5578 - The MIRI deep imaging survey of the lensing clusters Abell2744 and MACS0416

Cycle: 3, Proposal Category: GO

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OBSERVATIONS

Folder	Observation	Label	Observing Template	Science Target
A2744				
	1	A2744	MIRI Imaging	(1) A2744
MACS0416				
	2	M0416	MIRI Imaging	(2) M0416

ABSTRACT

JWST has marked a turning point in astronomy by offering an unprecedented view of the universe at near- and mid-IR wavelengths, enabling statistical studies of galaxies at redshifts $z > 6$, and the identification of candidates up to $z \sim 16$. Spectral energy distribution fitting techniques are crucial to confirm and explore the physical properties (e.g. z, stellar age, mass, dust extinction) of such statistical sample of galaxies. To obtain solid results, however, deep imaging surveys with long wavelength baselines and coverage of critical galaxy spectral features are needed. With its unique capabilities, JWST/MIRI allows for the detection and characterization of the rest-frame near-IR and optical emission of galaxies at $z > 4$, a key wavelenght regime to probe for robustly constraining galaxy physical properties, while also eliminating contamination from intermediate-z dusty star-forming galaxies and AGNs.

We are requesting a 75-hour MIRI imaging at 7.7 and 10 um to survey two of the most well-known Hubble Frontier Fields galaxy clusters: Abell 2744 and MACS J0416.1-2403. The proposed observations will cover a total area of about 8.8 arcmin^2, double the wavelength coverage so far available in these fields and achieve unprecedented depths than any previous extragalactic survey at similar wavelengths and recent MIRI lensing cluster studies in the same filters. Thanks to lensing magnification, this data will also probe fainter galaxies than the deepest MIRI blank field observations. These observations will have a crucial legacy value since they will also allow the access to the rest-frame near-/mid-IR emission of low-z galaxies in both the cluster and the fore-/back.

OBSERVING DESCRIPTION

This proposal aims at obtaining deep MIRI imaging in the wavelength range 6.5-11.1 um for two of the most well-studied galaxy clusters in the literature: the Hubble Frontier Fields Abell 2744 (A2744) and MACS J0416.1-2403 (MACS0416).

We choose as targets A2744 and MACS0416 since these lensing fields have rich ancillary dataset (both photometric and spectroscopic) and robust lensing models. In fact, high-quality imaging coming from JWST/NIRCam as well as from the Advanced Camera for Surveys (ACS) and the Wide Field Camera 3 (WFC3) on board the Hubble Space Telescope (HST) is already available for both clusters.

This multi-wavelength imaging is complemented by spectroscopic information from the MUSE instrument at the Very Large Telescope (VLT), from NIRISS on board JWST and from NIRCam/WFSS and MSA.

Together with this wealth of ancillary data and the existing lensing models, the proposed JWST observations will enable us to reach the main goal of our research: to study and constrain the physical properties of galaxies at $z > 4$ while cleaning the sample of high-z galaxies for contamination from intermediate-redshift dusty star-forming galaxies and dust-hidden AGNs.

We ask the observations to be carried out in the MIRI filters F770W and F1000W.

We carefully choose these filters so to double the wavelength coverage available in the targeted fields (currently limited to the NIRCam 4.4 um observations) over a total coverage area of 4.4 arcmin^2 per cluster while minimizing the total exposure time needed.

In fact, MIRI sensitivity significantly decreases at wavelengths > 10 um. To reach depths comparable to the proposed one in the adjacent F1280W filter, it would be necessary a 2.5-fold increase in the allocated on-source time.

These observations will reach an unprecedented depth of 26 - 26.2 mag in the wavelength range probed: a factor of 50 to 100 than any previous Spitzer/IRAC extragalactic survey at similar wavelengths and more than an order of magnitude deeper with respect to recent MIRI lensing cluster studies in the same filters (SMACS 0723; EROs). In addition, by leveraging the gravitational lensing effect of magnification, we will also probe significantly fainter galaxies than the deepest MIRI blank field observations available (e.g. PRIMER, CEERS, COSMOS-Webb).

For the observing strategy we follow the one adopted by the MIRI GTO for the imaging of the Hubble eXtreme Deep Field (APT file of the JWST program PID 1283, PI: G. Oestlin).

	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
Fixed Targets	(1)	A2744	RA: 00 14 21.0592 (3.5877467d)	Epoch of Position: 2000	
			Dec: -30 23 17.62 (-30.38823d)		
			Equinox: J2000		
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Clusters of Galaxies* *Description=[Abell clusters]*				
	(2)	M0416	RA: 04 16 8.3800 (64.0349167d)	Epoch of Position: 2000	
			Dec: -24 04 20.80 (-24.07244d)		
			Equinox: J2000		
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=Clusters of Galaxies* *Description=[Rich clusters]*				

Observation

Proposal 5578, Observation 1: A2744   Thu Sep 11 17:00:10 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 1:2) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	A2744	RA: 00 14 21.0592 (3.5877467d)	Epoch of Position: 2000	
		Dec: -30 23 17.62 (-30.38823d)		
		Equinox: J2000		

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Clusters of Galaxies
Description=[Abell clusters]

Template

Subarray

FULL

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	Tile Order
2	2	50.0	20.0	0.0	0.0	HILBERT_CURVE

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	CYCLING	13	10						MEDIUM

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	F770W	FASTR1	98	7	1	Dither 1	10	70	19203.277	
2	F1000W	FASTR1	99	13	1	Dither 1	10	130	36047.77	

Special Requirements

Group Visits within 53.0 Days
Visits Same PA
Offset 0.05184342146670762 arcsec, 27.945710020450292 arcsec
Background Limited. Background no more than 10th percentile above minimum

Proposal 5578 - Observation 2 - The MIRI deep imaging survey of the lensing clusters Abell2744 and MACS0416

Observation

Proposal 5578, Observation 2: M0416   Thu Sep 11 17:00:10 GMT 2025

Diagnostic Status: Warning

Observing Template: MIRI Imaging

Diagnostics

(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 2:2) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	M0416	RA: 04 16 8.3800 (64.0349167d)	Epoch of Position: 2000	
		Dec: -24 04 20.80 (-24.07244d)		
		Equinox: J2000		

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Clusters of Galaxies
Description=[Rich clusters]

Template

Subarray

FULL

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	Tile Order
1	2	80.0	20.0	0.0	0.0	DEFAULT

Dithers

#	Dither Type	Starting Point	Number of Points	Points	Starting Set	Number of Sets	Optimized For	Direction	Pattern Size
1	CYCLING	1	9						DEFAULT
2	CYCLING	11	9						DEFAULT
3	CYCLING	21	8						DEFAULT

Spectral Elements

#	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	Optional ETC ID
1	F770W	FASTR1	100	3	1	Dither 1	9	27	7542.559	
2	F770W	FASTR1	100	3	1	Dither 2	9	27	7542.559	
3	F1000W	FASTR1	100	5	1	Dither 1	9	45	12587.581	
4	F1000W	FASTR1	100	5	1	Dither 2	9	45	12587.581	
5	F1000W	FASTR1	100	5	1	Dither 3	8	40	11188.961	

6

Special Requirements

Group Visits within 53.0 Days
Visits Same PA
Offset -0.43063788459297514 arcsec, 6.298717131492044 arcsec
Background Limited. Background no more than 10th percentile above minimum