



## 3414 - HH24: A Jet Complex driven by a Young Multiple 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>
NIRCam imaging				
	1	Narrow-band imaging	NIRCam Imaging	(1) HH24-NORTH

### ABSTRACT

HH 24 is a unique complex of 6 jets emanating from a cloud core with an embedded multiple system of at least 8 protostars. Two of the outflows constitute the bright bipolar jet HH 24 E/C, which form the inner part of a 3.1~pc giant HH flow. We propose to study the inner part of the HH 24 complex in two filters: F164N ([FeII] 1.64) and F405N (Brackett-alpha). The resulting images will allow 1) the study of the jets in unprecedented detail, 2) for the first time examine the more embedded parts of the jets, 3) determine spatially resolved kinematics with a velocity resolution of only ~5 km/s when compared to older HST images, and 4) explore processes such as expansion of the jet beam, knot interactions, and sideways ejection in working surfaces. The Brackett-alpha line will be used in conjunction with earlier HST Halpha images to measure the overall change of extinction along the jets. Dereddened fluxes will then allow a determination of electron densities and thus the jet mass and momentum flow. The images and fluxes will be modelled with an advanced gas dynamic code. The E-jet is ejected directly into an evacuated cavity and is perfectly collimated, while the C-jet ploughs through the cloud core and emanates in a highly jumbled flow. Brackett-alpha imaging offers the opportunity to analyze how a jet interacts with a complex environment inside a molecular cloud (already mapped by ALMA in several transitions). The embedded sources studied

with ALMA all have masses of 1-2 Msun. We will use continuum filters to search for the expected lower-mass embedded members of the multiple system and identify binary companions.

### **OBSERVING DESCRIPTION**

NIRCam will be used to image a ~3 by 6 arcminute field covering the entire HH 24 complex using a dithered grid using FULLBOX dither mode. The grid has an orientation requirement so that the entire outflow complex is covered. Fortunately, avoidance of the micrometeoroid expulsion zone and other spacecraft constraints requires only a minor tilt of the grid with respect to the main outflow orientation. The best PA is around 87 degrees.

Shocks will be investigated using the two transitions [FeII] 1.64 micron and Brackett-alpha 4.05 micron, which will be observed with the filters F164N and F405N. Since the region has significant reflection nebulosity it is necessary to do a background subtraction using the filters F162M and F410M.

The narrow-band filters will be used to study shocks and the plasma morphology, while the medium-band filters will be used, in addition to background subtraction, to identify low-mass protostellar members of the small multiple system embedded in the HH 24 cloud core. Such low-mass members will be distinguished from background M-giants by placing them in color-color and color-magnitude diagrams and comparing energy distributions.

Images in the Brackett-alpha line observed with the F405N filter will be compared to previously obtained H-alpha HST images (smoothed by a factor of 3 to match the 4.05 micron resolution). Since the Brackett-alpha

to H-alpha ratio varies only weakly with temperature, they can be used to determine the extinction along a jet axis. Although the Brackett-alpha flux is only about 1/5 of the H-alpha flux, the lower extinction at 4 micron means that for  $A_v$  more than about 2.5 magnitudes, Brackett-alpha is stronger, and enables study of the embedded jet structure.

De-reddening the observed fluxes allow physical flow parameters to be derived.

Proposal 3414 - Targets - HH24: A Jet Complex driven by a Young Multiple System

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)  <i>Comments:</i> <i>Category=ISM</i> <i>Description=[Bipolar nebulae, Herbig-Haro objects]</i>	HH24-NORTH	RA: 05 46 10.0000 (86.5416667d) Dec: -00 08 15.00 (-.13750d) Equinox: J2000		

Proposal 3414 - Observation 1 - HH24: A Jet Complex driven by a Young Multiple System

Thu May 11 01:01:57 GMT 2023

<b>Observation</b>	<p><b>Proposal 3414, Observation 1: Narrow-band imaging</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRCcam Imaging</p>									
<b>Diagnostics</b>	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.									
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>		<b>Targ. Coord. Corrections</b>			<b>Miscellaneous</b>		
	(1)	HH24-NORTH	RA: 05 46 10.0000 (86.5416667d) Dec: -00 08 15.00 (-.13750d) Equinox: J2000							
	<p><i>Comments:</i>  <i>Category=ISM</i>  <i>Description=[Bipolar nebulae, Herbig-Haro objects]</i></p>									
<b>Template</b>	<b>Module</b>		<b>Subarray</b>			<b>Target Placement</b>				
	ALL		FULL			Module Gap				
<b>Dithers</b>	<b>#</b>	<b>Primary Dither Type</b>		<b>Primary Dithers</b>	<b>Subpixel Dither Type</b>		<b>Dither Size</b>	<b>Subpixel Positions</b>		
	1	FULLBOX		4	STANDARD			1		
<b>Spectral Elements</b>	<b>#</b>	<b>Short Filter</b>	<b>Long Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Total Integrations</b>	<b>Total Dithers</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F164N+F150W2	F405N+F444W	MEDIUM2	10	2	8	4	7945.21	
	2	F162M+F150W2	F410M	SHALLOW2	5	1	4	4	944.836	
<b>Special Requirements</b>	Aperture PA Range 87 to 87 Degrees (V3 87.0713531 to 87.0713531)									