



16506 - Imaging the sites of star formation at sub-kiloparsec scales in the Epoch of Reionization

Cycle: 28, Proposal Category: GO
(Availability Mode: SUPPORTED)

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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) UVISTA-Z-007	WFC3/IR	2	26-Mar-2021 14:09:48.0	yes
02	(2) UVISTA-Z-019	WFC3/IR	2	26-Mar-2021 14:09:49.0	yes

4 Total Orbits Used

ABSTRACT

We propose to acquire HST/WFC3 imaging of two galaxies at $z \sim 7$ recently detected by ALMA in [CII] 158 micron and [OIII] 88 micron emission at high angular resolution. The [OIII] emission, corresponding to diffuse, highly-ionized gas, and [CII] emission, tracing neutral gas, allow some of the first explorations of the interstellar medium in the Epoch of Reionization (EoR). Combined, they suggest we are witnessing intense star formation which locally shows extreme [OIII]/[CII] luminosity ratios that are indicative of 'leaking' ionizing radiation and hence may be of great importance to Reionization. Other regions in these galaxies, however, might be more metal-enriched and obscured by dust, as indicated by ALMA measurements of the dust continuum. To conclusively shed light on the key processes affecting star formation in the EoR, we propose to obtain deep HST images of the rest-frame UV (both a $\sim 5x$ improvement in limiting flux and angular resolution over existing, ground-based imaging). We will measure accurate sizes of star-forming clumps on sub-kiloparsec scales, study possible ongoing mergers, and compare the UV morphology with spatially resolved maps of dust continuum and physical parameters such as the ionization parameter extracted from the [CII] and [OIII] observations. These comparisons will give insight into the physical conditions of both UV-bright star-forming clumps and dust-obscured star-forming regions. Combined with a larger sample including three other galaxies, this data will paint a physically motivated picture of star formation in the EoR in time for science exploration with JWST.

OBSERVING DESCRIPTION

We propose IR imaging with the F140W filter of WFC3 of two sources, UVISTA-Z-007 and UVISTA-Z-019, both with spectroscopically confirmed redshifts of $z = 6.75$, for a total of 4 orbits. HST imaging is required for an accurate comparison between the spatial extent of the rest-frame UV emission with that of [OIII] 88 micron, imaged by ALMA at a resolution of $0.4''-0.5''$ (existing ground-based IR imaging only reaches an angular resolution of $0.7''$ at best).

In order to properly resolve the spatial substructure of the rest-frame UV - that is, obtain a robust size measurement and have sufficient sensitivity for fainter galaxy fragments that could indicate dust-obscured star formation or a merger - we require a signal-to-noise ratio of 5 for the faint UV structures with typical surface brightness of 25 mag/arcsec^2 (see e.g. Bowler et al. 2017 for galaxies at $z \sim 7$ with similar brightness).

With an estimated orbital visibility of 52 minutes (3120 s) per orbit for both targets, or about 41.5 minutes (2490 s) after subtracting overhead time for 4 individual science exposures per target, we have inferred each target will require 2 orbits of observing time to reach this signal-to-noise

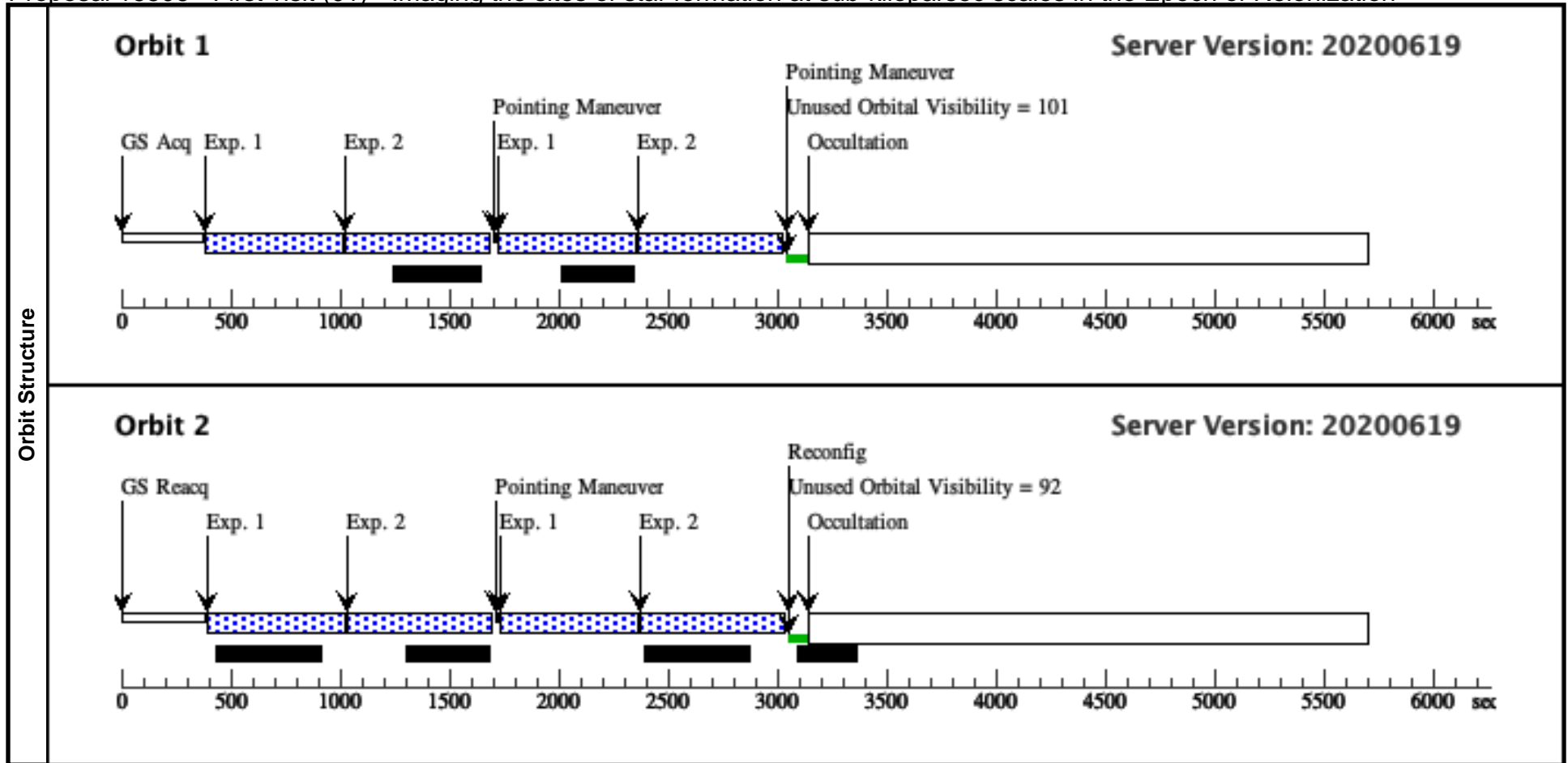
threshold. We divide each orbit into 4 exposures, which will allow to perform a box dithering pattern to improve PSF sampling, and to remove bad pixels, cosmic ray impacts, and detector artefacts. We use the SPARS50 sampling sequence with NSAMP=13 and NSAMP=14 in two subsequent orbits for both targets (similar to Bowler et al. 2017).

In the event HST will operate in reduced-gyro mode, these observations will be impacted by having a shorter exposure time and therefore signal to noise.

Proposal 16506 - First visit (01) - Imaging the sites of star formation at sub-kiloparsec scales in the Epoch of Reionization

Fri Mar 26 18:09:50 GMT 2021

Visit	Proposal 16506, First visit (01) 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					(1-2)		
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections			Fluxes	Miscellaneous			
	(1)	UVISTA-Z-007	RA: 09 58 46.2100 (149.6925417d) Dec: +02 28 45.80 (2.47939d) Equinox: J2000				V=(?) J-band: 24.5 +/- 0.1	Reference Frame: ICRS			
	<i>Comments:</i> Category=GALAXY Description=[HIGH REDSHIFT GALAXY, STAR FORMING REGION]										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit
	1		(1) UVISTA-Z-007	WFC3/IR, MULTIACCUM, IR	F140W	NSAMP=13;		Pattern 1, Exps 1-2 in First visit (01) (1)	602.937703 Secs (2411.751 Secs)		
						SAMP-SEQ=SPAR			[=>(Pattern 1)]		[1]
						S50			[=>(Pattern 2)]		[2]
	2		(1) UVISTA-Z-007	WFC3/IR, MULTIACCUM, IR	F140W	NSAMP=14;		Pattern 1, Exps 1-2 in First visit (01) (1)	652.938154 Secs (2611.753 Secs)		
						SAMP-SEQ=SPAR			[=>(Pattern 1)]		[1]
						S50			[=>(Pattern 2)]		[2]
									[=>(Pattern 3)]		
									[=>(Pattern 4)]		



Proposal 16506 - Second visit (02) - Imaging the sites of star formation at sub-kiloparsec scales in the Epoch of Reionization

Fri Mar 26 18:09:50 GMT 2021

Visit	Proposal 16506, Second visit (02) 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					(1-2)		
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous		
	(2)	UVISTA-Z-019	RA: 10 00 29.8900 (150.1245417d) Dec: +01 46 46.40 (1.77956d) Equinox: J2000				V=(?) J-band: 25.1 +/- 0.2	Reference Frame: ICRS			
	<i>Comments:</i> Category=GALAXY Description=[HIGH REDSHIFT GALAXY, STAR FORMING REGION]										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit
	1		(2) UVISTA-Z-019	WFC3/IR, MULTIACCUM, IR	F140W	NSAMP=14;		Pattern 1, Exps 1-2 in Second visit (02) (1)	652.938154 Secs (2611.753 Secs)		
						SAMP-SEQ=SPAR			[==>(Pattern 1)]		[1]
						S50			[==>(Pattern 2)]		[2]
									[==>(Pattern 3)]		
									[==>(Pattern 4)]		
2		(2) UVISTA-Z-019	WFC3/IR, MULTIACCUM, IR	F140W		NSAMP=13;		Pattern 1, Exps 1-2 in Second visit (02) (1)	602.937703 Secs (2411.751 Secs)		
						SAMP-SEQ=SPAR			[==>(Pattern 1)]		[1]
						S50			[==>(Pattern 2)]		[2]
									[==>(Pattern 3)]		
									[==>(Pattern 4)]		

