



7390 - Probing Pair-Instability Supernovae through the Triply-lensed MACS0647-JD at $z=10.17$

Cycle: 4, Proposal Category: GO

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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Observation Folder				
	1	C1_JD_compA, C1_all _clumps, C1_JD1_2_o nly	NIRSpec MultiObject Spectroscopy	(1) MACS0647_cat_replan_260215

ABSTRACT

Stars with initial masses of 140-300 Msun are predicted to undergo the pair instability stage and explode as supernove (PISNe). PISNe will significantly enrich the interstellar medium (ISM) with iron and prevent the formation of black hole seeds. As a cornerstone of stellar evolution theory, PISNe have been the focus for decades of searches in local Universe. Yet, no PISN has been conclusively identified at high redshift. JWST is creating unprecedented opportunities by pushing the redshift frontier to $z > 10$. Only ~ 400 Myr after the Big Bang, these infant galaxies, with star formation < 40 Myr, provide the best laboratories for hunting PISNe. The first hints of PISNe have been tested in GNz11; however, the AGN nature of GNz11 makes it hard to draw any definitive conclusions. Among spectroscopically confirmed galaxies at $z > 10$, MACS0647-JD at $z = 10.2$, the brightest one without any AGN signature, is the ideal target for a pilot search.

In this proposal, we aim to directly detect iron from PISNe through the FeIII absorption (the 1978-index) in the triply-lensed galaxy MACS0647-JD. Using NIRSpec/MOS mode, we can observe all three images of this galaxy simultaneously to reach the continuum signal-to-noise ratio of ~ 8 . With the archival MIRI data, MACS0647-JD has the first direct-measured Oxygen abundance at $z > 10$. The derived [O/Fe] can examine the existence of PISNe after comparing it with that from theoretical models. Additionally, the lensing effect enables us to probe intervening cold gas at $z > 8$ for the first time along the sightline. Further, thanks to the multiplexing capabilities of MSA, we will have sufficient fillers for investing in their stellar and ISM properties.

OBSERVING DESCRIPTION

We proposed the deep exposures with NIRSpec MSA in the MACS0647 cluster field, and our primary targets are three images of the triply-lensed galaxy JD. We only have one single pointing to target the three images of JD TOGETHER.

We note that, to include three images together and cover the existing NIRCcam footprint, these proposed PA will be 232 degrees.

We include a target list for three images of JD primarily. We also have a filler catalog (having accurate phot-z) from archival HST and JWST/NIRCcam observations (GO 1433, Coe, private communication).

Proposal 7390 - Targets - Probing Pair-Instability Supernovae through the Triply-lensed MACS0647-JD at z=10.17

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	MACS0647_cat_replan_26021 5	RA: 06 47 50.2000 (101.9591667d) Dec: +70 14 50.02 (70.24723d) Equinox: J2000		
	<i>Comments:</i> Description=[]				

Proposal 7390 - Observation 1 - Probing Pair-Instability Supernovae through the Triply-lensed MACS0647-JD at z=10.17

Mon Feb 16 22:00:26 GMT 2026

Observation	Proposal 7390, Observation 1: C1_JD_compA, C1_all_clumps, C1_JD1_2_only Diagnostic Status: Warning Observing Template: NIRSpec MultiObject Spectroscopy										
	(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)	MACS0647_cat_replan_26021 5	RA: 06 47 50.2000 (101.9591667d) Dec: +70 14 50.02 (70.24723d) Equinox: J2000								
<i>Comments: Description=[]</i>											
Acquisition	#	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
	1	Filter: CLEAR; Readout: NRSRAPIDD6; 8 sources in 3 quads; [Optimal TA Accuracy]	SAME	CLEAR	Auto Acq MSA Config	NRSRAPIDD6	3	1	4	687.153	
Template	TA Method	HFF Readout Mode	Obtain Confirmation Images	Science Aperture	Primary Candidate List	Filler Candidate List	Spectral Overlap Map	Spectral Overlap Threshold			
	MSATA	false	No	MSA Center	MUST_DO (21 sources)	filler (1029 sources)	jwst-nirspec-g235m	1.5			
Reference Stars	Visit	ID	RA	Dec	Magnitude	Visit	ID	RA	Dec	Magnitude	
	1	50	101.965010	70.190473	23.845	1	1172	101.927062	70.219784	24.646	
	1	213	101.963727	70.211952	23.302	1	1273	101.982658	70.200843	24.812	
	1	866	101.958009	70.247802	24.01	1	1647	102.011745	70.254613	25.433	
	1	882	101.999618	70.248707	24.474	1	1964	101.962337	70.200890	25.409	
Spectral Elements	#	Exposure Specification	MSA Configuration	Nod Pattern	Pointing	Aperture PA	Dispersion Offset (Shutters)	Cross-Dispersion Offset (Shutters)	Total Dithers	Total Integrations	Total Exposure Time
	1	1 (G235M/F170LP)	c1 : C1_JD_compA	3 Shutter Slitlet	101.97366904166 667 Degrees 70.224807222222 22 Degrees	235.01369429069 464			3	18	25209.602
	2	1 (G235M/F170LP)	c1 : C1_all_clumps	3 Shutter Slitlet	101.9677725 Degrees 70.225958333333 34 Degrees	235.00814276866 41			3	18	25209.602
	3	1 (G235M/F170LP)	c1 : C1_JD1_2_only	3 Shutter Slitlet	101.96687083333 333 Degrees 70.222761111111 11 Degrees	235.00730096928 416			3	18	25209.602

Proposal 7390 - Observation 1 - Probing Pair-Instability Supernovae through the Triply-lensed MACS0647-JD at $z=10.17$

Special Requirements

MSA Scheduled Aperture PA 235.0000 to 235.0000 Degrees (V3 96.42543 to 96.42543)