18339 - Identification of Supernova Progenitor Stars in High-Resolution Space-based Imaging

Cycle: 34, Proposal Category: GO

(Hubble-Roman Science (HRS))

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
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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) TOO1	WFC3/UVIS	1	03-Aug-2026 13:00:56.0	yes
02	(2) TOO2	WFC3/UVIS	1	03-Aug-2026 13:00:57.0	yes

2 Total Orbits Used

ABSTRACT

Directly establishing the observational properties of exploding stars is the only direct way to connect nearby core-collapse supernovae (SNe) to their initial conditions. The growing archive of Hubble Space Telescope (HST), James Webb Space Telescope (JWST), Euclid, and soon Roman imaging of galaxies within ~40 Mpc increasingly yields SN sites with candidate pre-explosion counterparts, including heavily dust-enshrouded red supergiants and stripped-envelope systems. Ground-based imaging at natural seeing often leaves multiple possible associations within the SN localization, and chance alignments must be excluded even when a progenitor candidate later disappears. We therefore propose WFC3/UVIS Target-of-Opportunity imaging to obtain a diffraction-limited image of each new SN, aligned to archival pre-explosion HST and JWST data with sufficient astrometric precision to confirm or reject progenitor identifications. The program supports science on the red supergiant problem, the diversity of Type Ib/c progenitors, LBV-related SNe IIn, and binary-driven stripping. Cycle 34 overlaps the start of Nancy Grace Roman Space Telescope Cycle 1 science operations; Roman wide area surveys will provide complementary archival data at resolutions comparable to HST imaging. At the estimated event rate, we expect of order two TOO triggers during Cycle 34.

OBSERVING DESCRIPTION

This is a target-of-opportunity proposal to observe up to 2 supernovae at <40 Mpc with pre-explosion JWST, HST, and/or Euclid imaging. The goal of the proposal is to obtain imaging at the site of each supernova in order to precisely align to the pre-explosion imaging and identify or rule out the presence of a counterpart in the pre-explosion data. We are requesting a 3 week minimum response time from the time of trigger in order to guarantee that we can calibrate our exposures to the expected brightness of the supernova at the time of observation and avoid either saturating or failing to detect the primary supernova target.

Our fiducial observation setup assumes that we will observe the supernova around or slightly after maximum light, with a required brightness of >16.5 mag to avoid saturating this source, which would limit the astrometric precision in centroiding on the supernova. We therefore use 68s exposures in F555W and use the UVIS2-C1K1C-SUB readout mode to reduce overheads between individual exposures. As we are targeting sources in galaxies at <40 Mpc, we expect the field around the supernova to be crowded with astrometric calibrators, and so the smaller readout region will not limit our science case. We have also adjusted FLASH=15 to avoid CTE losses. To improve PSF sampling, we use 4 iterations of a WFC3-UVIS-DITHER-BOX pattern for a total of 16 individual exposures.

Visit

Proposal 18339, TOO-1 (01) Mon Aug 03 17:00:57 GMT 2026

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ON HOLD ; TOO MIN RESPONSE TIME 21.0D; TOO MAX RESPONSE TIME 100.0D

Comments: This ToO will be executed on a supernova discovered at <40 Mpc with pre-explosion JWST, HST, or Euclid imaging.

On Hold Comments: On hold until trigger on a supernova discovered at <40 Mpc with pre-explosion JWST, HST, or Euclid imaging

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	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)

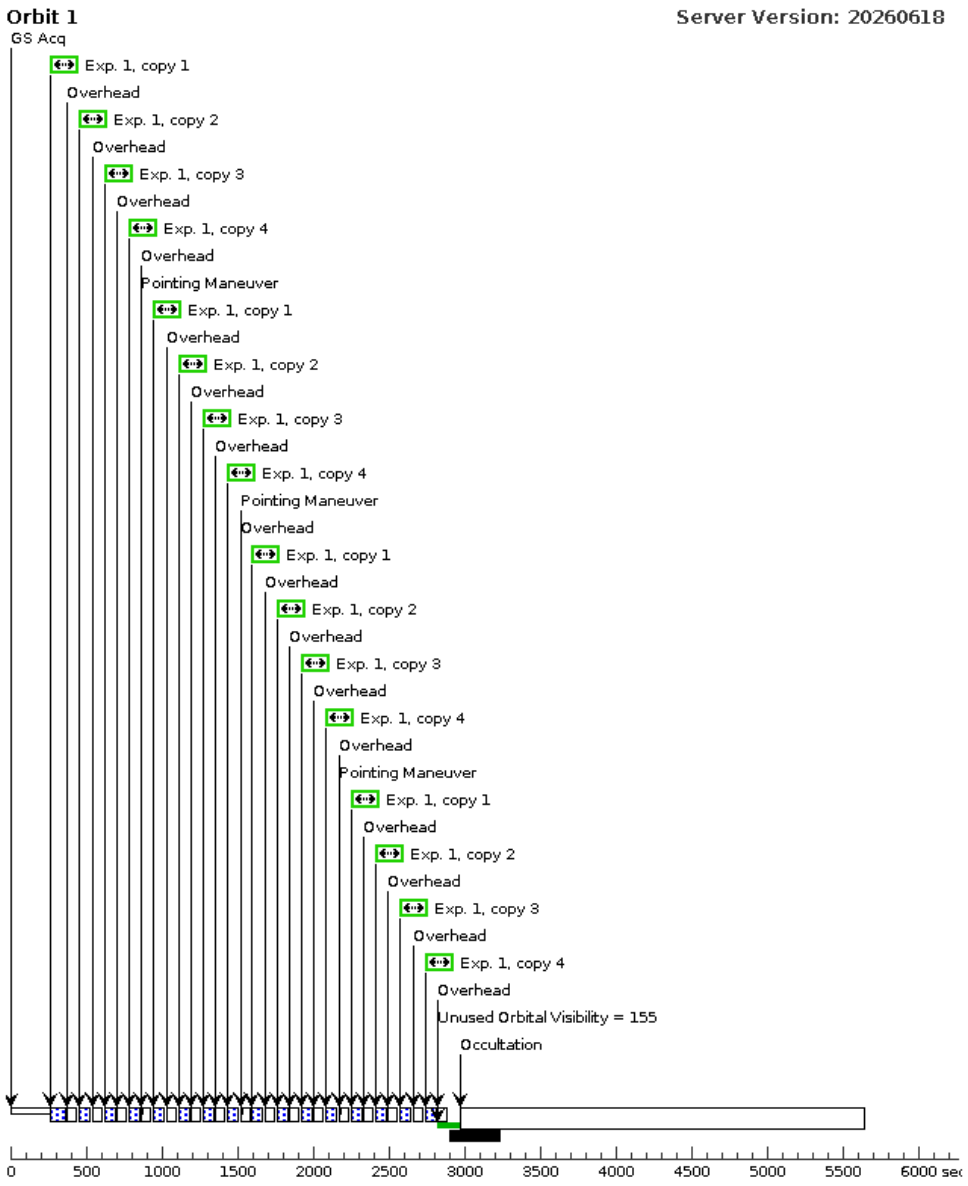
Generic Targets

#	Name	Criteria	Description
(1)	TOO1	First supernova at <40 Mpc with pre-explosion imaging	

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) TOO1	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F555W	FLASH=21		Pattern 1, Exps 1-1 in TOO-1 (01) (1)	68 Secs X 4 (1120 Secs)	
								[==>70.0 Secs (Pattern 1, Copy 1)]	***[1]***
								[==>70.0 Secs (Pattern 1, Copy 2)]	
								[==>70.0 Secs (Pattern 1, Copy 3)]	
								[==>70.0 Secs (Pattern 1, Copy 4)]	
								[==>70.0 Secs (Pattern 2, Copy 1)]	
								[==>70.0 Secs (Pattern 2, Copy 2)]	
								[==>70.0 Secs (Pattern 2, Copy 3)]	
								[==>70.0 Secs (Pattern 2, Copy 4)]	
								[==>70.0 Secs (Pattern 3, Copy 1)]	
								[==>70.0 Secs (Pattern 3, Copy 2)]	
								[==>70.0 Secs (Pattern 3, Copy 3)]	
								[==>70.0 Secs (Pattern 3, Copy 4)]	
								[==>70.0 Secs (Pattern 4, Copy 1)]	
								[==>70.0 Secs (Pattern 4, Copy 2)]	
								[==>70.0 Secs (Pattern 4, Copy 3)]	
								[==>70.0 Secs (Pattern 4, Copy 4)]	

Orbit Structure



Visit

Proposal 18339, TOO-2 (02) Mon Aug 03 17:00:57 GMT 2026

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ON HOLD ; TOO MIN RESPONSE TIME 21.0D; TOO MAX RESPONSE TIME 100.0D

Comments: This ToO will be executed on a supernova discovered at <40 Mpc with pre-explosion JWST, HST, or Euclid imaging.

On Hold Comments: On hold until trigger on a supernova discovered at <40 Mpc with pre-explosion JWST, HST, or Euclid imaging

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	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)

Generic Targets

#	Name	Criteria	Description
(2)	TOO2	Second supernova at <40 Mpc with pre-explosion imaging	

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) TOO2	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F555W	FLASH=21		Pattern 1, Exps 1-1 in TOO-2 (02) (1)	68 Secs X 4 (1088 Secs)	
								[==>(Pattern 1, Copy 1)]	***[1]***
								[==>(Pattern 1, Copy 2)]	
								[==>(Pattern 1, Copy 3)]	
								[==>(Pattern 1, Copy 4)]	
								[==>(Pattern 2, Copy 1)]	
								[==>(Pattern 2, Copy 2)]	
								[==>(Pattern 2, Copy 3)]	
								[==>(Pattern 2, Copy 4)]	
								[==>(Pattern 3, Copy 1)]	
								[==>(Pattern 3, Copy 2)]	
								[==>(Pattern 3, Copy 3)]	
								[==>(Pattern 3, Copy 4)]	
								[==>(Pattern 4, Copy 1)]	
								[==>(Pattern 4, Copy 2)]	
								[==>(Pattern 4, Copy 3)]	
								[==>(Pattern 4, Copy 4)]	

Orbit Structure