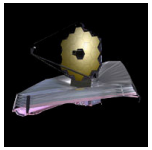

7760 - Testing the gravitational lens origin of SAV events -- MIRI/MFS IFU observations of PKS 1413+135

Cycle: 4, Proposal Category: GO

INVESTIGATORS

Name	*Institution*
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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	7	MIR Spectroscopy	MIRI Medium Resolution Spectroscopy	(1) PKS1413+135
	8		MIRI Medium Resolution Spectroscopy	(2) PKS1413+135_BKG

ABSTRACT

Time-domain surveys are an exciting new frontier, having discovered tidal disruption events, gamma-ray bursts and fast radio transients. Symmetric achromatic variability (SAV) events are a new class of new class of variability events, identified in 7 AGN out of 1830 monitored regularly by the Owens Valley Radio Observatory. SAV events have lightcurves that are time-symmetric and achromatic. They have been modeled by gravitational milli-lensing, which can occur when relativistically moving jet components in a background AGN, move through caustics created by 10^3-10^6 solar mass features in a foreground galaxy. Confirmation of the lensing nature of SAV could give us a powerful new tool, allowing future multiwaveband observations to reveal <0.01pc scale structure in distant galaxies.

We propose to test this idea with MIRI/MRS IFU observations of PKS 1413+135, which has had four SAV events between 1992-2015. PKS 1413+135 is one of the most puzzling blazars known, due to uncertainties about its host galaxy, redshift and nature. The apparent host galaxy, a

z=0.247 edge-on spiral, shows no evidence of activity in its optical spectrum. This is incongruent with the blazar projected on the sky 13 +/- 4 mas (52 +/- 16 pc) from its isophotal centroid in HST/NICMOS observations. The host also has a GMC complex projected within 25 mas of the AGN, with time-variable absorption. Confirming the lens model would require identifying AGN lines at z>0.247. This can only be done in the infrared, as the AGN suffers 30 mag of extinction in the optical. Existing Spitzer data are too low S/N and resolution to do this. We will also re-examine whether the AGN is centered in the z=0.247 spiral.

OBSERVING DESCRIPTION

We propose to obtain mid-infrared spectra and imaging of PKS 1413+135. The most important goal of the mid-IR spectroscopy is to obtain complete coverage between 5-28 μm so that we can obtain both emission lines from the AGN, as well as PAH and other molecular features due to the cloud(s) that may be the lensing screen in the z=0.247 spiral. Discovery of AGN lines at z>0.247 will test the gravitational lensing model of Vedantham et al. (2017a) and Peirson et al. (2022). The most important goal of the imaging is to re-examine whether the AGN is de-centered in the spiral, as shown at 3 sigma in HST/NICMOS images.

We have therefore chosen to use MIRI's MRS mode, using all four spectral channels to obtain complete spectral coverage. We have used the ETC to calculate the exposure times so that a S/N ~ 15-20 per pixel is achieved (using the Spitzer spectrum as a seed), and we have followed the recommendations of the JWST documentation as far as choosing the detector configuration. The goal of the simultaneous imaging is to both place in context the MRS spectra and also test the conclusion of Perlman et al. (2002) that the blazar is not centered within the z=0.247 spiral host galaxy. We have chosen to obtain images in F560W, F770W and F1000W. The F560W and F1800W imaging cover the continuum, while the F1280W imaging will be in the middle of the silicate dust feature at z=0.247. We have thus used the ETC to estimate the exposure time required to obtain a quick image that should show both the galaxy and the AGN. In the mid-IR, dust has very little effect.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	PKS1413+135	RA: 14 15 58.8168 (213.9950700d) Dec: +13 20 23.71 (13.33992d) Equinox: J2000		
Comments: This object was generated by the targetselector and retrieved from the NED database. *Category=Galaxy* *Description=[Active galactic nuclei, BL Lacertae objects, Einstein rings, Relativistic jets]*				
(2)	PKS1413+135_BKG	RA: 14 15 58.8168 (213.9950700d) Dec: +13 20 23.71 (13.33992d) Equinox: J2000	Epoch of Position: 2000	
Comments: *Category=Calibration* *Description=[Telescope/sky background]* *Extended=YES*				

Observation

Proposal 7760, Observation 7: MIR Spectroscopy Wed Jun 11 00:00:08 GMT 2025

Diagnostic Status: Error

Observing Template: MIRI Medium Resolution Spectroscopy

Background Observations:[Observation 8]

Diagnostics

(MIR Spectroscopy (Obs 7)) Error (Form): This target requires similar background exposures that are linked in a non-interruptible group/sequence.

(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)	PKS1413+135	RA: 14 15 58.8168 (213.9950700d) Dec: +13 20 23.71 (13.33992d) Equinox: J2000		

Comments: This object was generated by the targetselector and retrieved from the NED database.
Category=Galaxy
Description=[Active galactic nuclei, BL Lacertae objects, Einstein rings, Relativistic jets]

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
F560W	All MRS	NO	FULL	Allow Auto Reorder

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	SHORT(A)	MRSLONG		FASTR1	30	4	1	Dither 1	4	16	1365.32	
1	SHORT(A)	MRSSHORT		FASTR1	30	4	1	Dither 1	4	16	1365.32	
2	MEDIUM(B)	MRSLONG		FASTR1	30	4	1	Dither 1	4	16	1365.32	
2	MEDIUM(B)	MRSSHORT		FASTR1	30	4	1	Dither 1	4	16	1365.32	
3	LONG(C)	MRSLONG		FASTR1	30	4	1	Dither 1	4	16	1365.32	
3	LONG(C)	MRSSHORT		FASTR1	30	4	1	Dither 1	4	16	1365.32	

Special Requirements	Sequence Observations 7, 8, Non-interruptible

Observation

Proposal 7760, Observation 8 Wed Jun 11 00:00:08 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Background Observation For: [MIR Spectroscopy (Obs 7)]

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
(2)	PKS1413+135_BKG	RA: 14 15 58.8168 (213.9950700d) Dec: +13 20 23.71 (13.33992d) Equinox: J2000	Epoch of Position: 2000	

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

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
F560W	Imager	YES	FULL	Allow Auto Reorder

Dithers

#	Dither Type	Optimized For	Direction
1	2-Point	BACKGROUND	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	F1800W	FASTR1	30	2	1	Dither 1	2	4	338.555	
1	SHORT(A)	MRSLONG		FASTR1	30	2	1	Dither 1	2	4	338.555	
1	SHORT(A)	MRSSHORT		FASTR1	30	2	1	Dither 1	2	4	338.555	
2		IMAGER	F1280W	FASTR1	30	2	1	Dither 1	2	4	338.555	
2	MEDIUM(B)	MRSLONG		FASTR1	30	2	1	Dither 1	2	4	338.555	
2	MEDIUM(B)	MRSSHORT		FASTR1	30	2	1	Dither 1	2	4	338.555	
3		IMAGER	F560W	FASTR1	30	2	1	Dither 1	2	4	338.555	
3	LONG(C)	MRSLONG		FASTR1	30	2	1	Dither 1	2	4	338.555	
3	LONG(C)	MRSSHORT		FASTR1	30	2	1	Dither 1	2	4	338.555	

Special Requirements	Sequence Observations 7, 8, Non-interruptible