



# 5145 - Resolving the Global Stellar Populations and Star Formation History of the Starburst Galaxy M82

Cycle: 3, Proposal Category: GO

## INVESTIGATORS

<i>Name</i>	<i>Institution</i>
<b>Dr. Adam Smercina (PI)</b>	<b>Space Telescope Science Institute</b>
Dr. Benjamin F. Williams (CoI)	University of Washington
Dr. Julianne Dalcanton (CoI)	University of Washington
Prof. Eric F. Bell (CoI)	University of Michigan
Dr. Kristen B W McQuinn (CoI)	Space Telescope Science Institute
Dr. Andrew Eugene Dolphin (CoI)	Raytheon Company
Dr. Richard D'Souza (CoI)	Vatican Observatory
Prof. Puragra Guhathakurta (CoI)	University of California - Santa Cruz
Dr. Daniel R. Weisz (CoI)	University of California - Berkeley
Dr. Evan D. Skillman (CoI)	University of Minnesota - Twin Cities
Dr. Margaret Lazzarini (CoI)	California State University - Los Angeles
Dr. Thomas Williams (CoI) (ESA Member)	University of Oxford
Mr. Tobin Wainer (CoI)	University of Washington

## OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
M82-Mosaic Mosaic Group				
	19	M82-Mosaic	NIRCam Imaging	(1) M82
	20	M82-Mosaic Copy of Tile-14	NIRCam Imaging	(2) M82-Tile-14

## **ABSTRACT**

We propose a NIRCам imaging survey of the nearby starburst galaxy, M82. As the prototypical massive starburst, which is also engaged in the nearest major galaxy interaction in the universe, M82 is a galaxy evolutionary laboratory. Imaging M82's disk out to  $R \sim 8$  kpc, we will for the first time break through its horrific line-of-sight dust extinction to reveal the bulk of its luminous stellar population, which are uniquely accessible with JWST. We will resolve at least 10 million individual stars across M82's disk, generating a stellar catalog that will have a lasting legacy value to the astrophysical community for decades. The key science goals of this proposal are to: measure M82's globally resolved star formation history over at least the past 6 Gyr, including the evolution of its recent starburst; map the metallicity of its stellar populations; and constrain dynamical models of its interaction history in the M81 Group. These will inform our understanding of starbursts and their winds, major mergers as drivers of galaxy evolution, and stellar evolution in high-metallicity, starbursting environments. The multiple filters, combined with rich archival data and parallel NIRISS imaging, will allow abundant future breakthrough science, including on star cluster populations, dusty evolved stars, high-resolution mapping of dust in and above the disk, stellar spectroscopy, and M82's stellar halo. The exposure times of 6356s in F115W/F356W and 4638s in F150W/F444W will reach the Red Clump feature at all spatial positions and for all extinction values in the disk, except for the crowded central 1 kpc. The scientific impact of this 65 hour investment by JWST will be felt for years.

## **OBSERVING DESCRIPTION**

This program is organized into two 3x5 pointing NIRCам imaging mosaics, 15 visits total, with the following filter combinations and exposure times:

- 1) F115W (SW) / F335M (LW): 8 groups per integration
- 2) F150W (SW) / F444W (LW): 6 groups per integration

Each visit is composed of 4 standard subpixel dithers, using the INTRAMODULEBOX pattern, which sufficiently covers the detector gaps in each array, provides excellent PSF sampling, and results in robust cosmic ray rejection. Given the exposure time requirements for our observations, we adopt a DEEP readout pattern. Specifically, DEEP8 was chosen to protect against cosmic ray hits by allowing higher frame averaging (per the JWST User Documentation). Due to the 44" gap between the A and B arrays, we adopt a 60% overlap fraction between columns in the pointing mosaic, in order to eliminate these gaps across the entire survey footprint. We adopt a small 5% overlap between rows, making sure that all exposures overlap slightly to ensure contiguous depth across the footprint.

## JWST Proposal 5145 (Created: Tuesday, March 25, 2025, 12:00:11PM Eastern Standard Time) - Overview

We impose two observational constraints: (1) a relatively tight range in PA of the mosaics, to ensure placement along M82's major axis, and (2) the condition that all observations must be taken with the same PA.

We also request coordinated parallel NIRISS imaging, observing in the F115W filter paired with NIRCcam F115W/F335M, and F150W with F150W/F444W, and applying the NIRCcam 4-point dither pattern. For the NIRISS imaging, we adopt an NIS readout pattern, and to keep exposure times within, but close to, the NIRCcam exposures, we adopt the following exposure strategy:

- 1) F115W: 18 groups/integration with 2 integrations/exposure
- 2) F150W: 13 groups/integration with 2 integrations/exposure

# Proposal 5145 - Targets - Resolving the Global Stellar Populations and Star Formation History of the Starburst Galaxy M82

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	M82	RA: 09 55 52.4300 (148.9684583d) Dec: +69 40 46.93 (69.67970d) Equinox: J2000 <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> <i>Category=Galaxy</i> <i>Description=[Galaxy disks, Starburst galaxies]</i>	Epoch of Position: 2015.5	
(2)	M82-Tile-14	RA: 09 55 12.3831 (148.8015962d) Dec: +69 38 35.49 (69.64319d) Equinox: J2000 <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> <i>Category=Galaxy</i> <i>Description=[Galaxy disks, Starburst galaxies]</i>	Epoch of Position: 2015.5		

# Proposal 5145 - Observation 19 - Resolving the Global Stellar Populations and Star Formation History of the Starburst Galaxy M82

Tue Mar 25 17:00:11 GMT 2025

<b>Observation</b>	<b>Proposal 5145, Observation 19: M82-Mosaic</b> <b>Diagnostic Status: Warning</b> Observing Template: NIRCam Imaging Coordinated Parallel Template(s): NIRISS Imaging			
	<b>Diagnostics</b>	(Visit 19:1) Warning (Form): Data Excess over lower threshold		
(Visit 19:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.				
(Visit 19:2) Warning (Form): Data Excess over lower threshold				
(Visit 19:2) Warning (Form): Overheads are provisional until the Visit Planner has been run.				
(Visit 19:3) Warning (Form): Data Excess over lower threshold				
(Visit 19:3) Warning (Form): Overheads are provisional until the Visit Planner has been run.				
(Visit 19:4) Warning (Form): Data Excess over lower threshold				
(Visit 19:4) Warning (Form): Overheads are provisional until the Visit Planner has been run.				
(Visit 19:5) Warning (Form): Data Excess over lower threshold				
(Visit 19:5) Warning (Form): Overheads are provisional until the Visit Planner has been run.				
(Visit 19:6) Warning (Form): Data Excess over lower threshold				
(Visit 19:6) Warning (Form): Overheads are provisional until the Visit Planner has been run.				
(Visit 19:7) Warning (Form): Data Excess over lower threshold				
(Visit 19:7) Warning (Form): Overheads are provisional until the Visit Planner has been run.				
(Visit 19:8) Warning (Form): Data Excess over lower threshold				
(Visit 19:8) Warning (Form): Overheads are provisional until the Visit Planner has been run.				
(Visit 19:9) Warning (Form): Data Excess over lower threshold				
(Visit 19:9) Warning (Form): Overheads are provisional until the Visit Planner has been run.				
(Visit 19:10) Warning (Form): Data Excess over lower threshold				
(Visit 19:10) Warning (Form): Overheads are provisional until the Visit Planner has been run.				
(Visit 19:11) Warning (Form): Data Excess over lower threshold				
(Visit 19:11) Warning (Form): Overheads are provisional until the Visit Planner has been run.				
(Visit 19:12) Warning (Form): Data Excess over lower threshold				
(Visit 19:12) Warning (Form): Overheads are provisional until the Visit Planner has been run.				
(Visit 19:13) Warning (Form): Data Excess over lower threshold				
(Visit 19:13) Warning (Form): Overheads are provisional until the Visit Planner has been run.				
(Visit 19:14) Warning (Form): Data Excess over lower threshold				
(Visit 19:14) Warning (Form): Overheads are provisional until the Visit Planner has been run.				
(Visit 19:15) Warning (Form): Data Excess over lower threshold				
(Visit 19:15) Warning (Form): Overheads are provisional until the Visit Planner has been run.				
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>
	(1)	M82	RA: 09 55 52.4300 (148.9684583d) Dec: +69 40 46.93 (69.67970d) Equinox: J2000	Epoch of Position: 2015.5
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> <i>Category=Galaxy</i> <i>Description=[Galaxy disks, Starburst galaxies]</i>				

Proposal 5145 - Observation 19 - Resolving the Global Stellar Populations and Star Formation History of the Starburst Galaxy M82

<b>Template</b>	<b>NIRCam Imaging</b>				<b>NIRISS Imaging</b>						
	Module: ALL Subarray: FULL Target Placement: Module Gap										
<b>Mosaic</b>	<b>Rows</b>	<b>Columns</b>	<b>Row Overlap %</b>	<b>Column Overlap %</b>	<b>Row shift (deg)</b>	<b>Column shift (deg)</b>	<b>Tile Order</b>				
	3	5	5.0	60.0	0.0	0.0	DEFAULT				
<b>Dithers</b>	<b>#</b>	<b>Primary Dither Type</b>	<b>Primary Dithers</b>	<b>Dither Size</b>	<b>Subpixel Positions</b>	<b>Coordinated Parallel Subpixel Selector</b>	<b>Dither Direct Images Primes</b>				
	1	INTRAMODULEBOX	4		1	NIRCam Only	NO_DITHERING				
<b>Spectral Elements</b>	<b>NIRCam Imaging</b>	<b>Short Filter</b>	<b>Long Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Total Integrations</b>	<b>Total Dithers</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>	
	1	F115W	F335M	SHALLOW2	10	3	12	4	6141.432	169081	
	2	F200W	F444W	SHALLOW2	9	3	12	4	5497.226		
<b>Spectral Elements</b>	<b>NIRISS Imaging</b>	<b>Filter</b>	<b>Grism</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>	
	1	F115W		NIS	17	2	4	8	5926.697	169081	
	2	F200W		NIS	15	2	4	8	5239.544		
<b>Special Requirements</b>	Sequence Visits within 53.0 Days Aperture PA Range 145 to 156.8 Degrees (V3 145.07457694 to 156.87457694) Visits Same PA No Parallel Attachments										

Proposal 5145 - Observation 20 - Resolving the Global Stellar Populations and Star Formation History of the Starburst Galaxy M82

Tue Mar 25 17:00:11 GMT 2025

<b>Observation</b>	<b>Proposal 5145, Observation 20: M82-Mosaic Copy of Tile-14</b> <b>Diagnostic Status: Warning</b> Observing Template: NIRCam Imaging Coordinated Parallel Template(s): NIRISS Imaging									
	(Visit 20:1) Warning (Form): Data Excess over lower threshold (Visit 20:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.									
<b>Diagnosics</b>										
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>			<b>Targ. Coord. Corrections</b>		<b>Miscellaneous</b>		
	(2)	M82-Tile-14	RA: 09 55 12.3831 (148.8015962d) Dec: +69 38 35.49 (69.64319d) Equinox: J2000			Epoch of Position: 2015.5				
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> <i>Category=Galaxy</i> <i>Description=[Galaxy disks, Starburst galaxies]</i>										
<b>Template</b>	<b>NIRCam Imaging</b>					<b>NIRISS Imaging</b>				
	Module: ALL Subarray: FULL Target Placement: Module Gap									
<b>Dithers</b>	<b>#</b>	<b>Primary Dither Type</b>		<b>Primary Dithers</b>	<b>Dither Size</b>	<b>Subpixel Positions</b>		<b>Coordinated Parallel Subpixel Selector</b>		<b>Dither Direct Images Primes</b>
	1	INTRAMODULEBOX		4		1		NIRCam Only		NO_DITHERING
<b>Spectral Elements</b>	<b>NIRCam Imaging</b>	<b>Short Filter</b>	<b>Long Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Total Integrations</b>	<b>Total Dithers</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F115W	F335M	SHALLOW2	10	3	12	4	6141.432	169081
	2	F200W	F444W	SHALLOW2	9	3	12	4	5497.226	
<b>Spectral Elements</b>	<b>NIRISS Imaging</b>	<b>Filter</b>	<b>Grism</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F115W		NIS	17	2	4	8	5926.697	169081
	2	F200W		NIS	15	2	4	8	5239.544	

Proposal 5145 - Observation 20 - Resolving the Global Stellar Populations and Star Formation History of the Starburst Galaxy M82

Special Requirements

Aperture PA Range 147.05742306 to 147.05742306 Degrees (V3 147.132 to 147.132)  
No Parallel Attachments