



3514 - Panchromatic view of an Adolescent and Frigid Jovian Exoplanet

Cycle: 2, Proposal Category: GO

INVESTIGATORS

<i>Name</i>	<i>Institution</i>
Dr. Mickael Bonnefoy (PI) (ESA Member)	Institut de Planetologie et d'Astrophysique de Grenoble
Dr. Laurent Pueyo (CoI)	Space Telescope Science Institute
Dr. Caroline Morley (CoI) (CoPI) (US Admin CoI)	University of Texas at Austin
Dr. Anne-Marie Lagrange (CoI) (ESA Member)	Observatoire de Paris - Section de Meudon
Benjamin Charnay (CoI) (ESA Member)	Observatoire de Paris
Dr. Anthony Boccaletti (CoI) (ESA Member)	Observatoire de Paris - Section de Meudon
Mrs. Mathilde Malin (CoI) (ESA Member)	Observatoire de Paris - Section de Meudon
Dr. Simon Petrus (CoI)	Universidad de Valparaiso
Dr. Gael Chauvin (CoI) (ESA Member) (CoPI)	Institut de Planetologie et d'Astrophysique de Grenoble
Paulina Palma-Bifani (CoI) (ESA Member)	Observatoire de la Cote d'Azur
Dr. Pascal Tremblin (CoI) (ESA Member)	Commissariat a l'Energie Atomique (CEA)
Dr. Aurelien FALCO (CoI) (ESA Member)	CEA, Universite Paris-Saclay
Dr. Gabriel-Dominique Marleau (CoI) (ESA Member)	Universitaet Duisburg-Essen
Dr. Polychronis Alexandros Patapis (CoI) (ESA Member)	Eidgenossische Technische Hochschule Zurich (ETHZ)
Mr. Evert Nasedkin (CoI) (ESA Member)	Max Planck Institute for Astronomy
Dr. Philippe Delorme (CoI) (ESA Member)	Universite de Grenoble I
Dr. Olivia Venot (CoI) (ESA Member)	CNRS - Laboratoire Interuniv. des Systemes Atmospheriques
Celia Desgrange (CoI) (ESA Member)	Max Planck Institute for Astronomy
Prof. Thomas K. Henning (CoI) (ESA Member)	Max Planck Institute for Astronomy
Mr. Dorian Demars (CoI) (ESA Member)	Institut de Planetologie et d'Astrophysique de Grenoble
Dr. Beth Biller (CoI) (ESA Member)	University of Edinburgh, Institute for Astronomy
Dr. Elena Manjavacas (CoI) (ESA Member)	Space Telescope Science Institute - ESA - JWST
Dr. Matthias Samland (CoI) (ESA Member)	Max Planck Institute for Astronomy

OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Observation Folder				
	1	NIRSPEC	NIRSpec Fixed Slit Spectroscopy	(1) WISEP-J075108.79-763449.6
	2	MIRI	MIRI Low Resolution Spectroscopy	(1) WISEP-J075108.79-763449.6

ABSTRACT

Direct imaging has started unveiling the physical and atmospheric properties of young and hot (700-2700K) Jovian exoplanets. The recent detection of COCONUTS-2b, a 6MJup planet at 6471au from its host star challenges proposed formation models. The object is the coldest exoplanet identified around a star younger than 1Gyr, offering to extend our knowledge of the atmosphere of cool young Jovians at frigid temperatures where a larger diversity of molecular compounds condense and leave deep imprints in infrared spectra.

We propose to conduct an in-depth spectroscopic investigation of that exoplanet from 0.6-14microns with the JWST. We will determine accurately the bulk characteristics (mass, Teff, luminosity) of the object to better understand its formation. We will study the magnitude of non-equilibrium chemistry and formation of resurgent clouds proposed to happen at these extreme Teffs. We will constrain the abundances of key formation tracers (C/O, M/H, S/Fe, P/Fe) to better understand the object origin. To conclude, we will measure for the first time the abundance of CH3D -- and D/H -- in the atmosphere of an exoplanet. The companion is both exceptionally bright, cold, and should not have been fusing deuterium to allow for that measurement. Deuterium abundance could be used to improve the Deuterium-burning models, setting the dividing line between planets and brown-dwarfs. We will also compare the D/H to ISM, protoplanetary disk, and Jupiter values to draw a consistent picture of the formation of that exoplanet and contextualize our Solar System.

OBSERVING DESCRIPTION

We will observe the faint and ultracool exoplanet companion COCONUTS-2b (=WISEPA J075108.79-763449.6) with the fixed-slit modes of NIRSpec and MIRI.

We will collect at two visits:

*VISIT 1:i/ a low-resolution R=100 NIRpec-PRISM, 0.60-5.30microns of the source. This setup gives access to the near-infrared (1-2.5 microns) where the object displays characteristic bands sensitive to Teff, surface gravity, metallicity, and clouds; ii/ a low-resolution R=100 MIRI-LRS 5.0-1 micron spectrum giving extra sensitivity to non-equilibrium chemistry of N2/NH3 and clouds. Both NIRSPec observations are conducted with the

S200 slit at standard orientation.

*VISIT 2: a higher-resolution ($R=2700$) high signal-to-noise F290LP/G395H 2.9-5.3 microns spectrum of the peak emission region of the companion. The spectrum will give access to a rich set of rovibrational molecular absorptions of H₂O, CO, CH₄, N₃, CO₂, H₂S, PH₃. It will also allow detecting the methane isotopologue (CH₃D) to measure the D/H ratio of COCONUTS-2b.

In summary, the total charged time is 8.80 hours, including 5.31 hours of science time from the APT calculator.

Proposal 3514 - Targets - Panchromatic view of an Adolescent and Frigid Jovian Exoplanet

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	WISEP-J075108.79-763449.6	RA: 07 51 8.8058 (117.7866908d) Dec: -76 34 49.43 (-76.58040d) Equinox: J2000	Proper Motion RA: -104.8 mas/yr Proper Motion Dec: -189.7 mas/yr Parallax: 0.0979" Epoch of Position: 2000	
<i>Comments: Faint exoplanet detected at Wise W1 and W2, far from its host star.</i> Category=Unidentified Description=[Infrared sources] Extended=NO					

Proposal 3514 - Observation 1 - Panchromatic view of an Adolescent and Frigid Jovian Exoplanet

Thu Feb 01 21:00:46 GMT 2024

Observation	Proposal 3514, Observation 1: NIRSPEC Diagnostic Status: Warning Observing Template: NIRSPEC Fixed Slit Spectroscopy										
	(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)	WISEP-J075108.79-763449.6	RA: 07 51 8.8058 (117.7866908d)	Dec: -76 34 49.43 (-76.58040d)		Equinox: J2000		Proper Motion RA: -104.8 mas/yr Proper Motion Dec: -189.7 mas/yr Parallax: 0.0979" Epoch of Position: 2000			
Comments: Faint exoplanet detected at Wise W1 and W2, far from its host star. Category=Unidentified Description=[Infrared sources] Extended=NO											
Acquisition	#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	1 WISEP-J075108.79-763449.6	WATA	SUB2048	F110W	NRSRAPIDD6	3	1	1	14.452	136050
Template	Slit					Subarray					
	S200A1					SUBS200A1					
Dithers	#	Primary Dither Positions					Sub-Pixel Pattern				
	1	5					SPATIAL				
Spectral Elements	#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Ex #	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	PRISM/CLEAR	S200A1	NRSRAPID	10	1	NONE	10	10	171.585	136050
	2	G395H/F290LP	S200A1	NRS	250	1	NONE	10	10	15595.785	136050

Proposal 3514 - Observation 2 - Panchromatic view of an Adolescent and Frigid Jovian Exoplanet

Thu Feb 01 21:00:46 GMT 2024

Observation	Proposal 3514, Observation 2: MIRI 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)	WISEP-J075108.79-763449.6	RA: 07 51 8.8058 (117.7866908d) Dec: -76 34 49.43 (-76.58040d) Equinox: J2000	Proper Motion RA: -104.8 mas/yr Proper Motion Dec: -189.7 mas/yr Parallax: 0.0979" Epoch of Position: 2000						
	<i>Comments: Faint exoplanet detected at Wise W1 and W2, far from its host star.</i> Category=Unidentified Description=[Infrared sources] Extended=NO									
Acquisition	#	Target	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	
	1	1 WISEP-J075108.79-763449.6	F560W	FASTGRPAVG	10	1	1	111.002	136050	
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	10	1	1	1	1	27.75		F560W

Proposal 3514 - Observation 2 - Panchromatic view of an Adolescent and Frigid Jovian Exoplanet

Spectral Elements	#	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Exposures/Dith	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
	1	FASTR1	300	2	4	1	2	3335.598	136050