



18014 - An Extraordinary Strongly-Lensed Ly-C Leaker at $z=4.059$

Cycle: 33, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>
Prof. Michael D. Gladders (PI) (Contact)	University of Chicago
Dr. T. Emil Rivera-Thorsen (CoI) (ESA Member)	Stockholm University
Prof. Keren Sharon (CoI)	University of Michigan
Dr. Haakon Dahle (CoI) (ESA Member)	University of Oslo
Dr. Jane R. Rigby (CoI)	NASA Goddard Space Flight Center
Dr. Matthew Bayliss (CoI)	University of Cincinnati Main Campus
Dr. Brian Welch (CoI)	University of Maryland
Dr. Keunho J. Kim (CoI)	California Institute of Technology
Dr. Michael Florian (CoI)	University of Arizona
Dr. Taylor Alexandra Hutchison (CoI)	NASA Goddard Space Flight Center
Dr. Gourav Khullar (CoI)	University of Washington
Erik Solhaug (CoI)	University of Chicago
M. Riley Owens (CoI)	University of Cincinnati Main Campus
Ms. Sarah Grannis (CoI)	University of Chicago
Emory Murff (CoI)	University of Chicago
Camila Silva (CoI)	University of Chicago
Mr. Daniel Babnigg (CoI)	University of Chicago
Mr. Zewei Wu (CoI)	University of Chicago
Mr. Joseph Yeung (CoI)	University of Chicago

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) COOLJ1402-2809	WFC3/UVIS	2	13-Aug-2025 14:00:18.0	yes
02	(1) COOLJ1402-2809	WFC3/UVIS	2	13-Aug-2025 14:00:19.0	yes
03	(1) COOLJ1402-2809	WFC3/UVIS	2	13-Aug-2025 14:00:19.0	yes
04	(2) COOLJ1402-2809-OFFSETA	WFC3/UVIS	2	13-Aug-2025 14:00:19.0	yes
05	(3) COOLJ1402-2809-OFFSETB	WFC3/UVIS	2	13-Aug-2025 14:00:20.0	yes
06	(1) COOLJ1402-2809	WFC3/UVIS	3	13-Aug-2025 14:00:20.0	yes

13 Total Orbits Used

ABSTRACT

We propose HST imaging observations to measure the ionizing photons leaking from a remarkable $z=4.059$ strongly lensed galaxy. This galaxy, the highest redshift system yet identified to be spewing ionizing photons into the broader cosmos, and only the third strongly-lensed instance of a Ly-C leaker ever found, offers an opportunity to isolate and study the region(s) within the galaxy that are producing ionizing photons that are escaping. In addition to the direct measurement of the leaking ionizing photons we will also gather multi-band imaging, with both HST and JWST, to measure the continuum spectral energy distributions of all structures within the galaxy. We also propose for initial exploratory JWST spectroscopy to measure restframes emission lines in the nebular gas. All of this imaging and spectroscopy will inform an analysis of the physical conditions within and properties of the leaking components, which be correlated with the leaking Ly-C photons known to be emerging from this galaxy.

OBSERVING DESCRIPTION

This program is for imaging of a high redshift ($z=4.06$) strongly-lensed Lyman continuum leaker. The imaging from HST will be used for several purposes - including measuring the spatial distribution of the leaking photons and constructing a high fidelity lens model - and consist of imaging in 4 filters. Of the allocated 13 orbits, 7 will be used for imaging in the F438W filter; I have programed this as 2 2-orbit visits and 1 3-orbit visit. These data sample the Ly-C photons. To avoid post-flash losses in SNR, we take full orbit length images in each visit, dithered along a line; we add a small position offset to make sure the field is differently sampled (slightly) even if the visits end up occuring sequentially all at the sample rotation. We realise these offsets by specifying two slightly offset targets at ± 2 arcsec.

Because the lensing radius is reasonably small (maximally a few tens or arcseconds for all possible secondary image configurations) the whole system and all possible secondary lensd images fit comfortably on a single chip of WFC3, and we place the target accordingly on UVIS1-FIX; this

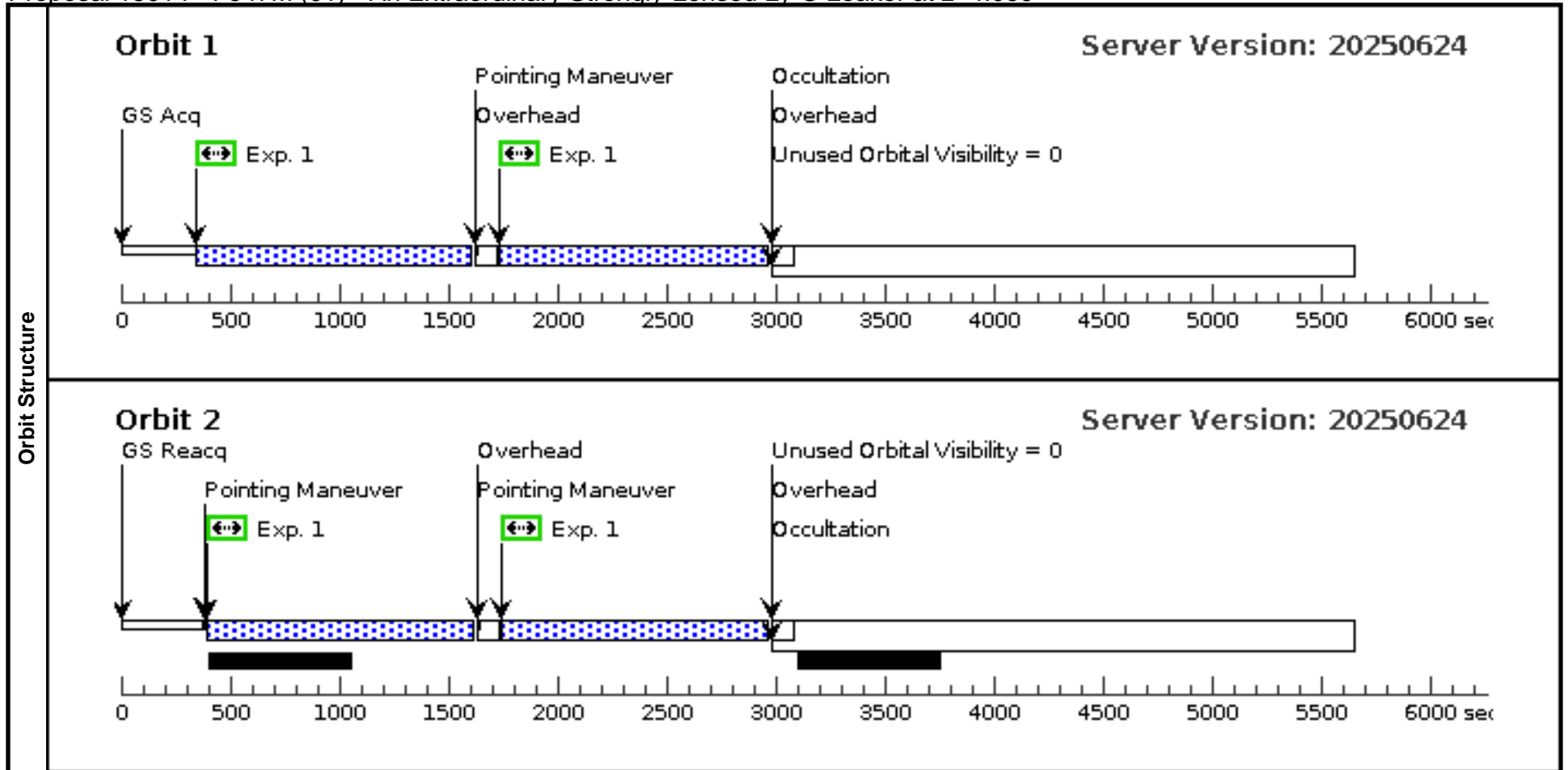
places the target such that it will be well way from chip edges at all possible rotations.

There are then 2 orbits each allocated to F547M, F606W and F814W, each programmed as a single 2-orbit visit. For each 2-orbit single filter observation, we observe a 4-point dither using a default WFC3-DITHER-UVIS-BOX pattern across the two orbits, to reject cosmic rays and bad pixels and sample the PSF for drizzling. The F547M images require a very slight postflash (level 2) to ensure that charge traps are well filled.

Proposal 18014 - F547M (01) - An Extraordinary Strongly-Lensed Ly-C Leaker at z=4.059

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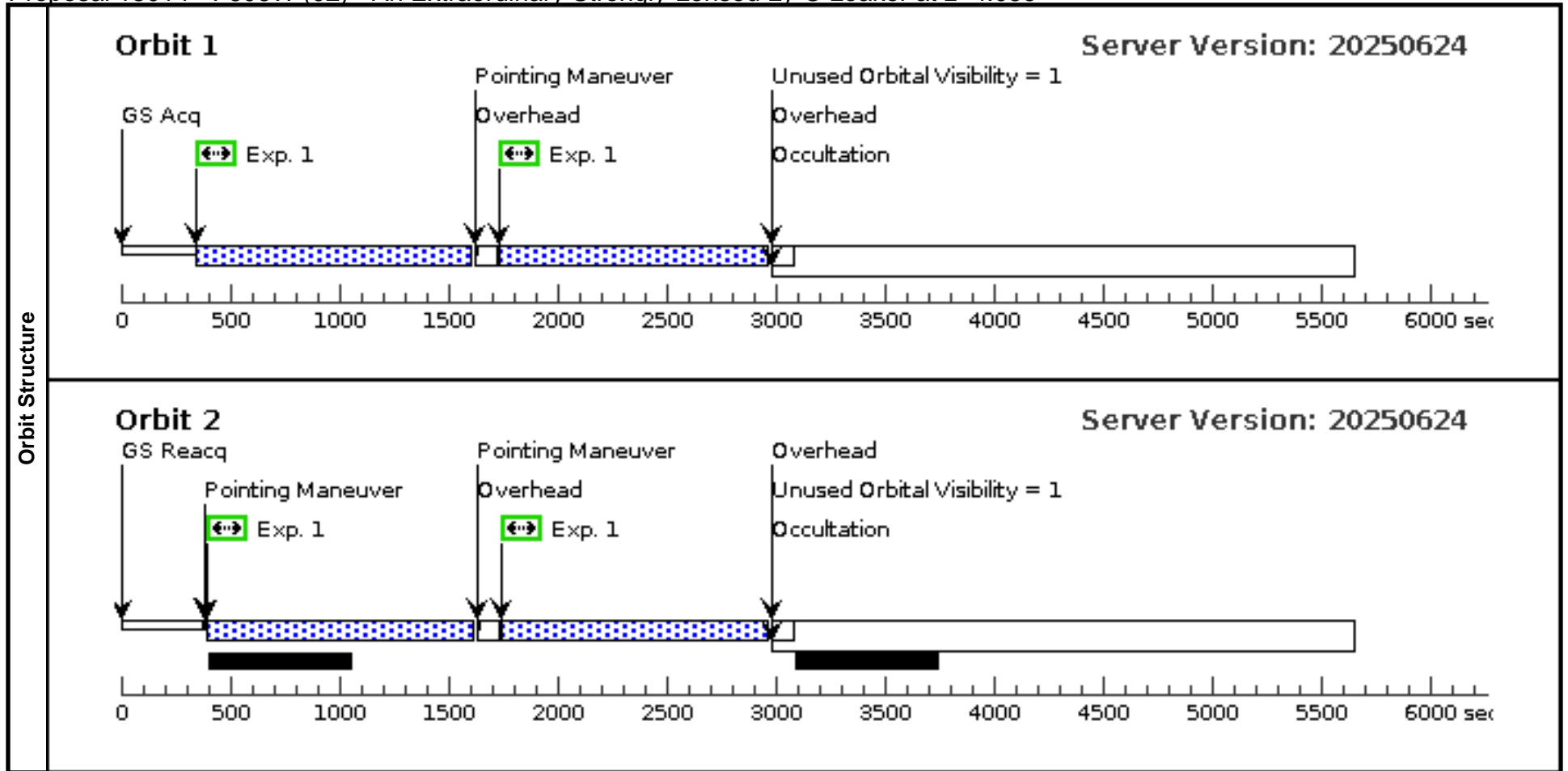
Visit	Proposal 18014, F547M (01), implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	COOLJ1402-2809	RA: 14 02 23.6160 (210.5984000d) Dec: -28 09 37.44 (-28.16040d) Equinox: J2000		V=22.3	Reference Frame: ICRS				
	Comments: Category=GALAXY Description=[GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY, PROTOGALAXY] Extended=YES									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) COOLJ1402-2809	WFC3/UVIS, ACCUM, UVIS1-FIX	F547M	FLASH=2		Pattern 1, Exps 1-1 in F547M (01) (1)	1200 Secs (4908 Secs)	
			9						[==>1232.0 Secs (Pattern 1)]	[1]
									[==>1232.0 Secs (Pattern 2)]	
								[==>1222.0 Secs (Pattern 3)]		
								[==>1222.0 Secs (Pattern 4)]	[2]	



Proposal 18014 - F606W (02) - An Extraordinary Strongly-Lensed Ly-C Leaker at z=4.059

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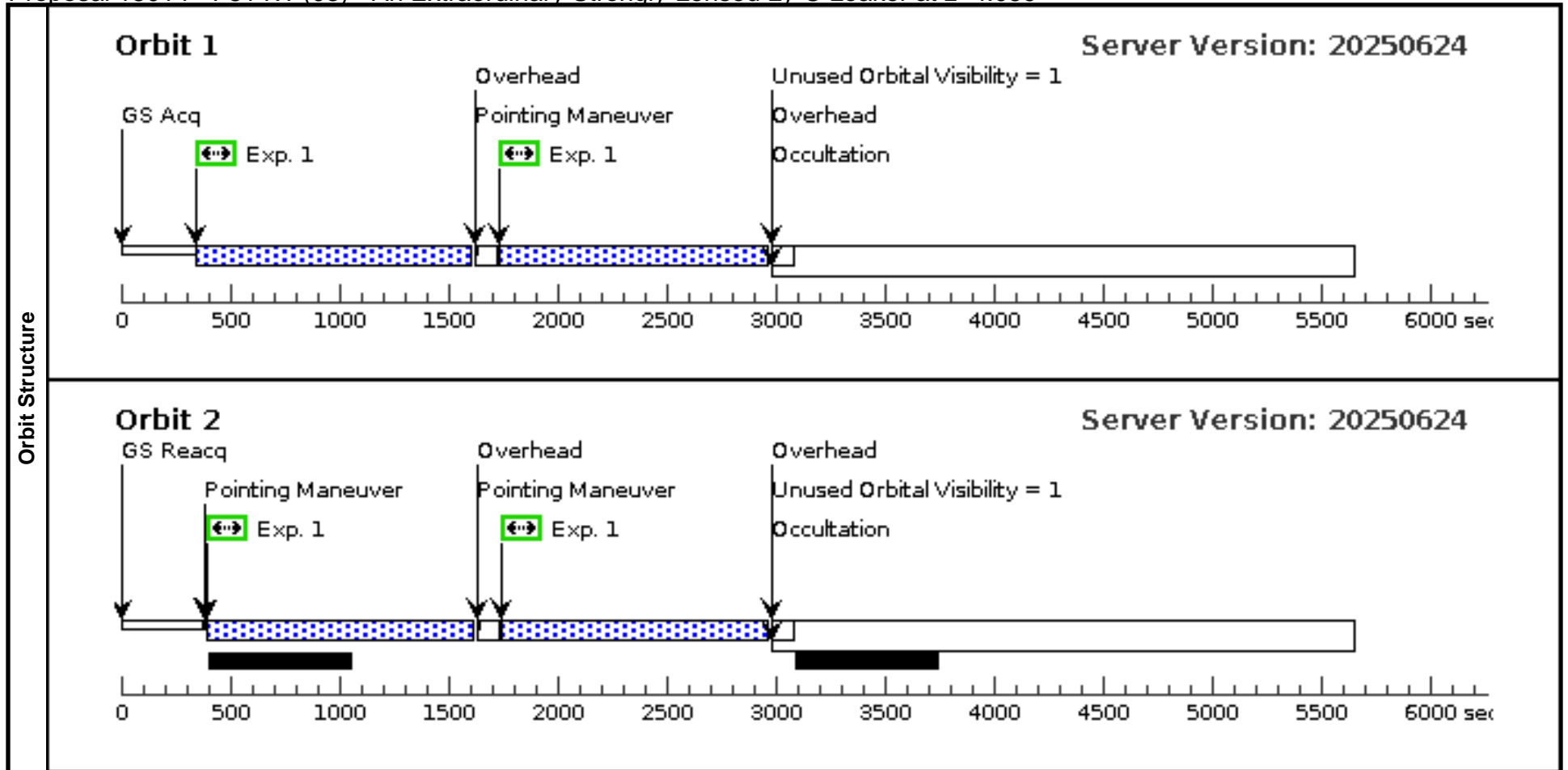
Visit	Proposal 18014, F606W (02), implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	COOLJ1402-2809	RA: 14 02 23.6160 (210.5984000d) Dec: -28 09 37.44 (-28.16040d) Equinox: J2000		V=22.3	Reference Frame: ICRS				
	<i>Comments:</i> Category=GALAXY Description=[GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY, PROTOGALAXY] Extended=YES									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) COOLJ1402-2809	WFC3/UVIS, ACCUM, UVIS1-FIX	F606W			Pattern 1, Exps 1-1 in F606W (02) (1)	1200 Secs (4912 Secs) [==>1233.0 Secs (Pattern 1)] [==>1233.0 Secs (Pattern 2)] [==>1223.0 Secs (Pattern 3)] [==>1223.0 Secs (Pattern 4)]	[1] [2]



Proposal 18014 - F814W (03) - An Extraordinary Strongly-Lensed Ly-C Leaker at z=4.059

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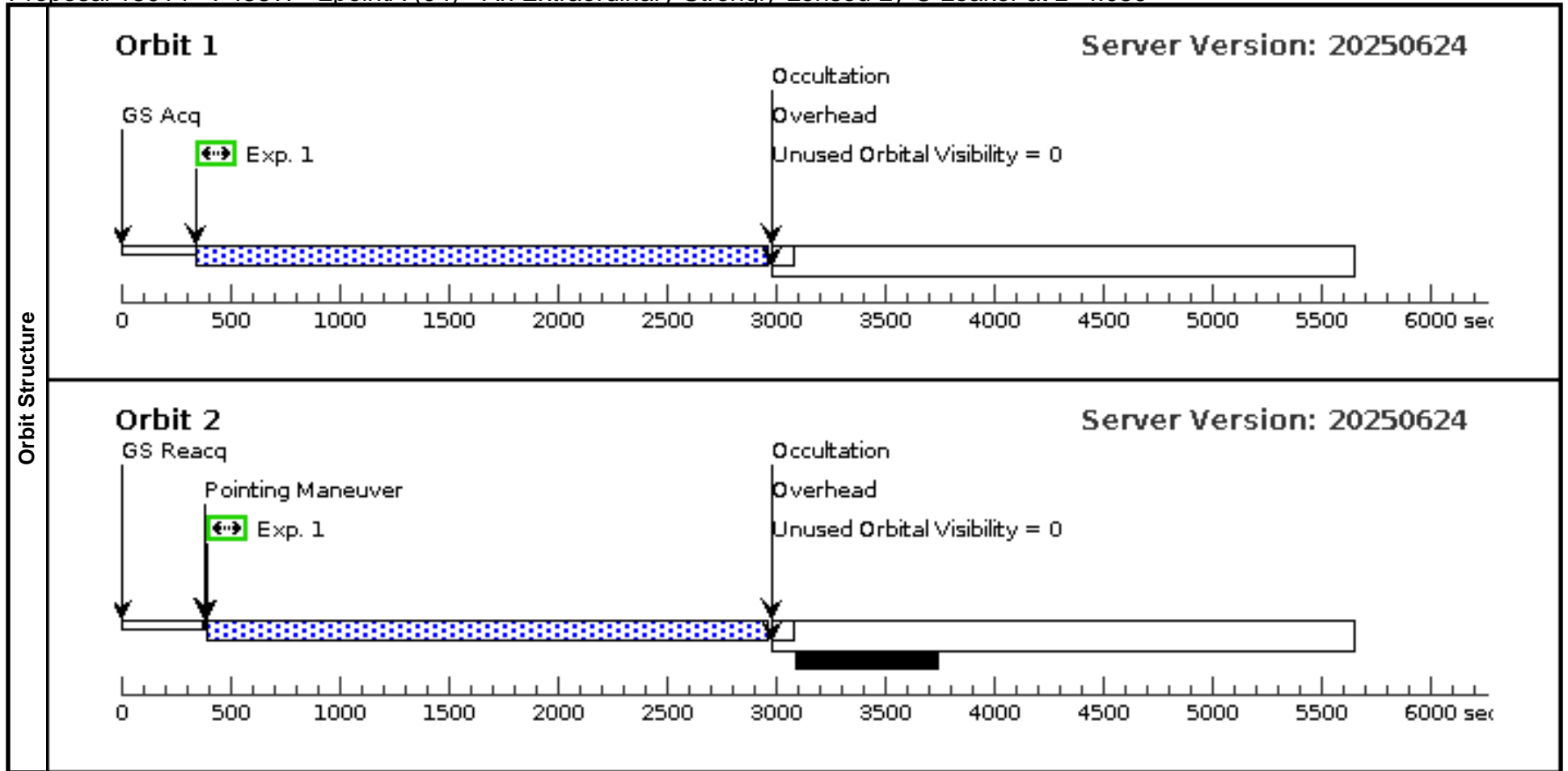
Visit	Proposal 18014, F814W (03), implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Patterns	# (1)	Primary Pattern Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Secondary Pattern Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false	Exposures (1)					
Fixed Targets	# (1)	Name COOLJ1402-2809	Target Coordinates RA: 14 02 23.6160 (210.5984000d) Dec: -28 09 37.44 (-28.16040d) Equinox: J2000	Targ. Coord. Corrections	Fluxes V=22.3	Miscellaneous Reference Frame: ICRS				
Comments: Category=GALAXY Description=[GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY, PROTOGALAXY] Extended=YES										
Exposures	# 1	Label (1) COOLJ1402-2809	Target 9	Config,Mode,Aperture WFC3/UVIS, ACCUM, UVIS1-FIX	Spectral Els. F814W	Opt. Params.	Special Reqs.	Groups Pattern 1, Exps 1-1 in F814W (03) (1)	Exp. Time (Total)/[Actual Dur.] 1200 Secs (4912 Secs) [==>1233.0 Secs (Pattern 1)] [==>1233.0 Secs (Pattern 2)] [==>1223.0 Secs (Pattern 3)] [==>1223.0 Secs (Pattern 4)]	Orbit [1] [2]



Proposal 18014 - F438W - 2pointA (04) - An Extraordinary Strongly-Lensed Ly-C Leaker at z=4.059

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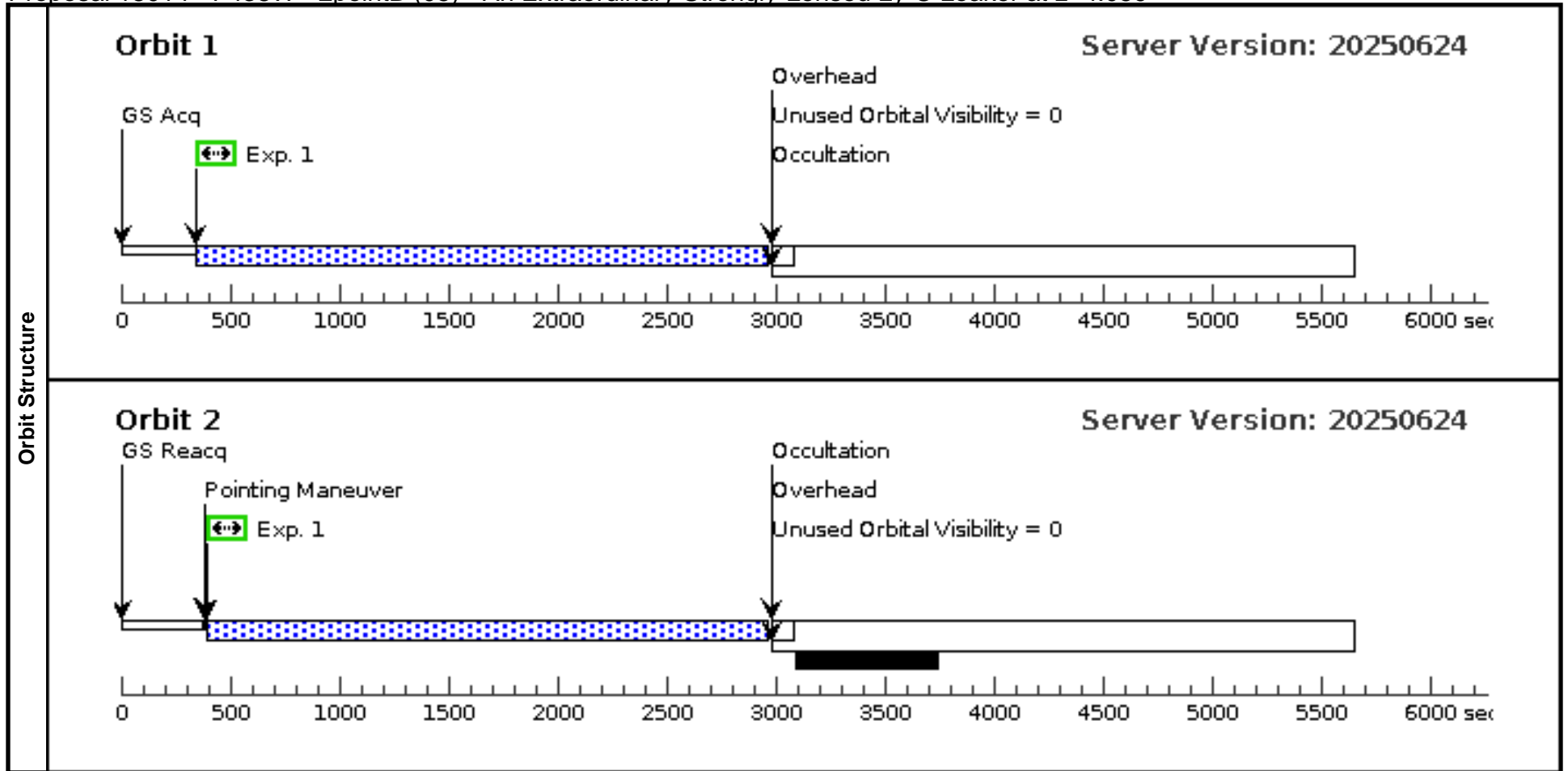
Visit	Proposal 18014, F438W - 2pointA (04), implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
Patterns	#	Primary Pattern	Secondary Pattern	Exposures						
	(2)	Pattern Type=WFC3-UVIS-DITHER- LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing= Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)						
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(2)	COOLJ1402-2809-OFFSETA	RA: 14 02 23.6160 (210.5984000d) Dec: -28 09 35.44 (-28.15984d) Equinox: J2000		V=22.3	Reference Frame: ICRS				
<i>Comments:</i> Category=GALAXY Description=[GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY, PROTOGALAXY] Extended=YES										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(2) COOLJ1402-2809-OFFSETA	WFC3/UVIS, ACCUM, UVIS1-FIX	F438W			Pattern 2, Exps 1-1 in F438W - 2pointA (04) (2)	2400 Secs (5170 Secs)	
									[=>2595.0 Secs (Pattern 1)]	[1]
								[=>2575.0 Secs (Pattern 2)]	[2]	



Proposal 18014 - F438W - 2pointB (05) - An Extraordinary Strongly-Lensed Ly-C Leaker at z=4.059

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Visit	Proposal 18014, F438W - 2pointB (05), implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
Patterns	#	Primary Pattern	Secondary Pattern	Exposures						
	(2)	Pattern Type=WFC3-UVIS-DITHER- LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing= Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1)						
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(3)	COOLJ1402-2809-OFFSETB	RA: 14 02 23.6160 (210.5984000d) Dec: -28 09 39.44 (-28.16096d) Equinox: J2000		V=22.3	Reference Frame: ICRS				
<i>Comments:</i> Category=GALAXY Description=[GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY, PROTOGALAXY] Extended=YES										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(3) COOLJ1402-2809-OFFSETB	WFC3/UVIS, ACCUM, UVIS1-FIX	F438W			Pattern 2, Exps 1-1 in F438W - 2pointB (05) (2)	2400 Secs (5170 Secs)	
									[=>2595.0 Secs (Pattern 1)]	[1]
								[=>2575.0 Secs (Pattern 2)]	[2]	



Proposal 18014 - F438W - 3point (06) - An Extraordinary Strongly-Lensed Ly-C Leaker at z=4.059

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Visit	Proposal 18014, F438W - 3point (06), implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(3)	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)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	COOLJ1402-2809	RA: 14 02 23.6160 (210.5984000d) Dec: -28 09 37.44 (-28.16040d) Equinox: J2000		V=22.3	Reference Frame: ICRS				
	<i>Comments:</i> Category=GALAXY Description=[GRAVITATIONAL LENS, HIGH REDSHIFT GALAXY, PROTOGALAXY] Extended=YES									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) COOLJ1402-2809	WFC3/UVIS, ACCUM, UVIS1-FIX	F438W			Pattern 3, Exps 1-1 i	2400 Secs (7745 Secs)	
			9					n F438W - 3point (0	[==>2595.0 Secs (Pattern 1)]	[1]
								6) (3)	[==>2575.0 Secs (Pattern 2)]	[2]
								[==>2575.0 Secs (Pattern 3)]	[3]	

