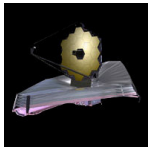

1256 - Brown dwarfs & free-floating planetary mass objects in Orion: imaging

Cycle: 1, Proposal Category: GTO

INVESTIGATORS

Name	*Institution*	*E-Mail*
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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Trapezium Cluster NIRCam imaging				
	1	Trapezium Cluster NIR Cam mosaic	NIRCam Imaging	(1) TRAPEZIUM-CLUSTER-P1
	2	Trapezium Cluster NIR Cam mosaic	NIRCam Imaging	(1) TRAPEZIUM-CLUSTER-P1

ABSTRACT

The origin of the stellar initial mass function (IMF) remains a mystery, despite many years of observational and theoretical work. One key issue is how far into the planetary-mass regime ‘free-floating objects’ can be found, and whether there is a cut-off in the IMF at the very lowest masses, deep into the brown dwarf regime. Embedded clusters in star-forming regions provide an excellent opportunity to search for such objects, as they are relatively warm and luminous when young. Models predict a minimum mass cut-off at a few MJup, and while ground- and space-based optical and near-infrared observations do show some objects at those limits, it is almost impossible to go any deeper in search of a cut-off without space-based thermal-IR imaging to catch cool (< 1000K) objects at ~1MJup and below (assuming a 1Myr age for the cluster).

Thus we will carry out a NIRCam survey in Cycle 1 of the inner regions (~11 x 7.5 arcmin) of the Orion Nebula Cluster, where the density of cluster members is greatest and the background molecular cloud extinction (and thus shielding from field stars) is highest. This will involve a set of 9 medium- and broad-band filters spanning the whole NIRCam wavelength range, optimised to detect cool objects and to provide selection criteria based on their age, surface gravity, etc. to eliminate field star contaminants, also accounting for dust extinction in the region and infrared excess

emission due to circumstellar disks. A further 3 narrow-band filters will be used for complementary imaging of silhouette circumstellar disks and molecular hydrogen outflows over the same region, another part of my GTO programme.

For the broad-band filter pair (F115W & F444W), a heavily overlapping mosaic (7 rows x 2 columns at V3PA = 270º) is used to create a good astrometric template. The five remaining filter pairs cover the same region but with a marginally overlapping mosaic (5 rows x 2 columns again at V3PA = 270º). Both mosaics use dithering to cover the gaps.

The mosaic centre is at the RA of the BN object & the declination of Theta 1 A, roughly 36 arcsec W & 9 arcsec of Theta 1 C, chosen to ensure the H2 fingers from BN-KL are fully covered & that the mosaic is slightly weighted to the west where there are more stars.

Version 4, 2022-05-28

OBSERVING DESCRIPTION

We will carry out a NIRCam survey in Cycle 1 of the inner regions of the Orion Nebula Cluster (a mosaic covering approximately 11 arcmin x 7.5 arcmin), where the density of cluster members is greatest and the background molecular cloud extinction (and thus shielding from field stars) is highest. This will involve a set of 9 medium- and wide-band filters spanning the whole NIRCam wavelength range, optimised to detect cool, very low-mass objects and to provide selection criteria based on their age, surface gravity, etc. to eliminate field star contaminants, also accounting for dust extinction in the region and infrared excess emission due to circumstellar disks. The filters are: F115W, F140M, F162M, F182M, F277W, F300M, F335M, F360M, and F444W. The choice of filters has been discussed with the NIRCam and NIRSpec teams also surveying young star-forming clusters to ensure a degree of commonality and overlap for future joint studies and for archival science. Follow-up NIRSpec MOS spectroscopy will be carried out in Cycle 2 for promising ultra-low mass candidates identified in these imaging observations.

A further 3 narrow-band filters are included for complementary science, namely imaging of silhouette circumstallar disks to determine their wavelength-dependent diameters with respect to extant HST optical imaging and thus their dust properties (F187N), and for extinction mapping in shocked molecular hydrogen outflows in the region (F212N & F470N).

The observations are split into two mosaics. For the two wide-band filters (F150W & F444W), a 7 (rows) x 2 (columns) mosaic at V3PA = 270º covers the 11 x 7.5 arcmin field (RA,dec) with considerable overlap between the rows and columns. This will allow accurate registration of the mosaic using stars in overlap regions to yield a good astrometric base for future proper motion studies. For the other five pairs of filters, a 5 (rows) x

2 (columns) mosaic covers the same region but with only marginal overlap in rows (RA). These mosaics will be mapped onto the wide-band one.

For the wide-band mosaic, BRIGHT1 (NGROUPS = 6, NINT = 1) is used to maximise the dynamic range: the region is full of bright sources which will saturate, but it is important to have a good overlap between JWST and extant ground- & space-based photometry for intermediate-bright sources in order to bootstrap calibrate the faintest sources in the JWST data. INTRAMODULEX with 4 primary dithers, no sub-dithers, is used to fill the intra-SCA gaps.

For the other mosaic, SHALLOW2 (NGROUPS = 3, NINT = 1) is used to reduce data volumes. As the filters are narrower, the effects of saturation should be lower. INTRAMODULEX with 6 primary dithers, no sub-dithers, is used to fill the inter-SCA gaps and increase signal-to-noise. The multiple offset positions will also be used to map and eliminate persistence effects from the very bright stars in the region.

The filter pairs are ordered roughly by width / throughput in order to minimise the effects of persistence, if the visits take place in sequence. By starting with the narrowest filters, the persistence "print-through" on to subsequent filters can, in principle, be minimised. Ideally, alternative custom mosaic sequences would also be used if available to help further mitigate the impact of persistence.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	TRAPEZIUM-CLUSTER-P1	RA: 05 35 14.1140 (83.8088083d) Dec: -05 23 14.45 (-5.38735d) Equinox: J2000		

Comments:
Category=Stellar Cluster
Description=[Young star clusters]
Extended=NO

Observation

Proposal 1256, Observation 1: Trapezium Cluster NIRCam mosaic Wed Jun 01 19:00:22 GMT 2022

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Comments: This is 5 (row) x 2 (column) mosaic with NIRCam. At V3PA = 270º it covers ~11 x 7.5 arcmin in RA & dec, respectively, with only a small overlap in RA between rows. It uses SHALLOW2 with Ngroups = 3 yielding 128.8 secs per image. INTRAMODULEX is used with 6 primary dithers & no sub-dithers to completely fill all inter-SCA gaps, yielding 773 seconds per position per filter.

Diagnostics

(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:2) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:3) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:4) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:5) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:6) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:7) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:8) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:9) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:10) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	TRAPEZIUM-CLUSTER-P1	RA: 05 35 14.1140 (83.8088083d) Dec: -05 23 14.45 (-5.38735d) Equinox: J2000		

Comments:
Category=Stellar Cluster
Description=[Young star clusters]
Extended=NO

Template

Module	Subarray
ALL	FULL

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift	Column shift	Tile Order
5	2	2.0	58.0	-1.0	0.5	DEFAULT

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	INTRAMODULEX	6	STANDARD		1

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F187N	F470N+F444W	SHALLOW2	3	1	6	6	773.047	
2	F212N	F300M	SHALLOW2	3	1	6	6	773.047	
3	F140M	F335M	SHALLOW2	3	1	6	6	773.047	
4	F162M+F150W2	F360M	SHALLOW2	3	1	6	6	773.047	
5	F182M	F277W	SHALLOW2	3	1	6	6	773.047	

Special Requirements	
	Group Visits within 22.0 Days Aperture PA Range 270 to 270 Degrees (V3 270.09936043 to 270.09936043) Visits Same PA No Parallel

Observation

Proposal 1256, Observation 2: Trapezium Cluster NIRCam mosaic Wed Jun 01 19:00:22 GMT 2022

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Comments: This is 7 (row) x 2 (column) mosaic with NIRCam. At V3PA = 270º it covers ~11 x 7.5 arcmin in RA & dec, respectively, with a significant overlap in RA between rows. It uses BRIGHT1 with Ngroups = 6 yielding 128.8 secs per image. INTRAMODULEX is used with 4 primary dithers & no sub-dithers to fill all inter-SCA gaps, yielding 515 seconds per position per filter.

Diagnostics

(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 2:2) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 2:3) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 2:4) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 2:5) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 2:6) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 2:7) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 2:8) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 2:9) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 2:10) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 2:11) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 2:12) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 2:13) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 2:14) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	TRAPEZIUM-CLUSTER-P1	RA: 05 35 14.1140 (83.8088083d) Dec: -05 23 14.45 (-5.38735d) Equinox: J2000		

Comments:
Category=Stellar Cluster
Description=[Young star clusters]
Extended=NO

Template

Module	Subarray
ALL	FULL

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift	Column shift	Tile Order
7	2	30.0	58.0	-1.0	0.5	DEFAULT

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	INTRAMODULEX	4	STANDARD		1

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F115W	F444W	BRIGHT2	6	1	4	4	515.365	

Special Requirements	Group Visits within 22.0 Days Aperture PA Range 270 to 270 Degrees (V3 270.09936043 to 270.09936043) Visits Same PA No Parallel