



11587 - Studying the Dark Hearts of Globular Clusters

Cycle: 5, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
NIRCam Observations				
	1		NIRCam Imaging	(1) NGC-104
	2		NIRCam Imaging	(2) NGC-2808
	3		NIRCam Imaging	(3) NGC-6388
	4		NIRCam Imaging	(4) NGC-6441
	5		NIRCam Imaging	(5) M-15
NIRCam Persistence Mitigation				
	11	Residual Persistence Check	NIRCam Dark	NONE
	22	Residual Persistence Check	NIRCam Dark	NONE

Folder	Observation	Label	Observing Template	Science Target
	33	Residual Persistence Check	NIRCam Dark	NONE
	44	Residual Persistence Check	NIRCam Dark	NONE
	55	Residual Persistence Check	NIRCam Dark	NONE

ABSTRACT

Globular clusters (GCs) may host large populations of stellar mass black holes (BHs), making them potential locations for the BH mergers emitting gravitational waves. They may also host intermediate-mass BHs (IMBHs), an important missing piece in our understanding of supermassive BH formation.

However, with most instruments it is very challenging to constrain the kinematics of the stars in the GC centers where the signatures of the different BH populations become visible.

We propose JWST NIRCam observations of five massive Milky Way GCs. Thanks to a first HST ACS/HRC epoch we can obtain proper motions with more than 20 years time baseline. This allows to study the velocity dispersion in the unstudied innermost arcseconds of our targets and will enable dynamical modeling with improved constraints of the central dark mass. Furthermore, we will be able to distinguish the nature of this dark mass between an IMBH and/or stellar mass BHs through the presence or absence of fast-moving stars.

OBSERVING DESCRIPTION

We target 5 massive globular clusters with NIRCam imaging with the goal to constrain their black hole content.

The NIRCam data will provide a second epoch to archival HST ACS/HRC high resolution images obtained between 2002-2006.

This will allow to measure proper motions with time-baselines >20 years in the crowded cluster cores, that are not accessible to other instruments.

The improved proper motion catalogs will allow measurements of the velocity dispersion in the innermost arcseconds of the cluster, necessary for improved dynamical models that can constrain the presence of stellar mass black holes.

In addition, the program will reveal potential fast-moving stars in the vicinity of a potential intermediate-mass black hole. A non-detection of fast-moving stars can provide upper limits on the IMBH presence.

For each cluster, we will obtain images with two short wavelength channel (SWC) filters: F070W and F090W.

We chose these blue filters as they:

JWST Proposal 11587 (Created: Friday, August 21, 2026, 1:00:37PM Eastern Standard Time) - Overview

- * Provide the highest spatial resolution, important for the crowded cluster cores and for high-precision astrometry
- * Have a comparably low throughput, which will mitigate saturation issues in the bright cluster centers
- * Suppress the diffraction spikes from red giant stars
- * Allow for the creation of a color-magnitude diagram, essential to identify cluster member stars

The LWC filters (F277W, F444W) are chosen to enable stellar population studies, especially at larger radii (where crowding is less problematic).

For each filter, we will obtain 6 dithers with the FULLBOX6 pattern and both NIRCcam modules. On the one hand, the 6 dithers will statistically improve our astrometry and will allow to reconstruct the undersampled images. On the other hand, the wide continuous coverage enabled by this dither pattern, will allow to study stellar populations and their proper motions over a wide radial range.

We chose readout mode BRIGHT2 with Ngroups=4 and Nint=2, resulting in a total integration time of 182 seconds per exposure. This allows to obtain proper motions measurements with a precision ranging between 0.005mas/yr for the brightest stars and 0.100 mas/yr at the faint end ($m_{F814W} \sim 23.5$).

Proposal 11587 - Targets - Studying the Dark Hearts of Globular Clusters

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	NGC-104	RA: 00 24 5.3590 (6.0223292d) Dec: -72 04 53.20 (-72.08144d) Equinox: J2000	Proper Motion RA: 5.25 mas/yr Proper Motion Dec: -2.529999915168446 mas/yr Parallax: 2.32E-4" Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM. Category=Stellar Cluster Description=[Globular star clusters]				
(2)	NGC-2808	RA: 09 12 3.1000 (138.0129167d) Dec: -64 51 48.60 (-64.86350d) Equinox: J2000	Proper Motion RA: 1.02 mas/yr Proper Motion Dec: 0.28 mas/yr Parallax: 1.12E-4" Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM. Category=Stellar Cluster Description=[Globular star clusters]				
(3)	NGC-6388	RA: 17 36 17.4610 (264.0727542d) Dec: -44 44 8.34 (-44.73565d) Equinox: J2000	Proper Motion RA: -1.33 mas/yr Proper Motion Dec: -2.6799999659488094 mas/yr Parallax: 1.0E-4" Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM. Category=Stellar Cluster Description=[Globular star clusters]				
(4)	NGC-6441	RA: 17 50 13.0600 (267.5544167d) Dec: -37 03 5.20 (-37.05144d) Equinox: J2000	Proper Motion RA: -2.551 mas/yr Proper Motion Dec: -5.348000058802427 mas/yr Parallax: 8.3E-5" Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM. Category=Stellar Cluster Description=[Globular star clusters]				
(5)	M-15	RA: 21 29 58.3300 (322.4930417d) Dec: +12 10 1.20 (12.16700d) Equinox: J2000	Proper Motion RA: -0.63 mas/yr Proper Motion Dec: -3.800000058618025 mas/yr Parallax: 9.7E-5" Epoch of Position: 2000	
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM. Category=Stellar Cluster Description=[Globular star clusters]				

Proposal 11587 - Observation 1 - Studying the Dark Hearts of Globular Clusters

Observation	Proposal 11587, Observation 1										Fri Aug 21 18:00:37 GMT 2026
	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. (Visit 1:4) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous		
	(1)	NGC-104	RA: 00 24 5.3590 (6.0223292d) Dec: -72 04 53.20 (-72.08144d) Equinox: J2000			Proper Motion RA: 5.25 mas/yr Proper Motion Dec: -2.529999915168446 mas/yr Parallax: 2.32E-4" Epoch of Position: 2000					
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM. Category=Stellar Cluster Description=[Globular star clusters]										
Template	Module		Subarray				Target Placement				
	ALL		FULL				Module B center (small extended source)				
Dithers	#	Primary Dither Type		Primary Dithers		Subpixel Dither Type		Dither Size		Subpixel Positions	
	1	FULLBOX		6		SMALL-GRID-DITHER				2	
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	Optional ETC ID	
	1	F070W	F444W	BRIGHT2	4	1	12	12	1030.73		
	2	F090W	F277W	BRIGHT2	4	1	12	12	1030.73		
Special Requirements	Sequence Visits , Non-interruptible, Exclusive Use Of Instrument Visits Same PA Offset -7.0 arcsec, 4.0 arcsec Persistence Risk Fiducial Point Override NRCBS_FULL										
	11 After 1 by 9 Hours to 2 Days, Exclusive Use Of Instrument										

Proposal 11587 - Observation 2 - Studying the Dark Hearts of Globular Clusters

Observation	Proposal 11587, Observation 2										Fri Aug 21 18:00:37 GMT 2026
	Diagnostic Status: Warning										
	Observing Template: NIRCam Imaging										
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)	NGC-2808	RA: 09 12 3.1000 (138.0129167d) Dec: -64 51 48.60 (-64.86350d) Equinox: J2000			Proper Motion RA: 1.02 mas/yr Proper Motion Dec: 0.28 mas/yr Parallax: 1.12E-4" Epoch of Position: 2000					
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.										
	SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.										
	Category=Stellar Cluster Description=[Globular star clusters]										
Template	Module		Subarray				Target Placement				
	ALL		FULL				Module B center (small extended source)				
Dithers	#	Primary Dither Type		Primary Dithers		Subpixel Dither Type		Dither Size		Subpixel Positions	
	1	FULLBOX		6		SMALL-GRID-DITHER				2	
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	Optional ETC ID	
	1	F070W	F444W	BRIGHT2	4	1	12	12	1030.73		
	2	F090W	F277W	BRIGHT2	4	1	12	12	1030.73		
Special Requirements	Offset -7.0 arcsec, 4.0 arcsec Persistence Risk Fiducial Point Override NRCBS_FULL										
	22 After 2 by 9 Hours to 2 Days, Exclusive Use Of Instrument										

Proposal 11587 - Observation 3 - Studying the Dark Hearts of Globular Clusters

Observation	Proposal 11587, Observation 3										Fri Aug 21 18:00:37 GMT 2026
	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		
	(3)	NGC-6388	RA: 17 36 17.4610 (264.0727542d) Dec: -44 44 8.34 (-44.73565d) Equinox: J2000			Proper Motion RA: -1.33 mas/yr Proper Motion Dec: -2.6799999659488094 mas/yr Parallax: 1.0E-4" Epoch of Position: 2000					
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.										
	SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.										
	Category=Stellar Cluster										
	Description=[Globular star clusters]										
Template	Module				Subarray				Target Placement		
	ALL				FULL				Module B center (small extended source)		
Dithers	#	Primary Dither Type		Primary Dithers		Subpixel Dither Type		Dither Size		Subpixel Positions	
	1	FULLBOX		6		SMALL-GRID-DITHER				2	
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	Optional ETC ID	
	1	F070W	F444W	BRIGHT2	4	1	12	12	1030.73		
	2	F090W	F277W	BRIGHT2	4	1	12	12	1030.73		
Special Requirements	Offset -7.0 arcsec, 4.0 arcsec										
	Persistence Risk										
	Fiducial Point Override NRCBS_FULL										
	33 After 3 by 9 Hours to 2 Days, Exclusive Use Of Instrument										

Proposal 11587 - Observation 4 - Studying the Dark Hearts of Globular Clusters

Observation	Proposal 11587, Observation 4										Fri Aug 21 18:00:37 GMT 2026
	Diagnostic Status: Warning Observing Template: NIRCam 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		
	(4)	NGC-6441	RA: 17 50 13.0600 (267.5544167d) Dec: -37 03 5.20 (-37.05144d) Equinox: J2000			Proper Motion RA: -2.551 mas/yr Proper Motion Dec: -5.348000058802427 mas/yr Parallax: 8.3E-5" Epoch of Position: 2000					
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.										
	SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM. Category=Stellar Cluster Description=[Globular star clusters]										
Template	Module		Subarray				Target Placement				
	ALL		FULL				Module B center (small extended source)				
Dithers	#	Primary Dither Type		Primary Dithers		Subpixel Dither Type		Dither Size		Subpixel Positions	
	1	FULLBOX		6		SMALL-GRID-DITHER				2	
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	Optional ETC ID	
	1	F070W	F444W	BRIGHT2	4	1	12	12	1030.73		
	2	F090W	F277W	BRIGHT2	4	1	12	12	1030.73		
Special Requirements	Offset -7.0 arcsec, 4.0 arcsec Persistence Risk Fiducial Point Override NRCBS_FULL 44 After 4 by 12 Hours to 2 Days, Exclusive Use Of Instrument										

Proposal 11587 - Observation 5 - Studying the Dark Hearts of Globular Clusters

Observation	Proposal 11587, Observation 5										Fri Aug 21 18:00:37 GMT 2026
	Diagnostic Status: Warning										
Observing Template: NIRCcam Imaging											
Diagnostics	(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections			Miscellaneous		
	(5)	M-15	RA: 21 29 58.3300 (322.4930417d) Dec: +12 10 1.20 (12.16700d) Equinox: J2000			Proper Motion RA: -0.63 mas/yr Proper Motion Dec: -3.800000058618025 mas/yr Parallax: 9.7E-5" Epoch of Position: 2000					
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.										
	SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.										
	Category=Stellar Cluster Description=[Globular star clusters]										
Template	Module		Subarray				Target Placement				
	ALL		FULL				Module B center (small extended source)				
Dithers	#	Primary Dither Type		Primary Dithers		Subpixel Dither Type		Dither Size		Subpixel Positions	
	1	FULLBOX		6TIGHT		SMALL-GRID-DITHER				2	
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	Optional ETC ID	
	1	F070W	F444W	BRIGHT2	4	1	12	12	1030.73		
	2	F090W	F277W	BRIGHT2	4	1	12	12	1030.73		
Special Requirements	Offset -7.0 arcsec, 4.0 arcsec Persistence Risk Fiducial Point Override NRCBS_FULL										
	55 After 5 by 6 Hours to 2 Days, Exclusive Use Of Instrument										

Proposal 11587 - Observation 11 - Studying the Dark Hearts of Globular Clusters

Observation	Proposal 11587, Observation 11: Residual Persistence Check Diagnostic Status: Warning Observing Template: NIRCam Dark							Fri Aug 21 18:00:37 GMT 2026
Diagnostics	(Visit 11:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.							
Template	Module	Subarray	Science Template		Occulting Mask		No. of Output Channels	
	ALL	FULL	Imaging				4	
Spectral Elements	#	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Integrations	Total Exposure Time	Optional ETC ID
	1	MEDIUM8	10	1	1	1	1052.203	
Special Requirements	11 After 1 by 9 Hours to 2 Days, Exclusive Use Of Instrument							

Proposal 11587 - Observation 22 - Studying the Dark Hearts of Globular Clusters

Observation	Proposal 11587, Observation 22: Residual Persistence Check Diagnostic Status: Warning Observing Template: NIRCam Dark							Fri Aug 21 18:00:37 GMT 2026
Diagnostics	(Visit 22:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.							
Template	Module	Subarray	Science Template		Occulting Mask		No. of Output Channels	
	ALL	FULL	Imaging				4	
Spectral Elements	#	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Integrations	Total Exposure Time	Optional ETC ID
	1	MEDIUM8	10	1	1	1	1052.203	
Special Requirements	22 After 2 by 9 Hours to 2 Days, Exclusive Use Of Instrument							

Proposal 11587 - Observation 33 - Studying the Dark Hearts of Globular Clusters

Observation	Proposal 11587, Observation 33: Residual Persistence Check Diagnostic Status: Warning Observing Template: NIRCam Dark							Fri Aug 21 18:00:37 GMT 2026
Diagnostics	(Visit 33:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.							
Template	Module	Subarray	Science Template		Occulting Mask		No. of Output Channels	
	ALL	FULL	Imaging				4	
Spectral Elements	#	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Integrations	Total Exposure Time	Optional ETC ID
	1	MEDIUM8	10	1	1	1	1052.203	
Special Requirements	33 After 3 by 9 Hours to 2 Days, Exclusive Use Of Instrument							

Proposal 11587 - Observation 44 - Studying the Dark Hearts of Globular Clusters

Observation	Proposal 11587, Observation 44: Residual Persistence Check Diagnostic Status: Warning Observing Template: NIRCam Dark							Fri Aug 21 18:00:37 GMT 2026
Diagnostics	(Visit 44:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.							
Template	Module	Subarray	Science Template		Occulting Mask		No. of Output Channels	
	ALL	FULL	Imaging				4	
Spectral Elements	#	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Integrations	Total Exposure Time	Optional ETC ID
	1	MEDIUM8	10	1	1	1	1052.203	
Special Requirements	44 After 4 by 12 Hours to 2 Days, Exclusive Use Of Instrument							

Proposal 11587 - Observation 55 - Studying the Dark Hearts of Globular Clusters

Observation	Proposal 11587, Observation 55: Residual Persistence Check Diagnostic Status: Warning Observing Template: NIRCam Dark							Fri Aug 21 18:00:37 GMT 2026
Diagnostics	(Visit 55:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.							
Template	Module	Subarray	Science Template		Occulting Mask		No. of Output Channels	
	ALL	FULL	Imaging				4	
Spectral Elements	#	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Total Integrations	Total Exposure Time	Optional ETC ID
	1	MEDIUM8	10	1	1	1	1052.203	
Special Requirements	55 After 5 by 6 Hours to 2 Days, Exclusive Use Of Instrument							