17200 - A census of massive binaries and luminous blue variables in the Whirlpool Galaxy

Cycle: 30, 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) M-51	WFC3/UVIS	5	12-Jul-2022 16:02:16.0	yes

5 Total Orbits Used

ABSTRACT

We propose UV and optical UVIS/WFC3 photometry of M51, a face-on Milky Way-like galaxy at d = 8.5 Mpc, in which individual luminous stars can be spatially resolved. Previous HST programs obtained 70 epochs of photometry in the red optical F606W and F814 filters, producing high-precision light curves of the 20,000 most luminous stars in the galaxy. Among these are hundreds of massive eclipsing binaries (EBs) and luminous blue variables (LBVs). These light curves are a treasure trove for studies of massive star evolution and population demographics, enabling a homogenous census of luminous star variability that would be impossible in the Milky Way. However, the existing photometry is in the Rayleigh-Jeans tail for hot stars and thus cannot constrain their temperatures and luminosities reliably. We propose 1 epoch in each of the F275W, F336W, F475W, F606W, and F814W filters (5 orbits total), enabling measurement of temperatures, radii, and luminosities for all hot stars, and masses for EBs. This program will significantly increase the utility of the existing 70 epochs of photometry, enabling a wealth of science related to massive star

evolution and binary population modeling.

OBSERVING DESCRIPTION

We adopt the well-tested strategy of observing in the UV-optical filters F275W, F336W, F475W, F606W, and F814W. Several authors have demonstrated that this combination of filters enables strong separation of temperature and dust effects, and a similar strategy was adopted by the Multi-Cycle Treasury program PHAT.

We request one orbit depth in each of the F275W, F336W, F475W, F606W, and F814 filters. We will split each orbit into 4 sub-exposures using a standard dither pattern. The UVIS ETC predicts SNR=20 at F275W=23.0, F336W=24.0, F475W=25.0, F606W=24.5, F814=24.0. These depths are necessary to: a) measure photometry at the few percent level; b) derive stellar parameters at the 10% level, and (c) enable longer-baseline analysis of optical CMD variability, when combined with archival data. Given that the sources of greatest interest will be time-variable, it is essential that the five filters be observed in consecutive orbits so that reliable stellar parameters can be derived. They are thus grouped into a single visit.

The proposed field overlaps with existing WFPC2 data from 1995, existing ACS data from 2005, and the high cadence observations from the Cycle 24 ACS program ID 14704. The orientation constaints are chosen to maximize overlap with the archival data.

We add a small amount of FLASH to all filters. This may slightly reduce SNR (and it produces a warning in F606W), but experience suggests that it will make the data more generally usable due to CTE degradation.

Visit

Proposal 17200, Visit 01 Tue Jul 12 20:02:17 GMT 2022

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 310D TO 320 D

Diagnostics

(F606 (01.001)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1), (2), (3), (4), (5)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M-51	RA: 13 30 2.3135 (202.5096396d) Dec: +47 09 57.83 (47.16606d) Equinox: J2000		V=8.36	Reference Frame: SIMBAD

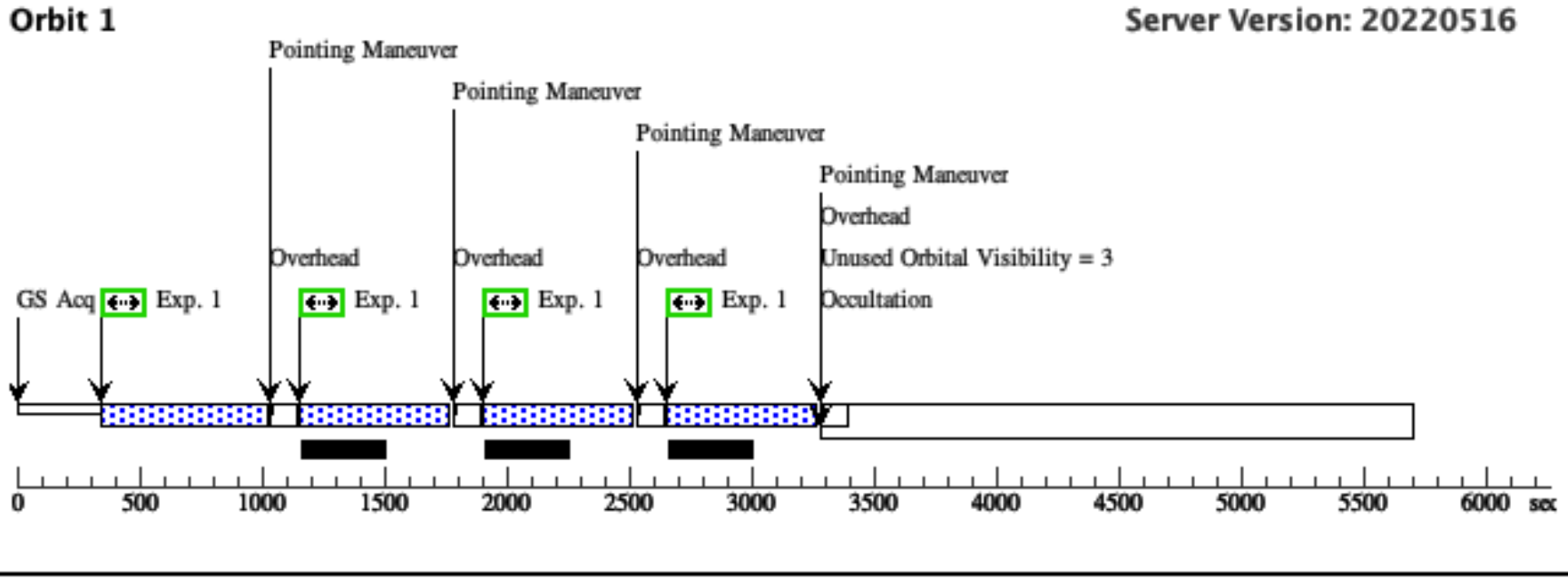
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=GALAXY
Description=[DISK, INTERACTING GALAXY, SPIRAL]

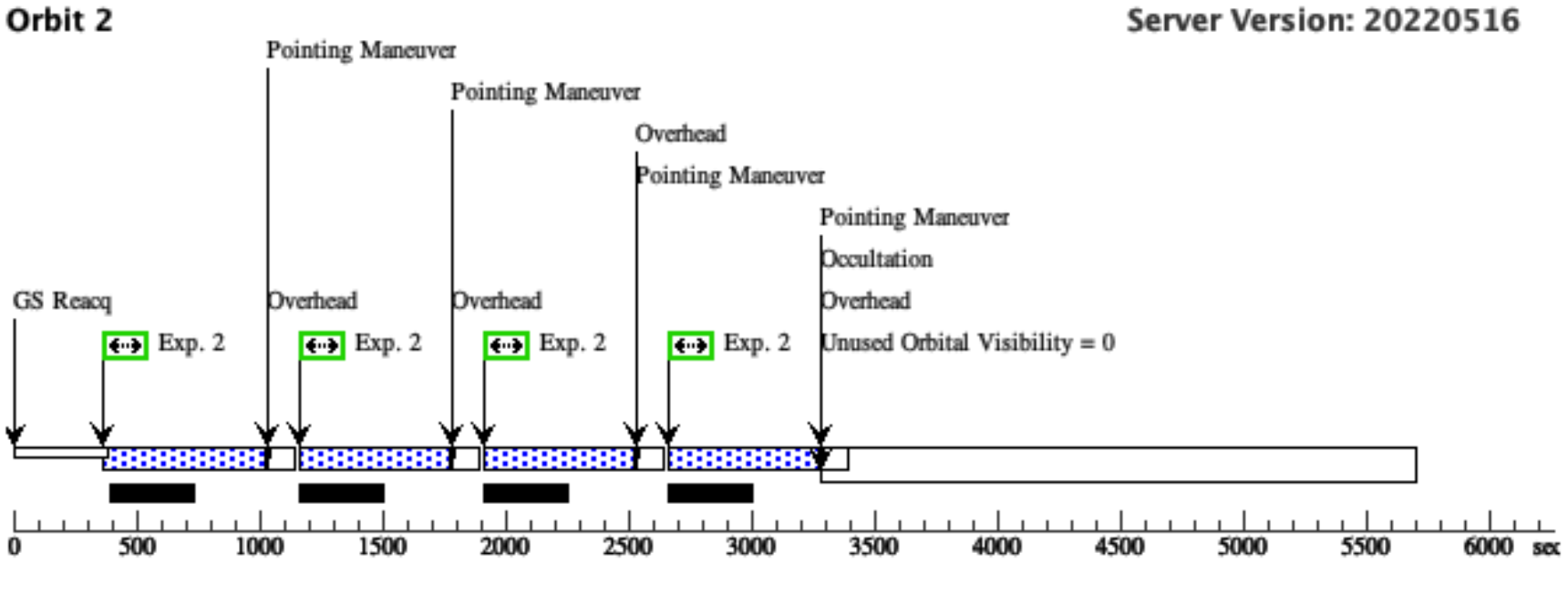
Proposal 17200 - Visit 01 - A census of massive binaries and luminous blue variables in the Whirlpool Galaxy

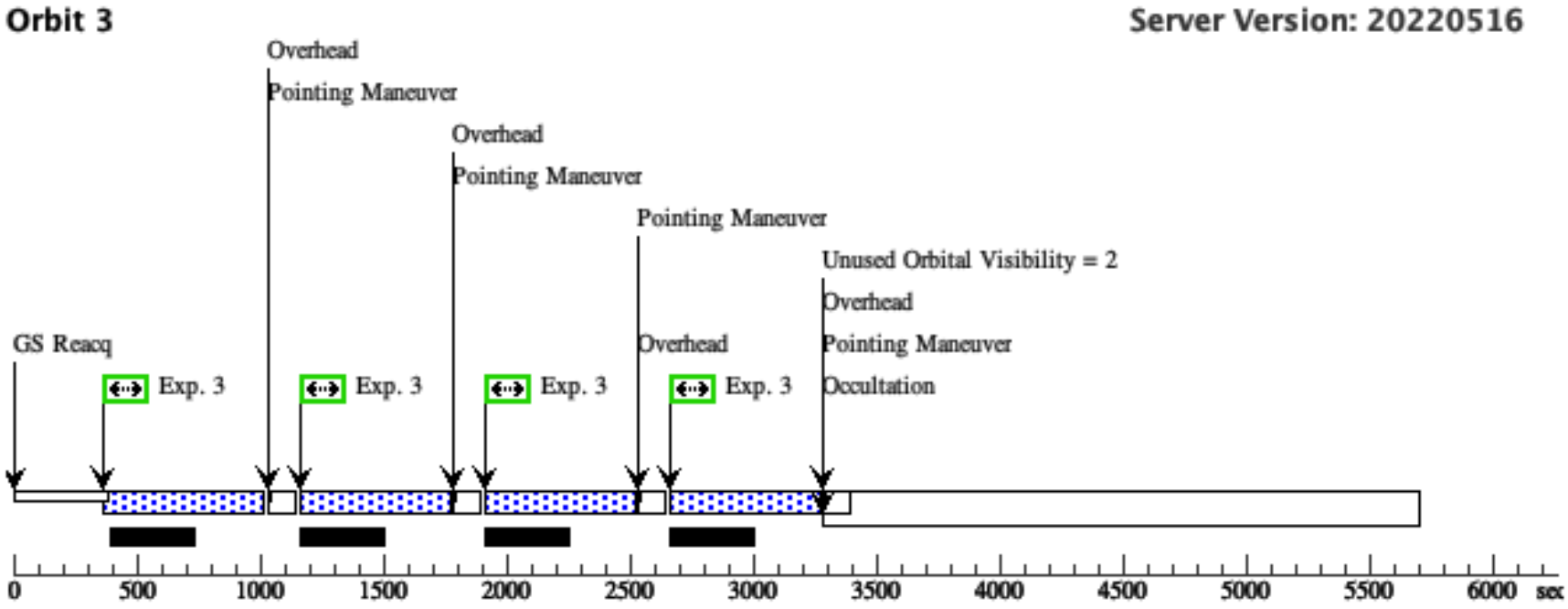
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F606	(1) M-51	WFC3/UVIS, ACCUM, UVIS1	F606W	FLASH=5	POS TARG 22.0550 3486973148,36.0327 9688265262	Pattern 1, Exps 1-1 in Visit 01 (1)	500 Secs (2492 Secs) *[==>647.0 Secs (Pattern 1)]* *[==>615.0 Secs (Pattern 2)]* *[==>615.0 Secs (Pattern 3)]* *[==>615.0 Secs (Pattern 4)]*	***[1]***
2	F275	(1) M-51	WFC3/UVIS, ACCUM, UVIS1	F275W	FLASH=20	POS TARG 22.0550 3486973148,36.0327 9688265262	Pattern 1, Exps 2-2 in Visit 01 (1)	500 Secs (2468 Secs) *[==>635.0 Secs (Pattern 1)]* *[==>611.0 Secs (Pattern 2)]* *[==>611.0 Secs (Pattern 3)]* *[==>611.0 Secs (Pattern 4)]*	***[2]***
3	F336	(1) M-51	WFC3/UVIS, ACCUM, UVIS1	F336W	FLASH=20	POS TARG 22.0550 3486973148,36.0327 9688265262	Pattern 1, Exps 3-3 in Visit 01 (1)	500 Secs (2466 Secs) *[==>633.0 Secs (Pattern 1)]* *[==>611.0 Secs (Pattern 2)]* *[==>611.0 Secs (Pattern 3)]* *[==>611.0 Secs (Pattern 4)]*	***[3]***
4	F814	(1) M-51	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=5	POS TARG 22.0550 3486973148,36.0327 9688265262	Pattern 1, Exps 4-4 in Visit 01 (1)	500 Secs (2486 Secs) *[==>641.0 Secs (Pattern 1)]* *[==>615.0 Secs (Pattern 2)]* *[==>615.0 Secs (Pattern 3)]* *[==>615.0 Secs (Pattern 4)]*	***[4]***
5	F475	(1) M-51	WFC3/UVIS, ACCUM, UVIS1	F475W	FLASH=8	POS TARG 22.0550 3486973148,36.0327 9688265262	Pattern 1, Exps 5-5 in Visit 01 (1)	500 Secs (2481 Secs) *[==>639.0 Secs (Pattern 1)]* *[==>614.0 Secs (Pattern 2)]* *[==>614.0 Secs (Pattern 3)]* *[==>614.0 Secs (Pattern 4)]*	***[5]***

Orbit Structure






Orbit 3
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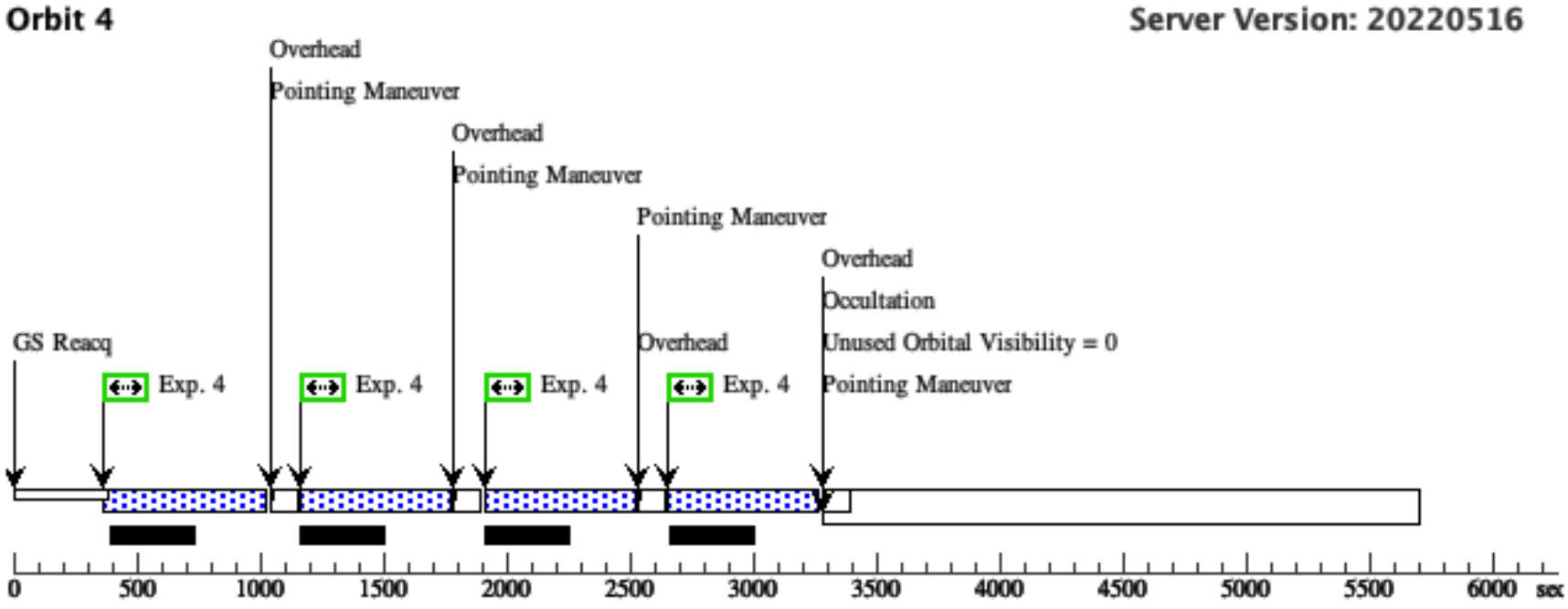
Overhead
Pointing Maneuver
Overhead
Pointing Maneuver
Pointing Maneuver
Unused Orbital Visibility = 2
Overhead
Pointing Maneuver
Occultation
Overhead
GS Reacq
Exp. 3
Exp. 3
Exp. 3
Exp. 3
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec


Orbit 4
Server Version: 20220516
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Pointing Maneuver
Overhead
Pointing Maneuver
Pointing Maneuver
Overhead
Occultation
GS Reacq
Overhead
Unused Orbital Visibility = 0
Exp. 4
Exp. 4
Exp. 4
Exp. 4
Pointing Maneuver
0
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1000
1500
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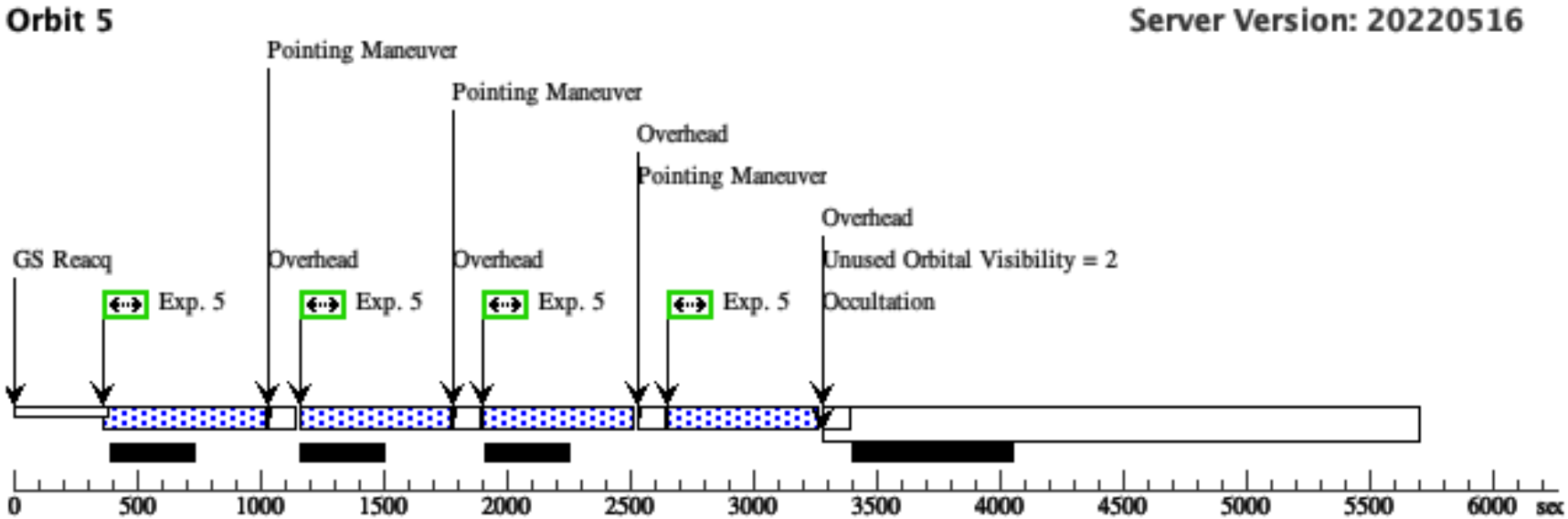
2500
3000
3500
4000
4500
5000
5500
6000
sec


Orbit 5
Server Version: 20220516
Pointing Maneuver
Pointing Maneuver
Overhead
Pointing Maneuver
Overhead
GS Reacq
Overhead
Overhead
Unused Orbital Visibility = 2
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Exp. 5
Exp. 5
Exp. 5
Occultation
0
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1000
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5500
6000
sec