



10476 - Confirming a Black Hole Candidate through Gravitational Microlensing

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				
	1	2026_fall	NIRCam Imaging	(1) OB240062
	2	2027_spring	NIRCam Imaging	(1) OB240062

ABSTRACT

The population of Milky Way black holes, and the stellar deaths that form them, are not well understood. All known galactic black holes besides one have been detected via binary interactions or companions. The majority of high-mass stars are expected to be born in multiple star systems, but most black holes are expected to be isolated as a result of natal kicks, mass loss, or stellar mergers. The only known isolated black hole, OGLE-2011-BLG-0462 was discovered via gravitational microlensing. By combining long-term photometric monitoring and precise astrometry, the lens' mass was measured and confirmed as a black hole. A new microlensing event reached its peak magnification in summer 2024, called OGLE-2024-BLG-0062. It is a long duration event ($t_E \sim 200$ days) with low microlensing parallax ($\pi_E < 0.08$), which mark a high-probability black hole microlensing candidate. Astrometric follow-up of this event began with DD Program 6777 to measure the astrometric signal as it rose following the photometric peak. We propose continued monitoring of this event over the next 3 cycles to follow the astrometric curve back to the source's baseline proper

motion and complete the measurements required to weigh the lens. If OGLE-2024-BLG-0062 is confirmed to be a black hole, it will double the sample size of known isolated black holes, greatly improving our understanding of the Milky Way's black hole population, in terms of total number, mass distribution, and natal kicks.

OBSERVING DESCRIPTION

We propose to obtain NIRCcam imaging of a microlensing event (OB240062) identified from ground-based OGLE data that is a good candidate to be a black hole lens. It was imaged with JWST NIRCcam twice during the year following its photometric peak. A microlensing event occurs when a foreground lens passes in front of a background source star. The target is located towards the crowded Galactic Bulge region.

The JWST observations will provide precision astrometric measurements needed to measure an astrometric microlensing signal over time and thus measure the mass of the lens object. JWST photometry in multiple epochs is also needed to determine the brightness of the source star and the lens object. Taken together, the few-epoch astrometric and photometric signals from JWST will be combined with the OGLE light-curve to confirm whether the lens is a black hole.

The NIRCcam imaging includes 2 filters (F210M, F090W) in the first new measurement, which needs to be taken in the 2026 Fall observing window to cover the astrometric shift curve as it evolves over time and to constrain parallax. Multi-filter coverage during and after the photometric event will help disentangle the source from any light from a luminous neighbor or lens. The next new NIRCcam imaging epoch of just F210M will be taken in 2027 Spring. Additional F210M should also be repeated in the Fall and Spring throughout Cycles 6 and 7 to follow the astrometric trajectory as it declines and returns to baseline proper motion. These epochs may be rotated with respect to each other; however, the target should always be centered in the B4 corner of the B-module to minimize distortions for the target and the 100s of stars surrounding it within 30" radius that are used as astrometric standards to establish a precise astrometric reference frame.

NIRCcam configurations and filters were chosen to maximize SNR while not saturating the target or nearby neighbor stars. $\text{SNR} > 1000$ is needed to achieve astrometric precisions of ~ 0.1 mas per epoch. $\text{SNR} > 300$ is needed for photometric measurements. The filters were also chosen to yield color-magnitude diagrams that can be used to determine the luminosity distance of the source star.

Proposal 10476 - Targets - Confirming a Black Hole Candidate through Gravitational Microlensing

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1) <i>Comments:</i> Category=Star Description=[Black holes, Multiple stars] Extended=NO		OB240062	RA: 17 49 11.1151 (267.2963129d) Dec: -21 10 19.95 (-21.17221d) Equinox: J2000	Epoch of Position: 2000

Proposal 10476 - Observation 1 - Confirming a Black Hole Candidate through Gravitational Microlensing

Tue May 19 20:00:16 GMT 2026

Observation	<p>Proposal 10476, Observation 1: 2026_fall</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRCcam 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)	OB240062	RA: 17 49 11.1151 (267.2963129d) Dec: -21 10 19.95 (-21.17221d) Equinox: J2000			Epoch of Position: 2000				
	<p><i>Comments:</i> <i>Category=Star</i> <i>Description=[Black holes, Multiple stars]</i> <i>Extended=NO</i></p>									
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	INTRAMODULEBOX		4		STANDARD				3
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	Optional ETC ID
	1	F210M	F460M	BRIGHT2	5	1	12	12	1288.412	
	2	F090W	F335M	BRIGHT2	2	1	12	12	515.365	
Special Requirements	<p>Between Dates 05-AUG-2026:00:00:00 and 25-SEP-2026:00:00:00 Aperture PA Range 89.55262691 to 91.55262691 Degrees (V3 89.5 to 91.5) Offset -32.0 arcsec, 37.0 arcsec Fiducial Point Override NRCBS_FULL</p>									

Proposal 10476 - Observation 2 - Confirming a Black Hole Candidate through Gravitational Microlensing

Tue May 19 20:00:16 GMT 2026

Observation	<p>Proposal 10476, Observation 2: 2027_spring</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRCcam Imaging</p>									
Diagnostics	<p>(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p> <p>(Visit 2:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.</p>									
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections		Miscellaneous		
	(1)	OB240062	RA: 17 49 11.1151 (267.2963129d) Dec: -21 10 19.95 (-21.17221d) Equinox: J2000			Epoch of Position: 2000				
	<p><i>Comments:</i> Category=Star Description=[Black holes, Multiple stars] Extended=NO</p>									
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	INTRAMODULEBOX		4	STANDARD			3		
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	Optional ETC ID
	1	F210M	F460M	BRIGHT2	5	1	12	12	1288.412	
Special Requirements	<p>Between Dates 13-MAR-2027:00:00:00 and 02-MAY-2027:00:00:00</p> <p>Aperture PA Range 269.55262691 to 271.55262691 Degrees (V3 269.5 to 271.5)</p> <p>Offset -32.0 arcsec, 37.0 arcsec</p> <p>Fiducial Point Override NRCBS_FULL</p>									