



## 16842 - Evolution of long-lasting obscuration in NGC 5548

Cycle: 29, Proposal Category: GO

(Availability Mode: SUPPORTED)

### INVESTIGATORS

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### VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) NGC-5548	COS/FUV COS/NUV	1	18-Nov-2021 09:00:15.0	yes
02	(1) NGC-5548	COS/FUV COS/NUV	1	18-Nov-2021 09:00:16.0	yes

2 Total Orbits Used

### ABSTRACT

Obscuring outflows are remarkably different from the warm-absorber outflows in AGN. They exhibit large columns of high-velocity gas close to the accretion disk. They shield the X-ray radiation, which has important implications for the launching of outflows. They were first discovered in NGC 5548 thanks to simultaneous X-ray and UV observations in 2013. Recent Swift monitoring of NGC 5548 points to remarkable long-term changes in

Proposal 16842 (STScI Edit Number: 0, Created: Thursday, November 18, 2021 at 9:00:16 AM Eastern Standard Time) - Overview  
the strength of X-ray obscuration in NGC 5548. In order to study this change, simultaneous X-ray and UV high-resolution spectroscopy is required. Therefore, we propose simultaneous Chandra/HETG (150 ks) and HST/COS (2 orbits) observations to help us address existing questions about the origin and physical structure of the long-lasting obscuration in NGC 5548.

## **OBSERVING DESCRIPTION**

The goal of our proposal is to obtain joint X-ray (Chandra/HETG) and UV (HST/COS) spectra of NGC 5548 to determine the physical changes in the obscuring outflows in this AGN. To this end, as requested in our proposal we need the Chandra and HST observations to be taken contemporaneously since the source and the obscuring outflows vary over time. We have specified in our proposal that the Chandra and HST observations to be taken within +/- 2 days of each other, which has been approved. To help scheduling of the observations the 150 ks Chandra observation can be split. According to the 'Chandra Initial Parameter Signoff' that we recently checked and approved, the 150 ks Chandra observation is planned to be split into five 30 ks exposures. However, each exposure is still requested to be within +/- 2 days of the HST observation. We would greatly appreciate the coordination of Chandra and HST planners so that our observations are taken contemporaneously.

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 Chandra. Also, any orientation limitation would not impact our program.

Our HST/COS time and set-up is based on the prior observations of NGC 5548 (Kaastra et al. 2014, Science, 345, 64), which required 2 orbits per visit to observe broad absorption lines of Ly-alpha, N V, and C IV with gratings G130M and G160M. This yields a S/N of at least 15 in the continuum at C IV, adequate to measure the broad UV absorption in C IV and other lines, as well as the weak, low-ionization lines associated with the new ionization state of the warm absorber. The new HST/COS observation enables us to constrain the covering fraction of the broad UV absorber, and measure how much it has changed with the lower X-ray obscuration in NGC 5548.

Following the Phase II Proposal instructions and the allowed COS settings for Cycle 29, 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, 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 5548.

We obtained the required time for each exposure using the COS Exposure Time Calculator (ETC) tool and the NGC 5548 HST UV continuum (1367 Å) fluxes published by Kriss et al. (2019, ApJ, 881, 153). For the target acquisition we used the minimum observed UV flux of NGC 5548 ( $1.8 \times 10^{-14}$  erg/cm<sup>2</sup>/s/Å, Kriss et al. 2019) and calculated the required exposure time to get a S/N of at least 30 using ACQ/IMAGE with BOA. Using the mean flux of the NGC 5548 campaign in 2014 ( $4.3 \times 10^{-14}$  erg/cm<sup>2</sup>/s/Å, Kriss et al. 2019), the exposure time is calculated to give a S/N of at least 10 for each exposure with G130M/1222, and for the total exposure with G130M/1291. Similarly, the exposure time is calculated to give a S/N of at least 10 for exposures with G160M/1600 and G160M/1623. The maximum flux ever observed with NGC 5548 ( $8.6 \times 10^{-14}$ , Dunn et al. 2006, PASP, 118, 572. ETC run #1541128 for G130M/1291) does not pose a bright object risk for COS.

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

NGC 5548 has been acquired and observed on many occasions at a variety of orientations, and there are no bright field objects that would prove an oversight risk to COS.

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:

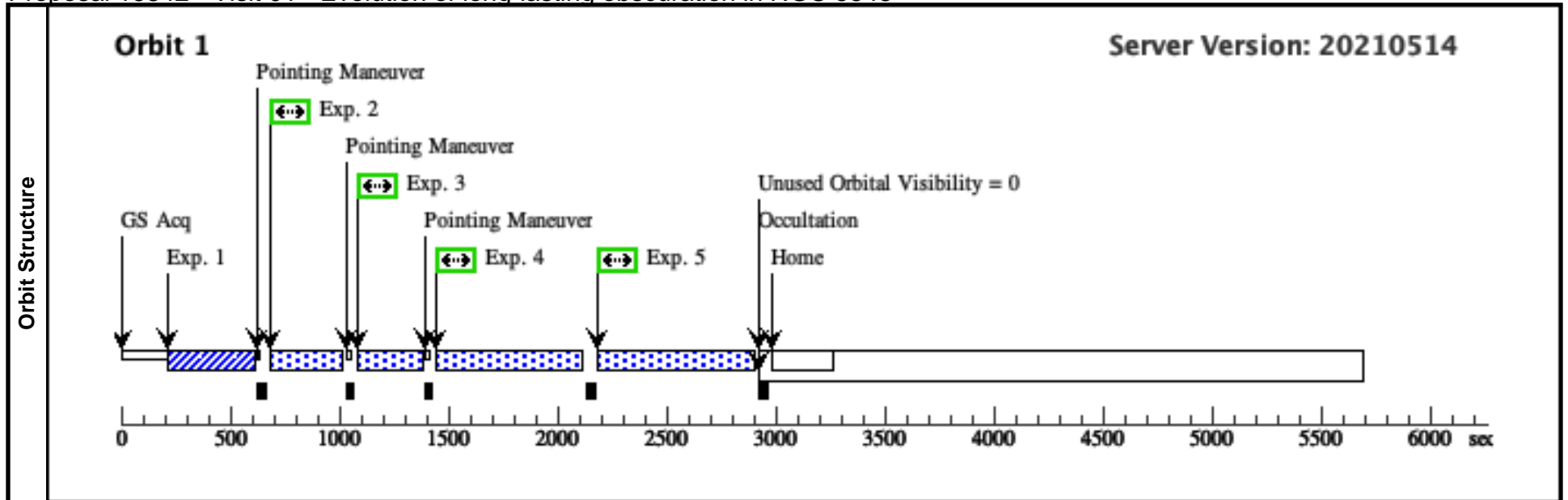
- (1) Better science return: the spectrum is placed at four different locations on the detector, enabling us to detect and reject detector anomalies like dead spots, hot spots, grid-wire shadows, etc.
- (2) Spread the flux across the detector in multiple locations, especially in bright emission lines, 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.

Proposal 16842 - Visit 01 - Evolution of long-lasting obscuration in NGC 5548

Thu Nov 18 14:00:16 GMT 2021

Visit	<b>Proposal 16842, Visit 01, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: COS/FUV, COS/NUV Special Requirements: SCHED 100%									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
		(1)	NGC-5548	RA: 14 17 59.5399 (214.4980829d) Dec: +25 08 12.60 (25.13683d) Equinox: J2000	Proper Motion RA: -1.6053682911936426E-5 sec of time/yr Proper Motion Dec: 2.6700000000000004E-4 arcsec/yr Epoch of Position: 2015.5	V=13.73	Reference Frame: ICRS			
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> 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	(1537535)	(1) NGC-5548	COS/NUV, ACQ/IMAGE, BOA	MIRRORA				81 Secs (81 Secs) [==>]	[1]
	<i>Comments: Using the NGC 5548 HST UV continuum (1367 A) lightcurve published by Kriss et al. (2019), we took the lowest observed flux (1.8e-14 erg/cm^2/s/A), to calculate the required exposure time to obtain S/N ratio of 30 for ACQ/IMAGE with BOA.</i>									
	2	(1542897)	(1) NGC-5548	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=12 68; FP-POS=1			144 Secs (144 Secs) [==>]	[1]
	<i>Comments: Using the NGC 5548 HST UV continuum (1367 A) lightcurve published by Kriss et al. (2019) and the mean flux of the 2014 campaign (4.3e-14 erg/cm^2/s/A), the exposure time is calculated to give S/N ratio of about 7 with 1222.</i>									
	3	(1542898)	(1) NGC-5548	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=96 7; FP-POS=3			155 Secs (155 Secs) [==>]	[1]
	<i>Comments: Using the NGC 5548 HST UV continuum (1367 A) lightcurve published by Kriss et al. (2019) and the mean flux of the 2014 campaign (4.3e-14 erg/cm^2/s/A), the exposure time is calculated to give S/N ratio of about 7 with 1291.</i>									
	4	(1542901)	(1) NGC-5548	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=20 67; FP-POS=2			500 Secs (500 Secs) [==>]	[1]
	<i>Comments: Using the NGC 5548 HST UV continuum (1367 A) lightcurve published by Kriss et al. (2019) and the mean flux of the 2014 campaign (4.3e-14 erg/cm^2/s/A), the exposure time is calculated to give S/N ratio of about 7 with 1600.</i>									
	5	(1542900)	(1) NGC-5548	COS/FUV, TIME-TAG, PSA	G160M 1623 A	BUFFER-TIME=22 81; FP-POS=4			596 Secs (596 Secs) [==>]	[1]
	<i>Comments: Using the NGC 5548 HST UV continuum (1367 A) lightcurve published by Kriss et al. (2019) and the mean flux of the 2014 campaign (4.3e-14 erg/cm^2/s/A), the exposure time is calculated to give S/N ratio of about 7 with 1623.</i>									



Proposal 16842 - Visit 02 - Evolution of long-lasting obscuration in NGC 5548

Thu Nov 18 14:00:16 GMT 2021

Visit	<b>Proposal 16842, Visit 02, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: COS/FUV, COS/NUV Special Requirements: SCHED 100%									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
		(1)	NGC-5548	RA: 14 17 59.5399 (214.4980829d) Dec: +25 08 12.60 (25.13683d) Equinox: J2000	Proper Motion RA: -1.6053682911936426E-5 sec of time/yr Proper Motion Dec: 2.6700000000000004E-4 arcsec/yr Epoch of Position: 2015.5	V=13.73	Reference Frame: ICRS			
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> 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	(1537535)	(1) NGC-5548	COS/NUV, ACQ/IMAGE, BOA	MIRRORA				81 Secs (81 Secs) [==>]	[1]
	<i>Comments: Using the NGC 5548 HST UV continuum (1367 A) lightcurve published by Kriss et al. (2019), we took the lowest observed flux (1.8e-14 erg/cm^2/s/A), to calculate the required exposure time to obtain S/N ratio of 30 for ACQ/IMAGE with BOA.</i>									
	2	(1542897)	(1) NGC-5548	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=12 68; FP-POS=2			144 Secs (144 Secs) [==>]	[1]
	<i>Comments: Using the NGC 5548 HST UV continuum (1367 A) lightcurve published by Kriss et al. (2019) and the mean flux of the 2014 campaign (4.3e-14 erg/cm^2/s/A), the exposure time is calculated to give S/N ratio of about 7 with 1222.</i>									
	3	(1542898)	(1) NGC-5548	COS/FUV, TIME-TAG, PSA	G130M 1291 A	BUFFER-TIME=96 7; FP-POS=4			155 Secs (155 Secs) [==>]	[1]
	<i>Comments: Using the NGC 5548 HST UV continuum (1367 A) lightcurve published by Kriss et al. (2019) and the mean flux of the 2014 campaign (4.3e-14 erg/cm^2/s/A), the exposure time is calculated to give S/N ratio of about 7 with 1291.</i>									
4	(1542901)	(1) NGC-5548	COS/FUV, TIME-TAG, PSA	G160M 1600 A	BUFFER-TIME=20 67; FP-POS=1			500 Secs (500 Secs) [==>]	[1]	
<i>Comments: Using the NGC 5548 HST UV continuum (1367 A) lightcurve published by Kriss et al. (2019) and the mean flux of the 2014 campaign (4.3e-14 erg/cm^2/s/A), the exposure time is calculated to give S/N ratio of about 7 with 1600.</i>										
5	(1542900)	(1) NGC-5548	COS/FUV, TIME-TAG, PSA	G160M 1623 A	BUFFER-TIME=22 81; FP-POS=3			596 Secs (596 Secs) [==>]	[1]	
<i>Comments: Using the NGC 5548 HST UV continuum (1367 A) lightcurve published by Kriss et al. (2019) and the mean flux of the 2014 campaign (4.3e-14 erg/cm^2/s/A), the exposure time is calculated to give S/N ratio of about 7 with 1623.</i>										

