13336 - Probing Io's putative global magma ocean through FUV auroral spot morphology

Cycle: 21, 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) IO-WEST-1	STIS/CCD STIS/FUV-MAMA	5	11-Dec-2013 21:37:02.0	yes
02	(2) IO-WEST-2	STIS/CCD STIS/FUV-MAMA	5	11-Dec-2013 21:37:35.0	yes

10 Total Orbits Used

ABSTRACT

Whether Io possesses a magma ocean or not is a central issue for understanding the most volcanically active body in our solar system and is a long standing question as well. Khurana et al., Science 2011, recently substantiated the existence of a highly conductive magma layer inside Io's interior based on Galileo magnetometer measurements and techniques similar to those used to probe the crusts of Europa, Ganymede, and Callisto for liquid water oceans. If a global magma ocean modifies Io's local magnetic field environment, it will also significantly alter the morphology of Io's UV aurora. The most prominent aurora features are two bright spots that rock around the equator roughly in correlation with the varying orientation of the tilted Jovian magnetic field. Magnetic induction in a magma ocean would strongly attenuate the rocking of these near-surface spots. Interestingly, in previous STIS FUV observations the measured spot locations disagree considerably from the locations theoretically predicted for the global magma ocean case, but are in reasonable agreement if there is no ocean. However, the temporal and orbital coverage of Io's rocking auroral spots for the STIS dataset is presently insufficient to conclusively exclude or further investigate the molten magma layer idea. We therefore propose two visits of five consecutive STIS orbits to trend the auroral spot feature locations over a full variation cycle of the Jovian magnetic field near western elongation. This investigation will decisively constrain the molten magma layer inside Io and tests the putative evidence for a global ocean by Khurana et al. (2011).

OBSERVING DESCRIPTION

The observations consist of two visits with 5 orbits each to map the full synodic rotation cycle of Jupiter, when Io is close to western elongation.

During visit 1 we want to observe a sweep of the magnetic field orientation from one extreme inclination to the other. A start-CML of Jupiter from Io of ~20 deg puts the magnetic field inclination close to its maximum pointing towards Jupiter. At the end of the 5th consecutive orbit the end-CML of Jupiter from Io of ~200 deg puts the inclination close to maximum pointing away from Jupiter.
During visit 2 we want to observe the opposite sweep of the magnetic field orientation completing a full cycle. A start-CML of Jupiter from Io of ~200 deg puts the magnetic field inclination close to its maximum pointing away from Jupiter. At the end of the 5th consecutive orbit the end-CML of Jupiter from Io of ~20 deg puts the inclination close to maximum pointing towards Jupiter.
The order, in which the visits are scheduled (first visit 1 or first visit 2), is NOT relevant.

For both visits the second most important constraint is the proximity to maximum western elongation (OLG of Io centered around 270 deg for the 5-orbits visits) to ensure a good visibility of both equatorial aurora spots. The ~7 hours of observation during the 5-orbit visits correspond to a change of the Io OLG of ~60 deg. The optimal OLG range for both visits is thus 240 - 300 deg, +/- 5 deg. This constraint can be further relaxed in case of scheduling problems.

With the STIS G140L mode and the 52"x2" aperture the full disk of Io is well imaged for the brightest oxygen and sulfur multiplets OI] 1356 A, OI 1304 A and SI 1479 A. We propose to center the disk of Io (maximum diameter ~1.2 acrseconds) across the slitwidth (as usual) to obtain a symmetric field of view around the disk. Due to the blotch on the MAMA detector we choose to use the pseudo aperture 52X2D1 putting the image of Io a few arcsec from the bottom of the detector array.

Visit

Proposal 13336, Visit 01, implementation Thu Dec 12 02:37:48 GMT 2013

Diagnostic Status: Warning

Scientific Instruments: STIS/CCD, STIS/FUV-MAMA

Special Requirements: SCHED 100%

Diagnostics

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Solar System Targets

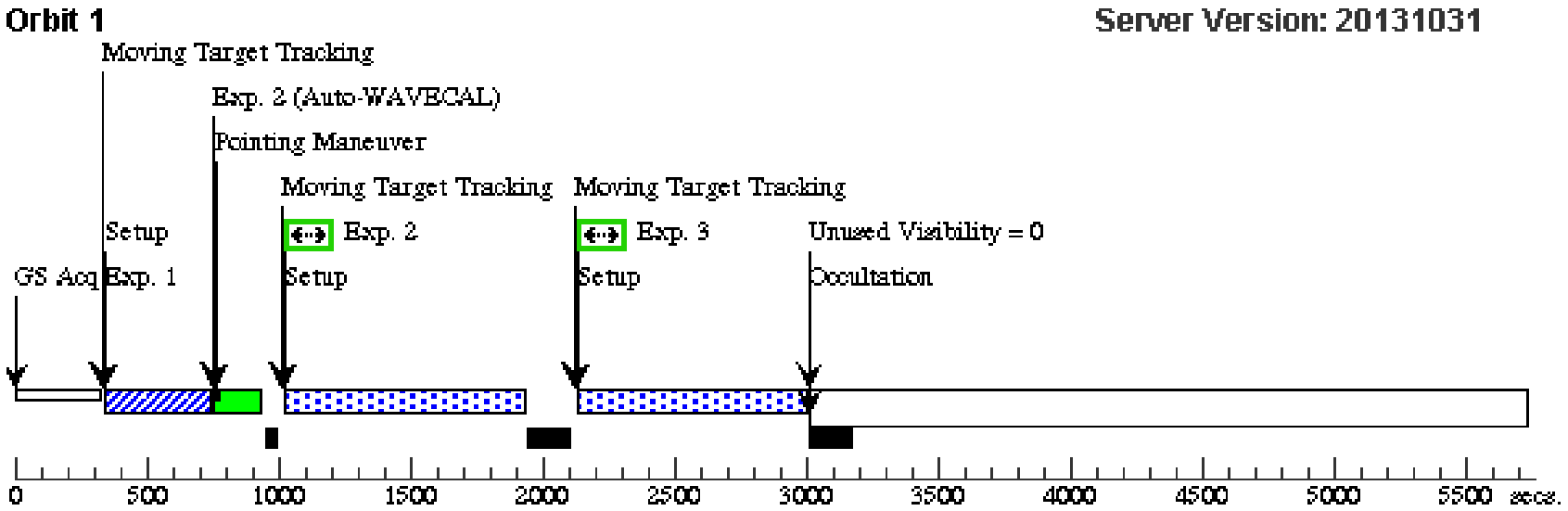
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	IO-WEST-1	STD=JUPITER	STD=IO		SEP OF IO-WEST-1 JUPITER FROM EARTH GT 30", SEP OF IO-WEST-1 CALLISTO FROM EARTH GT 10", SEP OF IO-WEST-1 EUROPA FROM EARTH GT 10", SEP OF IO-WEST-1 GANYMEDE FROM EARTH GT 10", OLG OF JUPITER FROM EARTH BETWEEN 330 30, OLG OF IO FROM EARTH BETWEEN 235 305, CML OF JUPITER FROM IO BETWEEN 10 210	EARTH

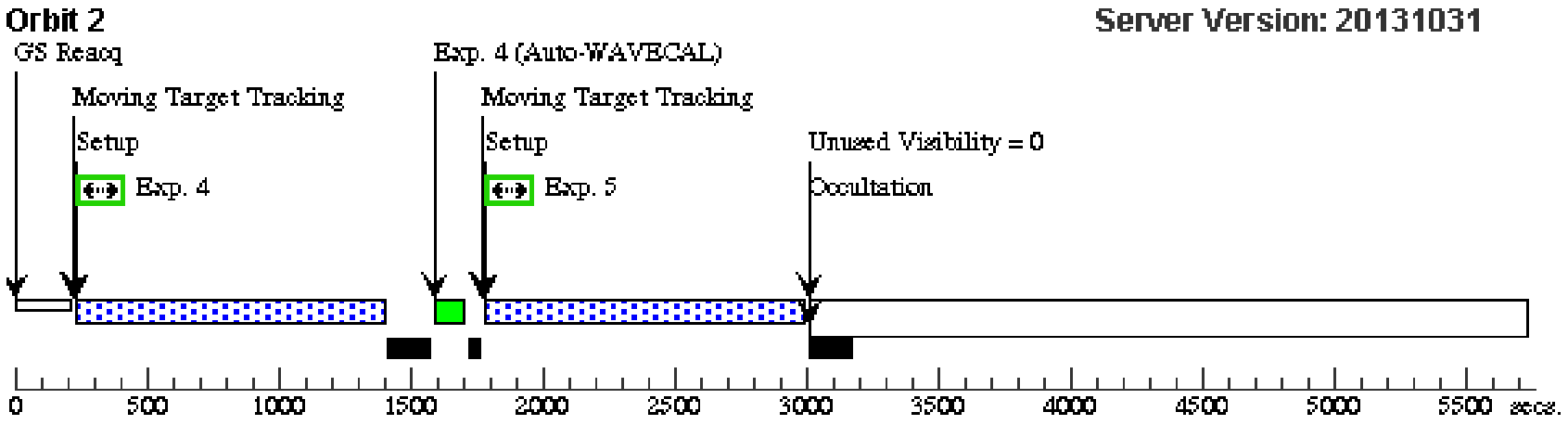
Proposal 13336 - Visit 01 - Probing Io's putative global magma ocean through FUV auroral spot morphology

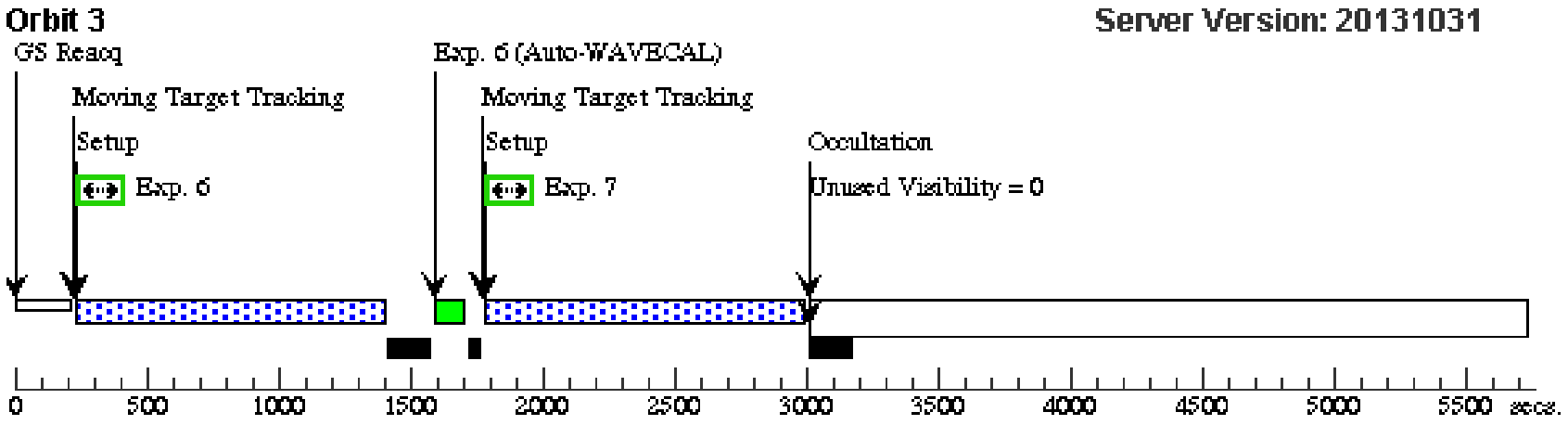
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ	(1) IO-WEST-1	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=DIFFUSE; CHECKBOX=25; DIFFUSE-CENTER=GEOMETRIC-CENTER	GS ACQ SCENARIO BASE1B3		0.1 Secs (0.1 Secs) *[==>]*	 ***[1]***
2	Science	(1) IO-WEST-1	STIS/FUV-MAMA, TIME-TAG, 52X2D1	G140L 1425 A	BUFFER-TIME=500			800 Secs (855 Secs) *[==>855.0 Secs]*	 ***[1]***
3	Science	(1) IO-WEST-1	STIS/FUV-MAMA, TIME-TAG, 52X2D1	G140L 1425 A	BUFFER-TIME=500			800 Secs (855 Secs) *[==>855.0 Secs]*	 ***[1]***
4	Science	(1) IO-WEST-1	STIS/FUV-MAMA, TIME-TAG, 52X2D1	G140L 1425 A	BUFFER-TIME=600			1200 Secs (1159 Secs) *[==>1159.0 Secs]*	 ***[2]***
5	Science	(1) IO-WEST-1	STIS/FUV-MAMA, TIME-TAG, 52X2D1	G140L 1425 A	BUFFER-TIME=600			1200 Secs (1159 Secs) *[==>1159.0 Secs]*	 ***[2]***
6	Science	(1) IO-WEST-1	STIS/FUV-MAMA, TIME-TAG, 52X2D1	G140L 1425 A	BUFFER-TIME=600			1200 Secs (1159 Secs) *[==>1159.0 Secs]*	 ***[3]***
7	Science	(1) IO-WEST-1	STIS/FUV-MAMA, TIME-TAG, 52X2D1	G140L 1425 A	BUFFER-TIME=600			1200 Secs (1159 Secs) *[==>1159.0 Secs]*	 ***[3]***
8	Science	(1) IO-WEST-1	STIS/FUV-MAMA, TIME-TAG, 52X2D1	G140L 1425 A	BUFFER-TIME=600			1200 Secs (1159 Secs) *[==>1159.0 Secs]*	 ***[4]***
9	Science	(1) IO-WEST-1	STIS/FUV-MAMA, TIME-TAG, 52X2D1	G140L 1425 A	BUFFER-TIME=600			1200 Secs (1159 Secs) *[==>1159.0 Secs]*	 ***[4]***
10	Science	(1) IO-WEST-1	STIS/FUV-MAMA, TIME-TAG, 52X2D1	G140L 1425 A	BUFFER-TIME=600			1200 Secs (1159 Secs) *[==>1159.0 Secs]*	 ***[5]***
11	Science	(1) IO-WEST-1	STIS/FUV-MAMA, TIME-TAG, 52X2D1	G140L 1425 A	BUFFER-TIME=600			1200 Secs (1025 Secs) *[==>1025 Secs]*	 ***[5]***

Orbit Structure



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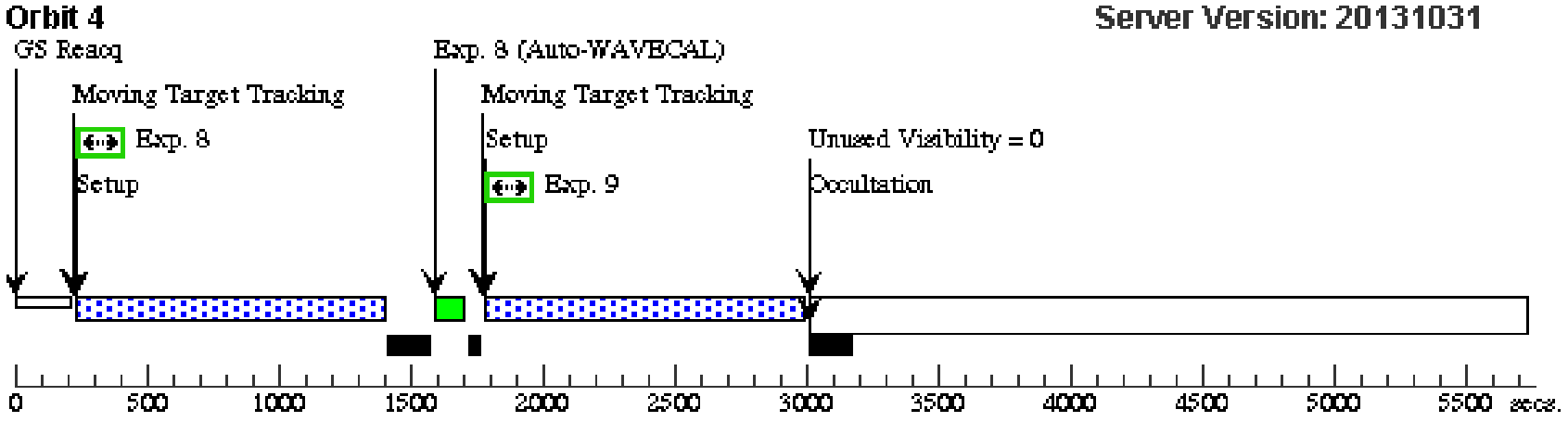
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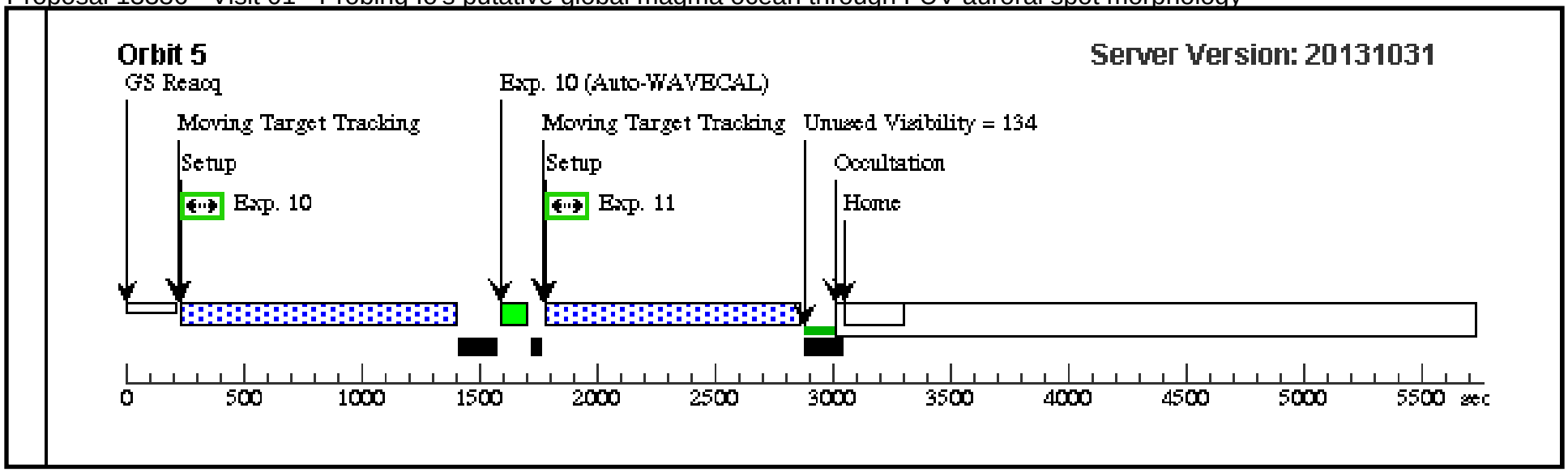
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Visit

Proposal 13336, Visit 02, implementation Thu Dec 12 02:37:52 GMT 2013

Diagnostic Status: Warning

Scientific Instruments: STIS/CCD, STIS/FUV-MAMA

Special Requirements: SCHED 100%

Diagnostics

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Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(2)	IO-WEST-2	STD=JUPITER	STD=IO		SEP OF IO-WEST-2 JUPITER FROM EARTH GT 30", SEP OF IO-WEST-2 CALLISTO FROM EARTH GT 10", SEP OF IO-WEST-2 EUROPA FROM EARTH GT 10", SEP OF IO-WEST-2 GANYMEDE FROM EARTH GT 10", OLG OF JUPITER FROM EARTH BETWEEN 330 30, OLG OF IO FROM EARTH BETWEEN 235 305, CML OF JUPITER FROM IO BETWEEN 190 30	EARTH

Proposal 13336 - Visit 02 - Probing Io's putative global magma ocean through FUV auroral spot morphology

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ	(2) IO-WEST-2	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=DIFFUSE; CHECKBOX=25; DIFFUSE-CENTER=GEOMETRIC-CENTER	GS ACQ SCENARIO BASE1B3		0.1 Secs (0.1 Secs) *[==>]*	 ***[1]***
2	Science	(2) IO-WEST-2	STIS/FUV-MAMA, TIME-TAG, 52X2D1	G140L 1425 A	BUFFER-TIME=500			800 Secs (855 Secs) *[==>855.0 Secs]*	 ***[1]***
3	Science	(2) IO-WEST-2	STIS/FUV-MAMA, TIME-TAG, 52X2D1	G140L 1425 A	BUFFER-TIME=500			800 Secs (855 Secs) *[==>855.0 Secs]*	 ***[1]***
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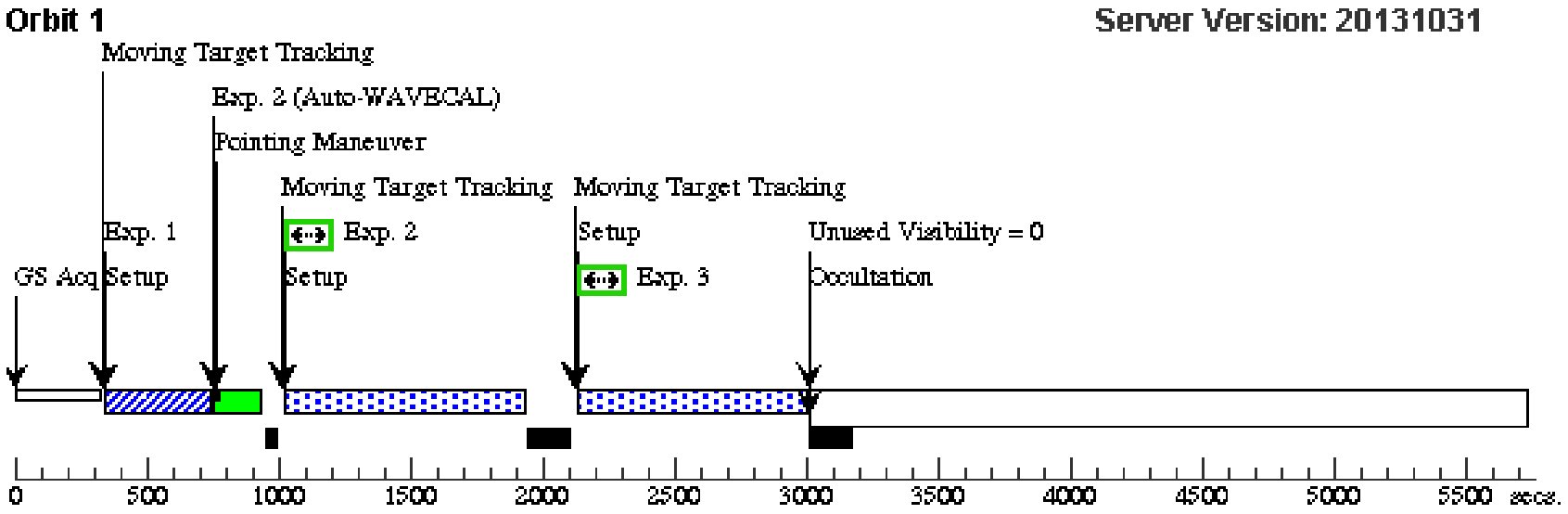
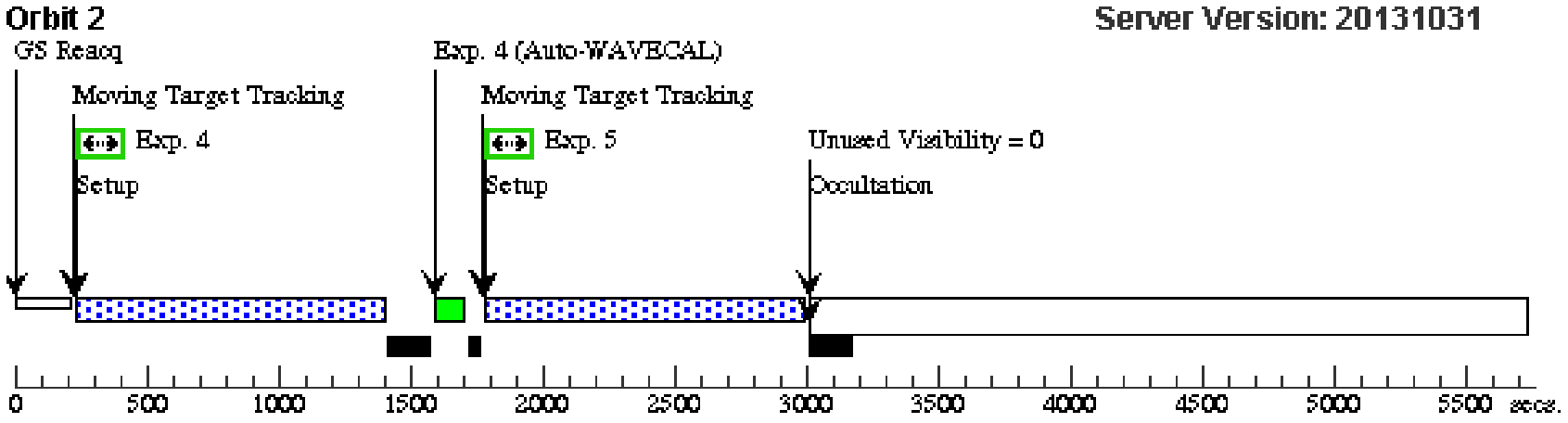
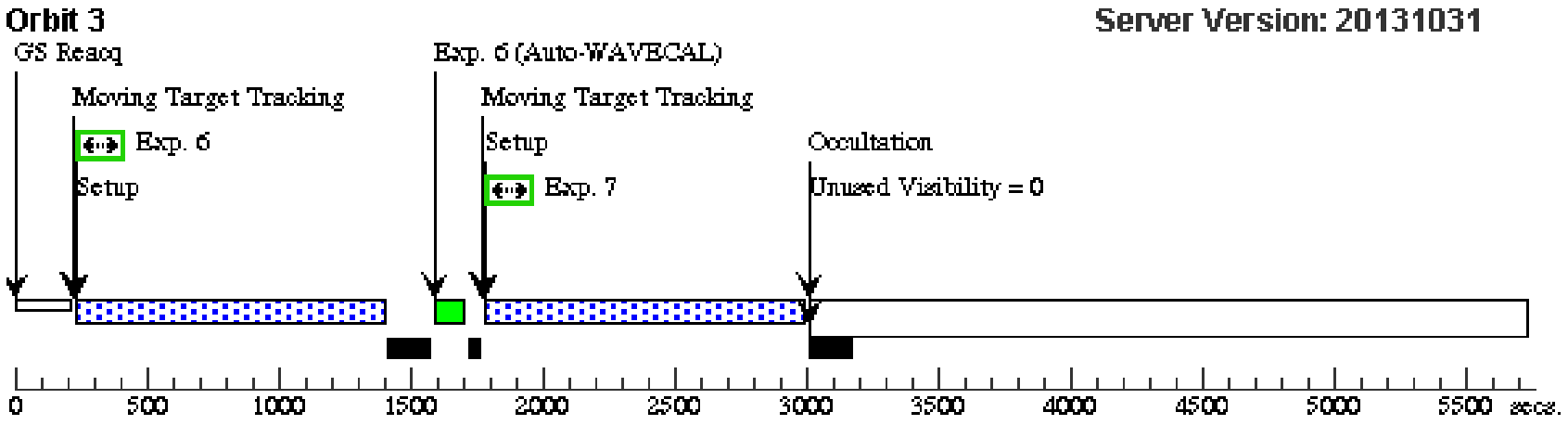
Orbit Structure



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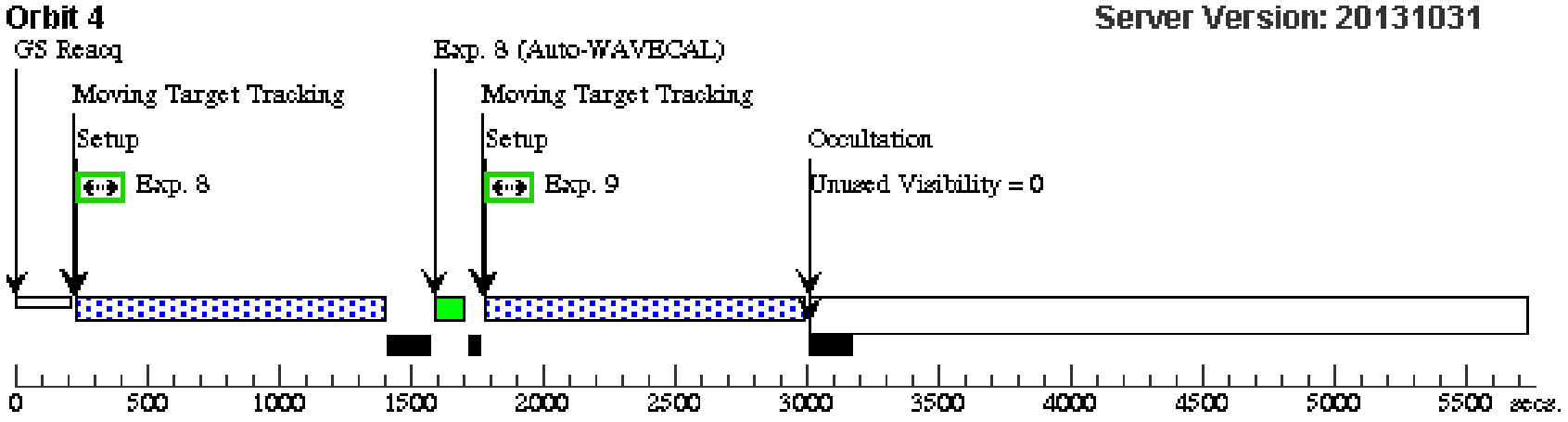
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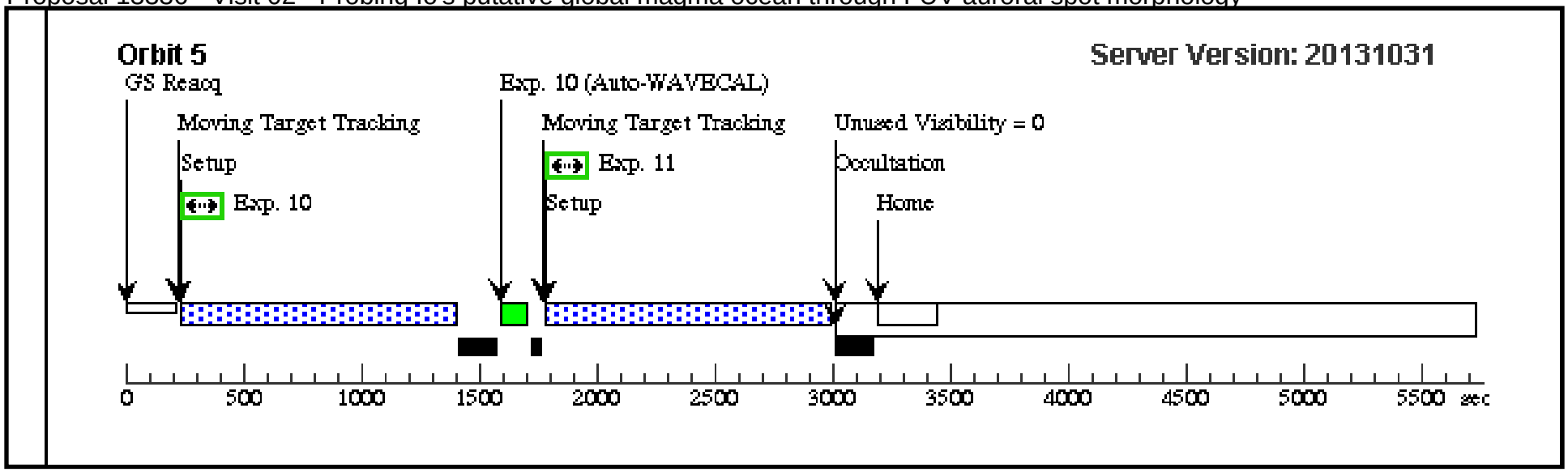
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