16681 - Advancing a decades long experiment at the Galactic center

Cycle: 29, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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Dr. Jay Anderson (CoI)	Space Telescope Science Institute	jayander@stsci.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) NAME-SGR-A	WFC3/IR	3	28-Jul-2021 17:00:16.0	yes
02	(1) NAME-SGR-A	WFC3/IR	3	28-Jul-2021 17:00:19.0	yes

6 Total Orbits Used

ABSTRACT

Observations of the orbits of stars around the supermassive black hole at the center of our Galaxy have brought us new and exciting insights into the physics and astrophysics of supermassive black holes. These observations have not only provided the best evidence so far for the existence of supermassive black holes, but they have also advanced our understanding of star formation and stellar dynamics in this region. With a time baseline of over 25 years, we can perform ever more powerful experiments, the latest of which are measurements of the effect of General Relativity on the orbit of the star S0-2/S2. As astrometry becomes more precise, the discovery of our Galaxy's dark cusp of compact objects is now within reach. However, there is a fundamental limitation: the stability of the reference frame. We propose to observe the Galactic center with WFC3-IR in the next three cycles, which when combined with Gaia data will create the most accurate reference frame to date. These measurements from 2022-2024 will (1) enable the detection of a dark cusp around the black hole (2) take advantage of the unique overlap in observations between HST, Gaia (ending in 2024), JWST (beginning in 2022), and the ground to cross-calibrate instrumental systematic uncertainties to build on the legacy of astrometry with HST; (3) use HST observations to double our yearly time baseline for monitoring the near-infrared activity of Sgr A* to determine the physical origins of its recent unprecedented increase in activity.

OBSERVING DESCRIPTION

This program has two main goals:

Measure precise astrometry for a sample of stars in common between HST and Gaia at the Galactic center in order to build a stable reference frame for the measurements of orbits around the supermassive black hole at the Galactic center. The stability of the reference frame is driven by the goal of measuring the precession of the orbit of the star S0-2 from General Relativity and extended mass. As such, this program requires very high astrometric precision and minimal systematic errors. We have designed the Phase II observations to achieve these goals.

Monitor the flux variation from the supermassive black hole Sgr A* in the near-infrared. Sgr A* is ideally monitored early and late in the year, when the Galactic center is not visible from the ground, doubling the yearly monitoring baseline.

Astrometry and photometry:

We request that observations in the F153M filter with a spiral dither pattern to subsample the PSF. We request that observations be made at an ORIENT=270 early in the year (Feb. to May) and ORIENT=90 later in the year (Jul. to Oct.). These two ORIENTS have been used in past astrometry programs at the Galactic center and keeping this orientation will help to minimize the effect of residual optical distortions.

Timing constraints:

We request 3 orbits be allocated early in the year and 3 later in the year. This in part, comes from the constraints on the ORIENT and also driven scientifically to maximize the baseline during the year that we can use to monitor the behavior of the near-infrared emission from Sgr A*.

Visit

Proposal 16681, Visit 01 Wed Jul 28 21:00:20 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 270D TO 270 D; BETWEEN 01-FEB-2022:00:00:00 AND 31-MAY-2022:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=SPIRAL	Coordinate Frame=POS-TARG		(1)
	Purpose=DITHER	Pattern Orientation=11.0		
	Number Of Points=21	Angle Between Sides=		
	Point Spacing=0.42	Center Pattern=false		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NAME-SGR-A	RA: 17 45 40.0360 (266.4168167d)	Epoch of Position: 2015.5	V=14	Reference Frame: SIMBAD
		Dec: -29 00 28.17 (-29.00783d)			
		Equinox: J2000			

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STELLAR CLUSTER
Description=[NUCLEUS]
Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) NAME-SGR-A	WFC3/IR, MULTIACCUM, IR-FIX	F153M	SAMP-SEQ=STEP50; NSAMP=11		Pattern 1, Exps 1-1 in Visit 01 (1)	299.232481 Secs (6283.882 Secs)	
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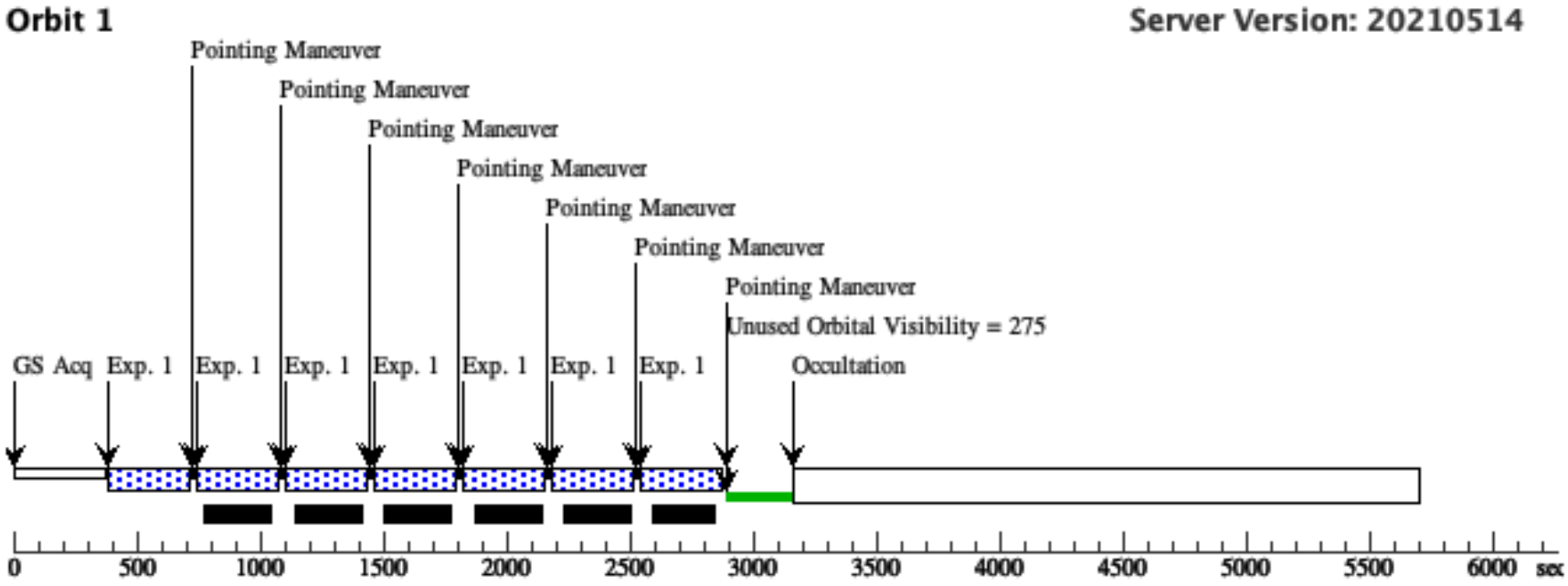
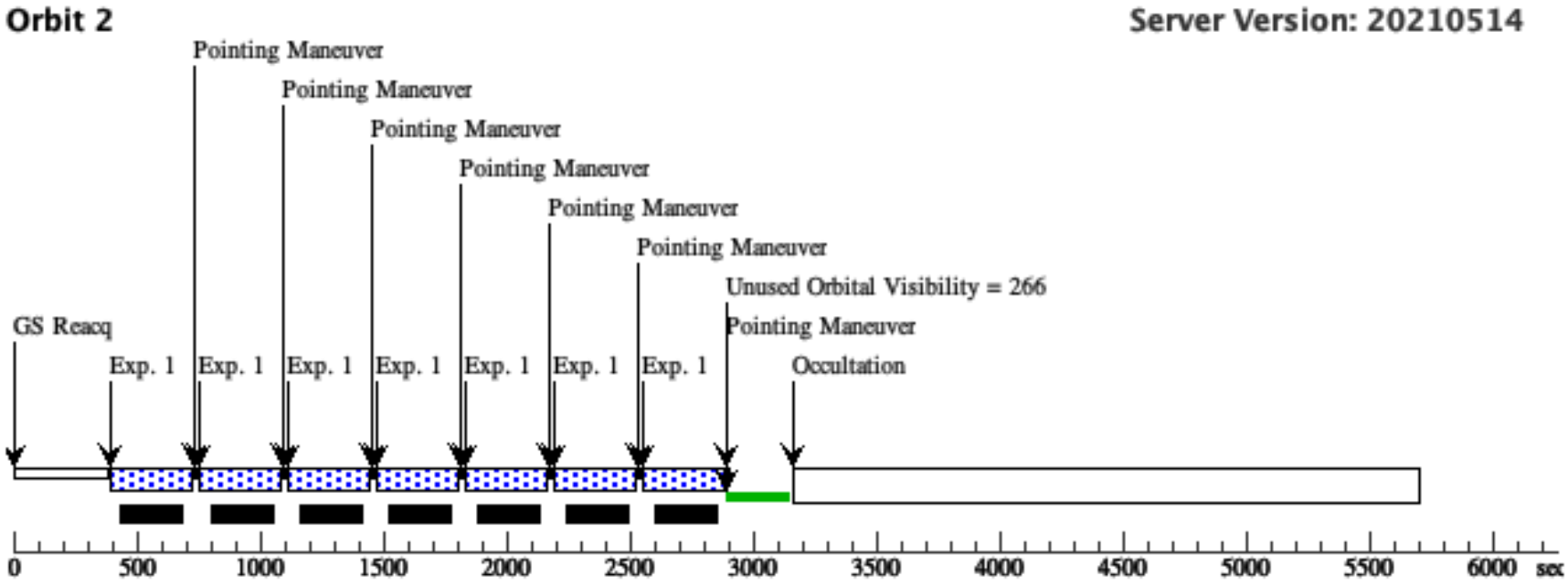
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	***[1]***
								[==>(Pattern 5)]	
								[==>(Pattern 6)]	
								[==>(Pattern 7)]	
								[==>(Pattern 8)]	
								[==>(Pattern 9)]	
								[==>(Pattern 10)]	
								[==>(Pattern 11)]	***[2]***
								[==>(Pattern 12)]	
								[==>(Pattern 13)]	
								[==>(Pattern 14)]	
								[==>(Pattern 15)]	
								[==>(Pattern 16)]	
								[==>(Pattern 17)]	
								[==>(Pattern 18)]	***[3]***
								[==>(Pattern 19)]	
								[==>(Pattern 20)]	
								[==>(Pattern 21)]	

Orbit Structure

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Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
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Pointing Maneuver
Pointing Maneuver
Unused Orbital Visibility = 266
Pointing Maneuver
GS Reacq
Exp. 1
Exp. 1
Exp. 1
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Exp. 1
Exp. 1
Occultation
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500
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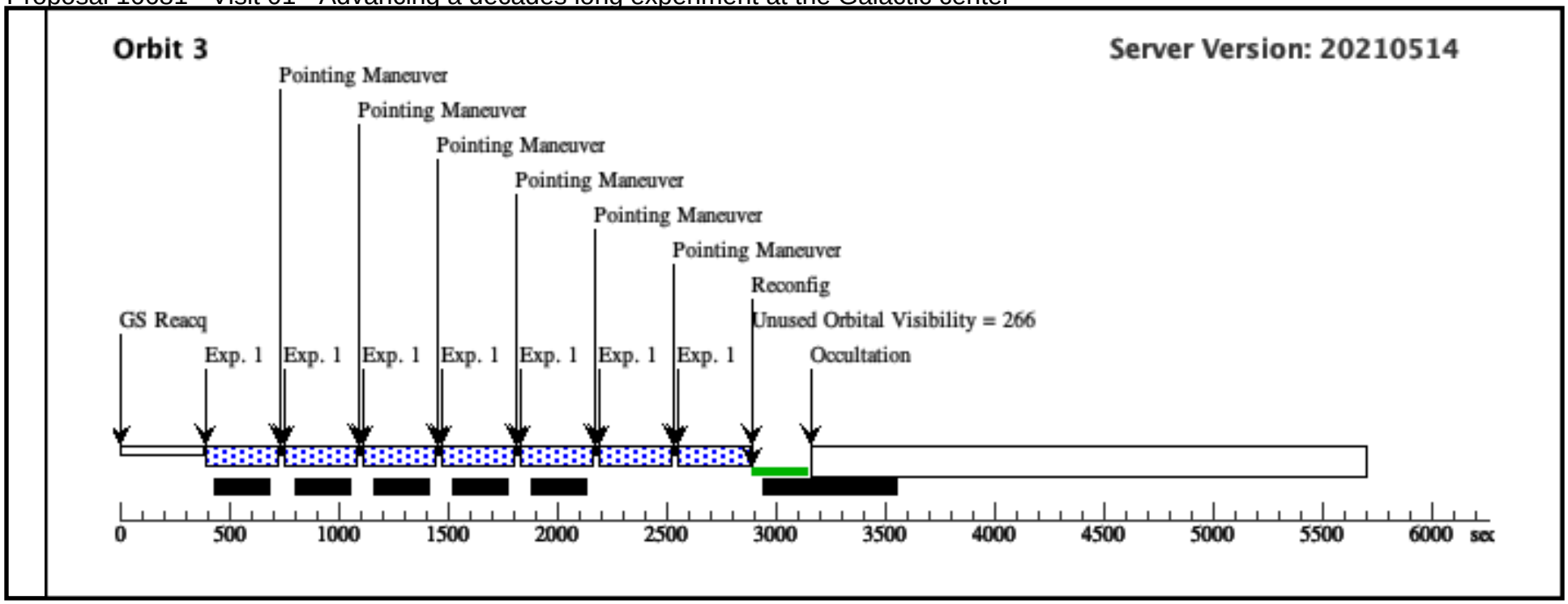
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Pointing Maneuver
Reconfig
GS Reacq
Unused Orbital Visibility = 266
Exp. 1
Exp. 1
Exp. 1
Exp. 1
Exp. 1
Exp. 1
Exp. 1
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 16681, Visit 02 Wed Jul 28 21:00:20 GMT 2021

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 90D TO 90 D; BETWEEN 01-JUL-2022:00:00:00 AND 31-OCT-2022:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=SPIRAL	Coordinate Frame=POS-TARG		(1)
	Purpose=DITHER	Pattern Orientation=11.0		
	Number Of Points=21	Angle Between Sides=		
	Point Spacing=0.42	Center Pattern=false		
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#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) NAME-SGR-A	WFC3/IR, MULTIACCUM, IR-FIX	F153M	SAMP-SEQ=STEP50; NSAMP=11		Pattern 1, Exps 1-1 in Visit 02 (1)	299.232481 Secs (6283.882 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	
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								[==>(Pattern 4)]	***[1]***
								[==>(Pattern 5)]	
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								[==>(Pattern 9)]	
								[==>(Pattern 10)]	
								[==>(Pattern 11)]	***[2]***
								[==>(Pattern 12)]	
								[==>(Pattern 13)]	
								[==>(Pattern 14)]	
								[==>(Pattern 15)]	
								[==>(Pattern 16)]	
								[==>(Pattern 17)]	
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								[==>(Pattern 19)]	
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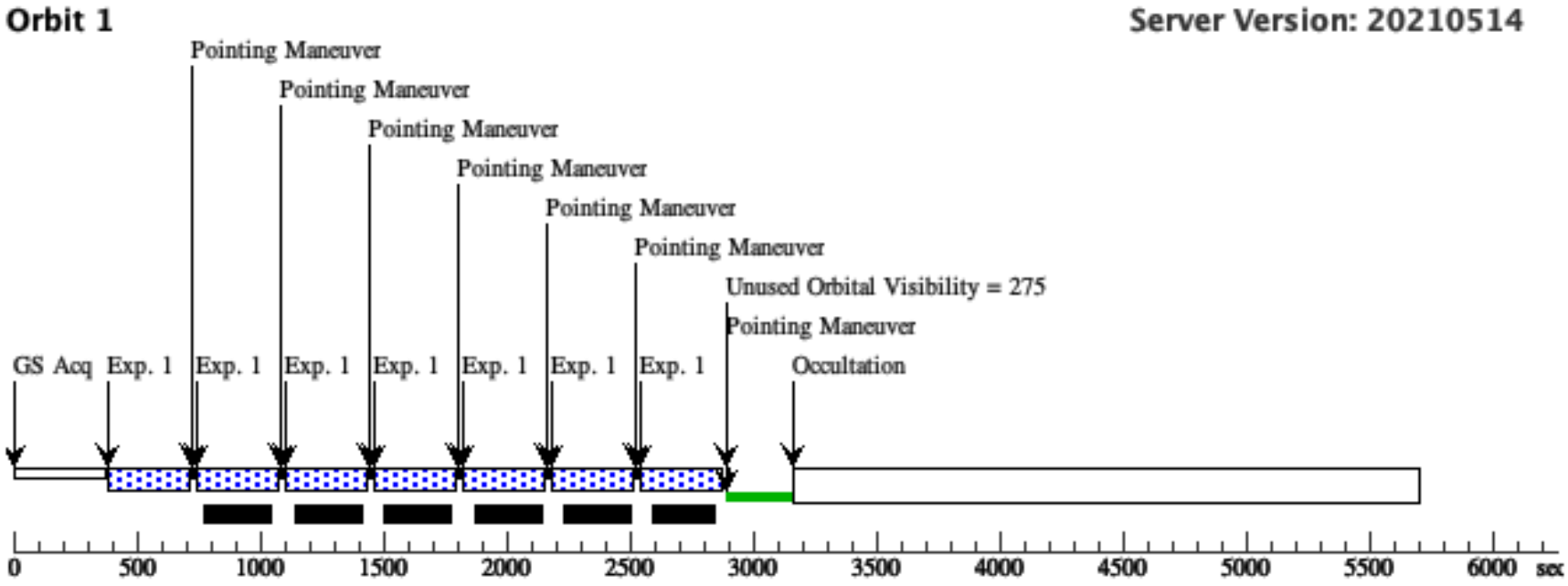
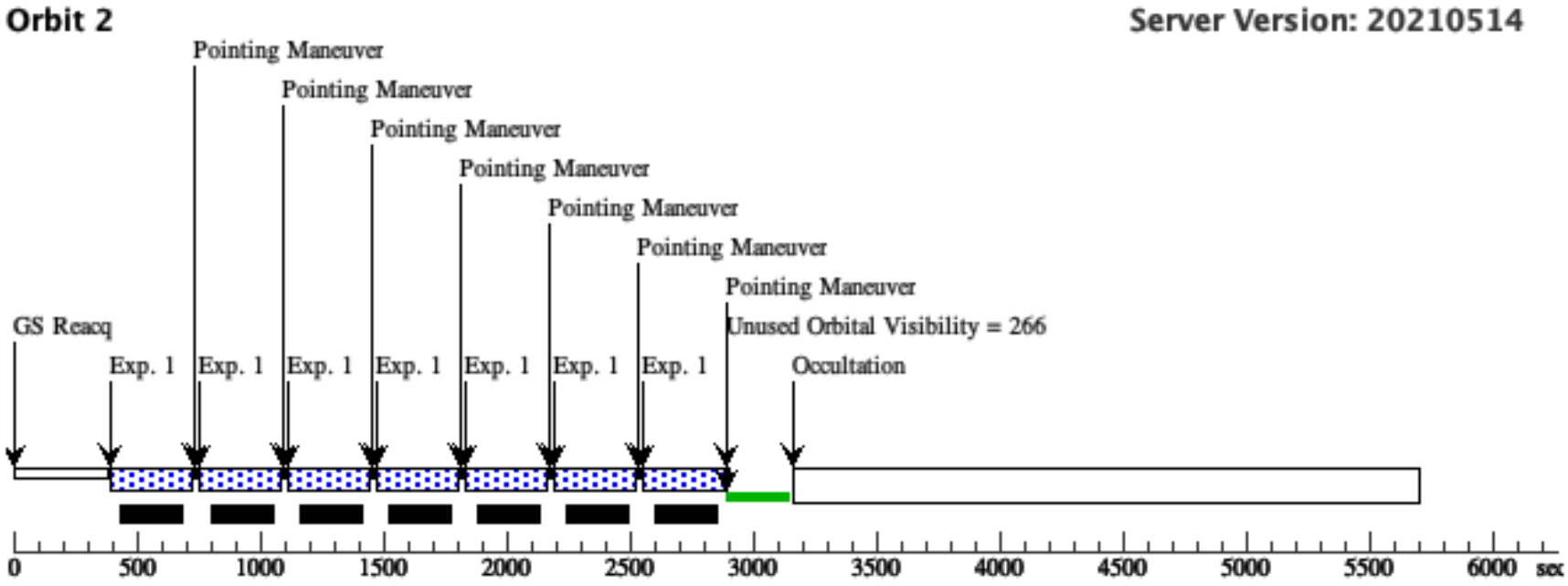
Orbit Structure




Orbit 2
Server Version: 20210514
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
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Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
GS Reacq
Exp. 1
Exp. 1
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Exp. 1
Unused Orbital Visibility = 266
Occultation
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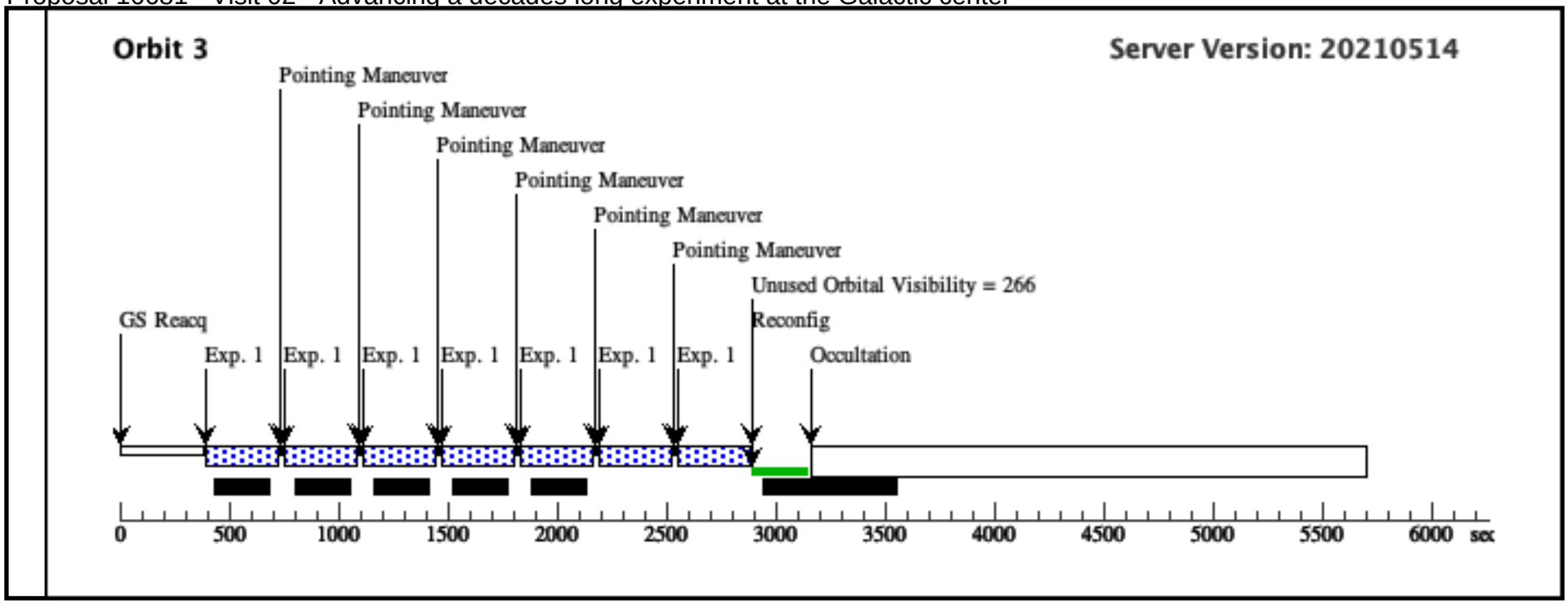
Orbit 3
Server Version: 20210514
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Unused Orbital Visibility = 266
GS Reacq
Reconfig
Exp. 1
Exp. 1
Exp. 1
Exp. 1
Exp. 1
Exp. 1
Exp. 1
Occultation
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