



14244 - Possible Stellar Donor or Remnant for the Type Iax SN 2008ha

Cycle: 23, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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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-2008HA	ACS/WFC	3	01-Dec-2015 21:08:20.0	yes
02	(1) SN-2008HA	ACS/WFC	5	01-Dec-2015 21:08:22.0	yes

8 Total Orbits Used

ABSTRACT

White dwarf (WD) supernovae (SN) play a pivotal role in astrophysics, but are surprisingly poorly understood. We now know that not all exploding WDs are SN Ia. Some are SN Iax: low-energy stellar explosions that are similar to, but physically distinct from, SN Ia. Recent deep HST pre-

explosion images reveal a blue source at the position of a SN Iax. This is the first detection of the progenitor system for a WD SN! Our favored interpretation is that this source is the helium star binary companion to the progenitor WD.

Observations suggest, and theory predicts, that some SN Iax do not completely disrupt their WD progenitor stars, leaving behind a battered, bruised, and possibly very luminous remnant. In Cycle 20, we imaged the location of a nearby SN Iax, SN 2008ha, 4 years after explosion, and detected a luminous red source, S1, at the position of the SN. S1 could be (1) the companion star, possibly affected by the SN impact, (2) the luminous remnant star, which would be the first time such an object has ever been detected, or (3) a chance coincidence (although unlikely, it is not completely ruled out).

A companion or remnant star is predicted to vary on years timescales, while an unrelated star should not vary. Basic assumptions suggest that a companion would brighten and a remnant would fade between our last observations and now. We propose to observe S1 with HST to measure its possible variability and distinguish between the possible scenarios.

These measurements will result in deeper understanding of SN Iax, and all WD SN, and possibly reveal the second detected companion star to a thermonuclear SN or a completely new class of object (the remnant).

OBSERVING DESCRIPTION

We plan to obtain ACS/WFC images of the site of SN 2008ha in UGC 12682. HST resolution/depth is necessary to investigate the potential companion star or remnant (S1) of SN 2008ha and determine if it varies. Additional HST images will also improve our astrometric uncertainties and provide a more stringent limit on any association between S1 and SN 2008ha.

As S1 was most strongly detected in F814W ($F814W = 26.3$ mag), our best chance to detect variability is to repeat observations in this filter. The energy input from radioactive decay would suggest a change of 1.5-1.9 mag between our previous observation and the various timing windows available for our target (as determined from APT). Therefore, we aim to have a 5 sigma limit of $F814W = 28.2$ mag, which orbit calculations from APT combined with ETC estimates suggest can be done in 5 HST orbits.

A 10-point spiral dither pattern with a 0.2" spacing has been applied to these orbits in order to reduce issues with cosmic rays/hot pixels and to provide a subsampled combined image via astrodrizzle.

F435W observations are required in order to detect a possible blue companion star similar to that of SN 2012Z. 3 HST orbits (again combining APT and ETC results) are required in order to investigate this possibility.

For this filter we will use a 6-point spiral dither pattern with a 0.2" spacing. This pattern will again be used to create a subsampled drizzled image.

Because of its better sensitivity, wide field of view, and correspondence to previous observations, ACS has been chosen over WFC3.

To improve our astrometry, we have placed S1 in the South-West corner of the ACS FOV, increasing the FOV to the North-East, where there is currently no HST data.

A roll angle between 60-70 degrees has been specified in order to maximize the currently non-covered FOV and provide a significant number of stars for alignment. For alignment purposes and the reduction of geometric distortion correction inaccuracies we request that both visit 1 and visit 2 have the same orient restriction.

As the object in question may be variable we also request that visit 2 be taken no later than 7 days after visit 1.

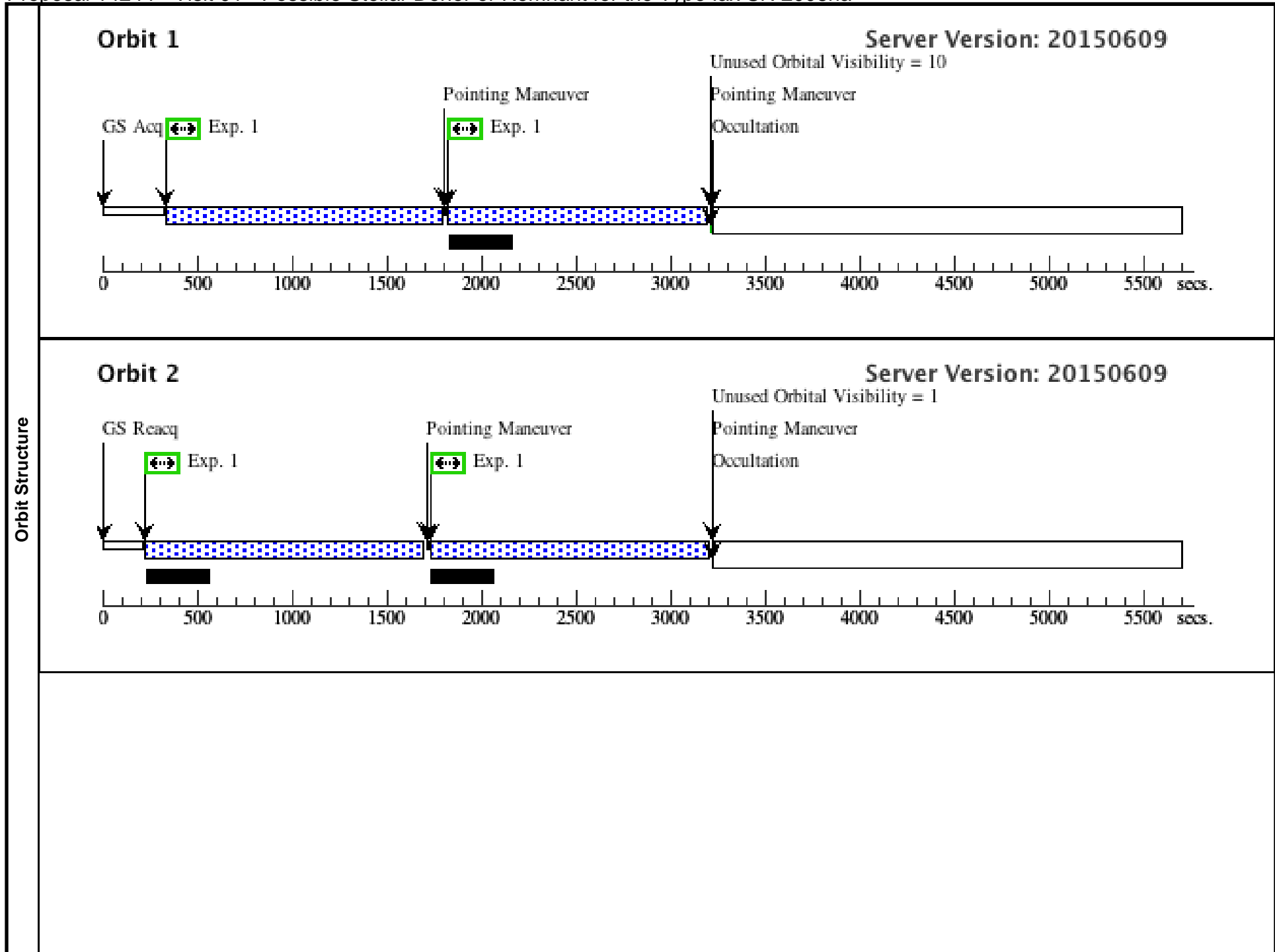
A timing requirement between the 14th of November 2015 and the 17th of January 2016 was put in place to optimize the exposure time, window length and roll angle coverage.

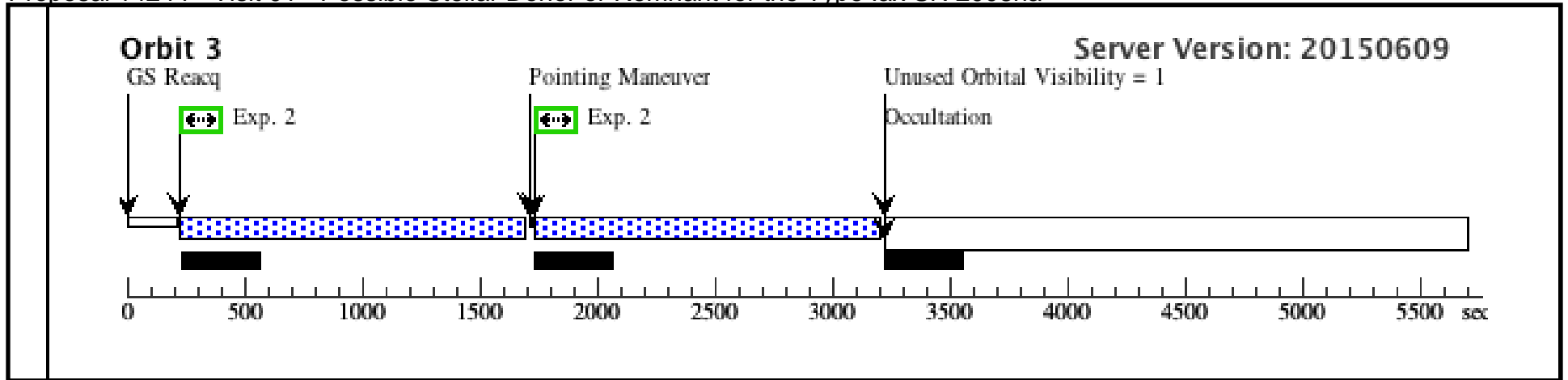
We would like to look into using POS TARGS rather than using dither pattern containers to improve subsampling and acquire a better dither pattern. During the CS reviews we would like to receive comments on the advantages of POS TARGS verses the spiral dither pattern currently applied.

Proposal 14244 - Visit 01 - Possible Stellar Donor or Remnant for the Type Iax SN 2008ha

Wed Dec 02 02:08:24 GMT 2015

Visit	Proposal 14244, Visit 01, implementation Diagnostic Status: No Diagnostics Scientific Instruments: ACS/WFC Special Requirements: SCHED 30%; ORIENT 60D TO 70 D; BETWEEN 14-NOV-2015:00:00:00 AND 17-JAN-2016:00:00:00									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(3)	Pattern Type=ACS-WFC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.265 Line Spacing=0.187	Coordinate Frame=POS-TARG Pattern Orientation=20.67 Angle Between Sides=69.05 Center Pattern=false		(1)					
	(5)	Pattern Type=LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.15 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=34.13 Angle Between Sides= Center Pattern=false		(2)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	SN-2008HA	RA: 23 34 52.6900 (353.7195417d) Dec: +18 13 35.40 (18.22650d) Equinox: J2000		V=27	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1) SN-2008HA	(1) SN-2008HA	ACS/WFC, ACCUM, WFC2	F435W		POS TARG 60,-15	Pattern 3, Exps 1-1 in Visit 01 (3)	1250 Secs (5202 Secs)	
									[==>(Pattern 1)]	[1]
									[==>(Pattern 2)]	
									[==>1351.0 Secs (Pattern 3)]	[2]
									[==>1351.0 Secs (Pattern 4)]	
	2	(1) SN-2008HA	(1) SN-2008HA	ACS/WFC, ACCUM, WFC2	F435W		POS TARG 60.1125,-14.8875	Pattern 5, Exps 2-2 in Visit 01 (5)	1200 Secs (2702 Secs)	
									[==>1351.0 Secs (Pattern 1)]	[3]
									[==>1351.0 Secs (Pattern 2)]	

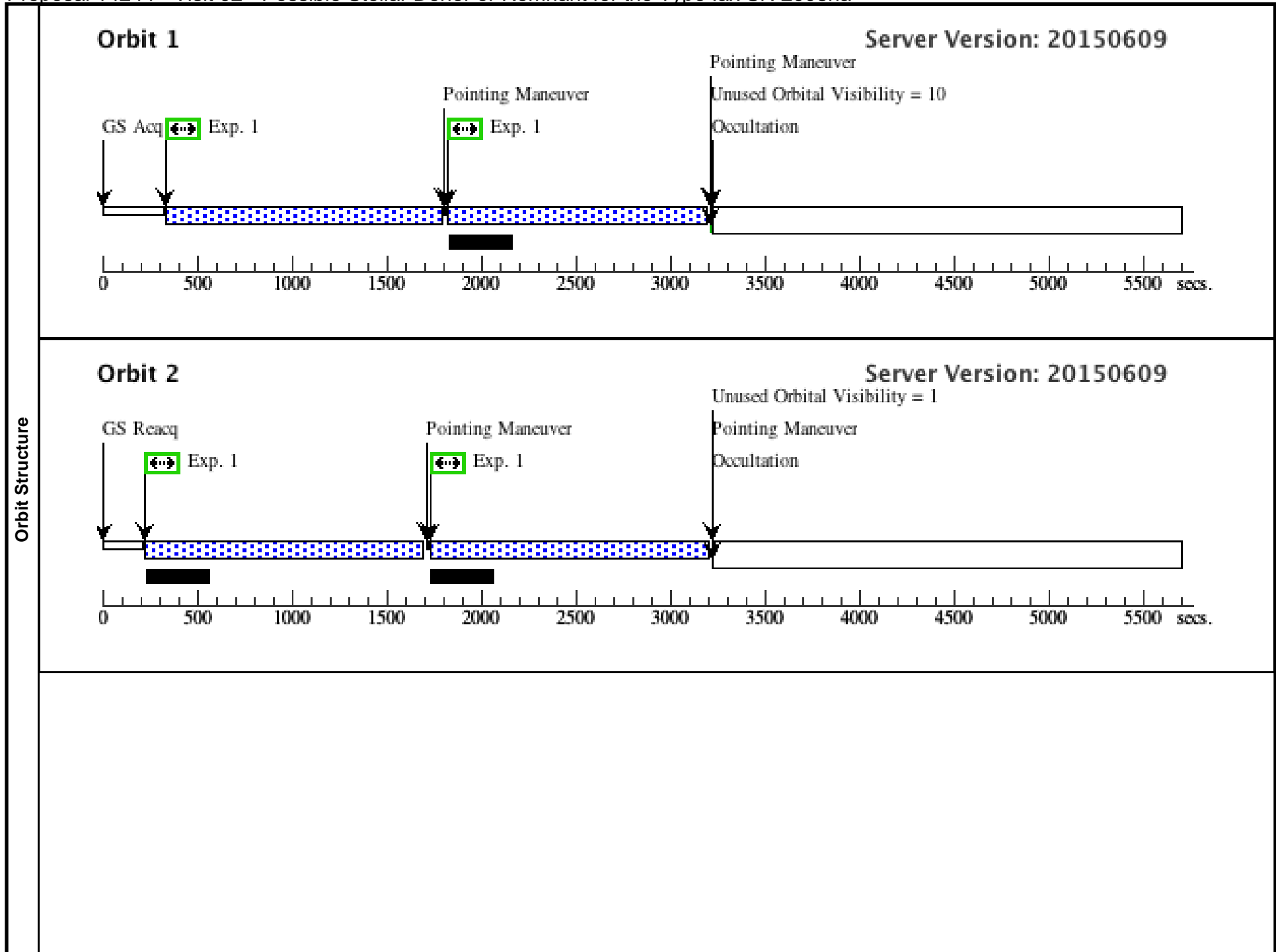




Proposal 14244 - Visit 02 - Possible Stellar Donor or Remnant for the Type Iax SN 2008ha

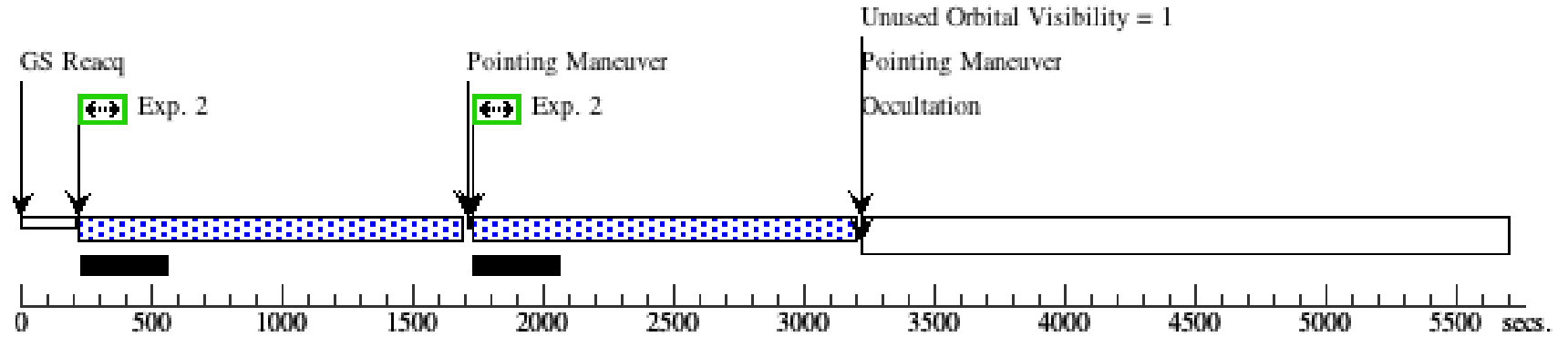
Wed Dec 02 02:08:24 GMT 2015

Visit	Proposal 14244, Visit 02, implementation Diagnostic Status: No Diagnostics Scientific Instruments: ACS/WFC Special Requirements: SCHED 30%; SAME ORIENT AS 01; AFTER 01 BY 0 D TO 7 D; BETWEEN 14-NOV-2015:00:00:00 AND 17-JAN-2016:00:00:00									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
		(3)	Pattern Type=ACS-WFC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.265 Line Spacing=0.187	Coordinate Frame=POS-TARG Pattern Orientation=20.67 Angle Between Sides=69.05 Center Pattern=false		(1), (2)				
	(5)	Pattern Type=LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.15 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=34.13 Angle Between Sides= Center Pattern=false		(3)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	SN-2008HA	RA: 23 34 52.6900 (353.7195417d) Dec: +18 13 35.40 (18.22650d) Equinox: J2000		V=27	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1) SN-2008HA	(1) SN-2008HA	ACS/WFC, ACCUM, WFC2	F814W		POS TARG 60,-15	Pattern 3, Exps 1-1 in Visit 02 (3)	1250 Secs (5202 Secs)	
									[==>(Pattern 1)]	[1]
									[==>(Pattern 2)]	
									[==>1351.0 Secs (Pattern 3)]	[2]
									[==>1351.0 Secs (Pattern 4)]	
	2	(1) SN-2008HA	(1) SN-2008HA	ACS/WFC, ACCUM, WFC2	F814W		POS TARG 59.8875,-15.1125	Pattern 3, Exps 2-2 in Visit 02 (3)	1200 Secs (5404 Secs)	
								[==>1351.0 Secs (Pattern 1)]	[3]	
								[==>1351.0 Secs (Pattern 2)]		
								[==>1351.0 Secs (Pattern 3)]	[4]	
								[==>1351.0 Secs (Pattern 4)]		
3	(1) SN-2008HA	(1) SN-2008HA	ACS/WFC, ACCUM, WFC2	F814W		POS TARG 60.1125,-14.8875	Pattern 5, Exps 3-3 in Visit 02 (5)	1200 Secs (2702 Secs)		
								[==>1351.0 Secs (Pattern 1)]	[5]	
								[==>1351.0 Secs (Pattern 2)]		



Orbit 3

Server Version: 20150609



Orbit 4

Server Version: 20150609

