16513 - The resolved PAH properties at low metallicity

Cycle: 28, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) IC-1613	WFC3/UVIS	3	25-Oct-2022 13:00:14.0	yes
02	(1) IC-1613	WFC3/UVIS	1	25-Oct-2022 13:00:16.0	yes
03	(1) IC-1613	WFC3/UVIS	1	25-Oct-2022 13:00:16.0	yes

5 Total Orbits Used

ABSTRACT

The NIR-MIR SED of galaxies is dominated by spectral features from polycyclic aromatic hydrocarbon (PAH) molecules fluorescing in regions illuminated by FUV photons. In low metallicity systems (Z < 0.2 Zo), previous studies with Spitzer have revealed a substantial deficiency in the

emission and abundance of PAHs, the origin of which remains unexplained due to the lack of deep, resolved, multi-band photometry or spectroscopy. We will obtain NIRCam and MIRI imaging to observe the 3.3, 7.7, and 11.3 micron PAH features in dusty star-forming regions in two low metallicity galaxies, IC 1613 (15% solar) and Sextans A (8% solar). Additionally, we will obtain HST/WFC3 imaging with F275W, F336W, F475W, and F814W to complement the JWST observations. The HST observations will allow us to derive extinction maps, which will be used to normalize the PAH abundance to that of big grains. To obtain the extinction maps, we will fit the NUV-NIR SED of thousands of stars in the HST and JWST images with the BEAST code (Gordon+2016) in order to constrain the stellar mass, age and dust extinction (A_V) toward each sight-line. A_V measurements toward individual stars will be combined on the sky to produce the extinction maps.

The observations will allow us to 1) estimate the PAH properties, particularly their abundance, ionized fraction, and size distribution; and 2) correlate those properties with other tracers of the ISM, such as the star formation rate density, the distance and UV spectrum of massive stars, the distance to PAH-producing stellar sources, the ISM column density of gas and dust, and gas-phase abundances. By observing how the PAH properties and abundance vary with environment, we will constrain the mechanisms responsible for the formation, destruction, excitation, and low abundance of PAHs in those poorly shielded low metallicity environments. Since JWST will measure star formation rates as low as 10 Mo/yr from PAH emission at the peak of cosmic star formation at redshift z~2 when the average metallicity of the universe was about 10% solar, it is crucial that we deepen our physical understanding of PAHs at low metallicity.

OBSERVING DESCRIPTION

This program will obtain WFC3/UVIS imaging of the dusty star-forming regions in IC 1613 (15% solar) in order to map extinction. The filters (F275W, F336W, F475W, F814W) were selected to
cover the NUV-optical stellar + dust SEDs so as to disentangle stellar mass from reddening. This program is designed to support JWST GO-2391 (a joint JWST-HST program). The HST NUV-optical imaging will complement the NIRCam and MIRI imaging.

We will obtain single fields centered on the dustiest star-forming regions where PAH emission was previously detected with Spitzer. We will use the WFC3-UVIS-GAP-LINE dither to cover the chip gap for the most sensitive filters for which we are getting 2 exposures (F475W, F814W). We do not expect saturation in those filters. We will use a custom box dither pattern (a hydrid pattern covering the gap and providing sub-pixel sampling) for the less sensitive filters that require 4 exposures (F275W, F336W). The parameters of the custom dither pattern are explained in the associated comments.

Exposure times were computed to reach a S/N of 10 for A5 stars with A_V = 1.

Visit

Proposal 16513, Visit 01, failed Tue Oct 25 17:00:17 GMT 2022

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

(Exposure 3 (Pattern 1, Exps 3-3 in Visit 01)) Warning (Form): FLASH level may be too low for this exposure or a short subexposure. See extended explanation in the diagnostic browser

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-GAP-LINE Purpose=MOSAIC Number Of Points=2 Point Spacing=2.414 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.759 Angle Between Sides= Center Pattern=true		(2), (3)
(2)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=2.414 Line Spacing=0.1448	Coordinate Frame=POS-TARG Pattern Orientation=85.759 Angle Between Sides=38.92 Center Pattern=false		(4), (5)

Fixed Targets

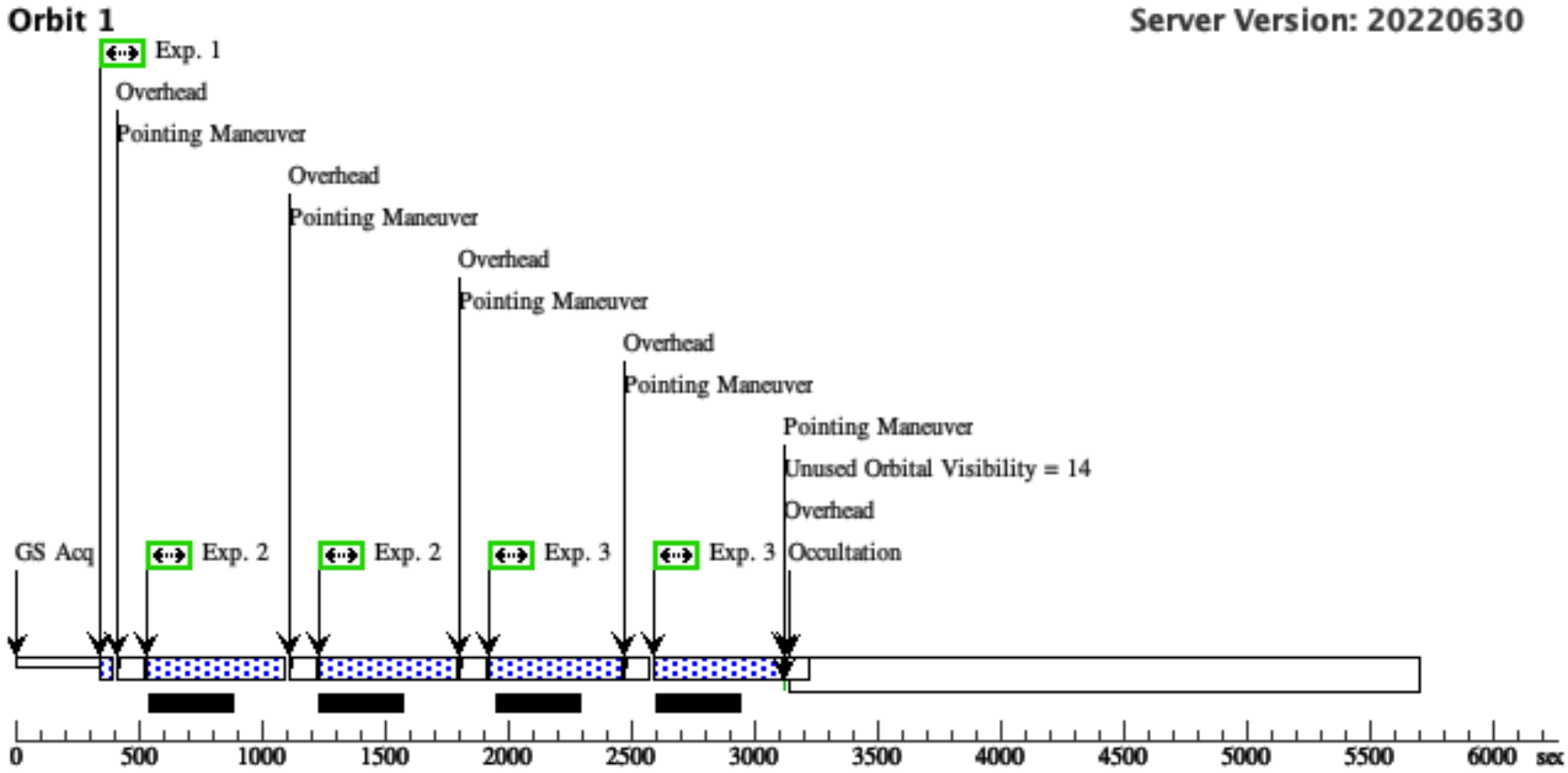
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	IC-1613	RA: 01 05 0.9264 (16.2538600d) Dec: +02 09 16.21 (2.15450d) Equinox: J2000		V=9.9	Reference Frame: ICRS

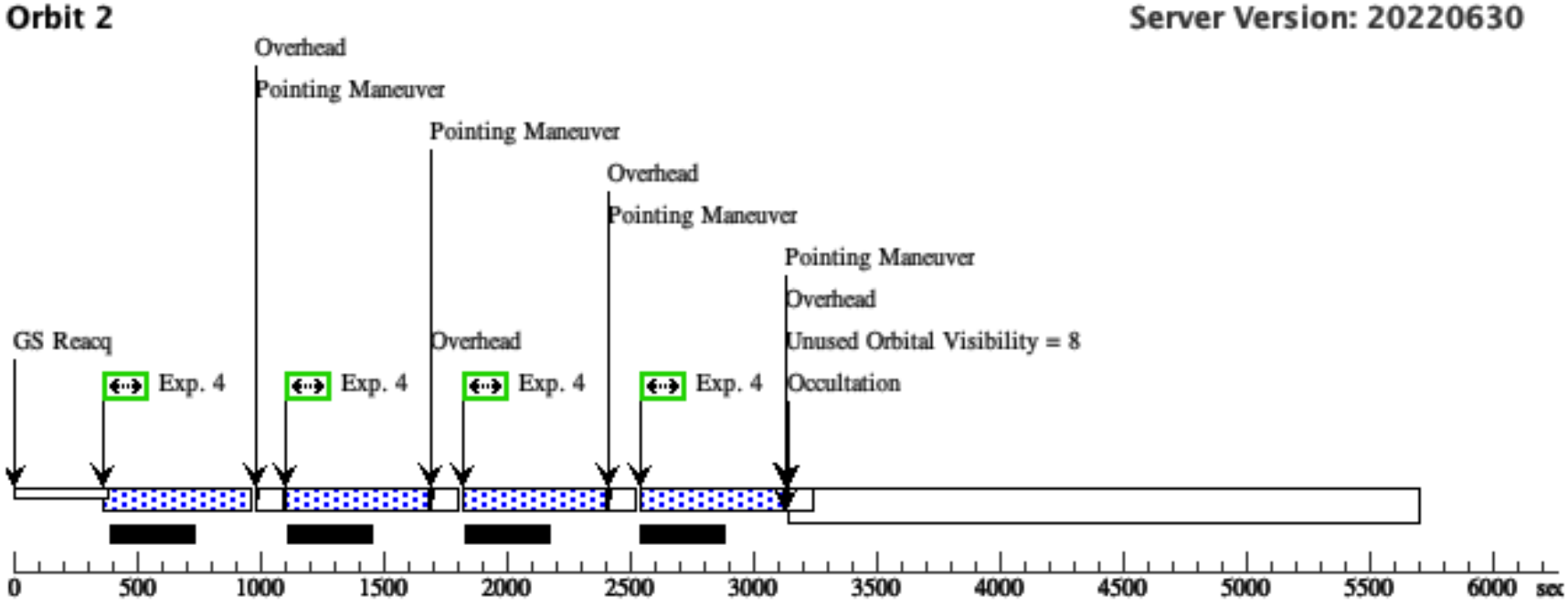
Comments:
Category=GALAXY
Description=[MAGELLANIC IRREGULAR, STAR FORMING REGION]
Extended=YES

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1534117)	(1) IC-1613	WFC3/UVIS, ACCUM, UVIS	F475W	FLASH=19			20 Secs (20 Secs)	
								[==>]	***[1]***
2	(1534127)	(1) IC-1613	WFC3/UVIS, ACCUM, UVIS	F475W	FLASH=6		Pattern 1, Exps 2-2 in Visit 01 (1)	560 Secs (1120 Secs)	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***
3		(1) IC-1613	WFC3/UVIS, ACCUM, UVIS	F814W	FLASH=2		Pattern 1, Exps 3-3 in Visit 01 (1)	520 Secs (1040 Secs)	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***
4	(1534118)	(1) IC-1613	WFC3/UVIS, ACCUM, UVIS	F275W	FLASH=18		Pattern 2, Exps 4-4 in Visit 01 (2)	580 Secs (2320 Secs)	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
5	(1534131)	(1) IC-1613	WFC3/UVIS, ACCUM, UVIS	F336W	FLASH=18		Pattern 2, Exps 5-5 in Visit 01 (2)	580 Secs (2320 Secs)	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[3]***

Orbit Structure

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Server Version: 20220630
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Overhead
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Pointing Maneuver
Overhead
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GS Reacq
Overhead
Occultation
Exp. 4
Exp. 4
Exp. 4
Exp. 4
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3500
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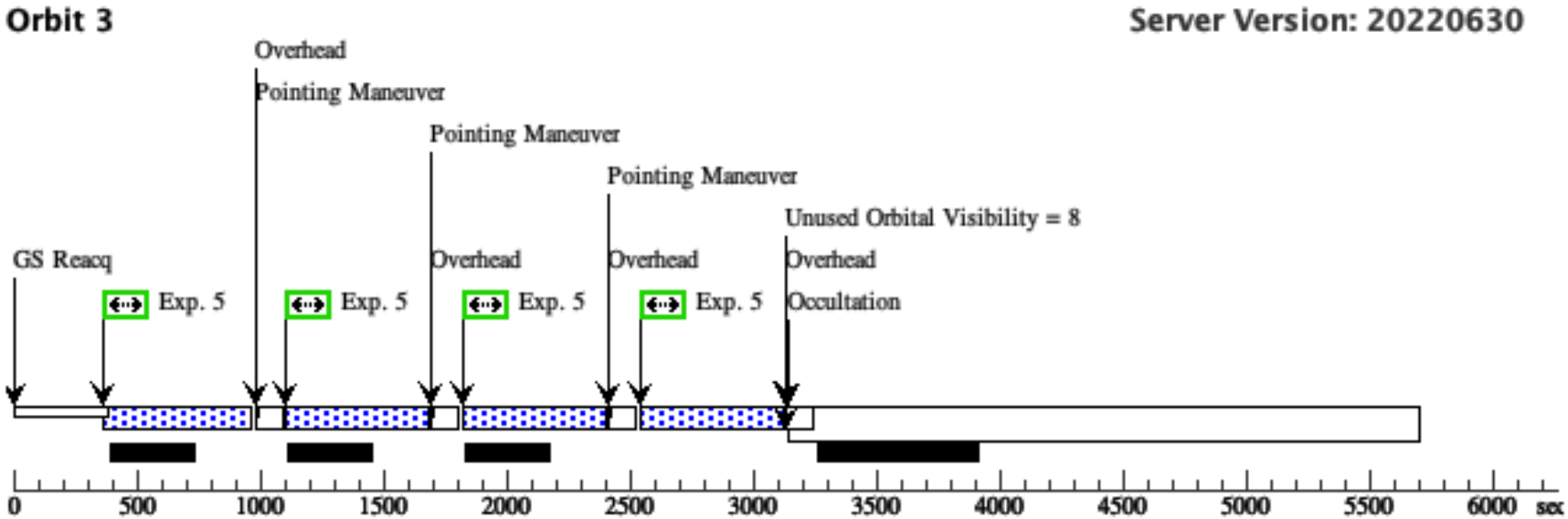
6000
sec


Orbit 3
Server Version: 20220630
Overhead
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Unused Orbital Visibility = 8
GS Reacq
Overhead
Overhead
Overhead
Occultation
Exp. 5
Exp. 5
Exp. 5
Exp. 5
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500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 16513, Visit 02, failed Tue Oct 25 17:00:17 GMT 2022

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-GAP-LINE	Coordinate Frame=POS-TARG		(2), (3)
	Purpose=MOSAIC	Pattern Orientation=85.759		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=2.414	Center Pattern=true		
	Line Spacing=			

Fixed Targets

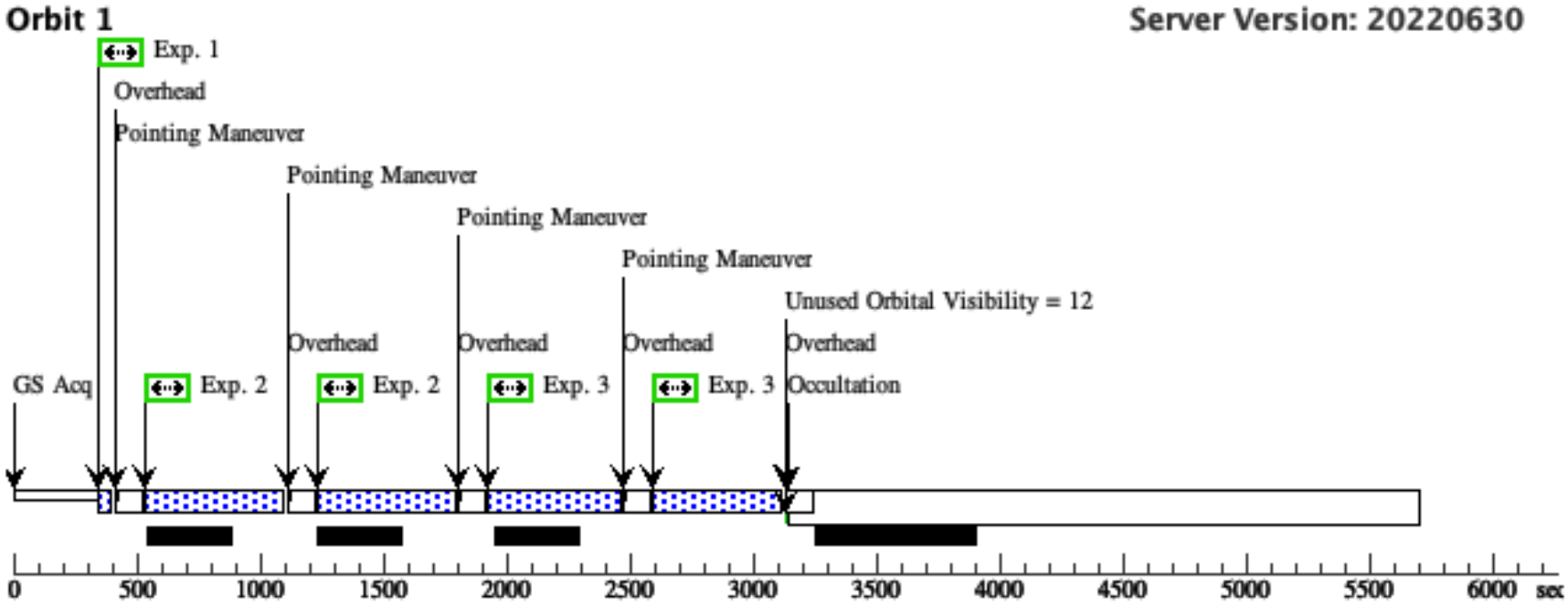
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	IC-1613	RA: 01 05 0.9264 (16.2538600d) Dec: +02 09 16.21 (2.15450d) Equinox: J2000		V=9.9	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[MAGELLANIC IRREGULAR, STAR FORMING REGION]
Extended=YES

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1534117)	(1) IC-1613	WFC3/UVIS, ACCUM, UVIS	F475W	FLASH=19			20 Secs (20 Secs)	
								[==>]	***[1]***
2	(1534127)	(1) IC-1613	WFC3/UVIS, ACCUM, UVIS	F475W	FLASH=6		Pattern 1, Exps 2-2 in Visit 02 (1)	560 Secs (1120 Secs)	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***
3		(1) IC-1613	WFC3/UVIS, ACCUM, UVIS	F814W	FLASH=7		Pattern 1, Exps 3-3 in Visit 02 (1)	520 Secs (1040 Secs)	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 16513, Visit 03 Tue Oct 25 17:00:17 GMT 2022

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-GAP-LINE	Coordinate Frame=POS-TARG		(2), (3)
	Purpose=MOSAIC	Pattern Orientation=85.759		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=2.414	Center Pattern=true		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	IC-1613	RA: 01 05 0.9264 (16.2538600d) Dec: +02 09 16.21 (2.15450d) Equinox: J2000		V=9.9	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[MAGELLANIC IRREGULAR, STAR FORMING REGION]
Extended=YES

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1534117)	(1) IC-1613	WFC3/UVIS, ACCUM, UVIS	F475W	FLASH=19			20 Secs (20 Secs)	
								[==>]	***[1]***
2	(1534127)	(1) IC-1613	WFC3/UVIS, ACCUM, UVIS	F475W	FLASH=6		Pattern 1, Exps 2-2 in Visit 03 (1)	560 Secs (1120 Secs)	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***
3		(1) IC-1613	WFC3/UVIS, ACCUM, UVIS	F814W	FLASH=7		Pattern 1, Exps 3-3 in Visit 03 (1)	520 Secs (1040 Secs)	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***

Orbit Structure