15199 - Building an astrometric reference frame for tests of General Relativity with stellar orbits at the Galactic center with HST and GAIA

Cycle: 25, Proposal Category: GO

(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) SGR-A	WFC3/IR	3	20-Jul-2017 20:02:31.0	yes

3 Total Orbits Used

ABSTRACT

The short-period star S0-2 will reach its closest approach to the supermassive black hole at the Galactic center in 2018 at a separation of < 120 AU. This event will offer the first of a series of tests of General Relativity with stellar orbits around a supermassive black hole, an unexplored regime for tests of gravity. While S0-2 has been monitored for over 20 years with high angular resolution measurements from the ground, the astrometric reference frame is currently not stable enough for GR tests. The current reference frame is constructed using observations of 7 radio masers with narrow-field adaptive optics imaging from the ground. While this method provides a reference frame that is stable enough to measure the Keplerian orbits, it does not meet the more stringent requirements needed to measure post-Newtonian effects such as the precession of the periapse of the orbit. The small number of reference stars and the systematic errors associated with using large mosaics to observe these stars limit the accuracy of this method. We propose to construct a new reference frame for tests of gravity with WFC3-IR observations in Cycles 25, 26, & 27. When combined with absolute positions and proper motions from GAIA, these observations will provide the required precision in the reference frame. The WFC3-IR field of view has over 1000 times greater areal coverage than the narrow-field AO observations, providing 3 times the number of absolute reference sources from GAIA. The proposed observations build on a legacy of HST, GAIA, and adaptive optics data to open an era of gravitational science with orbits at the Galactic center.

OBSERVING DESCRIPTION

This is an astrometric program to measure precise astrometry for a sample of stars in common with 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 effect of General Relativity on the orbit of the star S0-2. As such, this program requires very high astrometric precision and minimal systematic errors. We have designed the Phase II observations to achieve these goals.

We request that observations in Cycle 25 to have an ORIENT=270 deg, the same as GO-13770, in order to optimize the astrometric performance and minize the effect of residual optical distortions.

We request that the observations be made between 2018-02-01 and 2018-05-31 in order to be close in time to GAIA observations of this region. This time range will also allow us to observe near the closest approach of the star S0-2 to the supermassive black hole in 2018.

We request observations in the F153M filter with a spiral dither pattern for astrometry. We also plan to observe with the F127M filter to check against the astrometry at F153M, since the stellar crowding is much higher at F153M. Since the GAIA sources are very blue compared to the background Galactic center sources, we will be able to use the F127M astrometry instead of F153M for confused sources at F153M.

Visit

Proposal 15199, Visit 01 Fri Jul 21 00:02:33 GMT 2017

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 270D TO 270 D; BETWEEN 01-FEB-2018:00:00:00 AND 31-MAY-2018:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(6)	Pattern Type=SPIRAL Purpose=DITHER Number Of Points=15 Point Spacing=0.42 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=11.0 Angle Between Sides= Center Pattern=false		(1)
(7)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(2)

Fixed Targets

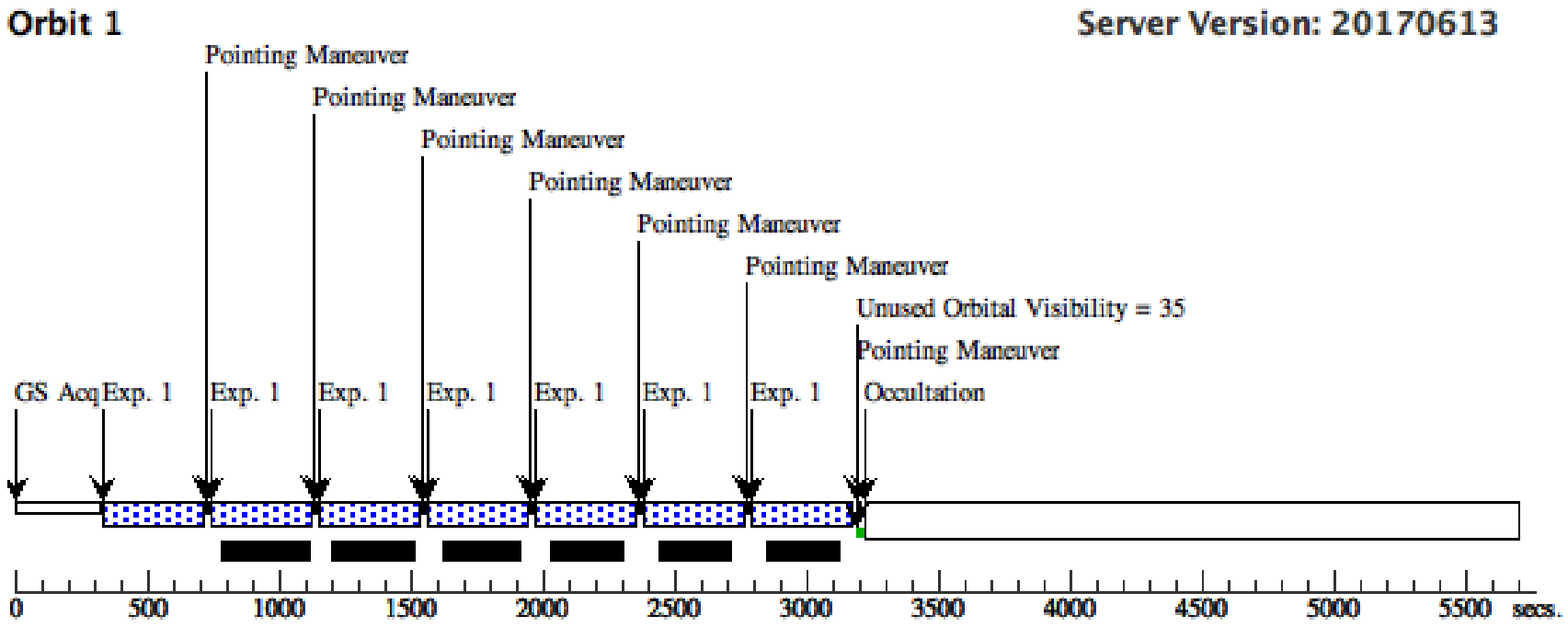
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SGR-A	RA: 17 45 40.0360 (266.4168167d) Dec: -29 00 28.17 (-29.00783d) Equinox: J2000		V=14	Reference Frame: SIMBAD

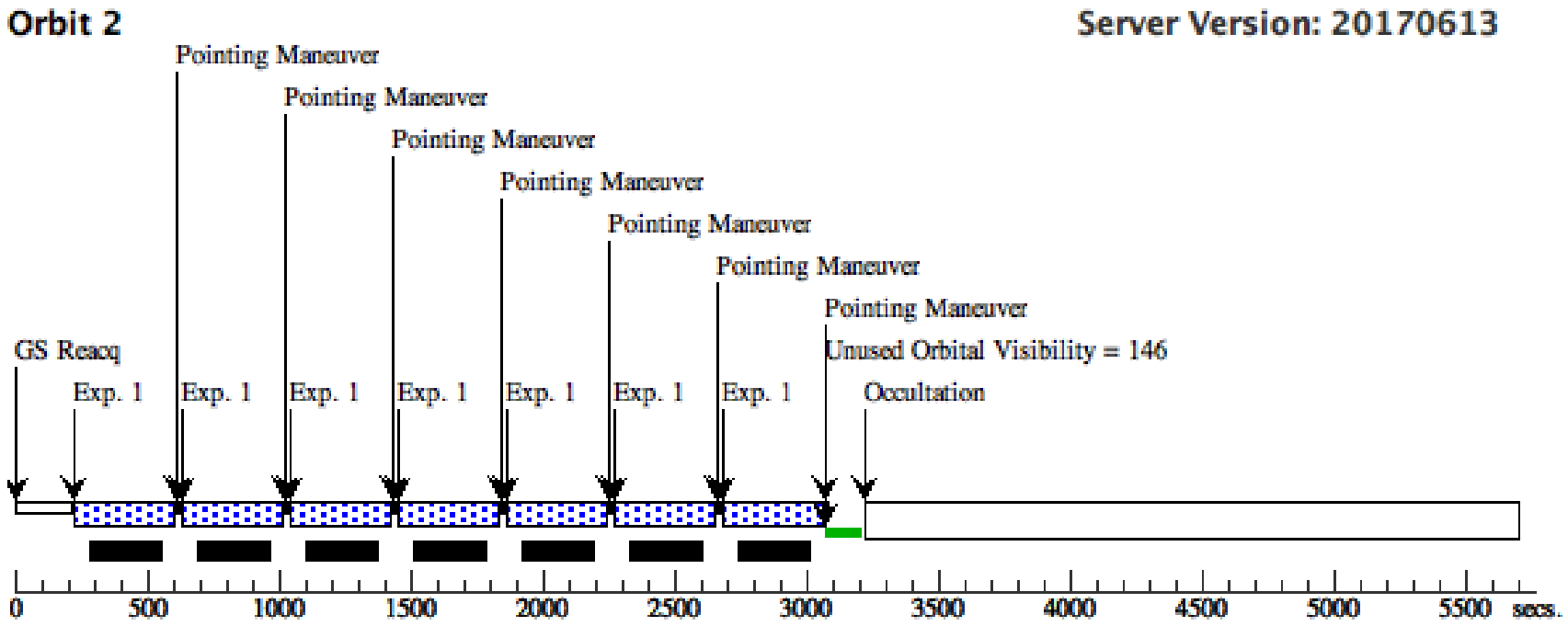
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Extended=NO

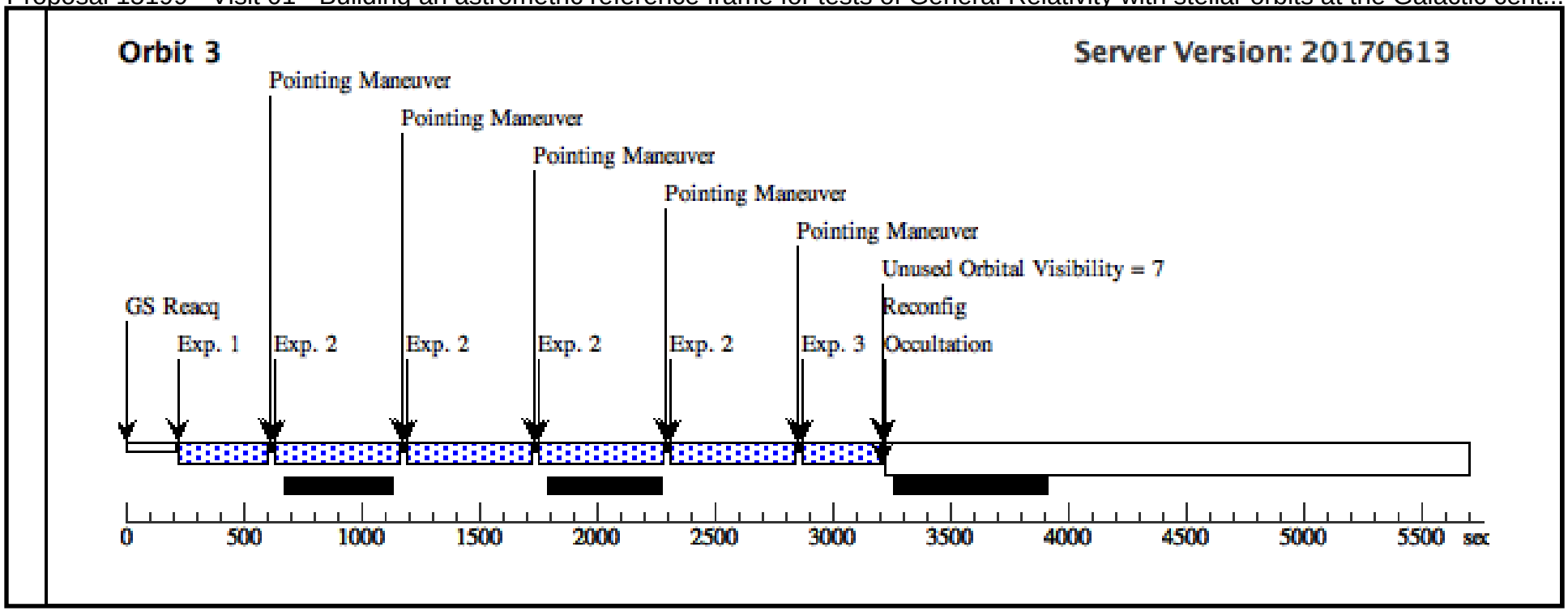
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) SGR-A	WFC3/IR, MULTIACCUM, IR-FIX	F153M	SAMP-SEQ=STEP50; NSAMP=12		Pattern 6, Exps 1-1 in Visit 01 (6)	349.232932 Secs (5238.494 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	
								[==>(Pattern 5)]	
								[==>(Pattern 6)]	
								[==>(Pattern 7)]	
								[==>(Pattern 8)]	***[2]***
								[==>(Pattern 9)]	
								[==>(Pattern 10)]	
								[==>(Pattern 11)]	
								[==>(Pattern 12)]	
								[==>(Pattern 13)]	
								[==>(Pattern 14)]	
								[==>(Pattern 15)]	***[3]***
2		(1) SGR-A	WFC3/IR, MULTIACCUM, IR-FIX	F127M	NSAMP=11; SAMP-SEQ=STEP100		Pattern 7, Exps 2-2 in Visit 01 (7)	499.231969 Secs (1996.928 Secs)	
								[==>(Pattern 1)]	***[3]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	
3	Stare	(1) SGR-A	WFC3/IR, MULTIACCUM, IR-FIX	F153M	NSAMP=11; SAMP-SEQ=STEP50			299.232481 Secs (299.232 Secs)	
								[==>]	***[3]***

Orbit Structure




Orbit 2
Server Version: 20170613
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
GS Reacq
Unused Orbital Visibility = 146
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
secs.


Orbit 3
Server Version: 20170613
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Unused Orbital Visibility = 7
GS Reacq
Exp. 1
Exp. 2
Exp. 2
Exp. 2
Exp. 2
Exp. 3
Reconfig
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec