17273 - Through darkness and light: the many faces of the outflows in NGC 3783

Cycle: 30, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
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Dr. Atsushi Tanimoto (CoI)	Kagoshima University
Dr. Missagh Mehdipour (CoI) (Contact)	University of Michigan
Dr. Jon Matthew Miller (CoI)	University of Michigan

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) NGC-3783	COS/FUV COS/NUV	1	09-Dec-2025 10:00:15.0	yes
02	(1) NGC-3783	COS/FUV COS/NUV	1	09-Dec-2025 10:00:16.0	yes

2 Total Orbits Used

ABSTRACT

Various types of photoionised outflows are observed from AGN. A 200 ks XRISM PV observation is scheduled to study the nature of the outflows in NGC 3783, the best case for this purpose. We propose joint observations of XMM-Newton, NuSTAR, HST, and Swift. XMM/RGS characterises lower ionised absorbers in soft X-rays. In combination with the higher ionised ones revealed by XRISM, we can study all absorbers comprehensively. XMM/EPIC and NuSTAR determine the spectral energy distribution and constrain the continuum. HST accurately measures outflow velocity from UV absorption lines. Swift observations preceding XRISM brings the flux history for photoionisation modelling of the variable absorbers.

OBSERVING DESCRIPTION

This HST observation (approved as part of a joint XMM-Newton proposal) plans to obtain the COS spectrum of NGC 3783 during observation with the upcoming XRISM mission. The contemporaneous HST UV spectrum of NGC 3783 is crucial for AGN wind studies with the groundbreaking XRISM mission.

NGC 3783 is a Performance Verification (PV) target of XRISM and will certainly be observed. However, currently, prior to the launch of XRISM, the exact observation time is not known. In the scheduling requirement section, we have specified the two visibility windows of XMM-Newton. The XRISM observation will likely be taken in the second visibility window, which is 12-Dec-2023 to 24-Jan-2024.

As justified in the XMM-Newton proposal, the HST observation is needed to be taken during the XRISM observation.

Our HST/COS time and setup is based on the prior observations of NGC 3783 (Mehdipour et al. 2017, A&A, 607, A28; Kriss et al. 2019, A&A, 621, A12), which required 2 orbits to constrain broad absorption lines of Ly-alpha, N V, and C IV with gratings G130M and G160M. This also allows measurement of weak, low-ionization lines associated with the new ionization state of the warm absorber.

Following the Phase II Proposal instructions and the allowed COS settings for Cycle 30, the central wavelengths and FPPOS positions that we have selected provide the optimum full spectral coverage of the interested regions with the G130M and G160M gratings, minimize spectral gaps, and maximize the potential of the detection of the relevant broad and narrow absorption lines. This enables us to fully explore the UV spectral signatures of the obscuring outflow in NGC 3783. Thus, for our observation we utilize G130M/1222, G130M/1291, G160M/1600, and G160M/1623.

We obtained the required time for each exposure using the COS Exposure Time Calculator (ETC) tool and the NGC 3783 UV fluxes at 1368 A published by Dunn et al. (2006), PASP, 118, 572. As the HST/COS spectrum of NGC 3783 (Kriss et al. 2019) is approximately flat in the NUV and

FUV, we used a flat spectrum in ETC. The redshift z=0.00973 and foreground extinction of E(B-V)=0.107 are taken into account. For the target acquisition we used the minimum UV flux of 1.2e-14 erg/cm^2/s/A and calculated the required exposure time to get a S/N of 30 using ACQ/IMAGE with BOA. Using the median flux of 4.7e-14 erg/cm^2/s/A, the exposure times were calculated to give a S/N of at least 10 for each exposure with G130M/1222, G130M/1291, G160M/1600, and G160M/1623. The maximum UV flux ever observed (10.8e-14) does not pose a bright object risk for COS. NGC 3738 has been acquired and observed with HST COS before, and there are no bright field objects that would prove an overlight risk to COS.

For the BUFFER-TIME, we obtained the recommended buffer (2/3 of the buffer fill time) from the ETC for each exposure.

Please note because we are using two different CENWAVES with each grating and two FP-POS positions in each, we already accomplish the actual objectives of switching between different FP-POS settings:

(1) Better science return: the spectrum is placed at four different locations on the detector, enabling us to detect and reject detector anomalies like dead spots, hot spots, grid-wire shadows, etc.

(2) Spread the flux across the detector in multiple locations, especially in bright emission lines, to decrease charge depletion and extend the lifetime of the detectors.

We do not want to sacrifice S/N with unnecessary extra exposures and increased overhead during each visit by using all 4 FP-POS settings with each CENWAVE. When only one CENWAVE is used, then 4 FP-POS settings makes sense, but that's not the case for our observations. Our chosen FP-POS settings reflect our S/N requirements while still meeting the objectives of using different FP-POS settings in our program.

Although reduced gyro operations for HST would be unfortunate, our program would still remain fully feasible. Reduced gyro operations would approximately halve the opportunities for coordination with XMM-Newton and XRISM. Also, any orientation limitation would not impact our program.

Visit

Proposal 17273, Visit 01, completed Tue Dec 09 15:00:16 GMT 2025

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: SCHED 100%; ORIENT 132D TO 132 D; VISIBILITY INTERVAL 51 M

Diagnostics

(Visit 01) Warning (Form): For the best data quality, it is generally required to use all four FP-POS positions at a given COS cenwave (or 2 positions for certain exception cases). See extended explanation in the diagnostic browser.

Fixed Targets

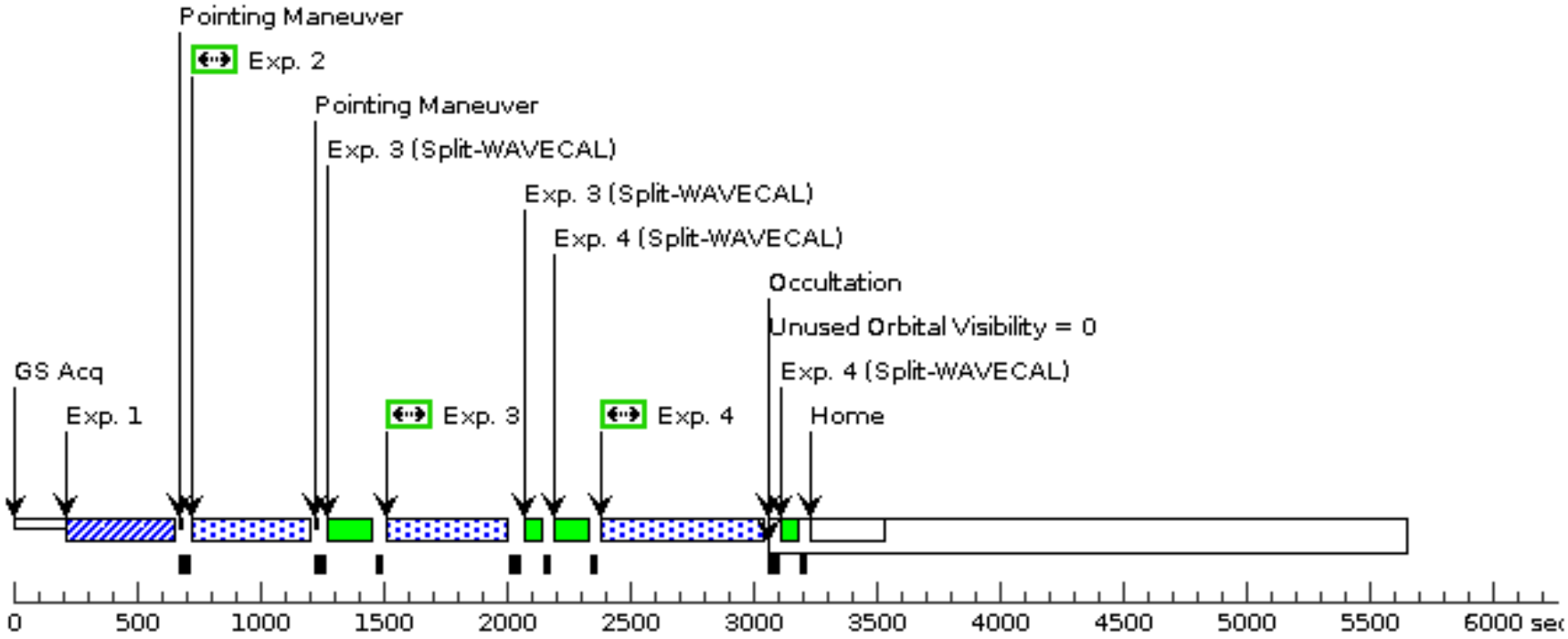
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NGC-3783	RA: 11 39 1.7098 (174.7571242d) Dec: -37 44 19.01 (-37.73861d) Equinox: J2000	Proper Motion RA: 9.357479870409743E-6 sec of time/yr Proper Motion Dec: -2.149999090761412E-4 arcsec/yr Epoch of Position: 2015.5	V=13.43	Reference Frame: ICRS

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=GALAXY
Description=[ACCRETION DISK, BLR, SEYFERT, WIND]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1836037)	(1) NGC-3783	COS/NUV, ACQ/IMAGE, BOA	MIRRORA				110 Secs (110 Secs) *[==>]*	*[1]*
Comments: Using NGC 3783 minimum flux of 1.2e-14 erg/cm2/s/A at 1368 A (Dunn et al. 2006), we calculated the exposure time to achieve target acquisition with S/N of 30.									
2	(1836043)	(1) NGC-3783	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=982; FP-POS=3			310 Secs (310 Secs) *[==>]*	*[1]*
Comments: Using NGC 3783 median flux of 4.7e-14 erg/cm2/s/A at 1368 A (Dunn et al. 2006), we calculated the exposure time to achieve S/N of at least 10 with G130M/1222.									
3	(1836054)	(1) NGC-3783	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=1865; FP-POS=1			437 Secs (437 Secs) *[==>]*	*[1]*
Comments: Using NGC 3783 median flux of 4.7e-14 erg/cm2/s/A at 1368 A (Dunn et al. 2006), we calculated the exposure time to achieve S/N of at least 10 with G160M/1600.									
4	(1836050)	(1) NGC-3783	COS/FUV, TIME-TAG, PSA	G160M 1623 A	BUFFER-TIME=2048; FP-POS=2			610 Secs (610 Secs) *[==>]*	*[1]*
Comments: Using NGC 3783 median flux of 4.7e-14 erg/cm2/s/A at 1377 A (Dunn et al. 2006), we calculated the exposure time to achieve S/N of 11 with G160M/1623.									

Orbit Structure



Visit

Proposal 17273, Visit 02, completed Tue Dec 09 15:00:17 GMT 2025

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: SCHED 100%; ORIENT 132D TO 132 D; AFTER 01 BY 0.8 Orbits TO 1.2 Orbits; VISIBILITY INTERVAL 51 M

Diagnostics

(Visit 02) Warning (Form): For the best data quality, it is generally required to use all four FP-POS positions at a given COS cenwave (or 2 positions for certain exception cases). See extended explanation in the diagnostic browser.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NGC-3783	RA: 11 39 1.7098 (174.7571242d) Dec: -37 44 19.01 (-37.73861d) Equinox: J2000	Proper Motion RA: 9.357479870409743E-6 sec of time/yr Proper Motion Dec: -2.149999090761412E-4 arcsec/yr Epoch of Position: 2015.5	V=13.43	Reference Frame: ICRS

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=GALAXY
Description=[ACCRETION DISK, BLR, SEYFERT, WIND]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1836037)	(1) NGC-3783	COS/NUV, ACQ/IMAGE, BOA	MIRRORA				110 Secs (110 Secs) *[==>]*	*[1]*
Comments: Using NGC 3783 minimum flux of 1.2e-14 erg/cm2/s/A at 1368 A (Dunn et al. 2006), we calculated the exposure time to achieve target acquisition with S/N of 30.									
2	(1836043)	(1) NGC-3783	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=982; FP-POS=4			310 Secs (310 Secs) *[==>]*	*[1]*
Comments: Using NGC 3783 median flux of 4.7e-14 erg/cm2/s/A at 1368 A (Dunn et al. 2006), we calculated the exposure time to achieve S/N of at least 10 with G130M/1291.									
3	(1836054)	(1) NGC-3783	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=1865; FP-POS=3			434 Secs (434 Secs) *[==>]*	*[1]*
Comments: Using NGC 3783 median flux of 4.7e-14 erg/cm2/s/A at 1368 A (Dunn et al. 2006), we calculated the exposure time to achieve S/N of at least 10 with G160M/1600.									
4	(1836050)	(1) NGC-3783	COS/FUV, TIME-TAG, PSA	G160M 1623 A	BUFFER-TIME=2048; FP-POS=4			613 Secs (613 Secs) *[==>]*	*[1]*
Comments: Using NGC 3783 median flux of 4.7e-14 erg/cm2/s/A at 1377 A (Dunn et al. 2006), we calculated the exposure time to achieve S/N of 11 with G160M/1623.									

Orbit Structure