



2521 - The First Ever Low Metallicity PDR Benchmark

Cycle: 1, Proposal Category: GO

INVESTIGATORS

<i>Name</i>	<i>Institution</i>
Dr. Karin Marie Sandstrom (PI)	University of California - San Diego
Dr. Mark Wolfire (CoI) (CoPI)	University of Maryland
Prof. Alberto Bolatto (CoI)	University of Maryland
Dr. Jeremy Chastenet (CoI) (ESA Member)	Ghent University
Dr. Daniel Dale (CoI)	University of Wyoming
Prof. Ilse De Looze (CoI) (ESA Member)	Universiteit Gent
Dr. Brandt Alfred Lloyd Gaches (CoI) (ESA Member)	Universitat zu Koln
Dr. Maud Galametz (CoI) (ESA Member)	Commissariat a l'Energie Atomique (CEA)
Dr. Simon Glover (CoI) (ESA Member)	Universitat Heidelberg
Dr. Karl D. Gordon (CoI)	Space Telescope Science Institute
Dr. Brent Groves (CoI)	University of Western Australia
Prof. Ralf Stephan Klessen (CoI) (ESA Member)	Universitat Heidelberg
Prof. JD Smith (CoI)	University of Toledo
Prof. Stefanie Walch (CoI) (ESA Member)	Universitat zu Koln

OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Observation Folder				
	1	N13-MIRI	MIRI Medium Resolution Spectroscopy	(1) N13PDR1-MIRI
	3	OFF-MIRI	MIRI Medium Resolution Spectroscopy	(2) OFFSMC
	2	N13-NIRSpec	NIRSpec IFU Spectroscopy	(3) N13PDR1-NIRSPEC
	999	N13-NIRSpec	NIRSpec IFU Spectroscopy	(3) N13PDR1-NIRSPEC

ABSTRACT

We propose the first ever near- to mid-infrared observations of the resolved structure of a low-metallicity photodissociation region (PDR). PDRs are fundamental to ISM physics and the source of a major fraction of all galactic line emission. They describe much of the molecular gas and essentially all of the atomic gas in galaxies. The first resolved maps of the Orion Bar by Tielens et al (1993), showing the transition from ionized to atomic to molecular gas using near- to mid-IR observations, became a benchmark for PDR models. Low metallicity PDRs are expected to be very different, due to the competing effects of enhanced FUV penetration due to low dust abundance, deficits in heating from the photoelectric effect from dust and photoionization by metals, and deficits in cooling due to lower abundance of elements that emit fine structure lines. With the extraordinary resolution of JWST in the near- to mid-IR we can now observe a PDR in the nearest low metallicity galaxy, the Small Magellanic Cloud, at comparable sub-pc resolution to the original Orion Bar observations. Using the NIRSpec and MIRI IFUs, we will map the resolved layers of the PDR in the N13 star-forming region of the SMC, a simple, edge-on PDR similar to Orion. We will measure temperatures, ionization structure, density, and PAH size and charge and use these to provide vital constraints for PDR models. These observations will reveal the inner workings of this key ISM component at low metallicity and are only possible in the Small Magellanic Cloud and with the angular resolution and sensitivity of JWST.

OBSERVING DESCRIPTION

We propose NIRSpec and MIRI IFU observations of a photodissociation region in the Small Magellanic Cloud. This requires a single pointing with both instruments. We will use 4-point dither patterns to fully sample the PSF, using the optimization for extended sources with MIRI. We will use the medium resolution gratings on NIRSpec (G140M, G235M, G395M) and full coverage of all four channels of MRS. Our exposure times are set to detect various emission lines from H₂ molecules and ions in the photodissociation region and neighboring HII region. These are 1517s in NIRSpec, with 25 groups and 1 integration and 4 dither positions in the NRSIRS2RAPID readout pattern, and 4778s in MIRI, with 50 groups and 1 integration and 4 dither positions in the SLOW readout pattern. We will obtain NIRSpec leakcals at every grating setting and dither position. We will obtain background observations for MIRI by observing a blank sky field off the Small Magellanic Cloud. We will also observe with the F560W, F770W and F1130W filters simultaneously with the MIRI MRS observations.

Proposal 2521 - Targets - The First Ever Low Metallicity PDR Benchmark

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	N13PDR1-MIRI	RA: 00 45 26.8510 (11.3618792d) Dec: -73 22 56.04 (-73.38223d) Equinox: J2000		
<i>Comments:</i> <i>Category=ISM</i> <i>Description=[H II regions, Photodissociation regions]</i> <i>Extended=YES</i>				
(2)	OFFSMC	RA: 00 37 35.4515 (9.3977146d) Dec: -72 42 48.51 (-72.71348d) Equinox: J2000		
<i>Comments:</i> <i>Category=ISM</i> <i>Description=[H II regions, Photodissociation regions]</i> <i>Extended=YES</i>				
(3)	N13PDR1-NIRSPEC	RA: 00 45 26.8510 (11.3618792d) Dec: -73 22 56.04 (-73.38223d) Equinox: J2000		
<i>Comments:</i> <i>Category=ISM</i> <i>Description=[H II regions, Photodissociation regions]</i> <i>Extended=YES</i>				

Fixed Targets

Proposal 2521 - Observation 1 - The First Ever Low Metallicity PDR Benchmark

Fri Jun 09 20:02:20 GMT 2023

Observation	Proposal 2521, Observation 1: N13-MIRI Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy Background Observations:[OFF-MIRI (Obs 3)]												
	(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)	N13PDR1-MIRI	RA: 00 45 26.8510 (11.3618792d) Dec: -73 22 56.04 (-73.38223d) Equinox: J2000										
<i>Comments:</i> <i>Category=ISM</i> <i>Description=[H II regions, Photodissociation regions]</i> <i>Extended=YES</i>													
Acquisition	#	Target											
	1	NONE											
Template	AcqFilter	Primary Channel			Simultaneous Imaging			Imager Subarray		Grating Wheel Direction			
		ALL			YES			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/E xp	Exposures/Dit h	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1		IMAGER	F1130W	SLOWR1	25	1	1	Dither 1	4	4	2388.992	
	1	LONG(C)	MRSLONG		SLOWR1	50	1	1	Dither 1	4	4	4777.984	
	1	LONG(C)	MRSSSHORT		SLOWR1	50	1	1	Dither 1	4	4	4777.984	
	2		IMAGER	F770W	SLOWR1	25	1	1	Dither 1	4	4	2388.992	
	2	MEDIUM(B)	MRSLONG		SLOWR1	50	1	1	Dither 1	4	4	4777.984	
	2	MEDIUM(B)	MRSSSHORT		SLOWR1	50	1	1	Dither 1	4	4	4777.984	
	3		IMAGER	F560W	SLOWR1	25	1	1	Dither 1	4	4	2388.992	
	3	SHORT(A)	MRSLONG		SLOWR1	50	1	1	Dither 1	4	4	4777.984	
	3	SHORT(A)	MRSSSHORT		SLOWR1	50	1	1	Dither 1	4	4	4777.984	

Proposal 2521 - Observation 1 - The First Ever Low Metallicity PDR Benchmark

Special Requirements

Sequence Observations 1, 3, Non-interruptible

Proposal 2521 - Observation 3 - The First Ever Low Metallicity PDR Benchmark

Fri Jun 09 20:02:20 GMT 2023

Observation	Proposal 2521, Observation 3: OFF-MIRI Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy Background Observation For: [N13-MIRI (Obs 1)]												
	(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)	OFFSMC	RA: 00 37 35.4515 (9.3977146d) Dec: -72 42 48.51 (-72.71348d) Equinox: J2000										
<i>Comments:</i> <i>Category=ISM</i> <i>Description=[H II regions, Photodissociation regions]</i> <i>Extended=YES</i>													
Acquisition	#	Target											
	1	NONE											
Template	AcqFilter	Primary Channel			Simultaneous Imaging			Imager Subarray		Grating Wheel Direction			
		ALL			YES			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/E xp	Exposures/Dit h	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1		IMAGER	F1130W	SLOWR1	25	1	1	Dither 1	4	4	2388.992	
	1	LONG(C)	MRSLONG		SLOWR1	50	1	1	Dither 1	4	4	4777.984	
	1	LONG(C)	MRSSSHORT		SLOWR1	50	1	1	Dither 1	4	4	4777.984	
	2		IMAGER	F770W	SLOWR1	25	1	1	Dither 1	4	4	2388.992	
	2	MEDIUM(B)	MRSLONG		SLOWR1	50	1	1	Dither 1	4	4	4777.984	
	2	MEDIUM(B)	MRSSSHORT		SLOWR1	50	1	1	Dither 1	4	4	4777.984	
	3		IMAGER	F560W	SLOWR1	25	1	1	Dither 1	4	4	2388.992	
	3	SHORT(A)	MRSLONG		SLOWR1	50	1	1	Dither 1	4	4	4777.984	
	3	SHORT(A)	MRSSSHORT		SLOWR1	50	1	1	Dither 1	4	4	4777.984	

Proposal 2521 - Observation 3 - The First Ever Low Metallicity PDR Benchmark

Special Requirements

Sequence Observations 1, 3, Non-interruptible

Proposal 2521 - Observation 2 - The First Ever Low Metallicity PDR Benchmark

Fri Jun 09 20:02:20 GMT 2023

Observation	<p>Proposal 2521, Observation 2: N13-NIRSpec Diagnostic Status: Warning Observing Template: NIRSpec IFU Spectroscopy</p>											
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			
	(3)	N13PDR1-NIRSPEC	RA: 00 45 26.8510 (11.3618792d) Dec: -73 22 56.04 (-73.38223d) Equinox: J2000									
	<p><i>Comments:</i> Category=ISM Description=[H II regions, Photodissociation regions] Extended=YES</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	G140M/F070LP	NRSIRS2RAPI D	25	1	false	true	NONE	4	4	1517.245	
	2	G140M/F070LP	NRSIRS2RAPI D	25	1	true	true	NONE	4	4	1517.245	
	3	G235M/F170LP	NRSIRS2RAPI D	25	1	false	true	NONE	4	4	1517.245	
	4	G235M/F170LP	NRSIRS2RAPI D	25	1	true	true	NONE	4	4	1517.245	
	5	G395M/F290LP	NRSIRS2RAPI D	25	1	false	true	NONE	4	4	1517.245	
	6	G395M/F290LP	NRSIRS2RAPI D	25	1	true	true	NONE	4	4	1517.245	

Proposal 2521 - Observation 999 - The First Ever Low Metallicity PDR Benchmark

Fri Jun 09 20:02:20 GMT 2023

Observation	<p>Proposal 2521, Observation 999: N13-NIRSpec</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p> <p><i>Comments: This is a WOPR for skipped Obs 2:1</i></p>											
Diagnostics	(Visit 999:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.											
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous			
	(3)	N13PDR1-NIRSPEC	RA: 00 45 26.8510 (11.3618792d) Dec: -73 22 56.04 (-73.38223d) Equinox: J2000									
	<p><i>Comments:</i> <i>Category=ISM</i> <i>Description=[H II regions, Photodissociation regions]</i> <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/Ex p	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G140M/F070LP	NRSIRS2RAPI D	25	1	false	true	NONE	4	4	1517.245	
	2	G140M/F070LP	NRSIRS2RAPI D	25	1	true	true	NONE	4	4	1517.245	
	3	G235M/F170LP	NRSIRS2RAPI D	25	1	false	true	NONE	4	4	1517.245	
	4	G235M/F170LP	NRSIRS2RAPI D	25	1	true	true	NONE	4	4	1517.245	
	5	G395M/F290LP	NRSIRS2RAPI D	25	1	false	true	NONE	4	4	1517.245	
	6	G395M/F290LP	NRSIRS2RAPI D	25	1	true	true	NONE	4	4	1517.245	