16943 - Exploring the Nature of the Recurring Flare in ULIRG F01004-2237 with UV spectroscopic Diagnosis

Cycle: 29, Proposal Category: GO/DD

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Ning Jiang (PI) (Contact)	**University of Science & Technology of China**	**jnac@ustc.edu.cn**
Dr. Stephen Bradley Cenko (CoI) (AdminUSPI) (Contact)	NASA Goddard Space Flight Center	brad.cenko@nasa.gov
Dr. Luming Sun (CoI)	Anhui Normal University	sunluming@ahnu.edu.cn
Mr. Subo Dong (CoI)	Peking University	dongsubo@pku.edu.cn
Dr. Liming Dou (CoI)	Guangzhou University	doulm@gzhu.edu.cn
Dr. Zhu Liu (CoI) (ESA Member)	Max-Planck-Institut fur extraterrestrische Physik	liuzhu@mpe.mpg.de

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) F01004-2237	STIS/CCD STIS/NUV-MAMA	3	24-Jun-2022 10:00:28.0	yes
02	(1) F01004-2237	STIS/CCD STIS/FUV-MAMA	2	24-Jun-2022 10:00:30.0	yes

5 Total Orbits Used

ABSTRACT

An unexpected luminous optical flare (peak Mg=-21.4) turns up in ULIRG F01004-2237 since 2021 September, revealed by its ATLAS and ASASSN light curves. This nearby galaxy once held a candidate tidal disruption event (TDE) because a luminous flare occurred in 2010, and now it brightens up again. The Gaia has also detected the new flare and pinpointed it at the galaxy's center. The flare is now UV bright yet X-ray weak, and its optical spectrum shows extremely broad Balmer emission lines. These observations have ruled out a supernova as its origin, and therefore the flare is likely to be associated with the central supermassive black hole (SMBH). Such recurrent flares are rare as only few reported recurrent flares in other galaxies with diverse time intervals. Their nature are still ambiguous. They may be caused by repeated TDEs, partial TDE, SMBH binary or peculiar accretion disk instabilities. The timely discovery of the ongoing recurring flare in F01004-2237 offers a unique opportunity to acquire useful clues. Aiming to further explore the mechanism that drives the second flare as well as its connection with the first one, we here propose to conduct STIS UV spectroscopic observations on F01004-2237 with 5 orbits time. Because the flare is darkening, we require the observation to be done as early as possible within the upcoming two visbility windows. The immediate objectives are mainly in three folds: 1) to better map the flare's SED and thus distinguish between the powerlaw (AGN) and blackbody (TDE) scenarios; 2) to detect possible characteristic UV emission lines of either TDEs or AGNs; 3) to detect possible UV absorption lines which might address the X-ray weakness.

OBSERVING DESCRIPTION

We request a single epoch (that could be split into multiple visits, if necessary) of UV spectroscopy of the recurring TDE candidate in IRAS F01004-2237, over the wavelength range from 1200-3000A. HST, with its sensitive UV spectrographs and exquisite angular resolution, is the only facility that can conduct such observations. We assume a spectrum proportional to lambda^(-2.2) and an AB magnitude of 18.4 in UVW1 band as suggested by the latest Swift observation. We assume that our targets are visible for 53 minutes each orbit. After including overheads for guide-star acquisition (6 min for the first orbit, 4 min for the subsequent orbits), target acquisition (~ 8 min for an extended source, no peak-up required for 0.2" slit width), and wavelength calibration (4 min per orbit), we find that we can obtain 35 min of exposure in the first orbit (43 in subsequent orbits). We request to allocate three-orbit time for G230L and two-orbit time for G140L, which will result in 7260 and 4680 second exposure time, respectively. According to the exposure time calculator by inputting our assumed SED, we would expect a SNR per resolution element >=10 for the range from 1650-3100 A. In addition, we use the actual data of iPTF16fnl on +51 day (Brown et al. 2018) as a reference. During this observation, iPTF16fnl had a UVW1 magnitude of 18.1 and a UV spectrum consistent with a blackbody curve with TBB ~32000 K, indicating that it is ~30% brighter than our target in the FUV band. The exposure time of iPTF16fnl is 4785 seconds and 5500 seconds for the G140L and G230L gratings, respectively, similar to our requested time. The SNR of the actual spectrum of iPTF16fnl meets our requirements. To summarize, we request a single epoch of STIS spectroscopy of F01004-2237, for a total of 5 orbits (2 FUV + 3 NUV).

Visit

Proposal 16943, Visit 01, implementation Fri Jun 24 14:00:30 GMT 2022

Diagnostic Status: No Diagnostics

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

Special Requirements: BEFORE 01-AUG-2022:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(2), (3), (4)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=0.4165	Center Pattern=false		
	Line Spacing=			

Fixed Targets

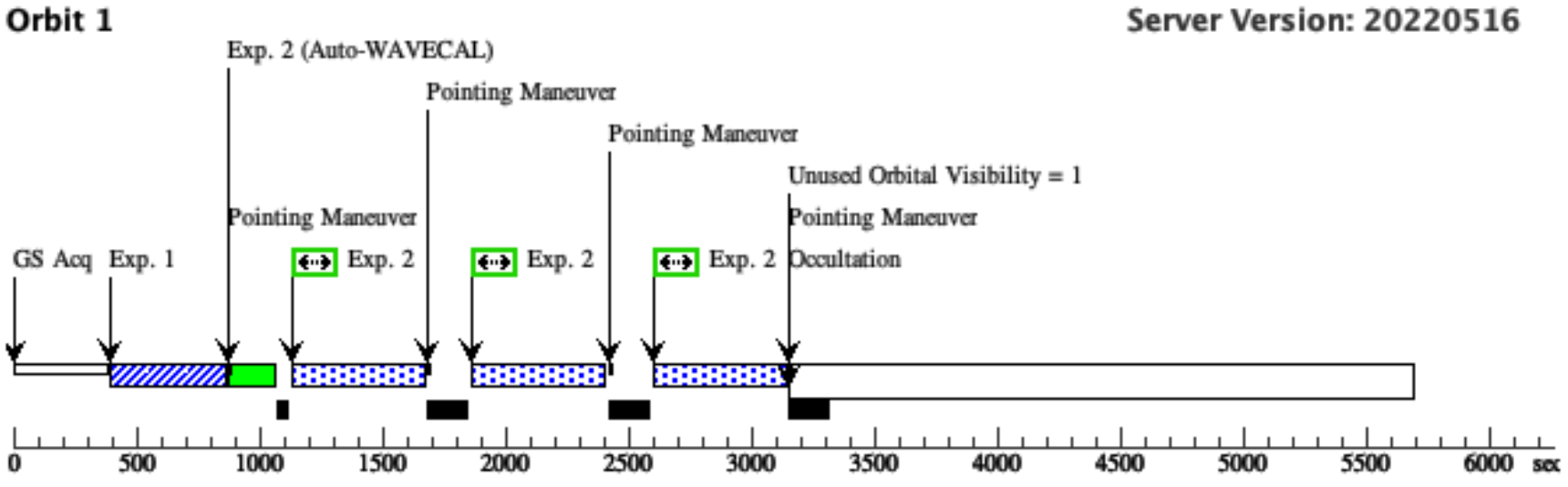
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	F01004-2237	RA: 01 02 50.0088 (15.7083700d) Dec: -22 21 57.20 (-22.36589d) Equinox: J2000	Redshift: 0.11797	V=17.3+/-0.2	Reference Frame: ICRS

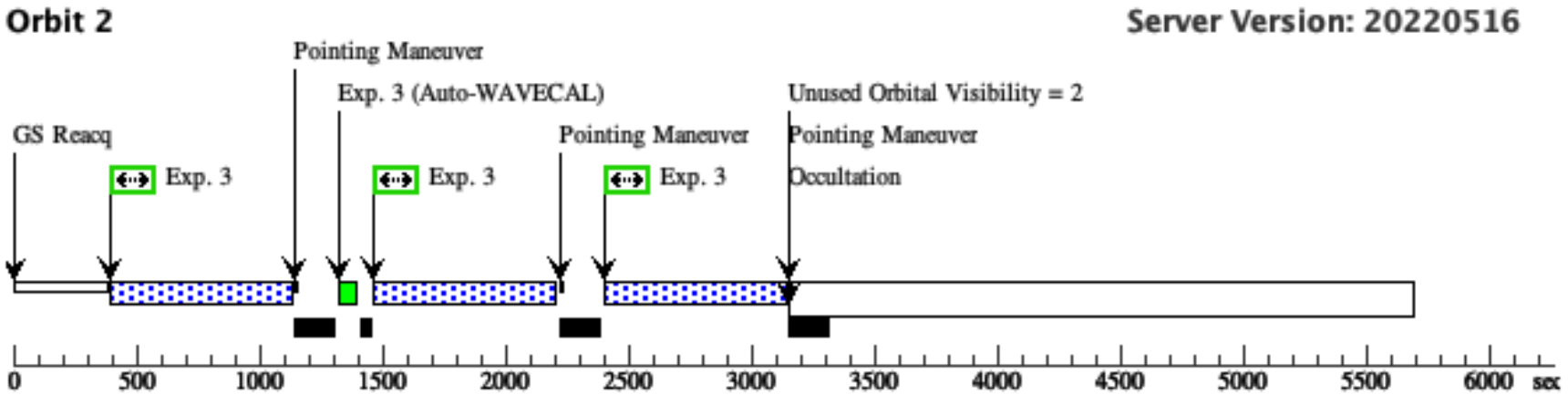
Comments: This object was generated by the targetselector and retrieved from the NED database.This object was generated by the targetselector and retrieved from the NED database.
Category=GALAXY
Description=[ACCRETION DISK, NUCLEUS, SEYFERT]

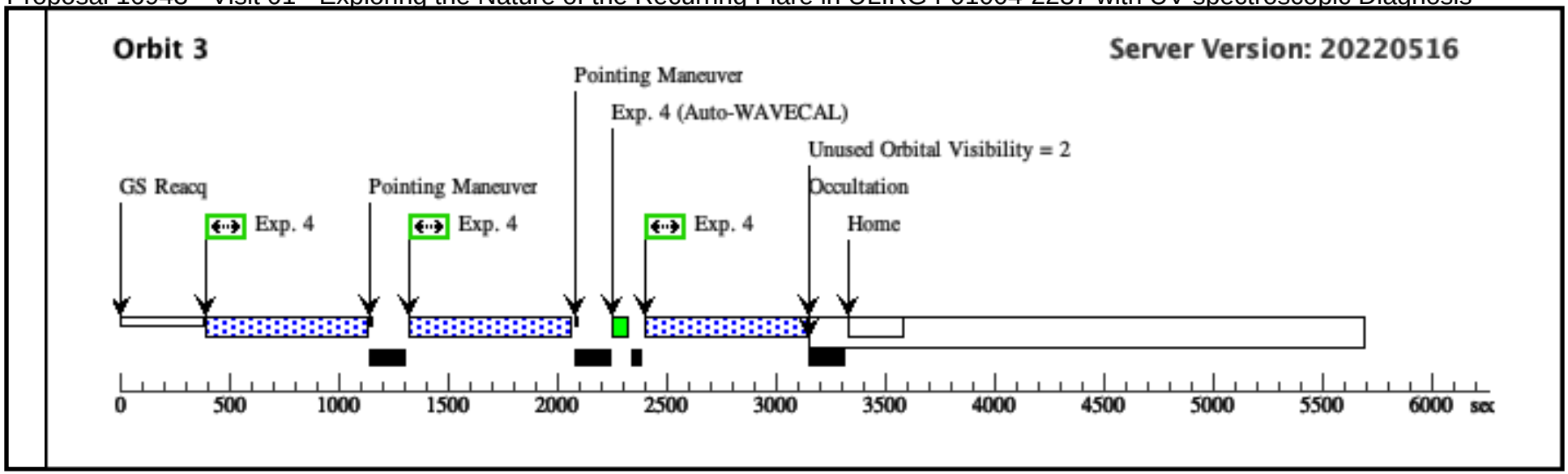
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1805455)	(1) F01004-2237	STIS/CCD, ACQ, F28X50LP	MIRROR				60 Secs (60 Secs)	
								[==>]	***[1]***
2	(1805403)	(1) F01004-2237	STIS/NUV-MAMA, TIME-TAG, 52X0.2	G230L 2376 A	BUFFER-TIME=676		Pattern 1, Exps 2-2 in Visit 01 (1)	528 Secs (1584 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
3	(1805403)	(1) F01004-2237	STIS/NUV-MAMA, TIME-TAG, 52X0.2	G230L 2376 A	BUFFER-TIME=676		Pattern 1, Exps 3-3 in Visit 01 (1)	727 Secs (2181 Secs)	
								[==>(Pattern 1)]	***[2]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
4	(1805403)	(1) F01004-2237	STIS/NUV-MAMA, TIME-TAG, 52X0.2	G230L 2376 A	BUFFER-TIME=676		Pattern 1, Exps 4-4 in Visit 01 (1)	727 Secs (2181 Secs)	
								[==>(Pattern 1)]	***[3]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	

Orbit Structure






Orbit 3
Server Version: 20220516
Pointing Maneuver
Exp. 4 (Auto-WAVECAL)
Unused Orbital Visibility = 2
GS Reacq
Pointing Maneuver
Occultation
Exp. 4
Exp. 4
Exp. 4
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 16943, Visit 02, implementation Fri Jun 24 14:00:30 GMT 2022

Diagnostic Status: No Diagnostics

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

Special Requirements: BEFORE 01-AUG-2022:00:00:00

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=0.4165	Center Pattern=false		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	F01004-2237	RA: 01 02 50.0088 (15.7083700d) Dec: -22 21 57.20 (-22.36589d) Equinox: J2000	Redshift: 0.11797	V=17.3+/-0.2	Reference Frame: ICRS

Comments: This object was generated by the targetselector and retrieved from the NED database.This object was generated by the targetselector and retrieved from the NED database.
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	(1805455)	(1) F01004-2237	STIS/CCD, ACQ, F28X50LP	MIRROR				60 Secs (60 Secs)	
								[==>]	***[1]***
2	(1805402)	(1) F01004-2237	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=676		Pattern 1, Exps 2-2 in Visit 02 (1)	528 Secs (1584 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[1]***
								[==>(Pattern 3)]	
3	(1805402)	(1) F01004-2237	STIS/FUV-MAMA, TIME-TAG, 52X0.2	G140L 1425 A	BUFFER-TIME=676		Pattern 1, Exps 3-3 in Visit 02 (1)	727 Secs (2181 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	

Orbit Structure