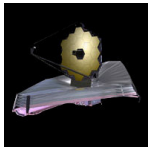

9033 - By the Ashes of Stars: A Chemical Census of a White Dwarf Planet

Cycle: 4, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	MIRI LRS (Transit 1)	MIRI Low Resolution Spectroscopy	(1) WD1856+534
	5	MIRI LRS (Transit 1) - bkgd	MIRI Low Resolution Spectroscopy	(2) WD1856+534-Bkg
	2	MIRI LRS (Transit 2)	MIRI Low Resolution Spectroscopy	(1) WD1856+534
	6	MIRI LRS (Transit 2) - bkgd	MIRI Low Resolution Spectroscopy	(2) WD1856+534-Bkg
	3	NIRSpec PRISM Transit 1	NIRSpec Bright Object Time Series	(1) WD1856+534
	4	NIRSpec PRISM Transit 2	NIRSpec Bright Object Time Series	(1) WD1856+534

ABSTRACT

We propose to obtain a detailed chemical inventory for the only known transiting planet orbiting a white dwarf: WD 1856b. Cycle 1 observations in the near-infrared have revealed the planet is far hotter than its equilibrium temperature (450 K vs. 160 K), implying WD 1856b should have substantial thermal emission in the mid-infrared. We propose to observe 2 transits with MIRI LRS to detect multiple molecular species in the mid-infrared beyond 5 um that are not accessible to the existing Cycle 1 observations. We also propose to observe 2 additional NIRSpec PRISM transits to enable precise chemical abundance constraints. Our 4-transit program will yield the first precise measurements of the main carbon-, nitrogen-, and phosphorus-bearing molecules in a post-main-sequence giant planet atmosphere. The short transit duration of this white dwarf planet renders these observations very time efficient, requiring only a total charged time of 13.7 hours. Finally, our out-of-transit MIRI LRS observations will also allow a direct test of planetary thermal excess spectroscopy, providing a new technique to characterize the atmospheres of non-transiting exoplanets.

OBSERVING DESCRIPTION

To achieve our science goals, we require 2 transit observations with MIRI LRS and 2 transit observations with NIRSpec PRISM of the white dwarf planet WD 1856b.

For the NIRSpec PRISM transits, we will use the NRSRAPID readout pattern on the SUB512 subarray. We will use an identical observing strategy over the two transits to increase the precision obtained over all wavelengths and will not conduct parallel observations. Each observation will consist of 310 integrations with 105 groups per integration, avoiding saturation by staying below 80% full well. The phase constraints ensure we capture the

transit along with a minimum pre-transit baseline of 20 minutes and about 15 minutes of settling time to handle ramp effects. The phase range provides 1 hour for start time flexibility to assist with schedulability. We will perform target acquisition (TA) directly on our target, WD 1856+534, using the Wide Aperture Target Acquisition (WATA) mode with the SUB32 subarray and the F110W filter. The readout pattern will use the NRSRAPIDD6 mode with 3 groups per integration and 1 integration, resulting in a 0.26 s exposure time. Our target acquisition strategy allows us to avoid saturation while still achieving an SNR of 59.8.

For the MIRI LRS transits, we will use the FASTR1 readout pattern on the SLITLESSPRISM. We will use an identical observing strategy over the two transits to increase the precision obtained over all wavelengths and will not be conducting parallel observations. Each observation will consist of 122 integrations with 380 groups per integration, avoiding saturation by staying below 80% full well. The phase constraints ensure we capture the transit along with a minimum pre-transit baseline of 20 minutes and about 15 minutes of settling time to handle ramp effects. The phase range provides 1 hour for start time flexibility to assist with schedulability. We will perform target acquisition (TA) directly on our target, WD 1856+534, using the SLITLESSPRISM with the F560W filter. The readout pattern will use the FAST mode with 44 groups per integration and 1 integration, resulting in a 7.0 s exposure time. Our target acquisition strategy allows us to avoid saturation while still achieving an SNR of 28.29.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	WD1856+534	RA: 18 57 39.3437 (284.4139321d) Dec: +53 30 33.30 (53.50925d) Equinox: J2000	Proper Motion RA: 240.749 mas/yr Proper Motion Dec: -52.47000008239411 mas/yr Parallax: 0.040393099999999994" 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

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	WD1856+534-Bkg	RA: 18 57 9.3437 (284.2889321d) Dec: +53 30 33.30 (53.50925d) Equinox: J2000	Proper Motion RA: 240.749 mas/yr Proper Motion Dec: -52.47000008239411 mas/yr Parallax: 0.040393099999999994" 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.

Dedicated background region offset 30" W from target star WD1856+534
Category=Star
Description=[White dwarfs]
Extended=NO

Observation

Proposal 9033, Observation 1: MIRI LRS (Transit 1)

Wed Jun 18 22:00:27 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(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)	WD1856+534	RA: 18 57 39.3437 (284.4139321d)	Proper Motion RA: 240.749 mas/yr	
		Dec: +53 30 33.30 (53.50925d)	Proper Motion Dec: -52.47000008239411 mas/yr	
		Equinox: J2000	Parallax: 0.040393099999999994"	
			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	SAME	F560W	FAST	98	1	1	15.586	254236

Template

Subarray	Obtain Verification Image?
SLITLESSPRISM	true

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	NONE				

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	44	1	1	1	1	6.998		F1800W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	380	122	122	1	1	7392.338	254236

Special Requirements

Phase 0.9512881814265912 to 0.9808822638544776 with period 1.40793913 Days and zero-phase 2458779.375086 HJD
Time Series Observation
No Parallel Attachments

Sequence Observations 1, 5, Non-interruptible

Observation

Proposal 9033, Observation 5: MIRI LRS (Transit 1) - bkgd Wed Jun 18 22:00:27 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	WD1856+534-Bkg	RA: 18 57 9.3437 (284.2889321d) Dec: +53 30 33.30 (53.50925d) Equinox: J2000	Proper Motion RA: 240.749 mas/yr Proper Motion Dec: -52.47000008239411 mas/yr Parallax: 0.040393099999999994" 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.

Dedicated background region offset 30" W from target star WD1856+534
Category=Star
Description=[White dwarfs]
Extended=NO

Acquisition

#	Target
1	NONE

Template

AcqFilter	Subarray	Obtain Verification Image?
F560W	SLITLESSPRISM	false

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	NONE				

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	380	5	5	1	1	302.812	254236

Special Requirements	
	Time Series Observation No Parallel Attachments Sequence Observations 1, 5, Non-interruptible

Observation

Proposal 9033, Observation 2: MIRI LRS (Transit 2)

Wed Jun 18 22:00:27 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low 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)	WD1856+534	RA: 18 57 39.3437 (284.4139321d)	Proper Motion RA: 240.749 mas/yr	
		Dec: +53 30 33.30 (53.50925d)	Proper Motion Dec: -52.47000008239411 mas/yr	
		Equinox: J2000	Parallax: 0.040393099999999994"	
			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	SAME	F560W	FAST	98	1	1	15.586	254236

Template

Subarray	Obtain Verification Image?
SLITLESSPRISM	true

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	NONE				

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	44	1	1	1	1	6.998		F1800W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	380	122	122	1	1	7392.338	254236

Special Requirements

Phase 0.9512881814265912 to 0.9808822638544776 with period 1.40793913 Days and zero-phase 2458779.375086 HJD
Time Series Observation
No Parallel Attachments

Sequence Observations 2, 6, Non-interruptible

Observation

Proposal 9033, Observation 6: MIRI LRS (Transit 2) - bkgd Wed Jun 18 22:00:27 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Diagnostics

(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	WD1856+534-Bkg	RA: 18 57 9.3437 (284.2889321d) Dec: +53 30 33.30 (53.50925d) Equinox: J2000	Proper Motion RA: 240.749 mas/yr Proper Motion Dec: -52.47000008239411 mas/yr Parallax: 0.040393099999999994" 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.

Dedicated background region offset 30" W from target star WD1856+534
Category=Star
Description=[White dwarfs]
Extended=NO

Acquisition

#	Target
1	NONE

Template

AcqFilter	Subarray	Obtain Verification Image?
F560W	SLITLESSPRISM	false

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	NONE				

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	380	5	5	1	1	302.812	254236

Special Requirements	
	Time Series Observation No Parallel Attachments Sequence Observations 2, 6, Non-interruptible

Observation

Proposal 9033, Observation 3: NIRSpec PRISM Transit 1 Wed Jun 18 22:00:27 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

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
(1)	WD1856+534	RA: 18 57 39.3437 (284.4139321d)	Proper Motion RA: 240.749 mas/yr	
		Dec: +53 30 33.30 (53.50925d)	Proper Motion Dec: -52.47000008239411 mas/yr	
		Equinox: J2000	Parallax: 0.040393099999999994"	
			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	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	WATA	SUB32	F110W	NRSRAPIDD6	3	1	1	0.26	226368

Template

Subarray
SUB512

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	PRISM/CLEAR	NRSRAPID	105	310	1	1	310	7437.966	226368

Special Requirements	
	Phase 0.9512881814265912 to 0.9808822638544776 with period 1.40793913 Days and zero-phase 2458779.375086 HJD Time Series Observation No Parallel Attachments

Observation

Proposal 9033, Observation 4: NIRSpec PRISM Transit 2 Wed Jun 18 22:00:27 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRSpec Bright Object Time Series

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
(1)	WD1856+534	RA: 18 57 39.3437 (284.4139321d)	Proper Motion RA: 240.749 mas/yr	
		Dec: +53 30 33.30 (53.50925d)	Proper Motion Dec: -52.47000008239411 mas/yr	
		Equinox: J2000	Parallax: 0.040393099999999994"	
			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	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	WATA	SUB32	F110W	NRSRAPIDD6	3	1	1	0.26	226368

Template

Subarray
SUB512

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	PRISM/CLEAR	NRSRAPID	105	310	1	1	310	7437.966	226368

Special Requirements	
	Phase 0.9512881814265912 to 0.9808822638544776 with period 1.40793913 Days and zero-phase 2458779.375086 HJD Time Series Observation No Parallel Attachments