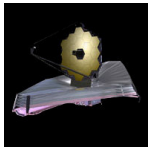

11424 - Resolving the Host Galaxy of AT 2021lwx with JWST: Testing SMBH Host Galaxy Scaling Relations with an Extreme Nuclear Transient (ENT)

Cycle: 5, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
AT2021lwx				

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
	1	AT2021lwx MIRI	MIRI Imaging	(1) AT2021lwx
	3	AT2021lwx MIRI	MIRI Imaging	(2) BACKGROUND
	2	AT2021lwx NIRCam	NIRCam Imaging	(1) AT2021lwx

ABSTRACT

Extreme Nuclear Transients (ENTs) are a new class of long-duration, ultra-luminous, and extremely energetic events likely resulting from the tidal disruption of massive stars by supermassive black holes (SMBHs). AT 2021lwx stands as a prototypical ENT at z ~ 1, reaching an unprecedented luminosity of log (L) = 45.7 erg/s, with total energy exceeding 10^53 erg, and continues to evolve after > 600 days in its rest-frame. Modeling of AT 2021lwx suggests that it is associated with the tidal disruption of a 14-15 solar mass star by a dormant 10^8 solar mass SMBH. Intriguingly no host galaxy associated with the theorized SMBH has been detected yet. We propose 7.4 hours of NIRCam+MIRI time to detect and characterize any host galaxy of AT 2021lwx and to fully sample its spectral energy distribution (SED). These data will constrain any inherent host's stellar mass, morphology, and dust content, revealing if ENTs can occur in faint dwarf or quenched galaxies. A non-detection of host galaxy would imply an overmassive SMBH, challenging traditional black hole–galaxy scaling relations. A low mass galaxy, constrained by the JWST upper limits, hosting a SMBH will point to a complex history of galaxy evolution, questioning the traditional modeling assumptions about the co-evolution of galaxies and their central BHs. JWST's superior IR sensitivity and sub-arcsecond resolution will uniquely provide the first complete view of the most extreme ENT known and a benchmark for SMBH-galaxy co-evolution at higher redshifts. This program will define the empirical framework required to contextualize the many ENTs that will soon be discovered by LSST, Roman, and next-generation time-domain surveys.

OBSERVING DESCRIPTION

Imaging observations of AT 2021lwx aka "Scary Barbie" will be obtained with NIRCam and MIRI to search for its host galaxy and constrain its overal SED. NIRCam filters F150W2, F200W, F356W and F444W will detect emissions from the transient as well as image extended structure of underlying galaxy resolving the precise location of AT 2021lwx relative to the host. The MIRI filters F560W, F770W, F1280W, F1800W, F2100W and F2550W will adequately sample the spectral energy distribution (SED) of AT 2021lwx, detecting reprocessed emissions from dust species including any CO, PAH or silicate grains around the accreting SMBH. The infrared observations will be used to characterize the morphology and stellar mass content of the detected host galaxy as well as estimate the amount of dust in the environemnt. NIRCam instrumental setup will use SUB400P subarray with 4 primary dithers and 4 standard sub pixel dither positions for obtaining the best spatial resolution and even depth. MIRI Instrument setup will use a FULL array with FASTR1 read out using a similar 4-point dither pattern for improved resolution.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	AT2021lwx	RA: 21 13 48.4152 (318.4517300d) Dec: +27 25 50.38 (27.43066d) Equinox: J2000		
Comments: *Category=Unidentified* *Description=[Infrared sources, Visible sources]* *Extended=NO*				
(2)	BACKGROUND	RA: 21 13 53.5800 (318.4732500d) Dec: +27 25 39.76 (27.42771d) Equinox: J2000		
Comments: *Category=Calibration* *Description=[Telescope/sky background]*				

Observation

Proposal 11424, Observation 1: AT2021lwx MIRI

Fri Mar 13 21:05:47 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	AT2021lwx	RA: 21 13 48.4152 (318.4517300d) Dec: +27 25 50.38 (27.43066d) Equinox: J2000		

Comments:
Category=Unidentified
Description=[Infrared sources, Visible sources]
Extended=NO

Template

Subarray
FULL

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	4-Point-Sets				1	4	POINT SOURCE	POSITIVE	DEFAULT

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	F560W	FASTR1	6	1	1	Dither 1	16	16	266.404	
2	F770W	FASTR1	6	1	1	Dither 1	16	16	266.404	
3	F1280W	FASTR1	6	1	1	Dither 1	16	16	266.404	
4	F1800W	FASTR1	6	1	1	Dither 1	16	16	266.404	
5	F2100W	FASTR1	6	1	1	Dither 1	16	16	266.404	
6	F2550W	FASTR1	6	1	1	Dither 1	16	16	266.404	

Observation

Proposal 11424, Observation 3: AT2021lwx MIRI

Fri Mar 13 21:05:47 GMT 2026

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	BACKGROUND	RA: 21 13 53.5800 (318.4732500d) Dec: +27 25 39.76 (27.42771d) Equinox: J2000		

Comments:
Category=Calibration
Description=[Telescope/sky background]

Template

Subarray
FULL

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	4-Point-Sets				1	4	POINT SOURCE	POSITIVE	DEFAULT

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	F1800W	FASTR1	6	1	1	Dither 1	16	16	266.404	
2	F2100W	FASTR1	6	1	1	Dither 1	16	16	266.404	
3	F2550W	FASTR1	6	1	1	Dither 1	16	16	266.404	

Observation

Proposal 11424, Observation 2: AT2021lwx NIRCam

Fri Mar 13 21:05:47 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	AT2021lwx	RA: 21 13 48.4152 (318.4517300d) Dec: +27 25 50.38 (27.43066d) Equinox: J2000		

Comments:
Category=Unidentified
Description=[Infrared sources, Visible sources]
Extended=NO

Template

Module	Subarray
B	SUB400P

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	SUBARRAY_DITHER	4	STANDARD		4

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	Optional ETC ID
1	F150W2	F356W	RAPID	5	2	32	16	318.653	
2	F200W	F444W	RAPID	5	2	32	16	318.653	