16877 - Determining the host sub-structure and local environment characteristics of highly-active FRB 20201124A

Cycle: 29, 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) FRB20201124	WFC3/IR	1	28-Jul-2022 09:00:19.0	yes
02	(1) FRB20201124	WFC3/UVIS	1	28-Jul-2022 09:00:19.0	yes

2 Total Orbits Used

ABSTRACT

We propose HST mid-cycle imaging of the host galaxy of a fast radio burst (FRB) localized to milliarcsecond precision to constrain the origin of this enigmatic, highly active, repeating burst. Recent publications (based on HST observations) have established that FRBs occur primarily in star-forming galaxies with galactocentric offsets ranging from ~1 to 10 kpc. These data also indicate a high incidence of spiral arm structure in the near-IR band and suggest the frequent appearance of FRBs within these arms. With deep WFC3/UVIS 475X images we will observe the host of FRB 20201124A to precisely measure its spiral arm structure and to add to the quantitative assessment of the distribution of FRB progenitor locations relative to the arms. Following similar studies on other transients (e.g. supernovae), our experiment will yield new constraints on FRB progenitor channels by establishing the relationship of FRBs to recent star-formation and their progenitor lifetimes, using the high-resolution HST imaging in conjunction with VLA imaging of radio emission (presumed associated to recent star formation). The proposed observations with deep HST/WFC3 F160W will also determine the morphology, galactocentric offset, radial light distribution and local measure of the stellar mass surface density. The observations will utilize HST's high angular resolution imaging and UV sensitivity to measure the immediate galactic environment of this FRB and the nature of star formation to within a single pixel (0.1 kpc) of the burst's origin. We commit to rapid publication and release of the data to guide future research of this unique source.

OBSERVING DESCRIPTION

We will observe this host over 2 orbits; 1 orbit in F475X and 1 orbit in F160W. As this is a dusty, star-forming galaxy with a high extinction of E(B-V)=0.7315, we choose to observe using a broad NUV filter in order to achieve higher throughput. This will allow us to effectively image regions with current or recent star formation (and therefore younger stellar populations), make morphological measurements, achieve high contrast between arm and inter-arm regions, and sample the rest-frame NUV enabling a measurement of the SFR. The NIR will be sampled by the F160W filter in order to differentiate between the foreground and background host and study low surface brightness features that trace the older stellar population.

In order to obtain images clean of cosmic rays and image artifacts and sub-sample the PSF for better pixel sampling, we will obtain 4 exposures in F475X in 1 orbit. We will use a custom 4 point dither pattern, 5 times larger than the default box pattern to dither over fixed pattern noise. These observations require no use of post-flash. 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 this bright target, and therefore will use SPAR25 with NSAMP of 15. Since this sets the exposure time per dither position, we end up with 7 dither positions of 353s in one orbit. We take dither positions 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 request that the NUV and NIR observations are obtained at the same ORIENT to aid
in alignment of the NUV and NIR images, and will offset the images to obtain maximum overlap of the two filters. We request an orient from the NIR imaging, from -10 to +10.

Visit

Proposal 16877, 201124_IR (01), implementation Thu Jul 28 13:00:20 GMT 2022

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: (none)

Fixed Targets

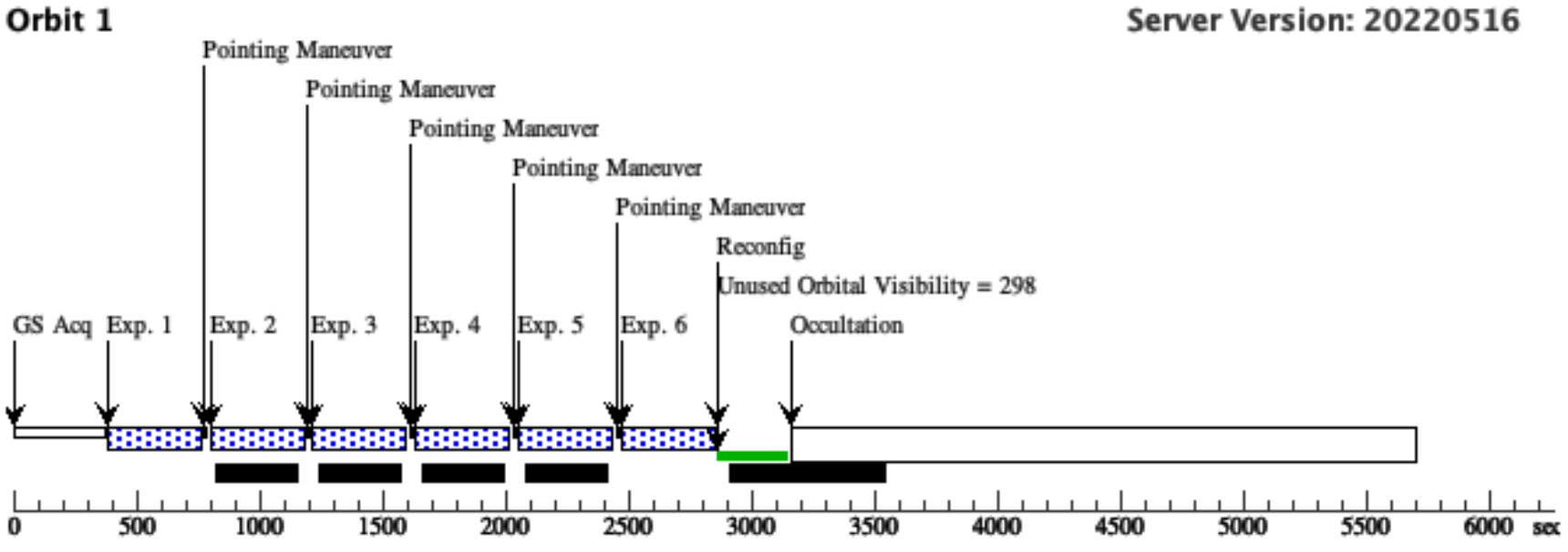
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	FRB20201124	RA: 05 08 3.4770 (77.0144875d) Dec: +26 03 37.93 (26.06054d) Equinox: J2000	Redshift: 0.0981	V=19.5+/-0.029	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[DISK]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) FRB20201124	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25			352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
2		(1) FRB20201124	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 2.1,0.189		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
3		(1) FRB20201124	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 4.197,0.075		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
4		(1) FRB20201124	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 0.204,2.118		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
5		(1) FRB20201124	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 2.304,1.944		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*
6		(1) FRB20201124	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25	POS TARG 4.404,2.07		352.939501 Secs (352.94 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 16877, 201124_UV (02), implementation Thu Jul 28 13:00:20 GMT 2022

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT -10D TO 10D FROM 01

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	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)	FRB20201124	RA: 05 08 3.4770 (77.0144875d) Dec: +26 03 37.93 (26.06054d) Equinox: J2000	Redshift: 0.0981	V=19.5+/-0.029	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[DISK]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) FRB20201124	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F475X			Pattern 2, Exps 1-1 in 201124_UV (02) (2)	597 Secs (2388 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***

Orbit Structure