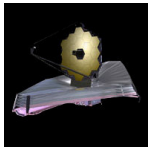

3547 - Revealing the early phase of the co-evolution of galaxies and super-massive black holes at a z=3 proto-cluster core

Cycle: 2, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
MIRI MRS				
	1	ADF22.A1	MIRI Medium Resolution Spectroscopy	(1) ADF22.A1
NIRCAM imaging				
	6	NIRCAM F115/F356	NIRCam Imaging	(2) ADF22.A1-NIRCAM
	11	NIRCAM F200/F444	NIRCam Imaging	(2) ADF22.A1-NIRCAM

ABSTRACT

A tight correlation between a mass of a central super massive black hole (SMBH) and a galaxy spheroid mass has been discovered in the local universe. Understanding the origin of this "co-evolution" of galaxies and SMBHs has been a major goal of modern astronomy. While the co-evolution has been usually investigated using optically selected quasars for years, such an approach only must be insufficient. Since the key phase in

which galaxies and SMBHs assemble masses very rapidly is predicted to be highly obscured by dust, it is of fundamental importance to directly measure the mass of (proto-)bulge and galaxies together with the BH mass in the heavily obscured phase in the early universe.

In this program, we propose NIRCam imaging and MIRI MRS spectroscopy of ADF22.A1, a z=3.09 bright DSFG located at a z=3.1 proto-cluster core. ADF22.A1 is a HyLIRG-class DSFG and hosts a heavily obscured, but intrinsically bright, AGN at the core, which offers an invaluable target to understand the early phase of the co-evolution. Recent intensive ALMA surveys uncover that ADF22.A1 has a proto-bulge and extended, rotating disk, also showing signatures of spiral arms and clumps. The four-band NIRCam imaging (F115W, F200W, F356W, and F444W) will measure stellar morphologies, tying the ALMA-indentified substructures with the stellar regime, and stellar masses for both galaxy and bulge. The MIRI MRS enables the BH mass measurements utilizing Pa-alpha line as a tracer. We will unveil the early stage of the co-evolution, which has been hidden for years, finally.

OBSERVING DESCRIPTION

ADF22.A1, a =3.09 bright DSFG harboring an X-ray luminous AGN, is the target. ADF22.A1 is a HyLIRG-class DSFGs and hosts a heavily obscured, but intrinsically bright AGN at the core. We propose NIRCam (4-bands; F115W, F200W, F356W, F444W) imaging and MIRI MRS spectroscopy of ADF22.A1.

NIRCam Imaging:

Four broad-band NIRCam filters are proposed in two combinations - F115W (short) and F356W (long) and F200W (short) and F444W (long). The standard 3-point dither pattern is adopted, which is sufficient to reconstruct the PSF for the chosen bands. On the FULL array, the MEDIUM8 readout mode is used for all exposures, with 6 groups and 1 integration per exposure, yielding 1900s per pointing. According to the JWST ETC, we will achieve a 5sigma point source limit of 27.8, 28.3, 28.5, and 28.1 (AB mag) for F115W, F200W, F356W, and F444W, respectively.

MIRI MRS:

We will use MIRI medium-resolution spectrometer (MRS) to observe ADF22.A1. Our primal target is the Pa-alpha line, which redshifts to 7.68um for a z=3.09 galaxy. This wavelength is well covered by the SHORT sub-band in channel-2. Therefore we request only this sub-band. Pa-beta line also falls in the SHORT sub-band of channel-1 and thus simultaneously observed.

We do not need to perform dedicated target acquisition observation. Channel-2, which will be used for the Pa-alpha observation, is adopted as the primary channel. The fiducial 4-point dither pattern for an extended source is adopted to achieve optimal PSF reconstruction, and we will do simultaneous observations using the F560W filter to give the absolute astrometry to the MRS cube as recommended. We will adopt slow readout mode for higher SNR for spectroscopy of faint sources.
Exposures are composed of two sets of 40 groups, 2 integration per dither point. This results in the total exposure time of 15000 sec.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	ADF22.A1	RA: 22 17 32.4100 (334.3850417d) Dec: +00 17 43.80 (.29550d) Equinox: J2000		
Comments: *Category=Galaxy* *Description=[Active galactic nuclei, High-redshift galaxies, Starburst galaxies, Ultraluminous infrared galaxies, X-ray quasars]* *Extended=YES*				
(2)	ADF22.A1-NIRCAM	RA: 22 17 35.3500 (334.3972917d) Dec: +00 16 58.60 (.28294d) Equinox: J2000		
Comments: *Category=Galaxy* *Description=[Active galactic nuclei, High-redshift galaxies, Starburst galaxies, Ultraluminous infrared galaxies, X-ray quasars]* *Extended=YES*				

Observation

Proposal 3547, Observation 1: ADF22.A1 Wed Aug 23 16:01:10 GMT 2023

Diagnostic Status: Warning

Observing Template: MIRI Medium Resolution Spectroscopy

Comments: Note: a dummy entry was made in the Acq ETC Wkbk.Calc ID box.

Diagnostics

(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)	ADF22.A1	RA: 22 17 32.4100 (334.3850417d) Dec: +00 17 43.80 (.29550d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[Active galactic nuclei, High-redshift galaxies, Starburst galaxies, Ultraluminous infrared galaxies, X-ray quasars]
Extended=YES

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray	Grating Wheel Direction
F560W	CHANNEL2	YES	FULL	NEUTRAL

Dithers

#	Dither Type	Optimized For	Direction
1	4-Point	EXTENDED SOURCE	NEGATIVE

Spectral Elements

#	Wavelength Range	Detector	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Exposures/Dith	Dither	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1		IMAGER	F560W	FASTR1	99	6	1	Dither 1	4	24	6648.996	
1	SHORT(A)	MRSLONG		SLOWR1	40	2	1	Dither 1	4	8	7740.334	
1	SHORT(A)	MRSSHORT		SLOWR1	40	2	1	Dither 1	4	8	7740.334	
2		IMAGER	F560W	FASTR1	99	6	1	Dither 1	4	24	6648.996	
2	SHORT(A)	MRSLONG		SLOWR1	40	2	1	Dither 1	4	8	7740.334	
2	SHORT(A)	MRSSHORT		SLOWR1	40	2	1	Dither 1	4	8	7740.334	

Observation

Proposal 3547, Observation 6: NIRCAM F115/F356

Wed Aug 23 16:01:10 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	ADF22.A1-NIRCAM	RA: 22 17 35.3500 (334.3972917d) Dec: +00 16 58.60 (.28294d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[Active galactic nuclei, High-redshift galaxies, Starburst galaxies, Ultraluminous infrared galaxies, X-ray quasars]
Extended=YES

Template

Module	Subarray	Target Placement
ALL	FULL	Module Gap

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	NONE		STANDARD		3

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F115W	F356W	MEDIUM8	6	1	3	3	1868.198	138207

Special Requirements

Aperture PA Range 71 to 76 Degrees (V3 71.0713531 to 76.0713531)

Same Aperture PA 6, 11

Observation

Proposal 3547, Observation 11: NIRCAM F200/F444

Wed Aug 23 16:01:10 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Visit 11:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	ADF22.A1-NIRCAM	RA: 22 17 35.3500 (334.3972917d) Dec: +00 16 58.60 (.28294d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[Active galactic nuclei, High-redshift galaxies, Starburst galaxies, Ultraluminous infrared galaxies, X-ray quasars]
Extended=YES

Template

Module	Subarray	Target Placement
ALL	FULL	Module Gap

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	NONE		STANDARD		3

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F200W	F444W	MEDIUM8	6	1	3	3	1868.198	138207

Special Requirements

Aperture PA Range 71 to 76 Degrees (V3 71.0713531 to 76.0713531)

Same Aperture PA 6, 11