17290 - Probing the nature of the UV-bright transient emission from AT2018cow more than 4 years post-explosion

Cycle: 30, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
Yuyang Chen (PI) (CSA Member) (Contact)	**University of Toronto**
Maria Drout (CoI) (CSA Member)	University of Toronto
Prof. Ryan Foley (CoI) (AdminUSPI)	University of California - Santa Cruz
Dr. Anthony Piro (CoI)	Carnegie Institution of Washington
Dr. Charles Kilpatrick (CoI)	Northwestern University

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) AT2018COW	WFC3/UVIS	5	19-Sep-2023 12:00:16.0	yes
02	(1) AT2018COW	WFC3/UVIS	1	19-Sep-2023 12:00:17.0	yes

6 Total Orbits Used

ABSTRACT

Recent advances in high-cadence surveys have revealed a new class of luminous and rapidly-evolving transients, which are not intrinsically rare but pose significant challenges to conventional supernova models. In 2018, an extreme member of this class, AT2018cow, was identified. AT2018cow was the first rapidly-evolving transient discovered promptly at a small distance, facilitating intensive multiwavelength follow-up. However, despite being the most extensively studied transient of its class, its true nature is still debated, with possibilities ranging from tidal disruption events to the failed explosion of a massive star.

Late-time observations of rapidly-evolving transients offer a means to break this degeneracy, and HST images taken during 2020 (more than 700 days post-explosion) revealed a UV-bright point source at the precise position of AT2018cow. The nature of this source was initially ambiguous, as it could be interpreted as either emission from the transient or an underlying stellar population. However, new observations obtained in June 2022 now definitively show that the source is fading in the UV---and hence that the emission is due to AT2018cow itself. Here we request a single epoch of HST/UVIS imaging in order to further trace the decline rate and change in spectral shape of the late-time emission, necessary to constrain the power source. In particular, extrapolations based on the 2020 and 2022 data indicate the peak of the SED may shift into the HST band during Mid-Cycle 30. We emphasize that with its current UV-optical brightness of 25-27 mag (AB), HST is the only current instrument capable of probing this source.

OBSERVING DESCRIPTION

We request five orbits of observations with WFC3/UVIS to constrain the evolution of a transient underlying source at the position of AT2018cow more than 4 years post-explosion. For the observations, we request the use of two UV filters (F225W and F336W), three optical filters (F438W, F555W, and F814W), and one narrow Halpha filter (F665N).

Two orbits are used to observe in the F814W and F665N filters with a box dither: each orbit contains four exposures (two for each filter). Three orbits are used to observe in the F225W, F336W, F438W, and F555W filters with a 3-point line dither: each orbit contains four exposures (one for each filter). The UVIS2-C1K1C-SUB aperture is used for all exposures to reduce overheads. We are aware of the recommendation of 1-3 orbits per visit for Cycle 30, but for our proposal, we do request a single visit that includes all five orbits. The reason is that our objective is to obtain an accurate spectral energy distribution of an evolving/transient source at a single epoch, which can only be achieved if all filters are observed at approximately the same time (i.e., consecutively). Finally, as indicated in the phase I proposal, we request the observation to be taken during the second half of Cycle 30 (after the start of April) when the predicted spectral evolution becomes significant enough to be discernible.

Visit

Proposal 17290, Visit 01, failed Tue Sep 19 16:00:18 GMT 2023

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: AFTER 01-APR-2023:00:00:00

Diagnostics

(Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(Visit 01) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

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		(3-6)
(2)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1-2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	AT2018COW	RA: 16 16 0.2290 (244.0009542d) Dec: +22 16 4.83 (22.26801d) Equinox: J2000	Epoch of Position: 2015.5	V=(?) 26.5 AB mag in F555W band	Reference Frame: SIMBAD

Comments: Magnitude is a rough estimate from extrapolating previous HST observations.
Category=EXT-STAR
Description=[SUPERNOVA]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) AT2018COW	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=3		Pattern 2, Exps 1-2 in Visit 01 (2)	609 Secs (2436 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	***[2]***
								[==>(Pattern 4)]	
2		(1) AT2018COW	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F665N	FLASH=16		Pattern 2, Exps 1-2 in Visit 01 (2)	597 Secs (2388 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	***[2]***
								[==>(Pattern 4)]	
3		(1) AT2018COW	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F225W	FLASH=17		Pattern 1, Exps 3-6 in Visit 01 (1)	673 Secs (2019 Secs)	
								[==>(Pattern 1)]	***[3]***
								[==>(Pattern 2)]	***[4]***
								[==>(Pattern 3)]	***[5]***
4		(1) AT2018COW	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F336W	FLASH=17		Pattern 1, Exps 3-6 in Visit 01 (1)	648 Secs (1944 Secs)	
								[==>(Pattern 1)]	***[3]***
								[==>(Pattern 2)]	***[4]***
								[==>(Pattern 3)]	***[5]***
5		(1) AT2018COW	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F438W	FLASH=14		Pattern 1, Exps 3-6 in Visit 01 (1)	602 Secs (1806 Secs)	
								[==>(Pattern 1)]	***[3]***
								[==>(Pattern 2)]	***[4]***
								[==>(Pattern 3)]	***[5]***
6		(1) AT2018COW	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F555W	FLASH=4		Pattern 1, Exps 3-6 in Visit 01 (1)	479 Secs (1437 Secs)	
								[==>(Pattern 1)]	***[3]***
								[==>(Pattern 2)]	***[4]***
								[==>(Pattern 3)]	***[5]***

Orbit Structure

Orbit 3
Server Version: 20230626
Overhead
Exp. 6
Occultation
*** ORBITAL VISIBILITY OVERRUN = 16
Pointing Maneuver
Overhead
GS Reacq
Exp. 3
Overhead
Exp. 4
Overhead
Exp. 5
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Orbit 4
Server Version: 20230626
Overhead
Exp. 6
*** ORBITAL VISIBILITY OVERRUN = 16
Occultation
Pointing Maneuver
Overhead
GS Reacq
Exp. 3
Overhead
Exp. 4
Overhead
Exp. 5
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Orbit 5
Server Version: 20230626
Overhead
Exp. 6
**** ORBITAL VISIBILITY OVERRUN = 16
GS Reacq
Overhead
Overhead
Occultation
Exp. 3
Exp. 4
Exp. 5
Overhead
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Visit

Proposal 17290, Visit 02 Tue Sep 19 16:00:18 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Comments: Repeat of failed second orbit of visit 01.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 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
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#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) AT2018COW	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=3.0		Pattern 3, Exps 1-2 in Visit 02 (3)	607 Secs (1214 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	*[1]*
2		(1) AT2018COW	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F665N	FLASH=16.0		Pattern 3, Exps 1-2 in Visit 02 (3)	595 Secs (1190 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	*[1]*

Orbit Structure