



12775 - Time-Critical Spectroscopy of the Brightest Microlensed Star Known Beyond Redshift One

Cycle: 4, Proposal Category: DD

INVESTIGATORS

<i>Name</i>	<i>Institution</i>
Dr. Fengwu Sun (PI)	Harvard University
Hollis Akins (CoI)	Princeton University
Dr. Joseph Frederick Victor Allingham (CoI)	Ben-Gurion University of the Negev
Dr. Yoshihisa Asada (CoI) (CSA Member)	University of Toronto
Prof. Marusa Bradac (CoI)	University of Ljubljana, Dept. of Physics
Dr. Gabriel Brammer (CoI) (ESA Member)	University of Copenhagen, Niels Bohr Institute
Prof. John Chisholm (CoI)	University of Texas at Austin
Dr. Dan Coe (CoI) (ESA Member)	Space Telescope Science Institute - ESA - JWST
Prof. Liang Dai (CoI)	Fudan University
Dr. Miroslava Dessauges-Zavadsky (CoI) (ESA Member)	University of Geneva, Department of Astronomy
Dr. Jose M. Diego (CoI) (ESA Member)	Instituto de Fisica de Cantabria
Dr. Daniel J. Eisenstein (CoI) (US Admin CoI)	Harvard University
Dr. Andreas L Faisst (CoI)	California Institute of Technology
Dr. Henry C. Ferguson (CoI)	Space Telescope Science Institute
Prof. Steven L. Finkelstein (CoI)	University of Texas at Austin
Dr. Seiji Fujimoto (CoI) (CSA Member)	University of Toronto
Dr. Lukas Jonathan Furtak (CoI)	University of Texas at Austin
Dr. Kohei Inayoshi (CoI)	Peking University
Mr. Tomokazu Kiyota (CoI)	National Astronomical Observatory of Japan (NAOJ)
Dr. Anton M. Koekemoer (CoI)	Space Telescope Science Institute
Dr. Vasily Kokorev (CoI)	University of Texas at Austin

JWST Proposal 12775 (Created: Monday, June 22, 2026, 7:00:13PM Eastern Standard Time) - Overview

<i>Name</i>	<i>Institution</i>
Dr. Vladan Markov (CoI)	University of Ljubljana, Dept. of Physics
Mr. Minami Nakane (CoI)	University of Tokyo, Institute of Cosmic Ray Research
Dr. Rohan Naidu (CoI)	University of Hawaii
Prof. Masamune Oguri (CoI)	Chiba University
Prof. Masami Ouchi (CoI)	National Astronomical Observatory of Japan (NAOJ)
Mr. Jose Maria Palencia (CoI) (ESA Member)	Instituto de Fisica de Cantabria
Richard Pan (CoI)	Tufts University
Dr. Massimo Pascale (CoI)	University of California - Los Angeles
Dr. Justin Pierel (CoI)	Space Telescope Science Institute
Dr. Johan Pierre Richard (CoI) (ESA Member)	Centre de Recherche Astrophysique de Lyon
Mr. Luke Robbins (CoI)	Tufts University
Kana Takechi (CoI)	
Dr. Francesco Maria Valentino (CoI) (ESA Member)	Technical University of Denmark-DTU Space
Dr. Brian Welch (CoI) (ESA Member)	International Space Science Institute (ISSI)
Dr. Chris J. Willott (CoI) (CSA Member)	NRC Herzberg Institute of Astrophysics
Mr. Hiroto Yanagisawa (CoI)	University of Tokyo, Institute of Cosmic Ray Research
Prof. Erik Zackrisson (CoI) (ESA Member)	Uppsala Astronomical Observatory
Prof. Adi Zitrin (CoI)	Ben-Gurion University of the Negev
Dr. Ruwen Zhou (CoI)	Westlake University

OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Observation Folder				
	1	Snake-LS1-prism	NIRSpec Fixed Slit Spectroscopy	(1) Snake-LS1

ABSTRACT

On 2026 June 14, the JWST Treasury program VENUS (GO-6882) discovered Snake-LS1 behind the massive galaxy cluster MACS J1206.2-0847. Snake-LS1 is an exceptionally bright microlensed star in the iconic "Cosmic Snake" arc at $z=1.036$. At $F322W2=25.7$ AB and magnified more than 1000-fold, it is the brightest microlensed star known at cosmological distance, at least a magnitude brighter than the >100 events identified in the Abell 370 Dragon Arc. Snake-LS1 is characterized by a rising, very red SED that marks it as a red supergiant star ($T\sim 3000-4000$ K). For the first time since 2016, when MACS J1149 Lensed Star 1 (Icarus) was discovered, a microlensed star at $z>1$ is bright enough for spectroscopy.

We request a time-critical, disruptive Target-of-Opportunity DDT: a 1-hour NIRSpec fixed-slit prism spectrum, taken while the magnification is near its peak. It will (1) confirm the source's nature via the TiO, CN, H₂O, and CO molecular bands, the unambiguous fingerprint of a cool stellar photosphere; (2) break the temperature-dust degeneracy that defeats broadband photometry and provide the first test of a $z \sim 1$ red supergiant against local stellar templates; and (3) deliver the first metallicity of an individual star at cosmological distance. The opportunity is closing fast: the visibility window will close on 2026 July 1, and the microlensing transient will completely fade within a few months. No other facility or epoch can provide this spectrum, and such an opportunity should not be missed.

OBSERVING DESCRIPTION

This is a time-critical observation. The spectrum must be obtained while the star remains microlensing-magnified, and before the current observing window for MACSJ1206-0847 closes on 2026 July 1. We therefore request a Disruptive Target-of-Opportunity (ToO) observation, and would greatly appreciate an expedited review of this program.

We request a one-hour on-source NIRSpec fixed-slit prism spectrum (PRISM/CLEAR, S200A1) of Snake-LS1, a microlensed red-supergiant candidate at $z = 1.036$ in the "Cosmic Snake" lensed arc behind the cluster MACSJ1206-0847 ($m \sim 25.7$ AB at 2-4.5 μm).

Because the science target is superimposed on the bright lensed arc, it is not a suitable direct-acquisition target. Target acquisition therefore uses WATA on an isolated offset reference star 16.4" away (12:06:10.4444 -08:47:45.867; NRS_CLEAR ~ 22.9 and selected through NIRCам pre-imaging), acquired through the CLEAR filter with the NRSRAPIDD6 readout (SUB2048 frame, 3 groups), followed by a small slew that places Snake-LS1 in the S200A1 slit. The science exposure uses PRISM/CLEAR with the NRSIRS2 readout (17 groups) and a 3-point nod dither, for ~ 1 hr on source. At the measured brightness, we estimate a continuum signal-to-noise ratio of $S/N \sim 10$ per pixel across 2-4.5 μm .

Proposal 12775 - Targets - Time-Critical Spectroscopy of the Brightest Microlensed Star Known Beyond Redshift One

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	Snake-LS1	RA: 12 06 10.7498 (181.5447908d) Dec: -08 48 1.59 (-8.80044d) Equinox: J2000	Proper Motion RA: 0 Proper Motion Dec: 0	
Comments: Category=Star Description=[Red supergiants]					
Fixed Targets	(2)	WATA-Snake-LS1	RA: 12 06 10.4444 (181.5435183d) Dec: -08 47 45.87 (-8.79607d) Equinox: J2000		
	Comments: From NIRCam pre-imaging. AB mag: F090W 23.4, F150W 22.7, F200W 22.9; NRS_F110W ~ 23.1, NRS_F140X ~ NRS_CLEAR ~ 22.9. Category=Calibration Description=[Target acquisition test] Extended=NO				

Proposal 12775 - Observation 1 - Time-Critical Spectroscopy of the Brightest Microlensed Star Known Beyond Redshift One

Observation	Proposal 12775, Observation 1: Snake-LS1-prism										Tue Jun 23 00:00:13 GMT 2026	
	Diagnostic Status: Warning											
	Observing Template: NIRSpec Fixed Slit Spectroscopy											
Diagnostics	(Snake-LS1-prism (Obs 1)) Warning (Form): Response time < 14.0 Days is disruptive to the scheduling process. Only a limited number of disruptive ToOs will be accepted.											
	(Snake-LS1-prism (Obs 1)) Warning (Form): Response time < 14.0 Days is disruptive to the scheduling process. Only a limited number of disruptive ToOs will be accepted.											
	(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)	Snake-LS1	RA: 12 06 10.7498 (181.5447908d)				Proper Motion RA: 0					
			Dec: -08 48 1.59 (-8.80044d)				Proper Motion Dec: 0					
			Equinox: J2000									
	Comments: Category=Star Description=[Red supergiants]											
Acquisition	#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID	
	1	2 WATA-Snake-LS1	WATA	SUB2048	CLEAR	NRSRAPIDD6	3	1	1	14.452	309099	
Template	HFF Readout Mode				Slit				Subarray			
	false				S200A1				FULL			
Dithers	#	Primary Dither Positions							Sub-Pixel Pattern			
	1	3							NONE			
Spectral Elements	#	Grating/Filter	Slit	Readout Pattern	Groups/Int	Integrations/Exp	#	Autocal	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
	1	PRISM/CLEAR	S200A1	NRSIRS2	17	1	1	NONE	3	3	3763.934	

Proposal 12775 - Observation 1 - Time-Critical Spectroscopy of the Brightest Microlensed Star Known Beyond Redshift One

Special Requirements	Before Date 02-JUL-2026:00:00:00 Target Of Opportunity Response Time 3 Days to 4 Days
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