15205 - Left Behind: A Bound Remnant from a White Dwarf Supernova?

Cycle: 25, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
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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) SN-2012Z	ACS/WFC	3	17-Sep-2018 11:00:12.0	yes
02	(1) SN-2012Z	ACS/WFC	3	17-Sep-2018 11:00:13.0	yes
03	(1) SN-2012Z	ACS/WFC	3	17-Sep-2018 11:00:14.0	yes
04	(1) SN-2012Z	ACS/WFC	3	17-Sep-2018 11:00:15.0	yes
05	(1) SN-2012Z	ACS/WFC	2	17-Sep-2018 11:00:16.0	yes
55	(1) SN-2012Z	ACS/WFC	1	17-Sep-2018 11:00:17.0	yes

15 Total Orbits Used

ABSTRACT

Type Ia supernovae (SN Ia) have enormous importance to cosmology and astrophysics, but their progenitors and explosion mechanisms are not understood in detail. Recently, observations and theoretical models have suggested that not all thermonuclear white-dwarf supernova explosions are normal SN Ia. In particular, type Iax supernovae (peculiar cousins to SN Ia), are thought to be exploding white dwarfs that are not completely

disrupted, leaving behind a bound remnant. In deep and serendipitous HST pre-explosion data, we have discovered a luminous, blue progenitor system for the type Iax SN 2012Z in NGC 1309, which we interpret as a helium-star donor to the exploding white dwarf. HST observations of SN 2012Z in 2016, when the supernova light was expected to have faded away, still show a source at the location, as expected in our model where the pre-explosion flux was coming from the companion. However, the 2016 data also show a surprise: an excess flux compared to the progenitor system. Our proposed observations here will help unravel the mystery of that excess flux: is it from the bound ex-white dwarf remnant? Or is it from the shocked companion star that has been bombarded by supernova ejecta? Either of these possibilities would provide key new evidence as to the nature of these white dwarf supernovae.

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 Cycle 22, which in turn corresponded to the pre-explosion images and photometry of S1 in terms of filters and depth. Our best measurement of any changes from the pre-explosion and Cycle 22 images will come from image-subtraction analysis. We will use dithering and subsampling to improve the spatial resolution of the ACS images, as we did in our previous observations.

To measure a meaningful change in the system, we will aim for S/N ~ 10 at the brightness of the progenitor S1 in the new F435W and F555W images, and S/N ~ 8 in F814W. These choices match the depth achieved in the Cycle 22 images from 2016. Based on the ACS/WFC ETC, using a 0.15 arcsec (3 pixel) aperture radius, we require 9500 sec of exposure in F435W, 13500 sec in F555W, and 14100 sec in F814W. With overheads, this requires 14 orbits.

Given the expected ~years timescale for changes in the system, we propose these data for the nominal Cycle 26 period (late 2018/early 2019, at approximately +2500 days. As a small program, we are proposing for this time now in Cycle 25, as required.

Visit

Proposal 15205, Visit 01, scheduling Mon Sep 17 15:00:17 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: ORIENT 240D TO 80 D; AFTER 01-JUL-2018:00:00:00

Fixed Targets

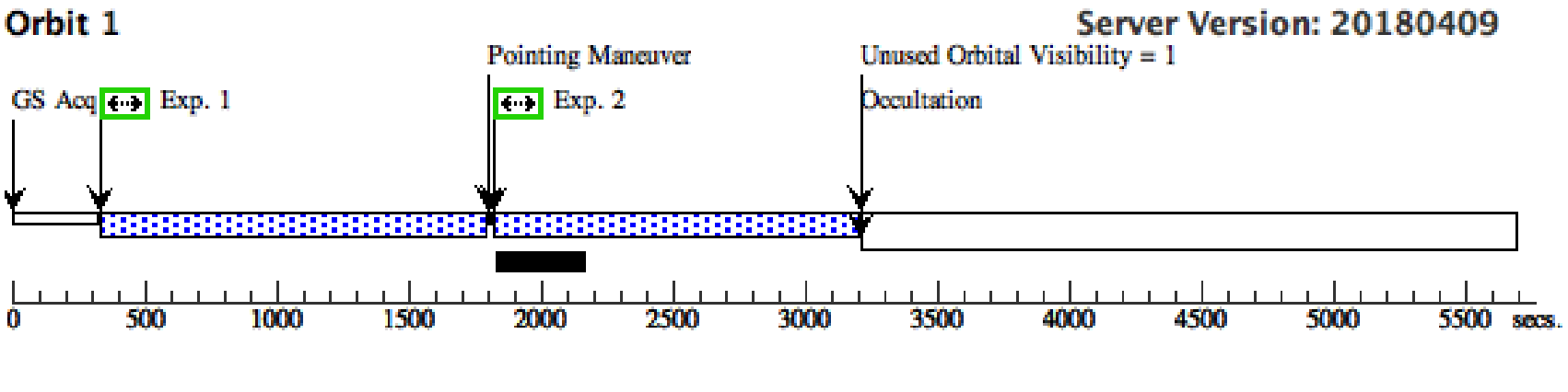
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2012Z	RA: 03 22 5.3500 (50.5222917d) Dec: -15 23 15.60 (-15.38767d) Equinox: J2000		V=27.6+/-2.0	Reference Frame: ICRS

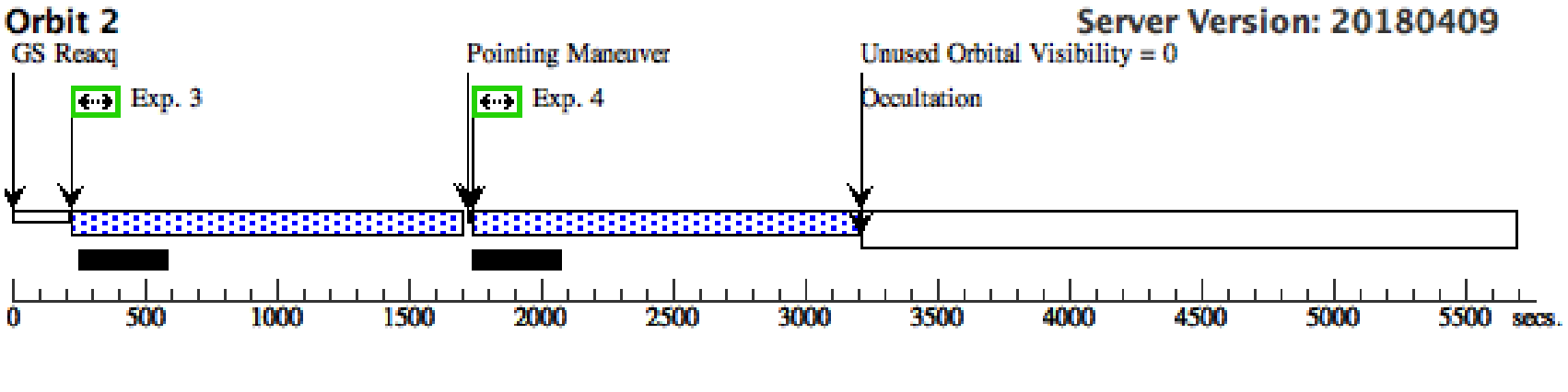
Comments:
Category=EXT-STAR
Description=[SUPERNOVA]

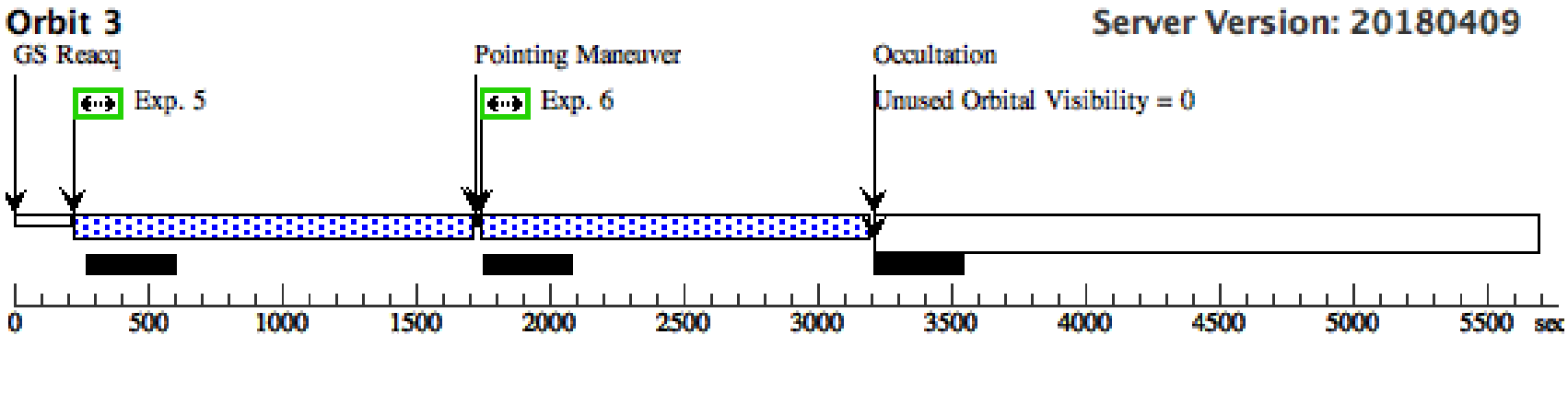
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F435W		POS TARG 0.000,0.000		1252 Secs (1252 Secs)	
								[==>]	***[1]***
2		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F435W		POS TARG 0.247,0.094		1252 Secs (1252 Secs)	
								[==>]	***[1]***
3		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0.247,0.094		1338 Secs (1338 Secs)	
								[==>]	***[2]***
4		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0.000,0.000		1338 Secs (1338 Secs)	
								[==>]	***[2]***
5		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.000,0.000		1329 Secs (1329 Secs)	
								[==>]	***[3]***
6		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.247,0.094		1329 Secs (1329 Secs)	
								[==>]	***[3]***

Orbit Structure







Visit

Proposal 15205, Visit 02, scheduling Mon Sep 17 15:00:17 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: SAME ORIENT AS 01; AFTER 01-JUL-2018:00:00:00

Fixed Targets

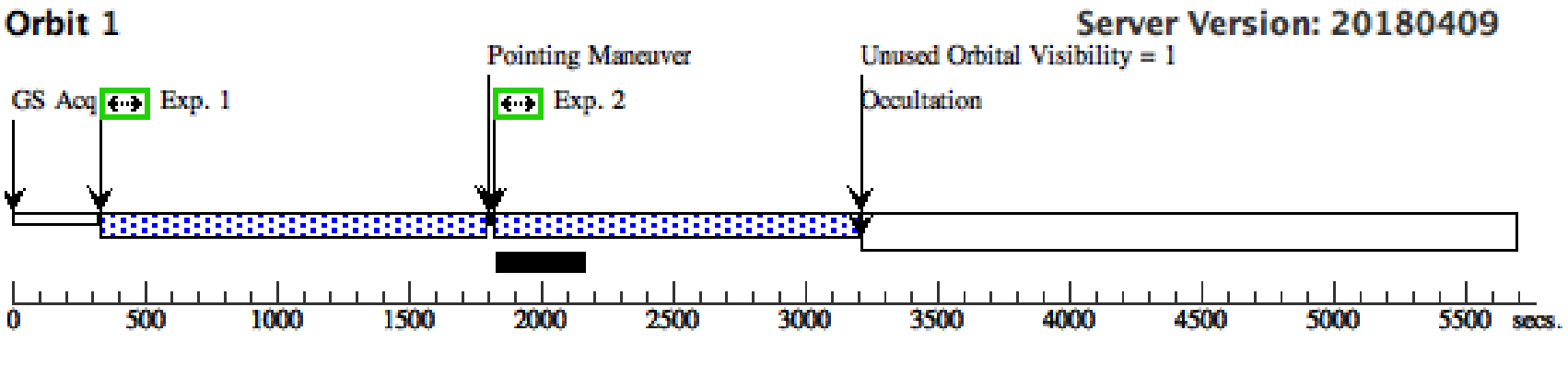
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2012Z	RA: 03 22 5.3500 (50.5222917d) Dec: -15 23 15.60 (-15.38767d) Equinox: J2000		V=27.6+/-2.0	Reference Frame: ICRS

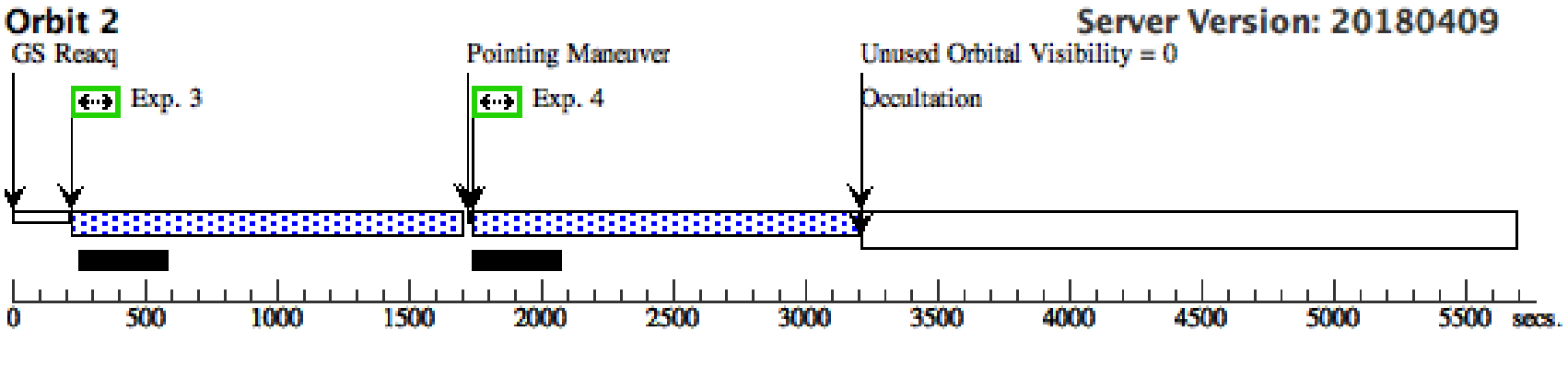
Comments:
Category=EXT-STAR
Description=[SUPERNOVA]

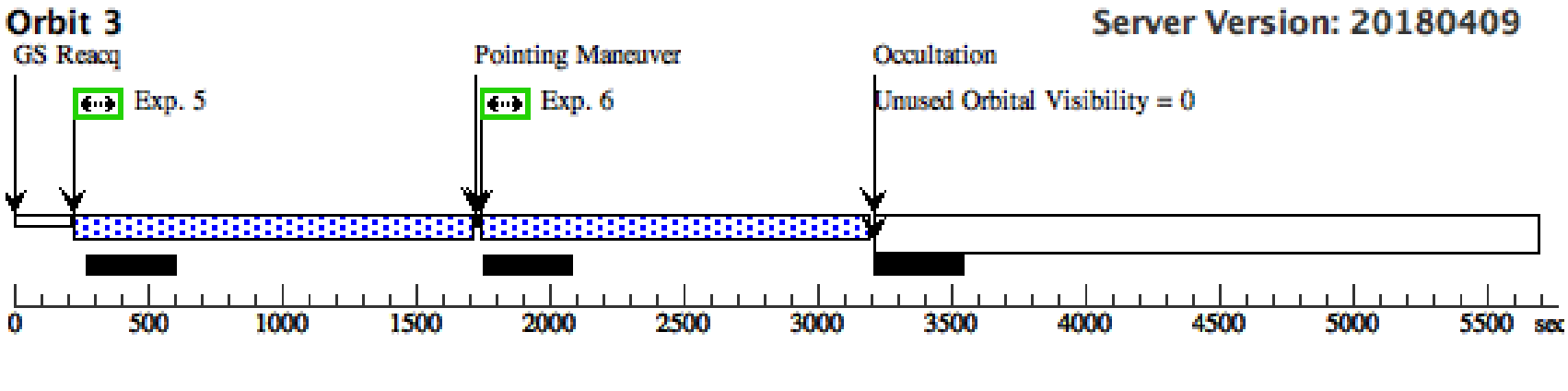
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F435W		POS TARG 0.124,0.232		1252 Secs (1252 Secs)	
								[==>]	***[1]***
2		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F435W		POS TARG -0.124,0.138		1252 Secs (1252 Secs)	
								[==>]	***[1]***
3		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F814W		POS TARG -0.124,0.138		1338 Secs (1338 Secs)	
								[==>]	***[2]***
4		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0.124,0.232		1338 Secs (1338 Secs)	
								[==>]	***[2]***
5		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.124,0.232		1329 Secs (1329 Secs)	
								[==>]	***[3]***
6		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG -0.124,0.138		1329 Secs (1329 Secs)	
								[==>]	***[3]***

Orbit Structure







Visit

Proposal 15205, Visit 03, scheduling Mon Sep 17 15:00:17 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: SAME ORIENT AS 01; AFTER 01-JUL-2018:00:00:00

Fixed Targets

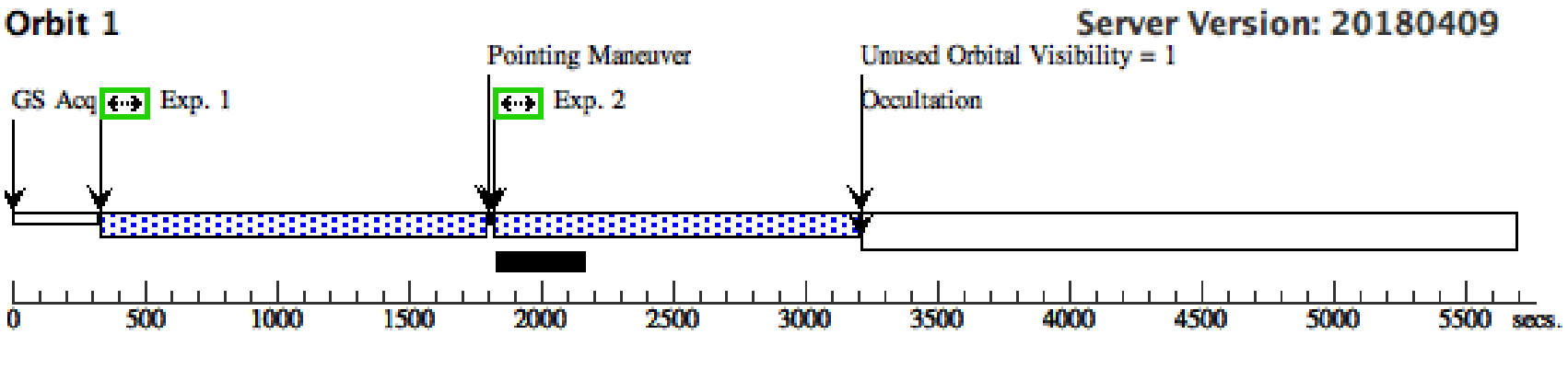
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2012Z	RA: 03 22 5.3500 (50.5222917d) Dec: -15 23 15.60 (-15.38767d) Equinox: J2000		V=27.6+/-2.0	Reference Frame: ICRS

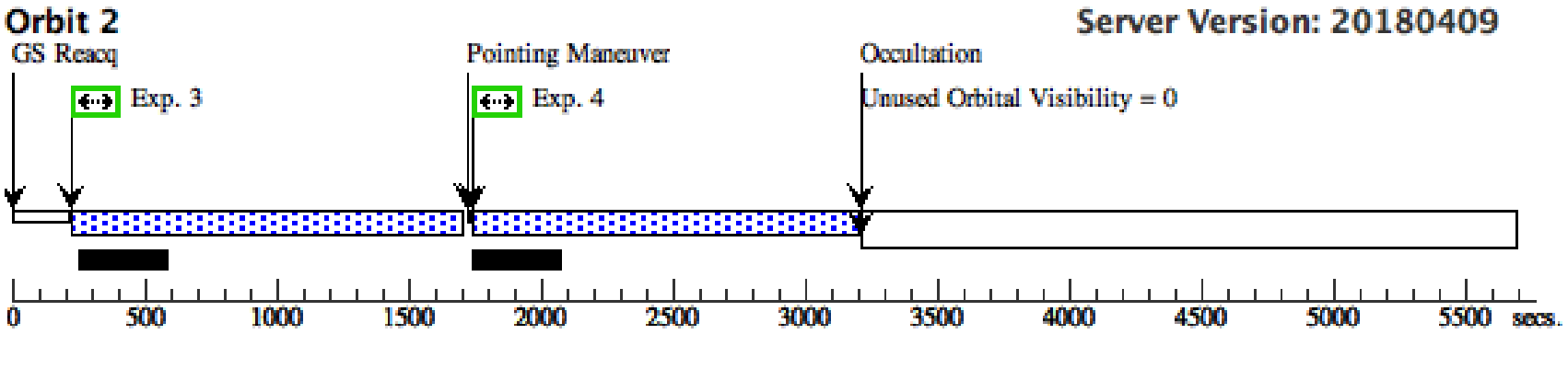
Comments:
Category=EXT-STAR
Description=[SUPERNOVA]

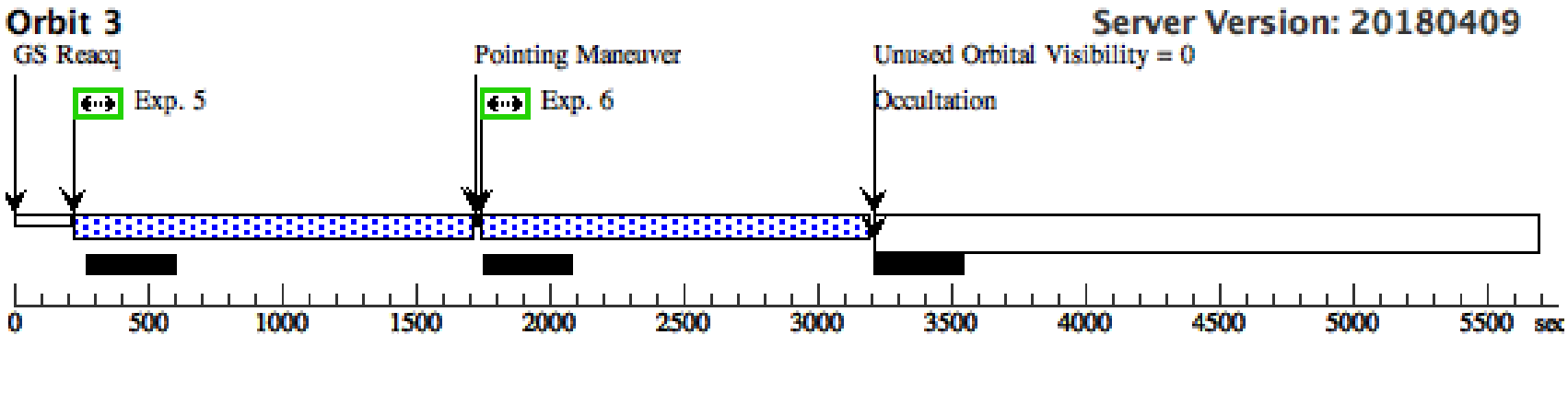
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F435W		POS TARG 0.000,0.000		1252 Secs (1252 Secs)	
								[==>]	***[1]***
2		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F435W		POS TARG 0.247,0.094		1252 Secs (1252 Secs)	
								[==>]	***[1]***
3		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0.247,0.094		1338 Secs (1338 Secs)	
								[==>]	***[2]***
4		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0.000,0.000		1338 Secs (1338 Secs)	
								[==>]	***[2]***
5		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.000,0.000		1329 Secs (1329 Secs)	
								[==>]	***[3]***
6		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.247,0.094		1329 Secs (1329 Secs)	
								[==>]	***[3]***

Orbit Structure







Visit

Proposal 15205, Visit 04, scheduling Mon Sep 17 15:00:18 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: SAME ORIENT AS 01; AFTER 01-JUL-2018:00:00:00

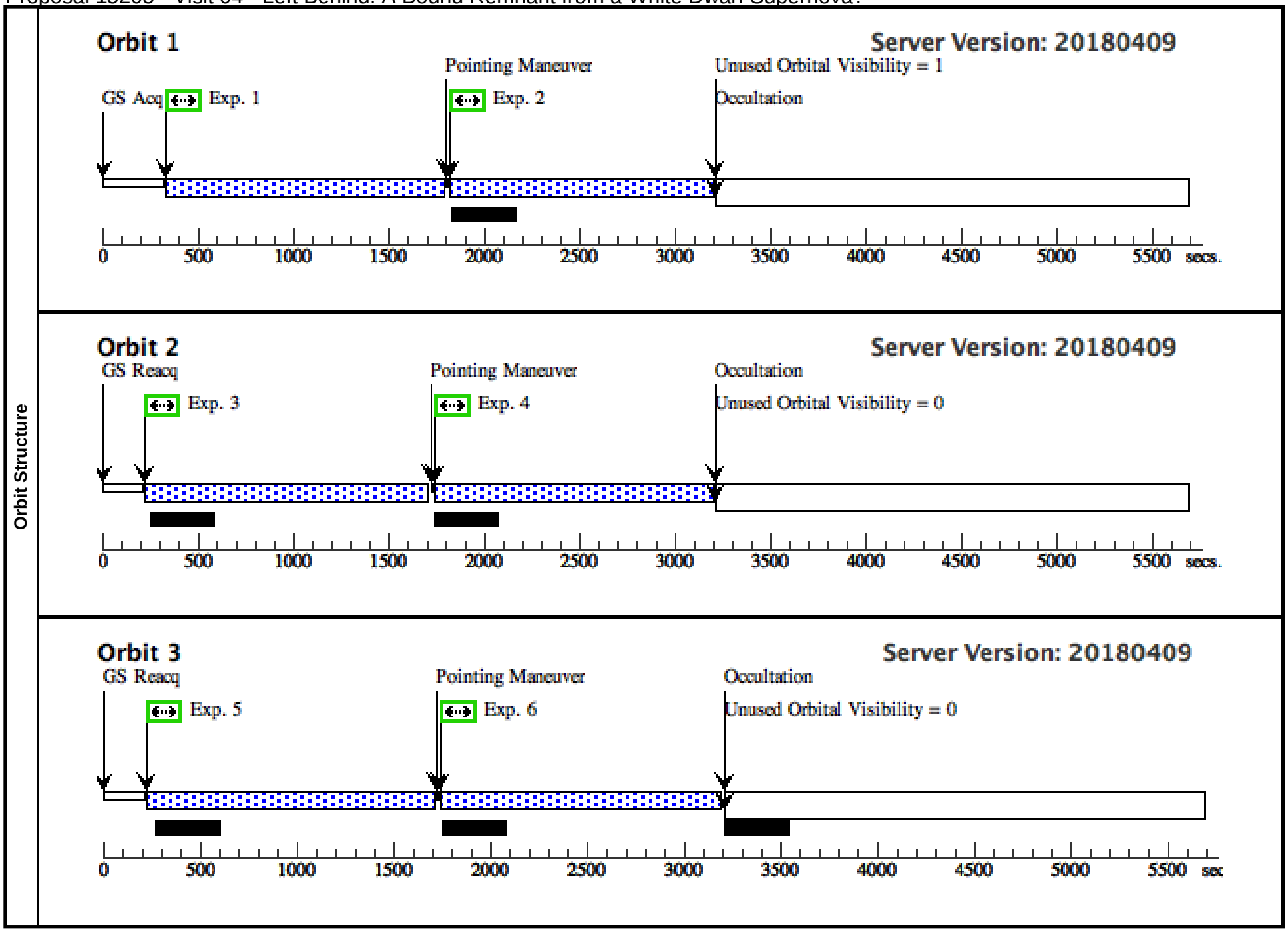
Fixed Targets

#	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

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) SN-2012Z	ACS/WFC, ACCUM, WFC1	F435W		POS TARG 0.124,0.232		1252 Secs (1252 Secs)	
								[==>]	***[1]***
2		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F435W		POS TARG -0.124,0.138		1252 Secs (1252 Secs)	
								[==>]	***[1]***
3		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F814W		POS TARG -0.124,0.138		1338 Secs (1338 Secs)	
								[==>]	***[2]***
4		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0.124,0.232		1338 Secs (1338 Secs)	
								[==>]	***[2]***
5		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.124,0.232		1329 Secs (1329 Secs)	
								[==>]	***[3]***
6		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG -0.124,0.138		1329 Secs (1329 Secs)	
								[==>]	***[3]***


Orbit Structure
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GS Acq
Exp. 1
Pointing Maneuver
Exp. 2
Unused Orbital Visibility = 1
Occultation
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Orbit 2
Server Version: 20180409
GS Reacq
Exp. 3
Pointing Maneuver
Exp. 4
Occultation
Unused Orbital Visibility = 0
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Orbit 3
Server Version: 20180409
GS Reacq
Exp. 5
Pointing Maneuver
Exp. 6
Occultation
Unused Orbital Visibility = 0
0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 sec

Proposal 15205 - Visit 05 - Left Behind: A Bound Remnant from a White Dwarf Supernova?

Visit

Proposal 15205, Visit 05, completed Mon Sep 17 15:00:18 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: ORIENT 240D TO 80 D; AFTER 01-JUL-2018:00:00:00

Fixed Targets

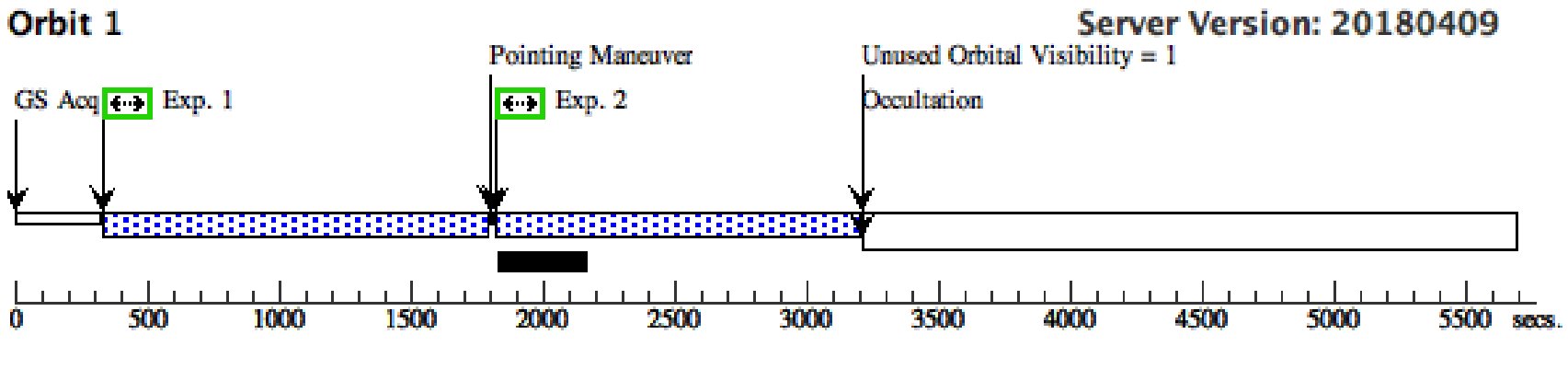
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2012Z	RA: 03 22 5.3500 (50.5222917d) Dec: -15 23 15.60 (-15.38767d) Equinox: J2000		V=27.6+/-2.0	Reference Frame: ICRS

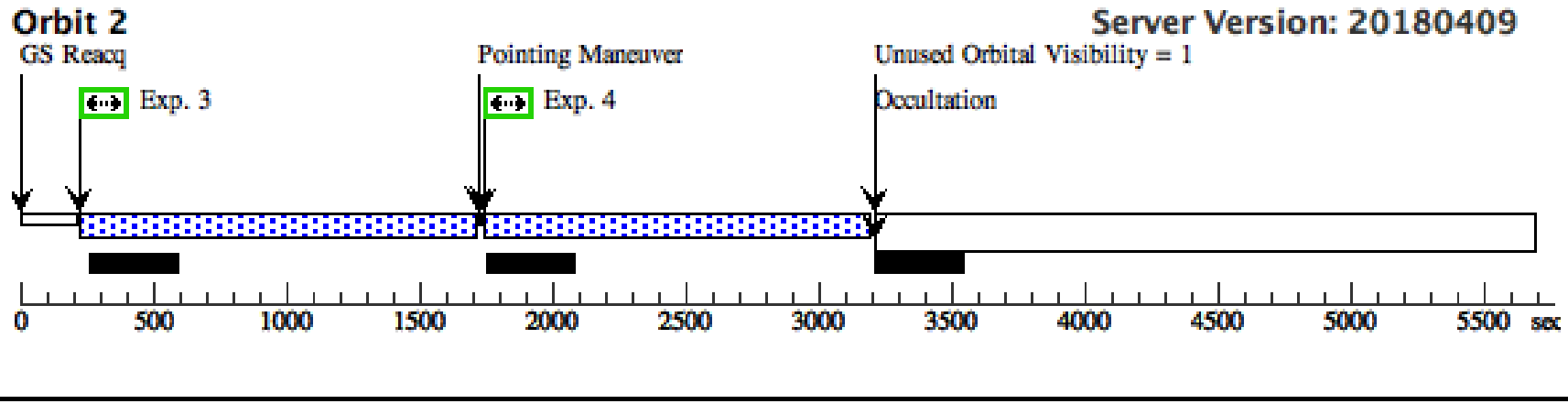
Comments:
Category=EXT-STAR
Description=[SUPERNOVA]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.000,0.000		1252 Secs (1252 Secs)	
								[==>]	***[1]***
2		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.247,0.094		1252 Secs (1252 Secs)	
								[==>]	***[1]***
3		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0.247,0.094		1329 Secs (1329 Secs)	
								[==>]	***[2]***
4		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F814W		POS TARG 0.000,0.000		1329 Secs (1329 Secs)	
								[==>]	***[2]***

Orbit Structure





Visit

Proposal 15205, Visit 55 Mon Sep 17 15:00:18 GMT 2018

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: ORIENT 240D TO 80 D; AFTER 01-JUL-2018:00:00:00

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

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) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.000,0.000		1252 Secs (1252 Secs) *[==>]*	 ***[1]***
2		(1) SN-2012Z	ACS/WFC, ACCUM, WFC1	F555W		POS TARG 0.247,0.094		1252 Secs (1252 Secs) *[==>]*	 ***[1]***

Orbit Structure