18017 - Investigating AGN Feedback in a z=0.8 Brightest Cluster Galaxy with a Remarkable 30 Kiloparsec Extended Dust Tail

Cycle: 33, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
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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) SPARCS0333	WFC3/UVIS	3	13-Sep-2025 00:00:16.0	yes

3 Total Orbits Used

ABSTRACT

We have discovered a remarkable star-forming Brightest Cluster Galaxy (BCG) at spectroscopic redshift of z=0.81 that has asymmetric and extended dust emission over 30 kiloparsecs, embedded with a powerful radio source. BCGs are the most massive galaxies in the Universe, at any epoch, and reside at the centers of galaxy clusters. Besides their inherent interest as extreme systems, BCGs undergo an astrophysical balancing act between gas cooling and energy feedback within the dense intracluster medium. They thus offer a unique opportunity to study the physics of AGN feedback, as the energy imparted by the AGN leaves unique imprints on the surrounding gaseous medium. We propose joint HST UV and JVLA imaging to map out recent star formation and search for jetted AGN emission. We will complement this with high-resolution archival ALMA dust continuum and optical Euclid observations for a premiere case study of a star-forming and radio-bright BCG. The full suite of observations will allow us to connect the origin of the dust tail to the radio source and investigate the role of feedback in this cluster core at z=0.81.

OBSERVING DESCRIPTION

The goal of this program is to obtain 3 orbits of WFC3/UVIS imaging over a galaxy cluster at z=0.8 in a single filter F475W. The cluster extends beyond the full FOV, so the full detector will provide useful ancillary data, but the primary target of interest is the brightest cluster galaxy (BCG). The BCG main lobe is 1.5 arcesc in diameter, but it also has a dust tail which extends over 6 arcsec to the east, and potential jetted radio emission over 16 arcsec, aligned along the dust tail. The primary aim of the F475W imaging is to trace clumpy and filamentary emission (rest-frame 260nm), roughly down to levels of ~4 Msol/yr, within the dust tail and in the vicinity of the BCG and radio emission. We aim to achieve this over 3 orbits in F475W. We are also getting joint VLA imaging at high-resolution with this program. We do not place orient constraints to maximize schedulability, but aim to place the BCG at the optimal detector position to maximize it's S/N and mitigate CTE losses, which could be especially important for fainter UV clumps along the dust tail.

Orbit / visit / dithering strategy:

The single visit consists of 3 orbits, all with F475W. We will use a standard 2-point dither pattern within each orbit to facilitate PSF reconstruction and cosmic ray removal (WFC3-UVIS-DITHER-LINE-2PT). We will thus acquire two individual exposures per orbit, at ~1220 seconds each. Given the long exposures, we expect the background to be high enough that we will not require a postflash to help mitigate CTE losses. We have also included small pos targ offsets of +1.5, -1.5 pixels and -2.33, +1.5 pixels from the first orbit to help with cosmic ray removal over the 6 dithered exposures.

Aperture:

We will place the BCG at the reference position of aperture UVIS2-C1K1C-CTE. We will stil read out the full 2-chip frame to gain coverage of the surrounding cluster field, but will minimize CTE losses of the BCG and dust tail by placing them closer to the readout amplifier. Given the extent of the dust tail and radio emisison over 16 arcsec, there should be ample space to still cover these features in full for any orient.

Visit

Proposal 18017, Visit 01, implementation Sat Sep 13 04:00:17 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2), (3)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SPARCS0333	RA: 03 33 16.7280 (53.3197000d) Dec: -26 53 46.40 (-26.89622d) Equinox: J2000	Redshift: 0.8	V=23.1	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[COOLING FLOW, HIGH REDSHIFT GALAXY, JET, TIDAL TAIL]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) SPARCS0333	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F475W			Pattern 1, Exps 1-1 in Visit 01 (1)	1233 Secs (2466 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[1]***
2		(1) SPARCS0333	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F475W		POS TARG +0.06,-0.07	Pattern 1, Exps 2-2 in Visit 01 (1)	1223 Secs (2446 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[2]***
3		(1) SPARCS0333	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F475W		POS TARG -0.092,+0.098	Pattern 1, Exps 3-3 in Visit 01 (1)	1223 Secs (2446 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	***[3]***

Orbit Structure