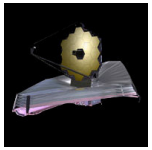

6662 - Unveiling the Mysterious Black Hole Binary IC10 X-1. Chandra Joint proposal ID 26400357

Cycle: 3, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Photometric imaging timeseries (Phase coverage) of X-ray Binary				
	1	Phase 0.0	NIRCam Imaging	(1) CXOU-J002029.1+591651
	2	Phase 0.1	NIRCam Imaging	(1) CXOU-J002029.1+591651
	3	Phase 0.2	NIRCam Imaging	(1) CXOU-J002029.1+591651
	4	Phase 0.3	NIRCam Imaging	(1) CXOU-J002029.1+591651
	5	Phase 0.4	NIRCam Imaging	(1) CXOU-J002029.1+591651
	6	Phase 0.5	NIRCam Imaging	(1) CXOU-J002029.1+591651
	7	Phase 0.6	NIRCam Imaging	(1) CXOU-J002029.1+591651
	8	Phase 0.7	NIRCam Imaging	(1) CXOU-J002029.1+591651
	9	Phase 0.8	NIRCam Imaging	(1) CXOU-J002029.1+591651
	10	Phase 0.9	NIRCam Imaging	(1) CXOU-J002029.1+591651

ABSTRACT

Black hole high mass X-ray binaries are among the leading candidates to be the progenitors of binary black holes. IC 10 X-1 is among the few known BH-HMXBs, yet its BH mass is subject to wide uncertainty, due to the effects of X-ray irradiation on the stellar wind which has confounded optical RV line studies. Additionally the foreground extinction to the host galaxy precludes UV spectroscopy which could otherwise solve the mystery by probing harder ion species. Infrared photometry with JWST can finally overcome this difficulty and obtain the binary lightcurve, which has a predicted exact phase offset with respect to the X-ray eclipse. Unlike all other BH-HMXB examples IC 10 X-1 has demonstrated consistent behavior over decades, making it an excellent target for this science.

OBSERVING DESCRIPTION

We request approx 3 hrs photometric observation (total charged approx. 14 hr) of IC 10 X-1 with NIRCam using the two wideband filters in short and long channel F150W and F277W. This observation consists of 10 separate visits at ten different phases (= 0.0-0.9 by = 0.1) of the IC 10 X-1 binary system. Observing these phases will be enough to construct the light curve and understand the dynamical changes in the eclipsed and un-eclipsed phases.

Visibility: The python-based JWST general visibility checker and APT were used to find out that the source will be visible and the requested observation can be scheduled from 22nd July 2024 to 03rd February 2025, within the cycle 3 observation window (6 months).

Choice of filter: Two wideband filters: F150W and F277W in both short and long channels will be used. This will provide not only a single photometric light curve but also a comparative study of color-magnitude variation of the IC 10 X-1 system and any other variable source within the field. Especially for IC 10 X-1, it will be interesting to monitor the color changes through the un-eclipsed and the eclipsed phases. In a similar system (Cyg X-3), the existence of a clumpy trail has been observed, and as a result a ‘depression’ can be seen near phase 0.4 (Antokhin et. al. 2022). Theoretically, the free-free optical depth of redder (277) band is larger than the optical depth in the bluer band (150). Hence, more absorption will be observed in the F277W light curve in some phases. A similar phenomenon can be observed due to bow shock absorption.

Instrument setup and dither: These observations will be using both the modules of NIRCam providing a field of view for monitoring a large chunk of the IC 10 galaxy. In order to account for the module gaps in both horizontal and vertical directions, FULLBOX-5TIGHT dither pattern will be applied. Using FULLBOX will be more efficient in terms of overhead time than FULL. This dither pattern 5TIGHT will ensure no gaps in the stacked observation, hence the primary target IC 10 X-1 can be placed at B4 (B short) for achieving the maximum exposure on target.
Exposure time: JWST's highly sensitive imaging capability allows for very high SNR using very low exposures. In order to fulfill both the primary and secondary objectives, the SNR needs to be high enough to detect the variability of the eclipsed and un-eclipsed phases in each observation of IC 10 X-1, and also provide a significantly higher limiting magnitude of the IC 10 stacked image (all visits) than previous studies (V 24).

The exposure time depends on the choice of readout method, number of groups, and integration in a single exposure. We have chosen to use the BRIGHT2 readout pattern, using 2 groups and 3 integrations for each dither (total 5 dithers). THis will deliver SNR>100 over most of the field, as require for precise time series photometry at the 1% level.

Feasibility of scheduling: This system has a very precisely constrained ephemeris (Porbit = 34.842±0.002 hr, Laycock+ 2015) which will make it easy to schedule observations accurately at the requested phases. The 10 observations can be made in any order, as needed to fill the schedule.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CXOU-J002029.1+591651	RA: 00 20 29.0900 (5.1212083d)	Proper Motion RA: 0	
		Dec: +59 16 51.90 (59.28108d)	Proper Motion Dec: 0	
		Equinox: J2000	Parallax: 0"	
			Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The primary target is the extragalactic X-ray binary IC10 X-1. Consequently the is no measureable proper motion or parallax.
Secondary targets include 50+ X-ray selected stars. Tertiary target is the stellar population of IC 10 itself.
Category=Star
Description=[Circumstellar matter, Wolf-Rayet stars, X-ray binary stars]
Extended=NO

Observation

Proposal 6662, Observation 1: Phase 0.0

Wed Nov 13 22:00:22 GMT 2024

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.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CXOU-J002029.1+591651	RA: 00 20 29.0900 (5.1212083d)	Proper Motion RA: 0	
		Dec: +59 16 51.90 (59.28108d)	Proper Motion Dec: 0	
		Equinox: J2000	Parallax: 0"	
			Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The primary target is the extragalactic X-ray binary IC10 X-1. Consequently the is no measureable proper motion or parallax.
Secondary targets include 50+ X-ray selected stars. Tertiary target is the stellar population of IC 10 itself.
Category=Star
Description=[Circumstellar matter, Wolf-Rayet stars, X-ray binary stars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module A (A3 corner)

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	Tile Order
3	1	10.0	10.0	0.0	0.0	DEFAULT

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	FULLBOX	5TIGHT	STANDARD		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	F150W	F277W	BRIGHT2	2	3	15	5	751.574	196772

Special Requirements	
	Phase 0 to 0.1 with period 1.45175 Days and zero-phase 2454041.37365 HJD Group Visits within 53.0 Days Visits Same PA Offset 10.0 arcsec, -30.0 arcsec Fiducial Point Override NRCAS_FULL

Observation

Proposal 6662, Observation 2: Phase 0.1

Wed Nov 13 22:00:22 GMT 2024

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
(1)	CXOU-J002029.1+591651	RA: 00 20 29.0900 (5.1212083d)	Proper Motion RA: 0	
		Dec: +59 16 51.90 (59.28108d)	Proper Motion Dec: 0	
		Equinox: J2000	Parallax: 0"	
			Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The primary target is the extragalactic X-ray binary IC10 X-1. Consequently the is no measureable proper motion or parallax.
Secondary targets include 50+ X-ray selected stars. Tertiary target is the stellar population of IC 10 itself.
Category=Star
Description=[Circumstellar matter, Wolf-Rayet stars, X-ray binary stars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module A (A3 corner)

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	FULLBOX	5TIGHT	STANDARD		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	F150W	F277W	BRIGHT2	2	3	15	5	751.574	196772

Special Requirements

Phase 0.1 to 0.2 with period 1.45175 Days and zero-phase 2454041.37365 HJD
Offset 10.0 arcsec, -30.0 arcsec
Fiducial Point Override NRCAS_FULL

Observation

Proposal 6662, Observation 3: Phase 0.2

Wed Nov 13 22:00:22 GMT 2024

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
(1)	CXOU-J002029.1+591651	RA: 00 20 29.0900 (5.1212083d)	Proper Motion RA: 0	
		Dec: +59 16 51.90 (59.28108d)	Proper Motion Dec: 0	
		Equinox: J2000	Parallax: 0"	
			Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The primary target is the extragalactic X-ray binary IC10 X-1. Consequently the is no measureable proper motion or parallax.
Secondary targets include 50+ X-ray selected stars. Tertiary target is the stellar population of IC 10 itself.
Category=Star
Description=[Circumstellar matter, Wolf-Rayet stars, X-ray binary stars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module A (A3 corner)

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	FULLBOX	5TIGHT	STANDARD		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	F150W	F277W	BRIGHT2	2	3	15	5	751.574	196772

Special Requirements

Phase 0.2 to 0.3 with period 1.45175 Days and zero-phase 2454041.37365 HJD
Offset 10.0 arcsec, -30.0 arcsec
Fiducial Point Override NRCAS_FULL

Observation

Proposal 6662, Observation 4: Phase 0.3

Wed Nov 13 22:00:22 GMT 2024

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
(1)	CXOU-J002029.1+591651	RA: 00 20 29.0900 (5.1212083d)	Proper Motion RA: 0	
		Dec: +59 16 51.90 (59.28108d)	Proper Motion Dec: 0	
		Equinox: J2000	Parallax: 0"	
			Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The primary target is the extragalactic X-ray binary IC10 X-1. Consequently the is no measureable proper motion or parallax.
Secondary targets include 50+ X-ray selected stars. Tertiary target is the stellar population of IC 10 itself.
Category=Star
Description=[Circumstellar matter, Wolf-Rayet stars, X-ray binary stars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module A (A3 corner)

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	FULLBOX	5TIGHT	STANDARD		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	F150W	F277W	BRIGHT2	2	3	15	5	751.574	196772

Special Requirements

Phase 0.3 to 0.4 with period 1.45175 Days and zero-phase 2454041.37365 HJD
Offset 10.0 arcsec, -30.0 arcsec
Fiducial Point Override NRCAS_FULL

Observation

Proposal 6662, Observation 5: Phase 0.4

Wed Nov 13 22:00:22 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam 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
(1)	CXOU-J002029.1+591651	RA: 00 20 29.0900 (5.1212083d)	Proper Motion RA: 0	
		Dec: +59 16 51.90 (59.28108d)	Proper Motion Dec: 0	
		Equinox: J2000	Parallax: 0"	
			Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The primary target is the extragalactic X-ray binary IC10 X-1. Consequently the is no measureable proper motion or parallax.
Secondary targets include 50+ X-ray selected stars. Tertiary target is the stellar population of IC 10 itself.
Category=Star
Description=[Circumstellar matter, Wolf-Rayet stars, X-ray binary stars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module A (A3 corner)

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	FULLBOX	5TIGHT	STANDARD		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	F150W	F277W	BRIGHT2	2	3	15	5	751.574	196772

Special Requirements

Phase 0.4 to 0.5 with period 1.45175 Days and zero-phase 2454041.37365 HJD
Offset 10.0 arcsec, -30.0 arcsec
Fiducial Point Override NRCAS_FULL

Observation

Proposal 6662, Observation 6: Phase 0.5

Wed Nov 13 22:00:22 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CXOU-J002029.1+591651	RA: 00 20 29.0900 (5.1212083d)	Proper Motion RA: 0	
		Dec: +59 16 51.90 (59.28108d)	Proper Motion Dec: 0	
		Equinox: J2000	Parallax: 0"	
			Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The primary target is the extragalactic X-ray binary IC10 X-1. Consequently the is no measureable proper motion or parallax.
Secondary targets include 50+ X-ray selected stars. Tertiary target is the stellar population of IC 10 itself.
Category=Star
Description=[Circumstellar matter, Wolf-Rayet stars, X-ray binary stars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module A (A3 corner)

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	FULLBOX	5TIGHT	STANDARD		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	F150W	F277W	BRIGHT2	2	3	15	5	751.574	196772

Special Requirements

Phase 0.5 to 0.6 with period 1.45175 Days and zero-phase 2454041.37365 HJD
Offset 10.0 arcsec, -30.0 arcsec
Fiducial Point Override NRCAS_FULL

Observation

Proposal 6662, Observation 7: Phase 0.6

Wed Nov 13 22:00:22 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Visit 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CXOU-J002029.1+591651	RA: 00 20 29.0900 (5.1212083d)	Proper Motion RA: 0	
		Dec: +59 16 51.90 (59.28108d)	Proper Motion Dec: 0	
		Equinox: J2000	Parallax: 0"	
			Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The primary target is the extragalactic X-ray binary IC10 X-1. Consequently the is no measureable proper motion or parallax.
Secondary targets include 50+ X-ray selected stars. Tertiary target is the stellar population of IC 10 itself.
Category=Star
Description=[Circumstellar matter, Wolf-Rayet stars, X-ray binary stars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module A (A3 corner)

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	FULLBOX	5TIGHT	STANDARD		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	F150W	F277W	BRIGHT2	2	3	15	5	751.574	196772

Special Requirements

Phase 0.6 to 0.7 with period 1.45175 Days and zero-phase 2454041.37365 HJD
Offset 10.0 arcsec, -30.0 arcsec
Fiducial Point Override NRCAS_FULL

Observation

Proposal 6662, Observation 8: Phase 0.7

Wed Nov 13 22:00:22 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Visit 8:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CXOU-J002029.1+591651	RA: 00 20 29.0900 (5.1212083d)	Proper Motion RA: 0	
		Dec: +59 16 51.90 (59.28108d)	Proper Motion Dec: 0	
		Equinox: J2000	Parallax: 0"	
			Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The primary target is the extragalactic X-ray binary IC10 X-1. Consequently the is no measureable proper motion or parallax.
Secondary targets include 50+ X-ray selected stars. Tertiary target is the stellar population of IC 10 itself.
Category=Star
Description=[Circumstellar matter, Wolf-Rayet stars, X-ray binary stars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module A (A3 corner)

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	FULLBOX	5TIGHT	STANDARD		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	F150W	F277W	BRIGHT2	2	3	15	5	751.574	196772

Special Requirements

Phase 0.7 to 0.8 with period 1.45175 Days and zero-phase 2454041.37365 HJD
Offset 10.0 arcsec, -30.0 arcsec
Fiducial Point Override NRCAS_FULL

Observation

Proposal 6662, Observation 9: Phase 0.8

Wed Nov 13 22:00:22 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Visit 9:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CXOU-J002029.1+591651	RA: 00 20 29.0900 (5.1212083d)	Proper Motion RA: 0	
		Dec: +59 16 51.90 (59.28108d)	Proper Motion Dec: 0	
		Equinox: J2000	Parallax: 0"	
			Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The primary target is the extragalactic X-ray binary IC10 X-1. Consequently the is no measureable proper motion or parallax.
Secondary targets include 50+ X-ray selected stars. Tertiary target is the stellar population of IC 10 itself.
Category=Star
Description=[Circumstellar matter, Wolf-Rayet stars, X-ray binary stars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module A (A3 corner)

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	FULLBOX	5TIGHT	STANDARD		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	F150W	F277W	BRIGHT2	2	3	15	5	751.574	196772

Special Requirements

Phase 0.8 to 0.9 with period 1.45175 Days and zero-phase 2454041.37365 HJD
Offset 10.0 arcsec, -30.0 arcsec
Fiducial Point Override NRCAS_FULL

Observation

Proposal 6662, Observation 10: Phase 0.9

Wed Nov 13 22:00:22 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Visit 10:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	CXOU-J002029.1+591651	RA: 00 20 29.0900 (5.1212083d)	Proper Motion RA: 0	
		Dec: +59 16 51.90 (59.28108d)	Proper Motion Dec: 0	
		Equinox: J2000	Parallax: 0"	
			Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. The primary target is the extragalactic X-ray binary IC10 X-1. Consequently the is no measureable proper motion or parallax.
Secondary targets include 50+ X-ray selected stars. Tertiary target is the stellar population of IC 10 itself.
Category=Star
Description=[Circumstellar matter, Wolf-Rayet stars, X-ray binary stars]
Extended=NO

Template

Module	Subarray	Target Placement
ALL	FULL	Module A (A3 corner)

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	FULLBOX	5TIGHT	STANDARD		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	F150W	F277W	BRIGHT2	2	3	15	5	751.574	196772

Special Requirements

Phase 0.9 to 1.0 with period 1.45175 Days and zero-phase 2454041.37365 HJD
Offset 10.0 arcsec, -30.0 arcsec
Fiducial Point Override NRCAS_FULL