



# 13644 - CIII] Emission in $z=5.7$ Galaxies: A Pathfinder for Galaxy Spectroscopy in the Reionization Era

Cycle: 22, Proposal Category: GO  
(Availability Mode: SUPPORTED)

## INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
<b>Prof. Xiaohui Fan (PI) (Contact)</b>	<b>University of Arizona</b>	<b>fan@as.arizona.edu</b>
Prof. Daniel P. Stark (CoI)	University of Arizona	dpstark@email.arizona.edu
Dr. Fuyan Bian (CoI)	Australian National University	fuyan.bian@anu.edu.au
Mr. Zheng Cai (CoI)	University of Arizona	caiz@email.arizona.edu
Dr. Linhua Jiang (CoI)	Arizona State University	linhua.jiang@asu.edu
Dr. Ian McGreer (CoI)	University of Arizona	imcgreer@as.arizona.edu
Prof. Brant Robertson (CoI)	University of Arizona	brant@email.arizona.edu
Prof. Brian Siana (CoI)	University of California - Riverside	brian.siana@ucr.edu

## 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) SDF1324	WFC3/IR	4	09-Sep-2014 21:14:44.0	yes
02	(1) SDF1324	WFC3/IR	2	09-Sep-2014 21:14:45.0	yes
03	(2) SXDF0217	WFC3/IR	4	09-Sep-2014 21:14:47.0	yes
04	(2) SXDF0217	WFC3/IR	4	09-Sep-2014 21:14:48.0	yes

14 Total Orbits Used

## **ABSTRACT**

The last few years has witnessed a rapid increase in the detections of galaxies at  $z > 7$ , at the end of the reionization era. However, as a result of the increasing attenuation of Ly alpha emission by the partially neutral IGM at this redshift, it is becoming clear that the traditional means of redshift confirmation is bound for limited success; this presents a major challenge to galaxy spectroscopy as we probe deeper into the reionization era with JWST and ELTs. Through our survey of reionization-era analog galaxies at  $z \sim 2$ , we find that low metallicity, low luminosity galaxies exhibit strong CIII]1909 nebular emission lines. If, as is expected, CIII] remains strong at high redshift, the line can be used as a powerful alternative to Ly alpha in spectroscopy of reionization-era galaxies. To explore this possibility, we will carry out deep HST WFC3/IR F128N narrow-band imaging of a sample of 8 galaxies at  $z = 5.7$  in two fields. At this redshift, the CIII] line is fortuitously located within the F128N passband, allowing detection of CIII] in this sample of spectroscopically confirmed galaxies, reaching a flux limit beyond what is possible with current ground-based observations. Combining the F128N narrow-band imaging with broad-band observations, we will reliably measure the CIII] flux for the brighter objects in our sample ( $J < \sim 26$ ), and measure or strongly constrain the stacked CIII] flux for fainter objects ( $J \sim 27$ ). This program will provide the first statistical sample of CIII] emission in galaxies close to the end of reionization. Success in this venture would usher in a new era of redshift confirmation at  $z > 7$ , guiding the strategy of such programs on future major facilities.

## **OBSERVING DESCRIPTION**

we will carry out 6-orbit F128N narrowband imaging for each of our two fields, SDF1324 and SXDF0217. We will also obtain a 2-orbit F125W broadband imaging of the SXDF0217 field, providing accurate continuum subtraction.

For SDF1324, we will rotate the field with a position angle (PA)=102.4 degree to include two high- $z$  galaxies in this field. The coordinates of the two galaxies are (13:24:16.13, +27:44:11.6) and (13:24:13.00, +27:41:45.8), which can be included into one WFC3/IR field with a rotation angle of 102.4 degree. We use the two visits to populate the 6-orbit F128N imaging.

In the Visit 01, we use a four-point-dither to populate the first two orbit; and also, we use another four-point-dither to populate the 3rd and 4th orbit.

In the Visit 02, we use a four-point-dither to populate the 5th and 6th orbit.

For SXDF0217, we will rotate the the field with a PA=49.9 deg to include five high- $z$  galaxies in this field. We will use two visits to populate a 8-

orbit for this field.

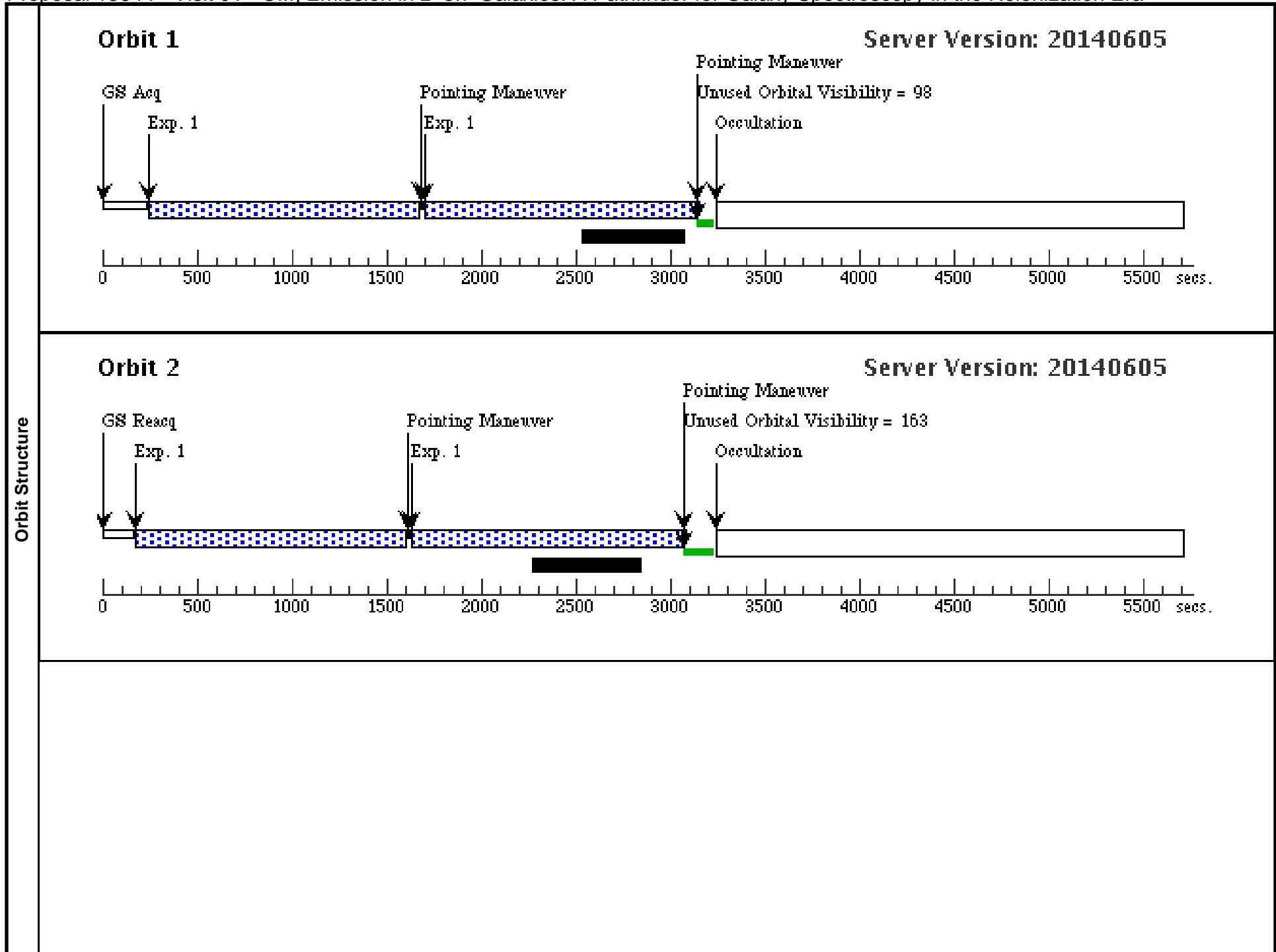
In the Visit 03, we will first obtain a 2-orbit F125W broadband imaging. We use two four-point-dither to populate each orbit of F125W imaging. Then, we obtain 2-orbit F128N narrowband imaging in this visit. We will use a four-point-dither to populate the 2-orbit F128N imaging.

In the Visit 04, we carry out a 4-orbit F128N narrowband imaging. We will (1) use a two-point-dither to populate 1-orbit F128N narrowband imaging; (2) a two-point-dither to populate the next orbit of F128N narrowband imaging; (3) a four-point-dither to populate the last 2-orbit of F128N narrowband imaging.

Proposal 13644 - Visit 01 - CIII] Emission in z=5.7 Galaxies: A Pathfinder for Galaxy Spectroscopy in the Reionization Era

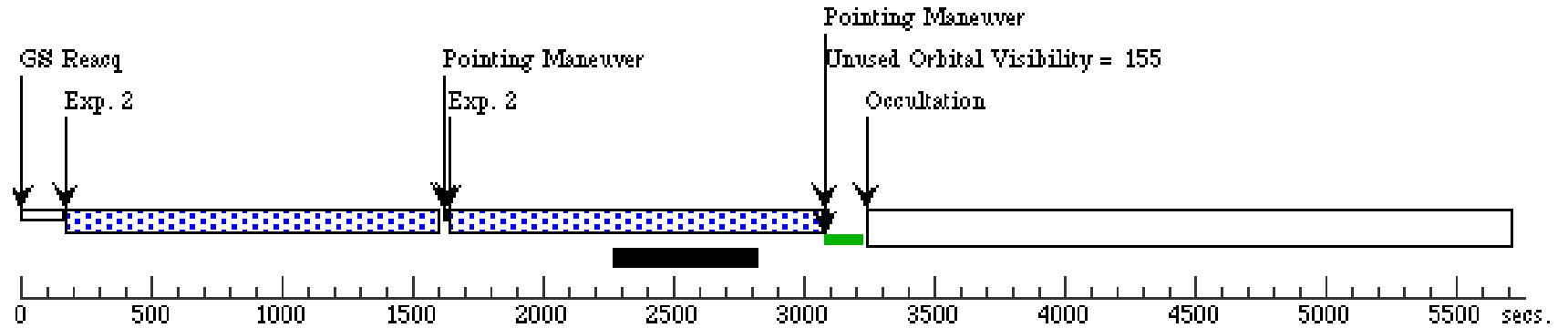
Wed Sep 10 01:14:50 GMT 2014

Visit	<b>Proposal 13644, Visit 01, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: WFC3/IR Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1), (2)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	SDF1324	RA: 13 24 16.1280 (201.0672000d) Dec: +27 44 11.62 (27.73656d) Equinox: J2000	Redshift: 5.7	V=(?) J_AB=24-27	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) SDF1324	WFC3/IR, MULTIACCUM, IR	F128N	NSAMP=14; SAMP-SEQ=STEP200	GS ACQ SCENARIO SINGLE	Pattern 1, Exps 1-1 in Visit 01 (1)	1399.231402 Secs (5596.926 Secs)	
									[==>(Pattern 1)]	[1]
									[==>(Pattern 2)]	
									[==>(Pattern 3)]	[2]
									[==>(Pattern 4)]	
2		(1) SDF1324	WFC3/IR, MULTIACCUM, IR	F128N	NSAMP=15; SAMP-SEQ=SPARS100	POS TARG 0.636,0		Pattern 1, Exps 2-2 in Visit 01 (1)	1402.936813 Secs (5611.747 Secs)	
								[==>(Pattern 1)]	[3]	
								[==>(Pattern 2)]		
								[==>(Pattern 3)]	[4]	
								[==>(Pattern 4)]		



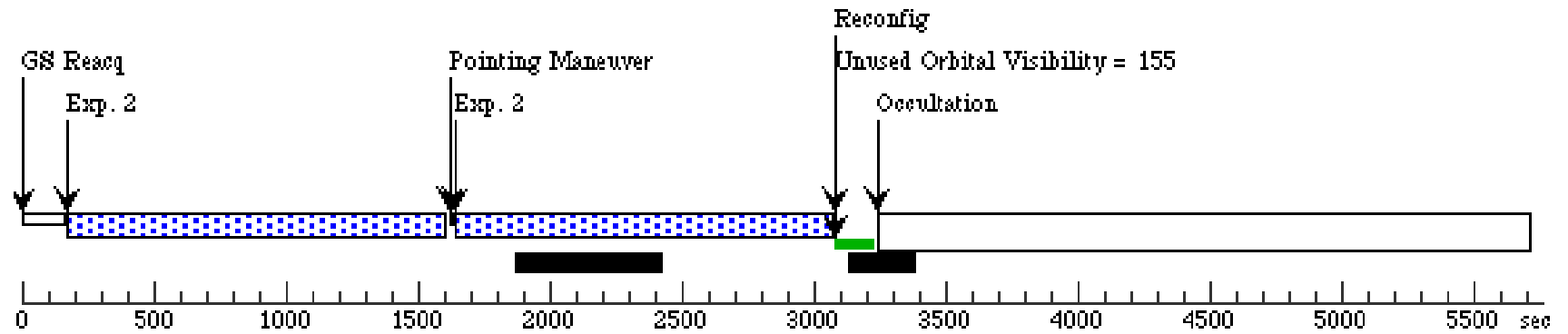
### Orbit 3

Server Version: 20140605



### Orbit 4

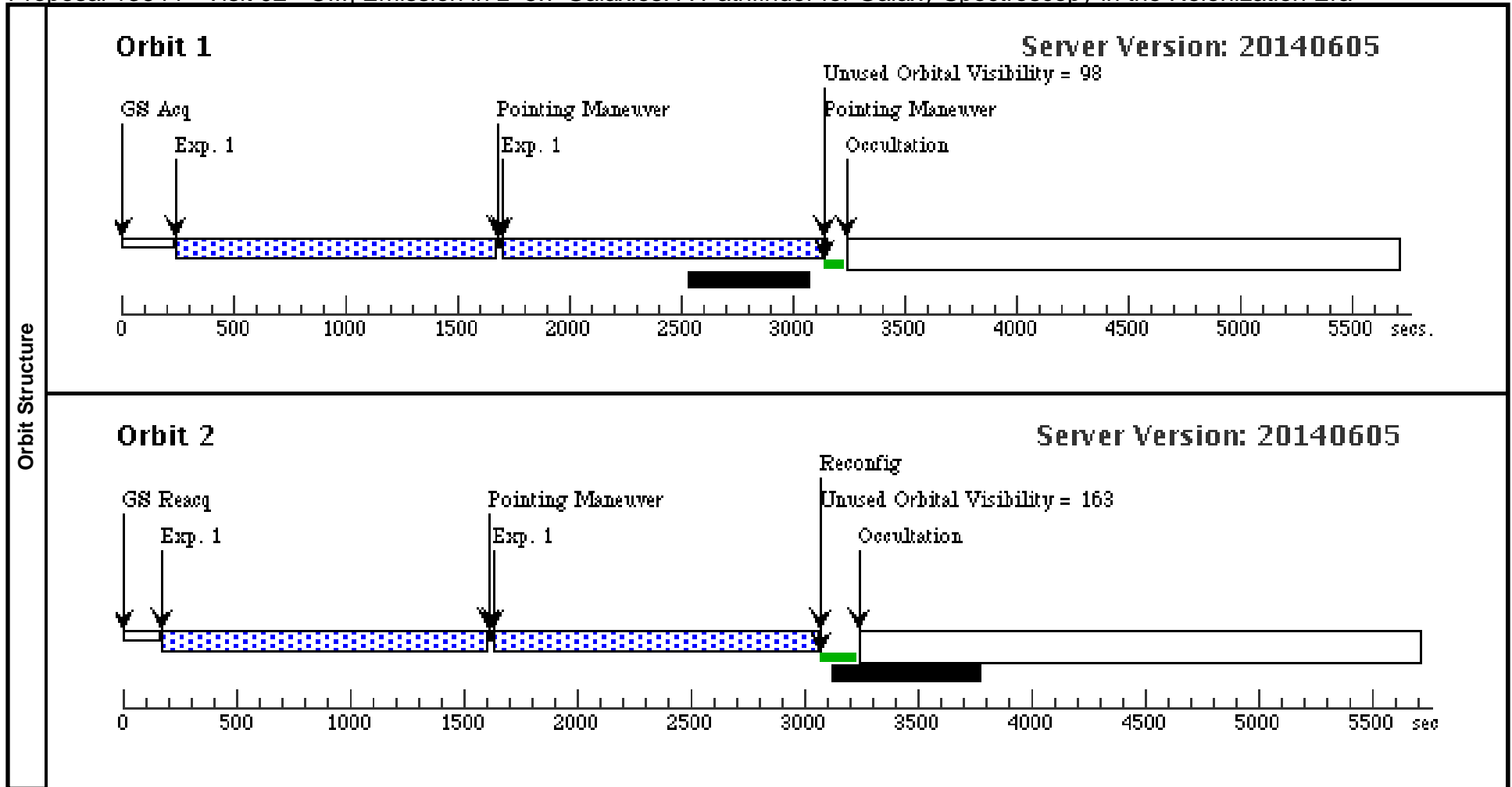
Server Version: 20140605



Proposal 13644 - Visit 02 - CIII] Emission in z=5.7 Galaxies: A Pathfinder for Galaxy Spectroscopy in the Reionization Era

Wed Sep 10 01:14:50 GMT 2014

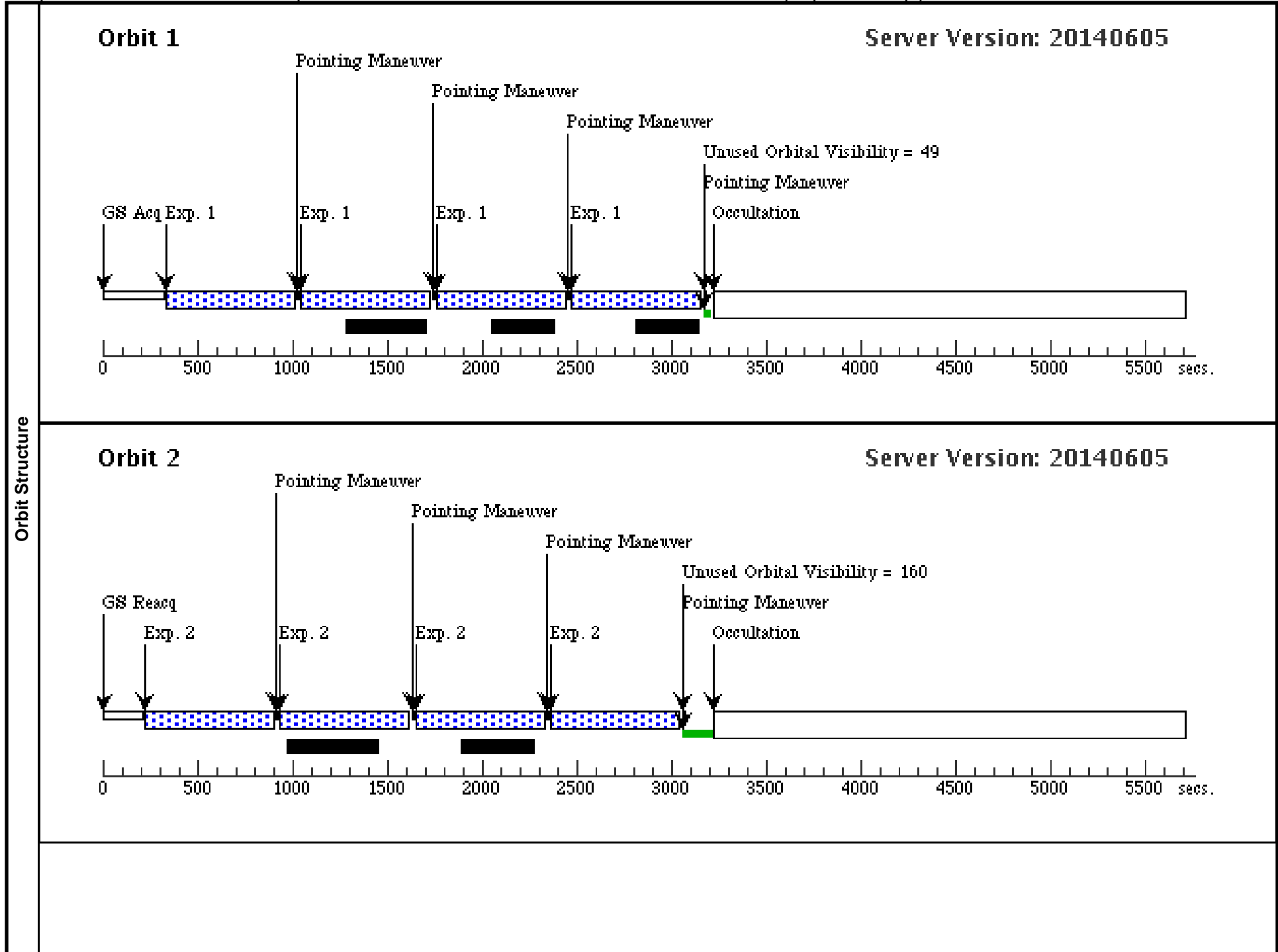
Visit	Proposal 13644, Visit 02, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR Special Requirements: (none)										
	Patterns	#	Primary Pattern				Secondary Pattern			Exposures	
		(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false							(1)
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous		
	(1)	SDF1324	RA: 13 24 16.1280 (201.0672000d) Dec: +27 44 11.62 (27.73656d) Equinox: J2000		Redshift: 5.7		V=(?) J_AB=24-27		Reference Frame: ICRS		
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit
	1		(1) SDF1324	WFC3/IR, MULTIACCUM, IR	F128N	NSAMP=14; SAMP-SEQ=STEP2 00	POS TARG -0.636,0 .0; GS ACQ SCENARI O SINGLE	Pattern 1, Exps 1-1 in Visit 02 (1)	1399.231402 Secs (5596.926 Secs)		
									[=>(Pattern 1)]		[1]
									[=>(Pattern 2)]		
									[=>(Pattern 3)]		
									[=>(Pattern 4)]		[2]



Proposal 13644 - Visit 03 - CIII] Emission in z=5.7 Galaxies: A Pathfinder for Galaxy Spectroscopy in the Reionization Era

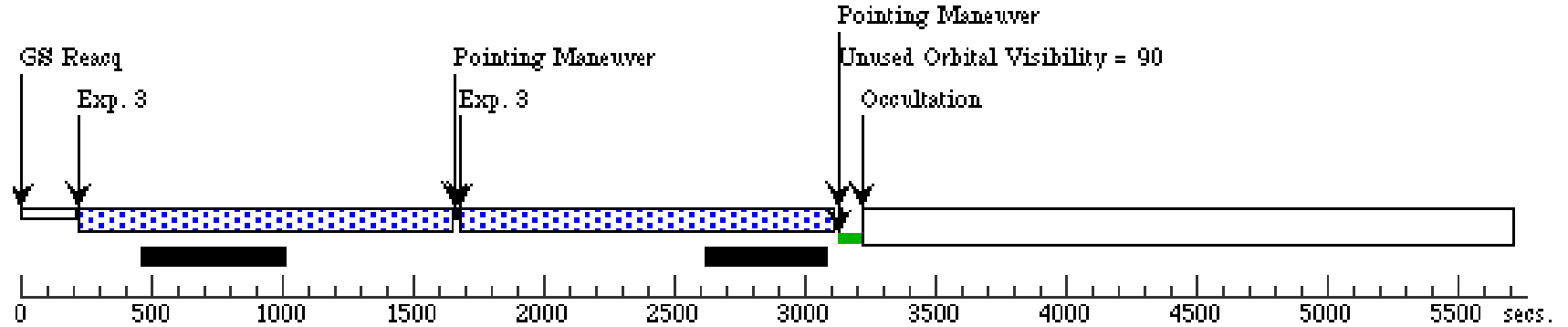
Wed Sep 10 01:14:50 GMT 2014

Visit	<b>Proposal 13644, Visit 03, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: WFC3/IR Special Requirements: ORIENT 44.8D TO 45.1 D									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1), (2), (3)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(2)	SXDF0217	RA: 02 17 46.3600 (34.4431667d) Dec: -05 27 58.00 (-5.46611d) Equinox: J2000		V=(?) J_AB=25-27	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(2) SXDF0217		WFC3/IR, MULTIACCUM, IR	F125W	NSAMP=14; SAMP-SEQ=SPAR S50		Pattern 1, Exps 1-1 in Visit 03 (1)	652.938154 Secs (2611.753 Secs)	
									[==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]
	2	(2) SXDF0217		WFC3/IR, MULTIACCUM, IR	F125W	NSAMP=14; SAMP-SEQ=SPAR S50	POS TARG 0.636,0.0	Pattern 1, Exps 2-2 in Visit 03 (1)	652.938154 Secs (2611.753 Secs)	
								[==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[2]	
3	(2) SXDF0217		WFC3/IR, MULTIACCUM, IR	F128N	NSAMP=15; SAMP-SEQ=SPAR S100	POS TARG 0.0,0.0	Pattern 1, Exps 3-3 in Visit 03 (1)	1402.936813 Secs (5611.747 Secs)		
								[==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[3]	
								[==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[4]	



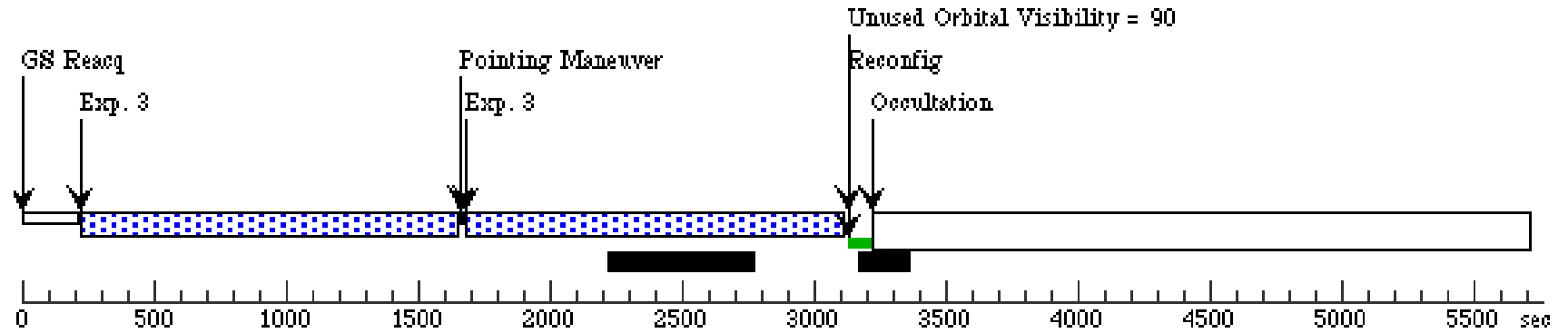
### Orbit 3

Server Version: 20140605



### Orbit 4

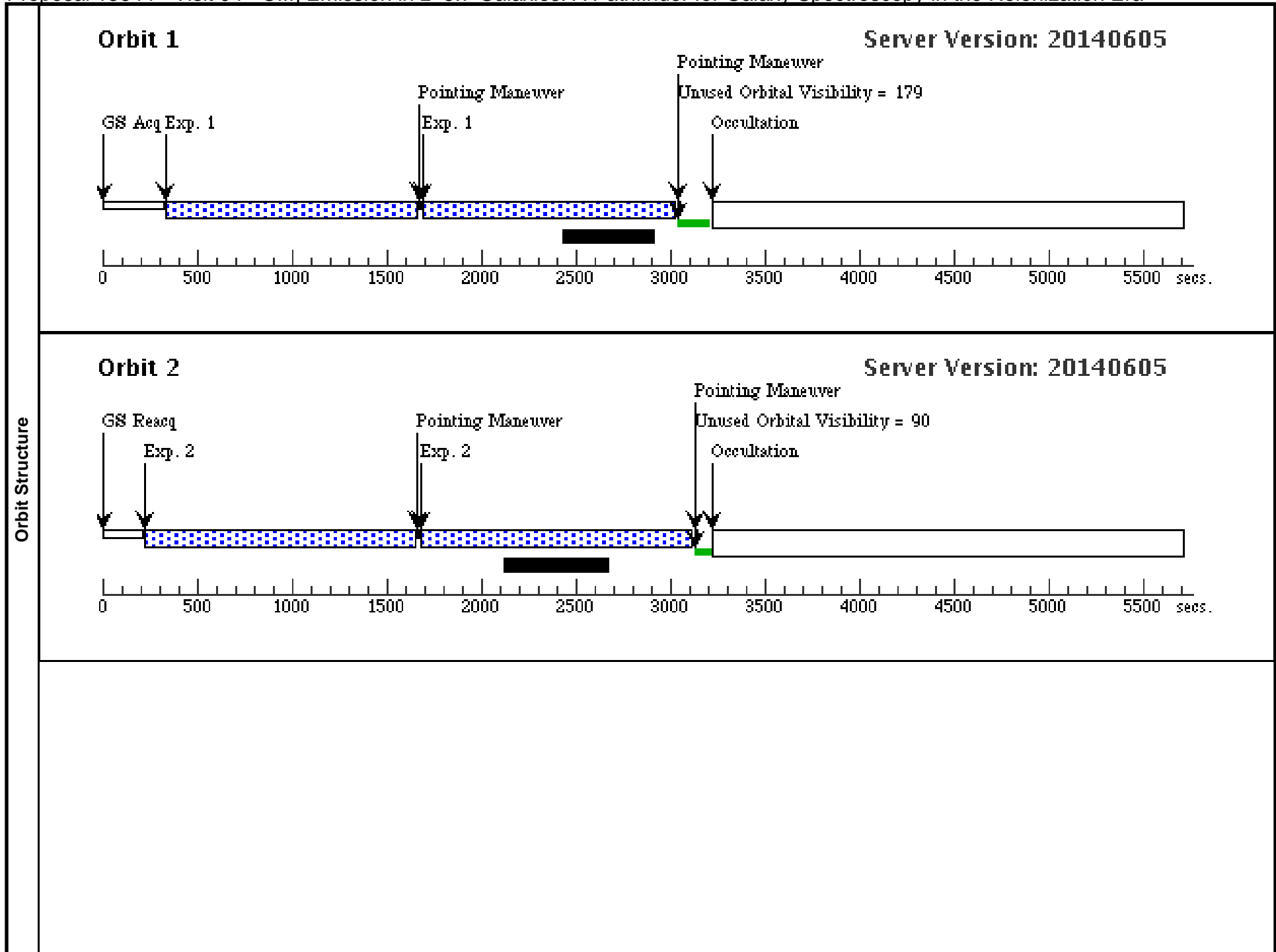
Server Version: 20140605



Proposal 13644 - Visit 04 - CIII] Emission in z=5.7 Galaxies: A Pathfinder for Galaxy Spectroscopy in the Reionization Era

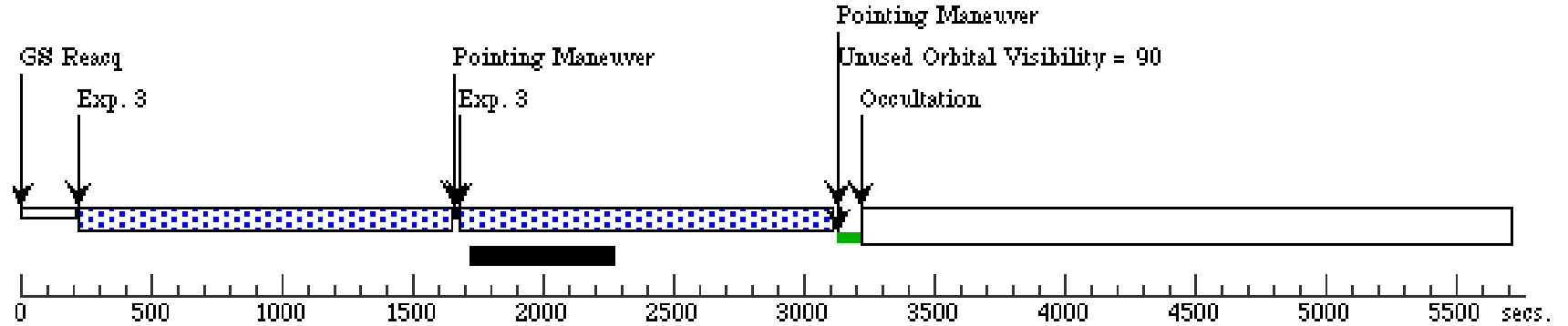
Wed Sep 10 01:14:50 GMT 2014

Visit	<b>Proposal 13644, Visit 04, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: WFC3/IR Special Requirements: ORIENT 44.8D TO 45.1 D										
	#	Primary Pattern			Secondary Pattern			Exposures			
Patterns	(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false							(3)	
	(2)	Pattern Type=WFC3-IR-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.636 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false							(1), (2)	
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous					
	(2)	SXDF0217	RA: 02 17 46.3600 (34.4431667d) Dec: -05 27 58.00 (-5.46611d) Equinox: J2000		V=(?) J_AB=25-27	Reference Frame: ICRS					
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit
	1		(2) SXDF0217	WFC3/IR, MULTIACCUM, IR	F128N	SAMP-SEQ=SPARS100; NSAMP=14	POS TARG 0.636,0.0	Pattern 2, Exps 1-1 in Visit 04 (2)	1302.93649 Secs (2605.873 Secs) [=>(Pattern 1)] [=>(Pattern 2)]		[1]
	2		(2) SXDF0217	WFC3/IR, MULTIACCUM, IR	F128N	NSAMP=15; SAMP-SEQ=SPARS100	POS TARG -0.636,0.0	Pattern 2, Exps 2-2 in Visit 04 (2)	1402.936813 Secs (2805.874 Secs) [=>(Pattern 1)] [=>(Pattern 2)]		[2]
	3		(2) SXDF0217	WFC3/IR, MULTIACCUM, IR	F128N	NSAMP=15; SAMP-SEQ=SPARS100	POS TARG 0.0,0.0	Pattern 1, Exps 3-3 in Visit 04 (1)	1402.936813 Secs (5611.747 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)]		[3] [4]



### Orbit 3

Server Version: 20140605



### Orbit 4

Server Version: 20140605

