



16251 - Accurate Mass Determination of the Nearby Single White Dwarf L145-141 (LAWD 37) through Astrometric Microlensing

Cycle: 28, Proposal Category: GO

(Availability Mode: AVAILABLE)

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VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
53	(2) LAWD-37-OFFSET	WFC3/UVIS	1	07-Aug-2020 08:00:26.0	yes

1 Total Orbits Used

ABSTRACT

White dwarf (WD) is the final stage for a vast majority of stars, and WDs are important in a variety of astrophysical and galactic contexts. However, there are surprisingly few WDs with direct mass measurements, all of them in binaries.

It has been reported recently that the fifth-nearest WD, L145-141 (LAWD 37), will pass closely in front of a background star in late 2019, with an impact parameter of only 380 milliarcsec. As it passes in front, the WD will relativistically deflect the light from the background star, providing a unique opportunity for direct measurement of the WD's mass. The gravitational deflection angle depends only on the distances and relative positions of the stars, and on the mass of the WD. Since the distances and positions can be determined precisely before the event, the astrometric measurement offers a direct method to measure the mass of the WD to high accuracy (~2.5%).

Precision HST astrometry was recently used to measure the astrometric deflection caused by the nearby white dwarf Stein 2051B, and thus measure its mass--the first application of this technique outside the solar system. We now propose to repeat this experiment for a second WD. Relativistic astrometric microlensing is the only available model-independent technique for determining the mass of a single WD. Our target is of special interest because it is the second-nearest single WD (after van Maanen's Star).

Our measurement will be the first model-independent mass measurement of a single WD, and will add to the surprisingly small number of accurate model-independent mass determinations for WDs--a key element in testing the theoretical mass-radius relation.

OBSERVING DESCRIPTION

We have tweaked the observing strategy that was used in program GO-14448 to determine the mass of Stein 2051B, in order to improve the accuracy even further. At each epoch, we will obtain images in WFC3/UVIS F814W (I-band). The contrast between source and lens is best in this filter, and its PSF is well characterized. We will use a 2kx2k subarray to ensure that there are enough reference stars within the field, yet interruptions for buffer

dumps will be unnecessary. At one epoch we will also obtain a few frames in F555W (V -band) in order to estimate the spectral types of the source and reference stars, and thus refine their distance estimates.

Since the astrometric deflection measurements are differential, it is important to measure them at several epochs, including close to the baseline and the peak. In addition, there must be enough epochs to independently solve for the proper motions and parallaxes of the reference stars and source.

These considerations dictate our proposal to observe at 8 epochs beginning in April 2019.

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Fri Aug 07 12:00:27 GMT 2020

Visit	Proposal 16251, Visit 53, implementation Diagnostic Status: Warning Scientific Instruments: WFC3/UVIS Special Requirements: ORIENT 181.99D TO 182.01 D; BETWEEN 16-SEP-2020 AND 19-SEP-2020												
	Diagnosics (Exposure 1 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 2 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 3 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 4 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 5 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 6 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 7 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 8 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 9 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 10 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 11 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 12 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 13 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 14 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 15 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 16 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 17 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 18 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 19 (Sequence 1-19 Non-Int in Visit 53)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser												
Fixed Targets	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Fluxes</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(2)</td> <td>LAWD-37-OFFSET</td> <td>RA: 11 45 50.9500 (176.4622917d) Dec: -64 50 41.50 (-64.84486d) Equinox: J2000</td> <td></td> <td>V=19</td> <td>Reference Frame: ICRS</td> </tr> </tbody> </table>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(2)	LAWD-37-OFFSET	RA: 11 45 50.9500 (176.4622917d) Dec: -64 50 41.50 (-64.84486d) Equinox: J2000		V=19	Reference Frame: ICRS
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Comments: Category=EXT-STAR Description=[DC] Extended=NO													

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Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=20; BLADE=A	POS TARG 0,0; GS ACQ SCENARI O BASE1B3	Sequence 1-19 Non-I nt in Visit 53	1.5 Secs (1.5 Secs)	[==>]	[1]
	2	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=18	SAME POS AS 1	Sequence 1-19 Non-I nt in Visit 53	85 Secs (85 Secs)	[==>]	[1]
	3	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=18	POS TARG 3.56,0	Sequence 1-19 Non-I nt in Visit 53	85 Secs (85 Secs)	[==>]	[1]
	4	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=18	POS TARG 3.08,1.7 8	Sequence 1-19 Non-I nt in Visit 53	85 Secs (85 Secs)	[==>]	[1]
	5	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=20	POS TARG 1.77,3.0 8	Sequence 1-19 Non-I nt in Visit 53	1.5 Secs (1.5 Secs)	[==>]	[1]
	6	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=18	SAME POS AS 5	Sequence 1-19 Non-I nt in Visit 53	85 Secs (85 Secs)	[==>]	[1]
	7	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=18	POS TARG -0.01,3. 55	Sequence 1-19 Non-I nt in Visit 53	85 Secs (85 Secs)	[==>]	[1]
	8	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=18	POS TARG -1.79,3. 07	Sequence 1-19 Non-I nt in Visit 53	85 Secs (85 Secs)	[==>]	[1]
	9	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=20	POS TARG -3.09,1. 77	Sequence 1-19 Non-I nt in Visit 53	1.5 Secs (1.5 Secs)	[==>]	[1]
	10	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=18	SAME POS AS 9	Sequence 1-19 Non-I nt in Visit 53	85 Secs (85 Secs)	[==>]	[1]
	11	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=18	POS TARG -3.55,-0. 02	Sequence 1-19 Non-I nt in Visit 53	85 Secs (85 Secs)	[==>]	[1]
	12	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=18	POS TARG -3.07,-1. 79	Sequence 1-19 Non-I nt in Visit 53	85 Secs (85 Secs)	[==>]	[1]
	13	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=20	POS TARG -1.76,-3. 09	Sequence 1-19 Non-I nt in Visit 53	1.5 Secs (1.5 Secs)	[==>]	[1]
	14	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=18	SAME POS AS 13	Sequence 1-19 Non-I nt in Visit 53	85 Secs (85 Secs)	[==>]	[1]
	15	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=18	POS TARG 0.02,-3. 55	Sequence 1-19 Non-I nt in Visit 53	85 Secs (85 Secs)	[==>]	[1]
	16	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=18	POS TARG 1.8,-3.0 7	Sequence 1-19 Non-I nt in Visit 53	85 Secs (85 Secs)	[==>]	[1]
	17	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=20	POS TARG 3.09,-1. 75	Sequence 1-19 Non-I nt in Visit 53	1.5 Secs (1.5 Secs)	[==>]	[1]
	18	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=18	SAME POS AS 17	Sequence 1-19 Non-I nt in Visit 53	85 Secs (85 Secs)	[==>]	[1]
	19	(2) LAWD-37-OFFS ET	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W	FLASH=18	POS TARG 0,0	Sequence 1-19 Non-I nt in Visit 53	85 Secs (85 Secs)	[==>]	[1]

