



16876 - Unveiling the Source of Extreme Ionization in a Lensed Galaxy at $z=2.6$

Cycle: 29, 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) J1356-2313	WFC3/UVIS	2	14-Dec-2021 15:00:13.0	yes
02	(1) J1356-2313	WFC3/UVIS	2	14-Dec-2021 15:00:14.0	yes
03	(1) J1356-2313	WFC3/UVIS	1	14-Dec-2021 15:00:14.0	yes
04	(1) J1356-2313	WFC3/UVIS	1	14-Dec-2021 15:00:15.0	yes
05	(1) J1356-2313	WFC3/IR	1	14-Dec-2021 15:00:16.0	yes
06	(1) J1356-2313	WFC3/IR	1	14-Dec-2021 15:00:17.0	yes

8 Total Orbits Used

ABSTRACT

Studies of the most highly ionized galaxies in the universe offer insights into the complex interplay between feedback, shocks, and radiative cooling, driven by extreme star formation or accreting supermassive black holes. We here propose eight orbits of broad and narrowband imaging of J1356-2313, a puzzling, newly discovered gravitationally lensed source at $z=2.6$ with the highly unusual combination of extreme high ionization UV line emission from O VI, N V, He II and C IV coupled with damped Ly α absorption. Integral field spectroscopy of the kinematically narrow O VI emission reveals that it is gravitationally lensed into an arc, indicating a spatially extended source larger than an AGN narrow-line region; further, the line is kinematically inconsistent with a quasar outflow. The very high ionization emission lines may instead be a signature of catastrophic radiative cooling, which may suppress feedback in the most extreme starbursts.

With the proposed broadband imaging, we will construct a lensing model and determine the intrinsic luminosity of the source and the structure of the emitting region(s). Modeling of the spectral energy distribution will offer further constraints on the nature of the ionizing source. We also propose narrowband imaging of the extremely strong and spatially extended O VI emission, which is fortuitously redshifted into the F373N filter. The spatial resolution of HST in combination with the magnification of gravitational lensing will provide an unprecedented map of extremely high ionization line emission in the distant universe, allowing tests of the emission mechanisms discussed above.

OBSERVING DESCRIPTION

The goal of this proposal is to use WFC3-UVIS/IR to obtain both broad (F606W, F814W, F125W, F160W) and narrow/medium-band (F373N and F390M) imaging of the gravitationally lensed galaxy J1356-2313. The program consists of 8 orbits, two in each of the narrow/medium filters and one in each of the broadband filters. Observations with each filter are configured as separate visits, so we have a total of six visits: two 2-orbit visits and four visits with one orbit each.

For the F373N and F390M imaging we divide each orbit into three exposures using the UVIS-DITHER-LINE-3PT pattern, balancing considerations of cosmic ray rejection with the changes in efficiency, background and S/N from increasing the number of exposures. We mitigate CTE effects by using the UVIS-C1K1C-CTE aperture in order to place the target near one of the amplifiers, and further specify FLASH=16 in order to reach the recommended background level of 20 e⁻, based on calculations with the ETC.

We also use the UVIS-C1K1C-CTE aperture for the broadband F606W and F814W observations. With one orbit and visit per filter, we divide these observations into four exposures per orbit with the UVIS-DITHER-BOX pattern in order to enable rejection of cosmic rays and detector artifacts. For the F814W observations the ETC predicts 19 background e⁻, and we therefore add FLASH=1 to reach the recommended level of 20. Note that this

Proposal 16876 (STScI Edit Number: 0, Created: Tuesday, December 14, 2021 at 3:00:17 PM Eastern Standard Time) - Overview differs from the APT background prediction, which is lower and therefore recommends more FLASH. As advised by the APT warning, we use the ETC predictions.

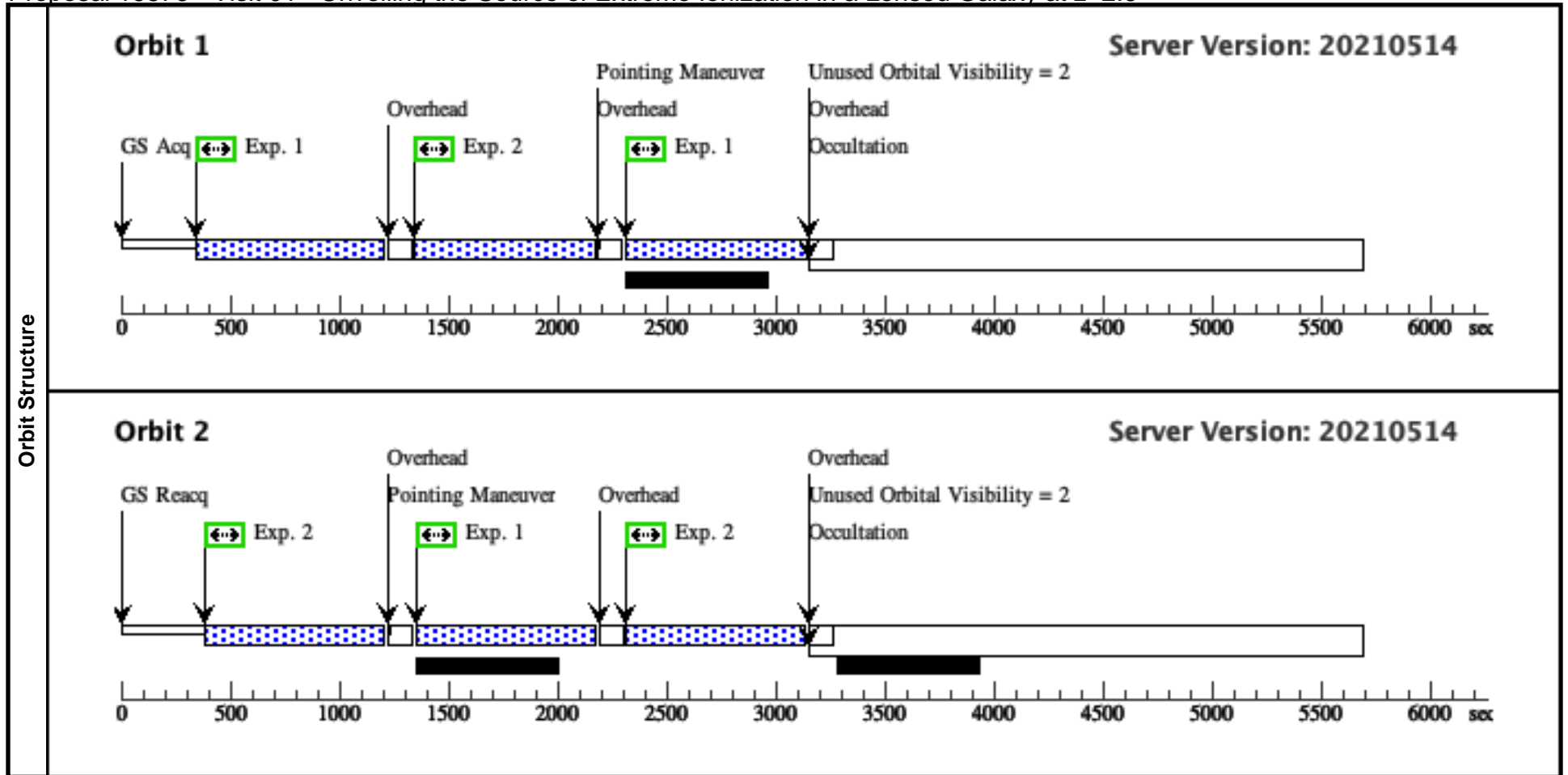
For the IR observations in F125W and F160W with larger pixels, we use a 4-point box dither followed by a 3-point line for a total of seven exposures at six different positions. The repeated position, corresponding to the first exposure in each dither pattern, will enable a consistency check of the slightly different exposure times of the two patterns, and the combination of the two patterns will improve the sub-pixel sampling over either pattern alone. We will use the STEP50 sampling sequence in order to obtain good sampling on both the lensed arc and on PSF stars to be used for the de-lensing model. The dither sequences will also enable rejection of detector artifacts and cosmic rays, and the seven exposures with two different exposure times enable the most efficient use of the full orbit.

This program has no constraints on the roll angle or on the time of observations, so there are no specific impacts of reduced gyro operations.

Proposal 16876 - Visit 01 - Unveiling the Source of Extreme Ionization in a Lensed Galaxy at z=2.6

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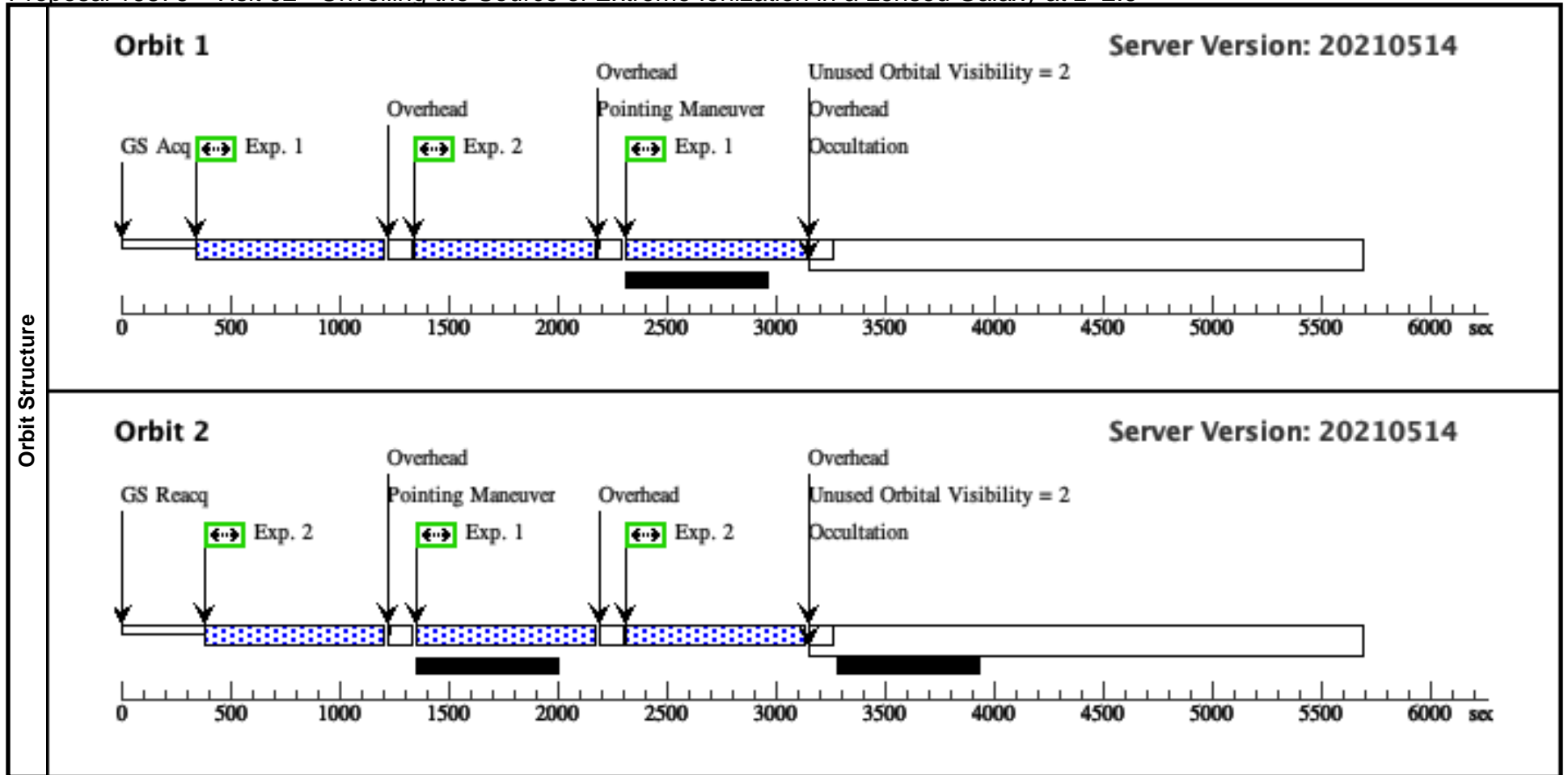
Visit	Proposal 16876, Visit 01 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(5)	Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1-2)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	J1356-2313	RA: 13 56 51.8760 (209.2161500d) Dec: -23 13 18.54 (-23.22182d) Equinox: J2000		V=20.5	Reference Frame: ICRS				
	<i>Comments:</i> Category=GALAXY Description=[EINSTEIN RING, GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY]									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) J1356-2313	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F373N	FLASH=16		Pattern 5, Exps 1-2 in Visit 01 (5)	800 Secs (2487 Secs)	
									[==>830.0 Secs (Pattern 1)]	[1]
									[==>830.0 Secs (Pattern 2)]	[1]
									[==>827.0 Secs (Pattern 3)]	[2]
2		(1) J1356-2313	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F373N	FLASH=16		Pattern 5, Exps 1-2 in Visit 01 (5)	800 Secs (2484 Secs)		
								[==>830.0 Secs (Pattern 1)]	[1]	
								[==>827.0 Secs (Pattern 2)]	[1]	
								[==>827.0 Secs (Pattern 3)]	[2]	



Proposal 16876 - Visit 02 - Unveiling the Source of Extreme Ionization in a Lensed Galaxy at z=2.6

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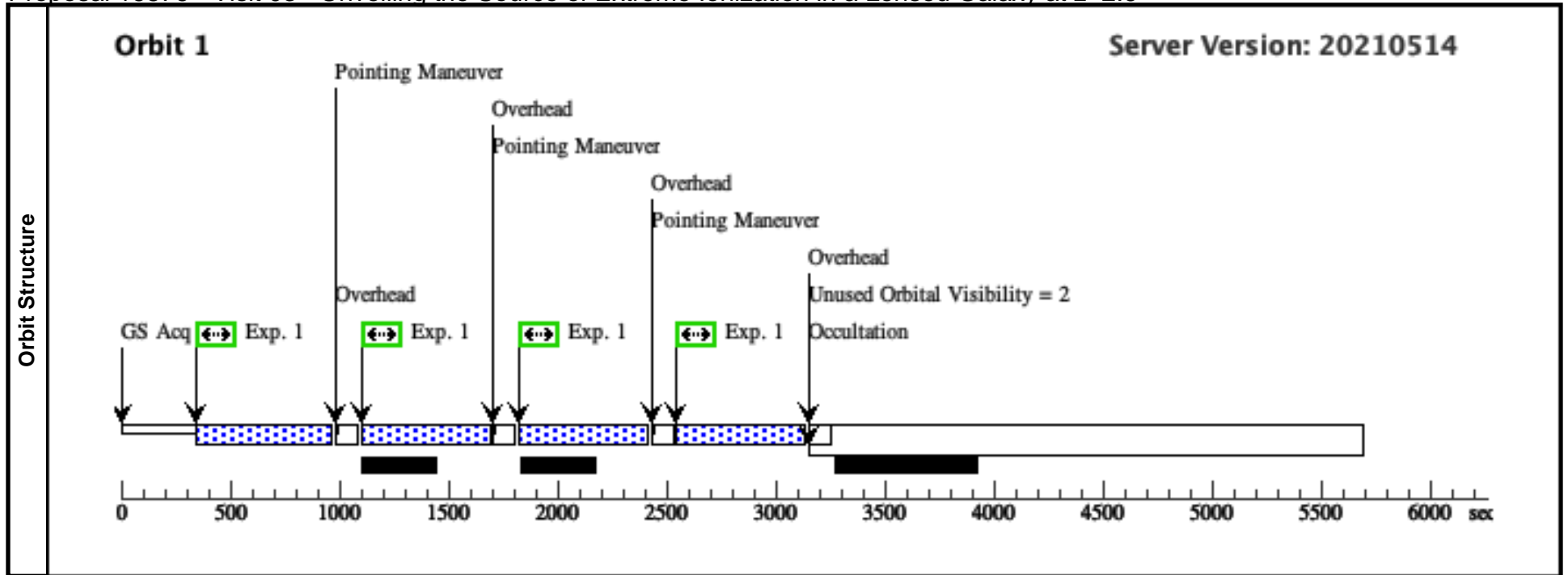
Visit	Proposal 16876, Visit 02 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern			Secondary Pattern			Exposures	
		(5)	Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false					(1-2)	
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections		Fluxes	Miscellaneous			
	(1)	J1356-2313	RA: 13 56 51.8760 (209.2161500d) Dec: -23 13 18.54 (-23.22182d) Equinox: J2000			V=20.5	Reference Frame: ICRS			
	<i>Comments:</i> Category=GALAXY Description=[EINSTEIN RING, GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY]									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) J1356-2313	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F390M	FLASH=16		Pattern 5, Exps 1-2 in Visit 02 (5)	800 Secs (2487 Secs)	
									[==>830.0 Secs (Pattern 1)]	[1]
									[==>830.0 Secs (Pattern 2)]	[1]
									[==>827.0 Secs (Pattern 3)]	[2]
2		(1) J1356-2313	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F390M	FLASH=16		Pattern 5, Exps 1-2 in Visit 02 (5)	800 Secs (2484 Secs)		
								[==>830.0 Secs (Pattern 1)]	[1]	
								[==>827.0 Secs (Pattern 2)]	[1]	
								[==>827.0 Secs (Pattern 3)]	[2]	



Proposal 16876 - Visit 03 - Unveiling the Source of Extreme Ionization in a Lensed Galaxy at z=2.6

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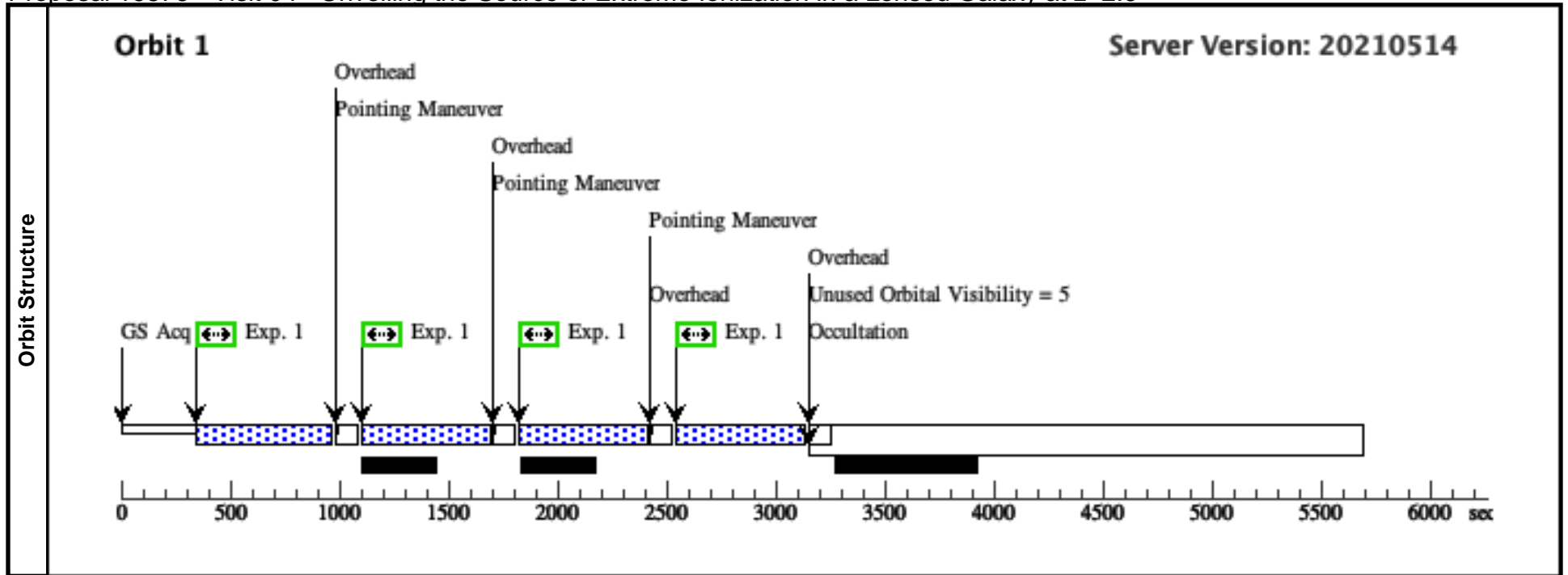
Visit	Proposal 16876, Visit 03 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(2)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	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)	J1356-2313	RA: 13 56 51.8760 (209.2161500d) Dec: -23 13 18.54 (-23.22182d) Equinox: J2000		V=20.5	Reference Frame: ICRS				
	<i>Comments:</i> Category=GALAXY Description=[EINSTEIN RING, GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY]									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) J1356-2313	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F606W			Pattern 2, Exps 1-1 in Visit 03 (2)	500 Secs (2380 Secs) [=>595.0 Secs (Pattern 1)] [=>595.0 Secs (Pattern 2)] [=>595.0 Secs (Pattern 3)] [=>595.0 Secs (Pattern 4)]	[1]



Proposal 16876 - Visit 04 - Unveiling the Source of Extreme Ionization in a Lensed Galaxy at z=2.6

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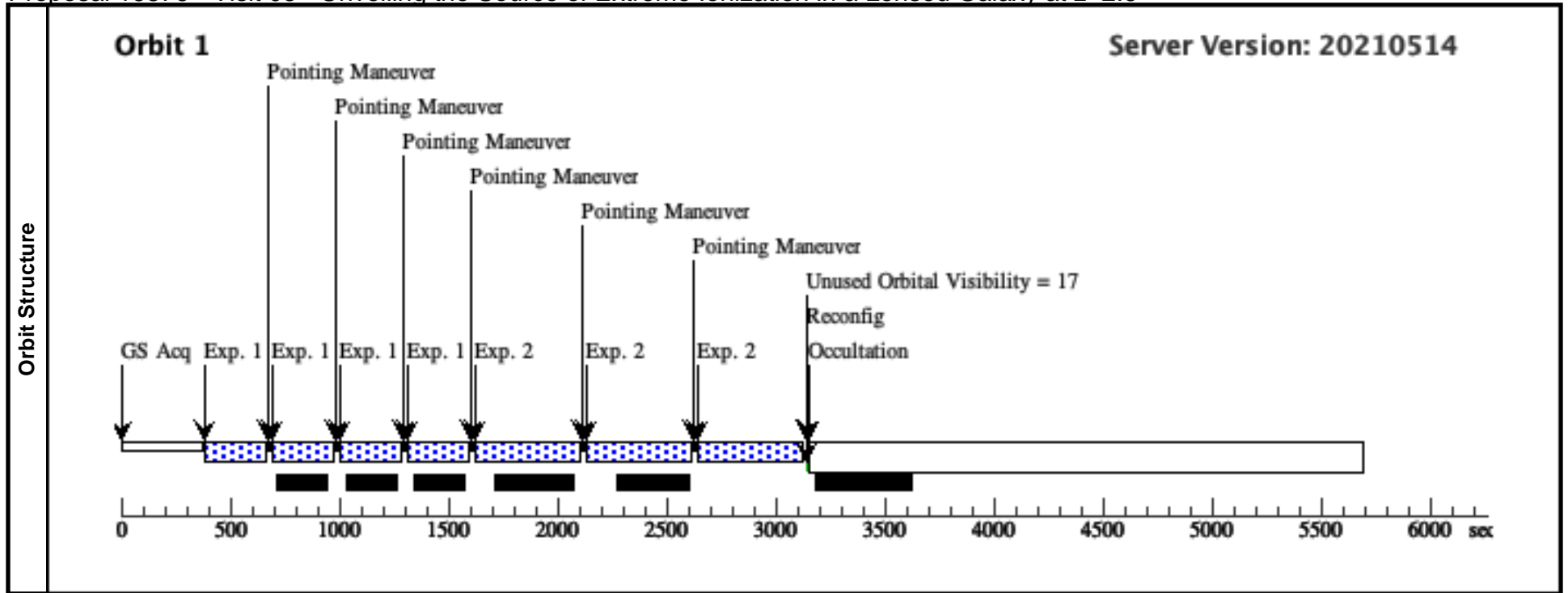
Visit	Proposal 16876, Visit 04 Diagnostic Status: Warning Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	(Exposure 1 (Pattern 2, Exps 1-1 in Visit 04)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser									
Diagnosics										
Patterns	#	Primary Pattern	Secondary Pattern			Exposures				
	(2)	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)	J1356-2313	RA: 13 56 51.8760 (209.2161500d) Dec: -23 13 18.54 (-23.22182d) Equinox: J2000		V=20.5	Reference Frame: ICRS				
Comments: Category=GALAXY Description=[EINSTEIN RING, GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY]										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) J1356-2313	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F814W	FLASH=1		Pattern 2, Exps 1-1 in Visit 04 (2)	592 Secs (2368 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)]	[1]



Proposal 16876 - Visit 05 - Unveiling the Source of Extreme Ionization in a Lensed Galaxy at z=2.6

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Visit	Proposal 16876, Visit 05 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR Special Requirements: (none)									
	#	Primary Pattern	Secondary Pattern	Exposures						
Patterns	(3)	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)						
	(4)	Pattern Type=WFC3-IR-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.605 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false	(2)						
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	J1356-2313	RA: 13 56 51.8760 (209.2161500d) Dec: -23 13 18.54 (-23.22182d) Equinox: J2000		V=20.5	Reference Frame: ICRS				
Comments: Category=GALAXY Description=[EINSTEIN RING, GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY]										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) J1356-2313	WFC3/IR, MULTIACCUM, IR	F125W	NSAMP=10; SAMP-SEQ=STEP5 0			Pattern 3, Exps 1-1 in Visit 05 (3)	249.23203 Secs (996.928 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)]
2		(1) J1356-2313	WFC3/IR, MULTIACCUM, IR	F125W	NSAMP=14; SAMP-SEQ=STEP5 0			Pattern 4, Exps 2-2 in Visit 05 (4)	449.233834 Secs (1347.702 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]



Proposal 16876 - Visit 06 - Unveiling the Source of Extreme Ionization in a Lensed Galaxy at z=2.6

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Visit	Proposal 16876, Visit 06 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR Special Requirements: (none)									
	#	Primary Pattern	Secondary Pattern	Exposures						
Patterns	(3)	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)						
	(4)	Pattern Type=WFC3-IR-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.605 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false	(2)						
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	J1356-2313	RA: 13 56 51.8760 (209.2161500d) Dec: -23 13 18.54 (-23.22182d) Equinox: J2000		V=20.5	Reference Frame: ICRS				
<i>Comments:</i> Category=GALAXY Description=[EINSTEIN RING, GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY]										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) J1356-2313	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=10; SAMP-SEQ=STEP5 0			Pattern 3, Exps 1-1 in Visit 06 (3)	249.23203 Secs (996.928 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)]
2		(1) J1356-2313	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=14; SAMP-SEQ=STEP5 0			Pattern 4, Exps 2-2 in Visit 06 (4)	449.233834 Secs (1347.702 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]

