09:00:23.0	yes
03	(1) SN-2012Z	ACS/WFC	3	22-Jan-2025 09:00:24.0	yes
04	(1) SN-2012Z	ACS/WFC	3	22-Jan-2025 09:00:25.0	yes
05	(1) SN-2012Z	ACS/WFC	2	22-Jan-2025 09:00:25.0	yes

14 Total Orbits Used

## **ABSTRACT**

Type Ia supernovae (SNe Ia) play a central role in cosmology, stellar evolution, and cosmic chemical enrichment. Nonetheless, their progenitors and explosion mechanisms remain uncertain. The classic model -- a Chandrasekhar-mass white dwarf (WD) accreting mass from a non-degenerate companion -- may not explain normal SNe Ia, but aligns well with observations of the peculiar Type Iax supernova (SN Iax) subclass. Intriguingly, pure deflagration (subsonic) explosion models of SNe Iax predict that the WD may not be completely disrupted, potentially leaving behind a bound remnant. SN Iax 2012Z offers an exceptional opportunity to stringently test this scenario. Deep pre-explosion HST ACS/WFC imaging of its host galaxy, NGC 1309, revealed a luminous, blue helium star thought to be the companion of the exploding WD. Subsequent ACS/WFC imaging at the location of SN 2012Z in 2016 and 2019 revealed that, remarkably, this source is still visible with a persistent flux excess beyond that expected from the companion star alone. We propose one final ACS/WFC observation, six years after the last, allowing for image subtraction to conclusively determine whether this mysterious flux excess originates from a bound remnant driving a radioactive wind or from shock-heating of the ejected companion star. This observation will cement the legacy of HST in elucidating the origins of SNe Iax.

## **OBSERVING DESCRIPTION**

We propose to obtain late-time optical ACS/WFC BVI images at the location of SN 2012Z in NGC 1309 to look for further changes in the system.

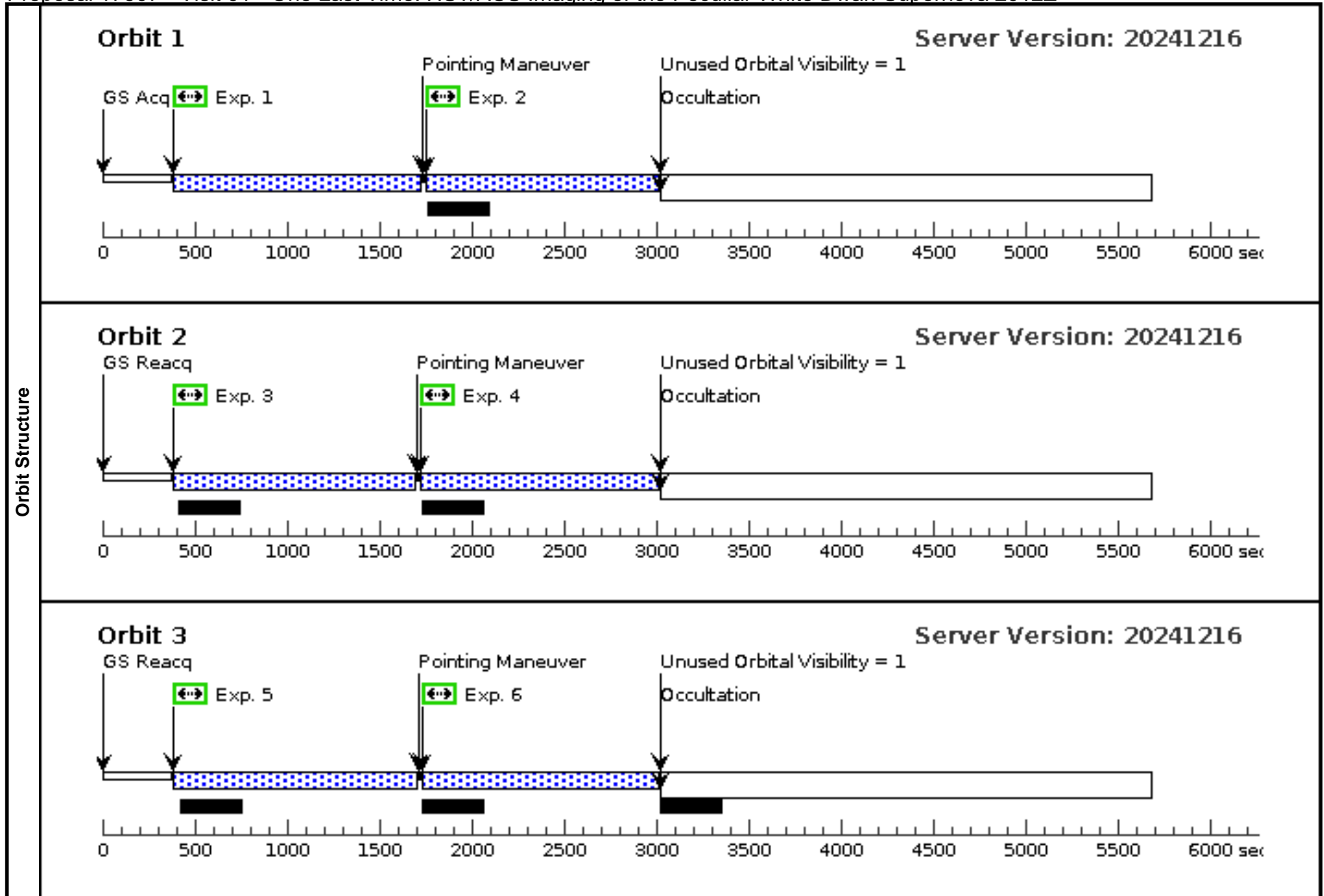
We have constructed our proposed observations to match the ACS/WFC data from Cycles 22 and 25 in filters and depth, allowing us to also compare with the pre-explosion ACS images and photometry of S1. Our best measurement of any changes from the pre-explosion and Cycle 22 or 25 images will come from image-subtraction analysis, so we request a similar orientation range as those data. We will use dithering and subsampling to improve the spatial resolution of the ACS images, as we did in our previous observations, and thus request the same orientation for all visits.

We divide our 14-orbit allocation into 5 visits, 4 visits of 3 orbits each in all three filters (F435W, F555W, and F814W) and 1 visit of 2 orbits in two filters (F555W and F814W). This yields a total exposure time of over 9000 sec in F435W and approximately 11500 sec in F555W and F814W.

Proposal 17907 - Visit 01 - One Last Time: HST/ACS Imaging of the Peculiar White Dwarf Supernova 2012Z

Wed Jan 22 14:00:25 GMT 2025

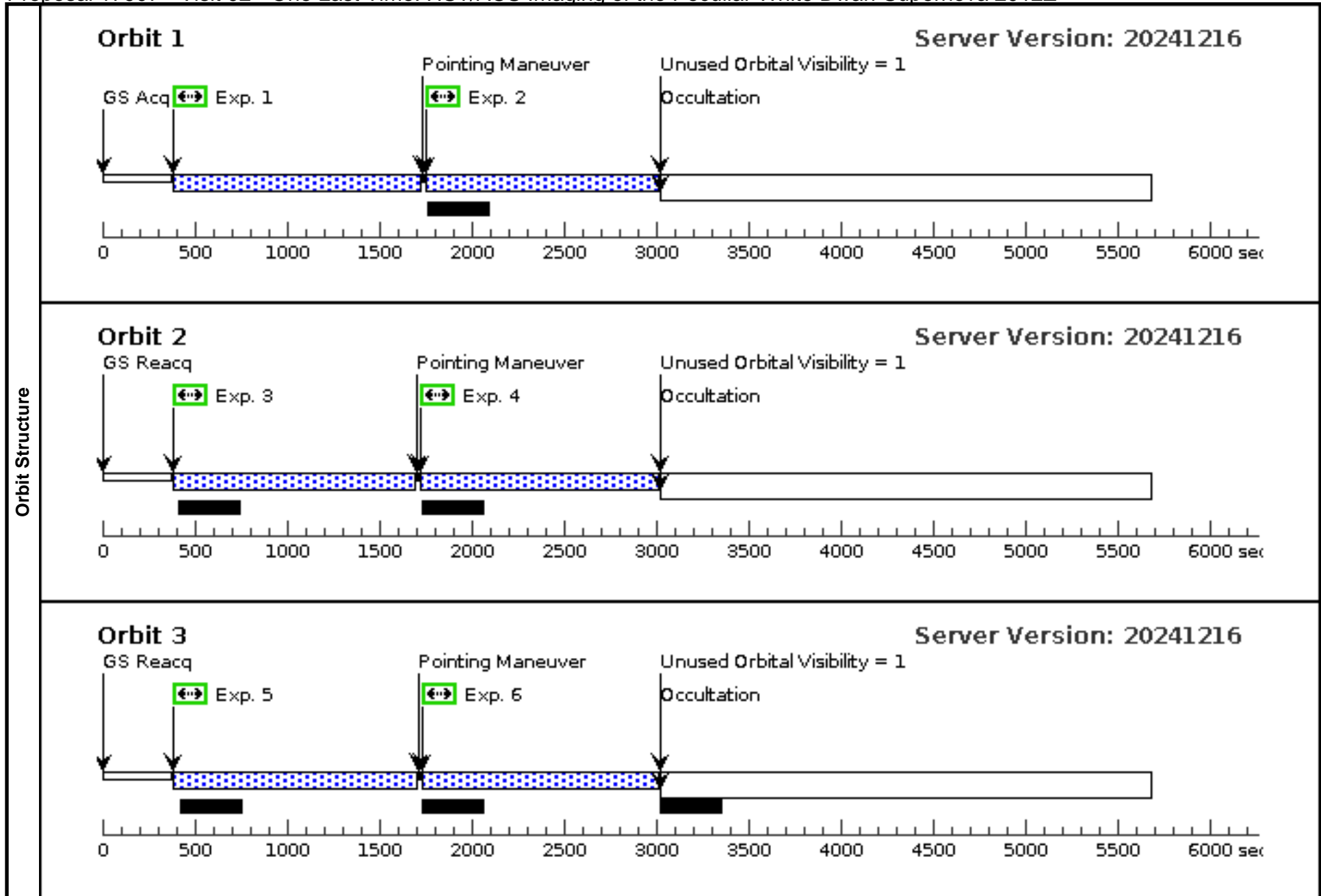
Visit	<b>Proposal 17907, Visit 01</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: ACS/WFC Special Requirements: SCHED 70%; ORIENT 240D TO 80 D									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
	(1)	SN-2012Z	RA: 03 22 5.3500 (50.5222917d) Dec: -15 23 15.60 (-15.38767d) Equinox: J2000		V=27.6+/-2.0	Reference Frame: ICRS				
	<i>Comments:</i> 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) SN-2012Z	(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F435W		POS TARG 0.000,0.000		1132 Secs (1132 Secs) [==>]	[1]
	2	(1) SN-2012Z	(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F435W		POS TARG 0.247,0.094		1132 Secs (1132 Secs) [==>]	[1]
	3	(1) SN-2012Z	(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0.247,0.094		1162 Secs (1162 Secs) [==>]	[2]
	4	(1) SN-2012Z	(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0.000,0.000		1162 Secs (1162 Secs) [==>]	[2]
	5	(1) SN-2012Z	(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.000,0.000		1153 Secs (1153 Secs) [==>]	[3]
	6	(1) SN-2012Z	(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.247,0.094		1153 Secs (1153 Secs) [==>]	[3]



Proposal 17907 - Visit 02 - One Last Time: HST/ACS Imaging of the Peculiar White Dwarf Supernova 2012Z

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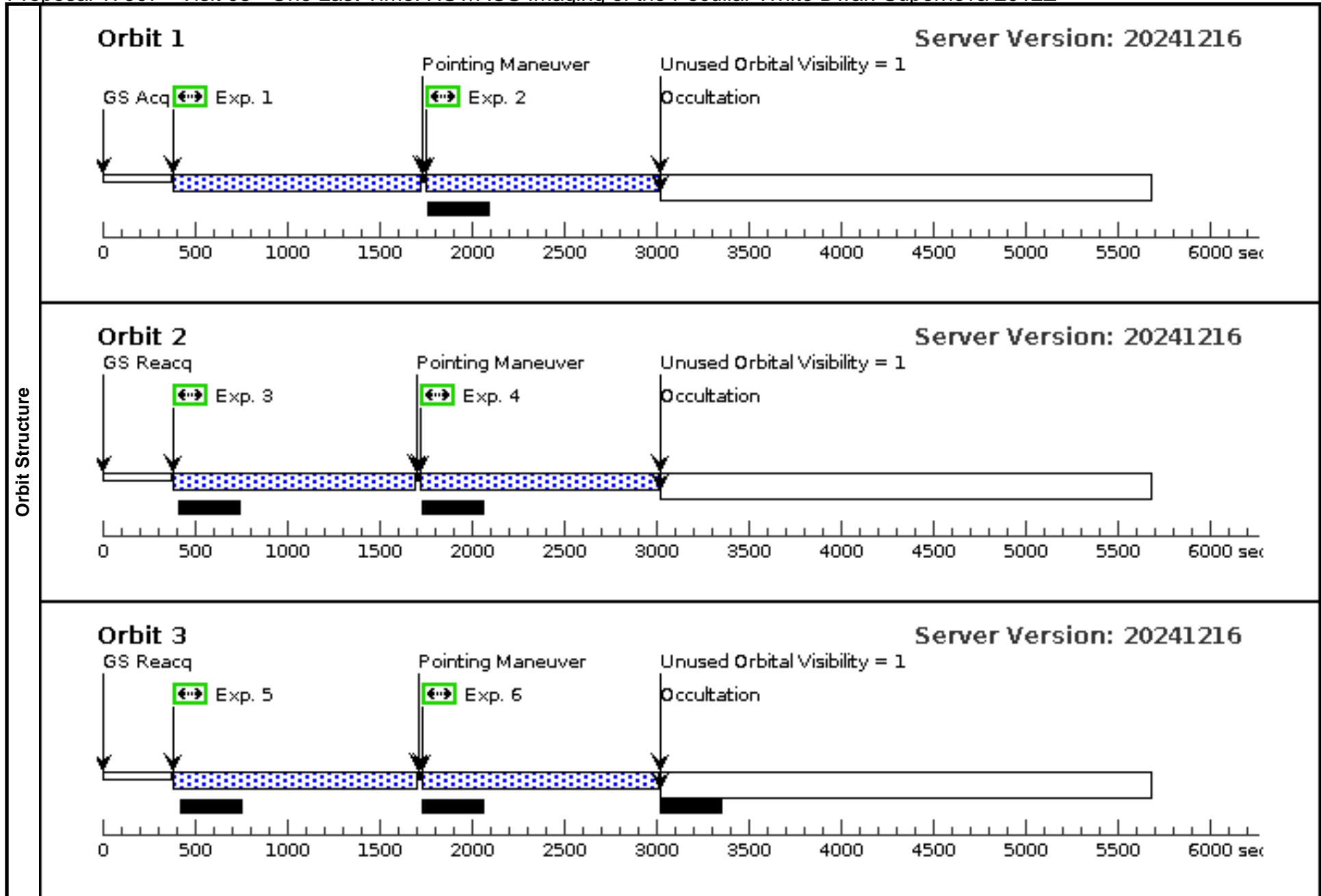
Fixed Targets	#		Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
		(1)	SN-2012Z	RA: 03 22 5.3500 (50.5222917d) Dec: -15 23 15.60 (-15.38767d) Equinox: J2000		V=27.6+/-2.0	Reference Frame: ICRS			
<i>Comments:</i> Category=EXT-STAR Description=[SUPERNOVA]										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1) SN-2012Z		ACS/WFC, ACCUM, WFC1	F435W		POS TARG 0.124,0.232		1132 Secs (1132 Secs) [==>]	[1]
	2	(1) SN-2012Z		ACS/WFC, ACCUM, WFC1	F435W		POS TARG -0.124,0.138		1132 Secs (1132 Secs) [==>]	[1]
	3	(1) SN-2012Z		ACS/WFC, ACCUM, WFC1	F814W		POS TARG -0.124,0.138		1162 Secs (1162 Secs) [==>]	[2]
	4	(1) SN-2012Z		ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0.124,0.232		1162 Secs (1162 Secs) [==>]	[2]
	5	(1) SN-2012Z		ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.124,0.232		1153 Secs (1153 Secs) [==>]	[3]
	6	(1) SN-2012Z		ACS/WFC, ACCUM, WFC1	F555W		POS TARG -0.124,0.138		1153 Secs (1153 Secs) [==>]	[3]



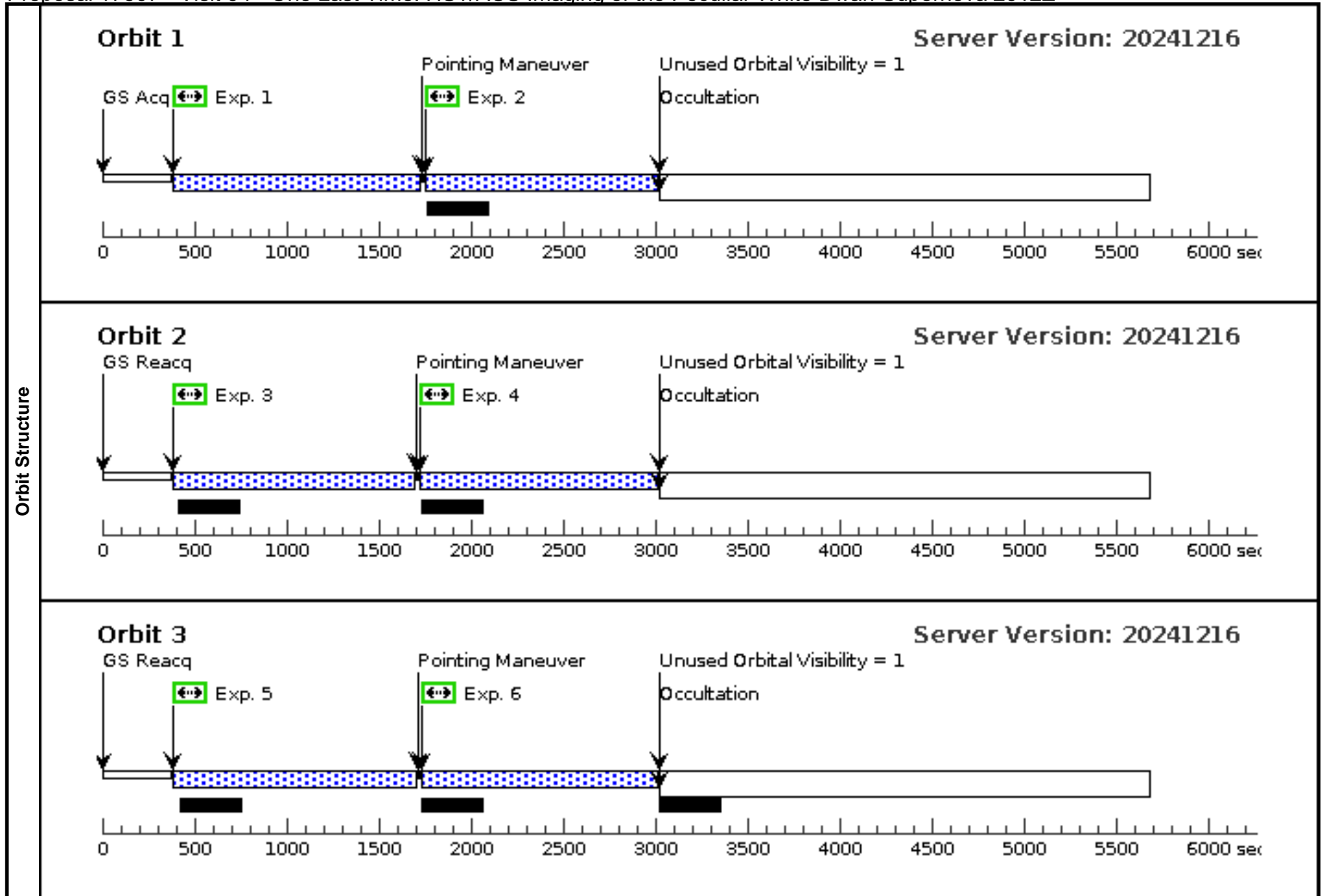
Proposal 17907 - Visit 03 - One Last Time: HST/ACS Imaging of the Peculiar White Dwarf Supernova 2012Z

Wed Jan 22 14:00:26 GMT 2025

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	SN-2012Z	RA: 03 22 5.3500 (50.5222917d) Dec: -15 23 15.60 (-15.38767d) Equinox: J2000			V=27.6+/-2.0	Reference Frame: ICRS			
<i>Comments:</i> 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) SN-2012Z	(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F435W		POS TARG 0.000,0.000		1132 Secs (1132 Secs) [==>]	[1]
	2	(1) SN-2012Z	(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F435W		POS TARG 0.247,0.094		1132 Secs (1132 Secs) [==>]	[1]
	3	(1) SN-2012Z	(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0.247,0.094		1162 Secs (1162 Secs) [==>]	[2]
	4	(1) SN-2012Z	(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0.000,0.000		1162 Secs (1162 Secs) [==>]	[2]
	5	(1) SN-2012Z	(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.000,0.000		1153 Secs (1153 Secs) [==>]	[3]
	6	(1) SN-2012Z	(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.247,0.094		1153 Secs (1153 Secs) [==>]	[3]







Proposal 17907 - Visit 05 - One Last Time: HST/ACS Imaging of the Peculiar White Dwarf Supernova 2012Z

Wed Jan 22 14:00:26 GMT 2025

Visit	<b>Proposal 17907, Visit 05</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: ACS/WFC Special Requirements: SCHED 70%; SAME ORIENT AS 01									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
	(1)	SN-2012Z	RA: 03 22 5.3500 (50.5222917d) Dec: -15 23 15.60 (-15.38767d) Equinox: J2000		V=27.6+/-2.0	Reference Frame: ICRS				
	<i>Comments:</i> 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) SN-2012Z		ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.000,0.000		1132 Secs (1132 Secs)	
									[==>]	[1]
	2	(1) SN-2012Z		ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.247,0.094		1132 Secs (1132 Secs)	
									[==>]	[1]
3	(1) SN-2012Z		ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0.247,0.094		1153 Secs (1153 Secs)		
								[==>]	[2]	
4	(1) SN-2012Z		ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0.000,0.000		1153 Secs (1153 Secs)		
								[==>]	[2]	

