18190 - Transient LMXBs in globular clusters

Cycle: 33, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
Dr. Jeroen Homan (PI) (Contact)	**Eureka Scientific Inc.**
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Dr. Craig Heinke (CoI) (CSA Member)	University of Alberta

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) GCTRANSIENT1	WFC3/UVIS	2	13-Oct-2025 18:00:14.0	yes
02	(2) GCTRANSIENT2	WFC3/UVIS	2	13-Oct-2025 18:00:15.0	yes

4 Total Orbits Used

ABSTRACT

Deep Chandra observations of globular clusters have revealed that globular clusters contain numerous quiescent LMXBs, any of which could go into outburst. Recent Chandra studies have confirmed that globular clusters can indeed harbor multiple transients and that more quiescent LMXBs are hiding under the sensitivity limits of even relatively deep Chandra exposures. Both findings have significant implications for studies of accreting neutron stars and have provided better insight into globular cluster compact binary populations. Here we propose a Chandra program to precisely localize new transients in globular clusters. As part of this effort we further request HST observations to identify the optical counterparts of these transients.

OBSERVING DESCRIPTION

The goal of this joint Chandra/HST Target-of-Opportunity (ToO) proposal is to measure accurate coordinates of the next two X-ray transients in a globular cluster with Chandra, and to use HST subsequently to look for their optical counterparts inside the Chandra positional error circles. The Chandra error circle is large enough (about 0.6" radius) that it likely contains multiple globular-cluster stars. Comparison of the photometry that is extracted from the observations requested here (to be taken about 25 days after triggering the proposal) with photometry from archival HST data reveals highly variable objects in the error circle, and hence the identity of the true counterpart. Our choice for the WFC3/UVIS is driven by the existence of a large body of archival globular-cluster images taken with this camera.

We have been allocated time to do Chandra/HST follow-up for two X-ray transients. For the HST component we have been granted 4 HST orbits in total (two orbits per transient). Our current program consists of two completely independent but identifical visits of two orbits each. One orbit in a visit is spent on observations in the F606W band, and the other orbit on observations in the F814W band. We note that the final filter choice, the observation sequence and the exposure times depend on the target that will be observed. We will try to match the filters to those that were used in archival HST observations of the selected source. This Phase-2 program should therefore be considered as a placeholder.

In each filter we take one short exposure (30s) to extract photometry of relatively bright stars that would otherwise saturate in the longer exposures. In addition, we obtain a sequence of longer exposures with a 4-point or 5-point dither pattern depending on the duration of the orbit, which is set once the target cluster is known. The dither pattern is defined by POS-TARG offsets entered manually and taken from ISR_2020-07. To elevate the background levels, we have added a post-flash to each exposure.

Given the ToO nature of our program, our targets have been defined as two generic targets with unknown coordinates. Once the coordinates are known, we can fine-tune the observational setup, such as the exposure times and number of exposures, as well as the detailed placement of the target (i.e. the Chandra error circle) on the WFC3/UVIS detectors.

** Impact of reduced-gyro operations

The primary impact of reduced-gyro operations is a reduction of HST's field of regard. Therefore, we expect that the main effect on our program is a possible reduced likelihood of responding to our Target-of-Opportunity trigger within the requested time frame of 25 days.

Visit

Proposal 18190, Visit-Transient1 (01), implementation Mon Oct 13 22:00:15 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ON HOLD ; TOO RESPONSE TIME 25.0D

On Hold Comments: Target of Opportunity

Generic Targets

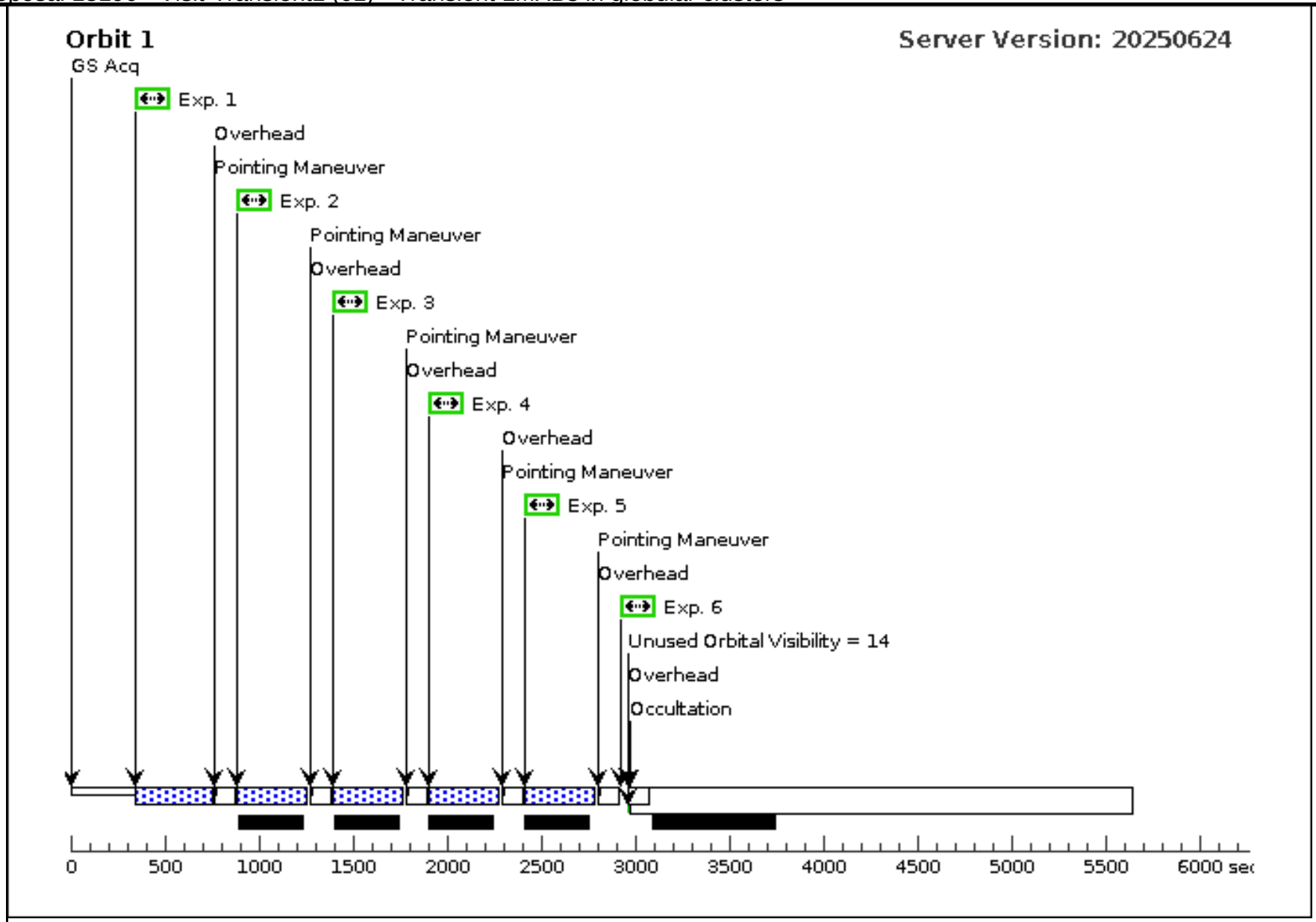
#	Name	Criteria	Description
(1)	GCTRANSIENT1	first trigger of globular-cluster X-ray transient program	X-RAY TRANSIENT

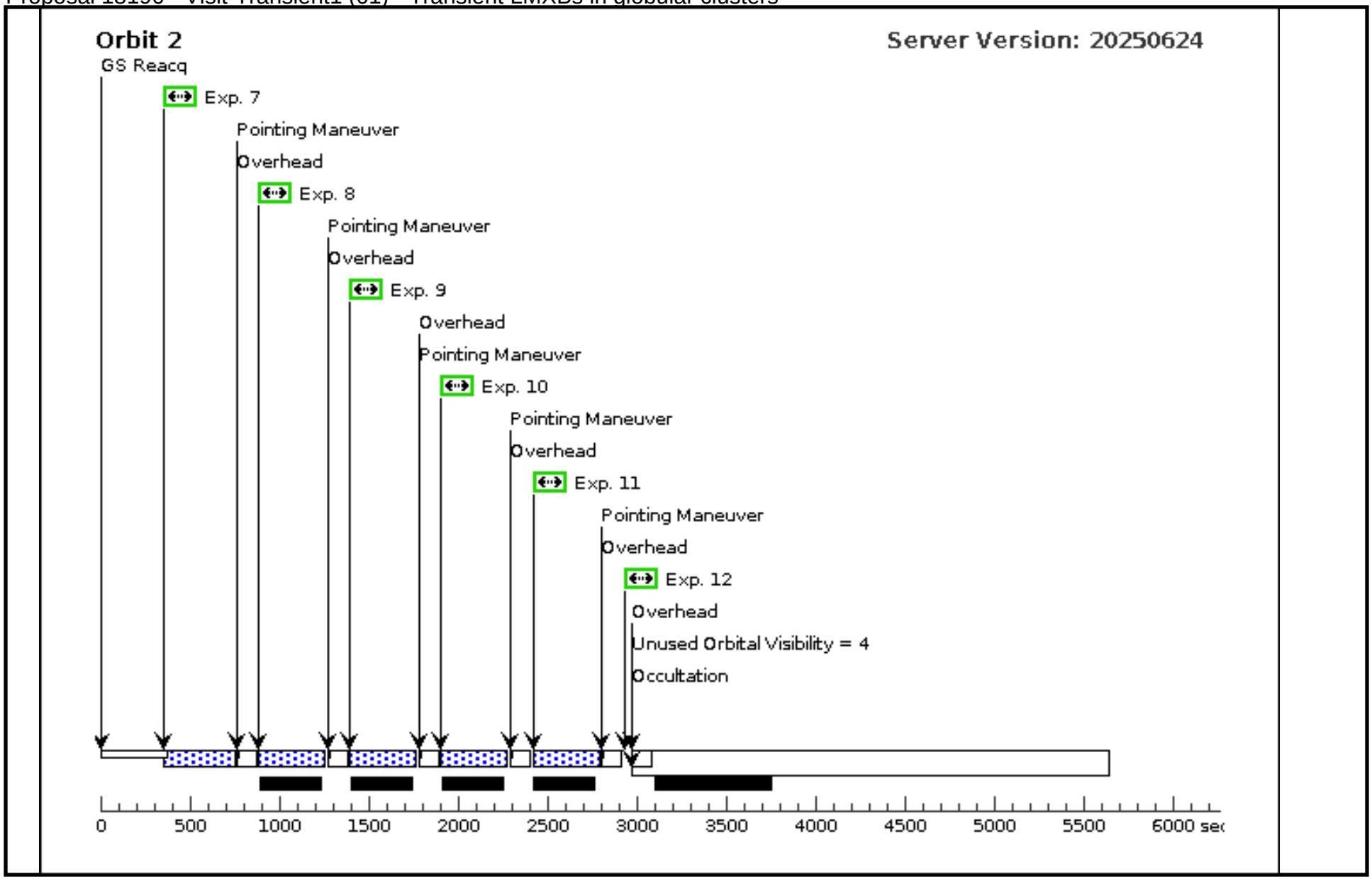
Comments: next X-ray transient discovered in a Galactic globular cluster, whose position can only be accurately determined with Chandra

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	long-V-1	(1) GCTRANSIENT 1	WFC3/UVIS, ACCUM, UVIS2	F606W	FLASH=5	POS TARG 0,0		376 Secs (376 Secs) *[==>]*	 ***[1]***
2	long-V-2	(1) GCTRANSIENT 1	WFC3/UVIS, ACCUM, UVIS2	F606W	FLASH=5	POS TARG 0.1719,0 .1837		376 Secs (376 Secs) *[==>]*	 ***[1]***
3	long-V-3	(1) GCTRANSIENT 1	WFC3/UVIS, ACCUM, UVIS2	F606W	FLASH=5	POS TARG 0.3437,0 .3674		376 Secs (376 Secs) *[==>]*	 ***[1]***
4	long-V-4	(1) GCTRANSIENT 1	WFC3/UVIS, ACCUM, UVIS2	F606W	FLASH=5	POS TARG 0.4760,0 .5286		376 Secs (376 Secs) *[==>]*	 ***[1]***
5	long-V-5	(1) GCTRANSIENT 1	WFC3/UVIS, ACCUM, UVIS2	F606W	FLASH=5	POS TARG 0.6544,0 .6796		376 Secs (376 Secs) *[==>]*	 ***[1]***
6	short-V	(1) GCTRANSIENT 1	WFC3/UVIS, ACCUM, UVIS2	F606W	FLASH=15			30 Secs (30 Secs) *[==>]*	 ***[1]***
7	long-I-1	(1) GCTRANSIENT 1	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=10	POS TARG 0,0		376 Secs (376 Secs) *[==>]*	 ***[2]***
8	long-I-2	(1) GCTRANSIENT 1	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=10	POS TARG 0.1719,0 .1837		376 Secs (376 Secs) *[==>]*	 ***[2]***
9	long-I-3	(1) GCTRANSIENT 1	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=10	POS TARG 0.3437,0 .3674		376 Secs (376 Secs) *[==>]*	 ***[2]***
10	long-I-4	(1) GCTRANSIENT 1	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=10	POS TARG 0.4760,0 .5286		376 Secs (376 Secs) *[==>]*	 ***[2]***
11	long-I-5	(1) GCTRANSIENT 1	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=10	POS TARG 0.6544,0 .6796		376 Secs (376 Secs) *[==>]*	 ***[2]***
12	short-I	(1) GCTRANSIENT 1	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=20			30 Secs (30 Secs) *[==>]*	 ***[2]***

Orbit Structure




Orbit 2
Server Version: 20250624
GS Reacq
Exp. 7
Pointing Maneuver
Overhead
Exp. 8
Pointing Maneuver
Overhead
Exp. 9
Overhead
Pointing Maneuver
Exp. 10
Pointing Maneuver
Overhead
Exp. 11
Pointing Maneuver
Overhead
Exp. 12
Overhead
Unused Orbital Visibility = 4
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Visit

Proposal 18190, Visit-Transient2 (02), implementation Mon Oct 13 22:00:16 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ON HOLD ; TOO RESPONSE TIME 25.0D

On Hold Comments: Target of Opportunity

Generic Targets

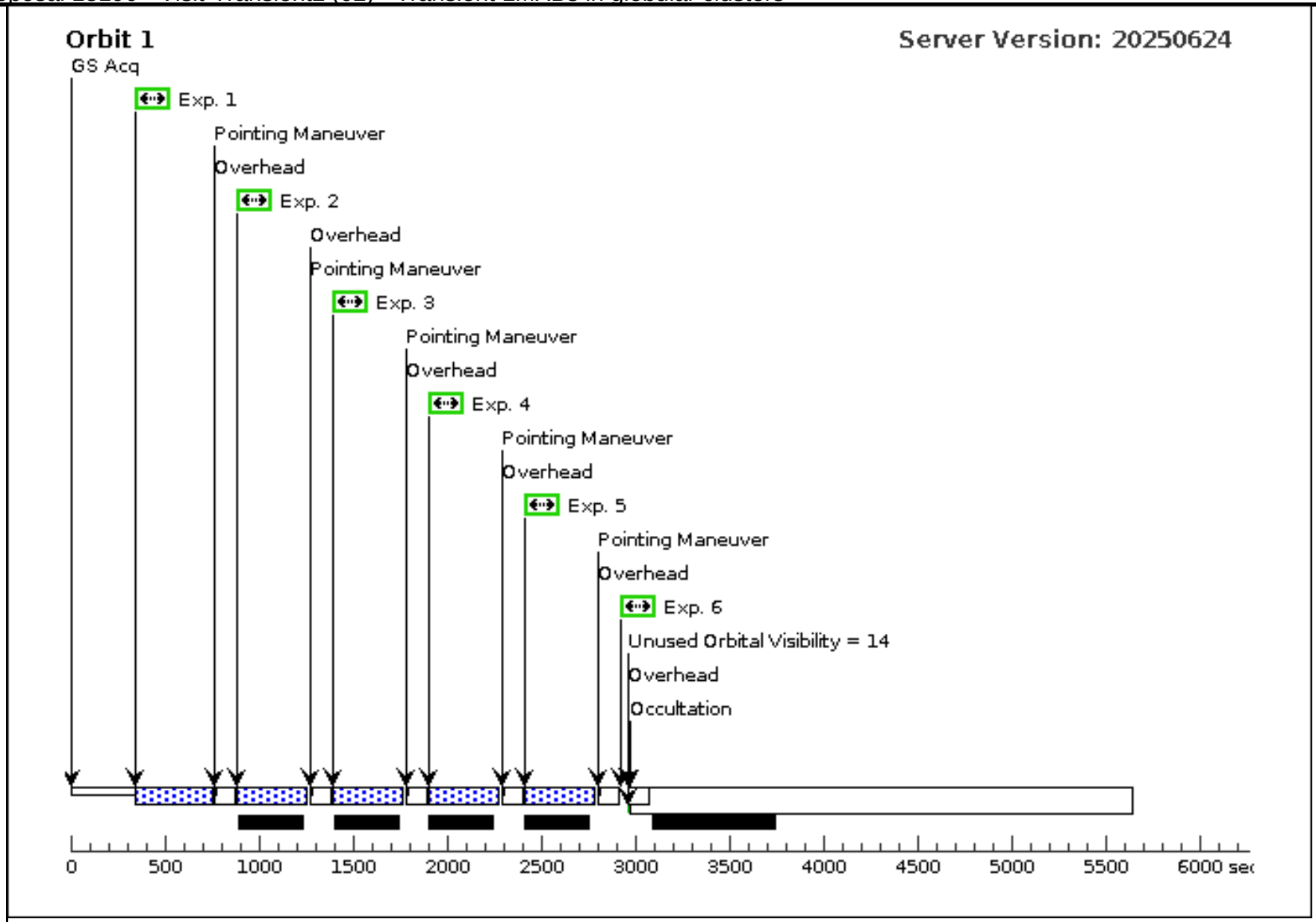
#	Name	Criteria	Description
(2)	GCTRANSIENT2	second trigger of globular-cluster X-ray transient program	X-RAY TRANSIENT

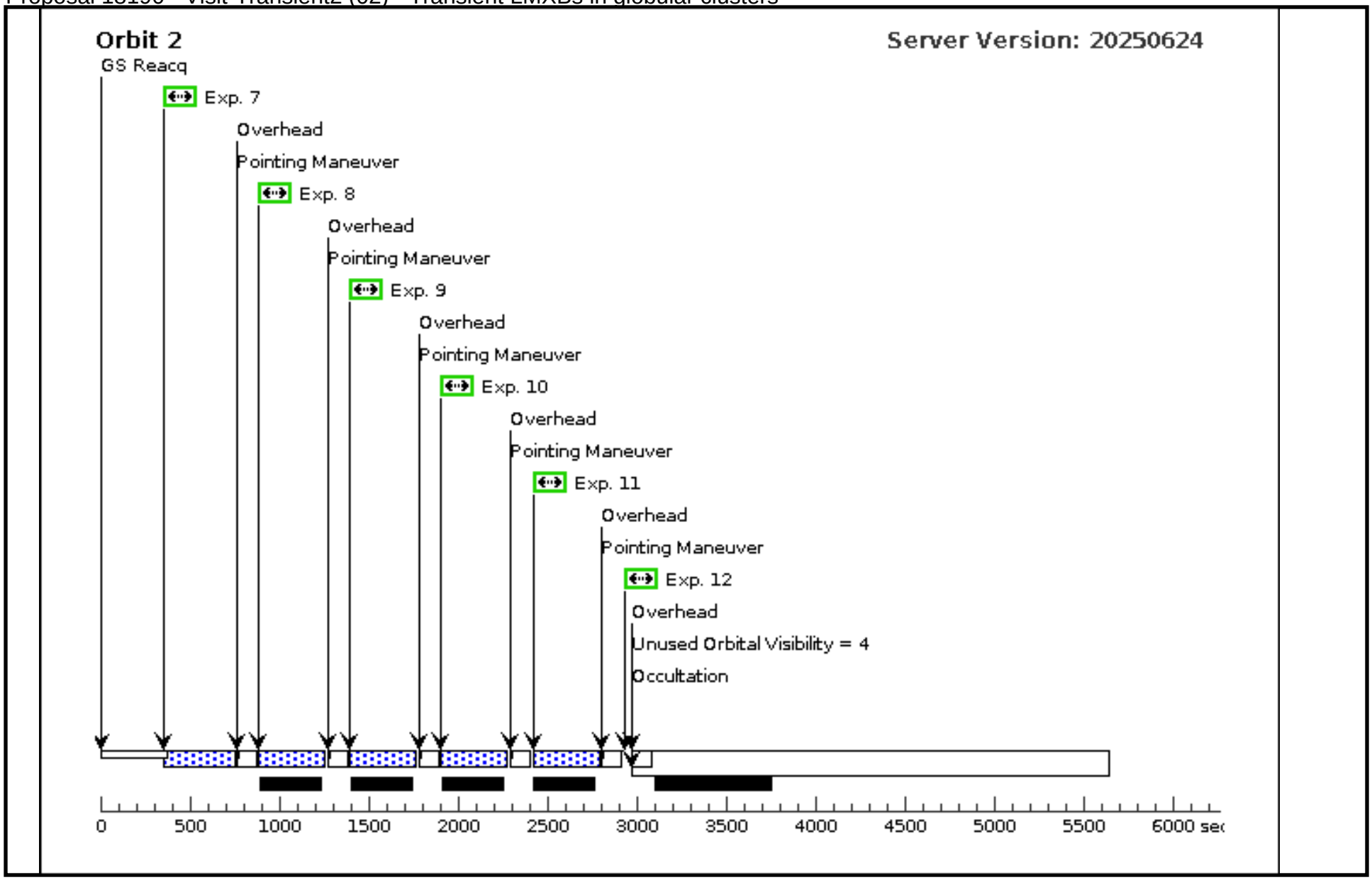
Comments: next X-ray transient discovered in a Galactic globular cluster, whose position can only be accurately determined with Chandra

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	long-V-1	(2) GCTRANSIENT 2	WFC3/UVIS, ACCUM, UVIS2	F606W	FLASH=5	POS TARG 0,0		376 Secs (376 Secs)	
								[==>]	***[1]***
2	long-V-2	(2) GCTRANSIENT 2	WFC3/UVIS, ACCUM, UVIS2	F606W	FLASH=5	POS TARG 0.1719,0 .1837		376 Secs (376 Secs)	
								[==>]	***[1]***
3	long-V-3	(2) GCTRANSIENT 2	WFC3/UVIS, ACCUM, UVIS2	F606W	FLASH=5	POS TARG 0.3437,0 .3674		376 Secs (376 Secs)	
								[==>]	***[1]***
4	long-V-4	(2) GCTRANSIENT 2	WFC3/UVIS, ACCUM, UVIS2	F606W	FLASH=5	POS TARG 0.4760,0 .5286		376 Secs (376 Secs)	
								[==>]	***[1]***
5	long-V-5	(2) GCTRANSIENT 2	WFC3/UVIS, ACCUM, UVIS2	F606W	FLASH=5	POS TARG 0.6544,0 .6796		376 Secs (376 Secs)	
								[==>]	***[1]***
6	short-V	(2) GCTRANSIENT 2	WFC3/UVIS, ACCUM, UVIS2	F606W	FLASH=15			30 Secs (30 Secs)	
								[==>]	***[1]***
7	long-I-1	(2) GCTRANSIENT 2	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=10	POS TARG 0,0		376 Secs (376 Secs)	
								[==>]	***[2]***
8	long-I-2	(2) GCTRANSIENT 2	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=10	POS TARG 0.1719,0 .1837		376 Secs (376 Secs)	
								[==>]	***[2]***
9	long-I-3	(2) GCTRANSIENT 2	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=10	POS TARG 0.3437,0 .3674		376 Secs (376 Secs)	
								[==>]	***[2]***
10	long-I-4	(2) GCTRANSIENT 2	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=10	POS TARG 0.4760,0 .5286		376 Secs (376 Secs)	
								[==>]	***[2]***
11	long-I-5	(2) GCTRANSIENT 2	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=10	POS TARG 0.6544,0 .6796		376 Secs (376 Secs)	
								[==>]	***[2]***
12	short-I	(2) GCTRANSIENT 2	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=20			30 Secs (30 Secs)	
								[==>]	***[2]***

Orbit Structure




Orbit 2
Server Version: 20250624
GS Reacq
Exp. 7
Overhead
Pointing Maneuver
Exp. 8
Overhead
Pointing Maneuver
Exp. 9
Overhead
Pointing Maneuver
Exp. 10
Overhead
Pointing Maneuver
Exp. 11
Overhead
Pointing Maneuver
Exp. 12
Overhead
Unused Orbital Visibility = 4
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec