



## 2756 - Imaging and Spectroscopic Follow-up of a Supernova at Redshift $z=3.47$

Cycle: 1, Proposal Category: DD

### INVESTIGATORS

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**OBSERVATIONS**

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Observation Folder				
	3	NIRCam Imaging Epoch 1	NIRCam Imaging	(1) ABELL2744
	2	NIRCam Imaging Epoch 2	NIRCam Imaging	(1) ABELL2744
	1	NIRSpec Spectroscopy	NIRSpec MultiObject Spectroscopy	(4) MSA-CAT-V9

**ABSTRACT**

After subtracting newly acquired JWST NIRISS pre-imaging from archival HST WFC3 IR imaging of the Abell 2744 galaxy cluster field, we have identified a magnified supernova (SN) at redshift  $z=3.47$ . From F115W, F150W, and F200W imaging, which correspond approximately to rest-frame U, B, and V bands, we find that the SN's colors may be most consistent with a H-rich Type II SN, and we measure an absolute V-band magnitude of approximately -18.1. These make the SN the most distant example of a SN that is not a superluminous SN ( $M_V < -21$  mag).

Core-collapse supernova (SN) rates from the CANDELS and CLASH surveys are in tension with inferences about the cosmic star-formation history from observations of galaxies. From our simulations, we find only  $p=0.08$  that a SN with redshift exceeding 2 would be found in the first two galaxy-cluster JWST visits, assuming the inferred CANDELS+CLASH rates. We request NIRSpec PRISM spectroscopy to determine if the SN is a core-collapse event, and two epochs of imaging to construct its light curve. The same visits will also provide follow-up imaging and spectroscopy of a microlensing event of a highly magnified star at  $z=2.65$ .

The repeat imaging epochs will be the first to a galaxy-cluster field and the publicly available dataset will provide a new view of the transient universe.

**OBSERVING DESCRIPTION**

We will acquire two epochs of NIRCam follow-up imaging (F115W, F150W, F200W, F277W, F356W, and F444W) of the newly identified supernova (SN) at  $z=3.47$ , and, simultaneously, of the location of the microlensing event of a star at  $z=2.65$ . These are required to construct the light curve of the SN, since the next planned visits to the Abell 2744 will not be until late October or November, which will be a full month after discovery in the rest frame at  $z=3.47$ . The first NIRCam visit should be scheduled as soon as possible without disruption of the schedule, and second should follow approximately between the first epoch and the planned UNCOVER NIRCam visit in late October or November.

We will acquire spectroscopy of the SN, microlensing events, and  $z > 5$  galaxies as soon as possible, without disruption of the telescope schedule, using NIRSpec MSA multi-object PRISM spectroscopy.

Proposal 2756 - Targets - Imaging and Spectroscopic Follow-up of a Supernova at Redshift  $z=3.47$

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
	(1)	ABELL2744	RA: 00 14 23.0668 (3.5961117d) Dec: -30 23 41.59 (-30.39489d) Equinox: J2000  <i>Comments:</i> Category=Clusters of Galaxies Description=[Abell clusters]		
(4)	MSA-CAT-V9	RA: 00 14 20.6892 (3.5862050d) Dec: -30 23 46.69 (-30.39630d) Equinox: J2000  <i>Comments:</i> Description=[]			

Proposal 2756 - Observation 3 - Imaging and Spectroscopic Follow-up of a Supernova at Redshift z=3.47

Fri Sep 30 00:00:36 GMT 2022

<b>Observation</b>	<p><b>Proposal 2756, Observation 3: NIRCam Imaging Epoch 1</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRCam Imaging</p>									
<b>Diagnostics</b>	(Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.									
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>		<b>Targ. Coord. Corrections</b>			<b>Miscellaneous</b>		
	(1)	ABELL2744	RA: 00 14 23.0668 (3.5961117d) Dec: -30 23 41.59 (-30.39489d) Equinox: J2000							
	<p><i>Comments:</i>  <i>Category=Clusters of Galaxies</i>  <i>Description=[Abell clusters]</i></p>									
<b>Template</b>	<b>Module</b>				<b>Subarray</b>					
	ALL				FULL					
<b>Dithers</b>	<b>#</b>	<b>Primary Dither Type</b>		<b>Primary Dithers</b>		<b>Subpixel Dither Type</b>		<b>Dither Size</b>		<b>Subpixel Positions</b>
	1	INTRAMODULEBOX		4		STANDARD				1
<b>Spectral Elements</b>	<b>#</b>	<b>Short Filter</b>	<b>Long Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Total Integrations</b>	<b>Total Dithers</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F115W	F444W	SHALLOW4	10	1	4	4	2104.407	
	2	F150W	F356W	SHALLOW4	10	1	4	4	2104.407	
	3	F200W	F277W	SHALLOW4	10	1	4	4	2104.407	
<b>Special Requirements</b>	<p>Between Dates 12-SEP-2022:00:00:00 and 23-OCT-2022:00:00:00</p> <p>Offset 85.0 arcsec, 0.0 arcsec</p> <p>Background Limited. Background no more than 40th percentile above minimum</p>									

Proposal 2756 - Observation 2 - Imaging and Spectroscopic Follow-up of a Supernova at Redshift z=3.47

Fri Sep 30 00:00:36 GMT 2022

<b>Observation</b>	<p><b>Proposal 2756, Observation 2: NIRCam Imaging Epoch 2</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRCam Imaging</p>									
<b>Diagnostics</b>	(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.									
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>		<b>Targ. Coord. Corrections</b>			<b>Miscellaneous</b>		
	(1)	ABELL2744	RA: 00 14 23.0668 (3.5961117d) Dec: -30 23 41.59 (-30.39489d) Equinox: J2000							
	<p><i>Comments:</i>  <i>Category=Clusters of Galaxies</i>  <i>Description=[Abell clusters]</i></p>									
<b>Template</b>	<b>Module</b>				<b>Subarray</b>					
	ALL				FULL					
<b>Dithers</b>	<b>#</b>	<b>Primary Dither Type</b>		<b>Primary Dithers</b>	<b>Subpixel Dither Type</b>		<b>Dither Size</b>	<b>Subpixel Positions</b>		
	1	INTRAMODULEBOX		4	STANDARD			1		
<b>Spectral Elements</b>	<b>#</b>	<b>Short Filter</b>	<b>Long Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Total Integrations</b>	<b>Total Dithers</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F115W	F444W	SHALLOW4	10	1	4	4	2104.407	
	2	F150W	F356W	SHALLOW4	10	1	4	4	2104.407	
	3	F200W	F277W	SHALLOW4	10	1	4	4	2104.407	
<b>Special Requirements</b>	<p>Between Dates 05-DEC-2022:00:00:00 and 30-DEC-2022:00:00:00                  Offset 85.0 arcsec, 0.0 arcsec</p>									

Proposal 2756 - Observation 1 - Imaging and Spectroscopic Follow-up of a Supernova at Redshift z=3.47

Fri Sep 30 00:00:36 GMT 2022

<b>Observation</b>	<b>Proposal 2756, Observation 1: NIRSpec Spectroscopy</b> <b>Diagnostic Status: Warning</b> Observing Template: NIRSpec MultiObject Spectroscopy										
	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.										
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>			<b>Targ. Coord. Corrections</b>			<b>Miscellaneous</b>		
	(4)	MSA-CAT-V9	RA: 00 14 20.6892 (3.5862050d) Dec: -30 23 46.69 (-30.39630d) Equinox: J2000								
<i>Comments: Description=[]</i>											
<b>Acquisition</b>	<b>#</b>	<b>Reference Star Bin</b>	<b>Target</b>	<b>Filter</b>	<b>MSA Configuration</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	Filter: CLEAR; Readout: NRSRAPID; 8 sources in 4 quads; [ Optimal TA Accuracy ]	SAME	CLEAR	Auto Acq MSA Config	NRSRAPID	3	1	4	171.788	
<b>Template</b>	<b>TA Method</b>	<b>Obtain Confirmation Images</b>		<b>Science Aperture</b>	<b>Primary Candidate List</b>		<b>Filler Candidate List</b>		<b>Spectral Overlap Map</b>	<b>Spectral Overlap Threshold</b>	
	MSATA	No		MSA Center	Primary_rev1 (13 sources)		Filler_rev1 (1206 sources)		jwst-nirspec-prism	1.5	
<b>Reference Stars</b>	<b>Visit</b>	<b>ID</b>	<b>RA</b>	<b>Dec</b>	<b>Magnitude</b>	<b>Visit</b>	<b>ID</b>	<b>RA</b>	<b>Dec</b>	<b>Magnitude</b>	
	1	320026	3.618268	-30.429608	22.94	1	320049	3.572696	-30.409550	22.31	
	1	320030	3.558250	-30.424366	22.94	1	320073	3.604204	-30.385645	21.66	
	1	320036	3.606292	-30.418043	21.61	1	320089	3.570270	-30.387376	22.9	
	1	320045	3.597144	-30.402225	23.07	1	320106	3.581209	-30.421064	21.55	
<b>Spectral Elements</b>	<b>#</b>	<b>Exposure Specification</b>	<b>MSA Configuration</b>	<b>Nod Pattern</b>	<b>Pointing</b>	<b>Aperture PA</b>	<b>Dispersion Offset (Shutters)</b>	<b>Cross-Dispersion Offset (Shutters)</b>	<b>Total Dithers</b>	<b>Total Integrations</b>	<b>Total Exposure Time</b>
	1	1 (PRISM/CLEAR)	c1	3 Shutter Slitlet	3.5889112499999 168.19787476937 998 Degrees - 30.412497222222 214 Degrees	464			3	3	2222.511
	2	1 (PRISM/CLEAR)	c2	3 Shutter Slitlet	3.5829014583333 168.20090794192 336 Degrees - 30.413124444444 463 Degrees	197			3	3	2222.511

Proposal 2756 - Observation 1 - Imaging and Spectroscopic Follow-up of a Supernova at Redshift  $z=3.47$

Special Requirements

MSA Scheduled Aperture PA 168.1992247 to 168.1992247 Degrees (V3 29.624655 to 29.624655)