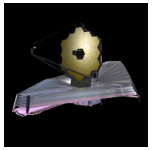

5037 - Confirmation of the closest directly detected exoplanet: a super-Jupiter orbiting Eps Ind A

Cycle: 3, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	BG_dituc F1550C	MIRI Coronagraphic Imaging	(3) BG-NEAR-DI-TUC
	2	BG_epsindi F1550C	MIRI Coronagraphic Imaging	(3) BG-NEAR-DI-TUC
	3	DITuc F1550C	MIRI Coronagraphic Imaging	(2) V-DI-Tuc
	4	EpsIndi F1550C	MIRI Coronagraphic Imaging	(1) -eps-Ind

ABSTRACT

We will confirm that a candidate companion to Eps Ind A is indeed a massive planet, and detect (or place stringent constraints on) a second massive planet in the system. Eps Ind A is the ideal location to search for solar-age exoplanets: the system is nearby, hosts a known RV planet, and is co-moving with a benchmark brown dwarf binary. Even super-Jupiters orbiting the ~4Gyr Eps Ind A could be as cold as ~200K, far older and colder than any imaged planet to date. Only JWST, with its excellent mid-IR sensitivity, can detect such companions - and these companions would be exquisite targets for detailed atmospheric characterization in future cycles. Radial velocity and astrometric measurements suggest a planet with mass ~3Mjup and semi-major axis ~8-11au - readily resolvable and detectable with JWST/MIRI.

JWST Cycle 1 images of Eps Ind A reveal a candidate companion that is consistent in color and magnitude with a massive (~10Mjup) planet. However, the position angle and mass of the candidate is different than expected from RV/astrometric models of the companion orbit - perhaps suggesting there are two giant planets in this system, with only one of these detected in the MIRI images. No counterpart is seen at the background location in archival Spitzer 8um and 24um images, and the object is challenging to explain as a chance-aligned background. A second epoch of observations will allow us to test for common proper motion to confirm that the source is a planet and not a chance-aligned background, carry out preliminary orbit fitting efforts to constrain a planet mass and test planet evolution models, and place further constraints on a proposed second candidate in the system.

OBSERVING DESCRIPTION

We will observe Eps Ind Ab with JWST/MIRI coronagraphic imaging, with the F1550C filter and the FQPM coronagraph. We will also collect PSF reference images of DI Tuc, using the 5-point small grid dither technique. This allows data to be reduced using reference differential imaging (RDI); we do not use angular differential imaging (ADI) for this target. It has been shown that ADI does not significantly improve performance, especially at small projected separations (Carter+2023), where companions would be significantly self-subtracted due to the small roll angles acheivable with JWST.

Our program aims to redetect a bright companion at ~4" from the host star, previously detected in Cycle 1. We also aim to reach deep sensitivities at the position angles that were not detectable during the cycle 1 observations due to the coronagraph bounday. We therefore provide a PA aperture constraint of between 53deg and 83deg (+ n x 90deg), justified in detail in the technical description. There are no orientation constraints for the reference star.

We will also collect background observations matching both the science and technical setup. This is needed to subtract of the glowstick feature present in MIRI cornagraphic images.

We include all of the observations in a non-interruptible block. It is crucial that the science and PSF observations are collected in a non-interruptible block since the JWST PSF is time-variable, and it is crucial to collect the backgtround observations in a non-interruptible block, to mimic the science background as closesly as possible.

Proposal 5037 - Targets - Confirmation of the closest directly detected exoplanet: a super-Jupiter orbiting Eps Ind A

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	-eps-Ind	RA: 22 03 21.6536 (330.8402233d)	Proper Motion RA: 3966.6610000000005 mas/yr	
		Dec: -56 47 9.52 (-56.78598d)	Proper Motion Dec: -2536.1920000932514 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Star* *Description=[K stars]* *Extended=NO*				
(2)	V-DI-Tuc	RA: 22 16 8.1950 (334.0341458d)	Proper Motion RA: 18.257 mas/yr	
		Dec: -57 34 5.06 (-57.56807d)	Proper Motion Dec: -12.32699999036413 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Star* *Description=[M giants]* *Extended=NO*				
(3)	BG-NEAR-DI-TUC	RA: 22 17 54.0000 (334.4750000d)		
		Dec: -57 28 50.00 (-57.48056d)		
		Equinox: J2000		
Comments: *Category=Calibration* *Description=[Telescope/sky background]*				

Observation

Proposal 5037, Observation 1: BG_dituc F1550C Fri Mar 01 00:00:46 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Coronagraphic Imaging

Background Observation For: [DITuc F1550C (Obs 3), EpsIndi F1550C (Obs 4)]

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)	BG-NEAR-DI-TUC	RA: 22 17 54.0000 (334.4750000d) Dec: -57 28 50.00 (-57.48056d) Equinox: J2000		

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

Acquisition

#	Target
1	NONE

Template

AcqFilter	Repeat observation	Background Quadrant
FND	YES	1

Dithers

#	Dither Type
1	BACKGROUND

Spectral Elements

#	Coron Mask/Filter	Subarray	Mask	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	4QPM/F1550C	MASK1550	4QPM	F1550C	FASTR1	811	14	1	2	28	5448.885	

PSF References

Additional Justification: false

Special Requirements	
	No Parallel Attachments Sequence Observations 1, 2, 3, 4, Non-interruptible

Observation

Proposal 5037, Observation 2: BG_epsindi F1550C Fri Mar 01 00:00:46 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Coronagraphic Imaging

Background Observation For: [DITuc F1550C (Obs 3), EpsIndi F1550C (Obs 4)]

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
(3)	BG-NEAR-DI-TUC	RA: 22 17 54.0000 (334.4750000d) Dec: -57 28 50.00 (-57.48056d) Equinox: J2000		

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

Acquisition

#	Target
1	NONE

Template

AcqFilter	Repeat observation	Background Quadrant
FND	YES	1

Dithers

#	Dither Type
1	BACKGROUND

Spectral Elements

#	Coron Mask/Filter	Subarray	Mask	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	4QPM/F1550C	MASK1550	4QPM	F1550C	FASTR1	1168	14	1	2	28	7844.726	

PSF References

Additional Justification: false

Special Requirements	
	No Parallel Attachments Sequence Observations 1, 2, 3, 4, Non-interruptible

Observation

Proposal 5037, Observation 3: DITuc F1550C Fri Mar 01 00:00:46 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Coronagraphic Imaging

Background Observations:[BG_dituc F1550C (Obs 1), BG_epsindi F1550C (Obs 2)]

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
(2)	V-DI-Tuc	RA: 22 16 8.1950 (334.0341458d)	Proper Motion RA: 18.257 mas/yr	
		Dec: -57 34 5.06 (-57.56807d)	Proper Motion Dec: -12.32699999036413 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[M giants]
Extended=NO

Acquisition

#	Target	Filter	Quadrant	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	FND	1	FAST	4	1	1	0.959	176691.3

Template

Repeat observation
NO

Dithers

#	Dither Type
1	5-POINT-SMALL-GRID

Spectral Elements

#	Coron Mask/Filter	Subarray	Mask	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	4QPM/F1550C	MASK1550	4QPM	F1550C	FASTR1	811	14	1	5	70	13622.213	

PSF References

PSF Reference: true

Special Requirements	
	No Parallel Attachments Sequence Observations 1, 2, 3, 4, Non-interruptible

Observation

Proposal 5037, Observation 4: EpsIndi F1550C Fri Mar 01 00:00:46 GMT 2024

Diagnostic Status: Warning

Observing Template: MIRI Coronagraphic Imaging

Background Observations:[BG_dituc F1550C (Obs 1), BG_epsindi F1550C (Obs 2)]

Diagnostics

(EpsIndi F1550C (Obs 4)) Warning (Form): Science observations should be linked to at least one other compatible science observation by an Aperture PA Offset of 1-14 degrees

(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)	-eps-Ind	RA: 22 03 21.6536 (330.8402233d)	Proper Motion RA: 3966.6610000000005 mas/yr	
		Dec: -56 47 9.52 (-56.78598d)	Proper Motion Dec: -2536.1920000932514 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[K stars]
Extended=NO

Acquisition

#	Target	Filter	Quadrant	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	FND	1	FAST	4	1	1	0.959	176691.1

Template

Repeat observation
NO

Dithers

#	Dither Type
1	NONE

Spectral Elements

#	Coron Mask/Filter	Subarray	Mask	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	4QPM/F1550C	MASK1550	4QPM	F1550C	FASTR1	1168	14	1	1	14	3922.363	

PSF References

DITuc F1550C (Obs 3) (PSF Reference; Filters [F1550C])

Additional Justification: false

Special Requirements	
	Aperture PA Range 53 to 83 Degrees (V3 48.16455103 to 78.16455103) Aperture PA Range 143 to 173 Degrees (V3 138.16455103 to 168.16455103) Aperture PA Range 233 to 263 Degrees (V3 228.16455103 to 258.16455103) Aperture PA Range 323 to 353 Degrees (V3 318.16455103 to 348.16455103) No Parallel Attachments Sequence Observations 1, 2, 3, 4, Non-interruptible