



7084 - Measuring the Thickness of a J-Shock in Cep A West

Cycle: 4, 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>
Observation Folder				
	1	GGD37 Shockfront C	MIRI Medium Resolution Spectroscopy	(4) HH-168-SHOCKFRONT-C
	2	GGD37 Shockfront G	MIRI Medium Resolution Spectroscopy	(3) HH-168-SHOCKFRONT-G
	3	GGD37 off-position	MIRI Medium Resolution Spectroscopy	(2) HH-168-SKY

ABSTRACT

We will measure the thickness of a resolved interface between jet and cloud shock for the first time, using the high spatial resolution of JWST/MIRI. Only JWST can spatially resolve the working surface (bow shock) or other sources of potential confusion in this edge-on, emission line flow. We will map the high velocity HH 168 flow with the MIRI IFU, slicing the shock pixel by pixel in the dissociative zone, in search of a resolved magnetic precursor. The working surface size is hinted at the subpixel level by Spitzer mapping but only JWST/MIRI has the spatial resolution needed, which

will provide critical constraints on interstellar shock models (pre-shock magnetic field, change in velocity, temperature, and density across the shock boundary). Resolving the working surface provides observational constraints on theoretical estimates for turbulence, mass density, and shock morphologies generated during periods of massive star formation used in models of interstellar shocks to justify star formation efficiency parameters. Observational constraints on these parameters are ultimately required to understand the role of clouds, shocks, and filaments in our galactic ecosystem.

OBSERVING DESCRIPTION

Observing plan: (1) Mosaic #1: at the “origin”. We will observe the HH168 “origin” position (centered on the [Fe II] peak just north of Knot HW from Hartigan et al., 2000) with a 1×5 MIRI mosaic in all three wavelength ranges. The position angle is constrained to fall roughly along the flow axis, and we estimate that only PA of 11.5 - 22.0, or 180 degrees reversed (191.5 - 202), will provide sufficient coverage to stay on this relatively narrow flow. (2) Mosaic #2 at the “shockfront”. We will observe the HH168 “shockfront” position (centered on on Knots D and C from Hartigan et al., 2000) with a 1×5 MIRI mosaic in all three wavelength ranges, with same PA range as Mosaic #1. Note that it is NOT a requirement that the PAs for the two mosaics match, but both must fall in the required range. (3) Single pointing: Off-flow sky position. We require a single MIRI IFU pointing to establish a baseline level of emission line and continuum flux, to assist in removal of contamination of extended dust components and scattered light from various luminous sources in the region (ie. the HW objects; Hughes & Wouterloot 1982). We have selected a position sufficiently distant to avoid the HH objects, 1 arcmin south of the shock center. There is no orient or timing restriction on this observation.

Observational requirements: In order to determine the depth of each tile in the MIRI mosaic, we require uniform sensitivity to a given emission line. To reach the necessary depth to perform our experiment, we defined two limiting cases, using the Spitzer-IRS integrated intensities as a guide. (1) We require S/N of at least 5 on the 5 faintest lines of sufficient energy to constrain the highest shock velocities - [Ne III] 15.5 μ m (A and C), [Fe III] 22.9 μ m (B), and [O IV] 25.9 μ m (C). This constrained the minimum integration depth for wavelength ranges B and C. (2) We require sufficient S/N to distinguish between shock velocities of 60, 80, 100, and 120 km/s (for example, see the bottom right panel of Fig. 3). Based on these predictions, we expect we need at least S/N of 25 on all four [Fe II] lines (5.3, 17.9, 24.5, and 26.0 μ m) in order to unambiguously fit the model parameters. The limiting lineflux is [Fe II] 5.3m, which sets our required depth for wavelength range A. We use the recommended 4-pt dither pattern to avoid any sensitivity gaps, with 10% tile overlap. Our pointing requirements (0.2) are achieved without target acquisition.

With these constraints, using ETC and APT, we plan the following. Each tile will be observed to the same depth by wavelength range - 40 groups/1

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integration for range C; 56 groups/1 integration for range B; 85 groups/3 integrations for range A, with the identified PA restrictions, for each of the two mosaics (22 56 08.8 +62 01 47.0, and 22 56 03.2 +62 02 4.8, all J2000 coords) and our designated sky background position (22 56 068 +62 00 52.0).

Proposal 7084 - Targets - Measuring the Thickness of a J-Shock in Cep A West

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(2)	HH-168-SKY	RA: 22 56 4.3465 (344.0181104d) Dec: +62 00 57.08 (62.01586d) Equinox: J2000		
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.This object was generated by the targetselector and retrieved from the SIMBAD database. Category=ISM Description=[Herbig-Haro objects] Extended=YES				
	(3)	HH-168-SHOCKFRONT-G	RA: 22 56 4.7334 (344.0197225d) Dec: +62 02 14.96 (62.03749d) Equinox: J2000		
	Comments: Category=ISM Description=[Herbig-Haro objects]				
	(4)	HH-168-SHOCKFRONT-C	RA: 22 56 2.8223 (344.0117596d) Dec: +62 02 9.88 (62.03608d) Equinox: J2000		
	Comments: Category=ISM Description=[Herbig-Haro objects]				

Proposal 7084 - Observation 1 - Measuring the Thickness of a J-Shock in Cep A West

Observation	Proposal 7084, Observation 1: GGD37 Shockfront C												Wed Jun 25 17:00:35 GMT 2025		
	Diagnostic Status: Warning														
	Observing Template: MIRI Medium Resolution Spectroscopy														
	Comments: Mosaic must cover on one end 22h56m01s +62d02m03s and on the other end 22h56m03.3s+62d01m48s, limited PAs will work.														
Diagnostics	(Visit 1:1) Warning (Form): Data Excess over lower threshold														
	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.														
	(Visit 1:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.														
Fixed Targets	#	Name	Target Coordinates				Targ. Coord. Corrections				Miscellaneous				
	(4)	HH-168-SHOCKFRONT-C	RA: 22 56 2.8223 (344.0117596d) Dec: +62 02 9.88 (62.03608d) Equinox: J2000												
	Comments: Category=ISM Description=[Herbig-Haro objects]														
Acquisition	#	Target													
	1	NONE													
Template	AcqFilter	Primary Channel				Simultaneous Imaging				Imager Subarray				Grating Wheel Direction	
	F1500W	All MRS				NO				FULL				Allow Auto Reorder	
Mosaic	Rows	Columns		Row Overlap %		Column Overlap %		Row shift (deg)		Column shift (deg)		Tile Order			
	1	5		10.0		10.0		0.0		0.0		DEFAULT			
Dithers	#	Dither Type				Optimized For				Direction					
	1	4-Point				EXTENDED SOURCE				NEGATIVE					
Spectral Elements	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/E xp	Exposures/Dit h	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID		
	1	LONG(C)	MRSLONG		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539		
	1	LONG(C)	MRSSHORT		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539		
	2	MEDIUM(B)	MRSLONG		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539		
	2	MEDIUM(B)	MRSSHORT		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539		
	3	SHORT(A)	MRSLONG		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539		
	3	SHORT(A)	MRSSHORT		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539		

Proposal 7084 - Observation 1 - Measuring the Thickness of a J-Shock in Cep A West

Special Requirements	Aperture PA Range 34 to 45 Degrees (V3 34.0 to 45.0) Aperture PA Range 214 to 225 Degrees (V3 214.0 to 225.0) Sequence Observations 1, 2, 3 within 1 Days
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Proposal 7084 - Observation 2 - Measuring the Thickness of a J-Shock in Cep A West

Observation	Proposal 7084, Observation 2: GGD37 Shockfront G												Wed Jun 25 17:00:35 GMT 2025	
	Diagnostic Status: Warning													
	Observing Template: MIRI Medium Resolution Spectroscopy													
Diagnostics	(Visit 2:1) Warning (Form): Data Excess over lower threshold													
	(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.													
	(Visit 2:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.													
Fixed Targets	#	Name	Target Coordinates					Targ. Coord. Corrections			Miscellaneous			
	(3)	HH-168-SHOCKFRONT-G	RA: 22 56 4.7334 (344.0197225d) Dec: +62 02 14.96 (62.03749d) Equinox: J2000											
	Comments: Category=ISM Description=[Herbig-Haro objects]													
Acquisition	#	Target												
	1	NONE												
Template	AcqFilter	Primary Channel				Simultaneous Imaging			Imager Subarray			Grating Wheel Direction		
		All MRS				NO			FULL			Allow Auto Reorder		
Mosaic	Rows	Columns		Row Overlap %		Column Overlap %		Row shift (deg)		Column shift (deg)		Tile Order		
	1	5		10.0		10.0		0.0		0.0		DEFAULT		
Dithers	#	Dither Type					Optimized For			Direction				
	1	4-Point					EXTENDED SOURCE			NEGATIVE				
Spectral Elements	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/E xp	Exposures/Dit h	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	
	1	LONG(C)	MRSLONG		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539	
	1	LONG(C)	MRSSHORT		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539	
	2	MEDIUM(B)	MRSLONG		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539	
	2	MEDIUM(B)	MRSSHORT		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539	
	3	SHORT(A)	MRSLONG		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539	
	3	SHORT(A)	MRSSHORT		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539	

Proposal 7084 - Observation 2 - Measuring the Thickness of a J-Shock in Cep A West

Special Requirements	Aperture PA Range 27 to 38 Degrees (V3 27.0 to 38.0) Aperture PA Range 207 to 218 Degrees (V3 207.0 to 218.0) Sequence Observations 1, 2, 3 within 1 Days
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Proposal 7084 - Observation 3 - Measuring the Thickness of a J-Shock in Cep A West

Observation	Proposal 7084, Observation 3: GGD37 off-position												Wed Jun 25 17:00:35 GMT 2025	
	Diagnostic Status: Warning													
Observing Template: MIRI Medium Resolution Spectroscopy														
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)	HH-168-SKY	RA: 22 56 4.3465 (344.0181104d)											
			Dec: +62 00 57.08 (62.01586d)											
			Equinox: J2000											
			Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.This object was generated by the targetselector and retrieved from the SIMBAD database. Category=ISM Description=[Herbig-Haro objects] Extended=YES											
Acquisition	#	Target												
	1	NONE												
Template	AcqFilter	Primary Channel				Simultaneous Imaging				Imager Subarray		Grating Wheel Direction		
		All MRS				NO				FULL		Allow Auto Reorder		
Dithers	#	Dither Type				Optimized For				Direction				
	1	4-Point				EXTENDED SOURCE				NEGATIVE				
Spectral Elements	#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	
	1	LONG(C)	MRSLONG		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539	
	1	LONG(C)	MRSSHORT		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539	
	2	MEDIUM(B)	MRSLONG		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539	
	2	MEDIUM(B)	MRSSHORT		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539	
	3	SHORT(A)	MRSLONG		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539	
	3	SHORT(A)	MRSSHORT		FASTR1	57	2	1	Dither 1	4	8	1276.518	225539	

Proposal 7084 - Observation 3 - Measuring the Thickness of a J-Shock in Cep A West

Special Requirements	Sequence Observations 1, 2, 3 within 1 Days
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