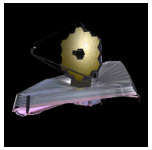

3348 - Crouching Galaxy, Hidden Stars: Observational Tests of Cluster Formation Theories

Cycle: 2, Proposal Category: GO

INVESTIGATORS

Name	*Institution*
Dr. Rupali Chandar (PI)	**University of Toledo**
Ms. Miranda Caputo (CoI)	University of Toledo
Dr. Paul Goudfrooij (CoI)	Space Telescope Science Institute
Dr. Angus Mok (CoI) (CSA Member)	OCAD University
Dr. Sean Linden (CoI)	University of Massachusetts - Amherst

OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	NIRCAM NGC3690	NIRCam Imaging	(1) NGC3690
	2	NIRCAM IC4687	NIRCam Imaging	(2) IC4687

ABSTRACT

Intensely star-forming galaxies provide a unique laboratory to study the relationship between star and cluster formation. The current generation of cosmological simulations, although starting from very different approaches and input physics, have converged in their predictions for the outcomes of the star formation process for galaxies with high star formation rate densities. Essentially, all modern simulations predict that ~50-80% of stars are born in compact clusters when star formation is very intense. While current observational results are inconsistent with these predictions, they are based on UV/optical studies with HST which almost certainly miss many (and possibly most) of the youngest, most massive, deeply embedded star clusters in extreme star-forming galaxies. We propose new NIRCAM observations of NGC 3690 and IC 4687, two dust-enshrouded mergers which have some of the highest star formation rates and surface densities in the nearby universe. Our 6-filter observations are designed to efficiently detect

embedded clusters and to estimate their ages and masses. From the complete JWST+HST census of massive clusters, we will determine the fraction of stars that form in clusters, and construct and fit the initial cluster mass function. We will establish if these new results, which account for all clusters (obscured and unobscured), agree with predictions from hydrodynamic simulations, or if new physics still needs to be considered.

OBSERVING DESCRIPTION

We will observe NGC 3690 and IC 4687, two merging/interacting, infrared-luminous systems with 6 filters on NIRCAM, in order to detect and age-date the obscured cluster population. We propose single-module NIRCAM imaging in 6 filters: Two hydrogen recombination lines, Paschen alpha (F182M) and Brackett alpha (M410M), plus 4 broader filters which will serve as continuum bands for the hydrogen lines and also cover the full wavelength range available on NIRCAM: F150W, F200W, F377W and F480W.

Our galaxies each fit within a single pointing \& module of NIRCam, thus saving on data rate, volume, and making scheduling easier. We do not include any roll angle constraints to make scheduling as easy as possible.

We select the `intramodulebox' 4-point primary dither pattern to image maximum area at full depth, and 3 small-grid dithers to improve PSF sampling. Our ETC calculations assume these parameters (i.e., 12 dithers), and we select the NIRCam readout pattern that produces our required photon collect times with 6 or more groups per integration to optimize cosmic ray rejection.

Proposal 3348 - Targets - Crouching Galaxy, Hidden Stars: Observational Tests of Cluster Formation Theories

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	NGC3690	RA: 11 28 32.2990 (172.1345792d) Dec: +58 33 42.90 (58.56192d) Equinox: J2000	Epoch of Position: 2000.0	
Comments: *Category=Galaxy* *Description=[Emission line galaxies, Infrared galaxies, Interacting galaxies, Starburst galaxies]* *Extended=YES*				
(2)	IC4687	RA: 18 13 39.6290 (273.4151208d) Dec: -57 43 31.30 (-57.72536d) Equinox: J2000	Epoch of Position: 2000.0	
Comments: *Category=Galaxy* *Description=[Emission line galaxies, Infrared galaxies, Interacting galaxies, Starburst galaxies]* *Extended=YES*				

Observation

Proposal 3348, Observation 1: NIRCAM NGC3690 Tue Jul 11 22:01:46 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Comments: 7/11/23: Added ORIENT constraints to address potential issues with claws as suggested by the NIRCam contact scientist

Diagnostics

(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)	NGC3690	RA: 11 28 32.2990 (172.1345792d) Dec: +58 33 42.90 (58.56192d) Equinox: J2000	Epoch of Position: 2000.0	

Comments:
Category=Galaxy
Description=[Emission line galaxies, Infrared galaxies, Interacting galaxies, Starburst galaxies]
Extended=YES

Template

Module	Subarray	Target Placement
B	FULL	Module Gap

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	INTRAMODULEBOX	4	SMALL-GRID-DITHER		3

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F182M	F410M	RAPID	8	1	12	12	1030.73	146729
2	F150W	F480M	BRIGHT2	8	1	12	12	2061.46	146729
3	F200W	F277W	RAPID	6	1	12	12	773.047	146729

Special Requirements

Aperture PA Range 110.05583529 to 191.05583529 Degrees (V3 110.0 to 191.0)
Aperture PA Range 193.05583529 to 251.05583529 Degrees (V3 193.0 to 251.0)
Aperture PA Range 262.05583529 to 265.05583529 Degrees (V3 262.0 to 265.0)
Aperture PA Range 267.05583529 to 270.05583529 Degrees (V3 267.0 to 270.0)
Aperture PA Range 275.05583529 to 321.05583529 Degrees (V3 275.0 to 321.0)
Aperture PA Range 333.05583529 to 334.05583529 Degrees (V3 333.0 to 334.0)

Observation

Proposal 3348, Observation 2: NIRCAM IC4687 Tue Jul 11 22:01:46 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Comments: 7/11/23: Added ORIENT constraints to address potential issues with claws as suggested by the NIRCam contact scientist

Diagnostics

(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	IC4687	RA: 18 13 39.6290 (273.4151208d) Dec: -57 43 31.30 (-57.72536d) Equinox: J2000	Epoch of Position: 2000.0	

Comments:
Category=Galaxy
Description=[Emission line galaxies, Infrared galaxies, Interacting galaxies, Starburst galaxies]
Extended=YES

Template

Module	Subarray	Target Placement
B	FULL	Module Gap

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	INTRAMODULEBOX	4	SMALL-GRID-DITHER		3

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F182M	F410M	BRIGHT2	8	1	12	12	2061.46	146729
2	F150W	F480M	SHALLOW4	10	1	12	12	6313.221	146729
3	F200W	F277W	RAPID	8	1	12	12	1030.73	146729

Special Requirements

Aperture PA Range 0.05583529 to 118.05583529 Degrees (V3 0.0 to 118.0)
Aperture PA Range 251.05583529 to 255.05583529 Degrees (V3 251.0 to 255.0)
Aperture PA Range 285.05583529 to 296.05583529 Degrees (V3 285.0 to 296.0)
Aperture PA Range 299.05583529 to 301.05583529 Degrees (V3 299.0 to 301.0)
Aperture PA Range 307.05583529 to 308.05583529 Degrees (V3 307.0 to 308.0)
Aperture PA Range 311.05583529 to 345.05583529 Degrees (V3 311.0 to 345.0)
Aperture PA Range 350.05583529 to 359.95583529 Degrees (V3 350.0 to 359.9)