15878 - Uncovering the birthplace of FRBs

Cycle: 27, Proposal Category: GO

(UV Initiative)

(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) FRB180924	WFC3/UVIS	1	22-Aug-2019 13:01:18.0	yes
02	(1) FRB180924	WFC3/IR	1	22-Aug-2019 13:01:20.0	yes
03	(2) FRB190102	WFC3/UVIS	1	22-Aug-2019 13:01:20.0	yes
04	(2) FRB190102	WFC3/IR	1	22-Aug-2019 13:01:21.0	yes
05	(3) FRB190608	WFC3/UVIS	1	22-Aug-2019 13:01:22.0	yes
06	(3) FRB190608	WFC3/IR	1	22-Aug-2019 13:01:23.0	yes

6 Total Orbits Used

ABSTRACT

Fast Radio Bursts (FRBs) are an enigmatic class of extragalactic object, whose study so far has been almost exclusively the domain of radio telescopes due to the inability to localize them to better than a few arcminutes. We propose to use HST to spatially resolve the morphology and distribution of star formation and stellar mass for the host galaxies of the first three non-repeating FRBs ever localized to <1" accuracy by the Australian SKA Pathfinder telescope. Analogous to previous advances with gamma-ray bursts, supernovae, and gravitational-wave counterparts, we will explore the origin of these FRBs through detailed examination of their host galaxies. By contrast with the dwarf galaxy host of the unusual repeating FRB 121102, our complementary ground-based observations have shown these non-repeating FRBs to lie in the outskirts of early-type galaxies having low star formation rates. However only HST offers the spatial resolution necessary to match the precision of the radio localizations in the ultraviolet through near-infrared that is required to properly characterize their environment, and thereby shed light on the nature of their progenitor objects.

OBSERVING DESCRIPTION

This program images three newly discovered FRB host galaxies to measure the distributions of the star formation and mass using WFC3 UVIS and IR. The sources are all moderately luminous galaxies at redshifts <0.5, enabling the observations in a single orbit per filter. The FUV and NUV will be sampled by the WFC3/UVIS F300X filter. This filter is the broadest FUV/NUV filter available on HST enabling us to trace recent star formation via young stars. This cleanly samples the rest-frame FUV and NUV continuum of our galaxies and provides the highest throughput possible for morphological measurements. The NIR will be sampled by the WFC3/IR F160W filter. This is the reddest wide filter available on HST to measure the distribution of the stellar mass as traced by the old stellar populations.

In order to obtain images clean of cosmic rays and image artifacts and sampling the PSF phase, we use a minimum of four dither positions. For the UV measurements we will obtain four exposures, which also ensures no saturation for our bright targets. Given the short exposure times in F300X, this requires us to utilize 8-9e- post-flash to reach 12e- per pixel. To maximize UV throughput and minimize our pixel-based CTE correction, we place the target on chip 2 close to the readout. For the NIR observations, we wish to stay in the linear regime and minimize persistence with our bright targets, and therefore will use SPAR25 with NSAMP of 15 or 14. Since this sets the exposure time per dither position, we end up with 7 dither positions per orbit.

For the WFC3/UVIS exposures we use a dither pattern that is 5 times the standard box pattern to remove residual background patterns and enable sky darks. For the WFC3/IR exposures we use the 7-point wide dither pattern from WFC3 ISR 2016-14 (pg 17) to get a good dither for the pixel phase and artificat mitigation. We multiply those values by 3 to better deal with IR blobs, and self persistence.

We do not place any orient constraints on the program, which makes this easy to schedule. We therefore do not forsee any issues if we have to go to 1 gyro mode. We note that this means that the UV and IR overlap in our area of interest, but depending on the orient they will not overlap significantly in other areas.

Visit

Proposal 15878, FRB180924UV (01), implementation Thu Aug 22 17:01:24 GMT 2019

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=0.865 Line Spacing=0.56	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)

Fixed Targets

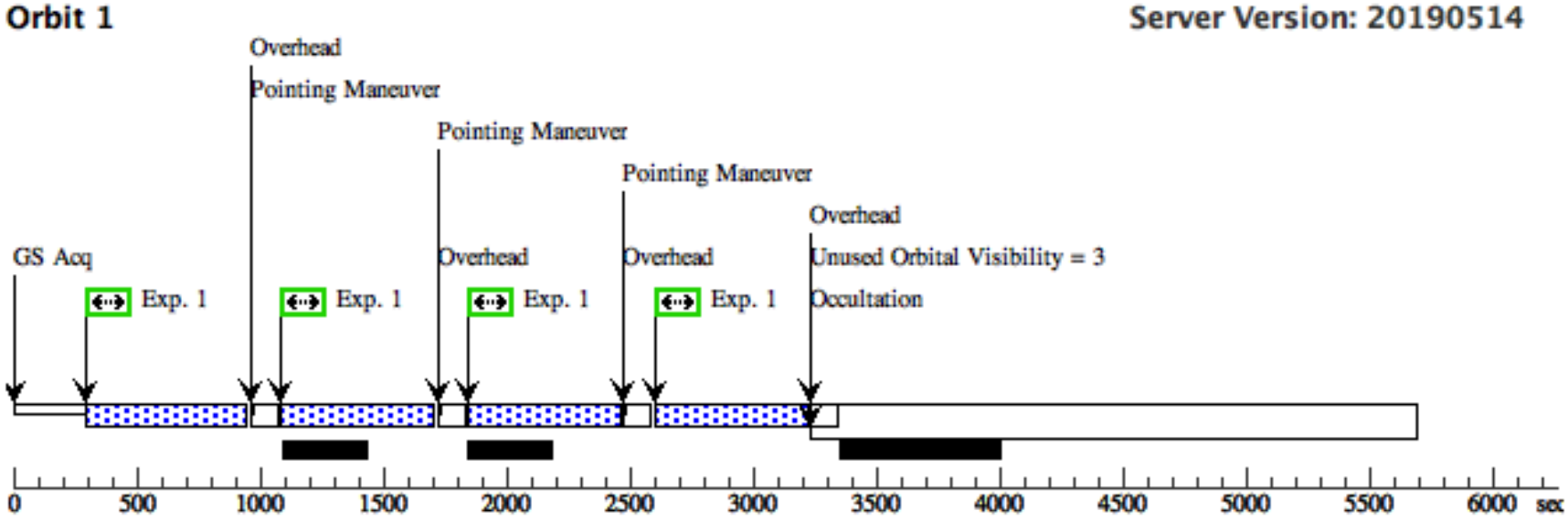
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	FRB180924	RA: 21 44 25.2301 (326.1051254d) Dec: -40 53 59.73 (-40.89992d) Equinox: J2000		V=20.5+/-0.3	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) FRB180924	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F300X	FLASH=9		Pattern 1, Exps 1-1 in FRB180924UV (01) (1)	623 Secs (2492 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***

Orbit Structure



Visit

Proposal 15878, FRB180924IR (02), implementation Thu Aug 22 17:01:24 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: (none)

Fixed Targets

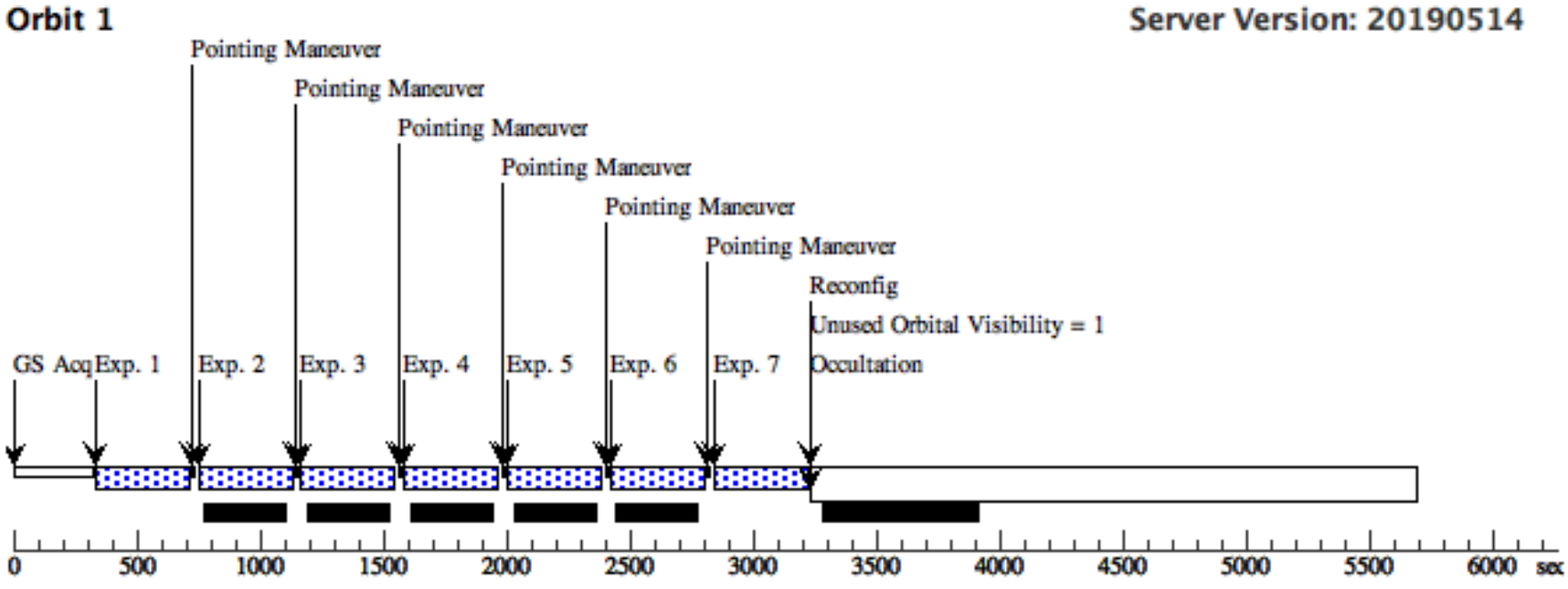
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	FRB180924	RA: 21 44 25.2301 (326.1051254d) Dec: -40 53 59.73 (-40.89992d) Equinox: J2000		V=20.5+/-0.3	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) FRB180924	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25			352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
2		(1) FRB180924	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 2.091,0.162		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
3		(1) FRB180924	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 4.179,0.324		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
4		(1) FRB180924	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 0.174,1.92		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
5		(1) FRB180924	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 2.265,2.082		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
6		(1) FRB180924	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 4.356,1.881		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
7		(1) FRB180924	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 1.164,3.843		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 15878, FRB190102UV (03), implementation Thu Aug 22 17:01:24 GMT 2019

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=0.865 Line Spacing=0.56	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)

Fixed Targets

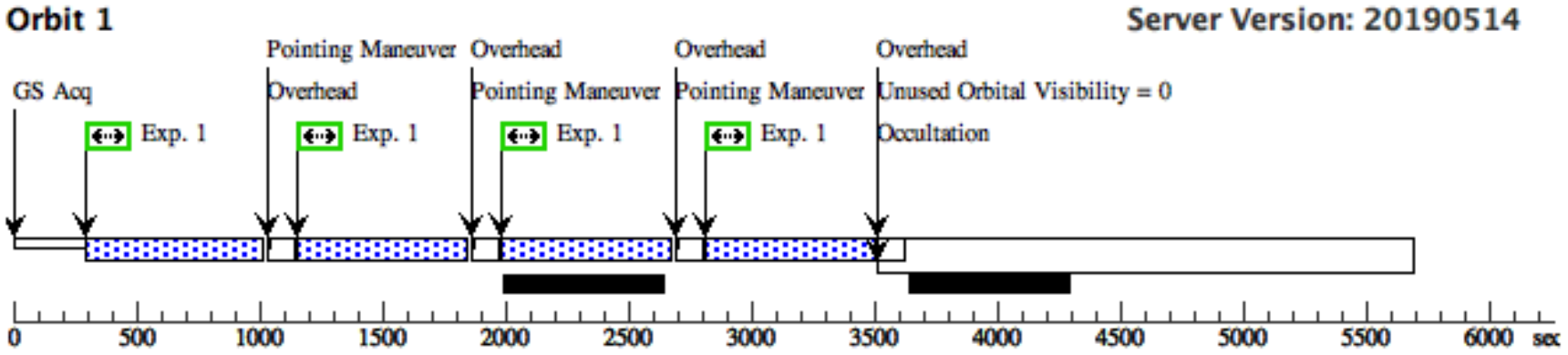
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	FRB190102	RA: 21 29 39.7008 (322.4154200d) Dec: -79 28 32.30 (-79.47564d) Equinox: J2000		V=21.1+/-0.3	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) FRB190102	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F300X	FLASH=8		Pattern 1, Exps 1-1 in FRB190102UV (03) (1)	694 Secs (2776 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	*[1]*

Orbit Structure



Visit

Proposal 15878, FRB190102IR (04), implementation Thu Aug 22 17:01:24 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: (none)

Fixed Targets

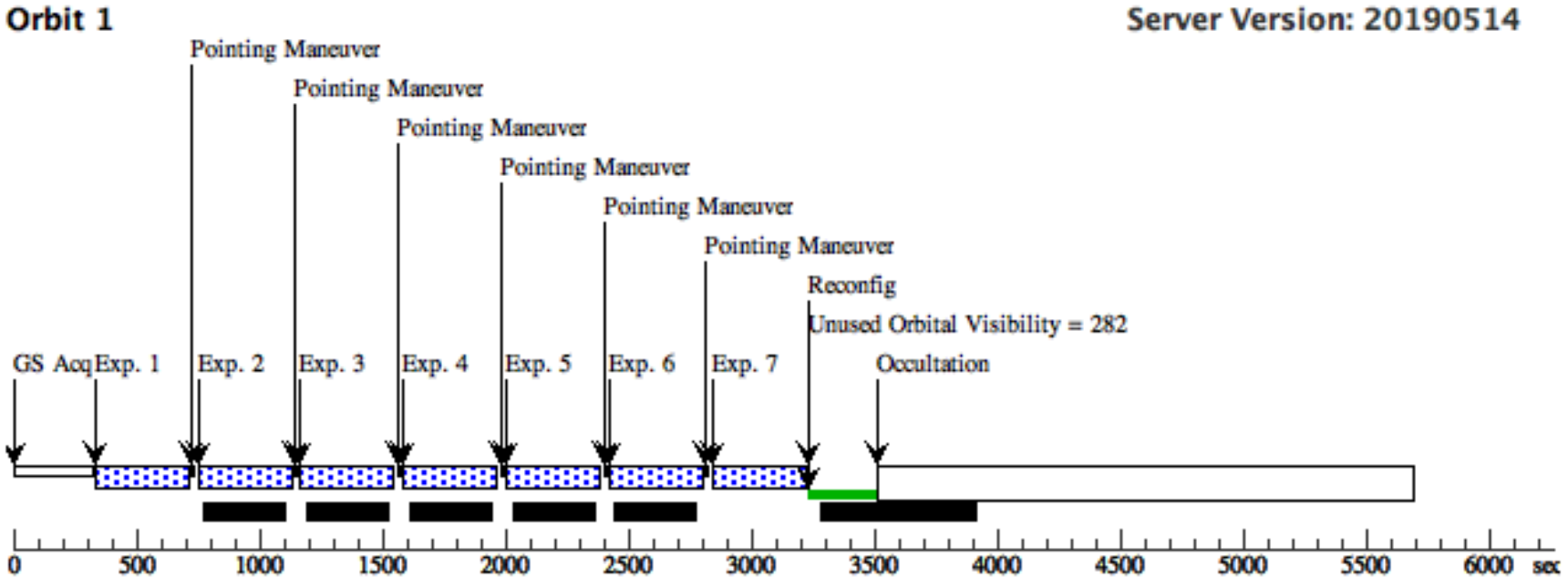
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	FRB190102	RA: 21 29 39.7008 (322.4154200d) Dec: -79 28 32.30 (-79.47564d) Equinox: J2000		V=21.1+/-0.3	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) FRB190102	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25			352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
2		(2) FRB190102	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 2.091,0.162		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
3		(2) FRB190102	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 4.179,0.324		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
4		(2) FRB190102	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 0.174,1.92		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
5		(2) FRB190102	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 2.265,2.082		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
6		(2) FRB190102	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 4.356,1.881		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
7		(2) FRB190102	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 1.164,3.843		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 15878, FRB190608UV (05), implementation Thu Aug 22 17:01:24 GMT 2019

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=0.865 Line Spacing=0.56	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)

Fixed Targets

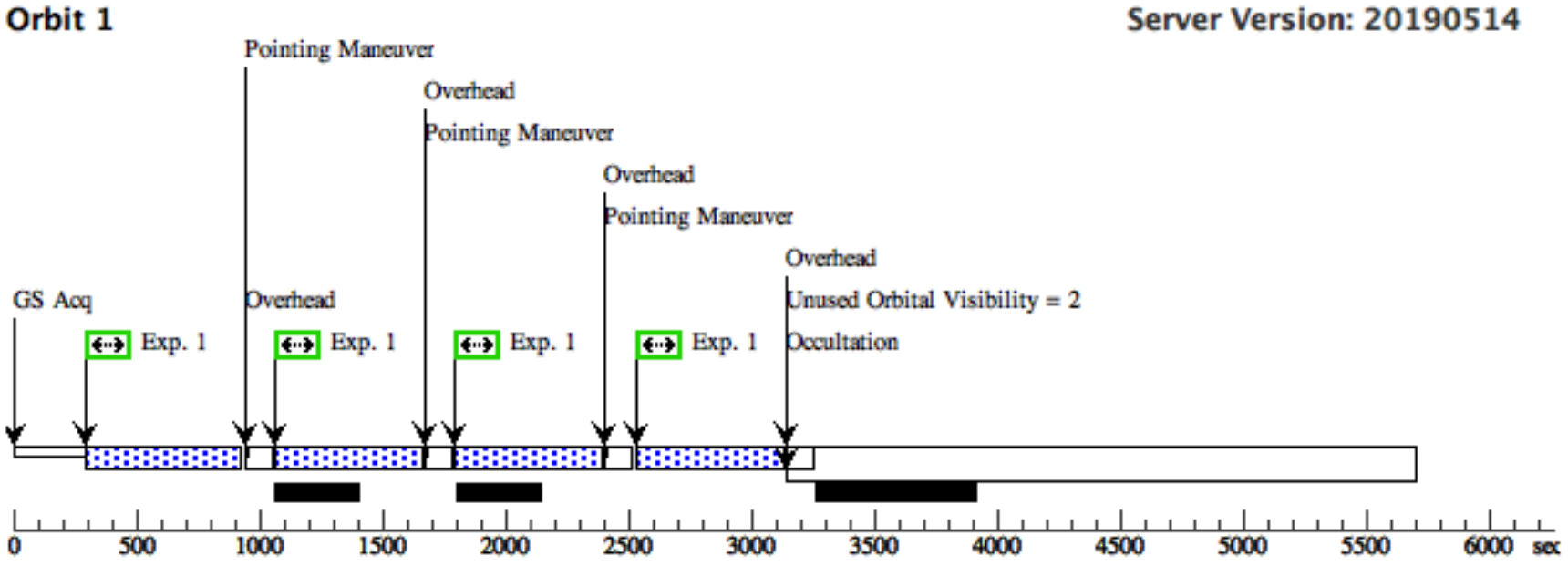
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	FRB190608	RA: 22 16 4.9000 (334.0204167d) Dec: -07 53 56.00 (-7.89889d) Equinox: J2000		V=17.65	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(3) FRB190608	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F300X	FLASH=9		Pattern 1, Exps 1-1 in FRB190608UV (05) (1)	600 Secs (2400 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***

Orbit Structure



Visit

Proposal 15878, FRB190608IR (06), implementation Thu Aug 22 17:01:24 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	FRB190608	RA: 22 16 4.9000 (334.0204167d) Dec: -07 53 56.00 (-7.89889d) Equinox: J2000		V=17.65	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[HIGH REDSHIFT GALAXY]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(3) FRB190608	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=14; SAMP-SEQ=SPARS25			327.938986 Secs (327.939 Secs) *[==>]*	*[1]*
2		(3) FRB190608	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=14; SAMP-SEQ=SPARS25	POS TARG 2.091,0.162		327.938986 Secs (327.939 Secs) *[==>]*	*[1]*
3		(3) FRB190608	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=14; SAMP-SEQ=SPARS25	POS TARG 4.179,0.324		327.938986 Secs (327.939 Secs) *[==>]*	*[1]*
4		(3) FRB190608	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=14; SAMP-SEQ=SPARS25	POS TARG 0.174,1.92		327.938986 Secs (327.939 Secs) *[==>]*	*[1]*
5		(3) FRB190608	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=14; SAMP-SEQ=SPARS25	POS TARG 2.265,2.082		327.938986 Secs (327.939 Secs) *[==>]*	*[1]*
6		(3) FRB190608	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=14; SAMP-SEQ=SPARS25	POS TARG 4.356,1.881		327.938986 Secs (327.939 Secs) *[==>]*	*[1]*
7		(3) FRB190608	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=14; SAMP-SEQ=SPARS25	POS TARG 1.164,3.843		327.938986 Secs (327.939 Secs) *[==>]*	*[1]*

Orbit Structure