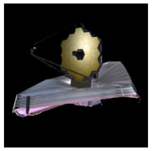

3523 - Evolution of protoplanetary disks and early stellar evolution in starburst: A NIRCam and MIRI observation of the young starburst cluster Westerlund 2

Cycle: 2, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	NIRCAM - Wd2	NIRCam Imaging	(1) CL-WESTERLUND-2-NIRCAM
	5	NIRCAM - Wd2	NIRCam Imaging	(1) CL-WESTERLUND-2-NIRCAM
	2	MIRI - Wd2	MIRI Imaging	(2) CL-WESTERLUND-2-MIRI
	3	NIRCAM - CF	NIRCam Imaging	(3) CONTROLFIELD
	4	MIRI - CF	MIRI Imaging	(3) CONTROLFIELD

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, the early stellar evolution, and the stellar mass distribution well within the brown dwarf regime 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 1-2 Myrs old starburst clusters Westerlund 2 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 in low-mass stars and 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 4.16 kpc (Vargas Alvarez et al. 2013) and a total mass of about 36000 Solar masses (Zeidler et al. 2017), Westerlund 2 (1-2 Myrs) is 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 2 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 2, the mass distribution of newborn stars well below 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. Combined with extisting observations of Westerlund 1 (slightly more massive but older, with an estimated age of about 5 Myrs, than Westerlund 2), these observations will allow us to understand the timescales of the environment feedback on star and planet formation.

Stars with disks in Westerlund 2 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, dynamical analysis based on HST and JWST observations, covering a temporal baseline of 17 years, 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 16 wide, medium and narrow filters and MIRI observations in three wide filters. NIRCAM observations are set with 7 groups, 1 integration and 4 subxiel positions, adopting the SHALLOW4 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 (down to 5 MJ) in the NIRCAM wide and medium filters. We did not adopt any primary dither pattern with NIRCAM, since the cluster fits inside one module. We set 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-2-NIRCAM	RA: 10 23 50.0000 (155.9583333d) Dec: -57 45 35.00 (-57.75972d) Equinox: J2000	Proper Motion RA: -6.556513357158305E-4 sec of time/yr Proper Motion Dec: 0.002895 arcsec/yr Epoch of Position: 2015.5	
Comments: The main target is Westerlund 2 core and its outskirts; NIRCAM pointing *Once the position angle of the observation will be known with precision, we require to be allowe to set the offsets in RA and Dec. in order to keep the cluster core within the Module A.* *Category=Stellar Cluster* *Description=[O clusters, Open star clusters, Young star clusters]*				
(2)	CL-WESTERLUND-2-MIRI	RA: 10 24 2.0000 (156.0083333d) Dec: -57 45 44.40 (-57.76233d) Equinox: J2000	Proper Motion RA: -6.556513357158305E-4 sec of time/yr Proper Motion Dec: 0.002895 arcsec/yr Epoch of Position: 2015.5	
Comments: Not specific comments. The main target is Westerlund 2 core and its outskirts; MIRI pointing *Category=Stellar Cluster* *Description=[O clusters, Open star clusters, Young star clusters]*				
(3)	CONTROLFIELD	RA: 10 15 17.0000 (153.8208333d) Dec: -56 59 42.00 (-56.99500d) Equinox: J2000	Epoch of Position: 2015.5	
Comments: Control field *Category=Stellar Cluster* *Description=[Young star clusters]*				

Observation

Proposal 3523, Observation 1: NIRCAM - Wd2 Tue May 14 20:00:13 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Comments: When the observation will be scheduled, we ask to be allowed to set the offset in RA and Dec, or alternatively to chenge the coordinates of Target 1, in order to keep the core of the cluster within Module A

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.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CL-WESTERLUND-2-NIRCAM	RA: 10 23 50.0000 (155.9583333d) Dec: -57 45 35.00 (-57.75972d) Equinox: J2000	Proper Motion RA: -6.556513357158305E-4 sec of time/yr Proper Motion Dec: 0.002895 arcsec/yr Epoch of Position: 2015.5	

Comments: The main target is Westerlund 2 core and its outskirts; NIRCAM pointing

Once the position angle of the observation will be known with precision, we require to be allowe to set the offsets in RA and Dec. in order to keep the cluster core within the Module A.
Category=Stellar Cluster
Description=[O clusters, Open star clusters, Young star clusters]

Template

Module	Subarray	Target Placement
ALL	FULL	Module Gap

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	NONE		STANDARD		4

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	SHALLOW4	7	1	4	4	1460.201	
2	F212N	F250M	SHALLOW4	7	1	4	4	1460.201	
3	F187N	F405N+F444W	SHALLOW4	7	1	4	4	1460.201	
4	F115W	F466N+F444W	SHALLOW4	7	1	4	4	1460.201	
5	F150W	F277W	SHALLOW4	7	1	4	4	1460.201	
6	F200W	F300M	SHALLOW4	7	1	4	4	1460.201	
7	F162M+F150W2	F335M	SHALLOW4	7	1	4	4	1460.201	
8	F182M	F410M	SHALLOW4	7	1	4	4	1460.201	

Observation

Proposal 3523, Observation 5: NIRCAM - Wd2 Tue May 14 20:00:13 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Comments: When the observation will be scheduled, we ask to be allowed to set the offset in RA and Dec, or alternatively to chenge the coordinates of Target 1, in order to keep the core of the cluster within Module A

WOPR copy of obs. 1

Diagnostics

(Visit 5:1) Warning (Form): Data Excess over lower threshold

(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CL-WESTERLUND-2-NIRCAM	RA: 10 23 50.0000 (155.9583333d) Dec: -57 45 35.00 (-57.75972d) Equinox: J2000	Proper Motion RA: -6.556513357158305E-4 sec of time/yr Proper Motion Dec: 0.002895 arcsec/yr Epoch of Position: 2015.5	

Comments: The main target is Westerlund 2 core and its outskirts; NIRCAM pointing

Once the position angle of the observation will be known with precision, we require to be allowe to set the offsets in RA and Dec. in order to keep the cluster core within the Module A.
Category=Stellar Cluster
Description=[O clusters, Open star clusters, Young star clusters]

Template

Module	Subarray	Target Placement
ALL	FULL	Module Gap

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	NONE		STANDARD		4

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	SHALLOW4	7	1	4	4	1460.201	
2	F212N	F250M	SHALLOW4	7	1	4	4	1460.201	
3	F187N	F405N+F444W	SHALLOW4	7	1	4	4	1460.201	
4	F115W	F466N+F444W	SHALLOW4	7	1	4	4	1460.201	
5	F150W	F277W	SHALLOW4	7	1	4	4	1460.201	
6	F200W	F300M	SHALLOW4	7	1	4	4	1460.201	
7	F162M+F150W2	F335M	SHALLOW4	7	1	4	4	1460.201	
8	F182M	F410M	SHALLOW4	7	1	4	4	1460.201	

Observation

Proposal 3523, Observation 2: MIRI - Wd2 Tue May 14 20:00:13 GMT 2024

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
(2)	CL-WESTERLUND-2-MIRI	RA: 10 24 2.0000 (156.0083333d) Dec: -57 45 44.40 (-57.76233d) Equinox: J2000	Proper Motion RA: -6.556513357158305E-4 sec of time/yr Proper Motion Dec: 0.002895 arcsec/yr Epoch of Position: 2015.5	

Comments: Not specific comments. The main target is Westerlund 2 core and its outskirts; MIRI pointing
Category=Stellar Cluster
Description=[O clusters, Open star clusters, Young star clusters]

Template

Subarray
FULL

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	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 3523, Observation 3: NIRCAM - CF

Tue May 14 20:00:13 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Visit 3:1) Warning (Form): Data Excess over lower threshold

(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(3)	CONTROLFIELD	RA: 10 15 17.0000 (153.8208333d) Dec: -56 59 42.00 (-56.99500d) Equinox: J2000	Epoch of Position: 2015.5	

Comments: Control field
Category=Stellar Cluster
Description=[Young star clusters]

Template

Module	Subarray	Target Placement
ALL	FULL	Module Gap

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	NONE		STANDARD		4

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	SHALLOW4	7	1	4	4	1460.201	
2	F212N	F250M	SHALLOW4	7	1	4	4	1460.201	
3	F187N	F405N+F444W	SHALLOW4	7	1	4	4	1460.201	
4	F115W	F466N+F444W	SHALLOW4	7	1	4	4	1460.201	
5	F150W	F277W	SHALLOW4	7	1	4	4	1460.201	
6	F200W	F300M	SHALLOW4	7	1	4	4	1460.201	
7	F162M+F150W2	F335M	SHALLOW4	7	1	4	4	1460.201	
8	F182M	F410M	SHALLOW4	7	1	4	4	1460.201	

Observation

Proposal 3523, Observation 4: MIRI - CF

Tue May 14 20:00:13 GMT 2024

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
(3)	CONTROLFIELD	RA: 10 15 17.0000 (153.8208333d) Dec: -56 59 42.00 (-56.99500d) Equinox: J2000	Epoch of Position: 2015.5	

Comments: Control field
Category=Stellar Cluster
Description=[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				2	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	