17894 - HST imaging and spectroscopy of the first off-nuclear tidal disruption event candidate

Cycle: 32, Proposal Category: GO/DD

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
Dr. Yuhan Yao (PI) (Contact)	**University of California - Berkeley**
Prof. Ryan Chornock (CoI)	University of California - Berkeley
Dr. Charlotte Ward (CoI)	Princeton University
Dr. Raffaella Margutti (CoI)	University of California - Berkeley
Mr. Itai Sfaradi (CoI)	University of California - Berkeley
Dr. Kate Denham Alexander (CoI)	University of Arizona
Dr. Wenbin Lu (CoI)	University of California - Berkeley
Luke Kelley (CoI)	University of California - Berkeley

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) AT2024TVD	WFC3/UVIS	1	19-Dec-2024 13:00:12.0	yes
02	(1) AT2024TVD (2) AT2024TVD-OFFSET	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	3	19-Dec-2024 13:00:13.0	yes

4 Total Orbits Used

ABSTRACT

The hierarchical assembly of galaxies through mergers naturally predicts the presence of off-nuclear massive black holes (MBHs). While tidal disruption events (TDEs) offer a unique avenue to probe this elusive population of wandering MBHs, no offset TDE has been observationally identified. Here we propose HST imaging and UV spectroscopy of AT2024tvd, a newly discovered TDE exhibiting a significant offset from its host galaxy's nucleus. AT2024tvd is the most compelling off-nuclear TDE candidate to date, showing all hallmark properties of nuclear TDEs --- luminous variable soft X-rays, a long-lived hot UV/optical component, and broad hydrogen and helium emission lines in its optical spectrum --- while astrometry from ZTF (optical) and Chandra (X-ray) suggests a spatial offset of ~1 arcsec. HST imaging will (1) unambiguously confirm the off-nuclear nature of AT2024tvd, (2) refine its position to precisely measure the offset, and (3) search for faint merger-related features in the host galaxy. Additionally, UV spectroscopy will allow us to extend our spectroscopic comparisons with nuclear TDEs to the peak of the spectral energy distribution and test the reprocessing scenario for TDE's UV/optical emission. This program will pioneer the intersection of time-domain astronomy and galaxy evolution, using TDEs to uncover the origins and demographics of off-nuclear massive black holes.

OBSERVING DESCRIPTION

We will observe AT2024tvd for four orbits.

First, we will use WFC3/UVIS to image the field for one orbit. We will use two filters: F225W and F625W.

Next, we will use STIS-MAMA to do spectroscopy for three orbits, including two orbits in FUV with the G140L grating and one orbit in NUV with the G230L grating.

Visit

Proposal 17894, Visit 01, scheduling Thu Dec 19 18:00:13 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: BETWEEN 10-JAN-2025:12:00:00 AND 25-JAN-2025:12:00:00; TOO RESPONSE TIME 35.0D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

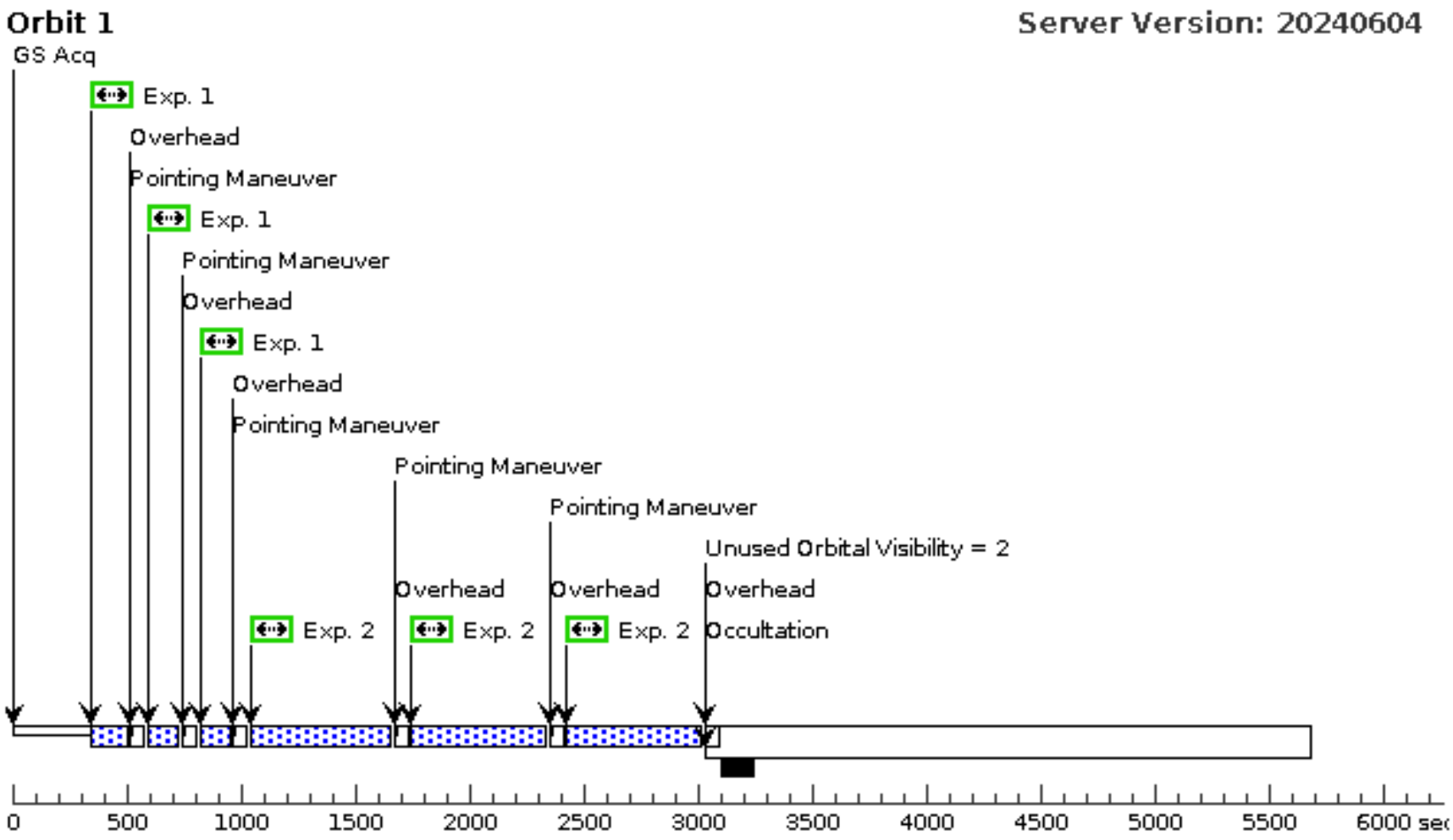
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	AT2024TVD	RA: 17 10 42.5738 (257.6773908d) Dec: +28 50 15.11 (28.83753d) Equinox: J2000	Parallax: 0" Epoch of Position: 2000 Redshift: 0.04494	V=19.0+/-0.3 FUV and NUV fluxes are estimated to be 18.9 +/- 0.3 mag (AB system)	Reference Frame: ICRS

Comments:
Category=UNIDENTIFIED
Description=[ACCRETION DISK, OPTICAL EMITTER, ULTRAVIOLET EMITTER, X-RAY EMITTER]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(WFC3UVIS.im.1945651)	(1) AT2024TVD	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F225W	FLASH=21		Pattern 1, Exps 1-1 in Visit 01 (1)	130 Secs (390 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
2		(1) AT2024TVD	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F625W	FLASH=5		Pattern 1, Exps 2-2 in Visit 01 (1)	589 Secs (1767 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***

Orbit Structure



Visit

Proposal 17894, Visit 02, implementation Thu Dec 19 18:00:13 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD, STIS/FUV-MAMA

Special Requirements: BETWEEN 10-JAN-2025:12:00:00 AND 25-JAN-2025:12:00:00; TOO RESPONSE TIME 35.0D

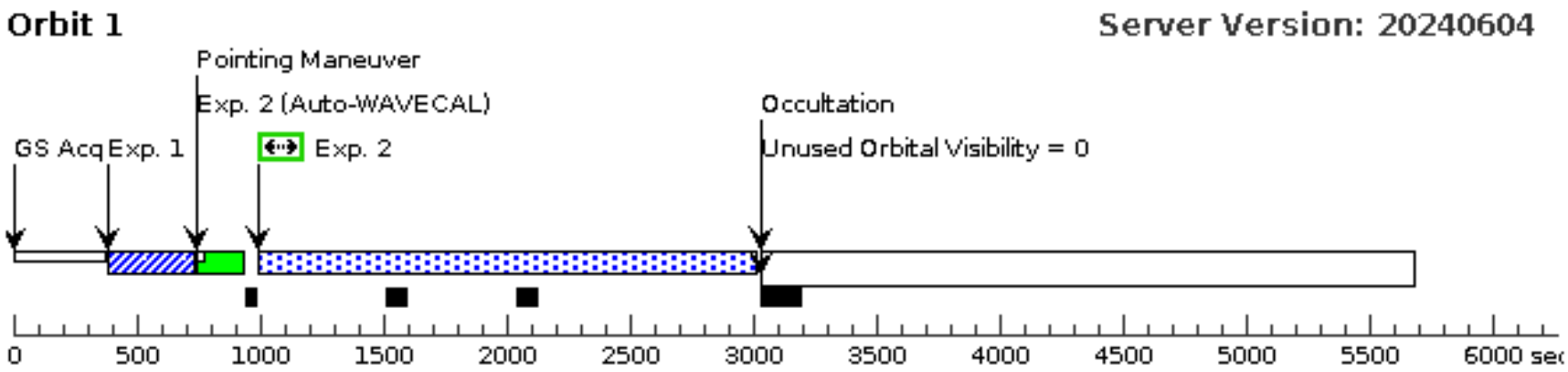
Fixed Targets

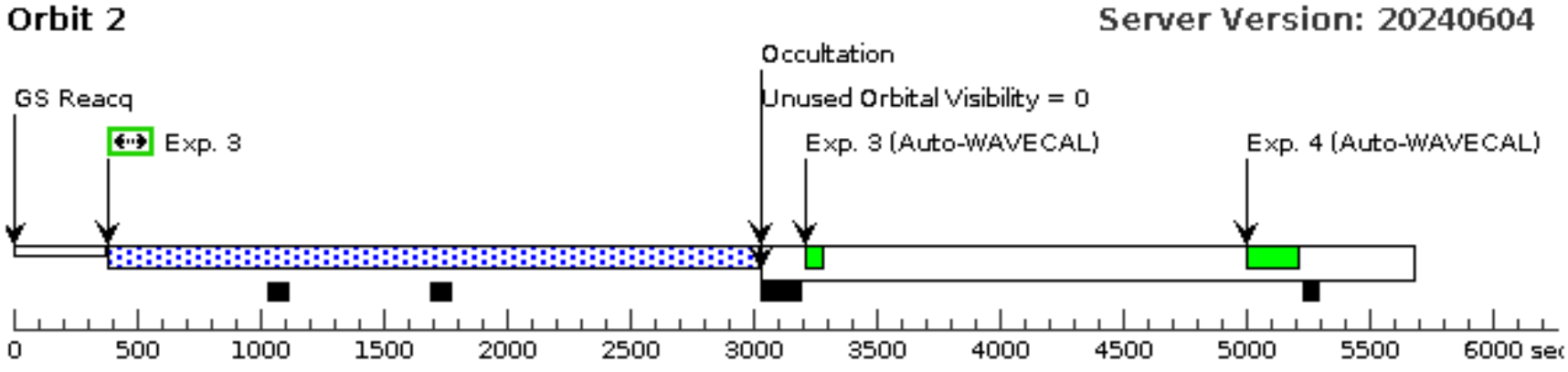
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	AT2024TVD	RA: 17 10 42.5738 (257.6773908d) Dec: +28 50 15.11 (28.83753d) Equinox: J2000	Parallax: 0" Epoch of Position: 2000 Redshift: 0.04494	V=19.0+/-0.3 FUV and NUV fluxes are estimated to be 18.9 +/- 0.3 mag (AB system)	Reference Frame: ICRS
Comments: *Category=UNIDENTIFIED* *Description=[ACCRETION DISK, OPTICAL EMITTER, ULTRAVIOLET EMITTER, X-RAY EMITTER]* *Extended=NO*					
(2)	AT2024TVD-OFFSET	RA: 17 10 42.9677 (257.6790321d) Dec: +28 49 40.93 (28.82804d) Equinox: J2000	Proper Motion RA: -2.641 mas/yr Proper Motion Dec: -4.187 mas/yr Epoch of Position: 2016	V=17.1+/-0.3	Reference Frame: ICRS
Comments: *Category=STAR* *Description=[UNDESIGNATED]* *Extended=NO*					

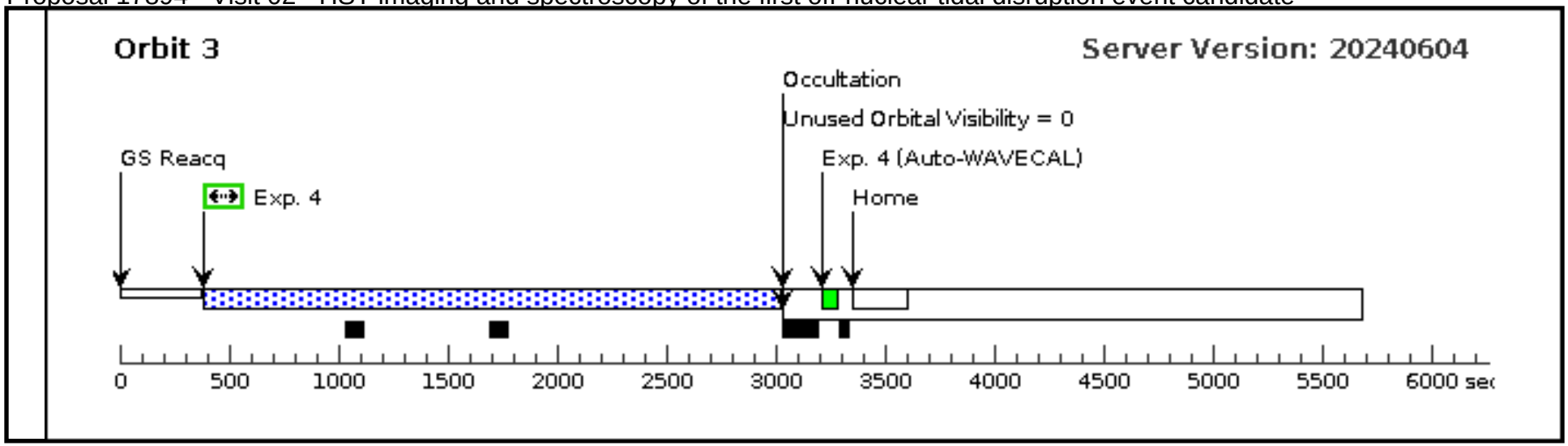
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	acquisition	(2) AT2024TVD-OFFSET	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			30 Secs (30 Secs) *[==>]*	 ***[1]***
Comments: This is an offset star.									
2	science FUV (1944054)	(1) AT2024TVD	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=520			2005 Secs (2005 Secs) *[==>]*	 ***[1]***
3	science FUV (1944054)	(1) AT2024TVD	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=657			2624 Secs (2624 Secs) *[==>]*	 ***[2]***
4	science NUV (1944055)	(1) AT2024TVD	STIS/NUV-MAMA, TIME-TAG, 52X0.2	G230L 2376 A	BUFFER-TIME=657			2624 Secs (2624 Secs) *[==>]*	 ***[3]***

Orbit Structure






Orbit 3
Server Version: 20240604
Occultation
Unused Orbital Visibility = 0
GS Reacq
Exp. 4 (Auto-WAVECAL)
Exp. 4
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec