16026 - Caught in the Act: Closest TDE Discovered Before Peak Light

Cycle: 27, Proposal Category: GO/DD

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) AT2019QIZ	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	1	03-Dec-2019 13:05:05.0	yes
02	(1) AT2019QIZ	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	1	03-Dec-2019 13:05:06.0	yes
03	(1) AT2019QIZ	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	1	03-Dec-2019 13:05:08.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
04	(1) AT2019QIZ	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	03-Dec-2019 13:05:09.0	yes

5 Total Orbits Used

ABSTRACT

Wide-field optical transient surveys have discovered about a dozen of tidal disruption events (TDEs), which belong to a rare class of transient phenomena that occur when an unlucky star is tidally disrupted by a supermassive black hole (SMBH). In recent years, two emission mechanisms (circularization v.s. reprocessing) have been put forward to explain the excess in the UV and optical emission in TDEs, which is unexpected according to the classical TDE framework. Albeit timely observations have only been made for ~5 TDEs so far, UV spectroscopy is critical to disentangling these scenarios, as most strong atomic features fall in this band. These emission and absorption line diagnostics can shine light on the physical state (velocity, density, composition) of the emitting gas (in analogy with quasars).

Being the closest and earliest TDE discovered and classified to date, AT2019qiz (at z=0.0151) is being intensively monitored by observations across the electromagnetic spectrum as it offers the first-ever opportunity to probe the early-time properties of a TDE. Here we propose to obtain 3 epochs of FUV and NUV observations of AT2019qiz at t_peak - 1 month, t_peak, and t_peak + 1 month with HST. These observations will allow us to test whether outflow is ubiquitous amongst TDEs and constrain its early evolution for the first time.

OBSERVING DESCRIPTION

We request 3 epochs of UV spectroscopy of the TDE AT2019qiz, over the wavelength range from 1200-3000A. Assuming a typical rise time of 50 days for TDEs, our designed cadence will be sampling AT2019qiz at t = tpeak - 1 month, tpeak, and tpeak + 1 month, respectively.

We use the most recent inferred blackbody temperature from the Swift-UVOT pho-tometry (T~22,000 K) as the input spectrum to estimate the expected SNR in different

instrumental congurations. Assuming an orbital visibility of 53 minutes, we find that we can obtain ~35 min of on-source exposure in a single orbit. We can achieve the best SNR in the near-UV (NUV) using STIS with the NUV-MAMA detector. Therefore, we also choose to use STIS with the FUV-MAMA detector for the far-UV (FUV) spectroscopy to avoid switching instruments during the same visit.

We request 1 orbit of HST time for each proposed epoch. We estimate the SNR conservatively by employing the most recent r-band magnitude (~16 mag). We can achieve a SNR per resolution element of >20 for the far UV with the G140L grating (over the range from 1150-1700A and a SNR per resolution element of >30 for the near UV (1650-3150A) for the continuum emission within 1 ks and ~500s exposure time, respectively. Even in the case where the TDE declines rapidly, the 1 ks exposure time will still yield a SNR~5 in the FUV and SNR~8 in the NUV at r = 20 mag.

Proposal 16026 - Visit 01 - Caught in the Act: Closest TDE Discovered Before Peak Light

Visit

Proposal 16026, Visit 01, completed Tue Dec 03 18:05:10 GMT 2019

Diagnostic Status: No Diagnostics

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

Special Requirements: BEFORE 22-OCT-2019:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(2), (3)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=0.55	Center Pattern=false		
	Line Spacing=			

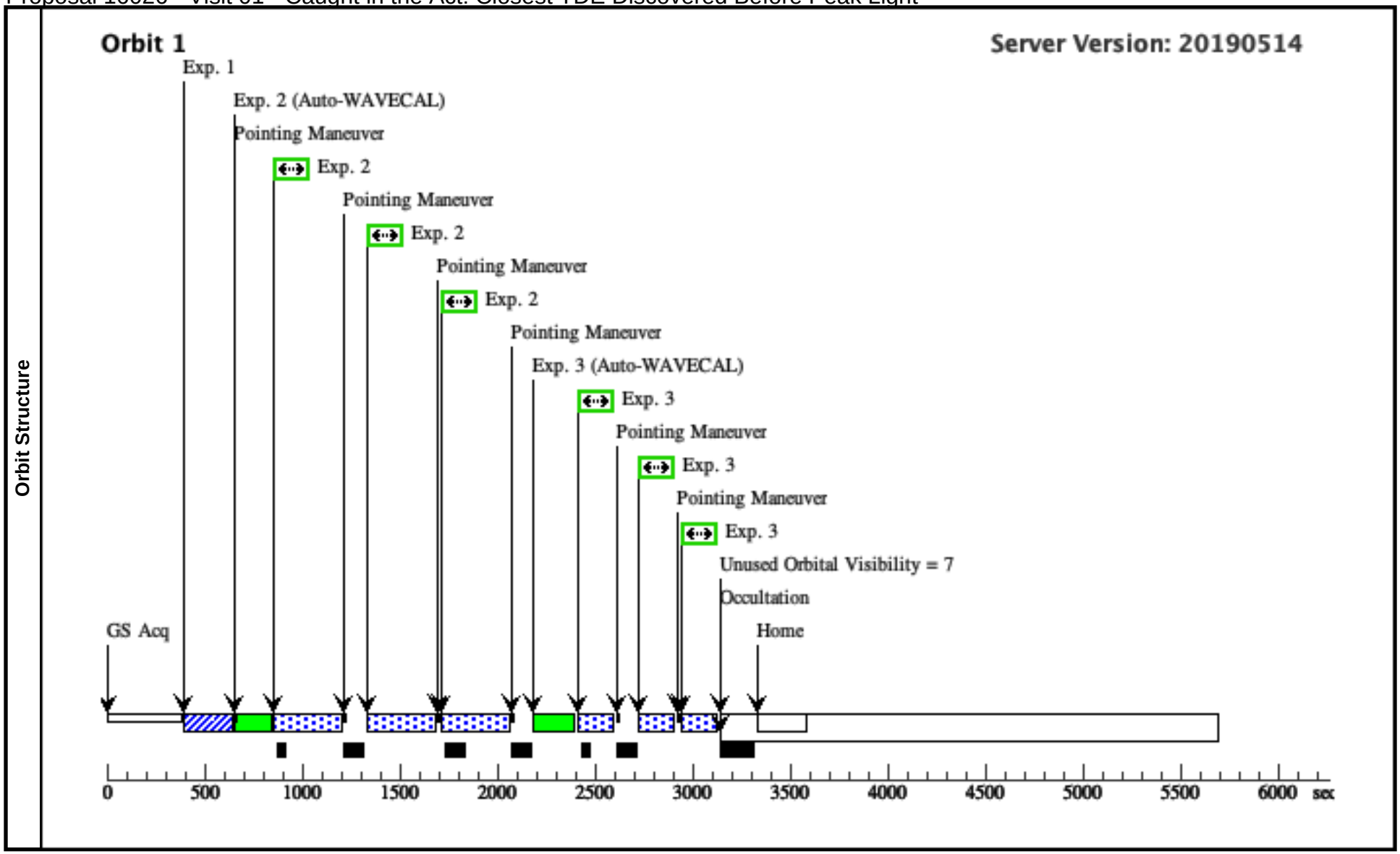
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	AT2019QIZ	RA: 04 46 37.8800 (71.6578333d)		V=16	Reference Frame: ICRS
		Dec: -10 13 34.90 (-10.22636d)			
		Equinox: J2000			

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

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1383712)	(1) AT2019QIZ	STIS/CCD, ACQ, F28X50LP	MIRROR				5 Secs (5 Secs)	
								[==>]	***[1]***
2	(1383725)	(1) AT2019QIZ	STIS/FUV-MAMA, ACCUM, 52X0.2	G140L 1425 A			Pattern 1, Exps 2-2 in Visit 01 (1)	335 Secs (1005 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[1]***
								[==>(Pattern 3)]	
3	(1383726)	(1) AT2019QIZ	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A			Pattern 1, Exps 3-3 in Visit 01 (1)	170 Secs (510 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[1]***
								[==>(Pattern 3)]	


Orbit Structure
Orbit 1
Server Version: 20190514
Exp. 1
Exp. 2 (Auto-WAVECAL)
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 3 (Auto-WAVECAL)
Exp. 3
Pointing Maneuver
Exp. 3
Pointing Maneuver
Exp. 3
Unused Orbital Visibility = 7
Occultation
GS Acq
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 16026, Visit 02, failed Tue Dec 03 18:05:10 GMT 2019

Diagnostic Status: No Diagnostics

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

Special Requirements: AFTER_01 BY 25 D TO 40 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(2), (3)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=0.55	Center Pattern=false		
	Line Spacing=			

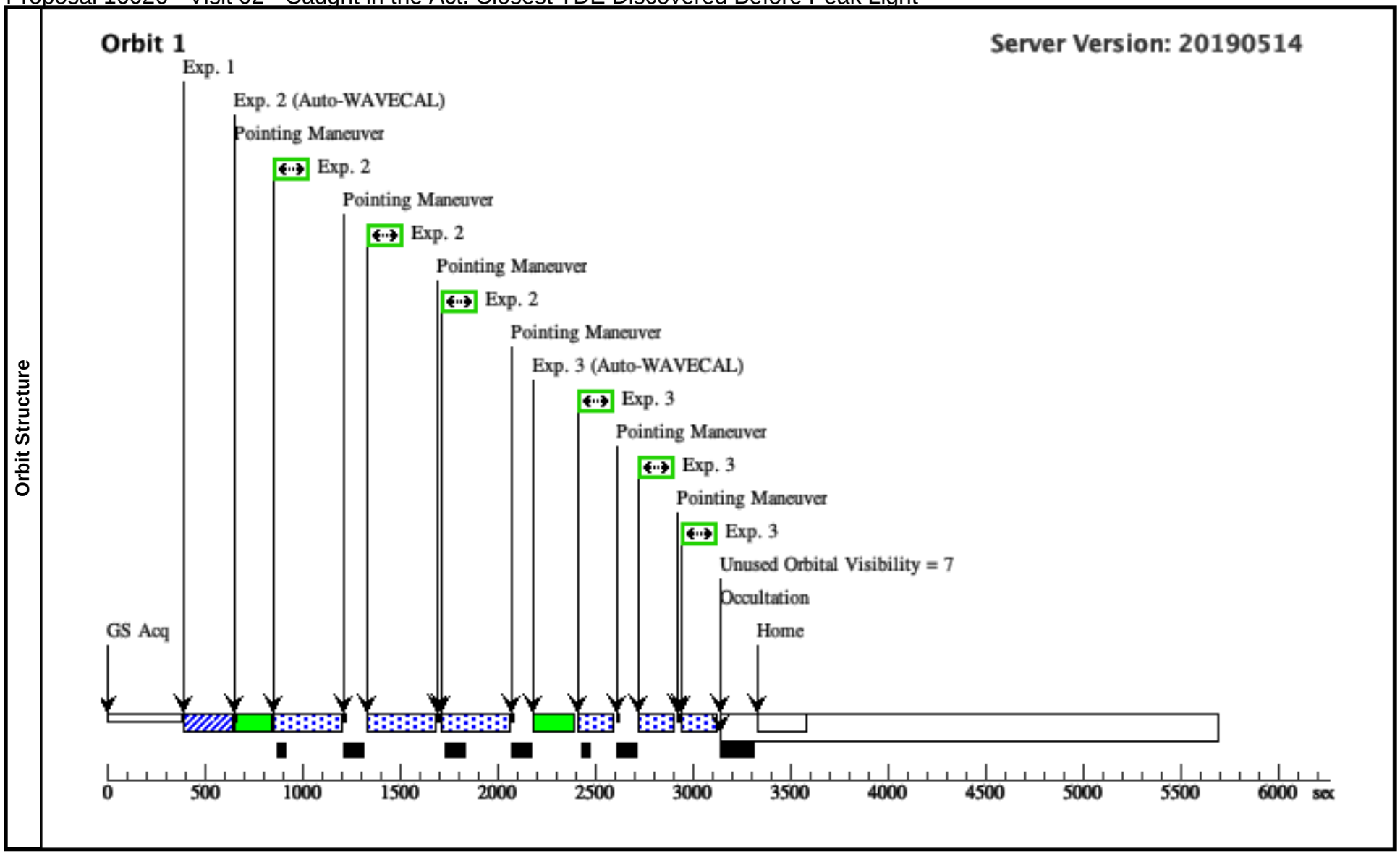
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	AT2019QIZ	RA: 04 46 37.8800 (71.6578333d) Dec: -10 13 34.90 (-10.22636d) Equinox: J2000		V=16	Reference Frame: ICRS

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

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1383712)	(1) AT2019QIZ	STIS/CCD, ACQ, F28X50LP	MIRROR				5 Secs (5 Secs)	
								[==>]	***[1]***
2	(1383725)	(1) AT2019QIZ	STIS/FUV-MAMA, ACCUM, 52X0.2	G140L 1425 A			Pattern 1, Exps 2-2 in Visit 02 (1)	335 Secs (1005 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[1]***
								[==>(Pattern 3)]	
3	(1383726)	(1) AT2019QIZ	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A			Pattern 1, Exps 3-3 in Visit 02 (1)	170 Secs (510 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[1]***
								[==>(Pattern 3)]	


Orbit Structure
Orbit 1
Server Version: 20190514
Exp. 1
Exp. 2 (Auto-WAVECAL)
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 3 (Auto-WAVECAL)
Exp. 3
Pointing Maneuver
Exp. 3
Pointing Maneuver
Exp. 3
Unused Orbital Visibility = 7
Occultation
GS Acq
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 16026, Visit 03, scheduled Tue Dec 03 18:05:11 GMT 2019

Diagnostic Status: No Diagnostics

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

Special Requirements: AFTER 02 BY 25 D TO 40 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(2), (3)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=0.55	Center Pattern=false		
	Line Spacing=			

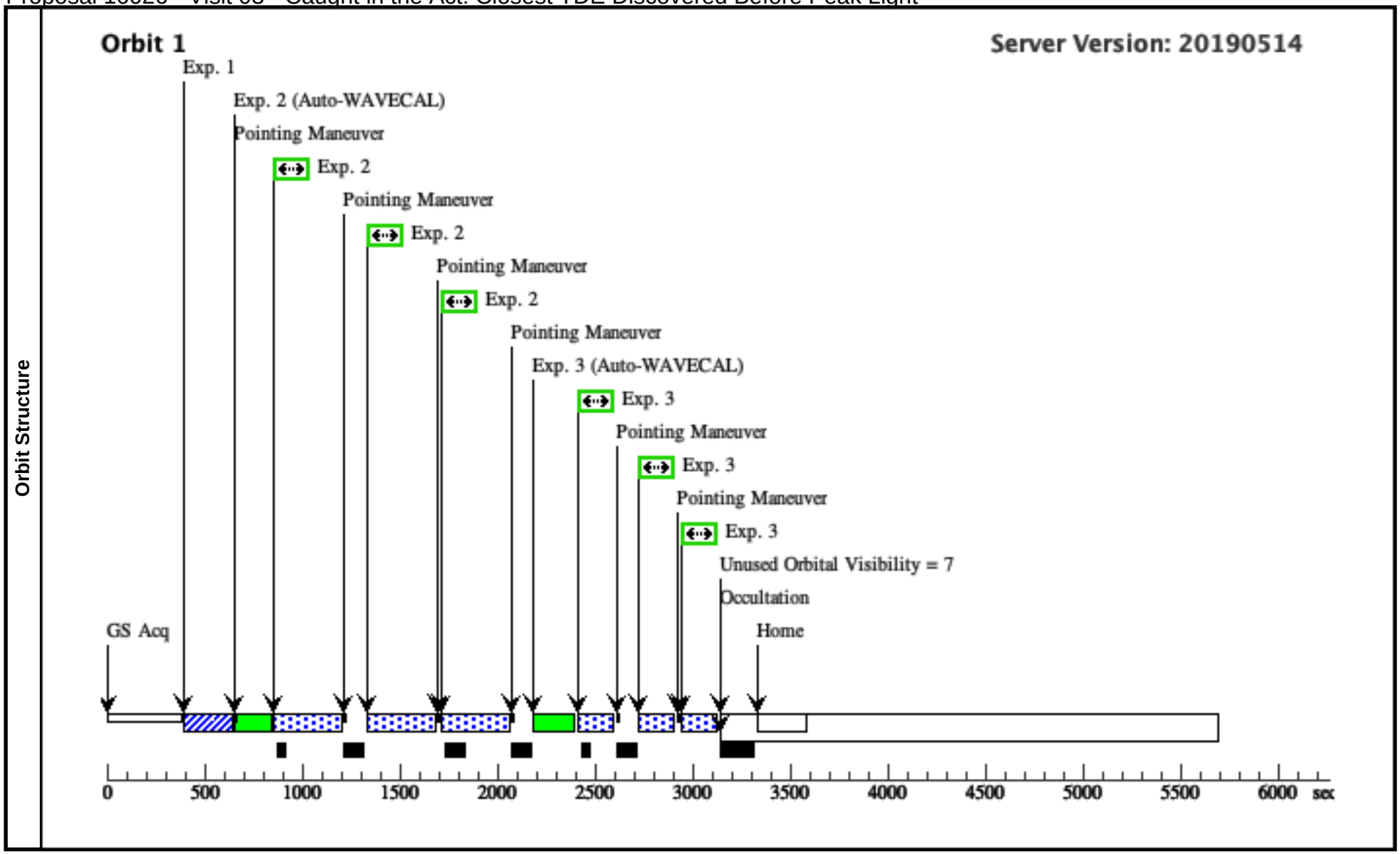
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	AT2019QIZ	RA: 04 46 37.8800 (71.6578333d) Dec: -10 13 34.90 (-10.22636d) Equinox: J2000		V=16	Reference Frame: ICRS

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

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1383712)	(1) AT2019QIZ	STIS/CCD, ACQ, F28X50LP	MIRROR				5 Secs (5 Secs)	
								[==>]	***[1]***
2	(1383725)	(1) AT2019QIZ	STIS/FUV-MAMA, ACCUM, 52X0.2	G140L 1425 A			Pattern 1, Exps 2-2 in Visit 03 (1)	335 Secs (1005 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[1]***
								[==>(Pattern 3)]	
3	(1383726)	(1) AT2019QIZ	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A			Pattern 1, Exps 3-3 in Visit 03 (1)	170 Secs (510 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[1]***
								[==>(Pattern 3)]	


Orbit Structure
Orbit 1
Server Version: 20190514
Exp. 1
Exp. 2 (Auto-WAVECAL)
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 3 (Auto-WAVECAL)
Exp. 3
Pointing Maneuver
Exp. 3
Pointing Maneuver
Exp. 3
Unused Orbital Visibility = 7
Occultation
GS Acq
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 16026, Visit 04 Tue Dec 03 18:05:11 GMT 2019

Diagnostic Status: No Diagnostics

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

Special Requirements: AFTER 03 BY 25 D TO 40 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(2), (3)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=0.55	Center Pattern=false		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	AT2019QIZ	RA: 04 46 37.8800 (71.6578333d) Dec: -10 13 34.90 (-10.22636d) Equinox: J2000		V=16	Reference Frame: ICRS

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

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1383712)	(1) AT2019QIZ	STIS/CCD, ACQ, F28X50LP	MIRROR				5 Secs (5 Secs) *[==>]*	***[1]***
2	(1395746)	(1) AT2019QIZ	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A			Pattern 1, Exps 2-2 in Visit 04 (1)	692 Secs (2076 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
3	(1395745)	(1) AT2019QIZ	STIS/FUV-MAMA, ACCUM, 52X0.2	G140L 1425 A			Pattern 1, Exps 3-3 in Visit 04 (1)	876 Secs (2628 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[2]***

Orbit Structure