



3772 - N6946-BH1: the first failed superova or a massive stellar eruption?

Cycle: 2, 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>
Observation Folder				
	1	NIRCam	NIRCam Imaging	(1) NAME-N6946-BH1
	2	MIRI	MIRI Imaging	(1) NAME-N6946-BH1

ABSTRACT

N6946-BH1 may represent the first case of a red supergiant (RSG) collapsing directly to form a black hole (BH), with no associated supernova (SN). If proven, this would solve the problem of missing high mass progenitors to Type IIP SNe, as well as providing a natural pathway for the formation of stellar mass BHs, as observed by LIGO/VIRGO. However, currently we are unable to rule out that the star is still there but has enshrouded itself following a mass-loss event, similar to Eta Car's 'Great Eruption'. If this is the case, we would expect to see a brightly emitting dust shell at wavelengths $>5\mu\text{m}$. If it has truly collapsed to a BH, there should be no luminous source left in the IR. With JWST we will be able to decisively rule out one of these scenarios. Either we will detect emission from a cool dust shell, indicating the RSG has not disappeared, or we will be able to rule out the presence of a luminous object embedded in a dust shell with 10sigma significance, and conclusively show the progenitor has indeed formed a

BH. Whichever case is confirmed, we stress that the results will be profound for stellar evolutionary theory. In the first scenario, this would be the first time an otherwise normal RSG has been observed to undergo such strong eruptive mass-loss, similar to that experienced by LBVs or the progenitors to Type II In SNe. In the second scenario, we would be confirming the first direct collapse of an RSG to BH, representing an exciting new challenge for stellar evolutionary theory. Given that we have extensive progenitor information from pre-explosion imaging, this would provide a crucial first data point for the formation of BHs via failed SN.

OBSERVING DESCRIPTION

We are proposing to observe N6946-BH1 with JWST NIRCams and MIRI with 6 filters across 1.1-21 micron. In total, we are requesting 4.2 hours of JWST time including overheads.

Proposal 3772 - Targets - N6946-BH1: the first failed superova or a massive stellar eruption?

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	NAME-N6946-BH1	RA: 20 35 27.5600 (308.8648333d) Dec: +60 08 8.29 (60.13564d) Equinox: J2000	Epoch of Position: 2015.5	

Proposal 3772 - Observation 1 - N6946-BH1: the first failed superova or a massive stellar eruption?

Fri Jul 21 00:01:03 GMT 2023

Observation	<p>Proposal 3772, Observation 1: NIRCam Diagnostic Status: Warning Observing Template: NIRCam Imaging</p>									
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)	NAME-N6946-BH1	RA: 20 35 27.5600 (308.8648333d) Dec: +60 08 8.29 (60.13564d) Equinox: J2000		Epoch of Position: 2015.5					
	<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=Star Description=[Red supergiants, Stellar winds, Supernovae]</p>									
Template	Module		Subarray			Target Placement				
	B		FULLP			Module Gap				
Dithers	#	Primary Dither Type		Primary Dithers	Subpixel Dither Type		Dither Size	Subpixel Positions		
	1	INTRASCA		4	STANDARD		8" (SMALL)	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	F250M	MEDIUM8	10	1	4	4	4208.814	
	2	F182M	F360M	SHALLOW4	10	1	4	4	2104.407	
Special Requirements	Group Observations 1, 2, Non-interruptible									

Proposal 3772 - Observation 2 - N6946-BH1: the first failed superova or a massive stellar eruption?

Fri Jul 21 00:01:03 GMT 2023

Observation	<p>Proposal 3772, Observation 2: MIRI Diagnostic Status: Warning Observing Template: MIRI Imaging</p>										
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			
	(1)	NAME-N6946-BH1	RA: 20 35 27.5600 (308.8648333d) Dec: +60 08 8.29 (60.13564d) Equinox: J2000			Epoch of Position: 2015.5					
	<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=Star Description=[Red supergiants, Stellar winds, Supernovae]</p>										
Template	<p>Subarray FULL</p>										
Dithers	#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size	
	1	CYCLING	1	4		1	1			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	F560W	FASTR1	21	1	1	Dither 1	4	4	233.103	
	2	F770W	FASTR1	11	1	1	Dither 1	4	4	122.102	
	3	F1000W	FASTR1	11	1	1	Dither 1	4	4	122.102	
	4	F2100W	FASTR1	11	1	1	Dither 1	4	4	122.102	
Special Requirements	Group Observations 1, 2, Non-interruptible										