



14228 - Thermal Equilibration and Cosmic-Ray Acceleration in Astrophysical Shocks: UV Spectra of the SN1006 Remnant

Cycle: 23, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
Dr. John Charles Raymond (PI) (Contact)	Smithsonian Institution Astrophysical Observatory	jraymond@cfa.harvard.edu
Dr. P. Frank Winkler (CoI)	Middlebury College	winkler@middlebury.edu
J. Martin Laming (CoI)	Naval Research Laboratory	j.laming@nrl.navy.mil

VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) SN1006-T1	COS/FUV	5	29-Jul-2016 13:21:47.0	yes
02	(1) SN1006-T1	COS/FUV	5	29-Jul-2016 13:21:49.0	yes
12	(2) SN1006-T1-ALTERNATE	COS/FUV	5	29-Jul-2016 13:21:50.0	yes
03	(1) SN1006-T1	COS/FUV	5	29-Jul-2016 13:21:51.0	yes
13	(2) SN1006-T1-ALTERNATE	COS/FUV	5	29-Jul-2016 13:21:52.0	yes

25 Total Orbits Used

ABSTRACT

Two outstanding questions about the physics of interstellar shock waves are 1) the degree of thermal equilibration among electrons and different ions and 2) efficiency of transfer of energy from the thermal plasma to energetic particles---cosmic rays. Those questions are closely related in that both

processes depend upon plasma turbulence in the shock. The degree of thermal equilibration is also important for diagnostics of shock speed based on measured electron or proton temperatures.

We propose to observe a fast shock in SN1006 to measure the kinetic temperatures of He, C and N from the widths of the He II, C IV and N V line profiles. It is known from HUT and FUSE observations that the plasma behind a 2300 km/s shocks in SN1006 is far from equilibrium, with He, C and O temperatures roughly mass-proportional (4, 12 and 16 times the proton temperature, respectively), rather than approximately equal to the proton temperature as full equilibration would dictate. By contrast, the He and C temperatures ARE close to equilibrium with the protons in a 350 km/s shock in the Cygnus Loop. However, the existing measurements for SN1006 are quite uncertain, and only one other measurement of ion temperatures in a fast collisionless shock exists. The proposed observation will tighten the constraints on thermal equilibration by factors of 4 to 6.

SN1006 is the only Galactic SNR with fast shocks and low enough reddening to be observable in the UV, and we have identified a filament twice as bright and 25% faster than the region studied previously. Thus spectroscopy with COS provides a unique opportunity to attack this problem.

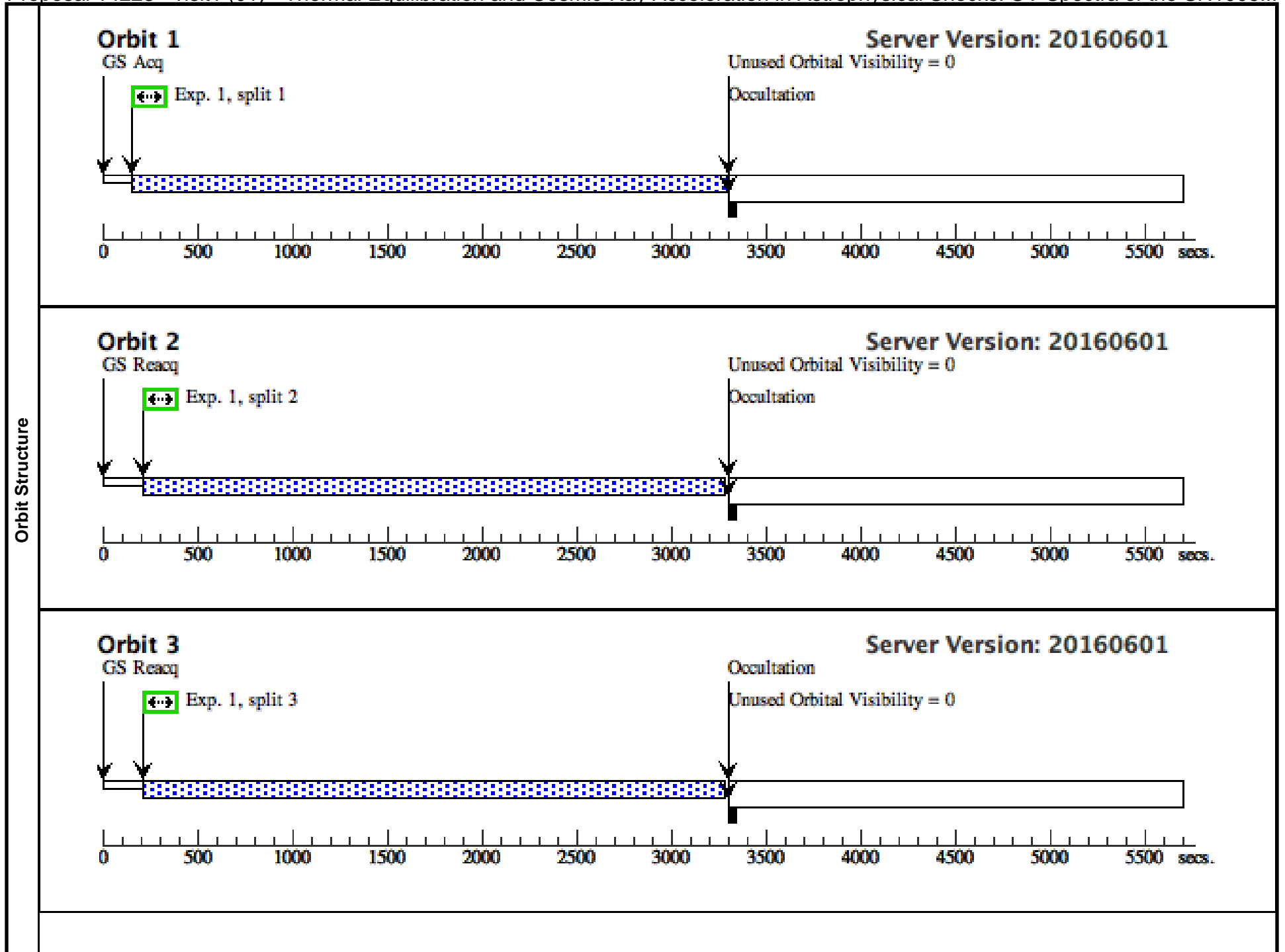
OBSERVING DESCRIPTION

We wish to obtain a COS spectrum with the G140L grating (1105 center) of a fast shock wave in the supernova remnant SN1006. We will spend the full 15 orbit allocation on this one position because it is very faint. The objective is to measure the widths of the He II, C IV and N V lines to determine the kinetic temperatures of those ions.

Proposal 14228 - visit1 (01) - Thermal Equilibration and Cosmic-Ray Acceleration in Astrophysical Shocks: UV Spectra of the SN1006...

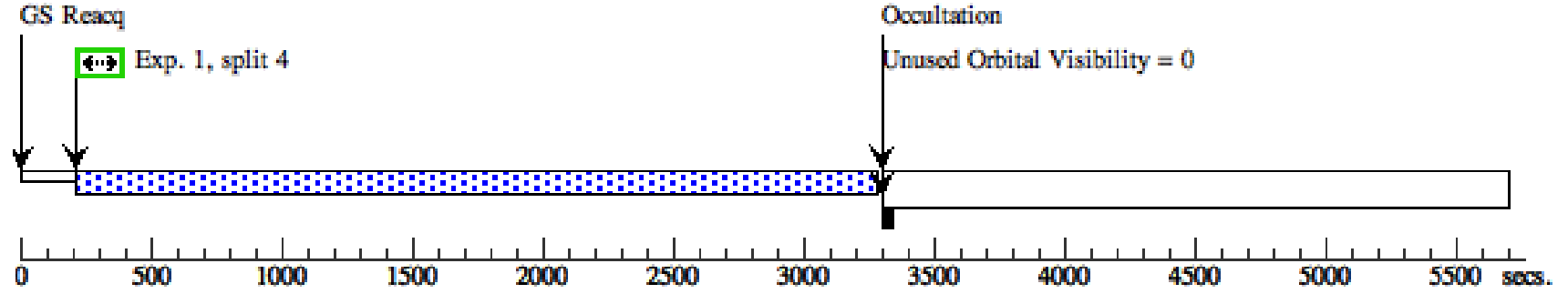
Fri Jul 29 17:21:53 GMT 2016

Visit	<p>Proposal 14228, visit1 (01), scheduled</p> <p>Diagnostic Status: Warning</p> <p>Scientific Instruments: COS/FUV</p> <p>Special Requirements: (none)</p> <p><i>Comments: First visit to SN1006-T1. 5 orbits, each with 4 FP-SPLITS.</i></p>																																																		
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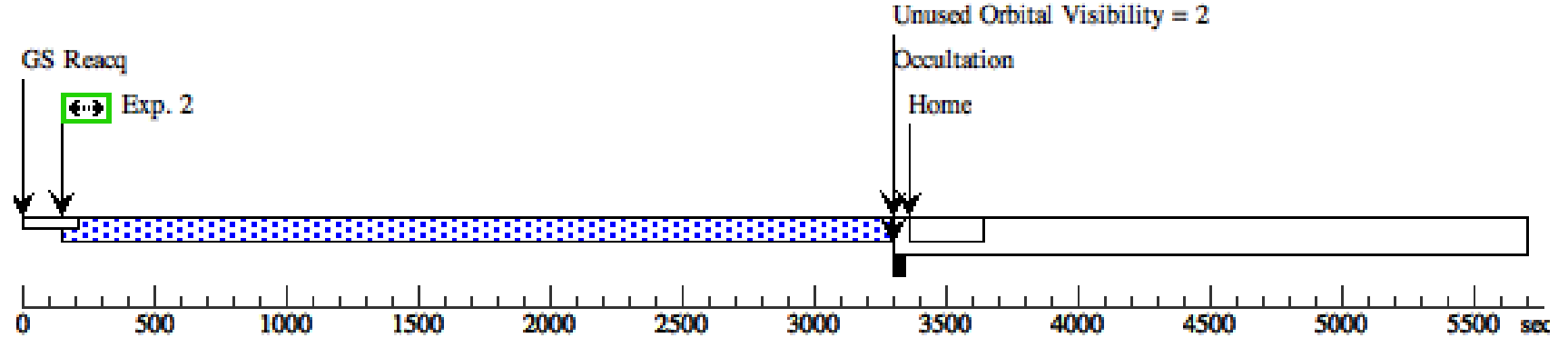
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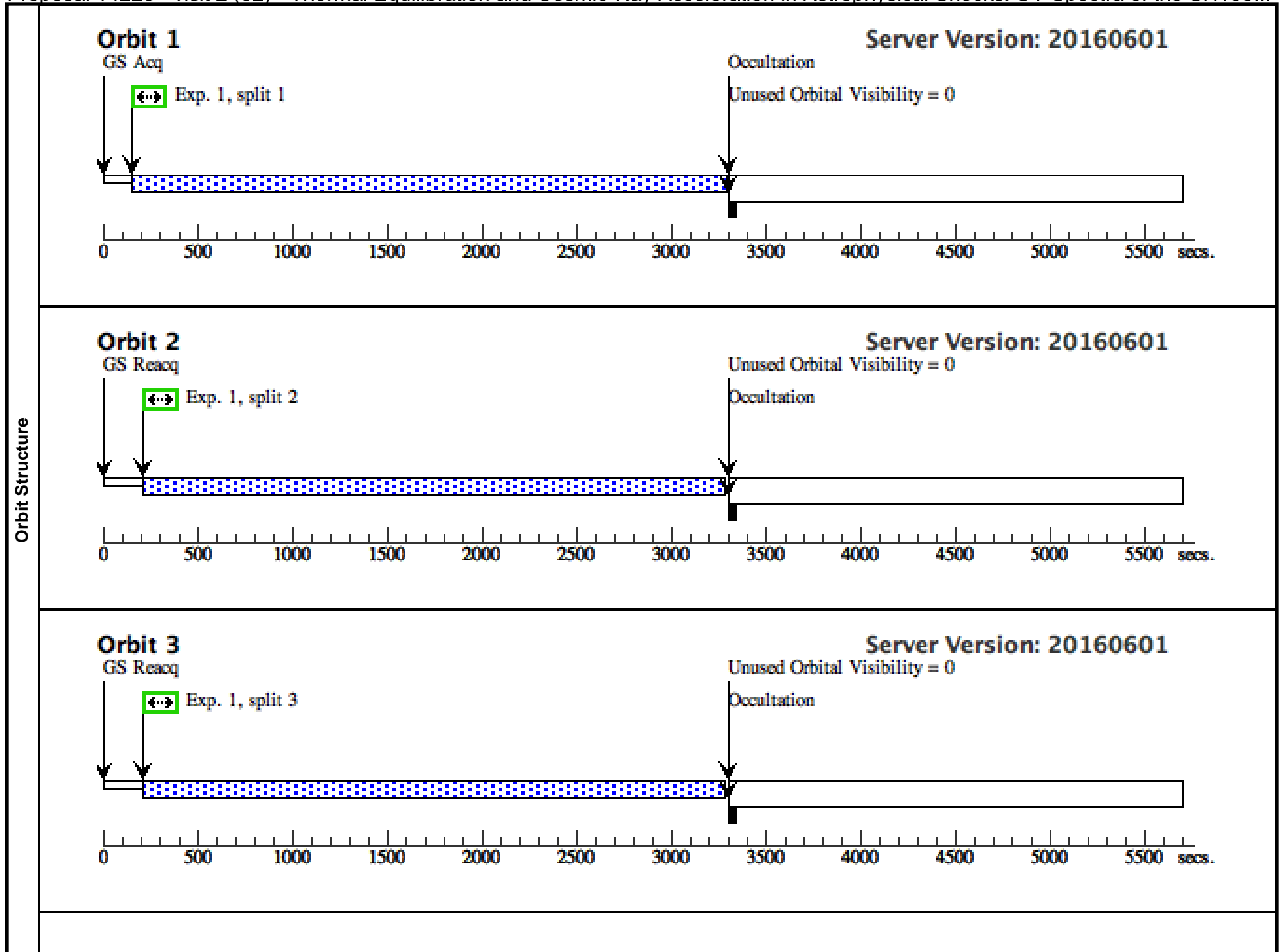
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Proposal 14228 - visit 2 (02) - Thermal Equilibration and Cosmic-Ray Acceleration in Astrophysical Shocks: UV Spectra of the SN100...

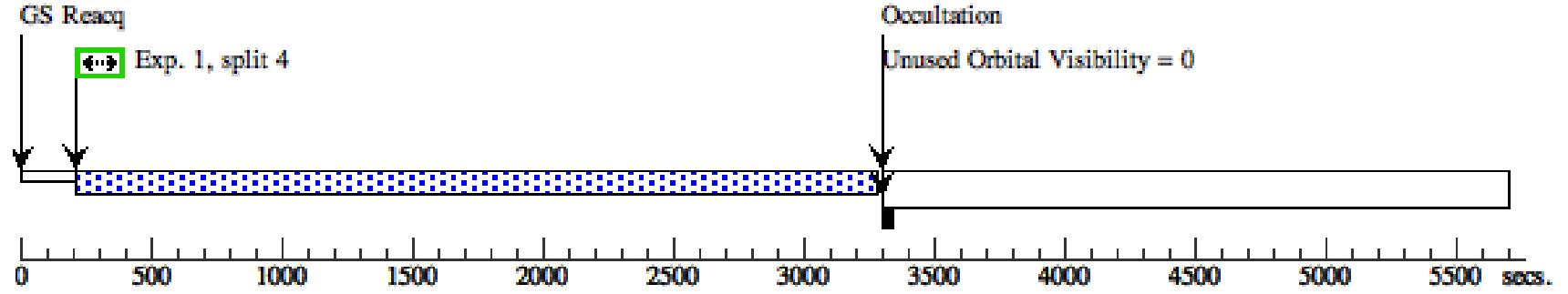
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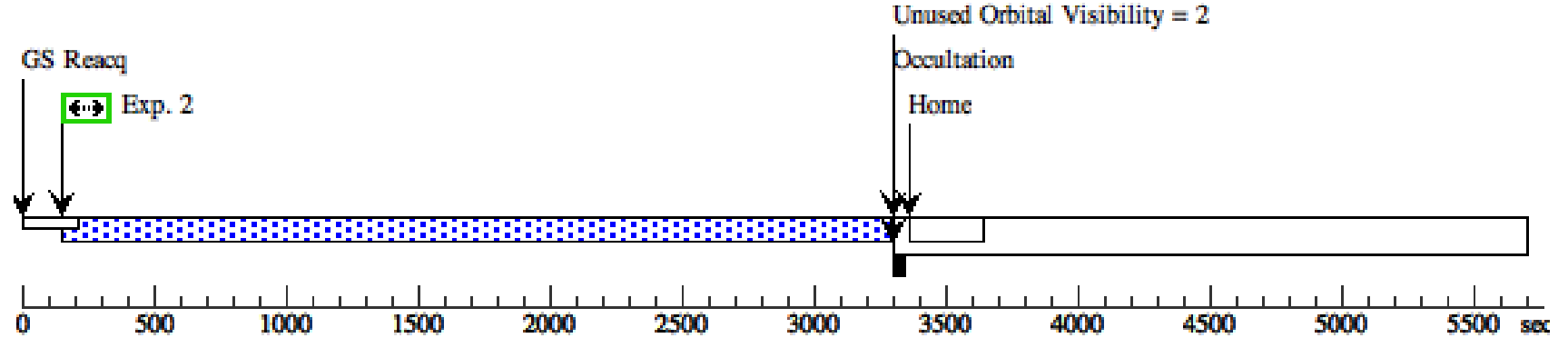
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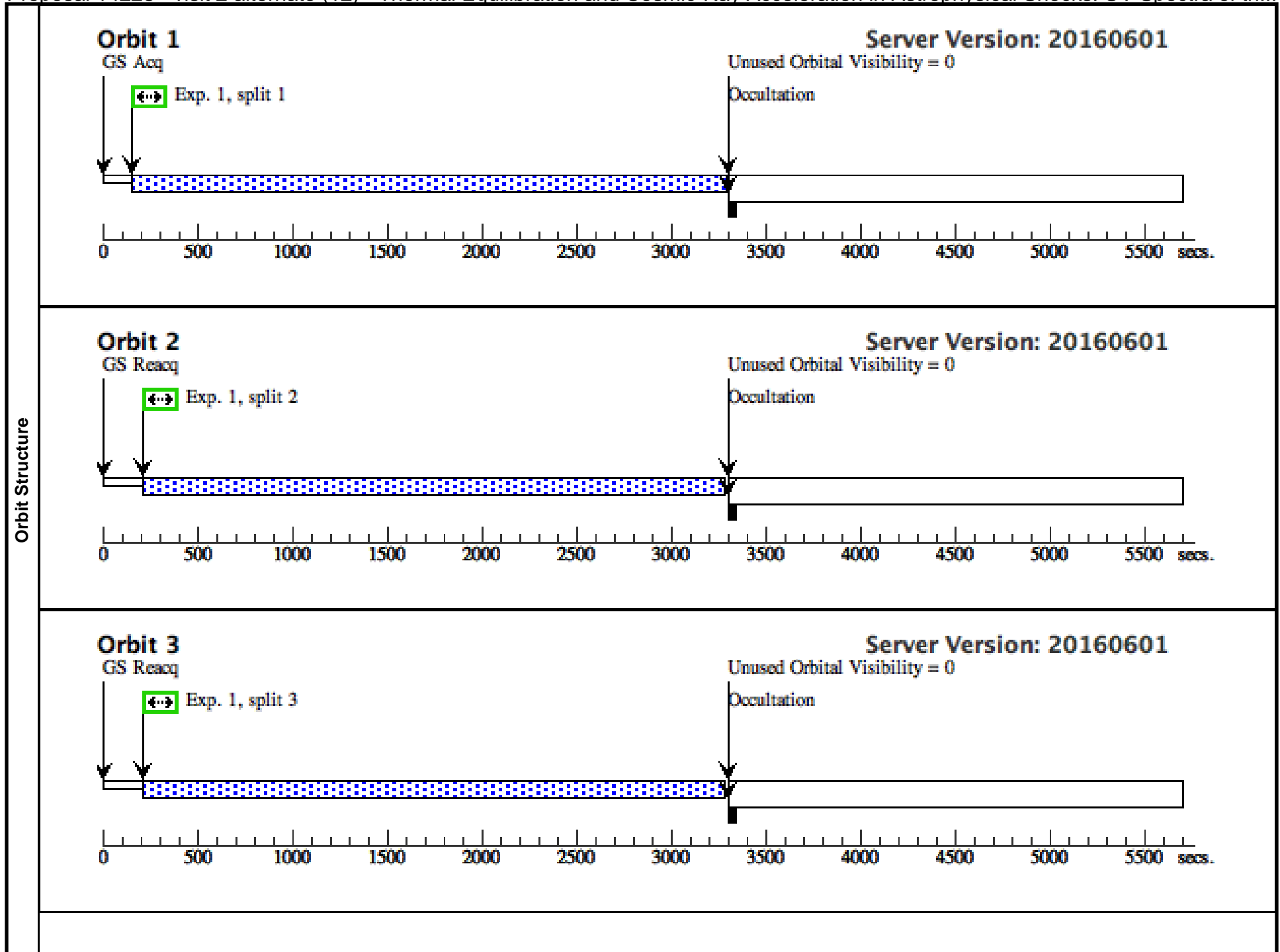
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Proposal 14228 - visit 2 alternate (12) - Thermal Equilibration and Cosmic-Ray Acceleration in Astrophysical Shocks: UV Spectra of th...

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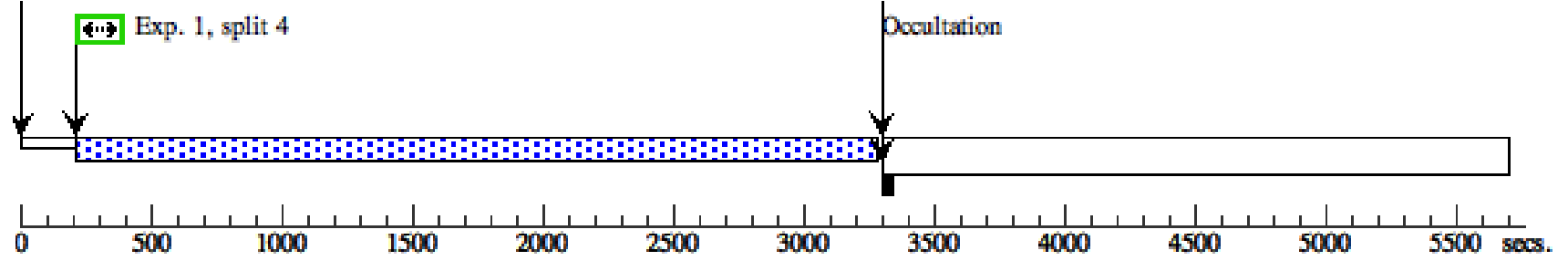
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2	visit 2 exp 2 (COS.sp.759 821)	(2) SN1006-T1-ALT ERNATE	COS/FUV, TIME-TAG, PSA	G140L 1105 A	FP-POS=2; BUFFER-TIME=1.0e4			3000 Secs (3019 Secs) [=>3019.0 Secs]	[5]																															



Orbit 4

GS Reacq

Exp. 1, split 4

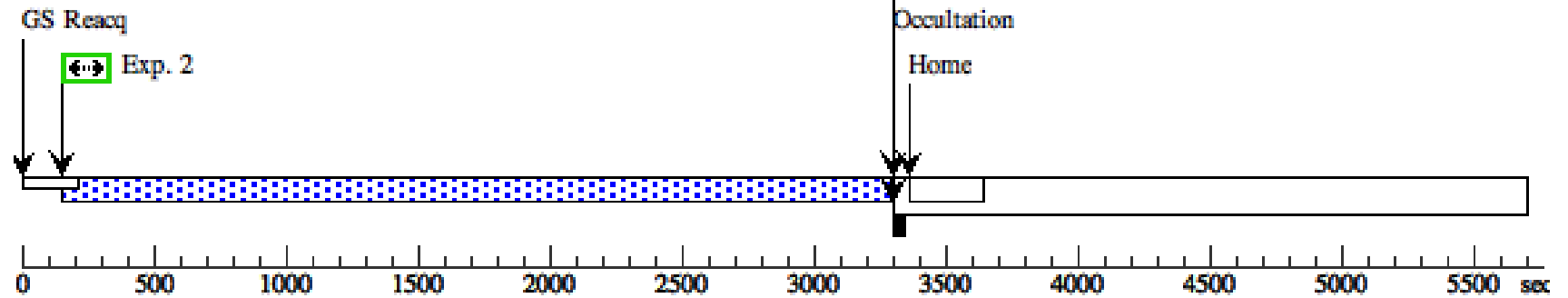


Server Version: 20160601

Orbit 5

GS Reacq

Exp. 2

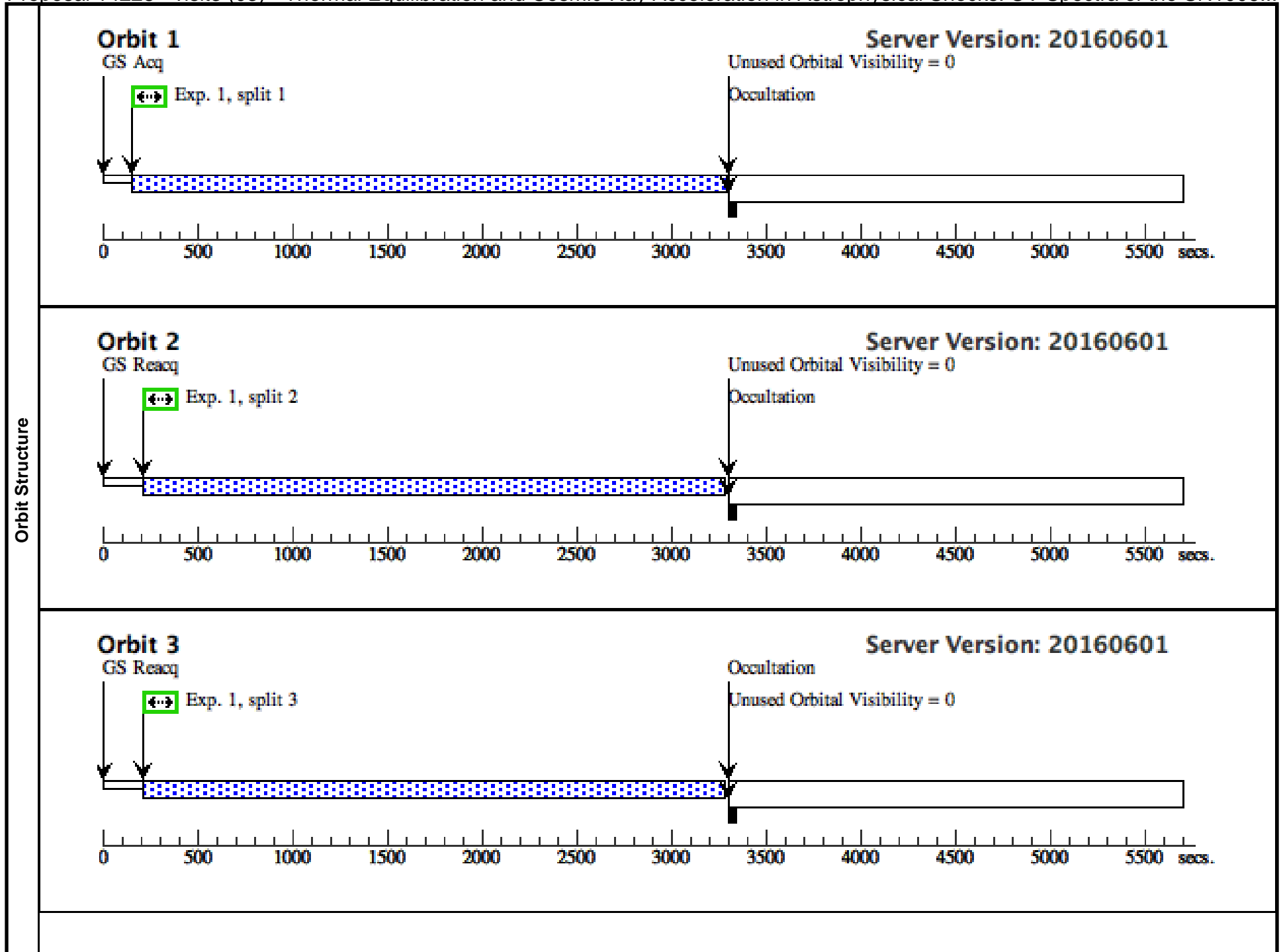


Server Version: 20160601

Proposal 14228 - visit3 (03) - Thermal Equilibration and Cosmic-Ray Acceleration in Astrophysical Shocks: UV Spectra of the SN1006...

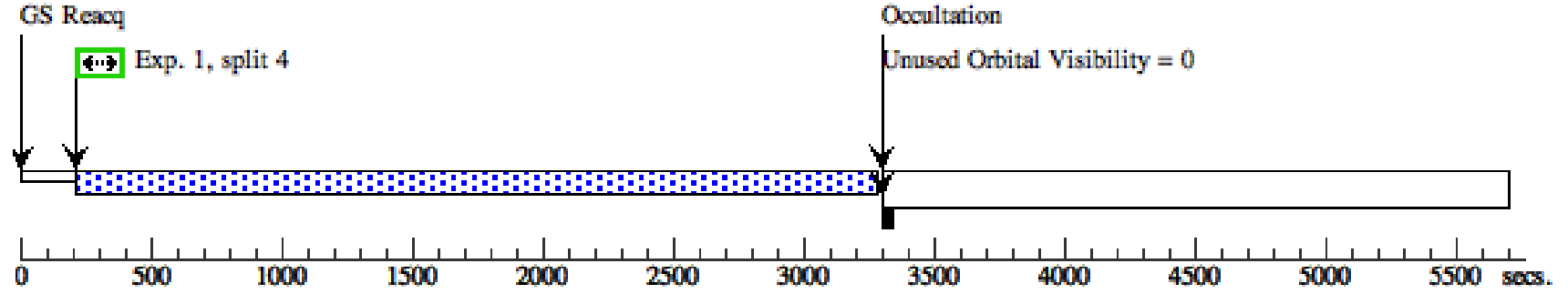
Fri Jul 29 17:21:53 GMT 2016

Visit	<p>Proposal 14228, visit3 (03), scheduled</p> <p>Diagnostic Status: Warning</p> <p>Scientific Instruments: COS/FUV</p> <p>Special Requirements: (none)</p>																																																																																									
	Diagnostics	<p>(visit3 (03)) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronagraphy with STIS or COS.</p> <p>(visit3 (03)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS</p> <p>(visit3 (03.001)) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.</p> <p>(Exposure 2 (visit3 (03))) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.</p>																																																																																								
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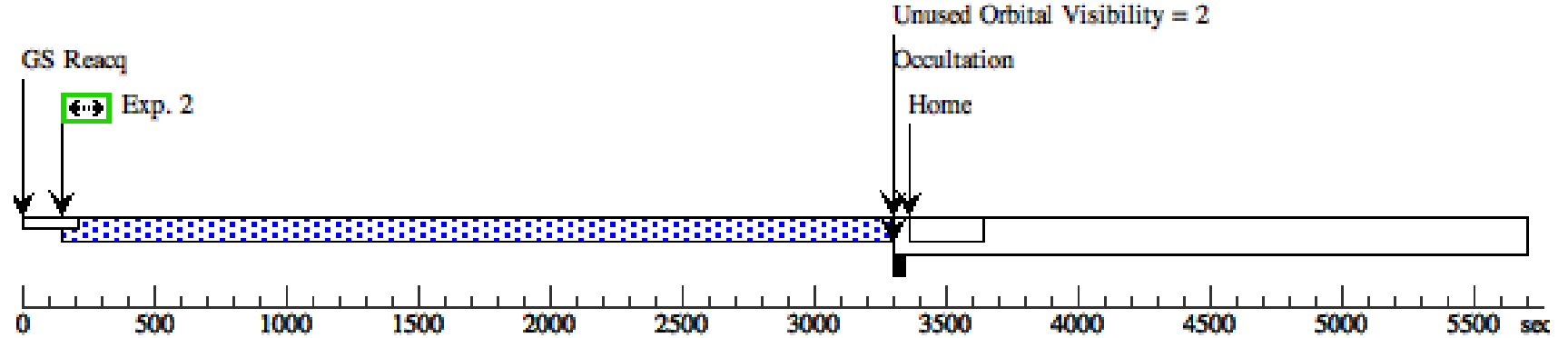
Orbit 4

Server Version: 20160601



Orbit 5

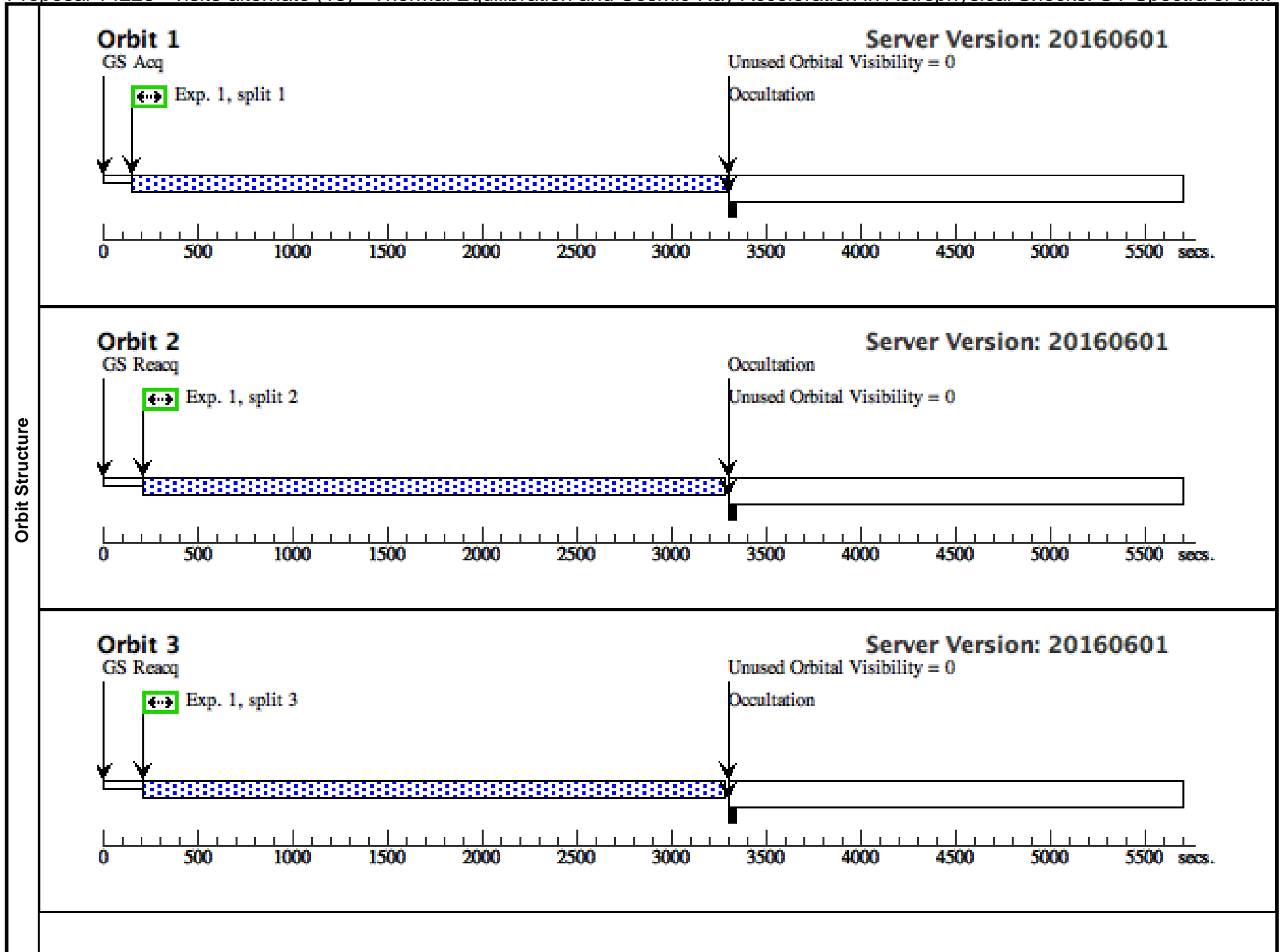
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Proposal 14228 - visit3 alternate (13) - Thermal Equilibration and Cosmic-Ray Acceleration in Astrophysical Shocks: UV Spectra of th...

Fri Jul 29 17:21:53 GMT 2016

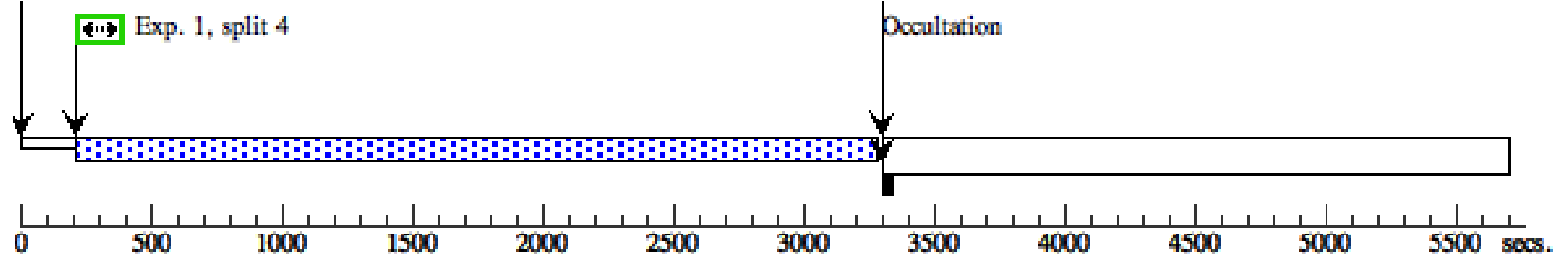
Visit	Proposal 14228, visit3 alternate (13) Diagnostic Status: Warning Scientific Instruments: COS/FUV Special Requirements: (none)																																							
	Diagnosics (visit3 alternate (13)) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronagraphy with STIS or COS. (visit3 alternate (13)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS (visit3 (13.001)) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details. (Exposure 2 (visit3 alternate (13))) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.																																							
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Orbit 4

GS Reacq

Exp. 1, split 4

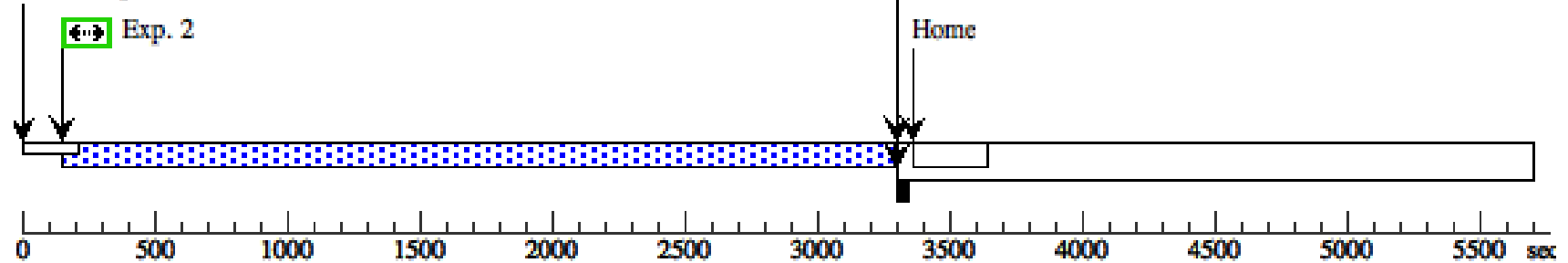


Server Version: 20160601

Orbit 5

GS Reacq

Exp. 2



Server Version: 20160601