



7564 - A Search for Life Around Two Dead Stars

Cycle: 4, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	Observation	Label	Observing Template	Science Target
Observation Folder				
	1		MIRI Medium Resolution Spectroscopy	(1) vMa-2
	2		MIRI Imaging	(1) vMa-2
Observation Folder				
	3		MIRI Medium Resolution Spectroscopy	(2) LAWD-37
	4		MIRI Imaging	(2) LAWD-37

ABSTRACT

Recent detections and theoretical modeling suggest that rocky planets may find their way into the habitable zone of white dwarf stars, and may even possess conditions necessary for the development of life. However, finding these planets has so far been very difficult. This program seeks to conduct the first search for terrestrial planets in the habitable zones of white dwarfs by targeting the two nearest (4-5 pc) solitary white dwarf systems, vMa 2 and GJ 440. Utilizing JWST's MIRI/MRS and imaging, the program will search for unresolved infrared excess from warm ($T > 200$ K) rocky planets and will also be capable of detecting cold gas giants ($T > 95$ K) at a wide range of separations (0-400 AU). Detecting the first HZ terrestrial exoplanet orbiting a white dwarf, or any exoplanet around one of these extremely nearby white dwarfs, would be a very useful outcome with broad implications. Furthermore, if the expected sensitivities are achieved, this program could pave the way for future, larger-scale efforts to constrain the occurrence rates of habitable zone planets around white dwarfs. These worlds could provide crucial insights into the survival and evolution of planetary systems after their stars leave the main sequence and could reveal key information about habitability in this unique environment. Any planets detected through this program would be prime candidates for detailed atmospheric characterization and possibly in-depth biosignature searches. Biosignatures on HZ planets orbiting either of these white dwarfs can be detected with a relatively modest follow-up effort, requiring between 12 and 50 hours of observation time, depending on the planet's size.

OBSERVING DESCRIPTION

The proposed observation is a MRS observation in all three sub-bands and 7m, 18m, 21m and 25m MIRI imaging of the white dwarfs GJ 440 and vMa 2 (Wolf 28), which are $K = 11.1$ and 11.5 mag, respectively.

MRS Observations: To achieve the required sensitivity needed to detect rocky planets (> 0.8 earth radii) in the HZ of white dwarfs with IR excess requires that we observe the each white dwarf for a total of 8.1 hours with MRS. We will use the nod in scene strategy using a 4-Point dither to remove background. We will use 110 groups/integration in all three sub-bands which results in 64 total integrations per sub-band. We are far from saturation, but larger numbers of groups/int would result in a result in a high number of cosmic ray events per read. For all MRS observations, we

JWST Proposal 7564 (Created: Wednesday, June 4, 2025, 5:00:16PM Eastern Standard Time) - Overview

will read out the full array using the FASTR1 readout pattern as this results in the highest SNR observation. We also considered LRS for our observation, but found MRS to provide superior sensitivity to white dwarf rocky planets. Acquisition: Using calculations from the ETC, adequate signal-to-noise without saturation is achievable for both of our targets using the TA acquisition mode, FAST readout, the full array, 4 groups, and the F1000W filter. This acquisition mode produces a signal-to-noise ratio of 268 and 320 on Wolf 28 and GJ 440, respectively. Proper Motion: Both of our targets have a large proper motion values (more than 2000 mas/year), which we input into the APT. The errors on propagated positions are much smaller than MIRI's acquisition field-of-view.

MIRI broadband Imaging: MIRI broadband imaging in the F770W, F1800W, F2100W and F2550W will be conducted on both targets to detect cold giant planets. The exposure times in the four bands are adjusted such that the data is (1) sufficiently sensitive to detect IR excess from cold giant planets at the two longest wavelengths, (2) sufficiently sensitive to detect, via direct imaging, cold giant planets in the three longest wavelengths (7 micron imaging is used to rule out background false positives). This results in 2 hours of imaging for both systems. We will use a 4-point dither pattern for imaging in both filters to correct of bad pixels and remove background noise. For both filters, we will read out the full array using the FASTR1 readout pattern.

Special Requirements: For MRS calibration, it is essential that the two white dwarfs be observed within 3 days of each other to minimize time-dependent systematics and enable photometric calibration between the two stars. This necessitates observing one white dwarf within the micrometeoroid avoidance zone, as there are no other suitable white dwarf targets for this program. Additionally, we require the MIRI imaging and MRS data to be collected back-to-back for each target. If a planet is on a short orbit, observing it at different orbital phases could lead to the planet displaying a significantly different brightness temperature, complicating the interpretation of infrared excess and planetary detection

Proposal 7564 - Targets - A Search for Life Around Two Dead Stars

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	vMa-2	RA: 00 49 9.8983 (12.2912429d) Dec: +05 23 18.99 (5.38861d) Equinox: J2000	Proper Motion RA: 1231.399 mas/yr Proper Motion Dec: -2711.8829999153604 mas/yr Parallax: 0.23178" Epoch of Position: 2000	
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM. Category=Star Description=[White dwarfs] Extended=NO				
Fixed Targets	(2)	LAWD-37	RA: 11 45 42.9169 (176.4288204d) Dec: -64 50 29.46 (-64.84152d) Equinox: J2000	Proper Motion RA: 2661.64 mas/yr Proper Motion Dec: -344.9329999739348 mas/yr Parallax: 0.2156753" Epoch of Position: 2000	
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM. Category=Star Description=[White dwarfs] Extended=NO				

Proposal 7564 - Observation 1 - A Search for Life Around Two Dead Stars

Observation	Proposal 7564, Observation 1												Wed Jun 04 22:00:16 GMT 2025
	Diagnostic Status: Warning												
Observing Template: MIRI Medium Resolution Spectroscopy													
Diagnostics	(Visit 1:1) Warning (Form): Data Excess over middle threshold												
	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.												
	(Visit 1:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.												
Fixed Targets	#	Name	Target Coordinates				Targ. Coord. Corrections				Miscellaneous		
	(1)	vMa-2	RA: 00 49 9.8983 (12.2912429d) Dec: +05 23 18.99 (5.38861d) Equinox: J2000				Proper Motion RA: 1231.399 mas/yr Proper Motion Dec: -2711.8829999153604 mas/yr Parallax: 0.23178" Epoch of Position: 2000						
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.												
	SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.												
	Category=Star Description=[White dwarfs] Extended=NO												
Acquisition	#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID				
	1	1 vMa-2	F1000W	FAST	4	1	1	11.1	215746				
Template	Primary Channel		Simultaneous Imaging				Imager Subarray				Grating Wheel Direction		
	All MRS		NO				FULL				Allow Auto Reorder		
Dithers	#	Dither Type				Optimized For				Direction			
	1	4-Point				POINT 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	110	8	1	Dither 1	4	32	9845.842	
	1	SHORT(A)	MRSSHORT		FASTR1	110	8	1	Dither 1	4	32	9845.842	
	2	MEDIUM(B)	MRSLONG		FASTR1	110	8	1	Dither 1	4	32	9845.842	
	2	MEDIUM(B)	MRSSHORT		FASTR1	110	8	1	Dither 1	4	32	9845.842	
	3	LONG(C)	MRSLONG		FASTR1	110	8	1	Dither 1	4	32	9845.842	
	3	LONG(C)	MRSSHORT		FASTR1	110	8	1	Dither 1	4	32	9845.842	

Proposal 7564 - Observation 1 - A Search for Life Around Two Dead Stars

Special Requirements	1 After 2 by 0 Days to 1 Days 4 After 1 by 0 Days to 3 Days
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Proposal 7564 - Observation 2 - A Search for Life Around Two Dead Stars

Observation	Proposal 7564, Observation 2										Wed Jun 04 22:00:16 GMT 2025
	Diagnostic Status: Warning										
	Observing Template: MIRI Imaging										
Diagnostics	(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
	(Visit 2:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.										
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous		
	(1)	vMa-2	RA: 00 49 9.8983 (12.2912429d)			Proper Motion RA: 1231.399 mas/yr					
			Dec: +05 23 18.99 (5.38861d)			Proper Motion Dec: -2711.8829999153604 mas/yr					
			Equinox: J2000			Parallax: 0.23178"					
						Epoch of Position: 2000					
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.										
	SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.										
	Category=Star										
	Description=[White dwarfs]										
	Extended=NO										
Template	Subarray										
	FULL										
Dithers	#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size	
	1	CYCLING	1	4						DEFAULT	
Spectral Elements	#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	F2100W	FASTR1	7	12	1	Dither 1	4	48	1054.515	
	2	F1800W	FASTR1	12	6	1	Dither 1	4	24	854.712	
	3	F2550W	FASTR1	7	38	1	Dither 1	4	152	3363.348	
	4	F770W	FASTR1	5	7	1	Dither 1	4	28	455.107	

Proposal 7564 - Observation 2 - A Search for Life Around Two Dead Stars

Special Requirements	1 After 2 by 0 Days to 1 Days
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Proposal 7564 - Observation 3 - A Search for Life Around Two Dead Stars

Observation	Proposal 7564, Observation 3												Wed Jun 04 22:00:16 GMT 2025
	Diagnostic Status: Warning												
Observing Template: MIRI Medium Resolution Spectroscopy													
Diagnostics	(Visit 3:1) Warning (Form): Data Excess over middle threshold												
	(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.												
Fixed Targets	#												
	Name												
Fixed Targets	Target Coordinates												
	Targ. Coord. Corrections												
Fixed Targets	Miscellaneous												
	(2) LAWD-37												
Fixed Targets	RA: 11 45 42.9169 (176.4288204d)												
	Dec: -64 50 29.46 (-64.84152d)												
Fixed Targets	Equinox: J2000												
	Parallax: 0.2156753"												
Fixed Targets	Epoch of Position: 2000												
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.												
Fixed Targets	SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.												
	Category=Star												
Fixed Targets	Description=[White dwarfs]												
	Extended=NO												
Acquisition	#												
	Target												
Acquisition	Filter												
	Readout Pattern												
Acquisition	Groups/Int												
	Integrations/Exp												
Acquisition	Total Integrations												
	Total Exposure Time												
Acquisition	ETC Wkbk.Calc ID												
	1 2 LAWD-37 F1000W FAST 4 1 1 11.1 215746												
Template	Primary Channel												
	Simultaneous Imaging												
Template	Imager Subarray												
	Grating Wheel Direction												
Template	All MRS												
	NO												
Template	FULL												
	Allow Auto Reorder												
Dithers	#												
	Dither Type												
Dithers	Optimized For												
	Direction												
Dithers	1 4-Point												
	POINT SOURCE												
Dithers	NEGATIVE												
	#												
Spectral Elements	Wavelength Range												
	Detector												
Spectral Elements	Filter												
	Readout Pattern												
Spectral Elements	Groups/Int												
	Integrations/Exp												
Spectral Elements	Exposures/Dith												
	Dither												
Spectral Elements	Total Dithers												
	Total Integrations												
Spectral Elements	Total Exposure Time												
	ETC Wkbk.Calc ID												
Spectral Elements	1 SHORT(A) MRSLONG												
	FASTR1 110 8 1 Dither 1 4 32 9845.842												
Spectral Elements	1 SHORT(A) MRSSHORT												
	FASTR1 110 8 1 Dither 1 4 32 9845.842												
Spectral Elements	2 MEDIUM(B) MRSLONG												
	FASTR1 110 8 1 Dither 1 4 32 9845.842												
Spectral Elements	2 MEDIUM(B) MRSSHORT												
	FASTR1 110 8 1 Dither 1 4 32 9845.842												
Spectral Elements	3 LONG(C) MRSLONG												
	FASTR1 110 8 1 Dither 1 4 32 9845.842												
Spectral Elements	3 LONG(C) MRSSHORT												
	FASTR1 110 8 1 Dither 1 4 32 9845.842												

Proposal 7564 - Observation 3 - A Search for Life Around Two Dead Stars

Special Requirements	3 After 4 by 0 Days to 1 Days
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Proposal 7564 - Observation 4 - A Search for Life Around Two Dead Stars

Observation	Proposal 7564, Observation 4										Wed Jun 04 22:00:16 GMT 2025
	Diagnostic Status: Warning										
Observing Template: MIRI Imaging											
Diagnostics	(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous		
	(2)	LAWD-37	RA: 11 45 42.9169 (176.4288204d) Dec: -64 50 29.46 (-64.84152d) Equinox: J2000			Proper Motion RA: 2661.64 mas/yr Proper Motion Dec: -344.9329999739348 mas/yr Parallax: 0.2156753" Epoch of Position: 2000					
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.										
	SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.										
	Category=Star Description=[White dwarfs] Extended=NO										
Template	Subarray										
	FULL										
Dithers	#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size	
	1	CYCLING	1	4						DEFAULT	
Spectral Elements	#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	F2100W	FASTR1	7	12	1	Dither 1	4	48	1054.515	
	2	F1800W	FASTR1	12	6	1	Dither 1	4	24	854.712	
	3	F2550W	FASTR1	7	38	1	Dither 1	4	152	3363.348	
	4	F770W	FASTR1	5	7	1	Dither 1	4	28	455.107	

Proposal 7564 - Observation 4 - A Search for Life Around Two Dead Stars

Special Requirements	3 After 4 by 0 Days to 1 Days 4 After 1 by 0 Days to 3 Days
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