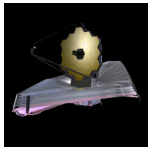

2297 - Unveiling formation signatures in the atmosphere of beta Pictoris c

Cycle: 1, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Beta Pic with NIRISS/AMI				
	1	Beta Pic	NIRISS Aperture Masking Interferometry	(1) -BET-PIC
	2	PSF Ref	NIRISS Aperture Masking Interferometry	(2) HD-40733

ABSTRACT

Beta Pictoris is a unique laboratory for studying the formation of giant exoplanets. The system contains two directly imaged planets with dynamically inferred masses, therefore it is a treasure for comparative exoplanetology and calibration of planet formation and evolution models. The presence of the second planet, which was discovered through radial velocity measurements, has recently been confirmed with GRAVITY at a separation of 2.7 au. Since beta Pic b orbits at 9.8 au, this system resembles a young and more massive instance of the giant planets in our Solar System. The K band spectrum indicates that beta Pic c is cooler and smaller than beta Pic b but the chemical characteristics of beta Pic c remain unknown. We propose NIRISS/AMI observations at F380M, F430M, and F480M to quantify the atmospheric composition of beta Pic c. At these wavelengths, we will be

sensitive to the carbon content of the atmosphere which, together with the available K band spectrum, will enable us to set unique constraints on both the carbon-to-oxygen ratio and the metallicity of beta Pic c. Additionally, the extended wavelength coverage of the spectral energy distribution will allow for a more accurate measurement of the radius and bolometric luminosity. Altogether, the proposed observations provide us with the exciting opportunity to study for the first time the chemical composition of a giant exoplanet at an orbital separation comparable to Jupiter. The combined constraints on the chemical composition and the macrophysical properties will unveil important clues about the formation history of beta Pic c.

OBSERVING DESCRIPTION

The proposal aims at the atmospheric characterization of the directly imaged exoplanet beta Pictoris c. We will observe beta Pictoris and a PSF reference (HD 40733) with NIRISS aperture masking interferometry at F480M, F380M, and F430M. The observations will be executed in a non-interruptible sequence and the order of the filters minimizes the motion of the filter wheel between subsequent observations. We aim for an SNR > 100 with the target acquisition to achieve a centroiding accuracy <0.05 pixels. The exposure times were calculated by following the recommenced observing strategy that a detection requires 100/contrast^2 photons. We used the ETC (see workbook #60901) to verify that we can only use 1 group to prevent saturation for this bright target (3.48 in L' and M'). In F380M, we expect that 1 pixel will saturate but this will not impact our science goals. The total exposure time amounts 2115s for beta Pic and 2400s for the PSF reference. Given the brightness of beta Pic, we will use the SUB80 subarray and the NISRAPID readout pattern. We do not perform any dithering to minimize the effect of persistence. The orbits of beta Pic b and beta Pic c have a nearly edge-on inclination so the observations need to be carried out between 01-Sep-2023 and 01-Feb-2024 to observe beta Pic c with a maximum separation from both beta Pic A and beta Pic b. The total requested telescope time is 5.1h.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	-BET-PIC	RA: 05 47 17.0961 (86.8212337d) Dec: -51 03 58.13 (-51.06615d) Equinox: J2000	Proper Motion RA: 2.4926642992795482 mas/yr Proper Motion Dec: 82.57699765820068 mas/yr Parallax: 0.050623090485178054" Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Star* *Description=[A stars, Exoplanet Systems]*				
(2)	HD-40733	RA: 05 58 37.5302 (89.6563758d) Dec: -44 02 4.26 (-44.03452d) Equinox: J2000	Proper Motion RA: -11.844966611595426 mas/yr Proper Motion Dec: 10.011405159796226 mas/yr Parallax: 0.0029842666199881336" Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Calibration* *Description=[Point spread function]*				

Observation

Proposal 2297, Observation 1: Beta Pic Tue Oct 10 00:00:14 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRISS Aperture Masking Interferometry

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)	-BET-PIC	RA: 05 47 17.0961 (86.8212337d) Dec: -51 03 58.13 (-51.06615d) Equinox: J2000	Proper Motion RA: 2.4926642992795482 mas/yr Proper Motion Dec: 82.57699765820068 mas/yr Parallax: 0.050623090485178054" Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[A stars, Exoplanet Systems]

Acquisition

#	Target	Acquisition Mode	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	AMIBRIGHT	F480M	NISRAPID	3	1	1	0.202	60901.1

Template

Subarray	Direct Image
SUB80	false

Dithers

#	Primary Dithers	Subpixel Positions
1	NONE	NONE

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F480M	NISRAPID	3	5047	1	5047	1626.345	60901.2
2	F480M	NISRAPID	3	5047	1	5047	1626.345	60901.2
3	F380M	NISRAPID	3	5930	1	5930	1910.883	60901.3
4	F430M	NISRAPID	3	4490	1	4490	1446.858	60901.4
5	F430M	NISRAPID	3	4490	1	4490	1446.858	60901.4

PSF References	PSF Ref (Obs 2) (PSF Reference; Filters [F380M, F430M, F480M]) Additional Justification: false
Special Requirements	Between Dates 01-SEP-2023:00:00:00 and 01-FEB-2024:00:00:00 Offset 0.03265 arcsec, 0.0329 arcsec No Parallel Attachments Group Observations 1, 2, Non-interruptible

Observation

Proposal 2297, Observation 2: PSF Ref Tue Oct 10 00:00:14 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRISS Aperture Masking Interferometry

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
(2)	HD-40733	RA: 05 58 37.5302 (89.6563758d) Dec: -44 02 4.26 (-44.03452d) Equinox: J2000	Proper Motion RA: -11.844966611595426 mas/yr Proper Motion Dec: 10.011405159796226 mas/yr Parallax: 0.0029842666199881336" Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Calibration
Description=[Point spread function]

Acquisition

#	Target	Acquisition Mode	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	AMIBRIGHT	F480M	NISRAPID	3	1	1	0.202	60901.5

Template

Subarray	Direct Image
SUB80	false

Dithers

#	Primary Dithers	Subpixel Positions
1	NONE	NONE

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F480M	NISRAPID	3	5733	1	5733	1847.402	60901.6
2	F480M	NISRAPID	3	5733	1	5733	1847.402	60901.6
3	F380M	NISRAPID	3	6737	1	6737	2170.931	60901.7
4	F430M	NISRAPID	3	5101	1	5101	1643.746	60901.8
5	F430M	NISRAPID	3	5101	1	5101	1643.746	60901.8

PSF References	PSF Reference: true
Special Requirements	Offset 0.03265 arcsec, 0.0329 arcsec No Parallel Attachments Group Observations 1, 2, Non-interruptible