



# 12201 - Ionizing Emission from the Faint Galaxies Responsible for Reionization

Cycle: 18, Proposal Category: GO

(Availability Mode: SUPPORTED)

## INVESTIGATORS

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## 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) A1689	WFC3/UVIS	4	09-Jul-2010 23:33:13.0	yes
02	(1) A1689	WFC3/UVIS	4	09-Jul-2010 23:33:20.0	yes
03	(1) A1689	WFC3/UVIS	4	09-Jul-2010 23:33:26.0	yes
04	(1) A1689	WFC3/UVIS	4	09-Jul-2010 23:33:32.0	yes
05	(1) A1689	WFC3/UVIS	4	09-Jul-2010 23:33:37.0	yes
06	(1) A1689	WFC3/UVIS	4	09-Jul-2010 23:33:42.0	yes
07	(1) A1689	WFC3/UVIS	4	09-Jul-2010 23:33:47.0	yes
08	(1) A1689	WFC3/UVIS	4	09-Jul-2010 23:33:52.0	yes
09	(1) A1689	WFC3/UVIS	2	09-Jul-2010 23:33:56.0	yes

34 Total Orbits Used

## **ABSTRACT**

The epoch of formation of the first galaxies, and the subsequent reionization of the universe is the final frontier in galaxy evolution studies. In order to reionize the intergalactic medium by  $z=6$ , large fractions of ionizing photons must be escaping from the numerous feeble galaxies which we are now just beginning to detect at  $6 < z < 10$ . Semi-analytic models and numerical simulations have suggested several different mechanisms to explain the required high escape fractions in these systems. Unfortunately, these feeble galaxies are far too faint to actually measure the escape fraction of Lyman continuum photons. Given their importance to the global star formation rate in the early universe and to reionization, our team has been identifying and characterizing large numbers of intrinsically very faint ( $-15 < M_{UV} < -19$ ) galaxies at  $1.5 < z < 4$  that are highly magnified by foreground massive clusters. Here we propose a single deep (34 orbit) near-UV (F275W) image of the restframe HI-ionizing continuum of 13 of these galaxies with  $2.52 < z < 2.66$  lying behind the cluster Abell 1689. The increased sensitivity and spatial resolution provided by the strong gravitational lensing allows an unprecedented measurement of the escape fraction of ionizing radiation from the types of galaxies deemed responsible for reionization. When combining these data with existing HST optical/IR imaging and our own very deep Keck/Subaru near-IR/optical spectra, we will be able to determine the mechanisms that allow for large escape fractions, and better understand the process of reionization.

## **OBSERVING DESCRIPTION**

We were initially allocated 36 orbits for WFC3 imaging of Abell 1689. Due to duplication with a cycle-17 program, we lost two orbits and now have a total of 34. All orbits will be used for imaging of Abell 1689 in one single pointing: 30 orbits in F275W and 4 orbits in F336W. In both filters, the default four point dither WFC3-UVIS-DITHER-BOX will be used with half-orbit ( $\sim 1310$ s) exposures. There will be a total of 10,480 s of exposure in F336W ( $8 \times 1310$ s) and 78,600 s of exposure in F275W ( $60 \times 1310$ s). Each 2-orbit dither pattern will be offset by  $\sim 1.5''$  to cover the gap in the UVIS chips. The ORIENT is required to be the same for all visits.

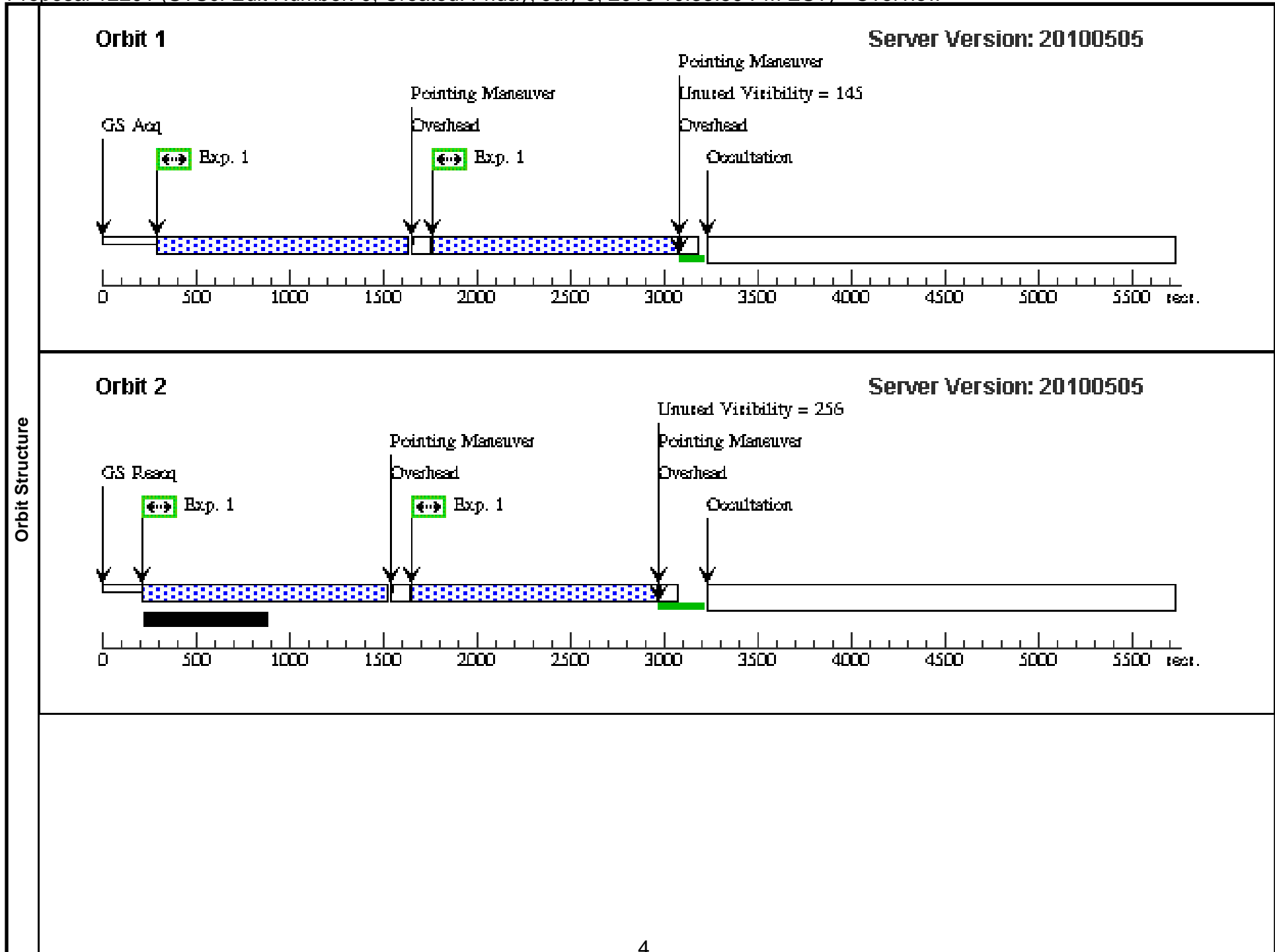
## **ADDITIONAL COMMENTS**

Though we can theoretically get about 5% more exposure time, we've chosen to use 1310s exposures because this allows the largest visibility window and easiest scheduling.

Proposal 12201 (STScI Edit Number: 0, Created: Friday, July 9, 2010 10:33:59 PM EST) - Overview

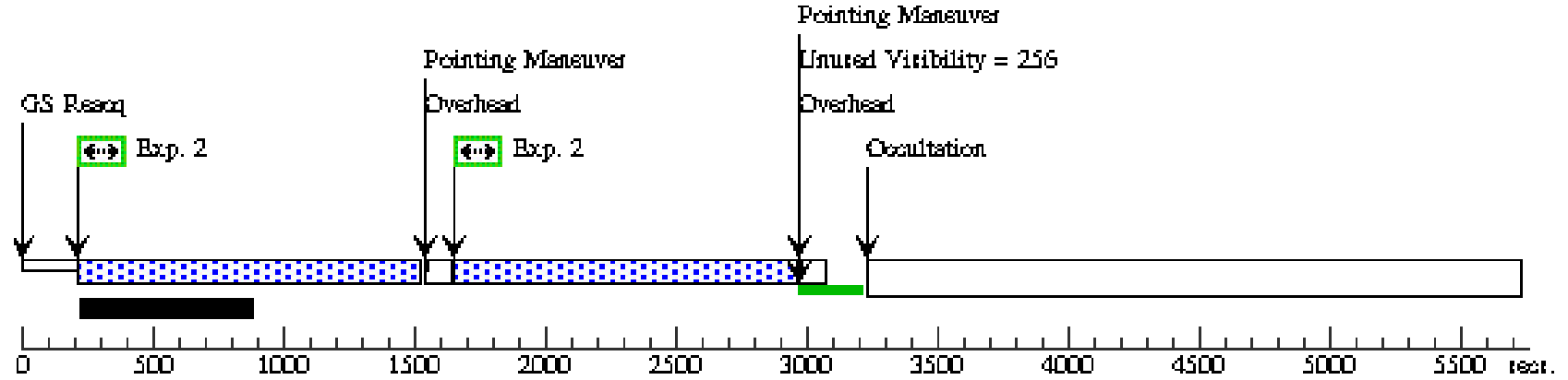
Sat Jul 10 03:33:59 GMT 2010

Visit	<b>Proposal 12201, Visit 01</b> <b>Diagnostic Status: No Diagnostics</b> 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)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	A1689	RA: 13 11 30.0341 (197.8751421d) Dec: -01 20 30.08 (-1.34169d) Equinox: J2000	Proper Motion RA: 0.0s/yr Proper Motion Dec: 0.0"/yr Epoch of Position:	V=24.5+/-0.5	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W		POS TARG -3.0,-3.0	Pattern 1, Exps 1-1 (1)	1310 Secs	
									[==>(Pattern 1)]	[1]
									[==>(Pattern 2)]	
									[==>(Pattern 3)]	[2]
									[==>(Pattern 4)]	
2		(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W			POS TARG 3.0,3.0	Pattern 1, Exps 2-2 (1)	1310 Secs	
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								[==>(Pattern 2)]		
								[==>(Pattern 3)]	[4]	
								[==>(Pattern 4)]		



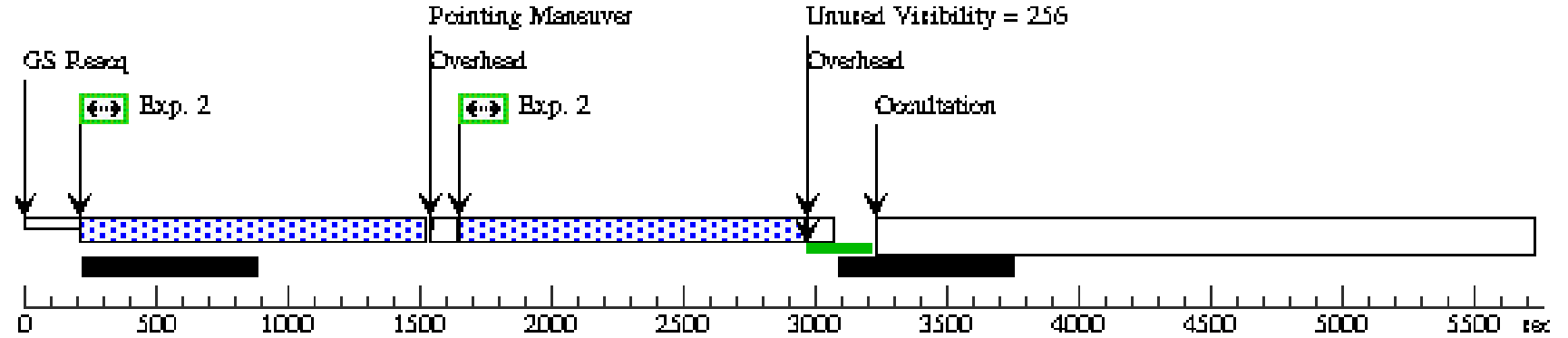
**Orbit 3**

Server Version: 20100505



**Orbit 4**

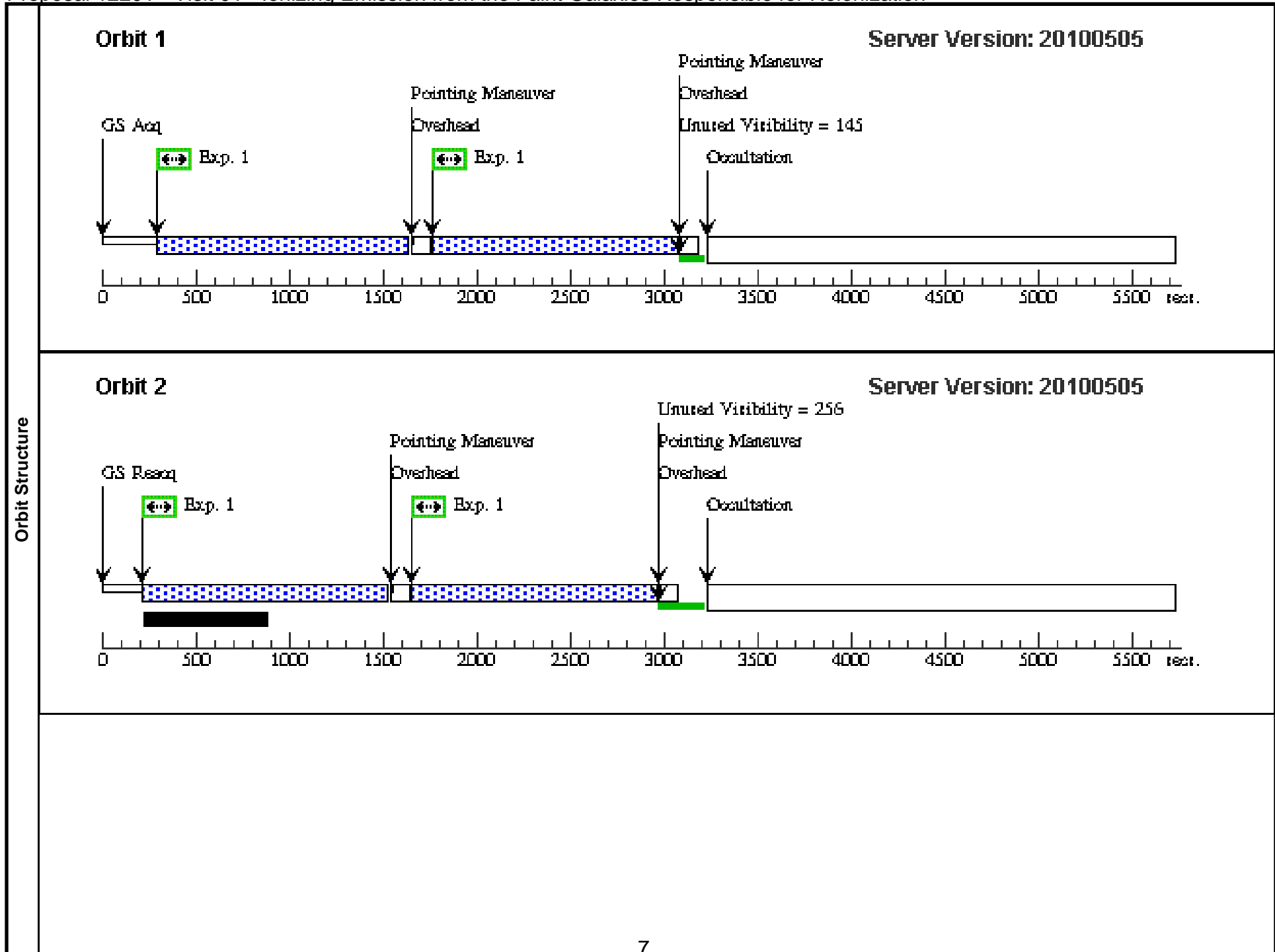
Server Version: 20100505



Proposal 12201 - Visit 01 - Ionizing Emission from the Faint Galaxies Responsible for Reionization

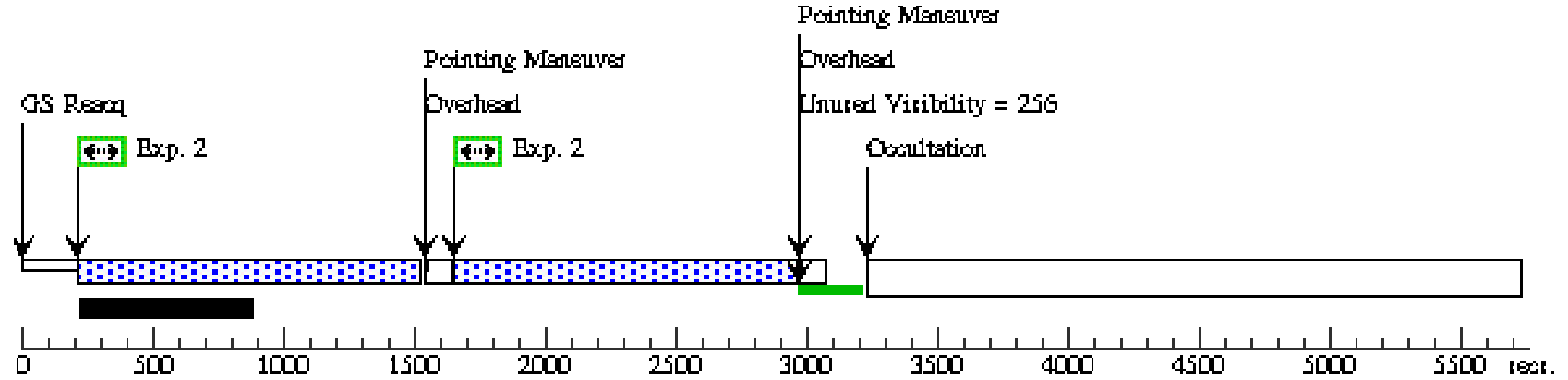
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Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	A1689	RA: 13 11 30.0341 (197.8751421d) Dec: -01 20 30.08 (-1.34169d) Equinox: J2000	Proper Motion RA: 0.0s/yr Proper Motion Dec: 0.0"/yr Epoch of Position:	V=24.5+/-0.5	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W		POS TARG 0,0,0	Pattern 1, Exps 1-1 (1)	1310 Secs	
									[==>(Pattern 1)]	[1]
									[==>(Pattern 2)]	
									[==>(Pattern 3)]	[2]
									[==>(Pattern 4)]	
2		(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W			POS TARG 1.5,1.5	Pattern 1, Exps 2-2 (1)	1310 Secs	
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									[==>(Pattern 2)]	
									[==>(Pattern 3)]	[4]
									[==>(Pattern 4)]	



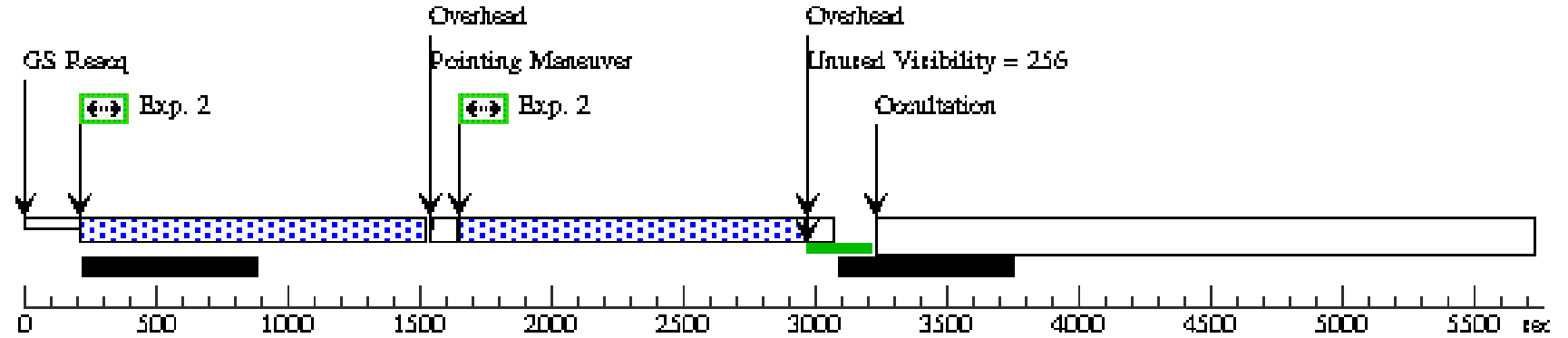
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Server Version: 20100505



**Orbit 4**

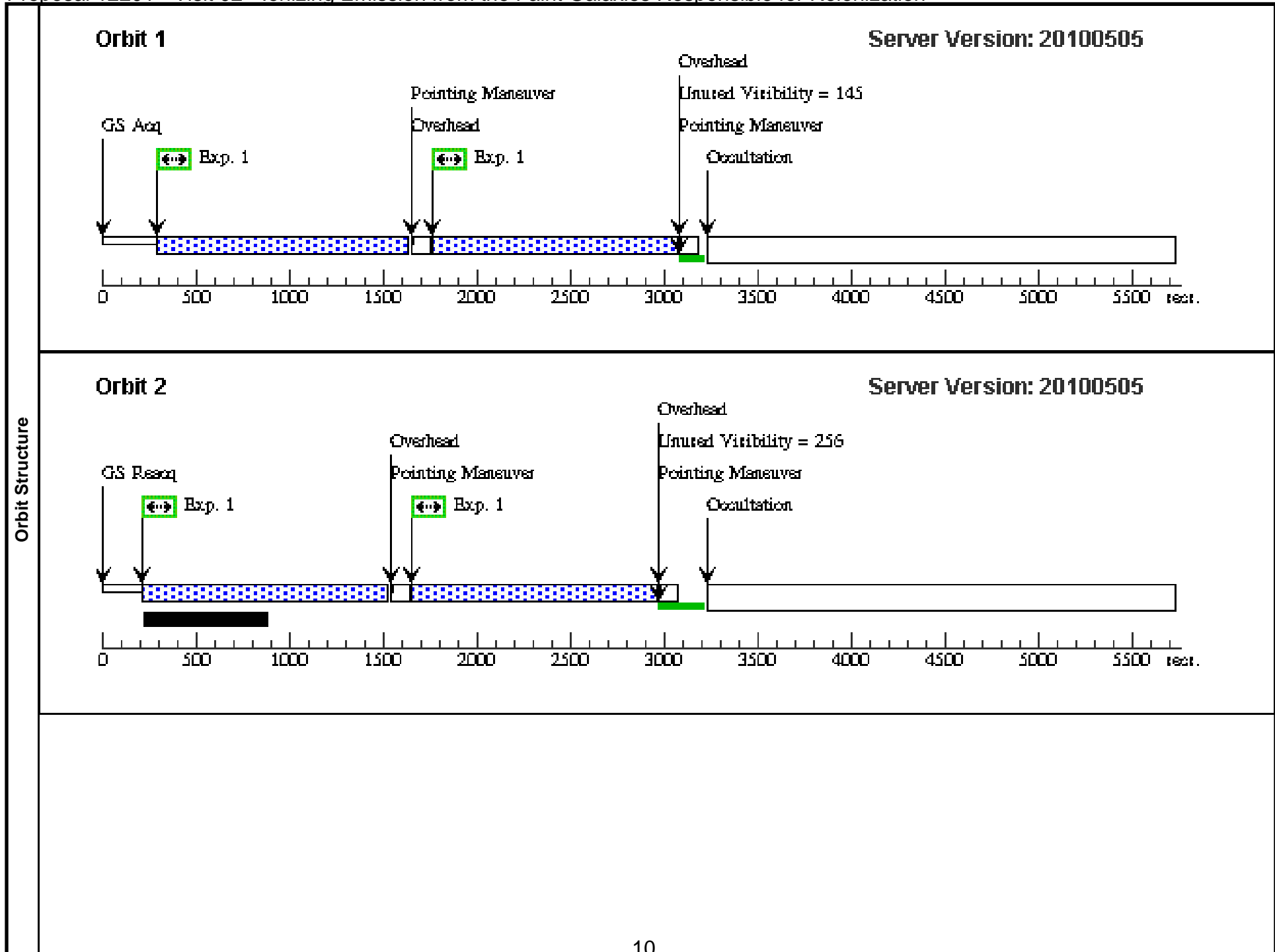
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Proposal 12201 - Visit 02 - Ionizing Emission from the Faint Galaxies Responsible for Reionization

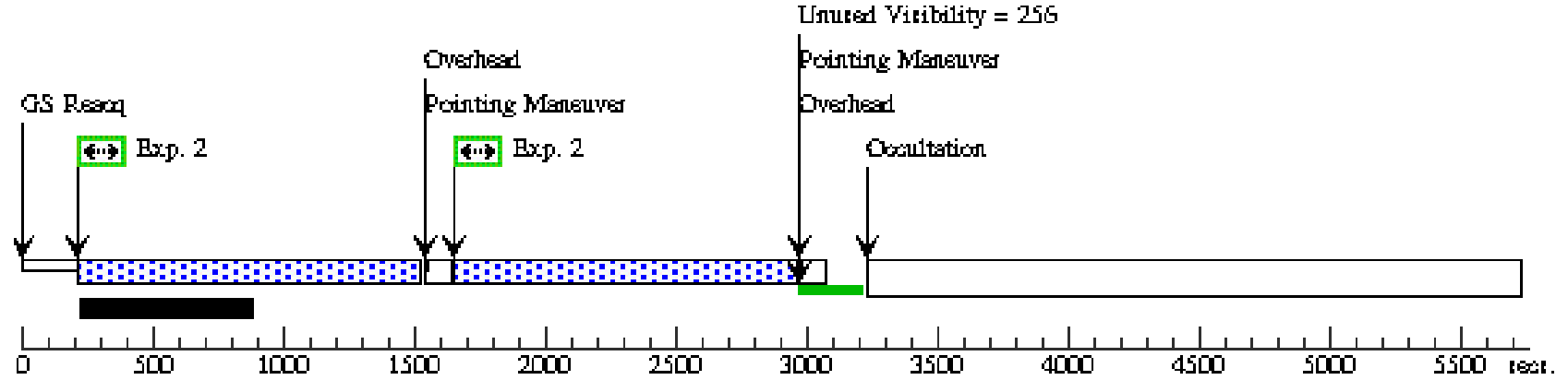
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Visit	<b>Proposal 12201, Visit 03</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: WFC3/UVIS Special Requirements: SAME ORIENT AS 01									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
		(1)	Pattern Type=WFC3-UVIS-DITHER-BOX 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)				
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	A1689	RA: 13 11 30.0341 (197.8751421d) Dec: -01 20 30.08 (-1.34169d) Equinox: J2000	Proper Motion RA: 0.0s/yr Proper Motion Dec: 0.0"/yr Epoch of Position:	V=24.5+/-0.5	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W		POS TARG 1.5,0	Pattern 1, Exps 1-1 (1)	1310 Secs	
									[==>(Pattern 1)]	[1]
									[==>(Pattern 2)]	
									[==>(Pattern 3)]	[2]
									[==>(Pattern 4)]	
2		(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W			POS TARG 1.5,-1.5	Pattern 1, Exps 2-2 (1)	1310 Secs	
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								[==>(Pattern 2)]		
								[==>(Pattern 3)]	[4]	
								[==>(Pattern 4)]		



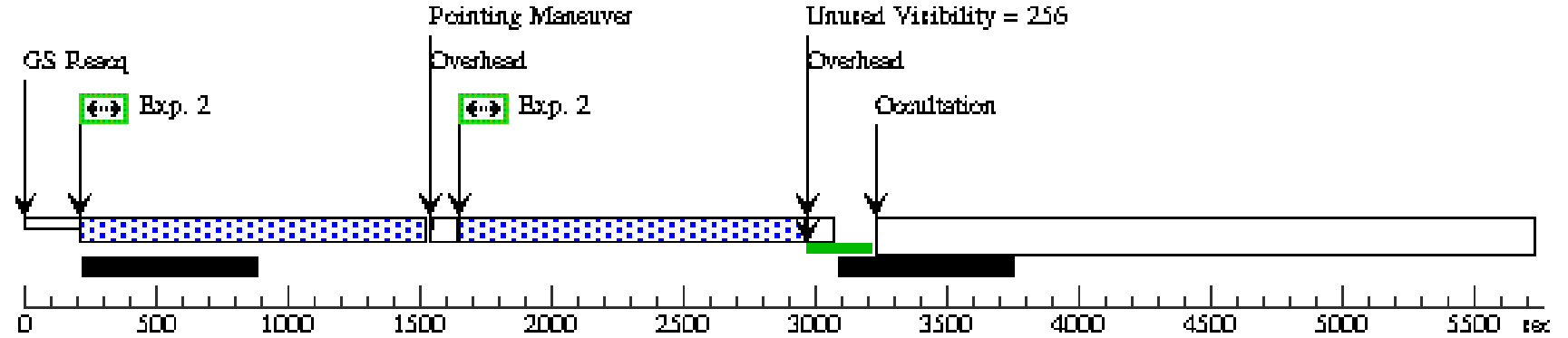
**Orbit 3**

Server Version: 20100505



**Orbit 4**

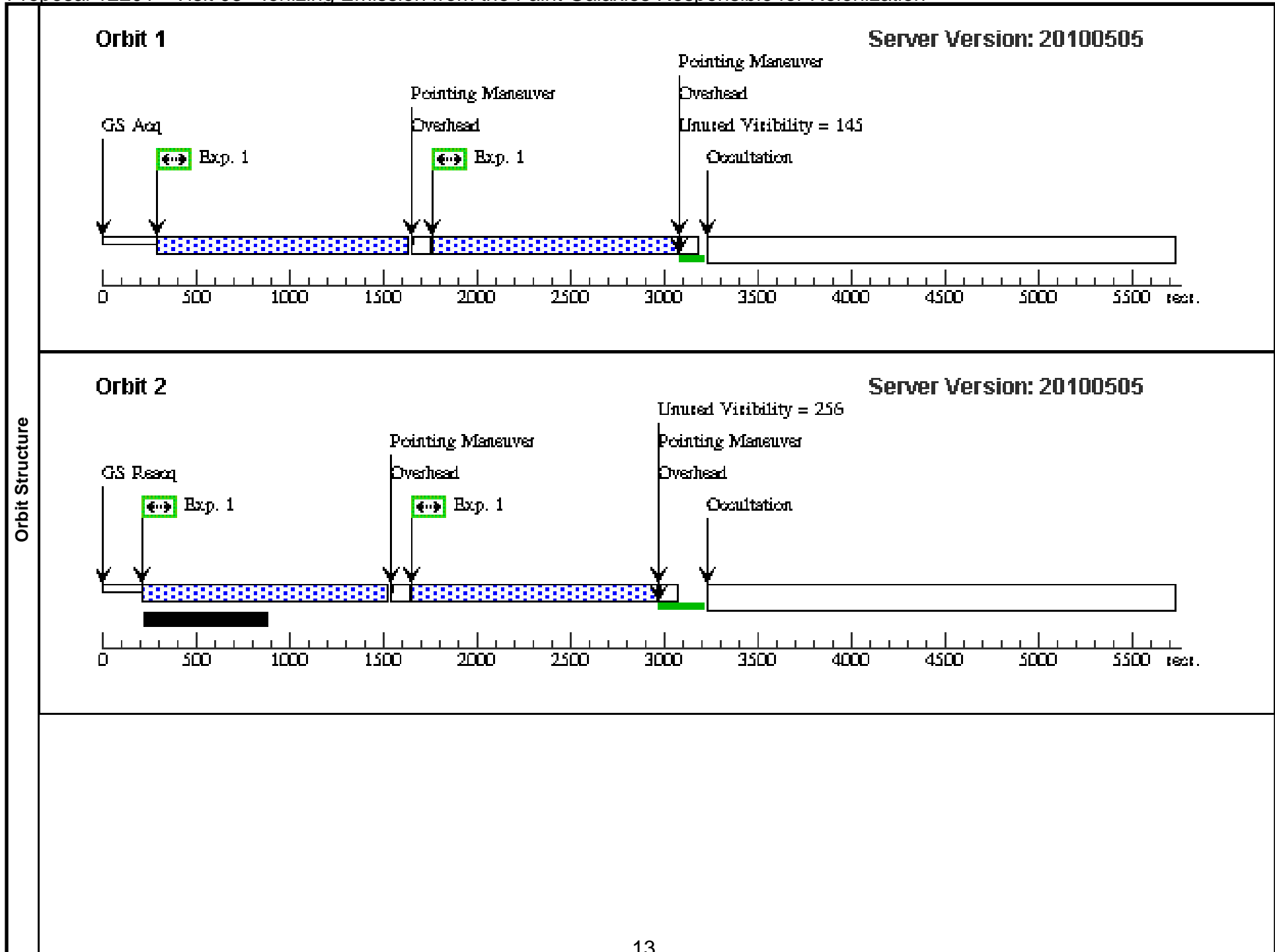
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Proposal 12201 - Visit 03 - Ionizing Emission from the Faint Galaxies Responsible for Reionization

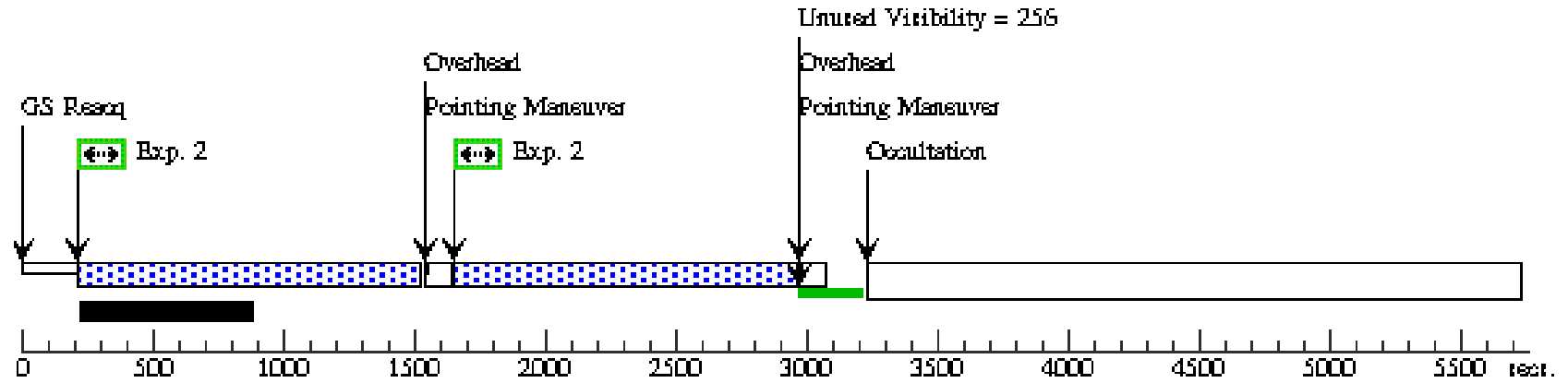
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Visit	<b>Proposal 12201, Visit 04</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: WFC3/UVIS Special Requirements: SAME ORIENT AS 01									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-UVIS-DITHER-BOX 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)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	A1689	RA: 13 11 30.0341 (197.8751421d) Dec: -01 20 30.08 (-1.34169d) Equinox: J2000	Proper Motion RA: 0.0s/yr Proper Motion Dec: 0.0"/yr Epoch of Position:	V=24.5+/-0.5	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W		POS TARG 0,-1.5	Pattern 1, Exps 1-1 (1)	1310 Secs	
									[==>(Pattern 1)]	[1]
									[==>(Pattern 2)]	
									[==>(Pattern 3)]	[2]
									[==>(Pattern 4)]	
2		(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W			POS TARG -1.5,-1.5	Pattern 1, Exps 2-2 (1)	1310 Secs	
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								[==>(Pattern 2)]		
								[==>(Pattern 3)]	[4]	
								[==>(Pattern 4)]		



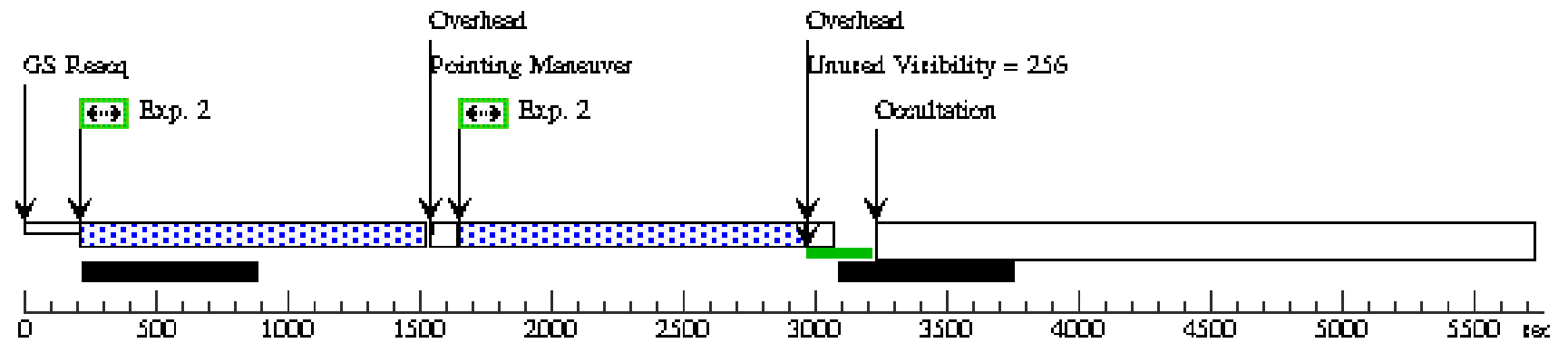
**Orbit 3**

Server Version: 20100505



**Orbit 4**

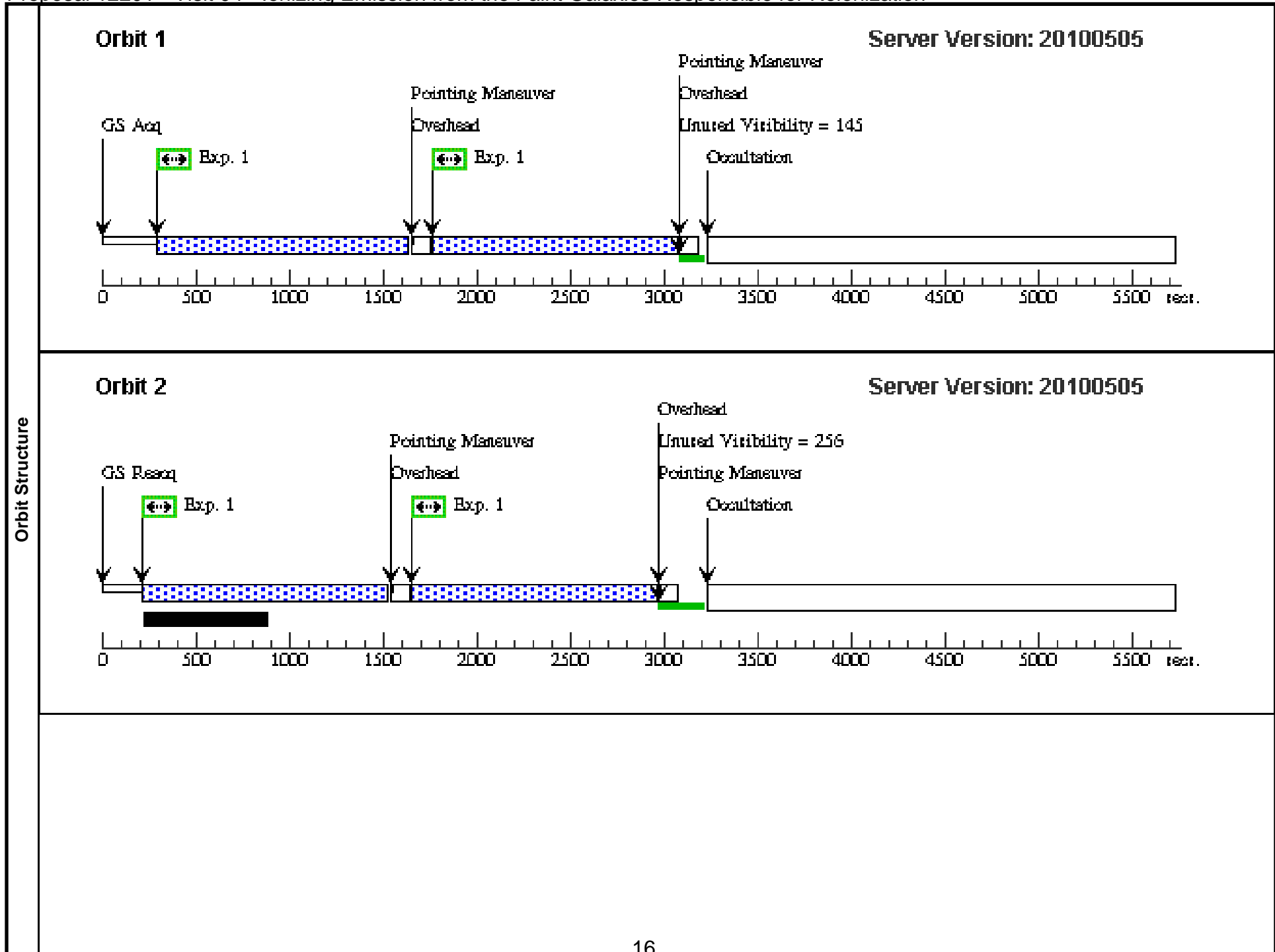
Server Version: 20100505



Proposal 12201 - Visit 04 - Ionizing Emission from the Faint Galaxies Responsible for Reionization

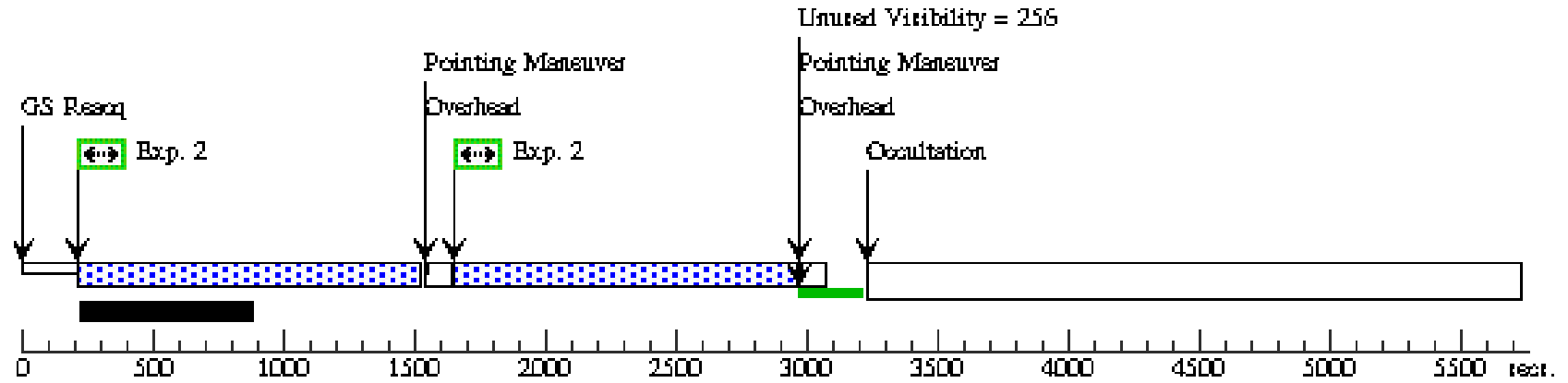
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Visit	<b>Proposal 12201, Visit 05</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: WFC3/UVIS Special Requirements: SAME ORIENT AS 01									
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	(1)	Pattern Type=WFC3-UVIS-DITHER-BOX 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)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	A1689	RA: 13 11 30.0341 (197.8751421d) Dec: -01 20 30.08 (-1.34169d) Equinox: J2000	Proper Motion RA: 0.0s/yr Proper Motion Dec: 0.0"/yr Epoch of Position:	V=24.5+/-0.5	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W		POS TARG -1.5,0	Pattern 1, Exps 1-1 (1)	1310 Secs	
									[==>(Pattern 1)]	[1]
									[==>(Pattern 2)]	
									[==>(Pattern 3)]	[2]
									[==>(Pattern 4)]	
2		(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W			POS TARG -1.5,1.5	Pattern 1, Exps 2-2 (1)	1310 Secs	
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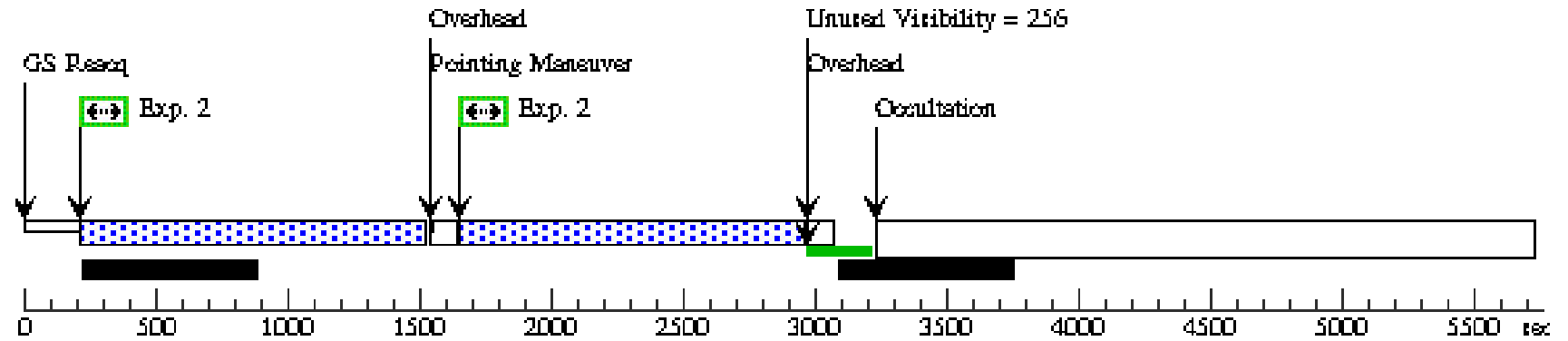
**Orbit 3**

Server Version: 20100505



**Orbit 4**

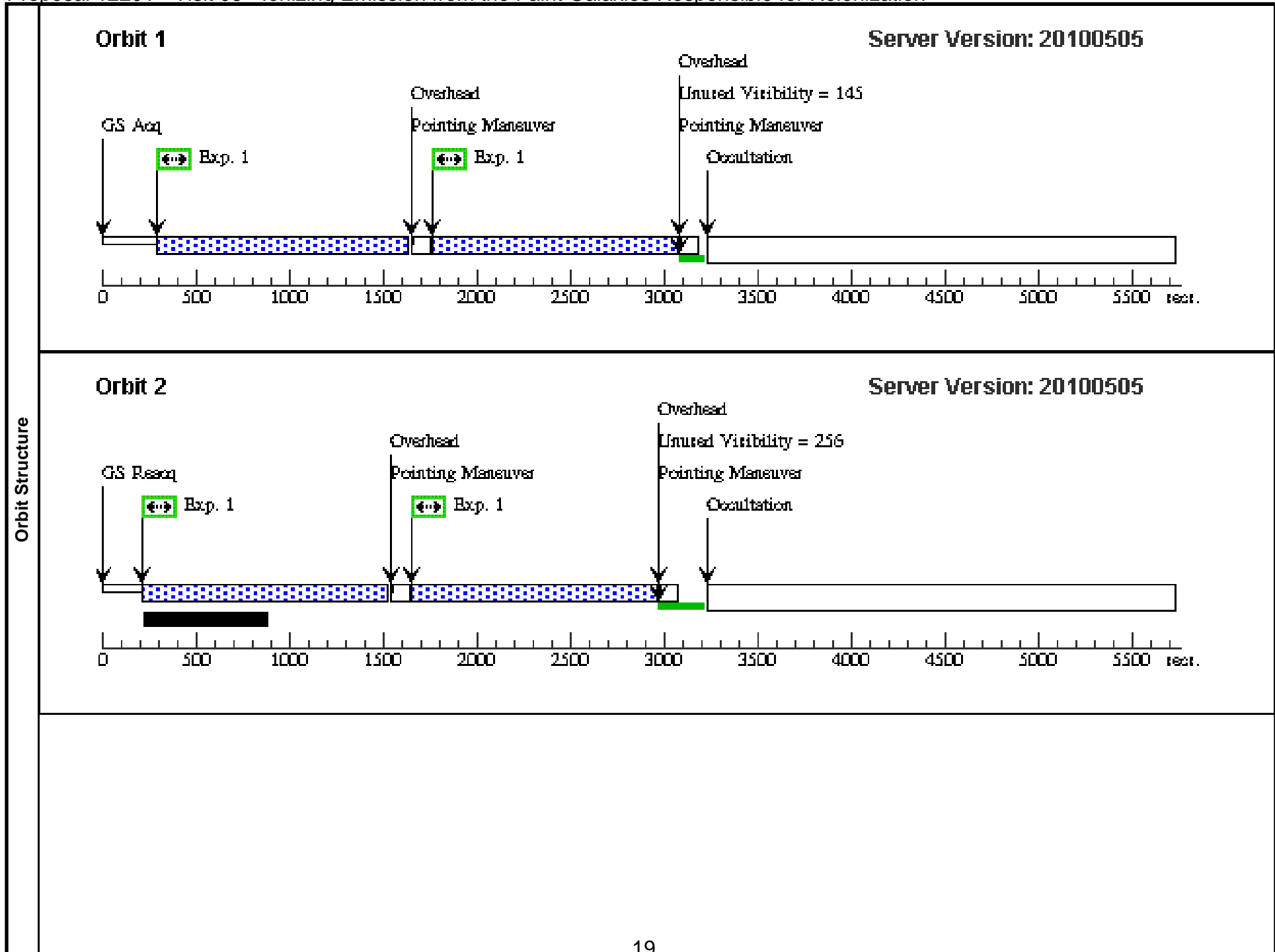
Server Version: 20100505



Proposal 12201 - Visit 05 - Ionizing Emission from the Faint Galaxies Responsible for Reionization

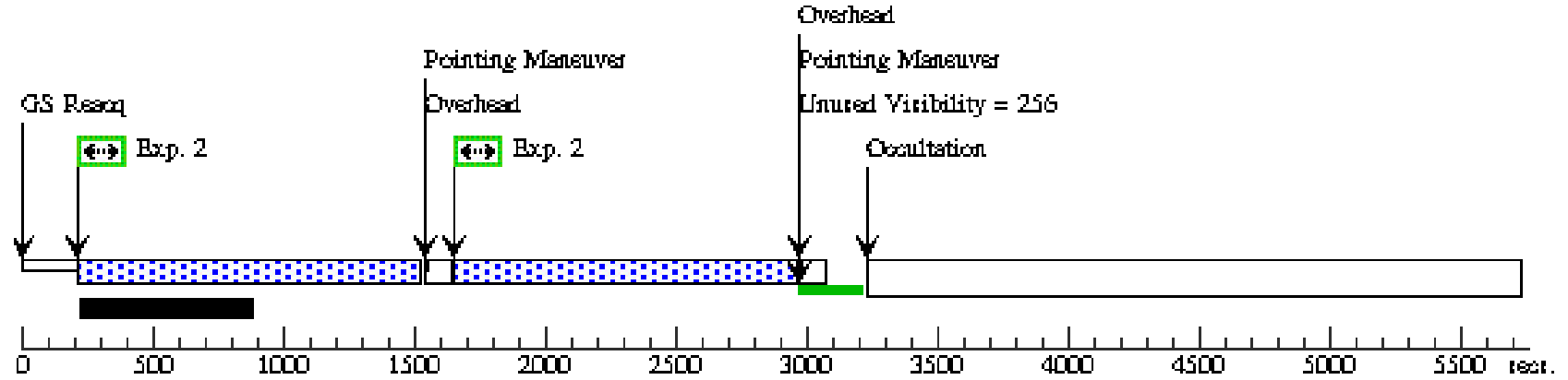
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Visit	<b>Proposal 12201, Visit 06</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: WFC3/UVIS Special Requirements: SAME ORIENT AS 01									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-UVIS-DITHER-BOX 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)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	A1689	RA: 13 11 30.0341 (197.8751421d) Dec: -01 20 30.08 (-1.34169d) Equinox: J2000	Proper Motion RA: 0.0s/yr Proper Motion Dec: 0.0"/yr Epoch of Position:	V=24.5+/-0.5	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W		POS TARG 0,1.5	Pattern 1, Exps 1-1 (1)	1310 Secs	
									[==>(Pattern 1)]	[1]
									[==>(Pattern 2)]	
									[==>(Pattern 3)]	[2]
									[==>(Pattern 4)]	
2		(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W			POS TARG 3.0,3.0	Pattern 1, Exps 2-2 (1)	1310 Secs	
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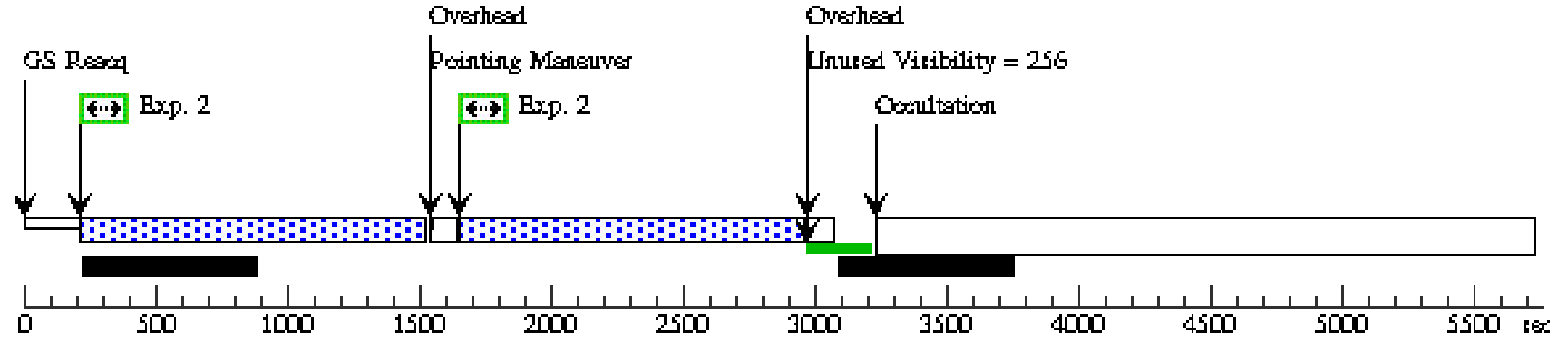
**Orbit 3**

Server Version: 20100505



**Orbit 4**

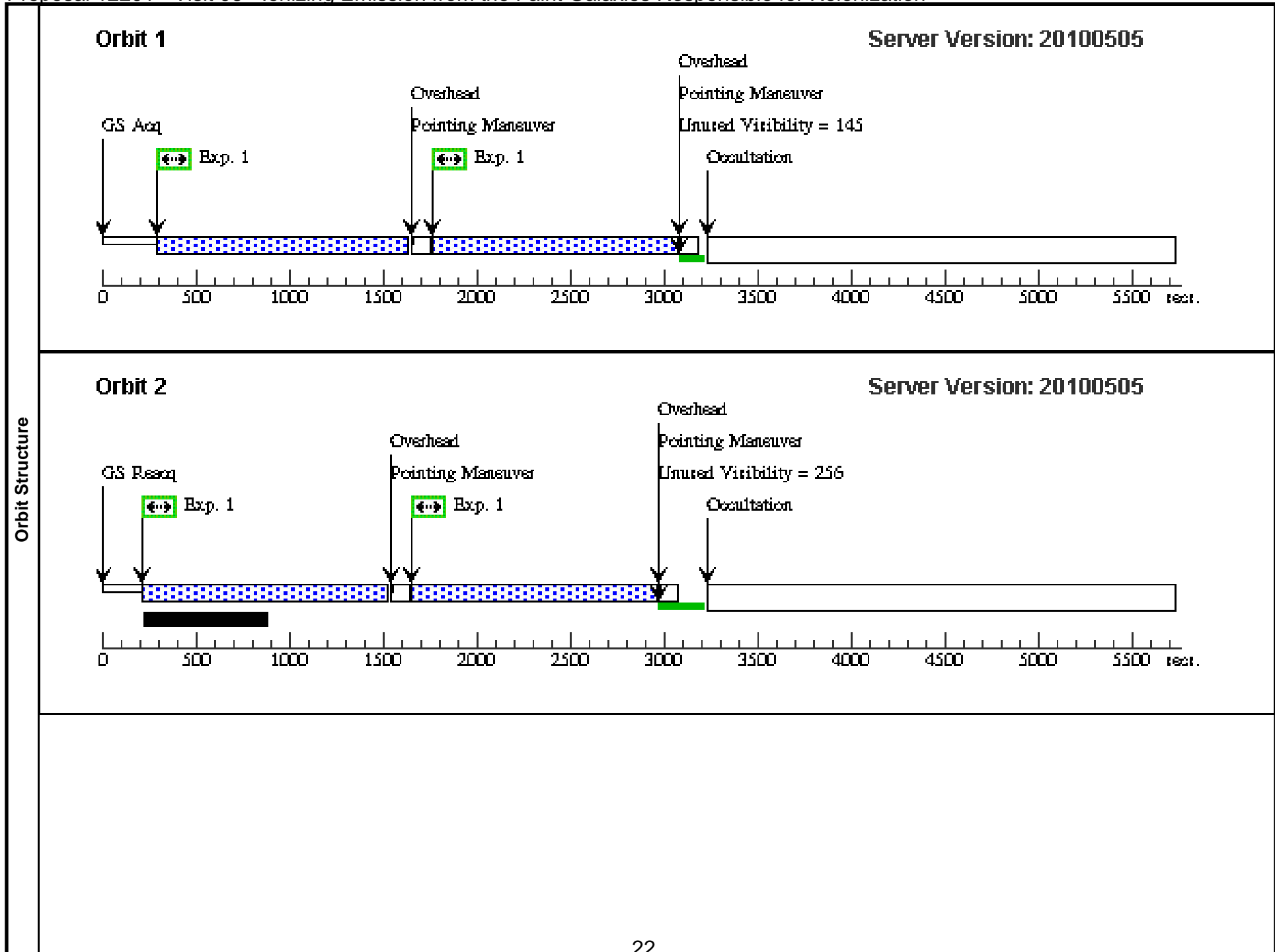
Server Version: 20100505



Proposal 12201 - Visit 06 - Ionizing Emission from the Faint Galaxies Responsible for Reionization

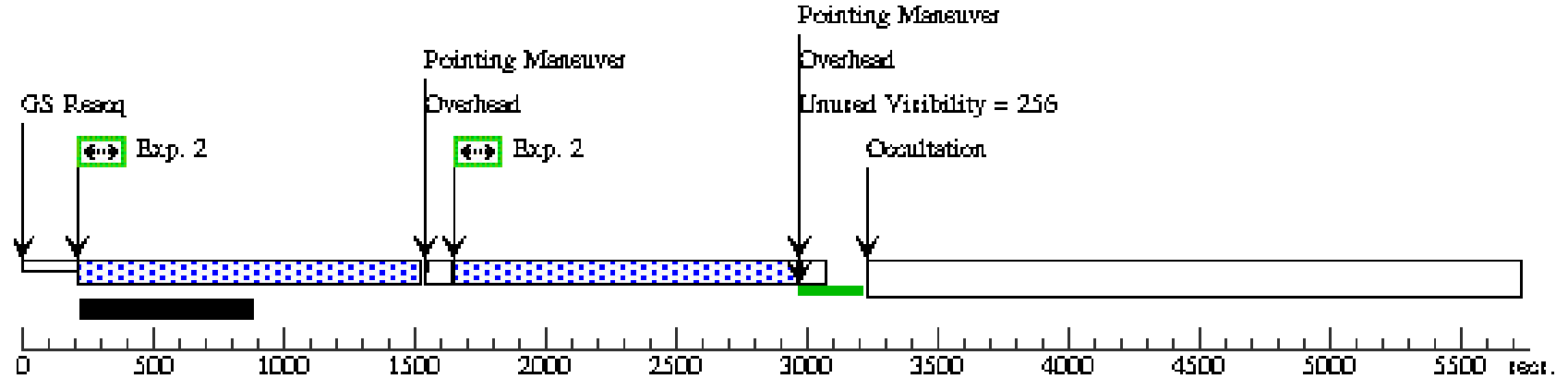
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Visit	<b>Proposal 12201, Visit 07</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: WFC3/UVIS Special Requirements: SAME ORIENT AS 01									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-UVIS-DITHER-BOX 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)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	A1689	RA: 13 11 30.0341 (197.8751421d) Dec: -01 20 30.08 (-1.34169d) Equinox: J2000	Proper Motion RA: 0.0s/yr Proper Motion Dec: 0.0"/yr Epoch of Position:	V=24.5+/-0.5	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W		POS TARG 3.0,0	Pattern 1, Exps 1-1 (1)	1310 Secs	
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									[==>(Pattern 2)]	
									[==>(Pattern 3)]	[2]
									[==>(Pattern 4)]	
2		(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W			POS TARG 3.0,-3.0	Pattern 1, Exps 2-2 (1)	1310 Secs	
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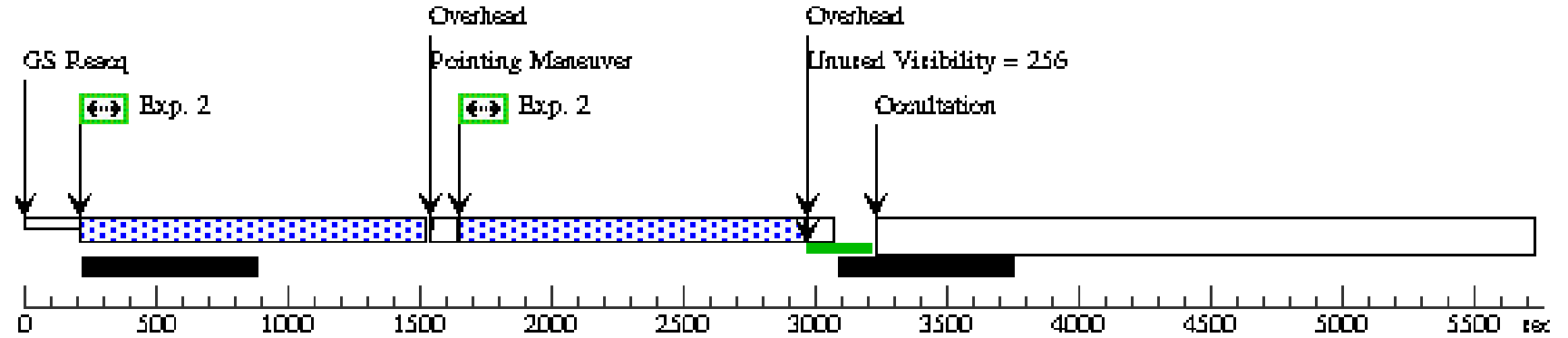
**Orbit 3**

Server Version: 20100505



**Orbit 4**

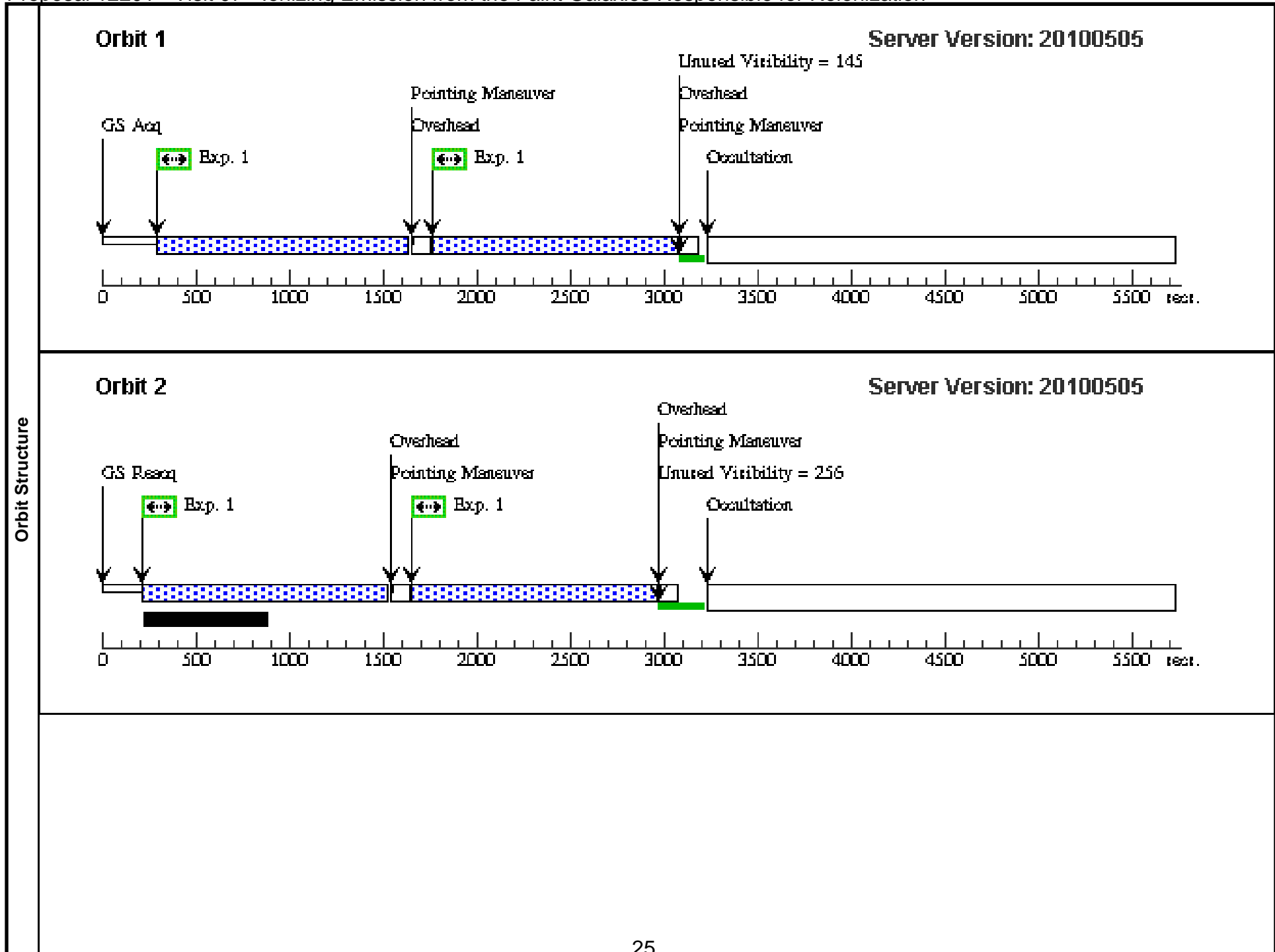
Server Version: 20100505



Proposal 12201 - Visit 07 - Ionizing Emission from the Faint Galaxies Responsible for Reionization

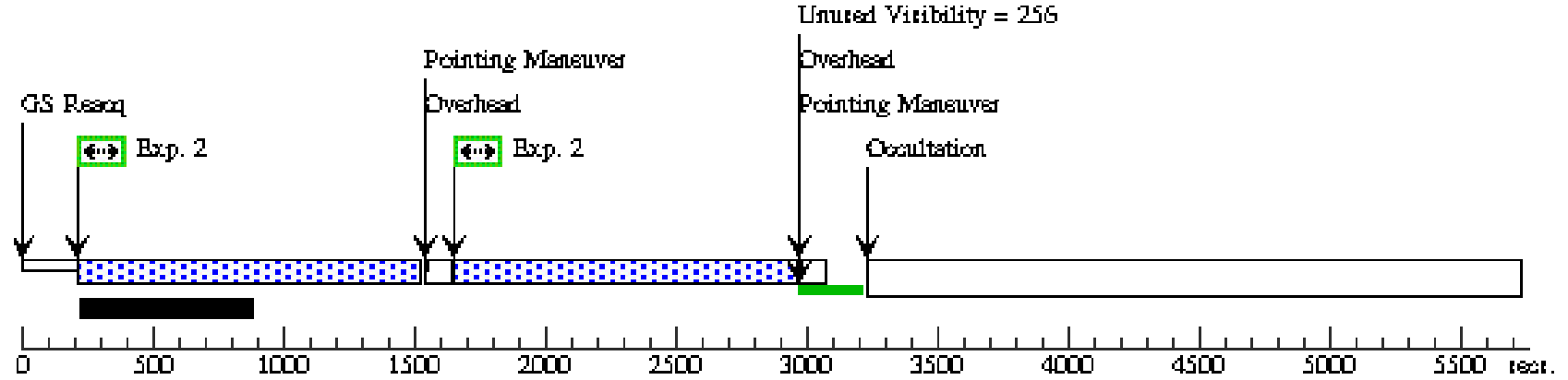
Sat Jul 10 03:34:04 GMT 2010

Visit	<b>Proposal 12201, Visit 08</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: WFC3/UVIS Special Requirements: SAME ORIENT AS 01									
	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)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	A1689	RA: 13 11 30.0341 (197.8751421d) Dec: -01 20 30.08 (-1.34169d) Equinox: J2000	Proper Motion RA: 0.0s/yr Proper Motion Dec: 0.0"/yr Epoch of Position:	V=24.5+/-0.5	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	(1) A1689	(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W		POS TARG -3.0,3.0	Pattern 1, Exps 1-1 (1)	1310 Secs	
									[==>(Pattern 1)]	[1]
									[==>(Pattern 2)]	
									[==>(Pattern 3)]	[2]
									[==>(Pattern 4)]	
2	(1) A1689	(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W		POS TARG -3.0,0	Pattern 1, Exps 2-2 (1)	1310 Secs		
								[==>(Pattern 1)]	[3]	
								[==>(Pattern 2)]		
								[==>(Pattern 3)]	[4]	
								[==>(Pattern 4)]		



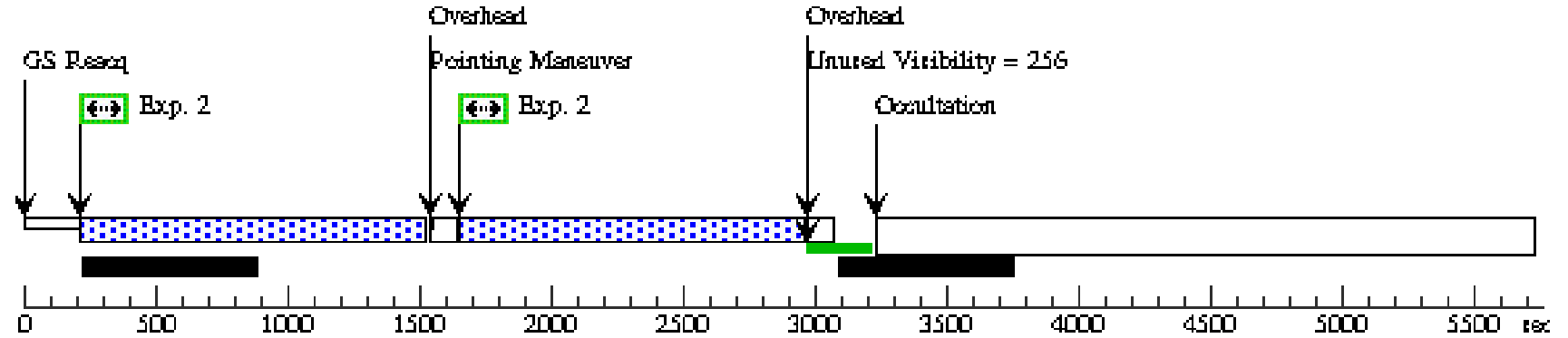
**Orbit 3**

Server Version: 20100505



**Orbit 4**

Server Version: 20100505



Proposal 12201 - Visit 08 - Ionizing Emission from the Faint Galaxies Responsible for Reionization

Sat Jul 10 03:34:05 GMT 2010

Visit	<b>Proposal 12201, Visit 09</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: WFC3/UVIS Special Requirements: SAME ORIENT AS 01									
	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)				
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	A1689	RA: 13 11 30.0341 (197.8751421d) Dec: -01 20 30.08 (-1.34169d) Equinox: J2000	Proper Motion RA: 0.0s/yr Proper Motion Dec: 0.0"/yr Epoch of Position:	V=24.5+/-0.5	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) A1689	WFC3/UVIS, ACCUM, UVIS-CENTER	F275W		POS TARG -3.0,-3.0	Pattern 1, Exps 1-1 (1)	1310 Secs	
									[==>(Pattern 1)]	[1]
									[==>(Pattern 2)]	
								[==>(Pattern 3)]		
								[==>(Pattern 4)]	[2]	

