



2547 - Quasar Feedback in Action: The Multiphase and Multiscale Outflow of the Most Luminous Quasar in the Local Universe

Cycle: 1, 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	MRS PDS 456-MIRI	MIRI Medium Resolution Spectroscopy	(1) PDS456-MIRI
	2	MRS PDS 456-MIRI-Background	MIRI Medium Resolution Spectroscopy	(2) PDS456-MIRI-BACKGROUND
	3	NIRSpec IFU - PDS 456	NIRSpec IFU Spectroscopy	(3) PDS456-NIRSPEC

ABSTRACT

Quasar outflows are among the leading internal negative-feedback processes to explain the inside-out quenching of star formation in massive galaxies and the tight SMBH-spheroid mass relation. The likely culprits, the fast-accreting quasars, are common at the epoch of peak SMBH accretion but rare locally, making it hard to catch and study this negative-feedback phenomenon in action, even with JWST. Fortunately, there is one spectacular exception: PDS 456, the most luminous quasar in the local universe. Clear unambiguous signatures of outflows have been detected in this

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object on all scales, ranging from the X-ray/UV-detected relativistic wind on sub-pc accretion-disk scales to the galaxy-wide warm-ionized and cold-molecular outflows which extend to at least 10 kpc. The energetics of the outflow indicate that it is potentially able to rapidly quench star formation in the host although the current observations are still missing the critically important coronal-ionized, neutral-atomic, and warm-molecular gas phases to determine if the quasar actually affects the host evolution. The proposed NIRSpec and MIRI data cubes, analyzed with the highly optimized PSF decomposition software package IFSFIT, will allow us to (1) get an accurate and complete census of the outflow energetics, (2) constrain the dominant mechanisms that drive this outflow and AGN duty cycle, and (3) characterize the impact of the quasar outflow and intense radiation field on the physical state of the host ISM, coeval star formation activity, and circumgalactic medium. These exquisite data will serve as a local template to help interpret the coarser data from scheduled GTO/ERS JWST studies of distant quasars.

OBSERVING DESCRIPTION

We will observe PDS 456 using the NIRSpec and MIRI IFUs with the following settings:

-NIRSpec IFU with G235H/F170LP

data acquisition starts on the quasar itself, before a shift 0.5" S to capture blobs A and B

4-point dither pattern

20 groups and 5 integrations per dither position

Readout mode: NRSRAPID

--> total exposure time on source: 75 min

1 leakage exposure at one dither position: 11 min

-MIRI IFU with the SHORT, MEDIUM, and LONG wavelength settings

data acquisition starts on the quasar itself (with FND filter), before a shift 0.5" S to capture blobs A and B

4-point all-wavelength extended source dither pattern

40 groups and 5 integrations per dither position for each wavelength setting

Readout mode: FAST

--> total exposure time on source: 3 x 37 min = 111 min

One simultaneous background image in F770W interspaced between each spectral setting

--> exposure time for interspaced F770W images: 244 sec each

1 off-source background data cube

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(obtained immediately after the on-source cube using the same settings as the on-source data cube)

--> total exposure time on background: $3 \times 37 \text{ min} = 111 \text{ min}$

--> exposure time for simultaneous interspaced F770W images: 244 sec each

Proposal 2547 - Targets - Quasar Feedback in Action: The Multiphase and Multiscale Outflow of the Most Luminous Quasar in the Loc...

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	PDS456-MIRI	RA: 17 28 19.7894 (262.0824558d) Dec: -14 15 56.56 (-14.26571d) Equinox: J2000	Proper Motion RA: 1.650907010083184E-6 sec of time/yr Proper Motion Dec: 8.999999999999999E-6 arcsec/yr Epoch of Position: 2015.5	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=Galaxy Description=[Quasars] Extended=YES</p>				
(2)	PDS456-MIRI- BACKGROUND	RA: 17 28 20.0000 (262.0833333d) Dec: -14 14 53.00 (-14.24806d) Equinox: J2000	Epoch of Position: 2015.5	
<p><i>Comments: Background for PDS 456 MIRI observations</i> Category=Unidentified Description=[Blank field] Extended=YES</p>				
(3)	PDS456-NIRSPEC	RA: 17 28 19.7894 (262.0824558d) Dec: -14 15 56.56 (-14.26571d) Equinox: J2000	Proper Motion RA: 1.650907010083184E-6 sec of time/yr Proper Motion Dec: 8.999999999999999E-6 arcsec/yr Epoch of Position: 2015.5	
<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=Galaxy Description=[Quasars] Extended=YES</p>				

Fixed Targets

Proposal 2547 - Observation 1 - Quasar Feedback in Action: The Multiphase and Multiscale Outflow of the Most Luminous Quasar in t...

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Observation	Proposal 2547, Observation 1: MRS PDS 456-MIRI Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy Background Observations:[MRS PDS 456-MIRI-Background (Obs 2)]												
	(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)	PDS456-MIRI	RA: 17 28 19.7894 (262.0824558d) Dec: -14 15 56.56 (-14.26571d) Equinox: J2000				Proper Motion RA: 1.650907010083184E-6 sec of time/yr Proper Motion Dec: 8.999999999999999E-6 arcsec/yr Epoch of Position: 2015.5						
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=Galaxy Description=[Quasars] Extended=YES													
Acquisition	#	Target											
	1	NONE											
Template	AcqFilter	Primary Channel				Simultaneous Imaging				Imager Subarray			
	FND	ALL				YES				SUB256			
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		IMAGER	F770W	FASTR1	40	5	1	Dither 1	4	20	244.408	
	1	LONG(C)	MRSLONG		FASTR1	40	5	1	Dither 1	4	20	2264.433	54907
	1	LONG(C)	MRSSHORT		FASTR1	40	5	1	Dither 1	4	20	2264.433	54907
	2		IMAGER	F770W	FASTR1	40	5	1	Dither 1	4	20	244.408	
	2	MEDIUM(B)	MRSLONG		FASTR1	40	5	1	Dither 1	4	20	2264.433	54907
	2	MEDIUM(B)	MRSSHORT		FASTR1	40	5	1	Dither 1	4	20	2264.433	54907
	3		IMAGER	F770W	FASTR1	40	5	1	Dither 1	4	20	244.408	
	3	SHORT(A)	MRSLONG		FASTR1	40	5	1	Dither 1	4	20	2264.433	54907
	3	SHORT(A)	MRSSHORT		FASTR1	40	5	1	Dither 1	4	20	2264.433	54907

Special Requirements

Sequence Observations 1, 2, Non-interruptible

Proposal 2547 - Observation 2 - Quasar Feedback in Action: The Multiphase and Multiscale Outflow of the Most Luminous Quasar in t...

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Observation	Proposal 2547, Observation 2: MRS PDS 456-MIRI-Background Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy Background Observation For: [MRS PDS 456-MIRI (Obs 1)]												
	(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.												
Diagnosics													
Fixed Targets	#	Name	Target Coordinates				Targ. Coord. Corrections			Miscellaneous			
	(2)	PDS456-MIRI-BACKGROUND	RA: 17 28 20.0000 (262.0833333d) Dec: -14 14 53.00 (-14.24806d) Equinox: J2000				Epoch of Position: 2015.5						
<i>Comments: Background for PDS 456 MIRI observations</i> <i>Category=Unidentified</i> <i>Description=[Blank field]</i> <i>Extended=YES</i>													
Acquisition	#	Target											
	1	NONE											
Template	AcqFilter	Primary Channel				Simultaneous Imaging			Imager Subarray				
	FND	ALL				YES			SUB256				
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	F770W	FASTR1	40	5	1	Dither 1	4	20	244.408	
	1	LONG(C)	MRSLONG		FASTR1	40	5	1	Dither 1	4	20	2264.433	54907
	1	LONG(C)	MRSSHORT		FASTR1	40	5	1	Dither 1	4	20	2264.433	54907
	2		IMAGER	F770W	FASTR1	40	5	1	Dither 1	4	20	244.408	
	2	MEDIUM(B)	MRSLONG		FASTR1	40	5	1	Dither 1	4	20	2264.433	54907
	2	MEDIUM(B)	MRSSHORT		FASTR1	40	5	1	Dither 1	4	20	2264.433	54907
	3		IMAGER	F770W	FASTR1	40	5	1	Dither 1	4	20	244.408	
	3	SHORT(A)	MRSLONG		FASTR1	40	5	1	Dither 1	4	20	2264.433	54907
	3	SHORT(A)	MRSSHORT		FASTR1	40	5	1	Dither 1	4	20	2264.433	54907

Special Requirements

Sequence Observations 1, 2, Non-interruptible

Proposal 2547 - Observation 3 - Quasar Feedback in Action: The Multiphase and Multiscale Outflow of the Most Luminous Quasar in t...

Mon Feb 27 21:02:26 GMT 2023

Observation	<p>Proposal 2547, Observation 3: NIRSpec IFU - PDS 456</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
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			
	(3)	PDS456-NIRSPEC	RA: 17 28 19.7894 (262.0824558d) Dec: -14 15 56.56 (-14.26571d) Equinox: J2000			Proper Motion RA: 1.650907010083184E-6 sec of time/yr Proper Motion Dec: 8.999999999999999E-6 arcsec/yr Epoch of Position: 2015.5						
	<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p>Category=Galaxy Description=[Quasars] 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/Ex p	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G235H/F170LP	NRSRAPID	20	5	false	true	NONE	4	20	4509.443	54907
	2	G235H/F170LP	NRSRAPID	20	2	true	true	NONE	4	8	1803.777	