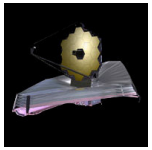

3762 - Stringent Tests of Atmospheric and Evolutionary Models with a Benchmark T Dwarf Companion

Cycle: 2, Proposal Category: GO

INVESTIGATORS

Name	*Institution*
Mr. Jerry Xuan (PI)	**California Institute of Technology**
Dr. Dimitri Mawet (CoI)	California Institute of Technology
Dr. Heather A. Knutson (CoI)	California Institute of Technology
Dr. Jason J. Wang (CoI)	Northwestern University
Dr. Jean-Baptiste Ruffio (CoI)	University of California - San Diego

OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1		NIRSpec IFU Spectroscopy	(3) HD-42581B-NIRSPEC
	2		MIRI Low Resolution Spectroscopy	(1) HD-42581B

ABSTRACT

We propose to collect NIRSpec medium-resolution (R~2700, 1-5 micron) and MIRI low-resolution spectroscopy (R~100, 5-14 micron) for Gl 229 B, one of the closest T dwarf companions with a precise dynamical mass. Previous studies on Gl 229 B have found strong tensions between observations and model predictions, specifically for its atmospheric composition and bolometric luminosity. Our proposed program will measure six different elemental abundances to provide a comprehensive picture of the formation history of Gl 229 B. This will allow us to uncover any deficiencies in the chemical and atmospheric models. In addition, we will measure the vertical mixing coefficient, a highly uncertain parameter, to unprecedented precision, which has important implications for cloud formation and 3D global circulation. The combined 1-14 micron spectra will provide tight constraints on the bolometric luminosity, effective temperature, and radius of Gl 229 B, which will be examined in the context of its

dynamical mass and evolutionary models. Combined with knowledge of its atmospheric composition gained from NIRSpec medium-resolution spectroscopy, we can begin to understand what may be missing in the models that have trouble explaining the low luminosity of T dwarfs. By testing these models with exquisite data for Gl 229 B, our proposal will also inform observations of directly imaged exoplanet atmospheres.

OBSERVING DESCRIPTION

We propose to collect NIRSpec fixed slit medium-resolution spectrum with G140H/F100LP, G235H/F170LP, and G395H/F290LP, as well as MIRI Slit low-resolution spectrum for the T dwarf companion Gl 229 B. The S200A1 slit is selected for NIRSpec.

We request position angle ranges that avoid aligning the NIRSpec/MIRI slit with bright diffraction spikes from the host star. One example PA range is provided in Special Requirements. Other PA ranges may be used given the symmetry of the diffraction pattern.

All observations including target acquisition were simulated with the ETC (notebook 135635).

Proposal 3762 - Targets - Stringent Tests of Atmospheric and Evolutionary Models with a Benchmark T Dwarf Companion

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	HD-42581B	RA: 06 10 34.5980 (92.6441583d) Dec: -21 51 57.08 (-21.86586d) Equinox: J2000	Proper Motion RA: -135.692 mas/yr Proper Motion Dec: -719.178 mas/yr Parallax: 0.17357" Epoch of Position: 2000.0	
Comments: These coordinates are for the brown dwarf companion HD 42581 B (Gl 229 B), the science target. *Category=Star* *Description=[Substellar companions, T dwarfs]* *Extended=NO*				
(2)	HD-42581	RA: 06 10 34.6149 (92.6442288d) Dec: -21 51 52.66 (-21.86463d) Equinox: J2000	Proper Motion RA: -135.692 mas/yr Proper Motion Dec: -719.178 mas/yr Parallax: 0.17357" Epoch of Position: 2000.0	
Comments: This is the host star, for use in target acquisition only. *Category=Star* *Description=[M dwarfs]* *Extended=NO*				
(3)	HD-42581B-NIRSPEC	RA: 06 10 34.5903 (92.6441262d) Dec: -21 51 56.92 (-21.86581d) Equinox: J2000	Proper Motion RA: -135.692 mas/yr Proper Motion Dec: -719.178 mas/yr Parallax: 0.173574" Epoch of Position: 2000.0	
Comments: *Category=Star* *Description=[T dwarfs]* *Extended=NO*				

Observation

Proposal 3762, Observation 1

Wed Sep 25 15:00:10 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRSpec IFU 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
(3)	HD-42581B-NIRSPEC	RA: 06 10 34.5903 (92.6441262d) Dec: -21 51 56.92 (-21.86581d) Equinox: J2000	Proper Motion RA: -135.692 mas/yr Proper Motion Dec: -719.178 mas/yr Parallax: 0.173574" Epoch of Position: 2000.0	

Comments:
Category=Star
Description=[T dwarfs]
Extended=NO

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	SMALL	1	7	

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	G395H/F290LP	NRSIRS2RAPID	12	1	false	true	NONE	7	7	1327.589	
2	G235H/F170LP	NRSIRS2RAPID	11	1	false	true	NONE	7	7	1225.467	
3	G140H/F100LP	NRSIRS2RAPID	6	1	false	true	NONE	7	7	714.856	

Special Requirements

Aperture PA Range 106.97164917 to 118.97164917 Degrees (V3 328.0 to 340.0)

Observation

Proposal 3762, Observation 2

Wed Sep 25 15:00:10 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Low Resolution Spectroscopy

Comments: Note that target acquisition will be done on the bright host star. The science target is HD-42581B, which is about 4.4 arcsec away from the host star.

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)	HD-42581B	RA: 06 10 34.5980 (92.6441583d)	Proper Motion RA: -135.692 mas/yr	
		Dec: -21 51 57.08 (-21.86586d)	Proper Motion Dec: -719.178 mas/yr	
		Equinox: J2000	Parallax: 0.17357"	
			Epoch of Position: 2000.0	

Comments: These coordinates are for the brown dwarf companion HD 42581 B (Gl 229 B), the science target.
Category=Star
Description=[Substellar companions, T dwarfs]
Extended=NO

Acquisition

#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	2 HD-42581	FND	FAST	4	1	1	11.1	135635.23

Template

Subarray	Obtain Verification Image?
FULL	true

Dithers

#	Dither Type	No. Spectral Steps	Spectral Step Offset	No. Spatial Steps	Spatial Step Offset
1	ALONG SLIT NOD				

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	6	1	1	1	1	16.65		F560W

Spectral Elements

#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	FASTR1	25	4	8	1	2	571.658	135635.27

Special Requirements

Aperture PA Range 12.75797 to 22.75797 Degrees (V3 8.0 to 18.0)
Aperture PA Range 342.75797 to 2.75797 Degrees (V3 338.0 to 358.0)