



# 4571 - Tracing Binary Star Metamorphosis: Chandra+JWST Imaging of Bipolar Planetary Nebulae

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	NGC 6537: NIRC <i>am</i> i maging	NIRC <i>am</i> Imaging	(1) NGC-6537
	2	NGC 2440: NIRC <i>am</i> i maging	NIRC <i>am</i> Imaging	(2) NGC-2440

## ABSTRACT

Planetary nebulae (PNe) serve as laboratories for the study of the late stages of stellar evolution and stellar mass loss. We propose a joint Chandra/JWST program aimed at understanding the origin and evolution of the class of high-excitation, molecule-rich, bipolar PNe. The proposed observations will generate a comprehensive, near-IR to X-ray view of shock-heated gas resulting from wind-wind collisions within NGC 2440 and

NGC 6537, two of the nearest-known and best-studied examples of these spectacular nebulae. These results will place stringent constraints on the timescales and time-variable geometries of PN-shaping collimated outflows and jets from the binary engines at the cores of bipolar PNe that are descended from massive progenitor stars.

### **OBSERVING DESCRIPTION**

This is the companion (joint) JWST program to Chandra Cycle 25 proposal 25200170, which has been awarded 160 ks of CXO observing time.

We are targeting a two nearby, extended bipolar planetary nebulae with NIRCcam, in its imaging mode (template). Our JWST/NIRCcam observing strategy is modeled on that employed for the ERO program targeting NGC 3132, which serves as proof of the feasibility of our proposed program. Our NIRCcam observing setups and exposure times precisely replicate the observing parameters used for the NGC 3132 NIRCcam EROs.

The angular sizes of the target nebulae are 100"-200" and are hence very well matched to the FOV of NIRCcam, using both modules. We will obtain NIRCcam images of each target PN in the filters F164N, F212N, F365W, F405N. We will obtain these four images in pairs, using the SW+LW channels, such that only two dithered observations of each target PN are required. We adopt the NGC 3132 ERO imaging parameters, using the SHALLOW2 readout pattern with 6 groups per integration and 1 integration per exposure, and the INTERMODULEX dither pattern with 8 primary dithers for all nebulae observed with module B; for the dual-module observations (of two targets) we will obtain small [2-row] mosaics, in tandem with FULLBOX/4TIGHT dithering.

Proposal 4571 - Targets - Tracing Binary Star Metamorphosis: Chandra+JWST Imaging of Bipolar Planetary Nebulae

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	NGC-6537	RA: 18 05 13.1230 (271.3046792d) Dec: -19 50 34.90 (-19.84303d) Equinox: J2000	Proper Motion RA: 0.0012403086013661687 sec of time/yr Proper Motion Dec: -0.0014000000646774424 arcsec/yr Epoch of Position: 2015.5	
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=ISM Description=[Bipolar nebulae, Planetary nebulae]					
(2)	NGC-2440	RA: 07 41 54.9100 (115.4787917d) Dec: -18 12 29.70 (-18.20825d) Equinox: J2000	Epoch of Position: 2015.5		
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=ISM Description=[Bipolar nebulae, Planetary nebulae]					

Proposal 4571 - Observation 1 - Tracing Binary Star Metamorphosis: Chandra+JWST Imaging of Bipolar Planetary Nebulae

Thu May 02 13:00:25 GMT 2024

<b>Observation</b>	<p>Proposal 4571, Observation 1: NGC 6537: NIRCcam imaging</p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRCcam Imaging</p>									
<b>Diagnostics</b>	(Visit 1:1) 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>			<b>Miscellaneous</b>		
	(1)	NGC-6537	RA: 18 05 13.1230 (271.3046792d) Dec: -19 50 34.90 (-19.84303d) Equinox: J2000		Proper Motion RA: 0.0012403086013661687 sec of time/yr Proper Motion Dec: -0.0014000000646774424 arcsec/yr Epoch of Position: 2015.5					
	<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p><i>Category=ISM</i></p> <p><i>Description=[Bipolar nebulae, Planetary nebulae]</i></p>									
<b>Template</b>	<b>Module</b>		<b>Subarray</b>			<b>Target Placement</b>				
	B		FULL			Module Gap				
<b>Dithers</b>	<b>#</b>	<b>Primary Dither Type</b>		<b>Primary Dithers</b>	<b>Subpixel Dither Type</b>		<b>Dither Size</b>	<b>Subpixel Positions</b>		
	1	INTRAMODULEX		8	STANDARD			1		
<b>Spectral Elements</b>	<b>#</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	F212N	F405N+F444W	SHALLOW2	6	1	8	8	2319.142	
	2	F164N+F150W2	F356W	SHALLOW2	6	1	8	8	2319.142	

Proposal 4571 - Observation 2 - Tracing Binary Star Metamorphosis: Chandra+JWST Imaging of Bipolar Planetary Nebulae

Thu May 02 13:00:25 GMT 2024

<b>Observation</b>	<p>Proposal 4571, Observation 2: NGC 2440: NIRCcam imaging</p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRCcam Imaging</p>									
<b>Diagnostics</b>	(Visit 2:1) 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>			<b>Miscellaneous</b>		
	(2)	NGC-2440	RA: 07 41 54.9100 (115.4787917d) Dec: -18 12 29.70 (-18.20825d) Equinox: J2000		Epoch of Position: 2015.5					
	<p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p><i>Category=ISM</i></p> <p><i>Description=[Bipolar nebulae, Planetary nebulae]</i></p>									
<b>Template</b>	<b>Module</b>		<b>Subarray</b>			<b>Target Placement</b>				
	B		FULL			Module Gap				
<b>Dithers</b>	<b>#</b>	<b>Primary Dither Type</b>		<b>Primary Dithers</b>	<b>Subpixel Dither Type</b>		<b>Dither Size</b>	<b>Subpixel Positions</b>		
	1	INTRAMODULEX		8	STANDARD			1		
<b>Spectral Elements</b>	<b>#</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	F212N	F405N+F444W	SHALLOW2	6	1	8	8	2319.142	
	2	F164N+F150W2	F356W	SHALLOW2	6	1	8	8	2319.142	