14155 - Using Stellar Evolution as a Clock to Watch the Dynamical Evolution of a Globular Cluster

Cycle: 23, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

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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) NGC-362	ACS/WFC WFC3/UVIS	5	24-Jul-2015 21:57:28.0	yes

5 Total Orbits Used

ABSTRACT

We propose a 5 orbit HST program to acquire UV imaging at the center of the massive globular cluster NGC 362, in order to directly measure the rate of diffusion of stars through its core. This measurement will overcome a major observational barrier; that the dynamical time scale for two-body relaxation in the core of a globular cluster is typically much shorter than the age of the population, and so mass segregation in the cluster occured billions of years ago. Our novel technique aims to resolve this dynamical evolution by using the full power of WFC3's exquisite UV sensitivity at <0.3 microns combined with its high spatial resolution. We will uncover ~1000 newly formed stellar remnants - white dwarfs - in the center of the globular cluster and track how their spatial distribution changes as they get "older" on the cooling sequence. Having just experienced a significant episode of mass loss, the youngest white dwarfs with ages <10s of Myr will still be moving slowly like their 0.8 Msun progenitors, whereas the "older" white dwarfs that have been cooling for >100s of Myr will be fully relaxed. To "watch" this dynamical evolution and directly measure the diffusion coefficient, we have selected the very populous globular cluster NGC 362. The cluster is nearby with low reddening, has moderate concentration, and has a theoretical expected relaxation timescale of 60 Myr in its core, perfect to split the young and old white dwarfs that we can observe with Hubble.

OBSERVING DESCRIPTION

We are obtaining UV imaging with WFC3/UVIS in F225W and F275W of the core of NGC 362, and parallel ACS imaging in F435W and F555W of an outer field. The goal of the program is to measure the spatial distribution of newly formed white dwarfs and compare them to "older" remnants. Although both populations have the same mass, the newly formed remnants were much heavier less than one relaxation time ago. The difference will constrain the diffusion constant due to dynamical relaxation. For the WFC3/UVIS observations, we place the core of the globular cluster near the center of the WFC3 field and obtain 1 short and 4 long (dithered) exposures in each orbit. Post flash has been added to ensure 12 e- in each exposure to mitigate CTE. The parallel field will image a part of the cluster at larger radii for additional constraints on the spatial distribution of cool white dwarfs. All observations require a standard dither, implemented through POSTARGs.

We have added an ORIENT constraint to ensure that the field nicely overlaps the archival F275W observations that will be coadded with this data.

Visit

Proposal 14155, Visit 01 Sat Jul 25 01:57:32 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS, ACS/WFC

Special Requirements: ORIENT 180D TO 220 D; ORIENT 0D TO 40 D

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NGC-362	RA: 01 03 14.2600 (15.8094167d) Dec: -70 50 55.60 (-70.84878d) Equinox: J2000		V=6.58	Reference Frame: SIMBAD

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

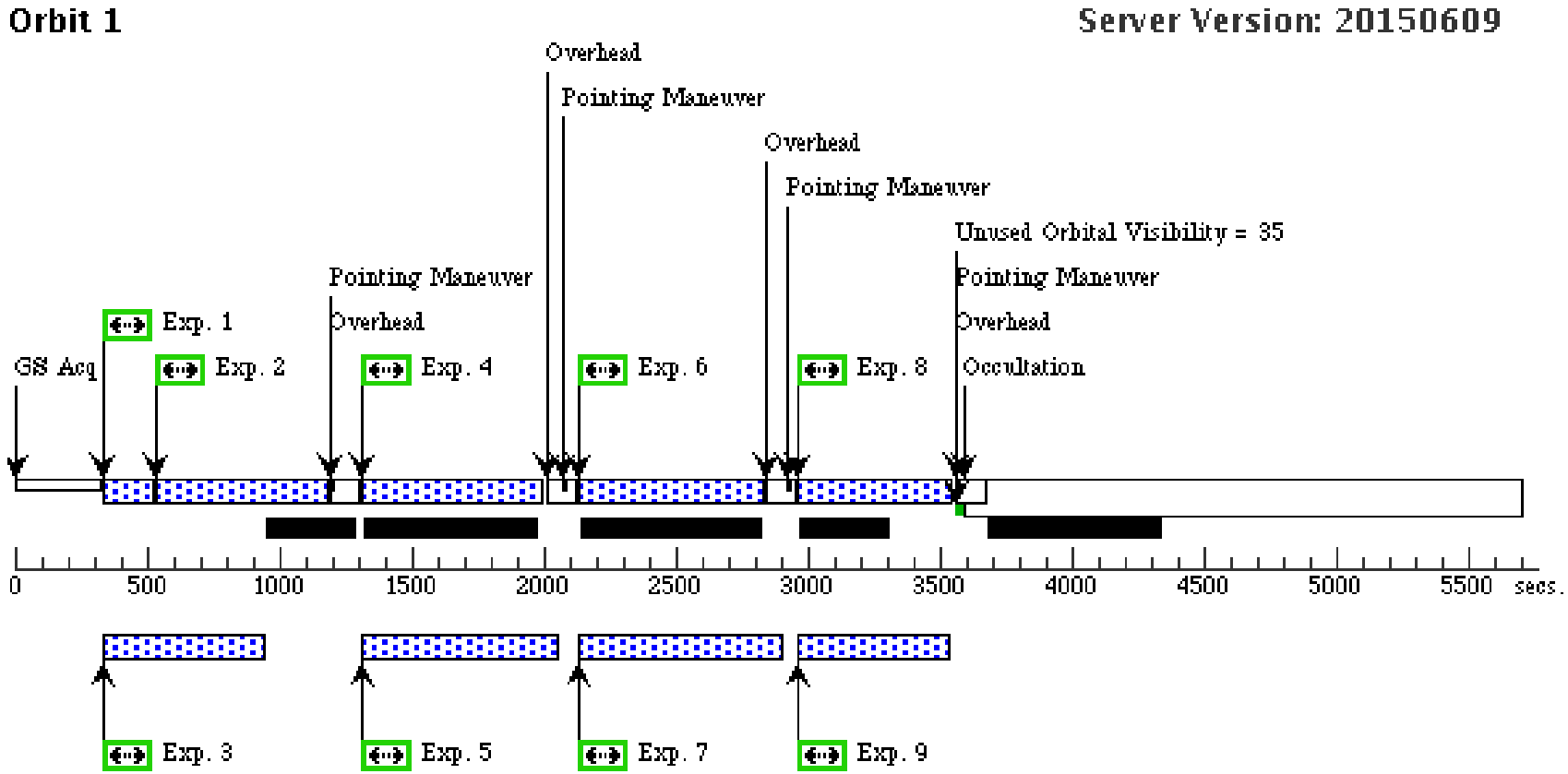
Exposures

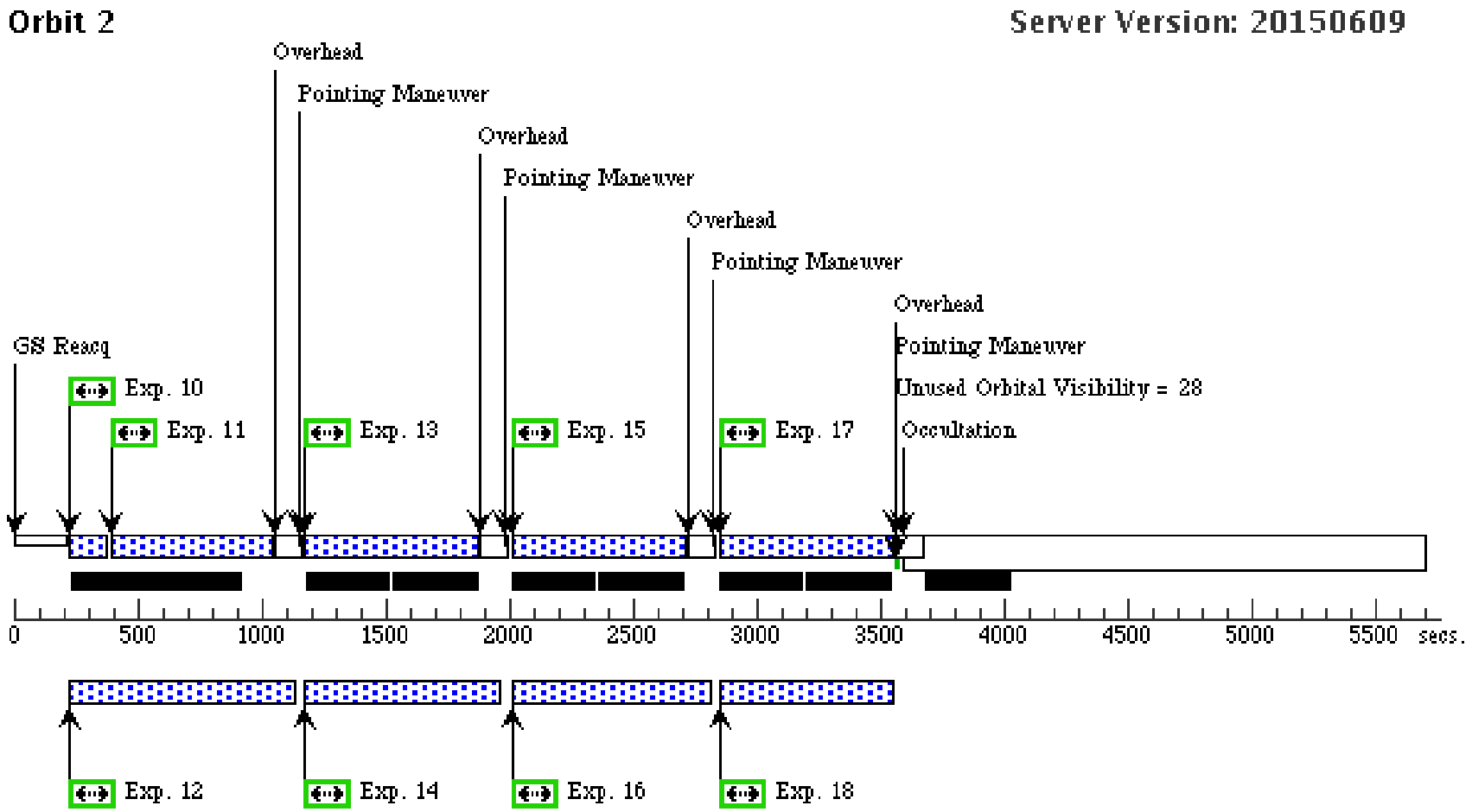
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG 0,-15	Prime + Parallel Group 1-3 in Visit 01	30 Secs (30 Secs)	
								[==>]	***[1]***
2		(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG 0,-15	Prime + Parallel Group 1-3 in Visit 01	650 Secs (650 Secs)	
								[==>]	***[1]***
3		(1) NGC-362	ACS/WFC, ACCUM, WFC	F435W			Prime + Parallel Group 1-3 in Visit 01	400 Secs (400 Secs)	
								[==>]	***[1]***
4		(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG 0.158,-15.070	Prime + Parallel Group 4-5 in Visit 01	680 Secs (680 Secs)	
								[==>]	***[1]***
5		(1) NGC-362	ACS/WFC, ACCUM, WFC	F435W			Prime + Parallel Group 4-5 in Visit 01	620 Secs (620 Secs)	
								[==>]	***[1]***
6		(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG 0.099,-15.165	Prime + Parallel Group 6-7 in Visit 01	700 Secs (700 Secs)	
								[==>]	***[1]***
7		(1) NGC-362	ACS/WFC, ACCUM, WFC	F435W			Prime + Parallel Group 6-7 in Visit 01	650 Secs (650 Secs)	
								[==>]	***[1]***
8		(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG -0.060,-15.298	Prime + Parallel Group 8-9 in Visit 01	580 Secs (580 Secs)	
								[==>]	***[1]***
9		(1) NGC-362	ACS/WFC, ACCUM, WFC	F435W			Prime + Parallel Group 8-9 in Visit 01	450 Secs (450 Secs)	
								[==>]	***[1]***
10		(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG -0.120,-15.358	Prime + Parallel Group 10-12 in Visit 01	30 Secs (30 Secs)	
								[==>]	***[2]***
11		(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG -0.120,-15.358	Prime + Parallel Group 10-12 in Visit 01	650 Secs (650 Secs)	
								[==>]	***[2]***
12		(1) NGC-362	ACS/WFC, ACCUM, WFC	F435W			Prime + Parallel Group 10-12 in Visit 01	790 Secs (790 Secs)	
								[==>]	***[2]***
13		(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG -0.6,-15.50	Prime + Parallel Group 13-14 in Visit 01	700 Secs (700 Secs)	
								[==>]	***[2]***
14		(1) NGC-362	ACS/WFC, ACCUM, WFC	F435W			Prime + Parallel Group 13-14 in Visit 01	670 Secs (670 Secs)	
								[==>]	***[2]***
15		(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG -1.1,-15.71	Prime + Parallel Group 15-16 in Visit 01	700 Secs (700 Secs)	
								[==>]	***[2]***
16		(1) NGC-362	ACS/WFC, ACCUM, WFC	F435W			Prime + Parallel Group 15-16 in Visit 01	680 Secs (680 Secs)	
								[==>]	***[2]***
17		(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG -1.55,-17.21	Prime + Parallel Group 17-18 in Visit 01	700 Secs (700 Secs)	
								[==>]	***[2]***
18		(1) NGC-362	ACS/WFC, ACCUM, WFC	F435W			Prime + Parallel Group 17-18 in Visit 01	580 Secs (580 Secs)	
								[==>]	***[2]***
19		(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG 0,-17.21	Prime + Parallel Group 19-21 in Visit 01	30 Secs (30 Secs)	
								[==>]	***[3]***
20		(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG 0,-17.21	Prime + Parallel Group 19-21 in Visit 01	650 Secs (650 Secs)	
								[==>]	***[3]***
21		(1) NGC-362	ACS/WFC, ACCUM, WFC	F435W			Prime + Parallel Group 19-21 in Visit 01	790 Secs (790 Secs)	
								[==>]	***[3]***
22		(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG 0.158,-17.28	Prime + Parallel Group 22-23 in Visit 01	700 Secs (700 Secs)	
								[==>]	***[3]***

23	(1) NGC-362	ACS/WFC, ACCUM, WFC	F435W			Prime + Parallel Group up 22-23 in Visit 01	670 Secs (670 Secs) *[==>]*	 ***[3]***
24	(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG 0.099,-17.375	Prime + Parallel Group up 24-25 in Visit 01	700 Secs (700 Secs) *[==>]*	 ***[3]***
25	(1) NGC-362	ACS/WFC, ACCUM, WFC	F435W			Prime + Parallel Group up 24-25 in Visit 01	680 Secs (680 Secs) *[==>]*	 ***[3]***
26	(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG -0.060,-17.508	Prime + Parallel Group up 26-27 in Visit 01	700 Secs (700 Secs) *[==>]*	 ***[3]***
27	(1) NGC-362	ACS/WFC, ACCUM, WFC	F435W			Prime + Parallel Group up 26-27 in Visit 01	580 Secs (580 Secs) *[==>]*	 ***[3]***
28	(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W	FLASH=12	POS TARG 0,-15	Prime + Parallel Group up 28-30 in Visit 01	30 Secs (30 Secs) *[==>]*	 ***[4]***
29	(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W	FLASH=12	POS TARG 0,-15	Prime + Parallel Group up 28-30 in Visit 01	650 Secs (650 Secs) *[==>]*	 ***[4]***
30	(1) NGC-362	ACS/WFC, ACCUM, WFC	F555W			Prime + Parallel Group up 28-30 in Visit 01	770 Secs (770 Secs) *[==>]*	 ***[4]***
31	(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG -0.7,-17.10	Prime + Parallel Group up 31-32 in Visit 01	680 Secs (680 Secs) *[==>]*	 ***[4]***
32	(1) NGC-362	ACS/WFC, ACCUM, WFC	F555W			Prime + Parallel Group up 31-32 in Visit 01	670 Secs (670 Secs) *[==>]*	 ***[4]***
33	(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG -0.4,-16.80	Prime + Parallel Group up 33-34 in Visit 01	700 Secs (700 Secs) *[==>]*	 ***[4]***
34	(1) NGC-362	ACS/WFC, ACCUM, WFC	F555W			Prime + Parallel Group up 33-34 in Visit 01	680 Secs (680 Secs) *[==>]*	 ***[4]***
35	(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12	POS TARG -0.1,-16.50	Prime + Parallel Group up 35-36 in Visit 01	680 Secs (680 Secs) *[==>]*	 ***[4]***
36	(1) NGC-362	ACS/WFC, ACCUM, WFC	F555W			Prime + Parallel Group up 35-36 in Visit 01	560 Secs (560 Secs) *[==>]*	 ***[4]***
37	(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W	FLASH=12	POS TARG 0.158,-16.303	Prime + Parallel Group up 37-39 in Visit 01	30 Secs (30 Secs) *[==>]*	 ***[5]***
38	(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W	FLASH=12	POS TARG 0.158,-16.303	Prime + Parallel Group up 37-39 in Visit 01	650 Secs (650 Secs) *[==>]*	 ***[5]***
39	(1) NGC-362	ACS/WFC, ACCUM, WFC	F555W			Prime + Parallel Group up 37-39 in Visit 01	790 Secs (790 Secs) *[==>]*	 ***[5]***
40	(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W	FLASH=12	POS TARG 0.099,-16.398	Prime + Parallel Group up 40-41 in Visit 01	700 Secs (700 Secs) *[==>]*	 ***[5]***
41	(1) NGC-362	ACS/WFC, ACCUM, WFC	F555W			Prime + Parallel Group up 40-41 in Visit 01	670 Secs (670 Secs) *[==>]*	 ***[5]***
42	(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W	FLASH=12	POS TARG -0.060,-16.531	Prime + Parallel Group up 42-43 in Visit 01	700 Secs (700 Secs) *[==>]*	 ***[5]***
43	(1) NGC-362	ACS/WFC, ACCUM, WFC	F555W			Prime + Parallel Group up 42-43 in Visit 01	680 Secs (680 Secs) *[==>]*	 ***[5]***
44	(1) NGC-362	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W	FLASH=12	POS TARG 0.158,-15.070	Prime + Parallel Group up 44-45 in Visit 01	680 Secs (680 Secs) *[==>]*	 ***[5]***

	45	(1) NGC-362	ACS/WFC, ACCUM, WFC	F555W		Prime + Parallel Group 44-45 in Visit 01	560 Secs (560 Secs) [==>]	 [5]

Orbit Structure

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Pointing Maneuver
Overhead
Pointing Maneuver
Overhead
Pointing Maneuver
Overhead
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Exp. 10
Exp. 11
Exp. 13
Exp. 15
Exp. 17
Unused Orbital Visibility = 28
Occultation
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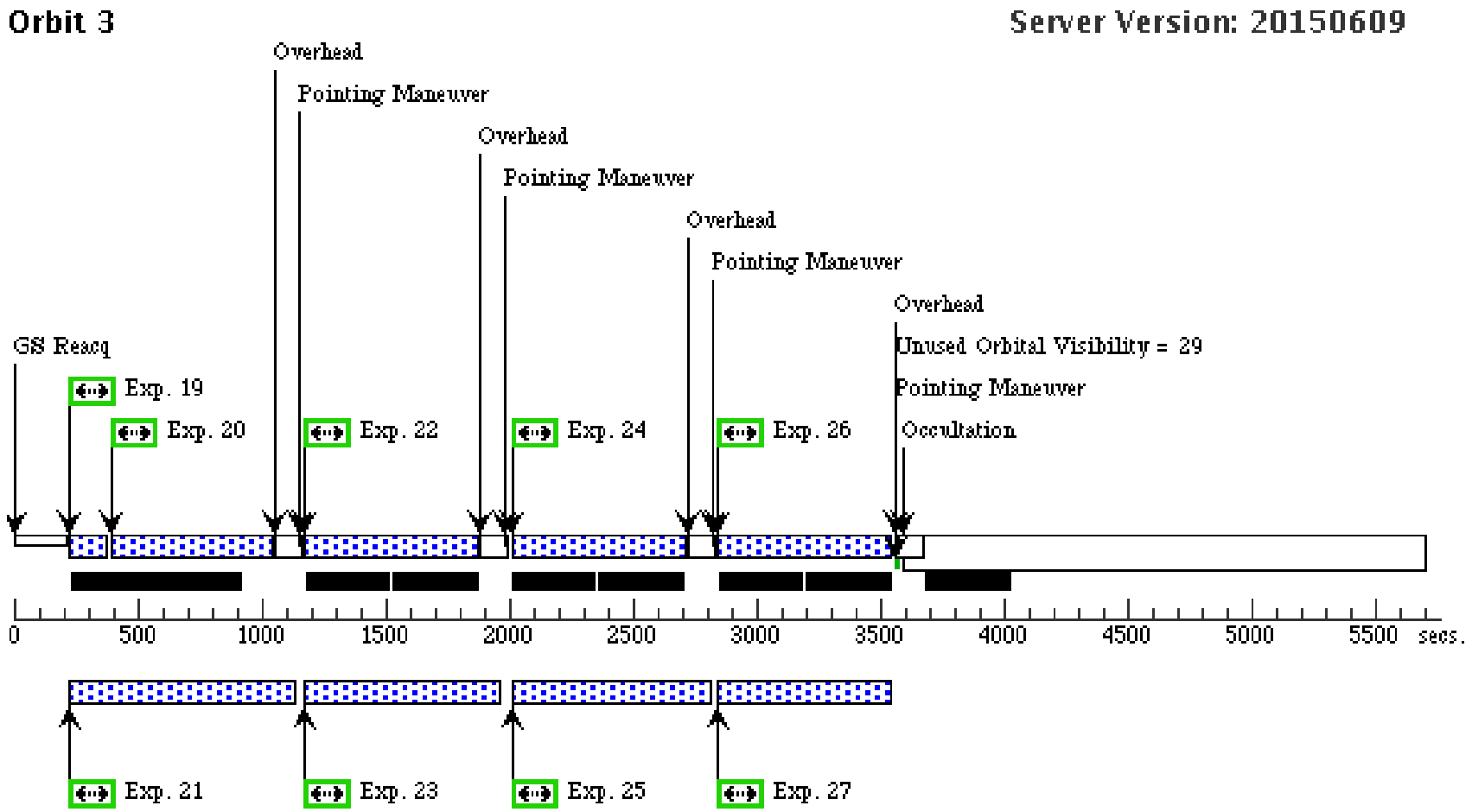
secs.
Exp. 12
Exp. 14
Exp. 16
Exp. 18


Orbit 3
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Pointing Maneuver
Overhead
Pointing Maneuver
Overhead
Pointing Maneuver
Overhead
Unused Orbital Visibility = 29
Pointing Maneuver
Occultation
GS Reacq
Exp. 19
Exp. 20
Exp. 22
Exp. 24
Exp. 26
0
500
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4500
5000
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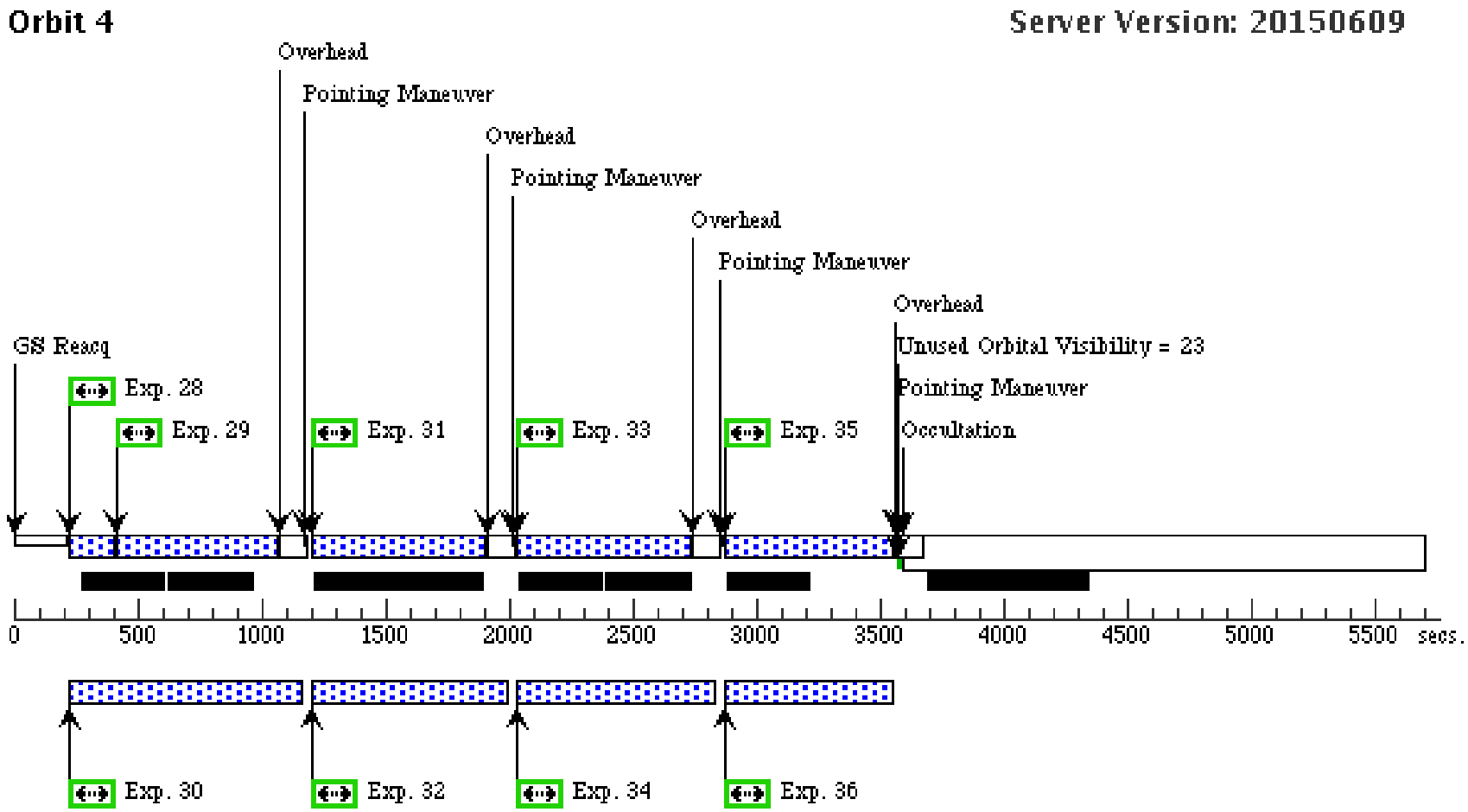
secs.
Exp. 21
Exp. 23
Exp. 25
Exp. 27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Overhead
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Pointing Maneuver
Overhead
Unused Orbital Visibility = 23
Pointing Maneuver
Occultation
GS Reacq
Exp. 28
Exp. 29
Exp. 31
Exp. 33
Exp. 35
0
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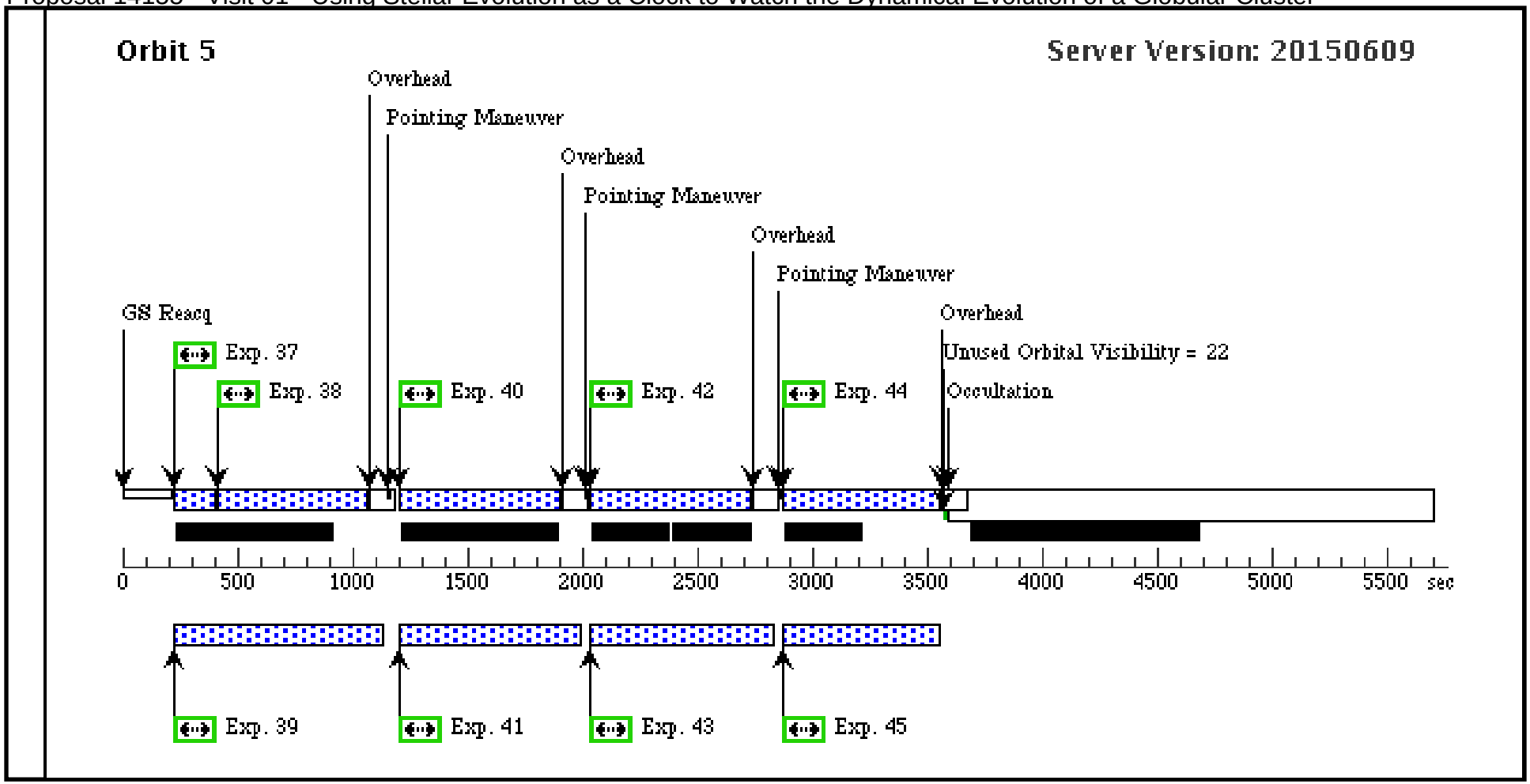
Orbit 5
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Exp. 38
Exp. 40
Exp. 42
Exp. 44
Unused Orbital Visibility = 22
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5500
sec
Exp. 39
Exp. 41
Exp. 43
Exp. 45