



3925 - Planets or Giant Collisions in the Fomalhaut Debris Disk System

Cycle: 2, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Fomalhaut				
	1	Fomalhaut-Roll1 Full Array	NIRCam Coronagraphic Imaging	(1) FOMALHAUT
	2	Fomalhaut-Roll2 Full Array	NIRCam Coronagraphic Imaging	(1) FOMALHAUT
	3	Fomalhaut-Roll1 Full Array	NIRCam Coronagraphic Imaging	(1) FOMALHAUT
	4	Fomalhaut-Roll2 Full Array	NIRCam Coronagraphic Imaging	(1) FOMALHAUT

ABSTRACT

Fomalhaut is one of the original debris disk systems discovered through its strong infrared excess and the debris disk phenomenon soon became a signpost of the planet formation process. Direct imaging from the visible through the millimeter has led to a detailed characterization of the distribution of the dust orbiting Fomalhaut. Yet, until now, there has been no convincing evidence for planets in the Fomalhaut system. Most recently MIRI observed the disk revealing dramatic new details and multiple rings in the disk system, including an outer "Kuiper Belt" ring at 140 AU, an inner ring, and a broad disk equivalent to the asteroid belt in the Solar System. NIRCcam coronagraphic imaging has revealed a half dozen faint targets within and near the debris disk, including Source 1 which coincides with a compact region of enhanced dust emission seen by MIRI within the outer disk. Source 1, or one of the other NIRCcam objects, might be planet-mass objects responsible for sculpting the various disk structures. Alternatively, with its unusual colors, Source 1 might be a transient knot of hot dust resulting from a recent collision of planetesimals which produced the excess MIRI emission. The goals of this program are: 1) to provide astrometric conformation (or rejection) for these sources to be associated with Fomalhaut through common proper motion; and 2) to improve the photometry to enable a fuller characterization of these sources. If one or more of the NIRCcam objects prove to be part of the Fomalhaut system, then they will be some of the lowest mass planets yet discovered by direct imaging.

OBSERVING DESCRIPTION

We will observe with the NIRCcam/MASK335R coronagraph mask simultaneously in two pairs of filters -- F200W+F444W and F200M+F356W. We will use the RAPID read mode with NGROUPS=5 and NINT=50 per filter for a total integration time of 3200 sec per roll. Based on the pynrc tool, these observations should achieve 5sigma sensitivities of: [F200W] = 21.9 mags and contrast $\sim 4.5 \times 10^{-9}$; [F356W] = 20.8 mags and contrast $\sim 1.2 \times 10^{-8}$; and [F444W] = 20.4 mags and contrast $\sim 1.7 \times 10^{-8}$ and mass limit of 0.4 MJup. With these settings, saturation will be limited to inner 1.0-1.5", well inside the region where the NIRCcam sources are found. Full frame imaging will rely exclusively on roll subtraction to remove the star. We choose not to request the observation of a reference star to keep this follow-up proposal short and maximize the observing time on the science target. This technique worked well for the Cycle-1 full frame images. Post processing will also take advantage of synthetic PSFs derived from the closest-in-time telescope optical phase difference (OPD) maps as demonstrated in observations of HD19467 (PID\#1189, private communication). We have no constraints on observing scheduling and are open to any observing window that mitigates micrometeoroid concerns.

Proposal 3925 - Targets - Planets or Giant Collisions in the Fomalhaut Debris Disk System

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	FOMALHAUT	RA: 22 57 39.0463 (344.4126929d) Dec: -29 37 20.05 (-29.62224d) Equinox: J2000	Proper Motion RA: 328.95 mas/yr Proper Motion Dec: -164.67 mas/yr Parallax: 0.12981" Epoch of Position: 2000	Comments: 10 parsec sample in GAIA era (Reyle, 2021) A4V-type star Kmag=1.05 15.5 mu F: 6.75 Jy 23.0 mu F: 3.08 Jy 25.5 mu F: 2.52 Jy Category=Star Description=[Circumstellar disks, Debris disks, Exoplanet Systems] Extended=NO

Proposal 3925 - Observation 1 - Planets or Giant Collisions in the Fomalhaut Debris Disk System

Thu Sep 12 04:00:11 GMT 2024

Observation	<p>Proposal 3925, Observation 1: Fomalhaut-Roll1 Full Array</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRCcam Coronagraphic Imaging</p>									
Diagnostics	<p>(Fomalhaut-Roll1 Full Array (Obs 1)) Warning (Form): By checking 'Additional justification', this observation is identified as part of a self reference survey. Remember to provide justification for this in the technical description text of your PDF attachment.</p> <p>(Visit 1:1) Warning (Form): Data Excess over lower threshold</p> <p>(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Fomalhaut-Roll1 Full Array (Obs 1)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections			Miscellaneous			
	(1)	FOMALHAUT	RA: 22 57 39.0463 (344.4126929d) Dec: -29 37 20.05 (-29.62224d) Equinox: J2000	Proper Motion RA: 328.95 mas/yr Proper Motion Dec: -164.67 mas/yr Parallax: 0.12981" Epoch of Position: 2000						
	<p><i>Comments: 10 parsec sample in GAIA era (Reyle, 2021)</i></p> <p><i>A4V-type star</i> <i>Kmag=1.05</i></p> <p><i>15.5 mu F: 6.75 Jy</i> <i>23.0 mu F: 3.08 Jy</i> <i>25.5 mu F: 2.52 Jy</i> <i>Category=Star</i> <i>Description=[Circumstellar disks, Debris disks, Exoplanet Systems]</i> <i>Extended=NO</i></p>									
Acquisition	#	Target	Filter	Target Brightness	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	1 FOMALHAUT	F335M	BRIGHT (ND Square)	RAPID	33	1	1	1.708	142341
Template	Module		Occulting Mask		Obtain Astrometric Confirmation Images?		Subarray	Dither Pattern		
	A		MASK335R		false		FULL	NONE		
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	F444W	RAPID	5	52	1	52	3339.135	

Proposal 3925 - Observation 1 - Planets or Giant Collisions in the Fomalhaut Debris Disk System

PSF References	Fomalhaut-Roll2 Full Array (Obs 2) (Filters [F200W/F444W]) Additional Justification: true
Special Requirements	Offset -0.006 arcsec, -0.012 arcsec Sequence Observations 1, 2, Non-interruptible Aperture PA Offset 2 from 1 by 7 to 14 Degrees (Same offsets in V3)

Proposal 3925 - Observation 2 - Planets or Giant Collisions in the Fomalhaut Debris Disk System

Thu Sep 12 04:00:11 GMT 2024

Observation	<p>Proposal 3925, Observation 2: Fomalhaut-Roll2 Full Array</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRCcam Coronagraphic Imaging</p>									
Diagnostics	<p>(Fomalhaut-Roll2 Full Array (Obs 2)) Warning (Form): By checking 'Additional justification', this observation is identified as part of a self reference survey. Remember to provide justification for this in the technical description text of your PDF attachment.</p> <p>(Visit 2:1) Warning (Form): Data Excess over lower threshold</p> <p>(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Fomalhaut-Roll2 Full Array (Obs 2)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections			Miscellaneous			
	(1)	FOMALHAUT	RA: 22 57 39.0463 (344.4126929d) Dec: -29 37 20.05 (-29.62224d) Equinox: J2000	Proper Motion RA: 328.95 mas/yr Proper Motion Dec: -164.67 mas/yr Parallax: 0.12981" Epoch of Position: 2000						
	<p><i>Comments: 10 parsec sample in GAIA era (Reyle, 2021)</i></p> <p><i>A4V-type star</i> <i>Kmag=1.05</i></p> <p><i>15.5 mu F: 6.75 Jy</i> <i>23.0 mu F: 3.08 Jy</i> <i>25.5 mu F: 2.52 Jy</i> <i>Category=Star</i> <i>Description=[Circumstellar disks, Debris disks, Exoplanet Systems]</i> <i>Extended=NO</i></p>									
Acquisition	#	Target	Filter	Target Brightness	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	1 FOMALHAUT	F335M	BRIGHT (ND Square)	RAPID	33	1	1	1.708	142341
Template	Module		Occulting Mask		Obtain Astrometric Confirmation Images?		Subarray	Dither Pattern		
	A		MASK335R		false		FULL	NONE		
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	F444W	RAPID	5	52	1	52	3339.135	

Proposal 3925 - Observation 2 - Planets or Giant Collisions in the Fomalhaut Debris Disk System

PSF References	Fomalhaut-Roll1 Full Array (Obs 1) (Filters [F200W/F444W]) Additional Justification: true
Special Requirements	Offset -0.006 arcsec, -0.012 arcsec 2 After 3 by 0 Days to 14 Days Sequence Observations 1, 2, Non-interruptible Aperture PA Offset 2 from 1 by 7 to 14 Degrees (Same offsets in V3)

Proposal 3925 - Observation 3 - Planets or Giant Collisions in the Fomalhaut Debris Disk System

Thu Sep 12 04:00:11 GMT 2024

Observation	<p>Proposal 3925, Observation 3: Fomalhaut-Roll1 Full Array</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRCcam Coronagraphic Imaging</p>									
Diagnostics	<p>(Fomalhaut-Roll1 Full Array (Obs 3)) Warning (Form): By checking 'Additional justification', this observation is identified as part of a self reference survey. Remember to provide justification for this in the technical description text of your PDF attachment.</p> <p>(Visit 3:1) Warning (Form): Data Excess over lower threshold</p> <p>(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Fomalhaut-Roll1 Full Array (Obs 3)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections			Miscellaneous			
	(1)	FOMALHAUT	RA: 22 57 39.0463 (344.4126929d) Dec: -29 37 20.05 (-29.62224d) Equinox: J2000	Proper Motion RA: 328.95 mas/yr Proper Motion Dec: -164.67 mas/yr Parallax: 0.12981" Epoch of Position: 2000						
	<p><i>Comments: 10 parsec sample in GAIA era (Reyle, 2021)</i></p> <p><i>A4V-type star</i> <i>Kmag=1.05</i></p> <p><i>15.5 mu F: 6.75 Jy</i> <i>23.0 mu F: 3.08 Jy</i> <i>25.5 mu F: 2.52 Jy</i> <i>Category=Star</i> <i>Description=[Circumstellar disks, Debris disks, Exoplanet Systems]</i> <i>Extended=NO</i></p>									
Acquisition	#	Target	Filter	Target Brightness	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	1 FOMALHAUT	F335M	BRIGHT (ND Square)	RAPID	33	1	1	1.708	142341
Template	Module		Occulting Mask		Obtain Astrometric Confirmation Images?		Subarray	Dither Pattern		
	A		MASK335R		false		FULL	NONE		
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	F356W	RAPID	5	52	1	52	3339.135	

Proposal 3925 - Observation 3 - Planets or Giant Collisions in the Fomalhaut Debris Disk System

PSF References	Fomalhaut-Roll2 Full Array (Obs 4) (Filters [F200W/F356W]) Additional Justification: true
Special Requirements	Offset -0.006 arcsec, -0.012 arcsec 2 After 3 by 0 Days to 14 Days Sequence Observations 3, 4, Non-interruptible Aperture PA Offset 4 from 3 by 7 to 14 Degrees (Same offsets in V3)

Proposal 3925 - Observation 4 - Planets or Giant Collisions in the Fomalhaut Debris Disk System

Thu Sep 12 04:00:11 GMT 2024

Observation	<p>Proposal 3925, Observation 4: Fomalhaut-Roll2 Full Array</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRCcam Coronagraphic Imaging</p>									
Diagnostics	<p>(Fomalhaut-Roll2 Full Array (Obs 4)) Warning (Form): By checking 'Additional justification', this observation is identified as part of a self reference survey. Remember to provide justification for this in the technical description text of your PDF attachment.</p> <p>(Visit 4:1) Warning (Form): Data Excess over lower threshold</p> <p>(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Fomalhaut-Roll2 Full Array (Obs 4)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.</p>									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections			Miscellaneous			
	(1)	FOMALHAUT	RA: 22 57 39.0463 (344.4126929d) Dec: -29 37 20.05 (-29.62224d) Equinox: J2000	Proper Motion RA: 328.95 mas/yr Proper Motion Dec: -164.67 mas/yr Parallax: 0.12981" Epoch of Position: 2000						
	<p><i>Comments: 10 parsec sample in GAIA era (Reyle, 2021)</i></p> <p><i>A4V-type star</i> <i>Kmag=1.05</i></p> <p><i>15.5 mu F: 6.75 Jy</i> <i>23.0 mu F: 3.08 Jy</i> <i>25.5 mu F: 2.52 Jy</i> <i>Category=Star</i> <i>Description=[Circumstellar disks, Debris disks, Exoplanet Systems]</i> <i>Extended=NO</i></p>									
Acquisition	#	Target	Filter	Target Brightness	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	1 FOMALHAUT	F335M	BRIGHT (ND Square)	RAPID	33	1	1	1.708	142341
Template	Module		Occulting Mask		Obtain Astrometric Confirmation Images?		Subarray		Dither Pattern	
	A		MASK335R		false		FULL		NONE	
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	F356W	RAPID	5	52	1	52	3339.135	

Proposal 3925 - Observation 4 - Planets or Giant Collisions in the Fomalhaut Debris Disk System

PSF References	Fomalhaut-Roll1 Full Array (Obs 3) (Filters [F200W/F356W]) Additional Justification: true
Special Requirements	Offset -0.006 arcsec, -0.012 arcsec Sequence Observations 3, 4, Non-interruptible Aperture PA Offset 4 from 3 by 7 to 14 Degrees (Same offsets in V3)