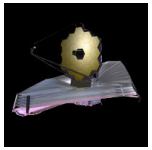

6139 - Angular Momentum Architectecture of the HR 8799 Planetary System

Cycle: 3, Proposal Category: GO

INVESTIGATORS

Name	*Institution*
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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
HR 8799				
	1	HR 8799-Roll 1	NIRCam Coronagraphic Imaging	(1) HR-8799
	2	HR 8799-Roll 2	NIRCam Coronagraphic Imaging	(1) HR-8799
	3	ups Peg-PSF Reference	NIRCam Coronagraphic Imaging	(2) -ups-Peg
	4	ups Peg-PSF Reference	NIRCam Coronagraphic Imaging	(2) -ups-Peg

ABSTRACT

HR 8799 is a system of four directly imaged giant planets orbiting at 15-70 AU. Asteroseismology of the host star, patient orbit monitoring of the planets, and resolved sub-mm observations of the outer cold disk all point to overall alignment of the system's angular momentum vectors. The only missing components are the planetary obliquities, which are expected to have been aligned at formation but can be tilted through post-formation processes including orbital migration, resonances with other planets, or interactions with moons. We propose NIRCam coronagraphic monitoring of all four HR 8799 planets in F200W and F444W to determine the angular momentum architecture of this unique system and test whether post-formation dynamical interactions have impacted the orientation of their spin axes. Rotation periods will be coupled with radius estimates and

recently measured projected rotational velocities of the planets to determine their inclinations, offering the first glimpse of the spin states of giant planets locked in mean motion resonance outside of the Solar System. Furthermore, this rich dataset will be used to study cloud layers via wavelength-dependent variability, compare the atmospheric dynamics of "sibling" planets, and conduct the deepest search for an outer "planet f" with sensitivity down to sub-Saturn masses.

OBSERVING DESCRIPTION

The goal of this program is to measure rotationally modulated variability from the four HR 8799 planets in NIRCam F444W and F200W with the MASK335R coronagraph. The planets have contrasts of ~8-10 mag at 4.4 microns and separations of 0.3-1.7", so this program will employ both ADI and RDI with a reference star. This 17-hour monitoring program will be split into two roll angles to facilitate ADI processing, and will subsequently target a reference star for RDI.

Proposal 6139 - Targets - Angular Momentum Architectecture of the HR 8799 Planetary System

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	HR-8799	RA: 23 07 28.7157 (346.8696488d)	Proper Motion RA: 108.284 mas/yr	
		Dec: +21 08 3.31 (21.13425d)	Proper Motion Dec: -50.03999999644293 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=[A stars, Exoplanet Systems]* *Extended=NO*				
(2)	-ups-Peg	RA: 23 25 22.7829 (351.3449288d)	Proper Motion RA: 191.856 mas/yr	
		Dec: +23 24 14.76 (23.40410d)	Proper Motion Dec: 36.183 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=[F stars]*				

Observation

Proposal 6139, Observation 1: HR 8799-Roll 1

Thu Nov 07 19:00:33 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Coronagraphic Imaging

Diagnostics

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

(HR 8799-Roll 1 (Obs 1)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	HR-8799	RA: 23 07 28.7157 (346.8696488d)	Proper Motion RA: 108.284 mas/yr	
		Dec: +21 08 3.31 (21.13425d)	Proper Motion Dec: -50.03999999644293 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=[A stars, Exoplanet Systems]
Extended=NO

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)	SHALLOW2	65	1	1	16.204	178374.7

Template

Module	Occulting Mask	Obtain Astrometric Confirmation Images?	Subarray	Dither Pattern
A	MASK335R	true	SUB320A335R	NONE

Confirmation

#	Conf. Readout Pattern	Conf. Groups/Int	Conf. Integrations/Exp	Conf. Total Integrations	Conf. Total Exposure Time	Conf. Total Dithers
1	RAPID	4	1	1	42.947	1

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	SHALLOW4	10	134	1	134	7165.312	178374
2	F200W	F444W	SHALLOW4	10	134	1	134	7165.312	178374
3	F200W	F444W	SHALLOW4	10	133	1	133	7111.84	178374
4	F200W	F444W	SHALLOW4	10	133	1	133	7111.84	178374

PSF References	ups Peg-PSF Reference (Obs 3) (PSF Reference; Filters [F200W/F444W]) ups Peg-PSF Reference (Obs 4) (PSF Reference; Filters [F200W/F444W]) Additional Justification: false
Special Requirements	Offset -0.006 arcsec, -0.012 arcsec No Parallel Attachments Sequence Observations 3, 1, 2, 4 (reordered), Non-interruptible Aperture PA Offset 1 from 2 by 10 to 14 Degrees (Same offsets in V3)

Observation

Proposal 6139, Observation 2: HR 8799-Roll 2

Thu Nov 07 19:00:33 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Coronagraphic Imaging

Diagnostics

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

(HR 8799-Roll 2 (Obs 2)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	HR-8799	RA: 23 07 28.7157 (346.8696488d)	Proper Motion RA: 108.284 mas/yr	
		Dec: +21 08 3.31 (21.13425d)	Proper Motion Dec: -50.03999999644293 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=[A stars, Exoplanet Systems]
Extended=NO

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)	SHALLOW2	65	1	1	16.204	178374.7

Template

Module	Occulting Mask	Obtain Astrometric Confirmation Images?	Subarray	Dither Pattern
A	MASK335R	true	SUB320A335R	NONE

Confirmation

#	Conf. Readout Pattern	Conf. Groups/Int	Conf. Integrations/Exp	Conf. Total Integrations	Conf. Total Exposure Time	Conf. Total Dithers
1	RAPID	4	1	1	42.947	1

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	SHALLOW4	10	134	1	134	7165.312	178374
2	F200W	F444W	SHALLOW4	10	134	1	134	7165.312	178374
3	F200W	F444W	SHALLOW4	10	133	1	133	7111.84	178374
4	F200W	F444W	SHALLOW4	10	133	1	133	7111.84	178374

PSF References	ups Peg-PSF Reference (Obs 3) (PSF Reference; Filters [F200W/F444W]) ups Peg-PSF Reference (Obs 4) (PSF Reference; Filters [F200W/F444W]) Additional Justification: false
Special Requirements	Offset -0.006 arcsec, -0.012 arcsec No Parallel Attachments Sequence Observations 3, 1, 2, 4 (reordered), Non-interruptible Aperture PA Offset 1 from 2 by 10 to 14 Degrees (Same offsets in V3)

Observation

Proposal 6139, Observation 3: ups Peg-PSF Reference

Thu Nov 07 19:00:33 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Coronagraphic Imaging

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)	-ups-Peg	RA: 23 25 22.7829 (351.3449288d)	Proper Motion RA: 191.856 mas/yr	
		Dec: +23 24 14.76 (23.40410d)	Proper Motion Dec: 36.183 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=[F 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)	BRIGHT2	65	1	1	6.574	178374.6

Template

Module	Occulting Mask	Obtain Astrometric Confirmation Images?	Subarray	Dither Pattern
A	MASK335R	true	SUB320A335R	9-POINT-CIRCLE

Confirmation

#	Conf. Readout Pattern	Conf. Groups/Int	Conf. Integrations/Exp	Conf. Total Integrations	Conf. Total Exposure Time	Conf. Total Dithers
1	RAPID	4	1	1	42.947	1

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	BRIGHT2	5	11	9	99	1166.212	178374

PSF References	PSF Reference: true
Special Requirements	Offset -0.006 arcsec, -0.012 arcsec No Parallel Attachments Sequence Observations 3, 1, 2, 4 (reordered), Non-interruptible

Observation

Proposal 6139, Observation 4: ups Peg-PSF Reference

Thu Nov 07 19:00:33 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Coronagraphic Imaging

Diagnostics

(Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	-ups-Peg	RA: 23 25 22.7829 (351.3449288d)	Proper Motion RA: 191.856 mas/yr	
		Dec: +23 24 14.76 (23.40410d)	Proper Motion Dec: 36.183 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=[F 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)	BRIGHT2	65	1	1	6.574	178374.6

Template

Module	Occulting Mask	Obtain Astrometric Confirmation Images?	Subarray	Dither Pattern
A	MASK335R	true	SUB320A335R	9-POINT-CIRCLE

Confirmation

#	Conf. Readout Pattern	Conf. Groups/Int	Conf. Integrations/Exp	Conf. Total Integrations	Conf. Total Exposure Time	Conf. Total Dithers
1	RAPID	4	1	1	42.947	1

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	BRIGHT2	5	11	9	99	1166.212	178374

PSF References	PSF Reference: true
Special Requirements	Offset -0.006 arcsec, -0.012 arcsec No Parallel Attachments Sequence Observations 3, 1, 2, 4 (reordered), Non-interruptible