



14876 - Spectacular mergers at the cosmic dawn: a HST, ALMA, and JWST synergy

Cycle: 24, Proposal Category: GO

(JWST Initiative)

(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) P231-20	WFC3/IR	1	14-Dec-2016 21:02:06.0	yes
02	(2) P167-13	WFC3/IR	1	14-Dec-2016 21:02:07.0	yes
03	(3) P308-21	WFC3/IR	1	14-Dec-2016 21:02:08.0	yes
04	(4) J0842+1218	WFC3/IR	1	14-Dec-2016 21:02:09.0	yes
05	(5) J2100-1715	WFC3/IR	1	14-Dec-2016 21:02:10.0	yes
06	(6) J2211-3206	WFC3/IR	1	14-Dec-2016 21:02:10.0	yes

6 Total Orbits Used

ABSTRACT

How did the first massive galaxies in the universe form? Theoretical models predict that these form through mergers of gas-rich galaxies at very high-redshifts. These models are often invoked to explain the existence of massive `red and dead` galaxies by $z \sim 2$. We have unexpectedly identified a sample of six $z > 6$ QSOs with close, gas-rich companions at the same redshifts through our on-going ALMA survey of [CII] and dust emission in QSO host galaxies. This is the first unambiguous direct observational evidence of gravitational interactions within the first Gyr of the universe, supporting the aforementioned theoretical models. These newly discovered QSO-galaxy pairs are a unique sample to demonstrate key capabilities of JWST in early science, such as the multi-object and IFU modes of NIRSpec. Remarkably, three of these systems are separated by less than 10 kpc (< 2 arcsec), which makes them prime targets to exploit the unparalleled IFU capabilities of JWST/NIRSpec in early science. Such observations will allow us to map the morphology and kinematics of these gravitational interactions as function of separation from the QSOs, which will enlighten our understanding of early black hole and galaxy growth. Thus, it is of critical importance to characterize the rest-frame UV/optical properties of these companions before the JWST launch. Here we propose deep WFC3/IR F140W observations to set the first firm constraints on their rest-frame UV properties, which can only be achieved by the sensitivity and resolution of HST. These timely HST observations will be essential to enable a plethora of JWST early science programs.

OBSERVING DESCRIPTION

We aim to characterize the rest-frame UV properties of six faint ($J > 26$) $z > 6$ galaxies very close (< 11 arcsec) to bright ($J < 21$) QSOs at the same redshift.

Proposal 14876 (STScI Edit Number: 0, Created: Wednesday, December 14, 2016 9:02:11 PM EST) - Overview

We will image each field for one orbit with WFC3/IR F140W to achieve an AB magnitude of ~ 27 at 5-sigma. These observations will allow us to clearly distinguish between blue, star-forming galaxies and red, obscured galaxies for the whole sample, providing clues to understand the general properties of these newly discovered sources in a statistical manner.

We will use the default 4-step box dither pattern (WFC3-IR-DITHER-BOX-MIN) since 1) it gives adequate subpixel sampling to reconstruct nyquist-sampled (2pix/FWHM) images, and 2) it is a commonly-used pattern, which facilitates finding a PSF reference with the same sampling for PSF subtraction purposes. We decided to increase the dither steps to avoid possible self-persistence issues due to the bright quasars.

We have restricted the orientations for P167-13 to avoid contamination from diffraction spikes from bright stars close to our target.

Proposal 14876 - P231-20 (01) - Spectacular mergers at the cosmic dawn: a HST, ALMA, and JWST synergy

Thu Dec 15 02:02:11 GMT 2016

Visit	Proposal 14876, P231-20 (01)										Thu Dec 15 02:02:11 GMT 2016	
	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=4.004 Line Spacing=4.015				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)	P231-20	RA: 15 26 37.8410 (231.6576708d) Dec: -20 50 0.66 (-20.83352d) Equinox: J2000		Redshift: 6.5855		V=35+/-1 expected J>26		Reference Frame: ICRS			
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit	
	1		(1) P231-20	WFC3/IR, MULTIACCUM, IR	F140W	NSAMP=14; SAMP-SEQ=SPAR S50		Pattern 1, Exps 1-1 in P231-20 (01) (1)	652.938154 Secs (2611.753 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)]		[1]	
Orbit Structure	Orbit 1											Server Version: 20160601

Proposal 14876 - P167-13 (02) - Spectacular mergers at the cosmic dawn: a HST, ALMA, and JWST synergy

Thu Dec 15 02:02:11 GMT 2016

Visit	Proposal 14876, P167-13 (02)										Thu Dec 15 02:02:11 GMT 2016	
	Diagnostic Status: No Diagnostics											
	Scientific Instruments: WFC3/IR											
	Special Requirements: ORIENT 340D TO 10 D; ORIENT 250D TO 290 D; ORIENT 160D TO 190 D; ORIENT 70D TO 100 D											
Patterns	#	Primary Pattern				Secondary Pattern				Exposures		
	(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=4.004 Line Spacing=4.015				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			
	(2)	P167-13	RA: 11 10 33.9760 (167.6415667d) Dec: -13 29 45.60 (-13.49600d) Equinox: J2000		Redshift: 6.5152		V=35+/-1 expected J>26		Reference Frame: ICRS			
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit	
	1		(2) P167-13	WFC3/IR, MULTIACCUM, IR	F140W	NSAMP=14; SAMP-SEQ=SPAR S50		Pattern 1, Exps 1-1 in P167-13 (02) (1)	652.938154 Secs (2611.753 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)]		[1]	
Orbit Structure	Orbit 1											Server Version: 20160601

Proposal 14876 - P308-21 (03) - Spectacular mergers at the cosmic dawn: a HST, ALMA, and JWST synergy

Thu Dec 15 02:02:11 GMT 2016

Visit	Proposal 14876, P308-21 (03)										Thu Dec 15 02:02:11 GMT 2016	
	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=4.004 Line Spacing=4.015				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			
	(3)	P308-21	RA: 20 32 9.9960 (308.0416500d) Dec: -21 14 2.31 (-21.23397d) Equinox: J2000		Redshift: 6.2430		V=35+/-1 expected J>26		Reference Frame: ICRS			
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit	
	1		(3) P308-21	WFC3/IR, MULTIACCUM, IR	F140W	NSAMP=14; SAMP-SEQ=SPAR S50		Pattern 1, Exps 1-1 in P308-21 (03) (1)	652.938154 Secs (2611.753 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)]		[1]	
Orbit Structure	Orbit 1											Server Version: 20160601

Proposal 14876 - J0842+1218 (04) - Spectacular mergers at the cosmic dawn: a HST, ALMA, and JWST synergy

Visit	Proposal 14876, J0842+1218 (04)										Thu Dec 15 02:02:11 GMT 2016	
	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=4.004 Line Spacing=4.015				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			
	(4)	J0842+1218	RA: 08 42 29.4290 (130.6226208d) Dec: +12 18 50.50 (12.31403d) Equinox: J2000		Redshift: 6.0758		V=35+/-1 expected J>26		Reference Frame: ICRS			
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit	
	1		(4) J0842+1218	WFC3/IR, MULTIACCUM, IR	F140W	NSAMP=14; SAMP-SEQ=SPAR S50		Pattern 1, Exps 1-1 in J0842+1218 (04) (1)	652.938154 Secs (2611.753 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]		[1]	
Orbit Structure	Orbit 1											Server Version: 20160601
	The diagram illustrates the timeline for Orbit 1, spanning from 0 to 5500 seconds. Key events are marked with arrows: GS Acq (at ~100s), Exp. 1 (at ~400s), Pointing Maneuver (at ~1000s), Exp. 1 (at ~1700s), Pointing Maneuver (at ~2400s), Exp. 1 (at ~3100s), Pointing Maneuver (at ~3800s), Reconfig (at ~4500s), and Occultation (at ~5200s). A blue checkered bar highlights the period from approximately 400s to 3800s, representing the main observation window. Below the timeline, black bars indicate periods of unused orbital visibility.											

Proposal 14876 - J2100-1715 (05) - Spectacular mergers at the cosmic dawn: a HST, ALMA, and JWST synergy

Visit	Proposal 14876, J2100-1715 (05)										Thu Dec 15 02:02:11 GMT 2016	
	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=4.004 Line Spacing=4.015				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			
	(5)	J2100-1715	RA: 21 00 54.6160 (315.2275667d) Dec: -17 15 22.50 (-17.25625d) Equinox: J2000		Redshift: 6.0870		V=35+/-1 expected J>26		Reference Frame: ICRS			
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit	
	1		(5) J2100-1715	WFC3/IR, MULTIACCUM, IR	F140W	NSAMP=14; SAMP-SEQ=SPAR S50		Pattern 1, Exps 1-1 in J2100-1715 (05) (1)	652.938154 Secs (2611.753 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]		[1]	
Orbit Structure	Orbit 1											Server Version: 20160601

Proposal 14876 - J2211-3206 (06) - Spectacular mergers at the cosmic dawn: a HST, ALMA, and JWST synergy

Visit	Proposal 14876, J2211-3206 (06)										Thu Dec 15 02:02:11 GMT 2016	
	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=4.004 Line Spacing=4.015				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			
	(6)	J2211-3206	RA: 22 11 12.3910 (332.8016292d) Dec: -32 06 12.94 (-32.10359d) Equinox: J2000		Redshift: 6.3360		V=35+/-1 expected J>26		Reference Frame: ICRS			
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit	
	1		(6) J2211-3206	WFC3/IR, MULTIACCUM, IR	F140W	NSAMP=14; SAMP-SEQ=SPAR S50		Pattern 1, Exps 1-1 in J2211-3206 (06) (1)	652.938154 Secs (2611.753 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]		[1]	
Orbit Structure	Orbit 1											Server Version: 20160601
	GS AcqExp. 1 Pointing Maneuver Exp. 1 Pointing Maneuver Exp. 1 Pointing Maneuver Exp. 1 Reconfig Unused Orbital Visibility = 57 Occultation 0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 sec											