14249 - The old pulsar PSR J0108-1431, a key target to understand the long-term evolution of neutron stars

Cycle: 23, 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?*
02	(1) PSRJ0108-1431	ACS/SBC	2	30-Jan-2016 21:03:39.0	yes
01	(1) PSRJ0108-1431	WFC3/UVIS	6	30-Jan-2016 21:03:43.0	yes
52	(2) PSRJ0108-1431-UPDATED	ACS/SBC	2	30-Jan-2016 21:03:46.0	yes
51	(2) PSRJ0108-1431-UPDATED	WFC3/UVIS	6	30-Jan-2016 21:03:49.0	yes

16 Total Orbits Used

ABSTRACT

The multi-wavelength study of >100 Myr old radio-pulsars holds the key to understanding the long-term evolution of neutron stars, including the advanced stages of the surface cooling history, and possible variations in the magnetosphere properties. Near-UV observations of neutron stars are particularly important for such studies because they offer the chance to explore both thermal and non-thermal emission processes. The first aim of this proposal is to obtain a robust detection of the candidate optical counterpart (U=26.4) to the 166 Myr old radio pulsar PSR J0108-1431, discovered by us with the VLT, through WFC3/UVIS imaging in the U and B bands. The detection of a point source at the pulsar radio position, computed from its VLBI radio coordinates and proper motion, with U and B-band fluxes compatible with those of the candidate counterpart, will firmly secure our proposed identification. The second aim is to obtain the first measurement of the pulsar flux in the optical-UV with both the WFC3/UVIS and the ACS/SBC. This will enable us to determine the slope of the Rayleigh-Jeans continuum, only hinted in the VLT data, affected by large errors, and measure the temperature of the bulk of the neutron star surface, too cold to be detected in the X-rays where only hot polar caps have been detected with Chandra and XMM-Newton. The measured temperature will provide the crucial information to constrain neutron star cooling curves for ages>100 Myr, where theoretical predictions are highly uncertain, and from them verify different models of the neutron star interior.

OBSERVING DESCRIPTION

This proposal has two goals. The first one is to confirm the identification of the old pulsar PSR J0108-1431 through absolute HST astrometry and comparison with the very accurate pulsar position obtained from radio measurements. The second goal is to study the optical/UV spectrum of this pulsar to characterise the slope of its, likely, thermal spectrum and derive its brightness temperature, thanks to accurate distance to the pulsar, also obtained from radio observations. In this way, we will be able to compare the inferred temperature with cooling models and investigate whether the neutron star surface temperature has been raised by re-heating processes in the interior, as observed in other pulsars. This will provide us with important information on the neutron star interior and composition.

To fulfill our goals, we need observations performed in the optical and in the near-UV. Therefore, we plan to observe our target in the optical with the WFC3/UVIS In three filters (225W, 336W, 438W) and in the near-UV with the ACS/SBC in one filter (F140LP). The WFC3 and ACS observations should be performed in two diferent visits. For the WFC3 observations we require two orbits for each of the selected filter, for a total of six orbits (visit 1). For the ACS observations we require two orbits (visit 2). We do not have any time constraints for our observations and we have no specific sequence for the visits and exposure execution. In all cases, observations will be performed in ACCUM mode.

There is no bright star close to our target so that we do not require any particular roll angle constraint to avoid that the saturation spikes overlap the

target position

Visit

Proposal 14249, Visit 02, failed

Sun Jan 31 02:03:51 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/SBC

Special Requirements: (none)

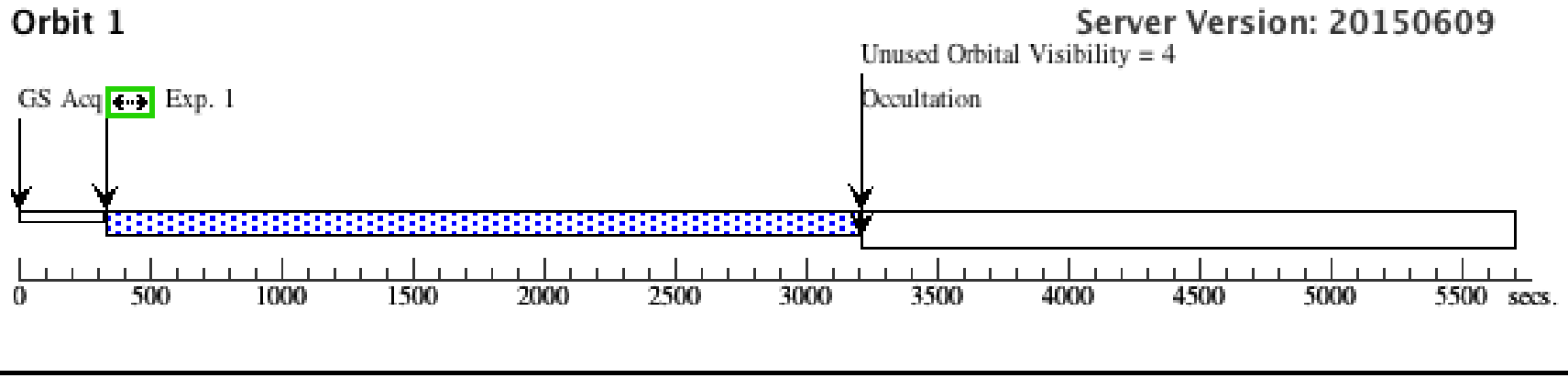
Fixed Targets

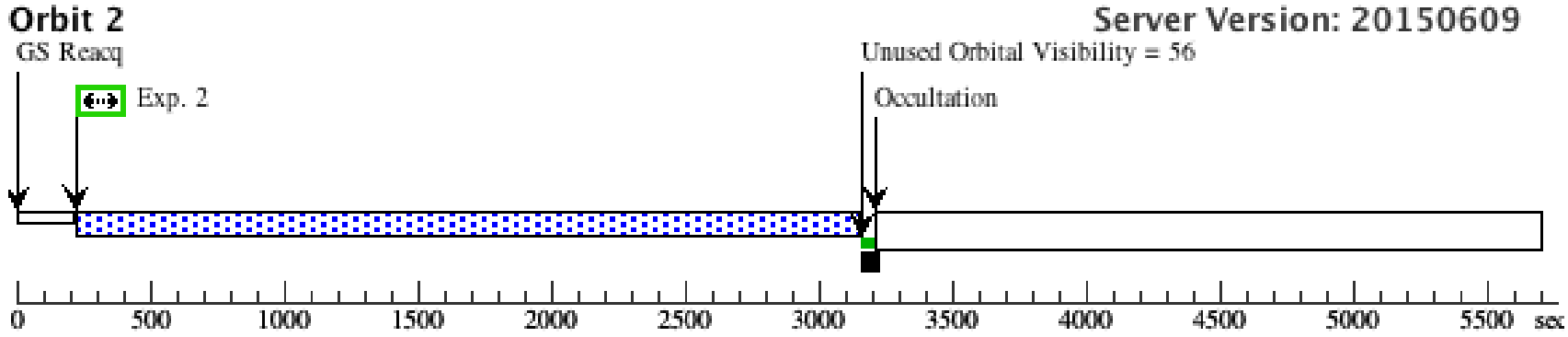
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	PSRJ0108-1431	RA: 01 08 8.3540 (17.0348083d) Dec: -14 32 50.38 (-14.54733d) Equinox: J2000		V=27.8 U = 26.4 +/-0.3	Reference Frame: ICRS

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(ACS.im.72 3158)	(1) PSRJ0108-1431	ACS/SBC, ACCUM, SBC	F140LP				2800 Secs (2800 Secs) *[==>]*	*[1]*
2	(ACS.im.72 3158)	(1) PSRJ0108-1431	ACS/SBC, ACCUM, SBC	F140LP				2900 Secs (2900 Secs) *[==>]*	*[2]*

Orbit Structure





Visit

Proposal 14249, Visit 01, failed

Sun Jan 31 02:03:51 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

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), (6)

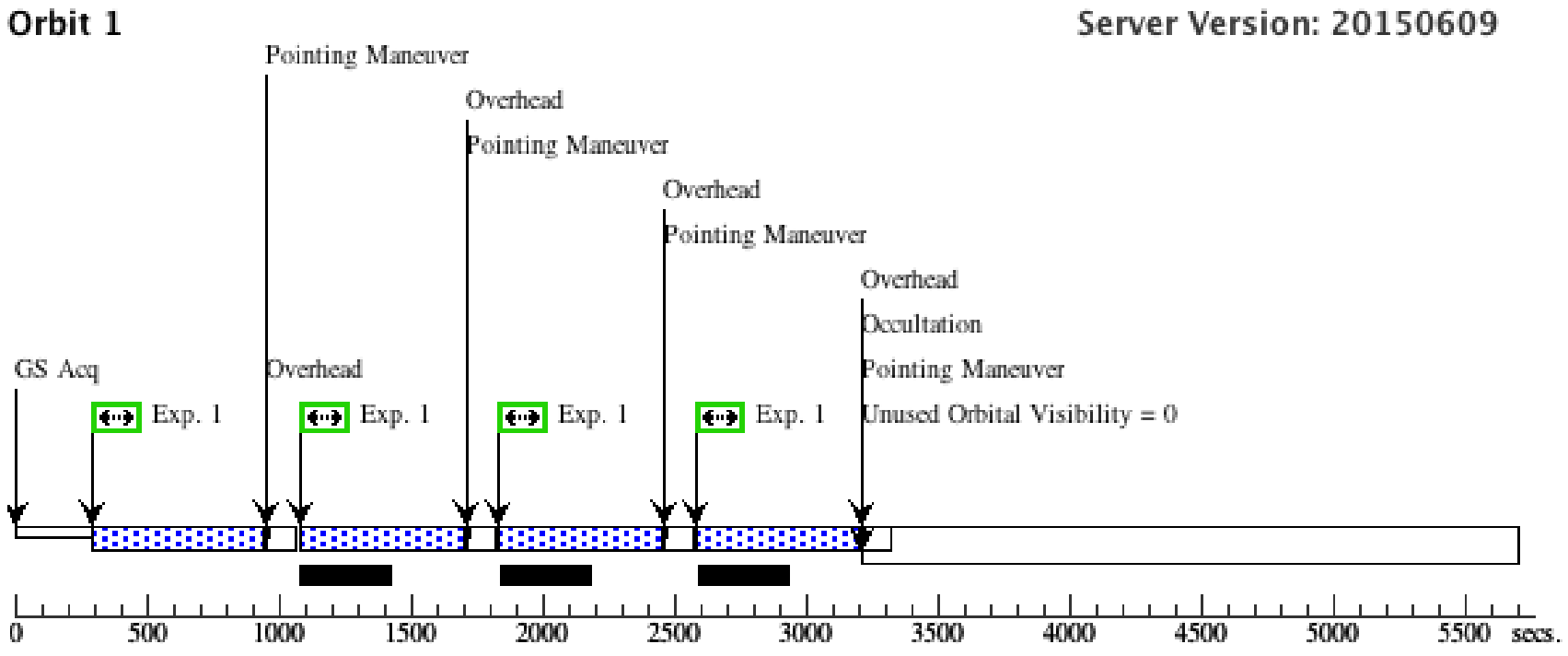
Fixed Targets

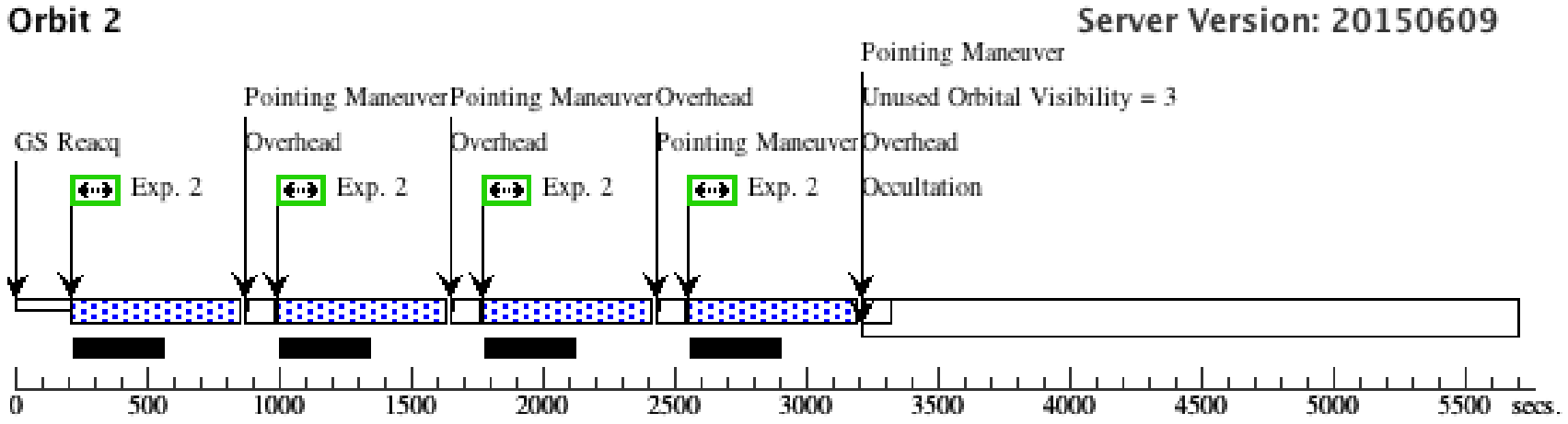
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	PSRJ0108-1431	RA: 01 08 8.3540 (17.0348083d) Dec: -14 32 50.38 (-14.54733d) Equinox: J2000		V=27.8 U = 26.4 +/-0.3	Reference Frame: ICRS

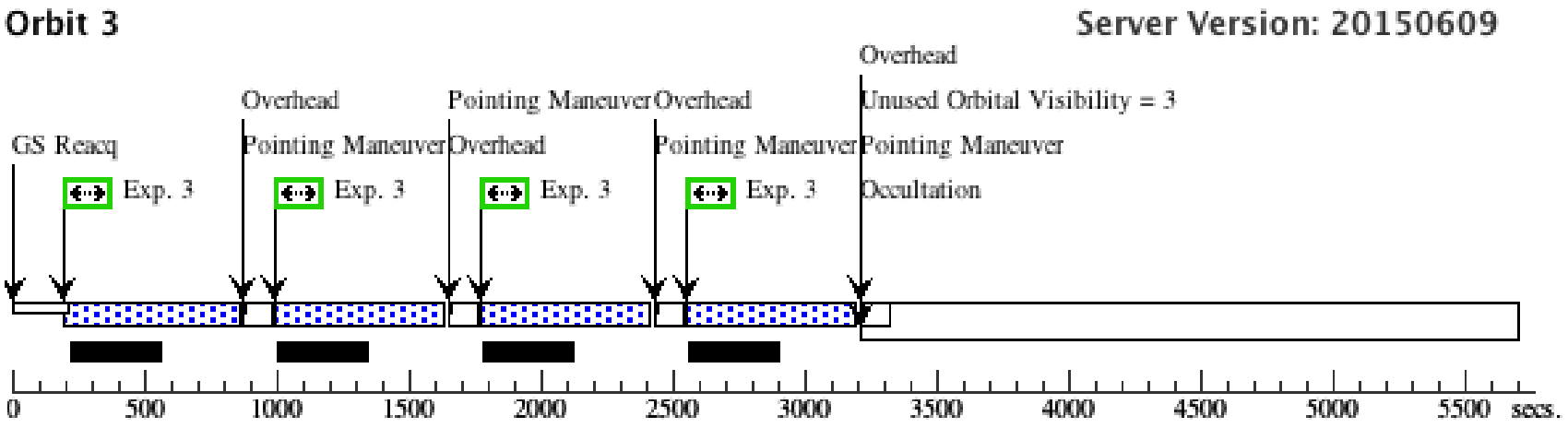
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) PSRJ0108-1431	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12		Pattern 1, Exps 1-1 in Visit 01 (1)	615 Secs (2472 Secs) *[==>618.0 Secs (Pattern 1)]* *[==>618.0 Secs (Pattern 2)]* *[==>618.0 Secs (Pattern 3)]* *[==>618.0 Secs (Pattern 4)]*	***[1]***
2		(1) PSRJ0108-1431	WFC3/UVIS, ACCUM, UVIS-CENTER	F225W	FLASH=12		Pattern 1, Exps 2-2 in Visit 01 (1)	645 Secs (2580 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
3		(1) PSRJ0108-1431	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W	FLASH=12		Pattern 1, Exps 3-3 in Visit 01 (1)	645 Secs (2580 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[3]***
4		(1) PSRJ0108-1431	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W	FLASH=12		Pattern 1, Exps 4-4 in Visit 01 (1)	645 Secs (2580 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[4]***
5		(1) PSRJ0108-1431	WFC3/UVIS, ACCUM, UVIS-CENTER	F438W	FLASH=8		Pattern 1, Exps 5-5 in Visit 01 (1)	645 Secs (2580 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[5]***
6		(1) PSRJ0108-1431	WFC3/UVIS, ACCUM, UVIS-CENTER	F438W	FLASH=8		Pattern 1, Exps 6-6 in Visit 01 (1)	645 Secs (2580 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[6]***

Orbit Structure



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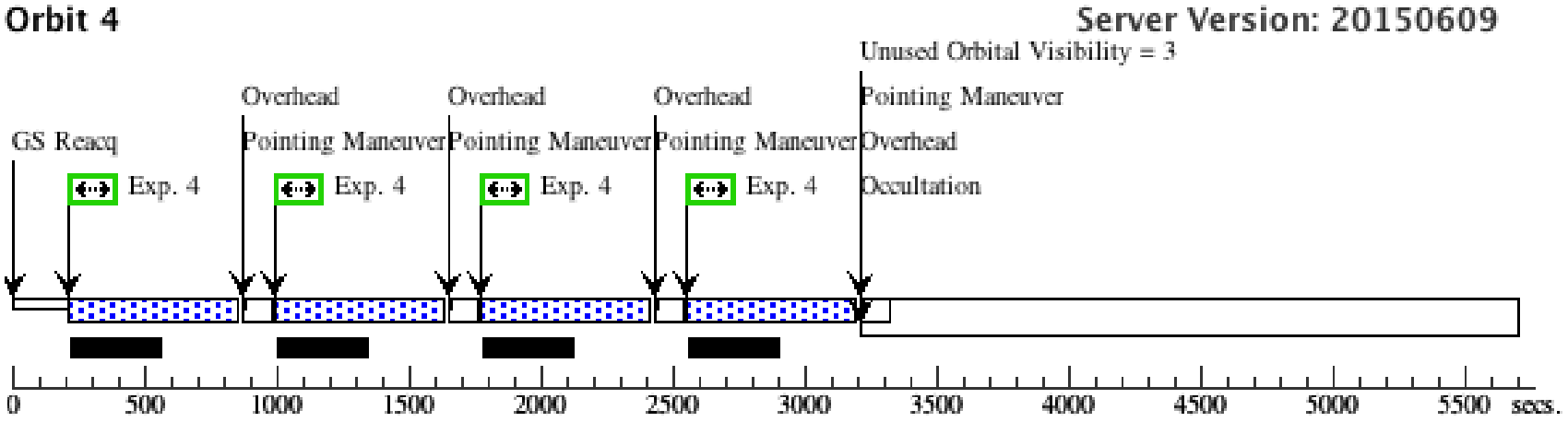
Exp. 3
Overhead
Pointing Maneuver
Exp. 3
Pointing Maneuver
Overhead
Exp. 3
Overhead
Pointing Maneuver
Exp. 3
Overhead
Unused Orbital Visibility = 3
Pointing Maneuver
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.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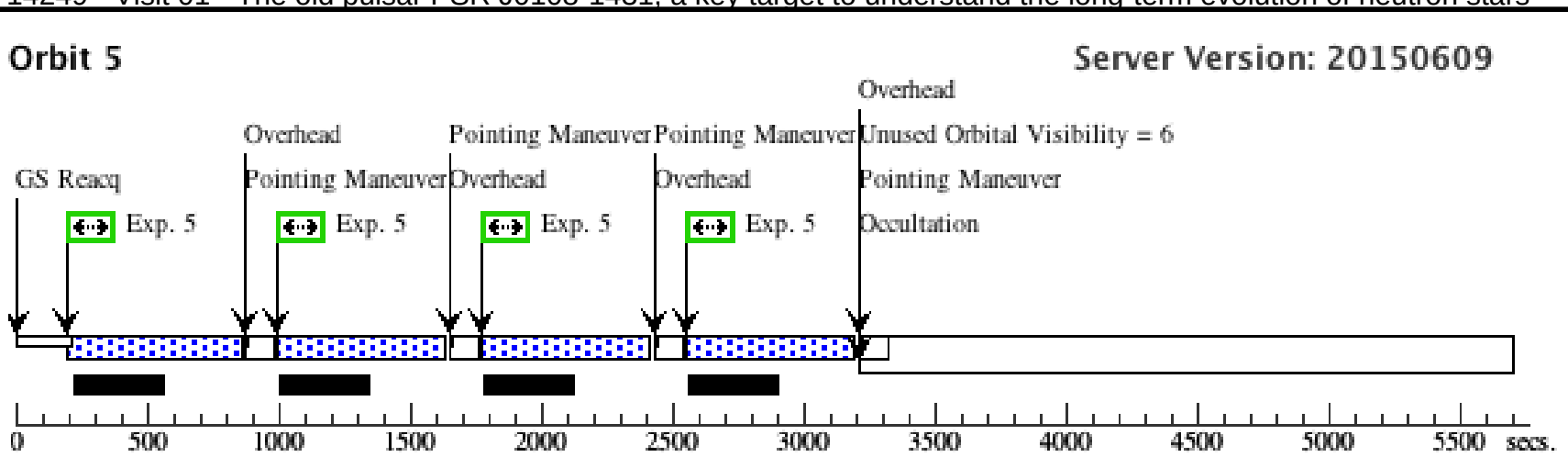
GS Reacq
Exp. 4
Overhead
Pointing Maneuver
Exp. 4
Overhead
Pointing Maneuver
Exp. 4
Overhead
Pointing Maneuver
Exp. 4
Unused Orbital Visibility = 3
Pointing Maneuver
Overhead
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.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Exp. 5
Overhead
Pointing Maneuver
Exp. 5
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Overhead
Exp. 5
Pointing Maneuver
Overhead
Exp. 5
Overhead
Pointing Maneuver
Occultation
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1000
1500
2000
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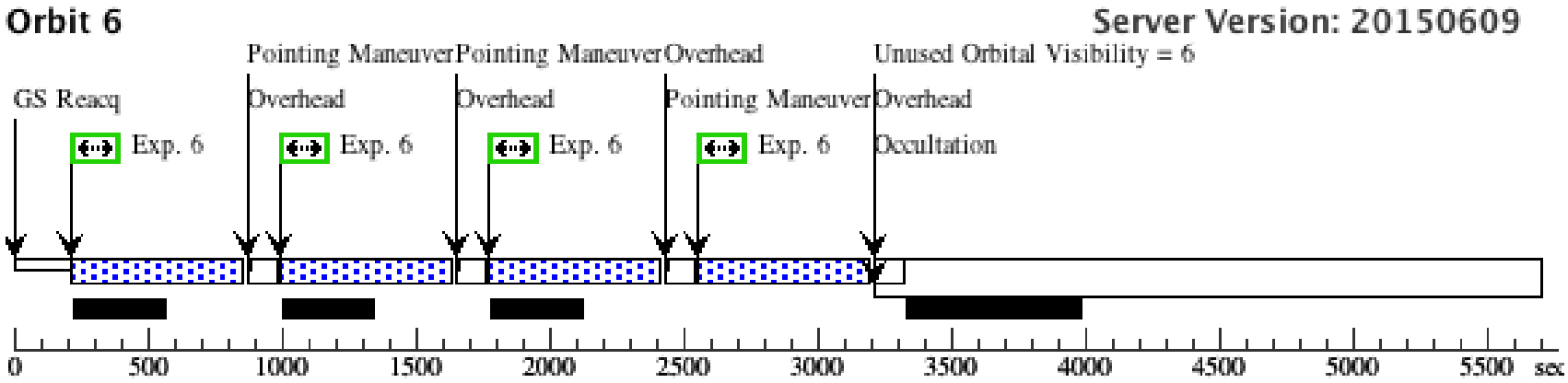
3000
3500
4000
4500
5000
5500
secs.


Orbit 6
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GS Reacq
Exp. 6
Pointing Maneuver
Overhead
Exp. 6
Pointing Maneuver
Overhead
Exp. 6
Overhead
Pointing Maneuver
Exp. 6
Unused Orbital Visibility = 6
Overhead
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 14249, Visit 52, implementation Sun Jan 31 02:03:52 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/SBC

Special Requirements: (none)

Comments: Copy of failed visit 02 with updated target coordinates.

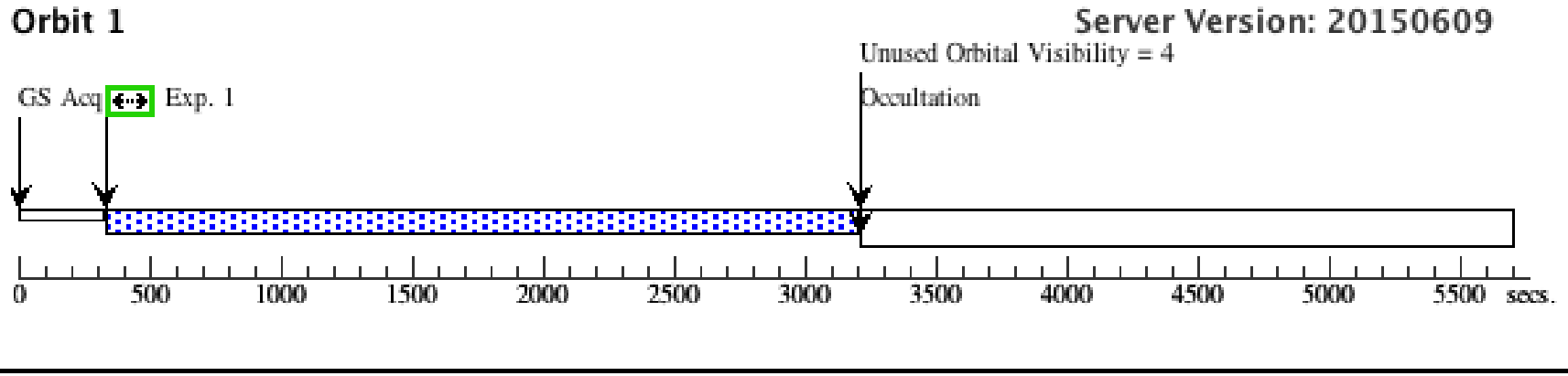
Fixed Targets

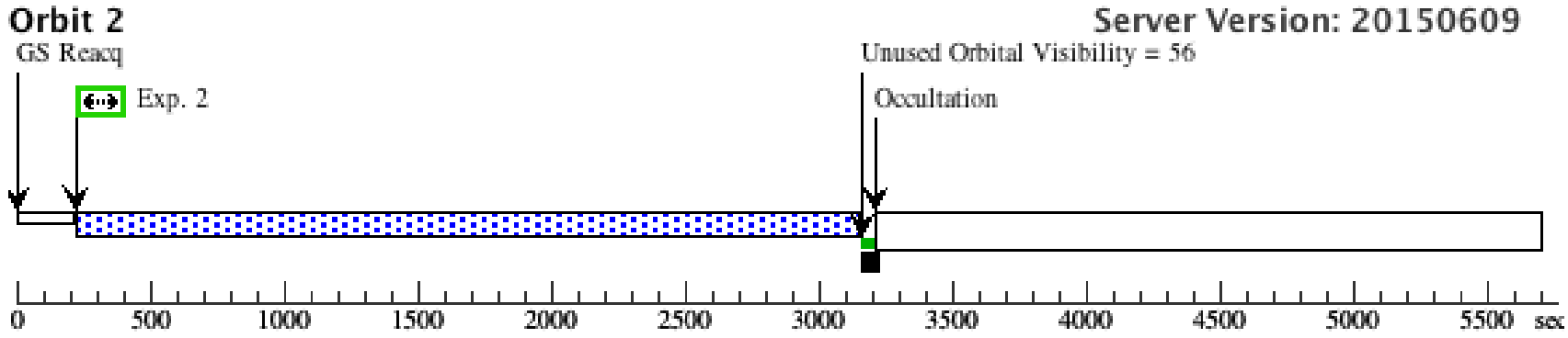
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	PSRJ0108-1431-UPDATED	RA: 01 08 8.3470 (17.0347792d) Dec: -14 31 50.19 (-14.53061d) Equinox: J2000	Proper Motion RA: 75.05 mas/yr Proper Motion Dec: -152.54 mas/yr Epoch of Position: 2007.0	V=27.8 U = 26.4 +/-0.3	Reference Frame: ICRS

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(ACS.im.723158)	(2) PSRJ0108-1431-UPDATED	ACS/SBC, ACCUM, SBC	F140LP				2800 Secs (2800 Secs)	
								[==>]	***[1]***
2	(ACS.im.723158)	(2) PSRJ0108-1431-UPDATED	ACS/SBC, ACCUM, SBC	F140LP				2900 Secs (2900 Secs)	
								[==>]	***[2]***

Orbit Structure





Visit

Proposal 14249, Visit 51, implementation Sun Jan 31 02:03:52 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Comments: Copy of failed visit 01 with updated target coordinates.

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), (6)

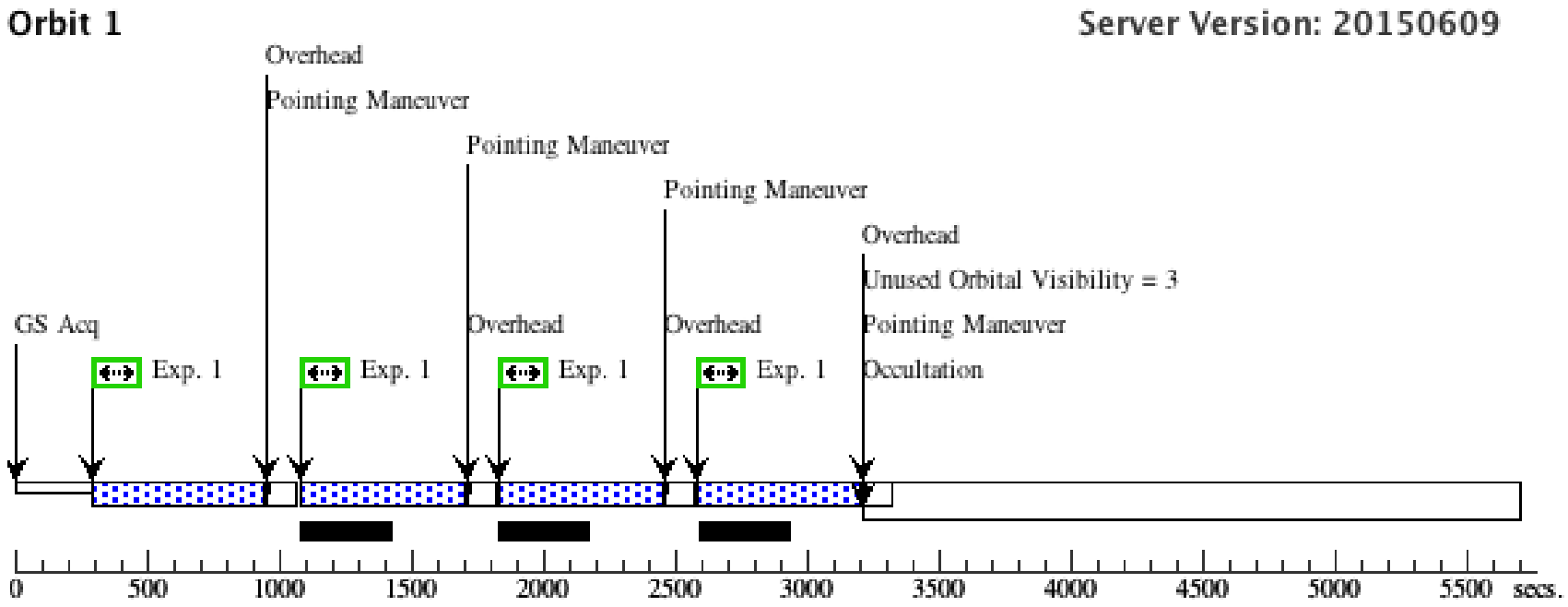
Fixed Targets

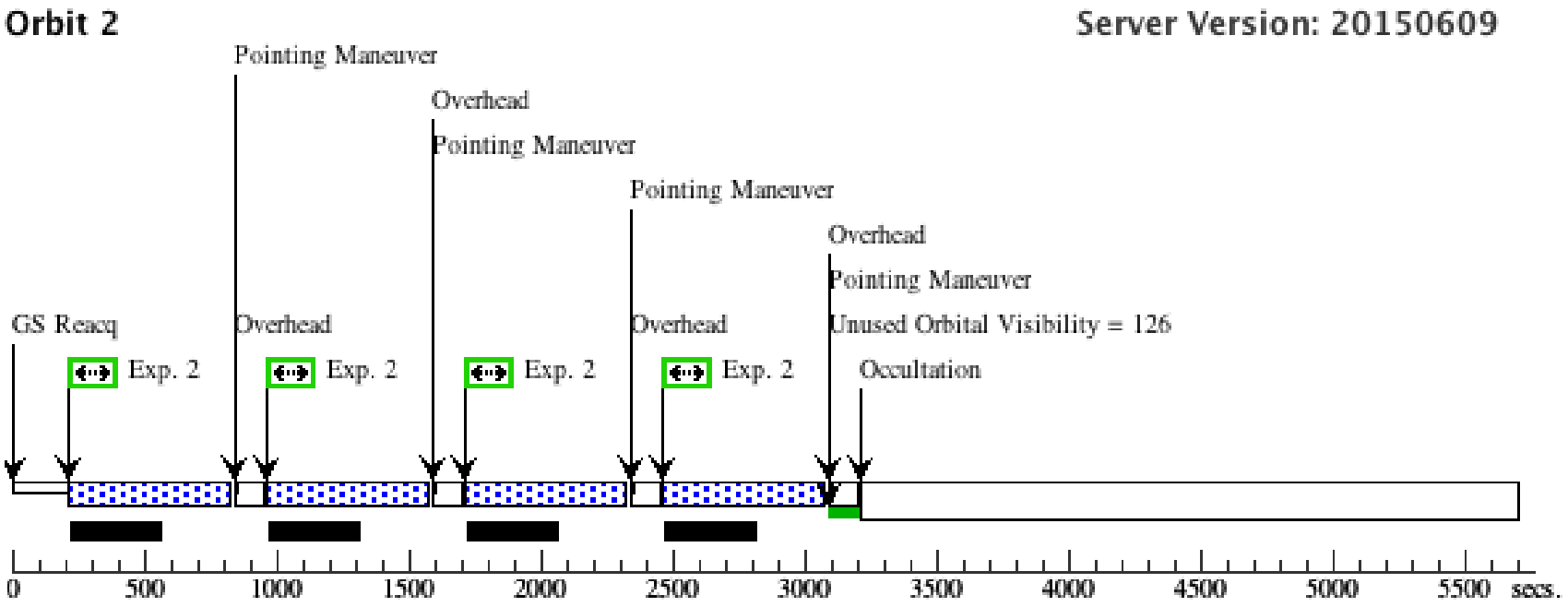
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	PSRJ0108-1431-UPDATED	RA: 01 08 8.3470 (17.0347792d) Dec: -14 31 50.19 (-14.53061d) Equinox: J2000	Proper Motion RA: 75.05 mas/yr Proper Motion Dec: -152.54 mas/yr Epoch of Position: 2007.0	V=27.8 U = 26.4 +/-0.3	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) PSRJ0108-1431-UPDATED	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F225W	FLASH=10		Pattern 1, Exps 1-1 in Visit 51 (1)	615 Secs (2472 Secs) *[==>618.0 Secs (Pattern 1)]* *[==>618.0 Secs (Pattern 2)]* *[==>618.0 Secs (Pattern 3)]* *[==>618.0 Secs (Pattern 4)]*	***[1]***
2		(2) PSRJ0108-1431-UPDATED	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F225W	FLASH=10		Pattern 1, Exps 2-2 in Visit 51 (1)	615 Secs (2460 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
3		(2) PSRJ0108-1431-UPDATED	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F336W	FLASH=10		Pattern 1, Exps 3-3 in Visit 51 (1)	645 Secs (2580 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[3]***
4		(2) PSRJ0108-1431-UPDATED	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F336W	FLASH=10		Pattern 1, Exps 4-4 in Visit 51 (1)	645 Secs (2580 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[4]***
5		(2) PSRJ0108-1431-UPDATED	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F438W	FLASH=6		Pattern 1, Exps 5-5 in Visit 51 (1)	645 Secs (2580 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[5]***
6		(2) PSRJ0108-1431-UPDATED	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F438W	FLASH=6		Pattern 1, Exps 6-6 in Visit 51 (1)	645 Secs (2580 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[6]***

Orbit Structure

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Pointing Maneuver
Overhead
Pointing Maneuver
GS Reacq
Overhead
Overhead
Unused Orbital Visibility = 126
Exp. 2
Exp. 2
Exp. 2
Exp. 2
Occultation
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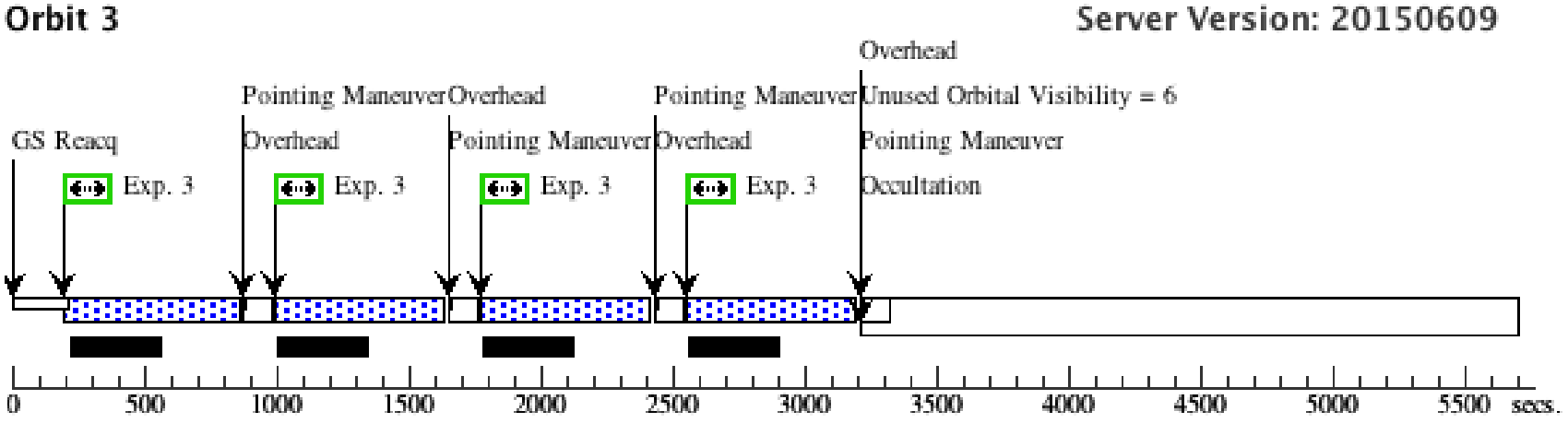
4000
4500
5000
5500
secs.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Overhead
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Unused Orbital Visibility = 6
GS Reacq
Overhead
Pointing Maneuver
Overhead
Pointing Maneuver
Exp. 3
Exp. 3
Exp. 3
Exp. 3
Occultation
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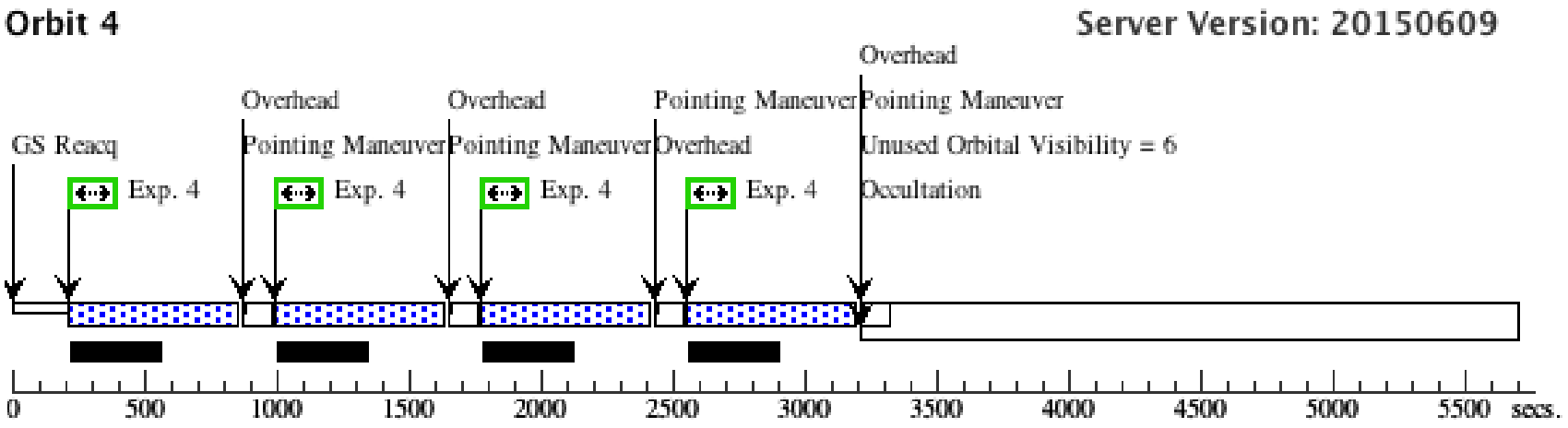
5500
secs.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GS Reacq
Exp. 4
Overhead
Pointing Maneuver
Exp. 4
Overhead
Pointing Maneuver
Exp. 4
Pointing Maneuver
Overhead
Exp. 4
Overhead
Pointing Maneuver
Unused Orbital Visibility = 6
Occultation
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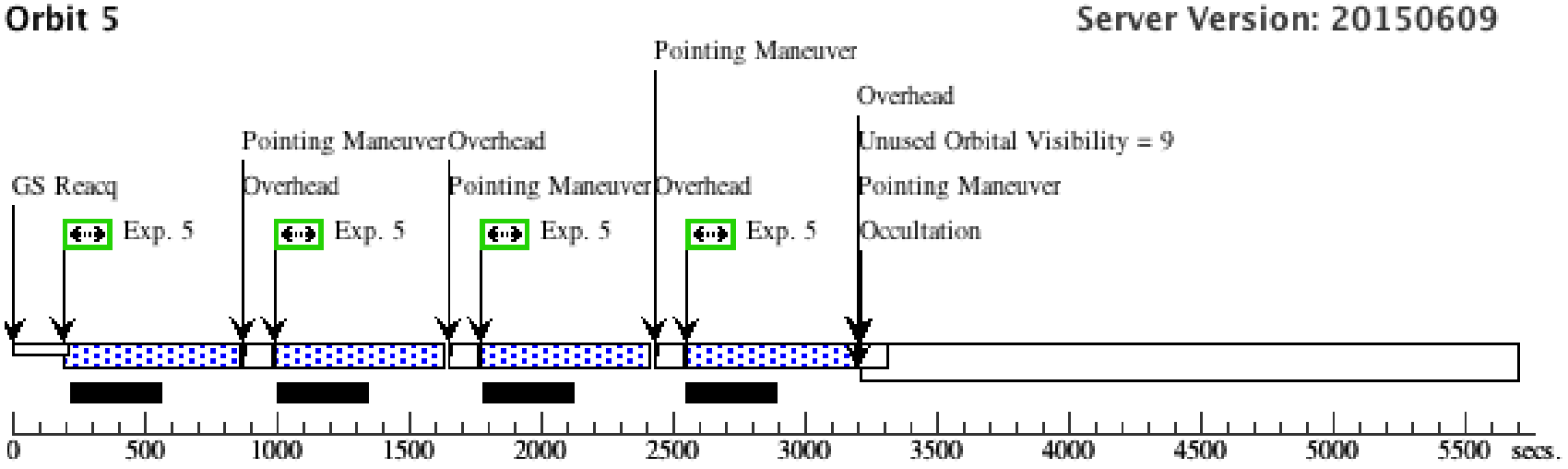
secs.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Exp. 5
Overhead
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Exp. 5
Pointing Maneuver
Overhead
Exp. 5
Pointing Maneuver
Overhead
Unused Orbital Visibility = 9
Pointing Maneuver
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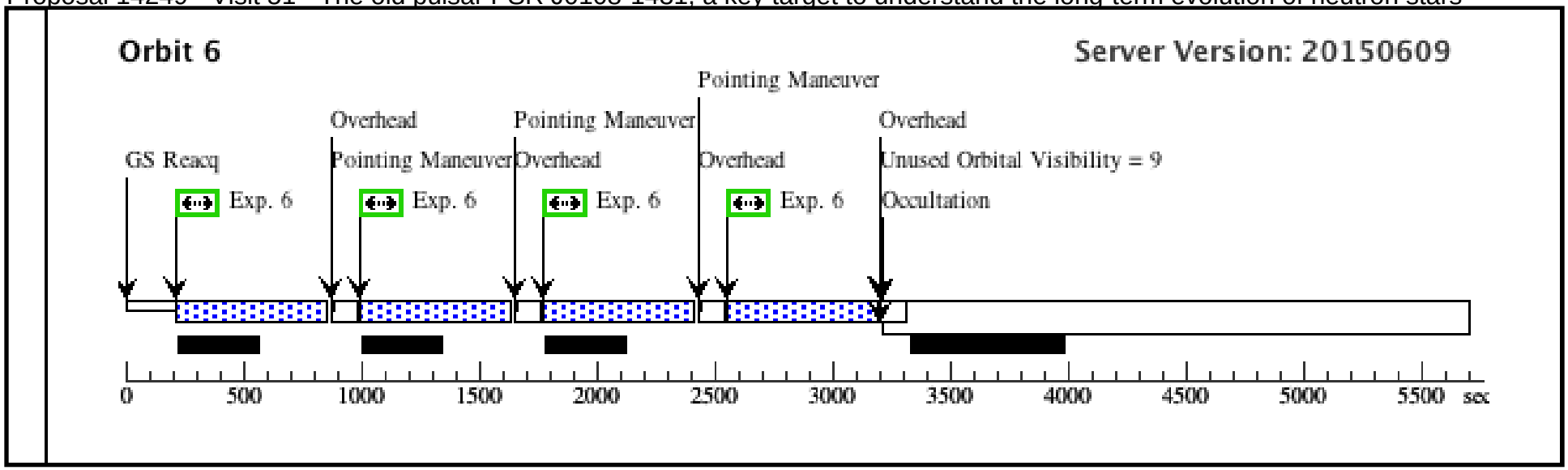
secs.


Orbit 6
Server Version: 20150609
GS Reacq
Exp. 6
Overhead
Pointing Maneuver
Exp. 6
Pointing Maneuver
Overhead
Exp. 6
Pointing Maneuver
Overhead
Exp. 6
Overhead
Unused Orbital Visibility = 9
Occultation
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1500
2000
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3500
4000
4500
5000
5500
sec