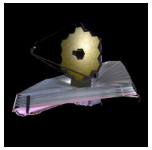

1905 - Testing protoplanetary disk evolution and brown dwarf formation in starburst: NIRCAM and MIRI observations of the young cluster Westerlund 1

Cycle: 1, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	NIRCAM - Wd1	NIRCam Imaging	(1) CL-WESTERLUND-1

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
	3	NIRCAM -.CF	NIRCam Imaging	(2) CL-WESTERLUND-CF
	2	MIRI - Wd1	MIRI Imaging	(1) CL-WESTERLUND-1
	4	MIRI -CF	MIRI Imaging	(2) CL-WESTERLUND-CF

ABSTRACT

The aim of this proposal is to extend our understanding of the environmental effects on the evolution of protoplanetary disks, the formation of planets, and the formation of brown dwarfs, for the first time, to the starburst regime. The large distances to starburst clusters make the JWST the only instrument (for a long time to come) capable of providing the required high spatial resolution and sensitivity in bands where disk emission is prominent. Besides, starburst environments are rare in our Galaxy today, but they are common in the early Universe, star forming and merging galaxies. We thus ask NIRCAM and MIRI observations of the 3-5 Myrs old starburst clusters Westerlund 1 in a set of wide and narrow filters, in order to: 1) select stars with disks from color-color and color-magnitude diagrams; 2) study disks properties from the analysis of their Spectral Energy Distributions, accretion from NIRCAM narrow band images, and the dust population in disks from MIRI observations; 3) correlate the spatial variation of the disk fraction and the average disk properties with local UV fields and stellar density, in order to assess the effects of the environment on disks evolution and dispersal; 4) Derive the IMF down to the brown dwarf regime and compare it with other clusters with different environments in order to understand if the low-mass end of the IMF is affected by the starburst environments.

OBSERVING DESCRIPTION

With a distance from the Sun of 3.87 kpc (Davies & Beasor 2019) and an initial mass of 52000 Solar masses (Brandner et al. 2008), Westerlund 1 (3-5 Myrs) is the closest starburst cluster to the Sun, and thus the best target to extend our knowledge of star formation and the evolution of protoplanetary disks in starburst environment. We plan to test whether the intense local ionizing flux and stellar density in Westerlund 1 induce a fast erosion of circumstellar disks, likely hampering the formation of planetary systems around the young low mass stars of the cluster. We also plan to test theories predicting that in extremely dense clusters with intense local ionizing fields, such as Westerlund 1, the formation of very low mass stars down to the brown dwarf limit is different than in the typical low-density star forming regions in the Solar neighbourhood. Since starburst clusters are typical star-forming environment in the early Universe and starburst galaxies, our study will constitute a true step forward our understanding of the products of stars and planets formation across the evolution of galaxies. The requested observations will be a crucial part of the EWOCS (Extended Westerlund One Chandra Survey) projects, currently based on an ongoing 1 Msec Chandra/ACIS-I observation of the cluster (P.I.: Guarcello)
Stars with disks in Westerlund 1 will be selected from the analysis of the Spectral Energy Distribution of these sources and suitable color-color and color-magnitude diagrams. The whole stellar content of the cluster will be instead determined from the X-ray observations and the comparison of the magnitude distribution of stars in the cluster and in a control field. To this aim, we ask NIRCAM observations in 6 wide and 6 narrow filters and

MIRI observations in three wide filters. NIRCAM observations are set with 2 groups, 1 integration and 1 exposure, adopting the BRIGHT2 readout mode and the FULL subarray; MIRI observations are instead set adopting 15 groups in 4 integrations and one exposure, using the FAST readout mode and FULL subarray. The observing strategy will result in not saturated images for GKM stars down to the low-mass regime, with a S/N ratio allowing detection of stars in the brown-dwarfs regime in the NIRCAM wide filters. Since we need to cover with a uniform sensitivity not only the cluster core, but also its halo, we adopted the FULLBOX/TWOTIGHTGAPS dither in a 3×1 mosaic with NIRCAM , and the 4-POINT-SET dither for the MIRI images in a 3×3 mosaic

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CL-WESTERLUND-1	RA: 16 47 4.0000 (251.7666667d) Dec: -45 51 5.00 (-45.85139d) Equinox: J2000	Proper Motion RA: -2.2253430573750216E-4 sec of time/yr Proper Motion Dec: -0.0036540000337481615 arcsec/yr Epoch of Position: 2015.5	
Comments: Target 1 is Westerlund 1 core and outskirt *Category=Stellar Cluster* *Description=[O clusters, Open star clusters, Young star clusters]*				
(2)	CL-WESTERLUND-CF	RA: 16 47 43.0000 (251.9291667d) Dec: -46 03 47.00 (-46.06306d) Equinox: J2000		
Comments: Target 2 is a control field necessary in order to account for contamination *Category=Stellar Cluster* *Description=[O clusters, Open star clusters, Young star clusters]*				

Observation

Proposal 1905, Observation 1: NIRCAM - Wd1

Mon Aug 09 17:00:11 GMT 2021

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

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.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CL-WESTERLUND-1	RA: 16 47 4.0000 (251.7666667d) Dec: -45 51 5.00 (-45.85139d) Equinox: J2000	Proper Motion RA: -2.2253430573750216E-4 sec of time/yr Proper Motion Dec: -0.0036540000337481615 arcsec/yr Epoch of Position: 2015.5	

Comments: Target 1 is Westerlund 1 core and outskirt
Category=Stellar Cluster
Description=[O clusters, Open star clusters, Young star clusters]

Template

Module	Subarray
ALL	FULL

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift	Column shift	Tile Order
3	1	10.0	10.0	0.0	0.0	DEFAULT

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	FULLBOX	2TIGHTGAPS	STANDARD		2

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F164N+F150W2	F323N+F322W2	BRIGHT2	2	1	4	4	171.788	54315
2	F187N	F405N+F444W	BRIGHT2	2	1	4	4	171.788	54315
3	F212N	F466N+F444W	BRIGHT2	2	1	4	4	171.788	54315
4	F115W	F277W	BRIGHT2	2	1	4	4	171.788	54315
5	F150W	F444W	BRIGHT2	2	1	4	4	171.788	54315
6	F200W	F444W	BRIGHT2	2	1	4	4	171.788	54315

Special Requirements	Group Visits within 53.0 Days Visits Same PA

Observation

Proposal 1905, Observation 3: NIRCAM -.CF

Mon Aug 09 17:00:11 GMT 2021

Diagnostic Status: Warning

Observing Template: NIRCam 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)	CL-WESTERLUND-CF	RA: 16 47 43.0000 (251.9291667d) Dec: -46 03 47.00 (-46.06306d) Equinox: J2000		

Comments: Target 2 is a control field necessary in order to account for contamination
Category=Stellar Cluster
Description=[O clusters, Open star clusters, Young star clusters]

Template

Module	Subarray
ALL	FULL

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	INTRAMODULE	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	F277W	BRIGHT2	2	1	4	4	171.788	54315
2	F150W	F356W	BRIGHT2	2	1	4	4	171.788	54315
3	F200W	F444W	BRIGHT2	2	1	4	4	171.788	54315

Observation

Proposal 1905, Observation 2: MIRI - Wd1

Mon Aug 09 17:00:11 GMT 2021

Diagnostic Status: Warning

Observing Template: MIRI Imaging

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.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CL-WESTERLUND-1	RA: 16 47 4.0000 (251.7666667d) Dec: -45 51 5.00 (-45.85139d) Equinox: J2000	Proper Motion RA: -2.2253430573750216E-4 sec of time/yr Proper Motion Dec: -0.0036540000337481615 arcsec/yr Epoch of Position: 2015.5	

Comments: Target 1 is Westerlund 1 core and outskirt
Category=Stellar Cluster
Description=[O clusters, Open star clusters, Young star clusters]

Template

Subarray
FULL

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift	Column shift	Tile Order
3	3	10.0	10.0	0.0	0.0	DEFAULT

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	4-Point-Sets				5	1	POINT SOURCE	POSITIVE	DEFAULT

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F770W	FASTR1	15	4	1	Dither 1	4	16	699.31	
2	F1000W	FASTR1	15	4	1	Dither 1	4	16	699.31	
3	F1130W	FASTR1	15	4	1	Dither 1	4	16	699.31	

Special Requirements	Group Visits within 53.0 Days Visits Same PA

Observation

Proposal 1905, Observation 4: MIRI -CF

Mon Aug 09 17:00:11 GMT 2021

Diagnostic Status: Warning

Observing Template: MIRI 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)	CL-WESTERLUND-CF	RA: 16 47 43.0000 (251.9291667d) Dec: -46 03 47.00 (-46.06306d) Equinox: J2000		

Comments: Target 2 is a control field necessary in order to account for contamination
Category=Stellar Cluster
Description=[O clusters, Open star clusters, Young star clusters]

Template

Subarray
FULL

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	4-Point-Sets				5	1	POINT SOURCE	POSITIVE	DEFAULT

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	F770W	FASTR1	15	4	1	Dither 1	4	16	699.31	
2	F1000W	FASTR1	15	4	1	Dither 1	4	16	699.31	
3	F1130W	FASTR1	15	4	1	Dither 1	4	16	699.31	