



18241 - Unveiling the dark matter structure of the least massive strong lensing galaxy ever found

Cycle: 33, Proposal Category: GO
(Availability Mode: SUPPORTED)

INVESTIGATORS

| <i>Name</i> | <i>Institution</i> |
|---|--|
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| Prof. Sherry H. Suyu (CoI) (ESA Member) | Technical University of Munich |
| Prof. Guoliang Li (CoI) | Purple Mountain Observatory, CAS |

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> |
|--------------|------------------------------|-------------------------------------|--------------------|-------------------------------|-------------------------------|
| 01 | (1) J0040+2555 | WFC3/UVIS | 1 | 30-Apr-2026 11:00:13.0 | yes |

1 Total Orbits Used

ABSTRACT

The nature of dark matter (DM) represents one of the most fundamental open questions in astrophysics. Although the cold dark matter (CDM) paradigm remains the prevailing framework, a number of alternative DM models have recently attracted increasing attention. Examining the spatial distribution of DM provides a promising means of constraining its nature, as different models predict distinct structural signatures. We serendipitously identified a remarkable system in which a $10^{8.5}$ solar mass dwarf galaxy, J0040-SL, acts as a strong lens. As the least massive

strong lensing galaxy known, J0040-SL provides a unique laboratory to place the most stringent constraints on the DM profile at these scales. To fully exploit its uniqueness, we request coordinated JWST and HST imaging observations to precisely determine the stellar content of J0040-SL, a critical input required to robustly disentangle DM from stars. These observations will enable a direct test of DM models in the dwarf galaxy regime.

OBSERVING DESCRIPTION

This is a part of our approved JWST+HST program on dissecting the least massive strong lensing galaxy ever found, J0040-SL. The multi-band imaging observations from JWST and HST will provide high-quality photometry covering from rest-frame ultraviolet (UV) to near-infrared (NIR), essential for determining the stellar mass of J0040-SL to a precision comparable to that on the total mass. For the HST, we propose the following observations:

One orbit in the WFC3/UVIS F390W filter. Given the lens redshift of 0.143, this will provide high-resolution imaging data for extracting rest-frame UV photometry for J0040-SL.

Based on our modeling results, an on-target exposure time of 2100s is needed to achieve the required signal-to-noise ratio. We will split the observations to four sub-exposures of equal time (525s) and use the 4-step dithering pattern (i.e. WFC3-UVIS-DITHER-BOX) to improve the sampling of the PSF and perform cosmic-ray/bad-pixel removal.

Proposal 18241 - Visit 01 - Unveiling the dark matter structure of the least massive strong lensing galaxy ever found

Thu Apr 30 15:00:13 GMT 2026

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|--|---|--------------------------------|--|---|-------------------------------|---|----------------------|--|--|---------------------|
| Visit | Proposal 18241, Visit 01 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: ORIENT 185D TO 255 D; ORIENT 5D TO 75 D | | | | | | | | | |
| | Patterns | # (1) | Primary Pattern Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112 | Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false | Secondary Pattern | Exposures (1) | | | | |
| Fixed Targets | # (1) | Name J0040+2555 | Target Coordinates RA: 00 40 18.2600 (10.0760833d) Dec: +25 55 35.88 (25.92663d) Equinox: J2000 | Targ. Coord. Corrections Redshift: 0.143 | Fluxes V=23.0+/-0.1 | Miscellaneous Reference Frame: ICRS | | | | |
| Comments: Category=GALAXY Description=[DWARF COMPACT, EINSTEIN RING, GRAVITATIONAL LENS] Extended=YES | | | | | | | | | | |
| Exposures | # 1 | Label (1) J0040+2555 | Target (1) J0040+2555 | Config,Mode,Aperture WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE | Spectral Els. F390W | Opt. Params. FLASH=16 | Special Reqs. | Groups Pattern 1, Exps 1-1 in Visit 01 (1) | Exp. Time (Total)/[Actual Dur.] 525 Secs (2100 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)] | Orbit [1] |

