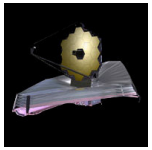

4547 - The stellar & sub-stellar initial mass function in Sharpless 305: imaging

Cycle: 3, Proposal Category: GTO

INVESTIGATORS

Name	*Institution*
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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
NIRCam imaging				
	1	NIRCam imaging	NIRCam Imaging	(1) S305_offset

ABSTRACT

The origin of the stellar initial mass function (IMF) remains a mystery, despite many years of observational and theoretical work. While many star-forming regions within ~2.5 kpc of the Sun have been studied, quite whether there is a single form of the IMF across the Milky Way, from the dense clusters near the Galactic Cluster to the low metallicity outer reaches of the galaxy, leads to one of the key questions – what is the effect of environment? But studying young, dense stellar clusters at large distances is challenging, requiring high spatial resolution to separate the many objects across a reasonably-sized field to cover a whole cluster, and high sensitivity to extend as far down the mass function into the sub-stellar regime as possible. The capabilities of JWST present a huge step forward in all regards.

Sharpless 2-305 (henceforth S305) is a relatively poorly studied, high-mass star-forming region (age ~ 2Myr) in the outer Galaxy (D ~ 5.1 kpc, Rgal ~ 12.2 kpc) containing OB stars and with an estimated stellar mass of ~3000 solar masses. The outer Galaxy has different physical properties from regions interior to the Sun, including lower metallicity, which are thought to affect star formation, perhaps leading to a steeper IMF. Broad-band near-infrared imaging of S305 with the VLT has revealed a dense embedded cluster covering a few square arcminutes, surrounded by a classical HII region with bright ionised gas, dust, and a number of embedded smaller clusters nearby, potentially younger. There is also a large reflection nebula

nearby that appears to be illuminated by a deeply embedded source that is very bright in the mid- to far-infrared – this may be a new massive star whose formation has been triggered by the expanding HII region.

Thus we will carry out a NIRCam survey in Cycle 3 of S305 and its environs, including the possible massive protostar candidate. This will involve a set of 7 medium- and broad-band filters spanning the whole NIRCam wavelength range, optimised to detect and characterise stars across the stellar IMF and substellar young brown dwarfs through H2O absorption down to 10–15MJup, also allowing the dust absorption in the region and the infrared excess emission from circumstellar disks to be assessed and accounted for. One narrow-band filterr will be used to search for evidence of jets and outflows from the embedded objects.

The mosaic will be centred between the main HII region and cluster, and the younger reflection nebula to the SE.

Version 2: 2025-02-11
Changed from SHALLOW2 / NGRPS=3 to BRIGHT2 / NGRPS=6 on advice from STScI to improve cosmic ray rejection
Changed one of the LW filters from F470N to F335M for scientific reasons

OBSERVING DESCRIPTION

The origin of the stellar initial mass function (IMF) remains a mystery, despite many years of observational and theoretical work. While many star-forming regions within ~2.5 kpc of the Sun have been studied, quite whether there is a single form of the IMF across the Milky Way, from the dense clusters near the Galactic Cluster to the low metallicity outer reaches of the galaxy, leads to one of the key questions – what is the effect of environment? But studying young, dense stellar clusters at large distances is challenging, requiring high spatial resolution to separate the many objects across a reasonably-sized field to cover a whole cluster, and high sensitivity to extend as far down the mass function into the sub-stellar regime as possible. The capabilities of JWST present a huge step forward in all regards.

Sharpless 2-305 (henceforth S305) is a relatively poorly studied, high-mass star-forming region (age ~ 2Myr) in the outer Galaxy (D ~ 5.1 kpc, Rgal ~ 12.2 kpc) containing OB stars and with an estimated stellar mass of ~3000 solar masses. The outer Galaxy has different physical properties from regions interior to the Sun, including lower metallicity, which are thought to affect star formation, perhaps leading to a steeper IMF. Broad-band near-infrared imaging of S305 with the VLT has revealed a dense embedded cluster covering a few square arcminutes, surrounded by a classical HII region with bright ionised gas, dust, and a number of embedded smaller clusters nearby, potentially younger. There is also a large reflection nebula nearby that appears to be illuminated by a deeply embedded source that is very bright in the mid- to far-infrared – this may be a new massive star

whose formation has been triggered by the expanding HII region.

Thus we will carry out a NIRCam survey in Cycle 3 of S305 and its environs, including the possible massive protostar candidate. This will involve a set of 6 medium- and broad-band filters spanning the whole NIRCam wavelength range, optimised to detect and characterise stars across the stellar IMF and substellar young brown dwarfs through H2O absorption down to 10–15MJup, also allowing the dust absorption in the region and the infrared excess emission from circumstellar disks to be assessed and accounted for. A further 2 narrow-band filters will be used to search for evidence of jets and outflows from the embedded objects.

The mosaic will be centred between the main HII region and cluster, and the younger reflection nebula to the SE.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	S305_offset	RA: 07 30 7.8530 (112.5327208d)	Proper Motion RA: 0 mas/yr	
		Dec: -18 33 29.03 (-18.55806d)	Proper Motion Dec: 0 mas/yr	
		Equinox: J2000	Parallax: 0"	
			Epoch of Position: 2000.0	

Comments: The target is located roughly halfway between the core of the Sharpless 305 HII region and cluster on one hand and a bright extended reflection nebula with an embedded luminous mid- to far-IR object to the SE, so that the chosen mosaic pattern covers both.
Category=Stellar Cluster
Description=[OB associations, Protoclusters, Young associations, Young star clusters]
Extended=YES

Observation

Proposal 4547, Observation 1: NIRCam imaging Wed Feb 12 15:00:09 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Comments: A PA of 90º is selected to best align the mosaic to cover the cluster and nearby embedded sources. A half rotation to 270º would yield the same mosaic, but there is no scheduleability there.

Diagnostics

(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:2) Warning (Form): Data Excess over lower threshold
(Visit 1:2) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:3) Warning (Form): Data Excess over lower threshold
(Visit 1:3) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:4) Warning (Form): Data Excess over lower threshold
(Visit 1:4) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:5) Warning (Form): Data Excess over lower threshold
(Visit 1:5) Warning (Form): Overheads are provisional until the Visit Planner has been run.
(Visit 1:6) Warning (Form): Data Excess over lower threshold
(Visit 1:6) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	S305_offset	RA: 07 30 7.8530 (112.5327208d)	Proper Motion RA: 0 mas/yr	
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		Equinox: J2000	Parallax: 0"	
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Comments: The target is located roughly halfway between the core of the Sharpless 305 HII region and cluster on one hand and a bright extended reflection nebula with an embedded luminous mid- to far-IR object to the SE, so that the chosen mosaic pattern covers both.
Category=Stellar Cluster
Description=[OB associations, Protoclusters, Young associations, Young star clusters]
Extended=YES

Template

Module	Subarray	Target Placement
ALL	FULL	Module Gap

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	Tile Order
3	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	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	F140M	F300M	BRIGHT2	6	1	4	4	515.365	
2	F162M+F150W2	F360M	BRIGHT2	6	1	4	4	515.365	
3	F182M	F444W	BRIGHT2	6	1	4	4	515.365	
4	F212N	F335M	BRIGHT2	6	1	4	4	515.365	

Special Requirements	
	Sequence Visits within 53.0 Days Aperture PA Range 90 to 90 Degrees (V3 90.07457694 to 90.07457694) Visits Same PA