



17721 - Building an ANT-hill: STIS UV Follow-up of Ambiguous Nuclear Transients

Cycle: 32, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>
Dr. Jason Hinkle (PI) (Contact)	University of Illinois at Urbana - Champaign
Prof. Benjamin John Shappee (CoI)	University of Hawaii
Dr. Chris S. Kochanek (CoI)	The Ohio State University
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Dr. Krzysztof Z. Stanek (CoI)	The Ohio State University
Dr. Anna Payne (CoI)	Space Telescope Science Institute

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	(4) AT2021ZFA	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	09-Dec-2025 14:00:13.0	yes
02	(4) AT2021ZFA	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	09-Dec-2025 14:00:14.0	yes

<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>
03	(5) EP251020A	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	09-Dec-2025 14:00:15.0	yes
04	(5) EP251020A	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	09-Dec-2025 14:00:16.0	yes

8 Total Orbits Used

ABSTRACT

Due in large part to the rapid growth of all-sky transient surveys, a rich diversity of nuclear transients has been discovered. The two most common such transients are tidal disruption events (TDEs) and active galactic nucleus (AGN) flares. However, it has become increasingly clear that there is a growing class of nuclear flares with characteristics distinct from typical TDEs and AGNs, currently known as ambiguous nuclear transients (ANTs). These ANTs likely represent a window into a hitherto unseen or poorly understood mode of accretion onto supermassive black holes, possibly a TDE occurring within an AGN disk. Here we propose to obtain 2 epochs of STIS UV spectroscopy each for 2 newly-discovered UV-bright ANTs in Cycles 32, 33, and 34 for a total of 12 spectra of 6 ANTs. For each ANT, emission lines in the UV spectra will identify if the source is more TDE-like or AGN-like in nature, providing physical insight into the complex interplay between the existing AGN disk and the disrupted tidal debris. The UV spectra will also allow for crucial insights into outflows launched by ANTs through measurements of broad absorption lines, photoionization physics from measurements of low- and high-ionization lines, and properties of circumnuclear gas through multi-ion curve of growth analysis. Obtaining two spectra per ANT separated by roughly 100 days will probe the temporal evolution of the emitting region, which will be compared with predictions from theoretical models of TDEs in AGN disks.

OBSERVING DESCRIPTION

The goal is to obtain a sequence of 2 STIS FUV-MAMA/G140L and NUV-MAMA/G230L UV spectra of two ambiguous nuclear transients (ANTs) per cycle, with a roughly 100-day spacing between the two epochs. This requires 2 orbits per spectroscopic epoch.

After identifying a UV-bright ANT (a Swift UVM2 flux above $1e-15$ erg/s/cm²/Å), we will trigger one of our 12 ToOs (4 triggers per cycle). Although these are non-disruptive ToOs, we request that the first epoch occur as close to peak as possible. At the same time, we will trigger a second epoch roughly 100 days later as scheduling allows. The exact timing of this second epoch can be flexible, it is most important to have a long baseline

between the two epochs.

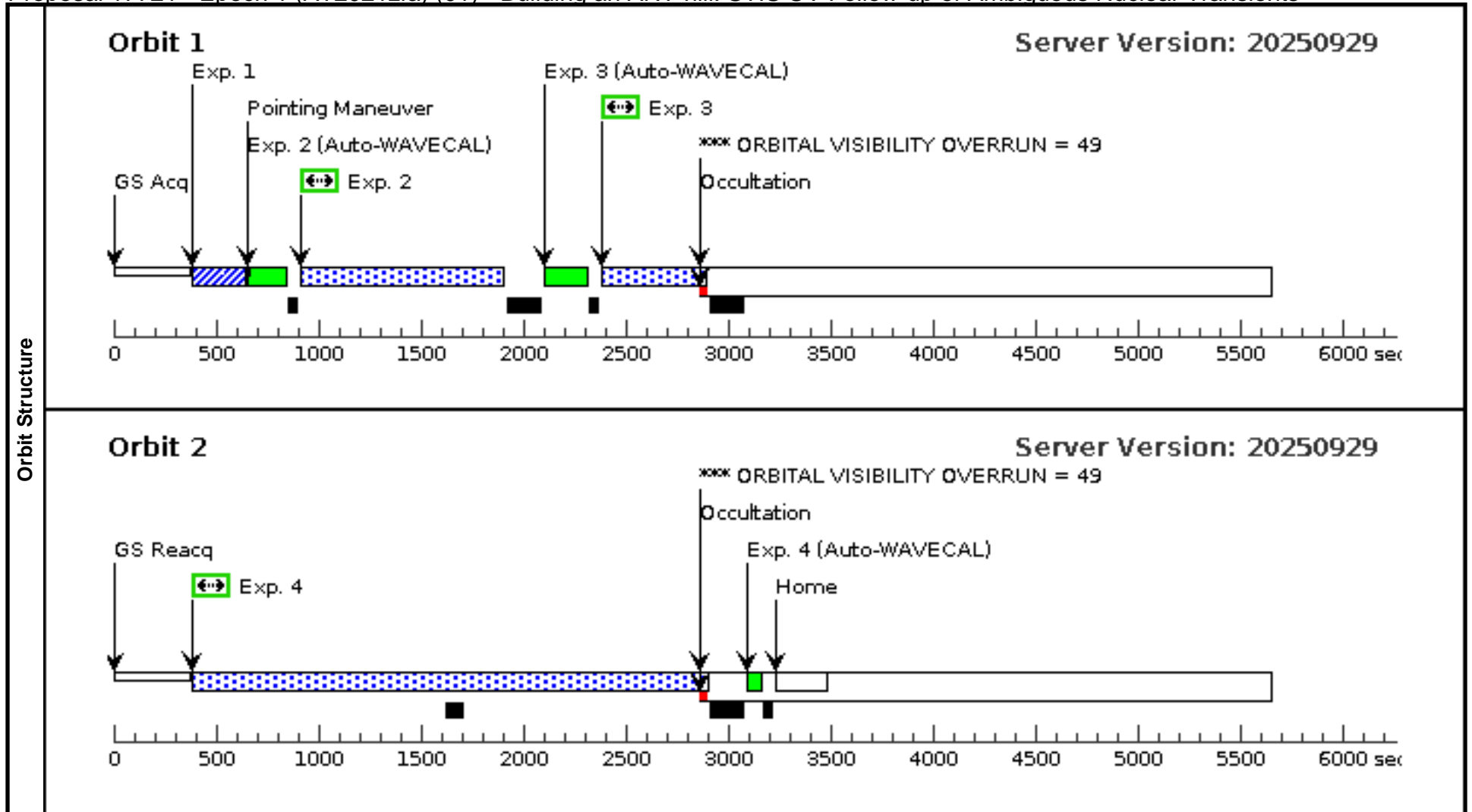
We have set the acquisition image for a point source with the clear/50CCD filter and a 5-second exposure time. This is appropriate for bright ANTs, which should have $V \sim 16-17$ mag and yield a S/N of ~ 150 according to the STIS acquisition ETC. This exposure time will be fine for targets with $18.5 > V > 14.5$ mag, outside of which we will tweak the exposure time to avoid saturation and ensure a sufficient S/N. We select the 50CCD filter as the contrast between the target (with a blue SED) and host galaxy will be larger than with the standard F28X50LP filter.

The source should be well above the sky, so the 52x0.2 slit should be fine for both the FUV and NUV observations.

Proposal 17721 - Epoch 1 (AT2021zfa) (01) - Building an ANT-hill: STIS UV Follow-up of Ambiguous Nuclear Transients

Tue Dec 09 19:00:16 GMT 2025

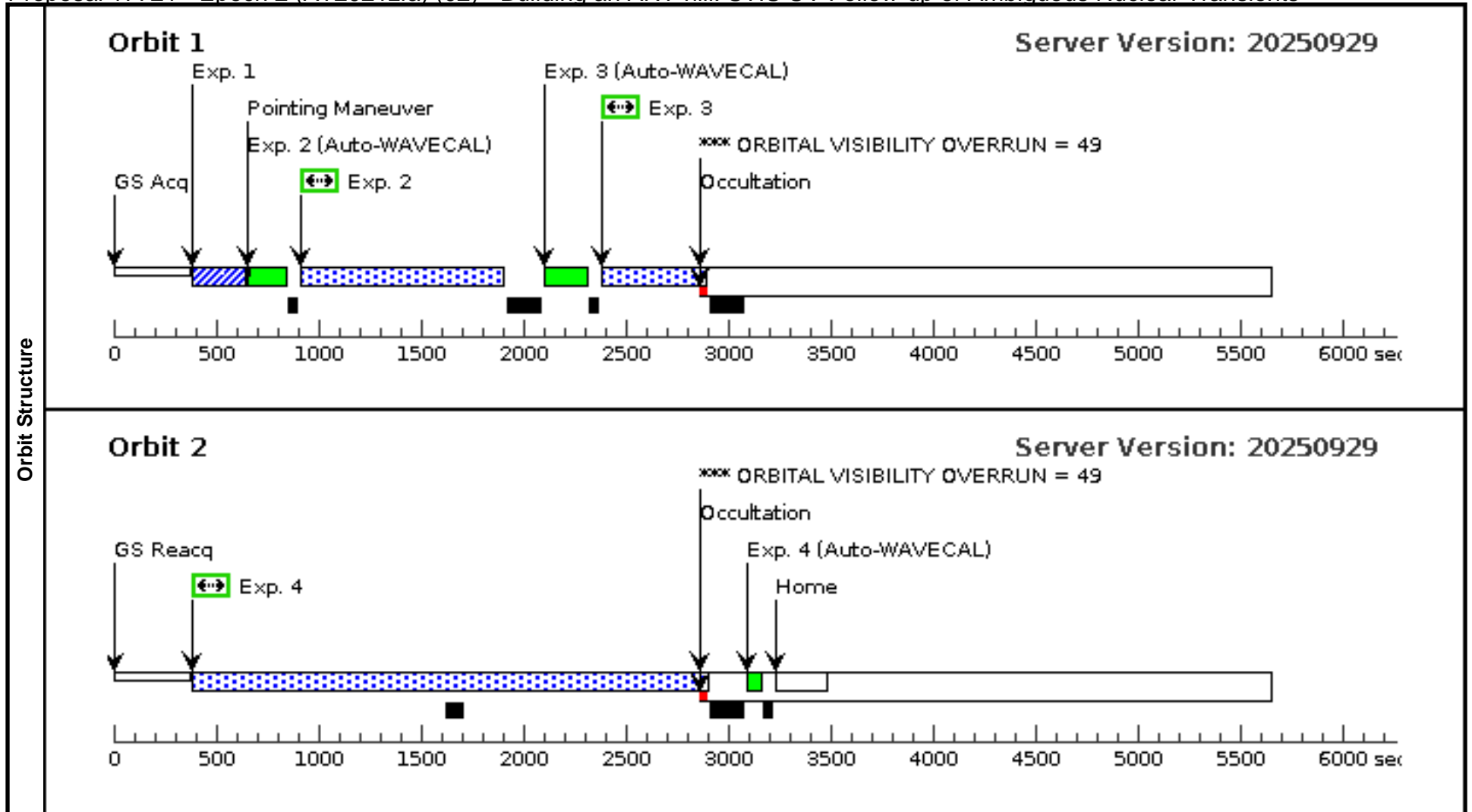
Visit	Proposal 17721, Epoch 1 (AT2021zfa) (01), completed Diagnostic Status: Warning Scientific Instruments: STIS/NUV-MAMA, STIS/CCD, STIS/FUV-MAMA Special Requirements: SCHED 100%; ON HOLD ; TOO RESPONSE TIME 21.0D Comments: First UV spectroscopic epoch of AT2021zfa. On Hold Comments: Requires discovery of a sufficiently bright ambiguous nuclear transient.										
	(Epoch 1 (AT2021zfa) (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Epoch 1 (AT2021zfa) (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN										
Diagnosics											
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous					
	(4)	AT2021ZFA Alt Name1: ATLAS21BIYB	RA: 04 52 18.4007 (73.0766696d) Dec: -25 37 5.36 (-25.61816d) Equinox: J2000	Redshift: 0.0245	V=16.25+/-0.07 2.0e-15 erg/s/cm^2/A	Reference Frame: ICRS					
Comments: The V magnitude is the host+transient measurement from Swift UVOT. The other flux provided is the transient-only flux in the Swift UVW2 filter. The archival GALEX NUV magnitude of the full host galaxy is ~18.9 mag, at least one magnitude fainter than the transient. Category=EXT-STAR Description=[ACCRETION DISK, NUCLEUS]											
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
	1	(STIS.ta.202 1913)	(4) AT2021ZFA	STIS/CCD, ACQ, 50CCD	MIRROR				5 Secs (5 Secs) [==>]	[1]	
	Comments: We select the clear/50CCD filter as our target will be blue and we want to maximize contrast from the redder host galaxy. The nominal exposure time of 5 seconds with the clear 50CCD filter will provide sufficient S/N for sources with V magnitudes between 14.5 and 18.5. Outside of this range we will adjust the acquisition exposure time slightly as needed.										
	2	(STIS.sp.20 21909)	(4) AT2021ZFA	STIS/NUV-MAMA, TIME-TAG, 52X0.2	G230L 2376 A	BUFFER-TIME=49 0				5 Secs (980 Secs) [==>980.0 Secs]	[1]
	Comments: The buffer time is calculated under the assumption that the source will be faint enough that the count rate is less than 4e6/exptime, which should generally be true for our sources. If the source is significant by brighter in the UV, we will lower the buffer time as recommended in Chapter 11.1 of the STIS instrument handbook.										
3	(STIS.sp.20 21912)	(4) AT2021ZFA	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=25 0				5 Secs (500 Secs) [==>500 Secs]	[1]	
Comments: The buffer time is calculated under the assumption that the source will be faint enough that the count rate is less than 4e6/exptime, which should nearly always be true for our ANTs in the FUV. Nevertheless, we will confirm the appropriate buffer time based on Swift observations of the UV SED of the source.											
4	(STIS.sp.20 21912)	(4) AT2021ZFA	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=12 50				5 Secs (2505 Secs) [==>2505.0 Secs]	[2]	
Comments: The buffer time is calculated under the assumption that the source will be faint enough that the count rate is less than 4e6/exptime, which should nearly always be true for our ANTs in the FUV. Nevertheless, we will confirm the appropriate buffer time based on Swift observations of the UV SED of the source.											



Proposal 17721 - Epoch 2 (AT2021zfa) (02) - Building an ANT-hill: STIS UV Follow-up of Ambiguous Nuclear Transients

Tue Dec 09 19:00:16 GMT 2025

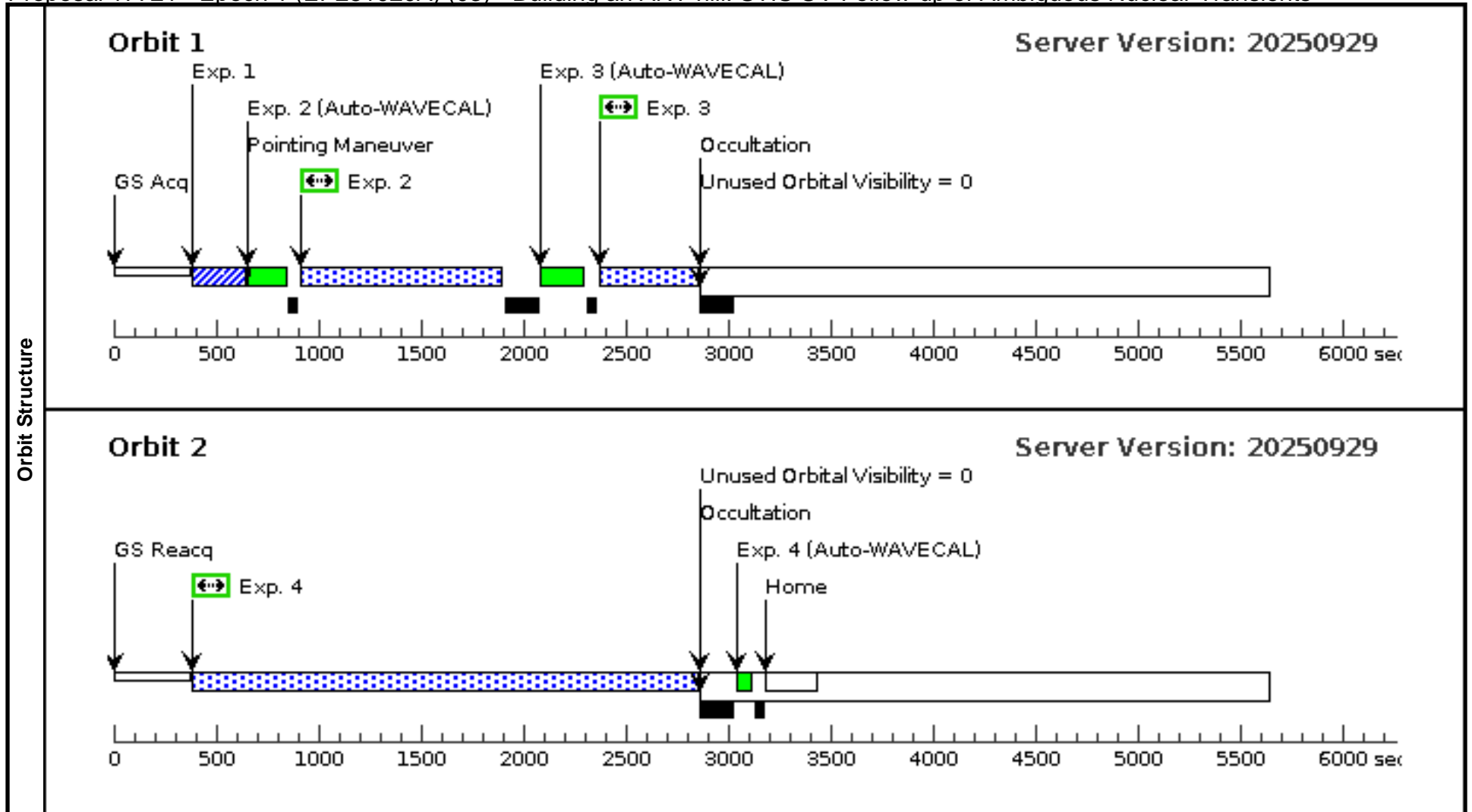
Visit	Proposal 17721, Epoch 2 (AT2021zfa) (02), withdrawn Diagnostic Status: Warning Scientific Instruments: STIS/NUV-MAMA, STIS/CCD, STIS/FUV-MAMA Special Requirements: SCHED 100%; AFTER 01 BY 80 D TO 110 D; ON HOLD Comments: <i>Second UV spectroscopic epoch of AT2021zfa.</i> On Hold Comments: <i>Requires discovery of a sufficiently bright ambiguous nuclear transient.</i>									
	(Epoch 2 (AT2021zfa) (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Epoch 2 (AT2021zfa) (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN									
Diagnosics										
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(4)	AT2021ZFA Alt Name1: ATLAS21BIYB	RA: 04 52 18.4007 (73.0766696d) Dec: -25 37 5.36 (-25.61816d) Equinox: J2000	Redshift: 0.0245	V=16.25+/-0.07 2.0e-15 erg/s/cm^2/A	Reference Frame: ICRS				
Comments: <i>The V magnitude is the host+transient measurement from Swift UVOT. The other flux provided is the transient-only flux in the Swift UVW2 filter. The archival GALEX NUV magnitude of the full host galaxy is ~18.9 mag, at least one magnitude fainter than the transient.</i> Category=EXT-STAR Description=[ACCRETION DISK, NUCLEUS]										
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(STIS.ta.202 1913)	(4) AT2021ZFA	STIS/CCD, ACQ, 50CCD	MIRROR				5 Secs (5 Secs) [==>]	[1]
	Comments: <i>We select the clear/50CCD filter as our target will be blue and we want to maximize contrast from the redder host galaxy. The nominal exposure time of 5 seconds with the clear 50CCD filter will provide sufficient S/N for sources with V magnitudes between 14.5 and 18.5. Outside of this range we will adjust the acquisition exposure time slightly as needed.</i>									
	2	(STIS.sp.20 21909)	(4) AT2021ZFA	STIS/NUV-MAMA, TIME-TAG, 52X0.2	G230L 2376 A	BUFFER-TIME=50 0			5 Secs (980 Secs) [==>980 Secs]	[1]
	Comments: <i>The buffer time is calculated under the assumption that the source will be faint enough that the count rate is less than 4e6/exptime, which should generally be true for our sources. If the source is significant by brighter in the UV, we will lower the buffer time as recommended in Chapter 11.1 of the STIS instrument handbook.</i>									
3	(STIS.sp.20 21912)	(4) AT2021ZFA	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=25 0			5 Secs (500 Secs) [==>500 Secs]	[1]	
Comments: <i>The buffer time is calculated under the assumption that the source will be faint enough that the count rate is less than 4e6/exptime, which should nearly always be true for our ANTs in the FUV. Nevertheless, we will confirm the appropriate buffer time based on Swift observations of the UV SED of the source. We use the 52x0.2 aperture as our default, although if the source fades more quickly than expected over the 100 day timespan between epochs, it may be necessary to use the 52X0.2D1 pseudo-aperture to avoid the FUV-MAMA glow region.</i>										
4	(STIS.sp.20 21912)	(4) AT2021ZFA	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=12 50			5 Secs (2505 Secs) [==>2505.0 Secs]	[2]	
Comments: <i>The buffer time is calculated under the assumption that the source will be faint enough that the count rate is less than 4e6/exptime, which should nearly always be true for our ANTs in the FUV. Nevertheless, we will confirm the appropriate buffer time based on Swift observations of the UV SED of the source. We use the 52x0.2 aperture as our default, although if the source fades more quickly than expected over the 100 day timespan between epochs, it may be necessary to use the 52X0.2D1 pseudo-aperture to avoid the FUV-MAMA glow region.</i>										



Proposal 17721 - Epoch 1 (EP251020A) (03) - Building an ANT-hill: STIS UV Follow-up of Ambiguous Nuclear Transients

Tue Dec 09 19:00:16 GMT 2025

Visit	Proposal 17721, Epoch 1 (EP251020A) (03), implementation Diagnostic Status: No Diagnostics Scientific Instruments: STIS/NUV-MAMA, STIS/CCD, STIS/FUV-MAMA Special Requirements: SCHED 100%; TOO RESPONSE TIME 21.0D Comments: First UV spectroscopic epoch of EP251020A.									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(5)	EP251020A	RA: 04 57 6.3768 (74.2765700d) Dec: -11 43 40.19 (-11.72783d) Equinox: J2000	Redshift: 0.026145	V=16.5+/-0.06 2.3e-16 erg/s/cm^2/A	Reference Frame: ICRS				
Comments: The V magnitude is the host+transient measurement from Swift UVOT. The other flux provided is the transient-only flux in the Swift UVW1 filter. Category=EXT-STAR Description=[ACCRETION DISK, NUCLEUS] Extended=NO										
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(STIS.ta.225 7525)	(5) EP251020A	STIS/CCD, ACQ, 50CCD	MIRROR				5 Secs (5 Secs) [==>]	[1]
	Comments: We select the clear/50CCD filter as our target will be blue and we want to maximize contrast from the redder host galaxy. The nominal exposure time of 5 seconds with the clear 50CCD filter will provide sufficient S/N for sources with V magnitudes between 14.5 and 18.5. Outside of this range we will adjust the acquisition exposure time slightly as needed.									
	2	(STIS.sp.22 57523)	(5) EP251020A	STIS/NUV-MAMA, TIME-TAG, 52X0.2	G230L 2376 A	BUFFER-TIME=50 0			5 Secs (967 Secs) [==>967.0 Secs]	[1]
	Comments: The buffer time is calculated under the assumption that the source will be faint enough that the count rate is less than 4e6/exptime, which should generally be true for our sources. If the source is significantly brighter in the UV, we will lower the buffer time as recommended in Chapter 11.1 of the STIS instrument handbook.									
3	(STIS.sp.22 57524)	(5) EP251020A	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=25 0			5 Secs (467 Secs) [==>467.0 Secs]	[1]	
Comments: The buffer time is calculated under the assumption that the source will be faint enough that the count rate is less than 4e6/exptime, which should nearly always be true for our ANTs in the FUV. Nevertheless, we will confirm the appropriate buffer time based on Swift observations of the UV SED of the source.										
4	(STIS.sp.22 57524)	(5) EP251020A	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=12 50			5 Secs (2459 Secs) [==>2459.0 Secs]	[2]	
Comments: The buffer time is calculated under the assumption that the source will be faint enough that the count rate is less than 4e6/exptime, which should nearly always be true for our ANTs in the FUV. Nevertheless, we will confirm the appropriate buffer time based on Swift observations of the UV SED of the source.										



Proposal 17721 - Epoch 2 (EP251020A) (04) - Building an ANT-hill: STIS UV Follow-up of Ambiguous Nuclear Transients

Tue Dec 09 19:00:16 GMT 2025

Visit	Proposal 17721, Epoch 2 (EP251020A) (04), implementation Diagnostic Status: Warning Scientific Instruments: STIS/NUV-MAMA, STIS/CCD, STIS/FUV-MAMA Special Requirements: SCHED 100%; ON HOLD Comments: <i>Second UV spectroscopic epoch of EP251020A.</i> On Hold Comments: <i>Requires discovery of a new ambiguous nuclear transient.</i>									
	(Epoch 2 (EP251020A) (04)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN (Epoch 2 (EP251020A) (04)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN									
Diagnosics										
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(5)	EP251020A	RA: 04 57 6.3768 (74.2765700d) Dec: -11 43 40.19 (-11.72783d) Equinox: J2000	Redshift: 0.026145	V=16.5+/-0.06 2.3e-16 erg/s/cm^2/A	Reference Frame: ICRS				
Comments: <i>The V magnitude is the host+transient measurement from Swift UVOT. The other flux provided is the transient-only flux in the Swift UVW1 filter.</i> Category=EXT-STAR Description=[ACCRETION DISK, NUCLEUS] Extended=NO										
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(STIS.ta.225 7525)	(5) EP251020A	STIS/CCD, ACQ, 50CCD	MIRROR				5 Secs (5 Secs) [==>]	[1]
	Comments: <i>We select the clear/50CCD filter as our target will be blue and we want to maximize contrast from the redder host galaxy. The nominal exposure time of 5 seconds with the clear 50CCD filter will provide sufficient S/N for sources with V magnitudes between 14.5 and 18.5. Outside of this range we will adjust the acquisition exposure time slightly as needed.</i>									
	2	(STIS.sp.22 57523)	(5) EP251020A	STIS/NUV-MAMA, TIME-TAG, 52X0.2	G230L 2376 A	BUFFER-TIME=50 0			5 Secs (1000 Secs) [==>1000.0 Secs]	[1]
	Comments: <i>The buffer time is calculated under the assumption that the source will be faint enough that the count rate is less than 4e6/exptime, which should generally be true for our sources. If the source is significant by brighter in the UV, we will lower the buffer time as recommended in Chapter 11.1 of the STIS instrument handbook.</i>									
3	(STIS.sp.22 57524)	(5) EP251020A	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=25 0			5 Secs (500 Secs) [==>500 Secs]	[1]	
Comments: <i>The buffer time is calculated under the assumption that the source will be faint enough that the count rate is less than 4e6/exptime, which should nearly always be true for our ANTs in the FUV. Nevertheless, we will confirm the appropriate buffer time based on Swift observations of the UV SED of the source. We use the 52x0.2 aperture as our default, although if the source fades more quickly than expected over the 100 day timespan between epochs, it may be necessary to use the 52X0.2D1 pseudo-aperture to avoid the FUV-MAMA glow region.</i>										
4	(STIS.sp.22 57524)	(5) EP251020A	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=12 50			5 Secs (2500 Secs) [==>2500.0 Secs]	[2]	
Comments: <i>The buffer time is calculated under the assumption that the source will be faint enough that the count rate is less than 4e6/exptime, which should nearly always be true for our ANTs in the FUV. Nevertheless, we will confirm the appropriate buffer time based on Swift observations of the UV SED of the source. We use the 52x0.2 aperture as our default, although if the source fades more quickly than expected over the 100 day timespan between epochs, it may be necessary to use the 52X0.2D1 pseudo-aperture to avoid the FUV-MAMA glow region.</i>										

