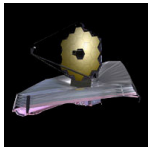

4014 - Imaging Planet Formation at its Earliest Stages: Measuring The Extinction Level of an Enshrouded Protoplanet

Cycle: 2, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1		NIRCam Coronagraphic Imaging	(2) HD-36575
	2		NIRCam Coronagraphic Imaging	(1) MWC758
	3		NIRCam Coronagraphic Imaging	(1) MWC758

ABSTRACT

We propose to use JWST's unique capabilities in the thermal infrared to measure the level of extinction of a highly attenuated protoplanet, MWC 758c. As one of the youngest planets known, and currently the most reddened by cirumplanetary dust, MWC 758c represents a novel opportunity to study planet formation at its earliest stages. By establishing the level of extinction of MWC 758c, we will constrain the amount of dust within the circumplanetary material. Current ground-based lower limits suggest optical extintion greater than 8 magnitudes, and due to the degeneracy with temperature, a wide range of optical extinction is possible (up to ~90 magnitudes based on existing data, which is on the upper end of planet-formation models). NIRCam's F430M mode, combined with the M335R coronagraph, will be able to constrain MWC758c's temperature to within 100-200K through the strength of molecular absorption features that are not observable from the ground. With temperature known, constraints on extinction will be improved by at least an order of magnitude, even in the event of a non-detection. Simulations suggest that observations with NIRCam will be able to detect MWC758c with SNR>10 for Av<40, and will be able to establish at least an S/N>5 detection for Av<90 under conservative assumptions of of wavefront error between roll angles and reference star. This covers essentially all possible values, and thus even a non-detection would be useful to constrain the amount of extinction to the upper end of its existing range. MWC 758c is a unique target for this scientific case and JWST is the first and only facility capable of measuring its temperature and level of extinction.

OBSERVING DESCRIPTION

This program aims to make the first measurement of the level of extinction of an extremely reddened protoplanet, MWC 758c. This will be used to constrain its effective temperature and mass, and will be linked to models of giant planet formation to determine the planet's level of initial entropy. These constraints will then be fed into new simulations of this benchmark system for planet-disk interactions.

The observations are centered around obtaining F430M coronagraphic imaging with the smallest possible inner working angle, which will enable us to determine the effective temperature and level of extinction of MWC 758c. For this purpose, our simulations identified M335R to be the optimal mask that provides a balance between inner working angle and PSF stability at 4.3 microns. The observing strategy includes two spacecraft roll positions and one PSF reference star to enable combined angular plus reference differential imaging. Simultaneously, we will collect F200W observations that will provide new images of the disk structures (in particular at smaller separations than are possible with existing F200W direct

imaging).

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	MWC758	RA: 05 30 27.5328 (82.6147200d) Dec: +25 19 56.67 (25.33241d) Equinox: J2000	Proper Motion RA: 2.718030636581846E-4 sec of time/yr Proper Motion Dec: -0.026373000014245918 arcsec/yr Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Star* *Description=[A stars]*				
(2)	HD-36575	RA: 05 33 54.3648 (83.4765200d) Dec: +27 09 50.50 (27.16403d) Equinox: J2000	Proper Motion RA: -0.134 mas/yr Proper Motion Dec: -3.6930000305801514 mas/yr Parallax: 0.0015638000000000002" Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Star* *Description=[K stars]*				

Observation

Proposal 4014, Observation 1

Wed Jan 17 19:01:58 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Coronagraphic Imaging

Diagnostics

(Observation 1) Warning (Form): The NO PARALLEL ATTACHMENTS requirement is expected for NIRCam Coronagraphic Imaging.

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	HD-36575	RA: 05 33 54.3648 (83.4765200d) Dec: +27 09 50.50 (27.16403d) Equinox: J2000	Proper Motion RA: -0.134 mas/yr Proper Motion Dec: -3.6930000305801514 mas/yr Parallax: 0.0015638000000000002" Epoch of Position: 2000	

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

Acquisition

#	Target	Filter	Target Brightness	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F335M	BRIGHT (ND Square)	SHALLOW4	65	1	1	16.305	147357

Template

Module	Coronagraphic Mask	Obtain Astrometric Confirmation Images?	Subarray	Dither Pattern
A	MASK335R	false	SUB320A335R	5-POINT-BOX

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F200W	F430M	SHALLOW4	10	5	5	25	1336.812	

PSF References

PSF Reference: true

Special Requirements	
	Offset -0.01 arcsec, 0.005 arcsec 2 After 1 Sequence Observations 1, 2, 3, Non-interruptible

Observation

Proposal 4014, Observation 2

Wed Jan 17 19:01:58 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Coronagraphic Imaging

Diagnostics

(Observation 2) Warning (Form): The NO PARALLEL ATTACHMENTS requirement is expected for NIRCam Coronagraphic Imaging.

(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Observation 2) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	MWC758	RA: 05 30 27.5328 (82.6147200d) Dec: +25 19 56.67 (25.33241d) Equinox: J2000	Proper Motion RA: 2.718030636581846E-4 sec of time/yr Proper Motion Dec: -0.026373000014245918 arcsec/yr Epoch of Position: 2015.5	

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

Acquisition

#	Target	Filter	Target Brightness	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F335M	BRIGHT (ND Square)	SHALLOW4	65	1	1	16.305	147362

Template

Module	Coronagraphic Mask	Obtain Astrometric Confirmation Images?	Subarray	Dither Pattern
A	MASK335R	false	SUB320A335R	5-POINT-BOX

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F200W	F430M	SHALLOW4	10	5	5	25	1336.812	

PSF References

Observation 1 (PSF Reference; Filters [F200W/F430M])

Additional Justification: false

Special Requirements	Offset -0.01 arcsec, 0.005 arcsec 2 After 1 3 After 2 Sequence Observations 1, 2, 3, Non-interruptible Aperture PA Offset 2 from 3 by 10 to 14 Degrees (Same offsets in V3)

Observation

Proposal 4014, Observation 3

Wed Jan 17 19:01:58 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Coronagraphic Imaging

Diagnostics

(Observation 3) Warning (Form): The NO PARALLEL ATTACHMENTS requirement is expected for NIRCam Coronagraphic Imaging.

(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Observation 3) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	MWC758	RA: 05 30 27.5328 (82.6147200d) Dec: +25 19 56.67 (25.33241d) Equinox: J2000	Proper Motion RA: 2.718030636581846E-4 sec of time/yr Proper Motion Dec: -0.026373000014245918 arcsec/yr Epoch of Position: 2015.5	

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

Acquisition

#	Target	Filter	Target Brightness	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	F335M	BRIGHT (ND Square)	SHALLOW4	65	1	1	16.305	147362

Template

Module	Coronagraphic Mask	Obtain Astrometric Confirmation Images?	Subarray	Dither Pattern
A	MASK335R	false	SUB320A335R	5-POINT-BOX

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F200W	F430M	SHALLOW4	10	5	5	25	1336.812	

PSF References

Observation 1 (PSF Reference; Filters [F200W/F430M])

Additional Justification: false

Special Requirements	Offset -0.01 arcsec, 0.005 arcsec 3 After 2 Sequence Observations 1, 2, 3, Non-interruptible Aperture PA Offset 2 from 3 by 10 to 14 Degrees (Same offsets in V3)