



# 6579 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Cycle: 3, Proposal Category: GO

## INVESTIGATORS

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## OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Observation Folder				
	1	19qiz: epoch 2: NIRSP EC	NIRSpec IFU Spectroscopy	(3) Melissandre-nirspec
	2	19qiz: epoch 2: MIRI MRS	MIRI Medium Resolution Spectroscopy	(1) Melisandre
	3	19qiz: epoch 2: MIRI MRS BKG	MIRI Medium Resolution Spectroscopy	(2) Melisandre-off-mrs
	4	23cvb: epoch 1: NIRSP EC	NIRSpec IFU Spectroscopy	(6) AT2023cvb-nirspec

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
	5	23cvb: epoch 1: MIRI MRS	MIRI Medium Resolution Spectroscopy	(4) AT2023cvb
	6	23cvb: epoch 1: MIRI MRS BKG	MIRI Medium Resolution Spectroscopy	(5) AT2019cvb-off-mrs
NIRSPEC repeat				

## ABSTRACT

A tidal disruption event (TDE) of a star by a massive black hole yields a short and luminous flare of radiation, thus providing a unique signpost of otherwise dormant black holes. While the detection rate of optical TDEs is accelerating, our understanding of their optical emission has hit a formidable obstacle: the missing energy problem. The observed electromagnetic output of TDEs is almost four orders of magnitude lower than the gravitational potential energy that must be released when a star is accreted. This missing energy could either be emitted over a much longer timescale than the optical flare, or it could be emitted promptly but in the extreme-UV band. Discriminating between these two models will be required to unlock TDEs as tools for black hole demographics. Fortunately, the infrared reverberation signal from dust heated by a TDE can be used to measure the total energy of the event. These TDE dust echoes have recently been discovered, however their use as bolometers requires a much better measurement of the dust temperature and composition. JWST is ideally suited to make these observations. With a sequence of spectroscopic observations triggered on an IR-bright TDE, we will measure the dust grain sublimation rate by comparing the nuclear hot dust spectrum to its pristine off-nuclear state. And because circumnuclear dust in TDEs is suddenly exposed to UV radiation we will also constrain the grain properties via the temporal variability of the emission lines. These observations will yield the first-ever infrared spectra of a TDE, allowing us to solve the missing energy problem and measure the dust covering factor at sub-parsec scales.

## OBSERVING DESCRIPTION

This proposal contains ToO observations for one target. We have constructed an identical set of multi-instrument observations over three epochs. The first observation has a 3 month response time after the trigger. The following two epochs are to be spaced about 6-8 months apart. This means that 2/3 of our time allocation is expected to happen in the next cycles.

Each epoch has three visits: MIRI/LRS (slit), MIRI/MRS, and NIRSPEC/PRISM. For MIRI/MRS we have selected the Medium and Long dispersers; simultaneous MIRI imaging is obtained in F770W and F1000W. Our target is expected to be relatively bright, 0.04-1 mJy at 3 micron. We have constructed the integration ramps to reach at most 50% of saturation for the bright end of this flux range. Upon triggering we will have a more precise knowledge of the flux, hence saturation can always be avoided.

## JWST Proposal 6579 (Created: Thursday, July 25, 2024 at 4:00:26 PM Eastern Standard Time) - Overview

We have requested that the three visits of a single epoch are scheduled as non-interruptible. This ensures that the observations of each epoch are executed in the same order, starting with target acquisition for MIRI/LRS.

# Proposal 6579 - Targets - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	Melisandre	RA: 04 46 37.8800 (71.6578333d) Dec: -10 13 34.90 (-10.22636d) Equinox: J2000	Proper Motion RA: 0 Proper Motion Dec: 0	
<i>Comments: This is a spectroscopically-confirmed tidal disruption event at <math>z=0.015</math></i> <i>Category=Galaxy</i> <i>Description=[Active galactic nuclei, Seyfert galaxies]</i> <i>Extended=YES</i>				
(2)	Melisandre-off-mrs	RA: 04 46 40.0100 (71.6667083d) Dec: -10 14 4.50 (-10.23458d) Equinox: J2000		
<i>Comments: This the target for an MRS background for AT2019qiz</i> <i>Category=Unidentified</i> <i>Description=[Blank field]</i> <i>Extended=YES</i>				
(3)	Melissandre-nirspec	RA: 04 46 37.8800 (71.6578333d) Dec: -10 13 34.90 (-10.22636d) Equinox: J2000	Proper Motion RA: 0 Proper Motion Dec: 0	
<i>Comments: This is a spectroscopically-confirmed tidal disruption event at <math>z=0.015</math> (duplicate, but without requirement for background)</i> <i>Category=Galaxy</i> <i>Description=[Active galactic nuclei]</i> <i>Extended=YES</i>				
(4)	AT2023cvb	RA: 19 14 25.6807 (288.6070029d) Dec: +41 40 9.30 (41.66925d) Equinox: J2000		
<i>Comments: Spectroscopically-confirmed TDE</i> <i>Category=Galaxy</i> <i>Description=[Active galactic nuclei]</i> <i>Extended=YES</i>				
(5)	AT2019cvb-off-mrs	RA: 19 14 26.6807 (288.6111696d) Dec: +41 39 42.30 (41.66175d) Equinox: J2000		
<i>Comments: This the target for an MRS background for AT2023cvb</i> <i>Category=Unidentified</i> <i>Description=[Blank field]</i> <i>Extended=YES</i>				
(6)	AT2023cvb-nirspec	RA: 19 14 25.6807 (288.6070029d) Dec: +41 40 9.30 (41.66925d) Equinox: J2000		
<i>Comments: Spectroscopically-confirmed TDE (duplicate, but without requirement for background)</i> <i>Category=Galaxy</i> <i>Description=[Active galactic nuclei]</i> <i>Extended=YES</i>				

Fixed Targets

Proposal 6579 - Observation 1 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Thu Jul 25 21:00:26 GMT 2024

<b>Observation</b>	<p>Proposal 6579, Observation 1: 19qiz: epoch 2: NIRSPEC</p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRSPEC IFU Spectroscopy</p>											
<b>Diagnostics</b>	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
<b>Fixed Targets</b>	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous			
	(3)	Melissandre-nirspec	RA: 04 46 37.8800 (71.6578333d) Dec: -10 13 34.90 (-10.22636d) Equinox: J2000			Proper Motion RA: 0 Proper Motion Dec: 0						
	<p><i>Comments: This is a spectroscopically-confirmed tidal disruption event at z=0.015 (duplicate, but without requirement for background)</i></p> <p><i>Category=Galaxy</i></p> <p><i>Description=[Active galactic nuclei]</i></p> <p><i>Extended=YES</i></p>											
<b>Template</b>	<p><b>TA Method</b></p> <p>NONE</p>											
<b>Dithers</b>	#	Dither Type		Size	Starting Point			Number of Points	Points			
	1	4-POINT-DITHER										
<b>Spectral Elements</b>	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G140H/F100LP	NRSIRS2RAPI D	5	2	false	true	NONE	4	8	700.267	167100.1
	2	G235H/F170LP	NRSIRS2RAPI D	5	2	false	true	NONE	4	8	700.267	
	3	G395H/F290LP	NRSIRS2RAPI D	5	2	false	true	NONE	4	8	700.267	
<b>Special Requirements</b>	Sequence Observations 1, 2, 3, Non-interruptible											

Proposal 6579 - Observation 2 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Thu Jul 25 21:00:26 GMT 2024

<b>Observation</b>	<b>Proposal 6579, Observation 2: 19qiz: epoch 2: MIRI MRS</b> <b>Diagnostic Status: Warning</b> Observing Template: MIRI Medium Resolution Spectroscopy Background Observations:[19qiz: epoch 2: MIRI MRS BKG (Obs 3)]												
	(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.												
<b>Fixed Targets</b>	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous				
	(1)	Melisandre	RA: 04 46 37.8800 (71.6578333d) Dec: -10 13 34.90 (-10.22636d) Equinox: J2000			Proper Motion RA: 0 Proper Motion Dec: 0							
<i>Comments: This is a spectroscopically-confirmed tidal disruption event at z=0.015</i> <i>Category=Galaxy</i> <i>Description=[Active galactic nuclei, Seyfert galaxies]</i> <i>Extended=YES</i>													
<b>Acquisition</b>	#	Target											
	1	NONE											
<b>Template</b>	AcqFilter	Primary Channel			Simultaneous Imaging			Imager Subarray		Grating Wheel Direction			
	F1500W	All MRS			NO			FULL		NEUTRAL			
<b>Dithers</b>	#	Dither Type			Optimized For			Direction					
	1	4-Point			EXTENDED SOURCE			NEGATIVE					
<b>Spectral Elements</b>	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	LONG(C)	MRSLONG		FASTR1	25	4	1	Dither 1	4	16	1143.316	145005.3
	1	LONG(C)	MRSSHORT		FASTR1	25	4	1	Dither 1	4	16	1143.316	145005.3
	2	MEDIUM(B)	MRSLONG		FASTR1	25	4	1	Dither 1	4	16	1143.316	145005.4
	2	MEDIUM(B)	MRSSHORT		FASTR1	25	4	1	Dither 1	4	16	1143.316	145005.4
	3	SHORT(A)	MRSLONG		FASTR1	25	4	1	Dither 1	4	16	1143.316	145005.10
	3	SHORT(A)	MRSSHORT		FASTR1	25	4	1	Dither 1	4	16	1143.316	145005.10

Proposal 6579 - Observation 2 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Special Requirements

Sequence Observations 1, 2, 3, Non-interruptible

Proposal 6579 - Observation 3 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Thu Jul 25 21:00:26 GMT 2024

<b>Observation</b>	Proposal 6579, Observation 3: 19qiz: epoch 2: MIRI MRS BKG <b>Diagnostic Status: Warning</b> Observing Template: MIRI Medium Resolution Spectroscopy Background Observation For: [19qiz: epoch 2: MIRI MRS (Obs 2)]												
	(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.												
<b>Fixed Targets</b>	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous				
	(2)	Melisandre-off-mrs	RA: 04 46 40.0100 (71.6667083d) Dec: -10 14 4.50 (-10.23458d) Equinox: J2000  <i>Comments: This the target for an MRS background for AT2019qiz</i> <i>Category=Unidentified</i> <i>Description=[Blank field]</i> <i>Extended=YES</i>										
<b>Acquisition</b>	#	Target											
	1	NONE											
<b>Template</b>	AcqFilter	Primary Channel			Simultaneous Imaging		Imager Subarray		Grating Wheel Direction				
	F1500W	All MRS			NO		FULL		NEUTRAL				
<b>Dithers</b>	#	Dither Type			Optimized For			Direction					
	1	2-Point			EXTENDED SOURCE			NEGATIVE					
<b>Spectral Elements</b>	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	LONG(C)	MRSLONG		FASTR1	25	1	1	Dither 1	2	2	138.752	145005.3
	1	LONG(C)	MRSSHORT		FASTR1	25	1	1	Dither 1	2	2	138.752	145005.3
	2	MEDIUM(B)	MRSLONG		FASTR1	25	1	1	Dither 1	2	2	138.752	145005.4
	2	MEDIUM(B)	MRSSHORT		FASTR1	25	1	1	Dither 1	2	2	138.752	145005.4
	3	SHORT(A)	MRSLONG		FASTR1	25	1	1	Dither 1	2	2	138.752	145005.10
	3	SHORT(A)	MRSSHORT		FASTR1	25	1	1	Dither 1	2	2	138.752	145005.10

Proposal 6579 - Observation 3 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Special Requirements

Sequence Observations 1, 2, 3, Non-interruptible

Proposal 6579 - Observation 4 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Thu Jul 25 21:00:26 GMT 2024

<b>Observation</b>	<p>Proposal 6579, Observation 4: 23cvb: epoch 1: NIRSPEC</p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRSPEC IFU Spectroscopy</p>											
<b>Diagnostics</b>	(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
<b>Fixed Targets</b>	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous			
	(6)	AT2023cvb-nirspec	RA: 19 14 25.6807 (288.6070029d) Dec: +41 40 9.30 (41.66925d) Equinox: J2000									
	<p><i>Comments: Spectroscopically-confirmed TDE (duplicate, but without requirement for background)</i></p> <p><i>Category=Galaxy</i></p> <p><i>Description=[Active galactic nuclei]</i></p> <p><i>Extended=YES</i></p>											
<b>Template</b>	<b>TA Method</b>											
	NONE											
<b>Dithers</b>	#	Dither Type		Size	Starting Point			Number of Points	Points			
	1	4-POINT-DITHER										
<b>Spectral Elements</b>	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G140H/F100LP	NRSIRS2RAPI D	12	1	false	true	NONE	4	4	758.622	203907
	2	G235H/F170LP	NRSIRS2RAPI D	12	1	false	true	NONE	4	4	758.622	203907
	3	G395H/F290LP	NRSIRS2RAPI D	12	1	false	true	NONE	4	4	758.622	203907
<b>Special Requirements</b>	<p>Before Date 19-OCT-2024:00:00:00</p> <p>Sequence Observations 4, 5, 6, Non-interruptible</p>											

Proposal 6579 - Observation 5 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Thu Jul 25 21:00:26 GMT 2024

<b>Observation</b>	<b>Proposal 6579, Observation 5: 23cvb: epoch 1: MIRI MRS</b> <b>Diagnostic Status: Warning</b> Observing Template: MIRI Medium Resolution Spectroscopy Background Observations:[23cvb: epoch 1: MIRI MRS BKG (Obs 6)]												
	(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.												
<b>Diagnosics</b>													
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>			<b>Targ. Coord. Corrections</b>			<b>Miscellaneous</b>				
	(4)	AT2023cvb	RA: 19 14 25.6807 (288.6070029d) Dec: +41 40 9.30 (41.66925d) Equinox: J2000										
<i>Comments: Spectroscopically-confirmed TDE</i> <i>Category=Galaxy</i> <i>Description=[Active galactic nuclei]</i> <i>Extended=YES</i>													
<b>Acquisition</b>	<b>#</b>	<b>Target</b>											
	1	NONE											
<b>Template</b>	<b>AcqFilter</b>	<b>Primary Channel</b>			<b>Simultaneous Imaging</b>			<b>Imager Subarray</b>		<b>Grating Wheel Direction</b>			
	F1500W	All MRS			NO			FULL		NEUTRAL			
<b>Dithers</b>	<b>#</b>	<b>Dither Type</b>			<b>Optimized For</b>			<b>Direction</b>					
	1	4-Point			EXTENDED SOURCE			NEGATIVE					
<b>Spectral Elements</b>	<b>#</b>	<b>Wavelength Range</b>	<b>Detector</b>	<b>Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/E xp</b>	<b>Exposures/Dit h</b>	<b>Dither</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	LONG(C)	MRSLONG		FASTR1	50	2	1	Dither 1	4	8	1121.116	203907
	1	LONG(C)	MRSSHORT		FASTR1	50	2	1	Dither 1	4	8	1121.116	203907
	2	MEDIUM(B)	MRSLONG		FASTR1	50	2	1	Dither 1	4	8	1121.116	203907
	2	MEDIUM(B)	MRSSHORT		FASTR1	50	2	1	Dither 1	4	8	1121.116	203907
	3	SHORT(A)	MRSLONG		FASTR1	50	2	1	Dither 1	4	8	1121.116	203907
	3	SHORT(A)	MRSSHORT		FASTR1	50	2	1	Dither 1	4	8	1121.116	203907

Proposal 6579 - Observation 5 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Special Requirements

Sequence Observations 4, 5, 6, Non-interruptible

Proposal 6579 - Observation 6 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Thu Jul 25 21:00:26 GMT 2024

<b>Observation</b>	<b>Proposal 6579, Observation 6: 23cvb: epoch 1: MIRI MRS BKG</b> <b>Diagnostic Status: Warning</b> Observing Template: MIRI Medium Resolution Spectroscopy Background Observation For: [23cvb: epoch 1: MIRI MRS (Obs 5)]												
	(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.												
<b>Diagnosics</b>													
<b>Fixed Targets</b>	#	Name	Target Coordinates		Targ. Coord. Corrections				Miscellaneous				
	(5)	AT2019cvb-off-mrs	RA: 19 14 26.6807 (288.6111696d) Dec: +41 39 42.30 (41.66175d) Equinox: J2000										
Comments: This the target for an MRS background for AT2023cvb Category=Unidentified Description=[Blank field] Extended=YES													
<b>Acquisition</b>	#	Target											
	1	NONE											
<b>Template</b>	AcqFilter	Primary Channel		Simultaneous Imaging		Imager Subarray		Grating Wheel Direction					
	F1500W	All MRS		NO		FULL		NEUTRAL					
<b>Dithers</b>	#	Dither Type		Optimized For				Direction					
	1	2-Point		EXTENDED SOURCE				NEGATIVE					
<b>Spectral Elements</b>	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	SHORT(A)	MRSLONG		FASTR1	50	1	1	Dither 1	2	2	277.504	203907
	1	SHORT(A)	MRSSHORT		FASTR1	50	1	1	Dither 1	2	2	277.504	203907
	2	MEDIUM(B)	MRSLONG		FASTR1	50	1	1	Dither 1	2	2	277.504	203907
	2	MEDIUM(B)	MRSSHORT		FASTR1	50	1	1	Dither 1	2	2	277.504	203907
	3	LONG(C)	MRSLONG		FASTR1	50	1	1	Dither 1	2	2	277.504	203907
	3	LONG(C)	MRSSHORT		FASTR1	50	1	1	Dither 1	2	2	277.504	203907

Proposal 6579 - Observation 6 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Special Requirements

Sequence Observations 4, 5, 6, Non-interruptible