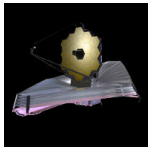

1242 - Planets in Formation and Exozodiacal Disks

Cycle: 1, Proposal Category: GTO

INVESTIGATORS

Name	*Institution*
Dr. Doug Johnstone (PI) (CSA Member)	**National Research Council of Canada**
Dr. Anand Sivaramakrishnan (CoI) (US Admin CoI) (Contact)	Space Telescope Science Institute
Prof. Peter Tuthill (CoI) (CoPI) (Contact)	University of Sydney
Dr. Christine Chen (CoI) (CoPI) (Contact)	The Johns Hopkins University

OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	TD HD 100546	NIRISS Aperture Masking Interferometry	(2) TD-HD-100546
	2	TD-CAL-HD-101531	NIRISS Aperture Masking Interferometry	(6) TD-CAL-HD-101531
	3	TD HD 135344B	NIRISS Aperture Masking Interferometry	(3) TD-HD-135344B
	4	TD-CAL-HD-123991	NIRISS Aperture Masking Interferometry	(5) TD-CAL-HD-123991
	5	TD-PDS-70	NIRISS Aperture Masking Interferometry	(1) TD-PDS-70
	9	NU-HOR	NIRISS Aperture Masking Interferometry	(12) NU-HOR
	10	HD 18638	NIRISS Aperture Masking Interferometry	(13) HD-18638

ABSTRACT

This is a joint NIRISS AMI GTO programme consisting of "Planets in Formation Around Young Stars: NIRISS AMI Observations of Transition Disk Systems" led by Doug Johnstone and "Exozodiacal Disks: A Theatre for Planetary Gravitational Shadow Plays" led by Peter Tuthill.

We aim to observe planets in formation around young stars using NIRISS AMI at thermal infrared wavelengths. We focus on Transition Disk

systems, in which the natal protoplanetary disk around the young star shows evidence of disruption and gap formation. Such a scenario is expected when a forming planet is dynamically clearing its local environment. We aim to show that planet formation is ubiquitous in Transition Disk systems and that it is responsible for carving the observed large inner cavities. Each detected, and categorized, planet will provide a unique proving ground for theorists modeling disk and planet evolution, disk dispersal, and planet migration. We will observe three transition disk sources: PDS70, HD 100546, and HD 135344B.

Halos of dust and debris are believed ubiquitous in most circumstellar environments. Even a relatively tenuous structure such as our solar system's zodiacal dust emits more radiation across the optical and infrared than all the planets combined. Our lack of knowledge of the prevalence of exozodiacal disks, and particularly the exozodiacal light they emit, remains an outstanding problem in designing future missions targeting spatially resolved imagery of exoplanets. The proposed observational campaign will establish NIRISS/AMI as the first platform to comprehensively address this critical observational blind spot. Furthermore, at the sensitivities available to JWST, the flux from bright exo-zodiacal disks can be used to prospect for signatures of embedded planets. Gravitational shepherding of the dust by any orbiting massive bodies will reveal telltale signatures that are orders of magnitude larger, and easier to detect, than the bodies themselves. To demonstrate the unique science reach for NIRISS/AMI in exo-zodiacal studies, we will observe the prominent debris system nu Hor, providing a secure detection and prospects for imaging any substructures present.

Note that only nu Hor and its calibrator are still to be observed.

OBSERVING DESCRIPTION

This is a joint NIRISS AMI GTO programme consisting of "Planets in Formation Around Young Stars: NIRISS AMI Observations of Transition Disk Systems" led by Doug Johnstone and "Exozodiacal Disks: A Theatre for Planetary Gravitational Shadow Plays" led by Peter Tuthill.

[Note there is also an attached MIRI observation of ETA CRV using Christine Chen's GTO time.]

We aim to observe planets in formation around young stars using NIRISS AMI at thermal infrared wavelengths. We focus on Transition Disk systems, in which the natal protoplanetary disk around the young star shows evidence of disruption and gap formation. Such a scenario is expected when a forming planet is dynamically clearing its local environment. We aim to show that planet formation is ubiquitous in Transition Disk systems and that it is responsible for carving the observed large inner cavities. Each detected, and categorized, planet will provide a unique proving ground for theorists modeling disk and planet evolution, disk dispersal, and planet migration. We will observe three transition disk sources: PDS 70, HD

100546, and HD 135344B.

Halos of dust and debris are believed ubiquitous in most circumstellar environments. Even a relatively tenuous structure such as our solar system's zodiacal dust emits more radiation across the optical and infrared than all the planets combined. Our lack of knowledge of the prevalence of exozodiacal disks, and particularly the exozodiacal light they emit, remains an outstanding problem in designing future missions targeting spatially resolved imagery of exoplanets. The proposed observational campaign will establish NIRISS/AMI as the first platform to comprehensively address this critical observational blind spot. Furthermore, at the sensitivities available to JWST, the flux from bright exo-zodiacal disks can be used to prospect for signatures of embedded planets. Gravitational shepherding of the dust by any orbiting massive bodies will reveal telltale signatures that are orders of magnitude larger, and easier to detect, than the bodies themselves. To demonstrate the unique science reach for NIRISS/AMI in exo-zodiacal studies, we will observe the prominent debris system eta Crv, providing a secure detection and prospects for imaging any substructures present

For completeness, the target magnitudes assumed in this proposal for all the sources above are:

Source	F480M	F430M	F380M	F277W
PDS 70	7.7	7.7	8.0	8.5
HD100546	3.5	3.5	4.2	
HD135344B	4.2	4.2	5.0	
ETA-CRV	3.55	3.55		
HD123991		6.4	6.4	6.3	6.4
HD101531	3.776	3.776		4.0	
HR4981	3.79	3.79	3.9		

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	TD-PDS-70	RA: 14 08 10.1137 (212.0421404d) Dec: -41 23 52.95 (-41.39804d) Equinox: J2000	Proper Motion RA: -0.0026360634619137357 sec of time/yr Proper Motion Dec: -0.02382299996952497 arcsec/yr Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Star* *Description=[Protoplanetary disks]*				
(2)	TD-HD-100546	RA: 11 33 25.4406 (173.3560025d) Dec: -70 11 41.24 (-70.19479d) Equinox: J2000	Proper Motion RA: -38.93 mas/yr Proper Motion Dec: +0.29 mas/yr Parallax: 0.01032" Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Star* *Description=[Protoplanetary disks]*				
(3)	TD-HD-135344B	RA: 15 15 48.4394 (228.9518308d) Dec: -37 09 16.03 (-37.15445d) Equinox: J2000	Proper Motion RA: -19.7 mas/yr Proper Motion Dec: -24.0 mas/yr Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Star* *Description=[Protoplanetary disks]*				
(5)	TD-CAL-HD-123991	RA: 14 12 1.9957 (213.0083154d) Dec: -46 21 51.20 (-46.36422d) Equinox: J2000	Proper Motion RA: -0.002702231598463888 sec of time/yr Proper Motion Dec: -0.029278000056365272 arcsec/yr 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]*				
(6)	TD-CAL-HD-101531	RA: 11 40 20.4704 (175.0852933d) Dec: -69 40 18.28 (-69.67174d) Equinox: J2000	Proper Motion RA: -11.27 mas/yr Proper Motion Dec: -15.91 mas/yr Parallax: 0.00281" Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Calibration* *Description=[Point spread function]*				
(12)	NU-HOR	RA: 02 49 1.7007 (42.2570863d) Dec: -62 48 23.04 (-62.80640d) Equinox: J2000	Proper Motion RA: 0.013766927915327498 sec of time/yr Proper Motion Dec: 0.028564 arcsec/yr Parallax: 0.0192611" Epoch of Position: 2015.5	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Star* *Description=[A stars, Circumstellar dust, Debris disks]* *Extended=NO*				

	(13)	HD-18638	RA: 02 56 57.4135 (44.2392229d) Dec: -61 48 45.17 (-61.81255d) Equinox: J2000	Proper Motion RA: 0.002693297596381723 sec of time/yr Proper Motion Dec: -0.017736999939188536 arcsec/yr Parallax: 0.0034193" 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]* *Extended=NO*			

Observation

Proposal 1242, Observation 1: TD HD 100546 Mon Sep 18 20:00:09 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRISS Aperture Masking Interferometry

Diagnostics

(TD HD 100546 (Obs 1)) Warning (Form): NGROUPS=1 may suffer from low calibration accuracy.

(TD HD 100546 (Obs 1)) Warning (Form): NGROUPS=1 may suffer from low calibration accuracy.

(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)	TD-HD-100546	RA: 11 33 25.4406 (173.3560025d) Dec: -70 11 41.24 (-70.19479d) Equinox: J2000	Proper Motion RA: -38.93 mas/yr Proper Motion Dec: +0.29 mas/yr Parallax: 0.01032" Epoch of Position: 2000	

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

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	89611.25

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	2	2002	1	2002	494.094	89611.9
2	F380M	NISRAPID	1	3384	1	3384	579.882	89611.11
3	F430M	NISRAPID	1	2765	1	2765	473.81	89611.10

PSF References	TD-CAL-HD-101531 (Obs 2) (PSF Reference; Filters [F380M, F430M, F480M]) Additional Justification: false
Special Requirements	No Parallel Attachments Sequence Observations 1, 2, 3, 4, 5, Non-interruptible

Observation

Proposal 1242, Observation 2: TD-CAL-HD-101531 Mon Sep 18 20:00:09 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRISS Aperture Masking Interferometry

Diagnostics

(TD-CAL-HD-101531 (Obs 2)) Warning (Form): NGROUPS=1 may suffer from low calibration accuracy.

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(6)	TD-CAL-HD-101531	RA: 11 40 20.4704 (175.0852933d) Dec: -69 40 18.28 (-69.67174d) Equinox: J2000	Proper Motion RA: -11.27 mas/yr Proper Motion Dec: -15.91 mas/yr Parallax: 0.00281" Epoch of Position: 2000	

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	89611.26

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	2	6186	1	6186	1526.705	89611.12
2	F380M	NISRAPID	1	2803	1	2803	480.322	89611.14
3	F430M	NISRAPID	2	5174	1	5174	1276.943	89611.13

PSF References	PSF Reference: true
Special Requirements	No Parallel Attachments Sequence Observations 1, 2, 3, 4, 5, Non-interruptible

Observation

Proposal 1242, Observation 3: TD HD 135344B Mon Sep 18 20:00:09 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRISS Aperture Masking Interferometry

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
(3)	TD-HD-135344B	RA: 15 15 48.4394 (228.9518308d)	Proper Motion RA: -19.7 mas/yr	
		Dec: -37 09 16.03 (-37.15445d)	Proper Motion Dec: -24.0 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=[Protoplanetary disks]

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	89611.27

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	2541	1	2541	818.812	89611.15
2	F380M	NISRAPID	3	2351	1	2351	757.586	89611.17
3	F430M	NISRAPID	2	2625	1	2625	647.85	89611.16

PSF References

TD-CAL-HD-101531 (Obs 2) (PSF Reference; Filters [F380M, F430M, F480M])

Additional Justification: false

Special Requirements	
	No Parallel Attachments Sequence Observations 1, 2, 3, 4, 5, Non-interruptible

Observation

Proposal 1242, Observation 4: TD-CAL-HD-123991 Mon Sep 18 20:00:09 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRISS Aperture Masking Interferometry

Diagnostics

(TD-CAL-HD-123991 (Obs 4)) Warning (Form): NGROUPS=1 may suffer from low calibration accuracy.
(TD-CAL-HD-123991 (Obs 4)) Warning (Form): NGROUPS=1 may suffer from low calibration accuracy.
(TD-CAL-HD-123991 (Obs 4)) Warning (Form): NGROUPS=1 may suffer from low calibration accuracy.
(TD-CAL-HD-123991 (Obs 4)) Warning (Form): NGROUPS=1 may suffer from low calibration accuracy.
(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(5)	TD-CAL-HD-123991	RA: 14 12 1.9957 (213.0083154d) Dec: -46 21 51.20 (-46.36422d) Equinox: J2000	Proper Motion RA: -0.002702231598463888 sec of time/yr Proper Motion Dec: -0.029278000056365272 arcsec/yr 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	17	1	1	0.839	89611.24

Template

Subarray	Direct Image
SUB80	true

Dithers

#	Primary Dithers	Subpixel Positions
1	NONE	NONE
2	NONE	NONE

Direct Image

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F480M	NISRAPID	2	25	1	25	6.17	89611.37
2	F430M	NISRAPID	1	43	1	43	7.368	89611.36
3	F380M	NISRAPID	1	1	1	1	0.171	
4	F277W	NISRAPID	1	1	1	1	0.171	

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F480M	NISRAPID	29	418	1	418	954.578	89611.5
2	F430M	NISRAPID	20	507	1	507	813.593	89611.6
3	F380M	NISRAPID	10	612	1	612	520.396	89611.7
4	F277W	NISRAPID	1	1951	1	1951	334.323	89611.8

PSF References	PSF Reference: true
Special Requirements	No Parallel Attachments Sequence Observations 1, 2, 3, 4, 5, Non-interruptible

Observation

Proposal 1242, Observation 5: TD-PDS-70 Mon Sep 18 20:00:09 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRISS Aperture Masking Interferometry

Diagnostics

(TD-PDS-70 (Obs 5)) Warning (Form): NGROUPS=1 may suffer from low calibration accuracy.

(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	TD-PDS-70	RA: 14 08 10.1137 (212.0421404d) Dec: -41 23 52.95 (-41.39804d) Equinox: J2000	Proper Motion RA: -0.0026360634619137357 sec of time/yr Proper Motion Dec: -0.02382299996952497 arcsec/yr Epoch of Position: 2015.5	

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

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	19	1	1	0.93	89611.23

Template

Subarray	Direct Image
SUB80	true

Dithers

#	Primary Dithers	Subpixel Positions
1	NONE	NONE
2	NONE	NONE

Direct Image

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F480M	NISRAPID	3	56	1	56	18.045	89611.33
2	F430M	NISRAPID	2	68	1	68	16.782	89611.32
3	F380M	NISRAPID	2	61	1	61	15.055	89611.31
4	F277W	NISRAPID	1	1	1	1	0.171	

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F480M	NISRAPID	96	418	1	418	3067.351	89611.1
2	F430M	NISRAPID	64	502	1	502	2471.888	89611.2
3	F380M	NISRAPID	49	597	1	597	2264.111	89611.3
4	F277W	NISRAPID	5	2769	1	2769	1310.069	89611.4

PSF References	TD-CAL-HD-123991 (Obs 4) (PSF Reference; Filters [F277W, F380M, F430M, F480M]) TD-CAL-HD-101531 (Obs 2) (PSF Reference; Filters [F380M, F430M, F480M]) Additional Justification: false
Special Requirements	No Parallel Attachments Sequence Observations 1, 2, 3, 4, 5, Non-interruptible

Observation

Proposal 1242, Observation 9: NU-HOR

Mon Sep 18 20:00:09 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRISS Aperture Masking Interferometry

Diagnostics

(Visit 9:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(12)	NU-HOR	RA: 02 49 1.7007 (42.2570863d) Dec: -62 48 23.04 (-62.80640d) Equinox: J2000	Proper Motion RA: 0.013766927915327498 sec of time/yr Proper Motion Dec: 0.028564 arcsec/yr Parallax: 0.0192611" Epoch of Position: 2015.5	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Star
Description=[A stars, Circumstellar dust, Debris disks]
Extended=NO

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	5	1	1	0.293	142908.5

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	5	4766	1	4766	2254.89	142908.3
2	F430M	NISRAPID	3	7041	1	7041	2268.892	142908.10

PSF References	HD 18638 (Obs 10) (PSF Reference; Filters [F430M, F480M]) Additional Justification: false
Special Requirements	No Parallel Attachments Group Observations 9, 10, Non-interruptible

Observation

Proposal 1242, Observation 10: HD 18638 Mon Sep 18 20:00:09 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRISS Aperture Masking Interferometry

Comments: Calibrator for nu Hor

Diagnostics

(Visit 10:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(13)	HD-18638	RA: 02 56 57.4135 (44.2392229d) Dec: -61 48 45.17 (-61.81255d) Equinox: J2000	Proper Motion RA: 0.002693297596381723 sec of time/yr Proper Motion Dec: -0.017736999939188536 arcsec/yr Parallax: 0.0034193" 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]
Extended=NO

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	7	1	1	0.384	142908.7

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	8	4869	1	4869	3405.573	142908.7
2	F430M	NISRAPID	5	6256	1	6256	2959.839	142908.13

PSF References	PSF Reference: true
Special Requirements	No Parallel Attachments Group Observations 9, 10, Non-interruptible