17899 - Unmasking the central engine in a Cow-like transient with XMM, VLT, CXO and HST

Cycle: 32, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
Dr. Ashley Chrimes (PI) (ESA Member) (Contact)	**European Space Agency - ESTEC**
Prof. Peter G. Jonker (CoI) (ESA Member)	Radboud Universiteit Nijmegen
Prof. Andrew James Levan (CoI) (ESA Member)	Radboud Universiteit Nijmegen
Dr. Deanne Coppejans (CoI) (ESA Member)	University of Warwick
Prof. Paul J. Groot (CoI) (ESA Member)	Radboud Universiteit Nijmegen
Dr. Anne Inkenhaag (CoI) (ESA Member)	University of Bath

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(2) PLACEHOLDER-LFBOT	WFC3/UVIS	1	09-Jan-2025 10:00:11.0	yes
02	(2) PLACEHOLDER-LFBOT	WFC3/UVIS	1	09-Jan-2025 10:00:12.0	yes

2 Total Orbits Used

ABSTRACT

Luminous Fast Blue Optical Transients (LFBOTs, or Cow-like transients, after the prototypical AT2018cow) are characterised by luminous multi-wavelength emission, blue optical colours and rapid evolution that is inconsistent with Ni56-powered supernovae (SNe). Although the number of LFBOTs is growing thanks to high-cadence, deep and wide-field surveys, detailed studies of individual events are lacking. These are necessary to determine the central engine and progenitor. We propose a joint programme, utilising XMM- Newton, the Very Large Telescope (VLT), Chandra X-

ray Observatory (CXO) and Hubble Space Telescope (HST) to firmly identify a single, low redshift LFBOT and to determine the nature of its central engine. We will monitor the long-timescale X-ray/UV light-curve, measure short-timescale X-ray variability and use environmental clues to distinguish between neutron star, stellar mass and intermediate mass black holes as the power source - placing the strongest constraints yet on the progenitors of these puzzling events.

OBSERVING DESCRIPTION

Two orbits (2 epochs, non-disruptive ToOs, 1 orbit per epoch) of HST/WFC3 imaging to pinpoint the transient location, determine the host galaxy morphology, and to follow the UV light-curve up to 3-4 months post-explosion. The first epoch will be at ~25 days. The second epoch, at ~3-4 months, will enable us to follow the lightcurve as it starts to plateau (assuming AT2018cow-like behaviour). Even if not, we will obtain an unobstructed view of the environment directly under the transient. Difference imaging between epochs 1 and 2 will reveal the precise location within the host, and along with the early-time XMM/OM UV data, we will obtain a UV light-curve spanning 3-4 months and several magnitudes in luminosity.

In each 20-min (half-orbit) observation we will reach m(F275W)=26 and m(F555W)=26.5 (AB) for SNR= 5 point source detections. A Cow-like event at z = 0.1 would have m(UV)~22 (26) at ~30 days (3-4 months).

Visit

Proposal 17899, Epoch 1 (01), implementation Thu Jan 09 15:00:13 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: TOO RESPONSE TIME 25.0D

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)

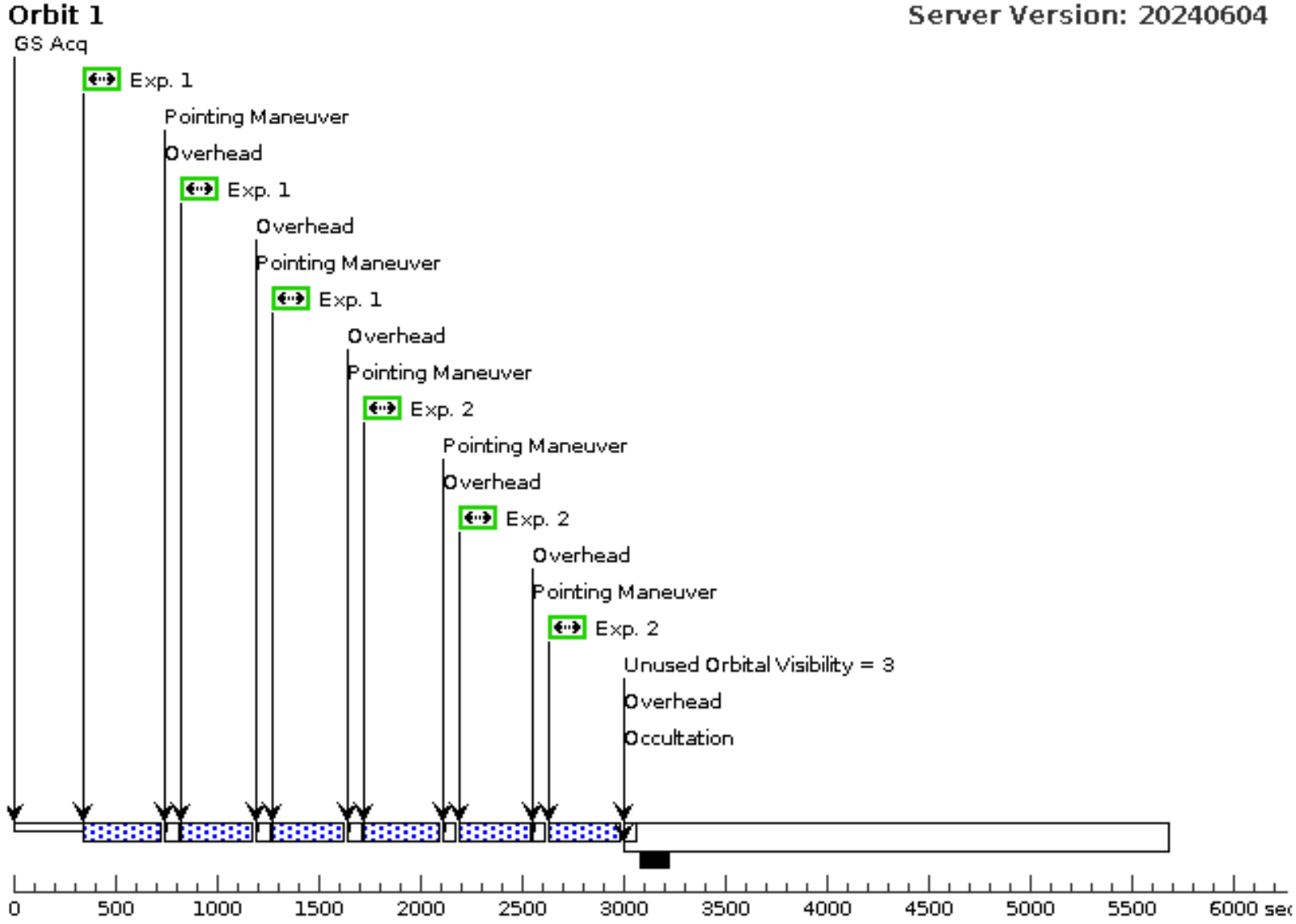
Generic Targets

#	Name	Criteria	Description
(2)	PLACEHOLDER-LFBOT	Newly discovered LFBOT	SUPERNOVA

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Epoch 1 F275W	(2) PLACEHOLDER-LFBOT	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F275W	FLASH=16		Pattern 1, Exps 1-1 in Epoch 1 (01) (1)	354 Secs (1062 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	 ***[1]***
2	Epoch 1 F555W	(2) PLACEHOLDER-LFBOT	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F555W	FLASH=7		Pattern 1, Exps 2-2 in Epoch 1 (01) (1)	354 Secs (1062 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	 ***[1]***

Orbit Structure



Visit

Proposal 17899, Epoch 2 (02), implementation Thu Jan 09 15:00:13 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: AFTER 01 BY 60.0 D TO 365.0 D; ON HOLD FOR 01; TOO RESPONSE TIME 90.0D

On Hold Comments: To be excuted >~2 months after visit 01.

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)

Generic Targets

#	Name	Criteria	Description
(2)	PLACEHOLDER-LFBOT	Newly discovered LFBOT	SUPERNOVA

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Epoch 2 F275W	(2) PLACEHOLDER-LFBOT	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F275W	FLASH=16		Pattern 1, Exps 1-1 in Epoch 2 (02) (1)	354 Secs (1062 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
2	Epoch 2 F555W	(2) PLACEHOLDER-LFBOT	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F555W	FLASH=7		Pattern 1, Exps 2-2 in Epoch 2 (02) (1)	354 Secs (1062 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***

Orbit Structure