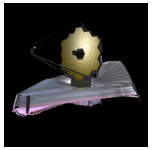

2692 - Accurate Mass Determination of the Nearby Single White Dwarf L845-70 through Astrometric Microlensing

Cycle: 1, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	EPOCH-1	NIRCam Imaging	(1) LAWD-66-SOURCE
	2	EPOCH-2	NIRCam Imaging	(1) LAWD-66-SOURCE

ABSTRACT

Precise masses of white dwarfs (WDs) are needed to understand the astrophysics of this final stage of evolution for the majority of stars. However, there are surprisingly few direct mass measurements for WDs, almost all of them in binaries. A nearby single WD, L 845-70, will pass in front of a background star in 2024, with an impact parameter of only 185 mas. As it passes by, the WD will relativistically deflect the background star's position, providing a rare opportunity to directly measure the WD's mass. The deflection depends only on the known distances and positions of the stars, and on the mass of the WD. Thus astrometry offers a direct method to measure the mass of the WD to high accuracy (~2.5%).

High-precision astrometric microlensing was recently used with HST to measure the mass of the WD Stein 2051B--the first application of this technique outside the solar system. We propose JWST/NIRCam imaging to measure the mass of L 845-70. JWST has a considerably higher figure of merit (about a factor of 4) for this project compared to HST because (1) JWST offers a higher spatial resolution, and (2) the brightness contrast between the lens and the source in the near-IR is much more favorable than in the optical. This makes it possible to image the source, lens, and reference stars in the same exposures, rather than compromising the precision due to the short/long sequence needed with HST. Relativistic astrometric microlensing is the only available model-independent method for determining the mass of a single WD. Our measurement will add to the small number of accurate direct mass determinations for WDs--and will be only the second such measurement for an isolated WD.

OBSERVING DESCRIPTION

Our aim is to obtain good S/N images of the faint source, the adjacent bright WD lens, and a number of reference stars at each epoch. The field surrounding L845-70 is fairly rich, as shown in Figure 2 of Scientific Justification. Our proposal requires the highest astrometric accuracy, which can be achieved in the NIRCam short-wavelength (SW) channel, which has the maximum spatial resolution. We also want to ensure uniform and maximum exposure times for all the reference stars. These considerations dictate that we use the 2048x2048 quadrant of the SW channel as the principal mode.

Accordingly, we plan to place our target at the center of a 2048x2048 quadrant, and use dithers so that the PSF is sampled well, but at the same time the lens, the source, and the reference stars have the same total exposure times.

With the field size described above, the 14th-mag lens would saturate even in the shortest exposure time of 10.6~sec, if we used any of the SW wide-band filters. We will use the narrow-band F164N filter to avoid this saturation problem. These images will provide good S/N for both the lens and the source, and also expected to give good S/N observations of a large number of reference stars. We plan to use BRIGHT2 readout mode, where the WD will saturate after 6 groups. We will confine our observations to 5 groups per exposure, in which the WD will have a S/N of 910 per exposure, the source will have a S/N of 330, and the reference stars will have S/N of a few hundred each.

We will simultaneously observe in the long-wavelength (LW) channel with the F323N filter, using the same dither strategy. These observations will also be used to measure the deflection, which will further improve the astrometric accuracy.

Proposal 2692 - Targets - Accurate Mass Determination of the Nearby Single White Dwarf L845-70 through Astrometric Microlensing

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	LAWD-66-SOURCE	RA: 17 11 27.2211 (257.8634213d) Dec: -14 48 0.59 (-14.80016d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[K dwarfs]
Extended=NO

Observation

Proposal 2692, Observation 1: EPOCH-1

Wed Mar 31 05:06:11 GMT 2021

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

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)	LAWD-66-SOURCE	RA: 17 11 27.2211 (257.8634213d) Dec: -14 48 0.59 (-14.80016d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[K dwarfs]
Extended=NO

Template

Module	Subarray
B	FULL

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	NONE		STANDARD		4

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F164N+F150W2	F323N+F322W2	BRIGHT2	5	3	12	4	1374.307	

Special Requirements

Between Dates 26-JUL-2022:00:00:00 and 05-AUG-2022:00:00:00
Offset -29.0 arcsec, -29.0 arcsec

Observation

Proposal 2692, Observation 2: EPOCH-2

Wed Mar 31 05:06:11 GMT 2021

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)	LAWD-66-SOURCE	RA: 17 11 27.2211 (257.8634213d) Dec: -14 48 0.59 (-14.80016d) Equinox: J2000	Epoch of Position: 2000	

Comments:
Category=Star
Description=[K dwarfs]
Extended=NO

Template

Module	Subarray
B	FULL

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	NONE		STANDARD		4

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F164N+F150W2	F323N+F322W2	BRIGHT2	5	3	12	4	1374.307	

Special Requirements

Between Dates 26-JUL-2023:00:00:00 and 05-AUG-2023:00:00:00
Offset -29.0 arcsec, -29.0 arcsec