



4038 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Cycle: 2, 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	epoch 1: MIRI LRS	MIRI Low Resolution Spectroscopy	(1) Melisandre
	2	epoch 1: MIRI MRS	MIRI Medium Resolution Spectroscopy	(1) Melisandre
	7	epoch 1: NIRSPEC	NIRSpec IFU Spectroscopy	(1) Melisandre
NIRSPEC repeat				
	8	epoch 1: NIRSPEC	NIRSpec IFU Spectroscopy	(1) Melisandre

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.

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 4038 - Targets - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Fixed Targets	#	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 <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>		

Proposal 4038 - Observation 1 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Fri Mar 01 21:01:08 GMT 2024

Observation	Proposal 4038, Observation 1: epoch 1: MIRI LRS Diagnostic Status: Warning Observing Template: MIRI Low Resolution Spectroscopy									
	(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)	Melisandre	RA: 04 46 37.8800 (71.6578333d) Dec: -10 13 34.90 (-10.22636d) Equinox: J2000 <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>							
Acquisition	#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	
	1	1 Melisandre	FND	FAST	10	1	1	27.75	167100.5	
Template	Subarray				Obtain Verification Image?					
	FULL				true					
Dithers	#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset				
	1	ALONG SLIT NOD								
Pointing Verification	#	PV Readout Pattern	PV Groups/Int	PV Integrations/Exp	PV Total Integrations	PV Exposures/Dith	PV Total Dithers	PV Total Exposure Time	PV ETC Wkbk.Calc ID	Filter
	1	FASTR1	10	1	1	1	1	27.75		FND

Proposal 4038 - Observation 1 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Spectral Elements	#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
	Special Requirements	1	FASTR1	5	10	20	1	2	327.455
Target Of Opportunity Response Time 14 Days Sequence Observations 1, 2, 7, Non-interruptible									

Proposal 4038 - Observation 2 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Fri Mar 01 21:01:08 GMT 2024

Observation	Proposal 4038, Observation 2: epoch 1: MIRI MRS Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy												
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)	Melisandre	RA: 04 46 37.8800 (71.6578333d) Dec: -10 13 34.90 (-10.22636d) Equinox: J2000										
	Comments: This is a spectroscopically-confirmed tidal disruption event at $z=0.015$ Category=Galaxy Description=[Active galactic nuclei, Seyfert galaxies] Extended=YES												
Acquisition	#	Target											
	1	NONE											
Template	AcqFilter	Primary Channel			Simultaneous Imaging		Imager Subarray		Grating Wheel Direction				
	F1500W	All MRS			NO		FULL		NEUTRAL				
Dithers	#	Dither Type			Optimized For			Direction					
	1	4-Point			EXTENDED SOURCE			NEGATIVE					
Spectral Elements	#	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	100	1	1	Dither 1	4	4	1110.016	145005.3
	1	LONG(C)	MRSSHORT		FASTR1	100	1	1	Dither 1	4	4	1110.016	145005.3
	2	MEDIUM(B)	MRSLONG		FASTR1	100	1	1	Dither 1	4	4	1110.016	145005.4
	2	MEDIUM(B)	MRSSHORT		FASTR1	100	1	1	Dither 1	4	4	1110.016	145005.4
	3	SHORT(A)	MRSLONG		FASTR1	100	1	1	Dither 1	4	4	1110.016	145005.10
	3	SHORT(A)	MRSSHORT		FASTR1	100	1	1	Dither 1	4	4	1110.016	145005.10

Proposal 4038 - Observation 2 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Special Requirements

On Hold for ToO that activates this group

Sequence Observations 1, 2, 7, Non-interruptible

Proposal 4038 - Observation 7 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Fri Mar 01 21:01:08 GMT 2024

Observation	<p>Proposal 4038, Observation 7: epoch 1: NIRSPEC</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSPEC IFU Spectroscopy</p>											
Diagnostics	(Visit 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
Fixed Targets	#	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									
	<p><i>Comments: This is a spectroscopically-confirmed tidal disruption event at z=0.015</i></p> <p><i>Category=Galaxy</i></p> <p><i>Description=[Active galactic nuclei, Seyfert galaxies]</i></p> <p><i>Extended=YES</i></p>											
Template	TA Method											
	NONE											
Dithers	#	Dither Type		Size	Starting Point			Number of Points	Points			
	1	4-POINT-DITHER										
Spectral Elements	#	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	10	1	false	true	NONE	4	4	641.911	167100.1
	2	G235H/F170LP	NRSIRS2RAPI D	7	1	false	true	NONE	4	4	466.844	
	3	G395H/F290LP	NRSIRS2RAPI D	5	1	false	true	NONE	4	4	350.133	
Special Requirements	<p>On Hold for ToO that activates this group</p> <p>Sequence Observations 1, 2, 7, Non-interruptible</p>											

Proposal 4038 - Observation 8 - First Infrared Spectra of a Tidal Disruption Event Dust Echo: Solving the Missing Energy Problem

Fri Mar 01 21:01:08 GMT 2024

Observation	<p>Proposal 4038, Observation 8: epoch 1: NIRSPEC</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSPEC IFU Spectroscopy</p>											
Diagnostics	(Visit 8:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
Fixed Targets	#	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									
	<p><i>Comments: This is a spectroscopically-confirmed tidal disruption event at z=0.015</i></p> <p><i>Category=Galaxy</i></p> <p><i>Description=[Active galactic nuclei, Seyfert galaxies]</i></p> <p><i>Extended=YES</i></p>											
Template	TA Method											
	NONE											
Dithers	#	Dither Type		Size	Starting Point			Number of Points	Points			
	1	4-POINT-DITHER										
Spectral Elements	#	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	10	1	false	true	NONE	4	4	641.911	167100.1
	2	G235H/F170LP	NRSIRS2RAPI D	7	1	false	true	NONE	4	4	466.844	
	3	G395H/F290LP	NRSIRS2RAPI D	5	1	false	true	NONE	4	4	350.133	
Special Requirements	<p>Before Date 05-MAR-2024:00:00:00</p> <p>On Hold Visit placed ON HOLD at PI's request until he can make a plan for when this obs should be executed</p>											