17849 - Probing the UV spectral evolution of a unique TDE with early bright X-ray emission

Cycle: 31, Proposal Category: GO/DD

(Availability Mode: SUPPORTED)

INVESTIGATORS

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Prof. Jane Dai (CoI)	University of Hong Kong

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) AT2020AFHD	STIS/CCD STIS/NUV-MAMA	2	26-Aug-2024 09:00:23.0	yes
02	(1) AT2020AFHD	STIS/CCD STIS/FUV-MAMA	2	26-Aug-2024 09:00:24.0	yes

4 Total Orbits Used

ABSTRACT

The 2024 outburst of AT2020afhd was identified as a unique tidal disruption event (TDE) with bright soft X-ray emission (~10^43 erg/s) although with a large amplitude of variability. A timely UV spectrum around its optical peak has been obtained, which showed a very steep continuum slope. Interestingly, the UV continuum below 2000 A shows a notable excess relative to the extrapolation of the blackbody inferred from the photometric spectral energy distribution (SED). The overall SED can be better fitted by a steep powerlaw function with an index of about -3. This discovery indicates that the blackbody assumption of the SED may have severely underestimated the intrinsic bolometric luminosity, leading to the so-called "missing energy" puzzle. Such SEDs, with a steep rise towards the blue, have previously been predicted by the reprocessing model. Here we propose an additional epoch of UV spectroscopic observations with a small amount of time (4 orbits) for this ongoing unique TDE. At the time of observation, its luminosity (accretion rate) will have decreased by an order of magnitude compared to the first visit (26 February). Therefore, it will provide us an unprecedented opportunity to study the intrinsic SED of a TDE at different accretion phases, which will definitely serve as a new observational test of models (e.g. reprocessing) that account for the optical emission of TDEs. Meanwhile, the evolution of the UV emission lines, including some unknown ones, can also be studied. Furthermore, the detection or not of BAL features in a lower X-ray phase will help to confirm or exclude whether the dramatic X-ray variability is caused by the change in absorption.

OBSERVING DESCRIPTION

We request to use G140L and G230L gratings to obtain a continuous wavelength coverage from 1100 to 3000 $\AA$ in the rest frame. Since our primary goal is to obtain a SED in this wavelength range, we prefer to perform the observation in a single epoch. If this is not possible, we hope that the observations of the two gratings can be made as close together as possible.

A slit width of 0.2$\arcsec$ is preferred to cover the galaxy's nucleus and minimize the starlight contamination. The UVW1 and UVW2 magnitudes measured from the latest Swift epoch on August 02 are 17.94 and 18.13, respectively. We expect that the source will be ~0.5 mag fainter in a couple of months when the proposed observation is conducted. Thus we try to estimate the needed exposure time assuming a magnitude of 18.6 in UVW2, the band of which is less contaminated by host emission. The calculations were performed with the Exposure Time Calculator (ETC) of HST/STIS. We assume a powerlaw continuum with an index of -2.78, that is the continuum shape of the UV spectroscopic observation around the optical peak. To achieve a signal-to-noise ratio (S/N) of 10 at ~1500~\AA, it requires an exposure time of ~3600 seconds with the G140L grating. Based on our previous experiences in analyzing the STIS data, a similar time in G230L is also sufficient. The estimate is also roughly consistent with the estimated from the observation on Feb. 26. Our target is visible in the next few months by selecting the "Increase Scheduling Flexibility" flag in APT. The estimated orbit visibility is 49 minutes per orbit. Therefore, we request a total of 4 orbits (two orbits for each), including overheads.

Visit

Proposal 17849, Visit 01 Mon Aug 26 13:00:24 GMT 2024

Diagnostic Status: No Diagnostics

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

Special Requirements: (none)

Fixed Targets

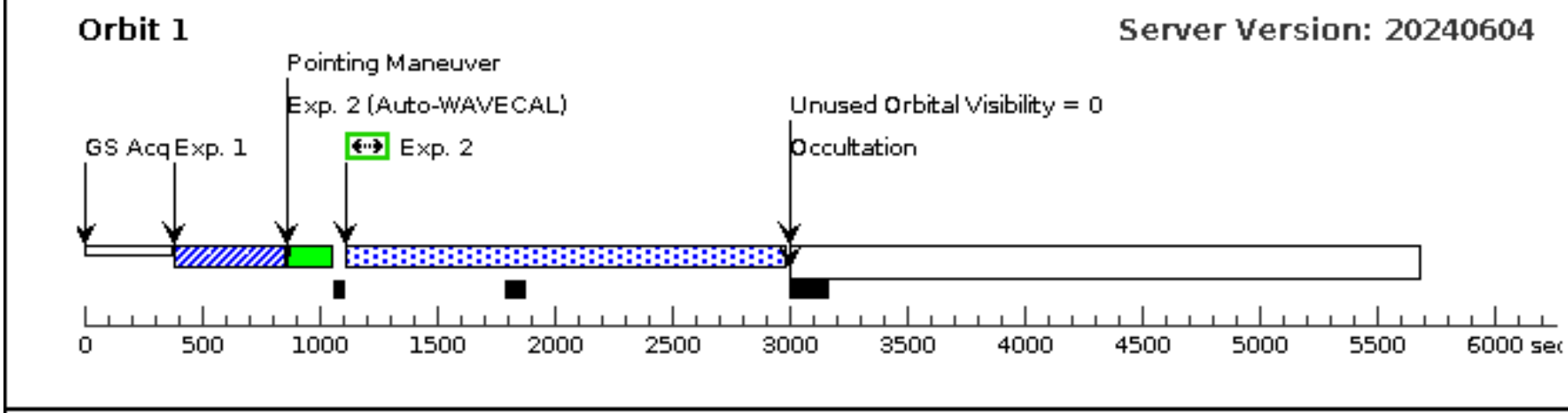
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	AT2020AFHD	RA: 03 13 35.6670 (48.3986125d) Dec: -02 09 6.21 (-2.15172d) Equinox: J2000		V=16.8+/-0.2	Reference Frame: ICRS

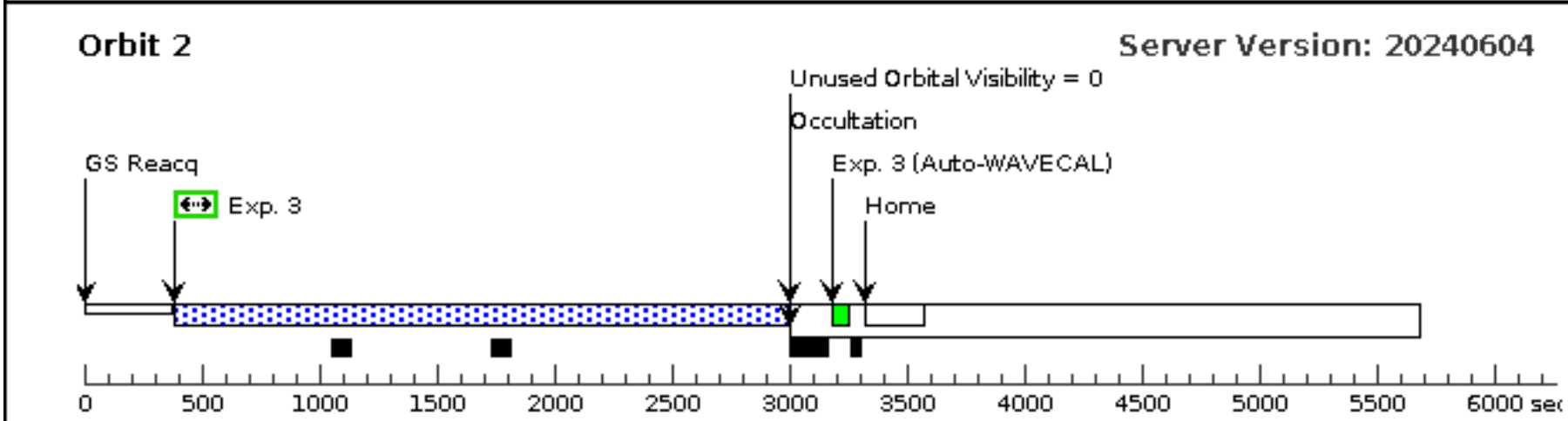
Comments:
Category=GALAXY
Description=[ACCRETION DISK, NUCLEUS, SEYFERT]

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	acquisition	(1) AT2020AFHD	STIS/CCD, ACQ, F28X50LP	MIRROR				60 Secs (60 Secs) *[==>]*	 ***[1]***
2	science (1928375)	(1) AT2020AFHD	STIS/NUV-MAMA, TIME-TAG, 52X0.2	G230L 2376 A	BUFFER-TIME=676			1858 Secs (1858 Secs) *[==>]*	 ***[1]***
3	science (1928375)	(1) AT2020AFHD	STIS/NUV-MAMA, TIME-TAG, 52X0.2	G230L 2376 A	BUFFER-TIME=676			2597 Secs (2597 Secs) *[==>]*	 ***[2]***

Orbit Structure





Visit

Proposal 17849, Visit 02 Mon Aug 26 13:00:25 GMT 2024

Diagnostic Status: No Diagnostics

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

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	AT2020AFHD	RA: 03 13 35.6670 (48.3986125d) Dec: -02 09 6.21 (-2.15172d) Equinox: J2000		V=16.8+/-0.2	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[ACCRETION DISK, NUCLEUS, SEYFERT]

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	acquisition	(1) AT2020AFHD	STIS/CCD, ACQ, F28X50LP	MIRROR				60 Secs (60 Secs) *[==>]*	 ***[1]***
2	science (1928375)	(1) AT2020AFHD	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=676			1858 Secs (1858 Secs) *[==>]*	 ***[1]***
3	science (1928375)	(1) AT2020AFHD	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=676			2597 Secs (2597 Secs) *[==>]*	 ***[2]***

Orbit Structure